Annex Q

Report of the Standing Working Group on Abundance Estimates, Stock Status and International Cruises

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1. INTRODUCTORY ITEMS

1.1 Opening remarks

The Standing Working Group (SWG) on Abundance Estimates, Stock Status and International Cruises (ASI) was established to formally review and agree on the status of the abundance estimates submitted to the Scientific Committee across all of the Committee's sub-committees and Working Groups. The SWG is also responsible for assisting the Committee and the Secretariat in developing a biennial document to inform the Commission on the abundance and status of whale stocks, for considering methodological matters related to estimates of abundance and status of stocks and for reviewing survey design and data analysis related to abundance estimates of National Programs and IWC-related projects. The terms of reference of the SWG were listed in IWC (2018).

1.2 Election of Chairs

Zerbini and Givens were elected Chairs.

1.3 Appointment of Rapporteurs

New and Doniol-Valcroze were appointed rapporteurs.

1.4 Adoption of the Agenda

The adopted Agenda is provided in Appendix 1.

1.5 Documents available

The following documents were available: SC/68A/ASI/01-09, SC/68A/ASI/11-16, SC/68A/E/11, SC/68A/SH/14, Cooke *et al.* (2019), Stamation *et al.* (2020), Taylor *et al.* (2018), SC/68A/Rep/01-02, Barlow *et al.* (2018), Monnahan *et al.* (2019) and Roberts *et al.* (2019).

2. EVALUATIONS OF ABUNDANCE ESTIMATES AND UPDATE OF THE IWC CONSOLIDATED TABLE

2.1 Evaluation of new abundance estimates

2.1.1 North Atlantic fin whales

SC/68A/ASI/07 provided an assessment of the accuracy of population abundance estimates for North Atlantic fin whales, which was performed based upon a review of North Atlantic Sightings Surveys (NASS) conducted since 2001 and peer reviewed scientific literature concerning the appropriate methodological components of line transect surveys for cetaceans. It is suggested that fin whale abundance estimates derived through NASS are potentially positively biased due to observer measurement errors that collectively resulted in an underestimate of duplicate sightings, the effective strip width and the track line detection probability. Other factors relevant to the potential sustainability of fin whale quotas based upon these abundance estimates include the effect of regional fin whale population distribution shifts, genetic analysis of pre-whaling era fin whale population levels (Roman and Palumbi, 2003) and the negative effect of the removal of large numbers of pregnant female fin whales.

SC/68A/ASI/16 provided comments in response to SC/68A/ASI/07. The design and analyses of the NASS surveys (1987-2015) have adhered to the Scientific Committee's Requirements and Guidelines for Surveys. All the issues raised concerning the 2007 and 2015 surveys were identified and discussed within the Committee. To minimise potential effects of negative bias in distance estimation, binocular reticle measurements were prioritised over naked eye, and a sensitivity analysis indicated that the uncorrected (for perception bias) estimate of fin whale abundance would be 16% lower if the distance measurements were corrected for this apparent bias. It is also recognised that bias in duplicate identification can lead to either positive or negative bias in abundance estimates. However, most duplicates were identified in the field in 2007 and the estimate for that year should be regarded as unbiased. In 2015 duplicate identification procedures were 'conservative' in the sense that they erred on the side of over-classifying sightings as duplicates. The resulting detection probability ($p(0)$) estimates show no sign of being abnormally low, nor was there any evidence of significant error in angle estimation in the NASS surveys. Distributional shifts were discussed and several stock structure hypotheses were included in the Implementation Simulation Trials for North Atlantic fin whales. The sex ratios in the Icelandic fin whaling have been close to 50:50, contrary to statements in SC/68A/ASI/07. In addition, the RMP has provisions to adjust for skewed sex ratios and it also takes account of pregnancy rates, which are not particularly high in the Icelandic operations. The Scientific Committee has identified several implausible assumptions in the Roman-Palumbi theory of vastly larger pre-whaling populations of large whales than generally assumed and found it impossible to reconcile these results with other known data sources (IWC, 2005). The North Atlantic fin whale abundance estimates referred to in SC/68A/ASI/07 were formally adopted by the relevant sub-committees and the full Scientific Committee for use in the RMP *CLA* in 2008 and 2016 for the TNASS-2007 and NASS-2015 surveys respectively (IWC, 2009, p.95; 2015, pp.136-138; 2017b, p.127-130).

In discussion, it was noted that the genetic-based estimate of historical population size (Roman and Palumbi, 2003) referred to in SC/68A/ASI/07 relies on assumptions of population closure and constant mutation rate over time (around which there is uncertainty), and thus is usually imprecise. Moreover, this estimate is representative of the population at the time of the last common ancestor and therefore is not relevant to the recent past. It was also noted that this method would not meet the current guidelines for genetic analysis (Waples *et al.*, 2018) and that current molecular methods cannot reliably distinguish between contemporary effective sizes that are relatively large (>1,000) and very large (>10,000).

The SWG noted that examination of photo-identification data might be useful to investigate the extent of fin whale distribution shifts in the North Atlantic. It was also noted that the main issues raised by SC/68A/ASI/07 (measurement errors, possible shifts in distribution, skewed sex ratio in whaling catches) have all been taken into account in the *Implementation* of the RMP, which is designed to be particularly conservative and robust to these sources of uncertainty. For instance, multiple stock structures hypotheses are usually included in the RMP, and new hypotheses can be brought forward for consideration at the time of the *Implementation Reviews*.

In conclusion, the SWG acknowledged that information in SC/68A/ASI/07 and SC/68A/ASI/16 was useful to consider, but **reiterated** that North Atlantic fin whale abundance estimates computed from the NASS cruises have been reviewed before and endorsed as appropriate for use with the *CLA*, and that no further action was warranted.

2.1.2 North Pacific minke whales

The SWG noted that the estimates for North Pacific common minke whales at present are considered under the conditions relevant to estimates provided under the RMP in the context of its requirements and guidelines for surveys.

Initial focus was on papers SC/68A/ASI/14rev1 and SC/68A/ASI/15 that had presented estimates in the context of being used for conditioning purposes.

SC/68A/ASI/14rev1 provided abundance estimates for western North Pacific common minke whales based on sighting surveys conducted in 2013, 2015, 2016, 2017 and 2018 (the survey periods varied from as early as April-May to as late as August-September). The surveys had followed the IWC Requirements and Guidelines (IWC, 2012). Estimates were presented for sub-areas 7, 8, 9, 10E and 11 using standard methods assuming that $g(0)=1$. A summary of survey period, survey areas and plotting of primary sightings of the common minke whales along the tracks was provided. The number of primary sightings was low and thus primary sightings during 2008-18 were used to estimate the detection function. The best (using AIC) model was the Hazard rate model with vessel type covariate. Estimates by year and sub-areas were presented.

SC/68A/ASI/15 provided abundance estimates for western North Pacific common minke whales in sub-areas 11, 10E and 7CN based on sighting surveys conducted using two vessels from late August to early September 2014. The surveys had followed the IWC Requirements and Guidelines (IWC, 2012). A summary of survey period, survey areas and plotting of primary sightings of the common minke whales along the tracks was provided. A total of 19 primary sightings (21 animals) were made. The best (using AIC) model was the half- normal model with covariates of Beaufort scale and vessel. Estimates for sub-areas 11, 10E and 7CN were presented using standard methods and assuming $g(0)=1$.

During the initial discussion a number of points were raised related to the robustness of the estimates which are based on a low number of sightings and in small areas. The assumption of $g(0)=1$ was questioned, recognising that an estimate of 0.79 (Hakamada *et al.*, 2010) had been accepted for some surveys (and was in fact used as the base case in the *Implementation Simulation Trials*). The appropriateness or not of that for the trials was more relevant to the sub-committee on *IST* but the issue of $g(0)$ correction was also relevant in the context of ASI. The SWG noted that there was agreement that the estimates presented were broadly satisfactory for use in conditioning and a small group was appointed to:

(1) examine each estimate individually to confirm that it could be used for conditioning purposes (this involved examining the pre-determined and actual cruise tracks, sample sizes and proportion of the study area covered);
(2) examine the abundance estimates initially presented at the JARPN II review meeting in 2016 (Hakamada and Matsuoka, 2016; IWC, 2017a) that had not been formally reviewed by the ASI group – it included estimates for sub-areas 7,8 and 9 for 2008-12 although the 2008 and 2009 surveys had not been undertaken under IWC oversight;
(3) to determine what work was needed to try to develop robust estimates for use in application of the *CLA* as well as to develop estimates at a scale suitable for the Commission and general public; and
(4) to examine the question of $g(0)$ and whether the 'agreed' estimate of Okamura *et al.* (2010) can be applied to other surveys.

The conclusions of the small group are provided below. An intersessional email group will discuss potential improvements to North Pacific minke whale abundance estimates provided in SC/68A/ASI/14rev1 and SC/68A/ASI/15 (see work plan below).

Attention: SC

With respect to abundance estimates related to western North Pacific common minke whales, the SWG ***agreed*** *that:*

(1) *the estimates by sub-area presented in table 3 of SC/68A/ASI/14rev1 are acceptable for use in conditioning and Allison will adjust the master table accordingly;*
(2) *the estimates in SC/68A/ASI/15 that are acceptable for conditioning should be those for the half-normal model as the authors preferred model using all covariates was based on very limited data and Allison will adjust the master table accordingly;*
(3) *future papers should identify coverage comparing pre-determined and actual tracklines and the available area to be covered as well as to the total sub-area - the coverage reported in both papers initially related to cover of the RMP sub-area rather than the area available able to be covered due to limited access to the Russian Federation EEZ;*
(4) *the estimates presented in Hakamada and Matsuoka (2016) suffered from similar problems to those for SC/68A/ASI/14rev1 and SC/68A/ASI/15 and as such they are acceptable for use in conditioning only (it was noted that use of estimates from the 2008 and 2009 cruises in an RMP context would require further discussion given the IWC oversight issue);*
(5) *the estimates presented in Hakamada and Matsuoka (2016) for sub-area 7 in 2008 and 2009 will need to be recalculated for the current sub-areas (7CS, 7CN, 7WR and 7E) if used in an RMP context; and*
(6) *the issue of the work required to: (a) try to develop robust estimates for use in application of the CLA, to*

provide management advice and/or to provide broader estimates for the public; and (b) address issues related to g(0) was referred to an intersessional advisory group led by Kitakado, noting that a number of issues would need to be addressed including those related to covariance (see ToR given in Appendix 3).

2.1.3 Southern Hemisphere blue whales

At last year's meeting, the ASI SWG reviewed an estimate of abundance for New Zealand blue whales (paper SC/67b/SH/05, now published as Barlow *et al.*, 2018). This document was referred to the Intersessional Correspondence Group (ICG) on the Review of Abundance Estimates for further review. The ICG contacted Dr. Brett McClintock ('reviewer') at NOAA's Alaska Fisheries Science Center, who developed the R package multimark (McClintock, 2015) used in the New Zealand blue whale estimation, and requested his assistance in reviewing the estimate. The ICG provided a copy of the paper, the discussion that followed the presentation of the document at last year's meeting and requested that he provide a review of the modelling approach, the potential limitations of the data/estimate, and suggestions for improvements.

The reviewer was not concerned about the low recapture rate and high CV. Instead, his main concerns were the lack of a clear definition of the study area and population being estimated, and the use of preferential sampling towards 'hotspots' of whale density, which may have biased the detection probability and therefore the abundance estimate. Because of violations of population closure assumptions, he suggests that the estimate only represents the abundance of whales using the South Taranaki Bight at some point during the two-month period of each year of the study. He suggests improvements such as including additional covariates on detection probability, investigating individual heterogeneity, or pooling encounter data across years. Another recommendation would be to use Pollock's robust design or a Jolly-Seber model for simultaneously estimating abundance within years as well as survival and temporary emigration across years. However, none of these options are implemented in the current version of the multimark package.

In discussion of the review, the SWG noted that numerous photo-identification studies do not survey their study area systematically but rather focus on hotspots of whale presence to maximise data collection, and therefore the group was less concerned about potential sampling bias. The SWG noted that four years is a relatively short time in the lifespan of a blue whale and concluded that the assumption of demographic closure is a reasonable approximation. However, the group did agree that the assumption of spatial population closure was problematic, due to the high potential for immigration and emigration into the study area, and that models capable of implementing survival and temporary emigration across years should be explored. The SWG **agreed** that the recently established Abundance Steering Group (ASG, see Item 3.1.1 below) to send the reviewer's comments along with the SWG's viewpoint to the authors and to **encourage** them to explore alternative modelling approaches. The SWG expressed appreciation to Dr. McClintock for providing the review of Barlow *et al.* (2018).

Attention: SC

*The SWG **agreed** that the review of the New Zealand blue whale abundance estimate performed by an external reviewer along with the viewpoint of the Working Group be provided to the authors and **encourage** them to explore alternative modelling approaches.*

2.1.4 Southern Hemisphere humpback whales

Monnahan *et al.* (2019) presented estimates of abundance and trends for Southern Hemisphere humpback whales in the Magellan Strait, Chile. The SWG **agreed** that these estimates will be reviewed intersessionally.

Attention: SC

*The SWG **agreed** to refer estimates of abundance of Magellan strait humpback whales to the ASG for review during the intersessional period.*

2.1.5 Beluga whales

SC/68/ASI/09 reported on aerial surveys in the Chukchi and Beaufort Seas. The eastern Chukchi Sea (ECS) stock of beluga whales helps meet subsistence needs, is subject to potential impacts from industrial activities, and occupies habitat that is experiencing rapid ecological changes. Its abundance and trend have been particularly difficult to monitor. SC/68A/ASI/09 reported on aerial line transect surveys conducted during 19 July-20 August, 2012-17, with onshore-offshore transects covering a study area of approximately 110,000km^2, from 140°W to 157°W longitude, from shore to 72°N latitude. These data were used to estimate abundance of the ECS stock of beluga whales while it summers in the Beaufort Sea. The data were stratified based on bathymetry, to reflect strong large-scale gradients in beluga density. A half-normal key function was used to model detection from a dataset of 999 sightings of 2,465 belugas. The detection function was found to depend significantly on sky condition and ice coverage. For the years 2012-17, respectively, the estimated numbers of ECS belugas in the study area during the study period were 7,355 (CV=0.47), 6,813 (CV=0.47), 16,598 (CV=0.49), 6,456 (CV=0.48), 6,965 (CV=0.49) and 13,305 (CV=0.51). A log regression of these results shows no statistically significant trend (estimated annual increase rate of 6.1%, with 95% CI=(-13.4%, 30.2%), p=0.59). These abundance estimates do not correct for belugas outside the study region. Indeed, diverse data indicate that belugas venture far outside the study region and their distribution varies interannually due to prey availability and other factors. Tagging data reviewed by Lowry *et al.* (2017) suggest that correcting for whales outside the study area would approximately double these abundance estimates. These results provide no indication that the stock has substantially declined during these six years due to the impact of subsistence hunting, industrial activity or climate change, although interannual variation and estimated CVs are both large, thereby potentially masking small scale impacts.

In discussion, it was questioned whether left truncation of perpendicular distance data at 0.2km prior to the estimation of detection probability was needed. In response, it was noted that left truncation was performed because time-in-view is very short when sightings are close to the trackline. Another question pertained to the validity of the assumption that $g(0)$=1 (i.e., that all beluga are detected at 0.2 km), and whether it would be worth estimating the real value of $g(0)$. It was noted that beluga whales are usually easy to spot at close distances because of their white colour, which should minimise perception bias.

The SWG also noted the lack of independence between the yearly estimates, given that they share some common parameters (detection function, correction factors for diving animals). Ideally, the authors might produce a covariance matrix to include in the IWC Consolidated Table of Abundance Estimates. However, the SWG **agreed** that it would suffice to add a note to the table indicating the presence of correlation, since these abundance estimates were not planned to be used in any management related simulations (e.g. *IST*s). It was also noted that the main contributing factor to variance in line-transect estimates of small cetaceans is usually the variance in encounter rates (rather than the detection function), which could be shown by presenting the decomposition of the CV in its separate components. The Working Group noted that the consequences of sharing detection functions and correction factors across multiple estimates for variance estimation should be further investigated as this is a general occurrence in abundance estimation.

The SWG **endorsed** the estimates for ECS beluga for inclusion as category 2 in the Consolidated Table (see Appendix 2).

2.1.6 Hector's/Māui dolphin

Cooke *et al.* (2019) fitted an individual-based model to genetic capture-recapture data from Māui dolphins from biopsies collected during 2001-16 and from some carcasses. Projections of the population into the future were made under various scenarios. The model fits show that the population has almost certainly been declining, but the best-fitting models involve an increasing survival rate and a decreasing rate of decline. If the estimates of fishing-related mortality rate from the risk assessment model of Roberts *et al.* (2019) (see also Annex J, item 2.4.3) are treated as a relative index, then the fit to the capture-recapture data is good and the fishing-related (bycatch) mortality is estimated to have decreased, but needs to decrease at least by a further 50% in order to stop the decline and avert the risk of extinction. If the estimates of fishing mortality from Roberts *et al.* (2019) are accepted as absolute rates, then the estimated fishing mortality rate is insufficient to explain the decline, and it is necessary to invoke other sources of mortality, such as toxoplasmosis or some as yet unknown factor. In that case, a reduction of the additional source of mortality by 50% per five years from 2025 would be sufficient to avert extinction, but a reduction of 50% per 10 years starting in 2030 would not be quite enough.

The SWG welcomed the presentation of this work in light of the species' critically low population size. The SWG expressed concerns regarding the assessment of model fit, but recognised that the equivalent of residual inspection does not exist for mark-recapture and that this issue requires additional attention more broadly. The SWG **agreed** the Abundance Steering Group (ASG) should establish a process to address model fit in mark-recapture estimates of abundance. The SWG therefore **agreed** that this concern should not delay the acceptance of the abundance estimate, since the analysis was thorough and in-line with current standards. The Working Group reiterated that for the purpose of estimating abundance, the choice of model is less important than the management implications, and so the simplest model that is not inferior to other models in the set should be used. Consequently, the SWG **endorsed** the abundance estimate of 57 (*SE*=6), for Māui dolphins in 2016 and **agreed** it should be accepted as Category 1.

Attention: SC

*The SWG **recommended** that the ASG choose an external expert to provide ASI with a detailed review of the Maui's dolphin abundance estimate in Cooke et al. (2019) at next year's meeting, so that this estimate can meet the definition of an Evaluation Extent of 1 ('examined in detail by the Scientific Committee')*

2.2 Update of the IWC Consolidated Abundance Table

Abundance estimates recommended for inclusion in the IWC Consolidated Table of Accepted Abundance Estimates during the 2019 meeting are presented in Appendix 2. The SWG **agreed** that the table continues to be updated intersessionally.

Attention: SC, S, C-A

*New abundance estimates **endorsed** by the ASI Standing Working Group for inclusion in the IWC Consolidated Table of Accepted Abundance Estimates are presented in Appendix 2. The Committee **agreed** that these estimates are incorporated into that table and uploaded to the IWC website. The Committee also **agreed** that the table should continue to be updated intersessionally.*

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3. METHODOLOGICAL MATTERS

The SWG reviewed the Report of the Pre-Meeting of the ASI SWG, held 8-9 May 2019. Participants at this pre-meeting proposed a process for reviewing and validating abundance estimates, including those that require population models (e.g. capture-recapture models), and considered how best to summarise the status of stocks. The pre-meeting report is given in Appendix 3.

3.1 Process to validate non-standard software and methods

The SWG **agreed** to produce a comprehensive document (Appendix 4; see Annex P) that outlines a process for the submission, review, and endorsement of abundance estimates submitted to the Scientific Committee. The pre-meeting proposal, Appendix 3, was the starting point. In discussion, the SWG made various amendments to that proposal.

3.1.1 Evaluation of estimates

The SWG **agreed** to establish an Abundance Steering Group (ASG) to coordinate the review of abundance estimates by the Committee and **agreed** that the ASG members would be the Chair and Vice-Chair of the Scientific Committee, the Head of Science and Head of Statistics from the Secretariat, and the Convenors of the following sub-committees and Working Groups: ASI, ASW, EM, IST, IA, NH, SM and SH.

The SWG **agreed** to amend the review process flowchart to the version given in Annex P.

The SWG rejected the data/code submission requirement proposed by the pre-meeting, and **agreed** instead on the following process. An abundance estimate should normally be submitted by the author (or a relevant Convenor) at least 1 month in advance of a Scientific Committee meeting to *abundance@iwc.int*. This will provide an opportunity for the ASG review to be completed before that meeting, and thus allow the abundance estimate to be considered by the ASI and potentially be accepted by the Scientific Committee. In order to proceed to the review stage, the submitted manuscript must include all applicable information outlined in Table 1 of Annex P. Authors must also agree that the data, computer code and associated input files used to calculate any abundance estimate put forward for review will be submitted to the ASG upon request[1]. Authors are encouraged to submit these files at the same time as their manuscript It should be noted that before an estimate can be fully endorsed by the Committee

[1]The data, code and input files will be treated as confidential, however provisions of the Data Availability Agreement (IWC, 2004) would apply to the data. The SWG **recommends** that the Scientific Committee consider provisions for the sharing of code and input files.

Table 1

Acronyms used in the IWC Consolidated Table of Abundance Estimates to describe methods.

Acronym	Description
LT	Line transect (or distance-sampling)
SM	Spatial modelling
CC	Cue counting
PA	Population dynamics model-based assessment
PId	Photo-identification of individuals
SC	Strip census
MR	Mark-recapture/capture-recapture; the type should be included, e.g. MR+PA or MR+PId
GMR	Genetic mark recapture
SBC-M	Shore based count with modelled correction factors

as Category 1 ('acceptable for use in in-depth assessments or for providing management advice') or 2 ('underestimate - suitable for AWMP usage or other conservative management but not reflective of total abundance'), the data, code and input files must be lodged with the Secretariat and tested to ensure that the results are reproducible. This might be possible to be undertaken at an Annual Meeting with the assistance of the author. The code needs to work, but not necessarily be perfectly tidy and commented. The ASG may also require these data, code and input files for estimates in other categories in some circumstances, and in cases when external reviews, simulation testing or code validation are needed.

Attention: SC
The ASI Standing Working Group noted that submission of the data, code and input files associated with an agreed abundance estimate would be a valuable part of the process of endorsing abundance estimates, but currently issues of confidentiality and sharing are addressed only for data (IWC, 2004). The Standing Working Group ***recommended*** *that the Scientific Committee give consideration to the possibility of these data availability rules being extended to apply also to computer code.*

3.1.2 Prioritisation
The Working Group **agreed** with the criteria given in Appendix 3 for determining the priority assigned to abundance estimates to be evaluated by the ASG. This is reflected in Appendix 4.

3.1.3 The overall review process

Attention: SC
A complete description of the proposed process for submission, review, and validation of new abundance estimates is given in Appendix 4. The ASI Standing Working Group ***recommends*** *that the Scientific Committee adopt this process.*

The pre-meeting had recognised that the review of abundance estimates in advance of the Annual Meeting of the Scientific Committee would represent a considerable workload for the ASG, and had considered that this might be facilitated by ensuring that the ASG could meet directly before, or in the initial days of, the Annual Meeting. This would help ensure the most efficient processing of abundance estimates by ASI and relevant sub-committees.

Attention: SC
The ASI Standing Working Group concurred that the ASG workload might be substantial, and ***strongly recommended*** *that a permanent, one-day pre-meeting for the ASG be established as a normal component of the Annual Meeting of the Scientific Committee.*

3.1.4 Simulated datasets
Appendix 3 addresses the use of simulated datasets for testing abundance estimation methods. The SWG **agreed** with these proposals. In 2018, a funding proposal to document and ensure the longevity of existing code previously developed for simulating line transect survey data had been presented and agreed for funding.

Attention: SC
The ASI Standing Working Group ***reiterated*** *its advice from last year that it considered the project to preserve existing software for simulating line transect survey data to be imperative and* ***recommended*** *its completion. Furthermore, although the Standing Working Group had recommended that the Committee endorsed this as a high priority budget item, the project was only partially funded last year. Therefore, the Standing Working Group* ***strongly recommended*** *that the remaining amount be funded this year.*

3.1.5 General
The SWG received information from Allison (requested by the pre-meeting) regarding the acronyms and categorisation of abundance estimates in the IWC Consolidated Table. The group **agreed** upon the acronyms listed in Table 1 and further agreed that all factors qualifying the analysis (e.g. spatial models) should be listed.

In response to a suggestion from the pre-meeting, the SWG considered that the terms 'mark-recapture' and 'capture-recapture' were both frequently used by Scientific Committee members and therefore did not propose any standardisation of terminology in this respect.

3.2 Process to consider abundance estimates from methods that require population models

Appendix 3 presents the pre-meeting considerations on this topic. The SWG **concurred** with these. In particular, the SWG **agreed** that a full time series of the abundance estimates output from mark-recapture models on record, together with their variance-covariance matrix, should be archived by the Secretariat. However, for tabulation in the IWC Consolidated Table of Abundance Estimates, only values for the first and last year for which estimates of reasonable quality are available should be shown.

3.3 Consideration of status of stocks

In response to a Commission request, the pre-meeting reviewed and extended a 2017 proposal on how to summarise the status of stocks in a broad sense (Appendix 3, item 4). To evaluate how this might work, the pre-meeting asked Punt to provide examples for North Pacific common minke whales and eastern North Pacific gray whales, each illustrating specific challenges regarding stock structure and other factors. The SWG considered this agenda item in light of the output produced by Punt.

Generally, the SWG noted that the output proposed by the pre-meeting was too complex and quantitative for its intended purpose. After discussion, the SWG **agreed to** the following process.

To provide advice on stock status to the Commission, the Scientific Committee should begin by conducting various analyses for internal use by the Scientific Committee. Then this information would be further summarised and simplified for conveyance to the Commission. The calculations for internal use are as follows.

First, consider stocks which have been the subject of RMP or AWMP *Implementations* and *Implementation Reviews*. The ASI SWG **agreed** that results of a set of *ISTs* should be summarised by the following three statistics:

- current depletion (number of animals aged 1+ relative to 1+ carrying capacity, if available);
- current 1+ abundance; and
- a pointwise median trajectory plot of 1+ abundance from pre-exploitation or the first year used in the simulations to the present.

The ASI SWG further **agreed** that results should be provided for two values of the MSY rate (1% in terms of harvesting of the total (1+) component of the population and 4% in terms of harvesting of the mature component) unless the base-case trials are based on a higher value for the lowest plausible value for MSY rate or if MSY rate has been estimated and there is an agreed value. In addition, results should be summarised across simulations and trials (medians over simulations and averages across base-case trials).

As each base-case trial may have a different number of breeding stocks, the ASI SWG **agreed** that results should be reported by area, specifically for the Ocean Basin (i.e. 'Region') and by 'Medium Area' rather than by the sub-areas on which the population models underlying the trials are based, to avoid having a very large number of summary statistics. However, there needs to be flexibility in reporting. For example, the Scientific Committee may also wish to present results for individual biological stocks about which it believes the Commission needs to be informed and hence that the default of reporting results by area only would be misleading. The choice of the stocks for which results are to be reported needs to be decided during *Implementations* and *Implementation Reviews*.

The SWG also considered the matter of reporting estimation precision. It **agreed** that 90% intervals should be produced for all three of the above statistics. These should be generated by pooling all replicates across the trials considered and computing the 5th and 95th percentile values (pointwise for the trajectory plot). Although there is no precise statistical interpretation for this 90% interval, it serves to convey a general sense of the uncertainty across all factors.

Attention: SC
*The ASI SWG **recommended** that the Guidelines for Conducting Implementations and Implementation Reviews be updated to ensure that information needed by ASI to report to the Commission on the status of stocks is provided during those processes, and that the control programs used for Implementation Simulation Trials be modified to report the three summary statistics (including 90% intervals) required for the status report: 1+ depletion, 1+ current abundance, and stock trajectories, as detailed in Annex Q, Item 3.3.*

The second step of the process for providing advice on status is for the Scientific Committee to consolidate and simplify the information described above for final presentation to the Commission. The SWG **agreed** that only the average values (and 90% intervals) for current 1+ abundance and depletion (if available) should be provided, for stocks/areas as determined above. Furthermore, the Scientific Committee should provide a qualitative statement on recovery in the past several decades, based on what is shown in the trajectory plot. The exact nature of this statement will depend on the stock(s) and simulation framework. In some cases, reference to available abundance estimates (i.e. from direct data, not simulation projections) may be a useful supplement. In addition, the Scientific Committee should highlight any additional matters that may be of particular interest to the Commission, such as drawing attention to peculiarities in the population trajectory, or information relevant to a small biological stock or population isolated spatially or genetically.

The above discussion pertains to stocks which have been the subject of RMP or AWMP *Implementations* and *Implementation Reviews*. If the stock has not been the subject of these, but has been the subject of an *In-depth Assessment*, the SWG **agreed** that the same outputs (internal and final) should be produced.

The pre-meeting also considered the case of a stock for which an agreed abundance estimate is available but no *Implementation*, *Implementation Review*, or *In-depth Assessment* has been done. The SWG **agreed** that the preceding outputs should still be used. However, in this and the prior case (*In-depth Assessment*), it is possible that some case-specific adjustments to the process would be required to cope with the peculiarities of the situation.

The pre-meeting also considered how to evaluate population model assessments that would be used to develop advice on stock status. The SWG considered that this would usually have already been done during the *Implementation*, *Implementation Review*, or *In-depth Assessment*. In this case, the ASI SWG does not need to evaluate the assessment.

3.4 Amendment of the RMP Guidelines

The 'Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme' (referred to here as the 'RMP Guidelines', IWC (2012) is a document prepared by the Scientific Committee to state the requirements and to guide the collection and analysis of survey data to compute abundance estimates for use in the Revised Management Procedure (RMP).

At last year's meeting, the SWG agreed that the RMP Guidelines needed to be modified to incorporate spatial model approaches to estimate abundance by 2020. A Steering Group was established to: (1) develop a set of specific instructions for the amendment of the RMP guidelines to consider model-based abundance estimates; and (2) select a candidate to conduct this work. Dr. David Miller from CREEM (Centre for Research into Ecological and Environmental Modelling, University of St. Andrews) was selected to modify the Guidelines. The SWG **agreed** that the Steering Group continues the intersessional work to develop instructions to guide the analysis of survey data using model-based approaches to the RMP Guidelines.

Attention: SC
*The 'Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme' need to be modified to consider estimates of abundance using model-based methods. The ASI Standing Working Group **agreed** that the Steering Group established to oversee this process should continue the intersessional work to develop instructions to amend these Guidelines.*

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4. RESEARCH PROGRAMS

4.1 IWC-POWER cruises

SC/68A/ASI/04 reports the results of the 9th annual IWC-POWER cruise, which was conducted between 3 July and 25 September 2018 in the central Bering Sea. The survey was conducted aboard the Japanese *R/V Yushin-Maru No. 2*. The cruise was organised as a joint project between the IWC and Japan. The cruise plan was endorsed at the SC/67B Scientific Committee meeting. Researchers from the IWC, the US and Japan participated in the survey. The survey was conducted using methods based on the guidelines of the IWC/SC. The acoustic survey was included for the 2nd time to acoustically monitor for the presence of marine mammals, with particular importance for detecting and locating North Pacific right whales. Survey coverage was 75.3% of the original trackline, with a total of 1,685.5 n.miles. Additionally, 421.6 n.miles were surveyed during transit between Japan and the research area. During the entire cruise, sightings of: blue (8 schools/12 individuals), fin (135/199), sei (5/7), common minke (17/17), North Pacific right (3/3), humpback (86/122), gray (27/88), sperm (35/36), Baird's beaked (2/24) and killer (20/136) whales were observed. Gray whales were only sighted north of 64°N. A solitary North Pacific right whale was sighted north of 64°N near St. Lawrence Island in the Central Bering Sea. There were no sightings of blue or sei whales in the Bering Sea. Photo-identification data were collected for: 3 North Pacific right whales, 41 gray whales, 8 blue whales, 69 fin whales, 39 humpback whales, 33 killer whales and 4 sperm whales. These data are preliminary, pending further processing and photo-identification confirmation. Two of three right whale sightings were detected and localised using acoustics. A total of 76 biopsy samples were collected from 6 blue, 24 fin, 29 humpback, 7 gray, 3 North Pacific right and 7 killer whales using the Larsen sampling system. A total of 253 sonobuoys were deployed, for a total of almost 700 monitoring hours. Species detected include fin whales, sperm whales, killer whales, right whales, humpback whales, gray whales and Baird's beaked whales. A total of 19 objects of marine debris were observed. The 9th annual cruise of this program was successfully completed and provided important information on cetacean distribution, in particular gray, fin and North Pacific right whales, in an area where limited survey effort had been conducted in recent decades, in a poorly-known and logistically difficult area. These results will contribute to the aforementioned objectives of the IWC/SC.

The SWG welcomed the important new information provided, especially with respect to North Pacific right whales, and highlighted the value of the acoustics component of the research program, which provided numerous detections in areas where few sightings were made. A point raised in discussion was that, during summer 2018, subsistence hunters on Saint Lawrence Island in the Bering Sea, USA, expressed concern that their subsistence hunts had been disrupted by a research vessel close to the island. The bowhead hunts at Saint Lawrence Island are covered under an approved IWC aboriginal subsistence quota. Initially, there was concern that the vessel associated with the POWER cruise may have disturbed hunters at Saint Lawrence Island. After further investigation it was apparent that the disturbance was not associated with the POWER cruise. This situation provides an opportunity to raise awareness that research vessels should not disturb subsistence hunters. This could be accomplished by communicating through the government of the relevant countries, with the communities that occur near cruise tracks, and with appropriate organisations within the relevant countries (for instance, Suydam would be the contact for this kind of enquiry in Alaska).

The SWG thanked Matsuoka for his effort in making this survey successful and thanked the Government of Japan for their continued investment in the POWER cruises. The Government of the USA was acknowledged for providing an acoustician and acoustic equipment. The SWG **endorsed** the IWC-POWER cruise report and recognised the value of the data contributed by this and previous IWC-POWER cruises, collected in accordance with survey methods agreed by the Committee and addressing an important information gap for several large whale species. The SWG **encouraged** the future provision of abundance estimates arising from these data as discussed at the Planning Meeting described below.

Kitakado introduced the report of the IWC-POWER Technical Advisory Group (TAG) Meeting (SC/68A/Rep/01), held in Tokyo from 12 to 14 October 2018. Kitakado thanked Japan for hosting the meeting and the warm welcome. The TAG Meeting reviewed the available data (including preliminary results from the 2018 cruise) and status of analyses with biopsy, photo-identification, acoustic and visual sighting data. The TAG meeting also received several papers which update on the abundance estimates for cetacean species such as blue, humpback, fin and Bryde's whales and marine debris. These pieces of information helped the TAG to develop a work plan to take these issues forward, including obtaining consolidated abundance estimates for various cetacean species as well as marine debris. Furthermore, the TAG commended the work by a team of Tokyo University of Marine Science and Technology (TUMSAT) and Institute of Cetacean Research (ICR) for its drafting a manual for analysing visual sighting data obtained from the IWC-POWER survey to produce the abundance estimates. The TAG Meeting discussed a short-term plan (up to 2020 including a back-up plan) and agreed that a high priority in the 2019 back-up plan should be try to obtain sufficient IO data to allow an estimate of $g(0)$ to be obtained for sei whales. Development of medium-term plan (6-10 years starting in 2021) is heavily dependent on consideration of the analyses of the data collected under the short-term programme, and the TAG gave advice and recommendations (see SC/68A/Rep/01 for more details).

The SWG recognised the considerable importance of this contribution. In discussion, it was noted that previous versions of this report included information on photo-identification matches with different catalogues (e.g. blue whales, humpback whales, killer whales) and that it would be interesting to continue to report on this issue in the future. It was noted by the authors that progress had been made on abundance estimation of large whales from IWC-POWER sighting data, using both design-based and model-based methods, with plans to present those results to the Scientific Committee in the near future. Moronuki stated that the Government of Japan was ready to continue its support to this important collaborative programme regardless of Japan's status at IWC after its withdrawal from the IWC.

The SWG **welcomed** the intention that the Government of Japan would continue its support for this important collaborative program. It **endorsed** the updated work plan for IWC-POWER.

Donovan introduced the report of the planning meeting for the IWC-POWER cruise for 2019 (SC/68A/Rep/02), held at the Japanese Fisheries Agency crew house on 15-16 October 2018. Donovan thanked Japan for hosting the meeting and the warm welcome. The Planning Meeting reviewed the available data (including preliminary results from the 2018 cruise) and status of analyses, including examination of the distance and angle experiments, and developed a workplan to take these issues forward, including obtaining consolidated abundance estimates. Given the potential difficulties in obtaining a permit for Russian waters in 2019, a back-up plan was developed to survey US waters. Because the Russian permit was not received in time, the 2019 IWC-POWER cruise will be held between 6 July and 28 September 2019 in Gulf of Alaska. These dates include transit from and to Japan using the research vessel *Yushin-Maru No.* 2, kindly provided by Japan, which has international clearance and can visit foreign ports. This will be the tenth cruise under the successful international IWC-POWER programme. The 2019 cruise objectives are broadly the same as in previous years although the primary focus will be collecting sufficient independent observer data to allow the estimation of $g(0)$ for sei whales, given previous indications that it is less than one. The use of acoustics had been previously endorsed by the Scientific Committee and is conducted in cooperation with the US. The cruise will focus on the collection of line transect data to estimate abundance as well as collection of acoustic, biopsy and photo-identification data. This will make a valuable contribution to the work of the Scientific Committee on the management and conservation of populations of large whales in the North Pacific. A number of tasks to be completed prior to the cruise were identified. Koji Matsuoka of Japan has been appointed Cruise Leader. Appropriate deadlines and responsible persons were identified. It was noted that the budget for the survey in 2019 had already been approved.

The SWG **endorsed** the 2019 IWC-POWER cruise plan and thanked the government of Japan for the provision of the vessel and logistical support. The SWG **looks forward** to receiving a report from this survey at the next Scientific Committee meeting.

There was discussion of the difficulty of obtaining research permits to survey Russian waters (a permit could not be secured for the 2019 cruise). It was noted that surveying the Russian part of the IWC-POWER cruise plan in the immediate future is more useful than to conduct that survey several years from now, in order to ensure that spatially proximal areas are surveyed in proximal years (thereby facilitating abundance estimation for larger areas). The SWG **strongly reiterates** a previous recommendation that Russia undertake all possible efforts to ensure that permits are issued to the next IWC-POWER cruise to survey the western Bering Sea.

SC/68A/E/11 reported on analyses using sighting data taken in the IWC-POWER surveys from 2010 to 2016 to draw attention to how many and how much floating marine debris occurs in the North Pacific. Marine debris is an element of concern in the marine ecosystem, and therefore during IWC-POWER cruises, sighting of floating marine debris has also been recorded. A statistical analysis was conducted to estimate the density and distribution of floating marine debris there. Line transect methods were used for estimating detection function and abundance for several types of marine debris. A multiple-covariate distance sampling (MCDS) analysis was applied to take environmental factors on sighting into consideration. In addition to the 'design-based' method, a 'model-based' approach was also employed to estimate spatial distribution of marine debris. Results showed abundance of 'plastic small' and 'single fishing float' were especially high in the study area. A model-based method showed that densities of debris were high between 20°N-40°N and concentrated around 145°W. The abundance estimates were generally robust to the methods and assumptions, so the results can be used for understanding of abundance of marine debris in the North Pacific.

The SWG thanked the authors for bringing this very useful document. In discussion, it was noted that the abundance of debris may be underestimated, especially in areas where whales occurred at high densities, because priority was given to whale sightings. It was suggested that density of whales could be added as a covariate in future analyses (to account for reduced attention to debris during such periods), as well as oceanographic factors such as currents. The authors answered that detection priority was given to whales, but that 15 minutes out of every hour of observation was dedicated for marine debris and that overall the results provide a realistic depiction of the situation. On several occasions the IWC has been asked to consider the collection of data on other marine life than cetaceans (e.g. birds) but this is unrealistic because the workload would interfere with the cetacean studies.

The SWG **welcomed** this estimate as a convincing analysis using appropriate methods, and welcomes similar analyses in the future.

Attention: SC, C-A, CG-R

*The ASI Standing Working Group **reiterated** to the Commission the great value of the data contributed by the 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 large whales. The SWG:*

*(1) **thanked** the government of Japan (who generously supplies the vessel and crew) and the government of the United States (who generously provides acoustic equipment and acoustic experts), for their continued support of this IWC programme;*
*(2) **agreed** that the 2018 cruise was duly conducted following the requirements and guidelines of the Committee (IWC, 2012) and **looks forward** to receiving abundance estimates based on these data;*
*(3) **endorsed** the report and work plan set out by the Technical Advisory Group (TAG) for continuation of work related to the IWC-Power cruises;*
*(4) **endorsed** the plans for the 2019 and 2020 POWER cruises;*
*(5) **reiterated** its previous strong recommendation that the Russia Federation facilitates the proposed research by providing permits for the IWC-POWER cruise to survey within their national waters; and*
*(6) **looks forward** to receiving a report from the 2019 survey at the next Scientific Committee meeting.*

4.2 National programs

SC/68A/ASI/08 by Japan outlined the objectives, survey and analytical procedures, target species and work schedule of a new Japanese research program on whales and the ecosystem in the Indo-Pacific region of the Antarctic, the Japanese Abundance and Stock structure Surveys in the Antarctic (JASS-A). The main research objectives (MO) of JASS-A are, MO1: the study of the abundance and abundance trends of Antarctic minke and other large whale species, and MO2: the study of the distribution, movement and stock structure of Antarctic minke and other large whale species. JASS-A also has several secondary research objectives (SO), SO1: investigation of the oceanographic conditions in the Indo-Pacific region of the Antarctic; SO2: to investigate the spatial and temporal trend of marine debris on the sea surface; SO3: to conduct feasibility studies to evaluate the utility of genetics data to estimate abundance; and SO4: to continue with feasibility studies to evaluate the utility of non-lethal techniques for whale biological research. The research program will be based on systematic sighting surveys utilising Line Transect Methods, to be conducted alternatively in IWC Areas III, IV, V and VI by one or two specialised vessels, during a tentative period of eight austral summer seasons. Analyses related to main and secondary objectives will be conducted based on new as well previous data collected by JARPA/JARPAII and NEWREP-A in the same research area. Therefore the analyses under each of the objectives will be based on large and consistent data sets. Scientists from the Institute of Cetacean Research (ICR) will play the leading role in order to pursue the research activities and achieve the research objectives of JASS-A, in collaboration with scientists from other domestic research organisations such as the National Research Institute of Far Seas Fisheries, and the Tokyo University of Marine Science and Technology. Qualified external scientists (national and international) are welcomed to participate in the field and analytical works of JASS-A. Qualified external scientists can submit field or analytical research proposals for consideration of a domestic Steering Group. To facilitate the process, the Steering Group will prepare guidelines for the submission process.

The appendix of SC/68A/ASI/08 presented the survey plan of JASS-A for the 2019/20 austral summer season. As is in the case of the 2017/18 and 2018/19 surveys, the design and implementation of the sighting survey will follow the IWC Scientific Committee 'Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme (RMS)'. The survey will be conducted using one research vessel, *Yushin-Maru No. 2* (YS2) in Area IIIW (south of 60°S, 0°E-35°E). Sighting surveys will be conducted under passing and IO modes. Biopsy sampling and photo-id of large whales as well oceanographic survey will be also conducted along the tracklines of the sighting survey. The report of the sighting survey will be submitted to the 2020 IWC Scientific Committee meeting. Sighting, oceanographic, biopsy and photo-identification data will be analysed in the context of the research objectives of JASS-A.

The SWG thanked the Japanese government for proposing to conduct these surveys in Antarctic waters and for investing in research using non-lethal approaches. The authors stressed that comments on the survey plan were welcomed at any stage. The SWG queried the potential for coordination of the JASS-A surveys with the IWC-SORP program and the possibility of accommodating international researchers. The SWG encouraged the JASS-A and the IWC-SORP programs to communicate and collaborate as much as possible with international efforts to yield maximum results from the planned surveys. Pastene informed the SWG that JASS-A generally welcomes research collaboration with international research programs and individual scientists in the context of its research objectives. Protocols will be prepared to facilitate the submission of analytical and field research proposals by external scientists.

Following discussion on the proposed methodology for the survey, the SWG **endorsed** the proposal and **agreed** that IWC oversight should be provided by Matsuoka.

SC/68A/ASI/01 presented a research plan for a COMHAFAT cetacean sighting survey in coastal waters of western North Africa in winter 2020. The study area is set in Guinea Bissau, Guinea and Sierra Leone, except for shallow waters less than 20m for safe sailing. The purpose of this survey is to accumulate further information on distribution and abundance of whales including small cetaceans in the COMHAFAT zone. In this zone, zigzag track lines with around 1,013.2 n.miles of length are placed in the area. A 15-day survey period will be set in winter of 2020 season (in January and/or February of 2020). In the western North Africa, it is dry season in winter. Rain is scarce and wind is not so strong. Furthermore, it is expected that baleen whales migrate to the low latitudinal waters in winter. Thus, this season is thought to be suitable for a cetacean sighting survey. The survey is started off Conakry, and finished off Guinea EEZ. The research vessel, *General Lansana Conte* of Guinea (198 tons), will be used. Researchers from COMHAFAT member states conduct the survey. Scientists from non-member states, however, can be onboard, if the COMHAFAT and vessel capacity allow it. Cetacean searching is conducted from line transect method, under good weather conditions (Beaufort wind scale of 3 or less and greater than 2 n.miles in visibility). Researchers search the sea surface for cetaceans from the vessel following the pre-determined track lines at around 10 knots. The normal closing mode survey is carried out, in which closing is made for all cetacean species encountered at searching.

The SWG welcomed this information and **endorsed** the proposal. Since this survey will be the fourth of its kind to be conducted in west Africa, the SWG **encouraged** the scientists to combine the sighting datasets and to provide quantitative abundance estimates.

SC/68A/ASI/05 presented the plan for Japan's dedicated sighting surveys in the North Pacific in 2019. As in previous years, the design and implementation of the survey will follow the 'Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme (RMS)'. The survey in 2019 will be conducted in sub-areas 6E, 7WR and 7E by the research vessels *Yushin-maru No.2* (*YS2*), *Yushin-maru* (*YS1*) and *Yushin-maru No. 3* (*YS3*), respectively in May-June and the survey will be conducted in sub-area 7WR by the research vessel *Kaiyo-maru No.7* (*KY7*) in August-September. This document specifies areas and timing of the surveys in 2019. The main objective of the surveys is to investigate the distribution and abundance of common minke whales in those sub-areas. The report of the sighting survey in 2019 will be submitted to the next IWC SC meeting.

In discussion, it was noted that whereas three areas will be surveyed in the spring, only one area will be surveyed in the summer because of the lack of available vessels. A question was raised about the proposed use of passive independent observer mode. In response, it was clarified that this mode will not be used in this year's survey but would likely be considered in the future.

Following discussion, the SWG **endorsed** the proposal and **agreed** that IWC oversight should be provided by Matsuoka.

SC/68A/ASI/13 presented a plan for a dedicated systematic cetacean sighting survey that will be conducted in the western part of the Sea of Okhotsk in 2019, using the Russian research vessel *Vladimir Safonov*. The vessel is a stern trawl type research vessel with a barrel for observation. The objective of the survey is to obtain information on distribution and abundance of large whales using the normal closing mode. The period of survey will be from 3 August to 6 September (35 days), and the research area is the eastern coastal waters off Sakhalin Island. During the transit to the research area, the vessel will conduct the sighting survey in

Table 2

National cruise reports received during SC/68A.

Document number	Title	Survey region	Cruise name	Authors
SC/68A/ASI/02	Results of the NEWREP-A dedicated sighting survey during the 2018/19 austral summer season	Antarctic	NEWREP-A	Mogoe, T., Yoshimura, I., Katsumata, T., Ohkoshi, C., Bando, T. Matsuoka, K.
SC/68A/ASI/03	Results of the Japanese dedicated cetacean sighting survey in the western North Pacific in 2018	Western North Pacific	NEWREP-NP	Matsuoka, K., Hakamada, T., Yoshimura, I., Katsumata, T., Kasai, H., Miyashita, T.
SC/68A/ASI/06	Report of the Norwegian 2018 survey for minke whales within the Small Management Area EN-the North Sea and fjord surveys for harbour porpoises in western Norway	North Sea	Minke Whale 2018 Norwegian Survey	Øien, N.I.
SC/68A/ASI/12rev1	Cruise report of the cetacean sighting survey in the north-west part of the Sea of Okhotsk in 2018	Sea of Okhotsk	Sea of Okhotsk Russian Survey	Gushcherov, P.S., Tyupeleev, P.A., Naberezhnykh, I.A., Makrak, S.V., Samonov, V.I., Miyashita, T.

Table 3

Work plan of the Standing Working Group on Abundance Estimates, Status of Stocks and International Cruises for the period 2019/20.

Item	Topic	Intersessional 2019-20	SC/68B	Agenda item
1	Review of Abundance Estimates	ASG to coordinate the review of the following abundance estimates identified at SC/68A. (1) New Zealand blue whale (Barlow *et al*., 2018; SH agenda item 3.1.2). (2) Magellan strait humpback whales (Monnahan *et al*., 2019; SH agenda item 6.2). (3) SE Australian right whales (Stamation *et al*., 2020; SH agenda item 5.2.2). (4) Review method used to estimate Māui dolphin abundance (Cooke *et al.,* 2019; ASI agenda item 2.1).	Review intersessional progress and estimates available at SC/68B	2
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 SC/68A (Allison).	-	2.2
3	Review and provide advice on plans for future surveys	-	Receive, review and provide feedback to research plans to conduct abundance estimates (SWG)	4
4	IWC-POWER Cruise in the Bering Sea	Conduct 2019 survey and planning meeting for the 2020 cruise (IWC, Japan, USA).	Review cruise report, report from the planning meeting and new abund-ance estimates from IWC-POWER cruises.	4
5	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	3.4
6	Develop simulation software to evaluate methods for abundance estimates	Continue development of software (Palka and Smith)	Review progress	3.1
7	Provide Commission with advice on status of stocks	Compute results for internal review (Punt and Allison)	Provide advice to Commission	3.3
8	Host a pre-meeting for the Abundance Steering Group (ASG)	ASG to review necessary information in preparation of pre-meeting.	Host pre-meeting	3.1
9	Address issues (including $g(0)$) related to estimates of abundance of western North Pacific abundance estimates for use in simulation trials and provision of regional estimates.	ICG to coordinate intersessional work, including: (1) review the applicability of the accepted $g(0)$ estimate to other North Pacific common minke whale cruises; and (2) try to develop robust estimates for use in application of the *CLA*, to provide management advice and/or to provide broader estimates for the public.	Review progress	2.1
10	Consider diagnostic methods (e.g. model fit) for mark-recapture models to estimate abundance.	ASG identify an expert group.	Review progress	2.1, 3.2

passing mode. The distance and angle estimation training and experiment will be conducted during the survey. Photo-identification of cetaceans such as northern right whales, gray whales and humpback whales will be also be attempted. When peeled skin is found after breaching, the vessel will try to collect it as a DNA sample using a landing net.

The SWG **endorsed** the proposal and **agreed** that IWC oversight should be provided by Miyashita.

The SWG was also informed that while the Russian surveys proposed in SC/68A/ASI/13 are scheduled to be conducted in block F of the Sea of Okhotsk in 2019, the remaining areas will be surveyed by Japan in the near future. The SWG welcomed this information and **encouraged** collaboration between Japan and Russia to continue in the Sea of Okhotsk.

Attention: SC, C-A

The ASI Standing Working Group recognises the value of information provided by national cruises. The Standing Working Group ***endorses*** *the proposed sighting survey plans in the Antarctic, off western North Africa, in the North Pacific and in the Sea of Okhotsk,* ***encourages*** *collaboration among member countries and other nations whenever possible in the development of these surveys, and* ***encourages*** *submission of abundance estimates from these studies the future in accordance with the Procedures for Submission, Review and Validation of Abundance Estimates (Appendix 4).*

Cruise reports received by the SWG at this year's meeting are listed in Table 2. The SWG **encouraged** authors to produce abundance estimates with data from these surveys and to present these estimates for review in the future.

5. REVIEW OF PRIOR RECOMMENDATIONS

The SWG agreed that significant progress was made with respect to recommendations from last year's meeting. It was recognised that items that had been in the agenda of the SWG for the past two years were addressed in detail during the ASI pre-meeting held prior to SC/68A (Appendix 3) and that a new process to review and validate abundance estimates was developed during the meeting (Appendix 4). The SWG noted that the review of abundance estimates and the update of the IWC Table of Accepted Abundance Estimates represent important ongoing tasks. The SWG also noted that the amendment of the RMP Guidelines is a priority for completion by next year's meeting (Item 3.4 above).

6. WORK PLAN

The work plan for 2019/20 is provided in Table 3. Items 6 and 8 have budgetary implications. The Intersessional E-mail Groups can be found in Annex T.

7. REVIEW OF BUDGET REQUESTS IN LIGHT OF THE TWO-YEAR BUDGET AGREED LAST YEAR AND THE WORK PLAN

The SWG **strongly endorsed** proposals for a 'Pre-Meeting of the Abundance Steering Group' (new proposal, Appendix 5) and for 'Simulating line transect data to investigate robustness of novel analysis methods' (continuation of existing proposal, Appendix 6).

8. ADOPTION OF THE REPORT

The Chairs expressed their deep appreciation to both rapporteurs. New handled a complex and controversial topic skillfully as well as also serving as Chair of WW, and Doniol-Valcroze proved to be indispensable, writing an excellent draft report. The report was adopted at 17:46 on 18 May 2019.

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Appendix 1

AGENDA

1. Introductory items
   - 1.1 Opening remarks
   - 1.2 Election of Chairs
   - 1.3 Appointment of Rapporteurs
   - 1.4 Adoption of the agenda
   - 1.5 Documents available
2. Evaluations of abundance estimates and update of the IWC consolidated table
   - 2.1 Evaluation of new abundance estimates
     - 2.1.1 North Atlantic fin whales
     - 2.1.2 North Pacific minke whales
     - 2.1.3 Southern Hemisphere blue whales
     - 2.1.4 Southern Hemisphere humpback whales
     - 2.1.5 Beluga whales
     - 2.1.6 Hector's/Māui dolphin
   - 2.2 Update of the IWC Consolidated Abundance Table
3. Methodological matters
   - 3.1 Process to validate non-standard software and methods
     - 3.1.1 Evaluation of estimates
     - 3.1.2 Prioritisation
     - 3.1.3 The overall review process
     - 3.1.4 Simulated datasets
     - 3.1.5 General
   - 3.2 Process to consider abundance estimates from methods that require population models
   - 3.3 Consideration of status of stocks
   - 3.4 Amendment of the RMP Guidelines
4. Research programs
   - 4.1 POWER Cruises
   - 4.2 National Programs
5. Review of prior recommendations
6. Work plan
7. Review of budget requests in light of the two-year budget agreed last year and the work plan
8. Adoption of the Report

Appendix 2

ABUNDANCE ESTIMATES RECOMMENDED FOR INCLUSION IN THE IWC CONSOLIDATED TABLE OF ACCEPTED ABUNDANCE ESTIMATES DURING THE 2019 MEETING

Sub-Area	Cat.	Eval. extent	RMP Status	Date stamp	Range of years	Methd	Corr.	Estimate	CV	Approx. 95% CI	Reference	Comments on survey	Program	Timing	% Areal cover	$g(0)$
Western North Pacific Common minke whales																
7WR	1#	1	C	2013	2013	LT	-	65	1.007	0-470	SC/68A/ASI/14rev	-	JARPNII	May-Jun.	89	1
7E	1#	1	C	2013	2013	LT	-	0	-	-	SC/68A/ASI/14rev	-	JARPNII	Jun.-Jun.	57	1
8	1#	1	C	2013	2013	LT	-	413	0.586	130-1,300	SC/68A/ASI/14rev	-	JARPNII	May-Jun.	65	1
9	1#	1	C	2015	2015	LT	-	140	0.963	10-1,100	SC/68A/ASI/14rev	-	JARPNII	Apr.-May	87	1
7CS	1#	1	C	2016	2016	LT	-	0	-	-	SC/68A/ASI/14rev	-	JARPNII	Aug.-Sep.	100	1
7CN	1#	1	C	2016	2016	LT	-	185	0.423	70-450	SC/68A/ASI/14rev	-	JARPNII	Jul.-Aug.	75	1
7WR	1#	1	C	2016	2016	LT	-	75	1.062	10-620	SC/68A/ASI/14rev	-	JARPNII	Jul.-Aug.	89	1
7E	1#	1	C	2016	2016	LT	-	0	-	-	SC/68A/ASI/14rev	-	JARPNII	Aug.-Sep.	57	1
7CS	1#	1	C	2017	2017	LT	-	284	0.497	100-770	SC/68A/ASI/14rev	-	NEWREP-NP	May	100	1
7CN	1#	1	C	2017	2017	LT	-	179	0.377	80-380	SC/68A/ASI/14rev	-	NEWREP-NP	Apr.-May	75	1
11	1#	1	C	2018	2018	LT	-	235	0.481	90-610	SC/68A/ASI/14rev	-	NEWREP-NP	May	35	1
10E	1#	1	C	2018	2018	LT	-	620	0.478	240-1,600	SC/68A/ASI/14rev	-	NEWREP-NP	May-Jun.	100	1
7CS	1#	1	C	2018	2018	LT	-	245	0.828	50-1,100	SC/68A/ASI/14rev	-	NEWREP-NP	May-Jun.	100	1
7CN	1#	1	C	2017	2017	LT	-	212	0.784	50-870	SC/68A/ASI/14rev	-	NEWREP-NP	May	75	1
11	1#	1	C	2014	2014	LT	-	306	0.6792	70-1,200	SC/68A/ASI/15	Half normal model	JARPNII	Aug.	35	1
10E	1#	1	C	2014	2014	LT	-	872	0.5848	240-3,100	SC/68A/ASI/15	Half normal model	JARPNII	Sep.	100	1
7CN	1#	1	C	2014	2014	LT	-	244	0.4542	90-660	SC/68A/ASI/15	Half normal model	JARPNII	Sep.	75	1
7	1#	1	C	2008	2008	LT	-	0	-	-	Hakamada and Matsuoka (2016)	-	JARPNII	Jul.-Sep.	-	1
8	1#	1	C	2008	2008	LT	-	0	-	-	Hakamada and Matsuoka (2016)	-	JARPNII	Jul.-Sep.	65	1
9	1#	1	C	2008	2008	LT	-	2,458	0.664	740-8,200	Hakamada and Matsuoka (2016)	-	JARPNII	Jul.-Sep.	87	1
7	1#	1	C	2009	2009	LT	-	215	0.942	30-1,400	Hakamada and Matsuoka (2016)	-	JARPNII	May-Jun.	-	1
8	1#	1	C	2009	2009	LT	-	602	0.725	140-2,600	Hakamada and Matsuoka (2016)	-	JARPNII	May-Jun.	65	1
9	1#	1	C	2009	2009	LT	-	2,079	0.688	570-7,600	Hakamada and Matsuoka (2016)	-	JARPNII	May-Jun.	63	1
8	1#	1	C	2011	2011	LT	-	121	0.966	10-1,500	Hakamada and Matsuoka (2016)	-	JARPNII	May-Jun.	65	1
9N	1#	1	C	2011	2011	LT	-	115	1.047	10-1,000	Hakamada and Matsuoka (2016)	-	JARPNII	May-Jun.	-	1
9S	1#	1	C	2011	2011	LT	-	0	-	-	Hakamada and Matsuoka (2016)	-	JARPNII	May-Jun.	-	1
7CS	2X	1	T	2012	2012	LT	P	890	0.393	420-1,870	Hakamada *et al.* (2013); IWC (2014)	See revised estimate (890)	JARPNII	May-Jun.	100	1
7CS	1#	1	C, T	2012	2012	LT	P	537	0.346	260-1,100	Hakamada and Matsuoka (2016), Hakamada *et al.* (2016)	Replaces estimate of 890 cv 0.393 (uses revised detection function)	JARPNII	May-Jun.	100	1
7CN	2X	1	T	2012	2012	LT	P	302	0.454	130-710	Hakamada *et al.* (2013); IWC (2014)	See revised estimate (542)	JARPNII	May-Jun.	66.7	1
7CN	1#	1	C, T	2012	2012	LT	P	542	0.601	160-1,800	Hakamada *et al.* (2016), Hakamada and Matsuoka (2016)	Replaces estimate of 302 cv 0.454. (uses revised detection function)	JARPNII	May-Jun.	66.7	1
7CN	2X	1	T	2012	2012	LT	P	398	0.507	160-1,020	Hakamada *et al.* (2013); IWC (2014)	See revised estimate (599)	JARPNII	Sep.	66.7	1
7CN	1#	1	C, T	2012	2012	LT	P	599	0.525	200-1,800	Hakamada *et al.* (2016)	Replaces estimate of 398 cv 0.507 (uses revised detection function)	JARPNII	Sep.	66.7	1
7WRN	1#	1	C	2012	2012	LT	-	64	0.935	0-1,500	Hakamada and Matsuoka (2016)	Combine for estimate for 7WR	JARPNII	May-Jun.	-	1
7WRS	1#	1	C	2012	2012	LT	-	314	0.934	50-2,000	Hakamada and Matsuoka (2016)		JARPNII	May-Jun.	-	1
7E	1#	1	C	2012	2012	LT	-	0	-	-	Hakamada and Matsuoka (2016)		JARPNII	May-Jun.	57	1

Area	Cat.	Eval. extent	RMP Status	Date stamp	Range of years	Methd	Corr.	Estimate	CV	Approx. 95% CI	References	Comments on survey	Program
Maui dolphin													
N. Island, NZ	1	1	-	-	2015-16	MR	-	63	0.11	-	IWC (2018), Baker *et al.* (2016)	Based on assumption of closure.	-
N. Island, NZ	1X	4	-	2001	-	GMR: PA	-	85	-	54-133	IWC (2019), Cooke *et al.* (2018)	Superseded: see revised estimate (96)	-
N. Island, NZ	1X	4	-	2016	2001-16	GMR: PA	-	57	-	44-75	IWC (2019), Cooke *et al.* (2018)	Superseded	-
N. Island, NZ	1*	4	-	2001	2001-16	GMR: PA	-	96	0.2	62-147	This report, Item 2.1.6, Cooke *et al.* (2019)	See Cooke *et al.* (2018) and Cooke *et al.* (2019) for details of model, etc.	-
N. Island, NZ	1*	4	-	2016	2001-16	GMR: PA	-	57	0.1	48-71	This report, Item 2.1.6, Cooke *et al.* (2019)	Model 10 in Cooke *et al.* (2019). Time series supplied	-
Beluga													
Eastern Chukchi Sea	ND	-	-	2012	2012	LT		20,752	0.70	-	Lowry *et al.* (2017)	Includes correction for whales outside the area (from tagging data).	ASAMM
Eastern Chukchi Sea Stock (ECS)	2	1	-	2012	2012	LT	AP	7,355	0.470	3,000-17,700	SC/68A/ASI/09	Uncorrected for whales outside area. Tagging data (Lowry *et al.*, 2017) suggest correction for whales outside area would double the estimates$	ASAMM
ECS stock	2	1	-	2013	2013	LT	AP	6,813	0.471	2,800-16,400	SC/68A/ASI/09	Uncorrected for whales outside area$	ASAMM
ECS stock	2	1	-	2014	2014	LT	AP	16,598	0.485	6,700-40,900	SC/68A/ASI/09	Uncorrected for whales outside area$	ASAMM
ECS stock	2	1	-	2015	2015	LT	AP	6,456	0.483	2,600-15,900	SC/68A/ASI/09	Uncorrected for whales outside area$	ASAMM
ECS stock	2	1	-	2016	2016	LT	AP	6,965	0.494	2,700-17,500	SC/68A/ASI/09	Uncorrected for whales outside area$	ASAMM
ECS stock	2	1	-	2017	2017	LT	AP	13,305	0.512	5,100-34,300	SC/68A/ASI/09	Uncorrected for whales outside area$	ASAMM
SH Blue whales													
New Zealand	In review				2014-17	-	-	718	0.60	270-1,930	SC/67b/SH05; Barlow *et al.* (2018)	-	-

*Category 1, Evaluation Extent 4 but method subject to review at SC/68B (see Annex Q, Item 2.1.5). #Category 1 but see also RMP status. $SC/68A/ASI/09 uses shared detection function and dive correction; hence years are correlated.

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Appendix 3

REPORT OF THE PRE-MEETING OF THE STANDING WORKING GROUP ON ABUNDANCE ESTIMATES, STATUS OF STOCKS AND INTERNATIONAL CRUISES (ASI)

1. INTRODUCTORY ITEMS

The pre-meeting was held in Nairobi, Kenya from 8-9 May 2019, with a session for report adoption on 11 May. The list of participants is given as Adjunct 1.

1.1 Opening remarks

The Convenor, Givens, welcomed participants to the meeting.

1.2 Election of the Chair

Givens was elected Chair.

1.3 Appointment of Rapporteurs

Butterworth was appointed rapporteur, to be assisted by other participants.

1.4 Adoption of the Agenda

The Agenda, as finally adopted, is given as Adjunct 2.

1.5 Documents available

The meeting considered a number of short working papers. One more substantive contribution was promoted to a primary document for the ASI Standing Working Group.

2. CONSIDERATION AND VALIDATION OF NON-STANDARD METHODS AND SOFTWARE

2.1 Evaluation of estimates

At the 2018 Annual Meeting of the Scientific Committee, the ASI Standing Working Group (ASI SWG) had noted that comprehensive validation of an abundance estimate is a process that would include many aspects of the associated analysis under consideration: for example, the data used, the options selected (e.g. as a software package might offer) for the analysis, the model and estimation approach underlying the analysis, the software and code used, and the results (as to whether their interpretation was correct). Even use of a widely accepted software package does not guarantee correct results; some options included in such packages may not have been subject to thorough testing of some form, or they may be used incorrectly.

Table 1 reviews the important components of an abundance estimation analysis submitted to the Scientific Committee. This is a revision to Table 3 of IWC (2019), reflecting additions agreed at the current meeting as discussed below.

Furthermore, a list (Adjunct 3) of items providing general guidance to the ASI Review of Abundance Estimates Intersessional Correspondence Group (ASI RAE ICG) in their review of abundance estimates was developed and **agreed** by the meeting.

2.2 Prioritisation

Both time limitations and costs preclude this full process from being conducted for every abundance estimate to be reviewed. The only obligatory requirement in every instance should be that the options selected for the analysis are fully detailed, inter alia to allow a check that they were appropriate for the circumstances.

Noting the constraints mentioned above would necessitate identification of priorities, the ASI SWG had agreed in 2018 that this would require consideration of several factors, including the following.

- The importance (of the result) with respect to Commission priorities. For example, an abundance estimate used for providing management advice is usually more important than one pertaining to a small portion of a large stock in a limited region.
- The cost, in time and money, to complete the validation.
- The degree to which the estimate and/or software or code has been corroborated by other means. One may have more confidence in the internal calculations of a software package if it has been widely used. When several completely independent methods produce similar estimates, the priority for validating one of them may also be lower.
- The degree to which the methods are clearly and completely elucidated in the accompanying document(s).
- According greater priority to methods and/or software likely to have multiple applications than to those intended for a single application only.

The current meeting agreed with these views on prioritisation, and **recommended** that the prioritisation itself be carried out by the ASI RAE ICG.

2.3 The overall review process

The meeting developed and **agreed** the flowchart shown in Fig. 1 for the process of the review of an abundance estimate submitted to the Scientific Committee. This flowchart sets out what needs to be submitted followed by the main steps in the review itself, including the possibilities of requiring simulation testing and/or code validation, with the key initial decisions to be made by the ASI RAE ICG. In seeking some perspective on the likelihood of more detailed evaluation being needed than could be conducted in a short time by the ASI RAE ICG alone (and consequently would probably result in extending the review process beyond completion within a single year), the meeting noted that in some 50 reviews to date, only three had been adjudged to require such more detailed review.

The process outlined in Fig. 1 begins in the top left corner with submission of an abundance estimate to the ASI RAE ICG. As explained in IWC (2019), this should normally be done by relevant sub-committee convenors or Scientific Committee members (i.e. authors) sufficiently in advance of an Scientific Committee meeting to enable ASI RAE ICG review to be completed before that meeting, at which the estimate will be discussed with the benefit of the completed review.

An important new addition recommended for this overall process is the mandatory provision to the IWC Secretariat of the computer code and associated data inputs that have been used to calculate any abundance estimate put forward for review. This is to facilitate checks that need to be conducted in the review process. Both data and code would be treated as confidential by the Secretariat. The Scientific Committee's data availability rules (IWC, 2004) would apply in relevant cases. The meeting **recommended** that the

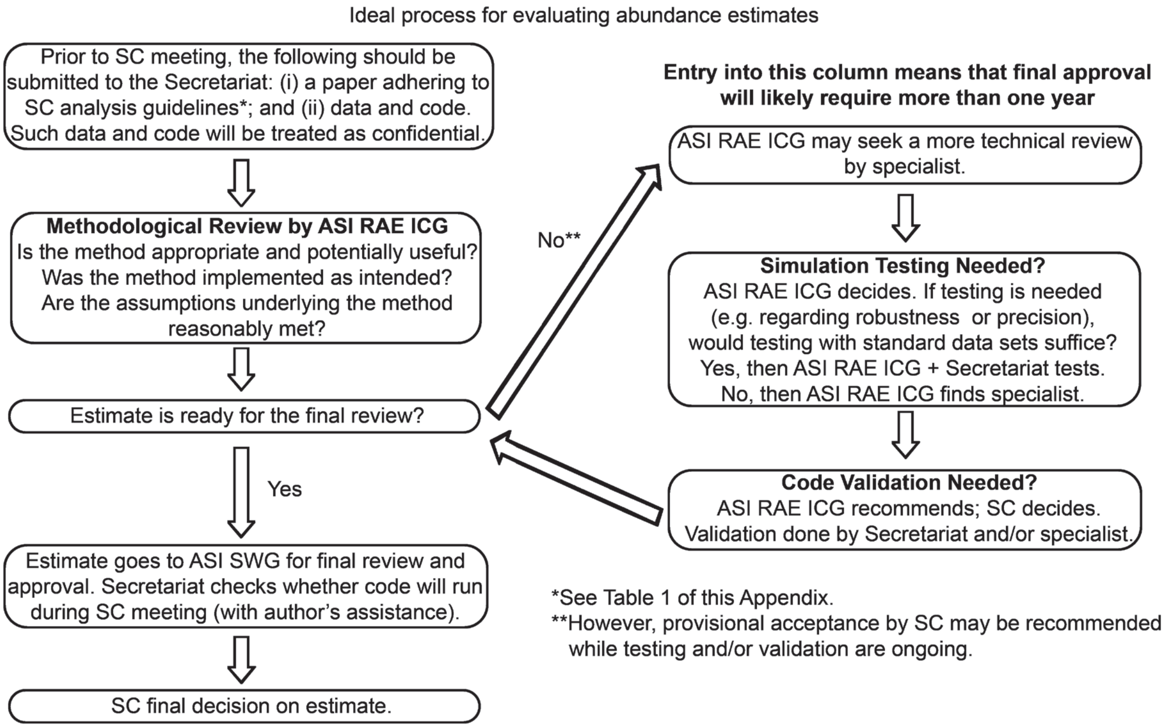

Fig.1. A flowchart of the review process for an abundance estimate submitted to the Scientific Committee.

Scientific Committee give consideration to the possibility of these data availability rules being extended to apply also to computer code.

The possibility was raised of difficulties arising with the requirement for mandatory provision of code if the computations had been conducted with the aid of a commercial software package which was subject to user restrictions. The meeting considered that this practice was becoming much less frequent, and if arising would be best handled on a case-by-case basis.

2.4 Simulated datasets

In 2018, the ASI SWG had also agreed that it might be useful to develop a set of simulated datasets which could be used to test new methods. A funding proposal to document and ensure the longevity of existing C++ code previously developed for simulating line transect survey data had been presented and agreed for funding. Although that software had originally been developed in the context of abundance estimation for Antarctic minke whales, the code is generic and could be applied for many different types of species and surveys.

To provide the meeting with some perspective on the relative priorities for developing such datasets for different methods of abundance estimation, Allison advised that of the approaching 400 abundance estimates requiring review or having been reviewed, roughly 75% were line transect, 10% mark recapture and 10 % shore-based counting approaches.

The proposal had been funded, but Palka advised that the work had yet to commence. The meeting reviewed details of the capabilities of this code (Palka, 2010), and **agreed** that it is eminently suitable for providing a basis for simulation testing of methods for analysing line transect surveys of cetaceans. The code covers a very wide range of possible actual circumstances, and the meeting saw no need for extensions at this time.

The meeting considered the matter of producing datasets for simulation testing of abundance estimates based on mark-recapture data. Some simple test datasets could be constructed that have properties typical of cetacean datasets. These would be reviewed by the ASI RAE ICG as they become available. The meeting noted that the MARK software package is able to output data sets for use for simulation testing, and that this might be adequate for more straightforward analysis methods that might be put forward. It further **agreed** that the matter of whether a particular package approach was sufficiently non-standard to require simulation testing should be decided on a case-by-case basis by the ASI RAE ICG.

The meeting **agreed** that consideration of the development of simulation datasets for methods of analysis of shore-based counts to provide abundance estimation could wait until such a need might arise, and be considered on a case by case basis.

2.5 General

Allison requested standardisation of the acronyms used for different abundance estimation methods, and was requested to prepare a proposal for consideration by the ASI WG. The question was also raised of whether the Scientific Committee should standardise on nomenclature to avoid the use of 'mark-recapture' and rather use 'capture-recapture'. The meeting **agreed** to refer this question to be referred to the ASI SWG.

There was some discussion on the utility of an ASI RAE ICG meeting being scheduled for the day before the Scientific Committee meeting starts, or on the afternoon of one of the first two days of the Scientific Committee meeting, so as to expedite approvals of abundance estimates needed for the work of other sub-committees (see Fig. 1). The meeting **referred** this issue to the Convenors' Group.

The need for sub-committee convenors to assist in ensuring timely submissions of abundance review proposals to the ASI RAE ICG was also stressed.

Table 1

Description of minimum requirements for presentation and review of abundance estimates for inclusion in the IWC consolidated table.

Topic	Description
Survey region	Describe the geographical region to which the estimate applies and identify whether this region fully or partially covers the range of the stock(s) under consideration, at the time the study was conducted.
Time period	Describe the time period (e.g. year, season) to which the estimate (or set of estimates) applies/apply.
Sampling period	Specify the time period during which sampling was conducted. If sampling occurs in multiple years, specify whether temporal and geographical consistency was achieved across years, and list other factors that potentially reduce comparability of data collected across the sampling period.
Survey design	If applicable, include figures/maps showing the proposed and realised survey design for the whole study area and, if applicable, for different strata. If realised coverage is inconsistent with that proposed, include a description of the factor(s) that precluded the survey to be completed as planned.
Method	Identify the method used to compute the estimates. Examples include: design-based distance sampling, spatial models applied to line transect data, mark-recapture methods, shore-based counts, population models, and combinations of these.
Survey platform and data collection	Provide an adequate description of the survey platform(s) (including shore-based observation points, vessels, aeroplanes or drones), and details of the data collection procedures and data processing. For line-transect surveys: • A description of the survey platform (e.g., size of vessels, including the height of the survey platform(s) or type of aircraft and whether they are equipped with bubble or belly windows). • 'Searching' modes (e.g., naked-eye, binoculars, towed arrays), searching strategy (e.g., passing or closing model, presence of independent observers/platforms) and methods for estimating perpendicular distance (e.g., reticles, angle boards, clinometers, acoustics). • Indicate whether observers/acousticians were experienced or whether training had been provided. • Describe how visibility and environmental conditions during the survey (e.g. weather, Beaufort sea state) were assessed and recorded. • If applicable, provide a description of experiments conducted to estimate visibility (perception/availability) bias on the trackline. • Describe how data were stored (e.g., paper sheets, data-logging software). For mark-recapture methods: • Describe data types (e.g., photo-identification of natural markings, including specification of targeted body parts, genotyping from biopsy samples, tracking of individual movements, or combination of these) • Describe sampling methods (e.g. search strategy, selection of animals for sampling etc.) • Specify ancillary information collected for each animal, e.g. adult/juvenile/mother/calf, group size and composition, and criteria used. • Specify what ancillary data were collected, such as date, position, start and end times of searching operations, and start and end times of each encounter if multiple data types collected, such as photo-id and biopsy; specify field methods used to ensure correct linkage between photographed and biopsied individuals. For other methods: • Describe survey methods, data types, and auxiliary information to an extent that allows adequate evaluation of the sampling procedures.
Correction factors	If applicable, specify whether correction factors were applied to the estimates to account for a missing proportion of the population. These include: correction for visibility bias on the trackline (availability and/or perception) in ship-based or aerial line transect surveys, proportion of animals in the population not presenting natural marks (e.g., 'proportion of unmarked animals') or not susceptible to marking in the case of mark-recapture models. In addition, if bias from other sources (e.g. responsive movement in ship surveys, heterogeneity in capture probability in mark-recapture) is expected, provide a quantitative/qualitative description of the bias correction methods. If correction was imperfect, provide a qualitative assessment of the direction of uncorrected bias.
Data processing	If applicable, describe criteria or exploratory analyses performed to select the data included in the analysis. Examples include: choices for truncation distances, how sightings of species identified with low confidence were treated, how potential issues with identifiability and quality of photographs were dealt with, and criteria used to censor data.
Modelling approach	Models and model parameters should be clearly defined and statistical methods to estimate these parameters and the uncertainty associated with these estimates should be described in detail, especially if novel methods are used. Any assumptions associated with the estimation method, the data (e.g. population-level assumptions), or the sampling should be clearly stated. Sensitivity analyses should be considered for exploring the impact of key assumptions. If the estimation method is standard, references to the original work should be provided to facilitate the review. Application of novel methods would benefit from a brief discussion contrasting them with more established techniques (e.g. why this new method is expected to offer an improvement over established approaches). Model diagnostics appropriate to the methods used should be considered and discussed. If multiple models are used, provide a description of all models, specify model selection technique (e.g. AIC, BIC) and whether inference is based on a single model, multiple models or model averaging. Clearly specify covariates that are used to model certain effects (e.g. detection probability in distance sampling surveys or capture probability in mark-recapture studies). A rationale should be given for considering that the modelling approach adequately accounts for the relevant properties of the data that were collected and of the population being estimated. If Bayesian approaches are used, specify the prior distributions used and the rationale behind their choice.
Parameter estimates	Provide values or estimates for all quantities required to compute the abundance estimates. For example, in line transect sampling these would include effort, number of sightings, detection probability, expected group size and correction factors for visibility bias. For mark-recapture models, parameters of interest include annual survival probabilities and recruitment rates, and where applicable, capture probabilities. If abundance is computed for different strata, provide stratum-specific parameter estimates whenever applicable. Estimates should be presented in a clear fashion (e.g. in a Table) and should always be accompanied by a measure of uncertainty (e.g. CVs, confidence intervals, posterior credibility intervals). If applicable, indicate estimates of model parameters for which uncertainty was not computed and explain why.
Software	Specify software used, including the version number and choices of options, and provide input and output files to the IWC Secretariat at *abundance@iwc.int.*
Recommended estimates	In many cases, multiple abundance estimates from a single survey are presented (e.g. corrected and uncorrected for visibility bias, including and excluding lower quality data). If applicable specify in the text which estimate is recommended to be accepted as the best estimate for a given species/population/stock in a particular time period and state the reasons why that estimate is preferred. In the case of mark-recapture estimates that involve fitting a multi-year population trajectory, specify for which years preferred estimates are proposed.
Caveats	List known caveats related to the estimate(s) of abundance, each with appropriate explanation.

3. CONSIDERATION OF ESTIMATES COMPUTED USING METHODS THAT REQUIRE POPULATION MODELS

This item was motivated particularly by the need to consider mark-recapture methods and the estimates of abundance which they provided, noting that such methods always required the assumption of some form of population model.

Cooke presented SC/68A/ASI/11, which identified some issues associated with the use of population models to generate abundance estimates with mark-recapture data. A population model is always required for interpreting mark-recapture data, although for some standard methods it may be a minimal model, such as a closed population model. The requirements for the population model are partly dictated by the nature of the data. For example, if the data are collected on a calving ground, it is necessary to model how often the whales visit the calving ground, which in turn requires that calving intervals be modelled. Experience shows that there is usually considerably heterogeneity in sighting probability related to factors such as age, sex and reproductive status, and that such heterogeneity can change over time, such that the best model for sampling probability may contain many interaction terms. The popular practice of treating capture probabilities in different years as equal whenever this yields a lower AIC is to be discouraged, because it amounts to treating sample size as an index of relative abundance without regard to sampling effort. This is inconsistent with the way the Scientific Committee normally considers abundance data. Population models can be bulk models or individual-based, or hybrids between these. Individual-based models are in practice fitted using Bayesian methods, with the results expressed as a posterior sample of population trajectories from which all quantities of interest can be computed. Prior distributions need to be chosen carefully so that posteriors for quantities of interest are valid and normalisable, and not unduly influenced by the priors, especially for small datasets. A method is proposed for defining implicit priors for parameters of the sampling model that ensures that the posteriors for biological quantities of interest, including population size, are independent of those implicit priors. While a scale-invariant prior can be used for population size, the question of the appropriate priors for other biological parameters has not yet been definitively answered. Verification of mark-recapture methods can involve substantial work. Testing methods by applying them to a limited suite of small test data sets is proposed as a simpler and quicker way to detect major problems.

Arising from discussions of this paper, additions and refinements to some of the material in table 3 of Allison *et al.* (2019) were **agreed**, and incorporated in Table 1 of this report.

The meeting also **agreed** that the Secretariat should archive a full time series of the abundance estimates output from mark-recapture models on record, together with their variance-covariance matrix. However, for tabulation in the standard list of accepted abundance estimates, only values for the first and last year for which estimates of reasonable quality are available should be shown. The meeting noted that such estimates will change with the acquisition of further data over time, together with the refinement of methodology to be able to account for new features in such additional data. Updated submissions in such instances should also include results for the previous model applied to the updated data set.

4. CONSIDERATION OF STATUS OF STOCKS

4.1 Background

The Scientific Committee has been asked to provide the Commission with a summary of advice on the status of stocks on a broad level (e.g. ocean basin or region).

At the 2017 Annual Meeting of the Scientific Committee, the ASI SWG noted that RMP and AWMP *Implementation Simulation Trials* (*ISTs*) are designed to provide robust management advice but not ‘status’ in the traditional sense expected by the Commission (i.e. what is the present ‘stock’ level compared to the unexploited level and what are the likely future trends). Rather these *ISTs* provide considerable output for a wide range of plausible scenarios that would need to be integrated and summarised to provide measures of status. The ASI SWG agreed that results of a set of *ISTs* should be summarised by the following three statistics to provide information on status:

- current depletion (number of animals aged 1+ and older relative to 1+ carrying capacity);
- current 1+ abundance; and
- 1+ abundance in 2050 if all future RMP and AWMP catches (but not projected bycatches) are assumed to be zero.

The ASI SWG further agreed at that time that results should be provided for two values for the MSY rate (1% in terms of harvesting of the total (1+) component of the population and 4% in terms of harvesting of the mature component) unless the base-case trials are based on a higher value for the lowest plausible value for MSY rate or if MSY rate has been estimated and there is an agreed value. In addition, results should be summarised across simulations and trials (medians over simulations and averages across base-case trials).

As each base-case trial may have a different number of breeding stocks, the ASI SWG had agreed that results should be reported by area, specifically for the Ocean Basin (i.e. ‘*Region*’) and by ‘*Medium Area*’ rather than by the sub-areas on which the population models underlying the trials are based, to avoid having a very large number of summary statistics. However, there needs to be flexibility in reporting. For example, the Scientific Committee may also wish to present results for individual biological stocks about which it believes the Commission needs to be informed and hence that the default of reporting results by area only provides a misleading impression. The choice of the stocks for which results are be reported needs to be decided during *Implementations* and *Implementation Reviews*. The ASI SWG had recommended that the Guidelines for Conducting *Implementations* and *Implementation Reviews* be updated to reflect this, and that the control programs used for *Implementation Simulation Trials* be modified to report the three measures of status listed above. In addition, the results for all stocks should be calculated and made available to the Commission, but not included in the primary presentation.

The meeting reviewed these recommendations of the 2017 ASI WG and made the following additional points.

4.2 Stocks which have been the subject of RMP or AWMP *Implementations* and *Implementation Reviews*

Allison reported the updates recommended above for the Guidelines and the control programs had yet to be implemented, but that this would be done during the coming intersessional period.

The meeting **endorsed** the recommendations above from 2017 for reporting on status for stocks in this category. However, concerns were expressed that the resultant output would prove too voluminous for ready interpretation, even amongst scientists. Consequently, it was agreed to request Punt and Allison to produce two example outputs: for the most recent RMP *Implementation Review* for North Atlantic common minke whales and the most recent AWMP *Implementation Review* for Eastern North Pacific gray whales. Their results would be for presentation to the ASI SWG, so as to allow that group to assess whether or not the recommendations made previously warranted amendment.

A further concern arose for stocks for which carrying capacity cannot (for various possible reasons) be estimated satisfactorily when *ISTs* are conditioned, and these trials commence instead from a year when the stock has already been reduced in abundance by earlier whaling. For these cases, the meeting **agreed** that 1+ abundance should be reported for the earliest year in the analysis for which that abundance is considered to be reliably estimated.

In summary, the pre-meeting **agreed** that two estimates of abundance in earlier years should always be reported:

(1) the carrying capacity if estimable, and if not some qualitative comments about likely historical abundances; and
(2) the estimate for the earliest year for which that abundance estimate is considered to be reliable.

The matter of reporting estimation precision in some form was raised. While agreeing that this was desirable in principle, the meeting realised that determining an appropriate general approach would not be straightforward, and furthermore that this would result in yet more voluminous output. It therefore **agreed** to refer this question to the ASI SWG for consideration when reviewing the examples mentioned above.

4.3 Stocks which have been the subject of in-depth assessments
The meeting **agreed** that the same outputs could and should be reported as for the stocks subject to *Implementations and Implementation Reviews* as set out above. If other than fully age-structured models are used (e.g. age-aggregated production models) to assess such stocks, results should be reported in terms of the component of abundance output by the method considered to correspond most closely to 1+ abundance.

4.4 Stocks which have not been subject either to *Implementations*, *Implementation Reviews* or in-depth assessments
The meeting **agreed** that if an estimate of abundance had been accepted for the stock, the procedure in the preceding section should be followed.

However, if there was no such accepted estimate, the case would fall outside the purview of the ASI SWG, and consequently would need to be referred to the Scientific Committee for appropriate consideration.

4.5 General
All cases above for which some estimate of the status of the stock concerned could be provided, would need to be based on some form of population model assessment; such assessments would, in turn, require review by the ASI RAE ICG. The meeting **agreed** that the list of points in Adjunct 4 would provide appropriate guidance to the ASI RAE ICG in carrying out such reviews.

5. WORK PLAN
Punt and Allison would prepare examples of the stock status outputs in the form proposed for two cases: the most recent Implementation Reviews for North Atlantic minke whales (RMP) and eastern North Pacific gray whales (AWMP). These would be for consideration by the ASI SWG.

6. ADOPTION OF REPORT
The report was adopted at 17:50 on 11 May 2019.

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Allison, C., Butterworth, D.S., Cañadas, A., Cooke, J., Donovan, G.P., Freitas, L., Herr, H., Kitakado, T., Mastuoka, K., McKinlay, J., Palka, D., Punt, A.E., Gunnlaugsson, T. and Zerbini, A.N. 2019. SC/67b/ASI/14. Report of the Intersessional Email Group on Abundance Estimates, Status and International Cruises (ASI) (unpublished). 7pp. [Paper available from the Office of this Journal].
International Whaling Commission. 2004. Report of the Scientific Committee. Annex T. Report of the data availability working group. *J. Cetacean Res. Manage. (Suppl.)* 6:406-08.
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Palka, D. 2010. Comparison of results from the OK, SPLINTR, Integrated and standard analytical methods when applied to simulated data, 2004-2008. Paper SC/62/IA14 presented to the IWC Scientific Committee, June 2010, Agadir, Morocco (unpublished). 21pp. [Paper available from the Office of this Journal].

Adjunct 1

Participants

Geof Givens
Alex Zerbini
Robert Suydam
André Punt
Marcus Wilberg
Cherry Allison
Doug Butterworth
Justin Cooke
Sally Mizroch
A. Saloma
Debi Palka

Adjunct 2

Agenda

1. Introductory items
   - 1.1 Opening remarks
   - 1.2 Election of the Chair
   - 1.3 Appointment of Rapporteurs
   - 1.4 Adoption of the Agenda
   - 1.5 Documents available
2. Consideration and validation of non-standard methods and software
   - 2.1 Evaluation of estimates
   - 2.2 Prioritisation
   - 2.3 The overall review process
   - 2.4 Simulated datasets
   - 2.5 General
3. Consideration of estimates computed using methods that require population models
4. Consideration of status of stocks
   - 4.1 Background
   - 4.2 Stocks which have been the subject of RMP or AWMP *Implementations* and *Implementation Reviews*
   - 4.3 Stocks which have been the subject of in-depth assessments
   - 4.4 Stocks which have not been subject either to *Implementations*, *Implementation Reviews* or in-depth assessments
   - 4.5 General
5. Work plan
6. Adoption of Report

Adjunct 3

General guidance for review of abundance estimates

Justin G. Cooke and Sally A. Mizroch

Data

- Was the overall design and implementation of data collection appropriate for the population of interest (geographical scope, time of year, relation to known or likely migration patterns)?
- Are the field techniques and post-processing of the data appropriate to ensure data of sufficient quality?
- Have the applicable IWC guidelines (e.g. for photo-identification, line transect surveys) been followed?
- Have the data used in the analysis, including any pre-selection process, been clearly specified?

Methods

- Have the methods used been adequately documented?
- In the case of 'standard' methods:
  - have the version and options used been specified?

  In the case of non-standard or new methods:
  - have the assumptions, the structure of the model and the way it is fit to the data been fully described?
  - have the commonalities and differences with other approaches been explained?

  Are the methods use appropriate in the light of:
  - the biology and behaviour of the species?
  - the specific nature of the data used?
- Do the estimates of precision adequately reflect all the major sources of uncertainty?
- In the case of Bayesian methods, were the priors appropriate?

Further steps

Specify whether required to accept the estimate, or following provisional acceptance:

- should (further) testing of the method be recommended:
  - generically or specific to this case?
  - what options for this are appropriate and available?
- should the software be validated (taking account of finite resources)?

Has the full documentation - data files, input file, code, output files - been submitted to the Secretariat? (Note that where a standard software package was used, the user code will be mainly data handling.)

General

- Have the data been used in a reasonably optimal way?
- Could appreciably more precise or reliable estimates have been produced using a different analysis? (In the case of data collected in major international programmes, the Committee has a particular responsibility to ensure that these are effectively used.)

Adjunct 4

Guidance on evaluating model-based assessments

André E. Punt

Conceptual basis for the assessment
List the data available for the stocks and their resolution (temporal/spatial). Describe any pre-processing of the data (e.g. assumptions regarding sei/Bryde's split; ex-Soviet catches), ideally by reference to background documents.

- Data included in the reference case assessments.
- Data available but excluded from the reference case assessment (e.g. CPUE).

A model-based assessment should identify (and justify) a reference set of assumptions and (if appropriate) a set of alternative assumptions for each of the following:

- stock structure and movement;
- productivity (source of density dependence; whether estimated or alternative scenarios provided);
- biological parameters and their values;
- selectivity;
- which (if any) parameters are time-varying; and
- if projections are to be undertaken, the basis for the projections and any associated assumptions.

Documentation of the base-case assessment(s) (based on reference assumptions). Ultimately, this will also reflect the outcomes of model fitting, model selection methods, and diagnostics.

Basis for parameter estimation, e.g.:

- maximum likelihood estimation (indicate which parameters, if any, were treated as random effects); and
- Bayesian methods (basis for the priors or sets of priors to be provided).

Diagnostics (and model evaluation; note that all may not be relevant for every case)
The following are the set of essential diagnostics to be reported.

- Residual analyses/assessments of model fit (posterior predictive checks for a Bayesian analysis).
- Plot of random effects vs time/other appropriate covariates.
- Measures of convergence (e.g., maximum gradients; results of any jitter analyses; MCMC convergence diagnostics).
- Results of sensitivity tests that explore the more consequential uncertainties (detailed results to be available on request; summarised by a set of 'core' output statistics, e.g. those associated with status).
- Qualitative evaluation of the 'realism' of estimated parameters, e.g. are estimates on (or close to) biological bounds?
- Measures of parameter uncertainty (e.g. likelihood profiles or asymptotic variance estimates for maximum likelihood assessments; posteriors for Bayesian analyses).

The following are desirable (but not essential) diagnostics for possible reporting:

- likelihood profiles for pre-specified parameters;
- simulation testing using a small number of simulated data sets, at least for the case where the model is correctly specified; and
- retrospective analysis (this may not be appropriate for assessments with few data points).

Appendix 4

PROCEDURES FOR SUBMISSION, REVIEW AND VALIDATION OF ABUNDANCE ESTIMATES

G. Givens, A. Zerbini and G. Donovan

See this volume, Annex P (pp.273-276) for the final version of this document.

Appendix 5

PROJECT PROPOSAL REQUEST – PRE-MEETING OF THE ABUNDANCE STEERING GROUP

1. PROPOSAL TITLE

Pre-Meeting of the Abundance Steering Group

2. BRIEF OVERVIEW OF THE PROPOSAL AND ITS EXPECTED OUTCOME

Pre-meeting prior to SC/68B for the Abundance Steering Group to meet and evaluate abundance estimates received intersessionally following the process established by the ASI Working Group.

3. RELEVANT IWC SCIENTIFIC COMMITTEE GROUPS OR SUB-GROUPS

Relevant for the following groups: ASI, ASW, EM, IST, IA, NH, SH, SM.

4. TYPE OF PROJECT

Workshop/meeting.

5. BRIEF DESCRIPTION OF THE PROPOSAL AND ITS CONNECTION WITH SCIENTIFIC COMMITTEE RECOMMENDATIONS

(a) Background, rationale, and relevance to the priorities identified by the IWC Scientific Committee

The Standing Working Group on Abundance Estimates, Status and International Cruises (ASI) was established to formally review abundance estimates submitted to the Scientific Committee across all of the Committee's sub-committees and Working Groups. This document describes the review process. At the 2019 meeting (SC/68A), the working group developed a process, including the formation of an Abundance Steering Group (ASG) to facilitate the review of abundance estimates. The ASI recommended that the ASG meet permanently for one day prior to prioritise estimates for review by the Committee during the Annual Meeting.

(b) Specific objectives or ToR and deliverables/ outcomes:

Provide an initial review of abundance estimates received by the Committee following the process outlined in the report of the Abundance, Status of Stocks and International Cruises Working Group (Annex Q).

(c) Methodological approach/work plan/administrative details

A one day pre-meeting would occur immediately prior to SC/68B (2020) and would require the attendance of the Scientific Committee Chair, Vice-Chair, Head of Science, at least one convener of ASI, ASW, EM, IST, IA, NH, SH, SM, and potentially 2-5 experts. Funding for up to 10 participants is requested to cover for per diem and hotel. Note that many of the participants are national delegates and their countries would cover their cost.

(d) Suggestions for outreach

The conclusions from the workshop will be disseminated among Scientific Committee members during the Annual Meeting that would follow the ASG one day pre-meeting.

6. TIMETABLE FOR ACTIVITIES AND OUTPUTS

Activity to by undertaken: Review of abundance estimates.
Key person(s): Abundance Steering Group.
Start: Intersessionally 05/2019.
Finish: SC/68B (05/2020).
Expected outputs: Report of the Scientific Committee.
Completion date: SC/68B (05/2020).

7. RESEARCHERS' (OR STEERING GROUP) NAME(S) AND AFFILIATION

- Robert Suydam, North Slope Borough, USA – Scientific Committee Chair.
- Alexandre Zerbini, Alaska Fisheries Science Center, NOAA, USA – Scientific Committee Vice Chair/ASI co-Convenor.
- Greg Donovan, IWC – IWC Head of Science.
- Cherry Allison, IWC – IWC Head of Statistics.
- Geof Givens, Givens Statistical Solutions LLC, USA – ASI co-Convenor.
- Lars Walløe, University of Oslo, Norway – ASW Convenor.
- Toshihide Kitakado, Tokyo University of Marine Science and Technology, Japan – EM Convenor
- Debra Palka, Northeast Fisheries Science Center, NOAA, USA – IA Convenor
- Jooke Robbins, Center for Coastal Studies, USA – NH Convenor.
- Jen Jackson, British Antarctic Survey, UK – SH Convenor.
- Lindsay Porter, Sea Mammal Research Unit, Hong Kong – SM Convenor.

8. TOTAL BUDGET

Funds are requested to cover hotel and per-diem for a one day pre-meeting prior to SC/68B.

Travel/subsistence (by person or est. total for IPs): Per-diem and hotel for 10 participants (members of the ASG and invited experts) - £2,000.

Total: £2,000.

Appendix 6

PROJECT PROPOSAL REQUEST – SIMULATING LINE TRANSECT DATA TO INVESTIGATE ROBUSTNESS OF NOVEL ANALYSIS METHODS

1. PROPOSAL TITLE

Simulating line transect data to investigate robustness of novel analysis methods.

2. BRIEF OVERVIEW OF THE PROPOSAL AND ITS EXPECTED OUTCOME

The IWC/SC has already invested time and money in developing simulated line transect data to evaluate the robustness of the Norwegian minke whale and Antarctic minke whale survey data. This proposal is to update the old code for the simulator to make it more user-friendly so that it can be made available to all Scientific Committee members and to produce some standard data sets in accordance to the specifications of the ASI sub-committee.

3. RELEVANT IWC SCIENTIFIC COMMITTEE GROUPS OR SUB-GROUPS

ASI is initialising this request to more completely and uniformly carry out its terms of reference to evaluate all needed abundance estimates. But just about all the sub-committees utilise abundance estimates so they would benefit from the outcome of this proposal.

4. TYPE OF PROJECT

Modelling.

5. BRIEF DESCRIPTION OF THE PROPOSAL AND ITS CONNECTION WITH SCIENTIFIC COMMITTEE RECOMMENDATIONS

(a) Background, rationale, and relevance to the priorities identified by the IWC Scientific Committee

The ASI Working Group formally reviews and agrees on the status of abundance estimates submitted to the Scientific Committee. One issue that makes this task difficult is how to evaluate the robustness of novel estimation methods. In several cases the Scientific Committee has used simulated data to evaluate novel analysis methods. This proposal is to update existing code that simulates line transect data so that the code is more accessible to Scientific Committee members. It was also suggested by ASI to develop a library of datasets that novel methods could be evaluated with. The proposed updated simulator could be used to generate this library of datasets. It is also proposed that already existing simulated datasets will be evaluated as to whether they are appropriate to be used in the envisioned library of datasets.

As background, the code to create simulated data was lastly used to create sighting and effort data from surveys that were conducted in the Antarctic so the simulated study area was populated with animals that follow the general features of the distribution, density and behaviour of Antarctic minke whales and the sighting surveys were similar to the IWC-IDCR-SOWER procedures. However, the program is sufficiently general to simulate line transect sightings and effort data resulting from a 1, 2, or 3 team line transect survey, where each team could have a different user-specified detection function that can be dependent on various factors, such as school size, Beaufort, and another unrecorded factor. The user can also specify the amount of time surveyed per day, the speed of the ship, and the amount of time spent in Closing and Passing mode. The spatial distribution and abundance of a target species can be pre-specified to allow spatial and temporal gradients, clustering of sightings clusters of group sizes, or any combination. Animal within groups had the ability to dive, swim, and move randomly or react to the ship. The school size distribution can be generated from either a theoretical Poisson distribution which could follow spatial gradients or from empirically measured dive sequences. In cases where school sizes are greater than one, all animals in a group could surface either simultaneously or in a non-synchronised fashion.

(b) Specific objectives or ToR and deliverables/outcomes

Deliverables would be the code to the simulator, document needed to use the code and some example datasets.

(c) Methodological approach/work plan/administrative details

Work plan is to evaluate and update the existing code, develop a user-friendly front end and associated user's manual. Also the existing datasets would be evaluated to determine if they are appropriate for the ASI library of datasets.

(d) Suggestions for outreach

Ad hoc material requested by the IWC Secretariat would be produced, as needed.

6. TIMETABLE FOR ACTIVITIES AND OUTPUTS

Activity to be undertaken: Evaluate, update and document existing code for simulator and existing and new datasets.

Key person(s): Smith/Palka
Start: 06/2019
Finish: 05/2020.
Expected outputs: Updated and available code of simulator and library of datasets.
Completion date: 05/2020.

7. RESEARCHERS' (OR STEERING GROUP) NAME(S) AND AFFILIATION

- D. Palka, NOAA Fisheries, Woods Hole, MA, USA.
- D. Smith, Integrated Statistics, Inc., Woods Hole, MA, USA.
- Others in ASI.

8. TOTAL BUDGET

(1) Salaries (by person). 2-3 weeks of salary: £3,000.
Total: £3,000.

9. DATA ARCHIVING/SHARING

The code and new datasets would be archived with the Secretariat. The older datasets are already archived with the Secretariat.