Annex P

Scientific Committee Procedures for Submission, Review and Validation of Abundance Estimates

1. INTRODUCTION

1.1 Opening remarks

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 the Committee's sub-committees and working groups. This document describes the review process.

1.2 The Abundance Steering Group

The Abundance Steering Group (ASG) is comprised of the Chair and Vice-Chair of the Committee, the Head of Science and Head of Statistics from the Secretariat, and the Convenors of the following sub-committees and working groups: ASI, IST, IA, SH, NH, SM, EM and ASW. The Convenor of ASI shall be designated as the Chair of the ASG.

The ASG shall work intersessionally to facilitate the review of abundance estimates using the processes and guidelines below. Exigencies may require the ASG to deviate from these processes in some circumstances.

2. SUBMISSION AND REVIEW OF ABUNDANCE ESTIMATES (AND SEE FIG. 1)

2.1 Submission

An abundance estimate should normally be submitted by the author (or a relevant Convenor) ***at least* 1 month** in advance of a 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 Committee. 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 ('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 ASG may also require these data, code and input files for estimates in other categories in some circumstances.

This timeline and information will be highlighted on the IWC website and a reminder will be sent to the Scientific Committee **six months** before the Annual Meeting.

[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 Data Availability Group will consider provisions for the sharing of code and input files.

2.2 Review

Although the ASG will strive to ensure that all abundance estimates it receives are given timely review in advance of the next annual Committee meeting, it may be necessary to prioritise submissions. In this case, the prioritisation below will be applied.

(1) Highest priority will be given to estimates of abundance required by sub-committees to complete their work during the upcoming Annual Meeting. Within this, highest priority will be given to estimates required to provide management advice.
(2) Second priority will be given to estimates of abundance needed for Scientific Committee intersessional meetings or workshops to complete their agendas within the intersessional period following the Scientific Committee meeting.
(3) Third priority will be given to estimates of abundance needed for future Scientific Committee Annual Meetings and meetings/workshops thereafter.
(4) Lowest priority will be given to requests to review estimates of abundance: (a) already included in the IWC Table of Abundance Estimates that had been previously accepted by the Committee but prior to the establishment of the ASI; or (b) are not immediately required by any sub-committee to complete its agenda.

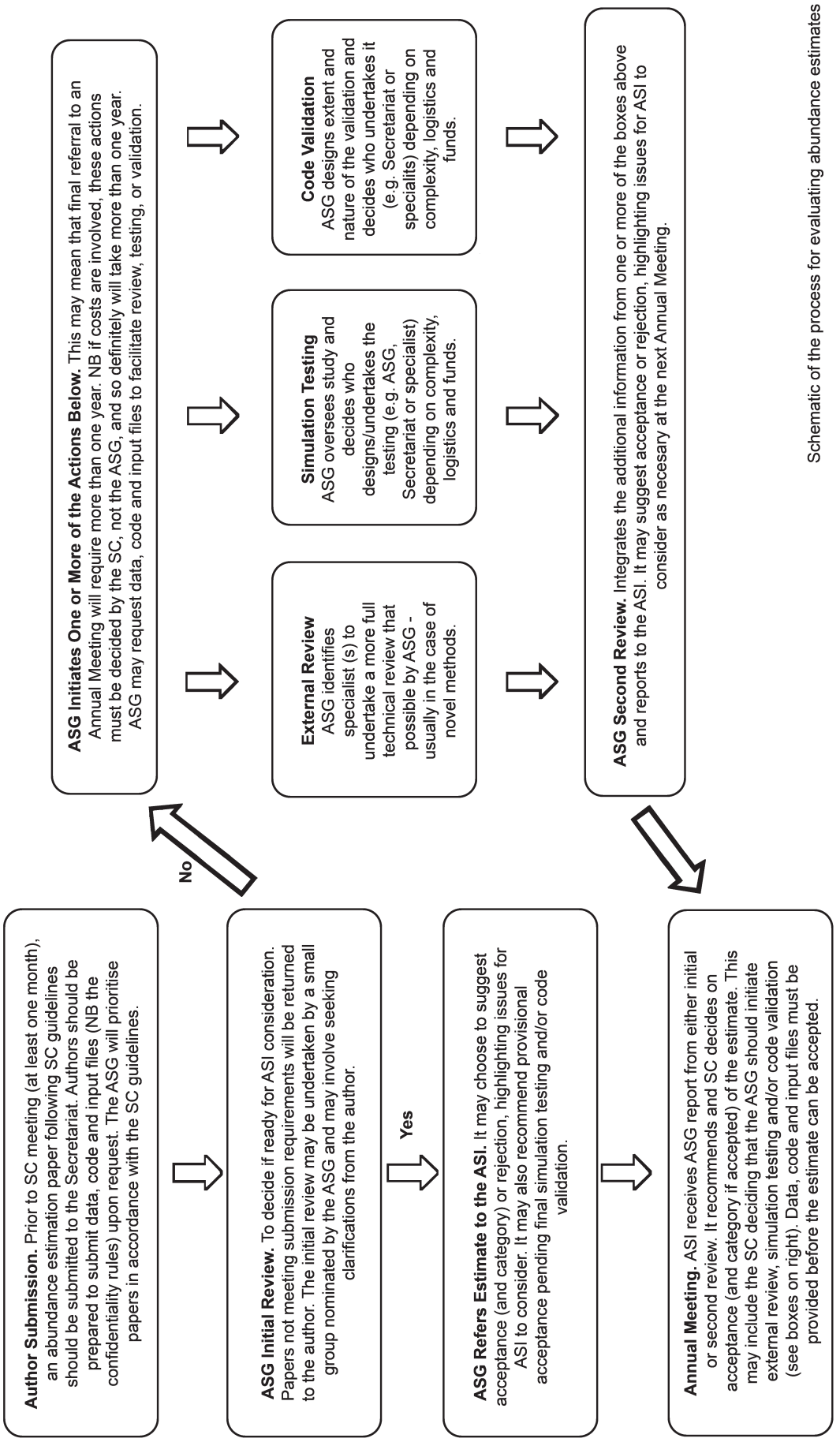
Fig. 1 shows a flowchart describing the ASG review process. The process begins in the top left corner with submission of an abundance estimate to the ASG in advance of a Scientific Committee meeting, and an indication that the authors are prepared to submit the corresponding data, code and input files. The ASG then conducts an initial review of the submission. Table 2 lists some issues that the ASG might consider. The purposes of this review include to:

(1) determine whether there is sufficient information provided for the ASI review to proceed;
(2) assess whether the method is broadly appropriate and potentially useful - the ASG should not necessarily insist that the analysis is 'optimal' or 'perfect';
(3) confirm that the method was implemented as intended and the assumptions underlying the method are reasonably met; and
(4) assess whether the conclusions are appropriate given the analysis.

This initial review may involve seeking clarifications from the author and the ASG may nominate a small group to complete the review.

After this review, the ASG may recommend that the estimate is ready for consideration by the ASI. In this case, the ASG may choose to suggest acceptance (and category) or rejection, highlighting issues for the ASI to consider. The ASG may also choose to make no specific recommendation to ASI, but rather provide a list of comments or concerns.

Alternatively, the initial ASG review may decide that one or more of the three types of additional work identified below are required before submission to the ASI. Data, code and input files may be requested by the ASG in order to facilitate this work.



Schematic of the process for evaluating abundance estimates

Fig. 1. A flowchart of the review process for an abundance estimate submitted to the Scientific Committee. The process begins in the top left box with submission of an abundance estimation manuscript.

Table 1

Description of minimum requirements for presentation and review of abundance estimates.

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	Details of the data collection procedures and data processing. For line-transect surveys: • a description of the survey platform(s) such as shore-based observation points, vessels, aeroplanes or drones. This description should include details relevant to the sighting process, such as the size of vessels, 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; and • 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; and • 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-identification 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.

Table 2
Guidelines for review of abundance estimates.

Topic	Description
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-id, 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? Is the method appropriate for the data and potentially useful? Was the method implemented as intended? 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 used 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? Are the assumptions reasonably satisfied? In the case of Bayesian methods, were the priors appropriate?
General	Are the conclusions appropriate given the results? 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 Scientific Committee has a particular responsibility to ensure that these are effectively used.)
Next steps	Has the author submitted relevant data and code to the Secretariat? Is a more technical review by a specialist(s) needed? Should the method be subject to simulation testing? Should the code be validated? If so, can the estimate be provisionally endorsed before validation? Is the analysis ready for ASI review? If so: • should the estimate be recommended for acceptance, rejection, or no recommendation? • in any of these cases, are there points of interest/concern to list for ASI's consideration?

(1) It may determine that a more detailed, technical review by a specialist(s) is needed, e.g. when the estimate uses complex novel methods.
(2) It may decide that the methodology requires some simulation testing (e.g. to evaluate bias, robustness or precision). Such testing might be conducted by the ASG, the Secretariat, or a specialist, depending on the complexity of the project.
(3) It may decide that some level of code validation is required. This would need to be completed by the Secretariat and/or a specialist.

If any of these tasks are deemed necessary by the ASG, final Committee approval of the estimate will probably require more than one year. If the required additional work has funding implications, this must be recommended by the Committee and therefore the review will definitely take more than one year. In all cases, specialists will be selected by the ASG.

Simulation testing and code validation incur potentially large costs in time and money. The ASG shall prioritise such projects on the basis of several factors, including those given below.

(1) The importance (of the result) with respect to Commission priorities (e.g. abundance estimates used for providing management and conservation advice are the highest priority).
(2) 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.
(3) The degree to which the methods are clearly and completely elucidated in the accompanying document(s).
(4) The degree to which the methods and/or software are likely to have multiple applications than to those intended for a single application only.
(5) The cost, in time and money, to complete the validation.

After any of these three additional review actions (external review, simulation testing, code validation) are complete, the ASI integrates this new information and reports it to ASI. It may suggest acceptance or rejection, highlighting issues for ASI to consider as necessary at the next Annual Meeting. In the case of multi-year projects, ASG will report progress annually to ASI.

Code validation is *not required* for an estimate to be endorsed, e.g. an analysis using relatively standard methods. Moreover, the ASG, ASI or the Committee may also elect to provisionally endorse an abundance estimate prior to subsequent validation. In this case, the estimate can be used for any Committee purposes, and added to the IWC Consolidated Table of Abundance Estimates on the understanding that if eventual validation necessitates any substantive changes to the estimate, corresponding changes to, *inter alia*, simulations, calculations and tables would be made as may be required.

REFERENCE

International Whaling Commission. 2004. Report of the Scientific Committee. Annex T. Report of the data availability working group. *J. Cetacean Res. Manage. (Suppl.)* 6:406-8.