APPENDIX 2.1: PRELIMINARY ASSESSMENT OF THE PACIFIC COD STOCK IN THE EASTERN BERING SEA

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Introduction

This document represents an effort to respond to comments made by the BSAI Plan Team ("Team") and the Scientific and Statistical Committee ("SSC") on last year's assessment of the Pacific cod stock in the eastern Bering Sea ("EBS," Thompson 2017), and to respond to suggestions made by various scientists at the Alaska Fisheries Science Center (AFSC) for development of alternative models to include in the assessment. Comments from the Team and SSC are shown below. Suggestions from AFSC scientists are addressed in the "Model structures" section.

Responses to Team and SSC comments on assessments in general

<u>Comments from the October 2017 SSC meeting</u>

SSC1: "The SSC recommends that, for those sets of environmental and fisheries observations that support the inference of an impending severe decline in stock biomass, the issue of concern be brought to the SSC, with an integrated analysis of the indices in future stock assessment cycles. To be of greatest value, to the extent possible, this information should be presented at the October Council meeting so that there is sufficient time for the Plan Teams and industry to react to the possible reduction in fishing opportunity."

To facilitate a coordinated response to this request, the co-chairs and coordinators of the BSAI and GOA Groundfish Plan Teams, with concurrence from stock assessment program leadership at the AFSC, have suggested that authors address it by using the previous year's Ecosystem Status Report (ESR) as follows:

> "No later than the summer of each year, the lead author of each assessment should review the previous year's ESR and determine whether any factor or set of factors described in that ESR implies an impending severe decline in stock/complex biomass, where "severe decline" means a decline of at least 20% (or any alternative value that may be established by the SSC), and where biomass is measured as spawning biomass for Tiers 1-3 and survey biomass as smoothed by the standard Tier 5 random effects model for Tiers 4-5. If an author determines that an impending severe decline is likely and if that decline was not anticipated in the most recent stock assessment, he or she should summarize that evidence in a document that will be reviewed by the respective Team in September of that year and by the SSC in October of that year, including a description of at least one plausible mechanism linking the factor or set of factors to an impending severe decline in biomass, and also including an estimate or range of estimates regarding likely impacts on ABC. In the event that new survey or relevant ESR data become available after the document is produced but prior to the October Council meeting of that year, the document should be amended to include those data prior to its review by the SSC, and the degree to which they corroborate or refute the predicted severe decline should be noted, with the estimate or range of estimates regarding likely impacts on ABC modified in light of the new data as necessary."

This suggestion was followed, and the results are addressed in the "Ecosystem considerations" section.

SSC2: "The SSC also recommends explicit consideration and documentation of ecosystem and stock assessment status for each stock ... during the December Council meeting to aid in identifying stocks of concern."

This recommendation was subsequently clarified, at some length, in the minutes of the December 2017 SSC meeting and then re-clarified in the minutes of the June 2018 SSC meeting. In the interest of efficiency, the clarification from the December 2017 minutes is not included here. The relevant portion of the clarification from the June 2018 minutes reads as follows:

"This request was recently clarified by the SSC by replacing the terms 'ecosystem status' and 'stock assessment status' with 'Ecosystem Status Report information' and 'Stock Assessment Information,' where the potential determinations for each will consist of 'Okay' and 'Not Okay,' and by issuing the following guidance:

- *The SSC clarifies that 'stock assessment status' is a fundamental requirement of the SAFEs and is not really very useful to this exercise, because virtually all stocks are never overfished nor is overfishing occurring.*
- *Rather the SSC suggests that recent trends in recruitment and stock abundance could indicate warning signs well before a critical official status determination is reached. It may also be useful to consider some sort of ratio of how close a stock is to a limit or target reference point (e.g., B/B35). Thus, additional results for the stock assessments will need to be considered to make the 'Okay' or 'Not Okay' determinations.*
- *The SSC retracts its previous request for development of an ecosystem status for each stock/complex. Instead, while considering ecosystem status report information, it may be useful to attempt to develop thresholds for action concerning broad-scale ecosystem changes that are likely to impact multiple stocks/complexes.*
- *Implementation of these stock and ecosystem determinations will be an iterative process and will require a dialogue between the stock assessment authors, Plan Teams, ecosystem modelers, ESR editors, and the SSC."*

The iterative process described in the final bullet above is scheduled to begin at this year's September meeting of the Joint BSAI and GOA Plan Teams. In the event that a procedure for making the requested determinations is established in time to be implemented in the final draft of this assessment, the determinations will appear there.

<u>Comments from the December 2017 SSC meeting</u>

SSC3: "The SSC reminds authors of the need to balance the desire to improve model fit with increased risk of model misspecification." This recommendation was subsequently clarified in the minutes of the June 2018 SSC meeting as follows: *"In the absence of strict objective guidelines, the SSC recommends that thorough documentation of model evaluation and the logical basis for changes in model complexity be provided in all cases."* Model evaluation is documented thoroughly in this preliminary assessment. However, in conformity with past practice, this preliminary assessment does not contain a recommendation for a final model, so there are as yet no "changes" in model complexity. If a more complex model (relative to the current base model) is recommended in the final draft of this assessment, the logical basis for the changes in model complexity will be provided.

SSC4: "Report a consistent metric (or set of metrics) to describe fish condition among assessments and ecosystem documents where possible." The authors of all assessments that reported fish condition in the respective 2017 SAFE report chapters, along with ESR editors and the authors of the groundfish condition sections of the BSAI and GOA ESRs, discussed this recommendation and agreed to adopt the "weight-length residual" method currently used in the ESRs as the standard method. The index of fish condition used in this preliminary assessment was the same as that reported in last year's BSAI ESR.

SSC5: "Projections ... clearly illustrate the lack of uncertainty propagation in the 'proj' program used by assessment authors. The SSC encourages authors to investigate alternative methods for projection that incorporate uncertainty in model parameters in addition to recruitment deviations. Further, the SSC noted that projections made on the basis of fishing mortality rates (Fs) only will tend to underestimate the uncertainty (and perhaps introduce bias if the population distribution is skewed). Instead, a two-stage approach that first includes a projection using F to find the catch associated with that F and then a second projection using that fixed catch may produce differing results that may warrant consideration." Following a consensus recommendation from the co-chairs and coordinators of the BSAI and GOA Groundfish Plan Teams, stock assessment program leadership at the AFSC has agreed to take the following steps:

1. Notify assessment authors that, for the purpose of the standard projection scenarios, the previous requirements for use of the standard Tier 3 projection model and measurement of spawning biomass at the time of peak spawning no longer apply, thereby enabling authors to use Stock Synthesis (SS) or other software to make the projections.
2. Task one or more individuals with modifying the current standard projection code so as to accommodate this request for non-SS Tier 3 assessments, with the understanding that it may not be possible to accomplish this in time for use in the 2018 assessments.
3. Task the authors of Tier 1 assessments with modifying their projection code so as to accommodate this request for Tier 1 assessments, with the understanding that it may not be possible to accomplish this in time for use in the 2018 assessments.

Because the models used in the EBS Pacific cod assessment are developed using SS, step #1 in the above list should make it possible to respond to this request in the final draft of the assessment.

Responses to Team and SSC comments specific to this assessment

<u>Comments from the November 2017 Team meeting</u>

BPT1: The Team recommends making a direct comparison between the EBS trawl survey length compositions and the NBS survey length compositions for 2010 and 2017, within each year. The NBS survey showed different length compositions between 2010 and 2017, and this comparison would provide a better understanding of the relationship between the stocks in the two areas. This comparison is presented in the "Data" section, under "Northern Bering Sea survey" (see also Figure 2.1.1).

BPT2: The Team recommends presenting in the next assessment document, the fishery CPUE for each of the separate sectors (pot, trawl, longline), as has been done in the past. This information would be useful to compare to estimated trends from the assessment. The requested data will be presented in the final draft of this year's assessment.

BPT3: The Team recommends reporting the fishery CPUE by area in the NBS areas to provide a context for the genetics proposal. A better understanding of the fishery CPUE in the northern areas would provide insight into population trends in these areas that would supplement the occasional surveys in those areas. The Team leaves it up to the analyst to determine the areas based on personal preference and data availability. The requested data are reported in the "Data" section, under "Northern Bering Sea fishery catch per unit effort."

BPT4: The Team recommends investigating the utility of dropping the first five years in the EBS shelf survey (starting the series in 1987) and thus allowing for the incorporation of the northwest strata (areas 82 and 90) into the survey index time-series. The Pacific cod abundance has potentially increased in the northwest strata, these areas are becoming more important to the fishery, and this change may provide an improved index of abundance for Pacific cod. A model incorporating this suggestion has been included in this preliminary assessment, as described under "Model structures."

BPT5: "The Team recommends funding the genetics proposal presented by Ingrid Spies as soon as possible. This proposal will answer questions related to the genetic relationship of Pacific cod caught in the NBS relative to other areas. In addition, the Team would like to understand how the results of this study may affect the assessment and management paradigm, and assumptions of spawning connectivity (or lack thereof) between EBS and NBS Pacific cod." Part 1 of the genetics study was funded earlier this year. Results indicate that the genetic samples from the NBS survey in 2017 are very similar to those from the EBS survey area, and quite distinct from samples collected in the Aleutian Islands and the Gulf of Alaska (Ingrid Spies, AFSC, pers. commun.). In addition, analyses indicated that the NBS samples were unlikely to be from a population that was not sampled, such as Russia. This preliminary assessment only begins to answer the question of how the results of the genetic study may affect the subjects listed above by the Team.

BPT6: "The Team recommends that models 17.2 and 17.6 remain as candidate model structures for continuing to understand the relationships between data and model choices. Models 16.6, 17.2, and 17.6 are structurally different models that represent a range of model uncertainty." Models 17.2 and 17.6 are included here, and have been updated with two new years' worth of age data.

BPT7: "The Team recommends continuing an investigation of why the various models show very different results. This could be accomplished by looking at the effect of model outputs when including individual features (expanding on the evaluation of effects presented). From this work we may gain a better understanding of both the range of model structural uncertainty and the linkages from the model back to the biology and ecology of the stock. Using Model 16.6 as the base model, the Team would like to see the effects of the features included in Models 17.2, 17.3, and 17.6. The effect can be measured with the average difference in spawning biomass, the relative change in the 2016 spawning biomass (not absolute value), the change in the estimate of natural mortality (M), and the unfished equilibrium biomass ($B_{100\%}$). Additionally, and if possible, a look at Mohn's rho for some of the features (at the author's discretion) would be helpful to understand which features affect the retrospective behavior." Although the issue of *why* the various models show different results is not a focus of this preliminary assessment (and Model 17.3 is not included at all, given that it was not listed as a candidate model in Comment BPT6), average difference in spawning biomass (ADSB), projected spawning biomass, natural mortality, unfished equilibrium biomass, and ρ (Mohn 1999) are presented for all models (see especially Table 2.1.10). Readers are also referred to the "Initial steps toward a bridging analysis between Models 16.6 and 17.6" subsection in last year's final assessment (Thompson 2017, especially table 2.11).

<u>Comments from the December 2017 SSC meeting</u>

SSC6: The SSC has encouraged the additional work on model averaging conducted during 2017, and the author and Plan Teams have made good progress on the topic, even if neither are ready to move forward with it. Remaining concerns include clearly identifying criteria for including models in an ensemble, specifically delineating between alternative plausible hypotheses and sensitivity analyses (which should not be included), as well as continued exploration of specific methods for calculating averaged results. The SSC supports the Plan Team's recommendation to conduct a spring workshop to address these and other issues which would not be limited to just Pacific cod. An immense list of issues pertaining to model averaging, including those listed above, were addressed at the June workshop, either in presentations or

discussion. Once any recommendations resulting from that workshop, or modifications or additions thereto, have been officially adopted, they will be incorporated into the assessment. In the meantime, this preliminary assessment continues the exploration of specific methods for calculating averaged results (see "Model averaging" section).

SSC7: Discontinue work on development of empirical weight at age; analysis to date suggests that this may not be a fruitful avenue given data available. Development of empirical weight at age has been discontinued.

SSC8: The SSC disagreed with the Plan Team's recommendation to drop the first 5 years of EBS trawl data in order to use the NW strata. Instead it encourages treatment of these data by allowing catchability to change after the first 5 years of the EBS survey in the model, or through geostatistical modelling approaches." A model incorporating this suggestion (inclusion of data from the two NW strata beginning in 1987, with a change in catchability) has been included in this preliminary assessment, as described under "Model structures."

Data

For the current base model, the data file used in this preliminary assessment was identical to the data file used in last year's assessment (Thompson 2017). With one exception, all other models in this preliminary assessment modify that data file in various ways, as described in the "List of alternative models" subsection of the "Models" section. With the exception of the data described below in the "Northern Bering Sea fishery CPUE" subsection, all data types described in this section were, at a minimum, analyzed in the context of developing the alternative models presented, and many of the data types were incorporated into one or more of the alternative models, as described in the "List of alternative models" subsection of the "Models" section.

Fishery age composition for 2010 and 2011

The procedure established in last year's assessment for selecting otoliths to be used in developing the fishery age composition data is as follows: Given a desired total annual sample size of 1000 otoliths, the objectives were, first, to distribute the sample so as to reflect the proportion of the total catch in each gear/area/week combination as closely as possible, and second, conditional on achieving the first objective, to maximize the number of hauls sampled.

This year, otoliths were requested to be read from the 2010, 2011, 2012, and 2017 fishery collections, to complement the existing fishery age data for each year from 2013-2016. Selection of otoliths for 2012 and 2017 followed the procedure established last year. For the 2010 and 2011 requests, however, the procedure was modified somewhat, because some otoliths from those years have already been aged, and it seemed appropriate, in the interest of efficiency, to leverage the existing collections to the maximum extent possible while still meeting the goal of matching the proportion of the total catch in each gear/area/week combination as closely as possible. For the 2010 collection, 411 previously aged otoliths were selected for use, and 589 new otoliths were requested (total = 1000). For the 2011 collection, 499 previously aged otoliths were selected for use, and 541 new otoliths were requested (total = 1040).

The resulting age compositions were as follow (rows sum to unity; note that ages 0 and 1 were both unrepresented in the otolith collections for both years):

Year	N	2	3	4	5	6	7	8	9	10	11	12+
2010	6514	0.0145	0.1266	0.4027	0.1993	0.1086	0.0666	0.0556	0.0209	0.0024	0.0019	0.0009
2011	8804	0.0090	0.1777	0.2453	0.3657	0.1247	0.0441	0.0151	0.0109	0.0054	0.0010	0.0011

These data were appended to the fishery age composition data used last year in Models 17.2 and 17.6, and the corresponding fishery size composition records were turned "off." Models 17.2 and 17.6 are the only models in this preliminary assessment that use fishery age composition data.

The fishery age composition data for 2012 and 2017 are scheduled to be available in time for use in the final draft of this year's assessment.

Partitions in the EBS shelf bottom trawl survey time series

The "standard" area covered by the EBS shelf bottom trawl survey was established in 1982. In 1987, however, two northwestern strata (82 and 90) were added to the standard area, resulting in an "expanded" survey area that has been covered annually ever since. Because relatively few Pacific cod were typically found in the two northwestern strata (biomass in the expanded area was 3.2% higher than in the standard area on average over the 1987-2017 time series, while abundance was 2.2% higher on average), and because including data from both survey areas would likely require estimating two catchability coefficients, two sets of selectivity parameters, or both, the EBS Pacific cod assessment has always used data from the standard area only. However, at the request of the Team and SSC (see comments BPT4 and SSC8), this preliminary assessment includes two models that include the data from the expanded area.

Table 2.1.1 compares the biomass and abundance indices from the two areas, Table 2.1.2 compares the age compositions from the two areas, and Table 2.1.3 shows the size compositions from the expanded area (the size of this matrix makes a comparison with the size compositions from the standard area, which were presented in last year's assessment, too unwieldy to include).

Another partition in the EBS survey time series that will need to be addressed at some point is the switch from length-stratified to random sampling of otoliths. Samples were collected using a length-stratified design exclusively through 2014, then both random and stratified samples were collected in 2015 and 2016, and a random design has been in use exclusively since 2017. This issue was discussed during the June 2017 of the BSAI Team's subcommittee on Pacific cod models, but not included in any of the subcommittee's requested models (https://www.npfmc.org/wp-content/PDFdocuments/membership/PlanTeam/Groundfish/BSAIPcod_subcommittee617minutes.pdf).

Northern Bering Sea survey

As discussed in last year's assessment, the time series for the northern Bering Sea (NBS) survey is very short. As of last year, the survey had been conducted only twice, in 2010 and again in 2017. Estimates of biomass (t) and abundance (1000s of fish), along with the corresponding lognormal sigma parameters (similar to a coefficient of variation) from those two years are shown below:

	Biomass		Abundance	
Year	Estimate	Sigma	Estimate	Sigma
2010	28,425	0.226	8,881	0.196
2017	286,310	0.131	135,065	0.128

Table 2.1.4 shows the size compositions from the 2010 and 2011 NBS surveys. At the request of the Team (see comment BPT1), Figure 2.1.1 compares the EBS and NBS sizecomps for 2010 and 2017.

This year, a partial survey of the NBS was also conducted. Results were not available in time for inclusion in this preliminary assessment. There may be issues of comparability between the 2010/2017 and 2018 surveys, but if these can be resolved, it should be possible to include the results from the 2018 partial survey in one or more of the models included in the final draft of this assessment.

Northern Bering Sea fishery catch per unit effort

Observer data

For the years 1988-2018, the data from longliners targeting Pacific cod in the NBS survey area come from a total of 12 observed hauls. There are no years in which hauls from more than two vessels were observed, so confidentiality restrictions prohibit these data from being broken down by year.

If the query is expanded by removing the restriction that the hauls need to have targeted Pacific cod, the sample size increases to 27, but the same confidentiality problems arise with respect to annual reporting.

The Team requested that fishery catch per unit effort (CPUE) be reported "by area" within the NBS (see comment BPT3). Aggregating the data over the entire time series and splitting the NBS at 170º W gives approximately equal sample sizes (both in terms of number of hauls and number vessels) over the course of the time series, and does not give rise to issues of confidentiality. The table below shows mean CPUE (in kg per 1000 hooks), along with the corresponding standard errors and approximate 95% confidence bounds for the means:

Subarea	N	Mean	Std. Err.	M-2SE	M+2SE
West of 170	15	129.1	26.9	75.3	182.9
East of 170	12	89.2	21.4	46.3	132.0
Overall	27	111.3	17.8	75.7	147.0

Given the very small sample size, and the inability to use year-disaggregated data, the observer NBS CPUE data were not used in any of the models included in this preliminary assessment.

Fish ticket data

A query of Alaska Department of Fish and Game (ADFG) fish ticket data yielded 552 records of Pacific cod taken in ADFG statistical areas north of 60º30′ in the U.S. portion of the Bering Sea by longline gear, spanning the years 1991-1993 and 1998-2017. These data were then winnowed as follows:

- All records from each ADFG statistical area that was not located predominantly within the NBS survey area were removed. This reduced the number of records to 173, covering the years 2001-2002 and 2006-2017.
- Confidentiality constraints reduced the sample size to 164, covering the years 2006-2012 and 2016-2017.
- All records in this data subset corresponded to vessels making shoreside deliveries except for 2016, when records for 4 catcher-processors were included. The average landing for those 4 catcher-processors in 2016 was 18 times higher than the average landing from any other year, so the analysis was then restricted to vessels making shoreside deliveries only. When the data for the 4 catcher-processors in 2016 were removed, the number of records was reduced to 154, covering the years 2006-2012 and 2017 (2016 was removed due to the confidentiality constraint, as data for only 1 vessel delivering shoreside in 2016 were available).
- In 2017, there are two records that were listed as delivering shoreside in the "processing sector" field, but they are identified as "floating catcher-processors" elsewhere. The average landing for those two records is 350 times higher than the average for the remaining 2017 records, which suggests that their listing as delivering shoreside is an error. When those two records were removed, the total number of records dropped to 152, which was the final data set used to compute fishery catch per ticket in the NBS.

The resulting time series of mean Pacific cod catch per ticket, with approximate 95% confidence intervals, is shown in Figure 2.1.2.

The ADFG fish ticket data were not included in any of the models presented in this preliminary assessment for the following reasons.

- The time series is short (8 years).
- The units are catch rather than catch per unit effort.
- The confidence intervals are wide enough that the data may not contain much information.
- Across the time series, the two small ADFG statistical areas just southwest of Nome (#666401 and #666402, which together comprise a half-degree-latitude × one-degree-longitude block) account for between 56% and 92% of the records in each year, so this might not be a good index of the overall NBS (all but two of the catches in the time series were delivered to Nome; the other two were delivered to Dutch Harbor).

Environmental indices

A total of 13 time series representing various environmental indices were examined in the process of developing the models included in this assessment, although, as noted above, not all of them were ultimately included in any of the models. The list of indices is as follows (the first 10 indices in the list below are those used in the ecosystem "Report Card" section of the ESR (Siddon and Zador 2017), and the last three have been suggested as potentially having particular importance for Pacific cod):

1. North Pacific Index ("NPI")
2. Benthic forager biomass ("bnthc_frgr")
3. St. Paul northern fur seal pups born ("fr_sl_pps")
4. Ice retreat index ("IRI")
5. Pelagic forager biomass ("plgc_frgr")
6. Habitat impacted by trawls ("trwl_mpct")
7. Euphausiid biomass ("ephsd")
8. Apex predator biomass ("apx_prd")
9. Motile epifauna biomass ("mtl_epfn")
10. Multivariate seabird breeding index ("brd_brdng")
11. Fish condition ("fsh_cndtn")
12. Mean bottom temperature in the EBS shelf bottom trawl survey ("bttm_tmp")
13. Age 1 walleye pollock abundance ("pllck_1")

Data for indices #1-10 listed above were obtained from the ESR website: https://access.afsc.noaa.gov/reem/ecoweb/Index.php?ID=9, data for #11 and #12 were obtained from the authors of the respective ESR chapters (Boldt et al. 2017 and Lauth 2017), and data for #13 were taken from Table 28 of the 2017 EBS walleye pollock assessment (Ianelli et al. 2017).

Table 2.1.5 shows the time series of each index, as z-scores, for the years 1977-2017 (or as many of those years for which data exist).

In addition to being used in the process of assessment model development, indices #1-12 were also used to address comment SSC1 (see "Ecosystem considerations" section).

Models

Software

As with all assessments of the EBS Pacific cod stock since 1992, the Stock Synthesis (SS) software package (Methot and Wetzel 2013) was used to develop and run the models. Since 2005, new versions of SS have been programmed in ADMB (Fournier et al. 2012). SS V3.30.08.03 was used to run the base model in last year's assessment. SS V3.30.12.00 (beta release, including various minor incremental upgrades through August 3, 2018) was used to run all of the other models in this preliminary assessment.

Base model

Model 16.6 was adopted by the SSC in 2016 as the new base model. In contrast to the previous base model (Model 11.5, which had been in use since 2011), Model 16.6 is a very simple model. Its main structural features are as follow:

- One fishery, one gear type, one season per year.
- Logistic age-based selectivity for both the fishery and survey.
- External estimation of time-varying weight-at-length parameters and the standard deviations of ageing error at ages 1 and 20.
- All parameters constant over time except for recruitment and fishing mortality.
- Internal estimation of all natural mortality, fishing mortality, length-at-age (including ageing bias), recruitment (conditional on Beverton-Holt recruitment steepness fixed at 1.0), catchability, and selectivity parameters.

List of alternative models

A total of 15 alternative models are presented here in addition to the base model. These differ either in terms of model structure, data used, or both. Table 2.1.6 lists differences in model structure relative to the base model and Table 2.1.7 lists the data used in the various models. Two of the alternative models were presented in the 2016 assessment, and the other 13 are new (8 of which constitute minor changes from the base model and 5 of which constitute major changes). The list of alternative models is as follows (the distinction between "minor" and "major" changes, along with the model numbering convention, conform to Option A in the SAFE chapter guidelines; the symbols *Q*, *K*, *Lmin*, and *M* represent catchability, the Brody growth coefficient, length at age 1.5, and the instantaneous natural mortality rate, respectively).

<u>Models constituting minor changes from the base model</u>

Models dealing with the use of data from the "expanded" EBS survey area:

- Model 16.6a:
    - Structure differences: None.
    - Data differences:
        - Exclude 1982-1986 EBS survey data.
        - Switch to expanded EBS survey data for 1987-2017.
- Model 16.6b
    - Structure difference: Estimate a separate *Q* for the 1982-1986 EBS survey.
    - Data difference: Switch to expanded EBS survey data for 1987-2017.

Models incorporating an environmental covariate of growth:

- Model 16.6c
    - Structure difference: Estimate a parameter linking *K* to fish condition.
    - Data difference: Include the fish condition time series (as z-scores).
- Model 16.6d
    - Structure difference: Estimate a parameter linking *Lmin* to bottom temperature.
    - Data difference: Include the bottom temperature time series (as z-scores).

Models incorporating time-varying catchability, without NBS survey data:

- Model 16.6e
    - Structure difference: Allow randomly time-varying EBS survey *Q*.
    - Data differences: None.
- Model 16.6f
    - Structure difference: Estimate a parameter linking EBS *Q* to the North Pacific Index.
    - Data difference: Include the North Pacific Index time series (as z-scores).

Models incorporating time-varying catchability, with NBS survey data:

- Model 16.6g
    - Structure differences:
        - Allow randomly time-varying EBS survey *Q*.
        - Estimate NBS survey selectivity and *Q*.
        - Allow randomly time-varying NBS survey *Q*.
    - Data differences: Include NBS survey data.
- Model 16.6h
    - Structure differences same as Model 16.6g, plus:
        - Estimate a parameter linking NBS *Q* to the North Pacific Index.
    - Data differences same as Model 16.6g, plus:
        - Include the North Pacific Index time series (as z-scores).

<u>Models constituting major changes from the base model</u>

Previously reviewed models:

- Model 17.2
    - Structure differences:
        - Adjust timing of fishery and survey per SS V3.30 conventions
        - Include a prior distribution for the natural mortality rate
        - Switch to flat-topped double normal selectivity for the fishery and survey
        - Allow randomly time-varying fishery selectivity
        - Use harmonic mean weighting of composition data
    - Data differences:
        - Set multinomial input sample size equal to number of sampled hauls
        - Include fishery age composition data (data for 2011 and 2012 new this year)
- Model 17.6
    - Structure differences same as Model 17.2, plus:
        - Allow randomly time-varying survey selectivity
        - Allow randomly time-varying *Lmin*
        - Allow randomly time-varying EBS survey catchability
    - Data differences same as Model 17.2

Models incorporating migration:

- Model 18.1
    - Structure differences:
        - Estimate base values of three migration parameters.
        - Allow random variation in migration parameters.
    - Data differences:
        - Include NBS survey data.
        - Treat EBS and NBS as separate areas.
- Model 18.2
    - Structure differences:
        - Estimate base values of three migration parameters.
        - Estimate three parameters linking migration to covariates.
    - Data differences same as Model 18.1, plus:
        - Include North Pacific Index (as z-scores).
        - Include benthic forager biomass index (as z-scores).
        - Include seabird breeding success index (as z-scores).

Models incorporating an environmental covariate of the instantaneous natural mortality rate:

- Model 18.3
    - Structure difference: Estimate a parameter linking *M* to fish condition
    - Data difference: Include fish condition time series (as z-scores)
- Model 18.4
    - Structure differences:
        - Estimate two additional parameters linking *M* to age
        - Estimate a parameter linking *M* at ages 2-4 to nutrition deficit
    - Data differences: Include nutrition deficit time series (as z-scores)

Model incorporating many new features:

- Model 18.5
    - Structure differences:
        - Estimate a parameter linking EBS *Q* to the North Pacific Index
        - Estimate NBS selectivity and *Q*.
        - Estimate base values of three migration parameters.
        - Allow random variation in migration parameters.
        - Estimate two additional parameters linking *M* to age.
        - Estimate a parameter linking *M* to a nutrition deficit index.
        - Estimate block-specific Ricker steepness internally.
    - Data differences:
        - Include NBS survey data.
        - Treat EBS and NBS as separate areas.
        - Include the North Pacific Index time series (as z-scores).
        - Include the nutrition deficit time series (as z-scores).

Models 17.2 and 17.6 were requested by the Team and SSC, Model 16.6a was requested by the Team, Model 16.6b was requested by the SSC, and several of the other models were requested by various AFSC scientists.

Additional details about various features of the alternative models

Choice of growth parameter to covary environmentally in Models 16.6c and 16.6d

Models 16.6c and 16.6d were developed in response to requests from AFSC scientists. The requests that gave rise to these two models specified that "growth" be linked to a particular environmental covariate, but they did not specify *which* of the four growth parameters should be linked. The specific parameter to link was chosen in each case by running four preliminary versions of the respective model with one of the four growth parameters linked to the specified environmental covariate, and choosing the parameter that gave the smallest negative log likelihood.

Prior distribution for *M* in Models 17.2 and 17.6

Following a pair of requests from the SSC, Models 17.2 and 17.6 include a prior distribution for *M*. The procedure for developing this prior distribution was described in last year's assessment. The distribution is lognormal, with μ and σ values of -0.6666 and 0.4930, respectively. The distribution has an arithmetic mean of 0.5798, a geometric mean of 0.5134, a harmonic mean of 0.4547, a mode of 0.4027, and a 95% credibility interval extending from 0.1954 to 1.3493.

Selectivity in Models 17.2 and 17.6

Models 17.2 and 17.6 also feature flat-topped, double normal selectivity for the fishery and survey. There are multiple ways to configure double normal selectivity so as to achieve a flat-topped functional form. As described in last year's assessment, the parameter governing the point at which the flat-topped portion of the function begins and the "ascending width" parameter are the only two parameters estimated internally. The others are fixed as follows:

- The parameter defining the length of the flat-topped portion of the curve (as a logit transform between the beginning of the flat-topped portion and the maximum age) was fixed at a value of 10.0, thereby eliminating any descending limb.
- Given the above, the parameters defining the "descending width" and selectivity at the maximum age are rendered essentially superfluous, and were both fixed at a value of 10.0.
- The parameter defining the selectivity at age 0 was fixed at a value of -10.0, corresponding to a selectivity indistinguishable from 0.0.

Models 17.2 and 17.6 also feature random annual time variability in selectivity (fishery only in the case of Model 17.2; both fishery and survey in Model 17.6). In both models, development began with both parameters of the relevant selectivity curve(s) being allowed to vary over time. The process of tuning the input standard deviations of the time-varying parameters is described in a later subsection.

The *dev*s pertaining to the parameter defining the beginning of the flat top were of the multiplicative type, because this parameter is logically constrained to be positive; while the *dev*s pertaining to the "ascending width" parameter were of the additive type, because this parameter is expressed on a log scale and so can take either positive or negative values.

The ranges of years for which selectivity *dev*s were estimated were 1977-2016 for the fishery and 1982-2016 for the survey, corresponding to the full ranges of years spanned by the fishery data and survey data used in the model, respectively. However, it should be noted that including survey selectivity *dev*s for 2015 or 2016 may result in confounding with the recruitment *dev* for 2015.

Length at age 1.5 (*Lmin*) in Model 17.6

Random annual variability in *Lmin* is a feature of Model 17.6, for which multiplicative *dev*s were estimated. The process of tuning the input standard deviations of this dev vector was the same one used for the selectivity *dev* vectors, and is described in a later subsection.

Care needs to be taken when interpreting the years for which these *dev*s were estimated. Each *dev* becomes "active" in the year for which it is estimated, meaning that it governs the parameters of the mean-length-at-age relationship for fish recruiting at age 0 in that year. However, its impact on the mean length of age 1.5 fish does not occur until the *following* year.

Migration parameters in Models 18.1, 18.2, and 18.5

Models 18.1, 18.2, and 18.5 all feature parameters governing the rates at which fish in the EBS in year *y* either stay in the EBS in year *y*+1 or move to the NBS and the rates at which fish in the NBS in year *y* either stay in the NBS in year *y*+1 or move to the EBS. These rates also vary with age. The user specifies the age endpoints of a range (which SS labels "A" and "B"), below which the rate takes the value of the lower endpoint, above which the rate takes the value of the upper endpoint, and within which the rate varies linearly between the endpoints. To simplify matters, it was assumed that the age range would be the same for all parameters.

For a two area model, it might be guessed that 8 parameters are required, representing 2 source areas × 2 destination areas × 2 age range endpoints. However, because the parameters for each endpoint are back-transformed via a multivariate logistic equation, half of the parameters cancel, so the destination=source parameter for each area and each age range endpoint can be fixed at 0, meaning that only 4 parameters need to be estimated.

Random variation in migation parameters was assumed in all three models that involve migration. The procedure for tuning the extent of random variability in migration parameters is described in a later subsection. In order to simplify the tuning process for the input standard deviations of the *dev* vectors for the migration parameters, the same input standard deviation was used for all migration parameters.

For Model 18.1, once the input standard deviations of the migration *dev* vectors had converged, a series of runs that profiled over a range of values for the endpoints of the age range were made, and new values of the endpoints were chosen if any were found that resulted a lower negative log likelihood than the existing endpoint values. The process was then repeated (i.e., tune the input standard deviations for the migration *dev* vectors, then profile over a range of endpoint values) until no further improvement could be made. Models 18.2 and 18.5 used the same endpoints as Model 18.1.

It was also necessary to specify a range of years for which years over which the migration parameters would be allowed to vary. Like the *Lmin* parameter discussed in the preceding subsection, the effects of the migration parameters estimated in year *y* are not manifested until year *y*+1 (at least in a single-season model such as the ones under consideration here). It was clear that the changes needed to encompass the years of the two NBS surveys, 2010 and 2017, so the range of years for which migration parameters needed to be specified had to span at least the range {2009, 2016}. The final choice of year range was based on trial and error, using Model 18.1 and focusing on the reasonableness of resulting parameter estimates such as the EBS survey *Q* (see "Results" section). Once a final range of years had been chosen for Model 18.1, the same range was assumed in Models 18.2 and 18.5.

Nutrition deficit index in Models 18.4 and 18.5

The original request for development of Models 18.4 and 18.5 called for use of a nutrition deficit index (as a covariate of age-dependent *M*), to be developed by the creators of the CEATTLE model (Holsman et al. 2017) on the basis of either diet data or bioenergetics. The basic idea was that natural mortality might be expected to vary directly with the difference between nutrition demand and nutrition supply.

Unfortunately, development of the requested index turned out to be much more complicated than anticipated. As time for producing this preliminary assessment began to run short, a "placeholder" nutrition deficit index was constructed so that development of Models 18.4 and 18.5 could proceed. Mean bottom temperature was chosen to represent an index of metabolic demand, and average of euphausiid biomass and age 1 pollock abundance was chosen to represent an index of prey supply (where all variables are represented as z-scores). The specific steps involved in constructing the placeholder for the nutrition deficit index are shown in Table 2.1.8 (moving from left to right).

After the point at which it was too late to make any changes to the models, the efforts to develop a nutrition index on the basis of either diet data or bioenergetics finally proved successful. Six alternative indices were developed; the first three are based on diet and the second three are based on bioenergetics (indices and descriptions courtesy of K. Holsman, AFSC, pers. commun.):

- consumedG: Lognormal mean weight of prey in stomach samples in terms of grams of food per gram of predator. This reflects how much fish are eating in a given year. Low values indicate less food consumed due to: 1) consumption of more energetically valuable prey, 2) lack of available prey that leads to lower rates, or 3) less need to forage as much (i.e., lower energetic demand or more ideal conditions).
- meanPreyED: Gravimetric-mean energy density of each prey item in the diet, so it reflects the relative energetic quality of the prey. Lower values indicate a switch to lower density prey that may be offset by consuming more prey.
- RFR (relative foraging rate): An index of observed prey consumption (grams of food per gram of predator per day) relative to a bioenergetics model-based theoretical maximum consumption rate (grams of food per predator per day). The value is typically 0 to 1, but can be higher than 1 if lab experiment-based consumption rates are less than rates in the wild due to schooling behavior or lab behavioral stress, of if the estimated energy densities of the prey or predator are inaccurate. RFR can go up when: 1) more prey is available, or 2) prey quality drops so fish must forage more to meet energetic demand.
- Cmax: Theoretical maximum consumption rate of a fish given its weight and temperature. Cmax tends to be low at cold and very warm conditions.
- maxG: Theoretical scope for growth if fish are able to consume prey at their maxium consumption rate (i.e., RFR=1). Lower values can result when: 1) cold conditions lead to slower growth potential; 2) prey energy is low; or 3) warm conditions result in metabolic demand becoming a large proportion of the energy budget, which means that the energy available for growth declines.
- Gpotential: Similar to maxG, this is theoretical scope for growth, given observed consumption rates and diet composition. Lower values can result under the same conditions listed for maxG.

The diet/bioenergetics-derived indices were presented in two forms: a version structured in terms of 20-cm size bins and another version for the population as a whole.

To help guide Team and SSC discussions regarding which, if any, of the indices should be used in models to be included in the final draft of this assessment, each index was correlated against the time series of instantaneous total mortality rates at age, which was estimated by a selectivity-adjusted catch-curve analysis of the raw EBS survey age composition data (where the data are expressed in numbers of fish rather than proportions, and where survey selectivity at age was taken from Model 16.6). For the version of the indices structured in terms of 20-cm size bins, this required converting from size bins to ages, which was done by using the (static) distribution of length at each age and the numbers-at-year-and-age matrix (both from Model 16.6) to create year-specific tables of age×bin weights, which were then used to give a weighted average (across bins) value for each age in that year.

Table 2.1.9 shows the correlations of each index with catch-curve-generated total mortality rate at each age 1-13. The data in the upper and lower portions of the table are identical; only the color coding is different. The upper portion of the table shows which correlations are positive (green) and which are negative (red). The placeholder index did not perform too badly, giving positive correlations for 7 of the 13 ages, doing at least as well as any of the population versions of the diet/bioenergetics-derived indices, which gave positive correlations for between 4 and 7 of the 13 ages. Three of the six age-specific versions of the diet/bioenergetics-derived indices gave a larger number of positive correlations than the placeholder index (the age-specific version of meanPreyED was the champion in this regard, giving positive correlations for 11 of the 13 ages). Notably, all six of the age-specific versions of the diet/bioenergetics-derived indices gave positive correlations for all ages from 5 to 9. The lower portion of Table 2.1.9 shows how the performances of the various indices compare with each other for a given age. Color coding goes from red (low) to green (high). The placeholder index at age 3 had the highest correlation (0.573) of any index at any age. The placeholder index tied with the age-specific version of the meanPreyED index for the highest number of best performances (3).

Age-dependent *M* in Models 18.4 and 18.5

SS implements *n* age breakpoints for *M* as follows (note that age breakpoints need not be integers):

- *M* for ages from 0 through breakpoint age 1 are equal to the 1st *M* parameter.
- For all $1<k<n$, *M* for ages from breakpoint age $k-1$ through breakpoint age *k* follow a linear interpolation between the *k*th−1 and *k*th *M* parameters.
- *M* for ages from breakpoint age *n* and above are equal to the *n*th *M* parameter.

In developing Model 18.4, the number and locations of breakpoints were guided by these considerations:

- *M* within at least one age range had to vary directly with the nutrition deficit index (the rows in Table 2.1.9 corresponding to the placeholder index proved helpful in exploring alternative ranges where this result would likely obtain).
- Any age range within which *M* did not vary directly with the nutrition deficit index should not be linked to that index.
- Base values of *M* must be a non-increasing function of age.

The number and locations of breakpoints for Model 18.5 were set equal to those for Model 18.4.

Ricker recruitment in Model 18.5

The request that gave rise to Model 18.5 called for at least one change in stock-recruitment steepness during the time series. All recent versions of the EBS Pacific cod model have assumed that recruitment is independent of spawning biomass, and this assumption is accommodated easily in SS by choosing the Beverton-Holt form of the stock-recruitment relationship with steepness fixed at 1.0 (steepness is traditionally defined as the ratio of recruitment at 20% of equilibrium unfished spawning biomass to recruitment at equilibrium unfished spawning biomass, where the measure of recruitment in both the numerator and denominator is the value from the stock-recruitment curve).

However, given that steepness values other than 1.0 were to be entertained in Model 18.5, it seemed appropriate to test whether the Ricker form of the stock-recruitment relationship might be more appropriate than the Beverton-Holt form. Comparing runs based on an early version of Model 18.5, with steepness estimated using the Beverton-Holt form in one case and the Ricker form in the other, indicated that the Ricker form gave a much lower negative log-likelihood, so the Ricker form was chosen.

The parameter labeled "beta" in the SS report file (but *h* in the user manual and Methot and Wetzel 2013) represents the ratio of equilibrium unfished spawning biomass to the spawning biomass associated with the peak of the stock-recruitment curve. It is related to the traditional definition of steepness as follows:

$$steepness = \left(\frac{1}{5}\right)\exp\left(\frac{4\beta}{5}\right).$$

As initial tuning of Model 18.5 proceeded, a single value of β was used for the entire time series. Once the tuning had converged, the time series of recruitment *dev*s was examined for breakpoints. The optimal number and locations of breakpoints was chosen on the basis of AIC. Once the breakpoints were chosen, the model was reconfigured with block-specific β parameters that were estimated internally.

In the event that Model 18.5 (or any model involving an internally estimated value of stock-recruitment steepness) is adopted by the SSC for use in setting harvest specifications, it will be necessary for the SSC also to determine whether the point estimate of F_{MSY} or the probability density function of F_{MSY} resulting from the model is reliable. If the respective determination is affirmative, then this stock will move from Tier 3 to Tier 2 or Tier 1 management.

Tuning the extent of random variability in parameters other than *Q* in Models 17.2 and 17.6

Like all of the models, Models 17.2 and 17.6 feature random annual variation in recruitment. However, unlike the other models, the extent of annual variation in recruitment is not estimated internally in Models 17.2 and 17.6. Models 17.2 and 17.6 also feature random annual variation in fishery selectivity parameters, and Model 17.6 also features random annual variation in survey selectivity parameters and in *Lmin*. This section describes the methods used to tune the input standard deviations governing the extent of random variability in those parameters.

Deriving statistically valid estimates of the input standard deviations that are used to constrain *dev* vectors is a perennial problem in stock assessments that use a penalized likelihood approach. SS V3.30 includes, as a change from SS V3.24, the ability treat these standard deviations as additional parameters to be estimated internally. Unfortunately, the maximum likelihood estimates based on the penalized likelihood tend to be biased (Thompson 2016a). An alternative procedure was introduced in the 2015 assessment (Thompson 2015), which constituted a multivariate generalization of one of the methods mentioned by Methot and Taylor (2011), viz., the third method listed on p. 1749), and proceeded as follows:

1. Set initial guesses for the *σdev*s.
2. Run SS.
3. Compute the covariance matrix (**V1**) of the set of *dev* vectors (e.g., element $\{i,j\}$ is equal to the covariance between the subsets of the *i*th *dev* vector and the *j*th *dev* vector consisting of years that those two vectors have in common).
4. Compute the covariance matrix of the parameters (the negative inverse of the Hessian matrix).
5. Extract the part of the covariance matrix of the parameters corresponding to the *dev* vectors, using only those years common to all *dev* vectors.
6. Average the values in the matrix obtained in step 5 across years to obtain an "average" covariance matrix (**V2**).

7. Compute the vector of σdevs corresponding to **V1**+**V2**.
8. Return to step 2 and repeat until the σdevs converge.

However, this method will not work in SS V3.30, because the functional form of the penalty term has been changed. In previous versions of SS, the penalty term was

$$-n\cdot\ln(\sigma dev)-\left(\frac{1}{2}\right)\cdot\sum_{i=1}^{n}\left(\frac{dev_i}{\sigma dev}\right)^2,$$

and the *dev*-adjusted parameter for year *i* (for the case of additive devs) took the form $parameter_i = base\_value + dev_i$.

In SS V3.30, on the other hand, σdev is removed from the denominator in the summation, so the penalty term is now

$$-n\cdot\ln(\sigma dev)-\left(\frac{1}{2}\right)\cdot\sum_{i=1}^{n}\left(dev_i\right)^2,$$

and the *dev*-adjusted parameter for year *i* takes the form $parameter_i = base\_value + \sigma dev\cdot dev_i$.

Note that, once the appropriate constant was added, the old form of the penalty term took the form of a sum of logged $N(0,\sigma dev)$ probability density functions. However, the new form of the penalty term takes the form of a sum of logged $N(0,1)$ probability density functions *minus* the quantity $n\cdot\ln(\sigma dev)$, meaning that the exponentiated penalty term no longer integrates to unity.

Further complicating matters is the fact that the new form of the penalty term in V3.30 does not apply to recruitment *dev*s, which still use the old form of the penalty term.

However, the most significant problem posed by the new form of the penalty term with respect to the above algorithm for estimating the σdevs is that, with the exception of σ_R, none of the σdevs appears in either **V1** or **V2**. To remedy this situation, the following changes were made to the algorithm (note that these changes assume implicitly that the *dev* vectors are all independent, which is not the case in the original algorithm):

- To obtain a covariance matrix analogous to the one in step #3 above:
  - Form a diagonal matrix consisting of the variances of the *dev* vectors.
- To obtain a covariance matrix analogous to the one in step #4 above:
  - Let *ndev* represent the number of non-recruitment *dev* vectors in the model, indexed k=1,...,*ndev*.
  - Read the Hessian matrix **H** returned by ADMB.
  - For each row *i* in **H**, set $dvec_i=k$ if the parameter represented by row *i* is an element of the *k*th *dev* vector; otherwise, set $dvec_i=0$.
  - For each row *i* and column *j* in **H**, if $dvec_i>0$, then multiply $\mathbf{H}_{i,j}$ by $dvec_i$, and if $dvec_j>0$, then multiply $\mathbf{H}_{i,j}$ by $dvec_j$.
  - Invert **H**.
- Because (given the above changes) it is now assumed implicitly that the *dev* vectors are all independent, it is no longer necessary to use only those years common to all *dev* vectors.

The above changes to the algorithm for estimating the σ*dev*s should be considered experimental at this point.

Another new feature of randomly time-varying parameters in SS V3.30 is the requirement either to specify or to estimate the degree of autocorrelation among the *dev*s in the log likelihood. Except as specified otherwise in the next subsection, all autocorrelation terms in all models were fixed at zero. Initial explorations allowing the recruitment autocorrelation term to be estimated internally resulted in values close to zero.

Tuning based on matching the sampling variance in survey indices (several models)

Randomly varying catchability (either EBS, NBS, or both) is a feature of Models 16.6e, 16.6g, 16.6h, and 17.6; and randomly varying migration parameters is a feature of Models 18.1 and 18.5.

Tuning of the input standard deviations for the *Q dev*s and migration parameter *dev*s followed a different procedure than the one described above for recruitment, selectivity parameters, and *Lmin* in Models 17.2 or 17.6. The procedure for tuning the input standard deviations for these *dev* vectors was analogous to a procedure that was often used historically (in assessment models for other stocks developed under certain older versions of SS) to estimate the amount of survey index measurement error, which was to inflate the standard errors specified in the data file by adding a constant chosen so as to equate the root-mean-squared-error (model estimates versus data) with the mean (across years) standard error specified in the data file. Here, however, the equivalence was achieved by tuning the input standard deviation rather than the standard errors. The reasons for using this procedure rather than the one described above were twofold: 1) it maintains consistency with historical precedents for dealing with survey index data; and 2) estimates of the amount of observation error are available due to the statistical design of the survey.

The table below shows the models for which the index RMSE and mean log-scale sigma from the two areas (EBS, NBS) were used to tune the input standard deviations for various *dev* vectors:

	Input standard deviation being tuned						
Quantities used for tuning	EBS *Q dev* s			NBS *Q dev* s		Migration *dev* s	
EBS RMSE and mean(sigma)	16.6e	16.6g	17.6				
NBS RMSE and mean(sigma)				16.6g	16.6h	18.1	18.5

It might be wondered why the fit to the NBS survey index, which contains only two points, was used to tune the input standard deviations for the *dev* vectors associated with the migration parameters, rather than using the EBS survey index, which contains 36 points. The reason is that the contrast between the two estimates of abundance in the NBS survey is so great that it seemed like the more important of the two survey time series to fit.

Catchability and migration parameters are expressed on a log scale in SS, so additive *dev*s were estimated for these.

Unlike the other parameters for which random annual variability was allowed, the autocorrelation coefficient for *Q* was allowed to be estimated freely in Model 17.6 rather than fixed at zero, because early explorations indicated that the amount of autocorrelation was likely to be substantial and because internal estimation of the autocorrelation coefficient would not complicate the estimation of the input standard deviation.

Choice of environmental covariates (several models)

Environmental covariates are used to calibrate at least one parameter in Models 16.6c, 16.6d, 16.6f, 16.6h, 18.2, 18.3, 18.4, and 18.5. With respect to the method used to choose the respective covariate(s), these models can be categorized as follows:

- Models 16.6c, 16.6d, 18.3, and 18.4 were developed in response to requests from AFSC scientists, and those requests specified, at least to some extent, which covariates to use.
    - The requests that gave rise to Models 16.6c and 16.6c specified that a growth parameter be linked to fish condition and bottom temperature, respectively.
    - The request that gave rise to Model 18.3 specified that *M* be linked to fish condition.
    - The request that gave rise to Model 18.4 specified that *M* be linked to nutrition deficit, although the precise form of the nutrition deficit index was not specified.
- Models 16.6f, 16.6h, and 18.2 (along with the link between *M* and nutrition deficit in Model 18.5) constitute environmentally linked counterparts to Models 16.6e, 16.6g, and 18.1, respectively. More specifically, each environmentally-linked parameter in Models 16.6f, 16.6h, and 18.2 corresponds to a *dev* vector for the same parameter in Models 16.6e, 16.6g, and 18.1, respectively. For each pair of models ({16.6e, 16.6f}, {16.6g, 16.6h}, and {18.1, 18.2}), the model with the *dev* vector for the parameter of interest was developed first; then the environmental covariate for that parameter in the corresponding model was chosen from the first 12 indices in Table 2.1.5 on the basis of maximum correlation with the respective *dev* vector.
- Model 18.5 is an omnibus model that borrows some features from other models, in addition to adding some features not included elsewhere. The environmental covariate for EBS survey *Q* was borrowed from Model 18.2, and the environmental covariate for *M* was borrowed from Model 18.4.

Convergence Behavior

As in previous assessments, development of the final versions of all models included calculation of the Hessian matrix and a requirement that all models pass a “jitter” test of 50 runs. Following the procedure established in the 2016 assessment (Thompson 2016b), when running a jitter test, the bounds for each parameter in the model were adjusted to match the 99.9% confidence interval (based on the normal approximation obtained by inverting the Hessian matrix). A jitter rate (equal to half the standard deviation of the logit-scale distribution from which “jittered” parameter values are drawn) was set at 1.0 for all models. Standardizing the jittering process in this manner will not explore parameter space as thoroughly as possible; however, it makes the jitter rate more interpretable, and shows the extent to which the identified minimum (local or otherwise) is well behaved.

In the event that a jitter run produced a better value for the objective function than the base run, then:

1. The model was re-run starting from the final parameter file from the best jitter run.
2. The resulting new control file, with the parameter estimates from the best jitter run incorporated as starting values, became the new base run.
3. The entire process (starting with a new set of jitter runs) was repeated until no jitter run produced a better value for the objective function than the most recent base run.

Results

Note: In all tables with color scales, red and green correspond to the minimum and maximum values within the given row or column (whether the scale varies horizontally or vertically varies by table). Also, in the context of the EBS survey, "std." denotes the standard survey area and "exp." denotes the expanded survey area.

Overview

Table 2.1.10 presents an overview of some key results for the models. Several of the rows in the table provide values that the Team requested for use in understanding differences between the models (see comment BPT7); specifically, average difference in spawning biomass (ADSB, representing the root-mean-squared relative differences between the time series of spawning biomass estimated by a given alternative model and the time series estimated by the current base model, using only data that were available that were available when the current base model was first adopted), projected spawning biomass, natural mortality, unfished equilibrium biomass, and Mohn's ρ.

Table 2.1.10 is divided into four sections: dimensions, diagnostics, base values, and 2019 quantities. The "dimensions" portion reproduces some key elements of Table 2.1.7 that might help readers to understand why some cells in the rest of the table are blank. The "diagnostics" portion lists ADSB and Mohn's ρ, the first of which is a measure of how "different" a given alternative model is from the current base model, and the second of which is a measure of retrospective bias. The "base values" section lists some key time-invariant quantities, which in some cases are the base values for time-varying parameters (note that *M* varies with age in Models 18.4 and 18.5; the values listed here are for ages 6+). The "2019 quantities" portion lists several quantities relevant to management of the fishery in 2019 (biomass, OFL, and maxABC are all in units of 1000s of t), but it is important to note that these estimates will change once the data sets are updated for the final draft of this assessment ("depletion" is the ratio of spawning biomass in 2019 to equilibrium unfished spawning biomass).

Goodness of fit

Table 2.1.11 shows negative log likelihood values and parameter counts for the models. The 16 models involve a total of 13 unique data sets (Models 16.6 and 16.6e share a common data set, Models 16.6c and 18.3 share a common data set, and Models 17.2 and 17.6 share a common data set). Because the data sets are different for nearly all models, and because the input standard deviations for various dev vectors are tuned to different values in many of the models, it is difficult to compare the negative log likelihoods across models in a meaningful way. Likewise, because all of the models involve *dev* vectors and the input standard deviations for those are not constant across models, comparing parameter counts is also difficult.

Table 2.1.12 shows the model fits to each year of the EBS survey index in terms of negative log likelihood. Table 2.1.12a lists the negative log likelihood values, which helps to show whether there are certain observations (years) that tend to be fit well or poorly by multiple models (i.e., lots of green or red in a row), and also whether a given model tends to be fairly consistent in its ability to predict the survey index (uniform color in a column) or whether its performance is variable across years (mix of colors in a column). The observed survey index is also shown for reference (e.g., does a model, or group of models, tend to do worse when the index changes dramatically in a single year?). Table 2.1.12b subtracts the row minimum from each row in Table 2.1.12a, thus showing, for each observation (year), how the models compare relative to the best model performance for that particular observation. The second row from the bottom lists the number of times that each model did better than any other model, and the bottom row shows the negative log likelihood from each model's worst performance.

Table 2.1.13 shows effective sample sizes for each model and data component, following the procedure introduced in last year's assessment.

- Cells shaded gray represent constants associated with the data (if a cell that is shaded gray for Model 16.6 is shaded yellow for some other model, it indicates an instance where the data in the other model differ from the data used in Model 16.6). The quantities in this category consist of:
  - The number of years represented in the particular data type ("Yrs").
  - The average sample size for the particular data type as specified in the data file ("N"), which, in the case of survey index data, consists of the average number of stations (hauls) sampled over the time series.
  - The average log-scale standard error of the survey index ("SEave").
- Cells shaded blue (the "Mult" column) represent values specified by the modeler that are used to modify the sample sizes for the given data component (compositional data only).
- Cells shaded gold (the "N×Mult" column) represent the product of the "N" and "Mult" values (compositional data only).
- Cells shaded tan represent model results. The quantities in this category consist of:
  - The harmonic mean of the effective sample size ("Har"; compositional data only).
  - The root-mean-squared-error of the model's log-scale survey index estimates ("RMSE"; survey index data only).
- Cells shaded green represent a pair of aggregate sample sizes computed from the other columns.
  - For composition data, these cells contain:
    - The aggregate effective sample size *assigned* to the particular data type ("ΣNeff1"), computed as Yrs×N×Mult.
    - The aggregate effective sample size *achieved* for the particular data type ("ΣNeff2"), computed as Yrs×Har.
  - For survey index data, these cells contain the same two quantities (ΣNeff1 and ΣNeff2), and ΣNeff1 is computed as in the case of composition data, but ΣNeff2 is computed as:
    - $\text{Yrs}\times\text{N}\times((\text{SEave}+\text{SEextra})/\text{RMSE})^2$.

By expressing ΣNeff1 and ΣNeff2 in units of hauls for both composition data and index data, the values for the two data types are comparable.

The ratio ΣNeff2/ΣNeff1 for a given data component provides a measure of how well the model is tuned with respect to that component (specifically, the ratio should equal unity). Red font in any pair of horizontally adjacent cells indicates that the respective model was tuned so that the value in the right-hand cell matched (approximately) the value in the left-hand cell. Only Model 17.6 achieves ratios equal (approximately) to unity for all components.

Parameter estimates, derived time series, and retrospective analysis

Table 2.1.14 lists virtually all of the parameters and constants estimated or used in the SS control files. For parameters estimated internally, both estimates ("Est.") and standard deviations ("StD") are listed. Table 2.1.14a lists the internally estimated parameters (other than *dev*s) that are common to all or nearly all of the models. Table 2.1.14b lists the internally estimated parameters (other than *dev*s) that are used in only a few of the models. Table 2.1.14c lists those parameters whose values were estimated iteratively, through the procedures described in the "Models" section. Table 2.1.14d lists the "early" recruitment *dev*s (that, along with the other parameters active at the start of the model, determine the initial numbers-at-age vector). Table 2.1.14e lists the "main" recruitment *dev*s (i.e., those for the years 1977-2016), and the color scales show a very high degree of consistency across models (at least qualitatively). Table 2.1.14f lists the remaining *dev* vectors estimated by the models. Table 2.1.14g lists miscellaneous constants specified in the SS control files.

Some values from Table 2.1.14 that might be difficult to interpret include the following:

- The age range for the linear ramp between sets of migration "A" and "B" parameters shown in Table 2.1.14b was {4,8}.
- The value of the "A" parameter for migration from the NBS to the EBS proved difficult to estimate internally. The parameter seemed to converge on a very large value in Models 18.1 and 18.2 (81.638 and 81.774, respectively), with an immense standard deviation that, in some runs, caused the Hessian not to be positive definite. Moreover, the *dev*s estimated for that parameter were all negligible. Therefore, this parameter was fixed at the (apparently) converged values (the value for Model 18.5 was set equal to the value from Model 18.1), as shown in Table 2.1.14c, and the associated *dev* vector was removed from all three migration models.
- The values of the Ricker β parameter shown in Table 2.1.14b for the four time blocks (1977-1979, 1980-2005, 2006-2013, and 2014-2016) correspond to steepness values (as traditionally defined) of 2.832, 1.043, 2.320, and 0.200. Figure 2.1.3 shows the estimated spawning biomass and recruitment time series along with the estimated Ricker stock-recruitment curves for the four specified time blocks.
- In Models 18.4 and 18.5, three breakpoints were specified for the age-dependent *M* schedule: 2, 5, and 6; with dependence on the nutrition deficit index active only on the parameter representing *M* at age 5 (but therefore influencing *M* at all ages from 2 through 5). The base value of *M* at age 5 and the *M* at ages 6+ conformed to the desired non-increasing form in both models, but if *M* for ages 0-2 was estimated freely, the resulting value was much lower than the base value of *M* at age 5 or *M* at ages 6+. Therefore, the values of *M* at ages 0-2 in Models 18.4 and 18.5 were tuned iteratively to match the corresponding base value of *M* at age 5, which tended to push the base values of *M* at age 5 downward, so that in the end there was little difference between *M* at ages 0-2, the base value of *M* at age 5, and *M* at ages 6+ in either model.

Table 2.1.15 shows the time series of estimated apical fishing mortality rates, along with their estimated standard deviations. As with the time series of recruitment *dev*s in Table 2.1.14e, the color scales show a very high degree of consistency across models (at least qualitatively).

Table 2.1.16 shows time-varying biology parameters after adjustments (i.e., after the applying the *dev*s to the corresponding base value).

Table 2.1.17 shows the time series of migration probabilities (EBS to EBS, EBS to NBS, NBS to EBS, and NBS to NBS) for each age over the time series 2006-2017. The row for EBS to EBS is highlighted with a color scale in each year. Migration probabilities for each source area sum to 1.0 at each age.

Table 2.1.18 shows catchability for all models, by year, and in the NBS as well as the EBS for the five models that estimate *Q* for the NBS. Models with time-varying catchability are shown with color scales. The entries for 1987-2017 under Models 16.6a and 16.6b are shown in italics, to indicate that those two estimates of EBS *Q* are based on the expanded survey area rather than the standard area.

Table 2.1.19 shows selectivity for all models. Table 2.1.19a shows base values of fishery selectivity at age, Table 2.1.19b shows based values of EBS survey selectivity at age, Table 2.1.19c shows base values of NBS survey selectivity at age, Table 2.1.19d shows fishery selectivity by age and year for Model 17.2, Table 2.1.19e shows fishery selectivity by age and year for Model 17.6, and Table 2.1.19f shows survey selectivity by age and year for Model 17.6.

Table 2.1.20 shows the time series of recruitment for all models, along with standard deviations. Note that recruitment is assumed equal to the mean for 2017-2019 in all models except Model 18.5, where the stock-recruitment relationship causes recruitment in those years to vary even though no recruitment data are available for those years. As with the time series of recruitment *dev*s in Table 2.1.14e, the color scales show a very high degree of consistency across models (at least qualitatively).

Table 2.1.21 shows the time series of depletion for all models, along with standard deviations. The color scales again show a very high degree of consistency across models (at least qualitatively), except that Model 17.6 does not show as much of an upward trend in recent years as the other models.

Table 2.1.22 shows the time series of spawning biomass for all models, along with standard deviations. As with the depletion time series shown in Table 2.1.21, Model 17.6 does not show as much of an upward trend in recent years as the other models.

Table 2.1.23 shows the time series of spawning biomass in both the EBS and NBS for the three models that produce such estimates (SS does not produce standard deviations for these quantities). The area-specific values in this table sum to the value of the point estimates for the respective model in Table 2.1.22.

Table 2.1.24 shows age 0+ biomass for all models (SS does not produce standard deviations for this quantity). Model 17.6 does not show as much of an upward trend in the 2011-2016 time frame as the other models.

Table 2.1.25 shows the time series of age 0+ biomass in both the EBS and NBS for the three models that produce such estimates (SS does not produce standard deviations for these quantities). The area-specific values in this table sum to the value of the point estimates for the respective model in Table 2.1.24.

Mohn's ρ, along with boundaries on acceptable values thereof as suggested by regressions against M based on the results of Hurtado-Ferro et al. (2015), are shown below (values shaded red fall outside of the acceptable range):

Model:	16.6	16.6a	16.6b	16.6c	16.6d	16.6e	16.6f	16.6g
M:	0.359	0.348	0.347	0.354	0.363	0.361	0.354	0.353
Min ρ:	-0.206	-0.202	-0.201	-0.204	-0.207	-0.206	-0.204	-0.204
Max ρ:	0.279	0.274	0.274	0.277	0.282	0.280	0.277	0.277
ρ:	0.243	0.202	0.217	0.304	0.222	0.323	0.291	0.359

Model:	16.6h	17.2	17.6	18.1	18.2	18.3	18.4	18.5
M:	0.348	0.374	0.312	0.305	0.331	0.349	0.381	0.294
Min ρ:	-0.202	-0.211	-0.189	-0.187	-0.196	-0.202	-0.213	-0.183
Max ρ:	0.274	0.287	0.256	0.252	0.266	0.274	0.290	0.247
ρ:	0.319	0.309	0.069	0.452	0.370	0.118	0.451	0.724

Note that the ρ values for 7 out of the 13 models fall outside the acceptable range. The values for Models 16.6, 16.6a, 16.6b, 16.6d, 17.6, and 18.3 fall within the acceptable range. Model 17.6 has the smallest retrospective bias of any model, and Model 18.5 has the largest.

In response to internal (AFSC) reviews of a previous draft of this document, Attachment 2.1.1 provides a bridging analysis between Models 17.2 and 17.6, showing how incorporation of each feature (cumulatively) affects each parameter in the model.

Model averaging

Unweighted averages

Table 2.1.26 shows the means and standard deviations of the OFL and maxABC distributions for 2019 in each model, based on the Hessian approximation, where means and standard deviations ("SDev") are expressed in t. The right-most pair of columns shows the probability that the mean maxABC exceeds the true-but-unknown OFL for the respective model. The first of those two columns ("Sam.") is based on the averaged sample distribution (i.e., the average (across models) of the normal distributions of 2019 OFL). The second of those two columns ("Pop.") is based on an attempt to estimate the population distribution from which the sample of models was drawn, and was derived by fitting a 3-parameter "t" distribution to the mean, standard deviation, and kurtosis of the averaged sample distribution (this method, using a simpler functional form, was introduced in last year's assessment, and presented at both the National Stock Assessment Workshop and the BSAI Team's Assessment Methods Workshop earlier this year). The average maxABC across all models is 159,962 t, which represents a 20.3% chance of exceeding the true-but-unknown OFL if the averaged sample distribution is used and a 26.7% chance of exceeding the true-but-unknown OFL if the estimated population distribution is used.

Figure 2.1.4 shows the probability density functions (upper panel) and cumulative distribution functions (lower panel) for the following:

- The averaged sample distribution of maxABC.
- The estimated population distribution of maxABC.
- The averaged sample distribution of OFL.
- The estimated population distribution of OFL.

Although the means of the averaged sample distribution and the estimated population (of either OFL or maxABC) are equal by design, the medians are not:

- The median of the averaged sample distribution of maxABC is 168,187 t; the mean is 159,962 t.
- The median of the averaged sample distribution of maxABC is 199,157 t; the mean is 189,727 t.

Weighted averages

Last year's assessment presented a method for model weighting that was based, in part, on the ΣNeff2 statistic presented in Table 2.1.13. These are reproduced in Table 2.1.27, with a color scale for each row, and without the other columns of Table 2.1.13. In the context of the models presented here, one difficulty with this measure is that the models do not all use the same data components. Taking the sum of the component-specific ΣNeff2 values might unfairly penalize some models that do not attempt to fit certain information-rich data components, while taking the average of the component-specific ΣNeff2 values might unfairly penalize some models that attempt to fit certain difficult-to-fit data components. Also, the fact that Model 17.6 is the only model that is fully tuned may complicate the interpretation of the ΣNeff2 statistics from the other models (e.g., a model might be able to achieve a high ΣNeff2 value for a compositional data component by giving it an immense average input sample size, even though the harmonic mean effective sample size, while high, is much lower than the average input sample size).

In last year's assessment, the ΣNeff2 values were adjusted by dividing them by an estimate of the "effective" number of parameters. The procedure for computing the effective number of parameters was very time-consuming and, given that the method did not receive much support during the reviews of last year's assessment, the computation was not undertaken here. However, if the Team or SSC wishes to see this method revived for the final draft of the assessment, it might be possible to do if the number of models is sufficiently small.

Last year's assessment also included a set of ad hoc adjustments to the model weights based on ΣNeff2 per effective parameter that resulted from SSC recommendations. Specifically, the SSC suggested that model weightings based on goodness off fit should be modified based on three factors: 1) retrospective performance, 2) model convergence behavior, and 3) general plausibility. These were implemented in last year's assessment as follows:

- Retrospective performance: Mohn's ρ was used to form the basis of a multiplicative adjustment factor, defined as exp(−|ρ|).
- Model convergence behavior: Model convergence behavior was measured on the basis of the RMSE from each model's "jitter" test, where the squared error for each jitter run was defined as the squared proportional difference between the ending year spawning biomass estimated in that run and the ending year spawning biomass estimated in the final (converged) run). The RMSE was used to create a multiplicative adjustment factor, defined as exp(−RMSE).
- General plausibility: Two quantities were used to measure "general plausibility:" First, because conventional wisdom is that the EBS Pacific cod stock was not heavily exploited prior to the rapid increase in biomass resulting from the 1977 regime shift (Wespestad et al. 1982), estimates of the initial (pre-1977) fishing mortality rate *Finit* that exceed the natural mortality rate were penalized. Second, because field studies to date provide little, if any, evidence that catchability in the EBS bottom trawl survey exceeds unity (Weinberg et al. 2016), estimates of catchability that exceed unity were penalized. Two multiplicative adjustments were defined as exp(−max(0,*Finit*−*M*)) and exp(−max(0,ln(*Q*))).

As it turned out, the SSC's requested adjustments, particularly the pair of "general plausibility" adjustments, had a large influence on the final model weights in last year's assessment. Some alternative adjustments are provided in Table 2.1.28. These all have functional forms broadly similar to those used last year, but with a couple of modifications. Each of the multiplicative adjustments used in last year's assessment took the form exp(−*X*), where *X* was specific to the factor responsible for the adjustment (retrospective performance, convergence behavior, and general plausibility). In contrast, the multiplicative adjustments in Table 2.1.28 take the form $\exp\big(-\alpha(X - X_{min})\big)$, where α is a parameter whose value is to be specified and X_{min} is the minimum value of X across all models. Setting α=1 gives a set of multiplicative adjustments that are proportional to the ones that would be generated using last year's formulas (the only difference is that they are now normalized so that one model has a multiplicative adjustment equal to 1.0), whereas setting α<1 reduces the impact of the multiplicative adjustments.

A method for model weighting based on 10-fold cross-validation is also presented here. For each model, each component of the respective data set (except for any that consisted of fewer than 10 records) was partitioned into 10 subsets of approximately equal size. A set of 10 training data sets was then created for each model by "turning off" one of the subsets in each of the constituent components. Each model was then fit to each of the training data sets and used to predict the respective data subset that was "turned off" (i.e., the testing data subset). Following a suggestion by Stewart and Martell (2015), the fit to the survey index was singled out here as an appropriate basis for model weighting.

Specifically, the negative log likelihood for each survey index observation in the testing data subset for each of the 10 runs was recorded and, because the data subsets were complementary (i.e., each observation was omitted in exactly one of the training data subsets), once all 10 runs had been made, a complete time series of negative log likelihoods for the survey index was obtained for the model.

Table 2.1.29 shows the time series of "testing" negative log likelihoods for the EBS survey index for each model. This table is constructed similarly to Table 2.1.12, which measured the fits of the models to the EBS survey index in terms of negative log likelihood. Table 2.1.29a lists the negative log likelihood values, which helps to show whether there are certain observations (years) that tend to be fit well or poorly by multiple models (i.e., lots of green or red in a row), and also whether a given model tends to be fairly consistent in its ability to predict the survey index (uniform color in a column) or whether its performance is variable across years (mix of colors in a column). Table 2.1.29b subtracts the row minimum from each row in Table 2.1.29a, thus showing, for each observation (year), how the models compare relative to the best model performance for that particular observation. The second row from the bottom lists the number of times that each model did better than any other model, and the bottom row shows the negative log likelihood from each model's worst performance.

Table 2.1.30 uses the total "testing" negative log likelihood (–*lnL*) for each model (i.e., the bottom row of Table 2.1.29) to compute a set of model weights, where the weight for model *i* is proportional to $\exp(-lnL_i - \min(lnL))$. The left half of the table is sorted in order of model number, and the right half is sorted in order of negative log likelihood. Note that, if these weights were to be used, 98.68% of the weight would be given to Model 17.6. Model 16.6g had the second lowest negative log likelihood, but it lagged 7.1798 points behind Model 17.6. Model 17.2 fared the worst, being 24.0568 points behind Model 17.6.

Implications of the NBS-EBS connection

Results of genetic studies to date indicate that the genetic samples from the NBS survey in 2017 are very similar to those from the EBS survey area, and quite distinct from samples collected in the Aleutian Islands and the Gulf of Alaska (Ingrid Spies, AFSC, pers. commun.). In addition, analyses indicated that the NBS samples were unlikely to be from a population that was not sampled, such as Russia. Nevertheless, questions remain about what these findings imply with respect to both the assessment of Pacific cod in the region and management of the fishery. In terms of basic biology, the extent to which fish in the NBS are spawning there, as opposed to returning to the EBS to spawn or not spawning at all; the viability of eggs or larvae (if any) that result from spawning in the NBS; and the persistence of the substantial biomass that was observed in the NBS during the 2017 are all unknown.

There are also issues regarding the design of appropriate stock assessment models and interpretation of stock assessment results. For example:

- Of the 11 models presented here that do not involve NBS survey data, only Model 18.4 estimates an EBS survey *Q* less than 0.913 and only Model 18.4 estimates an *M* higher than 0.374, which could be interpreted as confirmation that the fish in the EBS behave as a stand-alone stock. In other words, if persistent "leakage" of fish into the NBS were occurring, it might be expected that the models would tend to estimate lower values for *Q*, higher values for *M*, or both.
- On the other hand, all three of the 2-area migration models presented here project a substantial 2019 biomass in the NBS (between 38% and 100% of the EBS spawning biomass, and between 32% and 82% of the EBS age 0+ biomass), although it should be noted that migration models are very challenging to develop, especially in cases like this where there are no data on migration *per se* and where the amount of data from one of the two areas is extremely small.
- Catches from the NBS have historically been very small, and the area is currently closed to trawling. If catches in the NBS are assumed to be close to zero and the NBS fish are part of the same spawning stock as the EBS fish, then the EBS can be fished more heavily than would be the case if the EBS fish constituted a single, stand-alone stock.
- On the other hand, preliminary model runs with a fishery and equal effort in each of the two areas have resulted in higher overall maxABC values than similar model runs with a fishery in the EBS

only (although the part of the overall maxABC that comes out of the EBS in the two-fishery model is smaller than in the model with a fishery in the EBS only); but, again, this is predicated on the assumption that the NBS and EBS fish are part of the same spawning stock.

- It is not immediately how to configure a model in SS that allows migration back and forth between the two areas but that does not include the NBS fish as part of the spawning biomass.

Ecosystem considerations

To address the SSC's request for use of last year's Ecosystem Status Report (ESR, Siddon and Zador, editors (2017)) in predicting whether a (previously unanticipated) severe decline in biomass is imminent, the time series of relative changes in spawning biomass (=$B(t)/B(t\text{-}1)–1$) from last year's assessment (using Model 16.6) was computed as shown below:

Year:	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Δ(SB):	-0.024	0.011	0.332	0.633	0.736	0.433	0.067	0.136	-0.032	-0.025
Year:	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Δ(SB):	0.060	-0.032	-0.090	-0.199	-0.291	-0.073	0.047	0.112	-0.001	-0.038
Year:	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Δ(SB):	-0.116	-0.028	0.038	0.038	0.068	-0.003	0.016	-0.010	-0.118	-0.156
Year:	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Δ(SB):	-0.147	-0.080	0.076	0.324	0.187	0.127	0.030	0.011	0.124	0.086

Note that a decline in excess of 20% has been observed only once during the time series (between 1991 and 1992).

Using a cross-validation approach, the relative change in spawning biomass was then regressed against each of the first 12 environmental variables in Table 2.1.5 (although the fish condition indices for 1984 and 1993 were not used in the analysis, because they were isolated by several years from the other points in the time series).

A range of time lags between a given environmental variable and subsequent changes in spawning biomass (up to 10, if possible) was examined, as was a range of sizes for the training sets (which necessarily varied between indices because of differences in the total number of records). For each environmental variable, the combination of time lag and training set size that gave the highest median testing R^2 was chosen.

The next step in the analysis was to generate 10,000 pairs of training and testing data subsets (some redundancy was likely for indices with shorter time series).

For each variable, the parameter values estimated in the training sets were used to generate a distribution of projected changes in spawning biomass from 2017 to 2018, from which a mean and standard deviation ("2018 μ" and "2018 σ") were computed.

Six variables had a median testing R^2 greater than 0. The R^2 values were used to compute weights for the results corresponding to each of the seven variables as follows (the weighted average for 2018 σ was actually the root-mean-weighted-squared value):

Variable	nlags	R^2	weight	2018 μ	2018 σ
Benthic forager biomass	6	0.204	0.200	-0.032	0.095
Pelagic forager biomass	4	0.052	0.051	-0.072	0.106
Apex predator biomass	1	0.044	0.043	-0.005	0.123
Motile epifauna biomass	6	0.531	0.521	0.182	0.078
Multivariate seabird breeding	2	0.085	0.083	-0.208	0.122
Mean bottom temperature	3	0.104	0.102	-0.069	0.103
R^2-weighted mean	n/a	n/a	n/a	0.060	0.092

The R^2-weighted mean values of 2018 μ and 2018 σ imply a 25.8% chance that the 2018 spawning biomass estimated by Model 16.6 will decline, but only a 0.2% chance that it will decline by more than 20%.

Acknowledgments

Delsa Anderl, John Brogan, Charles Hutchinson, Beth Matta, and Kali Williams provided the 2010 and 2011 fishery age data; Rob Ames and Ren Narita provided the NBS fishery CPUE data; Kirstin Holsman and Kerim Aydin developed the nutrition deficit indices (other than the placeholder index); Chris Rooper provided the fish condition time series; Bob Lauth and Dan Nichol provided the bottom temperature time series and other survey data; and Rick Methot and Ian Taylor provided advice on technical details of SS.

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Tables

Table 2.1.1. Comparison of EBS survey indices in the “standard” and “expanded” areas. Biomass is in t; abundance is in 1000s of fish.

	Standard area				Expanded area			
	Biomass		Abundance		Biomass		Abundance	
Year	Estimate	Sigma	Estimate	Sigma	Estimate	Sigma	Estimate	Sigma
1987	1,027,518	0.062	677,054	0.065	1,064,600	0.060	697,075	0.064
1988	960,962	0.080	507,560	0.070	976,152	0.079	512,095	0.069
1989	833,473	0.075	292,247	0.068	868,804	0.072	301,748	0.066
1990	691,256	0.074	423,835	0.086	728,996	0.072	438,107	0.084
1991	514,407	0.074	488,892	0.104	530,488	0.072	496,765	0.103
1992	529,049	0.084	577,560	0.118	538,862	0.083	585,436	0.117
1993	663,308	0.080	810,608	0.122	669,305	0.079	814,187	0.121
1994	1,360,790	0.181	1,232,175	0.123	1,377,095	0.178	1,255,544	0.121
1995	1,002,961	0.091	757,910	0.099	1,008,293	0.091	761,681	0.099
1996	889,366	0.098	607,198	0.145	909,133	0.096	614,493	0.143
1997	604,439	0.112	485,643	0.145	627,151	0.109	493,660	0.143
1998	534,150	0.080	514,339	0.091	550,504	0.078	522,586	0.090
1999	569,765	0.087	488,337	0.093	618,679	0.091	542,229	0.100
2000	531,171	0.081	483,808	0.091	537,563	0.080	488,605	0.090
2001	811,816	0.090	960,917	0.095	827,176	0.088	974,016	0.094
2002	584,565	0.109	536,342	0.100	597,943	0.106	544,602	0.099
2003	590,973	0.105	498,873	0.124	625,659	0.099	516,468	0.120
2004	562,309	0.060	397,948	0.086	578,064	0.058	404,687	0.085
2005	606,050	0.071	450,705	0.140	638,764	0.068	464,647	0.136
2006	517,698	0.055	394,024	0.060	544,035	0.053	407,584	0.059
2007	423,704	0.082	733,402	0.263	450,337	0.078	753,821	0.256
2008	403,125	0.066	476,697	0.103	427,503	0.065	492,643	0.101
2009	421,291	0.083	716,637	0.087	430,084	0.081	721,812	0.087
2010	860,210	0.119	887,836	0.131	870,639	0.117	896,301	0.130
2011	896,039	0.074	836,840	0.094	911,082	0.073	844,482	0.094
2012	890,665	0.112	987,973	0.093	896,401	0.112	991,342	0.092
2013	791,958	0.093	750,889	0.165	811,667	0.091	760,225	0.163
2014	1,079,712	0.141	1,122,144	0.127	1,095,270	0.139	1,129,255	0.127
2015	1,102,261	0.136	982,470	0.115	1,109,115	0.136	985,698	0.115
2016	944,621	0.081	640,359	0.096	986,013	0.078	660,996	0.093
2017	598,260	0.077	346,693	0.090	643,953	0.077	364,129	0.088

Table 2.1.2. Comparison of age compositions in the “standard” and “expanded” EBS survey areas.

Standard area proportions at age

Year	N	0	1	2	3	4	5	6	7	8	9	10	11	12+
1994	346	0.000	0.089	0.382	0.171	0.123	0.118	0.080	0.021	0.007	0.005	0.001	0.001	0.001
1995	335	0.000	0.053	0.264	0.421	0.100	0.079	0.049	0.016	0.009	0.006	0.002	0.001	0.001
1996	341	0.000	0.056	0.208	0.203	0.293	0.136	0.058	0.029	0.010	0.004	0.002	0.001	0.001
1997	351	0.000	0.256	0.169	0.183	0.157	0.120	0.077	0.022	0.010	0.003	0.001	0.001	0.000
1998	344	0.000	0.077	0.441	0.204	0.112	0.057	0.060	0.028	0.016	0.004	0.001	0.001	0.000
1999	320	0.000	0.079	0.200	0.303	0.232	0.081	0.058	0.027	0.012	0.005	0.001	0.002	0.001
2000	343	0.000	0.234	0.127	0.150	0.242	0.148	0.062	0.014	0.014	0.005	0.003	0.001	0.000
2001	348	0.000	0.289	0.236	0.194	0.091	0.084	0.068	0.026	0.008	0.002	0.002	0.001	0.000
2002	344	0.000	0.080	0.188	0.318	0.233	0.072	0.059	0.034	0.010	0.004	0.001	0.001	0.000
2003	345	0.000	0.175	0.156	0.251	0.209	0.119	0.041	0.030	0.014	0.004	0.001	0.001	0.000
2004	345	0.000	0.144	0.166	0.271	0.128	0.128	0.091	0.040	0.019	0.009	0.002	0.003	0.001
2005	344	0.000	0.183	0.244	0.209	0.121	0.065	0.079	0.055	0.024	0.010	0.004	0.004	0.001
2006	344	0.000	0.324	0.143	0.165	0.121	0.093	0.063	0.046	0.028	0.010	0.003	0.001	0.001
2007	348	0.000	0.700	0.096	0.067	0.041	0.046	0.018	0.014	0.008	0.005	0.002	0.002	0.001
2008	330	0.000	0.213	0.445	0.145	0.083	0.049	0.033	0.010	0.010	0.006	0.003	0.001	0.002
2009	347	0.001	0.454	0.189	0.231	0.064	0.029	0.015	0.009	0.004	0.002	0.001	0.001	0.000
2010	328	0.000	0.047	0.479	0.179	0.203	0.064	0.015	0.008	0.003	0.001	0.000	0.001	0.000
2011	350	0.000	0.290	0.073	0.388	0.111	0.096	0.028	0.007	0.003	0.002	0.001	0.001	0.000
2012	343	0.000	0.366	0.234	0.058	0.237	0.062	0.031	0.007	0.002	0.002	0.000	0.000	0.000
2013	343	0.000	0.107	0.427	0.178	0.108	0.113	0.050	0.011	0.004	0.001	0.000	0.000	0.000
2014	355	0.000	0.279	0.188	0.238	0.197	0.048	0.036	0.010	0.002	0.001	0.001	0.000	0.000
2015	341	0.000	0.064	0.425	0.202	0.193	0.082	0.019	0.011	0.002	0.001	0.000	0.000	0.000
2016	356	0.000	0.112	0.094	0.361	0.221	0.145	0.049	0.012	0.004	0.001	0.000	0.000	0.000

Expanded area proportions at age

Year	N	0	1	2	3	4	5	6	7	8	9	10	11	12+
1994	346	0.000	0.090	0.387	0.170	0.123	0.117	0.079	0.020	0.007	0.005	0.001	0.001	0.000
1995	335	0.000	0.055	0.263	0.420	0.100	0.079	0.049	0.016	0.009	0.006	0.002	0.001	0.001
1996	341	0.000	0.057	0.206	0.201	0.293	0.137	0.059	0.029	0.010	0.004	0.002	0.001	0.000
1997	351	0.000	0.254	0.167	0.183	0.157	0.122	0.080	0.022	0.010	0.003	0.001	0.001	0.000
1998	344	0.000	0.076	0.437	0.204	0.114	0.058	0.061	0.029	0.016	0.004	0.001	0.001	0.000
1999	320	0.000	0.073	0.190	0.329	0.230	0.078	0.056	0.026	0.011	0.005	0.001	0.001	0.000
2000	343	0.000	0.232	0.127	0.150	0.243	0.148	0.062	0.014	0.013	0.005	0.003	0.001	0.000
2001	348	0.000	0.287	0.236	0.193	0.092	0.085	0.069	0.026	0.008	0.002	0.001	0.001	0.000
2002	344	0.000	0.079	0.187	0.316	0.234	0.074	0.060	0.034	0.010	0.004	0.001	0.001	0.000
2003	345	0.000	0.170	0.153	0.248	0.213	0.124	0.042	0.031	0.014	0.004	0.000	0.001	0.000
2004	345	0.000	0.142	0.165	0.269	0.128	0.129	0.092	0.041	0.019	0.009	0.002	0.003	0.000
2005	344	0.000	0.178	0.240	0.209	0.124	0.067	0.082	0.057	0.024	0.011	0.004	0.004	0.000
2006	344	0.000	0.315	0.143	0.166	0.126	0.096	0.064	0.047	0.029	0.010	0.003	0.001	0.001
2007	348	0.000	0.692	0.096	0.068	0.044	0.050	0.018	0.015	0.009	0.005	0.002	0.002	0.001
2008	330	0.000	0.208	0.443	0.147	0.084	0.050	0.035	0.011	0.011	0.006	0.003	0.001	0.001
2009	347	0.001	0.453	0.189	0.231	0.064	0.029	0.015	0.010	0.004	0.002	0.001	0.001	0.000
2010	328	0.000	0.046	0.479	0.179	0.203	0.064	0.015	0.008	0.003	0.001	0.000	0.001	0.000
2011	350	0.000	0.290	0.073	0.387	0.112	0.096	0.028	0.007	0.003	0.002	0.001	0.001	0.000
2012	343	0.000	0.365	0.234	0.058	0.237	0.062	0.031	0.007	0.002	0.002	0.000	0.000	0.000
2013	343	0.000	0.106	0.422	0.179	0.110	0.115	0.052	0.011	0.004	0.001	0.000	0.000	0.000
2014	355	0.000	0.278	0.187	0.237	0.198	0.048	0.036	0.010	0.002	0.001	0.001	0.000	0.000
2015	341	0.000	0.064	0.425	0.202	0.194	0.082	0.019	0.011	0.002	0.001	0.000	0.000	0.000
2016	356	0.000	0.109	0.092	0.360	0.223	0.148	0.050	0.012	0.004	0.001	0.000	0.000	0.000

Table 2.1.3. Size compositions from the EBS “expanded” area (page 1 of 4).

Year	N	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
1987	234	0	0	0	0	0	0	12	3	6	21	33	53	70	94	105	105	133	108	70	53	41	56	68	105	108	174	241	266	285	256
1988	167	0	0	0	0	0	0	0	5	5	19	9	20	18	16	28	19	13	18	23	32	47	53	60	58	74	56	85	82	92	121
1989	105	0	0	0	0	0	1	1	8	19	15	29	35	44	43	41	27	16	8	9	12	1	6	6	15	6	14	13	12	14	15
1990	134	0	0	0	0	0	24	67	97	143	140	173	220	242	193	140	110	84	53	33	39	41	32	47	73	74	93	99	93	87	111
1991	173	0	0	0	0	0	6	29	90	107	134	130	156	127	130	123	103	129	83	69	69	77	96	98	165	189	262	279	313	278	357
1992	250	0	0	0	0	0	0	1	17	85	191	198	182	157	206	232	245	260	225	237	119	125	142	194	280	303	319	368	390	368	327
1993	259	0	0	0	0	1	2	29	81	191	426	295	405	356	322	320	347	313	323	216	135	99	62	57	67	88	95	175	208	236	292
1994	319	0	0	0	0	0	3	9	5	24	38	70	83	91	92	108	126	102	96	88	130	119	175	157	207	306	408	521	598	676	705
1995	242	0	0	0	0	0	3	12	16	14	20	44	39	45	59	63	86	72	37	26	20	39	50	95	116	168	207	244	231	261	240
1996	231	0	0	0	0	0	1	2	11	9	23	33	48	63	53	66	69	63	54	35	20	23	24	58	64	129	162	192	227	272	235
1997	232	0	0	0	0	0	9	18	66	116	168	195	194	200	214	289	228	220	228	179	106	58	41	41	36	72	110	104	155	226	233
1998	236	0	0	0	0	0	1	4	23	52	83	115	103	134	90	45	22	7	4	19	24	58	72	185	275	381	489	595	619	607	507
1999	276	0	0	0	0	0	1	13	46	86	94	105	81	97	67	36	26	38	45	39	56	103	108	184	202	198	275	243	258	271	214
2000	300	0	0	0	4	10	22	49	95	131	286	460	559	424	267	263	137	84	31	9	12	24	37	75	114	164	189	215	251	294	216
2001	471	0	0	0	0	5	6	26	60	121	195	297	429	629	678	730	649	633	421	337	212	135	113	159	222	307	358	492	632	799	794
2002	293	0	0	0	0	1	3	6	21	41	60	76	100	153	107	158	106	68	49	33	17	41	62	104	156	234	260	418	457	533	530
2003	292	0	0	1	0	1	3	5	11	52	86	127	190	216	192	232	235	262	234	222	185	203	143	112	63	54	56	75	55	110	134
2004	257	0	1	0	0	0	1	4	19	43	82	145	101	186	180	205	200	128	137	105	64	54	71	89	103	180	189	211	228	264	287
2005	290	0	0	0	0	0	0	1	4	23	44	88	139	203	251	307	288	305	292	368	367	394	382	292	212	143	142	148	120	163	184
2006	309	0	1	0	4	7	40	101	336	404	427	455	402	345	329	359	281	245	146	107	65	55	61	57	64	90	118	173	196	249	254
2007	332	0	0	0	0	8	8	132	491	1187	1459	1435	1172	756	741	546	356	428	244	128	128	44	50	71	95	131	127	163	127	144	151
2008	331	0	0	1	0	0	6	54	169	350	380	390	352	312	227	151	76	40	21	41	76	168	313	487	558	724	765	746	701	576	484
2009	416	1	0	0	7	36	106	402	975	1062	1093	882	749	655	489	467	325	223	117	35	28	36	83	95	175	257	341	400	472	440	343
2010	346	0	0	0	0	0	1	9	32	44	53	92	92	103	85	57	28	30	17	25	58	111	232	357	443	655	791	775	726	728	597
2011	476	0	0	0	0	0	7	18	70	131	238	283	357	381	550	579	838	819	791	496	267	102	36	35	53	45	53	69	113	127	175
2012	326	0	0	6	0	0	74	382	691	737	567	427	421	314	413	399	210	130	48	32	10	29	38	60	85	180	261	271	361	356	393
2013	447	0	0	0	0	1	9	48	111	140	198	213	273	233	173	121	34	21	61	82	256	382	626	753	941	1032	805	871	624	630	398
2014	390	0	0	0	1	0	0	8	79	102	210	300	409	455	577	437	533	430	457	271	192	98	90	80	63	84	194	216	368	291	424
2015	472	0	0	0	0	0	0	11	41	41	84	76	52	47	56	57	60	73	84	69	76	75	77	81	121	177	277	381	518	714	896
2016	424	0	0	0	0	1	0	5	16	26	53	59	39	23	51	64	96	147	221	268	253	222	150	106	56	36	39	67	85	104	130
2017	271	0	0	0	0	0	0	2	2	12	33	43	43	57	53	65	79	90	116	124	146	163	169	154	127	90	92	85	111	85	105

Table 2.1.3. Size compositions from the EBS "expanded" area (page 2 of 4).

Year	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
1987	249	183	206	177	156	174	206	199	265	299	300	298	292	287	233	234	237	141	144	119	105	132	124	87	113	81	124	120	111	114
1988	128	181	145	131	142	95	123	112	162	150	133	215	186	199	186	166	208	179	154	171	171	175	151	144	154	130	134	113	139	111
1989	30	14	45	47	61	49	53	42	49	48	57	76	69	74	79	72	84	107	97	109	103	98	140	123	91	99	89	124	80	94
1990	116	75	107	89	63	54	63	49	44	38	36	31	35	49	38	39	29	50	33	60	54	69	58	70	71	76	81	85	87	78
1991	296	240	250	187	166	137	114	82	67	61	58	49	59	50	60	72	47	59	40	70	85	56	73	40	35	40	41	33	50	47
1992	318	257	233	189	159	134	195	153	226	198	231	256	195	194	169	149	160	125	112	93	82	59	66	32	45	53	54	70	47	37
1993	319	241	247	228	198	154	162	187	185	223	223	236	273	208	187	194	160	152	130	115	120	109	89	64	67	80	67	57	58	53
1994	620	588	432	333	266	181	108	121	107	204	173	153	213	234	243	276	159	174	210	174	166	161	201	231	231	150	200	142	187	150
1995	212	166	231	264	255	338	401	397	443	449	419	364	356	313	211	202	163	151	123	105	116	101	93	99	91	78	99	105	112	107
1996	248	189	198	167	157	166	153	176	212	237	286	258	291	320	300	295	322	270	282	281	246	256	206	168	155	135	143	102	95	87
1997	224	177	160	157	139	148	138	129	129	140	138	172	198	234	153	174	138	155	184	190	167	172	126	218	174	177	135	134	109	115
1998	530	343	258	225	164	145	133	100	125	118	136	128	176	119	115	136	113	93	90	84	82	74	64	79	92	76	67	77	88	86
1999	207	199	209	270	353	326	417	472	530	573	571	480	365	375	287	214	183	161	144	128	109	113	87	93	89	83	64	106	79	91
2000	191	180	184	169	193	217	248	257	293	300	338	298	354	316	383	334	343	254	305	233	250	189	196	176	157	154	143	107	98	87
2001	881	773	671	493	398	289	213	183	170	148	154	180	223	273	221	258	248	228	257	265	254	228	216	226	185	205	181	146	193	129
2002	501	367	383	300	284	241	281	251	398	350	439	384	382	269	321	185	225	180	163	133	159	125	155	88	113	117	125	104	112	104
2003	292	200	297	225	256	273	301	340	329	369	439	409	441	405	375	276	274	231	247	259	201	186	171	146	125	142	136	111	96	71
2004	303	296	321	298	311	242	235	204	199	180	174	150	145	145	168	164	198	192	155	176	168	181	164	185	141	152	165	145	138	133
2005	203	199	212	235	294	258	215	208	216	218	227	176	225	181	203	140	179	132	154	137	144	119	115	105	105	106	123	90	127	91
2006	269	259	316	271	305	268	251	219	206	170	177	153	157	143	171	161	209	181	185	166	191	143	186	112	132	95	103	107	101	111
2007	128	118	97	97	78	65	78	81	85	71	92	84	91	89	86	64	83	77	94	73	75	65	66	58	59	57	70	58	67	55
2008	353	293	203	173	159	142	135	124	150	135	147	141	143	118	140	127	129	131	150	119	115	103	118	91	124	105	121	93	89	83
2009	309	223	217	216	228	304	308	366	382	383	350	340	282	293	250	183	148	148	119	105	95	85	76	79	87	91	72	85	79	54
2010	501	343	312	199	178	123	139	145	229	243	427	283	309	293	292	227	251	196	273	210	286	279	257	176	258	207	186	136	166	108
2011	152	216	211	253	266	374	423	624	739	796	854	811	730	588	474	326	328	260	245	175	217	209	246	172	258	224	279	214	274	176
2012	286	312	192	159	101	82	63	46	64	60	86	82	134	112	199	189	242	288	383	325	413	312	320	222	201	169	167	98	122	87
2013	298	230	173	167	139	120	178	147	224	286	351	420	510	398	378	354	319	260	252	194	203	134	187	142	212	191	232	192	209	206
2014	405	438	306	273	161	167	127	179	249	391	403	577	595	536	492	434	374	252	192	180	184	164	148	174	222	222	177	171	181	121
2015	1043	1101	975	928	757	570	492	283	265	199	373	369	495	468	465	422	450	317	349	344	315	334	385	335	431	330	300	217	244	157
2016	176	162	225	246	292	281	328	383	461	582	608	811	888	862	878	762	687	537	416	418	297	296	285	278	254	269	260	229	237	240
2017	107	116	120	148	136	144	155	171	153	180	223	183	234	218	226	263	310	282	331	334	386	412	380	370	324	254	239	229	185	217

Table 2.1.3. Size compositions from the EBS "expanded" area (page 3 of 4).

Year	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1987	111	118	110	116	118	97	104	82	54	80	46	51	49	21	40	31	33	38	25	26	27	29	7	8	13	9	9	11	5	10	9	1	5	5	3	1	1
1988	78	84	67	93	71	72	55	79	57	57	38	54	48	32	29	37	49	44	36	21	22	10	19	10	5	10	2	12	2	4	4	4	3	1	3	5	2
1989	103	77	72	105	92	58	85	45	79	87	70	69	62	49	63	46	27	23	36	26	33	36	18	27	18	6	18	12	8	10	12	13	8	4	8	5	4
1990	78	54	80	55	62	38	64	45	54	54	52	45	32	38	38	26	36	36	11	24	20	22	18	13	12	18	12	5	4	4	6	11	9	2	1	1	4
1991	41	25	43	40	48	45	47	33	31	25	41	32	27	13	16	19	21	33	23	22	13	13	8	14	7	7	6	5	6	4	1	6	7	3	2	3	0
1992	27	32	32	50	38	35	26	16	24	26	22	19	27	16	19	26	30	15	19	16	12	14	15	7	10	8	13	6	7	7	5	7	8	3	9	2	4
1993	36	66	37	37	61	29	29	15	15	16	15	17	12	12	11	12	13	11	9	5	12	10	4	7	8	8	4	3	4	7	3	7	5	5	4	4	1
1994	165	146	118	77	122	56	94	45	61	28	37	18	28	12	20	9	8	9	12	5	8	7	8	6	3	6	32	12	9	2	1	3	6	4	1	1	2
1995	94	75	57	65	76	75	73	54	58	48	38	30	24	39	22	26	23	21	19	13	14	11	8	8	8	8	5	12	4	4	4	10	1	3	2	3	5
1996	81	58	61	62	58	57	48	57	64	34	47	37	27	29	35	23	21	24	25	15	26	10	14	22	17	9	4	3	7	10	3	5	5	3	3	2	4
1997	125	105	104	96	88	72	60	63	56	31	22	31	24	29	19	12	10	10	12	19	12	10	8	9	9	4	3	9	7	2	6	3	2	4	0	1	2
1998	74	66	98	57	64	50	47	56	56	40	53	29	36	21	21	24	12	17	9	16	11	8	10	8	4	4	5	5	9	3	6	3	1	2	2	0	1
1999	75	87	56	62	46	55	61	44	44	45	33	26	24	21	22	24	21	17	12	15	13	10	10	15	14	5	14	5	4	5	5	2	5	5	6	3	2
2000	82	53	62	57	50	34	48	32	37	30	33	28	22	12	14	21	21	12	17	18	8	9	5	8	26	6	7	7	4	4	10	2	7	5	3	1	0
2001	151	145	103	79	102	65	74	54	49	32	37	24	19	26	19	30	17	16	12	11	13	5	10	6	6	5	7	4	4	2	4	5	1	2	0	5	1
2002	99	57	105	70	64	65	58	45	35	35	32	23	30	23	13	10	19	13	6	6	3	7	2	3	5	1	2	3	5	5	1	3	2	3	6	1	1
2003	94	67	69	69	65	67	72	47	53	41	41	36	33	26	27	16	18	20	20	11	14	7	9	5	6	5	4	4	3	2	2	0	1	1	0	0	0
2004	118	101	96	87	105	82	62	70	60	61	33	49	45	41	43	30	26	23	22	15	22	10	25	12	18	15	12	6	4	7	4	4	4	4	3	2	0
2005	134	115	117	112	112	86	93	80	76	62	87	54	77	59	67	52	48	44	41	33	26	18	28	21	24	14	10	15	10	8	4	9	5	3	4	0	4
2006	96	90	104	64	101	52	72	63	61	68	71	57	63	46	59	46	59	53	53	38	45	39	36	20	35	16	24	16	18	10	10	6	12	9	1	7	5
2007	56	50	51	34	46	45	34	25	35	25	39	23	21	15	13	19	17	20	11	12	9	28	12	9	10	15	10	14	10	3	8	4	6	2	3	3	3
2008	106	64	81	67	86	48	59	35	48	25	46	19	28	24	25	13	17	12	19	15	13	9	20	11	10	8	16	5	10	10	10	9	3	8	9	2	4
2009	66	73	54	41	50	33	41	32	21	25	14	18	16	16	16	5	13	7	9	4	4	7	6	6	3	4	5	1	1	1	2	3	5	2	3	1	2
2010	123	75	79	55	41	31	37	32	17	12	13	15	19	5	13	4	3	8	4	4	1	6	8	0	4	1	4	2	1	4	1	0	3	2	1	3	2
2011	233	161	190	141	151	109	119	59	73	48	46	26	26	22	15	13	17	6	15	10	7	3	3	5	5	3	1	5	3	4	7	2	1	0	1	0	2
2012	104	78	80	63	67	47	74	38	48	24	29	21	20	19	18	6	11	5	7	6	6	4	4	4	1	1	2	2	1	3	3	2	1	0	1	2	1
2013	227	210	189	160	141	132	105	104	90	49	62	44	30	42	28	30	9	29	12	23	11	10	7	7	5	3	5	3	4	5	1	2	0	1	0	1	1
2014	124	97	95	55	56	47	59	50	47	58	44	39	36	26	25	18	15	15	7	7	7	3	4	5	3	1	6	2	3	2	0	0	3	1	2	0	1
2015	165	112	107	113	97	81	66	62	62	57	46	54	43	36	24	24	20	24	15	7	12	7	17	10	6	3	4	1	2	2	0	2	1	1	1	2	1
2016	215	227	251	195	180	164	171	144	95	87	69	50	47	48	37	26	24	36	16	19	22	16	10	9	7	8	5	6	5	3	2	3	2	2	2	0	1
2017	170	150	132	132	121	141	126	92	78	106	74	84	79	71	58	60	59	18	35	30	20	11	9	13	10	15	3	7	7	3	5	5	0	4	1	0	0

Table 2.1.3. Size compositions from the EBS "expanded" area (page 4 of 4).

Year	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120+
1987	2	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	0	2	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
1989	9	0	9	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	5	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	5	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	3	3	3	3	1	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0
1993	2	2	1	9	2	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
1994	9	5	3	1	6	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0
1995	1	3	1	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
1996	1	2	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	1	2	0	0	0	0	3	0	0	0	0	1	0	0	0	0	0	0
1998	1	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	1	0	2	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	1	0	2	1	3	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2002	0	0	1	0	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
2003	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	1	0	5	0	1	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0
2005	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	3	2	3	2	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0
2007	2	8	1	2	1	2	0	1	0	0	0	1	0	0	0	0	0	0	0	0
2008	3	7	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2009	1	1	0	1	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2010	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2011	1	1	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2016	3	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.1.4. NBS survey size compositions.

Year	N	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
2010	39	0	1.03	0	0	0	0	2.97	3.89	4.06	13.6	12.6	11.7	1.97	4.91	0.98	0
2017	561	0	0	0	0	0	0	0	0	0	0.85	10.4	5.31	11.9	9.83	4.7	6.47

Year	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
2010	0	5.68	2.73	1.9	5.91	5.67	1.03	7.31	4.87	6.04	8.73	2.21	2.02	2	1.03	0.98	0
2017	6.48	7.36	7.52	11	25.1	14.8	26.8	36	51.3	50.6	71.9	71.1	82.5	67.8	70.1	41.2	37.6

Year	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
2010	0.99	0.94	0	1.04	0.87	0	0	0.99	0	0	0.91	0	0	0	0.89	0	0
2017	35.2	30	17.2	23.6	20.1	29.5	31.2	41	51.7	53	45.7	50.3	57.5	80.8	89.2	99.4	101

Year	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70
2010	0	1	0	0	0	0	0.98	0.95	2	3.79	3.66	4.56	3.72	1.93	4.77	1.77	2.9
2017	105	126	179	149	144	147	136	126	127	125	109	96.8	71.2	87.5	71.3	54	63.1

Year	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87
2010	3.66	3.62	12.9	7.57	3.88	9.15	8.34	6.44	4.63	8.35	4.91	9.03	6.63	2.74	7.25	2.82	0.88
2017	45	58.7	37.9	38.8	33.5	20.9	23.8	13.8	19.2	16.4	13.7	9.69	9.44	5.08	3.23	2.53	1.9

Year	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104
2010	2.04	1.95	0	1.96	2.86	0	0	0	0	0	0	0	0	0	0	0	0
2017	2.6	4.23	3.66	0	0	2.73	0	2.09	0	0	0	0	0	0.89	0	0	0

Year	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
2010	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.1.5. Environmental variable time series (as z-scores). See text for definitions.

Year	NPI	bnthc_frgr	fr_sl_pps	IRI	plgc_frgr	trwl_mpct	ephsd	apx_prd	mtl_epfn	brd_brdng	fsh_cndtn	bttm_tmp	pllck_1
1977	-1.104		1.479										
1978	-0.865		1.733										
1979	0.943		1.708										
1980	-0.333		0.810	-0.507									
1981	-1.779		0.290										
1982	0.965	0.905	0.805	-0.392	-0.743			0.153	0.067			-0.275	-0.412
1983	-2.214	0.607	0.002	-1.150	0.367			1.500	-0.582			0.628	1.936
1984	-0.959	0.412	0.159	-0.147	-0.263			0.280	-1.107		-1.496	-0.199	-0.591
1985	0.700	-1.895	0.350	-0.176	-0.754			0.666	-2.708			-0.157	0.800
1986	-1.620	-1.907	0.039	-0.286	-0.048			1.160	-2.350			-0.766	-0.597
1987	-1.098	-0.508	0.123		-0.395			0.083	-0.544			0.864	-1.052
1988	-0.134	-0.066	0.776	-0.052	1.223			-0.064	0.077			-0.169	-1.183
1989	1.473	-0.310	0.122	-1.027	0.451			-0.425	0.095			0.564	-0.816
1990	1.100	-0.238	0.757	-0.791	1.081			-0.531	0.594			-0.060	1.776
1991	1.251	0.208		-1.076	0.127			-1.408	0.162			0.238	0.166
1992	-0.881	0.498	0.354	0.591	0.269			-1.044	-0.390			-0.580	-0.043
1993	0.142	0.703			3.087			-0.106	-0.340		1.186	0.670	1.595
1994	0.856	2.573	0.560	-0.697	0.694			2.959	-0.502			-1.110	-0.516
1995	0.057	0.165		0.558	1.248			1.152	-0.210			-0.904	-0.853
1996	-0.295	0.233	0.092		-0.790			0.888	-0.609	-0.660		1.108	-0.013
1997	0.105	1.463		-0.020	0.502			-0.404	-0.145	-0.554		0.292	0.561
1998	-1.316	0.401	0.284	-1.091	-1.258			-0.926	-0.612	-1.065	1.833	0.930	-0.525
1999	0.450	-2.190		0.479	-1.065			-1.398	-1.130	-0.150	-1.404	-2.001	-0.445
2000	0.005	-1.279	-0.151		-0.253			-1.296	-0.911	1.301	0.068	-0.408	0.184
2001	-0.601	-0.487			-0.765			0.061	-0.424	0.524	0.380	0.092	0.834
2002	0.339	-0.641	-0.429		-0.275			-1.076	-0.607	0.955	0.385	0.898	0.041
2003	-1.499	-0.070			1.834	0.834		-0.414	-0.068	0.334	1.916	1.574	-0.584
2004	0.058	0.774	-0.917	-1.143	-0.040	0.924	-0.967	-0.336	0.058	0.114	1.361	1.064	-1.126
2005	-0.126	1.480			0.001	0.733		0.139	1.001	-1.108	0.574	1.168	-1.254
2006	0.745	0.971	-1.192	-1.135	-1.194	0.729	-0.155	-0.356	1.064	-0.440	0.103	-0.747	-0.758
2007	0.620	0.267		0.485	-0.900	1.062	0.658	-1.052	0.554	-0.124	0.263	-0.852	0.191
2008	0.387	0.215	-1.347	1.510	-1.251	1.152	0.901	-1.234	-0.098	0.764	-0.180	-1.447	-0.612
2009	2.240	-1.119		1.523	-1.670	0.389	1.586	-1.572	-0.257	0.791	-0.838	-1.335	2.142
2010	-0.865	0.643	-1.540	2.003	-0.417	-0.288	0.674	0.672	0.740	1.070	-0.166	-1.159	-0.085
2011	1.201	0.665		-0.034	-0.747	-0.493		0.789	1.101	-0.030	-0.027	-0.037	-0.697
2012	0.841	-0.350	-1.472	2.342	-0.231	-0.998	-0.475	0.215	1.328	0.702	-1.503	-1.786	-0.816
2013	0.836	-0.380		0.737	0.417	-1.300		-0.067	1.226	0.956	-0.236	-0.749	2.584
2014	0.610	0.176	-1.580		1.153	-1.366	-0.851	1.226	0.738	1.288	-0.287	0.869	1.178
2015	-0.255	-1.676			1.441			1.192	1.274	-0.532	-1.397	1.036	-0.387
2016	-0.822	-0.232	-1.817		-0.353	-1.379	-1.370	0.948	1.708	-2.517	0.252	2.347	-0.319
2017	0.841	-0.010		-0.503	-0.483			-0.376	1.807	-1.618	-0.788	0.400	-0.303

Table 2.1.6. Structural differences between models.

	EBS survey area	EBS survey area	Growth covariates	Growth covariates	Time-vary *Q*, w/o NBS	Time-vary *Q*, w/o NBS	Time-vary *Q*, with NBS	Time-vary *Q*, with NBS	Previous models	Previous models	Migration	Migration	*M* covariates	*M* covariates	Omnibus
Feature	16.6a	16.6b	16.6c	16.6d	16.6e	16.6f	16.6g	16.6h	17.2	17.6	18.1	18.2	18.3	18.4	18.5
Separate *Q* for EBS survey 1982-1986		x													
K linked to environmental covariate			x												
Lmin linked to environmental covariate				x											
Randomly time-varying EBS *Q*					x		x			x					
EBS *Q* linked to environmental covariate						x		x							x
NBS *Q* and selectivity estimated							x	x							x
Randomly time-varying NBS *Q*							x	x							
Adjust timing of fishery and survey									x	x					
Prior distribution for *M*									x	x					
Flat-topped double normal selectivity									x	x					
Randomly time-varying fishery selex									x	x					
Harmonic mean composition weighting									x	x					
Randomly time-varying survey selex										x					
Randomly time-varying *Lmin*										x					
EBS-NBS migration											x	x			x
Randomly time-varying migration											x				x
Migration linked to environ. covariate												x			
M linked to environmental covariate													x	x	x
Age-varying *M*														x	x
Block-specific steepness estimated															x

Table 2.1.7. Data structures used in the models. Environmental variables 1-3 are constant across models (#1 indexes the 1977 regime shift, and #2 and #3 are year-specific weight-at-length parameters).

			EBS survey							
Category	Model	Comp. N	1982-1986	1987-2017	Fishery ages	NBS	Areas	Env. var. 4	Env. var. 5	Env. var. 6
Base model	16.6	mean=300	yes	standard	no	no	1	n/a	n/a	n/a
EBS survey area	16.6a	mean=300	no	expanded	no	no	1	n/a	n/a	n/a
EBS survey area	16.6b	mean=300	yes	expanded	no	no	1	n/a	n/a	n/a
K covariates	16.6c	mean=300	yes	standard	no	no	1	fsh_cndtn	n/a	n/a
K covariates	16.6d	mean=300	yes	standard	no	no	1	bttm_tmp	n/a	n/a
Time-vary *Q*, w/o NBS	16.6e	mean=300	yes	standard	no	no	1	n/a	n/a	n/a
Time-vary *Q*, w/o NBS	16.6f	mean=300	yes	standard	no	no	1	NPI	n/a	n/a
Time-vary *Q*, with NBS	16.6g	mean=300	yes	standard	no	yes	1	n/a	n/a	n/a
Time-vary *Q*, with NBS	16.6h	mean=300	yes	standard	no	yes	1	NPI	n/a	n/a
Previous models	17.2	no. hauls	yes	standard	yes	no	1	n/a	n/a	n/a
Previous models	17.6	no. hauls	yes	standard	yes	no	1	n/a	n/a	n/a
Migration	18.1	mean=300	yes	standard	no	yes	2	n/a	n/a	n/a
Migration	18.2	mean=300	yes	standard	no	yes	2	NPI	bnthc_frgr	brd_brdng
M covariates	18.3	mean=300	yes	standard	no	no	1	fsh_cndtn	n/a	n/a
M covariates	18.4	mean=300	yes	standard	no	no	1	ntrtn_dfct	n/a	n/a
Omnibus	18.5	mean=300	yes	standard	no	yes	2	NPI	ntrtn_dfct	n/a

Table 2.1.8. Development of the placeholder nutrition deficit index.

Year	Z-scores			Average of euphausiids and age 1 pollock	Re-normalized average prey	Bottom temp. minus average prey	Re-normalized difference
	Bottom temp.	Euphausiids	Age 1 pollock				
1982	-0.275		-0.412	-0.412	-0.432	0.157	0.102
1983	0.628		1.936	1.936	2.015	-1.388	-0.903
1984	-0.199		-0.591	-0.591	-0.619	0.420	0.273
1985	-0.157		0.800	0.800	0.831	-0.988	-0.643
1986	-0.766		-0.597	-0.597	-0.625	-0.141	-0.091
1987	0.864		-1.052	-1.052	-1.099	1.963	1.277
1988	-0.169		-1.183	-1.183	-1.236	1.067	0.694
1989	0.564		-0.816	-0.816	-0.854	1.417	0.922
1990	-0.060		1.776	1.776	1.848	-1.908	-1.241
1991	0.238		0.166	0.166	0.170	0.069	0.045
1992	-0.580		-0.043	-0.043	-0.048	-0.532	-0.346
1993	0.670		1.595	1.595	1.660	-0.989	-0.643
1994	-1.110		-0.516	-0.516	-0.541	-0.569	-0.370
1995	-0.904		-0.853	-0.853	-0.892	-0.012	-0.008
1996	1.108		-0.013	-0.013	-0.017	1.125	0.732
1997	0.292		0.561	0.561	0.581	-0.289	-0.188
1998	0.930		-0.525	-0.525	-0.550	1.480	0.963
1999	-2.001		-0.445	-0.445	-0.467	-1.534	-0.998
2000	-0.408		0.184	0.184	0.188	-0.596	-0.388
2001	0.092		0.834	0.834	0.866	-0.774	-0.504
2002	0.898		0.041	0.041	0.040	0.858	0.558
2003	1.574		-0.584	-0.584	-0.612	2.186	1.422
2004	1.064	-0.967	-1.126	-1.046	-1.094	2.158	1.404
2005	1.168		-1.254	-1.254	-1.310	2.478	1.612
2006	-0.747	-0.155	-0.758	-0.456	-0.479	-0.269	-0.175
2007	-0.852	0.658	0.191	0.424	0.439	-1.292	-0.840
2008	-1.447	0.901	-0.612	0.145	0.148	-1.595	-1.037
2009	-1.335	1.586	2.142	1.864	1.940	-3.275	-2.130
2010	-1.159	0.674	-0.085	0.294	0.304	-1.463	-0.951
2011	-0.037		-0.697	-0.697	-0.729	0.692	0.450
2012	-1.786	-0.475	-0.816	-0.645	-0.676	-1.110	-0.722
2013	-0.749		2.584	2.584	2.691	-3.440	-2.237
2014	0.869	-0.851	1.178	0.163	0.167	0.702	0.456
2015	1.036		-0.387	-0.387	-0.406	1.442	0.938
2016	2.347	-1.370	-0.319	-0.845	-0.883	3.231	2.101
2017	0.400		-0.303	-0.303	-0.319	0.719	0.468

Table 2.1.9. Evaluation of alternative nutrition deficit indices.

Color coding for positive and negative correlations

Type	Index	1	2	3	4	5	6	7	8	9	10	11	12	13
Population	Placeholder	0.118	-0.030	0.573	0.350	-0.004	-0.105	0.082	-0.022	0.204	-0.094	0.189	-0.360	0.049
Population	consumedG	-0.118	0.124	0.472	0.041	0.022	-0.081	-0.025	0.002	0.008	-0.331	-0.309	0.052	-0.379
Population	meanPreyED	-0.091	-0.087	0.078	-0.113	-0.315	-0.086	-0.576	-0.016	0.198	-0.047	-0.131	0.001	0.153
Population	RFR	0.006	0.145	0.410	-0.060	0.140	-0.027	-0.023	-0.003	-0.078	-0.265	-0.452	0.094	-0.489
Population	Cmax	-0.215	0.006	-0.136	0.206	-0.137	-0.095	0.023	-0.112	0.176	-0.117	0.287	-0.225	0.276
Population	maxG	-0.142	0.081	-0.016	0.110	-0.211	-0.181	-0.272	-0.285	0.241	-0.248	0.178	-0.372	0.275
Population	Gpotential	0.004	0.129	0.435	-0.051	-0.108	-0.104	-0.226	-0.157	0.159	-0.182	-0.170	-0.085	-0.062
Age-specific	consumedG	-0.236	0.351	-0.044	-0.147	0.154	0.173	0.188	0.172	0.011	-0.159	-0.381	-0.247	-0.070
Age-specific	meanPreyED	0.090	0.167	-0.147	0.020	0.136	0.245	0.167	0.353	0.171	0.257	-0.318	0.042	0.154
Age-specific	RFR	-0.168	0.354	-0.060	-0.203	0.193	0.220	0.167	0.177	0.013	-0.102	-0.436	-0.251	-0.011
Age-specific	Cmax	-0.019	0.177	-0.191	0.111	0.189	0.245	0.311	0.346	0.150	0.241	-0.184	-0.084	0.052
Age-specific	maxG	-0.158	0.068	-0.204	0.087	0.038	0.112	0.072	0.187	0.127	0.063	-0.196	-0.015	-0.016
Age-specific	Gpotential	-0.081	0.141	-0.347	-0.038	0.008	0.097	0.083	0.085	0.002	-0.160	-0.277	-0.219	0.031

Color coding for within-age performance

Type	Index	1	2	3	4	5	6	7	8	9	10	11	12	13
Population	Placeholder	0.118	-0.030	0.573	0.350	-0.004	-0.105	0.082	-0.022	0.204	-0.094	0.189	-0.360	0.049
Population	consumedG	-0.118	0.124	0.472	0.041	0.022	-0.081	-0.025	0.002	0.008	-0.331	-0.309	0.052	-0.379
Population	meanPreyED	-0.091	-0.087	0.078	-0.113	-0.315	-0.086	-0.576	-0.016	0.198	-0.047	-0.131	0.001	0.153
Population	RFR	0.006	0.145	0.410	-0.060	0.140	-0.027	-0.023	-0.003	-0.078	-0.265	-0.452	0.094	-0.489
Population	Cmax	-0.215	0.006	-0.136	0.206	-0.137	-0.095	0.023	-0.112	0.176	-0.117	0.287	-0.225	0.276
Population	maxG	-0.142	0.081	-0.016	0.110	-0.211	-0.181	-0.272	-0.285	0.241	-0.248	0.178	-0.372	0.275
Population	Gpotential	0.004	0.129	0.435	-0.051	-0.108	-0.104	-0.226	-0.157	0.159	-0.182	-0.170	-0.085	-0.062
Age-specific	consumedG	-0.236	0.351	-0.044	-0.147	0.154	0.173	0.188	0.172	0.011	-0.159	-0.381	-0.247	-0.070
Age-specific	meanPreyED	0.090	0.167	-0.147	0.020	0.136	0.245	0.167	0.353	0.171	0.257	-0.318	0.042	0.154
Age-specific	RFR	-0.168	0.354	-0.060	-0.203	0.193	0.220	0.167	0.177	0.013	-0.102	-0.436	-0.251	-0.011
Age-specific	Cmax	-0.019	0.177	-0.191	0.111	0.189	0.245	0.311	0.346	0.150	0.241	-0.184	-0.084	0.052
Age-specific	maxG	-0.158	0.068	-0.204	0.087	0.038	0.112	0.072	0.187	0.127	0.063	-0.196	-0.015	-0.016
Age-specific	Gpotential	-0.081	0.141	-0.347	-0.038	0.008	0.097	0.083	0.085	0.002	-0.160	-0.277	-0.219	0.031

Table 2.1.10. Overview of major results.

Dimensions	16.6	16.6a	16.6b	16.6c	16.6d	16.6e	16.6f	16.6g	16.6h	17.2	17.6	18.1	18.2	18.3	18.4	18.5
EBS exp. area data used?	no	yes	yes	no	no	no	no	no	no	no	no	no	no	no	no	no
NBS data used?	no	no	no	no	no	no	no	yes	yes	no	no	yes	yes	no	no	yes
Separate area for NBS?	no	no	no	no	no	no	no	no	no	no	no	yes	yes	no	no	yes
Diagnostics	16.6	16.6a	16.6b	16.6c	16.6d	16.6e	16.6f	16.6g	16.6h	17.2	17.6	18.1	18.2	18.3	18.4	18.5
ADSB	n/a	0.102	0.098	0.070	0.043	0.034	0.065	0.031	0.054	0.117	0.174	1.076	0.595	0.185	0.145	1.106
Mohn's ρ	0.243	0.202	0.217	0.304	0.222	0.323	0.291	0.359	0.319	0.309	0.069	0.452	0.370	0.118	0.451	0.724
Base values	16.6	16.6a	16.6b	16.6c	16.6d	16.6e	16.6f	16.6g	16.6h	17.2	17.6	18.1	18.2	18.3	18.4	18.5
Natural mortality rate	0.359	0.348	0.347	0.354	0.363	0.361	0.354	0.353	0.348	0.374	0.312	0.305	0.331	0.349	0.381	0.294
EBS std. area catchability	0.929		0.995	0.943	0.913	0.917	0.952	0.954	0.980	1.043	1.200	1.240	1.074	1.008	0.816	1.286
EBS exp. area catchability		0.994	0.990													
NBS catchability								0.058	0.060			0.457	1.030			0.526
Unfished equil. sp. biom.	629	645	645	637	627	631	638	640	645	604	703	753	684	626	619	484
2019 quantities	16.6	16.6a	16.6b	16.6c	16.6d	16.6e	16.6f	16.6g	16.6h	17.2	17.6	18.1	18.2	18.3	18.4	18.5
Depletion	0.424	0.392	0.401	0.418	0.431	0.443	0.424	0.448	0.428	0.356	0.208	0.529	0.481	0.327	0.461	0.741
EBS spawning biomass												199	239			188
NBS spawning biomass												199	90			170
Spawning biomass	267	253	259	266	270	279	270	287	276	215	147	399	329	205	285	358
EBS age 0+ biomass												589	690			541
NBS age 0+ biomass												483	220			409
Age 0+ biomass	775	731	746	774	797	810	781	813	782	657	488	1,072	910	614	835	950
OFL	209	186	196	206	214	220	209	220	208	155	53	197	212	133	237	179
maxABC	175	156	165	173	180	185	175	185	175	130	45	170	180	111	199	154

Table 2.1.11. Negative log likelihoods and parameter counts (p. 1 of 2).

Aggregated components

Component	M16.6	M16.6a	M16.6b	M16.6c	M16.6d	M16.6e	M16.6f	M16.6g
Equil. catch	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Survey indices	-23.31	-12.75	-22.82	-22.03	-22.87	-67.01	-28.12	-70.73
Sizecomps	1407.14	1264.39	1393.55	1394.61	1374.57	1408.18	1407.07	1514.86
Agecomps	293.08	285.75	285.77	290.24	296.43	290.40	292.65	294.04
Recruitment	5.14	-6.14	-3.23	-3.05	-4.03	-3.42	-2.97	-1.80
Initial recruitment		8.49	8.86	8.24	7.82	7.61	8.33	7.93
Priors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
"Softbounds"	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Parameter devs	0.00	0.00	0.00	0.00	0.00	-68.21	0.00	-64.95
Total	1682.06	1539.75	1662.14	1668.02	1651.92	1567.57	1676.97	1679.36

Survey index breakdown

Sub-component	M16.6	M16.6a	M16.6b	M16.6c	M16.6d	M16.6e	M16.6f	M16.6g
EBS std. index	-23.31		-10.12	-22.03	-22.87	-67.01	-28.12	-67.86
EBS exp. index		-12.75	-12.70					
NBS index								-2.86
Total	-23.31	-12.75	-22.82	-22.03	-22.87	-67.01	-28.12	-70.73

Sizecomp breakdown

Sub-component	M16.6	M16.6a	M16.6b	M16.6c	M16.6d	M16.6e	M16.6f	M16.6g
Fish. sizecomp	376.60	361.11	373.84	372.51	384.99	376.48	375.62	370.43
EBS std. sizecomp	1030.55		128.22	1022.10	989.57	1031.70	1031.45	1038.32
EBS exp. sizecomp		903.27	891.49					
NBS sizecomp								106.11
Total	1407.14	1264.39	1393.55	1394.61	1374.57	1408.18	1407.07	1514.86

Agecomp breakdown

Sub-component	M16.6	M16.6a	M16.6b	M16.6c	M16.6d	M16.6e	M16.6f	M16.6g
Fish. agecomp								
EBS std. agecomp	293.08			290.24	296.43	290.40	292.65	294.04
EBS exp. agecomp		285.75	285.77					
Total	293.08	285.75	285.77	290.24	296.43	290.40	292.65	294.04

Parameter counts

Type	M16.6	M16.6a	M16.6b	M16.6c	M16.6d	M16.6e	M16.6f	M16.6g
Parameter devs	60	60	60	60	60	96	60	104
Parms with priors								
Unconstrained parms	18	18	19	19	19	18	19	21
Total	78	78	79	79	79	114	79	125

Table 2.1.11. Negative log likelihoods and parameter counts (p. 2 of 2).

Aggregated components

Component	M16.6h	M17.2	M17.6	M18.1	M18.2	M18.3	M18.4	M18.5
Equil. catch	0.00	0.02	0.05	0.00	0.00	0.01	0.00	0.00
Survey indices	-32.52	-8.13	-64.60	-33.70	-24.74	-14.51	-25.35	-37.01
Sizecomps	1513.45	1481.27	1356.05	1443.81	1451.84	1400.21	1400.45	1438.15
Agecomps	296.32	81.65	89.96	288.84	288.66	275.25	300.69	292.20
Recruitment	-1.28	-9.29	-6.76	-1.42	-1.28	-1.23	-2.31	-15.25
Initial recruitment	8.41	14.70	9.93	4.65	6.27	8.26	5.74	3.66
Priors	0.00	0.21	0.51	0.00	0.00	0.00	0.00	0.00
"Softbounds"	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01
Parameter devs	3.11	-92.18	-400.01	0.67	0.00	0.00	0.00	-0.37
Total	1787.49	1468.26	985.12	1702.85	1720.77	1667.99	1679.22	1681.39

Survey ndex breakdown

Sub-component	M16.6h	M17.2	M17.6	M18.1	M18.2	M18.3	M18.4	M18.5
EBS std. index	-29.66	-8.13	-64.60	-30.84	-21.12	-14.51	-25.35	-34.15
EBS exp. index								
NBS index	-2.85			-2.86	-3.62			-2.86
Total	-32.52	-8.13	-64.60	-33.70	-24.74	-14.51	-25.35	-37.01

Sizecomp breakdown

Sub-component	M16.6h	M17.2	M17.6	M18.1	M18.2	M18.3	M18.4	M18.5
Fish. sizecomp	369.98	459.54	314.05	369.96	372.40	374.56	373.43	363.72
EBS std. sizecomp	1038.35	1021.73	1041.99	1012.42	1019.96	1025.65	1027.02	1012.30
EBS exp. sizecomp								
NBS sizecomp	105.11			61.43	59.48			62.13
Total	1513.45	1481.27	1356.05	1443.81	1451.84	1400.21	1400.45	1438.15

Agecomp breakdown

Sub-component	M16.6h	M17.2	M17.6	M18.1	M18.2	M18.3	M18.4	M18.5
Fish. agecomp		27.35	27.16					
EBS std. agecomp	296.32	54.30	62.80	288.84	288.66	275.25	300.69	292.20
EBS exp. agecomp								
Total	296.32	81.65	89.96	288.84	288.66	275.25	300.69	292.20

Parameter counts

Type	M16.6h	M17.2	M17.6	M18.1	M18.2	M18.3	M18.4	M18.5
Parameter devs	68	142	286	90	60	60	60	90
Parms with priors		1	1					
Unconstrained parms	22	16	17	24	27	19	20	43
Total	90	159	304	114	87	79	80	133

Table 2.1.12a. Fit to survey indices, measured in terms of negative log likelihood.

	Obs.	Negative log likelihood															
Year	abund.	16.6	16.6a	16.6b	16.6c	16.6d	16.6e	16.6f	16.6g	16.6h	17.2	17.6	18.1	18.2	18.3	18.4	18.5
1982	583781	-2.448		-2.543	-2.543	-2.409	-2.680	-2.731	-2.708	-2.701	-2.625	-2.513	-0.263	-1.599	-2.552	-1.692	-1.459
1983	752456	-1.825		-1.776	-1.776	-1.851	-2.160	-2.226	-2.126	-2.234	-1.714	-1.529	-2.101	-1.961	-1.790	-2.103	-2.228
1984	651058	-2.183		-2.261	-2.261	-2.146	-2.548	-1.485	-2.580	-1.687	-2.235	-2.554	-2.214	-2.263	-2.213	-1.271	-1.894
1985	841108	-1.597		-1.565	-1.565	-1.609	-1.874	-1.260	-1.848	-1.194	-1.491	-1.860	-1.539	-1.525	-1.622	-1.856	-1.525
1986	838217	-1.908		-1.862	-1.862	-1.883	-2.227	-2.299	-2.212	-2.293	-1.851	-1.910	-1.839	-1.825	-1.968	-2.234	-2.206
1987	677054	-2.322	-1.821	-2.287	-2.287	-2.280	-2.710	-2.733	-2.709	-2.732	-2.733	-2.732	-2.090	-2.169	-2.473	-2.587	-2.535
1988	507560	-2.429	-2.463	-2.438	-2.438	-2.404	-2.648	-2.518	-2.649	-2.534	-2.370	-2.593	-2.340	-2.316	-2.552	-2.365	-2.356
1989	292247	6.943	8.391	7.322	7.322	6.554	-1.537	3.176	-1.590	3.253	16.256	-1.512	5.150	5.430	7.964	4.946	3.011
1990	423835	-1.175	-1.145	-1.041	-1.041	-1.234	-2.136	-1.846	-2.174	-1.919	-0.457	-2.179	-2.066	-1.830	-0.992	-1.650	-2.309
1991	488892	-0.189	-0.132	-0.064	-0.064	-0.239	-1.637	-1.139	-1.707	-1.243	-0.397	-1.942	-0.996	-0.805	-0.092	-0.528	-1.497
1992	577560	-2.052	-2.047	-2.018	-2.018	-2.055	-2.102	-1.758	-2.110	-1.796	-2.085	-1.582	-2.096	-2.096	-2.041	-2.097	-2.061
1993	810608	-1.383	-1.552	-1.518	-1.518	-1.402	-1.844	-1.390	-1.839	-1.355	-0.967	-2.102	-1.534	-1.396	-1.324	-1.334	-1.576
1994	1E+06	7.256	7.531	6.687	6.687	7.372	1.323	8.673	1.262	8.788	9.380	2.525	6.995	7.265	7.816	6.914	7.081
1995	757910	0.167	-0.184	-0.273	-0.273	0.358	-1.695	0.079	-1.711	0.107	1.697	-1.634	-0.280	0.083	0.785	-0.020	-0.616
1996	607198	-1.128	-1.199	-1.373	-1.373	-1.010	-1.565	-1.319	-1.567	-1.305	-0.352	-1.350	-1.436	-1.212	-0.717	-1.113	-1.550
1997	485643	-1.560	-1.501	-1.326	-1.326	-1.596	-1.743	-1.553	-1.762	-1.578	-1.930	-1.915	-1.542	-1.589	-1.880	-1.577	-1.526
1998	514339	-1.497	-1.397	-0.991	-0.991	-1.519	-2.185	-0.098	-2.215	-0.224	-2.225	-2.355	-1.458	-1.578	-2.029	-1.453	-1.012
1999	488337	-2.055	-2.301	-1.604	-1.604	-2.104	-2.291	-2.191	-2.300	-2.207	-1.598	-2.364	-1.962	-2.072	-2.325	-1.997	-1.933
2000	483808	-0.512	-0.017	0.635	0.635	-0.777	-1.990	-0.354	-2.010	-0.376	1.087	-1.707	-0.498	-0.627	-2.223	0.104	0.445
2001	960917	6.657	6.280	5.074	5.074	7.234	-0.338	5.043	-0.435	4.999	5.169	-1.174	7.655	7.270	14.386	4.645	4.649
2002	536342	-2.008	-1.937	-1.727	-1.727	-2.100	-2.229	-2.089	-2.221	-2.058	-1.941	-2.089	-2.138	-2.100	-2.049	-1.542	-1.692
2003	498873	-2.085	-2.113	-2.083	-2.083	-2.076	-2.086	-1.887	-2.087	-1.841	-2.085	-2.081	-2.080	-2.076	-1.705	-2.086	-1.969
2004	397948	-1.932	-1.715	-1.829	-1.829	-1.980	-2.361	-1.846	-2.334	-1.690	-1.721	-2.034	-2.215	-2.125	-2.074	-2.142	-2.108
2005	450705	-1.078	-1.102	-1.048	-1.048	-1.131	-1.563	-1.247	-1.645	-1.369	-1.305	-1.966	-0.758	-0.846	-1.444	-0.464	-0.573
2006	394024	-0.618	-0.569	-0.031	-0.031	-1.169	-2.647	0.327	-2.700	-0.292	-0.036	-2.702	-0.049	0.104	-2.397	2.722	2.429
2007	733402	-0.406	-0.413	-0.223	-0.223	-0.519	-0.644	-0.313	-0.670	-0.329	0.194	-1.313	-0.463	-0.384	-0.883	-0.007	-0.144
2008	476697	0.888	0.768	-0.026	-0.026	1.361	-1.369	0.706	-1.435	0.569	-0.459	-1.269	-0.595	2.562	4.762	-0.307	-1.240
2009	716637	-1.521	-1.246	-2.060	-2.060	-1.265	-2.241	-2.428	-2.281	-2.441	-2.175	-1.588	-2.329	-0.428	1.481	-2.049	-2.136
2010	887836	-1.837	-1.864	-1.562	-1.562	-1.888	-1.971	-2.016	-1.959	-2.002	-1.387	-1.774	-1.425	-1.975	-2.013	-1.702	-1.542
2011	836840	-1.590	-1.760	-0.971	-0.971	-1.698	-2.217	-0.847	-2.231	-0.848	-0.722	-2.309	-1.854	2.490	-2.363	-1.148	-1.536
2012	987973	-1.729	-1.904	-1.276	-1.276	-1.731	-2.262	-1.342	-2.285	-1.410	-0.657	-2.352	-2.056	-2.358	-2.363	-1.794	-2.103
2013	750889	-1.218	-1.212	-1.398	-1.398	-1.289	-1.443	-1.392	-1.380	-1.314	-1.422	-1.577	-0.420	-0.329	-0.893	-0.893	-0.281
2014	1E+06	-0.963	-1.080	-0.725	-0.725	-0.857	-1.712	-0.779	-1.827	-1.045	-0.659	-1.233	-2.025	-1.900	-1.302	-1.424	-2.050
2015	982470	-1.177	-1.253	-1.029	-1.029	-1.097	-1.914	-1.506	-1.997	-1.665	-0.805	-1.225	-2.159	-2.075	-0.856	-1.580	-2.159
2016	640359	-2.209	-2.077	-2.169	-2.169	-2.180	-2.335	-2.334	-2.343	-2.298	-2.104	-2.100	-1.450	-2.122	-1.609	-2.190	-1.541
2017	346693	1.415	0.284	1.343	1.343	1.752	-1.429	0.800	-1.476	0.601	0.594	-2.008	-2.371	-0.736	-0.961	0.519	-2.406
Sum		-23.306	-12.752	-22.033	-22.033	-22.866	-67.010	-28.121	-67.862	-29.661	-8.131	-64.602	-30.838	-21.115	-14.508	-25.354	-34.149

Table 2.1.12b. Fit to survey indices, measured in terms of negative log likelihood (after subtracting minimum for each row).

	Obs.	Negative log likelihood minus row minimum															
Year	abund.	16.6	16.6a	16.6b	16.6c	16.6d	16.6e	16.6f	16.6g	16.6h	17.2	17.6	18.1	18.2	18.3	18.4	18.5
1982	583781	0.283		0.188	0.188	0.322	0.051	0.000	0.023	0.030	0.106	0.217	2.468	1.132	0.179	1.039	1.272
1983	752456	0.409		0.458	0.458	0.383	0.074	0.009	0.108	0.000	0.520	0.705	0.133	0.273	0.444	0.131	0.006
1984	651058	0.398		0.320	0.320	0.434	0.032	1.095	0.000	0.894	0.346	0.026	0.367	0.317	0.367	1.310	0.687
1985	841108	0.278		0.310	0.310	0.265	0.000	0.614	0.027	0.680	0.384	0.014	0.335	0.350	0.252	0.019	0.349
1986	838217	0.391		0.437	0.437	0.416	0.072	0.000	0.087	0.006	0.448	0.389	0.460	0.474	0.331	0.065	0.093
1987	677054	0.411	0.912	0.446	0.446	0.453	0.023	0.000	0.024	0.001	0.000	0.001	0.643	0.564	0.260	0.146	0.198
1988	507560	0.220	0.186	0.212	0.212	0.245	0.001	0.131	0.000	0.115	0.279	0.057	0.310	0.334	0.097	0.284	0.293
1989	292247	8.533	9.981	8.911	8.911	8.143	0.053	4.766	0.000	4.843	17.846	0.078	6.740	7.020	9.553	6.535	4.600
1990	423835	1.134	1.164	1.269	1.269	1.075	0.173	0.464	0.135	0.390	1.852	0.130	0.243	0.479	1.318	0.659	0.000
1991	488892	1.753	1.811	1.878	1.878	1.703	0.305	0.803	0.235	0.699	1.545	0.000	0.946	1.137	1.850	1.414	0.445
1992	577560	0.058	0.063	0.092	0.092	0.055	0.008	0.352	0.000	0.314	0.025	0.528	0.014	0.014	0.069	0.013	0.049
1993	810608	0.719	0.549	0.583	0.583	0.700	0.257	0.712	0.263	0.747	1.134	0.000	0.568	0.706	0.778	0.768	0.525
1994	1E+06	5.994	6.269	5.425	5.425	6.110	0.061	7.411	0.000	7.526	8.118	1.262	5.732	6.003	6.554	5.652	5.819
1995	757910	1.878	1.527	1.438	1.438	2.069	0.016	1.790	0.000	1.818	3.408	0.078	1.431	1.794	2.497	1.691	1.095
1996	607198	0.439	0.368	0.195	0.195	0.557	0.003	0.248	0.000	0.262	1.215	0.218	0.131	0.355	0.851	0.454	0.017
1997	485643	0.371	0.429	0.604	0.604	0.335	0.187	0.377	0.168	0.352	0.000	0.016	0.388	0.341	0.050	0.353	0.404
1998	514339	0.858	0.958	1.364	1.364	0.836	0.170	2.257	0.140	2.131	0.130	0.000	0.897	0.777	0.326	0.902	1.343
1999	488337	0.308	0.062	0.760	0.760	0.260	0.073	0.172	0.064	0.157	0.765	0.000	0.402	0.292	0.039	0.367	0.430
2000	483808	1.712	2.206	2.858	2.858	1.446	0.234	1.869	0.213	1.847	3.310	0.516	1.725	1.596	0.000	2.328	2.668
2001	960917	7.832	7.454	6.249	6.249	8.409	0.836	6.217	0.739	6.174	6.343	0.000	8.829	8.444	15.560	5.820	5.824
2002	536342	0.221	0.292	0.502	0.502	0.128	0.000	0.140	0.008	0.171	0.288	0.140	0.091	0.129	0.180	0.687	0.537
2003	498873	0.029	0.000	0.031	0.031	0.038	0.027	0.227	0.026	0.272	0.028	0.032	0.033	0.037	0.408	0.028	0.144
2004	397948	0.429	0.646	0.532	0.532	0.381	0.000	0.515	0.027	0.672	0.640	0.328	0.146	0.236	0.288	0.219	0.253
2005	450705	0.888	0.864	0.918	0.918	0.835	0.403	0.719	0.321	0.597	0.661	0.000	1.208	1.120	0.522	1.502	1.393
2006	394024	2.083	2.132	2.671	2.671	1.533	0.055	3.029	0.002	2.410	2.666	0.000	2.653	2.805	0.305	5.424	5.131
2007	733402	0.908	0.900	1.090	1.090	0.795	0.670	1.000	0.644	0.984	1.507	0.000	0.850	0.929	0.431	1.306	1.169
2008	476697	2.323	2.204	1.409	1.409	2.797	0.067	2.142	0.000	2.005	0.976	0.166	0.841	3.997	6.198	1.128	0.195
2009	716637	0.921	1.196	0.381	0.381	1.176	0.200	0.014	0.161	0.000	0.267	0.853	0.113	2.013	3.923	0.393	0.305
2010	887836	0.180	0.152	0.455	0.455	0.128	0.046	0.000	0.057	0.015	0.629	0.243	0.592	0.041	0.003	0.315	0.474
2011	836840	0.773	0.603	1.392	1.392	0.665	0.146	1.516	0.132	1.515	1.641	0.054	0.509	4.853	0.000	1.215	0.827
2012	987973	0.635	0.459	1.087	1.087	0.633	0.101	1.022	0.078	0.954	1.706	0.012	0.307	0.006	0.000	0.569	0.261
2013	750889	0.358	0.365	0.179	0.179	0.288	0.133	0.184	0.197	0.263	0.155	0.000	1.157	1.247	0.684	0.684	1.295
2014	1E+06	1.087	0.970	1.325	1.325	1.193	0.338	1.271	0.223	1.005	1.391	0.817	0.025	0.149	0.748	0.626	0.000
2015	982470	0.982	0.907	1.131	1.131	1.062	0.245	0.654	0.162	0.494	1.354	0.934	0.001	0.084	1.303	0.580	0.000
2016	640359	0.134	0.266	0.174	0.174	0.163	0.009	0.010	0.000	0.045	0.240	0.243	0.893	0.222	0.734	0.153	0.803
2017	346693	3.821	2.690	3.749	3.749	4.158	0.977	3.207	0.931	3.008	3.000	0.398	0.035	1.670	1.445	2.926	0.000
0s:		0	1	0	0	0	3	3	9	2	2	9	0	0	3	0	4
Max:		8.533	9.981	8.911	8.911	8.409	0.977	7.411	0.931	7.526	17.846	1.262	8.829	8.444	15.560	6.535	5.824

Table 2.1.13. Effective sample sizes, input and output (p. 1 of 4).

Base model

				Model 16.6				
Type	Fleet	Yrs	N	Mult	N×Mult	Har	ΣNeff1	ΣNeff2
Size	Fish.	41	300	1.0000	300	582	12299	23850
Size	Std.	36	300	1.0000	300	308	10798	11086
Size	Exp.	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Size	NBS	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Age	Fish.	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Age	Std.	23	343	1.0000	343	61	7889	1395
Age	Exp.	n/a	n/a	n/a	n/a	n/a	n/a	n/a
					SEave	RMSE		
Index	Std.	36	341	n/a	0.1074	0.1886	12260	3978
Index	Exp.	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Index	NBS	n/a	n/a	n/a	n/a	n/a	n/a	n/a
						Sum:	43246	40309

Minor change models that use data from the expanded EBS survey area

				Model 16.6a				
Type	Fleet	Yrs	N	Mult	N×Mult	Har	ΣNeff1	ΣNeff2
Size	Fish.	41	300	1.0000	300	572	12299	23439
Size	Std.	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Size	Exp.	31	300	1.0000	300	304	9298	9427
Size	NBS	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Age	Fish.	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Age	Std.	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Age	Exp.	23	343	1.0000	343	63	7889	1452
					SEave	RMSE		
Index	Std.	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Index	Exp.	31	341	n/a	0.1080	0.1969	10557	3177
Index	NBS	n/a	n/a	n/a	n/a	n/a	n/a	n/a
						Sum:	40043	37496

				Model 16.6b				
Type	Fleet	Yrs	N	Mult	N×Mult	Har	ΣNeff1	ΣNeff2
Size	Fish.	41	300	1.0000	300	580	12299	23779
Size	Std.	5	331	1.0000	331	453	1653	2264
Size	Exp.	31	295	1.0000	295	302	9149	9373
Size	NBS	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Age	Fish.	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Age	Std.	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Age	Exp.	23	343	1.0000	343	63	7889	1443
					SEave	RMSE		
Index	Std.	5	341	n/a	0.0956	0.0849	1703	2161
Index	Exp.	31	341	n/a	0.1080	0.1973	10557	3166
Index	NBS	n/a	n/a	n/a	n/a	n/a	n/a	n/a
						Sum:	43250	42185

Table 2.1.13. Effective sample sizes, input and output (p. 2 of 4).

Minor change models with growth covariates

				Model 16.6c					Model 16.6d				
Type	Fleet	Yrs	N	Mult	N×Mult	Har	ΣNeff1	ΣNeff2	Mult	N×Mult	Har	ΣNeff1	ΣNeff2
Size	Fish.	41	300	1.0000	300	586	12299	24015	1.0000	300	570	12299	23389
Size	Std.	36	300	1.0000	300	310	10798	11171	1.0000	300	321	10798	11546
Size	Exp.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Size	NBS	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Age	Fish.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Age	Std.	23	343	1.0000	343	61	7889	1392	1.0000	343	60	7889	1384
Age	Exp.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
					SEave	RMSE				SEave	RMSE		
Index	Std.	36	341	n/a	0.1074	0.1906	12260	3895	n/a	0.1074	0.1889	12260	3966
Index	Exp.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Index	NBS	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
						Sum:	43246	40473			Sum:	43246	40285

Minor change models with time-varying Q, without NBS survey data

				Model 16.6e					Model 16.6f				
Type	Fleet	Yrs	N	Mult	N×Mult	Har	ΣNeff1	ΣNeff2	Mult	N×Mult	Har	ΣNeff1	ΣNeff2
Size	Fish.	41	300	1.0000	300	576	12299	23606	1.0000	300	581	12299	23835
Size	Std.	36	300	1.0000	300	308	10798	11088	1.0000	300	308	10798	11078
Size	Exp.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Size	NBS	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Age	Fish.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Age	Std.	23	343	1.0000	343	61	7889	1408	1.0000	343	61	7889	1399
Age	Exp.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
					SEave	RMSE				SEave	RMSE		
Index	Std.	36	341	n/a	0.1074	0.1096	12260	11782	n/a	0.1074	0.1853	12260	4119
Index	Exp.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Index	NBS	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
						Sum:	43246	47885			Sum:	43246	40431

Minor change models with time-varying Q, with NBS survey data

				Model 16.6g					Model 16.6h				
Type	Fleet	Yrs	N	Mult	N×Mult	Har	ΣNeff1	ΣNeff2	Mult	N×Mult	Har	ΣNeff1	ΣNeff2
Size	Fish.	41	300	1.0000	300	583	12299	23899	1.0000	300	588	12299	24110
Size	Std.	36	300	1.0000	300	307	10798	11056	1.0000	300	307	10798	11045
Size	Exp.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Size	NBS	2	300	1.0000	300	52	600	105	1.0000	300	53	600	106
Age	Fish.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Age	Std.	23	343	1.0000	343	61	7889	1392	1.0000	343	60	7889	1383
Age	Exp.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
					SEave	RMSE				SEave	RMSE		
Index	Std.	36	341	n/a	0.1074	0.1071	12260	12332	n/a	0.1074	0.1835	12260	4201
Index	Exp.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Index	NBS	2	88	n/a	0.1620	0.1617	176	177	n/a	0.1620	0.1626	176	175
						Sum:	44022	48960			Sum:	44022	41020

Table 2.1.13. Effective sample sizes, input and output (p. 3 of 4).

Previous major change models

				Model 17.2					Model 17.6				
Type	Fleet	Yrs	N	Mult	N×Mult	Har	ΣNeff1	ΣNeff2	Mult	N×Mult	Har	ΣNeff1	ΣNeff2
Size	Fish.	35	5400	0.2416	1305	1305	45662	45671	0.1475	797	796	27878	27866
Size	Std.	36	336	0.8665	291	291	10470	10471	1.6603	557	557	20061	20062
Size	Exp.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Size	NBS	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Age	Fish.	6	9948	0.0225	224	223	1343	1339	0.0217	216	215	1295	1293
Age	Std.	23	343	0.1353	46	46	1067	1068	0.3172	109	109	2502	2506
Age	Exp.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
					SEave	RMSE				SEave	RMSE		
Index	Std.	36	341	n/a	0.1074	0.2098	12260	3215	n/a	0.1074	0.1075	12260	12246
Index	Exp.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Index	NBS	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
						Sum:	70802	61763			Sum:	63996	63973

Major change models with migration

				Model 18.1					Model 18.2				
Type	Fleet	Yrs	N	Mult	N×Mult	Har	ΣNeff1	ΣNeff2	Mult	N×Mult	Har	ΣNeff1	ΣNeff2
Size	Fish.	41	300	1.0000	300	540	12299	22152	1.0000	300	555	12299	22741
Size	Std.	36	300	1.0000	300	315	10798	11334	1.0000	300	312	10798	11239
Size	Exp.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Size	NBS	2	300	1.0000	300	103	600	206	1.0000	300	135	600	269
Age	Fish.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Age	Std.	23	343	1.0000	343	66	7889	1511	1.0000	343	63	7889	1454
Age	Exp.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
					SEave	RMSE				SEave	RMSE		
Index	Std.	36	341	n/a	0.1074	0.1776	12260	4487	n/a	0.1074	0.1926	12260	3814
Index	Exp.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Index	NBS	2	88	n/a	0.1620	0.1619	176	176	n/a	0.1620	0.0457	176	2216
						Sum:	44022	39866			Sum:	44022	41732

Major change models with M covariates

				Model 18.3					Model 18.4				
Type	Fleet	Yrs	N	Mult	N×Mult	Har	ΣNeff1	ΣNeff2	Mult	N×Mult	Har	ΣNeff1	ΣNeff2
Size	Fish.	41	300	1.0000	300	629	12299	25802	1.0000	300	577	12299	23640
Size	Std.	36	300	1.0000	300	310	10798	11155	1.0000	300	309	10798	11118
Size	Exp.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Size	NBS	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Age	Fish.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Age	Std.	23	343	1.0000	343	65	7889	1496	1.0000	343	59	7889	1367
Age	Exp.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
					SEave	RMSE				SEave	RMSE		
Index	Std.	36	341	n/a	0.1074	0.1988	12260	3580	n/a	0.1074	0.1876	12260	4021
Index	Exp.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Index	NBS	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
						Sum:	43246	42033			Sum:	43246	40146

Table 2.1.13. Effective sample sizes, input and output (p. 4 of 4).

Major change omnibus model

				Model 18.5				
Type	Fleet	Yrs	N	Mult	N×Mult	Har	ΣNeff1	ΣNeff2
Size	Fish.	41	300	1.0000	300	546	12299	22373
Size	Std.	36	300	1.0000	300	315	10798	11326
Size	Exp.	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Size	NBS	2	300	1.0000	300	104	600	208
Age	Fish.	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Age	Std.	23	343	1.0000	343	65	7889	1490
Age	Exp.	n/a	n/a	n/a	n/a	n/a	n/a	n/a
					SEave	RMSE		
Index	Std.	36	341	n/a	0.1074	0.1763	12260	4552
Index	Exp.	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Index	NBS	2	88	n/a	0.1620	0.1620	176	176
						Sum:	44022	40124

Table 2.1.14a. Internally estimated parameters common to all, or nearly all, models.

	Model 16.6		Model 16.6a		Model 16.6b		Model 16.6c		Model 16.6d		Model 16.6e		Model 16.6f		Model 16.6g	
Quantity	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.
Natural mortality (M)	0.359	0.012	0.348	0.014	0.347	0.014	0.354	0.012	0.363	0.012	0.361	0.014	0.354	0.012	0.353	0.014
Length at age 1.5 (cm)	16.418	0.088	16.312	0.093	16.375	0.088	16.407	0.088	16.695	0.092	16.419	0.088	16.422	0.088	16.409	0.088
Asymptotic length (cm)	99.64	1.921	102.30	2.388	100.14	2.014	100.00	1.919	100.10	1.936	99.48	1.930	100.06	1.959	98.55	1.796
Brody growth coefficient (K)	0.198	0.012	0.184	0.013	0.196	0.012	0.198	0.012	0.195	0.012	0.198	0.012	0.196	0.012	0.208	0.012
Richards growth coefficient	1.038	0.048	1.084	0.050	1.038	0.048	1.029	0.048	1.053	0.048	1.043	0.048	1.044	0.048	1.000	0.047
SD of length at age 1 (cm)	3.438	0.058	3.410	0.061	3.429	0.058	3.431	0.058	3.427	0.056	3.439	0.058	3.439	0.058	3.440	0.058
SD of length at age 20 (cm)	9.789	0.277	9.751	0.312	9.754	0.279	9.679	0.276	9.712	0.278	9.751	0.278	9.784	0.280	9.515	0.264
Ageing bias at age 1	0.332	0.012	0.334	0.013	0.332	0.012	0.331	0.012	0.335	0.012	0.333	0.012	0.331	0.012	0.331	0.012
Ageing bias at age 20	0.281	0.142	0.264	0.144	0.259	0.142	0.233	0.143	0.284	0.141	0.254	0.142	0.261	0.143	0.262	0.144
ln(mean post-1976 recruits)	13.123	0.100	13.031	0.110	13.040	0.110	13.092	0.101	13.151	0.100	13.149	0.111	13.091	0.101	13.089	0.110
SD of ln(recruitment) devs	0.644	0.066	0.616	0.069	0.647	0.066	0.644	0.066	0.631	0.065	0.636	0.065	0.646	0.066	0.655	0.068
ln(pre-1977 recruits offset)	-1.122	0.212	-1.068	0.255	-1.144	0.207	-1.126	0.209	-1.108	0.212	-1.093	0.214	-1.133	0.209	-1.118	0.213
Initial fishing mortality rate	0.180	0.069	0.162	0.071	0.186	0.073	0.180	0.069	0.174	0.066	0.168	0.063	0.182	0.070	0.173	0.066
ln(EBS std. area catchability)	-0.074	0.061			-0.005	0.099	-0.058	0.062	-0.091	0.062	-0.086	0.071	-0.050	0.062	-0.047	0.070
Select. inflection (fishery)	4.349	0.045	4.360	0.047	4.361	0.045	4.355	0.045	4.338	0.045	4.353	0.046	4.354	0.045	4.308	0.044
Select. 95% width (fishery)	1.164	0.032	1.179	0.032	1.173	0.032	1.169	0.031	1.171	0.031	1.167	0.032	1.168	0.032	1.158	0.031
Select. inflection (EBS sur.)	1.009	0.006	1.003	0.006	1.006	0.006	1.007	0.006	1.008	0.006	1.010	0.006	1.007	0.006	1.007	0.006
Select. 95% width (EBS sur.)	0.287	0.052	0.288	0.052	0.287	0.052	0.287	0.052	0.288	0.051	0.287	0.052	0.287	0.052	0.287	0.051

	Model 16.6h		Model 17.2		Model 17.6		Model 18.1		Model 18.2		Model 18.3		Model 18.4		Model 18.5	
Quantity	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.
Natural mortality (M)	0.348	0.012	0.374	0.018	0.312	0.012	0.305	0.014	0.331	0.013	0.349	0.012				
Length at age 1.5 (cm)	16.411	0.088	16.445	0.092	16.946	0.288	16.415	0.088	16.415	0.089	16.410	0.088	16.422	0.089	16.422	0.088
Asymptotic length (cm)	98.987	1.811	109.18	1.867	108.41	2.022	93.32	1.308	95.26	1.511	99.89	1.983	99.60	2.148	93.74	1.509
Brody growth coefficient (K)	0.206	0.012	0.171	0.009	0.170	0.009	0.241	0.011	0.229	0.012	0.200	0.012	0.194	0.012	0.238	0.012
Richards growth coefficient	1.002	0.047	1.071	0.037	1.017	0.037	0.899	0.045	0.934	0.047	1.020	0.049	1.067	0.048	0.909	0.045
SD of length at age 1 (cm)	3.440	0.058	3.492	0.058	3.130	0.039	3.438	0.057	3.437	0.058	3.430	0.058	3.454	0.058	3.445	0.057
SD of length at age 20 (cm)	9.545	0.266	8.675	0.227	9.459	0.232	9.049	0.247	9.319	0.252	9.915	0.281	9.576	0.290	8.943	0.252
Ageing bias at age 1	0.330	0.013	0.337	0.030	0.357	0.017	0.316	0.014	0.323	0.013	0.325	0.013	0.337	0.011	0.315	0.014
Ageing bias at age 20	0.269	0.144	-0.405	0.212	-0.327	0.161	0.407	0.151	0.394	0.146	0.321	0.143	0.274	0.141	0.388	0.153
ln(mean post-1976 recruits)	13.048	0.101	13.113	0.129	12.735	0.085	12.874	0.112	12.997	0.106	13.015	0.101	13.337	0.090	12.346	0.199
SD of ln(recruitment) devs	0.664	0.068					0.632	0.067	0.646	0.068	0.659	0.063	0.632	0.065	0.504	0.055
ln(pre-1977 recruits offset)	-1.148	0.208	-1.442	0.135	-0.977	0.201	-0.693	0.197	-0.908	0.214	-1.337	0.192	-1.006	0.224	-0.471	0.155
Initial fishing mortality rate	0.183	0.072	0.469	0.316	1.691	0.886	0.129	0.033	0.150	0.046	0.313	0.173	0.144	0.051	0.178	0.054
ln(EBS std. area catchability)	-0.021	0.062	0.042	0.063	0.182	0.056	0.215	0.080	0.072	0.068	0.008	0.059	-0.204	0.082	0.251	0.118
Select. inflection (fishery)	4.309	0.043					4.420	0.049	4.386	0.048	4.347	0.045	4.349	0.045	4.426	0.049
Select. 95% width (fishery)	1.159	0.031					1.200	0.033	1.184	0.032	1.158	0.032	1.168	0.031	1.212	0.033
Select. inflection (EBS sur.)	1.005	0.006					1.009	0.006	1.008	0.006	1.007	0.006	1.017	0.005	1.005	0.005
Select. 95% width (EBS sur.)	0.287	0.051					0.300	0.055	0.296	0.055	0.287	0.051	0.288	0.052	0.299	0.055

Table 2.1.14b. Internally estimated parameters common to only a few models (p. 1 of 2).

	Model 16.6		Model 16.6a		Model 16.6b		Model 16.6c		Model 16.6d		Model 16.6e		Model 16.6f		Model 16.6g	
Quantity	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.
M at age 5																
M at ages 6+																
Environmental link to M																
Environmental link to M(2-5)																
Environmental link to L(1.5)									0.619	0.079						
Environmental link to K							-0.006	0.001								
Migration "A" EBS to NBS																
Migration "B" EBS to NBS																
Migration "B" NBS to EBS																
Env. link to "A" EBS to NBS																
Env. link to "B" EBS to NBS																
Env. link to "B" NBS to EBS																
Ricker "beta" 1977-1979																
Ricker "beta" 1980-2005																
Ricker "beta" 2006-2013																
Ricker "beta" 2014-2016																

	Model 16.6h		Model 17.2		Model 17.6		Model 18.1		Model 18.2		Model 18.3		Model 18.4		Model 18.5	
Quantity	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.
M at ages 2-5													0.386	0.028	0.297	0.050
M at ages 6+													0.381	0.027	0.294	0.028
Environmental link to M											-0.061	0.011				
Environmental link to M(2-5)													0.054	0.017	0.049	0.018
Environmental link to L(1.5)																
Environmental link to K																
Migration "A" EBS to NBS							-1.448	0.261	-2.241	0.186					-1.526	0.303
Migration "B" EBS to NBS							1.571	0.506	0.070	0.369					1.469	0.783
Migration "B" NBS to EBS							0.272	0.340	1.964	1.286					0.456	0.414
Env. link to "A" EBS to NBS									-1.469	0.115						
Env. link to "B" EBS to NBS									-0.778	0.270						
Env. link to "B" NBS to EBS									-1.007	0.793						
Ricker "beta" 1977-1979															3.313	0.430
Ricker "beta" 1980-2005															2.064	0.353
Ricker "beta" 2006-2013															3.064	0.353
Ricker "beta" 2014-2016															0.000	0.001

Table 2.1.14b. Internally estimated parameters common to only a few models (p. 2 of 2).

	Model 16.6		Model 16.6a		Model 16.6b		Model 16.6c		Model 16.6d		Model 16.6e		Model 16.6f		Model 16.6g	
Quantity	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.
ln(EBS exp. area catchability)			-0.006	0.065	-0.010	0.064										
ln(NBS Q)															-2.840	0.396
ln(EBS Q) autocorrelation																
Env. link to ln(EBS Q)													-0.053	0.017		
Select. inflection (NBS sur.)															1.116	0.125
Select. 95% width (NBS sur.)															0.390	0.280
Select. peak age (fishery)																
Select. asc. wid. (fishery)																
Select. peak age (EBS sur.)																
Select. asc. wid. (EBS sur.)																

	Model 16.6h		Model 17.2		Model 17.6		Model 18.1		Model 18.2		Model 18.3		Model 18.4		Model 18.5	
Quantity	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.
ln(EBS exp. area catchability)																
ln(NBS Q)	-2.808	0.394					-0.783	0.192	0.029	0.182					-0.643	0.213
ln(EBS Q) autocorrelation					0.465	0.128										
Env. link to ln(EBS Q)	-0.053	0.017													-0.021	0.019
Select. inflection (NBS sur.)	1.101	0.119					0.959	0.117	1.063	0.146					0.968	0.128
Select. 95% width (NBS sur.)	0.374	0.298					0.394	0.140	0.491	0.132					0.442	0.152
Select. peak age (fishery)			5.740	0.123	5.884	0.133										
Select. asc. wid. (fishery)			0.922	0.076	1.014	0.079										
Select. peak age (EBS sur.)			2.531	0.152	1.032	0.011										
Select. asc. wid. (EBS sur.)			1.228	0.219	-8.218	1.299										

Table 2.1.14c. Iteratively estimated parameters.

Quantity	16.6	16.6a	16.6b	16.6c	16.6d	16.6e	16.6f	16.6g	16.6h	17.2	17.6	18.1	18.2	18.3	18.4	18.5
M for ages 0-2															0.386	0.298
Logit prop. recruits in NBS												-0.426	-0.826			-0.505
Migration "A" NBS to EBS												81.638	81.774			81.638
SD of L(1.5) devs											0.097					
SD of "A" EBS to NBS devs												0.494				0.504
SD of "B" EBS to NBS devs												0.494				0.504
SD of "B" NBS to EBS devs												0.494				0.504
SD of ln(recruitment) devs										0.577	0.593					
SD of ln(EBS Q) devs						0.100		0.102			0.089					
SD of ln(NBS Q) devs								0.523	0.523							

Table 2.1.14d. "Early" recruitment *dev*s.

	Model 16.6		Model 16.6a		Model 16.6b		Model 16.6c		Model 16.6d		Model 16.6e		Model 16.6f		Model 16.6g	
Quantity	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.
Initial age 20 ln(recruits) dev	-0.004	0.643	-0.006	0.614	-0.004	0.646	-0.004	0.643	-0.004	0.630	-0.004	0.634	-0.004	0.645	-0.005	0.653
Initial age 19 ln(recruits) dev	-0.003	0.644	-0.004	0.614	-0.003	0.646	-0.003	0.643	-0.003	0.630	-0.003	0.635	-0.003	0.645	-0.003	0.654
Initial age 18 ln(recruits) dev	-0.004	0.643	-0.006	0.614	-0.005	0.646	-0.005	0.643	-0.004	0.630	-0.005	0.634	-0.005	0.644	-0.005	0.653
Initial age 17 ln(recruits) dev	-0.008	0.642	-0.010	0.612	-0.009	0.645	-0.008	0.642	-0.007	0.629	-0.008	0.633	-0.008	0.643	-0.009	0.652
Initial age 16 ln(recruits) dev	-0.013	0.641	-0.017	0.611	-0.014	0.643	-0.014	0.640	-0.012	0.628	-0.014	0.632	-0.013	0.642	-0.014	0.650
Initial age 15 ln(recruits) dev	-0.021	0.638	-0.028	0.608	-0.024	0.640	-0.023	0.637	-0.021	0.625	-0.022	0.629	-0.022	0.639	-0.024	0.647
Initial age 14 ln(recruits) dev	-0.035	0.634	-0.044	0.603	-0.039	0.636	-0.037	0.633	-0.034	0.621	-0.037	0.625	-0.037	0.635	-0.039	0.643
Initial age 13 ln(recruits) dev	-0.057	0.628	-0.070	0.597	-0.063	0.630	-0.060	0.627	-0.055	0.616	-0.060	0.619	-0.060	0.629	-0.063	0.636
Initial age 12 ln(recruits) dev	-0.091	0.620	-0.108	0.588	-0.100	0.621	-0.096	0.618	-0.088	0.607	-0.095	0.610	-0.095	0.620	-0.099	0.627
Initial age 11 ln(recruits) dev	-0.142	0.608	-0.163	0.576	-0.154	0.609	-0.149	0.607	-0.138	0.596	-0.146	0.598	-0.148	0.608	-0.153	0.615
Initial age 10 ln(recruits) dev	-0.214	0.593	-0.238	0.561	-0.229	0.594	-0.222	0.592	-0.208	0.582	-0.218	0.583	-0.221	0.593	-0.227	0.599
Initial age 9 ln(recruits) dev	-0.309	0.575	-0.334	0.544	-0.327	0.576	-0.319	0.574	-0.301	0.564	-0.312	0.566	-0.318	0.575	-0.324	0.581
Initial age 8 ln(recruits) dev	-0.423	0.555	-0.446	0.525	-0.444	0.555	-0.434	0.553	-0.413	0.544	-0.425	0.546	-0.433	0.555	-0.440	0.560
Initial age 7 ln(recruits) dev	-0.544	0.533	-0.562	0.506	-0.566	0.534	-0.555	0.532	-0.533	0.523	-0.543	0.525	-0.554	0.533	-0.560	0.539
Initial age 6 ln(recruits) dev	-0.639	0.513	-0.650	0.488	-0.660	0.513	-0.649	0.511	-0.628	0.504	-0.635	0.506	-0.648	0.513	-0.654	0.519
Initial age 5 ln(recruits) dev	-0.624	0.501	-0.628	0.479	-0.642	0.500	-0.633	0.499	-0.618	0.492	-0.618	0.495	-0.632	0.500	-0.640	0.506
Initial age 4 ln(recruits) dev	-0.262	0.484	-0.266	0.463	-0.269	0.482	-0.261	0.481	-0.272	0.477	-0.256	0.479	-0.264	0.483	-0.277	0.490
Initial age 3 ln(recruits) dev	-0.096	0.469	-0.110	0.451	-0.104	0.468	-0.097	0.466	-0.089	0.460	-0.104	0.466	-0.100	0.468	-0.078	0.467
Initial age 2 ln(recruits) dev	-0.139	0.520	-0.156	0.499	-0.150	0.520	-0.147	0.518	-0.149	0.511	-0.135	0.516	-0.145	0.520	-0.167	0.522
Initial age 1 ln(recruits) dev	0.755	0.519	0.739	0.511	0.774	0.509	0.781	0.507	0.725	0.510	0.752	0.517	0.762	0.515	0.765	0.504

	Model 16.6h		Model 17.2		Model 17.6		Model 18.1		Model 18.2		Model 18.3		Model 18.4		Model 18.5	
Quantity	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.
Initial age 20 ln(recruits) dev	-0.004	0.662	0.000	0.577	0.000	0.593	-0.043	0.619	-0.018	0.640	0.000	0.659	-0.004	0.630	-0.021	0.499
Initial age 19 ln(recruits) dev	-0.003	0.663	0.000	0.577	0.000	0.593	-0.019	0.626	-0.010	0.643	0.000	0.659	-0.003	0.631	-0.010	0.502
Initial age 18 ln(recruits) dev	-0.005	0.662	0.000	0.577	0.000	0.593	-0.026	0.624	-0.014	0.641	-0.001	0.659	-0.005	0.630	-0.014	0.501
Initial age 17 ln(recruits) dev	-0.008	0.661	0.000	0.577	0.000	0.593	-0.037	0.620	-0.022	0.639	-0.001	0.658	-0.008	0.629	-0.020	0.499
Initial age 16 ln(recruits) dev	-0.014	0.659	0.000	0.577	0.000	0.593	-0.052	0.616	-0.033	0.636	-0.003	0.658	-0.013	0.628	-0.028	0.497
Initial age 15 ln(recruits) dev	-0.023	0.656	-0.001	0.577	0.000	0.593	-0.072	0.611	-0.049	0.631	-0.005	0.657	-0.021	0.625	-0.040	0.495
Initial age 14 ln(recruits) dev	-0.039	0.652	-0.002	0.576	0.000	0.593	-0.099	0.603	-0.072	0.624	-0.009	0.656	-0.035	0.621	-0.056	0.491
Initial age 13 ln(recruits) dev	-0.062	0.646	-0.005	0.576	0.000	0.593	-0.134	0.595	-0.104	0.616	-0.017	0.654	-0.056	0.616	-0.078	0.486
Initial age 12 ln(recruits) dev	-0.099	0.636	-0.011	0.575	0.000	0.593	-0.180	0.584	-0.148	0.605	-0.032	0.651	-0.089	0.607	-0.107	0.480
Initial age 11 ln(recruits) dev	-0.153	0.624	-0.025	0.573	0.000	0.593	-0.236	0.572	-0.207	0.592	-0.057	0.646	-0.137	0.596	-0.145	0.473
Initial age 10 ln(recruits) dev	-0.229	0.609	-0.052	0.573	0.000	0.593	-0.303	0.558	-0.281	0.577	-0.099	0.639	-0.206	0.582	-0.193	0.464
Initial age 9 ln(recruits) dev	-0.327	0.590	-0.102	0.578	0.001	0.593	-0.378	0.545	-0.368	0.560	-0.165	0.631	-0.295	0.564	-0.247	0.455
Initial age 8 ln(recruits) dev	-0.444	0.569	-0.185	0.589	0.006	0.595	-0.462	0.531	-0.468	0.543	-0.258	0.619	-0.402	0.545	-0.313	0.445
Initial age 7 ln(recruits) dev	-0.567	0.547	-0.297	0.596	0.032	0.602	-0.544	0.517	-0.570	0.526	-0.372	0.600	-0.515	0.525	-0.383	0.434
Initial age 6 ln(recruits) dev	-0.663	0.526	-0.403	0.578	0.135	0.630	-0.623	0.502	-0.655	0.509	-0.479	0.572	-0.601	0.507	-0.452	0.422
Initial age 5 ln(recruits) dev	-0.650	0.512	-0.423	0.514	0.424	0.687	-0.636	0.490	-0.647	0.498	-0.494	0.544	-0.578	0.498	-0.470	0.412
Initial age 4 ln(recruits) dev	-0.281	0.495	0.039	0.406	1.394	0.488	-0.290	0.470	-0.296	0.480	-0.141	0.522	-0.212	0.481	-0.208	0.403
Initial age 3 ln(recruits) dev	-0.072	0.469	0.599	0.280	0.376	0.390	-0.171	0.456	-0.146	0.463	0.059	0.488	-0.073	0.469	-0.112	0.396
Initial age 2 ln(recruits) dev	-0.172	0.526	-0.396	0.416	-0.398	0.427	-0.205	0.500	-0.195	0.512	-0.041	0.543	-0.117	0.521	-0.068	0.423
Initial age 1 ln(recruits) dev	0.775	0.503	1.214	0.256	0.900	0.305	0.673	0.476	0.690	0.503	0.868	0.536	0.803	0.514	0.530	0.456

Table 2.1.14e. "Main" recruitment *devs* (p. 1 of 2).

	Model 16.6		Model 16.6a		Model 16.6b		Model 16.6c		Model 16.6d		Model 16.6e		Model 16.6f		Model 16.6g	
Quantity	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.
ln(recruits) dev 1977	0.959	0.210	0.777	0.307	0.909	0.211	0.928	0.209	0.946	0.208	0.971	0.214	0.937	0.209	0.913	0.213
ln(recruits) dev 1978	0.503	0.252	0.520	0.357	0.464	0.248	0.493	0.245	0.498	0.249	0.510	0.256	0.490	0.250	0.507	0.244
ln(recruits) dev 1979	0.515	0.143	0.082	0.329	0.483	0.143	0.503	0.140	0.521	0.140	0.520	0.146	0.499	0.143	0.510	0.141
ln(recruits) dev 1980	-0.256	0.138	-0.705	0.402	-0.284	0.139	-0.261	0.137	-0.254	0.135	-0.246	0.140	-0.258	0.137	-0.242	0.137
ln(recruits) dev 1981	-0.851	0.142	0.461	0.165	-0.873	0.143	-0.846	0.142	-0.840	0.140	-0.847	0.144	-0.867	0.143	-0.848	0.142
ln(recruits) dev 1982	0.819	0.051	0.297	0.195	0.798	0.054	0.813	0.051	0.809	0.051	0.820	0.054	0.794	0.051	0.810	0.054
ln(recruits) dev 1983	-0.545	0.126	-0.006	0.229	-0.562	0.126	-0.548	0.125	-0.514	0.122	-0.546	0.127	-0.558	0.126	-0.532	0.124
ln(recruits) dev 1984	0.808	0.050	0.636	0.102	0.803	0.050	0.801	0.050	0.791	0.051	0.800	0.052	0.797	0.050	0.797	0.052
ln(recruits) dev 1985	-0.159	0.090	-0.041	0.108	-0.211	0.096	-0.161	0.089	-0.165	0.089	-0.162	0.091	-0.172	0.090	-0.138	0.090
ln(recruits) dev 1986	-0.563	0.102	-0.678	0.122	-0.623	0.119	-0.562	0.101	-0.555	0.100	-0.554	0.103	-0.557	0.101	-0.538	0.102
ln(recruits) dev 1987	-1.436	0.180	-1.202	0.177	-1.216	0.184	-1.416	0.178	-1.418	0.175	-1.389	0.179	-1.407	0.179	-1.371	0.177
ln(recruits) dev 1988	-0.414	0.095	-0.354	0.099	-0.332	0.100	-0.403	0.095	-0.447	0.096	-0.359	0.096	-0.390	0.095	-0.363	0.095
ln(recruits) dev 1989	0.578	0.057	0.532	0.057	0.552	0.057	0.583	0.056	0.573	0.056	0.566	0.059	0.581	0.056	0.559	0.058
ln(recruits) dev 1990	0.378	0.063	0.370	0.061	0.383	0.062	0.386	0.063	0.364	0.063	0.359	0.064	0.372	0.063	0.370	0.063
ln(recruits) dev 1991	-0.069	0.076	-0.085	0.075	-0.070	0.076	-0.051	0.076	-0.058	0.075	-0.092	0.077	-0.074	0.076	-0.085	0.077
ln(recruits) dev 1992	0.783	0.038	0.774	0.038	0.788	0.037	0.802	0.038	0.774	0.038	0.763	0.039	0.782	0.038	0.768	0.039
ln(recruits) dev 1993	-0.099	0.057	-0.111	0.057	-0.098	0.057	-0.080	0.057	-0.129	0.058	-0.119	0.058	-0.104	0.057	-0.105	0.058
ln(recruits) dev 1994	-0.302	0.062	-0.317	0.061	-0.304	0.061	-0.275	0.062	-0.323	0.062	-0.312	0.062	-0.305	0.061	-0.305	0.062
ln(recruits) dev 1995	-0.391	0.069	-0.409	0.069	-0.391	0.069	-0.327	0.069	-0.424	0.070	-0.395	0.070	-0.392	0.069	-0.391	0.069
ln(recruits) dev 1996	0.627	0.037	0.625	0.037	0.642	0.037	0.650	0.038	0.626	0.037	0.625	0.038	0.621	0.037	0.626	0.038
ln(recruits) dev 1997	-0.177	0.059	-0.186	0.060	-0.178	0.060	-0.157	0.060	-0.175	0.059	-0.184	0.060	-0.182	0.059	-0.170	0.060
ln(recruits) dev 1998	-0.212	0.063	-0.216	0.063	-0.201	0.063	-0.124	0.063	-0.251	0.064	-0.219	0.064	-0.208	0.063	-0.207	0.063
ln(recruits) dev 1999	0.523	0.039	0.519	0.039	0.535	0.039	0.558	0.040	0.494	0.039	0.507	0.041	0.520	0.039	0.517	0.040
ln(recruits) dev 2000	0.255	0.043	0.243	0.043	0.253	0.043	0.256	0.043	0.248	0.043	0.237	0.044	0.252	0.043	0.258	0.044
ln(recruits) dev 2001	-0.542	0.066	-0.552	0.066	-0.539	0.066	-0.535	0.066	-0.567	0.066	-0.553	0.067	-0.542	0.066	-0.527	0.066
ln(recruits) dev 2002	-0.263	0.052	-0.260	0.052	-0.250	0.052	-0.296	0.054	-0.250	0.051	-0.277	0.054	-0.262	0.052	-0.250	0.053
ln(recruits) dev 2003	-0.431	0.056	-0.425	0.055	-0.412	0.055	-0.453	0.056	-0.433	0.055	-0.449	0.057	-0.427	0.056	-0.419	0.057
ln(recruits) dev 2004	-0.604	0.061	-0.603	0.061	-0.593	0.061	-0.635	0.062	-0.561	0.060	-0.630	0.063	-0.596	0.061	-0.596	0.062
ln(recruits) dev 2005	-0.306	0.055	-0.320	0.055	-0.304	0.055	-0.340	0.055	-0.291	0.054	-0.324	0.056	-0.297	0.055	-0.302	0.056
ln(recruits) dev 2006	0.827	0.034	0.821	0.034	0.838	0.034	0.782	0.035	0.837	0.034	0.829	0.035	0.832	0.034	0.828	0.034
ln(recruits) dev 2007	-0.003	0.056	-0.015	0.055	0.000	0.056	-0.036	0.056	-0.005	0.057	-0.002	0.057	0.004	0.056	-0.007	0.056
ln(recruits) dev 2008	1.138	0.031	1.117	0.031	1.134	0.031	1.096	0.032	1.138	0.032	1.133	0.032	1.143	0.031	1.124	0.032
ln(recruits) dev 2009	-0.927	0.114	-0.919	0.109	-0.917	0.110	-0.966	0.114	-0.904	0.113	-0.942	0.115	-0.925	0.114	-0.814	0.105
ln(recruits) dev 2010	0.607	0.044	0.594	0.044	0.613	0.044	0.585	0.044	0.593	0.044	0.602	0.047	0.616	0.044	0.613	0.046
ln(recruits) dev 2011	0.986	0.043	0.965	0.042	0.985	0.042	0.970	0.042	0.964	0.043	0.987	0.048	0.992	0.043	1.017	0.046
ln(recruits) dev 2012	0.132	0.066	0.119	0.067	0.141	0.067	0.105	0.067	0.077	0.068	0.135	0.072	0.140	0.066	0.206	0.069
ln(recruits) dev 2013	0.933	0.051	0.913	0.052	0.934	0.052	0.940	0.051	0.935	0.051	0.941	0.061	0.939	0.052	0.982	0.061
ln(recruits) dev 2014	-0.943	0.107	-0.976	0.107	-0.958	0.107	-0.914	0.105	-0.939	0.107	-0.928	0.113	-0.937	0.107	-1.022	0.112
ln(recruits) dev 2015	-0.662	0.105	-0.713	0.107	-0.684	0.107	-0.668	0.106	-0.645	0.104	-0.628	0.114	-0.650	0.105	-0.592	0.096
ln(recruits) dev 2016	-1.220	0.225	-1.270	0.229	-1.253	0.234	-1.196	0.222	-1.040	0.208	-1.148	0.230	-1.200	0.225	-1.580	0.284

Table 2.1.14e. "Main" recruitment *devs* (p. 2 of 2).

	Model 16.6h		Model 17.2		Model 17.6		Model 18.1		Model 18.2		Model 18.3		Model 18.4		Model 18.5	
Quantity	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.
ln(recruits) dev 1977	0.893	0.209	0.461	0.152	0.505	0.160	1.058	0.219	1.012	0.215	0.975	0.198	1.050	0.217	0.347	0.319
ln(recruits) dev 1978	0.497	0.239	0.503	0.137	0.471	0.133	0.544	0.245	0.536	0.250	0.479	0.251	0.546	0.259	-0.205	0.348
ln(recruits) dev 1979	0.499	0.139	0.485	0.101	0.432	0.088	0.483	0.143	0.513	0.142	0.522	0.141	0.548	0.145	-0.253	0.305
ln(recruits) dev 1980	-0.246	0.134	-0.280	0.120	-0.786	0.158	-0.247	0.135	-0.248	0.136	-0.253	0.138	-0.234	0.138	-0.128	0.196
ln(recruits) dev 1981	-0.861	0.141	-0.367	0.102	-0.609	0.117	-0.870	0.142	-0.856	0.142	-0.851	0.143	-0.810	0.142	-0.783	0.178
ln(recruits) dev 1982	0.789	0.051	0.724	0.053	0.766	0.050	0.781	0.052	0.802	0.051	0.826	0.051	0.857	0.052	0.853	0.092
ln(recruits) dev 1983	-0.540	0.123	-0.333	0.103	-0.375	0.103	-0.564	0.124	-0.547	0.125	-0.533	0.126	-0.492	0.126	-0.311	0.150
ln(recruits) dev 1984	0.796	0.050	0.669	0.049	0.661	0.052	0.781	0.051	0.796	0.051	0.823	0.050	0.857	0.052	1.089	0.120
ln(recruits) dev 1985	-0.148	0.088	0.085	0.064	0.102	0.065	-0.195	0.089	-0.168	0.089	-0.138	0.090	-0.133	0.089	0.245	0.177
ln(recruits) dev 1986	-0.543	0.101	-0.389	0.076	-0.440	0.080	-0.636	0.103	-0.597	0.102	-0.542	0.102	-0.582	0.102	-0.239	0.182
ln(recruits) dev 1987	-1.391	0.176	-0.949	0.100	-1.254	0.135	-1.475	0.175	-1.462	0.177	-1.417	0.181	-1.460	0.178	-1.063	0.212
ln(recruits) dev 1988	-0.393	0.094	-0.333	0.067	-0.186	0.072	-0.494	0.097	-0.458	0.096	-0.400	0.095	-0.436	0.095	-0.099	0.184
ln(recruits) dev 1989	0.575	0.056	0.458	0.044	0.496	0.048	0.535	0.058	0.553	0.058	0.589	0.056	0.549	0.058	0.864	0.154
ln(recruits) dev 1990	0.383	0.062	0.345	0.047	0.403	0.052	0.362	0.063	0.377	0.063	0.390	0.062	0.350	0.064	0.591	0.123
ln(recruits) dev 1991	-0.066	0.076	-0.153	0.061	-0.243	0.075	-0.073	0.076	-0.072	0.076	-0.068	0.076	-0.074	0.077	0.059	0.096
ln(recruits) dev 1992	0.787	0.038	0.698	0.034	0.718	0.037	0.778	0.040	0.782	0.039	0.766	0.037	0.788	0.039	0.843	0.083
ln(recruits) dev 1993	-0.090	0.057	-0.225	0.059	-0.158	0.060	-0.094	0.058	-0.090	0.058	-0.128	0.057	-0.088	0.059	-0.029	0.103
ln(recruits) dev 1994	-0.297	0.061	-0.417	0.054	-0.338	0.057	-0.297	0.062	-0.300	0.062	-0.357	0.062	-0.299	0.062	-0.239	0.106
ln(recruits) dev 1995	-0.388	0.068	-0.464	0.057	-0.355	0.062	-0.385	0.068	-0.390	0.069	-0.462	0.069	-0.404	0.070	-0.329	0.100
ln(recruits) dev 1996	0.623	0.037	0.454	0.036	0.618	0.038	0.605	0.039	0.619	0.038	0.524	0.041	0.617	0.039	0.647	0.085
ln(recruits) dev 1997	-0.168	0.059	0.084	0.045	0.001	0.058	-0.204	0.060	-0.184	0.060	-0.300	0.063	-0.173	0.061	-0.142	0.100
ln(recruits) dev 1998	-0.198	0.062	-0.002	0.048	-0.144	0.067	-0.247	0.063	-0.230	0.063	-0.356	0.067	-0.198	0.066	-0.155	0.113
ln(recruits) dev 1999	0.530	0.039	0.546	0.035	0.576	0.040	0.475	0.041	0.503	0.040	0.446	0.041	0.570	0.046	0.589	0.107
ln(recruits) dev 2000	0.272	0.043	0.160	0.046	0.170	0.048	0.209	0.045	0.240	0.044	0.052	0.057	0.307	0.050	0.323	0.101
ln(recruits) dev 2001	-0.518	0.065	-0.728	0.067	-0.691	0.076	-0.577	0.066	-0.555	0.066	-0.757	0.077	-0.524	0.069	-0.476	0.105
ln(recruits) dev 2002	-0.237	0.052	-0.204	0.048	-0.036	0.047	-0.311	0.053	-0.287	0.053	-0.472	0.065	-0.285	0.054	-0.254	0.090
ln(recruits) dev 2003	-0.399	0.055	-0.335	0.051	-0.146	0.051	-0.473	0.057	-0.451	0.056	-0.613	0.065	-0.498	0.059	-0.449	0.094
ln(recruits) dev 2004	-0.566	0.061	-0.647	0.061	-0.675	0.061	-0.623	0.062	-0.616	0.061	-0.660	0.062	-0.683	0.064	-0.614	0.100
ln(recruits) dev 2005	-0.279	0.054	-0.477	0.065	-0.428	0.058	-0.307	0.055	-0.309	0.055	-0.253	0.055	-0.393	0.059	-0.313	0.103
ln(recruits) dev 2006	0.829	0.034	0.665	0.042	0.794	0.040	0.851	0.037	0.839	0.035	0.950	0.041	0.753	0.041	0.269	0.151
ln(recruits) dev 2007	-0.003	0.056	0.161	0.057	0.081	0.070	0.043	0.059	0.028	0.057	0.149	0.063	-0.055	0.059	-0.547	0.174
ln(recruits) dev 2008	1.132	0.031	0.993	0.037	1.073	0.036	1.155	0.035	1.166	0.033	1.336	0.048	1.094	0.035	0.562	0.187
ln(recruits) dev 2009	-0.802	0.105	-0.960	0.129	-1.021	0.144	-0.772	0.105	-0.784	0.109	-0.712	0.121	-0.979	0.116	-1.322	0.213
ln(recruits) dev 2010	0.622	0.044	0.543	0.053	0.525	0.053	0.636	0.047	0.614	0.046	0.770	0.053	0.601	0.045	0.078	0.189
ln(recruits) dev 2011	1.017	0.042	0.935	0.049	0.876	0.047	1.042	0.045	1.030	0.043	1.152	0.052	1.030	0.046	0.532	0.158
ln(recruits) dev 2012	0.203	0.064	0.211	0.075	0.009	0.083	0.251	0.067	0.204	0.065	0.300	0.073	0.176	0.069	-0.197	0.148
ln(recruits) dev 2013	0.973	0.051	0.869	0.060	0.778	0.072	1.055	0.056	0.995	0.051	0.999	0.052	0.959	0.052	0.647	0.134
ln(recruits) dev 2014	-1.038	0.105	-0.905	0.137	-0.792	0.127	-0.884	0.107	-0.971	0.105	-0.888	0.107	-0.944	0.106	-0.015	0.172
ln(recruits) dev 2015	-0.611	0.086	-0.745	0.126	-1.016	0.147	-0.390	0.092	-0.519	0.086	-0.623	0.106	-0.682	0.105	0.425	0.169
ln(recruits) dev 2016	-1.639	0.278	-1.135	0.206	-0.360	0.470	-1.524	0.279	-1.518	0.304	-1.262	0.226	-1.227	0.223	-0.803	0.288

Table 2.1.14f. Other *dev*s (1 of 4).

	Model 17.6	
Quantity	Est.	StD.
L at age 1.5 dev 1981	-0.754	0.404
L at age 1.5 dev 1982	-0.847	0.251
L at age 1.5 dev 1983	0.939	0.403
L at age 1.5 dev 1984	0.366	0.214
L at age 1.5 dev 1985	-1.297	0.352
L at age 1.5 dev 1986	0.210	0.236
L at age 1.5 dev 1987	-0.039	0.320
L at age 1.5 dev 1988	-0.194	0.301
L at age 1.5 dev 1989	-0.859	0.233
L at age 1.5 dev 1990	-0.035	0.243
L at age 1.5 dev 1991	0.503	0.218
L at age 1.5 dev 1992	-0.039	0.209
L at age 1.5 dev 1993	0.648	0.291
L at age 1.5 dev 1994	0.414	0.228
L at age 1.5 dev 1995	0.401	0.285
L at age 1.5 dev 1996	0.250	0.221
L at age 1.5 dev 1997	-0.295	0.289
L at age 1.5 dev 1998	-0.162	0.226
L at age 1.5 dev 1999	-0.935	0.231
L at age 1.5 dev 2000	0.594	0.217
L at age 1.5 dev 2001	0.765	0.230
L at age 1.5 dev 2002	0.957	0.215
L at age 1.5 dev 2003	0.520	0.258
L at age 1.5 dev 2004	1.323	0.218
L at age 1.5 dev 2005	-1.094	0.231
L at age 1.5 dev 2006	-1.219	0.204
L at age 1.5 dev 2007	-1.497	0.259
L at age 1.5 dev 2008	-1.628	0.209
L at age 1.5 dev 2009	-0.284	0.313
L at age 1.5 dev 2010	0.303	0.205
L at age 1.5 dev 2011	-1.883	0.233
L at age 1.5 dev 2012	0.227	0.260
L at age 1.5 dev 2013	-0.231	0.213
L at age 1.5 dev 2014	0.291	0.333
L at age 1.5 dev 2015	1.989	0.209
L at age 1.5 dev 2016	1.817	0.261

	Model 18.1		Model 18.5	
Quantity	Est.	StD.	Est.	StD.
Mig. "A" EBS to NBS dev 2007	1.101	0.644	0.988	0.690
Mig. "A" EBS to NBS dev 2008	2.345	0.608	1.861	0.688
Mig. "A" EBS to NBS dev 2009	-4.481	0.598	-4.531	0.603
Mig. "A" EBS to NBS dev 2010	0.219	0.648	0.052	0.680
Mig. "A" EBS to NBS dev 2011	0.680	0.800	0.358	0.853
Mig. "A" EBS to NBS dev 2012	-0.185	0.845	-0.292	0.842
Mig. "A" EBS to NBS dev 2013	-0.630	0.852	-0.585	0.843
Mig. "A" EBS to NBS dev 2014	-0.388	0.802	-0.362	0.805
Mig. "A" EBS to NBS dev 2015	-0.472	0.660	-0.348	0.680
Mig. "A" EBS to NBS dev 2016	3.066	0.508	2.919	0.521
Mig. "B" EBS to NBS dev 2007	-0.997	0.852	-1.039	0.846
Mig. "B" EBS to NBS dev 2008	-0.516	0.921	-0.569	0.915
Mig. "B" EBS to NBS dev 2009	-0.199	0.938	-0.199	0.923
Mig. "B" EBS to NBS dev 2010	-1.350	0.880	-1.181	0.901
Mig. "B" EBS to NBS dev 2011	-0.651	0.922	-0.677	0.908
Mig. "B" EBS to NBS dev 2012	0.025	0.876	-0.107	0.882
Mig. "B" EBS to NBS dev 2013	-0.310	0.825	-0.175	0.832
Mig. "B" EBS to NBS dev 2014	-0.352	0.871	-0.195	0.866
Mig. "B" EBS to NBS dev 2015	0.320	0.872	0.393	0.864
Mig. "B" EBS to NBS dev 2016	0.295	0.911	0.150	0.917
Mig. "B" NBS to EBS dev 2007	0.817	0.760	0.879	0.792
Mig. "B" NBS to EBS dev 2008	-0.186	0.838	-0.017	0.872
Mig. "B" NBS to EBS dev 2009	-0.062	0.846	-0.117	0.873
Mig. "B" NBS to EBS dev 2010	0.354	0.920	0.346	0.931
Mig. "B" NBS to EBS dev 2011	-0.129	0.955	-0.113	0.963
Mig. "B" NBS to EBS dev 2012	-0.301	0.980	-0.241	0.988
Mig. "B" NBS to EBS dev 2013	-0.758	0.928	-0.688	0.956
Mig. "B" NBS to EBS dev 2014	-0.580	0.935	-0.593	0.965
Mig. "B" NBS to EBS dev 2015	-0.306	0.859	-0.491	0.876
Mig. "B" NBS to EBS dev 2016	0.525	0.918	0.675	0.919

Table 2.1.14f. Other *devs* (2 of 4).

	Model 16.6e		Model 16.6g		Model 17.6	
Quantity	Est.	StD.	Est.	StD.	Est.	StD.
ln(EBS Q) dev 1982	-0.503	0.649	-0.352	0.639	1.040	0.664
ln(EBS Q) dev 1983	0.362	0.756	0.445	0.750	1.190	0.786
ln(EBS Q) dev 1984	-0.566	0.645	-0.451	0.637	0.410	0.707
ln(EBS Q) dev 1985	0.388	0.811	0.433	0.806	0.696	0.817
ln(EBS Q) dev 1986	0.389	0.727	0.434	0.720	0.798	0.762
ln(EBS Q) dev 1987	0.332	0.590	0.347	0.582	0.064	0.656
ln(EBS Q) dev 1988	0.215	0.614	0.206	0.606	-0.528	0.678
ln(EBS Q) dev 1989	-2.232	0.610	-2.224	0.602	-2.225	0.660
ln(EBS Q) dev 1990	-0.927	0.681	-0.886	0.673	-1.913	0.737
ln(EBS Q) dev 1991	-1.076	0.737	-1.035	0.731	-1.488	0.769
ln(EBS Q) dev 1992	-0.226	0.774	-0.201	0.768	-0.824	0.791
ln(EBS Q) dev 1993	0.590	0.783	0.608	0.777	0.672	0.803
ln(EBS Q) dev 1994	2.126	0.785	2.149	0.779	2.501	0.801
ln(EBS Q) dev 1995	1.123	0.720	1.130	0.713	2.166	0.753
ln(EBS Q) dev 1996	0.590	0.829	0.600	0.824	1.402	0.831
ln(EBS Q) dev 1997	-0.422	0.829	-0.409	0.824	0.385	0.833
ln(EBS Q) dev 1998	-0.715	0.693	-0.677	0.686	-0.209	0.730
ln(EBS Q) dev 1999	-0.442	0.700	-0.426	0.693	-0.453	0.731
ln(EBS Q) dev 2000	-0.992	0.693	-0.986	0.686	-0.734	0.731
ln(EBS Q) dev 2001	2.113	0.706	2.103	0.699	0.468	0.775
ln(EBS Q) dev 2002	-0.384	0.724	-0.413	0.717	-0.465	0.752
ln(EBS Q) dev 2003	0.038	0.788	-0.004	0.782	-0.704	0.803
ln(EBS Q) dev 2004	-0.499	0.678	-0.579	0.670	-1.244	0.725
ln(EBS Q) dev 2005	0.641	0.821	0.584	0.816	-0.953	0.829
ln(EBS Q) dev 2006	0.961	0.572	0.811	0.563	-1.253	0.642
ln(EBS Q) dev 2007	0.447	0.936	0.448	0.933	-1.143	0.919
ln(EBS Q) dev 2008	-1.306	0.732	-1.282	0.726	-1.856	0.775
ln(EBS Q) dev 2009	-0.728	0.676	-0.666	0.669	-1.651	0.741
ln(EBS Q) dev 2010	0.268	0.802	0.298	0.796	-0.211	0.821
ln(EBS Q) dev 2011	0.578	0.704	0.561	0.697	0.277	0.750
ln(EBS Q) dev 2012	0.511	0.707	0.465	0.698	0.404	0.749
ln(EBS Q) dev 2013	-0.513	0.862	-0.568	0.857	0.431	0.866
ln(EBS Q) dev 2014	0.660	0.806	0.552	0.800	1.334	0.830
ln(EBS Q) dev 2015	0.613	0.790	0.510	0.783	1.536	0.836
ln(EBS Q) dev 2016	0.138	0.763	0.018	0.755	0.899	0.854
ln(EBS Q) dev 2017	-1.555	0.779	-1.548	0.770	-0.274	0.900

	Model 16.6g		Model 16.6h	
Quantity	Est.	StD.	Est.	StD.
ln(NBS Q) dev 2010	-2.865	0.741	-2.880	0.740
ln(NBS Q) dev 2011	0.000	1.000	0.000	1.000
ln(NBS Q) dev 2012	0.000	1.000	0.000	1.000
ln(NBS Q) dev 2013	0.000	1.000	0.000	1.000
ln(NBS Q) dev 2014	0.000	1.000	0.000	1.000
ln(NBS Q) dev 2015	0.000	1.000	0.000	1.000
ln(NBS Q) dev 2016	0.000	1.000	0.000	1.000
ln(NBS Q) dev 2017	2.865	0.741	2.880	0.740

Table 2.1.14f. Other *devs* (3 of 4).

	Model 17.2		Model 17.6			Model 17.2		Model 17.6	
Quantity	Est.	StD.	Est.	StD.	Quantity	Est.	StD.	Est.	StD.
Select. peak age (fish.) dev 1977	-0.239	0.765	-1.210	0.998	Select. asc. wid. (fish.) dev 1977	-0.002	0.853	1.761	0.855
Select. peak age (fish.) dev 1978	-0.322	0.690	0.219	0.787	Select. asc. wid. (fish.) dev 1978	-0.339	0.651	-0.238	0.693
Select. peak age (fish.) dev 1979	-0.977	0.695	-0.406	0.728	Select. asc. wid. (fish.) dev 1979	-0.496	0.690	-0.225	0.686
Select. peak age (fish.) dev 1980	-0.206	0.715	0.088	0.723	Select. asc. wid. (fish.) dev 1980	0.113	0.647	0.144	0.675
Select. peak age (fish.) dev 1981	-1.203	0.801	-0.984	0.849	Select. asc. wid. (fish.) dev 1981	0.836	0.748	0.786	0.796
Select. peak age (fish.) dev 1982	0.683	0.635	0.634	0.676	Select. asc. wid. (fish.) dev 1982	0.191	0.675	-0.020	0.735
Select. peak age (fish.) dev 1983	1.193	0.561	1.122	0.602	Select. asc. wid. (fish.) dev 1983	0.963	0.555	0.662	0.659
Select. peak age (fish.) dev 1984	1.828	0.440	1.757	0.507	Select. asc. wid. (fish.) dev 1984	2.060	0.365	2.027	0.421
Select. peak age (fish.) dev 1985	-0.257	0.460	-0.480	0.494	Select. asc. wid. (fish.) dev 1985	-0.256	0.551	-0.541	0.628
Select. peak age (fish.) dev 1986	0.373	0.322	0.314	0.355	Select. asc. wid. (fish.) dev 1986	0.772	0.341	0.565	0.410
Select. peak age (fish.) dev 1987	0.452	0.330	0.629	0.347	Select. asc. wid. (fish.) dev 1987	0.567	0.338	0.564	0.369
Select. peak age (fish.) dev 1988	-0.109	0.521	-0.319	0.565	Select. asc. wid. (fish.) dev 1988	1.409	0.537	1.128	0.631
Select. peak age (fish.) dev 1989	1.443	0.524	0.928	0.575	Select. asc. wid. (fish.) dev 1989	2.009	0.500	1.447	0.599
Select. peak age (fish.) dev 1990	1.959	0.336	1.988	0.376	Select. asc. wid. (fish.) dev 1990	1.844	0.318	1.782	0.374
Select. peak age (fish.) dev 1991	0.019	0.332	0.133	0.395	Select. asc. wid. (fish.) dev 1991	0.219	0.341	0.280	0.415
Select. peak age (fish.) dev 1992	-0.797	0.279	-0.678	0.313	Select. asc. wid. (fish.) dev 1992	-0.965	0.337	-0.918	0.396
Select. peak age (fish.) dev 1993	-0.303	0.344	-0.225	0.398	Select. asc. wid. (fish.) dev 1993	0.318	0.351	0.350	0.421
Select. peak age (fish.) dev 1994	-0.058	0.327	0.070	0.374	Select. asc. wid. (fish.) dev 1994	0.631	0.304	0.762	0.353
Select. peak age (fish.) dev 1995	-0.399	0.347	-0.358	0.403	Select. asc. wid. (fish.) dev 1995	0.033	0.378	0.125	0.443
Select. peak age (fish.) dev 1996	1.030	0.298	0.796	0.339	Select. asc. wid. (fish.) dev 1996	1.142	0.305	0.905	0.367
Select. peak age (fish.) dev 1997	0.907	0.289	0.843	0.315	Select. asc. wid. (fish.) dev 1997	1.192	0.269	1.015	0.307
Select. peak age (fish.) dev 1998	0.204	0.266	0.419	0.312	Select. asc. wid. (fish.) dev 1998	0.269	0.273	0.341	0.320
Select. peak age (fish.) dev 1999	-0.315	0.269	-0.074	0.305	Select. asc. wid. (fish.) dev 1999	-0.300	0.289	-0.192	0.339
Select. peak age (fish.) dev 2000	-0.151	0.242	-0.114	0.284	Select. asc. wid. (fish.) dev 2000	-0.936	0.300	-1.176	0.400
Select. peak age (fish.) dev 2001	-0.338	0.277	0.199	0.291	Select. asc. wid. (fish.) dev 2001	-0.915	0.316	-0.475	0.334
Select. peak age (fish.) dev 2002	-0.731	0.257	-0.515	0.301	Select. asc. wid. (fish.) dev 2002	-0.837	0.298	-0.514	0.351
Select. peak age (fish.) dev 2003	-0.674	0.234	-0.710	0.263	Select. asc. wid. (fish.) dev 2003	-1.016	0.295	-1.050	0.358
Select. peak age (fish.) dev 2004	-1.137	0.229	-1.142	0.255	Select. asc. wid. (fish.) dev 2004	-1.481	0.315	-1.497	0.368
Select. peak age (fish.) dev 2005	-1.247	0.286	-1.058	0.309	Select. asc. wid. (fish.) dev 2005	-1.512	0.387	-1.294	0.407
Select. peak age (fish.) dev 2006	-0.934	0.253	-0.892	0.277	Select. asc. wid. (fish.) dev 2006	-1.769	0.373	-1.816	0.420
Select. peak age (fish.) dev 2007	0.516	0.259	0.457	0.293	Select. asc. wid. (fish.) dev 2007	-0.106	0.305	-0.404	0.386
Select. peak age (fish.) dev 2008	-0.086	0.261	0.116	0.281	Select. asc. wid. (fish.) dev 2008	-0.673	0.284	-0.647	0.328
Select. peak age (fish.) dev 2009	-0.790	0.296	-1.076	0.327	Select. asc. wid. (fish.) dev 2009	-2.030	0.379	-2.768	0.513
Select. peak age (fish.) dev 2010	0.405	0.464	0.389	0.499	Select. asc. wid. (fish.) dev 2010	0.352	0.452	0.557	0.482
Select. peak age (fish.) dev 2011	0.903	0.505	0.284	0.579	Select. asc. wid. (fish.) dev 2011	1.025	0.442	0.807	0.533
Select. peak age (fish.) dev 2012	0.216	0.282	0.397	0.351	Select. asc. wid. (fish.) dev 2012	-0.620	0.350	-0.683	0.468
Select. peak age (fish.) dev 2013	-0.895	0.551	-0.940	0.595	Select. asc. wid. (fish.) dev 2013	-0.362	0.589	-0.281	0.636
Select. peak age (fish.) dev 2014	-0.166	0.385	-0.282	0.393	Select. asc. wid. (fish.) dev 2014	-0.143	0.441	-0.085	0.465
Select. peak age (fish.) dev 2015	0.212	0.426	0.004	0.442	Select. asc. wid. (fish.) dev 2015	0.121	0.447	0.143	0.470
Select. peak age (fish.) dev 2016	0.060	0.533	-0.739	0.551	Select. asc. wid. (fish.) dev 2016	0.143	0.562	-0.480	0.665
Select. peak age (fish.) dev 2017	-0.071	0.379	0.415	0.412	Select. asc. wid. (fish.) dev 2017	-1.454	0.626	-0.846	0.601

Table 2.1.14f. Other *dev*s (4 of 4).

	Model 17.6			Model 17.6	
Quantity	Est.	StD.	Quantity	Est.	StD.
Select. peak age (sur.) dev 1982	0.633	0.339	Select. asc. wid. (sur.) dev 1982	0.000	1.000
Select. peak age (sur.) dev 1983	-0.050	0.220	Select. asc. wid. (sur.) dev 1983	0.001	1.000
Select. peak age (sur.) dev 1984	0.566	0.378	Select. asc. wid. (sur.) dev 1984	0.000	1.000
Select. peak age (sur.) dev 1985	-0.196	0.215	Select. asc. wid. (sur.) dev 1985	0.005	1.000
Select. peak age (sur.) dev 1986	0.408	0.279	Select. asc. wid. (sur.) dev 1986	0.000	1.000
Select. peak age (sur.) dev 1987	-0.100	0.235	Select. asc. wid. (sur.) dev 1987	0.003	1.000
Select. peak age (sur.) dev 1988	0.557	0.408	Select. asc. wid. (sur.) dev 1988	0.000	1.000
Select. peak age (sur.) dev 1989	1.030	0.282	Select. asc. wid. (sur.) dev 1989	0.000	1.000
Select. peak age (sur.) dev 1990	-0.177	0.217	Select. asc. wid. (sur.) dev 1990	0.005	1.000
Select. peak age (sur.) dev 1991	-0.060	0.222	Select. asc. wid. (sur.) dev 1991	0.002	1.000
Select. peak age (sur.) dev 1992	-0.493	0.212	Select. asc. wid. (sur.) dev 1992	0.003	1.000
Select. peak age (sur.) dev 1993	-0.279	0.197	Select. asc. wid. (sur.) dev 1993	0.006	1.000
Select. peak age (sur.) dev 1994	0.207	0.272	Select. asc. wid. (sur.) dev 1994	-0.001	1.000
Select. peak age (sur.) dev 1995	0.676	0.288	Select. asc. wid. (sur.) dev 1995	0.000	1.000
Select. peak age (sur.) dev 1996	0.876	0.283	Select. asc. wid. (sur.) dev 1996	0.000	1.000
Select. peak age (sur.) dev 1997	0.164	0.214	Select. asc. wid. (sur.) dev 1997	-0.001	1.000
Select. peak age (sur.) dev 1998	0.812	0.266	Select. asc. wid. (sur.) dev 1998	0.000	1.000
Select. peak age (sur.) dev 1999	0.687	0.277	Select. asc. wid. (sur.) dev 1999	0.000	1.000
Select. peak age (sur.) dev 2000	0.036	0.202	Select. asc. wid. (sur.) dev 2000	-0.001	1.000
Select. peak age (sur.) dev 2001	-0.474	0.188	Select. asc. wid. (sur.) dev 2001	0.004	1.000
Select. peak age (sur.) dev 2002	-0.160	0.226	Select. asc. wid. (sur.) dev 2002	0.004	1.000
Select. peak age (sur.) dev 2003	-0.225	0.209	Select. asc. wid. (sur.) dev 2003	0.005	1.000
Select. peak age (sur.) dev 2004	-0.071	0.222	Select. asc. wid. (sur.) dev 2004	0.002	1.000
Select. peak age (sur.) dev 2005	-0.575	0.206	Select. asc. wid. (sur.) dev 2005	0.000	1.000
Select. peak age (sur.) dev 2006	-0.574	0.210	Select. asc. wid. (sur.) dev 2006	0.000	1.000
Select. peak age (sur.) dev 2007	-0.579	0.193	Select. asc. wid. (sur.) dev 2007	0.000	1.000
Select. peak age (sur.) dev 2008	-0.213	0.213	Select. asc. wid. (sur.) dev 2008	0.005	1.000
Select. peak age (sur.) dev 2009	-0.299	0.192	Select. asc. wid. (sur.) dev 2009	0.006	1.000
Select. peak age (sur.) dev 2010	-0.187	0.234	Select. asc. wid. (sur.) dev 2010	0.005	1.000
Select. peak age (sur.) dev 2011	-0.295	0.194	Select. asc. wid. (sur.) dev 2011	0.006	1.000
Select. peak age (sur.) dev 2012	-0.975	0.465	Select. asc. wid. (sur.) dev 2012	-0.046	0.999
Select. peak age (sur.) dev 2013	-0.036	0.231	Select. asc. wid. (sur.) dev 2013	0.001	1.000
Select. peak age (sur.) dev 2014	-0.201	0.213	Select. asc. wid. (sur.) dev 2014	0.005	1.000
Select. peak age (sur.) dev 2015	0.026	0.269	Select. asc. wid. (sur.) dev 2015	0.000	1.000
Select. peak age (sur.) dev 2016	-0.844	0.337	Select. asc. wid. (sur.) dev 2016	-0.020	0.999
Select. peak age (sur.) dev 2017	0.384	0.649	Select. asc. wid. (sur.) dev 2017	0.000	1.000

Table 2.1.14g. Miscellaneous constants in the SS control files.

Quantity	16.6	16.6a	16.6b	16.6c	16.6d	16.6e	16.6f	16.6g	16.6h	17.2	17.6	18.1	18.2	18.3	18.4	18.5
Weight-at-length multiplier	6E-06	6E-06	6E-06	6E-06	6E-06	6E-06	6E-06	6E-06	6E-06	6E-06	6E-06	6E-06	6E-06	6E-06	6E-06	6E-06
Weight-at-length exponent	3.186	3.186	3.186	3.186	3.186	3.186	3.186	3.186	3.186	3.186	3.186	3.186	3.186	3.186	3.186	3.186
Maturity A50%	4.883	4.883	4.883	4.883	4.883	4.883	4.883	4.883	4.883	4.883	4.883	4.883	4.883	4.883	4.883	4.883
Maturity logistic slope	-0.965	-0.965	-0.965	-0.965	-0.965	-0.965	-0.965	-0.965	-0.965	-0.965	-0.965	-0.965	-0.965	-0.965	-0.965	-0.965
Migration "A" EBS to EBS												0	0			0
Migration "B" EBS to EBS												0	0			0
Migration "A" NBS to NBS												0	0			0
Migration "B" NBS to NBS												0	0			0
SD of ageing error at age 1	0.085	0.085	0.085	0.085	0.085	0.085	0.085	0.085	0.085	0.082	0.082	0.085	0.085	0.085	0.085	0.085
SD of ageing error at age 20	1.695	1.695	1.695	1.695	1.695	1.695	1.695	1.695	1.695	1.632	1.632	1.695	1.695	1.695	1.695	1.695
Proportion female	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
"A" EBS to NBS dev auto.												0				0
"B" EBS to NBS dev auto.												0				0
"B" NBS to EBS dev auto.												0				0
Beverton-Holt "steepness"	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Recruit dev autocorrelation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ln(EBS Q) dev autocorr.						0		0								
ln(NBS Q) dev autocorr.								0	0							
Select. top logit (fish.)										10	10					
Select. descend. width (fish.)										10	10					
Select. start logit (fish.)										-10	-10					
Select. end logit (fish.)										10	10					
Select. top logit (sur.)										10	10					
Select. descend. width (sur.)										10	10					
Select. start logit (sur.)										-10	-10					
Select. end logit (sur.)										10	10					
Sel. peak age (fish.) dev auto.										0	0					
Sel. asc. wid. (fish.) dev auto.										0	0					
Sel. peak age (sur.) dev auto.											0					
Sel. asc. wid. (sur.) dev. auto.											0					

Table 2.1.15. Fishing mortality (p. 1 of 2).

	Model 16.6		Model 16.6a		Model 16.6b		Model 16.6c		Model 16.6d		Model 16.6e		Model 16.6f		Model 16.6g	
Quantity	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.
Fishing mortality 1977	0.284	0.109	0.251	0.119	0.301	0.115	0.287	0.109	0.271	0.102	0.263	0.100	0.291	0.111	0.278	0.106
Fishing mortality 1978	0.370	0.148	0.324	0.163	0.395	0.160	0.374	0.148	0.350	0.138	0.340	0.135	0.379	0.152	0.361	0.143
Fishing mortality 1979	0.290	0.113	0.256	0.129	0.313	0.124	0.294	0.114	0.274	0.105	0.266	0.103	0.299	0.117	0.283	0.110
Fishing mortality 1980	0.321	0.106	0.295	0.132	0.347	0.116	0.326	0.106	0.305	0.098	0.297	0.098	0.331	0.109	0.312	0.102
Fishing mortality 1981	0.201	0.039	0.208	0.058	0.218	0.044	0.206	0.039	0.194	0.037	0.190	0.038	0.208	0.040	0.197	0.039
Fishing mortality 1982	0.104	0.013	0.116	0.020	0.113	0.015	0.107	0.013	0.102	0.013	0.100	0.014	0.107	0.013	0.105	0.014
Fishing mortality 1983	0.118	0.011	0.134	0.018	0.127	0.014	0.122	0.012	0.116	0.011	0.114	0.013	0.122	0.012	0.119	0.013
Fishing mortality 1984	0.160	0.013	0.193	0.023	0.171	0.017	0.164	0.014	0.158	0.013	0.155	0.015	0.164	0.014	0.161	0.016
Fishing mortality 1985	0.177	0.014	0.209	0.024	0.189	0.018	0.181	0.014	0.175	0.014	0.171	0.016	0.181	0.014	0.178	0.016
Fishing mortality 1986	0.180	0.013	0.187	0.019	0.191	0.017	0.183	0.013	0.177	0.013	0.174	0.015	0.184	0.013	0.179	0.015
Fishing mortality 1987	0.191	0.012	0.207	0.019	0.202	0.016	0.194	0.013	0.188	0.012	0.185	0.015	0.196	0.013	0.190	0.015
Fishing mortality 1988	0.255	0.016	0.270	0.022	0.268	0.020	0.258	0.016	0.251	0.015	0.247	0.018	0.261	0.016	0.253	0.018
Fishing mortality 1989	0.214	0.012	0.230	0.016	0.225	0.015	0.217	0.012	0.212	0.012	0.209	0.014	0.220	0.012	0.213	0.014
Fishing mortality 1990	0.239	0.012	0.253	0.016	0.251	0.015	0.241	0.013	0.237	0.012	0.233	0.014	0.244	0.013	0.237	0.014
Fishing mortality 1991	0.421	0.023	0.445	0.028	0.442	0.027	0.423	0.023	0.417	0.023	0.407	0.026	0.430	0.024	0.415	0.026
Fishing mortality 1992	0.513	0.035	0.532	0.040	0.531	0.039	0.513	0.035	0.506	0.034	0.487	0.037	0.522	0.035	0.496	0.037
Fishing mortality 1993	0.393	0.027	0.405	0.031	0.404	0.030	0.394	0.027	0.386	0.027	0.371	0.028	0.398	0.028	0.374	0.028
Fishing mortality 1994	0.420	0.025	0.439	0.029	0.436	0.028	0.421	0.026	0.413	0.025	0.403	0.027	0.425	0.026	0.408	0.027
Fishing mortality 1995	0.532	0.031	0.557	0.036	0.552	0.035	0.530	0.031	0.524	0.031	0.515	0.033	0.538	0.031	0.523	0.033
Fishing mortality 1996	0.497	0.031	0.522	0.036	0.518	0.034	0.491	0.031	0.486	0.030	0.485	0.033	0.504	0.031	0.490	0.032
Fishing mortality 1997	0.540	0.033	0.568	0.038	0.563	0.037	0.530	0.033	0.535	0.033	0.532	0.036	0.549	0.033	0.540	0.035
Fishing mortality 1998	0.429	0.028	0.451	0.033	0.446	0.031	0.420	0.028	0.427	0.028	0.423	0.030	0.436	0.028	0.432	0.030
Fishing mortality 1999	0.438	0.030	0.461	0.035	0.456	0.034	0.425	0.030	0.437	0.031	0.432	0.033	0.445	0.031	0.441	0.033
Fishing mortality 2000	0.424	0.030	0.446	0.035	0.441	0.033	0.407	0.029	0.418	0.029	0.417	0.032	0.432	0.030	0.421	0.031
Fishing mortality 2001	0.338	0.021	0.353	0.024	0.349	0.023	0.326	0.020	0.333	0.021	0.332	0.022	0.345	0.021	0.337	0.022
Fishing mortality 2002	0.409	0.024	0.423	0.028	0.419	0.027	0.388	0.023	0.405	0.024	0.401	0.026	0.416	0.025	0.407	0.026
Fishing mortality 2003	0.445	0.026	0.460	0.030	0.456	0.029	0.422	0.024	0.443	0.027	0.437	0.028	0.453	0.027	0.439	0.028
Fishing mortality 2004	0.422	0.023	0.436	0.026	0.432	0.025	0.411	0.021	0.422	0.023	0.416	0.024	0.429	0.023	0.417	0.024
Fishing mortality 2005	0.430	0.022	0.443	0.024	0.440	0.024	0.428	0.021	0.429	0.022	0.426	0.023	0.437	0.022	0.427	0.023
Fishing mortality 2006	0.494	0.026	0.507	0.029	0.503	0.028	0.498	0.025	0.489	0.027	0.489	0.028	0.501	0.027	0.487	0.027
Fishing mortality 2007	0.483	0.028	0.493	0.030	0.490	0.029	0.497	0.027	0.472	0.028	0.478	0.029	0.489	0.028	0.472	0.028
Fishing mortality 2008	0.599	0.038	0.609	0.040	0.606	0.039	0.627	0.039	0.577	0.037	0.595	0.039	0.606	0.038	0.583	0.038
Fishing mortality 2009	0.747	0.056	0.761	0.059	0.757	0.057	0.795	0.060	0.704	0.053	0.744	0.058	0.753	0.056	0.718	0.054
Fishing mortality 2010	0.580	0.043	0.601	0.047	0.597	0.045	0.621	0.047	0.548	0.041	0.575	0.045	0.585	0.044	0.554	0.042
Fishing mortality 2011	0.594	0.040	0.617	0.044	0.611	0.043	0.639	0.044	0.570	0.039	0.583	0.043	0.598	0.041	0.578	0.041
Fishing mortality 2012	0.567	0.041	0.595	0.045	0.589	0.044	0.611	0.045	0.546	0.039	0.554	0.043	0.570	0.042	0.553	0.042
Fishing mortality 2013	0.468	0.033	0.493	0.036	0.486	0.035	0.501	0.037	0.455	0.032	0.456	0.036	0.469	0.034	0.464	0.035
Fishing mortality 2014	0.546	0.045	0.576	0.049	0.569	0.047	0.587	0.050	0.530	0.043	0.530	0.048	0.545	0.045	0.534	0.047
Fishing mortality 2015	0.483	0.042	0.513	0.046	0.505	0.044	0.509	0.046	0.475	0.041	0.469	0.046	0.482	0.043	0.464	0.044
Fishing mortality 2016	0.430	0.039	0.457	0.042	0.449	0.040	0.447	0.042	0.429	0.039	0.417	0.044	0.429	0.039	0.409	0.041
Fishing mortality 2017	0.365	0.036	0.388	0.038	0.380	0.037	0.375	0.038	0.364	0.035	0.353	0.041	0.363	0.036	0.339	0.037

Table 2.1.15. Fishing mortality (p. 2 of 2).

	Model 16.6h		Model 17.2		Model 17.6		Model 18.1		Model 18.2		Model 18.3		Model 18.4		Model 18.5	
Quantity	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.
Fishing mortality 1977	0.301	0.114	0.565	0.270	0.487	0.148	0.202	0.062	0.241	0.082	0.454	0.204	0.216	0.080	0.225	0.077
Fishing mortality 1978	0.394	0.157	0.613	0.295	1.210	0.689	0.294	0.088	0.330	0.116	0.592	0.268	0.271	0.103	0.330	0.117
Fishing mortality 1979	0.309	0.120	0.325	0.108	0.530	0.181	0.206	0.060	0.246	0.084	0.453	0.195	0.209	0.077	0.232	0.077
Fishing mortality 1980	0.340	0.110	0.363	0.131	0.538	0.197	0.252	0.066	0.288	0.086	0.468	0.164	0.232	0.073	0.292	0.093
Fishing mortality 1981	0.211	0.039	0.140	0.027	0.175	0.039	0.187	0.034	0.197	0.037	0.249	0.048	0.153	0.032	0.215	0.049
Fishing mortality 1982	0.111	0.013	0.194	0.051	0.230	0.070	0.114	0.015	0.109	0.014	0.118	0.014	0.084	0.012	0.125	0.022
Fishing mortality 1983	0.125	0.012	0.206	0.039	0.241	0.049	0.144	0.016	0.132	0.013	0.131	0.012	0.099	0.012	0.153	0.023
Fishing mortality 1984	0.168	0.014	0.258	0.036	0.291	0.041	0.211	0.021	0.187	0.017	0.175	0.014	0.135	0.014	0.218	0.030
Fishing mortality 1985	0.185	0.014	0.212	0.020	0.246	0.020	0.263	0.025	0.220	0.019	0.193	0.015	0.151	0.014	0.268	0.035
Fishing mortality 1986	0.186	0.014	0.207	0.018	0.248	0.021	0.268	0.024	0.225	0.018	0.195	0.014	0.153	0.013	0.269	0.032
Fishing mortality 1987	0.199	0.013	0.228	0.019	0.280	0.026	0.290	0.025	0.237	0.018	0.206	0.013	0.166	0.013	0.293	0.035
Fishing mortality 1988	0.264	0.016	0.242	0.018	0.274	0.021	0.385	0.032	0.319	0.023	0.273	0.016	0.228	0.017	0.397	0.045
Fishing mortality 1989	0.221	0.012	0.269	0.025	0.287	0.028	0.312	0.024	0.265	0.018	0.228	0.012	0.196	0.014	0.327	0.035
Fishing mortality 1990	0.247	0.013	0.326	0.026	0.366	0.032	0.378	0.030	0.305	0.020	0.254	0.012	0.224	0.014	0.397	0.045
Fishing mortality 1991	0.434	0.024	0.426	0.025	0.461	0.027	0.668	0.053	0.550	0.039	0.449	0.023	0.391	0.025	0.694	0.075
Fishing mortality 1992	0.525	0.035	0.459	0.029	0.506	0.033	0.822	0.075	0.664	0.054	0.557	0.037	0.471	0.036	0.837	0.097
Fishing mortality 1993	0.397	0.027	0.324	0.026	0.357	0.032	0.546	0.045	0.471	0.035	0.430	0.029	0.356	0.029	0.560	0.060
Fishing mortality 1994	0.425	0.025	0.392	0.028	0.431	0.035	0.610	0.052	0.510	0.036	0.457	0.026	0.377	0.028	0.618	0.074
Fishing mortality 1995	0.542	0.031	0.510	0.029	0.546	0.034	0.770	0.064	0.655	0.046	0.585	0.032	0.472	0.035	0.780	0.090
Fishing mortality 1996	0.504	0.031	0.653	0.045	0.690	0.050	0.679	0.054	0.598	0.043	0.557	0.033	0.438	0.035	0.694	0.076
Fishing mortality 1997	0.552	0.033	0.757	0.058	0.863	0.071	0.789	0.072	0.662	0.049	0.620	0.037	0.481	0.039	0.814	0.105
Fishing mortality 1998	0.440	0.028	0.561	0.034	0.642	0.043	0.583	0.047	0.514	0.038	0.482	0.030	0.379	0.032	0.604	0.065
Fishing mortality 1999	0.450	0.031	0.568	0.037	0.636	0.041	0.611	0.056	0.531	0.042	0.488	0.032	0.387	0.034	0.636	0.081
Fishing mortality 2000	0.432	0.030	0.676	0.054	0.758	0.060	0.595	0.051	0.510	0.039	0.508	0.036	0.368	0.032	0.603	0.070
Fishing mortality 2001	0.346	0.021	0.461	0.042	0.564	0.056	0.472	0.039	0.402	0.028	0.411	0.027	0.291	0.023	0.469	0.053
Fishing mortality 2002	0.419	0.025	0.436	0.029	0.476	0.031	0.594	0.049	0.500	0.035	0.506	0.035	0.347	0.026	0.580	0.065
Fishing mortality 2003	0.451	0.026	0.443	0.028	0.490	0.030	0.637	0.049	0.548	0.038	0.538	0.036	0.381	0.028	0.628	0.065
Fishing mortality 2004	0.427	0.023	0.384	0.018	0.420	0.020	0.637	0.052	0.521	0.034	0.464	0.026	0.377	0.025	0.646	0.071
Fishing mortality 2005	0.436	0.022	0.425	0.018	0.458	0.020	0.649	0.049	0.536	0.034	0.443	0.023	0.402	0.026	0.682	0.070
Fishing mortality 2006	0.497	0.026	0.546	0.025	0.568	0.027	0.750	0.058	0.625	0.042	0.492	0.027	0.477	0.033	0.813	0.088
Fishing mortality 2007	0.481	0.027	0.662	0.042	0.663	0.047	0.736	0.060	0.608	0.042	0.469	0.027	0.466	0.034	0.791	0.086
Fishing mortality 2008	0.591	0.037	0.711	0.053	0.686	0.050	0.894	0.105	0.688	0.050	0.570	0.036	0.568	0.045	0.940	0.137
Fishing mortality 2009	0.724	0.053	0.905	0.085	0.822	0.065	1.240	0.167	0.901	0.077	0.717	0.053	0.679	0.062	1.245	0.200
Fishing mortality 2010	0.561	0.040	0.812	0.133	0.784	0.124	0.603	0.054	0.624	0.048	0.572	0.041	0.509	0.047	0.624	0.069
Fishing mortality 2011	0.590	0.039	0.895	0.163	0.764	0.124	0.877	0.112	0.898	0.098	0.580	0.037	0.526	0.047	0.886	0.143
Fishing mortality 2012	0.565	0.040	0.889	0.107	1.155	0.131	0.721	0.089	0.559	0.045	0.566	0.037	0.511	0.049	0.756	0.112
Fishing mortality 2013	0.474	0.033	0.496	0.044	0.548	0.046	0.606	0.075	0.512	0.042	0.492	0.031	0.406	0.039	0.618	0.094
Fishing mortality 2014	0.546	0.044	0.684	0.071	0.763	0.060	0.709	0.086	0.608	0.055	0.588	0.043	0.441	0.047	0.692	0.104
Fishing mortality 2015	0.476	0.040	0.680	0.105	0.798	0.107	0.607	0.075	0.525	0.050	0.549	0.044	0.397	0.044	0.603	0.092
Fishing mortality 2016	0.421	0.037	0.549	0.087	0.646	0.072	0.568	0.069	0.610	0.066	0.520	0.046	0.374	0.042	0.602	0.093
Fishing mortality 2017	0.351	0.033	0.548	0.083	0.972	0.158	0.581	0.077	0.433	0.046	0.460	0.047	0.334	0.039	0.605	0.098

Table 2.1.16. Biology parameters after adjustments.

	16.6c	16.6d	17.6	18.1			18.2			18.3	18.4	18.5			
				Mig A	Migration B		Mig A	Migration B					Mig A	Migration B	
Year	K	L(1.5)	L(1.5)	EBS-NBS	EBS-NBS	NBS-EBS	EBS-NBS	EBS-NBS	NBS-EBS	M	M(5)	M(5)	EBS-NBS	EBS-NBS	NBS-EBS
1977	0.20	16.69	16.95	-1.45	1.57	0.27	-2.24	0.07	1.96	0.35	0.39	0.30	-1.53	1.47	0.46
1978	0.20	16.69	16.95	-1.45	1.57	0.27	-2.24	0.07	1.96	0.35	0.39	0.30	-1.53	1.47	0.46
1979	0.20	16.69	16.95	-1.45	1.57	0.27	-2.24	0.07	1.96	0.35	0.39	0.30	-1.53	1.47	0.46
1980	0.20	16.69	16.95	-1.45	1.57	0.27	-2.24	0.07	1.96	0.35	0.39	0.30	-1.53	1.47	0.46
1981	0.20	16.69	15.75	-1.45	1.57	0.27	-2.24	0.07	1.96	0.35	0.39	0.30	-1.53	1.47	0.46
1982	0.20	16.52	15.60	-1.45	1.57	0.27	-2.24	0.07	1.96	0.35	0.39	0.30	-1.53	1.47	0.46
1983	0.20	17.08	18.57	-1.45	1.57	0.27	-2.24	0.07	1.96	0.35	0.34	0.25	-1.53	1.47	0.46
1984	0.20	16.57	17.56	-1.45	1.57	0.27	-2.24	0.07	1.96	0.35	0.40	0.31	-1.53	1.47	0.46
1985	0.20	16.60	14.94	-1.45	1.57	0.27	-2.24	0.07	1.96	0.35	0.35	0.27	-1.53	1.47	0.46
1986	0.20	16.22	17.30	-1.45	1.57	0.27	-2.24	0.07	1.96	0.35	0.38	0.29	-1.53	1.47	0.46
1987	0.20	17.23	16.88	-1.45	1.57	0.27	-2.24	0.07	1.96	0.35	0.45	0.36	-1.53	1.47	0.46
1988	0.20	16.59	16.63	-1.45	1.57	0.27	-2.24	0.07	1.96	0.35	0.42	0.33	-1.53	1.47	0.46
1989	0.20	17.04	15.59	-1.45	1.57	0.27	-2.24	0.07	1.96	0.35	0.44	0.34	-1.53	1.47	0.46
1990	0.20	16.66	16.89	-1.45	1.57	0.27	-2.24	0.07	1.96	0.35	0.32	0.24	-1.53	1.47	0.46
1991	0.20	16.84	17.80	-1.45	1.57	0.27	-2.24	0.07	1.96	0.35	0.39	0.30	-1.53	1.47	0.46
1992	0.20	16.34	16.88	-1.45	1.57	0.27	-2.24	0.07	1.96	0.35	0.37	0.28	-1.53	1.47	0.46
1993	0.20	17.11	18.05	-1.45	1.57	0.27	-2.24	0.07	1.96	0.35	0.35	0.27	-1.53	1.47	0.46
1994	0.20	16.01	17.64	-1.45	1.57	0.27	-2.24	0.07	1.96	0.35	0.37	0.28	-1.53	1.47	0.46
1995	0.20	16.14	17.62	-1.45	1.57	0.27	-2.24	0.07	1.96	0.35	0.39	0.30	-1.53	1.47	0.46
1996	0.20	17.38	17.36	-1.45	1.57	0.27	-2.24	0.07	1.96	0.35	0.43	0.33	-1.53	1.47	0.46
1997	0.20	16.88	16.47	-1.45	1.57	0.27	-2.24	0.07	1.96	0.35	0.38	0.29	-1.53	1.47	0.46
1998	0.19	17.27	16.68	-1.45	1.57	0.27	-2.24	0.07	1.96	0.23	0.44	0.34	-1.53	1.47	0.46
1999	0.21	15.46	15.47	-1.45	1.57	0.27	-2.24	0.07	1.96	0.44	0.33	0.25	-1.53	1.47	0.46
2000	0.20	16.44	17.95	-1.45	1.57	0.27	-2.24	0.07	1.96	0.35	0.36	0.28	-1.53	1.47	0.46
2001	0.20	16.75	18.26	-1.45	1.57	0.27	-2.24	0.07	1.96	0.33	0.36	0.27	-1.53	1.47	0.46
2002	0.20	17.25	18.60	-1.45	1.57	0.27	-2.24	0.07	1.96	0.33	0.42	0.32	-1.53	1.47	0.46
2003	0.18	17.67	17.82	-1.45	1.57	0.27	-2.24	0.07	1.96	0.23	0.46	0.37	-1.53	1.47	0.46
2004	0.19	17.35	19.27	-1.45	1.57	0.27	-2.24	0.07	1.96	0.26	0.46	0.37	-1.53	1.47	0.46
2005	0.19	17.42	15.23	-1.45	1.57	0.27	-2.24	0.07	1.96	0.31	0.47	0.38	-1.53	1.47	0.46
2006	0.20	16.23	15.05	-1.45	1.57	0.27	-2.24	0.07	1.96	0.34	0.38	0.29	-1.53	1.47	0.46
2007	0.20	16.17	14.65	-0.90	1.08	0.68	-3.15	-0.14	2.09	0.33	0.34	0.26	-1.03	0.94	0.90
2008	0.20	15.80	14.46	-0.29	1.32	0.18	-2.81	-0.10	1.20	0.36	0.33	0.25	-0.59	1.18	0.45
2009	0.20	15.87	16.48	-3.66	1.47	0.24	-5.53	0.94	1.17	0.40	0.27	0.19	-3.81	1.37	0.40
2010	0.20	15.98	17.45	-1.34	0.91	0.45	-0.97	-0.43	0.89	0.36	0.33	0.25	-1.50	0.87	0.63
2011	0.20	16.67	14.11	-1.11	1.25	0.21	-4.00	-0.45	1.99	0.35	0.41	0.32	-1.35	1.13	0.40
2012	0.21	15.59	17.32	-1.54	1.58	0.12	-3.48	0.34	1.26	0.44	0.35	0.26	-1.67	1.41	0.33
2013	0.20	16.23	16.57	-1.76	1.42	-0.10	-3.47	0.37	1.00	0.36	0.26	0.19	-1.82	1.38	0.11
2014	0.20	17.23	17.43	-1.64	1.40	-0.01	-3.14	-0.07	0.67	0.37	0.41	0.32	-1.71	1.37	0.16
2015	0.21	17.34	20.56	-1.68	1.73	0.12	-1.87	1.37	2.50	0.44	0.44	0.34	-1.70	1.67	0.21
2016	0.20	18.15	20.22	0.07	1.72	0.53	-1.03	0.25	4.50	0.33	0.50	0.40	-0.05	1.54	0.80
2017	0.20	16.94	16.95	-1.45	1.57	0.27	-2.24	0.07	1.96	0.40	0.41	0.32	-1.53	1.47	0.46

Table 2.1.17a. Migration rates (Model 18.1).

Year	Source	Dest.	0	1	2	3	4	5	6	7	8	9	10	11	12
2007	EBS	EBS	0.712	0.712	0.712	0.712	0.712	0.601	0.478	0.358	0.254	0.254	0.254	0.254	0.254
2007	EBS	NBS	0.288	0.288	0.288	0.288	0.288	0.399	0.522	0.642	0.746	0.746	0.746	0.746	0.746
2007	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.663	0.663	0.663	0.663	0.663
2007	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.337	0.337	0.337	0.337	0.337
2008	EBS	EBS	0.572	0.572	0.572	0.572	0.572	0.472	0.374	0.286	0.211	0.211	0.211	0.211	0.211
2008	EBS	NBS	0.428	0.428	0.428	0.428	0.428	0.528	0.626	0.714	0.789	0.789	0.789	0.789	0.789
2008	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.545	0.545	0.545	0.545	0.545
2008	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.455	0.455	0.455	0.455	0.455
2009	EBS	EBS	0.975	0.975	0.975	0.975	0.975	0.915	0.749	0.453	0.186	0.186	0.186	0.186	0.186
2009	EBS	NBS	0.025	0.025	0.025	0.025	0.025	0.085	0.251	0.547	0.814	0.814	0.814	0.814	0.814
2009	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.560	0.560	0.560	0.560	0.560
2009	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.440	0.440	0.440	0.440	0.440
2010	EBS	EBS	0.792	0.792	0.792	0.792	0.792	0.685	0.554	0.415	0.288	0.288	0.288	0.288	0.288
2010	EBS	NBS	0.208	0.208	0.208	0.208	0.208	0.315	0.446	0.585	0.712	0.712	0.712	0.712	0.712
2010	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.610	0.610	0.610	0.610	0.610
2010	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.390	0.390	0.390	0.390	0.390
2011	EBS	EBS	0.753	0.753	0.753	0.753	0.753	0.628	0.483	0.341	0.223	0.223	0.223	0.223	0.223
2011	EBS	NBS	0.247	0.247	0.247	0.247	0.247	0.372	0.517	0.659	0.777	0.777	0.777	0.777	0.777
2011	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.552	0.552	0.552	0.552	0.552
2011	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.448	0.448	0.448	0.448	0.448
2012	EBS	EBS	0.823	0.823	0.823	0.823	0.823	0.681	0.494	0.309	0.170	0.170	0.170	0.170	0.170
2012	EBS	NBS	0.177	0.177	0.177	0.177	0.177	0.319	0.506	0.691	0.830	0.830	0.830	0.830	0.830
2012	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.531	0.531	0.531	0.531	0.531
2012	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.469	0.469	0.469	0.469	0.469
2013	EBS	EBS	0.853	0.853	0.853	0.853	0.853	0.724	0.542	0.349	0.195	0.195	0.195	0.195	0.195
2013	EBS	NBS	0.147	0.147	0.147	0.147	0.147	0.276	0.458	0.651	0.805	0.805	0.805	0.805	0.805
2013	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.474	0.474	0.474	0.474	0.474
2013	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.526	0.526	0.526	0.526	0.526
2014	EBS	EBS	0.837	0.837	0.837	0.837	0.837	0.707	0.530	0.346	0.198	0.198	0.198	0.198	0.198
2014	EBS	NBS	0.163	0.163	0.163	0.163	0.163	0.293	0.470	0.654	0.802	0.802	0.802	0.802	0.802
2014	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.496	0.496	0.496	0.496	0.496
2014	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.504	0.504	0.504	0.504	0.504
2015	EBS	EBS	0.843	0.843	0.843	0.843	0.843	0.696	0.494	0.294	0.151	0.151	0.151	0.151	0.151
2015	EBS	NBS	0.157	0.157	0.157	0.157	0.157	0.304	0.506	0.706	0.849	0.849	0.849	0.849	0.849
2015	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.530	0.530	0.530	0.530	0.530
2015	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.470	0.470	0.470	0.470	0.470
2016	EBS	EBS	0.484	0.484	0.484	0.484	0.484	0.383	0.291	0.213	0.152	0.152	0.152	0.152	0.152
2016	EBS	NBS	0.516	0.516	0.516	0.516	0.516	0.617	0.709	0.787	0.848	0.848	0.848	0.848	0.848
2016	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.630	0.630	0.630	0.630	0.630
2016	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.370	0.370	0.370	0.370	0.370

Table 2.1.17b. Migration rates (Model 18.2).

Year	Source	Dest.	0	1	2	3	4	5	6	7	8	9	10	11	12
2007	EBS	EBS	0.959	0.959	0.959	0.959	0.959	0.917	0.838	0.709	0.535	0.535	0.535	0.535	0.535
2007	EBS	NBS	0.041	0.041	0.041	0.041	0.041	0.083	0.162	0.291	0.465	0.465	0.465	0.465	0.465
2007	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.890	0.890	0.890	0.890	0.890
2007	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.110	0.110	0.110	0.110	0.110
2008	EBS	EBS	0.943	0.943	0.943	0.943	0.943	0.894	0.811	0.685	0.524	0.524	0.524	0.524	0.524
2008	EBS	NBS	0.057	0.057	0.057	0.057	0.057	0.106	0.189	0.315	0.476	0.476	0.476	0.476	0.476
2008	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.768	0.768	0.768	0.768	0.768
2008	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.232	0.232	0.232	0.232	0.232
2009	EBS	EBS	0.996	0.996	0.996	0.996	0.996	0.980	0.909	0.663	0.281	0.281	0.281	0.281	0.281
2009	EBS	NBS	0.004	0.004	0.004	0.004	0.004	0.020	0.091	0.337	0.719	0.719	0.719	0.719	0.719
2009	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.763	0.763	0.763	0.763	0.763
2009	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.237	0.237	0.237	0.237	0.237
2010	EBS	EBS	0.725	0.725	0.725	0.725	0.725	0.697	0.668	0.638	0.606	0.606	0.606	0.606	0.606
2010	EBS	NBS	0.275	0.275	0.275	0.275	0.275	0.303	0.332	0.362	0.394	0.394	0.394	0.394	0.394
2010	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.708	0.708	0.708	0.708	0.708
2010	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.292	0.292	0.292	0.292	0.292
2011	EBS	EBS	0.982	0.982	0.982	0.982	0.982	0.958	0.903	0.792	0.610	0.610	0.610	0.610	0.610
2011	EBS	NBS	0.018	0.018	0.018	0.018	0.018	0.042	0.097	0.208	0.390	0.390	0.390	0.390	0.390
2011	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.880	0.880	0.880	0.880	0.880
2011	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.120	0.120	0.120	0.120	0.120
2012	EBS	EBS	0.970	0.970	0.970	0.970	0.970	0.926	0.827	0.649	0.415	0.415	0.415	0.415	0.415
2012	EBS	NBS	0.030	0.030	0.030	0.030	0.030	0.074	0.173	0.351	0.585	0.585	0.585	0.585	0.585
2012	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.779	0.779	0.779	0.779	0.779
2012	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.221	0.221	0.221	0.221	0.221
2013	EBS	EBS	0.970	0.970	0.970	0.970	0.970	0.925	0.825	0.644	0.410	0.410	0.410	0.410	0.410
2013	EBS	NBS	0.030	0.030	0.030	0.030	0.030	0.075	0.175	0.356	0.590	0.590	0.590	0.590	0.590
2013	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.731	0.731	0.731	0.731	0.731
2013	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.269	0.269	0.269	0.269	0.269
2014	EBS	EBS	0.958	0.958	0.958	0.958	0.958	0.914	0.832	0.697	0.517	0.517	0.517	0.517	0.517
2014	EBS	NBS	0.042	0.042	0.042	0.042	0.042	0.086	0.168	0.303	0.483	0.483	0.483	0.483	0.483
2014	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.661	0.661	0.661	0.661	0.661
2014	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.339	0.339	0.339	0.339	0.339
2015	EBS	EBS	0.866	0.866	0.866	0.866	0.866	0.742	0.561	0.363	0.202	0.202	0.202	0.202	0.202
2015	EBS	NBS	0.134	0.134	0.134	0.134	0.134	0.258	0.439	0.637	0.798	0.798	0.798	0.798	0.798
2015	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.924	0.924	0.924	0.924	0.924
2015	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.076	0.076	0.076	0.076	0.076
2016	EBS	EBS	0.738	0.738	0.738	0.738	0.738	0.671	0.597	0.518	0.438	0.438	0.438	0.438	0.438
2016	EBS	NBS	0.262	0.262	0.262	0.262	0.262	0.329	0.403	0.482	0.562	0.562	0.562	0.562	0.562
2016	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.989	0.989	0.989	0.989	0.989
2016	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.011	0.011	0.011	0.011	0.011

Table 2.1.17c. Migration rates (Model 18.3).

Year	Source	Dest.	0	1	2	3	4	5	6	7	8	9	10	11	12
2007	EBS	EBS	0.737	0.737	0.737	0.737	0.737	0.631	0.510	0.389	0.280	0.280	0.280	0.280	0.280
2007	EBS	NBS	0.263	0.263	0.263	0.263	0.263	0.369	0.490	0.611	0.720	0.720	0.720	0.720	0.720
2007	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.711	0.711	0.711	0.711	0.711
2007	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.289	0.289	0.289	0.289	0.289
2008	EBS	EBS	0.643	0.643	0.643	0.643	0.643	0.536	0.426	0.323	0.235	0.235	0.235	0.235	0.235
2008	EBS	NBS	0.357	0.357	0.357	0.357	0.357	0.464	0.574	0.677	0.765	0.765	0.765	0.765	0.765
2008	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.610	0.610	0.610	0.610	0.610
2008	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.390	0.390	0.390	0.390	0.390
2009	EBS	EBS	0.978	0.978	0.978	0.978	0.978	0.925	0.772	0.482	0.203	0.203	0.203	0.203	0.203
2009	EBS	NBS	0.022	0.022	0.022	0.022	0.022	0.075	0.228	0.518	0.797	0.797	0.797	0.797	0.797
2009	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.598	0.598	0.598	0.598	0.598
2009	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.402	0.402	0.402	0.402	0.402
2010	EBS	EBS	0.818	0.818	0.818	0.818	0.818	0.712	0.578	0.430	0.295	0.295	0.295	0.295	0.295
2010	EBS	NBS	0.182	0.182	0.182	0.182	0.182	0.288	0.422	0.570	0.705	0.705	0.705	0.705	0.705
2010	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.653	0.653	0.653	0.653	0.653
2010	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.347	0.347	0.347	0.347	0.347
2011	EBS	EBS	0.793	0.793	0.793	0.793	0.793	0.674	0.527	0.375	0.245	0.245	0.245	0.245	0.245
2011	EBS	NBS	0.207	0.207	0.207	0.207	0.207	0.326	0.473	0.625	0.755	0.755	0.755	0.755	0.755
2011	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.598	0.598	0.598	0.598	0.598
2011	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.402	0.402	0.402	0.402	0.402
2012	EBS	EBS	0.842	0.842	0.842	0.842	0.842	0.711	0.532	0.345	0.195	0.195	0.195	0.195	0.195
2012	EBS	NBS	0.158	0.158	0.158	0.158	0.158	0.289	0.468	0.655	0.805	0.805	0.805	0.805	0.805
2012	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.583	0.583	0.583	0.583	0.583
2012	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.417	0.417	0.417	0.417	0.417
2013	EBS	EBS	0.861	0.861	0.861	0.861	0.861	0.735	0.555	0.359	0.201	0.201	0.201	0.201	0.201
2013	EBS	NBS	0.139	0.139	0.139	0.139	0.139	0.265	0.445	0.641	0.799	0.799	0.799	0.799	0.799
2013	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.527	0.527	0.527	0.527	0.527
2013	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.473	0.473	0.473	0.473	0.473
2014	EBS	EBS	0.847	0.847	0.847	0.847	0.847	0.719	0.542	0.354	0.203	0.203	0.203	0.203	0.203
2014	EBS	NBS	0.153	0.153	0.153	0.153	0.153	0.281	0.458	0.646	0.797	0.797	0.797	0.797	0.797
2014	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.539	0.539	0.539	0.539	0.539
2014	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.461	0.461	0.461	0.461	0.461
2015	EBS	EBS	0.846	0.846	0.846	0.846	0.846	0.703	0.504	0.305	0.159	0.159	0.159	0.159	0.159
2015	EBS	NBS	0.154	0.154	0.154	0.154	0.154	0.297	0.496	0.695	0.841	0.841	0.841	0.841	0.841
2015	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.552	0.552	0.552	0.552	0.552
2015	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.448	0.448	0.448	0.448	0.448
2016	EBS	EBS	0.514	0.514	0.514	0.514	0.514	0.415	0.322	0.241	0.176	0.176	0.176	0.176	0.176
2016	EBS	NBS	0.486	0.486	0.486	0.486	0.486	0.585	0.678	0.759	0.824	0.824	0.824	0.824	0.824
2016	NBS	EBS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.689	0.689	0.689	0.689	0.689
2016	NBS	NBS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.311	0.311	0.311	0.311	0.311

Table 2.1.18. Catchability.

Area	Year	M16.6	M16.6a	M16.6b	M16.6c	M16.6d	M16.6e	M16.6f	M16.6g	M16.6h	M17.2	M17.6	M18.1	M18.2	M18.3	M18.4	M18.5
EBS	1982	0.929		0.995	0.943	0.913	0.872	0.904	0.920	0.931	1.043	1.316	1.240	1.074	1.008	0.816	1.260
EBS	1983	0.929		0.995	0.943	0.913	0.951	1.070	0.998	1.101	1.043	1.334	1.240	1.074	1.008	0.816	1.348
EBS	1984	0.929		0.995	0.943	0.913	0.867	1.001	0.911	1.030	1.043	1.244	1.240	1.074	1.008	0.816	1.312
EBS	1985	0.929		0.995	0.943	0.913	0.954	0.917	0.997	0.944	1.043	1.276	1.240	1.074	1.008	0.816	1.267
EBS	1986	0.929		0.995	0.943	0.913	0.954	1.037	0.997	1.067	1.043	1.288	1.240	1.074	1.008	0.816	1.331
EBS	1987	0.929	*0.994*	*0.990*	0.943	0.913	0.948	1.008	0.988	1.038	1.043	1.207	1.240	1.074	1.008	0.816	1.316
EBS	1988	0.929	*0.994*	*0.990*	0.943	0.913	0.937	0.958	0.974	0.986	1.043	1.145	1.240	1.074	1.008	0.816	1.290
EBS	1989	0.929	*0.994*	*0.990*	0.943	0.913	0.734	0.880	0.760	0.906	1.043	0.984	1.240	1.074	1.008	0.816	1.246
EBS	1990	0.929	*0.994*	*0.990*	0.943	0.913	0.836	0.898	0.872	0.924	1.043	1.012	1.240	1.074	1.008	0.816	1.256
EBS	1991	0.929	*0.994*	*0.990*	0.943	0.913	0.824	0.891	0.858	0.917	1.043	1.051	1.240	1.074	1.008	0.816	1.252
EBS	1992	0.929	*0.994*	*0.990*	0.943	0.913	0.897	0.997	0.935	1.026	1.043	1.115	1.240	1.074	1.008	0.816	1.310
EBS	1993	0.929	*0.994*	*0.990*	0.943	0.913	0.973	0.944	1.015	0.972	1.043	1.274	1.240	1.074	1.008	0.816	1.282
EBS	1994	0.929	*0.994*	*0.990*	0.943	0.913	1.134	0.909	1.188	0.936	1.043	1.499	1.240	1.074	1.008	0.816	1.263
EBS	1995	0.929	*0.994*	*0.990*	0.943	0.913	1.026	0.949	1.071	0.977	1.043	1.455	1.240	1.074	1.008	0.816	1.284
EBS	1996	0.929	*0.994*	*0.990*	0.943	0.913	0.973	0.966	1.014	0.995	1.043	1.359	1.240	1.074	1.008	0.816	1.294
EBS	1997	0.929	*0.994*	*0.990*	0.943	0.913	0.879	0.946	0.915	0.974	1.043	1.242	1.240	1.074	1.008	0.816	1.283
EBS	1998	0.929	*0.994*	*0.990*	0.943	0.913	0.854	1.020	0.890	1.050	1.043	1.178	1.240	1.074	1.008	0.816	1.322
EBS	1999	0.929	*0.994*	*0.990*	0.943	0.913	0.878	0.929	0.913	0.957	1.043	1.152	1.240	1.074	1.008	0.816	1.274
EBS	2000	0.929	*0.994*	*0.990*	0.943	0.913	0.831	0.951	0.863	0.979	1.043	1.124	1.240	1.074	1.008	0.816	1.286
EBS	2001	0.929	*0.994*	*0.990*	0.943	0.913	1.133	0.982	1.182	1.011	1.043	1.251	1.240	1.074	1.008	0.816	1.302
EBS	2002	0.929	*0.994*	*0.990*	0.943	0.913	0.883	0.935	0.915	0.962	1.043	1.151	1.240	1.074	1.008	0.816	1.277
EBS	2003	0.929	*0.994*	*0.990*	0.943	0.913	0.921	1.030	0.954	1.060	1.043	1.127	1.240	1.074	1.008	0.816	1.328
EBS	2004	0.929	*0.994*	*0.990*	0.943	0.913	0.873	0.949	0.899	0.977	1.043	1.074	1.240	1.074	1.008	0.816	1.284
EBS	2005	0.929	*0.994*	*0.990*	0.943	0.913	0.978	0.958	1.013	0.986	1.043	1.102	1.240	1.074	1.008	0.816	1.289
EBS	2006	0.929	*0.994*	*0.990*	0.943	0.913	1.010	0.915	1.036	0.942	1.043	1.073	1.240	1.074	1.008	0.816	1.266
EBS	2007	0.929	*0.994*	*0.990*	0.943	0.913	0.959	0.921	0.999	0.948	1.043	1.084	1.240	1.074	1.008	0.816	1.269
EBS	2008	0.929	*0.994*	*0.990*	0.943	0.913	0.805	0.932	0.837	0.960	1.043	1.017	1.240	1.074	1.008	0.816	1.275
EBS	2009	0.929	*0.994*	*0.990*	0.943	0.913	0.853	0.845	0.891	0.870	1.043	1.036	1.240	1.074	1.008	0.816	1.226
EBS	2010	0.929	*0.994*	*0.990*	0.943	0.913	0.942	0.996	0.983	1.025	1.043	1.178	1.240	1.074	1.008	0.816	1.310
EBS	2011	0.929	*0.994*	*0.990*	0.943	0.913	0.972	0.893	1.010	0.919	1.043	1.230	1.240	1.074	1.008	0.816	1.253
EBS	2012	0.929	*0.994*	*0.990*	0.943	0.913	0.965	0.910	1.000	0.937	1.043	1.244	1.240	1.074	1.008	0.816	1.263
EBS	2013	0.929	*0.994*	*0.990*	0.943	0.913	0.871	0.910	0.900	0.937	1.043	1.247	1.240	1.074	1.008	0.816	1.263
EBS	2014	0.929	*0.994*	*0.990*	0.943	0.913	0.980	0.921	1.009	0.948	1.043	1.351	1.240	1.074	1.008	0.816	1.269
EBS	2015	0.929	*0.994*	*0.990*	0.943	0.913	0.975	0.964	1.005	0.993	1.043	1.375	1.240	1.074	1.008	0.816	1.293
EBS	2016	0.929	*0.994*	*0.990*	0.943	0.913	0.930	0.994	0.956	1.023	1.043	1.300	1.240	1.074	1.008	0.816	1.309
EBS	2017	0.929	*0.994*	*0.990*	0.943	0.913	0.785	0.910	0.815	0.937	1.043	1.171	1.240	1.074	1.008	0.816	1.263
NBS	2010								0.013	0.013			0.457	1.030			0.526
NBS	2017								0.261	0.272			0.457	1.030			0.526

Table 2.1.19a. Base values of fishery selectivity.

Age	16.6	16.6a	16.6b	16.6c	16.6d	16.6e	16.6f	16.6g	16.6h	17.2	17.6	18.1	18.2	18.3	18.4	18.5
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.000	0.000	0.000	0.000	0.000
2	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.008	0.012	0.003	0.003	0.003	0.003	0.003
3	0.032	0.032	0.032	0.032	0.034	0.032	0.032	0.035	0.035	0.063	0.067	0.030	0.031	0.031	0.032	0.030
4	0.292	0.289	0.288	0.290	0.300	0.291	0.290	0.314	0.313	0.322	0.297	0.263	0.277	0.292	0.293	0.262
5	0.838	0.832	0.833	0.835	0.841	0.837	0.836	0.853	0.852	0.796	0.743	0.806	0.822	0.840	0.838	0.801
6	0.985	0.984	0.984	0.984	0.985	0.985	0.984	0.987	0.987	0.982	0.976	0.980	0.982	0.985	0.985	0.979
7	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999	1.000	0.999	0.998	0.999	0.999	0.999	0.998
8	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
9	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
10	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
11	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
12	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
13	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
14	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
15	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
16	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
17	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
18	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
19	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
20	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table 2.1.19b. Base values of EBS survey selectivity.

Age	16.6	16.6a	16.6b	16.6c	16.6d	16.6e	16.6f	16.6g	16.6h	17.2	17.6	18.1	18.2	18.3	18.4	18.5
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.477	0.493	0.484	0.481	0.479	0.475	0.482	0.482	0.487	0.414	0.467	0.479	0.479	0.482	0.455	0.489
2	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.907	1.000	1.000	1.000	1.000	1.000	1.000
3	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
4	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
5	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
6	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
7	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
8	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
9	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
10	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
11	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
12	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
13	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
14	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
15	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
16	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
17	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
18	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
19	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
20	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table 2.1.19c. NBS survey selectivity.

Age	16.6	16.6a	16.6b	16.6c	16.6d	16.6e	16.6f	16.6g	16.6h	17.2	17.6	18.1	18.2	18.3	18.4	18.5
0								0.000	0.000			0.001	0.002			0.002
1								0.294	0.311			0.577	0.406			0.552
2								0.999	0.999			1.000	0.996			0.999
3								1.000	1.000			1.000	1.000			1.000
4								1.000	1.000			1.000	1.000			1.000
5								1.000	1.000			1.000	1.000			1.000
6								1.000	1.000			1.000	1.000			1.000
7								1.000	1.000			1.000	1.000			1.000
8								1.000	1.000			1.000	1.000			1.000
9								1.000	1.000			1.000	1.000			1.000
10								1.000	1.000			1.000	1.000			1.000
11								1.000	1.000			1.000	1.000			1.000
12								1.000	1.000			1.000	1.000			1.000
13								1.000	1.000			1.000	1.000			1.000
14								1.000	1.000			1.000	1.000			1.000
15								1.000	1.000			1.000	1.000			1.000
16								1.000	1.000			1.000	1.000			1.000
17								1.000	1.000			1.000	1.000			1.000
18								1.000	1.000			1.000	1.000			1.000
19								1.000	1.000			1.000	1.000			1.000
20								1.000	1.000			1.000	1.000			1.000

Table 2.1.19d. Time-varying fishery selectivity in Model 17.2.

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1977	0.000	0.000	0.006	0.070	0.368	0.873	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1978	0.000	0.000	0.003	0.054	0.343	0.879	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1979	0.000	0.000	0.009	0.110	0.538	0.993	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1980	0.000	0.000	0.007	0.076	0.376	0.870	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1981	0.000	0.010	0.079	0.325	0.756	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1982	0.000	0.000	0.002	0.023	0.166	0.583	0.984	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1983	0.000	0.000	0.004	0.032	0.167	0.509	0.912	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1984	0.000	0.002	0.012	0.058	0.197	0.476	0.817	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1985	0.000	0.000	0.004	0.054	0.335	0.865	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1986	0.000	0.001	0.010	0.075	0.317	0.752	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1987	0.000	0.000	0.006	0.054	0.267	0.708	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1988	0.000	0.007	0.049	0.205	0.538	0.905	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1989	0.000	0.003	0.019	0.083	0.261	0.576	0.899	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1990	0.000	0.001	0.007	0.038	0.149	0.407	0.766	0.993	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1991	0.000	0.000	0.006	0.064	0.328	0.814	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1992	0.000	0.000	0.002	0.052	0.405	0.968	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1993	0.000	0.001	0.013	0.105	0.436	0.902	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1994	0.000	0.001	0.015	0.107	0.411	0.860	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1995	0.000	0.000	0.009	0.089	0.423	0.913	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1996	0.000	0.001	0.007	0.051	0.221	0.587	0.948	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1997	0.000	0.001	0.010	0.063	0.254	0.632	0.967	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1998	0.000	0.000	0.005	0.053	0.285	0.760	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1999	0.000	0.000	0.004	0.056	0.346	0.879	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2000	0.000	0.000	0.000	0.017	0.207	0.786	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2001	0.000	0.000	0.001	0.025	0.262	0.855	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2002	0.000	0.000	0.002	0.055	0.401	0.959	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2003	0.000	0.000	0.001	0.040	0.354	0.944	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2004	0.000	0.000	0.001	0.048	0.457	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2005	0.000	0.000	0.001	0.056	0.497	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2006	0.000	0.000	0.000	0.022	0.334	0.982	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2007	0.000	0.000	0.001	0.019	0.162	0.609	0.997	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2008	0.000	0.000	0.001	0.023	0.226	0.782	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2009	0.000	0.000	0.000	0.010	0.244	0.950	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2010	0.000	0.000	0.004	0.044	0.247	0.701	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2011	0.000	0.001	0.007	0.052	0.231	0.613	0.965	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2012	0.000	0.000	0.000	0.014	0.161	0.669	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2013	0.000	0.000	0.010	0.112	0.528	0.986	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2014	0.000	0.000	0.004	0.054	0.325	0.845	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2015	0.000	0.000	0.003	0.043	0.262	0.745	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2016	0.000	0.000	0.005	0.055	0.305	0.796	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2017	0.000	0.000	0.000	0.005	0.125	0.706	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table 2.1.19e. Time-varying fishery selectivity in Model 17.6.

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1977	0.000	0.042	0.176	0.455	0.807	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1978	0.000	0.000	0.002	0.025	0.190	0.649	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1979	0.000	0.000	0.006	0.067	0.358	0.864	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1980	0.000	0.000	0.005	0.051	0.274	0.736	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1981	0.000	0.008	0.063	0.268	0.669	0.986	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1982	0.000	0.000	0.001	0.017	0.134	0.517	0.958	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1983	0.000	0.000	0.002	0.022	0.129	0.440	0.866	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1984	0.000	0.002	0.013	0.057	0.188	0.449	0.781	0.990	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1985	0.000	0.000	0.003	0.052	0.334	0.869	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1986	0.000	0.001	0.008	0.062	0.278	0.703	0.997	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1987	0.000	0.000	0.004	0.040	0.207	0.596	0.967	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1988	0.000	0.006	0.046	0.197	0.530	0.904	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1989	0.000	0.002	0.015	0.077	0.266	0.610	0.937	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1990	0.000	0.001	0.005	0.031	0.124	0.350	0.692	0.965	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1991	0.000	0.000	0.006	0.057	0.282	0.734	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1992	0.000	0.000	0.002	0.044	0.340	0.908	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1993	0.000	0.001	0.013	0.096	0.391	0.846	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1994	0.000	0.002	0.016	0.102	0.371	0.793	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1995	0.000	0.001	0.010	0.091	0.396	0.869	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1996	0.000	0.001	0.007	0.049	0.218	0.583	0.947	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1997	0.000	0.001	0.008	0.053	0.223	0.582	0.941	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1998	0.000	0.000	0.004	0.041	0.222	0.643	0.990	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1999	0.000	0.000	0.003	0.043	0.268	0.762	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2000	0.000	0.000	0.000	0.010	0.148	0.684	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2001	0.000	0.000	0.001	0.018	0.164	0.630	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2002	0.000	0.000	0.004	0.056	0.348	0.880	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2003	0.000	0.000	0.002	0.040	0.331	0.912	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2004	0.000	0.000	0.001	0.047	0.421	0.988	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2005	0.000	0.000	0.002	0.052	0.419	0.979	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2006	0.000	0.000	0.000	0.018	0.280	0.937	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2007	0.000	0.000	0.001	0.012	0.123	0.534	0.982	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2008	0.000	0.000	0.001	0.016	0.161	0.644	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2009	0.000	0.000	0.000	0.005	0.210	0.967	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2010	0.000	0.000	0.007	0.056	0.259	0.677	0.993	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2011	0.000	0.001	0.013	0.083	0.322	0.735	0.998	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2012	0.000	0.000	0.000	0.008	0.105	0.520	0.987	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2013	0.000	0.001	0.013	0.125	0.523	0.973	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2014	0.000	0.000	0.006	0.066	0.342	0.836	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2015	0.000	0.000	0.006	0.058	0.296	0.764	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2016	0.000	0.000	0.006	0.080	0.426	0.935	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2017	0.000	0.000	0.000	0.006	0.087	0.489	0.984	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table 2.1.19f. Time-varying survey selectivity in Model 17.6.

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1982	0.000	0.218	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1983	0.000	0.388	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1984	0.000	0.230	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1985	0.000	0.514	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1986	0.000	0.260	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1987	0.000	0.421	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1988	0.000	0.231	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1989	0.000	0.158	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1990	0.000	0.492	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1991	0.000	0.394	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1992	0.000	0.958	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1993	0.000	0.631	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1994	0.000	0.302	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1995	0.000	0.211	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1996	0.000	0.179	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1997	0.000	0.313	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1998	0.000	0.189	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1999	0.000	0.209	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2000	0.000	0.350	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2001	0.000	0.938	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2002	0.000	0.474	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2003	0.000	0.550	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2004	0.000	0.401	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2005	0.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2006	0.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2007	0.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2008	0.000	0.535	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2009	0.000	0.663	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2010	0.000	0.503	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2011	0.000	0.658	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2012	0.000	0.676	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2013	0.000	0.381	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2014	0.000	0.520	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2015	0.000	0.354	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2016	0.000	0.772	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2017	0.000	0.265	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table 2.1.20. Recruitment (p. 1 of 4).

	16.6		16.6a		16.6b		16.6c	
Year	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.
1977	1,060,480	264,211	820,881	283,244	926,594	242,798	996,992	248,457
1978	672,148	188,012	634,774	244,892	594,186	169,572	645,366	176,654
1979	680,408	124,504	409,622	143,143	605,466	118,982	652,091	118,415
1980	314,763	54,722	186,448	80,752	281,199	53,116	303,722	52,699
1981	173,532	31,321	598,493	125,801	156,040	30,143	169,188	30,479
1982	922,404	108,027	507,754	117,848	829,440	112,063	888,805	104,847
1983	235,725	39,078	375,131	97,457	212,901	37,455	227,947	37,763
1984	912,156	102,669	712,704	107,950	833,662	102,901	878,523	99,554
1985	346,865	46,025	362,321	54,214	302,413	43,409	335,505	44,579
1986	231,572	31,713	191,560	30,832	200,266	30,971	224,745	30,832
1987	96,734	19,599	113,428	23,158	110,714	23,239	95,629	19,207
1988	268,840	35,657	264,822	38,454	267,919	38,691	263,558	35,031
1989	724,715	79,214	642,424	77,926	648,807	77,589	706,541	77,859
1990	593,602	65,758	546,436	66,104	547,648	65,685	580,114	64,730
1991	379,553	45,050	346,836	44,499	348,239	44,303	374,450	44,659
1992	889,717	87,178	818,117	90,737	821,554	89,772	879,118	87,265
1993	368,233	39,817	337,962	40,425	338,585	40,001	363,963	39,711
1994	300,691	33,229	275,048	33,512	275,465	33,194	299,389	33,444
1995	274,890	31,168	250,645	31,140	252,535	30,993	284,351	32,325
1996	761,012	77,339	704,890	81,483	709,748	80,698	754,947	77,777
1997	340,470	37,308	313,409	38,241	312,603	37,728	336,967	37,364
1998	328,955	34,858	304,017	35,471	305,500	35,247	348,109	36,760
1999	686,149	65,889	634,180	69,167	637,575	68,526	688,778	66,270
2000	524,642	51,095	481,073	52,980	481,052	52,247	509,192	49,767
2001	236,417	24,833	217,351	25,099	217,974	24,896	230,975	24,220
2002	312,664	31,395	290,988	32,541	290,903	32,127	293,139	29,782
2003	264,148	26,622	246,737	27,482	247,366	27,221	250,573	25,295
2004	222,208	23,354	206,474	23,747	206,406	23,473	208,951	22,006
2005	299,311	30,774	274,118	31,038	275,494	30,799	280,538	28,849
2006	929,719	90,292	858,185	93,927	863,479	93,072	861,777	83,875
2007	405,265	43,773	371,944	43,906	373,519	43,572	380,159	40,921
2008	1,269,140	126,733	1,153,530	127,617	1,161,040	126,586	1,179,100	118,420
2009	160,912	23,567	150,627	22,476	149,372	22,224	149,998	21,956
2010	746,163	78,508	683,445	78,280	689,142	77,908	707,732	75,007
2011	1,090,310	118,450	991,191	117,145	1,000,190	116,576	1,039,760	114,177
2012	464,148	54,708	425,251	53,350	430,081	53,351	437,766	52,322
2013	1,034,000	115,642	940,467	112,868	950,586	112,318	1,009,070	114,293
2014	158,380	22,994	142,282	21,504	143,308	21,481	157,994	22,849
2015	209,793	29,965	184,967	27,671	188,514	27,913	202,190	29,209
2016	120,010	30,278	106,054	27,753	106,654	28,112	119,246	29,804
2017	500,400	50,156	456,203	50,014	460,558	50,546	485,137	48,800
2018	500,400	50,156	456,203	50,014	460,558	50,546	485,137	48,800
2019	500,400	50,156	456,203	50,014	460,558	50,546	485,137	48,800

Table 2.1.20. Recruitment (p. 2 of 4).

	16.6d		16.6e		16.6f		16.6g	
Year	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.
1977	1,085,490	268,895	1,108,020	292,579	1,004,080	250,753	971,896	255,308
1978	694,174	192,519	698,738	203,661	642,189	178,601	648,005	181,871
1979	710,272	128,302	705,537	139,701	647,962	118,972	649,875	126,244
1980	327,000	56,267	327,951	61,875	304,083	52,854	306,172	56,820
1981	182,019	32,530	179,954	34,646	165,382	29,971	167,100	31,894
1982	946,880	111,035	952,874	126,640	870,111	103,152	876,786	116,169
1983	252,226	41,104	243,105	42,740	225,217	37,461	229,262	39,722
1984	930,010	104,923	933,724	115,970	873,299	98,958	865,614	107,133
1985	357,447	47,533	356,788	50,675	331,216	44,243	339,716	47,691
1986	242,142	32,815	241,185	34,948	225,337	30,916	227,711	32,739
1987	102,101	20,289	104,618	21,595	96,396	19,430	99,000	20,169
1988	269,673	35,899	292,995	41,166	266,547	35,401	271,322	37,885
1989	747,629	81,541	738,761	88,821	703,586	77,439	682,112	81,567
1990	607,029	67,303	600,734	72,430	570,714	63,673	564,585	67,408
1991	398,032	47,031	382,735	48,762	365,587	43,610	358,491	45,232
1992	914,580	89,537	899,763	97,424	859,789	84,818	841,106	90,457
1993	370,524	40,275	372,678	43,878	354,620	38,553	351,411	40,982
1994	305,418	33,795	307,050	36,818	289,979	32,217	287,710	34,244
1995	275,850	31,427	282,589	34,556	265,807	30,249	263,952	32,088
1996	788,871	80,107	784,111	88,388	732,218	75,023	729,942	82,064
1997	353,982	38,665	349,210	41,583	327,972	36,179	329,094	39,006
1998	327,986	35,126	337,104	38,524	319,474	33,979	317,126	36,143
1999	691,125	66,571	696,801	73,484	662,179	64,160	654,373	69,074
2000	540,244	52,759	531,839	56,740	506,162	49,747	505,000	53,855
2001	239,256	25,316	241,425	27,144	228,962	24,189	230,371	25,868
2002	328,315	33,052	318,115	34,529	302,917	30,678	303,903	33,021
2003	273,587	27,717	267,741	29,037	256,865	26,093	256,719	27,868
2004	240,582	25,317	223,462	25,116	216,922	22,975	214,958	24,110
2005	315,228	32,627	303,529	33,694	292,312	30,320	288,476	31,973
2006	974,146	95,187	961,670	103,981	903,958	88,962	892,564	96,533
2007	419,665	45,583	418,870	49,496	394,978	43,098	387,445	45,568
2008	1,315,240	131,733	1,303,030	145,203	1,234,530	124,980	1,199,990	132,626
2009	170,735	24,980	163,502	25,163	156,010	22,989	172,877	25,325
2010	762,905	80,379	766,205	89,426	728,662	77,626	720,219	83,425
2011	1,106,230	120,181	1,125,540	137,205	1,060,930	116,792	1,078,990	130,271
2012	455,452	54,054	480,326	62,599	452,447	53,846	479,580	61,642
2013	1,074,660	119,819	1,075,320	136,720	1,006,850	113,926	1,041,700	131,580
2014	164,922	23,982	165,867	26,164	154,128	22,529	140,452	21,900
2015	221,190	31,322	223,975	35,177	205,401	29,527	215,761	30,210
2016	149,035	35,201	133,123	34,845	118,564	29,972	80,357	25,223
2017	514,662	51,452	513,577	56,818	484,749	48,862	483,362	53,352
2018	514,662	51,452	513,577	56,818	484,749	48,862	483,362	53,352
2019	514,662	51,452	513,577	56,818	484,749	48,862	483,362	53,352

Table 2.1.20. Recruitment (p. 3 of 4).

	16.6h		17.2		17.6		18.1	
Year	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.
1977	909,234	226,863	664,653	146,389	472,907	94,940	919,599	243,154
1978	611,931	164,256	693,170	146,296	456,997	78,839	550,366	152,434
1979	613,372	110,660	680,782	123,833	439,556	61,198	517,630	99,447
1980	291,278	49,826	316,953	60,538	129,955	24,843	249,373	44,714
1981	157,388	28,298	290,525	51,495	155,420	23,731	133,838	25,217
1982	819,683	97,222	864,501	131,889	613,851	67,853	697,482	89,837
1983	217,044	35,597	300,512	53,508	196,308	27,603	181,679	31,328
1984	825,755	93,556	818,100	119,458	552,068	58,440	697,154	87,102
1985	321,269	42,479	456,316	67,716	315,967	34,445	262,805	37,532
1986	216,393	29,510	284,039	42,014	183,506	21,207	168,982	25,125
1987	92,703	18,459	162,353	26,100	81,484	12,516	73,042	15,034
1988	251,395	33,241	300,593	41,698	236,788	25,834	194,942	27,983
1989	661,958	72,685	662,813	84,757	468,391	44,327	545,088	65,518
1990	546,223	60,489	591,692	75,149	426,293	39,574	458,796	55,506
1991	348,641	41,290	359,625	47,692	223,829	23,924	296,748	37,851
1992	818,415	80,456	842,366	102,451	584,662	49,473	695,051	75,994
1993	340,518	36,773	334,609	44,276	243,493	23,273	290,759	34,238
1994	276,679	30,584	276,309	35,800	203,296	19,458	237,254	28,539
1995	252,699	28,653	263,508	34,708	199,931	20,292	217,299	26,560
1996	694,613	71,123	660,066	84,213	529,358	50,578	584,723	65,328
1997	314,657	34,589	455,929	59,875	285,406	28,703	260,357	30,924
1998	305,515	32,439	418,173	54,486	247,153	25,782	249,428	28,940
1999	632,395	61,382	723,635	89,459	507,984	45,498	513,519	54,859
2000	488,588	48,024	492,080	62,037	336,776	30,345	393,489	42,529
2001	221,755	23,405	202,459	26,765	143,024	15,029	179,285	20,597
2002	293,701	29,774	341,839	42,375	274,949	25,362	234,095	26,169
2003	249,804	25,401	299,896	37,825	246,325	22,764	199,059	22,466
2004	211,469	22,345	219,403	28,623	145,187	13,844	171,238	20,051
2005	281,690	29,181	260,133	35,178	185,821	16,655	234,992	27,090
2006	853,257	84,119	814,814	101,537	630,672	51,370	748,246	83,015
2007	371,456	40,420	492,296	65,297	309,179	31,844	333,321	40,319
2008	1,155,360	116,266	1,131,760	140,996	833,649	69,135	1,013,420	116,087
2009	167,037	23,375	160,546	28,734	102,661	16,515	147,530	22,112
2010	693,929	73,558	721,144	97,053	481,076	43,422	603,306	72,337
2011	1,029,440	112,586	1,067,850	147,658	686,648	60,058	905,055	110,531
2012	456,332	53,714	517,436	79,508	287,412	31,866	410,427	53,417
2013	985,053	111,082	999,495	143,966	621,083	65,162	917,186	115,423
2014	131,955	19,090	169,634	32,856	129,277	18,972	131,911	20,250
2015	202,157	25,583	198,907	36,718	102,059	16,417	216,227	29,654
2016	72,280	22,053	134,675	33,583	205,260	99,156	69,564	21,582
2017	464,138	46,969	495,128	63,763	340,172	28,872	389,840	43,743
2018	464,138	46,969	495,128	63,763	340,172	28,872	389,840	43,743
2019	464,138	46,969	495,128	63,763	340,172	28,872	389,840	43,743

Table 2.1.20. Recruitment (p. 4 of 4).

	18.2		18.3		18.4		18.5	
Year	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.
1977	985,555	253,376	983,901	241,016	1,450,070	368,082	866,951	208,389
1978	611,829	170,954	626,537	173,446	876,251	249,812	499,690	128,974
1979	597,943	111,750	638,754	114,967	878,441	157,420	475,434	91,491
1980	279,432	49,363	294,493	50,641	401,735	68,647	226,405	41,442
1981	152,071	28,059	161,572	28,904	225,761	39,752	127,909	24,131
1982	798,848	98,164	866,308	98,480	1,195,760	130,974	645,715	87,655
1983	207,231	35,027	221,818	36,299	310,231	49,403	172,674	30,199
1984	794,114	94,393	861,575	94,088	1,195,420	125,669	661,986	85,852
1985	302,731	41,774	328,337	42,678	444,385	55,153	248,075	35,911
1986	197,040	28,208	219,087	29,516	283,731	36,408	156,584	23,280
1987	83,033	17,008	90,647	18,365	117,868	23,281	71,035	14,249
1988	226,436	31,284	252,730	32,855	328,378	40,597	181,997	25,929
1989	622,458	71,250	679,797	71,918	878,881	86,523	501,048	60,623
1990	521,882	60,457	556,271	59,652	720,225	72,664	421,212	52,080
1991	333,306	41,046	351,970	40,502	471,620	51,853	279,234	35,884
1992	783,024	81,173	812,793	76,467	1,116,350	96,659	659,325	72,622
1993	327,316	37,005	332,376	34,826	464,754	45,613	276,261	32,785
1994	265,385	30,714	265,154	28,687	376,489	37,979	223,888	27,110
1995	242,521	28,566	239,034	26,650	339,049	35,867	204,359	25,266
1996	665,112	70,807	644,096	65,319	941,094	84,034	542,484	61,389
1997	297,992	34,037	282,688	31,451	426,964	42,040	246,842	29,379
1998	284,414	31,609	267,415	29,442	416,567	40,481	242,966	28,072
1999	592,223	59,989	593,274	57,885	897,878	75,200	510,076	54,202
2000	455,133	46,757	405,020	44,228	689,859	58,382	392,387	42,038
2001	205,543	22,598	180,296	21,235	300,538	28,429	176,676	19,912
2002	268,823	28,526	239,997	27,174	381,813	32,791	220,376	23,824
2003	227,994	24,331	207,808	23,097	308,518	27,347	181,386	20,301
2004	193,465	21,482	195,776	20,893	256,462	24,385	153,887	18,149
2005	262,794	28,605	291,141	29,394	342,729	32,549	207,906	24,825
2006	828,642	85,486	964,728	91,454	1,077,350	95,389	659,804	76,145
2007	368,212	42,117	431,572	45,635	480,499	48,660	300,473	37,938
2008	1,149,300	124,560	1,409,180	138,148	1,515,440	138,993	911,698	108,948
2009	163,456	24,130	180,476	26,201	190,663	27,641	137,306	21,181
2010	661,755	75,175	801,614	80,459	925,824	91,792	561,406	70,303
2011	1,003,170	115,800	1,174,930	121,043	1,421,460	145,466	870,296	110,982
2012	439,315	54,358	500,465	56,452	605,436	69,150	399,573	54,151
2013	968,607	114,535	1,017,320	107,171	1,323,750	139,158	864,862	112,545
2014	135,646	20,074	153,903	21,646	197,543	27,895	119,699	19,086
2015	213,189	27,596	201,037	27,910	256,691	35,745	194,555	27,669
2016	78,473	26,205	106,299	26,868	148,862	36,854	63,680	20,338
2017	441,036	46,859	472,760	46,302	619,680	55,818	172,217	43,339
2018	441,036	46,859	472,760	46,302	619,680	55,818	176,314	44,535
2019	441,036	46,859	472,760	46,302	619,680	55,818	170,378	42,783

Table 2.1.21. Depletion (p. 1 of 2).

	16.6		16.6a		16.6b		16.6c		16.6d		16.6e		16.6f		16.6g	
Year	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.
1977	0.098	0.037	0.107	0.051	0.091	0.035	0.096	0.036	0.103	0.038	0.105	0.040	0.095	0.036	0.097	0.037
1978	0.095	0.037	0.105	0.052	0.088	0.034	0.093	0.036	0.101	0.038	0.103	0.040	0.092	0.035	0.095	0.037
1979	0.097	0.035	0.105	0.051	0.088	0.033	0.094	0.034	0.102	0.037	0.105	0.039	0.093	0.034	0.095	0.036
1980	0.129	0.037	0.131	0.053	0.116	0.035	0.125	0.036	0.135	0.038	0.138	0.040	0.123	0.035	0.125	0.037
1981	0.210	0.042	0.198	0.058	0.189	0.041	0.203	0.040	0.217	0.043	0.222	0.047	0.201	0.040	0.202	0.043
1982	0.365	0.054	0.325	0.070	0.329	0.056	0.351	0.053	0.374	0.055	0.381	0.063	0.349	0.053	0.350	0.058
1983	0.523	0.066	0.452	0.080	0.475	0.070	0.503	0.064	0.533	0.067	0.543	0.076	0.502	0.064	0.502	0.072
1984	0.558	0.062	0.473	0.073	0.510	0.069	0.539	0.061	0.568	0.063	0.577	0.073	0.537	0.061	0.539	0.069
1985	0.634	0.067	0.536	0.079	0.581	0.075	0.614	0.066	0.645	0.067	0.655	0.078	0.611	0.066	0.615	0.075
1986	0.614	0.061	0.537	0.075	0.564	0.070	0.596	0.061	0.625	0.061	0.634	0.072	0.592	0.060	0.597	0.070
1987	0.598	0.056	0.542	0.070	0.552	0.064	0.583	0.055	0.609	0.056	0.617	0.066	0.577	0.055	0.584	0.064
1988	0.634	0.055	0.580	0.069	0.588	0.064	0.619	0.055	0.644	0.055	0.652	0.065	0.611	0.055	0.619	0.064
1989	0.614	0.052	0.563	0.063	0.570	0.060	0.600	0.052	0.622	0.051	0.630	0.060	0.591	0.051	0.601	0.059
1990	0.559	0.044	0.513	0.053	0.520	0.051	0.547	0.045	0.565	0.044	0.573	0.051	0.538	0.044	0.548	0.051
1991	0.447	0.034	0.414	0.040	0.418	0.039	0.439	0.034	0.452	0.034	0.460	0.039	0.432	0.034	0.442	0.039
1992	0.317	0.026	0.295	0.030	0.297	0.029	0.312	0.026	0.321	0.026	0.329	0.030	0.307	0.026	0.315	0.029
1993	0.294	0.025	0.276	0.029	0.277	0.028	0.290	0.026	0.299	0.025	0.308	0.029	0.286	0.025	0.294	0.029
1994	0.308	0.025	0.289	0.029	0.291	0.028	0.304	0.025	0.313	0.025	0.321	0.029	0.300	0.025	0.306	0.028
1995	0.342	0.027	0.321	0.031	0.323	0.030	0.340	0.028	0.348	0.027	0.353	0.031	0.334	0.027	0.337	0.030
1996	0.342	0.028	0.319	0.032	0.322	0.031	0.341	0.029	0.347	0.028	0.350	0.031	0.333	0.028	0.334	0.031
1997	0.329	0.027	0.307	0.031	0.310	0.030	0.330	0.028	0.333	0.027	0.335	0.030	0.320	0.027	0.320	0.029
1998	0.291	0.026	0.270	0.029	0.273	0.028	0.295	0.027	0.294	0.025	0.295	0.028	0.282	0.025	0.281	0.027
1999	0.283	0.026	0.263	0.029	0.265	0.028	0.283	0.026	0.285	0.025	0.286	0.028	0.274	0.025	0.272	0.027
2000	0.293	0.027	0.273	0.030	0.276	0.029	0.300	0.028	0.297	0.027	0.298	0.029	0.284	0.026	0.283	0.028
2001	0.304	0.027	0.285	0.030	0.288	0.029	0.313	0.028	0.308	0.027	0.309	0.029	0.295	0.027	0.295	0.029
2002	0.325	0.027	0.306	0.031	0.309	0.030	0.336	0.029	0.329	0.027	0.331	0.030	0.315	0.027	0.316	0.029
2003	0.324	0.027	0.306	0.030	0.309	0.029	0.337	0.028	0.327	0.027	0.330	0.029	0.315	0.027	0.316	0.029
2004	0.329	0.026	0.312	0.030	0.314	0.029	0.335	0.027	0.332	0.026	0.334	0.028	0.320	0.026	0.322	0.028
2005	0.326	0.025	0.310	0.029	0.312	0.028	0.325	0.025	0.329	0.025	0.330	0.027	0.317	0.025	0.319	0.027
2006	0.288	0.022	0.274	0.025	0.276	0.024	0.283	0.022	0.291	0.022	0.290	0.024	0.280	0.022	0.282	0.024
2007	0.243	0.019	0.232	0.022	0.234	0.021	0.236	0.019	0.248	0.020	0.245	0.020	0.237	0.019	0.240	0.021
2008	0.207	0.017	0.198	0.019	0.200	0.018	0.198	0.016	0.213	0.017	0.209	0.018	0.202	0.017	0.205	0.018
2009	0.191	0.016	0.182	0.018	0.183	0.018	0.179	0.015	0.198	0.017	0.192	0.017	0.186	0.016	0.189	0.017
2010	0.205	0.018	0.194	0.020	0.196	0.019	0.192	0.017	0.214	0.019	0.207	0.019	0.201	0.018	0.203	0.019
2011	0.271	0.023	0.256	0.026	0.258	0.025	0.253	0.022	0.281	0.023	0.275	0.025	0.266	0.023	0.267	0.025
2012	0.322	0.028	0.302	0.031	0.305	0.030	0.297	0.027	0.332	0.028	0.328	0.030	0.316	0.028	0.316	0.030
2013	0.363	0.032	0.338	0.035	0.342	0.034	0.339	0.031	0.373	0.033	0.371	0.035	0.357	0.033	0.356	0.035
2014	0.374	0.035	0.347	0.037	0.351	0.036	0.348	0.034	0.383	0.035	0.383	0.038	0.368	0.036	0.368	0.038
2015	0.378	0.037	0.349	0.039	0.354	0.038	0.353	0.036	0.385	0.037	0.388	0.042	0.373	0.038	0.376	0.041
2016	0.425	0.043	0.392	0.045	0.398	0.044	0.407	0.043	0.430	0.043	0.437	0.049	0.420	0.044	0.429	0.048
2017	0.461	0.049	0.425	0.050	0.433	0.049	0.443	0.049	0.466	0.049	0.476	0.056	0.457	0.050	0.474	0.056
2018	0.464	0.051	0.428	0.052	0.437	0.051	0.454	0.052	0.470	0.051	0.482	0.060	0.462	0.052	0.485	0.060
2019	0.424	0.050	0.392	0.050	0.401	0.049	0.418	0.051	0.431	0.050	0.443	0.061	0.424	0.051	0.448	0.060

Table 2.1.21. Depletion (p. 2 of 2).

	16.6h		17.2		17.6		18.1		18.2		18.3		18.4		18.5	
Year	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.
1977	0.090	0.034	0.049	0.020	0.018	0.004	0.201	0.063	0.141	0.050	0.084	0.032	0.129	0.047	0.266	0.078
1978	0.087	0.033	0.055	0.019	0.031	0.006	0.200	0.064	0.138	0.050	0.081	0.032	0.130	0.048	0.266	0.079
1979	0.087	0.032	0.066	0.019	0.042	0.008	0.197	0.061	0.138	0.048	0.082	0.031	0.135	0.048	0.263	0.078
1980	0.115	0.033	0.098	0.022	0.066	0.011	0.223	0.061	0.167	0.049	0.112	0.032	0.178	0.050	0.299	0.077
1981	0.188	0.038	0.162	0.028	0.117	0.017	0.299	0.064	0.245	0.053	0.190	0.037	0.280	0.060	0.402	0.080
1982	0.328	0.050	0.284	0.041	0.212	0.028	0.449	0.075	0.400	0.065	0.338	0.050	0.464	0.081	0.619	0.092
1983	0.476	0.062	0.410	0.053	0.312	0.038	0.602	0.084	0.557	0.075	0.491	0.062	0.639	0.098	0.845	0.101
1984	0.512	0.060	0.452	0.054	0.345	0.040	0.624	0.076	0.591	0.070	0.529	0.059	0.678	0.092	0.906	0.093
1985	0.586	0.064	0.528	0.060	0.399	0.045	0.710	0.082	0.670	0.075	0.603	0.064	0.760	0.095	1.039	0.098
1986	0.569	0.059	0.534	0.057	0.399	0.044	0.685	0.074	0.646	0.068	0.585	0.059	0.735	0.086	1.017	0.089
1987	0.556	0.054	0.543	0.054	0.407	0.043	0.656	0.066	0.626	0.062	0.572	0.054	0.713	0.077	0.986	0.081
1988	0.590	0.055	0.589	0.054	0.448	0.044	0.679	0.064	0.653	0.060	0.608	0.054	0.730	0.074	1.008	0.078
1989	0.573	0.051	0.584	0.051	0.452	0.043	0.652	0.059	0.630	0.056	0.590	0.050	0.694	0.069	0.960	0.072
1990	0.523	0.044	0.537	0.044	0.425	0.038	0.591	0.051	0.574	0.049	0.538	0.044	0.610	0.058	0.857	0.063
1991	0.421	0.034	0.441	0.034	0.355	0.030	0.481	0.041	0.463	0.038	0.430	0.034	0.488	0.044	0.702	0.051
1992	0.298	0.026	0.327	0.026	0.265	0.023	0.357	0.032	0.334	0.029	0.302	0.025	0.349	0.032	0.517	0.039
1993	0.276	0.025	0.312	0.025	0.251	0.022	0.331	0.031	0.309	0.029	0.277	0.024	0.328	0.032	0.480	0.038
1994	0.290	0.025	0.319	0.024	0.260	0.021	0.323	0.029	0.312	0.027	0.291	0.024	0.347	0.034	0.476	0.036
1995	0.323	0.027	0.341	0.024	0.278	0.021	0.345	0.030	0.340	0.029	0.323	0.026	0.391	0.038	0.516	0.039
1996	0.322	0.028	0.324	0.024	0.262	0.020	0.341	0.030	0.340	0.030	0.318	0.027	0.395	0.040	0.513	0.040
1997	0.310	0.027	0.293	0.021	0.235	0.018	0.330	0.030	0.329	0.029	0.301	0.025	0.375	0.039	0.491	0.039
1998	0.273	0.025	0.243	0.019	0.193	0.015	0.302	0.029	0.296	0.028	0.257	0.023	0.336	0.037	0.449	0.037
1999	0.265	0.025	0.224	0.018	0.181	0.015	0.299	0.030	0.290	0.028	0.273	0.024	0.323	0.036	0.438	0.037
2000	0.274	0.026	0.229	0.020	0.188	0.016	0.311	0.031	0.301	0.029	0.258	0.024	0.341	0.038	0.460	0.039
2001	0.285	0.026	0.241	0.021	0.200	0.018	0.316	0.030	0.310	0.029	0.261	0.024	0.358	0.038	0.476	0.040
2002	0.306	0.027	0.277	0.023	0.228	0.020	0.331	0.030	0.328	0.029	0.277	0.025	0.388	0.040	0.511	0.041
2003	0.305	0.027	0.300	0.025	0.242	0.020	0.327	0.029	0.325	0.028	0.270	0.025	0.388	0.038	0.509	0.041
2004	0.312	0.026	0.318	0.025	0.255	0.021	0.328	0.028	0.329	0.028	0.297	0.026	0.385	0.037	0.504	0.040
2005	0.310	0.026	0.315	0.023	0.256	0.020	0.324	0.027	0.325	0.027	0.317	0.026	0.364	0.034	0.484	0.037
2006	0.275	0.023	0.271	0.019	0.226	0.017	0.289	0.025	0.289	0.024	0.291	0.024	0.307	0.029	0.417	0.033
2007	0.234	0.020	0.224	0.016	0.194	0.015	0.250	0.022	0.247	0.021	0.250	0.021	0.256	0.025	0.354	0.029
2008	0.201	0.017	0.189	0.014	0.170	0.013	0.215	0.020	0.211	0.018	0.220	0.019	0.220	0.022	0.304	0.025
2009	0.186	0.017	0.172	0.014	0.154	0.012	0.198	0.019	0.194	0.018	0.204	0.018	0.206	0.022	0.280	0.025
2010	0.199	0.018	0.178	0.016	0.150	0.012	0.207	0.021	0.206	0.019	0.213	0.019	0.233	0.026	0.301	0.027
2011	0.261	0.023	0.236	0.020	0.191	0.014	0.266	0.025	0.268	0.024	0.282	0.024	0.312	0.034	0.394	0.035
2012	0.307	0.028	0.281	0.025	0.223	0.016	0.318	0.031	0.321	0.030	0.340	0.030	0.361	0.041	0.462	0.042
2013	0.346	0.032	0.303	0.028	0.232	0.017	0.365	0.037	0.367	0.035	0.357	0.031	0.410	0.048	0.530	0.051
2014	0.357	0.035	0.310	0.030	0.234	0.018	0.388	0.041	0.387	0.039	0.363	0.033	0.459	0.055	0.600	0.059
2015	0.364	0.038	0.310	0.033	0.221	0.018	0.404	0.045	0.397	0.042	0.360	0.034	0.471	0.059	0.628	0.066
2016	0.414	0.044	0.353	0.040	0.235	0.020	0.460	0.052	0.450	0.048	0.370	0.037	0.515	0.066	0.701	0.075
2017	0.456	0.050	0.389	0.047	0.245	0.024	0.518	0.060	0.499	0.055	0.398	0.043	0.523	0.070	0.749	0.084
2018	0.465	0.052	0.388	0.050	0.231	0.029	0.542	0.064	0.510	0.058	0.373	0.044	0.512	0.071	0.766	0.091
2019	0.428	0.051	0.356	0.049	0.208	0.033	0.529	0.065	0.481	0.057	0.327	0.044	0.461	0.066	0.741	0.093

Table 2.1.22. Spawning biomass (p. 1 of 4).

	16.6		16.6a		16.6b		16.6c	
Year	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.
1977	61,554	21,890	69,243	30,736	58,533	20,878	61,105	21,533
1978	60,086	21,828	67,932	31,495	56,703	20,749	59,544	21,430
1979	60,759	20,996	67,531	30,993	56,660	19,906	59,985	20,541
1980	80,942	21,286	84,796	31,673	75,025	20,379	79,480	20,798
1981	132,189	23,030	127,829	32,932	122,113	22,726	128,993	22,506
1982	229,453	28,613	209,532	37,417	212,414	29,412	223,313	27,979
1983	328,878	33,248	291,795	41,022	306,304	35,262	320,614	32,590
1984	351,050	30,361	305,088	36,366	328,865	33,177	343,281	29,886
1985	398,873	31,838	345,906	38,831	374,929	35,623	391,108	31,479
1986	386,291	28,735	346,777	36,322	364,160	32,900	379,784	28,527
1987	376,674	25,363	350,065	32,731	356,512	29,563	371,210	25,259
1988	399,213	24,410	374,267	31,195	379,402	28,638	394,206	24,364
1989	386,514	22,145	363,107	27,197	368,027	25,740	382,136	22,143
1990	351,645	18,486	331,324	21,628	335,823	20,990	348,481	18,515
1991	281,548	14,247	267,320	15,974	269,686	15,696	279,901	14,296
1992	199,551	11,561	190,507	12,568	191,513	12,391	198,940	11,628
1993	185,046	11,682	178,066	12,588	178,909	12,401	184,828	11,795
1994	193,736	10,884	186,755	11,694	187,915	11,515	193,810	11,038
1995	215,525	11,416	207,169	12,154	208,694	11,978	216,270	11,637
1996	215,283	11,851	206,010	12,571	207,756	12,395	217,169	12,166
1997	207,112	11,422	198,083	12,097	199,830	11,927	210,371	11,820
1998	182,988	11,193	174,400	11,819	176,150	11,660	187,827	11,671
1999	177,841	11,462	169,416	12,107	171,148	11,941	180,041	11,764
2000	184,565	11,983	176,059	12,727	177,871	12,539	191,195	12,575
2001	191,589	11,695	183,712	12,509	185,595	12,311	199,530	12,320
2002	204,573	11,633	197,452	12,467	199,344	12,268	213,940	12,229
2003	203,996	11,254	197,582	12,070	199,348	11,877	214,699	11,769
2004	207,254	10,702	201,179	11,490	202,904	11,311	213,587	10,766
2005	205,280	10,082	199,763	10,768	201,394	10,614	207,221	9,817
2006	181,099	8,996	176,687	9,506	178,048	9,388	180,327	8,599
2007	152,915	8,146	149,627	8,511	150,691	8,414	150,261	7,709
2008	130,418	7,311	128,030	7,565	128,851	7,484	125,892	6,873
2009	119,938	7,437	117,579	7,654	118,279	7,570	113,784	6,986
2010	129,028	8,267	125,327	8,521	126,194	8,424	122,027	7,802
2011	170,784	10,182	165,057	10,442	166,396	10,335	160,991	9,637
2012	202,683	12,605	194,700	12,779	196,638	12,676	188,952	11,996
2013	228,430	14,914	218,243	14,891	220,725	14,799	215,621	14,365
2014	235,287	16,841	223,924	16,544	226,784	16,481	221,427	16,354
2015	237,765	18,800	225,280	18,249	228,520	18,212	224,538	18,412
2016	267,364	22,232	252,982	21,354	257,067	21,358	259,182	22,203
2017	290,296	26,299	274,359	25,081	279,496	25,136	282,197	26,395
2018	292,246	28,455	276,495	27,058	282,249	27,149	289,016	28,920
2019	266,950	28,832	252,809	27,603	258,686	27,712	265,958	29,418

Table 2.1.22. Spawning biomass (p. 2 of 4).

	16.6d		16.6e		16.6f		16.6g	
Year	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.
1977	64,343	22,724	66,288	23,548	60,415	21,404	62,249	22,129
1978	63,063	22,702	65,065	23,624	58,798	21,297	60,632	22,071
1979	63,909	21,835	65,997	22,904	59,168	20,420	60,956	21,268
1980	84,468	22,079	87,057	23,496	78,607	20,687	80,245	21,774
1981	136,268	23,772	140,148	26,147	128,177	22,396	129,505	24,151
1982	234,342	29,342	240,525	33,459	222,718	27,884	223,814	30,955
1983	334,237	33,937	342,433	39,563	320,143	32,487	321,656	36,850
1984	355,948	30,918	364,202	36,748	342,729	29,743	344,808	34,484
1985	404,317	32,399	413,464	38,992	390,099	31,251	393,513	36,867
1986	391,523	29,222	400,244	35,542	377,977	28,242	382,253	33,814
1987	381,468	25,777	389,446	31,528	368,185	24,940	373,524	30,134
1988	403,655	24,792	411,670	30,287	389,877	24,009	396,498	29,072
1989	390,162	22,487	397,817	27,282	377,215	21,786	384,646	26,267
1990	354,223	18,778	361,410	22,538	343,723	18,190	351,036	21,754
1991	283,427	14,487	289,991	17,182	275,906	14,020	282,617	16,605
1992	201,316	11,767	207,709	13,788	195,878	11,381	201,937	13,322
1993	187,304	11,903	194,520	13,827	182,360	11,528	188,186	13,333
1994	196,141	11,103	202,246	12,759	191,681	10,766	195,764	12,269
1995	218,023	11,645	222,976	13,188	213,353	11,288	215,970	12,650
1996	217,742	12,065	221,036	13,510	212,702	11,695	213,770	12,925
1997	209,025	11,609	211,215	12,897	204,421	11,249	204,713	12,334
1998	184,136	11,367	186,053	12,526	180,320	11,010	179,822	11,984
1999	178,786	11,639	180,705	12,757	175,105	11,274	174,329	12,226
2000	185,861	12,176	187,816	13,331	181,556	11,791	181,116	12,809
2001	193,370	11,892	195,277	13,036	188,410	11,512	188,829	12,568
2002	206,172	11,837	208,598	12,936	201,348	11,457	202,279	12,533
2003	204,993	11,467	207,941	12,464	200,857	11,091	202,183	12,137
2004	207,818	10,941	210,687	11,803	204,170	10,552	205,810	11,555
2005	205,992	10,367	208,071	11,028	202,361	9,945	204,315	10,862
2006	182,412	9,319	183,266	9,728	178,658	8,880	180,832	9,635
2007	155,283	8,500	154,597	8,706	150,978	8,051	153,511	8,661
2008	133,714	7,671	131,627	7,755	129,045	7,246	131,474	7,723
2009	124,223	7,822	120,981	7,904	118,899	7,399	121,176	7,841
2010	133,939	8,666	130,647	8,952	128,078	8,270	129,849	8,783
2011	176,083	10,595	173,762	11,265	169,782	10,232	170,966	10,926
2012	208,259	13,011	207,174	14,184	201,776	12,715	202,036	13,633
2013	233,867	15,296	234,007	17,012	227,793	15,099	227,656	16,274
2014	239,956	17,146	241,626	19,437	235,199	17,101	235,286	18,596
2015	241,124	19,030	244,810	22,080	238,082	19,133	240,506	21,186
2016	269,488	22,412	275,782	26,654	268,101	22,647	274,500	25,757
2017	292,084	26,455	300,589	32,194	291,737	26,807	303,274	31,394
2018	294,837	28,601	303,854	35,569	294,577	29,041	310,239	34,991
2019	270,450	28,977	279,315	36,879	270,373	29,622	286,707	36,517

Table 2.1.22. Spawning biomass (p. 3 of 4).

	16.6h		17.2		17.6		18.1	
Year	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.
1977	57,913	20,497	29,540	11,783	12,950	2,454	151,655	45,902
1978	56,035	20,287	33,256	10,757	22,028	3,571	150,314	45,954
1979	56,025	19,358	40,108	10,874	29,353	5,008	148,102	44,197
1980	74,279	19,600	59,071	12,128	46,712	6,530	168,242	43,726
1981	121,293	21,210	98,137	14,881	82,612	9,294	224,877	45,258
1982	211,816	26,489	171,653	20,515	149,372	14,180	338,460	51,782
1983	306,712	31,044	247,906	25,587	219,158	18,654	453,093	56,847
1984	330,425	28,597	273,145	25,082	242,463	18,994	470,175	50,986
1985	377,773	30,227	319,255	27,696	280,679	21,594	534,630	54,482
1986	367,031	27,443	322,958	26,105	280,743	20,944	515,805	49,766
1987	358,586	24,314	328,155	23,804	286,374	19,572	494,335	43,922
1988	380,760	23,479	356,037	23,341	315,298	19,638	511,310	42,175
1989	369,388	21,350	353,190	21,420	318,154	18,277	490,747	38,658
1990	337,570	17,859	324,344	17,952	298,593	15,686	445,351	33,277
1991	271,535	13,773	266,462	13,652	249,969	12,361	362,569	26,992
1992	192,354	11,174	197,853	10,820	186,086	10,077	268,628	22,476
1993	178,266	11,292	188,478	10,683	176,540	9,936	249,273	21,942
1994	187,317	10,519	192,929	9,535	182,534	8,679	243,009	19,065
1995	208,542	11,008	206,134	9,219	195,817	8,123	259,489	18,909
1996	207,695	11,383	195,741	8,845	183,983	7,414	256,841	18,921
1997	200,054	10,948	177,159	8,031	165,042	6,556	248,826	18,575
1998	176,122	10,720	146,578	7,410	135,922	5,960	227,673	18,679
1999	170,766	10,988	135,535	7,476	127,492	6,100	225,483	19,365
2000	176,982	11,510	138,135	8,285	131,943	6,845	234,034	20,033
2001	184,047	11,263	145,870	8,994	140,436	7,481	238,092	19,148
2002	197,057	11,251	167,366	9,733	160,296	8,134	249,396	18,774
2003	196,998	10,933	181,175	9,927	170,395	8,310	246,410	18,055
2004	201,034	10,447	192,158	9,533	179,393	8,029	246,786	17,181
2005	200,123	9,895	190,622	8,494	180,265	7,379	244,070	16,622
2006	177,411	8,874	163,963	7,045	159,242	6,446	217,923	15,287
2007	150,781	8,072	135,066	6,193	136,575	5,922	188,403	14,256
2008	129,540	7,266	113,921	5,643	119,386	5,392	162,160	12,843
2009	119,688	7,392	103,881	5,875	108,342	5,332	148,937	12,825
2010	128,058	8,181	107,481	6,785	105,527	5,313	156,135	13,504
2011	168,089	10,022	142,857	8,468	134,230	5,639	199,965	15,978
2012	198,016	12,349	169,637	10,552	156,635	6,361	239,780	19,837
2013	222,889	14,590	183,344	12,463	163,157	7,111	275,090	24,070
2014	230,109	16,509	187,542	13,777	164,589	7,660	292,372	27,514
2015	234,645	18,491	187,521	15,740	155,346	8,488	304,117	30,728
2016	267,132	21,989	213,049	19,456	165,493	10,700	346,419	35,983
2017	293,961	26,191	234,934	23,833	172,287	14,647	390,203	42,488
2018	299,662	28,537	234,705	26,392	162,198	19,300	408,270	46,421
2019	275,850	29,232	215,395	26,740	146,654	23,205	398,582	48,383

Table 2.1.22. Spawning biomass (p. 4 of 4).

	18.2		18.3		18.4		18.5	
Year	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.
1977	96,667	32,475	52,708	19,202	80,124	27,952	128,411	43,546
1978	94,618	32,453	50,835	18,914	80,259	28,297	128,813	44,342
1979	94,193	31,398	51,197	18,075	83,528	27,849	127,145	43,528
1980	114,114	31,325	70,084	18,426	109,875	29,091	144,410	44,268
1981	167,926	32,936	118,715	20,172	173,069	33,614	194,413	48,190
1982	273,532	38,974	211,575	25,534	287,514	43,624	299,495	58,350
1983	381,152	43,973	307,816	30,056	395,811	50,127	408,829	65,429
1984	404,307	40,038	331,402	27,626	419,932	45,766	438,370	60,191
1985	458,614	42,373	377,752	29,087	470,337	46,375	502,670	63,545
1986	442,149	38,428	366,466	26,325	455,090	41,216	491,849	57,797
1987	428,132	33,935	358,418	23,249	441,629	36,567	477,016	51,434
1988	446,582	32,498	381,072	22,366	452,099	33,712	487,461	48,024
1989	430,891	29,702	369,522	20,229	429,859	30,503	464,370	43,766
1990	392,454	25,320	336,941	16,827	377,318	24,613	414,308	36,270
1991	316,668	20,102	269,663	12,935	302,143	18,455	339,326	28,587
1992	228,795	16,465	189,317	10,479	215,782	14,707	250,283	23,429
1993	211,599	16,187	173,811	10,515	203,103	15,562	232,115	23,639
1994	213,339	14,401	182,284	9,687	214,784	15,491	230,159	21,523
1995	232,606	14,649	202,071	10,052	241,819	16,848	249,536	21,591
1996	232,719	15,056	198,931	10,330	244,746	18,118	248,156	22,291
1997	225,061	14,738	188,313	9,919	232,247	17,528	237,527	21,793
1998	202,613	14,755	160,977	9,819	208,217	17,049	217,079	21,413
1999	198,765	15,239	170,738	10,103	200,130	16,942	211,850	21,832
2000	206,287	15,837	161,497	10,393	211,297	17,970	222,565	22,992
2001	212,236	15,283	163,631	10,472	221,333	17,916	229,976	22,518
2002	224,398	15,062	173,290	10,854	240,214	17,982	247,018	22,100
2003	222,561	14,496	169,209	11,129	240,326	17,427	246,169	21,380
2004	225,132	13,802	186,334	10,434	238,084	16,176	243,684	20,083
2005	222,742	13,201	198,524	9,977	225,622	14,296	234,133	18,235
2006	197,893	11,978	182,290	9,254	190,184	12,289	201,589	16,038
2007	168,994	10,997	156,646	8,565	158,438	11,093	171,147	14,757
2008	144,723	9,852	137,516	7,976	136,139	9,927	147,152	13,250
2009	132,563	9,833	127,939	8,072	127,712	10,306	135,255	13,463
2010	140,671	10,575	133,240	8,301	143,936	12,414	145,758	15,394
2011	183,436	12,775	176,437	10,048	193,194	16,108	190,754	19,342
2012	219,661	15,840	213,287	12,456	223,642	19,573	223,295	23,555
2013	251,262	19,099	223,703	13,112	254,000	23,480	256,566	28,872
2014	265,004	21,847	227,135	14,522	284,049	27,834	290,131	33,877
2015	271,915	24,328	225,559	15,923	291,354	30,751	303,531	38,168
2016	307,658	28,420	231,965	18,400	318,638	34,131	339,221	43,365
2017	341,785	33,285	249,215	22,267	323,814	36,483	362,082	48,153
2018	348,981	35,699	233,812	24,448	317,106	37,394	370,697	51,178
2019	329,222	36,403	204,892	25,613	285,467	35,861	358,216	51,654

Table 2.1.23. Area-specific spawning biomass.

	18.1		18.2		18.5	
Year	EBS	NBS	EBS	NBS	EBS	NBS
1977	84,092	67,563	71,949	24,717	75,116	53,295
1978	75,356	74,958	67,595	27,023	67,468	61,345
1979	84,237	63,865	71,419	22,775	75,099	52,047
1980	99,464	68,778	89,025	25,089	87,427	56,983
1981	145,770	79,107	137,431	30,496	130,049	64,365
1982	218,659	119,801	222,946	50,586	199,665	99,830
1983	280,485	172,608	299,982	81,171	260,102	148,728
1984	275,148	195,028	304,387	99,920	265,669	172,701
1985	277,616	257,017	326,641	131,974	270,355	232,316
1986	269,643	246,161	314,894	127,256	266,974	224,875
1987	258,378	235,957	308,456	119,676	258,854	218,162
1988	279,791	231,521	327,960	118,622	274,463	212,998
1989	278,452	212,295	319,830	111,061	270,261	194,109
1990	233,473	211,878	282,273	110,181	223,984	190,325
1991	196,235	166,334	227,099	89,568	189,963	149,363
1992	140,858	127,770	164,248	64,546	137,874	112,409
1993	145,545	103,729	161,992	49,607	140,979	91,137
1994	147,872	95,138	167,606	45,733	144,857	85,302
1995	166,596	92,893	185,358	47,248	164,433	85,104
1996	171,965	84,877	187,305	45,415	169,568	78,588
1997	157,072	91,753	177,653	47,408	153,340	84,187
1998	144,276	83,397	158,685	43,928	141,002	76,077
1999	137,121	88,362	152,559	46,206	131,915	79,936
2000	141,795	92,240	159,471	46,816	139,246	83,320
2001	147,622	90,471	166,852	45,385	147,026	82,951
2002	152,712	96,685	174,083	50,316	155,374	91,644
2003	155,607	90,803	173,590	48,971	158,795	87,374
2004	150,576	96,210	175,255	49,877	151,828	91,856
2005	150,209	93,861	172,765	49,976	146,985	87,148
2006	132,721	85,202	151,275	46,618	125,412	76,177
2007	111,412	76,991	128,089	40,905	104,855	66,293
2008	100,294	61,866	118,085	26,638	95,337	51,815
2009	86,409	62,529	105,539	27,024	83,850	51,405
2010	128,431	27,704	122,738	17,933	122,298	23,461
2011	130,475	69,491	127,761	55,675	129,066	61,688
2012	172,560	67,220	208,052	11,609	165,084	58,211
2013	187,620	87,470	209,568	41,693	179,341	77,225
2014	191,907	100,465	215,295	49,708	194,187	95,945
2015	202,601	101,516	224,201	47,714	205,605	97,925
2016	215,334	131,085	202,467	105,191	210,917	128,304
2017	206,622	183,581	259,319	82,466	202,227	159,855
2018	283,818	124,452	272,200	76,782	257,827	112,871
2019	199,474	199,108	239,224	89,999	188,490	169,726

Table 2.1.24. Age 0+ biomass (p. 1 of 2).

Year	16.6	16.6a	16.6b	16.6c	16.6d	16.6e	16.6f	16.6g
1977	207,053	223,703	194,605	204,040	216,890	221,236	202,175	207,014
1978	227,094	242,044	212,101	223,399	238,205	242,903	221,210	225,988
1979	333,391	330,012	306,967	324,937	348,601	354,298	323,005	325,546
1980	523,923	488,089	480,026	507,226	543,061	551,351	506,626	507,005
1981	771,004	690,206	707,420	745,783	793,936	805,597	746,028	746,949
1982	1,039,910	901,336	959,234	1,008,300	1,065,460	1,081,430	1,008,500	1,012,590
1983	1,170,690	1,017,360	1,087,980	1,139,680	1,195,600	1,213,360	1,138,960	1,146,890
1984	1,132,220	1,016,250	1,057,850	1,106,030	1,155,260	1,171,010	1,103,250	1,112,390
1985	1,216,370	1,104,160	1,139,990	1,190,660	1,239,600	1,256,880	1,185,330	1,198,190
1986	1,212,600	1,117,600	1,140,190	1,189,120	1,232,340	1,250,890	1,181,180	1,196,290
1987	1,238,960	1,151,320	1,169,550	1,216,700	1,257,610	1,274,330	1,206,830	1,223,460
1988	1,265,790	1,183,290	1,198,910	1,245,680	1,283,040	1,299,160	1,234,240	1,254,030
1989	1,157,460	1,086,920	1,098,790	1,141,740	1,171,980	1,187,720	1,130,070	1,151,320
1990	982,506	931,441	939,009	972,291	994,778	1,010,260	962,298	982,375
1991	807,762	772,936	777,301	801,288	819,673	834,179	794,179	810,205
1992	696,104	666,206	669,312	690,725	707,911	721,729	685,469	697,013
1993	803,765	767,587	771,672	798,324	819,239	830,614	792,004	800,531
1994	833,536	796,915	801,368	830,375	846,275	855,324	821,913	826,212
1995	886,877	848,336	853,066	886,849	896,042	904,933	874,320	875,540
1996	889,288	849,635	855,001	893,996	898,159	903,356	875,929	874,268
1997	767,569	733,461	738,665	777,235	776,338	778,297	756,038	754,210
1998	669,598	637,525	642,519	680,792	682,065	679,841	658,346	655,963
1999	699,556	666,671	671,687	692,438	712,233	711,454	686,959	685,424
2000	756,666	723,153	728,708	775,958	765,714	770,250	742,922	743,473
2001	768,515	736,862	742,377	793,979	777,191	782,285	754,924	756,439
2002	800,224	769,837	774,941	825,335	810,534	813,299	786,602	788,739
2003	797,989	769,360	774,193	819,553	809,845	809,412	784,808	788,300
2004	774,522	748,429	753,104	772,181	788,047	784,115	762,412	767,199
2005	701,952	680,342	684,384	686,559	716,949	709,720	691,661	697,623
2006	605,911	588,909	592,137	587,411	621,192	611,870	597,727	604,091
2007	533,747	519,266	521,988	514,277	548,470	538,412	527,244	533,351
2008	539,084	522,632	525,039	512,846	551,661	544,637	533,193	537,129
2009	598,143	577,121	579,846	565,793	610,347	606,495	591,900	594,515
2010	730,852	700,957	704,934	696,381	743,536	743,933	723,606	722,990
2011	874,834	837,277	842,674	829,103	890,087	891,555	867,221	864,618
2012	937,925	894,998	902,280	884,206	951,529	957,043	931,074	928,821
2013	961,906	915,238	923,588	925,464	970,935	983,285	956,223	956,655
2014	992,622	941,797	951,458	953,289	1,001,530	1,016,750	987,816	995,594
2015	1,019,330	965,164	976,716	983,143	1,034,600	1,046,580	1,015,580	1,034,700
2016	1,070,610	1,013,060	1,026,910	1,061,320	1,091,030	1,102,300	1,068,310	1,100,390
2017	1,047,990	990,839	1,006,960	1,034,600	1,069,820	1,083,270	1,048,420	1,089,600
2018	918,116	867,804	884,134	917,186	938,675	953,984	922,045	962,703
2019	774,678	731,012	746,232	773,859	796,631	810,480	781,088	813,439

Table 2.1.24. Age 0+ biomass (p. 2 of 2).

Year	16.6h	17.2	17.6	18.1	18.2	18.3	18.4	18.5
1977	193,350	141,105	101,274	267,334	232,650	180,828	271,084	239,619
1978	210,611	167,993	129,242	265,111	242,639	198,279	302,248	234,955
1979	304,194	255,666	204,766	374,907	346,695	296,726	446,215	329,493
1980	477,205	397,325	324,536	529,233	517,897	477,561	681,472	471,320
1981	707,555	594,484	484,456	736,756	746,820	714,402	970,794	673,778
1982	964,329	822,814	669,377	916,547	975,194	974,010	1,271,000	851,703
1983	1,097,420	954,107	783,514	962,650	1,054,540	1,104,960	1,389,340	901,167
1984	1,066,920	964,143	800,242	869,916	978,921	1,073,580	1,349,880	842,440
1985	1,149,380	1,056,260	877,750	858,835	1,006,110	1,155,680	1,432,650	833,934
1986	1,147,780	1,078,450	901,283	864,013	1,002,920	1,154,710	1,431,680	851,349
1987	1,175,520	1,124,650	952,317	868,744	1,028,280	1,183,690	1,456,790	863,928
1988	1,206,890	1,170,860	1,007,990	904,366	1,052,730	1,213,080	1,433,320	879,543
1989	1,108,380	1,092,030	952,751	833,540	963,358	1,110,740	1,284,320	804,566
1990	945,624	951,908	843,227	661,634	795,251	943,403	1,053,970	631,071
1991	778,997	801,338	723,914	561,658	653,818	773,775	877,495	543,757
1992	668,862	692,210	623,228	495,493	576,158	661,918	763,032	480,411
1993	771,287	784,177	703,115	615,930	695,625	761,014	888,160	593,225
1994	801,714	794,709	718,773	627,539	717,139	787,653	930,855	612,685
1995	854,005	823,068	743,491	675,133	761,097	832,272	1,000,980	664,351
1996	855,966	793,480	715,139	702,607	776,853	823,711	1,009,910	691,254
1997	739,720	663,785	603,303	583,105	661,368	699,814	857,699	567,159
1998	641,991	555,289	504,490	518,898	578,105	591,061	761,008	505,535
1999	669,048	574,411	519,370	534,432	600,950	673,495	785,583	512,686
2000	724,633	639,279	573,733	580,623	655,666	663,478	864,548	569,913
2001	737,227	684,768	615,912	579,321	663,181	657,050	889,340	578,387
2002	769,876	741,284	667,393	591,278	679,687	677,433	942,766	602,619
2003	770,849	749,374	676,557	600,781	680,315	666,774	936,666	612,669
2004	751,722	725,127	668,279	565,215	657,699	703,130	882,425	566,858
2005	684,614	653,412	613,523	510,105	590,551	682,003	768,070	496,681
2006	593,861	561,764	534,883	443,476	508,040	609,470	635,917	417,185
2007	525,386	490,641	468,291	390,169	448,814	544,441	556,804	365,876
2008	529,243	486,697	446,383	389,976	487,620	566,037	570,187	369,240
2009	584,421	529,690	467,503	401,011	532,882	634,580	640,389	390,057
2010	708,732	645,835	566,466	703,263	703,940	753,144	808,993	662,579
2011	847,231	768,945	674,592	659,706	636,486	907,110	976,074	644,684
2012	909,733	811,459	705,354	765,345	946,595	989,743	1,026,360	731,609
2013	935,861	822,486	700,610	783,424	899,910	944,623	1,076,880	751,146
2014	971,857	847,984	691,914	824,622	926,904	965,630	1,191,090	828,615
2015	1,007,260	875,087	701,815	864,619	967,543	977,939	1,222,310	866,843
2016	1,068,010	923,425	723,272	889,467	850,028	941,719	1,254,160	864,955
2017	1,054,200	900,177	684,141	693,813	890,136	918,160	1,156,590	674,061
2018	928,706	783,446	582,723	892,776	858,174	751,082	993,123	810,930
2019	781,790	657,067	487,566	589,406	689,675	613,667	834,544	540,515

Table 2.1.25. Area-specific age 0+ biomass.

	18.1		18.2		18.5	
Year	EBS	NBS	EBS	NBS	EBS	NBS
1977	267,334	157,670	232,650	59,369	239,619	125,770
1978	265,111	182,018	242,639	68,121	234,955	149,585
1979	374,907	177,173	346,695	69,068	329,493	144,703
1980	529,233	211,141	517,897	87,065	471,320	176,185
1981	736,756	260,020	746,820	112,850	673,778	215,263
1982	916,547	377,078	975,194	171,563	851,703	320,524
1983	962,650	479,397	1,054,540	233,844	901,167	417,527
1984	869,916	502,847	978,921	262,452	842,440	449,386
1985	858,835	615,310	1,006,110	321,508	833,934	557,775
1986	864,013	581,802	1,002,920	305,796	851,349	532,754
1987	868,744	576,753	1,028,280	297,744	863,928	533,746
1988	904,366	560,718	1,052,730	293,326	879,543	514,354
1989	833,540	516,976	963,358	274,408	804,566	471,206
1990	661,634	496,854	795,251	262,314	631,071	445,207
1991	561,658	386,794	653,818	211,412	543,757	348,128
1992	495,493	307,169	576,158	159,405	480,411	271,390
1993	615,930	278,945	695,625	140,205	593,225	246,893
1994	627,539	275,702	717,139	139,066	612,685	249,126
1995	675,133	276,095	761,097	145,811	664,351	254,177
1996	702,607	257,264	776,853	140,673	691,254	238,444
1997	583,105	263,140	661,368	138,527	567,159	241,080
1998	518,898	231,196	578,105	124,602	505,535	211,216
1999	534,432	244,431	600,950	130,799	512,686	220,893
2000	580,623	256,895	655,666	134,400	569,913	233,486
2001	579,321	260,650	663,181	135,095	578,387	240,952
2002	591,278	271,460	679,687	145,505	602,619	258,810
2003	600,781	254,476	680,315	140,207	612,669	245,023
2004	565,215	266,979	657,699	141,808	566,858	253,697
2005	510,105	251,694	590,551	136,920	496,681	232,548
2006	443,476	220,997	508,040	123,050	417,185	196,723
2007	390,169	199,541	448,814	108,081	365,876	172,414
2008	389,976	193,182	487,620	68,294	369,240	162,906
2009	401,011	236,623	532,882	77,567	390,057	191,582
2010	703,263	67,412	703,940	40,379	662,579	57,676
2011	659,706	267,483	636,486	261,271	644,684	232,919
2012	765,345	251,282	946,595	33,931	731,609	211,992
2013	783,424	279,329	899,910	115,859	751,146	246,637
2014	824,622	289,999	926,904	129,685	828,615	278,712
2015	864,619	304,647	967,543	128,792	866,843	292,193
2016	889,467	376,744	850,028	318,871	864,955	366,104
2017	693,813	608,381	890,136	283,899	674,061	528,959
2018	892,776	315,463	858,174	197,968	810,930	285,470
2019	589,406	482,545	689,675	219,825	540,515	409,366

Table 2.1.26. OFL and maxABC distribution parameters forecast for 2019.

	2019 OFL			2019 maxABC			Pr(ABC>OFL)	
Model	Mean	SDev	CV	Mean	SDev	CV	Sam.	Pop.
16.6	208,725	25,907	0.124	175,394	21,705	0.124	0.287	0.381
16.6a	186,345	44,764	0.240	156,497	38,104	0.243	0.189	0.245
16.6b	195,995	24,755	0.126	164,711	20,736	0.126	0.225	0.300
16.6c	206,168	26,255	0.127	173,237	21,998	0.127	0.273	0.364
16.6d	214,405	26,410	0.123	180,120	22,121	0.123	0.321	0.419
16.6e	220,429	32,303	0.147	185,156	27,067	0.146	0.363	0.460
16.6f	208,647	26,222	0.126	175,316	21,967	0.125	0.286	0.380
16.6g	219,645	31,185	0.142	184,787	26,172	0.142	0.359	0.457
16.6h	208,201	25,457	0.122	175,189	21,357	0.122	0.286	0.379
17.2	154,825	42,277	0.273	129,953	35,909	0.276	0.120	0.114
17.6	53,480	17,399	0.325	44,529	14,564	0.327	0.019	0.004
18.1	197,498	24,185	0.122	169,944	20,693	0.122	0.253	0.339
18.2	211,915	24,892	0.117	180,412	21,137	0.117	0.323	0.421
18.3	133,196	34,616	0.260	111,286	29,251	0.263	0.092	0.061
18.4	237,280	39,559	0.167	199,107	33,130	0.166	0.499	0.576
18.5	178,873	30,100	0.168	153,757	25,702	0.167	0.179	0.228
Average	189,727	52,872	0.279	159,962	44,672	0.279	0.203	0.267

Table 2.1.27. Summary of effective sample size model weightings.

Type	Fleet	16.6	16.6a	16.6b	16.6c	16.6d	16.6e	16.6f	16.6g
Size	Fish.	23,850	23,439	23,779	24,015	23,389	23,606	23,835	23,899
Size	Std.	11,086	n/a	2,264	11,171	11,546	11,088	11,078	11,056
Size	Exp.	n/a	9,427	9,373	n/a	n/a	n/a	n/a	n/a
Size	NBS	n/a	n/a	n/a	n/a	n/a	n/a	n/a	105
Age	Fish.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Age	Std.	1,395	n/a	n/a	1,392	1,384	1,408	1,399	1,392
Age	Exp.	n/a	1,452	1,443	n/a	n/a	n/a	n/a	n/a
Index	Std.	3,978	n/a	2,161	3,895	3,966	11,782	4,119	12,332
Index	Exp.	n/a	3,177	3,166	n/a	n/a	n/a	n/a	n/a
Index	NBS	n/a	n/a	n/a	n/a	n/a	n/a	n/a	177
	Sum:	40,309	37,496	42,185	40,473	40,285	47,885	40,431	48,960

Type	Fleet	16.6h	17.2	17.6	18.1	18.2	18.3	18.4	18.5
Size	Fish.	24,110	45,671	27,866	22,152	22,741	25,802	23,640	22,373
Size	Std.	11,045	10,471	20,062	11,334	11,239	11,155	11,118	11,326
Size	Exp.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Size	NBS	106	n/a	n/a	206	269	n/a	n/a	208
Age	Fish.	n/a	1,339	1,293	n/a	n/a	n/a	n/a	n/a
Age	Std.	1,383	1,068	2,506	1,511	1,454	1,496	1,367	1,490
Age	Exp.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Index	Std.	4,201	3,215	12,246	4,487	3,814	3,580	4,021	4,552
Index	Exp.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Index	NBS	175	n/a	n/a	176	2,216	n/a	n/a	176
	Sum:	41,020	61,763	63,973	39,866	41,732	42,033	40,146	40,124

Table 2.1.28. Options for multiplicative adjustments to model weights.

Model:	16.6	16.6a	16.6b	16.6c	16.6d	16.6e	16.6f	16.6g	16.6h	17.2	17.6	18.1	18.2	18.3	18.4	18.5
abs(ρ):	0.243	0.202	0.217	0.304	0.222	0.323	0.291	0.359	0.319	0.309	0.069	0.452	0.370	0.118	0.451	0.724
Adjust (α=1.0):	0.841	0.875	0.863	0.791	0.858	0.776	0.801	0.748	0.779	0.787	1.000	0.682	0.740	0.952	0.683	0.520
Adjust (α=0.8):	0.870	0.899	0.888	0.829	0.885	0.817	0.838	0.793	0.819	0.826	1.000	0.736	0.786	0.961	0.737	0.593
Adjust (α=0.6):	0.901	0.923	0.915	0.869	0.912	0.859	0.876	0.840	0.861	0.866	1.000	0.795	0.835	0.971	0.795	0.675
Adjust (α=0.4):	0.933	0.948	0.943	0.911	0.941	0.904	0.915	0.890	0.905	0.909	1.000	0.858	0.887	0.981	0.858	0.770
Adjust (α=0.2):	0.966	0.974	0.971	0.954	0.970	0.951	0.957	0.944	0.951	0.953	1.000	0.926	0.942	0.990	0.927	0.877

Model:	16.6	16.6a	16.6b	16.6c	16.6d	16.6e	16.6f	16.6g	16.6h	17.2	17.6	18.1	18.2	18.3	18.4	18.5
Jitter score:	0.000	0.000	0.000	0.000	2.110	0.000	0.000	0.000	0.004	0.001	0.125	0.000	0.000	0.000	0.000	0.000
Adjust (α=1.0):	1.000	1.000	1.000	1.000	0.121	1.000	1.000	1.000	0.996	0.999	0.883	1.000	1.000	1.000	1.000	1.000
Adjust (α=0.8):	1.000	1.000	1.000	1.000	0.185	1.000	1.000	1.000	0.997	1.000	0.905	1.000	1.000	1.000	1.000	1.000
Adjust (α=0.6):	1.000	1.000	1.000	1.000	0.282	1.000	1.000	1.000	0.998	1.000	0.928	1.000	1.000	1.000	1.000	1.000
Adjust (α=0.4):	1.000	1.000	1.000	1.000	0.430	1.000	1.000	1.000	0.998	1.000	0.951	1.000	1.000	1.000	1.000	1.000
Adjust (α=0.2):	1.000	1.000	1.000	1.000	0.656	1.000	1.000	1.000	0.999	1.000	0.975	1.000	1.000	1.000	1.000	1.000

Model:	16.6	16.6a	16.6b	16.6c	16.6d	16.6e	16.6f	16.6g	16.6h	17.2	17.6	18.1	18.2	18.3	18.4	18.5
Finit - M :	-0.179	-0.186	-0.161	-0.174	-0.189	-0.192	-0.172	-0.180	-0.165	0.094	1.379	-0.176	-0.182	-0.036	-0.237	-0.116
Adjust (α=1.0):	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.910	0.252	1.000	1.000	1.000	1.000	1.000
Adjust (α=0.8):	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.927	0.332	1.000	1.000	1.000	1.000	1.000
Adjust (α=0.6):	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.945	0.437	1.000	1.000	1.000	1.000	1.000
Adjust (α=0.4):	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.963	0.576	1.000	1.000	1.000	1.000	1.000
Adjust (α=0.2):	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.981	0.759	1.000	1.000	1.000	1.000	1.000

Model:	16.6	16.6a	16.6b	16.6c	16.6d	16.6e	16.6f	16.6g	16.6h	17.2	17.6	18.1	18.2	18.3	18.4	18.5
ln(EBS *Q*):	-0.074	-0.006	-0.005	-0.058	-0.091	-0.086	-0.050	-0.047	-0.021	0.042	0.182	0.215	0.072	0.008	-0.204	0.251
Adjust (α=1.0):	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.959	0.833	0.807	0.931	0.992	1.000	0.778
Adjust (α=0.8):	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.967	0.864	0.842	0.944	0.994	1.000	0.818
Adjust (α=0.6):	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.975	0.896	0.879	0.958	0.995	1.000	0.860
Adjust (α=0.4):	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.983	0.930	0.918	0.972	0.997	1.000	0.904
Adjust (α=0.2):	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.992	0.964	0.958	0.986	0.998	1.000	0.951

Table 2.1.29a. Cross-validation negative log likelihoods for the EBS survey index.

Year	16.6	16.6a	16.6b	16.6c	16.6d	16.6e	16.6f	16.6g	16.6h	17.2	17.6	18.1	18.2	18.3	18.4	18.5
1982	-1.982		-2.2257	-2.080	-1.866	-1.644	-2.492	-2.169	-2.647	-2.3705	-1.7589	4.035	0.449	-2.317	0.728	3.470
1983	-1.678		-1.6989	-1.643	-1.703	-1.832	-2.138	-1.656	-1.652	-1.7908	-0.7986	-1.931	-1.771	-1.496	-2.004	-2.010
1984	-1.414		-1.7609	-1.502	-1.386	-0.883	-1.478	-1.390	-1.742	-2.0507	-1.8605	-1.549	-0.991	-1.574	0.244	-1.354
1985	-1.417		-1.5855	-1.368	0.000	-1.459	-1.315	-1.356	-1.251	-1.5988	-1.7547	-1.420	-1.385	-1.439	-1.718	-1.519
1986	-1.876		-1.5008	-1.845	-1.805	-2.025	-1.849	-1.941	-1.779	-1.6689	-1.2082	-1.727	-1.828	-1.944	-2.235	-1.774
1987	-2.201	-1.837	-2.0314	-2.158	-2.174	-2.391	-2.577	-2.370	-2.342	-2.7278	-2.7289	-1.826	-1.975	-2.322	-2.438	-2.125
1988	-2.376	-2.411	-2.4883	-2.414	-2.316	-2.545	-2.413	-2.560	-2.445	-2.5259	-2.324	-2.263	-2.211	-2.409	-2.338	-2.424
1989	11.617	15.335	15.982	12.000	11.062	11.783	11.651	11.748	11.692	23.59	17.651	9.393	10.175	12.562	9.317	9.197
1990	-1.459	-0.936	-0.8894	-1.329	-1.486	-1.153	-1.256	-1.275	-1.369	-1.7879	-2.1228	-2.230	-1.977	-1.168	-1.852	-2.358
1991	-0.095	1.203	0.1834	0.016	0.000	0.059	0.027	-0.165	-0.158	-0.3754	-1.0776	-1.010	-0.722	-0.016	-0.345	-1.181
1992	-1.985	-2.015	-1.8701	-1.973	-1.971	-1.964	-1.915	-1.998	-1.946	-2.0945	-1.4311	-2.028	-2.028	-1.929	-1.994	-2.043
1993	-1.505	-1.464	-1.6891	-1.527	-1.544	-1.493	-1.629	-1.443	-1.593	-0.858	-2.0024	-1.685	-1.572	-1.610	-1.449	-1.744
1994	7.407	6.120	6.8897	6.921	0.000	7.465	7.331	7.641	7.462	10.719	8.8381	7.373	7.482	7.952	7.353	7.062
1995	0.433	-0.177	0.0058	0.014	0.642	0.395	0.304	0.433	0.308	1.2883	-0.4323	-0.017	0.233	0.970	0.487	-0.140
1996	-1.014	-1.283	-1.2106	-1.284	-0.895	-0.996	-1.070	-0.978	-1.050	-0.3048	-1.0509	-1.369	-1.120	-0.414	-0.860	-1.410
1997	-1.662	-1.498	-1.4513	-1.505	-1.667	-1.633	-1.637	-1.668	-1.658	-1.925	-1.931	-1.647	-1.671	-1.867	-1.670	-1.604
1998	-0.535	-1.059	0.0475	-0.171	-0.506	-0.427	-0.439	-0.613	-0.586	-1.9435	-1.8306	-0.247	-0.468	-0.727	-0.425	-0.249
1999	-1.835	-1.520	-1.6294	-0.906	-1.907	-1.669	-1.752	-1.753	-1.808	-1.4767	-2.2579	-1.783	-1.976	-2.218	-1.800	-1.301
2000	-0.218	0.436	0.3646	0.830	-0.480	-0.165	-0.099	-0.203	0.048	-0.925	-1.3228	0.038	-0.187	-1.807	0.486	1.163
2001	7.841	8.114	6.6955	6.007	8.581	7.777	7.617	7.627	7.508	6.0661	1.7465	8.836	8.551	19.043	7.740	6.250
2002	-2.016	-1.751	-1.7901	-1.706	-2.090	-2.006	-1.973	-1.942	-1.918	-1.6797	-1.5017	-2.102	-2.061	-2.238	-1.160	-1.045
2003	-2.084	-2.061	-2.0801	-2.072	-2.077	-2.087	-2.087	-2.086	-2.083	-2.0555	-1.9599	-2.076	-2.064	-1.801	-2.044	-1.982
2004	-1.479	-1.199	-0.8142	-1.440	-1.528	-1.690	-1.420	-1.455	-1.197	-1.5697	-0.8204	-1.908	-1.886	-1.236	-1.830	-1.726
2005	-1.238	-1.307	-1.4952	-1.253	-1.281	-1.260	-1.347	-1.430	-1.479	-1.2497	-1.9648	-1.039	-1.114	-1.433	-0.544	-0.754
2006	5.262	0.546	3.1863	6.018	4.138	4.873	4.489	2.983	2.729	2.8055	-1.4636	5.849	5.871	0.035	13.718	6.684
2007	-0.418	-0.476	-0.5588	-0.314	-0.536	-0.439	-0.496	-0.460	-0.504	-0.0558	-1.3291	-0.484	-0.385	-0.818	-0.188	-0.270
2008	0.966	2.614	1.4171	0.052	1.214	1.179	1.318	0.981	1.123	0.7368	2.8013	1.964	2.696	5.538	0.016	1.151
2009	-1.359	-0.405	-0.7313	-1.654	-0.868	-1.056	-1.110	-1.369	-1.372	-1.9175	2.4415	-1.573	0.006	0.492	-2.051	1.228
2010	-1.913	-1.797	-1.9672	-1.683	-1.949	-1.939	-1.956	-1.907	-1.915	-1.6709	-1.7259	-1.333	-1.971	-1.956	-1.783	-1.592
2011	-1.692	-1.852	-2.021	-1.426	-1.910	-1.880	-1.870	-1.849	-1.852	0.4274	-2.0951	-1.177	5.746	-2.209	-1.150	-0.105
2012	-1.173	-1.837	-1.5755	-1.058	-1.200	-1.522	-1.448	-1.634	-1.498	-0.1628	-1.397	0.462	-2.296	-2.094	-1.309	0.256
2013	-1.188	-0.965	-1.0945	-1.409	-1.271	-1.145	-1.067	-0.861	-0.880	-1.4597	-1.6251	0.190	0.154	-0.968	-0.488	0.559
2014	-0.421	-0.813	-0.7719	-0.383	-0.338	-0.795	-0.641	-1.161	-0.929	-0.1232	1.0508	-1.782	-1.548	-0.304	-1.155	-1.898
2015	-0.806	-0.915	-1.114	-0.598	-0.748	-1.150	-1.044	-1.474	-1.318	-0.6717	-0.1242	-2.131	-1.517	-0.430	-1.298	-2.160
2016	-2.010	-1.908	-2.1426	-1.847	-2.001	-2.201	-2.262	-2.319	-2.327	-2.0511	-1.8687	2.639	-1.873	-0.997	-1.914	1.444
2017	7.394	6.908	7.8307	7.334	8.206	7.364	8.144	8.678	7.170	8.9449	0.6696	-1.511	0.691	1.256	5.427	-2.176
Sum	-0.125	9.792	2.415	0.644	-5.662	-0.554	-1.896	-3.390	-5.259	13.487	-10.570	0.932	3.457	6.107	7.475	1.520

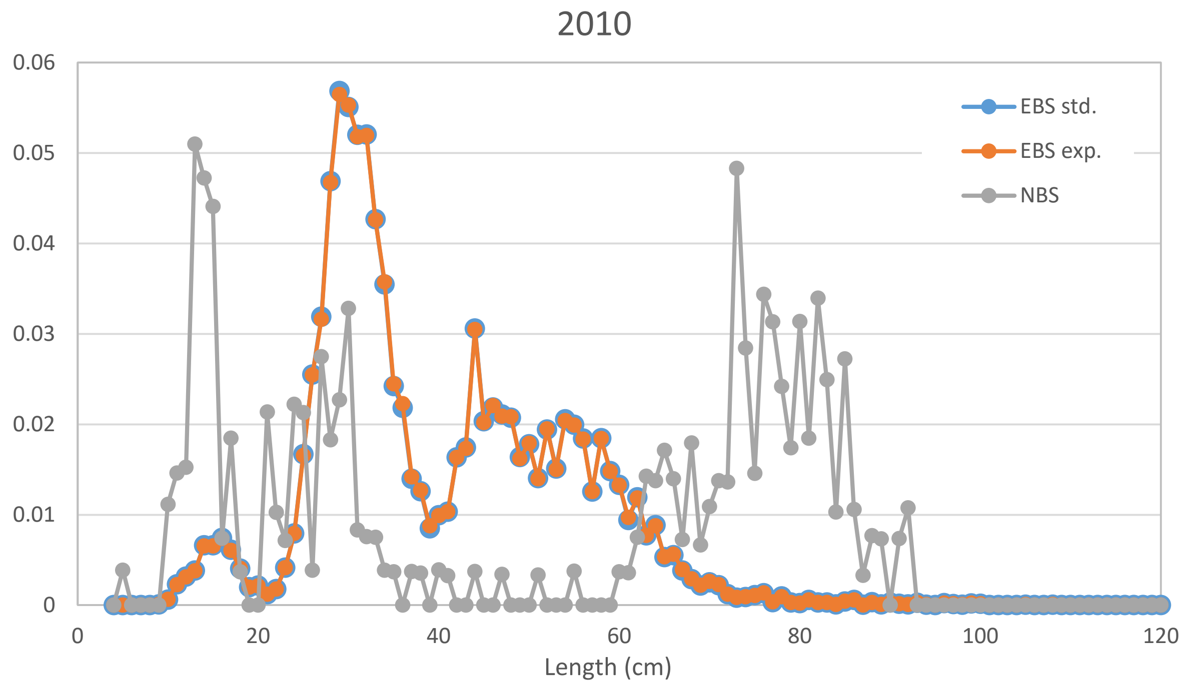
Table 2.1.29b. Cross-validation negative log likelihoods (after subtracting minimum for each row).

Year	16.6	16.6a	16.6b	16.6c	16.6d	16.6e	16.6f	16.6g	16.6h	17.2	17.6	18.1	18.2	18.3	18.4	18.5
1982	0.6654		0.4215	0.5677	0.7810	1.0029	0.1554	0.4786	0.0000	0.2767	0.8883	6.6821	3.0958	0.3302	3.3752	6.1172
1983	0.4601		0.4388	0.4944	0.4343	0.3053	0.0000	0.4815	0.4855	0.3469	1.3391	0.2065	0.3671	0.6418	0.1340	0.1275
1984	0.6370		0.2898	0.5489	0.6650	1.1677	0.5730	0.6607	0.3091	0.0000	0.1901	0.5020	1.0594	0.4762	2.2951	0.6967
1985	0.3376		0.1692	0.3872	1.7547	0.2958	0.4400	0.3986	0.5035	0.1559	0.0000	0.3347	0.3694	0.3152	0.0363	0.2356
1986	0.3596		0.7345	0.3906	0.4298	0.2104	0.3863	0.2944	0.4565	0.5664	1.0271	0.5086	0.4077	0.2918	0.0000	0.4609
1987	0.5283	0.8920	0.6974	0.5704	0.5546	0.3378	0.1515	0.3587	0.3865	0.0011	0.0000	0.9032	0.7540	0.4070	0.2904	0.6036
1988	0.1847	0.1491	0.0720	0.1461	0.2445	0.0155	0.1472	0.0000	0.1158	0.0344	0.2364	0.2974	0.3493	0.1508	0.2220	0.1364
1989	2.4197	6.1377	6.7846	2.8030	1.8648	2.5852	2.4536	2.5509	2.4944	14.3925	8.4531	0.1960	0.9774	3.3646	0.1192	0.0000
1990	0.8993	1.4218	1.4687	1.0293	0.8721	1.2046	1.1018	1.0828	0.9894	0.5701	0.2353	0.1279	0.3814	1.1905	0.5060	0.0000
1991	1.0863	2.3839	1.3645	1.1975	1.1810	1.2399	1.2083	1.0162	1.0235	0.8057	0.1035	0.1706	0.4594	1.1649	0.8364	0.0000
1992	0.1092	0.0792	0.2244	0.1210	0.1231	0.1305	0.1799	0.0965	0.1483	0.0000	0.6635	0.0663	0.0664	0.1658	0.1005	0.0518
1993	0.4974	0.5387	0.3133	0.4754	0.4580	0.5097	0.3737	0.5590	0.4099	1.1443	0.0000	0.3170	0.4302	0.3927	0.5535	0.2588
1994	7.4072	6.1204	6.8897	6.9206	0.0000	7.4647	7.3313	7.6405	7.4617	10.7194	8.8381	7.3730	7.4816	7.9525	7.3531	7.0615
1995	0.8655	0.2551	0.4381	0.4460	1.0740	0.8277	0.7362	0.8652	0.7401	1.7206	0.0000	0.4157	0.6653	1.4025	0.9195	0.2920
1996	0.3953	0.1270	0.1990	0.1259	0.5148	0.4138	0.3394	0.4320	0.3597	1.1048	0.3587	0.0408	0.2895	0.9957	0.5500	0.0000
1997	0.2689	0.4328	0.4797	0.4256	0.2637	0.2978	0.2944	0.2633	0.2734	0.0059	0.0000	0.2841	0.2604	0.0643	0.2607	0.3268
1998	1.4088	0.8841	1.9910	1.7729	1.4378	1.5162	1.5043	1.3310	1.3572	0.0000	0.1130	1.6967	1.4755	1.2170	1.5182	1.6946
1999	0.4231	0.7377	0.6285	1.3517	0.3505	0.5889	0.5063	0.5048	0.4494	0.7812	0.0000	0.4753	0.2822	0.0396	0.4578	0.9573
2000	1.5886	2.2429	2.1714	2.6372	1.3266	1.6416	1.7075	1.6035	1.8550	0.8818	0.4840	1.8446	1.6202	0.0000	2.2925	2.9693
2001	6.0950	6.3673	4.9490	4.2604	6.8349	6.0309	5.8708	5.8805	5.7612	4.3196	0.0000	7.0897	6.8044	17.2964	5.9939	4.5040
2002	0.2220	0.4874	0.4481	0.5320	0.1479	0.2323	0.2647	0.2962	0.3204	0.5585	0.7365	0.1364	0.1769	0.0000	1.0781	1.1933
2003	0.0029	0.0266	0.0073	0.0157	0.0107	0.0008	0.0000	0.0018	0.0048	0.0319	0.1275	0.0112	0.0230	0.2866	0.0435	0.1054
2004	0.4295	0.7096	1.0941	0.4678	0.3804	0.2187	0.4883	0.4537	0.7113	0.3385	1.0879	0.0000	0.0224	0.6726	0.0784	0.1821
2005	0.7267	0.6583	0.4696	0.7115	0.6837	0.7043	0.6182	0.5352	0.4858	0.7151	0.0000	0.9260	0.8513	0.5314	1.4209	1.2108
2006	6.7258	2.0099	4.6499	7.4814	5.6012	6.3365	5.9525	4.4471	4.1926	4.2691	0.0000	7.3123	7.3344	1.4984	15.1821	8.1481
2007	0.9113	0.8535	0.7702	1.0153	0.7934	0.8900	0.8336	0.8695	0.8246	1.2733	0.0000	0.8453	0.9441	0.5108	1.1412	1.0586
2008	0.9505	2.5982	1.4012	0.0356	1.1984	1.1626	1.3016	0.9653	1.1066	0.7208	2.7854	1.9485	2.6798	5.5218	0.0000	1.1354
2009	0.6912	1.6459	1.3192	0.3969	1.1821	0.9946	0.9403	0.6811	0.6788	0.1330	4.4920	0.4774	2.0564	2.5424	0.0000	3.2790
2010	0.0580	0.1737	0.0035	0.2875	0.0213	0.0320	0.0151	0.0641	0.0557	0.2999	0.2448	0.6375	0.0000	0.0145	0.1878	0.3785
2011	0.5176	0.3575	0.1882	0.7831	0.2988	0.3294	0.3394	0.3607	0.3577	2.6366	0.1141	1.0321	7.9550	0.0000	1.0592	2.1043
2012	1.1233	0.4593	0.7207	1.2385	1.0959	0.7746	0.8486	0.6622	0.7979	2.1335	0.8993	2.7585	0.0000	0.2024	0.9872	2.5524
2013	0.4368	0.6600	0.5306	0.2166	0.3543	0.4805	0.5581	0.7645	0.7449	0.1654	0.0000	1.8152	1.7789	0.6570	1.1374	2.1841
2014	1.4772	1.0850	1.1263	1.5153	1.5601	1.1033	1.2574	0.7377	0.9688	1.7750	2.9490	0.1159	0.3502	1.5947	0.7432	0.0000
2015	1.3543	1.2455	1.0465	1.5622	1.4129	1.0107	1.1168	0.6866	0.8424	1.4888	2.0363	0.0291	0.6437	1.7303	0.8624	0.0000
2016	0.3175	0.4193	0.1845	0.4799	0.3263	0.1258	0.0650	0.0078	0.0000	0.2760	0.4584	4.9660	0.4540	1.3301	0.4132	3.7715
2017	9.5708	9.0841	10.0071	9.5103	10.3823	9.5399	10.3206	10.8548	9.3463	11.1213	2.8460	0.6653	2.8676	3.4322	7.6031	0.0000
No. 0s:	0	0	0	0	1	0	2	1	2	3	11	1	2	3	3	7
Max:	9.5708	9.0841	10.0071	9.5103	10.3823	9.5399	10.3206	10.8548	9.3463	14.3925	8.8381	7.3730	7.9550	17.2964	15.1821	8.1481

Table 2.1.30. Model weights based on cross-validation negative log likelihoods.

Sorted in order of model number					Sorted in order of negative log likelihood				
Model	-lnL	Δ(-lnL)	Exp(-Δ)	Weight	Model	-lnL	Δ(-lnL)	Exp(-Δ)	Weight
16.6	-0.1254	10.4446	0.0000	0.0000	17.6	-10.5700	0.0000	1.0000	0.9868
16.6a	9.7917	20.3617	0.0000	0.0000	16.6g	-3.3902	7.1798	0.0008	0.0008
16.6b	2.4149	12.9849	0.0000	0.0000	16.6f	-1.8964	8.6736	0.0002	0.0002
16.6c	0.6439	11.2139	0.0000	0.0000	16.6e	-0.5542	10.0158	0.0000	0.0000
16.6d	-5.6623	4.9077	0.0074	0.0073	16.6	-0.1254	10.4446	0.0000	0.0000
16.6e	-0.5542	10.0158	0.0000	0.0000	16.6c	0.6439	11.2139	0.0000	0.0000
16.6f	-1.8964	8.6736	0.0002	0.0002	18.1	0.9316	11.5016	0.0000	0.0000
16.6g	-3.3902	7.1798	0.0008	0.0008	18.5	1.5202	12.0902	0.0000	0.0000
16.6h	-5.2589	5.3111	0.0049	0.0049	16.6b	2.4149	12.9849	0.0000	0.0000
17.2	13.4868	24.0568	0.0000	0.0000	16.6d	-5.6623	4.9077	0.0074	0.0073
17.6	-10.5700	0.0000	1.0000	0.9868	16.6h	-5.2589	5.3111	0.0049	0.0049
18.1	0.9316	11.5016	0.0000	0.0000	18.2	3.4571	14.0271	0.0000	0.0000
18.2	3.4571	14.0271	0.0000	0.0000	18.3	6.1074	16.6774	0.0000	0.0000
18.3	6.1074	16.6774	0.0000	0.0000	18.4	7.4747	18.0447	0.0000	0.0000
18.4	7.4747	18.0447	0.0000	0.0000	16.6a	9.7917	20.3617	0.0000	0.0000
18.5	1.5202	12.0902	0.0000	0.0000	17.2	13.4868	24.0568	0.0000	0.0000

Figures



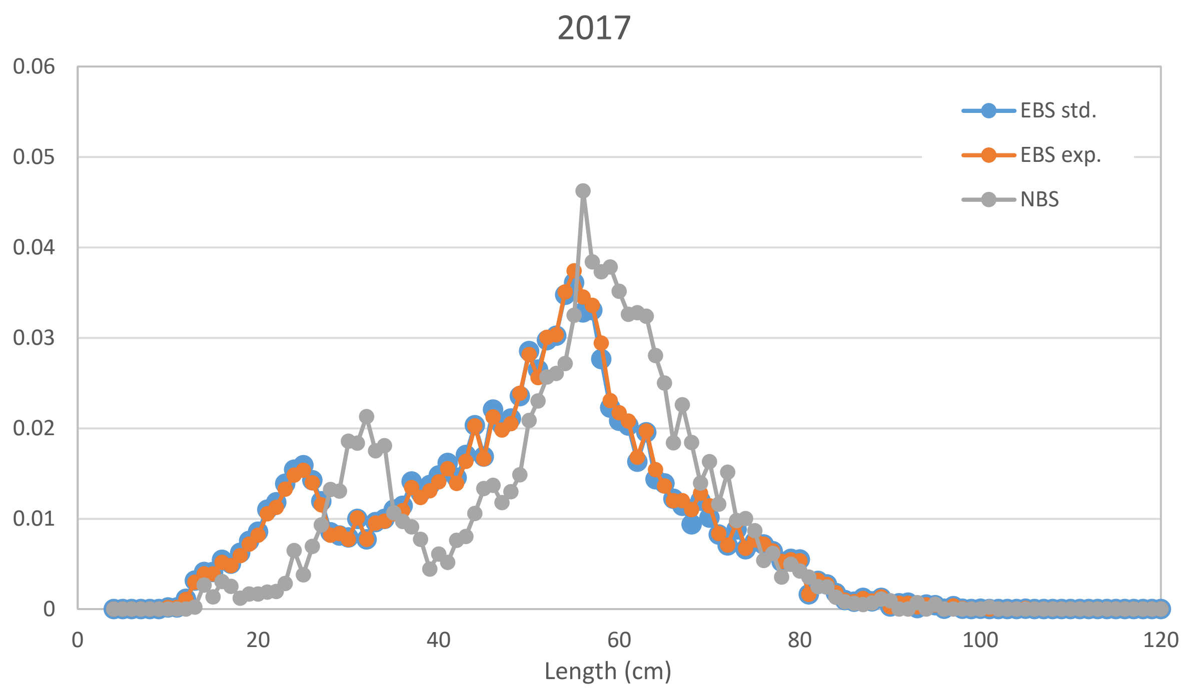


Figure 2.1.1. Comparison of EBS and NBS size compositions for 2010 and 2017.

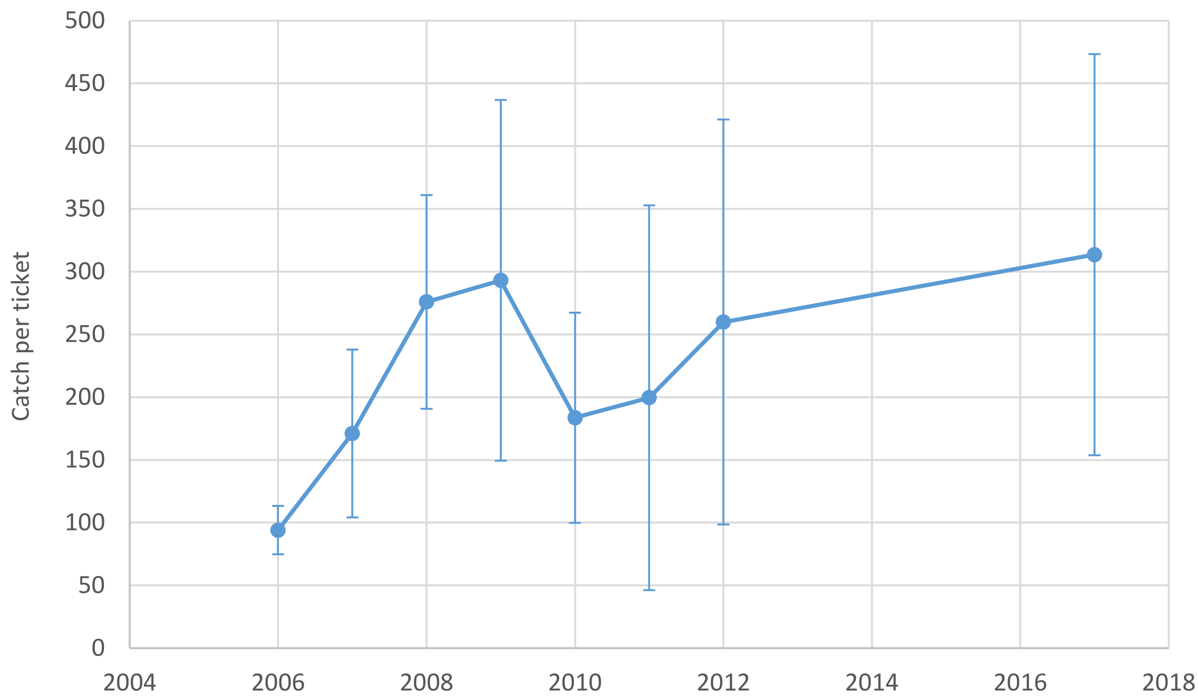


Figure 2.1.2. NBS fishery catch per fish ticket.

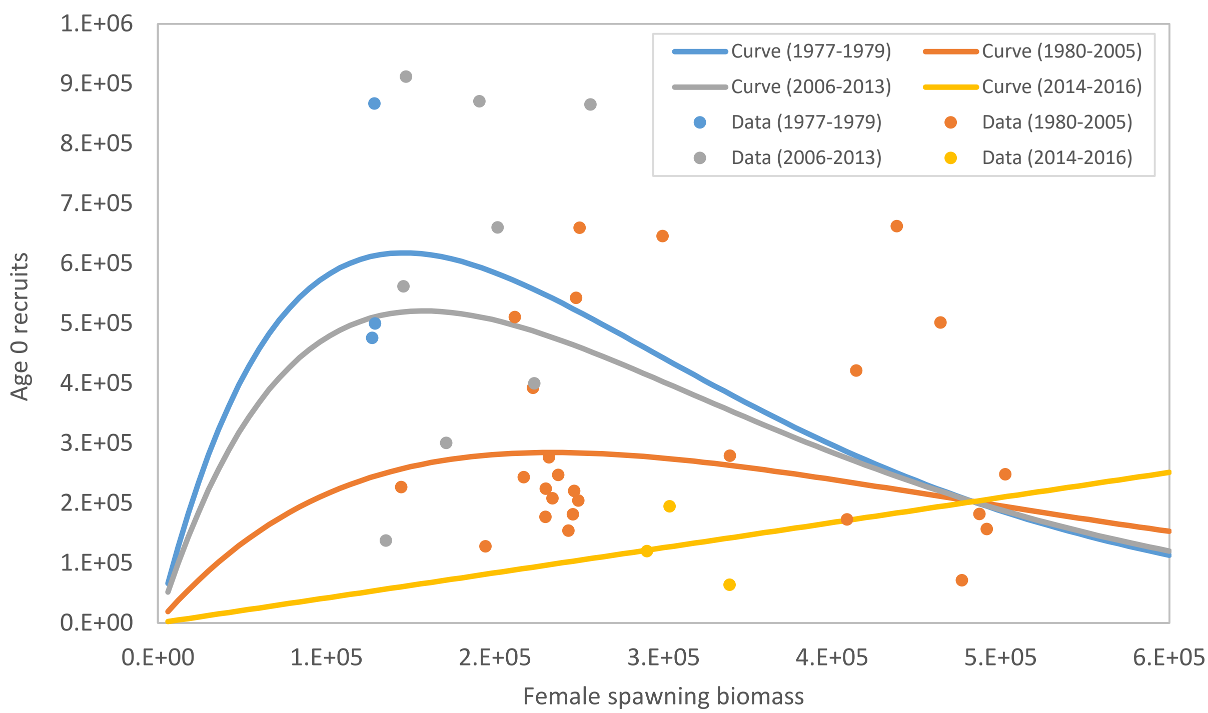


Figure 2.1.3. Ricker stock-recruitment relationships for 4 time blocks.

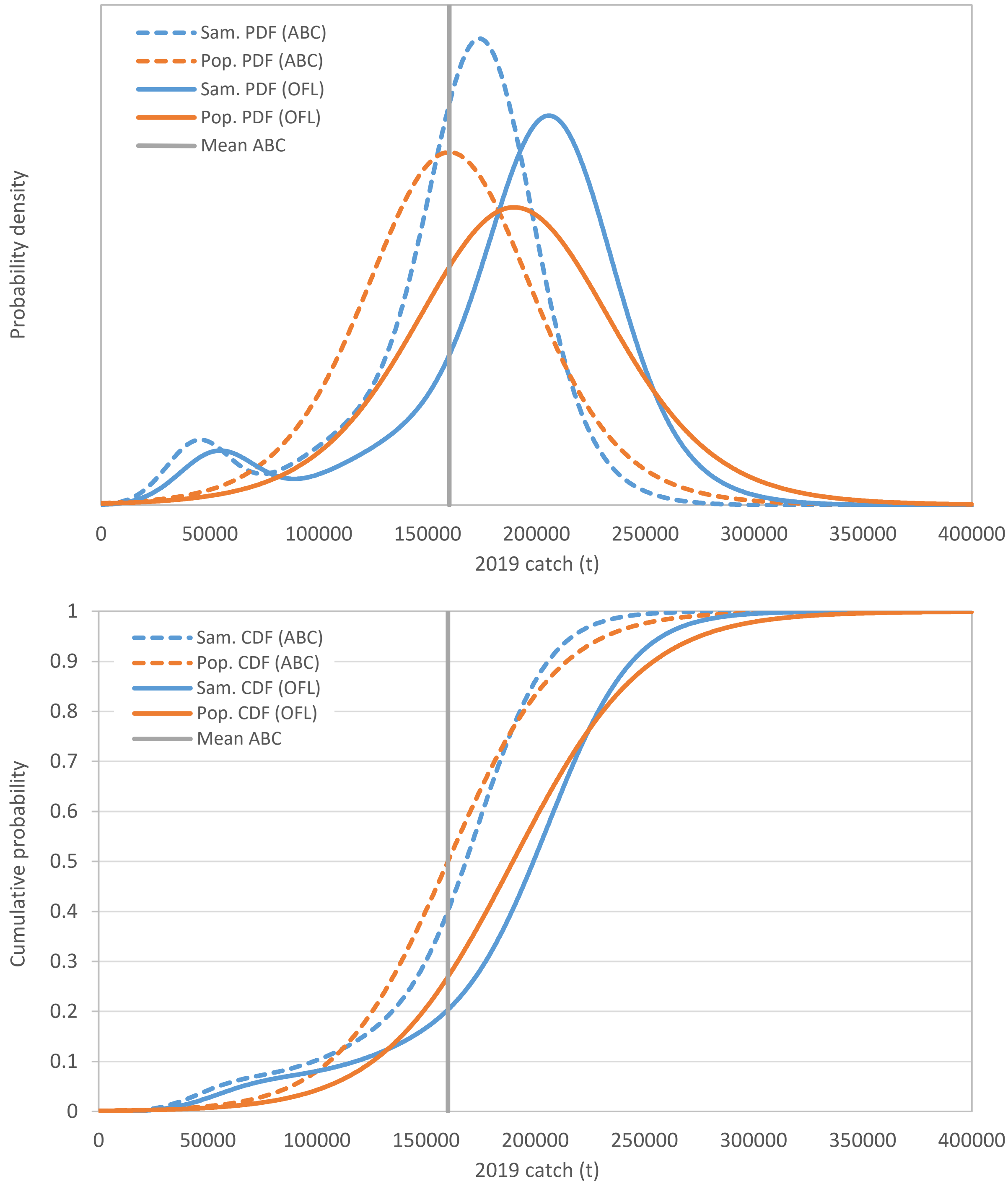


Figure 2.1.4. Distributions resulting from model averaging.

Attachment 2.1.1: Bridging analysis from Model 17.2 to Model 17.6

Introduction

As noted in the main text of Appendix 2.1 (see response to comment BPT7), last year's assessment included initial steps toward a bridging analysis between Models 16.6 and 17.6 (see subsection of the same name in Thompson 2017, especially Table 2.11). However, an internal (AFSC) review of this year's preliminary assessment resulted in a request for a second bridging analysis, this time running from Model 17.2 to Model 17.6.

Counting likelihood emphases for composition data and input "sigma" parameters that constrain parameter deviations (which are all estimated iteratively in both Model 17.2 and Model 17.6—see main text), there are 11 features that distinguish Model 17.6 from Model 17.2. Listed in the order in which they appear in the SS control file, these are as follow:

1. Model 17.6 has time-varying *Lmin*; Model 17.2 does not.
2. Model 17.6 has ln(recruitment) σ = 0.5928; Model 17.2 has 0.5771.
3. Model 17.6 has time-varying *Q*; Model 17.2 does not.
4. Model 17.6 has time-varying survey selectivity peak age; Model 17.2 does not.
5. Model 17.6 has time-varying survey selectivity ascending width; Model 17.2 does not.
6. Model 17.6 has fishery peak age deviation σ = 0.1187, Model 17.2 has 0.1155.
7. Model 17.6 has fishery ascending width deviation σ = 0.4088, Model 17.2 has 0.4123.
8. Model 17.6 has fishery sizecomp emphasis = 0.1475; Model 17.2 has 0.2416.
9. Model 17.6 has survey sizecomp emphasis = 1.6603; Model 17.2 has 0.8665.
10. Model 17.6 has fishery agecomp emphasis = 0.0217; Model 17.2 has 0.0225.
11. Model 17.6 has survey agecomp emphasis = 0.3172; Model 17.2 has 0.1353.

Methods

Starting from Model 17.2, 11 exploratory runs were made, with one of the 11 features changing from the respective Model 17.2 version to its Model 17.6 counterpart in each.

From this first batch of exploratory runs, the run that resulted in the largest proportional change (absolute value) in 2018 spawning biomass relative to Model 17.2 was denoted "Bridging run 1."

Bridging run 1 was then used as the starting point for a second batch of exploratory runs, with one of the remaining 10 features changing from the respective Model 17.2 version to its Model 17.6 counterpart in each. From this batch of exploratory runs, the run that resulted in the largest proportional change (absolute value) in 2018 spawning biomass relative to Bridging run 1 was denoted "Bridging run 2."

The above procedure was repeated until 10 of the 11 features had been changed from their respective Model 17.2 versions to their Model 17.6 counterparts. Changing the last remaining feature from its Model 17.2 version to its Model 17.6 counterpart resulted in Model 17.6, by definition.

Results

Relative to the 2018 spawning biomass estimated in Model 17.2, allowing time-variability in the ascending width parameter of the survey selectivity function had the biggest impact of the 11 features that distinguish Model 17.6 from Model 17.2, resulting in a *decrease* of 18.5% in Bridging run 1. Changing the survey sizecomp emphasis from 0.8665 (the Model 17.2 value) to 1.6603 (the Model 17.6 value) caused the biggest change in 2018 spawning biomass relative to Bridging run 1, an *increase* of 36.7%.

Further steps in the process continued to show a mix of decreases and increases relative to the respective preceding run.

The full sequence of features added during the process of developing the bridging runs is shown below (the color scale runs from red=low to green=high):

Run	Feature changed from preceding run	SB2018	Change
Model 17.2	None (starting point = Model 17.2)	234,705	n/a
Bridging run 1	Turn on time-varying survey selectivity asc. width	191,298	-0.185
Bridging run 2	Change survey sizecomp emphasis	261,465	0.367
Bridging run 3	Turn on time-varying Lmin	179,454	-0.314
Bridging run 4	Turn on time-varying Q	169,748	-0.054
Bridging run 5	Change survey agecomp emphasis	193,042	0.137
Bridging run 6	Turn on time-varying survey selectivity peak age	159,586	-0.173
Bridging run 7	Change fishery sizecomp emphasis	170,705	0.070
Bridging run 8	Change fishery agecomp emphasis	161,866	-0.052
Bridging run 9	Change fishery peak age dev sigma	170,752	0.055
Bridging run 10	Change sigmaR	162,491	-0.048
Model 17.6	Change fishery asc. width dev sigma	162,198	-0.003

Table 2.1.1.1 provides a detailed presentation of the impacts of each step in the bridging analysis, showing the impact of every bridging run on every estimated parameter. In all pages of this table, the color scale extends across bridging runs for each row, where red=low and green=high.

The upper portion of Table 2.1.1.1a shows all of the time-invariant estimated parameters (except for the autocorrelation of deviations in ln(Q), which appears in Table 2.1.1.1h). The lower portion of Table 2.1.1.1a shows, in step-wise fashion, the quantities which either appear for the first time in a particular bridging run and then remain in all subsequent bridging runs (e.g., the σ term for the survey selectivity ascending width parameter appears in Bridging run 1 and then remains in all subsequent bridging runs) or that change from the Model 17.2 value to the Model 17.6 value at some point in the process and then remain at the Model 17.6 value in all subsequent bridging runs (e.g., the likelihood emphasis for the survey sizecomp data changes from the Model 17.2 value of 0.8665 to the Model 17.6 value of 1.6603 in Bridging run 2 and then remains at that value in all subsequent bridging runs).

Like Table 2.1.1.1a, Tables 2.1.1.1b-2.1.1.1e pertain to parameters that are common to Models 17.2 and 17.6 and all the bridging runs; the difference being that all pages of Table 2.1.1.1 following Table 2.1.1.1a pertain to time-varying parameters. Table 2.1.1.1b shows the “early” recruitment deviations that structure the initial (1977) numbers-at-age vector. Table 2.1.1.1c shows the recruitment deviations for the main (1977-2016) portion of the time series. Table 2.1.1.1d shows the fishery selectivity peak age deviations. Table 2.1.1.1e shows the fishery selectivity ascending width deviations.

Tables 2.1.1.1f-2.1.1.1i pertain to time-varying parameters that are common to Model 17.6 and a subset of the bridging runs, but not Model 17.2 or the other bridging runs, and are organized in order of the number of bridging runs in which the parameters are estimated (from most to least). Table 2.1.1.1f shows the survey selectivity ascending width deviations. Table 2.1.1.1g shows the deviations for length at age 1.5. Table 2.1.1.1h pertains to log catchability deviations; the first row shows the estimated autocorrelation among the deviations and the remaining rows show the deviations themselves. Table 2.1.1.1i shows the survey selectivity peak age deviations.

Discussion

Bridging analyses are often difficult to interpret, because the order in which features are added can have an impact on the perception of the various features' respective importance. The method adopted here is to add the feature, at each step of the bridging analysis, that provides the largest impact on 2018 spawning biomass relative to the previous bridging run.

For this analysis, the correlations between rank orders of the impacts of the features common to any pair of adjacent bridging runs varied widely, as shown in the table below (as an aid to reading this table, using the first row as an example, the correlation between the ranks of the 10 features examined in Bridging run 2 and the ranks of those same features in Bridging run 1 was 0.83).

Bridging runs compared		No. ranks compared	Correlation
1	2	10	0.83
2	3	9	0.03
3	4	8	-0.14
4	5	7	0.89
5	6	6	0.54
6	7	5	-0.90
7	8	4	-0.40
8	9	3	0.50
9	10	2	1.00

Three of the nine correlations in the above table are negative, and only four are greater than 0.50 (one of which involved the ranks of only two features, where a correlation of 1.00 could have been achieved easily just by random chance). This suggests that interpreting the "final" importance of any single model feature on the difference in results between Model 17.2 and Model 17.6 is difficult at best.

Reference

Thompson, G. G. 2017. Assessment of the Pacific cod stock in the eastern Bering Sea. *In* Plan Team for the Groundfish Fisheries of the Bering Sea and Aleutian Islands (compiler), Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea/Aleutian Islands regions, p. 229-515. North Pacific Fishery Management Council, 605 W. 4th Avenue Suite 306, Anchorage, AK 99501.

Table

Table 2.1.1.1a—Main parameters. See text for details.

	Model (17.2, 17.6) or bridging run (BR_#)											
Parameter	17.2	BR_1	BR_2	BR_3	BR_4	BR_5	BR_6	BR_7	BR_8	BR_9	BR_10	17.6
Natural mortality (M)	0.3744	0.2073	0.3710	0.2035	0.1927	0.3489	0.3135	0.3376	0.3121	0.3350	0.3134	0.3123
Length at age 1.5 (cm)	16.4454	0.0000	0.0000	0.9297	0.9361	3.8434	16.9604	16.9647	16.9443	16.9647	16.9408	16.9457
Asymptotic length (cm)	109.1790	94.7823	102.7290	88.7880	89.1908	95.6643	109.0650	106.9510	108.4370	107.0670	108.3680	108.4180
Brody growth coefficient (K)	0.1714	0.3094	0.2105	0.3982	0.3954	0.2845	0.1702	0.1743	0.1706	0.1732	0.1707	0.1704
Richards growth coefficient	1.0706	0.4480	0.9078	0.1681	0.1705	0.5946	1.0155	1.0190	1.0167	1.0227	1.0170	1.0180
SD of length at age 1 (cm)	3.4923	2.1786	2.4389	1.5907	1.6042	2.1398	3.1440	3.1363	3.1298	3.1353	3.1298	3.1296
SD of length at age 20 (cm)	8.6749	9.0800	8.7923	9.7222	9.7114	9.0068	9.2613	9.3403	9.4556	9.3526	9.4550	9.4591
Ageing bias at age 1	0.3366	-1.9230	-0.7634	-1.9291	-1.9380	-0.7862	0.3543	0.3605	0.3565	0.3609	0.3567	0.3567
Ageing bias at age 20	-0.4049	-1.6124	-1.1629	-1.5518	-1.5248	-0.7048	-0.3184	-0.3429	-0.3233	-0.3442	-0.3227	-0.3262
ln(mean post-1976 recruits)	13.1126	12.3566	13.4167	12.2750	12.1885	13.1847	12.7322	12.9068	12.7262	12.8926	12.7456	12.7372
ln(pre-1977 recruits offset)	-1.4416	-0.2365	-1.2555	-0.2216	-0.1969	-1.3121	-1.1225	-1.2648	-0.9496	-1.2662	-0.9852	-0.9794
Initial fishing mortality rate	0.4688	1.5970	0.2765	1.8701	1.8781	0.3648	1.4953	0.2676	1.7148	0.2676	1.6817	1.6882
ln(EBS std. area catchability)	0.0418	0.5806	0.0506	0.6239	0.6746	0.2014	0.1948	0.0836	0.1834	0.0877	0.1784	0.1810
Select. peak age (fishery)	5.7405	7.3879	6.5985	7.2167	7.2295	6.3808	5.8968	5.8439	5.8842	5.8530	5.8826	5.8845
Select. asc. wid. (fishery)	0.9224	0.6942	0.8097	0.5418	0.5519	0.6745	1.0246	0.9748	1.0151	0.9804	1.0130	1.0144
Select. peak age (EBS sur.)	2.5308	2.9902	2.3055	2.9904	2.9906	2.2967	1.0354	1.0270	1.0383	1.0398	1.0437	1.0366
Select. asc. wid. (EBS sur.)	1.2279	-9.9999	-2.3387	-10.0000	-10.0000	-2.3273	-7.5042	-8.8091	-7.3322	-7.2893	-6.8926	-7.4939
Select. asc. wid. σ (EBS sur.)	n/a	0.1594	0.1594	0.1594	0.1594	0.1594	0.1594	0.1594	0.1594	0.1594	0.1594	0.1594
Sizecomp emphasis (EBS sur.)	0.8665	0.8665	1.6603	1.6603	1.6603	1.6603	1.6603	1.6603	1.6603	1.6603	1.6603	1.6603
Length at age 1.5 σ	n/a	n/a	n/a	0.0973	0.0973	0.0973	0.0973	0.0973	0.0973	0.0973	0.0973	0.0973
ln(EBS std. area Q) σ	n/a	n/a	n/a	n/a	0.0889	0.0889	0.0889	0.0889	0.0889	0.0889	0.0889	0.0889
Agecomp emphasis (EBS sur.)	0.1353	0.1353	0.1353	0.1353	0.1353	0.3172	0.3172	0.3172	0.3172	0.3172	0.3172	0.3172
Select. peak age σ (EBS sur.)	n/a	n/a	n/a	n/a	n/a	n/a	0.0544	0.0544	0.0544	0.0544	0.0544	0.0544
Sizecomp emphasis (fishery)	0.2416	0.2416	0.2416	0.2416	0.2416	0.2416	0.2416	0.1475	0.1475	0.1475	0.1475	0.1475
Agecomp emphasis (fishery)	0.0225	0.0225	0.0225	0.0225	0.0225	0.0225	0.0225	0.0225	0.0217	0.0217	0.0217	0.0217
Select. peak age σ (fishery)	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1187	0.1187	0.1187
SD of ln(recruitment) devs	0.5771	0.5771	0.5771	0.5771	0.5771	0.5771	0.5771	0.5771	0.5771	0.5771	0.5928	0.5928
Select. asc. wid. σ (fishery)	0.4123	0.4123	0.4123	0.4123	0.4123	0.4123	0.4123	0.4123	0.4123	0.4123	0.4123	0.4088

Table 2.1.1.1b—Early recruitment deviations. See text for details.

	Model (17.2, 17.6) or bridging run (BR_#)											
Parameter	17.2	BR_1	BR_2	BR_3	BR_4	BR_5	BR_6	BR_7	BR_8	BR_9	BR_10	17.6
Initial age 20 dev	0.000	0.000	-0.002	0.000	0.000	0.000	0.000	-0.001	0.000	-0.001	0.000	0.000
Initial age 19 dev	0.000	0.000	-0.001	0.000	0.000	0.000	0.000	-0.001	0.000	-0.001	0.000	0.000
Initial age 18 dev	0.000	0.000	-0.003	0.000	0.000	-0.001	0.000	-0.002	0.000	-0.002	0.000	0.000
Initial age 17 dev	0.000	0.000	-0.005	0.000	0.000	-0.002	0.000	-0.004	0.000	-0.004	0.000	0.000
Initial age 16 dev	0.000	0.000	-0.009	0.000	0.000	-0.003	0.000	-0.007	0.000	-0.007	0.000	0.000
Initial age 15 dev	-0.001	0.000	-0.017	0.000	0.000	-0.007	0.000	-0.012	0.000	-0.012	0.000	0.000
Initial age 14 dev	-0.002	0.000	-0.032	0.000	0.000	-0.013	0.000	-0.021	0.000	-0.022	0.000	0.000
Initial age 13 dev	-0.005	0.000	-0.058	0.000	0.000	-0.026	0.000	-0.037	0.000	-0.038	0.000	0.000
Initial age 12 dev	-0.011	0.000	-0.101	0.000	0.000	-0.050	0.000	-0.063	0.000	-0.064	0.000	0.000
Initial age 11 dev	-0.025	0.001	-0.169	0.000	0.000	-0.093	0.000	-0.105	0.000	-0.107	0.000	0.000
Initial age 10 dev	-0.052	0.005	-0.268	0.001	0.001	-0.163	0.000	-0.169	0.000	-0.170	0.000	0.000
Initial age 9 dev	-0.102	0.025	-0.394	0.009	0.009	-0.268	0.003	-0.257	0.001	-0.258	0.001	0.001
Initial age 8 dev	-0.185	0.108	-0.530	0.050	0.051	-0.396	0.013	-0.366	0.006	-0.367	0.006	0.006
Initial age 7 dev	-0.297	0.338	-0.630	0.214	0.220	-0.510	0.055	-0.479	0.030	-0.479	0.032	0.032
Initial age 6 dev	-0.403	1.321	-0.604	1.304	1.272	-0.518	0.205	-0.558	0.127	-0.556	0.135	0.135
Initial age 5 dev	-0.423	0.506	-0.144	0.527	0.509	-0.219	0.577	-0.522	0.404	-0.518	0.424	0.424
Initial age 4 dev	0.039	-0.991	0.467	-1.005	-1.024	0.538	1.037	0.023	1.407	0.033	1.389	1.394
Initial age 3 dev	0.599	-0.177	-0.513	-0.378	-0.412	-0.488	0.402	0.248	0.377	0.243	0.380	0.376
Initial age 2 dev	-0.396	0.467	1.037	0.460	0.409	0.897	-0.514	-0.323	-0.393	-0.322	-0.394	-0.396
Initial age 1 dev	1.214	0.594	1.789	0.698	0.633	1.757	1.021	1.153	0.866	1.160	0.908	0.904

Table 2.1.1.1c—Main recruitment deviations. See text for details.

Parameter	Model (17.2, 17.6) or bridging run (BR_#)											
	17.2	BR_1	BR_2	BR_3	BR_4	BR_5	BR_6	BR_7	BR_8	BR_9	BR_10	17.6
ln(rec.) dev 1977	0.461	0.359	0.631	0.382	0.342	0.709	0.413	0.609	0.504	0.604	0.506	0.505
ln(rec.) dev 1978	0.503	-0.464	0.572	-0.386	-0.427	0.420	0.455	0.542	0.468	0.537	0.471	0.471
ln(rec.) dev 1979	0.485	-0.598	-0.326	-0.793	-0.823	-0.179	0.412	0.500	0.430	0.493	0.433	0.432
ln(rec.) dev 1980	-0.280	0.608	-0.509	0.711	0.688	-0.393	-0.788	-0.724	-0.785	-0.735	-0.787	-0.787
ln(rec.) dev 1981	-0.367	-0.434	0.783	-0.814	-0.817	0.800	-0.445	-0.573	-0.608	-0.572	-0.606	-0.608
ln(rec.) dev 1982	0.724	0.611	-0.272	0.757	0.757	-0.554	0.728	0.808	0.763	0.805	0.765	0.766
ln(rec.) dev 1983	-0.333	0.114	0.716	0.150	0.159	0.766	-0.328	-0.344	-0.373	-0.346	-0.372	-0.374
ln(rec.) dev 1984	0.669	-0.405	0.170	-0.311	-0.289	0.230	0.615	0.686	0.658	0.684	0.658	0.660
ln(rec.) dev 1985	0.085	-0.933	-0.377	-1.321	-1.266	-0.327	0.105	0.117	0.102	0.114	0.102	0.102
ln(rec.) dev 1986	-0.389	-0.332	-1.182	-0.317	-0.291	-1.197	-0.423	-0.434	-0.442	-0.439	-0.444	-0.442
ln(rec.) dev 1987	-0.949	0.509	-0.230	0.578	0.575	-0.190	-1.077	-1.276	-1.249	-1.272	-1.253	-1.253
ln(rec.) dev 1988	-0.333	0.475	0.466	0.464	0.460	0.517	-0.185	-0.190	-0.189	-0.185	-0.189	-0.187
ln(rec.) dev 1989	0.458	-0.051	0.424	-0.007	-0.012	0.410	0.477	0.494	0.494	0.497	0.493	0.496
ln(rec.) dev 1990	0.345	0.826	-0.138	0.865	0.860	-0.143	0.368	0.377	0.401	0.393	0.399	0.401
ln(rec.) dev 1991	-0.153	-0.043	0.729	0.043	0.049	0.730	-0.214	-0.201	-0.243	-0.252	-0.243	-0.243
ln(rec.) dev 1992	0.698	-0.305	-0.132	-0.245	-0.236	-0.052	0.695	0.702	0.716	0.708	0.715	0.717
ln(rec.) dev 1993	-0.225	-0.435	-0.392	-0.528	-0.518	-0.348	-0.189	-0.169	-0.158	-0.173	-0.160	-0.159
ln(rec.) dev 1994	-0.417	0.479	-0.481	0.561	0.558	-0.509	-0.359	-0.348	-0.340	-0.348	-0.341	-0.339
ln(rec.) dev 1995	-0.464	0.142	0.504	0.134	0.139	0.525	-0.340	-0.360	-0.357	-0.357	-0.358	-0.356
ln(rec.) dev 1996	0.454	0.042	0.146	-0.023	-0.017	0.154	0.570	0.631	0.616	0.633	0.616	0.618
ln(rec.) dev 1997	0.084	0.654	-0.039	0.616	0.612	-0.010	0.036	0.002	0.000	0.001	-0.001	0.000
ln(rec.) dev 1998	-0.002	0.352	0.606	0.542	0.542	0.580	-0.099	-0.151	-0.145	-0.149	-0.146	-0.144
ln(rec.) dev 1999	0.546	-0.609	0.237	-0.663	-0.649	0.350	0.563	0.561	0.574	0.572	0.573	0.577
ln(rec.) dev 2000	0.160	-0.132	-0.669	-0.071	-0.067	-0.693	0.144	0.183	0.170	0.156	0.169	0.166
ln(rec.) dev 2001	-0.728	-0.185	-0.187	-0.361	-0.354	-0.180	-0.723	-0.721	-0.692	-0.712	-0.695	-0.691
ln(rec.) dev 2002	-0.204	-0.449	-0.274	-0.212	-0.207	-0.439	-0.047	-0.041	-0.038	-0.041	-0.039	-0.037
ln(rec.) dev 2003	-0.335	-0.407	-0.610	-0.252	-0.249	-0.362	-0.123	-0.156	-0.147	-0.158	-0.149	-0.147
ln(rec.) dev 2004	-0.647	0.751	-0.468	0.843	0.847	-0.361	-0.701	-0.693	-0.676	-0.694	-0.678	-0.676
ln(rec.) dev 2005	-0.477	0.281	0.705	0.266	0.278	0.745	-0.444	-0.460	-0.430	-0.454	-0.432	-0.429
ln(rec.) dev 2006	0.665	1.128	0.195	1.174	1.174	0.231	0.770	0.768	0.792	0.773	0.790	0.793
ln(rec.) dev 2007	0.161	-1.056	1.034	-1.416	-1.417	1.075	0.112	0.067	0.080	0.064	0.078	0.080
ln(rec.) dev 2008	0.993	0.617	-1.035	0.669	0.668	-1.264	1.051	1.057	1.071	1.058	1.070	1.072
ln(rec.) dev 2009	-0.960	0.991	0.507	1.074	1.069	0.534	-1.004	-1.045	-1.018	-1.049	-1.024	-1.022
ln(rec.) dev 2010	0.543	0.225	0.909	-0.065	-0.069	0.934	0.512	0.502	0.521	0.503	0.519	0.522
ln(rec.) dev 2011	0.935	0.872	0.216	0.935	0.916	-0.049	0.867	0.852	0.877	0.857	0.876	0.878
ln(rec.) dev 2012	0.211	-0.930	0.829	-0.848	-0.859	0.789	-0.006	-0.018	0.007	-0.019	0.005	0.007
ln(rec.) dev 2013	0.869	-0.737	-0.925	-0.808	-0.812	-0.928	0.767	0.751	0.777	0.754	0.776	0.778
ln(rec.) dev 2014	-0.905	-1.195	-0.819	-0.968	-0.960	-0.924	-0.777	-0.829	-0.789	-0.827	-0.797	-0.792
ln(rec.) dev 2015	-0.745	-0.165	-1.081	-0.173	-0.174	-1.127	-1.038	-1.063	-1.031	-1.083	-1.004	-1.028
ln(rec.) dev 2016	-1.135	-0.173	-0.234	-0.181	-0.182	-0.270	-0.351	-0.414	-0.310	-0.340	-0.294	-0.329

Table 2.1.1.1d—Fishery selectivity peak age deviations. See text for details.

Parameter	Model (17.2, 17.6) or bridging run (BR_#)											
	17.2	BR_1	BR_2	BR_3	BR_4	BR_5	BR_6	BR_7	BR_8	BR_9	BR_10	17.6
Peak(fis.) dev1977	-0.239	-1.620	-0.347	-1.448	-1.440	-0.443	-0.694	-0.462	-1.207	-0.480	-1.198	-1.210
Peak(fis.) dev1978	-0.322	0.086	-0.470	0.084	0.081	-0.353	0.062	-0.395	0.224	-0.392	0.217	0.220
Peak(fis.) dev1979	-0.977	-0.778	-1.034	-0.810	-0.819	-1.042	-1.166	-0.732	-0.398	-0.724	-0.408	-0.405
Peak(fis.) dev1980	-0.206	-0.177	-0.313	-0.177	-0.186	-0.339	0.744	-0.133	0.089	-0.128	0.089	0.089
Peak(fis.) dev1981	-1.203	-1.191	-1.213	-1.144	-1.155	-1.180	1.405	-0.946	-0.964	-0.958	-0.978	-0.984
Peak(fis.) dev1982	0.683	0.596	0.682	0.602	0.608	0.717	2.074	0.661	0.636	0.660	0.635	0.634
Peak(fis.) dev1983	1.193	1.016	1.129	1.015	1.031	1.107	-0.451	1.095	1.134	1.091	1.125	1.122
Peak(fis.) dev1984	1.828	1.433	1.481	1.189	1.226	1.175	0.337	1.727	1.786	1.710	1.759	1.757
Peak(fis.) dev1985	-0.257	-0.605	-0.898	-0.759	-0.743	-0.837	0.623	-0.550	-0.488	-0.536	-0.485	-0.481
Peak(fis.) dev1986	0.373	0.269	0.294	0.480	0.525	0.479	-0.182	0.311	0.321	0.304	0.314	0.313
Peak(fis.) dev1987	0.452	-0.126	0.342	0.097	0.223	0.351	1.368	0.612	0.643	0.605	0.627	0.629
Peak(fis.) dev1988	-0.109	-0.502	-0.172	-0.423	-0.336	-0.164	2.116	-0.290	-0.316	-0.295	-0.311	-0.319
Peak(fis.) dev1989	1.443	0.799	1.170	0.491	0.498	0.989	0.184	0.965	0.942	0.954	0.937	0.928
Peak(fis.) dev1990	1.959	1.460	1.787	1.535	1.560	1.752	-0.684	2.060	2.030	2.024	1.991	1.989
Peak(fis.) dev1991	0.019	-0.089	-0.200	-0.581	-0.544	-0.522	-0.309	0.097	0.135	0.103	0.129	0.133
Peak(fis.) dev1992	-0.797	-0.633	-0.627	-0.831	-0.810	-0.608	-0.026	-0.688	-0.694	-0.673	-0.678	-0.677
Peak(fis.) dev1993	-0.303	-0.193	-0.227	-0.064	-0.097	-0.172	-0.416	-0.233	-0.229	-0.230	-0.225	-0.225
Peak(fis.) dev1994	-0.058	-0.026	0.019	0.067	0.030	0.037	0.839	0.085	0.070	0.097	0.070	0.070
Peak(fis.) dev1995	-0.399	-0.476	-0.395	-0.526	-0.562	-0.458	0.831	-0.285	-0.368	-0.293	-0.356	-0.356
Peak(fis.) dev1996	1.030	0.812	0.898	1.009	0.969	0.997	0.324	0.898	0.814	0.852	0.800	0.797
Peak(fis.) dev1997	0.907	0.816	0.842	0.894	0.874	0.838	-0.125	0.913	0.861	0.888	0.845	0.843
Peak(fis.) dev1998	0.204	0.328	0.272	0.306	0.300	0.252	-0.133	0.459	0.427	0.455	0.419	0.420
Peak(fis.) dev1999	-0.315	-0.304	-0.313	-0.439	-0.445	-0.349	0.123	-0.060	-0.079	-0.048	-0.075	-0.073
Peak(fis.) dev2000	-0.151	-0.057	-0.093	0.036	0.020	0.041	-0.490	-0.088	-0.120	-0.085	-0.116	-0.114
Peak(fis.) dev2001	-0.338	-0.111	-0.208	-0.182	-0.182	-0.247	-0.717	0.194	0.201	0.201	0.196	0.200
Peak(fis.) dev2002	-0.731	-0.376	-0.667	-0.428	-0.416	-0.500	-1.306	-0.546	-0.529	-0.525	-0.517	-0.515
Peak(fis.) dev2003	-0.674	-0.280	-0.528	-0.287	-0.293	-0.372	-1.349	-0.728	-0.731	-0.697	-0.712	-0.708
Peak(fis.) dev2004	-1.137	-0.577	-0.806	-0.497	-0.511	-0.707	-1.079	-1.117	-1.174	-1.105	-1.142	-1.143
Peak(fis.) dev2005	-1.247	-0.864	-0.945	-0.926	-0.946	-0.962	0.420	-1.018	-1.089	-1.003	-1.060	-1.059
Peak(fis.) dev2006	-0.934	-0.687	-0.756	-0.603	-0.621	-0.639	0.077	-0.863	-0.920	-0.838	-0.895	-0.891
Peak(fis.) dev2007	0.516	0.407	0.474	0.289	0.267	0.347	-1.386	0.512	0.465	0.504	0.456	0.458
Peak(fis.) dev2008	-0.086	0.222	0.006	0.103	0.091	-0.073	0.371	0.111	0.116	0.118	0.113	0.117
Peak(fis.) dev2009	-0.790	-0.523	-0.681	-0.566	-0.586	-0.738	0.528	-1.118	-1.110	-1.072	-1.085	-1.075
Peak(fis.) dev2010	0.405	0.178	0.424	0.345	0.301	0.499	0.437	0.439	0.396	0.426	0.392	0.389
Peak(fis.) dev2011	0.903	0.998	0.927	1.305	1.292	1.040	-0.941	0.283	0.291	0.265	0.288	0.281
Peak(fis.) dev2012	0.216	0.394	0.293	-0.045	-0.057	-0.222	-0.276	0.459	0.401	0.450	0.396	0.398
Peak(fis.) dev2013	-0.895	-0.536	-0.593	-0.576	-0.586	-0.687	0.074	-1.000	-0.948	-0.978	-0.945	-0.942
Peak(fis.) dev2014	-0.166	-0.053	-0.088	0.092	0.078	0.111	-0.724	-0.290	-0.290	-0.289	-0.286	-0.285
Peak(fis.) dev2015	0.212	0.327	0.247	0.634	0.620	0.581	0.421	-0.027	0.005	-0.033	0.003	0.003
Peak(fis.) dev2016	0.060	0.425	0.206	0.457	0.463	-0.049	1.452	-0.767	-0.752	-0.772	-0.742	-0.742
Peak(fis.) dev2017	-0.071	0.216	0.083	0.284	0.278	0.349	-0.262	0.457	0.419	0.446	0.411	0.415

Table 2.1.1.1e—Fishery selectivity ascending width deviations. See text for details.

	Model (17.2, 17.6) or bridging run (BR_#)											
Parameter	17.2	BR_1	BR_2	BR_3	BR_4	BR_5	BR_6	BR_7	BR_8	BR_9	BR_10	17.6
Wid.(fis.) dev1977	-0.002	2.048	0.009	2.061	2.053	0.054	-0.411	0.208	1.846	0.213	1.757	1.759
Wid.(fis.) dev1978	-0.339	-0.044	-0.349	-0.001	-0.001	-0.229	0.173	-0.301	-0.248	-0.309	-0.238	-0.239
Wid.(fis.) dev1979	-0.496	-0.590	-0.662	-0.609	-0.605	-0.693	0.800	-0.276	-0.212	-0.290	-0.226	-0.225
Wid.(fis.) dev1980	0.113	0.059	0.040	0.007	0.007	-0.029	0.089	0.115	0.142	0.114	0.144	0.144
Wid.(fis.) dev1981	0.836	0.338	0.635	0.374	0.379	0.629	0.964	0.842	0.811	0.818	0.788	0.786
Wid.(fis.) dev1982	0.191	0.238	0.286	0.209	0.207	0.313	2.190	0.017	-0.032	0.027	-0.019	-0.020
Wid.(fis.) dev1983	0.963	1.115	1.150	1.188	1.185	1.290	-0.512	0.685	0.640	0.702	0.662	0.662
Wid.(fis.) dev1984	2.060	2.395	2.155	2.350	2.365	1.992	0.595	2.026	1.995	2.043	2.014	2.027
Wid.(fis.) dev1985	-0.256	-1.076	-1.277	-1.522	-1.496	-1.399	0.581	-0.563	-0.532	-0.566	-0.543	-0.541
Wid.(fis.) dev1986	0.772	0.939	0.810	1.311	1.327	1.084	1.296	0.606	0.556	0.604	0.560	0.564
Wid.(fis.) dev1987	0.567	-0.024	0.551	0.412	0.575	0.642	1.839	0.579	0.554	0.583	0.558	0.563
Wid.(fis.) dev1988	1.409	0.931	1.338	1.192	1.267	1.424	1.836	1.184	1.130	1.172	1.128	1.128
Wid.(fis.) dev1989	2.009	1.874	2.003	1.747	1.740	1.994	0.315	1.489	1.427	1.500	1.445	1.447
Wid.(fis.) dev1990	1.844	2.072	2.055	2.442	2.441	2.191	-0.855	1.836	1.754	1.846	1.771	1.782
Wid.(fis.) dev1991	0.219	0.188	0.042	-0.402	-0.347	-0.336	0.336	0.280	0.274	0.285	0.275	0.280
Wid.(fis.) dev1992	-0.965	-1.191	-0.943	-1.686	-1.618	-0.978	0.701	-0.870	-0.909	-0.874	-0.911	-0.917
Wid.(fis.) dev1993	0.318	0.357	0.372	0.533	0.508	0.459	0.100	0.381	0.348	0.377	0.348	0.350
Wid.(fis.) dev1994	0.631	0.802	0.763	1.046	1.015	0.900	0.964	0.786	0.752	0.805	0.755	0.762
Wid.(fis.) dev1995	0.033	-0.293	-0.024	-0.384	-0.429	-0.102	1.014	0.212	0.122	0.207	0.125	0.127
Wid.(fis.) dev1996	1.142	1.226	1.192	1.589	1.544	1.396	0.256	1.000	0.892	0.981	0.901	0.906
Wid.(fis.) dev1997	1.192	1.517	1.315	1.804	1.779	1.460	-0.234	1.081	1.001	1.075	1.008	1.015
Wid.(fis.) dev1998	0.269	0.628	0.443	0.785	0.777	0.507	-1.137	0.398	0.333	0.401	0.338	0.341
Wid.(fis.) dev1999	-0.300	-0.422	-0.348	-0.614	-0.612	-0.408	-0.546	-0.146	-0.195	-0.137	-0.192	-0.191
Wid.(fis.) dev2000	-0.936	-1.136	-0.960	-1.016	-1.037	-0.820	-0.459	-1.095	-1.170	-1.097	-1.167	-1.176
Wid.(fis.) dev2001	-0.915	-0.947	-0.823	-1.085	-1.085	-0.972	-0.947	-0.425	-0.476	-0.420	-0.473	-0.475
Wid.(fis.) dev2002	-0.837	-0.815	-0.934	-0.876	-0.843	-0.768	-1.572	-0.488	-0.512	-0.486	-0.512	-0.515
Wid.(fis.) dev2003	-1.016	-1.051	-1.075	-1.140	-1.134	-0.899	-1.598	-1.008	-1.043	-0.993	-1.043	-1.047
Wid.(fis.) dev2004	-1.481	-1.404	-1.350	-1.272	-1.287	-1.183	-2.047	-1.400	-1.486	-1.416	-1.484	-1.497
Wid.(fis.) dev2005	-1.512	-1.666	-1.387	-1.756	-1.790	-1.376	-0.449	-1.173	-1.285	-1.195	-1.286	-1.296
Wid.(fis.) dev2006	-1.769	-2.129	-1.787	-1.707	-1.730	-1.394	-0.651	-1.706	-1.805	-1.706	-1.804	-1.814
Wid.(fis.) dev2007	-0.106	-0.180	-0.040	-0.109	-0.142	-0.027	-3.205	-0.303	-0.407	-0.302	-0.400	-0.403
Wid.(fis.) dev2008	-0.673	-0.281	-0.540	-0.499	-0.509	-0.703	0.483	-0.604	-0.646	-0.600	-0.643	-0.647
Wid.(fis.) dev2009	-2.030	-2.208	-2.108	-2.814	-2.841	-2.634	0.929	-2.740	-2.752	-2.718	-2.759	-2.766
Wid.(fis.) dev2010	0.352	0.013	0.342	0.263	0.218	0.538	-0.581	0.607	0.547	0.609	0.554	0.557
Wid.(fis.) dev2011	1.025	1.161	1.086	1.544	1.523	1.264	-0.275	0.815	0.797	0.811	0.803	0.806
Wid.(fis.) dev2012	-0.620	-0.695	-0.488	-2.353	-2.355	-2.342	-0.097	-0.592	-0.687	-0.592	-0.678	-0.683
Wid.(fis.) dev2013	-0.362	-0.190	-0.153	-0.262	-0.263	-0.293	0.172	-0.293	-0.263	-0.294	-0.284	-0.282
Wid.(fis.) dev2014	-0.143	-0.254	-0.146	-0.094	-0.102	0.083	-0.452	-0.059	-0.087	-0.062	-0.089	-0.089
Wid.(fis.) dev2015	0.121	-0.040	0.034	0.379	0.360	0.514	-0.794	0.150	0.140	0.149	0.140	0.141
Wid.(fis.) dev2016	0.143	0.347	0.173	0.556	0.572	-0.018	0.801	-0.484	-0.468	-0.497	-0.480	-0.482
Wid.(fis.) dev2017	-1.454	-1.615	-1.398	-1.592	-1.614	-1.131	0.001	-0.770	-0.847	-0.770	-0.842	-0.844

Table 2.1.1.1f—Survey selectivity ascending width deviations. See text for details.

	Model (17.2, 17.6) or bridging run (BR_#)											
Parameter	17.2	BR_1	BR_2	BR_3	BR_4	BR_5	BR_6	BR_7	BR_8	BR_9	BR_10	17.6
Wid.(sur.) dev1982		-0.370	-1.899	-0.539	-0.631	-2.356	-0.001	0.000	-0.002	-0.002	-0.009	-0.001
Wid.(sur.) dev1983		0.000	-0.042	-0.451	-0.574	-0.249	0.005	0.000	0.000	0.000	-0.001	0.000
Wid.(sur.) dev1984		-0.366	-2.362	-0.455	-0.523	-1.793	-0.003	0.000	-0.003	-0.003	-0.011	-0.001
Wid.(sur.) dev1985		0.134	0.930	-0.147	-0.256	0.759	0.000	0.004	0.005	0.005	0.005	0.005
Wid.(sur.) dev1986		-0.538	-1.784	-1.014	-1.114	-2.140	0.000	0.000	-0.005	-0.005	-0.011	-0.003
Wid.(sur.) dev1987		-0.163	-0.354	-0.392	-0.448	-0.389	0.000	0.001	0.001	0.002	0.001	0.002
Wid.(sur.) dev1988		-0.401	-1.533	-0.352	-0.384	-1.122	0.004	0.000	-0.003	-0.003	-0.010	-0.001
Wid.(sur.) dev1989		-0.982	-3.609	-1.426	-1.337	-3.483	0.000	0.000	0.000	0.000	-0.002	0.000
Wid.(sur.) dev1990		-0.203	0.579	-0.406	-0.149	0.594	0.000	0.003	0.004	0.004	0.005	0.004
Wid.(sur.) dev1991		-0.599	-0.828	-0.966	-0.910	-0.838	0.007	0.000	0.000	0.000	-0.001	0.000
Wid.(sur.) dev1992		0.432	2.443	0.795	0.859	2.483	-0.005	0.000	0.006	0.007	0.009	0.005
Wid.(sur.) dev1993		0.370	1.808	0.579	0.609	1.773	0.000	0.004	0.008	0.008	0.009	0.007
Wid.(sur.) dev1994		-0.461	-1.662	-0.947	-1.026	-1.964	0.000	0.000	-0.006	-0.006	-0.008	-0.005
Wid.(sur.) dev1995		-0.535	-2.206	-0.974	-1.052	-2.506	-0.004	0.000	-0.001	-0.001	-0.009	0.000
Wid.(sur.) dev1996		-0.629	-2.740	-0.891	-0.935	-2.681	0.000	0.000	0.000	0.000	-0.004	0.000
Wid.(sur.) dev1997		-0.591	-1.340	-1.174	-1.171	-1.543	0.000	0.000	-0.005	-0.005	-0.007	-0.004
Wid.(sur.) dev1998		-1.169	-3.776	-1.796	-1.870	-4.128	-0.003	0.000	0.000	0.000	-0.006	0.000
Wid.(sur.) dev1999		-0.983	-2.985	-1.449	-1.496	-3.361	0.005	0.000	-0.001	-0.001	-0.009	0.000
Wid.(sur.) dev2000		-0.894	-1.186	-1.244	-1.204	-1.163	0.003	0.000	-0.003	-0.003	-0.004	-0.002
Wid.(sur.) dev2001		0.898	3.146	0.783	0.729	2.694	0.005	0.000	0.007	0.008	0.009	-0.010
Wid.(sur.) dev2002		-0.147	0.041	-0.087	-0.087	0.230	-0.001	0.003	0.004	0.004	0.004	0.004
Wid.(sur.) dev2003		0.226	1.238	0.512	0.566	1.578	0.000	0.004	0.006	0.006	0.007	0.006
Wid.(sur.) dev2004		-0.396	-0.413	-0.047	0.018	0.556	0.001	0.000	0.000	0.000	-0.001	0.000
Wid.(sur.) dev2005		0.561	2.685	1.366	1.416	3.012	0.000	0.000	0.001	0.001	0.001	0.001
Wid.(sur.) dev2006		1.761	4.251	2.661	2.728	4.024	0.004	0.000	0.001	0.002	0.002	0.001
Wid.(sur.) dev2007		3.240	5.616	4.687	4.696	5.609	0.007	0.000	0.000	0.000	0.000	0.000
Wid.(sur.) dev2008		-0.321	0.280	-0.409	-0.361	0.084	0.004	0.004	0.006	0.006	0.007	0.006
Wid.(sur.) dev2009		0.525	2.321	0.930	1.176	2.328	0.007	0.004	0.008	0.008	0.009	0.007
Wid.(sur.) dev2010		-0.005	0.283	0.144	0.155	0.597	0.007	0.004	0.005	0.005	0.005	0.005
Wid.(sur.) dev2011		0.613	2.203	0.972	1.003	2.087	-0.001	0.004	0.008	0.008	0.010	0.008
Wid.(sur.) dev2012		0.671	2.176	0.760	0.778	1.897	0.004	-0.027	0.008	0.008	0.010	0.007
Wid.(sur.) dev2013		-0.453	-1.290	-0.403	-0.404	-0.712	-0.003	0.000	-0.001	-0.001	-0.002	0.000
Wid.(sur.) dev2014		0.135	0.953	-0.042	0.002	0.826	-0.038	0.004	0.005	0.005	0.006	0.005
Wid.(sur.) dev2015		-0.138	-0.575	-0.313	-0.332	-0.562	-0.004	0.000	-0.003	-0.002	-0.004	-0.002
Wid.(sur.) dev2016		-0.066	0.073	-0.054	-0.069	0.276	-0.655	-0.013	-0.044	-0.050	0.011	-0.038
Wid.(sur.) dev2017		-0.097	-0.442	-0.079	-0.082	-0.415	-0.822	0.000	-0.005	-0.005	-0.011	-0.003

Table 2.1.1.1g—Length at age 1.5 deviations. See text for details.

	Model (17.2, 17.6) or bridging run (BR_#)											
Parameter	17.2	BR_1	BR_2	BR_3	BR_4	BR_5	BR_6	BR_7	BR_8	BR_9	BR_10	17.6
L(1.5) dev 1981				-0.154	-0.108	3.338	1.009	-0.739	-0.749	-0.745	-0.752	-0.754
L(1.5) dev 1982				-2.769	-2.701	0.280	0.370	-0.851	-0.845	-0.856	-0.844	-0.848
L(1.5) dev 1983				-0.877	-0.780	-2.943	-1.263	0.930	0.935	0.924	0.933	0.936
L(1.5) dev 1984				1.920	1.967	-0.779	0.174	0.349	0.364	0.352	0.365	0.365
L(1.5) dev 1985				-0.964	-0.902	1.642	-0.048	-1.289	-1.297	-1.295	-1.297	-1.298
L(1.5) dev 1986				1.641	1.686	-1.059	-0.164	0.178	0.210	0.183	0.210	0.210
L(1.5) dev 1987				0.693	0.668	1.462	-0.844	-0.063	-0.037	-0.064	-0.039	-0.040
L(1.5) dev 1988				1.474	1.355	1.275	-0.031	-0.208	-0.192	-0.214	-0.194	-0.196
L(1.5) dev 1989				-0.968	-1.057	1.126	0.483	-0.865	-0.857	-0.866	-0.855	-0.859
L(1.5) dev 1990				-1.555	-1.624	-1.247	-0.034	-0.041	-0.036	-0.040	-0.034	-0.036
L(1.5) dev 1991				1.207	1.173	-1.712	0.674	0.472	0.503	0.490	0.504	0.503
L(1.5) dev 1992				0.087	0.099	1.147	0.455	-0.055	-0.038	-0.055	-0.037	-0.039
L(1.5) dev 1993				1.234	1.277	0.060	0.394	0.648	0.649	0.630	0.650	0.647
L(1.5) dev 1994				1.372	1.428	1.274	0.254	0.344	0.413	0.381	0.412	0.414
L(1.5) dev 1995				1.564	1.581	1.186	-0.292	0.387	0.403	0.387	0.404	0.401
L(1.5) dev 1996				0.520	0.521	1.312	-0.135	0.239	0.252	0.238	0.253	0.250
L(1.5) dev 1997				-1.225	-1.249	0.249	-0.920	-0.290	-0.295	-0.293	-0.293	-0.296
L(1.5) dev 1998				0.357	0.298	-1.456	0.594	-0.188	-0.163	-0.179	-0.161	-0.162
L(1.5) dev 1999				-0.315	-0.338	-0.142	0.748	-0.949	-0.934	-0.950	-0.932	-0.935
L(1.5) dev 2000				1.709	1.695	-0.701	0.961	0.579	0.595	0.584	0.597	0.595
L(1.5) dev 2001				-0.641	-0.653	1.250	0.488	0.759	0.765	0.749	0.767	0.763
L(1.5) dev 2002				2.297	2.261	-0.320	1.259	0.952	0.958	0.939	0.960	0.955
L(1.5) dev 2003				0.333	0.291	2.206	-1.051	0.507	0.521	0.517	0.523	0.521
L(1.5) dev 2004				4.773	4.724	0.915	-1.214	1.331	1.323	1.333	1.326	1.324
L(1.5) dev 2005				-3.026	-3.043	4.610	-1.565	-1.088	-1.093	-1.090	-1.091	-1.094
L(1.5) dev 2006				-4.417	-4.433	-2.650	-1.656	-1.223	-1.218	-1.225	-1.215	-1.219
L(1.5) dev 2007				-3.363	-3.393	-4.238	-0.258	-1.501	-1.496	-1.500	-1.494	-1.496
L(1.5) dev 2008				-3.971	-3.977	-3.013	0.282	-1.647	-1.627	-1.645	-1.625	-1.628
L(1.5) dev 2009				-1.277	-1.291	-4.344	-1.886	-0.283	-0.282	-0.288	-0.280	-0.284
L(1.5) dev 2010				2.349	2.350	-1.001	0.219	0.276	0.303	0.283	0.305	0.304
L(1.5) dev 2011				-5.241	-5.225	2.120	-0.256	-1.891	-1.882	-1.892	-1.880	-1.883
L(1.5) dev 2012				-1.764	-1.773	-5.318	0.292	0.197	0.227	0.202	0.229	0.227
L(1.5) dev 2013				2.706	2.700	-1.457	1.952	-0.256	-0.231	-0.251	-0.229	-0.231
L(1.5) dev 2014				-1.279	-1.265	2.328	1.824	0.278	0.290	0.273	0.290	0.287
L(1.5) dev 2015				1.987	2.000	-1.291	1.154	1.966	1.990	1.977	1.989	1.991
L(1.5) dev 2016				3.475	3.488	0.935	1.150	1.829	1.823	1.835	1.810	1.821

Table 2.1.1.1h—Log survey catchability deviations. See text for details.

	Model (17.2, 17.6) or bridging run (BR_#)											
Parameter	17.2	BR_1	BR_2	BR_3	BR_4	BR_5	BR_6	BR_7	BR_8	BR_9	BR_10	17.6
ln(Q) dev autocor.					0.368	0.439	0.467	0.468	0.466	0.473	0.465	0.466
ln(Q) dev 1982					1.589	-0.062	0.403	0.558	1.043	0.604	1.025	1.036
ln(Q) dev 1983					1.618	0.252	0.682	0.773	1.191	0.807	1.174	1.185
ln(Q) dev 1984					1.156	-0.387	0.837	-0.014	0.416	0.030	0.398	0.408
ln(Q) dev 1985					1.196	0.230	0.089	0.396	0.698	0.424	0.685	0.693
ln(Q) dev 1986					0.912	0.231	-0.567	0.545	0.800	0.571	0.789	0.796
ln(Q) dev 1987					0.061	-0.548	-2.408	-0.127	0.063	-0.104	0.053	0.061
ln(Q) dev 1988					-0.832	-1.118	-2.079	-0.632	-0.528	-0.615	-0.529	-0.528
ln(Q) dev 1989					-3.164	-2.720	-1.549	-2.235	-2.228	-2.228	-2.225	-2.225
ln(Q) dev 1990					-1.959	-2.017	-0.742	-1.896	-1.916	-1.913	-1.914	-1.915
ln(Q) dev 1991					-1.436	-1.482	0.683	-1.461	-1.489	-1.497	-1.488	-1.490
ln(Q) dev 1992					-0.447	-0.570	2.518	-0.701	-0.822	-0.798	-0.819	-0.821
ln(Q) dev 1993					0.651	0.820	2.211	0.738	0.671	0.732	0.674	0.674
ln(Q) dev 1994					2.027	2.449	1.451	2.559	2.500	2.563	2.504	2.502
ln(Q) dev 1995					1.249	1.997	0.432	2.248	2.166	2.261	2.171	2.169
ln(Q) dev 1996					0.670	1.378	-0.112	1.471	1.401	1.481	1.406	1.404
ln(Q) dev 1997					-0.094	0.586	-0.452	0.417	0.385	0.423	0.387	0.386
ln(Q) dev 1998					-0.401	0.138	-0.817	-0.254	-0.206	-0.253	-0.207	-0.209
ln(Q) dev 1999					-0.672	-0.388	0.403	-0.479	-0.452	-0.488	-0.453	-0.456
ln(Q) dev 2000					-0.959	-0.779	-0.483	-0.696	-0.734	-0.732	-0.734	-0.740
ln(Q) dev 2001					1.065	0.752	-0.692	0.609	0.468	0.470	0.471	0.445
ln(Q) dev 2002					-0.700	-0.568	-1.222	-0.397	-0.467	-0.411	-0.465	-0.468
ln(Q) dev 2003					-0.825	-0.555	-0.963	-0.624	-0.708	-0.621	-0.703	-0.704
ln(Q) dev 2004					-1.235	-0.767	-1.267	-1.167	-1.248	-1.155	-1.244	-1.243
ln(Q) dev 2005					-0.316	-0.100	-1.141	-0.906	-0.957	-0.897	-0.953	-0.953
ln(Q) dev 2006					-0.362	-0.172	-1.838	-1.186	-1.257	-1.176	-1.251	-1.252
ln(Q) dev 2007					-0.380	-0.434	-1.679	-1.085	-1.146	-1.091	-1.141	-1.145
ln(Q) dev 2008					-1.567	-1.476	-0.220	-1.741	-1.858	-1.751	-1.852	-1.856
ln(Q) dev 2009					-1.273	-1.316	0.275	-1.503	-1.652	-1.508	-1.644	-1.648
ln(Q) dev 2010					0.014	0.017	0.419	-0.083	-0.210	-0.089	-0.204	-0.208
ln(Q) dev 2011					0.425	0.678	0.432	0.451	0.281	0.448	0.290	0.285
ln(Q) dev 2012					0.479	0.764	1.328	0.572	0.425	0.582	0.432	0.428
ln(Q) dev 2013					0.119	0.507	1.523	0.574	0.435	0.579	0.440	0.438
ln(Q) dev 2014					1.055	1.442	0.875	1.496	1.330	1.492	1.336	1.333
ln(Q) dev 2015					1.251	1.672	-0.282	1.721	1.529	1.711	1.537	1.532
ln(Q) dev 2016					0.691	1.340	-0.987	1.146	0.886	1.126	0.906	0.893
ln(Q) dev 2017					-0.677	0.164	0.084	-0.004	-0.272	-0.002	-0.276	-0.268

Table 2.1.1.1i—Survey selectivity peak age deviations. See text for details.

Parameter	Model (17.2, 17.6) or bridging run (BR_#)										
	17.2	BR_1	BR_2	BR_3	BR_4	BR_5	BR_6	BR_7	BR_8	BR_9	BR_10	17.6
Peak(sur.) dev1982							0.537	0.747	0.538	0.537	0.482	0.561
Peak(sur.) dev1983							-0.145	0.008	0.011	0.014	0.030	0.004
Peak(sur.) dev1984							0.394	0.680	0.479	0.475	0.435	0.497
Peak(sur.) dev1985							-0.004	-0.177	-0.140	-0.145	-0.129	-0.145
Peak(sur.) dev1986							0.712	0.531	0.332	0.330	0.311	0.346
Peak(sur.) dev1987							0.972	-0.072	-0.035	-0.039	-0.017	-0.043
Peak(sur.) dev1988							-0.118	0.651	0.476	0.458	0.432	0.492
Peak(sur.) dev1989							-0.005	1.164	0.924	0.943	0.836	0.954
Peak(sur.) dev1990							-2.077	-0.153	-0.118	-0.115	-0.105	-0.124
Peak(sur.) dev1991							-0.234	-0.030	0.002	-0.001	0.021	-0.006
Peak(sur.) dev1992							0.183	-1.808	-0.547	-0.537	-0.601	-0.531
Peak(sur.) dev1993							0.615	-0.247	-0.246	-0.244	-0.249	-0.246
Peak(sur.) dev1994							0.864	0.344	0.187	0.193	0.192	0.187
Peak(sur.) dev1995							0.150	0.820	0.574	0.596	0.510	0.600
Peak(sur.) dev1996							0.834	1.026	0.771	0.805	0.689	0.800
Peak(sur.) dev1997							0.702	0.338	0.157	0.188	0.167	0.157
Peak(sur.) dev1998							0.083	0.942	0.707	0.713	0.627	0.734
Peak(sur.) dev1999							-0.511	0.813	0.585	0.589	0.518	0.611
Peak(sur.) dev2000							-0.096	0.135	0.076	0.082	0.094	0.072
Peak(sur.) dev2001							-0.156	-1.987	-0.523	-0.522	-0.575	-0.803
Peak(sur.) dev2002							0.030	-0.148	-0.098	-0.103	-0.084	-0.104
Peak(sur.) dev2003							-0.630	-0.195	-0.175	-0.169	-0.168	-0.179
Peak(sur.) dev2004							-0.627	-0.021	-0.007	-0.004	0.012	-0.015
Peak(sur.) dev2005							-0.637	-0.486	-0.676	-0.699	-0.762	-0.649
Peak(sur.) dev2006							-0.120	-0.484	-0.673	-0.688	-0.757	-0.647
Peak(sur.) dev2007							-0.258	-0.488	-0.687	-0.714	-0.781	-0.658
Peak(sur.) dev2008							-0.101	-0.187	-0.160	-0.161	-0.152	-0.165
Peak(sur.) dev2009							-0.247	-0.259	-0.273	-0.270	-0.280	-0.272
Peak(sur.) dev2010							-0.253	-0.167	-0.127	-0.135	-0.117	-0.135
Peak(sur.) dev2011							0.032	-0.257	-0.270	-0.267	-0.276	-0.268
Peak(sur.) dev2012							-0.130	-0.796	-0.276	-0.276	-0.283	-0.275
Peak(sur.) dev2013							0.100	0.026	0.022	0.021	0.041	0.014
Peak(sur.) dev2014							-1.018	-0.177	-0.146	-0.145	-0.135	-0.151
Peak(sur.) dev2015							0.358	0.111	0.071	0.067	0.085	0.063
Peak(sur.) dev2016							0.000	-0.695	-1.096	-1.149	-0.364	-1.036
Peak(sur.) dev2017							0.000	0.498	0.361	0.375	0.353	0.357