NOAA FISHERIES

Alaska Fisheries Science Center

Preliminary assessment of Pacific cod in the Eastern Bering Sea

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Team and SSC comments

Comments on assessments in general (1 of 2)

- SSC1: "The SSC requests that all authors fill out the risk table in 2019, and that the PTs provide comment on the author's results in any cases where a reduction to the ABC may be warranted (concern levels 2-4)." *Response*: This request will be addressed in the final assessment.
- SSC2: "In response to the PT's request for guidance on model averaging and the development of ensembles, the SSC offers the following general recommendations:
  - "Progress on this effort will require an example to work through both expected and unanticipated details of how this process may work. The SSC requests again for 2019 that one or more assessments bring forward an ensemble of models.
  - "The combining of model output should occur on the basic estimates from the assessment (biomass, F, etc.) and not the reference points themselves.
  - (continued on next slide)

Comments on assessments in general (2 of 2)

- SSC2, continued:
  - "Where variance estimates among models differ appreciably, it may be more appropriate to combine the posterior distribution functions from each model than to average the expectations.
  - "It will be difficult for the PTs to combine model results without the author's assistance. Such an approach should only be attempted in unique cases, and it is preferable for the author to identify the intention to bring forward an ensemble in September and perform the analysis before the November PT meetings."
- *Response*: A new method for model weighting that may be useful in developing an example will be the subject of the next presentation. Although it does not satisfy the recommendation to operate on the "basic estimates from the assessment (biomass, F, etc.)," it does satisfy the recommendation to average posterior distribution functions.

Comments specific to this assessment (1 of 14)

- “For next year’s assessment, the Team recommended that...
- BPT1: “...the EBS Pacific cod ages be examined for potential biases and reader effects as seen with GOA Pacific cod (i.e., Barbeaux et al 2018/GOA cod assessment and Kastelle et al., 2017/Age validation of Pacific cod (*Gadus macrocephalus*) using high-resolution stable oxygen isotope (δ18O) chronologies in otoliths).” *Response*: All assessments of the EBS Pacific cod stock since 2009 have included estimates of ageing bias, and this practice is continued in all models presented here. In response to a recent concern that ageing criteria may have shifted after 2007, three of the models presented here include separate estimates of ageing bias for the pre-2008 and post-2007 portions of the time series.

Comments specific to this assessment (2 of 14)

- BPT2: “...fisheries data be examined to determine if there are within-year patterns that may indicate seasonal movement, and if the survey timing may intersect with that seasonal migration.” *Response*: The requested analysis is presented in the Discussion section.
- BPT3: “...a model-based survey time-series be developed that can predict combined abundance of the expanded EBS survey area and the Northern Bering Sea survey area for all years. Length and age compositions should also be created that account for and are appropriately weighted by these model-based estimates. Validate the predictions using various methods as well as consistency with observations from other external surveys (e.g., BASIS).”
- (response on next slide)

Comments specific to this assessment (3 of 14)

- *Response to BPT3*: A model-based survey time series for the combined EBS and Northern Bering Sea (NBS) areas, based on the vector autoregressive spatio-temporal (VAST) method developed by Thorson (2019), has been developed and is used in two of the models presented here, as are corresponding VAST estimates of survey age composition. However, when attempts were made to estimate corresponding VAST estimates of survey size composition, the 1-cm bin size currently used in the models caused computational problems that have not yet been resolved. Validation of the estimates “using various methods and comparison for consistency with other surveys” has not been attempted.
- BPT4: “...the NBS survey be conducted again in 2019 to provide data for the Pacific cod assessment.” *Reponse*: The NBS survey was conducted again in 2019 and will provide data for the Pacific cod assessment.

Comments specific to this assessment (4 of 14)

- BPT5: “...Pacific cod fishery catches and Pacific cod survey data in Russia be researched and summarized.” *Response*: A small amount of data on Russian catches of Pacific cod has been obtained and efforts to obtain further estimates, perhaps using Automatic Identification System data, are being discussed. The available data will be reported in the final assessment.
- BPT6: “...the significance of retrospective patterns when using a time-series with data mainly in recent years (for example, removing 2017 and 2018 leaves only one observation for the Northern Bering Sea survey time-series) be investigated and explained. For example, are the Mohn’s ρ estimates useful to compare across models?” *Response*: Some results pertaining to this issue are presented in the Discussion section.

Comments specific to this assessment (5 of 14)

- BPT7: “...the author considers an ensemble of models using the three hypotheses discussed above to address the structural uncertainty resulting from these hypotheses, as well as additional uncertainties captured by various models. The three hypotheses are 1) P. cod in the NBS are insignificant to the managed stock, 2) P. cod in the NBS are simply the same stock as in the EBS and should be managed as one stock, and 3) P. cod in the NBS and EBS are from the same stock and should be managed as one stock, but P. cod in the NBS should be modeled separately within one model with separate catchability and selectivity to capture differences observed in the fish in that area. *Response*: In addition to the base model, six new models are presented here, spread across the Team’s three hypotheses (specifically, two new models per hypothesis).

Comments specific to this assessment (6 of 14)

- BPT8: "...the author considers bringing forward an ensemble of models to capture structural uncertainty with a justifiable weighting as well as a "null" approach with equal weights. The Plan Team may also consider an ensemble even if not recommended by the author. If an ensemble is used, all model outputs in the ensemble that are management related should be averaged, and the ABC should be determined from those averaged outputs (i.e., the application of the control rule to averaged biological reference values). The Team would appreciate feedback from the SSC on appropriate methods to average model outputs to determine an ABC." *Response*: See Comment SSC2. The presentation on a new model averaging approach includes a focus on justifiable model weights.

Comments specific to this assessment (7 of 14)

- BPT9: "...the authors coordinate with Council staff to augment the fishery information section of the assessment for next year. Council staff will be providing a cod allocation review in 2019 and will work with the author to provide pertinent summary sections over the summer." *Response*: The requested augmentation will occur in the final assessment.

Comments specific to this assessment (8 of 14)

- BPT10: "...the authors coordinate with Alaska Department of Fish and Game on assessment data needs from the state managed Area O Pacific cod fishery as the fishery GHL is expanded under new allocation rules from 6.4% to a maximum 15% of the Bering Sea Pacific cod ABC." *Response*: Representatives from the Alaska Department of Fish and Game have been contacted regarding the need for data from the State-managed Pacific cod fishery in the EBS. They indicate a willingness to begin collecting these data. Specifics of the collection process will be developed soon.

Comments specific to this assessment (9 of 14)

- SSC3: “The SSC recommends that future efforts focus on treatment of the Northern Bering Sea data prior to adding to the assessment – via summation of the components (as in model 16.6i) or through model-based approaches that can estimate contributions of unsampled areas (such as developed for EBS walleye pollock). However, the SSC noted that many requested changes made in development of the 17.x and 18.x series of models represent improvements over the 16.x models. These improvements include inclusion of fishery age composition data, the prior on natural mortality, composition data weighted by the number of hauls, and harmonic mean composition weights. Other changes continue to be worthy of evaluation, but may not be clear improvements, such as time-varying selectivity and catchability. The SSC recommends bringing these branched model series back together either in the form of one model, or an ensemble of models for 2019.”
- (Response on next slide)

Comments specific to this assessment (10 of 14)

- *Response to SSC3*: Results from Model 16.6i, which uses simple summation of the design-based survey estimates, are again reported here, along with results from six new models, two of which use VAST estimates of survey abundance and age composition (see Comment BPT3). All of the new models include fishery age composition data and initial weighting of compositional data by the number of hauls (in either absolute or relative terms), and three of the new models include reweighting of compositional data and time-varying selectivity and catchability.
- SSC4: “The greatest concern identified by the SSC was the future survival and contribution to the greater cod stock of the fish observed in the Northern Bering Sea (over half of the total biomass) in 2018. The SSC reiterated its recommendation from October that in-season reporting of fishery performance be used to track the presence and/or success of these fish into next spring.” *Response*: This request could not be accommodated due to lack of the necessary data.

Comments specific to this assessment (11 of 14)

- “The SSC agreed with PT recommendations for additional work on...
- SSC5: “...resolving issues with ageing methods and historical age data, following the issues raised in the GOA Pacific cod assessment which may be applicable in the Bering Sea.” Response: See Comment BPT1.
- SSC6: “...use of a model-based method for developing a survey abundance estimate for the entire Bering Sea.” See Comment BPT3.
- SSC7: “...the critical importance of a Northern Bering Sea survey in 2019.” See Comment BPT4.

Comments specific to this assessment (12 of 14)

- SSC8: “The SSC strongly supported the PT approach of organizing alternative models around explicit hypotheses regarding the assessment structure or population dynamics. This approach was very helpful to make clear where the need for additional research was most important, and also provided a logical framework for developing an ensemble of models corresponding to each hypothesis. Moving forward, weighting of models for an ensemble may be developed based on the relative plausibility of each model hypothesis. The SSC recommends further efforts in developing this approach.” *Response*: See Comment BPT7 regarding the Team’s three hypotheses. See Comments SSC2 and BPT8 regarding model averaging. In addition to including a focus on justifiable model weights, the document describing a new model averaging approach also provides an explicit role for the relative plausibility of each model in the ensemble.

Comments specific to this assessment (13 of 14)

- SSC9: “The SSC supports tagging, which may be helpful for understanding connectivity among areas of the greater Bering Sea.” *Response*: This year’s NBS survey included plans to fit 32 fish with satellite archival tags. Genetic samples were to be taken prior to release, to determine spawning site fidelity.
- SSC10: “The SSC supported the use of projections integrated with the assessment analysis and the use of fixed catches (rather than fishing mortality rates) in these projections. This approach provided for more realistic projections that included uncertainty in the fishing mortality rate, parameter uncertainty, and allowed for the explicit calculation of the probability of exceeding the overfishing limit. The SSC suggest that this method be explored in other assessments and considered for routine use.” *Response*: Projections are again integrated with the assessment analysis here.

Comments specific to this assessment (14 of 14)

- SSC11: “The SSC also encouraged additional work to investigate recent and historical fishery catch in the Northern Bering Sea as there were a number questions regarding reports of fishery activity, but only a small amount of fishing identified by the author.” *Response*: Additional investigation revealed that the absence of fishery data from the NBS survey area last year was due to the timing of last year’s analysis. Last year’s data query was run in July, and resulted in very few records. However, when the same query was run *this* July, 620 records (hauls) were retrieved for 2018, all but 12 of which were for the months August-December. No records were retrieved for 2019 as a result of this year’s query, however.

Models

Base model

- Model 16.6i was adopted by the SSC last year as the new base 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 F.
  - 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.
- The only difference between Model 16.6i and Model 16.6 is the inclusion in Model 16.6i of data from the NBS survey, which were incorporated by simple summation with the EBS survey data.

Alternative models (1 of 6)

- A total of six alternative models are presented here in addition to the base model.
- These constitute a factorial design involving the Team's three hypotheses regarding treatment of the NBS (Comments BPT7 and SSC8) and the SSC's desire to explore multiple ranges of possible enhancements to the structure of the base model (Comment SSC3).
- Reprising the Team's three hypotheses:

1. Pacific cod in the NBS are insignificant to the managed stock, so the assessment should include data from the EBS only.
2. Pacific cod in the EBS and NBS comprise a single stock, and the EBS and NBS surveys can be modeled in combination.
3. Pacific cod in the EBS and NBS comprise a single stock, but the EBS and NBS surveys should be modeled separately.

Alternative models (2 of 6)

- Relative to the base model, two ranges of structural modifications are featured among the alternative models.
- More specifically, two models are presented for each hypothesis, one of which contains a certain set of structural modifications, and the other of which contains a second, larger, set of structural modifications.
- The two sets of structural modifications are the same across hypotheses, except that an additional set of survey parameters is required for Hypothesis 3.
- In addition to structural differences, the models for the various hypotheses also involve different data.

Alternative models (3 of 6)

- The first (smaller) set of structural modifications is as follows:
  - Set input sample size for compositional data equal to the number of hauls, rescaled to an average of 300 for each component (Model 16.6i sets input sample size equal to the number of *observations*, rescaled to an average of 300 for each component).
  - Include the available fishery age composition data (Model 16.6i ignores those data).
  - Use age-based, double-normal selectivity, potentially dome-shaped for the fishery but forced asymptotic for the survey (Model 16.6i uses age-based, logistic selectivity for both fleets).
  - Tune the input standard deviation of log-scale recruitment deviations (σ_R) to match the square root of the variance of the estimates plus the sum of the estimates' variances (Methot and Taylor 2011; Model 16.6i estimates σ_R internally).
  - Use size-based maturity (Model 16.6i uses age-based maturity).

Alternative models (4 of 6)

- The second (larger) set of structural modifications is as follows:
  - Set input sample size for compositional data equal to raw number of hauls rather (than rescaled to an average of 300).
  - Reweight compositional data internally using the Dirichlet-multinomial distribution (Thorson et al. 2017; see also Discussion).
  - Use size-based double-normal selectivity rather than age-based (but keeping the assumption of asymptotic survey selectivity).
  - Allow mean ageing bias at ages 1 and 20 to differ between the pre-2008 and post-2007 periods in order to compensate for an apparent change in ageing criteria (Beth Matta, AFSC, pers. comm., 6/27/19) .
  - Allow yearly variation in survey selectivity (two parameters), with the input standard deviation of the deviations tuned to set the variance of the estimates plus the sum of the estimates' variances equal to unity.
  - (continued on next slide)

Alternative models (5 of 6)

- The second (larger) set of structural modifications (continued):
  - Allow yearly random variation in survey catchability, with the input standard deviation of the deviations tuned to set the variance of the estimates plus the sum of the estimates’ variances equal to unity.
  - Allow yearly random variation in mean length at age 1.5, with the input standard deviation of the deviations tuned to set the variance of the estimates plus the sum of the estimates’ variances equal to unity, in order to address the significant amount of time-variability in growth documented by Puerta et al. (2019).
  - Allow yearly random variation in fishery selectivity (three parameters), with the input standard deviation of the deviations tuned to set the variance of the estimates plus the sum of the estimates’ variances equal to unity.

Alternative models (6 of 6)

- Referring to models conforming to the first set of structural modifications as “simple” and models conforming to the second (larger) set of structural modifications as “complex,” the set of alternative models can be summarized as follows:

Hypothesis:	1: EBS only		2: Combine EBS and NBS		3: Separate EBS and NBS	
Structure:	Simple	Complex	Simple	Complex	Simple	Complex
Name:	M19.1	M19.2	M19.3	M19.4	M19.5	M19.6

Features explored but not included

- Use of VAST survey index estimates without the cold pool covariate.
- Use of VAST estimates of survey abundance without bias correction.
- Internal estimation of a time-invariant “extra” survey standard error.
- Allowing yearly random variation in the Brody growth coefficient (K).
- Internal estimation of a parameter expressing cohort-specific growth.
- External re-weighting of compositional data components.
- Survey catchability fixed (i.e., not estimated statistically) at 1.0.
- Exponential-logistic fishery selectivity.
- Exponential-logistic survey selectivity.
- Different sets of selectivity parameters subject to random variation.
- Allowing survey selectivity to be dome-shaped.

Data

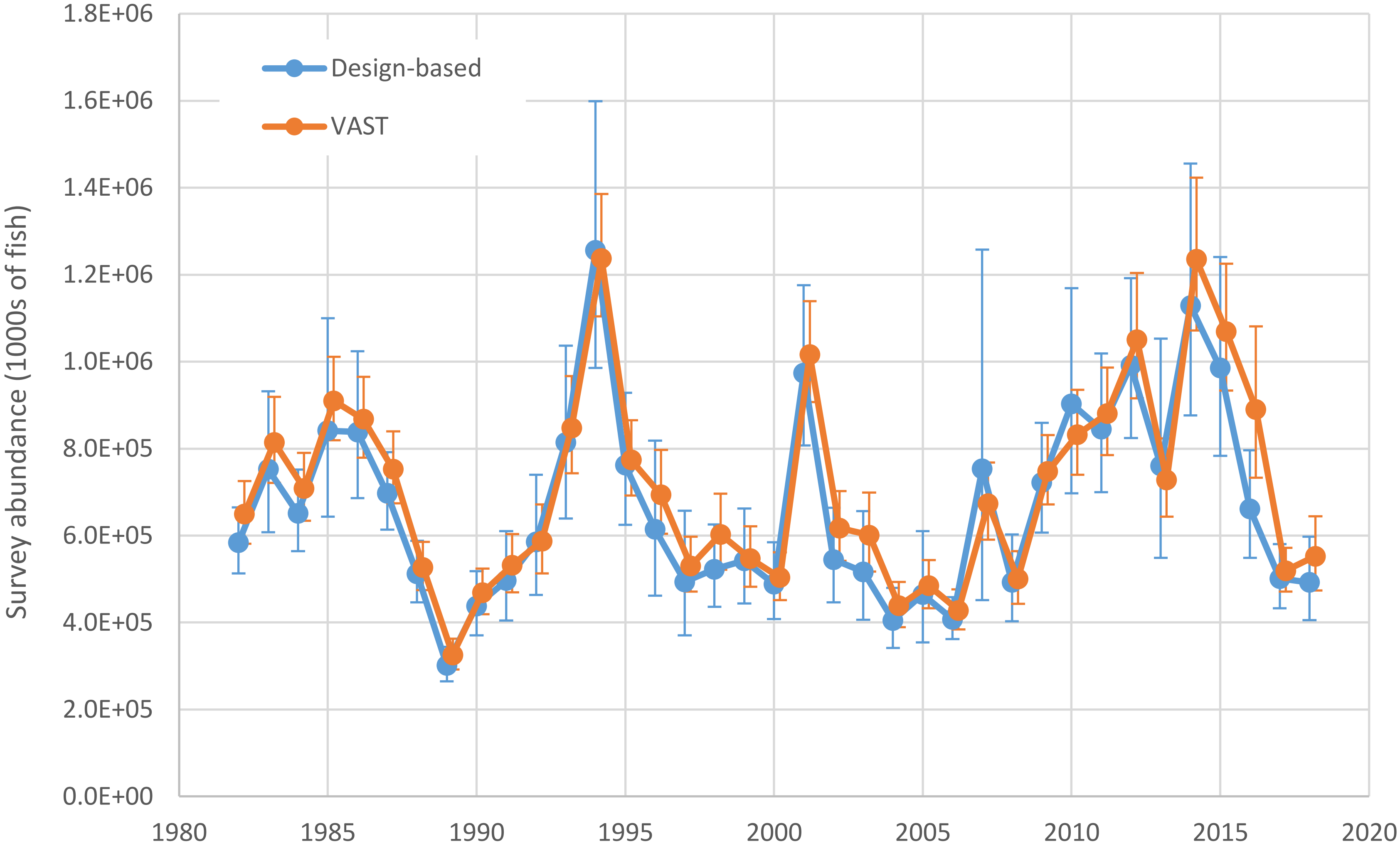
Input composition sample sizes

- The rescaled number of observations used as input sample sizes in Model 16.6i were replaced by:
  - rescaled number of hauls (Models 19.1, 19.3, 19.5) or
  - raw number of hauls (Models 19.2, 19.4, 19.6).

Abundance indices

- The design-based EBS+NBS survey estimates used in Model 16.6i were replaced by:
  - Design-based EBS-only survey estimates in Models 19.1 and 19.2 (Hypothesis 1).
  - VAST estimates for the combined surveys in Models 19.3 and 19.4 (Hypothesis 2).
    - Bias-corrected, with cold pool covariate.
    - Settings followed the recommendations given by Thorson (2019).
    - Estimates suggest that few Pacific cod were present in the NBS during years when that region was not surveyed.
  - Area-specific design-based estimates for the EBS and NBS surveys in Models 19.5 and 19.6 (Hypothesis 3).

VAST vs. design-based EBS+NBS index



Age composition

- The VAST estimates of age composition were substituted for their design-based counterparts in all models.
- The differences between the two sets of estimates (VAST minus design-based) are shown on the next slide, where the color scale extends from red=low to green=high.
- In general differences between the two sets of estimates are small:
  - 84% of the cells fall within the range (-0.01,0.01),
  - 95% fall within the range (-0.02,0.02), and
  - 99% fall within the range (-0.04,0.04).
- Age 1 had the largest positive changes (4% increases in 1997 and 2009, 5% increase in 2011).
- Ages 2 and 3 had the largest negative changes (4% decreases at age 2 in 2013 and age 3 in 1997).

VAST vs. design-based survey agecomp

Year	0	1	2	3	4	5	6	7	8	9	10	11	12
1994	0.00024	0.01528	0.01794	-0.00408	-0.01527	-0.00916	-0.00426	-0.00120	0.00045	-0.00043	-0.00002	0.00014	0.00038
1995	0.00016	0.00959	-0.00607	-0.00518	0.00325	-0.00250	0.00420	-0.00239	-0.00163	-0.00045	-0.00005	0.00079	0.00029
1996	0.00003	0.01601	-0.01188	-0.02337	-0.00894	0.01058	0.01321	0.00430	-0.00090	-0.00063	0.00014	0.00062	0.00081
1997	0.00032	0.04365	-0.00851	-0.03707	-0.01698	-0.00266	0.01743	0.00273	0.00071	-0.00069	0.00054	0.00020	0.00032
1998	0.00008	0.01032	-0.00432	-0.00957	-0.00389	0.00147	0.00212	0.00294	0.00103	-0.00052	-0.00005	0.00022	0.00021
1999	0.00009	0.01432	0.01333	0.00788	-0.02138	-0.00920	-0.00411	-0.00056	-0.00005	-0.00011	-0.00020	-0.00007	0.00006
2000	-0.00002	-0.01059	-0.01025	0.01305	-0.00573	0.00897	0.00098	0.00053	0.00206	-0.00046	0.00086	0.00029	0.00029
2001	0.00003	0.00701	0.00095	-0.00892	-0.00634	0.00413	0.00295	0.00018	-0.00014	-0.00033	0.00001	0.00029	0.00016
2002	0.00045	0.00381	0.00500	-0.02090	0.00564	0.00039	0.00253	0.00425	-0.00032	-0.00091	-0.00010	-0.00002	0.00017
2003	0.00000	-0.00014	0.00095	-0.01812	-0.00179	0.00882	0.00526	0.00241	0.00242	-0.00009	-0.00003	0.00006	0.00026
2004	0.00002	0.00338	-0.01270	-0.00666	0.00151	0.00660	0.00849	-0.00091	0.00157	-0.00089	-0.00003	-0.00057	0.00016
2005	0.00001	-0.02183	-0.00631	-0.00766	0.00557	0.00493	0.01396	0.00847	0.00203	0.00014	0.00017	0.00061	-0.00009
2006	0.00000	0.02470	-0.00110	-0.00096	-0.01076	-0.00640	-0.00249	-0.00076	-0.00167	-0.00045	0.00011	-0.00012	-0.00008
2007	0.00000	-0.02258	0.00829	0.00461	0.00453	0.00218	0.00195	0.00155	-0.00019	0.00023	-0.00003	-0.00049	-0.00006
2008	-0.00014	-0.00843	-0.01302	0.00676	0.00860	0.00442	-0.00089	0.00095	0.00052	0.00075	0.00006	0.00077	-0.00033
2009	-0.00068	0.04061	-0.01629	-0.01866	-0.00354	-0.00213	-0.00026	-0.00014	0.00089	-0.00020	0.00014	0.00014	0.00010
2010	0.00000	0.00171	0.00217	0.00201	-0.00589	-0.00194	0.00061	0.00053	0.00019	0.00025	0.00019	0.00012	0.00005
2011	0.00006	0.04794	-0.00215	-0.03108	-0.00716	-0.00764	-0.00025	0.00029	-0.00028	-0.00001	0.00017	0.00011	0.00002
2012	-0.00005	-0.01793	0.01913	0.00251	-0.00917	0.00241	0.00116	0.00096	0.00050	0.00027	0.00013	-0.00001	0.00006
2013	0.00000	-0.00272	-0.04109	0.01808	0.00820	0.01153	0.00387	0.00182	0.00003	0.00017	0.00003	0.00002	0.00005
2014	-0.00002	-0.00291	-0.02199	-0.00204	0.01135	0.00830	0.00619	0.00091	-0.00008	0.00000	0.00009	-0.00004	0.00025
2015	0.00002	-0.00202	0.00452	-0.00249	-0.00004	0.00058	-0.00029	-0.00007	-0.00011	-0.00009	-0.00002	-0.00005	0.00005
2016	0.00000	-0.02911	-0.00511	-0.01275	0.01747	0.02287	0.00684	0.00037	-0.00061	0.00001	0.00004	-0.00003	0.00001
2017	0.00007	-0.02334	0.00862	-0.03243	0.01693	0.01940	0.01070	0.00096	-0.00148	0.00010	0.00008	0.00008	0.00032
Ave:	0.00003	0.00403	-0.00333	-0.00779	-0.00141	0.00316	0.00375	0.00117	0.00021	-0.00018	0.00009	0.00013	0.00014

Results

Bridging analysis, part 1 (1 of 4)

- The differences between Model 16.6i and Model 19.3 serve as a convenient bridge from the base model to the set of alternative models.
- Both have a relatively simple structure and both use data from the combined EBS and NBS surveys.
- The steps can be outlined as follow, where Steps 1-4 all involve changes in data and Steps 5-8 all involve changes in model structure:

Step	Description
0	Model 16.6i (base model)
1	Same as Step 0, but using VAST survey index
2	Same as Step 1, but using VAST agecomps
3	Same as Step 2, but with sizecomp N = rescaled number of hauls
4	Same as Step 3, but with fishery agecomp data included (N = rescaled no. hauls)
5	Same as Step 4, but with asymptotic double-normal selectivity (fishery and survey)
6	Same as Step 5, but with potentially domed fishery selectivity
7	Same as Step 6, but with SD(ln(recruits)) tuned iteratively
8	Same as Step 7, but with size-based maturity

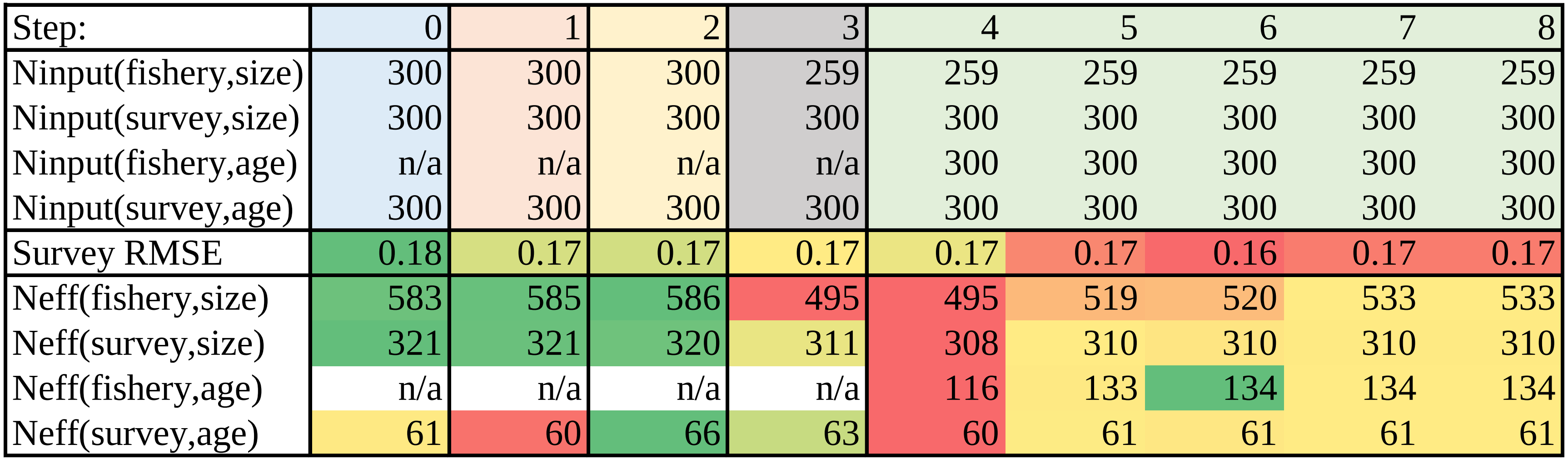
Bridging analysis, part 1 (2 of 4)

Step	0	1	2	3	4	5	6	7	8
B(2019)	290205	276542	281489	296803	260110	296340	299878	297312	303532
B(2020)	246467	235633	237954	252229	241528	243672	246114	245173	244208
maxABC(2019)	181431	176213	178281	184627	135539	196561	199539	196689	200978
maxABC(2020)	137364	130401	131135	140557	108726	148361	149111	141119	142515
B(2019)/B100%	0.44	0.43	0.44	0.45	0.37	0.48	0.48	0.46	0.47
B(2020)/B100%	0.38	0.37	0.37	0.38	0.34	0.40	0.40	0.38	0.38
maxFABC(2019)	0.31	0.31	0.31	0.30	0.24	0.32	0.33	0.33	0.34
maxFABC(2020)	0.29	0.28	0.28	0.29	0.22	0.32	0.33	0.31	0.31
Objective function	1679.54	1762.47	1737.49	1659.54	1773.34	1744.61	1743.21	1743.68	1743.68
Equilibrium catch	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Survey index	-26.54	45.77	45.63	37.54	41.20	37.95	37.69	37.78	37.78
Size compostion	1427.42	1437.81	1434.17	1349.17	1367.17	1357.60	1355.58	1354.36	1354.36
Age composition	271.94	272.60	250.74	266.17	357.12	346.41	347.52	347.41	347.41
Recruitment	-2.57	-2.84	-2.04	-0.22	-0.67	-3.11	-3.18	-1.18	-1.18
Initial regime	9.27	9.13	8.98	6.87	8.51	5.77	5.59	5.31	5.31
"Softbounds"	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
Deviations	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Bridging analysis, part 1 (3 of 4)

Step	0	1	2	3	4	5	6	7	8
Natural mortality	0.34	0.34	0.34	0.34	0.31	0.37	0.37	0.36	0.36
Length at age 1.5	16.38	16.38	16.38	16.38	16.42	16.42	16.43	16.42	16.42
Asymptotic length	100.62	99.57	99.56	100.53	101.39	102.26	102.39	102.43	102.43
Brody growth (K)	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Richards growth	1.04	1.01	1.02	1.02	1.02	0.99	0.99	0.99	0.99
SD(length at *a* =1)	3.46	3.45	3.45	3.44	3.48	3.48	3.48	3.48	3.48
SD(length at *a* =20)	9.53	9.54	9.57	9.19	8.60	8.48	8.48	8.50	8.50
Ageing bias (*a* =1)	0.33	0.33	0.33	0.33	0.34	0.32	0.33	0.33	0.33
Ageing bias (*a* =20)	0.16	0.22	0.41	0.38	-0.30	-0.25	-0.27	-0.27	-0.27
Bias (*a* =1, 2008+)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Bias (*a* =20, 2008+)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
ln(mean recruits)	12.98	12.99	12.99	12.96	12.76	13.12	13.12	13.14	13.14
SD(ln(recruits))	0.66	0.65	0.66	0.66	0.67	0.62	0.62	0.69	0.69
ln(regime offset)	-1.16	-1.15	-1.15	-0.99	-1.01	-0.95	-0.93	-0.99	-0.99
Initial fishing mort.	0.19	0.19	0.19	0.14	0.13	0.13	0.14	0.14	0.14
ln(catchability)	0.03	0.11	0.10	0.10	0.22	0.10	0.09	0.10	0.10

Bridging analysis, part 1 (4 of 4)



Step:	0	1	2	3	4	5	6	7	8
Ninput(fishery,size)	300	300	300	259	259	259	259	259	259
Ninput(survey,size)	300	300	300	300	300	300	300	300	300
Ninput(fishery,age)	n/a	n/a	n/a	n/a	300	300	300	300	300
Ninput(survey,age)	300	300	300	300	300	300	300	300	300
Survey RMSE	0.18	0.17	0.17	0.17	0.17	0.17	0.16	0.17	0.17
Neff(fishery,size)	583	585	586	495	495	519	520	533	533
Neff(survey,size)	321	321	320	311	308	310	310	310	310
Neff(fishery,age)	n/a	n/a	n/a	n/a	116	133	134	134	134
Neff(survey,age)	61	60	66	63	60	61	61	61	61

Bridging analysis, part 2 (1 of 4)

- Next, a bridge from the “simple” Model 19.3 to its “complex” counterpart, Model 19.4 can be created.
- The steps can be outlined as follow, where Step 1 involves a change in data and Steps 2-9 all involve changes in model structure:

Step	Description
0	Model 19.3
1	Same as Step 0, but with composition input N = number of hauls (no rescaling)
2	Same as Step 1, but with Dirichlet composition data weights
3	Same as Step 2, but with size-based selectivity
4	Same as Step 3, but with block-specific ageing bias (pre-2008, post-2007)
5	Same as Step 4, but with yearly random variation in survey selectivity (2 parameters)
6	Same as Step 5, but with re-tuned SD(ln(recruits))
7	Same as Step 6, but with yearly random variation in survey catchability
8	Same as Step 7, but with yearly random variation in mean length at age 1.5
9	Same as Step 8, but with yearly random variation in fishery selectivity (3 parameters)

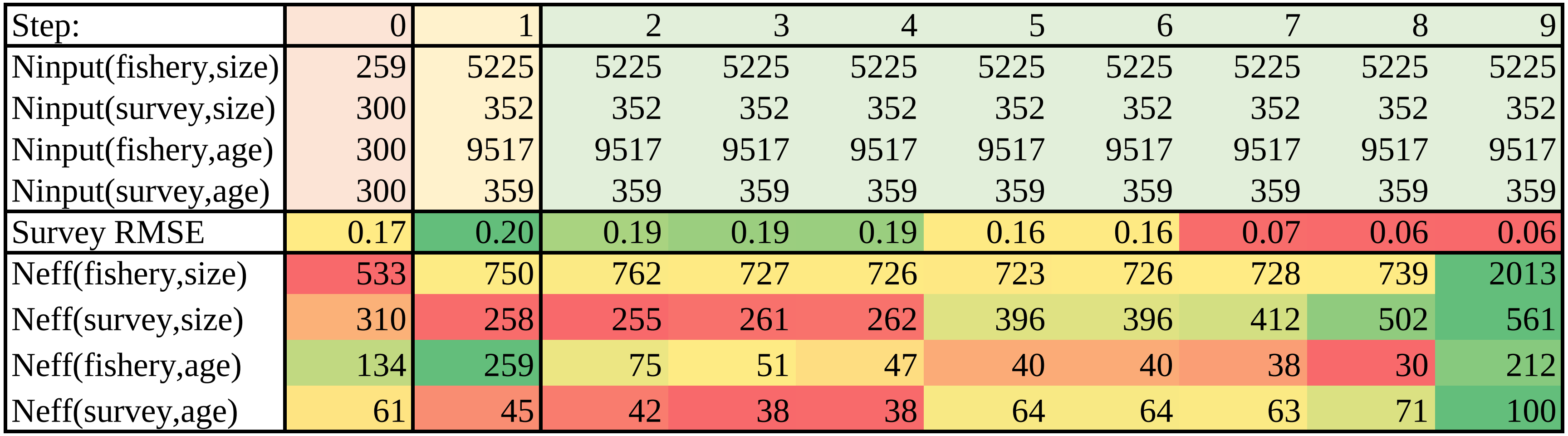
Bridging analysis, part 2 (2 of 4)

Step	0	1	2	3	4	5	6	7	8	9
B(2019)	303532	173690	230190	201686	205506	261955	262341	229335	248724	322998
B(2020)	244208	191242	225249	210212	211002	223558	223457	199915	211349	266750
maxABC(2019)	200978	46439	100880	72697	77731	176911	177884	149193	167945	218243
maxABC(2020)	142515	52740	89744	73762	76683	124003	134001	108160	120215	169733
B(2019)/B100%	0.47	0.20	0.30	0.27	0.28	0.40	0.44	0.39	0.42	0.50
B(2020)/B100%	0.38	0.23	0.29	0.28	0.29	0.34	0.37	0.34	0.36	0.42
maxFABC(2019)	0.34	0.12	0.20	0.16	0.17	0.34	0.34	0.33	0.34	0.37
maxFABC(2020)	0.31	0.13	0.20	0.17	0.18	0.29	0.32	0.28	0.30	0.37
Objective function	1743.68	7027.31	5571.25	5328.35	5315.12	4725.28	4726.94	4609.49	4376.22	2094.11
Equilibrium catch	0.00	0.06	0.04	0.06	0.06	0.02	0.04	0.04	0.04	0.01
Survey index	37.78	105.08	77.41	82.96	82.77	32.32	32.42	-84.15	-84.73	-85.07
Size compostion	1354.36	5149.60	4950.84	4660.78	4662.90	4133.31	4134.33	4083.91	3861.44	1602.93
Age composition	347.41	1756.49	530.01	563.74	549.22	509.09	509.01	512.15	499.47	436.92
Recruitment	-1.18	-5.25	-5.84	-1.63	-1.58	-4.46	-8.87	-8.80	-11.33	-10.05
Initial regime	5.31	21.32	18.76	22.44	21.75	14.57	19.62	19.69	19.32	9.67
"Softbounds"	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Deviations	0.00	0.00	0.00	0.00	0.00	40.43	40.38	86.65	92.01	139.70

Bridging analysis, part 2 (3 of 4)

Step	0	1	2	3	4	5	6	7	8	9
Natural mortality	0.36	0.28	0.31	0.28	0.29	0.36	0.36	0.36	0.36	0.37
Length at age 1.5	16.42	16.61	16.58	13.84	13.83	14.72	14.71	14.71	15.56	15.13
Asymptotic length	102.43	116.52	107.72	105.56	106.05	104.85	104.99	104.98	104.57	104.07
Brody growth (K)	0.20	0.13	0.17	0.16	0.16	0.17	0.17	0.18	0.17	0.18
Richards growth	0.99	1.29	1.13	1.23	1.23	1.12	1.12	1.11	1.15	1.12
SD(length at a =1)	3.48	3.45	3.51	3.58	3.57	3.46	3.46	3.46	3.36	3.46
SD(length at a =20)	8.50	9.23	8.65	10.05	10.10	9.83	9.81	9.78	9.94	9.09
Ageing bias (a =1)	0.33	0.25	0.33	0.33	0.31	0.31	0.31	0.30	0.31	0.33
Ageing bias (a =20)	-0.27	-0.70	0.28	0.48	1.62	1.55	1.57	1.66	1.50	0.89
Bias (a =1, 2008+)	n/a	n/a	n/a	n/a	0.03	0.03	0.03	0.04	0.04	0.02
Bias (a =20, 2008+)	n/a	n/a	n/a	n/a	-1.73	-1.53	-1.54	-1.84	-1.60	-2.22
ln(mean recruits)	13.14	12.59	12.76	12.54	12.57	13.15	13.08	13.05	13.04	13.22
SD(ln(recruits))	0.69	0.69	0.69	0.69	0.69	0.69	0.56	0.56	0.56	0.56
ln(regime offset)	-0.99	-1.48	-1.55	-1.50	-1.51	-1.63	-1.56	-1.55	-1.53	-1.13
Initial fishing mort.	0.14	1.37	1.07	1.13	1.10	0.69	0.70	0.74	0.70	0.23
ln(catchability)	0.10	0.39	0.30	0.40	0.38	0.16	0.15	0.19	0.16	0.01

Bridging analysis, part 2 (4 of 4)

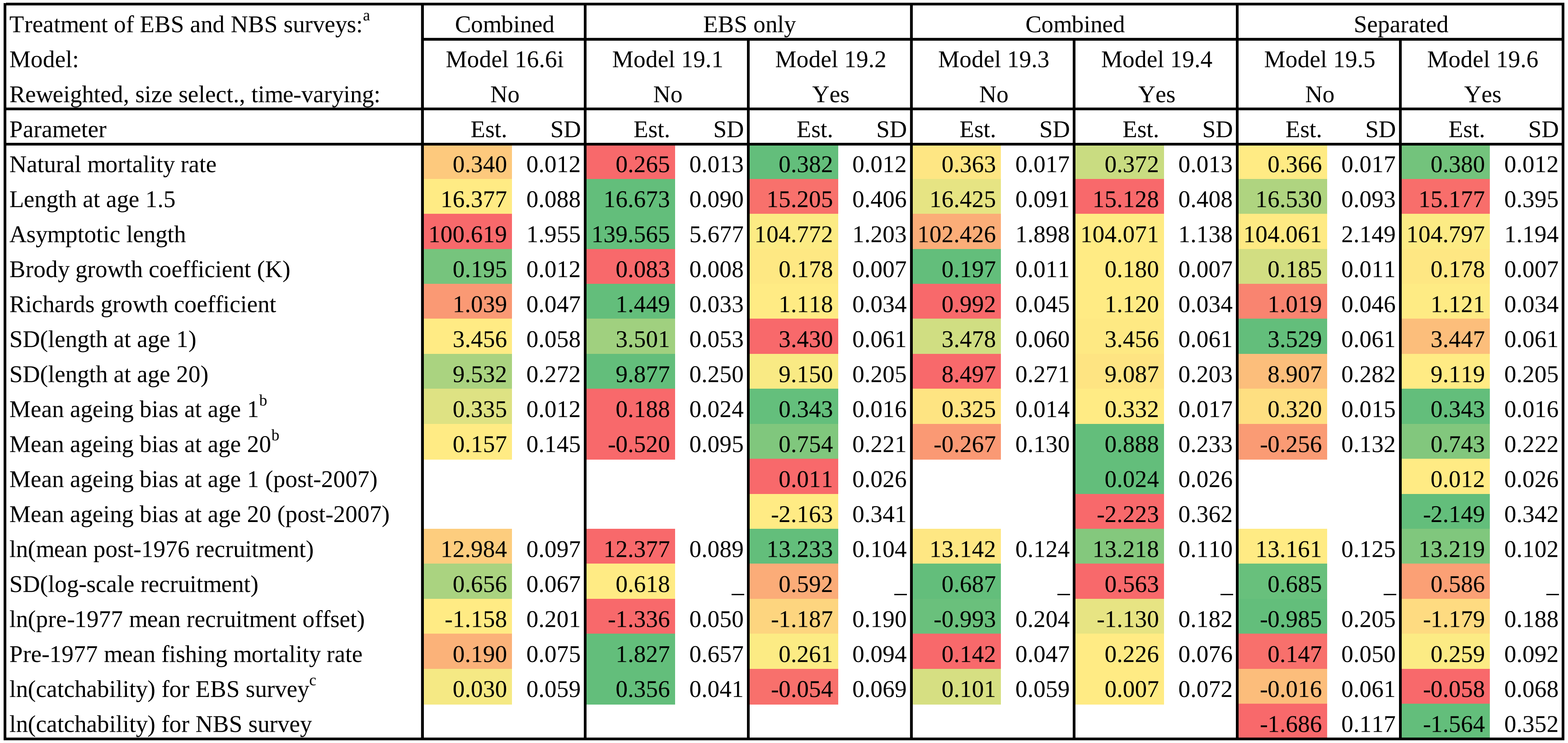


Step:	0	1	2	3	4	5	6	7	8	9
Ninput(fishery,size)	259	5225	5225	5225	5225	5225	5225	5225	5225	5225
Ninput(survey,size)	300	352	352	352	352	352	352	352	352	352
Ninput(fishery,age)	300	9517	9517	9517	9517	9517	9517	9517	9517	9517
Ninput(survey,age)	300	359	359	359	359	359	359	359	359	359
Survey RMSE	0.17	0.20	0.19	0.19	0.19	0.16	0.16	0.07	0.06	0.06
Neff(fishery,size)	533	750	762	727	726	723	726	728	739	2013
Neff(survey,size)	310	258	255	261	262	396	396	412	502	561
Neff(fishery,age)	134	259	75	51	47	40	40	38	30	212
Neff(survey,age)	61	45	42	38	38	64	64	63	71	100

Main results: management quantities

EBS/NBS hypothesis:	Combine	EBS only		Combine		Separate	
Model structure:	Base	Simple	Complex	Simple	Complex	Simple	Complex
Model	M16.6i	M19.1	M19.2	M19.3	M19.4	M19.5	M19.6
ADSB	0.090	0.323	0.255	0.106	0.573	0.100	0.351
Mohn's ρ	0.207	0.093	0.679	0.337	0.741	0.558	0.736
B(2019)	290205	96355	190394	303532	322998	221920	201524
B(2020)	246467	118012	169236	244208	266750	194879	176107
maxABC(2019)	181431	12191	108116	200978	218243	135217	120504
maxABC(2020)	137364	17707	81106	142515	169733	98986	87074
B(2019)/B100%	0.44	0.11	0.32	0.47	0.50	0.35	0.34
B(2020)/B100%	0.38	0.13	0.28	0.38	0.42	0.31	0.29
maxFABC(2019)	0.31	0.05	0.30	0.34	0.37	0.30	0.32
maxFABC(2020)	0.29	0.07	0.27	0.31	0.37	0.26	0.28

Main results: key parameters



Treatment of EBS and NBS surveys:[a]	Combined		EBS only				Combined				Separated			
Model:	Model 16.6i		Model 19.1		Model 19.2		Model 19.3		Model 19.4		Model 19.5		Model 19.6	
Reweighted, size select., time-varying:	No		No		Yes		No		Yes		No		Yes	
Parameter	Est.	SD	Est.	SD	Est.	SD	Est.	SD	Est.	SD	Est.	SD	Est.	SD
Natural mortality rate	0.340	0.012	0.265	0.013	0.382	0.012	0.363	0.017	0.372	0.013	0.366	0.017	0.380	0.012
Length at age 1.5	16.377	0.088	16.673	0.090	15.205	0.406	16.425	0.091	15.128	0.408	16.530	0.093	15.177	0.395
Asymptotic length	100.619	1.955	139.565	5.677	104.772	1.203	102.426	1.898	104.071	1.138	104.061	2.149	104.797	1.194
Brody growth coefficient (K)	0.195	0.012	0.083	0.008	0.178	0.007	0.197	0.011	0.180	0.007	0.185	0.011	0.178	0.007
Richards growth coefficient	1.039	0.047	1.449	0.033	1.118	0.034	0.992	0.045	1.120	0.034	1.019	0.046	1.121	0.034
SD(length at age 1)	3.456	0.058	3.501	0.053	3.430	0.061	3.478	0.060	3.456	0.061	3.529	0.061	3.447	0.061
SD(length at age 20)	9.532	0.272	9.877	0.250	9.150	0.205	8.497	0.271	9.087	0.203	8.907	0.282	9.119	0.205
Mean ageing bias at age 1[b]	0.335	0.012	0.188	0.024	0.343	0.016	0.325	0.014	0.332	0.017	0.320	0.015	0.343	0.016
Mean ageing bias at age 20[b]	0.157	0.145	-0.520	0.095	0.754	0.221	-0.267	0.130	0.888	0.233	-0.256	0.132	0.743	0.222
Mean ageing bias at age 1 (post-2007)					0.011	0.026			0.024	0.026			0.012	0.026
Mean ageing bias at age 20 (post-2007)					-2.163	0.341			-2.223	0.362			-2.149	0.342
ln(mean post-1976 recruitment)	12.984	0.097	12.377	0.089	13.233	0.104	13.142	0.124	13.218	0.110	13.161	0.125	13.219	0.102
SD(log-scale recruitment)	0.656	0.067	0.618	_	0.592	_	0.687	_	0.563	_	0.685	_	0.586	_
ln(pre-1977 mean recruitment offset)	-1.158	0.201	-1.336	0.050	-1.187	0.190	-0.993	0.204	-1.130	0.182	-0.985	0.205	-1.179	0.188
Pre-1977 mean fishing mortality rate	0.190	0.075	1.827	0.657	0.261	0.094	0.142	0.047	0.226	0.076	0.147	0.050	0.259	0.092
ln(catchability) for EBS survey[c]	0.030	0.059	0.356	0.041	-0.054	0.069	0.101	0.059	0.007	0.072	-0.016	0.061	-0.058	0.068
ln(catchability) for NBS survey											-1.686	0.117	-1.564	0.352

Main results: objective function values

EBS/NBS hypothesis:	Combine	EBS only		Combine		Separate	
Model structure:	Base	Simple	Complex	Simple	Complex	Simple	Complex
Model	M16.6i	M19.1	M19.2	M19.3	M19.4	M19.5	M19.6
Objective function	1679.54	6582.42	2046.81	1743.68	2094.11	1796.06	2091.54
Equilibrium catch	0.00	0.11	0.01	0.00	0.01	0.00	0.01
Survey index	-26.54	4.63	-66.47	37.78	-85.07	140.42	-70.16
Size compostion	1427.42	4938.20	1566.20	1354.36	1602.93	1327.04	1599.77
Age composition	271.94	1619.83	426.08	347.41	436.92	324.75	427.56
Recruitment	-2.57	-5.32	-7.25	-1.18	-10.05	-1.29	-7.32
Initial regime	9.27	24.97	9.02	5.31	9.67	5.13	9.15
"Softbounds"	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Deviations	0.00	0.00	119.22	0.00	139.70	0.00	132.53

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Main results: fits to data

EBS/NBS hypothesis:	Combine	EBS only		Combine		Separate	
Model structure:	Base	Simple	Complex	Simple	Complex	Simple	Complex
Model	M16.6i	M19.1	M19.2	M19.3	M19.4	M19.5	M19.6
Main survey RMSE	0.18	0.21	0.11	0.17	0.06	0.20	0.11
NBS survey RMSE	n/a	n/a	n/a	n/a	n/a	1.85	0.18
Neff(fishery,size)	583	748	2012	533	2013	533	2007
Neff(main survey,size)	321	248	578	310	561	319	576
Neff(NBS survey, size)	n/a	n/a	n/a	n/a	n/a	667	81
Neff(fishery,age)	n/a	278	215	134	212	125	218
Neff(main survey,age)	61	43	107	61	100	65	106

Alternative measures of effective sample size

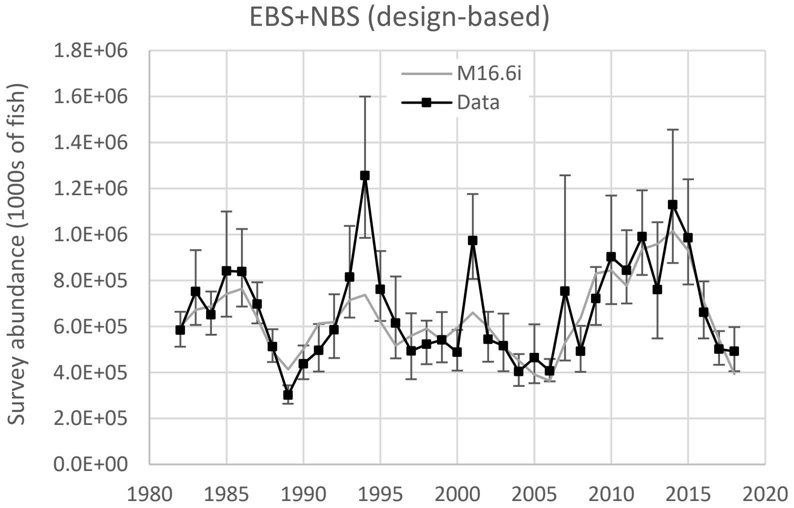
- The Dirichlet-multinomial distribution implies its own measure of effective sample size (Thorson et al. 2017), which can be compared to the traditional measure of effective sample size popularized by McAllister and Ianelli (1997)

	Average no. hauls			Thorson N			McAllister-Ianelli N		
Component	M19.2	M19.4	M19.6	M19.2	M19.4	M19.6	M19.2	M19.4	M19.6
Fishery sizecomps	5225	5225	5225	5225	5225	5225	2012	2013	2007
EBS survey sizecomps	346	352	346	346	352	346	578	561	576
NBS survey sizecomps	n/a	n/a	68	n/a	n/a	68	n/a	n/a	81
Fishery agecomps	9517	9517	9517	173	155	172	215	212	218
EBS survey agecomps	359	359	359	184	167	182	107	100	106
NBS survey agecomps	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

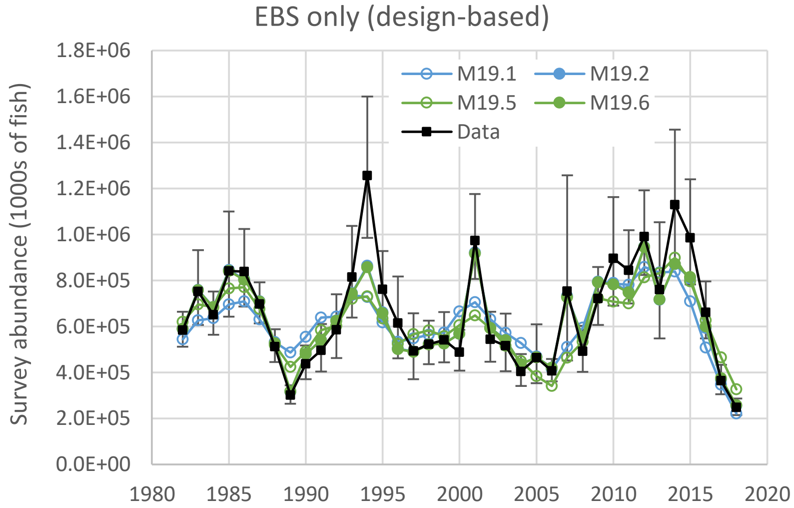
Key to figure colors and symbols

- Colors distinguish hypotheses:
  - Blue = Models 19.1 and 19.2 (hypothesis 1)
  - Orange = Models 19.3 and 19.4 (hypothesis 2)
  - Green = Models 19.5 and 19.6 (hypothesis 3)
  - Gray = Model 16.6i (base)
- Symbols distinguish levels of complexity:
  - Open circles = simple (Models 19.1, 19.3, and 19.5)
  - Solid circles = complex (Models 19.2, 19.4, and 19.6)
  - No circles = base (Model 16.6i)

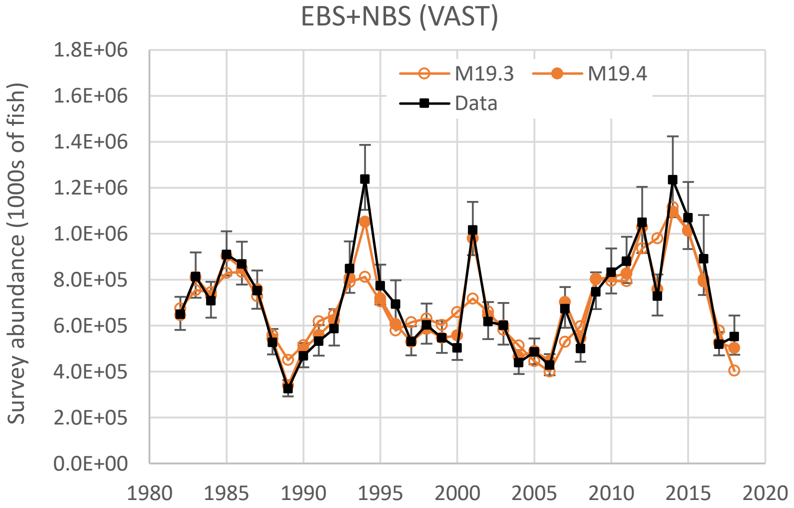
Fits to survey indices



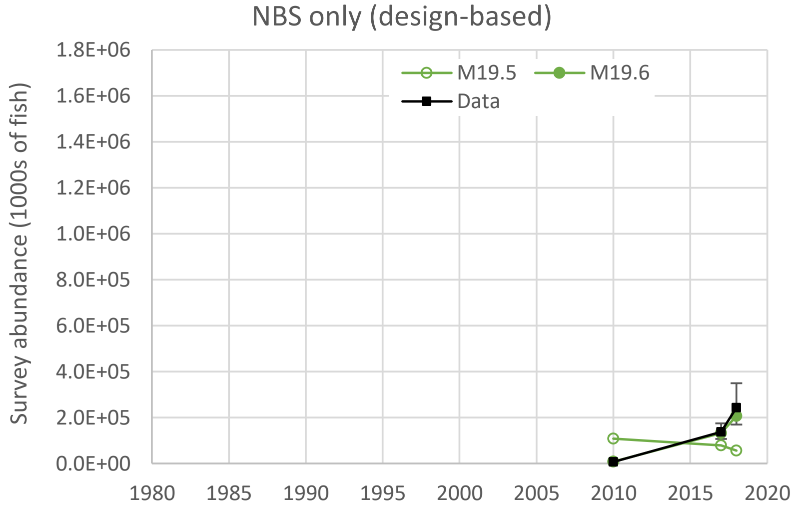
EBS+NBS (design-based)



EBS only (design-based)

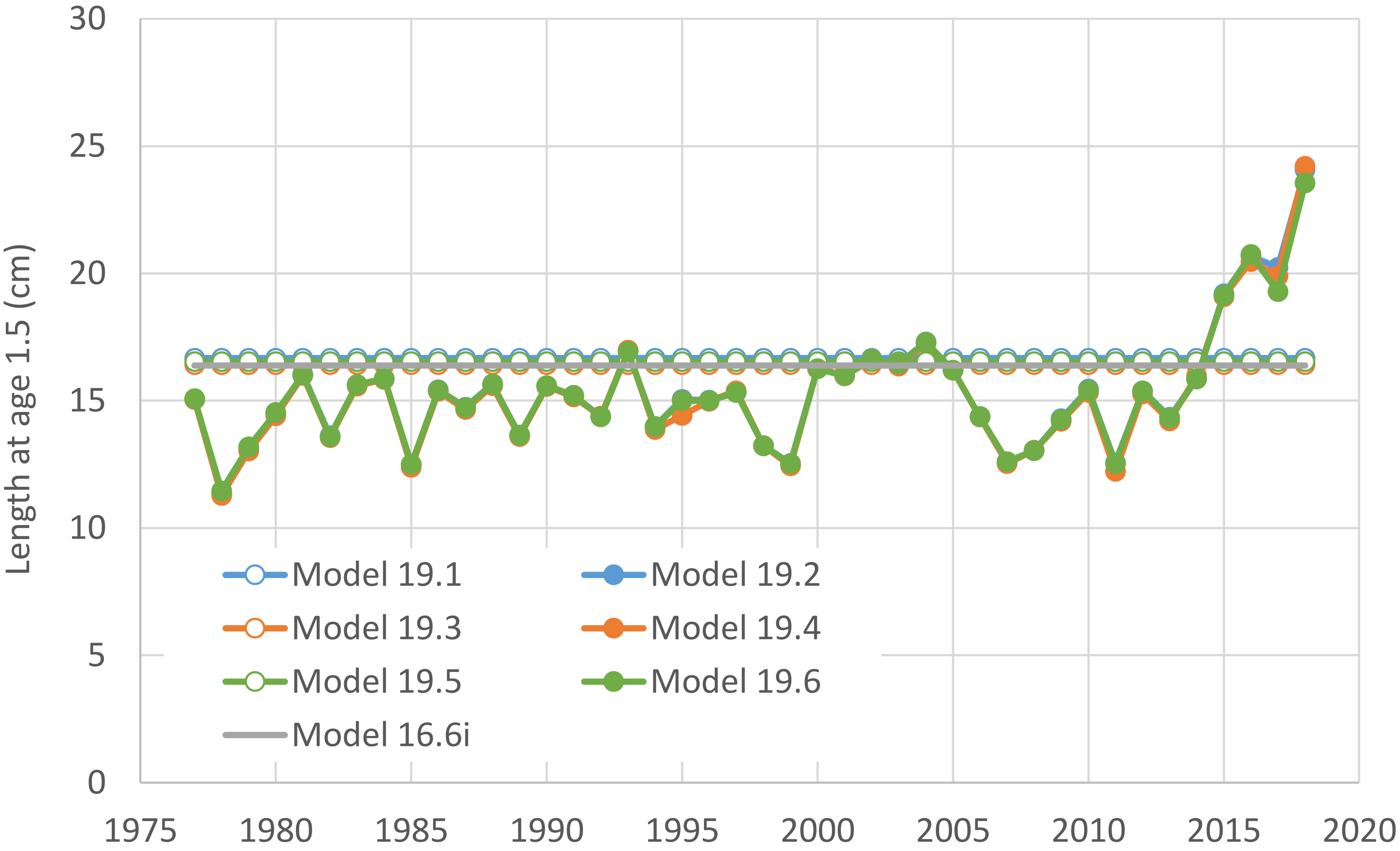


EBS+NBS (VAST)



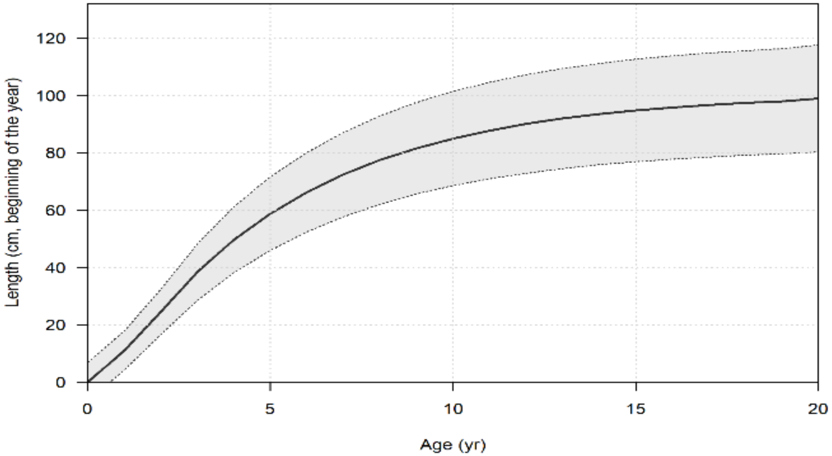
NBS only (design-based)

Length at age 1.5

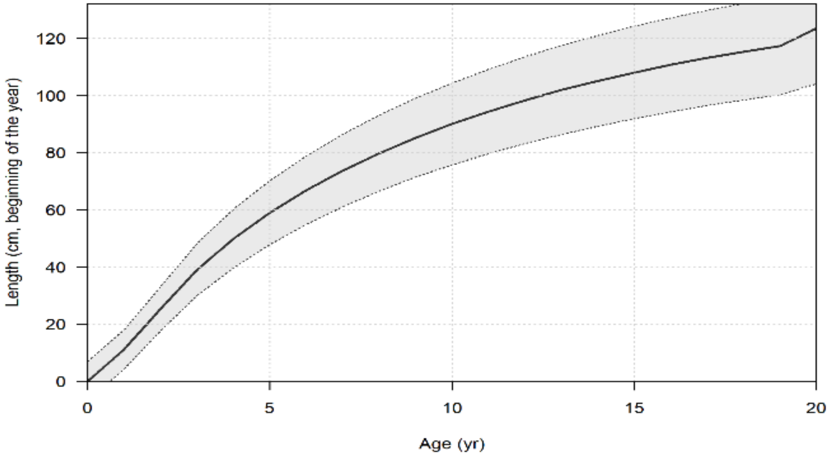


Length at age (Models 16.6i and 19.1-19.2)

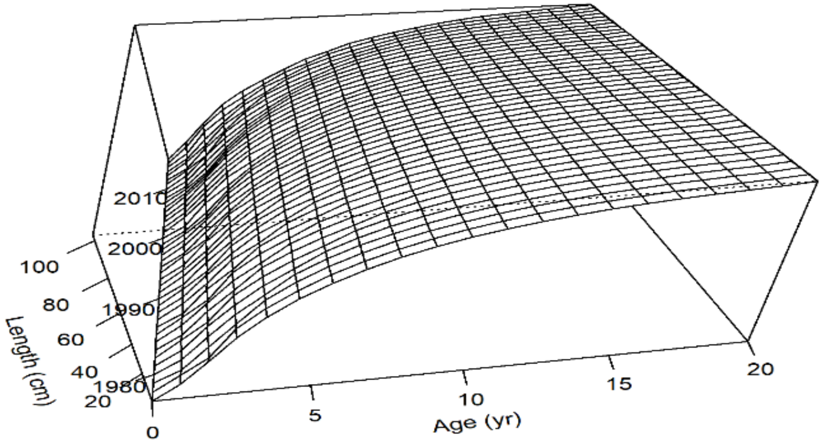
Model 16.6i



Model 19.1

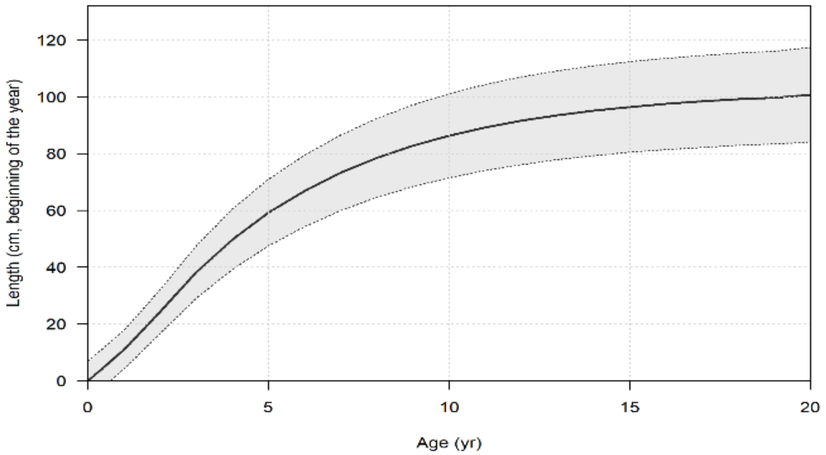


Model 19.2

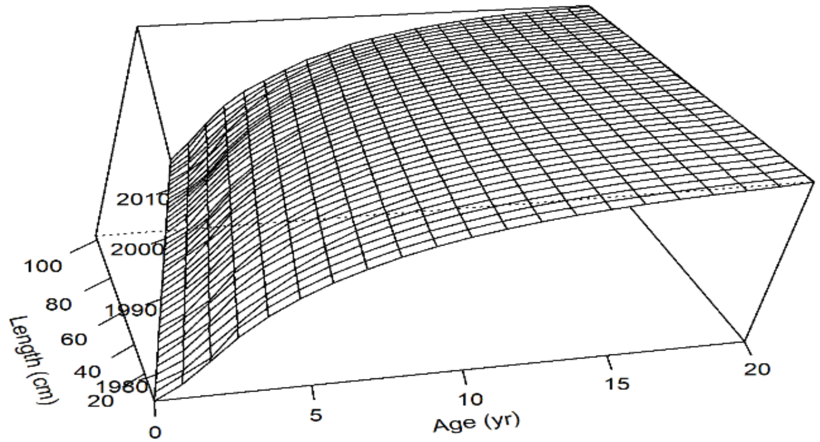


Length at age (Models 19.3-19.6)

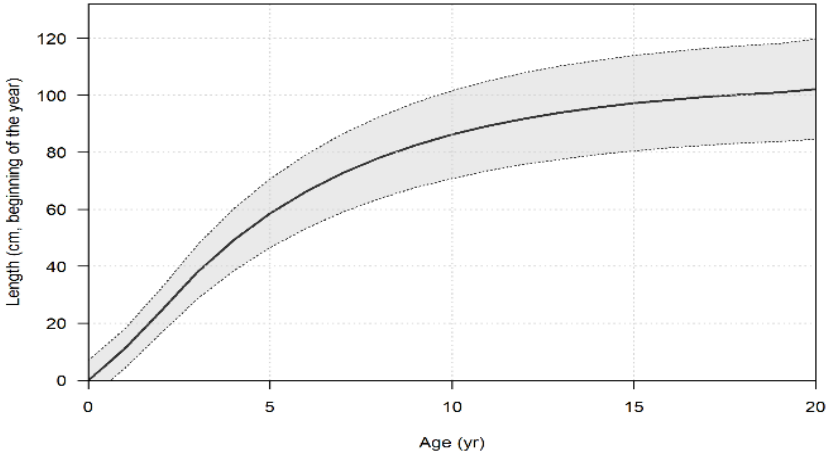
Model 19.3



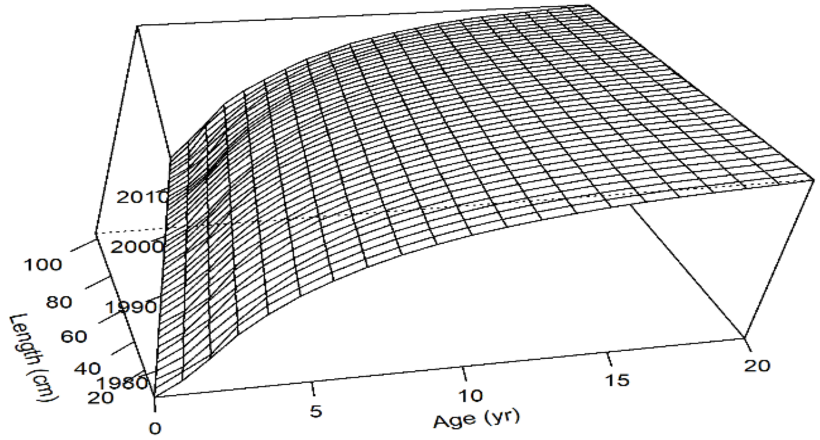
Model 19.4



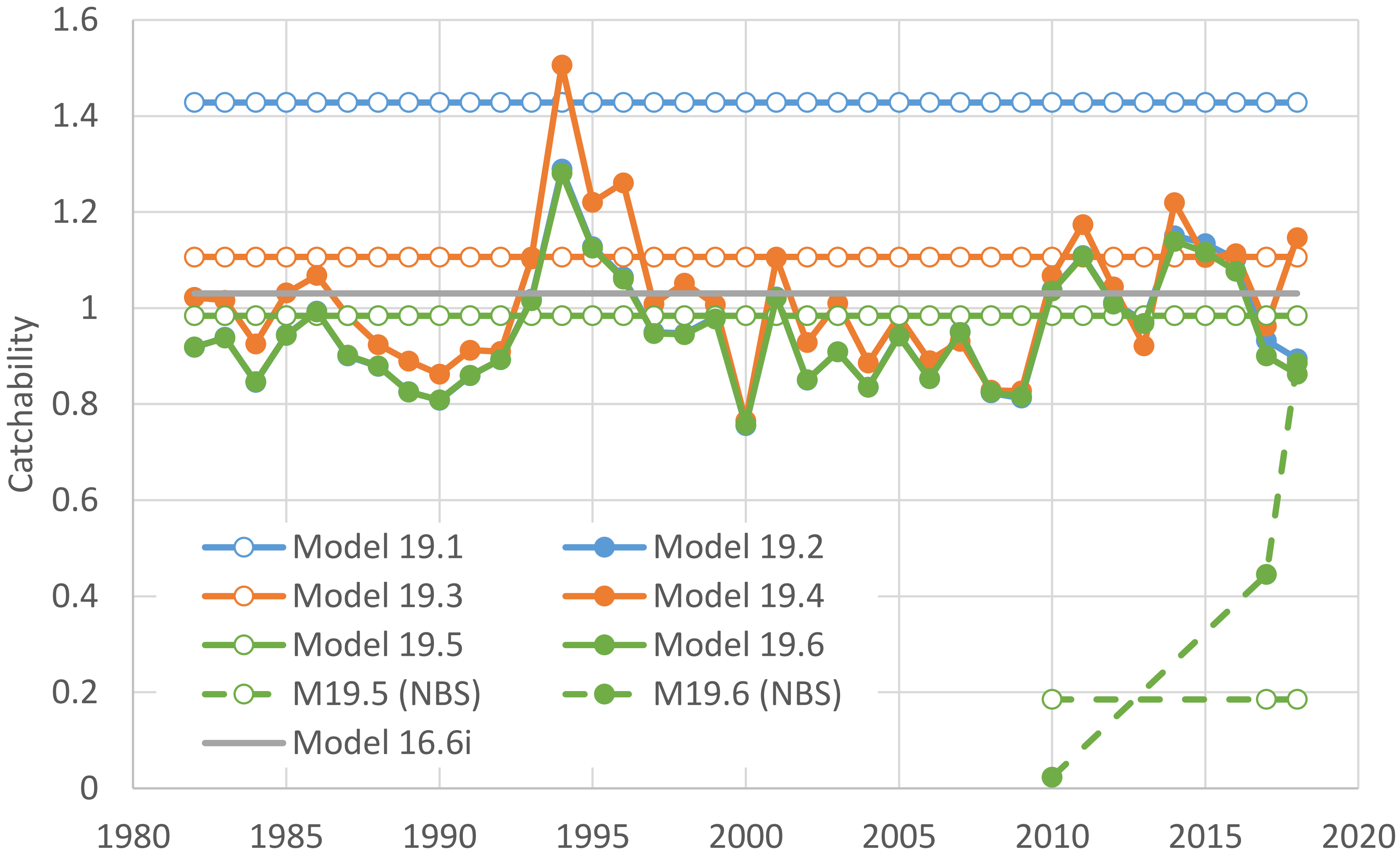
Model 19.5



Model 19.6

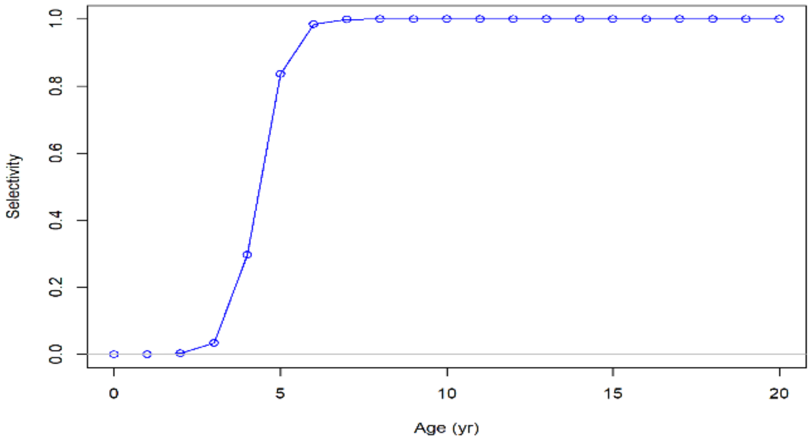


Catchability

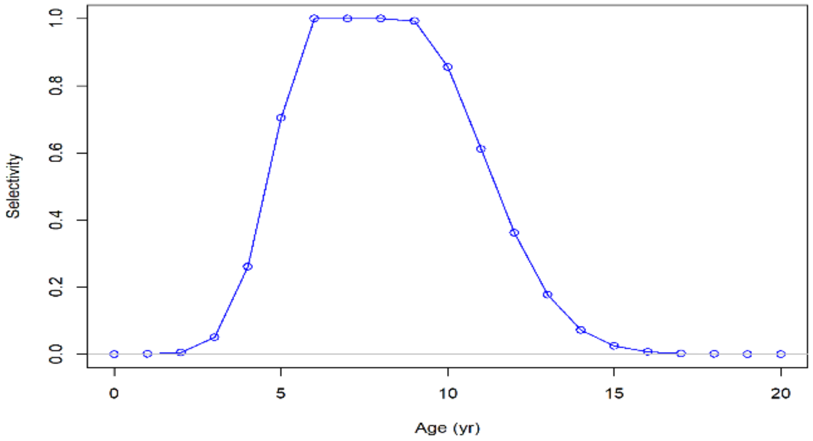


Fishery selectivity (Models 16.6i and 19.1-19.2)

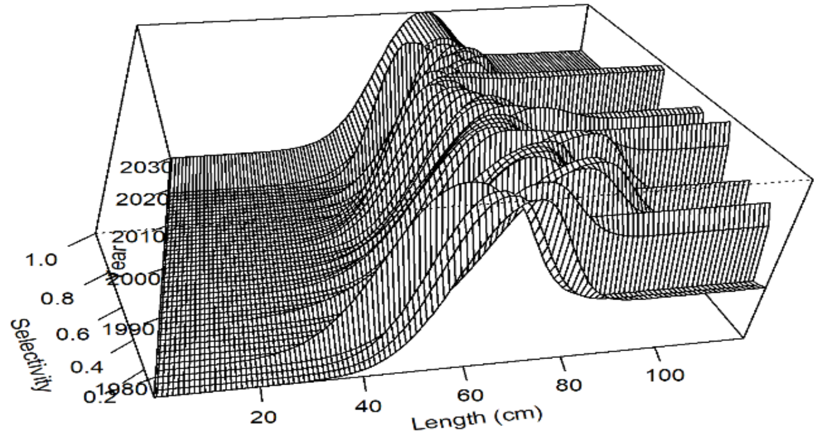
Model 16.6i



Model 19.1

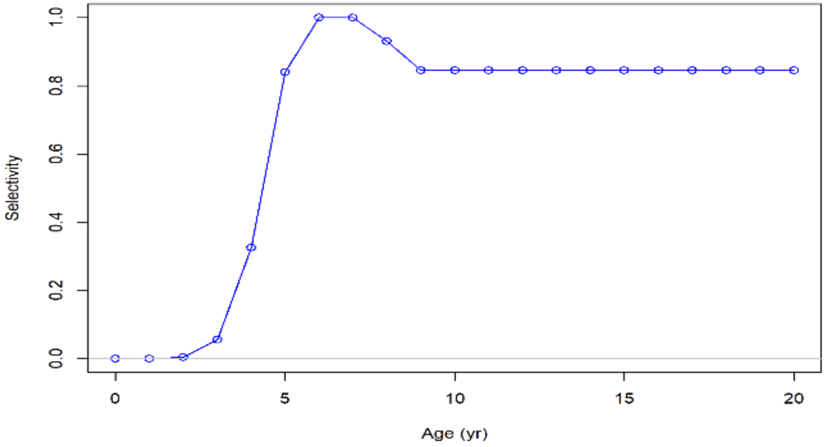


Model 19.2

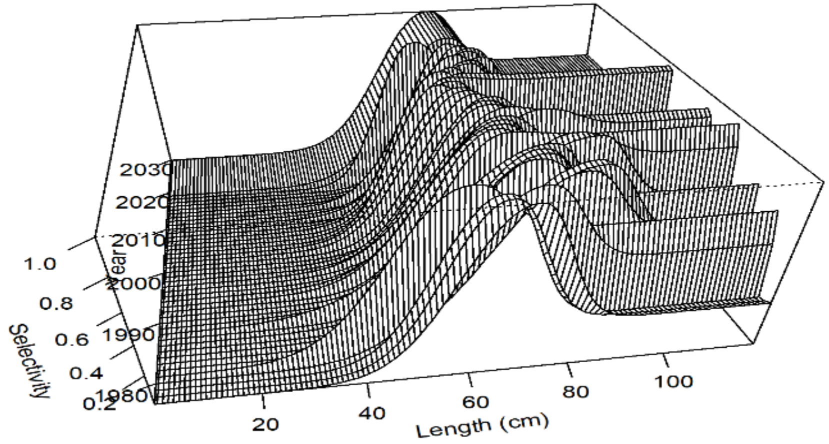


Fishery selectivity (Models 19.3-19.6)

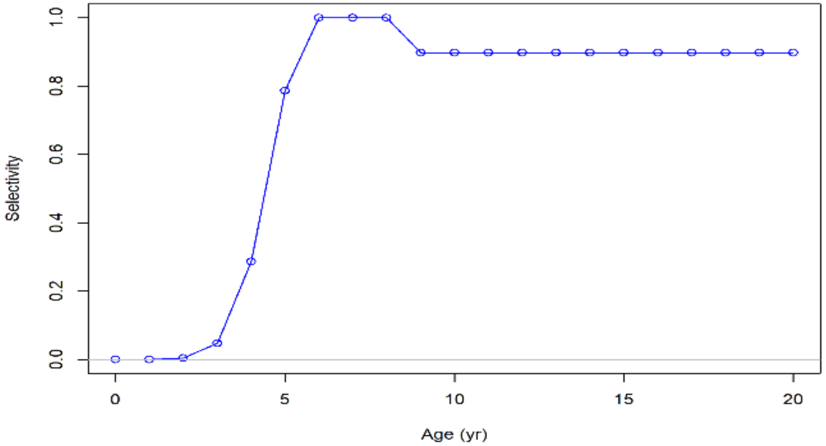
Model 19.3



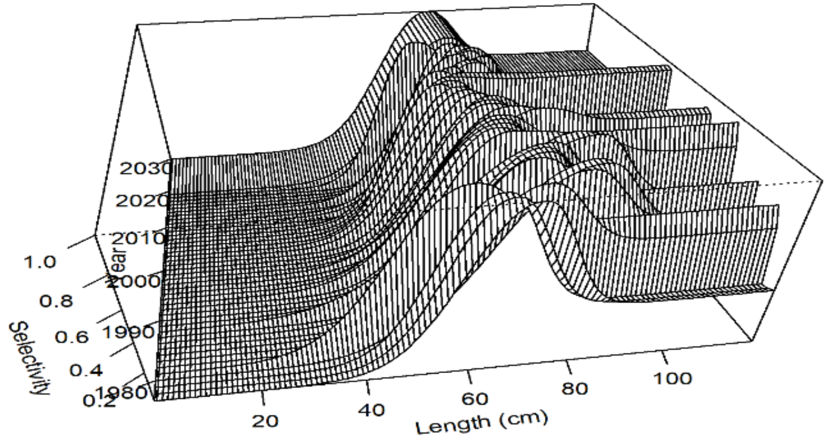
Model 19.4



Model 19.5

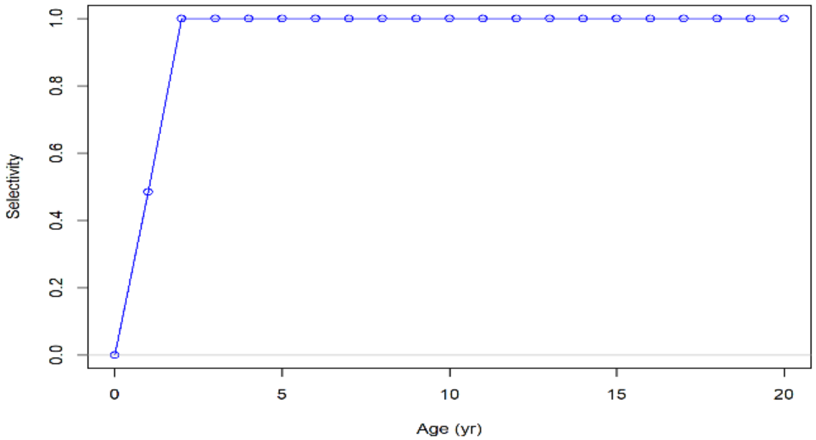


Model 19.6

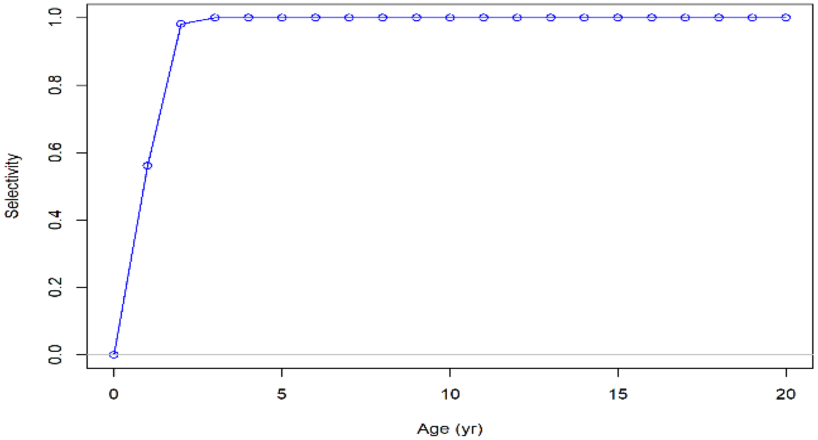


Survey selectivity (Models 16.6i and 19.1-19.2)

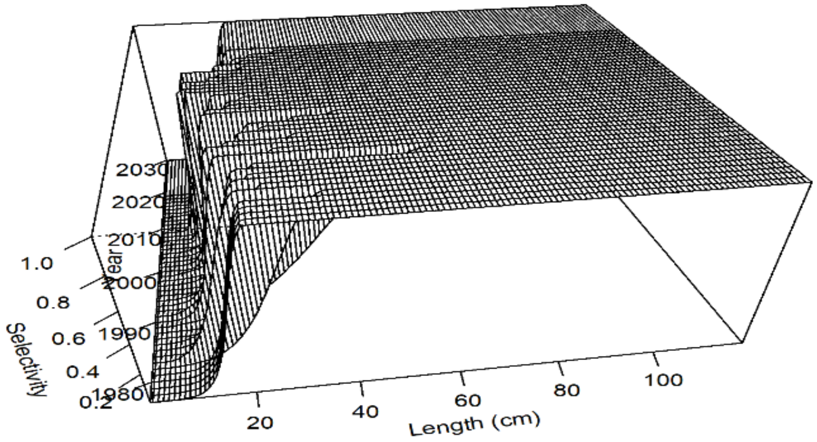
Model 16.6i



Model 19.1

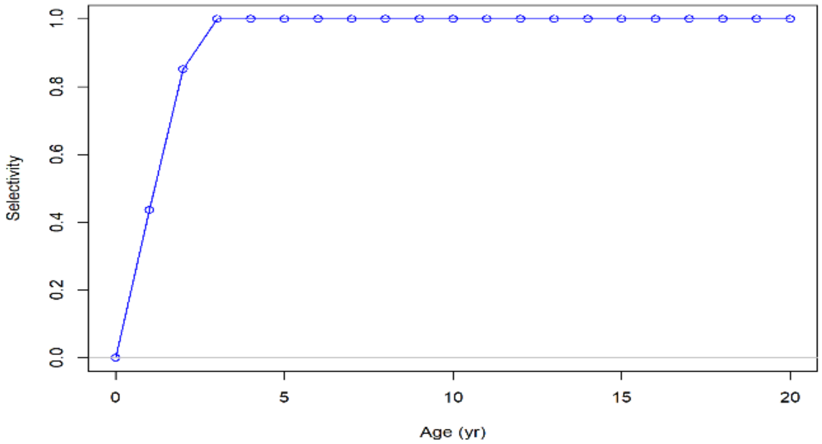


Model 19.2

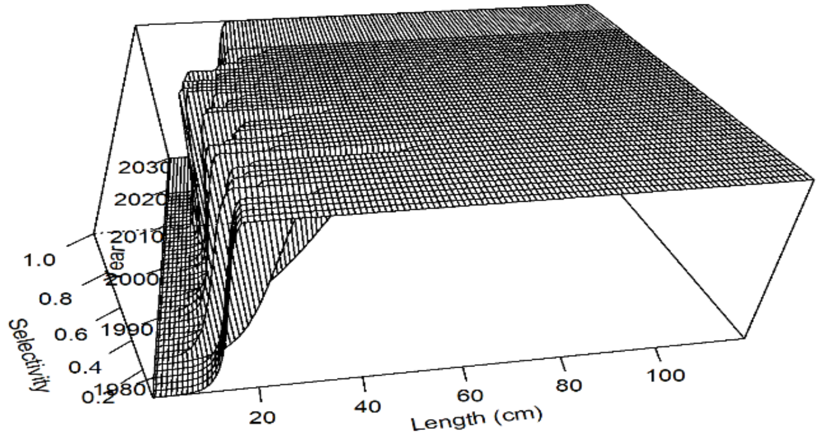


Survey selectivity (Models 19.3-19.6)

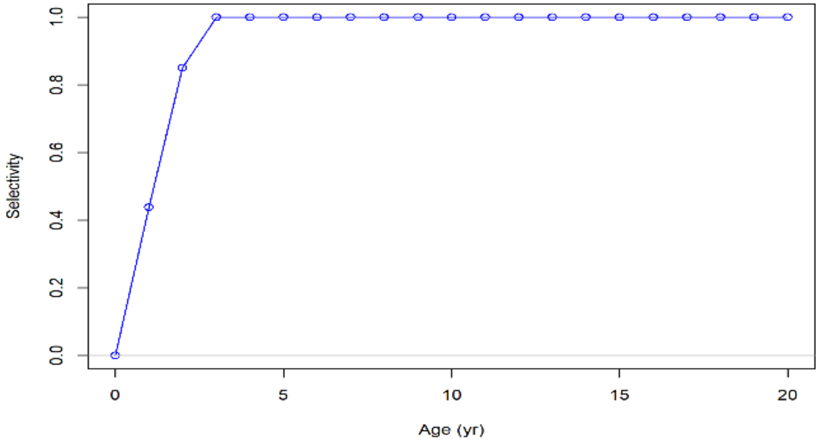
Model 19.3



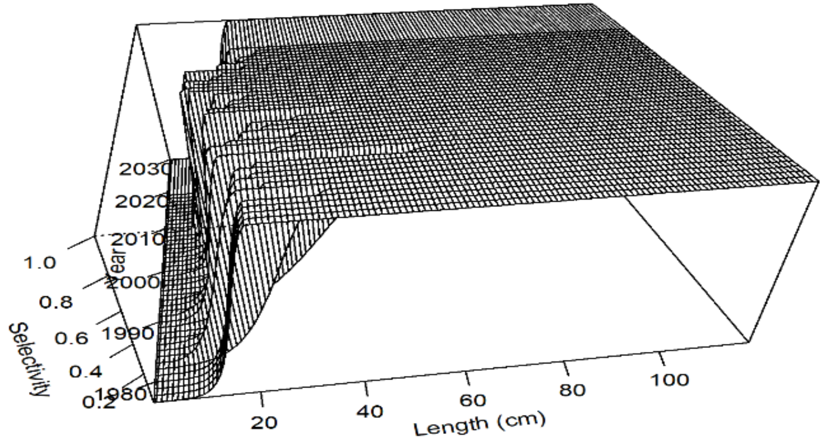
Model 19.4



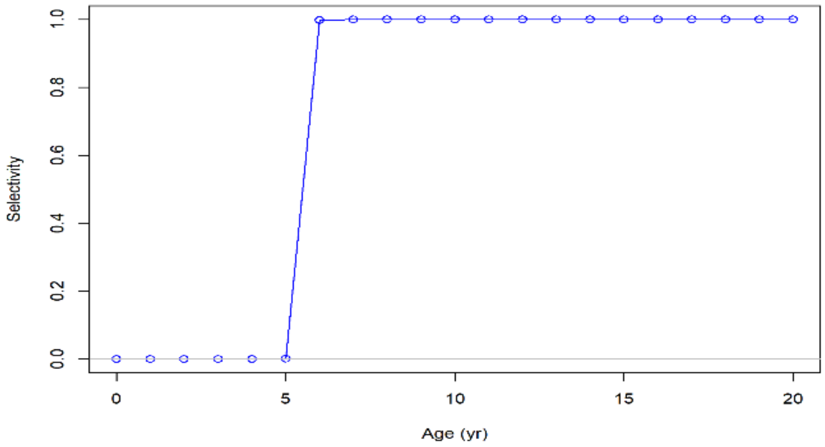
Model 19.5

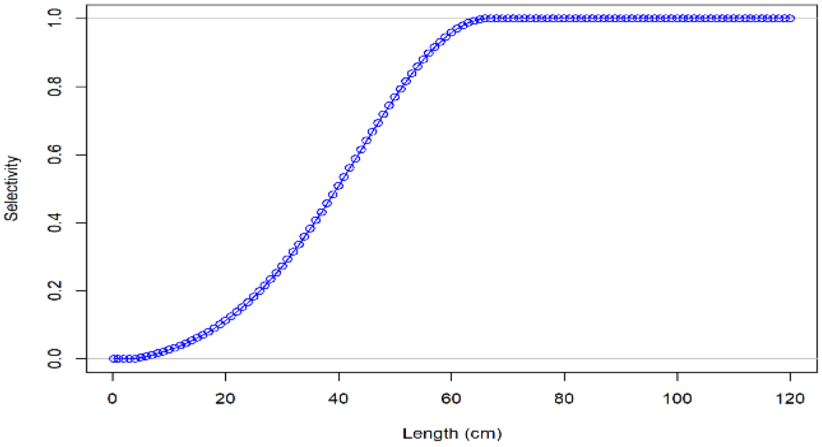


Model 19.6

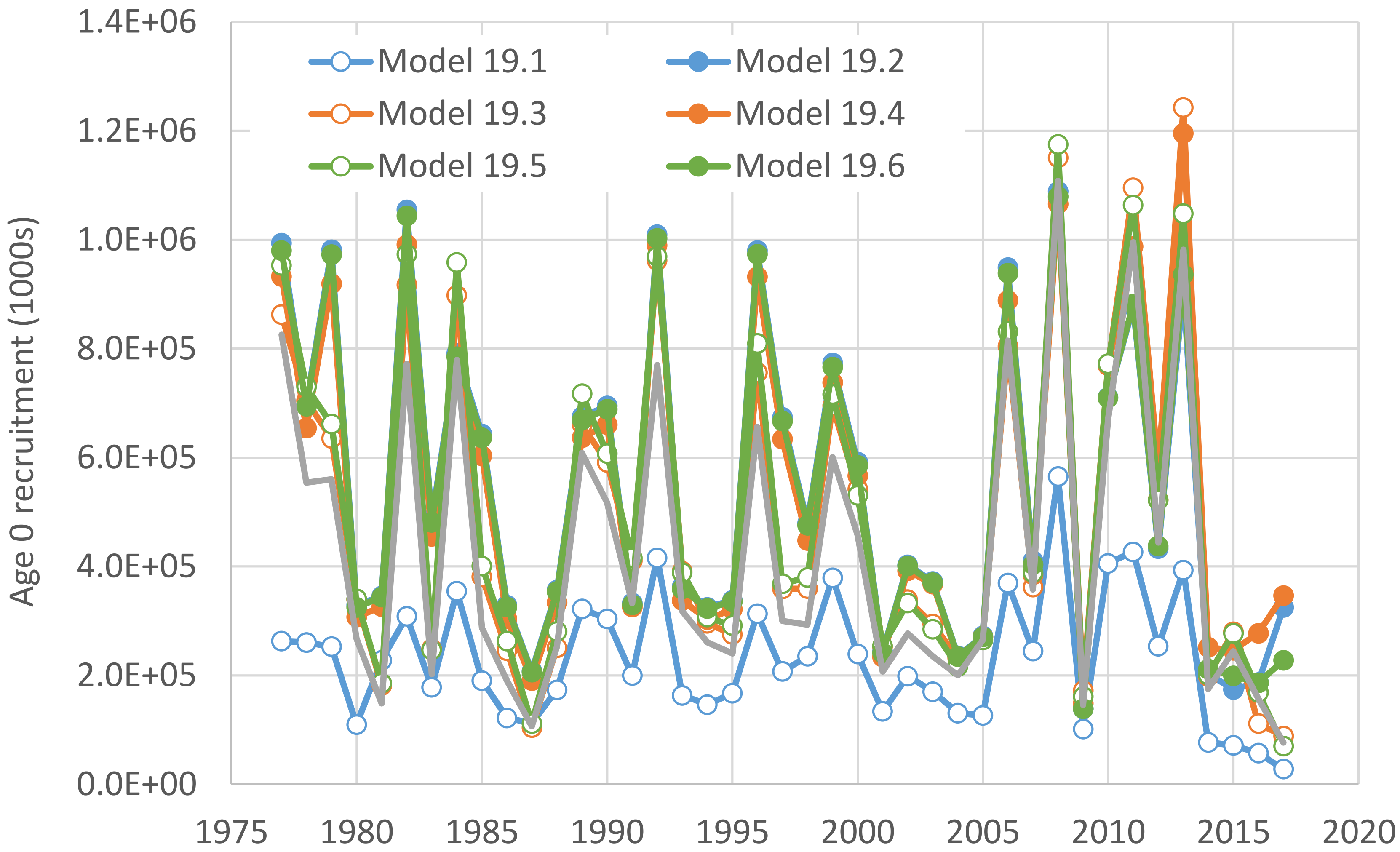


NBS survey selectivity (Models 19.5-19.6)

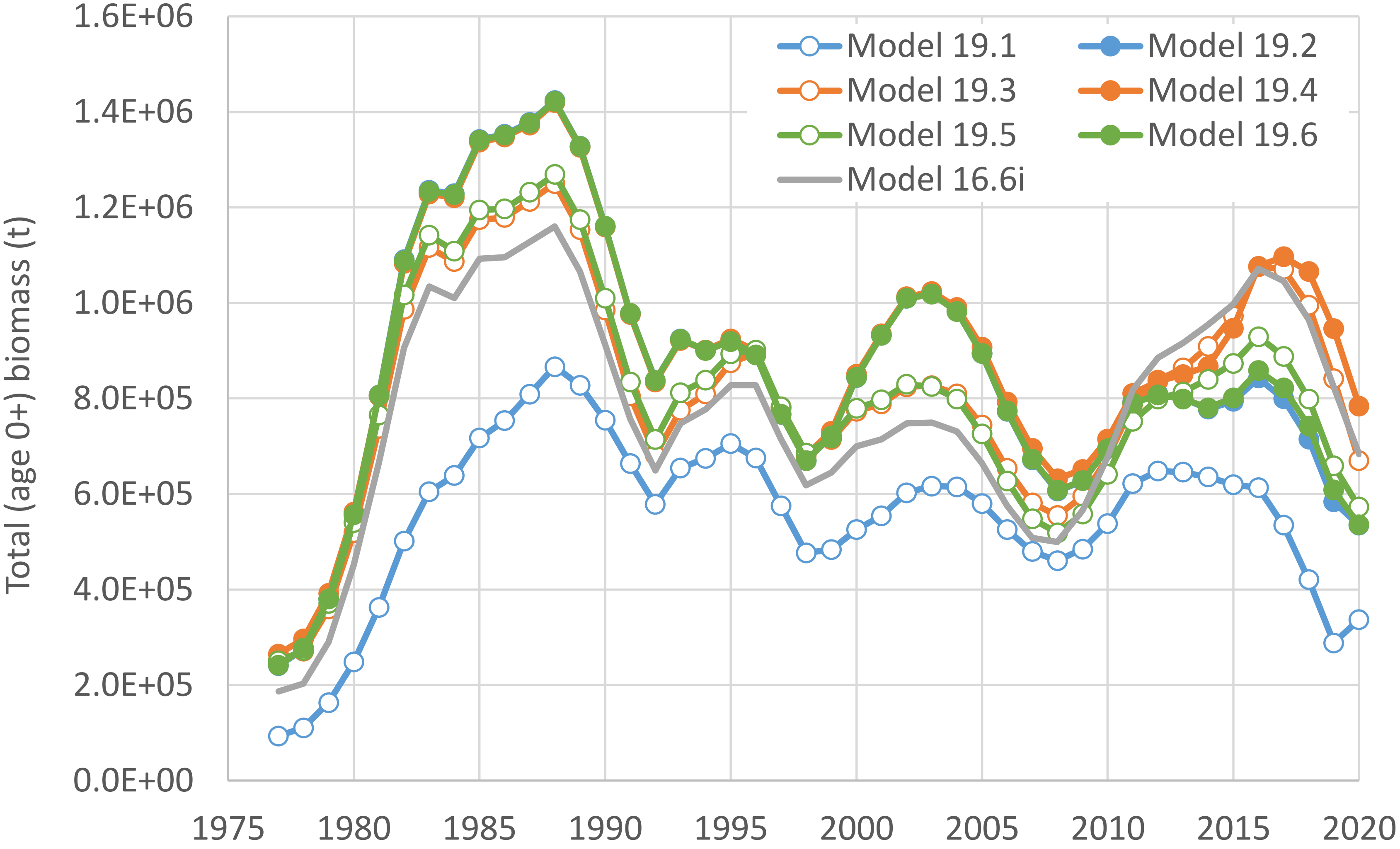

Model 19.5


Model 19.6

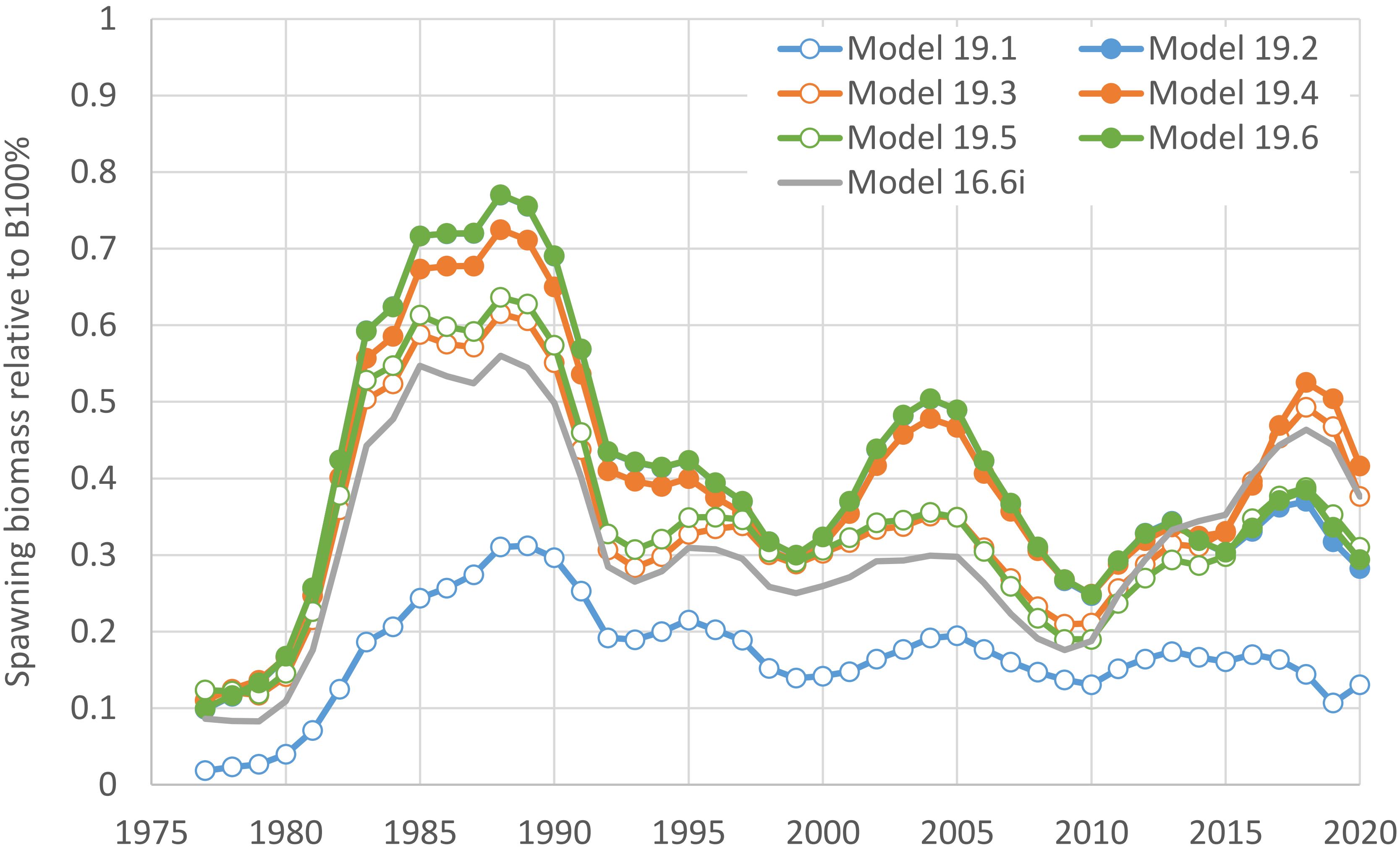
Recruitment



Total (age 0+) biomass, with projections



Relative spawning biomass, with projections



Discussion

Spatio-temporal summer fishery CPUE (1 of 4)

- Longline fishery CPUE (June, averaged over all years)

	-178	-177	-176	-175	-174	-173	-172	-171	-170	-169	-168	-167	-166	-165	-164	-163	-162	-161	All
-62.5																			
-62																			
-61.5																			
-61			437	455															446
-60.5			377	405															391
-60	354			333															344
-59.5	579	490	546		572	412	250												481
-59	967	630	488	698	675	423	402	539	473										555
-58.5		775	643	727	663	486	430	437	446										570
-58				198	979	356	387	427	403										485
-57.5					754	538	173	310	396		450								437
-57						738	561	363	340	343	440								468
-56.5						767	646	471		405									624
-56								653	499	310								557	460
-55.5											533								533
-55															824				824
-54.5														655					655
-54													308						308
-53.5												610							610
-53																			
All	620	632	528	552	731	551	455	419	431	337	460	610	308	655	824			557	510

Spatio-temporal summer fishery CPUE (2 of 4)

- Longline fishery CPUE (July, averaged over all years)

	-178	-177	-176	-175	-174	-173	-172	-171	-170	-169	-168	-167	-166	-165	-164	-163	-162	-161	All
-62.5																			
-62																			
-61.5																			
-61																			
-60.5			188	428															308
-60	949	331		270		426	357	488											537
-59.5	635	426	336	415	335	379	292	541	511										392
-59	700	704	501	519	380	338	322	484	345	669									475
-58.5		683	388	454	492	488	353	395	437	500	465								460
-58				1166	625	510	287	419	415	369	380		250						477
-57.5					408	407	416	357	396	258	250								386
-57						381	402	262	339		481	478							374
-56.5						318	236	376	252	359	384	334	223				310		328
-56								443	464	447	506	282	298	392		131	386	592	419
-55.5											444	255	330	356			309		378
-55												481	522	241	478				458
-54.5														329					329
-54													229	874					551
-53.5												415							415
-53																			
All	803	585	405	487	463	409	334	407	386	439	436	387	305	416	478	131	348	592	425

Spatio-temporal summer fishery CPUE (3 of 4)

- Longline fishery CPUE (August, averaged over all years)

	-178	-177	-176	-175	-174	-173	-172	-171	-170	-169	-168	-167	-166	-165	-164	-163	-162	-161	All
-62.5								386											386
-62									326										326
-61.5																			
-61			356																356
-60.5	225	294	349	310		729													360
-60	372	329	312	388	262	428		736											372
-59.5	322	418	330	313	290	329	341	524	432										345
-59	459	410	393	359	324	268	329	331	322										357
-58.5		417	382	366	501	472	316	279	401			368							404
-58				544	544	386	240	234	385	431		393	354						408
-57.5					446	435	352	252	461	446	364	474	322	427					400
-57						335	395	326	411	393	336	328	312			276	223		358
-56.5						189	375	362	292	348	417	384	365		358	422			367
-56								348	429	368	482	394	392	370	323	388			398
-55.5											401	239		372	385	440			388
-55												364	351	378	355	252			353
-54.5													393	576					531
-54																			
-53.5												443							443
-53																			
All	346	392	361	367	422	387	352	344	389	369	434	371	369	407	357	402	223		380

Spatio-temporal summer fishery CPUE (4 of 4)

- Results of regressions with fishery CPUE as the dependent variable:

	2017 model		2018 model		2017-2018 model	
Parameter	Est.	Est./SD	Est.	Est./SD	Est.	Est./SD
Intercept	-4.85E+05	8.03E+00	-4.34E+04	6.88E-01	-3.53E+05	8.74E+00
Day	2.39E+03	8.45E+00	3.01E+02	9.81E-01	1.75E+03	9.00E+00
Latitude	8.32E+03	7.98E+00	6.63E+02	6.17E-01	6.08E+03	8.83E+00
Longitude	-2.81E+03	7.94E+00	-2.46E+02	6.68E-01	-2.05E+03	8.65E+00
Day x latitude	-4.10E+01	8.38E+00	-4.71E+00	9.01E-01	-3.00E+01	9.05E+00
Day x longitude	1.39E+01	8.38E+00	1.74E+00	9.69E-01	1.02E+01	8.93E+00
Latitude x longitude	4.81E+01	7.90E+00	3.71E+00	5.91E-01	3.52E+01	8.73E+00
Day x latitude x longitude	-2.38E-01	8.32E+00	-2.72E-02	8.89E-01	-1.74E-01	8.98E+00

- None of the models fit the data very well (R^2 for the 2017, 2018, and 2017-2018 models was 0.20, 0.05, and 0.10, respectively).
- Coefficients of the 2018 model were estimated very imprecisely, although the coefficients of the other two models were fairly well estimated.
- Regardless, the estimated coefficient for day × latitude was negative in all three models, suggesting that Pacific cod overall are not migrating northward during the summer months.

Retrospective estimates of NBS ln(Q)

- Gray rows indicate years with NBS surveys
- No NBS data after 8th peel

		Model 19.5			Model 19.6		
Peel	Last_yr	Est.	SD	Bias	Est.	SD	Bias
0	2018	-1.686	1.17E-01	n/a	-1.564	3.52E-01	n/a
1	2017	-2.184	1.63E-01	0.146	-2.359	4.46E-01	0.083
2	2016	-4.527	3.92E-01	0.206	-2.258	9.47E-01	0.236
3	2015	-4.604	3.83E-01	0.428	-2.359	9.41E-01	0.345
4	2014	-4.661	3.82E-01	0.537	-2.448	9.43E-01	0.448
5	2013	-4.793	4.54E-01	0.695	-2.547	9.48E-01	0.553
6	2012	-4.948	5.79E-01	0.875	-2.777	9.45E-01	0.775
7	2011	-5.028	5.70E-01	0.823	-2.937	9.25E-01	0.961
8	2010	-5.143	5.58E-01	0.833	-3.089	9.40E-01	1.231
9	2009	-1.684	1.25E+04	0.596	-1.478	1.21E+04	1.811
10	2008	-1.684	1.25E+04	0.436	-1.484	1.21E+04	0.916

Internal estimation of compositional sample size

- Thorson et al. (2017) list the following as reasons to prefer the Dirichlet-multinomial approach:
  - The approach is faster than alternatives based on iteration, as the weighting is done internally by estimation of a single additional parameter.
  - Because the single additional parameter is estimated, uncertainty in that estimate is propagated appropriately, unlike iterative approaches that result in a fixed constant.
  - The same standard for convergence that is used for all other parameters applies to the weighting, unlike iterative approaches.
  - The resulting estimates of effective sample size can never exceed the input sample size, which is a desirable property so long as the input sample size is appropriate.

AFSC internal review comments

- “It would be informative to include a detailed description of the model(s) that were considered, model diagnostics, and AIC statistics if multiple models were explored ... in the November report....”
- “On page 7 you mention that all models include VAST estimates of age composition. Is this true for models 19.1 and 19.2 (the EBS-only models)? ... If the age composition data for models 19.1 and 19.2 include the combined VAST age composition estimates a statement justifying this inclusion is needed.”
- “I was surprised to see that the Mohn's rho statistic was higher ... for the complex models. ... I am wondering if time-varying survey selectivity is having a major impact on the retrospective pattern. ... Would time blocks be more appropriate? ... If there are patterns in the residuals this may indicate some aspect of the growth relationship is misspecified....”
- “Have you used CAAL data in your previous models to evaluate if the growth parameters are less sensitive to model assumptions?”