Assessment of Pacific cod in the eastern Bering Sea

NOAA FISHERIES
Alaska Fisheries Science Center

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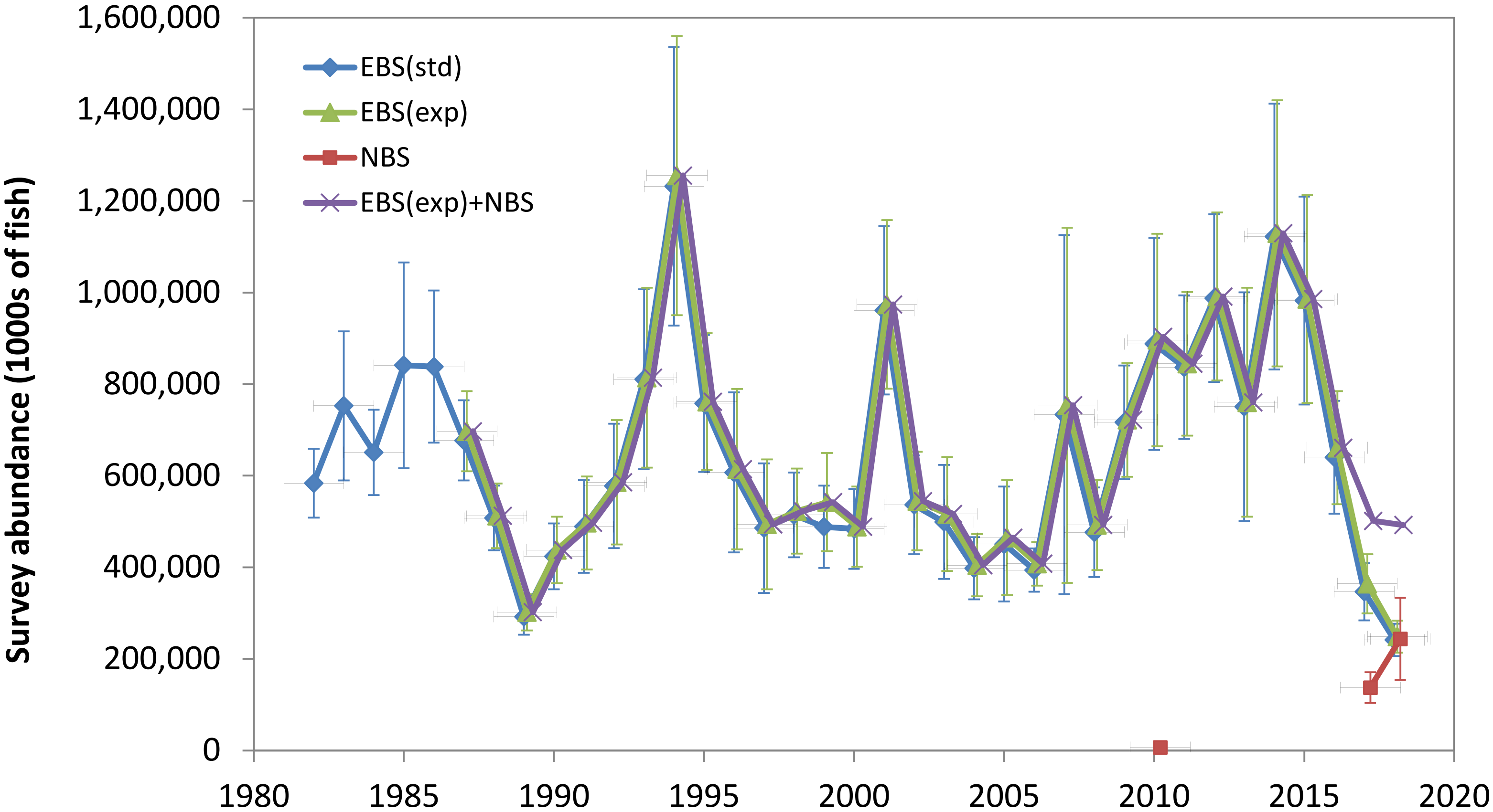
Data highlights

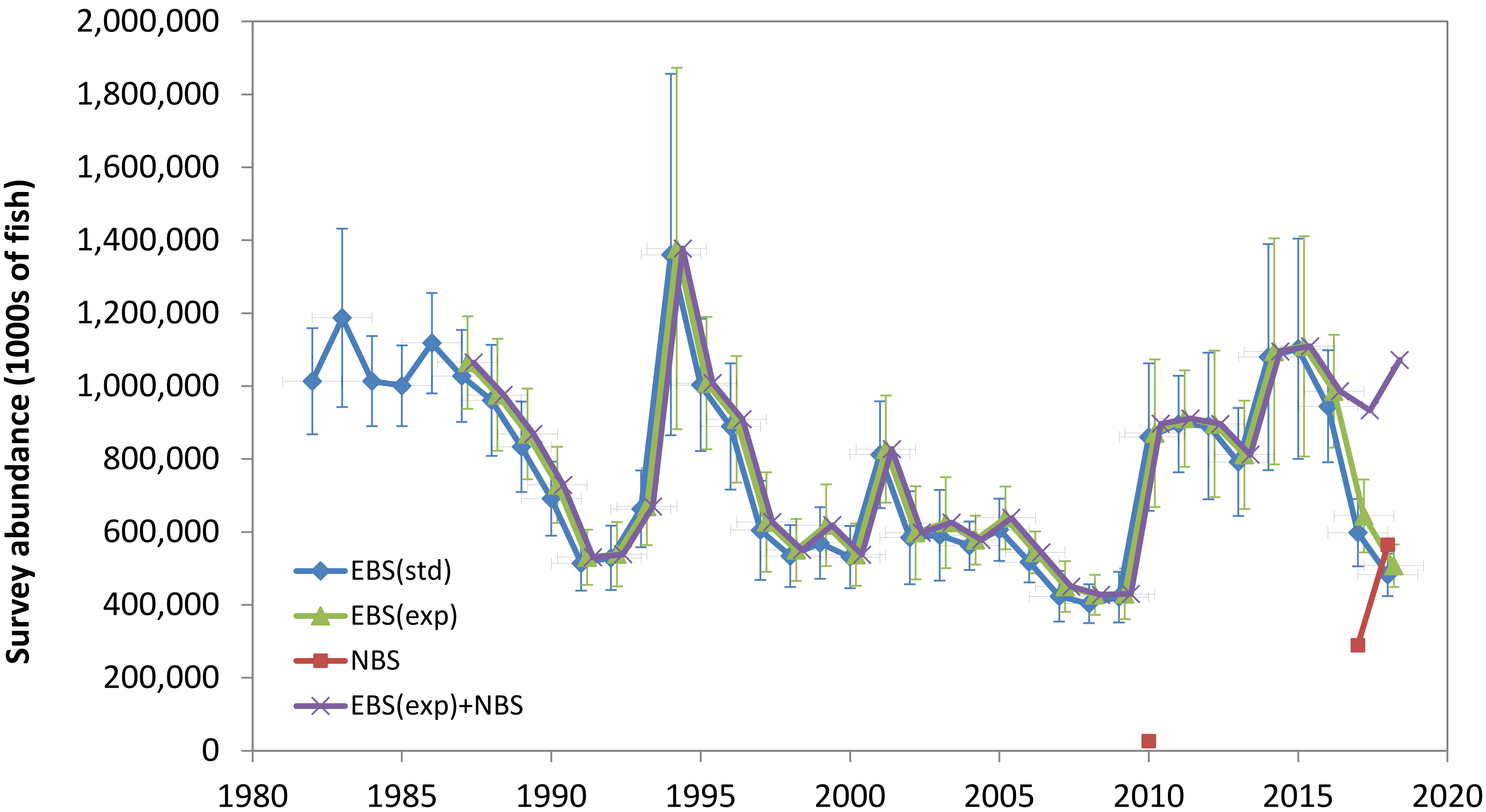
EBS, NBS shelf survey abundance (no. of fish)

- EBS has dropped 78% since 2014; 2018 EBS is all-time low



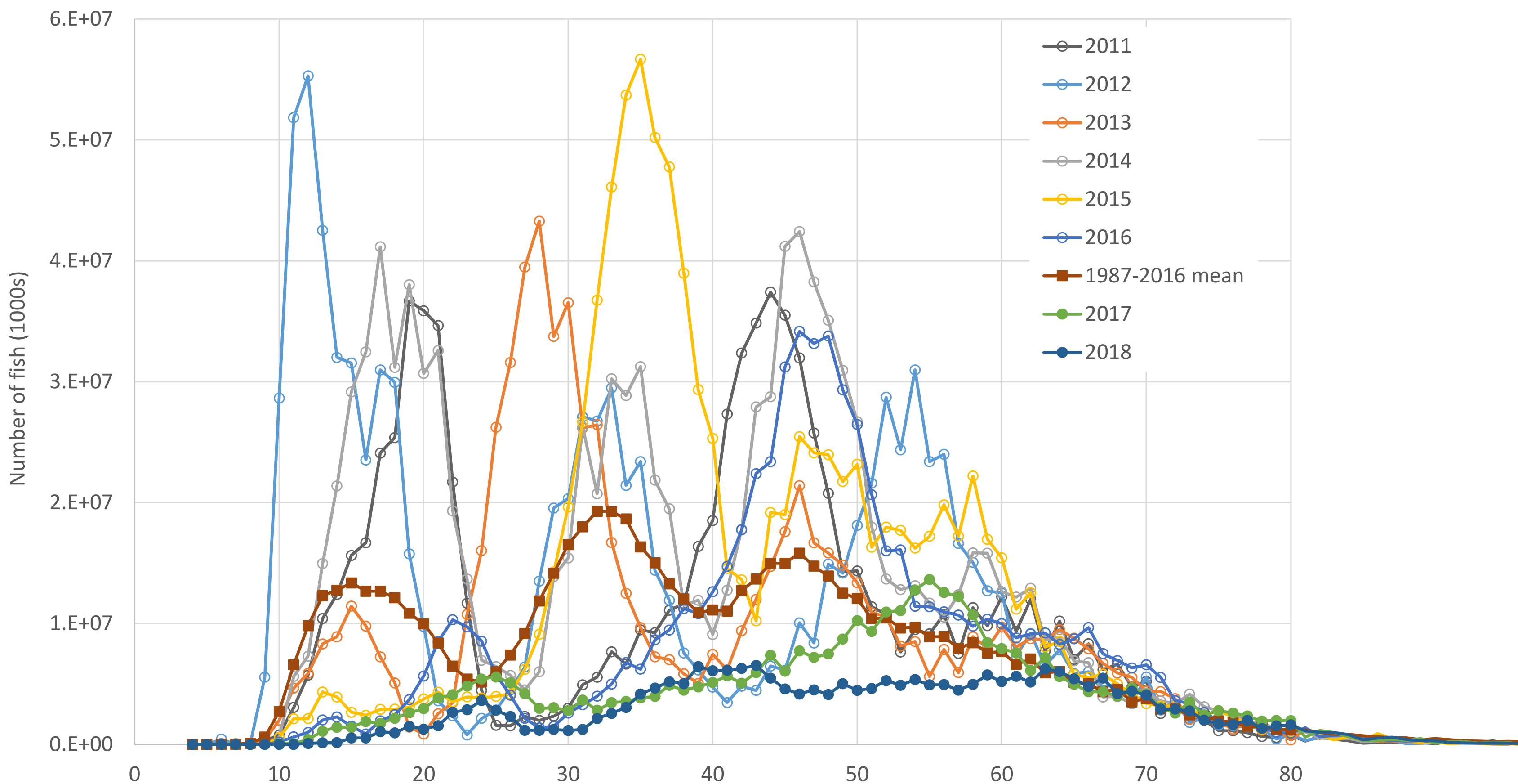
EBS, NBS shelf survey biomass

- EBS has dropped 54% since 2014



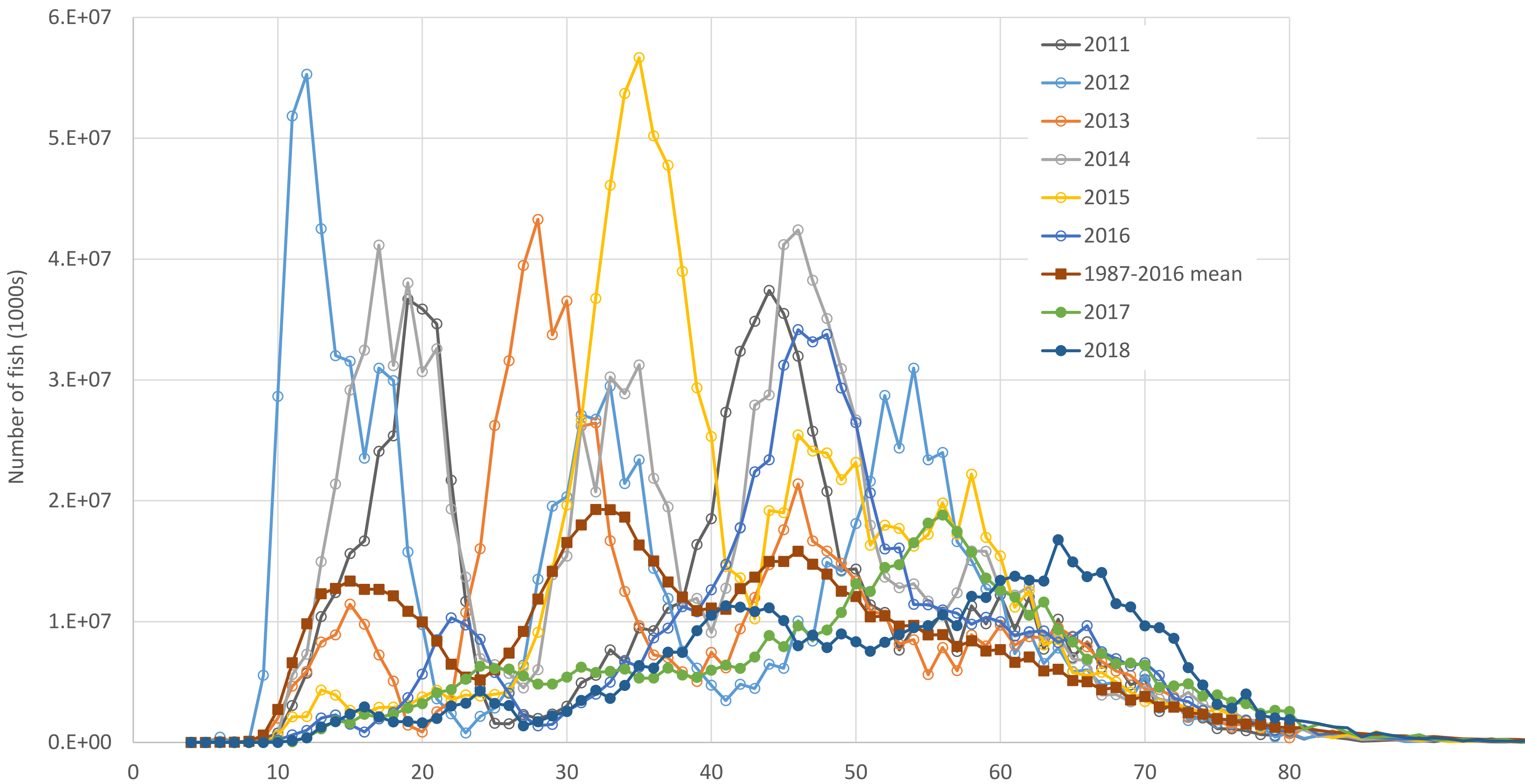
EBS shelf survey size composition

- 2017 below mean until 52 cm; 2018 below mean until 63 cm



EBS+NBS shelf survey size composition

- 2017 below mean until 50 cm; 2018 below mean until 54 cm



Model structures

List of models

- Following evaluation of the results, these model numbers were assigned:
  - Model 16.6 (previously numbered, requested by Team and SSC)
  - Model 16.6i (requested by SSC only)
  - Model 16.6j (requested by Team and SSC)
  - Model 16.6k (requested by Team and SSC)
  - Model 17.2 (previously numbered, requested by Team and SSC)
  - Model 18.6 (requested by Team and SSC)
  - Model 18.7 (added by author)
  - Model 18.8 (added by author)

Model features

- First rows list data sets that are included in the models
- Middle rows describe various ways in which *Q* is treated in the models
- Last rows describe miscellaneous features in three of the models

Feaure	16.6	16.6i	16.6j	16.6k	17.2	18.6	18.7	18.8
EBS survey strata 82 and 90		x	x	x		x	x	x
NBS survey as separate data set				x		x	x	x
Summed EBS and NBS data sets		x	x					
Fishery agecomps					x	x		x
EBS catchability estimated	x			x	x	x		
Annnually varying EBS catchability				x		x	x	x
NBS catchability estimated				x		x		
Annnually varying NBS catchability				x		x	x	x
EBS+NBS catchability estimated		x	x					
Annually varying EBS+NBS catchability			x					
Prior distribution for natural mortality					x	x		x
Flat-topped double normal selectivity					x	x		x
Annually varying fishery selectivity					x	x		x
Composition N = number of hauls					x	x		x
Harmonic mean composition weights					x	x		x

Results

Effective *N*: Models 16.6 and 16.6x (Table 2.14)

		Model 16.6						Model 16.6i					
Type	Fleet	Years	N	Mult.	Harm.	ΣNeff1	ΣNeff2	Years	N	Mult.	Harm.	ΣNeff1	ΣNeff2
Size	Fishery	42	300	1.0000	559	12599	23459	42	300	1.0000	583	12600	24502
Size	EBS(std) survey	37	300	1.0000	312	11098	11527	n/a	n/a	n/a	n/a	n/a	n/a
Size	EBS(exp) survey	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 survey	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	EBS(exp)+NBS	n/a	n/a	n/a	n/a	n/a	n/a	37	300	1.0000	321	11101	11886
Age	Fishery	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	EBS(std) survey	24	300	1.0000	62	7203	1495	n/a	n/a	n/a	n/a	n/a	n/a
Age	EBS(exp) survey	n/a	n/a	n/a	n/a	n/a	n/a	24	300	1.0000	61	7200	1456
				SEave	RMSE					SEave	RMSE		
Index	EBS(std) survey	37	353	0.1065	0.1917	13061	4028	n/a	n/a	n/a	n/a	n/a	n/a
Index	EBS(exp) survey	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 survey	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	EBS(exp)+NBS	n/a	n/a	n/a	n/a	n/a	n/a	37	378	0.1056	0.1819	13986	4717
					Sum:	43961	40509				Sum:	44887	42561

		Model 16.6j						Model 16.6k					
Type	Fleet	Years	N	Mult.	Harm.	ΣNeff1	ΣNeff2	Years	N	Mult.	Harm.	ΣNeff1	ΣNeff2
Size	Fishery	42	300	1.0000	581	12600	24404	42	300	1.0000	582	12600	24427
Size	EBS(std) survey	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	EBS(exp) survey	n/a	n/a	n/a	n/a	n/a	n/a	37	300	1.0000	317	11101	11724
Size	NBS survey	n/a	n/a	n/a	n/a	n/a	n/a	3	300	1.0000	82	900	246
Size	EBS(exp)+NBS	37	300	1.0000	321	11101	11869	n/a	n/a	n/a	n/a	n/a	n/a
Age	Fishery	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	EBS(std) survey	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	EBS(exp) survey	24	300	1.0000	61	7200	1468	24	300	1.0000	60	7200	1429
				SEave	RMSE					SEave	RMSE		
Index	EBS(std) survey	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	EBS(exp) survey	n/a	n/a	n/a	n/a	n/a	n/a	37	371	0.1054	0.1053	13727	13734
Index	NBS survey	n/a	n/a	n/a	n/a	n/a	n/a	3	89	0.1623	0.1624	267	267
Index	EBS(exp)+NBS	37	378	0.1056	0.1056	13986	13989	n/a	n/a	n/a	n/a	n/a	n/a
					Sum:	44887	51730				Sum:	45795	51828

Effective *N*: Models 17.2 and 18.x (Table 2.14)

		Model 17.2						Model 18.6					
Type	Fleet	Years	N	Mult.	Harm.	ΣNeff1	ΣNeff2	Years	N	Mult.	Harm.	ΣNeff1	ΣNeff2
Size	Fishery	34	5225	0.2517	1315	44713	44724	34	5225	0.2549	1332	45283	45278
Size	EBS(std) survey	37	332	0.8871	295	10904	10904	n/a	n/a	n/a	n/a	n/a	n/a
Size	EBS(exp) survey	n/a	n/a	n/a	n/a	n/a	n/a	37	346	0.8701	301	11139	11144
Size	NBS survey	n/a	n/a	n/a	n/a	n/a	n/a	3	68	1.3015	89	266	266
Size	EBS(exp)+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	Fishery	8	9516	0.0273	260	2078	2082	8	9516	0.0292	279	2223	2230
Age	EBS(std) survey	24	342	0.1402	48	1151	1151	n/a	n/a	n/a	n/a	n/a	n/a
Age	EBS(exp) survey	n/a	n/a	n/a	n/a	n/a	n/a	24	359	0.1281	46	1104	1104
				SEave	RMSE					SEave	RMSE		
Index	EBS(std) survey	37	353	0.1065	0.2065	13061	3474	n/a	n/a	n/a	n/a	n/a	n/a
Index	EBS(exp) survey	n/a	n/a	n/a	n/a	n/a	n/a	37	371	0.1054	0.1054	13727	13719
Index	NBS survey	n/a	n/a	n/a	n/a	n/a	n/a	3	89	0.1623	0.1624	267	267
Index	EBS(exp)+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:	71907	62336				Sum:	74008	74007

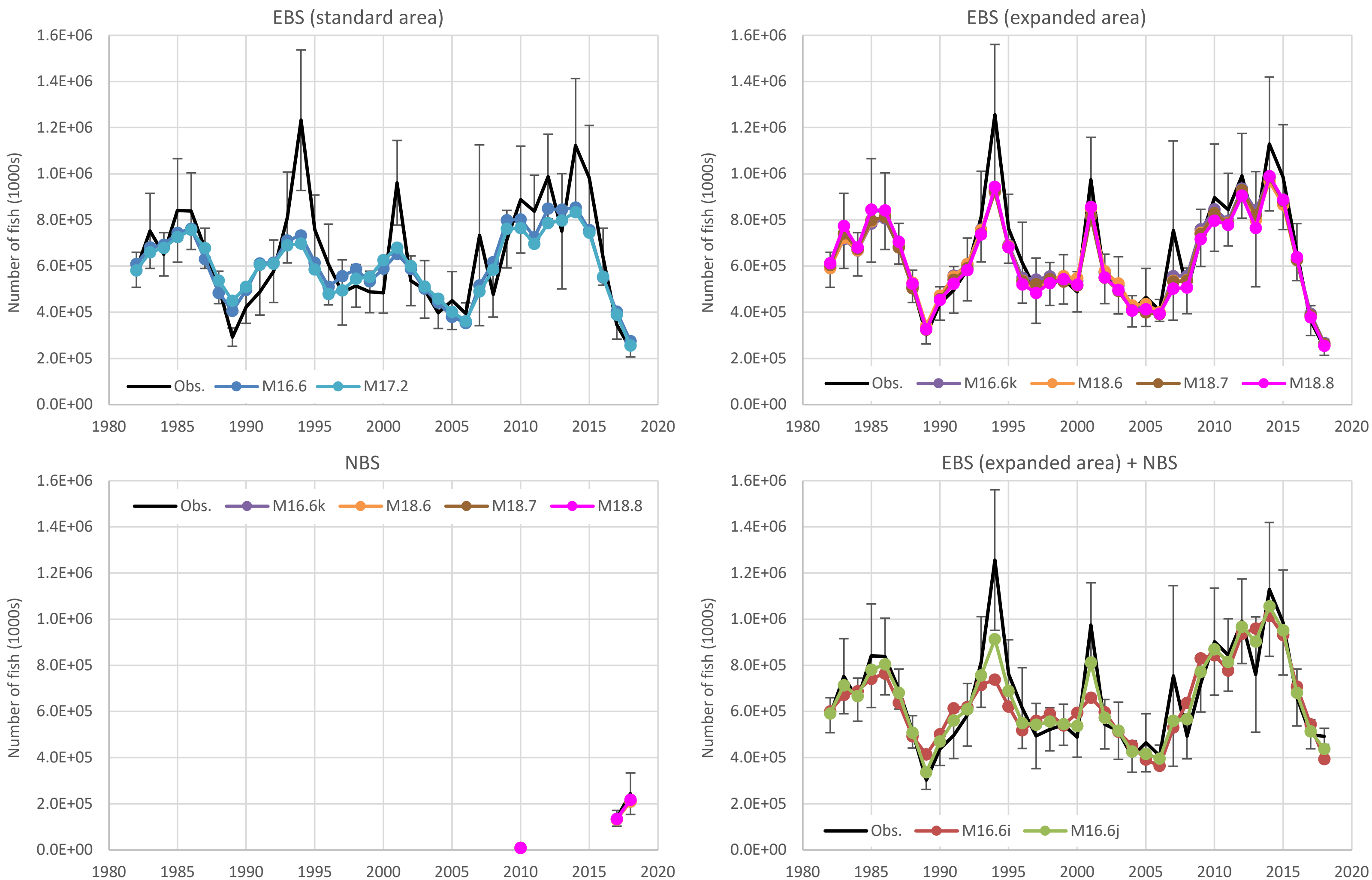
		Model 18.7						Model 18.8					
Type	Fleet	Years	N	Mult.	Harm.	ΣNeff1	ΣNeff2	Years	N	Mult.	Harm.	ΣNeff1	ΣNeff2
Size	Fishery	42	300	1.0000	569	12600	23917	34	5225	0.2398	1253	42600	42605
Size	EBS(std) survey	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Size	EBS(exp) survey	37	300	1.0000	317	11100	11728	37	346	0.8841	306	11318	11324
Size	NBS survey	3	300	1.0000	81	900	244	3	68	1.2940	88	264	264
Size	EBS(exp)+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	Fishery	n/a	n/a	n/a	n/a	n/a	n/a	8	9516	0.0324	309	2467	2470
Age	EBS(std) survey	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	EBS(exp) survey	24	300	1.0000	59	7200	1416	24	359	0.1239	45	1068	1068
				SEave	RMSE					SEave	RMSE		
Index	EBS(std) survey	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	EBS(exp) survey	37	371	0.1054	0.1054	13727	13720	37	371	0.1054	0.1053	13727	13729
Index	NBS survey	3	89	0.1623	0.1623	267	267	3	89	0.1623	0.1624	267	267
Index	EBS(exp)+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:	45794	51292				Sum:	71711	71727

Common parameters (subset of Table 2.16)

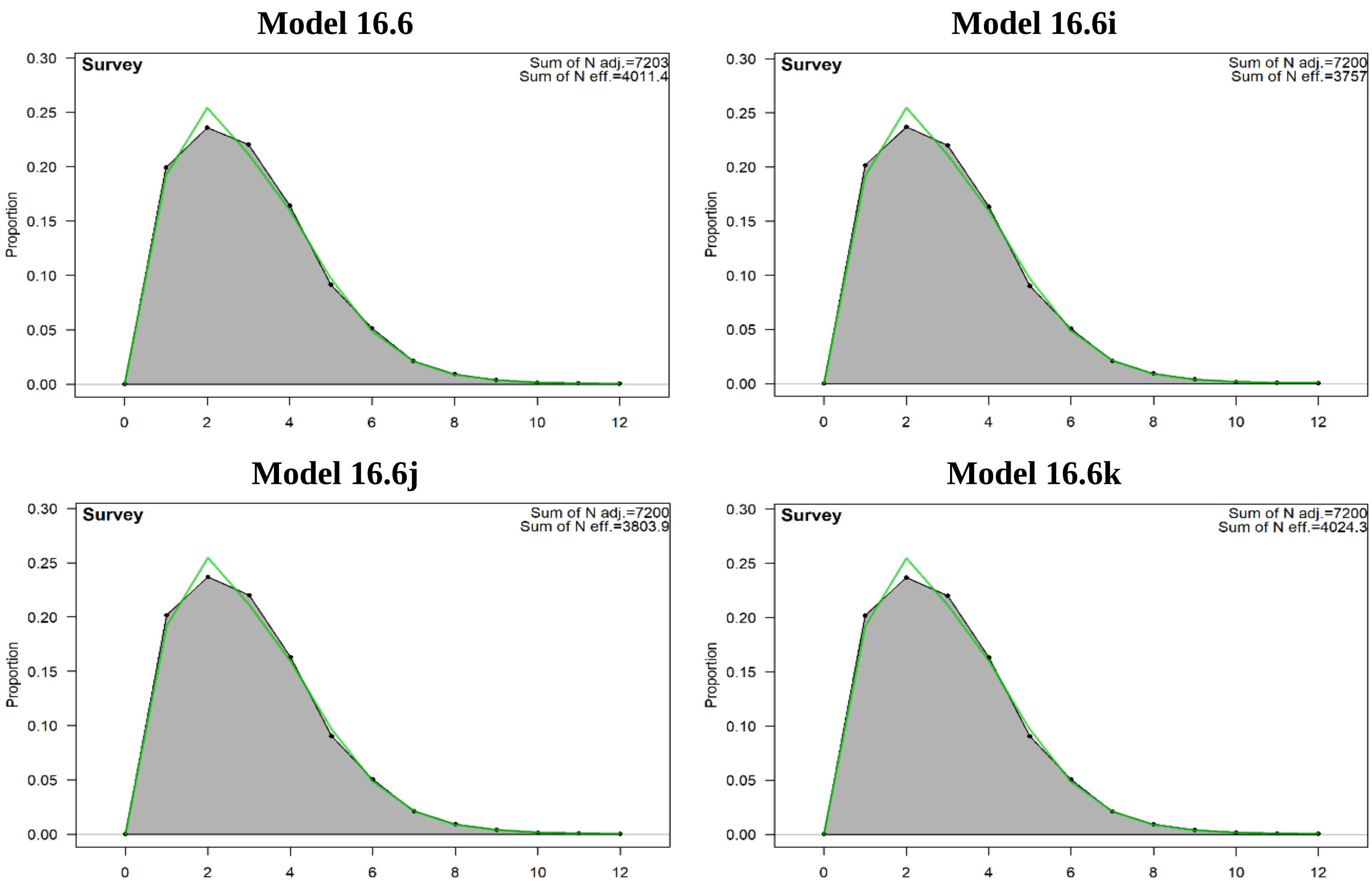
	Model 16.6		Model 16.6i		Model 16.6j		Model 16.6k		Model 17.2		Model 18.6		Model 18.7		Model 18.8	
Quantity	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.	Est.	StD.
Natural mortality (M)	0.354	0.012	0.340	0.012	0.340	0.013	0.345	0.013	0.356	0.020	0.364	0.023	0.398	0.007	0.471	0.011
Length at age 1.5 (cm)	16.358	0.087	16.377	0.088	16.378	0.089	16.423	0.088	16.458	0.091	16.479	0.091	16.418	0.088	16.468	0.090
Asymptotic length (cm)	100.60	1.952	100.62	1.955	100.71	1.986	100.09	1.850	109.05	1.923	108.79	1.915	98.444	1.666	106.34	1.629
Brody growth coefficient (K)	0.196	0.012	0.195	0.012	0.194	0.012	0.202	0.012	0.175	0.009	0.176	0.009	0.201	0.011	0.182	0.009
Richards growth coefficient	1.036	0.047	1.039	0.047	1.043	0.047	1.008	0.045	1.041	0.038	1.036	0.038	1.046	0.044	1.032	0.037
SD of length at age 1 (cm)	3.447	0.057	3.456	0.058	3.457	0.058	3.468	0.058	3.488	0.058	3.495	0.058	3.474	0.058	3.496	0.057
SD of length at age 20 (cm)	9.622	0.272	9.532	0.272	9.509	0.274	9.250	0.259	9.037	0.234	8.907	0.230	9.169	0.252	8.773	0.220
Ageing bias at age 1	0.337	0.012	0.335	0.012	0.335	0.013	0.335	0.013	0.340	0.029	0.334	0.031	0.347	0.011	0.347	0.028
Ageing bias at age 20	0.198	0.143	0.157	0.145	0.133	0.146	0.166	0.145	-0.491	0.191	-0.547	0.197	0.126	0.140	-0.793	0.200
ln(mean post-1976 recruits)	13.047	0.099	12.984	0.097	12.986	0.106	12.972	0.104	12.948	0.136	13.006	0.160	13.413	0.056	13.848	0.070
SD of ln(recruitment) devs	0.684	0.072	0.656	0.067	0.655	0.067	0.637	0.063	0.645	_	0.634	_	0.604	0.059	0.661	_
ln(pre-1977 recruits offset)	-1.120	0.216	-1.158	0.201	-1.147	0.203	-1.106	0.200	-1.465	0.053	-1.467	0.068	-0.867	0.214	-1.215	0.232
Initial fishing mortality rate	0.107	0.033	0.190	0.075	0.186	0.073	0.186	0.071	0.866	0.706	0.738	0.582	0.120	0.037	0.212	0.097

- Parameters with notably wide ranges:
  - M: ratio of max to min = 1.38
  - ln(mean post-1976 R): back-transformed ratio of max to min = 2.46
  - ln(pre-1977 R offset): back-transformed ratio of max to min = 1.82
  - Initial F: ratio of max to min = 8.07

Fit to survey abundance index

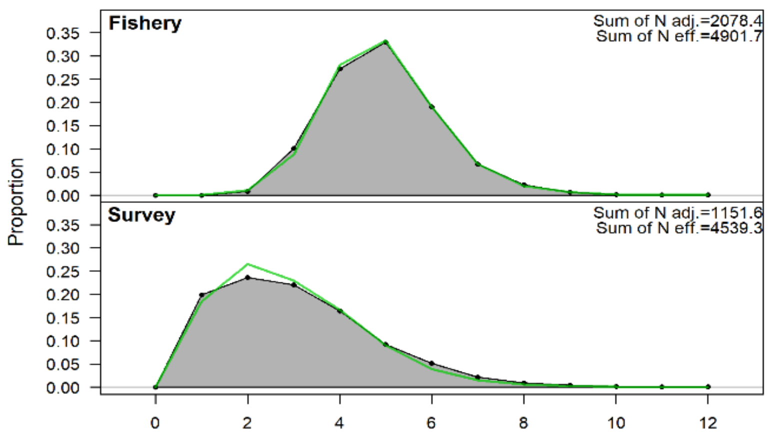


Time-aggregated agecomp fits: M16.6, M16.6x

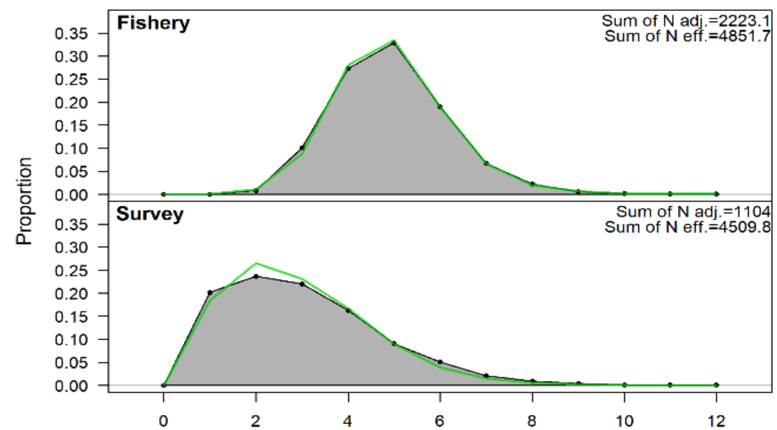


Time-aggregated agecomp fits: M17.2, M18.x

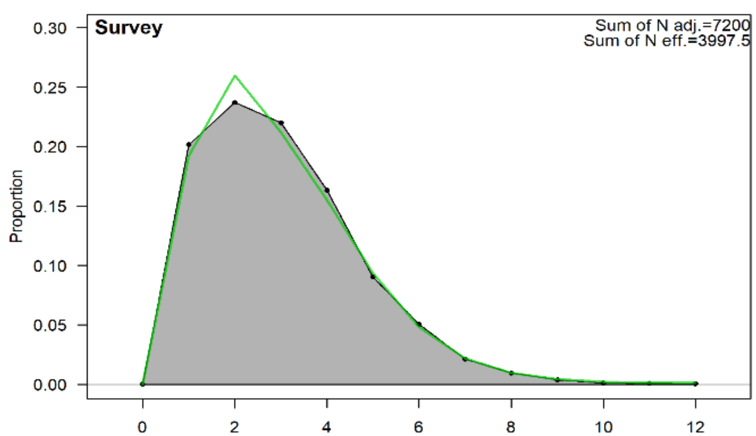
Model 17.2



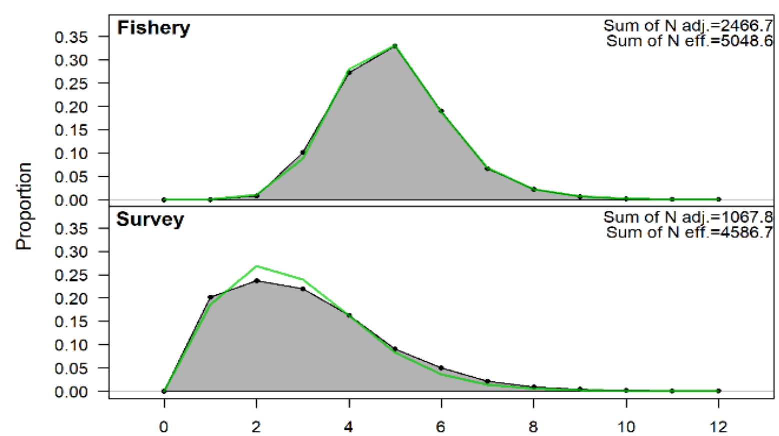
Model 18.6



Model 18.7

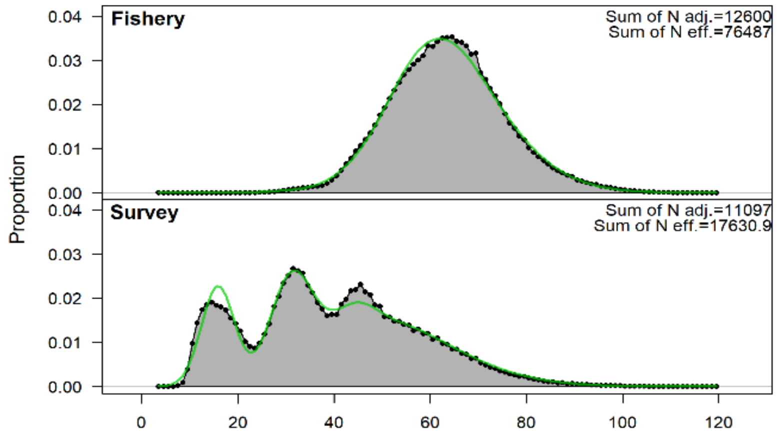


Model 18.8

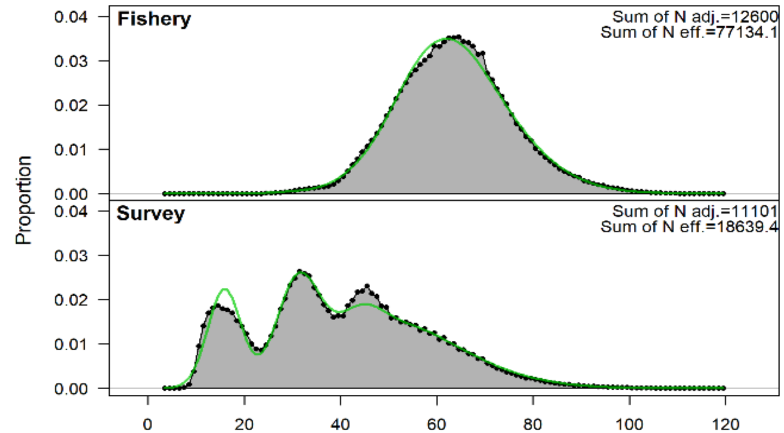


Time-aggregated sizecomp fits: M16.6, M16.6x

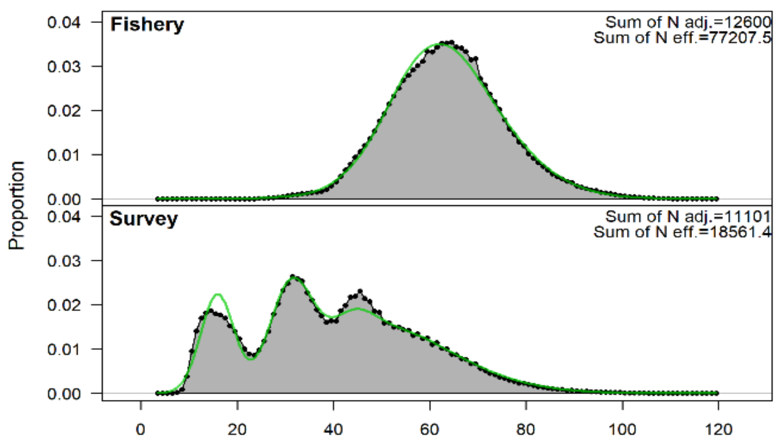
Model 16.6



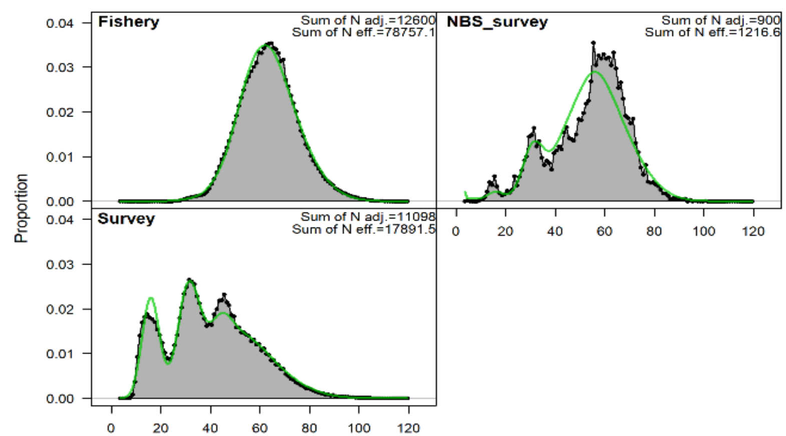
Model 16.6i



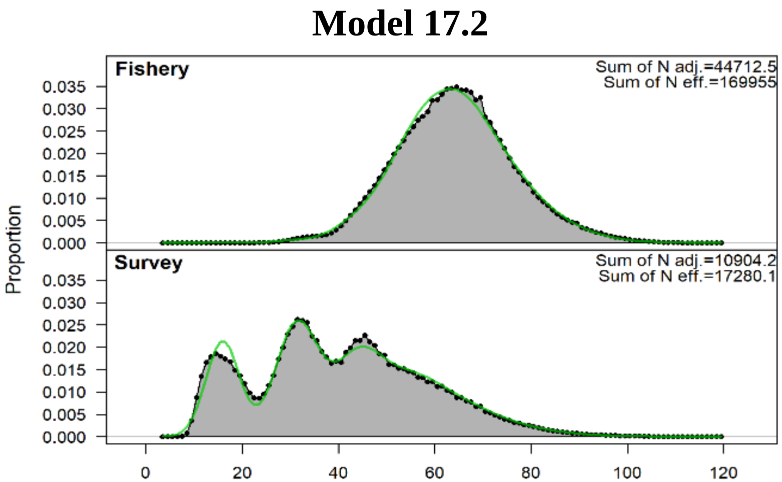
Model 16.6j

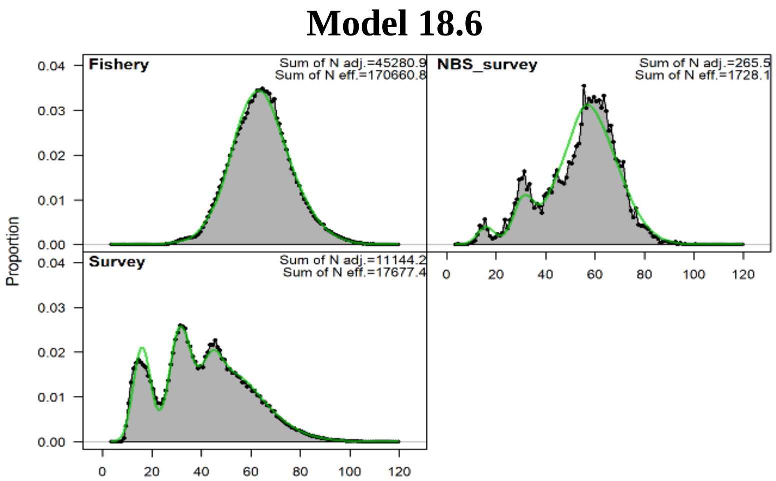


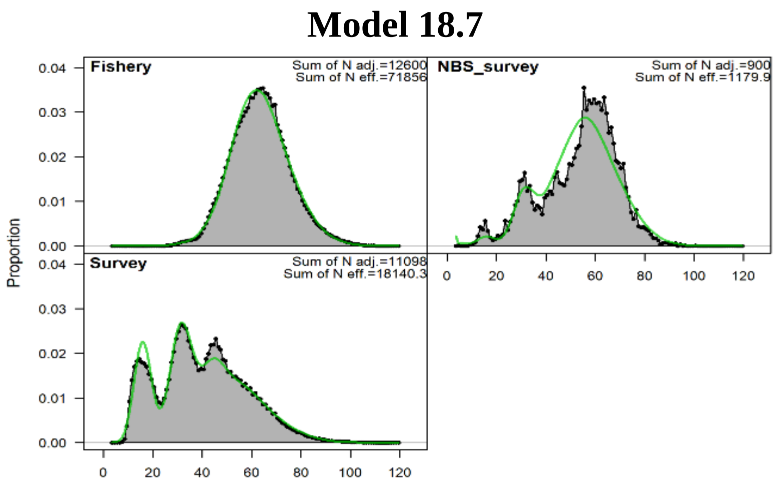
Model 16.6k

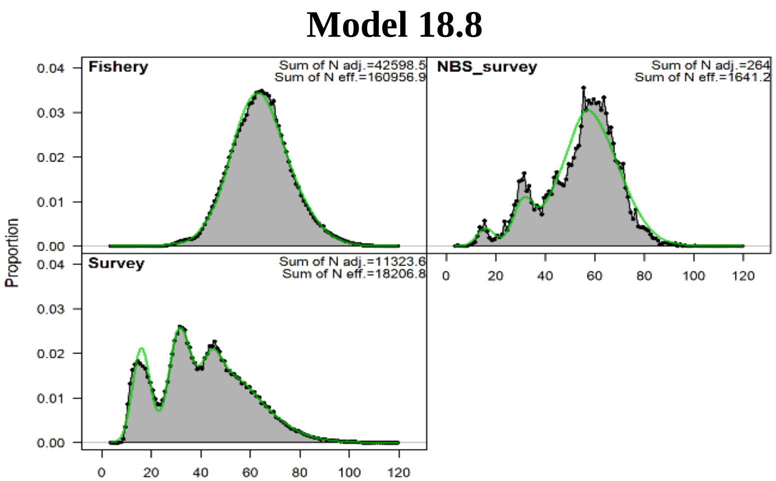


Time-aggregated sizecomp fits: M17.2, M18.x

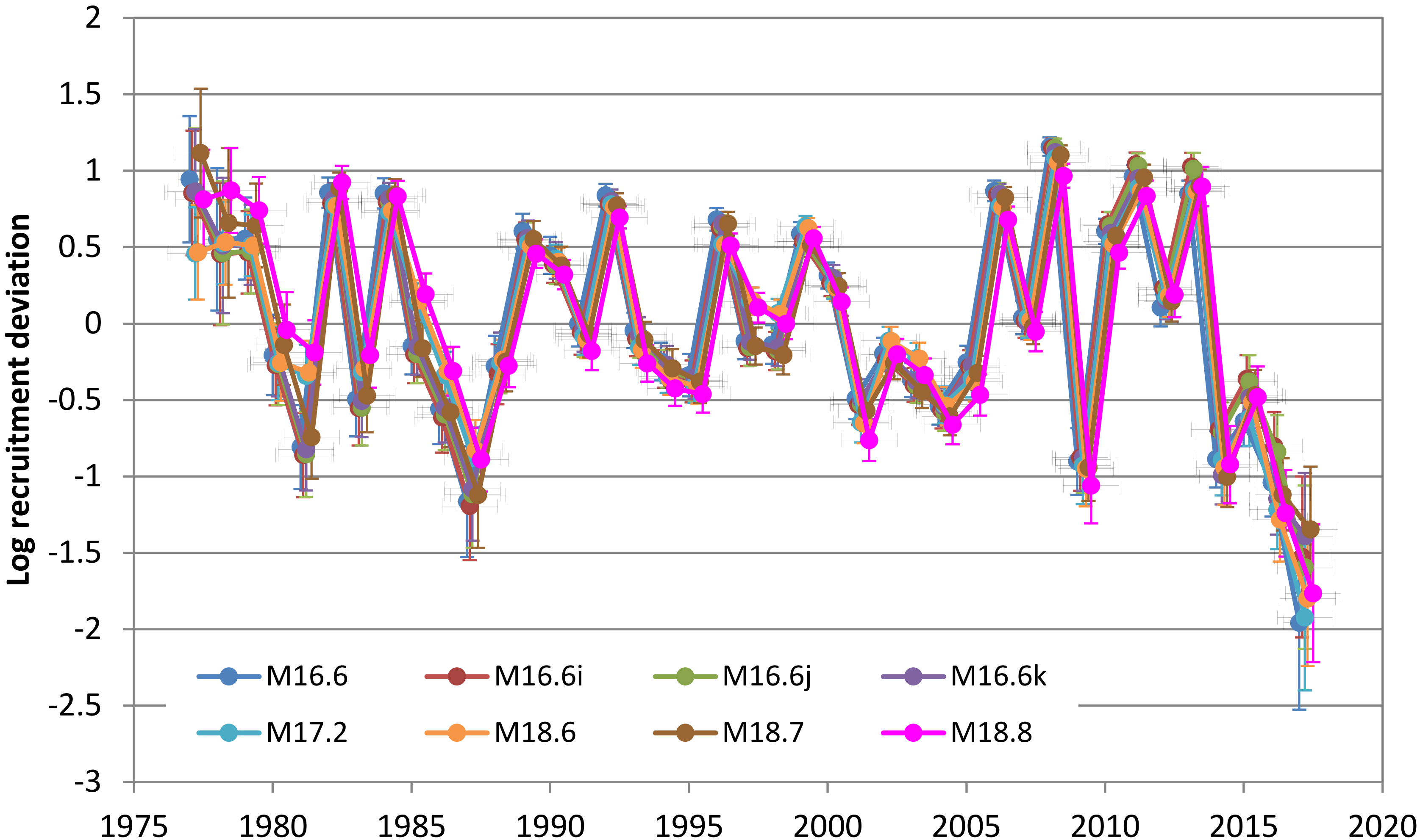




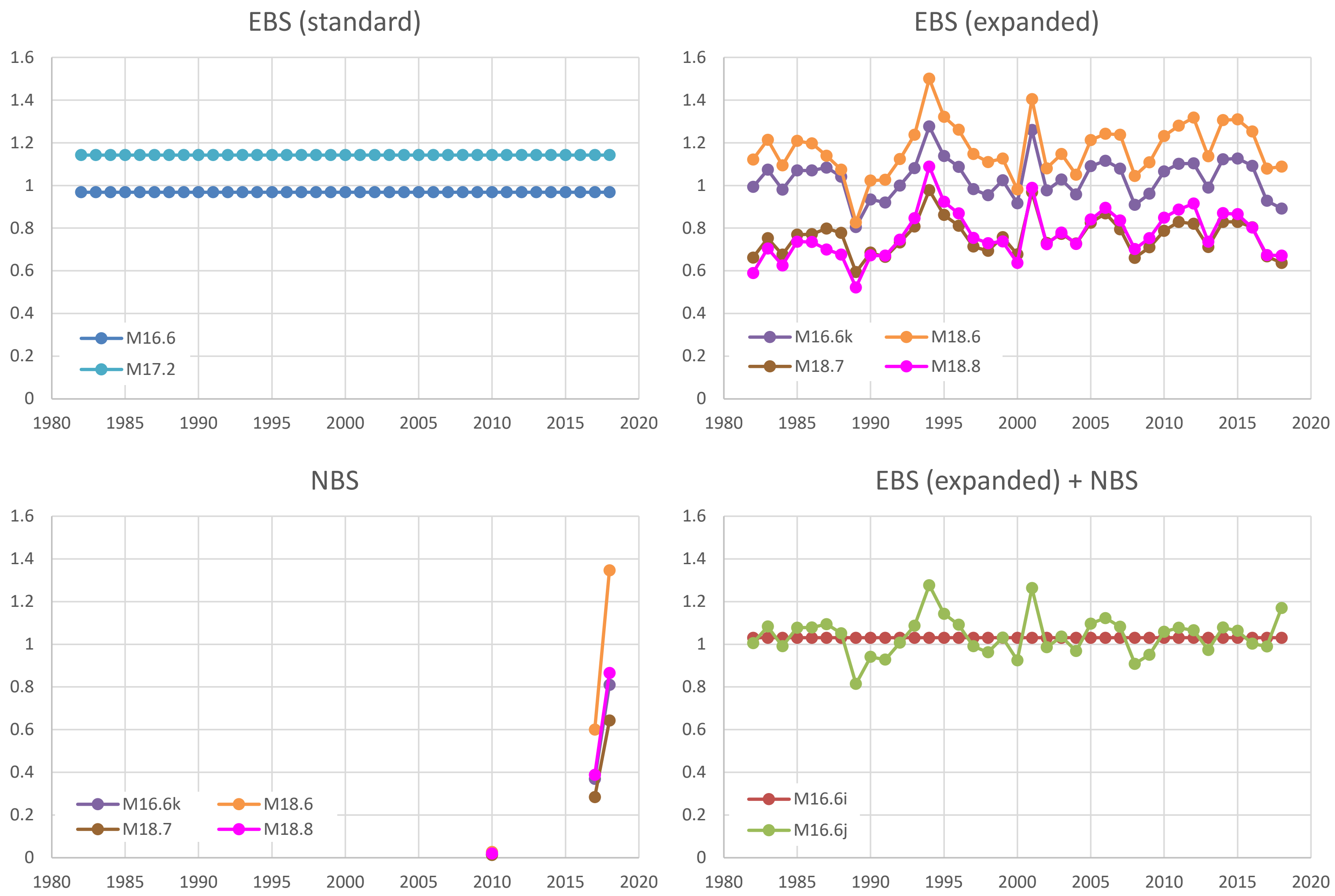




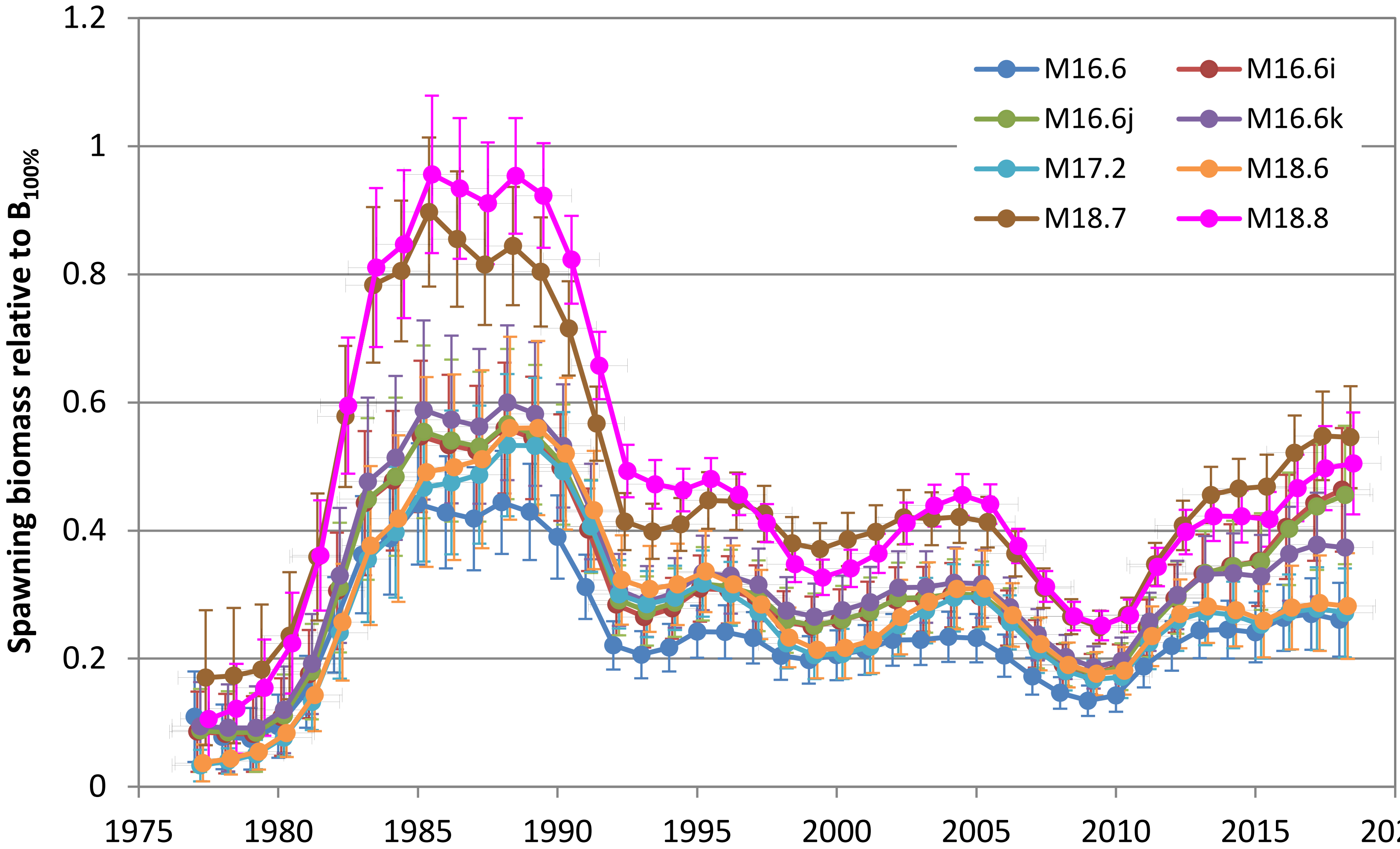
Age 0 recruitment deviations



Catchability

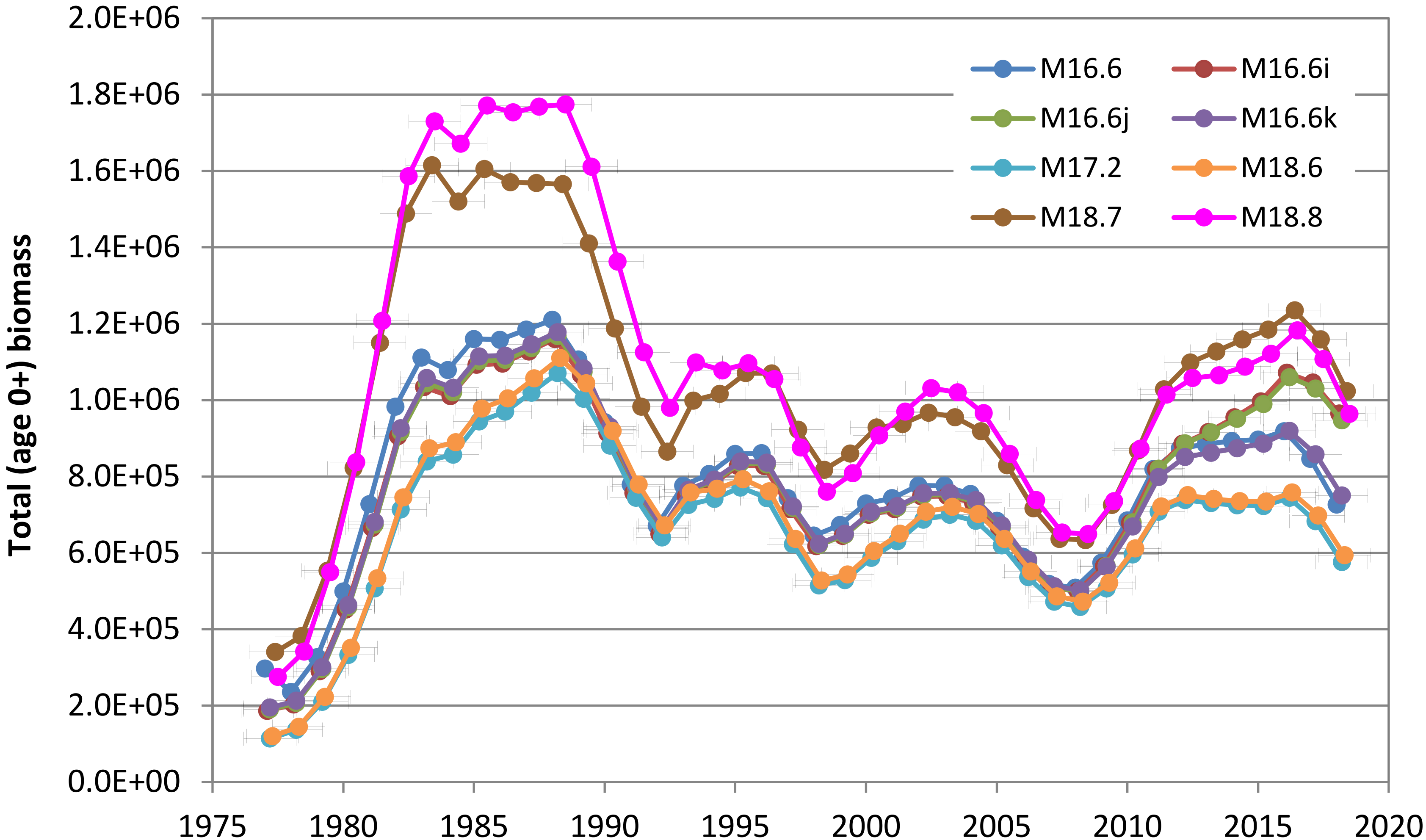


Depletion



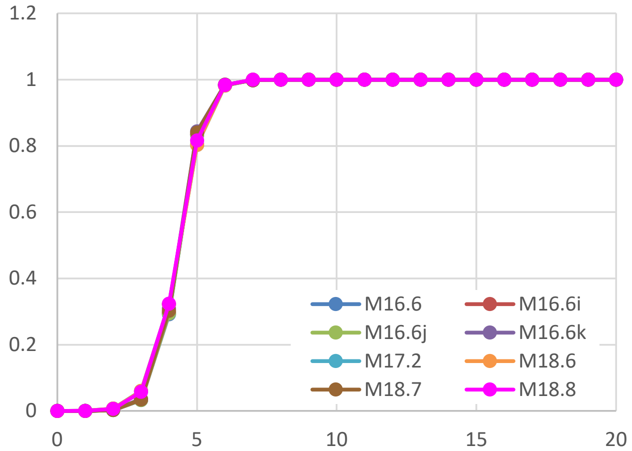
Spawning biomass relative to $B_{100\%}$
1.2
1
0.8
0.6
0.4
0.2
0
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
M16.6
M16.6i
M16.6j
M16.6k
M17.2
M18.6
M18.7
M18.8

Total (age 0+) biomass

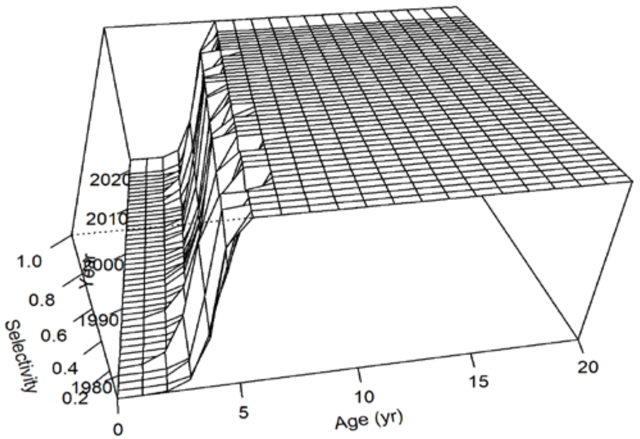


Fishery selectivity

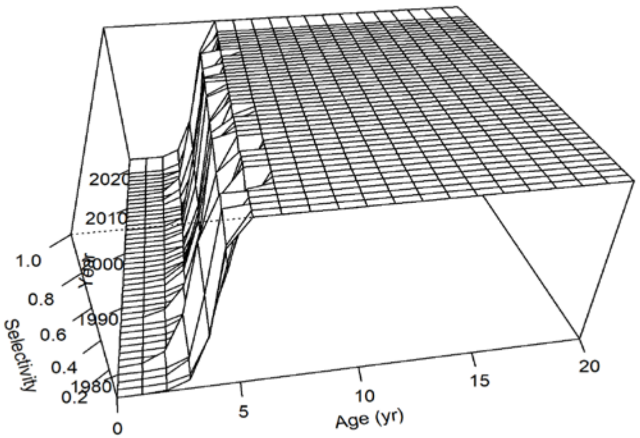
Base values (all models)



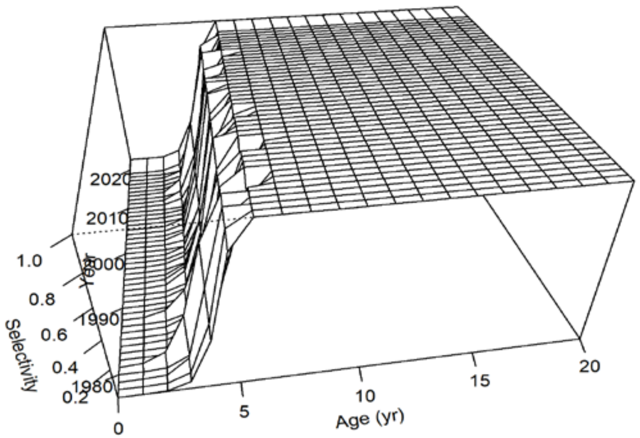
Model 17.2 time-varying



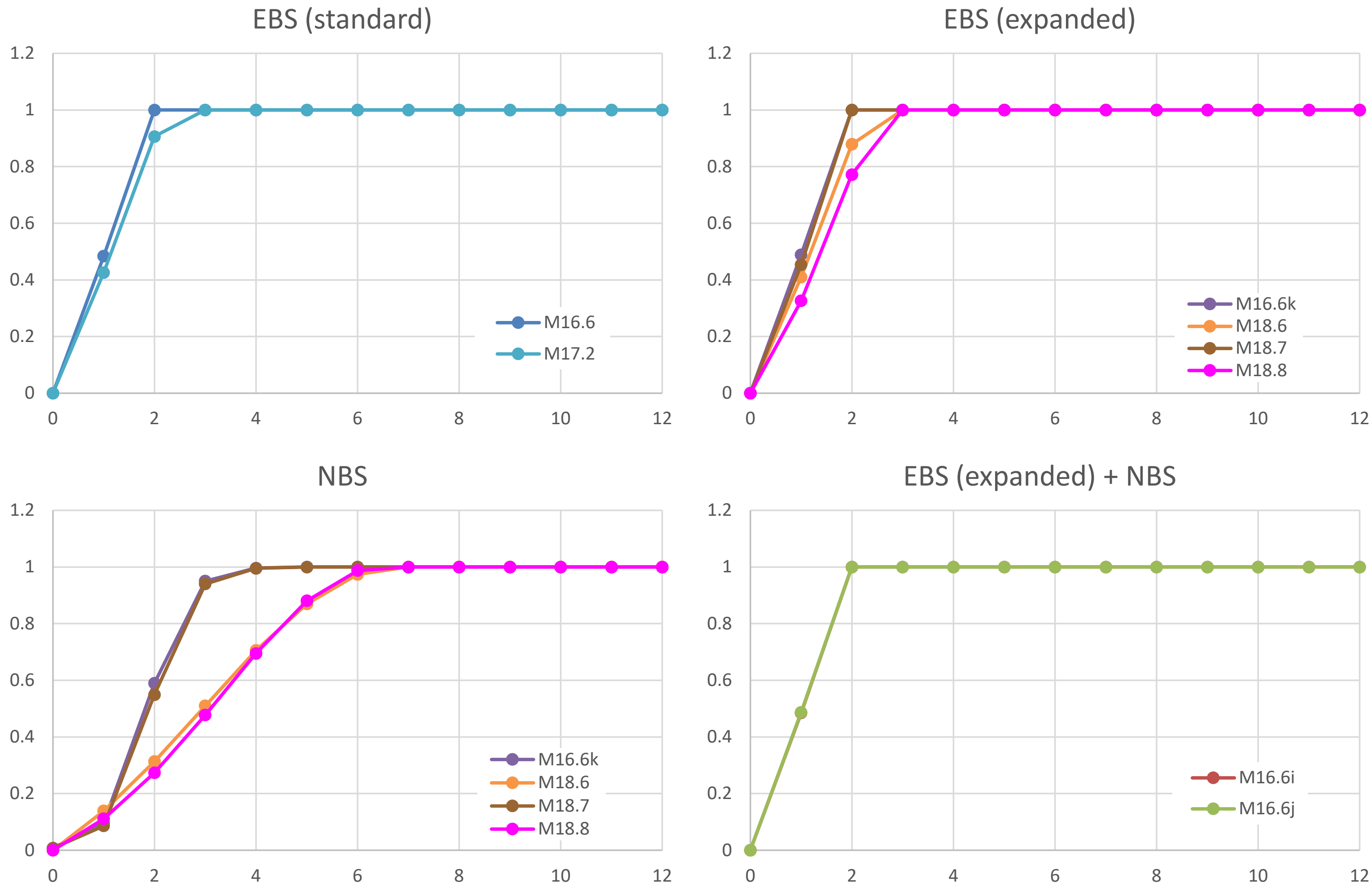
Model 18.6 time-varying



Model 18.8 time-varying



Survey selectivity



Choice of final model

Criteria and choice of final model

- The following criteria were used to choose the final model:
  - Are catchability estimates plausible?
  - Is retrospective performance acceptable?
  - Are changes in the complexity of model structure justified?
  - Are changes in model structure appropriately incremental?
- Evaluation of the eight models with respect to the above criteria resulted in a choice of Model 16.6i as the final model, as described on the following slides

Evaluation with respect to criterion #1 (1 of 2)

- Because the EBS and NBS surveys take place at nearly the same time and in disjoint areas, the estimated catchability in each area should approximate the relative survey abundance in each area

		EBS(std)		EBS(exp)				NBS				EBS+NBS	
Year	Quantity	16.6	17.2	16.6k	18.6	18.7	18.8	16.6k	18.6	18.7	18.8	16.6i	16.6j
2010	Rel. Abund.	0.98	0.98	0.99	0.99	0.99	0.99	0.01	0.01	0.01	0.01	1.00	1.00
2010	Catchability	0.97	1.14	1.07	1.23	0.79	0.85	0.01	0.03	0.01	0.02	1.03	1.06
2010	Abs. Diff.	0.01	0.16	0.07	0.24	0.21	0.14	0.01	0.02	0.00	0.01	0.03	0.06
2017	Rel. Abund.	0.69	0.69	0.73	0.73	0.73	0.73	0.27	0.27	0.27	0.27	1.00	1.00
2017	Catchability	0.97	1.14	0.93	1.08	0.67	0.67	0.37	0.60	0.28	0.39	1.03	0.99
2017	Abs. Diff.	0.28	0.45	0.20	0.35	0.06	0.05	0.10	0.33	0.01	0.11	0.03	0.01
2018	Rel. Abund.	0.49	0.49	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	1.00	1.00
2018	Catchability	0.97	1.14	0.89	1.09	0.64	0.67	0.81	1.35	0.64	0.87	1.03	1.17
2018	Abs. Diff.	0.48	0.65	0.39	0.58	0.13	0.17	0.32	0.85	0.15	0.37	0.03	0.17
All	RMSD	0.32	0.47	0.26	0.42	0.14	0.13	0.19	0.53	0.09	0.22	0.03	0.10

Evaluation with respect to criterion #1 (2 of 2)

- The table on the preceding slide illustrates why Models 18.7 and 18.8 were added to the set of models for this assessment:
  - Their closest counterparts, Models 16.6k and 18.6 respectively, tended not to satisfy the desired approximations
  - More specifically, Models 16.6k and 18.6 tended to estimate area-specific *Q*s much larger than the respective area-specific relative abundances, particularly in 2017 and 2018 when EBS survey abundances were smallest and NBS survey abundances were largest
- The lowest RMSD is obtained by Model 16.6i (0.03 for the combined areas), followed by Model 16.6j (0.10 for the combined areas) and Model 18.7 (0.14 for the EBS expanded area and 0.09 for the NBS)

Evaluation with respect to criterion #2

- Comparing realized values of Mohn's ρ to the "acceptable" range implied by Hurtado-Ferro et al. (2015):

Model:	16.6	16.6i	16.6j	16.6k	17.2	18.6	18.7	18.8
ρ:	0.315	0.207	0.288	0.397	0.475	0.555	0.301	0.477
M:	0.354	0.340	0.340	0.345	0.356	0.364	0.398	0.471
Min:	-0.204	-0.199	-0.199	-0.201	-0.205	-0.207	-0.219	-0.245
Max:	0.277	0.270	0.270	0.273	0.278	0.282	0.299	0.335

- Model 16.6i exhibits the lowest value among all the models
- Model 16.6i also exhibits the only value that falls within the acceptable range implied by Hurtado-Ferro et al. (2015)
  - Although the value exhibited by Model 18.7 is extremely close to the upper end of the range

Evaluation with respect to criterion #3 (1 of 2)

- Although the alternative models include many changes from the base model, not all of them constitute changes in structural complexity
- For example, the only difference between Models 16.6 and 16.6i is that the latter uses the combined EBS expanded area and NBS surveys in lieu of the EBS standard area survey used in the former
- The features that would most likely qualify as changes in structural complexity are:
  a. Addition of a second survey, with concomitant need to estimate an additional Q and selectivity parameters (16.6k, 18.6-18.8)
  b. Addition of randomly time-varying Q (16.6j, 16.6k, 18.6-18.8)
  c. Addition of randomly time-varying fishery selectivity (17.2, 18.6/8)

Evaluation with respect to criterion #3 (2 of 2)

- The SSC minutes from June 2018 offer guidance on justifying additional complexity: *"Existing assessments should be periodically evaluated for 'complexity creep' and consistency with similar assessments"*
  - Assume that "similar assessments" means "Tier 3 BSAI assessments"
- Features "a" through "c" on the previous slide can be evaluated with respect to similar assessments as follows:
  a. Some similar assessments include multiple surveys (typically bottom trawl surveys of the EBS shelf, EBS slope, or AI)
  b. Few, if any, similar assessments include randomly time-varying Q
  c. Some assessments include randomly time-varying fishery selectivity
- Given the above, the only models that have levels of complexity consistent with similar assessments are Models 16.6, 16.6i, and 17.2

Evaluation with respect to criterion #4 (1 of 2)

- The SSC has often expressed a preference for incremental changes in model structure:
  - SSC minutes, 6/12: "…The SSC encourages the authors to evaluate changes in one or a few structural elements at a time."
  - SSC minutes, 6/13: "...The SSC recommends that model changes be kept to a minimum to ensure that we can track model sensitivities to specific changes in model structure."
  - SSC minutes, 12/13: "…The SSC discussed the need for a more incremental approach to implementing changes to the model.…"
  - SSC minutes, 12/15: "...The SSC has repeatedly stressed the need to incrementally evaluate model changes...."

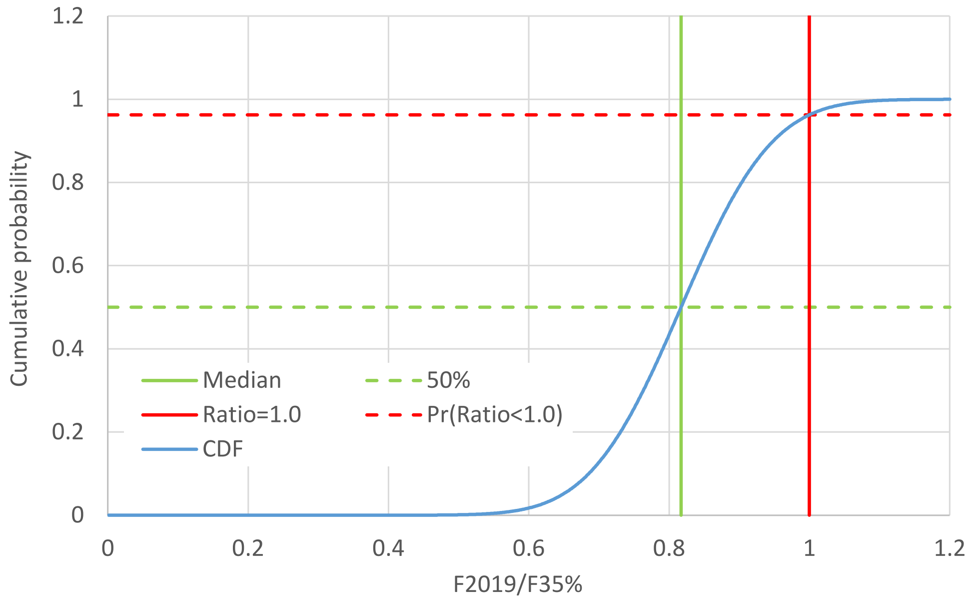
Evaluation with respect to criterion #4 (2 of 2)

- Given the relatively stable level of the combined EBS and NBS survey biomass over the last few years (Figure 2.6), the stock does not appear to be in an emergency situation that might render an incremental approach inappropriate
- On the contrary, given the uncertain effects of the large and potentially unprecedented movements of Pacific cod from the EBS and NBS that appear to have taken place in the last few years, an incremental approach to changes in model structure might be especially important at this particular time, with the understanding that additional changes may be called for in the future as more information becomes available
- While it is difficult to determine exactly which of the eight candidate models in this assessment qualify as involving only incremental changes in model structure, it is clear that Model 16.6 would qualify by definition, and Model 16.6i would likely qualify also

Final recommendations

Projections

- This year's assessment used Stock Synthesis to make all projections, rather than the formerly standard AFSC software
- Allowed responding to the SSC request to present the distribution of F2019/F35%, conditional on the choice of final model and the assumption that 2019 catch will equal the point estimate of maxABC



Reasons for not setting ABC<maxABC (1 of 2)

- SSC guidance
  - Last year, when the SSC concluded that no reduction was warranted:
    - Combined EBS+NBS survey biomass was down 5%
    - Persistence of NBS biomass was unknown
    - Genetic relationship between EBS and NBS fish was unknown
  - This year:
    - Combined EBS+NBS survey biomass is up 15%
    - Persistence of NBS biomass has been corroborated
    - EBS and NBS fish have been shown to be genetically similar
- 2019 maxABC is already down significantly from 2018 ABC (-10%)
  - With an even bigger drop from 2019 to 2020 (-24%)

Reasons for not setting ABC<maxABC (2 of 2)

- Difficulty in navigating the new rules
  - How to map risk matrix “concerns” into reductions without violating new prohibition against including socioeconomic concerns in ABC?
  - If it is *just* a matter of adjusting ABC to account for a retrospective bias, this might not be too hard, but M16.6i’s retrospective bias is low
  - What is gained/lost by various reductions, and how to choose an objective that does not involve socioeconomic concerns?
    - E.g., is dropping from $B_{20.01\%}$ to $B_{19.99\%}$ a concern because it critically impacts sea lions, or because directed fishery closes?
    - E.g., given $F=maxF_{ABC}$, biomass decreases through 2022, but given $F=F_{60\%}$, biomass still decreases through 2022

Management reference points

Year	Quantity	M16.6	M16.6i	M16.6j	M16.6k	M17.2	M18.6	M18.7	M18.8
n/a	B100%	623,000	658,000	656,000	623,000	609,000	598,000	594,000	556,000
n/a	B40%	249,000	263,000	263,000	249,000	244,000	239,000	238,000	222,000
n/a	B35%	218,000	230,000	230,000	218,000	213,000	209,000	208,000	195,000
n/a	F40%	0.32	0.31	0.31	0.31	0.31	0.32	0.38	0.46
n/a	F35%	0.40	0.38	0.38	0.38	0.37	0.39	0.47	0.58
2019	Female spawning biomass	195,000	290,000	283,000	206,000	141,000	145,000	290,000	249,000
2019	Relative spawning biomass	0.23	0.44	0.43	0.33	0.23	0.24	0.49	0.45
2019	Pr(B/B100%<0.2)	0.17	0.00	0.00	0.00	0.19	0.16	0.00	0.00
2019	maxFABC	0.25	0.31	0.31	0.25	0.17	0.18	0.38	0.46
2019	maxABC	103,000	181,000	177,000	111,000	53,900	59,900	212,000	216,000
2019	Catch	103,000	181,000	177,000	111,000	53,900	59,900	206,000	208,000
2019	FOFL	0.31	0.38	0.38	0.31	0.21	0.22	0.47	0.58
2019	OFL	123,000	216,000	211,000	132,000	60,900	72,000	253,000	257,000
2019	Pr(maxABC>truOFL)	0.24	0.07	0.11	0.26	0.30	0.32	0.03	0.07
2020	Female spawning biomass	176,000	246,000	240,000	187,000	146,000	148,000	221,000	180,000
2020	Relative spawning biomass	0.20	0.38	0.37	0.30	0.24	0.25	0.37	0.32
2020	Pr(B/B100%<0.2)	0.38	0.00	0.00	0.00	0.04	0.04	0.00	0.00
2020	maxFABC	0.22	0.29	0.28	0.23	0.18	0.19	0.35	0.37
2020	maxABC	78,900	137,000	131,000	86,100	53,800	58,600	144,000	123,000
2020	Catch	78,900	137,000	131,000	86,100	53,800	58,600	144,000	123,000
2020	FOFL	0.28	0.35	0.34	0.28	0.21	0.23	0.44	0.46
2020	OFL	94,800	164,000	157,000	103,000	64,600	70,400	173,000	147,000
2020	Pr(maxABC>truOFL)	0.25	0.23	0.27	0.28	0.28	0.34	0.22	0.31