# Report of the Scientific Committee

**Bled, Slovenia, 24 April-6 May 2018**

# Annex D

# Report of the Sub-Committee on the Revised Management Procedure

**This report is presented as it was at SC/67b.
There may be further editorial changes (e.g. updated references, tables, figures) made before publication.**

**International Whaling Commission**

**Bled, Slovenia, 2018**

# Annex D

# Report of the Sub-Committee on the Revised Management Procedure

**Members:** Robbins (Convenor), Allison, Aoki, Baba, Bell, Bjørge, Brandão, Brierley, Brownell, Burkhardt, Butterworth, Cipriano, Cooke, de la Mare, de Moor, DeWoody, Di Tullio, Doniol-Valcroze, Donovan, Double, Fortuna, Goto, Gunnlaugsson, Haug, Hoelzel, Hubbell, Iñíguez, Inoue, Jaramillo-Legorreta, Johnson, Kim, E.M., Kitakado, Lang, Lundquist, Maeda, Mallette, McKinlay, Miyashita, Morishita, Morita, Moronuki, Nelson, Øien, Palka, Panigada, Pastene, Punt, Reeves, Simmonds, Skaug, Slugina, Solvang, Strasser, Sampaio, Suydam, Taguchi, Tamura, Taylor, Terai, Tiedemann, Víkingsson, Wade, Walløe, Walters, Wambiji, Wilberg, Williams, Witting, Yasokawa, Yasunaga, Yoshida, Zerbini, Zharikov.

## 1. INTRODUCTORY ITEMS

### 1.1 Convenor's opening remarks

Robbins welcomed the participants and passed along the best wishes of the co-Convenor, John Bannister, who was unable to attend the meeting.

### 1.2 Election of Chair

Robbins was elected Chair.

### 1.3 Appointment of rapporteurs

Punt acted as the rapporteur.

### 1.4 Adoption of Agenda

The adopted Agenda is shown in Appendix 1.

### 1.5 Available documents

The documents considered by the sub-committee were SC/67b/RMP01-03, SC/67b/Rep02, SC/67b/Rep05, SC/67b/ASI15, SC/67b/SDDNA06, and SC/67b/EM07.

## 2. GENERAL ASSESSMENT ISSUES WITH A FOCUS ON THOSE RELATED TO THE REVISED MANAGEMENT PROCEDURE

### 2.1 Evaluate the energetics-based model and the relationship between $MSYR_{1+}$ and $MSYR_{mat}$

SC/67b/EM07 outlined enhancements to the individual-based energetics model (IBEM) developed since last meeting. One of these changes enabled feeding on migration to be explicitly modelled. Results presented for 'minke like' whales showed that carrying capacity and the parameters of the yield curve in terms of MSYR and MSYL were sensitive to the level of migration food, with a threefold difference in MSYR arising from a 30% reduction in migration food. Although based on a small number of scenarios, the ratios of $MSYR_{1+}$ to $MSYR_{mat}$ were similar to earlier results for 'minke like' populations from the previous version of the model.

The sub-committee thanked de la Mare for his efforts to continue to develop the IBEM. This model has the potential to inform the work of the Committee in several ways. Specifically, the IBEM and previous age-aggregated population dynamics models have shown that MSYL depends on the extent of stochasticity in the population dynamics, emphasising the importance of accounting for such stochastically in the work of the RMP sub-committee. The IBEM also provides a way to better understand the relationship between biological processes and MSYR, for example, with species that require food in winter having lower values for MSYR, all things being equal. The possibility was raised of inferring MSYR for species based on the values for parameters in the IBEM by calibrating the rates of increase for stocks for which these rates are known with values for these parameters in the IBEM. However, it was recognised that the IBEM has many parameters so that conducting such an analysis would be very difficult. Another potential use of the IBEM is to examine the impact of forage fisheries on growth rates for migrating species.

SC/67b/RMP01 reported on trials using the IBEM within the standard RMP testing framework. The trials covered three scenarios relating to the 'development' (D), 'sustain' (S) and 'recovery' (R) trials using one of the models presented in SC/67b/EM07, which had $MSYR_{mat}$ = 1.8%. The results were consistent with the behaviour of the RMP *CLA* observed from less complex population models. The author of SC/67b/RMP01 stated that, apart from confirming that the *CLA* did not exhibit unusual behaviour under this different scenario model, the results would provide a point of comparison for the emulator model for the IBEM currently under development.

The sub-committee noted that the trends in population numbers and catches from the IBEM-based D1, R1, and S1 trials match the patterns observed from deterministic operating models, although the outcomes were, as expected, more variable. Direct quantitative comparisons between the performance statistics in SC/67b/RMP01 and those for the single-stock trials was not possible owing to differences in MSYR. The sub-committee had previously agreed that an emulator model could form the basis for future *Implementation Simulation Trials* once it is fully developed. The sub-committee again identified priorities for the next steps for this work as:

(1) continue to assess whether it is possible to represent the trajectories from the IBEM using the emulator model;
(2) compare the yield curves from the IBEM with those from the emulator model; and
(3) develop guidelines for how to use an emulator model as the basis for a multi-stock, multi-area population dynamics model and how such a model could be conditioned given available data.

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*Attention: SC*

*The Committee* ***agrees*** *that work continue to develop an emulator model; assess whether it is possible to represent the trajectories from the IBEM using an emulator model; compare the yield curves from the IBEM with those from the emulator model; and develop guidelines for how to use an emulator model as the basis for a multi-stock, multi-area population dynamics model and how such a model could be conditioned given available data.*

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### 2.2 Implications of *IST*s for consideration of species' and populations' status

In SC/67a, it was concluded that the results of a set of *Implementation Simulation Trials* should be summarised using three statistics to provide information on status (IWC, 2018). Intersessional computing work was recommended to allow these values to be reported, but that work was not completed due to computing demands for other RMP and AWMP activities. The sub-committee **agreed** that the Donovan should draft updates to the Guidelines for *Implementations* and *Implementation Reviews* to reflect decisions on evaluation status of stocks, and that Allison should modify the control programs used for *Implementation Simulation Trials* to report the three measures of status agreed last year (IWC, 2018). The sub-committee, in conjunction with the ASI sub-committee, will review outcomes of the analyses at SC/68a.

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*Attention: SC*

*The Committee* ***agrees*** *that Allison should modify the control programs used for Implementation Simulation Trials to report the three measures of status agreed last year (IWC, 2018). The RMP sub-committee, in conjunction with the Working Group on ASI, will review outcomes of the analyses at SC/68a. Punt and Donovan will develop draft updates to the Guidelines for Implementations and Implementation Reviews to reflect decisions on evaluation status of stocks for consideration at SC/68a.*

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### 2.3 General consideration of how to evaluate the effect of special permit catches on stocks and levels of information needed to show improved management performance

#### *2.3.1 General issues*

Last year, the Committee received a paper (Punt and Donovan, 2018) that outlined a potential approach based on *Implementation Simulation Trials* to inform the quantification of the management-related benefits of research programs. The sub-committee agreed that it would be useful for both proponents and reviewers if there was general guidance on the level of information to be provided to show quantitatively that any proposed research will have management benefits. The sub-committee agreed last year that it is not reasonable to 'accept' either a general assertion that there will be benefits or to 'require' a formal demonstration with 100% certainty that there will be an improvement. It also recognised that what constitutes 'sufficient' information would be a difficult task. The sub-committee therefore recommended that that discussion documents be prepared intersessionally for discussion in SC/67b.

Appendix 2 lists some general guidelines to assist proponents in writing proposals which will in turn assist in the review process (e.g. minimising requests by the Expert Panel for additional information to be provided). It is stressed that these are guidelines not requirements. In particular, appointment and use of an Advisory Committee is not mandatory[1], but would be advisable for nations that have not previously developed proposals or that may be lacking analysts familiar with the modelling approaches commonly applied at the IWC.

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*Attention: SC*

*The Committee* ***agrees*** *that the general guidelines on the levels of information needed to show improved management improvement, for proposals that identify this as an objective (Appendix 2), should be included as an Appendix to the Scientific Committee handbook.*

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#### *2.3.2 Specific issues*

Government of Japan (2016) outlined RMP/*IST*-like simulations to evaluate whether or not a modified *CLA* that includes age data in the control rule will: (a) result in improved performance; and (b) if so, by how much. A small group reviewed the analyses and agreed that the approach was conceptually appropriate, but recognised that further work was needed to specify an appropriate trial structure (IWC, 2017). An Advisory Group (Bannister (Chair), Butterworth, Cooke, de la

[1]The decision to appoint an Advisory Committee and its membership shall be at the sole discretion of the proponents.

Mare, Donovan, Fortuna, McKinlay, Kitakado, Morishita, Punt and Walløe) was appointed to assist in the process to facilitate the Committee to review and agree trial specifications. It was recognised that the process would be iterative. Members of the Advisory Group provided advice to Kitakado during the intersessional period.

SC/67b/RMP03 provided draft specifications for an RMP/*IST* type simulation exercise to evaluate management procedures based on modified *CLA*s (MCLAs) that use information on recruitment inferred from age data from Antarctic minke whales. This work arose from discussions regarding NEWREP-A, in which the extent of improvement in RMP-related performance (e.g. through catch and risk indicators) that might be obtained by incorporating information on age of caught animals formed part of the justification for the sample size for NEWREP-A (Recommendation 1 of Panel Review for NEWREP-A). During SC/66b, to respond this recommendation, Government of Japan (2016) introduced preliminary work on minke whale population models that would be a part of the operating models to be used in simulation trials, and presented a quantitative evaluation of NEWREP-A in terms of improvements in the performance of alternative RMPs. SC/67b/RMP03 is separate and independent from NEWREP-A, and introduces a more general framework of trials for Antarctic minke whales to evaluate MCLAs, with a focus on conditioning and the generation of future observations.

It will be necessary to both refine the MCLA and how it is tested using a more extensive set of trials. The author of SC/67b/RMP03 plans to pursue this work further, potentially seeking advice from the Advisory Group established in 2016. The sub-committee noted that SC/67b/RMP03 was necessarily a work-in-progress, and that several features of the operating models would need to be modified before final conclusions could be drawn. In particular, there is need for the simulations to account for future stochasticity in the same variables as the statistical catch-at-age method on which the operating model is based (i.e. selectivity, carrying capacity, and growth), although there would be value in conducting projections in which these variables are time-invariant as an initial way to explore the feasibility of a MCLA outperforming the *CLA*. Future work should also consider alternative assumptions about mixing of the I- and P- stock. Other matters that might be included in trials would be density-dependence in both natural mortality and recruitment simultaneously and stochasticity. The set of trials should consider a broad range of assumptions regarding changes in recruitment rate, including a longer duration for the pulse in SC/67b/RMP03, pulse up and stay up, pulse down and stay down, linear changes over pulses. In addition, variations in recruitment rate seen in the past should be replicated into the future. The sub-committee noted that the specifications should be clear that the pulses pertain to recruitment rate (calves per mature female).

The performance statistics used to report the results of trials should include the standard sets of *CLA*/RMP performance statistics. Use of performance statistics that scale population size to the population size when there was no harvest have eased interpretation of trials with time-varying parameters such as carrying capacity, and included in the standard set of statistics.

### 2.4 Work plan 2019-20

Work plan for RMP (general issues)

| Topic | Intersessional 2018/19 | 2019 Annual Meeting (SC/68a) | Intersessional 2019/20 | 2020 Annual meeting |
|---|---|---|---|---|
| Item 2.1: Conduct work to evaluate the energetics-based model and hence the relationship between MSYR1+ and MSYRmat | (a) Continue to assess whether it is possible to represent the trajectories from the IBEM using the emulator model (de la Mare);<br>(b) Compare the yield curves from the IBEM with those from the emulator model (de la Mare); and<br>(c) Develop guidelines for how to use an emulator model as the basis for a multi-stock, multi-area population dynamics model and how such a model could be conditioned given available data (de la Mare). | Continue to work to evaluate the energetics-based model and hence the relationship between $MSYR_{1+}$ and $MSYR_{mat}$ | Conduct follow-up analyses | Continue to work to evaluate the energetics-based model and hence the relationship between MSYR1+ and MSYRmat |
| Item 2.2: Implications of ISTs, for consideration of status | (a) Draft updates to the Guidelines for *Implementations* and *Implementation Reviews* to reflect decisions on evaluation status of stocks (Donovan); and<br>(b) Modify the control programs used for *Implementation Simulation Trials* to report the three measures of status (Allison) | Review the results of the projections | | |
| Item 2.3: levels of information needed to show improved management performance | | Review progress implementing the suggested changes to the specifications of SC/67b/RMP03 and any results. | | |

## 3. RMP – *IMPLEMENTATION*-RELATED MATTERS

### 3.1 Completion of the *Implementation Review* of western North Pacific Bryde's whales

*3.1.1 Report of the intersessional Workshop*

Donovan summarised the report of the intersessional Workshop (SC/67b/Rep05) held in Tokyo from 14-16 February 2018. The objective of the second Workshop was to facilitate completion of the *Implementation Review*, and in particular to resolve any outstanding issues and complete the conditioning of the trials so that the final results could be developed during the intersessional period.

Much of the work therefore focussed on completing the final trial specifications and in particular: (a) confirming the mixing matrices; and (b) updating the abundance estimates for the new sub-areas (including consideration of $g(0)$ and additional variance (but see Item 3.1.3 below) as well as confirming future sighting survey plans and whaling options. The Workshop reviewed preliminary conditioning results for almost all trials and agreed that they were satisfactory. It developed a workplan to try to ensure completion of the *Review* at SC/67b.

The sub-committee noted that the intersessional Workshop led to considerable progress towards completing the *Implementation Review* and that the Workshop had been conducted in an excellent spirit of co-operation among the participants. It thanked Donovan for chairing the meeting, the Government of Japan for providing excellent facilities and all the participants for their contributions to the development of trial specifications and workplan.

*Attention: SC*

*The Committee* ***agrees*** *the updated trial specifications for the Implementation Review of western North Pacific Bryde's whales. These specifications are provided in Appendix 3.*

*3.1.2 Progress since the intersessional Workshop*
Following the intersessional Workshop, the code was modified to allow for the two future survey plans and the two future survey areas requested by Japan and agreed at the Workshop. The two future survey areas include a 'large' area with a southern boundary of 10°N in sub-areas 1W and 1E, and a 'small' area with a southern boundary of 20°N in sub-areas 1W and 1E.

*3.1.3 Final trial specifications*
Revised $g(0)$-corrected abundance estimates and CVs from the past surveys were adopted by the ASI sub-committee (Annex Q, item 3.1.1.6). Abundance estimates and CVs corresponding to the proposed small and large areas (Appendix 3, Table 2) were included in the conditioning. The estimates of additional variance (required for forecasts and not conditioning) for the case in which sub-area 1W is surveyed over three years were updated, and the trial specifications updated accordingly.

The sub-committee **agreed** the updated trial specifications (Appendix 3).

*3.1.4 Conditioning of trials*
Appendix 4 lists examples of the plots used to evaluate whether conditioning has been achieved satisfactorily. The sub-committee noted that trials 3 and 4, which involve alternative catch series, had yet to be conditioned but that conditioning for the remaining trials was satisfactory.

*3.1.5 Conclusions and recommendations*
There was insufficient time during the meeting to complete all of the required projections and to check the associated calculations. The sub-committee therefore **agreed** that the calculations would be completed intersessionally and reviewed and summarised by a Steering Group (Donovan (Convenor), Allison, Butterworth, deMoor, Kitakado, Palka, Pastene, Punt, Tiedemann). This would occur well prior to SC/68a so that Japan has sufficient time to consider the results, prior to final conclusions (e.g. with regard to preferred survey options) being drawn. The sub-committee expects that this work can be completed before the end of 2018, but if complications arise conducting the projections, an extra day should be added to the First Intersessional Workshop for the western North Pacific minke whales to address outstanding issues.

*Attention: SC*

*The Committee* ***agrees*** *that the Implementation Review of western North Pacific Bryde's whales will be completed in SC/68a. Outstanding tasks would be completed intersessionally and the results reviewed and summarized by a Steering Group convened by Donovan. This would occur well prior to SC/68a, but if complications arise then an extra day should be added to the First Intersessional Workshop for the western North Pacific minke whales to address those issues.*

**3.2 Start of the *Implementation Review* of western North Pacific common minke whales**
Last year, the sub-committee recognised that the most difficult aspect of the last *Implementation Review* had been selecting, modelling and assigning plausibility to stock structure hypotheses. Although considerable new data and analyses had been become available since 2013, the sub-committee considered it was likely that resolving how to handle stock structure uncertainty in the next *Implementation Review* will again be challenging. It therefore recommended that a preparatory meeting be held prior to SC67b focused on stock structure for western North Pacific minke whales.

*3.2.1 Report of the intersessional Workshop*
Donovan summarised the report of the preparatory Workshop for the Western North Pacific common minke whale *Implementation Review* (SC/67b/Rep05). The Workshop was held at the Crew House (*Senin Tsumesho*) of the Fisheries Agency of Japan, Tokyo from 12-13 February 2018. The objective of the Workshop was to provide a preliminary opportunity to review work undertaken since the last *Implementation Review* and to develop, if necessary and possible, consensus advice on further analyses that will assist in the forthcoming *Implementation Review.*

Three stock structure hypotheses were used in the previous *Implementation Review* (JCRM 13, pp.103).

- Hypothesis A: a single J stock distributed in the Yellow Sea, Sea of Japan, and Pacific coast of Japan, and a single 'O' stock in sub-areas 7, 8 and 9 (Fig. 1). The O stock migrates in summer mainly to the Okhotsk Sea (sub-areas 12SW and 12NE). Both J and O stocks overlap temporally along the Pacific coast (subareas 7CS and 7CN) and the southern part of the Okhotsk Sea (sub-areas 11 and 12SW).
- Hypothesis B: as for hypothesis A, but a different stock (Y stock) which resides in the Yellow Sea and overlaps with J stock in the southern part of sub-area 6; and
- Hypothesis C: five stocks, referred to Y, JW, JE, OW, and OE, two of which (Y and JW) occur in the Sea of Japan, and three of which (JE, OW and OE) are found to the east of Japan.

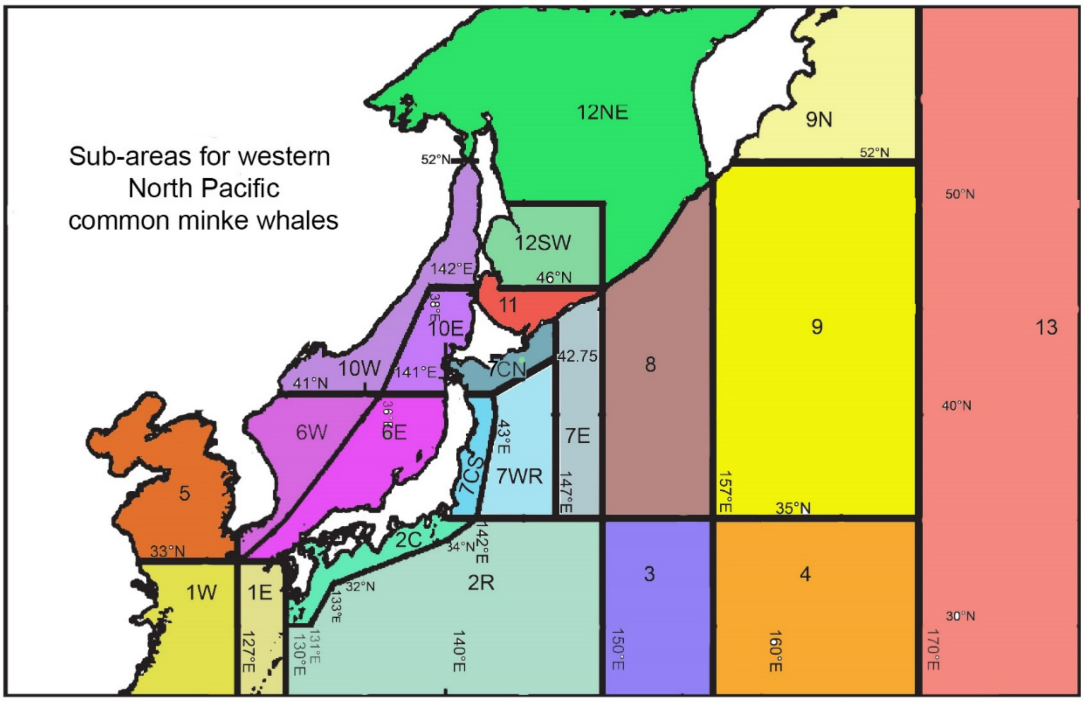


Fig. 1 Sub-areas used for the western North Pacific common minke whales.

There was no agreement within the Committee at the time regarding the plausibility category for these hypotheses, and so all were treated as 'medium' plausibility for the purposes of the *Implementation Review.* Stock structure hypothesis is perhaps the major factor in determining the acceptability of management variants.

The focus of the Workshop was to identify and conduct additional analyses to assist the discussion of stock structure during the upcoming *Implementation Review*. The results of these deliberations are reported in SC/67b/Rep05.

The Workshop was provided with an update to SC/67a/SCSP13 that used information on the trend over time in the J:O stock ratio for common minke whale bycatches around Japan to draw various inferences, in particular about the value of the MSYR. The Workshop agreed that J:O stock ratios in bycatch will require attention when formulating stock distribution assumptions for the process of conditioning *IST*s in the coming *Implementation Review* and made some recommendations for refinement of the analyses (see Item 3.2.2).

The intersessional Workshop was held in an excellent spirit of co-operational among the participants and led to identification of additional data sets and analyses that should be taken forward. Some analyses based on the Workshop recommendations were presented at SC/67b. The sub-committee thanked Donovan for chairing the meeting, the Government of Japan for providing excellent facilities and all the participants for their contributions to progress the *Implementation Review*.

*3.2.2 Progress since the intersessional Workshop*

SC/67b/RMP02 aimed at suggesting a plausible range for $MSYR_{1+}$ for the western North Pacific common minke whales, and the relative plausibility of stock structure Hypotheses A and C. MSYR is a difficult parameter to estimate, while Hypotheses A and C, were assigned equal plausibility in the last *Implementation Review*. An estimated time trend of the proportion of J-stock animals in the Japanese bycatch were analysed using a set of formula identified by the Committee. The resulting trend was compared to that estimated in the RMP/IST trials under different assumptions for stock structure (Hypotheses A and C) and $MSYR_{1+}$. Only for an $MSYR_{1+}$ value of 2% or more under Hypothesis A were the model predictions consistent with the bycatch data. This conclusion was robust to the error structure for the time trend estimate from the bycatch data. Also, the results were not sensitive to how unassigned J/O animals were handled. There are discrepancies between the bycatch data and the model predictions at a sub-area level, which highlights the need to revise the mixing matrices for the RMP/IST trials. SC/67b/RMP02 also proposed a possible mechanism/function in the RMP/IST to assess plausibility over various assumptions regarding $MSYR_{1+}$ and stock structures hypotheses.

The sub-committee thanked Kitakado for the updated analysis, which implements some of the recommendations from the intersessional Workshop. It **agreed** that:

(a) it was necessary to update the mixing matrices in the trial specifications to be more consistent with observed bycatch data;
(b) whether it is possible to use the bycatch data to assign plausibility ranks to $MSYR_{1+}$ values and stock structure hypotheses depends on assumptions regarding trends in effort spatially and temporally; and
(c) trials would need to consider different assumptions regarding the use of J:O bycatch ratios, including that these data do not provide information on $MSYR_{1+}$ and the plausibility of stock structure hypotheses because of possible differential distributional changes by stock.

Therefore, it **recommended** that scientists from Japan and Korea provide data on the amount, location and timing (seasonal and annual) of effort and bycatch to the First Intersessional Workshop (see item 3.2.3).

Analysis of genetic data since the intersessional workshop as well as a workplan are discussed in Annex I, Item 4.5.

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*Attention: SC*

*The Committee* ***agrees*** *that:*

*(a) it is necessary to update the mixing matrices in the trial specifications to be more consistent with observed genetic and bycatch data, also taking into account sensitivity to alternative methods of genetic assignment to stock;*
*(b) whether it is possible to use the bycatch data to assign plausibility ranks to $MSYR_{1+}$ values and stock structure hypotheses depends on assumptions regarding trends in fishing effort spatially and temporally; and*
*(c) trials would need to consider different assumptions regarding the use of J:O bycatch ratios, including that these data do not provide information on $MSYR_{1+}$ and the plausibility of stock structure hypotheses because of possible differential distributional changes by stock.*

*The Committee therefore* ***agrees*** *that scientists from Japan and Korea provide data on the amount, location and timing (seasonal and annual) of fishing effort and bycatch to the First Intersessional Workshop (see item 6.2.3).*

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*3.2.3 Preparation for the First Intersessional Workshop*

The primary objectives of the First Intersessional Workshop are:

(1) review the plausible hypotheses and eliminate any hypotheses that are inconsistent with the data) – this will take into account the probable management implications of such hypotheses to try to avoid unnecessary work in the precise specifications of hypotheses for which these are very similar;
(2) examine more detailed information in expected operations, including whether coastal, pelagic, on migration, on feeding, on breeding or combinations of these. When providing such information, users and scientists may provide options or suggest modifications to the pattern of operations;
(3) review the small geographical areas (‘sub-areas’) that will be used in specifying the stock structure hypotheses and operational pattern; and
(4) specify the data and methods for conditioning the trials that will be carried out before the next annual meeting.

The sub-committee re-established the Steering Group (Donovan (Chair), Allison, Butterworth, Kitakado, Palka, Pastene, Punt, Tiedeman, Kim) to organise the Workshop. Appendix 5 provides an initial agenda for the Workshop, highlighting the associated data and analysis requirements.

### 3.3 Workplan 2019-20

Work plan for RMP (*Implementation*-related matters).

| Topic | Intersessional 2018/19 | 2019 Annual Meeting (SC/68a) | Intersessional 2019/20 | 2020 Annual meeting |
|---|---|---|---|---|
| Item 3.1: Western North Pacific Bryde’s whales | Finalise the projections and the application of the criteria for evaluating which RMP variants are acceptable, borderline, and unacceptable | Complete the *Implementation Review* | | |
| Item 3.2: Western North Pacific minke whales | (a) conduct the First Intersessional Workshop; (b) code the resulting trials and condition the trials | Conduct the work required for the First Annual Meeting | Conduct the Second Intersessional Workshop | Conduct the work required for the Second Annual Meeting |

### 4. BUDGETARY ITEMS 2019-20

(1) An intersessional Workshop (in early 2019) to conduct the First Intersessional Workshop for the *Implementation Review* for North Pacific common minke whales, with the possibility of an extra day to complete outstanding work to finalise the calculations for the *Implementation Review* for the Western North Bryde’s whales (£15,000; Item 3.2).

(2) An intersessional Workshop (in early 2020) to conduct the Second Intersessional Workshop for the *Implementation Review* for North Pacific common minke (£15,000; Item 3.2).
(3) Essential computing support to the Secretariat for RMP (£23,000 over two years; Items 3.1 and 3.2).
(4) Development of an age-structured emulator for the individual-based energetics model (IBEM) (£7,000; Item 2.1).

The sub-committee gave high priority to the proposed Workshops and the essential computing support, recognising that without meetings to co-ordinate and focus intersessional work it will be impossible to achieve the Committee's ambitious schedule for two-year *Implementation Reviews.* Secondary priority was given to support for the development of an age-structured emulator for the individual-based energetics model. Volunteers from the sub-committee were asked to use the draft criteria in the proforma template to score the IBEM proposal to facilitate budgetary decisions across the Committee.

**5. ADOPTION OF REPORT**

The Report was adopted at 12:09 on 1 May 2018. The sub-committee acknowledged the considerable work undertaken by Allison, de Moor, and Punt during the intersessional period and at this meeting. The sub-committee expressed its appreciation to Robbins for her chairing of the sub-committee.

**References**

Government of Japan 2016. Results of the analytical work on NEWREP-A recommendations on sample size and relevance of age information for the RMP. SC/66b/SP10.
International Whaling Commission. 2017. Terms of reference for an Advisory Group on Recommendation 1 of the Expert Panel on NEWREP-A. *J. Cetacean Res. Manage*. 18 (Suppl.): 444-5.
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Punt, A.E. and D.P. Donovan. 2017. An approach to quantifying potential improvements in management performance from scientific research programmes. SC/67a/SCSP/02.

**Appendix 1**

**AGENDA**

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    1.2 Election of Chair
    1.3 Appointment of rapporteur
    1.4 Adoption of Agenda
    1.5 Documents available
2. GENERAL ASSESSMENT ISSUES WITH A FOCUS ON THOSE RELATED TO THE REVISED MANAGEMENT PROCEDURE
    2.1 Evaluate the energetics-based model and the relationship between $MSYR_{1+}$ and $MSYR_{mat}$
    2.2 Implications of *IST*s for consideration of species' and populations' status
    2.3 General consideration of how to evaluate the effect of special permit catches on stocks and levels of information needed to show improved management performance
    2.4 Work plan 2019-20
3. RMP - *IMPLEMENTATION*-RELATED MATTERS
    3.1 Completion of the *Implementation Review* of western North Pacific Bryde's whales
        3.1.1 Report of the intersessional Workshop
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    3.2 Start of the *Implementation Review* of western North Pacific common minke whales
        3.2.1 Report of the intersessional Workshop
        3.2.2 Progress since the intersessional Workshop
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4. BUDGETARY ITEMS 2019-20
5. ADOPTION OF REPORT

## Appendix 2

## GENERAL GUIDELINES FOR EVALUATING RESEARCH PROPOSALS WITH OBJECTIVES THAT INCLUDE IMPROVED MANAGEMENT

The following guidelines are designed to assist proponents as they develop their research proposals as well as the reviewers of such proposals. These guidelines relate only to those aspects of proposals that are aimed at improving management; proposals may often also include objectives unrelated to management. Proponents will normally provide an evaluation of:

(a) the potential benefits to management (and whether there is already evidence that such benefits exist or whether this is still unclear); and
(b) the likelihood that the research (including data collection and analysis within the timeline of the research) will be able to achieve the benefits within its stated timeline.

Proponents may also wish to provide a cost-benefit evaluation of alternative methods of obtaining and analysing data obtained using different techniques (e.g. lethal versus non-lethal) in the context of the levels of improved management expected.

It is noted that prior to long-term research proposals, proponents may include feasibility components intended to feed into the types of information/analyses envisaged below.

Proposals aimed at improved management would normally:

(1) include at least one objective of the research that can be expressed in a quantitative manner where the probability of success can in principle be evaluated, at least in a qualitative manner as outlined below (e.g. high, medium, low);
(2) express improved management as providing a greater level of catch without increasing risk to the stock(s) concerned, either by:
    - directly identify an improved management procedure given the current range of uncertainties; or
    - showing that additional research can, with reasonable probability, reduce the range of plausible hypotheses and thus uncertainty (i.e. a value of information approach).
(3) use a simulation test framework to demonstrate likely success and to provide some associated quantification unless some compelling reasons to the contrary can be offered (success of the approach proposed in other applications is a valuable but not sufficient basis for demonstration); and
(4) ensure that the test framework relates closely to the stock to which the proposal refers, taking into account the properties of existing data for the stock as well as future data planned to be collected.

Proponents might contact the Scientific Committee to form an Advisory Committee who would provide (technical) guidance on aspects of the analyses.

The guidance from an Advisory Committee would be non-binding on the proponents and following the guidance would not mean that the members of the Advisory Committee will automatically agree that the methodology is sufficient.

Establishment of an Advisory Committee could be especially beneficial for nations who lack the technical expertise and experience with the types of analyses outlined in (3)-(5), such as developing countries.

**Appendix 3**

**THE SPECIFICATIONS FOR THE *IMPLEMENTATION SIMULATION TRIALS* FOR WESTERN NORTH PACIFIC BRYDE'S WHALES**

C. Allison and C.L. de Moor

## A. Basic concepts and stock-structure

The trials detailed below consider the implications of alternative variants of the RMP for Bryde's whales in sub-areas 1 and 2 of the western North Pacific (Fig. 1). Sub-area 1 is further sub-divided into sub-areas 1W and 1E at 165°E. The trials model two stocks (Stocks 1 and 2) and explore alternative placements of the boundary between them and the area of overlap (if any). The sub-areas are further divided into smaller 'Component-areas' (see Fig. 1 and Table 1) to enable these alternatives to be tested.

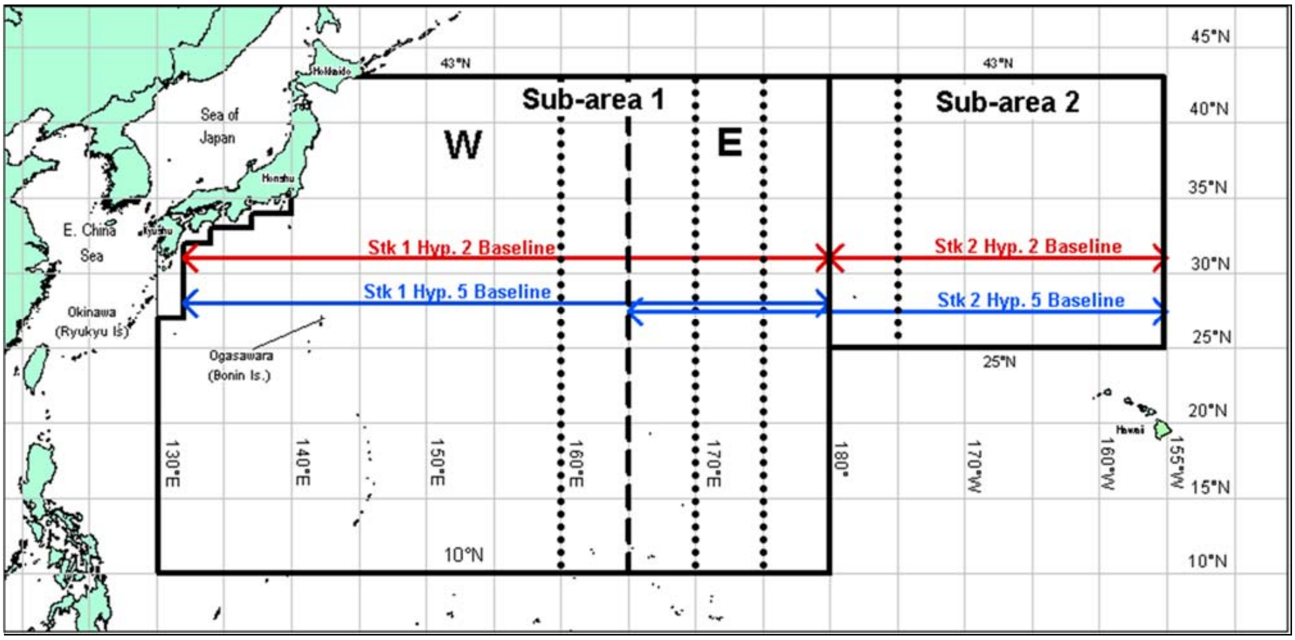


Fig. 1. Map of the western North Pacific showing the sub-areas defined for the western North Pacific Bryde's whales. The ranges of the stocks for Hypotheses 2 and 5 (baselines) are also shown. The boundary between the sub-areas 1W and 1E at 165°E, indicated by a dashed line, is a management boundary (used by the RMP). The dotted lines at 160°E, 170°E, 175°E and 175°W denote the boundaries between the "Component-areas" and are used for trials in which the true boundary between the stocks differs from the boundary on which the RMP is based. The staggered border to the south of Japan is used to ensure that no catches of the inshore form are included in these trials.

There are two general hypotheses regarding stock structure[2]:

(1) Stock structure hypothesis 2. There are two stocks of Bryde's whales in sub-areas 1 and 2. One stock is found in sub-area 1 and the other is found in sub-area 2. The trials investigate sensitivity to the position of the boundary between the stocks.

(2) Stock structure hypothesis 5. There are two stocks of Bryde's whales in sub-areas 1 and 2. One stock is found in sub-area 1W and the other is found in sub-area 2. Sub-area 1E is a region of mixing. The trials explore various assumptions regarding the regions of mixing.

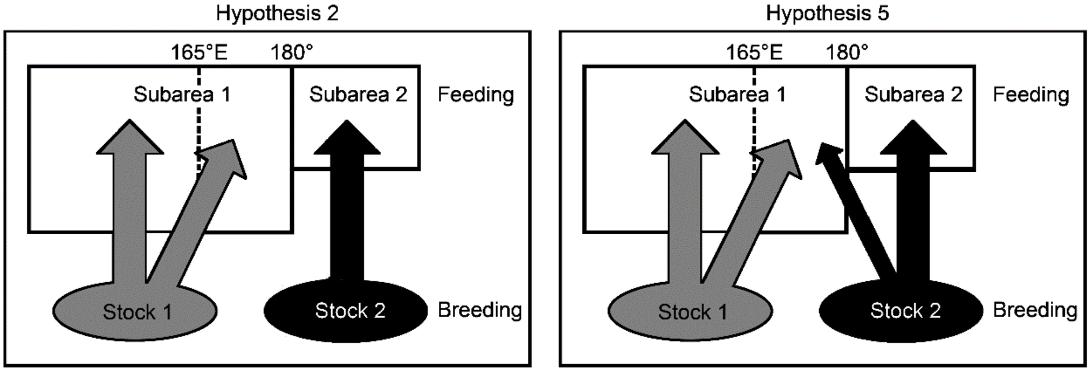


Fig. 2 The two hypotheses considered in the *Implementation Simulation Trials.*

[2] Note that stock structure hypotheses 1, 3 and 4 developed in the previous *Implementation* are not carried forward here; for consistency the hypothesis numbers have not been changed.

**B. Basic dynamics**

The dynamics of the animals in stock *j* are governed by equation B.1:

$$N_{t+1,a}^{g,j} = \begin{cases} 0.5\, b_{t+1}^{j} & \text{if } a = 0 \\ (N_{t,a-1}^{g,j} - C_{t,a-1}^{g,j})\tilde{S}_{t,a-1}^{j} & \text{if } 1 \le a < x \\ (N_{t,x}^{g,j} - C_{t,x}^{g,j})\tilde{S}_{t,x}^{j} + (N_{t,x-1}^{g,j} - C_{t,x-1}^{g,j})\tilde{S}_{t,x-1}^{j} & \text{if } a = x \end{cases} \quad \text{(B.1)}$$

where $N_{t,a}^{g,j}$ is the number of animals of gender *g* and age *a* in Stock *j* at the start of year *t*;

$C_{t,a}^{g,j}$ is the catch (in number) of animals of gender *g* and age *a* in Stock *j* during year *t* (whaling is assumed to take place in a pulse at the start of each year);

$b_t^j$ is the number of calves born to females from Stock *j* at the start of year *t*;

$\tilde{S}_{t,a}^{j}$ is the survival rate = $e^{-M_{t,a}^j}$ where $M_{t,a}^j$ is the instantaneous rate of natural mortality for animals of age *a* in Stock *j* during year *t* (assumed to be independent of gender); and

$x$ is the maximum age (treated a plus-group);

Note that *t*=0, the year for which catch limits might first be set, corresponds to 2017.

**C. Births**

For most trials (including the baseline trials), density-dependence is assumed to be a function of the 1+ component of the population[3].

$$b_t^j = B^j N_t^{f,j}\{1 + A^j(1-(N_t^{D,j}/K^{D,j})^{z^j})\} \quad \text{(C.1)}$$

where $B^j$ is the average number of births (of both sexes) per year for a mature female in Stock *j* in the pristine population;

$A^j$ is the resilience parameter for Stock *j*;

$z^j$ is the degree of compensation for Stock *j*;

$N_t^{\text{f},j}$ is the number of 'mature' females in Stock *j* at the start of year *t*

$$N_t^{\text{f},j} = \sum_{a=a_m}^{x} N_{t,a}^{\text{f},j} \quad \text{(C.2)}$$

$a_m$ is the age-at-first-parturition (the convention of referring to the mature population is used here, although this actually refers to animals that have reached the age of first parturition);

$N_t^{D,j}$ is the number of whales in the density-dependent component of Stock *j* at the start of year *t*. In these trials:

$$N_t^{D,j} = \sum_{a=1}^{x}(N_{t,a}^{\text{f},j} + N_{t,a}^{\text{m},j}) \quad \text{(C.3)}$$

and

$K^{D,j}$ is the number of whales in the density dependent component of Stock *j* in the pristine (pre-exploitation written as *t*=-∞) population.

$$K^{D,j} = \sum_{a=1}^{x}(N_{-\infty,a}^{\text{f},j} + N_{-\infty,a}^{\text{m},j}) \quad \text{(C.4)}$$

The values of the parameters $A^j$ and $z^j$ for each stock are calculated from the values for $MSYL^j$ and $MSYR^j$ (Punt, 1999). Their calculation assumes harvesting equal proportions of males and females.

**D. Natural mortality**

Natural mortality is assumed to be density-dependent in trials Br9 and Br10, i.e.:

$$M_{t,a}^j = M_a X_t^j \quad \text{(D.1)}$$

where $M_a$ is the rate of natural mortality for an animal of age *a* in the pristine population;

$X_t^j$ is the density-dependence term for natural mortality (Johnson and Punt, 2015):

$$X_t^j = \frac{1 + A^{\text{M},j}(N_t^{D,j}/K_t^{D,j})^{z^{\text{M},j}}}{1 + A^{\text{M},j}} \quad \text{(D.2)}$$

$A^{\text{M},j}$ is the resilience parameter for Stock *j*; and

$z^{\text{M},j}$ is the degree of compensation for Stock *j*.

[3]This was changed at the Feb 2018 Workshop. In earlier RMP trials, density-dependence was assumed to be a function of the mature female component of the population. The control program retains the option to act on the mature female component.

In these trials the number of calves born becomes:

$$b_t^j = B^j N_t^{f,j} \tag{D.3}$$

**E. Catches**

It is assumed that whales are homogeneously distributed across a Component-area. The catch limit for a Component-area is therefore allocated to stocks by gender and age relative to their true density within that Component-area and a mixing matrix $V$ (that is independent of year, gender and age in these trials), i.e.:

$$C_{t,a}^{g,j} = \sum_k F_t^{g,k} V^{j,k} S_{t,a}^k N_{t,a}^{g,j} \tag{E.1}$$

$$F_t^{g,k} = \frac{C_t^{g,k}}{\sum_{j'} V^{j',k} \sum_{a'} S_{t,a'}^k N_{t,a'}^{g,j'}} \tag{E.2}$$

where $F_t^{g,k}$ is the exploitation rate in Component-area $k$ on recruited animals of gender $g$ during year $t$;
$S_{t,a}^k$ is the selectivity on animals of age $a$ in Component-area $k$ during year $t$;
$C_t^{g,k}$ is the catch of animals of gender $g$ in Component-area $k$ during year $t$; and
$V^{j,k}$ is the fraction of animals in Stock $j$ that is in Component-area $k$ during year $t$.

The historical (pre-2017) catches by Component-area and year are set to one of three series (see Adjunct 1); or, in the future, are determined using the RMP. There are no incidental catches. The sex ratio for future catches is assumed to be 50:50.

**F1. Mixing**

The entries in the mixing matrix $V$ are selected to model the distribution of each stock at the time when the catch is removed. Mixing is deterministic. Table 1 lists the mixing matrices for each of the stock structure hypotheses.

Table 1

The catch mixing matrices. The $\gamma$s indicate that the entry concerned is to be estimated during the conditioning process. The shaded areas show the areas in which the stocks mix.

| | | Sub-Area | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1W | | 1E | | | 2 | |
| Stock structure hypothesis | Component Area | 1Wa 130-160°E | 1Wb 160-165°E | 1Ea 165-170°E | 1Eb 170-175°E | 1Ec 175°E-180° | 2a 180°-175°W | 2b 175-155°W |
| 2. Baseline. | Stock 1 | 4 | 1 | $\gamma_1$ | $\gamma_1$ | $\gamma_1$ | 0 | 0 |
| | Stock 2 | 0 | 0 | 0 | 0 | 0 | 1 | 4 |
| 2. Trial Br6 | Stock 1 | 4 | 1 | $\gamma_1$ | $\gamma_1$ | 0 | 0 | 0 |
| | Stock 2 | 0 | 0 | 0 | 0 | Y | 1 | 4 |
| 5. Baseline | Stock 1 | 4 | 1 | $\gamma_1$ | $\gamma_1$ | $\gamma_1$ | 0 | 0 |
| | Stock 2 | 0 | 0 | $\gamma_2$ | $\gamma_2$ | $\gamma_2$ | 1 | 4 |
| 5. Trials Br7 | Stock 1 | 1 | $\gamma_3$ | $\gamma_3$ | $\gamma_3$ | 0 | 0 | 0 |
| | Stock 2 | 0 | $\gamma_4$ | $\gamma_4$ | $\gamma_4$ | Y | 1 | 4 |
| 5. Trials Br8 | Stock 1 | 4 | 1 | 1 | $Y\gamma_5$ | $Y\gamma_5$ | $\gamma_5$ | 0 |
| | Stock 2 | 0 | 0 | 0 | $Y\gamma_6$ | $Y\gamma_6$ | $\gamma_6$ | 1 |

- The 4:1 ratios used in sub-area 1W are calculated from the ratio of the areas of sub-area 1Wa and 1Wb, but ignoring the area to the South of Japan between 130 -140°E as very few Bryde's whales are seen there.
- Y is calculated using the ratio of the number of degrees of latitude covered by the two areas 1Ec and 2a, i.e. Y=33/18.
- For Hypothesis 2, the ratio of the number of Stock 1 whales in sub-area 1W to that in 1E is estimated during conditioning using the relative abundance in the two sub-areas. In trials Br6, the boundary between the two stocks changes from 180° to 175°E.
- For Hypothesis 5, the density of each stock is assumed to be uniform across the mixing area band.

**F2. Boundary**

The management boundaries (i.e., the boundaries used by the RMP) are fixed at 165°E and 180° for all trials. In the baseline trials, the boundary between sub-areas 1W and 1E and that between 1E and 2 used when modelling the true population dynamics is the same as that used when applying the RMP i.e. at 165°E and 180°, respectively. However, a different boundary is used for some of the trials. Trials Br6 assume the boundary between Stocks 1 and 2 is at 175˚E. Stock structure hypothesis 5 assumes mixing between Stocks 1 and 2 in an intermediate area. This intermediate area corresponds to sub-area 1E for the baseline version of hypothesis 5. In trials Br7 the intermediate area is 5° further west than for the baseline trial, while in trials Br8 the intermediate area is 5° further east (Fig. 3).

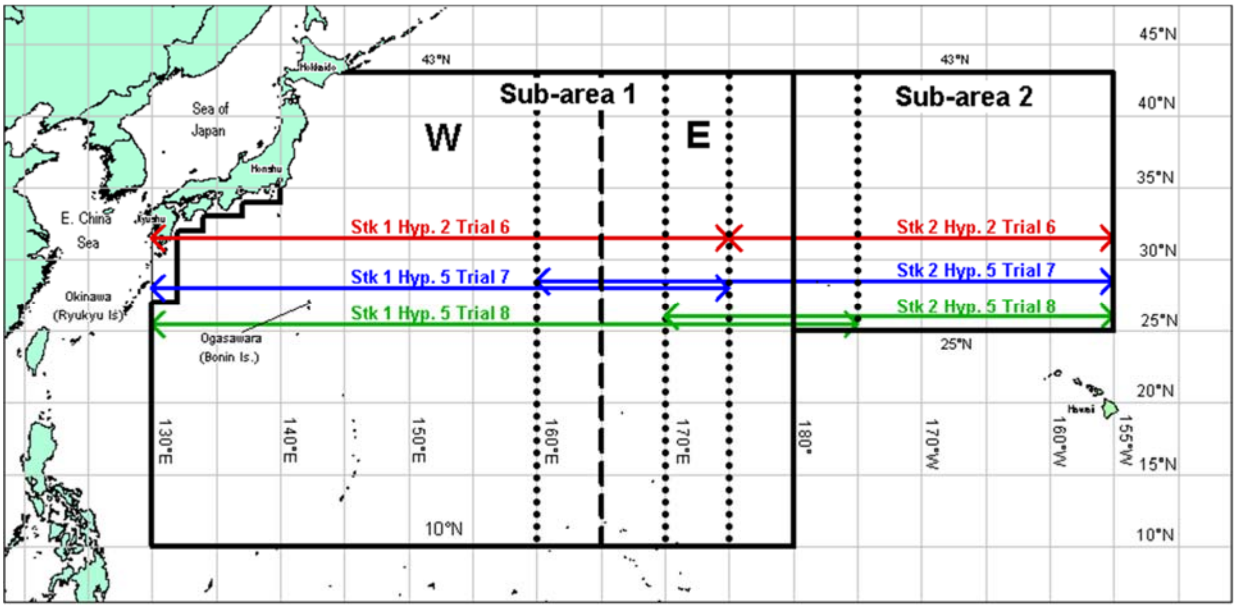


Fig. 3. The ranges of the stocks tested in trials 6, 7 and 8.

## G. Generation of data

The actual historical estimates of absolute abundance (and their associated CVs) provided to the RMP are listed in Table 2. Four ways of generating future survey data are considered. This allows for two alternative survey plans (Table 3) and two alternative southern survey boundaries in sub-areas 1W and 1E (at 10°N and 20°N). When future surveys are assumed to be conducted to 10˚N in sub-areas 1W and 1E, future surveys are assumed to cover each of sub-areas 1W, 1E and 2 in their entirety. This may be a simplification of reality for future survey option 2 (Table 3). The trials assume that it takes two years for the results of a sighting survey to become available to be used by the RMP, i.e. a survey conducted in 2020 could first be used for setting the catch limit in 2022.

The future estimates of abundance for a survey area *E* are generated using the formula:

$$\hat{P} = P\,Y\,w\,/\,\mu = P^*\,\beta^2\,Y\,w \qquad \text{(G.1)}$$

where $Y$ is a lognormal random variable $Y = e^{\varepsilon}$ where $\varepsilon \sim N(0;\sigma_\varepsilon^2)$ and $\sigma_\varepsilon^2 = \ell\text{n}(\alpha^2+1)$ ;

$P$ is the current total (1+) population size in survey area *E*:

$$P = P_t^E = \sum_{k\in E}\sum_j V_t^{j,k}\sum_g\sum_{a\geq 1} N_{t,a}^{g,j} \qquad \text{(G.2)}$$

$w$ is a Poisson random variable with $E(w) = \text{var}(w) = \mu = (P/P^*)/\beta^2$ , *Y* and *w* are independent; and

$P^*$ is the reference population level, and is equal to the expected total (1+) population size in the survey area prior to the commencement of exploitation in the area being surveyed (where the expectation is taken with respect to inter-annual variation in the mixing matrix).

Note that under the approximation $CV^2(ab) \cong CV^2(a)+CV^2(b)$ , $E(\hat{P}) \cong P$ and $CV^2(\hat{P}) \cong \alpha^2+\beta^2P^*/P$ .

For consistency with the first stage screening trials for a single stock (IWC, 1991, p.109; IWC 1994, p.85-6), the ratio $\alpha^2:\beta^2 = 0.12:0.025$ , so that:

$$CV^2(\hat{P}) = \tau(0.12+0.025P^*/P) \qquad \text{(G.3)}$$

The value of $\tau$ is calculated from the survey sampling CV's of earlier surveys in survey-area *E*. If $\overline{CV^2}$ is the average value of $CV^2$ estimated for each of these surveys, and $\overline{P}$ is the average value of the total (1+) population sizes in area *E* in the years of these surveys, then:

$$\tau = \overline{CV^2}\,/\,(0.12+0.025P^*/\overline{P}) \qquad \text{(G.4)}$$

Note therefore that:

$$\alpha^2 = 0.12\tau \qquad \beta^2 = 0.025\tau \qquad \text{(G.5)}$$

The above equations apply in the absence of additional variance. In these trials, an additional variance $CV_{add}$, is incorporated by making the following adjustment:

$$\sigma_\varepsilon^2 = \ell n\left(1+\alpha^2+CV_{add}^2\right) \qquad \text{(G.6)}$$

$CV_{add}$, = 0.335 in the baseline trials (SC/67a/RMP04), while for trials Br5, $CV_{add}$ = 0.737 [see item 3.2.3 of Feb 2018 workshop report].

An estimate of the $CV$ is generated for each sighting survey estimate of abundance $\hat{P}$ :

$$CV\left(\hat{P}\right)^2_{est} = \sigma^2\chi^2 / n \quad \text{(G.7)}$$

where $\sigma^2 = \ell n\left(1+\alpha^2+\beta^2 P^*/\hat{P}\right)$, and

$\chi^2$ is a random number from a Chi-square distribution with $n$ degrees of freedom (where $n$=10 as used for the North Pacific minke whale *Implementation Simulation Trials*; IWC, 2004).

Table 2

The estimates of abundance and their sampling errors. These estimates of abundance correspond to an western boundary of 130°E for sub-area 1W and a southern boundary of 10°N for sub-areas 1W and 1E. Additional estimates corresponding to the smaller area with a southern boundary of 20°N are also provided for sub-areas 1W and 1E. The methods used to derive these values from the original abundance estimates in cases where the survey area differed from the area used here, were agreed in Feb2018 report. The estimates of abundance in sub-areas 1E and 2 exclude the portion of the sub-area north of 40˚N (see Annex F, Feb2018 report), with the corresponding assumption that a negligible number of whales are found in this area. Survey-specific g(0) values are used (SC67b/ASI/15rev1) with an assumed constant $g$(0) CV=0.25.

| | | | Southern boundary of 10˚N in sub-areas 1W and 1E | | | | Southern boundary of 20˚N in sub-areas 1W and 1E | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Survey-specific $g$(0) | $g$(0) = 1 | | Survey-specific $g$(0) | | $g$(0) = 1 | | Survey-specific $g$(0) | |
| Sub-area | Year | | Estimate | Sampling CV | Estimate | Sampling CV | Estimate | Sampling CV | Estimate | Sampling CV |
| 1W | 1995[4] | 0.671 | 8,152 | 0.329 | 12,149 | 0.413 | 5,110 | 0.192 | 7,604 | 0.315 |
| | 2000 | 0.719 | 4,957 | 0.398 | 6,894 | 0.470 | 4,222 | 0.317 | 5,872 | 0.404 |
| | 2011 | 0.613 | 24,536[1] | 0.313 | 40,026 | 0.401 | 20,386[2] | 0.274 | 33,256 | 0.371 |
| 1E | 1995[4] | 0.689 | 10,814 | 0.342 | 15,695 | 0.424 | 7,246 | 0.479 | 10,517 | 0.540 |
| | 2000 | 0.584 | 11,213 | 0.498 | 19,200 | 0.557 | 9,251 | 0.295 | 15,841 | 0.387 |
| | 2011 | 0.721 | 6,914[3] | 0.211 | 9,589 | 0.327 | 6,716 | 0.216 | 9,315 | 0.330 |
| 2 | 1995[4] | 0.659 | 2,860 | 0.372 | 4,340 | 0.448 | | | | |
| | 2000 | 0.712 | 4,331 | 0.553 | 6,083 | 0.607 | | | | |
| | 2014 | 0.641 | 4,161 | 0.264 | 6,491 | 0.364 | | | | |

[1] This estimate was revised from15,422 [CV=0.289] to account for unsurveyed areas between 130-140°E and 10-20°N (Adjunct 2).
[2] This estimate was revised from 15,422 [CV=0.289] to account for unsurveyed areas between 10-20°N (Adjunct 2).
[3] This estimate was revised from 6,716 [CV=0.216] to account for unsurveyed areas between 10-20°N (Adjunct).
[4] The 1995 estimates are only used in conditioning and in the calculation of $x_{1W}$ and $x_{1E}$ , and not passed to the RMP.

*Future surveys covering smaller areas than historical surveys*

When future surveys are assumed to be conducted south to 20˚N in sub-areas 1W and 1E, the future survey estimates of abundance in these sub-areas is given by $\hat{P}_{k\prime} = x_k\hat{P}_k$, where $\hat{P}_k$ is provided by equation (G.1) for sub-area $k$, and the proportions are generated from normal distributions $x_{1W}{\sim}Beta(0.77, 0.12^2)$ and $x_{1E}{\sim}Beta(0.82, 0.15^2)$. These normal distributions are given the mean and standard deviations of the proportions of the three historical survey estimates of abundance in these sub-areas that was north of 20°N.

Table 3

Sighting survey plan. All surveys are conducted in Jul-Aug.

| Season | Option 1<br>130°-165°E | 165°E-180° | 180°-160°W | Option 2<br>130°-140°E | 140°-152.5°E | 152.5°-165°E | 165°E-180° | 180°-160°W |
|---|---|---|---|---|---|---|---|---|
| Sub-Area | 1W | 1E | 2 | 1W | 1W | 1W | 1E | 2 |
| 2017 | | | | | | | | |
| 2018 | | | | | | | | |
| 2019 | | | | | | | | |
| 2020 | Yes[1] | | | Yes | | | | |
| 2021 | | | | | Yes[2] | | | |
| 2022 | | Yes | | | | Yes | | |
| 2023 | | | | | | | Yes | |
| 2024 | | | Yes | | | | | Yes |
| 2025 | | | | Yes | | | | |
| 2026 | Yes[1] | | | | Yes[2] | | | |
| 2027 | | | | | | Yes | | |
| 2028 | | Yes | | | | | Yes | |
| 2029 | | | | | | | | Yes |
| 2030 | | | Yes | Yes | | | | |
| 2031 | | | | | Yes[2] | | | |
| 2032 | Yes[1] | | | | | Yes | | |
| and so on in this pattern | | | | | | | | |

[1] The survey effort in 1W will be double that of the past and thus $CV^2(\hat{P}) = \tau(0.12 + 0.025P^*/P)$ in equation (G,3) is replaced by $CV^2(\hat{P}) = \tau(0.12 + 0.025P^*/P)/\sqrt{2}$, prior to $CV_{add}$ being incorporated in equation (G.7). [2] Future surveys of sub-area 1W will be modelled to occur in a single year, although in practice it will take 3 years to survey the whole sub-area. Assuming the whales are distributed equally throughout the three part-areas of sub-area 1W surveyed, the variance from each of these annual surveys would be $(P/3 * SE)^2 = (P^2/9)(CV^2 + CV_{add}^2)$. The variance for 1W will thus be 3 times this, giving an effective CV of $\sqrt{(CV^2 + CV_{add}^2)/3}$, and equation (G.6) is replaced by $\sigma_\varepsilon^2 = ln[1 + (\alpha^2 + CV_{add}^2)/3]$. For this future survey plan, the additional CV increases to $CV_{add} = 0.767$ for sub-area 1W and for Trials Br05 to $CV_{add} = 1.516$ (Adjunct 3).

Table 4

The values for the biological and technological parameters that are fixed.

| Parameter | Value |
|---|---|
| Plus group age, $x$ | 15 yrs |
| Natural mortality, $M_a$ | 0.08yr$^{-1}$ |
| Age-at-first-parturition, $a_m$ | 9 years (See Annex I of SC/67a/Rep07: calculated as 8.6) |
| Selectivity (historical) | |
| Sub-area 1W: | Knife-edged at age 5 (IWC, 2000, 2005) |
| Sub-areas 1E & 2: | Knife-edged at age 9 (IWC, 2000, 2005) |
| Selectivity (future) | Knife-edged at age 5 (IWC, 2007 p415) |
| Maximum Sustainable Yield Level, *MSYL* | 0.6 in terms of the1+ component of the population |

**H. Parameters and conditioning**

The values for the biological and technological parameters are listed in Table 4. In relation to selectivity, historically a 35ft (10.7m) legal minimum size limit applied to coastal whaling and a 40ft (12m) limit applied to pelagic operations. These size limits correspond to ages of five and nine years respectively (Ohsumi, 1977). The size limits are implemented by making selectivity depend on sub-area. Historically, pelagic whaling occurred in sub-areas 1E and 2, and coastal whaling in sub-area 1W. Therefore, selectivity is assumed to be knife-edged at age five for sub-area 1W, while selectivity for sub-areas 1E and 2 is assumed to be knife-edged at age nine. All future catches are assumed have a knife-edged selectivity at age five (hence the $t$-subscript on $S$ in equations E.1 and E.2)**.**

The 'free' parameters of the above model are the initial (pre-exploitation) sizes of each of the stocks and the values that determine the mixing matrices. The process used to select the values for these 'free' parameters is known as conditioning. The conditioning process involves first generating 100 sets of 'target' data, detailed in steps (a) and (b) below, and then fitting the population model to each (in the spirit of a bootstrap). The number of animals in Component-area $k$ at the start of year $t$ is calculated starting with guessed values of the initial population sizes and projecting the operating model forward to 2017 to obtain values of abundance by stock and mixing proportions for comparison with the generated data.

(a) The 'target' values for the historical abundance by survey-area are generated using the formula:

$$P_t^E = O_t^E \exp[\mu_t^E - (\sigma_t^E)^2/2]\,;\;\; \mu_t^E \sim N[0;(\sigma_t^E)^2] \tag{H.1}$$

where $P_t^E$ is the abundance for survey-area $E$ in year $t$;

$O_t^E$ is the actual survey estimate for survey-area $E$ in year $t$ (Table 2, 10°N southern boundary); and

$\sigma_t^E$ is the CV of $O_t^E$ (Table 2).

(b) The 'targets' for the mixing proportion in the mixing area trials based on stock structure hypothesis 5 are generated from normal distributions (mean and SD given in Table 5), truncated at 0 and 1.

Table 5

Estimates and asymptotic standard errors for the mixing proportions between Stocks 1 and 2 in Hypothesis 5 trials (Punt 2018).

| Area | Average proportion of Stock 1 between 2004-2014 (from JARPNII/POWER samples) | Standard Error | Proportion of Stock 1 in 1979 (from commercial samples) | Standard Error |
|---|---|---|---|---|
| Baseline: 165°E-180° | 1.000 | 0.114 | 0.851 | 0.132 |
| Trial Br7: 160°E-175°E | 0.900 | 0.065 | 0.933 | 0.057 |
| Trial Br8: 170°E-175°W | 0.644 | 0.144 | 1.000 | 0.467 |

**I. Calculation of the Likelihood**

The likelihood function consists of two components. Equations H.2 and H.3 list the negative of the logarithm of the likelihood for each of these components so the objective function minimised is $L_1$+$L_2$, where $L_2$ only applies for Hypothesis 5. An additional penalty is added to the likelihood if the full historical catch is not removed.

*Abundance estimates*

$$L_1 = 0.5\sum_n \frac{1}{(\sigma_n)^2}\ell n\left(P_n/\hat{P}_n\right)^2 \tag{H.2}$$

where $\hat{P}_n$ is the model estimate of the 1+ abundance in the same year and survey-area as the $n^{\text{th}}$ estimate of abundance $P_n$ (the target abundances).

*Mixing proportions*

$$L_2 = 0.5\frac{1}{\sigma_{79}^2}\left(p_{79}-\hat{p}_{79}\right)^2 + 0.5\frac{1}{\sigma_{04}^2}\left(p_{04}-\hat{p}_{04}\right)^2 \tag{H.3}$$

where $\hat{p}_{79}$ is the model estimate of the proportion of Stock 1 animals in the mixing area[4] in 1979,

$\hat{p}_{04}$ is the average of the model estimate of the proportion of Stock 1 animals in the mixing area[3] over 2004 to 2014, and

$p_{79}$ and $p_{04}$ are the 'target' mixing proportions from commercial samples in 1979 and JARPNII/POWER survey samples between 2004-2014, respectively, given in Table 5.

## J. Trials

The *Implementation Simulation Trials* for the western North Pacific Bryde's whales are listed in Table 6. All of the trials are based on the assumption g(0)=0.672. Table 7 lists the factors used in the trials. These trials will be run under the following four future survey options:

i) Future survey option 1 (see Table 3), with surveys in sub-areas 1W and 1E conducted south to 10˚N
ii) Future survey option 1 (see Table 3), with surveys in sub-areas 1W and 1E conducted south to 20˚N
iii) Future survey option 2 (see Table 3), with surveys in sub-areas 1W and 1E conducted south to 10˚N
iv) Future survey option 2 (see Table 3), with surveys in sub-areas 1W and 1E conducted south to 20˚N

Table 6

The *Implementation Simulation Trials* for the Western North Pacific Bryde's whales.

| Trial | Stock structure hypothesis | MSYR[1] | Additional variance | Catch series | Western boundary of Stock 2 | Eastern boundary of Stock 1 | Comment |
|---|---|---|---|---|---|---|---|
| Br1-1 | 2 | 1 | Baseline | Best | 180° | 180° | Baseline stock structure hypothesis 2 |
| Br1-4 | 2 | 4 | Baseline | Best | 180° | 180° | Baseline stock structure hypothesis 2 |
| Br2-1 | 5 | 1 | Baseline | Best | 165°E | 180° | Baseline stock structure hypothesis 5 |
| Br2-4 | 5 | 4 | Baseline | Best | 165°E | 180° | Baseline stock structure hypothesis 5 |
| Br3-1 | 5 | 1 | Baseline | **Low** | 165°E | 180° | Stock hypothesis 5 with low catches |
| Br3-4 | 5 | 4 | Baseline | **Low** | 165°E | 180° | Stock hypothesis 5 with low catches |
| Br4-1 | 5 | 1 | Baseline | **High** | 165°E | 180° | Stock hypothesis 5 with high catches |
| Br4-4 | 5 | 4 | Baseline | **High** | 165°E | 180° | Stock hypothesis 5 with high catches |
| Br5-1 | 5 | 1 | **Upper CI** | Best | 165°E | 180° | Stock hypothesis 5 with higher additional variance |
| Br5-4 | 5 | 4 | **Upper CI** | Best | 165°E | 180° | Stock hypothesis 5 with higher additional variance |
| Br6-1 | 2 | 1 | Baseline | Best | 175°E | **175°E** | Stock hypothesis 2 with alternative boundaries 1 |
| Br6-4 | 2 | 4 | Baseline | Best | 175°E | **175°E** | Stock hypothesis 2 with alternative boundaries 1 |
| Br7-1 | 5 | 1 | Baseline | Best | **160°E** | **175°E** | Stock hypothesis 5 with alternative boundaries 1[2] |
| Br7-4 | 5 | 4 | Baseline | Best | **160°E** | **175°E** | Stock hypothesis 5 with alternative boundaries 1[2] |
| Br8-1 | 5 | 1 | Baseline | Best | **170°E** | **175°W** | Stock hypothesis 5 with alternative boundaries 2[2] |
| Br8-4 | 5 | 4 | Baseline | Best | **170°E** | **175°W** | Stock hypothesis 5 with alternative boundaries 2[2] |
| Br9-1 | 2 | 1 | Baseline | Best | 180° | 180° | Density-dependent *M* |
| Br9-4 | 2 | 4 | Baseline | Best | 180° | 180° | Density-dependent *M* |
| Br10-1 | 5 | 1 | Baseline | Best | 165° | 180° | Density-dependent *M* |
| Br10-4 | 5 | 4 | Baseline | Best | 165° | 180° | Density-dependent *M* |

[1]MSYR=1% is related to the 1+ component ; MSYR =4% is related to mature component
[2] Based on alternative mixing proportion data

Table 7

Factors considered in the revised trials. The values in bold are the baseline values.

| Factor | Values considered |
|---|---|
| Stock structure hypotheses | **2**, **5** |
| *MSYR* | $\boldsymbol{MSYR_{1+}}$ **= 1%;** $\boldsymbol{MSYR_{mat}}$**=4%** |
| Catch series | Low, **Best**, High |
| Additional variance | **Baseline = 0.335**, Upper 5%ile = 0.737 |
| Western boundary of Stock 2 | 160°E, **165°E**, **180°**, 170°E |
| Eastern boundary of Stock 1 | 175°E, **180°**, 175°W |

## K. Management Options

In all cases, the boundary between sub-areas 1W and 1E is defined as 165°E and that between sub-areas 1E and 2 at 180° irrespective of the true boundary used to define the structure of the populations in the operating model. The following five management options will be considered.

All future catches from sub-area 1W will be simulated to only be taken in component area 1Wa (closest to the coast of Japan).

V1 Sub-areas 1W, 1E and 2 are *Small Areas* and catch limits are set by *Small Area*.

[4]The mixing area is sub-area 1E (165˚E-180˚E) for the baseline trials, but changes to 160°E-175°E for trials Br7, and 170°E-175°W for trials Br8.

V2 Sub-area 2 is taken to be a *Small Area* and the complete sub-area 1 is treated as a *Small Area.* For this management option, all of the future catches in sub-area 1 are taken from sub-area 1W.

V3 Sub-area 2 is taken to be a *Small Area* and sub-area 1 is taken to be a *Combination area*. Sub-areas 1W and 1E are *Small Areas*, with catch-cascading applied.

V4 Sub-area 1W is taken to be a *Small Area* and sub-areas 1E and 2 (combined) are taken to be a *Combination Area*. Sub-areas 1E and 2 are *Small Areas*, with *catch-cascading* applied.

V5 Sub-areas 1 and 2 (combined) are taken to be a *Combination area*. Sub-areas 1W, 1E and 2 are *Small Areas*, with *catch-cascading* applied.

The simulated application of the RMP is based on using the "best" catch series (see Adjunct 1).

## L. Output Statistics

Population-size and continuing catch statistics are produced for each stock and catch-related statistics for each sub-area.

(1) Total catch (TC) distribution: (a) median; (b) 5th value; (c) 95th value.
(2) Initial mature female population size ($P_{\text{initial}}$) distribution: (a) median; (b) 5th value; (c) 95th value.
(3) Final mature female population size ($P_{\text{final}}$) distribution: (a) median; (b) 5th value; (c) 95th value.
(4) Lowest mature female population size ($P_{\text{lowest}}$) distribution: (a) median; (b) 5th value; (c) 95th value.
(5) Average catch by sub-area over the first ten years of the 100 year management period: a) median; b) 5th value; c) 95th value.
(6) Average catch by sub-area over the last ten years of the 100 year management period: a) median; b) 5th value; c) 95th value.

Plots are produced showing following types of outputs for all variants and the no-catch scenarios:
(a) the median population size trajectories by stock;
(b) the 5%-ile, median and 95%-ile of the population depletion trajectories by stock from year 2000 to the end of the projection period);
(c) the median catch trajectories from year 2000 onwards; and
(d) ten individual population trajectories for each stock.

In addition, plots and tables are produced summarising the application of the procedure for defining 'acceptable' - A, 'borderline' - B and 'unacceptable' - U performance, by comparison with the equivalent single stock trials – see IWC 2005 p84-92.

## M. References


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Punt 2018 Annex F of March 2017 workshop report. Estimates of mixing proportions for subarea 1E using mtDNA haplotype data.

To add in next version: Annex I of SC/67a/Rep07 SC/67a/RMP04

**Adjunct 1 [TO ADD: LOW AND HIGH SERIES]**

**The catch series used in the trials (L=low, B=best, H=high)**

| Year | 1Wa M | 1Wa F | 1Wb M | 1Wb F | 1Ea M | 1Ea F | 1Eb M | 1Eb F | 1Ec M | 1Ec F | 2a M | 2a F | 2b M | 2b F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1906 | 6 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1907 | 17 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1908 | 39 | 42 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1909 | 23 | 24 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1910 | 26 | 29 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1911 | 75 | 81 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1912 | 38 | 43 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1913 | 58 | 66 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1914 | 24 | 32 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1915 | 72 | 97 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1916 | 45 | 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1917 | 88 | 93 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1918 | 69 | 79 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1919 | 77 | 84 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1920 | 41 | 51 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1921 | 40 | 49 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1922 | 37 | 44 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1923 | 32 | 43 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1924 | 48 | 63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1925 | 55 | 63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1926 | 60 | 74 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1927 | 53 | 65 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1928 | 36 | 44 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1929 | 29 | 34 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1930 | 27 | 35 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1931 | 64 | 71 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1932 | 51 | 53 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1933 | 39 | 49 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1934 | 48 | 51 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1935 | 48 | 48 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1936 | 40 | 48 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1937 | 60 | 66 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1938 | 76 | 83 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1939 | 88 | 105 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1940 | 48 | 57 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1941 | 64 | 81 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1942 | 9 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1943 | 17 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1944 | 37 | 37 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1945 | 5 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1946 | 52 | 74 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1947 | 51 | 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1948 | 57 | 76 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1949 | 101 | 97 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1950 | 117 | 156 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1951 | 166 | 141 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1952 | 303 | 188 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1953 | 25 | 36 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1954 | 31 | 44 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1955 | 34 | 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1956 | 12 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1957 | 12 | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1958 | 113 | 141 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1959 | 153 | 110 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1960 | 188 | 216 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1961 | 83 | 84 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 209 | 295 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 100 | 110 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 25 | 43 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 1 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 2 | 0 | 0 |
| 1966 | 19 | 36 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 2 | 3 | 0 | 0 |
| 1967 | 17 | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 70 | 101 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 4 | 5 | 0 | 0 |
| 1969 | 34 | 55 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 10 | 16 | 22 | 0 | 0 |
| 1970 | 36 | 37 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 7 | 11 | 15 | 0 | 0 |
| 1971 | 96 | 121 | 0 | 0 | 37 | 54 | 19 | 19 | 62 | 93 | 48 | 70 | 23 | 29 |
| 1972 | 38 | 46 | 0 | 0 | 2 | 4 | 0 | 0 | 20 | 37 | 4 | 6 | 0 | 3 |
| 1973 | 185 | 391 | 5 | 11 | 6 | 6 | 7 | 12 | 7 | 13 | 4 | 11 | 16 | 25 |
| 1974 | 282 | 418 | 5 | 4 | 13 | 9 | 12 | 30 | 95 | 147 | 67 | 84 | 80 | 76 |
| 1975 | 349 | 331 | 9 | 12 | 17 | 37 | 72 | 76 | 40 | 54 | 89 | 119 | 138 | 89 |
| 1976 | 379 | 446 | 11 | 15 | 106 | 62 | 183 | 95 | 81 | 50 | 14 | 5 | 11 | 1 |
| 1977 | 182 | 192 | 234 | 179 | 66 | 49 | 10 | 14 | 2 | 9 | 0 | 3 | 2 | 4 |
| 1978 | 252 | 203 | 22 | 13 | 102 | 48 | 51 | 57 | 14 | 21 | 7 | 4 | 1 | 1 |

| Year | 1Wa M | 1Wa F | 1Wb M | 1Wb F | 1Ea M | 1Ea F | 1Eb M | 1Eb F | 1Ec M | 1Ec F | 2a M | 2a F | 2b M | 2b F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1979 | 589 | 517 | 81 | 53 | 23 | 13 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 2 |
| 1980 | 401 | 354 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 249 | 236 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1982 | 275 | 207 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 403 | 142 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 353 | 175 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1985 | 249 | 108 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1986 | 217 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 256 | 61 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1996 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1997 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2000 | 20 | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2001 | 17 | 33 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2002 | 25 | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 18 | 28 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2004 | 14 | 23 | 5 | 2 | 1 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 21 | 26 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2006 | 12 | 7 | 6 | 13 | 3 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2007 | 23 | 25 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2008 | 30 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2009 | 15 | 18 | 1 | 1 | 2 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2010 | 3 | 5 | 17 | 11 | 5 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2011 | 17 | 24 | 1 | 4 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2012 | 10 | 17 | 1 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2013 | 12 | 13 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2014 | 6 | 19 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2015 | 14 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2016 | 7 | 14 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

## Adjunct 2: A Strategy to Estimate Abundance for Conditioning

D. Palka

For conditioning, abundance estimates for the entire area for the entire historical time series are required. The entire area is defined as the sub-areas 1W, 1E and 2, less the hatched region between 165°E and 165°W in the northeast (Fig. 1). The abundance time series consists of three sets of abundance surveys where the abundance estimates are centred on, and therefore time stamped 1995 (1988-1996; Shimada et al. 2008 (SC60/PFI2); Figs 2-3), 2000 (1998-2002; Kitakado et al. 2008 (SC60/PFI3); Fig 4) and 2011 (2008-2015; Fig 5).

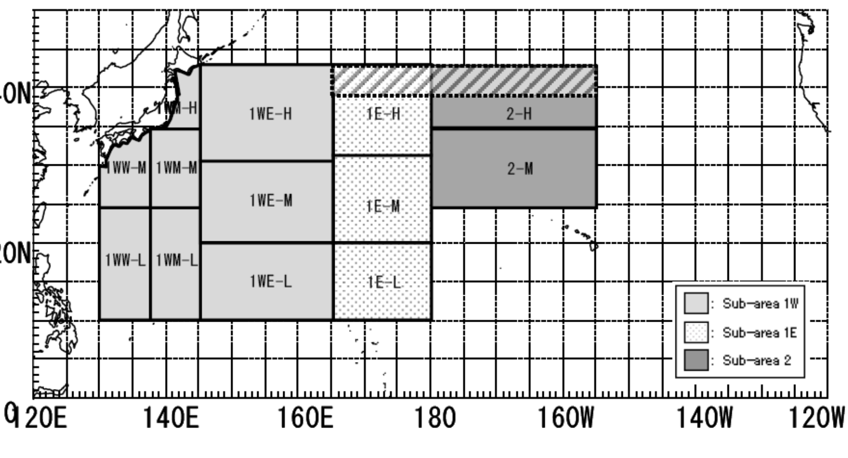



Fig. 1. Sub-areas and blocks used for the abundance estimation. "H", "M" and "L" mean high, middle and low latitudes. The northern parts (shaded) in the two blocks, 1E-H and 2-H, were excluded from the estimation of abundances, which means any detections and effort in those parts were not included in the analyses, and the abundance estimates in those blocks were calculated for the southern parts of 1E-H and 2-H. A more detailed explanation is given in Shimada et al. (2008).

The abundance for the entire area has already been estimated (and agreed by the Committee) for the first two sets of surveys that were time stamped 1995 and 2000. However, the set of surveys time stamped 2011 did not cover the whole of the 1W sub-area. Thus the previously reported abundance estimates for 1W and 1E for the 2011 set of surveys represents only a partial estimates for the 1W and 1E sub-areas, respectively. Therefore, to make the 1W and 1E abundance estimates from the 2011 set of surveys comparable to the earlier two sets of surveys, the partial 1W and 1E abundance estimates from the 2011 set of surveys must be expanded by adding an approximate estimate of the abundance in the unsurveyed areas.

The best abundance estimate for an unsurveyed sub-areas for the 2011 set of surveys was derived from the abundance estimates for these sub-areas as calculated from the 1995 and 2000 previous sets of surveys. It was assumed that for each set of surveys, the ratio of the abundance in the 2011 unsurveyed areas to the abundance in the 2011 surveyed areas were similar. Since there are two sets of previous surveys, the average ratio of unsurveyed to surveyed abundance estimates from the two previous sets of surveys was assumed to be the most representative number to use to expand the 2011 partial abundance estimates using:

$$N_{tot2011} = N_{part2011} + \left(N_{part2011} \cdot Average\left[\frac{N_{unsurv.i}}{N_{surv.i}}\right]\right) \qquad \text{eq. 1}$$

where $N_{unsurv.i}$ is the abundance in the 2011 unsurveyed sub-areas from the ith set of surveys

$N_{surv.i}$ is the abundance in the 2011 surveyed sub-areas from the ith set of surveys

$i$ is the set of surveys time stamped either 1995 or 2000.

The CV of $N_{tot2011}$ was estimated using the delta method.

The best estimates used to represent the 2000 set of surveys are the abundance estimates derived from a combination of the surveys conducted during 1998-2002, as reported in Kitakado et al. 2008, Table 3. Because combined abundances for each sub-sub-area was not available for the 1995 set of surveys, the most represent set of sub-sub-area abundance estimates was from the single year 1993 as reported in Shimado et al. 2008, Table 8a.

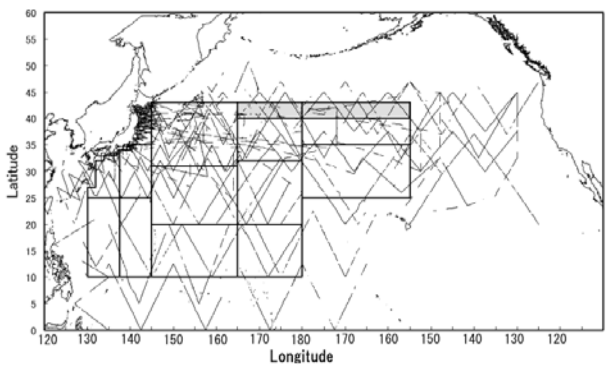


Fig. 2. Pre-determined cruise track lines on effort during the past sightings surveys in August and September, 1988-1996 (time stamp 1995). The northern part (north of 39° N) of 1E-H and 2-H block excluded this abundance estimation to keep consistency of estimation in the recent surveys that were not covered enough, shown as gray colour.

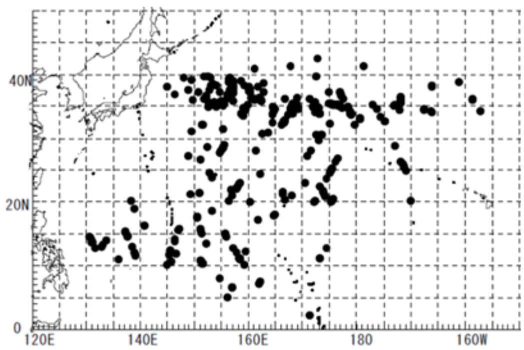


Fig. 3. Primary sighting positions of Bryde's whale during the past sighting surveys in August and September, 1988-1996 (time stamp 1995).

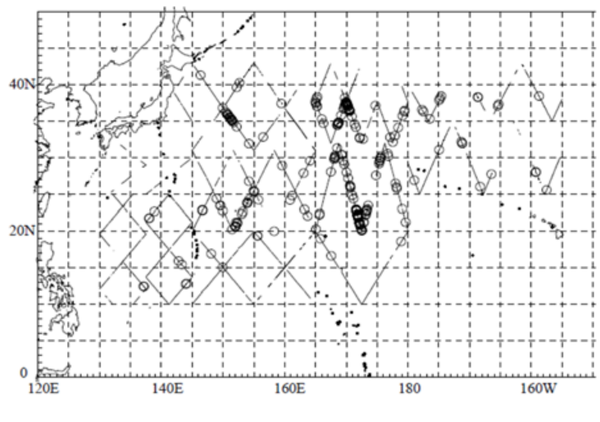


Fig. 4. Primary sighting positions of Bryde's whale and track lines on effort for surveys in August and September, 1998-2002 (time stamp 2000)

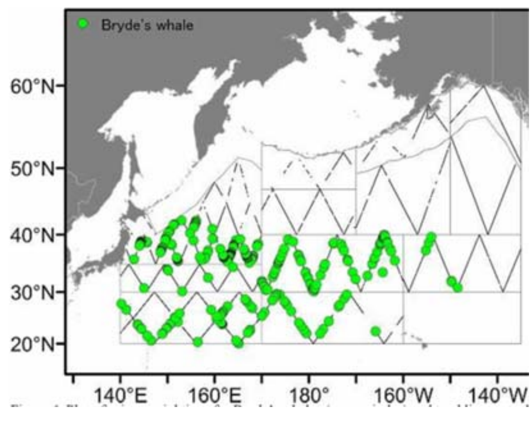


Fig. 5. Plot of primary sightings for Bryde's whales (green circles) and tracklines actually surveyed during 2008-2015 (time stamp 2011)

## Results

**1W sub-area:** The partial abundance estimate for the surveyed regions from the 2011 set of surveys in 1W is $N_{1W\text{-}part2011}$=15,422 CV=0.289. The 1W sub-sub-areas not surveyed during the 2011 set of surveys and where there were Bryde's whales are between 130°-140°E (sub-sub-areas 1WW-M, 1WW-L and 1WM-L) and between 10°-20°N (sub-sub-area 1WE-L). Sub-sub-areas 1WM-M and 1WM-H were also not surveyed in 2011, but there were no Bryde's whales detected in the earlier two set of surveys (Fig. 3 and 4), so it is assumed that there were no Bryde's whales in these sub-sub-areas during the 2011 set of surveys.

Using equation 1, the expanded 2011 abundance estimate for the entire 1W sub-area, $N_{1W\text{-}tot2011}$ (including 130°-140°E and 10°-20°N) was estimated to be 24,536 (CV=0.313; Table 1A). The expanded 2011 partial abundance estimate that represents the 1W sub-area that includes 130°-140°E, but no 10°-20°N is 20,386 (CV=0.274; Table 1B).

**1E sub-area:** The partial abundance estimate for the surveyed regions from the 2011 set of surveys in 1E is $N_{1E\text{-}part2011}$=6,716 CV=0.216. The 1E sub-sub-area not surveyed during the 2011 set of surveys is between 10°-20°N (sub-sub-area 1E-L).

Using equation 1, the expanded abundance estimate for the entire 1E sub-area, $N_{1E\text{-}tot2011}$ was estimated to be 6,914 (CV=0.211; Table 2).

## References


Kitakado, T., Shimada, H., Okamura, H. and Miyashita, T. 2008. CLA abundance estimates for western North Pacific Bryde's whales and their associated CVs with taking the additional variance into account. Paper SC/60/PFI3 presented to the IWC Scientific Committee, June 2008, Santiago, Chile (unpublished). 27pp. [Paper available from the Office of this Journal].

Shimada, H., Okamura, H., Kitakado, T. and Miyashita, T. 2008. Abundance estimate of western North Pacific Bryde's whales for the estimation of additional variance and CLA application. Paper SC/60/PFI2 presented to the IWC Scientific Committee, June 2008, Santiago, Chile (unpublished). 34pp. [Paper available from the Office of this Journal].


Table 1

Estimate of abundance for the entire 1W sub-area for the 2011 set of surveys ($N_{tot2011}$). Estimates representing the 1995 set of surveys were taken from the 1993 single year's estimates from the base case in Shimada et al. 2008 (SC60/PFI2; Table 8a). Estimates from the 2000 set of surveys were taken from run 1, Model 4 in Kitakado et al. 2008 (SC60/PFI3; Table 3).

| Timestamp year | | Unsurveyed sub-areas in 2011 set of surveys: 130°-140°E | | | Unsurveyed sub-areas in 2011 set of surveys: 10°-20°N | Surveyed sub-areas in 2011 set of surveys | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1WW-M | 1WW-L | 1WM-L | 1WE-L | 1WE-H | 1WE-M | $N_{surv.i}$ | $N_{unsurv.i}$ | total | unsurveyed/ surveyed | average extra bit | 1W $N_{part2011}$ | 2011 Unsurveyed sub-areas | **1W $N_{tot2011}$** |
| **A. Adding in unsurveyed regions between 130°-140°E and 10°-20°N** | | | | | | | | | | | | | | | |
| 1993 | Abun | 110 | 2132 | 792 | 3002 | 3531 | 3450 | 6981 | 6036 | 13017 | 0.8646 | 0.59095 | 15422 | 9113.6 | **24535.6** |
| | CV | 0.6682 | 0.5812 | 0.5627 | 0.7114 | 1.2805 | 0.5348 | 0.6995 | 0.4158 | 0.4218 | 0.8138 | 0.6225 | 0.289 | 0.6863 | **0.3130** |
| 2000 | Abun | 0 | 348 | 439 | 407 | 1238 | 2525 | 3763 | 1194 | 4957 | 0.3173 | | | | |
| | CV | 0 | 1.0632 | 0.784 | 0.7379 | 0.6371 | 0.6149 | 0.4628 | 0.4923 | 0.3708 | 0.6757 | | | | |
| **B. Adding in unsurveyed regions between 130°-140°E** | | | | | | | | | | | | | | | |
| 1993 | Abun | 110 | 2132 | 792 | 0 | 3531 | 3450 | 6981 | 3034 | 10015 | 0.4346 | 0.32185 | 15422 | 4963.6 | **20385.6** |
| | CV | 0.6682 | 0.5812 | 0.5627 | 0 | 1.2805 | 0.5348 | 0.6995 | 0.4347 | 0.5051 | 0.8236 | 0.6125 | 0.289 | 0.6773 | **0.2738** |
| 2000 | Abun | 0 | 348 | 439 | 0 | 1238 | 2525 | 3763 | 787 | 4550 | 0.2091 | | | | |
| | CV | 0 | 1.0632 | 0.784 | 0 | 0.6371 | 0.6149 | 0.4628 | 0.6421 | 0.3985 | 0.7915 | | | | |

Table 2.

Estimate of abundance for the entire 1E sub-area for the 2011 set of surveys ($N_{tot2011}$). Estimates representing the 1995 set of surveys were taken from the 1993 single year's estimates from the base case in Shimada et al. 2008 (SC60/PFI2; Table 8a). Estimates from the 2000 set of surveys were taken from run 1, Model 4 in Kitakado et al. 2008 (SC60/PFI3; Table 3).

| Timestamp year | | Unsurveyed in 2011 (10°-20°N) | Surveyed sub-areas in 2011 set of surveys | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1E-L | 1E-H | total | unsurveyed/ surveyed | average extra bit | 1E $N_{part2011}$ | 2011 Unsurveyed sub-areas | **1E $N_{tot2011}$** |
| 1993 | Abun | 622 | 13634 | 21388 | 0.03 | 0.02945 | 6716 | 197.8 | **6913.8** |
| | CV | 0.7428 | 0.7427 | 0.6442 | 0.9958 | 0.675 | 0.216 | 0.7087 | **0.2108** |
| 2000 | Abun | 315 | 3480 | 11213 | 0.0289 | | | | |
| | CV | 0.7646 | 0.5967 | 0.4765 | 0.908 | | | | |

## Adjunct 3: Future Sighting Survey Plan for North Pacific Bryde's Whale - Additional CV for Three Longitudinal Blocks in Sub-area 1W

T. Hakamada and T. Miyashita

One of the options in Japan's future sighting survey plan for North Pacific Bryde's whale is sub-area 1W divided into three longitudinal blocks: (1) 130°E-140°E; (2) 140°E-152°30'E; and (3) 152°30'E-165°E (Fig. 1). This is because the whole sub-area 1W is too large to be covered within one year survey. Estimates of additional variance for the three blocks is required.

Table 1 shows the abundance estimates and CV for estimating additional variance. In the period 2008-15, there was no abundance estimate for 1W_1 blocks. Abundance for 1988-96 was re-allocated from the value in 1993 when the surveys covered all blocks once a year in Shimada et al. 2008 (Table 8a in SC/60/PFI1). Abundance for 1998-2002 was re-allocated from those of run 1, Model 4 in Kitakado et al. 2008 (Table 3 in SC/60/PFI3). The value 2008-2015 was estimated from the original sighting data by Hakamada. The total abundance is re-allocated in proportional with (Area/Effort) for each block in the cases of 1988-96 and 1998-2002.

Since the covariances are very small (because for the abundance estimates the variance from sighting rate dominates those from the common factors of mean school size and effective search half-width), they have been neglected below in the estimation of additional variance.

Using the abundance estimate in Table 1, additional CV was estimated as 0.7670 and its upper 5th-percentile is 1.516.

### References

Kitakado, T., Shimada, H., Okamura, H. and Miyashita, T. CLA abundance estimates for western North Pacific Bryde's whales and their associated CVs with taking the additional variance into account. Document SC/60/PFI3.

Shimada, H., Okamura, H., Kitakado, T. and Miyashita, T. 2008. Abundance estimate of western North Pacific Bryde's whales for the estimation of additional variance and CLA application. Document SC/60/PFI2.

Table 1

Abundance estimates in the three longitudinal blocks of sub-area 1W for estimating additional variance.

| | 1W_1(130E-140E, 10N-43N) | | | | 1W_2 (140E-152.5E, 10N-43N) | | | | 1W_3 (152.5E-165E, 10N-43N) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year | P | CV(P) | Areal coverage (%) | Year | P | CV(P) | Areal coverage (%) | Year | P | CV(P) | Areal coverage (%) |
| 1988-1996 | 1993 | 2,506 | 0.506 | 90.9 | 1995 | 4,271 | 0.769 | 96.2 | 1995 | 6,239 | 0.675 | 76.1 |
| 1998-2002 | 2000 | 535 | 0.744 | 74.3 | 2000 | 2,579 | 0.393 | 89.8 | 2000 | 1,642 | 0.448 | 80.6 |
| 2008-2015 | | | | | 2011 | 7,097 | 0.308 | 63.4 | 2011 | 8,168 | 0.251 | 66.9 |

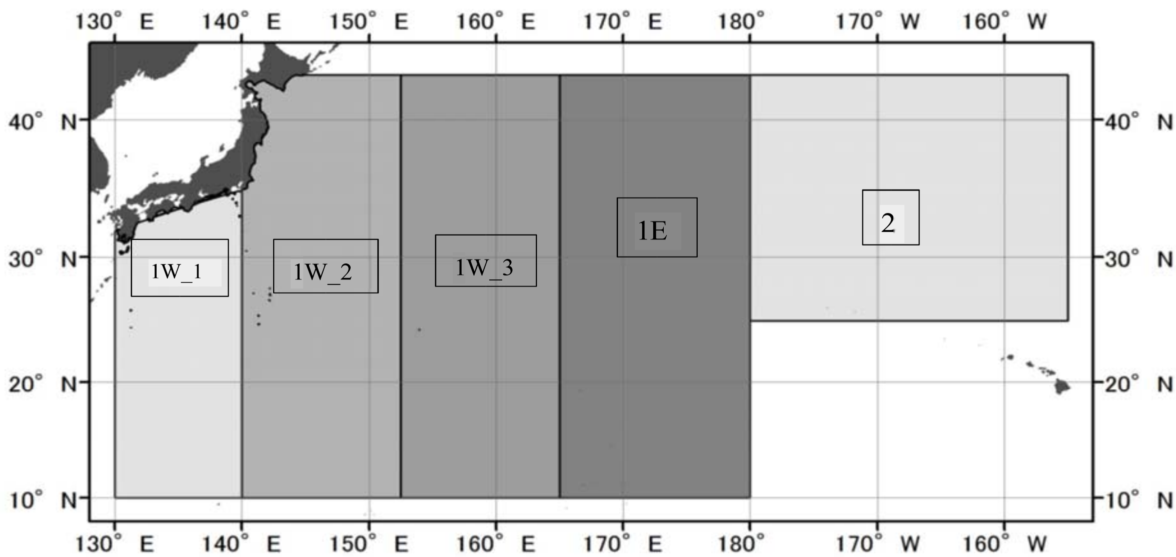



Figure 1. Three blocks (1W_1, 1W_2 and 1W_3) in sub-area 1W and sub-areas 1E and 2.

## Appendix 4

## RESULTS OF CONDITIONING THE *IMPLEMENTATION SIMULATION TRIALS* FOR NORTH PACIFIC BRYDES WHALES

C.L. de Moor

The following results are plotted.

(1) Deterministic (red line), median and 90% confidence intervals for the 1+ population. The abundance estimates are shown (x) together with 90% confidence intervals. The extended blue dashed line indicated the additional variance about the abundance estimates not used during conditioning but taken into account when generating future abundance estimates for each sub-area.

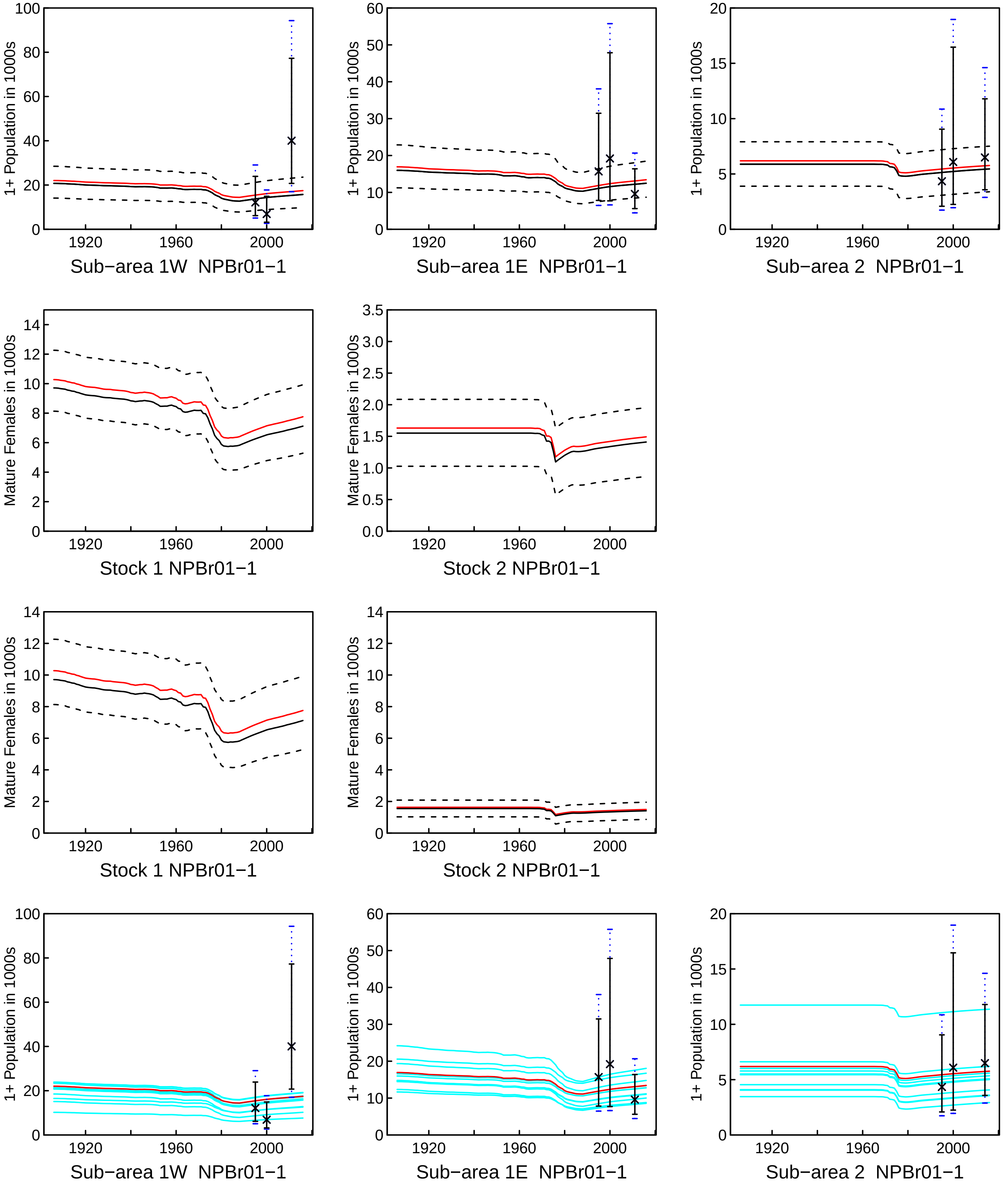
(2) Deterministic (red line), median and 90% confidence intervals for the proportion of stock 1 in the mixing area. The proportions estimated from commercial (1979) and survey (2004-14) samples are shown (x) together with 90% confidence intervals based on the sampling standard error. As target proportions are generated from truncated normal distributions, the median of the sampled targets is indicated by the green dash. Only shown for Hypothesis 5 trials.

(3) Deterministic (red line), median and 90% confidence intervals for the mature females by stock.

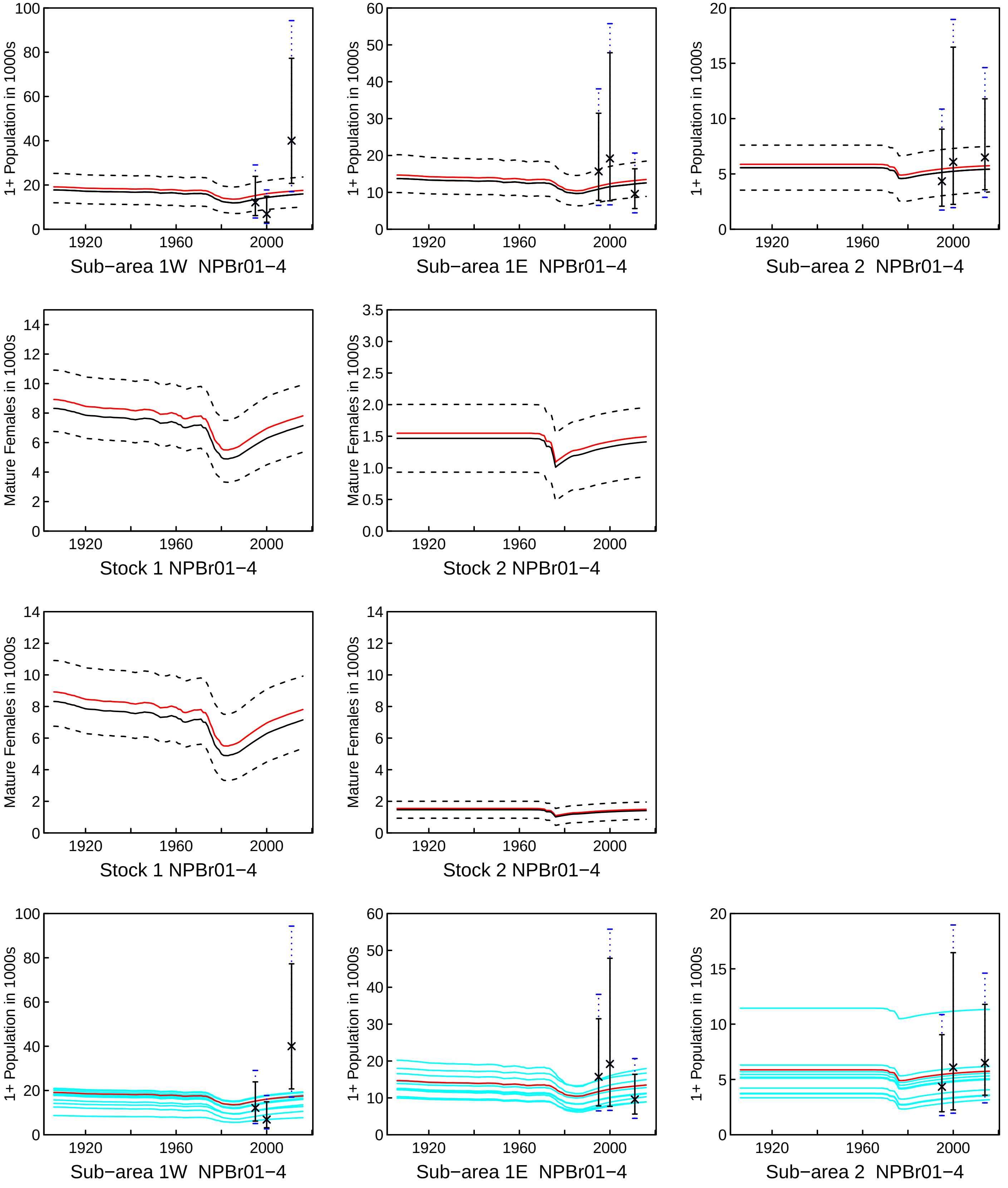
(4) As per (3), but with the same scale.

(5) As per (1), but with the first 10 individual trajectories rather than the median and 90% confidence intervals.

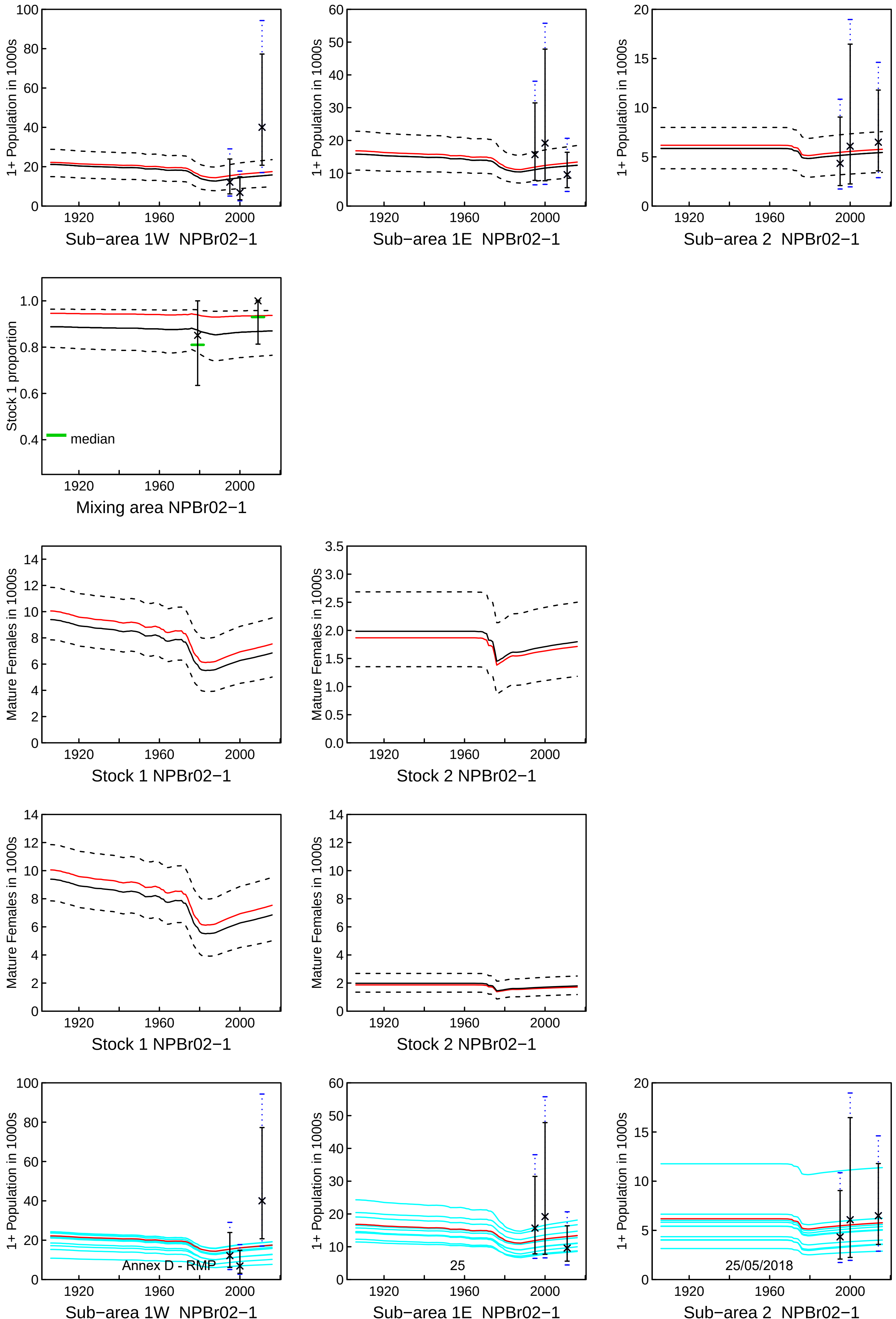
**NPBr01−1 H2 Baseline**



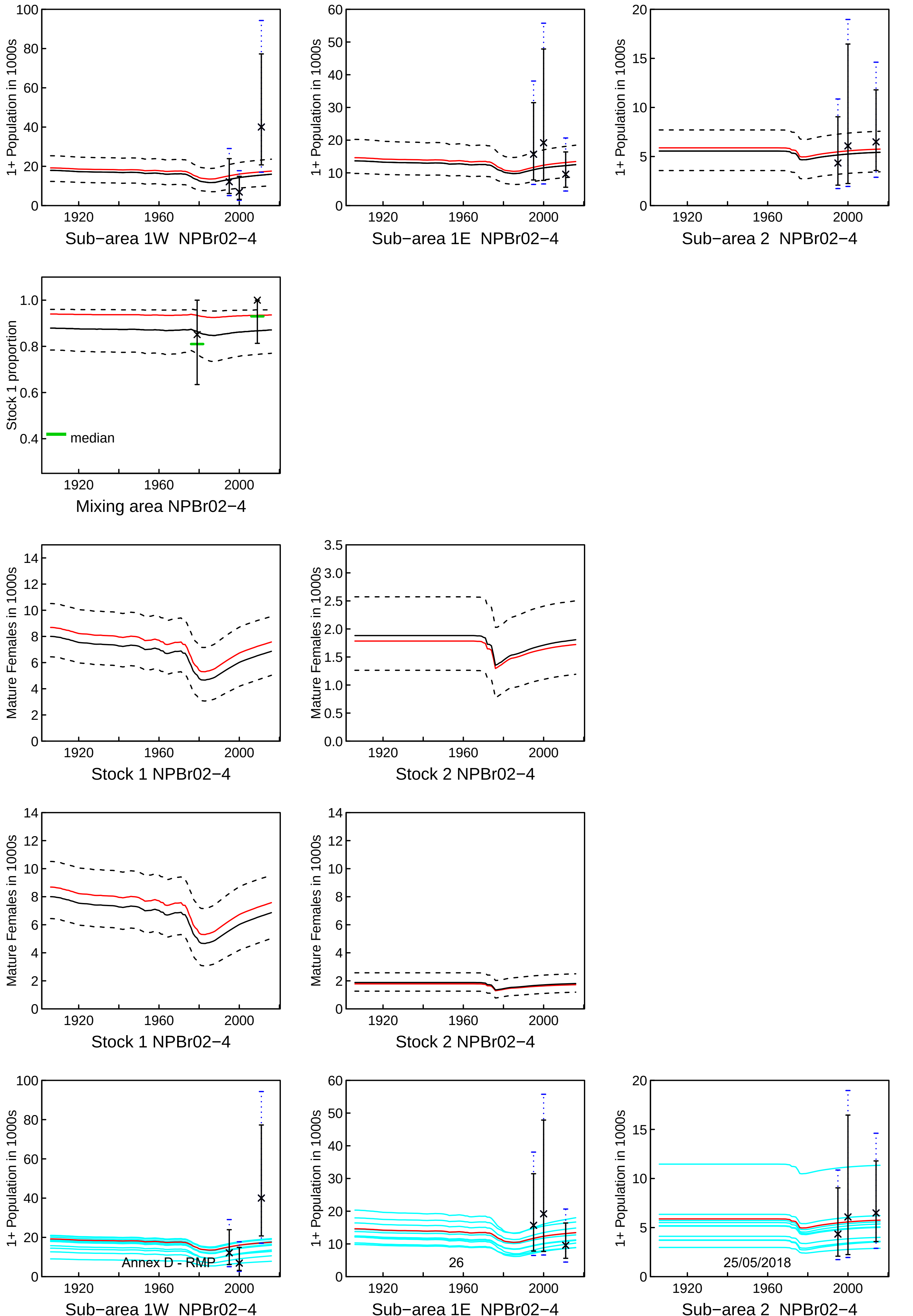
**NPBr01−4 H2 Baseline**



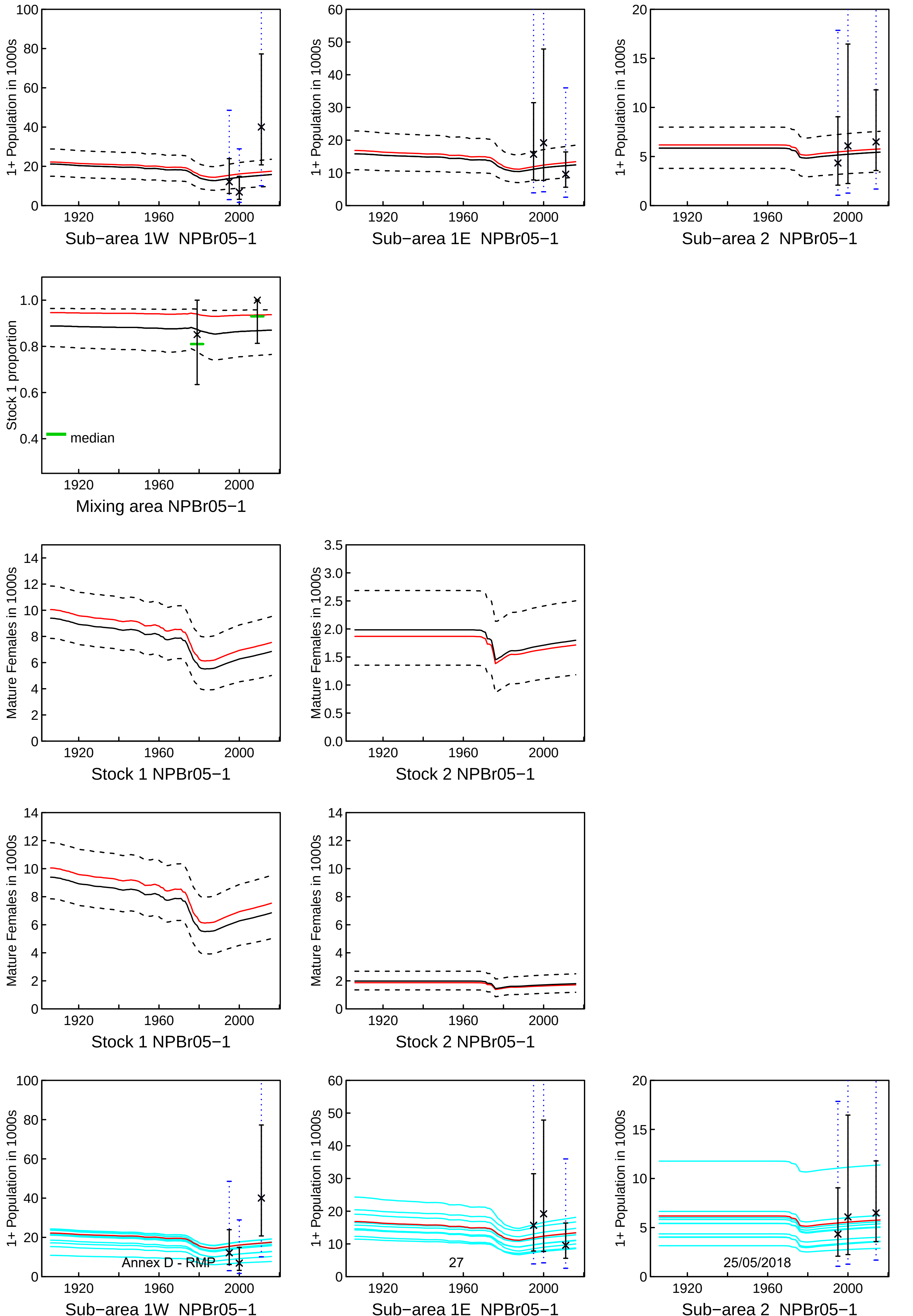
**NPBr02−1 H5 Baseline**



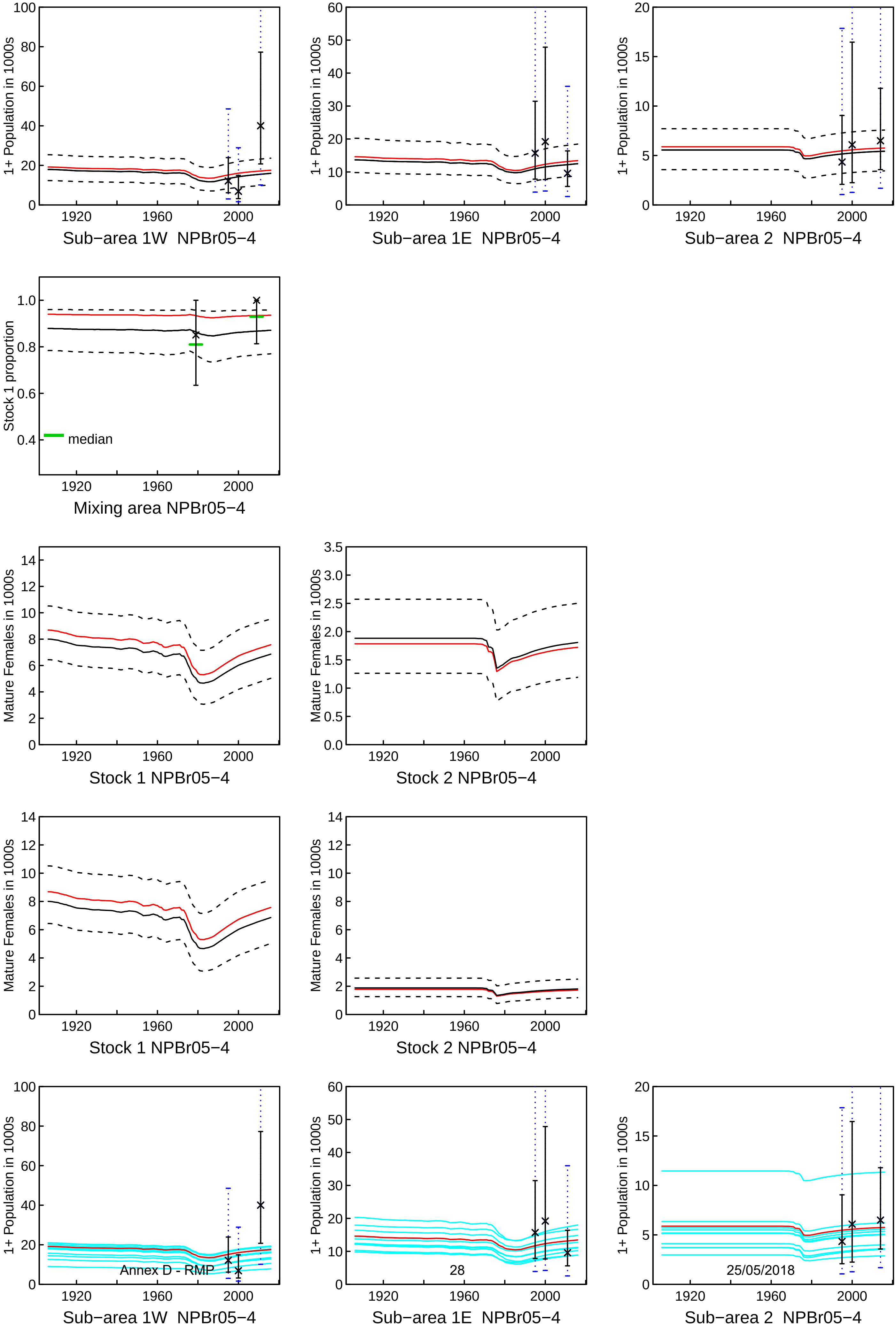
**NPBr02−4 H5 Baseline**



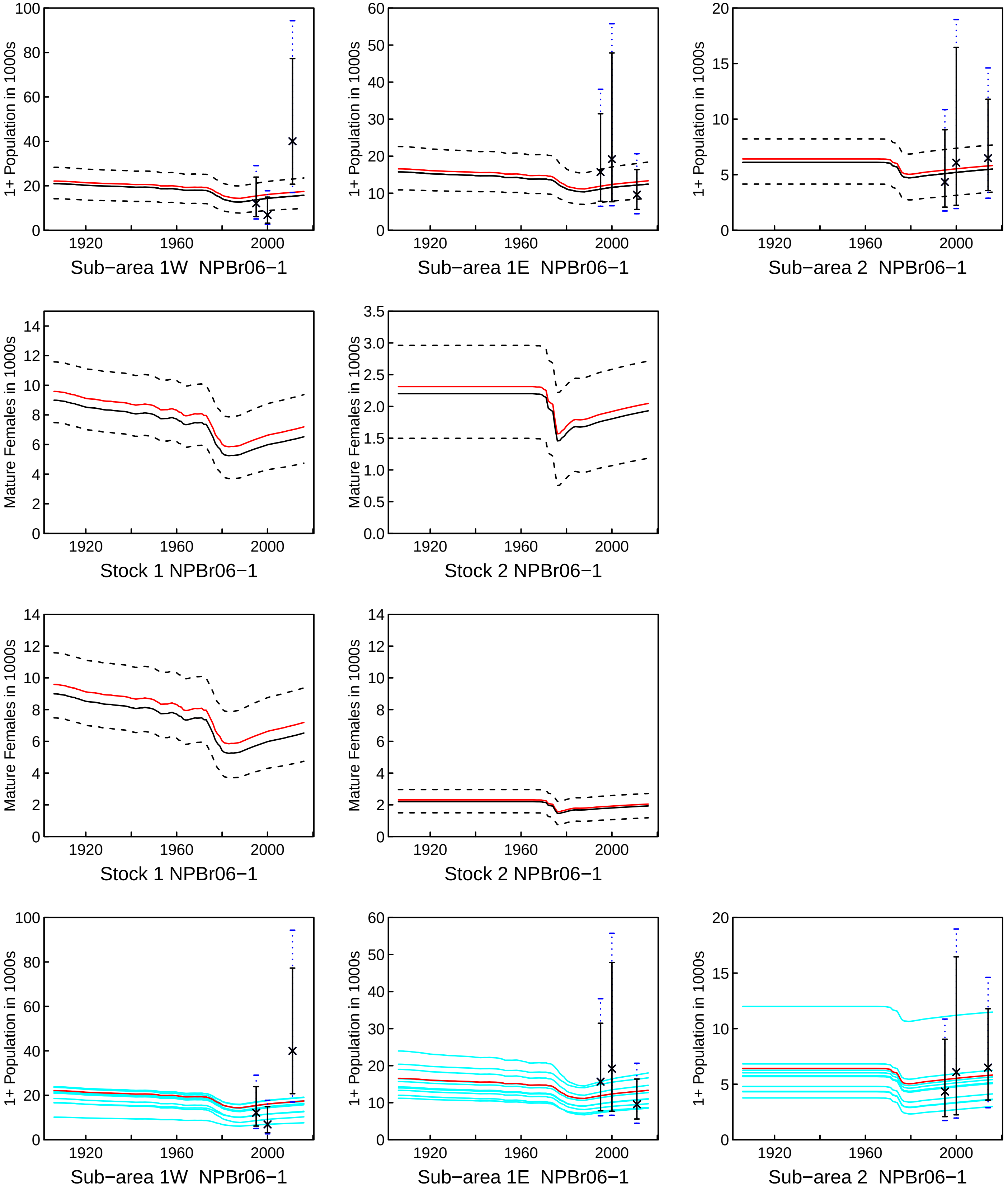
**NPBr05−1 H5 Upper CVadd**



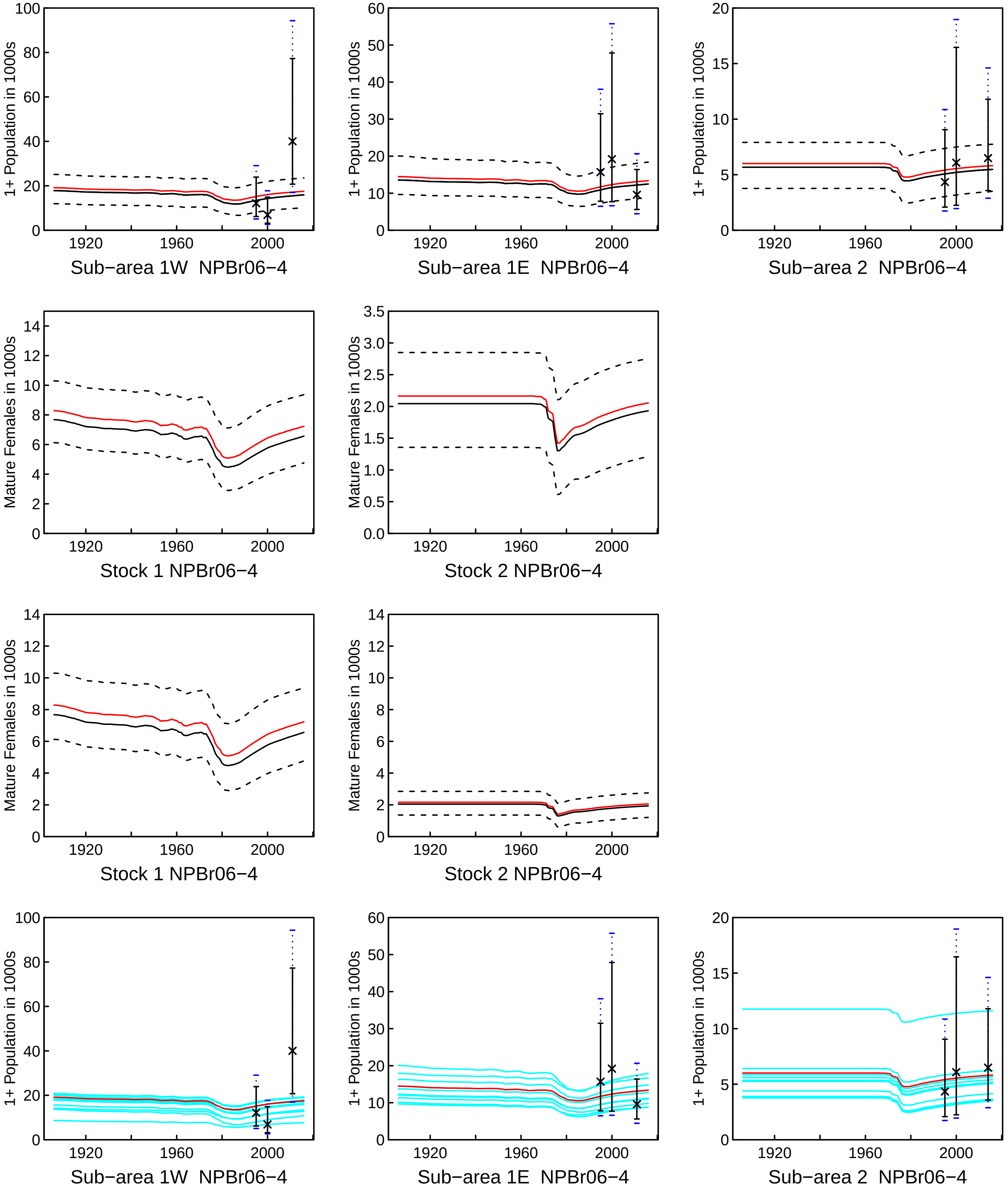
**NPBr05−4 H5 Upper CVadd**



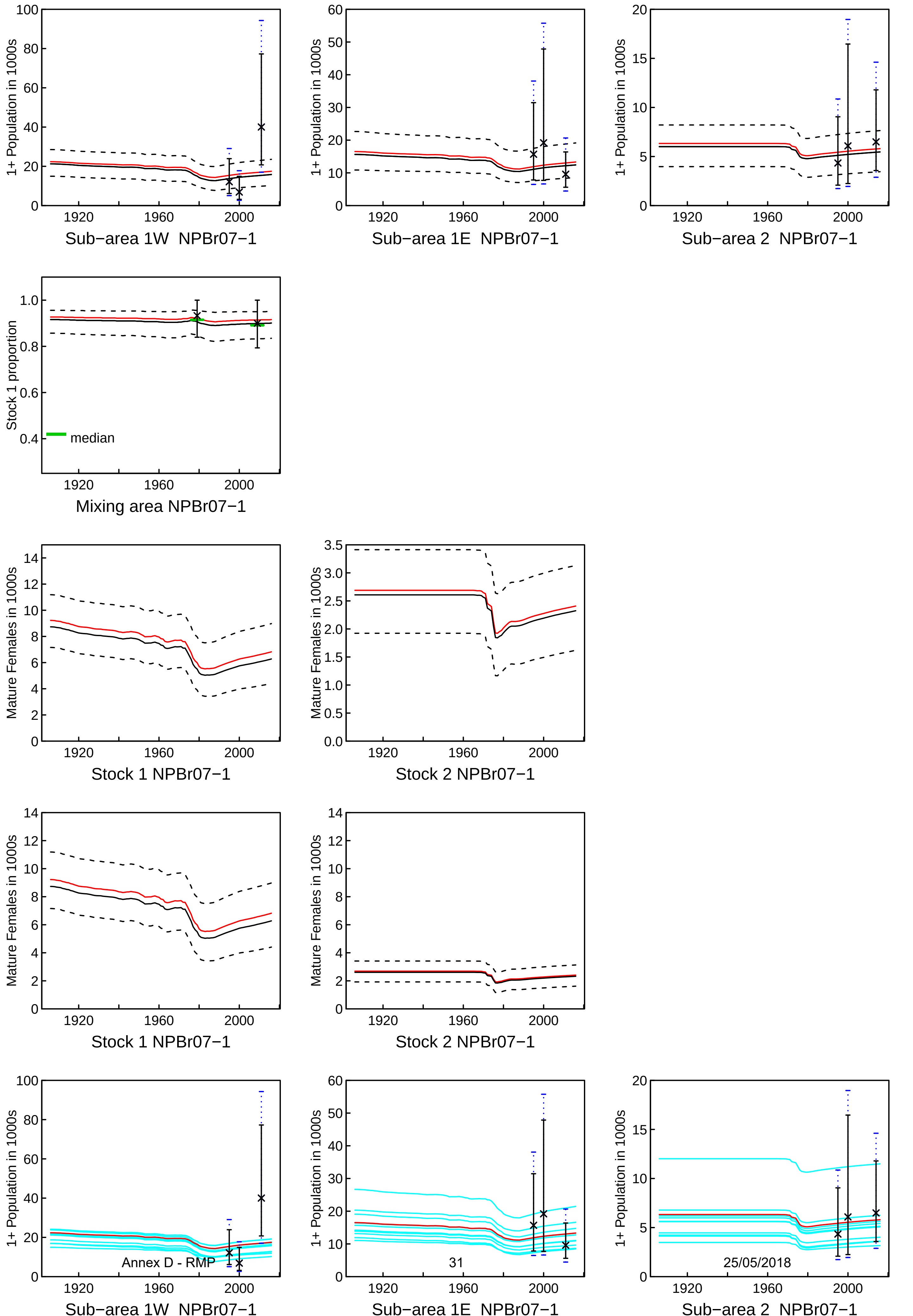
**NPBr06−1 H2 Boundary 5deg west**



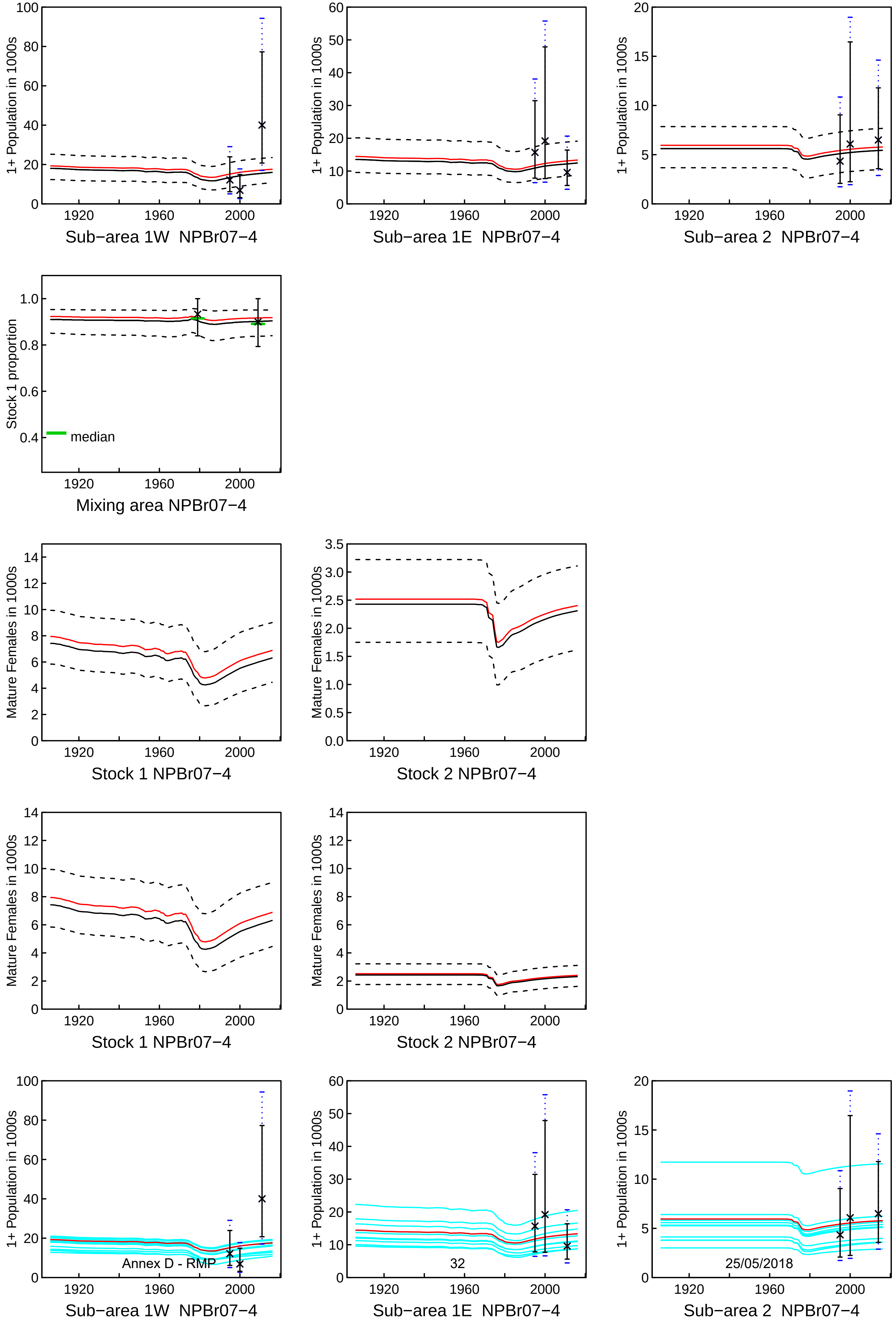
## NPBr06−4 H2 Boundary 5deg west



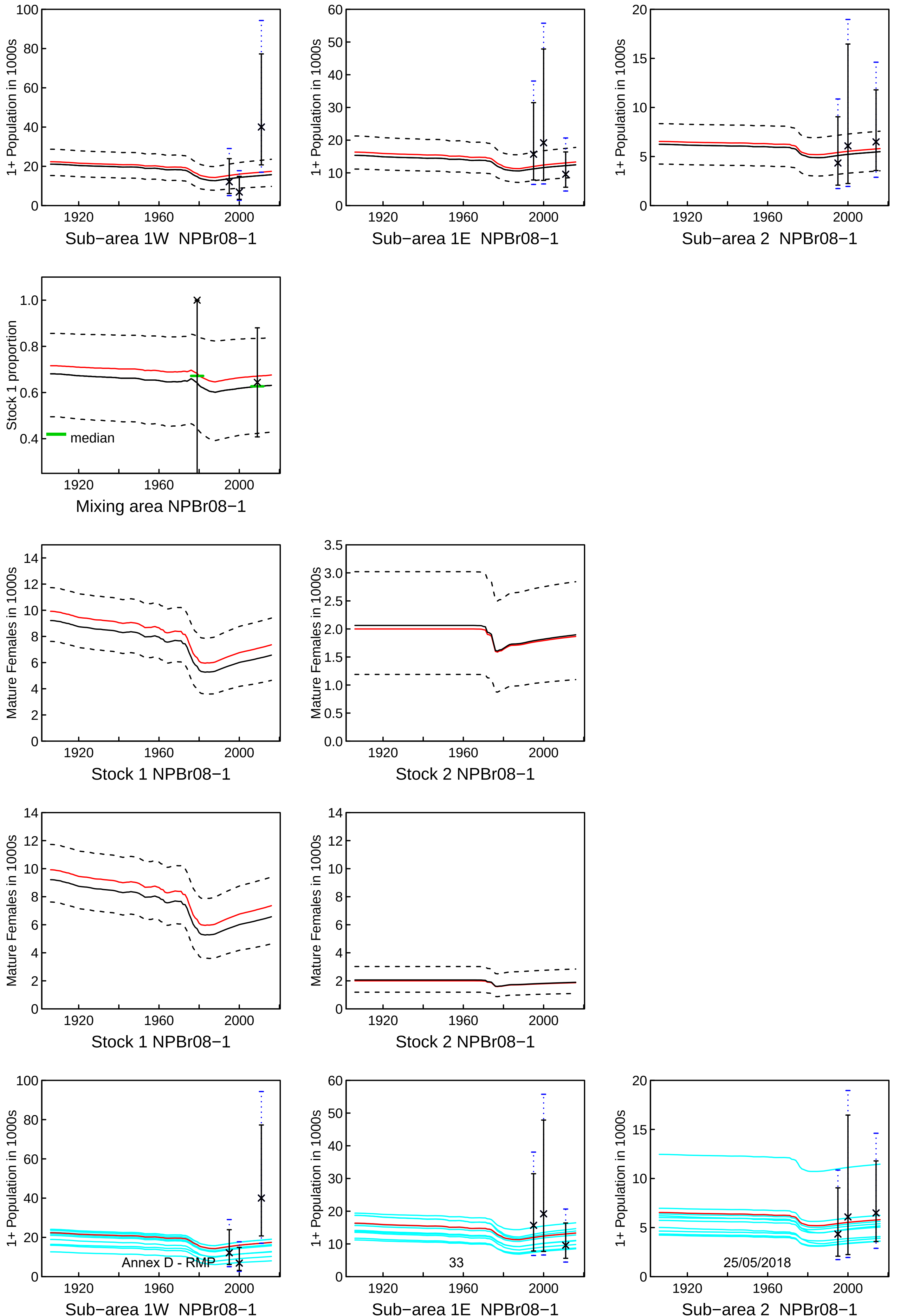
**NPBr07−1 H5 Mixing 5deg west**



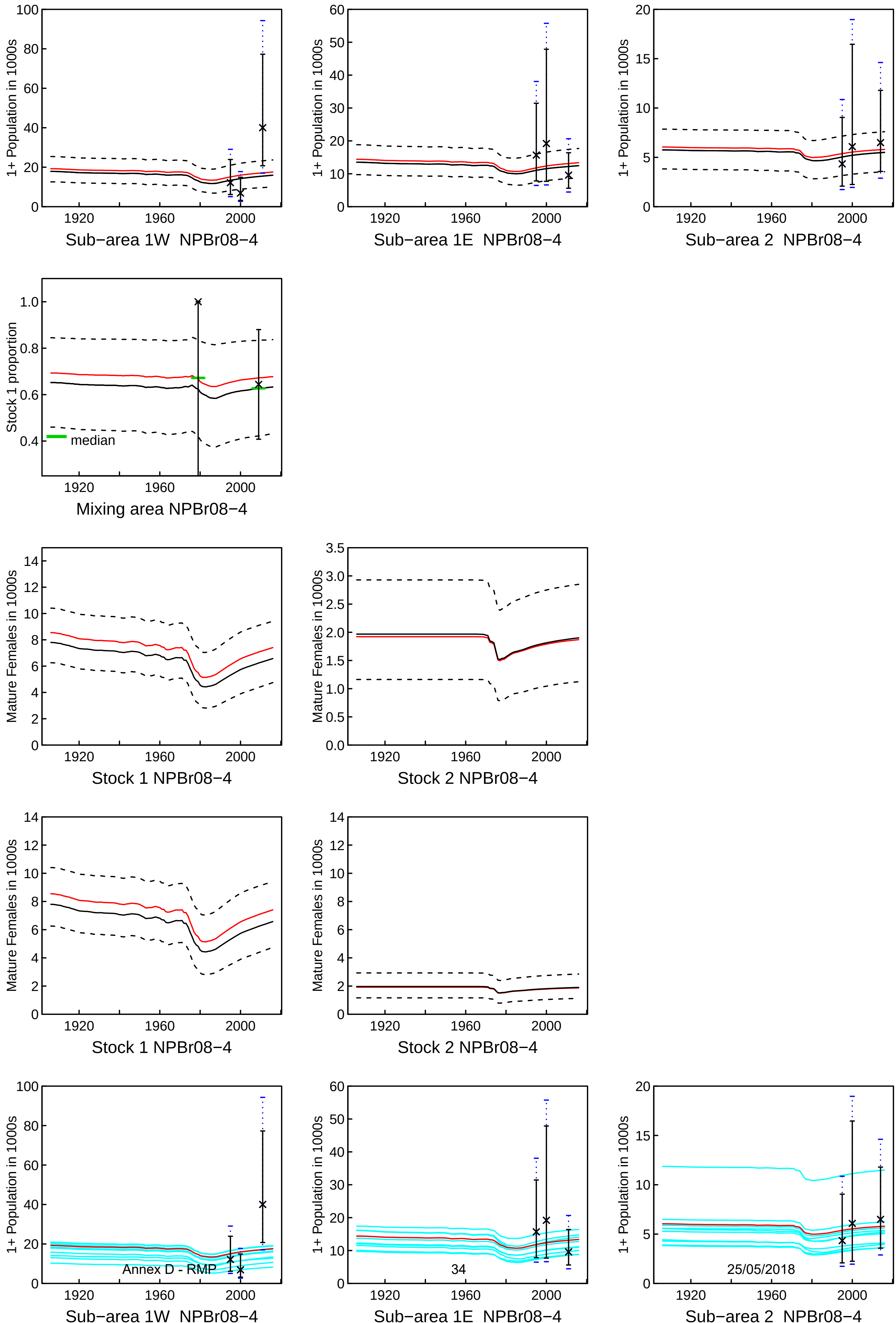
**NPBr07−4 H5 Mixing 5deg west**



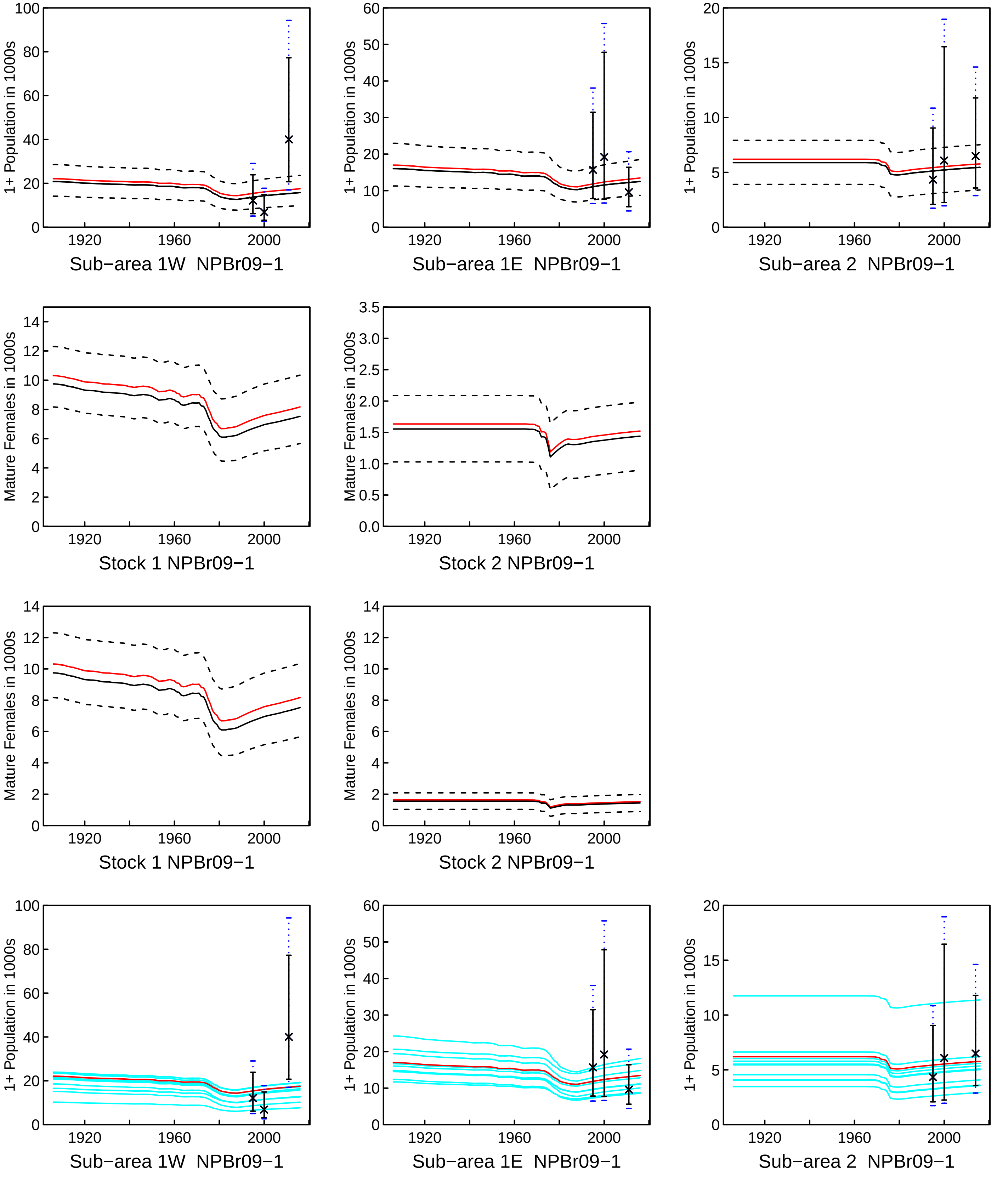
## NPBr08−1 H5 Mixing 5deg east



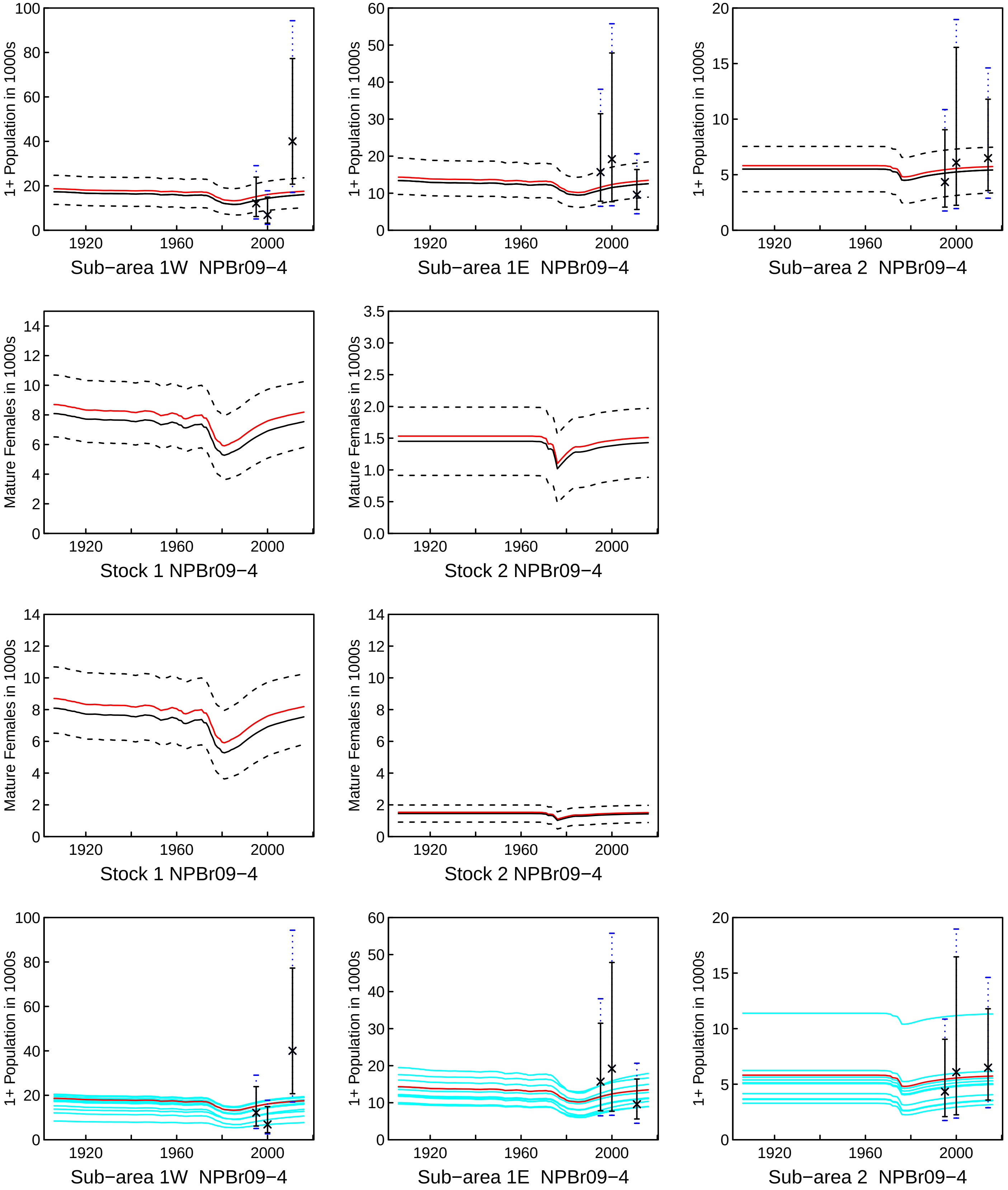
**NPBr08−4 H5 Mixing 5deg east**



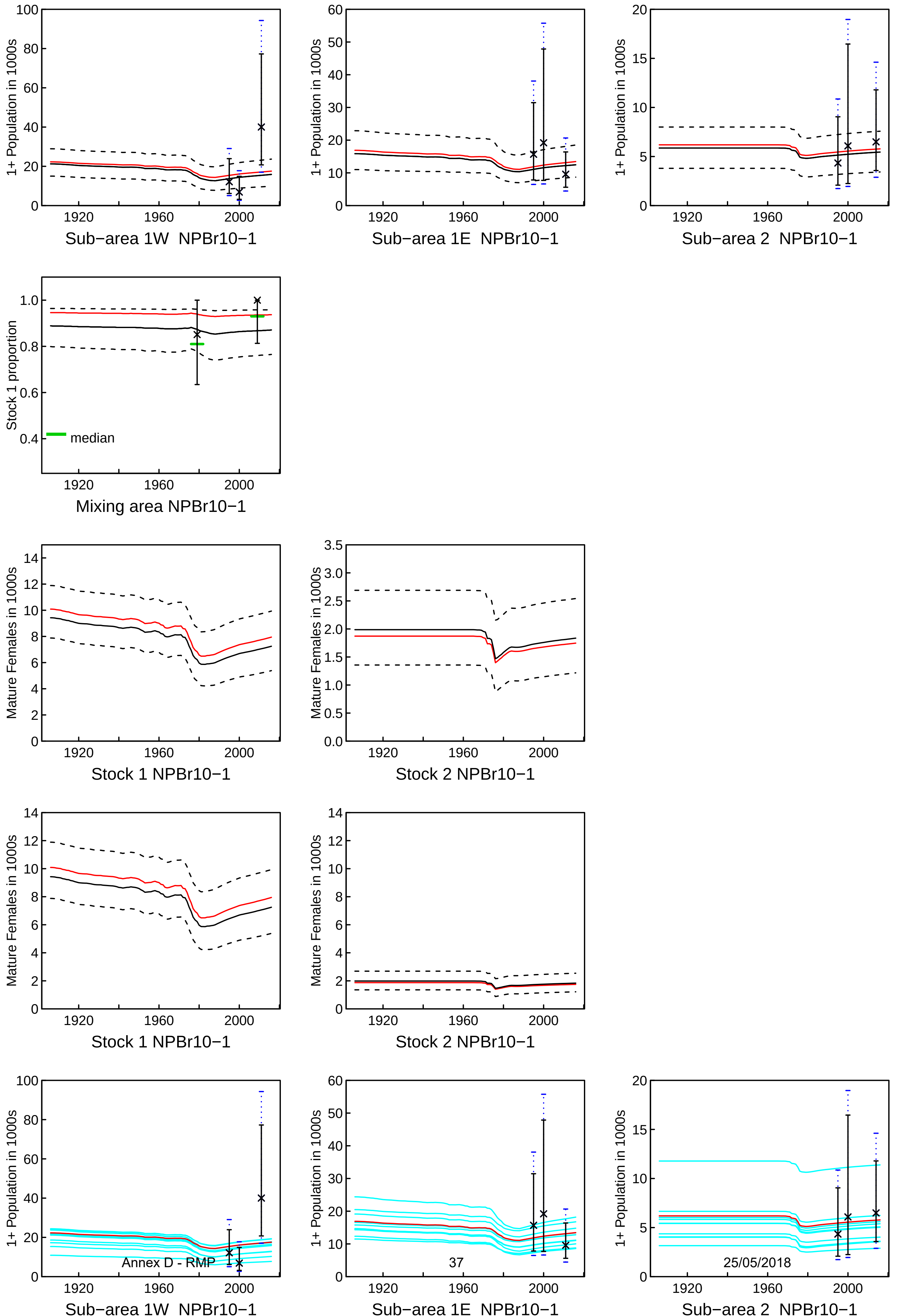
**NPBr09−1 H2 Density dependent M**



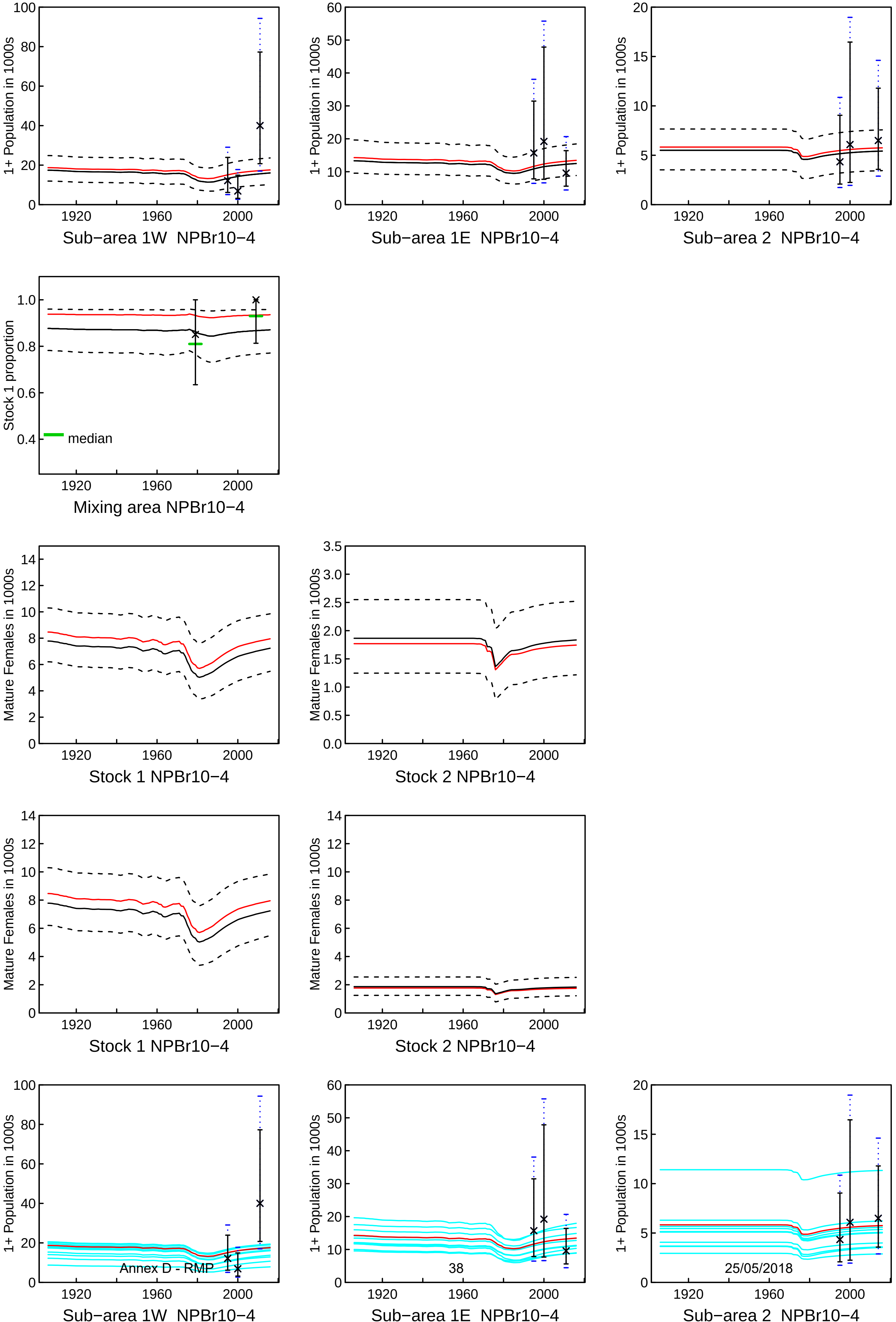
**NPBr09−4 H2 Density dependent M**



NPBr10−1 H5 Density dependent M



**NPBr10−4 H5 Density dependent M**



## Appendix 5

## DRAFT ANNOTATED AGENDA FOR THE FIRST INTERSESSIONAL WORKSHOP ON THE *IMPLEMENTATION REVIEW* FOR WESTERN NORTH PACIFIC MINKE WHALES

### 1 INTRODUCTORY ITEMS

#### 1.1 Opening remarks

#### 1.2 Election of Chair and appointment of rapporteurs

#### 1.3 Adoption of Agenda (may need modifying in the light of papers presented)

#### 1.4 Data available

The data protocol applicable to this Workshop is that of Procedure A (see Appendix). The table below summarises the process *assuming arbitrarily that the Workshop is held from 1 March 2019*. NB No *new* data are allowed after the completion of the First Intersessional Workshop although new analyses of existing data can be submitted to the First Annual Meeting. It was recognised that for collaborative projects, these dates can be more flexible.

| | | |
|---|---|---|
| (1) Any **data owner** wishing data to be used or considered for use in the *Implementation Review* process must (a) submit a description of data sets and formats to be and (b) the template to be used by accredited persons wishing to use the data. Both will be circulated/uploaded by the **Secretariat** upon receipt. | At least 6 months before the meeting | 1 September 2018 |
| (2) Accredited persons wishing to use data must submit their data requests (on the agreed template) to the **Secretariat** who will send them to the DAG and the data holders upon receipt | Within two days of receipt | |
| (3) **DAG** will review proposals and (1) determine acceptance promptly; (2) identify whether methods are considered novel or standard; and (3) inform data holders and proposers | Within 1 week of receipt of proposal | |
| (4) **Data holders** will send data in agreed format | Within 2 weeks of DAG approval | |
| (5) If novel methods are used then **authors** of papers using the data should be sent to Secretariat for circulation. Any such papers should include sufficient documentation of the analysis for it to be fully reviewed and any associated analytical software shall be lodged with the Secretariat. | At least 3 months before meeting | 1 December 2018 |
| (6) **Secretariat** will circulate/upload such papers | Within 2 days of receipt | 3 December 2018 |
| (7) If standard methods are used then **authors** of papers using the data should be sent to Secretariat and circulated/uploaded | At least 2 months before the meeting | 3 January 2019 |
| (8) **Secretariat** will circulate/upload such papers | Within 2 days of receipt | 3 December 2018 |
| (9) Alternative analyses carried out in response to papers submitted should be sent to Secretariat for circulation | At least 1 month before the meeting | 1 February 2019 |
| (10) Final submission of papers circulated/uploaded | At least 1 week before the meeting | 22 February 2019 |
| (11) Workshop held | | 1 March 2019 |

#### 1.5 Available documents

Authors intending to submit papers should advise the Steering Group as soon as possible (notwithstanding the).

### 2. SHORT SUMMARY OF THE 2013 *IMPLEMENTATION REVIEW*

*A paper will be submitted by the Workshop Steering Group (Donovan, Allison, Kitakado, Tiedemann, Punt, Butterworth, Palka, Pastene, Kim)*

#### 2.1 Hypotheses/scenarios considered

#### 2.2 Results and conclusions

#### 2.3 Recommendations/suggestions made for future work

### 3. STOCK STRUCTURE AND MOVEMENTS

*This will require: genetic data (spatially and temporarily resolved); relevant non-genetic data (spatially and temporally resolved. At least data from Japan and Korea are required.*

The following table lists available genotyped samples from South Korea (subareas 5 and 6W; data held by Hyun Woo Kim and coworkers) and Japan (other subareas; Pastene, Goto, Taguchi). At SC/67b, the South Korean scientists have kindly agreed to provide their genotype data to Pastene and co-workers for joint analyses.

| Marker set | Sub-area | | | | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1E | 2C | 5 | 6W | 6E | 7CN | 7CS | 7E | 7WR | 8 | 9 | 10 | 11 | |
| mtDNA** | 69 | 338 | 114 | 922 | 916 | 1178 | 925 | 49 | 89 | 251 | 541 | 15 | 129 | 5536 |
| 16 microsat loci** | 69 | 338 | -* | -* | 916 | 1178 | 925 | 49 | 89 | 252 | 541 | 15 | 129 | 4501 |
| 26 microsat loci | 26 | 28 | - | - | 126 | 42 | 148 | 27 | 27 | 35 | 39 | 15 | 25 | 538 |

*Microsatellites were also typed in South Korea, but have not yet been crossvalidated with Japanes typings

**Japanese samples from 2016 not yet included

*Expected papers: at least those presenting analyses agreed by the working group*
*Responsibility: (a) the Workshop Steering Group (see above); and (b) the Advisory Group on genetics (Tiedemann, Hoelzel, Pastene, Goto, Kim, Baker, Wade).*

### 3.1 Review of new analyses including those identified at SC/67b

*3.1.1 Genetic data*

At SC/67b a workplan was agreed (ref.) that the following analyses should be performed prior to and reported at the workshop (notwithstanding that further analyses are welcome where feasible and appropriate):

1. $F_{ST}$, $F_{IS}$, heterozygosities, haplotype diversity, and related measures;
2. PCA (or FCA) analyses, including partitioning based on multiple components, and DAPC;
3. spatially explicit analyses (BAPS, TESS, Geneland, spatial pattern of diversity measures);
4. updated kinship analyses including most recent samples; and
5. (if possible) Wahlund analyses as undertaken by Waples in 2011 (SC/65b/RMP05).

As specified in SC/67b/Rep05, the analyses will be organised and performed by ICR (Pastene and coworkers), under the advice and assistance of the advisory group, where appropriate. Whilst recognising the level of work required (and noting the timing regarding the DAA), authors are encouraged to try to submit papers at least one month before the Workshop.

*3.1.2 Non-genetic data*

This may include information relating to other data sources e.g. biological parameters, sightings and catch distribution, telemetry etc. Note that where possible, consolidated papers with genetic data should be presented.

### 3.2 Determination of hypotheses to be considered in the *Implementation Review*

Whilst these will be finalised at the Workshop and the results of the analyses above are important, participants are encouraged to think about possible conceptual hypotheses that are in accord with the data prior to the workshop and to submit documents – especially in the context of the intersessional analyses when they become available.

It should be noted that assignment of plausibility does not occur until the First Annual Meeting.

### 3.3 Initial discussion of data that might be used to develop mixing matrices

## 4. ABUNDANCE

*Sightings and associated data (see RMP Guidelines). Data available at the Workshop will need to allow abundance estimates to be generated for appropriate areas/ sub-areas determined under Item 2. At least information from Japanese and Korean surveys required.*

### 4.1 Summary of abundance estimates already agreed by the Scientific Committee, at least for use in conditioning and trials, including *g(0)*

The Steering Group will produce a summary table with references.

### 4.2 New estimates (if any)

### 4.3 Generation of future estimates and incorporation of uncertainty e.g. with respect to *g*(0) in trials

## 5. REMOVALS DATA

### 5.1 Catch data

*These will be provided by the Secretariat and will be available at the appropriate spatial and temporal resolution to account for various hypotheses.*

### 5.2 Bycatch data

*Location, timing of bycatch and associated effort (information on past bycatches and effort; hypotheses about future effort trends) for at least Japan and Korea*

It will be valuable if both Japan and Korea can provide review papers that not only provide information on bycatches (by year, season/month and at least approximate position) but also explain the nature of the fisheries involved, changes over time (e.g. in temporal and spatial distribution) and information on effort (at the best resolution available for each fishery type. e.g. by year, season/month and approximate areas – even a general comment on changes if no quantitative data are available is helpful).

**5.3 Ship strikes data**
*Location, timing of strike and associated effort*
Even if small, it will be helpful if Japan and Korea, at least, can provide any information available on ship strikes.

**5.4 Finalise the removals data for use in the trials (taking into account uncertainty) include generation of future data (especially bycatch)**
This will allow, for example, development to of 'best', 'high' and 'low' series or identify work to be done to develop the final series at the 'First Annual Meeting'.

## 6. DEVELOPMENT OF *IMPLEMENTATION SIMULATION TRIAL* STRUCTURE

**6.1 Factors to be considered in the trials (including incorporation of uncertainty)**
*6.1.1 Stock structure hypotheses*
*6.1.2 Mixing matrices*
*6.1.3 MSYR*
*6.1.4 Biological parameters*
*6.1.5 Bycatches*
*6.1.6 Other*

**6.2 Information to be used in conditioning**
*6.2.1 Abundance*
*6.2.2 Other*

## 7. FUTURE LIKELY WHALING OPERATIONS

*Expressed as RMP variants (specify months and sub-areas; whether selectivity might differ spatially; use of catch capping or catch cascading options etc.)*

Papers detailing management options must be submitted by Governments who might wish to catch from these stocks in the future. Advice on format could be sought from the Workshop Steering Group.

## 8. WORKPLAN TO ENSURE THAT THE OBJECTIVES AT THE FIRST ANNUAL MEETING CAN BE MET

The primary purpose of the First Annual Meeting is to review conditioning results and finalise the *IST*s. The primary output will be the final trial specifications including:

(1) plausibility rankings;

(2) data/research that might reduce hypotheses (including possible time frame);

(3) updates/improvements to standard datasets for use in final trials and assigning plausibility;

(4) final specification of operational variants;

(5) ensure code has ability to test 'options for research' should that prove necessary later in the process; and

(6) begin discussions on defining inputs for an actual application of the RMP.

## 9. ADOPTION OF REPORT

## Appendix 1

## EXTRACT FROM THE DATA AVAILABILITY GUIDELINES

**Procedure A**
The following shall apply with respect to data required for the process outlined in IWC (2003, pp.11-12) for the RMP, the AWMP (see IWC, 2003, pp.19-27) and other information used to provide advice on aboriginal subsistence catch limits before the relevant *SLA*s have been completed. The rules apply to all data owners who wish their analyses to be considered as part of the process to provide advice on catch limits. Data owners may submit data to be treated under this procedure, even if they do not intend to analyse the data themselves. When an application for data under this procedure is submitted, the Data Availability Group shall: (a) decide whether an application fulfils the criteria with respect to the objectives of the study; and (b) determine whether the methods proposed are considered standard or novel. The small group may take advice from the data owner, applicant or other relevant scientists in this process.

(1) If they wish analyses to be considered by the Committee, data owners must make data used for the analysis available in an agreed form and specified resolution (if desired, to the Secretariat) **no later than 6 months before the meeting at which they are to be used**. Examples are given in Appendix 1. These data shall be made available to accredited persons only under the conditions listed above. Data owners shall be notified of any such requests, including a description of the objectives of the study and the methods to be used.
(2) The Secretariat or data owners shall respond (i.e. send the data) to requests for data approved by the small group promptly, normally within 2 weeks of receiving the request.
(3) If novel methods are to be used, Scientific Committee papers documenting data analysis and results shall be circulated **no less than 3 months** before the meeting at which they are to be considered. Any such papers should include sufficient documentation of the analysis for it to be fully reviewed and any associated analytical software shall be lodged with the Secretariat.
(4) If standard methods are used, Scientific Committee papers documenting data analysis and results shall be circulated no less than 2 months before the meeting at which they are to be used.
(5) Alternative analyses carried out in response to papers submitted under (3) or (4) shall be circulated no less than 1 month before the meeting at which they are to be used.