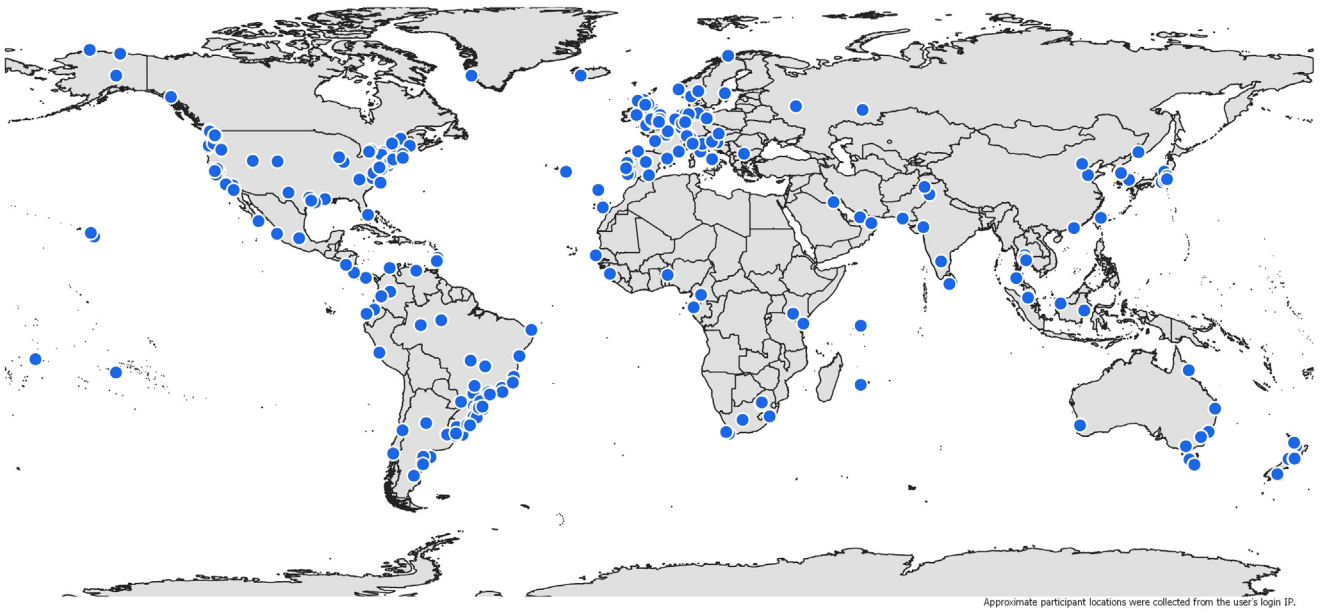
Report of the Scientific Committee 2021

1. INTRODUCTORY ITEMS

The 2021 meeting of the Scientific Committee (henceforth 'Committee' or 'SC') was held 27 April to 14 May 2021. As in 2020, it was held virtually due to the global coronavirus pandemic (COVID-19). The Chair (Suydam) and vice-Chair (Zerbini) of the Committee worked with the Convenors and the Secretariat to plan a series of 'virtual' pre-meetings and workshops prior to the Committee meeting.

1.1 Chair's welcome and opening remarks

In welcoming participants, the Chair noted that as in 2020, the meeting was again being held virtually. He explained that the meeting would be held over a three-week period, rather than the usual two but the Committee would only meet Monday to Friday and there would be no meetings on weekends. This would allow Committee members, Invited Participants and observers to attend to work and home responsibilities during the meeting. He expressed his pleasure at the global distribution of participants (see map below[1]). Because of the broad range of time zones, some participants would need to be in Committee meetings late at night or early in the morning. He apologised that this was consistently the case for some members but greatly appreciated those who worked at atypical times of the day.



He noted that it may be difficult to discuss highly technical issues during virtual sessions. Some of those discussions may need to wait until the Committee meeting in 2022 or at an intersessional in-person meeting. Whilst more virtual sessions were held in 2021 than last year the number of sessions was still less than half of a typical in-person meeting.

The Committee's leadership established a plan for developing, reviewing and agreeing the Committee's 2021 report and the 2022 budget request and workplan. The agreed report, budget request and workplan represent the Committee's decisions and recommendations. Because the Commission is meeting virtually in September 2021, there will not be time for them to review and endorse the 2021 report; however, it will be important for the Committee to seek review and endorsement for the 2022 budget and workplan from the Commission. That endorsement will be the Committee's roadmap for 2022.

The Committee will review and agree the 2021 report in a similar manner to the process used in 2020. Each sub-group will summarise, review and approve their discussions and recommendations in a style similar to a Chair's Summary in a normal year. No sub-group annexes were planned for 2021 although more technical or complicated issues were allowed as annexes. Once the sub-group sections of the report were approved, the full Committee was provided opportunity to comment on all sections of the draft report. The report was updated based on comments received. The final step will be for the Heads of Delegation to have a final review, modify as necessary, and approve the 2021 Committee report. It is expected that the 2021 recommendations will be presented to the Commission at its planned in-person meeting in late 2022 although

[1]Many thanks to Andre Barreto, Ellen Hines, Julie Creek and Moussa Sow for creating this map.

the 2021 Committee report will be available to Commissioners and others approximately 21 days following the close of the Committee meeting (i.e., the final Heads of Delegation meeting).

The IWC Executive Secretary (Lent) thanked the Committee Chair and Vice-Chair as well as all the Convenors, rapporteurs, reviewers of funding requests and all participants for their efforts to advance the work of the Committee in these challenging circumstances. The IWC Secretariat supported these efforts by participating in the virtual meetings to address audio-visual (AV) and information technology (IT) needs as well as to provide technical assistance for the Convenors, rapporteurs and participants.

The list of meeting participants is given as Annex A. This year there were a record breaking 550 participants, and 36 member countries were represented.

1.2 Remembrances

Zerbini provided a remembrance of Dr. Glenn VanBlaricom who passed away peacefully at this home in Mariposa, California, on 24 December 2020, after a 19-month battle with thyroid cancer. Glenn was a marine ecologist who dedicated much of his life to the study of marine mammals. He graduated from the University of Washington in Seattle with degrees in Oceanography and Zoology in 1972 and received his PhD from the Scripps Institution of Oceanography at the University of California in San Diego in 1978. Between 1977 and 1993, Glenn worked as a wildlife biologist for the California Sea Otter Project of the US Fish and Wildlife Service, and he received a number of awards for his work with rehabilitation of this species. Glenn returned to his home state of Washington in 1993 to become the Assistant Unit Leader at the Washington Cooperative Fish and Wildlife Research Unit and an associate professor at the School of Aquatic and Fisheries Science at the University of Washington or UW. At UW, Glenn taught one of the most popular courses for nearly 20 years, Marine Mammalogy. The class offered a relevant hands-on introduction to marine mammal research for hundreds of students, including some who have become highly successful marine mammal scientists. Glenn was ahead of his time when it came to promoting diversity and inclusion in science. He regularly advocated for underrepresented groups in science and included women, people of colour, and foreign nationals as students in all graduate programs he was part of. Glenn made important contributions for the SC without having ever attended one of our annual meetings. Glenn collaborated on a number of cetacean research projects with many members of the SC, including past SC Chairs. He was also a member of the Western Gray Whale Advisory Panel of the IUCN for over a decade and much of the work he was involved in was extensively reviewed by this Committee. Glenn is survived by his wife Kristina, his brother Don, his two daughters, and five grandchildren. A tribute to Glenn's life and career has been published in Marine Mammal Science (Zerbini *et al.*, 2021).

Thomas provided a remembrance of Dr. Lee Merriam Talbot who passed away peacefully at his home in Virginia on 27 April 2021 at the age of 90, 30 years after a bone marrow cancer diagnosis. He was a gracious, generous man, indefatigable in his efforts to protect the environment and wildlife through a long and illustrious career in conservation and science. Lee held an interdisciplinary Ph.D. in geography/ecology from the University of California, Berkeley. On completing his service in the US Marine Corps in 1954, he was asked by the National Academy of Sciences to research African and Asian endangered species; this led to the position as first ever Staff Ecologist at the IUCN. Over his career he held the roles of Director General of the IUCN, Director of Conservation and Scientific Advisor for the World Wildlife Fund International, and Research Associate at the Smithsonian Institution. He wrote over 300 scientific, technical, and popular publications and advised on environmental issues in over 130 countries. As a member of the Scientific Committee of the International Whaling Commission in 1969, he stated, correctly, to sceptical colleagues that one day whale watching would be a more lucrative industry than hunting whales.

In the early 1970s, as Senior Scientist and Director of International Affairs of the President's Council on Environmental Quality for US Presidents Nixon, Ford and Carter, Talbot was one of the visionaries drafting a number of ground-breaking conservation laws and treaties, including the US Marine Mammal Protection Act (MMPA) and Endangered Species Act, the Convention on International Trade in Endangered Species, and the World Heritage Convention. He pioneered many of the new and innovative elements in the MMPA, including the OSP concept, the ecosystem approach to marine mammal conservation and management, and establishment of a scientifically independent Marine Mammal Commission. At the 1972 United Nations Conference on the Human Environment, he was one of the leaders in the call for a cessation of commercial whaling, which eventually culminated in the IWC whaling moratorium. In recent decades, Lee was Professor teaching wild living resource management, biodiversity conservation and global environmental policy at George Mason University. He was a renowned adventurer, survivor of an aerial survey plane crash into the ocean and other occupational incidents such as falling off the side of a mountain, being bitten by a tiger and surviving an attack by an infamous rampaging lion. One of his passions was racing cars – he raced for 69 years, driving his final race at the age of 87. Lee is survived by Marty, his wife of 62 years, his two sons, and a myriad of students and dear friends.

1.3 Appointment of rapporteurs

Several members of the Secretariat, led by Staniland, were appointed rapporteurs for plenary items and were assisted by various members of the Committee as appropriate. Chairs of sub-committees and Working Groups appointed rapporteurs for their meetings (see Item 1.5).

1.4 Meeting procedures and schedule

A Guide to Participants was provided, particularly for those attending for the first time, which outlined the organisation of the Committee. The Chair and Vice-Chair provided information to Committee participants about the proposed process for SC68C.

At SC68C, three concurrent sessions were held in two time slots consistently each day. To accommodate agenda items that were regionally specific, sub-groups were allowed to schedule sessions outside of the two time slots that were more conducive to the respective region/time zone. A schedule of virtual sessions was established approximately a week in advance and regularly updated on the IWC's Sharepoint. A Zoom instruction video was prepared for Committee participants and posted on the IWC Portal in advance of the meeting. For the first time, meetings were recorded and available for each session. The recordings were deleted after a three-day period. The purpose of the recordings was to assist those whose first language is not English and those who could not attend a session due to challenges associated with time zones (i.e., meetings held late at night or early in the morning). A virtual *ad hoc* social room was made available for members to have small meetings in addition to the scheduled sessions.

1.5 Establishment of sub-committees and Working Groups

The following table contains the various sub-committees and Working Groups of the Committee that met in 2021, the relevant Convenor, Co-Convenor, and rapporteur(s) (Table 1.). The Committee is grateful for the commitment of these individuals, without which the Committee could not advance its work.

The following sub-groups met virtually this year as noted under Item 1.2. Their reports have been subsumed under the relevant agenda items in the report below after review by the Committee.

Ad hoc Working group on Photo-ID, PH

Standing Working Group on Abundance estimates, stock status and international cruises, ASI

Ad hoc Working Group on Sanctuaries, SAN

Table 1

Committee sub-groups and Convenors/rapporteurs for 2021.

Sub-committees/Working Group name	Convenor	Co-Convenor	Rapporteur(s)
Scientific Committee Plenary	Robert Suydam	Alex Zerbini	IWC Secretariat
Ad hoc Working group on Photo-ID, PH	Paula Olson	–	Danielle Buss
Standing Working Group on Abundance Estimates, Stock Status and International Cruises, ASI	Alex Zerbini	Geof Givens	Thomas Doniol-Valcroze Natalie Kelly
Ad hoc Working Group on Sanctuaries, SAN	Chris Parsons	–	
Ad Hoc Working Group on Databases and Related Issues, GDR	Mike Double	–	IWC Secretariat
Sub-committee on *Implementation Reviews* and Simulation Trials, IST	Greg Donovan	–	
Sub-committee on Aboriginal Subsistence Whaling, ASW	Lars Walløe	–	Dave Weller
Working Group on Stock Definition and DNA Testing, SD&DNA	Aimee Lang	Ralph Tiedemann	Frank Cipriano
Sub-Committee on In-depth Assessments, IA	Debbie Palka	Helena Herr	
Sub-Committee on the Other Northern Hemisphere Whale Stocks, NH	Jooke Robbins	–	Kim Goetz
Sub-Committee on the Other Southern Hemisphere Whale Stocks, SH	Jen Jackson	Elanor Bell	Elisa Seyboth Danielle Buss
Sub-Committee on Conservation Management Plans, CMP	Bob Brownell	Jorge Urban-Rámirez	Sarah Mallette Dave Weller Sal Cerchio
Sub-Committee on Non-deliberate Human-Induced Mortality of Cetaceans, HIM	Russell Leaper	Gianna Minton	Marguerite Tarzia David Mattila Hannah Cuybanes
Sub-Committee on Environmental Concerns, E	Patricia Holm	Danielle Cholewiak	Tilen Genov Penny Clarke Gaby Hernandez Rocio Gonzalez Danielle Cholewiak
Standing Working Group on Ecosystem Modelling, EM	Toshihide Kitakado	–	Justin Cooke Megan Ferguson Vicki James DJ Schubert Hiroko Solvang Viv Tulloch
Sub-Committee on Small Cetaceans, SM	Lindsay Porter	Fernando Trujillo	Frank Cipriano Maria Clara Jimenez Naomi Brannan Randy Reeves
Sub-Committee on Whale Watching, WW	Leslie New	–	Naomi Rose

Ad hoc Working Group on Databases and related issues, GDR
Sub-committee on Implementation Simulation Trials, IST
Sub-committee on Aboriginal Subsistence Whaling, ASW
Working Group on Stock Definition and DNA testing, SDDNA
Sub-Committee on In-depth Assessments, IA
Sub-Committee on the other Northern Hemisphere whale stocks, NH
Sub-Committee on the other Southern Hemisphere whale stocks, SH
Sub-Committee on Conservation Management Plans, CMP
Sub-Committee on Non-deliberate Human-Induced Mortality of Cetaceans, HIM
Sub-Committee on Environmental Concerns, E
Standing Working Group on Ecosystem Modelling, EM
Sub-Committee on Small Cetaceans, SM
Sub-Committee on Whale watching, WW

2. ADOPTION OF AGENDA

The adopted Agenda is given as Annex B.

3. REVIEW OF AVAILABLE DATA, DOCUMENTS AND REPORTS

3.1 Documents submitted

The documents submitted to the meeting are listed in Annex C. All papers were only available at the meeting in electronic format. Over 200 primary papers and four intersessional meeting and workshop reports were available.

3.2 National Progress Reports on research

All member nations are urged by the Commission to provide Progress Reports to the Committee. The National Progress Reports have their origin in Article VIII paragraph 3 of the Convention and Scientific Committee Rule of Procedure E.1.

As agreed at the 2012 Annual Meeting, National Scientific Progress Reports should be submitted electronically through the IWC Progress Reports data portal. The Secretariat noted that revisions were made to the on-line submission process in order to facilitate the submission of data, including enhanced instructions. Countries were reminded on 17 March 2021 (IWC.ALL.393) of the critical importance of providing the National Progress Reports as well as any data relevant to the work of the Commission. The Secretariat reported that it had received 13 National Progress Reports thus far this year (Argentina, Australia, Brazil, Croatia, Germany, Iceland, Italy, Korea, Mexico, Netherlands, New Zealand, United Kingdom, USA), which is a decrease from the 17 received in 2020. The Secretariat is investigating ways of making the data entry easier and welcomes any suggestions or feedback from all countries.

3.3 Data collection, storage and manipulation

3.3.1 Catch data and other statistical material

Table 2 lists data received by the Secretariat since the 2020 meeting. Details of large whale catches from the 2020 season are listed in SC/68C/O/06 rev1.

Allison reported that last year Mizroch provided scans of individual records from the Dale W. Rice Memorial Research Library including Japanese Antarctic operations 1936/7–1951/2, Japanese North Pacific operations 1943–51, operations by the USA and Canada in the North Pacific 1924–1930 and by the USA in 1937 and 1939. These include over 13,500 new individual records, some of which were included in the most recent release of the catch databases (see Item 3.3.2) and others which are starting to be encoded.

3.3.2 Progress of data coding projects and computing tasks

Allison reported that a new version of the Catch Database v7.1 was released in December 2020 and is available on request. A new version incorporating the 2020 catches, improved separation of North Pacific sei and Bryde's whales and recently validated data from Japanese expeditions in the 1946/7 and 1947/8 seasons will be released shortly.

The IWC tables of accepted abundance estimates have been updated with estimates agreed at SC68B and work will continue on updates after this meeting. Programming work has concentrated on updating the control program and input data for use in the North Pacific common minke whale trials (see Item 8.1.3).

3.4 Guidance for the format of recommendations and discussion of Recommendations Database

Staniland briefly explained the background to the Database of Recommendations (DoR). It was requested by the Commission in 2016 and after extensive work it is now available online. It now includes recommendations from the Scientific Committee, Conservation Committee and Commission from 2010 to 2021, details of which can be found in SC/68C/GDR/01. Regarding

Table 2
List of data and programs received by the IWC Secretariat since the 2020 meeting.

Date received	From	IWC reference	Details
Catch data from the 2020 season			
24/03/2021	Japan: Y. Hosoda	E143 Cat2020	Individual data for commercial catches by Japan in the North Pacific in 2020.
15/04/2021	Japan: L. Pastene	E134	Summary of bycatches of minke whales off Japan by subarea 2001–20.
27/04/2021	Norway: N. Øien	E143 Cat2020	Individual minke records from the Norwegian 2020 commercial catch. Access restricted (specified 14/11/00).
30/04/2021	Canada: D. Townsend	E143 Cat2020	Details of the Canadian bowhead harvest for the 2015–20 seasons and information on the 2021 quota (see SC/68C/ASW/05).
03/05/2021	USA: R. Suydam	E143 Cat2020	Individual records from USA Alaska aboriginal bowhead hunt 2020.
06/05/2021	St Vincent and The Grenadines: J. Cruickshank-Howard	E143 Cat2020	Information on the St Vincent and the Grenadines aboriginal hunt 2020–21.
07/05/2021	USA: R. Suydam	E143	Summary of beluga catches in Alaska from 2010–19 from the Alaska Beluga Whale Committee.
08/05/2021	Russia: D. Litovka	E143 Cat2020	Individual data from Russia aboriginal hunt 2020.
Catch and other data from earlier seasons			
27/05/2020	S. Mizroch	E142	Individual catch records from the Dale W. Rice Memorial Research Library including Japanese Antarctic operations 1936/37–1951/52, Japanese North Pacific operations 1943–51, operations by the USA and Canada in the North Pacific 1924–30 and by the USA in 1937 and 1939.
27/04/2021	Japan: L. Pastene	E134	Update to the numbers of large-scale set nets in operation off Japan by sub-area.
Sightings data			
29/03/2021	Japan: K. Matsuoka	E145	2020 POWER sightings cruise data (including photographs and sightings data).
26/04/2021	Japan: K. Matsuoka	E144	Sighting data from the 2020 Japanese dedicated sighting survey in the North Pacific, and 2020/21 JASS-A survey (weather, effort, sighting and distance and angle experiment records). For access, apply through the Institute of Cetacean Research or the National Research Institute of Far Seas Fisheries.
15/04/2021	Japan: T. Hakamada	E134	Update to the table of North Pacific minke whale abundance estimates, including extra information on no. of sightings, esw, school size etc.

back-data entry, Commission resolutions and Committee workshop recommendations are currently being prioritised. It is hoped that by looking at its previous recommendations the Committee can improve those made in the future. Recommendations since 2019 for each sub-committee were made available at this meeting and guidance on how to draft new recommendations was provided. A well-constructed recommendation should: (1) be concise; (2) stand alone; (3) give specific instruction who it is targeted at; (4) give details of others who should be aware of it; (5) have a single action; and (6); have a clear timeline.

4. COOPERATION WITH OTHER ORGANISATIONS

4.1 Summary of Secretariat co-operation with other organisations

Document SC/68C/O/04 provides detailed information on the Secretariat's activities in collaboration with other organisations. The 2020–2021 pandemic hampered the ability of the Secretariat to engage with other IGOs during the past year, as is the case globally. While virtual meetings are often being used as opportunities to continue IGO work, staff time constraints along with the budget restrictions have underscored the need to establish priorities for engagement and to seek other means for communication and coordination. The Secretariat regularly provides updates to Contracting Governments and observers on the relevant activities of other IGOs and these include requests for assistance in preparation for IWC engagement, whether by the Secretariat or member country representatives.

The Committee designates observers for meetings of relevant organisations, which enhances the ability of the Committee and the IWC to be represented in these important fora and to find opportunities for collaboration. The Committee and Secretariat are grateful to these observers, whose reports are compiled in document SC/68C/O/05. The reports below indicate the cases where the representation was by a member of the Committee, including NAMMCO, PICES, ICES, ASCOBANS and IMO.

4.2 African States Bordering the Atlantic Ocean (ATLAFCO)

The Secretariat maintains regular communication with ATLAFCO to ensure effective outreach and engagement of the IWC member countries in Africa. ATLAFCO served as host for the IWC Chair's Regional Meetings in December 2020 and March 2021. These were opportunities to update the Commissioners in Africa on intersessional activities of the IWC, encourage engagement in the Working Group of Operational Effectiveness (WG-OE) process for the governance review, and join on-line meetings of the scientific and conservation communities. ATLAFCO have proposed a collaborative capacity building project for consideration by the Committee (document SC/68C/ASI/09 and see Item 22.3).

4.3 Arctic Council

No report was received under this item.

4.4 Convention on Biological Diversity (CBD)

As a member of the Liaison Group of Biodiversity-related Conventions (BLG), the IWC has been invited to participate in various discussions of this group as part of the development of the post 2020 framework for biodiversity and associated targets and indicators under CBD. Several IWC Circulars highlighted this activity and opportunities for the IWC to be engaged either through the Secretariat or through national efforts. The IWC Chair, Committee Vice-Chair and Secretariat participated in a second ('Bern 2') workshop of the Secretariats of the Biodiversity-related Conventions which was held virtually in early 2021. The Chair of IWC and several members of the Secretariat participated in the February 2021 virtual meetings of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) and additional meetings are planned in the run-up to the CBD COP.

The process and preparatory meetings contributing to development of the post-2020 framework continue to be impacted by COVID 19. Key preparatory meetings are being held virtually and the dates and venue for the CBD COP is still pending – possibly in-person in China in October 2021. Further information will be provided to IWC Contracting Governments when this timeline is clear. The latest Zero draft of the post-2020 framework can be found here: *https://www.cbd.int/doc/c/3064/749a/0f65ac7f9def86707f4eaefa/post2020-prep-02-01-en.pdf.*

The Secretariat will continue to engage with this process and will keep the Commission informed. Based on the latest version of the 'Zero draft' of the post 2020 framework, the Secretariat will undertake an illustrative mapping exercise to show how this relates to IWC priorities, identify any existing IWC datasets which might be useful to monitoring progress towards the post-2020 Goals and Targets and inform ongoing input to the process. This will be distributed by Circular to the IWC community, inviting any comments and notifying our intentions to continue to engage in this process. The Secretariat will continue to highlight issues most directly relevant to healthy cetacean populations, including key threats to cetaceans and any opportunities for these to be addressed through increased cooperation, capacity building, engagement of key sectors (e.g. shipping and fisheries) and data management and reporting. We will highlight opportunities for IWC scientific information to support monitoring of progress in achieving the new framework of targets.

4.5 Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR)

Scientists at the British Antarctic Survey (BAS) have been in contact with the IWC Secretariat over the past couple of years to consider ways to enhance scientific collaboration. A draft work plan has been developed, based on an independent review of the two IGO scientific bodies. However, the implementation of this work plan has been delayed due to Covid-19 and the requirement for the two Commissions to meet virtually with focused agendas. There is still a potential benefit to developing an MoU or other more formal agreement, which is under consideration. There have also been ongoing discussions between the science leads as well as the two Executive Secretaries regarding practical ways to increase scientific collaboration.

4.6 Convention on the Conservation of Migratory Species (CMS) (Secretariat and Simmonds)

The Secretariat has continued co-operation with the CMS and its daughter agreements ASCOBANS and ACCOBAMS on a wide range of common challenges, including bycatch, strandings, CMPs, ship strikes, ecosystem functioning and whale watching. The IWC has a MoU with the CMS and also collaborates with ASOCBANS and ACCOBAMS. The Executive Secretaries of each organisation have visited the offices of their counterpart to meet with staff and discuss areas of mutual interest.

Joint work has continued with CMS on the IWC Whale Watching Handbook (particularly translations) and preparations for, and participation in, the SC workshop on Ecosystem Functioning (SC/68C/REP/03). IWC Expert Panels for strandings, entanglement and bycatch provided input to Guidelines for the safe and humane handling and release of bycaught small cetaceans from fishing gear which have been published as a CMS Technical Series (see IWC Circular IWC.ALL.382).

There is a strong, long-standing collaboration between the IWC and ACCOBAMS on many issues including matters related to population assessment, ship strikes, bycatch, whale watching, noise, chemical pollution and CMPs. The need to continue and improve co-operation has constantly been underscored and opportunities for further collaboration were recently discussed in a virtual meeting between the IWC and ACCOBAMS Secretariats.

The Secretariat provided input to the ASCOBANS Advisory Committee (October 2019), where the IWC was represented by other members of the IWC community and participated virtually in the 9TH ASCOBANS MOP in September 2020. This highlighted a number of opportunities for collaboration between IWC and ASCOBANS which will be pursued in coming months. In December, the Head of Science, Conservation and Management attended the second meeting of the ASCOBANS common dolphin group. (See also Section 4.6.3 below with observer report from ASCOBANS).

The Secretariat has also participated in the first meeting of Joint Bycatch Working Group of ACCOBAMS and ASCOBANS, which was held in February 2021. The Bycatch Coordinator is a member of this working group. (See also section 4.6.3, observer report from ASCOBANS).

4.6.1 Scientific Council

No meeting has been held since SC68B.

4.6.2 Conference of Parties
No meeting has been held since SC68B.

4.6.3 Agreement on Small Cetaceans of the Baltic and North Seas (ASCOBANS) (Simmonds)
Since SC68B, the following ASCOBANS meetings have taken place, all online:

- 16th Meeting of the Steering Group for the ASCOBANS Conservation Plan for the Harbour Porpoises in the Baltic Sea, and the Conservation Plan for the Harbour Porpoise in the Western Baltic, the Belt Sea and the Kattegat in June 2020.
- 9th Meeting of the Parties (MOP9) to ASCOBANS in September 2020. The Parties adopted a new work plan for the Advisory Committee and resolutions on marine debris, food availability and resource depletion, and Baltic Proper Harbour Porpoise. The Parties also updated existing resolutions on bycatch, conservation of the common dolphin, national reporting, EIA for noise generating activities, and stranding response. With that, Parties also adopted the 'Best practice on cetacean post-mortem investigation and tissue sampling', a joint ASCOBANS-ACCOBAMS document; and the CMS Family Guidelines on EIA for marine noise-generating activities. Several resolutions refer to IWC. The resolutions are available on the MOP9 website with the meeting report.
- 2nd Meeting of the Common Dolphin Group (Steering Group for the Species Action Plan for North-East Atlantic Common Dolphin), in December 2020.
- 9th Meeting of the North Sea Steering Group Steering Group for the ASCOBANS Conservation Plan for Harbour Porpoises in the North Sea in January 2021. Agreed to Priority recommendations.
- 1st Meeting of the ACCOBAMS-ASCOBANS Joint Bycatch Working Group in February 2021. Experts shared experiences in monitoring and mitigating cetacean bycatch and then Working Group Members to discuss and decide on the priorities to be addressed during the next years.

Upcoming meetings include a workshop on management of MPAs for small cetaceans (18 May 2021), the 26th meeting of the ASCOBANS Advisory Committee (8–12 November 2021) and the 10th meeting of the North Sea Group (6–7 December 2021). New intersessional groups were formed for beaked whales in the Northeast Atlantic and for data deficient taxa.

4.7 Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES)
No report was received under this item.

4.8 Food and Agriculture Organisation of the United Nations (FAO)
The IWC Executive Secretary and BMI Coordinator attended the virtual meeting of the 34th session of the FAO Committee on Fisheries (COFI) in February 2021. IWC interventions and statements were provided in relation to the need to address cetacean bycatch, in particular to welcome the new technical Guidelines to Reduce and Prevent Marine Mammal Bycatch in Capture Fisheries (FAO, 2021a), and to promote collaborative opportunities between the FAO, fisheries management organisations and the IWC. The FAO's Responsible Fishing Operations Workplan (FAO, 2021b) was presented to the COFI meeting, and this includes references to potential collaboration between the FAO and the IWC's BMI. The IWC Secretariat has continued to engage with the FAO Secretariat in relation to potential collaboration to promote the guidelines.

The IWC Secretariat provides annual statistics to FAO on anthropogenic cetacean mortality for their annual publication of fishery data, using information from the IWC Progress Reports or submitted directly to the IWC. The IWC Secretariat participates in a number of task groups under the Coordinating Working Party on Fishery Statistics, including the ad hoc task group on reference harmonization standard, the ad-hoc task group on fishing effort concepts and the ad-hoc task group on catch concepts.

The FAO host the Regional Secretariat's Network (RSN) which is an organisation of Executive Secretaries/Directors of Regional Fishery Management Organisations and other Regional Bodies, including IWC. The IWC Secretariat's Executive Secretary joined the RSN's virtual meeting in February 2021. The RSN is an excellent opportunity for the IWC to exchange information on Secretariat-level issues (such as the mechanics for virtual meetings) and is particularly important for collaboration on bycatch with RFMOs. The IWC Executive Secretary participated in a small group of RSN members preparing comments on the Terms of Reference for the RSN in an effort to increase its potential for effective cross-RSN leadership collaboration.

4.9 Regional Fisheries Management Organizations (RFMOs)
IOTC – Indian Ocean Tuna Commission – The IWC Secretariat is engaging with the Indian Ocean Tuna Commission (IOTC) in relation to cetacean bycatch. Prioritisation of the IOTC was recommended by the Scientific Committee (Recommendation SC1878 and SC2095 and SC20106) and by the Conservation Committee (Recommendation BMI906, BMI 1919). The IWC and IOTC Secretariats held a joint meeting in September 2020 to discuss potential collaborative activities on cetacean bycatch (IOTC and IWC, 2020) and this was briefly presented to the IOTC's

16th Working Party on Ecosystems and Bycatch (WPEB) meeting (IOTC, 2020). The IOTC's WPEB is planning to work on an ecological risk assessment for cetaceans across the region in collaboration with other organisations. A follow-up workshop or meeting between the IWC, IOTC and experts working on cetaceans and bycatch is being planned and will take place in

advance of the 17th WPEB meeting in September 2021. The IWC and IOTC Secretariats are also exploring the development of a Letter of Agreement to formalise collaboration in relation to joint activities, including the proposed activities in the Common Oceans ABNJ Tuna Phase 2 project.

Common Oceans Areas Beyond National Jurisdiction – Working in collaboration with RFMOs, the BMI has submitted a draft concept to the GEF/FAO Common Oceans ABNJ Tuna Phase 2 project development team. The overall project is focused on improving the sustainability of the world's tuna fisheries. The IWC's proposed concept aims to collaboratively advance efforts to assess and mitigate cetacean bycatch in tuna fisheries across two ocean basins – the Indian Ocean (with possible collaboration with IOTC and other partners) and the Pacific Ocean (with possible collaboration with SPREP, WCPFC). The project would also lay the foundation to scale up to other regions and fisheries. At the regional level, the proposed activities fall across three themes: assessing bycatch/data gaps; building regional capacity and awareness; and collaboratively developing recommendations for monitoring and mitigation.

RFMO Bycatch Review – The IWC Secretariat commissioned a review of 16 RFMOs in relation to how they are addressing cetacean bycatch in their relevant fisheries. This review was discussed in paper SC/68B/HIM/05, at the Conservation Committee meeting in 2020 and at this present meeting and the original paper has been revised in preparation for consideration in a peer-reviewed publication.

4.10 IUCN Task Force on Marine Mammal Protected Areas (formerly ICMMPA) (Cooke)

The Marine Mammal Protected Areas Task Force has continued its work since SC68C, with thirteen new Important Marine Mammal Areas (IMMA's) approved in the Southern Ocean and 31 approved for Australia, New Zealand and the Southeast Indian Ocean. This brings the total number of IMMA's to 159 worldwide (see *marinemammalhabitat.org/imma-eatlas* for map). The seventh Regional Workshop (February 2021), covering the Caspian and Black Seas and the Sea of Marmara and connecting straits, identified 23 candidates for IMMAs, which are undergoing review.

The Cetacean Specialist Group (CSG) undertook a reassessment of all cetacean species on the Red List (redlist.org) during 2018–2021. Since SC68B, Red List assessments have been updated for 25 cetacean species, and one new species, *Berardius minimus* (Sato's beaked whale), has been added. The North Atlantic right whale, *Eubalaena glacialis*, has been uplisted from Endangered (E) to Critically Endangered (CR) due to the recent continuing decline in this already small population. The tucuxi, *Sotalia fluviatilis*, and Perrin's beaked whale, *Mesoplodon perrini*, have both been reclassified from Data Deficient to Endangered. The tucuxi listing is based on strong evidence of severe decline over the last 25 years, while the listing of *M. perrini* is based on the small population size coupled with some evidence of decline in this rarely observed species. Several other beaked whale species have also been moved from Data Deficient to other categories. A new listing of the recently recognized Rice's whale *Balaenoptera ricei* (currently listed as a Critically Endangered Gulf of Mexico subpopulation of Brydes whales) will be published shortly.

SC/68C/O/01 explains how the IUCN Red Listing process has been applied to cetaceans, both to species and to some subspecies and populations (see Item 19.2). News items on other activities by members of the IUCN SSC Cetacean Specialist Group are regularly posted on the CSG web site (*iucn-csg.org*). IUCN has continued to convene the Western Gray Whale Advisory Panel (WGWAP), which will conclude its work at the end of 2021 (see Item 9.1.3). The Panel's recent activities and remaining plans are described in SC/68C/CMP19.

The quadrennial IUCN World Conservation Congress (WCC) has been postponed to 3–11 September 2021 and will include both on-line and on-site participation (Marseille, France). Of the three directly cetacean-related motions, two (110 – Safeguarding the endangered finless porpoise *Neophocoena asiaorientalis* in the Yellow Sea; and 027 – Reducing impacts of incidental capture on threatened marine species) have already been adopted with advance on-line voting. Motion 118 – Reinforcing the protection of marine mammals through regional co-operation – which calls inter alia for greater protection of cetaceans in IMMAs, has been referred to further discussion during WCC.

4.11 International Council for the Exploration of the Sea (ICES) (Haug)

The ICES Working Group on Marine Mammal Ecology (WGMME) met in Barcelona, Spain, in February 2020. There was a review of new and updated information on seal and cetacean population abundance, population/stock structure, management frameworks as well as anthropogenic threats to individual health and population status. This review included grey and ringed seals. The WG reviewed a number of recent studies addressing diet, foraging distribution and trophic interactions. Additionally, published and unpublished data on diet and distribution of marine mammals in the North Sea were synthesised.

In 2020, WGMME focused its efforts on: (i) reviewing conservation objectives with respect to maximum mortality since the lack of conservation targets was identified as hindering the ability to address marine mammal-fisheries interactions; and (ii) assessing the use of stranding records as a source of information to identify abnormal mortality and possible relations to fisheries. A country-by-country review of current stranding network activities was included.

ICES WGBYC

The Working Group on Bycatch of Protected Species (WGBYC) met in the Netherlands, in March 2020. WGBYC responded to a special request from the European Commission on emergency bycatch mitigation measures for common dolphin in the

Bay of Biscay and harbour porpoise in the Baltic Sea. This work demanded a great deal of resources from WGBYC and, coupled with the COVID–19 and the need to work remotely, it was not possible to complete all tasks.

The quality and scope of Member States' reports on the implementation of bycatch regulations varied during 2018. Bycatch monitoring is further implemented through the EU-level requirements. For 2018, bycatch information received through the WGBYC data call included 82 cetaceans (5 species) and 175 seals (4 species). Bycatch of marine mammals was observed in all ecoregions and several gear types including gillnets, traps, longlines, and trawls. Eight countries also contributed numbers of bycaught stranded cetaceans. Bycatch was the predominant cause of death of common dolphins stranded in the Bay of Biscay and Channel.

In general, there has been little progress in the mitigation of cetacean bycatch and the effectiveness of pingers appears to vary among fishing gears and geographical areas. WGBYC continues to have insufficient data within their database to determine bycatch rates.

An assessment of bycatch for common dolphins was conducted in the Celtic Seas Ecoregion and the Bay of Biscay and Iberian coast Ecoregion. In the Celtic Seas, the mean annual bycatch in 2016–2018 across all gears ranged from 278–1,345 dolphins, with bottom otter trawls (OTB) and gillnets (GNS) targeting demersal fish accounting for the highest bycatch. In the Bay of Biscay and Iberian Peninsula, the mean annual bycatch for 2016–2018 across all gear types ranged from 1,998–6,599 dolphins, with trammel nets (GTR) for demersal fish accounting for the largest bycatch. When combined with estimates based on strandings, common dolphin bycatch likely exceeds the upper limits of 'sustainable' anthropogenic removals, defined using a Potential Biological Removal threshold of 4,927 common dolphins per year. For the Baltic harbour porpoise, bycatch rates generated from the WGBYC database (2005–2018) in all regions identified high-risk gear, given the lack of data for the Baltic proper. In the North Sea and Celtic Sea, the highest bycatch rates occurred in gillnet or trammel nets. In the Bay of Biscay, the highest bycatch rate occurred in pelagic trawls, but it is likely that gillnets would pose the greatest threat in terms of total harbour porpoise mortality due to the size of the fleet.

WGBYC needs to continue coordination with other expert groups to better understand the distribution of monitoring and fishing effort. A clear inverse relationship was demonstrated between the bycatch risk index and amount of monitoring of fishing effort. Considering that Member States are obliged to monitor protected species bycatch, the Regional Coordination Groups (RCGs) will need to consider increasing monitoring of fishing effort by static gears which have high bycatch risk. WGBYC conducted a comparative analysis which highlighted discrepancies with the quantity of fishing effort data submitted to WGBYC and the ICES Regional Database (RDB). Some of these inconsistencies might be explained by gear type definitions for the different submissions and/or national effort recording systems prior to submission. When the new Regional Database Estimations System (RDBES) becomes operational (2022), WGBYC will carry out complete comparisons of fishing effort, monitoring effort, and bycatch before any decisions on full transition to RDBES as a sole data source. ICES needs to work with the General Fisheries Commission for the Mediterranean (GFCM) and other regional organisations to coordinate bycatch estimation techniques in order to accurately reflect relative and absolute bycatch.

ICES WKEMBYC

Following a submission of two reports from 26 European environmental non-governmental organisations (NGOs) to the European Commission (DG MARE) concerning the introduction of emergency measures to mitigate bycatch of common dolphins in the Bay of Biscay and harbour porpoises in the Baltic Sea, ICES established the Workshop on Emergency Measures to mitigate bycatch of harbour porpoise in the Baltic Sea and common dolphin in the Bay of Biscay (WKEMBYC). WKEMBYC was tasked to build on the work conducted by WGMME and WGBYC to assess the emergency measures proposed by the NGOs, explore alternative measures, and suggest emergency measures that are necessary to ensure a satisfactory conservation status of these stocks. The work of WKEMBYC, which met by correspondence on 1–3 April 2020, was based on the examination of the information provided by NGOs, as well as the work conducted by WGMME 2020 and WGBYC 2020.

The population of harbour porpoise in the Baltic Proper is considered to be critically endangered with an estimated abundance of 497 individuals (95% CI 80–1,091). At least 5–10 individuals might die from bycatch every year. The three proposed emergency measures by NGOs aiming at a reduction of bycatch numbers are not sufficient for the protection and recovery of the Baltic Proper harbour porpoise population, therefore WKEMBYC recommended adjustments. The proposed monitoring actions by NGOs would however increase the knowledge of the harbour porpoise population.

The common dolphin is one of the most abundant cetacean species in European waters. The appropriate scale at which to evaluate the population status of common dolphins occurring in the Bay of Biscay is the European Atlantic Assessment Unit, where its abundance is estimated to be 634,286 (CV = 0.307) (ICES, 2020). In 2017 and 2018, the mortality due to bycatch inferred from French strandings in the Bay of Biscay and Western English Channel at large was respectively estimated at 9,300 [5,800; 17,900] and 5,400 [3,400; 10,500] common dolphins (ICES, 2020). In the Bay of Biscay and the Iberian Coast, the mean annual bycatch estimated from at sea observations for 2016–2018 across all gears amounted to 3,973 (95% CI 1,998–6,599) dolphins. PBR was calculated as 4,926 individuals per year. Comparing bycatch estimates obtained from strandings with PBR suggests recent estimates (2017–2019) were higher than the PBR limit. Removing bycatch in the January–March winter period reduces the estimated bycatch to a small proportion of the total, and much lower than the calculated PBR.

WKEMBYC considered that the NGO proposed closure of all fisheries of concern in the Bay of Biscay from December to March was expected to significantly reduce bycatch of common dolphins. However, alternative closures and the use of 'pingers' should also be considered.

Measures allowing the population to recover should be implemented as soon as possible and over the longer term, with the mortality limit of 0.7 animals per year as an operational threshold. The WKEMBYC recommended closure of a defined summer core area for the population for all fishing gears, with the exception of passive gears proven not to bycatch harbour porpoises. Closures were also recommended in a number of Nature 2000 sites and additional areas, within the seasonal distribution range of the Baltic Proper harbour porpoise. Additionally, the workshop recommended prohibiting the use of static nets without the simultaneous use of pingers in the entire seasonal Baltic Proper harbour porpoise management area. A series of monitoring recommendations were provided aimed at increasing the knowledge on bycatch risk and status of the Baltic proper harbour porpoise population.

Regarding the Bay of Biscay common dolphin, WKEMBYC agreed that PBR may be a useful tool. Two management objectives were tested: (1) Reduce bycatch below 50% of PBR; and (2) Reduce bycatch below 10% of PBR. To achieve a level of bycatch below 50% of PBR, WKEMBYC recommended a two-month closure for the gears of concern, from mid-January to mid-March, and midwater and bottom pair trawlers the rest of the year. To achieve reductions that minimise bycatch (<10% of PBR) WKEMBYC recommended a three-month winter closure from January to March, and a one-month summer closure from mid-July to mid-August for the gears of concern along with the use of acoustic deterrents on midwater and bottom pair trawlers the rest of the year. WKEMBYC also recommended a series of monitoring actions to improve bycatch estimates and the assessment of the northeast Atlantic common dolphin.

ICES ASC

Because of the global COVID-19 crisis, the planned ICES Annual Science Conference (ASC) 2020 was postponed, and will take place 6–9 September 2021 at Øksnehallen in Copenhagen, Denmark. More information is available at the ICES website *http://www.ices.dk* .

4.12 International Maritime Organisation (IMO) (Secretariat and Leaper)

Several papers on underwater noise were tabled for the Marine Environment Protection Committee (MEPC 75) in 2020. MEPC 75 was initially postponed and then had a reduced agenda when it did take place. Australia, Canada and the US submitted a proposal for a new output concerning a review of the 2014 Guidelines for the reduction of underwater noise from commercial shipping to address adverse impacts on marine life (MEPC.1/Circ.833) and identification of next steps (MEPC/75/14) with comment papers from European Union countries (MEPC/75/14/1) and other organisations (MEPC/75/14/2 and MEPC/75/14/3). However, there was not time to discuss these papers. It is expected that the proposal in MEPC/75/14 will be discussed at MEPC 76 in June 2021. The Secretariat has submitted a short paper to MEPC 76 outlining recent IWC work on underwater noise and highlighting desire to work with IMO on this issue.

Proposals for ship routing measures (of relevance to ship strikes on whales) are considered by the IMO sub-committee on Navigation, Communications and Search and Rescue (NCSR) which has not met since SC68B. NCSR 8 will meet from 19–23 April 2021 but all routing proposals have been deferred to NCSR 9.

4.13 International Union for the Conservation of Nature (IUCN) (Cooke)

There is a long-standing collaboration between IUCN and the IWC on matters of mutual interest. In recent years these have focused on the Western Gray Whale Advisory Committee (WGWAP) and the newly formed IUCN Marine Mammal Protected Areas Task Force (MMPATF). The Secretariat Head of Science, Conservation and Management and the Executive Secretary joined the on-line meetings of the WGWAP in November 2020 which marked the penultimate year of the programme. The panel was presented with recommendations from the IWC Scientific Committee and a report from the Russia Gray Whale Project partially funded by the IWC.

The IUCN Global Species Programme has contacted the Secretariat to offer an opportunity to review the 'GSAP Action Table' which contains the CBD Post-2020 Targets (1–20). Each target has an indicative set of draft actions and the goal is to support and complement the implementation of the post-2020 framework. As staff time allows, the Secretariat will strive to provide comments on this document and is requesting Committee members to express their interest in joining in this effort.

4.14 North Atlantic Marine Mammal Commission (NAMMCO) (Secretariat and Haug)

Because of the COVID-19 crisis, there was no NAMMCO Scientific Committee meeting in 2020. A new NAMMCO SC meeting was held in January 2021, but the plan is to report from that meeting next year (2022). For cetaceans, the prime focus was on narwhals and very little on the traditional IWC-whales. NAMMCO SC has decided that they will continue to meet in January in their future annual meetings.

NAMMCO held its annual Commission meeting virtually between 22–25 March 2021. Several members of the IWC Secretariat attended sessions of the meeting. NAMMCO and the IWC share overlapping scientific and programmatic areas of work including cetacean surveys, stock assessments, bycatch and entanglement response.

4.15 North Pacific Marine Science Organisation (PICES) (Tamura)

The PICES-2020 meeting was held online in October 2020. The 2015–2020 project 'Climate and Trophic Ecology of Marine Birds and Mammals' was reviewed and chapters drafted for the Scientific Report as final products of the project. This included the results from the workshop on 'Anthropogenic stressors, mechanisms and potential impacts on Marine Birds and Mammals'. The draft Scientific Report will be provided at PICES-2021.

At the Business meeting held in September 2020, Tamura (Japan), as the representative of the IWC-SC, presented the observer report of the 2020 IWC/SC meeting on topics related to the North Pacific (e.g. the Research Plan for the IWC/POWER cruise). The Marine birds and Marine Mammals Advisory Panel (AP-MBM) nominated Tamura to continue participating in the IWC/SC as the observer representing PICES. It was proposed and agreed that the future five-year project (2021–2025) focuses on the 'Interaction between MBMs and other ecosystem components and stressors'. This will include forecasting changes in forage species and response of top predators, and the role of marine birds and marine mammals as ecological indicators and predictors of changing marine ecosystems.

Further discussion will take place by e-mail, and a future five-year project will be proposed at PICES-2021. The 2021 annual meeting of the PICES will be held at Qingdao, China. The schedule will be decided later.

Finally, the Secretariat noted that the Biological Oceanography Committee of the North Pacific Marine Science Organization (BIO-PICES) held its annual meeting online in September 2020. The IWC was invited as an observer, and the Head of Science, Conservation and Management gave a presentation about the work of the IWC.

4.16 Protocol on Specially Protected Areas and Wildlife (SPAW) of the Cartagena Convention for the Wider Caribbean

The Secretariat has continued working with counterparts in SPAW on a draft MoU to facilitate collaboration in areas of common interest in cetacean science and stewardship, particularly in small-scale coastal fisheries. Depending on response from the SPAW, the Secretariat will present the draft MoU to the Commission at IWC68. Areas of common interest and possible collaboration include small-scale fishery bycatch, ship strikes, strandings response, entanglement response training, whale watching and swim-with programmes.

In the spirit of this cooperation, the Secretariat has participated in several virtual meetings of various SPAW activities, including discussions of the CARI'MAM project, funded largely by the European Regional Development Fund (ERDF), providing presentations of the IWC's BMI, entanglement, Whale Watching handbook and stranding initiatives. The IWC Secretariat also attended technical meetings of SPAW-STAC in the lead up to their COP, currently planned for 21–30 June 2021. In addition, the Secretariat has provided advice to the development of a new SPAW Marine Mammal Action Plan, available as (SPAW-RAC *et al.*, 2020) and Committee members are invited to give their input on this plan.

4.17 Secretariat of the Pacific Regional Environmental Programme (SPREP)

SPREP hosted the Chair's IWC Regional Meeting in the Pacific Islands in April 2021. As with ATLAFCO, this was an opportunity to update the Commissioners in the Pacific Islands region on intersessional activities of the IWC, encourage engagement in the WG-OE process for the governance review, and join on-line meetings of the Scientific and Conservation communities. At this Chair's Regional meeting it was noted that in August 2021 there will be a meeting of signatories to the CMS MoU on the Conservation of Pacific Islands Cetaceans and Their Habitats. As many SPREP members are also members of IWC, SPREP is exploring the opportunity for a member of the IWC Secretariat to join this meeting.

The IWC Secretariat has held a number of meetings with the SPREP Secretariat in relation to work areas of common interest and overlap, including bycatch and whale watching. The IWC BMI is proposing possible collaboration with SPREP and other regional organisations on the ABNJ Bycatch concept proposed under the Common Oceans Programme (see FAO section above). SPREP is currently involved in an EU-funded project through its Pacific-European Union Marine Partnership (PEUMP), which includes a multi-taxa bycatch component focused on coastal fisheries. The SPREP Secretariat is also actively engaged in raising awareness on cetacean bycatch in the Western Central Pacific Fisheries Commission (WCPFC).

4.18 Marine Traffic (Secretariat and Leaper)

Marine Traffic provided Automatic Identification System (AIS) data from the SW Atlantic and these were used in research regarding Ship Strikes risk that will be presented in HIM at SC68C.

The IWC Secretariat continues to work with the HIM Convenor (Leaper) to develop an MOU between IWC and Marine Traffic to provide data on shipping for scientific studies. This MoU would allow the IWC to serve as a single point for data requests in a standardised format, minimising work for the data provider. Marine Traffic, who have generously donated data for previous research are reviewing final drafts of documents that lay out the MoU and provide a framework for collaboration on projects aligned with the mission and vision of both organisations. Once the Marine Traffic leadership has cleared these draft documents, they will be forwarded to the IWC68 meeting for consideration.

5. GENERAL ASSESSMENT AND MODELLING ISSUES (IST)

There is no immediate urgency to advance this agenda item in 2021. Thus, this agenda item has been postponed until SC68D.

6. AWMP IMPLEMENTATION-RELATED MATTERS (IST)

There is no immediate formal urgency for all items to be completed in time for the 2021 Commission meeting (should that take place) in that the management advice for each aboriginal quota block, including carryover provisions, has already been agreed until 2026. It was therefore agreed that this year, priority should be given to the examination of two Items (see Items 6.1 and 6.3) regarding planning for *Implementation Reviews* for West Greenland humpback and bowhead whales.

The primary objectives of an *Implementation Review* are to:

(1) review the available information (including biological data, abundance estimates and data relevant to stock structure issues) to ascertain whether the present situation is as expected (i.e. within the space tested during the development of a *Strike Limit Algorithm* (*SLA*)) and to determine whether new simulation trials are required to ensure that the *SLA* still meets the Commission's objectives; and
(2) review information required for the SLA, i.e. catch data and, when available at the time of the Review, new abundance estimates (note that this can also occur outside an *Implementation Review* at an Annual Meeting).

6.1 Develop plan for Implementation Review of West Greenland humpback whales

The *WG-Humpback SLA* is based upon the conservative assumption of a West Greenland feeding aggregation being treated as a single stock. The Committee welcomed a short summary of information available from Greenland (both West and East Greenland) since the development of the *WG-humpback SLA*, including on abundance, removals, life history, genetic samples, telemetry and local distribution. It was agreed last year and confirmed this year that the *Implementation Review* can most efficiently be undertaken after the completion of the planned in-depth assessment of all North Atlantic humpback whales that will be undertaken by NH, SDDNA and ultimately the IA sub-committee. The Greenland information will be available for this review.

In discussion, it was noted that the most recent (2015) IWC-approved estimate for West Greenland humpback whales of 993 (CV 0.44; Hansen *et al.*, 2018) was appreciably lower than the previous one from 2007 of 2,704 (CV 0.34; Heide-Jørgensen and Laidre, 2015). It was reiterated that this estimate is not outside the parameter space tested during the initial *Implementation*, so that it was appropriate for use within the existing *SLA.* The next surveys are expected in 2024.

6.2 Update ASW in light of results from the 2020 meeting

This will be undertaken intersessionally.

6.3 Develop plan for Implementation Review of West Greenland bowhead whales

At SC67B, the Committee agreed that the Doniol-Valcroze *et al.* (2015) fully corrected estimate from the 2013 aerial survey of 6,446 bowheads (CV = 0.26, 95% CI 3,722–11,200) that covered the major summering area for the Eastern Canada/West Greenland stock was acceptable for management advice and for use within the AWMP.

The *WG-Bowhead SLA* had been developed on the conservative assumption that the abundance estimate for the West Greenland area alone (1,274 whales in 2012 (CV = 0.12)) represented the abundance of the whole Eastern Canada/West Greenland stock. This was largely because it was not possible to assume that a non-member country would continue with regular surveys, although Canada has indicated that it does intend to obtain regular abundance estimates and that these will be shared with the IWC. At that time, the Committee had agreed that consideration of how to incorporate abundance estimates from Canada should be one focus of the next *Implementation Review*.

The Committee welcomed a short summary of information available from Greenland (both West and East Greenland) since the development of the *WG-bowhead SLA*, including on abundance, removals, life history, genetic samples, telemetry and local distribution. This information will be important in completing the *Implementation Review* at next year's meeting. The Committee **agreed** that the information provided by the Greenlandic scientists fulfilled the initial part of the Data Availability requirements (IWC, 2004) for *Implementation Reviews.* It noted that a finalised document, including 'references to data collection and validation protocols and any associated information needed to understand the datasets or to explain

Table 3

Potential long term workplan for RMP and AWMP *Implementation Reviews.*

Species/area	Year *Implementation* (*IR*s) completed	Next *Implementation Review*
West Greenland humpback whales (AWMP)	2014	After completion of North Atlantic humpback whale in-depth assessment – estimated start of IR 2024 or 2025
West Greenland bowhead whales (AWMP)	2015	Estimated completion 2022
North Atlantic common minke whales (RMP)	1993 (2003, 2008, 2017)	Estimated start 2022
North Atlantic fin whales (RMP)	2009 (2016)	Estimated start 2023
West Greenland fin whales (AWMP)	2018	Estimated start 2023
Alaskan and Chukotka bowhead whale hunts (AWMP)	2000 (2007, 2012, 2018)	Estimated start 2025
Common minke whales off Greenland (AWMP)	2018, 2019	Estimated start 2026
Chukotka and Makah gray whales hunt (AWMP)	2004 (2010) (2020)	Estimated start 2027

gaps or limitations' should be available one month after the adoption/circulation of the Scientific Committee report, along with an explanation of how to obtain the data in electronic format.

6.4 Recommendations, budget and workplan

In recent years, given the commonality of stocks in some cases and the need to try to undertake only one major *Implementation Review* at a time, the Committee had agreed to develop a longer-term *Implementation Review* work plan (IWC, 2020c), recognising that in some cases the period between such reviews may be slightly longer than the target of every six years. The Committee again reviewed the plan this year, recognising that it is provisional depending on the time taken to complete each review (1–2 years). An updated proposed schedule is given as Table 3.

7. STOCKS SUBJECT TO ABORIGINAL SUBSISTENCE WHALING (ASW)

7.1 New information and progress on recommendations

7.1.1 Eastern Canada/West Greenland bowhead whales

SC/68C/ASW/05 reported on the Canadian subsistence hunt of Eastern Canada-West Greenland (EC-WG) bowhead whales that occurs annually within the Nunavut Settlement Area (NSA) and the Nunavik Marine Region (NMR). Fisheries and Oceans Canada licenses bowhead whale hunts upon written confirmation that the appropriate Regional Wildlife Organization has approved the hunt plan. The combined maximum allowed take is seven EC-WG bowhead whales per year. During the 5-year period 2016–2020, a combined (NSA and NMR) total of 11 bowhead whales was landed. The length of the whales ranged from 8.0m to 17.0m and they comprised nine females, one male and one individual of undetermined sex.

For the 2021 season, allocations for two Inuit subsistence harvests within the Nunavut Settlement Area have been made. The remaining EC-WG bowhead harvest allocation decisions for Nunavut Settlement Area and the Nunavik Marine Region have yet to be announced.

The Committee thanked Canada, a non-member nation, for providing this important information, and welcomed Canadian participants at this and future meetings.

No bowhead whales were struck off West Greenland in 2020 (see SC/68C/O/06).

The Committee noted that an annual review of management advice was not required and **agreed** that the new information provided did not require calling for an early Implementation Review (IWC, 2019). The Canadian hunt of bowhead whales is taken into account within the West Greenland (WG) Bowhead Strike Limit Algorithm (SLA).

7.1.2 Bering-Chukchi-Beaufort Seas bowhead whales

Data from the aboriginal hunt for bowhead whales in Alaska are presented in SC/68C/ASW/01. In 2020, 69 bowhead whales were struck resulting in 54 animals landed. The total struck and the total landed for the hunt in 2020 were higher than the average over the past 10 years (2010–2019: mean struck = 56.9, SD = 10.7; and mean landed = 43.4, SD = 7.3). Efficiency (# landed / # struck) in 2020 was 78%, which was similar to the average for the past 10 years (mean of efficiency = 77%; SD = 7%). Of the landed whales, 22 were female and 32 were male. Based on body length, seven of the females were presumed to be sexually mature (≥13.7m in length). One whaling captain reported a whale to be pregnant with a foetus estimated at 1.8–2.1m long, while another captain reported a whale to be pregnant with a female foetus 4.4m long. None of those whales were closely examined by biologists for pregnancy primarily because monitoring was suspended in response to COVID-19.

The 2019 bowhead whale ice-based abundance survey, summarised in paper SC/68C/ASW/03, was conducted near Point Barrow, Alaska, from 16 March to 23 May. While every effort was made to conduct the survey in a manner consistent with past surveys, several factors compromised visual detection. Leads were closed during the beginning of the migration; however, once they opened, they grew much wider than during most past surveys. An unusual shore-fast ice event, in which a large portion of ice broke off close to shore between Point Franklin and Utqiaġvik, likely caused whales to migrate farther from the lead edge and farther offshore than usual. The Point Barrow area was designated as a power-boat hunting area for a variety of reasons; nevertheless, due to the ice conditions, the Point was still the best location for the observation perch. The motorized skiffs appeared to have a substantial effect on whale behavior, distribution and the number of whales observed in 2019.

Other locations farther south were not suitable for counting bowheads because an ice attachment (*iiguaq)* blocked the view of the lead and made them unusable. The primary observation perch was set in relatively shallow water which is associated with a lower proportion of whales within 4 km of the ice edge (termed P4) than perches in deeper water, such as those in the 1993, 2001 and 2011 seasons. Five ice floes became grounded in the lead partially obstructing the viewing area at the primary perch in the north.

The 2019 survey was visual-only and, unlike previous surveys, did not include an acoustic array to locate vocalising whales. Since an acoustic array was not deployed, a P4 estimate specific to 2019 could not be computed. Instead, a weighted average of past P4 statistics was used to correct the estimated number of whales within 4km of the lead edge (N4). Despite these limitations, sufficient visual effort occurred during periods with open leads, and sufficient numbers of whales were seen to allow calculation of an abundance estimate. Givens *et al.* (2020) calculated an abundance estimate of 12,505 whales

(CV 0.228) for the 2019 season. SC/68C/ASI/01 estimated a correction factor for boat disturbance that increased the initial abundance estimate by about 12%, yielding a corrected abundance of 14,025 (CV = 0.228). This corrected estimate was accepted by the Committee as Category 1A (acceptable for providing management advice using an AWMP SLA); see Item 11.1.7. Recognising the survey limitations experienced in 2019, the Committee suggested that even the corrected abundance estimate of 14,025 (see SC/68C/ASI/01) is likely to be an underestimate.

The Committee noted that an annual review of management advice was not required and **agreed** that the new information provided did not require an early Implementation Review (IWC, 2019c).

7.1.3 North Pacific gray whales

Shore-based surveys to estimate the abundance of eastern North Pacific (ENP) gray whales have been conducted by US NOAA Fisheries since 1967. These estimates are obtained from visual survey data collected off central California between December and February during the gray whale southward migration and provide regular updates to a now 50+ year time series of estimates. Surveys have recorded a generally increasing trend in ENP gray whale abundance, with the most recent estimate from 2016 being 26,960 whales (Durban *et al.*, 2017). This indicates that the population has roughly doubled since 1967 when it was estimated to be 13,426 whales (Laake *et al.,* 2012).

The most recent estimate of abundance for ENP gray whales migrating southward off the central California coast was derived from data collected between December and February 2019/2020 and is reported in Stewart and Weller (2021). The median estimate of total gray whale abundance for 2019/20 was 20,580 (95% Confidence Interval = 18,700–22,870). This estimate is considerably lower than the next most recent estimate of 26,960 (95% Confidence Interval = 24,420–29,830) in 2016.

Attention: ASI SWG
The Committee **agreed** *that the 2019/20 abundance estimate for ENP gray whales (Stewart and Weller, 2021) should be reviewed intersessionally by the ASI Standing Working Group following the procedure of IWC (2020, Annex P).*

Although the time series of abundance estimates for ENP gray whales has recorded generally increasing numbers, this trend has been punctuated by occasional declines such as the one observed between 1997 and 2000. In that period, estimated abundance declined from about 21,000 in 1997 to about 16,000 in 2001. This decline coincided with an unusual mortality event (UME) that occurred in 1999 and 2000 when higher than usual strandings and mortalities of gray whales were observed along the west coast of the United States, Mexico and Canada. Nevertheless, the population recovered from this decline and in 2016 the abundance was estimated at nearly its all-time high of 27,000 whales.

In 2019, the US NOAA Fisheries declared another UME for ENP gray whales (SC/68C/E/10). This UME coincided with the 23.7% decline in abundance estimates that occurred from 2016 to 2020 and is comparable to the 22.6% decline reported during the 1999–2000 gray whale UME.

In discussion, the Committee agreed with the authors that the pattern of population growth and decline represented in the time series of estimates suggests that these fluctuations are not uncommon. A decline was noted around 1990 in the absence of an observed UME leading to a suggestion that future population modelling should consider the possibility of a change in the bias of these estimates at that time.

Both the 2019 abundance estimate for Bering-Chukchi-Beaufort seas bowhead whales and the 2019/20 abundance estimate for eastern North Pacific gray whales were notably lower than previous estimates. SC/68C/ASW/02 examined the parameter spaces used during the development and testing of the Strike Limit Algorithms for these stocks to determine whether additional simulation testing is warranted. For bowheads, the new lower estimate is believed to be attributable to bias, and perhaps also normal statistical uncertainty. In terms of both bias and variation, the 2019 estimate falls within the range of what might be expected given the scenarios tested. For gray whales, the new lower estimate is believed to be attributable to the recent UME discussed above. That mortality event motivated a variety of testing scenarios that explored the impacts of similar future events. What was tested bears a remarkable resemblance to what has now occurred. Thus, for both stocks, the authors concluded that, despite the lower new abundance estimates, the respective Strike Limit Algorithms remain fully tested to cover present circumstances.

The Committee **welcomed** this work, highlighted its value, and acknowledged its validation of the SLA process in general. Moving forward, it was suggested that an evaluation of this type could be more fully formalized by using the SLA testing software to assess confidence intervals (or other parameters) for simulated abundance estimates.

Finally, a recent paper by Willoughby *et al.* (2020) regarding killer whale predation on bowhead whales was briefly discussed in the context of tested parameter space. In that paper, eighteen bowhead carcasses over 10 years were categorized as probable killer whale predation and it was hypothesised that such interactions may increase with the changing Arctic environment. The level of mortality observed thus far is well within the boundaries of tested parameter space, which included a broad range of mortality rates (a most likely annual mortality rate of 1% with random values up to about 5%).

Information on the 2020 subsistence hunt of gray whales in Russia was presented in SC/68C/ASW/04. In 2020, the Association of Indigenous Peoples of Chukotka distributed the Russian part of the block quota among 16 local whaling

communities. A total of 133 gray whales (69 male and 64 female – two of these 133 were 'stinky' whales [i.e., whales with a strong medicinal smell that are inedible]) were landed and 3 whales were struck and lost (total = 136 strikes). Mean body length (10.4m), blubber thickness (167mm) and weight (13.1 tons) were recorded in 2020 compared to mean length and weight of 10.0m and 10.3 tons, respectively, in 2019. The largest animal taken was a 14.7m female (33.9 tons) and the smallest a 7.5m female (5.6 tons). No females were lactating and three had a foetus. Sixteen whales had various injuries/traumas that were, in many cases, attributable to interactions with killer whales.

In discussion of SC/68C/ASW/04, the authors mentioned that there were no signs or symptoms of the Unusual Mortality Event observed in the eastern North Pacific 2019–2021 (see SC/68C/E/10).

The Committee welcomed the information on gray whales from across the Pacific and noted that an annual review of management advice was not required. The Committee **agreed** that the Gray Whale SLA and the Makah Management Plan remain the best way to provide management advice while noting that 'stinky whales' are accounted for in the Gray Whale SLA that calculates the aboriginal subsistence hunting strike limit.

Attention: SC, CG, ASW
With respect to matters related to hunts of North Pacific gray whales, the Committee:

(1) **reiterates** *previous advice that biological data, genetic samples and photographic data from Russia continue to be collected from live and harvested whales and analysed to provide information on stock structure and biology; and*

(2) **recommends** *collaborative sharing and integration of data from all ASW countries (e.g. photo-id catalogues, genetic samples) to help form joint scientific assets to best inform conservation and management actions.*

7.1.4 Common minke whale stocks off East Greenland

Twenty minke whales (5 male and 15 female) were landed in 2020 (SC/68C/O/06). None were struck and lost. These numbers include carry-over from 2019 to 2020 of three minke whales in East Greenland.

7.1.5 Common minke whale stocks off West Greenland

One hundred fifty-five minke whales (26 male and 129 female) were landed in 2020 (SC/68C/O/06). Seven were struck and lost. These numbers include carry-over from 2019 to 2020 of 52 minke whales in West Greenland.

The Committee **agreed** that an annual review of management advice was not required and noted that the review of the performance of the G-common minke SLA is appropriate to provide management advice to the Commission on both the West and East Greenland common minke whale hunts.

7.1.6 Fin whales off West Greenland

Three fin whales (2 male and 1 female) were landed in 2020 (SC/68C/O/06). None were struck and lost.

The Committee noted that an annual review of management advice was not required and **agreed** that the new information provided did not require calling for an early Implementation Review (IWC, 2019c).

7.1.7 Humpback whales off West Greenland (see Items 6.1 and 8.2.7)

Four humpback whales (2 male and 2 female) were landed in 2020 (SC/68C/O/06). None were struck and lost.

The Committee noted that an annual review of management advice was not required and **agreed** that the new information provided did not require calling for an early Implementation Review (IWC, 2019c).

7.1.8 Humpback whales off St. Vincent and the Grenadines (see Items 6 and 8.2.7)

The Secretariat was informed that no humpback whales were struck off St. Vincent and the Grenadines in 2020.

The Committee noted that an annual review of management advice was not required and **agreed** that the new information provided did not require any change to its existing management advice (IWC, 2019c).

7.2 Biennial workplan

In 2022, the Committee will review new biological information and catch information on species and stocks subject to aboriginal subsistence whaling.

The Committee reviewed a Research request titled 'Research and Monitoring of Endangered Western North Pacific Gray Whales Feeding off Sakhalin Island in 2021 and its Relevance to Aboriginal Subsistence Whaling Proposed by the Makah Indian Tribe in U.S. Waters' (SC/68C/RP/19). This proposal was submitted on behalf of the Far East Division of Russian Academy of Sciences and is an application for ASW voluntary funds[2] not the Scientific Committee research fund. It is stipulated that such proposals be reviewed by the Scientific Committee therefore, the Committee was asked to consider and endorse this Research request, if appropriate.

[2]Note: The Aboriginal Subsistence Whaling Fund is not under the governance of the Scientific Committee. It is overseen by the ASW Committee. Ordinarily such proposals would have been considered by the ASWWG but as this group no longer meets the SC reviewed the proposal to inform the ASW Chair in approving funding. The ASW fund was established at IWC64 and further information can be found in Appendix 2 of the Commission's Financial Regulations.

The proposal requests funds of £18,020 to continue research surveys by the Russia Gray Whale Programme (RGWP) on endangered western North Pacific (WNP) gray whales summering off Sakhalin Island and Kamchatka, Russia, which have been conducted annually from 1995-2020. The SC has repeatedly highlighted the importance of this research and the data time-series has proven critical to assessment of the population by the IWC, as well as the CMP, the IUCN, and in support of the range state Memorandum of Cooperation.

In addition to the scientific value of this work for conservation purposes, the annual photo-identification and genetic data are envisioned to serve a role in management of an ASW hunt proposed by the Makah Indian Tribe 802 to take ENP gray whales in US waters off Washington State. If a waiver to the US Marine Mammal Protection Act as requested by the Makah were to be granted, it would be specific to ENP gray whales and would exclude WNP gray whales. Therefore, the proposed US regulations governing the hunt include provisions for photographic (or genetic) identification of WNP gray whales. The regulations would require that there are adequate photo-identification catalogues and processes available to allow for the identification of WNP whales before issuance of a hunt permit. To meet this need, the US NOAA Fisheries must be able to utilise a photo-identification catalogue and/or genetic data to be able to determine quickly whether or not each whale struck is from the WNP population.

In summary, the principal outcomes of this work will include: (a) continuing the critical research by the RGWP on WNP gray whales; (b) fulfilling actions required under the western gray whale CMP; (c) supporting the spirit and intent of the range states Memorandum of Cooperation; and (d) ensuring that the ASW hunt as proposed by the Makah is managed following the aforementioned proposed US regulations.

In discussion of this Research request, the Committee endorsed its importance and **agrees** that the work proposed should move forward.

8. WHALE STOCKS NOT SUBJECT TO DIRECTED TAKES BY CONTRACTING GOVERNMENTS

8.1 Comprehensive or In-Depth Assessments (IA)

An updated process for undertaking Comprehensive (the first time an assessment is completed for a species/region) and In-Depth Assessments (subsequent assessments for a species/region) was agreed in 2018. The full process is described in Donovan (2018) and (IWC, 2020c, p.15).

8.1.1 Comprehensive Assessment of North Pacific Humpback Whales

Work towards a Comprehensive Assessment of North Pacific humpback whales began in 2016. An intersessional workshop was held in April 2017 (IWC, 2018b). In 2018, a simplified age-aggregated assessment model and four potential stock structure hypotheses were proposed (IWC, 2019c, p.18–19). However, there were questions about the connections among the proposed breeding and feeding areas. In 2019, Cheeseman was able to improve an automated photo-ID matching algorithm that became the technical basis for his website *happywhale.com*. As a result, it was decided that the Comprehensive Assessment should be postponed until the completion of a large-scale photo-ID matching exercise that was to incorporate a substantial quantity of new data from many regions across the North Pacific, including from some areas that had been under-represented during the ocean-basin-wide SPLASH project in 2003–2005 (Calambokidis *et al.*, 2008).

Clapham reported on the progress of the intersessional work since SC68B that is summarised below. Progress included further analyses of regional interchange and stock structure through photo-ID, genetics and satellite tagging; abundance and movement analyses; and the development of an updated catch series.

8.1.1.1 Stock structure hypotheses

In January 2021, a small group met virtually to discuss how recent matching affected region designation/boundaries, and other issues. Ultimately, they agreed to run a variant on the original SPLASH regions because the abundance and interchange model required contemporaneous sampling that was not possible with more recent data because of variations in temporal effort among regions. Consequently, insights from new data (either from areas not covered by the SPLASH program or covered with lower effort) were for the most part not incorporated into the assessment model. New information regarding population structure will be pursued separately outside the framework of the assessment.

Further discussions during an additional virtual intersessional meeting on 20 April 2021 resulted in a decision to use the regional breakdown shown in Fig. 1 (with the original SPLASH boundaries also illustrated). This structure includes:

- pooling Kamchatka, Commanders and the Western Aleutians into a single Russia stratum, which includes the Arctic region;
- including the Shumagin Islands with the Gulf of Alaska stratum, but running a variation in which they are part of the Eastern Aleutians/Eastern Bering Sea stratum;
- continue to pool Asia; and
- running Mexico as a single pooled stratum for a base case, but considering an alternative strata structure in which Mexico is split into Mainland and the offshore Revillagigedo Islands (with or without Baja California, which appears to be a mixing area).

There were questions regarding the location of the boundary between the Mexican and Central American winter feeding areas. Martínez-Loustalot *et al.* (2020) examined this question through photo-ID, calculating interchange indices between areas from Baja California south to Nicaragua, and a movement index that considers differing sample sizes. They concluded that the southern Mexico provinces (Guerrero and Colima) are part of the Central America population, where Bahia de Banderas is a mixing area between southern and northern Mexico.

The *Happywhale* photo-ID data showed an extremely high recapture rate (95%) from animals photographed off Central America, which was not the case in Mexico. Thus, it was suggested the Central American animals constitute a demographically older population with lower recruitment. The new SPLASH-2 project obtained about 350 photo-IDs from southern Mexico in 2021. This is a much larger sample size than was available from the original SPLASH project, which could provide new insights into this issue.

The Committee noted that conclusions drawn about Mexican areas from studies based on recent years (2014–2019) should be viewed in light of the strong anomalous oceanographic conditions throughout the North Pacific during these years, which are known to have affected humpback whale distribution patterns in other areas.

To shed more light on this issue, the Committee **agrees** that photo-ID data should be further examined to separate whales seen south of Banderas from those seen elsewhere. These subsets could then be subject to separate mark-recapture estimates for the two areas. Cheeseman, Calambokidis and Urban agreed to coordinate on data sharing to enable such an exercise.

For the time being, a provisional boundary between the Mexican and Central American populations was set just south of Bahia de Banderas (see Fig. 1); this may be revised based upon the analysis described above.

8.1.1.1.1 Mixed-stock analysis of mtDNA haplotypes

The allocation of catches from the feeding grounds to breeding stocks is one of the objectives of the Comprehensive Assessment. This catch allocation process is complicated by the mixing of individuals from different breeding stocks on shared feeding grounds. SC/68C/IA/01 used mixed-stock analyses to estimate the apportionment of humpback whales from feeding areas to breeding regions as a proxy for allocation of historical catches, where breeding regions are considered to be source stocks. The analyses first updated the frequencies of mitochondrial DNA haplotypes from regional samples collected during the SPLASH program from 2004 to 2006, adding nearly 1,000 additional samples to the 1,800 published previously (Baker *et al.*, 2013). Most of these additional samples were collected in Mexico, a region known to have a complex pattern of interchange and varying migratory destinations. The analyses then used the Statistics Programme for Analyzing Mixtures (SPAM) to estimate the contributions of breeding regions to feeding areas. The original SPLASH program recognized

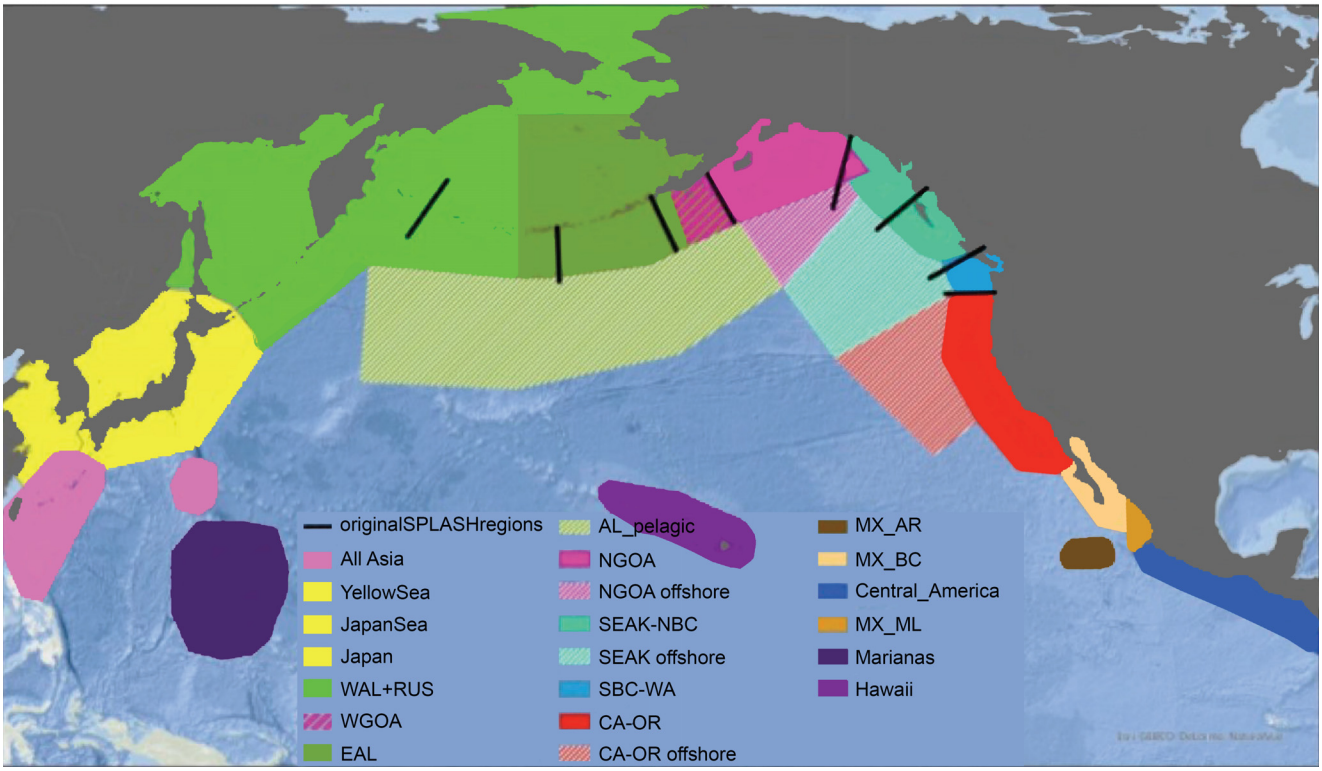


Fig. 1. Regions and region boundaries agreed by the Working Group on 20 April 2021; dark lines represent the boundaries from the original SPLASH project (as shown in Calambokidis *et al.*, 2008).

10 feeding areas and 8 breeding regions. Following discussion in the Working Group in January 2021, the authors considered three revised stratifications of breeding regions (B) representing the putative 'pure' stocks, and two revised stratifications of feeding areas (F) representing the 'mixed' stocks, as follows:

(B1) 4 Breeding regions (including Baja) – [OG + OK + PHI], Hawaii, [MX–ML + MX–AR + MX–BC], Central America
(B2) 4 Breeding regions (excluding Baja) – [OG + OK + PHI], Hawaii, [MX–ML + MX–AR], Central America
(B3) 5 Breeding regions (excluding Baja) – [OG + OK + PHI], Hawaii, MX–ML, MX–AR, Central America
(F1) 8 Feeding areas – [RUS + WAL], EAL, BER, WGOA, NGOA, [SEA + NBC], SBC–WA, CA–OR
(F2) 6 Feeding areas – [RUS + WAL], [EAL + BER + WGOA], NGOA, [SEA + NBC], SBC–WA, CA–OR

Together, the combination of the revised strata provided six scenarios for mixed-stock analyses: B1/F1, B1/F2, B2/F1, B2/F2, B3/F1 and B3/F2. These six scenarios allowed for the revision of the breeding regions and feeding areas previously defined by the SPLASH program. After discussion, it was agreed to use a third stratification of the feeding areas in an additional analysis, as follows:

(F3) 6 Feeding areas – [RUS + WAL], [EAL + BER], [WGOA + NGOA], [SEA + NBC], SBC–WA, CA–OR

The B3/F2 Scenario was most consistent with other evidence concerning stock structure in the North Pacific, especially in distinguishing between the migratory destinations of mainland Mexico and Revillagigedo Mexico (Fig. 2). An interesting finding was that the haplotypes of a small sample from the Mariana Islands were surprisingly similar to those from offshore Mexico.

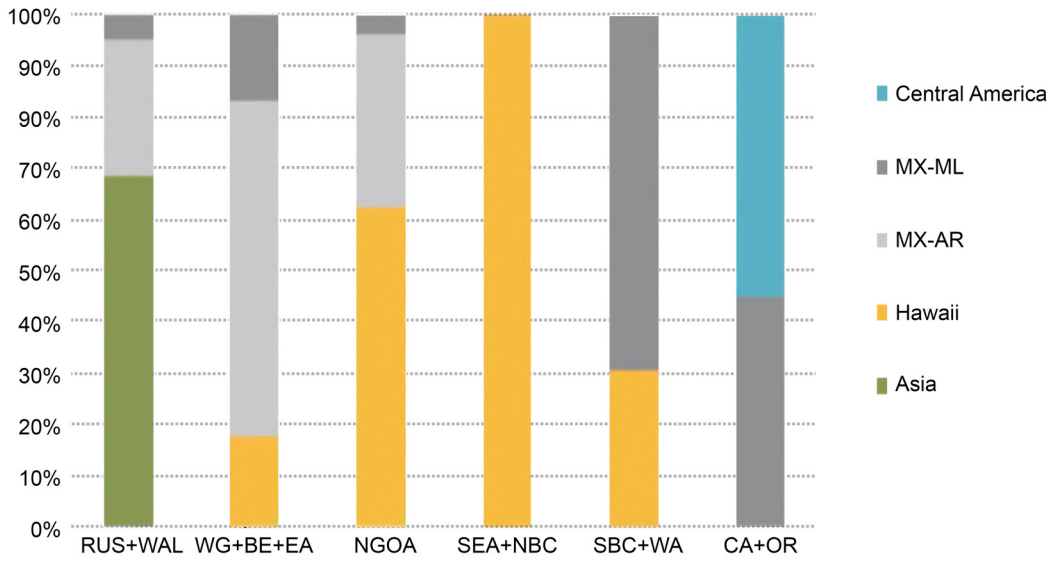


Fig. 2. Mixed-stock apportionment of North Pacific humpback whale breeding regions to feeding areas, as outlined in scenario B3/F2 (from SC/68C/IA/01).

8.1.1.1.2 Photo-ID matching

Since SPLASH (Calambokidis *et al.* 2008), there has been a considerable quantity of new photo-ID data in the North Pacific. The most recent *Happywhale* photo-ID matching exercise, known now as the North Pacific Photo-ID Collaboration (NPC), involved 42 photo-ID collections from 18 regions. This includes 109,925 identified encounters of 26,925 individual humpback whales. The temporal distribution of all available records for this comparison ranged from 1977 to the present; however, the majority are relatively recent. In contrast, SPLASH's collection includes only two breeding ground seasons and three feeding ground seasons. Overall, 7.8% of NPC records date from pre-SPLASH (i.e. prior to 1 December 2003), representing 8,594 of the 109,925 ID'd encounters; and 12.9% (14,163 encounters) from the SPLASH time period (2003–2005). These latter records include approximately two-thirds of the full SPLASH dataset as well as records from other sources. NPC, like SPLASH, is relatively data-constrained in the western Pacific. NPC has a much larger Russian dataset than SPLASH, but has very little post-SPLASH data from Japan due to constraints in establishing collaborations that may be resolved in the coming year. Little data exist for the Revillagigedos post-SPLASH, though a current Sea Shepherd effort holds some promise.

Preliminary findings show migratory patterns consistent with those described by SPLASH. Some notable but preliminary differences include:

(1) Connectivity between Hawaii and Mexico, both Revillagigedos and the mainland: NPC found encounters of 276 individuals out of 17,452 total (101 to Revillagigedos, 140 to Baja, and 77 to mainland Mexico). This is four times higher than that found in SPLASH (17 individuals out of a 3,950 total);

(2) Connectivity from Russia to Mexico: from Russia, of 2,192 individuals, the NPC contains breeding ground sightings of 624 individuals. Of these, 341 are in Hawaii, 117 in Mexico (23 in Revillagigedos, 80 in Baja, 36 in Bahia Banderas, with no observed connections to southern Mexico). While effort varies between locations, this suggests that Russian whales roam more widely than whales from other feeding grounds; and
(3) While the data have not yet been explored in depth, there are many cases of individuals changing feeding grounds, often apparently becoming site-faithful to new grounds.

A major gap in humpback whale photo-ID data for the North Pacific concerns Japanese and nearby waters, including Ogasawara and Okinawa. Currently, the majority of images from this region come from the SPLASH project (2004–2006), with few more recent data. The matching and exchange of whales using the various breeding grounds in Japanese waters would enhance understanding of the occurrence and feeding ground origins of these whales.

It was noted that there has been photo-ID sampling in Central America this past winter, including in Costa Rica, Nicaragua and Panama, as part of the SPLASH-2 project; results are not yet available, but the data are expected to provide important new insights into the movements of whales from this region.

8.1.1.1.3 Satellite tagging

SC/68C/IA/02 provided an overview of humpback whale satellite tagging efforts conducted by Oregon State University (OSU) in the North Pacific between 1995 and 2019, in the context of the ongoing Comprehensive Assessment. During the 1995–2019 period, OSU deployed 256 tags on humpback whales in three wintering areas (Hawaii, n = 105; Baja California, Mexico, n = 7; Revillagigedo Islands, Mexico, n = 11) and three summering areas (Aleutian Islands, n = 5; Southeast Alaska, n = 47; and U.S. West Coast, n = 81, which comprised separate tagging efforts in Washington, Oregon, and California). Movements towards, or arrival at, long-distance migratory destinations were documented for multiple animals across the North Pacific, including winter-summer and summer-winter transits, providing an opportunity to examine how tagging data might inform the assessment. In particular, the tagging results can be used to confirm the current feeding and breeding designations as well as to determine the relative apportionment of animals from an area that migrate to one or more distinct destinations in the opposite season. The tagging data can also be mined to obtain presence/absence and mixing matrix probabilities among the strata considered in the assessment for input into the assessment model as independent data. Additional metrics that can be extracted for each stratum include timing of occurrence, travel speed, and residence time, which might be informative in the interpretation of the assessment results. Finally, as genetic and photo-ID materials are available from the tagged animals, these data could also be used for further validation of results.

8.1.1.2 Abundance time series

As noted above, the first comprehensive photo-ID study of humpback whales throughout the North Pacific occurred in 2004–2006 during the SPLASH project. Photo-ID data were collected for three years (2004–06) in winter areas and for two years (2004–05) in summer areas. Total abundance for the entire North Pacific was estimated by Barlow *et al.* (2011) to be 21,808 (CV = 0.04). In SC/68C/IA/03, the objectives were to estimate abundance within all sampled winter and summer areas in the North Pacific, as well as to estimate migration rates between these areas. Based on genetic analyses (Baker *et al.*, 2013), and an examination of migratory destinations, winter areas were defined to be (1) Asia (including Ogasawara, Okinawa, and the Philippines), (2) Hawai'i, (3) Mexico, and (4) Central America. Based primarily on interchange (or lack thereof) between adjacent areas, and an examination of migratory destinations, summer areas were defined to be (1) Russia, (2) the Aleutian Islands and Bering Sea, (3) the Gulf of Alaska, (4) Southeast Alaska and northern British Columbia, (5) southern British Columbia and Washington, and (6) California and Oregon. A multi-state mark-recapture model was fitted to the photo-ID data using a six-month time-step, with the four winter areas and the six summer areas defined to be the sample strata. Results show a strong migratory connection between the Russia feeding area (N = 1,340, CV = 0.30) and the Asia winter area (N = 1,084, CV = 0.09). The winter feeding areas in Alaska, as well as northern British Columbia, support the majority of the North Pacific population, including the Aleutian Islands and Bering Sea (N = 7,758, CV = 0.20), the Gulf of Alaska (2,129, CV = 0.08), and Southeast Alaska and northern British Columbia (N = 5,890, CV = 0.08). Those feeding areas all have a strong migratory link to Hawaii (N = 11,540, CV = 0.04), with the link between Southeast Alaska/northern British Columbia and Hawaii (a 0.98 proportion) being particularly high. On their return, nearly all Hawaiian whales migrate to Alaska and northern British Columbia. The migratory destination of whales that winter in Mexico (N = 2,913, CV = 0.07) is the most diverse, with whales going to all feeding areas. Nearly all Central American whales (N = 755, CV = 0.24) migrate to California and Oregon to feed (a 0.97 proportion), but the California/Oregon feeding area (N = 1,477, CV = 0.13) comprises a mix of whales from Mexico and Central America.

The combined feeding ground estimates in this analysis totaled 18,942 whales, similar to the Barlow *et al.* (2011) estimate of 21,808, which was pooled across all areas. There was a difference between the multi-state estimate for (pooled) Mexico (2,913, CV = 0.06) and a separate Chao mark-recapture estimate (4,910, CV = 0.04); the lower estimate is difficult to explain.

In general, winter-summer mark-recapture estimates for humpback whale abundance are more reliable than those using winter-winter pairs. The winter-summer estimates from SC/68C/IA03 are quite close to the Barlow SPLASH estimate.

The much larger sample size obtained by the NPC could be used to provide more recent estimates of abundance than those from SPLASH (which are now 17 years old), at least for areas with adequate sample sizes. If these indicated population growth since the 2004 SPLASH benchmark, it might be possible to calculate a current overall estimate for the North Pacific by applying a mean rate of increase to the SPLASH estimates and those from the multi-strata model given in SC/68C/IA/03.

Calambokidis and Barlow (2020a) calculated updated estimates of abundance for humpback whales along the US west coast, based on regions, capture-recapture models, years, and datasets. For California/Oregon, they concluded that the estimate of 4,973 (SE:239, 80% CI: (4,776, 5,178)) based on the Chao model for the last four most recent available years (2015–2018) for photo-IDs obtained from June to October (and excluding NPC contributions) is the best overall estimate of abundance of humpback whales in this region. This is more than three times larger than the corresponding estimate calculated from SPLASH data.

8.1.1.3 Catch history

An updated catch series from 1656-1972 for North Pacific humpback whales was presented in SC/68C/IA/04. Adjustments were made for missing or incomplete data from three areas/time periods: net whaling in Japan (17th–19th centuries), historical sail-based Yankee whaling (late 18th century to early 1900s), and early modern coastal whaling off California. The revised catch total for all areas for the 20th century only (1900–72) is 30,871 whales. Including the median and maximum historical values for Asia, historical pelagic and California-Oregon land-stations brings the catch totals for the entire period (1656–1972) to 37,340 (median) and 40,727 (maximum). Catches were assigned to currently designated assessment regions (Table 4).

The Committee noted the uncertainties due to the missing and incomplete data, particularly for aboriginal whaling data, and agrees that sensitivity trials be developed to investigate the impact of these uncertainties and the adjustments used.

Ivashchenko re-stated her continued view that the relatively low levels of humpback catches taken by the USSR in Russian waters beginning in the 1930s likely reflects depletion of the stock off Japan as a result of the historical exploitation of the species in that region.

Table 4

Total catches of North Pacific humpback whales, 1656–1972. The totals for Asia and CA/OR are both 'high' estimates derived from correction factors for missing data. The figure for Central America is apportioned from catches off the population's major feeding ground off California; there were no known humpback whale catches taken off the Central American coast in the boreal winter. Abbreviations: SEAK/NBC: SE Alaska, northern British Columbia; SBC/NWA: southern British Columbia, northern Washington State; CA/OR: California/Oregon. The total catch for the entire period is 40,727 whales, including 30,871 taken in the 20th century.

Asia	W Aleutians Bering Sea, Russia	E Aleutians, Bering Sea	Shumagin Islands	Gulf of Alaska	SEAK NBC	SBC NWA	CA OR	Mexico all	Central America
11,562	1,802	5,567	516	4,082	4,567	4,101	5,581	2,695	164

8.1.1.4 Time series of other human mortalities

Data on other human-caused mortalities are difficult to obtain for many areas in the North Pacific.

The US annual Stock Assessment Reports attempt to estimate mortality and serious injury (the latter broadly defined as an injury likely to lead to death) from a combination of direct observation of mortalities and extrapolations of rates derived from fishery observer data. Not all mortalities are detected or reported, especially in areas outside US waters (where some survey or observer coverage exists), so reported rates are regarded as minima. Further complicating the use of these data are the stock designations used in US Report differ from those employed for the IWC assessment. The most recent mean annual minimum estimates of mortality and serious injury for humpback whales, from all sources (fishery interactions, ship strikes and other causes), for the five-year period 2013–2017, and for the three stocks used in the US Reports are as follows (Carretta *et al.*, 2020; Muto *et al.*, 2020):

(1) California/Oregon/Washington: 20.25 humpbacks/year;
(2) Central North Pacific: 26.2 humpbacks/year; and
(3) Western North Pacific: 2.6 humpbacks/year.

The Committee noted other sources of mortalities that should be investigated include the following: bycatch from all countries in the North Pacific, bycatch from fisheries no longer operating (such as high-seas driftnets), and native subsistence whaling operations (such as by the Makah and the Nootka). It also noted that some information could be compiled from the IWC National Progress Reports (see Annex H), where adjustments could be made in future for under-reporting or missing regions.

8.1.1.5 Life history parameters

A Workshop in April 2017 compiled and reviewed the available information on biological parameters for humpback whales in all oceans (IWC, 2018b). There is no new information on biological parameters since that review.

8.1.1.6 Assessment

A preliminary simplified assessment of North Pacific humpback whales was conducted during SC68C. The assessment model was based on the B1/F2 stock structure hypothesis. Catch data by breeding and feeding grounds were the medium level specified in SC/68C/IA/04. Mixing proportions of animals on each feeding ground that originated from each breeding ground were based on genetic data (SC/68C/IA/01) and on mark-recapture data. Both mixing proportions of animals on each breeding ground that migrate to each feeding ground and estimates of abundance by feeding and breeding ground were based on mark-recapture data. In all these cases data were updated from SC/68C/IA/03 to reflect the B1/F2 stock structure hypothesis. Minimum levels of uncertainties (SDs of 0.02 and CVs of 0.05) were imposed if the reported measures of uncertainty were very small or not available. The data were all assumed to relate to period 2004–2006. The assumed intrinsic growth rate parameter was set to r = 0.1.

The Committee thanked Punt and Privitera-Johnson for providing an initial assessment run during the virtual meeting and was pleased to note that the model captured the general pattern of the data, even though all the data had not been included in the model. The Committee discussed the plans for a more complete model and some of issues that needed to be investigated further. The more complete model will include the additional available abundance estimates, which need review by the ASI sub-group, and movements between breeding and feeding grounds based on site fidelity. The population intrinsic growth rate will be set to a more realistic value such as r = 0.07 or be estimated when all the data are included. Several discrepancies in the input data will also be addressed, such as, the sum of the abundance estimates based on mark-recapture for the breeding grounds being 16,332, while the sum of the abundance estimates based on mark-recapture for the feeding grounds is 17,080. In addition, the proportion of animals in the Russia + WAL feeding ground from the Mexico breeding ground is 0.248 (SD 0.11) using genetics data, but only 0.001 (CV 0.008) from the mark-recapture data.

The Committee **recommends** that the intersessional steering group be re-established under Chapham (Annex O) to further the work towards this assessment that should include the following.

(1) Update estimates of abundance and movement rates from photo-ID data (Wade and others).
(2) Investigate whether the genetic data can be used to estimate 'reverse' migration along with the estimates already provided from a mixed-stock analysis (Baker).
(3) Further investigate the location of the boundary between the Mexican and Central American feeding areas (Cheeseman, Calambokidis and Urban).
(4) Identify and summarize other data that can be used in the assessment, including trend data and more recent estimates of abundance for some strata.
(5) Refine factors to account for missing data in historical catches, as possible (Ivashchenko).
(6) Assess satellite tagging data to inform the assessment model (Palacios).
(7) Collate humpback whale bycatch data from National Progress Reports issued by Japan, Korea, Russia and any other western North Pacific country as far back as reports are available (Palka).
(8) Develop the assessment model further to incorporate all available data and inspect preliminary results. Attempt to run for several stock structure hypotheses (Privitera-Johnson, Punt).
(9) Develop sensitivity scenarios around uncertainties.
(10) Arrange a workshop to further the assessment. The Marine Mammal Laboratory in Seattle is expected to offer to again host this meeting, likely at some time later in 2021.

Attention: SC, R
The Committee is undertaking a Comprehensive Assessment of North Pacific humpback whales and to complete the matching of the large-scale photo-ID effort, the Committee **reiterates** *its previous strong encouragement for all catalogue holders to contribute photographs to participate in this exercise, after the appropriate data sharing agreements have been reached;*

The Committee **agrees** *that to complete the Assessment:*

(a) ongoing genetic analyses should be completed and reviewed by the Committee;
(b) abundance estimates should be developed and reviewed by the Committee;
(c) options to quantify bycatch, ship strikes, and aboriginal whaling should be developed;
(d) the proposed analysis of satellite tag data should be conducted to inform the assessment model;
(e) the assessment model should be developed further; and to facilitate this work, the Committee:
(f) **re-establishes** *an intersessional steering group, convened under Clapham and* **endorses** *its work plan;*
(g) **endorses** *the proposed analysis of satellite tag data, along with its budget, and*
(h) **econfirms its previous endorsement** *for holding an intersessional workshop to complete or appreciably advance the progress of the assessment using funds allocated previously.*

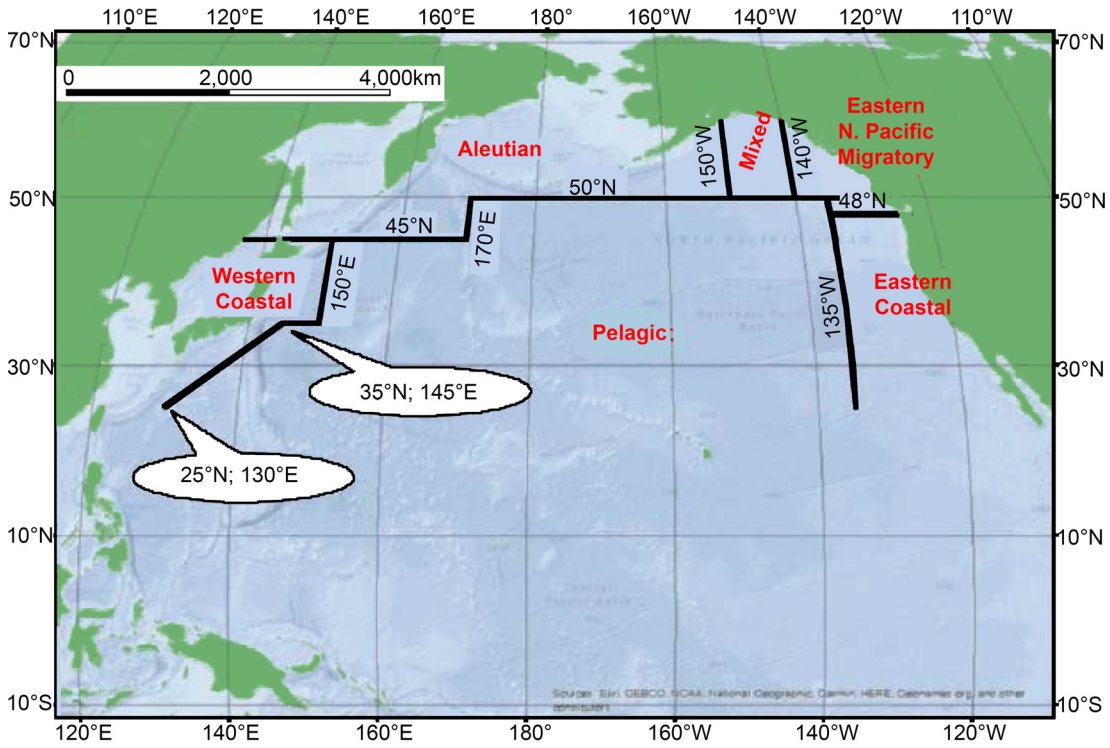


Fig. 3. Lines (black lines) for dividing data into sub-areas for the Comprehensive Assessment of North Pacific sei whales. Red words indicate name of the sub-areas. Numbers indicate locations of the lines.

8.1.2 Comprehensive assessment of North Pacific sei whales

The Comprehensive Assessment of North Pacific sei whales has been structured around attempts to integrate information from the following sources of data: (a) historic catches; (b) estimates of recent absolute abundance from POWER and other surveys; (c) indices of relative abundance derived from other surveys and scouting vessels extending back to 1965; and (d) data from Discovery marks and recoveries. A multi-area age-structured population model has been developed by Punt that integrates the above sources of data into a common likelihood framework.

The work to date has proceeded on the basis of two working hypotheses regarding the population structure: (i) a single stock of sei whales distributed throughout the North Pacific; and (ii) five stocks, centered on five designated sub-areas, but with some overlap in their summering grounds (Fig. 3). The sub-areas are Western Coastal, Aleutian, Pelagic, Eastern North Pacific and Eastern Coastal. A mixing sub-area was also defined in the Gulf of Alaska containing whales from Aleutian, Pelagic and Eastern North Pacific. There has not been consensus on the relative plausibility of the two hypotheses.

8.1.2.1 Progress of intersessional work

SC/68C/IA/07 documented the progress made by the intersessional working group on North Pacific sei whales. The group worked on refining the input data for the assessment and reviewed the results of further exploratory fits of the population model. The catch series was revised using the latest releases of the IWC Catch Data Base (Allison 2020; 2021). The main changes were the incorporation of more data from original Japanese sources that enabled sei and Bryde's whales to be separated in catch statistics from 1955, prior to the recognition of sei and Bryde's whales as separate species by the BIWS. The resulting catch series included 68,287 sei whales, a net reduction of 1,700 whales relative to the series produced at SC/67b. The Committee thanked Allison and Yoshida for their work on revising the catch data, and **agrees** that the catch series can now be considered sufficiently complete for assessment purposes.

The revised catch data also allowed some improvements to the marking data set. Recoveries from 1955 onwards in the zone of overlap of sei and Bryde's whales could now be more reliably assigned to species. This led to an increase in the sample size of recoveries assigned to categories A and B, which are used when fitting the assessment model. The analysis of the relative abundance data from scouting vessels and dedicated surveys was repeated using corrected input data.

SC/68C/IA/06 presented updated specifications and results for the age-, sex-, and season-structured population dynamics model, using the revised input data and considering options discussed by the intersessional group. The fundamental conflicts in the data, noted by the Committee in previous years, remain. The estimate of absolute abundance for the Pelagic sub-area suggests a population that is much less depleted than the relative abundance and mark-recapture data. The point estimate of abundance for the Pelagic sub-area (approx. 30,000 whales) exceeds the inferred pre-exploitation size of the population in that subarea.

The intersessional group explored whether the lack of fit could be caused by seasonal effects, but after reviewing the seasonal pattern of the catch and abundance data, concluded that seasonal differences were unlikely to explain the discrepancy.

8.1.2.2 Finalise input data

The Committee **agreed** that no further refinements to the catch, marking and relative abundance data were required, but that the relative abundance data could be more flexibly interpreted in the model fitting, to allow some variation in the relative/absolute ratio among sub-areas, as suggested in SC/68C/IA/06.

There was some discussion of the absolute abundance data, given the difficulty in fitting the high abundance estimate for the Pelagic sub-area. The estimates of abundance east of 170°E for the Pelagic, Aleutian and Mixing sub-areas were obtained from the POWER surveys conducted north of 40°N during 2010–2012 (while JARPN II data had been used for the areas west of 170°E). The POWER surveys during 2013–2016 confirmed the near absence of sei whales south of 40° in the Pelagic sub-area during summer. There were sei whale sightings during the 2019 POWER survey in the Gulf of Alaska, in areas that had poor coverage but no sei whale sightings in 2010–2012. The Committee considered that using the additional data for just this part of the area after an 8-year gap would not improve the estimate of abundance for the Pelagic sub-area, given the likelihood of fluctuations in distribution between years. The possibility that the estimate from 2010–2012 could have been subject to inter-annual distribution shifts was discussed. Model-based estimation using ecological covariates such as sea surface temperature, as proposed in the preliminary analyses of Inai *et al.* (2019), could throw light on the distribution shifts. The Committee **encourages** presentation of results next year.

As noted at SC68A (IWC, 2020c), the Committee had agreed that the evidence for multiple stocks was weak. However, because virtually all the genetic samples had been obtained in just one of the putative sub-areas (the Pelagic sub-area), the Committee was not able to reject the hypothesis of multiple stocks at that stage. The Committee notes that the catches in 2019 and 2020 were taken in the Western Coastal (WC) sub-area.

Pastene explained that the genetic data from samples of the 2019 and 2020 catches are currently being validated in Japan, and that the priority for analysis is a domestic assessment. He indicated that if something interesting is found or the results change, they will share the information with the Committee. However, the plan is to conduct a combined analysis of the genetic and satellite tagging data, which could take some time. They also plan to conduct kinship analysis, using these data combined with data from JARPN II and POWER.

There was no longer an agreed summer abundance estimate for the Eastern Coastal area, after the intersessional group had concluded that the sightings on which last year's estimate was based were far offshore and late in the season and likely belonged to other populations on migration. Determination of a zero or maximum estimate for the Eastern Coastal area was assigned to intersessional work.

8.1.2.3 Finalise assessment model

The Committee **agreed** that changes to the model suggested in SC/68C/IA/06 be implemented intersessionally, but accepted that it may not be possible to find an assessment that reconciles all the available information. The Committee **agrees**, however, that it is important that (i) the input data and the model fits that were explored be documented in one place; and (ii) the available information on sei whales in each area of the North Pacific be summarised to provide a general picture of the status of the historical and current status of the species in each sub-area. A provisional outline for the status summary document was agreed. The task of producing these documents was included in the work plan.

The Committee **agrees** to reestablish the North Pacific sei whale Comprehensive Assessment intersessional correspondence group convened under Cooke (Annex O).

Attention: SC
To complete the Comprehensive Assessment of North Pacific sei whales, the Committee:

(1) **re-establishes** *the intersessional correspondence group under Cooke, where the terms of reference are:*
- *check final model inputs and review results of the model fitting.*
- *produce a document detailing the input data and the main modelling results.*
- *produce a document summarizing the status of sei whales in each area of the North Pacific, based on the outline agreed at this meeting.*
- *review any new genetic results or abundance estimates that become available.*

(2) **confirms** *that the remaining budget allocation for the North Pacific sei whale population modelling work should be carried over to allow Punt to complete the modelling work.*

8.1.3 Progress on in-depth assessment of western North Pacific common minke whales

This assessment, which started as an *RMP Implementation Review*, is focusing on the conservation implications of removals of common minke whales throughout the western North Pacific. Last year, the Committee agreed that given the withdrawal

of Japan from the IWC, the appropriate process to follow was that of an in-depth assessment with a particular focus on levels of bycatch and the status of J-stock(s) rather than an *RMP Implementation Review*.

The in-depth assessment is based on three primary stock structure hypotheses (see Fig. 4 for the sub-areas included in the assessment):

(1) *Hypothesis A.* There is a single J-stock that occurs to the west of Japan (Sea of Japan and Yellow Sea) and the Pacific coast of Japan (sub-areas 2C, 7CS, 7CN, 11 and 12SW) and a single O-stock in sub-areas to the east and north of Japan (2C, 2R, 3, 4, 7CS, 7CN, 7WR, 7E, 8, 9, 9N, 10E, 11, 12SW, 12NE and 13);
(2) *Hypothesis B.* As for hypothesis (A), but there is a third stock (Y) that occurs in the Yellow Sea (sub-areas 1W, 5 and 6W) and overlaps with J-stock in the southern part of sub-area 6W; and
(3) *Hypothesis E.* There are four stocks, referred to as Y, J, P, and O, two of which (Y and J) occur in the Sea of Japan, and three of which (J, P, and O) are found to the east of Japan. Stock P is a coastal stock. There is demographic dispersal between the J- and P-stocks and between the O- and P-stocks.

In 2019 the Committee agreed that the inclusion of hypothesis E can only be maintained if some demographic exchange between the P stock and both J- and O- stocks is allowed (IWC, 2020c).

Intersessional progress had focused on the details of the assessment specifications and developing the computer code to implement the four stock structure and other scenarios already agreed. Allison reported that the population dynamics model for the assessment had been coded and most of the data had been assembled. The Committee thanked Japan and Korea for providing updated data on direct catches and bycatches, as well as details of the surveys (e.g., effective search width, track line length, number of animals observed).

Allison and de Moor reported on several changes to the specifications of the assessment that were identified during the coding process. The Committee reviewed proposed changes to these specifications and agrees (see Annex D for the revised specifications) that:

(1) estimates of abundance based on less than 70% coverage should be treated as 'minimum abundance estimates' (except in sub-areas where there are no other estimates);
(2) the approach used to generate abundance estimates for estimates of abundance that are not 'minima' should be applied to 'minimum' estimates of abundance;
(3) the maximum size for each survey estimate for sub-areas 5 and 6W should be based on scaling the minimum sizes upwards by the inverse of the proportion of area surveyed, and the minimum and maximum abundance estimates should be in included in the objective function using a method that allows for the uncertainty of the estimates;
(4) the model expectation for an abundance estimate based on a survey conducted during multiple months should be based on weighting the model predictions using the proportion of the months during which the survey occurred;
(5) the zero abundance estimates should be included in the objective function under the assumption of an overdispersed Poisson distribution, with the extent of overdispersion specified as detailed in Annex D;
(6) the effort in the fisheries that lead to bycatch off Japan should be based on the numbers of large-scale set nets (where the nets with unknown location are assigned to sub-area in the same proportion as the data for set nets with known location);
(7) the effort in the net fisheries that lead to bycatch off Korea should be based on the number of nets rather than licenses; and
(8) projections of set net numbers beyond the years with data (2018 for Japan; 2009 for Korea) should be set to the average of the last five years with data. The Committee identified several additional sensitivity tests based on alternatives to the baseline specifications (see Annex D).

Allison and de Moor presented initial conditioning results for hypotheses A and E. The Committee then identified the following tasks that need to be completed before the conditioning process can be completed.

(1) The ASI Standing Working Group should conduct an intersessional review of the abundance estimates that have yet to be accepted to date to enable the conditioning process to be finalized.
(2) The time-series of set nets for Korea should be updated if possible, by summer 2021.
(3) Additional details should be added to the table of abundance estimates (exact survey dates, effective search width, track line length, number of animals observed), where possible by summer 2021.
(4) The approach for implementing minimum estimates should be refined as the current penalty is too weak to prevent the population size in sub-areas 5 and 6W being estimated to be lower than the minima.
(5) The actual, rather the model-predicted, bycatches should be removed for the years for which actual values are available.
(6) Estimates of dispersal rates between the J- and P-stocks and the P- and O-stocks (planned for the intersessional workshop) need to be confirmed.

Two years ago, the Committee had approved funds to hold an intersessional workshop to further this in-depth assessment, but it could not be held prior to SC68C due to COVID-19. The Committee **reiterates** its support for holding the

workshop prior to SC68D. The Committee **agrees** to reestablish the Intersessional Steering Group (Annex O) that should decide toward the end of September 2021 whether sufficient intersessional progress has been made to warrant holding the workshop, which may need to be hybrid (some in-person, other remote participants) given COVID-19. The Committee noted that members can apply for the use of data held by Japan in the normal way through the Institute of Cetacean Research or the National Research Institute of Far Seas Fisheries (the standard data related to catch and bycatches are and will continue to be publicly available) (IWC, 2021a, p. 22 for information on Japan stance on participation in SC meetings and data access). The Committee again **encourages** the attendance of Japanese and Korean experts at the workshop if possible.

Attention: SC
The Committee **reiterates** *the need to conduct an in-depth assessment of western North Pacific common minke whales with a focus on bycatch levels and the status of J-stock(s). Recognising the difficulties in holding the workshop agreed last year prior to SC68C, the Committee* **reiterates** *the importance of the workshop and:*

(1) **recommends** *that the funds allocated two years ago are used to hold a workshop prior to SC68D at a time when it is safe to do so;*
(2) **agrees** *that the primary objectives of the workshop are to: (a) build upon the work undertaken thus far on finalising and conditioning the operating models; (b) confirm or update levels of dispersal to include in the trials; (c) review the results of the initial conditioning and determine the necessary scenarios for future projections; and (d) develop a work plan that will allow for results to be presented to SC68D, ideally enabling the in-depth assessment to be completed at SC68D; and*
(3) **establishes** *a Steering Group under Donovan to: (a) oversee the preparations for the workshop including finalising the agenda, the pre-workshop preparations, the venue and date of the workshop, and the list of invited participants; and (b) coordinate the pre-workshop work, including commenting on trial specifications and initial conditioning results.*

The Committee **endorses** *the funding request for the assessment model analyses that are essential to complete this in-depth assessment.*

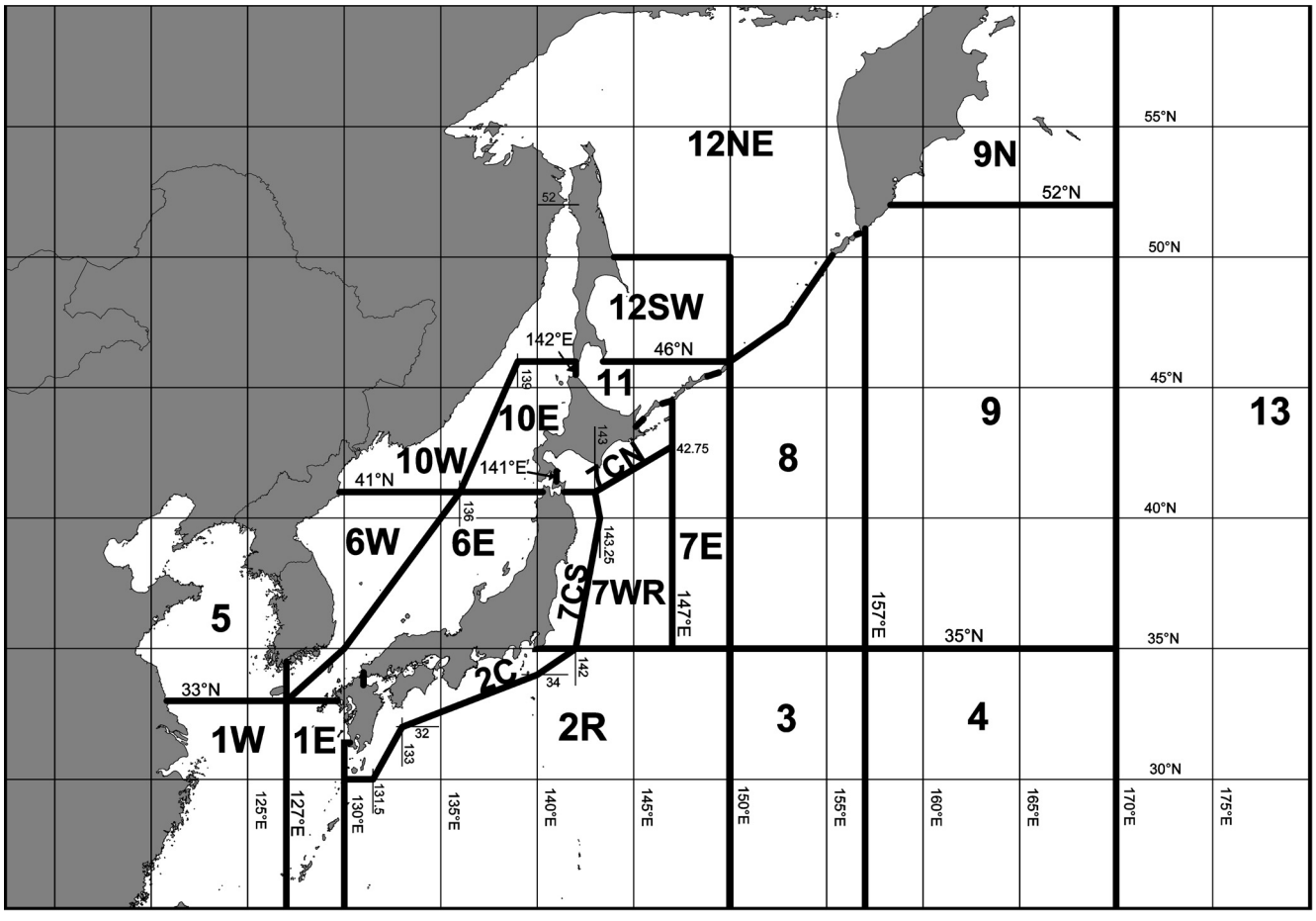


Fig. 4. The 22 sub-areas included in the population dynamics model for the western north Pacific minke whales.

Table 5

Work plan for Comprehensive and In-depth Assessments.

Item	Intersessional 2021/22	2022 Annual Meeting (SC68D)
Comprehensive Assessment of North Pacific humpback whales (Item 8.1.1)	Re-establish the ISG to further data preparation, development of the assessment model and hold a Workshop	Review progress of intersessional work and continue the assessment
Comprehensive Assessment of North Pacific sei whales (Item 8.1.2)	Re-establish the ISG to finalise assessment model, summarise the assessment process, and summarise the status	Review progress of intersessional work and finalise the assessment
In-depth Assessment of western North Pacific common minke whales (Item 8.1.3)	Re-establish the ISG to further development of the assessment model and hold a Workshop	Review progress of intersessional work and continue/finalise the assessment

8.1.4 Work plan

Table 5 provides the work plan for Comprehensive and In-Depth Assessments. For details of Intersessional Correspondence Groups, see Annex O. In addition, during the 2022 annual meeting the Committee will continue to evaluate when additional species will be at the stage where a Comprehensive or In-depth Assessment should commence.

8.2 Potential new assessments: progress on previous recommendations and prioritised workplan (SH and NH)

8.2.1 Non-Antarctic Southern Hemisphere and Indian Ocean blue whales

The Committee is preparing for an In-depth Assessment of non-Antarctic Southern Hemisphere blue whales, which is anticipated to be finalised in 2022. Pre-assessment of the available data was planned to be conducted at the 2020 and 2021 meetings. In the Southern Hemisphere and Indian Ocean, non-Antarctic blue whales are distinguished primarily by song-type and occur in the north-west Indian Ocean (NWIO, Oman song type), central Indian Ocean (CIO, Sri Lanka), south-west Indian Ocean (SWIO, Madagascar to Kerguelen), south-eastern Indian Ocean (SEIO, Australia to Indonesia), south-western Pacific Ocean (SWPO, New Zealand) and south-eastern Pacific (SEPO, Chile to Peru). Since Southern Hemisphere blue whale songs vary amongst regions (Fig 1, IWC, 2019a), to assess blue whale population distribution and structure the Committee have also supported the continuing development of a web-based Southern Hemisphere blue whale song library (Item 3, IWC, 2020b) which will enable researchers to compare their blue whale acoustic recordings with validated song archetypes. The library should be launched on the IWC website (*https://iwc.int/blue-whale*) later this year.

In 2021, the Committee received new information on distribution, inter-hemispheric population structure, historical regional catch allocations and photo-ID matching.

8.2.1.1 Distribution

Warren *et al.* (2021) used passive acoustic recorders deployed across central New Zealand waters in autumn, winter and spring (June 2016 to September 2017) to detect the spatiotemporal occurrence of Southern Hemisphere (Southwest Pacific Ocean SWPO) blue whales. These detections were highly concentrated in the eastern portion of the South Taranaki Bight (STB), particularly during autumn. During spring they were detected off the east coast of New Zealand, with fewer detections recorded in the eastern STB. Antarctic blue whales were detected most strongly during winter and early spring, particularly in the STB, suggesting that the area is visited during their northward migration and potentially also during the breeding season. These detections confirm the importance of the STB and New Zealand waters for both blue whale subspecies.

The Committee thanked the authors for this contribution, which provides valuable spatiotemporal data on the occurrence of both subspecies and has contributed to the Southern Hemisphere-wide catch allocation analysis using acoustic data (SC/68C/SH/17).

The Committee was informed of ongoing analyses (L. Torres, unpublished data) to compare the occurrence of Antarctic and SWPO blue whale calls from five hydrophones deployed for two years across the whole STB region (overlapping and to the west of the survey location in Warren *et al.*, 2021). The SWPO call has been detected year-round at those hydrophones. The Antarctic blue whale call shows strong seasonal occurrence during August and September during the two-year period, particularly in the record of the two hydrophones in the western region of the STB. One Australian blue whale (SEIO) call was also detected over a two day period, likely from a rare vagrant. This information has been contributed for use in catch separation analyses (SC/68C/SH/17). The Committee **invites** further updates at SC68D.

The Committee received two papers that related blue whales to oceanographic variables, which were discussed in the Ecosystem Modelling Working Group. Barlow *et al.* (2020b) investigated the relationship between oceanographic features of the STB and the occurrence of SWPO blue whales and krill in summer 2014, 2016 and 2017. They found that overall krill metrics predicted whale occurrence better than oceanography. However, oceanographic features that predicted more krill aggregations (typical regime) and higher krill density (warm regime) aligned closely with the features that predicted higher probability of blue whale presence in each temperature regime (see Item 15.6). Bedriñana-Romano *et al.* (2021a) constructed a single-step continuous-time correlated-random-walk model using satellite tracking data from SEPO whales in northern Chilean Patagonia. This model was used to make spatially explicit predictions of whale behavioural responses and was combined with density predictions from previous species distribution models and vessel tracking data to estimate the relative probability of vessels encountering whales and identify areas where interaction is likely to occur. Blue whale movement

patterns agreed strongly with previous species distribution models, confirming the importance of oceanography in habitat selection by blue whales in this region (see Item 15.3).

Blue whale spatiotemporal occurrence in the Northern Indian Ocean is poorly understood. In 2020, the Committee received evidence suggesting that two distinct blue whale populations occur in this ocean (Northwest Indian Ocean NWIO and Central Indian Ocean CIO), based on song-types (Cerchio *et al.*, 2020c). In order to better understand the spatiotemporal occurrence of NWIO whales, in 2020 the Committee recommended, passive acoustic monitoring (PAM) offshore of Oman (Item 8.2.1.5; IWC, 2021). A PAM recorder was deployed on 6th March 2020 and recorded until 6th October 2020 (Item 9.2.1, SC/68C/CMP/03). A second six-month deployment (planned for September 2020) has not yet been possible due to pandemic restrictions. The Committee looks forward to an update on Oman NWIO blue whale occurrence at SC68D.

8.2.1.2 Population structure

A good understanding of population structure and connectivity is necessary to conduct population assessments. In 2019, the Committee proposed a comparison of length data from catches and mitochondrial DNA patterns between the southeast (SEPO) and northeast Pacific (NEPO) in order to establish the level of population connectivity (Item. 9.2.1.1 in IWC, 2020), since a recent genetic study suggested that these populations have some genetic interchange in their low-latitude wintering grounds (LeDuc *et al.*, 2017b). In 2021, the Committee received SC/68C/SH/20, a length data comparison (SC/68C/SH20) between SEPO (n = 86 mature females, 2470 total whales) and NEPO whales (n = 64 mature females, 1167 total whales). Both populations contain animals with similar total lengths, lengths of sexually mature females, and tail length as a proportion of total length; these features distinguish them from the western and central North Pacific, Antarctic, and non-Antarctic Southern Hemisphere blue whale populations. Additional data from catches, sightings, surveys, satellite tags, acoustics, and genetics were also reviewed and support the hypothesis of a strong division between the two populations at 2°–6°N, albeit with rare vagrants that may move briefly from one region into the other.

The Committee **agreed** that the current evidence summarised in SC/68C/SH/20, combined with genetic evidence from LeDuc *et al.* (2017a), suggests that the NEPO and SEPO populations are geographically distinct, and sufficiently demographically independent that their populations can be assessed separately. An expanded genetic comparison shows a similar pattern and will be presented at SC68D. Many demographically independent cetacean populations have shared haplotypes and morphological similarities. While there is evidence of occasional, probable vagrant movements between the wintering ranges of these two populations in the Eastern Tropical Pacific (based both on acoustic and photo-ID data), these are exceptional observations, supporting a hypothesis of very limited movement between them. This hypothesis is further supported by a recent study investigating eastern Pacific blue whale diet based on stable isotopes in skin samples. Busquets-Vass *et al.* (2021) found that southern ETP samples (south of the equator) were substantially different from those in the northern ETP (north of 7°N), while northern ETP, Gulf of California and California samples were all similar.

Caution was expressed that abundance estimates might be biased if derived from the Eastern Tropical Pacific wintering areas where the two populations may overlap. This is not a concern for SEPO as all abundance surveys have been conducted along the coast of Chile. Geographic overlap of photo-identification data should be taken into account in upcoming mark recapture modelling. The Committee **agreed** that mark recapture analyses would not include ETP photo-IDs.

SC/68C/SH/23rev01 reviewed the movements of blue whales from the Chilean coast and into the ETP using 838 photo-identified blue whales collected by five different research groups working in southern and northern Chile, in the ETP, as well as opportunistic sightings. This effort provided 25 re-sightings within and between regions. One match was made between southern Chile and the southern ETP. Other matches were found within southern (n = 22) and northern Chile (n = 2), providing further evidence for strong site fidelity within these feeding areas. The longest period between re-sightings was 18 years and one animal was seen 11 times in six different years.

The Committee commended the authors for this update, noting that this new match with the southern ETP is the second one connecting that area with southern Chile (Torres-Florez *et al.,* 2015). This, along with recent satellite tracking of whales between both locations (Hucke-Gaete *et al.*, 2018), supports the hypothesis that the southern ETP is an important wintering ground for Chilean blue whales.

The Committee discussed the implications of the observed site fidelity within Chile. This is important for understanding if photo-identification data planned to be used in mark recapture analysis (mostly collected off southern Chile) are representative of the entire SEPO blue whale population. There is no evidence to date of population structuring within Chile based on mitochondrial or nuclear DNA (Torres-Florez *et al.*, 2014), suggesting that site fidelity patterns may not be inter-generational (i.e. a maternally-inherited preference, which might lead to genetic differentiation between feeding areas) but may reflect some fine-scale multi-annual habitat use partitioning across the feeding ground. Satellite telemetry data also shows mostly local movements off southern Chile until migration north, supporting the hypothesis of local feeding ground fidelity (Hucke-Gaete *et al.*, 2018). To investigate this hypothesis, the Committee **encouraged**: further collection of biopsy samples off northern Chile, to increase the sample size, as well as analysis of stable isotopes and contaminant profiles of individual whales off northern and southern Chile, to establish if persistent local differences in habitat use are reflected in trophic feeding patterns and local environmental contaminants respectively (e.g., Busquets-Vass *et al.*, 2021; Muñoz-Arnanz *et al.*, 2019; Schnitzler *et al.*, 2018).

Attention: SC, R
To test if southeast Pacific blue whales exhibit persistent site fidelity to local feeding grounds, the Committee **encouraged***: further collection of biopsy samples off northern Chile, as well as analysis of stable isotopes and contaminant profiles of individual whales off northern and southern Chile.*

8.2.1.3 Abundance

The ASI Standing Working Group reviewed available abundance estimates for blue whales and agreed abundance categories for each estimate (see Item 11.1.3).

Of the abundance estimates reviewed, the Barlow *et al.* (2018) abundance estimate for SWPO of 718 (SD = 433, 95% CI = 279–1,926) was approved for use in upcoming In-depth assessment. An ASI category 2 means that the estimate is suitable for a stock or study area for which conservative management is acceptable. The estimate may be subject to considerable negative bias for reasons such as limited spatial coverage or lack of correction factor(s).

The Committee acknowledged that there are no upcoming surveys planned to generate new abundance estimates for the SWIO and CIO populations. Therefore, the Committee **strongly encouraged** photo-ID collection and matching to support mark recapture analyses, and emphasised the importance of conducting surveys to sample a representative portion of these populations to assist future assessments. For the SEIO population, more work was recommended for the Jenner *et al.* (2008b) estimate (Annex E). The SEIO assessment may also be supported by a new mark recapture estimate developed through use of the Southern Hemisphere blue whale catalogue (SHBWC).

In preparation for the In-depth assessment of non-Antarctic Southern Hemisphere blue whales in 2022, the Committee has supported ongoing work compiling the Southern Hemisphere blue whale catalogue (SHBWC) to identify re-sightings for use in mark-recapture analysis of abundance. This catalogue is now managed by the IWC Secretariat. The SHBWC currently comprises 2,189 blue whales (1,572 right sides, 1,616 left sides, 91 flukes). From May 2020 to March 2021, another 416 photo-identifications have been received from areas off Chile, New Zealand, Timor Leste, Sri Lanka and the Southern Ocean (SC/68C/SH/22rev). Intersessional work has focussed on completing matching in the southeast and southwest Pacific, and on reviewing photo-identification datasets from the Central Indian Ocean. Quality control of the southeast Indian Ocean photo-ID catalogue is now underway. Currently, manual coding is required to perform quality control in the catalogue, but a new tool is anticipated to be implemented shortly which will make the process of quality control more efficient. The following work is required to complete regional photo-identification datasets for mark recapture analysis: (1) matching and quality coding of new photographs is needed for the SWPO and SEPO and (2) quality coding and matching of metadata to photographs for the Southeast Indian Ocean.

SC/68C/PH/05 reported the compilation of a photo-ID dataset from northern Patagonia (Chile) from 2003–2015, comprised of 206 individuals. This item is discussed in Item 21.2.3 and responds to a recommendation by the Committee in 2020 to reconcile this catalogue (Item 9.2.1.1; IWC, 2021). The Committee thanked the authors for this update and **strongly encouraged** submission of this dataset for matching with the SHBWC and inclusion in the In-depth assessment.

The Committee **welcomed** these updates, congratulated Galletti and contributors on the large amount of work conducted, and noted that the SHBWC is a long-term initiative financially supported by the Committee in order to, among others, deliver regional photo-ID based mark recapture estimates of blue whale abundance. Various aspects of photo-identification of both papers were discussed in Item 21.2.4.

The Committee discussed the readiness of these photo-ID datasets for use in mark-recapture analyses of abundance. In discussion, the Committee noted that some photo-ID datasets are almost ready for use in mark-recapture analyses to estimate abundance (SEPO, SWPO, SEIO), but that there was insufficient photo-ID information from Oman (NWIO), Sri Lanka (CIO) and Madagascar (SWIO) for such analysis at present. The Committee acknowledged that there were likely to be substantial biases in the regional photo-ID datasets, including from varying survey effort in time and space, and **strongly encouraged** intersessional work, to complete matching and quality coding of datasets, and to make them available for intersessional mark-recapture investigation by an expert group. This work has financial implications for the Committee. The Committee looks forward to receiving mark-recapture-based abundance estimates from SEPO, SWPO and SEIO for review prior to next year's meeting.

The Committee was informed that although more than 150 individuals have been photo-identified off Sri Lanka, few have been re-sighted to date and appreciable numbers of additional photographs still await review (SC/68C/SH/22). The Committee **commended** the authors for the amount of data collected off Sri Lanka given the logistical challenges of working in this region. The population identity of the Sri Lankan blue whales was discussed. It was noted that the call type detected off northeastern Sri Lanka is associated with the acoustically defined CIO population, but the call type associated with the photo-identified animals has not been confirmed. The Committee therefore **encourages** acoustic surveys close to the area where the photo-IDs are collected, to confirm the call type of these whales.

The SWIO blue whale population winters near Madagascar and may summer in the northwest Indian Ocean (Cerchio *et al.*, 2020a). There has been little research on this population, but photo-IDs have been collected during a 1996 survey (Best *et al.*, 1996) and subsequently by Cerchio in 2012. The Committee was informed that a project to conduct photo-ID, biopsy

sampling and satellite tagging of blue whales in the Northern Mozambique Channel is planned for 2022, coinciding with the time of year when both Antarctic and non-Antarctic blue whales are known to be in the region. These data will likely not be available in time for the In-depth assessment. However, the Committee highlighted the importance of collecting photo-IDs to enable mark-recapture based estimates of abundance, and **encouraged** their collection and submission to the Southern Hemisphere Blue Whale Catalogue (SHBWC). The Committee looks forward to a progress update at the next Annual Meeting. This work has financial implications for the Committee.

The Committee were informed that the blue whale photo-ID collection from Madagascar is small and requires work to quality code and match, both for Madagascar and in comparing to other Indian Ocean catalogues. The Committee **encouraged** this work and requests an update to be reported to SC68D. This work has financial implications for the Committee.

Attention: SC, R
To complete pre-assessments of Southern Hemisphere non-Antarctic and southeast Pacific blue whales, the Committee **reiterates** *its recommendations (Item 8.2.1.6; IWC, 2021):*

(1) that a new photo-ID catalogue from Chilean Patagonia be submitted to the Southern Hemisphere Blue whale catalogue (SHBWC) (Item 9.2.1.1; IWC, 2021);
(2) that development of the Southern Hemisphere Blue Whale Catalogue continue, with a priority focus on: (i) finalisation of photo-ID matching within the southeast Pacific; (ii) addition of southeast Indian Ocean (Australian) metadata to associate photo-IDs with sighting date and location; (iii) quality control of southwest Pacific, southeast Pacific and southeast Indian Ocean photographs to finalise datasets for mark recapture analysis and estimation of regional blue whale abundance; (iv) construction of a central Indian Ocean blue whale photo-ID catalogue; and (v) collection, review and compilation of photo-ID data from Madagascar within the SHBWC.

To establish Sri Lankan blue whale population identity and connectivity, Committee also **encouraged***:*

(1) acoustic surveys close to where photo-IDs are collected off Sri Lanka, to confirm the call type of whales;
(2) continued photo-ID collection and matching of the Sri Lanka photo-ID catalogues with other Indian Ocean catalogues; and
(3) continued collection of faecal samples to provide DNA and establish genetic identity.

8.2.1.4 Progress towards in-depth assessment

Recognising the importance of the catch allocation process for conducting regional blue whale population assessments, at last year's meeting the Committee recommended further work to finalise the catch allocations required for an In-depth assessment of non-Antarctic Southern Hemisphere and Indian Ocean blue whales (Item 9.2.1, IWC, 2021), and in particular to update the allocation of catches to two putative acoustic stocks in the northern Indian Ocean, using new acoustic data (Cerchio *et al.*, 2020c).

SC/68C/SH/17 provided historical catch estimates for five blue whale populations in the north-west Indian Ocean (NWIO, Oman song type), central Indian Ocean (CIO, Sri Lanka), south-west Indian Ocean (SWIO, Madagascar to Kerguelen), south-eastern Indian Ocean (SEIO, Australia to Indonesia), and south-western Pacific Ocean (SWPO, New Zealand). Location data for all available acoustic song recordings were collated, and spatial models fitted, to predict where each population occurs by month. Spatial models were then used to separate historical catches by population, under the assumption that current distribution is similar to historical distribution. Almost all non-Antarctic blue whale catches (97% of the total of 12,043) were taken by Japanese and Soviet pelagic whalers during 1959/60 to 1971/72 seasons. Estimated total catches from each of the five non-Antarctic blue whale populations were 1,118 (NWIO), 822 (CIO), 5,677 (SWIO), 3,953 (SEIO), and 473 (SWPO).

The Committee **commended** Branch and colleagues for this work and recognised how invaluable these models will be to progressing the population assessment. The Committee also **thanked** data contributors for making their datasets available. In discussion, comments were made that the current regression model does not fit the data well for some regions, with catches assigned to some areas where no or few call types are recorded. The author agreed to investigate classifier algorithms and generalised additive models intersessionally. The Committee **strongly encouraged** the completion of this work to infer historical catches of non-Antarctic blue whales from song detections.

The Committee aims to finalise the pre-assessment of non-Antarctic Southern Hemisphere blue whales at the next Annual Meeting (2022) and begin an In-depth assessment of these populations in 2023.

Attention: SC, R
To complete pre-assessments of Southern Hemisphere non-Antarctic and southeast Pacific blue whales, the Committee **reiterates** *that regional catch scenarios for non-Antarctic Southern Hemisphere blue whales need to be finalised, to be able to proceed to an In-depth assessment of these populations.*

8.2.2 Antarctic blue whales (SH)

The Committee is preparing for a new population assessment of Antarctic blue whales; the last assessment (Branch, 2008) concluded that, whilst increasing, in 1997 Antarctic blue whales were only at 0.9% (95% Probability Intervals 0.7–1.0%) of their pre-exploitation level (Item 3.2, p237, IWC, 2009a). In 2019, the Committee developed a four-year timeframe for a new Antarctic blue whale assessment, due to be completed in 2023 (Item 3.1.4, IWC, 2020b).

8.2.2.1 Distribution

Spatiotemporal patterns of Antarctic blue whale occurrence in New Zealand waters were detailed by Warren *et al.* (2021). More details can be found in Item 8.2.1.1.

The Committee was informed about a recent Antarctic voyage which conducted concurrent sighting and acoustic surveys of whales and krill, and biogeochemical investigations, between 64–67°S and 138–154°W (SC/68C/SH/19). Over 49 days, six broad-scale transects were covered, with 4,471km of visual sighting effort. There were 569 sightings of 1,380 cetaceans. Sightings of humpback whales were most common (201) followed by fin (124), blue (26) and minke whales (23). Nineteen groups of blue whales were approached for photo-identification from which suitable imagery was collected from 25 whales (SC/68C/PH/01). Further details can be found in Item 21.2.

SC/68C/ASI/03 reported the results of 2020/21 JASS-A dedicated sighting survey program, which was conducted in the western part of Area III (015°–035° E; south of 60°S). The total searching distance was 1,744.3 nautical miles during which 24 schools (29 individuals) of Antarctic blue whales were observed. In total, 20 individuals were photographed and eight biopsy samples (from different individuals) collected. Data obtained will be analysed to provide abundance estimates and for stock structure studies at the Institute of Cetacean Research.

The Committee welcomed these updates and noted the value of the information in relation to the upcoming In-depth assessment, highlighting that photo-IDs collected on these expeditions are contributing toward a new circumpolar wide abundance estimate for blue whales (Item 8.2.2.1).

8.2.2.2 Population abundance

SC/68C/ASI/15 reports a mark recapture analysis using photo-identification data for Antarctic blue whales collected from 2003/2004 to 2018/2019 from locations around the Southern Ocean. Estimates of abundance were produced using left and right side photographs, and more details can be found in Item 11.1.4. Following review by the ASI Standing Working Group, this abundance estimate was endorsed as category 'P' (provisional) with some intersessional changes to the analysis recommended.

The Committee welcomed this update and thanked the authors for their work to address recommendations made previously by the IWC (Item 9.2.3, IWC, 2019d). Given the importance of this abundance estimate to update previous assessment results for Antarctic blue whales, the Committee **strongly encouraged** the further work recommended by the ASI Standing Working Group.

The Committee received an update from the IWC-SORP Acoustic Trends Working Group (IWC-SORP ATWG; SC/68C/SH/12) on progress toward a new estimate of Antarctic blue whale (ABW) trend in abundance. Currently the IWC-SORP ATWG is: (1) working towards improving coverage of circumpolar acoustic recordings of blue (and fin) whales; (2) standardising analysis methods to move beyond regional analyses and towards circumpolar analyses (see project reports SC/68C/SH/13 and Bell, 2020); and (3) developing a robust method for measuring long-term, regional and circumpolar trends in male song abundance. Intersessional progress on (1) has been slow due to limited ship access, but the number of sites and spatial coverage is increasing. Substantial progress has been made on (2) and (3) toward a standardised analysis framework. The ATWG aims to deliver a proof-of-concept comparison of the regional temporal trend in ABW song density to SC68D and provide some form of circumpolar comparison by 2023, contingent on funding. This analysis framework can potentially be adapted to work on any sounds that can be detected reasonably often (e.g., blue whale D-calls, non-Antarctic blue whale song, fin whale 20 Hz pulses) and may be of use for ecosystem management. Finally, the ATWG have been using machine learning tools to develop better automated detectors of blue whale calls. These improved detectors should yield more precise estimates of detection-rate and call-density, thereby improving certainty regarding these quantities and reducing the amount of analyst time required to validate automated detections.

The Committee thanked the IWC-SORP ATWG for their progress update and looks forward to a full report at next year's meeting.

8.2.2.3 Progress towards population assessment

In 2020, the Committee agreed to progress two items to help understand possible sub-structuring of Antarctic blue whales around the Southern Hemisphere. These were: (1) a quantitative review of Discovery marking and recovery patterns to assess inter-oceanic movements; and (2) a quantitative comparison of Antarctic blue whale songs from different low-latitude regions using recordings with high signal-to-noise ratios, to evaluate if there are inter-oceanic differences in song. The Committee was informed that this work is ongoing and updates will be provided at SC68D.

The Committee noted that an updated population assessment requires the IWC endorsement of a new abundance estimate for Antarctic blue whales (see Item 8.2.2.2) and **encourages** the review of past Antarctic blue whale abundance

estimates intersessionally so that these are ready for use in an up-dated assessment (Branch, 2007; Matsuoka and Hakamada, 2014).

8.2.3 Southern Hemisphere right whales not the subject of CMPs (SH)

In 2016, the Committee agreed to start gathering pre-assessment information (e.g. population structure, abundance, trend, catches) in order to conduct regional In-depth assessments of southern right whales (Item 10.8.1.5, IWC, 2017b). In 2021, new information was received on regional population abundance, trends demography and health.

8.2.3.1 South Africa

Van den Berg *et al.* (2021a) assessed the trophic ecology of South African southern right whales using carbon and nitrogen stable isotopes, comparing biopsy samples from the late 2010s with those from the 1990s. Patterns show a strong shift and increased diversification in foraging in the 2010s compared to the 1990s, suggesting that recent foraging occurs in regions with isotopic signatures similar to those found in the sub-Tropical convergence, Polar Front and Marion Island, while foraging in the 1990s was at higher latitudes, on prey with isotopic signatures similar to those found south of the Polar Front. This change in foraging strategy has occurred alongside a decline in reproductive rates and is hypothesised to reflect recent changes in prey distribution and a possible reduction in high latitude foraging habitat.

The Committee welcomed this work which demonstrates the value of comparing historical and contemporary samples to identify changes in habitat use over time (see Item 8.2.3.4 for further discussion). The authors advised that stable isotope and hormone analyses are also underway using baleen from adult whales collected between 1960 and 1990, which will enhance this work and may be informative about year-round offshore movements. The foraging ecology aspects of this paper were discussed under Item 15.6. The Committee invited the authors to submit an update at SC68D.

Shifts in offshore habitat use by southern right whales are relevant to current discussions about which historical catches are allocated to which calving ground. This flexibility of habitat use suggests that connectivity patterns based on contemporary data may underestimate the range of areas used by each calving ground historically (e.g. southwest and southeast Atlantic whales may visit the 'Pigeon Ground' east of Tristan da Cunha, and the Indo-Pacific Crozet and Kerguelen Islands may be visited by whales from South Africa as well as Australia). To account for this, it was agreed that hypotheses for catch allocation need to be longitudinally broad, assuming calving grounds had a larger historical range than current data might suggest.

The Committee welcomed the results of the 2020 survey of southern right whales flown along the coast of South Africa, part of an uninterrupted long-term monitoring programme since 1979 (SC/68C/SH/04). As in 2019, the 2020 surveys recorded a very low number of cow-calf pairs (n = 67), the second lowest number since 1986. Low numbers of unaccompanied adults were also seen (n = 31), the fourth lowest since aerial surveys commenced. The observed calving intervals indicated that the majority of cows had normal 3 (68%), 6 (11%) or 9 year (7%) calving intervals, in contrast to recent years. For the fourth consecutive year, data indicated a clear shift in peak presence of cow-calf pairs to earlier in the year. Overall, these data continue the trend of extreme fluctuations in the occurrence of cow-calf pairs in South African waters observed since 2015.

It was noted that low numbers of cow-calf pairs were also recorded on calving grounds in Brazil and Australia (SC/68C/SH/18) during the 2020 season compared with previous years, raising concerns that changes in the marine environment might be affecting southern right whales across the Southern Hemisphere.

The Committee received two papers regarding the health of right whales on their South African calving ground.

SC/68C/SH/08 used aerial photographs to compare the body condition of whales in 1988/89 (n = 83 whales, 15 lactating females) and 2019 (n = 46 whales, 17 lactating females), and found a 24% (standard error SE = 5.31) decrease in maternal body condition between these periods. Body condition comparisons of lactating females with Southern Hemisphere calving areas in Australia (n = 40) and Argentina (n = 26) in 2019 also found South African whales to be in significantly poorer condition ($F = 3.639$, $p = 0.031$). A significant positive correlation was found between Glucocorticoid (GC) levels (indicators of stress) and visual assessments of the body condition of lactating females ($F = 8.99$, $p = 0.03$, n = 11). This is contrary to expectations about the relationship between body condition-stress and may be related to small sample sizes.

The Committee welcomed this report and **expressed concern** over the declining trend in body condition of South African right whales, noting that body condition is estimated to be better on other calving grounds (Item 8.2.3.6, Christiansen *et al.*, 2020). In relation to the temporal comparison, it was noted that since body condition can vary over the season (Christiansen *et al.*, 2018) and the timing of the calving cycle has shifted (see SC/68C/SH/04), investigation into how these factors vary over the season would also be important to ensure that inter-annual comparisons take calving cycle into account. The Committee also **encouraged** inter-annual comparisons of body condition over the same timeframe for other calving grounds, to ascertain whether this is a phenomenon specific to South Africa, or evidence of a broader trend. Further discussion of body condition is reported in Item 8.2.3.6 and was proposed for a Sub-Committee on Environmental Concerns (E) workshop (Item 14.1).

SC/68C/SH/14 reviewed all reported southern right whale mortalities, ship-strikes and entanglements along the South African coast between 2009 and 2019 (see Item 13.1 for a summary), The Committee ***recognised*** the importance of monitoring mortalities and impacts on southern right whales, particularly in areas where anthropogenic interactions are

anticipated. The Committee **encouraged** the continued monitoring and reporting of mortalities in this population (e.g., via the Global Ship Strike database and National Progress Reports to the IWC).

SC/68C/SH/05 includes the 2019 and 2020 survey counts in a demographic model (Brandão *et al.*, 2019) which was developed to explain patterns of whale occurrence and calving rates in South African waters, and extended to include the possibility of an early abortion so that a receptive, pregnant whale can become pregnant again the following year (the 'delta-loop'). The intent of this additional parameter has been to account for an increase in calving intervals that are dependent on environmental conditions and better explain the low number of sightings of females with calves observed over the 2015 to 2017 period. However, the low sighting probability estimates for 2019 and 2020 (see SC/68C/SH/04) cannot be explained by this additional parameter alone. A strongly weighted penalty function (w = 5.0) for sighting probabilities is required, to achieve predicted sighting patterns close to the average of previous sighting probabilities for both periods of low sightings without invoking an increase in the adult mortality rate. Changing environmental (particularly feeding) conditions seem the likely cause, also associated with a shift in the calving ground distribution.

The Committee welcomed this update which addresses a previous recommendation. There was a query whether the shift in peak presence on the calving ground might explain the lower sighting probabilities since 2015. The authors acknowledged that while this could be the case, changing the aerial survey timing would break a long comparable time series and consequently there were no plans to change survey timings at present. The authors also highlighted that the current model fits the data well and indicates a continuing increase in abundance, rather than requiring an increase in adult mortality to explain the observed patterns. This is positive news given that some recent low numbers of sightings might otherwise have been interpreted as a decline in abundance. The Committee **encouraged** further development of this work and looked forward to an update at next year's meeting.

Attention: SC, CG, R
The Committee expresses concern over the declining trend in body condition of South African right whales since the 1990s and **encourages** *similar comparisons to be conducted for calving grounds off Australia, Argentina, Brazil and New Zealand, in order to establish if this is a species-wide trend, or is specific to South Africa.*

Attention: SC, CG, R
Recognising the importance of monitoring human impacts on southern right whales, particularly in areas where anthropogenic interactions are anticipated, the Committee **encourages** *the continued monitoring and reporting of mortalities off South Africa, via the Global Ship Strike database and National Progress Reports to the IWC.*

8.2.3.2 Southwest Australia

This year the Committee received two papers on trends in abundance of right whales off Australia. Both studies also form part of an ongoing IWC-SORP project to investigate the impact of climate drivers on migration and reproduction patterns across calving grounds (Item 8.2.3.7).

SC/68C/SH/18 reported on long-running aerial surveys for southern right whales along the south-west coast of Australia (Cape Leeuwin to Ceduna). Between 1993 and 2020, surveys were undertaken to monitor the recovery of this species following commercial whaling. The comparable count for the 2020 survey used the maximum count for each leg, incorporating a correction for an unsurveyed area between Head of the Bight and Ceduna (a result of COVID-19 restrictions). This resulted in 384 individuals (156 cows accompanied by calves of the year and 72 unaccompanied adults) and represented a substantial decrease in overall sightings compared to recent trends. Such low counts were last seen in 2007 (n = 286 individuals), while the number of unaccompanied adults was the lowest seen since 1993 (n = 47). Previous surveys in 2007 and 2015 were also noted as years of low whale counts and had been deemed anomalous years (Bannister *et al.*, 2016), although low numbers from the current survey now suggest that the 3-year female breeding cycle is becoming more unpredictable.

The Committee also received an update on long-term cliff-based surveys (1991–2020) at the Head of the Great Australian Bight (HoB), South Australia (SC/68C/SH/11). In 2020, counts were lower than recent trends, with calf counts the lowest since 2015. At Fowlers Bay (South Australia), low numbers were also recorded and only a single cow-calf pair was seen during two survey days. The predominant calving interval at HoB in 2020 was four years, reflecting a significant increase in mean apparent calving intervals since the 1990s, from 3.2 years (95% confidence intervals CI 2.9–3.6) over 1996-2014, to 3.9 years (95% CI 3.8–4.1) between 2015–2020. Research is underway to examine the correlation and lag times between HoB calving success and climate anomalies including the Oceanic Niño Index, Antarctic Oscillation and Antarctic sea ice extent. Their key priority is securing funding for the 31st consecutive year of research at this major calving ground in 2021 and updating the national Australasian Right Whale Photo Identification Catalogue with outstanding Head of Bight photo identification data (ca.40% of catalogue still to be merged).

In discussion, the Committee noted that that numbers of cow-calf pairs and unaccompanied adults were lower than expected in both studies, similarly to concurrent observations off South Africa (see SC/68C/SH/04, Item 8.2.3.1). The Committee then discussed potential environmental drivers of these common patterns, including high latitude climate

anomalies and the Southern Annular Mode (e.g., Leaper *et al.*, 2006). Occurrence patterns of unaccompanied adults in the southwest Atlantic were noted to be changing. In Brazil, unaccompanied adults have been moving southward (Renault-Braga *et al.*, 2021), while in Argentina their relative abundance has decreased, with solitary animals shifting northwards in their distribution towards San Matias Gulf (Crespo *et al.*, 2019). Recent decreases in the numbers of unaccompanied adults on calving grounds might reflect a change in distribution, e.g. they may be moving more offshore, and therefore not detected during coastal surveys. Contrary to recent observations in Australia and Argentina, it was noted that the number of unaccompanied adults observed around Campbell Island, New Zealand, has increased over time (Torres *et al.*, 2016), highlighting the possibility that they may also be aggregating in new areas, or recolonising other parts of their historical range.

The Committee **encourages** work to investigate the drivers of the observed increase in mean calving intervals for southern right whales off Australia and assess potential correlations between reproductive success and climate variation. Progress on a multi-calving ground model to investigate these drivers is discussed in Item 8.2.3.8.

The Committee noted that SC/68C/SH/18 provided an abundance estimate for southwest Atlantic right whales which will be reviewed intersessionally (p.94, IWC, 2017b). It was also noted that this abundance was based on a species-wide conversion factor of 3.94, agreed by the IWC in 2011 to convert estimated numbers of parous females into total population size (IWC, 2013a). Given the population-level and demographic changes recorded across multiple calving grounds since this time, the Committee **encouraged** an intersessional review of this conversion factor, to be conducted as part of the development of the common population dynamic model (Item 8.2.3.8).

8.2.3.3 Southeast Australia

Watson *et al.* (In Press-a) assessed calving rates and site fidelity to the Logans Beach nursery ground, Warrnambool (southeast Australia) using sightings and photo-identification data, as well as movements between this location and other areas of Australia. At least 93 calves were born at Logans Beach between 1980–2018 (2.6 per year on average) with a mean calving interval of 3.5 (standard error, SE = 0.2) years (n = 34). The mean calving interval between 2007 and 2018 was 3.9 ± 0.2 years (n = 23). Comparisons of photo-identification catalogues between regions shows evidence of long-range movements within southern Australia, with females resighted up to 3,800 km apart across seasons and 7% of identified whales also re-sighted in southwest Australian waters. In addition, catalogue comparisons showed one female belonging to the southeast subpopulation (1985–2002) relocating long-term to a south Australian calving area (2007–2017). Further work is required to measure the proportion of female calves born at Logans Beach returning to their natal site, and the degree of mixing between the two Australian subpopulations outside their wintering areas.

The Committee welcomed this update on a population of concern, noting that its small abundance and coastal association make it particularly vulnerable (Item 8.2.3.2; Stamation *et al.*, 2020). The Committee **encouraged** further work to understand the demography and broader connectivity of this site.

The Committee received an update on an Australia-wide study funded by Australia's National Environmental Science Programme (NESP) – Marine Biodiversity Hub and led by Dr Karen Evans (CSIRO). This aims to describe the population abundance and trend of southern right whales in Australian waters and to assess the connectivity between the calving areas. This study has, for the first time, combined the long-term survey and photo-identification data from southern Australia, Head of Bight and south-eastern Australia in the Australasian Right Whale Photo-Identification Catalogue. Data entry and analyses are ongoing with the final report due later in 2021.

The Committee welcomed this update and **encouraged** a report on this work at next year's meeting.

Attention: SC, CG, R
The Committee **encourages** *further work on southern right whale populations to:*

(1) model population demography across Australia and to investigate potential links between the increase in calving intervals, health and climate;
(2) establish the level of population connectivity between southeast Australia, southwest Australia and New Zealand.

The Committee also **encourages** *a Southern Hemisphere-wide review of the ratio between parous females and total abundance in southern right whale populations, to establish if new conversion factors should be employed for estimating total abundance. These factors will likely be population-specific.*

8.2.3.4 New Zealand

SC/68C/SH/01 reported a preliminary assessment of the historical genetic diversity and foraging ecology of southern right whales in mainland New Zealand with a comparison to contemporary patterns. From 18 bone samples, 11 southern right whales were identified, nine with a high-quality mitochondrial DNA (mtDNA) sequence. Only one mtDNA haplotype was shared with the contemporary population (n = 692 whales). Despite a small sample size, the haplotype and nucleotide diversity of the historical population (h = 0.98 ± 0.05, π = 2.78 ± 0.43) was substantially greater than that of the contemporary population (h = 0.69 ± 0.01, π = 1.91 ± 0.05). Historical stable isotope (SI) data from four southern right whales had δ13C

and δ15N values at the top end of the contemporary distribution, suggesting a potential shift in foraging patterns over time. Larger sample sizes are needed to determine the statistical significance of these results.

In discussion, the Committee was informed that the SI dataset is small due to poor quality of material, but more sample acquisition is planned, including of baleen plates if possible, since these will also be informative about foraging patterns across seasons. Comments were made that historical whalebones and artefacts occur in a number of museum collections and could also be accessed for sequencing (e.g. Burrell *et al.*, 2015). The Committee discussed the high levels of genetic diversity in the historical dataset, including the presence of one haplotype seen only in Argentina to date. The authors commented that this observation, coupled with long-range movements seen by satellite telemetry (SC/68C/SH/02) could suggest populations had higher levels of connectivity across the Southern Hemisphere. Remarks were made that this diversity would also suggest that historically right whales had large effective population sizes. The question was posed whether deamination might be one reason for the occurrence of multiple novel haplotypes. The authors confirmed that they had obtained good quality forward and reverse sequences and had not seen any deamination damage patterns. The authors plan to conduct shotgun sequencing on available material in order to obtain whole mitogenomes.

In relation to the inferred shift in foraging patterns, high numbers of historical catches were observed at mid-latitudes along Louisville Ridge northeast of New Zealand (near the Kermadec Islands) in spring and summer, suggesting that this area was a feeding area historically (Townsend, 1935). A question asked was whether the historical SI values might reflect this feeding area. The response was that there are a few contemporary southern right whale sightings in this area, but sighting effort is very limited, so that current whale presence there is uncertain, and no prey data are available from the region. It was noted that uncertainty around the correction for the Suess effect may mean that historical and contemporary trophic patterns are more similar than they appear, for example if historical samples are older than assumed with the current correction (which is based on the late 1800s). The authors advised that the present analysis is preliminary and that further investigation into SI patterns and Suess corrections is planned. The Committee **strongly encouraged** the continuation of this work, noting its particular relevance in helping to develop historical population structure hypotheses that can inform catch allocations. The Committee were informed that similar historical analyses are being conducted in the southwest Atlantic and **encouraged** an update from that research group at SC68D.

SC/68C/SH/02 reported the results from satellite transmitters deployed on six adult southern right whales wintering at the sub-Antarctic Auckland Islands, New Zealand, during August 2020. As of 1st March 2021, tags had transmitted for an average of 125 days (range: 40-209 days) and two were still transmitting. Tracking data for five individuals showed south and westward migratory movements toward likely feeding areas south of Australia (north of the polar front); one individual (with a long tag duration) continued migrating west before travelling south to Antarctica. These movements indicate that whales from the Auckland Islands travel across vast areas, spanning the South Pacific, South Indian and Southern Ocean, and feed in the offshore waters south of Australia. These findings have implications for allocation scenarios for historic catches of southern right whales; the east-west movement (up to 5,800km) suggests that some catches in the Indian Ocean as far west as the Kerguelen Islands may have comprised whales from the New Zealand calving ground.

The Committee welcomed this new information which provides important insights into offshore movements of Indo-Pacific right whales and will be informative for allocation of regional catches for population assessments. Noting the particularly long-distance movements revealed in this study, the question was posed whether summer 2020/21 (spanning a La Niña period) might have been a poor feeding year, necessitating longer distance foraging movements. Whilst this is unknown at present, the authors advised that they plan to deploy 14 satellite tags in a second survey season, which will allow a comparison of movements between years. The Committee welcomes an update on this work at next year's meeting.

SC/68C/SH03 reported on an 18-day expedition to the sub-Antarctic Auckland Islands in August 2020, collecting population demographic and foraging ecology information for this calving area. There were 220 biopsy samples collected (of which 178 unique whales have been identified by microsatellite genotyping). Twenty-one samples were accompanied by photogrammetry measurements. Drone surveys were undertaken and six satellite tags deployed (SC/68C/SH/02). Genotype comparisons with the 1995–2009 catalogue revealed 21 inter-annual re-sightings within the Auckland Islands (16 females), one to Campbell Island, one to mainland New Zealand and one potential match to New South Wales (southeast Australia). Two females were seen with calves over three decadal surveys. Further work is planned to investigate body condition, close-kin mark recapture patterns, and to conduct analysis of stable isotope analysis and satellite tracks to investigate foraging ecology and habitat use.

The Committee **commended** the researchers on the large amount of work conducted during this expedition and noted that this work forms part of IWC-SORP Theme 6 '*The right sentinel for climate change: linking foraging ground variability to population recovery in the SRW*' (Item 22.2). The Committee discussed the connectivity implications of the potential re-sighting with southeast Australia, noting that recent microsatellite and mtDNA analysis had found no evidence for differentiation between this area and New Zealand (Carroll *et al.*, 2019). A subsequent genomic survey using restriction-site associated DNA sequencing (RAD-seq, 26,000 nuclear loci) also found very little differentiation between the two areas. There is ongoing work conducting close-kin mark recapture analysis focussed on New Zealand (Item 8.2.3.5, IWC, 2021), and the authors commented that this work will also be useful for measuring levels of close-kin connectivity with neighbouring grounds. The Committee looks forward to an update on the RAD survey and close-kin analysis at SC68D.

Recent observations of gull feeding behaviour close to and on whales were discussed; it was noted that such behaviour has not previously been seen on this calving ground (regularly visited since the 1990s). Visual health assessments of photo-identified whales do not show any signs of lesions consistent with gull attacks; the Committee **encouraged** further updates on these observations during the upcoming 2021 expedition.

Attention: SC, R
The Committee **encourages** *genetic and stable isotope analyses of southern right whales, using historical (pre-20th century) material to measure connectivity and foraging patterns during and before the whaling period, for informing stock structure hypotheses and catch allocations in population assessments.*

8.2.3.5 Southwest Atlantic

This population is subject to a Conservation Management Plan and additional research can be found under Item 9.1.2. This year, a paper was received on habitat selection by southern right whales at Península Valdés, Argentina (SC/68C/CMP/06), and a new estimate of abundance was provided for Brazil using mark recapture approaches (SC/68C/CMP/10). This latter paper will be reviewed intersessionally by the ASI Standing Working Group.

In 2019 the Committee identified the reconciliation of photo-identification catalogues from Brazil and Argentina as a high priority, recognising that these two calving grounds are likely to represent a single expanding population, but are currently being monitored separately (Item 5.2.4, IWC, 2020a). The result of that matching was reported in 2020 (Rowntree *et al.*, 2020). Subsequent work recommended was to conduct a multi-strata mark recapture analysis to estimate movement rates between Brazil and Argentina and to compare these to re-sighting rates within countries (Item 8.2.3.5, IWC, 2021). SC/68C/SH/16 provides more details of the planned work, which will measure movement probabilities, and region-specific apparent survival and recapture probabilities. This work will also investigate the influence of Kelp Gull micropredation, calving failure and density-dependent processes at Península Valdés on movement rates from Argentina to Brazil.

The Committee welcomed this update and **encouraged** a full report be presented when this analysis is completed. Further discussion of this item can be found in Item 9.1.2.

Attention: SC, R
The Committee **encourages** *mark recapture analysis of right whale connectivity between Brazil and Argentina, for informing the regional population assessment of southwest Atlantic southern right whales.*

8.2.3.6 Cross-population comparisons

Multiple papers were received on multi-area photo-identification comparisons and visual health assessments for southern right whales (also see SC/68C/SH/08 in Item 8.2.3.1 above). Comparisons within and across photo-identification catalogues are important for helping to assess movements between populations as well as comparisons of local population dynamics (e.g. calving rates). The photo-identification aspects of these papers are more fully discussed in Item 21.2.1. Health assessments based on photographs of southern right whales, in particular the body condition of lactating females (a predictor of reproductive success), provide observations that can directly relate to population dynamics (i.e. calving success, calf survival).

SC/68C/SH/07 introduces the 'Southern Right Whale Consortium' (SRWC), a circumpolar consortium that aims to facilitate multi-ocean collaboration and comparative studies to progress priority research questions for the conservation and management of southern right whales (see also SC/68C/SH/06). The first aim of this Consortium is to use this framework to compare population demographics across the main Southern Hemisphere wintering grounds (see Item 8.2.3.7). This work is a key component of IWC-SORP Theme 6 (details in SC/68C/SH/12).

The Committee welcomed this initiative and invited participants to contact the coordinators if they wish to contribute data to this Consortium. The Committee was informed that a second draft of the SRWC's Memorandum of Understanding has been circulated and is open for comment. The first stage of this work will focus on compiling long-term sighting histories using aerial images, but analyses of other image types, such as lateral images, are planned (see also Item 21.2.1).

SC/68C/PH/04 reports on the development of Artificial Intelligence tools for right whale photo-identification of aerial and lateral head images, hosted on the Flukebook platform. The intent of this platform is to identify matches using multi-feature matching approaches. This tool has high potential to streamline data processing and matching of right whale images, and the development to support lateral head matching is particularly welcome as this is time-consuming and difficult to carry out manually.

The Committee welcomed this report; more detailed discussion of this paper can be found in Item 21.2.1. It was noted that the tools developed here could be particularly useful within the recently developed SRWC photo-ID initiative (SC/68C/SH/07) and for progressing multi-area photo-ID matching.

Christiansen *et al.* (2020) used aerial photogrammetry from unmanned aerial vehicles to carry out a global assessment of right whale body condition, finding that North Atlantic right whales (juveniles, adults and lactating females) all had

significantly lower body condition scores compared to southern right whales measured on calving grounds in Argentina, Australia and New Zealand. Among these three calving grounds, body condition scores were similar and overlapping for immature animals and lactating females, but calf condition varied significantly between grounds, being lowest for Australia and highest for New Zealand. Low-scoring body condition in Australia is not linked to calf survival rates; since maternal condition is also good, it is hypothesised to reflect the warmer sea temperatures in Australia. Warmer temperatures mean that calves do not need to build up as much blubber thickness for insulation.

The Committee welcomed this work and acknowledged the insights such quantitative body condition data can contribute to modelling of whale population dynamics over time. It was noted that SC/68C/SH/08 expands the calving ground comparison to include South African right whales, albeit in different years of survey, suggesting that lactating females in South African waters have poorer body condition compared to the other calving grounds (Item 8.2.3.1). The Committee **strongly encouraged** the standardisation of methodologies whenever possible to facilitate future regional comparisons.

To provide a synoptic visual assessment of southern right whale health across the Southern Hemisphere, in 2019 the Committee **encouraged** the development of a global, standardised visual health assessment protocol, to be presented to the IWC for endorsement. The protocol described in SC/68C/SH/21 builds on previous qualitative visual health assessment protocols (Hörbst *et al.*, 2019; Pettis *et al.*, 2004) and proposes a standard approach to categorise (1) body condition; (2) skin lesions; (3) skin condition; and (4) cyamids around the blowhole, to be applied to both aerial and lateral images and used to provide a total score of visual health. A score weighting was proposed to favour body condition, since subcutaneous fat has been identified as the most important contributor to female reproductive health.

The Committee welcomed this report which addresses a previous recommendation (Item 9.2.4.6, IWC, 2019d) and thanked the authors for the compilation. The Committee recognised the protocol could provide a useful framework for global comparisons and temporal comparisons within the same population. Clarification was provided that the protocol is intended to provide a comparison framework for aerial images or lateral images, but that further field testing is required to see if comparisons between the two image types can be made in this framework. The Committee **encourages** field testing of the protocol classification system, and looked forward to an update at SC68D.

In recognition of the importance of the new body condition results discussed at this meeting, it was suggested that an intersessional workshop (for example hosted at the upcoming Society for Marine Mammalogy meeting) would provide a useful opportunity for sharing information on body condition analyses across cetacean species, and coordinating and standardizing body condition assessment methods. The Committee welcomed this initiative and formed an Intersessional Correspondence Group to organise this workshop (Table 3).

Attention: SC, R
The Committee **encourages** *the field testing and finalisation of a global, standardised, IWC-endorsed health assessment protocol to assist a synoptic assessment of southern right whale health across calving grounds.*

8.2.3.7 Offshore areas

The Committee received two papers relating to offshore occurrences of southern right whales, both in the southwest Atlantic. SC/68C/CMP/08 reported on the population connectivity, trophic ecology and health status of southern right whales from summer sighting surveys conducted in the vicinity of the island at 54°15'S 36°45'W in 2018 and 2020. SC/68C/CMP/09 Rev 01 described the wintertime occurrence of right whales in the the islands at 51°33'S, 59°49'W Surveys in 2019 and 2020, combined with acoustic monitoring, indicate appreciable and persistent southern right whale occurrence along the north-east coast of the islands during winter. These papers were discussed under Item 9.1.2.

In 2020, the Committee formed an Intersessional Correspondence Group (ICG) to assess southern right whale distribution using passive acoustic monitors in the Southern Ocean (Item 8.2.3.4, IWC, 2021). No update was received on this topic, and the ICG discussion was moved into an IWC-SORP project which is also collating right whale sightings south of 40°S (see SC/68C/SH/06). The Committee looks forward to a progress update at SC68D.

8.2.3.8 Progress towards in-depth assessment

The Committee expressed their appreciation for the valuable long-term monitoring of southern right whales in wintering grounds across the Southern Hemisphere, noting the central importance of these data for the upcoming population assessments.

In 2016, the IWC began the process of reviewing southern right whale population parameters and historical exploitation levels in order to initiate regional assessments of population recovery across the Southern Hemisphere (IWC, 2017a). To achieve this objective, working hypotheses of: (1) the contemporary and historical identity of Southern Hemisphere right whale breeding stocks, and: (2) the allocation of historical catches from breeding and feeding grounds to those stocks, must be agreed by the IWC Scientific Committee, to support regional population assessments. Southern right whale stock identity has previously been reviewed by the IWC (1986; 2001; 2013a). However, substantial additional photo-ID, genetic, isotopic and satellite tracking data are now available to further inform stock structure hypotheses (Carroll *et al.*, 2019; Carroll *et al.*, 2015; Carroll *et al.*, 2020; Mackay *et al.*, 2020; Rowntree *et al.*, 2020; Valenzuela *et al.*, 2018; van den Berg *et al.*, 2021b;

Watson *et al.*, In press-b; Zerbini *et al.*, 2018; Zerbini *et al.*, 2016). For southern right whales, considering both historical and contemporary stock structure hypotheses is important. The length and intensity of historical right whaling across the Southern Hemisphere has appreciably perturbed the distribution and connectivity of these populations for centuries. In some cases, local calving grounds were exterminated (e.g., the Critically Endangered Chile-Peru calving ground, mainland New Zealand and Delagoa Bay calving grounds for critically endangered populations), while other historically important offshore areas are no longer visited (e.g. Kermadec Islands, Kerguelen Islands, Tristan da Cunha, Richards, 2010), perhaps due to a loss of migratory memory (Carroll *et al.*, 2015; Carroll *et al.*, 2014) or due to changes in prey distribution (e.g. van den Berg *et al.*, 2021b). Stock structure hypotheses which explicitly consider historical distributions and seasonality need to be agreed before developing catch allocation scenarios for stocks at a regional level, to ensure that catches are allocated appropriately to historical stocks.

The Committee therefore **agreed** to form an Intersessional Correspondence Group (see Annex O), to: (i) review the available historical and contemporary evidence for Southern Hemisphere stock structuring, updating previous reviews of SRW stock identity (1986; 2001; 2013a); (ii) develop stock structure hypotheses for review and ranking, based on available evidence; and (iii) identify data gaps where further work is required to discriminate hypotheses (Table 6).

In 2019, the Committee encouraged the development of a common modelling framework to integrate southern right whale demographic data from all the calving grounds (p.28, IWC, 2019). An update is provided in SC/68C/SH/06, detailing trials of the modelling framework for South African and southwest Atlantic (Argentina and Brazil) whales. There are demographic aspects specific to each population which are being explored, with more development required before a common model can be fitted to all datasets; for example, some demographic parameters are estimated well for one population but poorly for others. If parameters cannot be estimated separately for all data sets, then discussion will be required to determine suitable values or priors for the remaining parameters. SC/68C/SH/06 also reports that major datasets have been provided for model input from Argentina/Brazil, Australia, New Zealand and South Africa; and on progress towards the collation of published and available information regarding confirmed southern right whale offshore sightings south of 40°S. This is underway to inform the selection of environmental variables for further investigation of links between demographic parameters (*e.g.*, reproductive success) and climate.

The Committee was also informed about ongoing work on the southwest Atlantic right whale population model (Argentina and Brazil). An early 'calf loss' parameter is included in the population model, associated with the increased probability of a mother who loses a calf becoming pregnant the following year (and then having a calf two years later), relative to those mothers whose calves are successfully weaned. Direct observations of calf mortalities in Argentina were not used in fitting the model, but the model predictions agreed fairly well with the observed numbers at Península Valdés. Suppressing the 'calf loss' parameter for the southwest Atlantic population provides a significantly worse fit to the data, highlighting the need to account for this factor explicitly in the common modelling framework which is being developed (SC/68C/SH/06). Since the method does not rely on observations of calf mortalities (but can be cross-checked against them where such observations are available) it should also be applicable to populations where calf mortalities are rarely observed.

The Committee welcomed both updates, which are being progressed under IWC-SORP Theme 6 (Item 22.2). The Committee **encouraged** continued development of these demographic models and work towards a common model framework, which has flexibility to account for the differing observability of various parameters and demographic features of populations (i.e. some are sub-structured, some have observable calf loss).

The Committee received an update about work in progress to assess the population dynamics of southern right whales from the western South Atlantic Ocean, to measure the effect of whaling numerically, and to estimate population trend and recovery level after depletion. The catch history of whaling for the period 1670–1973 was reconstructed by an extensive review of different bibliographical sources, and a Bayesian state-space model was developed to estimate the demographic parameters. The population trajectory suggests that the pre-exploitation abundance was close to 30,000 animals, and that abundance dropped to its lowest abundance level in the 1830s when less than 1,000 individuals were left. The population remained at low levels during the 19th century, and by the early 20th century was estimated to be around 2% of the pre-exploitation abundance. A brief recovery period was observed after 1920, followed by a second decline in abundance in the 1960s when illegal Soviet whaling operated in the Southern Hemisphere. Since no whaling occurred after 1973, the population has increased at a steady growth rate until the present. The model-predicted population abundance in 2017 indicates that the SRW population remains small relative to its pre-exploitation abundance (recovery level: 15-18%). Projected abundance, however, suggests that the population will continue to grow for the next decade. These results are anticipated to provide insights into the severity of whaling operations in the western South Atlantic Ocean and how the population responded at low densities, and thus contribute to understanding the observed differences in population trends across the global distributional range of the species.

In discussion, clarification was provided that the catches used in this model were from the southwest Atlantic, including Soviet catches west of 20°W (1,356 whales, Tormosov *et al.*, 1998) and the historical 'Pigeon grounds' (16–28°W). Catches around Tristan da Cunha (12°W) were not included; these were not substantial in the 20th century (227 whales caught by the Soviet Union) but may have been larger historically, and there is evidence for a linkage between this area and the southwest Atlantic (Best *et al.*, 1993). It was also noted that an indicated period of very low abundance of right whales over

a period of some 100 years (i.e. an extended bottleneck) is likely to lead to difficulties for the standard density dependent logistic model, as this is relatively inflexible in such circumstances. Specifically, only an extremely narrow range of pre-exploitation abundance values will fit such a model to produce this extended period at low abundance without the population either going extinct or prematurely increasing rapidly; a model incorporating an Allee effect may provide a more realistic and flexible approach (e.g. Moosa, 2017b; Moosa and Butterworth, 2017, where similar problems were encountered in explaining trends in the population of Antarctic fur seals during the 19th century). The authors agreed to review the catches allocated to the southwest Atlantic and commented that they were able to fit their model without invoking an Allee effect, but would be interested to explore this aspect in future. The Committee **encouraged** further interrogation of the catch data and invites an update of this analysis to be presented at next year's meeting.

Attention: SC, CG, R
To progress the In-depth regional population assessments, the Committee: **reiterates** *the importance of continuing the long-term monitoring programs to understand right whale population trends and dynamics;* **recommends** *that the monitoring continue in each wintering ground, and;* **encourages** *the range governments (South Africa, Argentina, Brazil, Australia, New Zealand) to do all they can to avoid interruptions to these important long-term efforts, noting that the COVID-19 pandemic is causing major problems for such long-term programs.*

The Committee **reiterates** *(IWC, 2019b, p.28) that it* **encourages** *the ongoing development of a common life-history model which allows for the estimation of demographic parameters and the investigation of commonalities in southern right whale population dynamics on their wintering grounds.*

Attention: SC, CG, R
The Committee **reiterates** *(IWC, 2019c, p.28) that it* **encourages** *the ongoing development of a common life-history model which allows for the estimation of demographic parameters and the investigation of commonalities in southern right whale population dynamics on their wintering grounds.*

Attention: SC, CG, R
The Committee also **encourages***:*

(1) a review of the evidence for historical and contemporary Southern Hemisphere stock structuring of southern right whales; and
(2) development of a population assessment model for southern right whales in the southwest Atlantic.

8.2.4 North Pacific blue whales (NH)

There are at least two populations of blue whales in the North Pacific, and possibly three, based mainly on song type. The status of the eastern North Pacific population was assessed by the Committee in 2016 as 'almost recovered' (IWC, 2017c). In recent years, the Committee has been evaluating the data available to assess blue whales in the less studied central and western North Pacific. The Committee remains in the pre-assessment stage for blue whales in this large region (the full process is described in IWC, 2019d, pp.18–19).

SC/68C/NH/04 presented acoustic data from three locations in the central and western North Pacific: Wake Atoll and around Saipan and Tinian in the Northern Mariana Islands. In data recordings from 2015-16, only the central/western Pacific song type was detected at the three locations, and was most frequent around Wake Atoll, less frequent off Tinian and least frequent off Saipan.

The Committee discussed implications of these findings briefly, noting that to date the Japan-type song has been detected in only one location (Hokkaido, Japan), and that it remains to be determined if it is from a historically depleted population or is new. Seismometer data may be useful for detecting blue whale calls in the western North Pacific where passive acoustic recorders are limited.

Due to time limitations, detailed discussion of North Pacific blue whales was postponed until SC68D, but Branch referred to the previous intersessional group report (Branch *et al.*, 2019) and reported briefly on the following new information. Atkinson *et al.* (2020) conducted hormone analysis on blubber samples from 51 non-calf female blue whales from the Gulf of California. Putative pregnant females had elevated progesterone levels, but cortisol levels were similar among classes of whales. After correcting for uncertain ages of females, and hence unknown maturity status, an estimated 33% (95% CI 32–34%) of mature females were pregnant, which is lower than estimates for Antarctic and pygmy blue whales. Updated abundance estimates for NE Pacific blue whales was also presented (Calambokidis and Barlow, 2020b) with a best estimate using the Chao method of 1,898 (80% CI 1767–2038). A simple model fitted to these data estimates a 2–3% increase rate per year from 1989 to 2018. In addition, Bradford *et al.* (2021) estimated abundance based on line-transect surveys covering the entire Hawaiian EEZ in 2002, 2010, and 2017, but only one blue whale was encountered while on effort in 2010, resulting in a highly uncertain estimate of 137 (CV = 1.12, 95% CI 23–796) individuals. Finally, the 2020 POWER survey sighted 22 schools (31 individuals) of blue whales mostly in the northern part of the research area west of 170°E, and collected photo-ID data for 26 and biopsy samples for 13 blue whales (SC/68C/ASI/05).

Branch suggested an updated assessment of eastern North Pacific blue whales could be conducted given the information available. The highest priority for an assessment of central and western North Pacific blue whales is an estimate of abundance from the POWER surveys. An update on the progress toward assessment will be a priority for the Committee in 2022.

Attention: SC, RThe Committee is continuing its work to assess blue whales in the North Pacific, especially in the central and western areas. The Committee **agrees** *that this work should continue through an intersessional correspondence group under Branch (Annex O), and that discussion of the progress towards assessment will be a priority for SC68D.*

8.2.5 North Atlantic sei whales (NH)

The Committee is at the pre-assessment stage for sei whales in the North Atlantic (the full process is described in IWC, 2019d, pp. 18–19). Given time constraints, discussion of this topic was postponed until 2022. Information gathering for a future Comprehensive Assessment will continue through the intersessional correspondence group convened by Cholewiak and will be reported at the 2022 Annual Meeting.

Attention: SC
The Committee is advancing its work to ascertain when sufficient information will be available to assess sei whales in the North Atlantic. The Committee **agrees** *that the intersessional correspondence group under Cholewiak (Annex O) should continue to review the availability of data needed for a Comprehensive Assessment.*

8.2.6 North Atlantic right whales (NH)

In response to the Committee's request (IWC, 2021a, p.38), the US provided an update on North Atlantic right whale population status and management initiatives. New information on population status was presented in SC/68C/NH/06Rev01. A Bayesian state-space mark-recapture model (Pace, 2021; Pace *et al.*, 2017) was updated through 2019 and shows a recent population decline, with an estimated abundance of 368 animals (credible interval: 356–378). This result suggests that right whales have lost nearly all of the 3% population growth experienced from 2004 to 2010. More males than females currently exist in the population, and only 150 females were estimated to be alive in 2019. Model results further indicate a decline in survival rates since 2011, a period during which there was a substantial change in the distribution of these whales (Pace *et al.,* 2017). The hierarchical state-space modelling approach was also used to estimate cryptic mortality and suggests that observed North Atlantic right whale carcasses accounted for approximately 36% of all deaths during 1990–2017 (Pace *et al.*, 2021). Compared to 2013–2017, serious injury and mortality rates increased 19% during 2014–2018 (Henry *et al.*, 2021). An examination of individual female reproduction between 2014 and 2021 determined that only 73 females were documented with a calf and that four of these females are now deceased. A detailed analysis of mark-recapture sightings data from the Gulf of St. Lawrence during 2015–2019 indicated high resighting rates for the portion of the population utilising this area.

The Committee welcomed the information presented in SC/68C/NH/06Rev1 and discussed possible reasons for population decline. It was noted in discussion that analysis of calving intervals over time could help to assess the degree to which this reflects a lower contribution from reproduction than in the past. However, prior efforts to model population trends in the absence of human impacts (e.g. Corkeron *et al.*, 2018; Kenney, 2018) suggests that anthropogenic impacts have had an appreciable effect on the population trajectory. Continuing and expanding comparative studies of northern and southern hemisphere populations may provide further insight into why the two populations exhibit disparate population trends. Finally, the Committee drew attention to the lower survival and abundance of females, and noted that a male-biased population composition has the potential to significantly impact future population growth and this scenario needs to considered in the work of the Committee, such as in population assessments and ecosystem modelling.

With regard to management initiatives (SC/68C/NH/05), NOAA Fisheries maintains an investigative team to monitor and assess the Unusual Mortality Event that has been underway since 2017. The total number of dead and seriously injured whales is currently 49, with six documented in 2020 and five thus far in 2021. With respect to entanglements, NOAA Fisheries continues to work through the stakeholder-based Atlantic Large Whale Take Reduction Team process. Additional regulations were proposed to address the northeast US lobster and Jonah crab trap/pot fisheries at the end of December 2020 and are in the process of being finalised. Measures include a reduction in the number of vertical buoy lines as well as gear modifications to reduce the strength of buoy lines, which could allow a whale to break free of gear. Additional gear marking requirements are also proposed, given that most of the gear taken off entangled whales continues to be unidentified. Concurrently, the Team is working to develop additional measures for gillnet fisheries, and for trap/pot fisheries that target species other than lobster and crab. With respect to vessel strikes, NOAA Fisheries continues to implement mandatory speed limits for vessels 65 feet or greater in seasonal management areas and voluntary speed limits in dynamic management areas and Slow Zones. NOAA Fisheries recently assessed this speed rule to evaluate its biological effectiveness, mariner compliance, outreach and enforcement efforts, navigational safety, and economic impacts. NOAA has developed recommendations for strengthening the vessel strike reduction strategy and for increasing protection for right whales[3].

[3] *https://www.fisheries.noaa.gov/national/endangered-species-conservation/reducing-vessel-strikes-north-atlantic-right-whales*.

NOAA Fisheries reports spending considerable time and effort – formally and informally – working with colleagues in Canada to address both ship strikes and entanglement issues. One example is a bilateral working group composed of NOAA Fisheries, Fisheries & Oceans Canada, and Transport Canada which collaborates on lessons learned, needed research and management actions. The US Northeast and Southeast Implementation Teams have assisted with the development of a 'Species in the Spotlight' 5-year action plan[4] to halt the North Atlantic right whale population decline. With respect to climate change, NOAA Fisheries undertook a scenario planning exercise to understand better the challenges right whales will face with changing conditions. This exercise focussed on identifying necessary research and coordination, and explored how scenario planning can be used to support decision-making.

The Committee welcomed this new information and discussed the implementation of mandatory (versus voluntary) slow zones for vessels less than 65 feet currently under consideration in the US.

With respect to population health, NOAA Fisheries convened an expert workshop in 2019 to assess current health information and to identify tools and techniques for standardizing data collection to understand the health effects of environmental and human impacts. This would ultimately feed into fecundity and survivorship modelling efforts. Moore *et al.* (2021) reported on the workshop outcomes, including health information from published literature, new analyses from the North Atlantic right whale Consortium database, and current efforts, and limitations to monitor individual and species health, survival, and fecundity. Since 2010, the annual percentage of females presumed alive and available to calve has been reduced by 17%. In contrast to southern right whales, North Atlantic right whales have failed to maintain a positive trajectory towards recovery since the impact of historic whaling. The primary known stressors include prey quantity and quality as well as the more direct anthropogenic stressors of entanglement, vessel strike, and noise. Climate change-driven distribution shifts of food, and subsequent changes in right whale distribution have complicated efforts to monitor and manage their health. The already poor fecundity and survival of North Atlantic right whales has resulted in a recent decline. While foraging success is critically linked to health and plays a role in reproductive success, little may be possible to enhance it. In contrast, anthropogenic trauma is avoidable, given adequate and effective management changes.

Given the precarious status of the species, Moore *et al.* (2021) identified the primary roles of existing and potential new health assessment tools to be: (1) evaluation of the efficacy of management changes designed to enhance species recovery; (2) greater understanding of North Atlantic right whale health and reproductive success; and (3) better understanding of the relative importance of anthropogenic impacts over time compared to the effects of food limitation/other impacts on population health. In conclusion, the authors noted that new tools are needed to assess mitigation strategies, existing tools should continue to be used in monitoring and should be refined as environmental changes alter distribution and behaviour.

The Committee **encourages** the continuation of collaborative efforts to understand health trends in North Atlantic right whales, including transboundary studies. It noted the important role of the North Atlantic Right Whale Consortium for facilitating research within and across nations and centralising key data, such as photo-identification, which have been critical for studying individuals and population trends over time.

The Committee thanks the USA for providing updates about North Atlantic right whales, and recognises the substantial efforts underway to understand North Atlantic right whale status and to mitigate human impacts.

Attention: C, CG, G, SC, R, S
The Committee strongly **reiterates***: (1) its serious concern over the status of right whales in the western North Atlantic, the only known viable population of this species; and (2) that the USA and Canada make every effort to reduce human-induced injury and mortality in the population to zero, recognizing that two primary threats to North Atlantic right whale recovery are entanglement in fishing gear and vessel strikes (IWC, 2021a, p.41). The Committee:*recognises

(1) existing USA/Canada collaborations and **encourages** *expansion of those efforts, where possible;*
(2) **encourages** *research to understand seasonal and transboundary movements of North Atlantic right whales and the ecological factors driving those movements;*
(3) **encourages** *the continuation and expansion of collaborative studies of right whales in the northern and southern hemisphere, and*
(4) **encourages** *further updates on North Atlantic right whale status, management and bilateral cooperation next year.*

8.2.7 North Atlantic humpback whales (and see Items 6.1, 7.1.7 and 7.1.8) (NH)

The Comprehensive Assessment of North Atlantic humpback whales was completed in 2002 (IWC, 2002b; 2003). In 2018, the Committee agreed that it was timely to consider a range-wide in-depth assessment (IWC, 2019c, p.133) and has since been collecting and evaluating the necessary information. The Committee received an update on that progress and several large-scale studies that are currently underway and expected to inform the assessment.

On-going genetic analysis of samples from all known feeding and breeding grounds suggests two genetic clusters in the North Atlantic: one in the western North Atlantic and another that includes animals from the southeastern Caribbean as

[4] *https://www.fisheries.noaa.gov/species/north-atlantic-right-whale#spotlight*.

well as the eastern North Atlantic (Palsbøll *et al.*, 2017; Palsbøll *et al.* in prep). Analyses including samples from the northeastern South Atlantic also revealed some dispersal and gene flow into the North Atlantic. This research suggests that the small eastern North Atlantic population off the Cape Verde Islands (estimated at 272 individuals, Wenzel *et al.*, 2020) is being supplanted due to substantial levels of influx from (and mating with) the larger western North Atlantic breeding population. Some humpback whales summering off Iceland and Norway are part of this small eastern North Atlantic breeding population. In addition, preliminary evidence suggests small, but statistically significant, levels of genetic heterogeneity in the maternally inherited mitochondrial DNA (mtDNA) among summer feeding grounds due to maternally-directed site-fidelity. Palsbøll and colleagues are continuing this work based on the basin-wide archive of ca.6,000 samples at the Marine Evolution and Conservation Group at the University of Groningen. Additional data and information continue to be sought from areas that are currently under-sampled or appear to be sites of mixing, such as the southeastern Caribbean and the eastern North Atlantic (see also Item 10.2.2.2).

Available photo-identification data provide further detail on the non-random mixing of North Atlantic humpback whales within the Caribbean and in relation to feeding grounds. SC/68C/NH/02 summarised the current North Atlantic Humpback Whale Catalogue sample sizes and exchange among primary feeding and breeding grounds as well as other sites, such as off Europe and the US East Coast south of the Gulf of Maine. Whales occupying the southeastern Caribbean appear later in the breeding season and exhibit exchange with the Cape Verde Islands (Stevick *et al.*, 2016). Both of these breeding sites appear to exhibit preferential exchange with eastern North Atlantic feeding grounds (Stevick *et al.*, 2019; Wenzel *et al.*, 2020). Nevertheless, some exchange does occur between the western and southeastern Caribbean, including during the same year (Mackay *et al.*, 2019). Jones is undertaking a formal analysis of exchange among all primary feeding and breeding sites in the North Atlantic, as an extension of prior work (Jones, 2018).

Recent analyses of humpback whale song support photo-identification evidence that breeding behaviour occurs later in the southeastern Caribbean, as singing starts later at Guadeloupe and Martinique than at western Caribbean sites (Heenehan *et al.*, 2019). Cholewiak and colleagues are examining passive acoustic data further, comparing song recordings from the western and southeastern Caribbean (December 2016–June 2017) to assess whether differences in song content might indicate subpopulation segregation.

Humpback whales continue to be detected on some feeding grounds during the breeding season in the North Atlantic (e.g. Zeh *et al.*, 2020) but it is not always clear whether this represents individuals who are overwintering, departing late or returning early. As discussed in Víkingsson *et al.* (2015), a particular on-going question is whether there may be large numbers of humpback whales overwintering at high latitudes in Iceland, or undertaking migrations that are much later than previously expected. Analysis of biopsy samples from such individuals may help to clarify any potential stock structure implications of this behaviour. Biotelemetry data are being used to study movements in the North Atlantic, and may also help to identify and understand those occurring outside of expected feeding and breeding times and areas. Kettemer (University of Tromsø), Lefort (University of Manitoba) and Heide-Jørgensen are leading a process of synthesising data from 176 satellite tags deployed by collaborators who have conducted deployments on North Atlantic feeding and breeding grounds between 2002 and 2019.

One or more abundance estimates are available for all primary feeding grounds since the Comprehensive Assessment. However, a continuing data gap is the estimation of population abundance for the overall North Atlantic as well as the Caribbean breeding population(s). A follow-up study to YONAH (the MONAH project, 2003–2005) sampled males on Silver Bank (western Caribbean) and in the Gulf of Maine under the assumption of a panmictic breeding population. Preliminary MONAH results suggested either little growth (ca.20%) in the West Indies breeding population since YONAH (NMFS unpublished data, Bettridge *et al.*, 2015), or that Silver Bank, the largest breeding habitat in the region, has become saturated. However, further analyses are warranted to understand those results in light of the current understanding of stock structure (IWC, 2019c, Annex E, item 5.8.2). Clapham reported plans to explore ways to complete that work in support of an in-depth assessment.

The Committee also received updates on available demographic data, catch data and other sources of mortality in the North Atlantic. With regard to the last, there is an on-going Unusual Mortality Event along the US East Coast, but no new information was available at the meeting. These topics will continue to be reviewed through the continuation of the intersessional correspondence group.

The Committee notes the importance of continued progress toward an in-depth assessment for North Atlantic humpback whales. To this end, the Committee:

(1) **Agrees** *to the continuation of the intersessional correspondence group under Robbins to compile and evaluate information available for the in-assessment.*

(2) **Recognises** *that there are several important ocean-scale analyses (photo-ID, genetic, acoustic and telemetry) still underway and* **agrees** *to a virtual intersessional workshop in 2021, if needed, and an in-person meeting in 2022 to receive and evaluate that information in the context of assessment.*

(3) **Reiterates** *the importance of new information from the understudied areas in the southeastern Caribbean and eastern North Atlantic (IWC, 2020c, p.131) and particularly* **recommends** *data sharing with repositories that are leading ocean-scale analyses of photo-identification (North Atlantic Humpback Whale Catalog, College of the Atlantic) and genetic data (Marine Evolution and Conservation group, University of Groningen).*
(4) **Reiterates** *its previous recommendations to the USA for further analysis of the MONAH project data to estimate humpback whale abundance (IWC, 2019c, p.18, p.134; 2020c, p.131), and* **encourages** *Clapham to provide an update at SC68D.*

8.2.8 Gulf of Mexico Bryde's (Rice's) whales (NH)

In response to last year's request, the US provided updates on Bryde's whales in the Gulf of Mexico. Several lines of evidence suggest that this population represents a new species (Rice's whale, *Balaenoptera ricei*, Rosel *et al.*, 2021b) that numbers only approximately 50 individuals (Garrison *et al.*, 2020). Committee discussions of species status and abundance are provided under Items 10.1.2 and 11.1.10, respectively.

SC/S8C/NH/03 summarised research and management activities for Rice's whales over 2020 and early 2021. These whales are the only baleen whale resident year-round in the northeastern Gulf of Mexico. During 2020 and 2021, research continued to focus on a better understanding of the trophic ecology of these whales (what they feed on, where they are feeding, and what oceanographic features of the northeastern Gulf of Mexico currently make this their preferred habitat) and on the use of passive acoustic monitoring (PAM) to characterize their acoustic repertoire. In addition, deployment of a PAM unit in the southern Gulf of Mexico, in collaboration with Mexican scientists, is aimed at continued efforts to evaluate whether these whales may be present in areas outside the core habitat area of the northeastern Gulf of Mexico. Efforts to improve understanding of the distribution of these whales in the Gulf of Mexico will continue and efforts are underway to identify and determine critical habitat. For conservation and management, Recovery Planning workshops are planned for the fall of 2021 to gather information, facts, and perspectives on this population. Two *Deepwater Horizon* restoration projects are aimed at addressing vessel strike and noise impacts on the species. Finally, Gulf of Mexico Weather Buoy web pages that are in the vicinity of the core habitat in the northeastern Gulf of Mexico are being used to inform mariners about these whales and encourage slow transit speeds.

The Committee **welcomes** this new information from the US and **encourages** a further update at SC68D. Rosel advised that information on the acoustic repertoire of Rice's whale, as well as the oceanographic variables associated with species distribution should be available by then. The Committee cautioned that care should be taken when referring to 'calls' and 'song', where song may reflect seasonal breeding activity. Garrison clarified that sounds produced by Rice's whales do not appear to be seasonal, but that differences in calls have been observed in different parts of the Gulf of Mexico, implying differences between groups of animals. One carcass had evidence of plastic ingestion prior to the animal's death (Rosel *et al.*, 2021b) and the Committee realised that impacts from marine debris may be important but are challenging to assess. Rowles noted that NOAA and NASA are studying marine debris accumulation in relation to storm events, which could help identify priority areas for debris removal. The Committee noted that in addition to potential interactions with fishing gear, emerging threats from aquaculture should be evaluated. Finally, the Committee discussed the value of analysing tissue samples for toxins, as well as for reproductive and stress hormones.

Attention: SC, CC, CG, R
The Committee previously expressed serious concern about a small, isolated population of Bryde's whales in the Gulf of Mexico (IWC, 2019c, p.26; 2020c, p.31). That concern has now been reinforced by the fact that these whales were recently described as a new species, Rice's whale (Balaenoptera ricei), with estimated total abundance of only around 50 (51, CV = 0.50) animals. This makes Rice's whale the world's most endangered large whale. The Committee:

(1) **recognises** *that the USA has initiated a recovery program and encourages expedited efforts to complete and implement a recovery plan and to designate critical habitat given the extreme urgency of reducing injury and mortality to zero;*
(2) **encourages** *future studies using photo-ID and other data that will be valuable to assess threats to the population and the health status of individuals;*
(3) **encourages** *collaboration among the range states, particularly between the USA and Mexico, to understand and protect these whales outside their known core range in the northeastern Gulf of Mexico; and*
(4) **welcomes** *the information provided by the USA this year and encourages further updates in 2022, including: (a) findings from passive acoustic monitoring, photo-identification and studies of trophic ecology; and (b) information on known or emerging anthropogenic threats such as interactions with fishing gear, marine debris, vessel strikes, noise and aquaculture.*

8.2.9 Biennial workplans

The Committee continues to prioritise North Atlantic humpback whales, North Atlantic sei whales and North Pacific blue whales for intersessional work to accumulate data for future assessments (Table 6). Intersessional work is also planned to facilitate

Table 6
Workplan for NH.

Item	Intersessional work	SC68D
North Atlantic humpback whales	Accumulate data and plan for future in-depth assessment	Review new information
North Atlantic sei whales	Accumulate data for future assessment	Review new information
North Pacific blue whales	Accumulate data for future assessment	Review new information
North Atlantic right whales		Review new information
Rice's whales		Review new information

Intersessional correspondence groups for NH

SC Agenda Item/ Sub-Committee	Type	Group (short name)	Terms of Reference	Members
Item 8.2.4	ICG-5	NP blue whales	Locate and/or analyse data on abundance, catches and stock structure to prepare for a future assessment.	Branch (Convenor), Brownell, Clapham, Ivashchenko, Matsuoka, Mizroch, Monnahan, Olson, Palacios, Širović, Sremba
Item 8.2.5	ICG-6	NA sei whales	Continue to identify and evaluate data on distribution, abundance, stock structure and catches, with a particular focus on the western North Atlantic.	Cholewiak (Convenor), Breiwick, Brownell, Mallette, Mizroch, Palka, Robbins, Vikingsson, Weinrich
Item 8.2.7	ICG-4	NA humpback whales	Identify and evaluate data available for a potential future assessment of North Atlantic humpback whales.	Robbins (Convenor), Allen, Allison, Cholewiak, Chosson, Clapham, Donovan, Jones, Lang, Mallette, Mattila, Øien, Palka, Palsbøll, Punt, Rosenbaum, Tiedemann, Vély, Vikingsson, Weinrich, Wilberg, Witting
Item 8.2.7	SG	NA humpback whales	Plan for an in-person intersessional meeting in 2022 to advance the in-depth assessment of North Atlantic humpback whales.	Robbins (Convenor), Donovan (co-Convenor) and ICG-4 members

the future in-depth assessment of North Atlantic humpback whales, and two proposed projects have financial implications (see Item 23). Finally, the Committee plans to review any new information on North Atlantic right whales and Rice's whales in the light of concerns about their population status and recent implementation of conservation management efforts.

8.3 New information for other northern stocks *(NH)*

8.3.1 North Atlantic blue whales

Given the time constraints of SC68C discussion of this agenda item was postponed until 2022.

8.3.2 North Atlantic common minke whales

SC/68C/NH/01Rev01 provided information on the occurrence of minke whales in the wider Caribbean region, and adjacent western tropical Atlantic, based on data (1) found in the literature, (2) through social networks, and (3) collected in the field. Of the 130 records, 128 were common minke whales (*Balaenoptera acutorostrata*) and two were Antarctic minke whales (*B. bonarensis*) that stranded in the Gulf of Mexico and Surinam. Most of the records (81%) were from the northern and northeastern Caribbean, followed by the Gulf of Mexico (10%), and the western tropical North Atlantic (9%). No minke whale sightings or strandings were confirmed south of Martinique. Most records (84%) corresponded with the Caribbean upwelling season (December–March), and were associated with three types of water masses as well as extreme climatic events. The document concluded that the results were consistent with the Caribbean serving as a wintering ground for the common minke whale.

There was limited time to discuss this topic in SC68C, but the Committee **welcomes** this new information and **encourages** further studies on minke whales in the North Atlantic. An Unusual Mortality Event continues along the US East Coast, but new information was not available at this meeting. An update on this event is requested for SC68D.

Attention: SC, CG
The Committee **reiterates** *its concern about the Unusual Mortality Events affecting North Atlantic common minke whales, and* **requests** *an update on this event from the US at the next Annual Meeting (IWC, 2021, p.39).*

8.3.3 East Greenland-Svalbard-Barents Sea (Spitsbergen) bowhead whales

The East Greenland-Svalbard-Barents Sea (Spitsbergen) population of bowhead whales is endangered and poorly understood. Kovacs *et al.* (2020) provided new information on the distribution and movements of this population based on satellite tagging. Due to the strong affinity of bowhead whales for the ice edge, a helicopter platform (launched from a ship) was necessary for satellite tagging operations. This novel approach resulted in 16 tagged bowhead whales in late May–early June 2017 in the Fram Strait between Svalbard and Greenland. Despite the low abundance of this population, bowheads were found to

Table 7

Workplan for SH.

Item	Intersessional 2021/22	2022 Annual Meeting (SC68D)
Southern Hemisphere non-Antarctic blue whales (Item 8.2.1)		
Distribution (8.2.1.1)	Assess the stock identity and movements of blue whales in the Mozambique Channel (Cerchio). Funding is required to complete this work.	Report
Acoustic monitoring (8.2.1.1)	Analyse passive acoustic monitoring data collected off Oman in order to characterise the distribution and seasonal movements of the NWIO blue whales (Cerchio).	Report
Catalogue matching (8.2.1.3)	(i) Finalise photo-ID matching within the southeast Pacific; (ii) add metadata from Australian catalogues to associate photo-IDs with sighting date and location; (iii) quality control southwest, southeast Pacific and southeast Indian Ocean photographs; (iv) assess suitability of central Indian Ocean blue whale dataset for mark recapture analysis; and (v) review and compile photo-ID data from Madagascar within the SHBWC (Galletti and Olson). Funding is required to complete this work.	Report
Catalogue matching (8.2.1.3)	Submit the Blue Whale Center blue whale catalogue from Chile to SHBWC for matching (Torres Florez and Hucke Gaete).	None
Abundance (8.2.1.3)	Generate population abundance estimates using southwest Pacific Ocean (New Zealand), southeast Indian Ocean (Australia) and southeast Pacific mark-recapture data from SHBWC (Jackson).	Report
Antarctic blue whales (Item 8.2.2)		
Acoustic monitoring (8.2.2.1)	Conduct passive acoustic monitoring off the west coast of South Africa and off Durban, in order to characterise the density, distribution and seasonal movements of Antarctic blue whales (Shabangu).	Report
Population abundance (8.2.2.2)	Mark recapture modelling work following recommendations from the ASI Standing Working Group on SC/68C/ASI/15 (Olson).	Report one month ahead of SC68D for ASI review
Population structure (8.2.2.3)	Compare frequency and temporal features of Antarctic blue whale song at mid to low latitudes to assess regional variation (Buchan).	Report
Population trend estimation (8.2.2.3)	Provide regional Antarctic blue whale trend estimates using song density patterns (Miller).	Report one month ahead of SC68D for ASI review
Southern right whales (Item 8.2.3)		
Population structure (8.2.3.5)	Multi-state mark recapture and population dynamic analysis of Brazil-Argentina photo-ID data to assess movement rates between regions (two-year project led by Agrelo including Groch, Rowntree, Sironi, Vilches, Marón, Renault-Braga, Cooke).	Progress report
Population abundance (8.2.3.1)	Population modelling of South African right whale abundance and trend (Brandão, Butterworth).	Report for review at SC/69a
Population abundance (8.2.3.8)	Development of a common model to jointly assess population dynamics of multiple calving grounds (IWC-SORP funded). Estimate conversion factor to convert estimated numbers of parous females into total population size (Butterworth, Brandão, Ross-Gillespie, Cooke).	Report for review at SC/69a
Body condition (8.2.3.6)	Test a protocol to use for conducting body condition assessments of southern right whales using overhead images (Vermeulen, Christiansen).	Protocol in report, requesting endorsement by IWC at SC/69a
Catch records (8.2.3.8)	Right whale catch series discussion to update regional catch estimates from IWC (2013a) (Jackson and Carroll).	Meeting report
Southern Hemisphere humpback whales (8.4.1)		
Survey feasibility for Breeding Stock D (west Australia) (8.4.1)	Reanalyse pilot study to assess feasibility of future West Australia surveys (Kelly).	Meeting report
Southern Hemisphere fin whales (8.4.2)		
Population structure (8.4.1)	Review available published and unpublished Discovery mark data on fin whales (Pastene and Jackson).	Report
Catch densities (8.4.1)	Update fin whale catch model to include Soviet catch data (de la Mare).	Report
Population abundance (8.4.1)	Abundance estimate using IDCR-SOWER data (Matsuoka).	Report one month ahead of SC/69a for ASI review
Population abundance (8.4.1)	Develop common survey protocol to assist comparable future data gathering via SORP fin whale theme (Herr=Convenor).	Report

Intersessional correspondence groups for SH

Item	Group	Terms of reference	Members
8.2.1.3	SH mark-recapture	Advise on construction and analysis of southeast Pacific, southeast Indian Ocean and southwest Pacific mark recapture datasets, including timespan, regions to include, and modelling framework.	Jackson (Convenor), Barlow, Butterworth, Cooke, Double, Findlay, Fewster, Galletti, Gill, Jenner, Matsuoka, Möller, Olson, Salgado-Kent, Torres, Torres-Florez, Weinrich, Zerbini
8.2.2.3	Antarctic blue whale song	Low- and mid-latitude analysis of Antarctic blue whale song to establish any differences between wintering grounds.	Buchan (Convenor), Barlow, Branch, Cerchio, McCauley, Miller, Samaran, Shabangu, Širović, Stafford, Torres
8.2.3.6	Southern right whale body	Develop a global, standardised southern right whale body condition and visual health assessment protocol for IWC	Christiansen, Vermeulen (co-Convenors), Charlton, Findlay, Leslie, Minton, Moore

Intersessional correspondence groups for SH			
Item	Group	Terms of reference	Members
	condition	endorsement.	
			Cont.
8.2.3.6	Whale body condition assessment meeting	Organise a workshop (hosted at the upcoming Society for Marine Mammalogy) to share information on body condition analysis across cetacean species, and coordinate and standardize body condition assessment methods.	Charlton (Convenor?), Christiansen, Bell, Dawson, Groch, Hamilton, Jackson, Rowntree, Salgado-Kent, Sironi, Torres-Flores, Uhart, Vermeulen, Weir, Weinrich
8.2.3.8	Southern right whale catch data	Compile new SRW catch series and update regional catch estimates.	Jackson (Convenor), Allison, Andrews-Goff, Azizeh, Bell, Carroll, Charlton, Chatwin, Double, Findlay, Kemper, Paton, Reeves, Richards, Smith, Tryniw, Vermeulen, Zerbini
8.2.3.8	Southern right whale stock structure hypotheses	Review of the available historical and contemporary evidence for Southern Hemisphere stock structuring, develop stock structure hypotheses for review and ranking, based on available evidence; and identify data gaps where further work is required to discriminate hypotheses.	Jackson (Convenor), Agrelo, Azizeh, Baker, Carroll, Charlton, Evans, Findlay, Galletti-Vernazzani, Groch, Matsuoka, Richards, Rosenbaum, Sironi, Tiedemann, Torres Florez, Valenzuela, Vermeulen, Weinrich, Zerbini
8.2.3.8	Southern right whale modelling	Progress towards development of a common population modelling framework for Southern right whale calving grounds, to assess common: (1) population dynamics patterns; and (2) environmental drivers.	Charlton (Convenor), Agrelo, Brandão, Butterworth, Carroll, Cooke, Double, Groch, Leaper, Rayment, Ross-Gillespie, Rowntree, Seyboth, Sironi, van den Berg, Vermeulen, Watson

occupy much of their historical range from the northern Barents Region to Franz Josef Land. Data collected from 13 animals showed that at least some individuals exhibit the opposite movement pattern to most Arctic bowhead populations which migrate northward in summer. Instead, the data suggest that this small population stays in the northernmost latitudes of their range during winter followed by a southward dispersal in spring and then returning to their wintering grounds in autumn. The authors hypothesized that the southward movement may allow animals from the Spitsbergen population to take advantage of productivity created by upwelling in the marginal ice zone. They also expressed concern that rapid sea ice habitat loss may lead to population impacts from increased predation, changes to food web dynamics, and increased vessel traffic. Additionally, retreating sea ice may cause the population to retract northward where they would be forced to feed on pelagic zooplankton, a situation that the authors concluded would likely thwart population recovery.

The Committee **welcomes** this new information on the East Greenland-Svalbard-Barents Sea (Spitsbergen) population of bowhead whales. It was unable to discuss the information in detail due to time limitations in SC68C, but **encourages** future updates on the seasonal distribution and other aspects of the biology of this population. Discussion of new genetic findings for this population can be found under Item 10.1.2.

8.3.4 Unusual mortality events affecting northern stocks

In 2020, the Committee recommended exploration of the possible implications of unusual mortality events for future assessments of Northern Hemisphere populations (IWC, 2021a, p.41). Given the time constraints of SC68C, discussion of this topic was postponed until 2022, but will be advanced through the continuation of an intersessional correspondence group under Cholewiak.

8.3.5 Workplan

The Committee will continue to receive new information on other Northern Hemisphere stocks that are not subject to directed takes. It will also review information available on Unusual Mortality Events involving Northern Hemisphere populations in relation to population status and potential implications for assessment priorities.

Table 8

Workplan for NH, other stocks and UMEs.

Item	Intersessional work	SC68D
Northern hemisphere stocks not subject to direct takes		Review new information
Unusual mortality event in northeastern Atlantic		Review new information

Intersessional correspondence group for NH				
SC Agenda Item/ Sub-Committee	Type	Group (short name)	Terms of reference	Members
Item 8.3.4	ICG-*	UMEs and assessments	Review information on Unusual Mortality Events for their potential relevance to future assessments of Northern Hemisphere populations and their priorities.	Cholewiak (Convenor), Mallette, Mattila, Palka, Rowles, Robbins, Weinrich

8.4 New information (if provided) for other Southern stocks *(SH)*

8.4.1 Southern Hemisphere humpback whales (If new information from Australia provided for estimating BSD)

The assessment of the breeding stocks D (West Australia), E1 (East Australia) and Oceania was completed in 2014 (IWC, 2015a), but there were difficulties in obtaining a reliable estimate of absolute abundance for breeding stock D (IWC, 2017a; 2018a). Assessment of the feasibility of a new survey is underway, and a report to the Committee is anticipated for the 2022 meeting. In 2018, the Committee recommended a review of methods to survey humpback whales migrating along the west coast of Western Australia (IWC 2019b: 27). Kelly reported that this work has not progressed substantially in the 2020/21 intersessional period, mostly due to the COVID-19 global pandemic; it is hoped progress can be made before next year's meeting.

In 2021, the Committee received new information on population abundance in breeding stock G, derived from mark recapture analysis of photo-identifications (SC/68C/ASI/02, Item 11.1.9). Breeding stock G spans the northwestern coast of South America, southwestern Central America and feeding grounds around the Antarctic Peninsula and southern Chile. When the Southern Hemisphere In-Depth Assessment of humpback whales concluded, the sub-committee expressed support for efforts to collect and reconcile photo-identification datasets from central America in order to better investigate population abundance and substructure in Breeding stock G (Item 10.1.1, IWC, 2016a). The Committee welcomed this paper, which will be reviewed intersessionally.

Attention: SC, G, CG
The Committee **agrees** *that obtaining a reliable estimate of absolute abundance for Breeding Stock D (west Australia) remains a priority for any future in-depth assessment of humpback whales. The Committee therefore* **reiterates** *(IWC, 2019d:27) its recommendation that an evaluation of survey feasibility be carried out, with a view to implementing a new survey of this population in the future.*

8.4.2 Southern Hemisphere fin whales (SH)

The Committee is currently conducting a pre-assessment of Southern Hemisphere fin whales. However, this year no new reports **were invited** due to the limited discussion time available at the meeting.

SC/68C/ASI/03 reported the results of 2020/21 JASS-A dedicated sighting survey program, which was conducted in the western part of Area III (015°-035°E; south of 60°S). The total searching distance was 1,744.3 nautical miles during which 136 schools (228 individuals) of fin whales were observed. In total, 15 biopsy samples (individuals) were collected and seven satellite tags were deployed (see Appendix 2, SC/68C/ASI/03). Data obtained will be analysed for abundance estimates and stock structure studies at the Institute of Cetacean Research.

An update on intersessional progress made by the IWC-SORP Acoustic Trends Working Group on measuring trends in fin whale abundance in the Antarctic can be found under Item 8.2.2.3 and SC/68C/SH/12.

Progress on a joint analysis of Antarctic Peninsula and Scotia Sea sightings data compiled from different sources and preliminary density predictions can be found in SC/68C/SH/12.

In 2018, the Committee agreed that a review of all Discovery mark data published on fin whales should be conducted, to assess population connectivity patterns (item 4.1, IWC, 2019a). This review has not yet been provided and the Committee encourages provision of this analysis in 2022.

Attention: SC, CG, R, S
Knowledge of population structure is essential to future efforts to assess Southern Hemisphere fin whales. The Committee **reiterates** *its* **recommendations** *from 2018 and 2019 (IWC, 2019d:23) regarding (i) analysis of fin whale acoustic recordings to assess song variation; (ii) strategic biopsy sampling and analysis to measure fin whale genetic differentiation; and (iii) a review of all Discovery mark data published on fin whales, to assess population connectivity patterns.*

In order to estimate fin whale abundance for upcoming assessment, the Committee **reiterates** *(IWC, 2019d:23) that it:*

(1) **encourages** *the completion of a new circumpolar fin whale abundance estimate;*
(2) **encourages** *analysis of fin whale distribution and geographic aggregations using catches; and*
(3) **encourages** *completion of the joint analysis of the Antarctic Peninsula and Scotia Sea sightings data, to measure contemporary fin whale distribution and density patterns.*

To maximise the value of fin whale sightings datasets, the Committee also **recommends** *that a sightings survey protocol be developed to assist researchers to collect sightings data in a comparable way across survey platforms.*

9. STOCKS THAT ARE OR HAVE BEEN SUGGESTED TO BE THE SUBJECT OF CONSERVATION MANAGEMENT PLANS (CMP)

Conservation Management Plans (CMPs) are an important conservation initiative of the IWC. They provide a framework for countries within the range of vulnerable cetacean populations to work together and in collaboration with other relevant stakeholders, to protect and rebuild those populations. This item covers stocks (with a focus on progress of scientific work

and information) that are either: (1) the subject of existing CMPs; or (2) are high priority candidates for a CMP. This report also addresses stocks that have previously been considered as potential CMPs, recognising the Commission's interest that range states support IWC CMPs.

9.1 Stocks with existing CMPs: new information and progress with previous recommendations

9.1.1 SE Pacific southern right whales (CMP, SH)

The Committee received the report of the Third International Coordination meeting of the Eastern South Pacific southern right whale CMP (SC/68C/CMP/16). Due to COVID-19, the meeting was conducted virtually from 20–22 April 2021. The main goal was to review progress made since 2018 and to develop a new implementation strategy for 2021–2023. Representatives from the governments of Chile and Peru, and members of the IWC CMP sub-committee attended the meeting. The adoption of the Memorandum of Understanding (MoU) was highlighted as a long-term commitment for the conservation of this population of southern right whales.

In 2020, new information was provided about sightings, including surface active groups off Isla de Chiloe and mother-calf pairs in Gulf of Penas (SC/68C/CMP/16). Given the difficulty in locating the animals, concomitant with the small number of whales, the need for the development of a web platform to streamline reporting of whales in real or near real time would be helpful. Such a system would facilitate rapid response to entanglement and stranding events while increasing the number of observations reported.

An 'experience exchange' workshop, originally schedule for 2019 or 2020, was postponed due to the ongoing COVID-19 pandemic and will be further postponed until 2021 or 2022. The goals of the workshop are to facilitate an exchange in experiences and lessons learned, including reviewing whale watching regulations, entanglement response procedures, and scientific research permit protocols (for stranded and live animals). Further an outcome of the workshop will be to propose protocols for obtaining genetic samples, photo-identification, satellite tracking, and use of drones. The need to have sound scientific protocols for research activities was highlighted as a priority. Protocols will be useful by national authorities to facilitate permitting of research projects. Specifically, tagging is not currently allowed. Development of best practices would assist national authorities and help facilitate responsible research opportunities. Advice from the Committee was therefore requested in order to draft a document for input prior to the workshop. This workshop also has the support of the Whale Watching Sub-committee (WW).

Other important activities proposed under the Implementation Strategy (2021–2023) were also presented, such as entanglement response trainings, a southern right whale day celebration, increased use of IWC CMP webpage, and conducting informative virtual meetings with stakeholders in Chile and Peru.

Attention: SC
The last CMP review for Southeast Pacific Southern right whales was in 2016. Since then, considerable new scientific information has been collected and actions undertaken.
The Committee **agreed** *to conduct a CMP review for this population in 2022.*

Holding a scientific workshop in conjunction with the Fourth International Coordination meeting which will review the entire CMP should be considered.

A report on the progress of a passive acoustic monitoring (PAM) project was also received (SC/68C/CMP/14). The PAM project seeks to assists in the identification of a breeding area along the coast of Chile and Peru. Six sites were selected and two sites have already been covered (northwestern Isla de Chiloe and Arauco Gulf). One of the acoustic monitoring systems was lost in the Arauco Gulf due to COVID-19 restrictions. Other equipment will be deployed at Peninsula de Mejillones during 2021–2022. Logistics have already been coordinated with a local NGO (CIFAMAC) and the Universidad Católica del Norte to deploy the equipment. The next site to be monitored will likely be in southern Peru. The project is considering the participation of a Peruvian specialist in a maintenance survey in northern Chile to build capacity in the use of the hydrophone. A newer version of the acoustic equipment, that requires less maintenance, was offered by the Centro de Estudios Avanzados en Zonas Aridas (CEAZA), to monitor the Gulf of Penas site in the second half of 2022.

The Committee received results on the acoustic presence of southern right whales using data obtained from northwestern Chiloé Island and Arauco Gulf (SC/68C/CMP/17). Recordings were analyzed using an automatic detector specially developed under this project for right whale upcall vocalizations. Off Chiloé, 189 positive detections were found in the 2018–2019 period, with calls present during the austral summer, autumn and winter, with no clear seasonal trend. There were two peaks of detections off Chiloé, one in December 2018 with high vocalization rates for two days, and the second in March 2019 with eight days of acoustic presence. Gunshots were detected along with upcalls during March 2019. The presence of gunshots is of relevance because they have been associated with mating or agonistic behaviour between males in other populations. The presence of upcalls in almost all seasons suggest that northwestern Chiloé Island is potentially used by individuals as a non-migratory habitat, but also could be the reflection of a population so small that seasonality cannot be detected. The coupled results from the acoustic and sighting data are providing strong evidence for year-round presence of this species in the area off northwestern Chiloé. The automatic detector will be tested to corroborate

its probability of omitting vocalizations (false negatives) and to assess whether acoustic presence may be underestimated. In the Arauco Gulf, there were no positive detections.

The Committee congratulated Chile and Peru and the researchers for the considerable advances made under the CMP and noted the request of support to develop draft protocols (for research activities) in advance of the experience exchange workshop. The Committee expressed strong support for the collaborative efforts and results presented. It was noted that funding was necessary to conduct the (1) PAM field work in 2022–2023, and (2) the paired scientific workshop and fourth coordination meeting to review the CMP. The possibility of establishing a southern right whale day for the benefit of both south American right whale CMPs was also highlighted.

Attention: SC, CC, CG
The Committee **reiterates** *the importance of the CMP for the conservation of the critically endangered Southeast Pacific southern right whale population (IWC, 2019a, p.28). The Committee* **welcomes** *the progress made and* **draws attention** *to the need for funding to continue to conduct the PAM field work and to develop a workshop and meeting to review and update the CMP.*

The Committee:

(1) **commends** *the scientific work and international cooperation being undertaken for the PAM (passive acoustic monitoring) project and* **congratulates** *the researchers for the results, which will assist in designing future sighting surveys and providing baseline information on the location of breeding grounds.*
(2) ***notes*** *the importance of increasing information about the presence of the species in southern Chile, which could merit additional monitoring efforts.*
(3) **endorses** *the proposed workshop and coordination meeting to review and update the CMP.*

9.1.2 SW Atlantic southern right whales (CMP, SH)

The Committee received the Report of the Intersessional Workshop on the IWC CMP for the Souhtwest Atlantic Southern Right Whale (SRW) Population (SC/68C/CMP/20). The workshop aimed to review research, monitoring, and mitigation actions, establish the status of each action, evaluate the next steps necessary to accomplish those actions not yet completed, evaluate the continuity of accomplished actions and establish new actions if necessary. The main results for the workshop are summarised in Table 9.

Table 9

Summary of future work required to selected research (RES), monitoring (MON) and mitigation (MIT) objectives of the Southwest Atlantic SRW CMP.

Action	Future work
RES-01 – Determine movements, migration, habitat use, location of feeding grounds, and relevant population structure analyses.	(i) Share photo-ID catalogues between researchers/institutions to better understand migratory connections; (ii) Continue satellite tagging in Argentina and initiate tagging in Brazil and Uruguay; (iii) Conduct fine-scale population structure analyses and relate with health status; (iv) Conduct Passive Acoustics Monitoring and encourage analyses of data already recorded from the Antarctic Peninsula; (v) Conduct feeding ecology analyses (e.g., stable isotope analysis) to assess foraging grounds; and (iv) Conduct selected habitat studies in Uruguay.
RES-02 – Development of a GIS (meta) database on information on human activities that might have an adverse impact on whales.	Gather and standardise information for comparison among the range states, develop the database in order to gather all the data from the different range states, and compile a SRW Sensitivity Atlas (funds to support this work are necessary considering the importance of this information for spatial planning and management by governments).
MON-01 Ensure long-term monitoring of abundance, trends and biological parameters.	(i) Monitoring efforts should expand in Uruguay and Chile to improve estimates of trends in abundance and biological parameters; (ii) Adequate long-term funding, especially for these two countries, should be secured. (iii) Work to estimate abundance and understand population dynamics should continue in Brazil and Argentina. (iv) Regional population assessments should be conducted. (v) Body condition (drone) studies should be carried out in Brazil and continue in Argentina.
MON-02 Enhance capacity building for existing stranding networks including post-mortem exam and cause of death assessments.	Although Brazil and Argentina both have a strong stranding response network (REMAB and SRWHMP, respectively), it is necessary to: (i) Review and update protocols (as appropriate); (ii) Enhance the logistical capacity of the stranding networks (if necessary), including provision response equipment, following the recommendations in IWC (2011a); (iii) Develop post-mortem protocols; – for Argentina and Uruguay; – strengthen diagnostic capacity for pathogens biotoxins and pollutants among others.
MIT-01: Development of a regional entanglement response strategy	Disentanglement workshops are needed in some locations and more people should be trained in places where workshops have already been held. Targeting trainings in Uruguay and Brazil are needed.

The Committee received population estimates for SRWs which use the Brazilian coast as a wintering area (SC/68C/CMP/10). In 2005, the population growth rate was estimated at 14% per year using linear regression of identified females. Later, a population growth rate was updated to 12% per year analyzing a mark-recapture dataset from 1987 to 2010. Population size was estimated as 569 (±38) for females and 2,626 (±737) for adults. The final PRADEL model showed that the population growth rate was the same and constant for females and adults (4.8% ± 1.2%). GOFs tests did not indicate a signal of response to capture (TEST2.CT: p = 1) and there was no evidence of transiency (TEST3.SR: p = 0.43). This is the first update of the population trends for Southern right whales in Brazilian breeding ground since 2010. The Committee noted that the estimates of population size and trends should be added to the list for ASI to review intersessionally and requested an update from ASI at SC68D.

Two papers were received on southern right whale research in the Southwest Atlantic outside of the area covered by the CMP. Information was received on a newly-documented wintering area for southern right whales in the southwest Atlantic (SC/68C/CMP/09 Rev01). Vessel surveys were conducted along the north-east coast of the islands at 51° 33' S, 59° 49' W during the winters of 2019 and 2020. There were 195 right whale sightings (433 animals), comprising adults and juveniles. This area was used for both socialising and mating. The encounter rate showed a strong temporal peak in July. Cataloguing of 36,000 lateral photo-identification images is underway, and analysis has produced single inter-annual and intra-annual recaptures to date. Biopsy samples (n = 95) were collected in 2019/2020 and are currently undergoing genetic and stable isotope analyses. A two-year continuous acoustic monitoring deployment has been completed and its analysis should better clarify the temporal occurrence of right whales at the site.

SC/68C/CMP/08 assessed the body condition, connectivity, and trophic ecology of southern right whales feeding at the island at 54°15'S 36°45'W in summer. There are 77 whales in the photo-identification catalogue for this feeding area; matching to low-latitude grounds and opportunistic photos has revealed one match to Brazil (a female, born in 2002) and one (probably female) to the Western Antarctic Peninsula. Visual assessment of whale health showed most whales in good or moderate body condition, with skin condition being poorer in 2019/20 compared to 2017/18. Carbon and nitrogen stable isotopes showed that in the months prior to visiting SG (GS), most whales (n = 7, six females, one male) had isotope patterns consistent with feeding at or southwest of the Polar Front, while two males had higher nitrogen values, consistent with lower latitude feeding.

The Committee congratulated the authors for their work off the islands at 51°33'S, 59°49'W. In discussion, the contemporary habitat use of the islands at 51°33'S, 59°49'W versus the island at 54°15'S 36°45'W was noted. A question arose whether historical whaling records could elucidate whether historical records are consistent with current habitat use. Based on limited whaling records and data, it appears that there were few whales present in the area currently used and that most were present in summer and in pelagic areas. It was noted that there are areas where right whales were historically dense but now there are few whales, suggesting whales are using new areas in the South Atlantic.

The Committee commends the impressive array of research being undertaken, the collaborative efforts of the researchers within the boundary of the CMP, and the extensive collaboration among CMP member countries to undertake this research.

Attention: SC, CC, CG

The Committee **reiterates** *the importance of the CMP for Southwest Atlantic southern right whales and* **welcomes** *the progress made since its implementation.*

The Committee therefore:

(1) **recommends** *continued collaboration among range states to generate new information and* ***encourages*** *additional effort from Brazil given the additional funding received;*

(2) **reiterates** *the importance of continuing the long-term monitoring programme, noting that the COVID-19 pandemic is causing major problems for such long-term programmes and* ***encourages*** *governments to do all they can to avoid interruptions to these important long-term efforts;*

(3) **encourages** *the continuation of existing aerial coastal surveys and* ***recommends*** *expanding the surveyed area to include deeper waters to assess whether whales are using new habitats, and that a monitoring programme and aerial surveys are developed for Uruguay;*

(4) **encourages** *the continuation of telemetry studies in Argentina and* ***recommends*** *satellite tagging in Brazil, Uruguay and Chile;*

(5) **respectfully requests** *that the IWC Commissioners for these countries (Brazil, Uruguay and Chile) continues facilitating the internal permit process for the right whale tagging programme;*

(6) **encourages** *studies of stress hormones in baleen and the presentation of results to the Committee when they become available;*

(7) **encourages** *comparisons of photo-identification catalogues between Argentina, Brazil, Chile, and Uruguay; and*

(8) **recognises** *that coordination and staff time for disentanglement trainings is voluntary and* ***encourages*** *agencies involved to continue to allow their employees to participate.*

9.1.3 North Pacific Gray whales (CMP, IST, ASW)

The Committee was pleased to receive recent information from long-term studies on sightings, distribution, strandings, and body condition on the wintering grounds in Mexico (SC/68C/CMP/11; SC/68C/CMP/12; SC/68C/CMP/13), as well as photo-identification on the summer feeding grounds off Sakhalin Island and southeast Kamchatka, Russia (SC/68C/CMP/02). The Committee also received updated information on the status of gray whales in Japan. No sightings or strandings were reported there in 2020/21, but it was noted that skeletal remains were found near Abashiri, Hokkaido in July 2020 (SC/68C/CMP/07). Brownell provided information he compiled with Uni and others on the Abashiri whale and estimated its total length at 7.9m, based on the length of the mandible. The whale was thought to have died in 2018 or 2019 based on the condition of the remains and the size.

Weller reported on the 2019–2021 Unusual Mortality Event (UME) of eastern North Pacific (ENP) gray whales (SC/68C/E/10). While this UME has continued in 2021, the numbers of stranded whales appear to be decreasing compared with the same time period in 2019 and 2020. It was noted that there are no signs or symptoms of a UME in the Chukotka region or off Sakhalin Island, Russia in 2020.

Stewart and Weller (2021) presented results from NOAA's abundance survey of ENP gray whales between December 2019 and February 2020. Additional information is provided under item 7.1.3.1. A repeat survey to estimate abundance that had been scheduled for 2020/2021 was not undertaken due to COVID-19 restrictions. Planning is underway to conduct a repeat abundance survey in 2021/2022. Similarly, NOAA's annual survey of ENP gray whale calf production was cancelled in 2020 due to COVID-19, but the 2021 survey was underway at the time of this meeting (April–May 2021).

Attention: SC
The Committee **recommends** *that the estimates of abundance of Eastern North Pacific gray whales be reviewed by the Abundance Steering Group (ASG) intersessionally.*

New information and discussions on stock-structure of North Pacific gray whales are presented in Item 10.2.3.

The Russian Gray Whale Project (RGWP) has provided a long time-series of photo-id and genetic data used in the assessments by WGWAP. The Committee was informed that, despite COVID-19 related restrictions, field work was conducted in 2020, funded in part by the IWC. The latest assessment (presented by Cooke at the WGWAP-21 meeting, SC/68C/CMP/19, p.4), using long-term photo-identification data collected up to and including the 2019 season, indicated that the Sakhalin feeding population had increased at 4.5% (SE = 0.2%) per year over the 20 years up to 2019, reaching 231 (SE = 10) in 2019, of which 67 (SE = 4) were reproductive females.

Panigada reported on the rare sighting of a gray whale observed in the Mediterranean Sea during 2021. One previous record in the Mediterranean region was off the coast of Israel in May 2010 and a few weeks later the same animal was sighted near Barcelona, Spain (Scheinin *et al.,* 2011). The first sighting of the 2021 gray whale was recorded off Morocco and then along the coasts of Italy, France and Spain. Calculating the route from Rabat, Morocco, to France, the whale travels an average of about 60 km per day. It tends to stay very close to the coast and in shallow waters. Based on the estimated length (7.7–8.0 meters) and colour (scars, etc.), this whale is estimated to be over one year old (born in early 2020). Based on photogrammetry, the body condition of this whale is estimated at 37.6% lower than the average condition measured in the calving lagoons of Mexico. This is close to the starvation threshold (40 to 50%) estimated for stranded dead whales in Mexico (Christiansen *et al.*, 2021). Underwater videos also confirmed the poor body condition; the whale appears very thin with a protruding dorsal spine. The whale had two healing wounds along the lateral sides of the caudal peduncle. This is similar to wounds seen of other whales that had been, previously entangled.

Attention: CG-R, SC, G, I, CC
The Committee **reiterates** *the importance of long-term monitoring of gray whales,* **strongly recommends** *that Range States and others support this work and welcomes the new information provided by Mexico, U.S., Russia and Japan. In particular, the Committee:*

(1) commends the work in the wintering lagoons of Mexico, **urges** *its continuation and* **expresses concern** *about the high number of strandings, poor body condition and low calf counts observed off Mexico in 2019–2021 as related to the UME event;*
(2) **welcomes** *the continued provision of information from Japan and encourages researchers there to continue to collect as much information on sightings and strandings as possible, including attempting to obtain biopsies or tissues and photographs whenever feasible;*
(3) **recommends** *that every effort be undertaken to enable continuation of the Russian Gray Whale Project in order to maintain the several-decades long time series upon which assessment of the population relies; and*
(4) highlights the importance of data collected by NOAA/SWFSC on gray whale abundance and calf production off central California, particularly in light of the ongoing 2019–2021 unusual mortality event, and **recommends** *that this long time series, like that produced by the Russian Gray Whale Project, continue in 2021/2022 and into the future.*

The Committee has a long-standing cooperative relationship with the IUCN Western Gray Whale Advisory Panel (WGWAP) and there is a joint IUCN/IWC draft CMP for western gray whales. Reeves provided a summary of WGWAP work since the last SC meeting (SC/68C/CMP/19). In brief, the work of the WGWAP continued by way of several formal meetings and the drafting of a suite of 'legacy papers' for publication, including one on the population assessment modelling that has also been reported regularly to the Scientific Committee. The WGWAP will be dissolved on 31 December 2021, after which date the Panel will no longer be able to report back to the SC.

The Panel (and the IWC Scientific Committee) has repeatedly recommended that a 'joint photo-ID catalogue' of western gray whales (together with associated data) be established under the auspices of the IWC. A draft agreement has been shared and all parties involved have agreed in principle to make their photographs, biopsies, and data available under a data-sharing agreement based upon the safeguards incorporated in the IWC's data-sharing agreement and guidelines for catalogues. However, despite the agreement in principle, this initiative has made little or no progress over the last few years and remains in the hands of the two oil and gas companies (Exxon Neftegas Limited and Sakhalin Energy).

Significant progress has been made by the Ministry of Natural Resources and Environment of the Russian Federation (Minprirody of Russia) in collaboration with Russian marine mammal scientists to strengthen the effort to conserve western gray whales under the National Project 'Ecology'. A process is underway to establish an Expert Section on Cetacean Conservation and Restoration under the Minprirody Working Group on Conservation and Restoration of Selected Rare and Endangered Wildlife Objects in the Russian Federation. Minprirody convened two expert meetings, one in January and the other in April 2021, to review the Russian Federation Conservation Strategies of the Okhotsk Sea Populations of Gray Whales and Bowhead Whales. The purposes of these expert meetings are intended to identify, develop, and improve mechanisms for the long-term conservation of these populations in the Russian Far East in the face of increasing anthropogenic impact and climate change. The Expert Section is expected to become operational in the coming months and, among other tasks, will review the revised drafts and finalise strategies for next steps and action plans for 2021–2030.

The Committee spent some time discussing issues related to the CMP and the Memorandum of Cooperation on western gray whales, signed by most range states. In 2019, the Committee supported a workshop (including some modelling to focus on particular conservation questions) to complete updating of the scientific components of the CMP. That work was expected to feed into a proposed stakeholder meeting (already approved in principle by the Conservation Committee) to be co-sponsored by the IWC and IUCN after the SC68A and before the 2020 Commission meeting. Because it proved impossible to hold the workshop (and thus the associated modelling), limited progress has been made on planning for a stakeholder meeting. The Committee agreed that the postponed workshop should be supported and the work undertaken as soon as feasible. Funds for the workshop are already available. This workshop will continue the collaboration of range states, along with the IUCN (at least for the remainder of 2021) and the CMP group within the Conservation Committee, to develop plans for the stakeholder meeting in the nearest term.

Attention: C, CC, IGO, S, I, R
In light of the continued importance of the joint IUCN/IWC CMP for western gray whales, the associated research off Sakhalin and elsewhere, and the long-standing co-operation with the IUCN Western Gray Whale Advisory Panel, the Committee:

(1) **supports** *the planned update of the scientific components of the CMP via a intersessional workshop that will report to SC68D;*
(2) **encourages** *the range states and signatories of the Memorandum of Co-operation on western gray whales to continue to work with the CMP Steering Group and Secretariats of IWC and IUCN to facilitate a stakeholder meeting after SC68C and in light of the results of the above scientific workshop; and*
(3) **strongly reiterates** *its previous recommendation for a consolidated western North Pacific gray whale photo-identification catalogue under the auspices of the IWC and urges the relevant data holders to finalise a formal agreement to that effect with the IWC and IUCN.*

9.1.4 Franciscana (CMP, SM)

The Committee reviewed the Report of the Workshop on the Review of the Status of the Franciscana which was held from 7–9 April 2021 (SC/68C/REP/02). This three-day virtual meeting addressed two specific topics as part of the review: stock structure was addressed on the first day and abundance estimation was discussed on the second and third days. At last year's meeting, the Committee received various papers to initiate the review of the status of the franciscana. There was insufficient time to evaluate those papers because of the reduced amount of time available during the 2020 virtual meeting. At that time, the Committee established two intersessional correspondence groups (ICGs) to: (1) review population structure, including the level of support for each of the proposed stock subdivisions based on genetic and other lines of evidence (e.g. morphology and contaminant); (2) review abundance estimates and factors to correct for potential sources of bias in these estimates. Intersessional progress made by these ICGs was discussed during the workshop and future work, which will be conducted intersessionally, was identified. Further discussion of franciscana population structure and outcomes of the reviews of abundance estimates are found in items 10.2.1.1 and 11.1.3, respectively.

During SC68B, two funding proposals to support actions under the Franciscana CMP were approved by the Committee, including: (1) a proposal to conduct aerial surveys to estimate abundance in Uruguay, and (2) a workshop to advance the status review of franciscana by the Committee. Due to the COVID-19 pandemic and restrictions, the activities proposed could not be completed in 2021, but remain a priority for the Committee. The aerial survey is now planned to take place during the austral summer of 2021/22. The in-person workshop is expected to be held late in 2021 or early 2022. The goal of the workshop is to review intersessional work and advance the review of the franciscana prior to its completion by the Committee at next year's meeting. Upon completion of the review, the actions of the franciscana CMP for will be updated.

The Committee received three papers relevant to the actions identified as priorities in the CMP (SC/68C/E/11, SC/68C/HIM/10, and SC/68C/HIM/11). Review of these papers can be found under items 12.6 and 14.3.2.

The Committee thanked all those involved in the review of the status of franciscana review for their work on long-term research, for sharing valuable information and for their contribution with the review.

Attention: SC, CC
The Committee **agrees** *that the review of the franciscana continue during the intersessional period and at next year's meeting.*
The Committee **recommends** *that the proposed aerial survey off Uruguay and Workshop be completed prior to SC68D, if possible.*

9.2 Progress with identified priorities

9.2.1 Humpback whales in the northern Indian Ocean including the Arabian Sea

Humpback whales in the Arabian Sea do not undertake the same seasonal migrations between high latitude feeding grounds and low latitude breeding grounds as other populations. Evidence indicates that they remain in the Arabian Sea year-round, are genetically distinct, and are endangered (Minton *et al.*, 2008). The only available population estimate is fewer than 100 animals off the coast of Oman (Minton *et al.*, 2011). The population is subject to multiple threats, including ship strikes, entanglement in fishing gear, and coastal development. These whales have been identified as a candidate for a future CMP (IWC, 2019c, p.31).

SC/68C/CMP/05Rev1 provides an overview of activities undertaken by the Arabian Sea Whale Network (ASWN). Although the ASWN focuses on all large whale species (and occasionally small cetaceans as well), the Arabian Sea humpback whale (ASHW) is a flagship species. The network has no formal legal status, and coordination currently takes place voluntarily. Nearly 70 people are currently part of a group email list that shares messages about new publications, grant opportunities, meetings and webinars, and strandings or sightings of whales in the region. This email list has led to valuable exchanges, such as help with identifying species and suggestions for new areas for focussed research. The group also maintains a website (*https://arabianseawhalenetwork.org/*).

SC/68C/CMP/05Rev1 summarises the current status of work toward a joint IWC-CMS CMP, which has been hindered by the COVID-19 pandemic and recent changes to the IWC Commissioners in both India and Oman, the only two ASWH range states that are IWC members. However, progress continues on advancing the recommended actions under the CMS Concerted Action for Arabian Sea humpback whales. This progress focuses on three areas: addressing knowledge gaps, information sharing and raising awareness, and capacity building (see Annex 1, SC/68C/CMP/05Rev1). A further update will be provided at SC68D.

The type specimen for Megaptera indica was sampled at the Paris Museum of Natural History in November 2019. However, issues related to COVID-19 have prevented its shipment from France to New York, and thus prevented analysis. This is also a factor in the delay of analysis of additional samples from Oman to better understand taxonomy of ASHW. In recent weeks all the relevant permissions (e.g. CITES, ESA, MMPA) were finally secured by WCS, AMNH, and Paris Museum to complete the shipment; the sample may even be received by the time this paper is presented at the IWC SC.

Three separate modelers have generated abundance and trend estimates for ASHW using photographic capture-recapture and genetic data (covering the period from 2000-2017) provided by the Oman research team. In the coming weeks these results will be exchanged between the modelers and additional members of the IWC SC Intersessional Correspondence Group that was formed to support this process in 2018. It is anticipated that the results will be compared to assess the strengths and weaknesses of each model, and that a manuscript will be prepared for submission to a peer reviewed journal as soon as possible. If published, these results can be presented as a For Info paper to IWC SC 68D and discussed in both CMP and ASI.

During virtual meetings in January and February 2021, the ASWN formed two new working groups: one to look at ways to maximise sharing of resources and expertise for acoustic research in the Arabian Sea, and another to focus on helping collate and make available tools to support stranding response. The stranding group will benefit from involvement and advice of the IWC Stranding Initiative as well as the Global Stranding Network.

The Committee commended the ASWN members for their dedication and the amount of work that has been accomplished despite the COVID-19 pandemic, through limited fieldwork, and activities such as raising awareness and data analysis.

SC/68C/CMP/03 provided an annual update on baleen whale sightings reported by crew members onboard tuna gillnet vessels operating out of the port of Karachi in Pakistan. The programme formally commenced in 2012 and concluded in

September 2019 when funding ended. Even though the project ended, 37 captains continued to provide information voluntarily. During 2020, sightings included: one blue whale, one killer whale, 12 unidentified baleen whales, and five ASHW, including one mother-calf pair near Shumal Bundar Area, Balochistan. Fewer sightings were reported in 2020 than in previous years, due to the termination of the funding in 2019 and consequent reduction in effort. It was emphasised that this is a low-cost, high-value program that should be replicated if possible, not only in Pakistan but in other countries in the region. The information collected can be very helpful particularly for areas where neither dedicated cetacean surveys nor the placing of dedicated fisheries observers onboard vessels is possible.

The Committee noted that this work has made a valuable contribution to understanding of cetacean distribution in the Arabian Sea off Pakistan, and the lack of funding in 2020 is an unfortunate setback for a project that had at one point up to 80 observers.

SC/68C/HIM/20, summarised a project to develop methodology to characterise gillnet fleets in Pakistan in the Indian Ocean using satellite imagery. The project, which is in early phases, seeks to (1) use satellite imagery to quantify the number of boats in the tuna gillnet fleets, and ideally estimate bycatch, and (2) develop and validate a methodology that can be used throughout the region. The paper establishes a set of assumptions and potential biases and seeks input from Committee members on other unrecognised biases, potential collaborators following similar objectives, and recommendations for other IOTC gillnet fleets. Additional details can be found in Item 12.4.

The Committee recognised the relevance and importance of this work, given that entanglement in fishing gear poses a serious threat to ASHW. It was noted that many vessels in Karachi are also registered in Iran. Since the Iranian tuna gillnet fleet is the largest in the Arabian Sea, this work presents an important opportunity to monitor it as well. It was also noted that a similar project is underway off Oman, using High Resolution Satellite imagery to examine co-occurrence of artisanal fishing effort with ASWH distribution based on ecological niche modelling. It was recommended that the authors similarly consider distribution models for ASHW throughout the Arabian Sea (Willson *et al.*, 2017) to determine overlap. Other recommended areas of focus within the region included the Gulf of Aden, and the waters of Somalia and Socotra, which are difficult-to-impossible to work in directly. The Somali gyre was emphasised as an important upwelling region with high productivity, intense fishing pressure, and little information on cetaceans and bycatch.

The Committee welcomed an update (SC/68C/CMP/04) on research in the Sultanate of Oman during 2021, in part funded by two SC proposals awarded in 2020 (SC68B). Progress on one project, 'Passive acoustic monitoring for blue whales and other baleen whales off Oman', involved the recovery of acoustic monitoring equipment that was deployed in March 2020. Originally scheduled for recovery in September 2020, the recovery was delayed due to the COVID-19 pandemic, and successful recovery of the acoustic gear during March 2021 revealed that it had acquired 214 days of acoustic data between its deployment and October 2020. The primary objective was the detection of song from a newly identified Northwest Indian Ocean population of blue whales (Cerchio *et al.*, 2020b) with added value of detection of ASHW song. Analysis of acquired data will commence over the coming months. Immediate redeployment has not been possible due to hydrophone failures.

The second project, 'Assessment of Arabian Sea humpback whale body condition and co-occurrence with human activities off Oman', delivered information on body condition. Survey efforts occurred during 105 hours over 13 days in March 2021. No ASHWs were encountered (visually or acoustically) during the survey. It is not clear why no humpbacks were seen but one hypotheses was a distribution shift, linked to reproductive behaviour, foraging and oceanographic anomalies. The authors recommend concurrent acoustic monitoring work in southern Oman and other important ASHW habitat in the Northern Indian Ocean to improve understanding of distributional shifts during the breeding season. SC/68C/CMP/04 recommends continuation of body condition assessment to better understand the influence of upwelling on prey availability, with respect to known ecosystem state change in the Northern Indian Ocean (Goes *et al.*, 2020).

In the last two years there have been apparent shifts in distribution of blue whales in the Maldives that are thought to be related to changes in oceanographic conditions. It was also noted that it will be interesting to look at changes in distribution of Bryde's whales, which was one of the most frequently sighted species in the March 2021 Oman survey. The unique life history of the ASHW, feeding throughout the year unlike other humpback whale populations that fast during the breeding period, makes it more likely that oceanographic features affecting prey and feeding ecology may in turn influence breeding season distribution. The Committee recommended that the authors examine historical data for all three species, such as catches by illegal Soviet whaling during the 1960s and the possible influence of El Niño on locations of catches. The Committee noted that oceanographic drivers on distribution are being discussed in SH, and that increased perturbations in the last 4 or 5 years in the Southern Hemisphere appear to be resulting in reduced observations of whales in various breeding areas. The importance of extending survey effort to other areas of the Northern Indian Ocean region was highlighted, particularly in light of growing human development and increasing threats.

The Committee welcomed an interim report on ASHW song that was in part funded by CMP and SH, 'Assessing continued isolation of the Arabian Sea humpback whale population and continuity across the Arabian Sea through geographic variation in song'. This work extended the analysis of 3 years of song data presented in SC/67B/CMP/18 to an 8-year period from 2011-2018, reinforcing the conclusions of that previous study. ASHW singers off Oman changed their song relatively slowly with only a few exceptions, which is atypical compared to other populations of humpback whales globally. There was no indication of large-scale introductions of new song patterns that would indicate influence of and interaction with Southern

Hemisphere populations. There was evidence of a slightly increased rate of change and some novel song content during 2016–2017, which may reflect the influx of males from another subregion (e.g., eastern Arabian Sea). These results reinforce the understanding that ASHW are isolated as indicated by population genetic studies, and unique on multiple levels of their behaviour and life history patterns; furthermore, it was noted that long-term concurrent sampling of song throughout the Arabian Sea and analysis of subtle variations in song structure may allow inferences to be made about variation in rates of interchange of males across the Arabian Sea.

The Committee encouraged continued collaboration under the ASWN. The Committee highlighted the immense value of data being collected that can inform ASHW conservation and management, and provided strong support for continuing the programme, while recognising that new funds were required to do so. Lastly, the small size of this population was emphasised, and the critical need to better understand the combination of shifts in distribution, oceanographic drivers of those shifts, and potential overlap with anthropogenic threats and consequent increased risks; these underscore the importance of moving forward with a CMP for this species.

Attention: SC, CG, G, I, R, S
The Committee **reiterates** *that the Arabian Sea humpback whales are priority candidates for a CMP and* **welcomes** *efforts to encourage range states to develop one. It commends the efforts of scientists within the region and especially the Arabian Sea Whale Network to develop a strong scientific basis to guide the development of a CMP and recommends continuation of those studies. The Committee commends members of the Arabian Sea Whale Network for having achieved important conservation work despite the challenges of the pandemic over the past year. The Committee* **encourages** *continued regional collaboration among ASWN members, particularly the work proposed to be undertaken by the stranding working group and the acoustics working group.*

Furthermore, the Committee:

(1) **recommends** *that ASWN members and relevant ASHW range states undertake and support the work proposed in the CMS Concerted Action, especially those actions needed to address knowledge gaps and assess the Key Ecological Attributes (KEAs), and to apply them to practical management measures;*

(2) **recommends** *that the work of the crew-based observer programme in Pakistan (SC/68C/CMP/03) continue, and where possible, be replicated throughout the region, especially in areas where systematic cetacean surveys are not feasible;*

(3) **recommends** *that (1) once the Pakistan gillnet fleet has been mapped and characterised, the map(s) be overlain with models of ASHW distribution based on WWF Pakistan crew-based observer data (e.g. SC/68C/CMP/03 and similar papers from previous years) and models derived from satellite tracking of whales off the coast of Oman (e.g., SC/67A/CMP/15) to determine potentially high-risk areas for fishery interactions; (2) where and if species-specific bycatch data from WWF-Pakistan and other Arabian Sea fishing nations allow, humpback whale bycatch rates be calculated; and (3) this approach be applied to other Arabian Sea gillnet fisheries, including those in the Gulf of Aden and off Somalia, to generate coarse bycatch estimates where data allow, especially for humpback whales.*

(4) **encourages***: (1) that research include continuous and simultaneous passive acoustic monitoring in identified ASHW habitat in both the western Arabian Sea (different parts of Oman's waters) and eastern Arabian Sea (Pakistan, India and Sri Lanka) to better understand the population's spatiotemporal distribution and potential connectivity across a larger area of suspected range, as well as to understand if range or distribution shifts begin to emerge as a result of climate change and other threats (noting that this technique also yields valuable data on other whale species, e.g. blue whales); (2) that research include the use of UAVs to assess body condition, and that body condition indices be used together with other metrics to assess seasonal and annual variation and to evaluate health, scarring, and foraging success (e.g. Ramp et al. 2021); and (3) that future research include methods to assess (modelled) whale distribution in relation to oceanographic variables and data on fisheries and likely prey species, to better understand the drivers of distribution for ASHW, as well as the potential threat of fisheries interactions.*

(5) **recommends** *that continued efforts are made to simultaneously collect humpback whale song samples from the western and eastern Arabian Sea to allow further analysis of a) how Arabian Sea humpback whales change their songs over time on both sides of the Arabian Sea; and b) yearly variation in song similarity between the subregions, and what that might imply about long-term trends in exchange of animals across the Arabian Sea;*

(6) **commends** *the effort to catalyse dedicated cetacean surveys in the Northern Indian Ocean, particularly where they can shed further light on ASHW distribution in areas that have not been covered by past research efforts.*

(7) **recommends** *that wherever possible, such surveys, whether conducted from dedicated survey vessels or on platforms of opportunity: (1) are (co-)developed and implemented by relevant NIO range state scientists and organisations; (2) sightings of humpback whales recorded during surveys are shared with the relevant ASWN members in each ASHW range state and/or with the ASWN so they can be shared with members and contribute to a shared understanding of ASHW distribution in the NIO/Arabian Sea; and (3) any surveys that are organised include protocols that will allow individual identification of humpback whales that are encountered, especially in the Northern Indian Ocean/Arabian Sea, to enable comparisons with existing photo-identification catalogues from ASHW range states.*

9.2.2 Central American humpback whales

A CMP workshop for the preparation of the IWC Template nomination for the endangered Central American humpback whale population (CAHW) was held virtually on 6–7 April 2021. The workshop was organized by Mexico with representation of eight countries (US, Mexico, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, and Panama). The CAHW CMP nomination was presented to the Committee in the document SC/68C/CMP/15. The main objective of the CMP is to conserve the Central America humpback whale population and its habitat through collaborative regional actions to reduce anthropogenic threats throughout its range. Additional objectives include improving habitat connectivity and conservation and improving knowledge about population size, trends, movement patterns, and habitat use of CAHWs.

There was broad support for the comprehensive information included and the nomination of the CAHW CMP. In discussion, it was noted that the status of the CAHW is being discussed in the ongoing In-depth assessment of North Pacific humpback whales (Item 8.1.1). During discussion of the proposed CMP, consideration was given to whether there was geneflow and movement between the CAHWs and whales documented off Colombia. There are implications for management if there is a connection given the additional threats whales would encounter, such as mega-infrastructure (e.g., large ports for cargo including dredging activity, concrete piloting, and natural ecosystem transformation) and potentially sensitive areas along the route. There was concurrence that Colombia should be included with the CMP to implement the actions proposed and to confirm any sightings of whales from that population with a dedicated effort to document and match whales between locations. It was noted that existing data, particularly mitochondrial DNA and photo-identification, do not support a connection of the humpbacks present in Colombia with the CAHW, although there is the possibility of interchange. The Commissioner (Arguedas) from Costa Rica expressed interest in being involved in the CMP. Arguedas noted that systematic monitoring of cetaceans will be conducted off the Pacific coast of Costa Rica and that national monitoring could support the objectives of the CMP and help articulate the data into management action. It was mentioned that upcoming efforts by the IUCN task force to undertake the Important Marine Mammal Area (IMMA) in the southeast temperate and tropical Pacific Ocean in October 2021 might help support the objectives of the CMP.

Attention: SC, CC, CG

At SC68B, the Committee **reiterated** *the recommendation that the Central American humpback whale population be treated as a '***priority population'** *for the purpose of the CMP development process. After the presentation of the report of the Workshop on the Central America Humpback Whales' population' at Panama City, Panama (SC/68B/CMP/25), the Committee* **recommended** *the continuation and increased collaboration of the Range States. The Committee also* **recommended** *that the report of a second workshop be developed into a draft CMP to be presented at the SC68C meeting.*

The participating range states developed and presented the draft CMP for this population (SC/68C/CMP/15). There was broad support from the Committee for the comprehensive information included in this draft. Therefore, the Committee **recommends** *its suitability for endorsement.*

9.2.3 Mediterranean sperm whales

The Committee received information on the ACCOBAMS Scientific Committee meeting held in February 2020 that acknowledged the need to start work on an IWC-ACCOBAMS CMP for sperm whales. This new regional assessment should be ready by the end of 2021.

Attention: CG, CC, IGO

ACCOBAMS is considering drafting a CMP for sperm whales in the near future and the Committee **agrees** *that consideration should be given to this being a joint ACCOBAMS/IWC CMP*

The Committee **reiterates** *the recommendations of last year (IWC, 2020c) that the Mediterranean sperm whale be treated as a 'priority population' for the purpose of the CMP development process.*

9.2.4 Mediterranean fin whales

The Committee received a report on the ACCOBAMS CMP for the Mediterranean fin whales. Next steps are: (1) the updated draft CMP will be examined by the ACCOBAMS SC; (2) the IWC SC will review the CMP from a scientific perspective; and (3) a stakeholder Workshop will be held to develop a final CMP, to include participation from IWC as well as other IGOS, NGOs, local and national authorities, depending on funding availability. The first ever, basin-wide survey was completed in summer 2018 and the full set of analytical results (i.e. abundance and relative density throughout the region) is expected soon. These results will need to be taken into account in the draft CMP when they become available. A predictive model for local and seasonal occurrence/density of fin whales has been developed and is being tested (so far for the summer only). The need for a full-time co-coordinator under the guidance of a Steering Group representing key stakeholders was emphasised. Ongoing effort is aimed at integrating the draft CMP with actions targeting acoustic work.

Attention: CG, CC, IGO
The Committee **notes** *that ACCOBAMS has adopted the IWC guidelines for its CMPs. It* **welcomes** *progress made in developing a CMP for Mediterranean fin whales and* **reiterates** *the recommendations of last year (IWC, 2020) that the Mediterranean fin whale be treated as a 'priority population' for the purpose of the CMP development process. The Committee* **encourages** *the relevant IWC members and ACCOBAMS parties to work towards finalising a draft CMP for fin whales for presentation at SC*68D.

9.2.5 South American river dolphins

During SC68B, a nomination for a South American river dolphin CMP was presented by the Governments of Colombia, Brazil, Ecuador, and Peru and the scientific aspects of the CMP were subsequently endorsed in principle by the Committee. A small group reviewed the research elements of the proposal intersessionally and felt there were no specific scientific details that needed review. The Brazilian Delegation requested that further review of section 6 of the CMP during SC68C would be helpful so as not to hold up the CMP process. A small group, including the convenors of the sub-committees of CMP and SM, reviewed the actions and objectives and provided the proponents of the CMP some suggestions for clarifying section 6.

The Committee Chair thanked the proponents for drafting, presenting, and working together to protect and conserve the river dolphins in South America. Additionally, the SC Chair thanked the small group for its suggested clarifications to the CMP. He re-emphasized that the Committee unequivocally supports and re-endorses the CMP.

Attention: SC, CC
The Committee **recognises** *the range States revisions following the Committee's recommendations last year (SC/68B) for the CMP for South American river dolphins.*

The Committee:

(1) **Strongly endorses** *the CMP for South American river dolphins;*
(2) **encourages** *the range states to work with the IWC's Bycatch Mitigation Initiative since bycatch was identified as a key threat for river dolphins; and*
(3) **encourages** *the proponents to appoint a full-time co-ordinator for the plan and ultimately the CMP as soon as possible.*

It is likely the 2021 Commission meeting will be virtual and will only cover a limited number of agenda items. An endorsement from the Committee on the CMP for South American river dolphins will likely not be reviewed by the Commission until October 2022. In the meantime, the Committee encourages the proponents to move forward to implement the CMP as there is strong support and the scientific aspects are sound.

A representative from the Colombian Ministry of Environment and Sustainability provided updates on the interest of the respective governments to continue to work together to carry out the proposed activities. He also expressed the interest on behalf of Colombia to agree on a schedule and plan to bring the proposal to the next annual meeting of the Commission.

SC/68C/CMP/18 provided an update on progress of activities carried out between 2020 and 2021 within the framework of the South American River Dolphin Initiative (SARDI) to support the CMP. Although the COVID-19 pandemic restricted some activities, several initiatives were implemented to consolidate key actions, including: (1) evaluation of the national action plans by Colombia, Peru, Brazil, Bolivia, Ecuador, and Venezuela), (2) identification of positive experiences in the conservation of river dolphins in South America, (3) evaluation of the most effective conservation practices used in each of the countries, (4) launch of a data platform (dashboard), for sharing and archiving data; (5) celebration of the river dolphins international day (24 October 2020), (6) development of capacity building activities at the Cuyabeno-Lagartocoha – Yasuni Ramsar Site (Ecuador), (7) collection of field data and sample for river dolphins, (8) at least two scientific publications, (9) updates on the action plan for aquatic mammals in Colombia, (10) surveys in Colombia (Guaviare, Tillava rivers), (11) satellite tracking of three dolphins in Colombia (Guaviare, Orinoco), (12) analysis of mercury of five dolphins in Colombia and (13) extension of the SARDI range of action for the Tocantins-Araguaia basin.

There continues to be encouragement for collaboration by the respective countries involved. A question arose on how progress will be measured with such a large area with so many threats. It was suggested identifying smaller units to conserve would make it more feasible to address the problem and make tangible progress. A question was also asked regarding plans to resolve population structure to allow for such an approach.

The Committee again congratulates the countries of Colombia, Brazil, Ecuador, and Peru for submitting an excellent draft CMP proposal for South American river dolphins; such international collaboration at governmental, environmental and scientific levels is exemplary and is a useful example for others to follow.

9.3 Budget requests

Budget requests are discussed under Item 23.

9.4 Biennial workplan

The work plan for CMP is detailed in Table 10.

Table 10
Work plan for CMP.

Item	Intersessional 2021/2022	2022 Annual Meeting (SC68D)
Southeast Pacific right whale	Passive acoustic monitoring near Antogafasta for one full year; and start work in Peru, conduct CMP six year review-March–April 2022	Review progress on scientific aspects of CMP
Southwest Atlantic right whale	Workshop to review and update CMP actions	Review progress on scientific aspects of CMP
Gray whale	Scientific workshop in La Jolla or Seattle	Review progress on scientific aspects of CMP
Franciscana	Workshop to finalize the review, conduct aerial surveys in URU	Review the intersessional workshop report and new information
Arabian Sea humpback whale	Complete the revised abundance and trend estimates; complete genetic analyses to provide clarity on the taxonomic status of ASHW	Review progress on identified priorities for research and conservation
Mediterranean fin whale	Coordinate with ACCOBAMS SC to prepare final draft CMP including updating research priorities and actions for initial email review by range states and others	Review the draft CMP and progress on scientific aspects
Mediterranean sperm whale	Coordinate work with ACCOBAMS to identify drafting working group and streamline the development process	Review new information
South American river dolphin	Continue work on proposed CMP	Review material for proposed CMP
Central American humpback whale	Workshop on Research Actions, at La Paz, Mexico, November 2021	Review of the revised CMP proposal

10. STOCK DEFINITION AND DNA TESTING (SD-DNA)

During SC68C, the Stock Definition and DNA Testing Working Group (i) received voluntarily submitted information on the DNA registers maintained by Iceland, Norway, and Japan (Item 10.1.1); (ii) provided advice on stock structure to other sub-committees (Item 10.2.1, 10.2.2, 10.2.3); (iii) discussed supplementing the genetic data analysis guidelines (Item 10.3.2); and (iv) considered recommendations to avoid the depletion of tissue samples in existing collections (Item 10.4).

10.1 DNA Testing

The Committee received voluntary updates of the DNA registers from Iceland, Norway, and Japan. Details are given in Annex F. The Japanese and Norwegian registers cover the period up to and including 2020. The Icelandic register covers the period up to 2018; no whales were taken in Iceland in 2019 or 2020. Almost all samples in the Japanese and Icelandic registers have been analysed for mitochondrial DNA (mtDNA) and a standard set of microsatellites. Norway discontinued mtDNA analyses of samples in 2016. Almost all of the samples in the Norwegian register have been analysed for a standard set of microsatellites, and almost all of the samples collected in 2016 or later have also been genotyped for SNPs.

Representatives of Iceland and Norway submitted a statement reasserting the position of the Governments of Iceland, Norway and Japan on DNA registers (see Annex P).

The Committee **thanked** Japan, Norway and Iceland for providing updates to their DNA registers using the standard format agreed in 2011 and providing the detailed information contained in their DNA registers.

10.2 Advice on stock structure to other groups

The Working Group has the task of discussing high-priority stock related papers from other sub-committees and working groups, and then providing them with stock structure related feedback and recommendations. These discussions often refer to the genetic analysis guidelines and genetic data quality documents.

10.2.1 Small cetaceans stock structure

10.2.1.1 Franciscana population structure

The franciscana (*Pontoporia blainvillei*) is a small dolphin endemic to the Southwestern Atlantic that has been classified as vulnerable by the IUCN due to fishing-related mortality at levels believed to be unsustainable (Zerbini *et al.*, 2017). During SC68B, the Committee received several papers relating to the stock structure of franciscana (Cunha *et al.*, 2020a; Cunha *et al.*, 2020b; Cunha *et al.*, 2020d); when combined these papers proposed that a total of 11 Franciscana Management Areas (FMAs) be recognised. Due to limited time to thoroughly review those and other relevant papers, the Committee agreed to form an intersessional correspondence group (ICG). The objectives of this ICG were to summarize the data available from genetic and non-genetic lines of evidence that could be used to infer population structure; evaluate the level of scientific support for each of the proposed subdivisions based on the combined data; and provide advice on future work (additional analyses, sample collection efforts) to address remaining questions.

A workshop on the Review of the Status of the Franciscana (SC/68C/Rep/02) was held in April 2021. The first session of this workshop was dedicated to reviewing the available genetic evidence relating to stock structure of franciscana. After reviewing this evidence and providing suggestions on additional genetic analyses that might be completed intersessionally, the Workshop participants agreed that a review of the non-genetic lines of evidence was needed before drawing any conclusions about the newly proposed management units. Intersessionally, members of the ICG drafted text summarizing the available data for the non-genetic lines of evidence; however, there was limited time for workshop participants to review

the summaries and discuss their implications. Thus the participants agreed to continue the work of the ICG, with the objective of providing a final report summarizing the ICG's advice at SC68D.

At SC68C, the Committee reviewed the stock structure portions of the Workshop report. The Committee noted that a substantial amount of genetic data is currently available; over 700 samples have been collected, sequenced for mtDNA control region, and genotyped at microsatellite loci, some of which are common across datasets and could be combined after calibration between laboratories.

Attention: SC
The Committee recognises the value of understanding the population structure of the franciscana and the need to integrate data from multiple lines of evidence (genetic and other, e.g., stable isotopes, contaminants, etc.) when evaluating support for the eleven proposed management areas. After reviewing intersessional progress on this topic, the Committee:

(1) **agrees** *that an integrated range-wide genetic analysis is needed to better evaluate population structure and* **encourages** *continued efforts to combine existing datasets for such analyses where possible;*
(2) **recommends** *that ongoing collaborative efforts to combine available tissue samples from across the franciscana's range continue and* **encourages** *the use of such a combined sample set to generate a SNP panel that will facilitate additional genetic analysis of population structure in the future; and*
(3) **agrees** *to continue its intersessional work, and report to SC68D, focusing on evaluating non-genetic lines of evidence, reviewing any new genetic results that become available, and evaluating the strength of the combined evidence at SC68D.*

10.2.1.2 *Sotalia guianensis*

The Guiana dolphin (*Sotalia guianensis*) is a small coastal delphinid that ranges from Nicaragua to southern Brazil (Flores and Da Silva, 2009). This species faces anthropogenic threats throughout most of its distribution and is listed as Near Threatened by the IUCN (Secchi *et al.*, 2018). In 2018, the Committee listed the Guiana dolphin as a priority species for evaluation of its conservation status (IWC, 2019b), and last year the Committee received a proposal to identify twelve management units within the Guiana dolphin's range (Cunha *et al.*, 2020c). Although the support for these delineations was summarized in Cunha *et al.* (2020c), the Committee did not have time to thoroughly review this paper or those that it covered. An intersessional correspondence group (ICG) was formed to make progress on this item (IWC, 2021b). The terms of reference for this ICG were to review the genetic and other evidence relating to population structure in *Sotalia guianensis* and to provide advice on the proposed management unit delineations. The ICG compiled a list of references that may be useful for understanding population structure in this species and identified lines of evidence that should be included in the review. However, summaries of the available data are not yet complete.

At SC68C, the Committee reviewed the stock structure portions of the progress report (SC/68C/SM/18) provided by the ICG preparing for the assessment of *Sotalia guianensis*. When the available evidence from genetics, acoustics, stable isotopes and diet was compiled, only three of the MUs were ranked as having high or moderate support. However, efforts are ongoing to incorporate other types of evidence. It was noted that a proposal has been submitted to conduct SNP genotyping of samples collected across the Guiana dolphin's range. The specific approach has not yet been determined. The Committee noted that with modern high-throughput sequencing instruments it is now possible to use restriction site-associated DNA sequencing approaches to genotype hundreds of samples at thousands of loci in a single lane, making this approach quite cost-effective.

In discussion, it was noted that the range of the Guiana dolphin appears patchy. There appears to be gaps in the distribution. For example, Guiana dolphins are often found near river mouths but may be absent in areas where the shelf is narrow. More comprehensive information about distribution is needed.

Attention: SC
The Committee notes the importance of understanding the population structure of Sotalia guianensis *in order to delineate management units within the species' range. The Committee:*

(1) **recognises** *the value of conducting a broad-scale genetic analysis of* Sotalia guianensis *and* **encourages** *the planned collaborative efforts to conduct SNP genotyping of samples collected across the species' range; and*
(2) **agrees** *to continue the intersessional correspondence group charged with reviewing genetic and other evidence relating to population structure in this species and providing advice on the proposed management unit delineations. A summary of this group's progress will be reported at SC68D.*

10.2.1.3 *Lagenorhynchus* spp.

SC/68C/SM/15 describes planned work to evaluate population structure, distribution, demography, and disease status of the two endemic North Atlantic *Lagenorhynchus* species (*L. acutus* and *L. albirostris*). Both species are generally considered

to be data deficient and in 1996 the Committee called for a global review. The currently planned work includes a reduced representation sequencing approach (DArTseq, Kilian *et al.*, 2012) using a large database of tissue samples that have been collected by stranding networks or through other sampling efforts in at least eight European countries. SNP markers will be retained and analysed using multivariate and Bayesian statistical approaches to investigate population structure. Metadata on stomach content, contaminant load and pathogenic infections are available for some samples; the correlation between this genetic data and the metadata will be explored to investigate whether some genetic groups may be more susceptible to certain stressors than others. Lastly, the high number of neutral genetic markers and the recently published whole genome sequence for *L. acutus* will allow an investigation of the demographic history, including modelling of differences in historical population sizes. The results will inform the delineation of management units for conservation.

While noting the value of reduced representation sequencing approaches in evaluating population structure, the Committee observed that given the availability of a reference genome for *L. acutus*, low-coverage whole genome resequencing could allow a broader range of questions to be addressed. Such an approach may be pursued in the future.

The Committee noted the value of using different approaches, such as those proposed (SC/68C/SM/15), that integrate multiple lines of evidence when assessing population structure. The Committee looks forward to reviewing the results of this work in the future.

10.2.2 Northern Hemisphere stocks

10.2.2.1 EAST GREENLAND-SVALBARD-BARENTS SEA (SPITZBERGEN) BOWHEAD WHALES

Bachmann *et al.* (2021) analysed mitogenome data generated from bowhead whales (n = 12) that were biopsy sampled by scientists from the Norwegian Polar Institute off the west coast of the Svalbard Archipelago in the summers of 2017 and 2018. Those data were combined with previously published mitogenome data from Nyhus *et al.* (2016) (n = 8 samples) to represent contemporary patterns of mitochondrial DNA diversity in this stock of bowhead whales. The samples collected by Nyhus *et al.* (2016) were from bowhead whales in Fram Strait between 2006 and 2010. Six of these eight samples were collected on the same day and from the same general area. All six of the samples shared the same haplotype, raising the possibility that some or all of these samples may have been collected from the same animal or may represent non-random sampling of related individuals (i.e., calves with their mothers). The inclusion of duplicate and/or related individuals could bias estimates of genetic differentiation and diversity within the combined dataset. Generating nuclear data to determine if all samples represent unique individuals would be helpful.

The results from the contemporary samples indicated that the Svalbard/Spitsbergen stock has retained noticeable amounts of mitochondrial genome diversity despite small population size due to historical harvest levels. Haplotype and nucleotide diversities were similar to those estimated for other bowhead whale populations. The reconstructed demographic history was in accordance with a boom–bust scenario, combining a slight Pleistocene population growth 25,000–35,000 years ago and a Holocene decline. Based on 370bp fragments of the D-loop region, significant genetic differentiation was detected between all extant bowhead whale populations across the circumpolar Arctic, indicating that the Svalbard bowhead whales can be regarded as a population with its own genetic legacy.

In discussion, it was noted that the Bayesian skyline plot analysis, which assumes panmixia, combined contemporary and historic samples (pieces of bones found at Svalbard and the 14C age of the bones ranged from 225 to 8885 years). However, significant genetic differentiation between ancient and historic samples was found, which could result in an artefactual decline during the recent time period. Rerunning the analysis with only the contemporary samples could be useful to see if the same pattern is present.

Attention: SC
The Committee **welcomes** *this new information on the endangered East Greenland-Svalbard-Barents Sea (Spitsbergen) stock of bowhead whales. The Committee* **encourages** *further genetic analysis of existing tissue samples, including the generation of nuclear DNA data, in order to better understand this little known stock.*

10.2.2.2 NORTH ATLANTIC HUMPBACK WHALES

SC/68/SDDNA/02 uses genetic analyses to investigate the population structure of humpback whales occupying the Icelandic feeding area, an area that has been shown, via photo-identification studies, to be used by whales from four different wintering areas (Chosson-P *et al.*, 2015). Minimum spanning network using mtDNA control region sequences of 94 individuals revealed two differentiated groups, which is consistent with previous studies on North Atlantic humpback whales (Palsbøll *et al.*, 1995). Bayesian clustering using multilocus genotypes (n = 17 loci) of 101 individuals identified three clusters among the sampled individuals, as inferred by Bayesian information criterion and STRUCTURE analysis. No apparent geographic pattern was present with respect to individual assignment to clusters. Pairwise genetic differentiation between clusters was relatively moderate, suggesting distinct genetic units rather than fully differentiated subpopulations. Kinship analysis detected 18 putative full-sibling pairings, four of which were identified in a separate analysis as potential parent-offspring pairs. Only one of these pairings was not consistent with assignments to the same genetic cluster and did not share the same haplotype. Icelandic photo-ID data was not available for most of the sampled individuals and thus it was not possible

to link genetic clusters to a particular breeding ground. The results encourage a further characterization of these clusters. The high number of close relatives among the sample set could potentially indicate inherited site fidelity, representing a factor that could play a role in the genetic differentiation of different groups of humpback whales that coexist in the Icelandic feeding area. Altogether, this study shows fine-scale genetic structure of Icelandic humpback whales, which is generally consistent with previously described structure based on photo-ID data, but suggests three as opposed to four distinct units.

The Committee **welcomed** the opportunity to review the new information presented in SC/68C/SDDNA/02. The Committee is preparing to conduct an in-depth assessment of North Atlantic humpback whales and expects to review additional stock structure-related papers next year. As such, this year's review of SC/68C/SDDNA/02 focused only on the technical aspects of the paper rather than on what the implications of the results are for evaluating stock structure hypotheses.

In discussion, it was noted that samples that contain individuals from multiple breeding stocks will exhibit a Wahlund effect (Wahlund, 1928), which is a deficiency of heterozygotes compared to the expected Hardy Weinberg proportions. Under this scenario, a positive correlation would be expected between the single-locus value of F_{IS} for the mixture and the F_{ST} between the two breeding stocks contributing to the mixture. Testing for such an effect among the Icelandic humpback whale samples could provide insight into whether the area is being used by multiple breeding stocks, although the strength of the effect is dependent on the existing degree of genetic differentiation between the breeding stocks and the evenness with which the stocks are sampled (Waples, 2011).

It was noted that a high number of full sibling relationships were detected, almost all of which (17 of 18 pairs) were found between individuals that also shared the same haplotype and sex. While the authors ran standard analyses to check for the presence of null alleles and allelic dropout, it is possible that these or other issues remained undetected in some loci. If genotyping errors are present, samples collected from the same individual (i.e., duplicates) could instead appear to share a full sibling relationship. Including duplicate samples could result in the identification of clustering patterns that would then be interpreted as evidence of population structure. One way to further evaluate whether genotyping errors are present is to calculate the probability of identity between unrelated individuals (Paetkau *et al.*, 1995) to determine the minimum number of loci needed to identify duplicate samples (i.e., samples collected from the same individual). Identifying pairs that match at this minimum number of loci but not at others may reveal inconsistencies in genotyping in some loci that have led to duplicate samples being assigned as full sibling pairs. Using a maximum likelihood approach to evaluate the relationship between the false discovery rate and the power to detect parent-offspring pairs (Skaug *et al.*, 2010) could also be informative when evaluating whether genotyping errors are present. The Committee suggests that these or other approaches be used to further investigate the identified pairs that share the same sex and mtDNA haplotype before its consideration of how the results can be used to inform management advice.

Attention: SC
In preparation for a future in-depth assessment, the Committee **encourages** *the completion of genetic analyses to evaluate the stock structure of North Atlantic humpback whales and the submission of papers to next year's meeting (SC68D).*

10.2.2.3 Rice's whale

Bryde's-like whales are found in tropical waters of all three major ocean basins. A single species (*Balaenoptera edeni*) is currently recognized, with two subspecies, Eden's whales (*B. edeni edeni*) and Bryde's whales (*B. edeni brydei*). However, the taxonomic and phylogenetic relationships of Bryde's-like whales have remained under debate. Previous genetic analyses of mtDNA control region sequence data suggested that Bryde's-like whales in the Gulf of Mexico (GOMx) represent an evolutionarily distinct lineage (Rosel and Wilcox, 2014). (Rosel *et al.*, 2021a) expands on this work by sequencing additional samples from the GOMx (n_{total} = 36) and incorporating recently published sequence data that expands the geographic representation of the other Bryde's-like forms. Comparison of the GOMx whales with Eden's whales, Bryde's whales, and sei whales (*B. borealis*) revealed fixed differences and identified net nucleotide divergence (d_A = 0.10–0.13) that was equivalent to that seen between the two *B. edeni* subspecies. The magnitude of divergence, along with high diagnosability resulting from the fixed differences, meet both of the quantitative genetic criteria described in Taylor *et al.* (2017) for the recognition of a species. In addition, the stranding of a whale, genetically confirmed to be a GOMx whale, on the southwestern coast of Florida in 2019 allowed the first morphological comparisons of a GOMx whale with other balaenopterids/ The result was the identification of several cranial characteristics that distinguish the GOMx whales from Omura's whales (*B. omurai*) and the two recognised subspecies of Bryde's-like whales. This morphological comparison provides a second independent line of evidence supporting recognition of GOMx whales as a separate species, as recommended in Reeves *et al.* (2004). Further, a review of Bryde's-like whale records in the Caribbean and greater Atlantic indicates that the GOMx whales have an isolated distribution. The newly proposed species was named *Balaenoptera ricei* (Rice's whale) in honor of Dale Rice who first recognised the presence of Bryde's whales in the GOMx (Rice, 1965).

The Committee received a report of the Society for Marine Mammalogy (SMM) Taxonomy Committee's discussion of Rosel *et al.* (2021). The Taxonomy Committee agreed that Rice's whales should be recognised as a new species, and their decision will be published in the next update of the SMM List of Marine Mammal Species and Subspecies later this year.

In discussion, the Committee noted that recognition of Rice's whale as a separate species would render *B. edeni* paraphyletic and thus highlights the need to resolve the phylogenetic inconsistencies within the genus Balaenoptera.

Attention: SC
The Committee **agrees** *with the conclusion of the Taxonomy Committee of the Society of Marine Mammalogy that the Bryde's-like whales in the Gulf of Mexico should be recognised as a new species but* **notes** *that its recognition creates phylogenetic inconsistencies among the other recognised species within the Bryde's whale complex. In order to resolve this inconsistency, the Committee* **encourages** *future work utilising nuclear genomic approaches to evaluate the phylogenetic relationships of whales within the genus Balaenoptera.*

Attention: S
The Committee **requests** *the Secretariat to contact the IWC Commissioner from India and request assistance with facilitating the collection and sequencing of DNA from the type specimen of B. edeni, which is held in the Indian Museum in Kolkata. Progress in understanding the populations of Bryde's whales found in the Indian Ocean is not possible without this genetic data gap being resolved. In addition, the Committee* **recommends** *that a neotype for B. brydei be designated and the DNA sequences of it and the type specimens of all other forms of Bryde's-like whales be compared.*

10.2.3 Gray whale stock structure

During the Rangewide Workshops on the Population Structure and Status of Gray Whales in the North Pacific that were held between 2014–2018 (IWC, 2018c), it was agreed that two stock structure hypotheses (3a and 5a, see Annex G) would be considered a high priority for inclusion in the modelling framework used to evaluate the status of North Pacific gray whales. The primary difference between these two hypotheses is that in 3a all of the whales that feed off Sakhalin Island, Russia, migrate to the wintering grounds in Mexico, while in 5a the Sakhalin feeding ground is used by both whales that migrate to Mexico and by a separate breeding stock of whales (the Western Breeding Stock, WBS) that uses the western wintering area (specified as Vietnam-South China Sea in the model). Additional hypotheses were considered medium priority and were incorporated as sensitivity tests, including those that consider a WBS to be extant but not to feed off Sakhalin Island (3b, where the WBS feeds off Southern Kamchatka-Northern Kurils; 3e, where the WBS does not feed off Southern Kamchatka-Northern Kurils but only in other areas of the Okhotsk Sea), a hypothesis that includes the possibility that the whales migrating between Sakhalin and Mexico occasionally pass through the area where the Chukotka harvest occurs (3c); and a hypothesis that considers the whales that feed off Sakhalin to represent a breeding stock that uses both eastern and western wintering areas (6b).

In subsequent discussions, the Committee determined that the priority of hypothesis 4a should be elevated to high priority and its variants (4b, 4c, and 4e) should be ranked as medium priority (IWC, 2021b) based on new and previously reviewed genetic evidence (Brüniche-Olsen *et al.*, 2018; Lang *et al.*, 2011; Lang *et al.*, 2020; Lang *et al.*, 2010) indicating that the whales that feed off Sakhalin do not interbreed at random with the other whales that use the Mexican wintering ground (IWC, 2021b). While hypotheses 3a and 4a are functionally equivalent with respect to the modelling framework, they differ in that hypothesis 4a considers the whales that migrate between Sakhalin and Mexico to be part of a separate breeding stock while hypothesis 3a includes them as part of the Eastern Breeding Stock (EBS). Following this discussion, an intersessional correspondence group (ICG) was formed in 2020 to re-evaluate the plausibility of all hypotheses under consideration in order to best inform the ongoing Range-wide Review of the Status and Population Structure of gray whales. That ICG also considered issues relating to terminological distinctions being used in discussions of gray whale stock structure (see Annex G).

Based on the intersessional correspondence group's advice, the Committee reconsidered the priority of hypothesis 7a. Hypothesis 7a was originally assigned low priority for modelling because it was functionally the same as Hypothesis 5a. As with hypotheses 3a and 4a, hypotheses 5a and 7a differ only in that the latter includes the whales migrating between Sakhalin and Mexico as a separate breeding stock versus being part of the EBS. Upon re-evaluation, the Committee determined that the evidence indicating a lack of random mating between Sakhalin whales and Northern Feeding Grounds (NFG) whales was sufficiently strong that the priority of both sets of hypotheses (4a and 7a) should be considered high, while the hypotheses that considered the Sakhalin whales that migrate to Mexico to be part of the EBS (3a and 5a) should be downgraded to medium.

The Committee also re-evaluated the priority of hypothesis 6b, which was classified as a medium priority hypothesis and thus was to be included in the modelling efforts as a sensitivity test. This hypothesis includes a Western Breeding Stock (WBS) that feeds in the western North Pacific but overwinters in both Mexico and in the Vietnam-South China Sea region, showing no fidelity to either. In discussion it was noted that there is evidence that whales show fidelity to the Mexican wintering ground (e.g. Martínez A. *et al.*, 2016) and that it is unlikely that EBS whales would show wintering ground fidelity while WBS whales would not. However, it was proposed that a lack of fidelity to western migratory routes or the western wintering ground could have developed as a response to whaling; as the numbers of whales declined in the west they would have been at an increasingly high risk of being taken if they continued to use their traditional migratory pathways. Another

possibility that was put forward is that some of the whales that traditionally migrate between the Mexican wintering grounds and the Sakhalin feeding ground may have eventually re-discovered the western migratory route and recolonized the wintering ground. There was some discussion as to the plausibility of this hypothesis in light of genetic data and general life history information. This though did not make the Committee change the priority of hypothesis 6b, such that it remains a medium priority hypothesis.

The Committee noted that genetic analyses have found support for the presence of two distinct clusters within the North Pacific (Brüniche-Olsen *et al.*, 2018; Lang *et al.*, 2020), but have failed to detect a third genetically distinct group, which would be expected under hypothesis 7a. It was pointed out, however, that if the third stock is comprised of a very small number of animals, as may be the case with the WBS, then such a genetic signal might be difficult to detect in the existing genetic datasets representing Sakhalin Island. Identifying whether such a signal exists would be greatly facilitated by the analysis of samples from WNP migratory routes and presumed wintering areas.

Attention: SC
Upon reviewing information relevant to evaluating the plausibility of the hypotheses that have been proposed to describe the stock structure of gray whales in the North Pacific (IWC 2015), the Committee **agrees** *that for the purposes of the Rangewide Review of the Status and Population Structure of Gray Whales:*

(1) Hypotheses 4a and 7a should be considered high plausibility while Hypotheses 3a and 5a should be ranked as medium plausibility; and
(2) the plausibility of Hypothesis 6b will remain unchanged;
(3) the intersessional correspondence group that was formed last year will continue its work to clarify the terminology used to describe the hypotheses, to re-evaluate the plausibility of the hypotheses currently under consideration, and to determine if all plausible scenarios are represented; and
(4) **encourages** *the collection and genetic analysis of samples from gray whales on western North Pacific migratory routes and wintering areas in order to better evaluate the plausibility of the hypotheses.*

10.2.4 Southern Hemisphere stocks

The Committee reviewed SC/68C/SH/20, which looks at connectivity between blue whales in the southeastern and northeastern Pacific using a catch length comparison. Details of this discussion can be found in Item 8.2.1.2.

The Committee also reviewed SC/68C/SH/01, which is a preliminary assessment of the historical genetic diversity and foraging ecology of southern right whales in New Zealand, and SC/68C/SH/03, which reports on genotype recaptures among 220 right whales biopsied during an expedition to the sub-Antarctic Auckland Islands in August 2020. Details of this discussion can be found in Item 8.2.3.4.

10.3 DNA data quality and genetic analysis guidelines

Two sets of guidelines have been developed for reference in the Committee's discussions of stock structure: (1) the DNA quality guidelines, which provide advice on best practices for ensuring the quality of data produced for genetic analyses; and (2) the genetic analyses guidelines, which provide advice on genetic analyses commonly used in the Committee's work. Both documents are intended to be 'living documents' that are updated as analytical approaches and technologies evolve.

10.3.1 Updates to DNA quality guidelines

The DNA data quality guidelines address DNA validation and systematic quality control in genetic studies and are currently available on the IWC website[5]. In past years, the Committee identified a need to update these guidelines to address issues related to the generation of data using Next Generation Sequencing approaches (e.g., Single Nucleotide Polymorphisms, Whole Genome Sequencing). The Committee agreed to continue such work intersessionally (see Table 11).

10.3.2 Consideration of need to update analysis guidelines

Guidelines for genetic data analyses relevant to the management of cetacean species were published in the *Journal of Cetacean Research and Management* (Waples *et al.*, 2018). This document includes valuable information in support of genetic data collection and analysis that can help ensure clear interpretation and high quality results. However, it is a substantial document and necessarily reflects the technology available at that time. In order to keep the document current, facilitate its utility for the interpretation of current data, and guide future studies, the Committee proposes the generation of a relatively short 'bridge' document. This would provide a checklist of key aspects of data quality and analysis that could aid interpretation of documents reviewed by the Committee. It could also update aspects of the guidelines, especially in the context of genomic methodologies and analysis. The Committee agreed to form an intersessional correspondence group to discuss and generate this document, which will then be considered at the next Committee meeting in 2022 (see Annex O).

[5] *http://iwc.int/scientific-committee-handbook#ten*.

Attention: SC, S
The Committee **reiterates** *the importance of keeping its guidelines related to genetic data quality and analyses up to date. It therefore:*

(1) **agrees** *to continue the intersessional correspondence group to review revised sections of the DNA data quality guidelines that apply to data generated from next generation sequencing platforms, including SNPs and whole genome sequencing; and*
(2) **agrees** *to form an intersessional correspondence group to produce a short document containing a checklist of key aspects of the genetic data analysis guidelines in order to facilitate their use.*

10.4 Recommendations on the avoidance of sample depletion

In previous years, the Committee has agreed that whole genome sequencing (WGS) is generally the best approach to maximise the value and avoid depletion of tissue samples, and that requests for projects using this approach would usually be prioritised. In discussion, however, it was noted that while WGS provides the most complete genomic data, some WGS methods require substantially more DNA than do more traditional methods (e.g. mtDNA control region sequencing, microsatellite genotyping), which are often sufficiently powerful to address management questions. Thus, evaluation of requests to use samples collected under IWC auspices (e.g., SOWER, POWER) should take into consideration how much tissue/DNA will be used, whether an approach that uses less tissue/DNA would be adequate to address the management question, and how the data produced could be used in future studies.

Furthermore, it was noted that when drawing inferences about deep-time evolutionary processes (e.g., speciation/divergence) generating WGS data from only a few individuals is usually sufficient, as the evolutionary histories of all individuals within a population or even species coalesce in deep time. In such cases, WGS data allows sampling of essentially all of the genes and reduces overall uncertainty to a very low level. Much of the Committee's work, however, is focused on understanding processes that have occurred over eco-evolutionary time scales (e.g, the most recent few generations). In these cases, there is a tradeoff between the precision gained by sampling more genes versus more individuals. Generating WGS data for a few individuals from a large population will allow parameter estimates (e.g. effective size) to converge on the true value for the individual pedigrees; however, that parameter value is not necessarily representative of the population as a whole (King *et al.*, 2018; Waples *et al.*, 2020). Thus uncertainty associated with sampling individuals can only be reduced by increasing the sample size of individuals.

Unless 'platinum-standard reference genomes' are being generated, WGS assemblies will vary in sequence quality (error rate), completeness (how much of the genome is covered), contiguity, and what portions of the genome remain unresolved or incorrect (Rhie *et al.*, 2021). In cases where a reference genome for the species is available, a large number of individuals may be included in the study. However, some studies will have been re-sequenced at very low depths of coverage, perhaps due to cost constraints. While this can provide useful population-level data, portions of the genome will not be represented and individual genotypes are essentially lost. Thus in addition to considerations about the number of individuals represented, consideration should be given to the quality of sequences needed for the analyses planned.

The Committee further notes the value of having a 'platinum-standard reference genome' when designing WGS studies and commends efforts to establish these for all cetacean species (Morin *et al.*, 2020).

Attention: SC
In previous years (IWC, 2020d; 2021b), the Committee agreed that whole genome sequencing (WGS) is generally the best approach to maximise the value and avoid depletion of tissue samples in existing collections (including those collected during the IWC SOWER and POWER surveys). While recognizing that WGS provides the most complete genomic data, some WGS approaches require substantially more DNA than do more traditional approaches targeting a limited set of loci (e.g., microsatellite genotyping) and thus the Committee **encourages** *sample requestors to consider whether less consumptive methods would be sufficient to address the management question.*

Furthermore, the Committee **notes** *that additional factors may affect the utility of WGS. In particular, the Committee* **encourages** *that consideration be given to the number of individuals sequenced and the quality of the sequences generated in order to ensure that the methodology is appropriate to achieving the objectives of a given study.*

The Committee **agrees** *that the intersessional working group should continue its work to provide recommendations on genomic approaches to maximise the utility of these samples for future studies. The Committee also* **encourages** *submission of reports detailing the current status of genome sequencing of cetaceans and implications for tissue collection and preservation.*

10.5 Review terminology used for stock structure related terms used within the IWC

Defining and standardising the terminology used to discuss 'stock issues' remains a long-standing objective of the Working Group, in order to help the Committee report on these issues according to a common reference of terms (see Appendix 5, IWC, 2014, pp. 287–8). Discussion of this item was postponed until SC68D.

Attention: SC
The Committee **agrees** *that the intersessional email group to review terminology with specific reference to the implications of inferred stock structure in other sub-committees should continue, with a focus this year on terms used in large whale assessments, including those used to describe gene flow among stocks versus the movements of whales between areas.*

10.6 New genetic approaches of use to the Scientific Committee in addition to stock structure issues

No papers on new genetic approaches were received. This agenda item will remain on the Committee's agenda and new information will be reviewed in 2022.

Attention: SC
The Committee **welcomes** *the opportunity to review papers that take advantage of technological advances to improve the ability to detect and identify species, subspecies, stocks, and individual cetaceans. As in previous years, it* **encourages** *the submission of similar papers in the future and recognises the relevance of these techniques to the Committee's work.*

10.7 Biennial workplan

The details of the workplan are given in Table 11.

Table 11

Work plan for SDDNA.

Topic	Intersessional 2021/22	2022 Annual Meeting (SC68D)
2.1.1 *Sotalia guianensis* population structure	Intersessional email group to evaluate stock structure in *Sotalia guianensis*	Report and provide advice
2.1.2 Franciscana population structure	Intersessional email group to evaluate stock structure in franciscana	Report and provide advice
2.3 Gray whale population structure	Intersessional email group to clarify terminology associated with the gray whale stock structure hypotheses and, where needed, to further evaluate plausibility of hypothesis in preparation for the Range-wide Review of the Status and Population Structure of Gray Whales	Report and provide advice
3.1.1 DNA quality guidelines	Intersessional email group to review recent revisions to the DNA quality guidelines that pertain to data produced using NGS approaches.	Report and finalize updated guidelines
3.1.2 DNA guidelines checklist	Intersessional email group to generate a short document providing a checklist of key aspects of the genetic data analysis guidelines and to identify aspects of the guidelines that may need updating, particularly in the context of genomic methodologies and analysis	Report and provide advice
4. Recommendations to avoid sample depletion	Intersessional email group to provide recommendations on genomic approaches to maximize the utility of tissue samples that are in danger of becoming depleted in the future	Report and provide advice
5. Terminology	Intersessional email group to continue discussions of the use of stock structure-related terms within the SC	Report

Intersessional correspondence groups for SDDNA

SC Agenda Item/ Sub-Committee	Type	Group (short name)	Terms of Reference	Members
Item 2.1.1 SD&DNA/SM	ICG	*Sotalia guianensis* population structure	Review genetic and other evidence relating to population structure in *Sotalia guianensis*; provide advice on the proposed management unit delineations.	Lang and Caballero (co-Convenors), Archer, Baker, Briceño, Buss, Cipriano, Cunha, Domit, Fruet, Natoli, Tiedemann, Torres-Florez, Zerbini
Item 2.1.2 SD&DNA/SM	ICG	Franciscana population structure	Summarize the data available from other (i.e., non-genetic) lines of evidence that could be used to infer population structure; evaluate the level of support for each of the proposed subdivisions based on this combined data and provide advice on future work (additional analyses, sample collection efforts) to address remaining questions.	Lang and Ott (co-Convenors), Andriolo, Archer, Buss, Cipriano, Cunha, Farro, Gariboldi, Hoelzel, Mendez, Pampoulie, Oliveira,, Passadore, Secchi, Tiedemann, Torres-Florez, Zerbini
Item 2.3 SD&DNA	ICG	Gray whale population structure	(1) To clarify the terminology used to describe the gray whale stock structure hypotheses[1]; (2) to re-evaluate the plausibility of the hypotheses, including consideration of adding new variants if needed, to inform the Range-wide Review of the Status and Population Structure of gray whales[2].	Lang (Convenor), Bickham, Donovan, Hoelzel, Goto, Nakamura, Pampoulie, Punt, Scordino, Tiedemann, Weller

Item 3.1 SD&DNA	ICG	DNA quality	Review recent revisions in sections of the DNA quality guidelines that pertain to data produced using NGS approaches.	Tiedemann (Convenor), Archer, Baird, Baker, Bickham, Carroll, DeWoody, Hoelzel, Goto, Jackson, Lang, Palsbøll, Pampoulie, Solvang, Taguchi, Torres-Florez, Waples
Item 3.2 SD&DNA	ICG	Genetic data analysis	Generate a checklist of key aspects of the genetic data analysis guidelines and identify aspects of the guidelines that may need updating, particularly in the context of genomic methodologies and analysis.	Tiedemann (Convenor), Bickham, DeWoody, Hoelzel, Lang, Torres-Florez, Waples
Item 4 SD&DNA	ICG	Sample depletion	Discuss and provide recommendations on genomic approaches to maximise the utility of tissue samples, particularly those in danger of depletion.	Lang (Convenor), Archer, Baker, Bickham, Buss, Carroll, Hoelzel, Goto, Jackson, Morin, Palsbøll, Robertson, Sremba, Taguchi, Tiedemann, Torres-Florez
Item 5 SD&DNA	ICG	Terminology	Revisit the definitions that were previously put forward for stock-related terms at IWC 2014, particularly those related to large whale assessments, and revise them where necessary.	Tiedemann (Convenor), Baird, Bickham, Carroll, Cipriano, Hoelzel, Lang, Scordino

[1]Including but not limited to consideration of whether the breeding stock of whales that migrates between SI and Mexico under hypothesis 4 and its variants should be renamed for clarity. [2]Consideration will focus on re-evaluating the plausibility of hypothesis 3 and its associated variants and determining if additional variants need to be added under hypothesis 5.

11. CETACEAN ABUNDANCE ESTIMATES AND STOCK STATUS (ASI)

The Standing Working Group on Abundance Estimates, Status of Stocks and International Cruises (ASI) has evolved since its inception in 2016, and continues to evaluate how it can best serve the Committee. This year, the role of ASI was clarified as follows.

The ASI was established to provide consistent, rigorous reviews of abundance estimates submitted to the Committee. It was also instructed to provide a broad overview on the abundance and status of whale stocks for the Commission and the public. Finally, the ASI offers advice on survey design, new technologies, data collection and analysis for abundance surveys coordinated by the IWC (e.g. POWER and SORP) and national research programmes. The ASI provides an advisory service for other sub-groups of the Committee upon request by individual convenors. Not all abundance estimates require review by ASI. Primarily, the ASI will review estimates that need to be endorsed for a specific purpose such as: (i) inclusion in the IWC Table of Accepted Abundance Estimates, including those on the IWC website; (ii) use in an assessment, other mission-critical modelling, or with RMP/AWMP calculations; (iii) informing the Commission on the status of stocks/species; or (iv) use as the basis for providing management advice and SC recommendations. However, there are also circumstances where information on abundance can be used by the Committee's subgroups to progress their work without review by ASI.

11.1 Review of Abundance Estimates and update of IWC Table of Accepted Abundance Estimates

11.1.1 Abundance review process

The Abundance Steering Group (ASG) discussed refinements of the abundance review process (see Annex E).

- Changes to the abundance estimate categories for the IWC Table of Accepted Abundance Estimates were proposed by the ASG and presented to the Committee. Adopting those changes would create the need to re-assign previously accepted estimates to one of the new categories when relevant. The Committee **endorses** the new categories and a small group convened by Givens (Abundance Review Process – ARP: see Annex O) will develop a list of proposed recategorizations. The new categories are as follows:
- Category 1A: An estimate which is acceptable for use in in-depth assessments or for providing management advice using the RMP, AWMP or other modelling or analysis. This (and category 1B) may include estimates with minor or possibly competing small biases (e.g. assuming $g(0) = 1$ when it may be slightly less).
- Category 1B: An estimate which pertains to a 'very small' stock and is acceptable for providing management advice in that context, including situations where no sophisticated modelling or analysis is required.
- Category 2: An estimate for a stock or study area for which conservative management is acceptable (e.g. in the AWMP). The estimate may be subject to considerable negative bias for reasons such as limited spatial coverage or lack of correction factor(s).
- Category 3: An estimate which is informative but not acceptable for inclusion in (1A), (1B) or (2). This category includes estimates with a bias which is too severe to allow inclusion in Category 2, as well as relatively unbiased estimates that are adequate to provide some general indication of abundance while still not qualifying for (1A) or (1B).
- Category P: A preliminary estimate, not suitable for use at the time of review, but which may provide an acceptable estimate once finalised. It will be omitted from published tables.
- Category X1: Category 1A or 1B estimates that have been superseded by revised estimates. They will be omitted from published tables.

- Category ND: An estimate which was not discussed. Used to indicate estimates which have not been discussed by the Scientific Committee, but which may be discussed in future. They will be omitted from published tables.
- Category NS: An estimate reviewed by the Scientific Committee but agreed not to be suitable for acceptance due to factors such as: insufficient data; insufficient methodological information presented; concerns about analysis design, conduct or interpretation; failure to account for very large potential biases; or assumptions that are unreasonable or clearly violated. It will be omitted from published tables.

The Committee also **agreed** that the ARP group (convened by Givens) would discuss how best to draw a distinction between categories 2 and 3, and would develop supplementary wording to be presented to the Committee next year that explains how estimates in categories 1A, 1B, 2 and 3 might be used. The group will also provide examples of the reasoning for choosing one category over another in various circumstances.

At its pre-meeting, the ASG also recommended a variety of improvements to the review process (Annex 1). The Committee **endorses** these, highlighting that:

(a) it is common courtesy to inform authors that their paper is being considered for review for addition to the IWC Table of Accepted Abundance Estimates;
(b) authors should be provided the reviews and an opportunity to respond, either in writing or during a meeting of ASI; and
(c) the ASI should explain SC procedures to authors in a positive, non-confrontational manner.

The Committee **reiterates** the need for a transparent review process, and preferred that, by default, reviews be signed unless there was a specific request for anonymity (i.e. reviewer identity not seen by the authors). The identity of reviewers would not be shared beyond the ASG, and the reviews would not be SC meeting documents. However, reviews would be archived by the Secretariat in case there was a need to revisit them, as described in Annex E. It was **agreed** that in cases where a review is negative, especially if strongly-worded, Staniland would act as an intermediary to facilitate constructive communication. The Committee also highlighted the benefits of liaising between authors and reviewers, so that authors can respond and clarify some of the issues before the reviews are finalised.

There was further discussion of the two current paths for reviews in ASI: in-person reviews at the annual meeting and intersessional written reviews. The Committee discussed whether the in-person path was still needed, noting that the process had to be perceived as fair and that it was not clear who decides which path is used. It agreed that intersessional reviews are the preferred path, but in-person reviews are also acceptable, especially in cases such as urgent situations or when an intersessional review is not practical. Ideally, papers presented in person should be subject to advance review in a similar manner to papers reviewed intersessionally. The Committee emphasised that conducting reviews ahead of time allows the reviews to be more thorough, especially for new methods, and also allows the authors time to provide a considered response.

The Committee **endorses** the recommendations of the ASG regarding the review process (Annex E).

Attention: SC, S
The Committee **agrees** *that the review of abundance estimates should follow an objective and transparent process. Therefore, the Committee* **recommends** *that:*

(1) future reviews are undertaken using the new categories and process developed during SC/68C.
(2) estimates previously agreed by the Committee be recategorized by an intersessional correspondence group under Givens.

The Committee next turned to consider a wide variety of abundance estimates, many of which had been subject to intersessional review and consideration by the ASG. It noted that decisions of the ASG (Annex E) are considered to be recommendations to ASI. The Committee further **agrees** that all of the abundance estimates reviewed below meet the definition of an Evaluation Extent of 1 ('examined in detail by the SC').

11.1.2 Franciscana

Several documents on abundance estimation of franciscana dolphins were received by the Committee in 2020 as part of the ongoing review of the status of this species. Time constraints due to the cancelation of the SC in-person meeting in response to the covid-19 pandemic precluded a review of these documents at the 2020 meeting, and the Committee had agreed that an Intersessional Correspondence Group (ICG) should be established to complete the review of franciscana abundance estimates. The reviews by the ICG were presented at a virtual Workshop on the Status of the Franciscana held between 7 and 9 April 2021 (SC/68C/REP/02).

The section of the report on abundance estimation was reviewed by the Committee. The Committee thanked the members of the ICG for their contributions to the reviews and noted the productive discussions during the workshop and the benefits of the analysts being available to answer questions from the reviewers. There was some discussion of how to

treat estimates that cover a small proportion of a stock range (e.g. 2% for FMA III), as the necessary extrapolation will create considerable uncertainty. In some cases, these estimates had been classified as category P using the previous categorisation developed by the Committee (IWC, 2018e). Consensus was that Category NS is probably the most appropriate in cases where estimates are computed when only a small fraction of the range of the stock is surveyed.

The Committee noted that new analyses to update some abundance estimates for FMA Ia, Ib, II and IV will be performed during the intersessional period following recommendations by the reviewers. Evaluations of updated estimates will be coordinated by the ICG and presented to the Committee at next year's meeting, when the review of the status of the franciscana is expected to be completed. The Committee looks forward to review updated estimates resulting from the intersessional work.

The Committee **endorses** the recommendations in SC/68C/REP/02 and **agrees** that the abundance estimates be assigned to the new categories by a small group (established under Item 11.1.1), noting that estimates with no category should be considered NS. The agreed abundance estimates are shown in Annex 2.

11.1.3 Southwest Pacific and Indian Ocean blue whales

The Abundance Steering Group (ASG) solicited reviews intersessionally for seven papers estimating abundance of blue whales in the Indian Ocean and Southwest Pacific Ocean. The ASG considered these reviews and made recommendations about whether the estimates should be endorsed by the Committee. Full details of the papers, the reviews, and ASG discussions can be found in Annex E. The Committee thanked the reviewers and the ASG for their hard work. The Committee's decisions about these estimates are given in Item 11.1.2 and summarised below.

Barlow *et al.* (2018) describe a mark-recapture abundance estimate of New Zealand blue whales using photo-ID data collected in the South Taranaki Bight (STB) region during January and February 2014–17. Noting the lengthy review history of this abundance estimate, and that views of ASI/ASG had evolved since the original reviews in 2018, the Committee **agrees** that the Barlow *et al.* (2018) estimate of 718 (SD 433; 95% CI 279–1,926) be accepted as Category 2.

Jenner *et al.* (2008a) outline a mark-recapture estimate of non-Antarctic blue whales from Western Australia (Perth Canyon). An open population POPAN model was considered the best model by the authors., providing an abundance estimate of 791 (95% CI 569–1,147). Consistent with ASG guidance, the Committee **recommends** that the Jenner *et al.* (2008 and see IWC, 2009) estimate of 791 (95% CI 569–1,147) be categorised as P (provisional). The Committee **encourages** the authors to refine this modelling work, recognising the value of the underlying data.

Kato *et al.* (2007) describe a study involving line transect surveys and blue whale detections from SOWER vessels operating south of Australia in the summers of 1993 and 1995/96. The authors considered the most reliable estimate was that for 1993 only, based on 12 sightings within the region bounded 35–45°S and 115–125°E. Concurring with the ASG, the Committee **agrees** that the estimate of 671 (CV 0.45; 95% CI 279–1,613) should be categorised as NS.

McCauley and Jenner (2010) used blue whale acoustic data collected along the West Australian coast to derive an estimate of abundance based on the assumption that 8.5–20% of animals call, and integrated over an entire season. The hydrophones were deployed in an array provided complete coverage of the migration pathway (based on satellite tag information (Double *et al.*, 2014; M ller *et al.*, 2020)) between Australia and Indonesia for the SE Indian Ocean blue whale population, The 8.5–20% range is not dissimilar to that reported for other blue whale populations (Lewis *et al.,* 2018). Supporting the view of the ASG, the Committee **agrees** that the estimate of McCauley and Jenner (2010) should be categorised as NS, using the new categories given under Item 11.1.1.

McCauley *et al.* (2018) describe a study of blue whale acoustics data collected at 32 sites around Australia from 2004 to 2016. Calls from New Zealand, eastern Indian Ocean and Antarctic blue whales were identified. Call rates over time at a site near Portland, Victoria provided an estimate of a 4.3% growth rate in the proportion of the eastern Indian Ocean population visiting the area. The Committee concurred with the ASG that further work should be encouraged in light of the impressive volume long-term dataset. The paper did not include an abundance estimate and thus the Committee made no endorsement for Annex 2. The Committee did not endorse the trend estimate as sufficiently reliable for assessment or modelling purposes.

Best *et al.* (2003) describes a line transect survey of blue whales on the Madagascar Plateau in late 1996. Using CDS methods, and an assumption of $g(0) = 1$, a design-based abundance estimate of 424 (CV 0.42) was produced; a second abundance estimate which included the 'like blue' sightings of 472 (CV 0.48) was also presented.

Although the ASG had recommended that this estimate be endorsed as Category 2, the Committee was concerned that the survey area covered only a small fraction of the likely area occupied by the SWIO blue whale population. Therefore, the Committee **agrees** that the estimate of 424 (CV 0.42) be accepted as Category 3.

Priyadarshana *et al.* (2016) described a line transect study of blue whales off the southern coast of Sri Lanka, designed to explore the distribution patterns of blue whales in relation to the density of shipping traffic The ASG recognised that although the survey region itself was relatively small, these estimates may still provide an indication of minimum abundance for population assessments but considered that there was insufficient information in Priyadarshana *et al.* (2016) to fully evaluate the abundance estimates, and had recommended Category P (provisional). Subsequently, Leaper developed SC/68C/ASI/18 to provide additional information on the study requested by reviewers (e.g. more details on those abundance estimates and to help clarify a number of points raised by reviewers, including: that angle and distance estimates were

verified using video tracking equipment; that due to the relatively slow speeds of the survey vessels, the assumption of $g(0) = 1$ is probably reasonable; and, finally, that whilst the small CV had been amended to more fully incorporate sources of uncertainty, it did not yet include group size error).

The Committee thanked Leaper for producing an update at short notice. The Committee recognised that the small survey region (i.e. perhaps ca.1–2% of the total geographic area occupied by this stock) might make this abundance estimate heavily subject to process error. As such, the Committee **agrees** that the three abundance estimates described in SC/68C/ASI/18[6] be assigned to Category 3, noting that the associated CVs are still an underestimate given they do not account for group size error. The Committee recalled that a category 3 classification does not preclude use of the estimates for specific applications.

11.1.4 Antarctic blue whales

ASI/68C/ASI/15 used photo-identification data of Antarctic blue whales from 2003/2004 to 2018/2019 in a POPAN capture-recapture analysis to produce estimates of 'super-population' abundance, from which derived estimates of annual abundances were obtained for the circumpolar Antarctic. Separate capture-recapture estimates were made using photos taken of the left and right sides of the whales. Two values of annual survival rates, 0.90 and 0.96, were used as model inputs. The estimates for the separate sides were similar but the assigned survival values had a larger impact on the population estimates.

The Committee agreed that the 0.90 survival rate was too low for Antarctic blue whales (the population would not be increasing given other life history parameters for the species). The survival parameter in the POPAN model corresponds to the apparent survival rate, but given the estimates are circumpolar it can be considered true survival and therefore the more realistic value of 0.96 should be used (which also corresponds to the model with the best AIC). There was discussion on whether the super-population estimate should be used. Preference was expressed for an average of the derived point estimates for annual population, based on the left sides and right sides. It was noted, however, that the confidence interval in Annex 2 (which was generated using the lowest of the left/right lower confidence limits and the highest of the left/right upper limits) was probably overly conservative (i.e. too wide).

There were concerns about the apparent temporal trend shown by the model, which might be driven by the probabilities of entry in the POPAN model. It was also noted that these entry probabilities do not sum to one as they should. In addition, the estimates for the first years of the time series are inconsistent with the numbers expected from projecting previous circumpolar estimates from 10 years earlier. Since the model used is not designed to measure growth, use of a population model with exponential growth (e.g. consistent with the Pradel formulation in program MARK), or with logistic growth as has been implemented for Indian Ocean humpback whales (Johnston and Butterworth, 2008), should be considered.

The Committee **agrees** that the 2019 abundance estimate of 3,257 (95%CI 1,329–8,264) for Antarctic blue whales should be accepted as Category P). The Committee also **requests** that the authors investigate use of a population model with a Pradel formulation and that the results be reviewed intersessionally, preferably by experts familiar with the program Mark software. Further consideration should also be given as to whether the super-population estimate can be used.

11.1.5 North Pacific humpback whales

SC/68C/IA/03 provide estimates of abundance of North Pacific humpback whales. These estimates were discussed under item 8.1.1.2. Review by ASI will occur in the future and will be handled by the ASG.

11.1.6 North Pacific sei whales

Estimates of abundance for North Pacific sei whales in west coast of the US (Barlow, 2016) and for the western North Pacific (Hakamada and Matsuoka, 2016; Hakamada *et al.*, 2009) were reviewed intersessionally and the Committee thanked the reviewers for their assistance. The estimates for the western North Pacific were briefly considered by the ASG (Annex 1) and the Committee noted that that additional information was needed before the estimates could be fully evaluated. The Committee **agrees** that ASG will review these estimates intersessionally once the necessary information is provided.

Barlow (2016) presented *inter alia* sei whale abundance estimates for the US EEZ from multispecies line transect ship surveys off the coast of California, Oregon, and Washington. The estimates were corrected for $g(0)$, groups missed on the trackline using a new method to estimate based on comparing abundance estimates made in different Beaufort sea state conditions (Barlow, 2015).

The Committee expressed interest in the new method to estimate $g(0)$ and **agrees** that the author should be invited to present this approach at a future meeting.

The Committee noted that the surveys only covered a small fraction of the expected range and the Committee considered whether the estimates should be considered Category 2 or 3. It was noted that more generally, categorisation is dependent on stock structure hypotheses and the objectives of the analyses using those estimates as inputs. The Committee **agrees** that decisions to categorise estimates should be consistent but, especially for Categories 2 and 3, specific knife-edge

[6]A design-based CDS abundance estimate of 270 (CV 0.25), assuming g(0) = 1, was produced. Considering only 2014, survey effort produced an abundance estimate of 306 (CV 0.35; 95% CI 155–599); the 2015 survey produced an estimate of 257 (CV 0.25; 95% CI 159–416).

guidelines (e.g. quantitative thresholds) will be difficult to establish. The Committee **agrees** that the rationale for such decisions and the possibility of pooling Categories 2 and 3 should be considered further by a small group (see Item 11.1.1) that will report back at next year's meeting.

The Committee **endorses** the sei whale estimates in the time series provided in Barlow (2016, Table 8, p. 21)[7], and **agrees** that they should be accepted as Category 2, with a footnote mentioning the approximate proportion of the stock covered by the surveys.

11.1.7 Bering-Chukchi-Beaufort Bowhead whales

SC/68C/ASI/01 noted that the 2019 ice-based survey of Bering-Chukchi-Beaufort Seas bowhead whales was challenged by missed survey effort, unusual ice conditions, and more frequent use of motor-powered skiffs by hunters. All three probably led to downward bias in the abundance estimate of Givens *et al.* (2021), which was 12,505 (CV = 0.228). Data were collected about boat excursions during the survey period. Indices of short-term whale abundance at the survey perch and short-term boat noise disturbance were computed from the available data, where 'short term' refers to a few hours. A generalised additive model (GAM) was fit to the results, predicting short-term whale abundance as a smooth function of the boat noise disturbance index, after controlling for long-term variation in the whale passage rate over the course of the season. The fitted GAM was then used to predict passage with and without the presence of boat noise. The ratio of the integrals of these two predicted passage curves provided a correction factor which can be applied post hoc to the abundance estimate of Givens *et al.* (2021). Variance of this correction factor was estimated using two approaches, and found to be small. A wide array of sensitivity analyses was conducted to examine the robustness of the result to potential changes in methodology, and the correction factor was found to be quite stable. The estimated correction factor would inflate the original abundance estimate by about 12%, yielding a corrected abundance of 14,025 (CV = 0.228). The authors recommended that this corrected estimate replace the original one.

The Committee welcomed this new approach to correct for boat disturbance, whilst noting that the resulting CV of the corrected estimate was no larger than the uncorrected CV (since both the variance and point estimate increased after correction). The author clarified that the small CV of the correction factor is due to it being calculated from a ratio of integrals of smooth, relatively stable functions, and noted that the two approaches used gave essentially the same result and that the extensive sensitivity analysis suggested the results were robust.

With respect to the possible need for previous estimates to be corrected, it was noted that the conditions of the 2019 survey (i.e., the frequent disruptive presence of powered skiffs) had not been encountered in previous years.

The Committee **endorses** the new corrected 2019 abundance estimate of 14,025 (CV = 0.228) for Bering-Chukchi-Beaufort bowhead whales, and **agrees** that it should be accepted as Category 1A (acceptable for use in *In-depth Assessments* or for providing management advice). It was noted that this work will be submitted for publication, and the Committee **agrees** that any minor adjustment resulting from the review process (e.g., to the CV) can be included in the table (by Allison) without the need for a new review, following the procedures outlined in Annex E.

11.1.8 Eastern Canada/Western Greenland bowhead whales

Last year, the Committee received an abundance estimate for Eastern Canada-Western Greenland bowhead whales computed using genetic mark-recapture methods (Frasier *et al.*, 2020) but time constraints meant that it was agreed that the ASG would follow the intersessional review process. Reviews were solicited and considered by the ASG (Annex E).

The ASG noted that it is plausible that the abundance of EC-WG bowhead stock lies between the higher Frasier *et al.* (2020) estimate and that of 6,446 (95% CI: 3,838–10,827) aerial survey estimate (Doniol-Valcroze *et al.*, 2015) already agreed. It was also noted that the modelled growth of the EC-WG bowhead whales (Witting, 2013) suggested a faster recovery than has been observed and did not fit well to the aerial survey abundance estimates.

In concordance with the views of ASG, the Committee **recommends** that the 2008–2013 abundance estimate of 13,899 (highest posterior density interval 7,782–30,602) be accepted as Category 3. This precludes use in an *SLA*, but not other applications. The Committee **encourages** the authors to continue their work noting that the underlying data provide a promising basis for abundance estimation. A full mathematical description of the estimator, and an in-depth description of the simulation tests, would be greatly appreciated in any subsequent publication.

11.1.9 Eastern South Pacific humpback whales (breeding stock G)

SC/68C/ASI/02 presented a new population estimate for eastern South Pacific humpback whales (Breeding Stock G) based on mark-recapture models and fluke catalogues from 23 research groups. The sample includes 6,354 individuals, 1,698 (26.7%) from feeding areas and 4,656 (73.3%) from breeding areas, over the period 1991–2018. Mixture models with two different data types, full likelihood and conditional likelihood, produced similar results of 11,784 (SE = 266) and 11,786 (SE = 266) whales, respectively. In both cases, a model with two mixtures (M_{th2}) provided the best fit. Two Cormack-Jolly-Seber with Pledger mixtures models produced apparent survival estimates for the two mixtures of 0.924 (SE = 0.003) and 0.959 (SE = 0.008), respectively. An annual rate of increase of 5.07% was estimated for this stock. sources of bias were associated with effort heterogeneity, population stratification, and the time scale.

[7]1996: 150 (CV = 0.78), 2001: 48 (CV = 1.48), 2005: 136 (CV = 0.96), 2008: 311 (CV = 0.76) and 2014: 864 (CV = 0.40).

The Committee expressed its appreciation for the scope and complexity of compiling these multiple databases and highlighted the value of the resulting dataset. It acknowledged the challenges created by the huge size of the geographical area and the fact that some humpback movements are still poorly understood. The Committee also noted the value of incorporating these data into circumpolar assessments (e.g., as new information for SH).

In regard to whether it was possible to obtain estimates specific to the breeding grounds, the authors replied that there were some genetic and photographic matches with Oceania and therefore such estimates could be obtained in theory, but the work had not be done yet. It was noted that the CVs seemed unrealistically small and that additional details and better diagnostics were needed for the analyses. There were also some concerns with the assumptions of a closed population and the sources of the samples.

The Committee **agrees** that an intersessional review of this paper, including advice on how estimates could be improved, would be coordinated by the ASG.

11.1.10 Rice's whales

Garrison *et al.* (2020) presents abundance estimates for Rice's whale in the Gulf of Mexico, derived from vessel-based zig-zag line transect surveys in the Gulf of Mexico in the summers of 2017 and 2018. In 2017, 5,577km of survey effort was achieved, and 5,205km in 2018. Given the small sample size of Rice's whales during the two surveys, prior sightings of Bryde's whales in the Gulf of Mexico region from 2003–19 were used to estimate some of the parameters (e.g. effective search half-width) in a CDS analysis, assuming that $g(0) = 1$. These analyses derived a design-based abundance estimate of Rice's whale of 84 (CV 0.92) in 2017 for an area considered to be the core habitat (area ca.49,200km^2), an estimate of 40 (CV 0.55) in 2018, and a weighted average of 51 (CV 0.50) across both years.

ASG consideration of the intersessional reviews of this paper is summarised in Annex E. It is an example of a small population which lead the ASG to recommend the creation of a new category, 1B, for such estimates; see Item 11.1.1.

In discussion, the Committee noted that telemetry data may inform on the likely habitat range of this population. Garrison reported that some TDR-style tagging had been undertaken on individuals from this population (allowing some indication of availability bias), and that longer-term implantable satellite tag work is planned for the future. It was further noted that the abundance estimates had a smaller than expected CV, but Garrison suggested that between-transect variation was relatively small because only effort from what was considered the population's 'core habitat' was included; inclusion of all effort from the Gulf of Mexico surveys would substantially increase the resultant CV. Finally, the Committee discussed implications for future survey design to specifically target this population, with aerial surveys being mooted as a potential method to target a broader habitat area (i.e. further west in the Gulf of Mexico) in a shorter period of time.

The Committee thanked Garrison *et al.* for presenting their work. The Committee noted the potential substantial negative bias in the abundance estimates due to $g(0) < 1$, and that survey effort had not covered the full extent of the species' habitat. However, it considered that abundance estimates with some bias and potentially large or approximate CVs can still be useful to inform management for this critically small population. The Committee **recommends** that the weighted 2017–2018 abundance estimate (51, with CV = 0.50) for Rice's whale be categorised as 1B, and **encourages** both further work on these abundance estimates and future survey effort.

11.1.11 North Atlantic common minke whales

The Committee received a report by Norway (SC/68C/ASI/04) with updated estimates of abundance for common minke whales in the Northeast Atlantic (Small Management Areas CM, EN, EW, ES, and EB) from line-transect surveys conducted in 2014–2019. The Committee noted that these estimates will provide useful input for the Implementation Review for North Atlantic minke whale planned for next year, and agreed they will be reviewed during the intersessional period or at next year's meeting.

11.1.12 Update of the IWC Table of Accepted Abundance Estimates

Abundance estimates recommended for inclusion in the IWC Table of Accepted Abundance Estimates during the meeting are listed below. The Committee **agrees** that the IWC Table should be updated intersessionally and endorsed by the Commission.

Attention: SC, S, C

The Committee **recognises** *that the IWC Table of Accepted Abundance Estimates is an important tool for the work of the Committee, and to provide advice to the Commission on the status of whale stocks.*

The Committee **agrees** *that estimates endorsed during the 2021 meeting (SC68C) should be incorporated into that table, uploaded to the IWC website, and endorsed by the Commission. Specifically, these estimates are:*

- *Franciscana in FMA II in 2009: 6,827 (CV = 0.26), Category 2*
- *Franciscana in FMA III in 2004: 6,839 (CV = 0.32), Category 3*
- *Franciscana in FMA III in 2010: 9,651 (CV = 0.24), Category 2*
- *Franciscana in Babitonga Bay in 2001–2003: 47 (CV = 0.3), Category 2*

- *Franciscana in Babitonga Bay in 2011: 49 (CV = 0.23), Category 2*
- *Blue whales near New Zealand in 2014–2017: 718 (CI 279 to 1,926), Category 2*
- *Blue whales south of Madagascar in 1996: 424 (CV = 0.419), Category 3*
- *Blue whales south of Sri Lanka in 2014–2015: 270 (CV = 0.25), Category 3*
- *Blue whales south of Sri Lanka in 2014: 306 (CV = 0.35), Category 3*
- *Blue whales south of Sri Lanka in 2015: 257 (CV = 0.25), Category 3*
- *Sei whales in eastern North Pacific in 1996: 150 (CV = 0.78), Category 2*
- *Sei whales in eastern North Pacific in 2001: 48 (CV = 1.48), Category 2*
- *Sei whales in eastern North Pacific in 2005: 136 (CV = 0.96), Category 2*
- *Sei whales in eastern North Pacific in 2014: 864 (CV = 0.40), Category 2*
- *Bowhead whales in Bering-Chukchi-Beaufort Seas in 2019: 14,025 (CV = 0.228), Category 1A*
- *Bowhead whales in eastern Canada – West Greenland in 2008–2013: 13,899 (Highest posterior density interval 7,782 to 30,602), Category 3*
- *Rice's whale in Gulf of Mexico in 2017–2018: 51 (CV = 0.50), Category 1B*

The Committee **recommends** *that all of these abundance estimates meet the definition of an Evaluation Extent of 1 ('examined in detail by the SC'). The Committee also* **recommends** *that Allison should update the table intersessionally.*

11.3 Methodological issues

11.3.1 Amendments of the RMP Guidelines to consider model-based abundance estimates

The Committee agreed in 2018 (IWC, 2019f) that the 'Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme' (referred to as the RMP Guidelines, IWC, 2012) need to incorporate spatial model approaches to estimate abundance from line transect surveys. David Miller from CREEM (Centre for Research into Ecological and Environmental Modelling, University of St. Andrews) was selected to make proposals to modify the RMP Guidelines following a set of specific instructions developed by a Steering Group under Staniland (Annex O). It was noted that these survey guidelines also apply broadly across many applications considered by the Committee and that analyses presented to the Committee using such methods could serve as useful examples when the amendments to the guidelines are under discussion. The Committee **agrees** that this work will be conducted intersessionally and progress will be evaluated at next year's meeting.

11.3.2 Progress on simulation software to evaluate methods for abundance estimates

SC/68C/ASI/13 provided an update on modernisation of visual survey simulation programs. The Committee has used simulated data to evaluate novel analysis methods for line transect abundance surveys in the past. These datasets have been archived with the Secretariat, but the original executable code used to create those simulated data was generated using compilers that are now outdated. The Committee provided financial support for a project to document, update and streamline the code so that it is compatible with current compilers. This document describes the updating process, now complete, and provides guidelines and examples showing how to use the programs to create new simulated data scenarios, and how to re-compile the code after further development. The existing simulated datasets, together with others that may be generated with the updated programs, could comprise a library of datasets for use by the Scientific Committee in evaluating future novel analysis methods for line transect data.

The Committee expressed appreciation to the authors and noted the value of such simulations to advance the work of the SC. The Committee looks forward for the completion of this project.

11.3.3 Consider diagnostic methods for mark-recapture models

The Committee did not receive information on this topic, but recognises the importance of developing diagnostic methods to assess mark-recapture models. This item may be addressed at the next SC meeting.

11.4 Consideration of the status of stocks

The Committee has been asked to provide broad information on the status of whale stocks for the Commission and general public. Recent work on this project is summarised by IWC (2019, p.281–2; 2020a, p.61–3). During the intersessional period, Punt and Allison worked to generate some of the simulation results needed to assess status for certain stocks. The ASG considered a rough draft of how status results might be presented on the web, using some of those results as an example. A small working group (ASOS, Annex O) has been asked to develop this example further.

The Committee recognised that a written document cannot fully convey the potential interactive features of a website. It is proposed that the welcome page that will have a table of species and stocks, with columns summarising simple categorisations of 'Status' and the 'Recent growth/depletion rate'. Links to more detailed stock pages and methodological documents would be available, as well as links to the IWC's species information and extinction pages (*https://iwc.int/whale-specieshttps://iwc.int/cetaceans-and-extinction*). The importance of co-ordinating work was emphasised to ensure there is no duplication of effort or ambiguity.

The Committee agreed that the ideas presented formed a basis for future developments and agreed that, despite the scientific complexity of assessing status, the primary target audience was non-scientists (e.g. the general public) and thus the website information should be non-technical whilst retaining simplicity, brevity and clarity. There was discussion of comparisons with existing websites that provide similar information (e.g. NAMMCO), and the Committee recognised the need to take care not to introduce ambiguity in terminology and/or categorisation (e.g. with the IUCN Red List).

Potential improvements were discussed (e.g. combining the information of the two main criteria in a single plot (c.f. simplified Kobe plots used in Fisheries Science) or summary plots by stock or multiple stocks. Continuous colour gradient approaches might be used to avoid arbitrary categories and threshold effects (i.e., large changes in perceived status due to small numerical differences). The advantages and disadvantages of simple knife-edge descriptive categories, numbers of categories (e.g. is poor and good sufficient or should there be up to five), the balance between graphics and verbal descriptions requires further attention. The development/choice of terms that do not imply a value system (e.g. c.f. depleted and recovered versus increasing and recovering) or that are conceptually more difficult to explain (e.g. carrying capacity versus pre-exploitation levels) is also important.

There are also challenges when presenting information for data-rich than data-poor 'stocks' a consistent system needs to be developed that also indicates in a simple way the levels of uncertainty with respect to available data. It is not feasible to address all stocks simultaneously (especially when incorporating the many small cetaceans species and stocks) so a prioritisation scheme needs to be developed e.g. start with the stocks that have recently been or still are subject to whaling, continue with stocks of greatest conservation concern (e.g. those with CMPs or classified as 'Critically Endangered' by IUCN), before moving to other species/stocks. During the developmental phase, it is important to include both data-rich and data-poor examples. The table of assessment information available for large whales developed last year (Table 14 in IWC 2020b) will assist in prioritisation.

To move this process forward, the Committee **agrees** that Givens convene an Intersessional Correspondence Group (DSOS, Annex O) that will work on the general approach, and delegate work to species experts when needed.

Attention: SC
The Committee **recognises** *that the provision of information on status of stocks to the Commission and the general public is a priority. The Committee* **agrees** *that a process on how to best provide this information in an effective manner has to be considered intersessionally and* **recommends** *this work be undertaken by an intersessional correspondence group under Givens.*

11.5 Progress on previous recommendations

The Committee **recognises** that cancellation of the 2020 and 2021 in-person meetings severely impacted its work. The technical nature of the review of abundance estimates and providing information on status of stocks is such that annual in-person meetings are essential in combination with intersessional email/zoom work. Nevertheless, progress was made with respect to some recommendations from last year's meeting. The IWC Table of Accepted Abundance Estimates was updated during the intersessional period and estimates requested by various of the Committee's sub-groups were reviewed intersessionally, during the ASG meeting (Annex E) and during the present meeting (Item 11.1 above). Nearly fifty reviews were received. The Committee **reiterates** that review of abundance estimates and the update of the IWC Table represent important recurring tasks for the work of the Committee. Indeed, during the current annual meeting more than thirty papers were identified for review in the 2021–2022 intersessional period, and more are expected to be requested in the coming months.

The Committee developed a process to review and validate abundance estimates during SC68A (IWC, 2020f) and this was followed to the extent possible and facilitated productive discussions by the Committee. The process is continuing to evolve (see Item 11.1).

Progress was also made on the provision of advice to the Commission on status of stocks (Annex E and item 11.4) and a workplan has been developed (see Item 11.6). The Committee **agrees** that the three-day meeting on this topic planned for 2021 but cancelled due to COVID-19, and for which funding has already been approved by the Committee, remains a priority and **recommends** it be held as an in-person meeting prior to SC68D. Subject to other priorities, abundance estimates for ecosystem modelling (see Item 15.2.1) may be considered at this pre-meeting.

In 2019, the Committee agreed that work required to: (a) to address issues related to estimation of *g(0)*; and (b) develop robust estimates of abundance for North Pacific minke whales, be referred to an intersessional correspondence group (IWC, 2020g). The Committee **recognises** that the work of this group should continue and **agrees** that a report by this ICG will be reviewed in 2022.

The amendment of the RMP Guidelines to incorporate spatial modelling approaches to line transect data has been on the agenda since 2018. The Committee **agrees** that completion of this work (item 11.3.1) within the next two years is a priority.

The Committee **recognises** that development of a set of simulated datasets can be used to test new methods for abundance estimation. At SC67B, the Committee recommended that existing computer code previously developed for simulating line transect data be updated (IWC, 2019d) and a progress report of this work was reviewed at this meeting

(SC/68C/ASI/13, item 11.3.2 above). The Committee **agrees** that this ongoing project should be continued, and that progress be reviewed at next year's meeting. Funding for this project is already in place.

The Committee also **agrees** that intersessional work on priority tasks identified in the workplan should continue and progress be reviewed in 2022.

11.6 Biennial workplan

The Committee **agrees** to the workplan provided in Table 12. Intersessional email groups are provided below.

Table 12

Work plan for the review of abundance estimates and provision of advice to the Commission on status of stocks for the period 2021/22.

Item	Topic	Intersessional 2021–22	SC68D	Agenda Item
1	Review of Abundance Estimates	ASG to coordinate the review of the abundance estimates with priorities to include: (1) franciscana; (2) non-Antarctic blue whales in the Southern Hemisphere; (3) Antarctic blue whales; (4) North Pacific humpback whales; (5) North Pacific sei whales; (6) Southern Hemisphere humpback whales; (7) Southern Hemisphere right whales; (8) Eastern North Pacific gray whales; (9) North Atlantic right whales; (10) North Atlantic common minke whales; and (11) other species/stocks identified intersessionally by SC sub-group convenors.	Review intersessional progress and new estimates of abundance available prior to the next annual meeting.	11.1
2	Upload the estimates accepted at the annual meeting to the IWC website and continue to update the IWC Abundance Table	Update the table with estimates accepted at SC68C (Allison).	Review progress	11.1
3	Abundance Review Process	ICG will continue to refine definition of abundance categories and re-categorise estimates of abundance previously accepted by the Committee to adhere to the new category definitions.	Review progress	11.1
4	Franciscana Abundance Review	ICG will continue coordination of the review of estimates of franciscana abundance to complete the review of the status of the species by the SC meeting in 2022.	Review progress	11.1.2
5	Address issues (including $g(0)$) related to estimates of abundance of western North Pacific minke whale abundance estimates for use in the current in-depth assessment and the provision of regional estimates	ICG to coordinate intersessional work.	Review progress	11.1.11
6	Amend the RMP Guidelines to consider abundance estimates computed with model-based methods	Develop a set of specific instructions for the amendment of the RMP Guidelines to consider model-based abundance estimates (SG Amendment of RMP Guidelines and Miller).	Review an updated document of the RMP Guidelines	11.3.1
7	Develop simulation software to evaluate methods for abundance estimates	Continue development of software (Palka and Smith).	Review Progress	11.3.2
8	Consider diagnostic methods (e.g. model fit) for mark-recapture models to estimate abundance and trends	ASG identify an expert group.	Review progress	11.3.3
9	Provide Commission with advice on status of stocks	Finalise a proposal on how to provide information on the status of stocks to the Commission	Review Progress	11.4
10	Host a three-day pre-meeting for the Abundance Steering Group (ASG) and the Intersessional Steering Group (SG) on Status of Stocks	SG on Status of Stocks and ASG to review intersessional work and necessary information in making preparations for the pre-meeting	Host pre-meeting	11.1 and 11.4

Intersessional steering/correspondence groups for abundance estimates and status of stocks

SC Agenda Item	Type	Group (short name)	Terms of Reference	Members
11	SG	Abundance Steering Group (ASG)	(1) Coordinate the intersessional review of abundance estimates by the ASI SWG. (2) Appoint expert small group to conduct review of abundance estimates required for next year's meeting.	Givens (Convenor), Allison, Donovan, Jackson, Kitakado, Palka, Porter, Robbins, Staniland, Suydam, Walløe, Zerbini
11	ICG	Abundance Review Process (ARP)	(1) Discuss and refine definitions of categories 2 and 3 to classify estimates of abundance. (2) Develop supplementary wording that explains how estimates in categories 1A, 1B, 2 and 3 might be used, and examples of the reasoning for choosing one category over another. (3) Review estimates previously added to the table to re-categorize them as necessary to adhere to the new category definitions agreed by the SC at this meeting.	Givens (Convenor), Allison, Butterworth, Donovan, Jackson, Zerbini

Cont.

11.1.2	ICG	Franciscana abundance review group	(1) Coordinate the intersessional review of franciscana abundance estimates. (2) Produce a report of the review for presentation next year.	Zerbini (Convenor), Andriolo, Cañadas, Cremer, Crespo, Danilewicz, Domit, Doniol-Valcroze, Donovan, Ferguson, Fortuna, Givens, Herr, Miller, Sucunza, Palka.
11.3	SG	Amendment of RMP Guidelines	Develop a set of specific instructions for the amendment of the RMP guidelines to consider model-based abundance estimates.	Staniland (Convenor), Butterworth, Cooke, Donovan, Herr, Kelly, Kitakado, Miller, Palka, Punt, Zerbini.

Intersessional steering/correspondence groups for abundance estimates and status of stocks

SC Agenda Item	Type	Group (short name)	Terms of Reference	Members
11.4	SG	Advice on Status of Stocks (ASOS)	(1) Finalise a proposal on how to provide information on the status of stocks to the Commission and the public (including agreed-upon terminology and graphics). (2) Evaluate work by the ICG on developing status of stock examples.	Givens (Convenor), Allison, Brownell, Butterworth, Cooke, Donovan, Jackson, Palka, Porter, Punt, Staniland, Suydam, Trujillo, Víkingsson, Walløe, Wilson, Zerbini.
11.4	ICG	Develop Status of Stocks examples DSOS	(1) Develop several example stock status reports including both cases with sophisticated modelling of good data, and cases with minimal modelling and limited data. (2) Begin development of website to convey status information.	Givens (Convenor), Allison, Butterworth, Donovan, and Punt, the Chair and Vice-Chair of the Committee, and any co-convenor of ASI.
11.6	ICG	NP minke abundance	(1) Review the applicability of the accepted *g*(0) estimate from one cruise to other cruises. (2) Try to develop robust estimates for use in the in-depth assessments and/or to provide management advice and/or to provide broader estimates for the public.	Kitakado (Convenor), Allison, Butterworth, Donovan, Hakamada, Kelly, Matsuoka, Miyashita, Palka, Punt.

12. BYCATCH AND ENTANGLEMENTS (HIM)

12.1 IWC's Bycatch Mitigation Initiative

The IWC Bycatch Coordinator (Tarzia) gave a brief overview of recent progress of the Bycatch Mitigation Initiative (BMI) described in SC/68C/HIM/24.

Work plan 2020–2024

The Bycatch Mitigation Initiative's (BMI) new four-year work plan (2020–2024) was endorsed by the Conservation Committee in October 2020 and is now being implemented. In 2020–2021 the focus has been on individual pilot project development, exploring fundraising opportunities, capacity building programme, and progressing collaborative work with other organisations, including in the Indian Ocean.

Fundraising

The voluntary fund for Bycatch Mitigation Initiative (BMI) currently stands at £94,598.74. Contributions were received from the Governments of Austria, Belgium, Netherlands and New Zealand. Further contributions were received from the Animal Welfare Institute (AWI), Natural Resources Defense Council (NRDC), OceanCare, Sea Legacy, World Wide Fund for Nature (WWF) and VIVA Institute Verde Azul. Tarzia noted that the recent contributions will enable progress on pilot projects and capacity building efforts in particular.

Full implementation of the BMI work plan requires external fundraising, particularly in relation to pilot projects, the capacity building programme and engagement of Regional Fisheries Management Organisations (RFMOs). The Bycatch Coordinator and others in the IWC Secretariat are exploring possible external funding opportunities for individual pilot projects – in collaboration with national governments and relevant organisations. Also see Item 12.1.5.

Pilot Projects and Affiliated projects

The BMI has made particular progress towards the collaborative development of pilot project concepts in Peru and the Republic of Congo. In relation to the other prioritised countries and locations (India, Pakistan, Kenya, Thailand, Malaysia and Indonesia), the Bycatch Coordinator has held discussions with locally based experts and Government representatives about the potential to establish collaborative bycatch projects. The BMI continues to explore opportunities to collaborate on existing and new projects focused on bycatch mitigation, particularly in small-scale fisheries and gillnets. Tarzia noted that collaboration provided the BMI with the opportunity to learn from projects and export these lessons elsewhere, and at the same time affiliation with the IWC could help raise awareness and support for collaborating projects.

Capacity building

The BMI is establishing its capacity building programme related to bycatch assessment, monitoring and mitigation. The BMI held a virtual workshop with the Government of Colombia focusing on rapid bycatch risk assessments, and the potential applicability of these tools for assessing bycatch in small-scale fisheries. The BMI is keen to explore opportunities for future

capacity building, including through technical workshops, training of individuals, and a proposed sharing scheme for bycatch mitigation and monitoring equipment.

Discussion on the overall progress of the BMI included a focus on how the COVID-19 pandemic has already impacted or is likely to impact the BMI's work plan. Tarzia noted that some aspects, such as capacity building workshops had moved to a virtual format. With respect to pilot projects, much of the current work remains preparatory, including fundraising. Careful planning will be needed as each project develops to address likely delays in field work and fisher engagement.

In relation to BMI pilot projects and plans to potentially adapt a US-model of 'Take Reduction Teams' within pilot project countries, Long offered to provide advice on how these teams operate.

12.1.1 Update on progress of Expert Panel

The Expert Panel on Bycatch has continued to provide technical advice and guidance to the Bycatch Coordinator and the Standing Working Group on Bycatch. This has included: input to the development of pilot projects; participation in external meetings such as the IOTC/IWC meeting on potential collaboration; presentations at conferences alongside the Bycatch Coordinator; leading the development of material for capacity building; and review and feedback on IWC documents and those of external organisations (e.g., FAO). The first four-year term of the Expert Panel ends in early 2022, and panel membership is currently being reviewed to ensure optimal geographical representation and range of expertise.

12.1.2 Review new information for identifying pilot projects or capacity building

Rivadeneyra described legislation in Peru related to fishing activities and conservation of small cetaceans, together with measures adopted by the Peruvian Government to protect small cetaceans from bycatch in artisanal fisheries (SC/68C/HIM/15). Recent regulations (Ministerial Resolution No. 451-2019-PRODUCE) require report of any cetacean bycatch or ship strike to the Marine Institute of Peru (IMARPE). IMARPE carries out on-board monitoring on large vessels through the *Programa Bitácoras de Pesca*, and information on small cetacean bycatch, including the records of interactions and evaluation of stranding events is collected by coastal IMARPE laboratories. Monitoring of strandings of small cetaceans in the regions of La Libertad, Lambayeque, Piura and Tumbes showed that Burmeister's porpoises and long-beaked common dolphins were the most affected by capture for human consumption and entanglement with fishing nets. Fisheries along the coast are abundant and diverse. Therefore projects and solutions to cetacean bycatch will be dependent on the fishery, but with the overarching goal off approaches that are effective, practical and sustainable. While the pandemic caused delays, much of the work so far has been in planning. It was hoped that the projects can begin to engage with the selected fishing communities in May or June 2021, and that fieldwork can begin later in the year.

The Committee congratulated Peru on this thorough report and referred to previous discussions of mitigation trials in Peru. Rivadeneyra noted that there had been helpful collaboration with the BMI, in the context of pilot project development, and that collaboration would continue. She also recognized the value of collaborating with local NGOs who have established trust and communication with local communities, and who have conducted surveys and mitigation trials using, for example, pingers and LED lights along parts of the Peruvian coast (e.g. Bielli *et al.* 2020).

Rivadeneyra noted that the large size of the Peruvian fleet, which is primarily made up of small vessels, makes effective observer coverage for bycatch monitoring impractical. This may necessitate some type of video monitoring, but cameras and operations must be simple, inexpensive, and accepted by the fishers. The Committee offered to share experience from previous trials of remote electronic monitoring in Peruvian fisheries (e.g. Bartholemew *et al.,* 2018).

There was additional discussion of bycatch in Peru under agenda Item 16.11 (Campbell *et al.,* 2020).

12.1.3 Review of other BMI activities

The IWC Secretariat has submitted a draft concept to the Common Oceans ABNJ Tuna Phase 2 project development team (see Item 12.1.5) of the Global Environment Facility/Food and Agriculture Organisation of the United Nations. The overall project is focused on improving the sustainability of the world's tuna fisheries. The IWC's proposed concept aims to collaboratively bring about a step-change in relation to assessing and addressing cetacean bycatch in tuna fisheries across two ocean basins – the Indian Ocean and the Pacific Ocean. This work would lay the foundation to scale up efforts to address bycatch across multiple ocean basins. At regional level, the proposed activities include:

(1) Assessing cetacean bycatch and data gaps across an ocean basin to inform RFMOs on the scale and scope of the issue in relevant fisheries to provide a baseline assessment.
(2) Building regional capacity and awareness of cetacean bycatch and available practical solutions; working with key countries to train fishers and fisheries managers and observers in cetacean bycatch mitigation, monitoring and safe handling and release; review and dissemination of relevant information on best practices to address bycatch.
(3) Collaboratively developing recommendations to address cetacean bycatch across multi-lateral environmental and fisheries agreements. The IWC will focus on developing recommendations on cetacean conservation through its own Committee and Commission processes and build a coordinated and collaborative approach with national governments participating in both IWC and the relevant RFMOs.

The Committee **welcomes** and **endorses** the proposed project and looked forward to an update on progress next year.

12.2 Collaboration on bycatch mitigation with IGOs (including FAO, Regional Fisheries Management Organisations and others)

Tarzia summarised the collaborations between the BMI, the FAO, and RFMOs, over the past year (SC/68C/O4). The IWC Secretariat has continued to engage with the FAO through participation in the FAO Committee on Fisheries (COFI) meeting in 2021. The IWC Secretariat provided a written statement welcoming the newly published Technical *Guidelines for Preventing and Reducing Marine Mammal Bycatch in Capture Fisheries* (FAO, 2021). The FAO has included a reference to collaborating with the BMI in its new Responsible Fishing Operations work plan. Discussion with the FAO regarding possible collaboration on outreach, awareness raising and capacity building relating to the Technical Guidelines, is ongoing.

The Committee welcomed this report and congratulated Tarzia for the work accomplished. Einarsson, a consultant for the FAO, welcomed the BMI's continued work with the FAO and, in particular noted that the FAO Secretariat encourages help from the IWC to disseminate the Technical Guidelines. He indicated that translation by the FAO of the Guidelines into French and Spanish were being undertaken and that translation into some other key languages would be valuable if funding could be found. The Committee **agrees** that relevant RFMOs would make good initial target audiences, although clarification is required as to whether other FAO processes are already undertaking this effort. The UK and others offered to assist with outreach to some specific RFMOs.

Tarzia then outlined recent progress in developing a collaboration with the Indian Ocean Tuna Commission (IOTC) to better understand and address cetacean bycatch in the Indian Ocean tuna fisheries. The IWC and IOTC Secretariats and members of the Bycatch Expert Panel working in the Indian Ocean, held a joint meeting in September 2020 to discuss potential collaborative activities (IOTC and IWC, 2020) and this was briefly presented to the IOTC's 16th Working Party on Ecosystems and Bycatch (WPEB) meeting (IOTC, 2020). The IOTC's WPEB is planning to work on an ecological risk assessment for cetaceans across the region in collaboration with other organisations. A follow up workshop or meeting by the IWC, IOTC and experts working on cetaceans and bycatch is planned, and will take place in advance of the 17th WPEB meeting in 2021. De Bruyn from the IOTC Secretariat reiterated their interest in further collaboration with the IWC and mentioned that both the IWC and IOTC Secretariats are exploring the development of a Letter of Agreement to formalise collaboration in relation to joint activities, including the proposed activities in the Common Oceans ABNJ Tuna Phase 2 project. The IOTC invited Committee members to provide their cetacean expertise to the WPEB, particularly with respect to a potential gap analysis.

Several representatives of other national and regional entities expressed interest in cooperating (formally or informally) with the BMI on bycatch mitigation efforts (e.g. The Protocol for Specially Protected Areas and Wildlife under the Cartagena Convention – SPAW, the Secretariat of the Pacific Regional Environment Programme – SPREP, USA-NOAA). Specifically, SPAW would welcome cooperation with its newly supported bycatch assessment project, and Tarzia indicated that the BMI is already exploring cooperation with several regional bodies (i.e., SPREP, and some RFMOs such as the Western Central Pacific Fisheries Commission) including through the proposed Common Oceans ABNJ Phase 2 project (see Item 12.1.5).

It was noted that, with proper and relevant input, the Marine Mammal Bycatch Impacts Exploration tool discussed under agenda Item 12.3.2 would be useful in assisting RFMOs (e.g., IOTC) with bycatch assessment, and it was suggested that this could be included in the Common Oceans ABNJ Tuna Phase 2 Project proposal.

12.3 Review bycatch risk assessments

12.3.1 The Bycatch Risk Assessment (ByRA) toolkit

Assessing bycatch risk poses a particular challenge in developing countries, where bycatch data and the effects of bycatch are often lacking due to limited time, money, and training. Verutes *et al.* (2020) and Hines *et al.* (2020) describe the Bycatch Risk Assessment (ByRA) toolkit, a suite of tools for place-based risk assessment of marine mammal bycatch that makes use of existing data and creates a framework for data collection. The tools have open-source processing to guide scientists and managers in obtaining results in a spatial risk analysis to support science-policy processes. Within the toolkit, users are provided with methods to evaluate existing data related to distribution of fishing effort and the use of fishing gear associated with bycatch. The toolkit has been applied in three field-sites in the eastern Gulf of Thailand, Sarawak and peninsular Malaysia, and southwestern Vietnam, which have similar coastal cetaceans and sirenians, small-scale and industrial fisheries, and support from either local universities or management agencies. Using these diverse sites as input has enabled the creation of an adaptable and scalable toolkit to support marine mammal conservation and inform fisheries management strategies. These methods are intended to support practitioners to find effective measures to reduce bycatch to sustainable levels.

SC/68C/HIM/08 describes data from interviews and boat-based surveys conducted between 2013 and 2017 in Matang, Malaysia, and how they were integrated using the ByRA toolkit to identify the main gear associated with bycatch and areas with highest bycatch risk to small cetaceans. This effort will help guide planning for local bycatch mitigation strategies. A total of 198 respondents in 17 fishing villages were interviewed to assess fishers' perceptions, fishing effort, cetacean sightings and bycatch. The Indo-Pacific humpback dolphin (*Sousa chinensis*) was the most frequently reported cetacean species to be entangled in fishing gear, according to the fishers' responses to the survey. Gillnets, driftnets and trammel nets were the main gears that entangled humpback dolphins and Irrawaddy dolphins (*Orcaella brevirostris*) in inshore

environments, whereas trawls more frequently entangled Indo-Pacific finless porpoises (*Neophocaena phocaenoides*) further offshore. Kuala Sangga Besar and Kuala Larut were identified as areas with the highest cetacean bycatch risks. Based on the risk analysis, the authors identified the fisheries and gears where bycatch mitigation trials could be most effectively targeted for mitigation efforts.

In discussion it was noted that the circumstances encountered in the study (e.g. poor data, interview reluctance, lack of clarity from regulators), are commonly found in other parts of the world. Ponnampalam reported that fishers were willing to trial or use mitigation methods, as long as they were low cost and did not negatively impact catches of the target species. While a few fishers in the region reported consuming bycaught cetaceans, most would attempt to release live bycaught cetaceans, or they would discard dead ones at sea. Noting that most nets were tended, and as much as 50% of bycaught cetaceans were released alive. Ponnampalam agreed that translating the UNEP-CMS 'Guidelines for the Safe and Humane Handling and Release of Bycaught Small Cetaceans from Fishing Gear' into the local language, together with some training, could be helpful in reducing mortality from bycatch in the region.

Costanza described an application of ByRA in northern Peru. Within the last decade, accounts of entangled humpback whales off the northern coast of Peru have increased. By leveraging local fishers' experience and knowledge, the objective was to use a low-cost approach to provide a spatio-temporal assessment of bycatch risk off two Peruvian fishing ports. The assessment incorporated 85 interviews with fishers, which included participatory mapping, along with expert marine biologists' opinions, and scientific literature to determine gear impact on various species. A presence-only species distribution model was constructed from sightings data gathered from mapping exercises. Outputs were seasonal risk maps identifying higher risk for humpback whales overlapping with gillnet fisheries near the coast and higher bycatch risk for leatherback turtles in longline fisheries. Costanza noted that the ByRA toolkit can be used even with limited data and funds to provide rapid visual interpretations of information via risk maps and replicable techniques to assess the risk of bycatch for single or multiple species.

In discussion the value and accuracy of local knowledge and the importance of developing trust with the local fishing community was stressed. In particular, projects benefit from partnering with local NGOs who have already established trust and a working relationship with fishers. In addition, providing feedback and even small gifts (e.g. T-shirts, hats) can be helpful. Costanza noted that fishers had a personal motivation to solve the problem, as whale entanglements damage gear and cause significant financial loss. In addition, researchers provided feedback to participating fishers, and worked with fishers to archive marine mammal observations in an online 'story book', a process which also helped to validate data. Some members warned that in certain settings, too many interviews could overwhelm fishers and cause them to evade questioning, or even collude to provide mutually agreed upon group answers, as was believed to be the case for some studies in British Colombia, and with the fishing fleet encountering bycatch of vaquita in Mexico. Additionally, a pre-existing concern about potential regulations could also cause a shut down or evasive and uninformative answers.

The ByRA tool kit uses a 'traffic light' (i.e. red, amber, green) system of rating the quality and accuracy of data. There is an inherent hierarchy of data reliability, with traditional boat surveys for animals and VMS or AIS for fishing effort representing the most reliable, or 'green' category. However, where these data are not available, literature reviews and stranding data are a second tier of reliability. Interviews with fishers or local NGOs are considered less accurate and are usually rated as 'amber' at best. Several methods were used to rate the quality of interviews. In the authors' experience, good interviews could provide reasonably accurate data about effort and interactions, but are less reliable for species identification, suggesting that, in areas with very little existing data of any type, boat-based surveys for species abundance and distribution should be prioritized, with interviews complementing those data. If none of these are available, the tool can still generate some useful guidance based on interviews with local researchers, NGOs and relevant government agencies.

The ByRA toolkit was designed for use in data poor areas. In discussion it was suggested that it would be valuable to evaluate its outputs in a data rich situation. Hines noted that this had not been specifically done for any single scenario, but several ByRA assessments had been successfully conducted in areas with differing levels of data quality. The Committee **agrees** that a comparison of ByRA and different assessment tools in a data rich area would be valuable.

In Chile, there are critical information gaps about distribution and abundance of most marine mammal species, and a lack of data on species that are most affected by fisheries bycatch. SC/68C/HIM/21 describes a proposal for a collaborative project between Chilean stakeholders, including national and international scientists, to analyse existing data, and generate methods to characterise the spatial and seasonal distribution and abundance of fishing boats, gear, and marine mammals. The proposal focuses on 17 areas of presumptive high bycatch risk nested within four larger regions along the coast of Chile, including industrial and artisanal fisheries. Additionally, interviews will be conducted in artisanal fishery communities to increase socioeconomic and cultural understanding of small-scale fisheries and bycatch. The ByRA toolkit will be used to generate results to provide Chilean agencies with information on areas and seasons of bycatch risk, and levels of risk for various fishing gear, which can support precautionary actions and policies, and inform future research and management. By selecting diverse sites as input for the risk assessment framework, the capacity of personnel for the applied management of fisheries and marine mammal bycatch in Chile will be maximised.

The Committee **welcomes** the proposal and **endorses** its approach and goals.

12.3.2 Assessment of conservation implications of bycatch

An Ocean Modelling Forum Working Group (*https://oceanmodelingforum.org/working-groups/marine-mammal-bycatch-working-group/*) is developing a set of tools to assist countries to prepare for the requirements of the US *Marine Mammal Protection Act Seafood Import Provisions*. These tools include documents outlining best practices for estimating abundance and bycatch of marine mammals, a web application that allows users to compare alternative scenarios regarding bycatch and bycatch rates, and methods for determining thresholds for bycatch. Potential Biological Removal (PBR, Wade, 1998) is a standard way to compute such thresholds. However, it requires estimates of absolute abundance, which are often not available in data-poor situations. Punt *et al.* (2020) therefore developed approaches, based on methods for setting catch limits in data-poor fisheries, for computing bycatch thresholds using relative abundance data. These new methods can be tuned to achieve the same recovery and maintenance goals as PBR but at the cost of greater variability and lower average thresholds. Thus, they can be applied in some situations with limited data while efforts are underway to obtain estimates of absolute abundance.

It was noted that while the tool was modified to use relative abundance, it was not currently set up to use relative indices of bycatch. There are a number of challenges with using relative indices of bycatch in terms of understanding whether changes are due to changes in abundance or bycatch rates. In discussion of how this toolkit might be most useful to countries, it was noted that a paper is being produced to accompany the tool kit. It will review relevant existing technologies and methodologies for (1) assessing species distribution abundance and trends, (2) estimating bycatch, (3) monitoring mitigation measures. The authors of the toolkit also plan to bring the product to the Committee. The Committee **agrees** that this would be valuable, and that the Committee could assist with responses to specific questions. The BMI would welcome discussions on collaboration.

Siple introduced the Marine Mammal Bycatch Impacts Exploration tool *(https://msiple.shinyapps.io/mammaltool/*), developed by the Ocean Modeling Forum's Marine Mammal Bycatch Working Group. This app displays population projections for marine mammal populations based on life history parameters, abundance estimates, and bycatch estimates. It uses an age-structured population model and user inputs to project population size. The app provides management performance metrics (e.g., recovery probability), a calculator for solving for the maximum bycatch rate that could be sustained while allowing the achievement of a user-specified management goal, a printable report with inputs and outputs, and a tool for calculating Potential Biological Removal (PBR). An R package 'mmrefpoints' which contains all the functions used in the app is online at *https://github.com/mcsiple/mmrefpoints* and is available for use offline and for broader implementation of the population model.

The tool is not currently set up to handle extremely data-poor situations or dynamic situations of changes in fishing effort or cetacean distribution. However, if this initial version proves helpful, other scenarios could be included in future versions. It was suggested that there was value in combining a ByRA approach with the Marine Mammal Bycatch Impacts Exploration tools to assist with assessments in data-poor areas. The Committee **welcomes** these tools and looks forward to future developments.

12.4 Review new methods and estimates of entanglement rates, risks and mortality

SC/68C/HIM/20 outlines a preliminary methodology to use satellite imagery to characterize semi-industrial drift gillnet tuna fleets. The study was developed following recommendations from the IOTC-IWC Joint Meeting in 2020 (IOTC and IWC, 2020) and discussions with the Bycatch Coordinator. This project will focus on the ports of Karachi and Gwadar in Pakistan as pilot study sites. It will use imagery from two different satellites to quantify drift gillnet vessels and then ground-truth vessel information in ports with support from WWF-Pakistan. The data will be used alongside crew-based observations to generate coarse bycatch estimates. The study also aims to develop a transferable and transparent approach that can be used in other data-poor regions and fisheries.

In discussion, it was suggested that these methods could be particularly appropriate for IOTC gillnet fleets in India and Iran. The authors were encouraged to collaborate with a project in Oman which is undertaking similar work and is partly funded by IWC. It was noted that these methods could also be used to assess density and distribution patterns of vessels at sea, which is also relevant to ship strike risk (see Item 13.3).

The Netherlands has initiated a proposal for a new international project (CIBBRiNA) to address multi-taxa bycatch in high-risk fisheries in the OSPAR and HELCOM regions. Twelve countries, relevant Advisory Councils and some national fisheries organisations are interested in participating. The proposal will be submitted under an EU LIFE call for proposals in October 2021. One of the main aims is to collaboratively involve fishers and fisheries management organisations at national and EU regional scale to implement bycatch monitoring and mitigation programmes. Project actions will include the development of a framework to assess conservation implications of bycatch, as well as a framework to determine the factors contributing to the success of different methods for monitoring and mitigation. Socio-economic aspects such as mapping the supply chain and determining opportunities for leveraging change via market-based methods will also be included. Conservation actions will focus on sustainable funding mechanisms, the fisheries perspective, examination of species ecology and behaviour in the context of mitigation, and a mitigation toolkit. The project is being designed to complement the work of the BMI and other initiatives and a broad range of participants are sought, ranging from fisheries and environment ministries, fishing industry, NGOs and academia.

The Committee **welcomes** this initial proposal and volunteers a small group (Annex O; Hines, Rojas, Shahid, Al Sayegh, Long and Dolman) to work intersessionally with the authors in order to provide advice as the project proceeds.

Bycatch rates of humpback, minke and killer whales with fishing gear in Norway were estimated from the proportion of observed fishing effort to total fishing effort (SC/68C/HIM/13). From 2010-2020, a total of 77 (95% CI 43–177) humpback whales and 121 (95% CI 75–232) killer whales were estimated entrapped in purse seines. The annual incidents were generally low when fisheries were conducted in open waters but entrapments peaked when the herring wintered in very narrow fjords in Northern Norway in 2016–2017. All humpback and killer whale interactions were with purse seine fisheries for wintering herring. Based on estimated mortality rates, the average annual mortality 0.35 humpbacks and 0.66 killer whales are well within Norway's calculated PBR of 98 humpbacks and 161 killer whales. For estimates of minke whale bycatch, data from the High Seas Reference Fleet were used. About 30 vessels are contracted by the Norwegian Institute of Marine Research to provide very detailed information on effort, catch and bycatch. Two bycaught minke whales were reported, one caught in a demersal trawl and one entangled in a longline. Both entanglements were fatal. Extrapolating to entire trawl and longline fisheries, the total annual mortality was estimated as 5.7 minke whales. This is well within the PBR of 1498 minke whales.

With the abrupt increase in entrapments in 2016 and 2017, the Norwegian Directorate of Fisheries issued a new rule stating that the wellbeing of any entrapped or entangled cetacean is to be prioritized over the catch. This entails that a purse seine full of herring would have to be opened up again if there were cetaceans inside that could not otherwise be removed in a timely fashion. Relevant personnel were given large whale entanglement response training by Mattila, in line with IWC's best practice guidelines for entanglement responders.

Bjørge noted that the study did not include entanglements in pot or trap gear, as this gear is not currently monitored under an observer program. But he noted that a new snow crab trap fishery was growing in the Barents Sea, and this was of concern, given what is known about interaction between this type of gear and whales in other parts of the world. Mattila noted that observer programs in static gear fisheries are less likely to find entangled large cetaceans, as they are more likely to swim away with some or all of the gear (SC/59/BC/02) but suggested that an updated analysis of large cetacean displacement of entangling gear, perhaps in conjunction with analysis of reported gear loss, might shed some light on large cetacean entanglement in unobserved fisheries.

Mattila provided an update on his work in the role of Technical Advisor to the Secretariat for reducing human impact. A significant portion of the initiative since 2012 has been toward building capacity to respond to entangled large whales, including documentation and release. The pandemic necessitated a shift to the consideration of progressing the work virtually. This included facilitating the discussion of COVID-19 precautions for entanglement and stranding responses, and assisting international participation (e.g. Canada, New Zealand and Norway) in a virtual workshop on killer whale entanglement and release hosted by NOAA in 2020. It also stimulated discussion of virtual trainings, which re-invigorated an initiative by Australia to produce whale disentanglement virtual training software (Edwards *et al.*, 2021). The idea for this training software was first proposed by Coughran at a 2011 Global Whale Entanglement Response Network (GWERN) meeting, and was later endorsed by SC64 (IWC, 2013b). Also, in response to recommendation SC19208, concerning the potential for Bering–Chukchi–Beaufort (BCB) bowhead entanglement in ghost crab gear, the Technical Advisor was able to engage stakeholders in the Alaskan Arctic (AEWC, NSB and NOAA) in discussion of possible first steps toward identifying, quantifying and addressing the issue. The BCB bowhead population has been identified as a whale population for which entanglement in ghost gear may uniquely be responsible for a significant portion of their entanglement risk. Finally, the Technical Advisor and IWC Entanglement Expert Panel were able to advise on several responses around the world, including the successful release of an Arabian Sea humpback whale (SC/68C/CMP/05Rev1), by members of a team trained in Oman in 2015.

Edwards *et al.* (2021) provided an update on the Australian effort to develop virtual training software for entanglement responders that was originally proposed in 2011. An interactive 2D proof of concept, with some basic interactive functionality, has been developed, but the developers are seeking support to complete a fully realized three-dimension training package. The completed package is intended to provide essential 'refresher' trainings in a more cost effective, and therefore more reliable, manner, but could also be used to assist with initial trainings, especially during the pandemic. It would also be valuable as an educational and outreach tool for a public audience.

The Committee thanked Mattila and the GWERN for their work. The Committee **endorses** the continued development of the whale disentanglement virtual reality training program as a refresher training and/or during pandemic. The Committee again **recognises** the value of disentanglement efforts for collecting scientific data and identifying gear origin.

Ramp *et al.* (2021) explored entanglement-related scarring rates in humpback, blue and fin whales in the Gulf of St. Lawrence, Canada, using drone footage. The proportion of entanglement-related scars observed on humpback whales was similar to that derived from analysis of boat-based imagery. Sample size for blue whales was not sufficient for analysis. The proportion of entanglement scarring on fin whales ranged from 44–55%, indicating a higher entanglement rate than suggested by documented entanglement events. The use of drone footage showed great promise for assessing the extent of entanglement in non-fluking rorqual whale species, as it can provide a better access to all body parts, except the mouth.

In discussion, Landry noted that the smaller proportion of fin whales with entanglement wounds compared to North Atlantic right whales or humpback whales could either be because fewer fin whales are entangled, or because a lower proportion survive their entanglement. The authors noticed few scars on fin whale flippers, the shape of which may reduce the likelihood of entanglement. Ship strike wounds were also observed on drone footage, however this study focused on entanglement wounds to highlight the need for more measures in Canadian waters to prevent entanglement of rorqual whale species.

12.5 Reporting of bycatch and entanglements (both small and large cetaceans) including National Progress Reports

A summary of the information in the National Progress Reports database for the past year with respect to bycatch and ship strikes is available in Annex I.

12.6 Review mitigation measures for preventing bycatch and entanglement

12.6.1 Review of visual and acoustic prevention

SC/68C/HIM/01 describes the acoustic properties of a wide range of gillnet filaments, as well as a range of objects that could be added to gillnets to enhance their acoustic detectability for specific odontocete species. Based on the requirements of omnidirectionality, small size, neutral buoyancy and strong echo, acrylic glass spheres were identified as the optimal reflector. Tests showed that the spheres provided the desired combination of target strength and a clear acoustic pattern created a barrier effect from gillnets for any angle of approach. In a pilot trial of the reflectors on gillnets, it appeared that fewer porpoises were caught in nets with beads than in control nets, but sample sizes were small and the difference was not significant.

In discussion, the authors clarified that they have not yet been able to conduct behavioural studies of porpoises around the nets fitted with beads but they hope to do this in the future through land-based operations or video cameras on the net. It was noted that these studies would be important to understand whether behavioural responses indicated avoidance or recognition of the net as a hazard. Stepputis also noted that adding an alerting alarm to the nets combined with the reflectors may help avoid situations where animals may be distracted (e.g. when searching on the bottom for food).

In response to questions about manufacturing and marine litter that might be generated by beads falling off the nets, Stepputis noted that the acrylic spheres were cut by laser and glued onto the net by hand, but that once attached to the net, very few came off, even during rough handling by cleaning machines. However, the process of manually cutting and gluing spheres to nets is time consuming, and an industrial manufacturer will need to be identified, in order to produce enough nets for planned deployments and attain sufficient statistical power in future trials. Tarzia offered to connect the authors with the IWC Bycatch Expert Panel and the BMI more broadly to assist with implementing further trials.

Moan presented SC/68C/HIM/02, which reported the results from two years of pinger trials in cod, saithe and monkfish fisheries in Norway. In this study, data were collected for about 500 fishing operations, corresponding to almost 3,000 net km days (net length multiplied by soak time). A total of 19 harbour porpoises were taken in nets without pingers, while no porpoises were taken in nets with pingers. This suggests that pingers can be effective as harbour porpoise bycatch mitigation tools in Norwegian gillnet fisheries, and that strategic pinger use has the potential to reduce total harbour porpoise bycatch in Norwegian gillnet fisheries to a small fraction of the calculated PBR. This study also evaluated time costs incurred by fishermen using pinger (e.g., extra time needed to disentangle pingers from gillnet meshwork, or from running hauling gear slightly more slowly to avoid issues with pingers going through the machinery). Estimates indicated that a typical Norwegian fisherman could be expected to spend an average of 5.5 hours extra per year because of delays associated with pinger use. These small impacts appear to be acceptable to the fishers.

The Committee **thanked** the authors and **welcomed** this extensive study that suggested that pingers could be highly effective. In response to a question about the possible displacement of porpoises from important areas the authors indicated that the study did not look at the question of avoidance versus displacement, but the fishery is being monitored and if animals are displaced, then bycatch levels may increase outside of the historical hotspots for bycatch where the pingers are currently mandated The authors also intend to begin some acoustic studies using C-PODs that will determine whether porpoises are still present in areas where pingers are being used. It was noted that the expansion of this trial to use in the commercial fishery probably represented the most widespread use of pingers to date. The Committee looks forward to receiving further updates and welcomed the study's inclusion of measures of the impact to the fishers, both in time and catch, as this important data is often overlooked.

The effectiveness of acoustic deterrents ('banana pingers' produced by Fishtek Marine) in reducing the bycatch of franciscana in gillnets was tested between October 2019 – March 2021 in collaboration with artisanal fishers of seven boats from Montevideo (Río de la Plata) and La Paloma (Atlantic coast), Uruguay (SC/68C/HIM/10). Data from nearly 6,000 fishing net sets were obtained, with roughly half equipped with pingers and half as a control without pingers. In total, 25 franciscana dolphins were entangled, 7 of them in the experimental treatment and 18 in the control treatment. After considering relevant ancillary variables (i.e., sea surface temperature, mesh size, soak time) and the fishing boat as random effect, the result of a Generalized Additive Mixed Model (GAMM) indicated a significant reduction in the bycatch of franciscana in the experimental treatment, in comparison to control nets. This indicates that the 'banana pinger' reduces the bycatch of

franciscana in the Uruguayan artisanal gillnet fishery. The authors note that these results are potentially applicable to other artisanal gillnet fisheries interacting with this species.

The franciscana was also recorded as bycatch in the industrial pair trawling fishery targeting mainly the whitemouth croaker (*Micropogonias furnieri*) (Franco-Trecu *et al.,* 2019). SC/68C/HIM/11 describes an experiment to test the effectiveness of Fishtek Marine Anti-Predation Pingers to reduce the bycatch of franciscana. This project was started in late 2019 in collaboration with fishers. The pingers emit sound signals at 40kHz at higher intensity than deterrent pingers. The fleet comprises 33 licensed vessels (mean length about 20 m) which operate within the Argentinean-Uruguayan Common Fishing Zone, mainly in the Río de la Plata and adjacent Atlantic coastal waters up to the 50m isobath. Three pingers were attached at the headline of the trawl, two at the extremes and one at the middle, with a spacing between pingers of about 20m. One vessel of the pair conducts trawl sets with pingers and the other without pingers. A total of nine franciscana dolphins were captured in the experiment, eight of them in the control treatment and one in the experimental treatment, indicating a substantial reduction in the bycatch rate.

The Committee **commended** these studies, noting that they support recommended activities under the CMP for the franciscana population of the region. In response to a question about why the potential impact of pingers on target catch was reported for the pair trawls (SC/68C/HIM/11) but not the artisanal gillnets (SC/68C/HIM/10), the authors explained that the artisanal gillnet boats are too small to carry observers. Furthermore, because one boat might simultaneously use nets both with and without pingers, any impact on target catch cannot be inferred from assessing landed catch. Jimenez also noted that, while similar fisheries in neighbouring Argentina had recorded evidence of depredation and a possible 'dinner bell' effect (from seals and sea lions), the current study in coastal and riverine Uruguay did not show evidence of this.

Gillnets are the main cause of death for the critically endangered Mahakam population of Irrawaddy dolphins. (Rasi, 2021) describes results from a study conducted in the Mahakam River in East Kalimantan, Indonesia to investigate the potential of pingers to reduce bycatch. A version of the 'Banana Pinger' emitting high-frequency sounds in the range of 50–125kHz was especially developed for this population. The study attempted to determine whether pingers can deter dolphins at a short distance from the nets without displacement from important feeding areas. Results suggested that that the pingers did not exclude dolphins from their feeding site and no habituation effects were detected. Fishing with pingers did not reduce fishers' target catch. To the contrary, significantly larger specimens of *Pangasius spp.* were caught with highest overall catch weight when pingers were active. Forty participating fishers reported no depredation or damage to gillnets while trialling pingers over a 6-month period, and all fishers agreed to continue using the pingers after the study.

The Committee **welcomed** the additional insight from this work, which provides important information for those working with other freshwater and potentially marine populations of Irrawaddy dolphins.

Ingman *et al.* (2021) documented changes in the number of sightings and timing of humpback, blue, and gray whale migratory phases in the vicinity of the Farallon Islands, California. The study investigated whether changes in the timing of migration off central California were driven by local oceanography, regional upwelling, and basin-scale climate conditions. These changes appear to have increased whale exposure to pot and trap fishery gear off the central California coast during the spring, elevating the risk of entanglements. Observed humpback whale entanglement rates were significantly associated with increased whale counts and early arrival in central California. The date of departure from the area for all species showed little to no change, whereas date of arrival occurred earlier for humpback and blue whales. Timing was significantly influenced by a mix of local oceanography, regional, and basin-scale climate variables. Earlier arrival time without concomitant earlier departure time results in longer periods when blue and humpback whales are at risk of entanglement in the Gulf of the Farallones. Actions to decrease the temporal overlap between whales and pot/trap fishing gear, particularly when whales arrive earlier in warm water years, would likely decrease the risk of entanglements.

The State of California has begun delaying the opening of the pot and trap fishery in order to reduce entanglement risks. In the 2020/2021 commercial fishing season the opening of the Dungeness crabbing season was delayed from November 15 to December 1, and in 2019/2020 until December 16. Hines noted that this has caused economic impacts and some fishers have been conducting trials with 'ropeless' pot gear in order to extend the fishing season. These experiments using remote release buoys have had mixed results. The Committee welcomed this paper and encourages reports of the results of the 'ropeless' trials be brought to future meetings.

12.7 Review studies examining the implications of effort reductions on cetacean bycatch, fisheries economics and yields

Leaper noted that this had been added to the agenda last year with a plan for an in-depth discussion of this issue. However, only one published paper had been identified and due to lack of time this agenda item was postponed to 2022.

12.8 Progress on previous recommendations

12.8.1 Threats to Hector's and Māui dolphins in New Zealand

In 2019, the Committee recommended a detailed independent review (see IWC 2019) of a 'Spatial risk assessment of threats to Hector's and Māui dolphins' (Roberts *et al.*, 2019) with respect to this document's use for informing management measures to address anthropogenic threats to Hector's and Māui dolphins off New Zealand. This review was recommended to be conducted intersessionally or as a pre-meeting to SC68B. In 2020, New Zealand informed the Committee that it was currently in the process of revising its management measures to protect Hector's and Māui dolphins, and therefore elected

to defer the proposed intersessional review of the Hector's and Māui dolphin modelling work until after that revision was completed.

Lundquist outlined papers presented by the New Zealand government (SC/68C/HIM/12; SC/68C/HIM/14; MacKenzie and Roberts, 2020; Roberts and Hendriks, 2020) and the broader context for the work conducted by or commissioned by the Government. He emphasised the importance of this topic to the Government of New Zealand and that a comprehensive suite of fishing and non-fishing measures had been implemented in 2020 to protect Māui and Hector's dolphins.

The Committee **welcomed** this news and New Zealand's broader efforts to address threats to Māui and Hector's dolphins, particularly the expanded fisheries restrictions.

SC/68C/HIM/14 provided assessments of the historical impact of setnet fisheries on Māui dolphins. The assessments (1) evaluated the sensitivity of estimates of the potential historical impacts of setnet fisheries on Māui dolphins, and (2) estimated entanglement rates, in light of updated abundance estimates from aerial surveys conducted in 2012 and 2013, which were reviewed and endorsed by the Committee in 2016. The same, or similar, methods were used in SC/68C/HIM/14 as in previous assessments of historical setnet fisheries impact (i.e. Davies *et al.*, 2008; Slooten and Dawson, 2010). Entanglement rates calculated for Hector's dolphins on the east coast of the South Island (ECSI) were applied to multiple sub-populations of Hector's and Māui dolphin, but these analyses had not been repeated using the updated aerial survey abundance estimates. The abundance estimates used in previous assessments were derived from boat-based surveys conducted in the austral summers of 1997/1998–1999/2000 (Dawson *et al.*, 2004), but abundance estimates from aerial surveys conducted in the austral summer and winter of 2012/2013 were consistently 2–2.5 times greater than the earlier estimates referenced above for the same areas (MacKenzie and Clement, 2016), leading to the conclusion that ECSI Hector's dolphin abundance was likely much greater at the time of the observed fishing effort. The results suggest that the modelled population estimate for Māui dolphins in 1970, before the onset of the widespread use of gillnets in fisheries, is extremely sensitive to the assumed entanglement rate. If the rate is much lower than previously assumed, as implied by the use of the updated population estimates, then the corresponding estimate of historical setnet fisheries impact is much lower than previously estimated, and current population status is much higher than previously estimated. However, SC/68C/HIM/14 did not consider the potential impact of other threats (both fishing and non-fishing related) on the population status.

A protracted discussion took place, with divergent views expressed. The detail of this discussion clearly indicated that the intersessional process proposed (see Table 11) to facilitate more in-depth consideration, is necessary.

Roberts and Hendriks (2020) characterised the seasonal and long-term trends in the prevalence of different causes of death of bycaught and beach-cast Hector's and Māui dolphins, as recorded in a publicly available incidents database. This database includes confirmed bycatch mortality events, which have been recorded since the mid-1980s, whereas non-fishery causes of death have been diagnosed by necropsies only since the early-2000s. The seasonal pattern of deaths detected varied by cause of death, with confirmed bycatch events and neonate deaths being more prevalent in summer and autumn, and disease (e.g., pneumonia, toxoplasmosis) being more prevalent in spring. Beach-cast deaths in spring are heavily biased toward females, and this was coincident with the period when all known toxoplasmosis mortalities have occurred to date. In the absence of other biases, the significantly skewed sex bias suggests that use of these data to estimate non-fishery threats (in the risk assessment of Roberts *et al.* (2019) may under-estimate the population-level risk attributable to those threats, because that risk assessment did not assume a disproportionate disease impact on females. The female bias in mortalities during spring was evident from 2000 to 2020, but not in the preceding decade although this earlier sample was very small. Few females were confirmed amongst the fishery bycatch sample since the implementation of wide-ranging fishing restrictions in 2008, although a large component of the recorded mortalities in this period was not necropsied and sexed. This study also developed a rudimentary proxy for seasonal carcass detection probability. This suggested that carcass detection probability is likely to be highly seasonal, such that threats that kill dolphins primarily outside the summer period, including diseases, may be greatly under-represented in the beach-cast sample of dolphins relative to those that kill dolphins in summer. With respect to risk assessment, future analyses using beach-cast dolphins to infer causes of death in the wider population should ideally include a larger sample size and apply an index of seasonal carcass recovery rate to account for seasonal biases. Targeting search effort outside the summer period could help to increase the carcass detection rate, and to better understand the causes of mortality outside the summer period.

In discussion, the Committee was advised that the New Zealand government is working to ensure that any bycaught animals or those that are found dead from other causes be retrieved and made available for necropsy. It was noted that as bycatch of dolphins was expected to be reduced following the new management measures, an important source of information for individual health assessment was therefore declining, and other approaches, including live capture and release may need to be considered. Roberts and Hendriks (2020) indicated that toxoplasmosis appears to affect breeding age females disproportionately. It was suggested that this could be related to female reproductive stress (pregnancy or lactation) and that this could be investigated with a detailed reproductive assessment during necropsy.

MacKenzie and Roberts (2020) analysed photo-ID mark-recapture data collected around Banks Peninsula, New Zealand, from 1985 to 2002 (sourced from DuFresne, 2004), to evaluate the robustness of conclusions about Hector's dolphin survival rates under different model structures and treatments of the data. In particular, comparison is made with the results of

Gormley *et al.* (2012) who found mean survival was higher from 1990 onwards, which approximately coincided with the establishment of the Banks Peninsula Marine Mammal Sanctuary (BPMMS). In contrast, re-analysis using the same modelling assumptions as Gormley *et al.* (2012), but applied to the DuFresne (2004) dataset, estimated that adult survival rate decreased at this time; post-sanctuary annual survival rates were similar to those of Gormley *et al.* (2012), but pre-sanctuary estimates were much higher. The different result is likely a result of the inclusion of additional sightings, particularly in the period 1990–1992, that were excluded from the dataset used by Gormley *et al.* (2012). The sightings excluded contain information on survival of some individuals, and pre-sanctuary survival estimates in particular, appear to be sensitive to their inclusion. It was noted that changes in estimated survival due to sanctuary establishment may also be confounded with other factors that have changed through time, including the spatial distribution of survey effort between years, and changing environmental conditions. The authors concluded that a better understanding of known changes in survey effort the effects on Hector's dolphin survival estimates including: (1) known changes in the location of survey effort; (2) refinements made to the to the photo-id database, between extractions; and (3) decisions regarding which sightings of individuals are included, or excluded, from each data set; are required before the outputs of either this analysis, or Gormley *et al.* (2012), are regarded as evidence of the effectiveness of the BPMMS.

Cooke noted that the annual recruitment implied by the analyses of survival in MacKenzie and Roberts (2020) and Gormley *et al.* (2012) was too high for the implied population size, and if true would imply a high level of immigration. If there was such a high level of immigration then similarly high levels of emigration are also likely, in which case the nominal survival estimates will not be closely related to actual survival. Survival should be estimated using a full, internally consistent population model which includes survival, recruitment and movement.

It was noted that a single well documented and geolocated Photo-ID data set would greatly facilitate future analyses, provided it includes suitable documentation and metadata with details of what data are included and, if applicable, what data have been withheld. Future photo-ID sampling covering a wider geographical range could better account for seasonal movements of individual dolphins.

The first year of a two-year project intended to replicate the 2010–2011 and 2015–2016 genotype mark-recapture surveys of Māui dolphins is described in SC/68C/SM/01. Surveys conducted along the west coast of the North Island, New Zealand, encountered a total of 26 groups of Māui dolphins. Group sizes ranged from 1–9 dolphins. Dolphins were encountered between South Kaipara and south of Port Waikato. A total of 50 biopsy samples were collected and as in previous years, the dolphins showed little behavioural response following the biopsy event. DNA profiling of the 50 samples identified 47 samples of 30 individual Māui dolphins and three samples of two individual Hector's dolphins; a female first identified in 2010, and a male not previously sampled. Including this newly identified male, four living Hector's dolphins have been found associated with Māui dolphins. Further analysis, including a two-sample, closed population estimate of abundance for comparison to previous surveys, will be undertaken once the 2021 field season is complete.

The Committee **welcomed** these results and looks forward to a new population estimate.

SC/68C/HIM/17 presents an evaluation of the spatial risk analysis model in Roberts *et al.* (2019) and the management decisions that were made in 2020 based on this analysis. The authors note a number of issues that they identified: (i) the need for validation of the model and the lack of information provided to show how dolphin distribution predicted by the model compares with dolphin distribution data from population surveys; (ii) in the habitat model, dolphin distribution changes between summer and winter, but the fish data used to construct the model assumed a year-round presence/absence of individual prey species based on trawl surveys; (iii) the use of turbidity as a seasonal variable given that turbidity may be a proxy for biologically meaningful factors such as prey availability, but is unlikely to influence dolphin distribution directly; (iv) a prediction that the overlap between dolphins and fishing has increased at times when fishing effort declined, protection measures designed to reduce overlap were introduced, or both; and (v) that some areas where Hector's and Maui dolphins have been documented are not included, and thus neither is the potential bycatch risk in these areas. The authors conclude that protection measures implemented in 2020 (SC/68C/HIM/12) will particularly fail to offer protection to the smallest, most vulnerable populations.

Some members offered rebuttal comments to HIM17. Other members offered counters to these. The Committee considered that the issues raised included many of the aspects which it had identified in 2019 as needing more time for in-depth discussion.

SC/68C/HIM/18 described an agent-based model that includes dolphins, trawlers and gillnets throughout New Zealand waters to provide a novel way of analysing the overlap between dolphins and fisheries that cause dolphin bycatch. Dolphin movements between protected and unprotected areas will be simulated according to population surveys and detailed habitat use data. The analysis will use all dolphin distribution and fishing effort data compared to previous approaches which either used part of the fishing effort or part of the dolphin distribution. The authors note that the approach will be useful for other bycatch situations, and other spatially varying human impacts.

Another protracted discussion took place, with divergent views expressed. The detail of this discussion further indicated that the intersessional process proposed (see Table 1) to facilitate more in-depth consideration, is necessary. Slooten noted that the work described in SC/68C/HIM/18 was still in progress, but that the model structure and any preliminary results could be presented for the review. It was suggested that the methods, structural assumptions, mathematical formulations,

and model input parameters should be clearly specified to allow for transparent evaluation of any new modelling analysis submitted for consideration by the Committee or as part of the intersessional process.

SC/68C/HIM/12 outlined the comprehensive suite of fishing and non-fishing measures implemented by the New Zealand government in 2020 to protect Māui and Hector's dolphins. The population outcomes that New Zealand has committed to are:

> '(i) Māui dolphins: human impacts are managed to allow the population to increase to a level at or above 95% of the maximum number of dolphins the environment can support; (ii) Hector's dolphins: human impacts are managed to allow the population to increase to a level at or above 90% of the maximum number of dolphins the environment can support.
>
> Fisheries management objectives have also been established to ensure that dolphin deaths arising from fisheries threats do not (a) exceed the maximum number of human-induced deaths that could occur to achieve the applicable population outcome (or PST) with 95% certainty; (b) cause localised depletion; (c) create substantial barriers to dispersal or connectivity between subpopulations.'

To support (b) and (c) a sub-objective to allow localised Hector's dolphin populations to recover to, and or remain at or above, 80% of un-impacted status (i.e., if fishing was not occurring) has been set. These measures include set net and trawl closure areas in Māui dolphin habitat around the North Island and Hector's dolphin habitat around the South Island. With these new measures, both the projected mean and the 95% CI of estimated number of annual Māui dolphin deaths are well below the population sustainability threshold of 0.14. The fisheries restrictions are the principal mechanism to ensure that the fishing-related mortality limit that has also been set is not exceeded. In addition, a fishing-related mortality limit of one Māui or Hector's dolphin is in place in an area defined as the Māui dolphin habitat zone. This allows the Government to respond quickly to any fishing-related incident with additional restrictions. In addition to the fishing measures, non-fishing measures have been implemented to reduce other sources of risk to the dolphins, including prohibitions on seismic surveying and seabed mining in marine mammal sanctuaries.

The Committee noted that it was not in a position to evaluate specific policy outcomes associated with management decisions.

Lundquist noted that the population outcomes that New Zealand has committed to were directly related to previous calls by the Committee for the New Zealand government to commit to specific population targets. In discussion it was noted that evaluating management objectives that are expressed as a fraction of unimpacted status is challenging. One method that has been previously used to assess the effectiveness of management options is comparison of future projections with and without human impacts. New Zealand noted that such projections have been conducted for Māui dolphins under the previous management regime and could be updated based on the new measures.

Lundquist further noted that the view of the New Zealand government is that this package of management measures and the underlying scientific data are a significant advance in management of the human-induced threats to these dolphins. For the first time there is enough information to quantify both the level of risk from different threats and the effectiveness of different options in reducing that risk. The New Zealand government believes that its decisions are based on the best available information and that previous recommendations from the Committee about management of these dolphins are based on outdated information. It is view of New Zealand that these recommendations should be substantially revised.

There were different views on these conclusions by participants, including the concerns expressed by the authors of SC/68C/HIM/17. The Committee did not reach any conclusions on these different views.

In order to provide a rigorous evaluation of this approach and its outputs, the Committee recommended in 2019 that an intersessional working group be convened to provide a thorough, independent review of the spatial risk assessment model. The Terms of Reference included the preparation of solicited review papers on the information and analysis presented in Roberts *et al.* (2019) on:

(a) Māui and Hector's dolphins' life history parameters;
(b) Māui and Hector's dolphins' spatial distribution;
(c) estimates of bycatch rates and vulnerability;
(d) toxoplasmosis; and
(e) the risk model outputs.

For a variety of reasons, the recommended review process was not undertaken before the management measures were implemented. In the light of the new information considered at the meeting, it was agreed that there were still a number of issues that would benefit from more in-depth consideration.

Given that management measures have now been implemented, the task for the Committee is to review the framework that was used to evaluate those measures, so as to assist New Zealand with future decisions regarding anthropogenic threats to Hector's and Māui dolphins. In addition, there are many aspects of the work undertaken in New Zealand which are relevant to addressing similar threats in other areas. These have the potential to contribute to other work of the Committee and the BMI. It was agreed to widen the review process to identify aspects relevant to other situations beyond the specific case of Hector's and Māui dolphins in New Zealand. The Committee is not being asked to assess whether the new management measures are likely to meet New Zealand's stated objectives. The New Zealand government has already

undertaken this assessment and will present the relevant analyses to the Committee as part of any review process. However, it is expected that the review will assist New Zealand to conduct such assessments in the future.

The Committee noted that data availability and reconciling different data sets have been identified as issues in several of the analyses in 2021. Where different analyses are applied to slightly different data sets it has been difficult to establish whether differences in results have been driven by the methodology or the data. In addition, some of the critical model assumptions and input parameters were not fully specified or did not appear in the published versions of previously published analyses, such that they could not be fully replicated. The Committee has spent considerable time discussing data sharing and has a Data Availability Agreement (DAA) that may be useful as a template for similar discussions within New Zealand. Procedure B of the DAA describes the process for obtaining access to data for analyses which the Committee considers would be valuable in providing advice to the Commission on issues other than catch limits (e.g. on the status of stocks not subject to whaling).

In 2019, five specific topics were identified for the risk assessment review based on discussions within the Committee. Each of these would form the subject of short review papers by independent experts with the appropriate background. A Steering Committee will be established to approach independent experts. The independent experts should not have been involved with any legal action or be closely involved with any of the studies of Hector's or Māui dolphins that have been considered by the Committee. Previous SC procedures for specifying a Steering Committee to select experts have included the Chair, Vice-Chair and Head of Science in consultation with relevant sub-committee convenors.

This list of topics was reviewed during the meeting and adjusted in the light of new information presented and associated discussions (Table 11). Although many of the topics remain the same, there are new data and estimates which should be considered. This list is based on the structure of the spatial risk assessment in Robert *et al.* (2019). However, where there are analyses by other authors that have estimated similar parameters, the reviewers will also be encouraged to include an equally rigorous review of these studies following the same structure as much as possible.

One of the topics identified for review in 2019 related to life history parameters and was to review the estimates of r_{max} for both subspecies. It has become apparent during other discussions in plenary that there is a need for a definition of r_{max} for use by the Committee, including how and when it should be used. An intersessional group was established to consider this (see Item 12.9, Table 12, for integration in Committee workplan). Examination of population trajectories for Hector's and Maui dolphins including (i) the implications of model estimates for forward population trends, and (ii) the potential for, and implications of, backward extrapolation to inform estimation of population trends prior to fisheries closures, including varying assumptions about risk and onset of disease (e.g. toxoplasmosis) will also be included in the work plan of the HIM sub-committee. The HIM sub-committee work plan will also include an examination of whether the risk assessment work undertaken in New Zealand might assist with the work of the BMI, as there are a number of topics included in the review which will also apply to bycatch risk assessments more generally, e.g. 3.1.4–3.1.9 in Table 13.

12.8.1.1 Review meeting

Attention: CG, SC
Based on the reviews (Item 12.8.1), the Committee **recommended** *scheduling a pre-meeting immediately prior to SC68D to:*

(1) Evaluate the design and structure of the multi-threat risk assessment model;
(2) Evaluate the overall sensitivity to model choices, data selection, uncertainties or potential biases identified in the review papers; and
(3) Make recommendations to reduce key uncertainties and improve the utility of the model to inform management decisions.

It is expected that the pre-meeting would require two days. Participants would include the authors of the review papers, the authors of the work being reviewed, and one or two other experts if a need for specific expertise was identified.

12.8.2 Harbour porpoise bycatch

In 2020, the Committee re-iterated its serious concern for the critically endangered harbour porpoise population of the Baltic Proper and again recommended, as a matter of urgency, that all countries adjoining the Baltic Proper immediately act to eliminate bycatch of the Baltic porpoise (Recommendation SC2097).

Carlén *et al.* (2021) provides an assessment of the situation of the harbour porpoise in Europe where the authors contend conservation measures are failing and conclude that bycatch is the most immediate threat for Europe's harbour porpoise populations. There are concerns for the species in the Baltic Proper, Black Sea, Mediterranean Seas and on the Iberian coasts. The Baltic Proper porpoise is Critically Endangered on the IUCN Red List of Threatened Species with a population in the low hundreds, and the Committee has repeatedly called for action to ensure its survival. Despite being 'highly protected' under European law including a requirement to designate Special Areas of Conservation (SACs), these measures have failed to generate effective conservation in practice. SACs cannot be expected to help improve the harbour porpoise's conservation status in the absence of appropriate management plans. In practice, mitigation could be carried out through the closing of high-risk fisheries in important areas of harbour porpoise distribution, and through the use of alternative gear, gear

Table 13

Comparison of proposed topics in 2019 with revised topics agreed in 2021.

Proposed topic in 2019	Revised topics, 2021
1. Life history parameters	**1. Estimation of rmax**
1.1 Review the estimates of r_{max} for both subspecies and the possible application of other approaches to this.	1.1 Review estimation of r_{max} and its use in the assessment. 1.2 Review demographic rates used to estimate r_{max}.
2. 2. Spatial distribution of Hector's and Māui dolphins	**2. Spatial distribution of Hector's and Māui dolphins**
2.1 Review aspects of the spatial models, both for the model based on coastal aerial survey data and for the model based on harbour areas using public sightings, with respect to:	2.1 Review aspects of the spatial models, both for the model based on coastal aerial survey data and for the model based on harbour areas using public sightings, including testing the implications of alternate model assumptions, parameters and priors via sensitivities. The following factors should be considered.
2.1.1 initial choice of static physical habitat variables;	*2.1.1 Choice of habitat variables, including variables not considered in Roberts et al. (2019) (including temporally dynamic variables, seasonal model relationships, etc.).*
2.1.2 initial choice of dynamic habitat variables (sea surface characteristics and prey);	*2.1.2 Choice of dolphin occurrence data for fitting the model.*
2.1.3 selection of dolphin occurrence data for fitting the model;	*2.1.3 Model selection criteria and fitting.*
2.1.4 model selection and fitting;	*2.1.4 Combination of models for merging coastal and harbour predictions (Māui model only).*
2.1.5 combination of models for merging coastal and harbour predictions (Māui model only); and	*2.1.5 Model validation and interpretation of results.*
2.1.6 model validation and interpretation of results.	
3. Estimates of bycatch rates and vulnerability of Hector's and Māui dolphins	**3. Estimates of bycatch rates and vulnerability of Hector's and Māui dolphins**
3.1 Review model parameters and choice of priors for bycatch risk model	3.1 Review model parameter estimates and choice of priors for bycatch risk model based on data from fisheries observers, including testing the implications of alternate model assumptions, parameters and priors via
3.1.1 based on data from fisheries observers including:	3.1.1 sensitivities. The following factors should be considered.
3.1.2 selection of fisheries data for use in model (incl. choice of years);	*3.1.2 Fisheries data for use in model (incl. choice of years).*
3.1.3 selection of bycatch data for use in model;	*3.1.3 Bycatch data for use in model.*
3.1.4 implications of level and spatial extent of observer coverage;	*3.1.4 Mathematical formulation of bycatch estimation.*
implications of any bias in bycatch rate as a result of having an	*3.1.5 Implications of level and spatial extent of observer coverage.*
3.1.5 observer onboard;	*Implications of any bias in bycatch rate as a result of having an observer*
implication of vulnerability/catchability not being constant across	*3.1.6 onboard.*
3.1.6 space and time;	*Implication of vulnerability/catchability not being constant across space*
implication of assumption of Poisson distribution for bycatch compared	*3.1.7 and time.*
3.1.7 to observed distribution of single and multiple captures; and	*Implication of assumption of Poisson distribution for bycatch compared to*
3.2 *sensitivity of estimates of bycatch to choice of priors.*	*3.1.8 observed distribution of single and multiple captures.*
Model diagnostics and goodness of fit.	*Sensitivity of estimates of bycatch to choice of priors, including cryptic*
	3.1.9 mortality, live release survival, and catchability.
	Implications of any changes in abundance or distribution over time (e.g. where fisheries data and abundance estimates are from different time
	3.2 *periods).*
	Model diagnostics and goodness of fit.
4. Toxoplasmosis	**4. Other anthropogenic threats**
4.1 Review the estimation of spatial toxoplasmosis exposure.	4.1 Review the use of beach cast necropsies as a means of estimating non-fishery deaths.
4.1.1 Use of hydrological model 2 Vulnerability and catchability are used here as defined in Roberts et al. (2019).	*4.1.1 The relative detectability of carcasses from animals dying of different causes, and resulting sources of bias (seasonal bias, spatial bias, factors affecting carcass buoyancy).*
4.1.2 Use of human habitation as a proxy for cat density.	*4.1.2 Implications of other evident patterns or biases for estimation of risk (sex or age bias, seasonal patterns).*
4.2 Review the use of beach cast necropsies as a means of estimating non-fishery deaths.	4.2 Identify data or research priorities to improve understanding of toxoplasmosis, recreational netting, climate change and other anthropogenic stressors.
4.2.1 Potential sources of bias affecting carcass detectability (seasonal/ spatial/ factors affecting buoyancy).	
4.2.2 Implications of other evident patterns or biases for estimation of risk (sex or age bias, seasonal patterns).	
4.2.3 Compare toxoplasmosis exposure estimates with numbers of observed carcasses at the subpopulation scale, considering population size.	
4.3 Identify data or research priorities to improve understanding of toxoplasmosis risk.	
5. Risk model outputs	**5. Risk model outputs**
5.1 Review model predictions of spatially resolved bycatch compared to known records including beach cast carcasses and fisher- reported catches from vessels without observers.	5.1 Review model predictions of spatially resolved bycatch compared to known records including beach cast carcasses and fisher- reported catches from vessels without observers.
5.2 Compare estimates of commercial fisheries deaths from the spatially explicit model with comparable estimates from simpler models, including uncertainty.	5.2 Compare estimates of commercial fisheries deaths from the spatially explicit model with comparable estimates from simpler models, including uncertainty.
5.3 Explore the implications of model estimates for forward population trends.	5.3 Review model estimates at smaller spatial scales (including small or hypothesised local dolphin populations) and patterns of changing fisheries risk over time.
5.4 Explore the potential for, and implications of, backward extrapolation to inform estimation of population trends prior to fisheries closures, including varying assumptions about risk and onset of disease, e.g. toxoplasmosis.	5.4 Examine the effect of updating the model with four additional years' fishing effort data (including the effect of the fishery closures implemented on 1 October 2020).

adaptations or acoustic deterrent devices. The authors noted the importance of public education campaigns and that conservation for this species is hindered by low public awareness.

SC/68C/HIM/04 reported on recent developments in the USA that show that harbour porpoise populations can recover if bycatch is properly addressed. In particular, Forney *et al.* (2020) demonstrate how reductions or bans of gillnet and trammel fishing effort in the Morro Bay, Monterey Bay, and San-Francisco Russian River Regions of California have all been linked to increases in local harbour porpoise populations. Hence, mitigation in the form of removal of gillnets from an area can be highly effective. However, closures could result in displacement of a fishery to another area where it may have another impact on porpoises or other species. Additionally, other factors may hinder recovery. For example, in the case of the Baltic harbour porpoise, reproduction may well be impacted by chronic persistent pollutants (Carlén *et al.,* 2021). The recently developed FAO Technical Guidelines (FAO, 2021a) list benefits and disadvantages of spatial closures. The authors of SC/68C/HIM/04 welcomed the serious assessment brought to this issue by the FAO, but commented that the guidelines appear unduly negative, especially as the latest results from North America, as outlined, support the notion that removal of fisheries with high bycatch can allow porpoise populations to recover.

In 2020, the Committee noted that that ICES was in the process of providing advice to the European Commission (EC) on fishery emergency measures for the Baltic porpoise. The advice proposed closures of static net fisheries in harbour porpoise MPAs within the range of the Baltic Proper population, and that pingers be made mandatory for static net fisheries in the rest of the population's range (ICES, 2020). Based on this advice, BALTFISH (the Baltic Sea regional fisheries body, composed of the Member States, fisheries directors and invited officials from the EC) has been drafting Joint Recommendations to put in place long-term measures for bycatch prevention. The first Joint Recommendation was submitted to the EC in December 2020 and contained measures to prevent bycatch within harbour porpoise Natura 2000 sites within the population range. Some areas would be closed for static net fisheries the entire year, and some for part of the year depending on data on seasonal distribution of the population. One Natura 2000 site in Puck Bay, Poland, would not be closed to static net fisheries but instead pingers would be required in static net fisheries in the entire area. This joint recommendation was evaluated by the Scientific, Technical and Economic Committee for Fisheries of the EC who expressed concerns about the area in Puck Bay not being closed, but the main concern was the lack of measures outside of MPAs (STECF, 2021). BALTFISH has promised a second Joint Recommendation to be submitted at the latest in June 2021 that will contain such measures.

In 2020, the Committee had requested the IWC Executive Secretary to write to all the Baltic harbour porpoise range states informing them of the Committee's concerns (Recommendation: SC20102). Replies were received from Denmark and Germany.

The Committee was informed that there were concerns from the military forces of some EU Member States that pingers may interfere with military sonars, compromising their ability to detect submarines and mines in the Baltic. The frequencies of the proposed pingers do overlap with frequencies used by the military, however the low source level means they are only likely to be detectable above background noise within a few hundred meters. The concerns of some member states regarding the use of pingers within their EEZs threaten to halt the mitigation, leaving the Baltic Proper harbour porpoise without adequate protection or the need for more extensive fisheries closures.

It was noted that concerns by the military about noise from pingers could have widespread implications for the use of pingers to reduce bycatch throughout the species' range. There is a need to understand the scientific basis of the military's concerns in order to ensure that there is a common understanding of the potential for pingers to interfere with sonar systems and the probability that this will happen given the source level, duty cycle, number of pingers expected to be deployed, density and distribution of fishing gear. Any scientific assessment should also take into account ambient sound levels and other sources of sound at similar frequencies from fishing, other commercial and recreational vessels. Members were not aware of any direct evidence of pingers interfering with sonar systems from other areas where the same type of pingers have been used. Pingers have been used in the North Sea and Celtic Seas for many years. Monitoring equipment to test whether pingers are operational has been developed, but detection ranges were limited to 50m from a vessel with an auxiliary engine running (ICES, 2010).

The Committee is well placed to support implementation of the ICES advice in the Baltic by providing comments on the issue of acoustic interference through the inter-sessional group on noise and the IWC Expert Panel on bycatch which includes pinger manufacturers. An intersessional group was formed to co-ordinate advice on this issue (Bell, C., Berggren, Bjorge, Carlén (convenor), Cosentino, Dolman, Leaper, Parsons, Plön, Simmonds, Tarzia).

Attention: CG, CC, SC, S
The Committee has repeatedly stated its serious concern for the critically endangered harbour porpoise population of the Baltic Proper (e.g. IWC, 2020c, p.46).

The Committee:

(1) **reiterates** *its previous recommendation (SC2097) that, as a matter of urgency, that all Baltic Sea range states immediately act to eliminate bycatch of the Baltic Proper porpoise;*

(2) **urges** *all Baltic Sea range states to heed the recent advice from ICES and implement long-term bycatch mitigation measures accordingly until population recovery is achieved;*
(3) **encourages** *countries to make full assessment of any potential interactions between pingers and military sonars, and offers its advice (noting that an intersessional group of the Scientific Committee has been established to facilitate this);*
(4) **encourages** *further research into stranded and/or bycaught porpoises to investigate all factors negatively impacting the population, including chemical and noise pollution and prey depletion;*
(5) **encourages** *again the Baltic Sea range states to propose the Baltic Proper porpoise population for listing on CMS Appendix 1 at the earliest opportunity and calls on CMS Parties to support this process;*
(6) **encourages** *all stakeholders to work expeditiously to increase public awareness of harbour porpoises and the challenges to their conservation; and*
(7) **requests** *the IWC Executive Secretary to write to all the range states and to the EU Commission informing them of the Committee's ongoing concerns and recommendations.*

Moan *et al.* (2020) provided information about harbour porpoise bycatch in Norwegian commercial gillnet fisheries from 2006 to 2018. Bycatch was estimated with data from a contracted reference fleet and scaled up using fish tickets (Moan *et al.*, 2020). Average bycatch from 2006 to 2018 was 2871 porpoises/year (CV 0.17). Between 2014 and 2018, however, average bycatch was estimated to 1642 porpoises per year (CV 0.15). This decline in bycatch coincided with a decline in monkfish fishing effort. Currently, bycatch in the small vessel segment of Norwegian gillnet vessels is within the PBR, but these estimates do not account for larger vessels, drop-out rates, and recreational fisheries. This year, a regulation mandating pingers on all gillnets in one high bycatch area during the cod season came into effect. There is also a program in place to collect data on fisher compliance and pinger effects on bycatch rates.

In discussion it was noted that the estimates did not include bycatch from larger vessels or porpoises that dropped out of the net before they were observed. Bjorge noted that there had been observer programmes on the larger vessels and that these bycatch estimates would be available soon. Long noted that in the US, it has been found that observers with other duties were unlikely to detect drop-outs and so programmes are designed such that there is a proportion of the observer effort where the observer watches the entire haul. Norway has also been testing Remote Electronic Monitoring (REM) systems that can detect drop-outs. It was also noted that there are uncertainties around porpoise population structure in the Northeast Atlantic and that assessments of conservation implications may need to consider bycatch in other areas as well.

The Dutch Harbour Porpoise Conservation Plan (Camphuysen and Siemensma, 2011) concentrates on new developments in the areas of policy and legislation, population abundance and ecology (including genetics), strandings research and contaminants, bycatch and noise. The most important actions for 2021 and beyond focus on an optimised design for aerial surveys, alternative approaches for population abundance estimation and ecology, improved strandings response, assessment of cumulative noise from seismic surveys, and an international project proposal for bycatch (see Item 12.4). The bycatch elements of the plan focus on assessing bycatch rates; sources of bycatch and REM in the Netherlands. The plan also identifies the need to assess the potential for using alternative gear to mitigate bycatch and further studies of the use of pingers to mitigate bycatch.

In 2020, the Committee noted that the level of bycatch of Iberian harbour porpoises is considered unsustainable and will consequently cause a population-level decline. It recommended a number of actions (IWC Recommendation SC20177) including a range of approaches to reduce bycatch throughout Iberian Peninsula waters. No new information was presented in 2021 but the Committee was made aware of some ongoing work, notes that all its recommendations from 2020 still apply, and looks forward to further information at next year's meeting.

12.8.3 Common dolphin bycatch in Bay of Biscay

Ridoux gave an update on stranded and drifting common dolphins in the Bay of Biscay (BoB) during 2020 and the first months of 2021. Although an action plan had been developed by the French Ministry of the Sea in October 2020, the only mitigation measure included was to continue the pinger requirements that were implemented for winter 2019/20. Between 1 January 2020 and 17 March 2020, 1,000 small cetaceans were found stranded along the coasts of the BoB. The most acute period of stranding was a six-week period (01 February 2020 to 17 March 2020). After that, the national lockdown as a response to the COVID-19 pandemic precluded the continuation of the stranding monitoring programme. Thus, under-reporting of stranded cetaceans is likely to have occurred from mid-March to late April. In addition to the winter season, a seasonal peak in the summer occurred in the northern BoB along the south-western coast of Brittany. This has occurred annually since 2016 but increased in 2020 to 195 common dolphins reported stranded from July–September. Stranding numbers in early 2021 were lower than in 2020 but this period was characterized by unusually long periods of north-easterly winds resulting in a low stranding probability. In 2021, 92% of the carcasses in good condition when stranded showed signs of capture in fishing gears. An aerial survey was conducted from 11 January to 15 March 2021. Three aircraft flew 25000 km following a line transect distance sampling protocol. Visual observers were supplemented by high resolution digital cameras on one aircraft. As well as abundance estimates for live animals, 33 dead striped/common dolphins were recorded, which should allow an estimate of the number of floating carcasses in the BoB. Analysis is ongoing, but Ridoux noted no indication of any

measurable reduction of common dolphin mortality in the BoB during the year 2020 and early 2021, compared to previous years.

In 2019, the Committee noted its concern that the bycatch of common dolphins in the Bay of Biscay may threaten the conservation status of the population and recommended that concurrent implementation of both monitoring and mitigation is required to ensure that bycatch is properly assessed and reduced (IWC Recommendation: SC19225, SC19226, and SC19227). The Committee also noted that time area closures would have to be considered if other mitigation options could not be effectively implemented. The Committee welcomed the advice provided by ICES (2020), noted that this advice was based on monitoring data collected from 2016 to 2018 and that the number of stranded common dolphins reported in the following two years (2019 and 2020) was higher than in any year of the reference period, and that these new data further reinforce the need for urgent action. In 2020, the Committee recommended the European Commission implement Emergency Measures for the North East Atlantic common dolphin. However, the Committee notes the advice of ICES (2020) that protection measures can only be effective when applied for a period of time longer than what is allowed by Emergency Measures. Therefore, the Committee advises consideration of long-term measures to be implemented rapidly.

The EMFF funded CetAMBICion project, and the EU LIFE CIBBRiNA proposal represent two encouraging steps toward cooperation between national governments, agencies and other stakeholders to monitor, assess, and reduce bycatch of small cetaceans at the appropriate regional scale. The Committee welcomes these extremely timely initiatives and looks forward to receiving reports of their outcomes. However, the Committee notes that any future mitigation methods trialled should not delay implementation of spatiotemporal closures in the Bay of Biscay.

The Committee recalls that data gaps and the calls for further research and technological development should not be reasons for inaction in the short term. Sufficient data are available to assess how spatiotemporal closures of the fishing métiers of concern could be implemented to reduce bycatch risk. The Committee also noted that current mitigation measures in place (equivalent to Scenario K of ICES 2020) have been evaluated as insufficient to address the issue, both by ICES (2020) and STEFC (2021). The Committee acknowledged that there is already sufficient understanding of common dolphin bycatch in the Northeast Atlantic to develop and implement initial mitigation measures based on ICES (2020) advice, while research continues that may be used to modify such measures at a later date.

Attention: CG, CC, S
Concerning bycatch of common dolphin in the Bay of Biscay , the Committee now **recommends** *urgent action by the European Commission and relevant member states to implement the ICES (2020) advice that there should be a combination of temporal closures of all fishing métiers of concern and application of pingers on pair trawlers to mitigate bycatch outside of the period of closure. A socio-economic analysis and assessment of the different scenarios tested by ICES (2020), including the use of alternative métiers which could replace those of concern in the periods and areas of closure, should also be undertaken. The Committee* **requests** *the Secretariat contact the European Commission about these concerns and call for urgent action.*

12.8.4 Bycatch in bather protection nets off South Africa

In 2019, the Committee recommended that prior to the deployment of new shark nets (now referred to as bather protection nets), data should be gathered on the use of the area by cetaceans and the likely impacts of the nets. Plon *et al.* (2020) reported on the entanglement of Indo-Pacific bottlenose dolphins (*Tursiops aduncus*) in bather protection nets placed off the coast of KwaZulu-Natal, South Africa, since the 1980's. Temporal trends indicate that the proportion of bycatch during the peak 'sardine run' period has been steadily decreasing, most likely due to different deployment of the nets. A large inter-annual fluctuation in the number of animals bycaught was observed, probably as a result of the inter-annual intensity of the 'sardine run'.

The Committee thanked the authors for their work on furthering the understanding of the impact of bather protection nets on the coast of South Africa and noted the need for dolphin population estimates as well as data on their demographics, movement patterns and population structure (including social and cultural aspects) of *T. aduncus* to assess the impact of bycatch on the populations off KwaZulu-Natal.

12.9 Biennial workplan

The biennial workplan for bycatch and entanglement is given in Table 14.

13. SHIP STRIKES (HIM)

13.1 Review new methods and estimates of rates of ship strikes, risk of ship strikes and mortality (including review progress on ship strike database)

In 2020, the Committee had an extensive discussion about the IWC Strategic Plan to mitigate the impacts of ship strikes. The Committee can contribute to this plan in various ways, including estimating rates of ship strike, identifying high-risk areas, and evaluation of mitigation options. An important component of the Committee's work has been the development of the global ship strike database. The Committee thanked Ritter and Panigada for their work on the database and welcomed O'Loughlin, the new ship strike and stranding data manager.

Table 14

Work plan for bycatch and entanglement.

Topic	Intersessional 2021/22	2022 Annual Meeting
Bycatch Mitigation Initiative		Review progress on the Bycatch Mitigation Initiative; aspects relevant to the Committee and requests for advice. Review case studies of bycatch risk assessment and whether these might assist with the work of the BMI
Rates and risks		Review new estimates of entanglement rates, risks and mortality. Review studies examining the implications of fishing effort reductions on cetacean bycatch, fisheries economics, and yields
Mitigation		Review new information on mitigation measures for preventing bycatch and entanglement
Collaboration on bycatch mitigation	Continue collaboration with FAO, IOTC and others	Continue to review
Potential for acoustic interference from pingers	Assessment by intersessional group in collaboration with intersessional group on noise (reporting to E) and Bycatch Expert Panel	Review report from intersessional group
Reviews of topics related to Hector's and Maui dolphins in New Zealand listed in Table 1.	Steering Committee request review papers on each topic from independent experts. Hold pre-meeting review as outlined in 12.8.1.1	Complete review process
Population trajectories for Hector's and Maui dolphins		Consider: (i) the implications of model estimates for forward population trends; and (ii) the potential for, and implications of, backward extrapolation to inform estimation of population trends prior to fisheries closures, including varying assumptions about risk and onset of disease (e.g. toxoplasmosis)
Consider a definition of r_{max} for small cetaceans for use by the Committee, including how and when it should be used	Proposal from intersessional group	Review report from intersessional group

The Committee recognises the important work achieved with the ship strike database and that it is a long-term effort. The Committee **endorses** the proposal for additional funding for the position of ship strike and stranding data manager. The Committee has relied on a Data Review group to assist with classifying records submitted to the database and **agrees** that the group should continue its work. The Committee welcomes new members to the group and invites volunteers with relevant expertise to contact the HIM convenor. It was noted that discussions during the meeting had revealed several ship strike incidents that were not in the database and the Committee encouraged anyone who has encountered a ship strike or knows of an incident to report it to the database.

SC/68C/SH/14 presented information about mortalities of southern right whales (SRW) and related anthropogenic factors in South African waters between 1999 and 2019. In total, 97 SRW mortalities were recorded, of which the majority were classified as calves of the year. Eleven of these mortalities could be attributed to ship strikes, whereas three mortalities were related to entanglements. In total, 14 ship strikes and 86 entanglements with SRWs, which did not result in a direct mortality or for which the outcome remained unknown, were recorded in the same time period. Ship strikes occurred mainly around the area of Cape Town harbour. Entanglements occurred mainly in rock-lobster gear and bather-protection nets in the Western Cape and KwaZulu-Natal provinces, respectively. Data suggest that entanglements and ship strikes do not pose a major conservation threat to the South African SRW population. Nonetheless, in view of the population growth rate and the increased anthropogenic activities in coastal South Africa, continued monitoring of these incidences is crucial to ensure accurate knowledge-based management decisions in the future.

The authors of SC/68C/SH/14 suggested the need for speed reductions for vessels within 15 nautical miles of the Port of Cape Town in order to reduce ship strike risks. It was noted that this would also benefit other baleen whale species present near Cape Town, such as humpback whales, which tend to form super groups in the vicinity. The Committee noted that collaboration between the shipping industry and port authorities has been successful in implementing vessel speed reductions and reducing ship strike risks in other areas.

Attention: CG, CC, SC
The Committee **recommends** *a detailed ship strike risk analysis for the approaches to the Port of Cape Town, including whale distribution and patterns of vessel traffic. This could form the basis to establish a dialogue with the port authority, shipping industry and relevant national authorities regarding measures to reduce risks.*

Silber *et al.* (2021) studied the co-occurrence of grey whales and vessel traffic in the North Pacific. The Committee notes that the authors identified the need for additional analysis, including quantitative assessment to further clarify the risk of vessel strikes to grey whales. The Committee would welcome any new information and analyses at future meetings.

Cooke reported that the IUCN Gray Whale Advisory Panel had conducted a quantitative assessment of gray whale mortalities due to ship strikes and entanglement. The Committee **encourages** this work to be presented next year. This analysis had highlighted the need for improved estimates of the proportion of mortality that could be attributed to a specific cause. This is a wider issue affecting estimates of total mortality for a number of threats including bycatch and ship strikes which are often severely under-reported. It **agrees** to include an item in the HIM work plan on estimating the proportion of total mortality from a specific cause, with a particular emphasis on ship strikes. This will examine the additional data and analyses that may be required to generate total estimates from the number of reported ship strike incidents.

Bedriñana-Romano *et al.* (2021b) describes overlap between blue whales and vessel traffic in Chilean Patagonia. The authors defined four areas where blue whales tend to concentrate based on species distribution models, and movement models based on telemetry data. Two of these four areas were identified as high-risk areas for ship strikes as they are crossed by a major vessel corridor. Vessel tracking data were made available by the Chilean government through recent Chilean legislation, which make it mandatory for all vessels carrying satellite positioning devices to provide their navigational track on a daily basis. Ship strikes have been recorded in the two areas identified as high-risk (at least three blue whales and one sei whale). However, the lack of a systematic recording system in Chile means that many ship strikes may not be reported.

The authors noted that the tracking data cover a variety of vessel types and sizes and that the proportion of vessels in the area required to carry tracking devices is increasing. The data provided by the Chilean government includes the speed of maritime traffic but not the vessel length. These would be useful additional data because there is much variation in vessel length within the aquaculture fleet, which was identified as the dominant type of vessel traffic in the area.

The Committee noted that Bedriñana-Romano *et al.* (2021b) had also been discussed within the Ecosystem Modelling and Southern Hemisphere subcommittees and encouraged the authors to continue to provide further updates related to ship strike risks. The authors noted that there are various initiatives in Chile working on the issue of ship strikes and these would benefit from developing a set of combined recommendations to share with the Government. It was noted that Important Marine Mammal Areas (IMMAs) were currently being identified in the South East tropical and temperate Pacific Ocean (from Chile to the North of Baja California) and examining ship strike risks in these areas would assist in this process.

Botero-Acosta reported on the proposed construction of a multi-purpose port in the Gulf of Tribugá, Colombia, an important breeding ground for humpback whales. The area is recognised for its high biological diversity and has been identified as a 'Hope spot' for protection by the international Mission Blue organisation. The construction of the port would cause a substantial increase in ship strike risk within the area, as well as increased disturbance in an area that currently has low levels of anthropogenic underwater noise. The Committee encouraged a more detailed update and risk analysis to be presented at next year's meeting and also offered intersessional advice from the Ship's Routing Group in relation to the proposed port development, if requested.

13.2 Mitigation of ship strikes in high-risk areas

SC/68C/HIM/09 describes an analysis of ship strike risk around the island at 54°15'S 36°45'W. Sighting data collected during a survey in summer 2020 were used to estimate humpback and blue whale density together with AIS data on shipping traffic, in order to examine ship strike risk and possible mitigation options. Densities of humpback whales were particularly high across the shelf to the north of the island, which corresponds to the area most used by cruise ships. A simple encounter model was used to estimate a risk index for humpback and blue whales based on whale and cruise ship densities in austral summer 2020. This index allows comparison with other areas and suggests that in a global context, the island at 54°15'S 36°45'W could be considered a high-risk area based on the whale densities observed in 2020. The authors noted that there was no indication of particularly important areas for humpback whales that could be avoided by simple routing measures and thus consideration of speed restrictions for vessels in the island at 54°15'S 36°45'W waters would be the most effective way to reduce ship strike risk. There is also considerable fishing activity during the austral winter but at present there are insufficient data on whale presence in winter to examine ship strike risks.

It was noted that the International Association of Antarctic Tour Operators (IAATO) has already implemented speed restrictions for vessels operated by their members in areas around the Antarctic Peninsula (IWC, 2020c, p.35). Vessel speeds are restricted to less than 10knots primarily because of concern about risk to humpback whales. Estimated densities of humpback whales around the island at 54°15'S; 36°45'W in 2019 and 2020 were similar to those areas of the Peninsula where these measures have been implemented. It was noted that the island in the area at 54°15'S; 36°45'W had been identified as an IMMA for large whale species in 2020 and that the Committee had previously discussed using the IMMA process to help identify high risk areas of ship strikes. Leaper noted that a dialogue had already been initiated with the relevant government authorities and IAATO regarding ship strike risks.

Attention: CG, CC, SC
Based on the high densities of whales observed in 2019 and 2020 and overlap with vessel traffic near the island at 54º15'S 36º45'W in 2020, the Committee **recommends** *the addition of the island at 54º15'S 36º45'W to the list of high-risk areas where mitigation measures should be considered in the IWC Strategic Plan to Mitigate the Impacts of Ship Strikes on Cetacean Populations.*

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

The Committee has been discussing the risk to the eastern sub-population of sperm whales in the Mediterranean from ship strikes in the Hellenic Trench for a number of years. In 2015 the Committee recommended that interested parties (including Greece, ACCOBAMS and the shipping industry) move forward with Greece in order to develop a proposal for routing measures. This initiated a dialogue with the Greek Ministry of Maritime Affairs and Insular Policy. In 2020, the Secretariat requested an update from the Ministry regarding any progress with consideration of mitigation measures in the Hellenic Trench. A response was received on 18 March 2021 which describes NAVTEX messages and updates of the pilot books to make mariners aware of the risk of ship strikes in the specific areas considered by the Committee (SC/65b/HIM/07).

The Committee noted that this is a welcome step forwards in terms of mariner awareness. It provides a basis for potential adoption of voluntary measures by the industry, and hopefully will facilitate the next steps in following up Committee recommendations for routing measures to reduce the ship strike risk.

Attention: CG, CC, SC
The Committee **recommends** *that although mariner awareness is an important step it does not in itself reduce ship strike risk and thus further measures are still required.*

13.2.2 Provide advice on routing measures

The Committee established an intersessional Ship's Routeing Group to respond to requests for advice on implications for cetaceans of new routing measures or changes to shipping activities associated with port developments. There were no requests for advice in 2021 but it was agreed to maintain the group and new members with relevant expertise would be welcome.

13.3 Review methods for estimating vessel traffic for vessel types that are not equipped with AIS

The Committee has discussed many studies that used AIS data to estimate large vessel traffic. Smaller vessels that are not required to carry AIS may still pose a ship strike risk. A number of methods are available for estimating vessel traffic for vessels that are not equipped with AIS.

SC/68C/HIM20 presented a preliminary methodology to characterise gillnet fleets in the Indian Ocean using satellite imagery, based on a case study in Pakistan. These methods provide potential for examining small vessel activity at sea. The authors noted that the ability of these methods to locate and identify drift gillnet vessels on pelagic fishing grounds still needs to be verified. Future studies will investigate ways to cross-validate the identity of vessels observed on satellite imagery from port surveys with direct observations.

Montes *et al.* (2020) reported on the estimation of an index between relative encounter risk of North Atlantic right whales and recreational vessel traffic to inform potential management measures. The recreational vessel traffic was estimated through data collected during aerial surveys, as these vessels tend to not be equipped with AIS, and high-risk areas meriting mitigation measures were identified.

Cope *et al.* (2020) presented the Marine Monitor (M2) vessel tracking system, which was used to quantify vessel traffic in a region of San Francisco Bay where large-scale shipping traffic, a high-speed ferry service, and recreational use are common. The M2 system integrates marine radar, a high-definition camera, and Automatic Identification System (AIS) received to track all vessels. Commercial ships commonly travelled at speeds greater than 10 knots, and ferries commonly travelled at speeds greater than 30 knots. Recreational traffic, which typically did not broadcast AIS data, accounted for roughly 34% of all traffic. M2 can provide systematic data collection on vessel activity regardless of vessel participation in tracking technologies.

In discussion Hines noted that a project was under way to examine ship strike risk for all vessels entering San Francisco Bay, and she hopes to provide an update next year. Cope noted that the M2 radar is a relatively low-cost system, but the developers would be happy to facilitate conversations with potential funders for specific applications. It is a coastal system with a limited effective range depending on observation height.

The Committee noted that although there were some methods that could be used to characterise vessel traffic for vessels without AIS, these methods were often expensive (satellite imagery) or limited to coastal areas (radar). The Committee noted that if AIS was required on smaller vessels it would greatly facilitate studies of the potential for vessel impacts from such vessels. The Committee also **encourages** (i) collection of data on vessel activities during cetacean surveys (boat-based or aerial) in areas where there might be a ship strike risk from smaller vessels, and (ii) further development of methods using visual satellite data to examine vessel activity as well as fishing effort.

13.4 Co-operation with IMO Secretariat and relevant IMO committees

The IMO meeting schedule has been impacted by Covid and so there has been less contact than usual over the last year. The IWC did submit a paper for MEPC 76 (MEPC 76-12) which was mainly on underwater noise but did highlight that slowing ships can have multiple environmental benefits including reduced underwater noise and ship strike risk.

13.5 Review new information regarding risks from fast ferries and support vessels for energy industries

No information was received this year but the item will remain on the agenda for 2022.

13.6 Progress on previous recommendations

Jacob reported on a review of impacts of shipping to cetaceans and mitigation options for policymakers and other stakeholders commissioned by WWF, to be released prior to the IMO MEPC 76 meeting. A summary of this report was discussed in 2020 (SC/68B/HIM15). The report was reviewed by an intersessional group and amended accordingly. Once it is finalised, the report will be distributed using relevant channels, including through the IWC Ship Strike Working Group.

Lent provided an update on co-operation with Marine Traffic for provision of shipping data. Marine Traffic has generously provided Automatic Identification System (AIS) data for a number of studies considered by the Committee including HIM09 considered this year. A MoU between the IWC and Marine Traffic is under development to provide data on shipping for scientific studies. This MoU would allow the IWC to serve as a single point for data requests in a standardised format, minimising work for the data provider. Marine Traffic are reviewing final drafts of documents that lay out the MoU and provide a framework for collaboration on projects aligned with the mission and vision of both organisations. Once the Marine Traffic leadership has cleared these draft documents, the Secretariat will take them forward to the IWC Commissioners at IWC68 for consideration. Panigada suggested that it could be useful to offer shapefiles of existing IMMAs to Marine Traffic so that they could include these on their global shipping maps.

In 2020 the Committee also made recommendations regarding previously identified high-risk areas for ship strikes around the Canary Islands, the NW Mediterranean, and southern Sri Lanka (IWC Recommendations SC20116, SC20117, SC20118, SC20119). Although no new information had been received this year the Committee encouraged updates related to all these areas in 2022 including following up on correspondence by the Secretariat.

13.7 Biennial workplan

The biennial workplan for ship strikes is given in Table 15.

Table 15

Work plan for ship strikes.

Topic	Intersessional 2021/22	2022 Annual Meeting
Rates and risks	Continue ongoing work on database	Review new methods and estimates of rates of ship strikes, risk of ship strikes and mortality including progress on Ship Strike Database
Estimating the proportion of total mortality from a specific cause		Review information on methods for estimating the proportion of total mortality from bycatch and ship strikes
Mitigation		Review new information on mitigation
Advice on routing measures related to ship strike risk	Provide advice as required (Ship Routing Group)	Review advice
Follow up on previous contacts offering IWC assistance regarding high risk areas	Secretariat to maintain contact with relevant authorities in identified high-risk areas	Review progress on identified high risk areas in IWC Ship Strike Strategic Plan
Continued co-operation with IMO	Secretariat to maintain dialogue with IMO Secretariat. Attend relevant IMO meetings	Review cooperation
Provision of AIS data	Secretariat continue to develop MOU with Marine Traffic for provision of data	Consider best way to handle requests for data through the MOU

14. ENVIRONMENTAL CONCERNS (E)

14.1 Chemical Pollution

14.1.1 Trace elements/heavy metals

McCormack *et al.* (2020) measured the total mercury (THg) and selenium concentrations from small cetaceans (predominantly short-finned pilot whales (*Globicephala macrorhynchus*), false killer whales (*Pseudorca crassidens*) and killer whales (*Orcinus orca*)) taken between 2015 and 2016 off St Vincent and the Grenadines (SVG). The FAO/WHO human consumption advisory level for THg was exceeded by all liver samples and the majority of kidney, muscle, and blubber samples. SVG killer whale mean THg concentrations in liver were seven times higher than reported in Japan and SVG short-finned pilot whale mean THg concentrations in muscle were 9.4 times higher than reported in long-finned pilot whales in the Faroe Islands. These results indicate that the Caribbean is a region where heavy metals, including mercury, are significant contaminants in cetacean products consumed by local people.

IWC Resolution 2016–4 on the Minamata Convention requested the Scientific Committee 'provide … a summary of the current state of knowledge on the presence of heavy metals, with emphasis on mercury compounds, in cetaceans worldwide, and to identify areas of ocean health and human health concerns, and geographic areas where research should be prioritised in this regard'. This work is ongoing.

Attention: CG, SC
The Committee draws the attention of the government of St Vincent and the Grenadines to the high mercury levels measured in muscle, blubber, liver and kidney in small cetaceans hunted for local consumption (McCormack et al., 2020) and **recommends** *that:*

(1) St Vincent and the Grenadines continue to monitor and assess heavy metal contamination in tissues of cetaceans taken in the local hunt and consult with the necessary experts to determine the impact of this contamination on ecosystem, cetacean and human health; and
(2) research on trace element contamination in Caribbean cetaceans be prioritised, including the identification of possible sources.

Monteiro *et al.* (2020) examined concentrations of nine trace elements (arsenic (As), cadmium (Cd), copper (Cu), lead (Pb), manganese (Mn), mercury (Hg), nickel (Ni), selenium (Se) and zinc (Zn) in kidney, liver and muscle samples of 31 striped dolphins stranded along the Portuguese coast. Notably, the Cd concentrations in kidney were high compared to those from the same species from other locations. Dolphins with high parasite burdens showed higher levels of Hg in muscle, while animals showing gross pathologies presented higher concentrations of hepatic Cd and renal Se.

Lischka *et al.* (2021) quantified trace element concentrations (Al, As, Cd, Co, Cr, Cu, Fe, Hg, Ni, Mn, Pb, Se, V, Zn) in four tissues (blubber, kidney, liver, muscle) from 21 Southern Hemisphere long-finned pilot whales (*Globicephala melas edwardii*) from two stranding sites in New Zealand. Trace element concentrations were comparable to concentrations measured in *G. m. melas* harvested in North Atlantic waters. Larger and older individuals had higher Hg concentrations. Selenium had a positive correlation with Cd and Hg, suggesting the involvement of Se in Cd and Hg detoxification. Observed Hg concentrations in the liver could be hazardous for human consumption and might be a significant source of exposure for scavenging fauna. Arrow squids play a major role in trace element uptake by *G. m. edwardii* and a. significant correlation for Hg between the squid tissue and the whale tissue was found. The authors recommended that future studies on stranded long-finned pilot whales should include pathological investigations in order to determine the relationship between trace elements and the health of this cetacean.

The Committee **welcomed** the results and noted that information on trace elements in cetaceans from this region has been limited. Direct links to health impacts are difficult to determine, but new studies underway may help elucidate potential effects on reproductive output. It was also discussed that the similarity of trace element levels to those from long-finned pilot whales from the North Atlantic was somewhat surprising.

The Committee noted that information on mercury concentrations alone is difficult to interpret. Information on selenium levels, such as on potential thresholds for the protection level of Se to sustain high mercury concentrations and potential markers of Se deficiency, should accompany such data, due to its protective role against the toxicological risk posed by mercury. Further, there is a need to better understand the interactions of mercury and selenium on cetacean health and potential sources of high mercury exposure.

14.1.2 Synthetic compounds

Schultz *et al.* (2021) provided an integrative review of long-term monitoring data on persistent organic pollutants (POPs) in BCB bowhead whales and presented new data on polycyclic aromatic hydrocarbon (PAH) exposure and heavy metal trends in various tissues from whales harvested for subsistence by Alaskan Inuit during 2006–2015. Tissues collected from 2006–2007 had elevated median ∑PAH values compared to whales sampled in subsequent years. Elevated concentrations of the more volatile, low molecular weight PAHs measured in blubber and muscle sampled in 2006–2007 was coincidental with land-based oil spills that occurred in the North Slope region of Alaska. When adjusted for body length, liver cadmium content was similar to those reported in prior studies, indicating that tissue levels are not increasing since monitoring began approximately 35 years ago. In summary, levels of contaminants in bowhead whale tissues pose low risk to humans when consumed at current levels and there are no clearly documented negative effects of these contaminants on bowhead whales. Given the rapid transformation of the arctic ecosystem and increased human activity, continued surveillance of established contaminant classes is important as is monitoring for emerging contaminants.

The Committee **welcomed** this information and noted that it represents a rare example of good news on this topic.

Bolton *et al.* (2020) presented temporal trends of various legacy POPs in blubber and muscle from male BCB bowhead whales, harvested by Alaskan Inuit during 2006–2015. In summary, concentrations of most POP classes measured in bowhead whales have declined significantly since peak concentrations of most POPs in ca.1985–2005. It is likely that international action taken to restrict the use and production of many POPs (e.g. Stockholm Convention) has been effective in driving this decline. POPs in bowhead blubber and muscle meat are now approximately one half to one quarter what they had been in the 1990s, which is good news for Arctic Inuit. For bowhead whale health, given the multiple negative effects chemicals have on immunity and endocrine dynamics, low contaminant levels are generally good news.

Poirier *et al.* (2018) presented new data on the linkage of polycyclic aromatic hydrocarbons (PAH) and cancerogenesis in St. Lawrence Estuary (SLE) beluga whales in Québec, Canada. In the past, the SLE received significant industrial effluents and was considered heavily polluted (e.g. PAHs, heavy metals, PCBs). The geographically isolated resident endangered beluga

population (ca.900) that inhabits the estuary is characterized by high contaminant body burden and a cancer associated mortality of 20% in mature SLE beluga. However, tumour formation remains complex, often requiring additional factors such as inflammation and cell proliferation before tumour growth occurs.

The Committee noted the importance of this study, also as a good example of how to elucidate potential cause-effect relationships. Parallels between cetaceans and humans in the exposure and vulnerability to these compounds from the same region are obvious. PAH exposure may be a contributing factor in the observed declines in some populations, such as the Cook Inlet beluga population, and long-term monitoring and health assessment, as well as interdisciplinary collaboration are key in better understanding the effects of these contaminants, especially in combination with other stressors.

Contaminant information from two new studies conducted in the Svalbard Archipelago in Norway was presented (Tartu *et al.*, 2020). During summer 2014–2018 biopsy samples from blue, fin and bowhead whales off the west coast of the Svalbard Archipelago in Norway were obtained. Analyses of POPs were dominated by DDTs, PCBs and toxaphenes. Pollutant concentrations were 1.6–3 times higher in fin whales than in blue whales, which is likely related to the higher trophic positions of fin whales. Pollutant concentrations in the balaenopterid whales from Svalbard waters were generally much lower than in conspecific whales from the Mediterranean Sea or the Gulf of California, but higher than those in conspecifics from the Antarctic Peninsula.

Routti *et al.* (2021) investigated concentrations and endocrine disruptive potential of phthalates in blubber of blue, fin and bowhead whales in Svalbard. Phthalate is a synthetic organic chemical that impact flexibility and elasticity to plastics (a so-called plasticiser) and has the hormone modulating potential. Among 12 different phthalates investigated, only one compound was present in blubber of most whale samples.

The Committee **welcomed** this valuable new information and noted that the inability to detect a compound is not evidence of its absence, especially due to difficulty in the analysis and the detection of such compounds. Consequently, caution is needed in interpreting these results. Finally, assessments of contaminant levels in Spitzbergen bowhead whales are useful as data are limited from this stock, especially when compared to BCB bowheads.

Alava *et al.* (2020) presented information on POPs and mercury in Inner Estuary bottlenose dolphin from the Guayaquil Gulf, Ecuador. In this gradually declining population with a population estimate of 43 animals, where causes of the decline are unclear, mercury and POP concentrations were analysed in skin and blubber biopsies of 9 specimens. While the POP concentrations were lower than those found in dolphins from many other regions, some of the THg concentrations were within the concentration range found in dolphins from the southeastern coast of the United States. The authors state that the low genetic diversity of this distinct dolphin population, likely exhibiting genetic isolation and a unique evolutionary heritage, could be lost if the population continues to decline in the face of anthropogenic threats, including chemical pollution.

Baini *et al.* (2020) provided the first assessment of POPs and activity of detoxification enzymes in 22 Cuvier's beaked whale skin biopsies from the Mediterranean Sea. All the tested 18 PCB congeners and 23 out of 27 tested PBDEs congeners were detected in all sampled whales, with 80 % of the animals exceeding the toxicity threshold for the onset of physiological effects in marine mammals.

The Committee **welcomed** this information and noted that previous studies have shown high PCB concentrations in Mediterranean cetaceans. It also noted that while anthropogenic sound, particularly from military sonars, has been identified as one of the primary threats to Cuvier's beaked whales, this new information sheds light onto the potential role of POPs as additional threats to this species.

Jeong *et al.* (2020) presented information on accumulation and time trends of POPs in blubber of finless porpoises from entanglement in Korean coastal waters during 2003–2015. The concentrations of 22 PCB congeners, 15 organochlorine pesticide (OCP) congeners and 21 polybrominated diphenyl ethers (PBDE) congeners were measured. DDTs were detected at the highest concentrations, followed by PCBs and PBDEs. Concentrations of PCBs were lower than in several other species in various locations in other parts of the world, but PBDE levels were substantially higher. Significant reductions of POPs were found between 2003 and 2010, likely reflecting the impact of domestic and global regulation of POPs. However, no changes in most POPs were found between 2010 and 2015, suggesting a trend toward stabilization. Approximately 10% and 27% of porpoises exceeded previously proposed threshold levels for PCBs and DDTs, associated with health effects in marine mammals, respectively, implying a potential health risk.

SC/68C/E/13 provided information on the toxicology of gray whales in the Mechigmensky Bay (western Bering Sea, Russia) during 2013–2020. Concentrations of As, Cd, Hg, Pb and radioactivity levels in the muscle and blubber never exceeded the maximum permissible levels (MPL). The Cd concentration only exceeded the MPL twice in the liver of a 'stinky' gray whale male and in a 'normal' female. The Pb concentration exceeded the MPL three times in organs of 'stinky' whales. Since 2015 MPL has not been exceeded in organs of either stinky or normal gray whales. In 2020–21 the serum-positivity to *Toxoplasma, Trichinella*, *Candida*, Morbillivirus, herpes virus and *Mycoplasma* was determined in 33 gray whales, harvested in Chukotka during 2018–2020. Two gray whales were found positive to *Toxoplasma*, while another whale was positive to *Candida,* Mycoplasma and Morbillivirus. Gray whales in Chukotka waters did not test positive for *Trichinella* or herpes virus.

The Committee thanked Litovka for presenting this information.

SC/68C/E/09 provided information on the evaluation of Per- and poly-fluorinated alkyl substances (PFAS) which were (partly) banned due to their persistence, toxicity and partly bioaccumulative potential. Seventeen compounds were analysed

in liver of 20 bottlenose dolphins (*Tursiops truncatus*) stranded along the northern Adriatic Sea between 2008 and 2020. In recent years chemical spills including PFAS occurred in the north-eastern Italy. One of these substances, PFOS, was the most predominant and is known for its bioaccumulative potential. It was found in all the liver tissues analysed, despite its production being phased out two decades ago. The results of this study suggest that PFASs, especially long-chain, are widespread in bottlenose dolphins along the northern Adriatic Sea. The Committee thanked Mazzariol for presenting this information.

Information on per- and polyfluoroalkyl substances (PFAS), trace elements and life history parameters of mass-stranded common dolphins (*Delphinus delphis*) in New Zealand was presented (Stockin *et al.*, in review). Profiles of 32 PFAS and 13 trace elements were determined in livers. PFAS concentrations were largely comparable to those measured in other marine mammal species globally and profiles did not vary significantly by location, body condition or life history. Overall, these results contribute to global understanding of PFAS by offering first insights of PFAS exposure in marine mammals living within South Pacific Australasian waters.

The Committee **welcomed** this information and noted in discussion that the sources of the reported PFAS are unclear, especially given that PFAS appear to be higher in some of the offshore rather than inshore marine mammal species from the region. The capacity of these contaminants to be transported over large distances was highlighted, as well as the need to ensure standardisation of investigation approaches to be able to compare information from different regions and better understand potential sources and long-range transport.

Lopez-Berenguer *et al.* (2020) examined PFAS in liver and muscle of cetaceans of five species stranded along the southeastern coast of Spain between 2009–2018. Twelve out of the 15 targeted compounds were detected in > 50% of the liver samples. PFOS values were 3- to 5-fold higher compared to the last report for this area three decades ago, although still within the range reported for other cetacean species worldwide. Despite reductions in the manufacturing industry (PFOS production was phased out almost two decades ago), these compounds still appear in high concentrations compared to more than two decades ago in the Mediterranean Sea, with PFOS being the dominating compound. The biological effects of PFASs in the organism and the mechanisms by which they occur are still vaguely understood. Moreover, considering its apparently stronger effects on the developing central nervous system, the high concentrations of PFOS reported here and by other studies is a source of concern.

The Committee noted that while information from cetaceans is limited, neurological and reproductive effects from PFOS have been found in humans, including children.

The Committee noted that there is an important intersection between climate change and pollutants in marine ecosystems. Moreover, it is recognized that interactions of various factors are relevant to animal health and while some pollutants may have bioaccumulative impacts, others may be relevant from the standpoint of chronic exposure and chronic impacts. Consequently, it is imperative to consider the population-level consequences of multiple contaminants, as well as other stressors.

The Committee reiterated the threats that chemical pollutants pose to cetaceans. Furthermore, it recalled its previous recommendation on engagement with other organisations on mitigation and requests the Secretariat to liaise with the Pollution 2025 Intersessional Group as it engages with other organisations on this issue.

14.1.3 Cumulative effects/effects with unclear causation

Bengtson Nash *et al.* (2018) reported results of the first 6 years of monitoring from the Humpback Whale Sentinel Program (HWSP). Body condition, as measured by POP burdens in the outer blubber and the Adipocyte Index, as well as diet were found to oscillate closely with environmental parameters in the corresponding Antarctic feeding ground. Notably the captured timeline revealed low body condition and elevated POP burdens in blubber in 2011, which coincided with the strongest La Niña on record. The data demonstrated the principle of using a cetacean consumer of the Antarctic sea-ice ecosystem for long-term biomonitoring.

In discussion, it was noted that the use of adipocytes proved very informative as an estimate of body condition and was less prone to error than using lipid content. The Committee also pointed out that this work may be useful to future studies on the effects of climate change.

SC/68C/SM/18 provided a progress report on the studies of Guiana dolphin (*Sotalia guianensis*), including studies of chemical contaminants. This species is restricted to coastal areas in the western tropical Americas. Due to its exclusive coastal habits, the species overlaps with dense human coastal populations, raising concerns for the status of various populations. Various anthropogenic activities were identified as potential threats to Guiana dolphins, including fishing activities (gillnetting, trawling and longline fishing), the development of coastal infrastructure, port activities (including dredging), underwater explosions, vessel traffic, environmental disasters, mining, oil exploration and exploitation (including oil spills), aquaculture/fish farming, industrial activities, agricultural activities, nautical activities and nautical tourism. This species has been found to be exposed to a range of chemical pollutants, including critical compounds resulting from insecticides and UV filters. Several pathogens have been identified as the cause of various stranding episodes and mortality events and represent a potential risk to the life and conservation of the Guiana dolphin.

The Committee expressed concern over high levels of compounds resulting from insecticides and UV filters and **agreed** this issue warrants further monitoring.

Attention: C, SC
The Committee:

(1) **agrees** *it should consider ways in which it could take a more active role in providing advice, expert knowledge and guidance on issues such as,* inter alia*, improving monitoring programs on legacy and emerging contaminants to interested organisations, particularly in circumstances where pollution is an actual or suspected risk factor in a given country or region; and*
(2) **agrees** *to further develop these ideas by the intersessional group.*

Nelms *et al.* (2021) reviewed marine mammal conservation with a goal to identify evidence-based priorities of both research and conservation needs. Specifically, it attempted to address the key threats to marine mammals and their impacts, identify the associated knowledge gaps and recommend actions needed, as well as discuss the merits and downfalls of established and emerging conservation mechanisms. With respect to pollution, this review underlined the importance of pollutants. Genotoxicity, immunosuppression and endocrine disruption are among the toxic effects commonly associated with legacy POPs and heavy metals, but oil spills are also a threat. The challenge is to understand how exposure to complex environmental chemical mixtures is expressed in wild marine mammal populations.

The Committee noted that the understanding of emerging contaminants is limited, particularly for compounds that may not be the focus of the Stockholm Convention but nevertheless have potential to cause harm.

Murphy *et al.* (2018) provided information on organochlorine contaminants and their reproductive implication in cetaceans. Concentrations of PCBs declined rapidly following the ban in America and Europe in 1979 and 1985 respectively, but in some instances this decline has stalled. This is attributed to continued input into the marine environment through activities such as dredging of PCB-laden sediment and mariculture, as well as from land-based sources such as leakages from old landfills and PCB-contaminated building materials. The review highlights the remaining valid concerns of the impact of pollutants on top predators and underlines the greatest potential for toxicity during periods of low prey abundance and the high maternal transfer of OCs in some species. The northeast Atlantic harbour porpoise population exhibits a lower pregnancy rate and longer calving interval than other conspecific populations, possibly resulting from PCB-mediated effects. Results from data collected over 22 years show almost 50% of mature females had evidence of reproductive failure or incidences which could contribute to reproductive failure.

The combined effects from exposure to multiple pollutants, including (low doses of) DDT and other legacy and emerging pollutants are likely but as yet unquantified.

Centelleghe *et al.* (2019) aimed at providing a baseline for assessing the immune status of bottlenose and striped dolphins living in the Mediterranean Sea. Given that this basin is considered heavily polluted, a comparison with animals living in open waters such as the Atlantic Ocean was also made. Tissues of immune system organs from 16 individuals stranded along the Italian and 11 individuals along the Canary Island shores were sampled. A moderate negative correlation was found between the presence of OC compounds in blubber tissue and the number of T lymphocytes. Further studies are needed to confirm the possible relation between pathogens, pollutants and cetacean immune response. It also demonstrated the need of extensive and common approaches in collecting and storing samples in anticipation of future retrospective monitoring and investigative studies.

In discussion, the inherent biases in sampling were pointed out, as it is difficult to find appropriate animals for certain analyses retrospectively for the past 20 years. A standardisation of basic protocols is needed, which would include the consideration of issues such as which tissues to sample, how to sample, how to choose specimens, etc. This is important to consider with a view of the continuous development of new tools. The Committee also stressed the importance of archival tissue banks, both for retrospective studies and for guiding new research directions in the future. Where regional or national tissue banks already exist, or where existing intensive research efforts are ongoing, these should be leveraged for specific and general questions that may offer insight and feed into larger questions globally. It is important to ensure the long-term continuity of such repositories. Whenever possible and when fresh carcasses are available, all tissues should be sampled, including lymphoid tissue and brain, in order to study the potential toxicological effects of contaminants on these tissues. The importance of freeze-storing samples (as opposed to just formalin fixed) was also emphasized.

Attention: C, SC, S
The Committee:

(1) **reiterates** *its recommendation that the IWC takes on a role in facilitating the permitting process for the transfer of samples between various tissue banks and research groups; and*
(2) **agrees** *to work intersessionally to outline the role that the Committee could play in this.*

Gulland *et al.* (2020) studied the association between organochlorine contaminants, otariine herpesvirus (OtHV-1) and cancer in Californian sea lions (*Zalophus californianus*). Despite these not being cetaceans, the results have important implications for cetaceans. The prevalence of cancer in wild California sea lions is one of the highest amongst mammals.

The findings demonstrate the importance of contaminant exposure combined with OtHV1 infection, in the potential for cancer occurrence in wild sea lions.

The Committee **welcomed** this information, commended the authors for this comprehensive study and stressed the importance of long-term studies and collaboration in data collection and analysis. It was noted that specific analyses may require specific storage of samples and that a suite of tissues is needed for investigating potential confounding factors. While the association between contaminants exposure and cancer is clear, it is still unclear which particular contaminants are involved or if there are potential contaminants that were not analysed but may be collinear with those analysed. Therefore, it is important to consider the cumulative effects and interactions among various threats and risk factors.

Kershaw provided an overview and update on the IWC Effects of Pollutants on Cetacean Populations (SPoC) Model (*http://www.smru.st-andrews.ac.uk/IWC_PCB_Cet_Pop_Model*) and the IWC Contaminant Mapping Tool *http://www.smru.st-andrews.ac.uk/IWC_Contaminant_Explorer/*), which were previously coordinated by Hall. Both are freely accessible R Shiny apps currently hosted by the Sea Mammal Research Unit at the University of St. Andrews, Scotland.

The **SPoC Model** aims to investigate the effects of pollutants on cetacean populations using an individual based model approach. The web application allows users to explore the potential effects of pollutants on cetacean populations through simulating the effect of polychlorinated biphenyls (PCBs) on potential population growth through (a) maternal PCBs and their effect on the probability of calf survival and (b) the effect of PCBs on immune function and host resistance.

The **Contaminant Mapping Tool** displays published data on the concentration of persistent organic pollutants (POPs) and mercury in cetacean tissues on a global scale. It allows researchers to quickly view, and explore visually, trends in the concentrations of commonly monitored contaminants over time. The database needs to be updated with the most recent studies published over the last ca.3 years.

The Committee reiterated that these are tremendously useful tools, not only for research but also as educational tools for the public at large.

Attention: CG, SC-E, R
The Committee:

(1) **draws attention** *to two important tools: the 'IWC Effects of Pollutants on Cetacean Populations (SPoC) Model (http://www.smru.st-andrews.ac.uk/IWC_PCB_Cet_Pop_Model)' and the 'IWC Contaminant Mapping Tool http://www.smru.st-andrews.ac.uk/IWC_Contaminant_Explorer/),*
(2) **recommends** *that both the SPoC and the IWC Contaminant Mapping Tool continue to be maintained, and the Contaminant Mapping Tool updated; and*
(3) **requests** *Kershaw to provide an update at SC68D, as new data are included in the Contaminant Mapping Tool.*

In discussion, it was pointed out that to improve accuracy of the tool, long-term studies are highly important, so that the parameters such as female and calf survival, reproductive intervals and other demographic information will be important for improving the model's predictive ability in the future. As new data become available, it will allow the assessment of trends in contaminant levels and allow investigation of impacts on potential separate sub-populations.

In further discussion, the Committee also **agreed** that modelling and consideration of multiple stressors – both in terms of multiple contaminants, but also contaminants together with other non-contaminant stressors – is key, which has been one of the overarching issues raised during SC68C. It was agreed that the Population Consequences of Disturbance (PCOD) is a good general framework for integrating information, and identifying the population-level impacts of chemical pollutants on cetaceans. Even though this process is complex and data hungry, this should not restrict development of this framework further, with regards to both emerging contaminants and legacy pollutants.

The workplan for the pollution 2025 project was discussed. This project aims for a better understanding of cumulative effects and how multiple stressors, including multiple contaminants, act on cetaceans. The work which was started intersessionally by the Steering Group (SG-7) will be continued. A next milestone will be an intersessional workshop where possible approaches will be reviewed which are suitable to address this issue, designs will be developed on how to move forward and how to further the understanding of population level effects of multiple stressors. Besides the legacy pollutants, emerging contaminants will be considered. As well, modern tools and methods will be reviewed with respect to their utility to study cumulative effects. To review, decide on and apply an appropriate modelling approach is of high importance to accomplish this work. A better understanding of the cumulative threats that cetaceans are exposed to should eventually lead to developing risk mitigation ideas.

Attention: SC-E, R
The Committee **agrees** *on the work plan of Pollution 2025, the new multidisciplinary pollution/cumulative effects initiative which was established under the prior year's work plan.*

The Committee **recommends** *that a workshop on cumulative effects and multiples stressors be carried out intersessionally aiming at a better understanding of how cumulative effects and how multiple stressors act on cetaceans.*

SC/68C/E/01 outlined the general context on cumulative effects and multiple stressors in cetacean research by explaining (i) the approaches of how to identify the stressors involved and (ii) elucidating how to study the action and interaction of stressors. Cetaceans are almost always simultaneously subjected to multiple stressors which accumulate in their response. Their response is often hard to identify and to trace back to the causative factors, as (i) the easily observable responses are mostly nonspecific and (ii) the exposure to multiple stressors makes it difficult to identify the driving factors. For example, Population Viability Analyses (PVA) are used, which are based on a demographic model. They compare the relative importance of each stressor by projecting the population growth across the possible range of each stressor and explore the degree to which threats would have to be mitigated, alone or in combination, to reach a quantitative recovery target. The PCoD model (population consequences of disturbance; New *et al.,* 2014) proposes a bioenergetics model to detect biologically meaningful population responses, where disturbance costs are linked to lost energy.

The Committee **welcomed** the information and the perspectives provided and noted that there are overlapping topics and synergies with the Habitat degradation workshop held in 2004.

14.2 Diseases of concern – Focus session on *Morbillivirus* and *Brucella*

14.2.1 Focus session on Morbillivirus and Brucella

The Committee held a virtual focus session on cetacean diseases of concern (a standing topic for the sub-committee on Environmental Concerns). Two teams of invited scientific experts delivered comprehensive overviews on the current state of knowledge regarding Morbillivirus and *Brucella* infection in cetaceans.

Morbillivirus

Information presented about Morbillivirus included (i) characterisation of the infectious organism including taxonomy, (ii) phylogenetic analysis and evolution, (iii) similarities with other morbilliviruses affecting terrestrial species and man, (iv) virulence factors, (v) strain variability in different geographic areas and cetacean hosts, (vi) pathologic presentation of this agent in different cetacean species, (vii) tissue tropism of the virus, (viii) direct pathologic effects of the virus on different organ systems, (ix) means of transmission, (x) clinical signs and coinfections, (xi) epidemiology of infection, (xii) variation in disease outbreak presentation, (xiii) influence of habitat use and ecology of the affected species in the transmission of the disease, and (xiv) regional and global movements of different viral strains and spillovers from different areas of the world. One important topic briefly introduced was the use of epidemiological modeling to better predict and understand the behavior of outbreaks and the epidemiology of the disease. The new information built on the outcomes of a previous morbillivirus workshop held in Princeton in 2014 (Van Bressem *et al.*, 2014). A summary of key points are provided below.

Cetacean morbilliviruses (CeMV type 1–5) have a worldwide distribution causing small- and large-scale mortality events in odontocetes and mysticetes. Ongoing investigation into mortality events across geographic regions and preliminary analyses of long-term data indicate difference in morbillivirus infections and epidemiology by ocean basin. Endemic virus appears to be present in some cetacean populations (e.g. Brazil, Gulf of Mexico, USA), in contrast to other regions where recurring epizootics and single mortalities are more typical (i.e. Canary islands; Adriatic-Mediterranean). For example, in the Canary Islands 200 animals were tested across 16 species; morbilliviruses were detected in 29 animals of 7 species. In Brazil, morbilliviruses were detected postmortem in stranded Southern right whales (*Eubalaena australis*), a killer whale (*Orcinus orca*), and in the exhaled breath of groups of free-ranging humpback whales (*Megaptera novaeangliae*). Furthermore, a morbillivirus associated unusual mortality event (UME) occurred in Rio de Janeiro (Brazil) from 2017 to 2018 with over 277 Guiana dolphin mortalities. On the US mid Atlantic coast, recurring epizootics among bottlenose dolphins have resulted in significant mortalities (1987–1988 ca.700 animals; 2013–2015 ca.1,650 animals). Mortalities in at least 6 other cetacean species were also observed during the 2013–2015 UME. The US East coast morbillivirus isolates were most closely related to recovered isolates from the Mediterranean, while Gulf of Mexico isolates were most similar to an isolate from the Canary Islands of Spain. The similarity between US and European isolates underlines the epidemiological importance of cetacean movement in the geographic spread of the disease. Only sporadic small scale morbillivirus epizootics (single to multiple animals) have been observed among various toothed whales. An isolate from the US Pacific coast showed greatest similarity to the Hawaiian isolate, again emphasizing the role geographic connectedness and thus exchange between populations (temporal overlaps; emigration, immigration) plays in the occurrence of morbillivirus disease among free-ranging cetaceans. In the Mediterranean Sea, the largest morbillivirus epizootic occurred during 1990–1994 with > 1,000 striped dolphin mortalities. Since then, smaller outbreaks (20–100 animals) have been occurring frequently with other species being affected as well. With these regional statistics in mind, understanding the impacts to individual stocks is critically important for evaluation of population health and variation in stock-level exposure is important to consider for modeling of disease threats and recovery following mortality events.

The host range of CeMV among odontocete families remains highly dynamic (ca. 40 species) and continues to expand. Phylogenetically CeMV are more closely related to morbilliviruses that cause disease in ruminants (rinderpest and peste des petits ruminants virus) than those causing disease in carnivores (canine distemper viruses). Due to the common terrestrial ancestor shared between cetaceans and ruminants, it may be speculated that the 'land-to-sea transition' characterising cetaceans' evolutionary phylogeny could have been paralleled by that of CeMV, whose origin might be also traced back to a 'terrestrial progenitor' shared in common with RPV. Indeed, a CeMV isolate from the Southern Hemisphere

appears to be the one most closely related to RPV among the 5 hitherto defined CeMV strains. Recent molecular virus characterizations also suggest viral diversity akin to viral variants being represented within different ocean basins (e.g. Mexico and Western Atlantic, Mediterranean and Eastern Atlantic; coast of Brazil).

CeMV is transmitted by aerosol (dominant transmission route), while bodily fluids (saliva; milk; urine; blood), and possibly skin are likely infective sources as well. In utero infection, although rare, has been shown. Clinically morbillivirus infections are often characterised by acute infections (i.e. pneumonia, meningoencephalitis), high case-fatality rates, and what is thought to be life-long immunity (robust antibody titer response) following recovery. Infection is diagnosed by histology, immunohistochemistry, virus isolation, RT-PCR, and serology. Over the years CeMV has shown an increasing tendency to cross 'interspecies barriers' thereby giving rise to disease and mortality outbreaks in a wide range of cetaceans. Additional cases of infection have been reported in aquatic mammals with a mixed aquatic-terrestrial ecology like common seals (*Phoca vitulina*), monk seals (*Monachus monachus*) and Eurasian otters (*Lutra lutra*), increasing the overall concern and attention towards this Morbillivirus genus.

Interdisciplinary approaches with a wide range of collaborations are needed, including studies on ecological modeling of the dynamics of outbreaks and epidemiological exploration of which behaviors, societal organisation, ranging patterns and habitat use, species specific physiology, marine mammal immune responses and seasonality contribute to transmission, infection and establishment of the disease itself. Co-infection with brucella and toxoplasma, both on their own important disease agents of concern for cetaceans have been frequently reported in morbillivirus related mortalities. Furthermore, the hypothesized immune and endocrine modulatory role of pollutants (i.e. PCBs, legacy pesticides, emerging contaminants), on infectious disease risk and disease outcome needs further investigations as well. During the 2010–2014 Gulf of Mexico UME morbillivirus associated mortalities contributed about 10% to the total stranding cases. Lastly, climate change associated effects on marine ecosystems will likely influence infectious disease dynamics directly and indirectly. For example, shifting prey distribution and abundance, may result in range shifts/expansions where cetaceans abandon known feeding areas and explore new habitats. This variation on geographical distribution of cetaceans can set the stage for new epizootics of CeMV in immunological naïve populations worldwide.

Brucella

Information presented about *Brucella* included (i) characterisation of the bacteria, (ii) evolutionary adaptations for intracellular survival, (iii) replication and chronic persistence within the host, (iv) zoonotic potential, (v) common clinicopathologic presentations in cetaceans and other hosts, (vi) molecular characterisation, (vii) diagnostic techniques, (viii) variability in species susceptibility and (ix) impact on reproduction. A short summary of key points is provided below.

Brucella is a genus of pathogenic Gram-negative bacteria that evolved from soil bacterial organisms and adapted to invade and replicate within immune phagocytic cells of multiple mammalian species. As a facultative intracellular pathogen, Brucella evades host immune monitoring and can induce persistent infection. In the well-adapted host, including ungulates, this bacterium is typically associated with reproductive disease and abortion; the immune system is able to control the infection and avoids systemic pathology. While in a non-adapted or accidental host, like humans, it can cause a great variety of clinical syndromes, ranging from acute febrile disease to chronic, life threatening and debilitation pathologic conditions affecting multiple organs, particularly the brain (neurobrucellosis). The cetacean host appears to behave in an intermediate stage between a well-adapted host and an accidental host. There are nine species of brucella (terrestrial and marine types) associated with preferred hosts. Most of the brucella species are known to be zoonotic and reservoirs include domestic and wild animals. Rare cases of human infection with marine brucella have been reported, namely one laboratory acquired case and 3 natural disease cases where the source of infection could not be determined. It remains to be seen if marine brucella is indeed zoonotic.

Since discovery in the early 1990s, *Brucella ceti* has emerged as an important pathogen in free-ranging cetaceans worldwide (> 40 species). Transmission of brucella among cetaceans, although less well understood, is assumed to be similar to what is known for terrestrial species. *Brucella ceti* has been cultured from lungworms (*Halocercus* spp.) in brucella-positive cetaceans, but their role in transmission remains to be determined. Co-infection with lungworms is commonly observed in brucella infected cetaceans. Rare cases of brucella infection in killer whales (without apparent pathology) are suggestive that predation of brucella-infected marine mammals may be an exposure route. Brucella has also been detected in fish. Therefore, the possibility of infected prey playing a role in the transmission of brucella infection in cetaceans needs to be considered and further explored.

Brucella ceti infection in cetaceans shows a broad and variable disease presentation. Neurobrucellosis is relatively common in cetaceans, with striped dolphins (*Stenella coeruleoalba*) appearing to be more likely to develop this type of brucella infection. Cases of neurobrucellosis in striped dolphins have been reported from Costa Rica, United Kingdom, the Mediterranean, Canary Islands, Japan and the United States. The apparent species predilection for the development of neurobrucellosis deserves further attention. Although most cases of neurobrucellosis come from mortalities, live stranded cetaceans have been observed. Clinical symptoms observed range from erratic swimming, tremors, seizures, and repeatedly stranding themselves. In the US two live animals with undetected neurobrucellosis upon intake died within a year of captivity suggesting the potential for chronicity of nervous tissue infection. Of interest is that both animals had experienced complete

hearing loss. On post-mortem neurobrucellosis associated lesions of the cranial nerves associated with hearing were documented. Hearing loss may be an additional effect of brucella infection of the brain in cetaceans that requires further investigation.

Brucella infection in cetaceans is diagnosed by histology, immunohistochemistry, bacterial culture, PCR, and serology. Imaging techniques such as Computer tomography (CT) are helpful in detecting brain ventricular dilations in live and dead specimens. The culture of brucella from cetaceans can be challenging given variable carcass conditions. Important tissues to sample include brain, cerebrospinal fluid, fetal lung and placenta, lymph nodes, abscesses, reproductive tract tissue and milk.

The genetic variability of marine brucella appears to be greater than their terrestrial counterparts. Taxonomic and phylogenetic characterization of *Brucella ceti* continues to evolve and global analysis of isolates currently clusters them in at least 9 groups. Certain cetacean species seem to be more commonly affected. In Scotland, 146 isolations from 11 cetacean species, representing half the species found in UK waters have been recorded. Within the European Union, regional surveillance efforts for brucella in cetaceans vary greatly and are reflected in case reporting. Apart from Italy, Spain, Germany and Belgium, reporting from other countries is infrequent, but brucella infection has been detected in various cetacean stocks from the Netherlands, Croatia, and Norway. From Costa Rica, 43 isolations of Brucella ceti are reported. In other parts of Latin America, brucella infection has been detected using serology including in Peru in bycaught cetaceans. Brucella cases have been documented in four cetacean species in Brazil and in a southern right whale (*Eubalaena australis*) in Argentina. In Japan, the bacteria has been isolated from 13 Delphinidae; these cases were all in males. Variation in sex composition has not been reported for larger case materials (e.g., Scotland) but variation in age composition by species has been observed. Recent serological evidence from hunted whales (Mysticeti) suggests widespread exposure in common minke whales (38%) and more limited exposure in Bryde's whale (10%). In other parts of the Western North Pacific, two recent case reports provide further evidence for nursing and in utero infection being probable transmission routes. In the United States, Brucella has been detected in 10 cetacean species (both odontocetes and mysticetes) from the Gulf of Mexico, Hawaiian Islands, and the mid-Atlantic coast. Recently seropositive beluga (*Delphinapterus leucas*) and narwal (*Monodon monoceros*) have been identified in the Arctic, suggesting exposure. Many of the infections identified in the US have been in animals that were stranded during recent unusual mortality events (UMEs) (2013–2021). Based on available case material, geographic hotspots (Mid Atlantic (Cape Cod), Pacific coast (Oregon), Gulf of Mexico) are suggested; however more long-term data are needed to understand the contribution of various confounding factors. An increased prevalence of Brucella-associated abortions were observed in dolphin stocks impacted by the 2010 Deepwater horizon oil spill in the Gulf of Mexico. Oil exposure is hypothesized to have negatively affected maternal condition and immune system function leading to increased susceptibility of brucella infections. Co-infections with morbillivirus were identified in 25% of dolphins tested for both pathogens during the 2013–2015 morbillivirus-associated UME along the Mid-Atlantic region of the US. It is hypothesized that the immune suppressive actions of morbillivirus infection results in increased susceptibility to secondary brucella infection. Interestingly, no co-infections with morbillivirus were identified in cetaceans examined in Japan, and very few co-infections are reported from Scotland, while co-infections are more commonly reported in cases from Italy.

Brucella is likely more widespread than currently documented; with greater surveillance efforts increased detection among free-ranging cetaceans is probable. In addition to thorough gross post-mortem examinations, diagnostic testing with appropriate tissue sampling for PCR, culture, histopathology and serology is critically important for diagnosis. Given the specific technical expertise needed to investigate cetacean morbidity and mortalities, global investment in cetacean pathology training, laboratory diagnostic capacity, and funding for testing is needed in order to advance our understanding of marine Brucella infections. The prevalence of Brucella infections could be used as a measure of population stress and it will be of interest to monitor the variables that affect prevalence. More studies are needed to explore contaminant – pathogen interactions. Brucella infection also has the potential for population effects given its direct impact on reproductive rate and calf survival. The latter is important to consider for population modeling in endangered, geographically small and residential stocks.

Infectious diseases are likely to play a greater role in cetacean population ecology given the broad effects of climate change on marine ecosystems. The IWC Stranding Initiative will play a crucial role in bringing stranding expertise, necropsy training, sampling protocols for disease, contaminant and marine biotoxin monitoring, and capacity building to IWC and non IWC member nations to improve global stranding responses. Effective global stranding response networks and research is needed to better understand the state of cetacean health under a widening influence of cumulative stressors globally.

The Committee **thanked** the panel of invited experts for the valuable presentations on cetacean infectious diseases and encouraged the authors to publish the session's valuable discussions in peer-reviewed literature.

14.3.1 Strandings

The work of the Strandings Expert Panel (SEP; *https://iwc.int/index.php?cID=632&cType=html*) from May 2020–May 2021 was summarised. In the last year, the SEP have appointed seven new members, to broaden expertise and spatial coverage. Considering the pandemic, the SEP has adapted its provision of training, through use of remote tools such as Whatsapp and Zoom, successfully supporting responses to mass strandings in New Zealand, Australia, the North American UME, the

Indian Ocean and more recently Ghana; and successfully administering real time necropsy assistance in the Arabian Peninsula. The SEP has engaged with IGOs, the Arabian Sea Whale Network, and WWF, providing remote training on necropsy, and it continues to engage with IUCN, CITES, ACCOBAMS, and ASCOBANS, to enhance cooperation.

The development and strategy of the Strandings Initiative (SI), including a new four-year workplan, and the staffing and governance of the SI were discussed; and views sought from the sub-committee.

A new four-year (2021–2024) costed work programme for the SI was presented. The review proposed four interlinked strategic themes for the next four years: (1) data collection and dissemination; (2) emergency response; (3) expert advice; and (4) advocacy and capacity building. Specific attention was drawn to the increase in requests for assistance or remote advice during unusual mortality events (UMEs) and mass stranding events (MSEs) in 2020 and 2021, and the associated demands this was placing on SI in terms of frequency and depth of involvement. Three models proposed for filling the SEP Strandings Coordinator role were presented to the SEP for consideration. The SEP advocated a 'hybrid' model, whereby the administrative and technical aspects of the Strandings Coordinator role are separated. Finally, updates on SI governance structure and updated Terms of Reference for the SEP, reviewed in 2018 and 2019, were presented and the Committee was asked to review these proposals and provide any comments or suggested amendments.

In discussion, concerns were raised about the functioning of the Strandings Steering Committee. The Committee **agreed** that the membership of the Steering Committee would be refreshed in accordance with its new agreed ToR, existing members would be asked to confirm their continued involvement, and a convenor would be selected. The Steering Committee will remain open to Contracting Governments and Accredited Observers.

Attention: C, S, SC-E
The Committee expresses its ongoing strong support for the Strandings Initiative, **commended** *the work of the chair and the rest of the Strandings Expert Panel (SEP) to date and* **endorses** *the options presented, subject to an addition to the Terms of Reference (ToR)*[8] *for the SEP, whereby the SEP will provide regular updates to the Strandings Steering Committee, and* **endorses** *membership of the SEP and the Strandings Steering Committee.The Committee* **recommends***:*

(1) the Committee funds for strandings be carried over to the next biennial budget;
(2) the refreshed Strandings Steering Committee appoint a convenor; and
(3) the SEP and the Strandings Steering Committee meet shortly after the close of SC68C to review and complete a costed version of the Strandings Initiative work plan.

Attention: C, S, SC-E
The Committee emphasised the importance of the role of the Strandings Coordinator in underpinning the Strandings Initiative and:

(1) **requests** *the Secretariat to recruit a Strandings Coordinator as soon as possible subject to available funds; and*
(2) **encourages** *the Secretariat to seek funding to support the role of the Strandings Coordinator.*

A progress update regarding the Indonesian government's engagement with strandings monitoring was provided. Enhanced communication with the Indonesian government would likely improve the government's understanding of the importance of monitoring strandings. Communication challenges remain but are improving. Similar concerns were raised with respect to a recent pilot whale (*Globicephala macrorhynchus*) mass stranding event in Sri Lanka. It was emphasised that receiving information on what is happening and having the IWC support to distribute this information is vital, especially for those working in isolation. Governments and local stakeholders were invited to contact the Secretariat directly, for support during future events. In discussion, a request was made for the IWC to provide expertise and support to build local capacity within south Asia, including marine mammal training for veterinary students in Sri Lanka and necropsy training in Indonesia.

The Committee acknowledged that education and outreach is a key deliverable for the SI.

The request for a synergistic working relationship between the SI and the Global Stranding Network (GSN) was welcomed and Committee members were invited to volunteer as members of the GSN group.

In further discussion, it was suggested the development of 'beach friendly online material to support emergency stranding response', should include resources to assist less experienced responders with basic data collection.

14.3.2 Strandings and other issues

SC/68C/E/11 reported the preliminary results of necropsies performed on six specimens of franciscana (*Pontoporia blainvillei*) found during 2020 at the Río Negro Estuary, Northern Patagonia, Argentina. This area is considered the southernmost breeding and feeding area of this species. Two of the adults were confirmed to be bycaught in gill nets. Two specimens showed beak deviations, which would represent the southernmost report of beak anomalies. Scattered granulomatous lesions compatible with mycobacteria were detected in one franciscana and *Mycobacterium tuberculosis* complex was

[8]IWC/66/Rep01(2016); Annex K, Item 10.2 and Annex V : Expert Panel's Terms of Reference.

identified. This report will be the first case of *Mycobacterium tuberculosis* complex in this cetacean species. Cultured samples of the whitish nodular lesions showed the development of acid-fast bacilli detection. Based on the macroscopic lesions compatible with infectious diseases discovered here, it is necessary to extend the sanitary study of this population of franciscana. In discussion, the Committee expressed interest in genetic analysis of the mycobacterium complex and it was confirmed that further analyses are planned.

SC/68C/E/14 reported on the mass stranding of melon-headed whales (*Peponocephala electra)*, on the south-east coast of Mauritius Island in August 2020. Members of the SEP, the International Fund for Animal Welfare (IFAW), and the Indian Ocean/IndoCet network, provided remote assistance to local responders. Local NGOs and organisations herded live animals out of the lagoon until 13 September, however, 53 individuals of two species were found dead over a 27-day period: 52 melon-headed whales and a single bottlenose dolphin (*Tursiops spp.*). The Minister of Blue Economy, Marine Resources, Fisheries and Shipping, reported the results of 26 necropsies, evidencing lacerations, fractured mandibles, large bite wounds, empty stomachs, congested and emphysematous lungs, acoustic fat haemorrhage and gas embolism as the most common lesions. The Veterinary Services Division indicated the main cause of the death as barotrauma; which could have been triggered by a multitude of factors, such as navy sonar, oil industry seismic airguns, undersea earthquakes, and volcanic eruptions. In a non-public Forensic Science Laboratory (FSL) report, aliphatic hydrocarbon residue analysis detected a presence in samples from 11 whales. The mortality event occurred a few weeks after the grounding of the bulk carrier, *MV Wakashio*, on the same coast, which resulted in an oil spill in the area. The exact cause of the strandings has not yet been determined, and further histology, and a full epidemiological investigation of different potential causes is needed. The IWC Secretariat sent a letter to the Mauritian government offering expert advice and support in analysing samples, however, no formal response was received.

Members of the SEP emphasised the challenges of engaging with the Mauritian government and the uncertainty surrounding the current progress of causal investigation. They noted that frozen samples are held by the Ministry of Blue Economy and Shipping Resources, and their value for causal determination of barro trauma, and confirmed further plans to attempt to engage with the Mauritian government and offer support and expertise for further necropsies.

Raverty *et al.* (2020) reviewed pathology reports from 53 killer whales (*Orcinus orca)* that stranded in the Eastern Pacific Ocean and Hawaii between 2004 and 2013 and used data from 35 animals that stranded from 2001 to 2017, to assess relationships between morphometrics, blubber thickness, body condition, and cause of death. This study included data from ten southern resident killer whales, a small distinct population of endangered killer whales. Of the 53 pathology reports reviewed for the study, cause of death (COD) was determined for 22 (42%) and nine additional animals demonstrated findings of significant importance for population health. Causes of calf mortalities included infectious disease, nutritional, and congenital malformations. Mortalities in sub-adults were due to trauma, malnutrition, and infectious disease. Causes of adult mortalities included bacterial infections, emaciation, and blunt force trauma. Death related to human interaction was found in every age class. This study establishes a baseline for understanding health, nutritional status and causes of mortality in stranded killer whales. It also highlights the threat of human interactions, especially for small, endangered groups of killer whales that occur in close proximity to large human populations.

In discussion, the definition of nutrition, when attributed as cause of death was discussed and stated it could be attributed to a range of issues, namely the inability to absorb nutrients due to disease or defect or malnutrition due to lack of ability to acquire prey. It was suggested to bring the ship strike accident to the attention of the IWC ship strike database.

SC/68C/E/07 explores the possible role of chronic viral infections in gray whale (*Eschrichtius robustus*) unusual mortality events and highlights the utility of viral discovery work using unbiased metagenomic sequencing for prospective and retrospective investigations of gray whale mortalities. The Eastern North Pacific (ENP) gray whale population has undergone two official Unusual Mortality Events (UME) in the past 25 years. Common characteristics in both the 1999–2000 and 2019–2021 UMEs included: (1) increased stranding numbers throughout the species North American range (Mexico to Alaska); (2) apparent emaciation in a proportion of stranded whales; (3) low lipid content of blubber and body tissues in some whales; (4) apparent reduced reproduction (low calf counts) occurred during and following each event, and (5) average to good condition of post-parturient females and their calves observed in the breeding lagoons of Baja California during 2019 to 2021. Emaciation, low lipid content of blubber and body tissues, poor body condition, and reduced fecundity can be associated with a number of infectious diseases of wildlife, in addition to being features of purely nutritionally driven mortalities. A range of viruses detected in cetaceans to date, including morbilliviruses, herpesviruses, picornaviruses, arboviruses, astroviruses, anneloviruses and retroviruses (reviewed in Bossart and Duignan 2018) could cause chronic weight loss or mortality, although the effects of many of these emerging infections on cetaceans is unclear.

In discussion, the Committee recognised the importance of multi-disciplinary collaborations when dealing with strandings and mortality events, and in causal investigation; with emphasis placed on the role of veterinary pathologists. The Committee detailed the value, as well as the limitations, of histopathological sampling and analysis in identifying underlying pre-existing conditions and diseases that may result in the interaction of cumulative stressors.

Clarke *et al.* (In review) follows on from recommendations made in the SC67A meeting report (IWC, 2018, p.55), where the Scientific Committee agreed the method of Very High Resolution (VHR) satellite imagery to monitor standings, showed promise, and that continued refinement should occur to fully evaluate its potential. The paper reviews (1) the current gaps

in strandings monitoring globally (2) the opportunities and challenges of satellites to address those monitoring gaps, and (3) the areas where satellites hold the greatest potential to monitor strandings remotely. The authors recommend testing the robustness of this technology through pilot studies on mass stranding hotspots with established stranding networks, to develop working protocols and to address the technical challenges; and to then test on present and future areas of concern, where there is no prior knowledge of mass stranding events. They also recommend the development of automated and semi-automated detection processes, and the collaboration with other remote sensing fields to help develop predictive hypotheses; and for the IWC to encourage the development of collaborative partnerships between satellite providers and stranding networks, NGOs and governments, to develop an inclusive way for this platform to prosper.

Attention: C, SC
The Committee recognised the promise of Very High Resolution (VHR) satellite imagery and **encourages** *the further refinement and use of VHR for strandings monitoring.*

Attention: I
The Committee discussed the present accessibility of satellite imagery and **encourages** *satellite image providers to develop collaborative partnerships with stranding networks, NGOs and governments, to allow an inclusive way for this platform to prosper.*

14.4 Climate change

In 2020, the Committee approved a proposal to hold a workshop on climate change and a steering group and convener were appointed. The Conservation Committee (CC), which also has climate change on its agenda, subsequently indicated its support, agreed to partner in the workshop and representatives of the CC joined the steering committee. When it became apparent that an in-person workshop was not possible – planning for a virtual workshop began in early 2021 with two meetings of the steering committee. The steering committee agreed provisional dates for the workshop (12–14 October) and identified several key presentations for the workshop. The steering committee is now in the process of fully developing its agenda and participants list. The convener noted that recommendations for either were still very welcome and noted that no Committee funding will be needed because the workshop will be held virtually.

Rowles reported on recent work in the USA. In addition to the direct effects of climate change on cetaceans, there are cascading effects and unexpected consequences that result in additional impacts that will require adaptive management and mitigation. Three case studies were discussed that demonstrated cascading effects. These include a heat event that increased harmful algal blooms (HABS), triggering fishery management changes that increased large whale entanglements; habitat distribution effects, in which shifts in North Atlantic right whale distribution increased whale entanglement/ship strike risk, the reduction of which has been addressed through national and transboundary coordination; and an extreme weather event (e.g., coastal protection projects that affect small cetacean morbidity and mortality). The management strategies needed range from development of governance flexibility for rapid development and implementation of mitigation strategies, better prediction and forecasting information, management office cooperation, cumulative effects of multiple coastal protection activities and effective implementation of monitoring and mitigation strategies, and improving rapid international collaborations to mitigate impacts on transboundary species.

Further to a previous report to the Committee in 2016 and in preparation for the planned IWC workshop on climate change, SC/68C/E/06 provided an update on the relevant scientific literature concerning marine mammals. This preliminary assessment suggests that the focus of studies has broadened out from being focused on the polar regions to other areas and more species. Another development in the literature appears to be research seeking to assess the risk from climate change to marine mammals, including ranking the relative vulnerabilities of different taxa.

van den Berg *et al.* (2021a) assessed the trophic ecology of southern right whales using carbon and nitrogen stable isotopes, comparing samples from the late 2010s with those from the 1990s. Patterns show a strong northward shift and increased diversification in foraging in the 2010s compared with the 1990s, suggesting that recent foraging is in regions with isotopic signatures similar to those found in the Subtropical Convergence, Polar Front and Marion Island, while foraging in the 1990s was at higher latitudes, on prey with isotopic signatures similar to those found south of the Polar Front. This change in foraging strategy has occurred alongside a decline in reproductive rates and is hypothesised to reflect recent changes in prey distribution and a possible reduction in high latitude foraging habitat.

The Committee received the report on the recommendations of the international series of webinars 'The IWC after COVID-19'[9] concerning the importance for the IWC to apply a One Health approach into the work of the Commission and its Scientific and Conservation Committees. The One Health concept was introduced at the beginning of the 2000s. It recognises that human and animal health are interdependent and bound to the health of the ecosystems in which they

[9]The webinars were conducted in March 2021 and attended by more than 200 representatives from government institutions, academia, civil society organizations and tour operators from 30 countries. They were convened by Centro de Conservación Cetacea (Chile), Fundación Promar (Costa Rica), Fundación Conservaré (Colombia), Instituto de Conservación de Ballenas (Argentina), Comarino (México) and One Health (Ecuador) with the auspices of the Animal Welfare Institute, Humane Society International, Cetacean Society International and Ocean Care.

exist. Thus, a One Health approach can be implemented as a collaborative global approach to understanding risks for human and animal health and the ecosystem health as a whole[10].

At the 2019 and 2020 meetings, in discussions related to Pollution 2025, the Committee stressed 'the importance in addressing these stressors through a One Health approach' (IWC, 2021a) and that 'multidisciplinary studies were needed [...] and the approach should reflect the principle of One Health' (IWC, 2019e).

One Health implies a cross-sectorial and collaborative design and implementation of programs and policies at multiple scales, to achieve better global health and biodiversity conservation outcomes. Collaboration between the IWC and other intergovernmental bodies such as World Health Organization (WHO), Food and Agriculture Organization of the United Nations (FAO), and the World Organization for Animal Health (OIE), among others, would help promote multi-sectoral responses to numerous health and conservation hazards at the human-animal-ecosystem interface, as well as to guide ways to reduce them.

The webinar report highlighted that scientific information is needed to develop tools and methods to identify health-relevant ecosystem stressors and implement mitigation measures. However, there are large gaps in the information available to understand changes and impacts to species living in marine environments. As a repository of valuable information, it was suggested that the IWC has a responsibility to review its global historical data on annual stranding and disease reports, identify baselines, trends, and linkages to ecosystem stressors, particularly those of human origin that can be targeted for risk reduction.

In September 2020, the Liaison Group of Biodiversity-related Conventions (BLG), of which the IWC is part, endorsed and committed to the One Health concept. The BLG stated that 'one of the lessons that we learned from the COVID-19 pandemic is that human, animal and plant health are connected and interdependent, and we must do more to protect the diversity of all life forms'. Furthermore, they added that 'responses to the pandemic provide a unique opportunity for transformative change'.

In this sense, the webinar report highlighted that current times call for more action, call for a paradigm shift, and a series of recommendations to include One Health approach into IWC work were discussed.

The Committee **welcomed** the presenters' highlighting of the importance of integrating the One Health approach in the IWC's work, such as with discussions about emerging diseases, recognising the intricate relationships between humans, animals and the environment. It noted previous discussions on this topic at Pollution 2025 and congratulated the initiative to move this forward. The Committee also called for the recognition of One Health problems, thus enabling the implementation of preventative actions. Considering that the COVID-19 pandemic has made the need and appropriateness of this approach evident worldwide, it is urgent to advance in its implementation. Some members also suggested the possibility that Commissioners could present a resolution on the inclusion of the One Health concept at the IWC68.

Attention: SC
The Scientific Committee **welcomes** *the* One Health Approach which recognises the intricate relationships between humans, animals and the environment and notes previous discussions on this topic (IWC, 2020c).

The Committee **recommends** *developing specific recommendations on how the One Health approach can be operationalised in the Committee and its sub-committees to facilitate the protection and health of cetaceans and marine ecosystems.*

14.5 Review progress from intersessional work on impacts to cetaceans from underwater noise

SC/68C/E/02 reported a summary of the findings of the intersessional working group (IWG) of ASCOBANS (Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas). The IWG was established to bring together experts to summarise information about an apparent increase in beaked whale strandings that had occurred in the UK, Ireland, Iceland, the Faroes and elsewhere in the region, to discuss potential reasons for the strandings. Beaked whale strandings data from the NE Atlantic region (1990–2020) show a high and potentially growing incidence of strandings (978 reported over this period), with several Unusual Mortality Events (UMEs) recorded over this period. The eastern North Atlantic has become a global hotspot for beaked whale UMEs, with the largest ever Cuvier's beaked whale stranding occurring in 2018, and such UME's appear to be increasing in both magnitude and frequency. It was noted that there is a clear need to improve how these events are investigated and expand the scope of investigation. It was also noted that stranding networks play a crucial role and these should be further supported and developed. The Committee was asked to review the report recommendations on monitoring and mitigation, and for endorsement, as appropriate.

The Committee noted the data deficiency for beaked whale species, and highlighted the importance of the suite of recommendations in the report. In discussion, the Committee also noted the difficulty in obtaining data regarding noise-producing activities, as well as the need for a consistent stranding response protocol that would allow researchers to better document beaked whale mortalities.

[10]*https://www.oie.int/en/what-we-do/global-initiatives/one-health/.*

Attention: SC, CC, CG, C
Recalling Resolution 2018–04, and the Commission's objective to facilitate mitigation of the adverse effects of underwater noise on cetaceans, the Committee welcomes the report from the intersessional working group (IWG) of ASCOBANS and **endorses** *its recommendations. The Committee recognises the impacts of anthropogenic underwater noise on beaked whales and other cetacean species and* **encourages** *the communication and implementation of the ASCOBANS IWG recommendations by all relevant stakeholders.*

In addition, the Committee **recommends** *the development of harmonised response protocols for beaked whale strandings to ensure that the necessary datasets (e.g. pathology, meteorology prior to the stranding, oceanography, acoustic monitoring, and any information on use of high intensity sound sources) can be rapidly assembled to assist with the identification of the time, location and cause of the mortality event. Identifying which data are required for such an investigation will also highlight data collection gaps which could be prioritised to ensure such data are available when needed. The Committee further* ***recommends*** *improved data sharing between countries to better identify and investigate mortality events. Further work on beaked whales will be progressed through an intersessional group to be established in cooperation with SM.*

Duarte *et al.* (2021) provided a review of how the changing ocean soundscape in the Anthropocene is affecting marine life. The authors noted that oceans have become substantially noisier since the Industrial Revolution, with an increase in shipping, resource exploration, and infrastructure development that has increased the anthrophony (sounds generated by human activities). In contrast, the biophony (sounds of biological origin) has been reduced by hunting, fishing, and underwater habitat degradation. Furthermore, climate change is affecting the geophony (abiotic, natural sounds). Strong evidence was compiled that demonstrates that anthropogenic noise negatively affects marine mammals, with some studies also finding impacts on fishes, invertebrates, marine birds and reptiles. Studies show that anthropogenic noise affects marine animals at multiple levels, including their behaviour, physiology, and, in extreme cases, their survival. The authors emphasize the need for management actions to reduce noise levels in the ocean. In discussion, a recent paper was mentioned that reviews various management approaches, actions and recommendations related to underwater noise (Chou *et al.* 2021).

Attention: C, CG, CC, SC
Recognising that multiple studies have demonstrated the impacts of anthropogenic noise on a suite of marine taxa, the Committee:

(1) **reiterates** *the threats posed to cetaceans by underwater noise and acknowledges the additional adverse effects on other trophic levels including fishes and invertebrates; and*
(2) **recommends** *the inclusion of noise in assessments of cumulative pressures on marine ecosystems.*

In 2018, the IWC CC established the Anthropogenic Underwater Noise Intersessional Correspondence Group (AUN ICG). This group held a meeting in December 2020 to develop a work plan. The AUN ICG identified the following priority topics: seismic exploration, vessel noise, military sonar, underwater construction, operational activities and destruction of ammunition, and agreed to start working on the topic of noise produced by seismic exploration. The engagement with other organisations on AUN was also discussed. Two working groups were established during this session. The first will develop a paper on effects of seismic activity and a second will further develop the review paper on work by IWC and other international organisations on noise. In April 2021, the ICG met again to discuss a seismic activity paper which was presented to SC68C. The workplan 2020–2024 will be developed during a virtual 2021 workshop.

Reyes discussed the intention of the AUN ICG to focus on seismic survey activities during the next year. The immediate goal is to describe the extent of these activities worldwide, identify areas where cetacean populations, especially threatened ones, may be exposed, and develop recommendations regarding seismic survey noise. A questionnaire will be circulated among stakeholders to compile data related to marine seismic surveys, including ongoing activities and planned activities for the next 5 years, whether an environmental impact assessment is required prior to receiving a permit and what kind of assessment criteria are applied, as well as mitigation measures required and any applicable legislation. The IWC Secretariat could circulate the questionnaires through a notification to all IWC member states, as well as other bodies, such as the CMS, CBD, etc. Questions will be directed to governmental agencies as well as stakeholder groups, including oil and gas industries. The AUN ICG looks forward to obtaining collaboration of the Committee during the elaboration of questionnaires as well as contribution from experts of the SC to identify key stakeholders to distribute questionnaires and compile the data. A final document will be prepared for submission to the IWC CC, the Committee and the Commission.

The International Maritime Organization (IMO) does not currently have underwater noise in the work plan of the Marine Environment Protection Committee (MEPC). A proposal from Australia, Canada and the US will be considered at MEPC 76 in June 2021 to include work on underwater noise from shipping. IWC submitted a short update paper in response, noting that the IWC would welcome the opportunity to contribute to a MEPC work item on underwater noise through the work of its Scientific and Conservation Committees. In particular, the IWC could contribute to the proposed outputs of raising awareness related to the available scientific evidence on the impacts of underwater vessel noise on marine ecosystems,

and to the evaluation of measures to further prevent and reduce underwater radiated noise in terms of the expected benefits to cetaceans. The paper also highlights connections between reducing underwater noise and ship strike risk associated with slower vessel speeds. The intersessional noise group was asked to continue its work and provide advice as required if noise is included in the IMO MEPC work programme.

Attention: SC, CC
The Committee **encourages** *further intersessional collaboration and coordination between the Scientific Committee and the Conservation Committee on underwater noise.*

14.6 Review progress on recommendations on marine debris

Simmonds presented a report from the marine debris intersessional correspondence group. The group monitored relevant literature, discussed emerging issues and is in the process of reviewing the progress of the recommendations made by the IWC Marine Debris workshop held in 2019. Three emerging issues have been identified: (1) a surge in waste (primarily personal protective equipment (PPE)) related to the COVID-19 pandemic has been reported and there have been a small, but accumulating number of published cases of entanglement or ingestion by animals. A group of researchers who recently published an overview of cases in the Journal of Animal Biology have a website (covidlitter.com) on which the public can report cases. The working group encouraged a review of this topic by the Committee, and this is provided in the comprehensive review SC/68C/E/12; (2) progress towards a new international treaty on marine plastic pollution was initiated by UNEA-5. The United Nations Environment Assembly (UNEA) has adopted several resolutions on marine plastic litter and microplastics. There is growing support for a new global agreement and for the next UNEA meeting to establish an intergovernmental negotiating committee to start work on the agreement. The 2019 Marine Debris workshop recommended the development of such an international agreement and this recommendation was subsequently endorsed by the Scientific and Conservation Committees; and (3) growing concerns and associated attention being paid to abandoned or lost Fisheries Aggregation Devices (FADs). The intersessional group will be continuing to examine this issue intersessionally with a view to making recommendations. The Secretariat has engaged on this topic with the IOTC, SPREP, SPAW and others. During this engagement it has become clear that the problem of abandoned and lost FADS (especially pelagic dFADs) is greater than previously reported and growing.

The Committee **welcomes** the progress made on this and highlights the synergies between the IWC work on marine debris and the Global Ghost Gear Initiative (GGGI, *https://www.ghostgear.org/*), which has been signed by several IWC member countries.

SC/68C/E/12 collated new information from scientific, grey and popular literature, to provide an update on the cetacean species affected by marine debris. There has been a drastic increase in the number of species and the number of animals per species reported to have ingested marine plastic, which is the main component of marine debris. In 1997, Laist (1997) reported 37% (28 out of 75 recognised cetacean species at the time) as affected by either ingestion or entanglement or both. The new review shows that 80% (72 out of 90 cetacean species currently recognised) are affected by marine plastic pollution – either by ingestion or entanglement. This includes 60 species impacted by entanglement (66.7%) and 53 species reported to have ingested plastic (58.9%) with macroplastics being the main issue for all. Evidence indicates that plastics in different forms constitute the largest proportion of ingested materials.

No studies in the last 50 years have reported direct evidence of population level effects of plastic pollution despite increased interest in and awareness of the presence of plastic pollution worldwide (Senko *et al.*, 2020). However, it is important to highlight that for small populations of cetaceans listed as either Endangered or Critically Endangered, any negative effects may have severe and immediate population-level impacts. The recently proposed Rice's whale (Rosel *et al.*, 2021b) has already been recorded as affected by fatal plastic ingestion. Due to its extremely small population size (current best estimate being 51), any anthropogenic mortality is likely to be unsustainable. During the ongoing COVID-19 pandemic, large amounts of discarded face masks, gloves and other PPE, and first wildlife found entangled in PPE or with PPE parts in their stomachs were reported, with implications for impacts on cetaceans as well. The pandemic may offer an opportunity to investigate the potential links between industry, human behaviour and effects on cetaceans. The known time frame, rate of production, consumption and discardment of PPE and other COVID-19 related litter may help build a conceptual model of this specific 'COVID-19 litter cycle', possibly providing a better and holistic perspective on this specific issue. More generally, it can be used to inform management, prevention efforts, and identify knowledge gaps, and guide further research on the impacts of marine debris on cetaceans. It is also important to consider the associated welfare implications. For example, Alexiadou *et al.* (2019) noted that sperm whales found stranded with substantial amounts of ingested plastic had changed their swimming and diving behaviour prior to stranding, highlighting how such changes may increase the risk of ship strikes.

The Committee welcomes this information and encouraged the authors to publish it in peer-reviewed literature. In discussion, the Committee noted that even small pieces of plastic may be fatal to cetaceans in some circumstances. Moreover, the Committee highlighted the potential interplay between marine debris and other threats. For example, animals compromised by injuries resulting from entanglement or ship strikes may be more likely to ingest or be entangled in marine

debris. Likewise, the ingestion of marine debris or entanglement in it may predispose animals to being hit by ships or otherwise harmed. As noted under other agenda items, the interactions of threats and their cumulative effects are of particular concern. Furthermore, the importance of standardisation of necropsy protocols was stressed again, as it is key to include information on the presence (or absence) of marine debris in necropsied animals.

Attention: SC
The Committee **recommends** *consideration of how multiple existing and potential IWC databases could be successfully integrated to enable better comparison and cross-referencing of multiple data sources.*

Zantis *et al.* (2021) provided a review of published literature on microplastics in marine mammals. A lack of studies from the Southern Hemisphere was noted. Differences in contamination protocol, reporting and data transparency made the comparison of studies difficult. Standards for sample preparation and analysis are needed, and propositions on collection of qualitative and quantitative data as well as on standardised sample analysis metrics and statistics to report in publications were provided.

The Committee **welcomes** this information and agreed on the need for broader geographic coverage of microplastic studies, re-iterating the need for standardised contamination protocols, key qualitative and quantitative metric collection and reporting.

Frey (2021) presented a review on the sources, sinks, and impacts of marine plastic pollution on cetaceans in European waters. Although the current knowledge on the sinks and effects of plastic debris on cetaceans is still limited, available evidence shows that the impacts are of concern and that further measures are needed to protect cetaceans from the effects of marine debris.

14.7 SOCER report (Pacific Ocean)

The State of the Cetacean Environment Report (SOCER) was presented (see Annex J). SOCER is the result of several resolutions of the Commission, including Resolutions 1997–7 and 1998–5, which directed the Committee to provide regular updates on environmental matters that affect the cetacean environment. In 2018, the authors completed a compendium of the previous five years, which is now available on the IWC website (*https://archive.iwc.int/pages/view.php?ref=7007&k=*). The 2021 SOCER (SC/68C/E/03) focuses on the Pacific Ocean. A wide range of recognized threats to cetaceans and their environment were reported for the Pacific Ocean, including ship strikes along the U.S. West Coast, directed takes to bait fish aggregating devices in tuna fisheries, noise, bycatch and disease. Marine debris was a major issue, with a focus on microplastics. One location in the South China Sea proved to be the worst plastic-contaminated deep-sea zone ever recorded for larger litter, helping answer the much-posed question of where most of the estimated 8 million tons of litter that enter the world's oceans every year ultimately end up (the seafloor). Several cetacean species were also reported in the 'Great Pacific Garbage Patch'. Chemical pollution was an issue, with concern about high values in certain remote populations and because of long-term persistence and ineffective bans. The cumulative effects of threats were highlighted for Southern resident killer whales, with potential extinction by the late 21st century. Several papers were devoted to defining, monitoring and improving the habitat of New Zealand cetacean populations, including the critically endangered Māui dolphins. A closer partnering of scientists with seafood restaurants to reduce shrimp-fishery-related impacts was introduced as yet another strategy to counteract the impending extinction of the vaquita. On a larger scale, severe marine heatwaves in the northeast Pacific changed the geographic distributions and/or abundances ('thermal displacement') of three cetacean species. Harmful algal blooms were reported in several areas, with one in Chile being 'one of the major social and environmental crises' in the country's history. The East China Sea was identified as one of the three largest hypoxic systems in the world. On an ecosystem-shift level, the reaction of the Humboldt squid in the Gulf of California to altered oceanographic conditions was implicated in the collapse of Mexico's fourth largest fishery. On a positive note, light emitting diodes (LEDs) on the gillnets of fishing vessels in Peru reduced the cetacean bycatch probability per set by almost 71%.

Regarding the global overview, an estimated 11% of global plastic waste entered aquatic ecosystems in recent years, in addition to microplastics and discarded fishing gear, major sources of ocean plastic. If society continues to produce plastic waste at current rates, with no improvements in waste management, this figure could triple by 2030 and annual plastic emissions may increase more than 6-fold even if governments adhere to their ambitious plans. Some traditional methods of analysing cetacean carcasses miss plastics; for example, traditional methods detected plastics in 6% of porpoises but a plastic-dedicated protocol led to a plastic detection rate of 15%. In addition, cetaceans have been reported ingesting microplastics, a threat to marine ecosystems being increasingly highlighted. Moreover, nanoplastics (several orders of magnitude smaller than microplastic fragments) are of increasing concern for their toxicological impacts in aquatic vertebrates. Climate change modelling efforts predict impacts on cetaceans historically affected by commercial whaling, including a decrease in blue, fin, humpback, Antarctic minke and southern right whale populations in the Southern Ocean, a decrease in blue, fin and southern right whale populations in the Pacific and a decrease in fin and humpback whale populations in the Atlantic and Indian Ocean by 2100. Several studies on underwater noise found impacts on cetaceans at lower received levels of sound and at much greater distances than currently considered by regulations, and traditional

models to estimate sound impacts may underestimate the number of whales exposed. Other modelling studies show that just 20 days of disturbance could lead to complete annual reproductive failure for some species.

The Committee **welcomed** the new compilation of SOCER and thanked the authors for their continued hard work in compiling it. The full SOCER report can be found as Annex J.

Attention: SC
The Committee **agrees** *that the State of the Cetacean Environment Report for SC68D should be compiled for the Polar regions.*

14.8 Biennial workplan

The biennial workplan for environmental concerns is given in Table 16.

Table 16

Work plan for environmental concerns.

Topic	Intersessional 2021/22	2022 Annual Meeting (SC68D)
Pollution 2025	Workshop, monitor and research on trace element and heavy metal contamination in Caribbean cetaceans, (SC20122)	Review progress of intersessional work
Cetacean Diseases of Concern	Emerging diseases, adapt ToR (SG-8), SC20125	Review progress of intersessional work
Strandings	Reform steering committee of the SI and appoint a convener, SI and SEP will finalise the details of the workplan, work on recommendations on satellite imagery, SC20128, SC20128, SC20130, SC20131	Review progress
Climate Change	Workshop, adapt ToR (ICG-9)	Review Workshop results
Noise	Adapt ToR (ICG-9), SC20133, SC20134, SC201235	Review progress
Marine Debris	Follow up on recommendations (SC19185-19224), adapt ToR (ICG-10); 20137	Review progress
SOCER	Report compilation on the Polar regions	Review SOCER report
Sub-committee coordination (ICG)	Porter and Holm will work with SC sub-committee Convenors to develop a strategy to better integrate the SM and E workplan across the SC as appropriate	Review progress
One Health approach (ICG)	Develop recommendations	Review progress
ICG on beaked whales in conjunction with SM ICG	Develop response protocol, develop recommendations for improved data sharing	Review progress

15. ECOSYSTEM MODELLING

The Ecosystem Modelling (EM) Working Group was first convened in 2007 (IWC, 2008) and was tasked with informing the Committee on relevant aspects of the nature and extent of the ecological relationships between whales and the ecosystems in which they live.

Each year, the EM reviews new work on a variety of issues in three main areas:

(1) ecosystem modelling undertaken outside the IWC;
(2) exploring how ecosystem models can contribute to developing scenarios for e.g., ISTs; and
(3) reviewing other issues relevant to ecosystem modelling within the Committee.

15.1 Review results of ecosystem modelling in the Antarctic Ocean

Ecosystem modelling is an active area of research of particular interest to EM, including investigating ecological functions of whales in the ecosystem. The Antarctic Ocean is considered a prime area for such research. However, this year no new information was received. It was noted that data from JARPAII and NEWREP-A are still being analysed but will likely be useful for this work. The Working Group looks forward to future submissions to the Committee.

The Committee noted that some of the discussions in the workshop on the ecosystem functioning of cetaceans overlapped with the ecosystem modelling in the Antarctic Ocean (see Item 15.2.1). The Committee also noted that there is an abundance of peer-reviewed literature on the Antarctic Ocean ecosystems, and their processes and functions. Additional relevant information, including on the role of climate change in affecting the Antarctic Ocean processes, was shared at the Committee meeting in Nairobi in 2019.

The Working Group encouraged contributions from areas other than the Antarctic Ocean. Future work will not be limited to Ecosystem Modelling of the Antarctic Ocean but will aim at comparing different ecosystems, including the ecosystem functions of whales therein.

15.2 Cooperation with CCAMLR and CMS on ecosystem modelling including progress from workshop(s)

15.2.1 Review progress from Workshop on the Role of Cetaceans in Ecosystem Functioning: Gap Analysis

In response to Resolution 2016–3 (IWC, 2017c), which tasked the Committee with investigating the contribution of cetaceans to ecosystem functioning, it was recognised that this is a complex long-term task. Thus, it was agreed to start the process by holding a gap analysis workshop to: (a) define short- and medium-term objectives to be addressed; and (b) identify what

further research is required in order to begin initial modelling of the contribution of cetaceans to ecosystem functioning (IWC, 2019c, p.46).

In 2019, the Committee reiterated the need to hold a Workshop to begin the process of responding to Resolution 2016–3 and agreed a plan for the Workshop, which included potential hypotheses and questions for consideration, and the need to ultimately compare the ecosystem function of cetaceans amongst different ecosystems (IWC, 2021a). To advance the funding and other logistical matters intersessionally, an intersessional steering group (ISG) had been re-established under Ritter.

However, due to the pandemic, the in-person meeting scheduled for 2021 was postponed until 2022, and the ISG decided to proceed with a two-step approach: (i) hold a virtual workshop as a pre-meeting of SC68C to discuss ways forward; and (ii) hold an in-person meeting in 2022 to finalise an initial response for the Committee to consider in response to Resolution 2016–3. The first workshop took place 19–21 April 2021.

Ritter, the co-convenor of the workshop together with Kitakado, provided a comprehensive overview of the workshop report (SC/68C/Rep03) summarising the two keynote presentations by Roman (SC/68C/EM/05) and by Wassmann *et al.* (SC/68C/EM/02), along with the other expert presentations (by Costa, Pearson, Savoca, Smith, Pitman, Wing, Kiszka, Pershing and Tulloch) on whale falls, nutrient circulation, cetaceans as predators and other related topics. The workshop fulfilled its tasks of reviewing the ecological roles of cetaceans in ecosystem functioning and in identifying the existing knowledge gaps. During the workshop, the areas of agreement, overarching questions, and the research needs to be addressed in the future (both in the short and long term) were identified and summarised in three tables. Table 3 of SC/68C/REP03 lists six fundamental questions, hypotheses, and tasks (with a number of detailed sub-items under each main issue) related to the ecosystem functioning of whales; these are to be accomplished or considered during a follow-up workshop. Hence, Table 3 provides a road map for the coming year leading up to the second workshop, although some refinement or prioritisation of those six fundamental issues may be necessary.

The Committee thanked Ritter and Kitakado for their considerable efforts in organising the workshop. It also thanked all workshop participants, including experts attending from around the world, for their contributions to the workshop and noted the excellent work of the rapporteurs, Schubert and James, in assisting in the preparation of the workshop report. The Committee thanked CMS for co-hosting the workshop and acknowledged the Animal Welfare Institute, Whale and Dolphin Conservation, OceanCare and Pro Wildlife for providing funding toward the workshop.

The Committee noted that the workshop had provided considerable information covering some key ecosystem functioning roles of cetaceans and recognised that the issue has relevance to other Committee sub-groups and sub-committees, such as ASI, NH, SH, E, SM and possibly others.

One pertinent paper had not been fully discussed at the workshop, so was presented to the Committee. Durfort presented (Durfort *et al.*, In review), which examined the direct (whale falls) and indirect (nutrient introduction into the euphotic zone and subsequent deposition of carbon to the depths) pathways of carbon sequestration involving five baleen whale species in the Southern Ocean comparing pre-whaling, current, and forecasted estimates under two climate change scenarios, including the 'business as usual' scenario. The research found that baleen whales in the Southern Ocean, prior to their commercial exploitation, sequestered a considerable amount of carbon, mainly through the indirect sequestration pathway (90%). As this pathway relies on feeding and egestion rate (that is hypoallometric regarding the body mass), the smaller, but more numerous minke whales, contributed more to carbon sequestration in the Southern Ocean compared to larger but less numerous whale species. The commercial exploitation of whales in the Southern Ocean adversely impacted their role in sequestering carbon but, as the stocks recover, it is estimated that their contribution to carbon sequestration at the turn of the century will likely match their contributions prior to their commercial exploitation. As climate change will delay recovery of the stocks, it will prevent recovering stocks from returning to pre exploitation carbon sequestration rates.

General discussion on the workshop noted the need to narrow the scope of the tasks to be completed before the second workshop and the need to expand the area of focus beyond the Southern Ocean to include other areas with different characteristics to provide contrasting information. There is also a desire to obtain accurate pre-whaling and current abundance estimates; it was highlighted that the ASI Standing Working Group would need to be involved in providing that abundance estimates, if available.

After discussion, EM Chair proposed:

(1) to re-establish the Steering Group to plan the second workshop and to engage in further discussions so as to refine the questions/tasks to address/complete prior to the next workshop;
(2) to focus attention on the temporal and spatial dynamics of cetaceans and ecosystem functioning as in items 3 and 4 of Table 3 in the workshop report;
(3) to discuss the Terms of Reference again in the 2022 Committee meeting; and
(4) to establish a technical working group to provide input on historical and current cetacean abundance estimates for the Southern Ocean, North Atlantic and potentially some other regions.

In discussion, some participants raised concerns about the fourth proposal, suggesting that it would be best to engage in discussions with ASI during SC68C before establishing a technical working group. During a joint session between EM and

ASI, the need to prepare and/or critically review estimates of historical and current abundance of large whale populations in the Southern Ocean and North Atlantic Ocean was discussed. The proposed terms of reference included to 'provide plausible sets of pre-exploitation and current abundance of populations of relevant large whale species in the Southern Ocean and the North Atlantic from literature, as well as to conduct additional analyses if needed'. The following suggestions and details related to each ocean basin were proposed:

For the Southern Ocean consider:

- The circumpolar region south of 60 degrees might be an appropriate specification of this region.
- The impact to the ecosystem functioning and species distribution with respect to the range of interest, large baleen whales (blue, fin, humpback, Antarctic minke and possibly right whales) should be the primary species for which results are provided.
- Some values from the existing literature on ecosystem modelling were tabled (Taken from original papers: Moosa, 2017a; Tulloch *et al.*, 2019). Note that these give historical abundance estimates that sometimes differ appreciably from those from conventional single species models (especially for fin whales) because of taking account of trophic interactions (the 'krill surplus' effect).
- There is other literature regarding single species assessment (e.g. Punt (2014) for the Antarctic minke whales).
- Table of IWC-agreed abundance estimates.

For the North Atlantic Ocean, consider:

- North of 60 degrees (including the Barents Sea) might be an appropriate specification of this region.
- The impact to the ecosystem functioning and species distribution with respect to the range of interest, large baleen whales (blue, fin, humpback, right and common minke whales) should be the primary species for which results are provided.
- Estimates of recent and pre-exploitation abundance are available from ISTs for fin, humpback and common minke whales
- A comprehensive list of abundance estimates is summarized in NAMMCO (2020), which contributes to providing the current abundance as well as a basis for further exercises using single species and possibly also ecosystem modelling.
- Table of IWC-agreed abundance estimates.

During discussion, the ASI Standing Working Group emphasized that this is an important task and agreed to support what was planned, but acknowledged that it represents a heavy workload, especially given ASI's current work plan. Two main tasks were identified: (1) obtaining and reviewing estimates of current abundance, for which several gaps remain; and (2) deriving and/or reviewing estimates of pre-exploitation abundance, which are characterized by numerous gaps and larger uncertainty. Furthermore, some estimates of pre-exploitation abundance are derived from extremely complex ecosystem models, and these model formulations may need to be reviewed by the Committee. It was noted that pre-exploitation abundance estimates are also required for the Committee's stock status website that is in early stages of development. Given the amount of work involved to identify and review abundance estimates, strategies for accomplishing this substantial but important task were addressed. One approach could be to prioritize the work based on regional considerations. For instance, abundance estimates for several North Atlantic stocks have already been approved by the Committee and used by IST for the AWMP or RMP; therefore, identifying the best abundance estimate for each stock would be a relatively simple undertaking. In contrast, the Committee has not recently conducted implementation reviews for Southern Ocean stocks. Reviewing existing and identifying the best abundance estimates for the Southern Ocean would be a larger task, although this region is of primary importance to the Committee's investigations into the ecosystem functions of cetaceans. Another important consideration for ecosystem models that are used to investigate the ecosystem function of cetaceans is the sensitivity of the results from such a model to pre-exploitation abundance estimates. If the ecosystem functioning models are relatively robust to a wide range of pre-exploitation abundance estimates, the derivation of those Southern Ocean estimates could justifiably undergo less complex evaluations and scrutiny. The consensus was that additional clarity was needed on the requirements and sensitivity of the results of ecosystem models before the Committee could determine how best to allocate responsibilities between ASI and EM.

Therefore, the Committee **endorsed** the creation of a steering group to work on these issues, with Kitakado as convenor, Givens as co-convenor, and additional members to be determined. Group membership should ideally include expertise on the Committee's statistical and computational needs and priorities, the Southern Ocean ecosystem (including perhaps representation from CCAMLR), and the North Atlantic ecosystem (including perhaps representation from NAMMCO). In parallel, further investigations should occur into the sensitivity of ecosystem models to pre-exploitation cetacean abundance estimates.

15.2.2 Finalise response to Commission's request on review of contributions of cetaceans to ecosystem functioning (Resolution 2016–3)

In 2022, the Committee will provide the Commission an update on the progress with assessing the contributions of cetaceans to ecosystem functioning and recommendations for next steps. The update will include the progress made at SC68C (see

Item 15.2.1) and results from the second workshop planned for 2022. Based on the outcomes of the workshops, the Committee will review and revise as necessary the Terms of Reference at SC68D for the mid- and long-term tasks.

15.2.3 Planning of the future joint IWC-CCAMLR workshop(s) and possible MoU

Ecosystem modelling in the Antarctic Ocean is an active area of research of interest to the Committee, especially with regard to the ecological functions of whales. The Committee noted that the proposed joint IWC-CCAMLR Workshop (IWC, 2018, Appendix 5) is now expected to take place after the upcoming second Ecosystem Functioning workshop discussed under Item 15.2. 1. A full discussion of the latter is expected at SC68D which will take into account any progress made (since the original plans were developed) by both the Committee and the CCAMLR Scientific Committee in identifying information gaps and necessary research. The Committee's upcoming climate change workshop will be able to provide valuable contributions to these discussions. The Committee **agreed** to invite a member of CCAMLR's Scientific Committee to future Committee meetings to function as a bridge between CCAMLR and the Committee.

The Committee was informed that, in light of the need for enhanced scientific collaboration between the IWC and CCAMLR, the development of a Memorandum of Understanding (MOU) is under development for consideration by the IWC Bureau prior to advancing it to the full Commission at IWC68. A similar process is underway within CCAMLR. However, due to the COVID-19 pandemic and other pressing matters, the process has been delayed. Nevertheless, if the development of an MOU is approved by both bodies, it will be presented to both Commissions next year.

15.3 Progress on multi-species distribution models (MSDMs)

El-Gabbas presented El-Gabbas *et al.* (2021) on static species distribution models in the marine realm: the case of baleen whales in the Southern Ocean (SO). The authors used presence-only species distribution models to predict the circum-Antarctic habitat suitability of baleen whales and identify important predictors affecting their distribution. The Maxent was used to model habitat suitability for Antarctic minke, Antarctic blue, fin, and humpback whales. The models employed extensive circum-Antarctic cetacean data and carefully prepared predictors describing the SO's environment and corrected for spatial sampling bias using spatial filtering (rarefaction). Species-specific spatial-block cross-validation was used to optimise model complexity and for spatially-independent model evaluation. The most important predictors were derived from sea ice, particularly the seasonal mean and variability of sea ice concentration and distance to the sea ice edge. The models support the usefulness of presence-only models as a cost-effective tool in the marine realm, particularly for studying the distribution of migratory whales. However, discrepancies were found between their results and those of similar studies, mainly due to differences in cetacean data quality and quantity, study area extent, and analytical methods. Furthermore, the limitations of implementing static distribution models in the highly dynamic marine realm were highlighted. Dynamic models, which relate species information to environmental conditions contemporaneous to species occurrences, can predict near-real-time habitat suitability, which is necessary for dynamic management. The view was expressed that obtaining sufficient cetacean and environmental predictors at high spatiotemporal resolution, which are necessary for dynamic models, can be challenging for polar regions.

There was considerable discussion concerning the spatial and temporal extent of environmental variables and survey data used in the model, and their applicability to current conditions for whales. One concern raised was that some of the survey and environmental data used dated back to 1981, but variables in the model were used as proxies for current whale distribution. It was suggested that the model variables should be limited to a more recent time period, or that survey data and environmental data should be more closely aligned to relevant temporal periods (i.e., blocks of years). The authors responded that there are not sufficient survey data since 2010 to allow the model to converge, so that they had incorporated historical data and assumed that environmental conditions had not changed greatly in the last 40 years, whilst acknowledging this is a major assumption and caveat associated with the model. Another suggestion made was for the research to collaborate with the *Humpback Whale Consortium* to use recent satellite tracks to validate the models. A further concern raised was that the model is described as a year-round habitat suitability model, but most of the data are for summer, so there is a mismatch between the seasonality of the environmental variables and the majority of the survey data. The authors responded that the main objective of the model was to compare static and dynamic models; furthermore, the habitat suitability should be interpreted as representing summer months only, even though year-round environmental variables were used. El-Gabbas *et al.* (2021) also indicated that new dynamic seasonal models using these data fail to predict suitability in winter due to the limited number of sightings in that season.

Questions were raised regarding the analytical method used to account for sampling bias, and whether there was adequate control for survey effort in the model. The authors responded that the question of sampling bias was addressed through the process of refraction, wherein the number of samples in each grid was reduced to 1 to build the model. El-Gabbas *et al.* (2021) had added dynamic Maxent models in preparation to correct for sampling effort. A concern was raised regarding the ability of rarefaction to fully account for spatial sampling bias, because the majority of the available survey data were from vessels that could not penetrate sea ice. A suggestion was made that future modelling efforts conduct sensitivity analyses, in which survey data within a particular habitat (e.g., defined by isobaths, SIC, or distance to ice edge) are purposely withheld or thinned during model building and the resulting model predictions are tested on the data withheld.

Bedriñana-Romano presented results from Bedriñana-Romano *et al.* (2021b) regarding defining priority areas for blue whale conservation and investigating overlap with vessel traffic in Chilean Patagonia, using a fast-fitting movement model. Blue whale environmental habitat selection drivers were addressed, along with an assessment of priority areas for conservation and overlap with vessel traffic off northern Chilean Patagonia (NCP). A single-step continuous-time correlated-random-walk model which accommodates observational error and movement parameters variation in relation to oceanographic variables was implemented. Spatially explicit predictions of whales' behavioural responses were combined with density predictions from previous species distribution models (SDMs) and vessel tracking data to estimate the relative probability of vessels encountering whales and identifying areas where interaction is likely to occur. These estimations were conducted independently for the aquaculture, transport, artisanal fishery, and industrial fishery fleets operating in NCP. Blue whale movement patterns were in strong agreement with SDM results, reinforcing knowledge regarding oceanographic habitat selection drivers. By combining movement and density modelling approaches, strong support for purported priority areas for blue whale conservation and how they overlap with the main vessel traffic corridor in the NCP is provided.

The Committee thanked the authors of Bedriñana-Romano *et al.* (2021b) for drawing attention to this comprehensive research outcome and looks forward to receiving updates in future meetings.

Attention: SC
The Committee **agrees** *to continue SDM-related work under a new Intersessional Correspondence Group, with the following members: Kitakado (Convenor), Ferguson (co-convenor), Palacios (co-convenor), Biuw, Burkhardt, Friedlaender, Genov, Herr, McKinlay, Miller, Kelly, New and Palka. This group will develop guidelines for analyses, with Terms of Reference as follows:*

(1) to finalise the guidelines for single species distribution models (SDMs);
(2) to conduct a literature review of multi-species distribution models (MSDMs); and
(3) to develop possible simulation platforms to evaluate these models.

Attention: SC
The Committee recognises the importance of multi-species distribution models (MSDMs) to its work on ecosystem modelling and ***agrees*** *to establish an Intersessional Correspondence Group to work towards the future development of guidelines for such models.*

15.4 Progress with development of individual-based energetic models (IBEMs)

In SC/68C/EM/04 de la Mare outlined applications of the individual based energetics models (IBEMs) in addition to its use in RMP simulations. These include using IBEMs as strategic models to design and interpret research. There are two related ways in which the models could be used: (1) to interpret observable behaviours in whale feeding ecology; and (2) to examine whether different hypotheses about feeding ecology lead to observable outcomes in whale behaviour and distribution such that certain hypotheses are corroborated or otherwise. The second use can aid the design of research programmes by using the IBEM to model ecological processes to predict observable behaviours. A third use is the scaling upwards of detailed observations of individual whales on local scales to the behaviour of whale populations over their range of distribution. IBEMs could enable better models of inter-specific competition by using detailed local observations on the feeding ecology of different species to observe whether they rely on prey that is found in different locations or concentrations. The IBEMs can then be used to scale those observations to the population level. Following this, the observed distributions of whales would enable inferences to be drawn about the characteristics of prey, and conversely, the observed characteristics of prey would predict the distribution of whales. Although development of the IBEM modelling framework has begun to enable a multi-species application, further development is required, particularly in improving the spatial modelling of prey distributions on local scales.

The Committee noted that the IBEM presented in SC/68C/EM/04 has application well beyond the context of CLA simulations. It provides a means of incorporating information on prey types, foraging strategies, individual energetics, and breeding and feeding cycles into the simulations of population used in the context of population assessments and the testing of ecological hypotheses to explain population trends.

De la Mare also presented SC/68C/EM/03 which describes the development of an emulator for the IBEM as requested by the Committee in 2018. The emulator is a conventional age-structured model, but with density and age-dependent natural mortality and recruitment parameters using age-structures derived from extensive simulations using the IBEM. The aim of the emulator was to reduce the computing time required for the simulations, and in that respect the emulator had proved successful. However, comparing the yield curves derived from the IBEM and from the emulator showed that the emulator was not uniformly successful in reproducing the results obtained from the IBEM. The emulator could satisfactorily reproduce the yield curves when variability in carrying capacity was low, but with high levels of variability the emulator yield curves did not always match either the MSYR or MSYL and in some cases neither. De la Mare advised that the amount of computation required to set up the emulator for further species is comparable with that entailed by direct use of the IBEM in CLA simulations. He concluded that the latter approach should be preferred except where there are compelling

reasons for more rapid computations. He also noted that low-cost cloud-based computing makes available hundreds of processors, which means that large computations no longer need to lead to lengthy delays in obtaining results.

The development of the emulator model presented in SC/68C/EM/03 had been requested by the Committee to provide a more practical means to include the dynamics implied by IBEMs into the simulation framework used for testing RMP variants. The results showed little net advantage relative to using the IBEM directly. Results of the IBEM are easier to interpret and relate more directly to ecological hypotheses.

Attention: SC
The Committee **agrees** *that future efforts should be directed toward making the IBEM easier to use directly, rather than in further refining the emulator. A possible exception is in the conditioning of RMP trials, where the emulator may be useful for the purpose of making operating model parameters more compatible with the current information.*

15.5 Evaluate the energetics-based model and the relationship between MSYR1+ and MSYRmat (previously considered in IST)

In the IBEM models examined, the ratios of MSYR1+ to MSYRmat were not greatly different from those implied by the traditional BALEEN-type models used by the Committee in assessments. However, the proportion of the population that is mature is typically considerably lower in IBEMs than in the BALEEN model. The latter assumes that natural mortality rate is constant from age 1 yr onwards, while the former predicts that the mortality rate of juveniles remains higher than that of adults for the first few years of life. Hence the ratio MSY1+ to MSYmat can be very different from the models currently used by the Committee. This should be taken into account in evaluating the plausibility of MSYR1+ values for specific populations. The Committee does not consider it necessary to continue the use of MSYRmat as a separate concept.

The Committee thanked de la Mare for his work on developing the IBEM and emulator. The Committee considers that further work should focus on the incorporation of existing ecological and demographic information to set values or ranges for the parameters of the IBEM for application to Southern Hemisphere whale populations with krill as the main prey species. The nature of baleen whale foraging dives should be incorporated if possible.

Attention: SC
The Committee **agrees** *to re-establish the intersessional correspondence group with members Friedlaender (convenor), Biuw, Cooke, de la Mare, Donovan, Kitakado, Palacios and Palka to facilitate this work with new terms of reference:*

(1) to further develop individual-based energetics models (IBEMs), with emphasis on their application to Southern Hemisphere baleen whale populations and their interaction with krill;
(2) find ways to incorporate existing ecological and demographic data; and
(3) use the model to infer functional responses for baleen whale feeding on krill.

During discussion about IBEM, the NH sub-committee raised the concern about the perilous state of North Atlantic right whales and asked if females might suffer a higher mortality rate than males. EM might add this as an additional task to determine under what circumstances a higher female mortality rate would be expected on energetic grounds. There was insufficient time to address this issue this year, so it will be added to the agenda for next year.

15.6 Modelling of competition among whales and relationships between whales and prey

Solvang presented (Solvang *et al.*, 2021) on an investigation into the spatial association among three rorquals (blue, fin and common minke whales), a predatory fish (Atlantic cod), and their main prey groups (zooplankton and 0-group fish, Atlantic cod) in Arctic Ocean waters to the west and north of Svalbard. The data were collected by a Barents Sea ecosystem survey called the 'Strategisk Initiative Arktisk Project' in 2014–2017. Four statistical analyses were applied to the data: spatial overlapping test, independence test, logistic regression analysis, and categorical data analysis. The authors found statistically significant spatial overlap between the occurrence of minke whale sightings and prey species, and between fin whale sightings and 0-group fish in the upper 200m water layer; however, blue whales showed no statistically significant overlap with any prey species. In addition, relationships between minke whales and prey species, and between minke whales and Atlantic cod was found to be positive, not independent. The positive association between minke whales and Atlantic cod and between fin whales and Atlantic cod were estimated. Furthermore, the directional relationships for minke whales to all prey species and for Atlantic cod to zooplankton and 0-group fish were identified. These results suggest that the presence of Atlantic cod increases the interaction strength between minke whales and their preferred prey; they might indicate indirect predatory effects, which play an important role in the predator-prey dynamics in the Barents Sea ecosystem.

The authors of Solvang *et al.* (2021) were asked whether any other statistical modelling or numerical approaches would be applied to these data. The authors replied that they are more interested in investigating additional interactions that consider more fish species, rather than investigating new numerical approaches. In further analysis, the relationship for the co-occurrence of rorquals with more fish species will be discussed.

Palacios presented Barlow *et al.* (2020a), which addressed the issue that environmental data are frequently used as proxies for prey availability in marine predator distribution models, as the ephemeral nature of prey makes sampling difficult. For this reason, the functional, ecological links among environment, prey, and predator are rarely described or explicitly tested. The paper aimed to fill this knowledge gap by examining the relationship between environment (oceanography), prey (krill), and predator (blue whales) under different oceanographic regimes using species distribution modelling. Boosted regression trees were applied to three years of vessel-based whale survey data paired with oceanographic sampling and hydroacoustic backscatter in New Zealand's South Taranaki Bight region under typical (2014 and 2017) and warm (2016) austral summer oceanographic regimes. The results showed that krill metrics predicted blue whale distribution better than oceanography did. However, oceanographic features that predicted more krill aggregations (typical regime) and higher krill density (warm regime) aligned closely with those that predicted higher probability of blue whale presence in each regime. Therefore, this study confirms that environmental drivers of prey availability can serve as suitable proxies for blue whale distribution when prey data are not available.

The authors of Barlow *et al.* (2020a) were asked whether the modelled relationships held across different climate regimes. They responded that while the range of conditions experienced during the normal and warm regime were largely non-overlapping, the relationships generally held across both regimes, although the predictive power of the model was different, and not all variables from the normal regime were included in the models for the warm regime. Furthermore, the authors were asked how well the relationship from this study can be extrapolated to other species and parts of the world. The authors noted that blue whales can be considered an 'easy case' because of the short/direct food web linkages in wind-driven coastal ecosystems. For other species, more complex food web linkages would make models based on prey less robust. However, the methods and lessons learned (connecting predator, prey and environment, and sampling across different environmental regimes) should be useful and transferable to other species or systems.

A subsequent study in South Taranaki Bight (Barlow *et al.*, 2021) further determined the optimal temporal and spatial lags between wind, coastal upwelling, and blue whale occurrence based on the timing of whale acoustic presence. The study found lags of 0–2 weeks between wind forcing and a sea surface temperature response, depending on distance to the upstream upwelling focus, and a lag of 3 weeks between wind forcing events and increased blue whale calling at the farthest site downstream along the upwelling plume. These lags are currently being used to fine-tune new species distribution models for blue whales based on environmental variables remotely sensed by satellite, and the authors look forward to reporting their results of this investigation to the Committee at next year's meeting. These studies thus emphasize the importance of developing species distribution models based on ecological principles, conducting calibration across a broad range of conditions, and incorporating the appropriate spatio-temporal lags to best inform effective conservation management, especially in consideration of global climate change and shifting ocean conditions.

Konishi presented Konishi *et al.* (2020) on the results from satellite-monitored tags of Antarctic minke whales on their Antarctic feeding grounds (between 60°E and 140°E in NEWREP-A) from January to March of 2016 and 2017 between 60°E and 140°E in NEWREP-A. Results of a state-space model and a GAM model suggested that Antarctic minke whales in the study area preferred habitat represented by a small ice-free area (ice gap) above the continental shelf where they remained for extended periods, rather than shelf breaks which are rich in krill. While these results suggested that Antarctic minke whales are likely to search for ice gaps areas, further investigations are needed into the associations between Antarctic minke whales, food, and the physical environment within ice gaps. During discussion, the authors of Konishi *et al.* (2020) were advised of a useful study by Labrousse *et al.* (2018), which found that the same ice gap areas are known as important winter-feeding hotspots for elephant seals. Furthermore, the authors were asked whether the results fitted with observations of Antarctic minke whales made from helicopters, as reported in Williams *et al.* (2014). The authors responded that the study area of Williams *et al.* (2014) was the Weddell Sea sector, which was not the same area as examined in Konishi *et al.* (2020); because the environment between different sectors might be variable, the observations made by helicopter need to be compared in the same sector.

Bengtson Nash presented Groß *et al.* (2020) on a major output of the Humpback Whale Sentinel Program (HWSP), a long-term biomonitoring program for circum-polar surveillance of the Antarctic sea-ice ecosystem. The paper reported results of the first 10 years of monitoring of the sentinel parameter of diet, using lipid and fatty acid profiles, on the migrating humpback whale population on the east coast of Australia. Blubber fatty acid profiles revealed a high level of inter-annual variability; however, the signature fatty acids for Antarctic krill, 20:5ω3 and 22:6ω3, were unchanged over time, indicating that Antarctic krill remain the principal prey item for the humpback whales in this population. A distance-based linear model showed that 33% of the total variation in fatty acid profiles was explained by environmental variables and climate indices. The high degree of variability observed in this study was unexpected for a species that is thought to feed primarily on a single prey item. The authors proposed that the observed variability likely arises from changes in the diet of Antarctic krill rather than changes in the whale's diet.

A question was raised whether there was any environmental signature in the interannual variability in the fatty acid signature. This question was based on observations by Braithwaite *et al.* (2015), who found that the body condition/total lipid of Western Australian humpbacks was correlated with sea ice extent. The authors replied that the SAM (Southern Annular Mode) explained only about 20–30% of the variability.

Van den Berg presented van den Berg *et al.* (2021a), which assessed the trophic ecology of southern right whales using carbon and nitrogen stable isotopes, comparing samples from the late 2010s with those from the 1990s. Patterns show a strong northward shift and increased diversification in foraging in the 2010s compared with the 1990s, suggesting that recent foraging is in regions with isotopic signatures similar to those found in the Subtropical Convergence, Polar Front and Marion Island. By comparison, foraging in the 1990s was at higher latitudes, on prey with isotopic signatures similar to those found south of the Polar Front. This change in foraging strategy has occurred alongside a decline in reproductive rates and is hypothesized to reflect recent changes in prey distribution and a possible reduction in high latitude foraging habitat.

In discussion, a question was raised whether the samples had been lipid extracted. Lipids are enriched in 12C relative to bulk proteins, which decreases the bulk tissue 13C/12C ratio and hence results in lower δ13C values. Failing to account for the presence of lipids (by using either an a priori or a posteriori approach), can result in appreciable different δ13C values and cause false interpretations of trophic ecology (Ryan *et al.*, 2012). The authors replied that all skin samples underwent lipid extraction.

Five papers on various species and various analysing methods were presented. While it was difficult to draw overarching conclusions, the Committee received very useful information from these papers. The purpose of this agenda item was to receive new information on modelling the competition amongst whales and understanding predator-prey relationships in any region. Therefore, the Committee maintains this agenda item for subsequent meetings to enhance further understanding of ecosystems and analytical methods for ecological modelling.

15.7 Standing topics

15.7.1 Progress on considering effects of long-term environmental variability on whale populations

The issue of variability in baleen whale demographics was last examined at a Workshop held in 2010 (IWC, 2011b).

Although direct progress has not been made on analysing the effects of long-term environmental variability on whale populations in general, a specific case study undertaken by SORP to examine variability in southern right whale populations based on long-term time series (up to 50 years) is nearing completion. The results from the southern right whale study will provide insight into the types of modelling approaches that might be well-suited for examining the effects of long-term environmental variability on baleen whales in general. The southern right whale data are ideally suited for this issue because the time series comprises rapid population increases and decreases. In contrast, it is often difficult to identify the effects of long-term trends in environmental parameters on whale populations using data-based methods due to the multitude of other factors that might be influencing population dynamics. The Committee identified that a productive way forward may be to use datasets with sufficient contrast (e.g, due to rapid changes) to estimate model parameters, and then use a simulation approach (e.g., an individual based energetic model) to predict the effects of long-term trends.

Attention: SC
*The Committee **reiterates** the importance of understanding baleen whale demographics and long-term environmental variability and re-established an intersessional corresponding group led by Cooke (convenor) with membership of Butterworth, Friedlaender, Kitakado, de la Mare, Palacios and Tulloch to conduct a literature review into the effects of climate change and environmental variability on whales and marine ecosystems.*

It was acknowledged that other IWC SC entities (e.g., sub-committees, standing working groups, or intersessional working groups) might have similar interests in these issues, and it is important to communicate effectively to share information and progress. In particular, the steering group for the upcoming IWC SC climate change workshop would likely be interested in receiving updates and providing feedback. The Committee looks forward to receiving contributions on this topic at its next meeting.

15.7.2 Progress on evaluation of krill distribution and abundance

The Committee was informed that Japan conducted a dedicated krill survey independent of NEWREP-A in the Indian Sector of the Southern Ocean in 2018/19. The Committee expects to receive further information after they have been formally reviewed by CCAMLR WG-ASAM. The Committee was also informed that no update on analysis of krill abundance or distribution from krill surveys within NEWREP-A was yet available. The Committee noted that members can apply for the use of data held by Japan in the normal way through the Institute of Cetacean Research or the National Research Institute of Far Seas Fisheries (see IWC, 2021a; pp.22–23).

The Committee noted that information about the effects of climate change on the distribution and abundance of krill and other prey types could potentially be used in individual based energetics models to examine effects of climate change on whales. The Committee also noted that communication and collaboration with other entities investigating these issues, such as CCAMLR and the Scientific Committee for Antarctic Research's (SCAR) Krill Action Group, would be beneficial.

15.8 Progress on previous recommendations

Progress on previous recommendations is given in Table 17.

Table 17

Progress on previous recommendations.

Number	Text	Type	Year	Species	Themes	Actions	To be actioned by	Also relevant to	Status	Progress	Last reviewed	Outcome	Further action	Recommendation notes
SC19122	The Committee reaffirms the importance of species distribution models (SDMs) to its work and agrees to re-establish the intersessional correspondence group (Annex T) that is working to develop guidelines for best practices for the application of Species Distribution Models (SDMs).	Work plan action	2019	General	Population assessment, Ecosystem functioning	(1 – In progress) – Reestablish the intersessional corres-pondence group (Annex T) that is working to develop guidelines for best practices for the application of Species Distribution Models (SDMs).	Working Group on Ecosystem Modelling	–	Open	Extended to IWG for MSDM	12/02/2021	–	See SC20140	–
SC19123	The Committee reiterates (IWC, 2019a, p.46) the need to hold a Workshop to begin the process of responding the Commission' s Resolution asking for advice on the role of cetaceans in ecosystem functioning. Considerable progress has been made and the workshop will be held in the intersessional period and the report will be submitted to the 2020 meeting of the Committee. The Committee: (1) agrees to the revised Terms of Reference and draft agenda for the workshop provided in Annex L, appendix 2 and the guidance provided in Annex L, appendix 3 including the need to explore conducting analyses for regions outside the Southern Ocean to compare ecosystem function of cetaceans amongst different ecosystems; (2) welcomes the advances made with respect to funding and other logistics; and (3) reinstates the workshop Steering Group under Ritter (Annex T).	Work plan action	2019	–	Population assessment, Ecosystem functioning	(1 – In progress – Policy and/ or policy implementation) – Continue work towards workshop.	Working Group on Ecosystem Modelling	–	Open	In progress	12/02/2021	Virtual meeting was held in April 19–21.	A second meeting planned in 2022	Continue the steering group for preparation of 2022 workshop. Also, establish an ICG for preparation of pre-whaling and current abundance estimates (joint with ASI)
SC20139	The Committee reiterates (IWC, 2019b, p.46) the need to hold a Workshop to assist in responding to the Commission Resolution 2016–3 asking for advice on the role of cetaceans in ecosystem functioning. Considerable progress was made towards organising the Workshop, but it had to be postponed due to COVID-19. The Committee recommends that the workshop be held during the next intersessional period and the report submitted to the 2021 meeting of the Committee (SC68C). The Committee re-establishes the Workshop Steering Group under Ritter.	Recom mend-ation	2020	Small Cetaceans	Ecosystem functioning	(1 – Complete – Establish group) – Re-establish Workshop steering group (2 – In progress – Hold meeting) – Hold workshop	Scientific Committee	–	Open	In progress	12/02/2021	–	–	Virtual meeting was held in April 19–21. A second meeting planned in 2022
SC20140	The Committee recognises the importance of multi-species distribution models (MSDMs) to its work on ecosystem modelling and agrees to establish an intersessional correspondence group to work towards the future development of guidelines for such models.	Work plan action	2020	–	–	(1 – Establish group) – SC to establish an intersessional correspondence group to work towards the future development of guidelines for multi-species distribution models (MSDMs)	Scientific Committee	–	Open	In progress	12/02/2021	Works are ongoing	Continue the ICG	Attention: SC The Committee recognises the importance of multi-species distribution models (MSDMs) to its work on ecosystem modelling and agrees to establish an Intersessional Correspondence Group to work towards the future development of guidelines for such models.

Number	Text	Type	Year	Species	Themes	Actions	To be actioned by	Also relevant to	Status	Progress	Last reviewed	Recommendation notes		
												Outcome	Further action	
SC20142	The Committee reiterates the importance of understanding baleen whale demographics and long-term environmental variability and re-establishes an intersessional corresponding group.	Work-plan action	2020	–	Ecosystem functioning	(1 – Establish group) – SC and EM to re-establish the ICG for understanding baleen whale demographics and long-term environmental variability	Scientific Committee	–	Open	In progress	12/02/2021	Works are ongoing	Continue the ICG	
SC20141	The Committee recognises the importance of further development of IBEMs to account for competitions among whales and agrees to establish an intersessional correspondence group to facilitate work on modelling competition among whales.	Work-plan action	2020	–	Ecosystem functioning	(1 – Establish group) – SC establish an ICG to facilitate work on modelling competition among whales	Scientific Committee, Working Group on Ecosystem Modelling	–	Open	In progress	12/02/2021	Progress reported as SC/68C/EM03, SC/68C/EM04	Continue the ICG	The group will meet virtually on February 16th and April 8th 2021 prior to SC68C

15.9 Biennial workplan

The biennial workplan and list of email correspondence groups for EM are given in Table 18.

Table 18

Summary of work plan for ecosystem modelling.

Item	Intersessional 2021/22	2022 Annual Meeting (SC68D)
(1) Ecosystem modelling in the Antarctic and Northeast Atlantic Oceans	Continue further analyses	Review results of further analyses
(2) Multi-species distribution models (MSDM)	Intersessional Correspondence Group activity	Review progress of Working Group
(3) Effect of long-term environmental variability on whale populations	Intersessional Correspondence Group activity	Review results of further analyses and progress of Working Group on literature review
(4) Further development of individual-based energetic models (IBEMs)	Intersessional Correspondence Group activity	Review results of further analyses
(5) Modelling of competition among whales and relationship between whales and prey	Continue further analyses	Review results of further analyses
(6) Update of any exercises on krill distribution and abundance	Conduct any data analysis	Review results of analyses
(7) Cetaceans and ecosystem functioning: a gap analysis workshop	Continue analyses and hold 2nd workshop	Review result of analyses and outcomes of workshop
(8) Preparation of estimates of pre-exploitation and current abundance of large whale populations	Intersessional Correspondence Group activity	Review results from the ICG and discuss associated outcomes

Intersessional Correspondence Groups, Steering Groups, Working Groups and Terms of Reference.

Group	Sub-committee	Terms of Reference	Membership
(1) Best practices for multi-species distribution modelling (MSDM)	EM	(1) To finalize the guidelines for single species distribution models (SDMs); (2) to conduct a literature review of multi-species distribution models (MSDMs); and (3) to develop possible simulation platforms to evaluate these models.	Kitakado (Convenor), Ferguson (co-Convenor), Palacios (co-Convenor), Biuw, Burkhardt, Friedlaender, Genov, Herr, McKinlay, Miller, Kelly, New, Palka, Solvang
(2) Development of individual-based energetics models (IBEMs)	EM	(1) To further develop individual-based energetics models (IBEMs), *inter alia* for progressing the emulator model to use in RMP trial specifications; (2) to discuss new strategies for model development that utilize new data; and (3) to infer functional responses using an IBEM for rorqual foraging dives.	Friedlaender (Convenor), Biuw, Cooke, de la Mare, Donovan, Kitakado, Palacios, Palka
(3) Effect of long-term environmental variability on whale populations	EM	Compile a literature review on the subject of how environmental variability may affect whale populations	Cooke (Convenor), Butterworth, de la Mare, Friedlaender, Kitakado, Palacios, Tulloch
(4) Cetacean and ecosystem functioning: a gap analysis workshop	EM	Prepare the 2nd Workshop under a Steering Group	Kitakado (Convenor), Biuw, Butterworth, Cavanagh, Donovan, Frisch-Nwakanma, Galletti, Haug, Punt, Ritter, Roman, Staniland, Suydam, Víkingsson, Virtue, Zerbini + others
(5) Preparation of estimates of pre-exploitation and current abundance of large whale populations	EM/ASI/SH/NH	Provide plausible sets of pre-exploitation and current abundance of populations of relevant large whale species in the Southern Ocean and the North Atlantic from literature, as well as to conduct additional analyses if needed.	Kitakado (Convenor), Givens (co-Convenor), Allison, Biuw, Butterworth, Donovan, Haug, Jackson, Moosa, Palka, Punt, Robbins, Solvang, Tulloch, Víkingsson, Zerbini + CCAMLR and NAMMCO scientists

16. SMALL CETACEANS

16.1 Small Cetacean Use as Aquatic Wildmeat

The Committee has prioritised the need to better document the take of small cetaceans for consumptive and non-consumptive purposes. The products from small cetaceans are referred to as 'aquatic wildmeat' and defined as (IWC, 2016b):

> *'The products derived from aquatic mammals and reptiles that are used for subsistence food and traditional uses, including shells, bones and organs and also bait for fisheries. Aquatic wildmeat is obtained through unregulated, and sometimes illegal, hunts as well as from stranded (dead or alive) and/or by caught animals.'*

16.1.1. New Information

The Committee received a report on the use of Guiana dolphins (*Sotalia guianensis*) as bait or food in the Lake Maracaibo system of Venezuela (Briceño *et al.*, 2021). The authors conducted 95 semi-structured interview surveys from 2017 to 2019

in seven artisanal fishing communities, including three of the largest. Most cases involved dolphins that were bycaught but some involved animals that were killed intentionally. Each respondent reported at least one bycatch incident and noted calves and juveniles comprise the majority of bycaught animals. Most respondents denied selling incidentally/intentionally caught dolphins (77%), however, a few respondents (5%) admitted to participating in the trade of dolphins. During the survey period, three directed takes were reported, totalling 23 dolphins. Most respondents (93%) were aware that the capture, consumption, or sale of dolphins is illegal. An average annual bycatch of 180 individuals was estimated across seven communities, which will likely have a negative impact on the population.

In discussion, it was affirmed that, given the social and political situation in Venezuela and the poor economic state of the local communities, the use of dolphins as bait and food is expected to escalate.

Attention: S, CG, R
*The Committee recalls its previous concerns and recommendations for Guiana dolphins in Lake Maracaibo, Venezuela (*SC1899; SC18102; SC20212*), **draws attention to** recent efforts to document threats to the species as previously recommended, and **expresses serious concern** about continuing catches of Guiana dolphins in the lake and adjacent waterways, the lack of enforcement of regulations forbidding the capture, consumption, or sale of these dolphins, and the lack of reliable information on stock structure, abundance and conservation status for almost all regional populations of the species.*

*The Committee now **recommends** that the government of Venezuela implement or support the following measures to address these concerns:*

(1) A coordinated national programme to survey cetacean populations in and around Lake Maracaibo to estimate abundance systematically.
(2) Systematic monitoring of the hunting of small cetaceans, including formal reporting of all catches (e.g., collection, analysis and archiving of samples from each cetacean landed or stranded).

*The Committee **requests** that the Secretariat contact the government of Venezuela to bring these concerns and recommendations to its attention.*

Mangel summarised Campbell *et al.* (2021), a report on current uses of small cetaceans taken in small-scale coastal fisheries in Peru based on community surveys in four ports. Most respondents reported bycatch of small cetaceans: gillnet fishers reported using 1 to 4 bycaught cetaceans as bait (per trip) and that surplus bycatch was discarded; longline fishers reported using 10 to 20 cetaceans (per trip), obtained from either direct take (harpoon) or trade with gillnet fishers. Bycatch included dusky, bottlenose, and common dolphins and Burmeister's porpoises. Bycaught and hunted cetaceans will likely continue to be used as bait as it is effective, readily available and economical (also see Item 12.1.3).

In discussion, it was noted that national Peruvian national law, bans the capture, use and trade of small cetaceans, however, both the use and trade of animals at sea makes the law difficult to enforce. Recent provisions of the US Marine Mammal Protection Act could affect trade with Peru. Recent regulations enacted by Peru have been put in place to address this issue, i.e., Article 4 of Ministerial Resolution No. 451-2019-PRODUCE now require bycatch to be reported.

Alfaro presented a summary of Campbell *et al.* (2020) on the use of a rapid assessment method to understand bycatch and the use of river dolphins as bait in the piracatinga fishery, for both species of river dolphins in the Peruvian Amazon. The study was conducted between 2010 and 2015, surveying both fishers and other community members at 12 sites in the Loreto and Ucayali regions. Around 30% of respondents stated that they used dolphins as bait. Bycatch was also reported at all sites. Respondents reported up to 10 events (per year) and over 70% of respondents stated interactions with dolphins had a negative economic impact (e.g. net damage). This survey methodology made it possible to cover a large geographic area and helped identify areas of for future work. The results could help to implement the National Action Plan of the Ministry of Production of Peru.

In discussion, it was noted that respondents were quite willing to participate openly in the interview survey, admitting freely to the use of dolphins as bait, but not food. Similar to marine species in Peru, cetacean use in rivers as bait was effective, easily accessible and economical. It was pointed out that, as in other countries, such willingness to participate in surveys could change if fishermen become concerned about prosecution or other consequences.

On review of this report, the Government of Peru, through the Ministry of Production, responded immediately and noted the studies provided by Campbell *et al.* (2020; 2021) were independent to government studies and stated that the information in the publications would be reviewed. Peru also stated that the conservation strategy applied by the Peruvian government is based on the official reports that the Ministry receives from the Instituto del Mar del Peru. The National Action Plan for the Conservation of River Dolphins and Amazonian indicates that there are '(...) episodes of entanglement in nets (...) but not the use of dolphin meat as bait (...)'.

The Peru Government are thanked for their swift attention and the Committee looks forward to their further comments in future meetings.

Attention: S, CG, R
The Committee recalls its previous concerns and recommendations on the use of river dolphins as bait in the piracatinga fishery in Brazil, draws attention to recent efforts to document use of this practice in Peru, and **expresses** *serious concern about directed catches of river dolphins for this purpose in addition to high levels of mortality associated with bycatch. The Committee* **commends** *the government of Peru for the recent requirement, in Ministerial Resolution No. 451-2019-PRODUCE, that bycatch be reported.*

The Committee **encourages** *researchers to continue and expand their studies to document the magnitude of small cetacean use as aquatic wildmeat, and* **recommends** *that researchers work with the government of Peru to implement systematic monitoring of the hunting and bycatch of small cetaceans, including observer coverage and formal reporting and documentation of all catches, i.e. collection, analysis and archiving of samples from each cetacean caught, landed or stranded.*

The Committee respectfully **requests** *that Peru submit National Progress Reports annually.*

A report on small cetacean landings in Barrouallie, Saint Vincent and the Grenadines (SVG) was presented (SC/68C/SM/10). This is currently the largest hunt of cetaceans in the Wider Caribbean and began in 1931 (Adams, 1973). Hunting of all small cetaceans is unregulated in SVG and no data on takes are publicly available at a national level. Landings of 603 small cetaceans were reported in Barrouallie for the period January 2014 – December 2020, including 468 short-finned pilot whales (*Globicephala macrorhynchus*), spinner dolphins (*Stenella longirostris*), killer whales (*Orcinus orca*), false killer whales (*Pseudorca crassidens*), pygmy killer whales (*Feresa attenuata*), rough-toothed dolphins (*Steno bredanensis*), Atlantic spotted dolphins (*Stenella frontalis*), pantropical spotted dolphins (*Stenella attenuata*), Clymene dolphins (*Stenella clymene*), Risso's dolphins (*Grampus griseus*) and Fraser's dolphins (*Lagenodelphis hosei*). It was also noted that a review of the status of small cetaceans in the Caribbean by the Committee would be timely because substantial new information has been produced since the last review in 2006 (IWC, 2007, pp.47–50).

The Committee received another report on cetacean takes in SVG (Fielding and Kiszka, 2021). Past takes were summarised from the literature and recent takes of small cetaceans were determined using logbook data, interview surveys, and ethnographic observations from 2007 to 2012, and 2015 to 2017. Takes of small cetaceans in SVG have been documented since 1949, encompassing at least 15 species of odontocetes. Data on catches from one boat were collected each year from 2007 to 2017 (excluding 2013 and 2014) and the total landings recorded were 3,058 odontocetes, comprising 766 short-finned pilot whales, 29 killer whales, and 2,263 other small cetaceans.

In discussion it was noted that no abundance estimates or classifications of conservation status exist for regional populations of any of the small cetacean species targeted in the Wider Caribbean. The small cetacean catch records presented here are incomplete and an estimation of total catches has not been attempted. The Committee agreed that these studies provide minimum estimates of numbers taken in recent years and identify the primary species involved. The Committee notes that the true extent and impact of the Barrouallie hunt on cetacean populations is unknown but raises concern, given the long history of this hunting and the lack of rigorous information on regional conservation status for any of the targeted species.

Attention: CG, S
The Committee ***expresses serious concern*** *about continuing small cetacean catches in Barrouallie, Saint Vincent and the Grenadines, which have been documented since 1949, as well as the lack of abundance estimates and information on conservation status of regional populations of any of the small cetacean species targeted in the Wider Caribbean. The Committee* ***reiterates*** *its longstanding, over-arching recommendation that no small cetacean removals (live capture or directed harvest) should be authorised until a full assessment of status has been made (IWC, 2015b, p.55; 2016b, p.63; 2017c, p.65; 2018d, p.67; 2019c, p.53).*

The Committee ***recommends*** *that the government of Saint Vincent and the Grenadines implements or supports the following measures to address these concerns:*

(1) A coordinated national programme to survey cetacean populations in and around St Vincent and the Grenadines to estimate abundance systematically.
(2) Systematic monitoring of the hunting of small cetaceans, including formal reporting of all catches, i.e. collection, analysis and archiving of samples from each cetacean landed or stranded.

The Committee ***requests*** *that the Secretariat contact the government of Saint Vincent and the Grenadines to bring these concerns and recommendations to its attention, and to inform the Committee, via the Chair and Vice-Chair, on receipt of any response.*

16.1.2 Progress on Collaboration with CMS Aquatic Wildmeat Group

The Convention on the Conservation of Migratory Species of Wild Animals (CMS) Aquatic Wildmeat Group, with which this Committee collaborates in matters of cetacean wildmeat, presented a review of the exploitation of aquatic animals to the

Third Meeting of the Sessional Committee of the CMS Scientific Council (2017) and the Twelfth Meeting of the Conference of the Parties to CMS (2017). The review included information from the eastern Atlantic, the Indian Ocean, the seas of Southeast Asia, the Timor Sea, the Pacific Islands Region, the Caribbean and Latin America. This ongoing review process has been expanded to include the 33 targeted species that are listed as endangered, and/or requiring international cooperation for their conservation, on the CMS Appendices. Members of this Committee have provided their expertise to compile an overview of the cetacean species, with other experts on marine turtles and crocodiles, for all regions of the world. It is anticipated that this manuscript will be published in late 2021.

16.1.3 Review of Workshop Reports and Framework for Progress

There was insufficient time to review the Aquatic Wildmeat workshop reports, from 2016-2020, and thoroughly consolidate all new published information, therefore, this work will be carried forward to SC68D.

Attention: SC, ICG

*The Committee **draws attention** to the new information compiled in papers presented at SC68C that highlight areas where wildmeat, once supplied from incidental takes, is now being obtained from targeted hunting and a commercial trade has developed. The Committee **recommends** that these data, in addition to any emerging data, are reviewed in conjunction with the Aquatic Wildmeat workshop report series, which has been postponed to SC68D.*

16.2 Ongoing and Potential CMP for Small Cetaceans

16.2.1 The IUCN Integrated Conservation Planning for Cetaceans (ICPC)

An introduction to Integrated Conservation Planning for Cetaceans (ICPC) was presented by Taylor and Abel, who co-chair this team within the IUCN Species Survival Commission's (SSC) Cetacean Specialist Group (SC/68C/SM/03). ICPC was formed in response to the desperate situation of increasing numbers of endangered riverine and coastal dolphin and porpoise species and populations. The authors emphasised the importance of the One Plan approach developed by the SSC (Byers *et al.*, 2013) to create integrated conservation plans which explicitly consider all tools that may be needed to save a species or population and to actively fill-in knowledge gaps. The time-consuming processes of (a) addressing key knowledge gaps concerning a species' biology and (b) considering the risks and potential benefits of *ex situ* actions for an integrated conservation action plan should both begin well before a species or population is nearing extinction, preferably when thousands of individuals remain. Effective use of *ex situ* conservation measures requires extensive information, intensive preparation, informed community stakeholder engagement and adequate long-term funding. Crucially, *ex situ* approaches become less and less likely to succeed once wild populations have been reduced to near extinction (Rojas-Bracho *et al.*, 2019).

In discussion, it was noted that: (a) small cetacean species differ greatly in their biology and response to capture, transport and confinement, (b) some species are probably not good candidates for certain *ex situ* actions, (c) the success with Yangtze finless porpoise has been made possible by the availability of large, semi-natural areas (oxbows) to serve as reserves (see item 16.3.5), (d) successful breeding in such reserves will only help if the natural habitat into which animals are returned is restored, so that healthy, natural habitat is available for reintroduction or supplementation of the wild population, and (e) the Yangtze finless porpoise example demonstrates the importance of extensive stakeholder engagement for long-term success.

It was further noted that some of the same people who are involved in ICPC projects may also be involved with this Committee's initiatives such as a CMP or a Task Team, with similar goals and objectives; synergy in such efforts will give a better likelihood of success, and coordination will augment progress on matters of urgency.

Attention: SC, R

*As there is no time to waste and funds and needed skills are often in limited supply, the Committee **encourages** efforts to enhance coordination and communication between research programs under the auspices of the Committee, IUCN/ICPC, NGOs such as WWF, and other fora (such as CMS) involved in small cetacean conservation. The Committee **agrees** that a mechanism is needed to enhance communication among the different parties involved in conservation planning and actions for small cetaceans, such as an annual meeting to provide updates on progress on the issues, and **encourages** further discussions among the parties to develop such a mechanism. Progress towards establishing any such coordination mechanism should be reported back to the Committee at SC68D, if possible.*

16.2.2. Franciscana CMP

This agenda item was discussed in the Conservation Management Plans and is reported therein (see Item 9.1.4).

16.2.3. South American River Dolphins CMP

This agenda item was discussed in the Conservation Management Plans and is reported therein (see Item 9.2.5).

16.3 Progress Intersessional Correspondence Groups and Previous Recommendations

16.3.1 Recommendation Review

At SC68B, the Committee recommended that an Intersessional Correspondence Group (ICG) be established to develop a process for objectively reviewing previous recommendations, begin that review and ensure they reach their intended target. It was noted that this may require finessing past recommendation wording to meet the current standards for the Committee recommendations whilst ensuring that the recommendations are neither re-written nor re-focused. Jimenez and Porter continued to work intersessionally to expand the database of recommendations compiled in 2020, identifying in detail species, issues and geographic regions so that recommendations could be more easily assessed. The ICG met immediately prior to the SC68C and presented a preliminary framework to move forward with the review. The Committee **agreed** that the ICG should continue its work on recommendation review, expand its membership in the intersessional period to incorporate more expertise and report on progress at next year's SC meeting.

16.3.2 Tursiops Taxonomy Update

In 2021, an ICG, convened under Natoli, reviewed new publications relating to *Tursiops* taxonomy. In April 2021, a virtual workshop was held to review relevant research published between 2018 and 2021 and finalise updates to the two Annexes established during this Committee's initial review of the genus (IWC, 2016b; 2017c; 2018d). Goals of the workshop were to (1) review new publications (2018–2021) on *Tursiops* taxonomy and (2) update summary tables in the 2018 *Tursiops* Workshop Report (IWC, 2019c) with new information, including a review of geographic regions with little information on *Tursiops*. Updates to the list of references, summary table and table of data deficient regions are available in SC/68C/REP/04.

The main findings of the workshop (SC/68C/REP/04) were presented by Natoli, and discussion focussed on lines of evidence supporting recognition of Lahille's bottlnose dolphin as a separate species. Concern was expressed about the dire conservation status of Lahille's bottlenose dolphin and it was pointed out that Brazil has a National List of Endangered Species, but endangered subspecies are not afforded similar recognition or protection. It was noted that improved analysis of nuclear markers was needed to clarify the amount and pattern of genetic differentiation, and whether that was consistent with accepted guidelines (IWC/68C/SM03) for species or sub-species recognition. The Committee also noted the lack of progress in clarifying the taxonomic affinity of the putative southern Australia species '*Tursiops australis*'.

Attention: R

*The Committee **recalls** its previous recommendations (IWC, 2019c, p.49) and **welcomes** recent progress in characterising divergence between coastal and offshore forms of* Tursiops *in the western South Atlantic Ocean. The Committee **encourages** researchers working on Lahille's bottlenose dolphin (*T. t. gephyereus*) to investigate the possibility that there is a third type or population of bottlenose dolphins in Argentine waters.*

*The Committee **respectfully requests** that updates be provided to the Committee as new information becomes available.*

Attention: R

*The Committee **recalls** its previous recommendations (*SC18184*) and **welcomes** recent progress in characterising divergence between coastal and offshore forms of* Tursiops *in the western South Atlantic Ocean. The Committee **encourages** researchers working on Lahille's bottlenose dolphin (*T. t. gephyereus*) to investigate the possibility that there is a third type or population of bottlenose dolphins in Argentine waters.*

*The Committee **respectfully requests** that updates be provided to the Committee as new information becomes available.*

Attention: R

The Committee recalls its previous recommendations (SC18184) and, given the lack of progress in clarifying the phylogenetic affinity of the 'T. australis' mtDNA lineage in the context of both T. truncatus *and* T. aduncus*, **encourages** researchers working on bottlenose dolphin taxonomy in southern Australia to focus future efforts on ensuring that (1) such efforts include collaborations to allow analysis of samples from around Australia, (2) a consistent genomic approach is applied to all samples, (3) analysis of 'ancient DNA' from historical (bone) samples also be incorporated, if possible, and (4) the available mitochondrial DNA, nuclear DNA and morphological data are incorporated into the analysis, particularly if there are samples for which both genomic and morphological data are available.*

*The Committee **respectfully requests** that updates be provided to the Committee as new information becomes available.*

Attention: R

*The Committee **recalls** its previous recommendations (SC18184) and **welcomes** recent progress in characterising divergence between coastal and offshore forms of bottlenose dolphins in the western South Atlantic Ocean. The Committee **encourages** researchers working on bottlenose dolphins in Brazil, Uruguay, and Argentina to adopt a unified approach for understanding the distribution, habitat use and taxonomic and population-level divergence of Southwest Atlantic bottlenose dolphins, including collaborations to merge independent sample sets to (1) identify sampling gaps and (2) allow analysis of nuclear DNA data from across the entire geographic range so that outstanding questions of taxonomic and population-level divergence of the different forms of Tursiops identified in that region can be addressed.*

*The Committee **respectfully requests** that updates be provided to the Committee as new information becomes available.*

Attention: R
*The Committee **recalls** its previous recommendations (SC18184) and **welcomes** recent progress in characterising divergence between coastal and offshore forms of bottlenose dolphins in the western South Atlantic Ocean. The Committee **encourages** researchers working on bottlenose dolphins in Brazil, Uruguay, and Argentina to adopt a unified approach for understanding the distribution, habitat use and taxonomic and population-level divergence of Southwest Atlantic bottlenose dolphins, including collaborations to merge independent sample sets to (1) identify sampling gaps and (2) allow analysis of nuclear DNA data from across the entire geographic range so that outstanding questions of taxonomic and population-level divergence of the different forms of Tursiops identified in that region can be addressed.*

*The Committee **respectfully requests** that updates be provided to the Committee as new information becomes available.*

Attention: SC
*The Committee **recalls** its previous recommendation (IWC, 2019c, p.49) and **agrees** that Annexes D and E, developed by the 2018 Tursiops Taxonomy Workshop to summarize available data relevant to this topic for the major geographic areas worldwide, and indicative of where such data are still lacking or incomplete, will continue to be updated and made publicly available as a 'living document' on the IWC website.*

*The Committee **respectfully requests** such updates be supplied to the Committee at regular intervals, preferably of not more than 2–3 years.*

Attention: R, SC
*The Committee again **draws attention to** the need for bottlenose dolphin research in areas the 2018 Tursiops Taxonomy Workshop identified as being data deficient (SC18184): the eastern South Atlantic, the African coast of the eastern North Atlantic, the southern and eastern Mediterranean Sea, the eastern South Pacific, and the Mexican mainland and Central American coasts of the eastern North Pacific, eastern Australia and in the western Pacific islands of Micronesia, Melanesia, Polynesia, the Philippines and Vietnam, and the Red Sea.*

*The Committee **encourages** Tursiops research and collaborative efforts to examine and analyse Tursiops specimens throughout these regions.*

*The Committee **requests** that updated information be provided to the Committee when available.*

*The Committee **recalls** its previous recommendation (SC18184) and agrees that the Committee should continue compilation of specimen, study, and researcher details, and concentrate effort on improving understanding of Tursiops species, subspecies and population-level divergence in data-deficient areas.*

16.3.3. Guiana dolphin (Sotalia guianensis)

In 2018, this Committee listed the Guiana dolphin, *Sotalia guianensis*, as a priority species for evaluation of conservation status. The proposed assessment is intended to document current knowledge on population structure, distribution, threats, abundance and trends, and biological parameters of Guiana dolphins. Domit presented SC/68C/SM/18 which detailed the activities of the *Sotalia* ICG, which encompasses more than 50 experts, following last year's advice and recommendations from this Committee. The main activity has been the development of an action plan focusing on short-term research priorities with management objectives and metrics.

The actions proposed by the *Sotalia* ICG are organised by major topic, area (country/region), period, stakeholders who should be engaged, logistical needs, financial support and 'governability'. The group has attempted to address last year's recommendations, however, due to the impacts of the COVID-19 pandemic, limited progress has been made towards obtaining critical data to better define and delimit management units (such as identifying true gaps in distribution vs. areas with little data) and developing recommendations to improve management actions and monitoring efforts in current action plans (such as establishing legislative mandates for mitigating impacts, especially bycatch). An ICG formed by the SD-DNA Working Group is currently reviewing the compiled data and analyses and will continue to discuss current results and potential new analyses in upcoming meetings, in preparation for the assessment (see Item 10.2.1.2).

Attention: R, SC
*The Committee **recalls** its previous concerns and recommendations for Guiana dolphins in the face of multiple threats and stressors (IWC, 2021a, p.102) **draws attention** to recent efforts to document threats to the species as previously recommended and **commends** efforts by the Sotalia working group to fill information gaps and develop an effective action plan.*

*The Committee **encourages** the Sotalia Intersessional Correspondence Group to continue its activities, including, as needed:*

(1) consultation with relevant sub-committees, e.g., ASI (abundance, surveys, international cruises), HIM (incidental takes), SD-DNA Working Group (stock structure analysis), Environmental Concerns (pollution, disease) and Whale Watching;

(2) coordination of science and governance to support mitigation and management actions both in national and international contexts;
(3) further development of the action plan and implementation of its components and monitoring of its effectiveness when possible and appropriate;
(4) consultation with the IWC Conservation Management Plan (CMP) convenors on the prospects for developing a CMP for the Guiana dolphin;
(5) submission of an updated report of its activities at the next Committee meeting in 2022.

16.3.4. Vaquita (Phocoena sinus)

Rojas-Bracho and Jaramillo presented an update on vaquita (*Phocoena sinus*) surveys that have been conducted since 2019 (SC/68C/SM/20). Many new challenges for surveying vaquitas have arisen over the past decade, and alternative methods have been explored, including deploying fewer detectors in the Zero Tolerance Area (ZTA) and sampling only during neap-tide periods when gillnet fishing is generally not attempted, in the hope of reducing acoustic detector loss. Acoustic detectors were deployed in this manner in the ZTA during two periods in the summer of 2019.

In 2020, the programme was further hampered by COVID-19 restrictions, and only a single survey was possible (September) across four sites with historically high acoustic detection rates. As probability of detection has diminished with the population decline, a circular formation of detectors (CPOD) plus one in the centre was used at three sites within the ZTA. Vaquitas were detected by 5 out of the 22 deployed detectors, at just 2 of the sampling sites, with a total of 9 acoustic encounters. Only one encounter was detected by the central CPOD, which indicates that using only one detector in a central position could substantially decrease encounter probability. The chronology of these detection events suggests that vaquitas remained in some areas for extended periods.

From 8–23 November 2020 a small effort was carried out jointly by the National Commission for Natural Protected Areas (CONANP), the Sea Shepherd Conservation Society (SSCS) and two experienced observers. Effective searching conditions (i.e., Beaufort 1–3) held for only 32 hours. Two sightings were made, the first on 13 November (31°07.257´N, 114°41.878´W), involving two or three animals, and the second on 23 November (31°06.698´N, 114°39.796´W) when two animals were observed on several occasions. It is important to emphasize that despite continued high fishing effort, vaquitas were at least detected in the Upper Gulf during summer (acoustic survey) and late autumn (visual survey).

Rojas-Bracho outlined the problems faced during recent vaquita surveys. For example, poor weather limits survey effort and results in poor photo-identification image quality, which leads to less confidence in identification of resighted individuals. To explore these problems, an 'expert elicitation' workshop was organized in August 2020 to estimate the number of unique individuals and calves seen within the area of highest vaquita density. Expert elicitation is a means by which data are combined with expert judgement to –at a minimum— provisionally fill knowledge gaps via the development of probabilistic distributions. Workshop participants included observers who participated in the October 2019 field survey. This Committee discussed the Rational Impartial Observer method (EE-RIO) which resulted in a mean estimated number of calves seen as 3.1 with a 73% belief that there were at least 3 calves. The mean estimated number of unique vaquitas seen across all sightings (7) was 10.4 with a 66% belief that there were at least 10.

The next steps for the vaquita program are to continue the targeted acoustic monitoring and, if circumstances permit, conduct a visual survey in late 2021.

Reeves called the Committee's attention to a letter from Jon Paul Rodriguez, Chair of the IUCN Species Survival Commission, to the Secretaries of the Mexican Navy, Environment, and Agriculture and Fisheries on 26 March 2021 to counter allegations that vaquitas are going extinct because of a change in salinity that allows shark predation within the vaquita habitat (https://iucn-csg.org/wp-content/uploads/2021/03/2021-03-26-SSC-vaquita-English.pdf).

The Committee commended Rojas-Bracho, Jaramillo, their teams of science and conservation collaborators, including co-operating fishermen and those involved in net-removal operations for continuing their work during challenging times in a difficult environment. The Committee also **agreed** to re-state previous recommendations briefly and to provide a link to the full text within last year's report.

Attention: SC, CC, CG
The Committee yet again **expresses** *its disappointment and frustration that, despite almost three decades of repeated warnings, the vaquita population edges closer to extinction caused by gillnet entanglement and ineffective fisheries management and enforcement measures in the Upper Gulf of California.*

The Committee **recalls** *its previous* **strong concerns and urgent recommendations** *for the vaquita (*SC20181*) and* **reiterates the urgent recommendations** *of the past five Committee meetings, especially regarding the need to remove gillnets from the species' range immediately.*

In addition, the Committee **urges** *the Mexican Government to re-establish conditions in the field that are safe for field personnel and which allow acoustic sampling, as well as a visual survey, to continue unimpeded; this is the only way the scientific team can continue to obtain reliable information on the status of the vaquita population.*

16.3.5 Yangtze Finless Porpoise (Neophocaena asiaeorientalis)

Wang Ding presented a summary of integrated practices and progress on protecting Yangtze finless porpoises (*Neophocaena asiaeorientalis asiaeorientalis*) in the People's Republic of China (PRC). *In situ* and *ex situ* programmes have been pursued since the 1990s, the objectives of which are to preserve the natural habitat, fill knowledge gaps by studying captive animals, establish seed populations in *ex situ* reserves, re-introduce seed animals into natural habitat and enable the wild population to recover. *In situ* measures have focused on restoring the Yangtze River ecosystem. To this effect, the Yangtze River Protection Law was introduced in early 2021, which implemented a 10-year fishing ban in the Yangtze River to preserve its biodiversity. *Ex situ* measures have focused on establishing semi-natural reserves. The first was established in Tian-e-Zhou oxbow (TEZ) in 1990, where a few additional translocations and many births have increased the population from 5 to 100 (as of 2021), demonstrating that these porpoises are able to survive and reproduce successfully within oxbow reserves. Based on the success of TEZ, two more semi-natural reserves and one enclosed side channel reserve have been established, holding approximately another 150 individuals, additional to those in TEZ. An experimental breeding programme was initiated by the Institute of Hydrobiology (IHB), Chinese Academy of Sciences in 1996 at an aquarium in Wuhan, with three successful births in 2005, 2018 and 2020. Overall, *in situ* and *ex situ* programmes have made significant progress towards halting the decline of the Yangtze finless porpoise population, though its conservation status remains of great concern.

Attention: SC, CC, S, R

The Committee **recalls** *its previous recommendations (*SC17364 and SC18169*) that every possible effort be made to protect Yangtze River finless porpoises in their natural riverine and lacustrine habitat, including the identification of river and lake segments with the highest porpoise concentrations, the enforcement of year-round protection measures (including fishing bans) in those areas, and the vigorous enforcement of a basin-wide prohibition of electro-fishing and other fishing activities known to threaten porpoises. The Committee recognizes the Chinese government for the progress made in implementing IWC recommendations and enacting other policies that benefit Yangtze finless porpoises and their habitat (IWC, 2016b).*

The Committee **commends** *the People's Republic of China for its implementation, in early 2021, of a 10-year fishing ban in the Yangtze River specifically to protect its biodiversity.*

This Committee **reiterates** *its previous recommendations that (a) pollution control measures be strengthened and (b) if further modification of the natural flow regime (or other natural features) of the Yangtze ecosystem is allowed to take place, that the potential impacts are considered and mitigated for finless porpoises.*

The Committee **respectfully requests** *that annual updates be provided to the Committee, both on the effectiveness of the fishing closure in the river and on progress made with the* in situ and ex situ *conservation programmes.*

16.3.6 Finless Porpoise-Marine (Neophocaena spp.)

SC/68C/SM/02 summarised a workshop held in 2019, attended by 30 scientists representing all range states of the two finless porpoise species *Neophocaena asiaeorientalis* and *N. phocaenoides.* Participants discussed issues and potential solutions for addressing bycatch, standardising research, management and conservation. Priorities for future work included: (a) collecting data on the interaction between finless porpoise and fisheries, (b) establishing an international committee to develop regional protocols, and (c) developing practical approaches for bycatch mitigation. Pros and cons of various measures for bycatch mitigation including acoustic deterrents (such as pingers), spatial-temporal closures, use of alternative gear, and enforcing regulation were discussed. Raising public awareness and educating communities was noted as a key step in supporting conservation efforts. The workshop agreed that lack of information on finless porpoise distribution, abundance, and population structure across their known range was one of the biggest issue impeding their conservation. In discussion, it was noted that this Committee had previously raised concerns over the level of direct porpoise takes in South Korea, however, it was noted that changes in South Korean national legislation has banned directed takes of porpoise (Notice No. 2018–98 of the Ministry of Oceans and Fisheries, August 27, 2018 (partially revised). Ministry of Oceans and Fisheries (Fisheries Resource Policy Division))[11]

Stokes presented a summary of conservation efforts for Indo-Pacific finless porpoise (*N. phocaenoides*) in Hong Kong S.A.R. waters (SC/68C/SM/04). Investigations into the increasing number of strandings in Hong Kong have been hindered by a lack of data on abundance, inconsistent reporting of strandings and the difficulty in determining cause of death (COD) using traditional necropsies. Multiple recommendations were presented, including the need to design abundance surveys specifically for finless porpoise, so that the growing number of strandings could be assessed in relation to robust population abundance estimates. Other issues highlighted included the lack of marine protected areas specifically for finless porpoise in areas of known high density (e.g., Lamma Island) and the need to increase enforcement efforts to mitigate threats from illegal, unregulated and unreported (IUU) fishing. Hong Kong banned all commercial trawling in 2012 to prevent the collapse of local fisheries. There is a need for more consistent reporting of finless porpoise necropsy results and use of state-of-the-art necropsy tools (e.g. SC/68C/SM/09, this report), as cause of death (COD) is established for only 5% of the finless porpoise stranded in Hong Kong waters. It was suggested that these findings, particularly those related to changes in finless porpoise

[11] *https://www.law.go.kr/%ED%96%89%EC%A0%95%EA%B7%9C%EC%B9%99/%EA%B3%A0%EB%9E%98%EC%9E%90%EC%9B%90%EC%9D%98%EB%B3%B4%EC%A1%B4%EA%B3%BC%EA%B4%80%EB%A6%AC%EC%97%90%EA%B4%80%ED%95%9C%EA%B3%A0%EC%8B%9C.*

density associated with decreased marine traffic activity related to COVID-19 restrictions, should be brought to the attention of the Marine Mammal Conservation Working Group (MMCWG). New approaches to strandings investigation could be used to further elucidate origin of stranded animals (Peltier *et al.*, 2014).

Progress was made with previous Committee recommendations regarding the use of passive acoustic monitoring (PAM) to study various aspects of finless porpoise behaviour and habitat use. Le Double presented a long term study that used acoustic detection devices to study Indo-Pacific finless porpoise (*N. phocaenoides*) behaviour and habitat use in Hong Kong S.A.R. waters (SC/68C/SM/06). Results showed diurnal and seasonal patterns in finless porpoise vocal activity, with most activity at night, and seasonally in April and May. Tidal height, CPOD angle, rainfall and water temperature were correlated with vocal activity patterns. Use of acoustic devices provided detailed information on finless porpoise behaviour and habitat use. Towed acoustic array surveys have recently improved detection rates, suggesting that acoustic surveys should be extended into eastern Hong Kong waters, where weather conditions often preclude effective visual survey monitoring. It was suggested that the establishment of a PAM database, to include the long-term dataset from this and ongoing Hong Kong studies, might benefit regional research and encourage collaboration. Including environmental parameters in this database would help to further explore population drivers. The extensive literature on harbour porpoise was noted; research tools and methods used for that species should be assessed for potential use with finless porpoise.

Kot summarised virtopsy investigations of Indo-Pacific finless porpoises that stranded in Hong Kong S.A.R. waters between July 2017 and November 2020 (SC/68C/SM/09). The study was conducted jointly with the Agriculture, Fisheries and Conservation Department of the Hong Kong S.A.R. Government and Ocean Park Corporation. Upon retrieval, carcasses underwent 'postmortem computed tomography' (PMCT), magnetic resonance imaging (PMMRI), 3D surface scanning (3DSS) and conventional necropsy using standard protocols. Out of 92 finless porpoise carcasses that were investigated, 32 showed evidence of bycatch (e.g. entanglement, entrapment) and vessel (e.g. sharp or blunt-force trauma) interactions. The remaining 60 showed evidence of non-human-related CODs (e.g. disease). Comparison of conventional necropsy and virtopsy techniques revealed that PMCT was better able to reveal skeletal trauma and pathological gas accumulation, whereas PMMRI was better able to detect soft tissue anomalies. 3DSS complemented PMCT and PMMRI, particularly for documenting injuries from fisheries and vessel interactions. These findings confirm that virtopsies are efficient, objective and non-invasive and complement conventional necropsies. Proper implementation of virtopsies in cetacean stranding response could significantly improve the ability to diagnose pathology and COD, thereby facilitating better management measures for conservation.

Wang, W.C., provided a summary of finless porpoise (both species) strandings in Taiwan (SC/68C/SM/19). In the past 21 years, a total of 307 strandings (about 5 per year) have been documented, most were of single individuals, except in 8 instances where two individuals stranded together. No mass strandings have been recorded. The majority of strandings occurred along the north and west coasts of Taiwan, which have significantly shallower waters than the east coast. In 2019 and 2020, finless porpoises were the second most frequently stranded cetaceans. Of the 43 finless porpoises stranded in 2019, 14 (33%) were attributed to possible bycatch, 1 (2%) to possible vessel strike and 28 (65%) to unidentified causes. Of 46 finless porpoises stranded in 2020, 2 (4%) were attributed to disease, 3 (7%) to possible bycatch, 1 (2%) to possible vessel strike and 40 (87%) to unidentified causes. There was a peak in strandings in early spring. Of 161 individuals that stranded between 2016 and 2020, 41 were identified as *N. phocaenoides* and 21 were identified as *N. asiaeorientalis*. The remaining 60% could not be identified to species, either due to decomposition or lack of identifying photographs, highlighting a need to implement species identification protocols. Since 2016, Taiwan has seen an overall increase in the number of finless porpoise strandings, particularly in the outlying islands (namely Kinmen Island and Matsu Island). This is a concerning trend and underscores the need to understand the status of finless porpoises in Taiwan. Gathering and analysing stranding information from nearby waters, such as China, Hong Kong S.A.R. and the Philippines, would be useful.

Morimura and Mori (2019) detailed the social responses of travelling finless porpoise to boat traffic in Misumi West Port, Ariake Sound, Japan, using imagery obtained from unmanned aerial systems (UASs). In total, 25 encounters between finless porpoise and vessels were recorded and results showed a group size effect in diving duration when vessels passed through groups of finless porpoise. This suggests that social bonds among conspecifics may mitigate collision risk. A fixed-wing drone has been developed for future line-transect surveys, which will help visualise the spatio-temporal dynamics of conflicts between finless porpoises and humans in the Ariake Sound.

Morimura (2021) detailed a structural analysis of behavioural freedom in free-ranging and captive chimpanzees and it was suggested that such an analyses could be used to better understand finless porpoise society. The results demonstrated that clearly distinguishable ranging patterns between free-ranging and captive chimpanzees could be discerned, namely the differences in dynamic and static ranging patterns based on range size variation, regardless of the absolute value of range size. It was suggested that the collection of such behavioural data in both micro and macro scales can be used to monitoring the conflicts between humans and animals.

Thomas, L., reported on estimating finless porpoise population density using passive acoustics (extracted from Marques *et al.*, 2013). Reliable estimation of population size is important for effective management and conservation. Currently, the most widely used estimation methods involve surveying animals along transect lines, but finless porpoise are difficult to observe. As finless porpoise produce readily identifiable sounds, passive acoustic monitoring (PAM) to estimate porpoise density, using both towed and static monitoring systems, may be an effective alternative. Towed arrays can provide large

spatial coverage; confounding factors (e.g., responsive movement or a change in acoustic behaviour near the research vessel) must be carefully considered. Static PAM can provide greater temporal coverage, but that approach requires information on acoustic detectability, particularly for poorly understood species. Fundamental research on vocalization rates and group sizes, and the relation between these and other factors such as season or behaviour state, is critical if this method is to be used for finless porpoise. It was noted that evaluation of these methods under known density scenarios will be important for empirically validating the suggested methods. Extensive information on sound production of Yangtze River finless porpoise (*N. a asiaeorientalis*) exists; Wang Ding offered to provide information if needed.

The Committee stressed that finless porpoises appear to be at risk from a myriad of human activities throughout their range in Asia. Regional collaborative efforts might expediate progress on the effective use of acoustic and other research tools, and clarify the status of both species. Effective methods could then be used elsewhere, e.g., the northern Indian Ocean, to improve information on finless porpoise throughout their range.

Attention: CC, CG-R, SC, S
The Committee has **previously expressed concerns** *(IWC, 2006; 2018d) that as it is likely that numerous small and vulnerable populations of finless porpoise occur discontinuously along their coastal range, research into population structure in the genus Neophocaena is urgently required.*

Information presented to this Committee indicates that the number of strandings are increasing in East Asia, providing an opportunity to collate a large, regional depository of genetic material. The Committee **reiterates its previous recommendation** *that analyses of existing specimens, pooling of samples and exchange of expertise between research groups would greatly advance the understanding of finless porpoise population structure.*

The Committee **agrees** *that to better understand and compare causes of mortality, disease prevalence and population health, a standard regional standings investigation protocol should be established and encourages researchers to do so, particularly in East Asia, where samples are readily available.*

Further, the Committee **encourages** *management authorities and/or strandings programmes to make full use of imaging tools as part of every necropsy procedures ('virtopsy'), when possible, as these techniques greatly improve our understanding of mortality, disease and health status, when compared to traditional necropsy alone.*

Attention: CC,CG-R, SC, S
The lack of robust estimates of density and abundance from throughout the species range, and noting that Passive Acoustic Monitoring (PAM) is a particularly effective monitoring tool for this cryptic and elusive species, the Committee **recommends** *that PAM, both static and vessel-based towed array surveys, be conducted as the primary means for gathering data for abundance estimation and distribution mapping, particularly in Hong Kong SAR where the number of strandings appears extremely high and better information on population size and density is urgently required.*

In addition, given the urgency of the situation in Hong Kong SAR, this committee **recommends** *that aerial surveys, using robust line transect methodology, be conducted without delay as a rapid means to establish population density so the impact of the high number of strandings on population status can be assessed.*

Further, to expand the scope of population size estimation data derived from acoustic studies, the Committee **encourages** *the use of additional parameters, e.g., salinity, time of day, to investigate the relationship between finless porpoise occurrence, behaviour and environmental variables.*

The committee notes with interest the changes in finless porpoise density and distribution related to the cessation of passenger ferry traffic in Hong Kong and encourages funding bodies to support research in this topic, as it is a unique and, likely, limited opportunity.

*This Committee notes the extensive body of work on harbour porpoise (*Phoecoena phoecoena*) and* **encourages** *researchers to assess the suitability and application of tools used in these studies for finless porpoise, including the use of Unmanned Aerial Systems (UAS).*

Attention: CC,CG-R, SC, S
Noting the paucity of data for N. phocaenoides *from the western part of the range, the Committee* **recommends** *that research efforts be increased in this area, including the Arabian/Persian Gulf, the Sea of Oman, Arabian Sea and the Bay of Bengal, with the primary objective of collecting baseline data on distribution, density and health that can support an improved understanding of the biology and knowledge of the status of* N. phocaenoides*.*

Attention: SC, ICG
The Committee **recognises** *that inadequate information exists on the distribution of* Neophocaena *throughout much of their range, although there is a growing body of data from East Asia. To assess current population status, collaboration and data sharing between groups currently working on finless porpoises is essential.*

The Committee **recommends** *that an intersessional correspondence group (ICG) be established, to collate existing information and to progress towards an assessment of both species throughout their range, and* **respectfully requests** *that this group reports back to the Committee.*

16.3.7 Atlantic Humpback Dolphin (Sousa teuszii)

Kamla and Kema presented a summary of a report compiled by the Consortium for the Conservation of the Atlantic Humpback Dolphin (CCAHD)[12]. (Minton *et al.*, 2020). The CCAHD is an informal collaboration that involves over 60 individuals, including scientists and NGOs from 13 of the 19 Atlantic humpback dolphin range states and international scientists involved in conservation of other critically endangered cetacean populations. Membership is open to all who wish to contribute. CCAHD has identified a shortlist of priority actions to address knowledge, resource and capacity gaps. Planned activities include a survey of the Saloum Delta, Senegal, to (i) deploy static acoustic monitoring devices to collect data on the distribution and relative abundance of Atlantic humpback dolphins, (ii) collect photo-identification information and (iii) train local scientists from Senegal, the Gambia and Mauritania.

Previously, the Committee expressed grave concern over the status of the Atlantic humpback dolphin and at its last meeting welcomed the first report on the consortium's development. In 2020, the Committee recommended that surveys be conducted in the Senegal/Gambia area without delay and it was heartened to learn that this is a priority action for the CCAHD. The Committee is encouraged by the swift progress made by this collaboration of researchers and stakeholders during the intersessional period.

There is overlap between CCAHD and the Committee's Africa-focused Sousa Task Team in terms of membership and goals. It was also noted that CCAHD has been working with the IWC Bycatch Mitigation Initiative (BMI), which is currently working to develop and externally fund a bycatch pilot project in the Republic of Congo. There appears to be strong synergy between the CCAHD initiative and the activities of the SC and IWC; much of the work planned by CCAHD will help address the Committee's concerns. Both CCAHD and IWC stand to benefit from maintaining a close and collaborative relationship. The IWC Secretariat agreed to reach out to range state Governments and other stakeholders in the region to highlight this initiative and to express support of CCAHD activities.

Attention: SC, CC, R

The Committee **draws attention** *to the progress made intersessionally by the Consortium for the Conservation of the Atlantic Humpback Dolphin (CCAHD) and* **welcomes** *the news that the consortium plans to conduct surveys in the Saloum Delta, Senegal, thus addressing one of this Committee's priority recommendations for the Atlantic humpback dolphin (Sousa teuszii).*

Understanding that a comprehensive list of actions and activities are planned, the Committee **respectfully requests** *that CCAHD report on their research, as results emerge, to the Committee and the Conservation Committee of the IWC, as appropriate.*

Further, given the synergies that exist between CCAHD and the Committee, through membership and work with the Bycatch Mitigation Initiative (BMI), it was **agreed** *that the Africa focused Sousa Task Team be restructured and focus solely on Africa Indian Ocean Humpback Dolphin (S. plumbea).*

The Committee **requests** *that the Task Team Steering Committee work with the existing Task Team and assist in redefining its purpose.*

16.3.8 South American River Dolphins (Inia geoffrensis, Sotalia fluviatilis)

Between 2011 and 2020, the density and abundance of river dolphins was estimated for 15 rivers in the Amazon and Orinoco basins (SC/68C/SM/11). The density of both botos (*Inia geoffrensis*) and tucuxis (*Sotalia fluviatilis*) varied significantly among areas and was linked to the features particular to each basin and to the hydro-geomorphological characteristics of each river, in addition to types and levels of human activity and habitat modification. Areas that are typically productive (e.g., the Japurá and Solimões rivers) had lower dolphin densities than expected (especially for botos). These are known areas where dolphins have been used as bait in the piracatinga fishery. Declines in dolphin numbers have also been reported from other areas where piracatinga fisheries exist, such as the lower Purus River which saw reductions of 37% and 6% in botos and tucuxis, respectively between 2012 and 2017 (CEPAM 2017).

The Committee received preliminary results of a river dolphin monitoring programme conducted in several parts of the Amazon that are heavily impacted by fisheries (IWC/68C/SM/12). The programme aims to estimate abundance and trends of both botos and tucuxis, based on encounter rates, and to document densities of gillnets. A total of 1,101km was surveyed and the highest encounter rate for botos was 0.4 dolphins/km (during flood season 2019, n = 75) and the lowest 0.2/km (during draining season 2018, n = 18). For tucuxis, the highest was 1.7/km (during flood season 2019, n = 331) and the lowest 0.9/km (during draining season 2018, n = 160). The highest number of gillnets counted in a single survey was 75 (170.76km surveyed). Although encounter rates may not represent best population monitoring index, low encounter rates of botos are concerning given the well-documented history of conflict between fisheries and botos. Continued and expanded studies that quantify mortality and assess the impact of bycatch and take of dolphins in the Amazon are urgently required.

The Committee received population estimates for Amazonian river dolphins in the Mamirauá Sustainable Development Reserve (MSDR) before and after a piracatinga fishery moratorium, which began in 2015 (IWC/68C/SM/16). The objectives of the study were to (i) compare encounter rates of botos and tucuxis between 2014–2020 and (ii) estimate dolphin density

[12] *https://www.sousateuszii.org/*.

between 2017–2020 by season and by year. There was a slight decline in the average encounter rate (groups/km) for botos between 2014–2017, but this decline was reversed, and the trend line plateaued between 2018–2020. Marmontel considered the apparent trend in encounter rate as likely reflecting the fact that botos were used as bait in the piracatinga fishery until the moratorium began in 2015. There was no change in average encounter rate for tucuxis between 2014–2017, likely because they were not used as bait to the same degree as botos. In one area, boto density (individuals/km^2) increased between 2017–2018 but has now started to decline. The reasons for this are unknown and should be investigated. Tucuxi density between 2017–2020 showed a slight increase overall. It is a concern that despite the moratorium, box traps (used for piracatinga fishing) and nets were recorded until 2019. Overall, these results indicate the importance of the piracatinga moratorium as a conservation strategy and the need to continue monitoring both dolphins and fishing activity in the MSDR.

Attention: SC, CC, CG-R, S
The Committee welcomes these updates on South American river dolphins and the impact of piracatinga fishing and ***reiterates its previous recommendation*** *that a regionally co-ordinated fisheries management plan for the Amazon River basin and a regional strategy for the conservation of river dolphins are established urgently. Further, the Committee* ***recommends*** *that;*

(1) alternative sources of income for local communities are developed in areas where the use of dolphins as bait in the piracatinga fishery is prevalent;
(2) research efforts are enhanced in areas where threats have been highlighted;
(3) regulations to prevent the use of dolphins as bait are actively enforced throughout the piracatinga fishing areas;
(4) cross-border controls are promoted among Peru, Colombia and Brazil to prevent illegal trade in piracatinga; and
(5) use of alternative sources of bait (e.g. slaughterhouse offal or pirarucu fishery waste products) are promoted and encouraged for the piracatinga fishery if it is allowed to resume.

Given continued concern over the use of dolphins as bait in the piracatinga fishery, the Committee ***recommends*** *that:*

(1) the Government of Brazil (i) extends the moratorium on piracatinga fishing to allow sufficient time to evaluate the effectiveness of protective measures, (ii) maintains and enhances the necessary protection of river dolphins and (iii) provides a report to the Committee on this matter at its next annual meeting; and
(2) the Committee requests the IWC Executive Secretary to send a letter, drafted with input from the Chair of the Committee, to the South American contracting governments within the range of the dolphins highlighting the issue of dolphins being used as bait in the piracatinga fishery and requesting joint efforts to enhance enforcement of wildlife and trade laws.

16.3.9 Irrawaddy Dolphin (Orcaella brevirostris) Riverine and Lagoon

In 2020, the WWF River Dolphin Initiative organised a tri-national workshop, including Myanmar, Cambodia, and Indonesia, to build on existing knowledge and to gain government support for collaborative initiatives, including a possible IWC Asian River dolphin CMP. The critically endangered freshwater populations of the Irrawaddy dolphin occupy three river systems in Asia; the Ayeyarwady, the Mekong, and the Mahakam. The workshop discussed each population in depth and reviewed progress on existing recommendations for the Mekong population. It was agreed that a 'threat-based approach' for an IWC Conservation Management Plan was appropriate. It was also proposed that interaction with the IWC Bycatch Mitigation Initiative (BMI) would be useful. Latest abundance estimates are ca.79, ca.79–81 and ca.89 for the Ayeyarwady, Mahakam and Mekong, respectively. All populations face severe threats from bycatch mortalities and range contraction.

In discussion, it was noted that researchers in Kalimantan have experience in rescuing and transporting Mahakam dolphins, and thus can provide a greater understanding of physiological responses to handling/transport, as well the feasibility of tag and release programmes. It was also suggested that environmental DNA (eDNA) may be a useful way to improve knowledge of distribution, in combination with passive acoustic monitoring.

The Committee **welcomed** the progress made by WWF in enhancing collaborations between the three range countries, to share knowledge, know-how and experience, and to thereby support and strengthen existing conservation work and guide future efforts.

16.3.10 Killer Whale (Orcinus orca)

SC/68C/SM/08 provided an update (Bolanos *et al.*, 2014) on the occurrence and natural history of killer whales in the Caribbean Sea, including 156 new records collected between 2012–2021. This review is based on 332 records in total, obtained from the published literature, biodiversity platforms, internet (social networks and video hosting websites), and citizen-based initiatives. Citizen-science reports were an important source of records (39%) as were research projects and activities (49%). Group size (mean: 4.1, range: 1–25) of Caribbean killer whales is not different from group size in other tropical regions (Perú, Ecuador, Hawaii), but it is different from group size reported in Western Africa. Orcas are widespread in the Caribbean, but are found in low densities. No temporal differences in group size were observed by season or month and killer whales were present at all times of year.

In discussion, it was noted that several research groups working throughout the Caribbean have photo-identification catalogues, but so far only one repeat sighting (from Honduras) has been found. Continued data collection and efforts to cross check between catalogues may eventually reveal some pattern of movements or site-fidelity, but this may take a long time to detect given the low density of these animals and the low number of dedicated surveys throughout the region.

SC/68C/SM/05 provided new information on killer whale interactions with longline fishing operations in the Sea of Okhotsk, Russia. Analyses of killer whale images obtained during interactions with long lines in 2017 identified 19 different individuals. The saddle patch visibility and dorsal fin morphology of the killer whales photographed were considered indicative of the 'mammal eating' ecotype and therefore, Gushcherov proposed that killer whales in the Sea of Okhotsk may not be strictly divided by food specialization alone, but may adapt to food availability. In discussion, it was acknowledged that indeed, the 'mammal eating' ecotype in this region may have learned to take advantage of an energy-rich fish species (black halibut) but otherwise exhibits behaviour and food specialization typical of killer whales elsewhere. The Committee **agreed** that more work is required to explore such a hypothesis further.

Attention: SC, CC, R
The Committee **welcomes** *the new information presented on killer whale (*Orcinus orca*) photo-identification in the Sea of Okhotsk, Russia, and* **reiterates** *its previous recommendation that these studies be continued and expanded.*

16.3.11 Bottlenose Dolphin-Ecuador (Tursiops truncatus)

SC/68C/SM/14 detailed the first results from surveys conducted for bottlenose dolphins (*Tursiops* spp.) in Central Ecuador. Initiated in February 2021, this research programme aims to: (1) map the occurrence and distribution of bottlenose dolphins that inhabit central Ecuador; (2) identify priority areas for cetaceans; (3) support marine park rangers; and (4) strengthen collaboration among researchers, conservation groups and other stakeholders. Initial results show that both coastal and offshore ecotypes occur, although much less frequently than elsewhere in Ecuador (Castro and Van Waerebeek, 2019; Castro and Rosero, 2010; Félix *et al.*, 2017; 2019).

Attention: SC, CG
The Committee **welcomed** *this new information. Acknowledging that the results are preliminary, the Committee* **respectfully requests** *that updates from this study be provided when available.*

16.3.12 White-beaked and Atlantic white-sided dolphins (Lagenorhynchus spp.)

In 2016 (IWC, 2017c), the Committee received a summary of current knowledge on *Lagenorhynchus spp.* and a list of recommendations aimed at addressing gaps in understanding of these species. The Committee subsequently encouraged studies to clarify the taxonomic revision of the genus *Lagenorhynchus* (SC/68C/SM/16). A recent study addressing matters of taxonomy was summarised by SDDNA (see Item 10.2.1.3).

16.3.13 Harbour Porpoise (Phocaena phocaena)

At SC68B, the Committee endorsed recommendations within the report of the International Workshop on the Status of Harbour Porpoises in the North Atlantic (IMR/NAMMCO 2018). The Committee also highlighted the challenges that exist for accessing reliable bycatch data and estimates, and noted the importance of this information for generating scientifically sound assessments. The Committee recommended that it was imperative to: (1) construct more reliable time series of bycatch data for the different fisheries in the different areas; (2) modify the fishing effort database in such a way that the data is consistent and reliable; (3) include by-catch data from small vessels in reporting, and (4) conduct more reporting of by-catch by different types of gear. Moan *et al.* (2020) addressed (1) and (3) and SC/68C/HIM/02 addressed (4). More details are presented in item 12.8.2.

16.3.14 Hector's and Māui Dolphins (Cephalorhynchus hectori)

The government of New Zealand presented several technical documents on the management plan already underway for Hector's and Māui dolphins (*Cephalorhynchus hectori*). New research on these species was also presented (SC/68C/SM/01). More details are presented in Item 12.8.1.

16.4 Small Cetacean Task Team Progress

Initiated in 2015, Task Teams aim to provide rapid and targeted responses to situations where significant and swift population decline of a species or population of small cetaceans is known or suspected to be occurring. Task Teams can be proposed at any time but must be endorsed by the Committee.

16.4.1 Review of Task Team Procedures

The Task Team terms of reference (TOR) were reviewed intersessionally, and small revisions were made (SC/68C/SM/22). The revised TOR were noted by the Committee and have been posted on the Task Team webpage (*https://iwc.int/task-teams*) and will be included in the updated Committee Handbook (IWC/67/FA/20)

16.4.2 South Asian River Dolphins

SC/68C/SM/07 provided an update on the South Asian River Dolphn Task Team's activities. A recent taxonomic revision (Braulik *et al.* 2021) has concluded that Indus and Ganges river dolphins should be recognised as separate species. The conservation of South Asian river dolphins is now actively being supported and addressed by domestic and international collaborations, in which many of the IWC task team members are involved. Therefore, the current task team has been suspended on the understanding that it could be reconstituted at any time should new actions be warranted on specific issues based on the recommendations made earlier by this task team. The Task Team Steering Committee will continue to monitor work on these two species and identify areas where additional work or involvement is required.

16.4.3 Africa-focused Sousa

Noting the request made under Item 16.3.7 Atlantic Humpback Dolphin (*Sousa teuszii*), the current Task Team will be restructured and focus solely on Indian Ocean Humpback Dolphins in Africa (*S. plumbea*) with guidance and support from the Task Team Steering Committee.

16.4.4 Lahille's bottlenose dolphin

SC/68C/SM/17 provided an update on activities of the Lahille's Bottlenose Dolphin Task Team, which has had two informal virtual meetings since it was proposed in 2020. The team has now received formal approval from the Task Team Steering Group (March 2021). Despite restrictions during the COVID-19 pandemic, photo-identification surveys and biopsy sampling continued during 2020 in the Patos Lagoon Estuary (42 surveys, 12 biopsy samples) and Laguna (18 surveys) but were delayed in other locations in southern Brazil, Uruguay and Argentina. At least 54 sightings of Lahille's bottlenose dolphins were reported by Uruguayan citizens; around half of these sightings were in the La Plata River estuary where sightings have been scarce for the last 40 years. The Task Team will continue with the activities suggested in previous Committee recommendations (IWC, 2019c, p.49; 2020c, p.88). Tarzia offered assistance by those working on similar issues in the Bycatch Mitigation Initiative.

16.5 Review direct takes and live captures of small cetaceans

16.5.1 Direct takes

The Committee received the summary of takes of small cetaceans. These data were, extracted from National Progress Reports, online reports of the Japan Fisheries Agency and other information provided to the Committee. The IWC Secretariat (Allison and Burkett) compiled data from 2014-2019 (see Annex J). Data prior to 2014 are available in IWC (2021a, p.219). The Committee **notes** its great appreciation for all who compiled and reviewed data on directed takes.

The Small Cetaceans sub-committee has been tasked with databasing all of its previous recommendations, while doing so it was noted that recommendations to develop more specific terms of reference for evaluating direct take data have been made by the Committee in the past (e.g. IWC 1979, p.50), including the possibility of developing case studies or other analyses from this information. The Committee **notes** that in the last two years, considerable effort has been expended on verifying and agreeing to all figures presented in this database, which now spans more than 23 years and includes information on catches (from 1997) and on quotas (from 2005)[13].

As at SC68B, the virtual nature of SC68C makes detailed discussion of some topics challenging, however, compilation of such data has been an ongoing activity and progress on analyses must be made as a matter of priority. The Committee **agrees** to establish a working group, to initiate discussion intersessionally on a framework, including TOR, for moving forward with direct take data analyses.

Attention: SC

The Committee **reiterates** *its previous recommendation to make progress on the analyses of the data in the direct take tables, compiled by the Committee.*

The Committee **agrees** *to establish a working group (co-convenors: Porter and Allison) to progress on this matter intersessionally and report to Committee in 2022.*

16.5.2 Live captures

Reeves presented information from the CITES trade database (UNEP-WCMC) indicating that China imported 56 live, wild-caught *Tursiops aduncus* from Solomon Islands between 2016 and 2018 for commercial and zoological purposes, and Ghana exported 50 live wild-caught *Tursiops truncatus* to China in 2019 for commercial purposes. Fisher explained that confirmation of these import and export records has been sought from the CITES Secretariat along with details of the required determinations that the specimens were acquired legally and that their export would not be detrimental to the survival of the species (in this case meaning the local population(s) of *T. aduncus* and *T. truncatus*).

Baird reported that the government of Solomon Islands had informed the South Pacific Regional Environment Programme (SPREP) that no dolphins were exported during the period in question (2016–2018) but the government has a new export quota of 10 dolphins a year and has not made a new non-detriment finding of CITES, i.e., that removals will not negatively

[13]The full dataset can be requested from *statistics@iwc.int*.

impact the population, which is required before any export can occur. Baird also noted that SPREP had sought information from the government of Solomon Islands about the status of a capture and export ban that was implemented in 2013 but which court records indicate was lifted in 2017. Frisch-Nwakanma offered the help of CMS to clarify the situation.

The Committee discussed the sustainability of live captures of *T. aduncus* in Solomon Islands in 2013 and concluded (IWC, 2014, p.50) that new survey results The Committee discussed the sustainability of live captures of *T. aduncus* in Solomon Islands in 2013 and concluded (IWC, 2014, p.50) that new survey results (Oremus *et al.*, 2013) 'reinforce previously expressed concerns regarding the sustainability of live-capture removals from this small island-associated population of Indo-pacific bottlenose dolphins'. The impact of removals of live bottlenose dolphins from Solomon Islands remains a concern, particularly in the absence of any new population information.

Attention: CG, S
The Committee **recalls** *its previous recommendations regarding live captures of* T. aduncus *in Solomon Islands (IWC, 2014, p.50). It* **reiterates** *its concern about the sustainability of removals and its longstanding, overarching recommendation that no small cetacean removals (live capture or directed harvest) should be authorised until a full assessment of status has been made (*SC19129*).*

The Committee again **recommends** *that the government of Solomon Islands implement the IWC's 2013 recommendations, verify the number of live-captures and deaths associated with captures since 2013 and the number of dolphins currently being held and clarify the status of the 2013 capture and export ban and the current export quota for* T. aduncus*.*

The Committee **requests** *the Secretariat to seek clarification from the CITES secretariat and governments of Solomon Islands and China on the reported import by China of 56 live, wild-caught dolphins from Solomon Islands between 2016–2018.*

No abundance estimates of *T. truncatus* are available for Ghana, or elsewhere in West Africa. Bycatch of *T. truncatus* in small-scale gillnet and purse-seine fisheries in Ghana has long been recognised (e.g., Ofori-Adu, 1987; Ofori-Danson and Odei, 1997; reviewed in Van Waerebeek and Ofori-Danson, 1999) and should be accounted for in any management decision. The bycatch rates provided in the above references suggest that bycatch of *T. truncatus* in Ghana have been unsustainable for at least two decades and that any additional removals for export would compound the negative effects to dolphins in the region. Uncertainties about abundance, stock structure and past and continuing removals of *T. truncatus* in the Gulf of Guinea raise concern about the sustainability of live captures.

Attention: CG, S
The Committee **recalls** *its previous* **expressions of concern** *about the sustainability of removals of* T. truncatus *and other small cetacean species in Ghana and the lack of information on the status of small cetacean populations in Ghanaian waters (IWC, 2011a).*

The Committee **reiterates** *its* **longstanding, overarching recommendation** *that no small cetacean removals (live capture or directed harvest) should be authorised until a full assessment of status has been made (e.g.,* SC19129*).*

The Committee **requests** *the Secretariat to seek clarification from the CITES secretariat and governments of Ghana and China on the reported export by Ghana of 50 live, wild-caught dolphins to China in 2019.*

16.6 Status of the voluntary fund for small cetacean conservation research

The Voluntary Fund for Small Cetacean Conservation Research currently totals £93,371.92 (SC/68C/O/03). Contributions were received from the Government of the United Kingdom, Animal Welfare Institute, Campaign Whale, Cetacean Society International (CSI), Dolphin Connection, Humane Society International, OceanCare, SeaLegacy and Whaleman Foundation.

The Committee **expressed** its sincere gratitude for these contributions and noted that the Fund is intended to support critical conservation research projects of direct relevance to the work of the small cetaceans sub-committee.

The Secretariat has updated the Small Cetacean Voluntary Fund webpage with a full list of donors, completed projects and new publications from the last call for proposals (*https://iwc.int/sm_fund*). A short video highlighting the 2016–2020 project on the Chilean dolphin has also been uploaded.

16.6.1 Review Panel Recommendations for 2021–22 Projects

The Small Cetacean Research Conservation Fund was developed in 2010 (IWC, 2011c, pp.289–290) and its purpose and procedures for use were finalised in 2011 (IWC, 2012, pp.282–284):

(1) the IWC Small Cetacean Conservation Research Fund is intended to support high priority research that demonstrably links to improving conservation outcomes for small cetaceans globally, particularly those species and populations that are threatened or particularly vulnerable to human activities;
(2) preference for funding must be based on a determination of need, the quality of the research application and the demonstration of links between research and conservation outcomes;

(3) proposals that demonstrate a capacity building legacy will be viewed favourably; and
(4) higher priority will be given to projects in line with recommendations made by the sub-committee on small cetaceans for its priority topics.

A call for proposals for new research projects was announced in early 2021 and 56 applications were received. The call was circulated widely, through IWC communication channels, such as the European Cetacean Society, the Society for Marine Mammalogy, and the Sociedad Latino-Americana de Especialistas em Mamíferos Aquáticos (SOLAMAC) list-servers, as well as social media groups in Asia and South America. Applications were received for studies in South America (28), Asia (9), Europe (8), Africa (6), Oceania (3) and the Caribbean (2) and included research, community awareness and capacity building projects. The Burmeister's and the finless porpoises were highlighted by many applicants as species of emerging concern. The Small Cetacean Research Fund Review Panel comprises the Chair and Vice-Chair of the Committee, the Secretariat Head of Science, Conservation and Management, the convenor and co-convenor of the Small Cetacean Sub-committee and five other members of the Committee with appropriate expertise and broad geographical representation. The panel followed the review procedures described on the IWC website (*https://iwc.int/sm_fund*).

The Review Panel considered each application and shortlisted 21 of the 56 proposals based on how well the project addressed recommendations made by the small cetaceans sub-committee. The projects were then scored, based on determination of need, the quality of the application and the demonstration of links between research and conservation outcomes and, when appropriate, the extent of the project's capacity building component. The successful applicants fulfilled the above criteria and their projects can be expected to demonstrably improve knowledge and conservation outcomes for species and populations that are threatened or particularly vulnerable to human activities. The Review Panel acknowledged the extremely high quality of all submitted research proposals and commended all applicants. The projects recommended for funding are detailed in Table 19.

Table 19

Proposals recommended for funding from the Voluntary Research Fund for Small Cetaceans.

Principal Investigator	Title	Species
Gopal Khanal	Understanding the effects of trans-boundary barrage operations on the Nepal-India border for Ganges River dolphin habitat and population dynamics	*Platanista gangetica*
Laura J. May-Collado	Rapid assessment of the occurrence and conservation status of Guiana dolphins at the northern periphery of their range in Central America	*Sotalia guianensis*
Mariano Alberto Coscarella	Population assessment and dynamics of Lahille's bottlenose dolphins in Argentina	*Tursiops truncatus gephyreus*
Yurasi Briceño	More knowledge, less mortality: education for the conservation of Guiana dolphins (*Sotalia guianensis*), Lake Maracaibo, Venezuela	*Sotalia guianensis*
Joanna Alfaro Shigueto	Assessing the conservation status of Burmeister's porpoises in Peru – trialling tools for estimating abundance and bycatch of this cryptic and poorly known species	*Phocoena spinipinnis*

The Review Panel's rationales for selecting the projects are summarised briefly below:

Khanal proposal: the effects of barrage operations on and near the Nepal-India border on Ganges River dolphin habitat and on the species' population dynamics in this portion of its range have been highlighted previously by the Committee and were among the critical information gaps identified by the South Asian River Dolphin Task Team [Recommendation of the South American River Dolphin Task Team Report, Annexed to SC68B. IWC 2021].

May-Collado proposal: the conservation status of Guiana dolphins in Central America is poorly understood and has been highlighted by the Guiana dolphin intersessional correspondence group (ICG) as a significant gap in current knowledge. [Recommendation of the Guiana ICG Report, Annexed to SC68B. IWC 2021]

Coscarella proposal: the Committee's concerns over the rapidly declining status of Lahille's bottlenose dolphins prompted the establishment of a Task Team in 2020 and this project is designed to fill some of the main knowledge gaps for this small, endangered subspecies (e.g., Item 16.4.4. above).

Briceño proposal: concerns for the Guiana dolphin population in Lake Maracaibo, Venezuela, where directed takes, bycatch and pollution are believed to cause serious population-level impacts (e.g., Item 16.1.1 above), have led this Committee to make several recommendations concerning the need for NGOs, researchers and authorities to work with local communities to document threats and mitigate impacts.

Shigueto proposal: The Burmeister's porpoise is one of the least-known small cetacean species and the Peruvian population is thought to be genetically distinct from porpoise in other parts of the species range. Both direct and indirect (bycatch) mortality are high and the lack of any abundance estimates has been a high concern of this Committee for the last several years [e.g., Recommendation to investigate magnitude of the use of this species as aquatic wildmeat (IWC, 2019c, p.50)].

The proposals recommended for funding will be included in the Committee's budget, for consideration by the Commission at their special session in September 2022. They will be highlighted under the heading of Voluntary Research

Fund for Small Cetaceans. Grant contracts, incorporating any suggested modifications and a specification of deliverables, will be developed by the Review Group and the Secretariat after formal approval of the projects by the Commission.

16.7 Workplan

The workplan was discussed both in session and via the 'Comments document'. Several ICG/AG were noted as long term and ongoing; Franciscana Review, Poorly Documented Take of Small Cetaceans, Recommendation Review, Guiana Dolphin Review, Small Cetacean Task Team Steering Committee, Lahille's Dolphin Task Team and Tursiops Taxonomy Review. In addition, several ICG were proposed during the meeting;

- South American River Dolphins, to coordinate CMP activities across sub-committees,
- Finless Porpoise (Marine) to consolidate existing information on both species of finless porpoise and develop regional collaborations,
- Direct Takes of Small Cetaceans, to develop a framework to analyse the 15 years of directed take tables that have been collated by the small cetacean sub-committee,
- ICPC/SM Communication platforms, to provide an easy mechanism for communication across various conservation initiatives, particularly the IUCN ICPC and SM,
- Sub-Committee Co-ordination, to improve communication across SC so that sub-committees can better coordinate discussion, when appropriate.

During the workplan discussion, requests were received to establish two new ICGs;

- Strait of Gibraltar Killer Whale, to compile information on the novel behaviour of the Strait of Gibraltar killer whale subpopulation, seek input from other marine mammal behaviour experts and suggest appropriate management actions,
- Beaked Whales, as it has been some years since SC reviewed beaked whales, this group review current progress work on the conservation of beaked whale species.
- The final SM workplan is presented in Table 20.

Table 20

Work plan for small cetaceans.

Topic	Intersessional 2021/22	2022 Annual Meeting (SC68D)
Franciscana Review (ICG)	Co-ordinate presentation of CMP projects across sub-committees.	Report progress
South American River Dolphins (ICG)	Co-ordinate presentation of CMP projects across sub-committees.	Report progress
Poorly Documented take of Small Cetaceans (ICG)	Continue development of framework for SM work on aquatic wildmeat.	Report progress
Recommendation Review (ICG)	Make progress on a review framework and propose a mechanism to establish regional and species assessment teams to review the past recommendations of the SM sub-committee so that they are current relevant and prioritised and conform to the new SC recommendation format.	Report progress
Sotalia guianensis (ICG)	Continue to compile relevant information on *Sotalia guianensis* to provide an action plan and recommendations to the Scientific Committee.	Report progress
Small Cetacean Task Team Steering Committee (AG)	Assist the Scientific Committee in providing timely and effective advice on situations where a population of cetaceans is or suspected to be in danger of a significant decline that may eventually lead to its extinction; the ultimate aim being to ensure that extinction does not occur.	Report progress
Lahille's Dolphin Task team	(1) Coordinate regional efforts; (2) work cooperatively with fishing communities and fisheries authorities to reduce bycatch; and (3) explore possible synergies with the Franciscana CMP and the BMI.	Report progress
Sub-Committee Coordination (new ICG)	Porter and Holm will work with SC sub-committee convenors to develop a strategy to better integrate the SM workplan across the SC as appropriate.	Report progress
Finless Porpoise (Marine) (new ICG)	Porter (Convenor), Brannan. Solicit membership for an ICG and compile existing work, with a view to initiating an assessment of both Indo-Pacific and narrow-ridged finless porpoise as an SM priority topic (2022–26).	Report progress
Direct Takes (new ICG)	Make progress on the analyses of the direct take data of small cetaceans compiled by the SC since 1977 (in consultation with IWC Secretariat Statistician).	Report progress
Tursiops Taxonomy (ICG)	Cipriano, Natoli and Rosel. Develop *Tursiops* taxonomy database and monitor new publications related to this issue.	Report progress
Beaked Whales (ICG)	Simmonds (Convenor). To review the opportunities for the Scientific Committee to progress work on the conservation of beaked whale species, including taking into account its previous contributions, and by working with others who are also interested in these taxa, such as ASCOBANS.	Report progress
Strait of Gibraltar, Killer whale (ICG)	Esteban (Convenor) García-Bellido, Rose, Sequeira, Simmonds, Porter. The ICG will grow its membership and compile information on the novel behaviour of the Strait of Gibraltar killer whale subpopulation, seek input from other marine mammal behaviour experts and suggest appropriate management actions.	Report progress
ICPC/SM Communication Platform	Porter, Trujillo (co-Convenors); discuss mechanisms to enhance communication among the different parties involved in conservation planning and actions for small cetaceans.	Report progress

17. WHALE WATCHING

17.1 Assess the impacts of whale watching and swim-with-whale operations on cetaceans

17.1.1 Studies on assessing impacts, (i) short-term; (ii) mid- to long-term; (iii) swim-with operations; (iv) Emerging areas of concern

The Committee welcomed an update of global swim-with-whale operations (SC/68C/WW/03) that was prepared to help support responsible whale watching in Timor-Leste and to inform the Committee about the current extent of swim-with-whale operations around the world. In discussion, it was noted that the Committee has done considerable work in the past on swim-with-whale operations, including global reviews (e.g. Hendrix and Rose, 2014) and a survey of operators (Gero *et al.*, 2016). The Convention on Migratory Species (CMS) has also done in-depth work on this topic (CMS, 2017; Notarbartolo di Sciara and Frisch-Nwakanma, 2018). Due consideration should be given to this body of work when reviewing the status of these types of whale watching operations, as should the fact that an English-based internet search will exclude some geographic areas where swim-with-whale activity is occurring.

The Committee noted that, after nearly five decades of research on mysticetes, no long-term, population level detrimental effects from whale watching have been reported in the literature. This contrasts with odontocetes, where long-term impacts have been identified in some delphinid populations. In fact, several mysticete populations subject to whale watching, some of it intense, are nevertheless steadily recovering from the depletion caused by whaling. However, it is important to note there is a lack of longitudinal studies on mysticetes related to whale watching impacts. The Modelling and Assessment of Whale watching Impacts (MAWI) initiative (Item 17.1.2) is part of the Committee's efforts to encourage and pursue such studies.

The presentation and discussion of Argüelles *et al.* (2016) and Chalcobsky *et al.* (2020) under Item 17.3.2 addressed short-term impacts.

17.1.2 Progress on plans for 3rd workshop on Modelling and Assessment of Whale Watching Impacts (MAWI)

The COVID-19 pandemic and other complications prevented the development and distribution of the planned questionnaire proposed for 2020 (see IWC, 2021a, p.96). The MAWI intersessional steering group intends to move forward with the questionnaire under the guidance of New. However, it was noted that timing and manner of its distribution would be key to maximising participant response, and the International Statistical Ecology Conference may serve as an appropriate venue to facilitate participant engagement.

Attention: SC, S

The Committee **agrees** *to postpone planning for a third workshop for the Modelling and Assessment of Whale Watching Impacts (MAWI) initiative (and, for budgetary reasons, return the allocated funding for the workshop to the Secretariat), and instead prepare and distribute a questionnaire intersessionally (as discussed at SC/68B; IWC, 2021, p. 96), targeting modelling and statistical experts, in an effort to determine the best methods to address research questions developed at the first and second MAWI workshops (New et al., 2018; New et al., 2015). Responses to the questionnaire will be collated, assessed, and presented at SC68D by members of the MAWI intersessional steering group (see Annex O), and its results will help determine whether a third workshop is necessary (see New, 2020).*

17.1.3 Review responses to MAWI questionnaire

See Item 17.1.2.

17.2 Update on IWC's General Principles for Whale Watching after intersessional discussion with the Conservation Committee and Secretariat

In 2019, the Committee approved revisions to the IWC General Principles for Whale Watching (IWC, 2020e, pp. 258–59), which have not been updated since 1996. The Committee drew the attention of the Conservation Committee (CC) and the Commission to the need to review and adopt updated General Principles based on this draft 'at the earliest opportunity' (IWC, 2020e, p.255). Wulff reported that the CC discussed the draft revisions at their virtual meeting in September/October 2020. Some CC participants proposed amendments to the swim-with provisions (see IWC, 2020e, appendix 2, Iiii, p.258) to encourage consideration of phasing out, rather than regulating, existing operations. Others noted that, while direct in-water interactions with cetaceans have increased potential for harmful interactions, the development of such operations should not be avoided as a principle. It was noted that the General Principles provide good precautionary advice, but some expressed concern that the proposed Principles were more restrictive than current science supports. Others noted the Commission should make very clear that these Principles are purely advisory in nature.

In light of these comments, the CC asked the CC's Standing Working Group on Whale Watching (SWG) to further review the General Principles and incorporate recommendations for final text into its report to the CC and the Commission at IWC/68, where the Principles would be reviewed and adopted. The SWG will discuss these proposed revisions over the next several months with a goal of endorsing or proposing revisions to be discussed by the Committee during SC68D.

In discussion, it was noted that whale watching is a rapidly expanding industry and there has been a tremendous body of whale watching science published since 1996. The current IWC General Principles are so outdated as to be unhelpful to the many governments that seek IWC input on developing guidelines and regulations governing whale watching. Work on updating the General Principles on Whale Watching dates back to at least SC/65A (Carlson *et al.*, 2013), although the proposed revisions have been available for review by the CC and SWG only since 2019. The postponement of IWC68 due to the pandemic has resulted in significant, if unavoidable, delays in reviewing and finalising the proposed update. Nevertheless, the SWG intends to have the final version reviewed and approved at IWC/68 in 2022.

Attention: SC, CC, C, S
The Committee **agrees** *that posting updated General Principles for Whale Watching to the IWC website has become a matter of urgency. Given the unavoidable delays in the Commission approving and finalising the proposed revisions to the General Principles approved by the Committee at SC/68A, the Committee* ***recommends*** *that those provisions of the proposed update that are not considered controversial, based on the discussion by the Conservation Committee in late 2020 and during the next Conservation Committee meeting in 2021, should be 'fast-tracked' if at all possible and posted on the website at the earliest opportunity. The remaining provisions will be posted when the Scientific Committee, the Conservation Committee, and the Commission approve a final draft.*

Attention: SC, CC, S
The Committee **recommends** *that, until the revised General Principles for Whale Watching are approved by the Commission for posting to the IWC website, the Secretariat take down the current General Principles (https://iwc.int/wwguidelines#manage) and replace them with a disclaimer, drafted intersessionally with assistance from the Convenor for the Sub-Committee on Whale Watching and the Chair of the Standing Working Group, noting that an update will be forthcoming.*

17.3 Progress with regional reviews of whale watching

The Committee reviewed two documents submitted by the Specially Protected Areas and Wildlife Protocol of the Cartagena Convention (SPAW) Regional Activity Centre (RAC): UNEP (2021a) regarding the potential development of a marine mammal watching certification programme for the Wider Caribbean Region (WCR) and UNEP (2021b), prepared by members of the SPAW Species Working Group, proposes a toolkit including education and outreach, capacity building, networking and certification schemes for implementing marine mammal viewing guidelines in the WCR. The SPAW RAC is asking for input from the Committee on which tools are best to include in the Toolkit and assistance in identifying pitfalls in a certification approach.

The Committee welcomed both of these documents, appreciating their depth and thoroughness. The Committee noted some pitfalls with certification schemes, including their abuse, when certificates are used to imply a holder employs best practices when in fact guidelines or codes are frequently violated. Non-certified operators can also undercut certified operators, offering less expensive excursions. ACCOBAMS' voluntary 'High Quality Whale Watching' certification programme[14] was offered as an example of a successful programme in French territories. ACCOBAMS has formed strong relationships with operators and employs an on-board observer scheme that inspects compliance once a year. Compliance can be monitored by other operators as well; peer pressure can be effective in this circumstance. Operator acceptance of guidelines is crucial where government monitoring is difficult.

Attention: SC
The Committee **agrees** *to form an intersessional advisory group to help provide recommendations, support and advice to the SPAW RAC of the Cartagena Convention in the Wider Caribbean Region with respect to the latter's proposed toolkit and certification plan for sustainable marine mammal viewing. See Annex O for Membership and Terms of Reference.*

The Committee discussed Fumagalli *et al.* (2021) which reviewed the approaches taken in quantifying the impact of cetacean tourism in New Zealand, and critically assessed the efficacy of the research and management strategies adopted. The paper proposed a set of best research practices, exposing the most notable knowledge gaps and identifying emerging research questions and suggesting four golden rules for future management efforts: (1) acknowledge cetacean tourism as a sub-lethal anthropogenic stressor to be managed with precaution, (2) apply integrated and adaptive site- and species-specific approaches, (3) fully conceptualise tourism within its broader social and ecological contexts, and (4) establish authentic collaborations and engagement with the local community. Despite New Zealand's early establishment of precautionary legislation and advanced tourism research and management approaches, there are flaws in its current schemes, and a need for more adaptive and comprehensive strategies.

[14] *https://accobams.org/main-activites/high-quality-whale-watching-certificate/*

The Committee welcomed this paper, noting the connection between it and the discussion on the IWC General Principles on Whale Watching. In discussion, it was noted that identifying where guidelines or regulations are working and where they are often violated would be a useful exercise. It was further noted that Marine Protected Areas are helpful to whale watching regulation (see Urbán and Viloria-Gómora, 2021, under Item 17.3.2) and early establishment of whale watching guidelines is important, rather than allowing bad practices to become entrenched.

It was reported that whale watching in Benin began in 2002; however, at-sea attacks by pirates started in 2009 and have continued to worsen, resulting in a halt in cetacean research and tourism in the area.

17.3.1 Sri Lanka

Researchers in Sri Lanka were contacted in advance of SC68C and indicated that papers will be available for presentation at SC68D.

17.3.2 Latin America

The Committee welcomed a review of current state of whale watching in Málaga, Colombia, analysed using data from 2011 to 2019 (SC/68C/WW/01). Whale watching operations, participants and trips increased greatly in this decade. However, existing whale watching guidelines were frequently ignored by operators, as there was limited government capacity for enforcement. Authorities need to determine the whale watching carrying capacity of Málaga, conferring with relevant stakeholders, and strengthen monitoring and oversight of this growing activity.

Attention: CG
Noting that whale watching operators in Málaga, Colombia, appear to violate current guidelines, the Committee **endorses** *the following recommendations (from SC/68C/WW/01), in order to promote responsible whale watching in this location: (1) compliance with the current whale watching guidelines; (2) vessel speeds below 10 knots in the whale watching area; (3) use of propeller-guards (especially for large boats); (4) land-based whale watching where possible; (5) hydrophones use in an effort to reduce vessel presence around whale groups; and (6) emphasis on environmental education.*

In addition, the Committee **agrees** *that operators forming a local whale watching association would improve cooperation amongst operators, which should reduce pressure on the whales and promote best practice within their ranks and* **encourages** *the Government of Colombia to facilitate the formation of such an association.*

Urbán and Viloria-Gómora (2021) noted that boat-based whale watching operations in Mexico target multiple mysticete species and 'swim with dolphins' excursions target multiple delphinids. In the past decade, whale watching income, trips, and jobs have greatly increased. Legislation is in place to regulate whale watching, but monitoring and enforcement were significantly higher when whale watching occurs within a Marine Protected Area. Regulations specifically for swimming with dolphins are now being considered. It was noted that the occurrence of swimming with whales (see Item 17.1) in Mexico is increasing, although it is not advertised.

Attention: CG
Noting that, in Mexico, monitoring and enforcement of whale watching regulations are significantly higher within Marine Protected Areas (MPA), versus outside of them (Urbán et al., 2021), the Committee **draws attention** *to MPAs as a strong tool for management and* **endorses** *this proposal for additional MPAs in Mexico. Where supportive data exist, the Committee generally* **encourages** *the designation of well designed, resourced and properly enforced MPAs to improve whale watching management and to assist with managing other human activities in marine habitat.*

Argüelles *et al.* (2016) described the short-term behavioural responses of southern right whale breeding groups in Península Valdés to different types of approach by whale watching vessels. Whales showed short-term behavioural reactions to boats, depending on several factors. If the boat approached according to guidelines, which included the engines being off, whales reacted positively, approaching the boat. Whales moved away from vessels not following guidelines. In the same location, Chalcobsky *et al.* (2020) studied the effect of whale watching boats on whale breathing rate, linearity of travel, reorientation rate and total distance travelled for different types of social groups (mother with calf, calf, adults). Short term movement patterns were not significantly affected by whale watching vessels. However, significant changes in breathing rates were detected for calves, which tend to surface less frequently and remain underwater close to whale watching vessels. This response should be studied further.

The Committee welcomed these studies and noted that Península Valdés is an example of an area with a mature whale watching industry and a growing whale population. A question was raised regarding whether it was best practice to keep a stationary whale watching vessel's engine on (in neutral) or off when in close proximity to whales. It was determined that the best practice is specific to species, location and even individuals, and that operators may need to prioritise vessel manoeuvrability and passenger safety when necessary. This operational factor should be assessed in every location, as any regulation will need to be based on solid evidence. There was general consensus that turning engines on, off and then on again was never ideal, as this can cause whales to startle.

17.3.3 Timor-Leste

New and Porter have been in contact with the Government of Timor-Leste during the intersessional period and have provided information and support to the Marine Tourism Association of Timor-Leste at their request, although engagement was limited due to the COVID-19 pandemic. The floods in Timor-Leste prevented the preparation of a document this year to update the Committee on the current status of whale watching in the country, but it is anticipated that a paper will be presented at SC68D.

17.4 Collaborative work within the IWC

The Committee is grateful that the Chair of the Conservation Committee's (CC) Standing Working Group on Whale Watching (SWG) was able to attend SC68C and offer an update on the deliberations within the CC and the SWG during 2020. It welcomes these detailed updates and looks forward to a similar update at SC68D.

17.4.1 Update on IWC's Whale Watching Handbook

Wulff provided an update on work planned for the Handbook in 2021. This work is now focused on consolidation of content, working with the Convention on Migratory Species to finalise and upload translations for all existing and new content, modest updates to existing content requested by countries/data providers and updating the searchable table of literature following SC68C. Any minor updates to the Handbook will be undertaken in accordance with the agreed Editorial Protocol (Smith and Minton, 2020). At its meeting in September 2020, the CC endorsed a plan to focus on promotion of the Handbook in 2021 and Wulff reported on some highlights. Highlights include (i) recording a live Handbook demo, which is published on YouTube; (ii) distributing an IWC Circular reminding the IWC community of the benefits of engagement with the Handbook, seeking support for promotion and highlighting the need for Spanish and French language outreach; (iii) holding an online event for tour operators and other stakeholders hosted by the Environment Society of Oman, at which the IWC Executive Secretary gave opening remarks and Minton gave a virtual tour of the Handbook and (iv) giving an October presentation to the UNEP SPAW CARI'MAM (Caribbean Marine Mammals Preservation Network) Conference.

The Committee welcomed the news that Minton had been awarded a contract to continue working on the Handbook. It is a very useful resource, of which the Commission can be justifiably proud.

17.4.2 Work of Conservation Committee's Standing Working Group on Whale Watching

It was proposed that Committee representation on the SWG be revised to include the Convenor of the Sub-Committee, and either the Chair or Vice-Chair of the Committee and one other Committee member. The Committee was invited to comment on this proposal and nominate this representative, as well as to nominate industry representatives, as there are two vacancies on the SWG for industry as ex officio members. The SWG welcomes closer collaboration with the Committee and hopes that the above proposals provide a positive way forward to strengthen collaboration and communication between the two committees.

Regarding industry representatives, it was noted that they should come from countries that have not yet been represented on the SWG (e.g. not from Australia or Mexico) and also from industries and operations of different types (e.g. large versus small vessels).

Attention: SC, S

*The Committee **agrees** to reconstitute a standing intersessional correspondence group on communication between the Conservation Committee's Standing Working Group on Whale Watching and the Scientific Committee's Sub-Committee on Whale Watching, with a Chair who is a member of both. Iñiguez was nominated to serve as Chair. Membership and Terms of Reference for this group can be found in Annex O.*

17.4.3 Collaboration with other SC sub-committees on platforms of opportunity and citizen science

No papers were submitted in 2021 but the Item will remain on the agenda for 2022.

17.5 Progress on previous recommendations

The majority of the recommendations are on-going, with work in progress toward their completion. Whilst there was the expectation that additional recommendations would be resolved by the present meeting, the COVID-19 pandemic prevented their conclusion, pending Commission approval.

17.6 Biennial work plan

The work plan is given in Table 21. Africa was identified as a whale watching region of interest to the Committee at SC68A. Given a possible review of the Indian Ocean Sanctuary (IOS; see item 18), pending Commission guidance, a regional review of whale watching on Africa's east coast, focusing particularly on Réunion, where swim-with-whale operations are now active, will be added to the agenda for SC68D. This review will also be offered to the Whale Sanctuaries Working Group. A call for papers will be made intersessionally in the region through members of the Committee. It was noted that several papers were published last year from research undertaken in Réunion, e.g. Hoarau *et al.* (2020), which could be discussed at SC68D.

It was also noted that the intersessional advisory group on communication with the Indian Ocean Rim Association (IORA; see Annex O) could assist with an IOS review, if one is undertaken. The remaining intersessional correspondence groups not previously mentioned – on human-induced behavioural changes of concern, Timor-Leste and river dolphin interactions – will continue.

It was emphasised that there should be proactive outreach to Committee members and users of citizen science from cell phone whale watching apps to prepare papers for SC68D under item 17.4.3 and addressing previous IWC recommendation SC19147 (1) and (2).

Table 21

Summary of the work plan for matters related to whale watching. Several of these items have intersessional correspondence groups (ICG) or intersessional advisory groups (IAG). Those groups will work intersessionally and provide updates at SC/68D.

Topic	Intersessional 2021/2022	2022 Annual Meeting (SC68D)
Assess the impacts of whale watching on cetaceans – PRIORITY (i) Short-term impacts. (ii) Mid- and long-term impacts. (iii) Swim-with operations. (iv) Emerging issues of concern, e.g. drones and other emerging technology in the context of whale watching.	Prepare papers	Papers to be presented
MAWI questionnaire	Email correspondence and work	Paper to be presented
Finalise IWC's General Principles for Whale Watching (*https://iwc.int/wwguidelines*)	–	Receive update
Review whale watching in Timor-Leste	Intersessional correspondence and work	Papers to be presented
Review whale watching in Sri Lanka	Prepare papers	Papers to be presented
Review whale watching in Reunion and Zanzibar	Prepare papers	Papers to be presented
Intersessional correspondence groups	Email correspondence and work	Receive reports
Increased collaboration with other sub-committees, particularly regarding platforms of opportunity and citizen science data	Email correspondence and work	Receive updates
Discuss documents on whale watching in Indian Ocean Sanctuary Area to assist with possible review	Prepare papers	Papers to be presented

18. WHALE SANCTUARIES (SAN)

18.1 Updates from relevant sub-committees on new information relevant to the Southern Ocean Sanctuary management plan

Due to a variety of logistical issues related to the pandemic's shut down of scientific activities in Sanctuary regions and the nature of this year's virtual Committee meeting, the Committee decided to postpone most of the work of the Ad Hoc Working Group until SC68D. However, the Committee emphasised that in 2022 the activities of the Working Group will be substantive due to the initiation of the decadal review of the Southern Ocean Sanctuary (SOS).

The SOS was established in 1994 and Paragraph 7(b) of the Schedule, which established the SOS, specifies that the SOS '…shall be reviewed ten years after its initial adoption and at succeeding ten-year intervals…'.

In 2003, the Commission directed the Committee to undertake the first in a series of decadal (1994–2004) reviews of the SOS (IWC, 2004, pp.47–50). Thus, 2024 will mark the third decade of the Southern Ocean Sanctuary and preparations need to be made for a decadal review.

18.2 New information for other sanctuaries

The Commission adopted the Indian Ocean Sanctuary (IOS) in 1979; this adoption was reviewed and renewed in 2002. Therefore, 2022 will mark the end of the second decade since the renewal of the IOS. The Committee requests guidance from the Commission on whether it should conduct a review of the IOS.

18.3 Progress on previous recommendations

The Committee will take into consideration previous instructions from the Commission to the Committee for Review of Sanctuaries (IWC, 2002a), Resolution 2002–1 providing guidance to the Committee on the Sanctuary review process (IWC, 2003), and the terms of reference for the review of Sanctuaries (IWC, 2016d) as it prepares for review of the SOS.

In discussion, it was noted that the Terms of Reference (ToR) should perhaps be updated to take into account the broadening of the scientific range covered by the Committee, for example, the role of ecosystem functioning (see Item 11.5.2). The Committee **agreed** that discussing the Terms of Reference would be added to the Agenda for next year's meeting.

In addition, it was noted that several Committee documents and work streams could prove useful to the review process, including the State of the Cetacean Environment Report. An updated version of the review of SOS research – which was

presented previously (SC/66B/SAN/01) – would also be useful and a drafting group (to be led by Bell) was established to update the document. For the IOS region, the proposed pan-regional survey initiative (SC/68C/ASI/16) and Bycatch Mitigation Initiative work were also suggested as useful topics to include in IOS discussions. Documents relevant to both the SOS and IOS will be reviewed at next year's meeting, and relevant contributions are **encouraged**.

18.4 Work plan

The work plan for Sanctuaries is given in Table 22.

Table 22

Work plan for Sanctuaries.

Item	Intersessional 2021/2022	2022 Annual Meeting (SC68D)
Southern Ocean Sanctuary	Establish Southern Ocean Sanctuary (SOS) review Steering Group	Report
	Begin update of the Sanctuary review Terms of Reference	Report
	Develop a list of potential SOS reviewers	Report and finalize reviewers
		Review documents relevant to SOS review
		Plan for or initiate SOS review
Indian Ocean Sanctuary		Receive documents relevant to the IOS

The process for the review of the SOS will follow previous guidance (IWC, 2016c). Parsons will serve as convenor for an intersessional Steering Group (SG). That intersessional SG will begin review of the ToR and solicit suggestions from Committee members for potential external reviewers with recognised expertise in relevant research fields. An agenda for an Ad Hoc Working Group on Whale Sanctuaries at SC68D will be developed based on the following.

Proposed Agenda for the Ad Hoc Working Group on Whale Sanctuaries at SC68D

1. INTRODUCTORY ITEMS
   - 1.1. Opening remarks
   - 1.2. Election of Chair
   - 1.3. Appointment of rapporteurs
   - 1.4. Adoption of Agenda
   - 1.5. Documents available
2. PREPARATION FOR THE DECADAL REVIEW OF THE SOUTHERN OCEAN SANCTUARY (SOS)
   - 2.1. Form a SOS review Steering Group
   - 2.2. Discuss Terms of Reference
   - 2.3. Discuss the SOS Review process
   - 2.4. Receive the State of the Cetacean Environment Report
   - 2.5. Receive documents on the SOS
   - 2.6. Plan joint work with ASI to review SOS whale stocks and abundance
   - 2.7. Plan joint work with the WW sub-committee to review whale watching in the SOS
   - 2.8. Other SOS review matters
3. DISCUSS REVIEW OF THE INDIAN OCEAN SANCTUARY (IOS)
   - 3.1. Receive documents on the IOS
   - 3.2. Whale watching in the IOS (joint with WW)
   - 3.3. Draft request to the Commission on guidance re: IOS review.
4. WORK PLAN AND BUDGET CONSIDERATIONS
5. ADOPTION OF REPORT

19. EXTINCTION INITIATIVE

19.1 Extinction Initiative Report

Michael Stachowitsch (Austria) presented an update on the Extinction Initiative. This initiative grew out of a suggestion at SC/68B that the Committee should be better prepared to address the potential extinction of a cetacean species, possibly by preparing in advance a template for a statement noting that such an event had occurred (IWC 2021, p.96). The initiative was initially developed within the Small Cetacean sub-committee but was continued by an intersessional group including participants from other sub-committees, and has had extensive support from the Secretariat including coordination of the effort by Kate Wilson.

This initiative was developed to address a key component of the IWC's mission – preventing cetacean extinction – and builds off momentum to identify species or populations of particular concern to better address potential extinction. The

initiative provides a mechanism for the IWC to respond in a timely manner to an actual extinction of a cetacean species, to be proactive in highlighting pending extinctions, and it increases communication and outreach efforts.

In the following intersessional period, this initial extinction initiative was expanded to encompass two tasks: (1) to create a new IWC webpage on extinction and cetaceans; and (2) to develop templates for statements, to be issued by the IWC, warning that extinction of a species or extirpation of a local population seemed likely to happen in the near future, was also developed. The templates are intended to communicate news of an extinction to the public and perhaps raise support for measures to help avert such a catastrophe. The IWC website page has text focused more generally on the topic of extinctions and an explanation of the IWC's crucial role in addressing 21st century threats and preventing cetacean extinctions (*https://iwc.int/cetaceans-and-extinction*). The text in the extinction and extirpation templates, and the website, have been developed as communications tools to facilitate outreach and education, and do not commit the IWC to any specific actions.

The IWC webpage on extinction and cetaceans went online on 3 March 2021 (UN World Wildlife Day). Templates were developed for species of concern, divided into three extinction scenarios: actual extinction, serious concern of extinction raised, and disappearance from a region (extirpation). Draft versions to test these templates are being prepared for franciscana, vaquita, Hector's and Maui dolphins, and Rice's whale. This initiative was presented to and endorsed by the Conservation Committee in 2021, with the intention to proceed as a joint or parallel project, as the CC is already working on directly relevant issues.

The Scientific Committee recognized the Secretariat's excellent work on the website, and thanked Wilson and the Secretariat for putting it together, noting that it looks very professional and has added considerably to IWC's outreach efforts to the general public. The Committee also noted that public education as well as communication from the SC to the Commission is an important aspect of the Committee's work.

In discussion, it was noted that identifying and prioritizing vulnerable species and populations is a difficult task, that different fora with different objectives would likely come up with different lists, and that within the SC there are various similar or related efforts. The Abundance Estimates, Stock Status and International Cruises (ASI) sub-committee is developing a status of stocks list, starting with baleen whale stocks that are at risk and for which there are takes, and distinguishing between data-rich/data-poor species, as well as incorporating anthropogenic threats into their considerations; a website page with that list is also planned. IUCN publishes a list of the most endangered species (IUCN, 2021; see Item 19.2, this report), and many Committee members contribute to that effort; the approach and criteria used for that effort do not necessarily overlap with IWC's in-depth assessments of species and stocks. The recently formed IUCN Cetacean Specialist Group adjunct, ICPC (Item 16.2.1) is planning to hold a two-day workshop just before the upcoming Society for Marine Mammalogy biennial in Palm Beach, Florida, 13–17 December 2021, and one of the items planned for that workshop is initiation of such an extinction risk/priority ranking exercise.

It was noted that the discussion about this at SC/68C had also led to the development of an independent statement of concern signed by many SC members and others from more than 40 countries. This statement was made public in September 2020 and presented at the Conservation Committee (see 'The Real and Imminent Extinction Risk to Whales, Dolphins and Porpoises', *https://www.mammalresearchinstitute.science/whale-unit*).

During discussion a concern regarding timing was expressed, since the next Commission meeting is not until 2022, meaning first statements of concern would not go out until 2023, which could be problematic if any concerns involve critically endangered species that require action before that time. A proposal was made that any species of urgent concern so identified could be presented to the Commission at its special meeting in September 2021. Additional next steps require broader consensus and input from other areas of expertise, including outside of the IWC. These steps include identifying the most vulnerable species or populations, prioritizing the taxa for which IWC statements should be prepared, and, in close cooperation with the secretariat, recommending to the Commission that specific statements be made public.

An intersessional steering group was created to advance this work. Members include: Cipriano, Cooke, Hines, Jiménez, (Sarah) Malette, Minton, Parsons, Porter, Rojas-Bracho, Scheidat, Simmonds, Torres-Flores, Trujillo, Slooten, Stachowitsch, Stimmelmayr and Zerbini. Simmonds agreed to act as convenor. It was suggested that the convenor of this steering group for the extinction initiative be added to the ASI small working group.

Attention C, CC, SC

The Committee **recalls** *the discussions at SC/68C about developing a communications plan to increase public awareness about extinctions in general and extinction risks for cetacean species in particular (IWC 2021, p.96) and* **commends** *the work of the Extinctions Initiative intersessional group and Secretariat on this work.*

The Committee **endorses** *the goals identified by the Extinction Initiative.*

The Committee **suggests** *that the SC's conclusions be forwarded to the CC, and that the initiative be forwarded to the Commission for its endorsement.*

The Committee **agrees** *that the extinction initiative steering group should: a) communicate with ASI to avoid a duplication of efforts; b) communicate the need for any statements of concern to the Commission's special meeting in September 2021; c) further discuss collaborations for cetacean extinction risk and priority ranking with relevant organizations, such as CMS and ICPC; and d) the extinction initiative should remain on the SC's agenda for next year's meeting.*

19.2 IUCN Report

Braulik, on behalf of the IUCN Cetacean Specialist Group (CSG), presented an overview of the IUCN's Red List program, with a focus on cetaceans. This overview described how Red List entries are produced, how they should be interpreted, and how they can help inform IWC priorities, including the Extinctions Initiative. The IUCN Red List and its criteria are well known and used worldwide to inform legislation and policy decisions, funding allocation and assigning conservation priority. It is important for the List to be up-to-date and each individual assessment to be scientifically comprehensive and robust. The CSG is composed of volunteer scientists (many of whom are also members of the IWC Scientific Committee) who produce the assessments. The assessments are reviewed by Red List Focal Point Taylor and Chair Reeves to ensure consistency with the way the criteria are applied and are further reviewed by additional experts, often members of the CSG, who are named on the published version. The assessments are then submitted to the IUCN Red List Unit and are usually published within three months of the final assessment. Editions of the Red List are published two to three times a year and new or revised assessments are announced on the CSG website (iucn-csg.org) once they are available. In the last two and a half years, the CSG has done a complete re-assessment of cetaceans (104 new or updated assessments including all 90 assessed species). Until recently, many cetacean species were classified as Data Deficient, but now only 10% of cetacean species are Data Deficient. Just over 50% of cetaceans listed are 'Least Concern,' and 24% are listed in a threatened category (Critically Endangered, Endangered, or Vulnerable). A small number are listed as Near Threatened. Due to limited resources, not all sub-species and populations have been assessed, and priority has tended to be given to those of particular concern. Consequently, while the coverage of species is complete, the number of sub-species and sub-populations in the various categories is not representative of the global situation.

The Committee acknowledged the value of the IUCN Red List and thanked the members who have contributed to it.

During discussion it was noted that the criteria for the Red List looked at a number of issues during development and went through a number of iterations. Considerable experience was gained during the development of the criteria. If the IWC develops its own lists, it should look to the IUCN's experience. The intersessional group established to take forward the Extinctions Initiative will include several members involved in the Red List process.

Differences were noted between the IUCN Red List and the approaches of the Committee and other international bodies in relation to the unit of assessment (e.g. species versus stocks or populations), the intent behind programs, and the criteria for status. The purpose of the IUCN list is to provide an alert where there appears to be a conservation problem rather than a definitive verdict on the status of a species or population. The Committee should be mindful of the purpose for which each list is created, as different schemes have different objectives.

Differences between the two lists were also noted, such as the use of terms (species versus stocks or populations), the intent behind programs, and the IUCN's criteria for status, which can often differ from those being used in other international organisations, particularly in the case of fisheries. It is also important to understand that the purpose of the IUCN list is not to provide a definitive verdict on stock status but rather to provide an alert where there appears to be a problem with the status. It was noted that the Committee should be mindful of purpose of the lists created, as various groups have different objectives. The need for active communication was highlighted in order to achieve objectives.

20. IWC LIST OF RECOGNISED SPECIES

Brownell and Mallette presented a revised list of scientific and common names to be used by the Committee. Six new species have recently been described or resurrected: *Balaenoptera ricei, Platanista minor, Sousa plumbea, Sousa sahulensis, Berardius minimus* and *Mesoplodon hotaula.* Two other species (*Inia boliviensis* and *Delphinus capensis*) were removed from the list because they are now considered subspecies. A few other corrections were made at the Family or generic level. All of these proposed changes are in agreement with the List of Marine Mammal Species and Subspecies (List) used by the Society for Marine Mammalogy (SMM). The Committee's practice in recent years has been to follow the SMM List. The Committee **agrees** that this practice should continue.

It is noted that the SMM Taxonomy Committee recently reviewed Rosel *et al.* (2021), *Balaenoptera ricei* (Rice's whales) and is currently reviewing the proposal made by Braulik *et al.* (2021) to recognize South Asian River dolphins as two separate species (*Platanista gangetica* and *P. minor*). The SMM Taxonomy Committee's revised list will not be published before the end of the 2021 SC meeting. However, the Committee received a report that Rice's whales was accepted as a distinct species by the SMM Taxonomic Committee and the new species name was used this year in several subcommittee reports. Based on the extensive review and compelling evidence presented in Braulik *et al.* (2021), the two *Platanista* species names have also been used in the Small Cetacean subcommittee discussions and reports. Therefore, we are proposing that both of these species be included in the Committee's list at this time.

21. IWC DATABASES AND CATALOGUES (PH AND GDR)

21.1 Guidelines for IWC catalogues and photo-ID databases (PH)

The Committee agreed to postpone this item until SC68D in 2022.

21.2 Progress with existing or proposed new catalogues (PH)

Recent developments in artificial intelligence (AI) technology for recognizing individual whales are revolutionizing the ability to use photo-identification data as a research tool. Cross-comparisons of ocean basin-wide photographic databases numbering in the thousands of individuals are now possible, yielding information on population structure, site fidelity, site connectivity, and life history.

21.2.1 Southern right whale photo catalogues

SC/68C/PH/04rev01 provides an update on the progress of successfully using an AI algorithm for matching right whale photographs using the platform Flukebook. This project was a NOAA-led collaboration with the New England Aquarium, Wild Me, Deepsense.ai, Kaggle, and right whale researchers around the world. In 2021, the system was expanded to include southern right whales, and Flukebook successfully implemented multi-feature matching. Multi-feature matching allows right whales to be matched by vertical photographs of their heads (Deepsense), lateral photographs of their heads (Pose Invariant Embeddings), flukes (new CurvRank v2), and peduncle scarring (HotSpotter). This capability to apply new forms of AI and match an individual North Atlantic right whale from multiple poses and marks has now been successfully cross-applied to southern right whales.

In discussion it was explained that while the top-1 accuracy rate is 89% during testing, currently the real-world top-1 accuracy rate is approximately 60%. The authors encouraged Committee members and catalogue holders to submit photographs of southern right whales to aid in training the AI algorithms, trial the system, and provide feedback. The development of this AI system is timely for the cross-region catalogue comparisons relevant to population assessments of southern right whales and the Committee **draws attention to** its importance and **looks forward** to future updates (see also Item 8.2.3.6).

SC/68C/SH07 describes the new Southern Right Whale Consortium. This collaborative research group involves 22 researchers from 7 countries. The group aims to compare population demographics across the main Southern Hemisphere wintering grounds by applying a common demographic model to populations in each region (South Africa, Argentina/Brazil, Australia, New Zealand), to investigate correlations between southern right whale reproductive success and environmental variables. This work forms a critical component of the IWC-SORP Theme 6 '*The right sentinel for climate change: linking foraging ground variability to population recovery in the SRW*' (see SC/68C/SH12). The group's current priority is the continued development of the common biological model for population assessments, and a future priority will include working with Flukebook and other AI systems to develop a global photo-identification catalogue. The Committee **commended** the researchers for their collaboration and acknowledged the importance of the Consortium's work and eventual development of a global catalogue for population assessments. Future updates are **welcomed** by the Committee.

21.2.2 Happywhale database

SC/68C/PH/03rev01 reviews the recent progress of Happywhale (*www.happywhale.com*), a web-based cetacean photo-identification crowd-sourcing platform. Happywhale implements a fast and accurate automated image recognition of humpback whale flukes. Cheeseman *et al.* (In press) details the development of the algorithms behind Happywhale, including a Kaggle competition and subsequent accuracy testing. Happywhale is a valuable tool as a broad research collaboration platform for humpback whale fluke photo-identification, used to the greatest extent in the North Pacific Ocean. As of March 2021, Happywhale had found 276 breeding ground interchanges between Hawaii and Mexico, about 3% of each area's population, where prior to this collaboration only about 20 such interchanges had been found, about 0.25% of previously compared datasets. In Southeast Alaska, capture probabilities above 90% are enabling studies dependent upon a high recapture rate, such as body condition assessment between breeding and feeding grounds. The results from photo comparisons by Happywhale are integral to the current in-depth assessment of North Pacific humpback whales being conducted by the Committee. Also see Item 8.1.1.

While 98% of the Happywhale data collection consists of humpback whales, the other 2% of global cetacean encounters includes 62 species and ecotypes. The data originate primarily from opportunistic citizen science contributions but also include efforts from research collaborators. Examples of research use of opportunistic data include over a dozen individuals added to the Antarctic Blue Whale Catalogue (e.g. SC/67B/PH/02) and a southern right whale match found between the Antarctic Peninsula and the island at 54°15'S 36°45'W, the first recorded migratory connectivity for this area for the species (SC/68C/CMP/08rev01). Unlike for humpback whales, Happywhale does not currently have an AI algorithm implemented for other species.

The Committee **recognised** the substantial contribution that Happywhale is making to research focused on populations of humpback whales and **encourages** future updates.

21.2.3 Flukebook

Applications of Flukebook were presented in SC/68C/PH/04rev01 (see Item 21.2.1).

21.2.4 Southern Hemisphere blue whale catalogue (SHBWC)

The results of an internal reconciliation of a blue whale photo catalogue from Chilean Patagonia were presented in SC/68C/PH/05. A total of 206 individuals (155 left sides, 144 right sides) have been identified using photographs taken

between 2003–2015. Of those, 35 individual whales were re-sighted within the same season, and 45 were re-sighted from previous years, suggesting feeding area fidelity was similar to elsewhere in southern Chile (see SC/68C/SH/23rev01). The Committee thanked the authors for the completion of this work and **strongly encouraged** them to submit photographs to the Southern Hemisphere Blue Whale Catalogue. With the addition of Patagonian photos, the dataset for the southeastern Pacific will be complete within the Southern Hemisphere Blue Whale Catalogue and the full dataset can be used for population assessments (see Item 8.2.1).

SC/68C/PH/02 contains a guide for photo quality coding for blue whale photographs. The guide has been used by the Southern Hemisphere Blue Whale Catalogue since 2018 and was presented to the Committee in order to make it accessible to members and to other researchers. In addition to the Southern Hemisphere Blue Whale Catalogue, the guide is used for the Antarctic Blue Whale Catalogue and a Sri Lanka catalogue.

SC/68C/SH/22rev01 provides information on the progress made with the Southern Hemisphere Blue Whale Catalogue. During the past year the catalogue was moved to the IWC and has benefitted from the support from the Secretariat IT staff. The catalogue now holds a total of 2,189 individual blue whale photos (1,616 left sides, 1,572 right sides, 91 flukes) that include regions off Antarctica, Chile, Peru, Ecuador-Galapagos, eastern tropical Pacific (ETP), Australia, Timor-Leste, New Zealand, southern Africa, Madagascar and Sri Lanka. From May 2020 to March 2021, new photo-identifications (416 IDs) were received from areas off Chile, New Zealand, Timor-Leste, Sri Lanka and the Southern Ocean. Photo comparisons from within the southeast Pacific and to the ETP, with photographs received up to March 2020, were completed. One match between southern Chile and the ETP provides evidence of migratory movements, similar to the findings in Torres-Florez *et al.* (2015). Photographic matches were found within southern Chile and within northern Chile, revealing site fidelity to these feeding areas (see also SC/68C/SH/23rev01). Datasets from Australia, New Zealand, and the southeastern Pacific (primarily Chile) are being prepared for use in population assessments. While these regions are currently the priority, photographs from Sri Lanka and regions of the Indian Ocean, and from Timor-Leste are being added to, and compared within, the catalogue for pre-assessments of populations from these regions (see Item 8.2.1.4).

The Committee **commended** the work of the catalogue team and all contributing research groups for the substantial progress made by the catalogue in the past year.

Attention: SC, SH, R

*(1) The Committee **strongly encourages** the uploading of photographic data from northern Patagonia, Chile into the Southern Hemisphere Blue Whale Catalogue.*

*(2) The Committee **agrees** that the Southern Hemisphere Blue Whale Catalogue continues its work preparing photo-identification data for the southeast Pacific, Australia, and New Zealand for population assessments.*

*(3) The Committee **agrees** that photographic data from the Indian Ocean should continue to be added to the Southern Hemisphere Blue Whale Catalogue to provide data for pre-assessments.*

21.2.5 Antarctic blue whale catalogue (ABWC)

The Committee was informed (SC/68C/PH/01rev01) about the results of the photo-identification of Antarctic blue whales during the IWC-SORP ENRICH multi-disciplinary research voyage in 2019. Twenty-five blue whales (21 left sides, 21 right sides) were photo-identified. Those photographs were compared to the Antarctic Blue Whale Catalogue resulting in one match with a whale seen previously in 2013 (six-year time interval). There is a 384km straight-line distance between those two sightings. No whales were photographically recaptured within the voyage. A full report of the voyage is provided in SC/68C/SH/19.

The 25 identifications from the voyage were incorporated into the Antarctic Blue Whale Catalogue, which as of April 2021 totals 552 individual whales, (414 left sides, 409 right sides). The data from this catalogue were used in capture-recapture estimates of abundance (SC/68C/ASI/15). Those estimates are discussed in Item 8.2.2.2.

21.2.6 Fin whale photo catalogues

No information on this item this year.

21.2.7 Humpback whale photo catalogues

Franklin and Franklin (2020) examined the long-term stability of natural marks on humpback whale ventral-tail flukes, dorsal-fin shapes and lateral body marks. The study also demonstrated the reliability of using multiple complementary tags (ventral-tail flukes in conjunction with dorsal-fin shapes and lateral body marks) for matching photographs. By using a multi-feature system, the number of mis-identification errors can be reduced. Currently the authors are further developing this multi-feature approach by collaborating with the Flukebook team to create an appropriate AI algorithm. The development of a multi-feature algorithm has the potential to address issues related to identifying poorly marked or non-distinctive whales, such as whales with all-white flukes common in Southern Hemisphere populations. The authors are working with Happywhale to collaborate on a South Pacific basin-wide study of humpback whales.

Jones reported on the current photo comparison system used by the North Atlantic Humpback Whale Catalogue. The catalogue now totals over 10,000 individual humpback whales. In collaboration with Happywhale, the North Atlantic Catalogue developed a private (due to the sharing agreements with the many photo contributors) AI system for matching. Using the AI system, the time needed to find the match of a whale within the catalogue has been reduced by 98%. Manual matching is still required for whales not found in the catalogue. Overall, the speed of the AI system enables the catalogue to produce timely results based on recent data (SC/68C/NH/02rev01). Results from these photo-ID data pertaining to population structure are relevant to the pre-assessment of North Atlantic humpback whales (Item 8.2.7).

21.2.8 Other photo-identification catalogues

A nascent catalogue of killer whales from the Sea of Okhotsk, in relation to interactions with a longline fishing vessel, is reported in SC/68C/SM/05 (also see Item 16.3.10). Updates on the catalogue of gray whales curated by the Russian Gray Whale Project are presented in SC/68C/CMP/02 and assessing the western Pacific populations using data from the catalogue is discussed in Item 9.1.3.

21.2.9 Work plan

The work plan on work related to catalogues is provided in Table 23.

Table 23

Work plan for 2021/22 on catalogues.

Item	Intersessional 2021/22	2022 Annual Meeting (SC/68D)
Completion of within-region southeast Pacific and New Zealand blue whale photo comparisons	Continue comparisons within SHBWC	Included in SHBWC report
Prepare datasets from the southeast Pacific, New Zealand, and Australia for capture-recapture analyses	Complete the addition of recent photos and data; quality code photos	Report
Addition of blue whale photos from the Indian Ocean	Facilitate the collaboration with research groups in the Indian Ocean	Included in SHBWC report

21.3 Progress with existing IWC databases (GDR, Secretariat)

The GDR Working Group aims to assess the utility and support required for IWC maintained databases relevant to the work of the Committee. Specifically, the Group:

(1) collates summary information on all IWC databases relevant to the Committee;
(2) summarises data use by the Committee for each database;
(3) provides recommendations to improve integration, content and workflows;
(4) reviews technical progress on existing databases or databases under development;
(5) considers needs and specifications for potential new databases, including developing simple technical guidelines on new proposals; and
(6) produces a budget and workplan for the implementation and development of existing and new databases.

This Group has not met formally since SC67B (2018).

21.3.1 Summary of IWC databases and current priorities

SC/68C/GDR/01 presented a review of the current status of IWC databases and data holdings. Work on existing databases included the Database of Recommendations that is now available online and the catch database which was updated this year. A new database manager has been employed to progress the ship strikes database and scope work for collection of strandings data. A number of new databases have been discussed by the Committee and there is a requirement to fully understand (i) how these would integrate with existing ones and (ii) the long-term maintenance requirements, including costs. The need for a holistic approach to data collection and management was highlighted in particular around streamlining different submission processes, and developing guidelines for data availability.

In summarising the current suite of IWC databases the Secretariat emphasised the need for predictable, ongoing funding. This is more critical now because many of the IWC's databases are hosted 'in the cloud' with recurring fees. When supporting new and existing databases these ongoing fees must be considered. Currently some costs are covered by Committee's Research Fund.

Attention: CG, SC, CC, S
The Committee **agreed** *the financial support of Committee's databases requires a robust, long-term approach and request GDR to work with the Secretariat and Committee's Chair to propose a more appropriate funding model at SC68D.*

The Committee thanked the Secretariat for preparing SC/68C/GDR/01. The summary table from this paper has been updated and is presented below (Table 24). This summary highlights the need for a strategy to address the following high-level data collation and data management needs:

- To co-ordinate and minimise data requests from IWC bodies and ensure data submission is efficient and well supported.
- Potential integration of data submission workflows.
- Potential integration of IWC databases that are currently independent.
- Expectations in regards to data access with IWC-hosted and IWC-funded databases.

The Committee **agreed** an intersessional virtual workshop is required to discuss these issues and to develop a data management strategy (see Intersessional Workplan).

Table 24

Summary table of IWC databases.

Database/application (including those listed in 2018)	Status	Work required	Priority *as set by Scientific Committee**	Owner/ associated body
IWC Portal	Retired	None	Complete	N/A
National Progress Reports	Live	**Improvement:** Create auto generated PDF summaries – to make the data more accessible to the public **Maintenance:** Break out public frontend from portal and host under IWC website after planned reskin	**Improvement**: High **Maintenance**: Highest	SC
Ship Strikes	Live	**Improvement:** Bulk import tool (csv). Allow data to be submitted via API directly from country databases **Maintenance:** Create public frontend with mapping of confirmed cases and host under IWC website	**Improvement**: Medium (default) **Maintenance**: Highest	SC
Research Requests	Retired	None – research requests to be received by email	Complete	N/A
Meeting Registration	Live	None – now using EventLeaf – *https://www.eventleaf.com/iwc*	Complete	N/A
Meeting Documents	Live	None – now using SharePoint	Complete	N/A
Meeting Schedule	Live	None – now using SharePoint	Complete	N/A
Meeting Room Entry System	Retired	None	Complete	N/A
IWC photographic cruise database and archive	Live	Updates only (in progress)	Medium (default)	SC
IWC biopsy sampling database	Under development	Updates only (in progress)	Medium (default)	SC
SH Blue Whale Catalogue	Live	**Improvement:** Convert Python code to PHP (in progress)	**Improvement:** High	SC
WNP Gray Whale Catalogue	Under consideration	SC Recommendation to join two existing databases (industry and research)	tbc	External (SC)
Document Web Archive	Live	*https://archive.iwc.int/* Missing meta data for historical SC documents needs updating	Medium (default)	IWC
Bibliographic reference database (EndNote)	Live	Import commission papers and circulars	Medium (default)	SC
Individual Catch Database	Live	**Improvements:** Migrate raw data to SQL database and generate public visual summaries. **Maintenance:** Document idiosyncrasies within data. Creation of a database of records for which there are no individual data and which conforms to all available summary data on the area, sex and month of these catches, to enable easy creation of catch series. Requires full documentation.	**Improvements**: Highest **Maintenance**: Highest	IWC
Catch Summary Database	Live	As above for Individual Catch DB	Highest	IWC
Discovery Marking Data	Live	Incorporate NP marking data, Document	Medium (default)	IWC
Sightings Data (IWC-DESS)	Retired	Data to be integrated into the new integrated sightings, photo-ID, database	Medium (default)	IWC
New integrated sightings, photo-ID, database	Under development	Migration of the DESS database of SOWER and integration of POWER data	Medium (default)	SC
Small Cetaceans Catches (Bycatch and Direct)	Retired	None	N/A	IWC
Compendium of Whale Watching Regulations	Outdated	None	N/A	N/A
Database of Recommendations	Live	*https://recommendations.iwc.int*	N/A	IWC
Entanglement Response	Deferred	None	N/A	IWC
Cetacean Diseases of Concern Site	Stalled	Finalise website	Medium (Default)	SC
Whale Watching Handbook	Live	**Maintenance:** Update to CraftCMS v3 from v2.7 and update custom map plugin *https://wwhandbook.iwc.int/*	**Maintenance**: Highest	IWC/CMS
Blue Whale Song Library	Awaiting development	Develop database and song delivery pages	High	SC
Voluntary National Conservation Report Database	Under consideration	Finalise specification	Medium (Default)	CC
Journal/JCRM Submission Site	Live	*https://journal.iwc.int* DOI published online	Complete	IWC
InforMea (UN data harvesting tool)		*https://www.informea.org/*. Develop and implement database and Drupal 9 CMS, connect to InforMea API – in progress	High	IWC

The Convenor of the Environmental Concerns (E) noted that two important database-related tools for that sub-committee were not yet captured in Table 24: the 'IWC Effects of Pollutants on Cetaceans Populations (SPoC)' and the 'IWC Contaminants Mapping Tool'. The Head of Science, Conservation and Management acknowledged this deliberate omission and indicated that once ongoing discussions clarified the support requirements for these tools it may be necessary to include them in future summaries of IWC databases.

The Committee **agreed** the priorities for the further development and support of IWC databases by the Secretariat, as presented in Table 24, were appropriate. It also supported the submission of a funding proposal from the Secretariat to facilitate this work.

21.3.2 IWC National Progress Reports

The Committee acknowledged the low reporting rate of National Progress Reports (see item 3.2) and supported the proposed an intersessional workshop include discussions to determine and develop strategies to resolve the challenges Contracting Governments encounter in collecting, collating and reporting data at the national level. It also supports the idea of approaching Commissioners through the Bureau to gain a greater understanding of barriers to reporting. Improvements to the current reporting framework could include adopting software that will allow workflows to be tailored to the preferences of individual countries.

Attention: CG, SC, CC, S
The Committee continues to **encourage** *all Contracting Governments to report relevant cetacean data through National Progress Reports.*

21.4 Potential future IWC databases (GDR)

24.4.1 IWC database proposal proforma

The Committee was reminded of the IWC database proposal proforma developed by GDR previously. Following discussion, it was agreed the proforma should be updated so proponents of a new database include an estimate of the frequency of use so the most efficient form and accessibility of the database (e.g. web interface, downloadable database, offline database) can be determined.

24.4.2 New proposals for IWC databases

The GDR Working Group did not receive any proposals for the development and support of new IWC databases during SC68C.

21.5 Intersessional workplan (GDR)

To progress the work of the GDR Working Group an intersessional workshop will be convened in 2021 with the following Terms of Reference:

- *In order to improve data management within the IWC an ISG led by Double and Staniland will be formed to plan and convene an online workshop to address the following:*
- *Review data collection procedures across the IWC identifying need, use and overlap with external data holdings. In particular seek ways that processes can be simplified, and streamlined, to increase submission rates and minimise duplication of effort. [with a focus on National Progress Reporting].*
- *Scope areas of potential integration and consolidation of current IWC databases and report on their status.*
- *Define rules/expectations surrounding data accessibility for databases with different levels of IWC support.*
- *Review any new database requests from SC68C.*

22. MULTINATIONAL RESEARCH PROGRAMMES AND NATIONAL RESEARCH CRUISES THAT REQUIRE IWC ENDORSEMENT (ASI)

Multinational research programs (e.g., IWC-POWER and IWC-SORP) and national research cruises are an integral part of the work of the Committee and provide valuable information to the assessment of whale stocks. These programmes occur in many regions around the world, most notably in the Antarctic and in the North Pacific, including the Bering and the Okhotsk Seas.

22.1 IWC-POWER and co-operation with Japan

The Committee received the report of the IWC-POWER Steering Group (SC/68C/ASI/17) that incorporated the work of both the Planning Meeting for the 2021 cruise and the Technical Advisory Group during intersessional meetings online in November 2020 and April 2021 (SC/68C/REP/01). The Steering Group highlighted the achievements of the IWC-POWER programme since 2010, recognising that the surveys cover pelagic waters of the central and eastern North Pacific that have rarely if ever been covered by systematic line transect surveys and had not been surveyed by any means in decades prior to the implementation of the programme. POWER has important scientific conservation and management value, and the

results have contributed greatly to the work of the Committee. The IWC agreed (IWC, 2012b) that the long-term IWC-POWER programme:

> *'will provide information to allow determination of the status of populations (and thus stock structure is inherently important) of large whales that are found in North Pacific waters and provide the necessary scientific background for appropriate conservation and management actions.'*

The medium-term objectives were reviewed and updated by the Technical Advisory Group (TAG) in light of the results of the programme thus far – these are given in Table 1 of SC/68C/REP/01. The Steering Group report also summarised the results of the programme with a focus on stock structure and movements (genetic and individual identification); and distribution, abundance and trends (sightings and acoustics). Some 540 biopsy samples from nine large whale species (including the rare blue and North Pacific right whales) and one small cetacean species have been collected and analysed. The results are summarised in SC/68C/ASI/17). Individual photo-identification data have been collected from over 1,163 individuals (the same ten species). A photographic database of over 100,000 photographs has been coded and keyworded to provide an invaluable resource for a number of potential studies. Abundance estimates have been developed for five large whale species for the first time in the research area covered. The information from the cruises has proved invaluable to the assessment work by the Committee on Bryde's, sei and humpback whales.

Last year (IWC, 2021, Item 21.1) the Committee had reiterated to the Commission '…the great value of the data contributed by the Committee-designed IWC-POWER cruises which cover many regions of the North Pacific Ocean not surveyed in recent years and address an important information gap for several cetaceans species, providing fundamental information on abundance necessary for developing conservation and management advice' and '…that it would be valuable for the scientific, conservation, management and assessment work of the Committee for these cruises to continue, particularly in light of the information being provided on the status of species once heavily exploited by whaling including blue, fin, sei, humpback, gray and right whales'.

The Committee considered the options for the 2021 cruise in light of the continuing difficulties posed by the COVID-19 pandemic (SC/68B/ASI/17). In discussion, it was clarified that the map for the back-up plan (Appendix Fig 1. in SC/68C/ASI/17) is for illustrative purposes only, and that the final survey design will be chosen to allow variance to be estimated according to best distance sampling practices. It was pointed out that this area might be too large to obtain a good estimate given the number of days available, and the Steering Group was encouraged to consider this when designing the survey. The Committee commends the work undertaken by the Steering Group and Japan to try to ensure that the 2021 cruise goes ahead, and strongly encourages the efforts being made by Japan, Russia and the USA to enable international participation despite the problems of COVID-19. The Committee also noted the proposal of the Steering Group and TAG to hold a workshop or pre-meeting to develop detailed plans for the post-2021 cruises after the identified preparatory work has been undertaken.

The Committee welcomed the results of the 11th annual IWC-POWER cruise conducted between 11 July and 24 September 2020 in the High Seas of the Central North Pacific (SC/68BC/ASI/05). The cruise was carried out by the R/V *Yushin-Maru No. 2* with researchers from Japan and the IWC, and following plans endorsed by the Committee at last year's meeting (a US researcher could not join due to the COVID-19 situation). The vessel surveyed 1,903 nautical miles of trackline, and documented a total of 696 sightings of nine cetacean species. Photo-identification data (46 individually identified individuals from three species and biopsy samples (65 samples from six species) were obtained. The cruise also documented the distribution and characteristics of floating marine debris. No acoustic survey was conducted during this cruise. The cruise was successfully completed and provided important information on cetacean distribution, in particular for blue, fin and sei whales, in a poorly-known and logistically difficult area, where limited survey effort had been spent in recent decades. The data will be analysed during the coming year and results presented at next year's Committee meeting.

In discussion, the Committee stressed the importance of the IWC-POWER cruises and reiterated the small cost to the Scientific Committee compared to the contribution of a vessel and crew. The Committee **thanks** the government of Japan (which generously supplies the vessel, crew and many of the researchers) and the government of the United States (which has generously provided acoustic equipment and acoustic experts), for their continued support of this IWC programme, as well as members of the Technical Advisory Group and the international scientists who have participated in these cruises. The Committee also stressed the importance of covering these offshore areas for which very little information is available, and **thanks** Japan for sharing the data collected during the cruises (photo-identification and biopsy samples). Finally, the Committee expresses its sincere thanks to Matsuoka for his excellent leadership in acting as Cruise Leader for over 10 years.

Attention: SC, C, CG-R
The Committee **reiterates** *to the Commission the great value of the data contributed by the IWC-POWER cruises which have covered many regions of the North Pacific Ocean not surveyed in recent years. The programme addresses important information gaps for several species, and has already contributed greatly to the ongoing assessment work of the Committee. The Committee* **endorses** *the report of the Steering Group (SC/68C/ASI/17) and* **recommends** *that the programme continues.*

The Committee also:

(1) **agrees** *that the 2020 cruise was duly conducted following the requirements and guidelines of the Committee (IWC, 2012) and* **looks forward** *to receiving abundance estimates based on the data obtained;*
(2) **endorses** *the proposed plans for the 2021 cruise and* **looks forward** *to receiving a report from this survey at the next meeting of the Committee; and*
(3) **endorses** *the report and work plan for continuation of work related to the IWC-POWER cruises, including the updated medium-term objectives.*

22.2 Southern Ocean Research Partnership (IWC-SORP)

The IWC Southern Ocean Research Partnership (IWC-SORP) was established in 2009 as an integrated, collaborative consortium for cetacean research. The goal of this research program is to maximise conservation-orientated outcomes for Southern Ocean cetaceans through an understanding of the post-exploitation status, health, dynamics and environmental linkages of their populations, and the threats they face.

A report of the 2019 Australian-led Antarctic research voyage 'ENRICH' (SH/68C/SH/19) is discussed under Item 8.2.2.1. The Committee noted that photo-identification data obtained during the cruise were relevant to capture-recapture estimates of Antarctic blue whale abundance (Item 11.1.4), and encourages the use of these data to produce new estimates for that subspecies.

Attention: SC, C
The IWC Southern Ocean Research Partnership (IWC-SORP) is an integrated, collaborative consortium for cetacean research. The goal of this research program is to maximise conservation-orientated outcomes for Southern Ocean cetaceans through an understanding of the post-exploitation status, health, dynamics and environmental linkages of their populations, and the threats they face.

The Committee ***recognises*** *the great value of the data contributed by the IWC-SORP Programme in the Southern Oceans and* ***looks forward*** *to receiving information on future estimates of cetacean abundance produced by IWC-SORP as they become available.*

22.3 Other International Programs

The Committee has been invited to collaborate with ATLAFCO, a West African multinational organisation and accredited observer to the IWC (SC/68C/ASI/09). ATLAFCO has funded a series of cetacean surveys off the northwest coast of Africa with technical support from Japanese scientists and financial support from ATLAFCO. SC/68C/ASI/09 provides an overview of the research plan for cetacean sighting surveys in this region, and an invitation to organise future capacity building workshops with engagement by scientists from across the Committee. Funding for the participation of African scientists (travel, per diem) and simultaneous interpretation will be provided by ATLAFCO, and a request for funding by the SC, to be presented in the future, would cover travel expenses for SC scientists participating in the workshops.

The Committee **endorses** the survey proposed in SC/68C/ASI/09 and **encourages** the engagement and outreach processes described therein. ACCOBAMS may be a possible template for the survey protocols training workshops. It was noted that the Committee had endorsed the plan for 2021–2022 cruises during SC67A. The Committee **recommends** the creation of a Steering Group convened by Staniland (Annex O) to develop a proposal for further collaboration between the IWC Scientific Committee and ATLAFCO. **Steering Group**: Staniland (Convenor), Diallo, Laamrich, Pastene, Ridoux and Zerbini.

SC/68C/ASI/16 outlines an initial concept for a pan-regional cetacean survey initiative for the Indian Ocean. It was developed to stimulate discussion within the Scientific Committee on the need for coordinated surveys at the ocean-basin scale, and the potential role of the IWC in such an initiative. Despite widespread recognition over many decades of the need for dedicated cetacean research across the ocean basin, large parts of the Indian Ocean have never been systematically studied for cetacean distribution and abundance. Coverage of cetacean visual surveys in the Indian Ocean is very low in comparison to the Atlantic, North Pacific and Southern Oceans. The Indian Ocean marine environment is appreciably impacted by human activities, including cumulative impacts from multiple stressors. It has long been recognised as a region with high levels of cetacean bycatch in gillnets. The lack of regional information on cetacean distribution, abundance, population units and trends both limit national and international conservation efforts and prevent a full understanding of cetacean population status. Detailed information on cetacean distribution and abundance is necessary to understand, monitor and address threats through conservation and management actions. SC/68C/ASI/16 highlights a number of potentially relevant historical and recent cetacean surveys and data sets collected within the region. Some spatial and temporal gaps in coverage are identified within Exclusive Economic Zones (EEZs) and the Areas Beyond National Jurisdiction (ABNJ). Objectives for the initiative are proposed with a potential structure comprising four elements: (1) compilation, review and analysis of historical survey data and other relevant datasets; (2) national surveys in EEZs; (3) international collaborative surveys in the ABNJ; and (4) coordinated use of platforms of opportunity. Possible next steps to explore and

develop this proposed initiative include: a recommendation from the Scientific Committee to develop the concept further; the scheduling of a virtual workshop to scope out the key elements/structure of the initiative and the establishment of a working group(s) to address specific aspects and assist in the design of the initiative.

The importance of advancing the work of the SC in areas where there are important data gaps was highlighted in discussion. Integration of this project and its recommendations with the Indian Ocean Sanctuary of the IWC was encouraged. The Distributed Biological Observatory in the Arctic was suggested as a possible template for incorporating information from multiple sources, including platforms of opportunity. Collaboration with the Indian Ocean Tuna Commission was also encouraged. The Committee **recommends** the creation of a Steering Group convened by Tarzia (Annex O).

Attention: SC, S, C
International research programs provide valuable information to advance the work of the Committee. In reviewing proposals for new multinational research initiatives to conduct cetacean surveys, the Committee:

(1) **recognises** *the value of information provided by national cruises and* **encourages** *the IWC-ATLAFCO collaboration in western Africa and the proposed Indian Ocean Initiative to conduct cetacean surveys in the region,*
(2) **encourages** *submission of abundance estimates from these studies in the future in accordance with the Procedures for Submission, Review and Validation of Abundance Estimates (IWC, 2020c).*

22.4 National cruises that require IWC oversight

The Committee welcomed plans to conduct the following national research cruises in the intersessional period: cruises in the Antarctic and the North Pacific by Japan (SC/68C/ASI/07 and SC/68C/ASI/08) and in the northern Okhotsk Sea by Russia (SC/68C/ASI/11). One of the main goals of these cruises is to estimate abundance of various cetacean species. The Committee appoints the following scientists to provide IWC oversight of these cruises: Matsuoka (Japanese surveys in the western North Pacific and in the Antarctic), Miyashita (Russian cruise in the Okhotsk Sea).

The Committee received cruise reports from surveys conducted in 2020 and early 2021 by Japan in the Antarctic (SC/68C/ASI/03) and in the western North Pacific (SC/68C/ASI/10 and SC/68C/ASI/14), by Russia in the Okhotsk Sea (SC/68C/ASI/12) and by Norway in the Northeast Atlantic (small management area EW-Norwegian Sea, SC/68C/ASI/06). The Committee noted that the survey in the Northeast Atlantic is the first in a set of surveys planned for the period 2020–2025 to cover the entire Northeast Atlantic Ocean. It was also noted that these surveys will provide relevant estimates for future Implementation Reviews of North Atlantic minke whales. The Committee **expresses appreciation** to the countries sponsoring these surveys and their important contribution to cetacean research.

Attention: SC, C
National research programs provide valuable information to advance the work of the Committee.

In reviewing reports of national research cruises that require IWC oversight, the Committee ***encourages*** *submission of abundance estimates from these studies in the future in accordance with the Procedures for Submission, Review and Validation of Abundance Estimates (IWC, 2020c).*

22.5 Work Plan for Research Cruises

The Committee **agrees** to the workplan provided in Table 25. Item 1 in this table (IWC-POWER cruises) has financial implications for the Committee. A research proposal to conduct this work was reviewed. The Committee **strongly endorses** this proposal. An intersessional Steering Group has continued to assist with planning of the IWC-POWER cruises (Table 26).

Table 25

Work plan for multinational research programs and national research cruises that require IWC oversight.

Item	Topic	Intersessional 2021–22	SC68D	Agenda Item
1	IWC-POWER Cruise in the North Pacific Ocean	Conduct 2021 survey and planning meeting for the 2022 cruise (IWC, Japan, Russia, USA) and update medium-term objectives	Review cruise report, report from the planning meeting and new abundance estimates from IWC-POWER cruises	21.1
2	Review and provide advice on plans for future surveys		Receive, review and provide feedback to research plans to conduct abundance estimates	21.3
3	IWC-ATLAFCO collaboration for capacity building and develop cetacean surveys	Develop a proposal to enhance collaboration between the IWC and ATLAFCO to develop a training workshop on survey design and data analysis. and to conduct cetacean sighting surveys	Review progress	21.3
4	Indian Ocean pan-regional initiative to conduct cetacean surveys	Develop a plan for a collaborative pan-regional survey initiative across the Indian Ocean to conduct cetacean surveys	Review progress	21.3

Table 26

Intersessional steering correspondence groups for multinational research programs and national research cruises that require oversight.

SC Agenda Item	Type	Group (short name)	Terms of Reference	Members
21.1	SG	IWC-POWER/ SOWER	To provide advice on the 2021/22 IWC-POWER cruises (including holding the Planning Meetings), on data analyses, storage and on requests for data/sample use of IWC-POWER/SOWER cruises.	Matsuoka (Convenor), An, Brownell, Clapham, Donovan, Ensor, Gushcherov, Kato, Kelly, Kim, Kitakado, Staniland, Miyashita, Murase, Pastene, Wade, Zharikov, Zerbini.
21.3	SG	IWC-ATLAFCO collaboration	(1) Identify workshop topics; (2) schedule the workshops into modules (annual or biennial); (3) identify potential SC scientists to invite to design and lead these workshops; and (4) prepare a proposal to this regard for presentation at SC68D.	Staniland (Convenor), Diallo, Laamrich, Pastene, Ridoux, Zerbini.
21.3	SG	Indian Ocean pan-regional initiative	(1) Compile additional sources of information (surveys, data sets etc.) to that presented in SC/68C/ASI/16, and further assess existing data for applicability to abundance estimation and ecological research; (2) explore the design and development of the initiative, including the scale and scope, partnerships, roles and governance structure and collaborations, and funding; (3) convene virtual workshops or meetings with relevant experts, organisations and stakeholders across the region to create a network of interested collaborators and collect feedback on the proposed concept; (4) identify potential external funding sources and develop proposals where appropriate; (5) explore opportunities to engage with existing platforms of opportunity; and (6) prepare a detailed proposal on the pan-regional initiative for presentation at SC68D.	Tarzia (Convenor), Braulik, Cerchio, Collins, Dulau, Kelly, Kitakado, Palka, Seakamela, Willson, Zerbini.

23. SCIENTIFIC COMMITTEE BUDGET FOR 2022

Due to the COVID-19 pandemic, the 2020 IWC/68 Commission meeting was delayed until September 2021. Unfortunately, the global situation has meant that this meeting has been further delayed until October 2022. Therefore, as in 2020, the Committee developed a single-year budget and workplan for 2022.

It is anticipated that the one-year budget and workplan will be approved by a virtual Special Commissioner's meeting in September 2021.

23.1 Status of funded research

The Committee was informed of the position on the Committee's Research budget at the end of the 2020 financial year, and year-to-date up to 31 March 2021 (see SC/68C/O/03).

Projects undertaken in 2020 were either in line with, or under budget. It should be noted that due to the COVID-19 pandemic, a significant number of projects had to be postponed and these projects were reviewed by the Committee.

23.1.1 Funded proposals for 2022

The Committee proposed a research programme for 2022, as show in the table below (Table 25). The total amount requested from the Commission is equivalent to the same level of funding requested in 2021, a budget freeze.

23.1.2 Invited participants

Invited participants (IPs) are a vital component of the working of the Committee. IPs contribute in many ways including as sub-committee and Working Group Convenors, co-Convenors and rapporteurs, subject area experts and Convenors of intersessional groups. All sub-committees and Working Groups benefit from this budget item. The 2022 budget request for IPs is higher than usual due to having only virtual meetings for the last two years, and agenda items being postponed until the 2022 meeting. Additional IPs will be required in order to address these postponed items next year.

23.1.3 Amount to support Commission Recommendations

These funds will assist the SC in responding to any urgent issues under its mandate that may arise at the Special Commissioner's meeting scheduled for September 2021, and/or intersessionally.

23.1.4 Seed Funding – Communications Small Group

The Committee established a small group to explore how it can improve its communication, primarily with the Commission, but also with the general public. These funds will be used to facilitate these improvements.

Table 27

Proposed budget for 2022.

Sub-committee	Project Title	Brought Forward From Previous Years	Reallocated From Other Projects*	2022 Core Budget Request	**Total**		**In-Kind Support**
	General						
ALL	Invited Participants 2022	100,000	–	–	**100,000**		**–**
ALL	Amount to support Commission Recommendations	–	–	15,000	**15,000**		–
ALL	Seed Funding – Communications Small Group	–	–	15,000	**15,000**		–
ALL	Responding to Commission Developments	–	94,093	14,591	**108,684**		–
ALL	Contingency Fund	44,848	–	–	**44,848**		–
	Meetings/Workshops						
NH	RP05 NA Humpback workshop	–	–	16,960	**16,960**		Venue
CMP	RP01 Chile-Peru SRW CMP Workshop	–	–	8,750	**8,750**		Venue
	Modelling/Computing						
IST, IA	RP10 Essential computing support	–	–	13,500	**13,500**		–
	Research						
IST, IA, ASI, E	RP12 IWC-POWER cruise	15,714	–	15,106	**30,820**		990,230
SH	RP07 SH Blue Whale Catalogue	–	–	11,500	**11,500**		–
SH	RP08 Madagascar blue whale photographs	–	–	400	**400**		–
IA	RP11 HW Tag Data Analysis	–	–	9,860	**9,860**		–
SH	RP06 SRW Australia Aerial Survey	–	–	17,008	**17,008**		–
NH	RP04 MEGARA 2022	–	–	6,000	**6,000**		2,500
SH	RP09 Antarctic BW Stock and Movement	–	–	16,076	**16,076**		126,050
CMP, SH	RP13 Chile-Peru SRW Acoustics	–	–	19,400	**19,400**		8,000
CMP, SH	RP17 Blue whale acoustics Oman	–	–	16,904	**16,904**		25,627
CMP, SH	RP16 ASHW conservation	–	–	14,845	**14,845**		34,674
	Databases						
HIM, SM	RP02 Ship strikes database coordinator	–	–	10,000	**10,000**		30,000
GDR, PH, HIM, SM	RP18 Secretariat Database Support	–	–	6,000	**6,000**		–
	Reports						
E	RP03 SOCER	–	–	4,000	**4,000**		**–**
	TOTALS	**160,562**	**94,093**	**230,900**	**485,555**		**1,217,081**

*See Table 29.

23.1.5 Responding to Commission Developments

The Committee acknowledges the possibility of transformational changes to the way it operates as a result of the ongoing work of the Working Group and Operational Effectiveness and work to balance the Commission's budget in the long term. Whilst its strong preference is to not alter current funding or working practices, it is noted that this is a possibility. In the event of such changes being required, these funds will assist the SC in implementation and/or 'phasing in' changes to its budget. Funds for this have been primarily set aside from one-off underspends resulting from the COVID-19 pandemic. The need to hold these funds will be reviewed at SC68D.

23.1.6 Contingency fund

This fund allows for unforeseen overspend, for example. higher than anticipated travel costs, or project overruns. No funding has been required since the last Committee meeting and so the fund remains at £44,848.

23.1.7 Workshops

SC/68C/RP/05 Workshop to Advance the In-Depth Assessment of North Atlantic Humpback Whales

The Comprehensive Assessment of North Atlantic humpback whales was completed in 2002 (IWC 2002, 2003). In 2018, the Committee agreed that it was timely to consider a rangewide in depth assessment (IWC,2019, p.133) and has since been collecting and evaluating information needed for assessment through an intersessional correspondence group. After some intersessional work, a 3-day, in person meeting is proposed for 2022 to evaluate this information in the context of assessment and in particular to: (a) finalise the initial conceptual stock structure and movement hypotheses (b) identify how these can be parameterised; and (c) develop awork plan to allow some preliminary modelling to occur before the next Scientific Committee meeting.

SC/68C/RP/01 Workshop for the Six-Year Review of the Eastern South Pacific Southern Right Whale Conservation Management Plan

The Conservation Management Plan (CMP) for the Critically Endangered eastern South Pacific southern right whale population was established in 2012 and a major review occurred in 2016 with Peru becoming an active member. Since then, the Steering Committee conducted three coordination meetings to review the CMP implementation and constantly modified its strategies. Moreover, considerable scientific knowledge about the southern right whales off Chile-Peru have emerged and should be incorporated to the CMP including genetics, acoustics, photo-ID and threats. At last CMP coordination meeting, it was noted that a major review of the CMP should occur every four to six years. It was agreed to conduct a CMP review in 2022. It was considered to hold a scientific workshop to update data on the CMP in conjunction with the IV coordination meeting, to review the entire CMP.

23.1.8 Modelling/computing

SC/68C/RP/10 Essential Computing Support to the Secretariat ror Ia ror the In-Depth Assessment of Western North Pacific Common Minke Whales

The Committee is currently engaged in an In-depth assessment of Western North Pacific common minke whales. The Committee has developed a complex assessment model structure towards this end. A key task in this process is to develop and validate the code for this model, together with its variants which are required for the associated sensitivity tests; these are the core components of this process. Experience has shown that the Secretariat staff alone cannot handle this complete process themselves, so that computing support is needed.

23.1.9 Research

SC/68C/RP/12 Iwc-Power Cruise in 2022 Including Associated Meetings and Processing

The Committee strongly advocated the development of an international medium- to long-term research programme involving sighting surveys to provide information for assessment, conservation and management of cetaceans in the North Pacific, especially areas that have not been surveyed for decades. The programme has been running since 2010 and has contributed greatly to the work of the Committee and its assessment work. This was summarised and commended most recently this year (Item 22.1). Objectives have been developed for the overall plan and requested funding will allow for the finalisation of the initial phase and progress on developing the medium-term phase. The amount of money is extremely small when seen in the context of Japan providing the vessel and associated costs which it wishes to do although it has now left the IWC. The IWC contribution is for: (1) IWC researchers and equipment; and (2) to enable analyses and the photographic database to be updated prior to the 2022 Annual Meeting.

SC/68C/RP/07 Southern Hemisphere Blue Whale Catalogue

The Southern Hemisphere Blue Whale Catalogue (SHBWC) is an international collaborative effort to facilitate cross-regional comparison of blue whale photo-identifications catalogues. To date more than 2,000 individual blue whales have been contributed to the SHBWC from researcher groups working on areas off Antarctica, Chile, Peru, Ecuador-Galapagos, Eastern Tropical Pacific, Australia, Timor Leste, New Zealand, Indonesia, Sri Lanka and Madagascar. The Scientific Committee is currently working on Comprehensive Assessment of non-Antarctic Southern Hemisphere blue whales, with emphasis on Australia, southeast Pacific blue whales and New Zealand. The SHBWC is assisting in matching catalogues in order to deliver regional photo-ID based mark recapture assessments of blue whale abundance. The Committee is also considering the suitability of Sri Lanka blue whale datasets for potential mark recapture analysis. The SHBWC has become the largest repository of Southern Hemisphere blue whale photo-identifications. Matching process and photo-quality control have been completed or are underway for different geographic areas. The 2022 work will focus on: (1) matching new left photo-IDs received from southern Chile; (2) continue to internally reconciliate Sri Lanka dataset from Biosphere Foundation (years 2010–15); and (3) photo quality coding of new entries from Sri Lanka and Chile.

SC/68C/RP08 Identifying Individual Blue Whales from Madagascar Photographs

The population structure of blue whales (*Balaenoptera musculus*) in the Indian Ocean is understood primarily from acoustic song types, where five different acoustic populations occur and may overlap geographically in their distribution (Branch *et al.* 2021). Much remains unknown about these specific populations including movement between regions of the Indian Ocean. It is suspected that blue whales that winter near Madagascar spend the summer in the northwest Indian Ocean (Cerchio *et al.*, 2020). Overall there are few data from the southwest region, including the waters adjacent to Madagascar. Photo-identification data from the area may provide information on residency and/or movement patterns. Photographs are available from the IWC/SOWER Madagascar survey in 1996 and from Dr Sal Cerchio who collected photographs opportunistically in 2012. A total of 457 photos representing 12–17 individuals is available. This project entails extracting all of the individually identifiable blue whales from the photographs, comparing them to one another, and uploading the ID photographs into the Southern Hemisphere Blue Whale Catalogue (SHBWC; Galletti Vernazzani *et al.* 2021). Once in the collaborative SHBWC, the Madagascar photos can be compared to other blue whale ID photographs from the Indian Ocean per encouragement by the Scientific Committee in 2020 (IWC, 2020).

SC/68C/RP/11 Analysis of Satellite Tag Data for Incorporation into the Stock Assessment Process: An Application with North Pacific Humpback Whales

The Comprehensive Assessment of North Pacific Humpback Whales is currently evaluating various sources of input data for the model, including tagging. This project will use an independent dataset consisting of 256 satellite tags deployed across several breeding and feeding grounds in the North Pacific spanning the period 1995–2019. Proposed analyses of this data will involve: investigation of connectivity between breeding and feeding areas to confirm the current stock structure hypothesis; derivation of movement patterns among the pre-defined subareas, including: a presence/absence matrix for input into the model; and additional metrics including timing of occurrence, travel speed, and residence time. Beyond the goals of this assessment and considering the widespread adoption of whale satellite tagging by the global research community, the methods developed for this project will have broad applications for the incorporation of satellite telemetry data for other stocks into the IWC assessment process.

SC/68C/RP/06 Aerial Survey of Southern Right Whales Contributing to the Western Population Off Southern Australia

An aerial survey is proposed to be carried out in 2021, the data from which will contribute to a long-term monitoring program of southern right whales across the south-western Australian region and an associated photo identification time series initiated by John Bannister in 1976. The count data will provide a relative estimate of annual population size and relative trend for the 'western' population and the photo-identification data will contribute to the determination of life history parameters (e.g. calving intervals) and information on the connectivity of the 'western' and 'eastern' Australian populations, with the larger dataset of sightings. The data from this survey will directly contribute to: (1) the IWC-SORP funded project comparing population demographics across the main SH wintering grounds; and (2) the Australian Conservation Management Plan for southern right whales (2011–21) This is a one-off request to the IWC for funding; no Government funding has been secured for the 2021 aerial survey due to a delay in the roll-out of Australia's National Environment Science Program (NESP), which has supported aerial surveys over the last five years.

SC/68C/RP/04 Megara

MEGAPTERA, the French NGO dedicated to marine mammal conservation and research, intends to intensify the effort on humpback whales skin biopsies in the waters of Saint Barthélemy, Saint Martin and Anguilla (Anguilla Bank) in the North Eastern Caribbean. Since 2014, MEGAPTERA has been involved in the MEGARA project, supported by the National Natural Reserve of Saint Martin with the scientific collaboration of Heide-Jørgensen's team, at the Greenland Institute of Natural Resources (Denmark). The MEGARA project (MEGAptera Reproduction Areas), uses predominantly satellite telemetry and its main objective is to better understand the movements of the humpback whales, equipped with satellite stags, within the vicinity islands and on their migratory routes. Besides the deployments of satellite tags skin biopsies are conducted on target individuals used for telemetry. In MEGARA2022 more individuals will be biopsied. Those aim is to gain a greater understanding of the genetic structure of the migrating population on Anguilla Bank.

SC/68C/RP/09 Assessing Stock Identity and Movements of Antarctic and Pygmy Blue Whales in the Northern Mozambique Channel/Southwest Indian Ocean

Acoustic monitoring from 2017 to 2020 indicates the sympatric occurrence of Antarctic blue whales *(Baleanoptera musculus* intermedia) and Southwest Indian Ocean pygmy blue whales (*B. m. brevicauda*) off the northwest of Madagascar, ranging within 50-100km off the coast. Antarctic blue whales appear to use the area as breeding habitat during the Austral winter. Pygmy blue whales appear to utilise it as a migratory corridor. The proposed work involves a 20-day expedition during the period when both sub-species are present. Passive acoustics will be used to locate singing blue whales; Collected photo-IDs will be contributed to the Southern Hemisphere Blue Whale Catalogue; Biopsies and eDNA will be collected to identify sub-species and contribute to global assessments of blue whale population structure; Satellite tags will be deployed to provide new data on movement patterns and migratory destinations. These data will inform IWC blue whale assessments, providing invaluable information on poorly sample populations.

SC/68C/RP/13 Passive Acoustic Monitoring of the Eastern South Pacific Southern Right Whale, A Key to Improve Conservation Management Plan Outputs 2022

Eastern South Pacific right whales are considered Critically Endangered by IUCN. The IWC has a Conservation Management Plan for this population and since 2016 the Scientific Committee has supported a Passive Acoustic Monitoring (PAM) project. The PAM project will assist in the identification of a breeding area along the coast of Chile and Peru. Six sites have been selected and two sites have already been covered (central and southern Chile). Northern Chile will be monitored during 2021–22. The next monitoring site will be in southern Peru. The project considers the participation of a Peruvian specialist in one maintenance survey in northern Chile to build capacity in the use of the hydrophone. The acoustic presence of southern right whales was assessed using data off Chiloe Island and Arauco Gulf. The Workplan for the 2022 includes the training of a Peruvian specialist, data collection in southern Peru and analyse acoustic datasets obtained off northern Chile.

SC/68C/RP17 Enhancement and Continuation of Passive Acoustic Monitoring for Blue Whales and Other Baleen Whales Off Oman

The status and population identity of blue whales in the Arabian Sea are poorly understood, and recent acoustic evidence indicates that the whales off Oman belong to an acoustic population that has not been previously described. This implies the existence of a population in the Northwest Indian Ocean that is distinct from the Sri Lanka / Central Indian Ocean stock, with which it has been historically conflated. Consequently, illegal Soviet whaling in the 1960s depleted this stock, potentially severely. This project proposes to build on IWC SC funded passive acoustic monitoring (PAM) in deep water off the coast of Oman in 2020 by deploying 3 units off the Arabian Sea coast of Oman.

SC/68C/RP/16 Tools to Support ASHW Conservation in Oman

This proposal builds on existing funding and planned fieldwork allowing a continuation of body condition assessments of Endangered Arabian Sea humpback whales (ASHW) in Oman to determine the reproductive potential of the population in relation to prey availability and distribution. The survey will also provide opportunities to train Omani nationals in whale research techniques (particularly photo-ID) complementing a recently launched campaign to promote submission of sightings records and photos by public stakeholders to the Environment Society of Oman. These objectives will improve the scientific value of the existing database and will raise the profile of the population within Oman, highlighting conservation concerns for ASHWs and requirements for the adoption of science driven management initiatives.

23.1.10 Databases

SC/68C/RP/02 Progressing the Development and Use of the IWC Ship Strikes Database

This will further progress the development of the ship strikes database and to ensure the increased reporting of ship strikes incidents into the IWC database. key task for the Data Manager is to progress submission of data from national databases into the global IWC effort. This will be reliant on external factors but making progress on including these large existing data sets into the IWC database is likely to take a substantial proportion of the coordinators time.

SC/68C/RP/18 Ongoing SC Database Hosting and Server Management by IWC Secretariat

The IWC Secretariat hosts and manages several databases for the SC. These have annual service costs associated with them including web/database servers, storage, backups, software licences and other associated infrastructure costs.

Table 28

Projects that have received funding previously and are still progressing.

Project	Funds remaining
Ecosystem Functioning Workshop 2020	20,550
SWA Right Whale CMP Workshop	7,600
CAHW CMP Workshop	11,460
Pre-Meeting of the Abundance Steering Group	6,000
Franciscana Workshop	16,600
Implementation Review NP Minke Whales	15,000
Chile and Peru Whale Watching Workshop	4,210
Franciscana Aerial Survey	23,820
SH Blue Whale Catalogue – Chile	7,800
Reconciling Chilean Blue Whale Catalogue	2,000
Western Gray Whale CMP	10,500
IA NP Humpbacks	10,000
Amendment of RMP Guidelines	1,250
Computing Support to WNP Minke	6,000
Strandings Emergency Response	9,915
In-depth Assessment of NP Sei Whales	5,000
Pygmy Blue Whale Pre-Assessments	7,535
Acoustics Blue Whale Oman	8,000
Mid-Latitude Antarctic Blue Whale Acoustics	4,400
ASHW Songs India	6,749
ASHW Body Conditions and Fisheries Mapping	6,412
Southeast Pacific Right Whale Acoustics	10,000
NPHW Mixed Stock Analysis	13,200
SH Blue Whale Catalogue	11,237
Exploration of Survey Methods – West Australian BSD Humpbacks	4,000
Population Dynamics SR Whales Península Valdés	1,400
Abundance Estimates Franciscana Buenos Aires	1,775
Quantitative assessment of threats to Arabian Sea humpback whales using existing photographic and UAV data	3,641
Photo ID SR Right Whales in Brazil and Argentina	2,000
Development of Permanent Blue Whale Reference Library	4,000
Total	**242,054**

23.1.11 Reports

SC/68C/RP/03 State of the Cetacean Environment Report (SOCER) for 2022

SOCER is in response to several Commission resolutions requesting regular updates on the state of the world's oceans as relevant to cetaceans. SOCER is an appendix to the annual SC Environmental Concerns sub-committee report and is made available online on the IWC website. For 2022 it will focus on a regional overview of the state of the Arctic and Antarctic Oceans as relevant to cetaceans, including matters of global concern, based on the published literature in reviewed scientific journals in the period ca. 2019–22.

23.1.12 Funded proposals in previous years still ongoing

The following projects received funding and were approved by the Commission in prior years and are continuing to progress as planned (Table 28):

23.1.13 Report on fund reallocations and contingencies for the Research Fund, Voluntary Fund for Small Cetaceans and SORP Voluntary Fund

Table 29 shows all funds which were reallocated within the research funds at this meeting. Due to the COVID-19 pandemic, many projects were unable to take place or had to progress virtually. The contingency fund remains at £44,848 as no requests were submitted in the intersessional period.

Table 29

Funds reallocated within the research funds at this meeting.

	Carried Forward	Re-allocated	Totals	Notes
Invited Participants 2021	100,000	–	100,000	Cancelled due to COVID. Carried forward to next in-person meeting.
SC Contingency Fund	44,848	–	44,848	Contingency funds to be maintained at the current rate.
POWER Cruise	15,714	–	15,714	Underspends from prior years taken forward to support the 2022 cruise.
Priority Arabian Sea Humpbacks	–	913	913	Small amount left over at end of project.
JCRM SOWER	–	16,650	16,650	Amount not required to complete project.
IA NP Humpbacks	–	1,481	1,481	Amount to complete project has been reduced.
MAWI Workshop	–	17,000	17,000	Funding no longer required.
Comparative biology, health, status and future NA Right Whales	–	10,000	10,000	Funding no longer required.
Amendment of RMP Guidelines	–	1,116	1,116	Amount needed to complete the project has been reduced.
Climate Change Workshop	–	20,000	20,000	Will now proceed online.
Computing Support to WNP Minke	–	7,500	7,500	Amount needed to complete the project has been reduced.
Reconciling Chilean Blue Whale Catalogue	–	2,628	2,628	Amount needed to complete the project has been reduced.
Cumulative Impacts (CDoC)	–	9,817	9,817	Held virtually.
Masking and Ship Noise	–	4,000	4,000	Funding no longer required.
Historic Catch Data	–	2,988	2,988	Historic unspent funds.
TOTALS	**160,562**	**94,093**	**254,655**	

Small Cetaceans Research Fund.

In 2020, the Small Cetaceans Fund gratefully received voluntary contributions totalling £25,644 from The Government of the United Kingdom, Animal Welfare Institute, Campaign Whale, Cetacean Society International, Dolphin Connection, Humane Society International, OceanCare, Sea Legacy and Whaleman Foundation.

The Small Cetaceans Research Fund also undertook a successful call for applications for funding. Six projects were successful and received funding (see Table 30).

Following these allocations, £25,974 remained unallocated in the Small Cetaceans Research Fund.

Table 30

Projects receiving funding from the Small Cetaceans Research Fund.

Rapid assessment of the occurrence and conservation status of Guiana dolphins at the northern periphery of their range in Central America	Laura J. May-Collado	£19,563.92
More knowledge, less mortality: education for the conservation of Guiana dolphins (*Sotalia guianensis*), Lake Maracaibo, Venezuela	Yurasi Briceño	£5,820.00
Population assessment and dynamics of Lahile's bottlenose dolphins in Argentina	Mariano Alberto Coscarella	£17,020.00
Understanding the effects of trans-boundary barrage operations on the Nepal-India border for Ganges River dolphin habitat and population dynamics	Gopal Khanal	£ 4,994.06
Assessing the conservation status of Burmeister's porpoises in Peru – trialling tools for estimating abundance and bycatch of this cryptic and poorly known species	Joanna Alfaro Shigueto	£20,000.00
TOTAL		**£67,397.98**

Southern Ocean Research Partnership Fund
The Committee was updated on the progress of projects funded through the Southern Ocean Research Partnership (SORP). Despite the challenges of COVID-19 and consequent unavoidable delays, significant progress had still been made in delivering these projects. No new allocations of funding were made for 2021. £25,244 remains unallocated in the SORP Fund.

Contributions to the IWC Small Cetaceans Fund, SORP Fund and other voluntary funds are welcomed.

23.2 Scientific Committee discussion of future budget cuts

The Committee discussed Annex K. In 2018 the SC research budget was reduced by approximately one third and due to the financial difficulties currently facing the Commission, it would be wise for the Committee to plan for possible cuts in the future. Whilst the postponement of in-person meetings in 2021 and 2022 has resulted in budget savings which will help in the short term, longer term solutions are required. Two budget groups were established under the Commission's budgetary sub-committee, one of which focused on SC research and meeting budgets. The SC Chair and Vice-Chair participated in this group and discussed a range of possible scenarios to mitigate the effects of future budget reductions.

Regarding SC meeting structure, the implications of biennial in-person meetings were explored, along with reducing the length of the meetings. There was also discussion of hybrid meetings, in which some people attend in person, whist others participate remotely. The Committee would prefer to meet annually, but if funding cuts are necessary the Committee **recommends** the following approach:

(1) Hold in-person biennial meetings of the full SC.
(2) During intervening years, hold in-person workshops (which would need relatively little support from the Secretariat) for the highly technical sub-groups/sub-committees.
(3) Other sub-groups/sub-committees hold virtual workshops during intervening years or in-person, if necessary and justifiable.
(4) Reduce the amount of funding for IPs, make appropriate arrangements for many of the IPs toattend meetings virtually and seek external funding for IPs.
(5) Reduce the amount of funding for research projects while keeping in mind that many of the research projects occur in areas where there are few alternative sources of funding.

The Committee fully **recognises** the urgent need to reach a balanced budget within the IWC. The above recommendations are intended to help accomplish this but the Committee acknowledges that changes to the SC budget and meeting structure will have consequences.

In 2018, the Governance Review of the IWC stated: 'The IWC Scientific Committee (SC) is the premier body worldwide regarding cetacean science, comprising some of the greatest experts on cetacean biology in the world. The unique and enormous expertise on cetaceans in the SC provides IWC with the stature and credibility to remain as the main global body for cetacean management and conservation. The Review Team notes the Scientific Committee is a key strength of the IWC and every effort should be maintained to ensure its effectiveness and global pre-eminence on cetacean research' (*https://archive.iwc.int/*).

24. COMMITTEE PRIORITIES FOR 2022 AND INITIAL AGENDA FOR 2022

Each sub-group developed their priorities and work plan for 2022 (see relevant sections of this report). Those work plans will be used by the Chair and Vice-Chair to develop a draft agenda for SC68D for presentation to the Commission at their September 2021 virtual meeting for their review and endorsement.

25. WORKING METHODS OF THE COMMITTEE

25.1 Updates on Rules of Procedure and Handbook of the Scientific Committee

At IWC67, the Commission requested the Committee regularly revise and update their Rules of Procedure (RoP) and Handbook. The out-going Chair, the in-coming Chair, and the Secretariat will review, revise, and update those documents intersessionally for consideration by the Committee at SC68D. Once endorsed by the Committee, the revised documents will be presented to IWC68 for Commission consideration and endorsement. The Chair notes that some Committee members may be contacted for advice and input on these revisions during the intersessional period. Committee members are encouraged to raise questions or offer comments regarding the Handbook but should first contact the Chair and Vice-Chair prior to fully developing proposed revisions.

25.2 Reporting to the Commission and related matters

The Committee's report for SC68C will be made available to the Commission and the public as soon as possible following the completion of the meeting. The Commission has directed the Committee to complete the final draft report within 21 days of the meeting. The Heads of Delegation will review, revise as necessary, and endorse the 2021 Committee report by 01 June 2021. Additional editing will occur after that date. Thus, the final draft of the Committee's report is expected to be available by about 21 June 2021.

Given postponement of IWC68 until late in 2022, the Chair and Vice-Chair will provide a summary of the Committee's work from four years: 2019, 2020, 2021 and 2022. The Committee has been encouraged by the Commission and within the Governance Review to make the Committee's work more transparent and understandable by the Commission. A small intersessional group led by Double will address the challenge of presenting the Committee report to the Commission (Annex O). They will develop and implement the most succinct and effective ways to ensure better communication with the Commission and the broader range of IWC stakeholders.

25.3 Capacity building and succession plan for Scientific Committee

The Committee continues to pursue and enhance a succession plan. For example, the work of Punt continues to be followed by Wilberg as part of ensuring ongoing modelling expertise within the Committee.

Within the Secretariat, Greg Donovan retired on 9 May 2021 after serving for 40 years with the IWC, including the recent past year as Scientist Emeritus. In addition, after more than 37 years with the IWC Secretariat, Cherry Allison will be retiring before the next SC meeting. The Committee expresses deep appreciation for the many decades of guidance, analyses and advice provided by Donovan and Allison to the work of the Committee. The Committee is also grateful that Allison and Donovan will continue to work with the Committee as independent scientists and IPs.

An intersessional Small Group comprised of Secretariat and Committee representatives was formed to continue planning for succession of the programming and implementation of population models, within both the Committee and the Secretariat (Annex O).

25.4 Update on Data Availability requests and consideration of potential updates/clarifications

The IWC Data Availability Agreement (DAA) is overseen by the Data Availability Group (DAG). The DAG is chaired by the Vice-Chair of the Committee and also includes the Chair and the Head of Science, Conservation and Management. The IWC website provides further information on the Procedures for data sharing and full rules. The Chair and Vice-Chair will work intersessionally to review and revise the DAA. Those proposed modifications will be presented at SC68D.

The Secretariat maintains multiple databases, including many for the Committee (see Item 21). Researchers are able to request data. An intersessional group will consider, as part of its remit, the rules and expectations surrounding data accessibility for databases with different levels of IWC support (Item 21.3.1 and Annex O).

25.5 Committee involvement in the IWC recommendations database

An update on the Database of Recommendations (DoR) was provided in SC/68C/GDR/01. The Secretariat has now made the DoR available online and it includes a number of years of Commission and Committee recommendations. A bulk upload tool in Excel has been designed to assist data entry, including by Committee participants.

Recommendation numbering follows the format: *Committee abbreviation: year: number* (no spaces). For example, SC1901 means this is the first recommendation entered into the database from the Scientific Committee's 2019 meeting. Likewise, SC20106 would be the 106th entered recommendation from the Committee's 2020 meeting. This format can be used to find recommendations in the DoR. Increasingly, the Committee's past recommendations are being referenced in the report according to their DoR number.

As requested at SC68C, the Secretariat provided an extract of recommendations from 2019 and 2020 for each Sub-Committee so that Convenors would be able to review these during their meetings to track progress and plan next steps. Convenors were also asked to update progress on their recommendations to feed back into and update the database. In addition, the Secretariat provided additional guidance on drafting of Recommendations for the Convenors and rapporteurs during SC68C.

25.6 Governance Review: Review of papers from the Working Group on Operational Effectiveness

In the period between SC68B and SC68C, the Working Group on Operational Effectiveness (WG-OE) continued its mandate to address the IWC Governance review, including a virtual workshop held in September 2020. Four revised papers from the WGOE were made publically available in February 2021 regarding: (1) potential reforms to Commission structure and meeting operations; (2) potential 'low-hanging fruit' items, including those relating to the Rules of Procedure; (3) IWC Strategic Principles and ToR for Working Group on Strategic Plan; and (4) budget reform strategy. At SC68C, DeMaster compiled comments from the Committee on the revised versions of the four papers. These comments were presented during the Plenary of SC68C for discussion. Concerns raised included the appropriate structure for addressing scientific aspects of welfare, the placement of the Scientific Committee in the overall structure of the Commission, and ensuring that the Commission's work is based on a strong scientific foundation. Following edits to reflect the discussion in Plenary, the Committee's comments will be provided to the Co-chairs of the WG-OE in advance of their planned virtual workshop later in May/June 2021. The Committee's final comments can be found in Annex L.

25.7 Any other matters

25.7.1 Joint CC-SC statement

The Joint Working Group of the Conservation Committee and the Scientific Committee met this year virtually just prior to the SC meeting. Chairs and Vice-Chairs of the committees drafted a document to present to the Commission that describes

the urgent actions that need to be addressed before IWC68 in 2022 (see Annex M). The document notes the growing number of cetacean species on the ICUN red lists and the key anthropogenic drivers behind these declines in cetacean status. The document also underscores the ongoing work of the committees, through initiatives such as CMPs, BMI, the climate change workshop, underwater noise, SOCER, Task Teams, and the Whale Watching handbook. The statement requests that the Commission provide an opportunity for the Chairs to speak to the Commission at its virtual Special Meeting in September 2021 to receive guidance and endorsement of important initiatives. Various suggestions were made to include in the document, including a reference to the possible bias in using the numbers of cetaceans on the IUCN red list (as noted in Item 19.2). Following the discussion in SC Plenary, the document was revised and sent to the Chair of the IWC for consideration.

25.7.2 Dale W. Rice Research Library

Sally Mizroch reported on the opening of the Dale W. Rice Memorial Research Library (*http://dalewricelibrary.org/*) located in Seattle, Washington, U.S. Rice bequeathed the library to the NMFS Marine Mammal Laboratory in his will. It contains his extensive marine mammal book and reprint collection, field data, photos and correspondence, in addition to many old and obscure references. Mizroch stated that if researchers are looking for something obscure, to send her an email enquiry. The library is open by appointment and can also host visiting researchers. The Secretariat thanked Mizroch for providing copies of individual catch data from several Japanese pelagic expeditions dating back to 1939, 1940, and 1941. This is new data for the individual catch database and will fill a sizeable gap in the database. Mizroch noted that the Rice's whale is named after Dale Rice.

25.8 Biennial workplan

The Chair and Vice-Chair will review intersessionally the individual sub-committee workplans from SC68C. Based on that input they will prepare a draft agenda for 2022. This draft work plan along with the proposed 2022 Committee budget will be presented to the Commission at their virtual meeting in September 2021 for their review and endorsement.

26. PUBLICATIONS

The *Journal of Cetacean Research and Management* (*JCRM*) is the IWC's peer-reviewed scientific journal. The IWC Secretariat's Head of Science, Conservation and Management is its editor and the Editorial Board is comprised of members of the Committee. Over the last twelve months, this team has introduced a number of new initiatives aimed at increasing ease of use, accessibility, visibility and impact of the Journal.

New software for authors and editors streamlines the submission and review processes, significantly reducing the time from receipt of manuscript to publication. Recognising that the vast majority of readers now access *JCRM* digitally, the Journal is being moved to a new website that makes it easier to search for specific papers, topics or authors. New page layouts have also been designed to maximise clarity and make pages easier to read on-screen. The Journal is free to access and download.

JCRM's visibility is much improved with the introduction of Digital Object Identifiers (DOIs). A digital repository known as LOCKSS is also now used to 'future-proof' articles, ensuring every paper published is conserved independently of either *JCRM* or the IWC. These steps have led to *JCRM's* acceptance into the Directory of Open Access Journals which should help promote *JCRM's listing* in citation indexes and gaining a recognised impact factor. A formal 'relaunch' of the Journal will take place shortly after SC68C. Work will continue to raise the profile of *JCRM*, mainly via the IWC website and social media.

Management of the *JCRM* is done in-house by the Secretariat and the Editorial Board volunteer their time, thus there are negligible costs to the IWC.

Volume 21 of the Journal was published in 2020 and contained 14 papers. The first two papers of Volume 22 are available now. The Report of the Scientific Committee meeting (and intersessional workshops) is published annually as a Supplement to *JCRM* and the report of the 2020 Committee meeting (SC68B) held virtually is available here.

The Committee thanks the Editorial Board for their tireless work and all the expert reviewers who had given up their time to ensure the Journal maintained its rigorous scientific standards (see Annex N). An appeal was made for SC members to consider reviewing manuscripts to support the work of their Journal and help speed up publication times.

The IDCR/SOWER Cruises and RMP commemorative special issues of JCRM will be reviewed by the Editorial Board this year and options considered on ways this work can be progressed.

27. ELECTION OF VICE-CHAIR

The Chair proposed, and the Plenary fully supported, that the Vice-Chair move into the position of Chair of the Committee. Zerbini thanked the Committee for their support and accepted the invitation. A new Vice-Chair was elected by secret ballot by the Heads of Delegation. Porter accepted the invitation and was warmly welcomed by the Committee.

28. ADOPTION OF REPORT

The report was adopted by correspondence on 01 June 2021.

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