Report of the Abundance Steering Group

Bled, Slovenia, 21-23 April 2023

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Participants: Allison, Bell, Brandão, Butterworth, Cañadas, Cholewiak, Citta, Cooke, Constantine, Coscarella, Doniol-Valcroze, Donovan, Ferguson, Fortuna, Givens (Chair), Hansen, Katara, Kelly, Kinzey, Kitakado, Leaper, Lundquist, Miller, Mizroch, New (Co-Chair), Olson, Palka, Porter, Punt, Sigurðsson, Slooten, Skaug, Solvang, Staniland, Sucunza, Suydam, Vermeulen, Walløe, Weller, Witting, Zerbini.

1. INTRODUCTORY ITEMS

This meeting of the Abundance Steering Group took place on 21-23 April 2023 in Bled, Slovenia, as a pre-meeting of the SC69A Scientific Committee (SC) meeting.

1.1 Opening remarks

The Convenor, Givens, welcomed participants to the meeting, recalling that the Scientific Committee (SC) had agreed in 2016 to form the Standing Working Group for Abundance Estimates, Stock Status and International Cruises (ASI) to ensure that abundance estimates used by the SC receive a consistent level of formal review. Since then, ASI has developed a suitable review process and undertaken many such reviews.

It quickly became apparent that the ASI workload was greater than could be accomplished during the annual SC meeting. In 2019 the SC therefore agreed to form the Abundance Steering Group (ASG) to coordinate an intersessional review process. The ASG is comprised of the SC Chair and Vice-Chair, the Secretariat's Head of Science, Conservation, and Management, the Secretariat's Head of Statistics, and convenors of the following SC sub-committees and standing working groups: ASI, ASW, CMP, EM, IST, IA, NH, SM and SH. Numerous independent experts also participated in the ASG pre-meeting this year.

Givens thanked the participants for contributing their expertise and offered special thanks to the 25 independent reviewers for their voluntary and thoughtful reviews which would be relied on at the ASG pre-meeting (see Item 4).

1.2 Election of Chair

Givens was elected Chair. New was elected Co-Chair.

1.3 Appointment of rapporteurs

Kelly and Doniol-Valcroze were appointed rapporteurs. Givens thanked them for the outstanding work they contribute each year and their ongoing commitment to the success of ASG and ASI.

1.4 Adoption of the agenda

The adopted agenda is given as Appendix 1.

1.5 Documents available

The following documents were available: Bradford *et al*. (2021), Brandão *et al*. (2023), Calambokidis *et al*. (2020), Constantine *et al*. (2021), Eguchi *et al*. (2022), Hamabe *et al*. (2023), Harris et *al*. (2022), Jackson *et al*. (2016), Monnahan *et al*. (2019), Palka (2006), Palka (2020), Romero *et al*. (2022), SC/69A/ASI/01/Rev, SC/69A/ASI/02, SC/69A/ASI/03/Rev2, SC/69A/ASI/15 and SC/69A/ASI/19. Abundance estimate reviews were also available to the ASG and have been archived by the Secretariat.

1.6 Online participation

Seven experts with specific pre-identified contributions were permitted to attend the relevant pre-meeting session via online participation, in accordance with the Committee's Rules of Procedure and recent guidance from the Committee Chair. The relevant procedures were explained to all participants.

1.7 New ASG/ASI process to reduce redundancy

The ASG pre-meeting and ASI sessions at SC68D struggled with the online format necessitated by the Covid-19 pandemic. These online meetings were designed to cope with the severely limited session count and hours. After reflecting on this experience however, the convenors agreed there were redundant elements of the ASG/ASI process that could be eliminated.

The convenors explored a new approach for SC69A. For each paper reviewed, in addition to standard recommendations about endorsement and categorisation, the ASG assigned the following labels: 'Needs further review' or 'Does not need further review'. 'Needs further review' was intended for estimates that the ASG concluded might be controversial, estimates where ASG discussion failed to resolve lingering questions and concerns, and estimates where the quality of overall review would be enhanced by discussion by the wider ASI audience. 'Needs further review' was the default option where the ASG was uncertain about which label best applied.

[1]Presented to the SC meeting as SC/69A/REP/02.

When ASI meets at SC69A next week, it will only discuss estimates labelled 'Needs further review'. For all other estimates (i.e., estimates designated 'Does not need further review'), ASI will simply endorse these *en masse* without discussion, unless at least one ASI participant requests that a specific case should be revisited.

The efficacy of this approach will be subsequently evaluated by ASI and the convenors of the relevant SC subgroups.

1.8 Update on inclusion of abundance estimates in the IWC Table of Agreed Abundance Estimates

All endorsed estimates are added to the IWC Table of Agreed Abundance Estimates (hereafter, 'the IWC Table'). ASI also recommends which endorsed abundance estimates should be published on the IWC webpage about abundance (hereafter, 'the webpage') which is intended for public view. While there are no fixed criteria, the SC agreed at SC68D that estimates representing very large areas or nearly complete populations, which are believed to have no severe biases, should be published on the webpage. An intersessional correspondence group (ICG) was established to finalise this specification and to review estimates already published on the webpage to ensure a consistent approach.

The ICG and additional experts met during an IST meeting in May 2022 (Copenhagen). In addition to the SC's proposed criteria, the ICG agreed that smaller sub-units or sub-regions of particular interest to the Commission or the public may also be published.

The ASG agreed to apply the ICG's criteria when making recommendations at SC69A. In what follows, where the ASG's recommendation does not refer to the webpage, this indicates the ASG does not support its publication on the webpage.

2. REVIEW OF ABUNDANCE ESTIMATES

The classification system used to categorise abundance estimates endorsed by ASI and included in the IWC Table of Agreed Abundance Estimates is explained in item 11.3.1 of IWC (2023). The ASG noted that, while categories have numeric labels (and one is 'Not Suitable'), these are not intended to rank the scientific quality or importance of studies. These categories are used only to identify how estimates are best used by the Committee, since many of the studies were not explicitly designed to inform Committee projects.

During the evaluation of Bradford *et al*. (2021), Palka (2006), Palka (2020) and Hamabe *et al*. (2023), it became apparent that the existing classification system was not sufficient to advise the SC subgroups in cases where well designed and implemented surveys yielding small sample sizes, due to the scarcity of whales in the surveyed area, resulted in abundance estimates which the ASG considered insufficiently reliable for direct use in SC assessments, but nevertheless constituted reliable information about low abundance. The existing Category 1B identifies cases where the abundance estimate is considered directly usable, but the only option in the situation described here would be the 'Not Suitable' Category due to the small sample size.

The ASG therefore recommended that the definition of Category 3 be revised to allow endorsement of the information from such surveys with low sample sizes, usable data, but abundance estimates which cannot be endorsed. The revision is as follows, with additions in boldface and deletions in ~~strikethrough~~:

> *Category 3: An estimate which is informative, but not acceptable for inclusion in 1A, 1B or 2. This category includes estimates with an unquantified bias which is likely to be too severe to allow inclusion in Category 2, as well as relatively unbiased estimates* **or informative data** *that are adequate to provide some general indication of abundance while still not qualifying for 1A, 1B or 2. Such estimates* **or data** *may be used when fitting population models,* **and Category 3 data indicating very low abundance may be used in SC assessments, but Category 3 estimates should not be used** ~~*for use as estimates*~~ *in actual implementations of IWC management procedures (i.e., the RMP CLA or AWMP SLAs).*

The intent is that a Category 3 endorsement shall specify explicitly whether it pertains to an abundance estimate or only the relevant data. Where it only pertains to the relevant data, the estimate itself is not endorsed, but SC subgroups may use the data for assessment and modelling purposes, other than RMP CLA and AWMP SLA applications.

The ASG **recommended** that all papers considered below should be assigned the highest level of Evaluation Extent (1 - estimate was considered in detail by the Sub-Committee) in the IWC Table. The metric for the Evaluation Extent levels is given in IWC (2014).

2.1 Māui dolphins

The Māui dolphin subspecies is currently restricted to a relatively small segment of remote coastline along the northwest coast of Te Ika-a-Māui/the North Island of Aotearoa New Zealand. Constantine *et al*. (2021) report the results from continued genetic monitoring of Māui dolphins during 2020-21, following the same methods as previously reported for surveys conducted in 2001-07, 2010-11 and 2015-16. A primary objective of this work has been to estimate the abundance and effective population size of Māui dolphins in 2020-21. Small-boat surveys dedicated to the collection of biopsy samples operated during the austral summers of 2020 (February) and 2021 (February-March). A total of 84 biopsy samples were collected during these surveys from individual dolphins aged one year and older (50 in 2020, 34 in 2021). Based on DNA profile matching, 32 individuals were identified from the 50 samples collected in 2020 and 24 individuals from the 34 samples collected in 2021, with 13 individuals recorded in both surveys. Genotype recaptures were assembled into capture histories for individuals sampled in 2020-21. Using a Lincoln-Petersen estimator with Chapman's correction, the census

abundance of Māui dolphins in 2020-21 was estimated to be 54 individuals aged one year or older (95% CI 48–66) within the survey area. This estimate applies to the number of individuals alive during either sampling year and is intended to be comparable with the previous estimates based on the genotype surveys in the same area in 2010-11 (Hamner *et al*., 2014) and 2015-16 (Baker *et al*., 2016).

Constantine *et al*. (2021) was reviewed by the SC Sub-Committee on Small Cetaceans in 2022, which then referred the paper to ASI for potential endorsement and classification (IWC, 2023, item 16.4.2). Previous Māui dolphin abundance estimates (2001 and 2016; Cooke *et al*., 2019) were classified as Category 1B in 2022 (IWC, 2023, item 11.2.2).

The ASG review of this new estimate concluded that the field study design, biopsy sampling and genetic sampling were appropriate, and that the assumptions of the Lincoln-Petersen estimator with Chapman's correction were supported. While some challenges arose from the collection of genetic samples from such a small population, the study was generally well done.

In response to review comments, the authors of Constantine *et al.* (2021) agreed there were likely to be some shortcomings or gaps due to the extremely small population size. The authors suggested that the methods used were selected with these constraints in mind, but also provide an approach that has been consistently applied since the first synoptic surveys in 2010-11, which allows comparisons over time.

The Lincoln-Petersen estimator assumes that both samples are drawn from essentially the same population and that in the past (1970s and 1980s), the Committee routinely applied mortality corrections to mark-recapture estimates to allow for the fact that not all marks placed in the first sample are still present in the second sample (e.g., Tillman *et al.*, 1980). If estimating the population size in 2021, then, on average, only a fraction, *S*, of the 2020 sample will be present in the 2021 population, where *S* is the annual survival rate. Therefore, a mortality-corrected estimate can be computed by multiplying the uncorrected estimate by *S.* If the aim is to estimate the population size in 2020, the correction factor would be 1 – *R*, where *R* is the proportion of the 2021 population that consists of new recruits. Estimates of *S* for Māui dolphins are available, such as 0.884 ± 0.018 in Cooke *et al*. (2019). Applying this estimate for *S* would correct the abundance estimate in Constantine *et al*. (2021) from 54 (95% CI 48-66) to 48 (95% CI 40-57), using the usual addition formula for CVs. The ASG concluded that the mortality correction should be applied to improve comparability with the currently accepted estimates of Māui dolphins in the IWC Table of Agreed Abundance Estimates. The authors of Constantine *et al*. (2021) supported the mortality correction. Further details are provided in Appendix 2.

The ASG **recommended** that the new mortality-corrected abundance estimate for Māui dolphins of 48 (95% CI 40-57), applicable to 2021, be endorsed as Category 3, because the ASG anticipates a fully integrated analysis.

The ASG **recommended** an update to the fit of the individual-based population model (Cooke *et al*. 2019) to the Māui dolphin genetic capture-recapture data. The ASG recommended this estimate should be footnoted with reference to this recommended update.

2.2 Southern right whales

Romero *et al*. (2022) describes the use of a population dynamics model for southern right whales in the southwestern Atlantic Ocean to measure the effect of whaling numerically and to estimate the population trend and recovery level after depletion. The catch history for the period 1670-1973 was reconstructed from the literature and used to estimate current and pre-exploited population abundance, using a Bayesian state-space surplus production model with a sampling-importance-resampling algorithm. Eleven models were developed to account for uncertainty regarding model formulation, prior probability specifications and input data. Estimates of annual abundance were derived from multi-model inference using Bayesian model averaging to balance model goodness of fit and model uncertainty rather than relying on one 'true' model. The median population abundance for 2021 was estimated at 4,742 whales (95% CI = 3,85-6,013). Romero *et al*. (2022) was previously discussed by the Committee (IWC, 2023, item 8.2.3.4) and was referred for further review.

The ASG agreed the study was well documented and the modelling appropriate. It suggested investigating the propagation of uncertainty in the catch allocation process through to the error estimates of abundance estimates in a future iteration of these analyses.

In the context of results presented in Romero *et al*. (2022) and Jackson *et al*. (2016), the ASG considered the implications of different data, modelling or analysis approaches being used to derive abundance estimates (i.e., population models versus direct survey estimates, such as from sighting or capture-recapture surveys), and whether these estimates are comparable. The importance of carefully documenting the data and analysis method for abundance estimates was underlined given these implications. The ASG noted that population model-based abundance estimates are not uncommon in the Committee's work and that a pragmatic approach is needed when reviewing and using these estimates.

In light of this discussion, a decision on the abundance estimates in Romero *et al.* (2022) was delayed, allowing ASI to consider the modelling more fully and to compare the forthcoming results with existing capture-recapture abundance estimates in Cooke (2013).

Jackson *et al*. (2016) describe an integrated population-level assessment of the whaling impact and pre-exploitation abundance of New Zealand southern right whales. The assessment uses a Bayesian population dynamics model integrating

multiple data sources: 19th Century catches, genetic constraints on bottleneck size and individual sightings histories informing abundance and trend. Different catch allocation scenarios are explored to account for uncertainty in the population's offshore distribution. From a pre-exploitation abundance of 28,800-47,100 individuals, hunting in the 19th Century reduced the population to approximately 30-40 mature females between 1914-26. A number of recent abundance estimates for New Zealand southern right whales are offered in table 2 of Jackson *et al*. (2016).

In discussion, the ASG considered the analysis to be high quality. There was a question about the range for the prior distribution on rate of increase prior (0-12%), and whether the upper bound was biologically feasible for southern right whales. It was noted that priors need not be biologically feasible, and that in this case, the computational impact of the population bottleneck coupled with the available data meant there was no influence of the prior on the posterior estimate of the rate of increase.

The ASG **recommended** the New Zealand southern right whale abundances based on New Zealand-only catches, with a high historical catch rate, be classified as Category 1A. These would be 2762 (95% CI = 2,100-3,671) for 2009 and 4,742 whales (95% CI = 3,853-6,013) for 2020. A number of other abundance estimates offered in Jackson *et al*. (2016) would also be endorsable if different assumptions of region and catch scenarios were preferred and could be used in assessments as appropriate.

Brandão *et al*. (2023) reported on a photo-identification-based assessment model of southern right whales surveyed in South African waters, with a focus on recent low counts of mothers with calves. After more than three decades of steady increase (~7% annually), these counts had become erratic and mainly low from 2015 onwards. One explanation would be high mortality and a declining population, but information from the photo-IDs indicated a lengthened calving interval, suggesting delayed reproduction as an explanation as well. To fit the extended photo-ID data, the standard 'receptive, calving and resting' model applied previously needed adjustment to include an early abortion factor as well as an increased probability of remaining in the 'resting' phase. The final fit to the data was satisfactory and preferred to that for an alternative model that assumed an increase in natural mortality from 2014 onwards. The estimated trajectory for the population reflected a continuing increase and abundance in 2020 was estimated to be 6,470 (SE 285).

In review, the modelling approach described in Brandão *et al*. (2023) was considered to be well documented, defined and supported, with appropriate conclusions. Some concern was expressed regarding over-parameterisation, as well as some indication that important sources of variation had not been captured in the model, but these points were not considered to invalidate the use of this modelling approach.

The ASG noted the complexity of the modelling used in Brandão *et al*. (2023), but also recognised that similar models have been used in Committee work for two decades (e.g., Cooke *et al*., 2003).

The ASG **recommended** the South African southern right whale abundances of 1,226 (SE 52) for 1990; 2,332 (SE 77) for 2000; 4,401 (SE 151) in 2010; and 6,470 (SE 285) in 2020 be classified as Category 1A. These estimates should also be added to the website.

2.3 Southern hemisphere humpback whales

Monnahan *et al*. (2019) describes a study of abundance and survival for a persistent feeding aggregation of humpback whales in the Magellan Strait in southern Chile. This persistent feeding aggregation is considered to be part of Breeding Stock G (BSG). Using Bayesian robust-design mark-recapture models (assuming closure) fit to photographic data from 2004-16, collected in the November-June period. Overall, the model estimated a total of 204 whales (95% CI 199-210) were present over the 12-year sampling period, and 93 (95% CI 86-100) in the 2016-17 austral summer. Annual abundance estimates were also offered in table 1 of Monnahan *et al*. (2019). Also estimated was a population growth rate of 2.3% (95% CI 2.1%-3.1%), an annual increase of two whales. Annual survival (including calves) was estimated at 0.892 (95% CI 0.871-0.910).

The independent reviewers agreed that the analysis in Monnahan *et al*. (2019) was well done and used current methodology. Despite the study being based on a complex and sophisticated model that was fitted to heterogeneous long-term opportunistic photo-ID data, the model itself fitted very well and provides apparently sensible estimates. In addition, one of the reviewers examined the code and found no issues. One reviewer suggested important limitations of the model are that temporary emigration is assumed not to exist and it is unclear what the overall population size (i.e., N=204) corresponds to.

In discussion, the ASG considered whether the low estimate of survivability was compatible with the estimated population growth rate over the duration of the study - and in particular, what that might mean for interpreting the overall abundance estimate and the assumption of population closure. It was noted that the Magellan Strait feeding aggregation is an accepted sub-component of BSG, with high site fidelity. Whilst the feeding aggregation may have high site fidelity, the ASG was informed that the photo-ID study itself did not cover the spatial extent of the feeding aggregation and any inter-annual variation it might display.

Therefore, the ASG **recommends** that the abundance estimates for humpback whales of the Magellan Strait feeding aggregation be classified as 'Not Suitable'.

2.4 Antarctic blue whales

Hamabe *et al*. (2023) presents abundance estimates of Antarctic blue whales south of 60°S from 70°E to 170°W using data collected during JARPA (1989/90-2004/05) and JARPAII (2005/06-2013/14). Sighting data were collected between December and February, from both sighting and sampling vessels (SSV) and dedicated sighting vessels (SV). The SVs and SSVs surveyed as one fleet in the JARPA, whereas the SV track lines were designed separately from SSVs in JARPAII. Both passing mode (where the sighting survey was continued on the track line without approaching the detected whale schools) and closing mode (where the approach was made by deviating from the track line) were employed. Multiple covariate distance sampling line transect methods were used to estimate a detection function, and detection probability on the track line $g(0)$ was assumed to be 1. Abundances were estimated using a Horvitz–Thompson-like estimator, and 95% confidence intervals were obtained by assuming that the abundance was log-normally distributed. Abundance estimates were derived for each survey year for IWC Management Areas IV and V.

The ASG noted the substantial changes in estimated abundance (for some years), relative to earlier analyses of the same survey data (Matsuoka *et al*. 2006; Matsuoka and Hakamada, 2014), which are very concerning and not fully understood. One of the key differences in the new analyses appears to be the inclusion of sightings with confirmed and non-confirmed school size estimates in the older analyses, but only the inclusion of sightings with confirmed school sizes in the new estimates. Moreover, it seems that sightings with non-confirmed school sizes were deleted from the numbers per transect length [n/L] component of the new analysis, not just from the school size estimation component of the analysis.

In response, the authors of Hamabe *et al*. (2023) noted their desire to only use confirmed school sizes in order to ensure robust analyses. The authors agreed that, given the relatively small number of detections of Antarctic blue whales, it might be worth including all detections, particularly given that unconfirmed school size estimates were only around 20% of all school sizes and that inclusion of information on school sizes did not contribute to significant reduction in AIC. The authors also expressed an interest in approaches to inflate the uncertainty of unconfirmed school size using latent variables or a similar approach, in order to use the data more efficiently and to check sensitivity or robustness of the analyses. Regarding the discrepancy in the number of detected schools and sighting effort between Hamabe *et al*. (2023) and the former analyses, the authors noted that the most recent analysis included all effort and sightings, not just those thought to be best timed with blue whale presence, which was the case previously with early JARPA surveys, so as to avoid replicated areas over a season. The implication of adding these data was worthy of exploring further. Finally, the authors suggested that the small number of detections per season is common for such small populations, and that whilst the resultant year-to-year abundance estimates might be less trustworthy, an overall trend might still be informative.

The ASG **recommended** that the authors provide an analysis to identify and quantify the reason(s) for the differences between the Hamabe *et al*. (2023) estimates and results and the older analyses, and to consider the implications of the small number of sightings in various years. The authors of Hamabe *et al*. (2023) agreed to pursue the proposed analysis. The ASG therefore **recommended** that Antarctic blue whale abundance estimates for Areas IV and V (tables 5 and 6 respectively in Hamabe *et al*., 2023) be categorised as provisional, Category P, until the planned re-analyses are completed and reviewed by ASI.

SC/69A/ASI/01Rev presents a capture-recapture analysis of photo-ID data of Antarctic blue whales from 2003/2004 to 2018/2019 in order to produce estimates of population abundance and growth rate for the circumpolar Antarctic. Photographs were collected during various voyages and survey programmes (e.g., IWC-SOWER, IWC-SORP, ICR, and SAABWS cruises) and other opportunistic contributors. Separate capture-recapture estimates were made using photos taken of the right and left sides of the whales. Two capture-recapture models, POPAN and Pradel, were applied to these data to estimate super-population abundance, recruitment-immigration, and probability of capture from the POPAN model and probability of capture and population growth rate from the Pradel model. Assigning a survival rate of 0.92 (mean from four best fitting models) to the combined and right and left-side models produced a POPAN abundance estimate for the last year, 2018/2019 (2,050, 95% CI 1,135-3,704).

An initial capture-recapture analysis of the series of Antarctic blue whale photo-ID data was presented in Olson *et al*. (2018), which was reviewed by ASI in 2018 (IWC, 2019a, item 3.1.1.9). A subsequent updated capture-recapture analysis of the Antarctic blue whale photo-ID data was presented in Olson *et al*. (2021), which was reviewed by ASI in 2021 (IWC, 2022, item 11.1.4). SC/69A/ASI/01Rev presented the revised analysis based on feedback from the 2021 review.

Considering SC/69A/ASI/01Rev, the ASG recognised the authors' work towards addressing previous concerns and noted improvements to the capture-recapture analyses, particularly comparisons with the Pradel-λ model in Program MARK, using higher values for the apparent survival rate, using the mlogit link for probabilities of entry in the POPAN model, and averaging of the super-population estimates from the left and right-sided POPAN analyses.

The ASG was concerned about the differences between the POPAN and PradLambda results when they should give the same apparent survival estimates (Schwarz *et al*., 2021). The differences suggest potential issues related to unidentifiability and the fixed-apparent-survival approach for dealing with it.

Regarding the combination of left and right-sided analyses, with the underlying assumption that these datasets are independent, a reviewer considered that such an approach is known to be problematic (e.g., Bonner *et al*., 2013; McClintock

et al., 2013), where, at best, it would seem to underestimate uncertainty, and, at worst, it could also be biased. The ASG considered a variety of potential remedies but was disinclined to recommend any due to their complexity, though it noted that a Bayesian approach might be appropriate, or application of methods developed for jointly analysing left and right-sided encounter data with shared parameters (e.g., Bonner *et al*., 2013; McClintock *et al*., 2013).

One independent reviewer also expressed concern that the authors had used unconventional methods to deal with what appears to be parameter unidentifiability (likely a result of insufficient data): specifically, the approach that fixed apparent survival at a range of values, fit the various fixed-apparent-survival models, and then compared AIC values for model selection and inference. The reviewer did not know of a theoretical justification for this approach and asked for either evidence from the literature or simulation experiments to support its validity.

The authors of SC/69A/ASI/01Rev stated that they considered their method of supplying a range of apparent survival values to POPAN and Pradel models in this study to be a form of likelihood profiling, with the range of apparent survival values supplied allowing the support of each model given the parameters it did estimate for these different survival values to be assessed (see Cole *et al*., 2013). The estimates from the left and right sides were averaged with equal weightings because the sample sizes were very similar (225 right, 214 left) as the authors felt the population estimates from either side are equally valid. The authors agreed that, with sufficient data to reach asymptotic expectations, the POPAN and Pradel models should be equivalent, and that the reason they are not in this case is likely the result of parameter unidentifiability due to insufficient data. The authors also agreed that the likelihood profiling method applied to the survival parameter could underestimate overall uncertainty due to the wide range of models with different values of survival that were within two ΔAICc of the best models. Regarding alternative analysis methods, such as Bayesian modelling with informative priors, or possibly combining the left, right and both-side matches into a single distribution using the method described in McClintock *et al*. (2013), the authors thought these could potentially be applied in the future to confirm or improve the results of the basic approach used in SC/69A/ASI/01Rev. The authors felt that, despite the data limitations and the potential for alternative modelling approaches to address these limitations in other ways, their approach is appropriate for making initial population estimates based on the information in this photo-ID dataset without constraining these data-based estimates by using prior assumptions.

As the profile likelihood (PL) argument had been introduced after reviews were complete, the convenors of ASG agreed that further evaluation of that question would be appropriate. Givens agreed to examine the statistical issues raised by the reviewers. He considered the POPAN abundance estimates more appropriate, given the suggestion to explore a Pradel model was apparently intended to guide estimation of survival and growth rate, consideration of which is not within the remit of ASI. Regarding the question of combining both sides of photo-ID capture-recapture data into a single model, he believed that while methods outlined in McClintock *et al*. (2013) would likely be superior, these are difficult to implement, and that averaging the estimates after analysing each side separately is likely to be adequate to the degree of approximation that the Committee can tolerate for its management and assessment purposes. However, he believed that the simple averaging approach could be improved by using inverse variance weighted averages, annually, with corresponding confidence intervals. Most importantly, he agreed with the authors' assertion that their approach is a form of likelihood profiling and that a PL approach was wholly appropriate. However, while the point estimates are correctly derived from PL, he was concerned that the authors' uncertainty estimates were highly approximate, suggesting that these might be substantially too small (i.e., underestimating uncertainty).

In discussion, the ASG noted the small number of recaptures throughout the entire photo-ID series, and that the relatively spatially and temporally clustered sampling to collect the photo-IDs means it is difficult to extrapolate these results to the Antarctic circumpolar region. It was also noted that sampling throughout the circumpolar region within a single season is impossible, but that Discovery mark data indicates these animals have been documented to mix throughout the entire Southern Ocean. The question of whether the PL approach, as implemented by the authors, underestimates uncertainty was raised again, and various suggestions were offered as potential improvements. Several members noted that the authors had fully complied with several rounds of suggested revised analyses from reviewer comments, and that the most serious concern by the first reviewer this year was at least partially resolved by the third review (i.e., the conclusion that the 'unconventional' approach was indeed conventional PL, at least with respect to the point estimate). The question was whether the remaining concerns about uncertainty estimation were so serious as to preclude endorsement in any Category, and whether, given the long history of the development of analyses in SC/69A/ASI/01Rev, it would be necessary for the ASG to propose yet more improvements, particularly if these involved very complex new analyses.

The ASG thanked the authors for their efforts over multiple years and **recommended** that the circumpolar abundance estimate of Antarctic blue whales of 2,050 (95% CI 1,135-3,704) for 2019 (based on assumed annual survival of 0.92) be endorsed as Category 3 because of the concerns regarding the measures of uncertainty.

2.5 Eastern North Pacific gray whales

Eguchi *et al*. (2022) provide results from shore-based surveys of eastern North Pacific (ENP) gray whales conducted by the Southwest Fisheries Science Center to estimate abundance. These estimates are obtained from visual survey data collected

Table 1
Abundance estimates for eastern North Pacific gray whales (Eguchi *et al*., 2022).

Year	N	LCL	UCL	Method
1968	13,426	10,952	15,900	Laake
1969	14,548	12,267	16,829	Laake
1970	14,553	12,186	16,921	Laake
1971	12,771	10,744	14,799	Laake
1972	11,079	9,060	13,099	Laake
1973	17,365	14,642	20,088	Laake
1974	17,375	14,583	20,168	Laake
1975	15,290	12,773	17,807	Laake
1976	17,564	14,603	20,525	Laake
1977	18,377	15,496	21,259	Laake
1978	19,538	16,168	22,908	Laake
1979	15,384	12,972	17,796	Laake
1980	19,763	16,548	22,978	Laake
1985	23,499	19,400	27,598	Laake
1986	22,921	19,237	26,605	Laake
1988	26,916	23,856	29,976	Laake
1993	15,762	13,661	17,863	Laake
1994	20,103	17,936	22,270	Laake
1996	20,944	18,440	23,448	Laake
1998	21,135	18,318	23,952	Laake
2001	16,369	14,412	18,326	Laake
2002	16,033	13,865	18,201	Laake
2007	19,126	16,464	21,788	Laake
2007	20,750	18,860	23,320	Durban
2008	17,820	16,150	19,920	Durban
2010	21,210	19,420	23,250	Durban
2011	20,990	19,230	22,900	Durban
2015	28,790	23,620	39,210	Durban
2016	26,960	24,420	29,830	Durban
2020	20,580	18,700	22,870	Durban
2022	16,650	15,170	18,335	Durban

off central California between December and February during the gray whale southward migration and provide regular updates to a time series of abundance estimates that began in 1967. In 2016, abundance was estimated at 26,960 (95% CI 24,420-29,830) whales, indicating that the population had roughly doubled since 1967 when it was estimated at 13,426 whales (95% CI 10,952-15,900). The population then declined to 20,580 whales (95% CI18,700-22,870) in 2020. This report presents a new estimate of abundance for ENP gray whales in 2022.

The ASG agreed that the analysis used well-tested published methods to continue a time series of abundance estimates that have been endorsed by the SC for years (the most recent change to the methods was endorsed at SC62). The reviewers recommended that the US should update the detection probability estimate, the proportion of night-time passage and the availability bias correction factor for offshore whales.

Having noted that the estimated abundance had declined from 2016-22 by more than 40%, the ASG reiterated the importance of this survey and the long time series of comparable estimates. The ASG also noted that such estimates are essential to support the provision of subsistence whaling management advice developed by ASW and IST. For all these reasons, the ASG strongly **recommended** that continued frequent surveys of this whale population be funded, conducted and reported to the SC, with additional effort undertaken to provide the updates and enhancements suggested above.

The ASG **recommended** that the 2022 estimate of 16,650 (95% CI 15,170-18,335) be endorsed as Category 1A. The entire time series should be added to the webpage (revising any previous estimate that has changed as a result of this update, Table 1).

Harris *et al*. (2022) provide updated abundance estimates for gray whales from the Pacific Coast Feeding Group (PCFG), a small group of ENP whales that has been recognised by the SC as demonstrating strong seasonal fidelity to the Pacific Northwest and includes individuals observed in two or more years between 1 June and 30 November from 41°N to 52°N latitude. Boat-based photo-ID of gray whale individuals from northern California (USA) to British Columbia (Canada) is part of a larger research collaboration to understand gray whale population abundance, movements and stock structure. Whereas transient ENP whales passing through to feed in the northern waters of the Chukchi, Beaufort and Bering seas are rarely observed more than once in the Pacific Northwest, PCFG whales are frequently re-sighted due to their higher fidelity

to the region and increased residency time through the summer and fall. Estimates of PCFG abundance were updated through 2020 using sighting histories since 1996 and the population modelling framework described in Calambokidis *et al*. (2019).

The ASG **agreed** that the methodology has been consistently applied over time and that the estimates are adequate given the nature of the data. As with earlier analyses from this project, concern was expressed about the nature of the opportunistic data, the heterogeneity in capture probability created by spatial and temporal variation in sampling effort, and the difficulty of handling individuals seen within the area only once (which are therefore not 'recruits' into the PCFG). The precision of the estimates also seemed high given the potential sources of uncertainty.

The ASG **agreed** that, despite these caveats, the estimates are acceptable for management advice and therefore **recommended** they be endorsed as Category 1A. Further review by ASI was recommended given the importance of this issue for ASW and IST. Moreover, the analysis was performed for three nested geographical regions. ASI must address which of these three time series will be endorsed and added to the IWC Table and the webpage.

2.6 West Greenland bowhead whales

A proportion of the East Canada-West Greenland population of bowhead whales spends January-June off West Greenland. Several aerial surveys between 1998-2012 have estimated the abundance of bowhead whales on this wintering ground, with the last estimated abundance of 744 whales (CV=0.34) based on an aerial survey conducted in 2012. SC/69A/ASI/03 reported on visual aerial line-transect surveys of bowhead whales conducted as a double-platform experiment covering the main distribution of the local winter aggregation of bowhead whales in West Greenland, undertaken between 26 March and 4 April 2022. The target region included an area of 34,742 km^2 and was divided into 6 strata with a total of 3,667 km of effort on systematic parallel transect lines. Abundance of bowhead whales was estimated using a mark-recapture distance sampling (MRDS) approach and a strip census analysis. In both approaches, the final estimate of abundance was corrected for both perception and availability biases. The median time a bowhead whale was visible for observers was 4.5 seconds, but this was not accounted for in the estimates.

The ASG concluded that the overall design and implementation of the data collection was appropriate but discussed which distance sampling model to apply and the need for the availability correction factor to include the time-in-view of sightings. Based on these comments, the authors provided a reanalysis that incorporated the time-in-view and used dive data from a subsample of telemetry data from three bowhead whales in West Greenland. The adjusted correction factors were weighted by the frequency of the observed time-in-view values and both the strip transect and the MRDS estimates were revised.

The ASG **agreed** that the authors' reanalysis had adequately addressed the key concerns. The ASG **recommended** that the revised MRDS estimate (with time-in-view) of 888 (CV 0.46) bowhead whales be endorsed as Category 1A and included on the webpage as the 'West Greenland feeding area'.

2.7 Franciscana dolphins

The franciscana (*Pontoporia blainvillei*) is endemic to coastal waters from Brazil to Argentina. The species is regarded as one of the most threatened cetaceans in the South Atlantic Ocean due to high bycatch levels. The Committee had agreed to review the status of the franciscana dolphin in 2019 but the review was delayed until the following year (IWC, 2020; item 10.1.4). Subsequently, the review was supposed to start in 2020, but the Covid-19 pandemic then further prevented it from being carried out as planned when papers on franciscana abundance estimates submitted to SC68B in 2020 were not reviewed due to time constraints. Instead, reviews were carried out intersessionally by a correspondence group and independent reviewers on behalf of ASI. These reviews were presented and discussed during a pre-meeting Workshop held in 2021 to advance the Committee's evaluation of the status of the franciscana (IWC, 2022b). One outcome of this pre-meeting included the identification of a series of tasks to improve estimates of abundance of franciscanas (IWC, 2022b; item 3.8). The pre-meeting Workshop report was subsequently endorsed by ASI during the 2021 annual meeting of the Committee (IWC, 2022a, item 11.1.2). Two documents presented to the ASG in 2023 address these tasks specifically: SC/68A/ASI/2 and SC/68/ASI/15. Furthermore, the four Franciscana Management Areas (FMAs) originally defined throughout the species' range have recently been reevaluated (Cunha *et al*., 2014) and FMA IV in Argentina was subdivided following a review of the stock structure.

SC/69A/ASI/02 presents results for new surveys conducted in October 2019 and March 2022 in two of the five subareas, FMA IVb and IVc. The two series of surveys had to be carried out in separate years because of travel restrictions associated with the Covid-19 pandemic. The surveys used a systematic zig-zag design and collected visual sightings and associated perpendicular distances in a single-platform configuration. The number of franciscana sightings in 2019 and 2022 were 41 (68 individuals) and 55 (80 individuals). The stratum used for extrapolation corresponds to the area between the coastline and the 30m isobath.

The ASG **agreed** there remained some confusion about various aspects of the analysis (e.g., separating detection functions by stratum but pooling density estimates over years/seasons, potential spatial heterogeneity in sightability and habitat). These issues potentially affect both bias and uncertainty.

The ASG discussed the availability correction factor and whether the variability around the mean dive time could result in dive times being shorter than the survey window (thus resulting in no correction, i.e., g(0)=1). It was clarified that this never happened because the viewing window is about five seconds, whereas dives usually last around a minute. The ASG agreed that the group size correction factor developed for other FMAs (Sucunza *et al*., 2022) should be applied to the FMA IV estimates. No correction factor for perception is available specifically for FMA IV, but because the observers are experienced, the perception bias is likely lower than 20%.

Extrapolation of density estimates beyond the area covered by the survey transects in the south part of FMA IVc is inappropriate because there are no data south of the effort gap. The authors explained that the spatial extent of the FMAs is informed by genetics, but that the exact latitudinal boundaries for FMAs are rather arbitrary and there is no reason to believe that density changes south of the surveyed lines. The ASG acknowledged the challenging logistics of surveying that area but did not support the extent of the extrapolation and concluded that estimates to be considered for ASI endorsement should pertain to density and abundance only in the area covered by the completed transects.

Therefore, the ASG developed the following list of suggested changes:

- Clarify in the text that sightings made beyond the 30m isobath were used to inform the detection function (but not used in the density estimate) because there was no reason to believe that the detectability of franciscana differed in the deeper waters and across areas.
- Fit a single detection function to all of the distance data with survey year and subarea as covariates.
- Consider shorter right-truncation values to minimise the influence of distant sightings.
- Apply the group size correction factor developed for other FMAs (Sucunza *et al*., 2022).
- Do not extrapolate the density estimate to the un-surveyed area in the south of FMA IVc when calculating abundance.

The ASG suggested that ASI should consider a revised estimate incorporating all these requested changes. Since surveys in different years correspond to different seasons, only the year-specific estimates (i.e., not averaged over years) will be considered for the IWC Table and webpage. The ASG thanked Coscarella for his efforts to revise estimates in time for ASI to potentially endorse during SC69A.

SC/69A/ASI/19 provides the first stock-wide estimate for franciscana dolphins in FMA III, which is the only stock shared across countries and encompasses the coast of southern Brazil and Uruguay. Aerial surveys were conducted using standard line-transect methods in February-April 2021 (Brazil) and in February-March 2023 (Uruguay). A total of 5,312km of tracklines were surveyed over a total area of 80,342km^2. A total of 96 franciscana groups (199 individuals) were recorded on effort by primary observers with an average group size of 2.09 (CV = 0.09). Overall density for FMA III was estimated at 0.54 individuals/km^2 (CV=0.31). This is the first study to compute an estimate of abundance in the whole range of this stock. The results suggest this is the most abundant among all franciscana stocks. FMA III is where most of the bycatch takes place. The surveys were partially funded by the Committee and also aimed at building capacity by training new scientists to use survey methods.

The ASG discussed the validity of extrapolating to the un-surveyed areas, which mostly occurred in the south of the Brazil stratum. In a revised version of ASI/19, the authors examined a 2014 survey conducted off the southern coast of Brazil with the same aircraft and observers (Sucunza *et al*., 2020) that sampled both the areas of the Brazil stratum that were covered and not covered in 2021 (in the same season). The encounter rates of the 2014 survey were identical in the covered and uncovered areas of the 2021 survey. Therefore, the ASG **agreed** that, assuming the distribution of franciscana in 2021 was similar to that in 2014, the extrapolation of the 2021 density from the covered to the uncovered area was warranted.

The ASG observed that there was variation in density within the La Plata stratum, which was surveyed for the first time in 2021, and these results could be used to inform the stratification of future survey designs. The length of transect lines in FMA III was discussed (FMAs are only defined latitudinally): the area covered by the transects was extended from 30m isobath to 50m isobath because bycatch data showed franciscana present in that area. However, there is little evidence that franciscana are present in waters deeper than 50m.

It was noted that, while the survey aircraft had both front and rear observers, the rear windows were different from the front ones (with little overlap in their fields of view), and the rear observers were in training. Therefore, the rear observer data could not be used as a second platform to estimate perception bias.

The ASG **recommended** that the area-specific estimates for Brazil in 2021 (13,137, CV=0.327), Uruguay in 2023 (30,011, CV=0.354) and FMA III as a whole (43,148, CV=0.311, 95% CI 23,786-78,271) all be endorsed as Category 1A. The combined estimate is considered to apply to the year 2022, since the surveys were done in different years (2021 and 2023). The ASG **recommended** that the estimate for FMA III should be added to the webpage.

SC/69A/ASI/15 addresses recommendations made by the Committee to improve correction factors used to estimate abundance of franciscana and update past estimates with the improved correction factors. It was agreed these tasks should be performed before the franciscana review is complete. The correction factor for both visibility and group size bias was revised to 4.76 (CV=0.25). Previous estimates for FMA Ia (Sucunza *et al*., 2020c) and Ib (Danilewicz *et al*., 2020) had been

discussed during the 2021 pre-meeting Workshop (IWC, 2022b, items 3.2.and 3.3) but categorised as Provisional until those new correction factors could be applied. As a result, estimates of abundance were last revised for FMA Ia in 2018 and Ib in 2011 and 2017.

Similarly, the estimate for FMA II in 2009 (Sucunza *et al*., 2020a) was categorised as Provisional until a new CV for the group size bias correction factor could be recalculated. The correction factor was built using a log-linear model incorporating the effect of platform (boat and airplane), and the uncertainty around these parameters was combined using the delta method to obtain the variance of the bias in group size estimates (Sucunza *et al*., 2022). The estimate for FMA II was corrected for group size bias using the 1.36 (CV=0.11) factor. Finally, the estimate for FMA III along the Brazilian portion of the range of the stock in 2014 (Sucunza *et al*., 2020b; IWC, 2022, item 11.1.12), which had been endorsed as Category 2, was corrected for visibility and group size bias.

The ASG noted that all of these estimates are now fully corrected for all of the known biases (availability, perception and group size) and therefore **recommended** that the estimates for FMA Ia (1,183, CV=0.76) in 2018 and Ib in 2011 (1,590, CV=0.53) and 2017 (1,521, CV=0.47), as well as the estimate for FMA II in 2009 (9,284, CV=0.28) and FMA III along the Brazilian portion of the range of the stock in 2014 (9,437, CV=0.34) all be endorsed as Category 1A. The estimates for the following areas should be added to the webpage: Ia, Ib (for two different years) and II.

2.8 Western North Atlantic cetaceans

Palka (2006) presents density estimates for marine mammals in areas of the northwestern Atlantic Ocean that are of interest to the US Navy. Surveys were conducted by the Northeast Fisheries Science Centre in 1998, 1999, 2002 and 2004. The 2004 estimates appear to be more representative of a springtime distribution or the transition between spring and summer distributions, while the 2002 and earlier estimates appear to be more representative of mid-summer distributions.

Palka (2020) presents non-overlapping, line-transect, aerial and shipboard abundance surveys conducted by NOAA in the northwestern Atlantic Ocean from 27 June to 28 September 2016. The goal was to estimate abundance of as many cetacean species and sea turtles as the data allowed. This document focuses on abundance estimates of cetaceans detected only during the surveys that covered waters from North Carolina to Maine, from the shore to the Gulf Stream, which is about 370km (200 nmi) offshore. In a study area of 425,192 km^2, the ship and plane surveyed 11,636km of track lines. To estimate abundance, data collected with the two-independent-team method were analysed using mark-recapture distance sampling to account for perception bias and using dive-time patterns to account for availability bias. Overall, 325,242 cetaceans (CV=0.19) of 23 species or species groups were estimated to be present in the study area during the summer of 2016.

The need for estimates that cover large areas means that several of these surveys, which usually cover only a portion of most stocks' ranges, may have to be combined when possible. The ASG noted that there were some differences in methodologies between the surveys, primarily in the use of the 'circle back' approach for aerial surveys to estimate $g(0)$. Limited flight times meant that this approach was only used for small groups because they had the highest effect on the correction. Therefore, detection rates for larger groups (>5 individuals) are likely overestimated, resulting in a negatively biased abundance estimate. In more recent surveys, the circle back method has been replaced by double platform mark-recapture surveys from the same plane to estimate perception bias, while availability bias is now estimated based on ancillary dive data.

Palka informed the ASG of her intention to create a list of abundance estimates by combining all of the relevant surveys that have used similar methods in the northwestern Atlantic Ocean and to apply the most recent correction factors where and when appropriate, thus making older estimates comparable to newer ones. This list will not be ready until 2024. The ASG **thanked** Palka for volunteering to perform such a large amount of work and **agreed** that the new estimates would be useful to NH and IST. It was noted that the use of several correction factors over multiple years was going to result in covariance among estimates and that this covariance ideally needs to be reported.

The ASG **agreed** that the survey methods and analyses for these surveys are of high quality and have been reviewed satisfactorily. Given that updated abundance estimates are anticipated next year, the ASG **recommended** that the estimates in Palka (2006; 2020) for minke, fin, humpback, blue and sei whales be endorsed as Category P. Once the Committee receives the list of revised estimates and time series, it will reevaluate them, but the methods will not have to be reviewed again in the intersessional period. The ASG will consider evaluating estimates for some small cetacean species, based on the needs of the Committee.

2.9 North Pacific humpback whales

Calambokidis *et al*. (2020) provide updated abundance estimates for blue and humpback whales on the US West Coast from mark-recapture estimates based on photo-ID work conducted by Cascadia Research Collective and collaborators through 2018. The small boat sightings covered the whole US West Coast. There were 821 sightings of an estimated 2,603 humpback whales during the surveys and almost 1,400 good quality photographic IDs were obtained, yielding just under 900 unique individuals. Capture-recapture estimates of humpback whales for California-Oregon using three closed-population models (as has been applied in the past) showed a substantial increase in recent years.

This document was previously reviewed at SC68D for blue whales only where these estimates had been endorsed as Category 1A. The ASG **agreed** that the methods used for humpback whales were similar to those used for blue whales, with more extensive sample size (roughly five times more identification) and the availability of an additional extensive dataset from the HappyWhale project. Moreover, estimates are available for two regions (California-Oregon and Washington-South British Columbia). The ASG also **agreed** that the Chao estimates should be preferred, since they account for heterogeneity of capture probabilities. Since there is some interchange of whales between California-Oregon and Washington-South BC, adding the two sets of estimates together would result in a positively biased estimate. Decisions not to include the HappyWhale dataset and restrict the data to June-October (i.e., estimates in table 3 of the paper) should reduce any bias due to changes in sampling effort over time.

Therefore, the ASG **recommended** that the humpback whale estimates be endorsed as Category 1A. The abundance estimates of 502 (CV 0.08) for 1989, 1,083 (CV 0.06) for 1998, 1,982 (CV 0.08) for 2008, and 4,973 (CV 0.05) for 2018 should be included in the IWC Table.

2.10 North Pacific sei whales

Bradford *et al*. (2021) report on abundance estimates for 21 species of cetaceans in the US Exclusive Economic Zone of the Hawaiian Islands using ship-based, line-transect surveys conducted in 2002, 2010 and 2017. Low encounter rates in the study area required that sightings of similar species be pooled together (in some cases pooled with sightings from previous line-transect surveys) when estimating detection functions.

The Committee reviewed the blue whale estimate at the request of the NH sub-committee at SC68D and considered that, while the survey was well designed and implemented, the number of sightings was insufficient to provide a reliable estimate. Although the survey showed blue whales are very scarce in this region at this time of year, the estimate was considered 'Not Suitable'. The IA sub-committee then requested that ASI review this paper focusing exclusively on sei whales. To avoid a potential third review in the future, it was decided to broaden the review to examine results for a variety of species of potential interest to the Committee.

The ASG **agreed** that the issue of very small sample sizes was a concern for many of the estimates in the paper and also arose in the review of Hamabe *et al*. (2023). ASI needs to determine whether an estimate is valid for specific purposes (e.g., RMP or AWMP) but does not have set criteria for minimum sample sizes. Surveys that yield enough sightings for a reliable estimate of total abundance can be statistically partitioned into smaller sub-areas where few or no sightings were made. Such estimates of zero in sub-areas have been used in RMP Implementations Simulation Trials (e.g., for North Pacific minke whales). However, surveys that have small sample sizes overall cannot always yield an endorsable estimate. In principle, any estimate with a variance can be used in a model regardless of sample size. In practice, high variances can result in models producing unrealistic results (but those estimates can sometimes be used with a different error distribution).

The ASG acknowledged that valuable information may be available from small sample sizes when the survey methods and coverage themselves are of high quality. It was noted that the wording in Category 3 fits that description except that it specifically uses the word 'estimate'. Therefore, ASG **recommended** that the wording of Category 3 be revised to accommodate these situations. A proposal for such revised wording is given above (Item 2). If ASI agrees to this revision, ASI can further re-evaluate whether to endorse the estimates and/or data from Bradford *et al*. (2021) and the appropriate Categories.

3. ASG PROCESS AND ICG RECOMMENDATIONS

3.1 Supplementary wording and examples to explain category selection

In 2021, the Committee agreed that ASI would improve the descriptions for the categories used to classify abundance estimates reviewed by ASG/ASI. Following consideration by the ICG, improvements to category descriptions and advice to reviewers were agreed by the Committee (IWC, 2022).

An additional update for Category 3 was suggested under Item 2 above and the ASG **recommends** that the new category descriptions and associated text are adopted, and that no supplementary text or examples are needed. Therefore, the ASG **agrees** that the ICG has completed its work.

3.2 Review of estimates regularly updated in long-term studies using consistent methods

At SC68D, the ASG noted that much cetacean research involves projects spanning many years. The ASG drew attention to the importance of the long time series of data generated by such work, including whale (or calf) counts, abundance estimates and photo-ID databases. For some such long projects, regular abundance estimates are routinely provided (e.g., annually) as more data are collected, using the same survey and analysis methods as in prior years. The same issue arose this year for several papers, including both photo-ID surveys (e.g., North Pacific humpback whales) and shore-based surveys (e.g., eastern North Pacific gray whales). In such cases, it is not efficient for ASI to review each new estimate every time it is updated. For such cases, the ASG had recommended that ASI consider a process to reduce the Committee's workload.

In order to reduce the workload for reviewers, the ASG **recommends** that such papers be routed via the 'alternative review path' (i.e., not soliciting intersessional independent written reviews), if the requesting convenor and the ASG convenor

agree that the paper is a routine update. It is the responsibility of the requesting sub-group convenor, in consensus with ASI convenors, to verify that methods have remained unchanged (including communicating with the authors if necessary).

3.3 Guidance for convenors about submission of documents for ASI review

ASI only reviews abundance estimates when requested by a convenor, the Committee Chair or the Secretariat's Head of Science, Conservation and Management. ASI is a relatively new subgroup of the Committee (established in 2017). Its review processes have evolved rapidly which means there is still some confusion about how the process operates. To help alleviate this confusion, a 'Guidance for Convenors' document has been developed and made available to convenors. The following checklist for convenors summarises the key steps in the process of requesting a review.

- Provide the actual PDF(s).
- Provide a brief statement explaining context about stock definition and survey area to reviewers.
- Provide the names and emails for at least two potential independent reviewers. The inclusion of experts who are not regular attendees of the Committee is especially helpful, as regular Committee members are already well-known to ASG and often heavily burdened with review requests.
- Provide background material if the paper to be reviewed does not include methodological detail.
- Check for supplemental material and errata, and provide these if available.
- Coordinate with other convenors to ensure the same paper is not redundantly requested for different species in different intersessional periods.
- Where possible, make the requests as soon as possible and at least six months in advance of the Committee meeting. The absolute deadline, except for highly extenuating circumstances, is six weeks prior to the start of the next review meeting, which usually means the start of an ASG pre-meeting.

The ASG noted that when it is not possible to make the request long in advance of the SC meeting, it is useful to provide the ASG convenors with advance notice that a certain paper will be submitted later so that reviewers can be selected and contacted ahead of time. The request to suggest names of specialist new reviewers who are not regular attendees of the Committee is not intended to exclude members of the SC, who are often among the most appropriate reviewers for a paper, but rather to help ensure that no individual is overburdened and that alternate reviewers can be quickly identified.

3.4 Software submissions

The Committee's Procedures for Submission, Review, and Validation of Abundance Estimates (IWC, 2020) provides the following instructions for authors/convenors requesting an ASI review:

> *'In order to proceed to the review stage, the submitted manuscript must include all applicable information outlined in Table 1. 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] It should be noted that, before an estimate can be fully endorsed by the Committee as Category 1 […] or 2 […], 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 ASG may also require these data, code and input files for estimates in other categories in some circumstances.'*

'Table 1' referred to above lists: '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.' Footnote 1 above states: '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 Data Availability Group will consider provisions for the sharing of code and input files.'

In the past three years, ASG/ASI has reviewed about 70 papers and none of the submissions during this period complied with the software/data submission rules above. There are several reasons for this. First, in most cases, the authors of the papers had limited or no engagement with the ASI review process and therefore had little incentive to submit their data/software. Second, most authors and convenors are unaware of the requirement. Third, the requirement is burdensome, especially for analyses that do not rely on standard software packages. Fourth, the process seems redundant with the Committee's Data Availability Agreement (DAA) (IWC, 2004). Fifth, authors may have concerns about data/code ownership and may be unaware of the Committee's data ownership and confidentiality protocols.

The ASG discussed whether to remove or revise these requirements, especially given the existing requirements of the DAA for estimates used for the AWMP or RMP. It was suggested that data and software could be treated differently. The ASG **agreed** that data requirements are useful to ensure the consistency of the Committee's work, especially for long time series, and that it is advantageous for the Committee to function as a back-up repository of data.

The ASG also **agreed** that complete reproducibility of the analyses should be the ideal standard but recognised that this will not be feasible for most older studies, considering that software may become obsolete or machine-specific over time, and that complex bespoke models are difficult to document and reproduce. Any requirement should not constitute a barrier to submission of new work.

The ASG noted that the Committee was planning to establish a small working group at SC69A to consider revising the DAA. Therefore, the ASG **agreed** not to make any decisions about ASI data and code requirements until such DAA revisions had been considered. Procedures for data and/or code provision relevant for ASI could be woven into a revised DAA.

3.5 Adapting to biennial Committee meetings

ASI has three large tasks: the review of abundance estimates, the status of stocks initiative (SOSI), and reporting on international surveys. This heavy workload has required regular ASG pre-meetings and numerous sessions at each annual Committee meeting. When the Committee switches to biennial meetings, a two-year accumulation of abundance estimates and international surveys may make this workload unmanageable.

The ASG is already taking steps to reduce redundancies in the ASG/ASI review process but needs to find additional ways to adapt to this change. It was noted that, while the backlog of older papers to review might ease in the future, the continual submission of new papers and regularly changing areas of focus for various SC sub-groups (e.g., IA) will probably mean that a heavy load of requests will persist. The ASG **agreed** that relying on ASG pre-meetings will continue to be essential and discussed the possibility of intersessional workshops in odd years, or quarterly ASG meetings in hybrid or remote format. The ASG noted that larger yearly meetings allow for synergy among papers and topics, but smaller and more frequent meetings offer flexibility and options to focus on specific topics and sets of experts.

4. ADOPTION OF REPORT

Givens and New thanked the rapporteurs, Kelly and Doniol-Valcroze, for their enormous contributions to the pre-meeting's success. They also thanked the independent reviewers who contributed their time and expertise: L. Bedriñana-Romano, A. Bradford, T. Branch, A. Brandão, D. Butterworth, A. Cañadas, J. Citta, T. Doniol-Valcroze, M. Ferguson, T. Frasier, O. Gimenez, G. Givens, P. Hammond, M.P. Heide-Jørgensen, P. Howell, V. Leos Barajas, P. Mahoney, B. McClintock, D. Miller, D. Palka, A. Punt, J.A. Royle, R. Schick, J. Seddon, H. Solvang, R. Waples.

The report was adopted at 13:30 on 25 April 2023.

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Annex A

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
   - 1.6 Online participation
   - 1.7 New ASG/ASI process to reduce redundancy
   - 1.8 Update on inclusion of abundance estimates on IWC website
2. Review of abundance estimates
   - 2.1 Māui dolphins
   - 2.2 Southern right whales
   - 2.3 Southern hemisphere humpback whales
   - 2.4 Antarctic blue whales
   - 2.5 Eastern North Pacific gray whales
   - 2.6 West Greenland bowhead whales
   - 2.7 Franciscana dolphins
   - 2.8 Western North Atlantic cetaceans
   - 2.9 North Pacific humpback whales
   - 2.10 North Pacific sei whales
3. ASG process and ICG recommendations
   - 3.1 Supplementary wording and examples to explain category selection
   - 3.2 Review of estimates regularly updated in long-term studies using consistent methods
   - 3.3 Guidance for convenors about submission of documents for ASI review
   - 3.4 Software submissions
   - 3.5 Adapting to biennial SC meetings
4. Adoption of report

Annex B

Mortality-corrected Estimate for Māui Dolphin Abundance

Justin Cooke

The abundance estimate of 54 for Māui dolphins in Constantine *et al*. (2021) employs a two-sample Lincoln-Petersen estimator with a Chapman bias adjustment (LP-C). The uncorrected two-sample LP-C estimator is:

$$\frac{(n_1 + 1)(n_2 + 1)}{(n_{12} + 1)} - 1,$$

where n_1 is the size of sample 1, n_2 is the size of sample 2, and n_{12} is the number of individuals common to both ('recaptures'). The estimate of 54 derives from 30 individuals identified in 2020 and 24 identified in 2021, of which 13 were common to both years.

The estimator assumes that both samples are drawn from essentially the same population. In the past (1970-80s), the Scientific Committee routinely applied mortality corrections to such mark-recapture estimates, to allow for the fact that not all marks placed in the first sample are still present in the second sample (e.g., Tillman *et al*., 1980).

If we want to estimate the population size in 2021, on average only a fraction, S, of the 2020 sample will be present in the 2021 population, where S is the annual survival rate. Therefore, the mortality-corrected estimate is a factor S lower than the uncorrected estimate.

If we wanted to estimate the population size in 2020, the correction factor would be $1–R$, where R is the proportion of the 2021 population that consists of new recruits.

Estimates of S for Māui dolphins are available e.g., 0.884 ± 0.018 (Cooke *et al*., 2019). Applying this estimate for S would correct the abundance estimate in Constantine *et al*. (2021), from 54 (48-66) to 48 (40-57), using the usual addition formula for CVs.

The main point remains that the population is very small. From this perspective, a change from 54 to 48 is relatively immaterial. However, there is a tendency in some quarters to compare published population estimates without regard to different methodologies. In view of this, the mortality correction should be applied to improve comparability with the currently accepted estimates of Māui dolphins included in the IWC Table of Agreed Abundance Estimates.

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