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Strategic Plan to Mitigate the Impacts of Ship Strikes on Cetacean Populations: 2017-2020

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Executive Summary:

[to be added]

1.0 Introduction

The International Whaling Commission (IWC) has identified the need to produce a Strategic Plan describing the direction of activities intended to reduce the threat of ship strikes with cetaceans in the near and distant future. The purpose of this document is to provide the IWC with a plan focusing on vessel-large whale collisions. Here, we: 1) Define and identify areas in which ships and large whales frequently co-occur (“High Risk Areas”), 2) identify large whale populations vulnerable to decline in part due to mortalities associated with ship strikes, 3) discuss the possible attributes of some ship strike avoidance technologies, 4) identify the need for collaboration among key constituent sectors and 5) discuss the importance of inter-organization communication and the streamlining of data.

The IWC is the primary international body responsible for the conservation and stewardship of large whales. Currently, the primary threats to whale populations globally include ship strikes, entanglement in active or ghost fishing gear, various forms of marine pollution (chemical and acoustic) and indirect effects of climate change that affect their habitats and prey. Therefore, it is important that a current summary of the nature and magnitude of these issues by population and region exists. Here we focus on one specific threat, ship strikes, and provide information and context for ship strike reduction and priority-setting to promote cetacean conservation. Priority activities are highlighted as bold text throughout this document.

1.1 Aim of the Strategic Plan

To contribute to conservation of large whale populations, globally, through the reduction of ship strikes between 2017 and 2020.

1.2 Objectives of the Strategic Plan

1) To reduce mortalities and injuries to large whales as a result of ship strikes

- 2) Increase the application of measures that reduce collision probability, such as re-routing and speed reduction/limits on a global scale
- 3) Improve reporting of incidents that do occur to the IWC Ship Strike Database
- 4) Increase development/use of avoidance technologies and push for their widespread-standardized where appropriate.
- 5) Improve collaboration on ship strike issues internationally (e.g. International Maritime Organization (IMO), other IGOs (ACCOBAMS, ASCOBANS), NGOs)
- 6) Increase public and industry awareness about the issue and measures used to reduce this threat.

1.3 Definitions:

1.3.1 High Risk Areas:

A High Risk Area is defined as the convergence of either areas of high volume of shipping and whales, or high numbers of whales and shipping. Areas of high volumes of shipping include designated shipping lanes, historic shipping routes and port approaches. Areas of high numbers of whales include areas where whales aggregate, whales are known to return in numbers on a regular basis, or critical population areas or habitats (Russell 2001). As used herein, the term “High Risk Area” is a relative term with no specific threshold assigned to its use.

1.3.2 At risk populations:

An at risk population is one in which the population viability is at risk due to ship strikes. Viability may be influenced by a number of single or interacting factors including: the proportion of a population in high risk areas, populations are prone to ship strikes, for species that swim slowly or remain at surface for long periods of time (sperm whales, humpback whales, bowhead whales and right whales), or for population that have a small number of reproductively mature females (e.g., western gray whales, eastern North Pacific right whales and Chile-Peru right whales).

1.3.3 Ship strike:

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. These injuries may not always be externally visible. Strikes may also result in non-fatal serious injuries.

1.4 Background:

Most reports of collisions between whales and vessels involve large whales, but all species can be affected. Collisions with large vessels often go unnoticed and/or unreported. Animals can be injured or killed and vessels can sustain damage. Severe and even fatal injuries to passengers have occurred involving traditional and hydrofoil ferries, whale watching vessels and recreational craft (IWC 2016). The types of vessels involved in collisions include a great variety of watercraft comprising large ships such as tankers, cargo

or cruise ships, but also whale watching vessels, navy ships, yachts, hydrofoils and others (Laist et al. 2001; Jensen and Silber 2004; Panigada et al., 2006; Van Waerebeek et al. 2007; Ritter 2009).

2.0 Strategies

The IWC has identified the need to address the effects of ship strikes on cetacean populations, and especially large whale populations, as a conservation concern worldwide. Reducing the threat of ship strikes can be difficult to address because factors contributing to ship strikes may differ by regions, across seasons, collisions may go unnoticed, and the nature of collisions may differ with each instance. Hence assessing the magnitude of the threat is difficult.

The IWC Ship Strike Working Group has recommended to the Commission the following strategies be undertaken: 1) create and maintain a global database of collisions between ship strikes and cetaceans, 2) seek ways to reduce the magnitude of this threat through technological solutions, 3) identify High Risk Areas and develop area specific mitigation strategies, 4) identify at risk (e.g., small) populations of large whales and evaluate the extent to which ship strikes are contributing to a lack of recovery, and 5) develop specific advice for the shipping industry regarding mitigation of ship strikes. The Commission has endorsed similar recommendations from the Scientific Committee in the past. [*Add as appropriate* - - These recommendations and the Strategic Plan in which they are described were approved by the Commission at its annual meeting in October 2016].

In addition, the IWC Scientific Committee and the Ship Strike Working Group have recommended to the Commission the importance of understanding the relationships between vessel speed, the risk of death or serious injury to the individual whale, and damage to the vessel. Moreover two SC guiding documents (SC 65b HIM 04 & 05) summarize recommendations to specific shipping sectors.

Additional studies, as well as additional analyses of available information, when reviewed by the SC or conducted with the assistance of SC members, will contribute to the Commission's ability to minimize the impact of ship strikes on large whale populations.

2.1 Database

2.1.1. Management

Since 2007, the IWC has been developing a global database of collisions between ships and whales with associated collaboration from several IMO members, the Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and contiguous Atlantic area (ACCOBAMS), and the Agreement on the Conservation of Small Cetaceans in the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS). The objectives of this database are to contribute to a better understanding of the scale of the problem, of the factors that relate to risk (such as vessel type and speed), to estimate ship strike mortalities for different whale populations, to identify High Risk Areas and inform mitigation measures. The data base went online in 2009. Since 2013, the IWC has employed two dedicated data coordinators to facilitate addressing this issue. Following outreach work undertaken by the data

coordinators, as well as recent changes to the database system, there was an increase in number of new reported incidents, bringing the total of existing records in the data base to around 1200 (as of May 2016). All new entries are verified and categorized by the current IWC Ship Strike Data Review Group.

2.1.2. Actions to be accomplished in the near term

Initiate efforts to get a more comprehensive and more accurate reporting of ship strike incidents into the Ship Strike Database. This will require increased public and shipping industry awareness of the importance of reporting such incidents to the proper authorities. It will then be necessary to develop a protocol such that local and regional authorities routinely submit ship strike data to the IWC. This protocol should include the existing online and paper version template for reporting. Improved public awareness could be achieved inter alia by further contact with the following authorities to request them to post notices on their products or as part of their outreach programs about the importance of reporting ship strikes: 1) agencies that are responsible for producing tide charts, regional charts, and Coast Pilot (e.g., <http://www.nauticalcharts.noaa.gov/nsd/cpdownload.htm>), 2) agencies that are responsible for certifying vessel operating licenses, 3) organizations whose members spend considerable time on or operating marine vessels (e.g. the international Chamber of shipping, Cruise Line International Association, World Ocean Council, International sailing Association, etc.), 4) organizations responsible for the conduct of vessel operators near and around harbors, and 5) naval academies and merchant marine schools. Another approach might be to utilize available software applications, such as Global Fishing Watch (<http://globalfishingwatch.org/map>), which could be modified to show overlap of large whales and areas of concentrated vessel traffic.

Records of ship strikes should be reviewed and added to the database in a reasonable time frame. To ensure timely reporting, National Progress Reports from IWC member states should be checked for completeness and thoroughness. If members are not reporting or are reporting incompletely, the Commission should request they submit complete and timely reports. To ensure that reports are complete, a brief summary of how reporting occurs should be provided to member states and should be placed in the annex of the annual National Progress Reports. Attempts should also be made to establish a point of contact for ship strike reporting, especially in those countries that do not have stranding networks, so that reports from member states can be consolidated through a single source. Lastly, it is recommended that non-member nations be asked to participate in submittals of National Progress Reports where ship strikes are known to occur (e.g., Canada, Sri Lanka). A preliminary target of 4 months has been established by the Working Group as the time it should take in general to get an incident report verified and entered into the database.

Improve on the reliability of species identification of ship struck whales. It is understood that not all species identifications will be equally reliable. Therefore, it would be valuable to include adequate information in the incident report to provide for the evaluation of the credibility of species identification. Also when possible, a skin sample should be collected to

confirm species ID by genetics. The Ship Strike Working Group [*has agreed to*] existing confidence criteria reported in Moore *et al.* 2013).

Maintain an easily assessable compendium of relevant papers and reports of ship strike issues; produce an updated bibliography related to ship strike issues on a two year schedule. Such a document would also be of considerable use to the scientific community interested in this topic.

2.1.3 Actions of work to be accomplished in the long term

The value of the Ship Strike database would be enhanced if all of the existing records and future records were reviewed using the existing standard protocol. This is an essential task and one that should start as soon as possible. Without it, any reporting out of summaries of data will potentially be meaningless.

Finally, public awareness of the risk of large whale conservation caused by ship strikes would be enhanced by the publication of routine summary statistics from the Ship Strike database coupled with specific/directed outreach efforts. This would include summaries by region and by species, as well as the efficacy of measures taken in a given region to mitigate ship strikes. **In addition, as appropriate, periodic publications should be prepared for publication in the Journal of Cetacean Research and Management that summarize the nature and magnitude of large whale – ship strike incidents and that illustrate the efficacy of reduction strategies, as well as possible impacts on whale stocks.**

2.2 Training/Technology

No single technology now exists, or will be developed in the foreseeable future that will eliminate, or reduce to zero the chances of ships striking large whales. **Reducing the spatial overlap of both high numbers of whales and high numbers of vessels is likely to remain the best means of reducing ship strikes followed by vessel speed reductions.** Various modifications to vessel and water craft operations have been used in an attempt to reduce the threat of ship strikes. Seeking ways to reduce the magnitude of the threat through technological solutions has also been proposed by maritime industries, resource managers, and government agencies. A combination of improved training opportunities or protocols, along with the application of existing technology may provide a means to reduce ship strike interactions, while simultaneously allowing maritime commerce and other activities to proceed with minimal biological and economic impact (Silber *et al.* 2008). This Strategic Plan seeks to identify some of the more promising training or technologies for the IWC to endorse and pursue, although it should be recognized that new training methods and technologies are occurring all the time. **Therefore, the Ship Strike Working Group should identify and evaluate various training/education programs to determine which might feasibly expand to other regions or marine resource user groups.** Ideally, such training programs would be incorporated into the curricula of nautical schools where appropriate, and/or made available online.

Finally, the wider dissemination of the IWC Power Point presentation on ship strikes (that will soon be made available online via <https://iwc.int/ship-strikes>) will add to the outreach

efforts to industries, mariners, managers and the general public. The presentation should be routinely updated on the basis of emerging knowledge.

2.2.1 Avoidance training for ship pilots: A Case Study

Ship pilots are currently working with the US National Park Service to understand the conditions in which whale encounters can result in potential collisions, by combining information on whale behavior, such as spout frequency, dive intervals, and swim speeds, with the operational constraints attributed to navigating a large vessel. Ultimately some guidelines will be produced that clarify these conditions when operating at different speeds, based on the operations of the ship. These guidelines seek to help less experienced marine pilots begin to develop search images for early detection, and consider avoidance maneuvers once detected, of whales in a simulator, which allows them to practice avoidance techniques necessary to reduce the likelihood of collisions. Another goal of this effort is to work with marine and coastal pilots to 'own' the issue of avoiding whales. This work is achieved in a full bridge simulator, by meetings with the industry, and other 'trust' building efforts. **It is recommended that a training curriculum paired with a mobile simulation (e.g., SEAIQ (<http://seaiq.com/>)) be developed that can be tailored based on the species/population of whale at risk and applied to regional areas where pilotage is required, similar to disentanglement training regions.**

2.2.2 Co-operation with the whale watching industry

Whale SENSE is a voluntary education program offered to commercial whale watching companies in the **U.S. Atlantic and Alaska Regions**. The program is sponsored by NOAA Fisheries in the United States and the non-profit organization, Whale and Dolphin Conservation. Developed in collaboration with the whale watching industry, Whale SENSE recognizes whale watching companies committed to responsible practices (<http://whalesense.org/>). Similar effort is currently on going in the ACCOBAMS Region, with a label of High Quality Whale Watching (http://www.accobams.org/index.php?option=com_content&view=article&id=1199:high-quality-whale-watching-certification-registered-by-accobams&catid=3:accobams-news&Itemid=68), awarded to companies which comply with a specific code of conduct. As appropriate, the IWC Ship Strike Working Group should consider implementing similar programs in other regions.

2.2.3. Detection technology

Carefully considered voyage planning that anticipates the potential for whale interaction is more desirable than attempting to react to the presence of whales in the near field. Several technologies (e.g., predictive modeling, passive acoustics, and real time information systems) employed together could provide far and nearfield detection capabilities to aid voyage planning, as well as immediate avoidance response (Silber et al. 2008). We recommend that the following technologies be evaluated for efficacy: Infrared Blow

Detection, Auto-detection buoys, Predictive Modeling, Passive Acoustics and real time reporting applications. However, it is important to note that the main focus of reducing ship strikes should remain on preventing ship and whale overlap and a reduction in speed where this is not possible. The use of a combination of predictive modeling whereby cetacean occurrence and distribution might be anticipated using proxies (e.g., oceanographic features, prey distribution and cetacean habitat requirements), and systems to notify mariners about cetacean aggregations, along with guidance about specific evasive measures, should remain the Commission's primary focus in mitigating the impacts of ship strikes on large whale populations.

2.2.4. Applications to Aid in Voyage Planning and Operations

There are likely many aids to voyage planning that could be adopted by mariners to reduce ship strikes. Two examples are provided herein.

Whale Alert is a growing network of non-profit institutions, government agencies, shipping and technology companies focused on reducing lethal ship strikes of whales. The Whale Alert network is currently in use in the California Current sanctuaries, Boston channel and SE Alaska, US. In the US federal agencies such as NOAA, the Marine Mammal Commission and the US Coast Guard, participate (<http://www.whalealert.org/>). **Expanding and applying such technologies in (to) other areas is recommended.**

The Automatic Identification System (AIS) is an automatic navigational aid used on ships and by vessel traffic services (VTS) for identifying and locating vessels by electronically exchanging data with other nearby ships, AIS base stations, and satellites. AIS is required aboard international voyaging ships of 300 gross tons or greater, and all passenger ships regardless of size. This system provides information that enables the tracking of vessel location, speed and routes (Webb and Gende 2015). This system is useful in characterizing vessel routes and relative densities of vessel traffic and has been considered for use in conservation (Reimer et al, 2016; Robards et al., 2016). The SC has continually reviewed studies using AIS data to identify High Risk areas, and has found this to be a valuable approach. The IWC should consider working with the International Maritime Organization (IMO) to require all vessels (including vessels 300 gross tons or less) in high-risk areas to have AIS (<https://www.vesselfinder.com/>). As noted above, and as an example, Global Shipping Watch has provided a software application that can assist in overlaying the activity of commercial fishing vessels and large whales. This would greatly facilitate further research in this field.

2.3 Identify High Risk Areas (IMO MEPC 69/10/3 [use standard reference format])

A High Risk Area is defined in 1.3.1. It is important to minimize the impacts of ship strikes particularly when vulnerable populations are involved or ship strikes could adversely impede population growth of large whales. The following areas have been identified as High Risk Areas, where ship strikes are common (MEPC 69/10/3). **For each location identified,**

the Ship Strike Working Group should develop proposals (with Table 1. in mind) for ship strike reduction measures specific to that region over the next 3 years.

Table 1. Stages in identifying high risk areas and developing appropriate mitigation strategies

Stage 1	High risk area of potential concern identified based on overlap of shipping and whale distribution or a high number of reported incidents
Stage 2	Survey data for whales and AIS data for shipping used to inform risk analysis
Stage 3	Consideration of possible practical options based on risk analysis. Recommendations from IWC Scientific Committee, IWC approaches relevant states to offer information and advice.
Stage 4	Stakeholder workshops to discuss possible mitigation measures and optimize risk reduction with stakeholder interests
Stage 5	Relevant states consider proposals to IMO assisted by supporting information from IWC
Stage 6	Measures implemented through IMO
Stage 7	Continued monitoring to evaluate ongoing effectiveness of measures

- Sri Lanka-Blue Whales (Priyadarshana et al., 2016; Redfern et al. 2016, de Vos et. al 2016)
- Hauraki Gulf, New Zealand-Bryde’s Whales (Van Waerebeek et al. 2007; Baker et al. 2010; Constantine et al., 2015)
- Canary Island-Sperm Whales (Carrillo and Ritter 2010, Ritter 2010, Fais et al. 2016)
- Panama-Humpback whales (Guzman et al. 2013)
- ENP blue whales
- Mediterranean High Risk Areas
 - Strait of Gibraltar-Fin and Sperm (de Stephanis and Urquiola 2006)
 - Pelagos Sanctuary-Fin (Panigada et al. 2006)
 - Island of Crete (SW)-Sperm whales (Frantzis et al., 2014;Frantzis et al., 2015)
 - Balearic Islands-Fin and sperm whales
 - Eastern Alboran Sea-Fin and sperm whales
 - Hellenic Trench, Greece-Sperm whales (Frantzis et al., 2014; Frantzis et al., 2015)
- NE coast of Sakhalin Island-western gray whale (R. Brownell and D. Weller)
- Arabian Sea-Humpback whale (Willson et al. 2016)
- Southern Pacific right whale

- Eastern Bering Sea-NP right whale
- Arctic (USA and Russian)-Potential threats to bowhead

2.3 Update on efficacy of implemented measures

Continued monitoring in areas where measures have been introduced to reduce ship strikes would be useful to determine efficacy and whether such measures would be useful elsewhere.

Potential areas for review:

Panama humpback whales

Arabian Sea humpback whales (add reference to recent document – 5OES 13 Oct 2016)

Eastern North Pacific blue whales

North Atlantic right whales

2.4 At risk populations

As noted, human-induced mortality caused by ship strikes can be an impediment to population growth. Populations of whales in the low hundreds of individuals are at risk of continuing declines even if only a small number of ship strikes occur per year. Therefore, it is important to identify populations that are small, are in decline, or for which human activities result in whale deaths or injuries and to monitor these populations to evaluate the extent to which ship strikes are a threat:

- a. Western North Atlantic right whale
- b. Eastern North Pacific right whale
- c. Chile-Peru right whale
- d. Arabian Sea humpback whale
- e. Western gray whale
- f. Blue whale-Sri Lanka and Arabian Sea
- g. Blue whale-Chile
- h. Sperm whale-Mediterranean Sea
- i. Fin whale-Mediterranean Sea
- j. Bryde's whale-Gulf of Mexico
- k. Omura's whale-Northwestern Madagascar
- l. Sperm whale-Canary Islands region

At a minimum, the Scientific Committee should provide a best estimate of the annual incidence rate of ship strikes for each of these populations and these will be reported to the Commission. **A preliminary target date for this effort is the 2018 meeting of the Scientific Committee and Commission.**

It should be recognized that identifying the cause of death of a stranded whale is often times highly uncertain. Efforts should be made to encourage, wherever possible and practical, the practice of performing necropsies on stranded whales in part to determine the cause of death.

See Annex 4.5 for additional details on the populations listed here.

2.5 Specific advice to shipping sectors (IWC guidance docs SC/65b/HIM5 and SC/65b/HIM4)

In June 2014, a joint IWC and UNEP-CEP-SPAW10 Ship Strikes Workshop was hosted by Panama. A key recommendation with respect to IMO activities was to develop an appropriate protocol to enable consideration of cetacean distribution and occurrences for proposed new or revised routing schemes or speed restriction. **The Ship Strike Working Group in combination with the Scientific Committee needs to develop such mechanisms globally.** It is likely that such an approach will be most effective, if the practice of focusing on a specific region is continued.

The IWC has also discussed developing specific guidance for vessels where there may be specific ship strike issues not covered by the general guidance in MEPC.1/Circ.674. This may for example be useful for cruise ships and sailing vessels (IWC 2014 a; IWC 2014 b). The IWC has developed a detailed guidance to provide information on the ship strike issue to sailing regatta/offshore race organizers as well as highlighting mitigation options. The guidance covers four main subject areas, i.e. collating baseline data, route planning, informing sailors and reporting. In 2015, the IWC collaborated with WWF and the Volvo Ocean Race to develop specific guidance for competitors and organizers. **These efforts should be continued and expanded in the future.** Such efforts will be most effective early in the planning stages when different route options and timing are still under consideration.

Additionally, the ship strike data coordinators have been regularly reaching out to shipping companies, shipping associations and maritime academies to disseminate awareness information and exchange views. **The receptiveness of such efforts needs to be evaluated.**

2.6 Future Studies

The IWC Scientific Committee has identified the need for a better understanding of the relationship between vessel speed, the risk of death or injury to the whale and damage to the vessel. It has considered a number of studies and approaches since 2009 when MEPC.1/Circ.674 was adopted by the IMO. Many studies considered have confirmed an increased risk of a strike being fatal with increased speed, supporting the use of speed restrictions to reduce risk. Some studies have quantified the speed-risk relationship for specific whale species (Conn and Silber, 2013) and the hydrodynamic forces in relation to speed (Silber et al., 2010). Others (e.g. Wiley et al., 2011) have evaluated the relative risk reduction that might be achieved by speed restrictions. In addition to studies based on collisions, studies based on observations of whales close to vessels have inferred greater collision risks with increased vessel speed (Gende et al., 2011; Harris et al., 2012).

As an example of a recent success in reducing whale-ship strikes, in the five years after the enactment of mandatory 10 knot speed restrictions in Seasonal Management Areas along the Atlantic coast of the United States, no right whale death due to collision has been reported either in, or within 45 NM of these areas. These results indicate a statistically

significant reduction in right whale ship strikes in these areas suggesting that the speed limits have been effective (Laist et al., 2014).

We encourage further consideration of the operational aspects of active avoidance; that is where bridge personnel are actively searching for, and will or are willing to enact avoidance measures (altering course or speed) should a whale be at risk of collision. Simulation models including the visual detection process and ship maneuverability characteristics may be useful in this regard (e.g. Clyne and Leaper, 2004).

3. Summary of Recommendations

Recommendations regarding activities to support mitigation of ship strikes are listed in Table 1 and are found in bold type throughout this document.

[tbd – once document is finalized.]

4. List of Annexes

- 4.1 IWC/63/CC8. Report of the Joint IWC-ACCOBAMS Workshop on Reducing Risk of Collisions between Vessels and Cetaceans.
- 4.2 IWC/65/CCRep01. Report of the Joint IWC SPAW Workshop to Address Collisions Between Marine Mammals and Ships with a Focus on the Wider Caribbean.
- 4.3 IMO MEPC 69/10/3. Information on recent outcomes regarding minimizing ship strikes to cetaceans, submitted by the International Whaling Commission.
- 4.4 IWC guidance docs SC/65b/HIM5 and SC/65b/HIM4.
- 4.5 Identify High Risk Areas supporting material
- 4.6 Figure depicting the overall approach used in developing this Strategic Plan.

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[Insert Table 1]

Annex 4.5 Identifying High Risk Areas (note: not all areas identified in the Strategic Plan have been included in this summary; tbd if all could be described)

1. Sri Lanka-Blue Whales (Redfern et al. 2016, De vos et. al 2015, In Review)

Shipping routes across the northern Indian Ocean converge along the southern tip of Sri Lanka resulting in one of the highest open ocean densities of ship traffic globally. These routes and the lanes associated with the Traffic Separation Scheme (TSS) off Dondra Head overlap with very high numbers of blue whales, concentrations of whale watching activity and coastal fisheries. Results of surveys designed to investigate blue whale distribution in relation to shipping have suggested that shifting the current TSS to the south would substantially reduce the ship strike risk and improve maritime safety (Priyadarshana et al., 2016). IWC has been in discussions with the Sri Lanka authorities and shipping interests about possible routing measures and this was discussed at Scientific Committee meeting in Bled in 2016. Status of this population is unknown, but anthropogenic deaths are of great

concern due to historic population reduction as a result of whaling. Possible resources to help minimize ship strikes include the development of a distribution model for data poor habitat areas, which could be used to identify key blue whale habitat (Redfern et al. 2016).

4. Hauraki Gulf, New Zealand-Bryde's Whales (Van Waerebeek et al. 2007; Baker et al. 2010, Constantine et al., 2014)

A year-round population of Bryde's whales inhabits the entrance of the Hauraki Gulf to the Port of Auckland, New Zealand. Since 1996, 85% of all 44 documented Bryde's whale deaths (2.3/per year) have been attributed to ship strikes (Constantine et al. 2015). The local population of Bryde's whales in the Hauraki Gulf is estimated at 159 whales. Whales are broadly distributed throughout the Gulf so re-routing traffic would not lessen the threat of ship strike. The Port of Auckland has issued a protocol for vessels transiting the Hauraki Gulf which includes recommendations for reduced speed to 10 knots.

5. Canary Island-Sperm Whales (Carrillo and Ritter 2010; Ritter 2010, Fais et al. 2016)

Collisions with sperm whales are of particular concern around the Canary Islands, although a number of other species are also affected. In 2012, a workshop on "Maritime Transport and Biodiversity Conservation" was held (Tejedor et al. 2013). Subsequently, a Working Group for the Prevention of Ship-Strikes was established in 2014, comprising stakeholders from authorities, the shipping industry and researchers, with the IWC fulfilling an advisory role. The PSSA (Particularly Sensitive Sea Area, IMO designation) in the Canary Islands was proposed as a means to facilitate implementation of ship strike mitigation measures. The mandatory reporting system for ships entering the PSSA could be a mechanism for relaying relevant information and guidelines to ships. Such measures might be coordinated through the development of a dedicated regional conservation management plan for sperm whales in the Canary Islands. It should be recognized that High Speed Crossings (HSC) represent a threat to the sustained population of sperm whales in this area, as the ship strike rate currently exceeds the natural reproduction rate of this population (Fais et al. 2016).

6. Panama-Humpback whales (Guzman et al. 2013)

The movement of whales in the Gulf of Panama coincides with major commercial maritime routes. A TSS mitigation strategy was implemented in December 2014 and includes a 4-month restriction on vessel speed (i.e., 10 knots) when the humpback whales are present. Preliminary data shows that TSS compliance is very high and future studies should examine whether compliance has resulted in a reduction of ship strikes.

7. Eastern North Pacific (ENP) blue whales

Aggregations of ENP blue whales feed in southern California shipping lanes (Calambokidis et al. 2000, 2007; McKenna et al. 2015). Recent estimates of the abundance of this population, using both line transect and mark-recapture methods, showed no clear increase in abundance, despite decades of protection from commercial whaling, which ended in 1971 (Barlow 1995, Calambokidis & Barlow 2004, Calambokidis et al. 2009). ENP blue whale population estimates range from 2000 to 3000 animals (Calambokidis & Barlow 2004). A recent study suggested that density dependence is likely the key reason for the observed

lack of increase (Monnahan et al. 2014). The only known source of juvenile and adult mortality for ENP blue whales is fatal collisions between ships and whales (Carretta et al. 2012), although noise and fishery interactions likely also impact the population. Between 1998 and 2007, 21 blue whale deaths (8 confirmed as ship struck animals) were reported along the California coast; 4 of those deaths occurred in the fall of 2007 in the Southern California Bight (Berman-Kowalewski et al. 2010). These Blue whale stranding's were spatially associated with locations of shipping lanes, especially those associated with the Ports of Los Angeles and Long Beach, and were most common in the fall months. Mitigation measures were implemented in 2010. As was the case for the Gulf of Panama, efforts to evaluate the efficacy of these measures should be undertaken.

7. Mediterranean High Risk Areas

7.1 Strait of Gibraltar-Fin and Sperm (de Stephanis and Urquiola 2006)

The Strait of Gibraltar is an area of high vessel traffic, most commonly transited by ferries, fast ferries and cargo ships. A new commercial harbor, built in 2007, has shifted traffic to cross directly through sperm whale feeding grounds. Sperm and fin whales are the most vulnerable cetacean species to ship strikes in this area (de Stephanis and Urquiola 2006). Details can be found in ...See Joint ACCOBAMS/Pelagos Workshop on Large Whale Ship Strikes in the Mediterranean Sea.)

7.2 Pelagos Sanctuary-Fin (Panigada et al. 2006)

From 1972 to 2001, out of 287 fin whale carcasses, 46 individuals (16.0%) were known to have been killed by vessel interactions. The minimum mean annual fatal collision rate increased from 1 to 1.7 whales/year from the 1970s to the 1990s. Fatal strike events (82.2%) were reported in or adjacent to the Pelagos Sanctuary, characterized by high levels of traffic, including High Speed Craft (HSC), and whale concentrations. Among 383 photo-identified whales, 9 (2.4%) had marks that were attributed to a ship impact. Near misses have been reported through an observer scheme on some of the ferries to occur frequently. The high likelihood of unreported fatal strikes combined with other anthropogenic threats suggests an urgent need for a comprehensive, basin-wide conservation strategy, including ship strike mitigation requirements, like real-time monitoring of whale presence and distribution to re-locate ferry routes to areas of lower cetacean density, and reducing ship speed in high cetacean density areas (Panigada et al. 2006). (See Joint ACCOBAMS/Pelagos Workshop on Large Whale Ship Strikes in the Mediterranean Sea).

7.3 Island of Crete-Sperm whales

Localized studies of sperm whales in the Mediterranean suggest that distribution is highly concentrated within limited areas with low densities elsewhere. Long-term studies to the SW of Crete have suggested that this is a consistent area of high concentrations of sperm whales where ship strike mortalities are known to have occurred. The density of shipping

also suggests this may be a High Risk Area. This area is suggested as a focus for further investigation to ensure sufficient data are gathered to determine whether minor routing changes to shipping could achieve a significant risk reduction. Although the conservation implications from ship strikes at a population level cannot be determined without further abundance data, studies to determine effective mitigation strategies could allow these to be implemented rapidly if new data on abundance indicated a serious conservation problem.

7.4 Balearic Islands-Fin and sperm whales

The main shipping routes radiating from Ibiza, Mallorca and Menorca towards the Gulf of Lyons, Valencia and Alicante constitute one of the top High Risk Areas for interactions between shipping, and especially fast ferry lines and whales. Studies conducted by Alnitak (e.g. Cañadas et al., 1999; Cañadas et al., 2000; Cañadas et al., 2005) highlight the relevance of the waters around these islands for cetaceans and particularly sperm whales and fin whales. Reports of collisions in all three islands and the intensity of ferry traffic clearly highlight the need for an intensified monitoring effort. Spain has been conducting pilot monitoring studies using AIS data.

7.5 Eastern Alboran Sea-Fin and sperm whales

This area constitutes one of the main cetacean hotspots in Europe and the Mediterranean (Cañadas et al., 2005). Maritime traffic in this region is also extraordinarily complex and new ferry and fast ferry lines have raised concern over the increased risk of collision with whales. New technological measures to mitigate risk in this area are of special interest given the positive momentum of cooperation between researchers, relevant authorities and the shipping sector as a result of the reconfiguration of the Traffic Separation Scheme of Cabo de Gata and the Notices to Mariners in the Strait of Gibraltar (Tejedor et al., 2008). This task is currently being directed by the Spanish Ministry of the Environment, Rural and maritime Affairs (Fundación Biodiversidad).

7.6 Hellenic Trench, Greece-Sperm Whales (Frantzi et al., 2014)

Ship strikes are a recognized problem for the Mediterranean sperm whale sub-population which is classified as Endangered by IUCN. The Hellenic Trench southwest of Greece is a known area of high sperm whale density which coincides with major shipping routes. Given the high overlap of sperm whale sightings with shipping tracks, and the high incidence of evidence of ship strikes from stranded sperm whales, IWC has initiated a dialogue with the Greek authorities and regional stakeholders (e.g. ACOBAMS) on possible re-routing measures.

8. NE coast of Sakhalin Island-western gray whale (R. Brownell and D. Weller)

The substantial nearshore industrialization and shipping congestion throughout the migratory corridor(s) of this population represents a potential threat by increasing the likelihood of ship strikes, especially in China and Japan. Present and planned large-scale offshore gas and oil development in the South China Sea and in close proximity to the only

known feeding ground for western gray whales off northeast Sakhalin Island in the Okhotsk Sea is of particular concern (Weller et al. 2002).

9. Arabian Sea-Humpback whale (Willson et al., 2016)

This is the world's most isolated, smallest, and non-migratory humpback whale population, which, when combined with low population abundance estimates and new anthropogenic threats, raises concern for its survival. Burgeoning anthropogenic threats in the Arabian Sea, including entanglement in fishing gear and ship strikes are known limitations to recovery (Pomilla et al. 2014).

10. Chile-Peru right whale

Collisions with vessels and entanglements in fishing gear are the leading causes of human-induced mortality of southern right whales in the eastern South Pacific. Since 1983, 23 ship strikes have been recorded for southern right whales. However, because ship strikes of right whales can go undetected or unreported, it is likely the number of collisions is greater than documented (IWC, 2001; Galletti-Vernazzani et al., 2014).

11. Eastern Bering Sea-NP right whale

The current abundance for right whales in the eastern Bering Sea is estimated to be about 30 animals. Because of their rare occurrence and scattered distribution, it is nearly impossible to assess all the threats to this species, but a possible threat includes ship strikes and this threat will increase as more traffic moves through the western Arctic region. In 2010, the US Coast Guard initiated a study on a proposed a potential vessel routing system (referred to as a Port Access Route Study) in the Chukchi Sea, Bering Strait, and Bering Sea. In December 2014, the Coast Guard published a Notice of Study, and a request for comments from the public. Consideration of further steps regarding this proposal is pending (<https://www.federalregister.gov/articles/2014/12/05/2014-28672/port-access-route-study-in-the-chukchi-sea-bering-strait-and-bering-sea#h-8>).

12. Arctic (USA and Russian)-Potential threats to bowhead

With Arctic ice reductions, increased shipping, as well as shifts in habitat ranges of cetaceans, is expected. While ship strikes with cetaceans are not currently an issue for the conservation status of western Arctic bowhead whale population, it may become so for individual whales as vessel traffic increases and migratory habitat changes in response to global warming/loss of sea ice. Therefore, there is a rational to start monitoring this region.

Annex 4.6 Flow Chart for the Strategic Plan



INTERNATIONAL
 WHALING COMMISSION

Ship Strike Working Group: Strategic Plan 2017-2020

Vision	To contribute to conservation of large whale populations through the reduction of ship strike events worldwide					
Objectives	Reduce mortalities to large whales as a result of vessel strikes	Increase application of proven mitigation measures	Improve reporting to IWC database	Standardize the widespread use of new and current avoidance technologies	Improve collaboration on ship strike issues	Increase awareness about ship strike issues and mitigation measures
Strategies	Identify High Risk Areas and at risk populations of large whales	Hold workshop to evaluate the efficacy of existing measures and implement effective measures in High Risk Areas, with special attention to limiting vessel-whale overlap	Increase reporting at all levels, standardize reporting, decrease time between incidents and entry into database, improve reliability of species ID, update ship strike bibliography and commit to disseminating summary reports to public	Be aware of any technologies with the potential to mitigate vessel-whale interactions, evaluate existing technologies for efficacy, provide support for new, and encourage technologies in voyage planning	Increase resources and information by collaboration with agencies such as the IMO. Develop specific advice for the shipping industry regarding mitigation of ship strikes	Educate through public awareness programs, tide charts, regional charts, Coastal Pilot guides and through licensing and vessel operating organizations
Measures of Success TBD at Ship Strike Workshop						