Report of the Second Workshop on North Pacific common minke whale *Implementation Simulation Trials*

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Participants: Donovan (Chair), Allison, Butterworth, Goto, Ishimura (observer), Kawahara, Kim, Martien, Okamura, Pastene, Polacheck, Punt, Rusin (observer), Smith, Taylor, Wade.

1. CONVENOR'S OPENING REMARKS

The Workshop took place from 15-18 January 2003 at the National Marine Mammal Laboratory in Seattle, USA. Butterworth (Convenor) welcomed the participants and reminded them that the terms of reference established by the Scientific Committee (IWC, 2003c, p.452) for the Workshop were to:

(1) specify final trials in the light of discussions at the 2002 Scientific Committee meeting and the results of trials run intersessionally, and decide upon which combinations of *Small Area* definitions and RMP variants to run the final trials;
(2) initiate discussion on approaches to advise on the relative plausibility of trials and their application in this instance to facilitate discussion of this matter at the 2003 Scientific Committee meeting;
(3) specify terms of reference for continued work under the intersessional e-mail group until the 2003 Scientific Committee meeting.

2. ELECTION OF CHAIR

Donovan was elected Chair.

2.1 Appointment of rapporteurs

Allison, Butterworth and Punt acted as rapporteurs with assistance from the Chair.

3. ADOPTION OF AGENDA

The adopted agenda is given as Annex A.

4. REVIEW OF DOCUMENTS

One primary document (SC/J03/NP1) was available to the meeting (Annex B). Relevant extracts from previous reports of the Committee were also circulated as background documents.

[1] Presented to the meeting as SC/55/Rep2.

5. PROGRESS ON TRIAL SPECIFICATION AND RESULTS OF CONDITIONING

5.1 General overview

Allison reported that she had conditioned most of the base-case trials for Baselines A-C and an initial version of Baseline D (see SC/J03/NP1), and had conditioned some of the sensitivity trials. For a description of the Baseline cases and sensitivity trials, see IWC (2003b) and Item 5.3. She noted that the specifications were those agreed at the 2002 Scientific Committee meeting, except that: (1) juveniles were now allowed to occur in sub-area 9 in the model for Baselines A-C; and (2) the specifications for the Baseline C trials that constrain the relative 'O_E'-' O_W' split in sub-areas 7, 8, 11 and 12 (Fig. 1) in the pre-exploitation state have been finalised. The Intersessional Steering Group had agreed these changes.

Taylor and Martien estimated dispersal rates[2] between the 'O' and 'W' stocks for the Baseline A trials and between the 'O_E' and 'O_W' stocks for the Baseline C trials (Annex C). The estimated rate of dispersal for the former was extremely small (best estimate $\sim 0.00018 \text{yr}^{-1}$) and it was **agreed** that the Baseline A trials should be conducted under the assumption of no 'O'-'W' dispersal. The 'best' and 'low' estimates of the dispersal rate between the 'O_W' and 'O_E' stocks (Baseline C) can be calculated from the F_{st} estimate of 0.0018, but the 'high' estimate of dispersal rate between these stocks (corresponding to the observed F_{st} value being the upper 5%ile of the distribution for such values when the rate of dispersal is equal to the 'high' estimate) could not be estimated; given the high abundances of the 'O_E' and 'O_W' stocks, the estimation method could not distinguish among rates >0.01 (Annex C). The Workshop **agreed** to conduct two 'high dispersal' trials for Baseline C: (1) in which 'O_E' and 'O_W' were merged into a single 'O' stock (reflecting an infinite dispersal rate); and (2) in which a dispersal rate of 0.01 between the 'O_E' and 'O_W' stocks is assumed.

5.2 Results of conditioning

Conditioning involves selecting the values for the parameters of the operating model such that this model is able to mimic the available data adequately. The agreed conditioning process for these *Implementation Simulation Trials* (IWC, 2003b) involved:

(1) generating 200 sets of pseudo abundance and proportion data;

[2] Dispersal, in the context of *Implementation Simulation Trials*, is permanent transfer of individuals between breeding stocks.

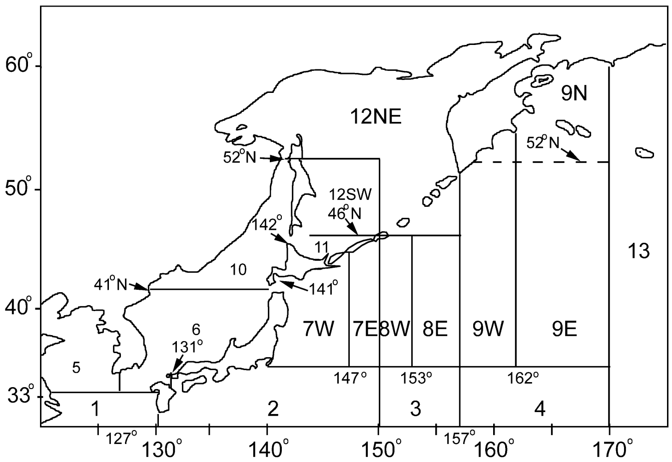


Fig. 1. Map showing the North Pacific region, including the areas and sub-areas relevant to *Implementation Simulation Trials*.

(2) fitting the operating model to each pseudo data set by minimising a negative log-likelihood function[3];
(3) ranking the replicates by the size of their negative log-likelihoods, and selecting the 100 replicates with the lowest negative log-likelihood.

These last 100 replicates then form the basis for the future projections on which the evaluation of the RMP will be based.

The Workshop considered the implications of basing the projections used to evaluate the performance of the RMP on the 100 replicates that have the lowest negative log-likelihoods. An advantage of this selection process is that it automatically avoids basing projections on values for model parameters for which the constraints imposed when conditioning (e.g. that the ratio of 'O' to 'W' stock animals in sub-area 12 equals a pre-specified value) could not be satisfied because failure to satisfy a constraint leads to a very large value for the negative log-likelihood. One potential negative consequence of this rejection process is that it may lead, for example, to the distributions of target population sizes differing from those corresponding to the actual data if the actual data are somehow in conflict with the model structure and/or other data. Fig. 2 shows an example of plot (i)[4] for the C1-J1 trial[5]. The distribution of the 100 target values on which projections are based were not notably different from that of the 200 target values generated initially. The Workshop therefore **agreed** to continue to base the projections on the 'best' 100 of 200 replicates.

The Workshop noted that deciding whether conditioning has been achieved successfully for a specific trial involves consideration of two issues: (1) whether the operating model is able to mimic the data (abundance estimates and proportion information) used for conditioning; and (2) whether the dynamics of the model conform to the biological assumptions and information on which the trial was originally based. The ability to mimic the available data was greatly improved in the model fits considered at this Workshop compared to previous attempts (e.g. IWC, 2003e, pp.455-6). Reasons for this include: (1) the omission (when conditioning) of some abundance estimates considered to be inappropriate due to survey design (IWC, 2003e, p.463; IWC, 2003d); (2) allowing juveniles to occur in sub-area 9 in the model; and (3) selecting only the best 100 of the 200 Monte Carlo replicates (see IWC, 2003b, p.139).

[3] Strictly, this negative log-likelihood includes not only contributions from the data (abundance estimates and 'J'-non-'J' stock mixing proportions) but also penalty functions to reflect constraints (e.g. on the depletion of the 'J' stock).

[4] See subsequent discussion specifying plots (a) to (i).

[5] Baseline C, *MSYR* = 1%, J1 and K1 incidental catches.

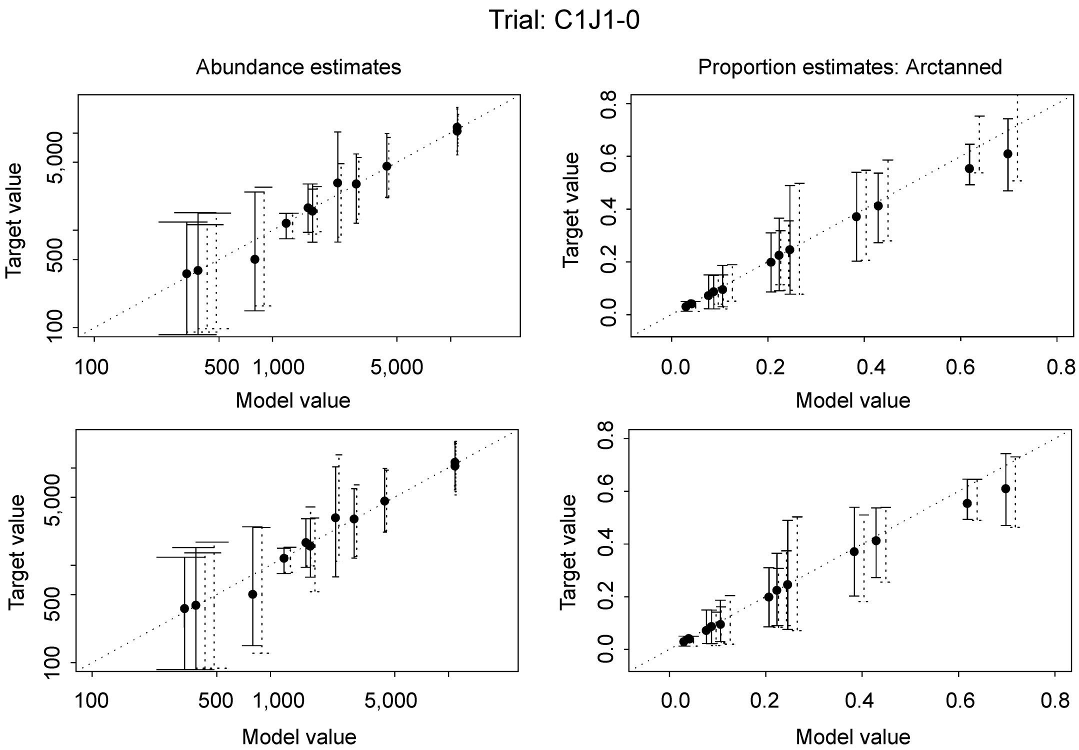


Fig. 2. The median target values plotted against the median operating model values (solid dots). In the upper panels, the solid and dotted bars represent the 90% intervals for the target values and the operating model values, while in the lower panels, these bars represent the 90% intervals for the 100 target values on the which the projections are based and the full set of 200 target values. Results are shown in the left panels for the abundance estimates (after log-transformation) and in the right panels for the 'J'-non-'J' stock proportions (after arctan-transformation).

In order to determine whether conditioning had been successful, the Workshop examined a variety of potential diagnostic plots and some of the catch-mixing matrices. Annex D contains a subset of these plots for trial C1-J1 (Baseline C, 1% MSYR, J1 and K1 incidental catch series). The Workshop **recommended** that all of the following diagnostic plots be produced by the Secretariat and collated for reference purposes.

(a) Histograms of the 100 target abundance estimates and 'J'-non-'J' stock mixing proportions that correspond to the lowest 100 of the 200 negative log-likelihoods. The solid arrows in this plot denote the values of the actual data points. Major discrepancies between the histograms in this plot and the distributions implied by the actual data indicate that there are conflicts between the model and the data.
(b) Histograms of the standardised residuals for each of the data points used when conditioning the trials. These distributions should ideally be centred about zero and not have high variance (except perhaps when there is more than a single data point corresponding to a particular quantity – see subsequent discussion).
(c) Time-trajectories of operating model-predicted population size by sub-area in August-September (medians – solid lines; 90% intervals – dotted lines). The crosses indicate the medians of the target abundances used for conditioning, the open dots indicate the actual abundance estimates, and the bars are the 90% intervals for the actual abundance estimates.
(d) Time-trajectories of the 'J'-non-'J' stock mixing proportions by sub-area and month (medians – solid lines; dotted lines – 90% intervals). The crosses indicate the medians of the target proportions and the open dots indicate the actual estimates of the 'J'-non-'J' stock mixing proportions for the sub-area concerned.
(e) Time-trajectories of abundance by sub-area for two individual simulations, together with the corresponding (pseudo) target abundance estimates used for conditioning.
(f) Time-trajectories of the 'J'-non-'J' stock mixing proportions by sub-area and month for two individual simulations, with the corresponding target ratio for the 'J'-non-'J' stock mixing proportion.
(g) The actual data used for conditioning (abundance estimates and 'J'-non-'J' stock mixing proportions) with their asymptotic 90% confidence intervals plotted against the corresponding model estimates. The model estimates for this plot are based on fitting the operating model to the actual data (rather than values that have been generated from the actual data). One purpose of this plot is to evaluate whether the operating model is able to mimic the actual data. The abundance data are log-transformed and the 'J'-non-'J' stock mixing proportions are arctan-transformed to separate the data on the plots.
(h) The median target values (abundance estimates and 'J'-non-'J' stock mixing proportions) plotted against the median operating model values. For each data point, the 90% interval for the target value (see plots (a) and (b)) and the 90% interval for operating model values are presented as solid and dotted bars respectively. The data are transformed as for plot (g).
(i) As for (h), except that the 90% intervals are shown for the 100 target values used as the basis for the projections (i.e. those corresponding to the 100 lowest negative log-likelihoods) (solid bars) and the full set of 200 target values (dotted bars). Any difference between these two sets of bars indicates that the process of selecting the 'best' 100 replicates has 'updated' the available data.

The Workshop noted that plots (g) and (h) would have identified problems with previous trials known from detailed examination of diagnostics not to have been conditioned successfully. The solid and dotted bars (90% intervals for the target values and the model estimates respectively) in plot (h) differ notably for the three lowest abundance estimates (Fig. 3) while plot (g) shows that the model was unable to exactly mimic one abundance estimate and one 'J'-non-'J' stock mixing proportion (Fig. 4). Given this, the Workshop **agreed** that examination of plot (g)[6] was sufficient to determine whether closer inspection of the other plots was necessary when determining whether conditioning had been achieved successfully (see Item 5.3 below).

The operating model often fitted the data more closely that would be expected given the sizes of the CVs of the data (e.g. see plot (g) in Annex D) – often the model mimics the data used for conditioning almost exactly. This could be considered to constitute overfitting. However, it was recognised that the objective of conditioning is not to find the most parsimonious representation of the data, but rather to explore a wide (yet plausible) range of behaviours consistent with the model structure and the data available for conditioning; overfitting will tend to lead to inflated variances and hence a wider range of population trajectories against which to assess robustness.

During discussion of the residual plots, it was noted that although these tended to be focussed around zero, some skewness was apparent. This skewness is probably due to the operating model fitting to 'contradictory' data (for example, if there are two abundance estimates for a sub-area, the residuals for the lower estimate will tend to be positive while those for the higher estimate will tend to be negative).

5.3 Baselines A, B and C[7]

The philosophy underlying the three Baselines is briefly summarised below (and see IWC, 2003e for further details). There is no attempt at a critique of the methodology or logic here. This can be done by individual participants in papers to be presented to the Berlin meeting, where a more detailed explanation of the background to each baseline will be presented (see Item 8).

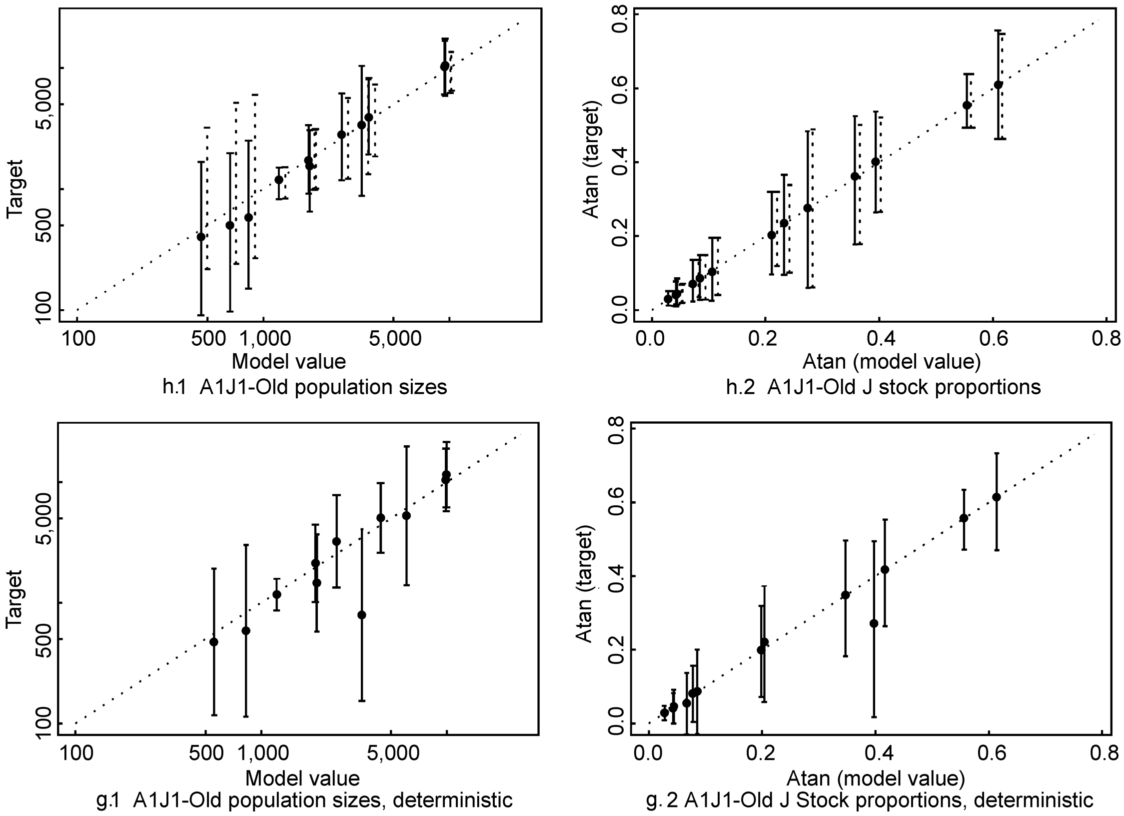
Baseline A. This is a 3-stock scenario ('J', 'O' and 'W') with the 'W' stock found only in sub-area 9W, and then only sporadically. This interpretation, based on hypothesis testing, has been developed from analyses of genetic and other data presented over a relatively long period (see Goto and Pastene, 2000; Goto *et al.*, 2000; Pastene *et al.*, 2002a; b). This included consideration of the results of *a posteriori* hypothesis testing.

Baseline B. This is a 2-stock scenario and reflects the limiting case of Baseline A with no 'W' whales present in sub-areas 8, 9 or 12. It is based on similar data and analyses to that for Baseline A (and was the preferred interpretation of Pastene *et al.*, 2002a and Pastene *et al.*, 2002b).

Baseline C. This is a 4-stock scenario, with three ('O_W', 'O_E' and 'W') stocks to the east of Japan. This scenario is motivated by the divisions suggested by the boundary rank

[6] The fits of the deterministic version of the operating model to: (1) the actual abundance; and (2) the actual 'J'-non-'J' stock mixing proportions.

[7] Not all participants agreed with each Baseline, as explained in the 2002 Workshop report (IWC, 2003e).



Figs 3 and 4. Results from an earlier version of the A1J1 trial (IWC, 2003b). Fig 3 shows the median target values plotted against the median operating model values. The solid and dotted bars represent the 90% intervals for the target values and the operating model values. Fig 4. shows the actual conditioning data with their asymptotic 90% confidence intervals plotted against the corresponding model estimates.

method (Martien and Taylor, 2001). The preferred variant of this hypothesis is one of non-mixing among the stocks, with boundaries at 147°E and 157°E.

Several variants of Baselines A and C exist that examine the implications of, for example, some 'W' stock animals in sub-area 8 (Baseline A), and different boundaries and levels of mixing between the 'O_W' and 'O_E' stocks (Baseline C).

The extent to which the trials for Baselines A-C conform to their intended general philosophy can be evaluated by examining time-trajectories of population size (e.g. for Baseline A, to confirm that infusion of 'W' stock animals does occur into sub-area 9W) and catch-mixing matrices[8] for age 4 'juveniles' (males and females combined), age 10 males and age 10 females. It also recognised the need to develop specific plots to illustrate the behaviour of each Baseline to the Scientific Committee. Suggestions in this latter regard included: (a) time-trajectories of population size by stock; (b) catch-mixing matrices, perhaps illustrated by way of spatial bar-charts; and (c) time-trajectories of population size by sub-area.

The Workshop examined the diagnostic plots for trials A1-J1, B1-J1 and C1-J1 (see Annex D). In general, the fits to the data for the three trials were quite similar. Where potential problems were encountered in conditioning (e.g. the 'J'-non-'J' stock mixing proportion for sub-area 12SW), these tended to be common across trials. It was noted, however, that for Baseline C, the median population size in sub-area 12SW in 1990 in the operating model was notably lower than the median target value, and that the point estimate of this population size lay on the upper 90th confidence interval for the operating model prediction, while in contrast the median target value and median model values were virtually identical for Baselines A and B. In addition, the 90% intervals for the operating model abundance in sub-area 12SW were notably tighter for Baseline C than for Baselines A and B. This behaviour is probably due to the larger number of constraints associated with Baseline C.

The Workshop noted that, after the conditioning process, the catch-mixing matrices for Baselines A, B and C did not capture the migration patterns upon which they were based (e.g. for 'O' stock males, there is little evidence for migration into sub-area 12 over the months April-June). The Workshop therefore investigated whether this was likely to result in a significant impact on the values for the performance statistics to the extent that the current trials were inappropriate for evaluating the performance of the RMP. It was noted that the key factor in this regard is whether catches by sub-area are correctly allocated to stocks i.e. can the lack of inclusion of a strong migration pattern lead to catches being incorrectly allocated to stocks? Annex E shows that if the mixing proportions are known for all sub-areas, and the RMP catch limits are based on the survey estimates for months for which actual data are available (as is the case for the North Pacific minke whales) the incorrect allocation of catches should not be problematic.

The Workshop noted that while the RMP catch limits are based on data for surveys in August and September and these are the months for which actual survey data are available, the mixing proportions are known for most but not all sub-areas in these months (for example, the same 'J'-non-'J' stock mixing proportion is assumed for all months for sub-area 7).

The Workshop therefore developed two trials (based on trials B4-J1 and C4-J1) to investigate this issue in which a migration pattern was forced to occur by substantially

[8] The catch-mixing matrices specify the fraction of each stock in each sub-area each month by age and sex.

increasing the values in the catch-mixing matrices for sub-areas 2, 3 and 4 in April and May. These trials were then conditioned by fitting them to the actual data and projections conducted for an RMP variant in which sub-areas 7W, 7E, 8W, 8E, 11, 12SW and 12NE are treated as one *Small Area* and sub-areas 9W and 9E as another *Small Area*. The catches for the first of these *Small Area*s are taken from sub-area 11 in April while the catches for the latter *Small Area* are taken from sub-area 9W. The assumption that all of the catches for the first *Small Area* are taken from sub-area 11 in April was selected to maximise the catch of 'J' stock whales and hence provide a test of greater power. The results for the changed B4-J1 trial were essentially identical to those for the original B4-J1 trial, while there were slight (~4% after 100 years) differences for one of the stocks ('O_W') for trial C4-J1 (Fig. 5). The Workshop **agreed** that the differences were sufficiently small that the original trials could form the basis for evaluating the performance of the RMP but **recommended** that Allison repeat this comparison exercise for some additional trials.

As agreed above, the Workshop examined the extent to which conditioning had been achieved using the (g) plots which show the fits of the deterministic version of the operating model to the actual abundance and 'J'-non-'J' stock mixing proportion data (Annex F). In examining these plots, it was **agreed** that if cases occurred in which the model prediction differed from the actual value by more than one half of a 90% confidence interval, further examination of the diagnostic plots was required to determine whether satisfactory conditioning had been achieved. Two such cases were identified in the conditioning process carried out thus far (Annex F).

(1) The trials in which the 'J' stock depletion is forced to be 0.7. The fact that these trials lead to poorer fits (particularly to the data for sub-area 12SW) is not surprising because they involve a fairly marked change to the base-case 'J' stock depletion and hence to the abundance of the 'J' stock. The Workshop **agreed** that no further work was required.
(2) All of the Baseline C trials exhibited the feature that the abundance in sub-area 7E was over-estimated while that in sub-area 12SW was under-estimated. This feature of the results for Baseline C is a consequence of the constraints imposed on the pristine ratios of the 'O_W' to 'O_E' stocks in sub-areas 7, 8, 11 and 12. The Workshop **agreed** that these constraints should not be weakened to try to improve the model fits to the data for sub-areas 7E and 12SW as it could lead to unanticipated splits of the 'O_W' and 'O_E' stocks among these sub-areas in some trials.

The Workshop therefore **agreed** that all of the trial results examined thus far indicated satisfactory conditioning (Table 1 and Annex F). With respect to the remaining trials, the Workshop **agreed** that Allison would examine the (g) plots (see Item 5.2) in the same way as had been carried out at the Workshop. If cases occurred in which the model prediction differed from the actual value by more than one half of a 90%

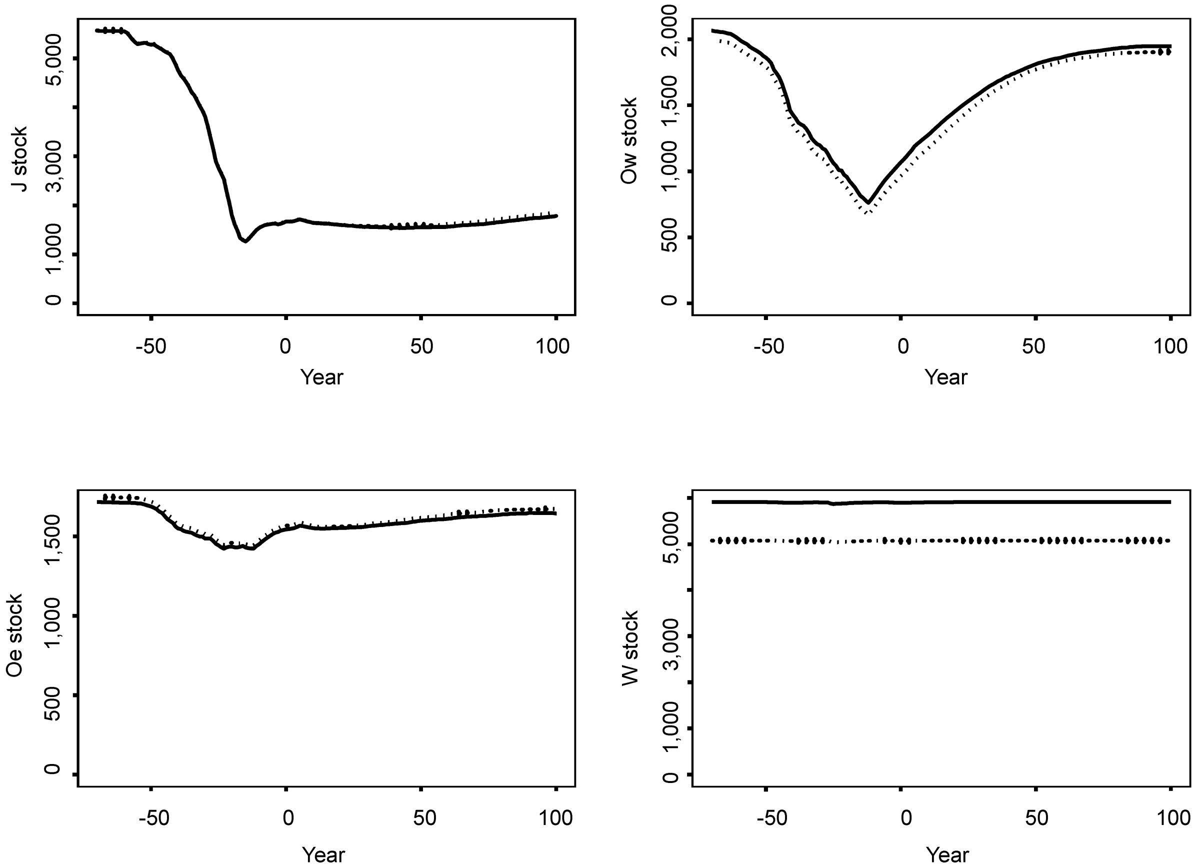


Fig. 5. Abundance of the four stocks ('J', 'O_W', 'O_E' and 'W') based on fits of the operating model to the actual data for the unmodified version of trial C4-J1 (solid lines) and a variant of this trial in which the proportion of animals in sub-areas 2-4 in April and May are increased (dotted lines).

confidence interval, the catch-mixing matrices and a full set of diagnostic plots will be circulated to the Intersessional Steering Group. Should that group consider it necessary, the Workshop **agreed** that Allison and Punt should attempt to identify changes to the trial specifications (e.g. the estimation of additional parameters) in order to rectify any major problems.

5.4 Baseline D[9]

Baseline D attempts to provide a synthesis of the implications of the various stock-structure methods applied to date to data for North Pacific minke whales, as well as those from other biological information. It has 'O' and 'W' stocks to the east of Japan mixing across the area from 147°E to 162°E. The basis for this interpretation is the argument that the genetic data suggest a change in haplotype frequencies as one moves east from Japan, and that this could result from two stocks mixing in proportions that differ by longitude. 'O' stock animals dominate in the west, but become increasingly less prevalent as one moves further east; the reverse is true for 'W' stock whales. Baseline D differs from Baselines A-C in that while the latter impose the spatial dynamics that underlie them through a heavily parameterised process, Baseline D attempts to impose its spatial dynamics rather more parsimoniously.

SC/J03/NP1 outlined the specifications developed intersessionally regarding the distribution of 'O' and 'W' minke whales on which the Baseline D trials presented to the Workshop were based. It identified several issues that required further discussion and decision.

The Workshop noted that the catch-mixing matrices in SC/J03/NP1 exhibited several undesirable features. For example, no 'W' stock animals were predicted to occur in sub-areas 7E-8E, which conflicts with the underlying premise of Baseline D that the 'O' and 'W' stocks mix across 147°E to 160°E, and fewer animals occur in sub-areas 2 and 3 than would be expected from Table 2 of SC/J03/NP1. The Workshop modified the specifications of the trials (see Item 6.1.2) to rectify these problems. The summary list of D-trials is given in Table 1.

6. SPECIFICATION OF TRIALS

6.1 Changes to trials previously agreed

The revised specifications for the *Implementation Simulation Trials* for the North Pacific minke whales are given in Annex G.

6.1.1 Baselines A-C

Trials A1-9 and C1-9 examine the implications of some 'O' stock animals moving from the southern Okhotsk Sea (sub-area 11) into the northern Sea of Japan (sub-area 10). The Workshop was informed that there was evidence from genetics data that 'O' stock animals are found in sub-area 10. Although this evidence is relatively weak (the presence in sub-area 10 of animals with haplotypes typical of the 'O' stock), this is nevertheless the first evidence that there might be 'O' stock animals in sub-area 10. Previously it had been noted (IWC, 1994) that any movement of 'O' stock animals into the northern Sea of Japan from the southern Okhotsk Sea is likely to be negligible, given the lack of observations from ferries between Honshu and Hokkaido of minke whales migrating into the Sea of Japan.

The Workshop reviewed and finalised the specifications for the sensitivity trials for Baselines A and C (Table 1 and Annex G).

(1) TRIALS A1-8 AND C1-8: SOME WHALES FROM 9 GO EAST OF KAMCHATKA (162° LINE)

The objective of this sensitivity trial is to examine the consequences if the animals in sub-area 9E migrate to sub-area 9N rather than to sub-area 12. The constraint '(d)'[10] is modified to 'the fraction of 'W' animals in sub-area 12 being set equal to the relative abundance of such animals in sub-areas 7, 8 and 9W (in place of 7, 8 and all of 9).' The catch-mixing matrices are the same as for the base cases except that estimable parameters are added to allow animals from sub-area 9E to be in sub-area 13 (to reflect their movement to sub-area 9N).

(2) TRIAL C1-9: SOME 'O_W' ANIMALS IN SUB-AREA 10

The sub-area 10 column in the catch-mixing matrix for the 'O_W' stock is modified as for matrix H (see sensitivity trial A1-9).

(3) TRIAL C1-15: MORE 'O_E' IN 12SW

In the base-case trials, animals migrate due north, so none of the animals from sub-area 8 go into sub-area 12SW. In trial C1-15, some animals from sub-area 8W veer west into sub-area 12SW. This is implemented by modifying constraint '(e)' so that the ratio of 'O_W' to 'O_E' stock animals in sub-areas 11 and 12SW is equal to their ratio in sub-areas 7(W+E) and 8W.

(4) TRIAL C1-16: LESS 'O_E' IN 12SW

This sensitivity trial involves the most extreme assumption regarding the extent to which 'O_E' animals veer east by excluding 'O_E' animals from sub-areas 11 and 12SW.

(5) TRIAL C1-17: HARD 'O_W'/'O_E' BOUNDARY AT 153°

This sensitivity trial involves moving the boundary between the 'O_W' and 'O_E' stocks from 147°E to 153°E. It is implemented by modifying the catch-mixing matrices for the 'O_W' and 'O_E' stocks so that no 'O_E' animals are found in sub-areas 7E, 8W, 11 and 12SW and so that 'O_W' animals are found in sub-areas 7E and 8W. The 'O_W':'O_E' dispersal rate for this sensitivity trial will be provided intersessionally to Allison by Taylor.

(6) TRIAL C1-18: 'O_W' AND 'O_E' MIXING BETWEEN 147° AND 153°E

This sensitivity trial is implemented by replacing the base-case catch-mixing matrix for the 'O_W' stock by one in which the 'O_W' stock is also found in sub-areas 7E and 8W. The two extra constraints needed to implement this sensitivity trial are that the pre-exploitation split of 1+ animals (August-September) between the 'O_W' and 'O_E' stocks in sub-areas 7E and 8W are 2:1 and 1:2 respectively. The 'O_W':' O_E' dispersal rate for this trial will be set to the average of the base-case 'O_W':' O_E' dispersal rate and that to be computed for trial C1-17.

(7) TRIAL C1-19: INTRUSION OF 'O_E' INTO SUB-AREA 9E

This trial is designed to reflect the possibility that the 'W' stock is restricted to sub-area 9W and that sub-area 9E is comprised entirely of 'O_E' animals. It is implemented by excluding the 'W' stock from sub-area 9E and modifying the

[9] See footnote 6.

[10] See Annex G for the full specifications of the trials.

Table 1

Implementation Simulation Trials for North Pacific minke whales. *Indicates the sensitivity trials to be conditioned first (see Item 10.1). A 'Y' in the column headed 'Conditioning OK?' indicates that the deterministic conditioning results were approved by the Workshop while a 'na' indicates that conditioning is not required for the trial as it is a variant of another trial.

Trial No.	Conditioning OK?	Base-line	*MSYR*	Sensitivity trial	Mixing matrices	'J' status in 2000	Description
A1-J1	Y	A	1%	0 i.e. baseline	AB F KL(60:40)	30% *K*	3 stocks with 2 in sub-area 9
A1-J2	Y	A	1%	0	AB F KL(60:40)	30% *K*	3 stocks with 2 in sub-area 9
A4-J1	Y	A	4%	0	AB F KL(60:40)	30% *K*	3 stocks with 2 in sub-area 9
A4-J2	Y	A	4%	0	AB F KL(60:40)	30% *K*	3 stocks with 2 in sub-area 9
B1-J1	Y	B	1%	0	AB F KL(60:40)	30% *K*	2 stock variant
B1-J2	Y	B	1%	0	AB F KL(60:40)	30% *K*	2 stock variant
B4-J1	Y	B	4%	0	AB F KL(60:40)	30% *K*	2 stock variant
B4-J2	Y	B	4%	0	AB F KL(60:40)	30% *K*	2 stock variant
C1-J1	Y	C	1%	0	AB F KL(60:40)	30% *K*	4 stocks with hard boundary at 147
C1-J2	Y	C	1%	0	AB F KL(60:40)	30% *K*	4 stocks with hard boundary at 147
C4-J1	Y	C	4%	0	AB F KL(60:40)	30% *K*	4 stocks with hard boundary at 147
C4-J2	Y	C	4%	0	AB F KL(60:40)	30% *K*	4 stocks with hard boundary at 147
D1-J1		D	1%	0	AB F KL(60:40)	30% *K*	3 stocks with mixing gradient
D1-J2		D	1%	0	AB F KL(60:40)	30% *K*	3 stocks with mixing gradient
D4-J1		D	4%	0	AB F KL(60:40)	30% *K*	3 stocks with mixing gradient
D4-J2		D	4%	0	AB F KL(60:40)	30% *K*	3 stocks with mixing gradient
A1-J1-3 *	Y	A	1%	3	AB F KL(60:40)	15% *K*	15% 'J' stock depletion
A1-J2-3	Y	A	1%	3	AB F KL(60:40)	15% *K*	15% 'J' stock depletion
A1-J1-4	Y	A	1%	4	AB F KL(60:40)	50% *K*	50% 'J' stock depletion
A1-J2-4	Y	A	1%	4	AB F KL(60:40)	50% *K*	50% 'J' stock depletion
A1-J1-5 *	Y	A	1%	5	AB F KL(60:40)	70% *K*	70% 'J' stock depletion
A1-J2-5	Y	A	1%	5	AB F KL(60:40)	70% *K*	70% 'J' stock depletion
A4-J1-5	Y	A	4%	5	AB F KL(60:40)	70% *K*	70% 'J' stock depletion
A4-J2-5	Y	A	4%	5	AB F KL(60:40)	70% *K*	70% 'J' stock depletion
A1-J1-6 *	Y	A	1%	6	AB F KL(60:40)	30% *K*	20% 'J' in sub-area 12SW (or max. achievable)
A1-J2-6	Y	A	1%	6	AB F KL(60:40)	30% *K*	20% 'J' in sub-area 12SW (or max. achievable)
A1-J1-7	Y	A	1%	7	AB F KL(60:40)	15% *K*	15% 'J' stock depletion + 20% 'J' in 12SW/max. achiev.
A1-J2-7	Y	A	1%	7	AB F KL(60:40)	15% *K*	15% 'J' stock depletion + 20% 'J' in 12SW/max. achiev.
A1-J1-8 *		A	1%	8	AB F_2 KL(60:40)	30% *K*	Some whales from 9 go E of Kamchatka. See F(d)
A1-J2-8		A	1%	8	AB F_2 KL(60:40)	30% *K*	Some whales from 9 go E of Kamchatka. See F(d)
A1-J1-9		A	1%	9	AB F/**H** KL(60:40)	30% *K*	Some 'O' animals in sub-area 10
A1-J2-9		A	1%	9	AB F/**H** KL(60:40)	30% *K*	Some 'O' animals in sub-area 10
A1-J1-10 *		A	1%	10	AB F KL(60:40)	30% *K*	*g*(0) = 0.5 (see item F.f)
A1-J2-10		A	1%	10	AB F KL(60:40)	30% *K*	*g*(0) = 0.5 (see item F.f)
A1-J1-11	na	A	1%	11	AB F KL(60:40)	30% *K*	Misreport future Japan incidental catch (*4)
A1-J2-11	na	A	1%	11	AB F KL(60:40)	30% *K*	Misreport future Japan incidental catch (/4)
A1-J1-12	na	A	1%	12	AB F KL(60:40)	30% *K*	Constant future Korean by-catch (=89)
A1-J2-12	na	A	1%	12	AB F KL(60:40)	30% *K*	Constant future Korean by-catch (=89)
A1-J1-13	na	A	1%	13	AB F KL(60:40)	30% *K*	Different future Japan incidental catch ref. level (=50)
A1-J2-13		A	1%	13	AB F KL(60:40)	30% *K*	Different hist + future Japan inc. catch ref. level (=150)
A1-J1-14 *		A	1%	14	AB F **M**L(60:40)	30% *K*	Sensitivity to A: some 'W' in 8 (see Item F.i)
A1-J2-14		A	1%	14	AB F **M**L(60:40)	30% *K*	Sensitivity to A: some 'W' in 8 (see Item F.i)
A1-J1-23	na	A	1%	23	AB F KL(60:40)	30% *K*	40% add variance in CV supplied to *CLA* (see 10.1)
A1-J2-23	na	A	1%	23	AB F KL(60:40)	30% *K*	40% add variance in CV supplied to *CLA* (see 10.1)
A1-J1-24	na	A	1%	24	AB F KL(60:40)	30% *K*	Close 11 in all months + 12SW in June
A1-J2-24	na	A	1%	24	AB F KL(60:40)	30% *K*	Close 11 in all months + 12SW in June
C1-J1-1	Y	C	1%	1	AB C D E	30% *K*	Lower dispersal rate
C1-J2-1	Y	C	1%	1	AB C D E	30% *K*	Lower dispersal rate
C4-J1-1	Y	C	4%	1	AB C D E	30% *K*	Lower dispersal rate
C4-J2-1	Y	C	4%	1	AB C D E	30% *K*	Lower dispersal rate
C1-J1-2 *	Y	C	1%	2	AB C D E	30% *K*	Higher dispersal rate
C1-J2-2	Y	C	1%	2	AB C D E	30% *K*	Higher dispersal rate
C1-J1-2a		C	1%	2a	AB E	30% *K*	Single O stock i.e. Infinite dispersal
C1-J2-2a		C	1%	2a	AB E	30% *K*	Single O stock i.e. Infinite dispersal
C1-J1-3 *	Y	C	1%	3	AB C D E	15% *K*	15% 'J' stock depletion
C1-J2-3	Y	C	1%	3	AB C D E	15% *K*	15% 'J' stock depletion
C1-J1-4	Y	C	1%	4	AB C D E	50% *K*	50% 'J' stock depletion
C1-J2-4	Y	C	1%	4	AB C D E	50% *K*	50% 'J' stock depletion
C1-J1-5 *	Y	C	1%	5	AB C D E	70% *K*	70% 'J' stock depletion
C1-J2-5	Y	C	1%	5	AB C D E	70% *K*	70% 'J' stock depletion
C4-J1-5	Y	C	4%	5	AB C D E	70% *K*	70% 'J' stock depletion
C4-J2-5	Y	C	4%	5	AB C D E	70% *K*	70% 'J' stock depletion
C1-J1-6	Y	C	1%	6	AB C D E	30% *K*	20% 'J' in 12SW (or max. achievable)
C1-J2-6	Y	C	1%	6	AB C D E	30% *K*	20% 'J' in 12SW (or max. achievable)
C1-J1-7		C	1%	7	AB C D E	15% *K*	15% 'J' stock depletion + 20% 'J' in 12SW/max. achiev.
C1-J2-7		C	1%	7	AB C D E	15% *K*	15% 'J' stock depletion + 20% 'J' in 12SW/max. achiev.
C1-J1-8 *		C	1%	8	AB C D E_2	30% *K*	Some whales from 9 go E of Kamchatka. See F(d)
C1-J2-8		C	1%	8	AB C D E_2	30% *K*	Some whales from 9 go E of Kamchatka. See F(d)
C1-J1-9		C	1%	9	AB D E	30% *K*	Some 'O_W' animals in sub-area 10

Cont.

Trial No.	Conditioning OK?	Base-line	*MSYR*	Sensitivity trial	Mixing matrices	‘J’ status in 2000	Description
C1-J2-9		C	1%	9	AB D E	30% *K*	Some ‘O_W’ animals in sub-area 10
C1-J1-10 *		C	1%	10	AB C D E	30% *K*	*g*(0) = 0.5 (see item F.f)
C1-J2-10		C	1%	10	AB C D E	30% *K*	*g*(0) = 0.5 (see item F.f)
C1-J1-11	na	C	1%	11	AB C D E	30% *K*	Misreport future Japan incidental catch (*4)
C1-J2-11	na	C	1%	11	AB C D E	30% *K*	Misreport future Japan incidental catch (/4)
C1-J1-12	na	C	1%	12	AB C D E	30% *K*	Constant future Korean by-catch (=89)
C1-J2-12	na	C	1%	12	AB C D E	30% *K*	Constant future Korean by-catch (=89)
C1-J1-13	na	C	1%	13	AB C D E	30% *K*	Different future Japan incidental catch ref. level (=50)
C1-J2-13		C	1%	13	AB C D E	30% *K*	Different hist+future Japan inc. catch ref. level (=150)
C1-J1-15 *		C	1%	15	AB C D E	30% *K*	More ‘O_E’ in 12 SW (see Taylor and Martien, 2002), F(e)
C1-J2-15		C	1%	15	AB C D E	30% *K*	More ‘O_E’ in 12 SW (see Taylor and Martien, 2002), F(e)
C1-J1-16 *		C	1%	16	AB C D_2 E	30% *K*	No ‘O_E’ in 11 or 12 SW (see Taylor and Martien, 2002)
C1-J2-16		C	1%	16	AB C D_2 E	30% *K*	No ‘O_E’ in 11 or 12 SW (see Taylor and Martien, 2002)
C1-J1-17 *		C	1%	17	AB C_3 D_3 E	30% *K*	Hard ‘O_W’/‘O_E’ boundary at 153°
C1-J2-17		C	1%	17	AB C_3 D_3 E	30% *K*	Hard ‘O_W’/‘O_E’ boundary at 153°
C1-J1-18		C	1%	18	AB C_3 D E	30% *K*	‘O_W’ and ‘O_E’ mix between 147-153ºE. New constraint
C1-J2-18		C	1%	18	AB C_3 D E	30% *K*	‘O_W’ and ‘O_E’ mix between 147-153ºE. New constraint
C1-J1-19 *		C	1%	19	AB C D_4 E_3	30% *K*	Further intrusion of ‘O_E’ into sub-area 9
C1-J2-19		C	1%	19	AB C D_4 E_3	30% *K*	Further intrusion of ‘O_E’ into sub-area 9
C1-J1-20 *		C	1%	20	AB **I** **J** E	30% *K*	Intrusion with mixing: ‘O_W’ and ‘O_E’ mixing in 7 and 8
C1-J2-20		C	1%	20	AB **I** **J** E	30% *K*	Intrusion with mixing: ‘O_W’ and ‘O_E’ mixing in 7 and 8
C4-J1-20		C	4%	20	AB **I** **J** E	30% *K*	Intrusion with mixing: ‘O_W’ and ‘O_E’ mixing in 7 and 8
C4-J2-20		C	4%	20	AB **I** **J** E	30% *K*	Intrusion with mixing: ‘O_W’ and ‘O_E’ mixing in 7 and 8
C1-J1-23	na	C	1%	23	AB C D E	30% *K*	40% add variance in CV supplied to *CLA* (see 10.1)
C1-J2-23	na	C	1%	23	AB C D E	30% *K*	40% add variance in CV supplied to *CLA* (see 10.1)
C1-J1-24	na	C	1%	24	AB C D E	30% *K*	Close 11 in all months + 12SW in June
C1-J2-24	na	C	1%	24	AB C D E	30% *K*	Close 11 in all months + 12SW in June
D1-J1-3 *		D	1%	3	AB P Q	15% *K*	15% ‘J’ stock depletion
D1-J2-3		D	1%	3	AB P Q	15% *K*	15% ‘J’ stock depletion
D1-J1-4		D	1%	4	AB P Q	50% *K*	50% ‘J’ stock depletion
D1-J2-4		D	1%	4	AB P Q	50% *K*	50% ‘J’ stock depletion
D1-J1-5 *		D	1%	5	AB P Q	70% *K*	70% ‘J’ stock depletion
D1-J2-5		D	1%	5	AB P Q	70% *K*	70% ‘J’ stock depletion
D4-J1-5		D	4%	5	AB P Q	70% *K*	70% ‘J’ stock depletion
D4-J2-5		D	4%	5	AB P Q	70% *K*	70% ‘J’ stock depletion
D1-J1-6 *		D	1%	6	AB P Q	30% *K*	20% ‘J’ in 12SW (or max. achievable)
D1-J2-6		D	1%	6	AB P Q	30% *K*	20% ‘J’ in 12SW (or max. achievable)
D1-J1-7		D	1%	7	AB P Q	15% *K*	15% ‘J’ stock depletion + 20% ‘J’ in 12SW/max. achiev.
D1-J2-7		D	1%	7	AB P Q	15% *K*	15% ‘J’ stock depletion + 20% ‘J’ in 12SW/max. achiev.
D1-J1-10 *		D	1%	10	AB P Q	30% *K*	*g*(0) = 0.5 (see item F.f)
D1-J2-10		D	1%	10	AB P Q	30% *K*	*g*(0) = 0.5 (see item F.f)
D1-J1-11	na	D	1%	11	AB P Q	30% *K*	Misreport future Japan incidental catch (*4)
D1-J2-11	na	D	1%	11	AB P Q	30% *K*	Misreport future Japan incidental catch (/4)
D1-J1-12	na	D	1%	12	AB P Q	30% *K*	Constant future Korean by-catch (=89)
D1-J2-12	na	D	1%	12	AB P Q	30% *K*	Constant future Korean by-catch (=89)
D1-J1-13	na	D	1%	13	AB P Q	30% *K*	Different future Japan incidental catch ref. level (=50)
D1-J2-13		D	1%	13	AB P Q	30% *K*	Different hist+future Japan inc. catch ref. level (=150)
D1-J1-21 *		D	1%	21		30% *K*	More rapid decline in O relative density with long
D1-J2-21		D	1%	21		30% *K*	More rapid decline in O relative density with long
D1-J1-22		D	1%	22		30% *K*	Less rapid decline in O relative density with long
D1-J2-22		D	1%	22		30% *K*	Less rapid decline in O relative density with long
D1-J1-23	na	D	1%	23	AB P Q	30% *K*	40% add variance in CV supplied to *CLA* (see 10.1)
D1-J2-23	na	D	1%	23	AB P Q	30% *K*	40% add variance in CV supplied to *CLA* (see 10.1)
D1-J1-24	na	D	1%	24	AB P Q	30% *K*	Close 11 in all months + 12SW in June
D1-J2-24	na	D	1%	24	AB P Q	30% *K*	Close 11 in all months + 12SW in June
D1-J1-25 *		D	1%	25		30% *K*	Increased proportion of both sexes in N
D1-J2-25		D	1%	25		30% *K*	Increased proportion of both sexes in N
D1-J1-26		D	1%	26		30% *K*	Decreased proportion of both sexes in N
D1-J2-26		D	1%	26		30% *K*	Decreased proportion of both sexes in N
D1-J1-27 *		D	1%	27		30% *K*	Random selection of mixing matrices
D1-J2-27		D	1%	27		30% *K*	Random selection of mixing matrices
D1-J1-28 *		D	1%	28		30% *K*	Increase O:W ratio in 12 – differential migration
D1-J2-28		D	1%	28		30% *K*	Increase O:W ratio in 12 – differential migration
D1-J1-29 *		D	1%	29		30% *K*	Increase O:W ratio in 12 – O stock in sub-area 9
D1-J2-29		D	1%	29		30% *K*	Increase O:W ratio in 12 – O stock in sub-area 9

catch-mixing matrix for the ‘O_E’ stock to allow ‘O_E’ animals in sub-area 9E. The ‘O_W’:‘ O_E’ dispersal rate for this trial will be computed by Taylor in conjunction with Allison and Pastene.

6.1.2 Baseline D

The Workshop noted that the implementation of Baseline D in SC/J03/NP1 interpreted the specifications for Baseline D in IWC (2003e, p.459; Smith, 2003) to relate to the relative density of the 'O' and 'W' stocks across sub-areas rather than the relative proportions of these stocks in each sub-area. Use of proportions would have:

(1) implied that the specifications in IWC (2003e, p.459) are incomplete because the year to which the proportions relate was not provided, and the 'O' and 'W' stocks show different dynamics over time so the relative proportion in each sub-area would change over time; and
(2) resulted in major changes being required to the software used to implement the trials.

In mathematically specifying the underlying hypothesis of Baseline D, there was an initial lack of clarity on the need to distinguish between a gradient in density and one in proportions. The essential difference between the use of relative density and proportions is that there is either a monotonic drop in the density of the 'O' stock as one moves east from Japan or that there is a monotonic drop in the proportion of animals that are from the 'O' stock as one moves east from Japan. It was noted that the interpretation of this evolved as attempts were made to implement the trials. Some noted that the current specifications lead to the 'O' stock being much smaller than would be the case if proportions had been used. However, a monotonic change in the 'O'-'W' proportion could imply that the density of 'O' animals in sub-area 9 was higher than that in sub-area 7 which seems inconsistent with the idea of two population centres and an area of mixing. The Workshop **agreed** to proceed with trial specification under the assumption that these relate to relative density and to add additional sensitivity trials in which the proportion of sub-area 12 which consists of 'O' stock animals was 0.8 in 1995.

The Workshop recognised the need to revise the specifications for Baseline D, noting that even during the intersessional period, the details of the trials had been evolving as the conceptual specifications were modelled mathematically. The changes to the implementation of Baseline D in SC/J03/NP1 (see Appendix 1 of Annex G) are summarised below.

(1) The SC/J03/NP1 implementation re-scaled the catch-mixing matrices over all sub-areas with the implication that a modification to the entry for sub-area 12NE impacted the entry for sub-area 2. The approach used to re-scale the catch-mixing matrices was modified so that the split of the 'O' and 'W' stocks among three 'super sub-areas' (sub-areas 2-4, 7W-9E, and 9N, 11 and 12) always remains equal to the values in Table 2 of Appendix 1 of Annex G.
(2) The proportion of the 'O' and 'W' stocks in each of the super sub-areas each month could be stock-specific (see Table 2 of Appendix 1 of Annex G). However, for the base-case version of Baseline D, the matrices that specify these proportions are independent of stock – some of the sensitivity tests involve stock-specific matrices.
(3) The values for the proportions of the 'O' and 'W' stocks in each of the super-sub-areas each month for older (age 10) males and females were originally set subjectively to match the qualitative description of migration (IWC, 2003e, p.459). The values specified in Table 2 of IWC (2003, p.486) were modified taking account of the sex-ratios of the historical commercial catches in sub-areas 7W-8E and the survey estimates of abundance for sub-areas 7W-12NE, along with an assumption about the proportion of whales in sub-areas 9N, 11 and 12 (Table 2; Annex H). The estimated proportion of males increases and that for females decreases as the proportion of whales in sub-areas 9N, 11 and 12 increases. The Workshop based the values for August in Table 2 of Annex G on the results for a proportion in sub-area 9N of 0.1 and the values for the remaining months were obtained by smoothing so that the values for August equalled 0.5 and 0.8 (males and females).
(4) The values for the proportions of the 'O' and 'W' stocks in each of the super-sub-areas each month for animals aged 4 years are set equal to the average of those for males and females aged 10 years.
(5) Estimable parameters were added to the catch-mixing matrices for sub-areas 11, 12SW, 12NE and 9N ('O' stock) and in sub-areas 12 and 9N ('W' stock) to better fit the relative abundance estimates.
(6) A single estimable parameter was added to the entries in the catch-mixing matrices for sub-areas 8W-9E ('O' stock) and 7E-8E ('W' stock) to better fit the abundance estimates for sub-areas 7E, 8W and 8E.
(7) The approach used to determine the relative density of 'W' stock animals was modified from the complement of the density of 'O' stock animals (had the two stocks been of the same size). For sub-areas 7E-8W, the relative density of 'W' stock animals in each sub-area was modelled by an exponential decline from 1 at 162°E to a value p_{153} at 153°E. The relative densities of 'W' stock animals in sub-areas 12SW and 12NE were assumed equal, and that in sub-area 9N was treated as an estimable parameter.
(8) An extra constraint was added – that the 'J'-non-'J' stock mixing proportion in sub-area 12SW in May (1973-75) equals 0.278. This constraint is needed to allow the parameter that determines how many 'J' stock animals are found in sub-area 12SW in May to be estimated.
(9) The proportion of 'O' stock animals in each of sub-areas 2, 3 and 4 relative to the total abundance of 'O' stock animals in these sub-areas combined was fixed at 0.1, 0.89 and 0.01. This change to the specifications was made because there is a 'J'-non-'J' stock mixing proportion of 0.707 for sub-area 2 in April. The data on which this estimate was based were collected from areas close to Japan and therefore probably only reflect mixing in a small part of sub-area 2. Fixing the relative proportion of 'O' stock animals in each of sub-areas 2, 3 and 4 mimics this.
(10) The density of 4-year-olds in sub-area 11 was increased by a factor of four compared to that for age 10 animals to reflect the observation that juveniles do not migrate as far north as adults.

The Workshop examined the diagnostics for a deterministic fit of the D1-J1 trial along with the catch-mixing matrices for this trial (Annex I) and **agreed** that the fit was satisfactory and that the model captures the mixing hypothesis underlying Baseline D adequately. Annex G (Appendix 1)

Table 2

Proportion of the 'O'/'W' stocks (adult males and females) in sub-areas 9N, 11 and 12 as a function of the assumed proportion of animals in these sub-areas in sub-area 9N. The sex-ratio for sub-areas 7W-8E is assumed to be 3.15 for this table.

	Proportion in 9N		
	0	0.1	0.01
Male	0.55	0.50	0.46
Female	0.18	0.16	0.15

lists the sensitivity trials developed for Baseline D (these are summarised in Table 1). The Workshop noted that it may prove impossible to implement all of these sensitivity trials and **agreed** that Allison and Punt could modify the specifications slightly if this was needed to achieve satisfactory conditioning. The Intersessional Steering Group should be informed by e-mail if changes to the specifications appear required.

6.2 *Small Areas*/RMP variants to be considered

This issue was discussed in IWC (2003e) and IWC (2003a, p.8; Item 6.1.3). The Committee had agreed that while the general issue of partial cascading and appropriate *Small Area* definitions for situations involving coastal whaling required further consideration, it was appropriate to use the RMP management variants described in IWC (2003e) in the simulation trials. The RMP variants to be considered in the trials and the sub-areas from which catches are taken when a *Small Area* consists of more than one sub-area were as follows.

(1) *Small Areas* equal sub-areas. For this option, the *Small Areas* for which catch limits would be set are 7W, 7E, 8W, 8E, 9W, 9E, 11, 12SW and 12NE.
(2) 7+8, 9, 11 and 12 are *Small Areas* and catches are taken from sub-areas 7W, 9W, 11 and 12SW.
(3) 7+8+12, 11 and 9 are *Small Areas* and catches are taken from sub-areas 11 and 9W.
(4) 7W, 7E+8+12 and 11 are *Small Areas* and catches are taken from sub-areas 7W, 11 and 12SW.
(5) 7+8+11+12 and 9 are combination areas and catches are cascaded to the sub-areas within each combination area.
(6) as (3) except that the catches from the 7+8+11+12 *Small Area* are taken from sub-areas 7W and 11 using catch cascading across those two sub-areas.

Simulations were also conducted for the scenario in which catches are not taken in sub-area 11 in April and July. The fraction of 'J' stock animals was not insubstantial in sub-area 12SW in June and in sub-area 11 in all months. Therefore, two additional variants based on variants (1) and (5) were also conducted. These variants were based on the assumption that catches are zero in sub-area 11 in all months and in sub-area 12SW in June.

7. TRIAL RESULTS

No trials results were considered during the meeting.

8. METHODS TO EXAMINE RESULTS OF TRIALS

The Workshop first discussed what form of tables and plots might best be prepared by Allison to summarise the results of the trials for the Scientific Committee. Discussion concerning tabular output was guided by the format used for presentation of the results from an earlier set of these trials (IWC, 2002).

For the detailed output for a single trial-RMP variant combination, the Workshop **agreed** that the following modifications should be made to the previous format:

(1) delete the continuing catch statistics (as their meaning was difficult to explain and they had seldom been referenced in previous discussions);
(2) omit sub-areas 3, 4 and 5 from the catch tabulations, as both commercial and incidental catches in these sub-areas are always zero;
(3) report catches for sub-area 12 split by sub-areas 12NE and 12SW; (catches for 7, 8 and 9 will continue to be reported for the W and E portions combined);
(4) where relevant, show results separately for 'O_W' and 'O_E' stocks.

The summary table was left unchanged, except for necessary adaptation to accommodate (4) above.

Standard plots have been developed in the past that provide ready comparison of a number of performance statistics across up to six trials or RMP variants. It was agreed that Allison would develop such plots to contrast performance for a particular trial across the six RMP variants under consideration, and also to contrast the performance of a particular RMP variant across a number of trials. Furthermore Allison will develop the following population trajectories for stocks of interest ('J' and 'O' or 'O_W', and possibly 'O_E') in particular trials:

(1) median and 90% probability envelopes for the mature female population and the total commercial catch for the *Small Areas* equal sub-areas RMP variant (option 1 – see Item 6.2);
(2) medians as in (1) above, but showing projections for all six RMP variants under consideration;
(3) mature female population and commercial catch trajectories for a small number (to be chosen by Allison based upon achieving a clear presentation) of the simulations constituting the trials for the *Small Areas* equal sub-areas RMP variant.

Allison will circulate a few examples of such plots to the Intersessional Steering Group to confirm that members are satisfied with such choices. Thereafter these plots would be prepared for every trial for inclusion in a composite file of all results maintained by Allison. In consultation with the Intersessional Steering Group, Allison will choose a sample from all these plots for general circulation at the Scientific Committee meeting.

There was some discussion as to whether the tabular output should include average catches over the first ten years of the 100-year period, as well as for the last 10 of these years as in the present format. It was **agreed** that, although these statistics would be extracted by Allison when running the trials, a decision on whether or not to include them with the material circulated upon which to base an RMP variant recommendation would be left to the Scientific Committee, given the different views expressed at the Workshop as to their value in determining appropriate RMP options.

It was also **agreed** that all trial results would be available to Scientific Committee members in electronic form. This includes all raw RMP simulation trial outputs, together with the tabular outputs described above (both for each trial-RMP variant combination, and summarised over all these combinations), as well as the *S-plus* extraction software used to produce tabular and graphical summary outputs.

In addition to the trial results described above, the Workshop considered it important that the Scientific Committee receive a brief paper explaining the *Implementation Simulation Trials* in a non-technical manner. It should succinctly: (1) describe the hypotheses underlying the trials and their rationale; (2) clarify the range of uncertainties spanned by the trials; and (3) explain the six RMP variants under consideration. It was **agreed** that Donovan would undertake responsibility for producing this document, and that he could request draft contributions (and comments) from other Workshop participants. The document would provide the basis for an introductory

PowerPoint presentation on these trials to be made by Donovan to the RMP sub-committee at the 2003 Scientific Committee meeting.

This summary paper will **not** discuss the relative merits, demerits and plausibilities of the different hypotheses (Baselines A, B, C and D) and their associated trials. Such issues are to be addressed in papers developed by individual scientists and submitted to the Scientific Committee for discussion after the presentation referenced above.

9. RELATIVE PLAUSIBILITY OF TRIALS

Two broad issues were discussed under this agenda item: the process to be used by the Scientific Committee for translating the results from the *Implementation Simulation Trials* into a recommendation as to which RMP variant to implement, and what auxiliary information (and in particular new 'data') might be considered in this process.

9.1 Process

The performance statistics output when the *Implementation Simulation Trials* above are run for each of the six RMP variants under consideration will be voluminous. A structured approach needs to be developed to allow the Scientific Committee to most effectively consider and interpret these results and ultimately develop a recommendation as to which RMP variant to implement. This will presumably require some method for consolidating the trial results. Certain participants expressed the view that this consolidation process needed to take account of the relative plausibility of the hypotheses underlying the different trials, in particular to avoid a recommendation being perhaps based only upon the trial for which acceptable performance proved the most difficult to achieve. Other members did not believe the latter was likely but there was little time for further discussion of this matter.

In discussion, a number of pertinent questions that might need to be addressed during any review process were raised. These are summarised below.

(a) What comprises acceptable performance by an RMP variant in a trial?
(b) Should the Committee concentrate only on results of trials for which performance was not always acceptable?
(c) Can sensitivity trials for which performance hardly differs from the corresponding base-case trial be ignored in the consolidation process?
(d) How can plausibility be assessed, and should this be qualitative (e.g. high/medium/low) or numeric?
(e) Can trials accorded 'low' plausibility be eliminated from the consolidation process?
(f) How should the Committee proceed if consensus on the relative plausibility of a trial cannot be achieved?
(g) Can some 'plausibility'-weighted average of each performance statistic over the trials comprise a sufficient basis for summarising results, taking account also of the fact that the trial 'design' did not provide a full 'cross' of all factors (e.g. most trials are for $MSYR_{\mathrm{mat}} = 1\%$, with only a few of these repeated for $MSYR_{\mathrm{mat}} = 4\%$)?

The Workshop **agreed** that a number of individuals familiar with the RMP trials process be invited to contribute written suggestions on this process if they wished. Those to be so invited were the participants at the Workshop and Cooke, Hammond, Magnússon, Schweder, Stefansson and Stokes; Donovan would provide a contribution related to the process used for the AWMP.

These contributions would be requested for submission by mid-April if possible, for circulation to an e-mail group comprising the Intersessional Steering Group augmented by those listed above and any other members of the Scientific Committee wishing to join[11]. Dialogue within this group on the suggestions made would be encouraged, but the group would not be expected to attempt to reach a consensus before the Scientific Committee meeting.

9.2 Data

In an ideal situation, decisions about the relative plausibility of trials would be determined at the trial development and selection stage, and prior to the results of runs of trials becoming available. It was noted, however, that in the case of these North Pacific minke *Implementation Simulation Trials*, trials had been included in the final set on the basis that at least some participants considered the associated underlying hypothesis plausible. This had been agreed on the understanding that a discussion of relative plausibility would take place at a later stage and before any RMP variant might be recommended.

The Committee had previously agreed that the trials themselves and the data to be used in their conditioning (sighting estimates of abundance and 'J'-non-'J' stock mixing proportion estimates by sub-area and month) should be finalised by this time (IWC, 2003a). However, at the Workshop, the question arose as to whether new auxiliary information could be used when commenting on the plausibility of various trials at the Scientific Committee meeting.

No consensus was achieved on this point; some believed that it was not acceptable to bring new information, others believed that it was. This must be considered further in Berlin. Given this, it was acknowledged that attempting to specify what comprised acceptable 'data' in the context of plausibility would be unproductive. The Workshop however, **recommended** that any 'new' information and/or analyses pertaining to this issue should preferably be forwarded to the Secretariat to allow electronic availability (e.g. via its web-site) to the Scientific Committee by mid-April.

In this regard, Pastene and Kawahara gave brief presentations regarding respectively genetic and ecological/oceanographic studies they intended to pursue in relation to the issue of relative plausibility of different stock-structure hypotheses for report to the Scientific Committee. The content of these presentations was not discussed by the Workshop.

10. WORK REQUIRED PRIOR TO SCIENTIFIC COMMITTEE MEETING

10.1 Schedule

Papers to be presented to the Scientific Committee involving analyses addressing the plausibility of the scenarios underlying different trials, and the process to be used to formulate a recommendation for an RMP variant to implement on the basis of the trial results, should be submitted to the Secretariat by mid-April for pre-circulation.

Donovan will coordinate the production of a paper describing the *Implementation Simulation Trials*, and prepare a PowerPoint presentation based upon this document (see Item 8).

Taylor will provide Allison with the 'O_W'-' O_E' dispersal rate estimates for trials C1-17 and C1-19 (see Item 6.1.1).

[11] Anyone wishing to join should contact Andre Punt: *aepunt@u.washington.edu*.

Dispersal rate estimation requires estimates as input of the 'pristine' abundance of the female component of the population. These estimates will be provided to Taylor by Allison.

The following tasks will be carried out by Allison in the order listed below:

(1) Run a small number (~6) of additional deterministic simulations with revised mixing matrices to confirm the conclusions drawn under Item 5.3, and circulate the results to the Intersessional Steering Group by the end of February.

(2) Condition and run projections for all of the Baseline trials and circulate the conditioning results (in (g)-plot format plus more detailed results for trials with a 'poor' fit to the data; the criterion for a 'poor' fit is given in Item 5.3) to the Intersessional Steering Group. Prepare the output from the projection runs for these trials in the format described under Item 8 and circulate an example to the Intersessional Steering Group for discussion on whether this format is sufficient.

(3) Condition and run the sensitivity trials, beginning with the trials denoted with a * in Table 1. If any of these trials present problems they would be set aside and the remaining trials completed first. Ideally, the complete set of summary results will be circulated to the Scientific Committee prior to the Scientific Committee meeting. The full output files will be made available upon request.

(4) Progress on the above tasks will be reviewed four weeks prior to the Scientific Committee meeting; if it is evident that the full set of trials will not be completed before the Scientific Committee meeting priorities will then be set.

It was **agreed** that all circulated results would be confidential prior to the Scientific Committee meeting.

10.2 Terms of Reference for intersessional e-mail group to facilitate conduct this work

These Terms of Reference are implicit in the descriptions of this work given under Item 10.1.

11. ADOPTION OF REPORT

It was **agreed** that the report would be agreed by e-mail.

12. CLOSURE

On behalf of the Workshop, the Chairman thanked Allison and Punt for the considerable work they had carried out during the Workshop to respond to its requests for additional calculations and diagnostic plots. He also thanked the participants for the cooperative spirit shown throughout the meeting, making this Workshop considerably easier to chair than the last one! He also expressed his great appreciation to the rapporteurs and the interpreter. The Workshop expressed its thanks to the Chairman for his excellent chairmanship.

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Annex A

Agenda

1. Convenor's opening remarks
2. Election of Chair
    - 2.1 Appointment of Rapporteurs
3. Adoption of agenda
4. Review of documents
5. Progress on trial specification and results of conditioning
    - 5.1 General overview
    - 5.2 Results of conditioning
    - 5.3 Baselines A, B and C
    - 5.4 Baseline D
6. Specification of trials
    - 6.1 Changes to trials previously agreed
        - 6.1.1 Baselines A-C
        - 6.1.2 Baseline D
    - 6.2 Small Areas/RMP variants to be considered
7. Trial results
8. Methods to examine results of trials
9. Relative plausibility of trials
    - 9.1 Process
    - 9.2 Data
10. Work required prior to Scientific Committee meeting
    - 10.1 Schedule
    - 10.2 Terms of Reference for intersessional e-mail group to facilitate conduct of this work
11. Adoption of report
12. Closure

Annex B

List of Documents

SC/J03/NP1. Allison, C. and Punt, A.E. Calculating a Baseline D mixing matrix.

Annex C

Dispersal Estimates For Western North Pacific Minke Whales

Barbara L. Taylor and Karen Martien

SUMMARY

Simulations were used to estimate the annual dispersal rates given observed rates of genetic differentiation for harvested North Pacific minke whales. Dispersal rates were estimated for two population structure hypotheses: Baseline A where most whales to the east of Japan are 'O' stock and 'W' stock appears in sub-area 9W in 60% of the years, and Baseline C with three stocks to the east of Japan. Several ways of excluding 'J'-stock individuals were used for Baseline A and had little impact on results. Baseline B used F_{st} values based on the '2-site' criterion for 'J'-stock exclusion. The mutation rate (μ) used in the simulation was tuned to match the observed number of haplotypes ($\mu = 0.0004$). Simulations were run for a range of dispersal rates with the objective of obtaining a range of plausibility from 'low yet plausible' to 'high yet plausible' and a middle 'most plausible' value. For Case A the low, best and high dispersal values were: 0.00008, 0.00018, 0.0005. For Baseline C the low and best for 'O_W' to 'O_E' (leaving 'O_E' to 'W' at 0.0011) were 0.001 and 0.0045. The 'high but plausible' proved problematic because the F_{st} estimate (0.0018) was so close to zero that it proved impossible to have a dispersal rate high enough that there was only a small probability of a value greater than the observed value. Thus, two possibilities for the 'high' scenario are to ignore the 'boundary' making 'O_W' and 'O_E' a single stock or to use a high but plausible dispersal rate like $d = 0.01$ which had 25% of its F_{st} estimates greater than the observed value.

Introduction

This paper updates previous estimates of dispersal rates for the population structure hypotheses A and C in the *Implementation Simulation Trials*. Dispersal rates were estimated using the same techniques used in Taylor *et al.* (2000). Following suggestions made at the 2000 meeting, a range of dispersal rates were estimated for use in the North Pacific minke whale *Implementation Simulation Trials* (ISTs). Preliminary estimates of historical numbers of mature females were obtained from Allison and were roughly: Baseline A:'O' = 8,807, 'W' = 2,309; Baseline C: 'O_W' = 3,400, 'O_E' = 1,600 and 'W' = 5,165.

Methods

A brief description of the simulation and analysis methods follow. Simulations followed previously used methods (Taylor *et al.*, 2000) but will be described here for Baseline C. The dynamics basically follow a stepping-stone model where each stock has the mean abundance for the estimated number of historical mature females (Fig. 1). The simulation (genmod.exe) begins with all individuals having the same haplotype (40 basepairs with a per/basepair mutation rate of 0.00004). Each year every individual is allowed to give birth, die or disperse to the neighbouring stock (with the probability d). The simulation runs for 30,000 years, which was sufficient to bring the dynamics into a state of quasi-equilibrium. The simulation is then run for an additional 20,000 years and is sampled every 100 years (Baseline A: $N_o = 8{,}807$, $n_o = 361$, $N_w = 2{,}309$ $n_w = 10$, Baseline C: $N_{ow} = 3{,}400$, $n_{ow} = 165$, $N_{oe} = 1{,}600$, $n_{oe} = 168$, $N_w = 5{,}165$, $n_w = 175$). A series of different dispersal rates were run and the fit measured as the proportion of the estimated measures of genetic differentiation that are greater than the observed.

Results

The proportion of the simulated estimates of F_{st} that were greater than the observed served as the measure of fit for the given set of dispersal rates. For Baseline A the dispersal rates corresponding to 95% > observed, 50% > observed and 5% > observed were: 0.00008, 0.00018, 0.0005, respectively.

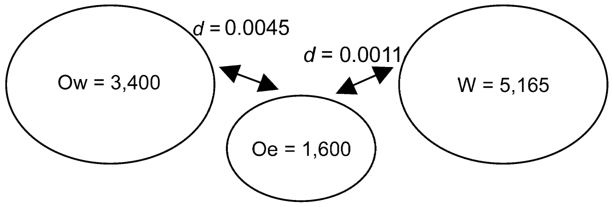

Fig. 1. Diagram of the simulation model for Baseline C with the best fit dispersal rates shown.

For Baseline C where two dispersal rates needed to be estimated, simulations were first run to achieve 50% > observed for both dispersal estimates, which resulted in $d(O_W - O_E) = 0.0045$ and $d(O_E - W) = 0.0011$. The $d(O_W - O_E)$ dispersal rate was then fixed and the 'high but plausible' and 'low but plausible' dispersal rates between 'O_W' and 'O_E' were sought. The low estimate (95% > observed) $d(O_W - O_E) = 0.001$. However, it was not possible to achieve a high estimate if defined as 5% > observed because the observed F_{st} (0.0018) is too close to the lower bound for F_{st} of zero (see discussion below). For $d = 0.01$, 0.02 and 0.03 the proportion > observed was 25%, 15% and 16% respectively.

Discussion

The general level of genetic differentiation is governed by the equation: $F_{st} = 1/(2NdT + 1)$, where d is the annual probability of dispersal and T is generation time. Although this equation (modified from Wright, 1931 for mitochondrial DNA) uses the average abundance and makes various assumptions that lead to biases, the general form reveals a strong decrease in F_{st} with dispersal (Fig. 2).

The result of the relatively high abundance of minke whales is that the expected F_{st} is close to zero over a large range of dispersal rates. This can be seen in histograms of the estimated levels of genetic differentiation (Fig. 3).

From the perspective of the *Implementation Simulation Trials*, two 'high dispersal' scenarios could be run. One would use a 'high but plausible' of $d = 0.01$ (with 25% of the estimated values greater than the observed). Another

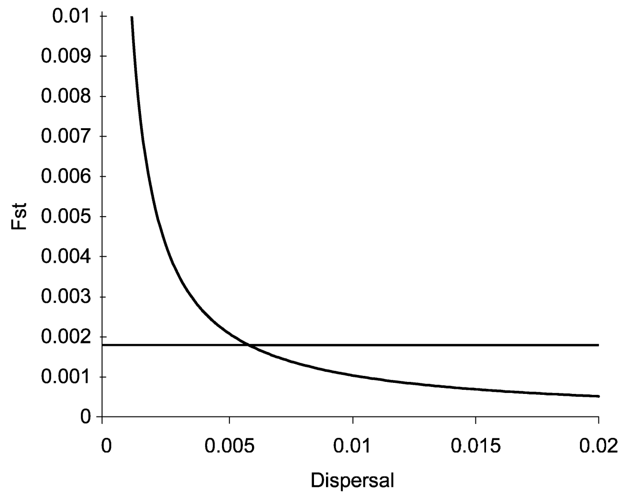

Fig. 2. Expected value for F_{st} assuming an average N = 2,400 (O_e+O_w/2), and T = 20. The horizontal line is observed F_{st} = 0.0018.

alternative is to lump 'O_W' and 'O_E' into a single stock ('O') which would correspond to earlier trials which had 'O' stock in sub-areas 7 and 8, and 'W' stock in sub-area 9.

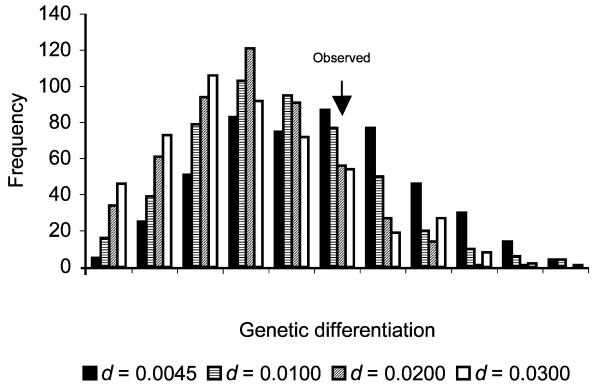

Fig. 3. Frequency histograms for estimated levels of genetic differentiation for a range of dispersal rates between 'O_W' and 'O_E' with the bin containing the observed value noted with the arrow.

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Annex D

Diagnostic Plots for the J1, *MSYR* = 1% Base-Case Trials for Baselines A and C

C. Allison

[*Figures on following pages*]

Fig a.1 Target abundances with arrow showing point estimate A1-J1

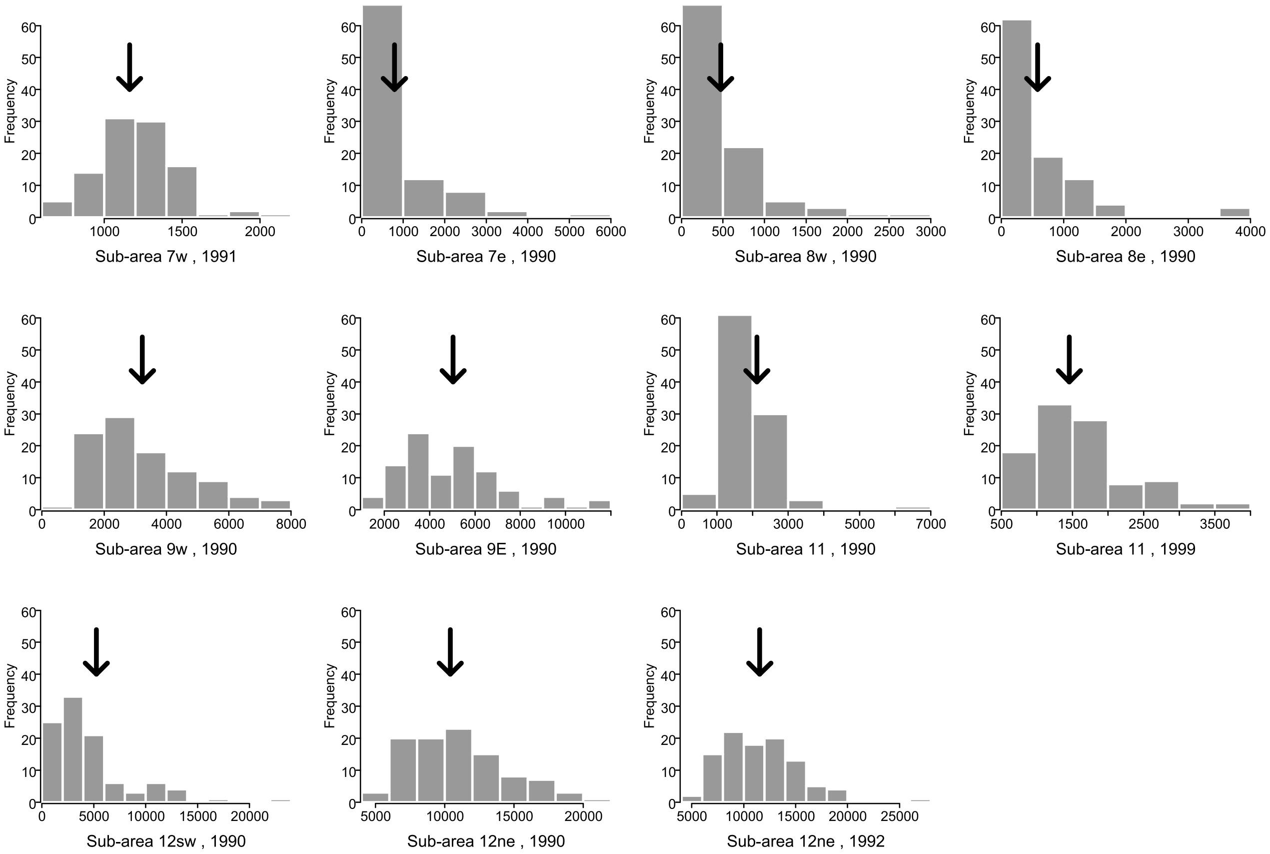


Fig a.2 Target J proportions with arrow showing point estimate A1-J1

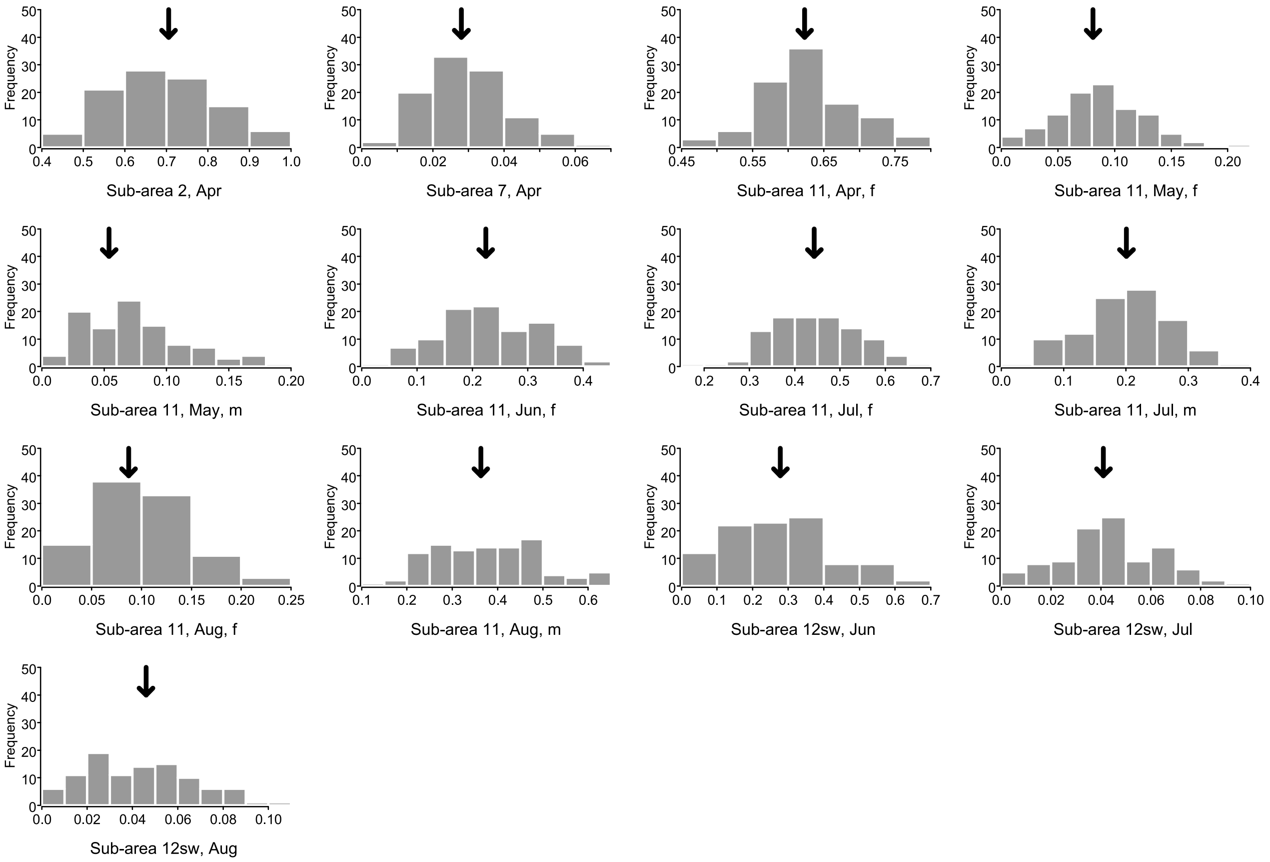


Fig b.1 Standardised residuals for abundances A1-J1

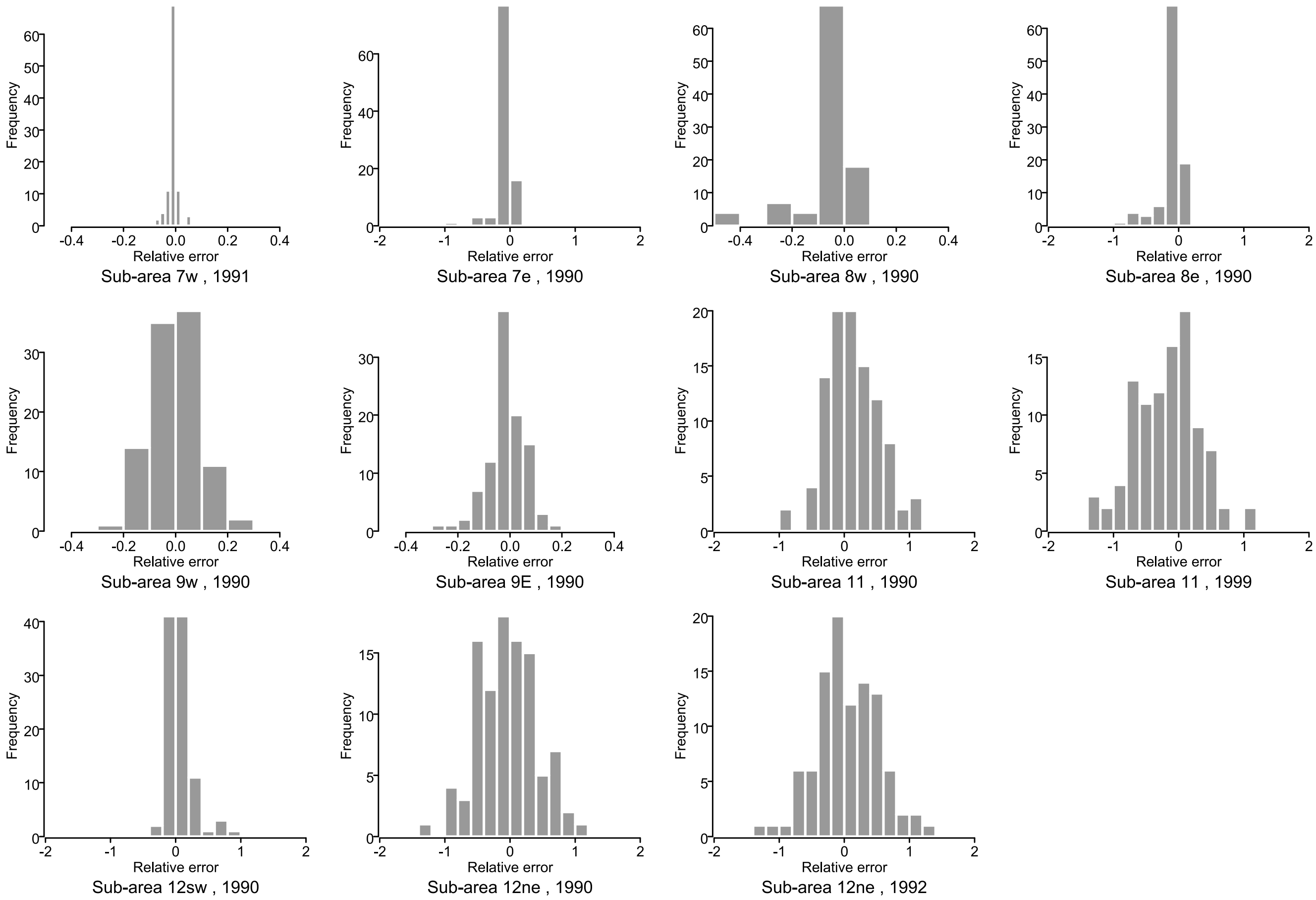


Fig b.2 Standardised residuals for J proportions A1-J1

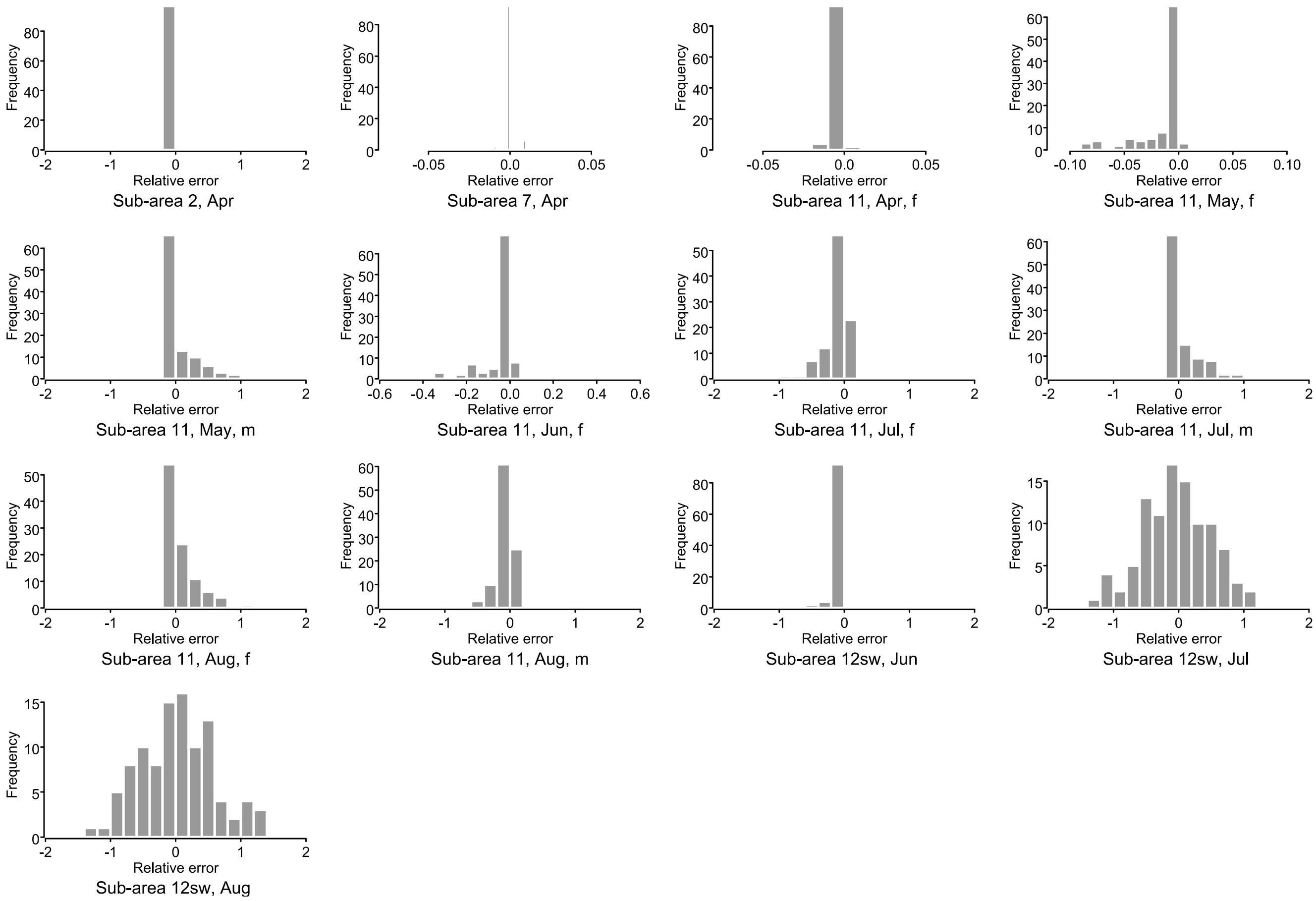


Fig c. Median trajectories (o=point estimate, x=median target) A1-J1

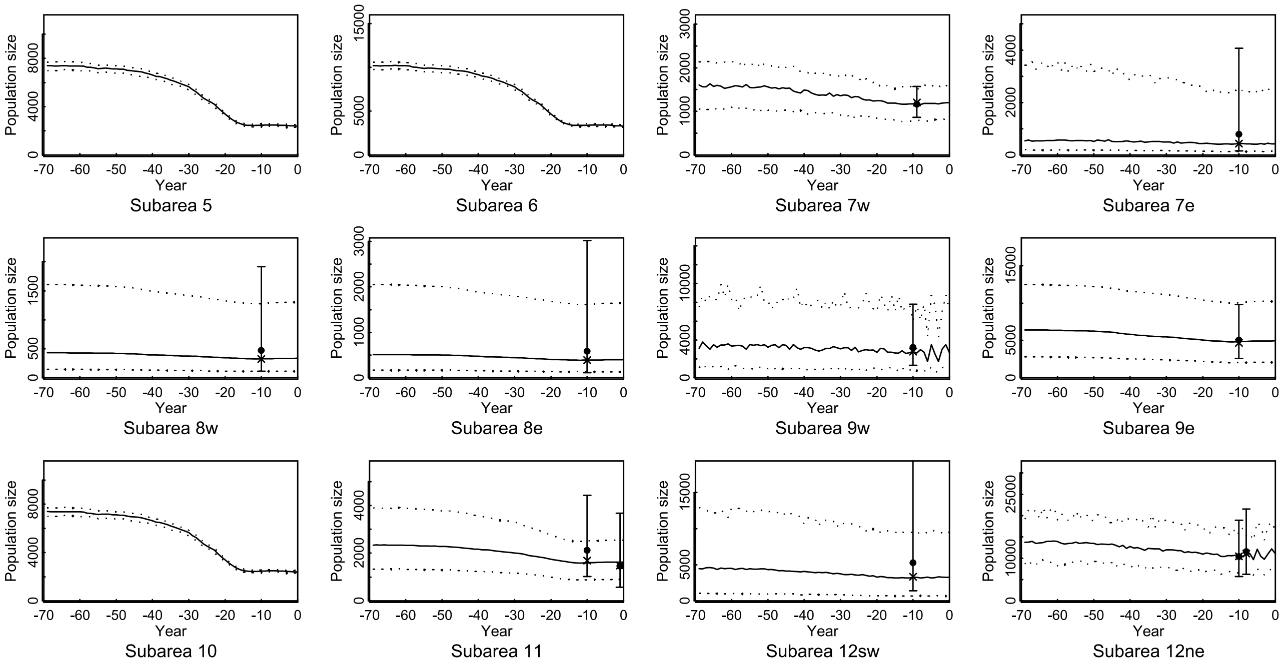


Fig d. J stock proportions by year: Median, 5 and 95%iles (o=point estimate, x=median target) A1-J1

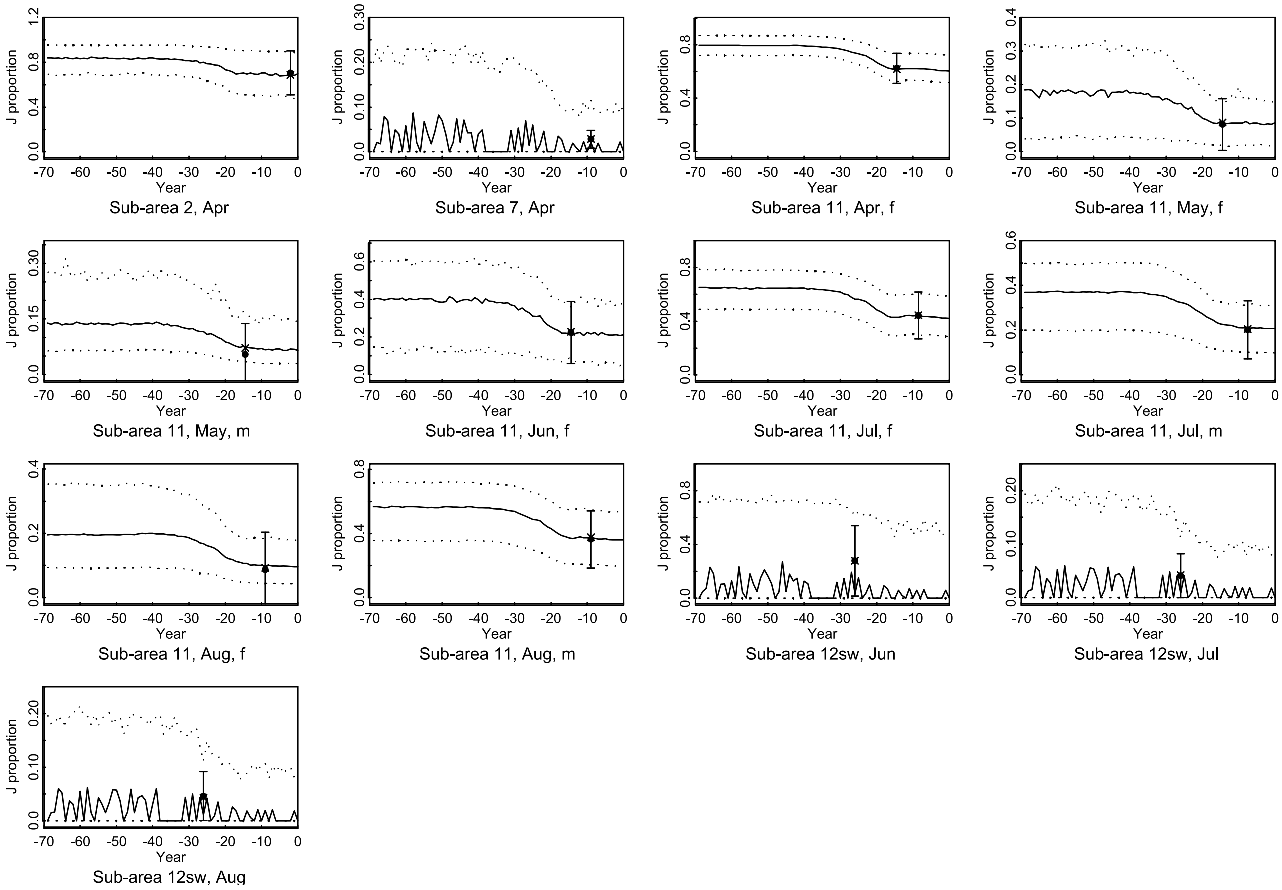


Fig e. Simulation 3 showing Aug/Sept (+ Jun/Jul dotted). o = simulation target A1 - J1

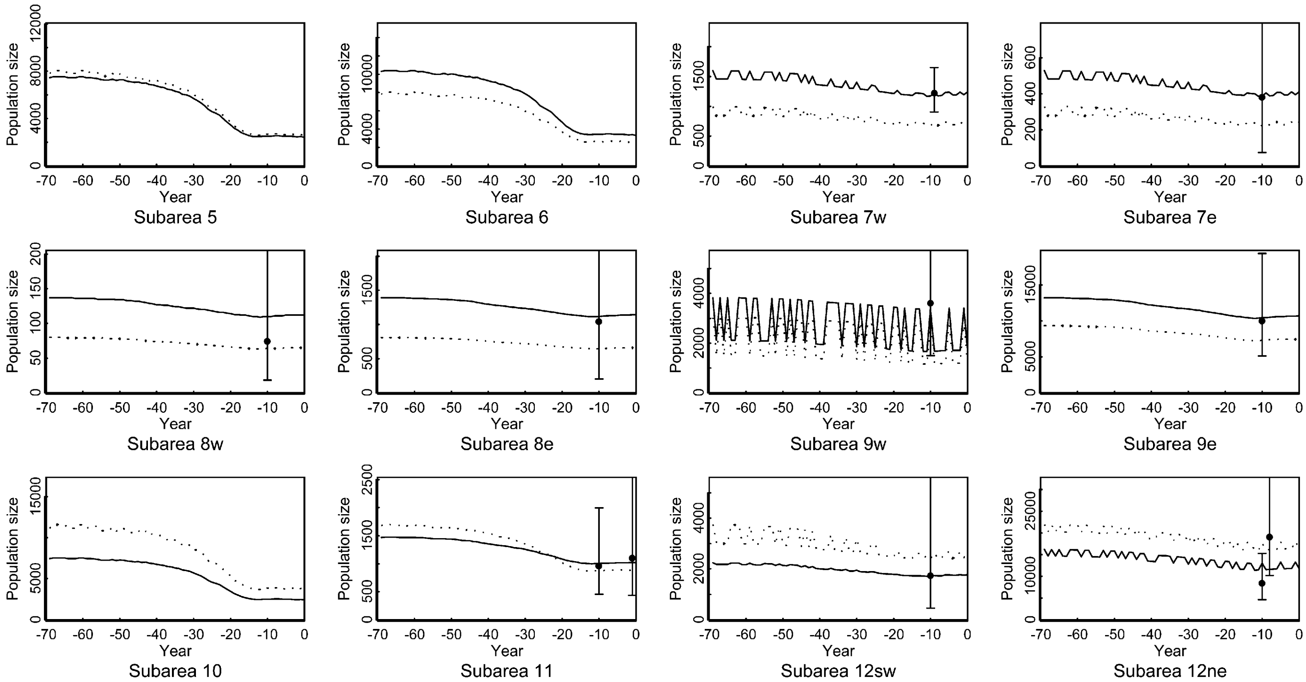


Fig e. Simulation 4 showing Aug/Sept (+ Jun/Jul dotted). o = simulation target A1 - J1

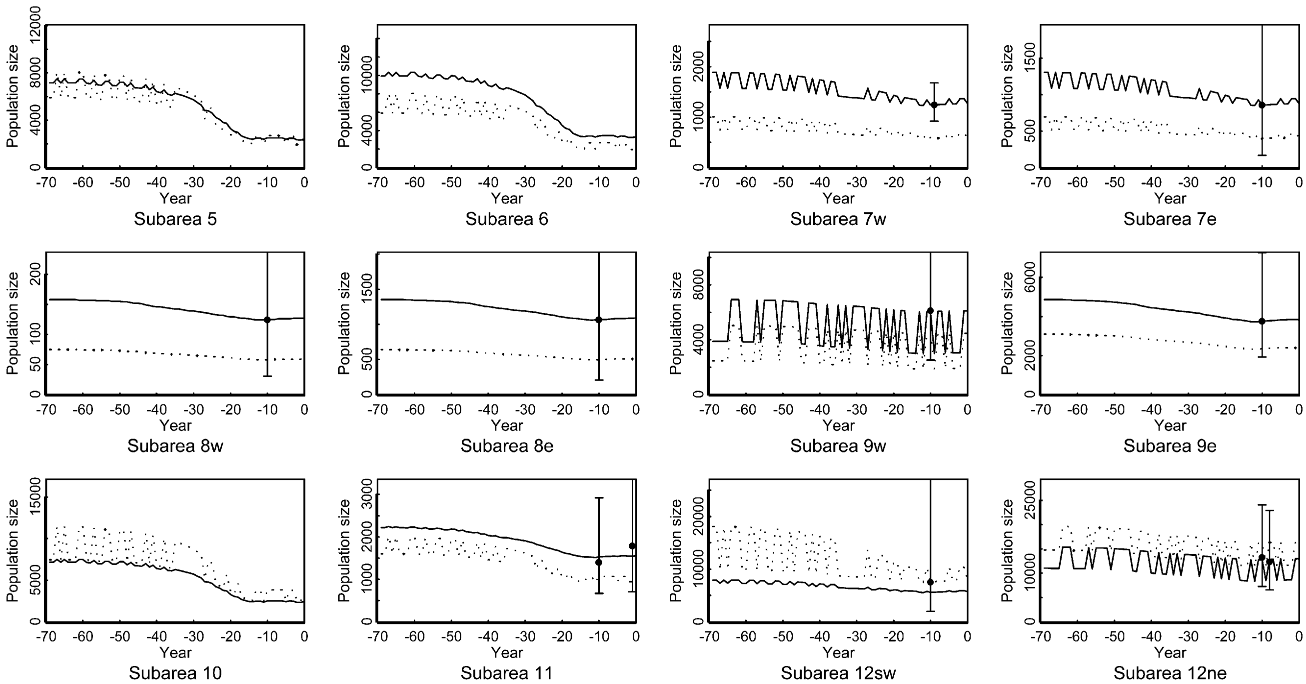


Fig f. J stock proportions by year: Simulation 3 (o=simulation target) A1-J1

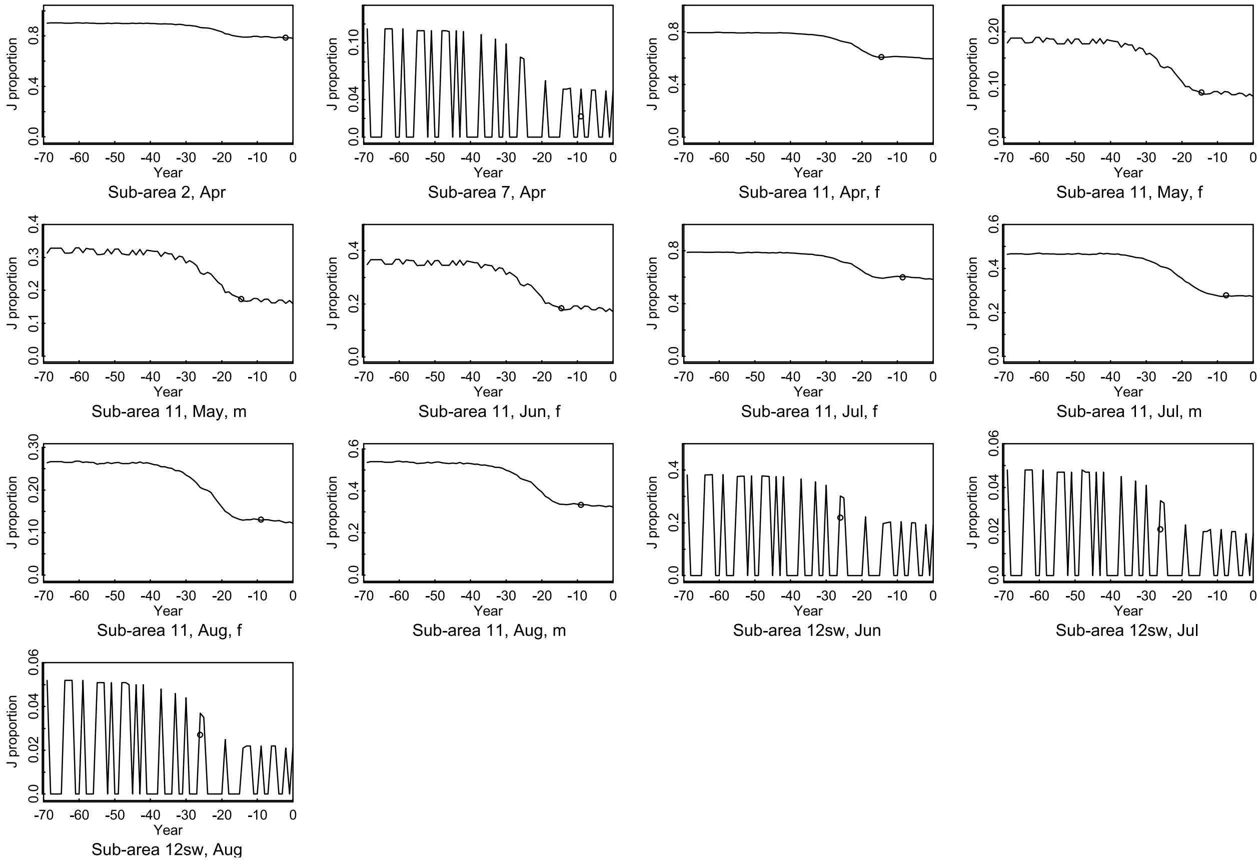
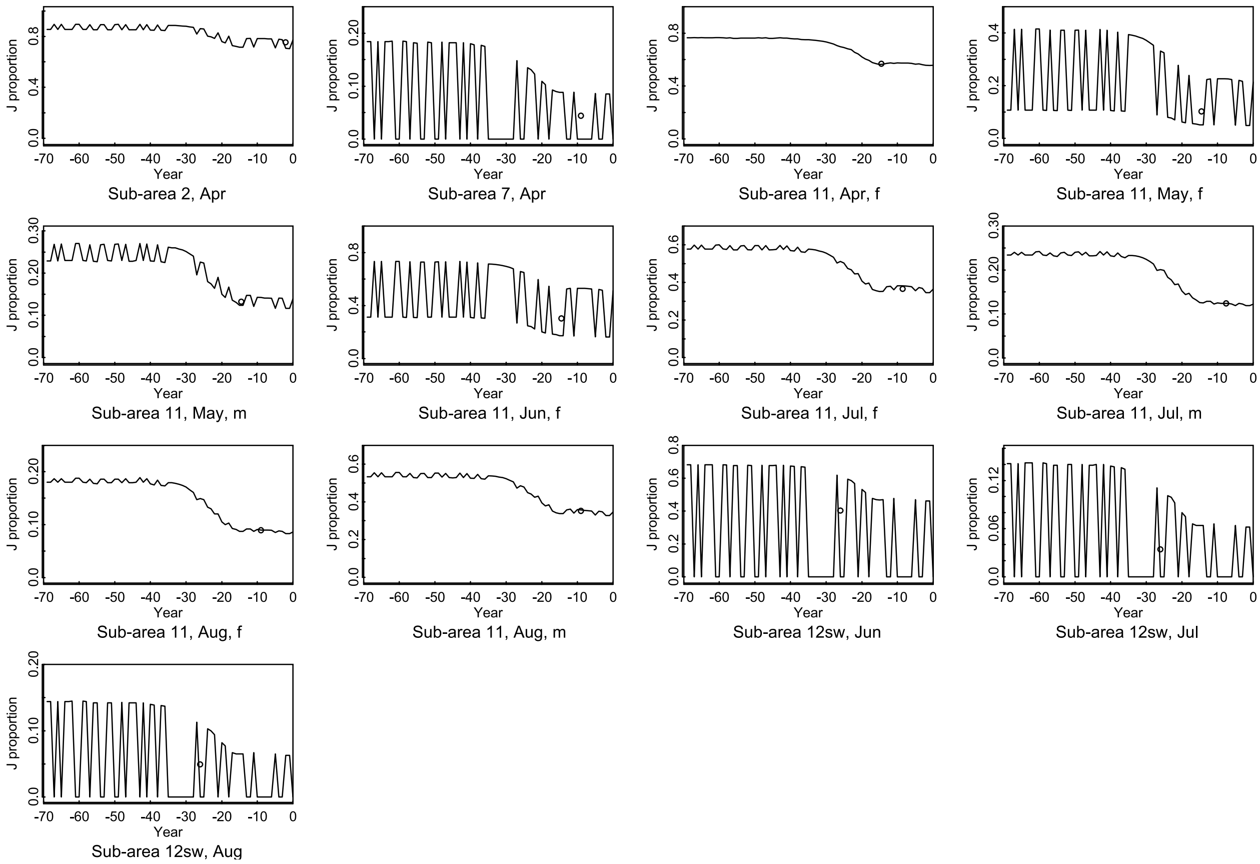


Fig f. J stock proportions by year: Simulation 4 (o=simulation target) A1-J1



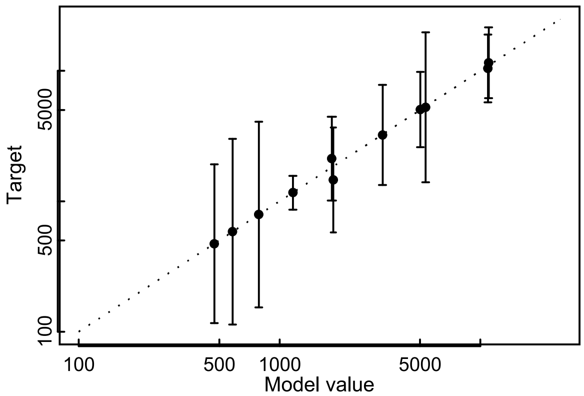


Fig g.1 A1-J1 Population sizes, deterministic

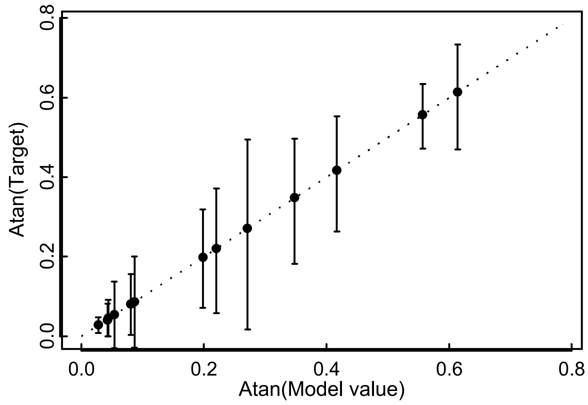


Fig g.2 A1-J1 J stock proportions, deterministic

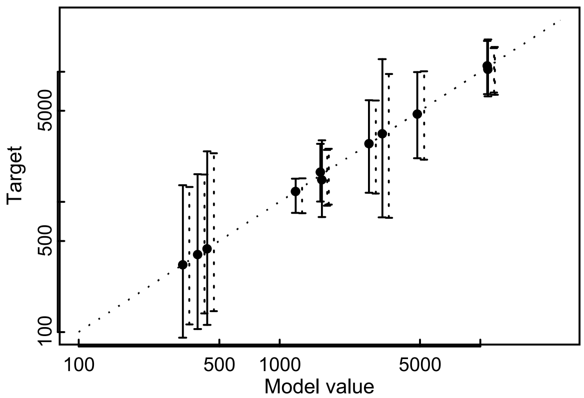


Fig h.1 A1-J1 Population sizes

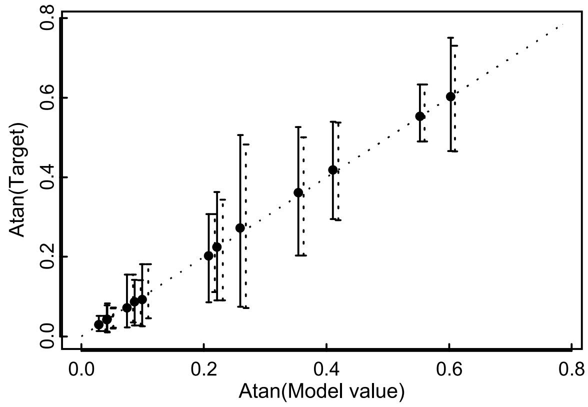


Fig h.2 A1-J1 J stock proportions

Fig a.1 Target abundances with arrow showing point estimate C1-J1

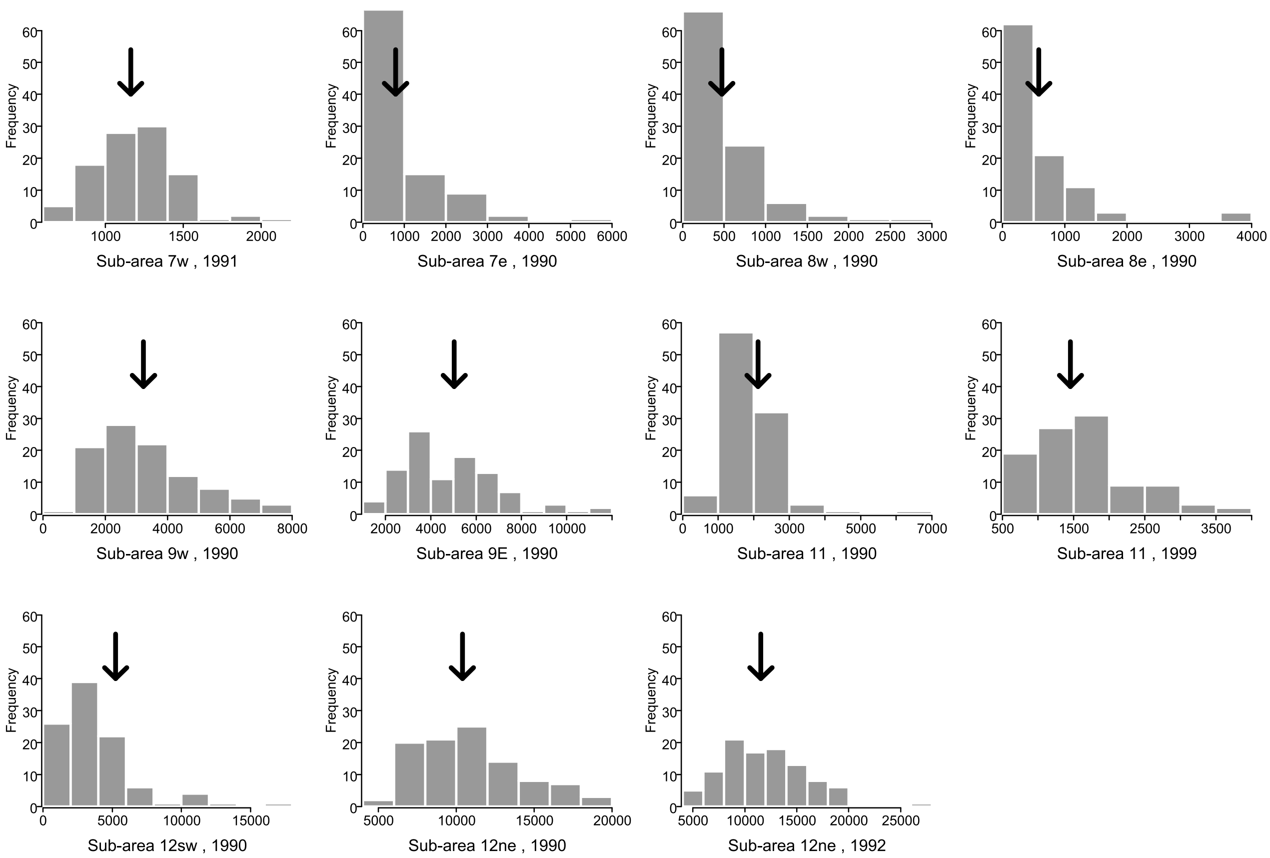


Fig a.2 Target J proportions with arrow showing point estimate C1-J1

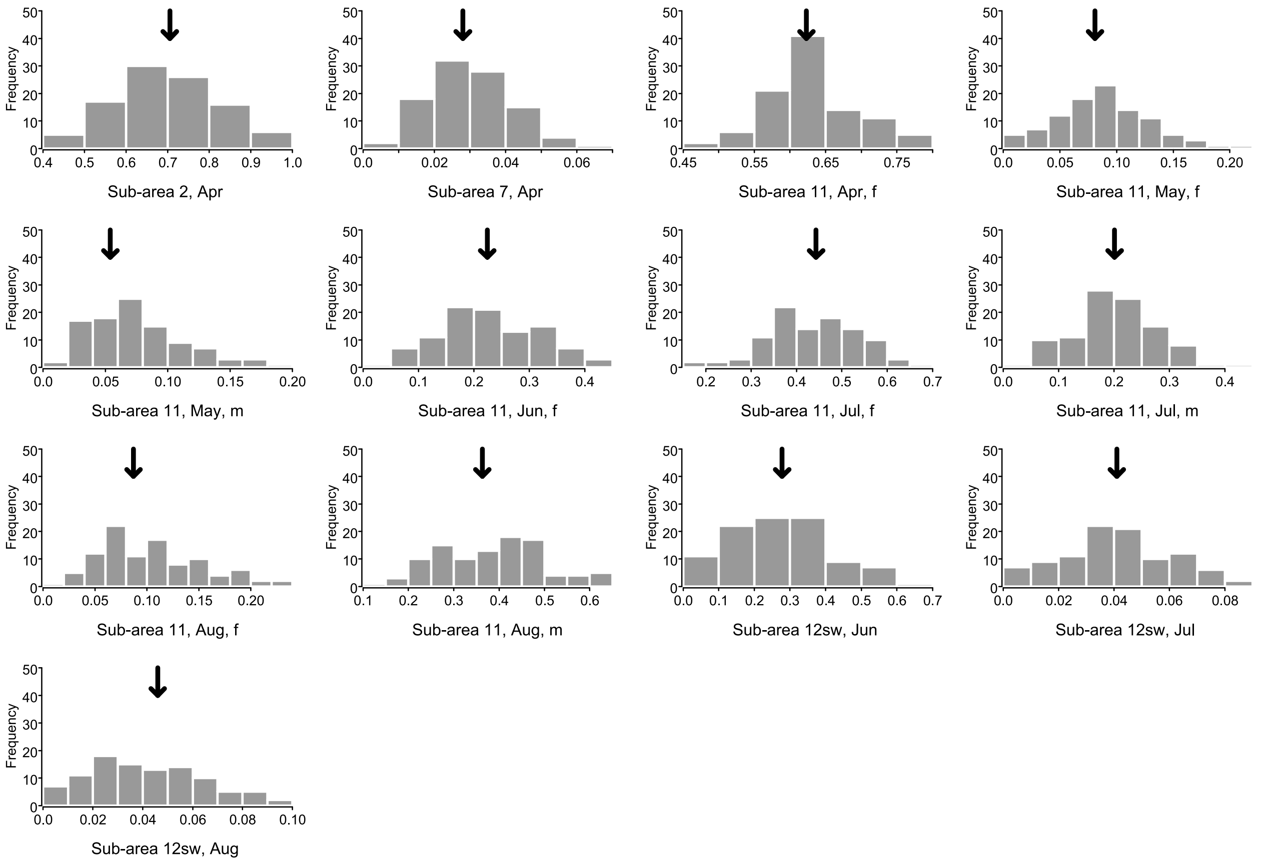


Fig b.1 Standardised residuals for abundances C1-J1

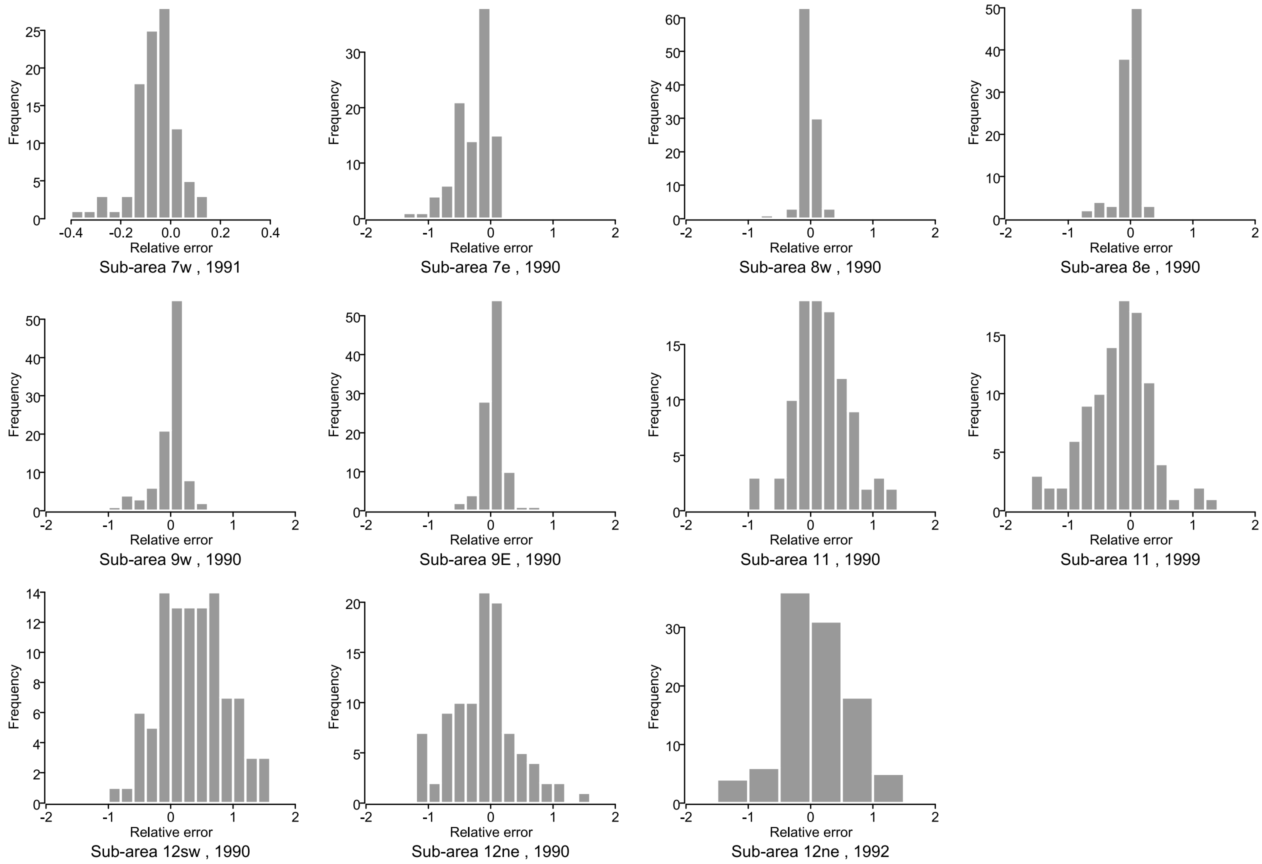


Fig b.2 Standardised residuals for J proportions C1-J1

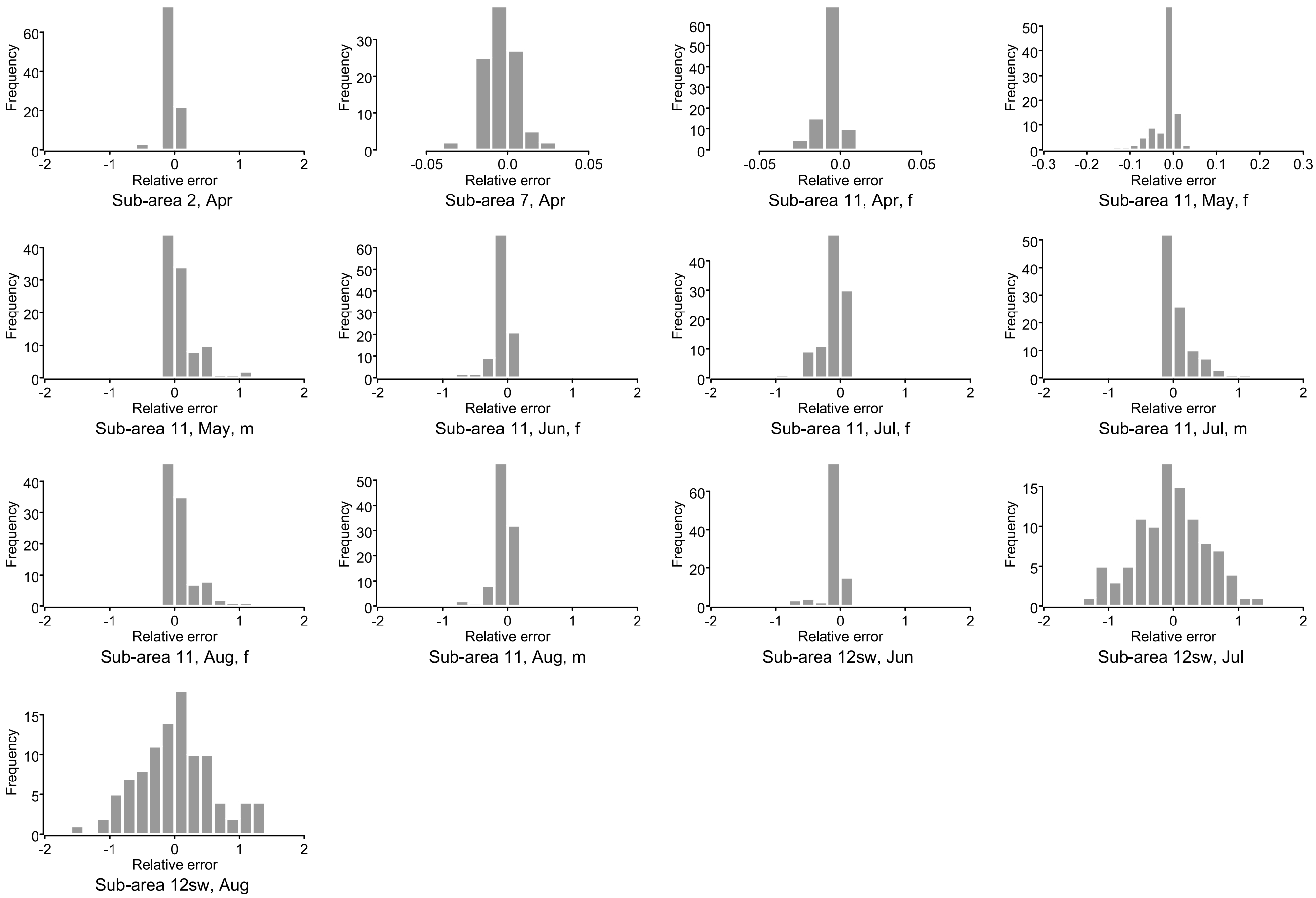


Fig c. Median trajectories (o=point estimate, x=median target) C1-J1

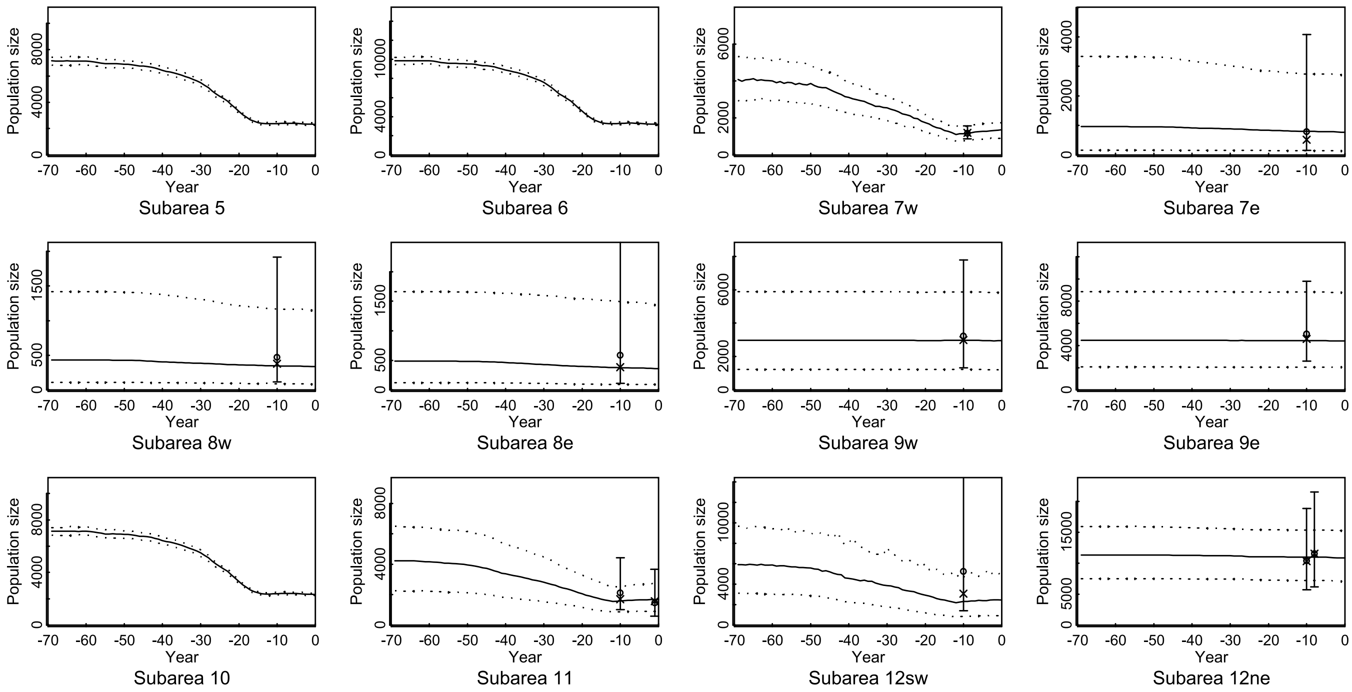


Fig d. J stock proportions by year: Median, 5 and 95%iles (o=point estimate, x=median target) C1-J1

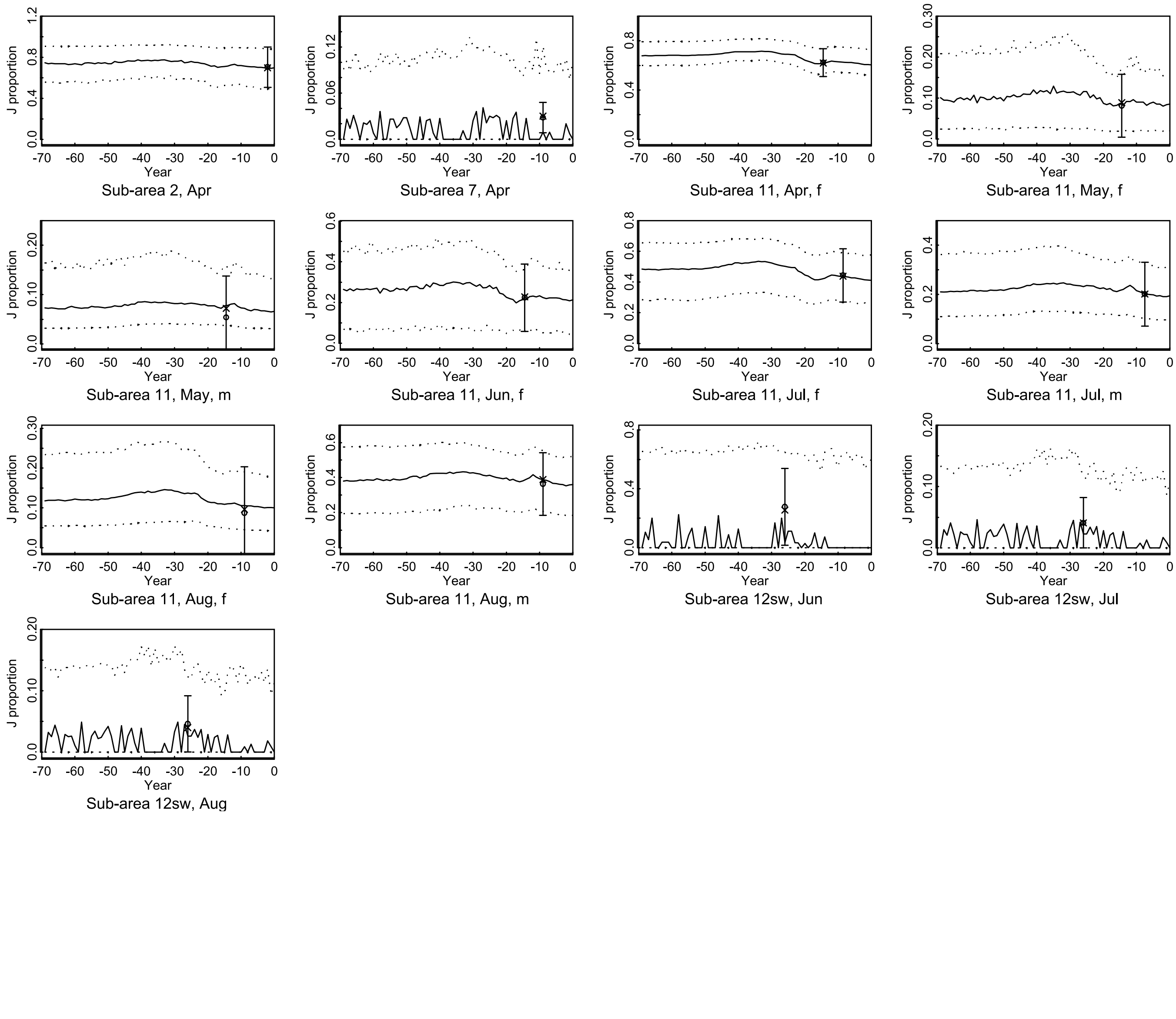


Fig e. Simulation 3 showing Aug/Sept (+ Jun/Jul dotted). o = simultion target C2 - J1

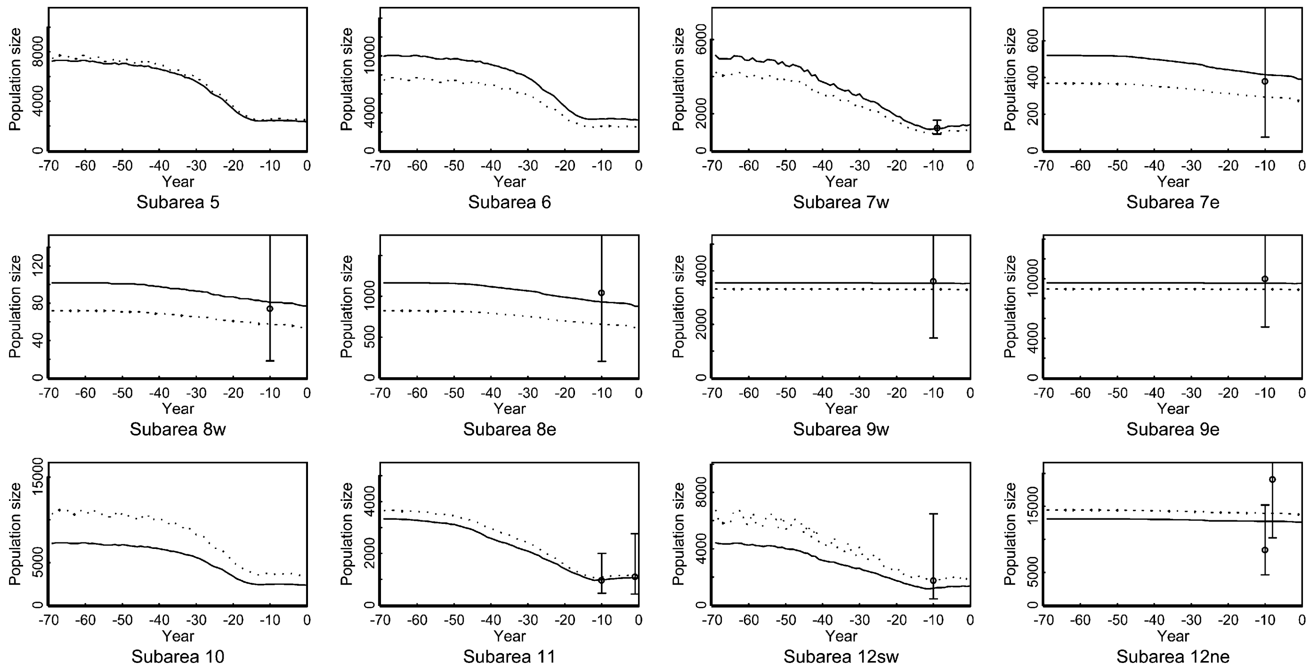


Fig e. Simulation 4 showing Aug/Sept (+ Jun/Jul dotted). o = simulation target C1 - J1

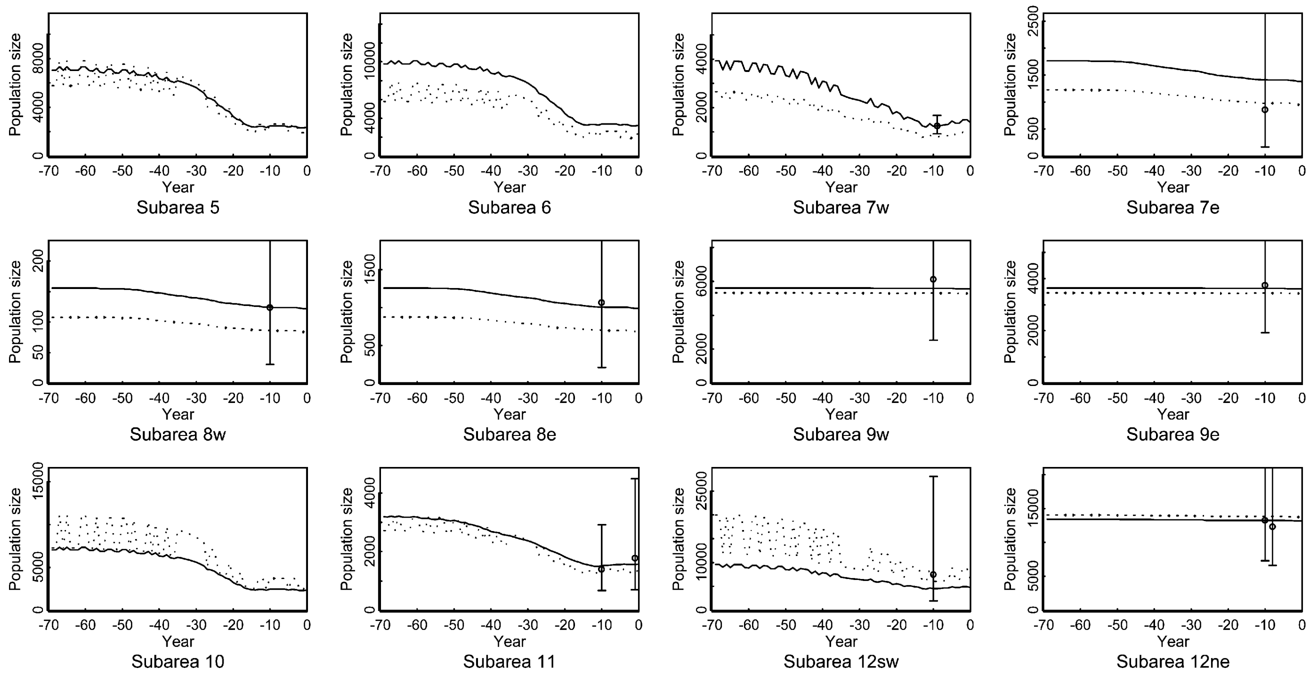


Fig f. J stock proportions by year: Simulation 3 (o=simulation target) C1-J1

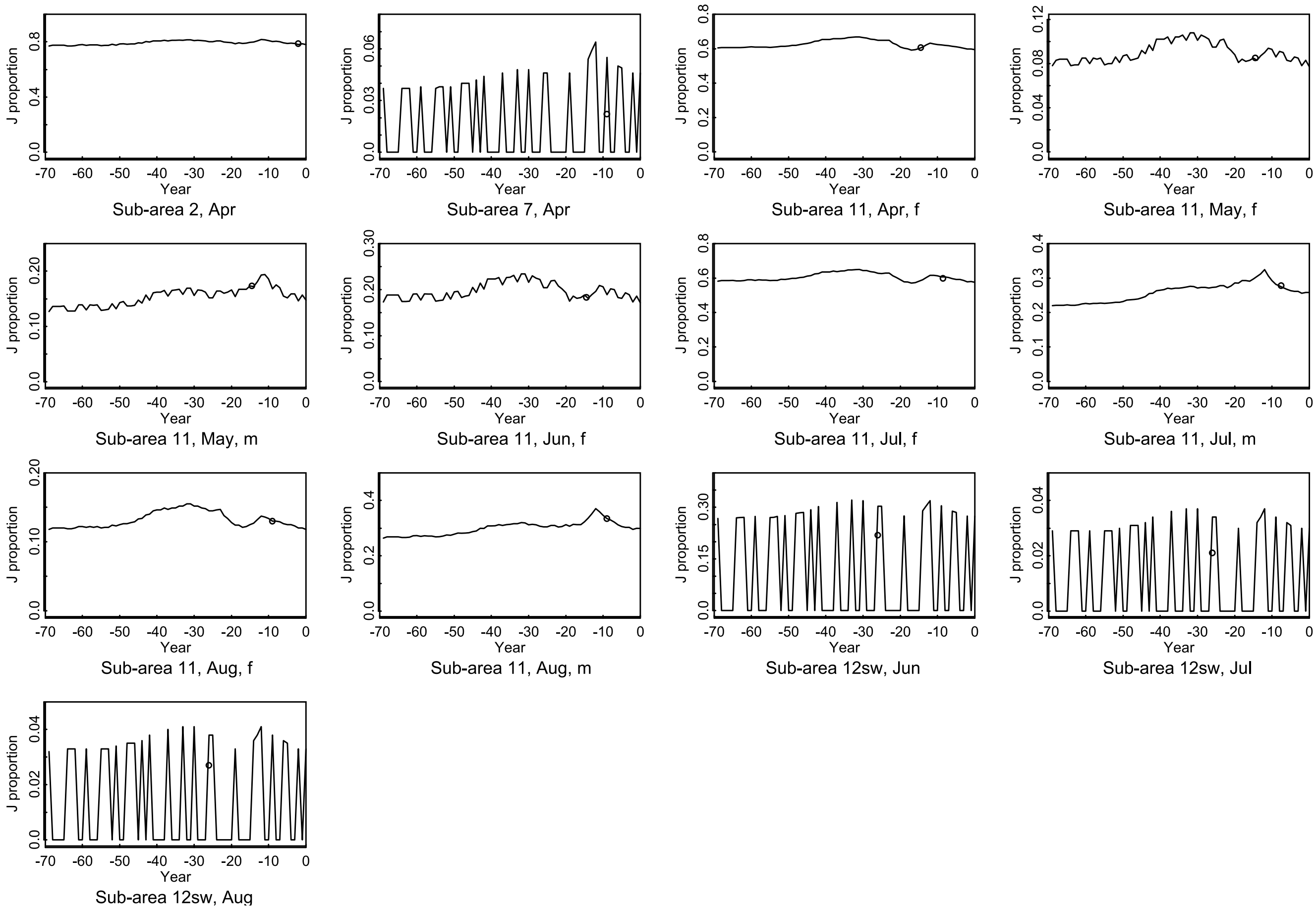
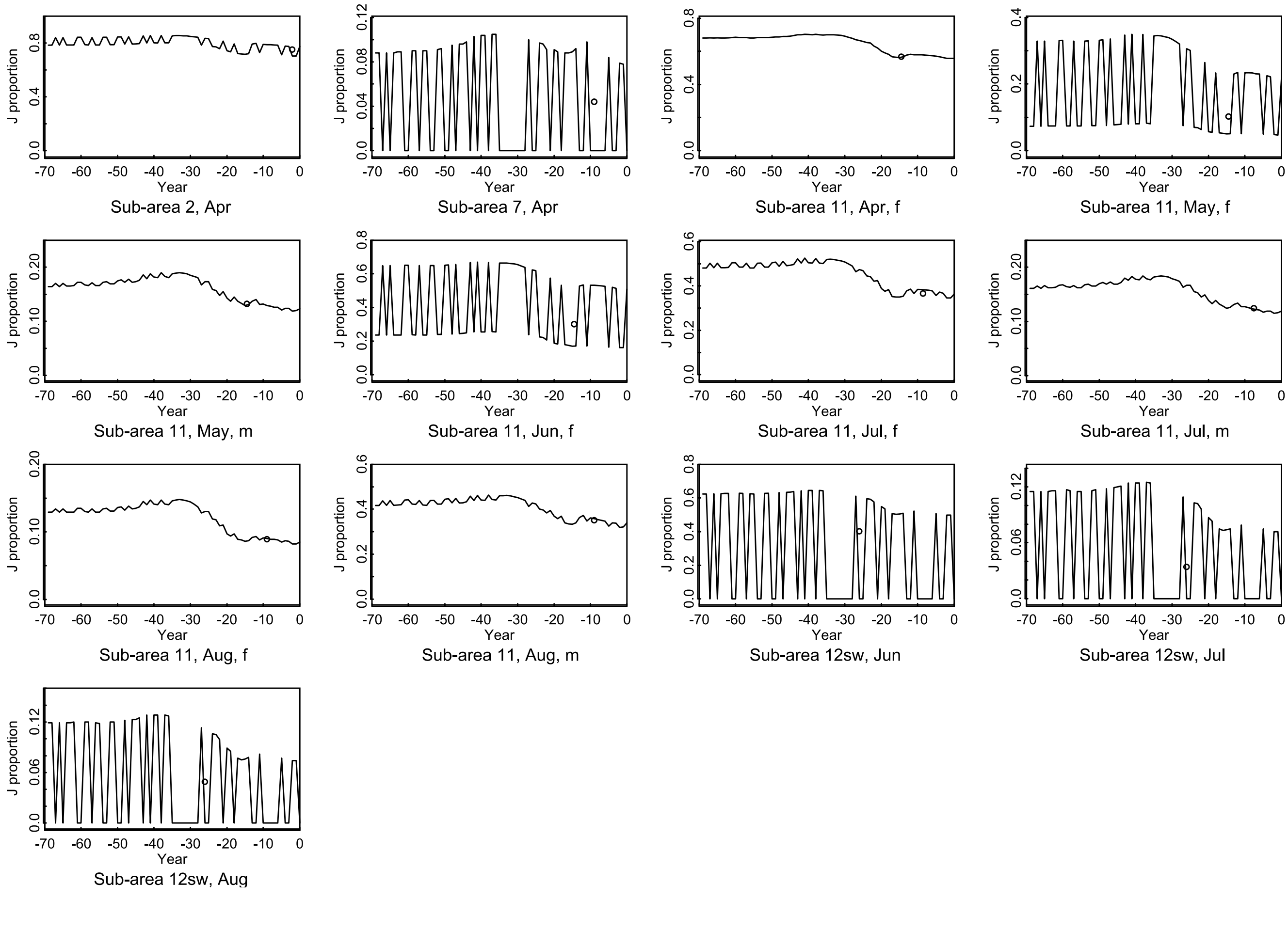


Fig f. J stock proportions by year: Simulation 4 (o=simulation target) C1-J1



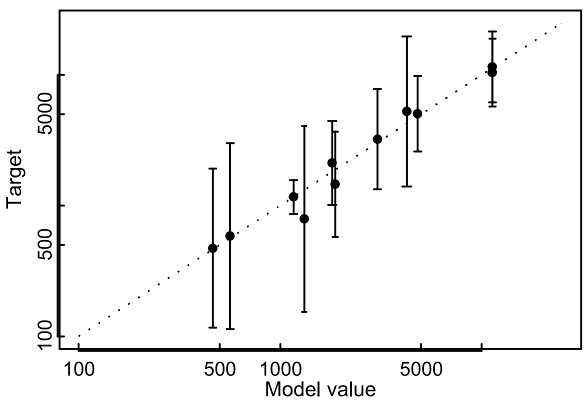


Fig g.1 C1-J1 Population sizes, deterministic

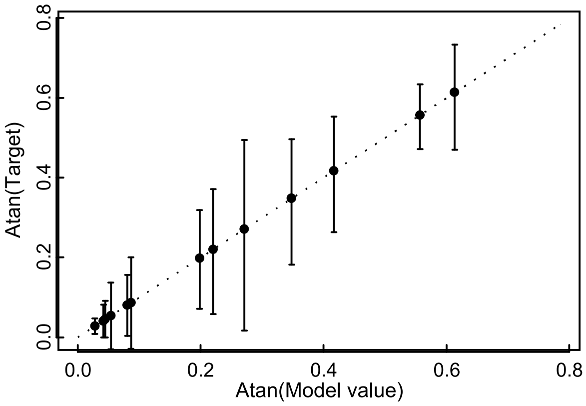


Fig g.2 C1-J1 J stock proportions, deterministic

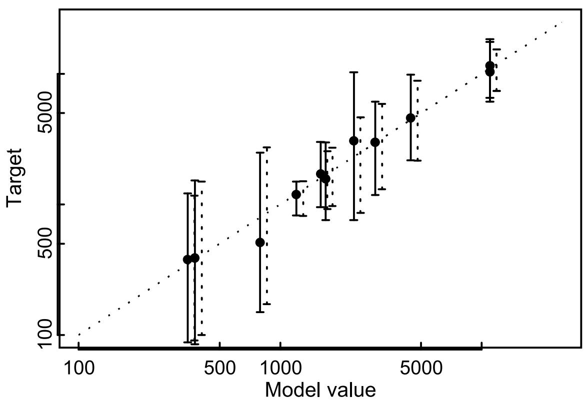


Fig h.1 C1-J1 Population sizes

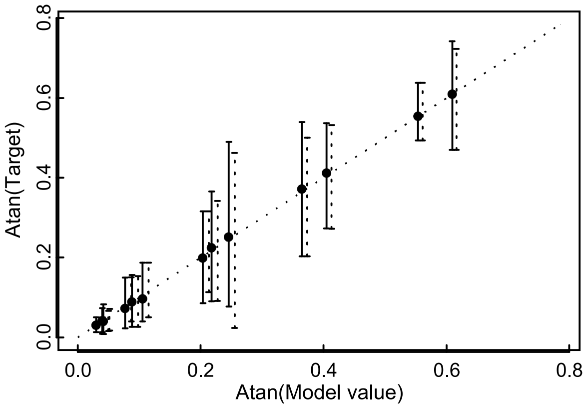


Fig h.2 C1-J1 J stock proportions

Annex E

Why Mis-specification of the Migration Pattern Should Not Lead to Errors in Estimation of the Effect of Catches on Stocks

D.S. Butterworth

Column I of Table 1 represents the situation as estimated for the present year (now). There are two stocks ('J' and 'O') in sub-area-month combination X. Genetic data from the catch shows that the stock mixture for this sub-area-month-year is 50:50; hence a total catch of 200 animals would be divided into 100 'J's and 100 'O's.

Fitting a population model to the sightings abundance survey data and assumed mixing matrix patterns (for each stock) yields a current total population estimate of 10,000 for each stock, 1,000 of each of which are in X. Hence, the mixing matrix elements for X for both 'J' and 'O' are estimated as 0.1.

Table 1

	I		II		III		IV	
	Estimated now		Actual now		Estimated later		Actual later	
	'J'	'O'	'J'	'O'	'J'	'O'	'J'	'O'
Total population	10,000	10,000	10,000	10,000	12,000	8,000	12,000	8,000
Sub-area-month X	1,000	1,000	2,000	2,000	1,200	800	2,400	1,600
Catch in X	100	100	100	100	120	80	120	80
Mix matrix for X	0.1	0.1	0.2	0.2	0.1	0.1	0.2	0.2

Now it so happens that the mixing matrix patterns (and hence migration patterns) have been mis-specified. Column II shows what is actually the situation. The total population estimates hardly differ from those in column I, as they depend primarily on the historic catch series and the *MSYR* value pre-specified. The proportions in X differ, though their ratio is unchanged from that estimated in column I, because genetic data fixed that at the 50:50 ratio observed in the catch. The actual population numbers in X are each 2,000 rather than 1,000; hence the mixing matrix values are really each 0.2 rather than 0.1.

Now consider the situation some years later when the overall population numbers have changed to 12,000 ‘J’ whales and 8,000 ‘O’ whales

A catch of 200 whales is taken from X. First, how is this estimated to be split between ‘J’ and ‘O’ whales? The results are shown in column III. The mixing matrix entries remain assumed to both be 0.1. This then specifies the number of ‘J’ and ‘O’ whales in X, and hence a 120:80 ‘J’:’O’ division of the catch of 200.

What is really going on? This is shown in column IV. If catches in the intervening period have been correctly allocated to stock (as follows from below), the true total populations now (column IV) will be the same as estimated in column III. The mixing matrix is assumed time-invariant, so that the values in column II apply also to column IV. From this, the numbers of ‘J’ and ‘O’ whales in X, and hence the true catch split of the 200 whales as 120 ‘J’s and 80 ‘O’s follow.

Note therefore that even though the relative overall abundances of ‘J’ and ‘O’ have changed, the per-stock allocation of the catch in X remains correct (as in column IV) even though the wrong mixing matrix is being used (as per column III).

Correct estimation of the effects of catches on stocks depends only on the correct allocation of catches to stocks. This is achieved even though the mixing matrix is mis-specified through imposition of an incorrect migration pattern.

[Note: X would be, in this case, a sub-area-month combination for which abundance estimates were *not* available for conditioning – hence the difference between the estimated and true abundance in columns I and II respectively.]

Annex F

Diagnostic Plots for Baselines A, B and C

C. Allison

[*Figures on following pages*]

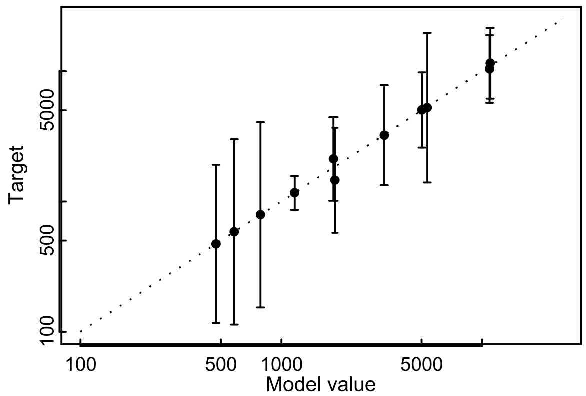


Fig g.1 A1-J1 Population sizes, deterministic

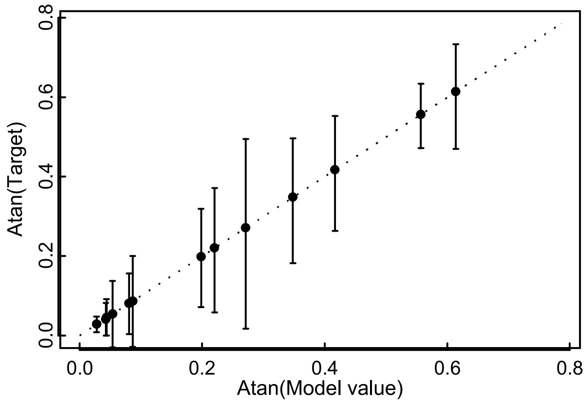


Fig g.2 A1-J1 J stock proportions, deterministic

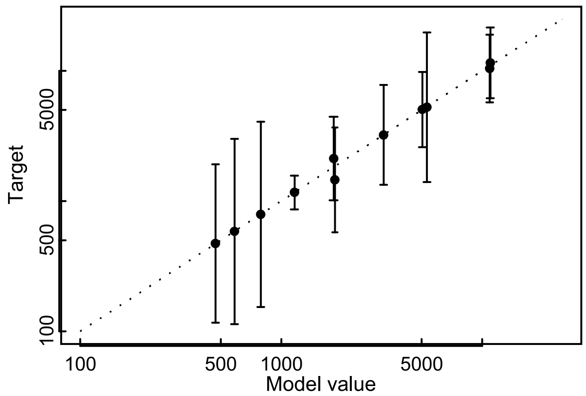


Fig g.1 A1-J2-0 Population sizes, deterministic

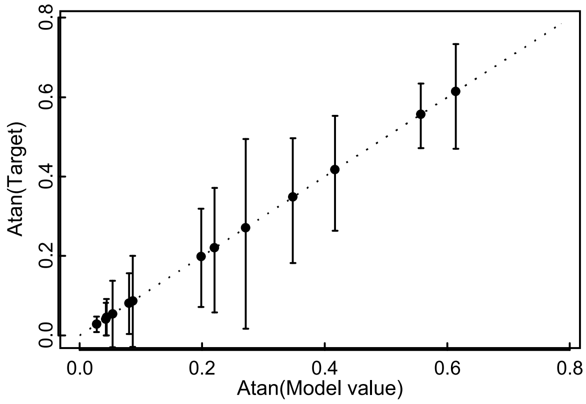


Fig g.2 A1-J2-0 J stock proportions, deterministic

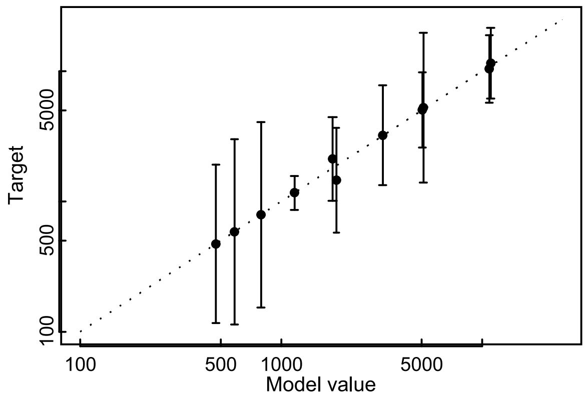


Fig g.1 A4-J1-0 Population sizes, deterministic

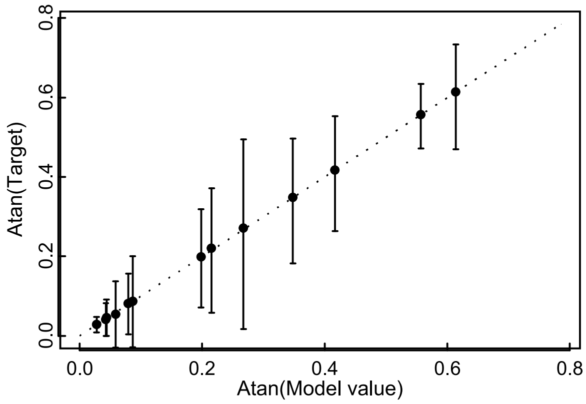


Fig g.2 A4-J1-0 J stock proportions, deterministic

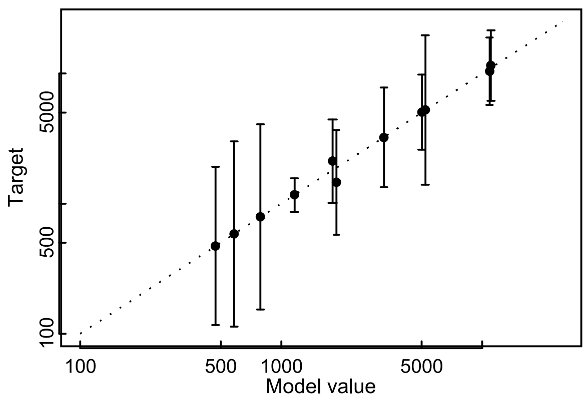


Fig g.1 A4-J2-0 Population sizes, deterministic

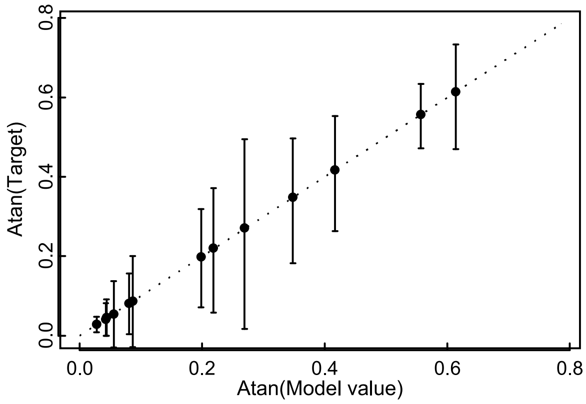


Fig g.2 A4-J2-0 J stock proportions, deterministic

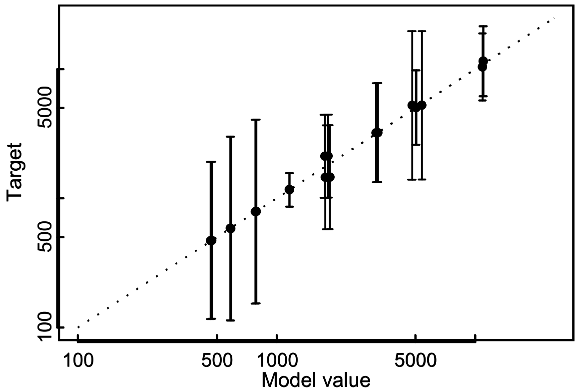


Fig g.1 A1-J1-3 Population sizes, deterministic

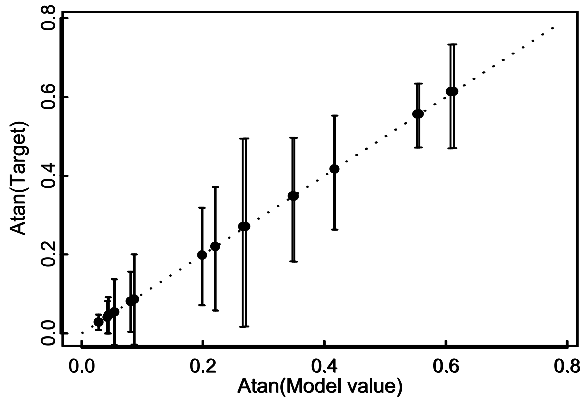


Fig g.2 A1-J1-3 J stock proportions, deterministic

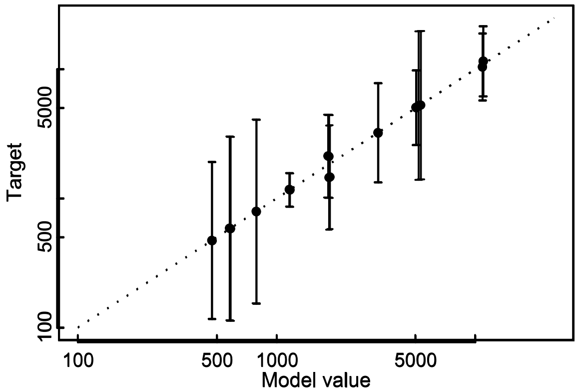


Fig g.1 A1-J2-3 Population sizes, deterministic

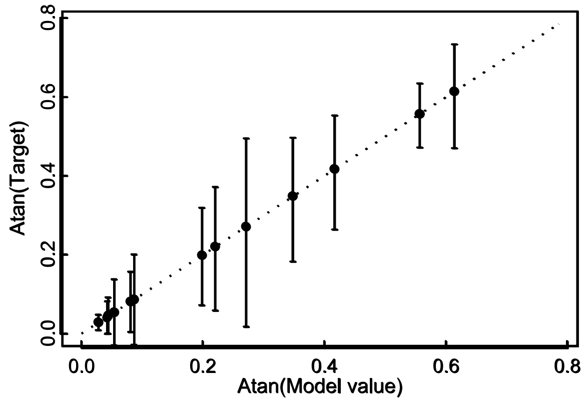


Fig g.2 A1-J2-3 J stock proportions, deterministic

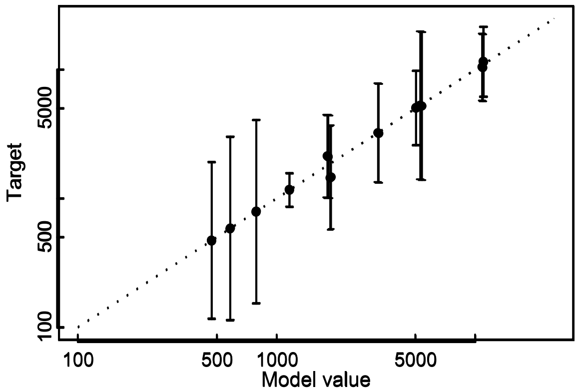


Fig g.1 A4-J1-4 Population sizes, deterministic

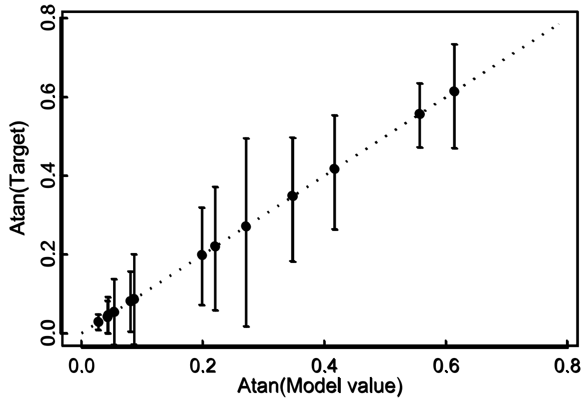


Fig g.2 A4-J1-4 J stock proportions, deterministic

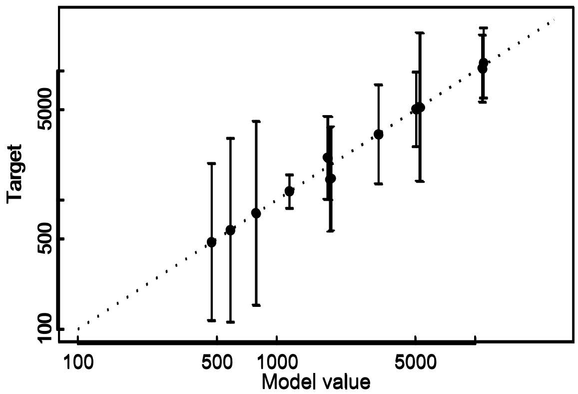


Fig g.1 A4-J2-4 Population sizes, deterministic

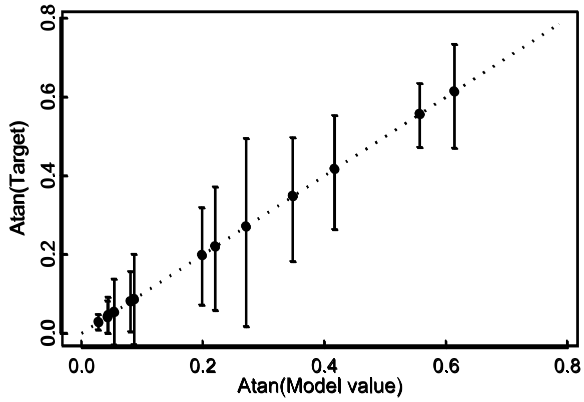


Fig g.2 A4-J2-4 J stock proportions, deterministic

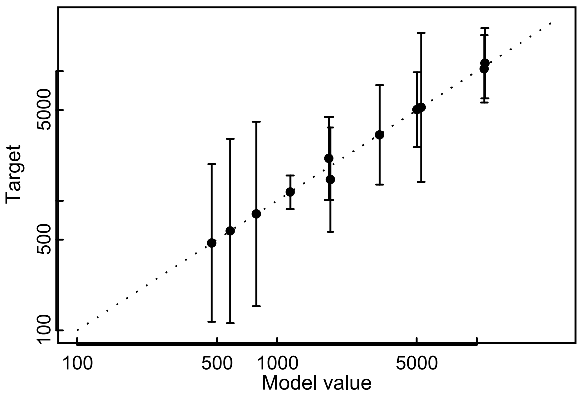


Fig g.1 A1-J1-6 Population sizes, deterministic

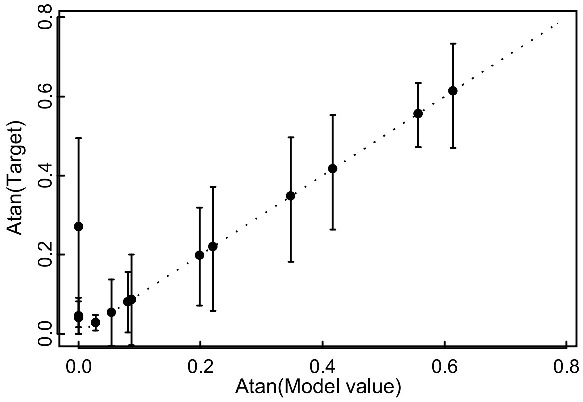


Fig g.2 A1-J1-6 J stock proportions, deterministic

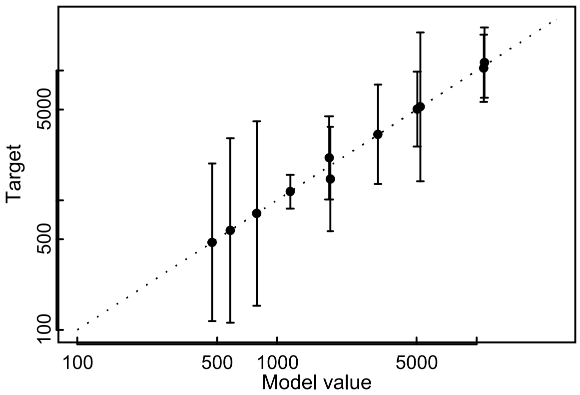


Fig g.1 A1-J2-6 Population sizes, deterministic

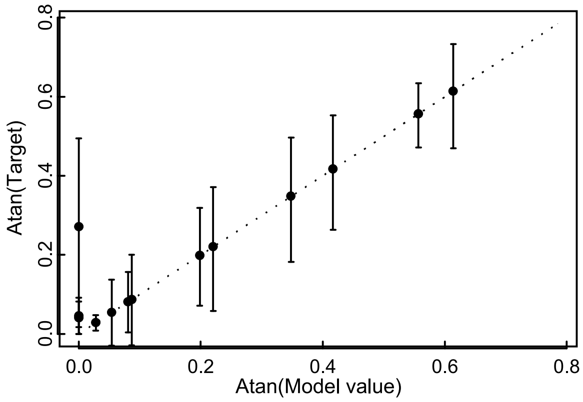


Fig g.2 A1-J2-6 J stock proportions, deterministic

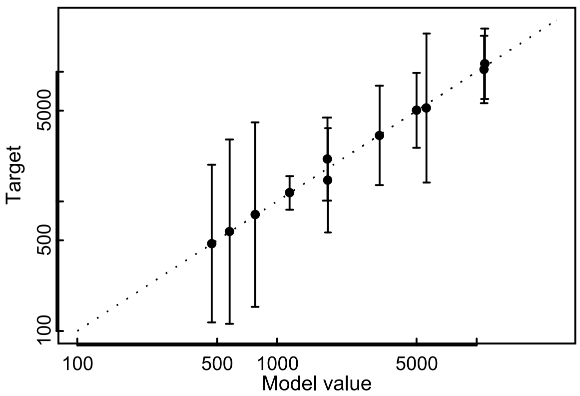


Fig g.1 N-A1-J1-7 Population sizes, deterministic

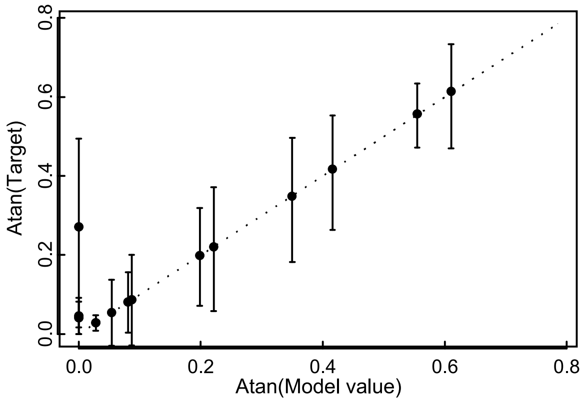


Fig g.2 N-A1-J1-7 J stock proportions, deterministic

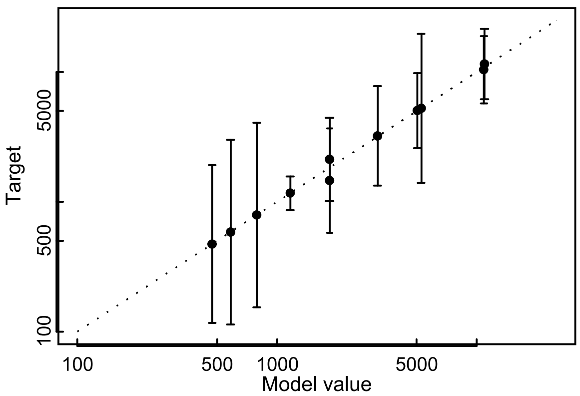


Fig g.1 A1-J2-7 Population sizes, deterministic

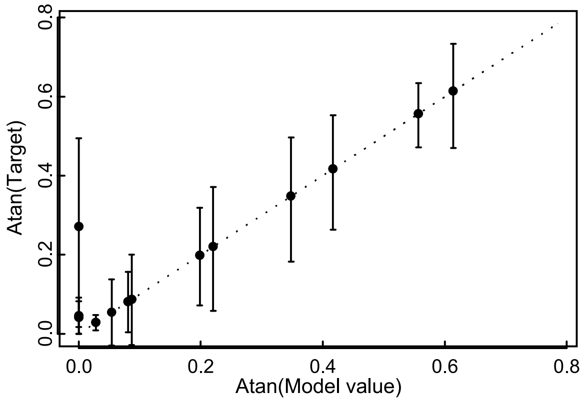


Fig g.2 A1-J2-7 J stock proportions, deterministic

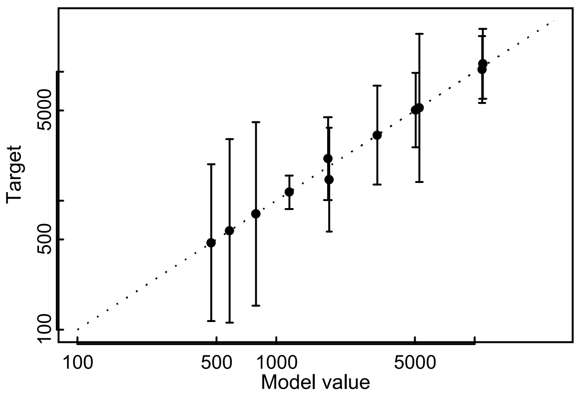


Fig g.1 B1-J1 Population sizes, deterministic

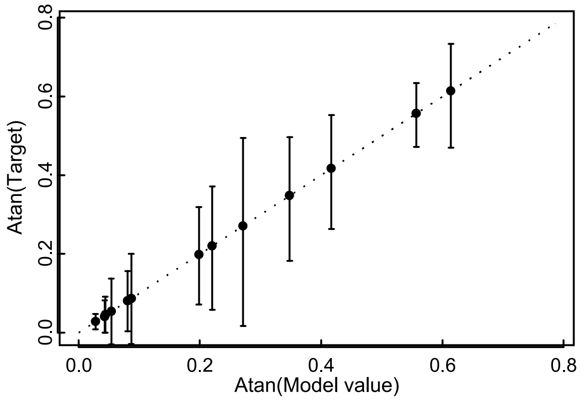


Fig g.2 B1-J1 J stock proportions, deterministic

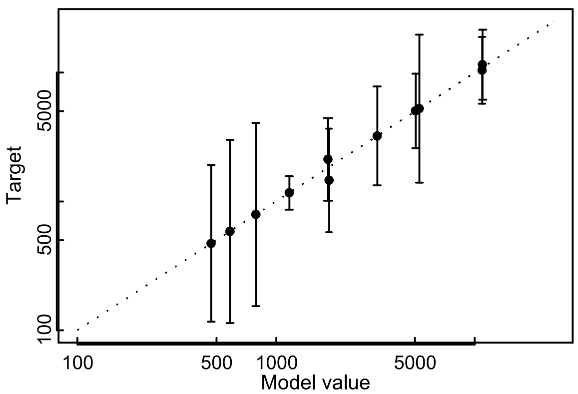


Fig g.1 B1-J2 Population sizes, deterministic

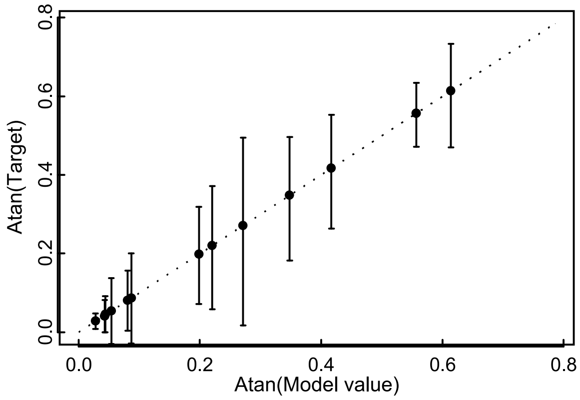


Fig g.2 B1-J2 J stock proportions, deterministic

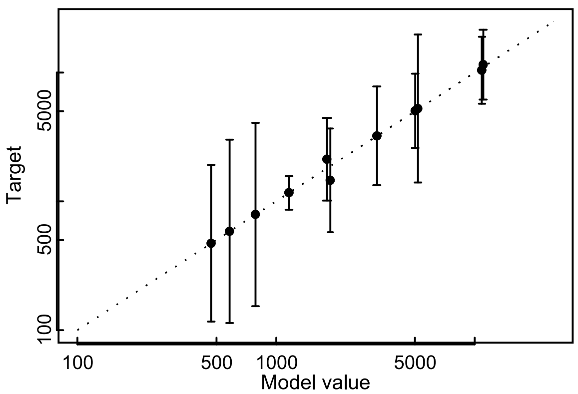


Fig g.1 B4-J1 Population sizes, deterministic

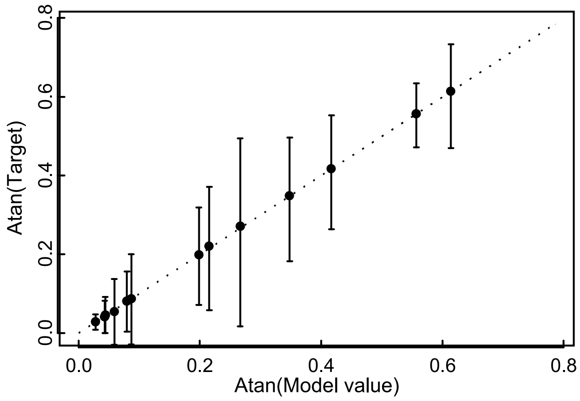


Fig g.2 B4-J1 J stock proportions, deterministic

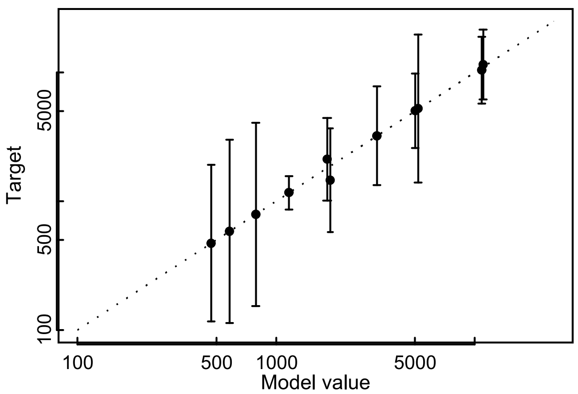


Fig g.1 B4-J2 Population sizes, deterministic

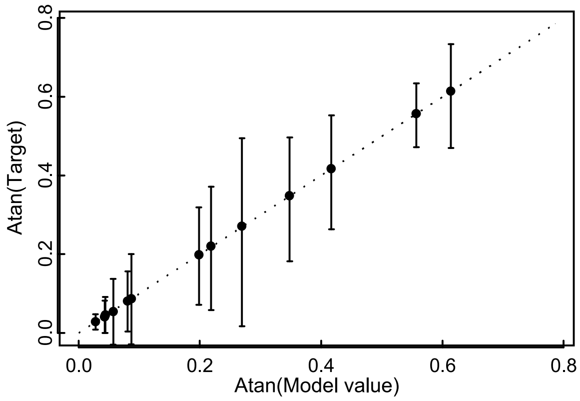


Fig g.2 B4-J2 J stock proportions, deterministic

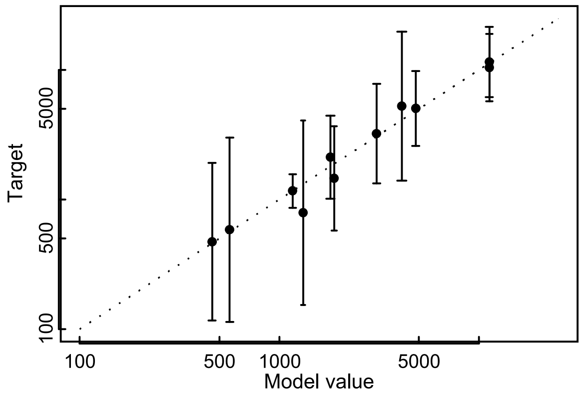


Fig g.1 C1-J1-5 Population sizes, deterministic

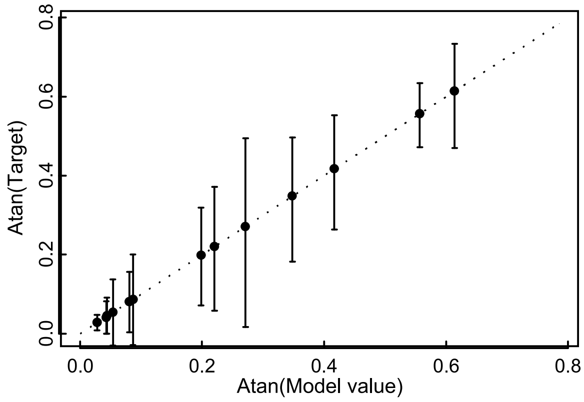


Fig g.2 C1-J1-5 J stock proportions, deterministic

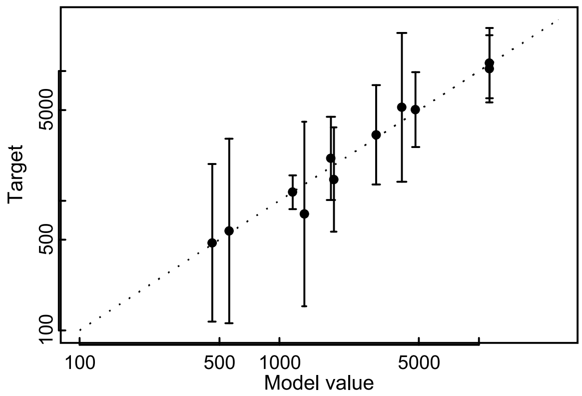


Fig g.1 C1-J2-5 Population sizes, deterministic

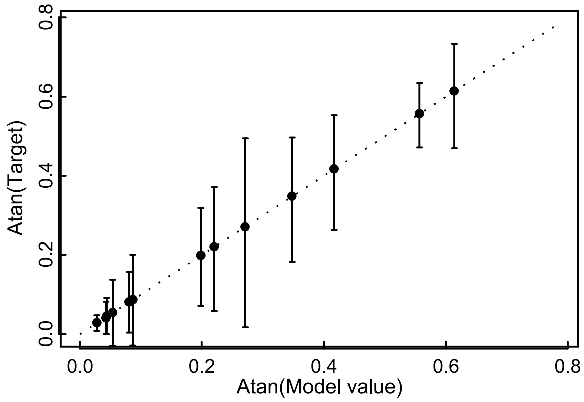


Fig g.2 C1-J2-5 J stock proportions, deterministic

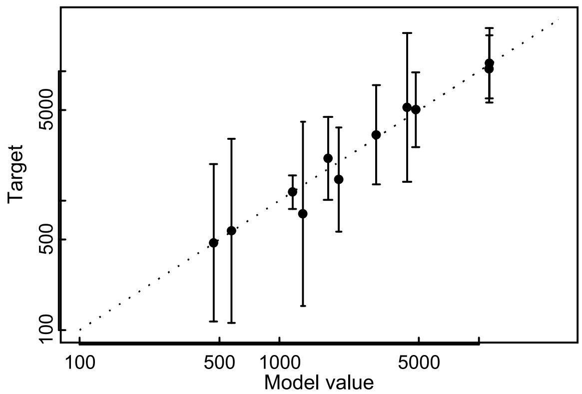


Fig g.1 C4-J1-5 Population sizes, deterministic

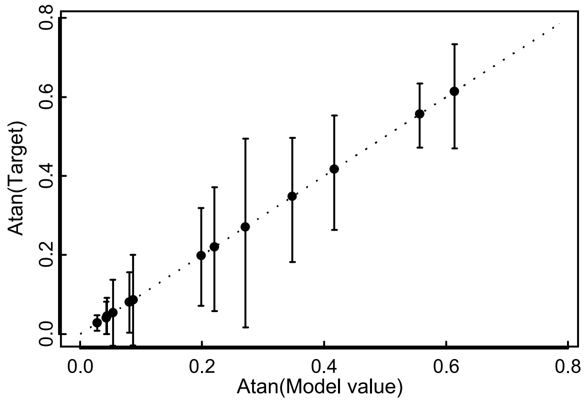


Fig g.2 C4-J1-5 J stock proportions, deterministic

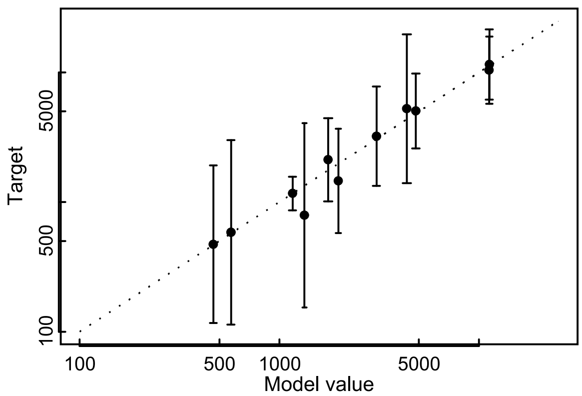


Fig g.1 C4-J2-5 Population sizes, deterministic

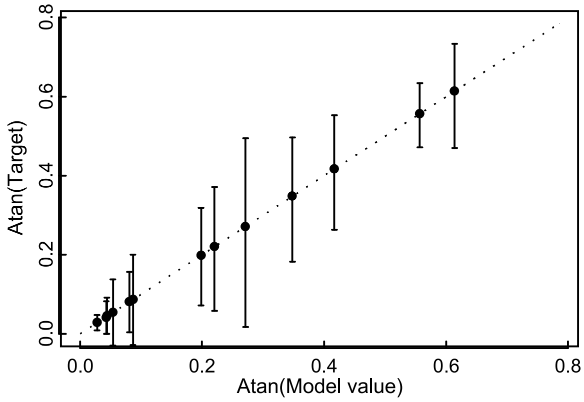


Fig g.2 C4-J2-5 J stock proportions, deterministic

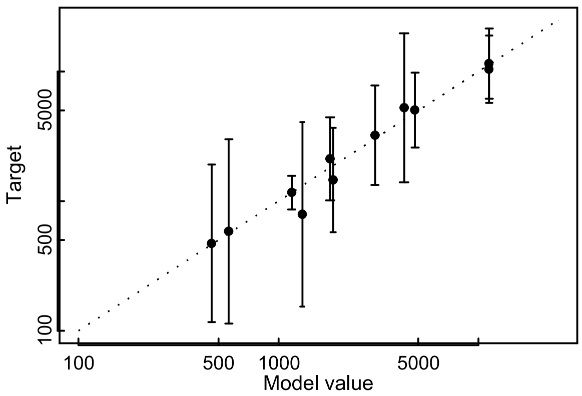


Fig g.1 C1-J1 Population sizes, deterministic

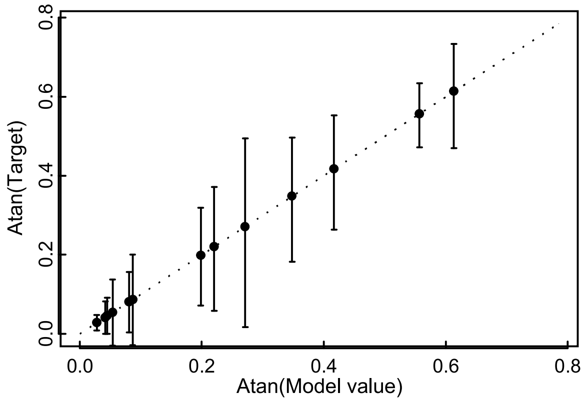


Fig g.2 C1-J1 J stock proportions, deterministic

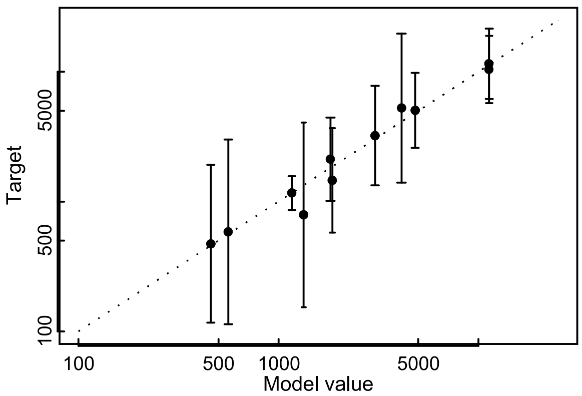


Fig g.1 C1-J2-0 Population sizes, deterministic

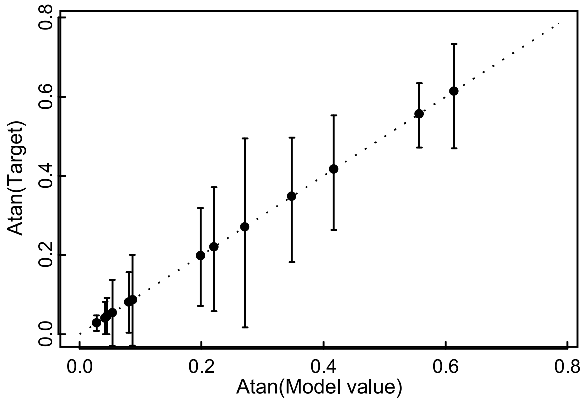


Fig g.2 C1-J2-0 J stock proportions, deterministic

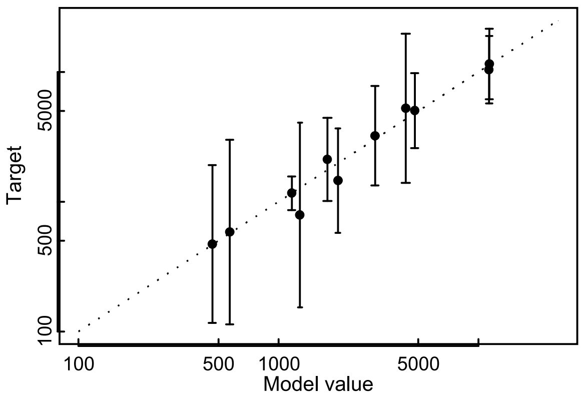


Fig g.1 C4-J1-0 Population sizes, deterministic

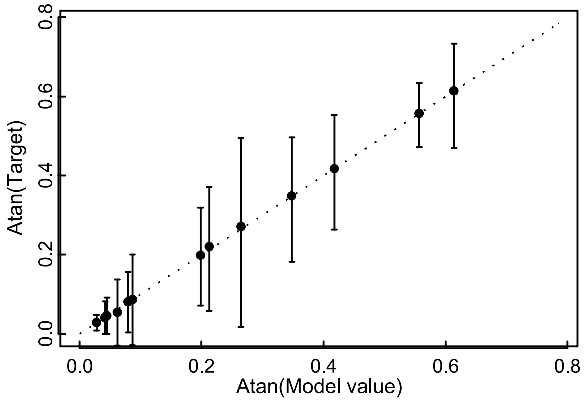


Fig g.2 C4-J1-0 J stock proportions, deterministic

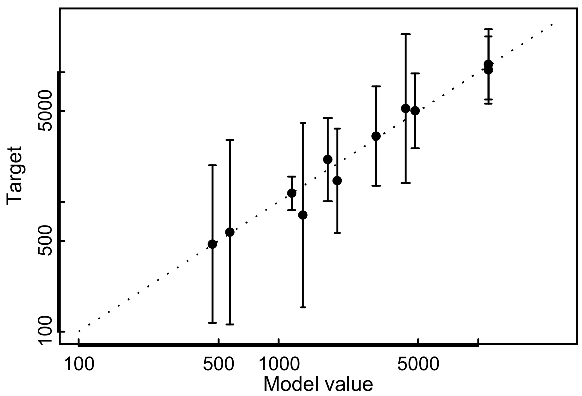


Fig g.1 C4-J2-0 Population sizes, deterministic

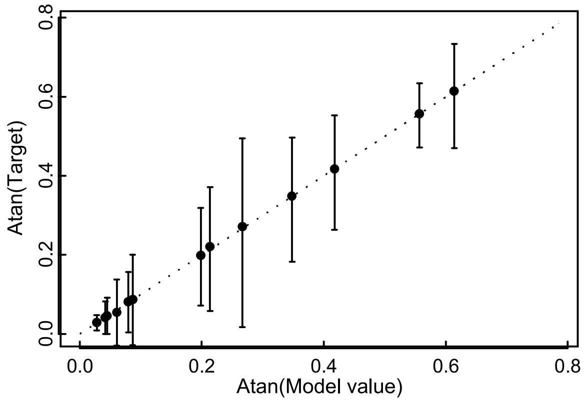


Fig g.2 C4-J2-0 J stock proportions, deterministic

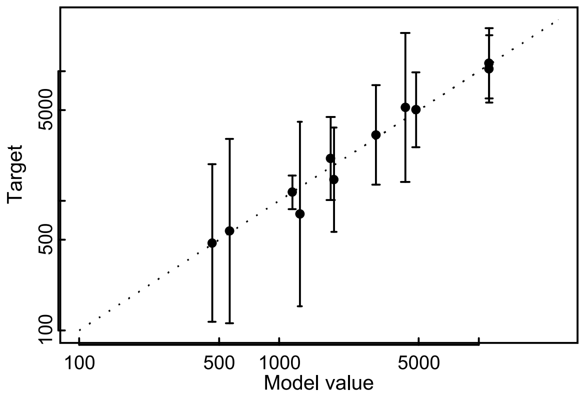


Fig g.1 C1-J1-2 Population sizes, deterministic

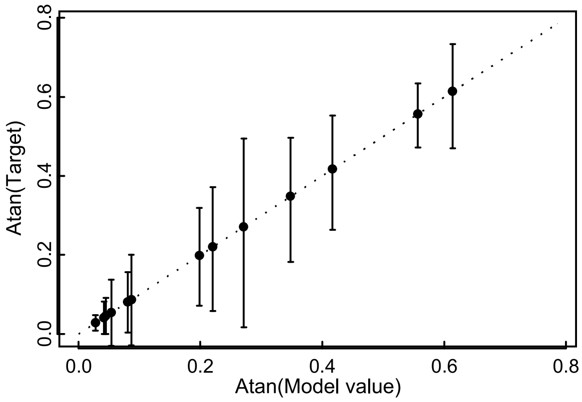


Fig g.2 C1-J1-2 J stock proportions, deterministic

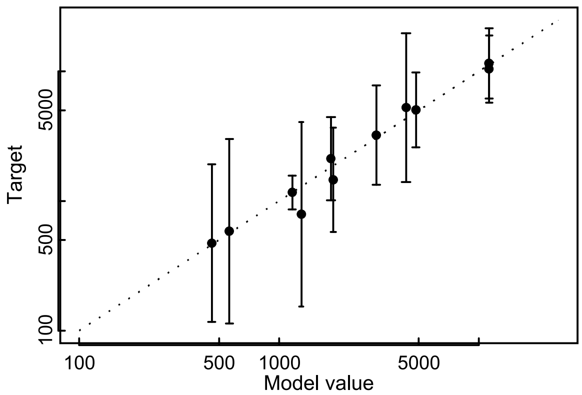


Fig g.1 C1-J2-2 Population sizes, deterministic

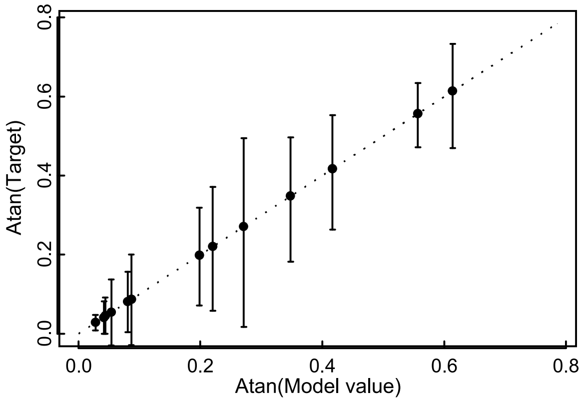


Fig g.2 C1-J2-2 J stock proportions, deterministic

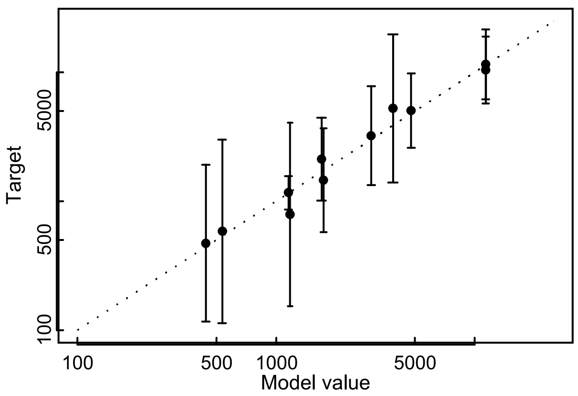


Fig g.1 C1-J1-3 Population sizes, deterministic

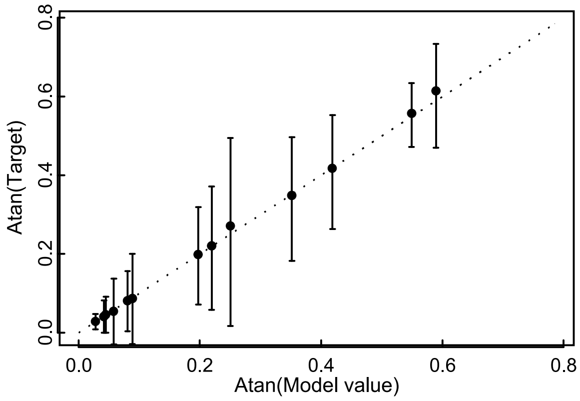


Fig g.2 C1-J1-3 J stock proportions, deterministic

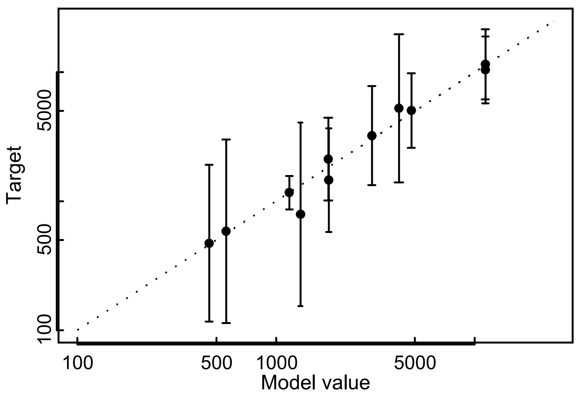


Fig g.1 C1-J2-3 Population sizes, deterministic

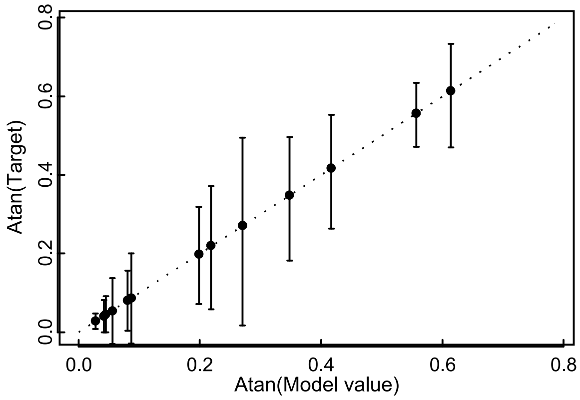


Fig g.2 C1-J2-3 J stock proportions, deterministic

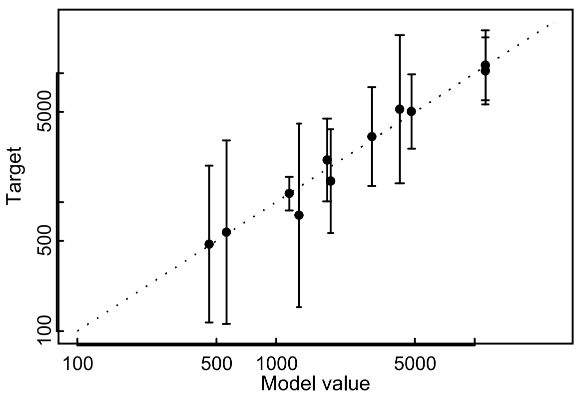


Fig g.1 C1-J1-4 Population sizes, deterministic

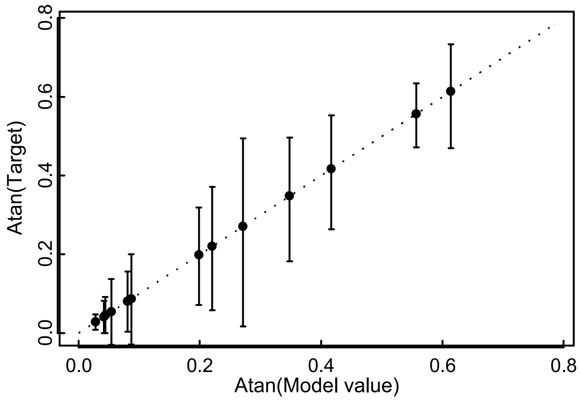


Fig g.2 C1-J1-4 J stock proportions, deterministic

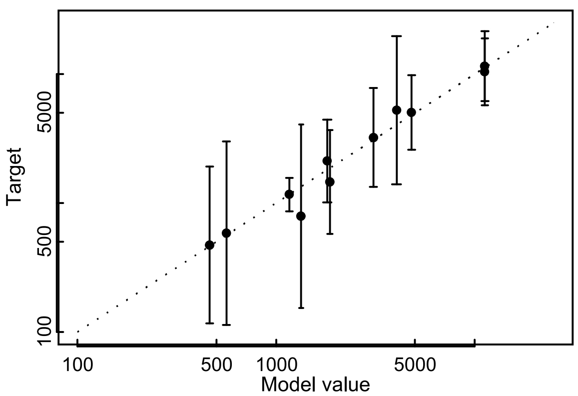


Fig g.1 C1-J2-4 Population sizes, deterministic

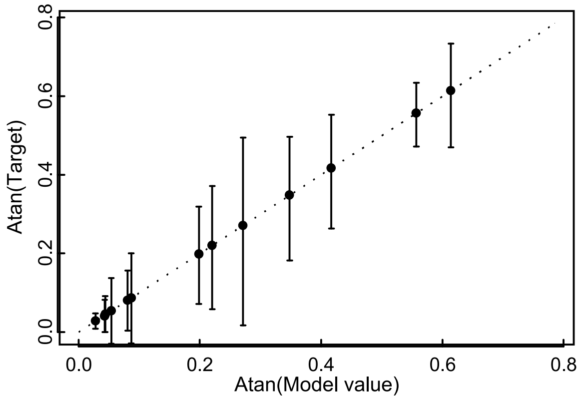


Fig g.2 C1-J2-4 J stock proportions, deterministic

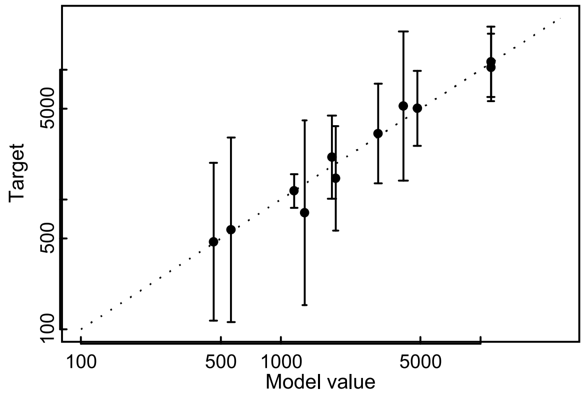


Fig g.1 C1-J1-5 Population sizes, deterministic

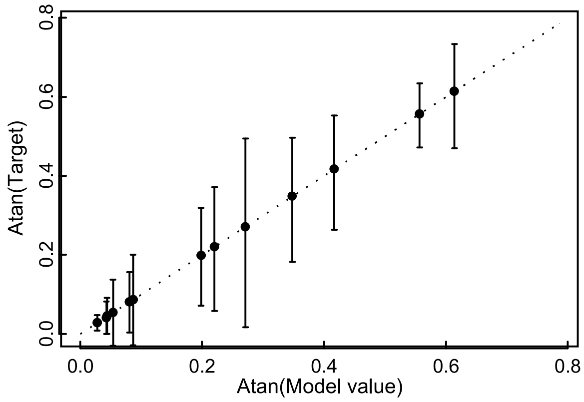


Fig g.2 C1-J1-5 J stock proportions, deterministic

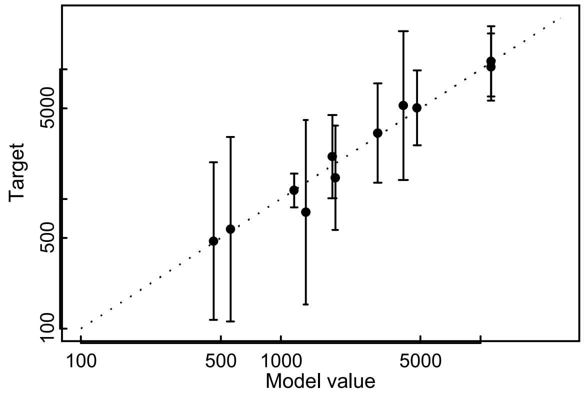


Fig g.1 C1-J2-5 Population sizes, deterministic

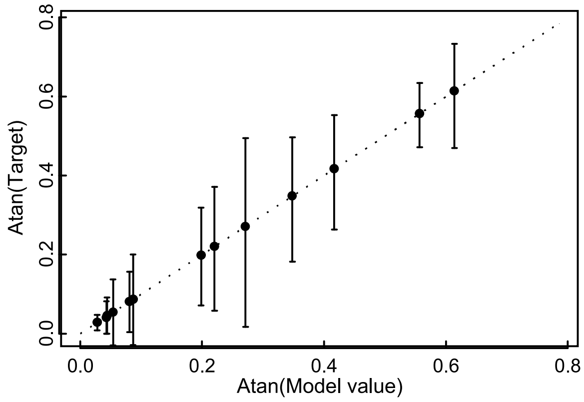


Fig g.2 C1-J2-5 J stock proportions, deterministic

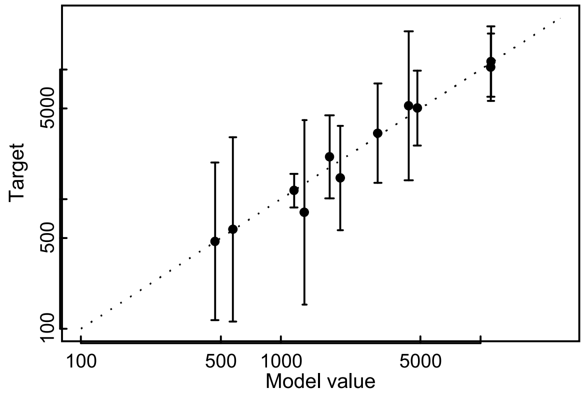


Fig g.1 C4-J1-5 Population sizes, deterministic

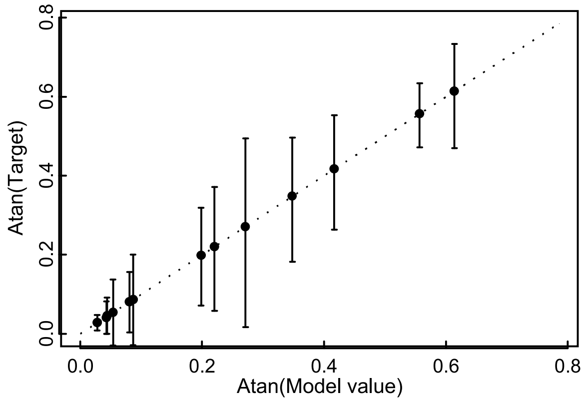


Fig g.2 C4-J1-5 J stock proportions, deterministic

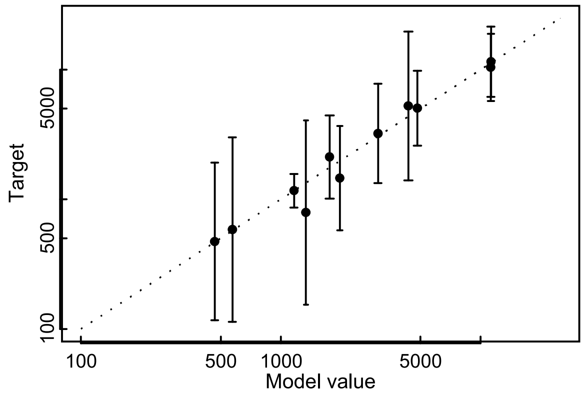


Fig g.1 C4-J2-5 Population sizes, deterministic

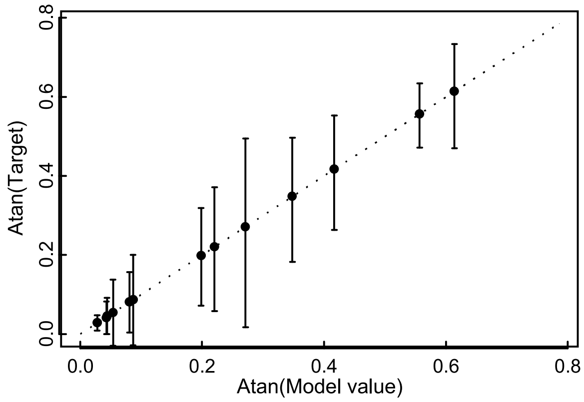


Fig g.2 C4-J2-5 J stock proportions, deterministic

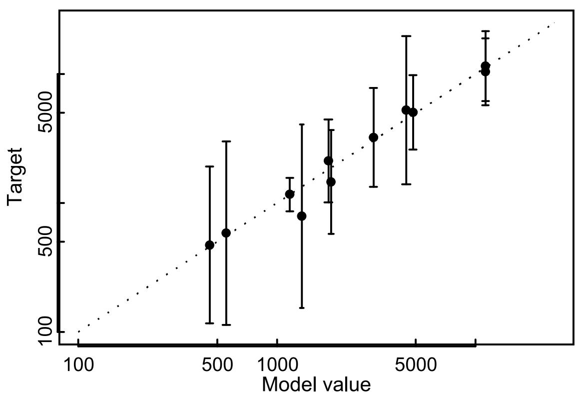


Fig g.1 C1-J1-6 Population sizes, deterministic

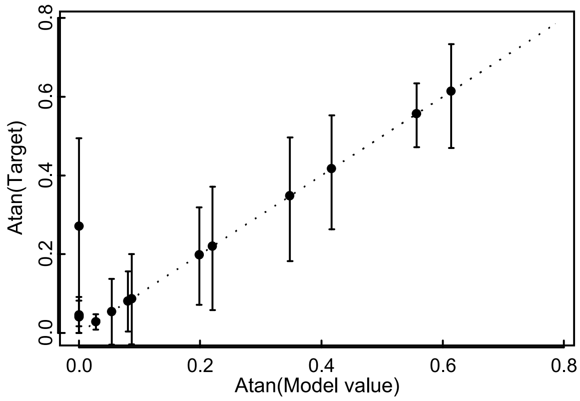


Fig g.2 C1-J1-6 J stock proportions, deterministic

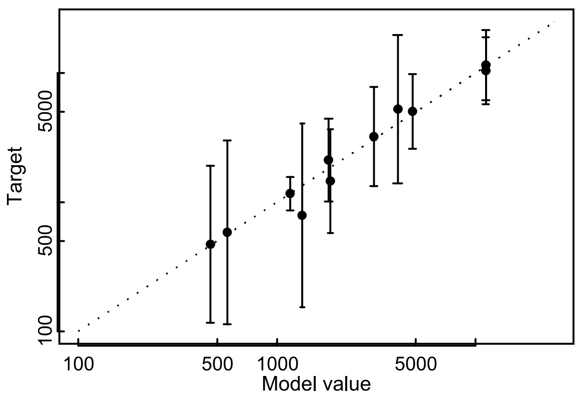


Fig g.1 C1-J2-6 Population sizes, deterministic

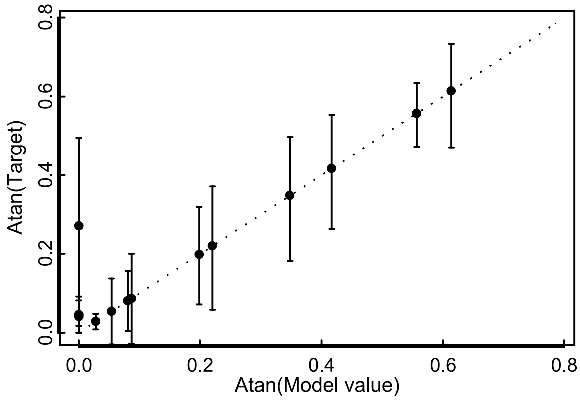


Fig g.2 C1-J2-6 J stock proportions, deterministic

Annex G

North Pacific Minke Whale *Implementation Simulation Trial* Specifications

[See Scientific Committee Report, Appendix 10 of Annex D, this volume, p. 118]

Appendix 1

THE SPECIFICATIONS FOR BASELINE D

The distribution of the 'O' and 'W' stocks across the sub-areas defined for the western North Pacific are determined by catch-mixing matrices.

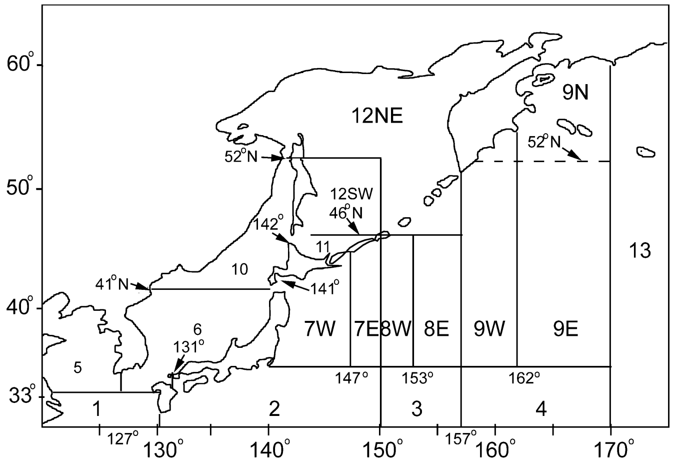


Fig.1 The 18 sub-areas used for the *Implementation Simulation Trials* for North Pacific minke whales.

The relative density of the 'O' and 'W' stocks in sub-area k, is determined by evaluating the functions f^O and f^W at a representative point in sub-area k (see Table 1). The function f^O is evaluated as follows:

$$f^O(lat,long) = \begin{cases} 1 & \text{if } long < \lambda(lat) \\ \min\{1, \exp[s(lat)(long \\ -\lambda(lat))]\} & \text{otherwise} \end{cases} \quad (1)$$

where $\lambda(lat)$ is a threshold that defines the latitude at which f equals 1, i.e.

$$\lambda(lat) = \begin{cases} 140 + \frac{7}{17}(lat-30) & \text{if } lat < 47 \\ 147 & \text{otherwise} \end{cases} \quad (2)$$

$s(lat)$ is a function that determines how rapidly 'O' stock density drops with increasing longitude, i.e.:

$$s(lat) = \begin{cases} \frac{\ell n[p_2 + (p_1 - p_2)(lat-30)/17]}{155 - \lambda(lat)} & \text{if } lat < 47 \\ \ell n(p_1)/(155 - \lambda(lat)) & \text{otherwise} \end{cases} \quad (3)$$

p_1 is the relative density of the 'O' stock at the point (155°E, 47°N), and

P_2 is the relative density of the 'O' stock at the point (155°E, 30°N).

The base-case value for p_1 is specified for males aged 10 years, females aged 10 years, and juveniles aged 4 years (0.35, 0.15 and 0.15 respectively) while the value for p_2 is assumed equal to 0.01.

The function f^W is evaluated as follows:

$$f^W(k) = \begin{cases} e^{-p_{153}\frac{162-long(k)}{162-153}} & \text{if } long(k)<30?? \\ 1 & \text{otherwise} \end{cases} \quad (4)$$

The base-case value for p_{153} is specified for males aged 10 years, females aged 10 years, and juveniles aged 4 years (0.35, 0.15 and 0.15 respectively).

The information on which conditioning is based is the relative fraction in groups of sub-areas (see Table 2). Let $\Omega^{G,q,s}$ denote the relative density of whales of sex s (all stocks) in super-sub-area G during month q (see Table 2). The raw catch-mixing matrices (i.e. before any γ's are added, i.e. $V^{s,j,k,q}$) is given by:

$$V^{s,j,k,q} = \Omega^{G(k),q,s} \frac{f^{s,j}(k)\ A^k}{\sum_{k'} f^{s,j}(k')\, A^{k'}} \quad (5)$$

where $G(k)$ denotes the super sub-area to which sub-area k has been assigned, and

A^k is the area of sub-area k (see Table 1).

Table 2

The relative number of animals (all stocks) by sub-area group in various months. The values for juveniles (age 4) are set to the averages of the values for males and females.

Sub-area group	Month					
	April	May	June	July	August	Sept
Males (age 10)						
2-4	0.8	0.5	0.0	0.0	0.0	0.1
7W-9E	0.2	0.3	0.7	0.7	0.8	0.8
9N,11,12	0.0	0.2	0.3	0.3	0.2	0.1
Females (age 10)						
2-4	0.7	0.1	0.0	0.0	0.0	0.1
7W-9E	0.1	0.3	0.2	0.2	0.3	0.3
9N,11,12	0.2	0.6	0.8	0.8	0.7	0.6

Table 3 lists the entries in the catch-mixing matrices for which γ-factors are used to adjust the raw catch-mixing matrices.

The sensitivity tests for Baseline D are listed in Table 4.

Trial D1-J1-21: More rapid decline in 'O' relative density with longitude.

This sensitivity trial involves changing the p_1 parameters to (0.2, 0.069 and 0.069) for males, females and juveniles respectively, and changing the p_{153} parameters to (0.5, 0.21 and 0.21) for males, females and juveniles respectively.

Table 1

Areas and representative points for each of the sub-areas (note that sub-area 9N is divided into two for the purposes of this table).

	Sub-area													
	2	3	4	7w	7e	8w	8e	9w	9e	11	12SW	12NE	9NW	9NE
Area	672,903	331,509	622,289	63,871	58,272	69,410	93,134	118,972	192,923	59,564	111,260	469,018	95,033	273,060
Longitude	142.1	153.5	163.5	144.5	148.6	151.5	154.9	159.5	166	145.8	146.7	150.1	159.8	166.1
Latitude	33	33.9	34	41.8	42.7	43.6	43.5	43.6	43.6	45.8	49.6	54.8	50.2	53.2

Table 3

The adjustment factors estimated for the 'O' and 'W' stocks (the adjustment factors are assumed to be independent of sex, age and month).

	Sub-area									
Stock	1-6	7W	7E	8W-8E	9E-9W	10	11	12SW	12NE	9N
'O'	0	0	0	γ^6	γ^6	0	γ^{15}	γ^7	γ^{25}	0
'W'	0	-	γ^6	γ^6	0	0	-	0	0	γ^{25}

Trial D1-J1-22: Less rapid decline in 'O' relative density with longitude.
This sensitivity trial involves changing the p_1 parameters to (0.5, 0.21 and 0.21) for males, females and juveniles respectively, and changing the p_{153} parameters to (0.2, 0.069 and 0.069) for males, females and juveniles respectively.

Trial D1-J1-25: Increased proportion of both sexes in N.
This sensitivity trial involves increasing the elements of Table 2 for the 9N, 11 and 12 super-sub-area by 0.1 and re-scaling the elements for the 2-4 and 7W-8E super-sub-areas so that the sum over all super-sub-areas equals 1.

Trial D1-J1-26: Decreased proportion of both sexes in N.
This sensitivity trial involves decreasing the elements of Table 2 for the 9N, 11 and 12 super-sub-area by 0.1 and re-scaling the elements for the 2-4 and 7W-8E super-sub-areas so that the sum over all super-sub-areas equals 1.

Trial D1-J1-27: Random selection of mixing matrices.
This sensitivity trial involves selecting the values for (p_1, p_2) at random and with equal probability from (0.35, 0.15, 0.15), (0.2, 0.069, 0.069) and (0.5, 0.21, 0.21) each year.

Trial D1-J1-28: Increase 'O' : 'W' ratio in 12 – differential migration.
This sensitivity trial involves increasing the entries for the 9N, 11 and 12 super-sub-area for the 'O' (but not 'W') stock until the ratio of 'O' to 'W' animals in sub-area 12 is 0.8. The change to the mixing matrix will be based on fitting the operating model to the actual data (i.e. a 'deterministic' fit).

Trial D1-J1-29: Increase 'O' : 'W' ratio in 12 – 'O' stock in sub-area 9.
This sensitivity trial involves changing the relative density of 'O' animals in sub-areas 9W and 9E until the ratio of 'O' to 'W' animals in sub-area 12 is 0.8. The change to the mixing matrix will be based on fitting the operating model to the actual data (i.e. a 'deterministic' fit).

Table 4

The sensitivity trials for Baseline D.

Baseline	Sensitivity trial no.	*MSYR*	Mixing matrices	'J' status in 2000	Description
D1	3	1%	AB P Q	15% *K*	15% 'J' stock depletion
D1	4	1%	AB P Q	50% *K*	50% 'J' stock depletion
D1	5	1%	AB P Q	70% *K*	70% 'J' stock depletion
D4	5	4%	AB P Q	70% *K*	70% 'J' stock depletion
D1	6	1%	AB P Q	30% *K*	20% 'J' in 12SW (or max. achievable)
D1	7	1%	AB P Q	15% *K*	15% 'J' stock depletion + 20% 'J' in 12SW (or max. achievable)
D1	10	1%	AB P Q	30% *K*	*g*(0) = 0.5 (see item F.f)
D1	11	1%	AB P Q	30% *K*	Misreport Japan incidental catch (*4 in opt J*i* and /4 in opt J*ii*)
D1	12	1%	AB P Q	30% *K*	Different Korean bycatch model (constant future catch = 89)
D1	13	1%	AB P Q	30% *K*	Different Japanese incidental catch level (50 in opt J*i* and 150 in J*ii*)
D1	21	1%		30% *K*	More rapid decline in O relative density with long
D1	22	1%		30% *K*	Less rapid decline in O relative density with long
D1	23	1%	AB P Q	30% *K*	40% additional variance in CV supplied to *CLA* (see item 10.1)
D1	24	1%	AB P Q	30% *K*	Sub-area 11 closed in all months + sub-area 12SW closed in June
D1	25	1%		30% *K*	Increased proportion of both sexes in N
D1	26	1%		30% *K*	Decreased proportion of both sexes in N
D1	27	1%		30% *K*	Random selection of mixing matrices
D1	28	1%		30% *K*	Increase O:W ratio in 12 – differential migration
D1	29	1%		30% *K*	Increase O:W ratio in 12 – O stock in sub-area 9

Annex H

Estimating Proportions of Males and Females in Sub-areas 7, 8 and 9 Combined

T. Polacheck and B.L. Taylor

The available information is the estimated abundances from summer sighting surveys in the northern band of sub-areas 11 and 12 ($N_n = 25{,}291$) and in the central band of sub-areas 7, 8, and 9 ($N_c = 11{,}276$), and the commercial catches in August in the central sub-areas by sex ($C_m = 527$ and $C_f = 169$). Let the ratio $C_m / C_f = 3.15$ be denoted by p.

The number of males in the central area (N_c^m) is related to the number of females in the central area (N_c^f) as:

$$N_c^m = pN_c^f$$

Further, $N_n^m + N_c^f = N_c$

Substituting appropriately, expressions for N_c^m and N_c^f can be derived from two pairs of equations:

Males	Females
$N_c^m = p\,N_c^f$	$N_c^f = N_c^m / p$
$N_c^m = N_c - N_c^f$	$N_c^f = N_c - N_c^m$

Solving these two sets of equations, one obtains expressions for the number of males and of females in the central band, in terms of the abundance in that band and the sex ratio from the catches.

$$N_c^m = N_c - N_c^m / p \qquad N_c^f = N_c - p\,N_c^f$$

$$N_c^m = N_c /(1+1/p) \qquad N_c^f = N_c /(1-p)$$

Using these two expressions, the proportion of males and of females in the population could be estimated if the abundance in sub-area 9N were available. Unfortunately, no sighting survey estimates are available for that sub-area. To determine the effect of this unknown on the proportions of all males and of all females in the central band of sub-areas, assume that the abundance in sub-area 9N was a proportion, q, of the animals in the central and northern bands so that the total abundance would be $(N_c + N_n)(1 + q)$.

Then, assuming an overall equal sex ratio, the proportions in the central band for males would be $N_c/[\frac{1}{2}(1 + 1/p)(N_c + N_n)(1+q)]$, and for females would be $N_c/[\frac{1}{2}(1 - p)(N_c + N_n)(1 + q)]$.

Annex I

Diagnostic Information for the J1, *MSYR* = 1% Base-case Trial for Baseline D

Andre E. Punt

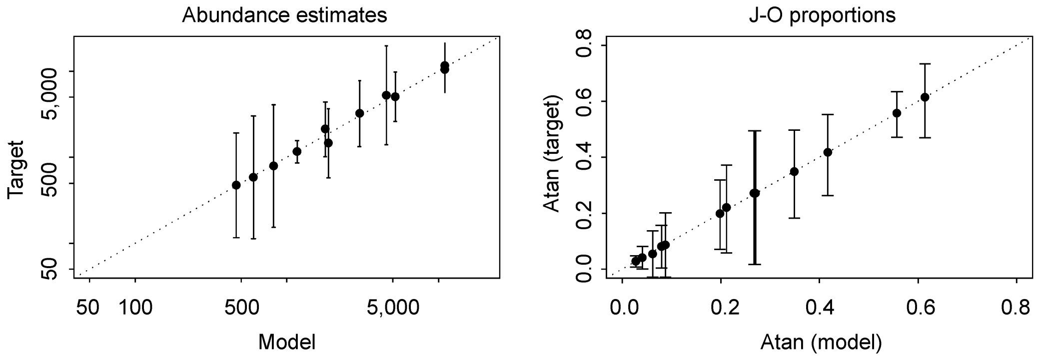


Fig. 1. Target values (actual abundance estimates and 'J'-non-'J' stock mixing proportions) and their 90% confidence intervals versus the operating model predictions. The results in this Figure arise from a 'deterministic' trial.

Table 1
The catch-mixing matrices.

		Sub-area																
Stock	Month	1	2	3	4	5	6	7W	7E	8W	8E	9W	9E	10	11	12SW	12NE	9N
(a) Juveniles (age 4)																		
J-A	Apr	0.203	0.100	0	0	0.203	0.203	0	0	0	0	0	0	0.203	0.089	0	0	0
J-A	May	0	0.057	0	0	0.233	0.233	0	0	0	0	0	0	0.467	0.010	0	0	0
J-A	June	0	0	0	0	0.239	0.239	0	0	0	0	0	0	0.478	0.044	0	0	0
J-A	Jul	0	0	0	0	0.295	0.295	0	0	0	0	0	0	0.295	0.115	0	0	0
J-A	Aug	0	0	0	0	0.317	0.317	0	0	0	0	0	0	0.317	0.048	0	0	0
J-A	Sept	0.194	0	0	0	0.194	0.389	0	0	0	0	0	0	0.194	0.028	0	0	0
J-B	Apr	0.202	0.099	0	0	0.202	0.202	0.005	0	0	0	0	0	0.202	0.088	0	0	0
J-B	May	0	0.057	0	0	0.232	0.232	0.006	0	0	0	0	0	0.464	0.010	0	0	0
J-B	June	0	0	0	0	0.237	0.237	0.006	0	0	0	0	0	0.475	0.044	0	0	0
J-B	Jul	0	0	0	0	0.293	0.293	0.008	0	0	0	0	0	0.293	0.114	0	0	0
J-B	Aug	0	0	0	0	0.315	0.315	0.008	0	0	0	0	0	0.315	0.047	0	0	0
J-B	Sept	0.193	0	0	0	0.193	0.387	0.005	0	0	0	0	0	0.193	0.028	0	0	0
O	Apr	0	0.070	0.623	0.007	0	0	0.095	0.041	0.007	0.004	0.002	0.001	0	0.065	0.084	0.002	0
O	May	0	0.020	0.178	0.002	0	0	0.190	0.082	0.014	0.009	0.004	0.002	0	0.215	0.279	0.005	0
O	June	0	0	0	0	0	0	0.190	0.082	0.014	0.009	0.004	0.002	0	0.301	0.392	0.007	0
O	Jul	0	0	0	0	0	0	0.190	0.082	0.014	0.009	0.004	0.002	0	0.301	0.392	0.007	0
O	Aug	0	0	0	0	0	0	0.221	0.096	0.016	0.010	0.005	0.002	0	0.280	0.363	0.007	0
O	Sept	0	0.010	0.089	0.001	0	0	0.221	0.096	0.016	0.010	0.005	0.002	0	0.236	0.308	0.006	0
W	Apr	0	0	0.338	0.362	0	0	0	0.005	0.006	0.009	0.048	0.082	0	0	0.025	0.103	0.022
W	May	0	0	0.096	0.104	0	0	0	0.010	0.012	0.018	0.096	0.163	0	0	0.082	0.343	0.075
W	June	0	0	0	0	0	0	0	0.010	0.012	0.018	0.096	0.163	0	0	0.114	0.480	0.106
W	Jul	0	0	0	0	0	0	0	0.010	0.012	0.018	0.096	0.163	0	0	0.114	0.480	0.106
W	Aug	0	0	0	0	0	0	0	0.012	0.015	0.021	0.113	0.190	0	0	0.106	0.446	0.098
W	Sept	0	0	0.048	0.052	0	0	0	0.012	0.015	0.021	0.113	0.190	0	0	0.090	0.377	0.083
(b) Males aged 10 years and older																		
J-A	Apr	0.203	0.100	0	0	0.203	0.203	0	0	0	0	0	0	0.203	0.089	0	0	0
J-A	May	0	0.058	0	0	0.236	0.236	0	0	0	0	0	0	0.471	0	0	0	0
J-A	June	0	0	0	0	0.250	0.250	0	0	0	0	0	0	0.500	0	0	0	0
J-A	Jul	0	0	0	0	0.331	0.331	0	0	0	0	0	0	0.331	0.007	0	0	0
J-A	Aug	0	0	0	0	0.305	0.305	0	0	0	0	0	0	0.305	0.084	0	0	0
J-A	Sept	0.190	0	0	0	0.190	0.379	0	0	0	0	0	0	0.190	0.052	0	0	0
J-B	Apr	0.202	0.099	0	0	0.202	0.202	0.005	0	0	0	0	0	0.202	0.088	0	0	0
J-B	May	0	0.041	0	0	0.167	0.167	0.004	0	0	0	0	0	0.334	0	0.286	0	0
J-B	June	0	0	0	0	0.148	0.148	0.004	0	0	0	0	0	0.296	0	0.403	0	0
J-B	Jul	0	0	0	0	0.312	0.312	0.008	0	0	0	0	0	0.312	0.006	0.049	0	0
J-B	Aug	0	0	0	0	0.289	0.289	0.007	0	0	0	0	0	0.289	0.079	0.045	0	0
J-B	Sept	0.189	0	0	0	0.189	0.377	0.005	0	0	0	0	0	0.189	0.052	0	0	0
O	Apr	0	0.070	0.623	0.007	0	0	0.104	0.060	0.013	0.011	0.007	0.005	0	0.042	0.056	0.002	0
O	May	0	0.030	0.267	0.003	0	0	0.155	0.089	0.020	0.016	0.011	0.008	0	0.172	0.221	0.006	0.001
O	June	0	0	0	0	0	0	0.207	0.120	0.026	0.022	0.015	0.010	0	0.256	0.334	0.009	0.001
O	Jul	0	0	0	0	0	0	0.207	0.120	0.026	0.022	0.015	0.010	0	0.256	0.334	0.009	0.001
O	Aug	0	0	0	0	0	0	0.260	0.149	0.032	0.027	0.019	0.013	0	0.214	0.277	0.007	0.001
O	Sept	0	0.010	0.089	0.001	0	0	0.260	0.149	0.032	0.027	0.019	0.013	0	0.172	0.221	0.006	0.001
W	Apr	0	0	0.305	0.395	0	0	0	0.005	0.007	0.011	0.064	0.113	0	0	0.017	0.068	0.015
W	May	0	0	0.131	0.169	0	0	0	0.008	0.010	0.016	0.096	0.170	0	0	0.065	0.275	0.060
W	June	0	0	0	0	0	0	0	0.011	0.014	0.021	0.127	0.228	0	0	0.097	0.412	0.091
W	Jul	0	0	0	0	0	0	0	0.011	0.014	0.021	0.127	0.228	0	0	0.097	0.412	0.091
W	Aug	0	0	0	0	0	0	0	0.013	0.017	0.027	0.159	0.284	0	0	0.082	0.343	0.075
W	Sept	0	0	0.044	0.056	0	0	0	0.013	0.017	0.027	0.159	0.284	0	0	0.065	0.275	0.060
(c) Females aged 10 years and older																		
J-A	Apr	0.203	0.100	0	0	0.203	0.203	0	0	0	0	0	0	0.203	0.089	0	0	0
J-A	May	0	0.057	0	0	0.231	0.231	0	0	0	0	0	0	0.462	0.019	0	0	0
J-A	June	0	0	0	0	0.229	0.229	0	0	0	0	0	0	0.458	0.085	0	0	0
J-A	Jul	0	0	0	0	0.266	0.266	0	0	0	0	0	0	0.266	0.202	0	0	0
J-A	Aug	0	0	0	0	0.330	0.330	0	0	0	0	0	0	0.330	0.009	0	0	0
J-A	Sept	0.199	0	0	0	0.199	0.399	0	0	0	0	0	0	0.199	0.003	0	0	0
J-B	Apr	0.202	0.099	0	0	0.202	0.202	0.005	0	0	0	0	0	0.202	0.088	0	0	0
J-B	May	0	0.040	0	0	0.165	0.165	0.004	0	0	0	0	0	0.330	0.014	0.283	0	0
J-B	June	0	0	0	0	0.140	0.140	0.004	0	0	0	0	0	0.281	0.052	0.382	0	0
J-B	Jul	0	0	0	0	0.254	0.254	0.007	0	0	0	0	0	0.254	0.192	0.040	0	0
J-B	Aug	0	0	0	0	0.312	0.312	0.008	0	0	0	0	0	0.312	0.008	0.049	0	0
J-B	Sept	0.198	0	0	0	0.198	0.397	0.005	0	0	0	0	0	0.198	0.003	0	0	0
O	Apr	0	0.070	0.623	0.007	0	0	0.064	0.027	0.005	0.003	0.001	0.001	0	0.087	0.111	0.002	0
O	May	0	0.010	0.089	0.001	0	0	0.190	0.082	0.014	0.009	0.004	0.002	0	0.258	0.335	0.006	0
O	June	0	0	0	0	0	0	0.126	0.055	0.009	0.006	0.003	0.001	0	0.344	0.447	0.008	0
O	Jul	0	0	0	0	0	0	0.126	0.055	0.009	0.006	0.003	0.001	0	0.344	0.447	0.008	0
O	Aug	0	0	0	0	0	0	0.126	0.055	0.009	0.006	0.003	0.001	0	0.344	0.447	0.008	0
O	Sept	0	0.010	0.089	0.001	0	0	0.126	0.055	0.009	0.006	0.003	0.001	0	0.301	0.392	0.007	0
W	Apr	0	0	0.338	0.362	0	0	0	0.003	0.004	0.006	0.032	0.054	0	0	0.032	0.138	0.030
W	May	0	0	0.048	0.052	0	0	0	0.010	0.012	0.018	0.096	0.163	0	0	0.097	0.412	0.091
W	June	0	0	0	0	0	0	0	0.007	0.009	0.012	0.064	0.109	0	0	0.130	0.549	0.121
W	Jul	0	0	0	0	0	0	0	0.007	0.009	0.012	0.064	0.109	0	0	0.130	0.549	0.121
W	Aug	0	0	0	0	0	0	0	0.007	0.009	0.012	0.064	0.109	0	0	0.130	0.549	0.121
W	Sept	0	0	0.048	0.052	0	0	0	0.007	0.009	0.012	0.064	0.109	0	0	0.114	0.480	0.106