2018 BSAI Pacific ocean perch Assessment

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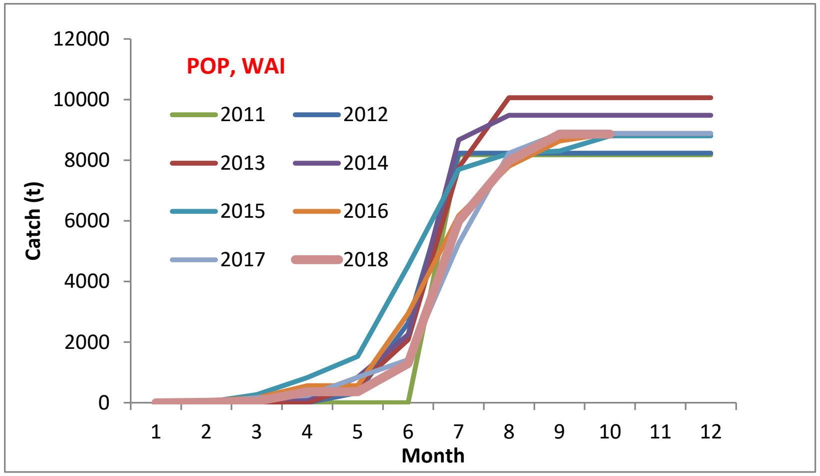
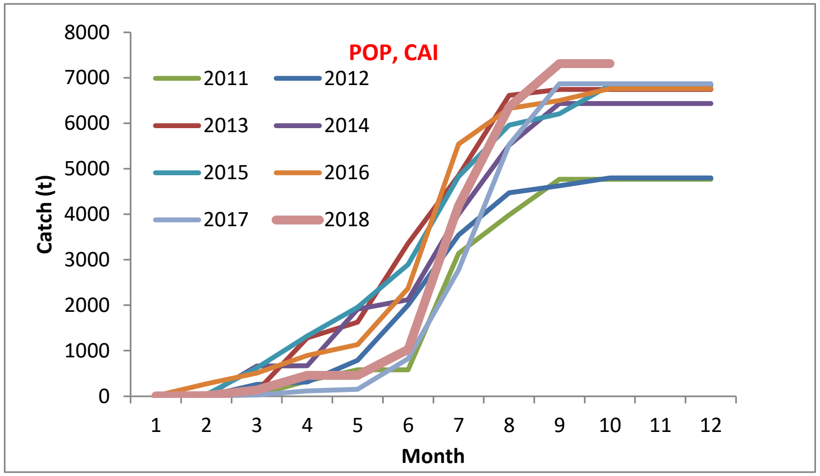
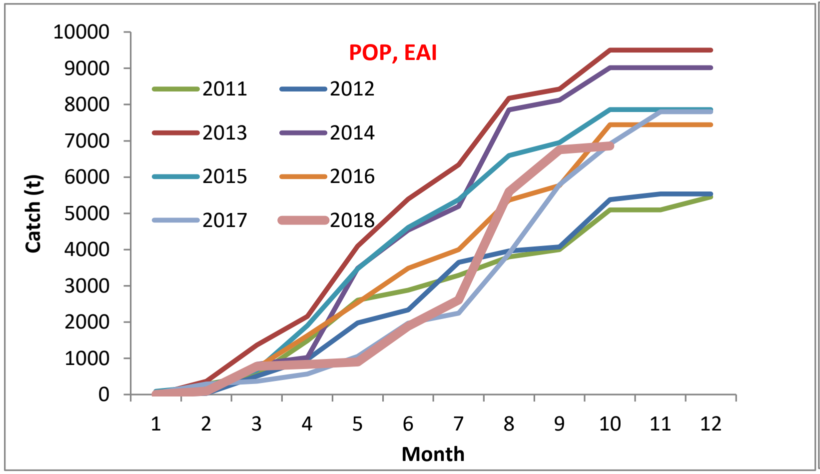
BSAI POP Outline

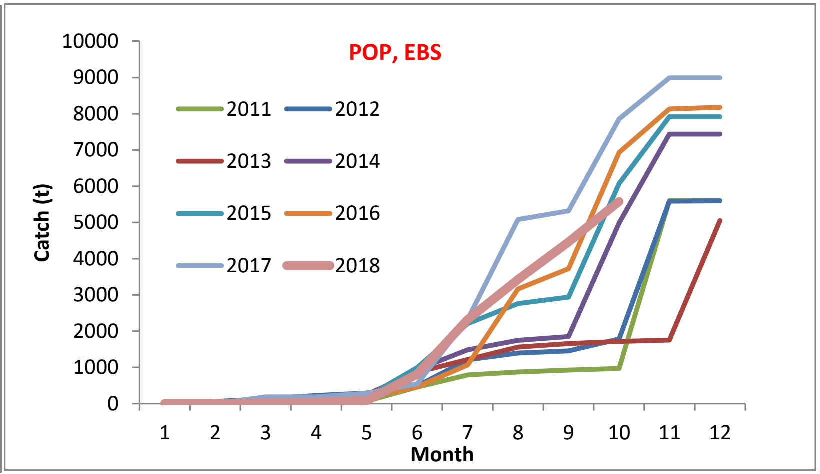
1) Catch information
2) Economic performance report
3) Survey and fishery data
4) Retrospective analysis
5) Model fits to data
7) Management recommendations
8) Appendix – time-varying q

BSAI POP catch by month and area, 2011-2018









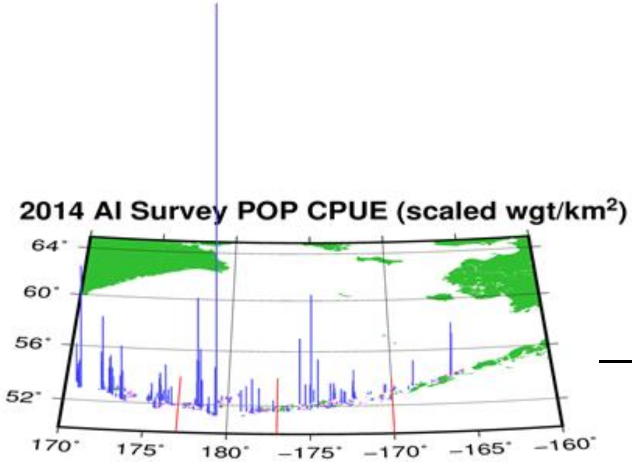
Economic performance report

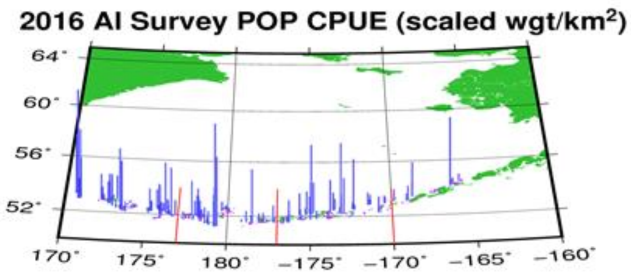
	2008-2012 Average	2013	2014	2015	2016	2017
Total catch K mt	24.2	34.9	36.1	39.6	36.9	38.4
Retained catch K mt	21.1	31.7	32.3	37.5	35.3	35.5
Pac. Ocn. perch share of retained	85%	91%	91%	80%	86%	85%
Northern share of retained	10%	5%	6%	18%	12%	12%
Vessels #	18.4	20	23	20	21	20
First-wholesale production K mt	11.3	16.9	18.0	19.4	17.6	17.4
First-wholesale value M US$	$31.5	$39.7	$47.1	$42.8	$34.7	$42.0
First-wholesale price/lb US$	$1.26	$1.07	$1.18	$1.00	$0.90	$1.09
Pac. Ocn. perch share of value	86%	92%	90%	83%	87%	88%
Pac. Ocn. perch price/lb US$	$1.26	$1.06	$1.19	$1.05	$0.91	$1.12
Northern rockfish share of value	7%	3%	5%	14%	8%	8%
Northern rockfish price/lb US$	$1.00	$0.72	$0.91	$0.74	$0.64	$0.76
H&G share of value	96%	97%	97%	97%	94%	95%

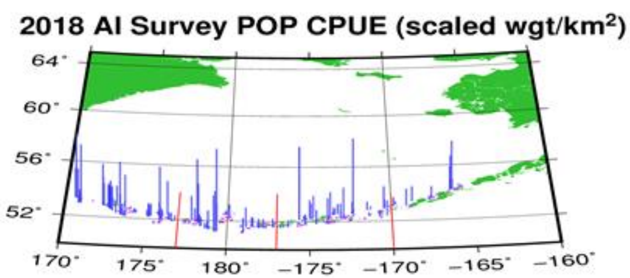
Increased discards in the EBS

	EBS			AI			BSAI		
Year	Retained	Discarded	Percent Discarded	Retained	Discarded	Percent Discarded	Retained	Discard	Percent Discarded
2011	5,249	353	6	18,021	382	2	23,269	735	3
2012	5,182	408	7	18,169	401	2	23,352	810	3
2013	4,746	304	6	26,063	249	1	30,809	553	2
2014	6,614	823	11	24,770	174	1	31,384	997	3
2015	6,749	1,166	15	23,267	240	1	30,016	1,406	4
2016	7,419	754	9	22,899	199	1	30,317	952	3
2017	6,986	2,001	22	23,293	264	1	30,279	2,265	7
2018*	3,785	1,792	32	22,635	394	2	26,419	2,186	8

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)

Has the area of POP expanded over time?

(Swain and Sinclair (1994), applied by Spencer 2008)

Based on cumulative distributions of survey CPUE data

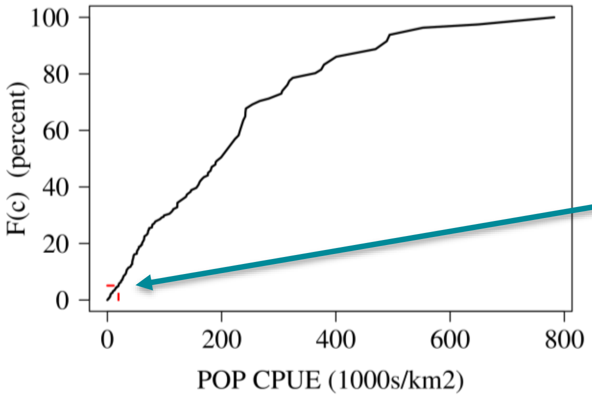
Model-free, and a useful way to describe the survey data (provided that the stratified design is considered). Each tow has an area, based on the total survey area and sampling density of the strata.

F(c) = Cumulative frequency of CPUE
G(c) = Cumulative area in relation to CPUE

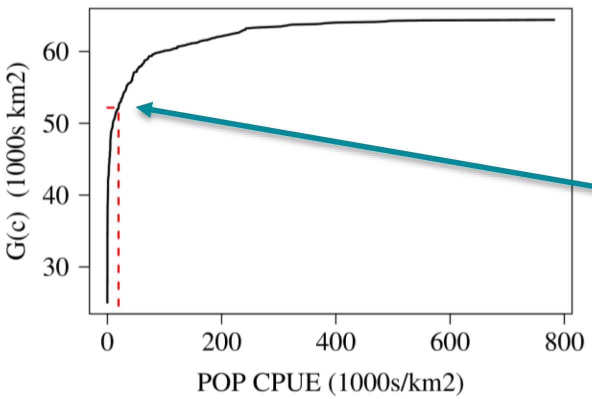
$$F(c) = 100 \frac{\sum_{h=1}^{L} \sum_{i=1}^{n_h} \frac{A_h}{n_h} X_{hi} I}{\sum_{h=1}^{L} \sum_{i=1}^{n_h} \frac{A_h}{n_h} X_{hi}} \quad \text{where } I = \begin{cases} 1 \text{ if } X_{hi} \leq c \\ 0 \text{ otherwise} \end{cases}$$

$$G(c) = \sum_{h=1}^{L} \sum_{i=1}^{n_h} \frac{A_h}{n_h} I \quad \text{where } I = \begin{cases} 1 \text{ if } X_{hi} \leq c \\ 0 \text{ otherwise.} \end{cases}$$

Example (POP, 2018)



95% of the distribution of survey CPUE observations are above this value

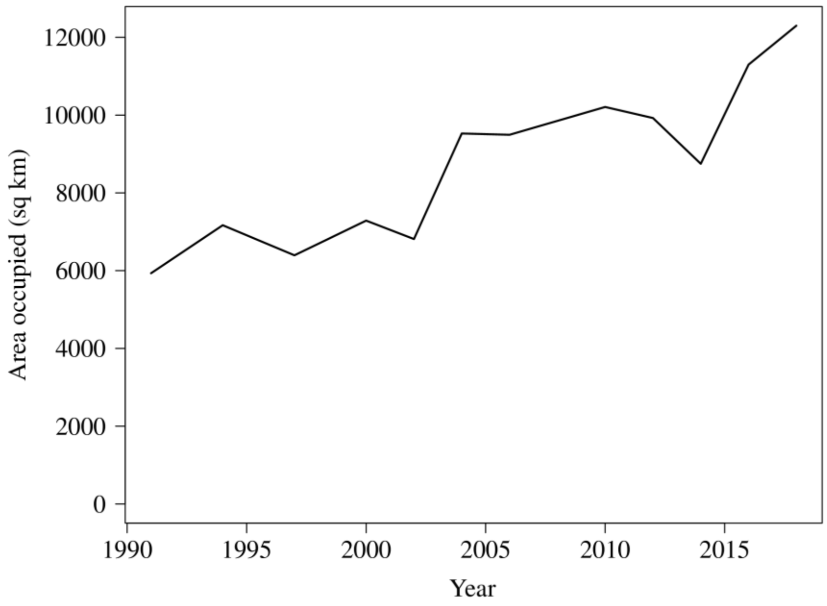


Area occupied (D_{95}) =

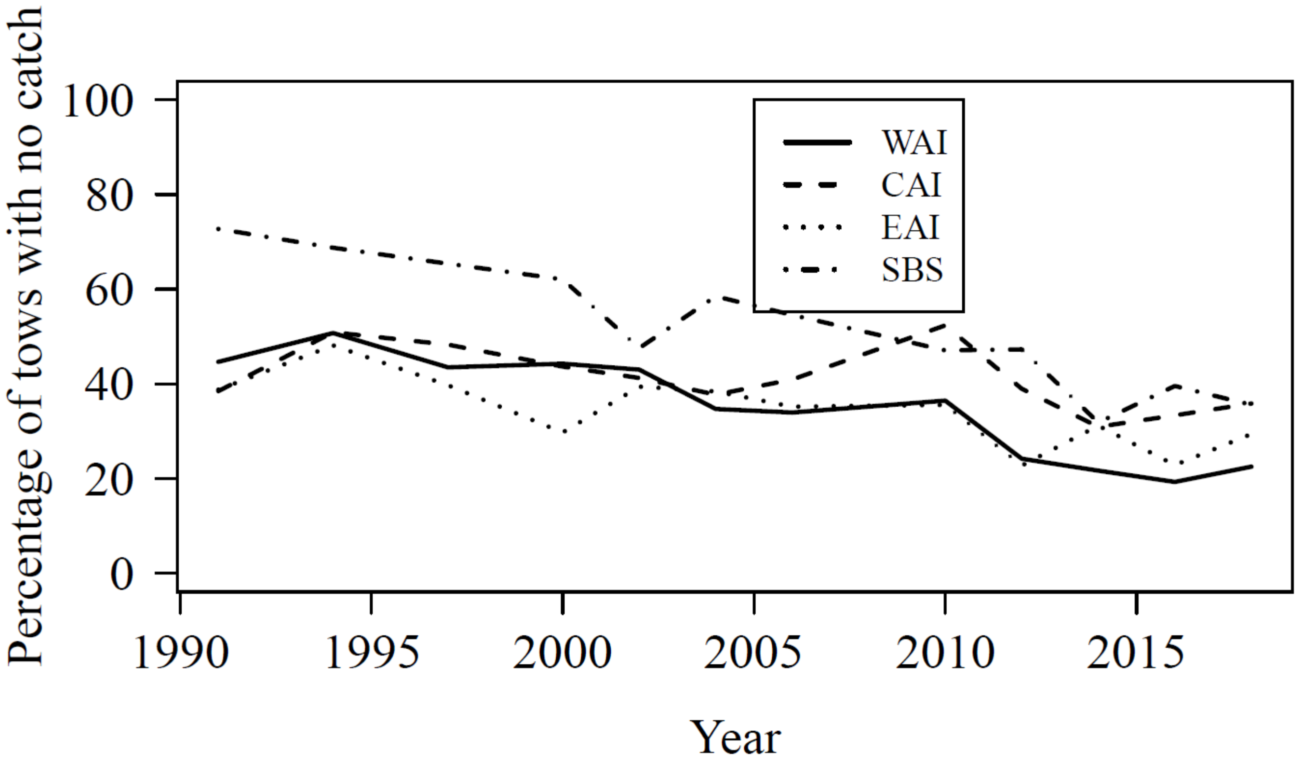
Total survey area (64,413 km2) –
area associated with tows with CPUE in the bottom 5% (52,113 km2)

= 12,300 km2

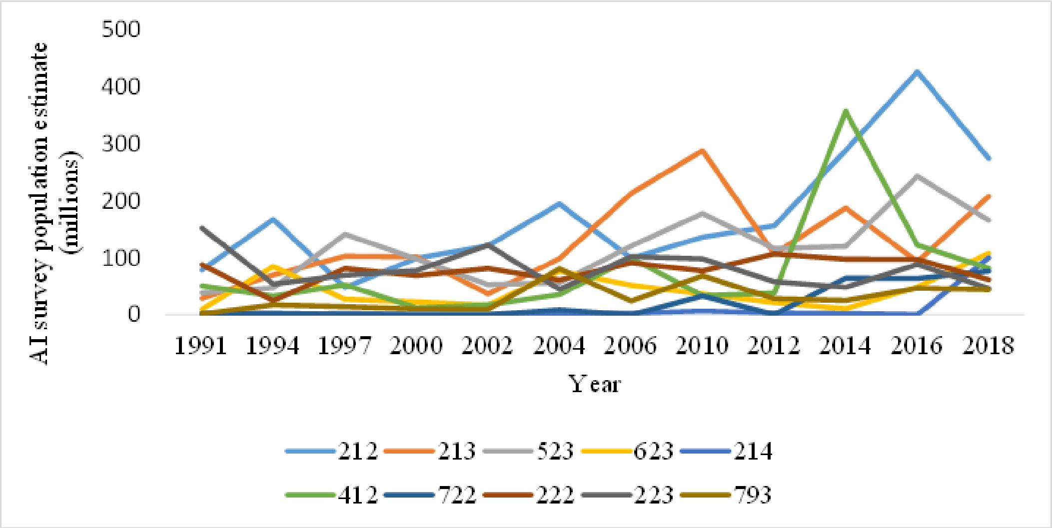
POP area occupied ($D_{95\%}$)



Increased proportion of tows catching POP



AI survey population increases by strata

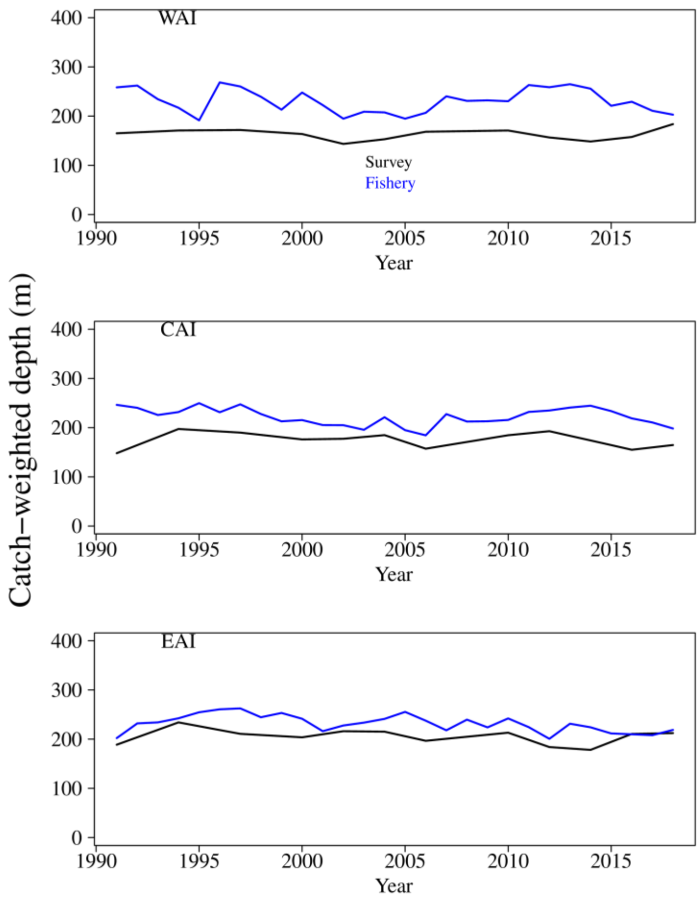


45 AI survey strata

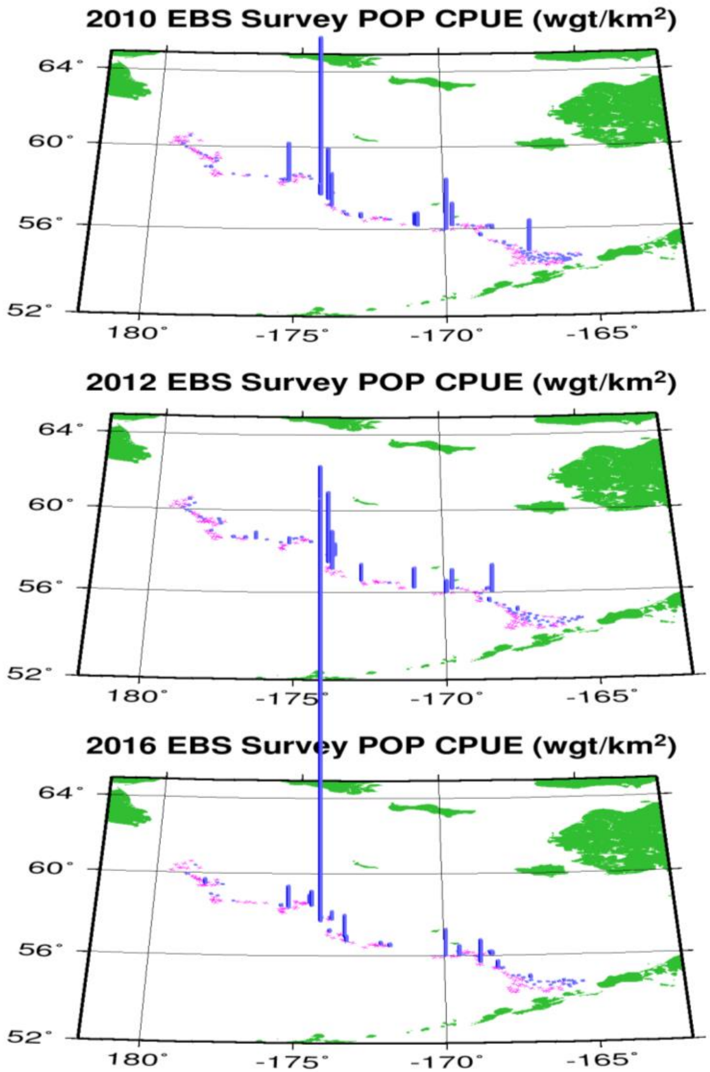
Plot shows top 10 strata with the largest abundance in the 2018 survey

In 9 of the 10, abundance has increased.

Mean depth in fishery and survey



Survey CPUE, 2010 – 2016 EBS surveys

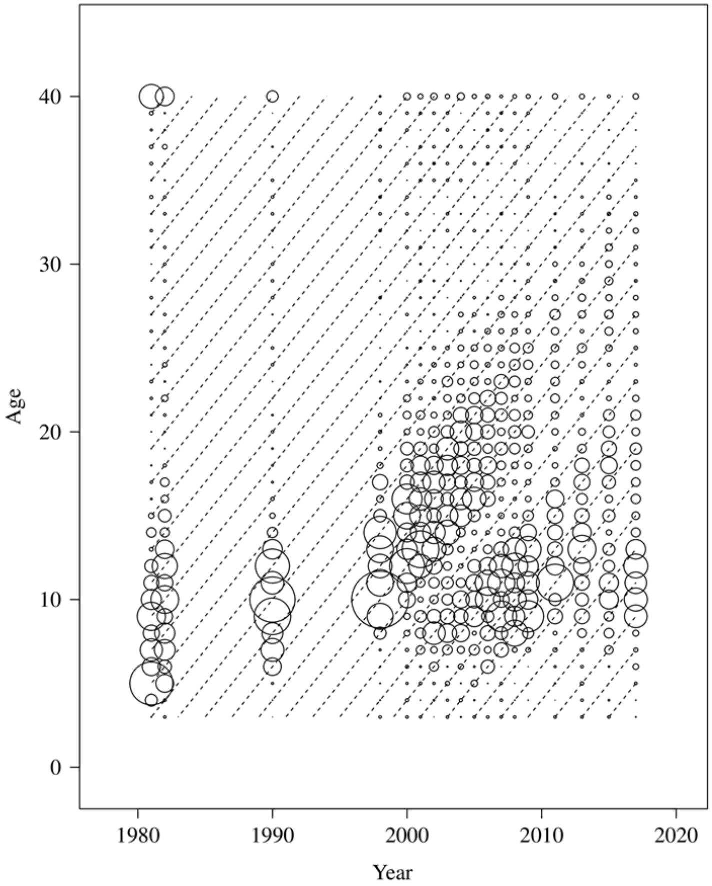


Year	EBS slope survey
2002	72,665 (0.53)
2004	112,273 (0.38)
2008	107,886 (0.41)
2010	203,421 (0.38)
2012	231,046 (0.38)
2016	357,369 (0.68)

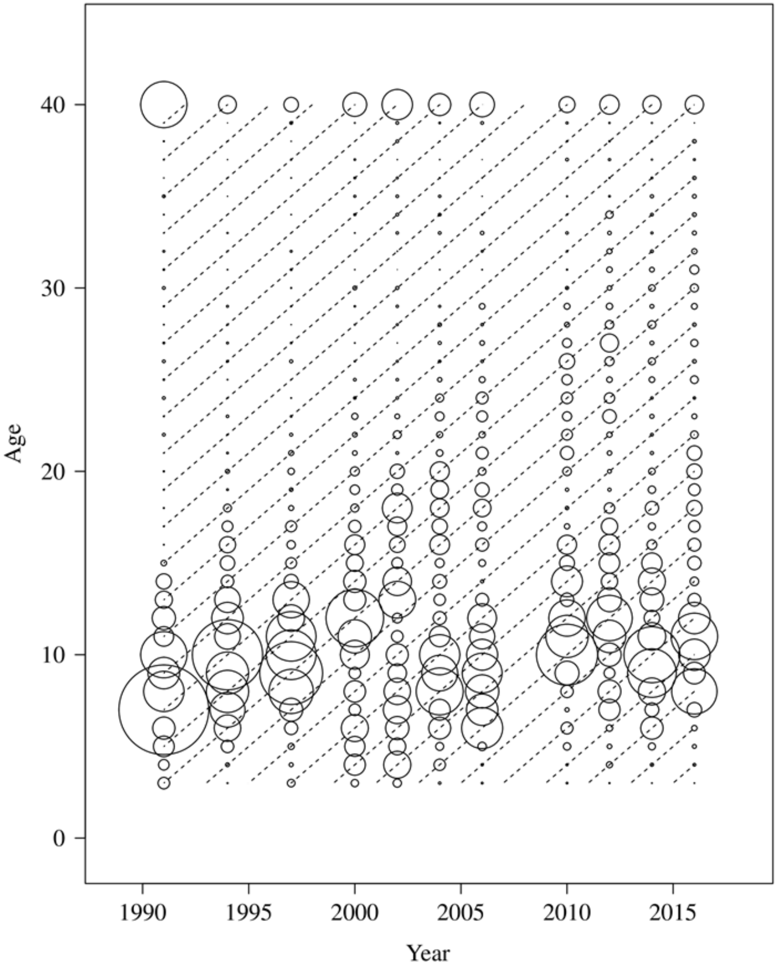
Data in assessment model

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

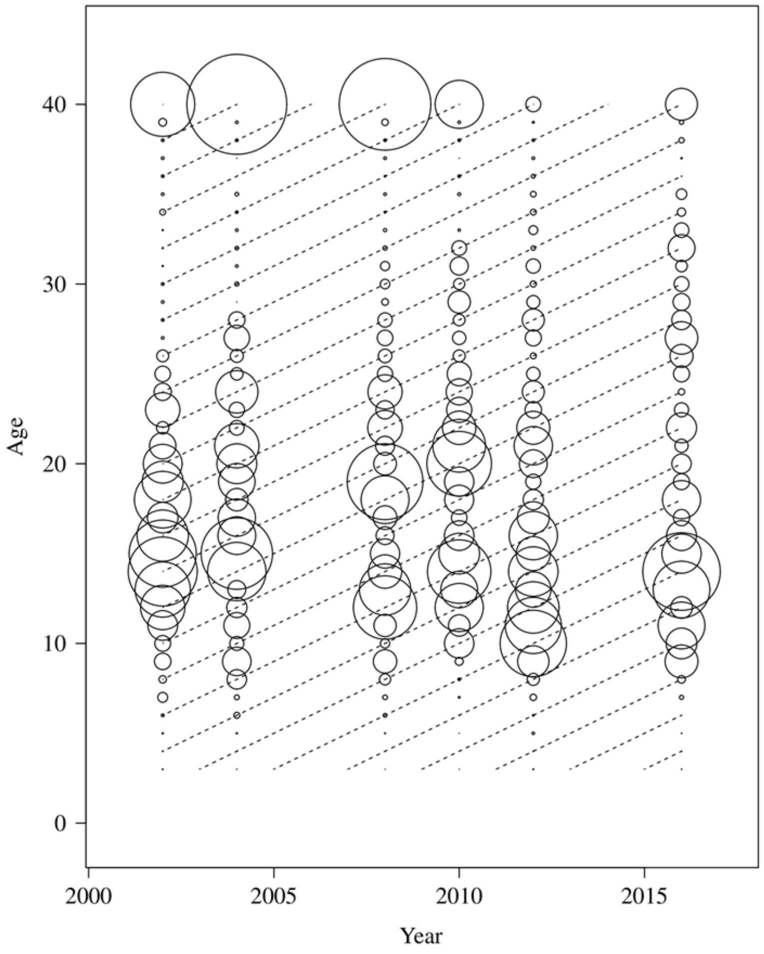
POP fishery age composition data



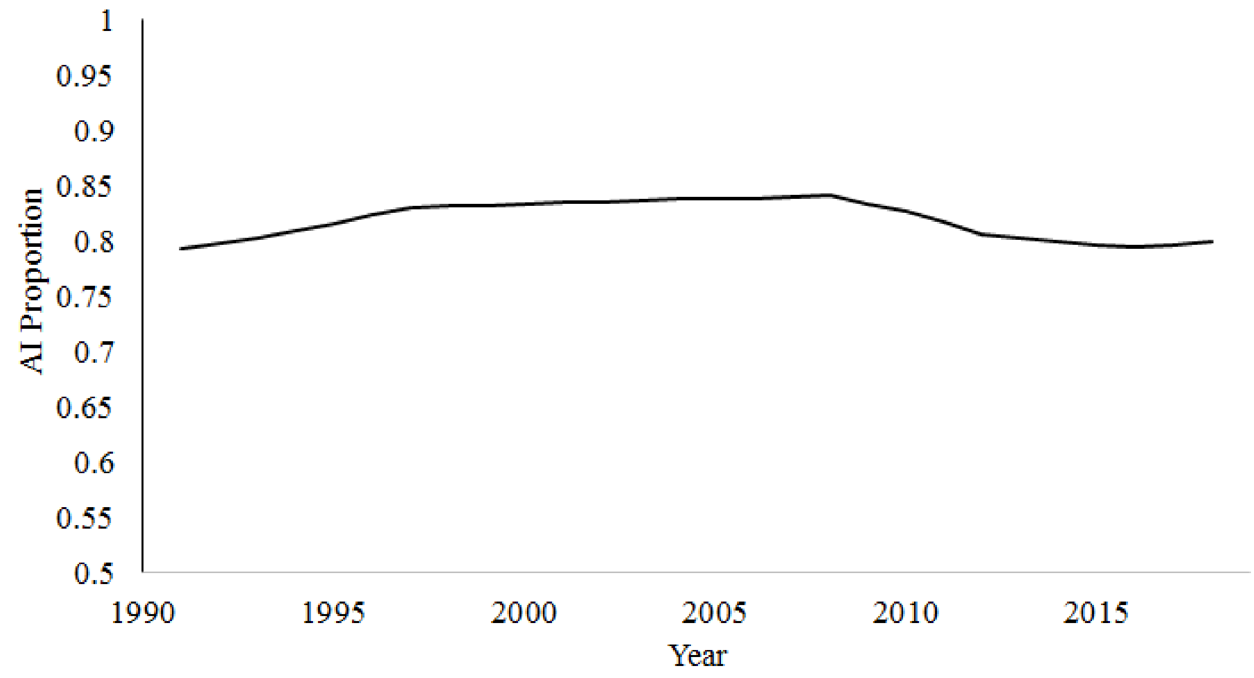
POP AI survey age composition data



POP EBS survey age composition data



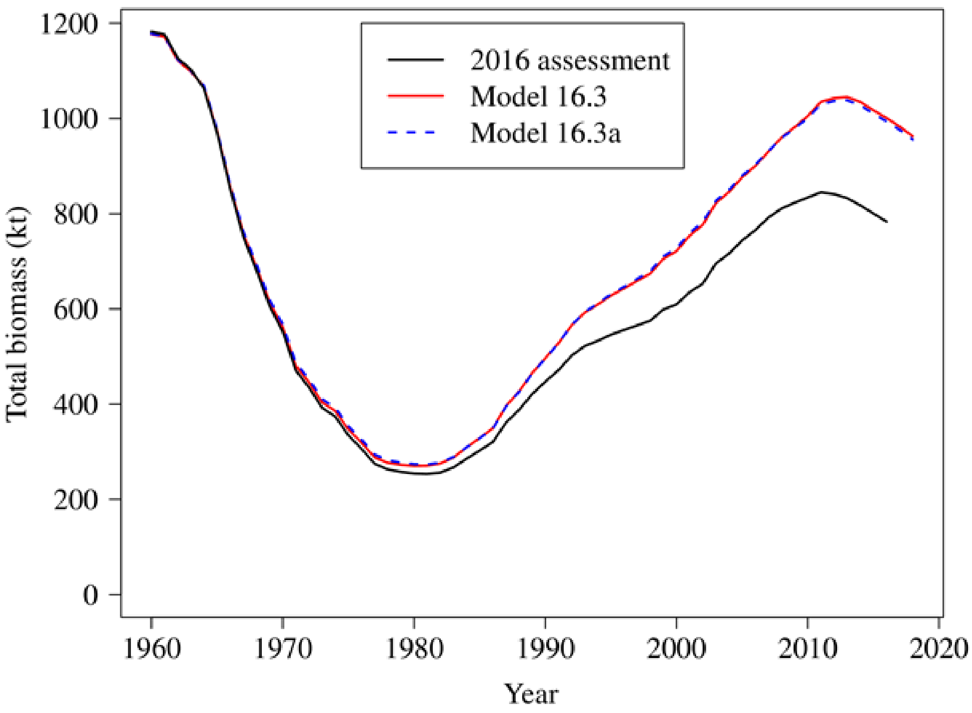
Time series of relative proportion of BSAI survey biomass in AI subarea



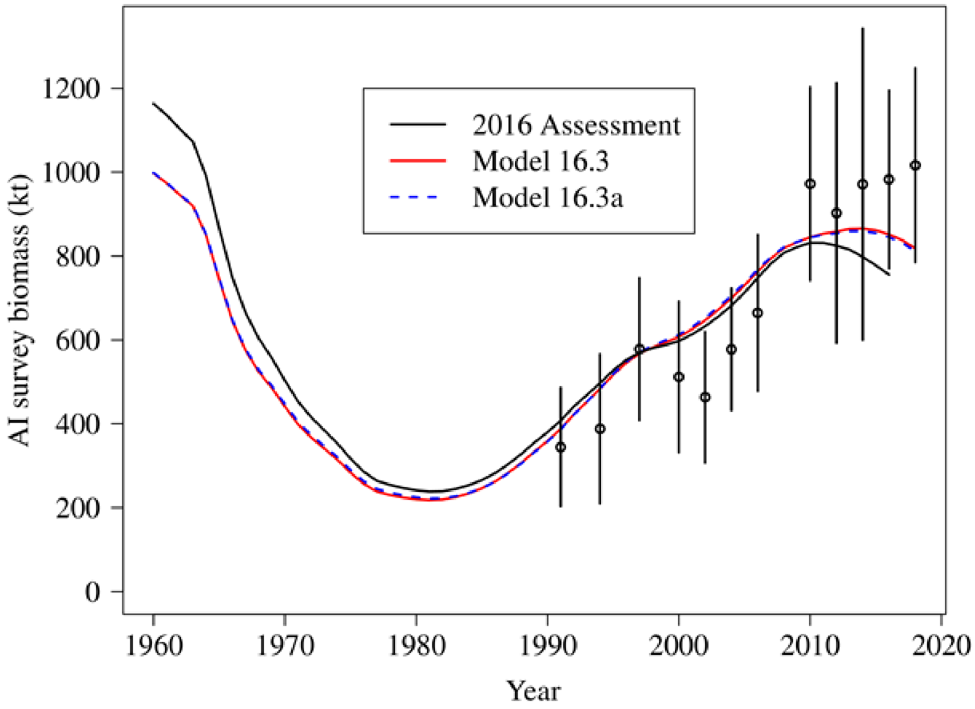
Models evaluated

- ***Model 16.3*** From 2016 assessment, updated data and reweighting of age/length compositions with McAllister-Ianelli method
- ***Model 16.3a*** Model 16.3, but with number of year nodes for fishery selectivity spline increased from 4 to 5

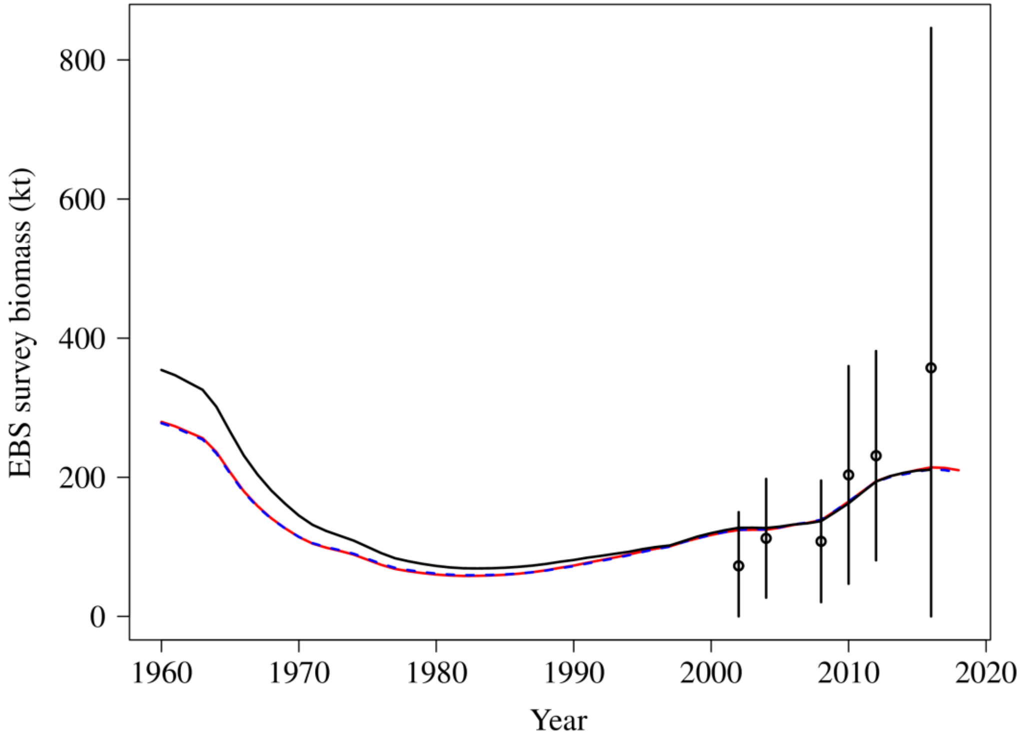
Estimates of total biomass



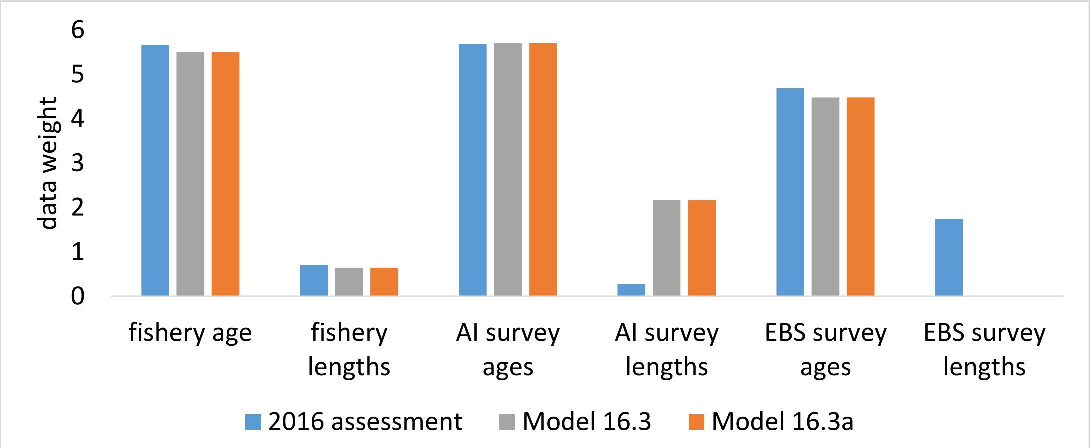
Fit to the AI survey



Fit to the EBS survey index

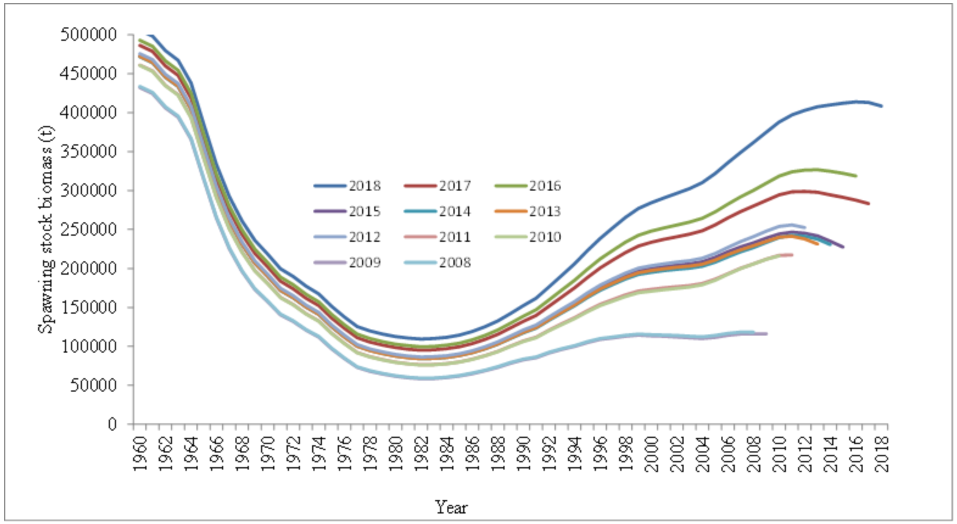


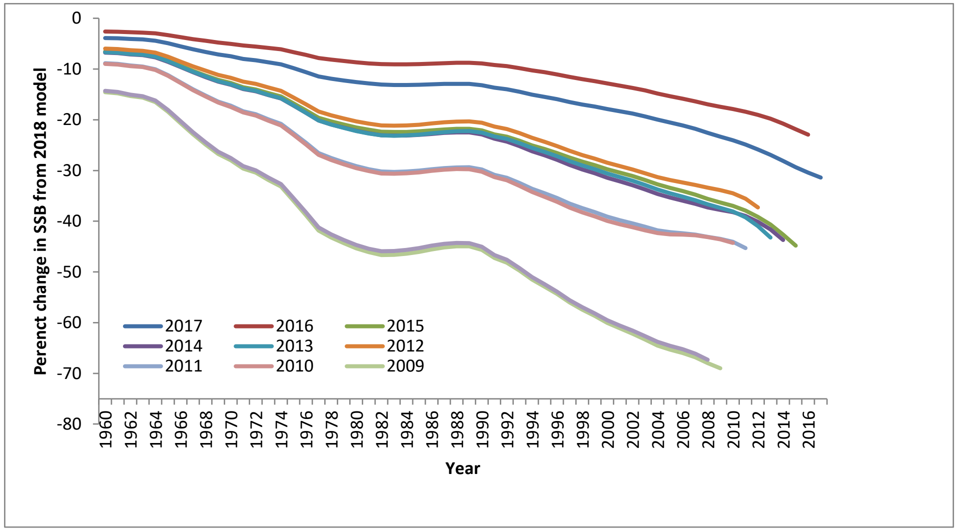
Age/length composition weights



Data weights

BSAI POP retrospective pattern



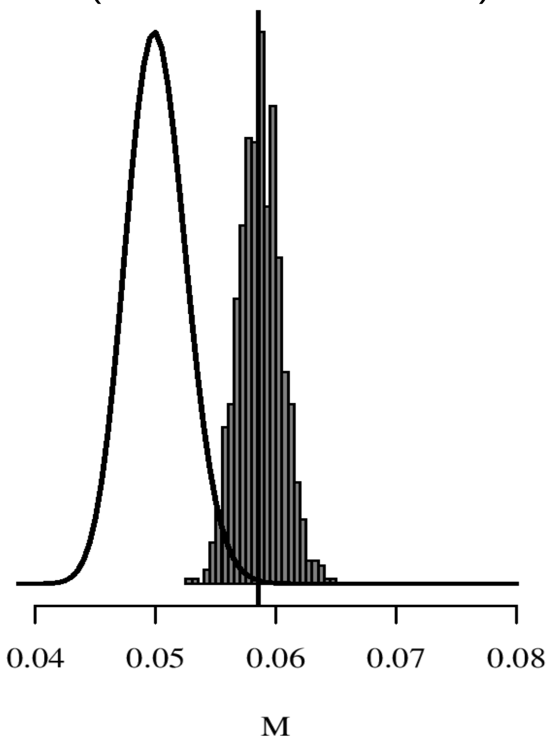


Mohn's rho = -0.45

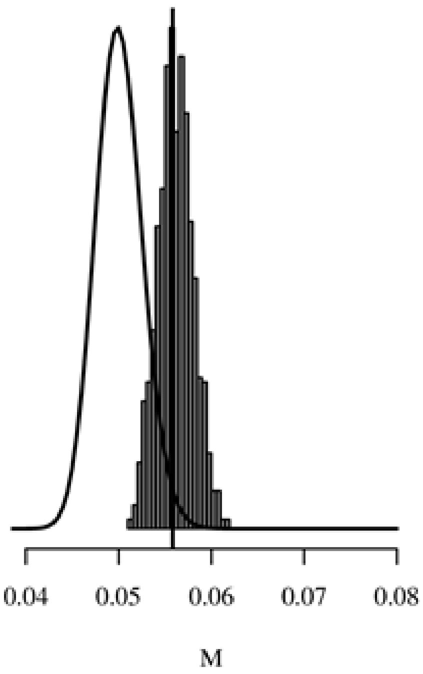
(-0.35 in 2016 assessment)

Is natural mortality unduly constrained?

(from 2016 assessment)



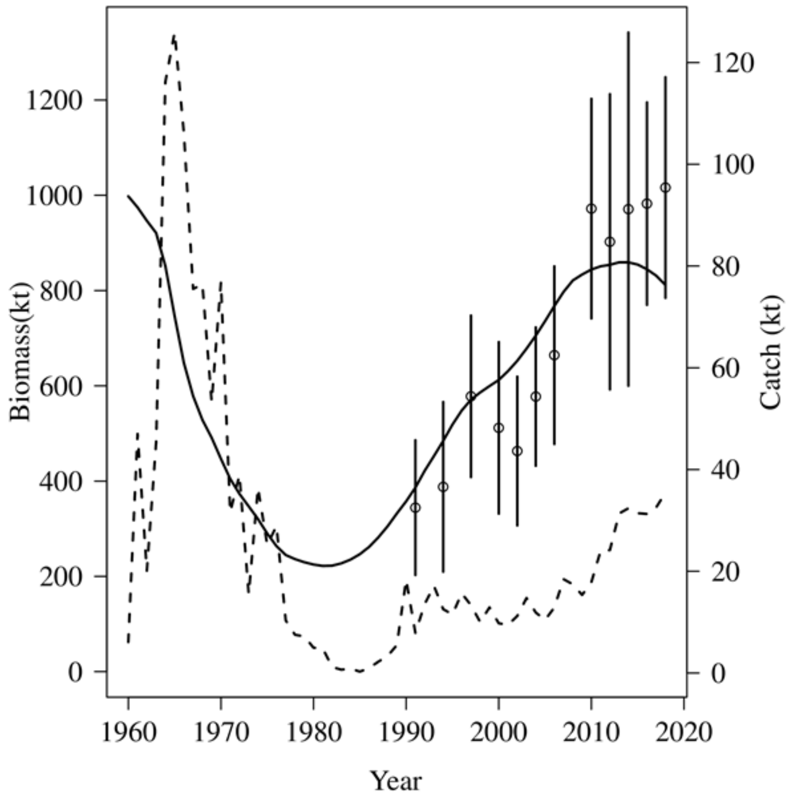
(from 2018 assessment)



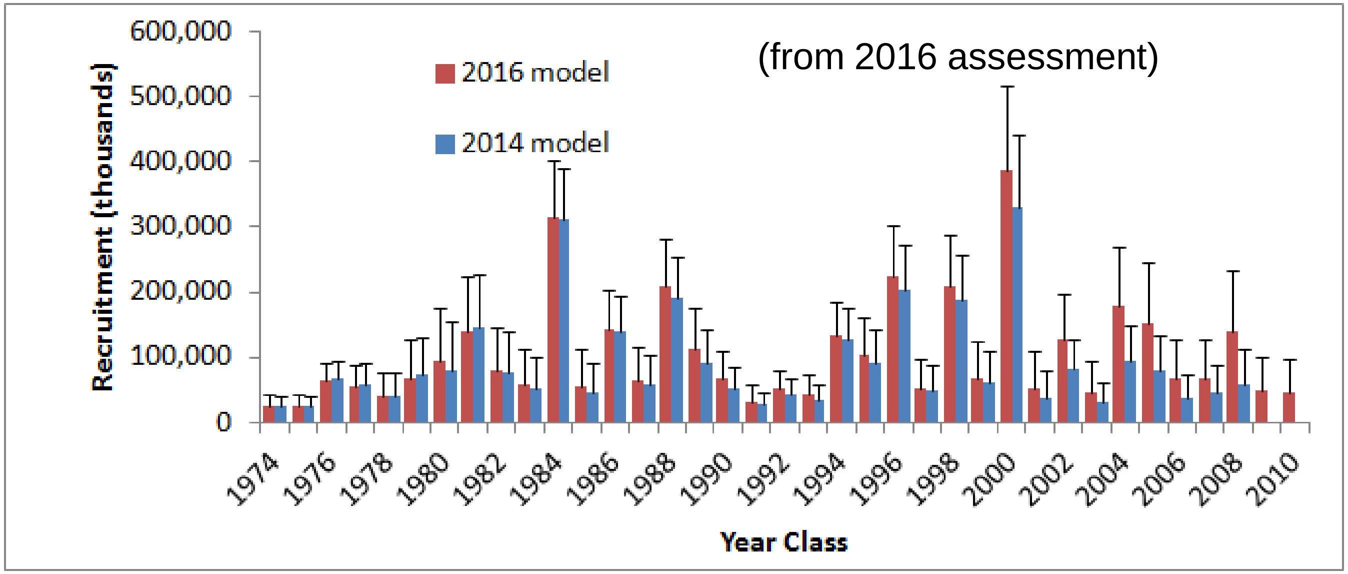
2018 M estimate = 0.056
2018 M estimate, prior distribution removed = 0.060

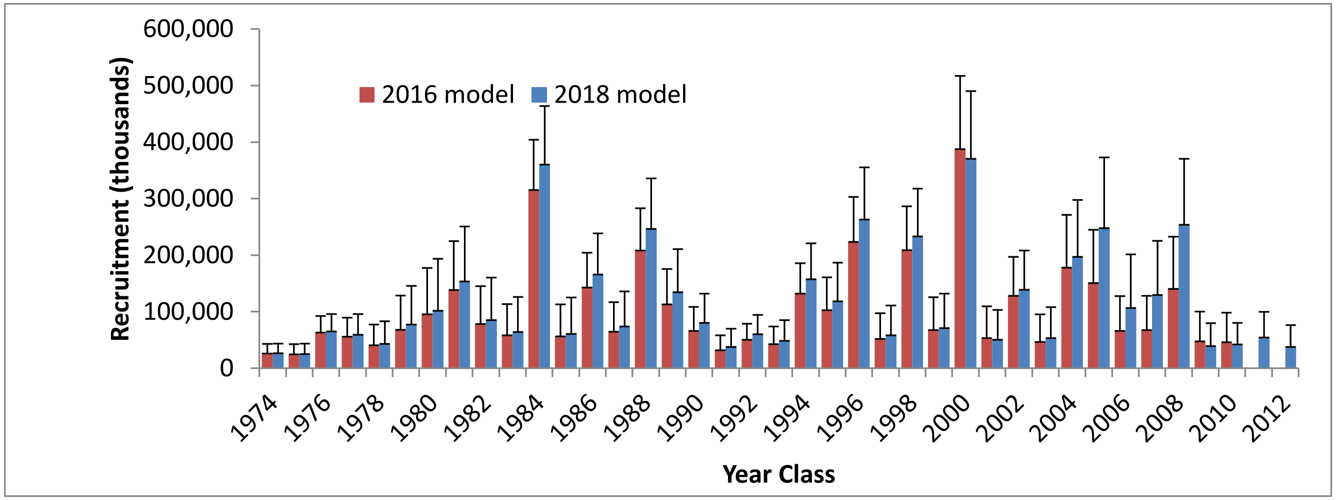
Empirical estimates, based on max age, range from 0.044 to 0.069 (Hoenig 1983, Then 2015, Hamel in prep)

BSAI POP catch and fit to AI survey biomass

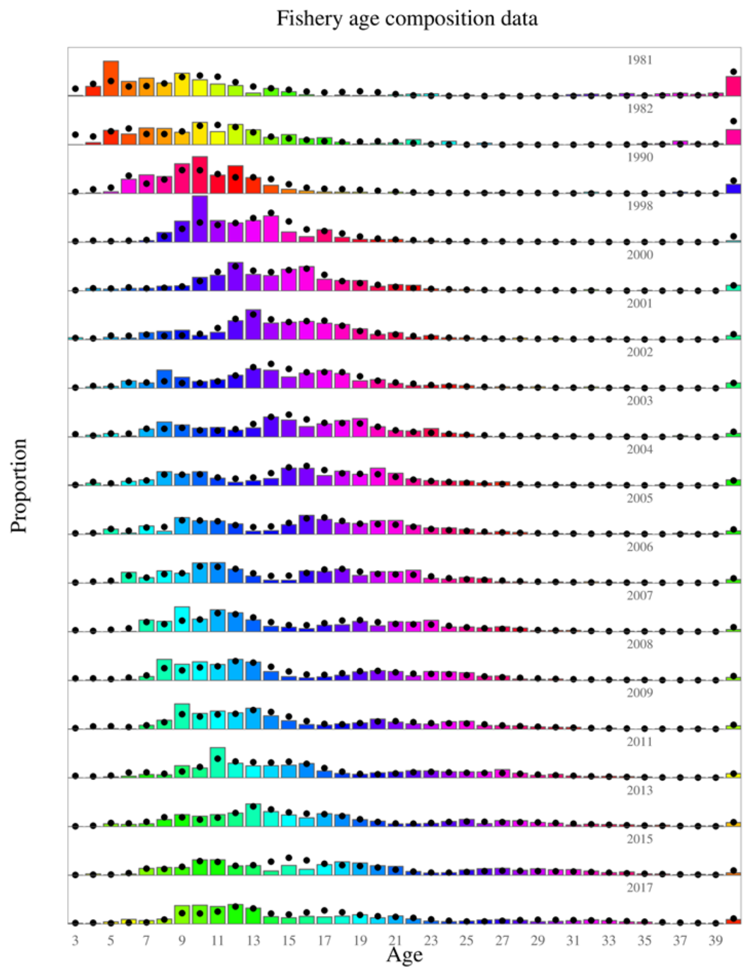


BSAI POP recruitment

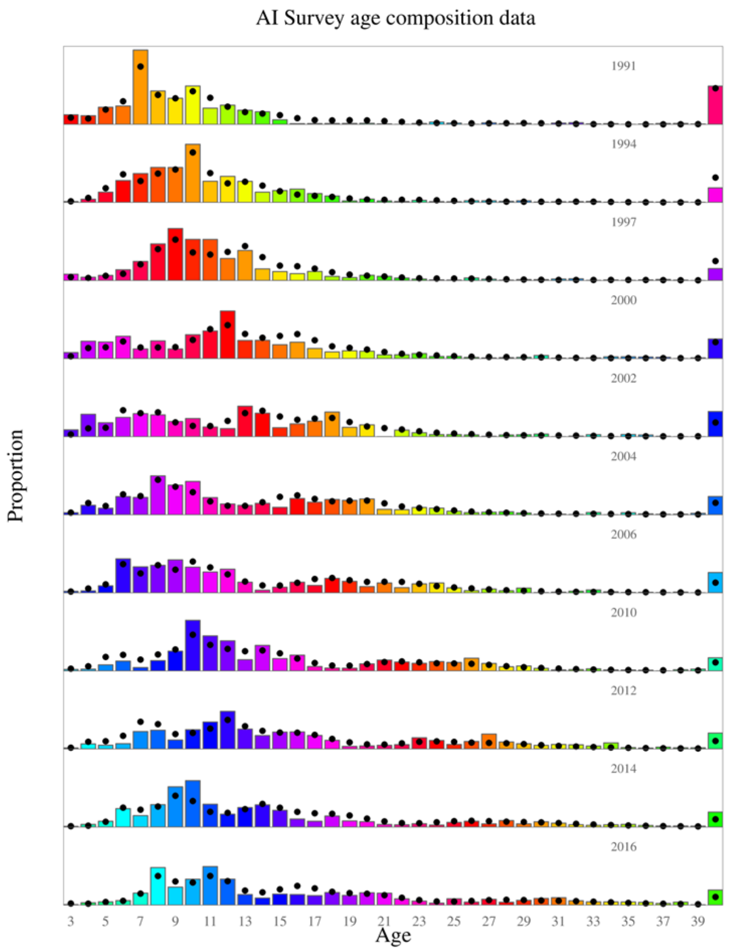




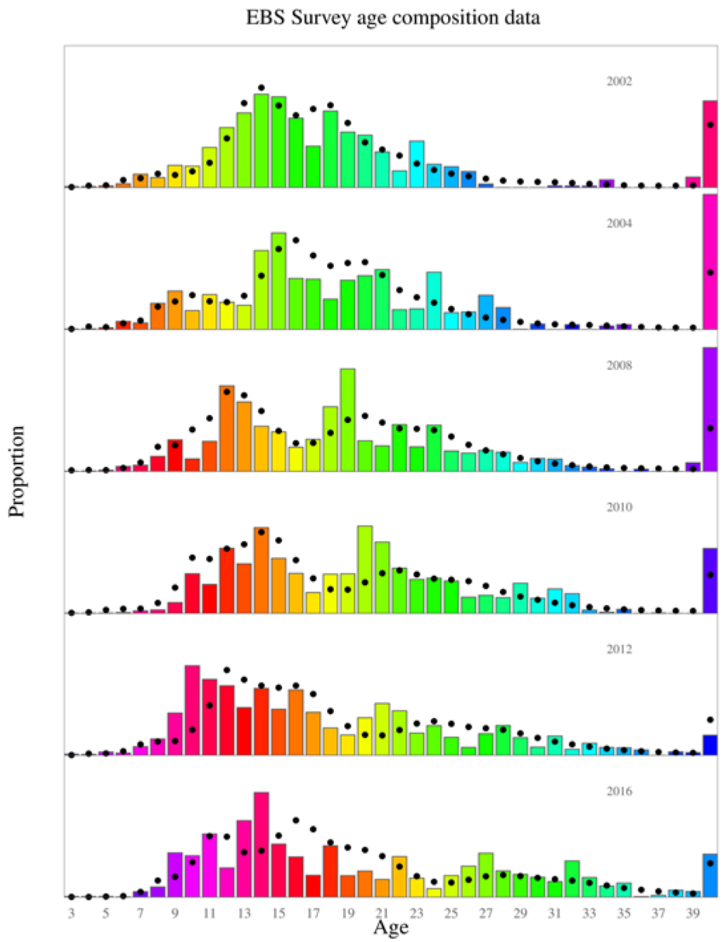
BSAI fishery age composition



AI survey age composition



EBS survey age composition



Not a great fit to the EBS survey age compositions

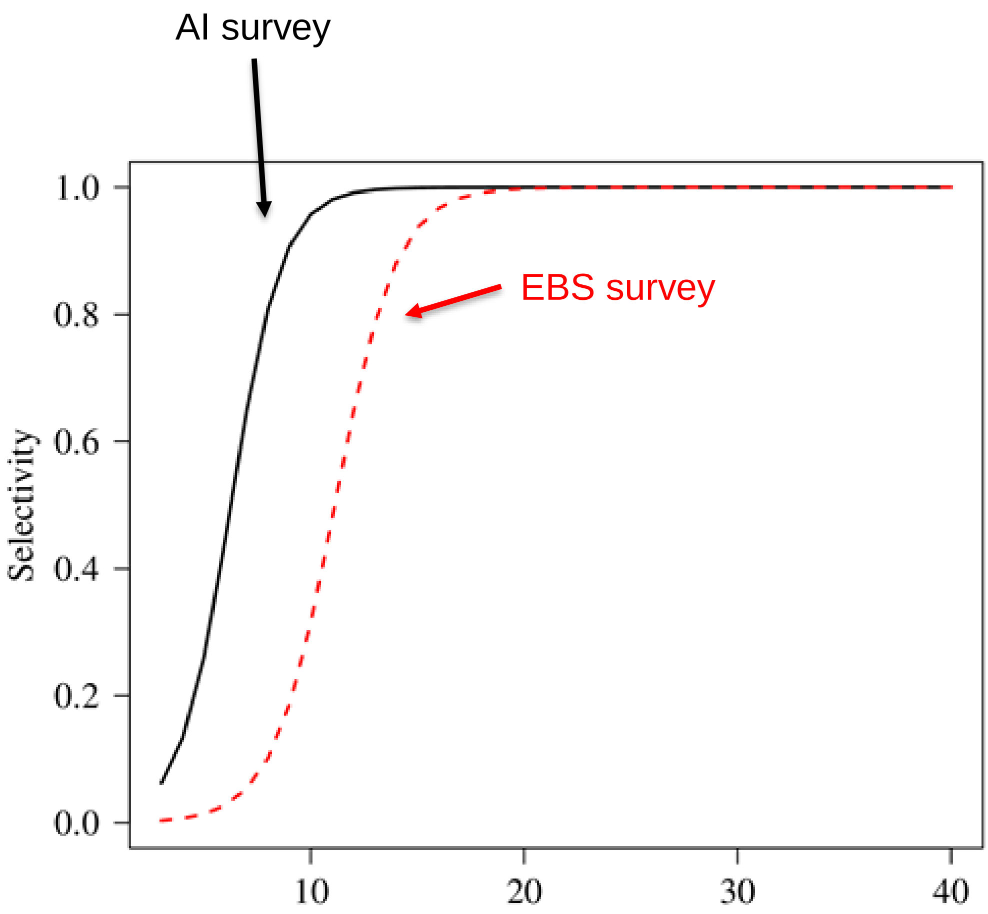
2000 year class is strong in the AI age data, not so much in the EBS data

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

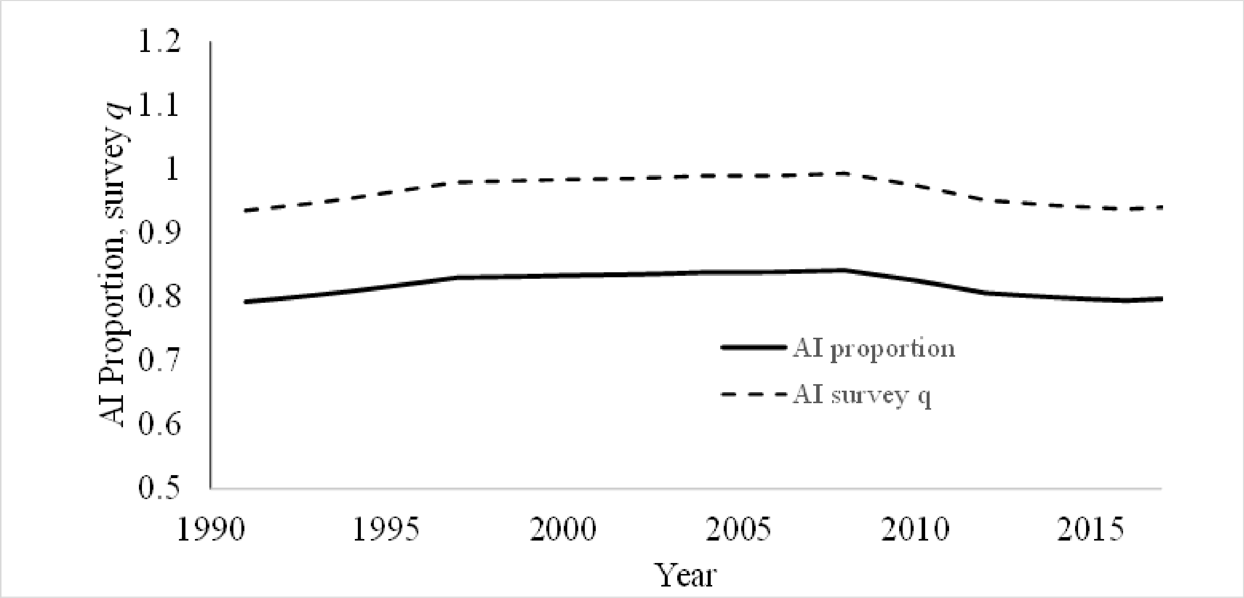
1) Different year class strengths in the 2 areas
2) Different ecosystems

Might be useful to consider a separate model for the EBS (which we had prior to 2001)

EBS and AI survey selectivity



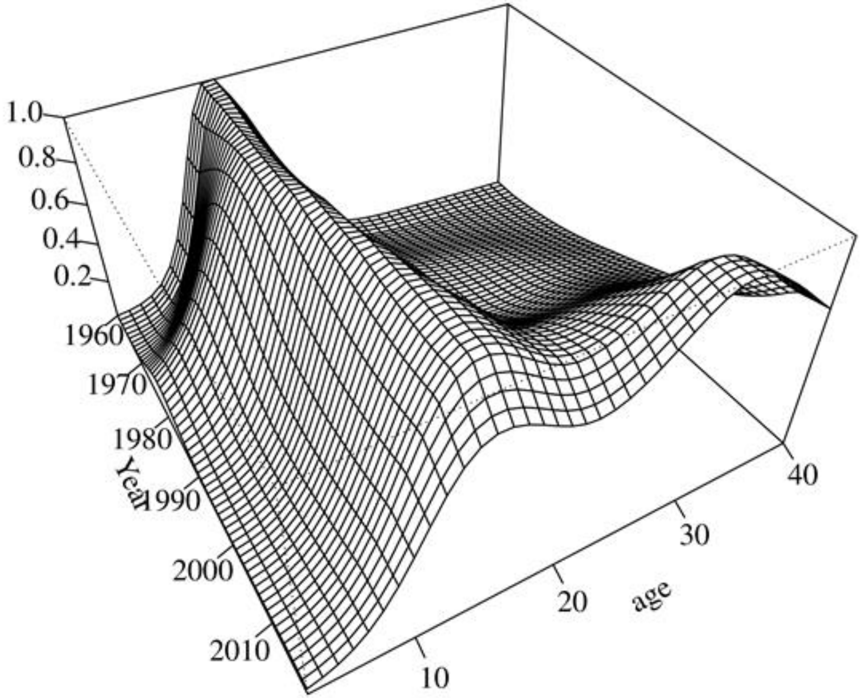
Survey catchability



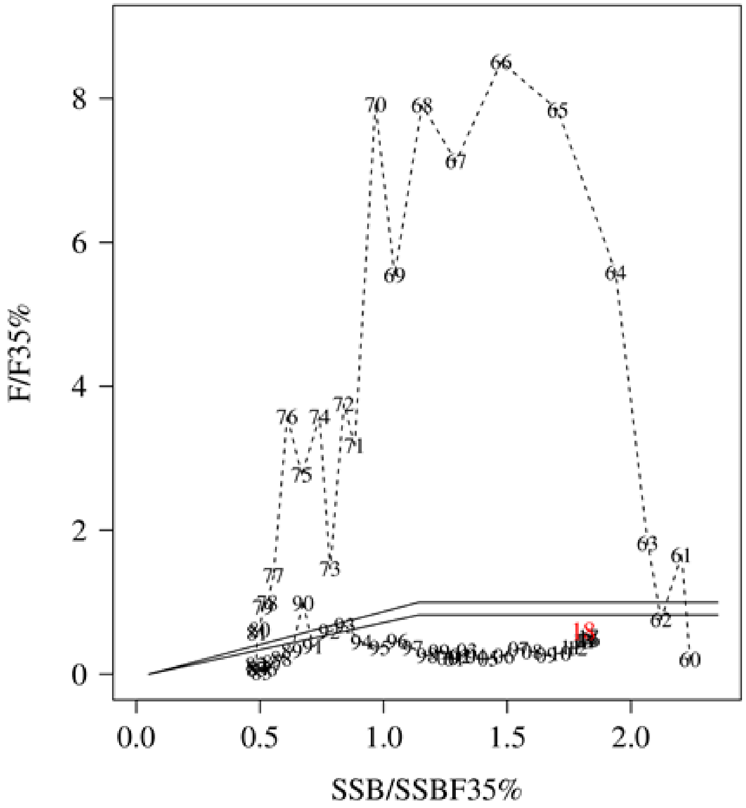
Survey catchability (unadjusted for availability)

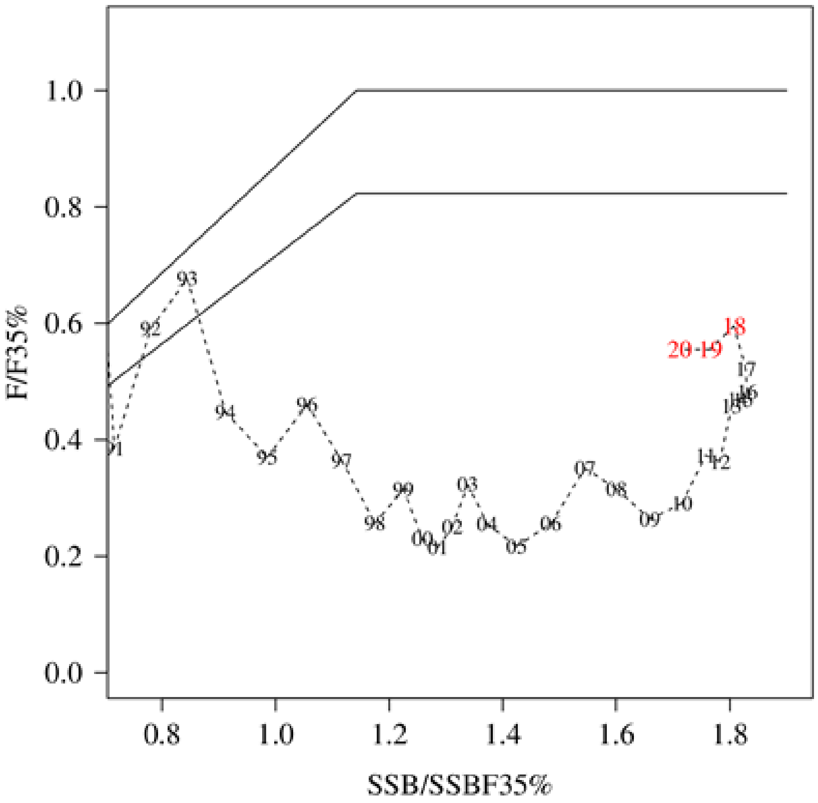
AI: 1.18
EBS: 1.44

Fishery selectivity

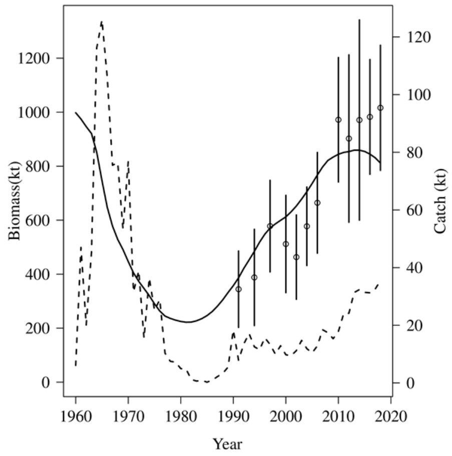


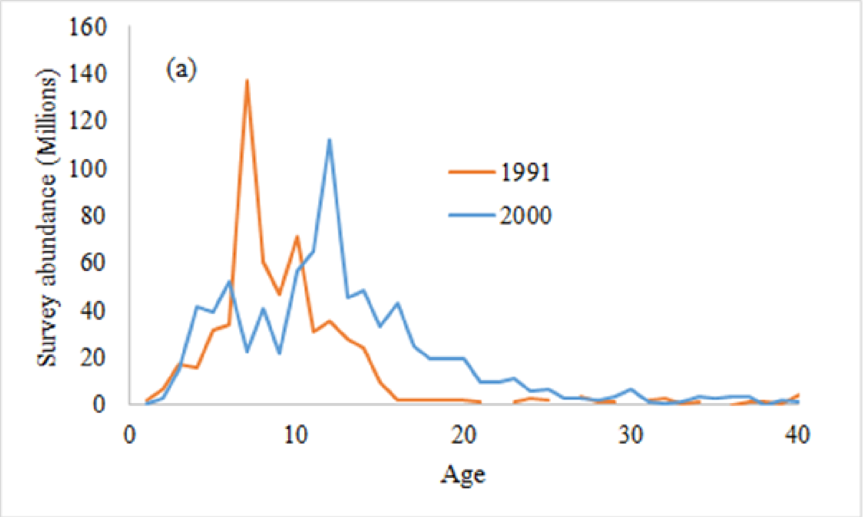
Phase plane plot

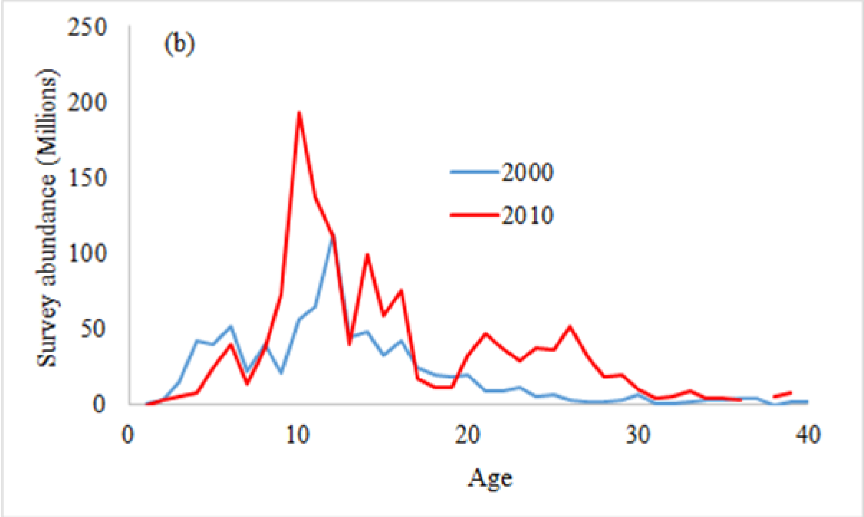




How have POP increased so rapidly?







For many ages, the abundance at age estimates from the AI survey have increased over time.

A recruitment pulse moving through the population would be expected to affect a limited number of ages

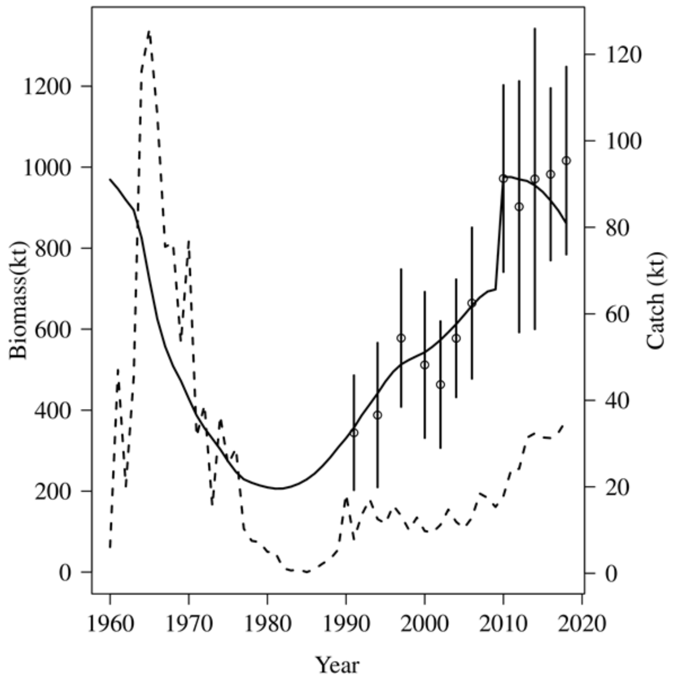
Where are these fish coming from?

- From myself and the internal reviewer:
  - Fish stocking?
  - Species ID? (could we trade the “extra” POP for the “missing” old blackspotted rockfish?) Great idea, but the numbers don’t balance.
  - Spontaneous generation?
  - Magical realism?

I focused on some exploratory model runs with time-varying survey catchability.

A (crude) 2q model

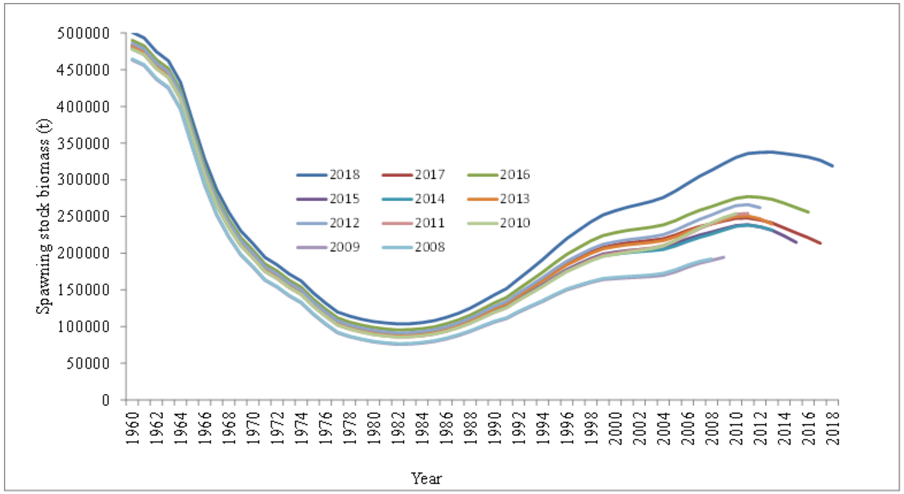
- A separate survey catchability beginning in 2010
- Shared survey selectivity for the two periods



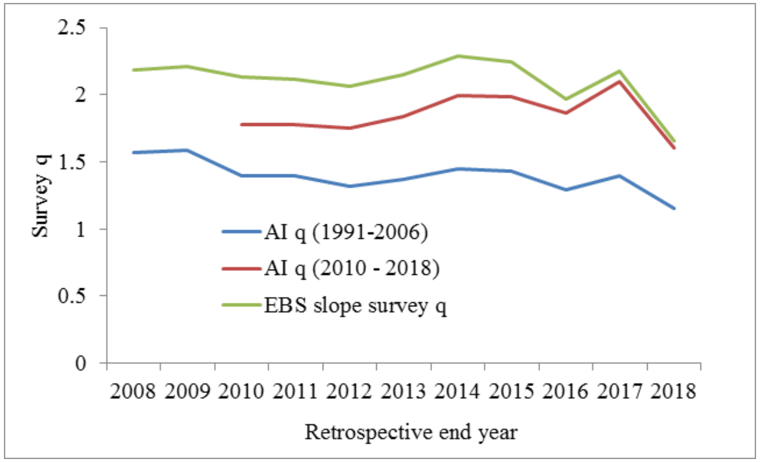
Residual pattern and retrospective pattern are improved

Mohn's rho = -0.30

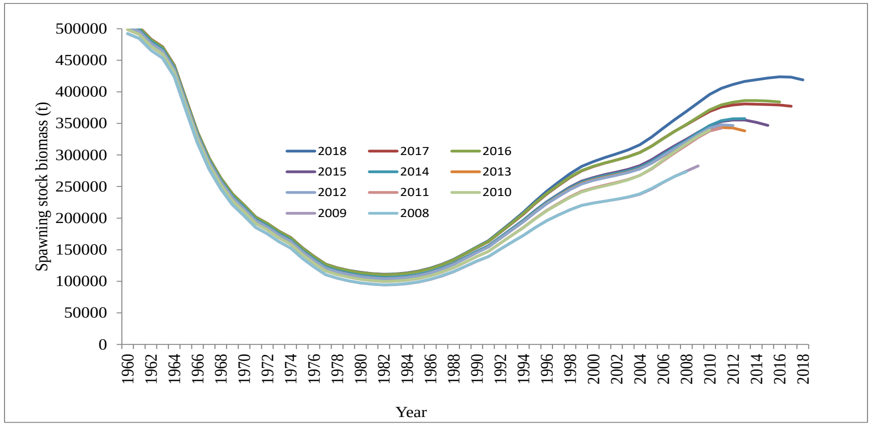
2018 total biomass reduced from 955 kt to 753 kt



Estimates of survey catchability differ between retrospective runs



The “early” AI q increases from 1.15 in 2018 to 1.57 in 2008, which explains some retrospective variability



Fixing the catchabilities at their 2018 estimates improves Mohn’s rho to -0.17.

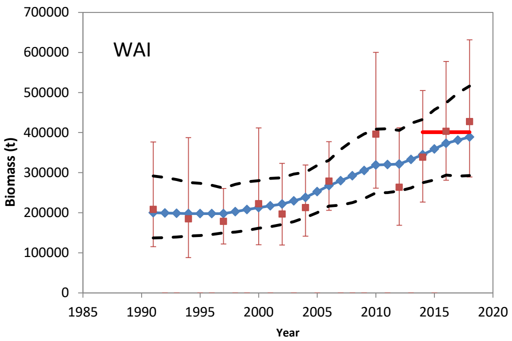
Time-varying survey q

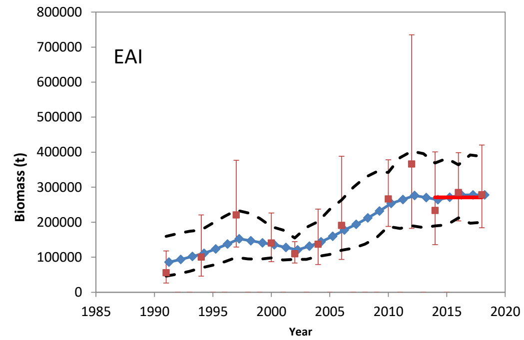
- Additional improvement in Mohn's rho could likely be obtained by varying q within each of the two time blocks.
- However, difficult to explain how the AI survey catchability would be changing over time.
- There is the potential of overreaching, such that nearly any change in survey biomass could be attributed to a change in selectivity.
- Without a better understanding of both the population and survey processes, it can be difficult to know how to interpret the increase in survey biomass.

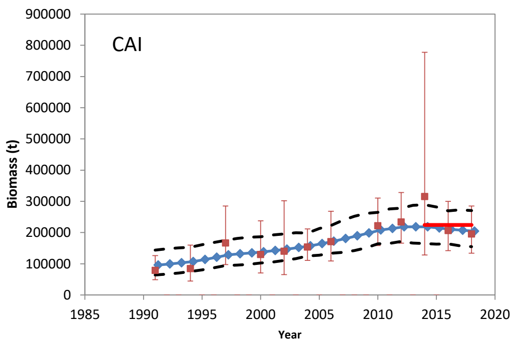
Reference points and ABCs

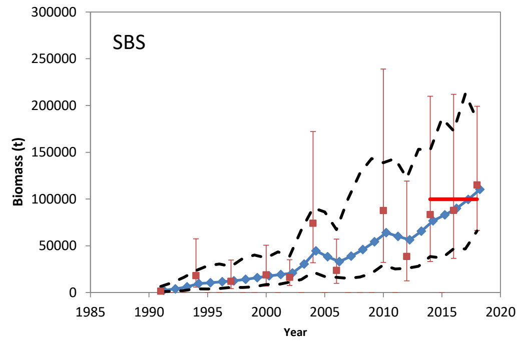
Quantity	As estimated or specified last year for: 2018	2019	As estimated or recommended this year for: 2019	2020
M (natural mortality rate)	0.058	0.058	0.056	0.056
Tier	3a	3a	3a	3a
Projected total (age 3+) biomass (t)	749,925	734,431	934,293	914,577
Female spawning biomass (t)				
Projected	305,804	295,593	399,024	386,835
$B_{100\%}$	536,713	536,713	645,738	645,738
$B_{40\%}$	214,685	214,685	258,295	258,295
$B_{35\%}$	187,849	187,849	226,008	226,008
F_{OFL}	0.101	0.101	0.095	0.095
$maxF_{ABC}$	0.082	0.082	0.079	0.079
F_{ABC}	0.082	0.082	0.079	0.079
OFL (t)	51,675	50,098	61,067	59,396
maxABC (t)	42,509	41,212	50,594	49,211
ABC (t)	42,509	41,212	50,594	49,211
Status	As determined last year for: 2016	2017	As determined this year for: 2017	2018
Overfishing	No	n/a	No	n/a
Overfished	n/a	No	n/a	No
Approaching overfished	n/a	No	n/a	No

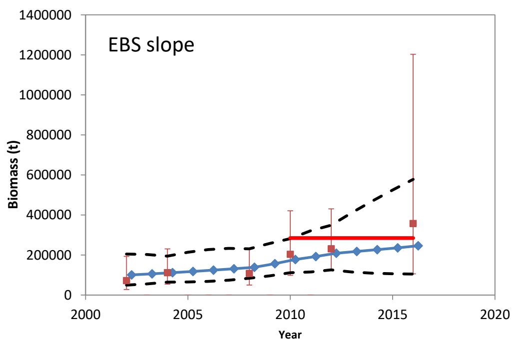
Smoothed survey time series by subarea











Subarea ABCs

Area	Year	Age 3 Bio (t)	OFL	ABC	TAC	Catch[1]
BSAI	2017	767,767	53,152	43,723	34,900	32,543
	2018	749,925	51,675	42,509	37,361	28,606
	2019	934,293	61,067	50,594		
	2020	914,577	59,396	49,211		
Eastern Bering Sea	2017			12,199	11,000	8,987
	2018			11,861	11,861	5,577
	2019			14,675	n/a	n/a
	2020			14,274	n/a	n/a
Eastern Aleutian Islands	2017			10,307	7,900	7,803
	2018			10,021	9,000	6,858
	2019			11,459	n/a	n/a
	2020			11,146	n/a	n/a
Central Aleutian Islands	2017			8,009	7,000	6,868
	2018			7,787	7,500	7,311
	2019			8,435	n/a	n/a
	2020			8,205	n/a	n/a
Western Aleutian Islands	2017			13,208	9,000	8,886
	2018			12,840	9,000	8,859
	2019			16,024	n/a	n/a
	2020			15,586	n/a	n/a

Conclusions

- Continued high abundance of POP
- Hard to explain increase in population abundance solely from recruitment
- It might be useful to explore whether a separate model could be supported for the EBS area