



**NOAA**  
**FISHERIES**

# 2019 BSAI Northern rockfish

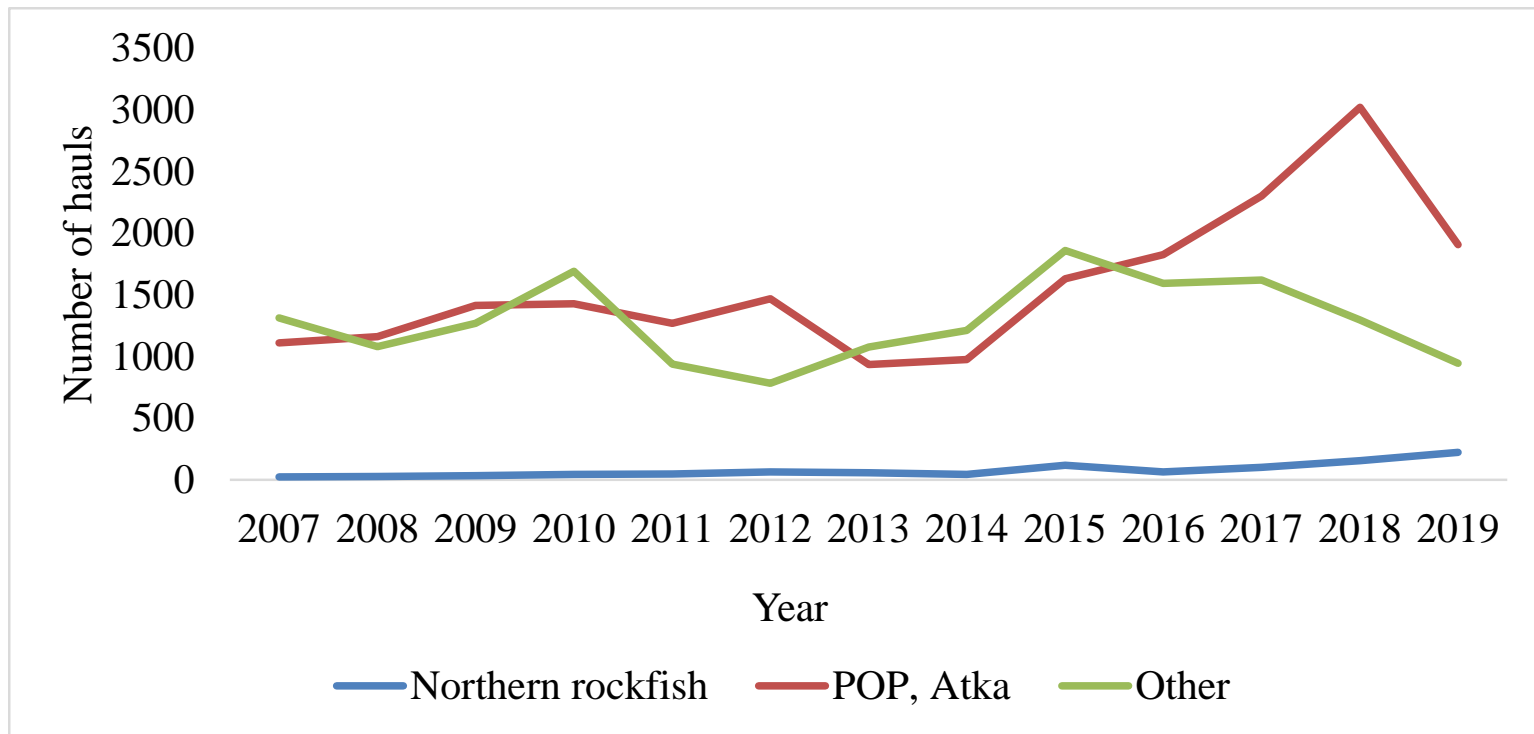
Paul Spencer  
Alaska Fisheries Science Center

# BSAI Northern Rockfish Outline

- 1) Catch information
- 2) Survey and fishery data, including computation of age compositions
- 3) Model fits to data
- 4) Retrospective analysis
- 5) Exploitation rates
- 6) Risk Table
- 7) Management recommendations

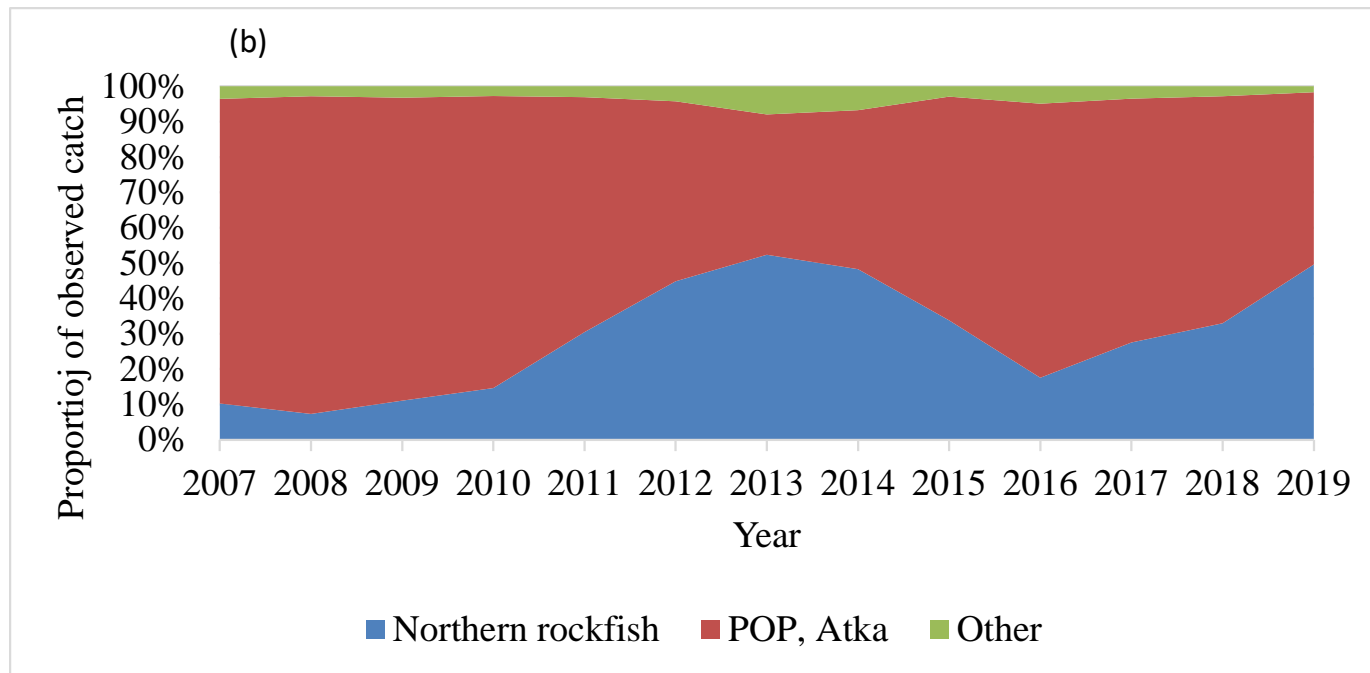
# Development of target fishery (again)

Number of tows that in which northern rockfish is the target species is increasing



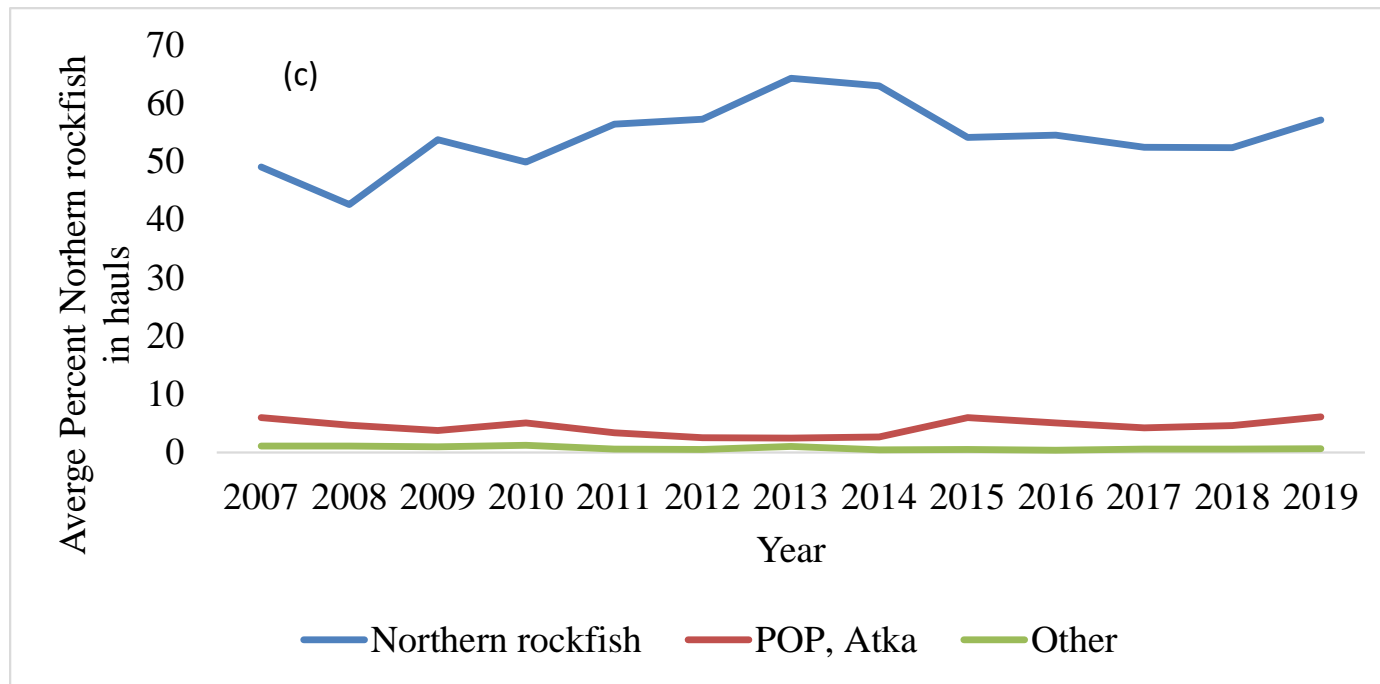
# Development of target fishery (again)

These tows account for a large portion of the catch

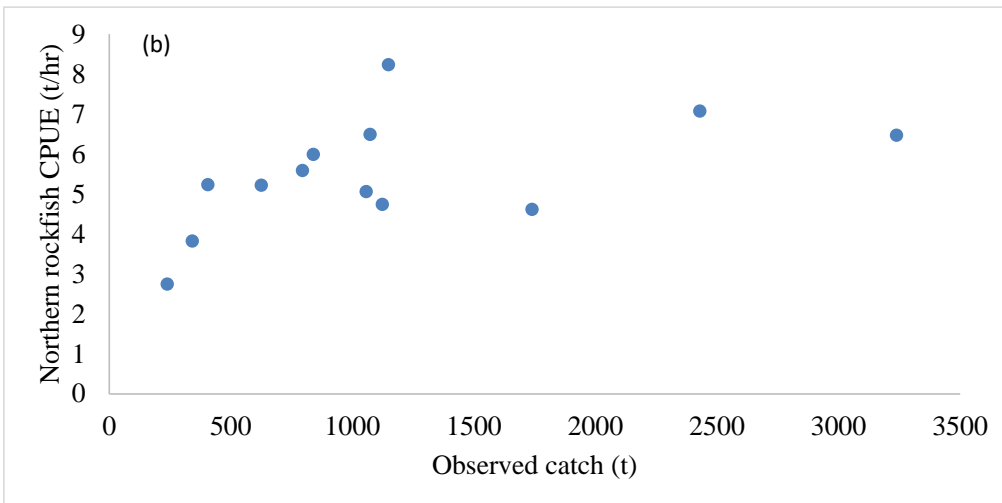
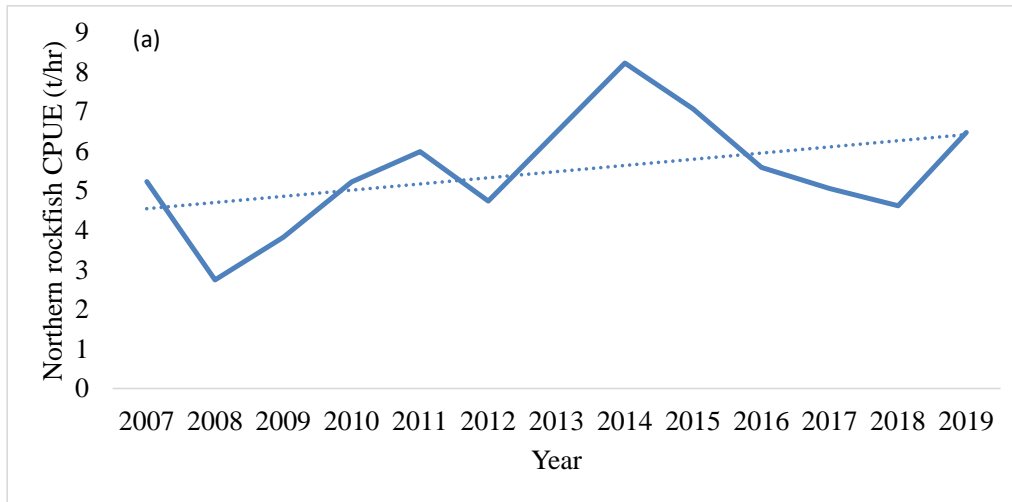


# Development of target fishery (again)

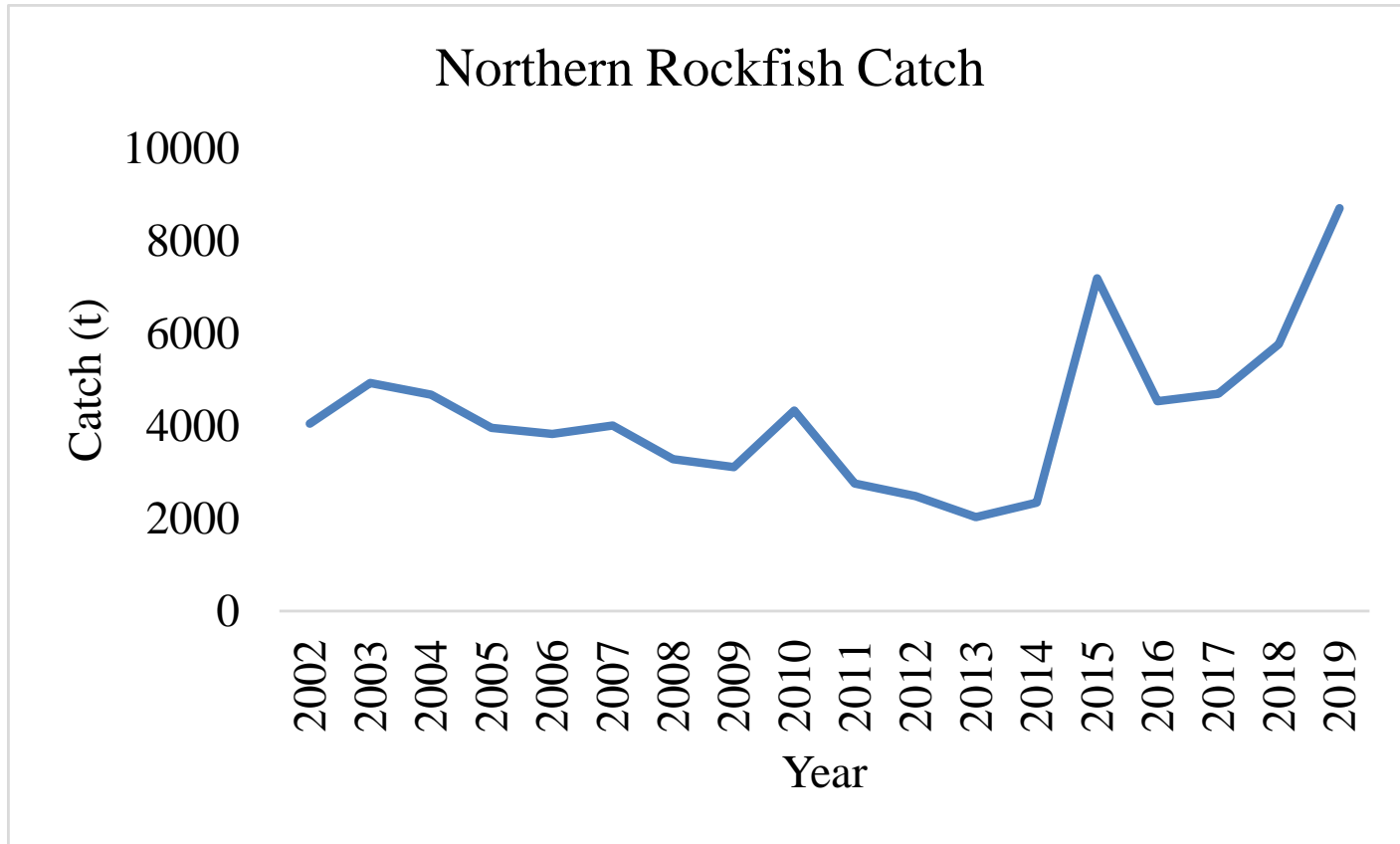
Within northern rockfish targeted tows,  $\geq 50\%$  of the catch is northern rockfish



# Fishery performance has been good



# Catches have been increasing

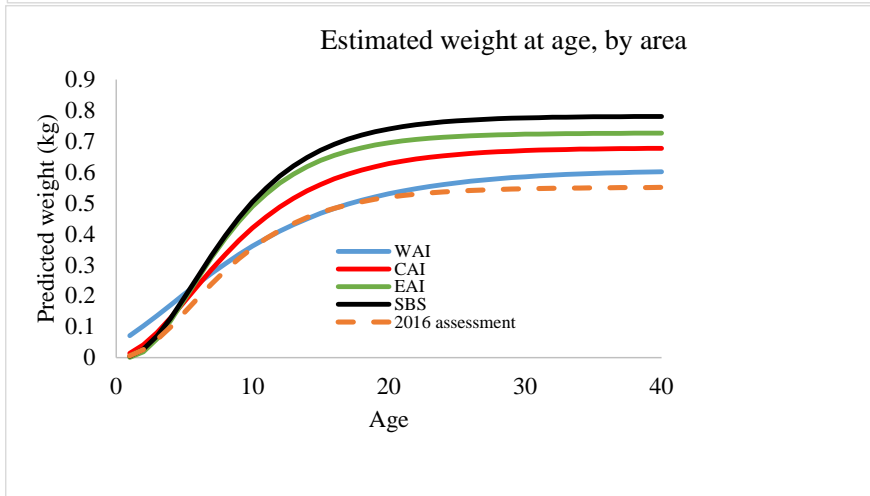
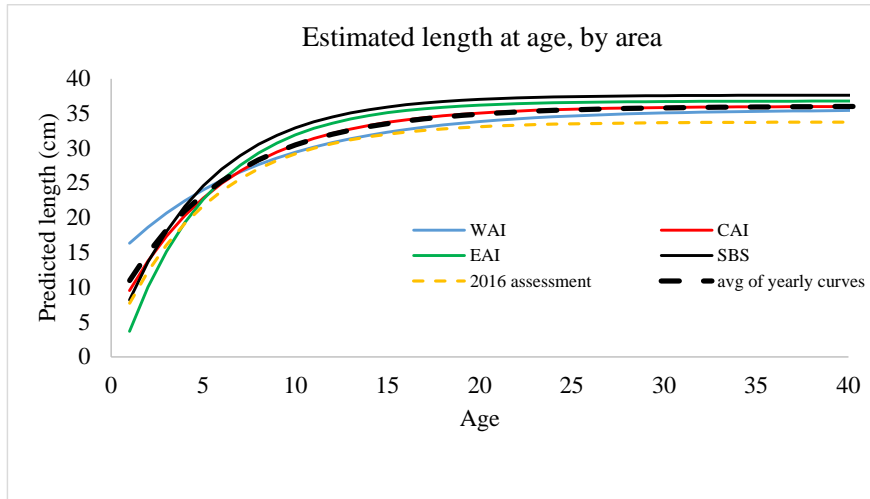


# Fishery has been on “open” status for large periods of time within recent years

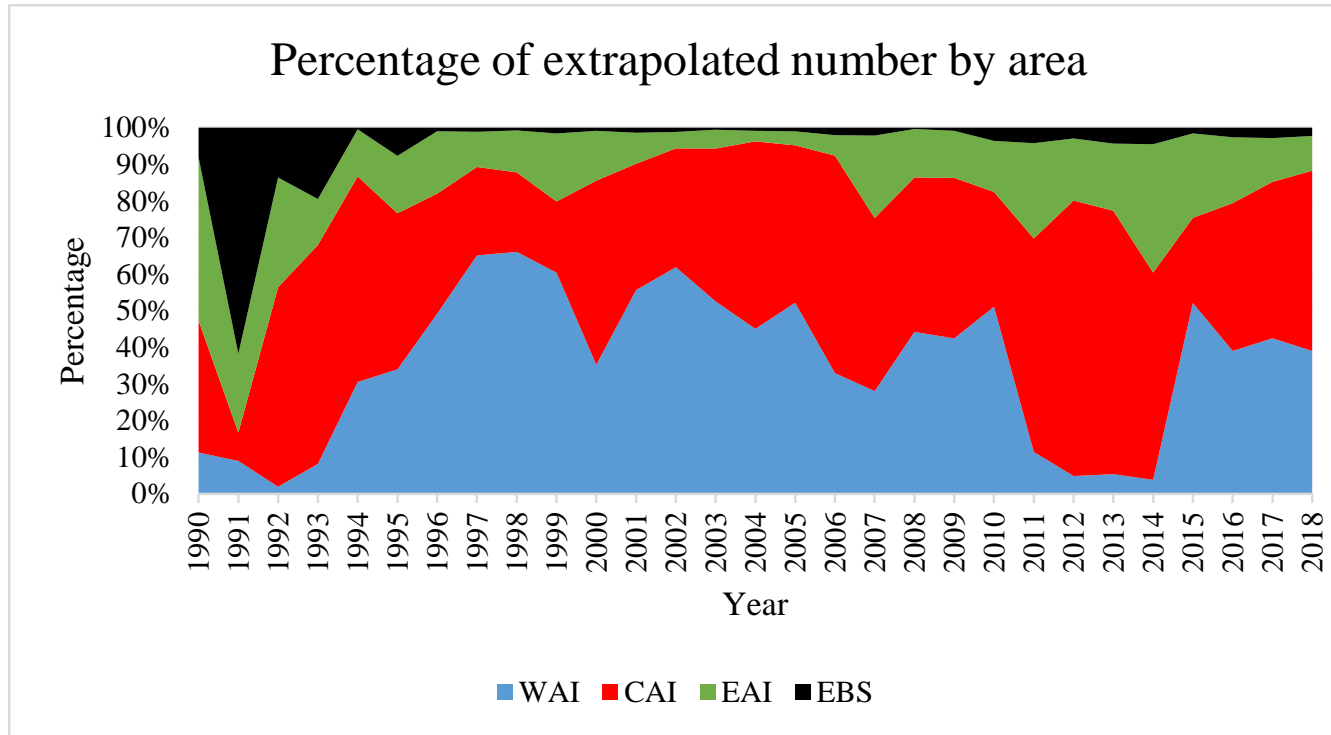
Year	Date of “opening” directed fishery	Date of “closing” of directed fishery
2013	June 7	None
2014	June 22	None
2015	April 2	None
2016	March 29	None
2017	March 16	None
2018	March 23	September 21
2019	April 12	None



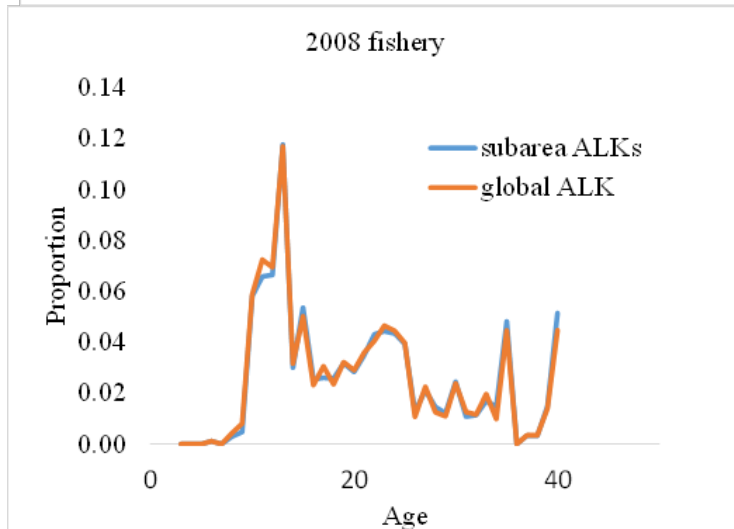
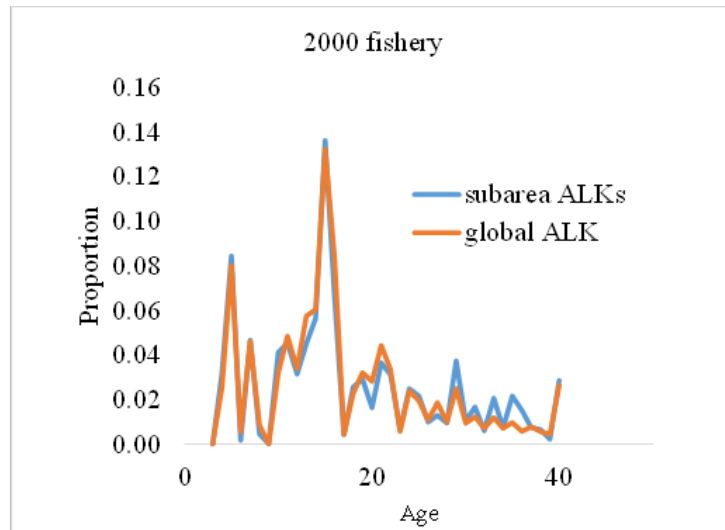
# Computation of fishery size at age, and age compositions



# Fishery catch by area



# Computation of fishery age compositions



2019 assessment used subarea age length keys.

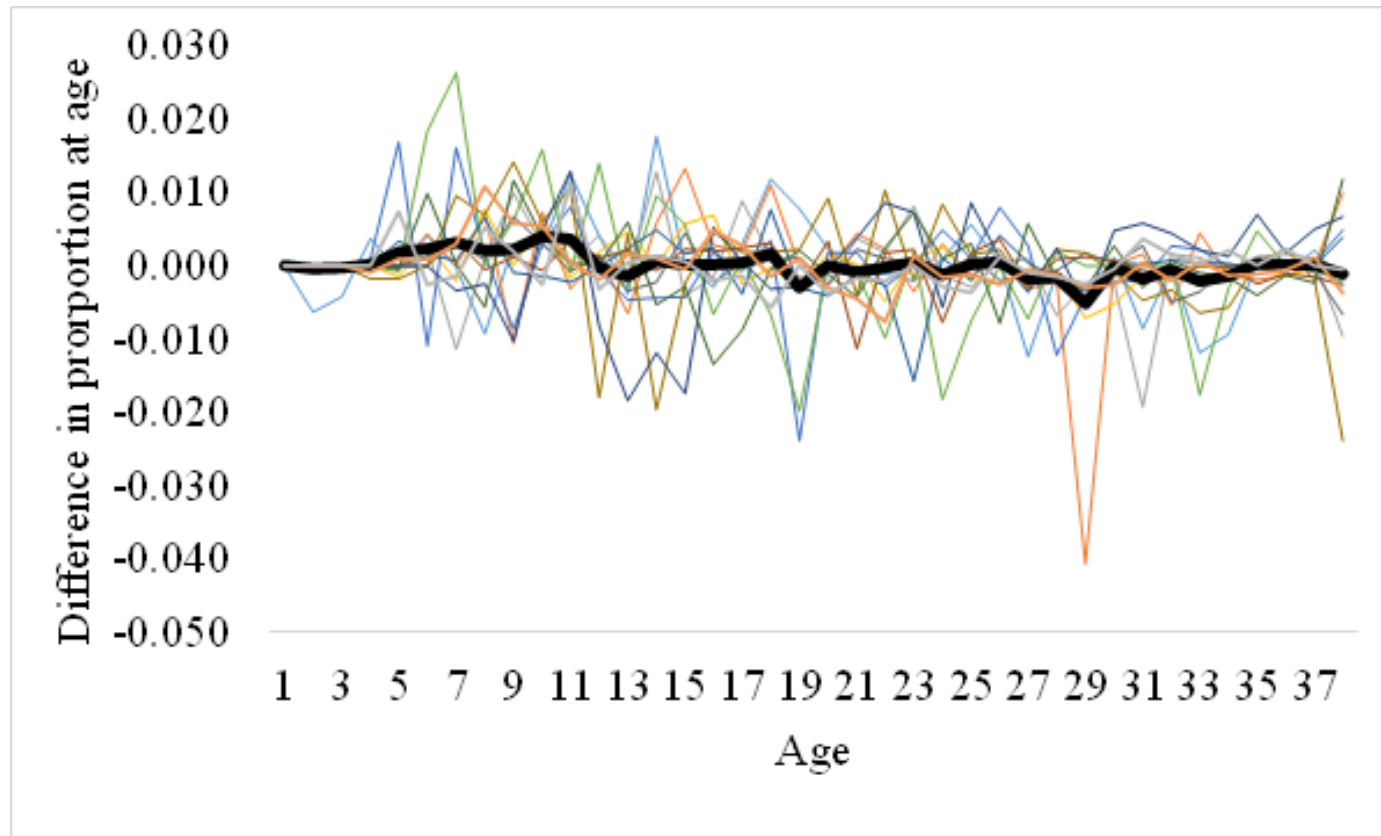
An age-length key for each subarea (i.e., WAI, CAI, EAI, EBS) was computed, and applied the fishery length composition from that area.

The subarea age compositions were added together, weighted by the fishery catch.

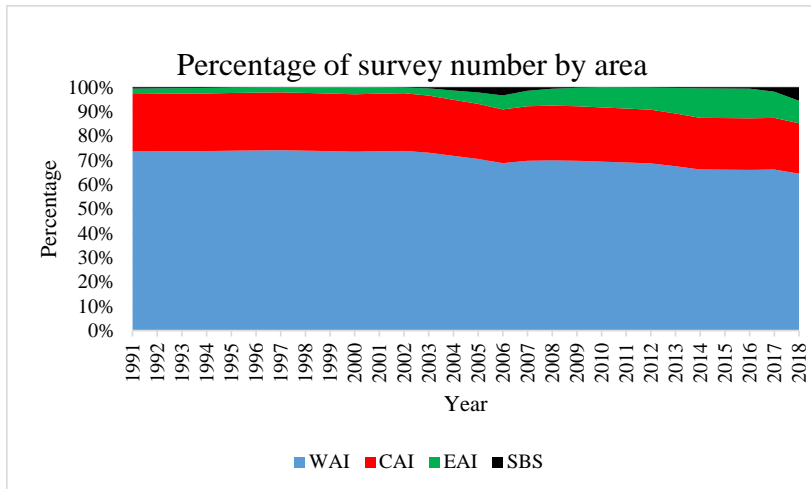
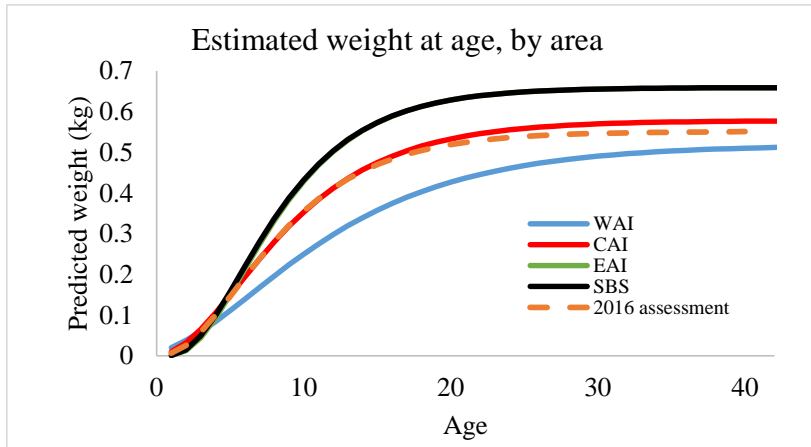
For the fishery data, there was not much difference between using the global vs subarea age-length keys.

# Computation of fishery age compositions

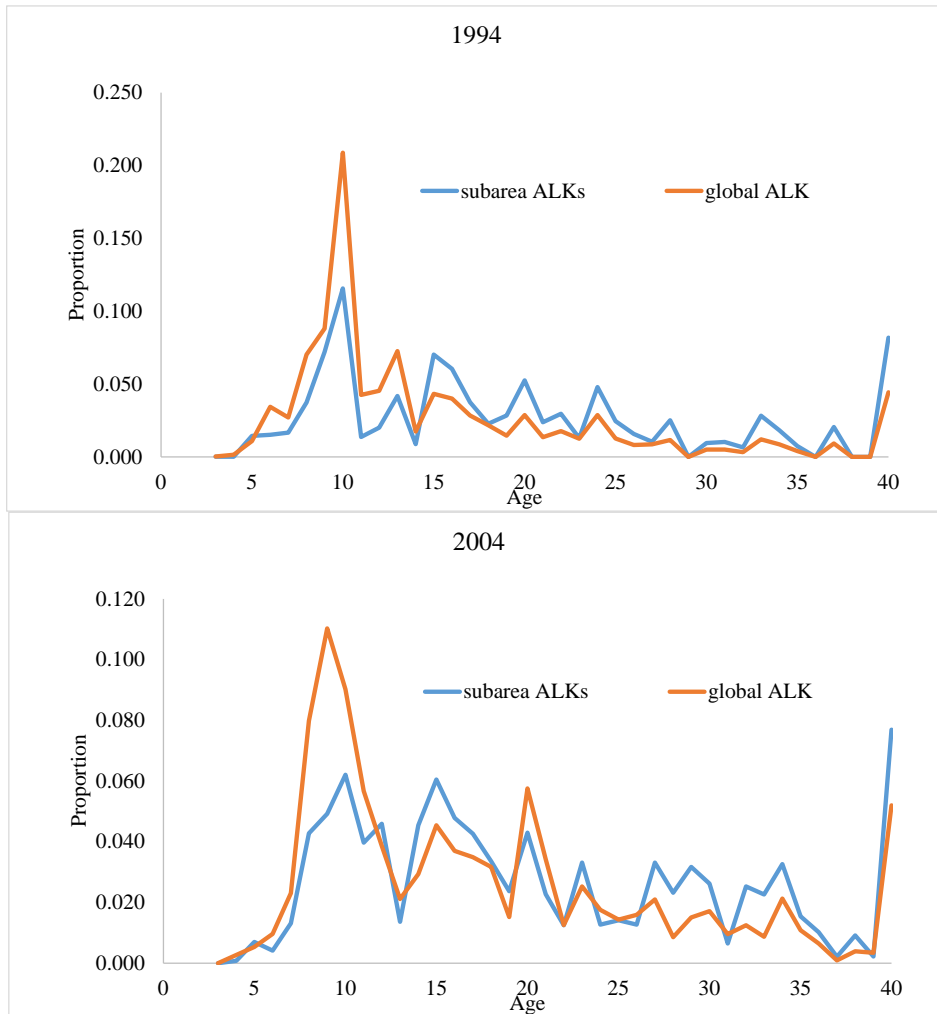
No difference in the age comps from the global vs subarea methods with age



# Computation of survey size at age, and age compositions



# Computation of survey age compositions

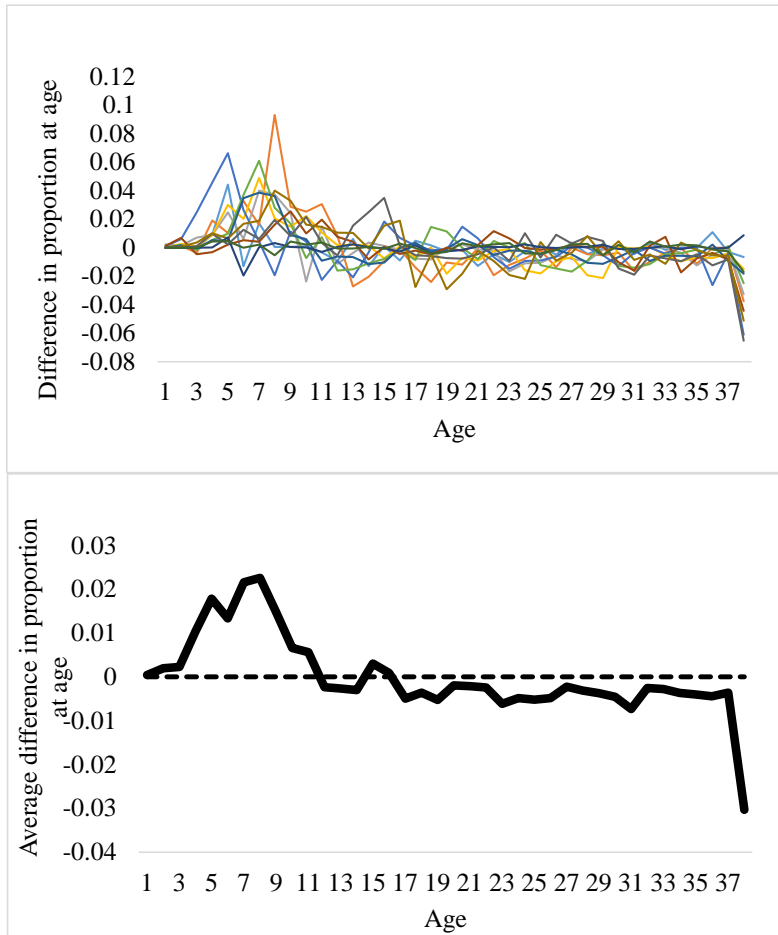


With the smaller size at age for the survey data in the 2019 assessment, fish of a given length would be estimated to have an older age relative to the 2016 assessment

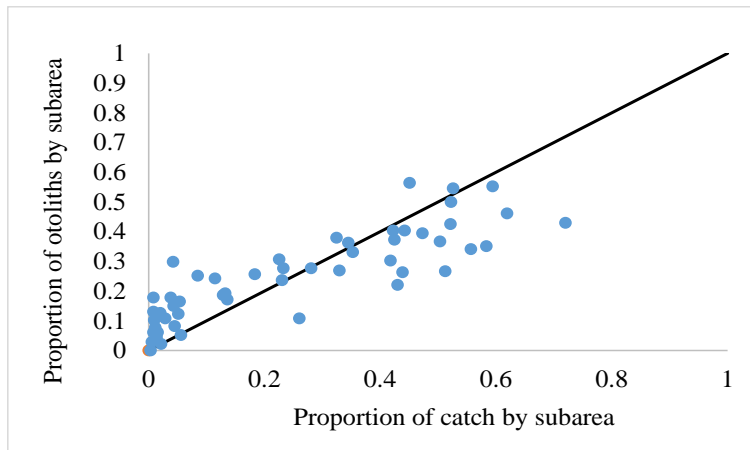
This results in age compositions of relatively few younger fish, and relatively more older fish

# Computation of survey age compositions

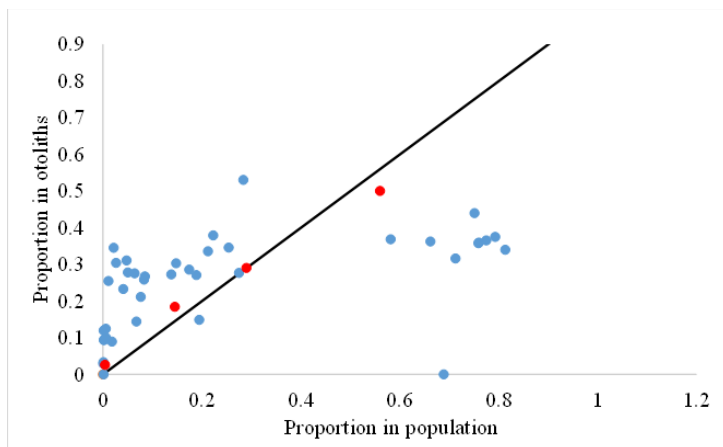
Subarea age-length keys give less younger fish, more older fish



# Why did the survey age compositions change more than the fishery age compositions?



The fishery otoliths have been randomly sampled for many years. This results in the spatial distribution of otoliths being relatively similar to the spatial distribution of the catch



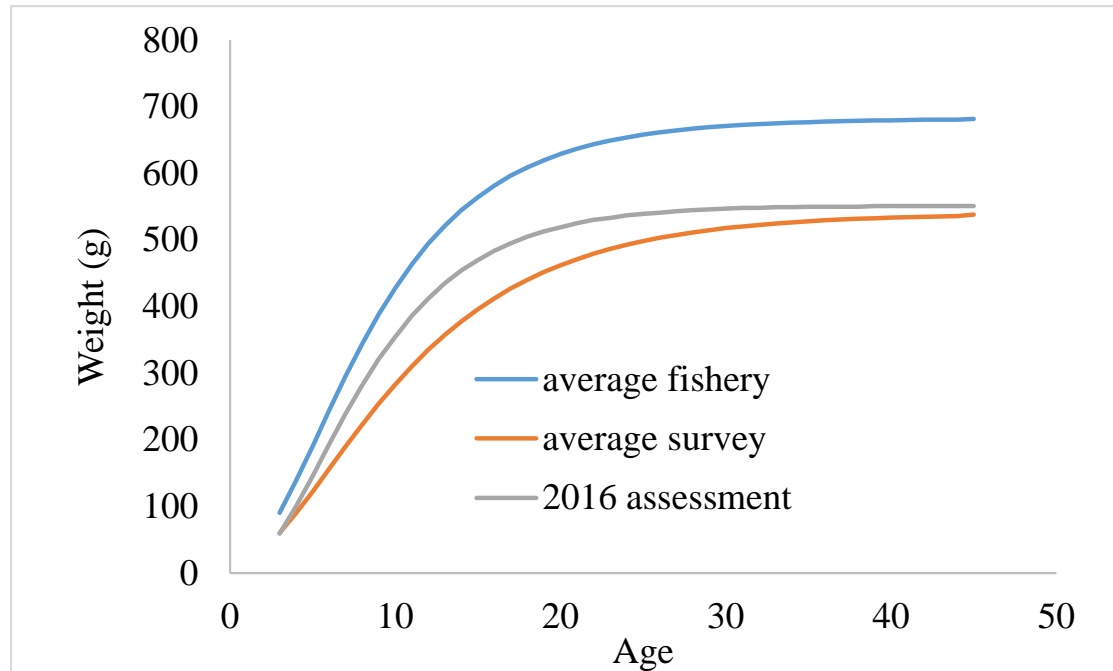
The survey otoliths have been randomly sampled only since 2016. In earlier years, the spatial distribution of otoliths was not similar to the spatial distribution of the catch



# Otoliths sample sizes in AI trawl survey, by area

Year	Western	Central	Eastern	Southern	Total
	AI	AI	AI	Bering Sea	
1980	201	92	180		473
1983	268	225	93	39	625
1986	132	293	25	115	565
1991		243	159	54	456
1994	180	61	127	41	409
1997	234	219	199		652
2000	229	275	200	21	725
2002	88	74	66	31	259
2004	193	156	120	46	515
2006	197	148	113	77	535
2010	195	186	139	18	538
2012	206	156	160	54	576
2014	201	147	150	52	550
2016	288	167	106	15	576
2018	289	150	119	30	588

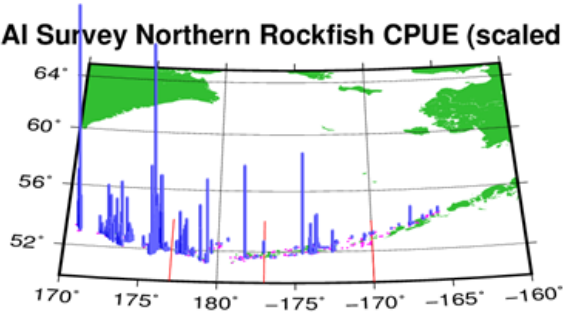
# Estimated mean weight at age



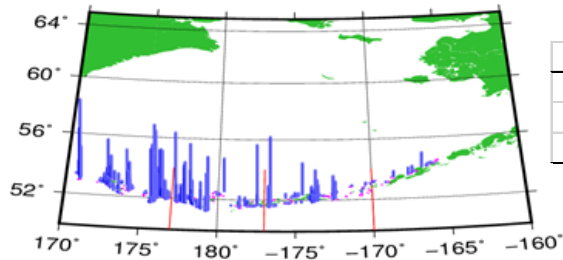
Fishery and survey mean weights are an average across years

# Square root of survey CPUE, 2014 – 2018 AI surveys

2014 AI Survey Northern Rockfish CPUE (scaled wgt/km<sup>2</sup>)

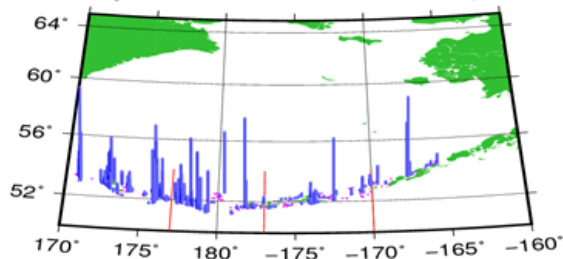


2016 AI Survey Northern Rockfish CPUE (scaled wgt/km<sup>2</sup>)

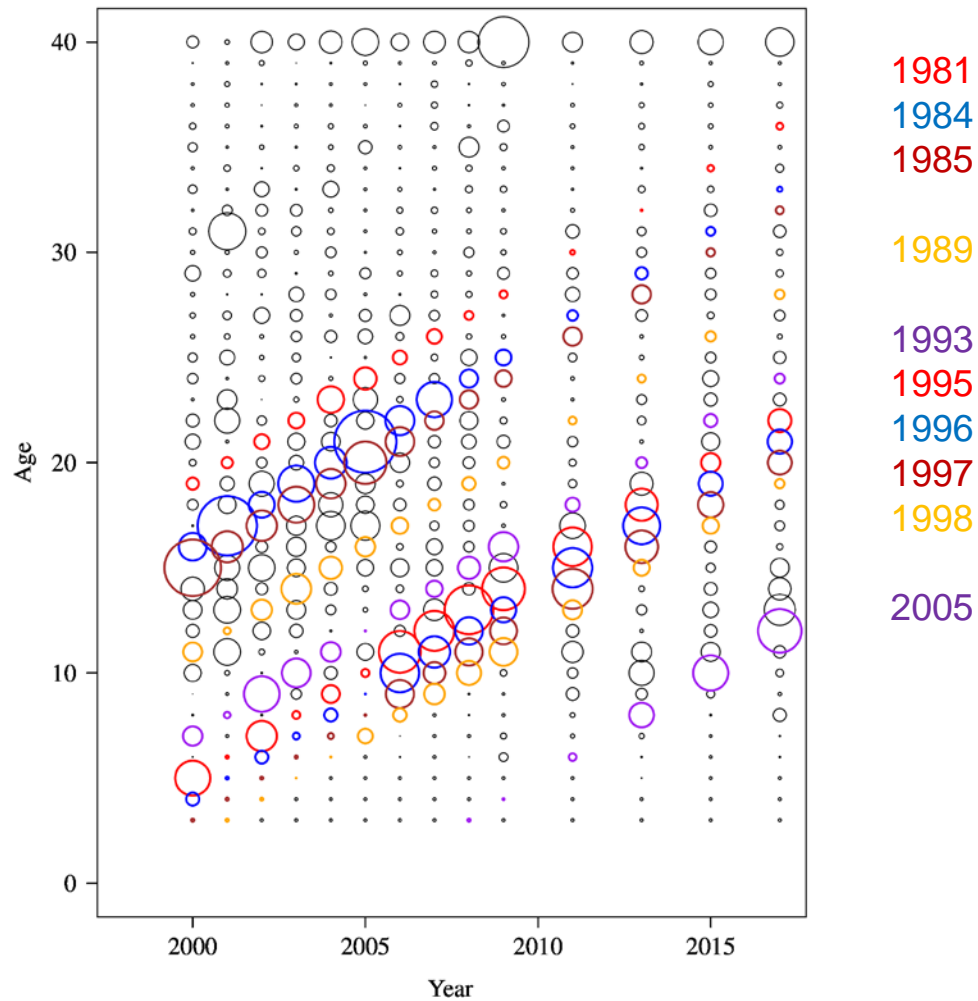


Year	WAI	CAI	EAI	SBS	Total
2014	346,392 (0.38)	48,049 (0.44)	76,787 (0.79)	1,668 (0.80)	472,895 (0.31)
2016	124,310 (0.21)	78,869 (0.37)	48,382 (0.52)	1,656 (0.55)	253,217 (0.18)
2018	98,756 (0.24)	59,500 (0.40)	20,096 (0.63)	34,120 (0.70)	212,472 (0.20)

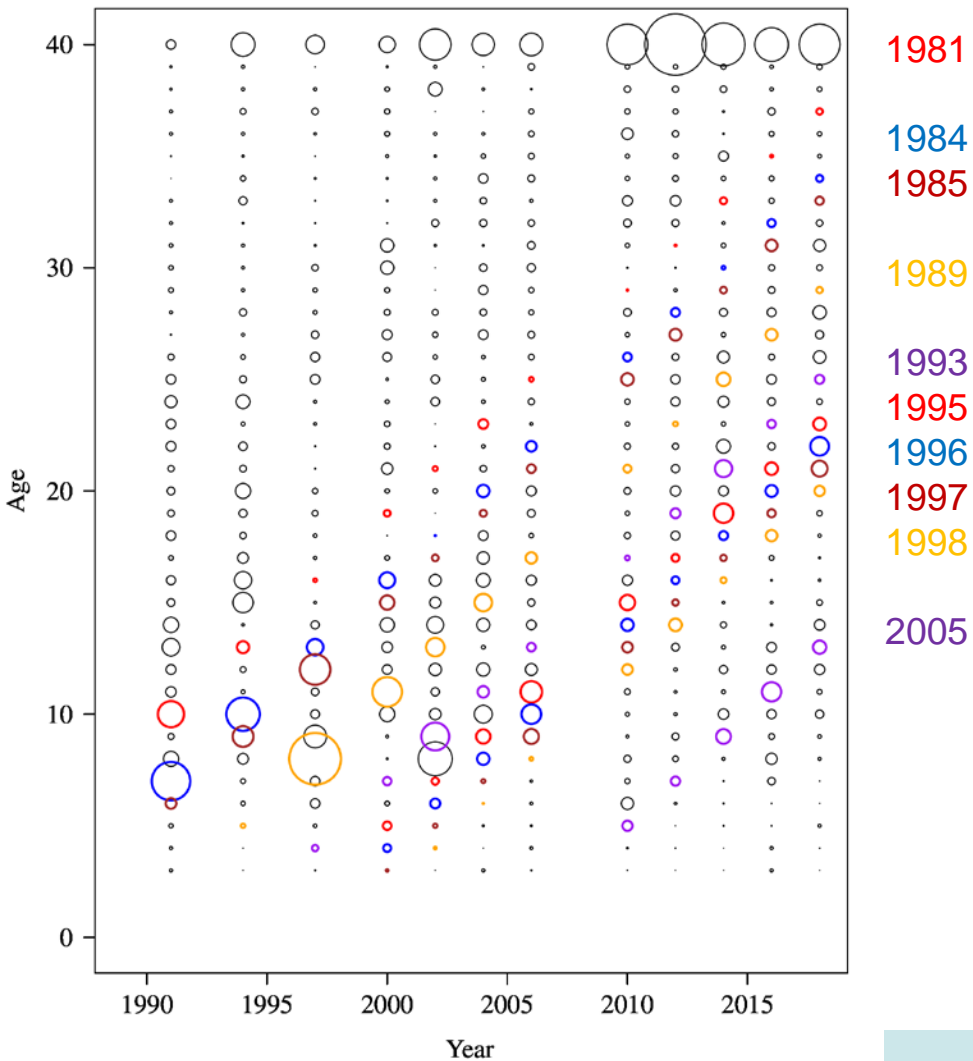
2018 AI Survey Northern Rockfish CPUE (scaled wgt/km<sup>2</sup>)



# BSAI northern rockfish fishery age compositions



# BSAI northern rockfish survey age compositions



# “Models” evaluated

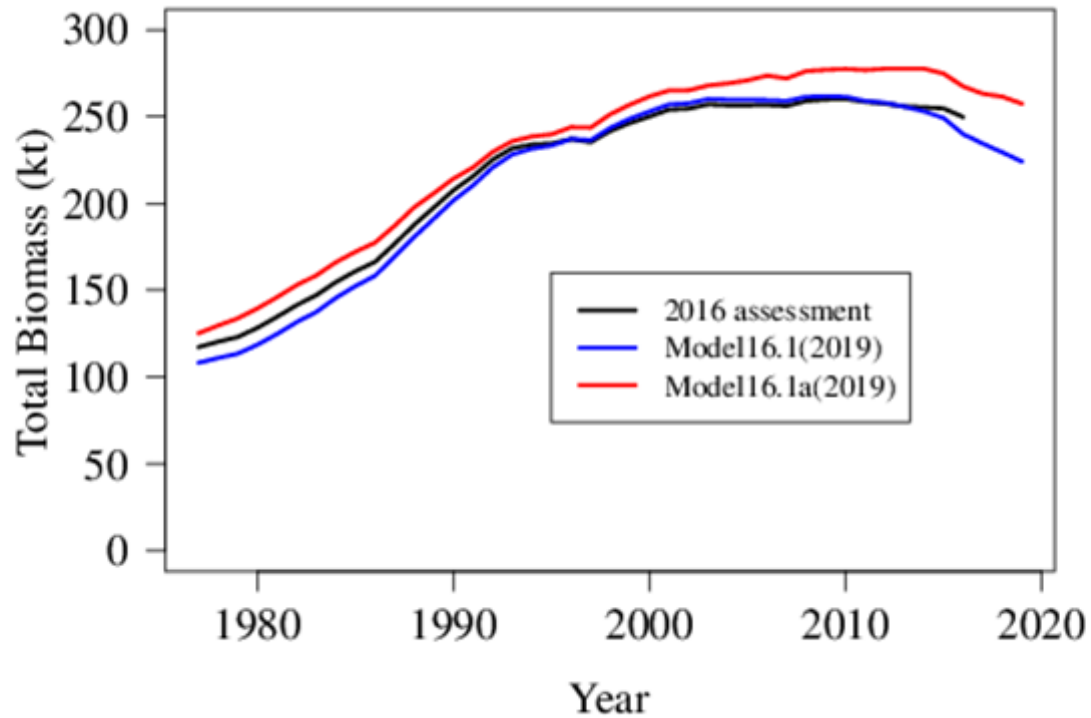
- *Model 0* The 2016 model results
- *Model 16.1 (2019)* The 2016 model, with data updated through 2019 in the same manner as in the 2016 assessment.
- *Model 16.1a(2019)* Input age comps and size at age use subarea age-length keys; prior put on survey selectivity.

Selectivity constraint

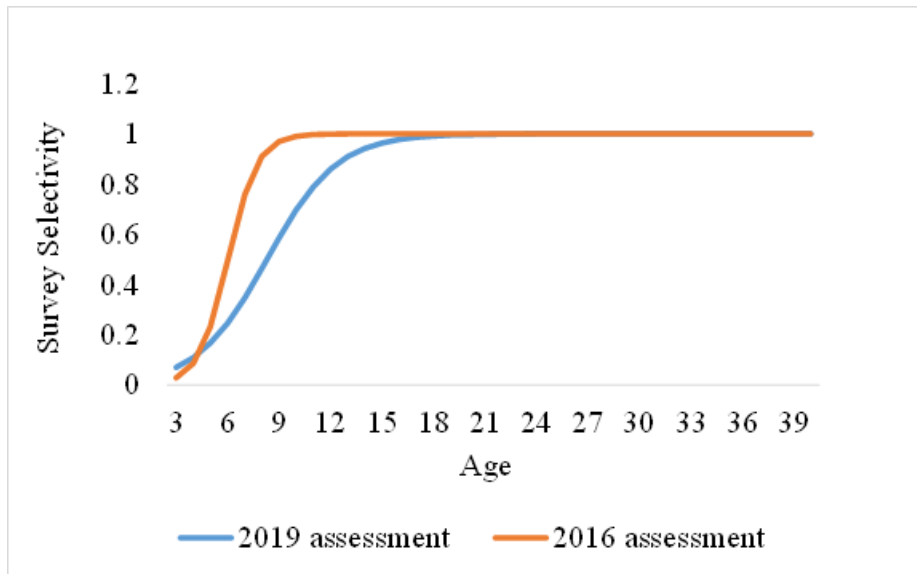
$$S_{15} \sim N(1, 0.03)$$



# Estimates of total biomass

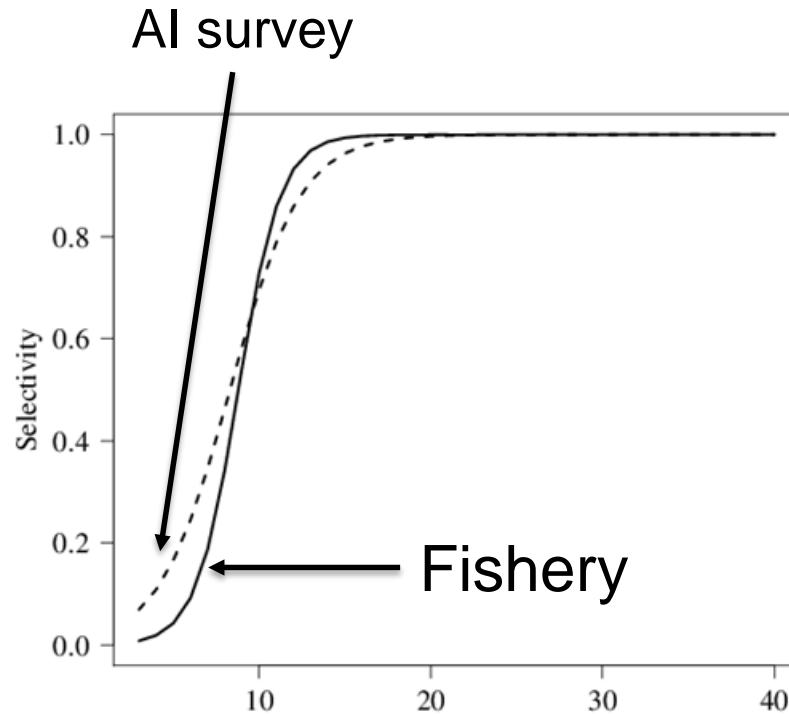


# Updated survey selectivity curve

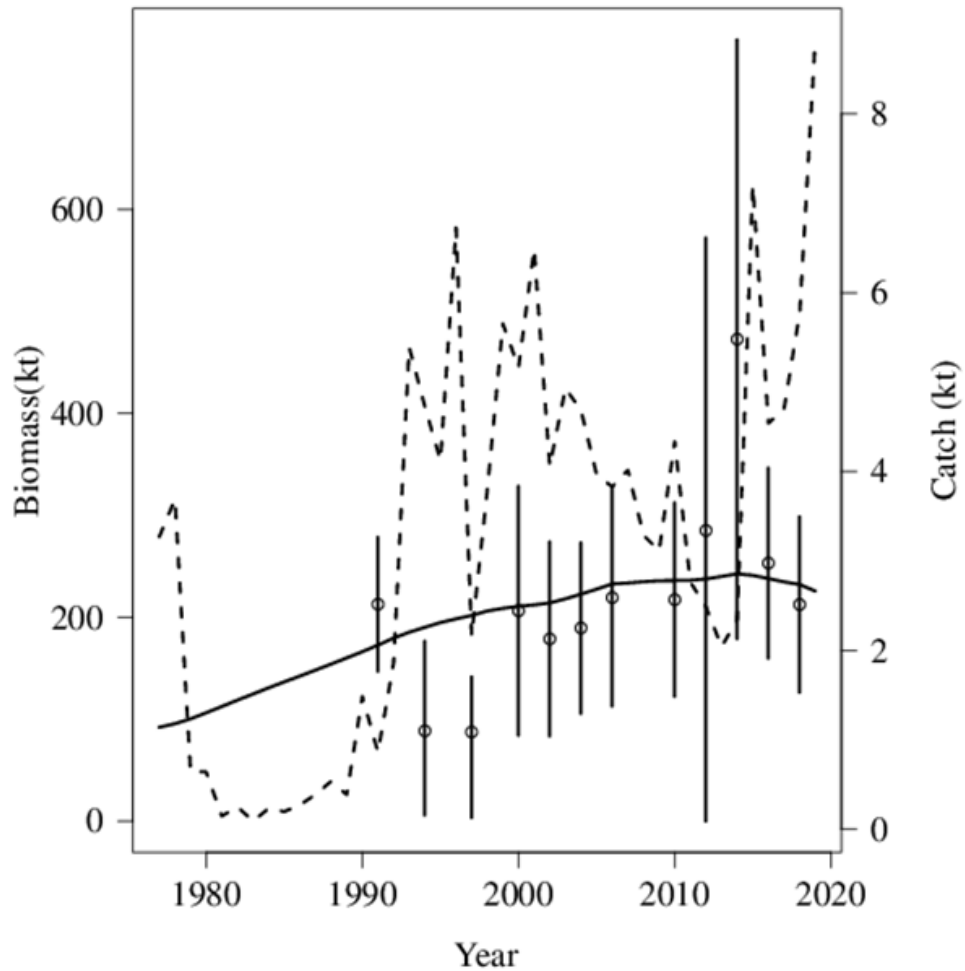




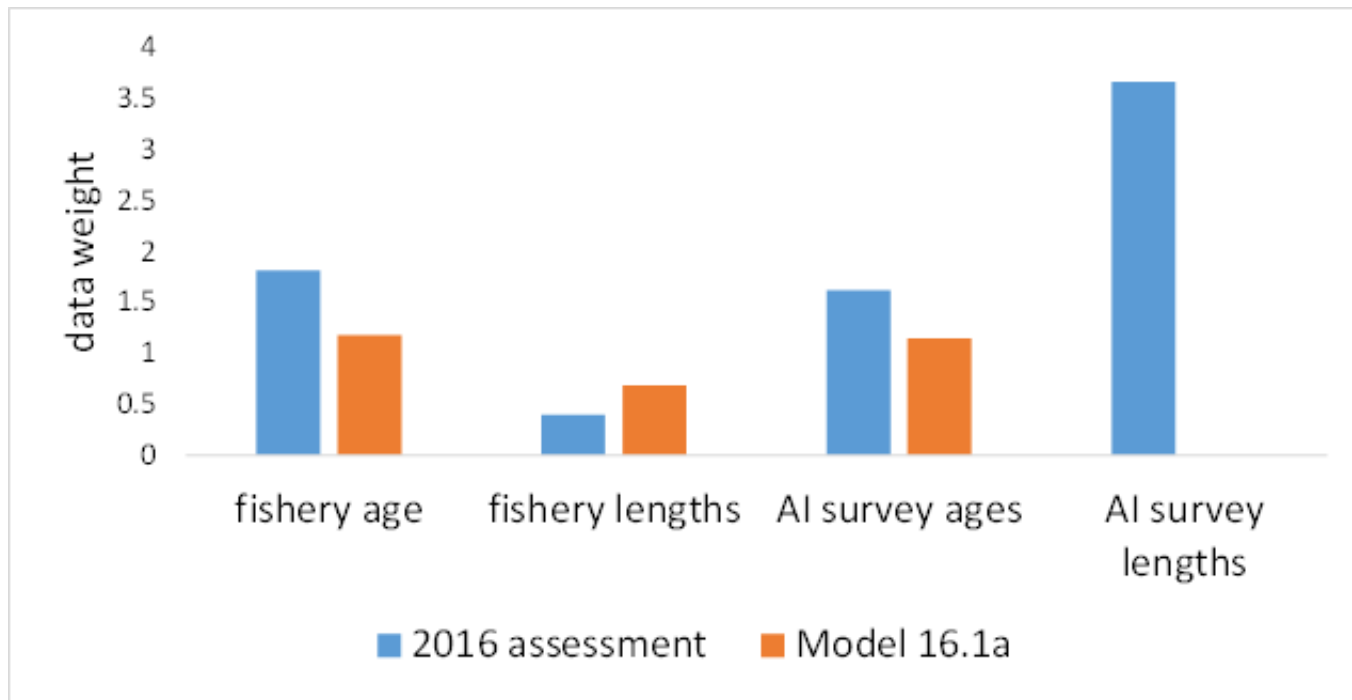
# Fishery and survey selectivity curves are similar



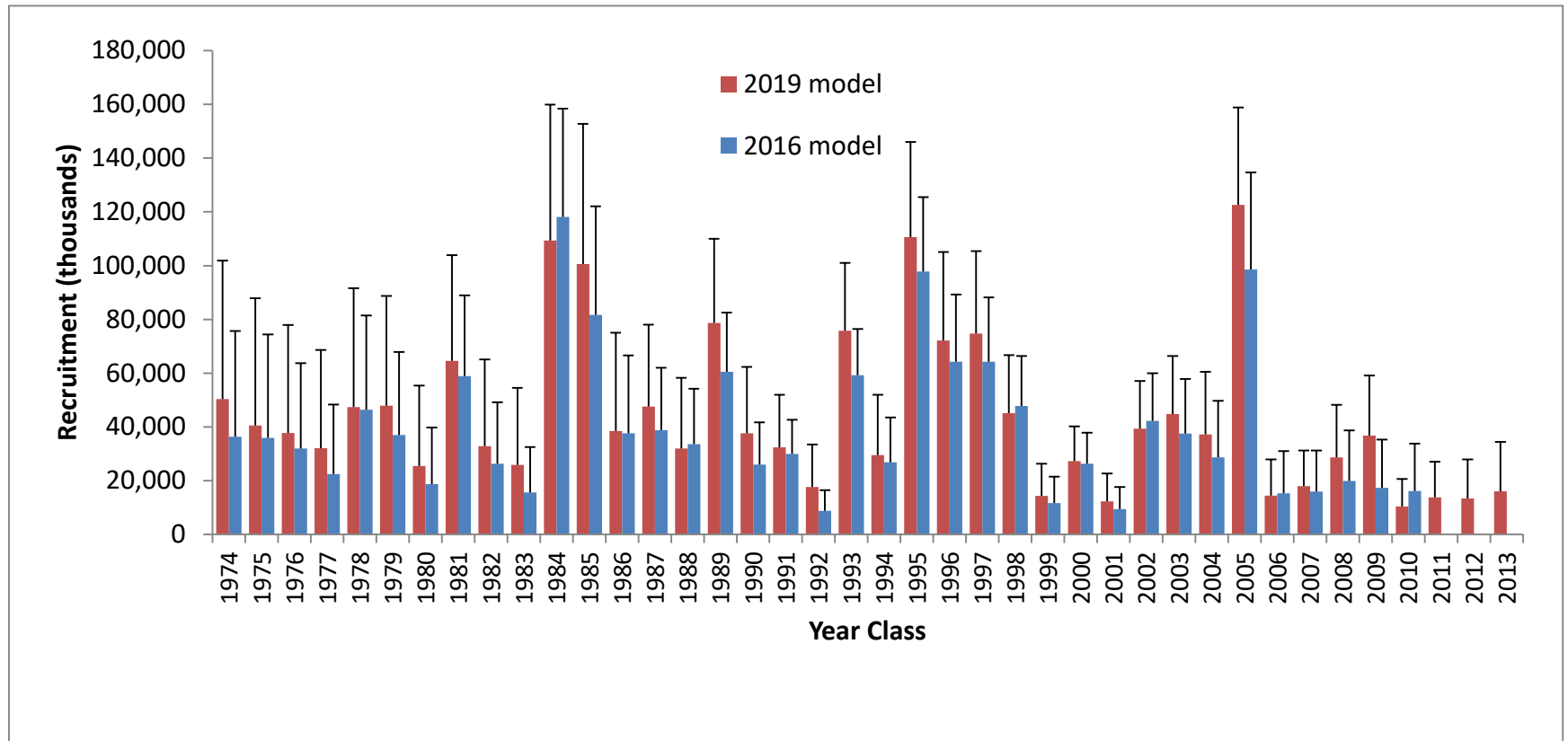
# Catch, and fit to the AI survey



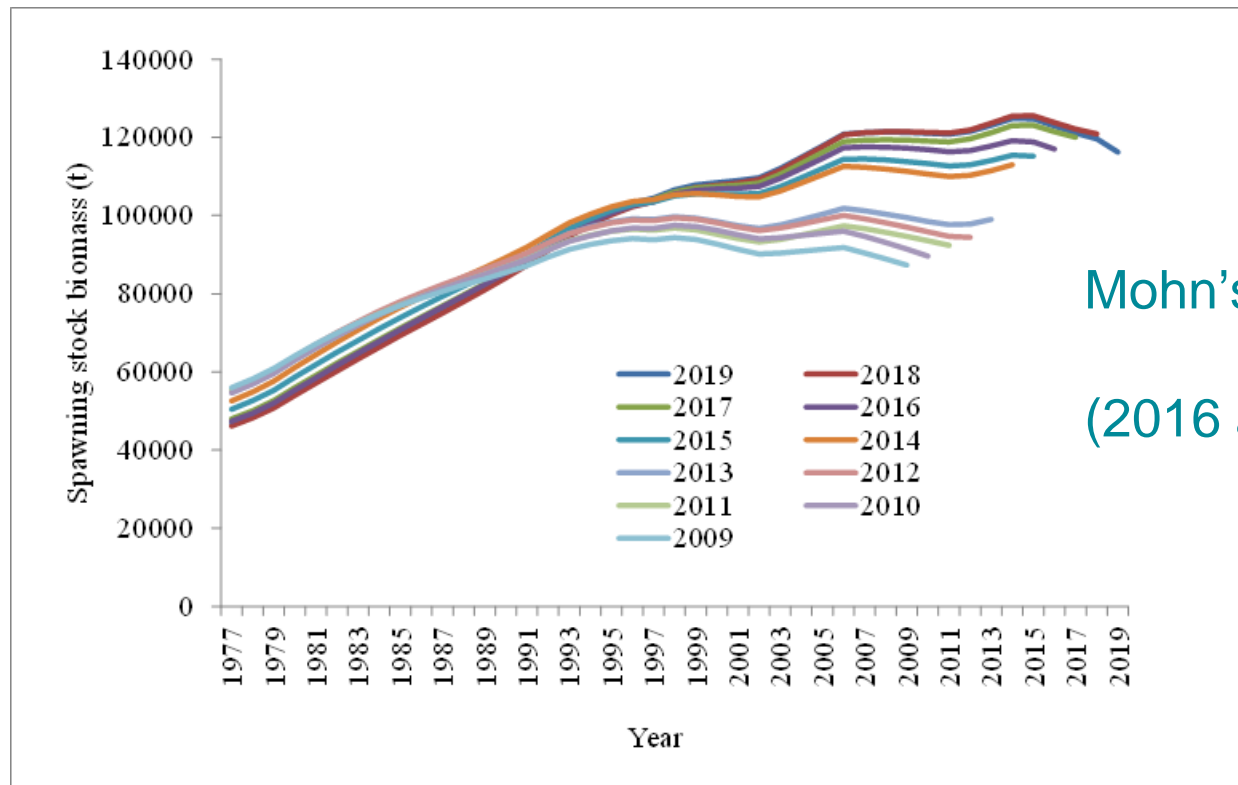
# Weights for age/length composition data



# Recruitment



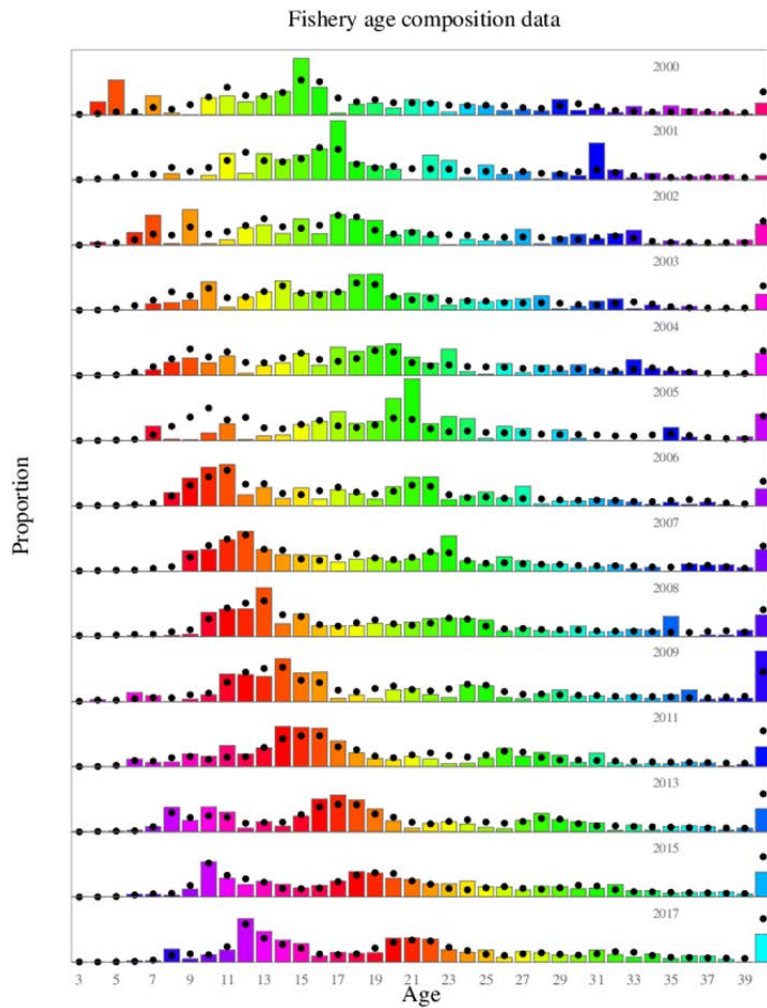
# Retrospective pattern



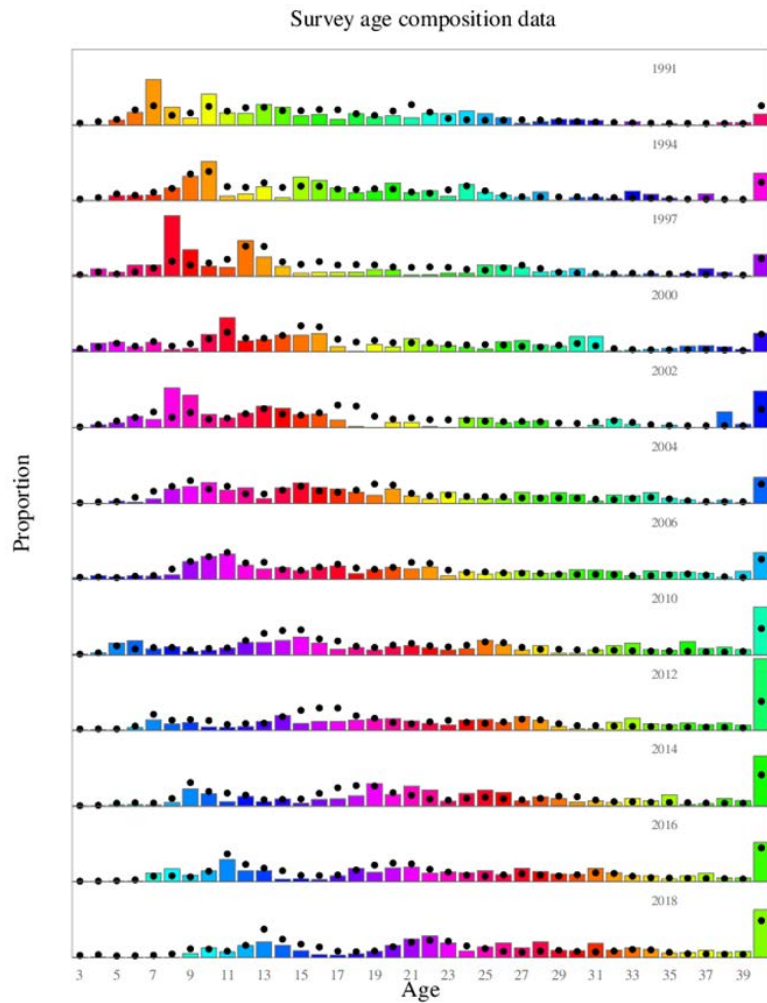
Mohn's rho = -0.14

(2016 assessment: -0.18)

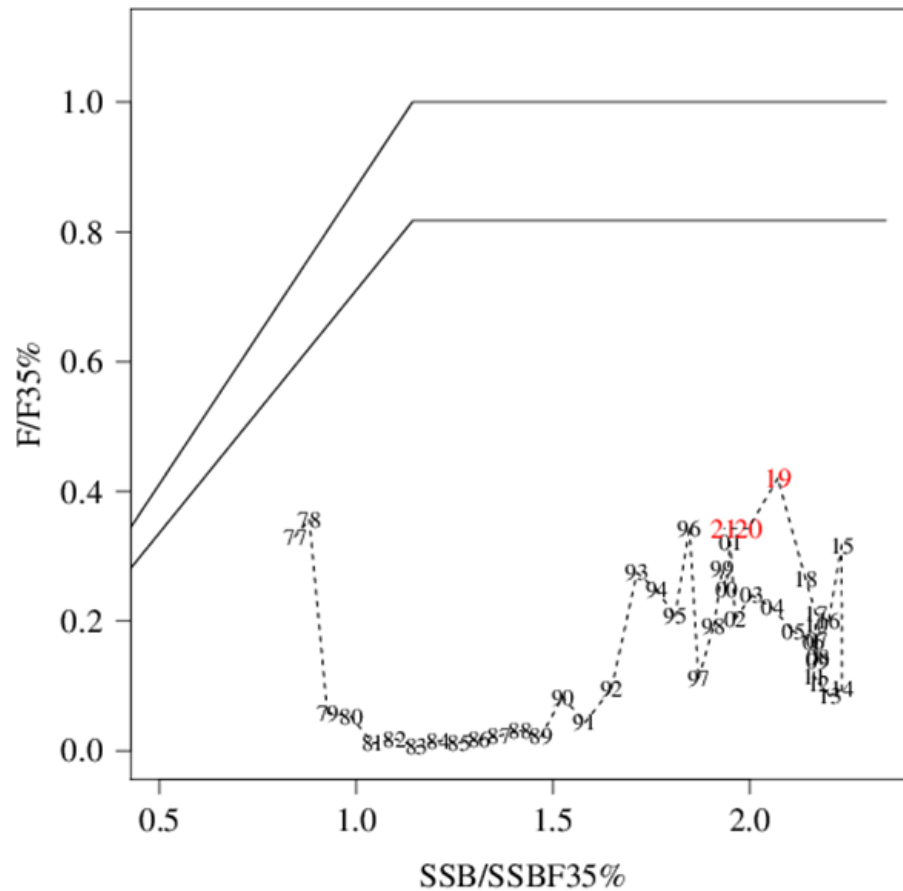
# Fishery age composition



# AI survey age composition



# Phase plane plot





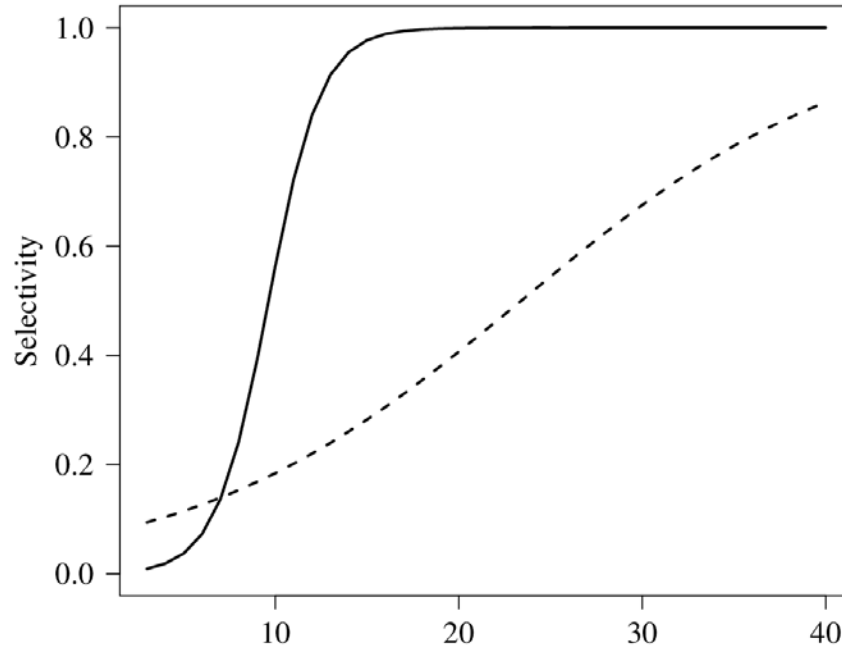
# Risk Table

<i>Assessment-related considerations</i>	<i>Population dynamics considerations</i>	<i>Environmental/ecosystem considerations</i>	<i>Fishery Performance considerations</i>	<i>Overall score (highest of the individual scores)</i>
Level 2: Substantially increased concerns	Level 1: Normal	Level 2: Substantially increased concerns	Level 1: Normal	Level 2: Substantially increased concerns

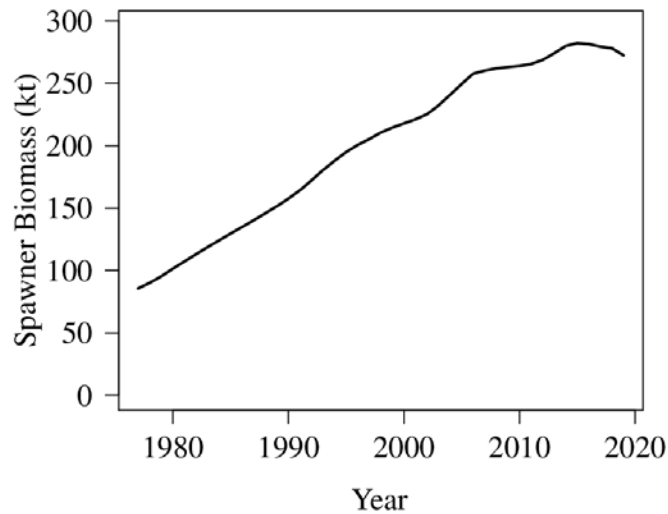
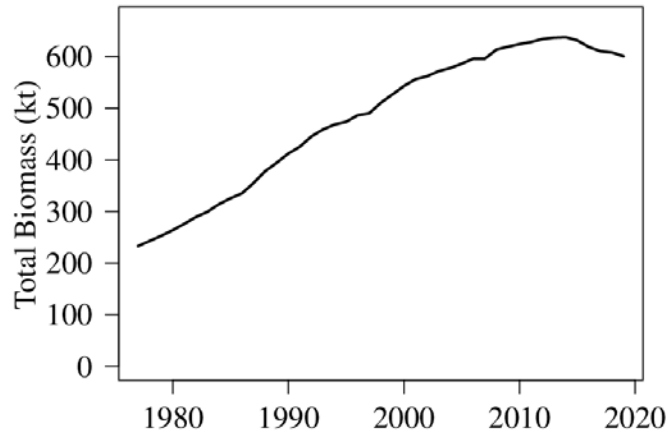
We do not recommend a reduction from the max ABC

*Assessment related considerations:* Several key parameters strongly constrained by prior distributions; retrospective bias.

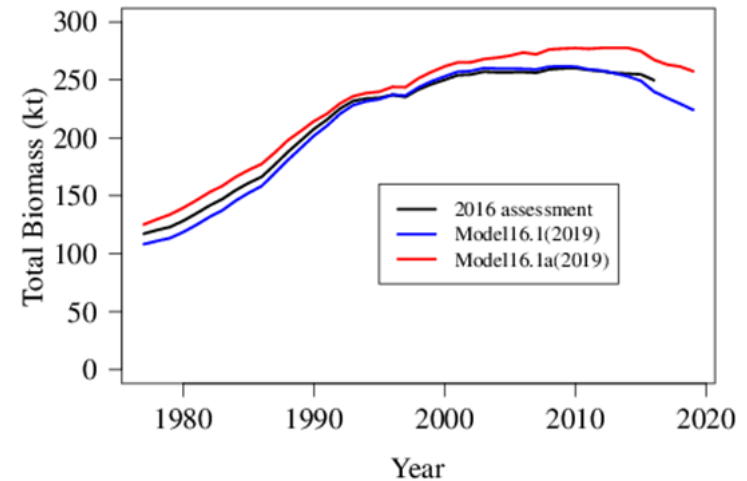
# Fishery and survey selectivity, without constraint on survey selectivity



# Total and spawning biomass, without constraint on survey selectivity



Results presented in this assessment

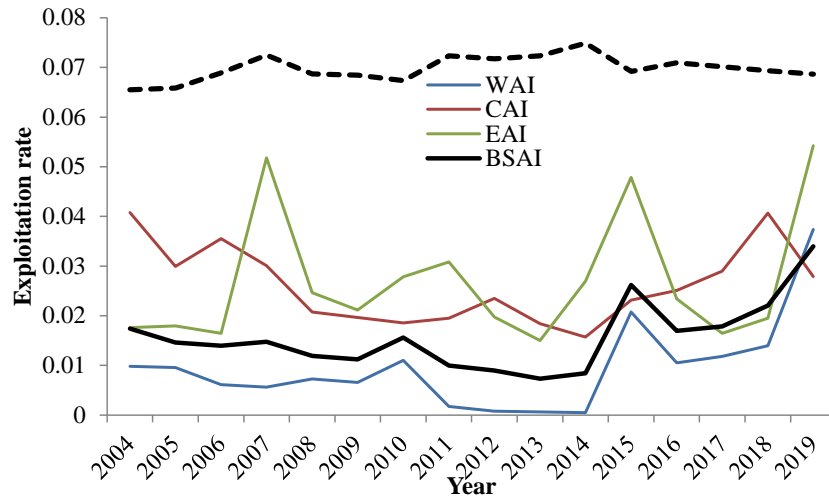
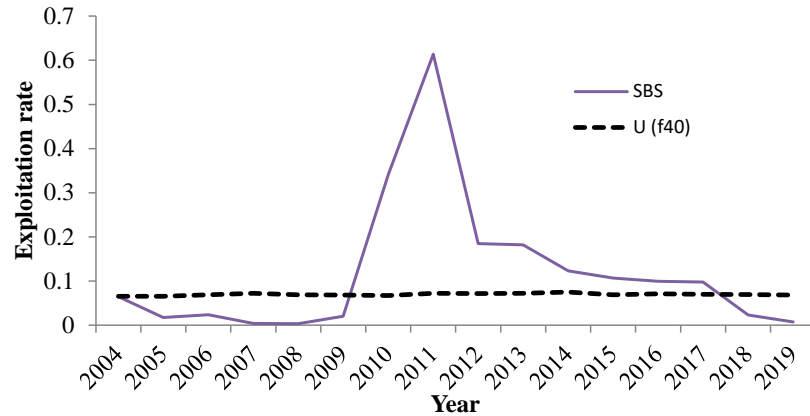


# Risk Table

<i>Assessment-related considerations</i>	<i>Population dynamics considerations</i>	<i>Environmental/ecosystem considerations</i>	<i>Fishery Performance considerations</i>	<i>Overall score (highest of the individual scores)</i>
Level 2: Substantially increased concerns	Level 1: Normal	Level 2: Substantially increased concerns	Level 1: Normal	Level 2: Substantially increased concerns

*Population dynamics considerations:* “Northern rockfish show genetic structure within the Aleutian Islands, with the lifetime dispersal distances estimated as not exceeding 250 km (Gharrett et al. 2012). Spatial management of the harvest does not occur within the BSAI, so a population dynamics consideration is that the spatial management of the stock is not consistent with the spatial structure of the stock.”

# Exploitation rates



# Risk Table

<i>Assessment-related considerations</i>	<i>Population dynamics considerations</i>	<i>Environmental/ecosystem considerations</i>	<i>Fishery Performance considerations</i>	<i>Overall score (highest of the individual scores)</i>
Level 2: Substantially increased concerns	Level 1: Normal	Level 2: Substantially increased concerns	Level 1: Normal	Level 2: Substantially increased concerns

*Environmental/ecosystem considerations*: Declining trend in condition since 2010; lack of forage fish (as indicated by seabird fledging rates).

(Thank you, Stephanie, for this part of the table)

# Reference points and ABCs

Quantity	As estimated or specified last year for:		As estimated or recommended this year for:	
	2019	2020	2020*	2021*
<i>M</i> (natural mortality rate)	0.046	0.046	0.048	0.048
Tier	3a	3a	3a	3a
Projected total (age 3+) biomass (t)	244,196	242,426	250,235	246,384
Female spawning biomass (t)				
Projected	104,201	102,480	111,476	108,063
<i>B</i> <sub>100%</sub>	164,674	164,674	159,850	159,850
<i>B</i> <sub>40%</sub>	65,870	65,870	63,940	63,940
<i>B</i> <sub>35%</sub>	57,636	57,636	55,947	55,947
<i>F</i> <sub>OFL</sub>	0.080	0.080	0.075	0.075
<i>maxF</i> <sub>ABC</sub>	0.065	0.065	0.061	0.061
<i>F</i> <sub>ABC</sub>	0.065	0.065	0.061	0.061
OFL (t)	15,507	15,180	19,751	19,070
maxABC (t)	12,664	12,396	16,243	15,683
ABC (t)	12,664	12,396	16,243	15,683
Status	As determined last year for: for:		As determined this year	
	2017	2018	2018	2019
Overfishing	No	n/a	No	n/a
Overfished	n/a	No	n/a	No
Approaching overfished	n/a	No	n/a	No

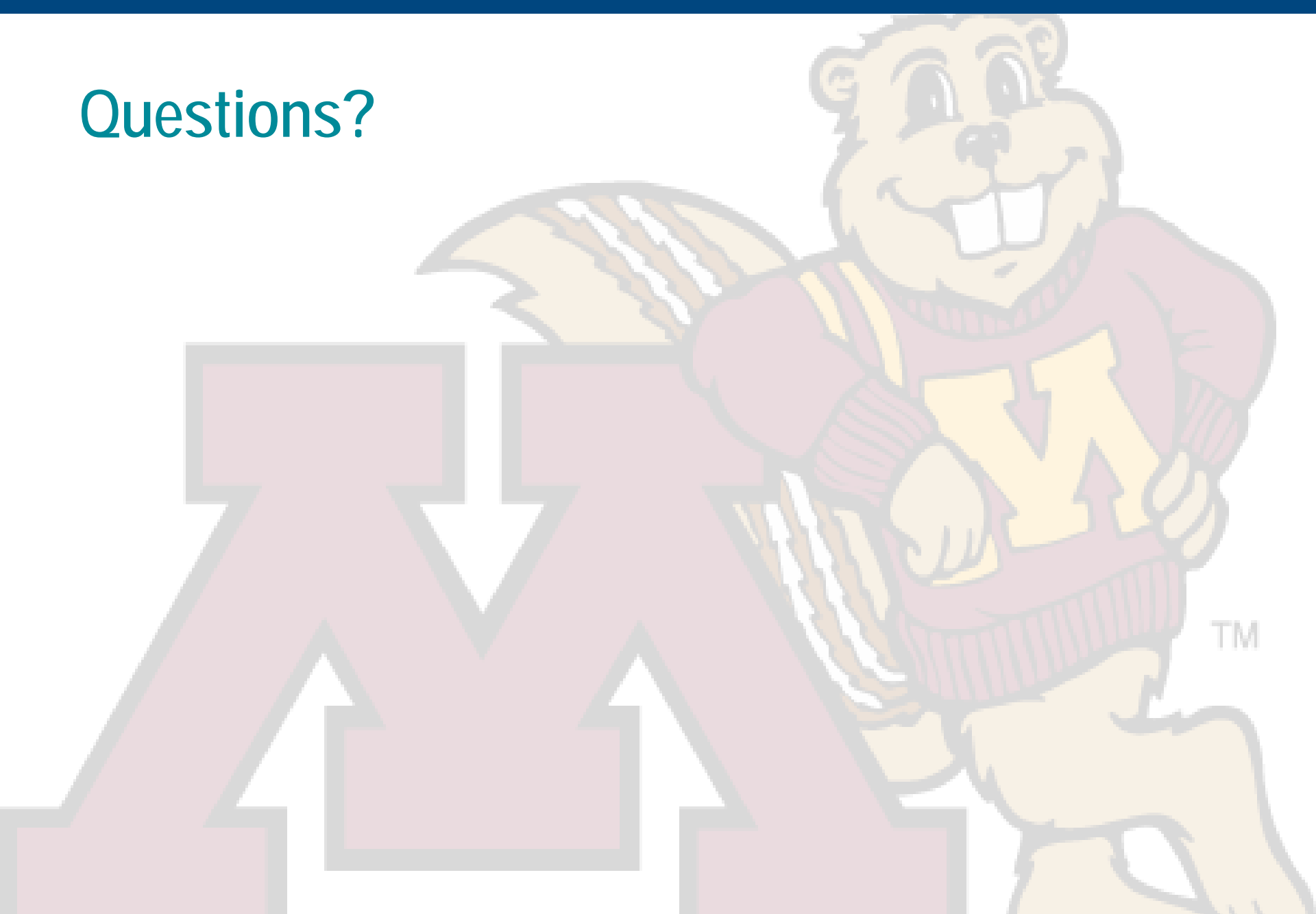
\*Projections are based on estimated catches of 6,930 t and 6,691 t used in place of maximum permissible ABC for 2020 and 2021.

# Future research plans

- Explore alternatives for estimating survey selectivity
- Explore global age-length keys that weight by the population size between areas



# Questions?



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