SC/69A/ASI/21

Sub-committees/working group name: ASI

History of work towards updating the IWC's 'Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme'

Nat Kelly

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Nat Kelly[1]

Introduction

Miller and Kelly (2023) provides some guidelines on spatial model-based estimation of abundance (and its uncertainty) from counts of cetaceans obtained using standard distance sampling line transect surveys. Work underpinning the development of the guidelines document has taken several years, and this paper provides an overview of the impetus for the project, and how it aligns with the work of the IWC-SC. Reference to the RMP/RMS is because the original aim was to develop guidelines to align with the *Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme*; the guidelines, however, are helpful for abundance estimation in general.

The Remit

(The following is taken from Section 11.3.1 of the Report of the Scientific Committee of the International Whaling Commission from the 2021 Annual Meeting.)

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

First, a bit of history

The following is highly summarised timeline of not only the process of including model-based estimators in the Requirements and Guidelines documents, but also the development of the Guidelines document itself.

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Basic timeline (for further details, see Appendix 1)

Meeting Year	Notes	Key references
1992	Recommendation issued to develop guidelines for conducting surveys and analysing results, for us in the RMP.	International Whaling Commission. (1993). Report of the Scientific Committee. Annex D. *Rep. int. Whal. Commn* 43: 227-235.
1993	"Guidelines for Conducting Surveys and Analysing Data Within the Revised Management Scheme" first produced and agreed	International Whaling Commission. (1994). Report of the Scientific Committee. Annex J. Guidelines for Conducting Surveys and Analysing Data Within the Revised Management Scheme. *Rep. int. Whal. Commn* 44: 168-174.
1995-1996	A number of updates included in the Guidelines document, resulting in a version that remains static for 8 years	International Whaling Commission. (1997). Report of the Scientific Committee. Annex K, Requirements and Guidelines for Conducting Surveys and Analysing Data Within the Revised Management Scheme. *Rep. int. Whal. Commn* 47: 227-235.
2004	Requirements and Guidelines document updated/re-published (and re-named?)	International Whaling Commission. (2005). Report of the Scientific Committee. Annex D, Appendix 3 Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme. Report of the sub-committee on the Revised Management Procedure. *J. Cetacean Res. Manage. (Suppl.)* 7: 92-100.
2011	Guidelines document updated/re-published. Also, first (?) mention of the need to consider including reference to model-based methods in the Requirements and Guidelines doc.	International Whaling Commission. (2012). Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme. *J. Cetacean Res. Manage. (Suppl.)* 13: 509-17.
2012	Issue of a recommendation for a review of Requirements and Guidelines with a view to include model-based (and quasi-design based) methods, with a comparison to design-based methods. Proposal for research funds.	International Whaling Commission. (2013). Report of the Scientific Committee. Annex D. Report of the sub-committee on the Revised Management Procedure. *J. Cetacean Res. Manage. (Suppl.)* 14: 103-117.
2014	Paper by Hedley and Bravington (SC/65b/RMP11) presented; included a range of topics such as fundamentals of design-based analyses, introduces model-based estimators, and included proposed updated text for Requirements and Guidelines doc. Further work recommended (around design-based survey diagnostic software; more background to concepts presented in SC/65b/RMP11; and development of a workshop. Two research proposals offered: 1) Testing proposed new guidelines for evaluating spatial model-based and design-based abundance estimates plus workshop; and 2) Evaluating abundance estimates—diagnostics and testing, plus supporting software. Small group offered further justification exploration of model-based abundance estimation, including stressing need for diagnostics for both design- and model-based approaches.	Hedley, S. and Bravington, M. (2014). Comments on design-based and model-based abundance estimates for the RMP and other contexts. Paper SC/65b/RMP11 presented to the Scientific Committee of the International Whaling Commission, Bled, Slovenia, May 2014. 33pp International Whaling Commission. (2015). Report of the Scientific Committee. Annex D. Report of the sub-committee on the Revised Management Procedure. *J. Cetacean Res. Manage. (Suppl.)* 16: 100-143. SC/65b/RMP-RP01 proposal titled 'Testing Proposed New Guidelines for Evaluating Spatial Model-based and Design-based abundance estimates.' SC/65b/RMP-RP02 proposal titled 'Evaluating Abundance Estimates: Diagnostics and Testing.' International Whaling Commission. (2015). Report of the Scientific Committee. Annex D, Appendix 4 'Report of the Small Group on Survey Guidelines'. *J. Cetacean Res. Manage. (Suppl.)* 16: 111-112.
2017	Pre-meeting held 7-8 May 2017, which reviewed current state of spatial modelling and introduced software 'ltdesigntester'. Pre-meeting, and Miller and Bravington (2017) covered a number of topics, such as an overview of spatial model-based approaches, dsm software, diagnostics, group size estimation, and acceptability of HT when assumptions are not met. **Time constraints during pre-meeting meant specific amendments to Requirements and Guidelines doc were not discussed in detail. An intersessional email group was formed.	Miller, D.L. and Bravington, M.V. (2017). When can abundance surveys be analysed with "design-based" methods? 30pp International Whaling Commission. (2018). Report of the Scientific Committee. Annex Q. Report of Ad hoc Working Group on Abundance Estimates, Status and International Cruises, Appendix 6 Report of the Pre-Meeting on Model-based Abundance Estimation (Bled, 7-8 May 2017). *J. Cetacean Res. Manage. (Suppl.)* 19: 393-398.
2019	Dave Miller agreed to modify the Requirements and Guidelines document to consider spatial model-based abundance estimation methods, with instructions to be provided by a Steering Group.	International Whaling Commission. (2020). Report of the Scientific Committee. Annex Q. Report of the Standing Working Group on Abundance Estimates, Status of Stocks and International Cruises. *J. Cetacean Res. Manage. (Suppl.)* 21: 277-299.

Key documents

Hedley, S. and Bravington, M. (2014). Comments on design-based and model-based abundance estimates for the RMP and other contexts. Paper SC/65b/RMP11 presented to the Scientific Committee of the International Whaling Commission, Bled, Slovenia, May 2014. 33pp

International Whaling Commission. (2012). The Revised Management Procedure (RMP) for Baleen Whales. *J. Cetacean Res. Manage*. *(Suppl.)* 13: 485-494.

International Whaling Commission. (2012). Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme. *J. Cetacean Res. Manage*. *(Suppl.)* 13: 509-17.

International Whaling Commission. (2015). Report of the Scientific Committee. Annex D, Appendix 4 'Report of the Small Group on Survey Guidelines'. *J. Cetacean Res. Manage*. *(Suppl.)* 16: 111-112.

International Whaling Commission. (2018). Report of the Scientific Committee. Annex Q. Report of Ad hoc Working Group on Abundance Estimates, Status and International Cruises, Appendix 6 Report of the Pre-Meeting on Model-based Abundance Estimation (Bled, 7-8 May 2017). *J. Cetacean Res. Manage*. *(Suppl.)* 19: 393-398.

Miller, D.L. and Bravington, M.V. (2017). When can abundance surveys be analysed with "design-based" methods? 30pp [Now an appendix in Miller and Kelly (2023)]

Miller, D.L. and Kelly, N. (2023). Guidelines for model-based estimation. Paper SC/69A/ASI/20. Paper presented to the Scientific Committee of the International Whaling Commission, Bled, Slovenia, May 2023. 38pp
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Tasks (past, present and future)

A trawl of all SC reports since 2012 was undertaken to come up the following specific tasks related to this 'project'. Completed tasks are described in the 'Noted' column.

Meeting Year	Aims	Outcomes	Notes
2012	(1) review statistical aspects of design-based estimators for surveys which do not strictly adhere to design-based principles; and (2) review past and current issues related to model-based abundance estimators, drawing on examples from experience with these types of models. Empirical and simulation-based diagnostics were to be suggested, and a quantitative description of pitfalls when extrapolating estimates beyond the surveyed area was to be given.	(1) propose a basis to assess the reliability of an abundance estimate either from a design-based analysis for which the statistical criteria are not met, or from a model-based analysis (2) provide draft text for inclusion in the 'Requirements and Guidelines for Conducting Surveys' document.	Hedley and Bravington (2014) presented a review of the fundamentals of design-based abundance estimation; described new approaches to variance estimation for design-based analysis; considered how the Committee might decide whether the criteria for design-based assessment might be met; suggested some ways to evaluate the adequacy of design-based estimates when the strict criteria are not met; presented a paradigm for (spatial) model-based abundance estimation, and a checklist of decisions that need to be made when making a spatial abundance estimate. Draft text provided in Hedley and Bravington (2014).
2014	To progress the update of Guidelines (both in an RMP sense and in a wider context) to: (1) assist evaluation of design-based estimates of abundance; and (2) accommodate recent (and future) developments in abundance estimation	(1) development of a simple-to-use diagnostic software that uses model-based analysis to assist in evaluating design-based estimates that can be applied when design-based criteria are not strictly met; (2) refinement of the material in SC/65b/RMP11, both in the explanatory background text and in the proposed Guidelines, on specific issues; and (3) hold a Workshop with two objectives: (a) to test the proposed new Guidelines against several test cases of model-based abundance estimates made specifically for and during the Workshop; and (b) to demonstrate and discuss the proposed diagnostic software with a wider Committee audience involved in basic line-transect abundance estimation.	(1) Software '*ltdesigntester*' was presented during pre-meeting workshop in 2017. (2) Miller and Bravington (2017), presented to pre-meeting workshop. (3) Pre-meeting workshop held 7-8 May 2017.
2017	The Committee **recommends** that draft amendments to the Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme be developed intersessionally (ICG-4, Annex W) to incorporate methods to compute abundance estimates not yet considered by the Guidelines, for review at SC/67b.		
2018	The 'Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme' need to be modified to consider estimates of abundance using model-based methods. The Working Group **agreed** that an intersessional e-mail group will develop instructions and select a candidate to amend these Guidelines.		During 2018 meeting, the ASI SWG agreed that the RMP Guidelines needed to be extended to incorporate spatial model approaches to estimate abundance by 2020. A Steering Group was established to: (1) develop a set of specific instructions for the amendment of the RMP guidelines to consider model-based abundance estimates; and (2) select a candidate to conduct this work. Dr. David Miller from CREEM (Centre for Research into Ecological and Environmental Modelling, University of St. Andrews) was selected to modify the Guidelines with advice from a Steering Group.
2019	The 'Requirements and Guidelines for Conducting Surveys and Analysing Data		

	within the Revised Management Scheme' need to be modified to consider estimates of abundance computed using model-based methods. The Committee **agrees** that the Steering Group established to oversee this process (see Annex P) should continue the intersessional work to develop instructions to amend the Guidelines.		
2021	Amend the RMP Guidelines to consider abundance estimates computed with model-based methods. Develop a set of specific instructions for the amendment of the RMP Guidelines to consider model-based abundance estimates. (SG Amendment of RMP Guidelines and Miller). Review an updated document of the RMP Guidelines.		

Basic list of the general 'products' from this work since 2012:

1) Background documentation on design-based and spatial model-based abundance estimation techniques.
2) Software tool providing diagnostics on evaluating whether design-based estimators are appropriate for given surveys
3) Draft text for updating document 'Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme.
4) The workshop held in 2017.

Going forward, some questions to consider

- What is the plan for the text and materials contained in Hedley and Bravington (2014; SC/65b/RMP11) and Miller and Bravington (2017)? Are they to be considered stand-alone references for the purposes of background to the design- versus model-based approaches, or is that plan to summarise and update?

- There was a suggestion for some simple case studies of the application of the spatial model-based approach—chiefly for demonstration purposes? Also, might we also refer to existing model-based abundance estimates (either published or presented to IWC-SC). (Noting the potential need for data-sharing agreements, etc, with new analyses; but also that the research contract won't pay for terribly much of Dave's time.)

- What is the status of *ltdesigntester*? Was the version presented in 2017 considered the final version, or are updates needed?

- Regarding draft text for updating the Requirements and Guidelines doc, can we take the proposed text in Hedley and Bravington (2014) as a starting point?

- Other points: What about the inclusion of other types of model-based estimators, such as hierarchical Bayesian? Or is that well out of scope. (Although, noting that hierarchical Bayesian studies have been presented to IWC-SC over the past few years.)

- Also, what about some of David Miller's new work, such as density surface models including multiple detection functions?

Appendix 1 Evolution of the document (now called) 'Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme'[2]

Timeline (where year indicates the year of the Annual Meeting, not publication of the JCRM supplement containing the report of the meeting of the Scientific Committee—but publication date is included in references).

1992

International Whaling Commission. (1993). Report of the Scientific Committee. *Rep. int. Whal. Commn* 43: 55-86.

> **Section 6.2.4** *Minimum standards for data*
> **The Committee recommends that a set of guidelines for conducting surveys and analysing the results should be developed. "As new methodologies are developed, tested and approved these would then be added to the set of available options."

International Whaling Commission. (1993). Report of the Scientific Committee. Annex D. *Rep. int. Whal. Commn* 43: 227-235.

> **Section 8** *Minimum standards for data—Data Required for implementation of the RMP*.
> **Sub-committee recommends that a set of guidelines for conducting surveys and analysing the results should be developed.

1993

International Whaling Commission. (1994). Report of the Scientific Committee. *Rep. int. Whal. Commn* 44: 41-67.

> **Section 7.1.3** *Comprehensive Assessment, Revised Management Scheme—Guidelines for conducting surveys and analysing data.*
> ** "It was noted these Guidelines will require updating from time to time as new methodology and analytical techniques are developed."

International Whaling Commission. (1994). Report of the Scientific Committee. Annex D. Report of the Sub-Committee on Management Procedures. *Rep. int. Whal. Commn* 44: 74-92.
Section 7 *Guidelines for conducting surveys and analysing data*

International Whaling Commission. (1994). Report of the Scientific Committee. Annex J. Guidelines for Conducting Surveys and Analysing Data Within the Revised Management Scheme. *Rep. int. Whal. Commn* 44: 168-174.

[Noting Annex J text was derived from: Hammond, P.S. and Donovan, G.P. (1993). Suggestions for draft guidelines for conducting surveys and analysing data. Paper SC/45/O13 presented to the IWC Scientific Committee, April 1993, Kyoto, Japan.]

[2] As reported in IWC-SC reports 1993-2022.

1995

International Whaling Commission. (1996). Chairman's Report of the Forty-Seventh Annual Meeting, Appendix 8 'IWC Resolution 1995-7 Resolution on Surveys Intended to Provide Abundance Estimates for the Implementation of the Revised Management Scheme'. *Rep int. Whal. Commn* 46: 45-46.

International Whaling Commission. (1996). Report of the Scientific Committee. *Rep. int. Whal. Commn* 46: 51-97.

Section 7.1 *Comprehensive Assessment/Revised Management Procedure—Guidelines for surveys*

**Includes discussions on International collaboration, process error, survey databases and software.

International Whaling Commission. (1996). Report of the Scientific Committee. Annex K. Guidelines for Conducting Surveys and Analysing Data Within the Revised Management Scheme. *Rep. int. Whal. Commn* 46: 211.

1996

International Whaling Commission (1997). Report of the Scientific Committee. *Rep. int. Whal. Commn* 47: 59-112.

Section 7.1 *Guidelines for surveys*

International Whaling Commission. (1997). Report of the Scientific Committee. Annex D, Report of the Sub-Committee on Management Procedures and General Matters. *Rep. int. Whal. Commn* 47: 122-127.

Section 3 *Guidelines for surveys*

International Whaling Commission. (1997). Report of the Scientific Committee. Annex K, Requirements and Guidelines for Conducting Surveys and Analysing Data Within the Revised Management Scheme. *Rep. int. Whal. Commn* 47: 227-235.

2004

International Whaling Commission. (2005). Report of the Scientific Committee. Annex D, Appendix 3 Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme. Report of the sub-committee on the Revised Management Procedure. *J. Cetacean Res. Manage. (Suppl.)* 7: 92-100.

Hammond, P.S. and Donovan, G.P. (2004). Suggestions for updating the 'Requirements and Guidelines for conducing surveys within the Revised Management Scheme. Paper SC/56/RMP4, presented to the Scientific Committee of the International Whaling Commission, 13pp.

2010

International Whaling Commission. (2011). Report of the Scientific Committee. Annex D. Report of the sub-committee on the Revised Management Procedure. *J. Cetacean Res. Manage. (Suppl.)* 12: 89-116.

Section 2.4 *Updates to RMP specifications and annotations (4)*

**Mentions the guidelines for conducting surveys under the RMP should be modified to clarify that changes to the guidelines are not retroactive—that surveys undertaken under earlier versions of the guidelines would not be inadmissible for use in the RMP.

2011

International Whaling Commission. (2012). Report of the Scientific Committee. *J. Cetacean Res. Manage. (Suppl.)* 13: 1-73.

Section 5.6 *Update requirements and guidelines for conducting surveys and Implementations*

International Whaling Commission. (2012). Report of the Scientific Committee. Annex D. Report of the sub-committee on the Revised Management Procedure. *J. Cetacean Res. Manage. (Suppl.)* 13: 88-101.

Section 2.6.2 *Update guidelines for conducting surveys and* Implementations*; Updated guidelines*

**Perhaps one of the first mentions of the need to consider acceptability of model-based estimates?

International Whaling Commission. (2012). Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme. *J. Cetacean Res. Manage. (Suppl.)* 13: 509-17.

2012

International Whaling Commission. (2013). Report of the Scientific Committee. *J. Cetacean Res. Manage. (Suppl.)* 14: 1-86.

Section 5.5 *Update the Requirements and Guidelines for Conducting Surveys and* Implementations

**mentions need to update the *Requirements and Guidelines for Conducting Surveys and Analysing Data* (that had just been published) did not currently include the prospect to use model-based (or quasi-design-based) methods for estimating abundance for use in the RMP. A review was recommended (covering model-based abundance estimation in theory and practice, and its relation to the design-based approach).

Section 23 Funding Requirements for 2012/13

(16) allocation of funds to the review proposed in **Section 5.5. Specifically, the review was to: (1) review statistical aspects of design-based estimators for surveys which do not strictly adhere to design-based principles; and (2) review past and current issues related to model-based abundance estimators, drawing on examples from experience with these types of models. Empirical and simulation-based diagnostics were to be suggested, and a quantitative description of pitfalls when extrapolating estimates beyond the surveyed area was to be given. The intended outcome of the project was: (1) propose a basis to assess the reliability of an abundance estimate either from a design-based analysis for which the statistical criteria are not met, or from a model-based analysis; and (2) provide draft text for inclusion in the 'Requirements and Guidelines for Conducting Surveys' document. The work was to be presented to the 2013 Annual Meeting and the request was for salary to complete this project.

International Whaling Commission. (2013). Report of the Scientific Committee. Annex D. Report of the sub-committee on the Revised Management Procedure. *J. Cetacean Res. Manage. (Suppl.)* 14: 103-117.

Section 2.5 *Update requirements and guidelines for conducting surveys and* Implementations
**Mentions the potential for model-based (and quasi-design-based) estimators for abundance, with particular reference to randomisation of trackline placement; coverage probability and realised coverage; extrapolation; propagation of variance; and model diagnostics.

Section 2.8 *Acceptableness of sighting surveys for use in the CLA*
**Also worth a read.

Appendix 4 *Review and guidelines for model-based and design-based line transect abundance estimates*
**Proposal text for research funds for review of model-based estimators.

2013

International Whaling Commission. (2014). Report of the Scientific Committee. *J. Cetacean Res. Manage. (Suppl.)* 15: 1-75.

Section 5.5 Update the 'Requirements and Guidelines for Conducting Surveys
**Mentions review that commenced in 2012 was not able to be completed; results will be presented at 2014 Annual Meeting.

Section 23 Research and Workshop Proposals and Results
**(16) Review and guidelines for model-based and design-based line transect abundance estimates Postponed until this year

Section 24 Committee Priorities and Initial Agenda for the 2014 Meeting
** For RMP: … (3) update the requirements and guidelines for conducting surveys to reflect considerations related to model-based methods for abundance estimation; …

International Whaling Commission. (2014). Report of the Scientific Committee. Annex D. Report of the sub-committee on the Revised Management Procedure. *J. Cetacean Res. Manage. (Suppl.)* 15: 87-111.

Section 2.5 *Update requirements and guidelines for conducting surveys and* Implementations
**Mentions review that commenced in 2012 was not able to be completed; results will be presented at 2014 Annual Meeting.
Section 2.8 *Work plan*.
** The sub-committee **agreed** that its work plan before the 2014 Annual Meeting would be as follows: … (2) review issues related to model-based methods for abundance estimation (Item 2.5). The sub-committee **agreed** that its work plan during the 2014 Annual Meeting would be as follows: … (3) update the requirements and guidelines for conducting surveys to reflect considerations related to model-based methods for abundance estimation (Item 2.5).

2014

International Whaling Commission. (2015). Report of the Scientific Committee. *J. Cetacean Res. Manage. (Suppl.)* 16: 1-87.

Section 5.6 *Update 'Requirements and Guidelines for conducting surveys and* Implementations*'*

** Describes presentation of SC/65b/RMP11 (Hedley, S. and Bravington, M. (2014). Comments on design-based and model-based abundance estimates for the RMP and other contexts. Paper presented to the Scientific Committee of the International Whaling Commission, Bled, Slovenia, May 2014. 33pp).

Paper SC/65b/RMP11 represents delivery of review project commenced in 2012. The paper presented a review of the fundamentals of design-based abundance estimation; described new approaches to variance estimation for design-based analysis; considered how the Committee might decide whether the criteria for design-based assessment might be met; suggested some ways to evaluate the adequacy of design-based estimates when the strict criteria are not met; presented a paradigm for (spatial) model-based abundance estimation, and a checklist of decisions that need to be made when making a spatial abundance estimate; and proposed some updated text for the Guidelines. An important overall conclusion concerned the necessity, when the Committee reviews an abundance estimate for 'acceptability', for thorough descriptions of the design and analysis process, including the rationale for making particular choices.

To progress the update of Guidelines (both in an RMP sense and in a wider context) to: (1) assist evaluation of design-based estimates of abundance; and (2) accommodate recent (and future) developments in abundance estimation, the Committee **recommends**: (1) development of a simple-to-use diagnostic software that uses model-based analysis to assist in evaluating design-based estimates that can be applied when design-based criteria are not strictly met; (2) refinement of the material in SC/65b/RMP11, both in the explanatory background text and in the proposed Guidelines, on specific issues (see Annex D); and (3) hold a Workshop with two objectives: (a) to test the proposed new Guidelines against several test cases of model-based abundance estimates made specifically for and during the Workshop; and (b) to demonstrate and discuss the proposed diagnostic software with a wider Committee audience involved in basic line-transect abundance estimation.

Updates to the Guidelines could then be considered during the full Committee meeting.

The Committee appointed at Steering Group under Bravington (see Annex D, items 2.6 and 5) to develop an agenda for the Workshop and facilitate preparations.

Section 23 *Research and Workshop Proposals and Results*

**(16) from 2012 (IWC, 2013) Review and guidelines for model-based and design-based line transect abundance Estimates. Completed (SC/65b/RMP11)

Section 26 *Funding Requirements for 2014/15 and 2015/16*

** Table 25 Summary of budget requests for the 2014-16 period. SC/65b/RMRP01. Testing proposed new guidelines for evaluating spatial model-based and design-based abundance estimates.

(22) SC/65b/RMP-RP01 proposal titled 'Testing Proposed New Guidelines for Evaluating Spatial Model-based and Design-based abundance estimates.' A pre-

meeting, which will be the point of delivery for intersessional work which comprises proposing updated guidelines (see SC/65b/RMP-RP02) for evaluating design- and (spatial-)model-based abundance estimates, and developing software for a diagnostic check on design-based estimates that have applied when the underlying criteria are not strictly met. The main objectives are: (1) to test the proposed new guidelines (see SC/65b/RMP-RP02) against several test cases of model-based abundance estimates made specifically for and during the Workshop; (2) to demonstrate and discuss the proposed diagnostic software with a wider Committee audience involved in basic line-transect abundance estimation. This will be a 2-day premeeting prior to the 2015 Annual Meeting…

(23) SC/65b/RMP-RP02 proposal titled 'Evaluating Abundance Estimates: Diagnostics and Testing.' Abundance estimates are central to the Committee's work. Spatial modelling is a powerful tool for abundance estimation which, in principle, can: (1) be used in many cases where design-based estimates are inappropriate; (2) overcome some bias associated with uneven survey coverage; and (3) deliver more stable CVs than a standard design-based analysis even when the latter is appropriate. However, spatial modelling requires expertise both to use and to assess. Hence it is important to have clear guidelines both for assessing new abundance estimates made specifically with spatial models, and for handling the situation where a simple design-based estimate has been applied without its assumptions being met; in this latter case some diagnostic software is desirable. The general idea is that surveys with dense and evenly distributed coverage should readily pass the diagnostic tests, whereas surveys with low or badly imbalanced coverage should raise a flag. Deliverables include software (R package of automated diagnostics based on results of automated trial fits of spatial models), Workshop preparation and delivery (see SC/65b/RMP-RP01), and proposals for new guidelines in the form of a paper to the 2015 Annual Meeting.

International Whaling Commission. (2015). Report of the Scientific Committee. Annex D. Report of the sub-committee on the Revised Management Procedure. *J. Cetacean Res. Manage. (Suppl.)* 16: 100-143.

Section 2.6 *Update 'Requirements and Guidelines for conducting surveys and* Implementations*'*

**More detail on delivery of paper (and contract) SC/65b/RMP11.

The sub-committee noted that having up-to-date criteria for evaluating abundance estimates (both design- and model-based) would be of great value to the entire Committee, since abundance estimates are central to much of its work (see Appendix 4 for additional details). In order to progress the update of Guidelines (both in an RMP sense and in a wider context) to assist evaluation of design-based estimates of abundance and accommodate recent (and future) developments in abundance estimation, the sub-committee **recommended** the following. (1) Develop a simple-to-use diagnostic software that uses model-based analysis to assist in evaluating design-based estimates which have been applied when design-based criteria are not strictly met. The software, which might for example consist of an R package that uses the data format of the widely-used 'mrds' and 'dsm' packages for Distance-sampling abundance estimation, would entail automated parameter selection and fitting of one or more spatial abundance-estimation models, and the calculation and reporting of appropriate diagnostics (including but not limited to the comparison of point estimates). It would be

for use as a robustness/sensitivity check only, and not as an all-purpose abundance estimator in its own right. The general idea is that surveys with dense and evenly-distributed coverage should readily pass the diagnostic tests, whereas surveys with low or badly imbalanced coverage should raise a flag. Naturally, the software would need to be tested in this regard. (2) Refine the material in SC/65b/RMP11, both in the explanatory background text and in the proposed *Guidelines*, on specific issues such as (but not necessarily limited to): (a) time series of repeated surveys; (b) multi-year surveys with partial coverage annually; (c) different levels of 'acceptability' within the RMP process; (d) design-based variance estimation for stratified surveys; and (e) an update on pitfalls to avoid when designing surveys. (3) Hold a workshop with two objectives: (a) to test the proposed new *Guidelines* against several test cases of model-based abundance estimates made specifically for and during the workshop; and (b) to demonstrate and discuss the proposed diagnostic software with a wider Committee audience involved in basic line-transect abundance estimation. Part 3(a) would involve only a small number of statistical analysts familiar with spatial modelling and could be held as a pre-meeting for SC/66a, with part 3(b) to follow on during the SC/66a meeting. Updates to the Guidelines could then be considered during the full SC/66a meeting next year. An appreciable amount of intersessional work would be required, particularly for item (1) and preparation for item (3). The sub-committee appointed a Steering Group (Bravington [Chair], Butterworth, Cooke, Hedley, Kitakado and Leaper) to develop an agenda for the Workshop and facilitate preparations.

Section 2.8 *Workplan*
**The sub-committee agreed that its work plan before the 2015 Annual Meeting would be as follows:
…
(4) develop a simple-to-use diagnostic software that uses model-based analysis to assist in evaluating design-based estimates (Hedley and Bravington, Item 2.6).
…
The sub-committee agreed that its work plan during the 2015 Annual Meeting would be as follows:
…
(4) hold a pre-meeting Workshop with Terms of Reference: (i) to test proposed new Guidelines against several test cases of model-based abundance estimates made specifically for and during the Workshop; and (ii) to demonstrate and discuss the proposed diagnostic
software with a wider Committee audience. There will be costs involved for travel and subsistence (Item 2.6);
…

Section 5 *Steering, correspondence and advisory groups*
**The sub-committee established the following groups to facilitate progress on the work plan during the intersessional period…(2) Steering Group: Bravington (Chair) with members Butterworth, Cooke, Hedley, Kitakado and Leaper, to develop an agenda for the Workshop on abundance estimation and facilitate preparations (Item 2.6).
Section 6 Prioritised budget requests
** The sub-committee received budget requests for four research projects and two intersessional Workshops (RMPWP01-06).
The research projects are:

(2) guidelines for evaluating abundance estimates: diagnostics and testing (Investigators: Hedley and Bravington) (funds; Item 2.6);
The intersessional Workshops are: a pre-meeting to test the proposed new Guidelines against several test cases of model-based abundance estimates made specifically for and during the Workshop and to demonstrate and discuss the proposed diagnostic software with a wider Committee audience involved in basic line-transect abundance estimation (Convenors: Hedley and Bravington) (funds; Item 2.6)

Appendix 4 *Report of the Small Group on Survey Guidelines. Members: Bravington, Butterworth, Cooke, Kitakado and Leaper.*

There have been substantial developments in design-based abundance estimation, and especially in spatial-model-based abundance estimation, since the last revision of the' Guidelines' document (IWC, 2012). The review material and proposed evaluation criteria in SC/65b/RMP11 should (after some refinement) provide a valuable basis for evaluating abundance estimates in many applications considered by the Committee. In particular, spatial model-based estimates have the potential to reduce bias in abundance estimates arising from unbalanced coverage (for whatever reason that arises), and to provide more stable variance estimates especially in repeat surveys. However, like most powerful tools, spatial models can easily go wrong if misapplied, so it is important to have clear criteria for assessment; these apply to many sub-committees besides RMP. Apart from numerical or graphical diagnostics, it is essential when reviewing both design based and model-based estimates to have thorough descriptions of processes followed and decisions made during design and analysis (as already specified in the Committee's 'guidelines' for the conduct and protocols of the survey operation itself).

The Committee is often faced with interpreting 'design-based estimates' applied to surveys which do not meet the strict criteria for design-based analysis (randomisation, estimable coverage probability, etc.; as per Buckland *et al.* (2001), and summarised in SC/65b/RMP11). However, this description applies to a wide range of cases, of which some will be problematic and others will not be. There is a continuum from: (i) cases where the coverage is clearly uneven and there is clear potential for bias if a 'design-based estimate' is applied; to (ii) cases where the coverage is dense and uniform but no randomisation has been used, so that a 'design-based estimate' should in practice give similar results to any reasonable spatial model even though the formal justification for design-based analysis is lacking. There is no implication that a non-randomised survey design is necessarily 'inferior' to a randomised design; the point is simply that the statistical rationale for design-based analysis is entirely built around randomisation. A 'design-based estimate' can also be viewed as a very simple type of (spatial) model-based abundance estimate, so in principle such estimates could be assessed by the same guidelines proposed for fully-developed spatial model-based estimates.

However, proper spatial modelling requires substantial analytical skills beyond those required for classical Distance sampling-based abundance estimation, even to report against all of the guidelines. Therefore, it would be very useful to have a largely automated default set of 'simple' spatial-model-based diagnostics, to be applied to any simple design-based estimate where the strict design criteria are not clearly met. The diagnostics should be set up so that they are not onerous for the person doing the abundance estimation, but that would enlighten the Committee about the sensitivity and robustness and potential biases of point estimates and CVs from the proposed design-based estimate. The general idea is that surveys with dense and evenly-distributed coverage should readily pass the diagnostic tests, whereas surveys with low or badly

imbalanced coverage should raise a flag. Importantly, any automated default spatial analysis would only be a tool for assessing a simpler estimate, and would not in itself yield a suitable abundance estimate (unless accompanied by a satisfactory report against all the proposed guidelines for full model-based analysis).

References

Buckland, S., Anderson, D., Burnham, K., Borchers, D. and Thomas, L. 2001. *Introduction to Distance Sampling*. Oxford University Press, Oxford, UK. 432pp.

International Whaling Commission. 2012. Requirements and Guidelines for Conducting Surveys and Analysing Data with the Revised Management Scheme. *J. Cetacean Res. Manage. (Suppl.)* 13: 509-17.

2015

International Whaling Commission. (2016). Report of the Scientific Committee. *J. Cetacean Res. Manage. (Suppl.)* 17: 1-92.

Section 5.5 *Update 'Requirements and Guidelines for conducting surveys and* Implementations*'*

** Recently, the Committee had recognised a need to consider what circumstances might require approval when the survey and analysis are conducted based on spatial modelling or quasi design-based approaches. The Committee had agreed in 2012 (IWC, 2013) that a review of this issue should take place and initial work was presented in 2014 (SC/65b/ RMP11; IWC, 2015 p.9). However, given the unavailability of contracted experts during the last intersessional period, it **agrees** that comprehensive discussion will be deferred to 2016. The Committee was advised that Bravington would continue to be involved in conducting this review and developing a guidelines manual. The work is expected to be completed by the 2016 Annual Meeting. A demonstration of the software implementing the analysis method should occur, preferably during a Workshop held as a pre-meeting to SC/66b. The Workshop will test the guidelines against several test cases of model-based abundance estimation. A Steering Group was established under Butterworth (see Annex D, item 5.5) to co-ordinate intersessional work, develop an agenda and facilitate preparations for the Workshop.

Section 23.1 *Research and Workshop Proposals and Results—Review results from previously funded research proposals*.

**Table 25 Workshop proposals agreed during this meeting (TBD: to be decided). Evaluating abundance estimates: diagnostics and testing. All Pre-meeting Bled
Table 26 Progress on Workshop and Research Proposals agreed last year (IWC, 2015, pp.70-80 and Table 22). RMP01 Testing proposed new guidelines for evaluating spatial model-based and design-based abundance estimates--Ongoing (Annex D). RMP02 Evaluating abundance estimates: diagnostics and testing--Ongoing (Annex D).

Table 29 Summary of budget requests for 2016 based upon the budget agreed last year. For explanation and details of each project see text and IWC (2015, pp.76- 80. Items marked '**' are ongoing items agreed last year that require no additional money. RMP01 Testing proposed new guidelines for evaluating spatial model-based and design-based abundance estimates All 0**. RMP02 Evaluating abundance estimates: diagnostics and testing All 0**.

International Whaling Commission. (2016). Report of the Scientific Committee. Annex D. Report of the sub-committee on the Revised Management Procedure. *J. Cetacean Res. Manage. (Suppl.)* 17: 106-184.

Section 5.5 *'Requirements and Guidelines for conducting surveys and* Implementations*'*

** The existing Committee's Requirement and Guidelines were written for design-based surveys only. Recently, the Committee recognised a need to consider what circumstances might require approval when the survey and analysis are conducted based on spatial modelling or quasi design-based approaches. The Committee agreed in 2012 (IWC, 2013) that a review of this issue should take place intersessionally, but due to the unavailability of contracted experts during the last intersessional period, comprehensive discussion will be deferred to 2016.

The sub-committee was advised that Bravington would continue to be involved in conducting this review and developing a guidelines manual related to how to conduct survey analyses based spatial modelling or quasi design-based approaches. This work is expected to be completed by the 2016 Annual Meeting. The sub-committee noted that a demonstration of the software implementing the analysis method should occur, preferably during a Workshop held as a pre-meeting to SC/66b. This Workshop would test the guidelines against several test cases of model-based abundance estimation. The sub-committee established a Steering Group under Butterworth (Chair) with members Bravington, Cooke, Kitakado and Leaper, to co-ordinate intersessional work, develop an agenda for the Workshop and facilitate preparations for the Workshop.

Section 5.6 *Workplan*

**

Before the 2016 Annual Meeting

..

Develop simple-to-use diagnostic software that uses model-based analysis to assist in evaluating design-based estimates (Bravington and David Miller [CREEM], Item 5.5).

During the 2016 Annual Meeting

Hold a pre-meeting Workshop with Terms of Reference: (i) to test proposed new Guidelines against several test cases of model-based abundance estimates developed specifically for and during the Workshop; and (ii) to demonstrate and discuss the proposed diagnostic software with a wider Committee audience. There will be costs involved for travel and subsistence (Item 5.5).

Section 7 *Budget Issues*

**Two intersessional Workshops are proposed:

(1) a Workshop held as a pre-meeting before SC/66b to test the proposed new *Guidelines* against several test cases of model-based abundance estimates made specifically for and during the Workshop and to demonstrate and discuss the proposed diagnostic software with a wider Committee audience involved in basic line-transect abundance estimation (Convenor: Bravington) (funds; Item 5.5); …

International Whaling Commission. (2016). Report of the Scientific Committee. Annex T. E-mail Correspondence Groups and Terms of Reference. *J. Cetacean Res. Manage. (Suppl.)* 17: 437-440.

(Group 6**) Requirements and Guidelines for conducting surveys and *Implementations* (Steering Group) RMP/ AWMP

Coordinate intersessional work, develop an agenda and facilitate preparations for the Workshop on model-based estimation with a pre-meeting to explain the package suggested to member country participants. Butterworth (Convenor), Bravington, Cooke, Kitakado, Leaper.

2016

International Whaling Commission. (2017). Report of the Scientific Committee. *J. Cetacean Res. Manage. (Suppl.)* 18: 1-109.

Section 5.2 *Requirements and Guidelines for conducting surveys: model-based abundance estimates*

****** The Committee's existing Requirements and Guidelines were written for design-based surveys only. The Committee has recognised a need to consider what circumstances might require approval when the survey and analysis are conducted based on spatial modelling or quasi design-based approaches (IWC, 2013c). The Committee had expected to hold a pre meeting on this topic this year (IWC, 2016i) but the expected software and paper were not yet available. This year, the Committee received an update on progress by Bravington and colleagues on the work towards developing guidelines and software for developing model based abundance estimates. *Attention: SC The Committee **agrees** that there should be pre-meeting to SC/67a (see Item 25.3), at which a demonstration of the software implementing the model-based analysis approach will take place; it will also test the guidelines for model-based estimation against several test cases. This is relevant to the work of several sub-committees.*

The Committee re-established a Steering Group under Butterworth (SG-2), with members and Terms of Reference given in Annex V.

Table 2 Work plan for general assessment matters with a focus on the RMP.
Model-based abundance estimates. Bravington and colleagues to complete guidelines and develop simple-to-use diagnostic software. During the 2017 meeting: Pre-meeting workshop to: (a) test proposed new guidelines; (b) demonstrate the proposed software. Intersessional. Depends on outcome of 2017 meeting.

International Whaling Commission. (2017). Report of the Scientific Committee. Annex D. Report of the sub-committee on the Revised Management Procedure. *J. Cetacean Res. Manage. (Suppl.)* 18: 123-173.

Section 2.4 *Work plan*

** Before the 2017 Annual Meeting. (2) Develop simple-to-use diagnostic software that uses model-based analysis to assist in evaluating design-based estimates (Bravington and Miller, Item 2.2). During the 2017 Annual Meeting. (2) Hold a pre-meeting Workshop with Terms of Reference: (i) to test proposed new Guidelines against several test cases of model-based abundance estimates developed specifically for and during the Workshop; and (ii) to demonstrate and discuss the proposed diagnostic software. There will be costs involved for travel and subsistence (Item 2.2).

Section 5 *Budget Issues*

** Three intersessional Workshops are proposed: (1) a Workshop held as a pre-meeting before SC/67a to test the proposed new Guidelines against several test cases of model-based abundance estimates made specifically for and during the Workshop and to demonstrate and discuss the proposed diagnostic software with a wider Committee audience involved in basic = line-transect abundance estimation (Convenor: Butterworth) (already funded; Item 2.2);…

International Whaling Commission. (2017). Report of the Scientific Committee. Annex V. Report of the sub-committee on the Revised Management Procedure. *J. Cetacean Res. Manage. (Suppl.)* 18: 450-454.

**This list contains the intersessional groups identified at SC/66b.

…

Item 5.2 RMP. Survey requirements and guidelines. Coordinate intersessional work, develop an agenda for the Workshop and facilitate preparations for the Workshop examining the use of model-based estimates including the demonstration of software. Butterworth (Convenor), Allison, Bravington, Cooke, Donovan, Leaper, Jackson, Kitakado, D. Miller, Palka, Walløe.

…

2017

International Whaling Commission. (2018). Report of the Scientific Committee. *J. Cetacean Res. Manage. (Suppl.)* 19: 1-101.

Section 12.2.1 *Methodological issues—Model-based abundance estimates (and amendments to RMP guidelines)*

In recent years, the Committee has recognised the need to develop its expertise in evaluating spatial-model-based abundance estimates from sighting surveys because these models have potential advantages in reducing bias resulting from patchy coverage, and in providing more reliable estimates of variance when compared to standard line transect methods. A pre-meeting, held on 7-8 May 2017, reviewed the current state of spatial modelling for cetacean abundance estimation, and introduced a software package 'ltdesigntester' for exploring the reliability of design-based abundance estimates of specific surveys. The report is given as Annex Q, Appendix 6.

The Committee has for some time (IWC, 2015, p.9) been considering the need to amend the Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme (IWC, 2012, p.509) to incorporate abundance estimates produced using methods (e.g. spatial models, mark-recapture models) not yet considered by the Guidelines. One of the tasks of the pre-meeting was to consider such amendments for spatial model-based estimates, but time constraints meant that these amendments could not be discussed in detail.

*Attention: SC The Committee **recommends** that draft amendments to the Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme be developed intersessionally (ICG-4, Annex W) to incorporate methods to compute abundance estimates not yet considered by the Guidelines, for review at SC/67b.*

International Whaling Commission. (2018). Report of the Scientific Committee. Annex Q. Report of Ad hoc Working Group on Abundance Estimates, Status and International Cruises. *J. Cetacean Res. Manage. (Suppl.)* 19: 376-398.

Section 6.1.1 *Model-based abundance estimates and amendments to the RMP Guidelines—Review of intersessional work and pre-meeting.*

**Bravington reported on the pre-meeting on model-based abundance estimation (Appendix 6). Abundance estimates from line-transect surveys can nowadays be derived statistically using spatial models, as well as the more familiar Horvitz-Thompson (HT) approaches. Spatial models have potential advantages in reducing bias

resulting from patchy coverage, and in providing more reliable estimates of variance. In recent years, the Committee has recognised the need to develop its expertise in evaluating spatial-model-based abundance estimates, which are fairly complex, and also in deciding whether an estimate based on the simpler HT formulae can safely be used in cases when the strict assumptions underpinning HT do not apply (e.g. design reflects uneven coverage). To further this process, a workshop was held on 7-8 May, run by David Miller (CREEM) and Mark Bravington (CSIRO). The workshop explored some issues around the current state of spatial modelling for cetacean abundance estimation, and introduced software (*ltdesigntester*) for exploring the reliability of HT-based abundance estimates of specific surveys, either post hoc or in the design phase. Bravington provided an overview of preliminary workshop conclusions and highlighted potentially controversial points. Details may be found in Appendix 6. The Committee has for some time been considering the need to amend the RMP guidelines (IWC, 2012) to incorporate abundance estimates produced using methods (e.g. spatial models, mark recapture models) not yet considered by the Guidelines. One of the tasks of the pre-meeting was to consider such amendments, but time constraints meant that these amendments could not be discussed in detail. The Working Group **agreed** that an intersessional e-mail group under Zerbini (Item 8 [or Item 12.1?]) would be tasked to propose amendments for discussion at next year's meeting.

Appendix 6 Report of the Pre-Meeting on Model-based Abundance Estimation (Bled, 7-8 May 2017).
**Contains summary of the 2-day workshop. For more details, see paragraph above and the document: Miller, D.L. and Bravington, M.V. (2017). When can abundance surveys be analysed with "design-based" methods? 30pp

International Whaling Commission. (2018). Report of the Scientific Committee. Annex W. Intersessional E-mail Groups. *J. Cetacean Res. Manage. (Suppl.)* 19: 424-428.
**This list contains the intersessional groups identified at SC/67a.
Item 12.1. ASI. ICG-4. Abundance process. …(5) amend the RMP Guidelines, particularly in regard to methods so far not included in the guidelines (e.g. spatial modelling and mark-recapture); …

2018

International Whaling Commission. (2019). Report of the Scientific Committee. *J. Cetacean Res. Manage. (Suppl.)* 20: 1-78.
Section 12.3.1 *Methodological issues-- Model-based abundance estimates (and amendments to RMP guidelines)*
** The Committee noted that there was a need for RMP guidelines to be modified in order to incorporate spatial modelling approaches to estimate abundance. *Attention: SC The Committee **noted** that whilst much progress has been made with respect to considering model-based estimates (IWC, 2016), the 'Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme' need to be modified. The Committee **agrees** that an intersessional steering group (Annex Y) will develop instructions and select a candidate to modify the Guidelines.*

****Table 17** *Workplan on abundance estimates and status*. Amend the RMP Guidelines to consider abundance estimates computed with model-based methods. Intersessional

2018-19: Identify a candidate to update the RMP Guidelines (see Annex Y). SC/68a: Review an updated document of the Guidelines.

Section 27 *Scientific Committee budget for the Biennium 2019-2020*. **Table 33** Summary of budget requests for the 2019 20 period. For explanation and details of each project see text. Reports RP02 Amendment of RMP Guidelines to incorporate spatial modelling approaches to estimate abundance RMP FUNDS. (See RP02 Amendment of the RMP guidelines to incorporate spatial modelling approaches to estimate abundance.) The 'Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme', referred to as the 'RMP Guidelines' (IWC, 2012) constitutes a document prepared by the Scientific Committee to state the requirements and to guide the collection and analysis of survey data to compute abundance estimates for use in the Revised Management Procedure (RMP). Currently this document provides detailed guidance for developing estimates using design-based line transect shipboard and aerial surveys. Amendments are required to consider other methods, for example, model-based analysis of survey data and mark-recapture models. This project will update the RMP Guidelines as required by the Scientific Committee. This update will be completed in consultation with the project's steering committee and presented for consideration of the SC by SC68b. The expected outcome is a new, revised document of with the 'RMP Guidelines'.

International Whaling Commission. (2019). Report of the Scientific Committee. Annex Q. Report of the Standing Working Group on Abundance Estimates, Status of Stocks and International Cruises. *J. Cetacean Res. Manage. (Suppl.)* 20: 394-412.

Section 2.6 *Amendments to the RMP Guidelines*

The 'Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme', hereafter referred to as the 'RMP Guidelines' (IWC, 2012) constitutes a document prepared by the Scientific Committee to state the requirements and to guide the collection and analysis of survey data to compute abundance estimates for use in the Revised Management Procedure (RMP). The Working Group noted that there was a requirement for the 'RMP Guidelines' to be modified in order to incorporate spatial modelling approaches to estimate abundance. It was noted that this work would have budgetary implications. The proposed modification to the RMP guidelines was not intended to capture any changes that might be required in relation to use of mark-recapture estimates, in that only model-based estimates would be considered at this time. The Working Group **agreed that a suitable candidate would be found to amend the RMP Guidelines and that this would be undertaken by an intersessional e-mail group led by Fortuna, which will include as members the Chair and Vice-Chair of the Scientific Committee, the Head of Science and the co- Convenors of the Working Group.

*Attention: SC The 'Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme' need to be modified to consider estimates of abundance using model-based methods. The Working Group **agreed** that an intersessional e-mail group will develop instructions and select a candidate to amend these Guidelines.*

International Whaling Commission. (2019). Report of the Scientific Committee. Annex Y. Intersessional E-mail Groups. *J. Cetacean Res. Manage. (Suppl.)* 20: 474-412.

** This list contains the intersessional groups identified at SC/67b.

Item 12.3 ASI. Amendment of the RMP Guidelines. (1) Develop a set of specific instructions for the amendment of the RMP guidelines to consider model-based abundance estimates; (2) select a candidate to amend the RMP Guidelines according to these instructions.

2019

International Whaling Commission. (2020). Report of the Scientific Committee. *J. Cetacean Res. Manage. (Suppl.)* 21: 1-65.

Section 12.2.3 *Methodological issues—Amendments to the RMP Guidelines.* At last year's meeting, the ASI SWG agreed that the RMP Guidelines needed to be extended to incorporate spatial model approaches to estimate abundance by 2020. A Steering Group was established to: (1) develop a set of specific instructions for the amendment of the RMP guidelines to consider model-based abundance estimates; and (2) select a candidate to conduct this work. Dr. David Miller from CREEM (Centre for Research into Ecological and Environmental Modelling, University of St. Andrews) was selected to modify the Guidelines with advice from a Steering Group.

Attention: SC The 'Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme' need to be modified to consider estimates of abundance computed using model-based methods. The Committee ***agrees*** *that the Steering Group established to oversee this process (see Annex P) should continue the intersessional work to develop instructions to amend the Guidelines.*

International Whaling Commission. (2020). Report of the Scientific Committee. Annex Q. Report of the Standing Working Group on Abundance Estimates, Status of Stocks and International Cruises. *J. Cetacean Res. Manage. (Suppl.)* 21: 277-299.

Section 3.4 *Methodological Matters—Amendment of the RMP Guidelines*

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

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

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

International Whaling Commission. (2020). Report of the Scientific Committee. Annex T. Intersessional E-mail Groups. *J. Cetacean Res. Manage. (Suppl.)* 21: 304-306.

** This list contains the intersessional groups identified at SC/68A.
Item 3.4 ASI. Amendment of the RMP Guidelines. (1) Develop a set of specific instructions for the amendment of the RMP guidelines to consider model-based abundance estimates.

2020 (Virtual meeting)

International Whaling Commission. (2021). Report of the Scientific Committee. *J. Cetacean Res. Manage. (Suppl.)* 22: 1-112.

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

**The Committee agreed in 2018 (IWC, 2019k) that the 'Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme' (referred to there as the RMP Guidelines; IWC, 2012) needed to be modified to incorporate spatial model approaches to estimate abundance. A Steering Group was established to: (1) develop a set of specific instructions for the amendment of the RMP guidelines to consider model-based abundance estimates; and (2) select a candidate to conduct this work. David Miller from CREEM (Centre for Research into Ecological and Environmental Modelling, University of St. Andrews) was selected to make proposals to modify the Guidelines.

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

**Table 15 Work plan for the review of abundance estimates and provision of advice to the Commission on status of stocks for the period 2020/21. 11.3.1 Amend the RMP Guidelines to consider abundance estimates computed with model-based methods. Develop a set of specific instructions for the amendment of the RMP Guidelines to consider model-based abundance estimates (SG Amendment of RMP Guidelines and Miller). 2021 Annual Meeting (SC68C): Review an updated document of the RMP Guidelines

International Whaling Commission. (2021). Report of the Scientific Committee. Annex K. Intersessional E-Mail Groups. *J. Cetacean Res. Manage. (Suppl.)* 22: 223-229.

** This list contains the intersessional groups identified at SC/68A.
Item 11.3 ASI. Amendment of the RMP Guidelines. Develop a set of specific instructions for the amendment of the RMP guidelines to consider model-based abundance estimates.

2021 (Virtual meeting)

International Whaling Commission. (2022). Report of the Scientific Committee. *J. Cetacean Res. Manage. (Suppl.)* 23: 1-171.

Section 11.3.1 *Methodological issues—Amendments of the RMP Guidelines to consider model-based abundance estimates*

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

**Table 10 Work Plan for the review of abundance estimates and provision of advice to the Commission on status of stocks for the period 2021/22. Amend the RMP Guidelines to consider abundance estimates computed with model-based methods. Develop a set of specific instructions for the amendment of the RMP Guidelines to consider model-based abundance estimates. (SG Amendment of RMP Guidelines and Miller). Review an updated document of the RMP Guidelines.

International Whaling Commission. (2022). Report of the Scientific Committee. Annex O. List of Intersessional E-Mail Groups. *J. Cetacean Res. Manage*. *(Suppl.)* 23.

**Intersessional Steering/Correspondence Groups for Abundance Estimates and Status of Stocks. Amendment of RMP Guidelines. (1) Develop a set of specific instructions for the amendment of the RMP guidelines to consider model-based abundance estimates. Staniland (Convenor), Butterworth, Cooke, Donovan, Herr, Kelly, Kitakado, Miller, Palka, Punt and Zerbini.

2022 (Virtual meeting)

International Whaling Commission. (2023). Report of the Scientific Committee. *J. Cetacean Res. Manage*. *(Suppl.)* 24: 1-190.

Section 11.4.1 *Amendments of the RMP Guidelines to consider model-based abundance estimates*

**The Committee agreed in 2018 (IWC, 2019) that the 'Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme' (referred to as the RMP Guidelines, IWC, 2012) need to incorporate spatial model approaches to estimate abundance from line transect surveys. Such work has been undertaken by Miller, and, intersessionally, oversight of this project was transferred to IST.