



BSAI Atka Mackerel

*Sandra Lowe, Jim Ianelli, Wayne Palsson
Alaska Fisheries Science Center*

BSAI Atka Mackerel

Model 16.0b



Changes in the Input Data

- Fishery catch data updated (2017, proj. 2018)
- **2017** fishery age composition data added
 - **2011 year class** ↓ 12% relative to last year's assessment
 - **2012 year class** ↑ 4% (above ave.)
 - **2013 year class** ↑ 12%
- **2018 survey biomass:** ↓ 21%, ↑ 6% in EAI, ↓ 80% in CAI, ↓ 14% in WAI
- The est. average selectivity for **2013-2017** used for projections
- Sample sizes for fishery age comp rescaled with **2017 data** (varied relative to # hauls)
- Assume 86% of the BSAI-wide ABC to be taken under revised SSL RPAs; % applied to 2019 (and 2020) maxABC for projections

BSAI Atka Mackerel



Key Results

□ Tier 3b

- $B_{100\%}$, $B_{40\%}$, and $B_{35\%}$ are 8% lower
- 2019 spawning biomass (106,800 t) 23% lower, **below** $B_{40\%}$ ($B_{38\%}$), Tier 3b
- 2019 age 1+ biomass 17% lower than last year's projection for 2018
- 2019 projections:

Yield at $F_{40\%adj} = 0.44$, 26% lower than 2018 ABC

2019 ABC = 68,500 t

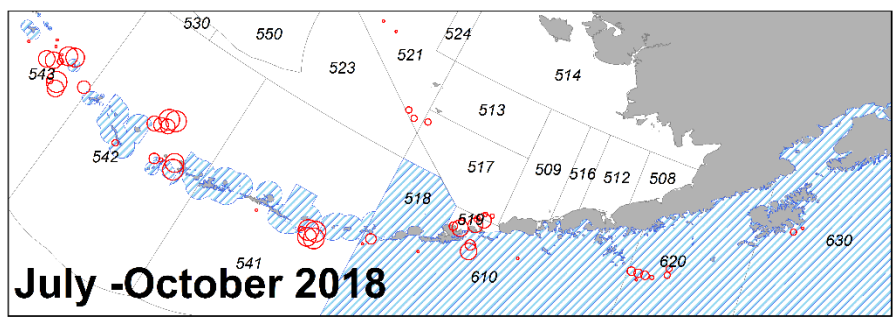
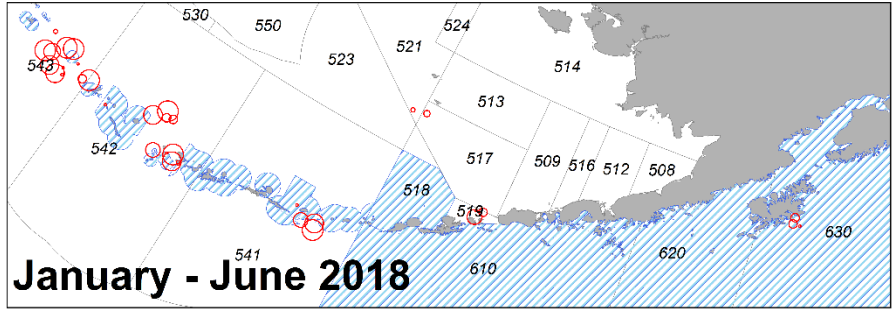
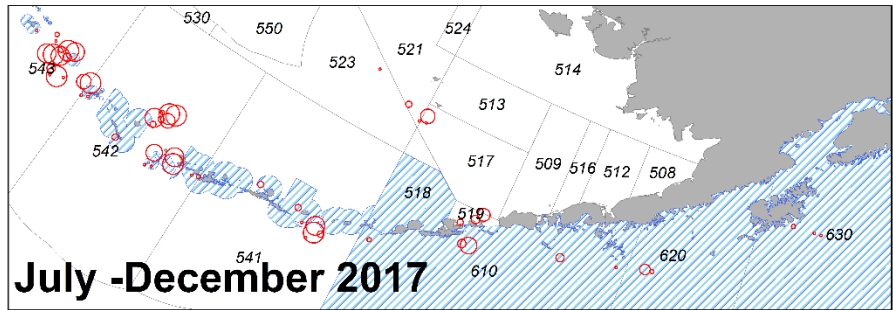
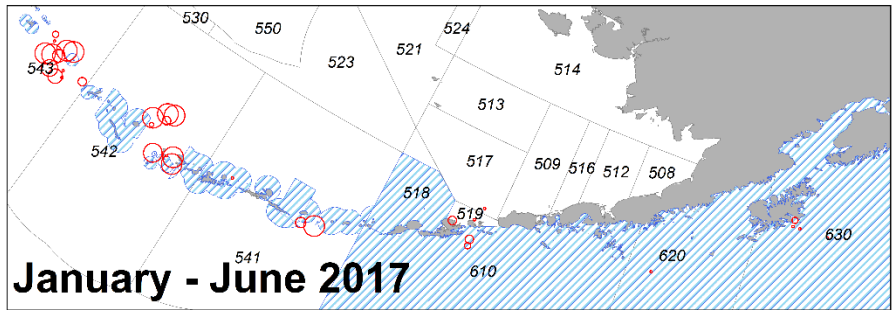
2019 OFL = 79,200 t

BSAI Atka Mackerel



- Model 16.0b (last year's accepted model)
- Conducted sensitivity evaluations for Model 16.0b
 - Alt. fishery selectivity patterns
 - Alt. fishery age sample sizes
 - Retrospective patterns
 - Age-specific M

(Sept, 2018 document in Appendix 17C)



Observed catch (Tons)

- 1 - 5
- 6 - 10
- 11 - 20
- 21 - 40
- 41 - 80
- 81 - 100
- 101 - 200
- 201 - 400
- 401 - 800
- > 800

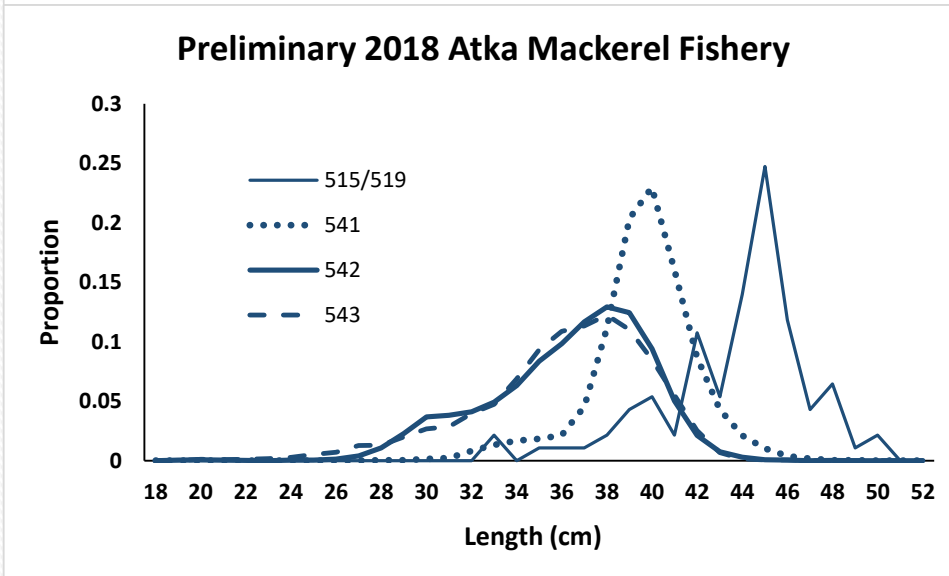
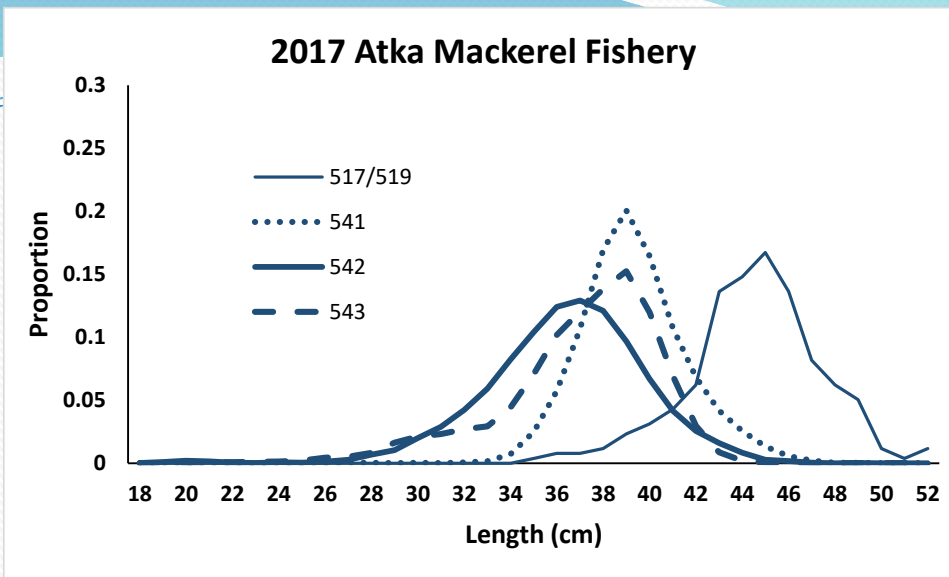
Observed catch (Tons)

- 1 - 5
- 6 - 10
- 11 - 20
- 21 - 40
- 41 - 80
- 81 - 100
- 101 - 200
- 201 - 400
- 401 - 800
- > 800

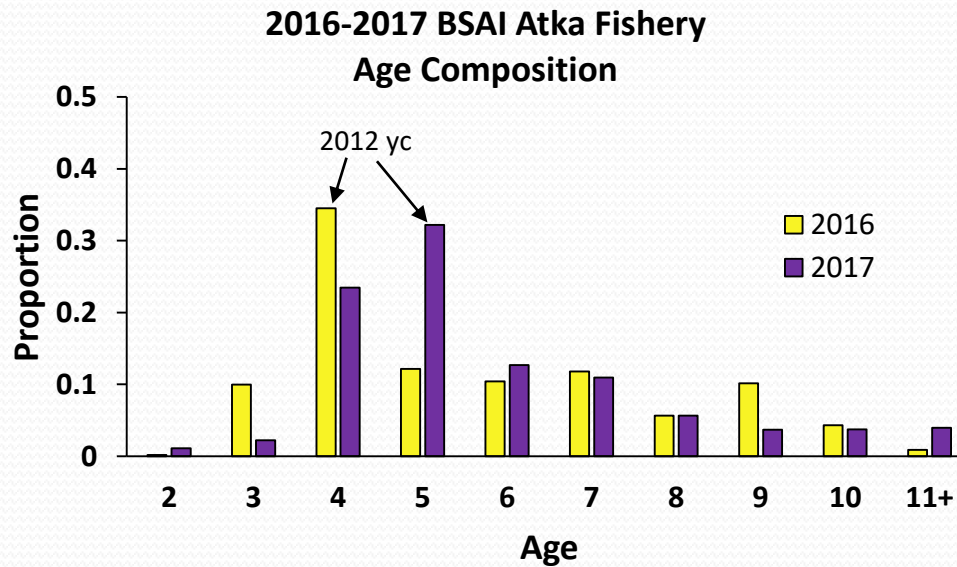


2017-2018

Atka mackerel fishery locations

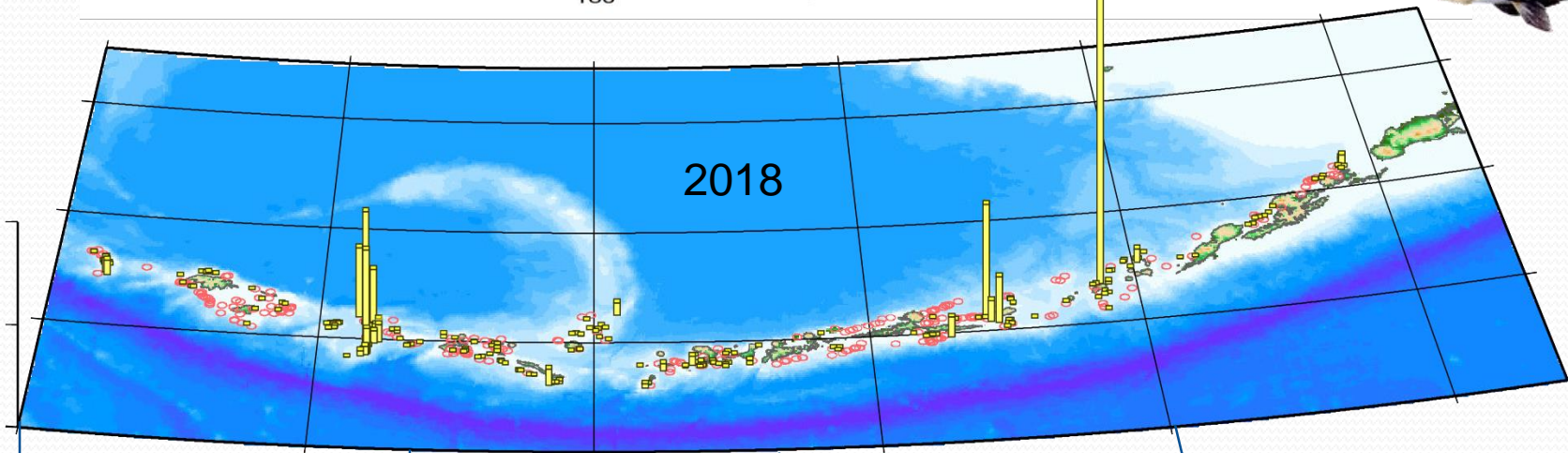
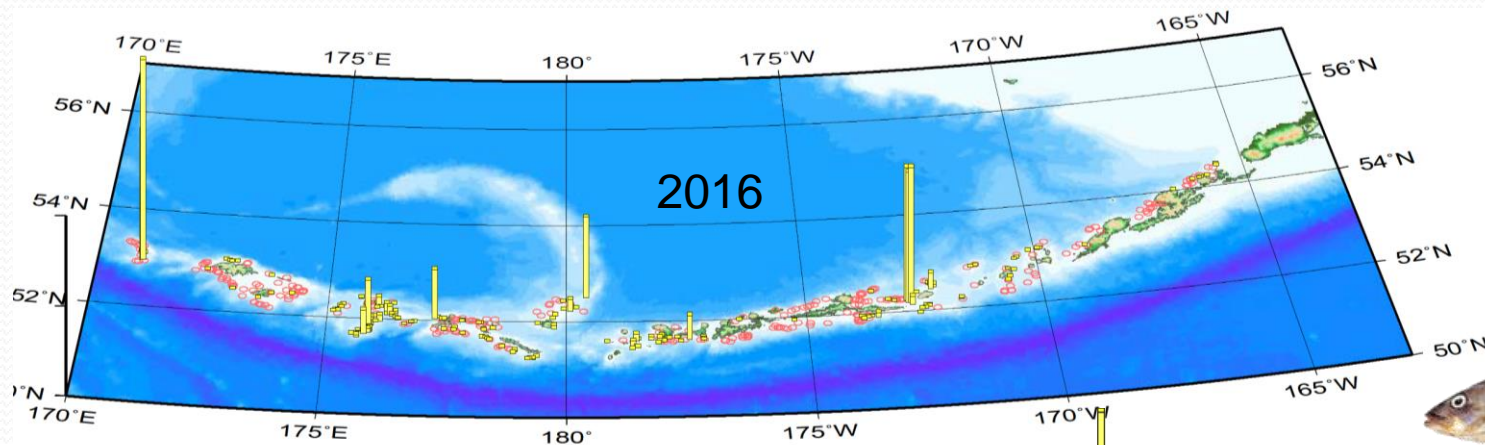


Atka mackerel fishery length-frequency data by area fished



A total of 1,868 otoliths were aged in 2016; mean age from the 2016 fishery is 5.6 years
A total of 1,318 otoliths were aged in 2017; mean age from the 2017 fishery is 5.8 years

Bottom trawl survey CPUE distributions of Atka mackerel catches

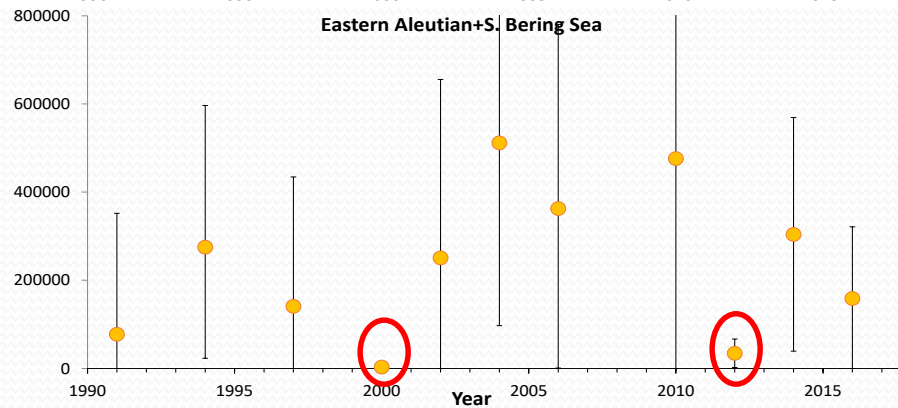
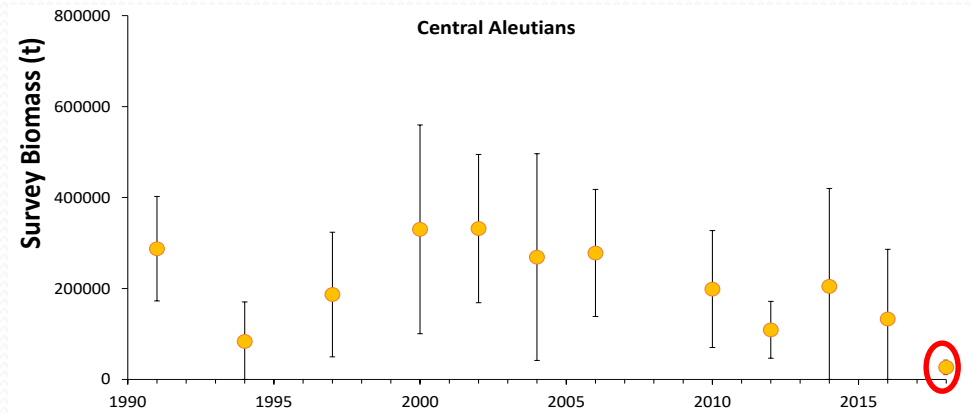
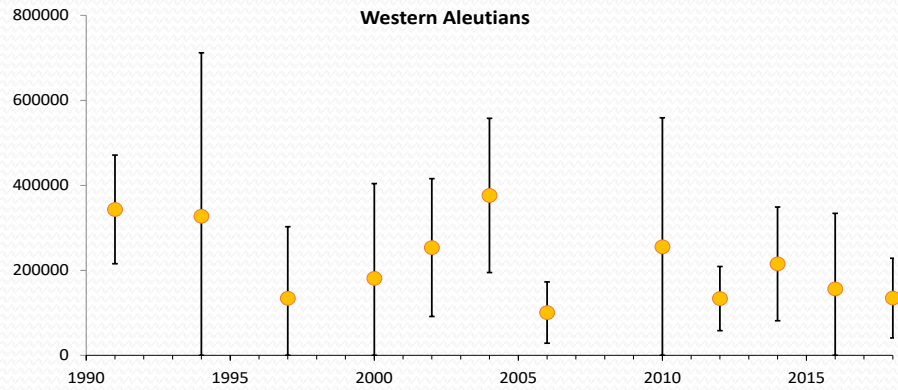


WAI

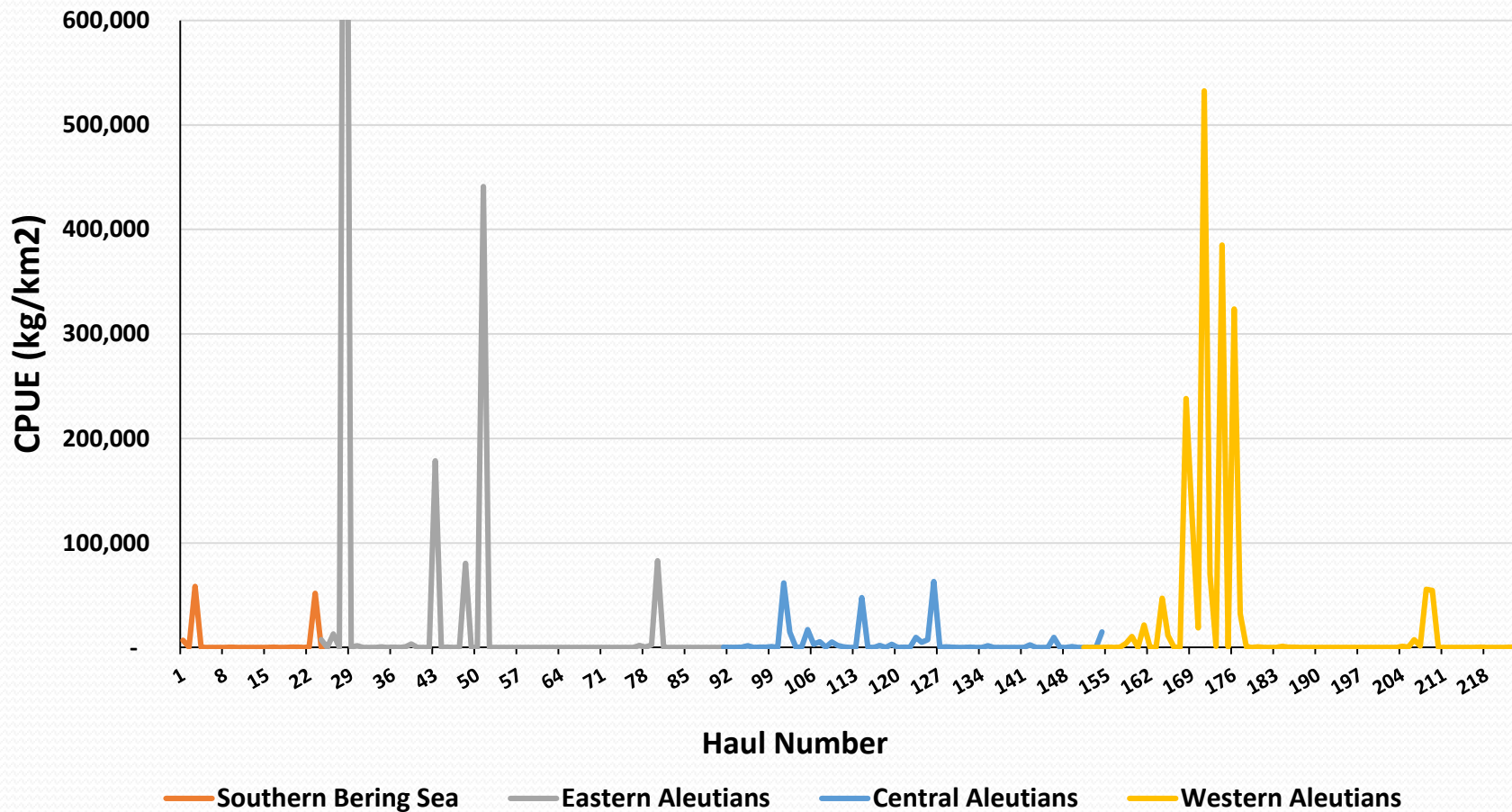
CAI

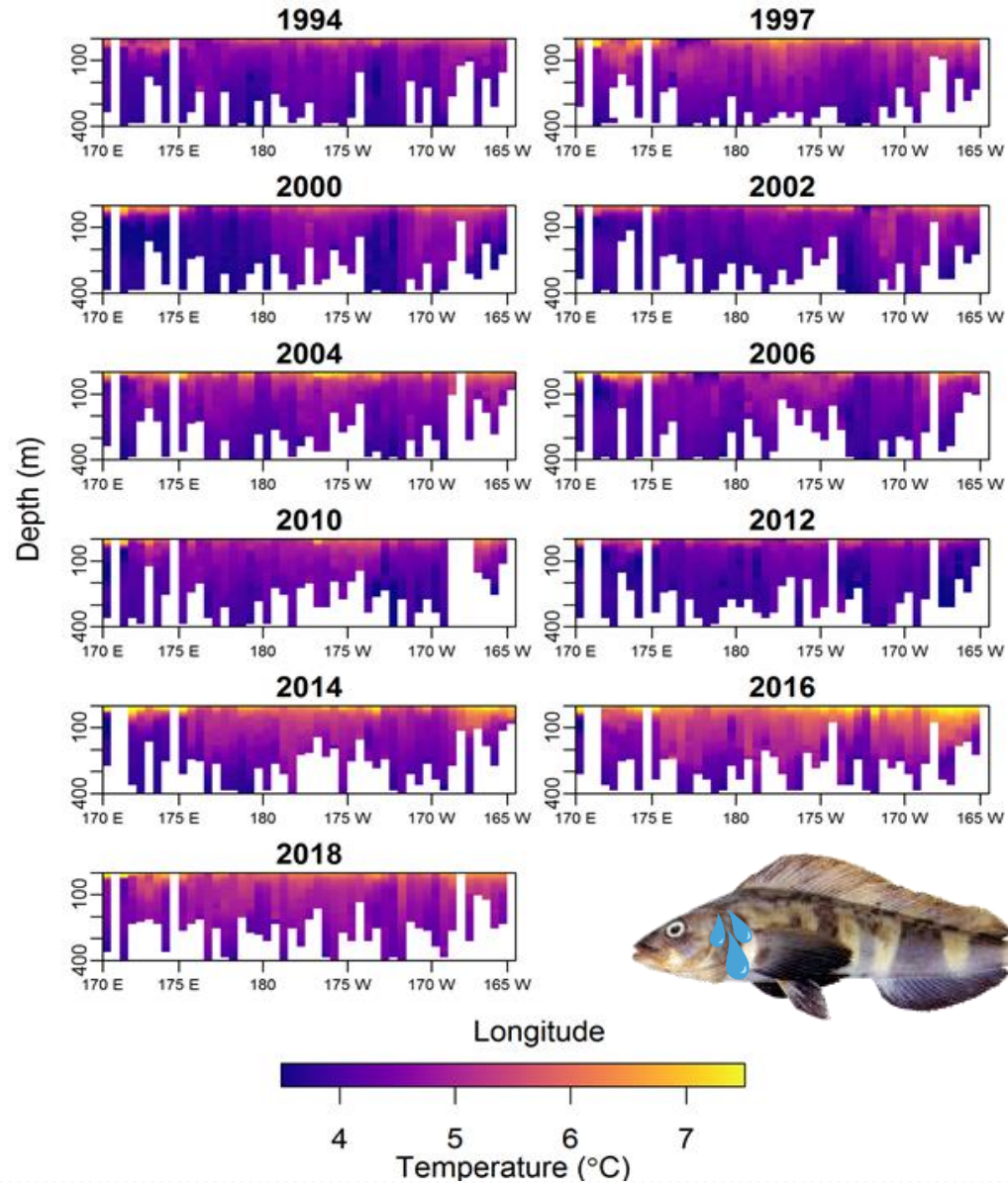
EAI

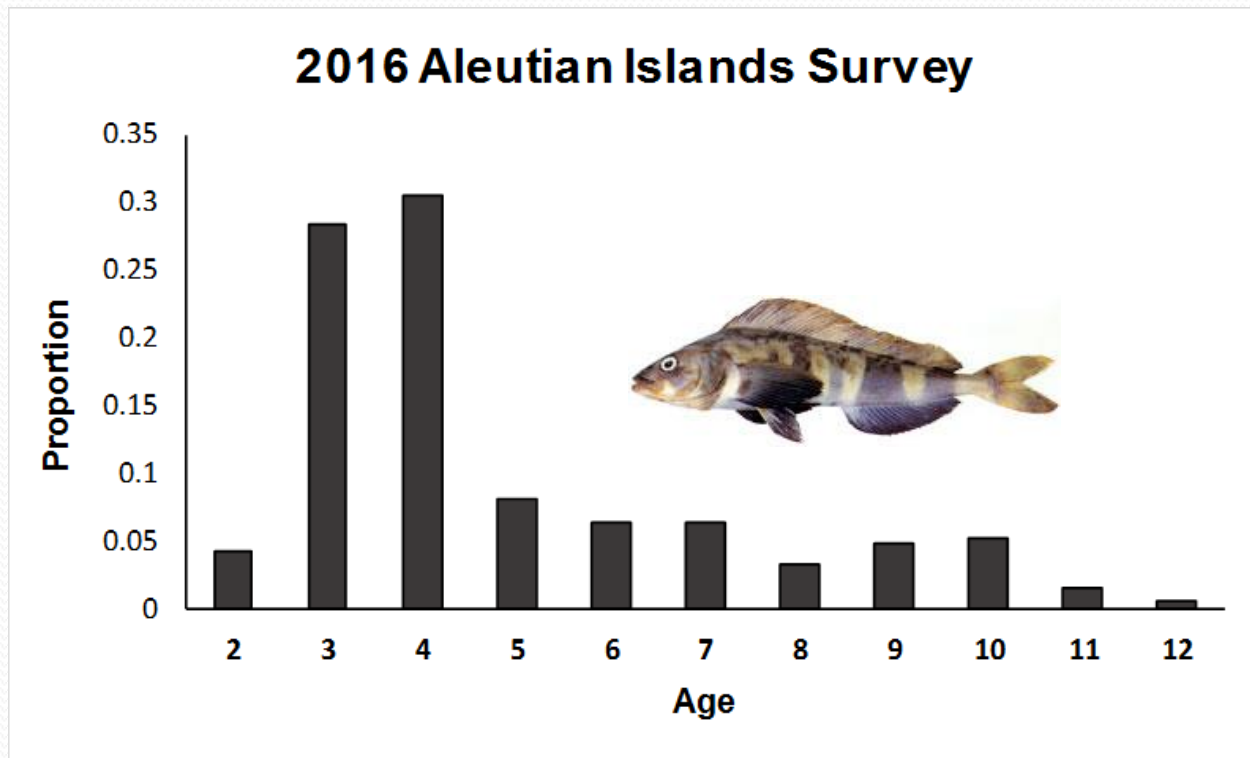
21% decrease, CV 30%



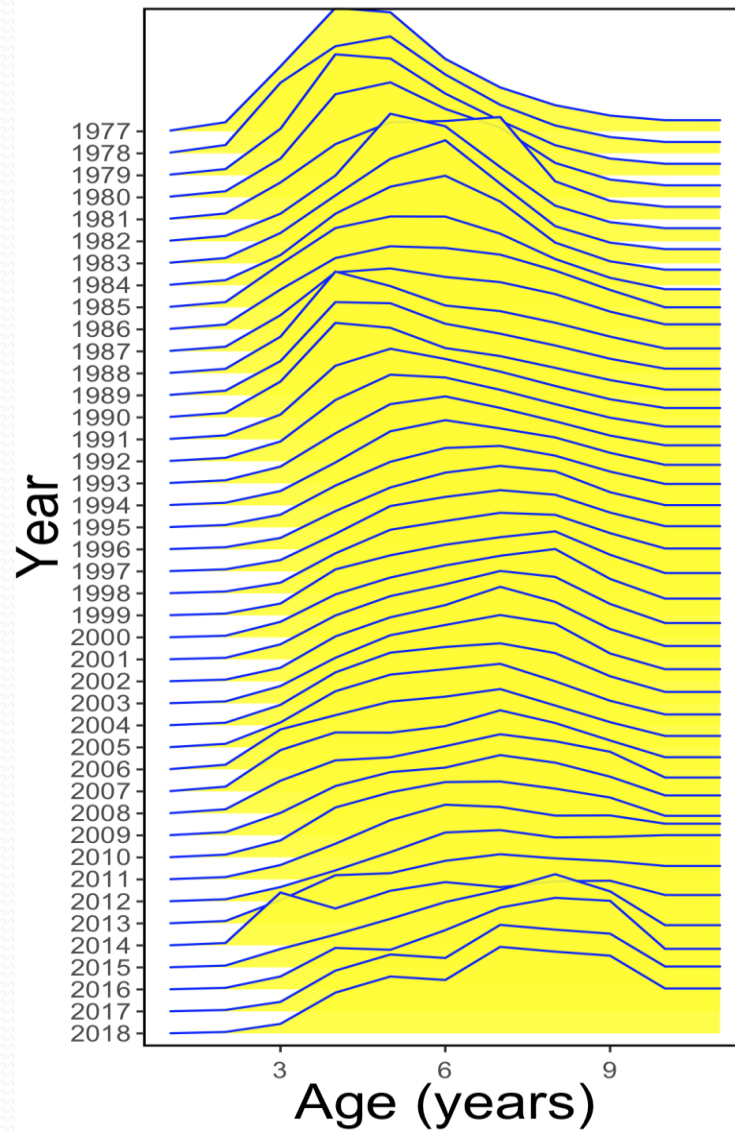
2018 Aleutian Islands Survey Atka Mackerel CPUE (kg/km2)



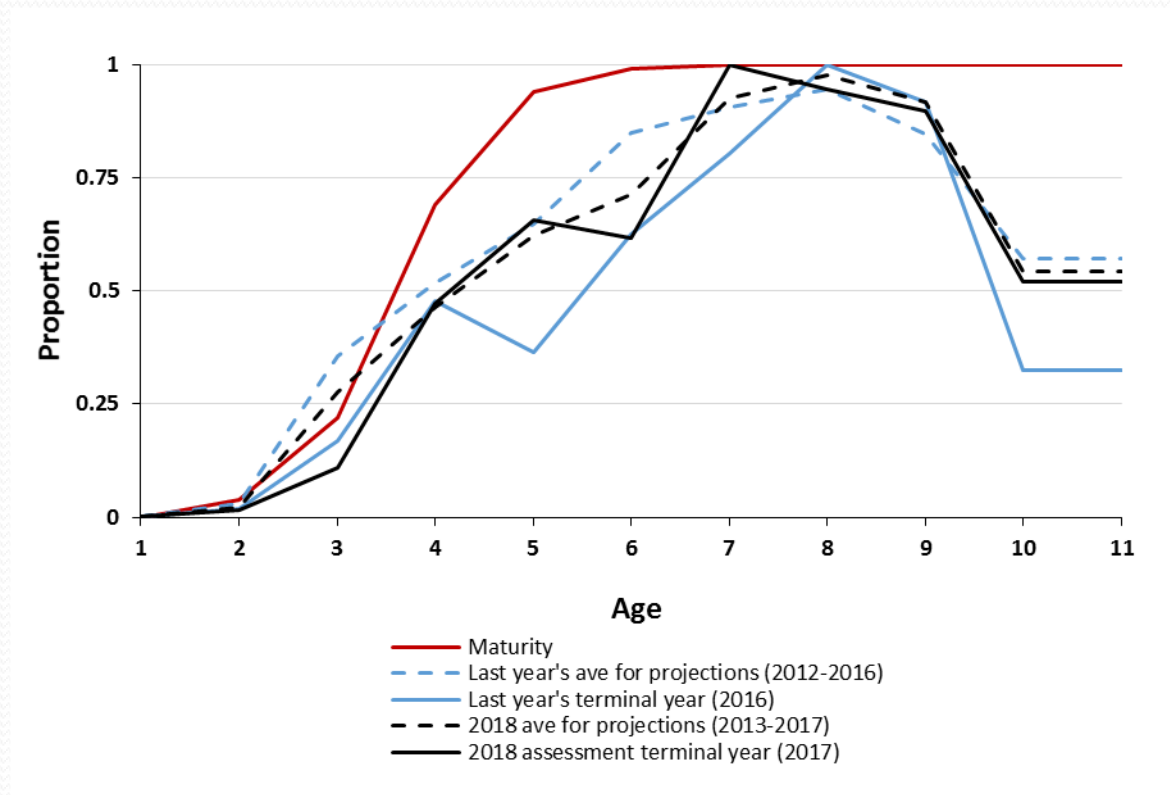




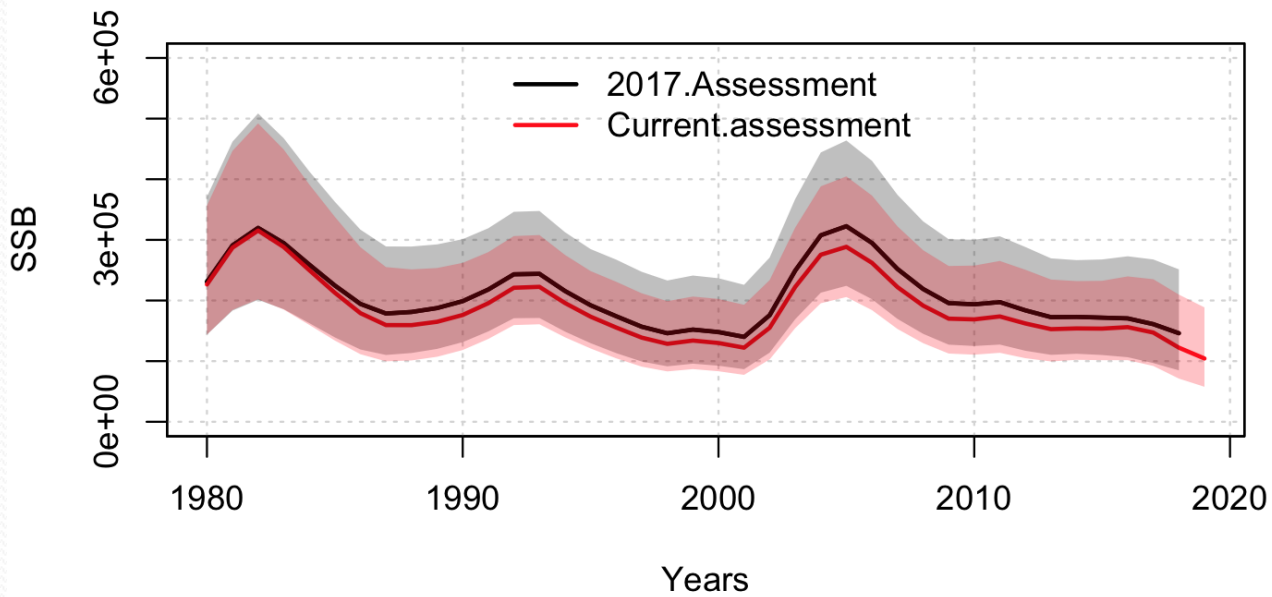
- ★ A total of 300 otoliths were aged; mean age from the 2016 survey is 4.9 years
- ★ A total of 1,078 otoliths were collected on the 2018 survey



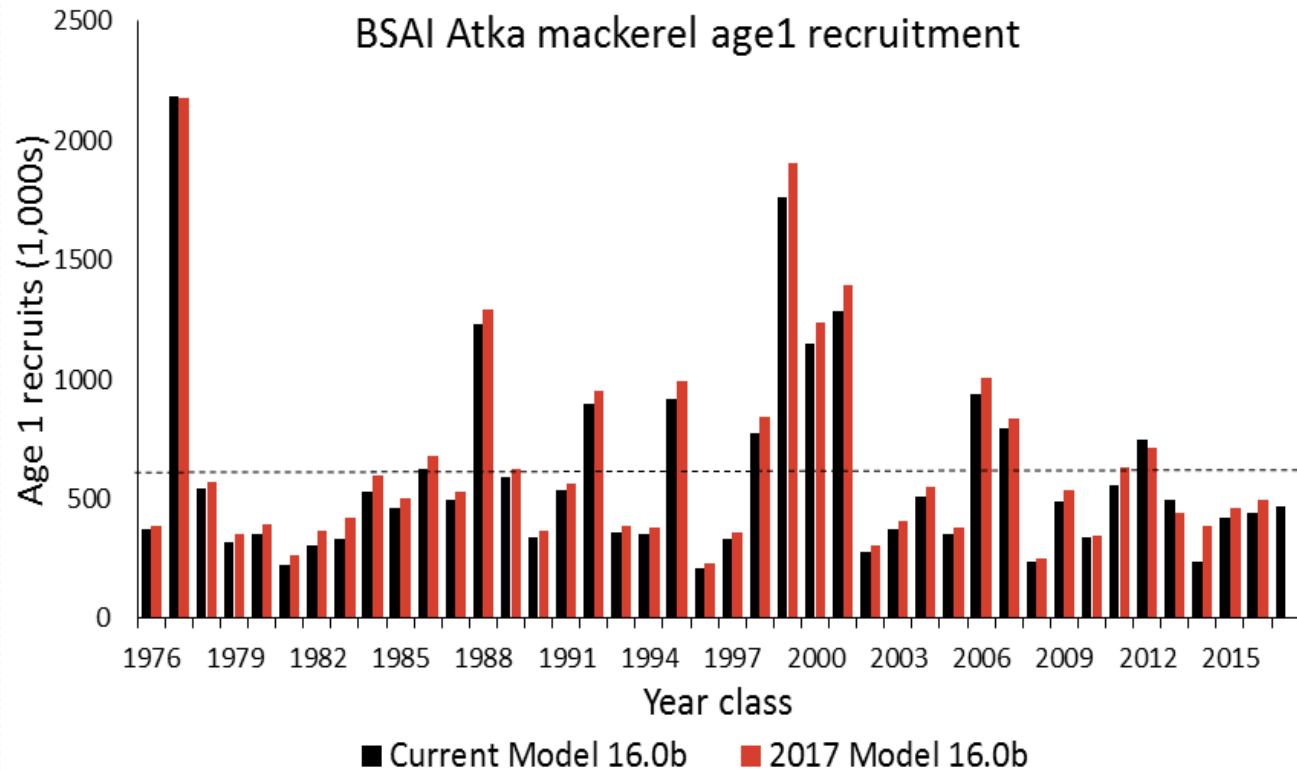
Fishery selectivity pattern from the BSAI Atka mackerel assessment Model 16.0b



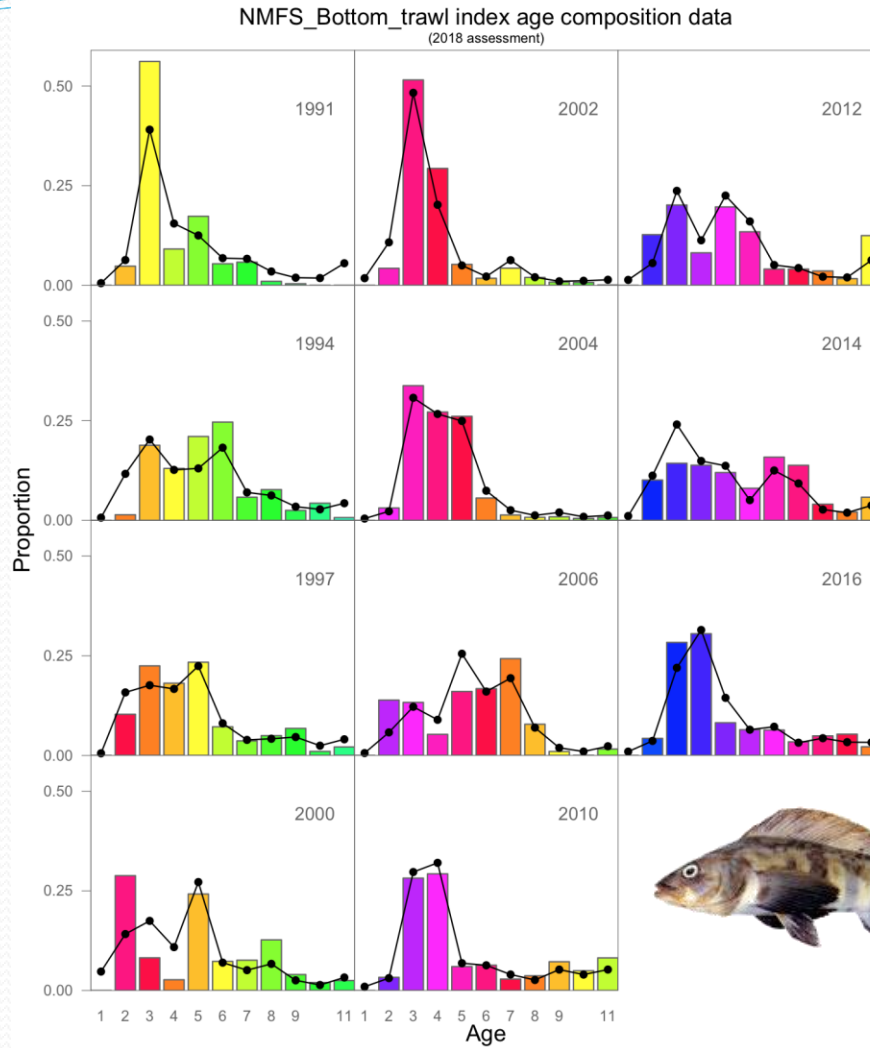
Estimated fishery selectivity patterns in the current assessment with a) last year's average for projections (2012-2016), b) the 2018 assessment average selectivity used for projections (2013-2017), c) last year's assessment terminal year (2016), and d) the 2018 assessment terminal year (2017) compared with the maturity-at-age estimates for BSAI Atka mackerel.



Time series of the current assessment (Model 16.0b) estimated AI Atka mackerel spawning biomass (t) with approximate 95% confidence bounds, compared to last year's Model 16.0b estimates (2017 assessment). Changes include 2017 fishery age composition data and the 2018 AI survey data included in the current assessment.

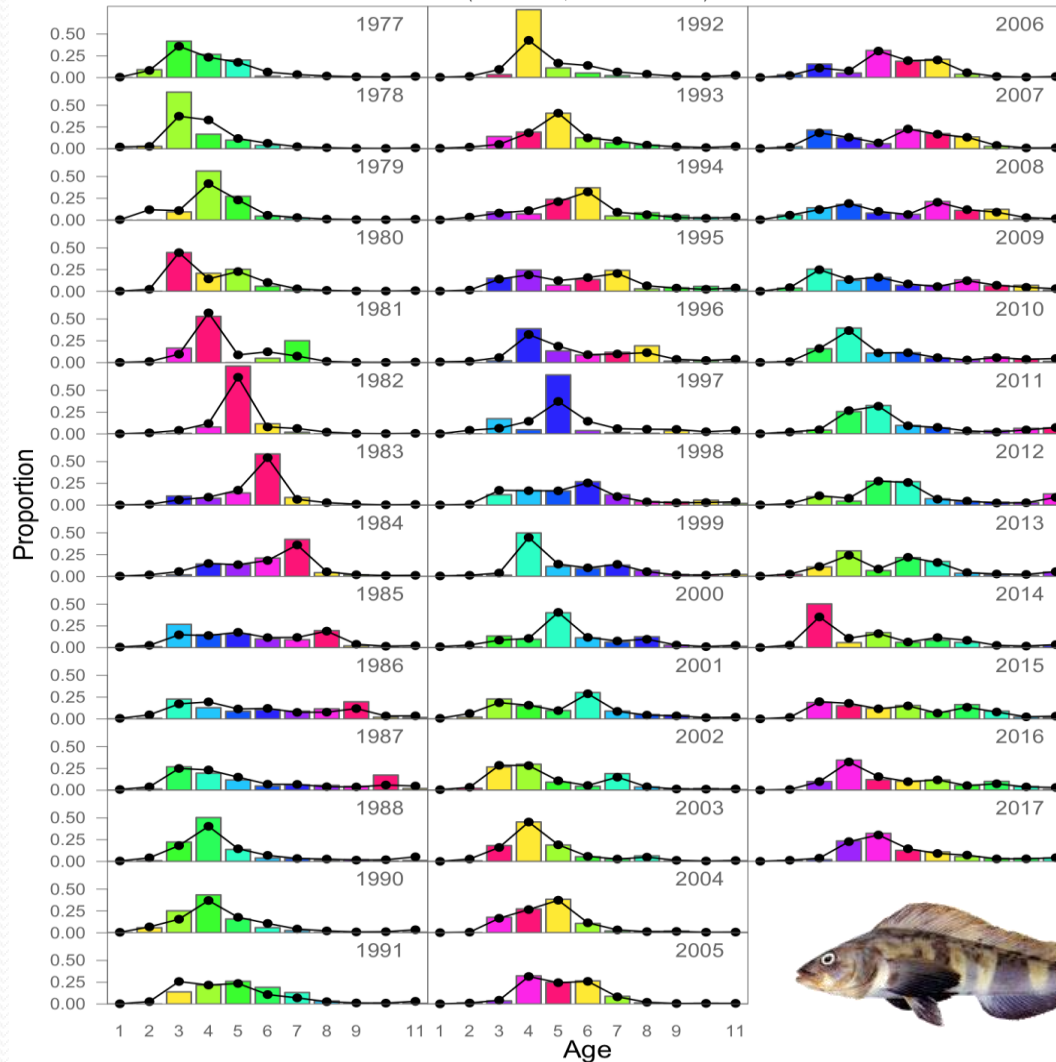


Age 1 recruitment from the current assessment (2018) with the dashed line indicating average recruitment (609 million) from the 1977-2016 year classes, and age 1 recruitment as estimated from the 2017 assessment

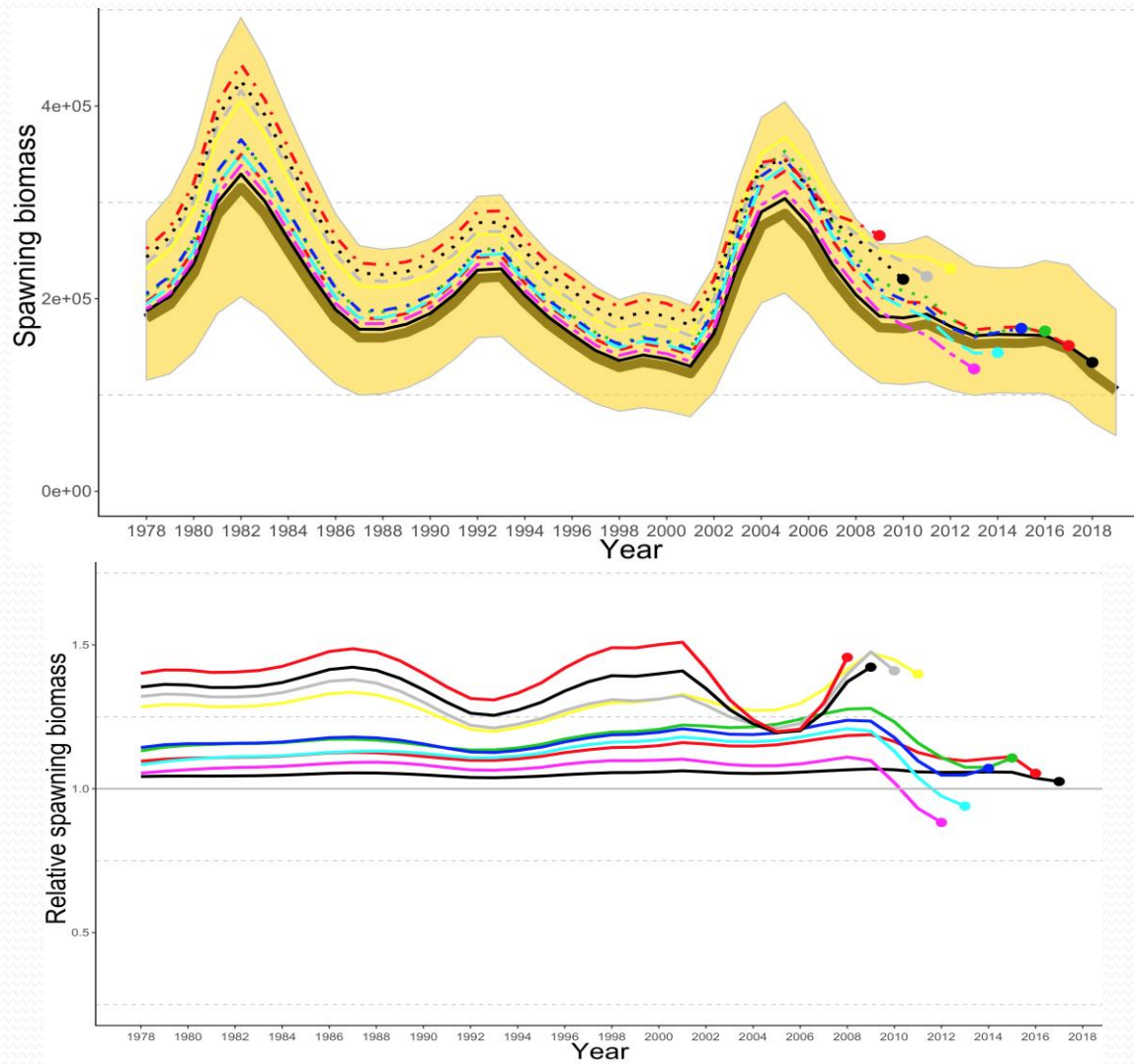


Observed and predicted **survey** proportions-at-age for BSAI Atka mackerel. Lines with “•” symbol are the model predictions and columns are the observed proportions at age

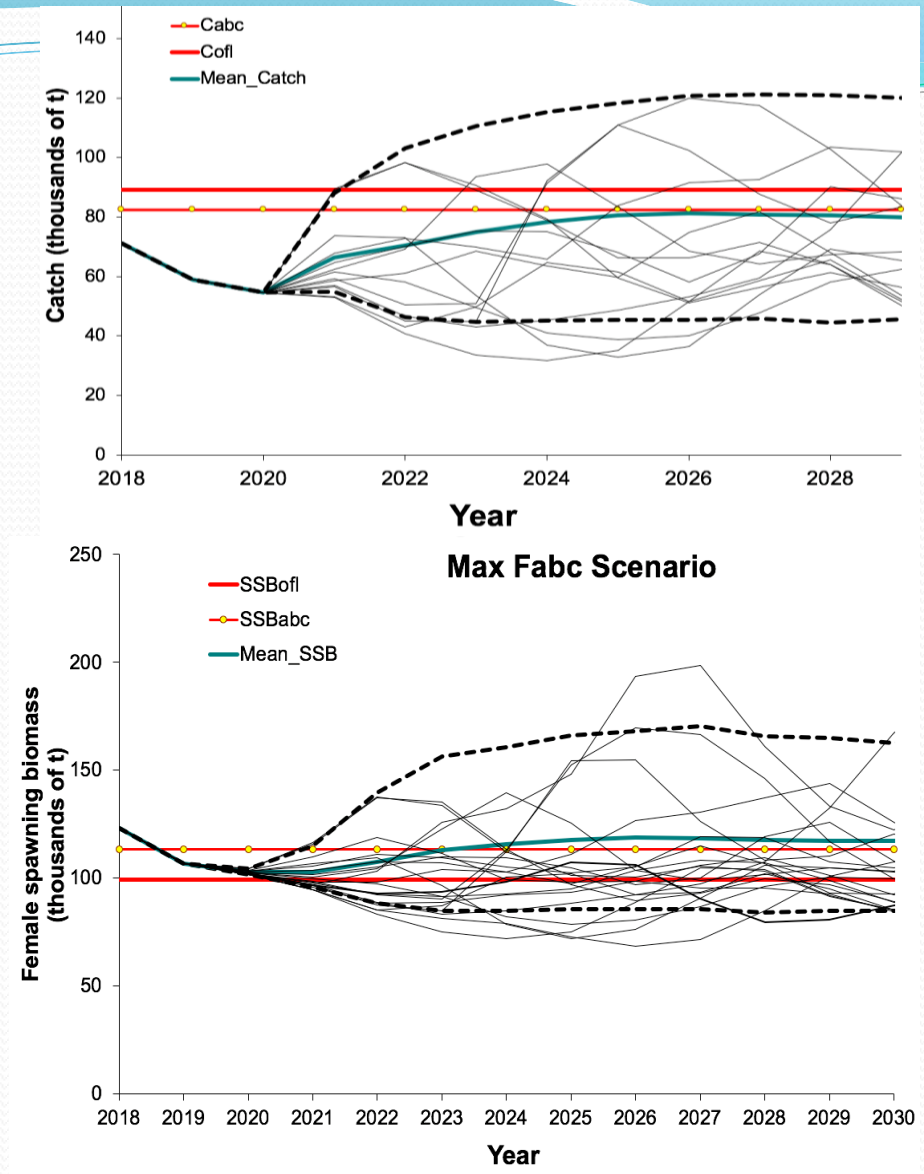
Atka_mackerel fishery age composition data (Model 16.0b, 2018 assessment)



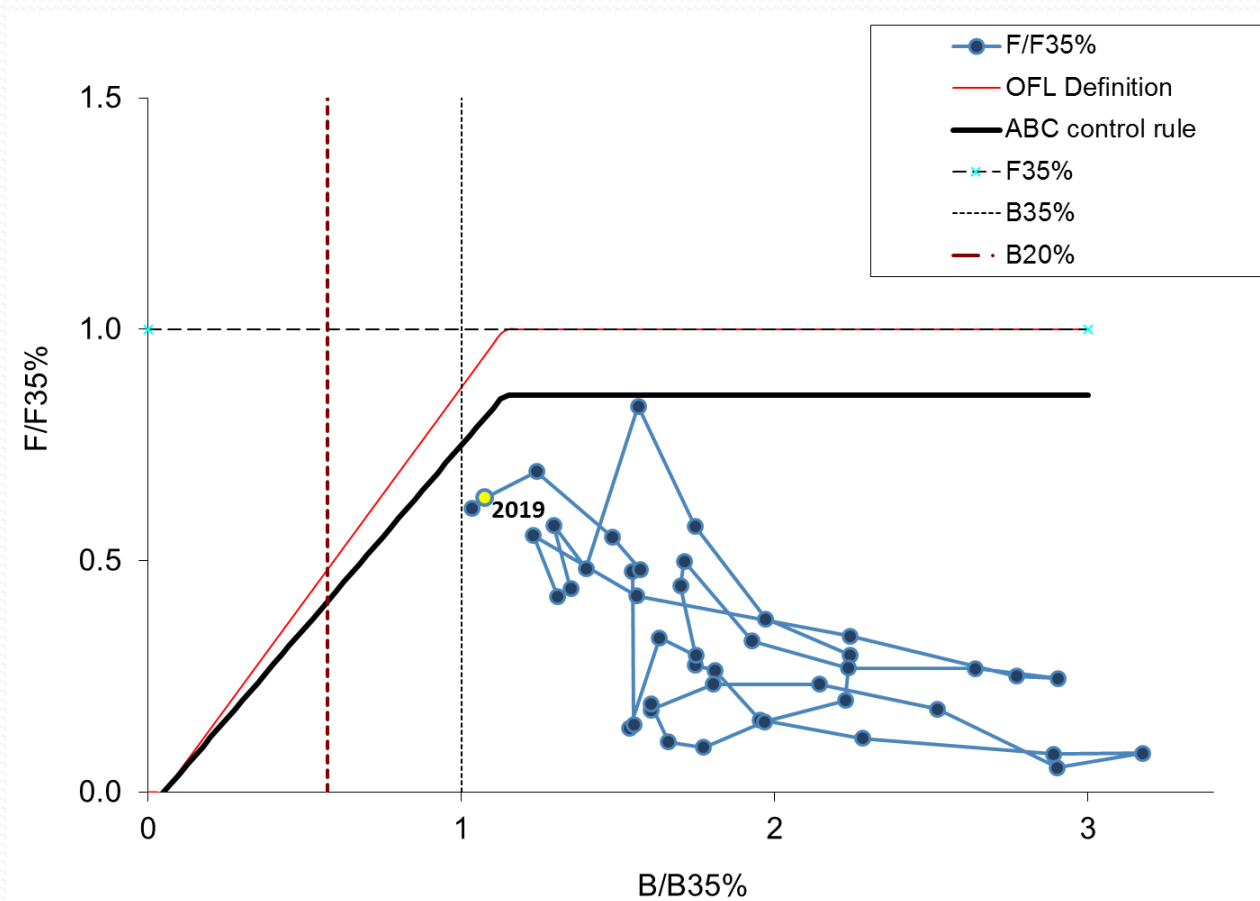
Observed and predicted Atka mackerel **fishery** proportions-at-age for BSAI Atka mackerel. Lines with “•” symbol are the model predictions and columns are the observed proportions at age (with colors corresponding to cohorts)



Retrospective plots showing the spawning biomass over time (top) and the relative difference (bottom) over 10 different “peels”



Projected Atka mackerel catch (assuming TAC taken in 2018 and reduced 2019 and 2020 catches; top) and spawning biomass (bottom) in thousands of metric tons under maximum permissible harvest control rule specifications after 2020.



BSAI Atka mackerel spawning biomass relative to $B_{35\%}$ and fishing mortality relative to F_{OFL} (1977-2020)

BSAI Atka Mackerel

Overfishing Level and Maximum Permissible ABC

Catch assumptions:

- Total 2018 year end catch set = to TAC (71,000 t) for ABC/OFL specification purposes
- For 2019 & 2020 assume that 86% of the BSAI-wide ABC would be taken
 - Due to revised SSL RPAs
 - Affects ABC and OFL values



Selectivity assumption for projections:

- Estimated ave. selectivity for 2013-2017

BSAI Atka Mackerel

| Quantity | As estimated or <i>specified last year for:</i> | | As estimated or <i>recommended this</i> year for: | |
|---|--|---------|---|---------|
| | 2018 | 2019 | 2019* | 2020* |
| Tier | 3a | 3a | 3b | 3b |
| Projected total (age 1+) biomass (t) | 599,000 | 600,440 | 498,320 | 514,400 |
| Projected female spawning biomass | 139,300 | 125,600 | 106,800 | 102,700 |
| $B_{40\%}$ | 122,860 | 122,860 | 113,510 | 113,510 |
| $B_{35\%}$ | 107,500 | 107,500 | 99,320 | 99,320 |
| F_{OFL} | 0.46 | 0.46 | 0.53 | 0.53 |
| $maxF_{ABC}$ | 0.38 | 0.38 | 0.44 | 0.44 |
| F_{ABC} | 0.38 | 0.38 | 0.44 | 0.44 |
| OFL (t) | 108,600 | 97,200 | 79,200 | 73,400 |
| maxABC (t) | 92,000 | 84,400 | 68,500 | 63,400 |
| ABC (t) | 92,000 | 84,400 | 68,500 | 63,400 |

*Projections are based on estimated total catch of 58,900 t and 54,500 t in place of maximum permissible ABC for 2019 and 2020, respectively.

BSAI Atka Mackerel Apportionment

| 2018 Random Effects Model | |
|---------------------------------|------------|
| 541 ¹ | 50% |
| 542 | 10% |
| 543 | 40% |

¹Includes eastern Aleutian Islands and southern Bering Sea areas.

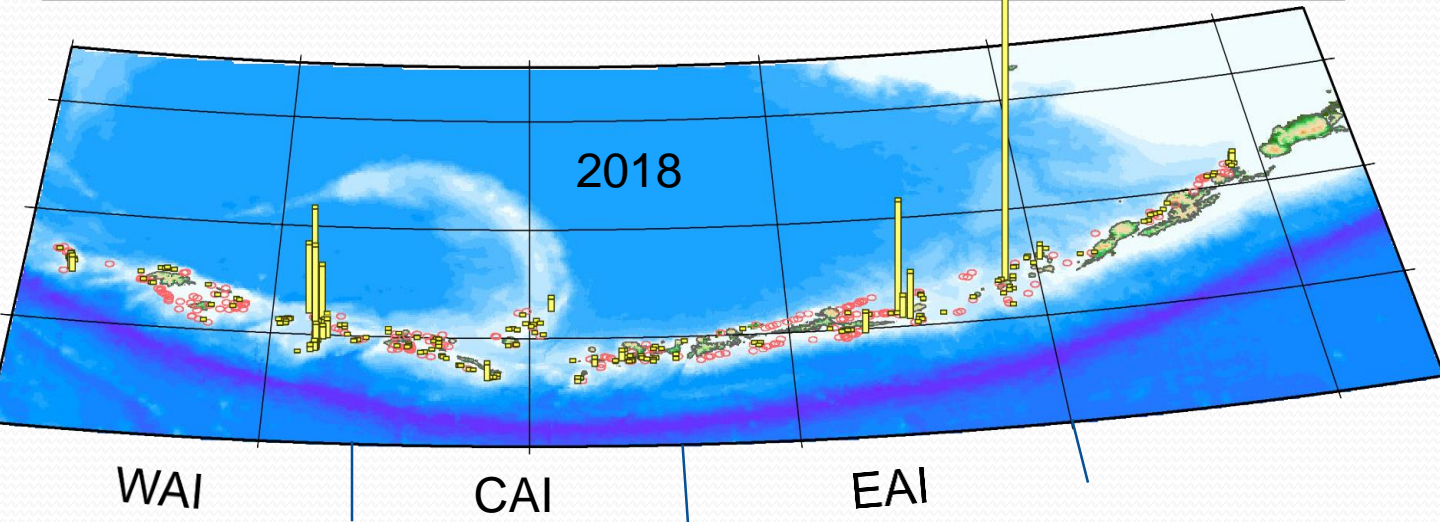
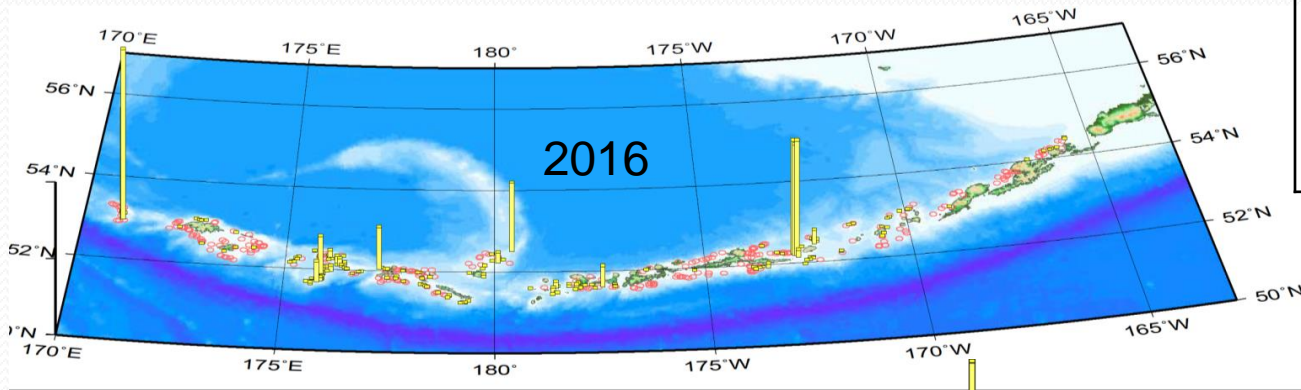
Apportionment of the recommended 2019 and 2020 ABCs based on 2018 RE model

| | Random Effects | | |
|----------------------|----------------|----------|----------|
| | Model | 2019 (t) | 2020 (t) |
| Eastern (541+S.Bsea) | 50% | 34,250 | 31,700 |
| Central (542) | 10% | 6,850 | 6,340 |
| Western (543) | 40% | 27,400 | 25,360 |
| Total | | 68,500 | 63,400 |



BSAI Atka Mackerel Apportionment

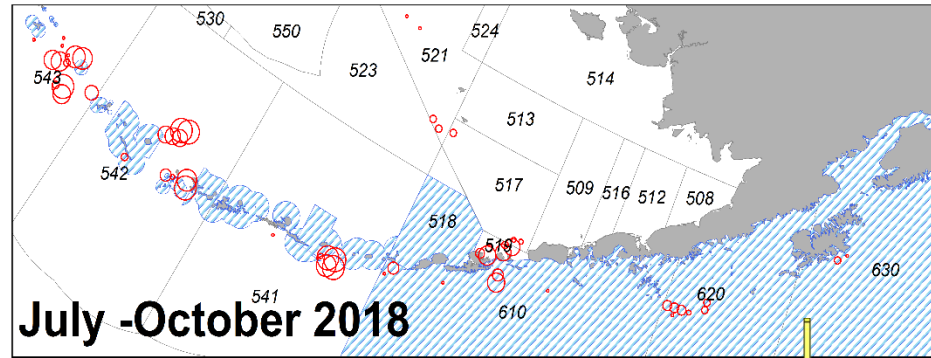
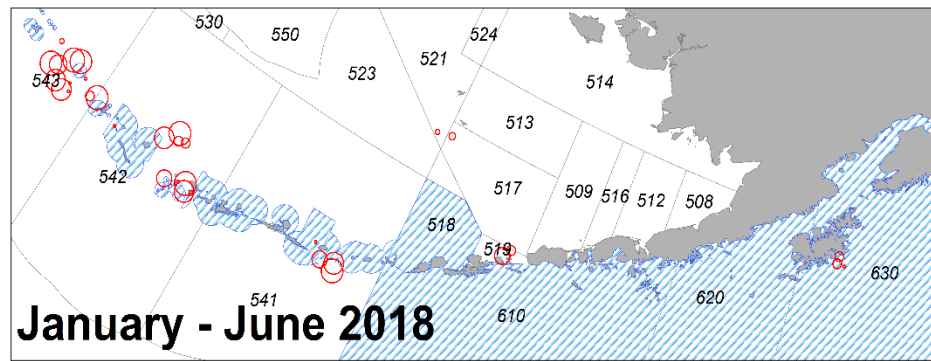
| | 2017 Random Effects Model | 2018 Random Effects Model |
|-----|------------------------------------|------------------------------------|
| 541 | 40% | 50% |
| 542 | 35% | 10% |
| 543 | 25% | 40% |



WAI

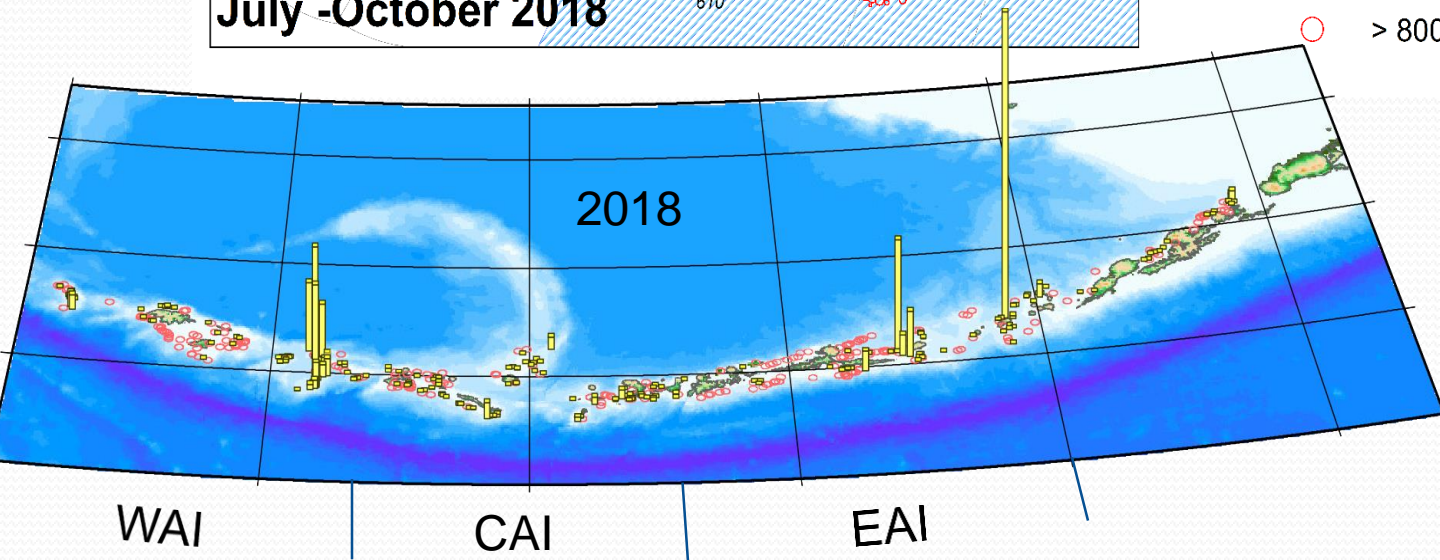
CAI

EAI



Observed catch (Tons)

- 1 - 5
- 6 - 10
- 11 - 20
- 21 - 40
- 41 - 80
- 81 - 100
- 101 - 200
- 201 - 400
- 401 - 800
- > 800



Things I looked at in survey and fishery data:

- Survey haul data for the CAI from 2014, 2016, and 2018
 - Survey start & end dates, no. hauls, haul performance, CPUE in CAI
- Survey haul data for the CAI from 2018 and EAI 2000 and 2012
- Survey temps. (surface and gear) in all areas from 2014, 2016, and 2018
- Locations of large survey catches (2014, 2016, 2018-absent-Petral Bank)

Things I looked at in survey and fishery data:

- Fishery CPUE for CAI from 2017 and 2018
 - Focused on July 1-19 and days immediately preceding
 - 2018 survey conducted in CAI July 1-19, 2018
- No. hauls and vessels in CAI July 1-9, 2017 & 2018
- Haul locations and CPUE in CAI July 1-9, 2017 and 2018
- Weekly catches from AKRO
- Industry for CAI fishery information during July, 2018

Recommended BSAI Atka Mackerel Apportionment

4-survey weighted ave. apportionments and **recommended** ABC apportionments for 2019 and 2020

| | Survey Year | | | | 2019 & 2020 Apport. | 2019 ABC | 2020 ABC |
|--------------|-------------|------|------|------|------------------------|-------------|-------------|
| | 2012 | 2014 | 2016 | 2018 | | | |
| 541+SBS | 12% | 42% | 35% | 38% | 35% | 23,970 | 22,190 |
| 542 | 39% | 28% | 30% | 7% | 21% | 14,390 | 13,310 |
| 543 | 48% | 30% | 35% | 55% | 44% | 30,140 | 27,900 |
| Weights | 8 | 12 | 18 | 27 | | | |
| Total ABC | | | | | | 68,500 | 63,400 |

Should the ABC be reduced below the maximum permissible ABC?

| Considerations | | | |
|---|--|---|-----------------|
| Assessment-related | Population dynamics | Environmental/ecosystem | Overall (max) |
| Level 1: Typical to moderately increased concerns | Level 1: Stock trends are typical for the stock and expected given stock dynamics; recent recruitment is within the lower end of the normal range. | Level 1: No apparent environmental/ecosystem concerns | Level 1: Normal |

The overall score of level 1 suggests that setting the ABC below the maximum permissible is not warranted

Assessment considerations

- Retrospective patterns
- Trawl survey estimates of Aleutian Islands biomass are highly variable
- Robust fishery age data well fit, prevents model from fitting the 2012 and 2016 extremely large drops in AM survey biomass
- Significant decrease in CAI survey biomass estimate

Overall 2018 BSAI survey data point fit fairly well by the assessment model. Supported by recent estimates of below average recruitment and only one slightly above average recruitment (2012 year class).

We rated the assessment-related concern as **Level 1**. We have typical to moderately increased concerns about assessment-related uncertainty, particularly in regard to the survey data.

Population dynamics considerations

- Decline in female spawning biomass since peak biomass in 2005. The peak biomass in 2005 is the result of 3 back-to-back very strong year classes (1999, 2000, 2001 year classes)
- Gaps of about 4-6 years between strong year classes seems to be typical for AM throughout the time series of estimated recruitments.
- Appearance of only a slightly above average year class (2012 year class) following the 2006 and 2007 strong year classes which were 54% above average is unusual
- Atka mackerel have been in Tier 3a until this year, when the 2019 female spawning biomass is projected to drop just below $B_{40\%}$ placing Atka mackerel in Tier 3b

We rated the population dynamics-related concern as **Level 1**. Stock trends are typical for the stock and expected given the stock dynamics; recent recruitment is within the lower end of the normal range.

Environmental/ecosystem considerations

- Reduced recruitment since 2007 maybe due to changing environmental factors such as water temperature which is known to affect AM eggs, larvae, and hatching times
- Ecosystem indicators suggest no clear concern for prey supply for Atka mackerel, very limited data on zooplankton abundance
- Atka mackerel condition through length-weight regressions indicate Atka mackerel have been meeting their energetic requirements
- Large drop in the CAI biomass inconsistent with AM biomass changes in other AI areas and reported fishing conditions in the region
- Lack of any moderate to large catches of AM by the survey in only one area may have been due to a combination of environmental factors that could have affected catchability, AM availability, and fish movement and behavior
- SSL populations have continued to decline in the Aleutians, suggesting that their predatory impact on Atka has not increased

Limited ecosystem information suggest no immediate concerns and warrant a risk score of **Level 1** at present