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Global Numbers of Ship Strikes: An Assessment of Collisions Between Vessels and Cetaceans Using Available Data in the IWC Ship Strike Database

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Introduction

Collisions between vessels and cetaceans, often also termed as "ship strikes", have long been known to be a major threat to cetaceans (Cates et al. 2017; Laist et al. 2001). Documenting threats of cetacean populations from anthropogenic activities, including the development of strategies for their conservation, is part of the work of the International Whaling Commission (IWC) (Ritter & Panigada, 2019). One of the threats that has been dealt with in greater detail by the IWC in the past is ship strikes, leading to the establishment of a global data base to archive as many collisions as possible, both historical and recent. As part of the "Strategic Plan to Mitigate the Impacts of Ship Strikes on Cetacean Populations: 2017-2020", the IWC is aiming to understand and permanently reduce ship strikes on cetaceans through the introduction of appropriate mitigation measures (Cates et al. 2017; Ritter & Panigada, 2019). Particularly, the importance of international collaboration has been highlighted, as well as the need for an improvement in data recording, reporting and increased application of mitigation measures (Cates et al. 2017; Peel et al. 2018). Generally, there is a lack of evaluation on ship strikes on a global scale, with continued underestimation of the actual overall number of ship strikes (Laist et al. 2001; Peel et al. 2018).

As per Cates et al. (2017) "a ship strike is defined as a forceful impact between any part of a watercraft, most commonly the bow or propeller, and a live cetacean, often resulting in death, major injuries or physical trauma". The reasons for ship strikes to happen are manifold. Often, they occur due to high vessel speed when cetaceans are not able to react fast enough or effectively. Also, cetaceans may not be aware of approaching ships. On the other hand, cetacean presence is often not noticed due to bad visibility, darkness, weather conditions, missing lookout on board or lack of communication of whale sightings between vessels (Laist et al. 2001).

Fatality of whales from ship strikes has been recorded since the 1800s and increased in occurrence between the 1950s and 1970s due to increasing vessel size, speed and overall traffic density. Most fatal injuries to large cetaceans are caused by large motorized vessels (80 m or longer) and at speeds of 14 knots or faster (Laist et al. 2001). The probability for a strike to be fatal increases from 21% to 79% as speed increases from 8.6 to 15 knots, respectively (Vanderlaan & Taggart 2007). If a ship strike is fatal or not depends on which body part of the animal is impacted, and the severity of the impact, e.g. depth of lesion, fractures of vital bones, etc. (Laist et al. 2001; Vanderlaan & Taggart 2007). Some cetaceans, however, have been known to recover even from severe injuries, e.g. short-term survival of propeller wounds has been observed in bottlenose dolphins (Dwyer et al. 2014).

Cetacean species most affected by vessel strikes include large fast whale species, but also slow-moving species that spend a considerable time at the water surface (Carrillo & Ritter 2010). Although calves and juveniles are smaller in size, they tend to spend more time at the surface and are therefore especially vulnerable to collisions with vessels (Carrillo & Ritter 2010; Laist et al. 2001). Van Waerebeek et al. (2007) show the significant impacts of boat traffic on small cetaceans, in particular coastal communities and populations living in rivers and estuaries.

Extensive work on ship strikes has been conducted in waters all over the world, e.g. Australia (Peel et al. 2018), Alaskan waters (Neilson et al. 2012), the Canary Islands (Carrillo & Ritter 2010) and the Mediterranean (Panigada et al. 2006), to name just a few. Laist et al. (2001) summarized for the first-time reports from all over the globe. Hot spots, i.e. areas where high cetacean abundance and ship traffic overlap, were identified for example in the Canary Islands (Spain) (Carrillo & Ritter 2010) and the Hellenic Trench (Greece) (Frantzis et al. 2019) for sperm whales, the North-Western Mediterranean Sea for fin whales (Panigada et al. 2006); Laist et al. (2014) discussed the hotspot off the East coast of the US for North Atlantic right whales. Ship strikes can have a significant effect on small and spatially restricted populations and discrete groups (Cates et al. 2017; Laist et al. 2001), such as the North Atlantic right whale, especially when they are part of a whole suite of threats and their effects may accumulate.

Currently, there is no up-to-date global overview of ship strikes on both large and small cetaceans. Previous work by Vanderlaan & Taggart (2007) on the investigation of fatality of ship strikes did not incorporate information about, *inter alia*, cetacean species, size and age, behaviour, vessel types. Likewise, Laist et al. (2001) and Vanderlaan & Taggart (2007) only looked into large whales. This document shall provide an updated summary of the data collected by the IWC to date, and thus fills some of the existing knowledge gaps.

CAVEATs: it has to be stressed that data and results described here have to be considered preliminary for several reasons (see also Discussion below). While the IWC database may be the most extensive compilation of ship strike data world-wide, it has to be acknowledged that there remains many (large) data gaps. The IWC database is not the only platform to report ship strikes and other regional data bases exist, e.g. held by the National Oceanic and Atmospheric Administration (NOAA) in the U.S. and the Australian Marine

Mammal Centre (AMMC). Including data from these regional databases, as well as a larger number of incidents currently waiting to be imported will significantly enhance the global perspective on this issue. Furthermore, the great majority of reports entered into the database were incomplete and thus, it is not possible to undertake more thorough investigations on those cases. It is just natural that reports were missing important portions of information, given the many uncertainties that may arise. In that sense, we caution to take the numbers summarized here as not wholly representing an exact picture of the ship strike issue on a global scale, while considering they are the only available information at this wide scale.

Methods

Data handling and streamlining

The IWC holds an online ship strike database, that enables the general public to submit reports on ship strikes (www.iwc.int/ship-strikes). Information compiled in the IWC database derive from publicly available evidence, including peer-reviewed research articles, scientific and technical reports, online newspaper articles and videos, social media platforms, IWC National Progress Reports, as well as direct witness reports. These data are then reviewed and validated by the Ship Strike Data Coordinators, in collaboration with a dedicated Data Review Group (DRG). Each ship strike case is assigned a case ID and a classification wherever possible, e.g. *Definite, Probable, and Possible, Not a Strike,* and *Rejected* (see IWC 2014). In doing so, a strict protocol was followed and the categories previously agreed by the IWC Scientific Committee were applied (Ritter & Panigada 2019). *Definite* cases were those that presented evidence of a strike beyond reasonable doubt. *Probable* cases had more evidence in favour rather than against a ship strike, with some evidence lacking and the report being classified as likely to be true. *Possible* cases had the majority of evidence lacking, though the report is likely to be true (IWC 2014). Cases that did not fall into those described categories where either classified as "*Not a strike*" or rejected. Moreover, duplicate reports were identified, and discrete cases were established from the information in the reports, whereby sometimes several reports resulted in one single case. For reports from U.S. or Australia, a variety of cases were left with no classification, wherever a clear-cut categorization was not possible, i.e. pending. It is assumed that, when complete datasets from the U.S. and Australia are made available to the IWC, such data will include an official classification.

For analysis within the current study, data were streamlined by adding information into blank cells, taken from more descriptive information in the reports (e.g. inclusion of the scientific species name based on the common name provided). When vessel speed was described as 'slow to no movement', 'drifting', 'engine off', or '0 – 1 knot', all were classified as 1 knot. If vessel speed was given as a range, the average of the upper and lower values of the range was used. If ambiguous statements were given (e.g. "at least 17 knots"), the minimum vessel speed value was used. Vessel categories and length were analysed separately for technical reason. For vessel categories, slight adjustments were made to group them further together for the purposes of the current analysis.

For the spatial assessment of cases, islands and archipelagos were assessed individually, where possible; e.g. archipelagos like the Hawaiian (U.S.) or Canary Islands (Spain) remained listed separately from their respective countries. Antarctic regions that could not be traced back to territorial waters were pooled as 'Antarctica'.

ArcGIS® Pro was used to map ship strikes globally. Cases were mapped according to the large areas assigned by the IWC reporting form (see Annex Table 1). Further, all cases were assigned to a Food and Agriculture Organization (FAO) Major Fishing Area based on latitude and longitude coordinates provided for the incident, or using details contained within the descriptive text on the incident, when no discrete coordinates were provided. When either the location was unknown or too little information were provided to narrow it down to one specific FAO Major Fishing Area, those cases were not included for that part of the analysis (n=152). A shapefile of FAO Major Fishing Areas was used for mapping purposes. For statistical analysis, including production of graphs, Minitab® and Microsoft Excel software were used.

Results

Data richness

Of all data fields available in the IWC data base, some (if not many) remained empty in all reports, and only few fields turned out to be data rich: e.g. location of the ship strike was most frequently reported, with 907 cases (97.2%) documenting the larger area where the collision occurred. Other parameters that were frequently reported included the date of the strike (n=844, 90.4%) and the cetacean species/genus involved (n=820, 87.8%). To the contrary, for 599 cases (64.2%) no outcome was provided and for 118 cases (12.6%) the outcome was reported as 'not known'. Further, similar data gaps were identified for age class, animal length and gender, where 866 (92.8%), 716 (76.7%) and 690 cases (73.9%) had no or 'unknown' information provided, respectively.

230 cases (24.6%) resulted from strandings, while 150 incidents (16.1%) were witnessed at sea. In 103 cases (11.0%), a live cetacean was observed at sea. In the remaining cases, the animal was found on the bow of a vessel (n=22, 2.4%). Again, a large number of cases (n=426, 45.7%) had no information on the evidence type provided.

Classification of ship strike reports

The procedure described above resulted in a total of 1,162 reports held in the data base. Seven of those were classified as 'test' and therefore not further looked at. Of the remaining reports, 13 were classified as *Not a* *strike*, 47 reports were rejected, another 13 reports did not have enough information for a classification and 148 cases were left without a classification, i.e. pending (see above). One of the cases had an unidentified object as cetacean ID and was also removed from the analysis, i.e. it was rejected.

This resulted in 933 cases for analysis, dating from 1820 to 2019. Of those 933 cases, 64.8% (n=605) were classified as *Definite*, 16.6% as *Probable* (n=155) and 18.5% (n=173) as *Possible* (Figure 1).

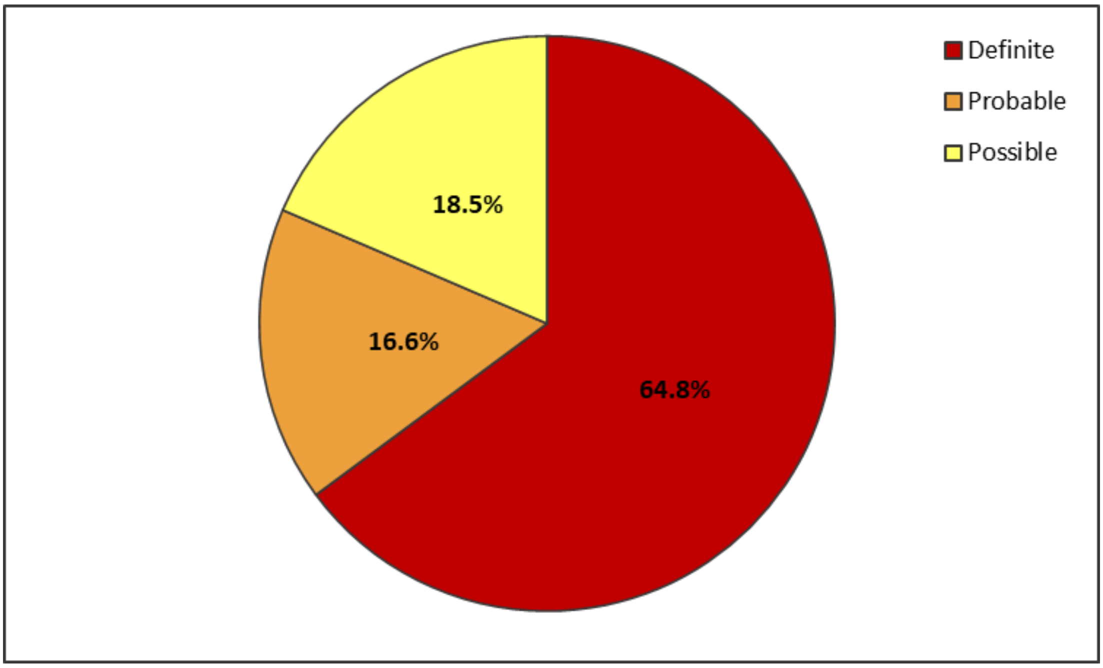

Figure 1: Ship strikes on cetaceans by case conclusion, based on data held in the IWC ship strike data base (1820-2019, n=933).

Geographic distribution of ship strikes

The majority of ship strikes were reported from the Atlantic Ocean (n=582, 62.4%), followed by the Pacific Ocean (n=269, 28.8%). For the Indian Ocean, 34 cases (3.6%) were recorded, whereas 18 (1.9%) and 4 (0.4%) were reported for the Southern Ocean and Arctic Ocean, respectively (Figures 2, 3 & 5 and Table 2). A total of 26 cases (2.8%) could not be assigned to one specific ocean. In all five oceans, the number of definite cases (65.1%, n =591) was higher than probable (16.0%, n=145) or possible cases 18.9%, (n=171), with the exception of the Arctic Ocean, where there was no difference in numbers assigned between categories *Definite* (n=2) and *Possible* (n=2).

Table 3 shows all cases by large area. Three IWC large areas accounted for over half (53.5%) of all the cases: North Atlantic Ocean (n = 299), North Pacific Ocean (n = 139) and South Pacific Ocean (n = 61). To the contrary, 26 IWC large areas accounted for 1-9 cases each, resulting in a total less than 10% of all cases for those areas.

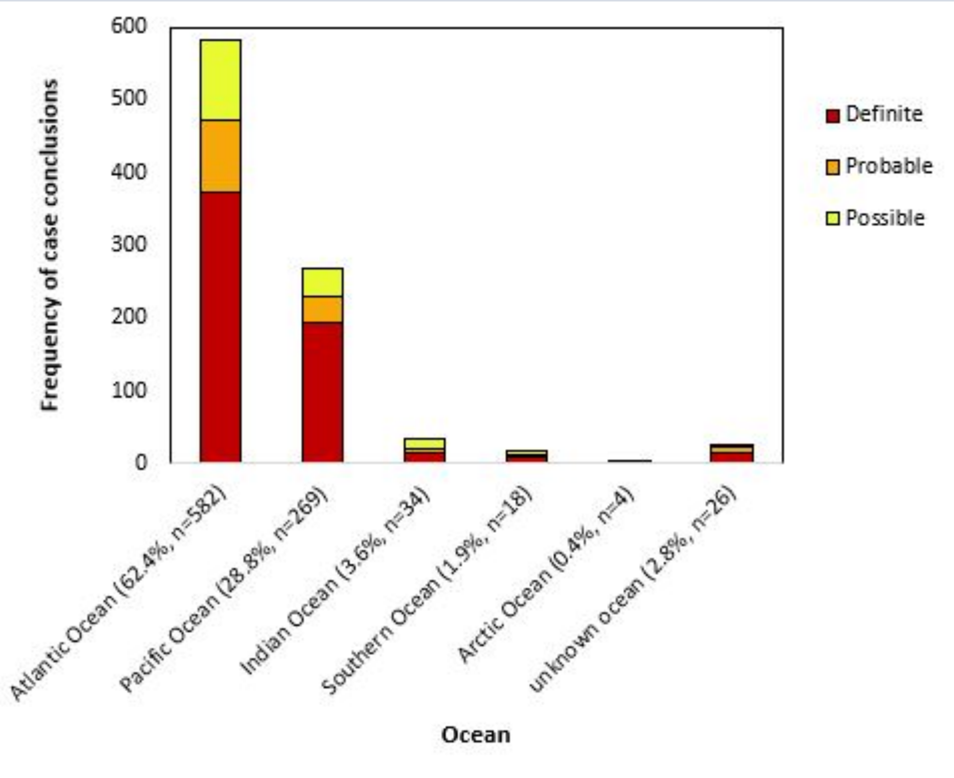

Figure 2: Ship strikes on cetaceans per ocean, by case conclusion, based on data held in the IWC ship strike data base (1820-2019, n=933).

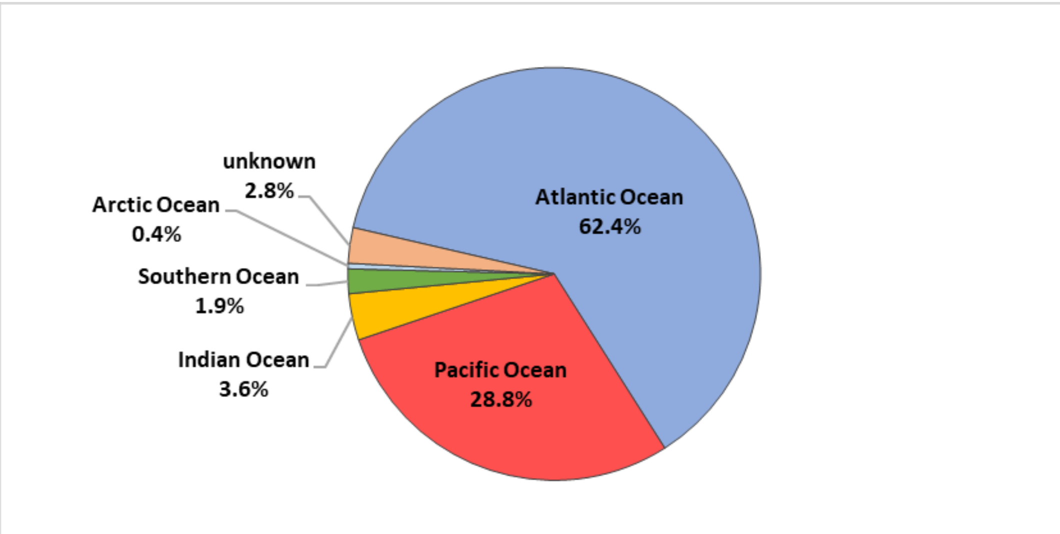

Figure 3: Ship strikes on cetaceans per ocean, by ocean basin, based on data held in the IWC ship strike data base (1820-2019, n=933).

Out of the total of 933 cases used for the analysis, 368 had discrete GPS coordinates. Those, and where possible, other cases were assigned to an individual country on the basis of the descriptive text (n=719). Cases were assigned to 62 countries and islands/archipelagos, results of which can be seen in Figure 4 and Table 4. Seven countries accounted for over half (52.8%) of all cases: U.S. (n=239, 25.6%), Canada (n=77, 8.2%), New Zealand (n=38, 4.1%), Hawai'i (n=37, 4.0%), Australia (n=35, 3.7%), France (n=35, 3.7%) and the Canary Islands (n=32, 3.4%). 48 countries accounted for less than 1% each (between 1 and 8 cases per country), as presented in Table 4 (see Annex). 214 cases (22.9%) could not be associated to a specific country, due to lack of associated information or being recorded in international waters.

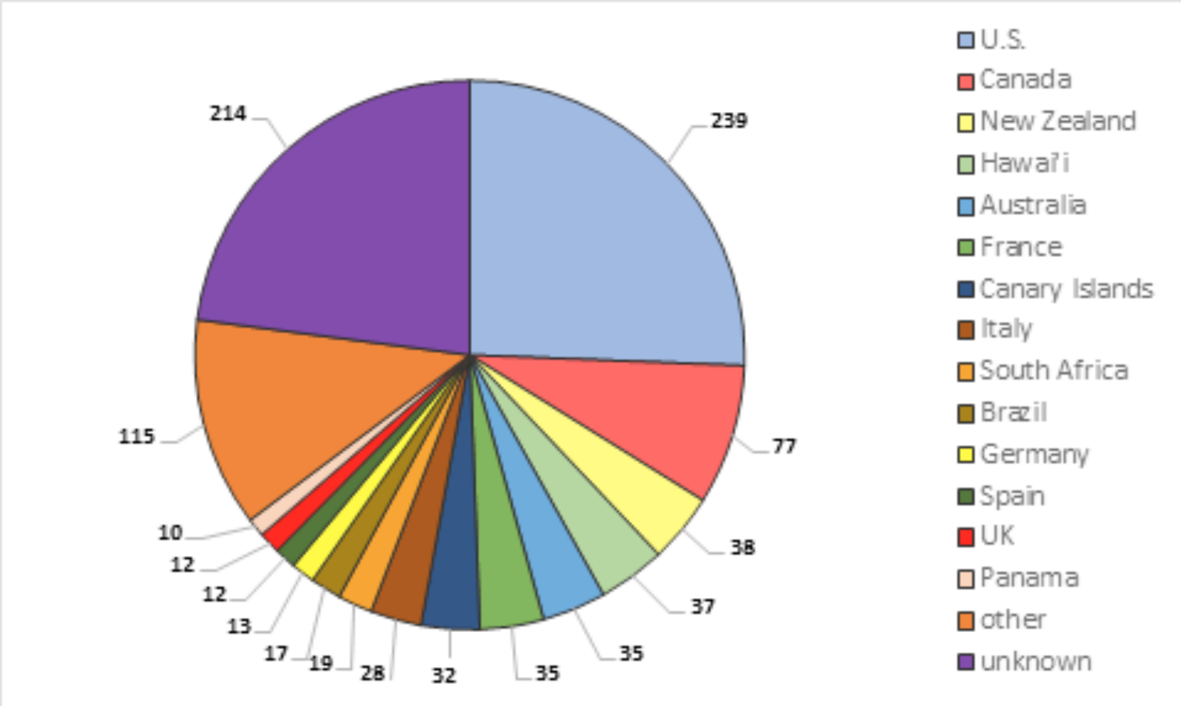

Figure 4: Numbers of ship strikes on cetaceans per country, based on data held in the IWC ship strike data base (1820-2019, n=933).

A total of 782 cases could be assigned to a FAO Major Fishing Area. FAO areas with the highest number of cases are Area 21 along the North-East coast of the US and Canada and West coast of Greenland (n=198, 21.2%), followed by Area 37 (Mediterranean) (n=108, 11.6%) and Area 77 (Central-East Pacific, including West coast of US and Central America) (n=93, 10.0%)(Figure 6). FAO Area 21 shows both the highest number of cases, and the highest number of definite cases (n=139, 14.9%) (Figures 6 & 7). FAO areas 27 (North-East Atlantic), 51 (West Indian Ocean) and 87 (South-East Pacific) are the only areas with a higher number of cases classified as *Possible*, rather than *Definite* (Table 5). FAO areas 18 (Arctic Sea), 58 (Antarctic and Southern Indian Ocean) and 88 (Antarctic Pacific Ocean) had no reported cases. 151 cases (16.2%) could not be assigned to a FAO area.

Please also see Figure 17 and 18 in the Annex (p.33) which represent only the numbers of Definite and Probable ship strike cases per FAO Area (Figure 17) and per ocean (Figure 18).

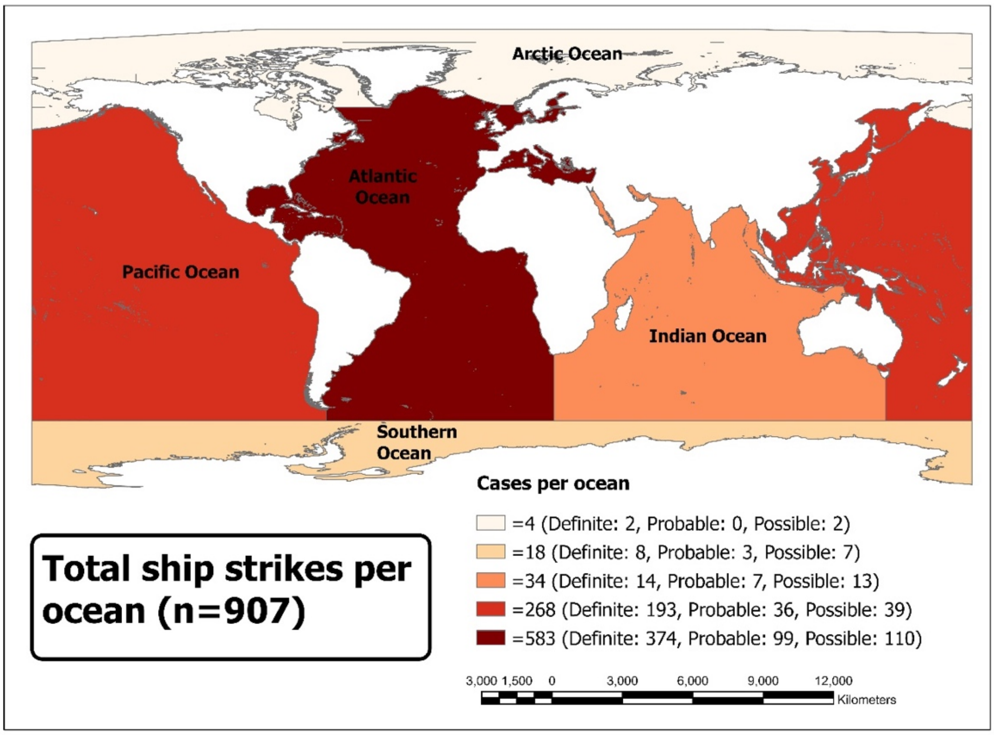

Figure 5: Ship strikes reported by ocean, based on data held in the IWC ship strike data base (1820-2019, n=907).

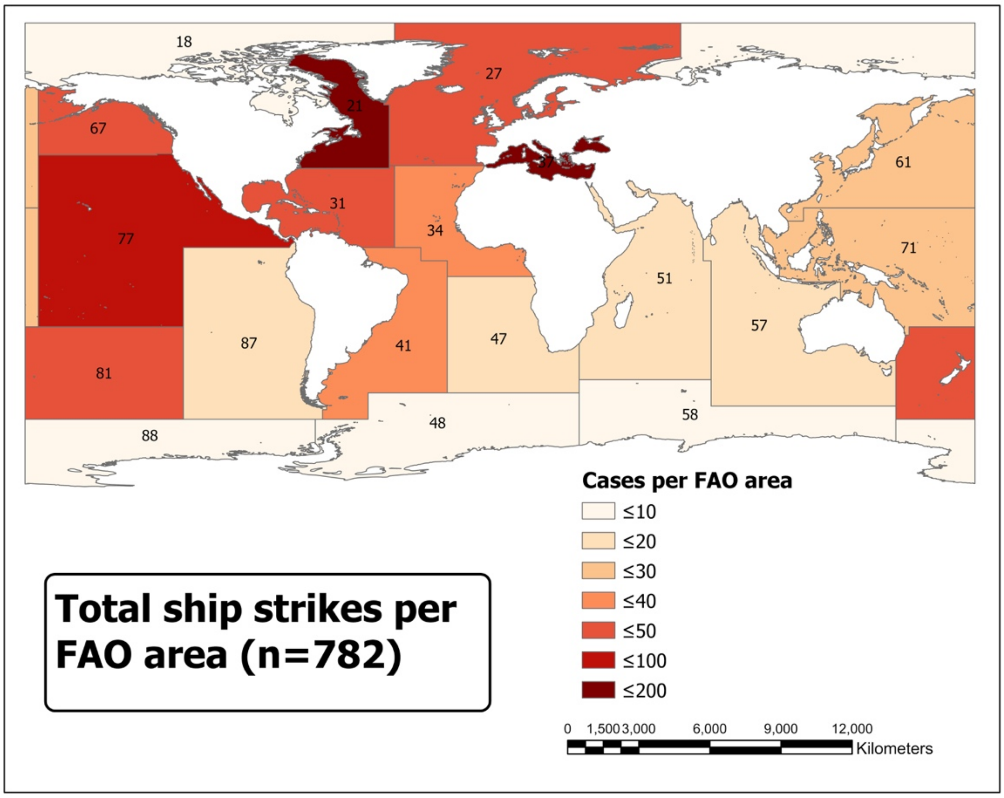

Figure 6: Numbers of ship strikes per FAO Major Fishing Area, based on data held in the IWC ship strike data base (1820-2019, n=782).

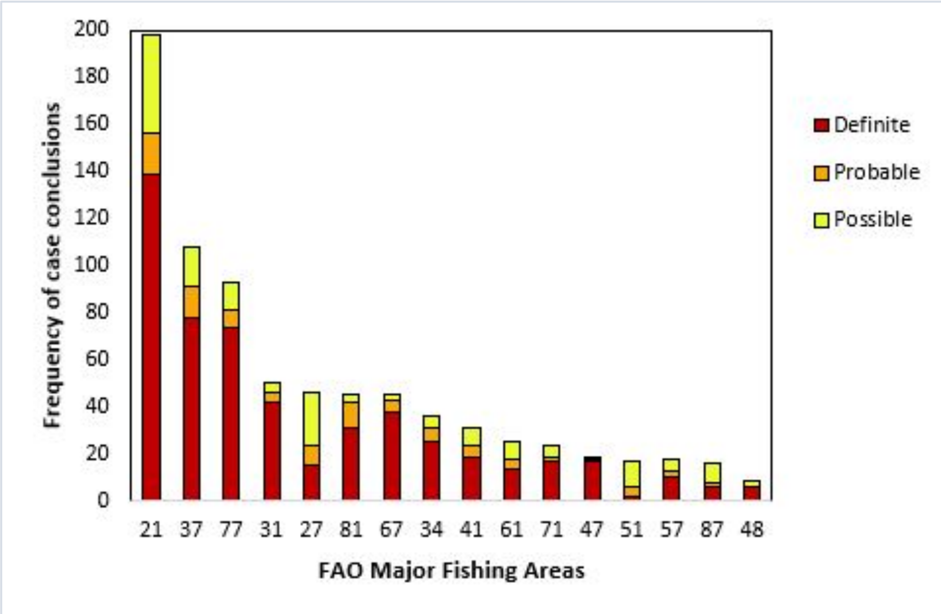

Figure 7: Ship strikes on cetaceans per FAO Major Fishing Area, by case conclusion, based on data held in the IWC ship strike data base (1820-2019, n=781).

Temporal trend in ship strikes

The number of cases that included a discrete date was 843. A clear trend can be seen in the number of reported cases over time. There is a steep increase from the 1980s with the highest count of cases in the 2000s (34.4%, n=321), followed by an apparent decline in the 2010s. Even though the 1990s show less reported cases than the 2000s, they still have the highest amount of definite cases (19.9%, n=186), as presented in Figure 8 and Table 6.

For a larger number of cases (9.6%, n=90) it was not possible to attribute a date, i.e. they remained in the "unknown" category. Within each decade, more than 50% of the cases were classified as *Definite*, and for older historical records reported for the period 1820 to 1970, all were classified as *Definite*.

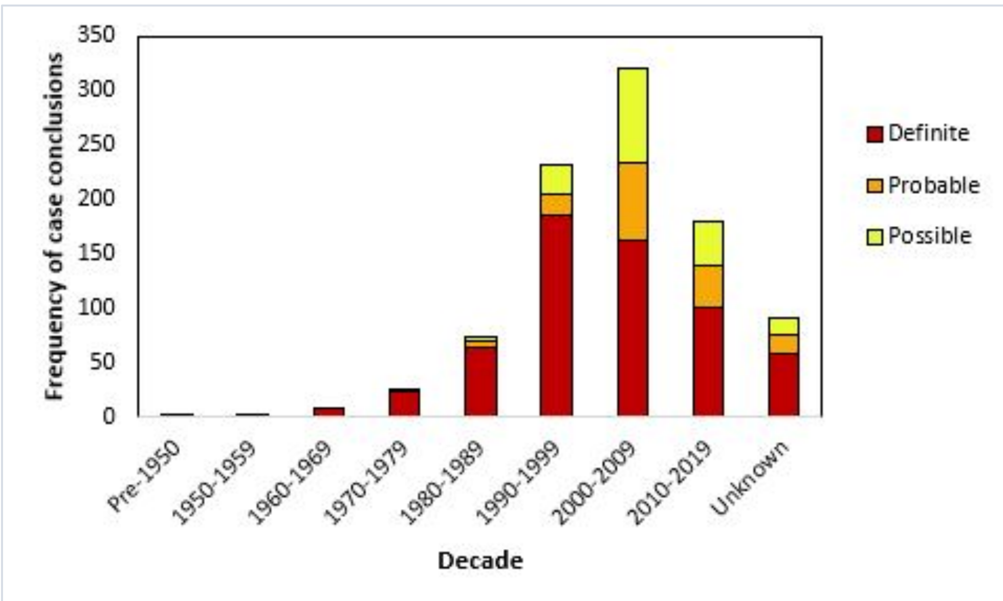

Figure 8: Ship strikes on cetaceans per decade, by case conclusion, based on data held in the IWC ship strike data base (1820-2019, n=933)

The trend detected using the decadal time scale is also reflected in the annual data (n=843, Figure 9). Until 1965, low numbers of ship strikes were recorded, with only one case per year, except for 1960 (two cases). Following this, multiple peaks were observed, with the highest total number of cases (=all categories) reported for the years 2006 (n=36, 3.8%) and 2007 (n=44, 4.7%). When only considering definite cases, the highest numbers of cases were reported for years 1995 and 1998 (n=26 and 2.8% each), followed by 1996 (n=23, 2.5%). From 1979 onwards, cases were reported on an annual basis, prior to this year cases were reported on a sporadic basis. Even though the earlier years show less cases, up to 1982 all cases were classified as *Definite* (with the exception of 1973 and 1976). Those two years had 80.0% and 83.3% of their cases classified as *Definite*, respectively. Again, it has to be remembered that 90 cases (9.6%) had no date associated.

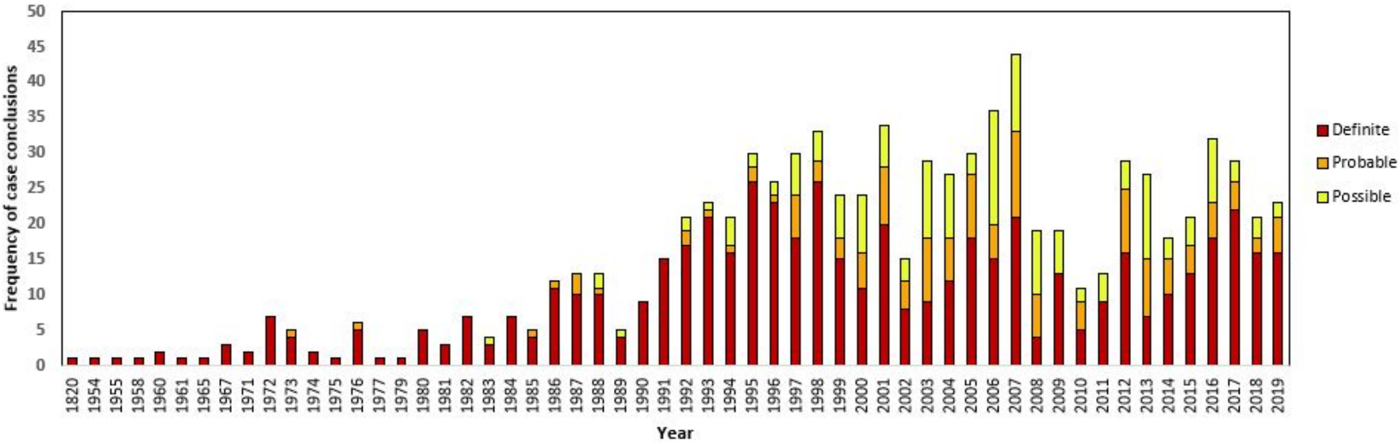

Figure 9: Ship strikes on cetaceans per year, by case conclusion, based on data held in the IWC ship strike data base (1820-2019, n=843).

Cetacean species involved in ship strikes

A total of 36 species and subspecies were identified in 818 cases. In two cases, the animals were identified only to genus level and 113 cases had no species identification provided.

586 individuals (62.8%) were identified as mysticetes, and 237 as odontocetes (25.4%). Whereas, 110 cases (11.8%) could not be classified as either an odontocete or mysticete. Regarding confidence of the identification, 556 cases (59.6%) included a confirmed species identification, while 28 cases (3%) remained unconfirmed, 79 (8.5%) were indeterminate, and 19 cases (2%) were identified only tentatively. The remaining cases either had ambiguous ID qualities due to duplicate reports (n=7, 0.7%), were classified as 'unknown' (n=21, 2.2%) or simply left blank (n=223, 23.9%).

417 cases (71.2%) of mysticetes are classified as *Definite*, 79 (13.5%) as *Probable* and 90 (15.3%) as *Possible* cases of ship strikes. 111 (46.8%) cases involving odontocetes were classified as *Definite*, 65 (27.4%) as *Probable* and 61 (25.7%) as *Possible* (Figure 10).

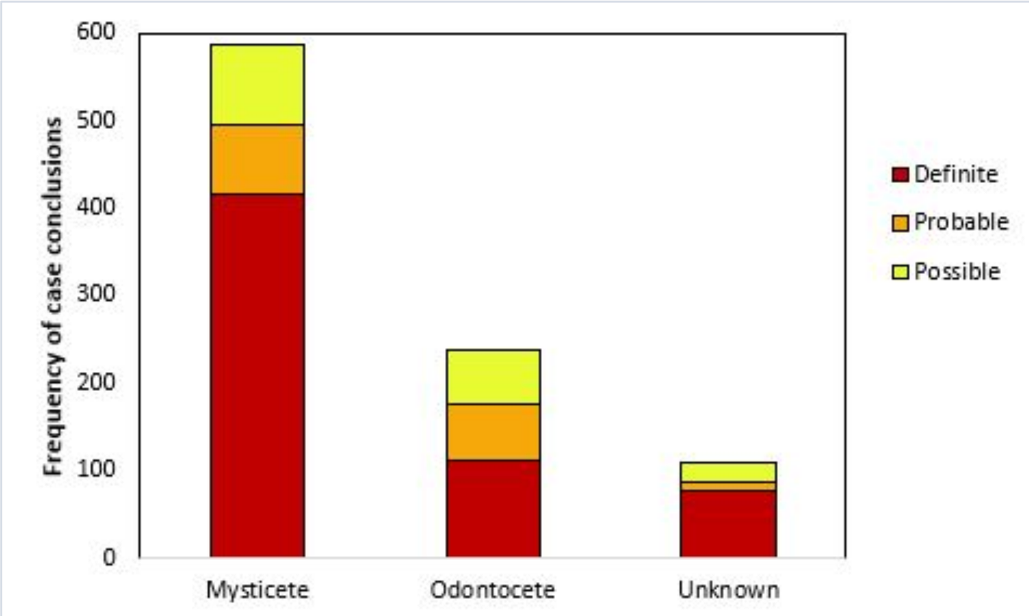

Figure 10: Ship strikes on cetaceans by case conclusion and cetacean suborders (mysticetes vs. odontocetes), based on data held in the IWC ship strike data base (1820-2019, n=933).

Most ship strikes reported involved fin whales (*Balaenoptera physalus,* n=189, 20.2%), followed by humpback whales (*Megaptera novaeangliae,* n=163, 17.5%) and sperm whales (*Physeter macrocephalus,* n=102, 10.9%) (Figure 11). Seven beaked whale species were reported, with Cuvier's beaked whales (*Ziphius cavirostris)* being the most frequently reported (n=14), comprising 66.7% of all beaked whales reported as struck. Again, it has to be noted that a larger proportion of all cases (n=113, 12.1%) did not provide a species identification.

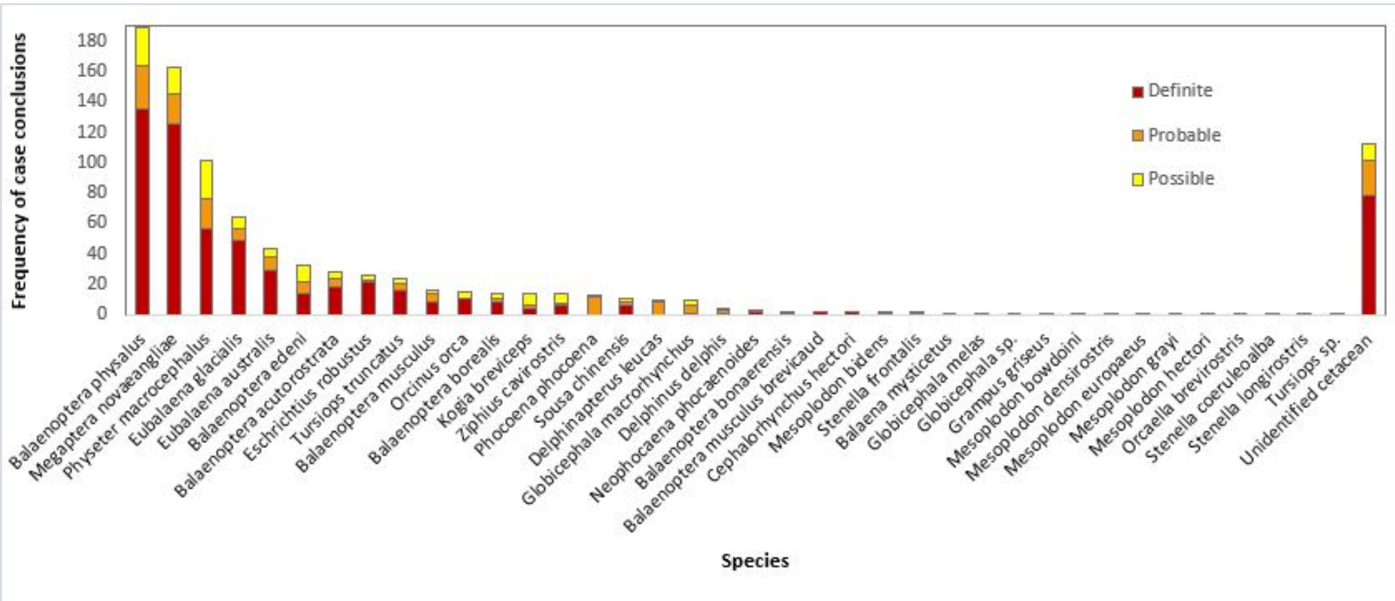

Figure 11: Ship strikes by case conclusion and cetacean species, based on data held in the IWC ship strike data base (1820-2019, n=933).

Ship Strikes by cetacean age class and sex

For 866 (92.8%) out of the total of 933 cases, no age class was given. From the remaining 67 cases, 19 (28%) were calves, 28 (42%) were juveniles , one (2%) was an subadult and the remaining 19 (28%) were adults (see Figure 12a). Hence, the majority (70%) of cases where the age class was known, were young or very young cetaceans.

Concerning the sex of the animals struck, in 690 cases (74%) it was not known. From the remaining 243 cases (26%), 113 (47%) were males and 130 (53%) were females.

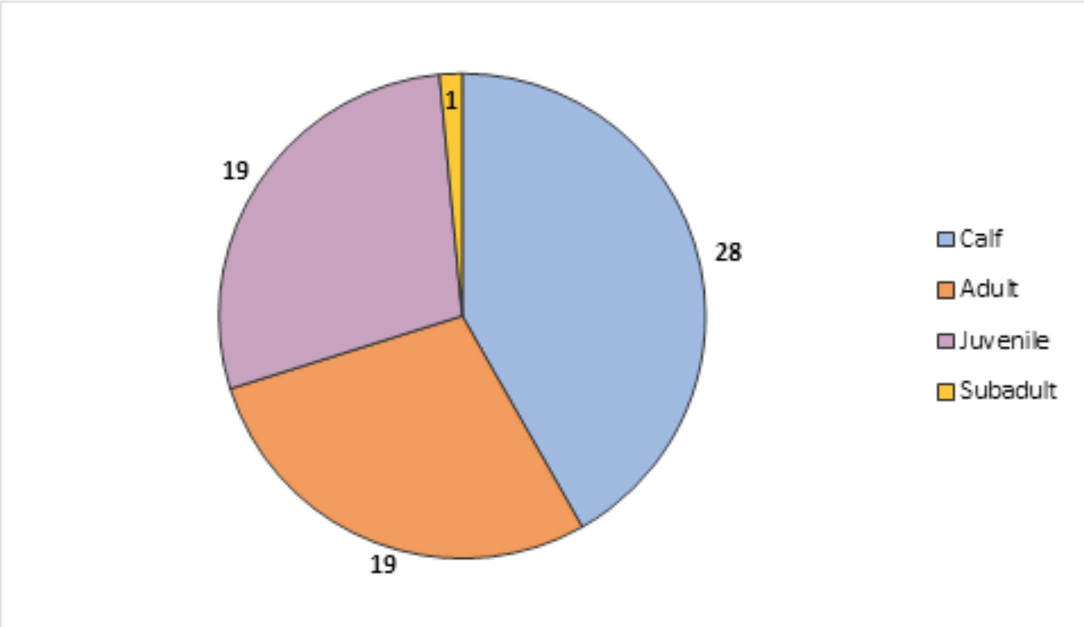

Figure 12a: Ship strikes on cetaceans by age class, based on data held in the IWC ship strike data base (1820-2019, n=67).

Ship strike by strike result

For 599 cases (64.2%), no outcome was provided and for 118 cases (12.6%) the outcome reported was 'not known'. The remaining 216 cases (23.1%) were classified as follows (Figure 12b and Table 9): 124 cases (57.4%) resulted in the death of the animal, while 12 (5.6%) were classified as "possibly dead" and 2 (0.9%) as "probably dead".

A further 34 cases (15.7%) were reported with a 'severe external visible injury', of which 30 were classified as *Definite* (88.2%), 3 as *Probable* (8.8%) and 1 as *Possible* (2.9%). Three cases (1.4%) had ambiguous information on the lesion and were captured together in 'indeterminate injury'. The remaining 41 cases (19.0%) were described with an 'apparent minor external injury' (n=19, 8.8%) or an 'indeterminate visible injury' (n=22, 10.2%).

Of the observations of injured whales at sea (n=103, 11.0%), there were difficulties in the determination of sex (n=31, 30.1% identified), as for most species the ventral side of the animal needs to be visible to do so. The same would account for age class (n=8, 7.8% identified) and length (n=25, 24.3% identified).

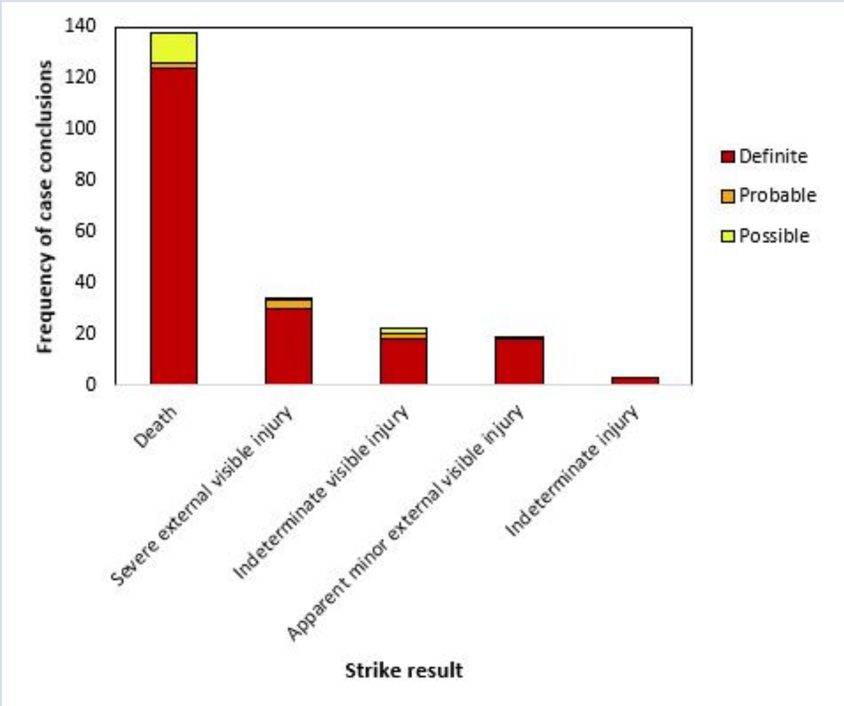

Figure 12b: Ship strike results by outcome for the cetacean and case conclusion, based on data held in the IWC ship strike data base (1820-2019, n=216).

The IWC data base also allows to enter information on the fate of the vessel and passengers/crew. In both categories the majority of cases provided no information: 796 (85.3%) for vessel fate and 886 (95.0%) for fate of passengers and/or crew. Two cases on vessel damage (0.2%) had ambiguous information provided, where it was not possible to determine what the information was actually relating to, these cases were left out of Figure 13. Out of 135 cases where information on vessel fate was reported, in 75 (55.6%) there was no damage to the vessel, while in 38 cases (28.1%) damage to the vessel was highlighted without providing further details. Ten vessels (7.4%) incurred major damage, seven vessels (5.2%) incurred minor damage, four vessels (3.0%) encountered total loss and one vessel (0.7%) showed superficial damage.

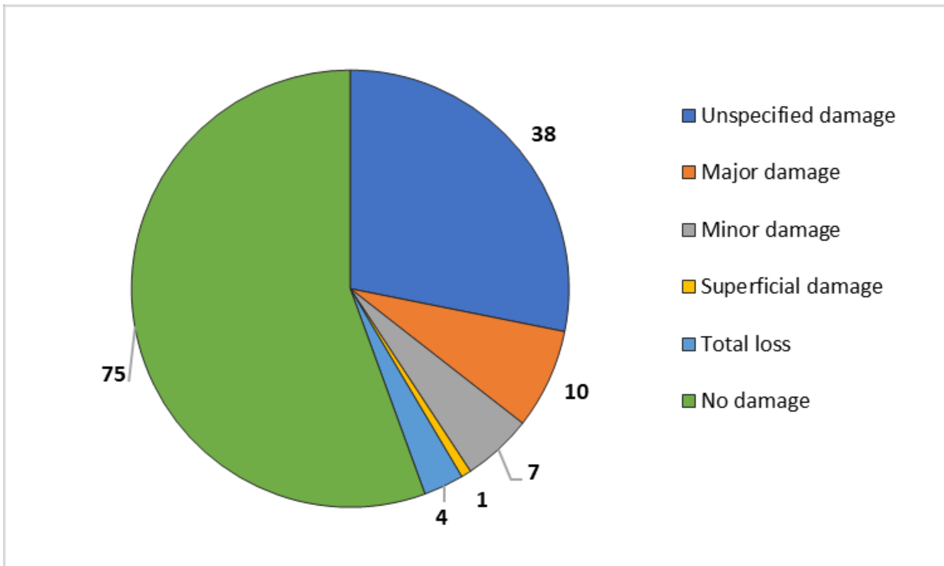

Figure 13: Numbers of ship strike by outcome for the vessel, based on data held in the IWC ship strike data base (1820-2019, n=135).

Regarding passenger and crew, there were 47 cases (5% out of the total of 933) including descriptions of injuries. The majority of those cases (n=36, 76.6%) involved no injuries, four cases (8.5%) involved minor and six (12.8%) major injuries. One case (2.1%) reported the death of one passenger, see Figure 14.

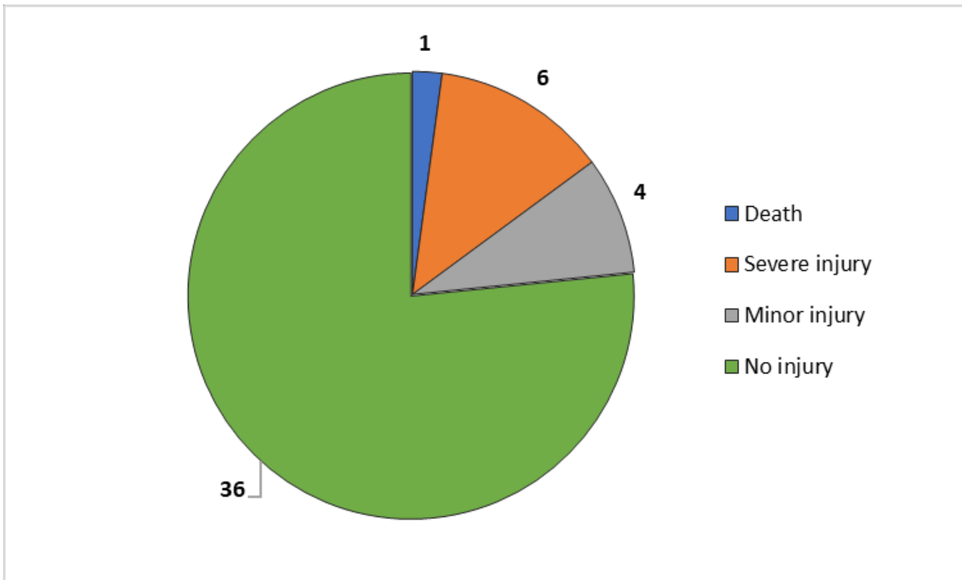

Figure 14: Numbers of ship strike results by injuries to passengers and crew, based on data held in the IWC ship strike data base (1820-2019, n=47).

Vessels involved in ship strikes

There were 402 cases that included vessel information and those data were assigned to one of 43 vessel type categories (see Table 10 in Annex). The highest number of identified vessels were ferries (n=52, 12.9%, including 10 fast ferries and 7 high-speed ferries, followed by sailing yachts (n=49, 12.2%) and passenger vessels (n=45, 11.2%, including cruise ships), motor yachts (n=42, 10.4%). Whale watching vessels accounted for 34 cases (8.4%), navy vessels and container ships for 33 cases (8.2%) each, and general cargo vessels for 25 (6.2%), see Figure 15.

Of those vessels that had associated length data, they ranged from 3 to 295m in length (n=210, 52.2%). Vessel lengths for some vessel types varied considerably. For example, for passenger vessels recorded lengths ranged from 118 to 295m - see Table 11 in Annex for further information on mean values and ranges for the different vessel types. Of the largest three vessel types, only two (0.9%) reported cases involved container ships (>50,000grt).

Information on vessel speed at the time of the collision was available for 101 cases (10.8%), and recorded speeds ranged from 0 to 51 knots. After pooling all available data into 5 knot intervals, it was shown that 49.5% of vessels (n=49) travelled at a speed of 11 to 20 knots at the time of collision (Figure 16). 47 vessels (47.0%) were travelling at 15 knots or faster, which is the speed associated with an increased cetacean mortality risk, of at least 79%, if a collision occurred (Vanderlaan & Taggart 2007). The largest number of cases with a *Definite* case conclusion were in the vessel speed category 16-20 knots (9.9%, n=10, see Figure 16). This speed category also has the same amount of *Probable* cases (9.9%, n=10). The highest amount of *Probable* case conclusions, however, can be found within speed category 11-15 knots (16.8%, n=17).

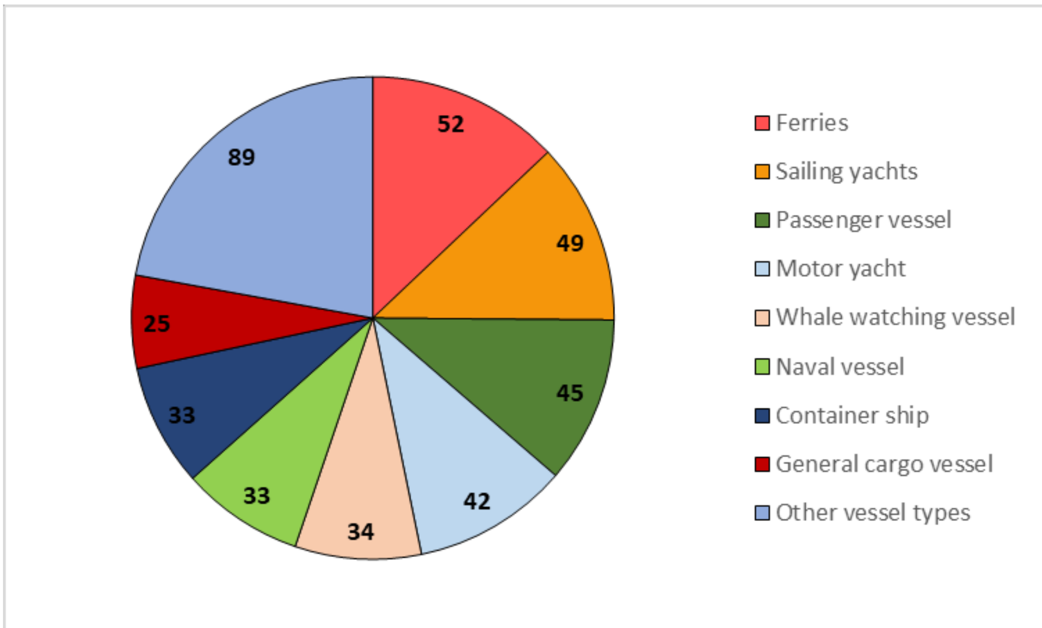

Figure 15: Numbers of ship strikes per vessel category, based on data held in the IWC ship strike data base (1820-2019, n=402).

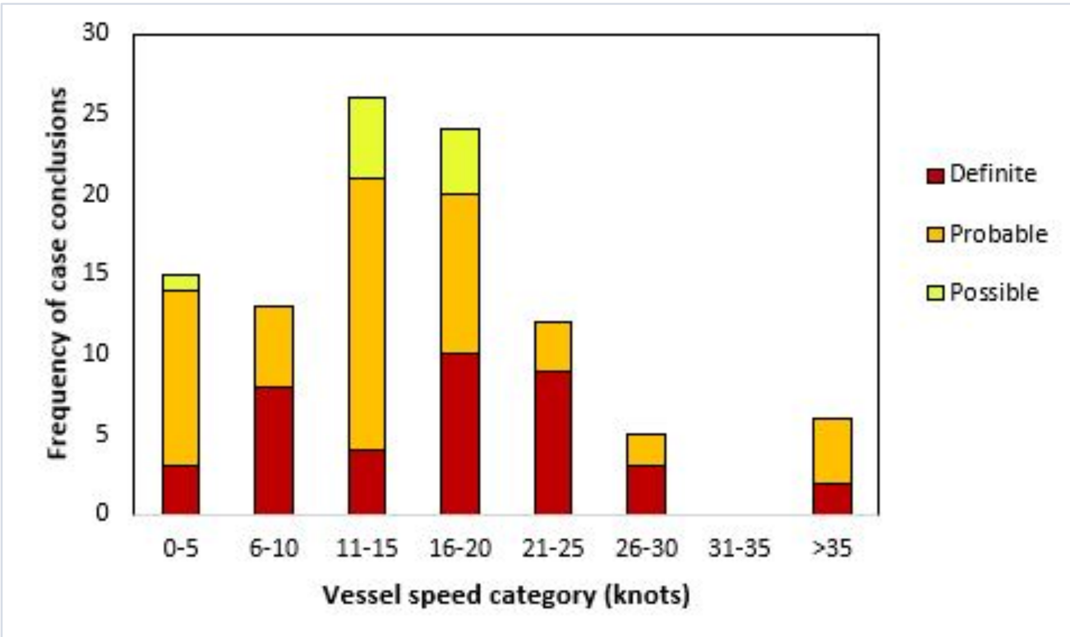

Figure 16: Vessel speed at time of collision categorized by case conclusion, based on data held in the IWC ship strike data base (1820-2019, n=101).

Conclusion & Recommendations

This paper presents a preliminary summary of data held in the IWC ship strike database that has been reviewed and validated by a team of experts according to criteria previously defined by the IWC Scientific Committee. This summary constitutes the most comprehensive contemporary overview of ship strikes on a global basis. 1,162 incidents were reported, resulting in 933 cases after validation. However, the results presented here have to be viewed and treated with caution, as there are several caveats that need to be considered. Principally, the IWC database is incomplete, lacking major contributions from regional databases held by contracting parties, as well as a larger number of archived cases not currently imported into the data base.

Data collection is heavily reliant on strandings and sightings at sea, weather and sea conditions, and the willingness of any witness to report the incident, as well as the knowledge on where to report it. This implies that a collision has to be noticed in the first place, and reported, thereafter - or, in the case of a stranding, that the animal died close enough to a coastline to be washed ashore (Laist et al. 2001; Peel et al. 2018). In stranded animals, symptoms of ship strike may not always be clearly identified. In addition, not all observed strikes may be reported due to feared penalties and negative publicity (Carrillo and Ritter 2010), all of which likely cause an underestimation of the actual number of strikes, and thus do not allow a proper assessment of their impacts, both on the individual and population level. This is exactly what the data in the IWC data base does reflect in many cases.

Hence, it has to be admitted that we are still a distance away from being able to draw firm conclusions from the data at hand. This has always been a major issue when dealing with ship strikes, be it locally, regionally or globally. Nevertheless, one of the main conclusions that can be drawn from this report is that ship strikes are notoriously underreported and underestimated. It also can be seen that the details of each report follow a temporal trend, with earlier reports being less detailed than more recent ones, indicating an increasing general awareness around the issue. Without any doubt, the work of the IWC on ship strikes, the establishment of the global data base and the recent work by the two data coordinators has contributed significantly to this trend.

At the same time, much remains to be achieved. Dedicated public awareness campaigns, targeting shipping companies, maritime schools and universities, direct outreach to crews and sea users in general would improve ship strike detection and reporting further. It would also allow a stronger and more robust reporting framework which can be seen as essential for the future. Improved information sharing with stranding networks are also crucial for collecting data on ship strikes, as well as conducting full necropsies on stranded animals, following systematic, shared, and ideally also standardized protocols.

The IWC has developed best practice guidelines for several maritime sectors (cruise shipping and offshore sailing regattas), and has repeatedly recommended careful planning of oceanic routes to avoid overlap of vessel traffic with cetacean abundance. Moreover, the IWC has set up a dedicated Ship Strike Working Group, and a strategic plan on ship strikes. In 2013, two ship strike data coordinators were appointed. All these measures, if continued or intensified, will further improve reporting and data management to reach more robust results, as well as the development of mitigation measures.

We therefore **recommend** the following:

- data from the U.S. and AUS regional data bases should be provided to the IWC global data base as soon as possible;
- bulk import of larger data sets must be made feasible by developing an according technical tool (bulk uploader);
- this document shall be provided to the general public, e.g. by posting it on the IWC website and providing it to interested parties upon request;
- a part-time IWC Ship Strike Coordinator to be appointed, following the examples of the existing Strandings and Bycatch Coordinators, to underpin and continue the work accomplished so far.
- A close collaboration of the IWC Strandings Coordinator with the Ship strike Coordinator is advisable so as to make sure that data held by international strandings programmes on cases of ship strikes are included in the IWC ship strike data base.

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Annex

Table 1: Large Areas as per IWC Ship Strike Data Base Reporting Form

Atlantic Ocean - North	*Pacific Ocean - Arafura Sea*
Atlantic Ocean - South	*Pacific Ocean - Banda Sea*
Pacific Ocean - North	*Pacific Ocean - Bering Sea*
Pacific Ocean - South	*Pacific Ocean - Bismarck Sea*
Indian Ocean	*Pacific Ocean - Bohai Sea*
Arctic Ocean	*Pacific Ocean - Bohol Sea (Mindanao Sea)*
Southern Ocean	*Pacific Ocean - Camotes Sea*
Atlantic Ocean - Adriatic Sea	*Pacific Ocean - Celebes Sea*
Atlantic Ocean - Aegean Sea	*Pacific Ocean - Ceram Sea*
Atlantic Ocean - Alboran Sea	*Pacific Ocean - Chilean Sea*
Atlantic Ocean - Argentine Sea	*Pacific Ocean - Coral Sea*
Atlantic Ocean - Bay of Biscay	*Pacific Ocean - East China Sea*
Atlantic Ocean - Bay of Bothnia	*Pacific Ocean - Flores Sea*
Atlantic Ocean - Bay of Campeche	*Pacific Ocean - Gulf of Alaska*
Atlantic Ocean - Bay of Fundy	*Pacific Ocean - Gulf of California (Sea of Cortés)*
Atlantic Ocean - Balearic Sea	*Pacific Ocean - Gulf of Carpentaria*
Atlantic Ocean - Baltic Sea	*Pacific Ocean - Gulf of Thailand*
Atlantic Ocean - Black Sea	*Pacific Ocean - Halmahera Sea*
Atlantic Ocean - Bothnian Sea	*Pacific Ocean - Java Sea*
Atlantic Ocean - Caribbean Sea	*Pacific Ocean - Koro Sea*
Atlantic Ocean - Celtic Sea	*Pacific Ocean - Molucca Sea*
Atlantic Ocean - Central Baltic Sea	*Pacific Ocean - Philippine Sea*
Atlantic Ocean - Chesapeake Bay	*Pacific Ocean - Salish Sea*
Atlantic Ocean - English Channel	*Pacific Ocean - Savu Sea*
Atlantic Ocean - Gulf of Bothnia	*Pacific Ocean - Sea of Japan/East Sea*
Atlantic Ocean - Gulf of Guinea	*Pacific Ocean - Sea of Okhotsk*
Atlantic Ocean - Gulf of Finland	*Pacific Ocean - Seto Inland Sea*
Atlantic Ocean - Gulf of Mexico	*Pacific Ocean - Solomon Sea*
Atlantic Ocean - Gulf of Sidra	*Pacific Ocean - South China Sea*
Atlantic Ocean - Gulf of St. Lawrence	*Pacific Ocean - Sulu Sea*
Atlantic Ocean - Gulf of Venezuela	*Pacific Ocean - Tasman Sea*
Atlantic Ocean - Ionian Sea	*Pacific Ocean - Yellow Sea*
Atlantic Ocean - Ligurian Sea	*Arctic Ocean - Amundsen Gulf*
Atlantic Ocean - Irish Sea	*Arctic Ocean - Baffin Bay*
Atlantic Ocean - Marmara Sea	*Arctic Ocean - Barents Sea*
Atlantic Ocean - Mediterranean Sea	*Arctic Ocean - Beaufort Sea*
Atlantic Ocean - Mirtoon Sea	*Arctic Ocean - Bering Sea*
Atlantic Ocean - North Sea	*Arctic Ocean - Cambridge Bay*
Atlantic Ocean - Sea of Azov	*Arctic Ocean - Chukchi Sea*
Atlantic Ocean - Sea of Crete	*Arctic Ocean - Cold Bay*
Atlantic Ocean - Sea of the Hebrides	*Arctic Ocean - Davis Strait*
Atlantic Ocean - Sargasso Sea	*Arctic Ocean - Denmark Strait*

Table 1 (cont.)	
Atlantic Ocean - Thracian Sea	*Arctic Ocean - East Siberian Sea*
Atlantic Ocean - Tyrrhenian Sea	*Arctic Ocean - Greenland Sea*
Indian Ocean - Andaman Sea	*Arctic Ocean - Hudson Bay*
Indian Ocean - Arabian Sea	*Arctic Ocean - James Bay*
Indian Ocean - Bay of Bengal	*Arctic Ocean - Kara Sea*
Indian Ocean - Gulf of Aden	*Arctic Ocean - Kara Strait*
Indian Ocean - Mozambique Channel	*Arctic Ocean - Labrador Sea*
Indian Ocean - Persian Gulf	*Arctic Ocean - Laptev Sea*
Indian Ocean - Red Sea	*Arctic Ocean - Lincoln Sea*
Indian Ocean - Timor Sea	*Arctic Ocean - Norwegian Sea*
Southern Ocean - Amundsen Sea	*Arctic Ocean - White Sea*
Southern Ocean - Bass Strait	
Southern Ocean - Bellingshausen Sea	
Southern Ocean - Davis Sea	
Southern Ocean - Great Australian Bight	
Southern Ocean - Gulf Saint Vincent	
Southern Ocean - Ross Sea	
Southern Ocean - Scotia Sea	
Southern Ocean - Spencer Gulf	
Southern Ocean - Weddell Sea	

Table 2: Vessel strikes per ocean divided by case conclusion

Ocean	**Definite**		**Probable**		**Possible**		**Total**
	Count	**%**	**Count**	**%**	**Count**	**%**	**Count**
Arctic Ocean	2	50.0	0	0.0	2	50.0	4
Atlantic Ocean	373	64.1	99	17.0	110	18.9	582
Indian Ocean	14	41.2	7	20.59	13	38.24	34
Pacific Ocean	194	72.0	36	13.4	39	14.6	269
Southern Ocean	8	44.4	3	16.7	7	38.9	18
unknown	14	53.8	10	38.5	2	7.7	26
Total	**605**	**64.8**	**155**	**16.6**	**173**	**18.5**	**933**

Table 3: Vessel strikes per large area divided by case conclusion

Large Area	Definite		Probable		Possible		Total
	Count	%	Count	%	Count	%	Count
Arctic Ocean - Bering Sea	0	0.0	0	0.0	1	100.0	1
Arctic Ocean - Davis Strait	1	100.0	0	0.0	0	0.0	1
Arctic Ocean - Norwegian Sea	1	50.0	0	0.0	1	50.0	2
Atlantic Ocean - Adriatic Sea	1	100.0	0	0.0	0	0.0	1
Atlantic Ocean - Argentine Sea	3	100.0	0	0.0	0	0.0	3
Atlantic Ocean - Alborán Sea	0	0.0	1	100.0	0	0.0	1
Atlantic Ocean - Balearic Sea	23	74.2	2	6.45	6	19.35	31
Atlantic Ocean - Baltic Sea	2	66.7	0	0.0	1	33.3	3
Atlantic Ocean - Bay of Biscay	2	100.0	0	0.0	0	0.0	2
Atlantic Ocean - Bay of Fundy	5	55.6	1	11.1	3	33.3	9
Atlantic Ocean - Caribbean Sea	11	73.3	2	13.3	2	13.3	15
Atlantic Ocean - Celtic Sea	0	0.0	0	0.0	1	100.0	1
Atlantic Ocean - Chesapeake Bay	10	83.3	1	8.3	1	8.3	12
Atlantic Ocean - English Channel	2	40.0	0	0.0	3	60.0	5
Atlantic Ocean - Gulf of Mexico	11	100.0	0	0.0	0	0.0	11
Atlantic Ocean - Gulf of St. Lawrence	5	13.2	7	18.4	26	68.4	38
Atlantic Ocean - Irish Sea	0	0.0	0	0.0	2	100.0	2

Table 3 (cont.)							
Atlantic Ocean - Ligurian Sea	24	68.6	5	14.3	6	17.1	35
Atlantic Ocean - Mediterranean	28	71.8	6	15.4	5	12.8	39
Atlantic Ocean - North	203	67.9	62	20.7	34	11.4	299
Atlantic Ocean - North Sea	6	25.0	7	29.2	11	45.8	24
Atlantic Ocean - South	32	71.1	5	11.1	8	17.8	45
Atlantic Ocean - Tyrrhenian Sea	5	100.0	0	0.0	0	0.0	5
Indian Ocean	12	80.0	2	13.3	1	6.7	15
Indian Ocean - Arabian Sea	0	0.0	4	36.4	7	63.6	11
Indian Ocean - Bay of Bengal	1	50.0	0	0.0	1	50.0	2
Indian Ocean - Persian Gulf	0	0.0	1	50.0	1	50.0	2
Indian Ocean - Red Sea	1	25.0	0	0.0	3	75.0	4
Pacific Ocean - Chilean Sea	2	33.3	2	33.3	2	33.3	6
Pacific Ocean - Coral Sea	10	62.5	2	12.5	4	25.0	16
Pacific Ocean - Gulf of Alaska	6	85.7	1	14.3	0	0.0	7
Pacific Ocean - Gulf of California/ Sea of Cortés	1	100.0	0	0.0	0	0.0	1
Pacific Ocean - North	110	79.1	15	10.8	14	10.1	139
Pacific Ocean - Philippine Sea	1	50.0	1	50.0	0	0.0	2
Pacific Ocean - Salish Sea	0	0.0	1	50.0	1	50.0	2
Pacific Ocean - Sea of Japan/East Sea	3	50.0	0	0.0	3	50.0	6
Pacific Ocean – South	40	65.6	8	13.1	13	21.3	61

Table 3 (cont.)							
Pacific Ocean - South China Sea	7	53.8	3	23.01	3	23.01	13
Pacific Ocean - Tasman Sea	13	81.25	3	18.75	0	0.0	16
Pacific Ocean - Yellow Sea	1	100.0	0	0.0	0	0.0	1
Southern Ocean	7	63.6	1	9.1	3	27.3	11
Southern Ocean - Bass Strait	0	0.0	0	0.0	1	100.0	1
Southern Ocean - Great Australian Bight	1	20.0	2	40.0	2	40.0	5
Southern Ocean - Scotia Sea	0	0.0	0	0.0	1	100.0	1
Unknown	14	53.8	10	38.5	2	7.7	26
Total	**605**	**64.8**	**155**	**16.6**	**173**	**18.5**	**933**

Table 4: Vessel strikes per country divided by case conclusion

Country	**Definite**		**Probable**		**Possible**		**Total**
	Count	**%**	**Count**	**%**	**Count**	**%**	**Count**
Aleutian Islands	0	0.0	0	0.0	1	100.0	1
Antarctica	3	37.5	1	12.5	4	50.0	8
Argentina	3	60.0	1	20.0	1	20.0	5
Australia	21	60.0	6	17.1	8	22.9	35
Azores	2	50.0	1	25.0	1	25.0	4
Belgium	2	66.7	1	33.3	0	0.0	3
Bonaire Islands	2	100.0	0	0.0	0	0.0	2
Brazil	9	52.9	3	17.7	5	29.4	17
Canada	39	50.6	10	13.0	28	36.4	77
Canary Islands	23	71.9	5	15.6	4	12.5	32
Chile	2	40.0	2	40.0	1	20.0	5

Table 4 (cont.)							
China	1	33.3	0	0.0	2	66.7	3
Colombia	1	50.0	1	50.0	0	0.0	2
Cook Islands	1	100.0	0	0.0	0	0.0	1
Costa Rica	0	0.0	2	100.0	0	0.0	2
Croatia	1	100.0	0	0.0	0	0.0	1
Crozet Islands	1	100.0	0	0.0	0	0.0	1
Desertas islands	0	0.0	1	100.0	0	0.0	1
Ecuador	2	28.6	0	0.0	5	71.4	7
Egypt	1	100.0	0	0.0	0	0.0	1
Enterprise Island	1	100.0	0	0.0	0	0.0	1
Eritrea	0	0.0	0	0.0	3	100.0	3
Faroe Islands	0	0.0	0	0.0	1	100.0	1
France	25	71.4	5	14.3	5	14.3	35
Germany	1	7.7	1	7.7	11	84.6	13
Greenland	1	100.0	0	0.0	0	0.0	1
Hawai'i	30	81.1	1	2.7	6	16.2	37
Hong Kong	6	85.7	0	0.0	1	14.3	7
India	0	0.0	1	50.0	1	50.0	2
Ireland	0	0.0	0	0.0	1	100.0	1
Italy	21	75.0	3	10.7	4	14.3	28
Japan	1	20.0	1	20.0	3	60.0	5
Kereguelen Islands	1	100.0	0	0.0	0	0.0	1
Khuriya Muriya Islands	0	0.0	0	0.0	1	100.0	1
Madeira	1	100.0	0	0.0	0	0.0	1
Marquesas Islands	0	0.0	0	0.0	1	100.0	1

Table 4 (cont.)							
Mexico	1	50.0	0	0.0	1	50.0	2
Netherlands	1	33.3	2	66.7	0	0.0	3
New Caledonia	4	100.0	0	0.0	0	0.0	4
New Zealand	26	68.4	9	23.7	3	7.9	38
Norway	0	0.0	0	0.0	1	100.0	1
Oman	0	0.0	2	28.6	5	71.4	7
Pakistan	0	0.0	0	0.0	1	100.0	1
Panama	7	70.0	1	10.0	2	20.0	10
Peru	1	33.3	0	0.0	2	66.7	3
Portugal	1	100.0	0	0.0	0	0.0	1
Puerto Rico	1	100.0	0	0.0	0	0.0	1
Senegal	1	100.0	0	0.0	0	0.0	1
Singapore	0	0.0	0	0.0	1	100.0	1
South Africa	17	89.4	1	5.3	1	5.3	19
South Georgia Islands	1	100.0	0	0.0	0	0.0	1
South Korea	1	100.0	0	0.0	0	0.0	1
Spain	6	50.0	1	8.3	5	41.7	12
Sri Lanka	3	100.0	0	0.0	0	0.0	3
Tanzania	1	100.0	0	0.0	0	0.0	1
The Bahamas	1	100.0	0	0.0	0	0.0	1
Tunisia	1	100.0	0	0.0	0	0.0	1
U.S.	205	85.8	17	7.1	17	7.1	239
UK	4	33.3	4	33.3	4	33.3	12
United Arab Emirates	0	0.0	1	50.0	1	50.0	2
unknown	114	53.3	70	32.7	30	14.0	214
Uruguay	5	71.4	1	14.3	1	14.3	7
Virgin Islands	1	100.0	0	0.0	0	0.0	1
Total	**605**	**64.8**	**155**	**16.6**	**173**	**18.5**	**933**

Table 5: Ship strikes per FAO areas divided by case conclusion

FAO Area	Definite		Probable		Possible		Total
	Count	%	Count	%	Count	%	Count
21	139	70.2	17	8.6	42	21.2	198
27	15	32.6	9	19.6	22	47.8	46
31	42	84.0	4	8.0	4	8.0	50
34	25	69.4	6	16.7	5	13.9	36
37	78	72.2	13	12.0	17	15.7	108
41	19	61.3	5	16.1	7	22.6	31
47	17	89.4	1	5.3	1	5.3	19
48	6	66.7	0	0.0	3	33.3	9
51	2	11.1	5	27.8	11	61.1	18
57	10	55.5	3	16.7	5	27.8	18
61	14	56.0	4	16.0	7	28.0	25
67	38	84.4	5	11.1	2	4.4	45
71	17	70.8	2	8.3	5	20.8	24
77	74	79.6	7	7.5	12	12.9	93
81	31	68.9	11	24.4	3	6.7	45
87	6	37.5	2	12.5	8	50.0	16
unknown	72	47.4	61	40.1	19	12.5	152
Total	**605**	**64.8**	**155**	**16.6**	**173**	**18.5**	**933**

Table 6: Ship strikes per decade divided by case conclusion

Decade	Definite		Probable		Possible		Total
	Count	%	Count	%	Count	%	Count
1820	1	100.0	0	0.0	0	0.0	1
1950-59	3	100.0	0	0.0	0	0.0	3
1960-69	7	100.0	0	0.0	0	0.0	7
1970-79	23	92.0	2	8.0	0	0.0	25
1980-89	64	86.5	6	8.1	4	5.4	74
1990-99	186	80.2	19	8.2	27	11.6	232
2000-09	163	50.8	71	22.1	87	27.1	321
2010-19	100	55.6	39	21.8	41	22.8	180
unknown	58	64.4	18	20.0	14	15.6	90
Total	**605**	**64.8**	**155**	**16.6**	**173**	**18.5**	**933**

Table 7: Ship strikes per year divided by case conclusion

Year	Definite		Probable		Possible		Total
	Count	%	Count	%	Count	%	Count
1820	1	100.0	0	0.0	0	0.0	1
1954	1	100.0	0	0.0	0	0.0	1
1955	1	100.0	0	0.0	0	0.0	1
1958	1	100.0	0	0.0	0	0.0	1
1960	2	100.0	0	0.0	0	0.0	2
1961	1	100.0	0	0.0	0	0.0	1
1965	1	100.0	0	0.0	0	0.0	1
1967	3	100.0	0	0.0	0	0.0	3
1971	2	100.0	0	0.0	0	0.0	2
1972	7	100.0	0	0.0	0	0.0	7
1973	4	80.0	1	20.0	0	0.0	5
1974	2	100.0	0	0.0	0	0.0	2
1975	1	100.0	0	0.0	0	0.0	1
1976	5	83.3	1	16.7	0	0.0	6
1977	1	100.0	0	0.0	0	0.0	1
1979	1	100.0	0	0.0	0	0.0	1
1980	5	100.0	0	0.0	0	0.0	5
1981	3	100.0	0	0.0	0	0.0	3
1982	7	100.0	0	0.0	0	0.0	7
1983	3	75.0	0	0.0	1	25.0	4
1984	7	100.0	0	0.0	0	0.0	7
1985	4	80.0	1	20.0	0	0.0	5
1986	11	91.7	1	8.3	0	0.0	12
1987	10	76.9	3	23.1	0	0.0	13
1988	10	76.9	1	7.7	2	15.4	13
1989	4	80.0	0	0.0	1	20.0	5
1990	9	100.0	0	0.0	0	0.0	9
1991	15	100.0	0	0.0	0	0.0	15
1992	17	81.0	2	9.5	2	9.5	21
1993	21	91.3	1	4.35	1	4.35	23
1994	16	76.2	1	4.8	4	19.0	21
1995	26	86.6	2	6.7	2	6.7	30
1996	23	88.5	1	3.8	2	7.7	26
1997	18	60.0	6	20.0	6	20.0	30
1998	26	78.8	3	9.1	4	12.1	33
1999	15	62.5	3	12.5	6	25.0	24
2000	11	45.8	5	20.8	8	33.3	24
2001	20	58.8	8	23.5	6	17.7	34

Table 7 (cont.)							
2002	8	53.3	4	26.7	3	20.0	15
2003	9	31.0	9	31.0	11	37.9	29
2004	12	44.4	6	22.2	9	33.3	27
2005	18	60.0	9	30.0	3	10.0	30
2006	15	41.7	5	13.9	16	44.4	36
2007	21	47.7	12	27.3	11	25.0	44
2008	4	21.0	6	31.6	9	47.4	19
2009	13	68.4	0	0.0	6	31.6	19
2010	5	45.4	4	36.4	2	18.2	11
2011	9	69.2	0	0.0	4	30.8	13
2012	16	55.2	9	31.0	4	13.8	29
2013	7	25.9	8	29.6	12	44.4	27
2014	10	55.6	5	27.8	3	16.7	18
2015	13	61.9	4	19.05	4	19.05	21
2016	18	56.3	5	15.6	9	28.1	32
2017	22	75.9	4	13.8	3	10.3	29
2018	16	76.2	2	9.5	3	14.3	21
2019	16	69.6	5	21.7	2	8.7	23
Unknown	58	64.4	18	20.0	14	15.6	90
Total	**605**	**64.8**	**155**	**16.6**	**173**	**18.5**	**933**

Table 8: Ship strikes per species divided by case conclusion

Species	**Definite**		**Probable**		**Possible**		**Total**
	Count	**%**	**Count**	**%**	**Count**	**%**	**Count**
Balaena mysticetus	1	100.0	0	0.0	0	0.0	1
Balaenoptera acutorostrata	18	64.3	4	14.3	6	21.4	28
Balaenoptera bonaerensis	1	50.0	0	0.0	1	50.0	2
Balaenoptera borealis	9	64.3	3	21.4	2	14.3	14
Balaenoptera edeni	14	42.4	11	33.3	8	24.2	33
Balaenoptera musculus	9	56.25	2	12.5	5	31.25	16
B. musculus brevicauda	2	100.0	0	0.0	0	0.0	2

Table 8 (cont.)							
Balaenoptera physalus	135	71.4	25	13.2	29	15.4	189
Cephalorhynchus hectori	2	100.0	0	0.0	0	0.0	2
Delphinapterus leucas	0	0.0	1	10.0	9	90.0	10
Delphinus delphis	1	25.0	1	25.0	2	50.0	4
Eschrichtius robustus	22	84.6	3	11.5	1	3.9	26
Eubalaena australis	29	65.9	6	13.6	9	20.5	44
Eubalaena glacialis	49	76.6	7	10.9	8	12.5	64
Globicephala macrorhynchus	1	10.0	4	40.0	5	50.0	10
Globicephala melas	1	100.0	0	0.0	0	0.0	1
Globicephala sp.	0	0.0	0	0.0	1	100.0	1
Grampus griseus	0	0.0	1	100.0	0	0.0	1
Kogia breviceps	4	28.6	8	57.1	2	14.3	14
Megaptera novaeangliae	126	77.3	18	11.0	19	11.7	163
Mesoplodon bidens	1	50.0	1	50.0	0	0.0	2
Mesoplodon bowdoini	0	0.0	0	0.0	1	100.0	1
Mesoplodon densirostris	0	0.0	1	100.0	0	0.0	1
Mesoplodon europaeus	0	0.0	1	100.0	0	0.0	1
Mesoplodon grayi	1	100.0	0	0.0	0	0.0	1
Mesoplodon hectori	1	100.0	0	0.0	0	0.0	1
Neophocaena phocaenoides	2	66.7	0	0.0	1	33.3	3
Orcaella brevirostris	0	0.0	1	100.0	0	0.0	1

Table 8 (cont.)							
Orcinus orca	11	73.3	4	26.7	0	0.0	15
Phocoena phocoena	0	0.0	1	7.7	12	92.3	13
Physeter macrocephalus	57	55.9	26	25.5	19	18.6	102
Sousa chinensis	6	54.5	3	27.3	2	18.2	11
Stenella coeruleoalba	0	0.0	1	100.0	0	0.0	1
Stenella frontalis	1	50.0	1	50.0	0	0.0	2
Stenella longirostris	1	100.0	0	0.0	0	0.0	1
Tursiops sp.	0	0.0	0	0.0	1	100.0	1
Tursiops truncatus	16	66.7	3	12.5	5	20.8	24
Ziphius cavirostris	6	42.9	7	50.0	1	7.1	14
Unidentified cetacean	**78**	**69.0**	**11**	**9.7**	**24**	**21.3**	**113**
Total	**605**	**64.8**	**155**	**16.6**	**173**	**18.5**	**933**

Table 9: Strike result by case conclusion (n=216)

Strike Result	**Definite**		**Probable**		**Possible**		**Total**
	Count	**%**	**Count**	**%**	**Count**	**%**	**Count**
Apparent minor external injury	18	94.7	0	0.0	1	5.3	19
Death	124	89.9	2	1.4	12	8.7	138
Indeterminate injury	3	100.0	0	0.0	0	0.0	3
Indeterminate visible injury	18	81.8	2	9.1	2	9.1	22
Severe external visible injury	30	88.3	3	8.8	1	2.9	34
Total	**193**	**89.3**	**7**	**3.2**	**16**	**7.4**	**216**

Table 10: Ship strikes per vessel type (n=402)

Vessel type	Count	Percent
Car-ferry	6	1.5
Container ship (<50,000grt)	3	0.7
Container ship (>50,000grt)	4	1.0
Container ship (unknown size)	26	6.5
Cruise ship	7	1.7
Dinghy	3	0.7
Fast ferry	2	0.5
Fast ferry (>25knots, >300grt)	8	2.0
Ferry (displacement hull > 300grt)	10	2.5
Ferry (unknown size)	19	4.7
Ferry small (<300grt)	2	0.5
Fishing vessel (< 300grt)	4	1.0
Fishing vessel (unknown size)	9	2.2
Freighter or container	2	0.5
General cargo	23	5.7
High speed ferry (>35 knots, >300grt)	2	0.5
High-speed ferry	5	1.2
Hopper dredge	2	0.5
Hydrofoil	4	1.0
Large passenger vessel/cruise ship	13	3.2
Motor yacht (<25m)	17	4.2
Motor yacht (>25m)	11	2.7
Motor yacht (unknown size)	14	3.5
Naval vessel	33	8.2
Open fishing boat	2	0.5
Other	26	6.5
Passenger vessel	21	5.2
Pilot boat	1	0.2
Research vessel	2	0.5
Rigid inflatable/inflatable	7	1.7
Sailing yacht (<25m)	37	9.2
Sailing yacht (>25m)	7	1.7
Sailing yacht (unknown size)	5	1.2
Small passenger vessel/cruise ship	4	1.0
Sport fishing vessel	1	0.2
Steamer	1	0.2
Submarine	2	0.5
Tanker	10	2.5
Tugboat	1	0.2
U.S. Coast Guard	10	2.5
Whale catcher boat	2	0.5
Whale watching vessel	34	8.5
Total	**402**	

Table 11: Vessel lengths (m) by vessel type (n=210)

Variable	Vessel type	N	Mean	SE Mean	Min.	Max.
Vessel length (m)	Container ship (<50,000grt)	1	210.00	*	210.0	210.0
	Container ship (>50,000grt)	2	294.01	0.015	294.0	294.0
	Container ship (unknown size)	9	186.89	19.280	75.0	275.0
	Cruise ship	4	222.63	19.061	173.0	259.7
	Dinghy	1	6.00	*	6.0	6.0
	Fast ferry (>25knots, >300grt)	3	78.83	48.733	30.1	176.3
	Ferry (displacement hull > 300grt)	9	132.54	11.400	81.1	173.7
	Ferry (unknown size)	4	73.63	24.881	20.0	129.0
	Fishing vessel (< 300grt)	3	13.60	7.700	5.8	29.0
	Fishing vessel (unknown size)	5	14.14	5.192	5.0	27.0
	General cargo	3	171.33	5.364	161.0	179.0
	High speed ferry (>35 knots, >300grt)	2	63.68	36.320	27.4	100.0
	High-speed ferry	2	23.90	7.100	16.8	31.0
	Hopper dredge	2	110.00	0.000	110.0	110.0
	Hydrofoil	1	24.00	*	24.0	24.0
	Large passenger vessel/cruise ship	7	254.41	25.102	111.0	293.0
	Motor yacht (<25m)	10	10.84	1.628	4.0	20.0
	Motor yacht (>25m)	11	71.91	11.651	25.0	144.0
	Motor yacht (unknown size)	1	25.00	*	25.0	25.0
	Naval vessel	22	137.27	12.431	19.8	253.0
	Other	8	64.84	27.038	3.0	205.0
	Passenger vessel	11	195.09	20.268	118.0	295.0
	Research vessel	2	89.00	0.000	89.0	89.0
	Rigid inflatable/inflatable	5	7.72	1.408	5.8	13.2
	Sailing yacht (<25m)	31	14.76	1.163	7.3	37.0
	Sailing yacht (>25m)	7	19.54	1.243	18.3	27.0
	Small passenger vessel/cruise ship	3	158.00	28.844	118.0	214.0
	Sport fishing vessel	1	10.00	*	10.0	10.0
	Steamer	1	131.00	*	131.0	131.0
	Tanker	5	141.90	18.020	105.0	203.0
	Tugboat	1	32.00	*	32.0	32.0
	U.S. Coast Guard	8	57.79	11.900	25.0	115.0
	Whale catcher boat	2	41.00	0.000	41.0	41.0
	Whale watching vessel	23	18.27	1.445	7.0	36.0

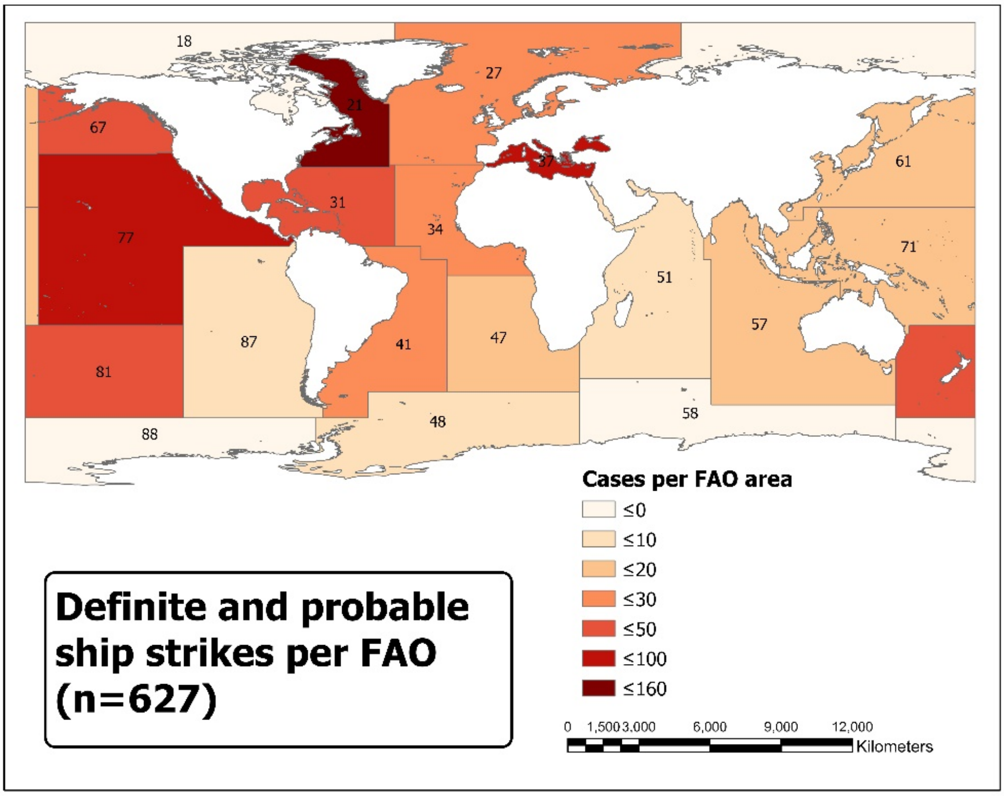

Figure 17: Number of definite and probable ship strikes per FAO, based on data held in the IWC ship strike data base (1820-2019, n=627)

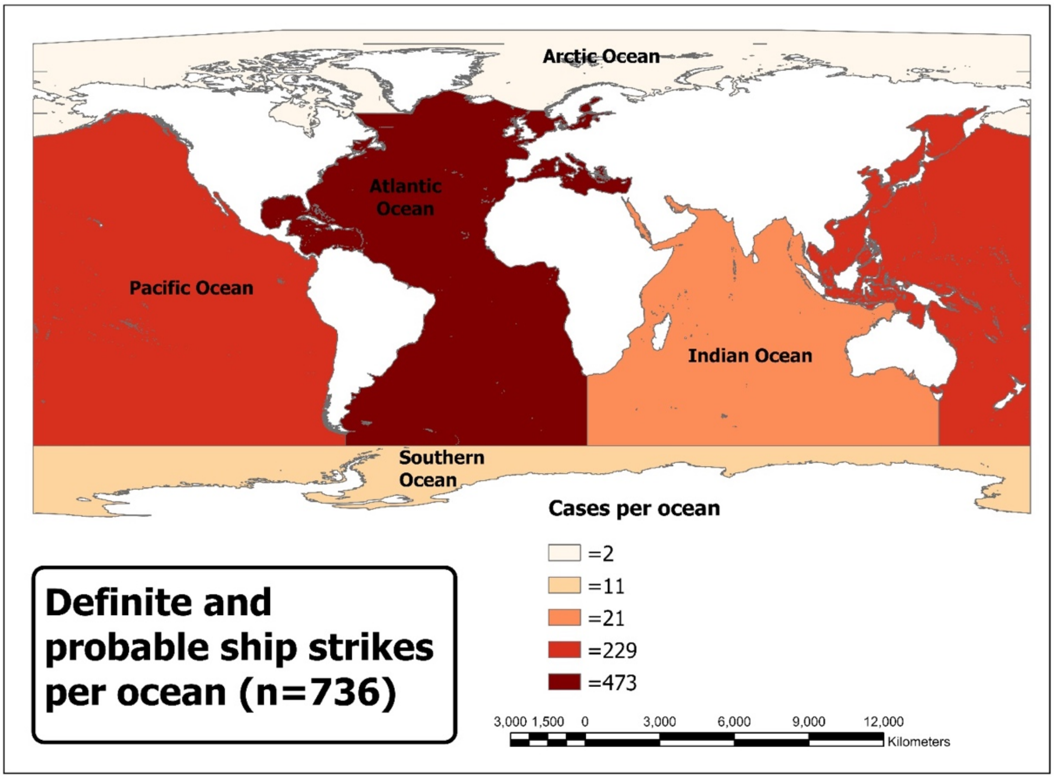

Figure 18: Number of definite and probable ship strikes per ocean, based on data held in the IWC ship strike data base (1820-2019, n=736)