Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic area, concluded under the auspices of the Convention on the Conservation of Migratory Species of Wild Animals (CMS)

Accord sur la Conservation des Cétacés de la Mer Noire, de la Méditerranée et de la zone Atlantique adjacente, conclu sous l'égide de la Convention sur la Conservation des Espèces Migratrices appartenant à la Faune Sauvage (CMS)

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A JOINT IWC-IUCN-ACCOBAMS WORKSHOP TO EVALUATE HOW THE DATA AND PROCESS USED TO IDENTIFY IMPORTANT MARINE MAMMAL AREAS (IMMAs) CAN ASSIST THE IWC TO IDENTIFY AREAS OF HIGH RISKS FOR SHIP STRIKE

SC/68A/HIM/07 Rev1

A Joint IWC-IUCN-ACCOBAMS workshop to evaluate how the data and process used to identify Important Marine Mammal Areas (IMMAs) can assist the IWC to identify areas of high risk for ship strike

IWC

INTERNATIONAL
WHALING COMMISSION

A Joint IWC-IUCN-ACCOBAMS workshop to evaluate how the data and process used to identify Important Marine Mammal Areas (IMMAs) can assist the IWC to identify areas of high risk for ship strike

6-7 April 2019: Messinia, Greece

Contents

1. INTRODUCTORY ITEMS

The Chair, Lorenzo Rojas Bracho, welcomed participants to the meeting. He thanked the IWC, IUCN, and ACCOBAMS for hosting the meeting, as well as WWF and Amalia Alberini for their assistance in organizing it. Ferriss, Mattila, and Leaper were appointed as rapporteurs.

The goals and objectives of the workshop were *to investigate the utility and process of using IMMAs to help identify areas of high risk for ship strikes, using the Mediterranean Sea as a test case*. The IWC defines high risk areas as 'the convergence of either areas of high volume of shipping and whales, or high numbers of whales and shipping'.

The workshop agenda is in Appendix 1, the list of documents in Appendix 2, and the participants list in Appendix 3.

The workshop also included a series of presentations which are summarised in sections 2 to 7 below. The workshop discussion and recommendations are provided in section 8.

2. BACKGROUND ON THE IUCN TASK FORCE AND THE IMMA PROJECT AND PROCESS

This part of the workshop included a series of presentations on Important Marine Mammal Areas and the data and process used to identify them. It also included a presentation of work to use visual satellite data to detect whales.

2.1 Review of IMMA criteria

Notarbartolo di Sciara introduced Important Marine Mammal Areas (IMMAs), a concept developed by the IUCN Joint SSC/WCPA[1] Marine Mammal Protected Areas Task Force and modelled on the successful example of the BirdLife International process for determining 'Important Bird and Biodiversity Areas' (IBAs). The aim of the IMMA classification is to 'identify discrete habitat areas, important for one or more marine mammal species that have the potential to be delineated and managed for conservation'.

IMMAs are identified through a consistent expert process that is independent of any political and socio-economic concern. It is intended that IMMAs will provide input about marine mammals into existing national and international conservation tools with respect to marine spatial designations including Marine Protected Areas (MPAs), Ecologically or Biologically Significant Areas (EBSAs) under the Convention on Biological Diversity (CBD), and Key Biodiversity Areas (KBAs) identified through the global KBA Standard (IUCN, 2016).

Hoyt explained that IMMAs are identified on the basis of eight criteria or sub-criteria designed to capture critical aspects of marine mammal biology, ecology and population structure. The IMMA selection criteria consider: Species or Population Vulnerability; Distribution and Abundance; Key Life Cycle Activities; and Special Attributes. Hoyt noted that, after filtering by species and overlaying shipping density, any of the eight IMMA criteria or sub-criteria could potentially identify areas of particularly high ship strike risk. More information is provided in Appendix 4 on the criteria and their potential use to identify high risk areas for ship strikes (see also IUCN Marine Mammal Protected Areas Task Force, 2018).

[1] IUCN World Commission on Protected Areas (WCPA) and Species Survival Commission (SSC)

Boyd outlined the relationship between IMMAs and Key Biodiversity Areas (KBAs). KBAs are sites that contribute significantly to the global persistence of biodiversity, identified and delineated using criteria, thresholds, and procedures set out in the KBA Standard (IUCN 2016). Boyd noted that KBAs for marine mammals will typically also qualify as IMMAs, however, some IMMAs may not meet the global KBA Standard or have sufficient data to be assessed against the KBA Standard (KBA Standards and Appeals Committee, 2019).

2.2 Overview of data sources related to IMMA designations

2.2.1 IMMAs data

Notarbartolo di Sciara outlined the process to assemble data for the selection of IMMAs, which is done on a regional basis. IMMAs draw upon a wide range of data sources in order to assess the relative importance of an area against the IMMA selection criteria. Primary data used include information on: abundance of animals, probability of occurrence, observed sightings, area of occupancy, extent of suitable habitat and range. Secondary information includes: records of habitat use, measures of distinctiveness, and indices of diversity. Predictive models are not used in the IMMA process to extrapolate in data poor situations. Similarly, historical whaling data are used as background information but on its own would not be enough to allow identification of an IMMA, because IMMAs are intended to reflect the current situation rather than former habitat of depleted populations. Local traditional knowledge can also be useful in the process to complement other data sources in some areas.

Once data are compiled, experts are brought together to review the data in a group expert participatory process (in contrast, for example, with the KBA identification process in which significance is assessed using quantitative thresholds). The list of candidate IMMAs is then scrutinized by an independent review panel. More information on the process is provided in Appendix 4.

2.2.2 Using visual satellite data to detect whales – case study of fin whales in the Pelagos Sanctuary

Fretwell outlined work undertaken in the Pelagos Sanctuary for Mediterranean Marine Mammals to determine whether whales can be detected from visual satellite images. Satellite data with a pixel size of 30 cm were available from one commercial company, and additional data available at 50 cm pixel size. In each case multiple images over an area were taken over a period of time, with one ‘strip’ taken per satellite pass. The images were reviewed by a team on a grid square basis, to see whether it was feasible to count and identify whales.

In the 2016 survey using 30 cm resolution images, the researchers were able to classify 34 fin whales, of which 23 were classified as definite, 6 as probable and 5 as possible whales. In the 2018 survey, using 50 cm resolution images, the researchers found 33 whales, of which 9 were definite, 8 were probable and 16 were possible whales. They found that such a use of satellite data requires a relatively calm sea state to obtain useful results and that, as expected, detecting whales on the 50 cm resolution images was considerably more difficult than with the 30 cm resolution.

The workshop discussed the potential use of machine learning and Artificial Intelligence (AI) to detect whales and classify objects in the visual imagery. Initially this is likely to be a semi-automatic process, where an expert will still be needed to determine if it’s a whale and, if so, what species. It remains challenging to identify to the species level,

with some species more easily identifiable than others (e.g. those which congregate in high density, spend time at the surface, and contrast with their background).

Participants noted that these techniques are currently only able to provide estimates of relative density rather than absolute values. However, with respect to ship strikes, the relative density of whales is often sufficient to inform management actions. Whales were reliably detected when the sea state is very calm, but detection probability reduces rapidly with increasing sea state. Visual clutter in the sea associated with waves can make detecting whales challenging.

2.3 Overview of the distribution of the IMMA Network, including candidate IMMAs and Areas of Interest for marine mammals

The IMMA network presently covers three regions: the Mediterranean, the Pacific Islands and the North East Indian Ocean and South East Asian Seas. Two regions are in process: the Extended Southern Ocean and the Western Indian Ocean and Arabian Seas. Two additional regions are funded for 2020: Australia-New Zealand and South East Indian Ocean (early 2020) and the South East Tropical and Temperate Pacific Ocean (late 2020). Other areas are under discussion but will not be attempted until after mid 2021. Selection of regions in which to identify IMMAs is on the basis of funding priorities, and it is hoped that the North Atlantic could be included in the areas to be considered. More information is provided in Appendix 4.

2.4 Overview of the IMMA process for the Mediterranean

Panigada presented the report of the first IMMA Regional Workshop for the Mediterranean (available as CCSC/APR19/SS/03), held in October 2016 to identify and delineate Important Marine Mammal Areas in the Mediterranean. This workshop also intended to help provide strategic direction and inform conservation priorities for the development of area-based marine mammal conservation within the Mediterranean region.

Forty-one candidate IMMAs (cIMMAs) in the Mediterranean were proposed through an expert-based process using the IMMA selection criteria and, in total, 26 IMMAs were accepted for full status by the review panel. Five cIMMAs were considered to show substantive evidence of their merit as possible IMMAs and could be assessed again at a later stage; these remain as cIMMAs.

3. IWC WORK ON SHIP STRIKES

This section of the workshop provided an overview of the work of the IWC with respect to ship strikes and associated data, and identifying high risk areas.

3.1 Overview of IWC concern about ship strikes and the work of the Conservation and Scientific Committees, including review of relevant aspects of Ship Strikes Strategic Plan

Ferriss introduced the work of the IWC with respect to ship strikes. A primary focus of both the Conservation Committee and the Scientific Committee, is the implementation of the "Strategic Plan to Mitigate the Impacts of Ship Strikes on Cetacean Populations: 2017-20". She noted that the Ship Strikes Working Group of the Conservation Committee will develop a costed work plan to identify the key actions, timelines and who will take each action forward

to ensure effective delivery of the Ship Strikes Strategic Plan. She also drew attention to the work of the IWC to collaborate with other organisations including the International Maritime Organization, the Convention on Migratory Species, including its daughter agreements such as ACCOBAMS and ASCOBANS.

Leaper introduced the IWC "Strategic Plan to Mitigate the Impacts of Ship Strikes on Cetacean Populations: 2017-20". The overall objectives of the Strategic Plan are to:

(1) Reduce mortalities and injuries to cetaceans 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, Arctic Council).

(6) Increase public and industry awareness about the issue and measures used to reduce this threat.

The IWC Strategic Plan describes seven stages in identifying high risk areas and developing appropriate mitigation strategies. The Scientific Committee has also identified specific aspects of these stages where it can contribute. The IWC has identified that 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. Further information is available in Appendix 5.

3.2 Links with the proposed joint IWC/ACCOBAMS CMP on Mediterranean Fin Whales

Conservation Management Plans are a conservation initiative of the IWC which aims to protect and rebuild vulnerable cetacean populations. ACCOBAMS and the IWC are working together to develop a joint CMP for the Fin Whale in the Mediterranean. An early draft document has been prepared and the next step is to bring in the regional experts, as well as the IWC Scientific Committee (May 2019) and Conservation Committee (2020) and ACCOBAMS parties (November 2019).

3.3 Summary of relevant data held by IWC (e.g. ship strike database, catches, SOWER, POWER)

Mattila explained that the International Whaling Commission Secretariat houses and maintains several whale catch and sightings databases. These include, in semi-chronological order:

Historical catches and sightings of American Whalers: 1780 to 1920 (1,381 voyages sampled)[2]

Modern whale catches: mostly 1900 to present day (~2,936,000 records of all large whale species)

Discovery tag program (~40,000 marks)

[2] These data were provided by Tim Smith and require his permission to use.

Sighting data from IWC SOWER (Southern Ocean: 1978-2010) and POWER (N. Pacific: 2010-Present) cruises

National Progress Reports: Strandings, entanglements, ship strikes and bycatch of large and small cetaceans (2001-present)

Historical locations were calculated by the noon sightings of the vessels (Smith *et al*, 2012). There are individual whale data for ~78% of the modern whale catches, with positions calculated as below:

Exact positions: Lat & long (as degrees and minutes) – have this for most of the recent catches

Noon positions of factory ships: The numbers of these can be extracted if needed.

Rough position of factory ships: Positions of catches by Soviet fleets in the 1950s and 60s was generally only given by 10 degree square – in this an approximate position in the centre of the square is used.

No position: There are **18,210 catches** by pelagic expeditions for which there are individual data but no position information.

Land stations with no individual position data: A position just outside the land station is used, so it should be correct to +/- 1 or 2 degrees.

The modern catch data have been successfully used for modelling of potential modern day distribution (e.g. Mizroch *et al*, 2009; Redfern *et al*. 2017), at fairly large scales (e.g. N. Pacific and Northern Indian Ocean). Indeed, some have been indirectly used in the IMMA process (e.g. through CBD's EBSAs). However, there is potential for whaling data to be more specifically used in helping to identify Areas of Interest (AoI) or to validate identified IMMAs. All data can be freely accessed through the IWC Secretariat.[1]

Panigada presented CCSC/APR19/SS/INFO/12, the 6th Progress Report on IWC Ship Strike Data Coordination. The primary objective of the Ship Strikes data coordinators is to collect information for ship strikes worldwide and to progress work on the IWC Ship Strikes Database. Data are collected from other databases, reports from the industry, media etc and 'cases' are assigned as being definite, probable, or possible ship strikes.

In recent years, priority has been given to data validation. It is expected that all reports will be evaluated over the next couple of years and it will then be possible to provide summary statistics on the available data.

The workshop discussed the precision of location information in the Ship Strikes Database. Panigada confirmed that many have an indication of region, and if an incident is witnessed, then the latitude and longitude may be available. Data are reported from many sources, e.g. industry, whale watchers, etc, and data quality is increasing over time.

3.4 Update on shipping data available

Leaper noted that AIS (Automatic Identification System) data have become the primary tool used to assess shipping activity. AIS has some limitations: many smaller vessels do not transmit AIS signals; there can be quite a high error rate in the data; and transmission may either be limited to line of sight reception from shore aerials or non-continuous

satellite coverage. Most of the issues can be overcome with careful analysis, although alternative methods are required for monitoring activities of smaller vessels.

The IWC Scientific Committee has noted that there are a number of measures of shipping activity that are not directly comparable. Ship strike risk can be assessed using the number of transits across an area and also shipping density (km travelled per km^2, i.e. km^{-1}). Risk analyses using either of these measures can be weighted according to speed, based on assumptions about speed-risk relationships.

Analysis methods to address intermittent reception include reconstructing ship tracks between locations or sampling strategies. Reconstructing tracks is more computationally intensive but can give more precise results for situations where it is safe to assume straight travel between received signals. Sampling strategies can process large amounts of data quickly and easily and do not make any assumptions about travel between observed locations, but estimates will have higher variance.

There are a number of commercial providers of AIS data and some providers have generously donated data for use on environmental projects. Marine Traffic has donated data for a number of ship strike related projects. IWC has had positive discussions with Marine Traffic to develop a MoU for obtaining data for projects related to the work of the Scientific Committee.

The workshop agreed that AIS data are very useful to assist with risk analysis for ship strikes and noted that, for all sizeable ships, it is possible to work out where a vessel is, speed, what type, and who owns it. In addition, AIS data can be helpful when engaging with industry. For example, in Hauraki Gulf, New Zealand, if a ship is travelling too fast, the public can see this through publicly available AIS data, and sometimes call up the port to inform them (see also section 6).

It was noted that where AIS data were not available, coast guards may have relevant data that they are willing to share. Visual satellite images may also aid in determining the proportion of boats that transmit AIS data (a requirement for larger vessels but voluntary for vessels less than 300GT) in order to estimate density for smaller vessels. This approach could be tested using the imagery collected for the Pelagos Sanctuary area described in 2.2.2.

4. GENERIC APPROACHES TO USE AREA-BASED MANAGEMENT TOOLS ALONGSIDE SHIPPING DATA, TO IDENTIFY "HIGH RISK AREAS" FOR SHIP STRIKES

This agenda item allowed for discussion of a number of papers that had used different ways to analyse high risk areas for ship strikes. Workshop participants discussed the methodologies used and the applicability of the general approaches proposed. The presentations are summarized here and the discussion is presented in section 8.

4.1 Presentations of papers

4.1.1 Rockwood et al.*, 2017*

Boyd introduced research by Rockwood *et al*. (2017) (available as CCSC/APR19/SS/INFO/15), which estimated ship strike mortality for blue, humpback and fin whales in U.S. West Coast waters using an application of a naval encounter model. Data used included AIS data on shipping traffic and line transect survey data on the horizontal distribution of

whales, supplemented with tracking data on time at depth, and ancillary information on avoidance behaviour and the probability of mortality given that a collision occurred. There were three main elements considered: given densities of ships and whales in a grid cell and velocities of both, what is the expected number of horizontal encounters; given a horizontal encounter, what is the probability of a strike given vertical overlap based on dive behaviour data and assumptions about avoidance; and given a strike, what is the probability of mortality. The authors concluded that mortality estimates were highly sensitive to the depth of the strike zone and to assumptions about avoidance behaviour, and both these elements need further research. Mortality estimates from the model were far higher than current minimum estimates derived from stranding records and are closer to extrapolations adjusted for detection probabilities of dead whales.

4.1.2 Pirotta et al**.,** *2019*

Notarbartolo di Sciara introduced a paper by Pirotta *et al*. (2019) (available as CCSC/APR19/SS/INFO/05) which compared marine roads with terrestrial roads, and used comparisons from terrestrial ecology to assess the potential consequences of marine ecology. Pirotta *et al*. divided these consequences into four categories: physical disturbances; modification of behaviour; pollution and marine environment degradation; and fragmentation.

The workshop agreed that the paper had increased global awareness of the marine impacts of shipping and posed a new way to think about impacts of marine traffic. However, its application was limited with respect to identification of high risk areas for ship strikes and associated management options.

4.1.3 Wiley et al*., 20013*

Wiley introduced Wiley *et al*. (2013) (available as CCSC/APR19/SS/INFO/06) that provided an overview of work undertaken in Stellwagen Bank National Marine Sanctuary, which was a "hotspot" for collisions between vessels and whales. The authors created a heatmap of where whales were likely to occur as well as a map of shipping activity, and then discussed various management options with the port authority and industry. The preferred option identified was to re-route the shipping lanes and, following a successful proposal to the IMO, the shipping lanes were moved, substantially reducing the overlap of whales and ships.

A subsequent proposal to develop two deep water ports for offloading liquefied natural gas (LNG) adjacent to the sanctuary posed additional problems, bringing increased traffic to the area. To mitigate this, acoustic buoys were put in place to notify ships in near real-time that there were whales present, and that they should slow down to less than 10 knots. An app 'Whale Alert' was developed which indicated when the buoys were activated. The specific position of the whales wasn't provided to the boats, as it wasn't possible to be sure of the location of the whale when the boat encountered it. In addition, 'Report cards' were created for each ship transiting, to determine how fast it was travelling and whether or not it was compliant. The LNG boats were generally compliant, whereas other vessels did not slow down. The impact of these measures on the number of whales struck is currently being assessed.

5. USE OF THE MEDITERRANEAN AS A CASE STUDY TO IDENTIFY HIGH RISK AREAS FOR SHIP STRIKES

This agenda item allowed for in-depth discussion on how IMMAs can be used to help identify high risk areas using the IMMAs data already compiled for the Mediterranean, along with AIS shipping data, and expert knowledge of the Mediterranean. The presentations are summarized here and the discussion is presented in section 8.

5.1 Presentations

5.1.1 European Cetacean Society (ECS) workshop report

Panigada presented the report of an ECS workshop entitled "Towards understanding the overlap of selected threats and Important Marine Mammal Areas (IMMAs) across the Mediterranean Sea", held in April 2018, in La Spezia, Italy (available as document CCSC/APR19/SS/04). The ECS workshop was supported by ACCOBAMS as part of its ongoing effort to map specific threats to cetaceans in the ACCOBAMS area. Workshop participants discussed an overlay of the Mediterranean IMMAs with the available area-explicit information on shipping and seismic surveys, thereby giving preliminary indications of new Cetacean Critical Habitats (CCH) in the ACCOBAMS area. This was a preliminary exercise mainly to show the applicability of IMMAs to address specific place-based threats to marine mammals, and the workshop recognised that more detailed efforts should be undertaken regionally by the competent management bodies to derive appropriate mitigation actions.

By way of example, three case study areas containing IMMAs — the Alborán Sea, the Northwest Mediterranean and the Strait of Sicily – were discussed during the workshop, where the overlap between IMMAs and ship traffic (suggesting the potential risk of ship strikes) and seismic survey blocks (with the potential of impacting noise production) appeared to be of special concern for marine mammals, and for fin, sperm and Cuvier's beaked whales in particular. Participants cautioned that outside the IMMAs there might be similar or indeed other problems and pressures on marine mammals. There must be attention to marine mammal conservation throughout the Mediterranean, although within IMMAs and CCH special "place-based" measures and attention should be implemented.

5.1.2 Species specific (fin and sperm) IMMA overlays with shipping

Panigada presented illustrative maps (available as document CCSC/APR19/SS/04), compiled by Mike Tetley, which provided the distribution of IMMAs in the Mediterranean for fin and sperm whales, as well as the potential buffer areas surrounding the IMMAs, shipping density, and marine mammal occurrence records. Panigada noted that the maps were compiled for illustrative purposes only, intended to support discussions on conservation and management initiatives across for shipping and species distributions.

The workshop thanked Mike Tetley for compiling the maps which were extremely useful and formed the basis for substantive discussions on whether and how IMMAs could be used to identify high risk areas for ship strikes.

The workshop discussed the 'Alborán Corridor IMMA' which includes the Straits of Gibraltar where there is a voluntary zone in which speeds of less than 13 knots are recommended, as well as a Traffic Separation Scheme (TSS). The speed restriction zone has been communicated to mariners through VHF radio notifications to mariners in the

area and a note on the shipping chart. However, there is no evidence of ships slowing down in the designated slow down area and the measure was not officially endorsed by the IMO. It also appears likely that most ships are unaware of the 13kt speed recommendation.

5.1.3 Frantzis et al. 2019

Frantzis *et al*. (2019) provides an overview of the core habitat of endangered sperm whales along the Hellenic Trench, Greece, key shipping routes in that area, an analysis of ship strikes risk, and proposed mitigation options. The eastern Mediterranean sperm whale sub-population numbers two to three hundred individuals, and major shipping routes running on or very close to the 1000 m depth contour along the Hellenic Trench are causing a likely unsustainable number of ship strikes with sperm whales. Routing options to significantly reduce ship strike risk by a small offshore shift in shipping routes were identified. The overall collision risk for sperm whales in the study area would be reduced by around 70%, while a maximum of 11 nautical miles would be added to major routes and only around 5 nautical miles for the majority of ships. No negative impacts were associated with re-routing by shipping away from sperm whale habitat and there would be additional shipping safety and environmental benefits.

The workshop examined the relevant scientific data, which indicates that mitigation of the problem can be effectively achieved by use of the existing IMO routing tools. The case has the potential to become a positive example of effective management that will significantly reduce ship-strikes.

6. MITIGATION STRATEGIES FOR HIGH RISK AREAS IDENTIFIED, AND THE BEST WAY TO ACCOMPLISH THOSE

This agenda item allowed for discussion of possible mitigation measures in areas of high risk for ship strikes. It included discussion of both regulatory and voluntary measures, using case studies from New Zealand and the USA. A summary of the presentations is include here and the discussion is presented in section 8.

6.1 Presentations

6.1.1 Hauraki Gulf Bryde's Whales

A year-round resident population of Bryde's whales was threatened by ship strike mortality (average = 2.3 whales/ annum) in the Hauraki Gulf, New Zealand (Constantine *et al*. 2015). Regulatory options were considered to manage shipping and mitigate the mortality risk, including possible measures through IMO. The shipping industry favoured a flexible, non-binding management option that did not involve IMO and developed the Hauraki Gulf Transit Protocol for Commercial Shipping[3]. The industry's preferred option was to re-route shipping rather than reduce speeds but due to unpredictability of habitat use by this population of whales, speed reduction was the best mitigation option. Within one year of adoption of the voluntary Transit Protocol, ships were transiting the Gulf at ~11 kts and since 2016 the average ship speed is ~10 kts. This has reduced the ship strike mortality risk from 51% to 26% (Ebdon *et al*. in review). A reporting system which encouraged mariners to report whale sightings in order to allow ships to route around the area where a whale had been sighted was also implemented. However, there were very few reports of whales and no evidence of any ships avoiding areas where whales were reported, indicating that this was ineffective as a mitigation

[3] https://www.poal.co.nz/sustain/Documents/150112-Transit%20Protocol.pdf

measure. With respect to the recommended speed in the Transit Protocol, the industry is self-regulated with companies and pilots ensuring that information is available to mariners. This has been a very effective voluntary approach, with generally good compliance with the recommended 10 knot speed limit. There have been no dead whales reported since September 2014.

The workshop discussed whether much effort had been required on an ongoing basis to maintain the reduced speeds by the industry. In the case of the Hauraki Gulf, once the companies had committed to slowing down, it was self-sustaining and the port and shipping industry run it themselves. A quarterly report on average speeds is presented to the relevant industry meetings. For the relatively rare occurrences of high speeds, companies are approached directly.

6.1.2 Update on the IWC Panama Workshop

The group reviewed the relevant aspects of the "Report of the Joint IWC-SPAW Workshop to Address Collisions Between Marine Mammals and Ships with a Focus on the Wider Caribbean" (IWC/65/CCrep01, 2014). At the time, that workshop reviewed currently used ship strike mitigation strategies and agreed that the only proven, effective mitigation measures are to avoid areas with known concentrations of whales, or reduce speed while transiting those areas. It also recognized that, in a number of venues, the shipping industry had stressed the need for any mitigation strategies to be predictable, in order to plan port arrivals and departures efficiently. In this regard, the Panama workshop recognized that the nascent IMMA process, in development by the IUCN MMPA Task Force at the time, might provide a helpful place to start, when looking for areas of high risk for whale and ship collisions.

7. OPPORTUNITIES FOR ENGAGEMENT WITH OTHER INSTITUTIONS AND RELEVANT PARTNERS WITH SIMILAR GOALS OR RELEVANT POLICY PROCESSES

7.1 Application of this approach (or similar) to identify high risk areas for other threats, including combined threats

After reviewing the criteria and process for identifying IMMAs, and having discussed their applicability for helping to identify areas of high risk for ship strikes, the group recognized that IMMAs might also be useful for identifying areas of high risk for interaction with other human activities. In particular, using overlays of fishing effort and ocean noise were discussed. Of course, the feasibility of this would depend on the quality of data about the human activity, the species that are potentially at risk, and the understanding of the interactions between the two.

7.2 Engagement with other organisations

7.2.1 European Commission

Nikolić, representing the European Commission, presented a summary of the relevant European policy and legislation. The Habitats Directive requires designation and management of protected areas ('Natura 2000' sites), some of which have been designated for bottlenose dolphin and harbour porpoise, and strict protection of species in their entire natural range which covers all cetaceans. Almost 10% of EU seas are marine Natura 2000 sites, and strict rules apply to avoid deterioration of the habitat (which includes noise) or disturbance of species as well as implementing appropriate conservation measures. The provisions on strict protection of species prohibit deliberate killing or disturbance of protected species and deterioration of their habitats. If ship strikes affect the protected species

then allowing the situation to continue may be in breach of the Habitats Directive. The European Commission is working on better implementation of Nature Directives with EU Member States and also has an enforcement role. Nikolić confirmed that there are no current plans to include additional habitat types or species in the Habitats Directive, both because a recent review or 'fitness check' had found the Directive was fit for purpose, and also because the existing Natura 2000 network is still being finalised based on the current Annex listings.

The workshop noted that in general, the Natura 2000 sites have not led to management actions for large vessels to avoid ship strikes. However, discussion is ongoing with respect to concerns raised in Sweden about the Baltic harbour porpoise.

The workshop discussed how the IWC concerns and recommendations are communicated to and within the European Commission and Member States, and Nikolić offered to help with transmitting recommendations where relevant.

7.2.2 Convention on Migratory Species

The CMS has a history of cooperation with the IWC, based on a high-level MoU, and there are a number of issues of mutual interest, e.g. IMMAs, live captures, in-water interactions, whale watching, underwater noise, and relevant Concerted Actions. However, the problem of ship strikes has not been addressed yet, except in specific cases such as the Concerted Action on Arabian Sea Humpback whales. Considering that ship strikes can affect species that are listed in the CMS Appendices, specific actions on ship strikes involving a cooperation between CMS and the IWC could be envisaged in the future.

7.2.3 ACCOBAMS

The ACCOBAMS Conservation Plan (Annex 2 to the Agreement) mandates Parties to assess and manage interactions between human activities and cetaceans, including ship strikes. The ACCOBAMS Scientific Committee has been working on this issue for many years, including holding a joint ACCOBAMS/IWC workshop on ship strikes in 2010. In the last three years, ACCOBAMS has continued work on ship strikes, especially though four actions:

- ACCOBAMS is currently revising Cetacean Critical Habitats, taking into account both the known distribution of cetaceans and the threat-based management approach. The cross analyses of all these data should facilitate (i) the identification of regional and national efforts to create appropriate conservation areas, and (ii) the implementation of relevant conservation measures with other relevant organizations;
- the ACCOBAMS Scientific Committee is drafting a Conservation and Management Plan for Mediterranean fin whales where ship strikes is an important issue;
- the ACCOBAMS Permanent Secretariat is supporting relevant projects in the ACCOBAMS area such as SICOMAR plus project;
- a specific recommendation on ship strikes was endorsed by the last Meeting of the ACCOBAMS SC in November 2018. This recommendation will become a draft Resolution that will be presented to the next Meeting of Parties in November 2019. This includes recommendations to collaborate with the IWC, IMO, and other international organizations on ship strikes.

7.2.4 International Whaling Commission (IWC)

The IWC has an ongoing and active area of work to collaborate with other organisations on ship strikes. This includes engagement with the IMO, the CMS and its daughter agreements, and other international organisations.

With respect to re-routing proposals and other measures, the IWC Scientific Committee has an intersessional group set up to provide advice or support on re-routing proposals if approached by a government. The IWC also works with the IMO Secretariat. This includes regular liaison between the IWC and IMO Secretariats; attendance by Leaper, on behalf of the IWC, at an IMO workshop in Sri Lanka which considered the issue of ship strikes to blue whales and safety concerns with the whale watching boats; and provision of an information paper to the IMO Marine Environment Protection Committee (See paper Info/09), which highlighted some key areas and species of high risk for ship strikes.

The IWC has also endorsed recommendations with respect to ship strikes in the Hellenic Trench and written to the Greek Government to offer support with the preparation of a proposal to the IMO.

Engagement with the CMS is summarised in sections 7.2.2 and 7.2.3.

7.2.5 International Maritime Organization (IMO)

Ship routing measures are established through the Maritime Safety Committee (and its Sub-Committee on Navigation, Communications and Search and Rescue) of the IMO. The IMO issued guidance on minimising the risk of ship strikes to cetaceans in 2009 which outlines the steps required to bring proposals for routing or speed restrictions to IMO. Subsequently a number of routing measures and speed restrictions, specifically to address ship strike risks to whales, have been established through IMO. Routing is principally established through Traffic Separation Schemes (TSS) or Areas To Be Avoided (ATBA) but can also include Recommended Routes or Recommended Tracks. Some high risk areas may be appropriate for designation as Particularly Sensitive Sea Areas (PSSAs). The International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) can also provide technical advice on the design of proposed routing measures including TSSs and ATBAs.

8. DISCUSSION AND RECOMMENDATIONS

This section draws together the key discussions and recommendations made by the workshop. These recommendations will be forwarded to the IWC Scientific and Conservation Committees and ACCOBAMS Parties.

8.1. Best practice guidelines for future determination of high risk ship strike areas for cetaceans (group discussion)

8.1.1 Use of IMMA data

One of the key components of the IWC Ship Strikes Strategic Plan is to identify high risk areas for ship strikes. Workshop participants noted that the IMMA process might allow a systematic way to identify such high risk areas. The IMMA Secretariat of the Marine Mammal Protected Areas Task Force welcomed feedback from the IWC into the IMMA process with respect to information and data needs.

Participants discussed the illustrative maps compiled by Mike Tetley that displayed the distribution of IMMAs in the Mediterranean for fin and sperm whales, as well as the potential buffer areas surrounding the IMMAs, shipping

density, and marine mammal occurrence records. Participants discussed the potential biases in the underlying data that are used in IMMAs and the shipping data overlays. For example, the species data from OBIS comprise both systematic and opportunistic sightings data, which will have an effort bias. Similarly, AIS data from terrestrial receivers may have an effort bias, with a lower proportion of transmissions received from vessels further offshore. Habitat modelling (not included in the IMMA process) may be useful to identify potential habitat for depleted populations or where survey data are not available for the whole area. The workshop suggested that weighting data for effort could be a useful approach in IMMAs. As well as occurrence data, it would be good to look at how the animals use the IMMA (e.g. feeding, or breeding) to help inform management options. It would also be useful to include records of actual ship strikes.

The workshop discussed the role played by existing networks in facilitating the IMMA process. In the Mediterranean, this included work done by ACCOBAMS and its member Governments, and work within the EU processes, and the Ecosystems Approach under the Barcelona Convention. The importance of input from the established network of researchers, governments, and NGOs working in the region was also recognized.

The workshop agreed that both small and large cetaceans can be vulnerable to ship strikes, although large whales are more likely to be hit. The IWC Ship Strikes Strategy addresses the problem for all cetaceans.

The workshop **agrees** that Important Marine Mammal Areas (IMMAs) represent a systematic and biocentric approach to identifying important habitats, and that as such they can be helpful in identifying potential high risk areas for ship strikes. In particular, if an IMMA contains a species or population that is vulnerable to ship strikes, and it is transited by significant shipping, the area can be "flagged" for further investigation and potential mitigation.

8.1.2 Assessing Ship Strikes Risk

In considering approaches to risk assessment, the workshop discussed a paper by Rockwood *et al*. (2017) looking at ship strike risk to a number of species off the US west coast.

The workshop agreed that Rockwood *et al*. (2017) was an interesting and useful study, noting the challenge of estimating the numbers of ship strikes and of knowing how many whales are actually struck. The workshop discussed whether the methods used by Rockwood *et al*. (2017) could be extrapolated from data rich areas to data poor areas and whether assumptions could be made about dive patterns for whales in different areas. However, participants cautioned that the same species can dive in a very different way in different places depending on the prey species.

The workshop discussed whether the approach of Rockwood *et al*. (2017) could be applied to IMMAs in determining risk of ship strikes. The workshop noted that being able to compare risk analyses between areas is very informative and that this would be assisted by standardising the approach to such analyses as much as possible. One approach to risk analyses used in several studies (e.g. Redfern *et al*. 2013; Bezamat *et al*. 2014; Priyadarshana *et al*. 2016; Rockwood *et al*. 2017) is based on an expected encounter rate which is proportional to whale density multiplied by shipping density. Further factors include the proportion of time spent at depth and assumptions about whale responses

to an approaching vessel. The process to identify IMMAs also requires data on whale density and distribution to be collated and analysed in ways that can be compared between areas.

The workshop agreed that where possible, risk analyses should be presented in a way that allows for comparison of predicted encounter rates with other studies and that the IMMA guidance should draw attention to the value of cetacean data that could be used for simple standardised ship strike risk assessments.

The workshop noted that data from whale watching boats could be used to identify high risk areas. Participants highlighted that if whale watching is occurring in a high risk ship strikes areas, then there may be a human safety risk too, with large vessels and small whale watch vessels occupying the same area.

The workshop agreed that it would be useful to better understand how far below the draft of ship a whale needs to be in order to avoid a strike. They noted the paper by Silber *et al*. (2010) (available as CCSC/APR19/SS/INFO/16) on vulnerability at depth, which found that some whales were vulnerable for 2-2.5 times the draft of the ship. However, the specific impact will depend on the species in question and the characteristics of the vessel.

8.1.3 Management and Mitigation

The workshop discussed whether IMMAs could be used to support the development of mitigation measures, including proposals to re-route shipping lanes and information on where the shipping lane should be moved to.

Participants noted that IMMAs often cover larger areas than those that might require management (e.g. in the Hauraki Gulf). Therefore they are a tool to highlight an area of concern but may not indicate exactly where management measures are needed. Instead a finer scale risk analysis within the IMMA area will frequently be required to identify possible management options. Similarly, a finer scale of spatial detail within an IMMA may be needed if they are to be included in voyage planning tools. Participants noted the need to avoid unintended consequences, e.g. if ships slow down in one place, they might speed up in others.

Many IMMAs have buffer areas around them, added to support management and conservation considerations. For many IMMAs it is likely that the area immediately outside is less important, however this cannot be assumed when that area lacks data. In these instances there may be more scope for management measures (such as re-routing or slowing down) within the IMMA, where the best data exist. Some IMMAs have zones or specific areas highlighted within them, which may inform re-routing options and in some cases, it may be necessary to re-route shipping within an IMMA. A reduction in speed within an IMMA may also be an option where marine mammal distribution patterns are not predictable or detailed information is not available. Zones within an IMMA are sometimes marked on the maps associated with the IMMA but more often this information is part of supporting material that accompany each IMMA, along with information on threats, which may help to identify areas of high ship strike risk.

Participants noted that some IMMAs are seasonal, in which case seasonal management measures could be considered. It was also agreed that modelling different scenarios could be useful to assess management options and to determine the potential impacts of these options. It was agreed that it would be useful to describe the levels of confidence in data and knowledge used to determine IMMAs with respect to possible ship strike risk analyses or mitigation measures.

The workshop agreed that currently there are probably no quick technological fixes to avoid ship strikes on a real-time basis. Even if robust information on the presence and location of the whales can be provided to mariners, it is not clear what the mariner should do in terms of taking evasive action. Instead information should be provided ahead of time, to indicate whether a vessel should slow down or an area should be avoided altogether. In the Hauraki Gulf, as the whales' movements are unpredictable, creating a shipping lane would not have been an effective solution, but speed reduction has been successful. The workshop noted that compliance for routing measures implemented through IMO is usually very high, whereas it can be less so for voluntary speed measures. Voluntary measures in the Hauraki Gulf have seen high rates of compliance.

Acknowledging that there is currently no universal technological solution to prevent ship strikes, the group **recommended** that the best overall, current mitigation measures, are to voyage plan to avoid high risk areas or, if they cannot be avoided, restrict speed to 10 knots, which has been shown to be an effective speed to reduce fatal collisions with most large whales (Vanderlan and Taggert, 2007; Conn and Silber, 2013; Laist *et al*., 2014

8.1.4 Identifying high risk areas for ship strikes

The participants grouped the recommendations on identifying high risk areas for ship strikes into three general categories: available information about shipping, information about relevant species, and potential mitigation measures.

The workshop **recommends** the following steps are undertaken by the IWC Ship Strikes Working Group and the IWC Scientific Committee as part of a process to identify High Risk Areas for Ship Strikes based on IMMAs:

1. Traffic information (e.g. Types of vessel, size, speed, flag, etc.): plotting major ship routes and see if they cross IMMAs which host significant or high density populations of species that are threatened and/or vulnerable to ship strikes.

1.1 Recommend analysing spatial patterns of traffic levels in IMMAs to examine the potential for management of vessel traffic within an IMMA.

1.2 Recommend working with relevant agencies (e.g. National Coast Guard offices) that hold this information, for access to shipping data including vessels that are not equipped with AIS.

1.3 Recommend analyses to estimate the proportion of vessel traffic that is not equipped by AIS (e.g. using remote sensing data).

2. Species information (e.g. Relative abundance, status, Animal Behaviour/seasonality/key lifecycle use in and within IMMAs)

2.1 Recommend presenting risk analysis in a way that allows comparisons between areas (e.g. Redfern *et al*. 2013; Bezamat *et al*. 2014; Priyadarshana *et al*. 2016; Rockwood *et al*. 2017).

2.2 Recommend when an IMMA is "flagged" that modelling of data within IMMA is conducted for a more refined estimate of risk (e.g. correct for effort at a minimum, etc.).

2.3 Recommend possible use of tracking and/or behavioural profiling data to further refine risk assessment in the IMMA.

If this cannot be done, the group recommends a review of documented behaviours, preferably within the IMMA (e.g. surface feed or deep, social, travel, etc.).

Where dive profile data exist these should be used in an approach similar to (Silber *et al*. 2010) to estimate the proportion of time at depths of high risk for types of vessel operating in the area.

Investigate stranding data near "flagged" IMMA including drift modelling to estimate locations of strikes.

Investigate availability of distribution data of at risk species within and around the IMMA, if shipping may be re-routed into other areas. Also, investigate other unintentional consequences of the move (e.g. other species, safety, human activities, etc.)

3. Management and Mitigation

Where a High Risk Area has been identified as requiring management action, the workshop **recommends** the following steps in developing a mitigation strategy:

Recommend identifying and engaging with shipping "nodes" (e.g. big company "command centers", port meetings, etc.).

Recommend a collaborative approach with stakeholders, prior to going to the IMO (if warranted).

Recommend maintaining a feedback loop with shipping will help encourage and sustain success.

8.2. Recommendations to the IWC in relation to its ongoing scientific work on the topic, and the implementation of its Ship Strikes Strategic Plan.

The workshop recommended that, subject to funding, the IWC, working with the IUCN MMPA Task Force and the CMS and its daughter agreements, undertake an initial analysis of global IMMAs, overlaid with shipping data, to identify potential high risk areas, taking into consideration the outputs of the workshop (Ships Strikes Working Group; IWC Scientific Committee; IUCN MMPATF; ACCOBAMS; CMS). The group recommends that the IWC Secretariat develop a costed proposal and seek funds to accomplish this (IWC Secretariat).

8.2.1 Cost of measures

The workshop noted that the costs of potential rerouting proposals or speed reductions was often an argument against mitigation measures. However, potential costs, including those associated with increased journey times, and administrative and bureaucratic costs, were often overestimated.

Estimates of the increase in distance transited have been done in some areas (e.g. USA Atlantic coast), but not the actual costs associated with increased distance and transit time. WWF had done a full economic analysis in the Pelagos Sanctuary to look at costs for measures relating to speed reduction and re-routing. They found it was cheaper to slow down, but neither were expensive. In addition, there were benefits to slowing down, such as reduced fuel consumption and greenhouse gas emissions, an issue to be discussed at the IMO in May 2019. The workshop noted that in some cases, delays in journeys resulted in higher port fees, so predictability of journey time was important. One of the advantages noted following the introduction of slow steaming had been fewer delays at ports and increased reliability of delivery times (Lee *et al*. 2015).

In the Hauraki Gulf, the industry were initially very concerned about the costs associated with reduced speeds and believed they would lose millions of USD. In practice the costs were much lower, although information on the exact costs were not publicly available.

The workshop **recommended** that the IWC Ship Strikes Working Group develop case studies to demonstrate the benefits, anticipated and actual costs of measures introduced to reduce ship strikes. The workshop **recommended** that the IWC Secretariat consider whether an intern could be recruited to support the development of these case studies.

8.3. Opportunities for engagement with other organizations

8.3.1 Intergovernmental organisations

The workshop requested the IUCN MMPA Task Force and the IWC Scientific Committee and Ships Strikes Working Group and ACCOBAMS to keep each other informed of developments in this area.

The workshop suggested that Simone Panigada become the liaison between the IWC Scientific Committee and Conservation Committee, ACCOBAMS Scientific Committee, the CMS and the IUCN MMPA Task Force.

The workshop welcomed support offered by the European Commission to facilitate discussions on the recommendations of the ACCOBAMS, CMS, and IWC with respect to ship strikes with EU Member States.

The workshop welcomed collaboration between the IWC, CMS and ACCOBAMS and **encouraged** further collaboration on the issue of ship strikes.

The workshop noted close collaboration between the IWC and the IMO on ship strike issues and **encouraged** the Secretariat to continue this collaboration.

The importance of engagement with industry in identifying mitigation measures was noted. Many companies met regularly with each other and/or port authorities, and this provides opportunity for sharing of information including with respect to voluntary measures. Sometimes bilateral discussions between industry and scientists can be productive to identify the most appropriate voluntary measure, without the need for government intervention.

The workshop commended the approaches taken in Stellwagen Bank National Marine Sanctuary and the Hauraki Gulf and agreed on the importance of presenting relevant data to industry in a visual and accessible way. It was noted that in both cases, follow up with feedback, both positive and negative, was an important contributor to success. In the Stellwagen Bank National Marine Sanctuary, the Whale Alert app and passive acoustic monitoring had been a great public outreach tool, however, it can only work in areas where the whale population of concern vocalises regularly. The workshop noted the opportunity of communicating positive measures to customers (e.g. cruise companies), although in Hauraki Gulf, this did not appear to be a significant motivating factor.

8.4. Other future work needed

The workshop **agreed** that IMMAs could potentially be used to identify high risk areas for other threats, including combined threats, e.g. bycatch and noise. The workshop noted that some measures may help address multiple threats (e.g. keeping vessels and whales apart and/or reduced vessel speed may reduce ship strikes and noise impacts). The workshop requested the IWC Scientific Committee consider this issue.

The workshop recommends that the IWC Scientific Committee and the IUCN MMPA Task Force review the potential uses of the IWC databases (e.g. historical catch, sightings, strandings etc) in helping to identify Areas of Interest (AOI) for future surveys, and for the verification of the longevity of IMMAs.

Reinforcing the IWC67b Scientific Committee recommendation which "recommends continued work to develop and evaluate mitigation measures, such as speed restrictions, that might be associated with the designation of a Particularly Sensitive Sea Area (PSSA) in the Pelagos Sanctuary area", the workshop **recommends** to the ACCOBAMS Secretariat and ACCOBAMS Parties to further develop the process for the designation of a PSSA by IMO at a scale that includes the North West Mediterranean Sea, Slope and Canyon IMMA, plus potentially the Spanish corridor, to take into account whale population movement and distribution. Zoning within the area with ship strike mitigation tools such as speed reduction and routing measures could be proposed as part of Associated Protective Measures within the PSSA. The ACCOBAMS Permanent Secretariat welcomes this recommendation.

Participants noted the information on sperm whales along the Hellenic Trench outlined in Frantzis *et al*. (2019), which had been drawn to the attention of the Greek Government, who would need to take forward any routing proposals to IMO. Tseliou, the representative of the Greek Ministry of Maritime Affairs and Insular Policy, highlighted the need to gain the support of the shipping industry. The workshop agreed that this was important and engagement with industry should be encouraged, but noted that the proposal could still proceed even without industry support.

The workshop **recommends** that the Greek Ministry of Maritime Affairs and Insular Policy work with other Greek Ministries (e.g. Ministry of Environment and Energy) and relevant stakeholders including the shipping industry, the European Commission and other countries, NGOs, IGOs and scientists to put in place risk reduction measures in the Hellenic Trench and submit a formal proposal by 2020 to the IMO for approval. In order to facilitate this process, a short document providing specific risk reduction options could be prepared by relevant experts to provide the necessary information.

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APPENDIX 1 – WORKSHOP AGENDA

1. Introductory items
- 1.1. Welcome and Introductions
- 1.2. Identification of Chair (*Bracho/Panigada)* and Rapporteurs (*Ferriss, Mattila, Leaper*)
- 1.3. Goals and objectives
- 1.4. List of documents
- 1.5. Adoption of the agenda

2. Background on the IUCN Task Force and the IMMA project and process
- 2.1. Review of IMMA criteria
- 2.2. Overview of data sources
- 2.3. Overview of the distribution of the IMMA Network, including candidate IMMAs and Areas of Interest for marine mammals
- 2.4. Overview of the IMMA process for the Mediterranean

3. IWC Work on Ship Strikes
- 3.1. Overview of IWC concern about ship strikes and the work of the Conservation and Scientific Committees, including review of relevant aspects of Ship Strikes Strategic Plan (e.g. stages in the plan for identifying high risk areas to implementing mitigation
- 3.2. Links with the proposed joint IWC/ACCOBAMS CMP on Mediterranean Fin Whales
- 3.3. Summary of relevant data held by IWC (e.g. ship strike database, catches, SOWER, POWER etc) -
- 3.4. Update on shipping data available

4. **Generic approaches to use area based management tools alongside shipping data, to identify "High Risk Areas" for ship strikes**

5. Use of the Mediterranean as a case study to identify high risk areas for ship strikes

6. **Mitigation strategies for high risk areas identified, and the best way to accomplish those**

7. **Opportunities for engagement with other institutions and relevant partners with similar goals or relevant policy processes**
- **7.1. Application of this approach (or similar) to identify high risk areas for other threats, including combined threats**

8. **Recommendations**
- 8.1. Best practice guidelines for future determination of high risk ship strike areas for cetaceans
- 8.2. Recommendations to the IWC in relation to its ongoing scientific work on the topic, and the implementation of its Ship Strikes Strategic Plan.
- 8.3. Opportunities for engagement with other organizations
- 8.4. Other future work needed

9. Review primary recommendations

10. Any other business

APPENDIX 2 – LIST OF DOCUMENTS

Title	Authors	Workshop document number
Agenda	.	CCSC/APR19/SS/GEN/01
Shipping routes through core habitat of endangered sperm whales along the Hellenic Trench, Greece: Can we reduce collision risks?	Alexandros Frantzis, Russell Leaper, Paraskevi Alexiadou, Aristides Prospathopoulos, Dimitrios Lekkas	CCSC/APR19/SS/01
Report 1st IMMA Regional Workshop - Mediterranean	IUCN Task Force on Marine Mammal Protected Areas	CCSC/APR19/SS/03
Report of European Cetacean Society workshop: Towards understanding the overlap of selected threats and Important Marine Mammal Areas (IMMAs) across the Mediterranean Sea.	IUCN MMPA TF and ACCOBAMS	CCSC/APR19/SS/04
IMMA Guidance Document (March 2018 update)	IUCN MMPATF	CCSC/APR19/SS/05
Supplement to the ECS Joint MMPATF/ACCOBAMS IMMA Workshop Report		CCSC/APR19/SS/06
IWC Strategic Plan on Ship Strikes Working Group	IWC	CCSC/APR19/SS/INFO/01
IMO Revised Guidelines For The Identification And Designation Of Particularly Sensitive Sea Areas	IMO	CCSC/APR19/SS/INFO/02
IMO - Guidelines For The Designation Of Special Areas Under Marpol 7378 and Guidelines for the Identification and Designation of PSSAs	IMO	CCSC/APR19/SS/INFO/03
IMO Resolution MEPC267(68) Amendments to the revised guidelines for the identification and designation of Particularly Sensitive Sea Areas (resolution a.982(24))	IMO	CCSC/APR19/SS/INFO/04
Consequences of global shipping traffic for marine giants	Vanessa Pirotta, Alana Grech, Ian D Jonsen, William F Laurance and Robert G Harcourt	CCSC/APR19/SS/INFO/05
Marine Sanctuaries and Marine Planning: Protecting endangered marine life.	David Wiley, Leila Hatch, Michael Thompson, Kurt Schwehr and Craig MacDonald	CCSC/APR19/SS/INFO/06
Mitigation of vessel-strike mortality of endangered Bryde's whales in the Hauraki Gulf, New Zealand	Rochelle Constantine, Mark Johnson, Leena Riekkola, Stephanie Jervis, Lily Kozmian-Ledward, Todd Dennis, Leigh G. Torres and Natacha Aguilar de Soto	CCSC/APR19/SS/INFO/07
Guidance document for minimizing the risk of ship strikes with cetaceans.	IMO	CCSC/APR19/SS/INFO/08
Information on recent outcomes regarding minimizing ship strikes to cetaceans.	IWC	CCSC/APR19/SS/INFO/09
Distribution patterns of blue whale (Balaenoptera musculus) and shipping off southern Sri Lanka	Tilak Priyadarshana, Sameera Madusanka Randage, Abigail Alling, Susannah Calderan, Jonathan Gordon, Russell Leaper, Lindsay Porter	CCSC/APR19/SS/INFO/10
	MMPA Task Force	CCSC/APR19/SS/INFO/11
6th Progress Report on IWC Ship Strike Data Coordination April 2018	Simone Panigada, Fabian Ritter	CCSC/APR19/SS/INFO/12
Report of the Joint IWC-SPAW Workshop to Address Collisions Between Marine Mammals and Ships with a Focus on the Wider Caribbean	IWC	CCSC/APR19/SS/INFO/13
Vulnerability of Arctic marine mammals to vessel traffic in the increasingly ice-free Northwest Passage and Northern Sea Route	Donna D. W. Hauser, Kristin L. Laidre, and Harry L. Stern	CCSC/APR19/SS/INFO/14
High mortality of blue, humpback and fin whales from modeling of vessel collisions on the U.S. West Coast suggests population impacts and insufficient protection	R. Cotton Rockwood, John Calambokidis, Jaime Jahncke	CCSC/APR19/SS/INFO/15
Hydrodynamics of a ship/whale collision	Gregory K. Silber, Jonathan Slutsky, Shannon Bettridge	CCSC/APR19/SS/INFO/16

APPENDIX 3 – PARTICIPANTS LIST

Amalia Alberini
Project manager
ICMMPA5 & Marine associate
WWF GREECE
21 Lembessi str
Athens 11743
GREECE
Email: a.alberini@wwf.gr

Charlotte Boyd
Research Scientist
School of Aquatic and Fishery Sciences
UNIVERSITY OF WASHINGTON
1122 NE Boat St,
Seattle, WA, 98105
USA
Email: boydchar@u.washington.edu

Rochelle Constantine
Associate Professor
School of Biological Sciences
UNIVERSITY OF AUCKLAND
Private Bag 92019
Auckland
New Zealand
Email: r.constantine@auckland.nz

Léa David
Docteur en cétologie
ECOOCÉAN INSTITUT
18 rue des Hospices
34090 Montpellier
FRANCE
Email: lea.david2@wanadoo.fr

Constanza Favilli
Acting Executive Secretary
Permanent Secretariat of the
PELAGOS AGREEMENT
Tour Odéon B1 – 36, avenue de l'Annonciade
MC – 98000
MONACO
Email: costanzafavilli@pelagos-sanctuary.org

Sarah Ferriss
Head of Programme Development
INTERNATIONAL WHALING COMMISSION
The Red House, 135 Station Road,
Impington, Cambridge, CB24 9NP, UK
Email: sarah.ferriss@iwc.int

Alexandro Frantizis
Scientific Director
PELAGOS CETACEAN RESEARCH INSTITUTE
Terpsichoris 21
16671 Vouliagmeni,
GREECE
Email: afrantzis@otenet.gr

Peter Fretwell
BRITISH ANTARCTIC SURVEY
High Cross
Madingley Road
CAMBRIDGE
CB3 0ET
Email: ptf@bas.ac.uk

Erich Hoyt
IUCN SSC/WCPA MARINE MAMMAL PROTECTED AREAS TASK FORCE
Park House, Allington Park
Bridport, Dorset DT6 5DD
UK
Email: erich.hoyt@mac.com

Théa Jacob
Marine Species and Fisheries Officer
WWF FRANCE
Bureau Marseille
6 rue des Fabres 13001 Marseille
FRANCE
Email: tjacob@wwf.fr

Sophia Kopela
Biodiversity Policy Officer
WWF Greece
21 Lembessi St.
117 43 Athens
GREECE
Email: s.kopela@wwf.gr

Russell Leaper
INTERNATIONAL FUND FOR ANIMAL WELFARE
Canal House
Banavie
Fort William
PH33 7LY
UK
Email: russell@ivyt.demon.co.uk

David Mattila
Human Impact Reduction
INTERNATIONAL WHALING COMMISSION
The Red House, 135 Station Road,
Impington, Cambridge, CB24 9NP, UK
Email: david.mattila@iwc.int

Aurelie Moulins
CIMA RESEARCH FOUNDATION
Via A. Magliotto, 2 - 17100 Savona (SV)
ITALY
Email: aurelie.moulins@cimafoundation.org

Vedran Nikolić
Policy officer - Nature conservation
European Commission
DG Environment
Unit D3 – Nature protection
BU5 06/156
B-1049 Brussels/Belgium
Email: vedran.nikolic@ec.europa.eu

Giuseppe Notarbartolo di Sciara
IUCN SSC/WCPA MARINE MAMMAL PROTECTED AREAS TASK FORCE
via Benedetto Marcello 43
20124 Milano
ITALY
Email: disciara@gmail.com

Simone Panigada
TETHYS RESEARCH INSTITUTE
Viale G.B. Gadio
220121 Milano
ITALY
Email: panigada69@gmail.com

Lorenzo Rojas Bracho
Comisión Nacional para el Uso y Conocimiento de la Biodiversidad (CONABIO)
Ensenada BC 22860
MEXICO
Email: lrojasbracho@gmail.com

Maylis Salivas
Programme Officer
ACCOBAMS Secretariat
Jardin de l'UNESCO
Terrasses de Fontvieille
98000 MONACO
Email: msalivas@accobams.net

Greg Silber
SMULTEA ENVIRONMENTAL SCIENCES
P.O. Box 256, Preston,
WA 98050
USA
Email: gregsilber@gmail.com

Fani Tseliou
Secretary General's, Dionysis Temponeras, Cabinet, Greek Ministry of Maritime Affairs and Insular Policy
Email: ftseliou@hotmail.com

David Wiley
Research Coordinator
NOAA/Stellwagen Bank National Marine Sanctuary
175 Edward Foster Road
Scituate, MA 02066
USA
Email: david.wiley@noaa.gov

APPENDIX 4 – PRESENTATION ON IMPORTANT MARINE MAMMAL AREAS

Background on the IUCN Task Force and the IMMA project and process

(See also IUCN Marine Mammal Protected Areas Task Force, 2018)

The IMMA concept, developed by the IUCN Joint SSC/WCPA Marine Mammal Protected Areas Task Force ('MMPA Task Force' or 'Task Force'), is modelled on the successful example of the BirdLife International process for determining 'Important Bird and Biodiversity Areas' (IBAs). The aim of the IMMA classification is to 'identify discrete habitat areas, important for one or more marine mammal species that have the potential to be delineated and managed for conservation'.

The intention is that the identification of IMMAs through a consistent expert process, independent of any political and socio-economic concerns, will provide valuable input of marine mammals into existing national and international conservation tools with respect to marine protected areas, including Ecologically or Biologically Significant Areas (EBSAs) under the Convention on Biological Diversity (CBD), and Key Biodiversity Areas (KBAs) identified through the IUCN Standard. The IMMA process should also assist in providing strategic direction and priorities to the development of spatially explicit marine mammal conservation measures, potentially for noise, ship strike and other threats to marine mammals.

Eight criteria or sub-criteria, divided into four main categories are designed to capture critical aspects of marine mammal biology, ecology and population structure, and they encompass vulnerability, distribution, abundance, key life cycle activities and special attributes.

The IMMA selection criteria consist of:

Criterion A: Species or Population Vulnerability

Areas containing habitat important for the survival and recovery of threatened or declining species or populations.

Criterion B: Distribution and Abundance

Sub-criterion Bi: Small and Resident Populations

Areas supporting at least one resident population, containing an important proportion of that species or population, which are occupied consistently.

Sub-criterion Bii: Aggregations

Areas with underlying qualities that support important concentrations of a species or population.

Criterion C: Key Life Cycle Activities

Sub-criterion Ci: Reproductive Areas

Areas and conditions that are important for a species or population to mate, give birth, and/or care for young until weaning.

Sub-criterion Cii: Feeding Areas

Areas and conditions that provide an important nutritional base on which a species or population depends.

Sub-criterion Ciii: Migration Routes

Areas used for important migration or other movements, often connecting distinct life cycle areas or connecting different parts of the year-round range of a non-migratory population.

Criterion D: Special Attributes

Sub-criterion Di: Distinctiveness

Areas which sustain populations with important genetic, behavioural or ecologically distinctive characteristics.

Sub-criterion Dii: Diversity

Areas containing habitat that supports an important diversity of species.

These criteria are not hierarchical in design. Any candidate IMMA need only satisfy one of the listed criteria or sub-criteria to successfully qualify for IMMA status. In practice, most cIMMAs satisfy at least two criteria.

Any of the 8 IMMA criteria or subcriteria—after filtering by species (sperm, fin, blue etc) and overlaying ship traffic lanes to measure intensity—could potentially identify a place where ship strikes are an issue; there is no one criterion related to ship strike occurrence. However, Criterion A (Species or Population Vulnerability) indicates a threatened species so that could be an additional reason for conservation concern. Criterion Dii on Diversity will indicate multiple species in an area, some more subject to ship strike than others, so that could be an additional reason for conservation concern. Subcriteria Ci Reproductive Areas and Cii Feeding Areas may indicate more intensive use of an area than Ciii Migration Routes. Species spending considerable time in a given area thus may be more susceptible to ship strike if the ship lanes go through the IMMA. Migrating baleen whales indicate seasonal use of an area; sperm and other toothed, and potentially non-migrating baleen whales may have more consistent use of an area.

Overview of data sources

IMMAs, by necessity, draw upon a wide range of data sources in order to assess the relative importance of an area against the IMMA selection criteria. As much as is possible, the data sources should be considered in ensemble. They are divided into primary and secondary currencies of information, considered most suitable for use in the assessment of the selection criteria for the identification of an IMMA.

Primary currencies include, in order, abundance of animals, probability of occurrence, observed sightings, area of occupancy, extent of suitable habitat and range.

The following secondary currencies of information are also useful to support the identification of an IMMA: records of habitat use, measures of difference, indices of diversity.

Approaches that are able to quantify the number of animals likely to occur within a given cIMMA have the highest rank of confidence for potential IMMA end-users.

The IMMA process relies upon experts to bring evidence to bear and to summarize it — in that sense it is a group expert participatory process (in contrast, for example, with the IUCN KBA identification process which relies on meeting strict numerical thresholds). The strength/ value of the IMMA tool lies partly in the robust standardized process that has been adopted for identifying IMMAs and putting them on the map.

This standardized process being undertaken by the IUCN MMPA Task Force throughout the Southern Hemisphere and, hopefully, after 2021, in the Northern Hemisphere, subject to further funding, aims to create the best possible scenario for the successful integration of these scientifically identified areas into conservation and management.

Overview of the distribution of the IMMA Network, including candidate IMMAs and Areas of Interest for marine mammals

The IMMA network presently includes three regions: the Mediterranean, the Pacific Islands and the North East Indian Ocean and South East Asian Seas. Two additional regions are in process: the Extended Southern Ocean and the Western Indian Ocean and Arabian Seas. Two additional regions are funded for 2020 and 2021: the Australia-New Zealand and South East Indian Ocean and the South East and Eastern Central Pacific Ocean. Other areas are under discussion but will not be attempted until after 2021.

In the three completed regions, 77 IMMAs have been created, spread across 143 polygons, comprising 2,185,781 km^2. The largest is 431,498 km^2 in the Cook Islands Southern Group and the smallest in 45 km^2 Akrotiri IMMA (Cyprus), with an average of 28,386 km^2. There are also 19 cIMMAs, and 87 AoI on the map and in the database.

Of the 77 IMMAs, sperm whales are in 8% of the IMMAs, humpback whales in 7%, fin whales and Cuvier's beaked whales both comprise 3%.

30 of the 77 IMMAs have as primary species sperm whales or large baleen whales (including Omura's and Bryde's).

IMMAs have buffers, some more than others. Some have indications for zones or specific areas within the IMMA. Sometimes these are marked on the map; more often zoning is part of supporting material in the PDFs that accompany each area. These and other information about threats presented in the supporting material may help to identify areas with ship strike problems.

APPENDIX 5 IWC WORK ON SHIP STRIKES

The IWC Scientific Committee has been discussing ship strikes for around 20 years. The early discussions focussed on trying to develop methods to estimate the number of strikes in the context of assessing overall human impacts on populations and particularly those that may be subject to commercial whaling. Estimating the number of deaths from ship strikes has proven challenging in all except the most well studied populations.

More recently, the SC has been working closely with the Conservation Committee and its Ship Strike Working Group to implement the IWC Strategic Plan to Mitigate the Impacts of Ship Strikes on Cetacean Populations.

The IWC Ship Strikes Strategic Plan can be accessed here: https://iwc.int/document_3647.download

The overall objectives of the Strategic Plan are to:

(1) To reduce mortalities and injuries to cetaceans 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, Arctic Council).

(6) Increase public and industry awareness about the issue and measures used to reduce this threat.

The plan itself also attempts to:

(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 has identified that 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. High risk areas are defined in the strategy as 'the convergence of either areas of high volume of shipping and whales, or high numbers of whales and shipping'.

The Strategic Plan describes seven stages in identifying high risk areas and developing appropriate mitigation strategies (Table 1). The Scientific Committee has also identified specific aspects of these stages where it can contribute (Table 2).

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, AIS data for shipping used to inform risk analysis and local vs international jurisdiction.
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.

Table 2. Potential advice from the Scientific Committee in response to requests related to different stages of implementation of mitigation measures identified in the IWC Strategic Plan to Mitigate Ship Strikes (SC Report 2018 Annex J)

Stage	Potential advice from the Scientific Committee
Stage 1: High risk area of potential concern identified based on overlap of shipping and whale distribution or a high number of reported incidents	The Committee could examine the available information on shipping and whale distribution and extract records for that area from the Ship Strike Database. The Committee could draw attention to other assessments such as those used to identify Important Marine Mammal Areas (IMMAs).
Stage 2: Survey data for whales, AIS data for shipping used to inform risk analysis and local *vs* international jurisdiction.	The Committee reviews the data available on whale habitat use, and analysis of risk.
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.	The Committee reviews the proposed routing or other risk reduction measures. If the routing measure is associated with a Particularly Sensitive Sea Area (PSSA) the SC may consider reviewing any other Associated Protective Measures (APMs) and their potential impact on whales. In line with 2.2.4 of the Strategic Plan, the Committee could identify any known aids to voyage planning available in the area, or assist in applying such technologies in these areas. If a particular type of vessel traffic appears primarily responsible for ship strikes in the area, the SC could draft guidance for operators of these vessels.
Stage 4: Stakeholder workshops to discuss possible mitigation measures and optimise risk reduction with stakeholder interests.	Especially valuable where new routes are being discussed, the Committee could offer advice on what associated protective measures would fit based on region and known species.

Stage 5: Relevant states consider proposals to IMO assisted by supporting information from IWC.	The IWC could submit supporting information for a routing measure to the relevant IMO Committee meeting based on the Committee evaluation. This submission could be especially important if the proposed routing measure is not primarily concerned with ship strike mitigation.
Stage 6: Measures implemented through IMO.	-
Stage 7: Continued Monitoring to evaluate ongoing effectiveness of measures.	The Committee could provide a review of the most recent data on whale distribution along with any known ship strikes since the implementation of the measures. If risk analyses are conducted then further advice to improve risk reduction could be provided.

SC/68A/HIM/07 Rev1

A Joint IWC-IUCN-ACCOBAMS workshop to evaluate how the data and process used to identify Important Marine Mammal Areas (IMMAs) can assist the IWC to identify areas of high risk for ship strike

IWC

INTERNATIONAL
WHALING COMMISSION

A Joint IWC-IUCN-ACCOBAMS workshop to evaluate how the data and process used to identify Important Marine Mammal Areas (IMMAs) can assist the IWC to identify areas of high risk for ship strike

6-7 April 2019: Messinia, Greece

Contents

1. INTRODUCTORY ITEMS

The Chair, Lorenzo Rojas Bracho, welcomed participants to the meeting. He thanked the IWC, IUCN, and ACCOBAMS for hosting the meeting, as well as WWF and Amalia Alberini for their assistance in organizing it. Ferriss, Mattila, and Leaper were appointed as rapporteurs.

The goals and objectives of the workshop were *to investigate the utility and process of using IMMAs to help identify areas of high risk for ship strikes, using the Mediterranean Sea as a test case*. The IWC defines high risk areas as 'the convergence of either areas of high volume of shipping and whales, or high numbers of whales and shipping'.

The workshop agenda is in Appendix 1, the list of documents in Appendix 2, and the participants list in Appendix 3.

The workshop also included a series of presentations which are summarised in sections 2 to 7 below. The workshop discussion and recommendations are provided in section 8.

2. BACKGROUND ON THE IUCN TASK FORCE AND THE IMMA PROJECT AND PROCESS

This part of the workshop included a series of presentations on Important Marine Mammal Areas and the data and process used to identify them. It also included a presentation of work to use visual satellite data to detect whales.

2.1 Review of IMMA criteria

Notarbartolo di Sciara introduced Important Marine Mammal Areas (IMMAs), a concept developed by the IUCN Joint SSC/WCPA[1] Marine Mammal Protected Areas Task Force and modelled on the successful example of the BirdLife International process for determining 'Important Bird and Biodiversity Areas' (IBAs). The aim of the IMMA classification is to 'identify discrete habitat areas, important for one or more marine mammal species that have the potential to be delineated and managed for conservation'.

IMMAs are identified through a consistent expert process that is independent of any political and socio-economic concern. It is intended that IMMAs will provide input about marine mammals into existing national and international conservation tools with respect to marine spatial designations including Marine Protected Areas (MPAs), Ecologically or Biologically Significant Areas (EBSAs) under the Convention on Biological Diversity (CBD), and Key Biodiversity Areas (KBAs) identified through the global KBA Standard (IUCN, 2016).

Hoyt explained that IMMAs are identified on the basis of eight criteria or sub-criteria designed to capture critical aspects of marine mammal biology, ecology and population structure. The IMMA selection criteria consider: Species or Population Vulnerability; Distribution and Abundance; Key Life Cycle Activities; and Special Attributes. Hoyt noted that, after filtering by species and overlaying shipping density, any of the eight IMMA criteria or sub-criteria could potentially identify areas of particularly high ship strike risk. More information is provided in Appendix 4 on the criteria and their potential use to identify high risk areas for ship strikes (see also IUCN Marine Mammal Protected Areas Task Force, 2018).

[1] IUCN World Commission on Protected Areas (WCPA) and Species Survival Commission (SSC)

Boyd outlined the relationship between IMMAs and Key Biodiversity Areas (KBAs). KBAs are sites that contribute significantly to the global persistence of biodiversity, identified and delineated using criteria, thresholds, and procedures set out in the KBA Standard (IUCN 2016). Boyd noted that KBAs for marine mammals will typically also qualify as IMMAs, however, some IMMAs may not meet the global KBA Standard or have sufficient data to be assessed against the KBA Standard (KBA Standards and Appeals Committee, 2019).

2.2 Overview of data sources related to IMMA designations

2.2.1 IMMAs data

Notarbartolo di Sciara outlined the process to assemble data for the selection of IMMAs, which is done on a regional basis. IMMAs draw upon a wide range of data sources in order to assess the relative importance of an area against the IMMA selection criteria. Primary data used include information on: abundance of animals, probability of occurrence, observed sightings, area of occupancy, extent of suitable habitat and range. Secondary information includes: records of habitat use, measures of distinctiveness, and indices of diversity. Predictive models are not used in the IMMA process to extrapolate in data poor situations. Similarly, historical whaling data are used as background information but on its own would not be enough to allow identification of an IMMA, because IMMAs are intended to reflect the current situation rather than former habitat of depleted populations. Local traditional knowledge can also be useful in the process to complement other data sources in some areas.

Once data are compiled, experts are brought together to review the data in a group expert participatory process (in contrast, for example, with the KBA identification process in which significance is assessed using quantitative thresholds). The list of candidate IMMAs is then scrutinized by an independent review panel. More information on the process is provided in Appendix 4.

2.2.2 Using visual satellite data to detect whales – case study of fin whales in the Pelagos Sanctuary

Fretwell outlined work undertaken in the Pelagos Sanctuary for Mediterranean Marine Mammals to determine whether whales can be detected from visual satellite images. Satellite data with a pixel size of 30 cm were available from one commercial company, and additional data available at 50 cm pixel size. In each case multiple images over an area were taken over a period of time, with one ‘strip’ taken per satellite pass. The images were reviewed by a team on a grid square basis, to see whether it was feasible to count and identify whales.

In the 2016 survey using 30 cm resolution images, the researchers were able to classify 34 fin whales, of which 23 were classified as definite, 6 as probable and 5 as possible whales. In the 2018 survey, using 50 cm resolution images, the researchers found 33 whales, of which 9 were definite, 8 were probable and 16 were possible whales. They found that such a use of satellite data requires a relatively calm sea state to obtain useful results and that, as expected, detecting whales on the 50 cm resolution images was considerably more difficult than with the 30 cm resolution.

The workshop discussed the potential use of machine learning and Artificial Intelligence (AI) to detect whales and classify objects in the visual imagery. Initially this is likely to be a semi-automatic process, where an expert will still be needed to determine if it’s a whale and, if so, what species. It remains challenging to identify to the species level,

with some species more easily identifiable than others (e.g. those which congregate in high density, spend time at the surface, and contrast with their background).

Participants noted that these techniques are currently only able to provide estimates of relative density rather than absolute values. However, with respect to ship strikes, the relative density of whales is often sufficient to inform management actions. Whales were reliably detected when the sea state is very calm, but detection probability reduces rapidly with increasing sea state. Visual clutter in the sea associated with waves can make detecting whales challenging.

2.3 Overview of the distribution of the IMMA Network, including candidate IMMAs and Areas of Interest for marine mammals

The IMMA network presently covers three regions: the Mediterranean, the Pacific Islands and the North East Indian Ocean and South East Asian Seas. Two regions are in process: the Extended Southern Ocean and the Western Indian Ocean and Arabian Seas. Two additional regions are funded for 2020: Australia-New Zealand and South East Indian Ocean (early 2020) and the South East Tropical and Temperate Pacific Ocean (late 2020). Other areas are under discussion but will not be attempted until after mid 2021. Selection of regions in which to identify IMMAs is on the basis of funding priorities, and it is hoped that the North Atlantic could be included in the areas to be considered. More information is provided in Appendix 4.

2.4 Overview of the IMMA process for the Mediterranean

Panigada presented the report of the first IMMA Regional Workshop for the Mediterranean (available as CCSC/APR19/SS/03), held in October 2016 to identify and delineate Important Marine Mammal Areas in the Mediterranean. This workshop also intended to help provide strategic direction and inform conservation priorities for the development of area-based marine mammal conservation within the Mediterranean region.

Forty-one candidate IMMAs (cIMMAs) in the Mediterranean were proposed through an expert-based process using the IMMA selection criteria and, in total, 26 IMMAs were accepted for full status by the review panel. Five cIMMAs were considered to show substantive evidence of their merit as possible IMMAs and could be assessed again at a later stage; these remain as cIMMAs.

3. IWC WORK ON SHIP STRIKES

This section of the workshop provided an overview of the work of the IWC with respect to ship strikes and associated data, and identifying high risk areas.

3.1 Overview of IWC concern about ship strikes and the work of the Conservation and Scientific Committees, including review of relevant aspects of Ship Strikes Strategic Plan

Ferriss introduced the work of the IWC with respect to ship strikes. A primary focus of both the Conservation Committee and the Scientific Committee, is the implementation of the "Strategic Plan to Mitigate the Impacts of Ship Strikes on Cetacean Populations: 2017-20". She noted that the Ship Strikes Working Group of the Conservation Committee will develop a costed work plan to identify the key actions, timelines and who will take each action forward

to ensure effective delivery of the Ship Strikes Strategic Plan. She also drew attention to the work of the IWC to collaborate with other organisations including the International Maritime Organization, the Convention on Migratory Species, including its daughter agreements such as ACCOBAMS and ASCOBANS.

Leaper introduced the IWC "Strategic Plan to Mitigate the Impacts of Ship Strikes on Cetacean Populations: 2017-20". The overall objectives of the Strategic Plan are to:

(1) Reduce mortalities and injuries to cetaceans 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, Arctic Council).

(6) Increase public and industry awareness about the issue and measures used to reduce this threat.

The IWC Strategic Plan describes seven stages in identifying high risk areas and developing appropriate mitigation strategies. The Scientific Committee has also identified specific aspects of these stages where it can contribute. The IWC has identified that 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. Further information is available in Appendix 5.

3.2 Links with the proposed joint IWC/ACCOBAMS CMP on Mediterranean Fin Whales

Conservation Management Plans are a conservation initiative of the IWC which aims to protect and rebuild vulnerable cetacean populations. ACCOBAMS and the IWC are working together to develop a joint CMP for the Fin Whale in the Mediterranean. An early draft document has been prepared and the next step is to bring in the regional experts, as well as the IWC Scientific Committee (May 2019) and Conservation Committee (2020) and ACCOBAMS parties (November 2019).

3.3 Summary of relevant data held by IWC (e.g. ship strike database, catches, SOWER, POWER)

Mattila explained that the International Whaling Commission Secretariat houses and maintains several whale catch and sightings databases. These include, in semi-chronological order:

Historical catches and sightings of American Whalers: 1780 to 1920 (1,381 voyages sampled)[2]

Modern whale catches: mostly 1900 to present day (~2,936,000 records of all large whale species)

Discovery tag program (~40,000 marks)

[2] These data were provided by Tim Smith and require his permission to use.

Sighting data from IWC SOWER (Southern Ocean: 1978-2010) and POWER (N. Pacific: 2010-Present) cruises

National Progress Reports: Strandings, entanglements, ship strikes and bycatch of large and small cetaceans (2001-present)

Historical locations were calculated by the noon sightings of the vessels (Smith *et al*, 2012). There are individual whale data for ~78% of the modern whale catches, with positions calculated as below:

Exact positions: Lat & long (as degrees and minutes) – have this for most of the recent catches

Noon positions of factory ships: The numbers of these can be extracted if needed.

Rough position of factory ships: Positions of catches by Soviet fleets in the 1950s and 60s was generally only given by 10 degree square – in this an approximate position in the centre of the square is used.

No position: There are **18,210 catches** by pelagic expeditions for which there are individual data but no position information.

Land stations with no individual position data: A position just outside the land station is used, so it should be correct to +/- 1 or 2 degrees.

The modern catch data have been successfully used for modelling of potential modern day distribution (e.g. Mizroch *et al*, 2009; Redfern *et al*. 2017), at fairly large scales (e.g. N. Pacific and Northern Indian Ocean). Indeed, some have been indirectly used in the IMMA process (e.g. through CBD's EBSAs). However, there is potential for whaling data to be more specifically used in helping to identify Areas of Interest (AoI) or to validate identified IMMAs. All data can be freely accessed through the IWC Secretariat.[1]

Panigada presented CCSC/APR19/SS/INFO/12, the 6th Progress Report on IWC Ship Strike Data Coordination. The primary objective of the Ship Strikes data coordinators is to collect information for ship strikes worldwide and to progress work on the IWC Ship Strikes Database. Data are collected from other databases, reports from the industry, media etc and 'cases' are assigned as being definite, probable, or possible ship strikes.

In recent years, priority has been given to data validation. It is expected that all reports will be evaluated over the next couple of years and it will then be possible to provide summary statistics on the available data.

The workshop discussed the precision of location information in the Ship Strikes Database. Panigada confirmed that many have an indication of region, and if an incident is witnessed, then the latitude and longitude may be available. Data are reported from many sources, e.g. industry, whale watchers, etc, and data quality is increasing over time.

3.4 Update on shipping data available

Leaper noted that AIS (Automatic Identification System) data have become the primary tool used to assess shipping activity. AIS has some limitations: many smaller vessels do not transmit AIS signals; there can be quite a high error rate in the data; and transmission may either be limited to line of sight reception from shore aerials or non-continuous

satellite coverage. Most of the issues can be overcome with careful analysis, although alternative methods are required for monitoring activities of smaller vessels.

The IWC Scientific Committee has noted that there are a number of measures of shipping activity that are not directly comparable. Ship strike risk can be assessed using the number of transits across an area and also shipping density (km travelled per km^2, i.e. km^{-1}). Risk analyses using either of these measures can be weighted according to speed, based on assumptions about speed-risk relationships.

Analysis methods to address intermittent reception include reconstructing ship tracks between locations or sampling strategies. Reconstructing tracks is more computationally intensive but can give more precise results for situations where it is safe to assume straight travel between received signals. Sampling strategies can process large amounts of data quickly and easily and do not make any assumptions about travel between observed locations, but estimates will have higher variance.

There are a number of commercial providers of AIS data and some providers have generously donated data for use on environmental projects. Marine Traffic has donated data for a number of ship strike related projects. IWC has had positive discussions with Marine Traffic to develop a MoU for obtaining data for projects related to the work of the Scientific Committee.

The workshop agreed that AIS data are very useful to assist with risk analysis for ship strikes and noted that, for all sizeable ships, it is possible to work out where a vessel is, speed, what type, and who owns it. In addition, AIS data can be helpful when engaging with industry. For example, in Hauraki Gulf, New Zealand, if a ship is travelling too fast, the public can see this through publicly available AIS data, and sometimes call up the port to inform them (see also section 6).

It was noted that where AIS data were not available, coast guards may have relevant data that they are willing to share. Visual satellite images may also aid in determining the proportion of boats that transmit AIS data (a requirement for larger vessels but voluntary for vessels less than 300GT) in order to estimate density for smaller vessels. This approach could be tested using the imagery collected for the Pelagos Sanctuary area described in 2.2.2.

4. GENERIC APPROACHES TO USE AREA-BASED MANAGEMENT TOOLS ALONGSIDE SHIPPING DATA, TO IDENTIFY "HIGH RISK AREAS" FOR SHIP STRIKES

This agenda item allowed for discussion of a number of papers that had used different ways to analyse high risk areas for ship strikes. Workshop participants discussed the methodologies used and the applicability of the general approaches proposed. The presentations are summarized here and the discussion is presented in section 8.

4.1 Presentations of papers

4.1.1 Rockwood et al.*, 2017*

Boyd introduced research by Rockwood *et al*. (2017) (available as CCSC/APR19/SS/INFO/15), which estimated ship strike mortality for blue, humpback and fin whales in U.S. West Coast waters using an application of a naval encounter model. Data used included AIS data on shipping traffic and line transect survey data on the horizontal distribution of

whales, supplemented with tracking data on time at depth, and ancillary information on avoidance behaviour and the probability of mortality given that a collision occurred. There were three main elements considered: given densities of ships and whales in a grid cell and velocities of both, what is the expected number of horizontal encounters; given a horizontal encounter, what is the probability of a strike given vertical overlap based on dive behaviour data and assumptions about avoidance; and given a strike, what is the probability of mortality. The authors concluded that mortality estimates were highly sensitive to the depth of the strike zone and to assumptions about avoidance behaviour, and both these elements need further research. Mortality estimates from the model were far higher than current minimum estimates derived from stranding records and are closer to extrapolations adjusted for detection probabilities of dead whales.

4.1.2 Pirotta et al**.,** *2019*

Notarbartolo di Sciara introduced a paper by Pirotta *et al*. (2019) (available as CCSC/APR19/SS/INFO/05) which compared marine roads with terrestrial roads, and used comparisons from terrestrial ecology to assess the potential consequences of marine ecology. Pirotta *et al*. divided these consequences into four categories: physical disturbances; modification of behaviour; pollution and marine environment degradation; and fragmentation.

The workshop agreed that the paper had increased global awareness of the marine impacts of shipping and posed a new way to think about impacts of marine traffic. However, its application was limited with respect to identification of high risk areas for ship strikes and associated management options.

4.1.3 Wiley et al*., 20013*

Wiley introduced Wiley *et al*. (2013) (available as CCSC/APR19/SS/INFO/06) that provided an overview of work undertaken in Stellwagen Bank National Marine Sanctuary, which was a "hotspot" for collisions between vessels and whales. The authors created a heatmap of where whales were likely to occur as well as a map of shipping activity, and then discussed various management options with the port authority and industry. The preferred option identified was to re-route the shipping lanes and, following a successful proposal to the IMO, the shipping lanes were moved, substantially reducing the overlap of whales and ships.

A subsequent proposal to develop two deep water ports for offloading liquefied natural gas (LNG) adjacent to the sanctuary posed additional problems, bringing increased traffic to the area. To mitigate this, acoustic buoys were put in place to notify ships in near real-time that there were whales present, and that they should slow down to less than 10 knots. An app 'Whale Alert' was developed which indicated when the buoys were activated. The specific position of the whales wasn't provided to the boats, as it wasn't possible to be sure of the location of the whale when the boat encountered it. In addition, 'Report cards' were created for each ship transiting, to determine how fast it was travelling and whether or not it was compliant. The LNG boats were generally compliant, whereas other vessels did not slow down. The impact of these measures on the number of whales struck is currently being assessed.

5. USE OF THE MEDITERRANEAN AS A CASE STUDY TO IDENTIFY HIGH RISK AREAS FOR SHIP STRIKES

This agenda item allowed for in-depth discussion on how IMMAs can be used to help identify high risk areas using the IMMAs data already compiled for the Mediterranean, along with AIS shipping data, and expert knowledge of the Mediterranean. The presentations are summarized here and the discussion is presented in section 8.

5.1 Presentations

5.1.1 European Cetacean Society (ECS) workshop report

Panigada presented the report of an ECS workshop entitled "Towards understanding the overlap of selected threats and Important Marine Mammal Areas (IMMAs) across the Mediterranean Sea", held in April 2018, in La Spezia, Italy (available as document CCSC/APR19/SS/04). The ECS workshop was supported by ACCOBAMS as part of its ongoing effort to map specific threats to cetaceans in the ACCOBAMS area. Workshop participants discussed an overlay of the Mediterranean IMMAs with the available area-explicit information on shipping and seismic surveys, thereby giving preliminary indications of new Cetacean Critical Habitats (CCH) in the ACCOBAMS area. This was a preliminary exercise mainly to show the applicability of IMMAs to address specific place-based threats to marine mammals, and the workshop recognised that more detailed efforts should be undertaken regionally by the competent management bodies to derive appropriate mitigation actions.

By way of example, three case study areas containing IMMAs — the Alborán Sea, the Northwest Mediterranean and the Strait of Sicily – were discussed during the workshop, where the overlap between IMMAs and ship traffic (suggesting the potential risk of ship strikes) and seismic survey blocks (with the potential of impacting noise production) appeared to be of special concern for marine mammals, and for fin, sperm and Cuvier's beaked whales in particular. Participants cautioned that outside the IMMAs there might be similar or indeed other problems and pressures on marine mammals. There must be attention to marine mammal conservation throughout the Mediterranean, although within IMMAs and CCH special "place-based" measures and attention should be implemented.

5.1.2 Species specific (fin and sperm) IMMA overlays with shipping

Panigada presented illustrative maps (available as document CCSC/APR19/SS/04), compiled by Mike Tetley, which provided the distribution of IMMAs in the Mediterranean for fin and sperm whales, as well as the potential buffer areas surrounding the IMMAs, shipping density, and marine mammal occurrence records. Panigada noted that the maps were compiled for illustrative purposes only, intended to support discussions on conservation and management initiatives across for shipping and species distributions.

The workshop thanked Mike Tetley for compiling the maps which were extremely useful and formed the basis for substantive discussions on whether and how IMMAs could be used to identify high risk areas for ship strikes.

The workshop discussed the 'Alborán Corridor IMMA' which includes the Straits of Gibraltar where there is a voluntary zone in which speeds of less than 13 knots are recommended, as well as a Traffic Separation Scheme (TSS). The speed restriction zone has been communicated to mariners through VHF radio notifications to mariners in the

area and a note on the shipping chart. However, there is no evidence of ships slowing down in the designated slow down area and the measure was not officially endorsed by the IMO. It also appears likely that most ships are unaware of the 13kt speed recommendation.

5.1.3 Frantzis et al. 2019

Frantzis *et al*. (2019) provides an overview of the core habitat of endangered sperm whales along the Hellenic Trench, Greece, key shipping routes in that area, an analysis of ship strikes risk, and proposed mitigation options. The eastern Mediterranean sperm whale sub-population numbers two to three hundred individuals, and major shipping routes running on or very close to the 1000 m depth contour along the Hellenic Trench are causing a likely unsustainable number of ship strikes with sperm whales. Routing options to significantly reduce ship strike risk by a small offshore shift in shipping routes were identified. The overall collision risk for sperm whales in the study area would be reduced by around 70%, while a maximum of 11 nautical miles would be added to major routes and only around 5 nautical miles for the majority of ships. No negative impacts were associated with re-routing by shipping away from sperm whale habitat and there would be additional shipping safety and environmental benefits.

The workshop examined the relevant scientific data, which indicates that mitigation of the problem can be effectively achieved by use of the existing IMO routing tools. The case has the potential to become a positive example of effective management that will significantly reduce ship-strikes.

6. MITIGATION STRATEGIES FOR HIGH RISK AREAS IDENTIFIED, AND THE BEST WAY TO ACCOMPLISH THOSE

This agenda item allowed for discussion of possible mitigation measures in areas of high risk for ship strikes. It included discussion of both regulatory and voluntary measures, using case studies from New Zealand and the USA. A summary of the presentations is include here and the discussion is presented in section 8.

6.1 Presentations

6.1.1 Hauraki Gulf Bryde's Whales

A year-round resident population of Bryde's whales was threatened by ship strike mortality (average = 2.3 whales/ annum) in the Hauraki Gulf, New Zealand (Constantine *et al*. 2015). Regulatory options were considered to manage shipping and mitigate the mortality risk, including possible measures through IMO. The shipping industry favoured a flexible, non-binding management option that did not involve IMO and developed the Hauraki Gulf Transit Protocol for Commercial Shipping[3]. The industry's preferred option was to re-route shipping rather than reduce speeds but due to unpredictability of habitat use by this population of whales, speed reduction was the best mitigation option. Within one year of adoption of the voluntary Transit Protocol, ships were transiting the Gulf at ~11 kts and since 2016 the average ship speed is ~10 kts. This has reduced the ship strike mortality risk from 51% to 26% (Ebdon *et al*. in review). A reporting system which encouraged mariners to report whale sightings in order to allow ships to route around the area where a whale had been sighted was also implemented. However, there were very few reports of whales and no evidence of any ships avoiding areas where whales were reported, indicating that this was ineffective as a mitigation

[3] https://www.poal.co.nz/sustain/Documents/150112-Transit%20Protocol.pdf

measure. With respect to the recommended speed in the Transit Protocol, the industry is self-regulated with companies and pilots ensuring that information is available to mariners. This has been a very effective voluntary approach, with generally good compliance with the recommended 10 knot speed limit. There have been no dead whales reported since September 2014.

The workshop discussed whether much effort had been required on an ongoing basis to maintain the reduced speeds by the industry. In the case of the Hauraki Gulf, once the companies had committed to slowing down, it was self-sustaining and the port and shipping industry run it themselves. A quarterly report on average speeds is presented to the relevant industry meetings. For the relatively rare occurrences of high speeds, companies are approached directly.

6.1.2 Update on the IWC Panama Workshop

The group reviewed the relevant aspects of the "Report of the Joint IWC-SPAW Workshop to Address Collisions Between Marine Mammals and Ships with a Focus on the Wider Caribbean" (IWC/65/CCrep01, 2014). At the time, that workshop reviewed currently used ship strike mitigation strategies and agreed that the only proven, effective mitigation measures are to avoid areas with known concentrations of whales, or reduce speed while transiting those areas. It also recognized that, in a number of venues, the shipping industry had stressed the need for any mitigation strategies to be predictable, in order to plan port arrivals and departures efficiently. In this regard, the Panama workshop recognized that the nascent IMMA process, in development by the IUCN MMPA Task Force at the time, might provide a helpful place to start, when looking for areas of high risk for whale and ship collisions.

7. OPPORTUNITIES FOR ENGAGEMENT WITH OTHER INSTITUTIONS AND RELEVANT PARTNERS WITH SIMILAR GOALS OR RELEVANT POLICY PROCESSES

7.1 Application of this approach (or similar) to identify high risk areas for other threats, including combined threats

After reviewing the criteria and process for identifying IMMAs, and having discussed their applicability for helping to identify areas of high risk for ship strikes, the group recognized that IMMAs might also be useful for identifying areas of high risk for interaction with other human activities. In particular, using overlays of fishing effort and ocean noise were discussed. Of course, the feasibility of this would depend on the quality of data about the human activity, the species that are potentially at risk, and the understanding of the interactions between the two.

7.2 Engagement with other organisations

7.2.1 European Commission

Nikolić, representing the European Commission, presented a summary of the relevant European policy and legislation. The Habitats Directive requires designation and management of protected areas ('Natura 2000' sites), some of which have been designated for bottlenose dolphin and harbour porpoise, and strict protection of species in their entire natural range which covers all cetaceans. Almost 10% of EU seas are marine Natura 2000 sites, and strict rules apply to avoid deterioration of the habitat (which includes noise) or disturbance of species as well as implementing appropriate conservation measures. The provisions on strict protection of species prohibit deliberate killing or disturbance of protected species and deterioration of their habitats. If ship strikes affect the protected species

then allowing the situation to continue may be in breach of the Habitats Directive. The European Commission is working on better implementation of Nature Directives with EU Member States and also has an enforcement role. Nikolić confirmed that there are no current plans to include additional habitat types or species in the Habitats Directive, both because a recent review or 'fitness check' had found the Directive was fit for purpose, and also because the existing Natura 2000 network is still being finalised based on the current Annex listings.

The workshop noted that in general, the Natura 2000 sites have not led to management actions for large vessels to avoid ship strikes. However, discussion is ongoing with respect to concerns raised in Sweden about the Baltic harbour porpoise.

The workshop discussed how the IWC concerns and recommendations are communicated to and within the European Commission and Member States, and Nikolić offered to help with transmitting recommendations where relevant.

7.2.2 Convention on Migratory Species

The CMS has a history of cooperation with the IWC, based on a high-level MoU, and there are a number of issues of mutual interest, e.g. IMMAs, live captures, in-water interactions, whale watching, underwater noise, and relevant Concerted Actions. However, the problem of ship strikes has not been addressed yet, except in specific cases such as the Concerted Action on Arabian Sea Humpback whales. Considering that ship strikes can affect species that are listed in the CMS Appendices, specific actions on ship strikes involving a cooperation between CMS and the IWC could be envisaged in the future.

7.2.3 ACCOBAMS

The ACCOBAMS Conservation Plan (Annex 2 to the Agreement) mandates Parties to assess and manage interactions between human activities and cetaceans, including ship strikes. The ACCOBAMS Scientific Committee has been working on this issue for many years, including holding a joint ACCOBAMS/IWC workshop on ship strikes in 2010. In the last three years, ACCOBAMS has continued work on ship strikes, especially though four actions:

- ACCOBAMS is currently revising Cetacean Critical Habitats, taking into account both the known distribution of cetaceans and the threat-based management approach. The cross analyses of all these data should facilitate (i) the identification of regional and national efforts to create appropriate conservation areas, and (ii) the implementation of relevant conservation measures with other relevant organizations;
- the ACCOBAMS Scientific Committee is drafting a Conservation and Management Plan for Mediterranean fin whales where ship strikes is an important issue;
- the ACCOBAMS Permanent Secretariat is supporting relevant projects in the ACCOBAMS area such as SICOMAR plus project;
- a specific recommendation on ship strikes was endorsed by the last Meeting of the ACCOBAMS SC in November 2018. This recommendation will become a draft Resolution that will be presented to the next Meeting of Parties in November 2019. This includes recommendations to collaborate with the IWC, IMO, and other international organizations on ship strikes.

7.2.4 International Whaling Commission (IWC)

The IWC has an ongoing and active area of work to collaborate with other organisations on ship strikes. This includes engagement with the IMO, the CMS and its daughter agreements, and other international organisations.

With respect to re-routing proposals and other measures, the IWC Scientific Committee has an intersessional group set up to provide advice or support on re-routing proposals if approached by a government. The IWC also works with the IMO Secretariat. This includes regular liaison between the IWC and IMO Secretariats; attendance by Leaper, on behalf of the IWC, at an IMO workshop in Sri Lanka which considered the issue of ship strikes to blue whales and safety concerns with the whale watching boats; and provision of an information paper to the IMO Marine Environment Protection Committee (See paper Info/09), which highlighted some key areas and species of high risk for ship strikes.

The IWC has also endorsed recommendations with respect to ship strikes in the Hellenic Trench and written to the Greek Government to offer support with the preparation of a proposal to the IMO.

Engagement with the CMS is summarised in sections 7.2.2 and 7.2.3.

7.2.5 International Maritime Organization (IMO)

Ship routing measures are established through the Maritime Safety Committee (and its Sub-Committee on Navigation, Communications and Search and Rescue) of the IMO. The IMO issued guidance on minimising the risk of ship strikes to cetaceans in 2009 which outlines the steps required to bring proposals for routing or speed restrictions to IMO. Subsequently a number of routing measures and speed restrictions, specifically to address ship strike risks to whales, have been established through IMO. Routing is principally established through Traffic Separation Schemes (TSS) or Areas To Be Avoided (ATBA) but can also include Recommended Routes or Recommended Tracks. Some high risk areas may be appropriate for designation as Particularly Sensitive Sea Areas (PSSAs). The International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) can also provide technical advice on the design of proposed routing measures including TSSs and ATBAs.

8. DISCUSSION AND RECOMMENDATIONS

This section draws together the key discussions and recommendations made by the workshop. These recommendations will be forwarded to the IWC Scientific and Conservation Committees and ACCOBAMS Parties.

8.1. Best practice guidelines for future determination of high risk ship strike areas for cetaceans (group discussion)

8.1.1 Use of IMMA data

One of the key components of the IWC Ship Strikes Strategic Plan is to identify high risk areas for ship strikes. Workshop participants noted that the IMMA process might allow a systematic way to identify such high risk areas. The IMMA Secretariat of the Marine Mammal Protected Areas Task Force welcomed feedback from the IWC into the IMMA process with respect to information and data needs.

Participants discussed the illustrative maps compiled by Mike Tetley that displayed the distribution of IMMAs in the Mediterranean for fin and sperm whales, as well as the potential buffer areas surrounding the IMMAs, shipping

density, and marine mammal occurrence records. Participants discussed the potential biases in the underlying data that are used in IMMAs and the shipping data overlays. For example, the species data from OBIS comprise both systematic and opportunistic sightings data, which will have an effort bias. Similarly, AIS data from terrestrial receivers may have an effort bias, with a lower proportion of transmissions received from vessels further offshore. Habitat modelling (not included in the IMMA process) may be useful to identify potential habitat for depleted populations or where survey data are not available for the whole area. The workshop suggested that weighting data for effort could be a useful approach in IMMAs. As well as occurrence data, it would be good to look at how the animals use the IMMA (e.g. feeding, or breeding) to help inform management options. It would also be useful to include records of actual ship strikes.

The workshop discussed the role played by existing networks in facilitating the IMMA process. In the Mediterranean, this included work done by ACCOBAMS and its member Governments, and work within the EU processes, and the Ecosystems Approach under the Barcelona Convention. The importance of input from the established network of researchers, governments, and NGOs working in the region was also recognized.

The workshop agreed that both small and large cetaceans can be vulnerable to ship strikes, although large whales are more likely to be hit. The IWC Ship Strikes Strategy addresses the problem for all cetaceans.

The workshop **agrees** that Important Marine Mammal Areas (IMMAs) represent a systematic and biocentric approach to identifying important habitats, and that as such they can be helpful in identifying potential high risk areas for ship strikes. In particular, if an IMMA contains a species or population that is vulnerable to ship strikes, and it is transited by significant shipping, the area can be "flagged" for further investigation and potential mitigation.

8.1.2 Assessing Ship Strikes Risk

In considering approaches to risk assessment, the workshop discussed a paper by Rockwood *et al*. (2017) looking at ship strike risk to a number of species off the US west coast.

The workshop agreed that Rockwood *et al*. (2017) was an interesting and useful study, noting the challenge of estimating the numbers of ship strikes and of knowing how many whales are actually struck. The workshop discussed whether the methods used by Rockwood *et al*. (2017) could be extrapolated from data rich areas to data poor areas and whether assumptions could be made about dive patterns for whales in different areas. However, participants cautioned that the same species can dive in a very different way in different places depending on the prey species.

The workshop discussed whether the approach of Rockwood *et al*. (2017) could be applied to IMMAs in determining risk of ship strikes. The workshop noted that being able to compare risk analyses between areas is very informative and that this would be assisted by standardising the approach to such analyses as much as possible. One approach to risk analyses used in several studies (e.g. Redfern *et al*. 2013; Bezamat *et al*. 2014; Priyadarshana *et al*. 2016; Rockwood *et al*. 2017) is based on an expected encounter rate which is proportional to whale density multiplied by shipping density. Further factors include the proportion of time spent at depth and assumptions about whale responses

to an approaching vessel. The process to identify IMMAs also requires data on whale density and distribution to be collated and analysed in ways that can be compared between areas.

The workshop agreed that where possible, risk analyses should be presented in a way that allows for comparison of predicted encounter rates with other studies and that the IMMA guidance should draw attention to the value of cetacean data that could be used for simple standardised ship strike risk assessments.

The workshop noted that data from whale watching boats could be used to identify high risk areas. Participants highlighted that if whale watching is occurring in a high risk ship strikes areas, then there may be a human safety risk too, with large vessels and small whale watch vessels occupying the same area.

The workshop agreed that it would be useful to better understand how far below the draft of ship a whale needs to be in order to avoid a strike. They noted the paper by Silber *et al*. (2010) (available as CCSC/APR19/SS/INFO/16) on vulnerability at depth, which found that some whales were vulnerable for 2-2.5 times the draft of the ship. However, the specific impact will depend on the species in question and the characteristics of the vessel.

8.1.3 Management and Mitigation

The workshop discussed whether IMMAs could be used to support the development of mitigation measures, including proposals to re-route shipping lanes and information on where the shipping lane should be moved to.

Participants noted that IMMAs often cover larger areas than those that might require management (e.g. in the Hauraki Gulf). Therefore they are a tool to highlight an area of concern but may not indicate exactly where management measures are needed. Instead a finer scale risk analysis within the IMMA area will frequently be required to identify possible management options. Similarly, a finer scale of spatial detail within an IMMA may be needed if they are to be included in voyage planning tools. Participants noted the need to avoid unintended consequences, e.g. if ships slow down in one place, they might speed up in others.

Many IMMAs have buffer areas around them, added to support management and conservation considerations. For many IMMAs it is likely that the area immediately outside is less important, however this cannot be assumed when that area lacks data. In these instances there may be more scope for management measures (such as re-routing or slowing down) within the IMMA, where the best data exist. Some IMMAs have zones or specific areas highlighted within them, which may inform re-routing options and in some cases, it may be necessary to re-route shipping within an IMMA. A reduction in speed within an IMMA may also be an option where marine mammal distribution patterns are not predictable or detailed information is not available. Zones within an IMMA are sometimes marked on the maps associated with the IMMA but more often this information is part of supporting material that accompany each IMMA, along with information on threats, which may help to identify areas of high ship strike risk.

Participants noted that some IMMAs are seasonal, in which case seasonal management measures could be considered. It was also agreed that modelling different scenarios could be useful to assess management options and to determine the potential impacts of these options. It was agreed that it would be useful to describe the levels of confidence in data and knowledge used to determine IMMAs with respect to possible ship strike risk analyses or mitigation measures.

The workshop agreed that currently there are probably no quick technological fixes to avoid ship strikes on a real-time basis. Even if robust information on the presence and location of the whales can be provided to mariners, it is not clear what the mariner should do in terms of taking evasive action. Instead information should be provided ahead of time, to indicate whether a vessel should slow down or an area should be avoided altogether. In the Hauraki Gulf, as the whales' movements are unpredictable, creating a shipping lane would not have been an effective solution, but speed reduction has been successful. The workshop noted that compliance for routing measures implemented through IMO is usually very high, whereas it can be less so for voluntary speed measures. Voluntary measures in the Hauraki Gulf have seen high rates of compliance.

Acknowledging that there is currently no universal technological solution to prevent ship strikes, the group **recommended** that the best overall, current mitigation measures, are to voyage plan to avoid high risk areas or, if they cannot be avoided, restrict speed to 10 knots, which has been shown to be an effective speed to reduce fatal collisions with most large whales (Vanderlan and Taggert, 2007; Conn and Silber, 2013; Laist *et al*., 2014

8.1.4 Identifying high risk areas for ship strikes

The participants grouped the recommendations on identifying high risk areas for ship strikes into three general categories: available information about shipping, information about relevant species, and potential mitigation measures.

The workshop **recommends** the following steps are undertaken by the IWC Ship Strikes Working Group and the IWC Scientific Committee as part of a process to identify High Risk Areas for Ship Strikes based on IMMAs:

1. Traffic information (e.g. Types of vessel, size, speed, flag, etc.): plotting major ship routes and see if they cross IMMAs which host significant or high density populations of species that are threatened and/or vulnerable to ship strikes.

1.1 Recommend analysing spatial patterns of traffic levels in IMMAs to examine the potential for management of vessel traffic within an IMMA.

1.2 Recommend working with relevant agencies (e.g. National Coast Guard offices) that hold this information, for access to shipping data including vessels that are not equipped with AIS.

1.3 Recommend analyses to estimate the proportion of vessel traffic that is not equipped by AIS (e.g. using remote sensing data).

2. Species information (e.g. Relative abundance, status, Animal Behaviour/seasonality/key lifecycle use in and within IMMAs)

2.1 Recommend presenting risk analysis in a way that allows comparisons between areas (e.g. Redfern *et al*. 2013; Bezamat *et al*. 2014; Priyadarshana *et al*. 2016; Rockwood *et al*. 2017).

2.2 Recommend when an IMMA is "flagged" that modelling of data within IMMA is conducted for a more refined estimate of risk (e.g. correct for effort at a minimum, etc.).

2.3 Recommend possible use of tracking and/or behavioural profiling data to further refine risk assessment in the IMMA.

If this cannot be done, the group recommends a review of documented behaviours, preferably within the IMMA (e.g. surface feed or deep, social, travel, etc.).

Where dive profile data exist these should be used in an approach similar to (Silber *et al*. 2010) to estimate the proportion of time at depths of high risk for types of vessel operating in the area.

Investigate stranding data near "flagged" IMMA including drift modelling to estimate locations of strikes.

Investigate availability of distribution data of at risk species within and around the IMMA, if shipping may be re-routed into other areas. Also, investigate other unintentional consequences of the move (e.g. other species, safety, human activities, etc.)

3. Management and Mitigation

Where a High Risk Area has been identified as requiring management action, the workshop **recommends** the following steps in developing a mitigation strategy:

Recommend identifying and engaging with shipping "nodes" (e.g. big company "command centers", port meetings, etc.).

Recommend a collaborative approach with stakeholders, prior to going to the IMO (if warranted).

Recommend maintaining a feedback loop with shipping will help encourage and sustain success.

8.2. Recommendations to the IWC in relation to its ongoing scientific work on the topic, and the implementation of its Ship Strikes Strategic Plan.

The workshop recommended that, subject to funding, the IWC, working with the IUCN MMPA Task Force and the CMS and its daughter agreements, undertake an initial analysis of global IMMAs, overlaid with shipping data, to identify potential high risk areas, taking into consideration the outputs of the workshop (Ships Strikes Working Group; IWC Scientific Committee; IUCN MMPATF; ACCOBAMS; CMS). The group recommends that the IWC Secretariat develop a costed proposal and seek funds to accomplish this (IWC Secretariat).

8.2.1 Cost of measures

The workshop noted that the costs of potential rerouting proposals or speed reductions was often an argument against mitigation measures. However, potential costs, including those associated with increased journey times, and administrative and bureaucratic costs, were often overestimated.

Estimates of the increase in distance transited have been done in some areas (e.g. USA Atlantic coast), but not the actual costs associated with increased distance and transit time. WWF had done a full economic analysis in the Pelagos Sanctuary to look at costs for measures relating to speed reduction and re-routing. They found it was cheaper to slow down, but neither were expensive. In addition, there were benefits to slowing down, such as reduced fuel consumption and greenhouse gas emissions, an issue to be discussed at the IMO in May 2019. The workshop noted that in some cases, delays in journeys resulted in higher port fees, so predictability of journey time was important. One of the advantages noted following the introduction of slow steaming had been fewer delays at ports and increased reliability of delivery times (Lee *et al*. 2015).

In the Hauraki Gulf, the industry were initially very concerned about the costs associated with reduced speeds and believed they would lose millions of USD. In practice the costs were much lower, although information on the exact costs were not publicly available.

The workshop **recommended** that the IWC Ship Strikes Working Group develop case studies to demonstrate the benefits, anticipated and actual costs of measures introduced to reduce ship strikes. The workshop **recommended** that the IWC Secretariat consider whether an intern could be recruited to support the development of these case studies.

8.3. Opportunities for engagement with other organizations

8.3.1 Intergovernmental organisations

The workshop requested the IUCN MMPA Task Force and the IWC Scientific Committee and Ships Strikes Working Group and ACCOBAMS to keep each other informed of developments in this area.

The workshop suggested that Simone Panigada become the liaison between the IWC Scientific Committee and Conservation Committee, ACCOBAMS Scientific Committee, the CMS and the IUCN MMPA Task Force.

The workshop welcomed support offered by the European Commission to facilitate discussions on the recommendations of the ACCOBAMS, CMS, and IWC with respect to ship strikes with EU Member States.

The workshop welcomed collaboration between the IWC, CMS and ACCOBAMS and **encouraged** further collaboration on the issue of ship strikes.

The workshop noted close collaboration between the IWC and the IMO on ship strike issues and **encouraged** the Secretariat to continue this collaboration.

The importance of engagement with industry in identifying mitigation measures was noted. Many companies met regularly with each other and/or port authorities, and this provides opportunity for sharing of information including with respect to voluntary measures. Sometimes bilateral discussions between industry and scientists can be productive to identify the most appropriate voluntary measure, without the need for government intervention.

The workshop commended the approaches taken in Stellwagen Bank National Marine Sanctuary and the Hauraki Gulf and agreed on the importance of presenting relevant data to industry in a visual and accessible way. It was noted that in both cases, follow up with feedback, both positive and negative, was an important contributor to success. In the Stellwagen Bank National Marine Sanctuary, the Whale Alert app and passive acoustic monitoring had been a great public outreach tool, however, it can only work in areas where the whale population of concern vocalises regularly. The workshop noted the opportunity of communicating positive measures to customers (e.g. cruise companies), although in Hauraki Gulf, this did not appear to be a significant motivating factor.

8.4. Other future work needed

The workshop **agreed** that IMMAs could potentially be used to identify high risk areas for other threats, including combined threats, e.g. bycatch and noise. The workshop noted that some measures may help address multiple threats (e.g. keeping vessels and whales apart and/or reduced vessel speed may reduce ship strikes and noise impacts). The workshop requested the IWC Scientific Committee consider this issue.

The workshop recommends that the IWC Scientific Committee and the IUCN MMPA Task Force review the potential uses of the IWC databases (e.g. historical catch, sightings, strandings etc) in helping to identify Areas of Interest (AOI) for future surveys, and for the verification of the longevity of IMMAs.

Reinforcing the IWC67b Scientific Committee recommendation which "recommends continued work to develop and evaluate mitigation measures, such as speed restrictions, that might be associated with the designation of a Particularly Sensitive Sea Area (PSSA) in the Pelagos Sanctuary area", the workshop **recommends** to the ACCOBAMS Secretariat and ACCOBAMS Parties to further develop the process for the designation of a PSSA by IMO at a scale that includes the North West Mediterranean Sea, Slope and Canyon IMMA, plus potentially the Spanish corridor, to take into account whale population movement and distribution. Zoning within the area with ship strike mitigation tools such as speed reduction and routing measures could be proposed as part of Associated Protective Measures within the PSSA. The ACCOBAMS Permanent Secretariat welcomes this recommendation.

Participants noted the information on sperm whales along the Hellenic Trench outlined in Frantzis *et al*. (2019), which had been drawn to the attention of the Greek Government, who would need to take forward any routing proposals to IMO. Tseliou, the representative of the Greek Ministry of Maritime Affairs and Insular Policy, highlighted the need to gain the support of the shipping industry. The workshop agreed that this was important and engagement with industry should be encouraged, but noted that the proposal could still proceed even without industry support.

The workshop **recommends** that the Greek Ministry of Maritime Affairs and Insular Policy work with other Greek Ministries (e.g. Ministry of Environment and Energy) and relevant stakeholders including the shipping industry, the European Commission and other countries, NGOs, IGOs and scientists to put in place risk reduction measures in the Hellenic Trench and submit a formal proposal by 2020 to the IMO for approval. In order to facilitate this process, a short document providing specific risk reduction options could be prepared by relevant experts to provide the necessary information.

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APPENDIX 1 – WORKSHOP AGENDA

1. Introductory items
- 1.1. Welcome and Introductions
- 1.2. Identification of Chair (*Bracho/Panigada)* and Rapporteurs (*Ferriss, Mattila, Leaper*)
- 1.3. Goals and objectives
- 1.4. List of documents
- 1.5. Adoption of the agenda

2. Background on the IUCN Task Force and the IMMA project and process
- 2.1. Review of IMMA criteria
- 2.2. Overview of data sources
- 2.3. Overview of the distribution of the IMMA Network, including candidate IMMAs and Areas of Interest for marine mammals
- 2.4. Overview of the IMMA process for the Mediterranean

3. IWC Work on Ship Strikes
- 3.1. Overview of IWC concern about ship strikes and the work of the Conservation and Scientific Committees, including review of relevant aspects of Ship Strikes Strategic Plan (e.g. stages in the plan for identifying high risk areas to implementing mitigation
- 3.2. Links with the proposed joint IWC/ACCOBAMS CMP on Mediterranean Fin Whales
- 3.3. Summary of relevant data held by IWC (e.g. ship strike database, catches, SOWER, POWER etc) -
- 3.4. Update on shipping data available

4. **Generic approaches to use area based management tools alongside shipping data, to identify "High Risk Areas" for ship strikes**

5. Use of the Mediterranean as a case study to identify high risk areas for ship strikes

6. **Mitigation strategies for high risk areas identified, and the best way to accomplish those**

7. **Opportunities for engagement with other institutions and relevant partners with similar goals or relevant policy processes**
- **7.1. Application of this approach (or similar) to identify high risk areas for other threats, including combined threats**

8. **Recommendations**
- 8.1. Best practice guidelines for future determination of high risk ship strike areas for cetaceans
- 8.2. Recommendations to the IWC in relation to its ongoing scientific work on the topic, and the implementation of its Ship Strikes Strategic Plan.
- 8.3. Opportunities for engagement with other organizations
- 8.4. Other future work needed

9. Review primary recommendations

10. Any other business

APPENDIX 2 – LIST OF DOCUMENTS

Title	Authors	Workshop document number
Agenda	.	CCSC/APR19/SS/GEN/01
Shipping routes through core habitat of endangered sperm whales along the Hellenic Trench, Greece: Can we reduce collision risks?	Alexandros Frantzis, Russell Leaper, Paraskevi Alexiadou, Aristides Prospathopoulos, Dimitrios Lekkas	CCSC/APR19/SS/01
Report 1st IMMA Regional Workshop - Mediterranean	IUCN Task Force on Marine Mammal Protected Areas	CCSC/APR19/SS/03
Report of European Cetacean Society workshop: Towards understanding the overlap of selected threats and Important Marine Mammal Areas (IMMAs) across the Mediterranean Sea.	IUCN MMPA TF and ACCOBAMS	CCSC/APR19/SS/04
IMMA Guidance Document (March 2018 update)	IUCN MMPATF	CCSC/APR19/SS/05
Supplement to the ECS Joint MMPATF/ACCOBAMS IMMA Workshop Report		CCSC/APR19/SS/06
IWC Strategic Plan on Ship Strikes Working Group	IWC	CCSC/APR19/SS/INFO/01
IMO Revised Guidelines For The Identification And Designation Of Particularly Sensitive Sea Areas	IMO	CCSC/APR19/SS/INFO/02
IMO - Guidelines For The Designation Of Special Areas Under Marpol 7378 and Guidelines for the Identification and Designation of PSSAs	IMO	CCSC/APR19/SS/INFO/03
IMO Resolution MEPC267(68) Amendments to the revised guidelines for the identification and designation of Particularly Sensitive Sea Areas (resolution a.982(24))	IMO	CCSC/APR19/SS/INFO/04
Consequences of global shipping traffic for marine giants	Vanessa Pirotta, Alana Grech, Ian D Jonsen, William F Laurance and Robert G Harcourt	CCSC/APR19/SS/INFO/05
Marine Sanctuaries and Marine Planning: Protecting endangered marine life.	David Wiley, Leila Hatch, Michael Thompson, Kurt Schwehr and Craig MacDonald	CCSC/APR19/SS/INFO/06
Mitigation of vessel-strike mortality of endangered Bryde's whales in the Hauraki Gulf, New Zealand	Rochelle Constantine, Mark Johnson, Leena Riekkola, Stephanie Jervis, Lily Kozmian-Ledward, Todd Dennis, Leigh G. Torres and Natacha Aguilar de Soto	CCSC/APR19/SS/INFO/07
Guidance document for minimizing the risk of ship strikes with cetaceans.	IMO	CCSC/APR19/SS/INFO/08
Information on recent outcomes regarding minimizing ship strikes to cetaceans.	IWC	CCSC/APR19/SS/INFO/09
Distribution patterns of blue whale (Balaenoptera musculus) and shipping off southern Sri Lanka	Tilak Priyadarshana, Sameera Madusanka Randage, Abigail Alling, Susannah Calderan, Jonathan Gordon, Russell Leaper, Lindsay Porter	CCSC/APR19/SS/INFO/10
	MMPA Task Force	CCSC/APR19/SS/INFO/11
6th Progress Report on IWC Ship Strike Data Coordination April 2018	Simone Panigada, Fabian Ritter	CCSC/APR19/SS/INFO/12
Report of the Joint IWC-SPAW Workshop to Address Collisions Between Marine Mammals and Ships with a Focus on the Wider Caribbean	IWC	CCSC/APR19/SS/INFO/13
Vulnerability of Arctic marine mammals to vessel traffic in the increasingly ice-free Northwest Passage and Northern Sea Route	Donna D. W. Hauser, Kristin L. Laidre, and Harry L. Stern	CCSC/APR19/SS/INFO/14
High mortality of blue, humpback and fin whales from modeling of vessel collisions on the U.S. West Coast suggests population impacts and insufficient protection	R. Cotton Rockwood, John Calambokidis, Jaime Jahncke	CCSC/APR19/SS/INFO/15
Hydrodynamics of a ship/whale collision	Gregory K. Silber, Jonathan Slutsky, Shannon Bettridge	CCSC/APR19/SS/INFO/16

APPENDIX 3 – PARTICIPANTS LIST

Amalia Alberini
Project manager
ICMMPA5 & Marine associate
WWF GREECE
21 Lembessi str
Athens 11743
GREECE
Email: a.alberini@wwf.gr

Charlotte Boyd
Research Scientist
School of Aquatic and Fishery Sciences
UNIVERSITY OF WASHINGTON
1122 NE Boat St,
Seattle, WA, 98105
USA
Email: boydchar@u.washington.edu

Rochelle Constantine
Associate Professor
School of Biological Sciences
UNIVERSITY OF AUCKLAND
Private Bag 92019
Auckland
New Zealand
Email: r.constantine@auckland.nz

Léa David
Docteur en cétologie
ECOOCÉAN INSTITUT
18 rue des Hospices
34090 Montpellier
FRANCE
Email: lea.david2@wanadoo.fr

Constanza Favilli
Acting Executive Secretary
Permanent Secretariat of the
PELAGOS AGREEMENT
Tour Odéon B1 – 36, avenue de l'Annonciade
MC – 98000
MONACO
Email: costanzafavilli@pelagos-sanctuary.org

Sarah Ferriss
Head of Programme Development
INTERNATIONAL WHALING COMMISSION
The Red House, 135 Station Road,
Impington, Cambridge, CB24 9NP, UK
Email: sarah.ferriss@iwc.int

Alexandro Frantizis
Scientific Director
PELAGOS CETACEAN RESEARCH INSTITUTE
Terpsichoris 21
16671 Vouliagmeni,
GREECE
Email: afrantzis@otenet.gr

Peter Fretwell
BRITISH ANTARCTIC SURVEY
High Cross
Madingley Road
CAMBRIDGE
CB3 0ET
Email: ptf@bas.ac.uk

Erich Hoyt
IUCN SSC/WCPA MARINE MAMMAL PROTECTED AREAS TASK FORCE
Park House, Allington Park
Bridport, Dorset DT6 5DD
UK
Email: erich.hoyt@mac.com

Théa Jacob
Marine Species and Fisheries Officer
WWF FRANCE
Bureau Marseille
6 rue des Fabres 13001 Marseille
FRANCE
Email: tjacob@wwf.fr

Sophia Kopela
Biodiversity Policy Officer
WWF Greece
21 Lembessi St.
117 43 Athens
GREECE
Email: s.kopela@wwf.gr

Russell Leaper
INTERNATIONAL FUND FOR ANIMAL WELFARE
Canal House
Banavie
Fort William
PH33 7LY
UK
Email: russell@ivyt.demon.co.uk

David Mattila
Human Impact Reduction
INTERNATIONAL WHALING COMMISSION
The Red House, 135 Station Road,
Impington, Cambridge, CB24 9NP, UK
Email: david.mattila@iwc.int

Aurelie Moulins
CIMA RESEARCH FOUNDATION
Via A. Magliotto, 2 - 17100 Savona (SV)
ITALY
Email: aurelie.moulins@cimafoundation.org

Vedran Nikolić
Policy officer - Nature conservation
European Commission
DG Environment
Unit D3 – Nature protection
BU5 06/156
B-1049 Brussels/Belgium
Email: vedran.nikolic@ec.europa.eu

Giuseppe Notarbartolo di Sciara
IUCN SSC/WCPA MARINE MAMMAL PROTECTED AREAS TASK FORCE
via Benedetto Marcello 43
20124 Milano
ITALY
Email: disciara@gmail.com

Simone Panigada
TETHYS RESEARCH INSTITUTE
Viale G.B. Gadio
220121 Milano
ITALY
Email: panigada69@gmail.com

Lorenzo Rojas Bracho
Comisión Nacional para el Uso y Conocimiento de la Biodiversidad (CONABIO)
Ensenada BC 22860
MEXICO
Email: lrojasbracho@gmail.com

Maylis Salivas
Programme Officer
ACCOBAMS Secretariat
Jardin de l'UNESCO
Terrasses de Fontvieille
98000 MONACO
Email: msalivas@accobams.net

Greg Silber
SMULTEA ENVIRONMENTAL SCIENCES
P.O. Box 256, Preston,
WA 98050
USA
Email: gregsilber@gmail.com

Fani Tseliou
Secretary General's, Dionysis Temponeras, Cabinet, Greek Ministry of Maritime Affairs and Insular Policy
Email: ftseliou@hotmail.com

David Wiley
Research Coordinator
NOAA/Stellwagen Bank National Marine Sanctuary
175 Edward Foster Road
Scituate, MA 02066
USA
Email: david.wiley@noaa.gov

APPENDIX 4 – PRESENTATION ON IMPORTANT MARINE MAMMAL AREAS

Background on the IUCN Task Force and the IMMA project and process

(See also IUCN Marine Mammal Protected Areas Task Force, 2018)

The IMMA concept, developed by the IUCN Joint SSC/WCPA Marine Mammal Protected Areas Task Force ('MMPA Task Force' or 'Task Force'), is modelled on the successful example of the BirdLife International process for determining 'Important Bird and Biodiversity Areas' (IBAs). The aim of the IMMA classification is to 'identify discrete habitat areas, important for one or more marine mammal species that have the potential to be delineated and managed for conservation'.

The intention is that the identification of IMMAs through a consistent expert process, independent of any political and socio-economic concerns, will provide valuable input of marine mammals into existing national and international conservation tools with respect to marine protected areas, including Ecologically or Biologically Significant Areas (EBSAs) under the Convention on Biological Diversity (CBD), and Key Biodiversity Areas (KBAs) identified through the IUCN Standard. The IMMA process should also assist in providing strategic direction and priorities to the development of spatially explicit marine mammal conservation measures, potentially for noise, ship strike and other threats to marine mammals.

Eight criteria or sub-criteria, divided into four main categories are designed to capture critical aspects of marine mammal biology, ecology and population structure, and they encompass vulnerability, distribution, abundance, key life cycle activities and special attributes.

The IMMA selection criteria consist of:

Criterion A: Species or Population Vulnerability

Areas containing habitat important for the survival and recovery of threatened or declining species or populations.

Criterion B: Distribution and Abundance

Sub-criterion Bi: Small and Resident Populations

Areas supporting at least one resident population, containing an important proportion of that species or population, which are occupied consistently.

Sub-criterion Bii: Aggregations

Areas with underlying qualities that support important concentrations of a species or population.

Criterion C: Key Life Cycle Activities

Sub-criterion Ci: Reproductive Areas

Areas and conditions that are important for a species or population to mate, give birth, and/or care for young until weaning.

Sub-criterion Cii: Feeding Areas

Areas and conditions that provide an important nutritional base on which a species or population depends.

Sub-criterion Ciii: Migration Routes

Areas used for important migration or other movements, often connecting distinct life cycle areas or connecting different parts of the year-round range of a non-migratory population.

Criterion D: Special Attributes

Sub-criterion Di: Distinctiveness

Areas which sustain populations with important genetic, behavioural or ecologically distinctive characteristics.

Sub-criterion Dii: Diversity

Areas containing habitat that supports an important diversity of species.

These criteria are not hierarchical in design. Any candidate IMMA need only satisfy one of the listed criteria or sub-criteria to successfully qualify for IMMA status. In practice, most cIMMAs satisfy at least two criteria.

Any of the 8 IMMA criteria or subcriteria—after filtering by species (sperm, fin, blue etc) and overlaying ship traffic lanes to measure intensity—could potentially identify a place where ship strikes are an issue; there is no one criterion related to ship strike occurrence. However, Criterion A (Species or Population Vulnerability) indicates a threatened species so that could be an additional reason for conservation concern. Criterion Dii on Diversity will indicate multiple species in an area, some more subject to ship strike than others, so that could be an additional reason for conservation concern. Subcriteria Ci Reproductive Areas and Cii Feeding Areas may indicate more intensive use of an area than Ciii Migration Routes. Species spending considerable time in a given area thus may be more susceptible to ship strike if the ship lanes go through the IMMA. Migrating baleen whales indicate seasonal use of an area; sperm and other toothed, and potentially non-migrating baleen whales may have more consistent use of an area.

Overview of data sources

IMMAs, by necessity, draw upon a wide range of data sources in order to assess the relative importance of an area against the IMMA selection criteria. As much as is possible, the data sources should be considered in ensemble. They are divided into primary and secondary currencies of information, considered most suitable for use in the assessment of the selection criteria for the identification of an IMMA.

Primary currencies include, in order, abundance of animals, probability of occurrence, observed sightings, area of occupancy, extent of suitable habitat and range.

The following secondary currencies of information are also useful to support the identification of an IMMA: records of habitat use, measures of difference, indices of diversity.

Approaches that are able to quantify the number of animals likely to occur within a given cIMMA have the highest rank of confidence for potential IMMA end-users.

The IMMA process relies upon experts to bring evidence to bear and to summarize it — in that sense it is a group expert participatory process (in contrast, for example, with the IUCN KBA identification process which relies on meeting strict numerical thresholds). The strength/ value of the IMMA tool lies partly in the robust standardized process that has been adopted for identifying IMMAs and putting them on the map.

This standardized process being undertaken by the IUCN MMPA Task Force throughout the Southern Hemisphere and, hopefully, after 2021, in the Northern Hemisphere, subject to further funding, aims to create the best possible scenario for the successful integration of these scientifically identified areas into conservation and management.

Overview of the distribution of the IMMA Network, including candidate IMMAs and Areas of Interest for marine mammals

The IMMA network presently includes three regions: the Mediterranean, the Pacific Islands and the North East Indian Ocean and South East Asian Seas. Two additional regions are in process: the Extended Southern Ocean and the Western Indian Ocean and Arabian Seas. Two additional regions are funded for 2020 and 2021: the Australia-New Zealand and South East Indian Ocean and the South East and Eastern Central Pacific Ocean. Other areas are under discussion but will not be attempted until after 2021.

In the three completed regions, 77 IMMAs have been created, spread across 143 polygons, comprising 2,185,781 km^2. The largest is 431,498 km^2 in the Cook Islands Southern Group and the smallest in 45 km^2 Akrotiri IMMA (Cyprus), with an average of 28,386 km^2. There are also 19 cIMMAs, and 87 AoI on the map and in the database.

Of the 77 IMMAs, sperm whales are in 8% of the IMMAs, humpback whales in 7%, fin whales and Cuvier's beaked whales both comprise 3%.

30 of the 77 IMMAs have as primary species sperm whales or large baleen whales (including Omura's and Bryde's).

IMMAs have buffers, some more than others. Some have indications for zones or specific areas within the IMMA. Sometimes these are marked on the map; more often zoning is part of supporting material in the PDFs that accompany each area. These and other information about threats presented in the supporting material may help to identify areas with ship strike problems.

APPENDIX 5 IWC WORK ON SHIP STRIKES

The IWC Scientific Committee has been discussing ship strikes for around 20 years. The early discussions focussed on trying to develop methods to estimate the number of strikes in the context of assessing overall human impacts on populations and particularly those that may be subject to commercial whaling. Estimating the number of deaths from ship strikes has proven challenging in all except the most well studied populations.

More recently, the SC has been working closely with the Conservation Committee and its Ship Strike Working Group to implement the IWC Strategic Plan to Mitigate the Impacts of Ship Strikes on Cetacean Populations.

The IWC Ship Strikes Strategic Plan can be accessed here: https://iwc.int/document_3647.download

The overall objectives of the Strategic Plan are to:

(1) To reduce mortalities and injuries to cetaceans 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, Arctic Council).

(6) Increase public and industry awareness about the issue and measures used to reduce this threat.

The plan itself also attempts to:

(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 has identified that 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. High risk areas are defined in the strategy as 'the convergence of either areas of high volume of shipping and whales, or high numbers of whales and shipping'.

The Strategic Plan describes seven stages in identifying high risk areas and developing appropriate mitigation strategies (Table 1). The Scientific Committee has also identified specific aspects of these stages where it can contribute (Table 2).

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, AIS data for shipping used to inform risk analysis and local vs international jurisdiction.
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.

Table 2. Potential advice from the Scientific Committee in response to requests related to different stages of implementation of mitigation measures identified in the IWC Strategic Plan to Mitigate Ship Strikes (SC Report 2018 Annex J)

Stage	Potential advice from the Scientific Committee
Stage 1: High risk area of potential concern identified based on overlap of shipping and whale distribution or a high number of reported incidents	The Committee could examine the available information on shipping and whale distribution and extract records for that area from the Ship Strike Database. The Committee could draw attention to other assessments such as those used to identify Important Marine Mammal Areas (IMMAs).
Stage 2: Survey data for whales, AIS data for shipping used to inform risk analysis and local *vs* international jurisdiction.	The Committee reviews the data available on whale habitat use, and analysis of risk.
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.	The Committee reviews the proposed routing or other risk reduction measures. If the routing measure is associated with a Particularly Sensitive Sea Area (PSSA) the SC may consider reviewing any other Associated Protective Measures (APMs) and their potential impact on whales. In line with 2.2.4 of the Strategic Plan, the Committee could identify any known aids to voyage planning available in the area, or assist in applying such technologies in these areas. If a particular type of vessel traffic appears primarily responsible for ship strikes in the area, the SC could draft guidance for operators of these vessels.
Stage 4: Stakeholder workshops to discuss possible mitigation measures and optimise risk reduction with stakeholder interests.	Especially valuable where new routes are being discussed, the Committee could offer advice on what associated protective measures would fit based on region and known species.

Stage 5: Relevant states consider proposals to IMO assisted by supporting information from IWC.	The IWC could submit supporting information for a routing measure to the relevant IMO Committee meeting based on the Committee evaluation. This submission could be especially important if the proposed routing measure is not primarily concerned with ship strike mitigation.
Stage 6: Measures implemented through IMO.	-
Stage 7: Continued Monitoring to evaluate ongoing effectiveness of measures.	The Committee could provide a review of the most recent data on whale distribution along with any known ship strikes since the implementation of the measures. If risk analyses are conducted then further advice to improve risk reduction could be provided.