2020 BSAI Pacific ocean perch Assessment

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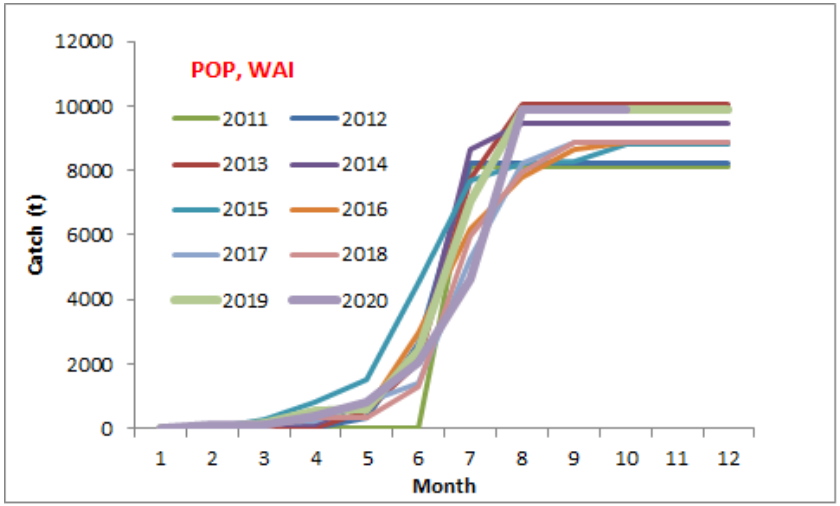
Overall summary

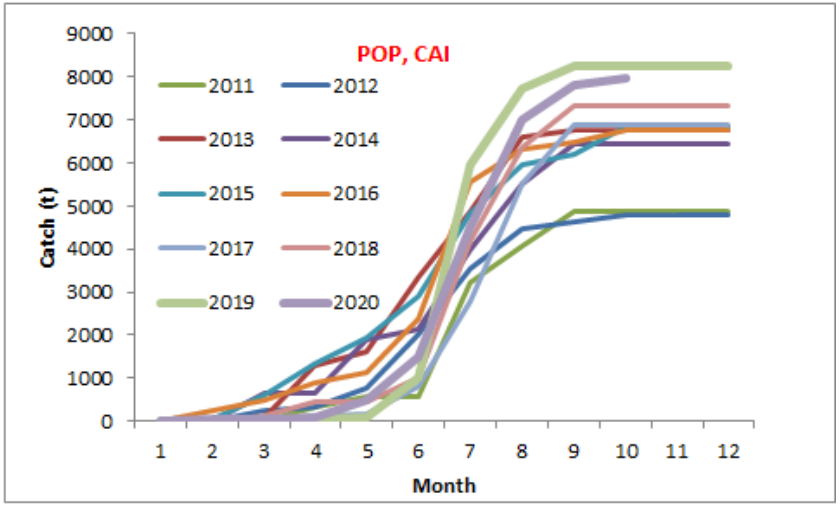
- No modeling changes.
- Recent high survey biomass estimates have been keeping model-estimated biomass high, but stock had been on a downward trend. Without a 2020 survey, the biomass and ABC are even lower.
- Slight change in fishery selectivity curve results in lower F_{spr} rates.
- 2021 ABC of 37,173 t (24% decrease from 2020 ABC).
- Assessment-related concerns noted in risk table.

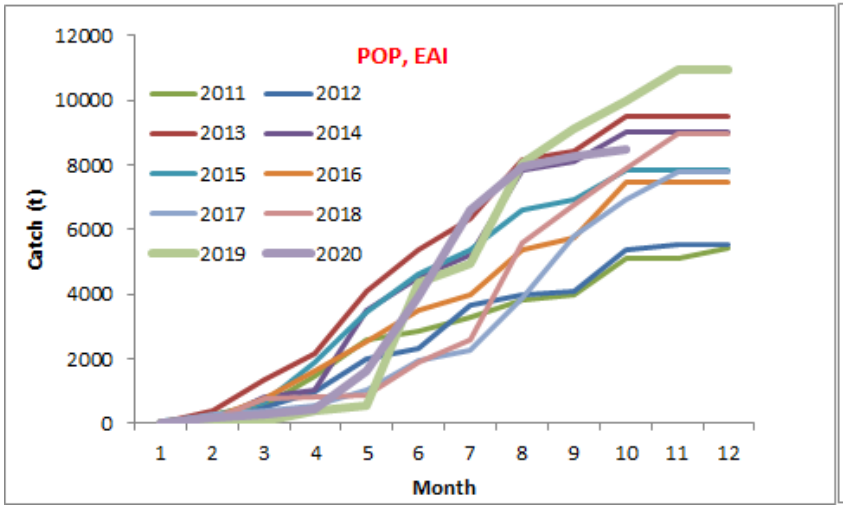
BSAI POP Outline

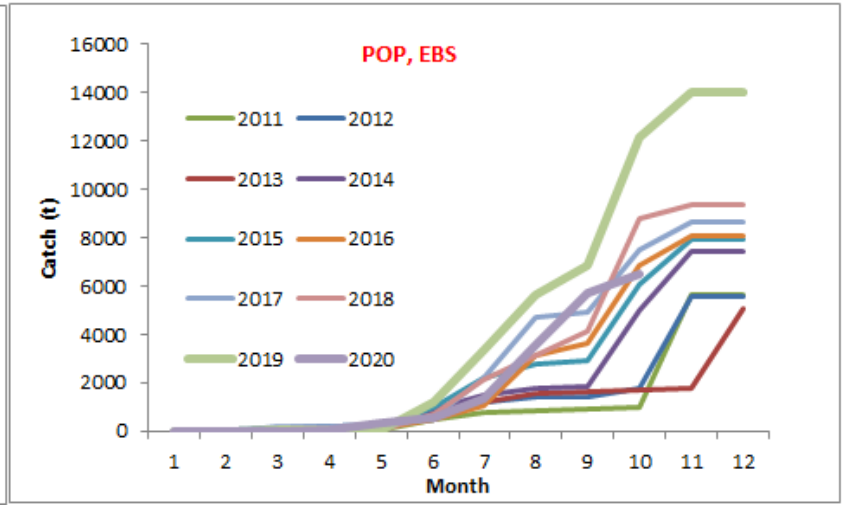
1) Catch information
2) Survey and fishery data
3) Model description, fits to data
4) Retrospective analysis
5) Sensitivity runs
7) Risk table
8) Management recommendations

BSAI POP catch by month and area, 2011-2020









Economic performance report

	2010-2014 Average	2015	2016	2017	2018	2019
Total catch K mt	30.16	39.7	36.9	38.4	42	54.7
Retained catch K mt	27.1	37.5	35.3	35.5	38.8	49.8
Pac. Ocn. perch share of retained	88%	80%	86%	85%	84%	80%
Northern share of retained	8%	18%	12%	12%	13%	17%
Vessels #	21.6	21	21	19	24	26
First-wholesale production K mt	14.7	19.4	17.6	17.4	19.4	24.0
First-wholesale value M US$	$42.0	$42.8	$34.6	$41.1	$43.3	$42.5
First-wholesale price/lb US$	$1.29	$1.00	$0.89	$1.07	$1.01	$0.80
Pac. Ocn. perch share of value	88%	83%	88%	88%	88%	80%
Pac. Ocn. perch price/lb US$	$1.29	$1.05	$0.91	$1.10	$1.03	$0.80
Northern rockfish share of value	6%	14%	8%	8%	9%	14%
Northern rockfish price/lb US$	$1.04	$0.74	$0.64	$0.76	$0.78	$0.69
H&G share of value	96%	97%	95%	94%	91%	89%

Increased discards in the EBS

	EBS			AI			BSAI		
Year	Retained	Discarded	Percent Discarded	Retained	Discarded	Percent Discarded	Retained	Discard	Percent Discarded
2011	5,249	351	6	18,021	382	2	23,270	733	3
2012	5,178	406	7	18,169	401	2	23,348	807	3
2013	4,746	304	6	26,063	248	1	30,809	553	2
2014	6,614	824	11	24,770	174	1	31,384	997	3
2015	6,749	1,176	15	23,267	240	1	30,016	1,416	5
2016	7,419	671	8	22,899	199	1	30,317	870	3
2017	6,986	1,621	19	23,293	264	1	30,279	1,885	6
2018	7,828	1,488	16	24,617	497	2	32,446	1,985	6
2019	11,211	2,811	20	28,592	505	2	39,803	3,315	8
2020	3,974	2,323	37	25,848	448	2	29,822	2,771	9

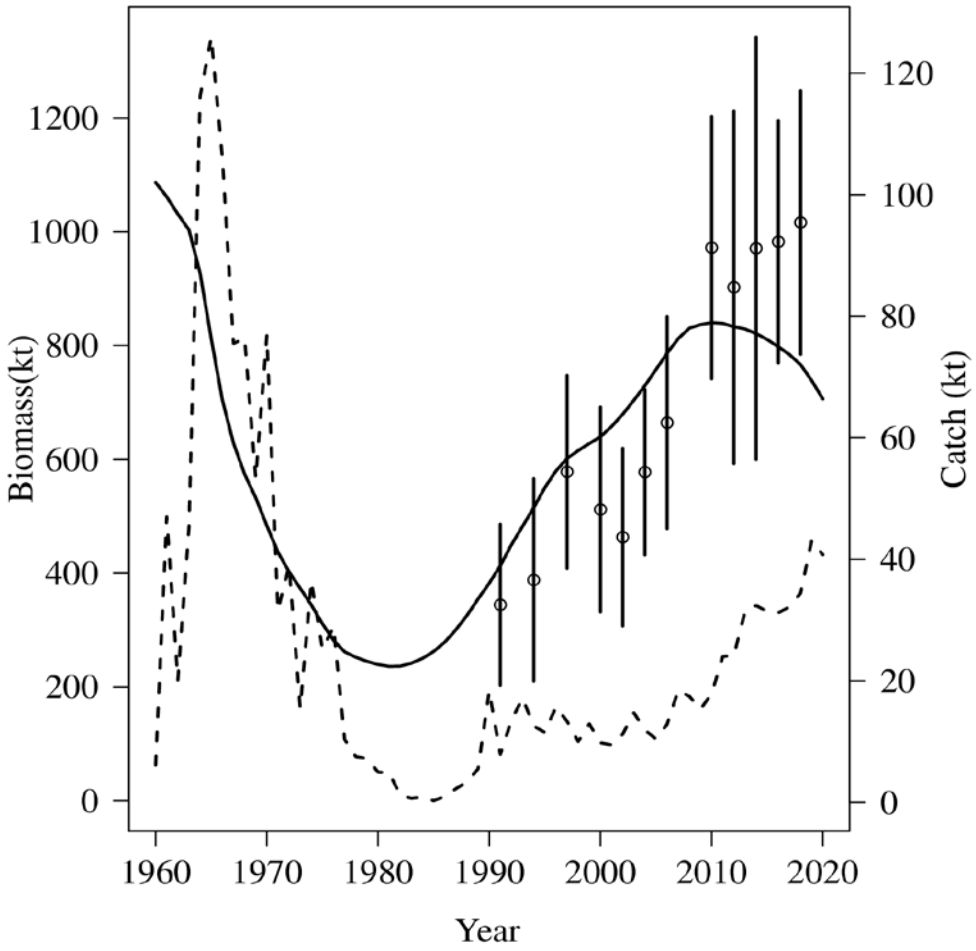
Data in assessment model

Component	BSAI
Fishery catch	1960-**2020**
Fishery age composition	1981-82, 1990, 1998, 2000-2009, 2011, 2013, 2015, 2017, **2019**
Fishery size composition	1964-72, 1983-1984, 1987-1989, 1991-1997, 1999, 2010, 2012, 2014, 2016, **2018**
AI Survey age composition	1991, 1994, 1997, 2000, 2002, 2004, 2006,2010,2012,2014,2016, **2018**
AI Survey biomass estimates	1991, 1994, 1997, 2000, 2002, 2004, 2006, 2010, 2012, 2014, 2016, 2018
EBS Survey age composition	2002,2004,2008,2010,2012,2016
EBS Survey biomass estimates	2002,2004,2008,2010,2012,2016

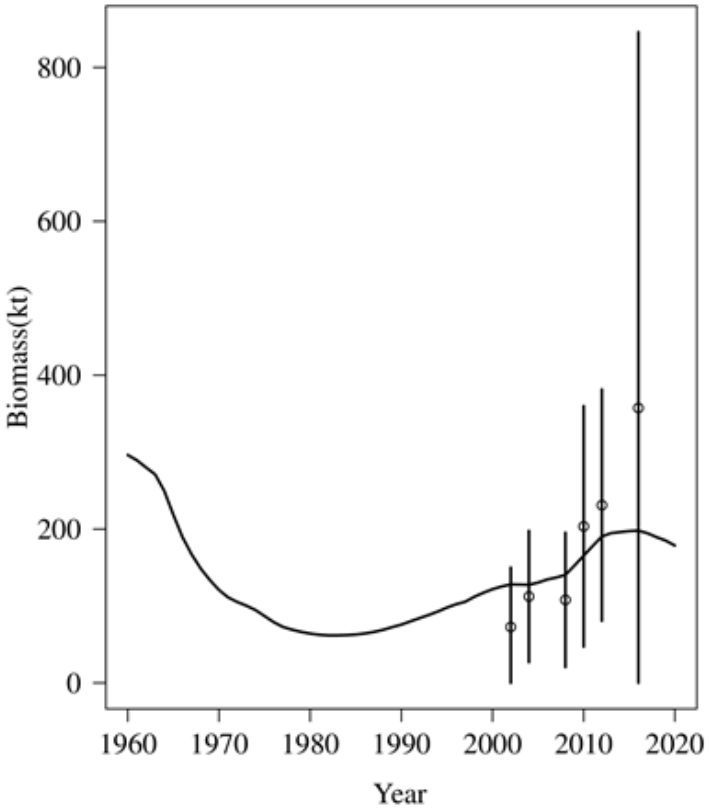
Model description

- Model 16.3a from the 2018 assessment, with updated data, estimated length-at-age, weight-at-age, and age-to-length conversion matrix, and McAllister-Ianelli weights

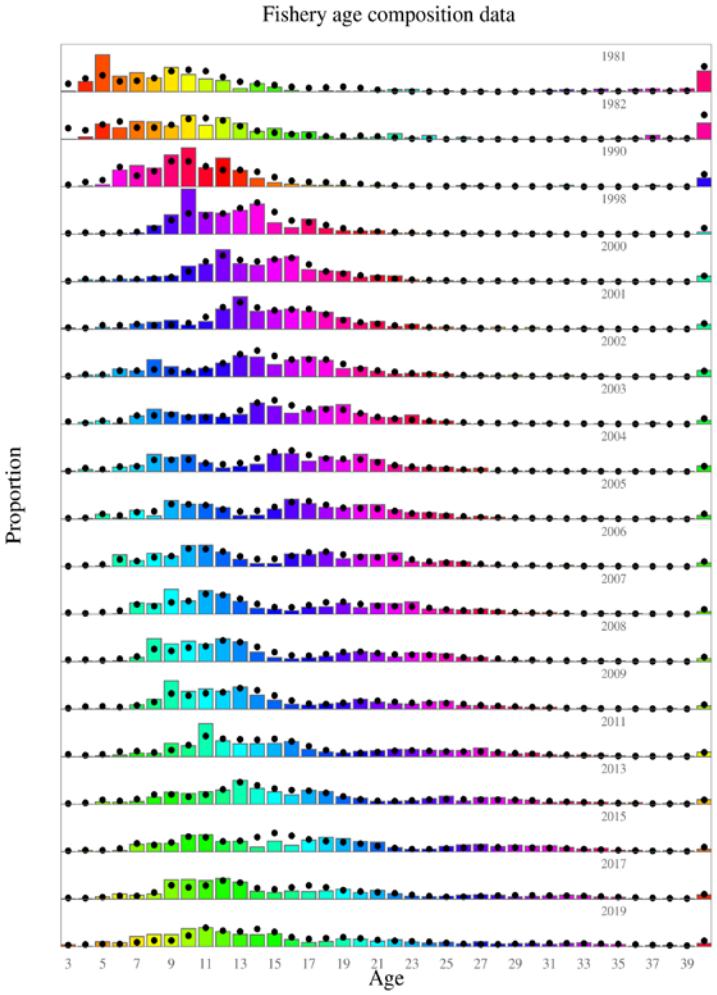
Fit to the AI survey



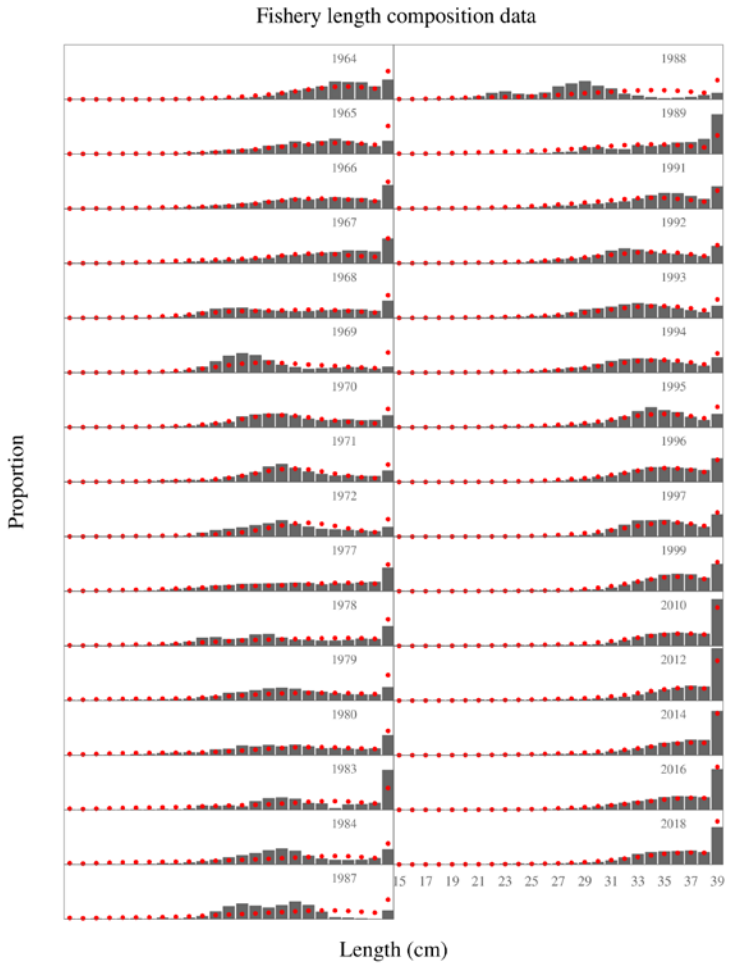
Fit to the EBS survey index



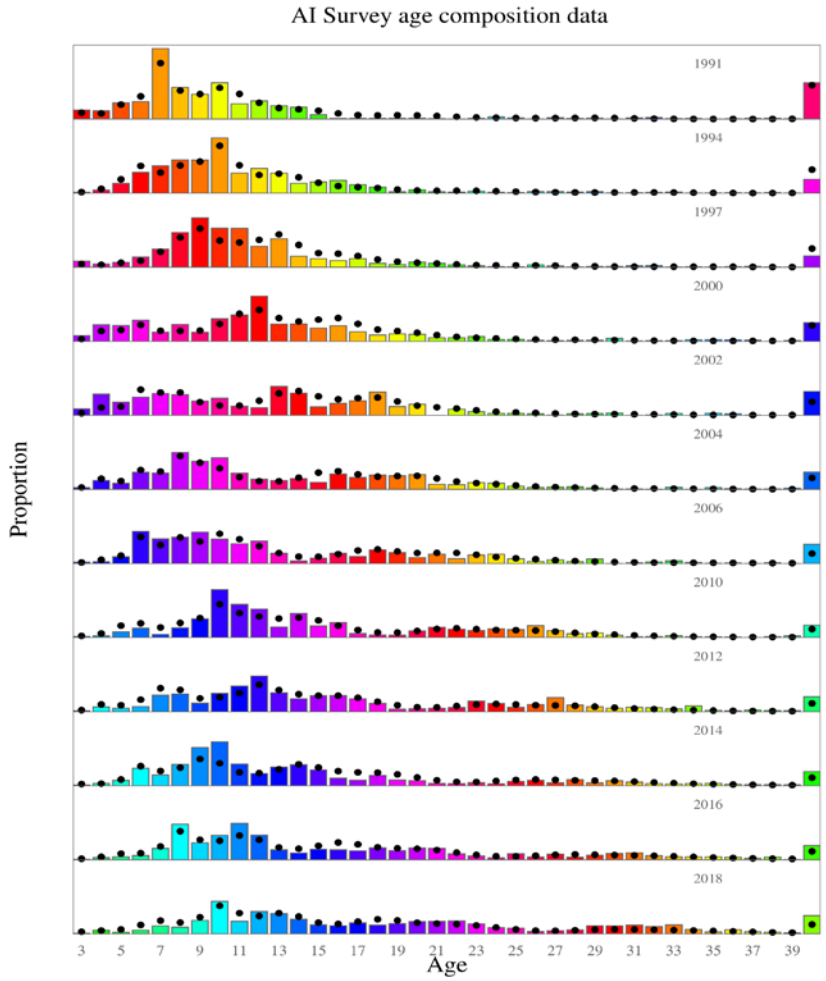
BSAI fishery age composition



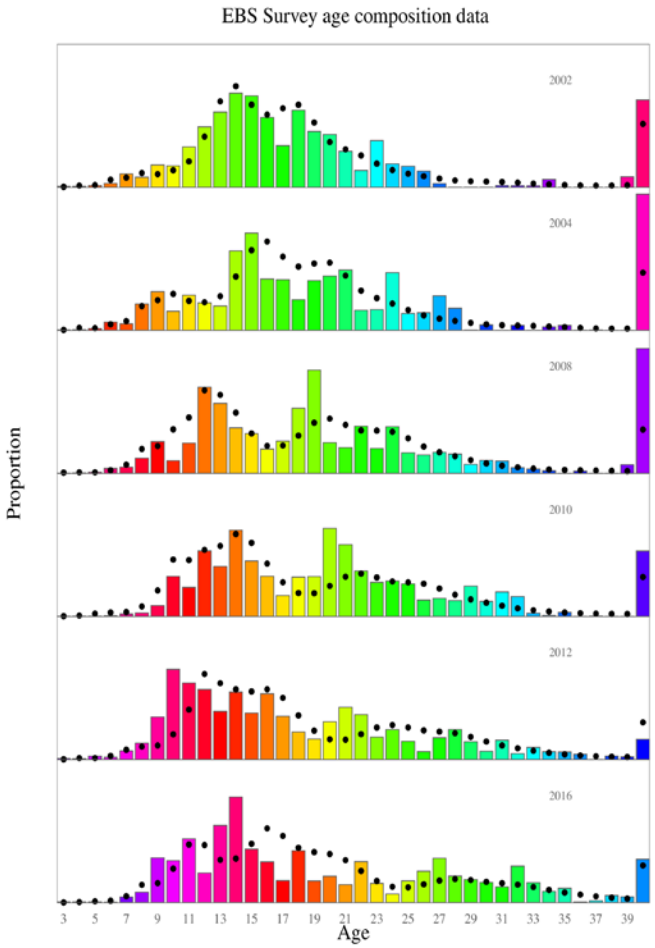
Fishery length composition



AI survey age composition



EBS survey age composition



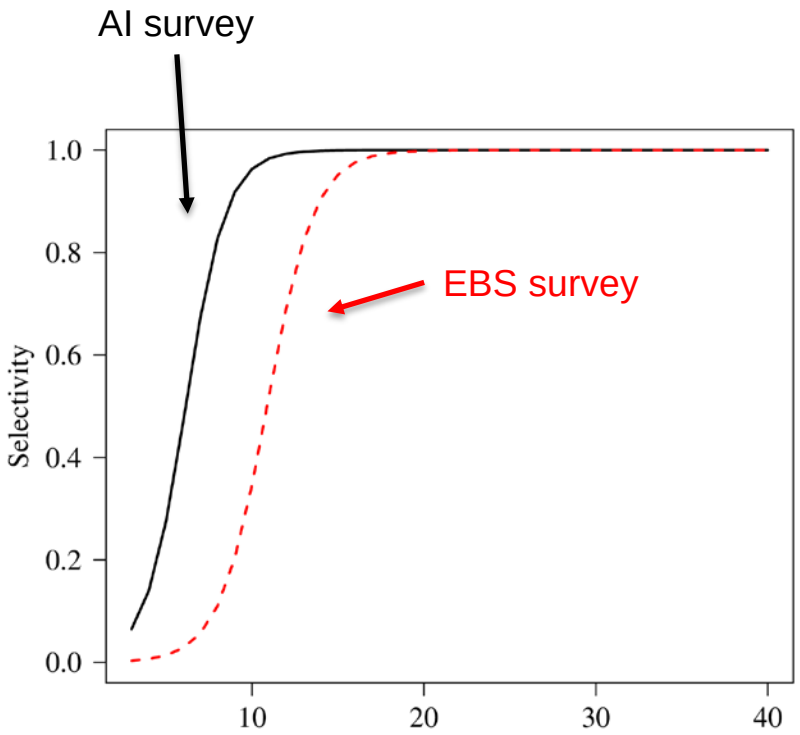
Not a great fit to the EBS survey age compositions

2000 year class is strong in the AI age data, not so much in the EBS data

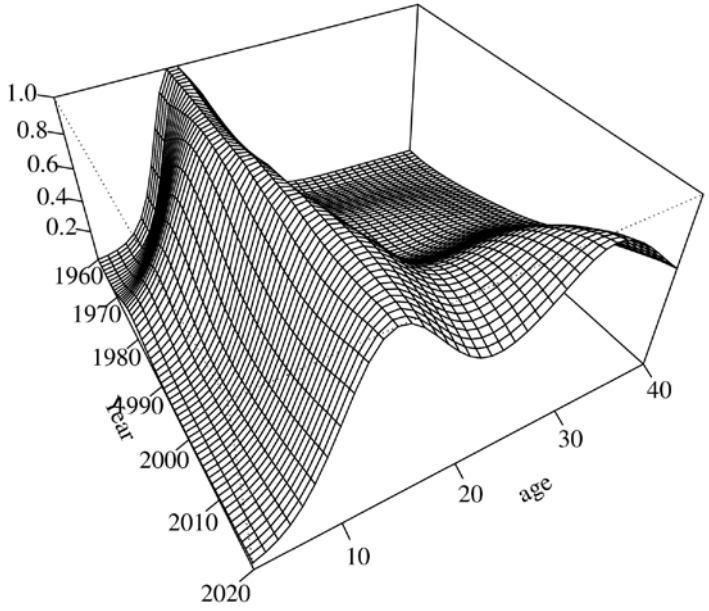
Some arguments about a combined BSAI for blackspotted apply here as well:

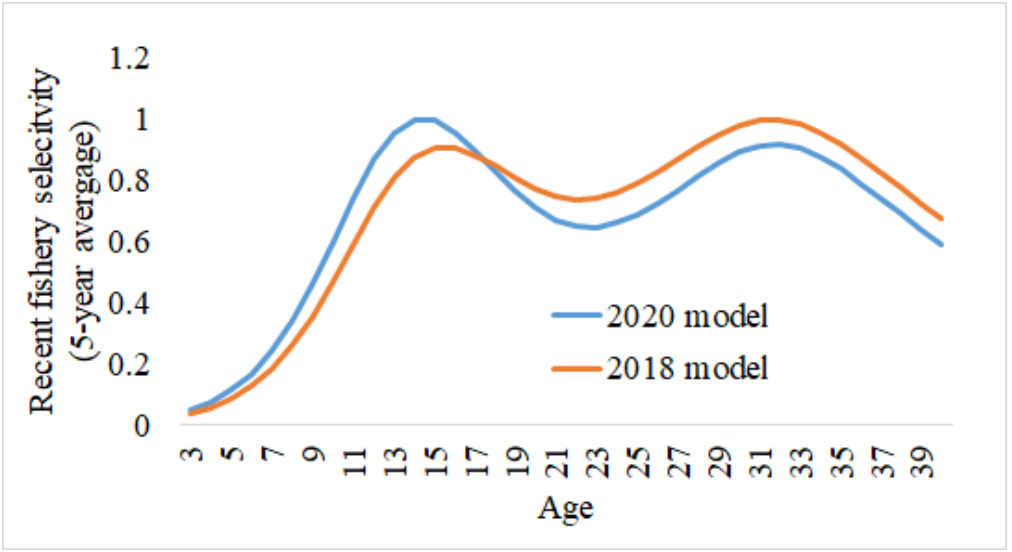
1) Different year class strengths in the 2 areas
2) Different ecosystems

EBS and AI survey selectivity



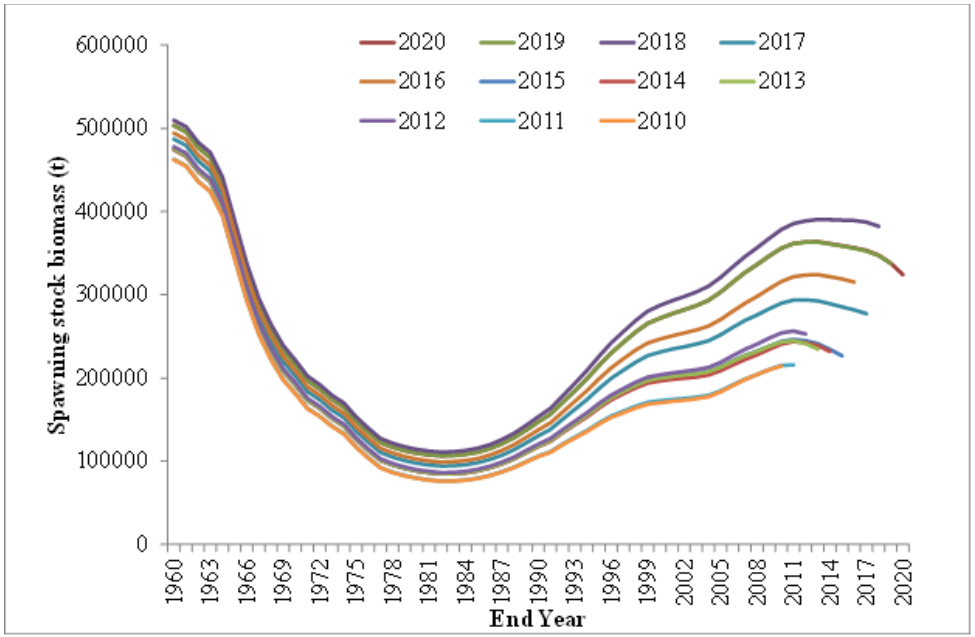
Fishery selectivity





Recent 5-year average selectivity is higher at younger ages, lowering F_{spr} reference points.

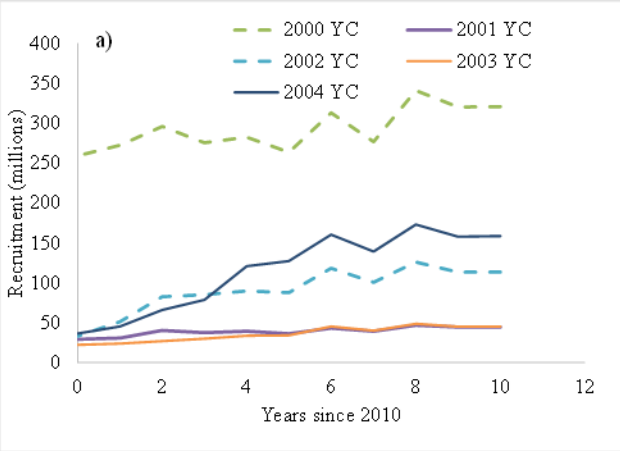
BSAI POP retrospective pattern

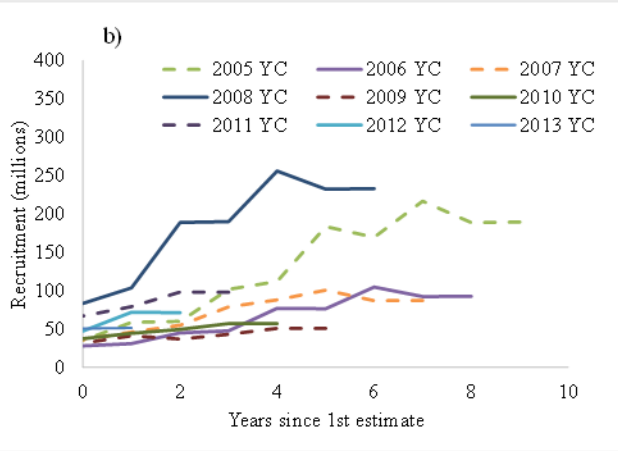


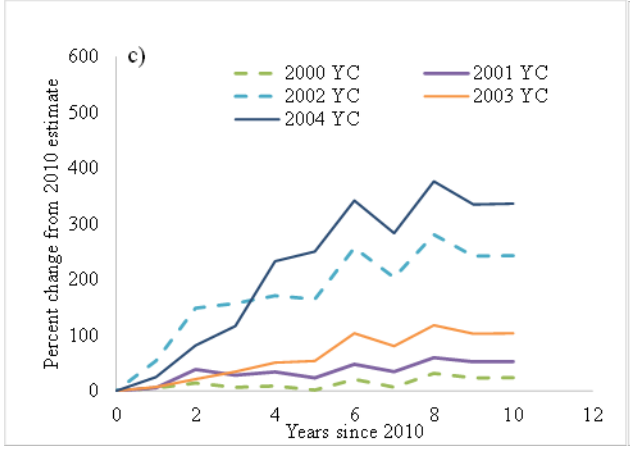
Mohn's rho = -0.24

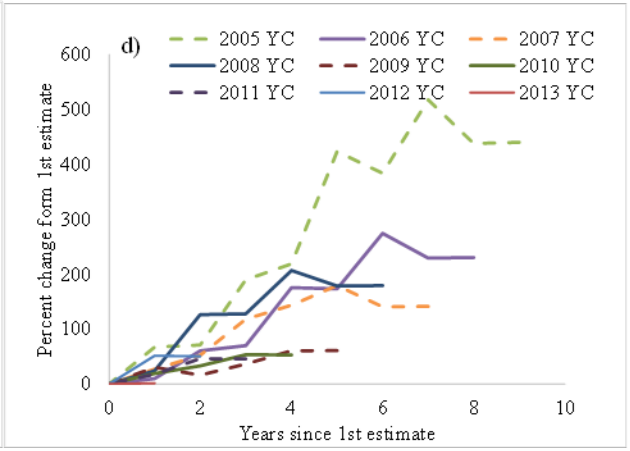
(-0.45 in 2018 assessment)

Retrospective estimates of recruitment

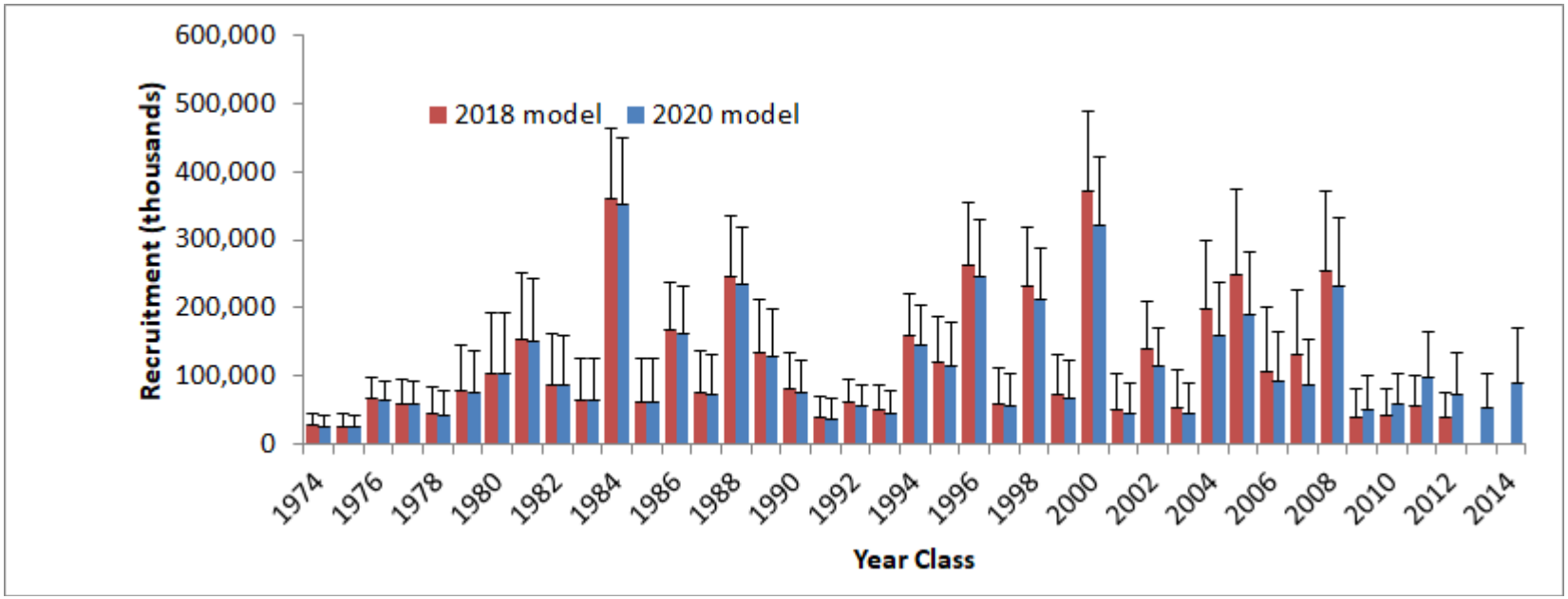




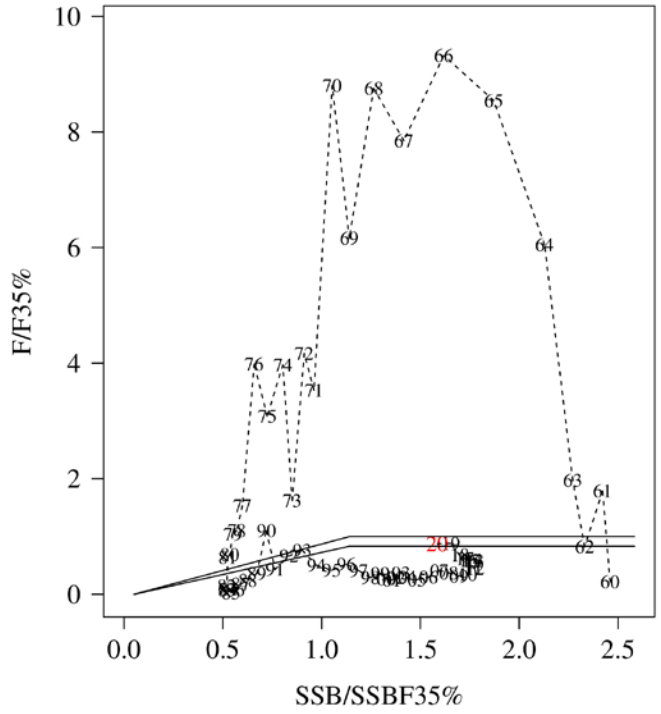


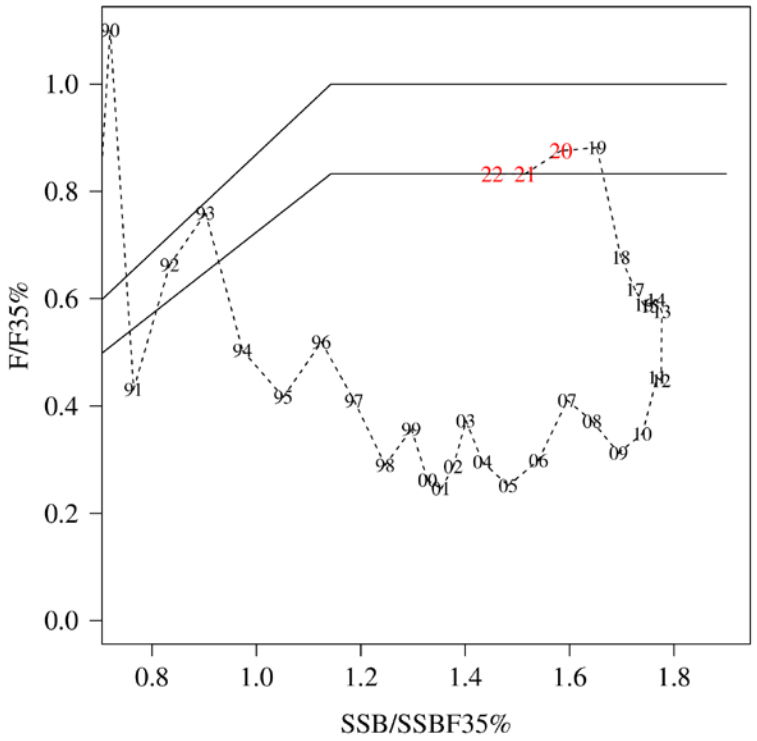


BSAI POP recruitment



Phase plane plot





Natural mortality

(BSAI Plan Team, November 2018) *The Team also recommends updating the prior on M using alternative methods for the next full assessment (e.g., Hamel method, Jason Cope online application,* [*http://barefootecologist.com.au/shiny_m.html*](http://barefootecologist.com.au/shiny_m.html)).

:

Method	Model	Maximum Age 79	104	129
$\text{Then}_{\text{1parm}}$	$M = a/t_{max}$	0.065	0.049	0.040
Then_{lm}	$\log(M) = a + b\log(t_{max})$	0.067	0.051	0.041
Then_{nls}	$M = at_{max}^{b}$	0.090	0.070	0.057

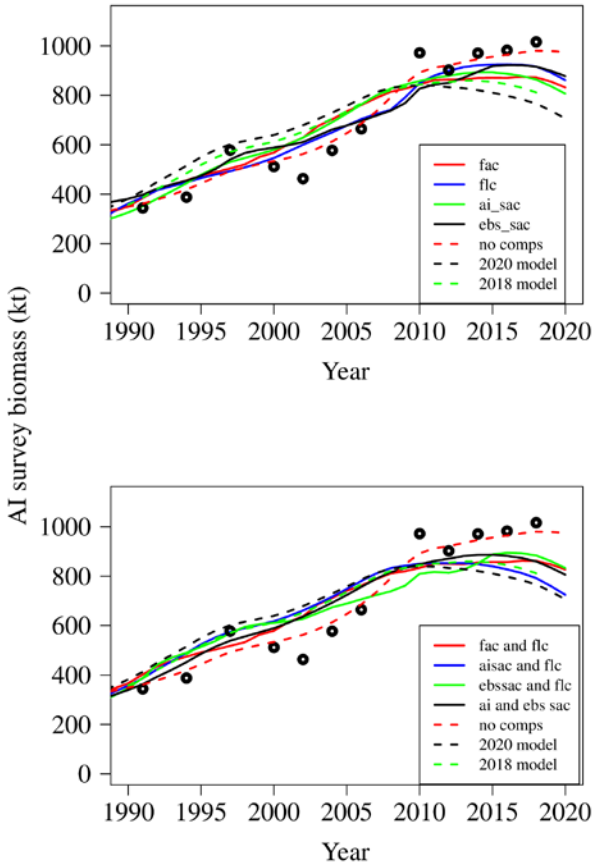
Average of 0.059 in table above

2020 assessment: Prior distribution for M has mean of 0.05, and CV of 0.05 (unchanged from previous assessments).

Estimate of M in 2020 assessment: 0.056.

Sensitivity model runs

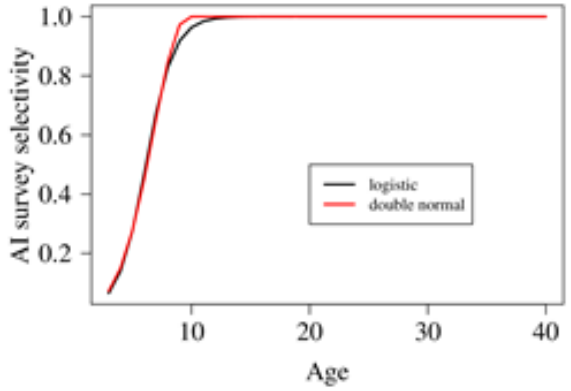
(SSC, December 2018) *The SSC encourages the author to look at sequentially removing data sources to see what data source may be causing the poor fit and residual pattern for the AI survey.*

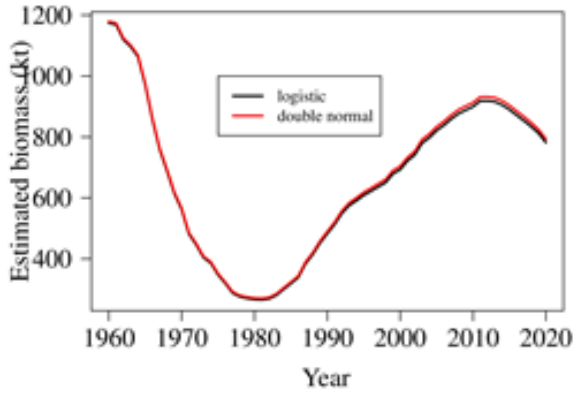


The residual pattern in the fit to the AI survey biomass is not attributable to any single composition data set, but rather the combination of the compositional data sets.

Sensitivity model runs

(SSC, December 2018) *Additionally, allowing survey selectivity to be a little more flexible in shape may be worth exploration.*





Model run with double-normal selectivity, allows for dome-shaped patterns.

For BSAI POP, the increase in survey biomass estimates, and the distribution across a wide range of survey ages, do not suggest dome-shaped survey selectivity.

Risk table considerations

- Assessment considerations: “data-inputs: biased ages, skipped surveys, lack of fishery-independent trend data; model fits: poor fits to fits to fishery or survey data, inability to simultaneously fit multiple data inputs; model performance: poor model convergence, multiple minima in the likelihood surface, parameters hitting bounds; estimation uncertainty: poorly-estimated but influential year classes; retrospective bias in biomass estimates.

- Level 2: Substantially increased uncertainty/unresolved issues. Strong retrospective bias that could represent model misspecification, but population dynamics and/or observational processes have not been identified. Poor residual pattern in fitting recent AI survey biomass estimates. Strong prior on natural mortality understates model uncertainty.

Risk table considerations

- Population dynamics considerations: “decreasing biomass trend, poor recent recruitment, inability of the stock to rebuild, abrupt increase or decrease in stock abundance.

- Level 1: Stock trends are typical for the stock; recent recruitment is in the normal range.

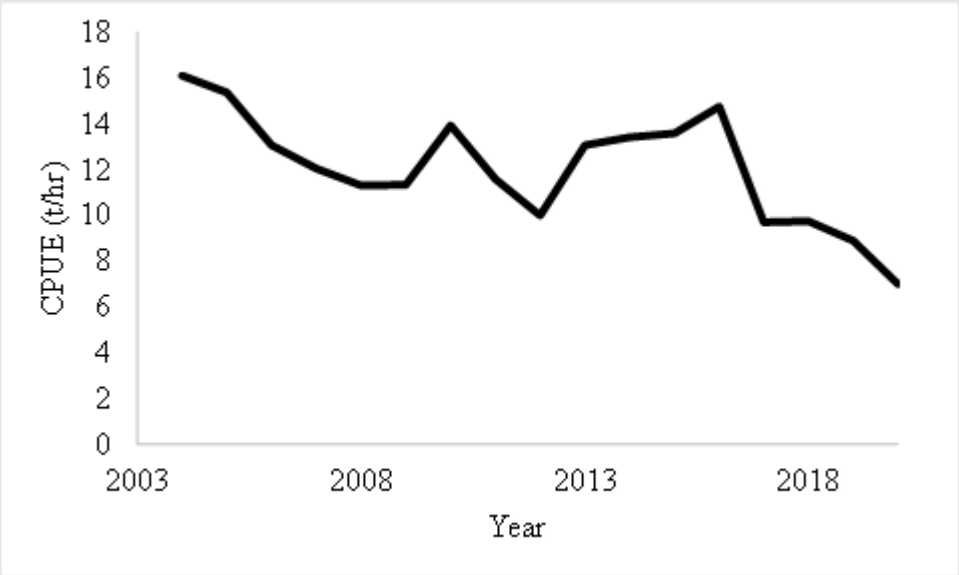
Rapid increase in the stock between 2006-2010 is somewhat unusual, although there is precedence for the stock rebuilding quickly from periods with strong recruitments. Recent recruitments have been lower.

Risk table considerations

- Environmental/ecosystem considerations: "*adverse trends in environmental/ecosystem indicators, ecosystem model results, decreases in ecosystem productivity, decreases in prey abundance or availability, increases or increases in predator abundance or productivity.*"

- Level 1: Normal. "*Taken together, these indicators suggest no clear concerns for the POP stock aside from the recent stretch of increased temperatures. That being said, the recent increasing trend in the POP stock suggests that the temperature impacts have not been limiting. However, the lack of data in 2020 limits our assessment of potential recent ecosystem impacts on this stock. Overall, we rank the assessment considerations as a 1"*

Fishery CPUE



Tons/hr, from tows targeting POP based on haul species composition. Source: North Pacific Groundfish Observer Program.

Risk table considerations

- Fishery performance considerations: “fishery CPUE is showing a contrasting pattern from the stock biomass trend, unusual spatial pattern of fishing, changes in the percent of TAC taken, changes in the duration of fishery openings.”

- Level 1: No apparent fishery/resource-use performance and/or behavior concerns.

  Fishery CPUE was relatively stable from 2004-2016. A decline in CPUE has occurred since 2017, which might be related to change in fishing practices in order to better avoid bycatch stocks.

Conclusions

- Continued high abundance of POP, but declining recently.
- High survey biomass estimates have been keeping the estimated biomass in the assessment at a high level. Without a 2020 survey, the estimated biomass is lower.

Reference points and ABCs

Quantity	As estimated or specified last year for: 2020	2021	As estimated or recommended this year for: 2021	2022
M (natural mortality rate)	0.056	0.056	0.056	0.056
Tier	3a	3a	3a	3a
Projected total (age 3+) biomass	908,529	885,439	756,011	735,367
Female spawning biomass (t)				
Projected	383,178	367,062	310,036	297,091
$B_{100\%}$	645,738	645,738	584,747	584,747
$B_{40\%}$	258,295	258,295	233,899	233,899
$B_{35\%}$	226,008	226,008	204,661	204,661
F_{OFL}	0.095	0.095	0.089	0.089
$maxF_{ABC}$	0.079	0.079	0.073	0.073
F_{ABC}	0.079	0.079	0.073	0.073
OFL (t)	58,956	56,589	44,376	42,384
maxABC (t)	48,846	46,885	37,173	35,503
ABC (t)	48,846	46,885	37,173	35,503
Status	As determined last year for: 2018	2019	As determined this year for: 2019	2020
Overfishing	No	n/a	No	n/a
Overfished	n/a	No	n/a	No
Approaching overfished	n/a	No	n/a	No

Recommended 2021 BSAI ABCs and OFLs

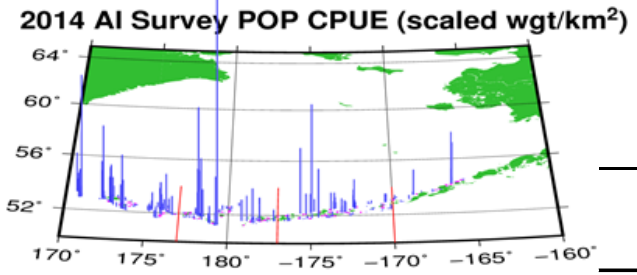
BSAI ABC: 37,173 t (decrease from 2020 ABC of 48,846 t)

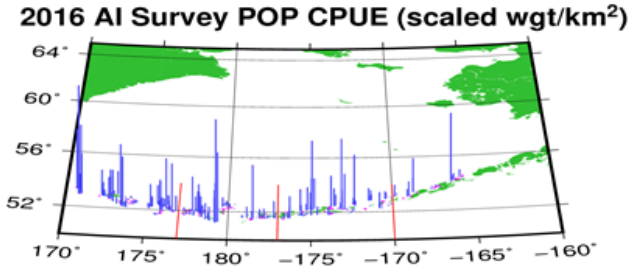
BSAI OFL: 44,376 t (decrease from 2020 OFL of 58,956 t)

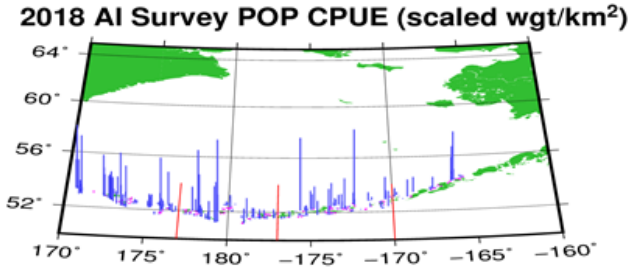
Subarea ABCs

Area	Year	Age 3 Bio (t)	OFL	ABC	TAC	Catch[1]
BSAI	2019	934,293	61,067	50,594	44,069	43,118
	2020	908,529	58,956	48,846	42,875	32,593
	2021	756,011	44,376	37,173		
	2022	735,367	42,384	35,503		
Eastern Bering Sea	2019			14,675	14,675	14,022
	2020			14,168	14,168	6,297
	2021			10,782	n/a	n/a
	2022			10,298	n/a	n/a
Eastern Aleutian Islands	2019			11,459	11,009	10,945
	2020			11,063	10,613	8,436
	2021			8,419	n/a	n/a
	2022			8,041	n/a	n/a
Central Aleutian Islands	2019			8,435	8,385	8,263
	2020			8,144	8,094	7,966
	2021			6,198	n/a	n/a
	2022			5,919	n/a	n/a
Western Aleutian Islands	2019			16,025	10,000	9,888
	2020			15,471	10,000	9,894
	2021			11,774	n/a	n/a
	2022			11,245	n/a	n/a

Survey CPUE, 2014 – 2018 AI surveys

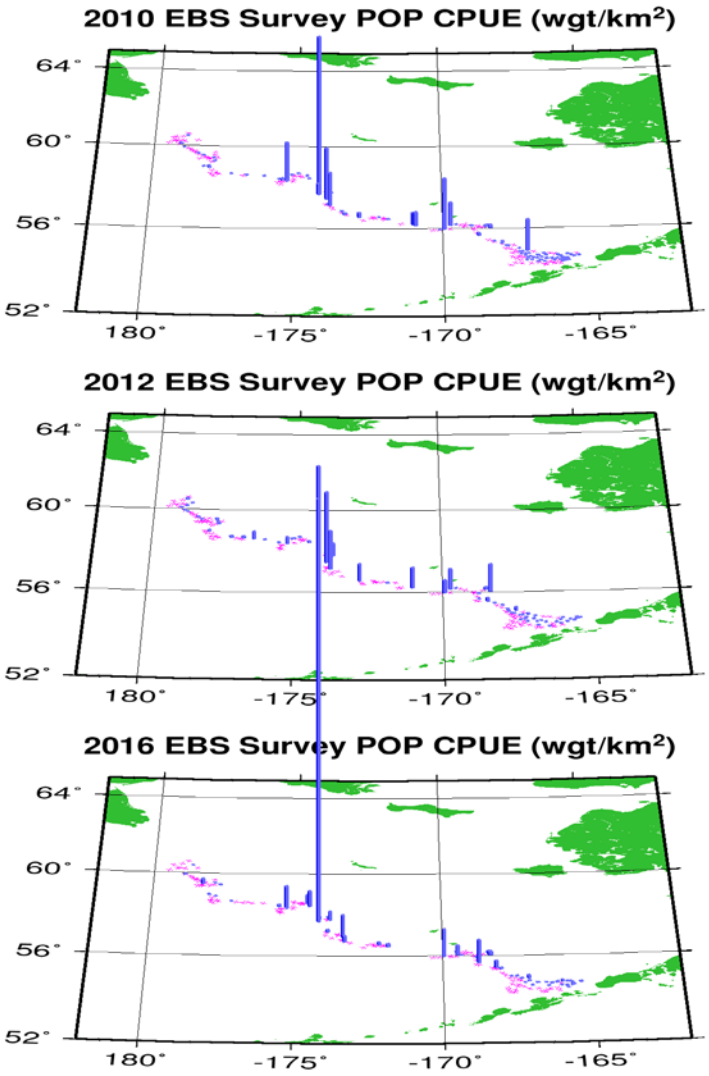






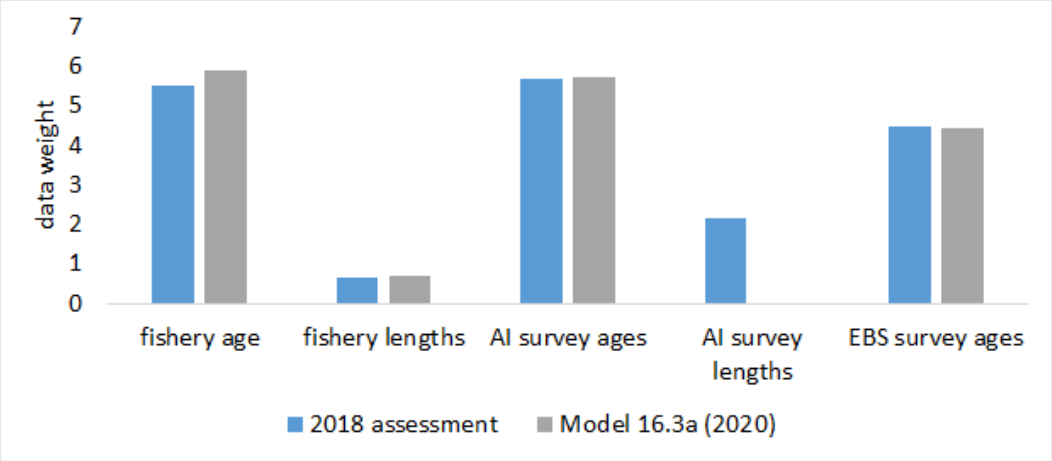
Year	Western	Central	Eastern	southern BS	Total AI survey
2014	338,455 (0.21)	315,544 (0.49)	233,560 (0.28)	83,409 (0.50)	970,968 (0.19)
2016	403,049 (0.19)	206,593 (0.19)	284,909 (0.17)	87,952 (0.47)	982,503 (0.11)
2018	427,440 (0.20)	195,497 (0.19)	278,326 (0.21)	115,046 (0.29)	1,016,309 (0.11)

Survey CPUE, 2010 – 2016 EBS surveys

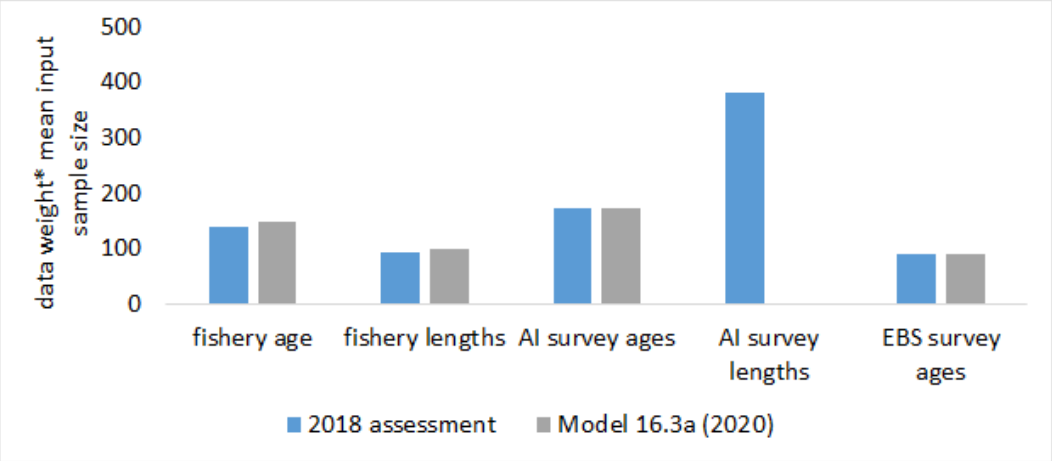


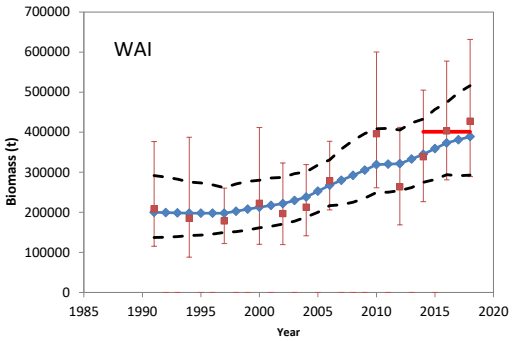
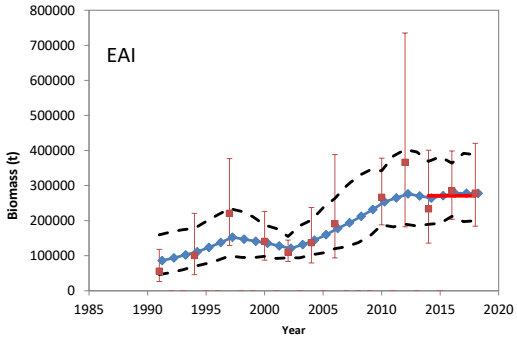
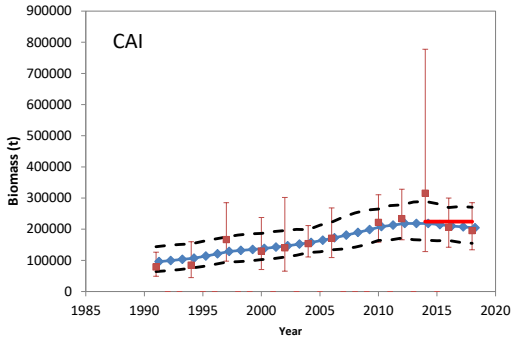
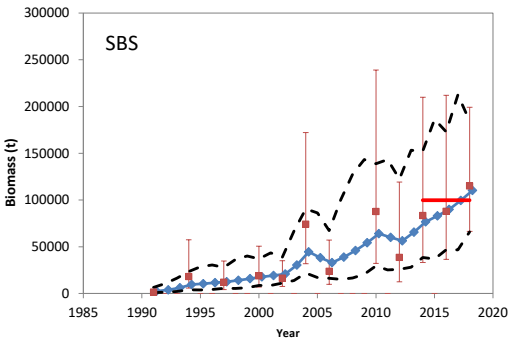
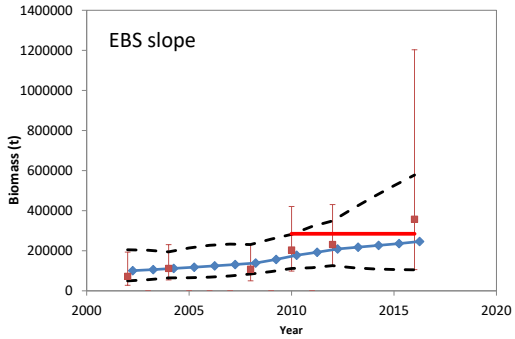
Year	EBS slope survey
2002	72,665 (0.53)
2004	112,273 (0.38)
2008	107,886 (0.41)
2010	203,421 (0.38)
2012	231,046 (0.38)
2016	357,369 (0.68)

Age/length composition weights



Data weights



(Data weights) *
(mean input sample size)

Smoothed survey time series by subarea