Annex J

Report of the Working Group on Non-Deliberate Human-Induced Mortality of Cetaceans

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1. INTRODUCTORY ITEMS

1.1 Convenor's opening remarks
Leaper welcomed participants. He reminded the participants that the terms of reference for the Working Group had been expanded to include consideration of non-deliberate Human Induced Mortality in all cetaceans rather than just large whales.

1.2 Election of chair and appointment of rapporteurs
Leaper was elected chair, Currey was elected co-chair and Mattila offered to rapporteur.

1.3 Adoption of agenda
The agenda was adopted, see Appendix 1.

1.4 Available documents
SC/67a/HIM01-12, SC/67a/HIM14-16, Redfern *et al.* (2017), Hill *et al.* (In press), Robbins *et al.* (2015), van der Hoop *et al.* (2016), George *et al.* (2017), Williams *et al.* (2016), Knowlton *et al.* (2015), Carretta *et al.* (2016), Anderson (2014) and SC/67a/SM20.

2. BYCATCH AND ENTANGLEMENT

As vice-chair of the Commission's new working group on bycatch mitigation, Bjørge presented a brief overview of the Bycatch Mitigation Initiative. The proposed actions in IWC/66/CC05, concerning the scope and urgency of the bycatch issue were endorsed by the Conservation Committee and the Commission in 2016. These included the formation of a Standing Working Group (SWG) under the Conservation Committee which will supervise the establishment of an Expert Panel and a coordinator position for the initiative. The SWG has been formed and is currently made up of 11 member countries and six NGOs and IGOs. It is chaired by Belgium and co-chaired by Norway. Simmonds was appointed by the Commission as the interim coordinator. He suggested that one of the first tasks that the Committee could assist with is to provide nominations for the Expert Panel.

2.1 Review new estimates of entanglement rates, risks and mortality (large whales)
SC/67a/HIM04 describes the use of aerial photographs taken of bowhead whales in the Bering-Chuckchi-Beaufort Sea (B-C-B Seas) area over multiple years for analysis of scars indicating non-lethal encounters with anthropogenic sources. Scars associated with entanglement injuries and ship strikes have been documented on B-C-B Seas bowhead whales harvested by Alaskan Eskimos for several decades. In 2016, preliminary estimates of the frequency of such injuries were presented (Kim *et al.*, 2015) and these have subsequently been published by George *et al.* (2017). The authors of that study estimated that ~12% of bowhead whales harvested by Alaska Native hunters show evidence of rope scarring likely associated with Bering Sea pot fisheries and that about 2% of these animals carry injuries/scars from ship strikes.

An aerial photo-identification survey was conducted during the spring 2011 migration near Barrow, Alaska. Inter-year matches, dating to 1985, were made against the long-term NSB, NMMF, LGL photo database to estimate abundance and survival rates (SC/67a/AWMP08). These photos also provided an opportunity to independently estimate line entanglement frequency for B-C-B bowheads (SC/67a/HIM04). The analysis of aerial photographs (n=693) with adequate photo quality of the caudal peduncle from the 2011 survey suggests ~12.6% of the whales showed evidence of entanglement scarring. An additional three whales were observed dragging gear (0.4%). Subsequently, photographs of all inter-year matches (between 1985, 1986, 2003, 2004, 2005 and 2011) from a multi-year photo mark-recapture study (SC/67a/AWMP08) were examined to identify whales that had acquired entanglement injuries during the study period. The probability of a bowhead acquiring an entanglement injury was estimated using two statistical methods: interval censored survival analysis and a simple binomial model. Both methods give similar results, suggesting a 2.4% (1.2%, 3.6%) annual probability of acquiring a scar. The estimated annual scar acquisition rate (2.4%) may seem high, particularly since both analyses suggest that the probability of acquiring a scar over 25 years is around 40%. However, this estimate is also consistent with the observation that of the 15 recaptures when the elapsed time was at least 25 years, five whales (38.5%), had acquired a scar. George *et al.* (2017) found that about 50% of large (~17m) and presumably old, harvested whales carried entanglement scars. Furthermore, when chronological ages were assigned to the dataset used in George *et al.* (2017), it was found that about 47% of the whales >50 years old carried entanglement scars (Wetzel *et al.*, 2014). These various metrics from independent data sources are in close agreement, and therefore suggestive that fishing gear entanglement is a concern for B-C-B Seas bowheads that requires further consideration.

The Working Group thanked the authors and noted that this work is based on a unique, long-term and multifaceted dataset for bowhead whales. Data for monitoring of changes in abundance and scarring would be improved through more frequent aerial surveys of (at least) every five years. In addition, increased engagement with the Bering Sea Crab Association would be very helpful, as to date, the only identified gear (n=2) removed from B-C-B Seas bowhead whales has been from that fishery, and it is the dominant fishery in the region. Although the fishery is not known to co-occur with bowhead presence in time, they do share the same region and, as has been noted previously, and this suggests that the surprisingly high level of interaction with this gear type may be with gear lost due to movements of the ice. Recognising the value of this work, and the increasing concern about the prevalence of large whale interactions with fishing gear, the Working Group suggested examination of other datasets to provide insights into the rates of interaction (e.g. scar acquisition) for other populations. It was suggested that the advances in drone technology might help to obtain useable images for these types of analyses.

George also noted that the careful examination of carcasses, as described in George *et al.* (2017), has been very helpful in understanding the wounds and in ground-truthing the inferences from aerial images. It was suggested that expanding the examinations of hunted whales to other local communities would increase the power of the analyses. With respect to ship strikes, the examination of carcasses described in George *et al.* (2017) indicates that visible (non-lethal) ship strike wounds are rare. However, the authors noted that with the anticipated increase in shipping through the region an increase in full examinations (e.g. for blunt force trauma) may be called for.

Non-hunting, human-caused injuries and mortalities (NHHCIM) can have significant impacts and gray whales are likely more vulnerable than most whale populations to interactions with fishing gear due to their nearshore migratory and feeding behaviour. SC/67a/HIM06 compiled all known sources of data on NHHCIM of gray whales in the North Pacific to document the frequency and source of NHHCIM. Data were compiled from national stranding and human-interaction databases, published reports, and newspaper articles. 397 reports of NHHCIM of gray whales were documented for the time period of 1924 through 2015. The majority of reports were from the time period of 1980 through 2015 when stranding networks were established along the US Pacific coast. Of the 397 reports, 152 documented whale deaths. The remaining 245 reports were assessed using the policy developed by NOAA for distinguishing serious from non-serious injuries and pro-rating a probability of death to seriously injured whales. Fifty-three cases were determined to be non-significant injury with the primary reason being that human intervention resulted in the disentanglement of the whale. The pro-rated sum of serious injuries and mortalities was 299.8 gray whales. Causes of NHHCIM were net fisheries (39.7%), unknown entanglements (21.5%), ship strikes (19.1%), and pot fisheries (17.1%). The primary regions for reports were California (62.8%) and Northern California through Northern British Columbia (21.5%). The most common form of NHHCIM in gray whales was entanglement in net fisheries in the 1980s and 1990s. In the 2000s and 2010s the most common cause of NHHCIM was entanglement in pot fisheries (assuming most unknown entanglements were from pot fisheries). This report represents a minimum estimate of the number of NHHCIM because it is difficult to definitively determine the cause of death of stranded whales, stranding networks had poor spatial coverage during all or part of the reporting time period, and because injured or killed whales not documented at sea may not wash to shore or be reported at-sea.

It was noted that the region covered by SC/67a/HIM06 was quite extensive, and in many cases remote, and that it might therefore be valuable to attempt to extrapolate, using these data, to the regions of gray whale habitat not covered by the established stranding networks. Scordino noted that this was currently being attempted by modelling the reporting rates before and after the establishment of the stranding networks, in order to gain insight into those areas that are currently not covered by networks.

There is clear evidence that gray whales can and do become entrapped or entangled in fishing gear, particularly gillnets and vertical lines used for pots or traps. SC/67a/HIM17 reports on the available evidence of gray whale entanglements in the western North Pacific, and reviews the literature on gear types used in the Russian Far East (RFE) that are known or suspected to impact gray whales. Additionally, the paper included: (1) an overview on the legal/regulatory situation in at least the Sakhalin Oblast region, including salmon fishing as well as other fisheries with potential risk of entangling or entrapping gray whales; (2) descriptions and maps of the relevant fisheries in the RFE and details on how they operate; (3) recognised gaps in knowledge and actions to close them; and (4) potential approaches to mitigation and consistent reporting and documentation of interactions of whales and fishing gear. The coastal salmon trap fishery off northeastern Sakhalin Island, which overlaps spatially and temporally with feeding gray whales during the summer and fall was identified as an area where entanglement risk is very high. This risk is of particular concern because adult females and their calves show strong site fidelity to this area at a critical time when the females are recovering from pregnancy and lactation and the calves are being weaned.

In response to a question about the relative risk of gear type versus geographic location, it was noted that extended co-occurrence with any static gear was the greatest risk, and in this area the whales overlap in distribution with (salmon) nets all season. Given the status of this population, Weller noted that this document had been sent to the relevant government agencies in Sakhalin and the Russian Federation.

SC/67a/HIM14 reports on an entanglement and death of an eastern South Pacific (ESP) southern right whale. The whale was first seen alive on 09/02/2017 off northwestern Isla de Chiloe, southern Chile, with clear wounds caused by entanglement in fishing gear and numerous cyamids with an abnormal distribution. The whale was compared to the Centro de Conservacion Cetacea southern right whale catalogue comprising of 39 individuals, but no match was found. Genetic samples were also collected which are the first for this population. The 13m long carcass of undetermined sex stranded and was examined ten days after the whale was seen alive at sea. Almost all the skin showed lineal marks of monofilament fishing line, most of them in the form of an 8x8cm (±2cm) net. A linear impression was found around the neck area, behind the blowholes, probably caused by a rope and on the right side of the body, four white wound circles of about 20cm in diameter were probably caused by buoys. Blubber thickness measured along the lateral mid-line was considered normal for the species showing no evidence of emaciation. Although no ropes or nets were found on its body, the pattern of the marks observed suggested that the whale was severely entangled and this was among the main factors that caused its death. This is the third entanglement reported in Chile since 1986 and the second in a relatively short period of time (approx. 2.5 years), for this Critically Endangered population, raising concerns about the negative impacts this threat is causing to the recovery. The Working Group thanked the authors and **recommended** that the planned expansion of entanglement response capability in the region, as part of the implementation of the CMP for this population, be considered as a matter of urgency.

Robbins *et al.* (2015) reported on the apparent survival of North Atlantic right whales after entanglement in fishing gear. The study used documented entanglements, long-term population studies and mark-recapture statistical techniques to evaluate the effect of entanglement events on survival. Estimates were based on 50 individuals observed carrying entangling gear between 1995 and 2008, and compared to 459 others that were never observed with gear during the same period. Entangled adults had low initial apparent survival (0.749, 95% CI: 0.601-0.855), but those that survived the first year achieved a survival rate (0.952, 95% CI: 0.907-0.977) that was more comparable to unaffected adult females (0.961, 95% CI: 0.941-0.974) and males (0.986, 95% CI: 0.975-0.993). Juveniles had a post-entanglement survival rate that was comparable to the initial survival of entangled adults (0.733, 95% CI: 0.532-0.869) and lower than un-impacted juveniles (0.978, 95% CI: 0.969-0.985). Of three entanglement characteristics examined, health status was the best predictor for subsequent survival, but the entanglement configuration and the resulting injuries also appeared to affect the outcome. When the entanglement configuration was assessed as high risk, human intervention (disentanglement) improved survival. The authors concluded a need for continued mitigation efforts for this species, as well as for a better understanding of entanglement impacts in other baleen whale populations.

The Working Group thanked the authors and George noted that their finding of a lower likelihood of juveniles surviving an entanglement might be an alternative explanation for the lower entanglement scarring observed on juvenile bowhead whales compared to adults. The possibility of inferring survival (and mortality) from scarring rates was discussed and Robbins noted that it had been previously estimated for humpback whales (Robbins *et al.*, 2009). However, estimates of the frequency of entanglement (e.g. through wound acquisition) and an estimate of survival when entanglement does occur (e.g. through monitoring the outcomes of actual documented cases), are required. In discussion of the lower survival rate of entangled females, it was noted that this may be due to higher energetic burdens related to pregnancy and lactation.

The success of a disentanglement intervention varies between species, as well as the complexity and severity of the entanglement itself, but its (positive) effect on subsequent survival of right whales is most pronounced for severely entangled whales. Robbins noted that it is likely to be similar for other species, but that a comparable analysis for humpback whales was complicated by the fact that it was often harder to identify individuals, as their flukes (e.g. their individual identifying mark) are often involved in the entanglement and not available for a surface photo, unlike the callosity patterns on the heads of right whales. Also, right whales appear to be stronger than humpbacks and can drag entangling gear for a longer period of time, giving them more opportunities to be found and released, but also, potentially resulting in more severe wounds. In contrast, humpback whales are easier to release, but those with severe entanglements may be more likely to die if not found quickly. Death can be by drowning, a gradual decline in body condition from impaired feeding, or a chronic infection. It was noted that recent work by van der Hoop *et al.* (2016) showed that even a relatively short length of rope can create significant energetic costs when dragged for extended periods of time behind an entangled whale.

2.2 Reporting of entanglements and bycatch in National Progress Reports

As in previous years, the Working Group reviewed summary tables of bycatch and ship strikes from National Progress Reports. These are shown in Appendix 3. Discussions related to changes to the National Progress Reports are given under Item 22 in the main Scientific Committee report.

2.3 Mitigation measures for preventing large whale entanglement

The work of the Technical Advisor to the Secretariat on human impact reduction is primarily reported to the Commission's Working Group on Whale Killing Methods and Welfare Issues. However, Mattila identified aspects of the work relevant to the Working Group. The curriculum that has been developed and endorsed by the IWC's entanglement advisory group, recognises that disentanglement is not the solution to the problem and that proper entanglement response must therefore include good documentation of the gear and the whale, that will hopefully lead to a better understanding of the issue, with an ultimate goal of prevention. This was stressed to the almost 600 trainees from 15 different countries (October 2014 to May 2017), and it is anticipated that, especially when the IWC's entanglement database is available, most of these newly formed networks will use it and submit data. In addition, a recently convened IWC workshop on cooperation for transboundary entanglements between Mexico, USA and Canada (Puerto Vallarta, 2016) has already increased communication on gear removed in Mexico this past winter, resulting in the identification of the type and origin of much of it.

The members welcomed the report, **agreed** that the IWC's initiative to develop a global entanglement response network was valuable to its work, and encouraged its continued expansion. It was noted that upcoming trainings were being planned for Russia, Colombia, Chile/Peru and Norway, and that several Pacific Island Countries had also expressed interest.

SC/67a/HIM10 described a study that evaluated the effectiveness of gear modifications in the Western Australian rock lobster fishery to reduce large whale entanglements. The Western Australian population of humpback whales is recovering rapidly and yet between 1990 and 2010 the reported entanglement rate in gear from the pot-based western rock lobster (*Panulirus cygnus*) fishery was relatively stable at around one or two per year. However, from 2010, reported entanglements increased dramatically, peaking at 17 in 2013, with this increase linked primarily to the fishery moving from a 7.5-month season to operating all year. To reduce entanglements a series of fishing gear modifications were implemented into the commercial rock lobster fishery, eliminating surface rope in waters deeper than 20 metres and minimising float numbers. The utility of these measures has been assessed using entanglements reported between 2000 and 2016. The assessment model incorporated expected changes in whale population size, entanglement sighting probability, commercial fishing effort, inter-annual variation in the timing of the whale migration and the implementation of gear modifications. The analyses suggest gear modifications reduced entanglements by ~65% with two and four entanglements in 2015 and 2016, respectively. The model also highlighted the northward migration and water depths of 37-73m as the times and areas with the greatest rate of entanglements. This is the first assessment that examines the effectiveness of such gear modifications to reduce whale entanglements and highlights the importance of incorporating all factors which may impact on entanglement rates to assess the effectiveness of gear modifications.

The group thanked the authors and commended Australia and its fishers for their rapid response to what had become a sudden, growing problem, and for what appears to be a major reduction in the numbers of whales entangled in this fishery. Similar gear modifications (e.g. reduced rope from pot gear) along the New England coast of the USA has not produced similar measurable reductions. Several possible explanations for this were discussed including differences in habitat characteristics and associated whale behaviours, as well as difference in the density of gear. The whales along Australia's coast are migrating, and closer to the breeding grounds than feeding grounds, while those in New England are foraging on their feeding grounds. Secondly, because official entanglement rates in both areas are primarily calculated using changes in the number or timing of reports, and those come from a variety of sources (e.g. fishers, whale watchers and the public) it is possible that changes in reporting could play a role. In a number of other areas evidence has caused concern that the threat of perceived negative management initiatives (e.g. fines, closures, gear restrictions) may reduce incentives to report. However, the Western Australian rock lobster fishers engaged in developing mitigatory gear modifications and information on the source of reported entanglements does not indicate that a fall in reporting by fishers could explain the observed reduction in the total number of reported entanglements (see Appendix 2). Double stated that the proportion of reports from fishers in the rock lobster fishery compared to other sources before and after the drop in reported entanglements showed no change. This suggests that the western rock lobster fishers have not biased their reporting, and that the reduction in reported entanglements after the modifications are consistent across all sources.

Nevertheless the Working Group also **agreed** that the numbers of witnessed (and reported) entanglement events in both areas are likely a subset of the total entanglements. Double agreed that this is a concern in Western Australia, as both of the two entangled whales that have been tracked with a telemetry device (for later intervention) had moved far offshore, where they were very unlikely to be reported or responded to. It was suggested that a dedicated scar study might be another way to assess the level of interaction between whales and gear in the region. In response to a question about modifications affecting catches of the target species, it was noted that all changes only impacted the gear retrieval system, and were therefore very unlikely to affect catches, but that this is an important variable to be considered for acceptance of mitigation measures.

Knowlton *et al.* (2015) reported on the effects of fishing rope strength on the severity of large whale entanglements. The authors examined live and dead whales entangled in fishing gear along the US east coast and the Canadian Maritimes from 1994 through 2010. Portions of entangling gear were recovered by the Atlantic Large Whale Disentanglement Network and the US Marine Mammal Stranding Network. These samples were used to determine rope polymer type, breaking strength, and diameter of the recovered gear. Rope characteristics were studied in relation to whale species, age, and injury severity. For the 132 retrieved ropes from 70 cases, tested breaking strength range was 0.80-39.63 kN (mean=11.64 kN, SD 8.29), which was 26% lower than the strength at manufacture (range 2.89-53.38 kN, mean=15.70 kN, SD 9.89). Median rope diameter was 9.5mm. Right and humpback whales were found in ropes with significantly stronger breaking strengths at time of manufacture than minke whales (19.30, 17.13, and 10.47 mean kN, respectively). Adult right whales were found in stronger ropes (mean=34.09 kN) than juvenile right whales (mean=15.33 kN) as well as all humpback whale age classes (mean=17.37 kN). For right whales, injury severity increased since the mid-1980s, possibly due to changes in rope manufacturing in the mid-1990s that resulted in production of stronger ropes at the same diameter. The authors concluded that if the sampled gear is representative of the entanglements, then broad adoption of ropes with breaking strengths of ≤7.56 kN could potentially reduce the number of life-threatening entanglements for large whales by at least 72%, and yet could provide sufficient strength to withstand the routine forces involved in many fishing operations. A reduction of this magnitude would achieve nearly all the mitigation legally required for US stocks of North Atlantic right and humpback whales.

Robbins noted that most of the lines removed from the whales and tested were in 'good' to 'very good' condition and potentially in better condition, and closer to the strength of new line, at the time the entanglement initially occurred. The Working Group welcomed this promising work and **recommended** that ropes with reduced breaking strength should be developed and tested to evaluate efficacy and to determine feasibility of use in a variety of fisheries. The group also noted that a potentially costly switch of all line was not likely to be successfully accomplished by voluntary methods. However, each country could have different schemes for implementing a switch like this if it was warranted. Several members noted that line in other parts of the world may vary, being either lighter (e.g. many UK fisheries) or stronger (e.g. Bering Sea fisheries) than those in the study.

Through the use of case studies, SC/67a/HIM01 summarised mitigation methods that have been undertaken with the objective of reducing cetacean bycatch, and assessed their efficacy and future potential. These included methods for reducing risk of contact between cetaceans and fishing gear, such as effort reduction, fishing bans and gear modifications, together with methods for reducing harm should entanglement occur. The review focussed on specific technical measures but these need to be considered as part of overall strategies involving all stakeholders. There are rather few examples of implemented mitigation measures substantially reducing cetacean bycatch. Enforcement and compliance were identified as key to the success of any measures, and the lack thereof has been one cause of many mitigation programmes' failure to meet their objectives. Generally, mitigating cetacean bycatch has not been viewed as intrinsic to successful fisheries management, but rather as a separate management issue. However, where reductions in bycatch have occurred, a feature of these situations has often been that a systemic change in the fishery itself has resulted in reduced cetacean bycatch, rather than the success of any mitigation measures specifically imposed for cetaceans.

The group thanked the authors for a thorough and helpful review. Long noted some new information related to weak hooks on long lines. Leaper welcomed the feedback and will include this in a revised draft. A. Leslie noted that this review is intended to become a Technical Briefing published by the Convention on Migratory Species. Based on this paper and previous Committee discussions a summary table outlining options for mitigation of large whale entanglement, with simple descriptions and examples, was agreed (see Table 1). The Working Group noted that this table is intended to be of use to the Commission's Bycatch Mitigation Initiative. The Working Group also **agreed** that a similar table covering measures to mitigate bycatch of small cetaceans would be valuable and included this on the work plan for SC/67b. It was also suggested that the Working Group should also list and prioritise recommendations for research into the most promising modifications of fishing practices and/or gear. This was not discussed in detail but attention was drawn to a table produced by the USA's Atlantic Large Whale Take Reduction Team[1]. It was also noted that the report of the Portsmouth Workshop held in 2016 (IWC, 2017) would also include research recommendations related to large whale entanglement prevention. As noted in the discussions of Knowlton *et al.* (2015), further testing involving weaker rope was identified as a high priority.

2.4 Estimation of rates of bycatch, risks of, and mortality for small cetaceans

Anderson (2014) highlights the scope and scale of cetacean bycatch in the Western, Central and Northern Indian Ocean tuna fisheries. Gillnets are the main source of bycatch of cetaceans throughout this region, including in coastal fisheries (Kiszka *et al.*, 2008). Although large-scale drift gillnetting on the high seas (using nets in excess of 2.5km length) is banned by both UN resolution 44/225 and IOTC resolution 12/12, there is evidence that it still occurs on vessels from Iran, Pakistan and possibly other countries. Furthermore, gillnet fleets are believed to be expanding throughout the region (SC/67a/CMP05, SC/67a/CMP12). Around 10% of purse seine sets were previously associated with baleen whales (most likely mainly Bryde's whales), and 30-40% of endangered Arabian Sea humpback whales (*Megaptera novaeangliae*) photographed off the coast of Oman bear scarring consistent with entanglement in fishing gear (Minton *et al.*, 2011).

In light of this information, and also recognising the considerable data gaps concerning cetacean bycatch associated with intensive and extensive gillnet fisheries in the Western, Central and Northern Indian Ocean, the Working Group **recommended** that bycatch in the Western, Central and Northern Indian Ocean be included in the work plan for the 2018 meeting. Through this, the Committee can encourage increased research and data collection efforts to assess and monitor fisheries bycatch of cetaceans in the region, in both industrial (open-ocean) and small-scale (more coastal) fisheries. The Working Group also **recommended** that the Secretary write to the IOTC to offer help and advice from the Committee in efforts to implement cetacean bycatch data collection and reporting protocols.

Ridoux described two recent unusual multiple stranding events of common dolphins that occurred in February-March 2017 along the French Atlantic coast. A total of approximately 800 common dolphins have been reported stranded (dead) from January 1st to March 31st 2017, mostly during two distinct unusual stranding events. Overall, 90% of them have been identified as common dolphins. Bycatch in fisheries was reported to be the primary cause of death given for 119 individuals of the 134 carcasses necropsied before mid-March.

The Working Group noted that this large number of strandings highlighted the need for accurate estimates of bycatch. The Committee has previously concluded that independent observer programs are the best way to estimate bycatch. In 2016 it was agreed that studies on monitoring bycatch through stranding data should complement observer programs and not be seen as potential replacements, and that the approaches together provide a means of ground-truthing each other. The Committee also encouraged papers on the use of strandings data for quantitative estimation of bycatch, including evaluation of different modelling approaches.

No such primary papers were received, but given the information presented by Ridoux on the large numbers of common dolphin strandings in France in early 2017, it was agreed that there was a pressing need to progress an expert evaluation of the bycatch estimates derived from strandings in the Bay of Biscay. It was **agreed** to establish an Expert Group including specialists in interpreting strandings and oceanographers, to provide an independent review. The terms of reference for the Expert Group are as follows.

(1) Review the methodology (i.e. modelling the drift of carcasses) and bycatch estimates in Peltier *et al.* (2016) and compare with any comparable results in the area using observer methodology.
(2) Review any new data provided by the authors of Peltier *et al.* (2016) that are intended for consideration by the Committee in 2018.
(3) Review whether modelling drift of bycaught carcasses can help identify the fisheries involved.
(4) In the light of (3), make recommendations for the design of new or existing observer programmes.
(5) Provide advice to the Committee on general issues (e.g. beyond the specific case of Bay of Biscay) that need to be considered whenever estimates based on strandings are being evaluated.

The Expert Group will need to include people with expertise outside of the Committee. It was proposed that Currey work with the Head of Science, Chair of the Committee and Chair of the Bycatch Mitigation Initiative to identify suitable experts. It is expected that the Expert Group will work remotely including video conferencing. Ridoux noted that the French authorities are also reviewing the situation. This might provide further information relevant to the work of the Expert Group.

2.4.1 Consider scientific aspects of bycatch mitigation measures and prevention

SC/67a/HIM07 estimated that reported bycatch of Hector's and Māui dolphins was 4-5% of actual bycatch, due to very low levels of observer coverage and voluntary reporting by fishermen. Current bycatch is estimated at 32-40 Hector's dolphins per year off the South Island east coast, 42-55 Hector's dolphins per year off the South Island west coast and 2.4-3.8 Māui dolphins per year, substantially exceeding PBR. Observer coverage in Māui dolphin habitat is 14.6% for trawling and 12.7 % for gillnetting vessels > 6m (IWC, 2016). This drops to 2% for all gillnet vessels regardless of size (Ministry for Primary Industries and Department of Conservation New Zealand Government, 2016). Current observer coverage off the east coast South Island is 2-3%. Observer coverage would need to increase to 81-91% to achieve bycatch estimates with a CV of 30%. Government plans for video camera monitoring of all inshore fishing vessels could substantially increase the amount and quality of information on dolphin bycatch. Video monitoring would be feasible in areas where dolphin densities are relatively

[1]*https://www.greateratlantic.fisheries.noaa.gov/protected/whaletrp/docs/Research/gear_research_matrix_2015.pdf.*

Table 1

Summary table of large whale mitigation measures that have been implemented to mitigate large whale bycatch and entanglement.

Measure	Situation to which it might be applied	Implementation process	Selected examples (not comprehensive)	Evaluation
Reducing amount of high risk gear in areas with whales				
Reduce fishing effort with high risk gears across a fishery.	Limits on effort are used in many fisheries management situations to address over capacity and reduce fishing mortality for target species.	A strategic component of fisheries management. Requires better coordination with fisheries management organisations such that effort reductions are prioritised in fisheries which pose a high risk to whales.	Rates of humpback whale entanglement off Newfoundland and Labrador (Canada) showed a clear relationship with fishing effort.	Will reduce risks if part of an overall fisheries management strategy with appropriate monitoring and enforcement.
Long-term or seasonal restrictions to reduce effort with high risk fishing gears in specific areas (e.g. time-area closures).	Any substantial overlap between whale distribution and high risk gears (throughout the year or seasonal).	Implemented by fisheries management organisations at global, regional, national and local levels.	High Seas and European Union (EU) driftnet bans, seasonal closures in New England (USA) trap/pot fisheries.	Only effective for the area and duration to which they apply. Limited efficacy if areas only address a proportion of the overlap between gear and whale distribution.
Reducing amount of line and surface systems in the water in pot/trap fisheries.	Pot/trap fisheries marked with surface floats and with pots/traps linked together by groundline.	Measures taken at local level.	New England vertical line restrictions, sinking ground line and minimising surface floats. Australian western rock lobster fishery. Timed or acoustic release of surface floats to remove vertical line.	Insufficient data from New England (USA) to demonstrate reduced entanglement rates but monitoring ongoing. Humpback whale entanglements in western Australia appear to have reduced.
Reduce gear loss.	Particularly pot/trap fisheries in areas covered by ice or with severe weather or in areas with gear conflicts (mobile gear).	Measures taken at national and local levels. Needs to be incentivised through fisheries management.	Bering Sea-Aleutian Island Crab Rationalization Program (USA).	Mainly relevant for fisheries with high rates of lost gear.
Reduce 'wet storage' of gear.	Fishers sometime leave gear in water even when not actively fishing.	Requirements to lift or attend to gear within a set time. Better coordination between fishers who may be using gear just to preserve their patch.	In the Australian West Coast Rock Lobster fishery, pots must be hauled every seven days.	Limited potential for risk reduction but may be achieved through engagement with fishers.
Gear modification to reduce the risk of whales making contact with gear				
Net sleeves or other devices to protect bait/catch to reduce depredation and associations between whales and long-lines.	Long-line interactions with odontocetes including sperm whales.	Co-operative development of practical systems with fishers who benefit from less interference with target catches.	Chilean Patagonian toothfish demersal long-line fishery.	Effective at reducing entanglement risk if feeding opportunities are removed such that whales are no longer attracted to the long-lines.
Pingers and acoustic alarms.	Attempting to keep whales away from gear e.g. large set nets.	Pinger requirements have been implemented for set net fisheries to reduce small cetacean bycatch.	No data demonstrating effective use. Studies of commercially used devices on migration routes of humpback whales showed no measurable avoidance response.	Although effective in certain circumstances for small cetaceans, no current systems appear effective for large whales.
Coloured or more visible line.	Allowing whales to detect and avoid gear.	Measures taken at national and local levels.	Not yet implemented.	Proof of concept research undertaken thus far that appears promising, but needs further research for low light and other species.
Reducing the risk of severe or fatal injury if contact does occur				
Weak links and reduced line strength allowing whales to break free from entanglement.	Any line that can pose risk of entanglement; links that break at points such as floats or weights which likely to get jammed around a whale.	Measures taken at national and local levels.	Weak links and limits on line strength required on North Atlantic right whale calving grounds off US.	Studies of gear recovered from entangled whales suggests risks could be reduced by limiting line strength.
Disentanglement.	Areas where whales are likely to be observed and suitably trained and motivated people are equipped to respond.	The IWC has held a number of workshops and training sessions for large whale disentanglement.	In South Africa interventions were successful in removing gear from 81% of whales entangled in shark nets off Kwa Zulu-Natal.	Not a prevention measure. Only a small fraction of the entanglements that occur are likely to be successfully disentangled in most areas.

high (e.g. South Island east and west coasts), but not for small populations (e.g. Māui dolphin) because in very small populations (such as Māui dolphin and vaquita) it becomes very difficult to accurately estimate bycatch and population size (Slooten and Dawson, 2016), let alone establish a causal link between protection measures and either increasing population size or decreasing bycatch.

In discussion, Lundquist noted difficulties with stratifying the effort and dolphin density used to determine the bycatch estimates in SC/67a/HIM07 because of protected areas with fishing restrictions. This could introduce bias resulting in an overestimate of bycatch rates. Ministry for Primary Industries in New Zealand (MPI) is currently conducting a spatially explicit risk assessment, which should address these concerns. He also noted that MPI are investigating how best to implement video monitoring and would welcome advice from the Committee. Slooten noted that she did not believe there was any reason to expect the bycatch estimates in SC/67a/HIM07 to be over-estimates. She also noted that quantitative targets for precision and bias of bycatch estimates would be useful in designing the video monitoring programme. She also suggested that observers would still be needed to estimate drop out and ground truth the video data (e.g. proportion released alive). ASCOBANS held a workshop on remote electronic monitoring in 2015 which noted the relatively rare occurrence of cetacean bycatch and recommended that all of the collected video footage be viewed rather than just shorter samples which are used for other fisheries monitoring purposes (ASCOBANS, 2015).

In 2016, the Committee made a number of recommendations related to Māui dolphins including that existing management measures in relation to bycatch mitigation fall short of what has been recommended previously and expressed continued grave concern over the status of this small, severely depleted subspecies.

SC/67a/HIM12 suggests that currently less than 30% of Māui habitat is protected from set nets and only 8% is protected from both set net and trawl threats. Gear switching from set net and trawl to longlining has been identified as one potential alternative to reduce the impact of fisheries on this dolphin population. Between 2002 and 2014 there were over 1,800,000 observed bottom longline hooks set in the Northland and Hauraki Gulf area and zero dolphin bycatch events were reported (Dragonfly, 2017a). During the same period, over 500 thousand surface longline hooks were observed, with only one dolphin capture (not death) reported (Dragonfly, 2017b). In addition to data on fishing effort, SC/67a/HIM12 also contained an economic analysis investigating the costs of transitioning away from commercial set netting and trawling within Māui habitat. The key finding was that by financially enabling set net and trawl fishers to switch to longlining, a higher proportion of fishers could remain fishing. The fishing industry is taking proactive steps towards transition and two of the largest fishing industry representatives have committed to transitioning between 40-50% of their fleet to alternative gears.

The discussion focussed on the risk reduction that might be achieved by switching to long lines. It was noted that an important risk statistic is the relative risk for the same catch of the target fish species. To evaluate this it would be useful to know the number of hooks that might be needed to be set to catch the equivalent of the current catch using set nets and trawls. Trials in the German Baltic Sea using automatic long lines as alternatives to set nets had resulted in lower catches but might still represent a viable fishing method. Lundquist noted that the reported bycatch of dolphins from long lines in New Zealand this year had been six events, five in surface long-line, and one in bottom long-line. The species involved were: three common dolphins, one bottlenose dolphin, two unidentified dolphins which were likely common or bottlenose based on the reported locations, which were well away from Hector's/Māui and dusky dolphin habitat. It is not known whether these involved animals that were hooked (suggesting depredation) or that were entangled.

The Working Group **agreed** that the evidence presented suggests that longlines are a potential alternative to reduce risk from the set nets and trawling currently associated with bycatch of Māui dolphin. Government support is required to develop and implement such alternatives and assess any associated impacts on target catch or other marine species.

SC/67a/SM20 described vaquita bycatch in multiple gear types from the mid-1980s to the early 1990s. These observations were possible because the population and bycatch reporting rates were much greater during that period than the present day.

In discussion, it was noted that even though no bycatch had been observed in 900 ghost gillnets that had been recovered, this does not mean that those nets did not pose a threat to the population. For a population at such small numbers (see Annex M, item 17.5) it is not surprising that no bycatch had been observed in the recovered gear.

2.5 Recommendations related to membership of the FAO Coordinating Working Party on Fisheries Statistics

IWC is a member of the FAO Coordinating Working Party on Fisheries Statistics (CWP). No one from IWC has attended CWP meetings for a number of years and the Secretariat had been asked by FAO if IWC wished to remain a member of this group. It was noted that recent reports of CWP meetings did not show any activities related to cetacean bycatch. The CWP handbook (*http://www.fao.org/fishery/cwp/en*) does provide useful information on definitions to describe fisheries including for fishing effort and fishing gears. The Working Group **agreed** that it would be useful to use these definitions wherever possible (National Progress reports already use FAO codes for gear types) but also **agreed** that there was no need, for the purposes of the Working Group, for IWC to remain a member of the CWP. However, the Working Group encouraged continued IWC engagement with FAO, including COFI.

2.6 Other

Reeves presented Williams *et al.* (2016) which evaluated a new rule requiring countries exporting seafood to the United States to demonstrate that their fisheries comply with the US Marine Mammal Protection Act (MMPA). The MMPA mandates periodic estimation of marine mammal population sizes (and uncertainty) to set PBR, monitoring of bycatch rates, and implementation of mitigation measures, such as gear modifications or fishery closures when PBR is exceeded. This has resulted in improvements in the status of cetacean populations, including Eastern Tropical Pacific dolphins and harbour porpoises. Countries will be given a (maximum) five-year grace period to achieve and document compliance before import restrictions come into force. The new regulations present opportunities but also risks to addressing cetacean bycatch effectively in different countries.

It was noted that one of the risks relevant to the Working Group is the potential for unintended consequences including reduced reporting. In some situations, introduction of penalties for fisheries with cetacean bycatch appear to have caused reporting rates to drop. Another potential risk is that fisheries with a high cetacean bycatch may simply switch markets. The Working Group **recommended** that updates on the implementation of the rule (from the United States or other countries that are affected), be provided for future meetings.

3. SHIP STRIKES

3.1 Review estimates of rates of ship strikes, risk of ship strikes and mortality

The Working Group briefly considered SC/67a/HIM05. This paper used an encounter model to estimate the relative spatial distribution of strike risk and estimate ship strike mortality for blue, humpback and fin whales in the US West Coast Exclusive Economic Zone (EEZ). The spatial distribution of risk showed high risk areas along the southern half of California, extending offshore where major trans-Pacific routes occur indicating the majority of strike risk could be addressed with measures that affect only 10% of the EEZ.

The Working Group noted that the authors had made a number of assumptions to develop total estimates of ship strike mortality from predicted encounter rates. This is a topic that the Committee has been considering for a number of years and has not been able to develop any appropriate factors to incorporate avoidance response by the whale. In the absence of the authors to discuss some of the parameters and assumptions it was agreed to consider the paper again in 2018 if the authors were able to be present.

Hill *et al.* (In Print) described a study of vessel collision injuries on live North Atlantic humpback whales in the southern Gulf of Maine. The research was based on 624 individuals that were photographed from commercial whale watch and research vessels from 2004 through 2013. Multiple reviewers evaluated 210,733 photos for five categories of injury consistent with a vessel strike. Injury severity, state of healing and timing of acquisition were examined, as were the sex and age class of the individual. The resulting documentation and assessments were most complete for dorsal body regions and the ventral fluke. In total, 14.7% (n=92) of individuals exhibited injuries consistent with one or more vessel strikes. Among dorsal areas, the flanks and peduncle were preferentially affected. When the age class at acquisition was known, the majority were adults (55%, n=31), including mothers with dependent calves. Of the injuries documented, 29% (n=44) involved propeller evidence, and most were only known to penetrate the skin (29%, n=43) or into the blubber (66%, n=98). Ten percent (n=15) of injuries were fresh at first observation, and 29% (n=43) were in the process of healing, including one that was not considered fully healed until two years later. These results likely underestimate vessel collision rates and impacts because multiple events, events resulting in acute mortality, and those that involved only blunt force trauma could not necessarily be detected. There was only one vessel strike formally reported in the area during the study period, and so these results also indicate that events are underreported. The authors recommend that a management strategy be developed for all classes of vessels transiting in the vicinity of whales.

The group welcomed this paper as it represents the first published attempt to undertake this type of analysis for humpback whales, and they commended the authors for not only obtaining the extensive photographic coverage over the nine years, but also for the detailed analysis. Robbins noted that much of the coverage was due to the participation of data collectors aboard whale watch vessels in the region. With visible wounds it was hard to determine the depth of wounds, and so the authors used the qualitative approach (i.e. skin, blubber, muscle). It was suggested that although gauging the depth might be difficult, perhaps the spacing between the propeller wounds might help to determine the size of the colliding vessel. Rowles noted that this method of visually scoring trauma will inherently have a very difficult time determining blunt trauma. The Working Group **recommended** that a careful examination of stranded carcasses and comparison with catalogues of images, that might include the stranded animal pre-mortem, would be valuable, and in some cases might assist the determination of blunt force trauma. Robbins noted that, while several individuals had large portions of the fluke missing, there were not any in this study that had completely lost one side of the fluke. However, several such cases have been documented throughout the years in the study area.

The dynamics of collisions between large ships and large whales was explored in SC/67a/HIM16, taking into account the flexible nature of whale bodies. Although there is a considerable literature on injuries to humans from traffic and other collisions, the physical parameters that determine impact injuries each scale differently with body size, which makes extrapolation to animals as large as whales difficult. A simple equation of motion was derived for flexible bodies and applied to simulated whale-ship collisions. Side-on, glancing and 'snagging' collisions were considered, depending on the orientation of whale relative to the trackline and the point of impact relative to the whale's centre of mass. An exploratory analysis assuming a body size and mass typical of a fin whale suggests that only at high vessel speeds or with side-on collisions would the impact energy be in the range required to cause death by blunt trauma. However even at moderate speeds the collision can impose a lateral bending moment on the whale's spine sufficient to cause serious or catastrophic spinal injury, but not necessarily near the point of impact. The model predicts that snagged whales will tend to slide and rotate into a side-on position across the bow, with a high bending moment maintained for several seconds. Spinal injury that is not immediately fatal may compromise the motility of the whale and render it incapable of feeding, leading to death from malnutrition over time. Carcasses from such delayed deaths may not be readily recognised as ship strike mortalities.

The group welcomed this study as an advancement of the effort to model the dynamics of whale and vessel collisions that could help refine understanding of the relationship between speed and lethal impacts. It was noted that the results could help with advice on identifying whether a ship strike had occurred. The group also **agreed** that some sightings of animals in poor body condition, but with no obviously compromising external trauma, could have been compromised by internal injuries that hinder their mobility enough to impact their health. Depending on the vessel size, this type of not-immediate lethal injury would be more likely to occur with vessels traveling at moderate speeds. In response to questions about data gaps and how to fill them, it was noted that human cadavers have been used to test the body's resilience to various forces, and therefore perhaps whale carcasses could be as well, in order to assist with improving the models. Leaper noted that there had been reports from whale watch operators of blue whales off southern Sri Lanka that were unable to swim effectively but showed no other signs of injury. The results of SC/67a/

HIM16 would be consistent with such animals having been struck by a ship and could help investigation of similar cases in the future. The group **recommended** that the work continue, and that the author discuss with relevant stranding coordinators, what type of data could be collected to help improve the models.

Galletti Vernazzani reported on a new case of a dead blue whale by ship collision in Southern Chile. On 22/02/2017, a dead blue whale was reported at Estero Mena, southern Chile, and the condition of the carcass was good (fresh) and not bloated. Fundacion Meri attended the stranding on 6th March and confirmed it was a female blue whale with a total estimated length of 12m (not including the tail). The carcass had at least four clear propeller cuts on the peduncle and the entire tail was missing. The cuts look closely spaced, and thus they probably do not correspond to a large vessel. This recent event represents the third confirmed case of a dead baleen whale from ship collision in this area. The first confirmed case corresponded to a female sei whale in 2009 (Brownell *et al.*, 2009) and the second was a male blue whale in 2014 (Brownell *et al.*, 2014). Southern Chile is an important feeding area for blue whales and other baleen whales. The reported cases of baleen whales from ship strikes in the area raises concerns about this threat and highlights the need to take immediate actions to reduce risk of ship strike with whales.

In discussion, members wondered if, with access to the best images, the size of the vessel might be estimated from the spacing between propeller cuts. In addition, the possibility that the toxins of a Harmful Algal Bloom (HAB) might influence an animal's ability to manoeuvre to avoid an oncoming ship was also mentioned. Galletti indicated that Redfern would be assisting with modelling whale and shipping distribution in the area, which might allow high risk portions of the habitat to be identified. The Working Group **recommended** that this work to identify high risk zones be undertaken, so that possible mitigation options might be evaluated.

3.1.1 Review progress on global ship strike database

Ritter presented an update on the work conducted by the ship strike data coordinators work in the past year (SC/67a/HIM08). General inquiries about the database were followed up and advice was given wherever possible. New incidents of collisions were searched for on the internet, in the news, in relevant Facebook groups, cetacean related emails lists, and in the scientific literature. Where necessary, additional information was solicited and authors were invited to make use of the database. Thirty-five new reports were received, with a total of around 1,200 reports now being hold in the database. Most of these new records came from scientists and the general public, indicating the database is being used increasingly. A close connection was held with ASCOBANS and ACCOBAMS and relevant meetings were attended. In terms of outreach, the IWC information banner, the ship strike leaflet and the Power Point presentation were utilised, the latter being presented on different occasions in Belgium and Germany. During an Antarctic cruise, a briefing on ship strikes was given to the ship crew and substantive information material was provided. Together with the Secretariat, the coordinators were in contact with various maritime and nongovernmental organisations. A magazine article was published in cooperation with Sailors for the Sea. The focus of the data coordinators, however, was data review. 112 existing reports in the database were reviewed in detail (spanning from most recent cases back to 2008), the majority of which were categorised according to the agreed criteria. In a number of cases, supplementary information was solicited; all other reports needing review were forwarded to the Data Review Group (DRG). Open issues remaining include: (a) the fact that collision incidents identified by the coordinators need to be entered into the database; and (b) the development of a tool to bulk uploads into the database.

The group welcomed this summary of the work and **recommended** that it continue according to the work plan agreed in 2016. In discussion it was noted that the hundreds of records, which still need to be bulk uploaded, will also need to be reviewed by the coordinators and, if needed, by the Data Review Group (DRG). However, Panigada noted that, with recent input from the DRG and suggestions for new 'reminders' during web entry, the review process is still improving, and should be less time consuming in the future. Some new members were appointed to the DRG (see Annex W) which will continue to work with the same terms of reference.

It was noted that most, but not all, of the identified ship strikes reported in SC/67a/HIM06, were included in the USA ship strike database, and would be uploaded to the IWC global database with the rest of the USA data. The Working Group requested Scordino to work with the database coordinators to identify and enter any reports that may not be in the USA database into the IWC database.

3.2 Mitigation of ship strikes in high risk areas

3.2.1 Review progress towards assessing and mitigating ship strikes in previously identified high risk areas

SC/67a/HIM11 notes that large dead whales have been recorded from the Sri Lankan coast since 1832 (Blyth, 1859). Between 1889 and 2004, there were records of 67 large whales stranded around Sri Lanka (Ilangakoon, 2002; 2006). Additional records for 54 large whales that stranded in the region over the next ten years (2005-14) were compiled creating a new total of 121 individuals (38 blue whales, *Balaenoptera musculus*; 5 Bryde's whales, *B. edeni*; 2 humpback whales, *Megaptera novaeangliae*; 33 sperm whales, *Physeter macrocephalus*, 28 unidentified baleen whales, and 15 unidentified large whales). The larger number of records over the more recent 10-year period reflects better reporting. The first two large whales that were confirmed deaths from ship strikes were in July 2002 and November 2003. It was not possible to determine the cause of death for any stranded individual before 2002, except for one humpback whale entangled in fishing gear in 1981. The authors could only determine the cause of death for two of the 54 strandings after 2004 and both were ship strikes. There were 12 additional deaths that were reported as ship strikes but these could not be confirmed due to the limited available details. However, the true number of whales killed from vessel strikes must be much greater than the confirmed number. Stranded individuals reported by Ilangakoon (2002) as either fin, *B. physalus* (9) or minke whales, *B. acutorostrata* (8) before 2005 were misidentified. The reported fin whales were most likely blue or Bryde's whales and the reported minke whales were likely Bryde's whales, or perhaps Omura's whales, *B. omurai*. There are no confirmed records of fin, sei, *B. borealis*, or minke whales from Sri Lankan waters, nor from the Northern Indian Ocean (Arabian Sea).

Brownell indicated that this review of historical information was undertaken because of recent concern expressed by the Scientific Committee about ship strikes in this region. Indeed in all cases where cause of death was known, it was due to ship strike, however the vast majority of the cases reviewed had very little information and so cause of death could not be determined. It was not clear if a stranding network currently operates in the area, and therefore whether documented increases were due to increases in strike fatalities or increased reporting

The goal of Redfern *et al.* (2017) was to develop methods for predicting cetacean distributions in data poor ecosystems. Blue whales (*Balaenoptera musculus*) were used as a case study because they are an example of a species that have well-defined habitat and are subject to anthropogenic threats. Models were based on 377 sightings of one or more blue whales from approximately 225,400km of effort during surveys conducted by NOAA Fisheries' Southwest Fisheries Science Center from August through November (California Current: 1991, 1993, 1996, 2001, 2005, 2008, and 2009; eastern tropical Pacific: 1998, 1999, 2000, 2003, and 2006). Blue whale data in the northern Indian Ocean (NIO) study area (defined as north of the equator) are extremely limited. Large scale blue whale distribution models cannot be built using the NIO data because of their limited spatial and temporal resolution. Models using the combined California Current (CC) and eastern tropical Pacific (ETP) data were used to predict blue whale distributions in the NIO because of the potential similarity of blue whale ecology in both regions. The accuracy of models built with combined CC and ETP data was similar to the accuracy of ecosystem-specific models in both eastern Pacific ecosystems. The predictions of blue whale habitat in the NIO from these models compare favourably to hypotheses about NIO blue whale distributions, provide new insights into blue whale habitat, and can be used to prioritise research and monitoring efforts.

The authors noted that they were now in a position to explore the potential for using these models to assess ship-strike risk in the NIO. In 2016 the Committee had agreed that the results previously presented from this study on large scale distribution patterns together with those of Priyadarshana *et al.* (2016), covering a smaller area, were sufficiently consistent to support a proposal to IMO to move the shipping lanes off the southern coast of Sri Lanka, should Sri Lanka so wish.

The Working Group **agreed** that the results presented would allow the Committee to provide advice on the relative risks of different routing options south of Sri Lanka. This type of analyses had been discussed during the most recent IWC convened ship strike Workshop (IWC, 2016) and further recommended at SC/66a. The Working Group also noted that this approach could be advanced in a number of possible ways and extended to multispecies modelling as well as expanded to other regions. In particular, telemetry data could assist in developing models of habitat use. In response to a query about this type of modelling approach in a time of relatively rapid climate change, it was noted that the information derived is useful over timescales relevant to managing shipping threats (such as routeing measures), but that models could also potentially include further relevant variables associated with climate change to make longer term predictions.

SC/67a/HIM03 describes using Automatic Identification System (AIS) data provided by Global Fishing Watch to reconstruct the track of a container vessel which docked in Colombo, Sri Lanka. The vessel arrived from Chennai, South India having travelled along the southeast coast of India and east coast of Sri Lanka prior to turning west along the southern coast and north along the west coast of Sri Lanka where it docked. After it docked, a dead blue whale (*Balaenoptera musculus*) with an estimated total length of 18m was discovered wrapped over the bulbous bow. This incident was reviewed by the Committee in 2013 (De Vos *et al.*, 2013). SC/67a/HIM03 provided further information on the track and speed of the vessel.

Although in the case of the incident described in SC/67a/HIM03 it had not been possible to match a change in vessel speed with the location of the ship strike, it was noted that the Committee had previously considered the potential for 'forensic' use of AIS data (IWC, 2014). AIS data is transmitted with a duty cycle of a few minutes but in the case of SC/67a/HIM03 the time interval between satellite passes meant that there were gaps of several hours in received signals.

Leaper noted that AIS data was being increasingly used within the Committee for a range of applications but that many researchers had found difficulty in obtaining data. There are several commercial providers who may be willing to provide data for conservation related purposed. For some of the studies previously considered by the Committee, Marine Traffic (*http://www.marinetraffic.com*) had generously provided data. However, providers may not wish to have to deal with large numbers of different requests. The Working Group **agreed** that IWC could play a valuable role in coordinating data requests for work which was intended to be considered by the Committee. It recommended that the Secretariat and HIM Convenor explore possibilities for developing a memorandum of understanding between IWC and a data provider. IWC could then pass on data requests in a standardised format which would minimise the work for the data provider. The data provider would then only have to deal with one organisation and may be pleased to be able to say that they have a relationship with IWC. It was suggested that IWC might maintain its own AIS database but this would have substantial cost and workload implications. However, if IWC was coordinating data requests then any data that was provided could be archived along with the request specification, for future use.

3.2.2 Consideration of methods to identify 'high risk' areas

In 2013, the International Union for Conservation of Nature (IUCN) established a Task Force (TF) on Marine Mammal Protected Areas (MMPA). This group grew out of the International Committee on Marine Mammal Protected Areas, which was established in 2006, and which has reported on its activities to the IWC since 2009. As its first major initiative the IUCN MMPA TF began an effort to develop criteria for identifying Important Marine Mammal Areas (IMMAs) through a consistent expert process, independent of any political and socio-economic concerns, to provide input of information regarding 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 also assists in providing strategic direction and priorities to the development of spatially explicit marine mammal conservation measures.

Notarbartolo di Sciara, co-chair of the MMPA TF, presented an overview of the IMMA process, and the results of the TF's first regional workshops to identify IMMAs in the Mediterranean Sea (SC/67a/HIM15) and in the Pacific Islands region. He briefly explained that the process of IMMA identification is articulated into successive regional expert workshops tasked to assess the scientific validity of 'Areas of Interest' previously proposed to the workshop for consideration. Regional workshops submit candidate IMMAs (cIMMAs) to subsequent review by an independent panel. Future workshops are being planned in the North-East Indian Ocean (2018), West Indian Ocean (2019), waters adjacent to Australia and New Zealand (2020), and East Pacific Ocean off Latina America (2021).

An overview of the IMMA criteria and process can be found online[2].

The working group thanked Notarbartolo for taking time to present on this important IUCN initiative, which has the potential to assist the work of the IWC. It was noted that the IMMA process is purely scientific, only looking at the biology and ecology of the marine mammals, and therefore it does not consider threats in the process. Any use for management (e.g. spatial planning, regulatory designation) would come later if warranted. However, it was noted that one candidate IMMA in the Mediterranean coincided with an existing high risk area for ship strikes in the Hellenic Trench where the Committee had considered routing measures. The current mechanism for using IMMAs to inform management would be through the work of regional IMMA groups, whose core make up comes from key experts who participated in the regional workshop that identified the candidate IMMAs. It is recommended that those regional groups then initiate engagement with the relevant local, or in some cases international, management bodies for those IMMAs that might need management of particular threats. It was noted that, in addition to their potential relevance to ship strikes (e.g. through voyage planning or speed reduction), managers might consider using them in co-occurrence analyses with fishing, noise (e.g. soundscape) or other spatial threats.

In response to a question about the recent Mediterranean Workshop, only the waters of Libya, Syria and Egypt did not produce identified candidate IMMAs, but this was likely due to data deficiency. The group discussed the use of historical data (e.g. whaling data), especially for those areas with little current information. A small intersessional group agreed to review historical data sources, and recommend their appropriate use in the process.

Both the IWC Scientific Committee and the Commission's standing working group on ship strikes have recognised that the IMMA process may be of value to the work of the Committee in several ways, but most immediately in assisting to identify potential 'high risk' areas for ship strikes. Following the SSWG strategic plan, the Working Group **recommended** to continue with the effort on identifying IMMAs, and suggested that a joint IWC-IUCN TF group be formed and charged with identifying those IMMAs which should be taken forward to the IMO, perhaps starting with the Mediterranean Sea. It also suggested that a small group work with the IUCN MMPA TF intersessionally in order to provide advice on the most appropriate use of the IWC's (and other) historical datasets in the IMMA consideration process.

3.3 Co-operation with IMO Secretariat and relevant IMO committees

SC/67a/HIM09 reviewed developments in the marine mammal avoidance provision of the Polar Code, along with a general review of available information on collection of data and mechanisms to convey these data to ships masters. The review highlighted the possible impacts of Polar shipping, and the context for the creation of the Polar Code, in particular a provision in Chapter 11 which calls on Masters to note current information on marine mammals densities and migratory routes, any known recommendations and measures that could be taken in the event of an encounter (IMO, 2014). The authors then reviewed available sources of information on marine mammal densities, noting its fragmentation across agencies, nations, NGOs, and intergovernmental organisations. SC/67a/HIM09 also highlighted the prospect of incorporating traditional ecological knowledge in implementation. This information could then be relayed to masters through notices to mariners, electronic navigation charts, pre-voyage planning documents, mariners guides, maps published by NGOs to highlight at risk cetaceans, apps like WhaleAlert, AIS communication, and in the event of effective collation, risk assessment tools.

The Working Group welcomed the information provided in SC/67a/HIM09. It **recommended** that information on known cetacean densities and migratory routes in the Arctic and Southern Ocean, including appropriate models of distribution patterns, should be compiled and reviewed by the Committee and made available in an appropriate form to assist the Polar states, IMO, and Arctic Council in the implementation of the IMO Polar Code's marine mammal avoidance provision. The Working Group recognised that this is a substantial task and **agree**d to include consideration of what can be made available in the work plan, including encouraging relevant papers in 2018.

The Working Group further **recommends** that information regarding cetaceans in the Western Arctic and Bering Strait migratory routes should also be integrated with the Arctic Waterways Safety Committee (AWSC) in order to support its development of traffic mitigation measures in those waters.

4. REVIEW SOURCES OF INFORMATION THAT WILL INFORM TIME SERIES ON ENTANGLEMENT AND SHIP STRIKE AFFECTING LARGE WHALE POPULATIONS

The Working Group reviewed Table 2, which assessed the available sources of data for 57 large whale populations to classify: (i) risk of ship strikes and entanglement; and (ii) reports of ship strikes and entanglements including time series where these are available. The Working Group thanked Double and the intersessional group for their work on this and noted that information was still being sought from regional experts to fill some data gaps within this table which would be reviewed again in the light of any new information.

5. OTHER

Rosenbaum provided a description of a cooperative effort, between a number of NGOs, IGOs and UN member countries, to bring issues of shipping and cetaceans, primarily noise and ship strikes, to the attention of the UN. A more detailed description was provided to the Environmental concerns sub-committee. In brief, the initial action is to bring a 'Call for Action' to the UN Ocean Conference (June, 2017), that would help to generate Voluntary Commitments that help to achieve the UN's Sustainable Development Goal 14 (SDG 14). SDG 14 reads as follows 'Conserve and sustainably use the oceans, seas, and marine resources for sustainable development'.

The group welcomed this effort, and discussed the best way for the IWC's ship strike work to complement it. While the Committee might be helpful in the future by providing

[2]*https://www.marinemammalhabitat.org/download/imma-guidance-document-october-2016/.*

Table 2

Available sources of data.

Entry	Species	Population	Time series - entanglement data?	Structured/ comprehensive entanglement reporting?	Overlap with high risk fisheries	Evidence of substantial entanglement numbers	Entanglement data sources	Time series - vessel strike data?	Structured/ comprehensive vessel strike reporting?	Overlap with high density of shipping	Evidence of substantial vessel strike incidents	Vessel strike data sources	Notes	Record entered by	Last up-dated
1	Bowhead whale	Bering-Chukchi-Beaufort Sea	Yes	Yes	Medium	Yes	NOAA, NSB publications	Yes	Some records	Medium	No	NOAA, NSB	Spatial overlap with Bering Sea crabbing; little temporal overlap; shipping through Bering Strait likely increasing	Craig George, David Matilla	2017
2	Bowhead whale	Okhotsk Sea	-	-	-	-	-	-	-	-	-	-	-	-	2016
3	Bowhead whale	Svalbard-Barents Sea	-	-	-	-	-	-	-	-	-	-	-	-	2016
4	NA right whale	-	Yes	Yes	Yes	Yes	NOAA, NEAq	Yes	Yes	High	Yes	NOAA	-	David Mattila	2016
5	Northern Pacific right whale	-	No	Some records	Yes	Don't know	NOAA, Russia	-	-	-	-	-	-	-	2016
6	Southern right whale	Western South Atlantic	-	-	-	-	-	-	-	Medium	-	CCC	One documented ship strike, Strait of Magellan, probable from western South Atlantic Population reported on Chile Voluntary Conservation report (IWC/62/CC15)	Barbara Galletti	2016
7	Southern right whale	Eastern South Pacific	No	Not comprehensive	Yes	Don't know	CCC, Sernapesca	-	-	-	-	-	One whale reported in October 2014 entangled. Reported to IWC Galetti-Vernazzani (2015).	Barbara Galletti	2016
8	Southern right whale	Australia	Yes	Not comprehensive	Yes	No	-	Yes	-	Medium	No	-	-	Mike Double	2016
9	Southern right whale	Southern Africa	Yes	Not comprehensive	Medium	No	SAWDN	Yes	Not comprehensive	Medium	No	SAWDN/ DEA	-	Mike Meyer	2017
10	Southern right whale	New Zealand	No	Some records	Low	No	DOC	No	No	Low	No	DOC	Low incidence of SRW around mainland NZ means low overlap with fisheries or shipping. Entanglement records will be included in DOC marine mammal incidents database, but unlikely to be comprehensive or easily identified.	Dave Lundquist	2017
11	Pygmy right whale	-	-	-	-	-	-	-	-	-	-	-	-		2016
12	Gray whale	Western North Pacific	No	Not comprehensive	Medium	Yes	NOAA	No	Not comprehensive	Medium	No	NOAA	Scarring analysis from Bradford *et al.* (2009); shipping information unclear.	Kristy Long	2016
13	Gray whale	E North Pacific	Yes	Not comprehensive	Yes	Don't know	NOAA, UABCS	Yes	Not comprehensive	High	No	NOAA	-	Kristy Long	2016
14	Humpback whale	SH Oceania	No	Some records	Low	No	DOC, SPWRC	No	Not comprehensive	Low	No	DOC, SPWRC	Low level of entanglement in pot fisheries in New Zealand. Entanglement records will be included in DOC marine mammal incidents database, but unlikely to be compre-hensive or easily identified.	David Mattila, Dave Lundquist	2017

Entry	Species	Population	Time series - entanglement data?	Structured/ comprehensive entanglement reporting?	Overlap with high risk fisheries	Evidence of substantial entanglement numbers	Entanglement data sources	Time series - vessel strike data?	Structured/ comprehensive vessel strike reporting?	Overlap with high density of shipping	Evidence of substantial vessel strike incidents	Vessel strike data sources	Notes	Record entered by	Last up-dated
15	Humpback whale	SH East Australia	Yes	Not comprehensive	No	No	State agencies, progress reports	Yes	Some records	High	No	Progress rep-ort, Peel *et al*.	-	Mike Double	2016
16	Humpback whale	SH West Australia	Yes	Not comprehensive	Yes	Yes	WA entanglement database	Yes	Some records	Medium	No	Progress rep-ort, Peel *et al*.	-	Mike Double	2016
17	Humpback whale	SH East Africa	Yes	Not comprehensive	Yes	Yes	SA DOC,	-	-	-	-	-	-	-	2016
18	Humpback whale	SH West Africa	Yes	Not comprehensive	High	Yes	SAWDN	Yes	Not comprehensive	High	Yes	SAWDN/ DEA	-	Mike Meyer	2017
19	Humpback whale	SH Eastern South America	Yes	Some records	Yes	Yes	ICMBIO	Don't know	Some records	Medium	Don't know	ICMBIO	-	David Mattila	2017
20	Humpback whale	SH Western South America	Yes	Not comprehensive	Yes	Yes	IMARPE, CPPS, ARAP, Sernapesca	Don't know	Some records	High	Don't know	CPPS, ARAP, Sernapesca	Time series from Ecuador	David Mattila	2017
21	Humpback whale	Western North Atlantic	Yes	Yes	Yes	Yes	NOAA, DFO,	Yes	Not comprehensive	Medium	No	NOAA	-	David Mattila and Kristy Long	2016
22	Humpback whale	Greenland	Don't know	Not comprehensive	Yes	Yes	Greenland Fisheries, MFH	-	-	-	-	-	-	David Mattila	2016
23	Humpback whale	North Pacific	Yes	Yes	Yes	Yes	NOAA, DFO, CRI, RABEN	Yes	Some records	Medium	No	NOAA	Summary of mortalities from US Stock Assess-ment Reports available	David Mattila, Kristy Long and Phil Clapham	2017
24	Humpback whale	Arabian Sea	Don't know	Not comprehensive	Yes	Yes	MECA, ASWN	-	-	-	-	-	Ask Rob Baldwin and Andy Willson for info on this population	David Mattila	2016
25	Common minke	Western North Pacific	-	-	-	-	-	-	-	-	-	-	-	-	2016
26	Common minke	SoJ/East Sea	Yes	Yes	Yes	Yes	CRI, NRIFSF	-	-	-	-	-	-	-	2016
27	Common minke	North Eastern Atlantic	-	Not comprehensive	Low	Some records	UK CSIP	-	Not comprehensive	Medium	Some records	UK CSIP	Has been considered in the context of *Implementation Review*	Russell Leaper	2016
28	Common minke	Central Atlantic	-	-	-	-	-	-	-	-	-	-	-	-	2016
29	Common minke	West Greenland	-	-	-	-	-	-	-	-	-	-	-	-	2016
30	Dwarf minke	-	-	-	-	-	-	-	-	-	-	-	-	-	2016
31	Antarctic minke	-	No	No records	No	No	-	No	No records	Low	No	-	-	Mike Double	2016
32	Bryde's whale	Western North Pacific	No	No records	Low	No	-	No	No records	Low	No	-	This is for the IWC-POW-ER survey observations in Central North Pacific area	Koji Matsuoka	2017
33	Bryde's whale	Eastern North Pacific	-	-	-	-	-	-	-	-	-	-	-	-	2016
34	Bryde's whale	Indian Ocean	No	Not comprehensive	High	-	MECA, ASWN	No	-	-	-		Check with Aida Al Jabri, Baldwin and Wilson	David Matttila	2017
35	Bryde's whale	North Atlantic	No	No records	Low	No	NOAA	No	Some records	Low	No	NOAA	This is for the Northern Gulf of Mexico area	Kristy Long	2016
36	Bryde's whale	Southern Hemisphere	No	Some records	Low	No	SAWDN	No	Some records	Low	No	SAWDN/ DEA	-	Mike Meyer	2017
37	Bryde's whale	New Zealand	No	Some records	Low	No	DOC	Yes	Yes	High	Yes	U of Auckland, DOC	Check with R. Constantine for ship strike records; voluntary protocol in place to reduce speeds and thereby risk of lethal ship strike. Entanglement records will be included in DOC marine mammal incidents database, but unlikely to be comprehensive or easily identified	Dave Lundquist	2017
38	Omura's whale	-	-	-	-	-	-	-	-	-	-	-	-	-	2016

Entry	Species	Population	Time series - entanglement data?	Structured/ comprehensive entanglement reporting?	Overlap with high risk fisheries	Evidence of substantial entanglement numbers	Entanglement data sources	Time series - vessel strike data?	Structured/ comprehensive vessel strike reporting?	Overlap with high density of shipping	Evidence of substantial vessel strike incidents	Vessel strike data sources	Notes	Record entered by	Last up-dated
39	Sei whale	North Atlantic	No	No records	Low	No	NOAA	No	Some records	Medium	No	NOAA	-	Kristy Long	2016
40	Sei whale	North Pacific	No	No records	Low	No	-	No	No records	Low	No	-	This is for the IWC-POWER survey observations in Central North Pacific area	Koji Matsuoka	2017
41	Sei whale	Indian Ocean	-	-	-	-	-	-	-	-	-	-	-	-	2016
42	Sei whale	Southern Hemisphere	-	-	-	-	-	No	Not comprehensive	Medium	No	CCC	One dead whale on bow of cruise ship reported in Brownell *et al.* (2009)	Barbara Galletti	2016
43	Fin whale	E Greenland to Faroes	-	No records	Low	No	-	-	Some records	Medium	Yes	IWC SS database	Whales found on the bows of vessels reported to IWC SC. Has been considered in the context of *Implementation Review*.	Russell Leaper	2016
44	Fin whale	W Greenland	-	-	-	-	-	-	-	-	-		-	-	2016
45	Fin whale	Mediterranean	No	No records	No	No	-	Yes	Yes	High	No	National stranding networks, ferry captains, NGOs, ACCOBAMS, Pelagos	-	Simone Panigada	2016
46	Fin whale	Southern Hemisphere	-	-	-	-	-	-	-	-	-	-	-	-	2016
47	Antarctic blue whale	-	-	-	-	-	-	-	-	-	-	-	-	-	2016
48	Pygmy blue whale	Indian Ocean	No	Some records	Medium	Don't know	SC/66b/SH34	No	Some records	High	Yes	-	Some records in de Vos *et al.* (2013). Risk analysis in Priyadarshana *et al.* (2015)	Russell Leaper	2016
49	Pygmy blue whale	Chilean	-	-	-	-	-	No	Not comprehensive	Medium	No	CCC	One dead whale struck by cruise ship reported in Brownell *et al.* (2014)	Barbara Galletti	2016
50	Pygmy blue whale	Indo-Australian	No	Some records	Low	No	WA entanglement database, Australia progress reports	No	Some records	Low	No	Australia progress reports	-	Mike Double	2016
51	Pygmy blue whale	Tasman Sea	No	No records	Low	No	Australia/NZ progress reports	No	No records	Low	No	Australia/NZ progress reports	-	Mike Double	2016
52	Sperm whale	Northern Hemisphere	No	Some records	Don't know	Don't know	NOAA, NRIFSF, Guadeloupe stranding	Don't know	Some records	Low	No	NOAA	-	Kristy Long	2016
53	Sperm whale	Mediterranean	Yes	Yes	Yes	Yes	National stranding records	Yes	Yes	High	No	National stranding networks, ferry captains, NGOs, ACCOBAMS, Pelagos	Bycatch rates in pelagic driftnets has been very high in the past; now this fishing gear is banned and there are only few nets still illegally used	Simone Panigada	2016
54	Sperm whale	Southern Hemisphere	-	-	-	-	-	-	-	-	-	-	-	-	2016
55	Blue whale	Eastern North Pacific	No	No records	Low	No	NOAA	Yes	Some records	High	No	NOAA	-	Kristy Long	2016
56	Fin whale	Western North Atlantic	Yes	Some records	Low	Yes	NOAA	Yes	Some records	Medium	No	NOAA		Kristy Long	2016
57	Common minke whale	Canada Eastern coastal	Yes	Some records	Medium	No	NOAA	Yes	Some records	Medium	No	NOAA	-	Kristy Long	2016

Table 3
Work plan.

Intersessional 2017/18	2018 Annual Meeting (SC/67b)
13. BYCATCH	
	Review new estimates of entanglement rates, risks and mortality (large whales).
Develop a global database from disentanglement activities conducted by members of the IWC network.	Review progress on database.
	Mitigation measures for preventing large whale entanglement (including collaboration with Bycatch Mitigation Initiative). Estimation of rates of bycatch, risks of, and mortality for small cetaceans. Consider scientific aspects of small cetacean bycatch mitigation measures and prevention (including collaboration with Bycatch Mitigation Initiative). Develop summary table of small cetacean bycatch mitigation measures. Review bycatch issues in the Western, Central and Northern Indian Ocean.
Secretary write to the IOTC to offer help and advice from the SC in efforts to implement cetacean bycatch data collection and reporting protocols.	
Establish Expert Group to review use of strandings and observer data to estimate bycatch.	Review work of Expert Group.
14. SHIP STRIKES	
	Review estimates of rates of ship strikes, risk of ship strikes and mortality.
Ongoing data entry into Ship Strike Database and validation of records by Data Review Group.	Continuing development and of the international database of ship strikes.
	Mitigation of ship strikes in high risk areas.
Continue co-operation with IMO Secretariat/relevant IMO committees.	Review co-operation. Consider how to make information available in an appropriate form to help in the implementation of the IMO Polar Code's marine mammal avoidance provision.
Secretariat and HIM Convenor explore possibilities for developing a memorandum of understanding between IWC and an AIS data provider.	Review access to AIS data.
Respond to any requests for advice regarding routing proposals that may be presented to IMO.	
Consider how to collate information regarding cetaceans in the Western Arctic and Bering Strait migratory routes.	Review progress and recommendations from intersessional group.
Provide input into the IMMA process related to shipping.	Review progress on designating IMMAs. Consider workplan and funding priorities for 2018-20.

its expertise on this issue, it **agreed** that, as the current effort is largely policy oriented, in the first instance the Secretariat should communicate with the authors of the initiative to see what role IWC might appropriately play. It was also noted that the IWC has been asked to increase its engagement with the UN on this, and other relevant issues of common interest.

6. WORK PLAN

See Table 3 for the work plan.

7. ADOPTION OF REPORT

The report was adopted at 11:50 on 17 May 2017.

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Appendix 1

AGENDA

1. Introductory items
    - 1.1 Convenor's opening remarks
    - 1.2 Election of chair and appointment of rapporteurs
    - 1.3 Adoption of agenda
    - 1.4 Available documents
2. Bycatch and entanglement
    - 2.1 Review new estimates of entanglement rates, risks and mortality (large whales)
    - 2.2 Reporting of entanglements and bycatch in national progress reports
        - 2.2.1 Review summary table
        - 2.2.2 Review the information submitted in National Progress Reports and evaluate its adequacy
    - 2.3 Mitigation measures for preventing large whale entanglement
        - 2.3.1 Review progress on developing a summary table of measures
    - 2.4 Estimation of rates of bycatch, risks of, and mortality for small cetaceans
        - 2.4.1 Consider scientific aspects of bycatch mitigation measures and prevention
    - 2.5 Recommendations related to joining the FAO Coordinating Working Party on Fisheries Statistics
    - 2.6 Other
3. Ship strikes
    - 3.1 Review estimates of rates of ship strikes, risk of ship strikes and mortality
        - 3.1.1 Review progress on global database
    - 3.2 Mitigation of ship strikes in high risk areas
        - 3.2.1 Review progress towards assessing and mitigating ship strikes in previously identified high risk areas
        - 3.2.2 Consideration of methods to identify 'high risk' areas
    - 3.3 Co-operation with IMO Secretariat and relevant IMO committees
        - 3.3.1 Review co-operation
4. Review sources of information that will inform time series on entanglement and ship strike affecting large whale populations
5. Other

Appendix 2

GEAR MODIFICATIONS IN COASTAL FISHERIES OFF WESTERN AUSTRALIAN TO REDUCE WHALE ENTANGLEMENTS

Mike Double and Jason How
West Coast Rock Lobster Managed Fishery

Gear restrictions were a reduction in float numbers and rope length used, while gear modifications were introduced to eliminate surface rope in waters generally deeper than ~20 m (see Table 1). A number of operational or occupational health and safety measures were identified by industry which led to a few minor changes to the gear restriction regulations in the 'shallow' waters (Table 2). Despite this the overall objectives of reduced rope length and float numbers, with no surface rope in 'deeper' water remained.

Octopus Interim Managed Fishery and Cockburn Sound Line and Pot Managed Fishery

Gear modifications were also introduced to the two octopus fisheries, Octopus Interim Managed Fishery (OIMF) and Cockburn Sound Line and Pot Managed Fishery (CSLPMF). They covered the full extent of the CSLPMF and zones 1 and 2 of the OIMF, which both occur on the state's west coast. Due to the different fishing methods in the octopus fisheries, two sets of gear modifications were available to fishers. Those fishers that longlined (a series of pots/cradles connected by an underwater line) must have at least 20 pots/cradles per longline. This served to reduce the number of vertical lines in the water column. They had no other restrictions on their gear configuration. Those fishing with less than 20 pots (usually fished as single pots/cradles) were required to have no surface rope with at least one third of the line held vertical in the water column. Gear modifications in both octopus fisheries regardless of fishing method were from 1 May to 14 November in all water depths. There were no alterations to the gear restrictions in these two octopus fisheries, as occurred in the rock lobster fishery, since their initial implementation.

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Table 1

Gear modification requirements for maximum rope length, surface rope, floats and float rig length and periods between pulling pots for both shallow and deep water.

	Shallow water* (~<20m)	Deeper water (>20m)
Rope length	No rope/water depth ratio	Rope (bridal-float) <2x water depth
Surface rope	Surface rope permitted	No surface rope [negatively buoyant rope (top third)]
Float rig	Float rig inc. in total rope	Max float rig 5 fathoms (inc. tail)
Floats	Max. 2 floats	Max. 2 floats (<30 fathoms); Max. 3 floats (>30 fathoms)
Pull Period	No max pull period	Pots pulled once every 7 days

*Shallow water was defined by the depth that could be fished with the maximum unweighted rope component (see Table 2) (adapted from Bellchambers *et al.,* 2017).

Table 2

Changes to the maximum unweighted rope and season timings by season since the gear modifications were introduced (adapted from Bellchambers *et al.,* 2017).

Season	Maximum unweighted rope	Whale mitigation season
2014	15 fathoms	1 Jul.-14 Nov.
2015	18 fathoms (inside whale zone[1])	1 May-14 Nov.
2016	18 fathoms	1 May-31 Oct.

[1]The 'whale zone' was a defined region within the fishery that generally encompassed waters less than 20m.

Appendix 3

DATA EXTRACTED FROM NATIONAL PROGRESS REPORTS

Complied by Marion Hughes, IWC Secretariat

Table 1

Bycatch of large whales entered into the National Progress Report database in 2017.

ID	Large Area	Species	Local area	Unk: Injured	Unk: Unk	RMP Small Area	Targeted species	Gear	Comments
Australia: 2016									
PR/R/6965	Pacific Ocean - South	Humpback whale	Queensland	0	2	Unknown or N/A	-	GN; FPO	Records from StrandNet.
PR/R/6980	Pacific Ocean - South	Humpback whale	Queensland	0	5	Unknown or N/A	White, tiger and bull sharks	NSC	All whales released alive.
PR/R/7002	Pacific Ocean - South	Unidentified large baleen whale	-	0	1	Unknown or N/A	-	FPO	-
PR/R/7067	Indian Ocean	Humpback whale	Hillary's Boat Harbour	0	1	Unknown or N/A	Crayfish	FPO	Confirmed entanglement in afternoon and animal not resighted.
PR/R/7068	Indian Ocean	Humpback whale	Jurien Bay	0	1	Unknown or N/A	Rock lobster	FPO	Animal cut free via disentanglement team.
PR/R/7069	Indian Ocean	Humpback whale	Tanabiddi Exmouth	0	1	Unknown or N/A	Rock lobster	FPO	Satellite tracker placed on by disentanglement team, came away days after. Animal not resighted.
PR/R/7071	Indian Ocean	Humpback whale	Geraldton	0	1	Unknown or N/A	Rock lobster	FPO	Animal had float cut off by fisherman. Headed south and picked up as a secondary entanglement a day later and then seen in Cervantes. Animal not re-sighted again after Cervantes.
PR/R/7097	Southern Ocean	Humpback whale	Tasmania	0	1	Unknown or N/A	Unknown	LL	Adult humpback observed entangled in heavy 4-strand gear off Tasman Peninsula in November, no injury observed. Travelling south, same animal sighted in NSW during northern migration 4 months earlier. Material suspected from illegal long-line operations in Southern Ocean.
PR/R/7288	Pacific Ocean - Tasman Sea	Humpback whale	-	4	0	Unknown or N/A	Crab/lobster/fish	FIX	NSW whale disentanglement data.
PR/R/7289	Atlantic Ocean - North	Andrews's beaked whale	-	10	0	Unknown or N/A	Unknown	MIS	NSW NPWS whale disentanglement data.
PR/R/7331	Pacific Ocean - South	Humpback whale	-	0	5	Unknown or N/A	-	FPO; GND; GNS	All whales released alive. From SOCI reports. Location or dates not provided by DAF.
PR/R/7370	Indian Ocean	Humpback whale	-	0	0	Unknown or N/A	-	-	-

ID	Large Area	Species	Local area	Males: Dead	Females: Dead	Unknown: Unknown	Targeted species	Gear	Comments
Denmark: 2016									
PR/R/8110	Arctic Ocean - Davis Strait	Common minke whale	West Greenland, near Maniitsoq	0	1	0	Cod	FPN	1 minke whale female, near Maniitsoq (4.3m) entangled in fishing gear from pond net, dead, November 2016.
PR/R/8111	Arctic Ocean - Davis Strait	Humpback whale	West Greenland, near Maniitsoq	1	0	0	Cod	FPN	1 humpback whale male, near Maniitsoq (9.4m) entangled in fishing gear from pond net was permitted euthanized, June 2016.
PR/R/8112	Arctic Ocean - Davis Strait	Fin whale	West Greenland, near Aasiaat	1	0	0	Crab	FPO	1 fin whale male, near Aasiaat (18m) entangled in fishing gear for crab fishing, dead, September 2016.
PR/R/8113	Arctic Ocean - Davis Strait	Humpback whale	West Greenland, near Ikerasaarsuk	0	1	0	Cod	FPN	1 humpback whale female, near Ikerasaarsuk (8.5m) entangled in fishing gear from pond net, permitted euthanized, July 2016.
PR/R/8114	Arctic Ocean - Davis Strait	Humpback whale	West Greenland, Fyllas Banke	0	0	1	Crab	FPO	1 humpback whale sex unknown near Fyllas Banke, off shore (10m) entangled in gear for crab fishing was observed and disentangled by fishermen, May 2016.

ID	Large Area	Species	Local area	Male: Dead	Fem: Dead	Unk: Dead	Unk: Unk	RMP Small Area	Gear	How observed	Contacts
Japan: 2016											
PR/R/7650	Pacific Ocean - North	Fin whale	Kanagawa prefecture	1	0	0	0	Unknown or N/A	FPN	Fisherman	PR/C/243 | FAJ ()
PR/R/7651	Pacific Ocean - North	Humpback whale	Aomori prefecture	1	0	0	0	Unknown or N/A	FPN	Fisherman	PR/C/243 | FAJ ()
PR/R/7652	Pacific Ocean - North	Humpback whale	Kochi prefectutre	1	0	0	0	Unknown or N/A	FPN	Fisherman	PR/C/243 | FAJ ()
PR/R/7653	Pacific Ocean - North	Common minke whale	Hokkaido	6	9	1	0	Unknown or N/A	FPN	Fisherman	PR/C/243 | FAJ ()
PR/R/7654	Pacific Ocean - North	Common minke whale	Aomori prefecture	0	6	0	0	Unknown or N/A	FPN	Fisherman	PR/C/243 | FAJ ()
PR/R/7655	Pacific Ocean - North	Common minke whale	Iwate prefecture	3	8	1	0	Unknown or N/A	FPN	Fisherman	PR/C/243 | FAJ ()
PR/R/7656	Pacific Ocean - North	Common minke whale	Akita prefecture	0	1	0	0	Unknown or N/A	FPN	Fisherman	PR/C/243 | FAJ ()
PR/R/7657	Pacific Ocean - North	Common minke whale	Chiba prefecture	3	1	0	0	Unknown or N/A	FPN	Fisherman	PR/C/243 | FAJ ()
PR/R/7658	Pacific Ocean - North	Common minke whale	Kanagawa prefecture	0	0	1	0	Unknown or N/A	FPN	Fisherman	PR/C/243 | FAJ ()
PR/R/7659	Pacific Ocean - North	Common minke whale	Niigata prefecture	0	4	0	0	Unknown or N/A	FPN	Fisherman	PR/C/243 | FAJ ()
PR/R/7660	Pacific Ocean - North	Common minke whale	Toyama prefecture	6	6	0	0	Unknown or N/A	FPN	Fisherman	PR/C/243 | FAJ ()
PR/R/7661	Pacific Ocean - North	Common minke whale	Ishikawa prefecture	12	16	0	0	Unknown or N/A	FPN	Fisherman	PR/C/243 | FAJ ()
PR/R/7662	Pacific Ocean - North	Common minke whale	Fukui prefecture	1	5	0	0	Unknown or N/A	FPN	Fisherman	PR/C/243 | FAJ ()
PR/R/7663	Pacific Ocean - North	Common minke whale	Shizuoka prefecture	1	1	0	0	Unknown or N/A	FPN	Fisherman	PR/C/243 | FAJ ()
PR/R/7664	Pacific Ocean - North	Common minke whale	Mie prefecture	2	1	2	0	Unknown or N/A	FPN	Fisherman	PR/C/243 | FAJ ()
PR/R/7665	Pacific Ocean - North	Common minke whale	Kyoto prefecture	6	2	0	0	Unknown or N/A	FPN	Fisherman	PR/C/243 | FAJ ()
PR/R/7666	Pacific Ocean - North	Common minke whale	Hyogo prefecture	0	0	1	0	Unknown or N/A	FPN	Fisherman	PR/C/243 | FAJ ()
PR/R/7667	Pacific Ocean - North	Common minke whale	Wakayama prefecture	3	2	1	0	Unknown or N/A	FPN	Fisherman	PR/C/243 | FAJ ()
PR/R/7668	Pacific Ocean - North	Common minke whale	Shimane prefecture	1	6	0	0	Unknown or N/A	FPN	Fisherman	PR/C/243 | FAJ ()
PR/R/7669	Pacific Ocean - North	Common minke whale	Yamaguchi prefecture	0	1	0	0	Unknown or N/A	FPN	Fisherman	PR/C/243 | FAJ ()
PR/R/7670	Pacific Ocean - North	Common minke whale	Kochi prefecture	3	9	1	0	Unknown or N/A	FPN	Fisherman	PR/C/243 | FAJ ()
PR/R/7671	Pacific Ocean - North	Common minke whale	Nagasaki prefecture	5	14	2	0	Unknown or N/A	FPN	Fisherman	PR/C/243 | FAJ ()
PR/R/7672	Pacific Ocean - North	Common minke whale	Oita prefecture	0	0	1	0	Unknown or N/A	FPN	Fisherman	PR/C/243 | FAJ ()
PR/R/7673	Pacific Ocean - North	Common minke whale	Miyazaki prefecture	0	0	3	0	Unknown or N/A	FPN	Fisherman	PR/C/243 | FAJ ()
PR/R/7674	Pacific Ocean - North	Common minke whale	Kagoshima prefecture	0	3	0	0	Unknown or N/A	FPN	Fisherman	PR/C/243 | FAJ ()
PR/R/7675	Pacific Ocean - North	North Pacific right whale	-	1	0	0	0	Unknown or N/A	FPN	Fisherman	PR/C/243 | FAJ ()
PR/R/7676	Pacific Ocean - North	Unidentified large baleen whale	-	0	0	0	1	Unknown or N/A	FPN	Fisherman	PR/C/243 | FAJ ()
PR/R/7699	Pacific Ocean - North	Humpback whale	Kumamoto prefecture	0	0	1	0	Unknown or N/A	FPN	Fisherman	PR/C/243 | FAJ ()
PR/R/7706	Pacific Ocean - North	Common minke whale	Miyagi prefecture	1	8	0	0	Unknown or N/A	FPN	Fisherman	PR/C/243 | FAJ ()

ID	Data Year	Large Area	Species	Local area	Local taxonomy	Males: Dead	Females: Dead	Unk: Injured	How observed	References
Spain: 2016/17										
PR/R/7618	2016	Atlantic Ocean - North	Fin whale	Ribeira (A Corunha)	Balea comun (*Balanoeptera physalus*)	0	1	0	Observer or inspector	PR/B/690: Agreement between Xunta de Galicia and Cemma for the assistance, rehabilitation and study of stranded marine mammals and reptiles along the Galician coast - 2016 Report. CEMMA, unpublished.
PR/R/7623	2016	Atlantic Ocean - North	Common minke whale	-	-	1	0	0	Observer or inspector	PR/B/690 as above.
PR/R/7819	2017	Atlantic Ocean - North	Bryde's whale	Canary Islands	Rorcual tropical	0	0	2	Public	-

ID	Large Area	Species	Local area	Males: Dead	How observed	Contacts	References	Comments
UK: 2016								
PR/R/8432	Atlantic Ocean - North	Common minke whale	Fife, Scotland	1	Scientist	PR/C/248: A. Brownlow (*andrew.brownlow@sac.co.uk*); PR/C/249: N. Davison (*nick.davison@sac.co.uk*)	PR/B/709: CSIP Annual Report to UK Government for 2016. Deaville, R (compiler). Unpublished.	Diagnosed as entanglement case through necropsy carried out under the UK strandings scheme.

ID	Data year	Large Area	Species	Fem: Dead	Unk: Dead	Unk: S. Injured	Unk: Injured	Gear	Contacts	References
USA: 2014-15										
PR/R/8163	2014	Atlantic Ocean - North	North Atlantic right whale	0	2	7	0	NK	PR/C/124: R. Pace (*richard.pace@noaa.gov*)	PR/B/702: Henry, A.G., T.V.N. Cole, L. Hall, W. Ledwell, D. Morin and A. Reid. Mortality and serious injury determinations for baleen whale stocks along the Gulf of Mexico, United States East Coast and Atlantic Canadian Provinces, 2010-14. Published.
PR/R/8164	2014	Atlantic Ocean - North	Humpback whale	0	2	3	5	NK	PR/C/124: R. Pace (*richard.pace@noaa.gov*)	PR/B/702 as above.
PR/R/8165	2014	Atlantic Ocean - North	Fin whale	0	1	0	2	NK	PR/C/124: R. Pace (*richard.pace@noaa.gov*)	PR/B/702 as above.
PR/R/8166	2014	Atlantic Ocean - North	Common minke whale	0	3	1	1	NK	PR/C/124: R. Pace (*richard.pace@noaa.gov*)	PR/B/702 as above.
PR/R/8247	2015	Pacific Ocean - North	Blue whale	0	0	0	1	FPO	PR/C/708: C. Fahy (*christina.fahy@noaa.gov*)	-
PR/R/8248	2015	Pacific Ocean - North	Fin whale	0	0	2	0	NK	PR/C/708: C. Fahy (*christina.fahy@noaa.gov*)	-
PR/R/8249	2015	Pacific Ocean - North	Gray whale	0	0	1	2	GN	PR/C/708: C. Fahy (*christina.fahy@noaa.gov*)	-
PR/R/8250	2015	Pacific Ocean - North	Gray whale	0	0	2	2	NK	PR/C/708: C. Fahy (*christina.fahy@noaa.gov*)	-
PR/R/8251	2015	Pacific Ocean - North	Gray whale	0	0	0	2	FPO	PR/C/708: C. Fahy (*christina.fahy@noaa.gov*)	-
PR/R/8252	2015	Pacific Ocean - North	Humpback whale	1	0	5	14	NK	PR/C/708: C. Fahy (*christina.fahy@noaa.gov*)	-
PR/R/8253	2015	Pacific Ocean - North	Humpback whale	0	0	1	0	GN	PR/C/708: C. Fahy (*christina.fahy@noaa.gov*)	-
PR/R/8254	2015	Pacific Ocean - North	Humpback whale	0	0	0	11	FPO	PR/C/708: C. Fahy (*christina.fahy@noaa.gov*)	-
PR/R/8255	2015	Pacific Ocean - North	Unid. large whale	0	1	0	7	NK	PR/C/708: C. Fahy (*christina.fahy@noaa.gov*)	-
PR/R/8256	2015	Pacific Ocean - North	Unid. large whale	0	0	0	2	GN	PR/C/708: C. Fahy (*christina.fahy@noaa.gov*)	-

Table 2

Non-Direct Anthropogenic Mortality of Large Whales entered into the National Progress Report database in 2017.

ID	Large Area	Species	Local area	Local taxonomy	Fem: Ser Inj	Fem: Unk	Unk: Inj	Unk: Unk	Submitted to Ship Strikes	Comments
Australia: 2016										
PR/R/7001	Pacific Ocean - South	Humpback whale	Queensland	-	0	1	0	0	-	One adult female rescued from rope entanglement.
PR/R/7442	Pacific Ocean - Coral Sea	Unidentified large whale	Double Island	-	0	0	0	1	Unknown	From StrandNet: 21/08/2016. Mop on board vessel *Surfari*; reported strike with whale about 2nm nth of double island. Unknown size or species, unknown if injured.
PR/R/7443	Pacific Ocean - Coral Sea	Unidentified large whale	Keppel Bay	-	0	0	1	0	Unknown	From StrandNet: While en route between Rosslyn Bay Harbour and Pumpkin Island, the 11.1m catamaran *Gormans Removals Rescue*; collided with a whale (presumed humpback, larger than the 11m vessel) at position 23°7; 36°S 150°; 50°; 20°E in Keppel Bay. The whale was in a pod of three travelling North to South at the time. The vessel had eight people on board and was travelling at approximately 20 knots. The vessel was stopped after the collision but was undamaged. One member on board suffered significant bruising when he was thrown against a solid part of the cabin. The whale proceeded on its way but small amounts of skin tissue were later found on the outboard motors. A sample was sent to CQUtin Rockhampton.
PR/R/7472	Southern Ocean	Southern right whale	Head of Bight, Great Australian Bight, SA	*Eubalaena australis*	1	0	0	0	No	Adult female seen with large cuts on the back by C. Charlton (Curtin University) and F. Christiansen (Murdoch University). Accompanied by a calf in an apparently good body condition. First sighting of the female in the area (no sightings in previous years). Last sighting on 18th Sep. 2016 with total of 11 re-sights for the season.

ID	Data year	Large Area	Species	Local area	Local taxonomy	Unk: Dead	Submitted to Ship Strikes	Contacts
Spain: 2016-17								
PR/R/7161	2016	Atlantic Ocean - North	Sperm whale	Canary Islands	Cachalote	2	Yes	
PR/R/7820	2017	Atlantic Ocean - North	Sperm whale	Canary Islands	Cachalote	2	Unknown	PR/C/664: M. Arbelo (*manuel.arbelo@ulpgc.es*) PR/C/665: A. Fernandez (*antonio.fernandez@ulpgc.es*)

ID	Large Area	Species	Local area	Females: Dead	Submitted to Ship Strikes	Contacts	References	Comments
UK: 2016								
PR/R/8430	Atlantic Ocean - North	Common minke whale	Essex, England	1	No	PR/C/247: R. Deaville (*rob.deaville@ioz.ac.uk*)	PR/B/709: Deaville, R. CSIP Annual Report to UK Government for 2016. Unpublished.	Diagnosed as possible ship strike through examination carried out under the UK strandings scheme. Deep, linear incision to lateral caudal peduncle.
PR/R/8431	Atlantic Ocean - North	Fin whale	Norfolk, England	1	Unknown	PR/C/247: R. Deaville (*rob.deaville@ioz.ac.uk*)	PR/B/709: Deaville, R. CSIP Annual Report to UK Government for 2016. Unpublished.	Diagnosed as probable ship strike through necropsy carried out under the UK strandings scheme.

ID	Data Year	Large Area	Species	Local Area	Males: Dead	Females: Dead	Unk: Dead	Unk: Injured	Submitted to Ship Strikes	Contacts	References
USA: 2014/15											
PR/R/8158	2014	Atlantic Ocean - North	North Atlantic right whale		0	0	0	1	Unknown	PR/C/124: R. Pace (*richard.pace@noaa.gov*)	PR/B/702: Henry, A.G., T.V.N. Cole, L. Hall, W. Ledwell, D. Morin and A. Reid. Mortality and serious injury determinations for baleen whale stocks along the Gulf of Mexico, United States East Coast and Atlantic Canadian Provinces, 2010-14. Published.
PR/R/8159	2014	Atlantic Ocean - North	Humpback whale		0	0	1	0	Unknown	PR/C/124: R. Pace (*richard.pace@noaa.gov*)	PR/B/702: as above.
PR/R/8160	2014	Atlantic Ocean - North	Fin whale		0	0	1	0	Unknown	PR/C/124: R. Pace (*richard.pace@noaa.gov*)	PR/B/702: as above.
PR/R/8161	2014	Atlantic Ocean - North	Sei whale		0	0	3	0	Unknown	PR/C/124: R. Pace (*richard.pace@noaa.gov*)	PR/B/702: as above.
PR/R/8162	2014	Atlantic Ocean - North	Common minke whale		0	0	1	0	Unknown	PR/C/124: R. Pace (*richard.pace@noaa.gov*)	PR/B/702: as above.
PR/R/8424	2015	Pacific Ocean - North	Fin whale	California-Oregon-Washington	2	0	0	0	Unknown	PR/C/708: C. Fahy (*christina.fahy@noaa.gov*)	-
PR/R/8425	2015	Pacific Ocean - North	Humpback whale	California-Oregon-Washington	1	1	0	0	Unknown	PR/C/708: C. Fahy (*christina.fahy@noaa.gov*)	-
PR/R/8426	2015	Pacific Ocean - North	Sei whale		0	0	1	0	Unknown	PR/C/708: C. Fahy (*christina.fahy@noaa.gov*)	-
PR/R/8427	2015	Pacific Ocean - North	Gray whale		0	1	0	0	Unknown	PR/C/708: C. Fahy (*christina.fahy@noaa.gov*)	-

Key to gear types
[FIX] TRAPS - Traps (not specified)
[FPN] TRAPS - Stationary uncovered pounds nets
[FPO] TRAPS – Pots
[GN] GILLNETS AND ENTANGLING GEAR - Gillnets (not specified)
[GND] GILLNETS AND ENTANGLING GEAR – Driftnets
[GNS] GILLNETS AND ENTANGLING GEAR - Set gillnets (anchored)
[LL] HOOKS AND LINES - Longlines (not specified)
[MIS] MISCELLANEOUS GEAR
[NK] GEAR NOT KNOWN OR NOT SPECIFIED
[NSC] SHARK CONTROL NETS