# BSAI Plan Team report

NOAA FISHERIES
Alaska Fisheries Science Center

Grant Thompson, co-chair
Steve Barbeaux, co-chair
Diana Stram, coordinator

December 3, 2021

# Team members

- Grant Thompson, co-chair (AFSC REFM)
- Steve Barbeaux, co-chair (AFSC REFM)
- Diana Stram, coordinator (NPFMC); "back in the saddle again!"
- Mary Furuness (NMFS AKRO)
- Alan Haynie (AFSC REFM)
- Allan Hicks (IPHC)
- Lisa Hillier (WDFW)
- Kirstin Holsman (AFSC REFM)
- Phil Joy (ADFG)
- Andy Kingham (AFSC FMA)
- Kalei Shotwell (AFSC REFM)
- Cindy Tribuzio (AFSC ABL)

# Big picture (with big font)

- Assessments of 17 stocks/complexes (8 full, 9 partial; 6 “none”)
  - Compared to 23 last year (21 full, 2 partial; 0 “none”)
- Total of 37 models, including Tier 5/6 methods (down from 53 last year):
  - 19 base models/methods (down from 25 last year)
  - 12 additional models/methods (down from 28 last year)
- The Team agreed with authors’ recommendations regarding preferred models/methods and harvest specifications in all but 1 case
- Change from current base model/method recommended in 4 cases
- Reductions from maxABC recommended in only 2 cases
- Of the 16 stocks/complexes in Tiers 1 or 3, only 4 are in sub-tier “b”
- No stocks/complexes were subjected to overfishing in 2020, and no Tier 1 or 3 stocks/complexes are overfished/approaching as of 2021



# Big picture (with small font)

| Ch. | Assessment | Lead author | Tier | Type | Numbered models (or Tier 5, 6) | Risk | % Red. |
|---|---|---|---|---|---|---|---|
| 1 | EBS pollock | Ianelli | 1b | Full | 20.0a (base), 20.0b, **20.0c** | 2.00 | **11%** |
| 1A | AI pollock | Barbeaux | 3a | Partial | 15.1 (base) | n/a | 0 |
| 1B | Bogoslof pollock | Ianelli | 5 | None | Tier 5 RE (base) | n/a | 0 |
| 2 | EBS Pacific cod | Thompson | 3b | Full | 19.12a (base), 19.12, 21.1, 21.2, **ensemble** | 1.25 | 0 |
| 2A | AI Pacific cod | Spies | **3a**,**5** | Full | **Tier 5 RE (base)**, 19.0, 19.0a, **19.0b** | 1.75 | 0 |
| 3 | Sablefish | Goethel | 3a | Full | 16.5 (base), **21.12** | 1.50 | 0 |
| 4 | Yellowfin sole | Spies | 1a | Full | **18.2 (base)**, 18.2a, 18.2b | 1.75 | **24%** |
| 5 | Greenland turbot | Bryan | 3a | Partial | 16.4a (base) | n/a | 0 |
| 6 | Arrowtooth flounder | Shotwell | 3a | Partial | 18.9 (base) | n/a | 0 |
| 7 | Kamchatka flounder | Bryan | 3a | Partial | 16.0b (base) | n/a | 0 |
| 8 | Northern rock sole | McGilliard | 1a | Partial | 18.3 (base) | n/a | 0 |
| 9 | Flathead sole | **Kapur** | 3a | Partial | 18.2c (base) | n/a | 0 |
| 10 | Alaska plaice | Ormseth | 3a | Full | 11.1 (base) | 1.00 | 0 |
| 11 | Other flatfish | Monnahan | 5 | None | Tier 5 RE (base) | n/a | 0 |
| 12 | Pacific ocean perch | Spencer | 3a | Partial | 16.3a (base) | n/a | 0 |
| 13 | Northern rockfish | Spencer | 3a | Full | 16.1a (base), **21** | 1.25 | 0 |
| 14 | Blackspot/rougheye | Spencer | 3b/5 | Partial | AI: 20 (base); EBS: Tier 5 RE (base) | n/a | 0 |
| 15 | Shortraker rockfish | Shotwell | 5 | None | Tier 5 RE (base) | n/a | 0 |
| 16 | Other rockfish | Sullivan | 5 | None | Tier 5 RE (base) | n/a | 0 |
| 17 | Atka mackerel | Lowe | 3b | Full | 16.0b (base) | 1.00 | 0 |
| 18 | Skates | Ormseth | 3a/5 | Partial | Alaska: 14.2 (base); others: Tier 5 RE (base) | n/a | 0 |
| 19 | Sharks | Tribuzio | 6 | None | Tier 6: 16.0 (base) | n/a | 0 |
| 22 | Octopus | Ormseth | 6 | None | Tier 6: cod consumption (base) | n/a | 0 |

# Reference point comparisons (all chapters)

| Quantity | Last asmt. | This asmt. | Change |
|---|---|---|---|
| M | 0.098 | 0.100 | 0.02 |
| 2021 tier | 3a | n/a | none |
| 2022 tier | 3a | 3a | none |
| 2021 age+ biomass | 753,110 | n/a | -0.24 |
| 2022 age+ biomass | 789,584 | 574,599 | -0.27 |
| 2021 spawning biomass | 134,401 | n/a | -0.04 |
| 2022 spawning biomass | 191,503 | 128,789 | -0.33 |
| B100% | 317,096 | 295,351 | -0.07 |
| B40% | 126,389 | 118,140 | -0.07 |
| B35% | 110,984 | 103,373 | -0.07 |
| 2022 FOFL | 0.117 | 0.094 | -0.20 |
| 2022 FABC | 0.042 | 0.080 | 0.90 |
| 2021 OFL | 60,426 | n/a | -0.33 |
| 2022 OFL | 70,710 | 40,432 | -0.43 |
| 2021 ABC | 22,237 | n/a | 0.55 |
| 2022 ABC | 29,309 | 34,421 | 0.17 |

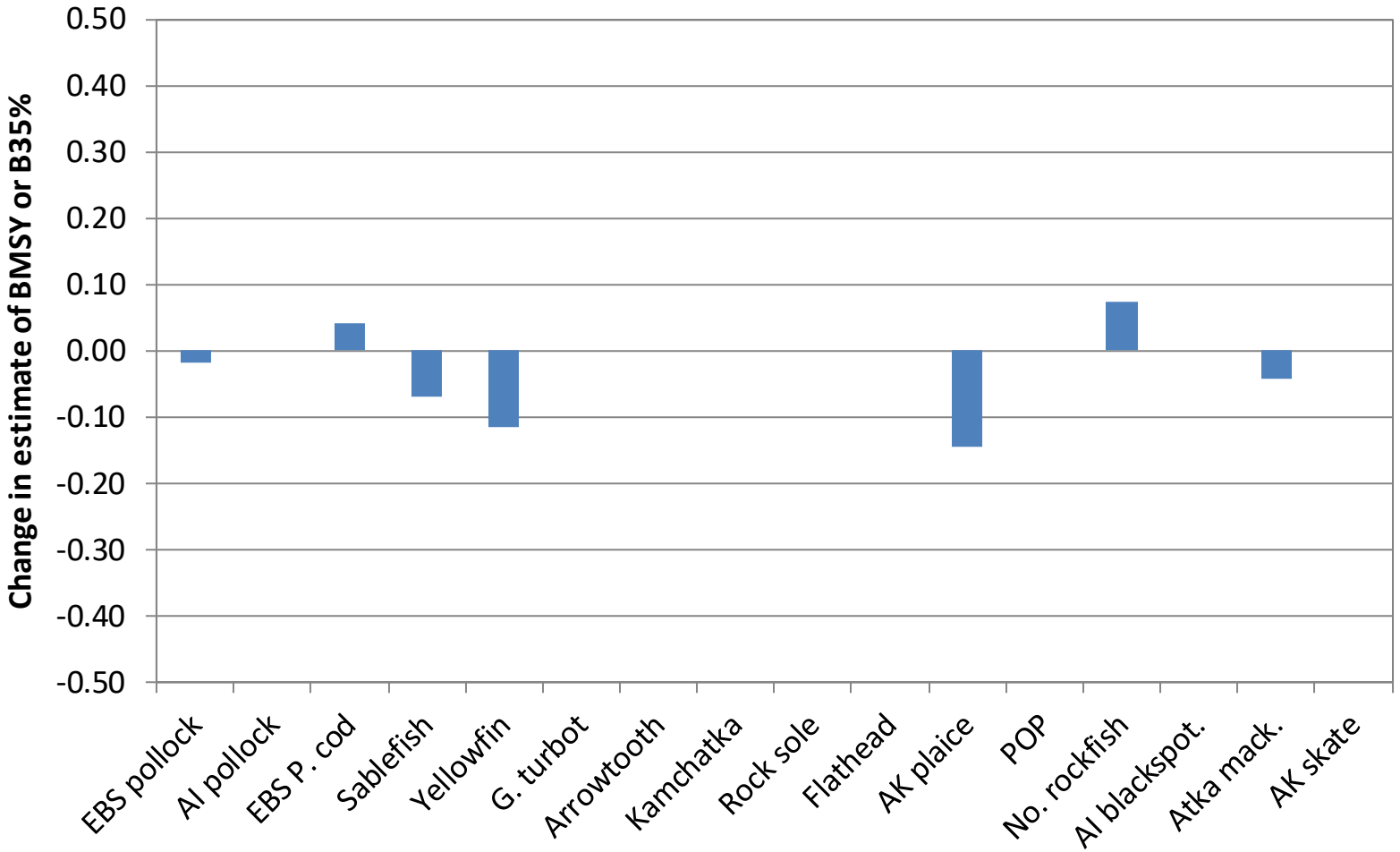
Except where "quantity" is shaded, "change" represents the relative difference between *this assessment's value* and *last assessment's value* for the same quantity.

Where "quantity" is shaded, "change" represents the relative difference between *this assessment's value for 2022* and *last assessment's value for 2021*.

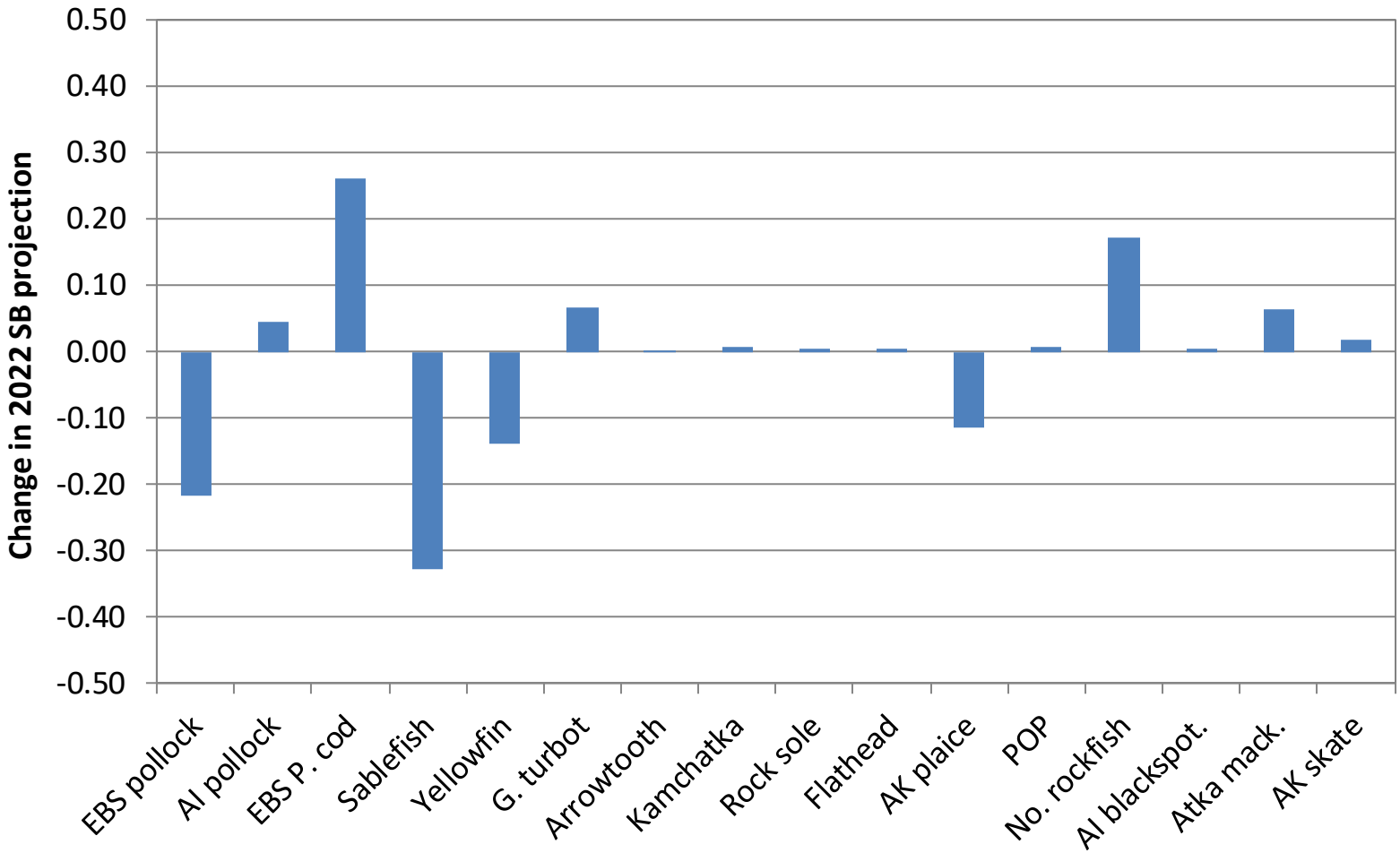
# Changes in reference points (Tiers 1-3)

| Quantity | EBS pollock | AI pollock | EBS P. cod | Sablefish | Yellowfin | G. turbot | Arrowtooth | Kamchatka | Rock sole | Flathead | AK plaice | POP | No. rockfish | AI blackspot. | Atka mack. | AK skate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2021 age+ biomass | -0.16 | 0.05 | 0.17 | -0.24 | -0.10 | -0.04 | 0.00 | 0.00 | 0.47 | 0.01 | 0.04 | -0.02 | 0.14 | 0.01 | -0.01 | -0.03 |
| 2022 age+ biomass | -0.10 | 0.00 | 0.12 | -0.27 | -0.18 | 0.06 | 0.00 | 0.01 | 0.00 | 0.00 | 0.03 | 0.00 | 0.16 | 0.00 | -0.08 | 0.01 |
| 2021 spawning biomass | -0.28 | 0.00 | 0.14 | -0.04 | -0.18 | -0.03 | 0.02 | 0.03 | -0.02 | 0.03 | -0.15 | -0.03 | 0.13 | 0.03 | 0.01 | -0.01 |
| 2022 spawning biomass | -0.22 | 0.04 | 0.26 | -0.33 | -0.14 | 0.07 | 0.00 | 0.01 | 0.00 | 0.00 | -0.11 | 0.01 | 0.17 | 0.00 | 0.06 | 0.02 |
| B0 (T1) or B100% (T3) | -0.04 | 0.00 | 0.04 | -0.07 | -0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -0.14 | 0.00 | 0.07 | 0.00 | -0.04 | 0.00 |
| B40% (T3 only) | | 0.00 | 0.04 | -0.07 | | 0.00 | 0.00 | 0.00 | | 0.00 | -0.14 | 0.00 | 0.07 | 0.00 | -0.04 | 0.00 |
| Bmsy (T1) or B35% (T3) | -0.02 | 0.00 | 0.04 | -0.07 | -0.11 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -0.14 | 0.00 | 0.07 | 0.00 | -0.04 | 0.00 |
| 2022 FOFL | 0.15 | 0.00 | 0.15 | -0.20 | 0.23 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.06 | 0.00 | 0.13 | 0.03 | 0.33 | 0.00 |
| 2022 FABC | 0.38 | 0.00 | 0.15 | 0.90 | -0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.06 | 0.00 | 0.13 | 0.03 | 0.32 | 0.00 |
| 2021 OFL | -0.43 | -0.01 | 0.24 | -0.33 | 0.10 | -0.10 | 0.04 | 0.03 | 0.47 | 0.03 | 0.04 | -0.04 | 0.24 | 0.04 | 0.07 | -0.04 |
| 2022 OFL | -0.38 | 0.00 | 0.43 | -0.43 | 0.01 | 0.07 | 0.00 | 0.01 | 0.00 | 0.00 | 0.06 | 0.01 | 0.29 | 0.01 | 0.15 | 0.01 |
| 2021 ABC | -0.32 | -0.01 | 0.24 | 0.55 | -0.14 | -0.10 | 0.04 | 0.03 | 0.47 | 0.03 | 0.03 | -0.04 | 0.24 | 0.05 | 0.07 | -0.04 |
| 2022 ABC | -0.25 | 0.00 | 0.44 | 0.18 | -0.22 | 0.07 | 0.00 | 0.01 | 0.00 | 0.00 | 0.06 | 0.01 | 0.28 | 0.01 | 0.15 | 0.01 |

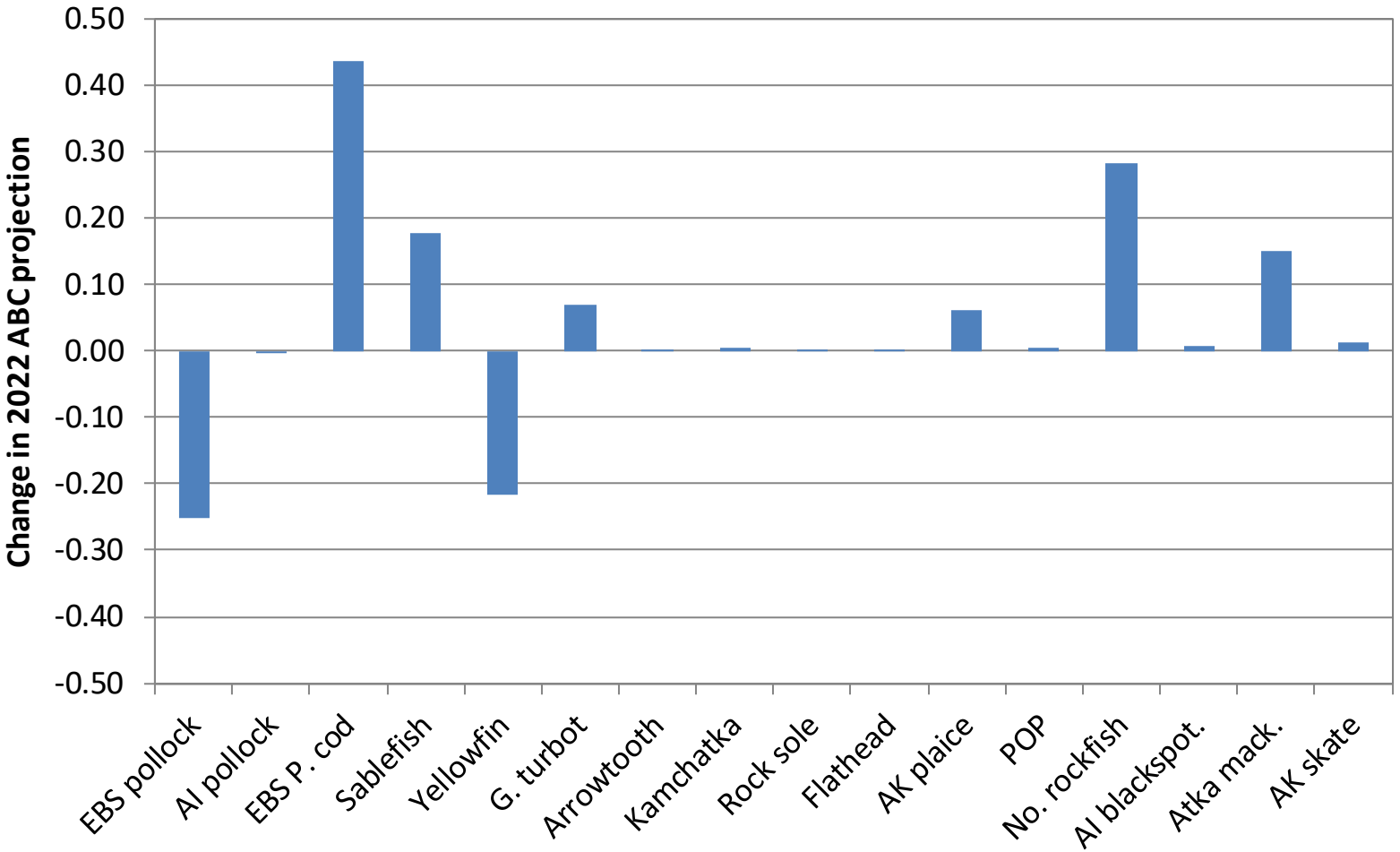
# Change in estimate of $B_{MSY}$ or $B_{35\%}$




# Change in 2022 spawning biomass *projection*



# Change in 2022 ABC *projection*



# Risk tables (included for all full assessments)

- The Team noted the SSC's recent guidance on risk tables
- The Team accepted the authors' risk levels and recommended reductions from maxABC in all but one case
- However, in keeping with the SSC's guidance that "risk scores should be specific to a given stock or stock complex" and that "considerations of reductions in ABCs below the maximum permissible continue to be made on a case-by-case basis," this acceptance should be interpreted more as the Team's acknowledgment that each author identified reasonable rationales in assigning levels and reductions (including reductions of zero) than an assertion that the criteria used to assign levels or reductions were consistent across authors



# Time series of risk levels

- For stock/complexes with full assessments this year:

**Stocks with increased risk levels in 2021**

| Stock | Year | Assess | PopDy | EnvEco | FishPerf |
|---|---|---|---|---|---|
| EBS pollock | 2018 | 1 | 2 | 2 | |
| | 2019 | 1 | 2 | 2 | 2 |
| | 2020 | 1 | 1 | 2 | 2 |
| | 2021 | 2 | 2 | 2 | 2 |
| Yellowfin sole | 2019 | 1 | 1 | 1 | 1 |
| | 2020 | 1 | 1 | 1 | 1 |
| | 2021 | 1 | 2 | 2 | 1 |

**Stocks with decreased risk levels in 2021**

| Stock | Year | Assess | PopDy | EnvEco | FishPerf |
|---|---|---|---|---|---|
| Sablefish | 2018 | 2 | 4 | 2 | |
| | 2019 | 2 | 3 | 2 | 3 |
| | 2020 | 3 | 3 | 2 | 3 |
| | 2021 | 1 | 2 | 1 | 2 |
| Northern rockfish | 2019 | 2 | 1 | 2 | 1 |
| | 2021 | 2 | 1 | 1 | 1 |

**Stocks with no change in risk levels in 2021**

| Stock | Year | Assess | PopDy | EnvEco | FishPerf |
|---|---|---|---|---|---|
| EBS Pacific cod | 2019 | 1 | 1 | 2 | 1 |
| | 2020 | 1 | 1 | 2 | 1 |
| | 2021 | 1 | 1 | 2 | 1 |
| AI Pacific cod | 2019 | 1 | 1 | 2 | 1 |
| | 2020 | 1 | 1 | 2 | 1 |
| | 2021 | 1 | 1 | 2 | 1 |
| Alaska plaice | 2019 | 1 | 1 | 1 | 1 |
| | 2021 | 1 | 1 | 1 | 1 |
| Atka mackerel | 2018 | 1 | 1 | 1 | |
| | 2019 | 1 | 1 | 1 | 1 |
| | 2020 | 1 | 1 | 1 | 1 |
| | 2021 | 1 | 1 | 1 | 1 |

# Typical summary format for full assessments

- Answers to the following: new model(s)?; change from base?; risk>1?
- New data, if any (updated catch data omitted for brevity)
- Model changes/alternatives, if any
- Stock status or trend
- Mohn's $\rho$ (Tiers 1-3 only)
- Risk levels, with rationales for any *changes* from previous assessment
- Some representative figures from the assessment
- Team recommendations (with discussion), if any
- Color scale chart showing magnitudes of relative changes
- *Not* included:
  - Detailed descriptions of current base models
  - Jillions of hard-to-read figures showing fits to compositional data
  - 2023 specs and area allocations (mostly)

# Team comments on assessments in general

- The Team recommends that the AFSC prioritize research on best practices for specifying the selectivity schedules used in projections for Tier 1-3 stocks in general

# EBS and AI Ecosystem Status Reports

- See separate presentations by Elizabeth Siddon and Ivonne Ortiz
- The Team recommends the Ecosystem Status Report team develop calibrated language statements for certainty (uncertainty) to accompany key messages summarized in the Assessment and Report Card sections of each report (when possible)
- The Team recommends that an Integrated Research Project for the Aleutian Islands be initiated in order to help understand climatic, ecological, and social-economic mechanistic linkages in this highly complex region

# Chapter summaries

# Chapter 1: EBS walleye pollock

- New model(s): yes; change from base: yes; risk>1: yes
- Switch to authors' presentation (Team comments will follow)

# EBS walleye pollock, continued

- The Team accepted all of the authors' recommendations:
  - Adoption of Model 20.0c for setting harvest specifications
  - Author's risk table:

| Year | Assess | PopDy | EnvEco | FishPerf |
|---|---|---|---|---|
| 2018 | 1 | 2 | 2 | |
| 2019 | 1 | 2 | 2 | 2 |
| 2020 | 1 | 1 | 2 | 2 |
| 2021 | 2 | 2 | 2 | 2 |

    - Assessment risk increased because of larger retrospective bias
    - Population dynamics risk increased because spawning biomass is now below $B_{MSY}$ and because of changes in weight at length and distribution
  - ABC to be reduced by 11% from the Tier 1 maxABC in 2022, following the Tier 2 maxABC control rule

# EBS walleye pollock, continued

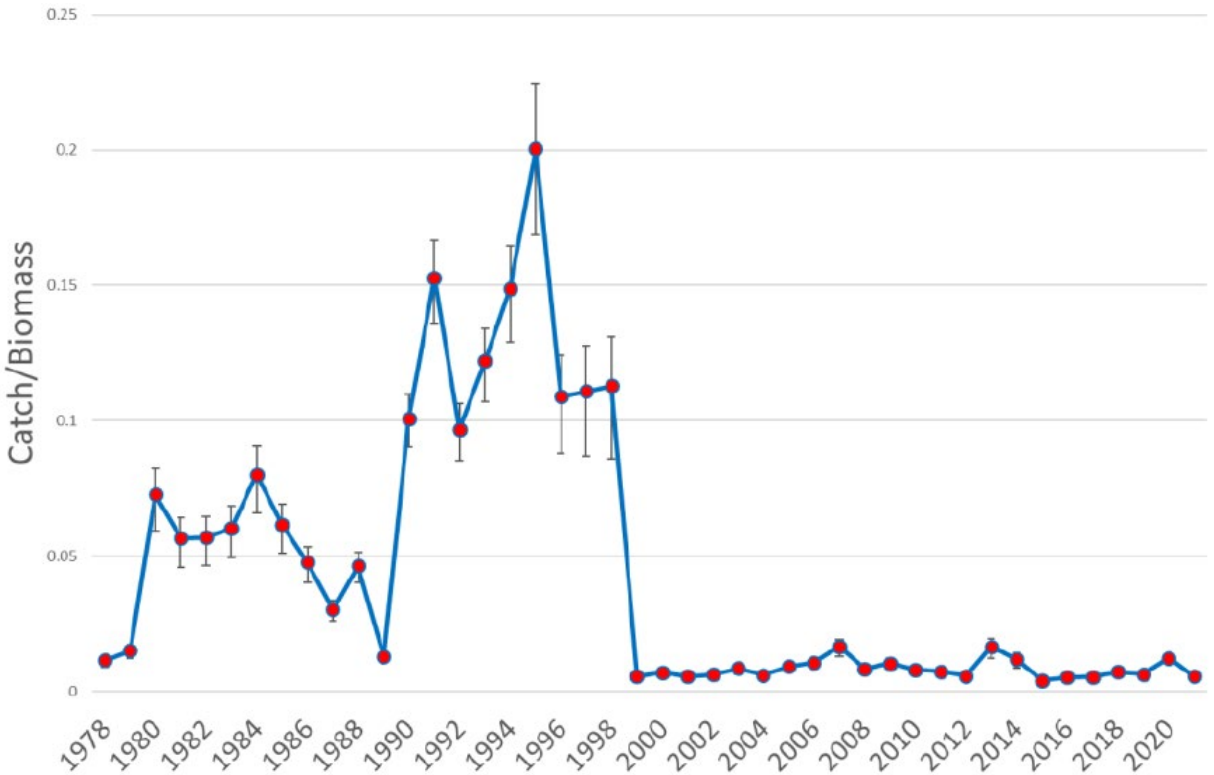
- The Team commends Eleni Petrou, Eleanor Bors, Lorenz Hauser, and Ingrid Spies for their research into the genetics of walleye pollock, and supports efforts to obtain genetic samples from Russian waters for use in future such analyses
- The Team recommends that authors work to streamline and coordinate the data pulls for single species assessments and CEATTLE in order to better align the data and multi-species model output for future use

# EBS walleye pollock, continued

| Quantity | Last asmt. | This asmt. | Change |
|---|---|---|---|
| M | 0.30 | 0.30 | 0.00 |
| 2021 tier | 1a | n/a | none |
| 2022 tier | 1a | 1b | ↓ |
| 2021 age+ biomass | 8,145,000 | n/a | -0.16 |
| 2022 age+ biomass | 7,641,000 | 6,839,000 | -0.10 |
| 2021 spawning biomass | 2,602,000 | n/a | -0.28 |
| 2022 spawning biomass | 2,406,000 | 1,881,000 | -0.22 |
| B0 | 5,792,000 | 5,575,000 | -0.04 |
| Bmsy | 2,257,000 | 2,220,000 | -0.02 |
| 2022 FOFL | 0.341 | 0.392 | 0.15 |
| 2022 FABC | 0.214 | 0.296 | 0.38 |
| 2021 OFL | 2,594,000 | n/a | -0.43 |
| 2022 OFL | 2,366,000 | 1,469,000 | -0.38 |
| 2021 ABC | 1,626,000 | n/a | -0.32 |
| 2022 ABC | 1,484,000 | 1,111,000 | -0.25 |

# Chapter 1A: AI walleye pollock (partial)

- New model(s): no; change from base: no; risk>1: n/a
- Stock status: projected 2022 spawning biomass = 48% of $B_{100\%}$
- Catch/biomass time series:




# AI walleye pollock, continued

| Quantity | Last asmt. | This asmt. | Change |
|---|---|---|---|
| M | 0.21 | 0.21 | 0.00 |
| 2021 tier | 3a | n/a | none |
| 2022 tier | 3a | 3a | none |
| 2021 age+ biomass | 292,967 | n/a | 0.05 |
| 2022 age+ biomass | 308,671 | 308,525 | 0.00 |
| 2021 spawning biomass | 89,906 | n/a | 0.00 |
| 2022 spawning biomass | 85,785 | 89,516 | 0.04 |
| B100% | 185,475 | 185,475 | 0.00 |
| B40% | 74,190 | 74,190 | 0.00 |
| B35% | 64,916 | 64,916 | 0.00 |
| 2022 FOFL | 0.390 | 0.390 | 0.00 |
| 2022 FABC | 0.313 | 0.313 | 0.00 |
| 2021 OFL | 61,856 | n/a | -0.01 |
| 2022 OFL | 61,308 | 61,264 | 0.00 |
| 2021 ABC | 51,241 | n/a | -0.01 |
| 2022 ABC | 50,789 | 50,752 | 0.00 |

# Chapter 2: EBS Pacific cod

- New model(s): yes; change from base: yes; risk>1: yes
- New data:
  - EBS+NBS survey abundance re-estimated, with 2021 (VAST)
  - 2021 fishery sizecomp added (preliminary)
  - Historic fishery sizecomps updated
  - 2018 NBS sizecomp data removed (non-standard design)
  - 2021 EBS+NBS survey sizecomp added
  - Survey agecomps re-estimated, with otoliths from the 2010, 2017, and 2019 NBS surveys (VAST)
  - Yearly weight-length parameters re-estimated, with 2021 (preliminary)
  - Fishery CPUE time series (VAST) added, used in one model only

# EBS Pacific cod, continued

- ESP (slide 1 of 4): “Full” version of the ESP that was initially presented in draft form last year included, accompanied by a 2021 “report card”
- Traffic light table (red = neg. relationship, blue = pos.; +/-1 SD only):

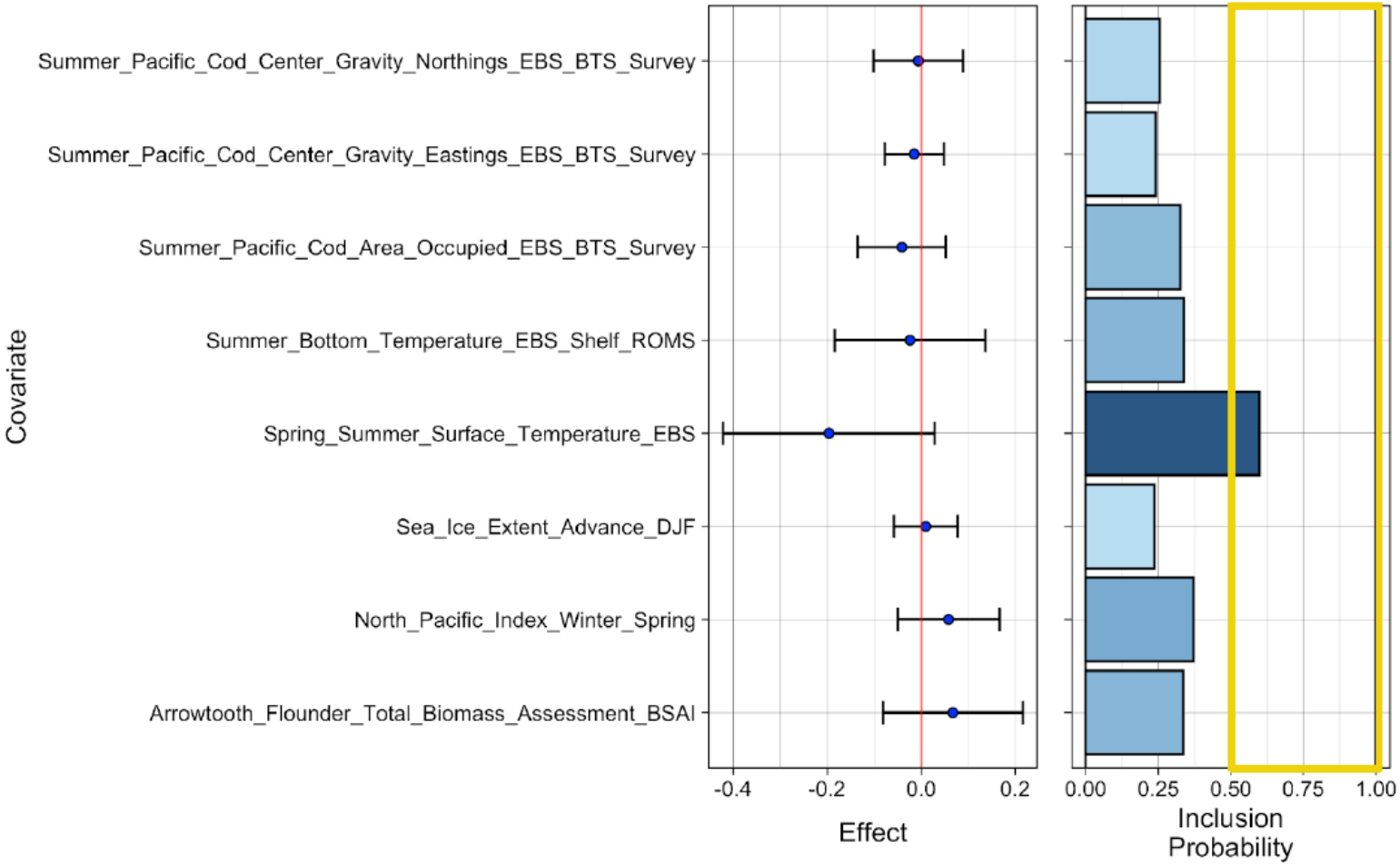
| Indicator category | Indicator | 2017 Status | 2018 Status | 2019 Status | 2020 Status | 2021 Status |
|---|---|---|---|---|---|---|
| Physical | Winter Spring North Pacific Index Model | neutral | *high* | neutral | *high* | neutral |
| | Winter Sea Ice Advance BS Satellite | **low** | **low** | **low** | neutral | NA |
| | Spring Sea Ice Retreat BS Satellite | **low** | **low** | **low** | neutral | NA |
| | Spring Summer Temperature Surface SEBS Satellite | neutral | **high** | **high** | **high** | neutral |
| | Summer Temperature Bottom SEBS Model | neutral | **high** | **high** | neutral | neutral |
| Lower Trophic | Spring Chlorophyll a Peak SEBS Satellite | **low** | *high* | neutral | neutral | neutral |
| | Summer Euphausiid Abundance EBS Survey | NA | neutral | NA | NA | NA |
| Upper Trophic | Summer Pacific Cod Condition Juvenile EBS Survey | neutral | neutral | neutral | NA | neutral |
| | Summer Pacific Cod Condition Adult EBS Survey | **low** | neutral | neutral | NA | neutral |
| | Summer Pacific Cod Center Gravity East EBS Model | neutral | **low** | *high* | NA | neutral |
| | Summer Pacific Cod Center Gravity North EBS Model | **high** | **high** | **high** | NA | **high** |
| | Summer Pacific Cod Area Occupied EBS Model | neutral | neutral | neutral | NA | neutral |
| | Annual Arrowtooth Biomass EBS Model | neutral | neutral | **high** | **high** | NA |

# EBS Pacific cod, continued

- ESP (slide 2 of 4): traffic light score
  - Ecosystem (9 of 13 total indicators)
    - Physical remains average
    - Lower tropic remains average
    - Upper trophic ↑ to just below ave.
  - Socioeconomic (3 of 5 total indicators)
    - Economic lagged by one year and remains above average
    - Community indicators not updated
  - Total: 12 of 18 indicators available

# EBS Pacific cod, continued

- ESP (slide 3 of 4): Potential recruitment covariates

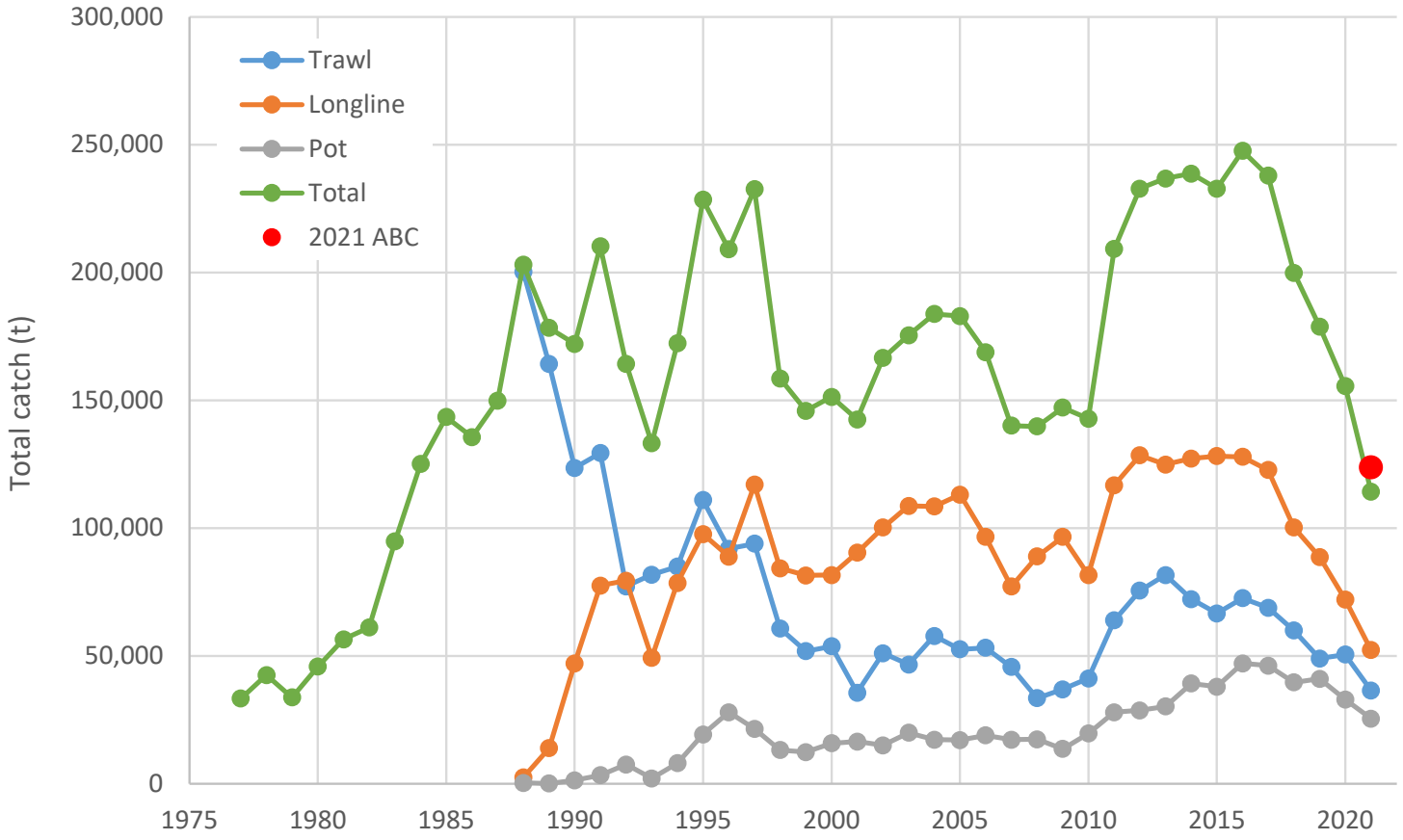



# EBS Pacific cod, continued

- ESP (slide 4 of 4): Team discussion
  - The Team appreciates the thoroughness of the ESP and report card, and thanks Kalei Shotwell and others that contributed to these documents
  - The Team recommends further consideration of ways to synthesize the EBS Pacific cod ESP and report card to succinctly convey the highlights

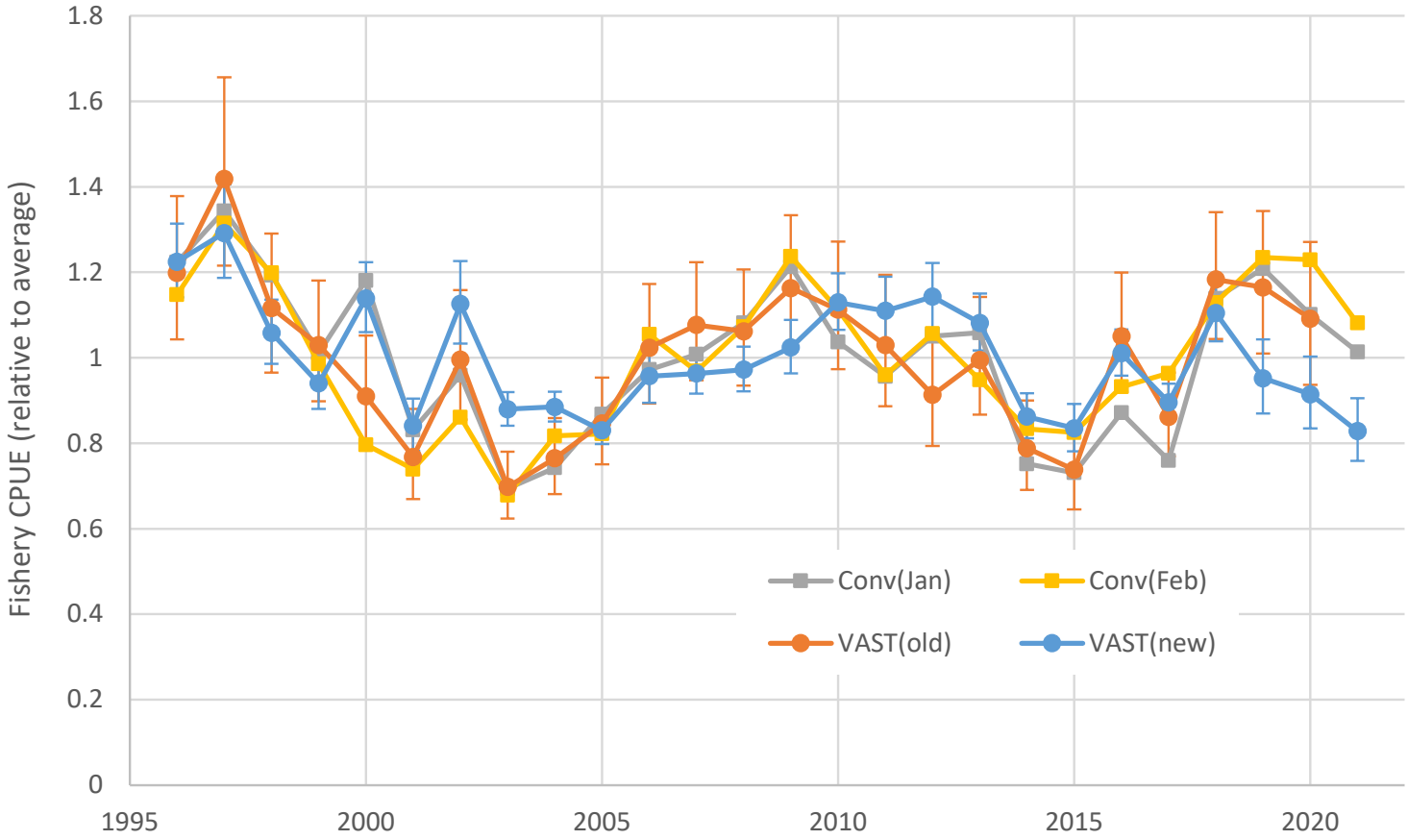
# EBS Pacific cod, continued

- Catch time series



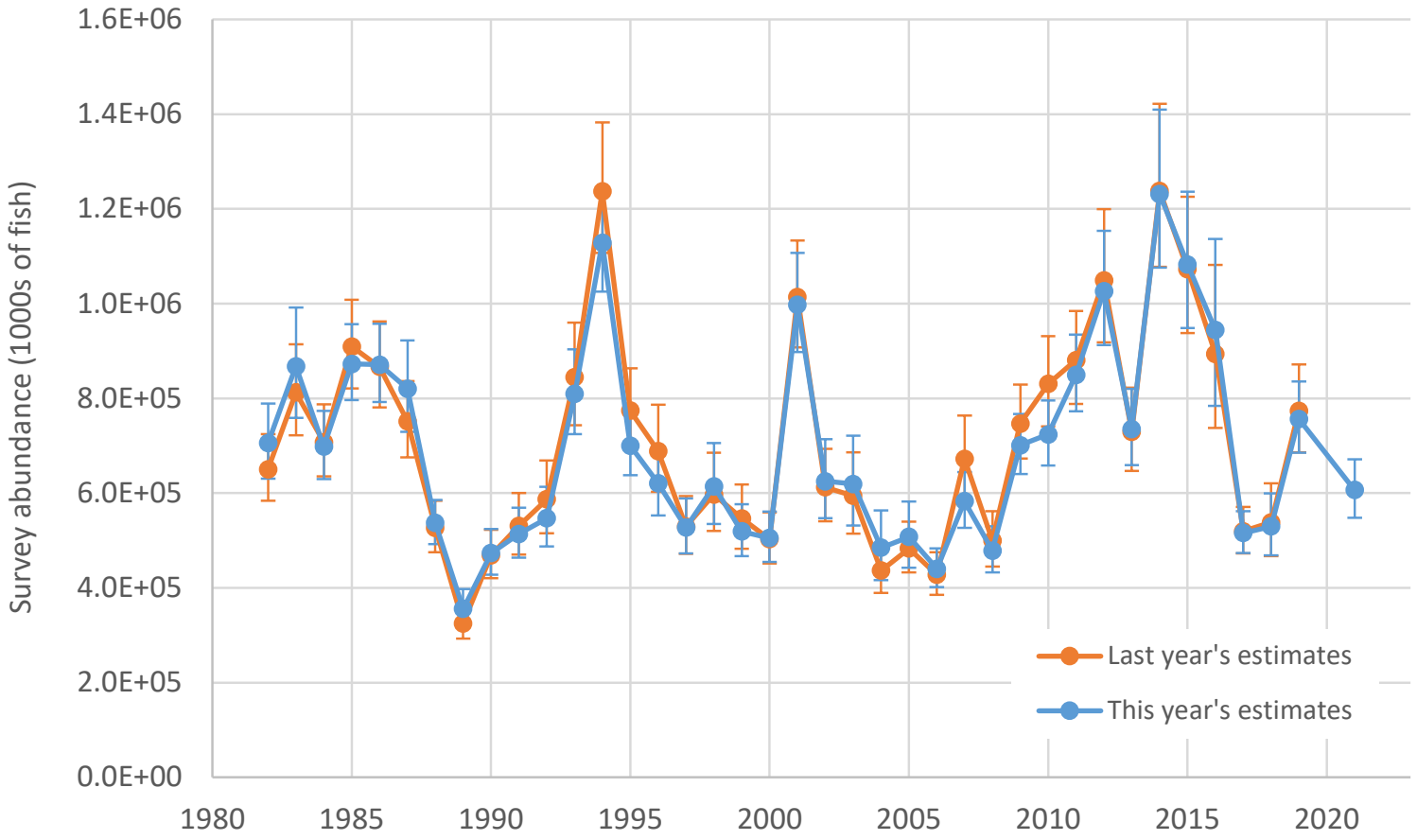

# EBS Pacific cod, continued

- January-February longline fishery CPUE




# EBS Pacific cod, continued

- Survey abundance (VAST)






# EBS Pacific cod, continued

- CIE/GPT model set:
  - Base model = Model 19.12a
  - Four new features; each new model = base model + 1 new feature

| Feature | 19.12a | 19.12 | 21.1 | 21.2 | 21.3 |
|---|---|---|---|---|---|
| Feature 1: Allow catchability to vary? | no | yes | no | no | no |
| Feature 2: Allow domed survey selectivity? | no | no | yes | no | no |
| Feature 3: Use fishery CPUE? | no | no | no | yes | no |
| Feature 4: Estimate survey CV internally? | no | no | no | no | yes |

- SSC model set: omit Model 21.3

| Feature | 19.12a | 19.12 | 21.1 | 21.2 |
|---|---|---|---|---|
| Feature 1: Allow catchability to vary? | no | yes | no | no |
| Feature 2: Allow domed survey selectivity? | no | no | yes | no |
| Feature 3: Use fishery CPUE? | no | no | no | yes |

- Author recommends “pragmatic” adoption of SSC ensemble, given near-unanimous agreement among CIE reviewers, GPT, and SSC

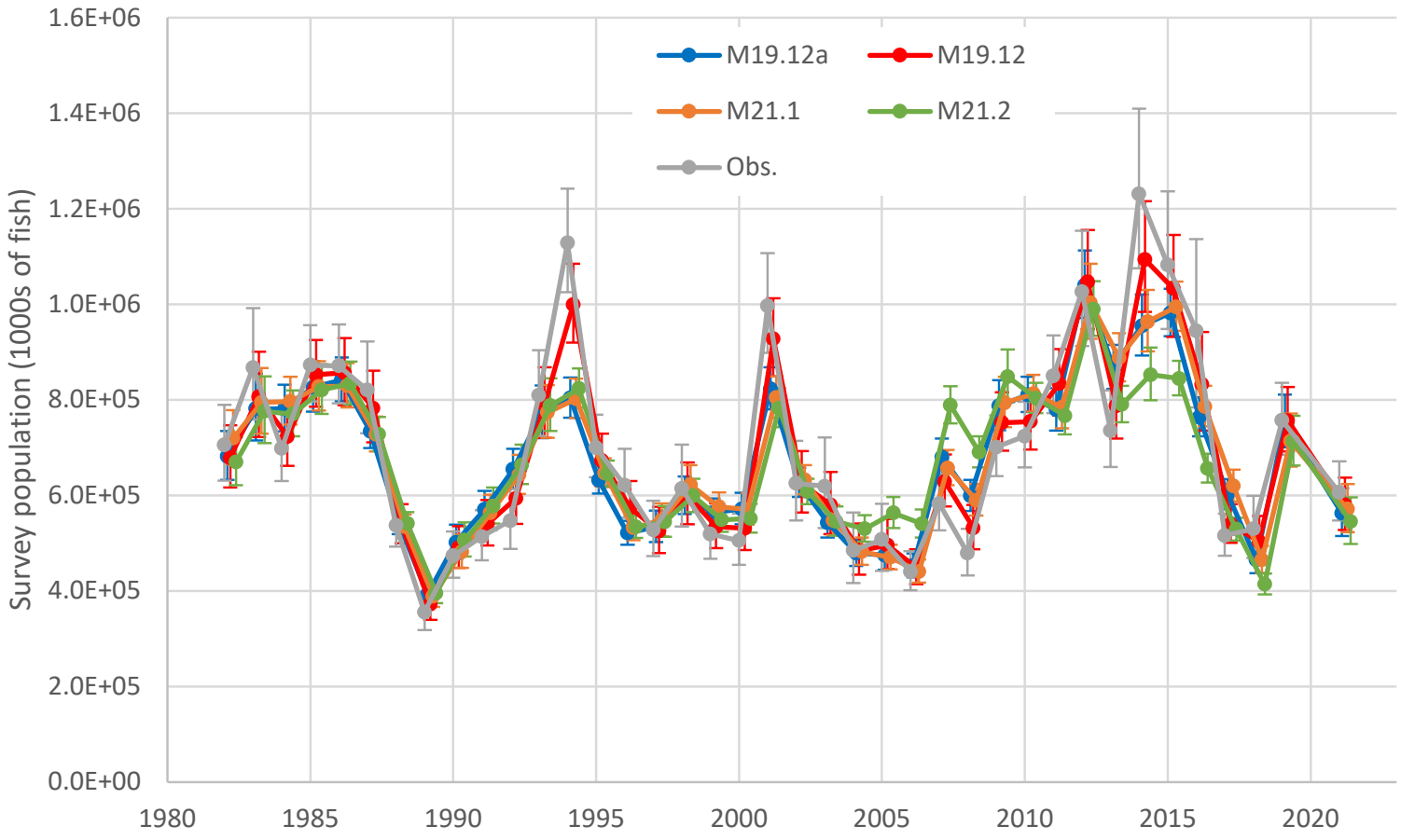
# EBS Pacific cod, continued

- Fits to index data (slide 1 of 3): RMSSR and correlation

| Index: | Survey | | | | Fishery |
|---|---|---|---|---|---|
| Model: | M19.12a | M19.12 | M21.1 | M21.2 | M21.2 |
| RMSSR: | 2.313 | 0.996 | 2.306 | 2.892 | 1.926 |
| Correlation: | 0.887 | 0.982 | 0.889 | 0.803 | 0.879 |

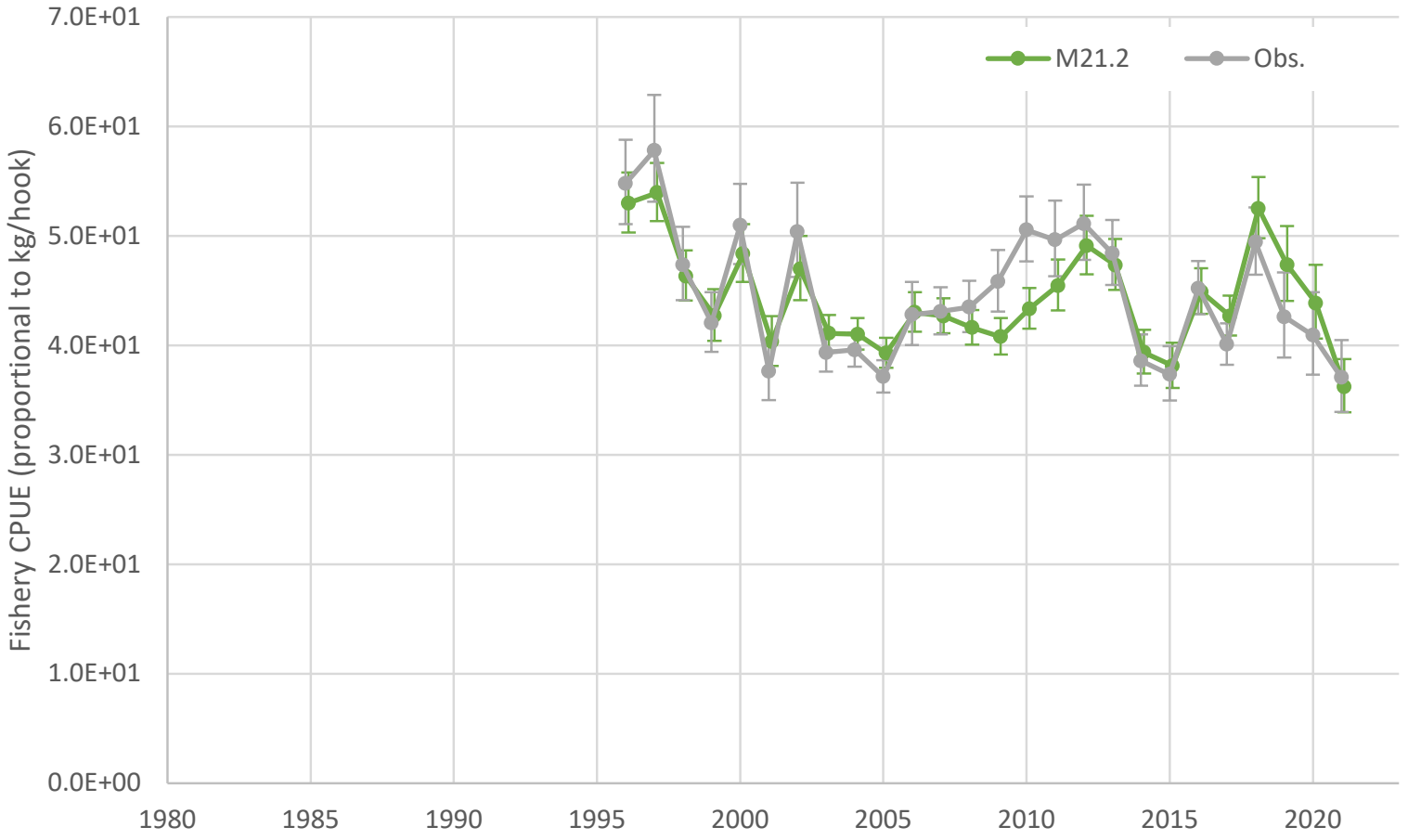
# EBS Pacific cod, continued

- Fits to index data (slide 2 of 3): trawl survey abundance data




# EBS Pacific cod, continued

- Fits to index data (slide 3 of 3): fishery CPUE (Model 21.2 only)




# EBS Pacific cod, continued

- Fits to sizecomp data

| | Fleet: | Fishery | | | | Survey | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Model: | M19.12a | M19.12 | M21.1 | M21.2 | M19.12a | M19.12 | M21.1 | M21.2 |
| | Nave: | 358 | 358 | 358 | 358 | 358 | 358 | 358 | 358 |
| McAllister-Ianelli | Neff: | 797 | 798 | 797 | 757 | 608 | 632 | 617 | 575 |
| | Ratio: | 2.228 | 2.231 | 2.230 | 2.116 | 1.701 | 1.767 | 1.726 | 1.609 |
| Thorson et al. | $\ln(\theta)$: | 9.990 | 9.991 | 9.989 | 9.989 | 9.984 | 9.984 | 9.985 | 9.982 |
| | Neff: | 358 | 358 | 358 | 358 | 358 | 358 | 358 | 358 |
| | Ratio: | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |

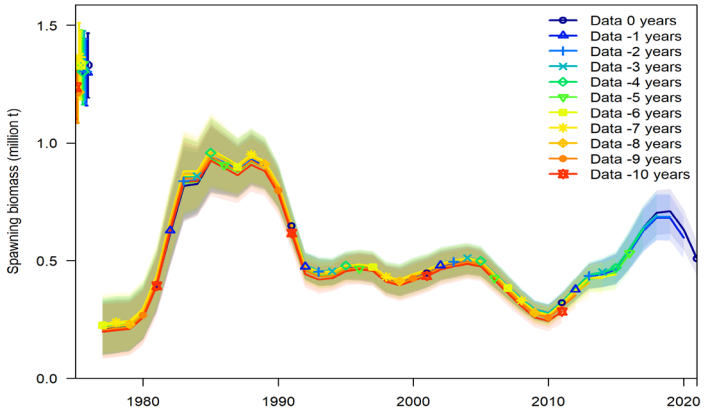
- Fits to agecomp data

| | Fleet: | Survey | | | |
|---|---|---|---|---|---|
| | Model: | M19.12a | M19.12 | M21.1 | M21.2 |
| | Nave: | 373 | 373 | 373 | 373 |
| McAllister-Ianelli | Neff: | 101 | 112 | 100 | 85 |
| | Ratio: | 0.271 | 0.302 | 0.268 | 0.227 |
| Thorson et al. | $\ln(\theta)$: | -0.137 | 0.137 | -0.296 | -0.574 |
| | Neff: | 174 | 199 | 159 | 135 |
| | Ratio: | 0.467 | 0.535 | 0.428 | 0.362 |

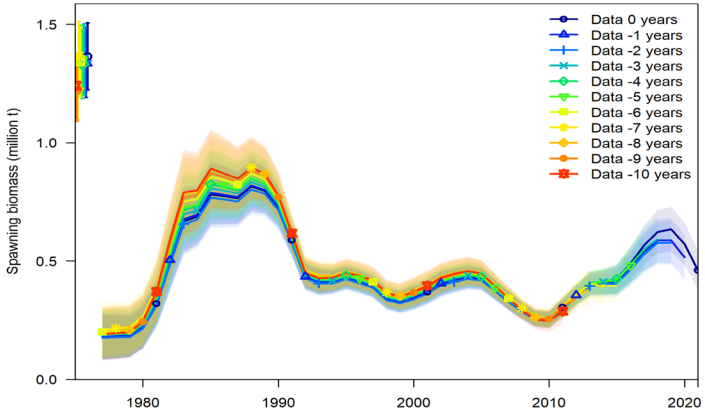
# EBS Pacific cod, continued

- Retrospective analysis

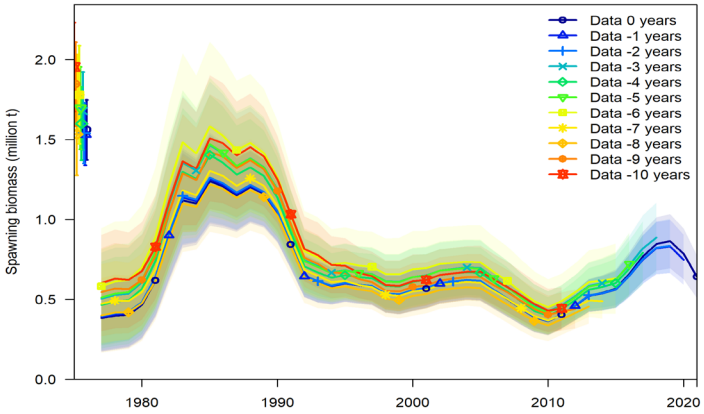
Model 19.12a (ρ = -0.0474)



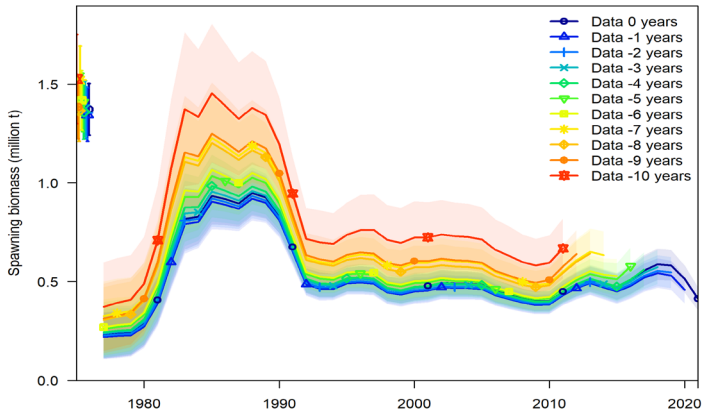

Model 19.12 (ρ = -0.0552)




Model 21.1 (ρ = 0.0030)

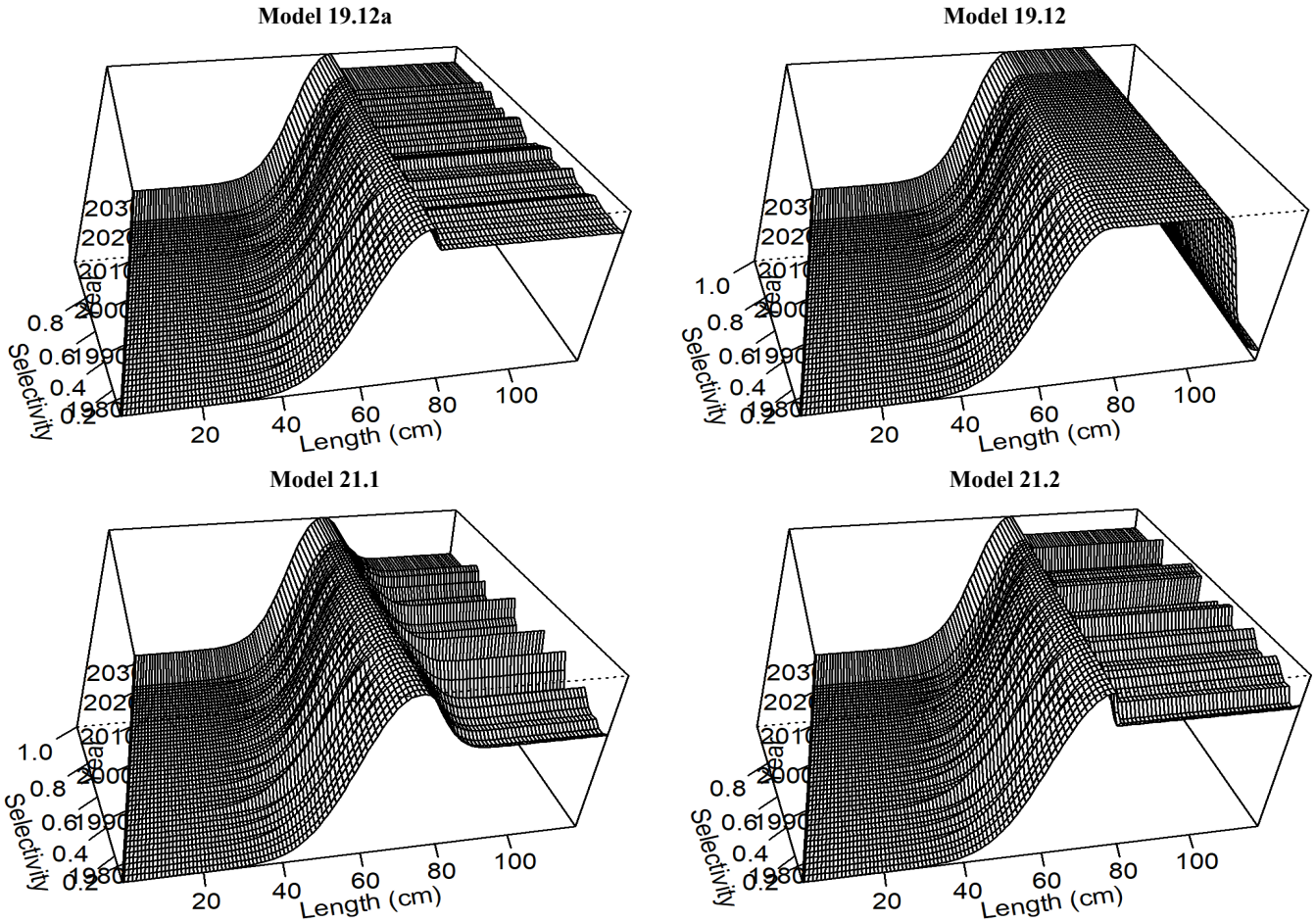



Model 21.2 (ρ = 0.1387)



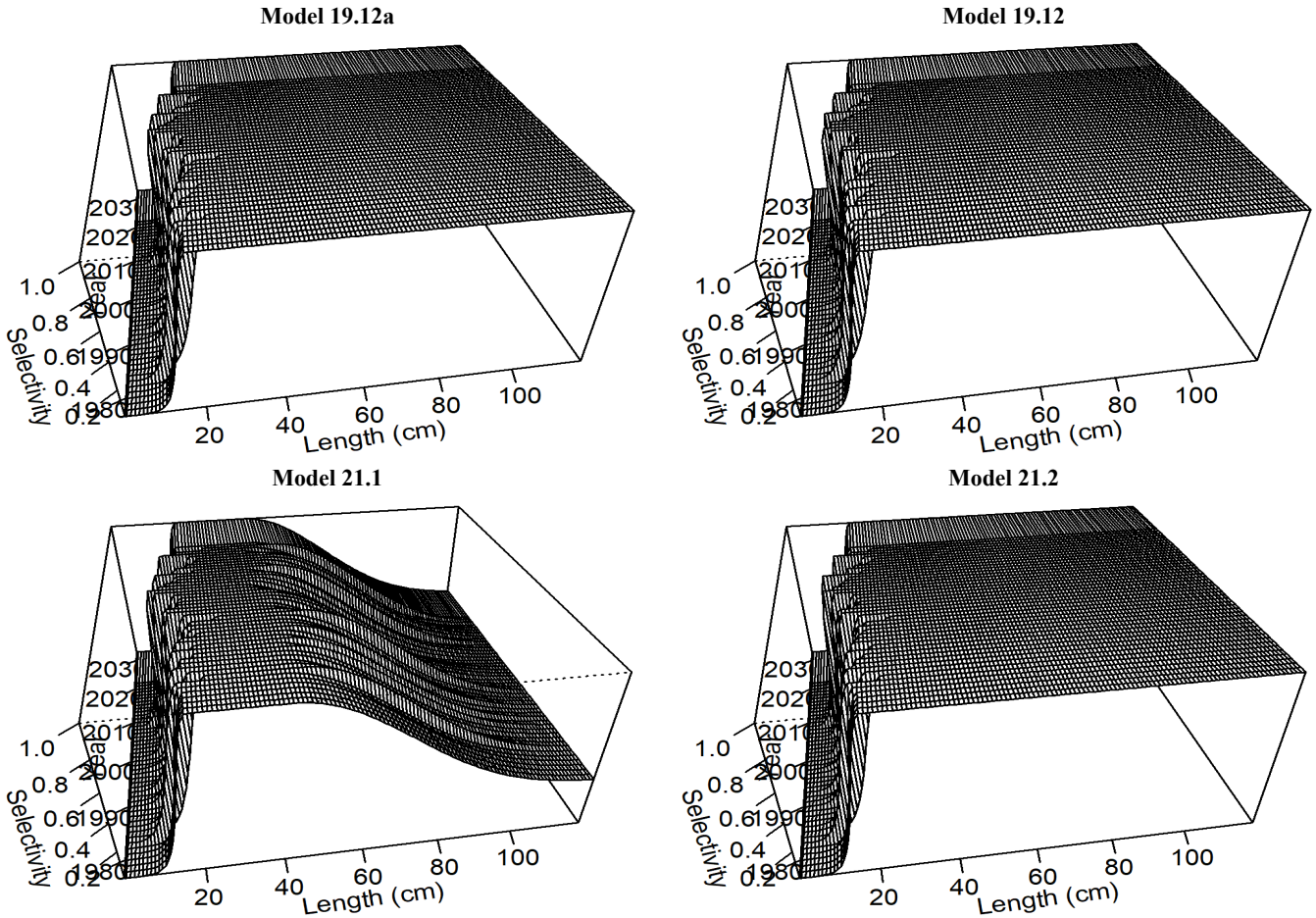

# EBS Pacific cod, continued

- Fishery selectivity



# EBS Pacific cod, continued

- Survey selectivity



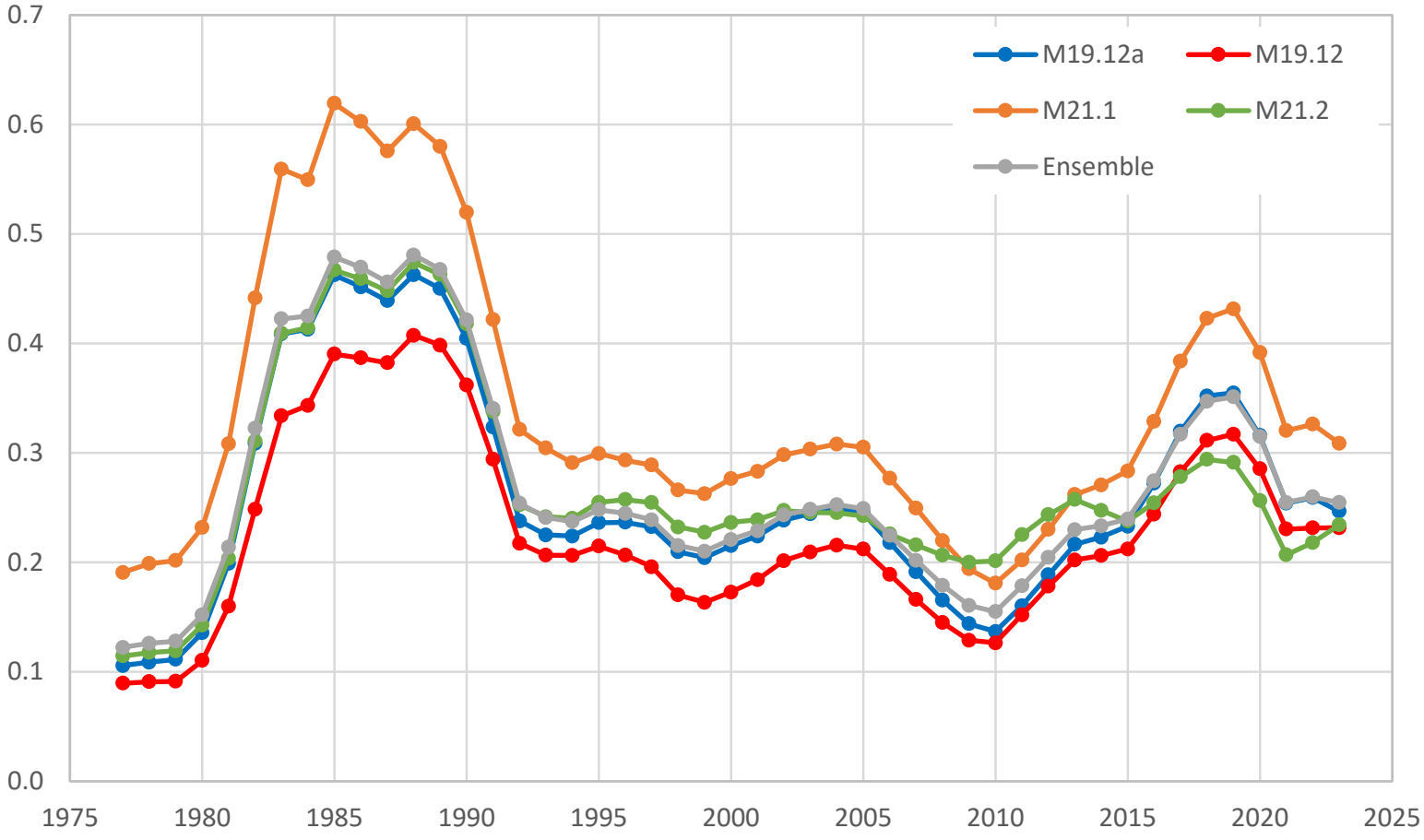
# EBS Pacific cod, continued

- Computing the model weights
  - Same as in CIE/GPT ensemble, but rescaled after dropping M21.3

| Criterion | Emph. | M19.12a | M19.12 | M21.1 | M21.2 |
|---|---|---|---|---|---|
| General plausibility of the model | 3 | 2 | 1 | 0.6667 | 1 |
| Acceptable retrospective bias | 3 | 2 | 2 | 1.3333 | 1 |
| Uses properly vetted data | 3 | 2 | 2 | 2 | 0 |
| Acceptable residual patterns | 3 | 2 | 2 | 2 | 2 |
| Comparable complexity | 2 | 2 | 1 | 1 | 2 |
| Fits consistent with variances | 2 | 1 | 2 | 1 | 0 |
| Dev sigmas estimated appropriately | 0 | | | | |
| Incremental changes | 0 | | | | |
| Objective criterion for sample sizes | 0 | | | | |
| Change in ageing criteria addressed | 0 | | | | |
| Density dependence (other than R) addressed | 0 | | | | |
| Regime shifts addressed | 0 | | | | |
| Average emphasis: | | 1.8750 | 1.6875 | 1.3750 | 1.0000 |
| Model weight: | | 0.3158 | 0.2842 | 0.2316 | 0.1684 |

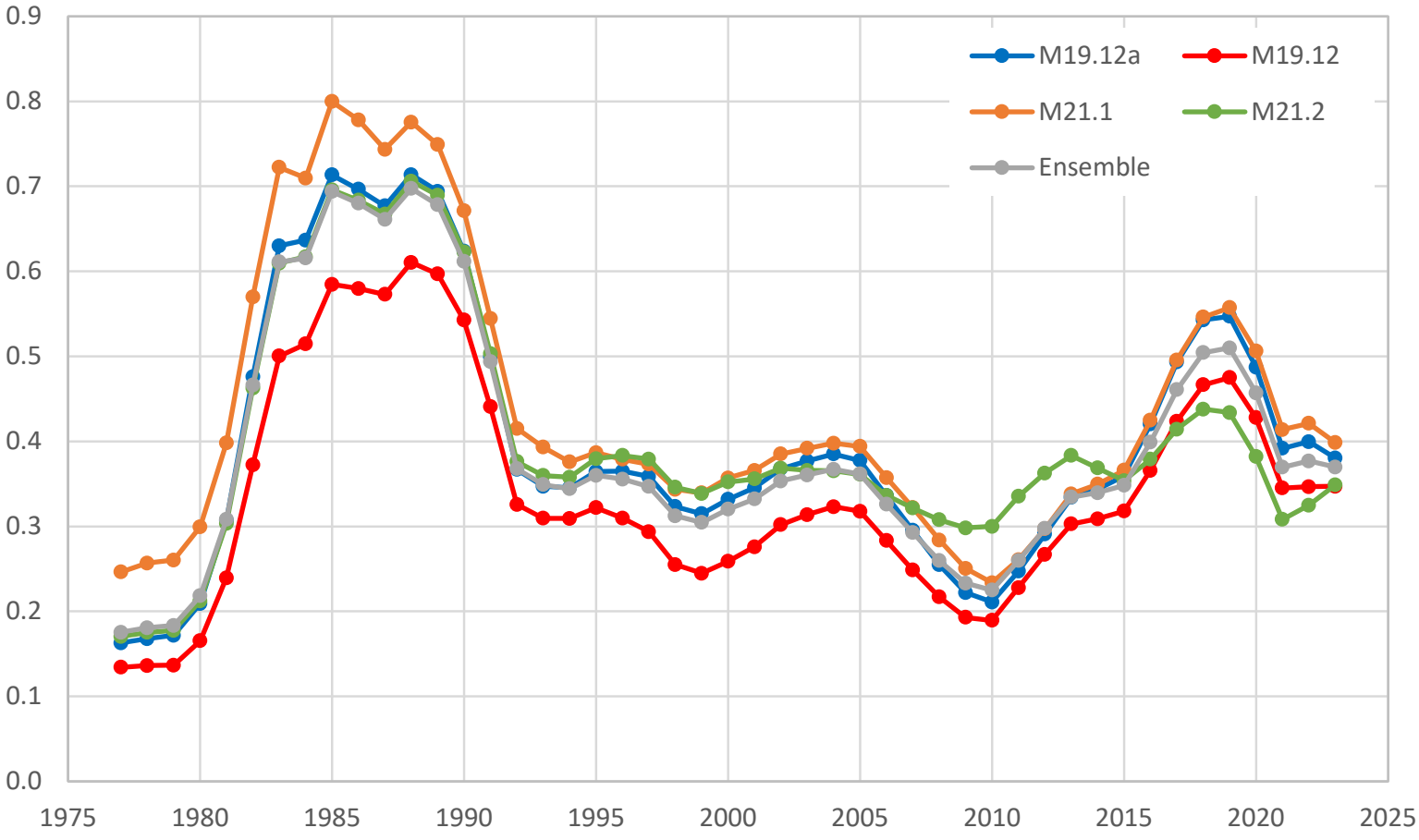
# EBS Pacific cod, continued

- Female spawning biomass (millions of t)



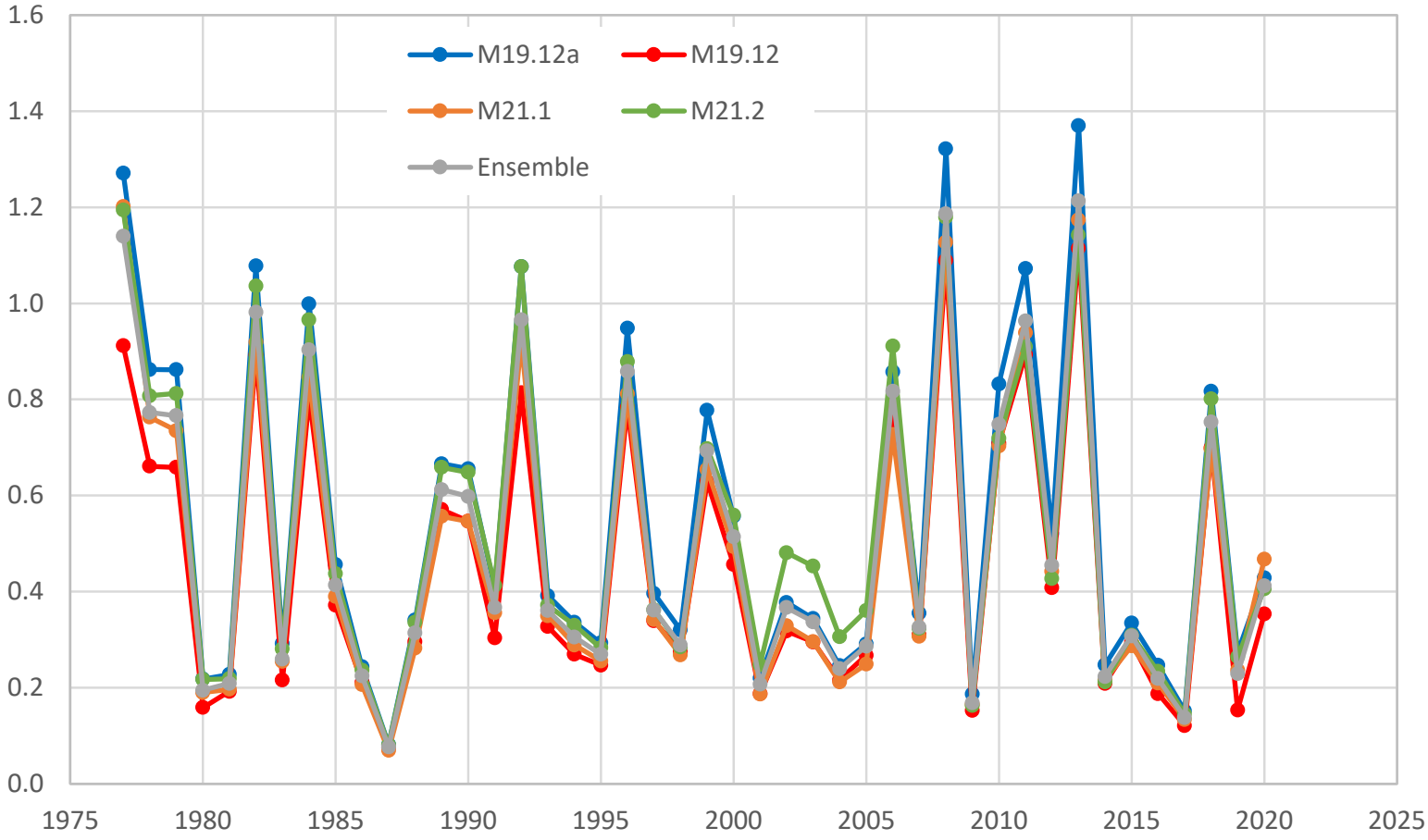

# EBS Pacific cod, continued

- Female spawning biomass relative to $B_{100\%}$



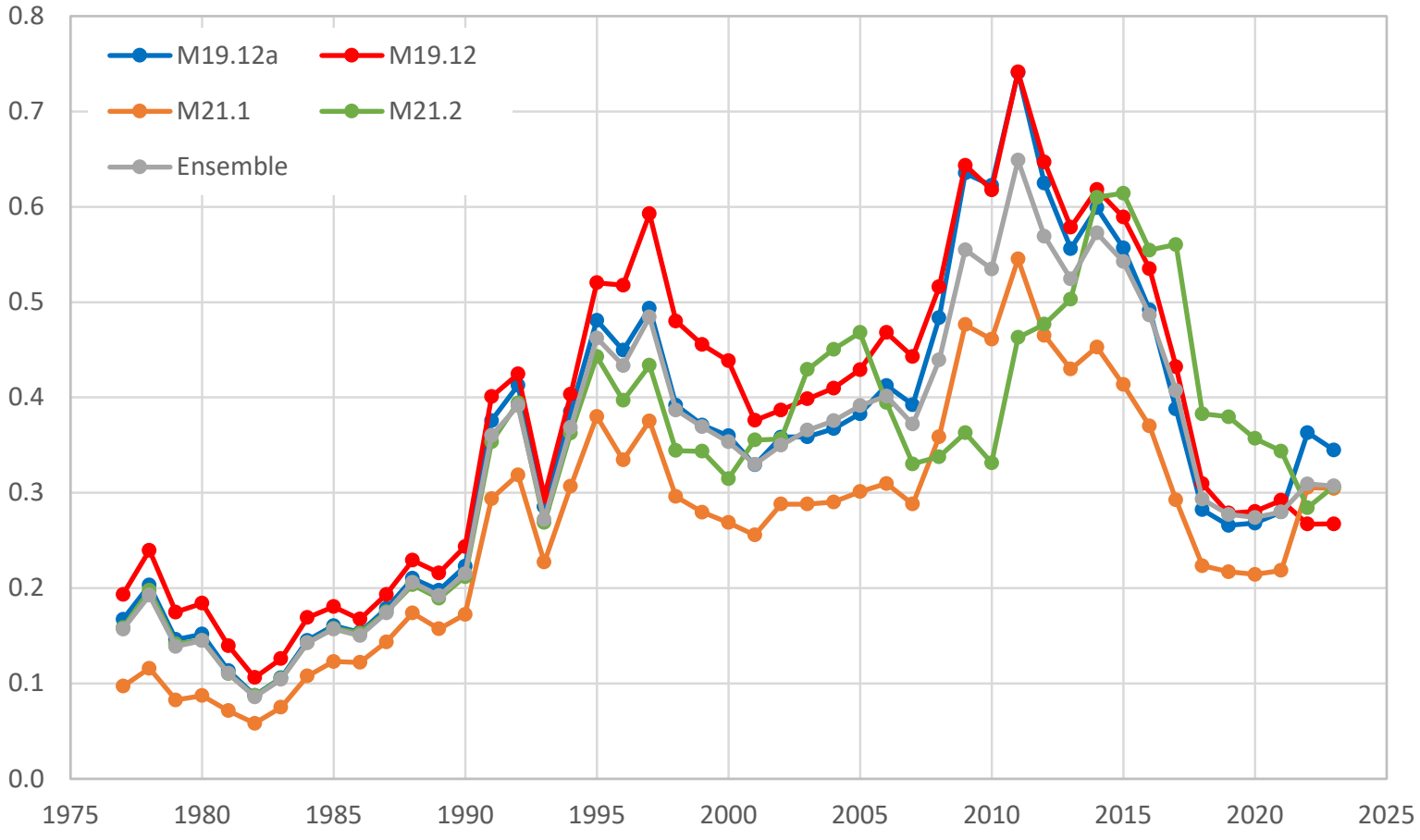

# EBS Pacific cod, continued

- Age 0 recruitment (billions of fish)



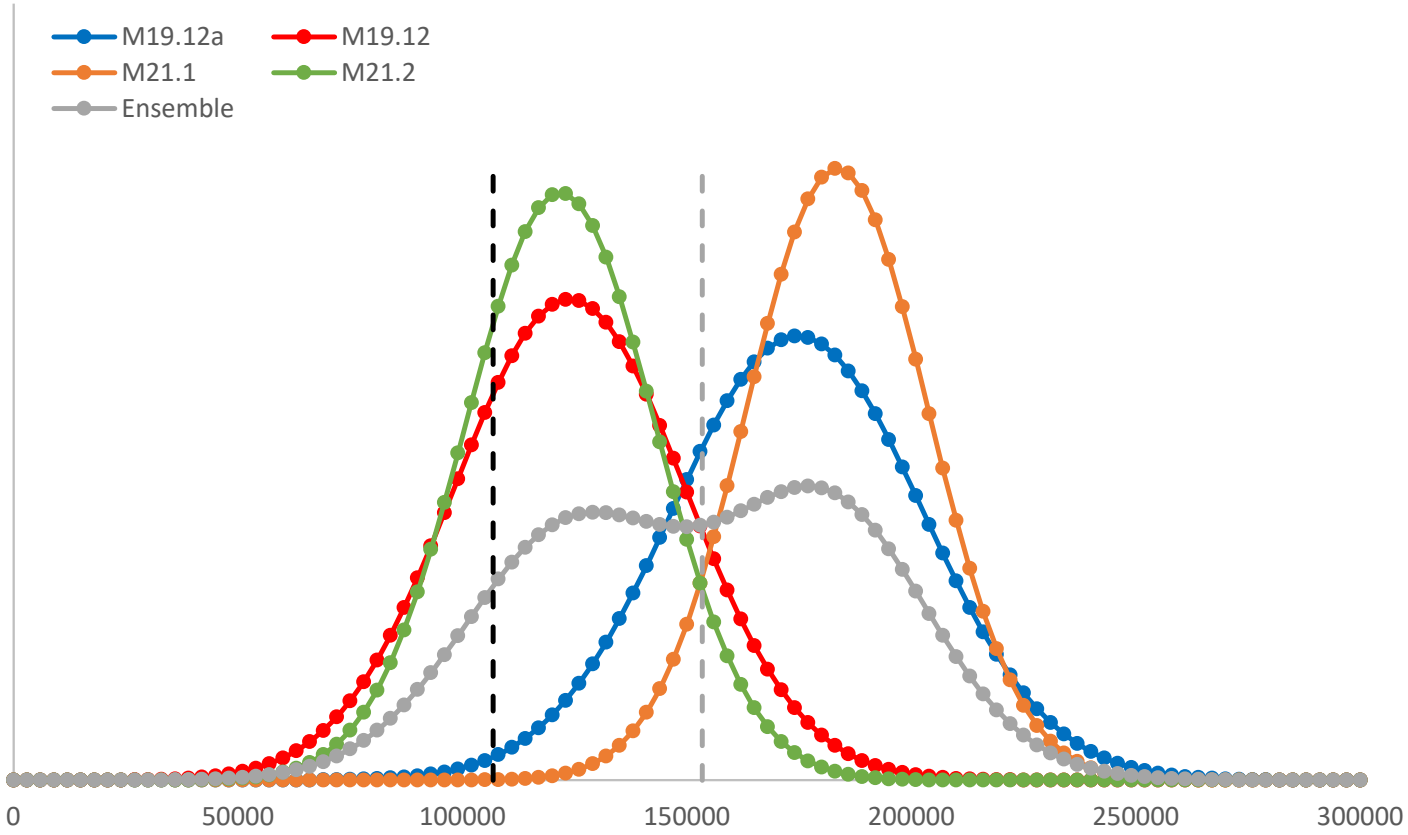

# EBS Pacific cod, continued

- Instantaneous full-selection fishing mortality rate




# EBS Pacific cod, continued

- 2022 ABC probability density (Hessian approximation)
  - Dashed lines: black = current specification; gray = ensemble mean




# EBS Pacific cod, continued

- Author's risk table:

| Year | Assess | PopDy | EnvEco | FishPerf |
|---|---|---|---|---|
| 2019 | 1 | 1 | 2 | 1 |
| 2020 | 1 | 1 | 2 | 1 |
| 2021 | 1 | 1 | 2 | 1 |

- Author recommends no reduction from maxABC
  - Procedure followed the "Joint probability approach" described in the report of the SSC workshop on risk tables (Discussion 8)
  - Author went to great lengths to comply with each of the applicable SSC recommendations on risk tables

# EBS Pacific cod, continued

- Change in 2022 ABC relative to 2021 ABC:

| 2022 ABC (recommended) | 2021 ABC (specified) | Change |
|---|---|---|
| 153383 | 123805 | 24% |

- Change in 2022 ABC relative to 2022 ABC *as currently specified*:

| 2022 ABC (recommended) | 2022 ABC (specified) | Change |
|---|---|---|
| 153383 | 106852 | 44% |

- All models showed increases from the preliminary assessment:

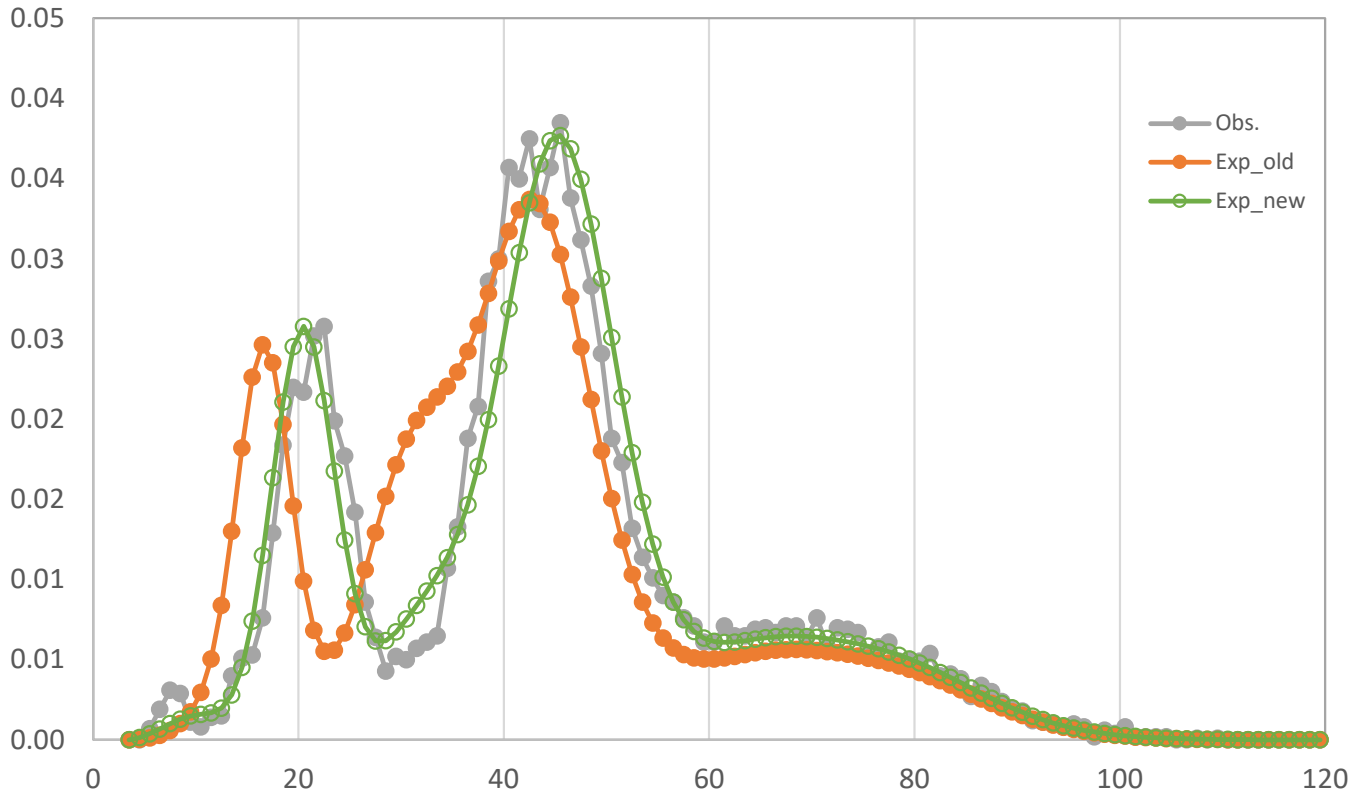
| Quantity | Version(s) | M19.12a | M19.12 | M21.2 | M21.2 |
|---|---|---|---|---|---|
| 2022 ABC | 2020 final | 106852 | 91845 | n/a | n/a |
| | 2021 preliminary | 105613 | 82924 | 115920 | 102594 |
| | 2021 final | 174668 | 123899 | 183492 | 121830 |
| Relative change | 2021 prelim. v. 2020 final | -0.01 | -0.10 | n/a | n/a |
| | 2021 final v. 2021 prelim. | 0.65 | 0.49 | 0.58 | 0.19 |
| | 2021 final v. 2020 final | 0.63 | 0.35 | n/a | n/a |

# EBS Pacific cod, continued

- Appendix 2.4: detailed analysis of the factors causing the increase
- Three changes in the data file (relative to last year's) account for 85% of the increase in projected 2022 ABC (see next 3 slides):
  - 2021 survey sizecomp data
  - 2021 survey index data
  - Revisions to the historic survey index data
- All year classes in the 1977-2018 time series increased from last year's Model 19.12a to this year's, with the 2018 year class increase being in the middle of the pack in both absolute and relative terms
- Increases in both selectivity and weight at ages 3 and 4 contributed to the increase as well
- Within the sloping portion of the harvest control rule, ABC changes much more rapidly than biomass (e.g., as a first approximation, if biomass increases by a factor of $X$, ABC increases by a factor of $X^2$)

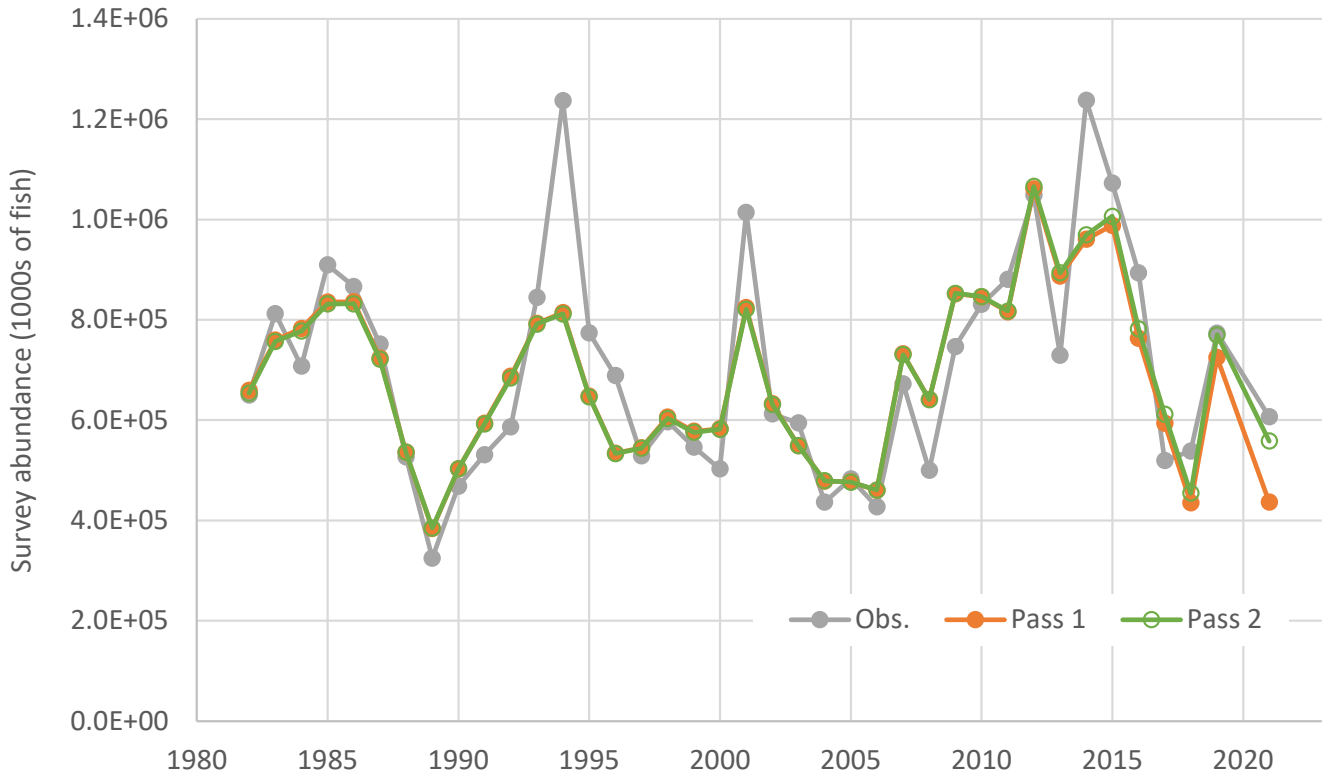
# EBS Pacific cod, continued

- Pass 1: add 2021 survey sizecomp to the base data file
  - Change in fit to 2021 survey sizecomp data:



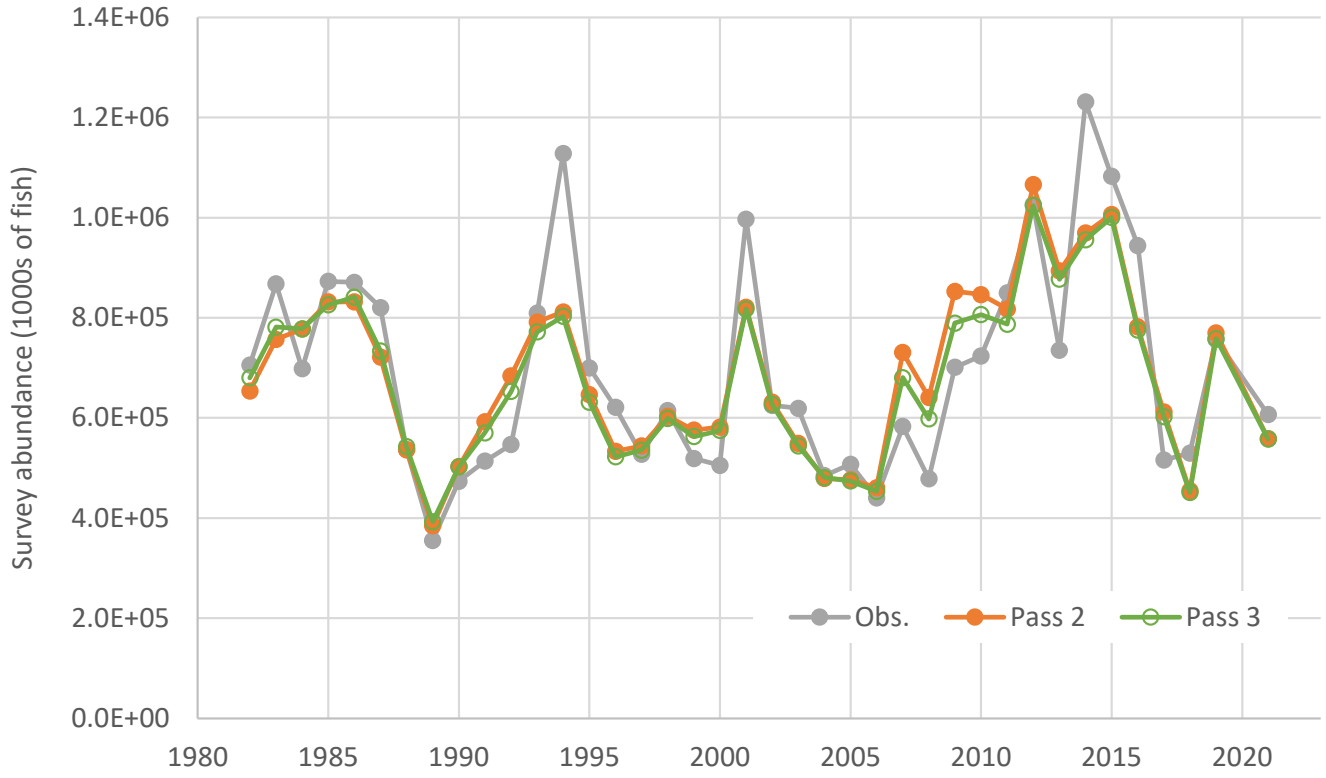
# EBS Pacific cod, continued

- Pass 2: add 2021 survey index to the Pass 1 data file
  - Change in fit to survey index time series:



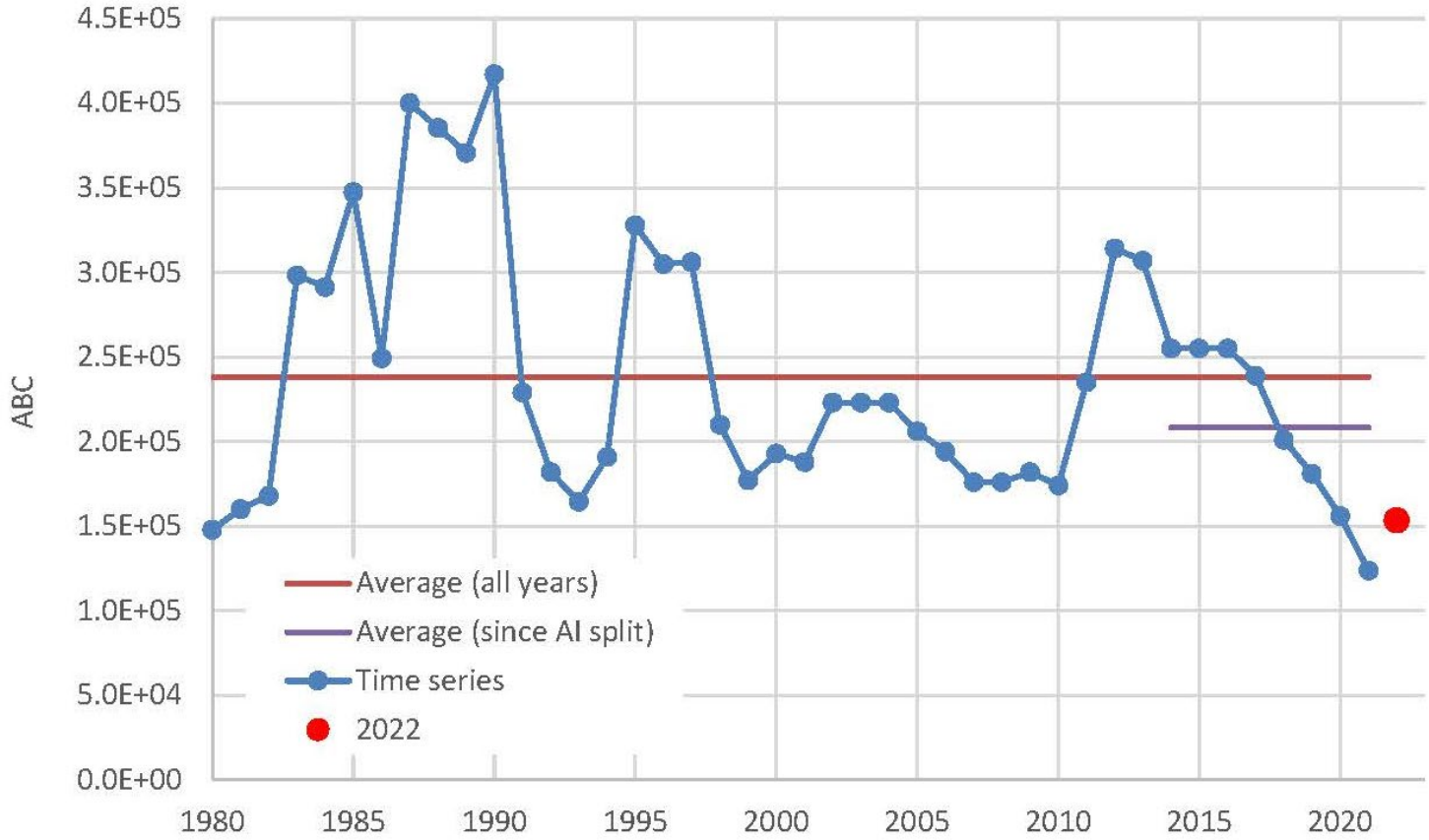

# EBS Pacific cod, continued

- Pass 3: revise historic survey index in the Pass 2 data file
  - Change in fit to survey index time series:




# EBS Pacific cod, continued

- Recommended 2022 ABC would still be the 3rd smallest in history, and the ratio of ABC to age 0+ biomass would be the 5th smallest in history



# EBS Pacific cod, continued

- The Team appreciated the pragmatic choice of the assessment authors to present the SSC recommended ensemble given the short timeframe to produce the assessment
- However, the Team also expressed concern that there are no clear or consistent criteria for inclusion or exclusion of ensemble components
- One benefit of an ensemble is that each model may perform differently in response to new data, which may reduce the interannual variability
- However, adding and removing models may *add* interannual variability and potentially important models may be lost to the process
- One potential drawback of the use of the ensemble approach is that future model development may be stymied as authors are required to produce the full set of models used in the ensemble in the following year



# EBS Pacific cod, continued

- The Team recognizes that the considerations for development, presentation, and choice of a model ensemble are necessarily different from those associated with an individual model for use in management
- The Team opined that the Team and SSC criteria for reviewing and approving ensembles have not been consistent and recommends a more standardized approach continue to be developed within the Team and SSC process for defining appropriate sets of models and weighting of those models for use in management
- The Team commends Grant's work on developing, explaining, and justifying the risk table
- The Team indicated that development of more quantitative methods for evaluating when possible reductions from maximum permissible ABC would be warranted should be explored further

# EBS Pacific cod, continued

- The Team recommends exploring environmental drivers of weight-length residuals, especially in recent years
- The Team encourages continued work of the AFSC fishery CPUE group regarding creating CPUE indices from fishery-dependent data and encourages assessment authors to consider best practices for incorporating fishing behavior
- The Team accepted the author's recommended model, risk levels, and harvest specifications
- The Team expressed deep appreciation for Grant's efforts investigating and improving the Pacific cod assessment over many years

# EBS Pacific cod, continued

| Quantity | Last asmt. | This asmt. | Change |
|---|---|---|---|
| M | 0.35 | 0.34 | -0.03 |
| 2021 tier | 3b | n/a | none |
| 2022 tier | 3b | 3b | none |
| 2021 age+ biomass | 754,000 | n/a | 0.17 |
| 2022 age+ biomass | 786,566 | 879,978 | 0.12 |
| 2021 spawning biomass | 228,219 | n/a | 0.14 |
| 2022 spawning biomass | 205,906 | 259,789 | 0.26 |
| B100% | 659,545 | 686,761 | 0.04 |
| B40% | 263,818 | 274,704 | 0.04 |
| B35% | 230,841 | 240,366 | 0.04 |
| 2022 FOFL | 0.33 | 0.38 | 0.15 |
| 2022 FABC | 0.27 | 0.31 | 0.15 |
| 2021 OFL | 147,949 | n/a | 0.24 |
| 2022 OFL | 128,340 | 183,012 | 0.43 |
| 2021 ABC | 123,805 | n/a | 0.24 |
| 2022 ABC | 106,852 | 153,383 | 0.44 |

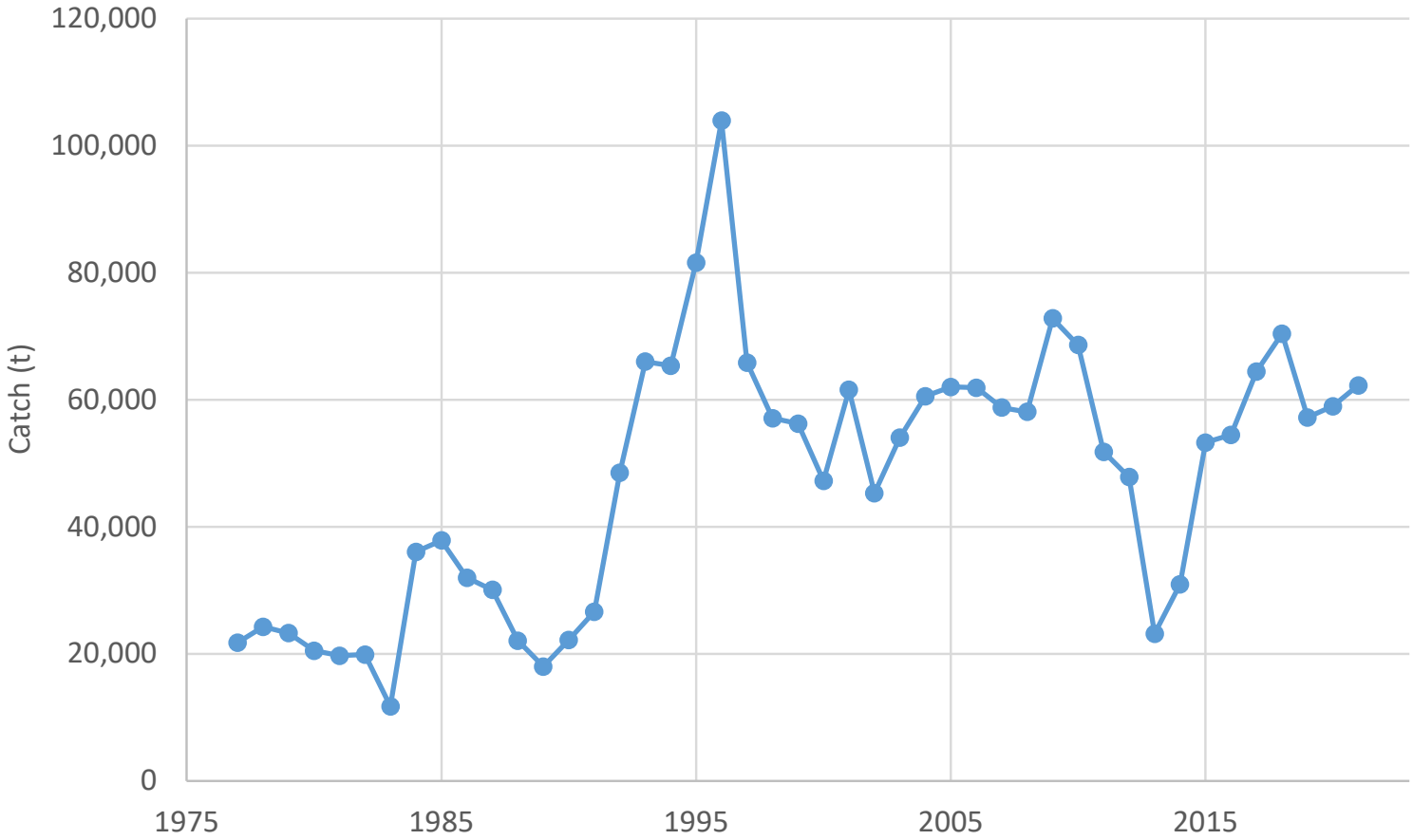
# Chapter 17: Atka mackerel

- New model(s): no; change from base: no; risk>1: no
- New data: 2020 fishery age composition
- Model changes/alternatives: none (Model 16.0b)
- Stock status: projected 2022 spawning biomass is 39% of $B_{100\%}$
- Mohn's $\rho = 0.067$
- Author's risk table:

| Year | Assess | PopDy | EnvEco | FishPerf |
|---|---|---|---|---|
| 2018 | 1 | 1 | 1 | |
| 2019 | 1 | 1 | 1 | 1 |
| 2020 | 1 | 1 | 1 | 1 |
| 2021 | 1 | 1 | 1 | 1 |

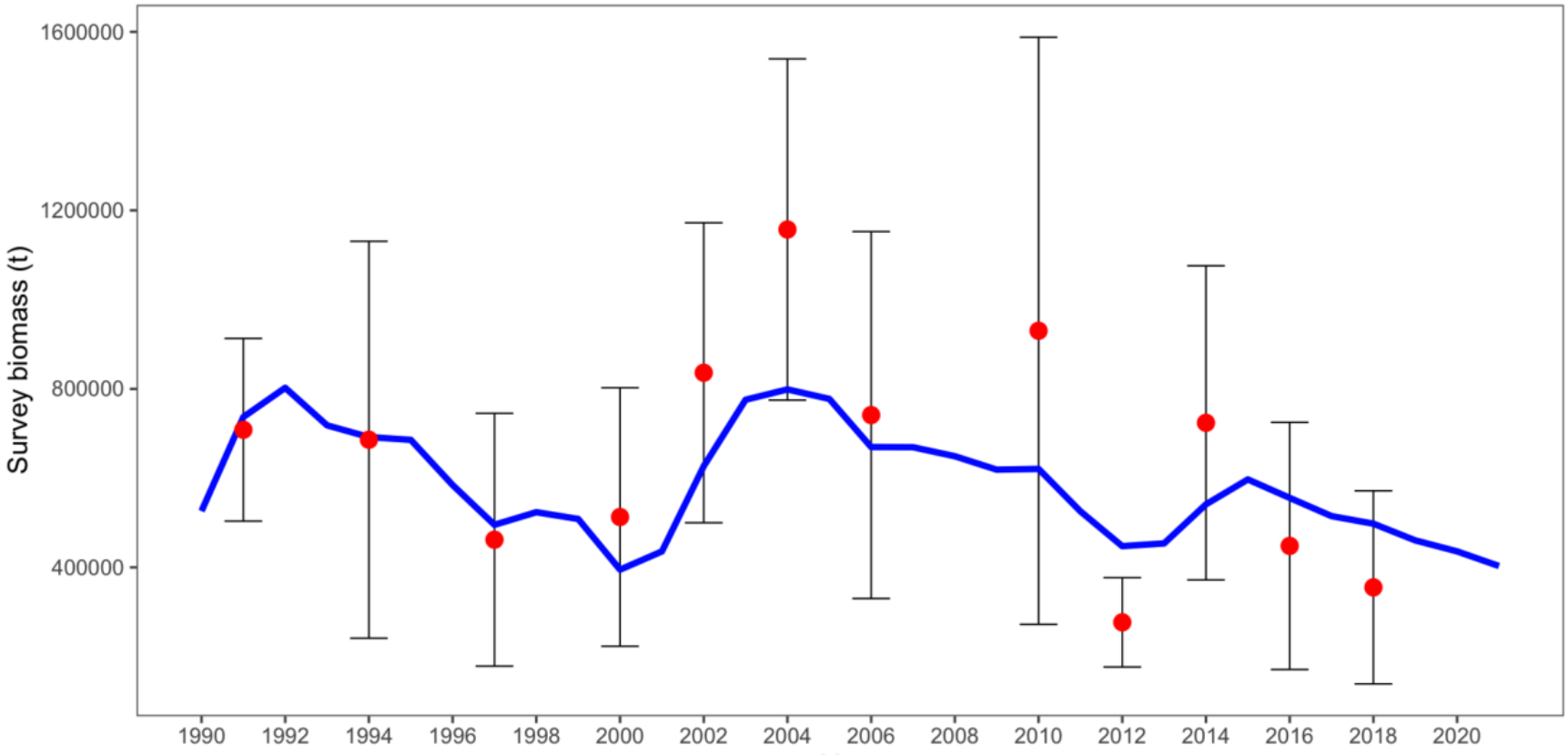
# Atka mackerel, continued

- Catch time series



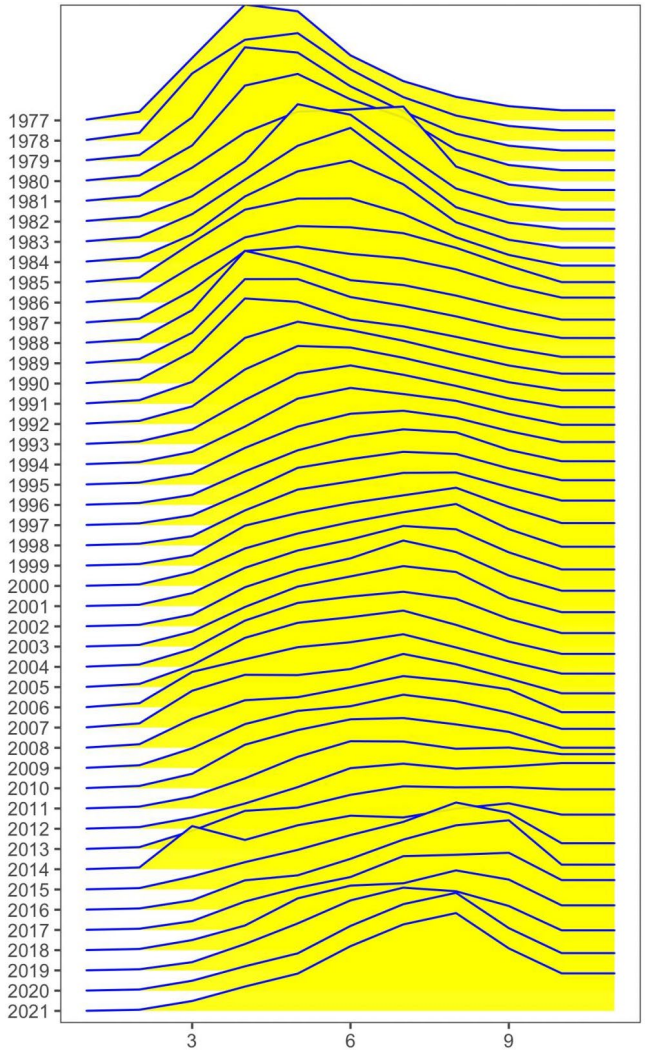

# Atka mackerel, continued

- Fit to AI survey biomass data



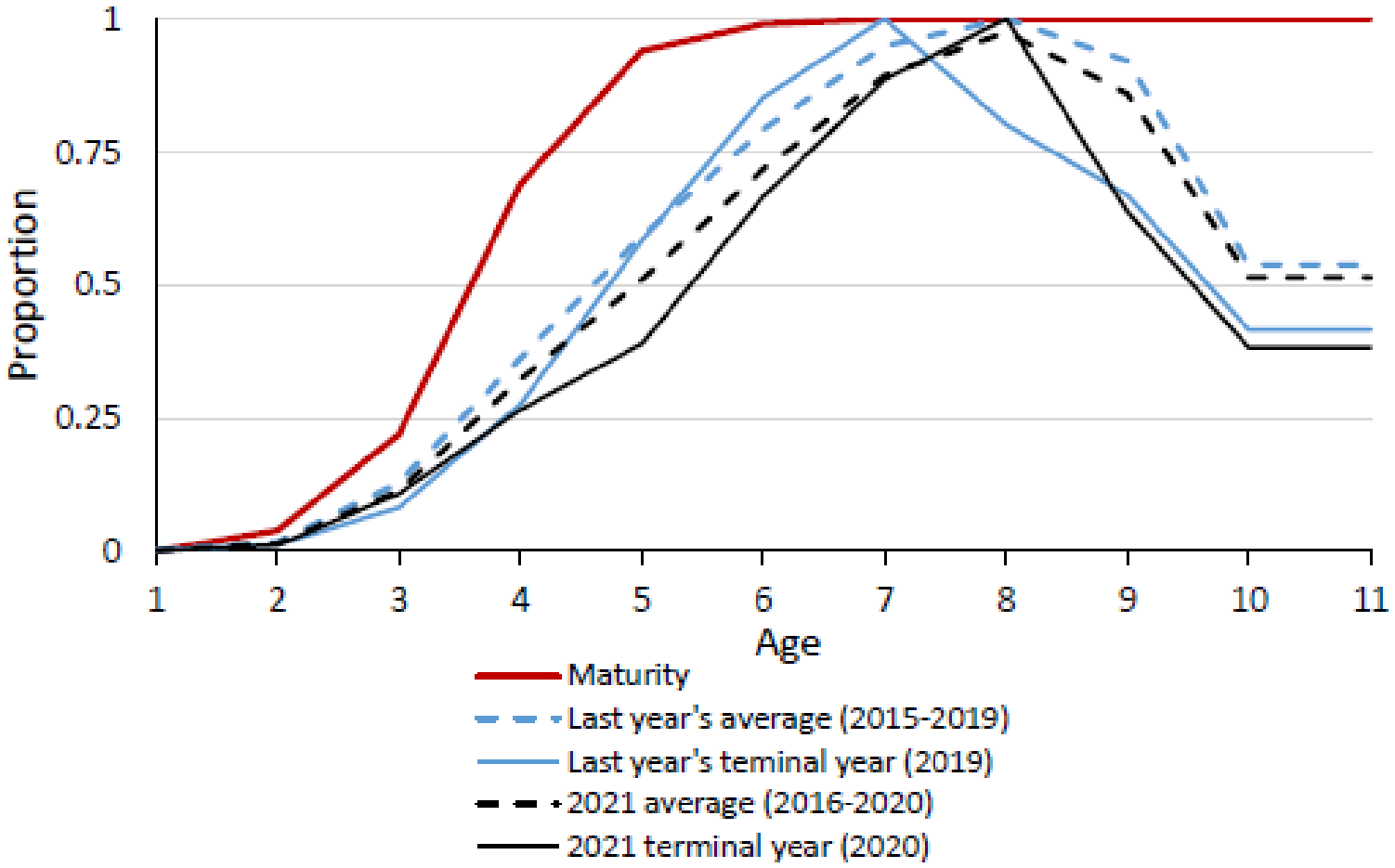
# Atka mackerel, continued

- Fishery selectivity



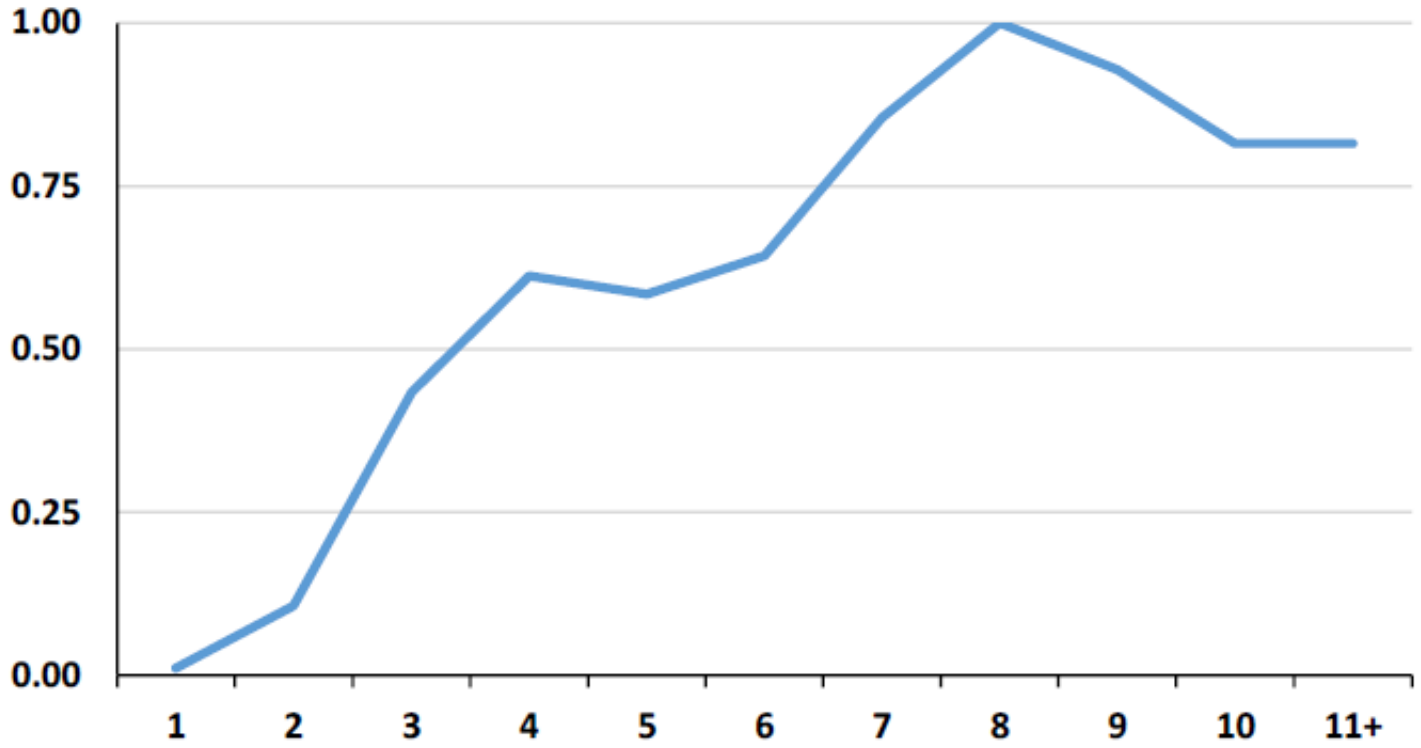

# Atka mackerel, continued

- Change in recent fishery selectivity between assessments



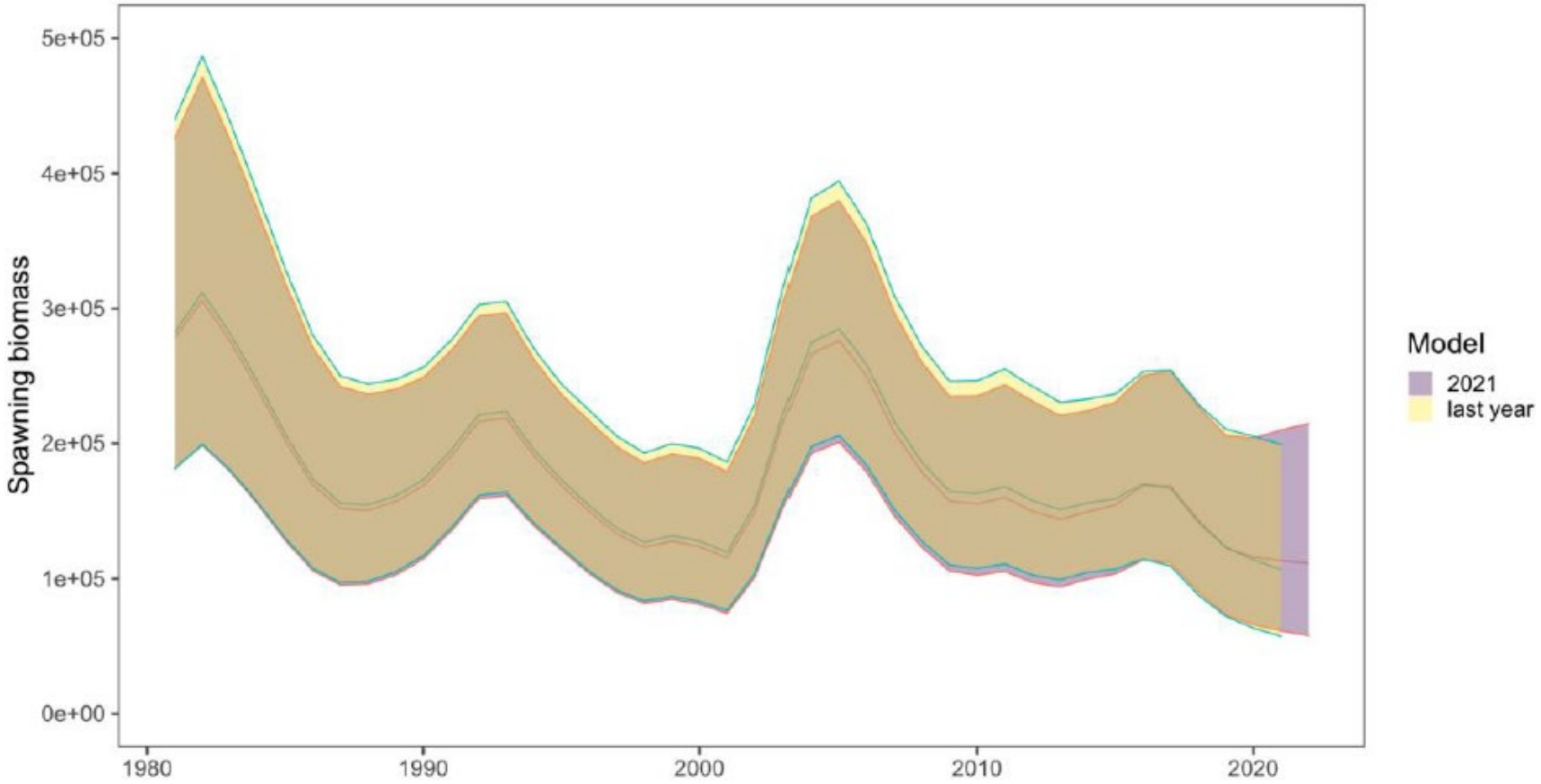

# Atka mackerel, continued

- Survey selectivity



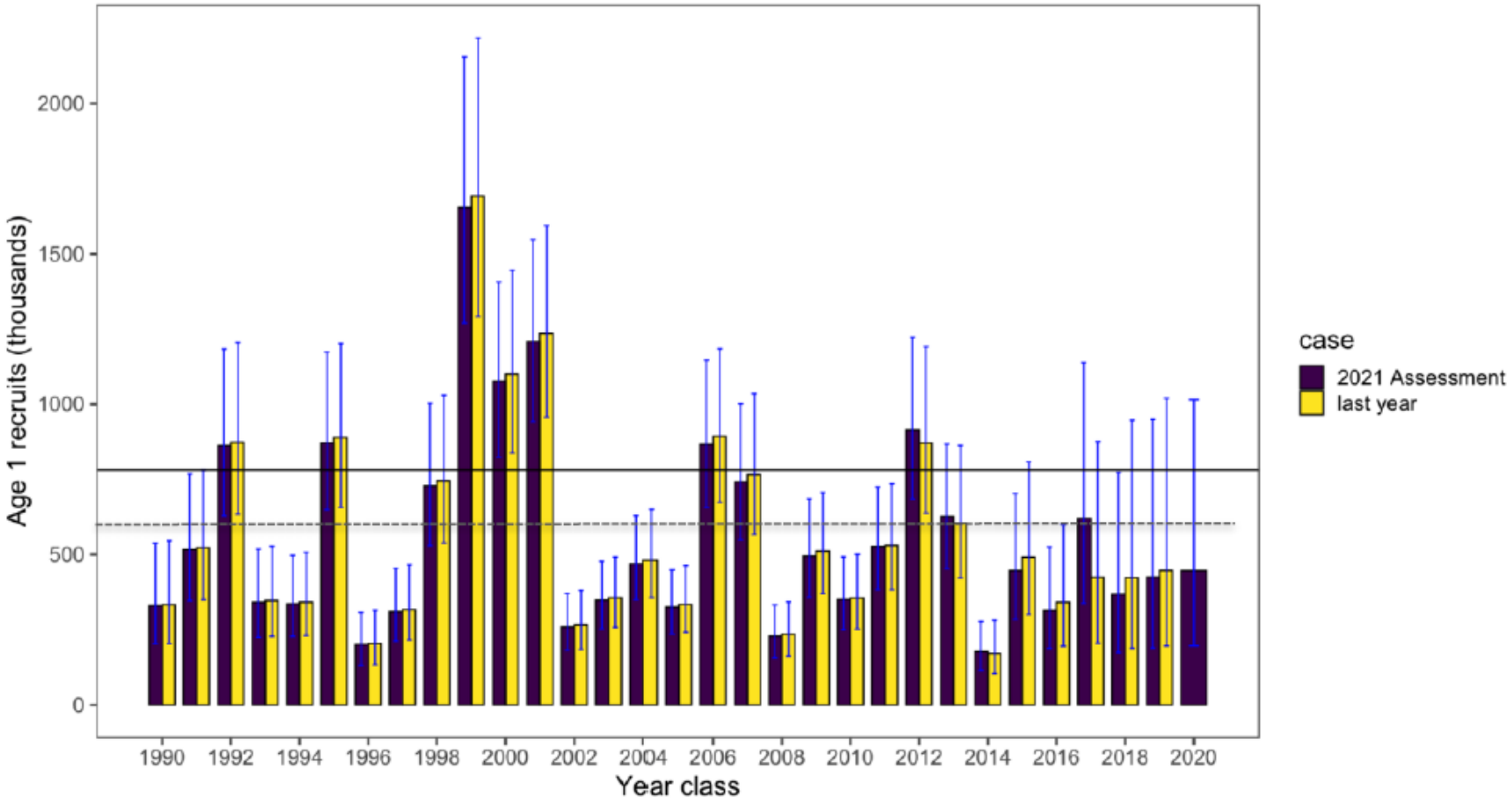

# Atka mackerel, continued

- Spawning biomass as estimated last year and this year



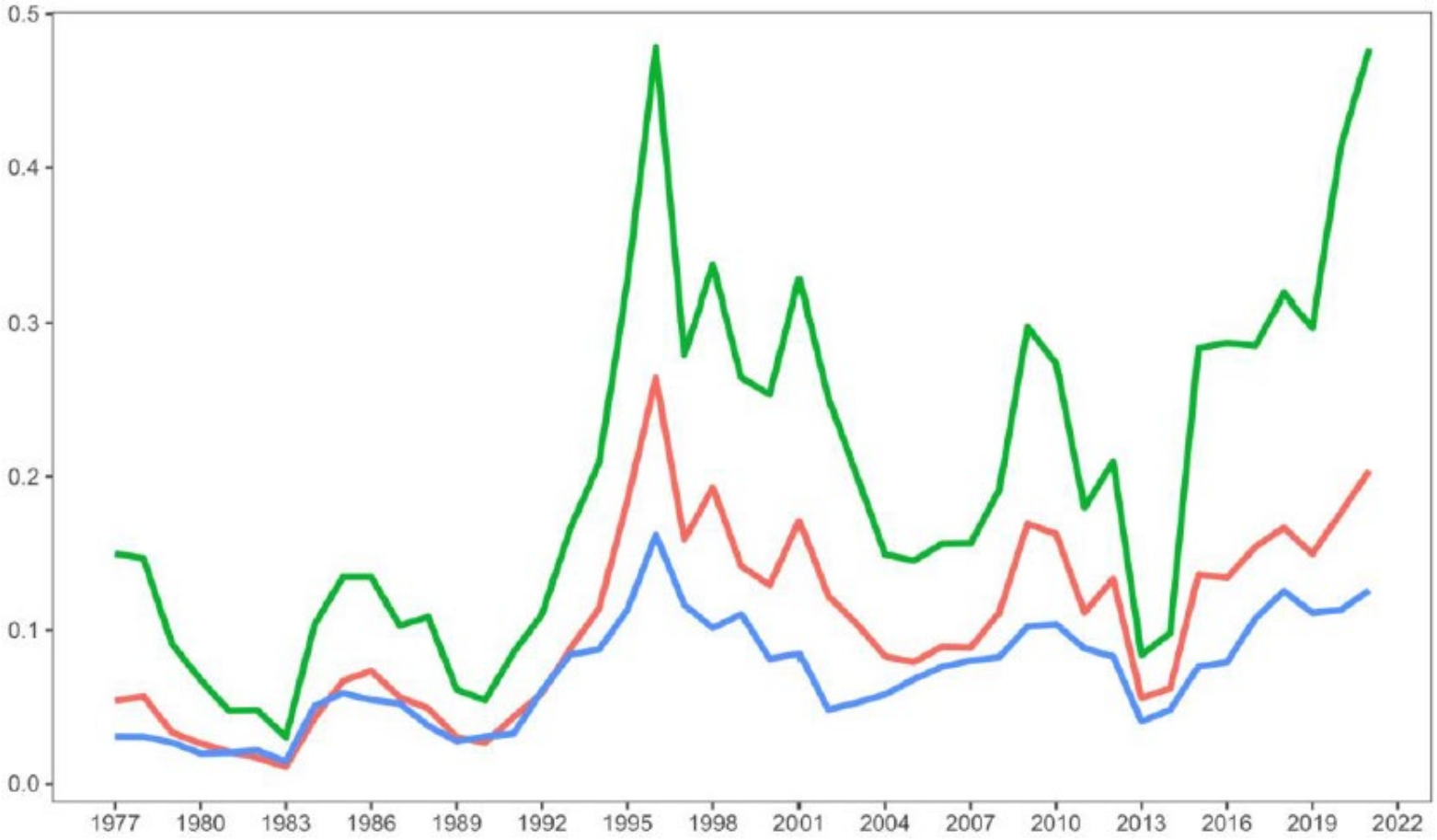
# Atka mackerel, continued

- Age 1 recruitment as estimated last year and this year



# Atka mackerel, continued

- Full selection F (green), mean F (red), and catch/biomass (blue)




# Atka mackerel, continued

- Area apportionment:
  - Except for the 2016 and 2017 assessments, when apportionments were based on the Tier 5 RE model, apportionments of Atka mackerel since the 2001 assessment have been based on a 4-survey weighted average, with weights of 8:12:18:27
  - Because no AI surveys have been conducted since 2018, the relative apportionments remain the same as in 2018-2020
- The Team accepted the author's recommended model, risk levels, and harvest specifications
- The Team recommends that the authors continue research into possible reasons for dome-shaped fishery and survey selectivity patterns, including senescence or differential distribution by age

# Atka mackerel, continued

| Quantity | Last asmt. | This asmt. | Change |
|---|---|---|---|
| M | 0.30 | 0.30 | 0.00 |
| 2021 tier | 3b | n/a | none |
| 2022 tier | 3b | 3b | none |
| 2021 age+ biomass | 560,360 | n/a | -0.01 |
| 2022 age+ biomass | 599,690 | 554,490 | -0.08 |
| 2021 spawning biomass | 107,830 | n/a | 0.01 |
| 2022 spawning biomass | 102,950 | 109,360 | 0.06 |
| B100% | 290,820 | 278,670 | -0.04 |
| B40% | 116,330 | 111,470 | -0.04 |
| B35% | 101,790 | 97,540 | -0.04 |
| 2022 FOFL | 0.49 | 0.65 | 0.33 |
| 2022 FABC | 0.41 | 0.54 | 0.32 |
| 2021 OFL | 85,580 | n/a | 0.07 |
| 2022 OFL | 79,660 | 91,870 | 0.15 |
| 2021 ABC | 73,590 | n/a | 0.07 |
| 2022 ABC | 68,220 | 78,510 | 0.15 |

# Chapter 4: yellowfin sole

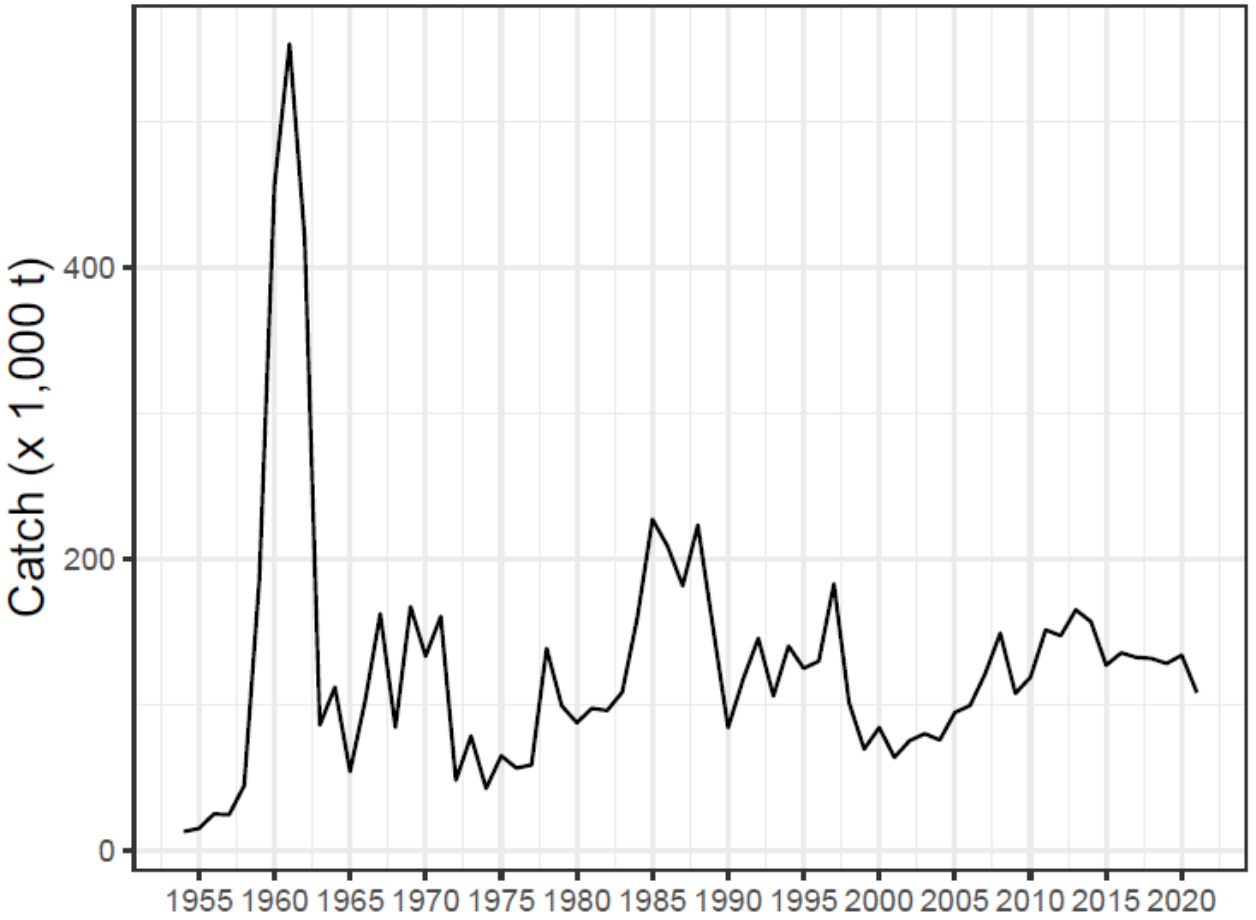
- >1 model: yes; change from base: no; risk>1: yes
- New data:
  - Fishery and agecomp for 2020
  - 2021 EBS (design-based, VAST) and EBS+NBS (VAST) survey
- Model changes/alternatives (all presented in 2020 or before):
  - Model 18.2 (base) fixes female $M=0.12$, estimates male $M=0.135$
  - Model 18.2a (formerly 18.3) is the same as Model 18.2, except with VAST estimates of the EBS survey biomass time series
  - Model 18.2b (formerly 18.4) is the same as Model 18.2, except with VAST estimates of the combined EBS and NBS survey time series

# Yellowfin sole, continued

- Author recommends retaining Model 18.2 because:
  - Models 18.2a and 18.2b use VAST survey *biomass* estimates, but not VAST *agecomp* estimates
  - Model 18.2b, which includes NBS survey biomass, does not include any NBS weight-at-age data or NBS agecomp data
  - Models 18.2a and 18.2b are best considered as "exploratory"
- The Team accepted the author's recommended model
- Stock status:
  - 2022 spawning biomass is 58% of $B_0$ and 73% above $B_{MSY}$
- Mohn's $\rho = -0.118$ (improved from $-0.185$ last year)

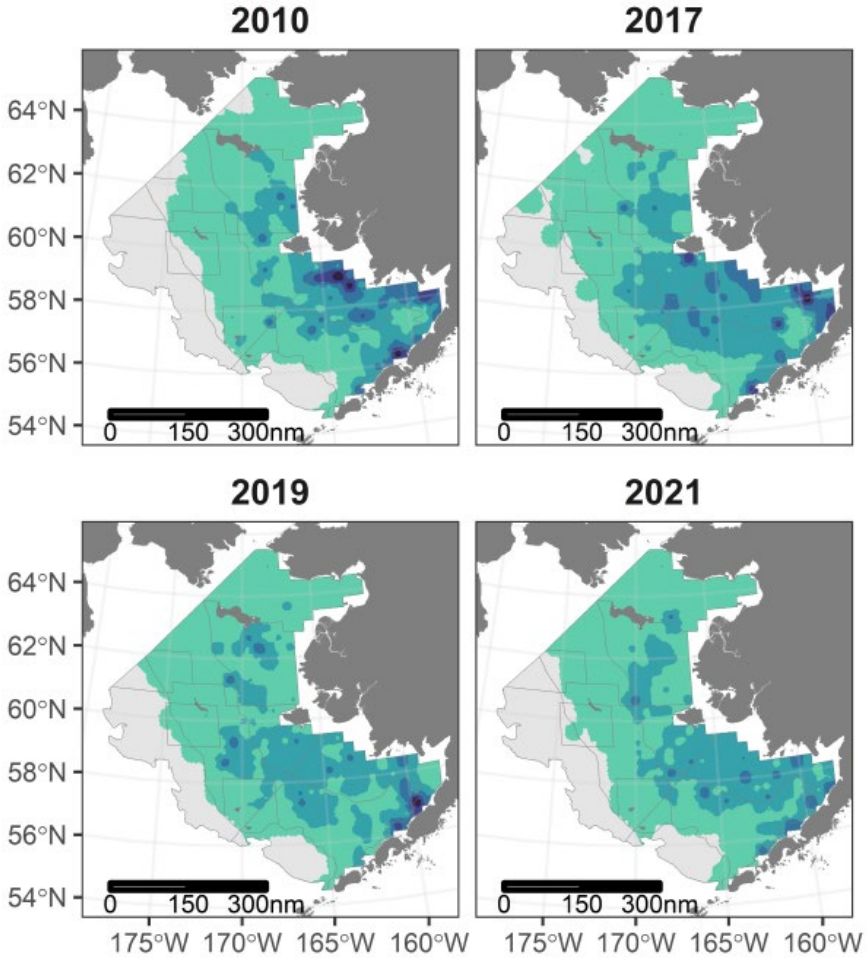
# Yellowfin sole, continued

- Catch time series



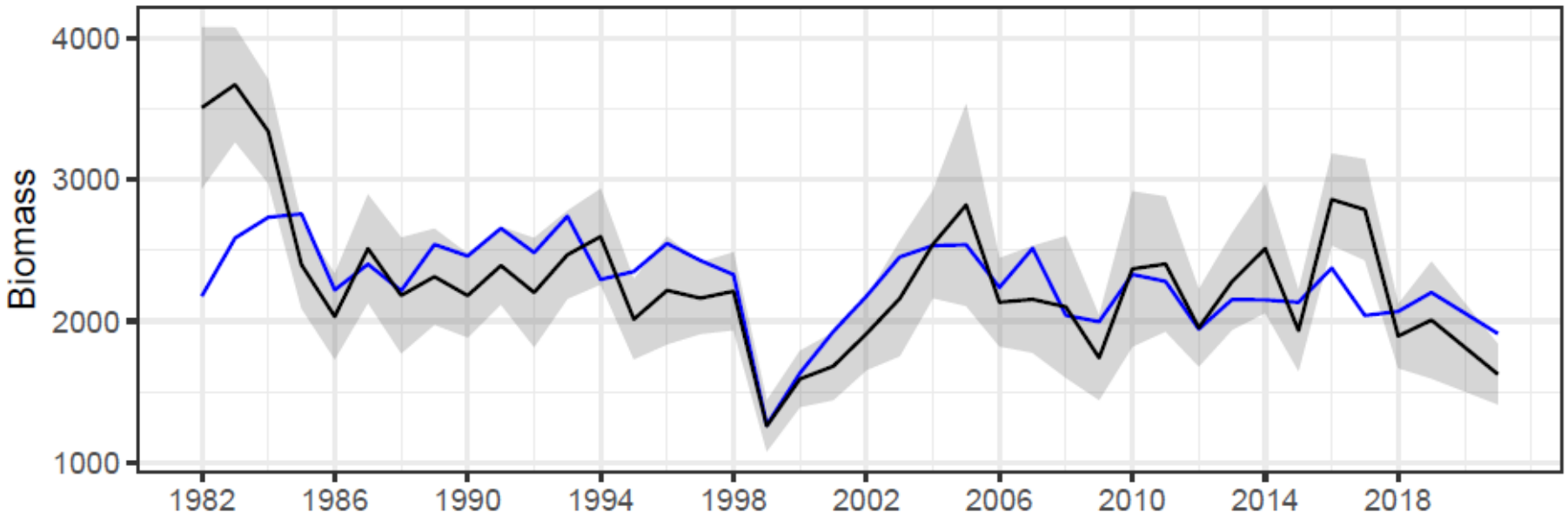

# Yellowfin sole, continued

- Survey CPUE in recent NBS survey years



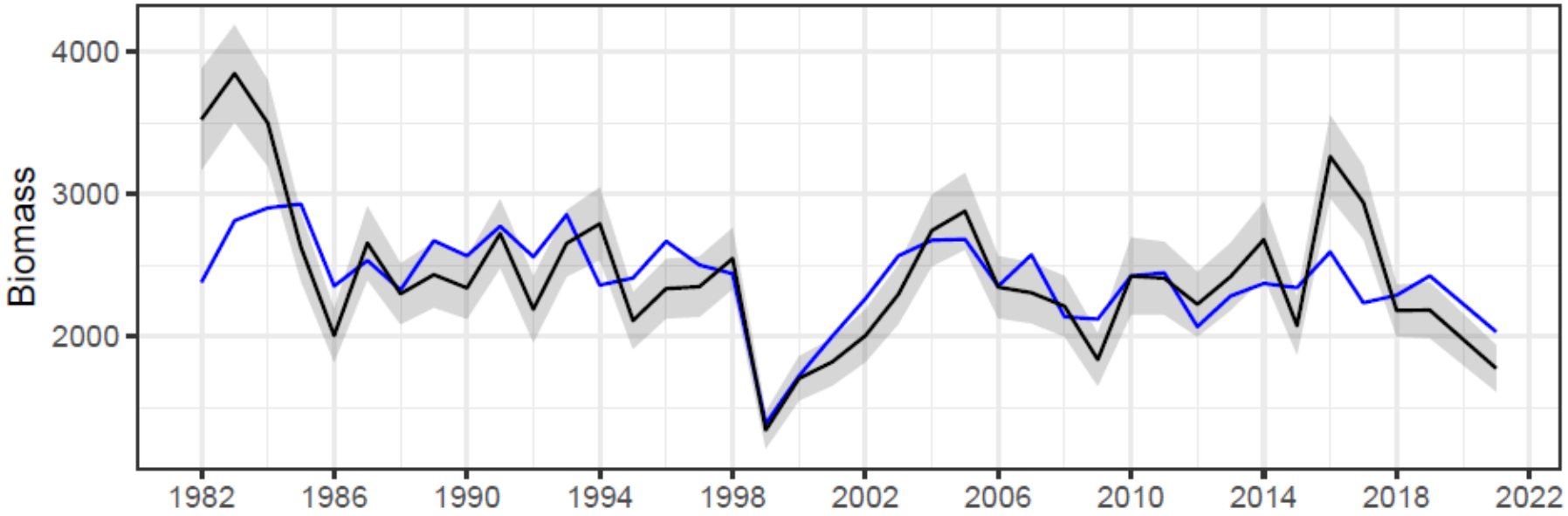
# Yellowfin sole, continued

- Fit to design-based EBS survey biomass (Model 18.2)



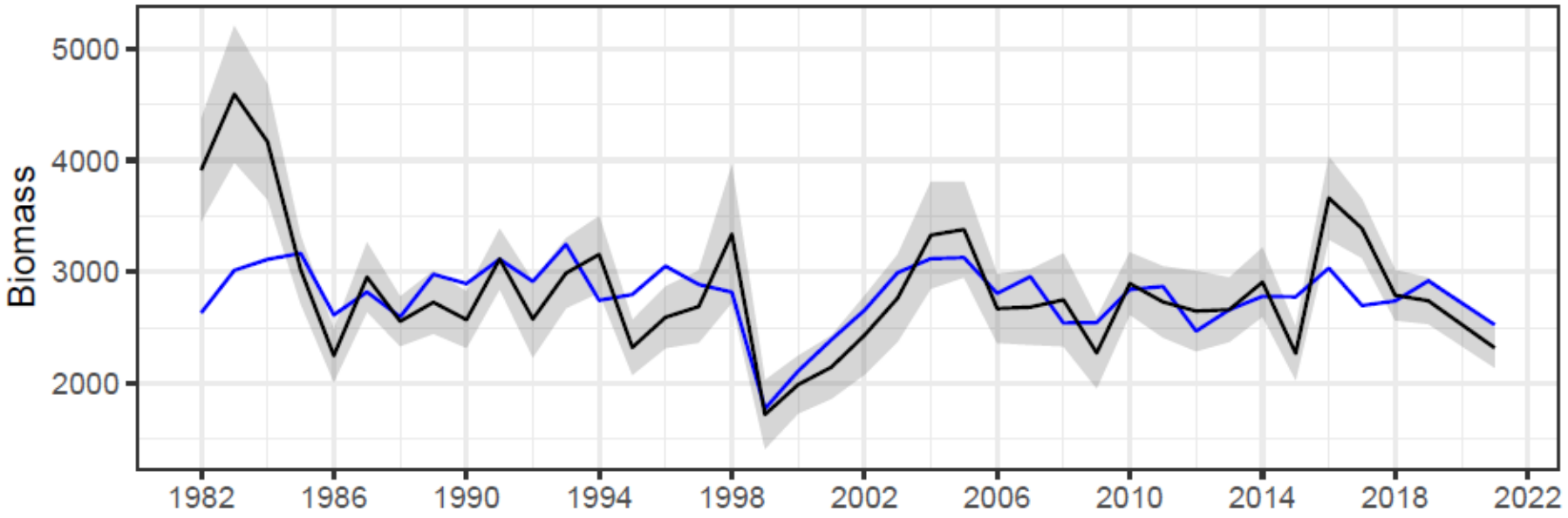

# Yellowfin sole, continued

- Fit to VAST-based EBS survey biomass (Model 18.2a)



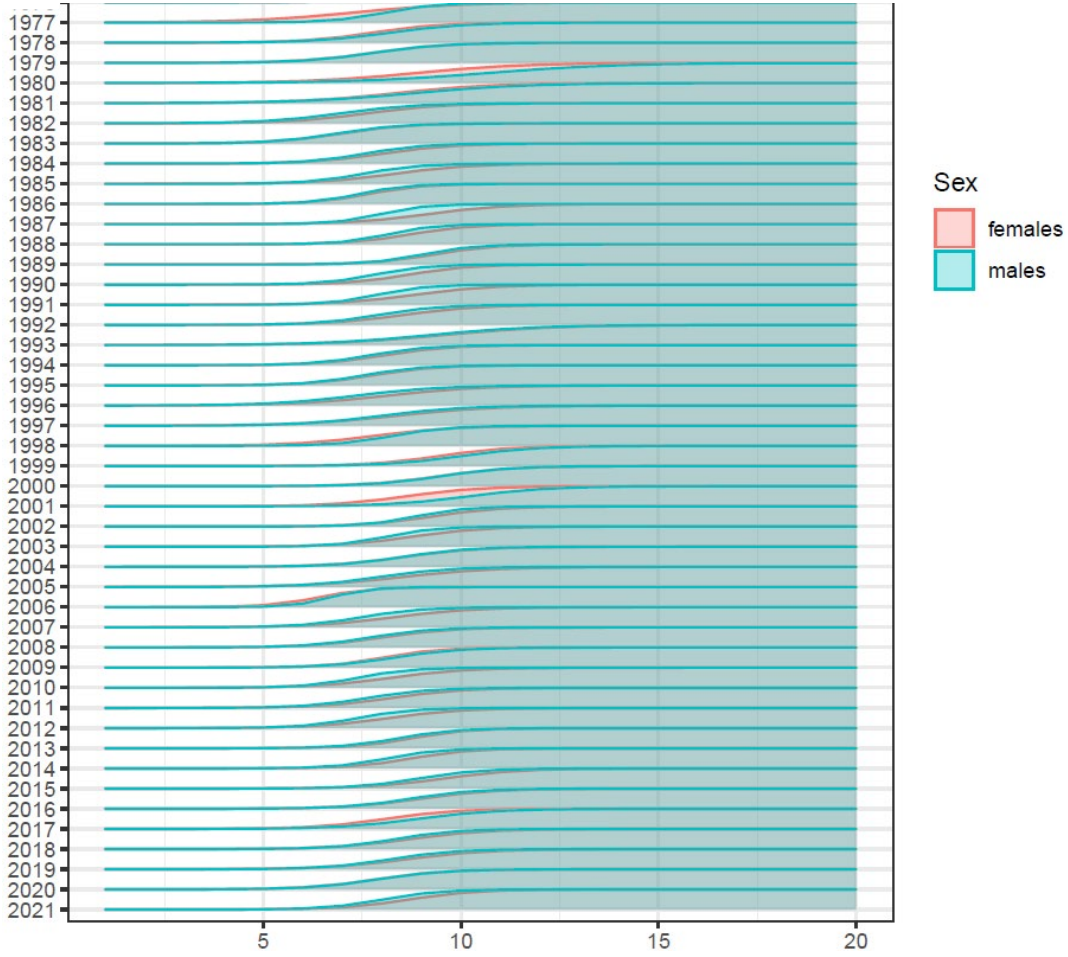

# Yellowfin sole, continued

- Fit to VAST-based EBS+NBS survey biomass (Model 18.2b)



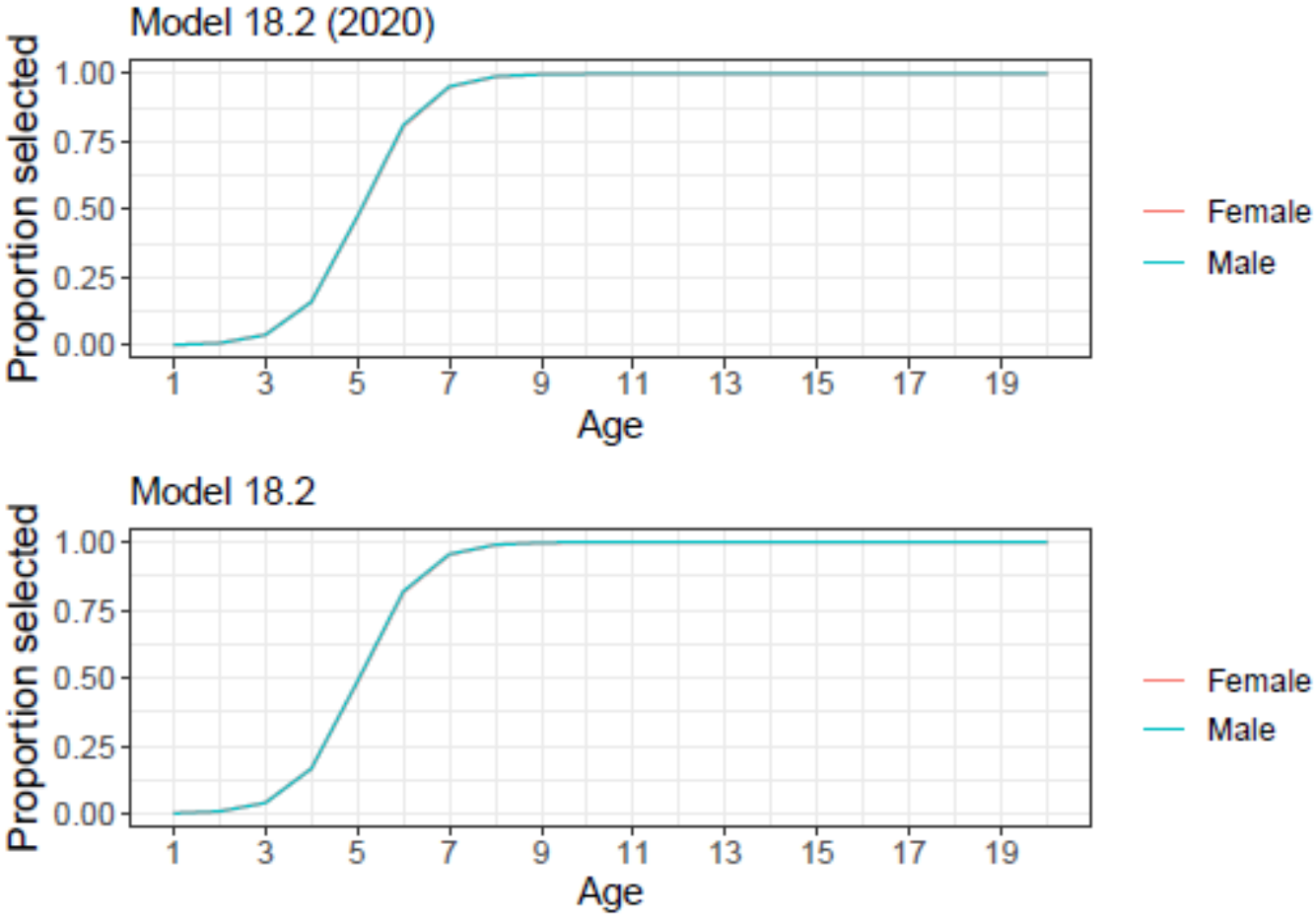

# Yellowfin sole, continued

- Fishery selectivity as estimated by Model 18.2



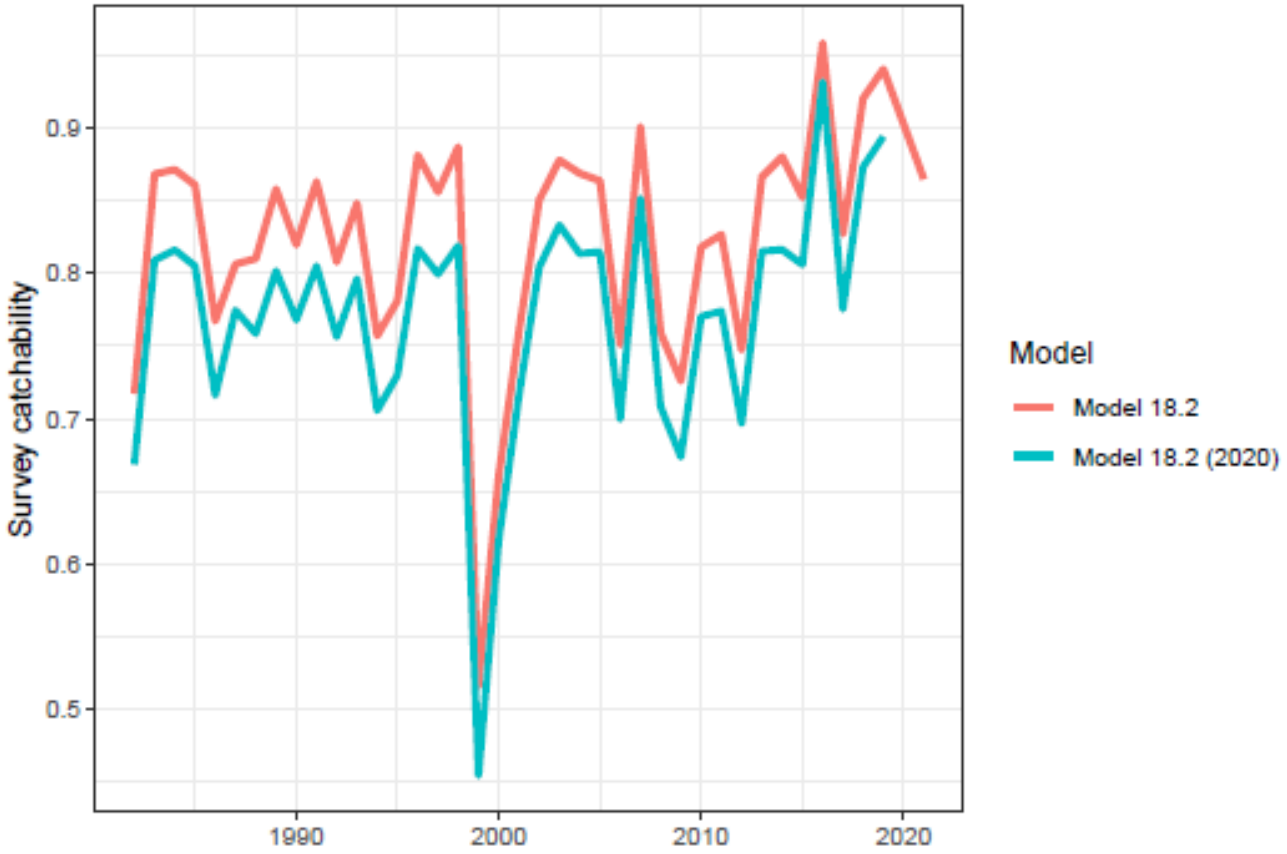
# Yellowfin sole, continued

- Survey selectivity as estimated by Model 18.2 last year and this year



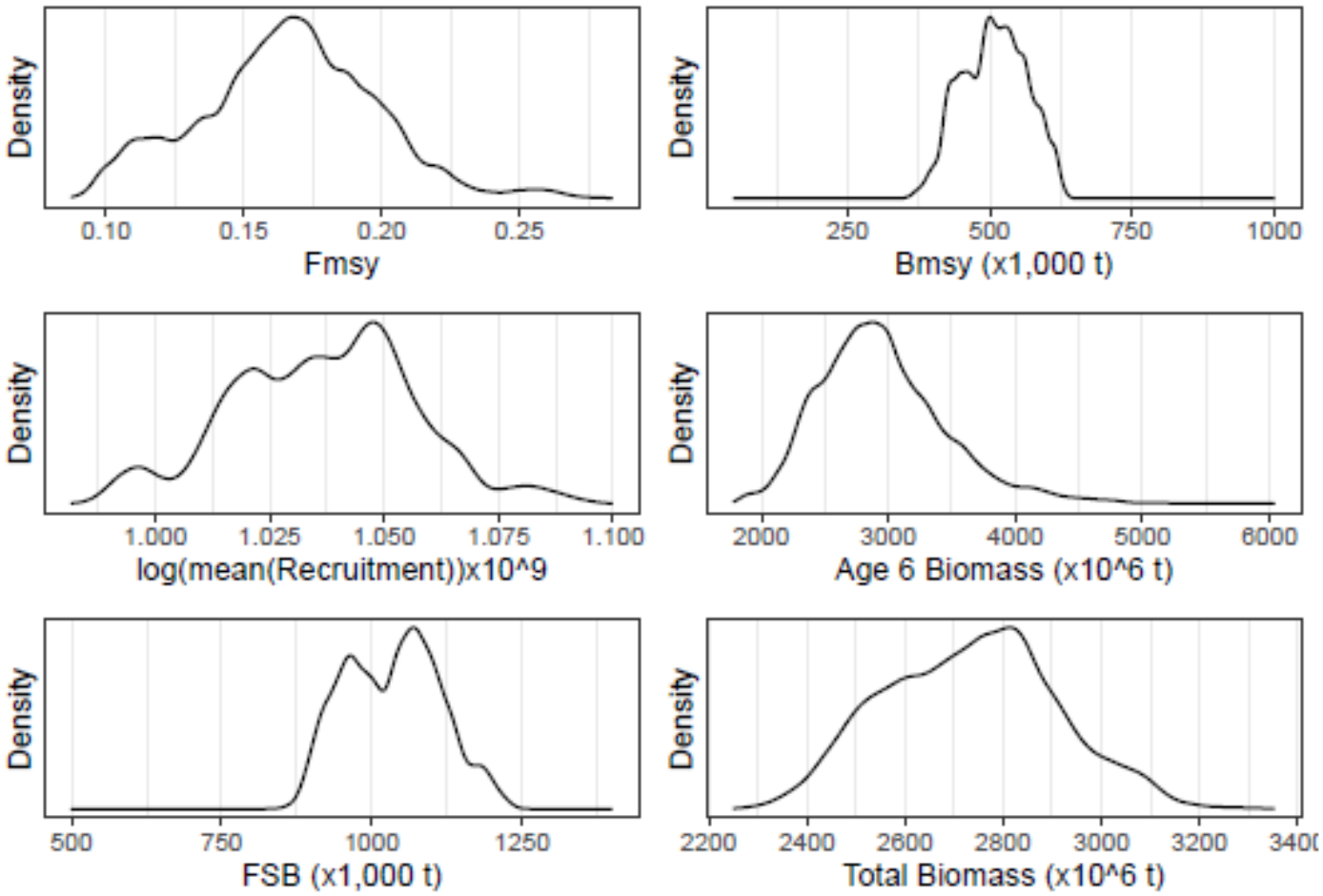

# Yellowfin sole, continued

- Survey catchability as estimated by Model 18.2 last year and this year
  - A function of temperature, survey start date, and interaction




# Yellowfin sole, continued

- MCMC posterior distributions (Model 18.2); biomasses are for 2021



# Yellowfin sole, continued

- The Team discussed whether the NBS and EBS portions of the population are truly separate
- The author indicated that no available evidence precludes connection
- Although the recent time series is short, there are trends in area-specific survey biomass estimates, with an increase in the NBS (as temperatures increased) and a corresponding decrease in the EBS
  - However, in 2021 there was a drop in NBS abundance but no corresponding increase in the EBS
- Survey distributions in the combined areas do not suggest separation
- Given the lack of evidence for or against the connection of the EBS and NBS portions of the population and the lack of NBS age composition data or weight at age data within Model 18.2b, the Team concurred with the author's choice of Model 18.2



# Yellowfin sole, continued

- Author's risk table:

| Year | Assess | PopDy | EnvEco | FishPerf |
|---|---|---|---|---|
| 2019 | 1 | 1 | 1 | 1 |
| 2020 | 1 | 1 | 1 | 1 |
| 2021 | 1 | 2 | 2 | 1 |

  - (Note that the minutes indicate an author score of 2 for assessment considerations, but the author revised her score after the meeting)
  - Population dynamics risk increased because the stock has been in a long-term decline and the 2021 survey estimate is the 3rd lowest
  - Environmental/ecosystem risk increased because of thermal exposure and fish condition in the NBS
- Author recommends a 24% reduction from the 2022 Tier 1a maxABC, based on an average of the Tier 1a and Tier 3a maxABCs, giving a 2022 ABC of 269,649 t

# Yellowfin sole, continued

- The majority of the Team agreed that ABC should be less than maxABC
- Two alternatives were proposed for reducing from the Tier 1a maxABC:
  1. Reduce all the way to the Tier 3a maxABC
  2. Author's recommended averaging of Tier 1a and Tier 3a maxABCs
- Arguments for Option 1: the Tier 3a maxABC is clearly defined, has a theoretical basis meant to address uncertainty in the SRR, and has previously been used in reductions for other Tier 1a stocks (EBS pollock)
- Arguments for Option 2: the magnitude of decrease (24%) is more in line with the risk levels than Option 1 (48% decrease), and was considered appropriate by the author; also, there is no requirement for consistency among stocks regarding methods used to reduce from maxABC
- After a Team vote resulted in a 6:6 tie between the two options, the Team agreed to defer to the recommendation of the author

# Yellowfin sole, continued

- The Team recommends that the connection between the NBS and EBS portions of the yellowfin sole population be investigated and that alternative models be developed for consideration next year using the combined EBS and NBS VAST estimates for biomass and VAST-derived age composition data
- The Team recommends that differences in length and weight at age for yellowfin sole between the two areas be investigated
- Possible impacts resulting from implementation of Amendment 80:
  - An incentive to reduce discards of smaller fish
  - Change in observer coverage may have impacted data collections
- The Team recommends the author investigate impacts of management changes since 2008 in the yellowfin sole fishery on fisheries data and subsequent impacts on estimates derived from these data, including mean length and age, length and weight at age, and selectivity



# Yellowfin sole, continued

| Quantity | Last asmt. | This asmt. | Change |
|---|---|---|---|
| M (male/female) | 0.12/0.135 | 0.12/0.135 | 0.0/0.0 |
| 2021 tier | 1a | n/a | none |
| 2022 tier | 1a | 1a | none |
| 2021 age+ biomass | 2,755,870 | n/a | -0.10 |
| 2022 age+ biomass | 3,025,430 | 2,479,370 | -0.18 |
| 2021 spawning biomass | 1,040,900 | n/a | -0.18 |
| 2022 spawning biomass | 996,044 | 857,101 | -0.14 |
| B0 | 1,528,700 | 1,489,190 | -0.03 |
| Bmsy | 559,704 | 495,904 | -0.11 |
| 2022 FOFL | 0.124 | 0.152 | 0.23 |
| 2022 FABC | 0.114 | 0.109 | -0.04 |
| 2021 OFL | 341,571 | n/a | 0.10 |
| 2022 OFL | 374,982 | 377,071 | 0.01 |
| 2021 ABC | 313,477 | n/a | -0.14 |
| 2022 ABC | 344,140 | 269,649 | -0.22 |

# Chapter 10: Alaska plaice

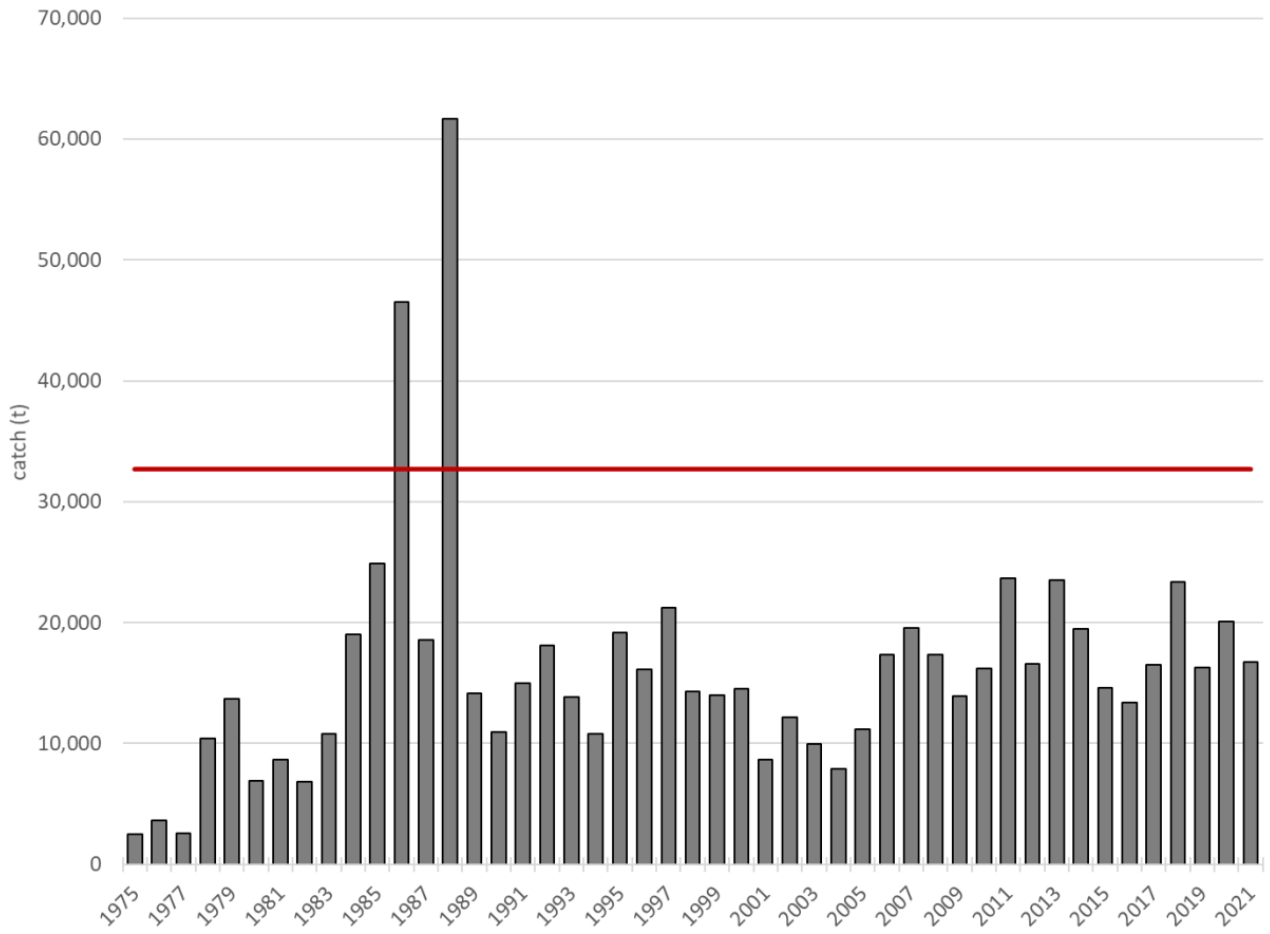
- New model(s): no; change from base: no; risk>1: no
- New data:
  - 2021 EBS survey biomass and sizecomp
  - 2019 EBS survey agecomp, 2019 and 2020 fishery sizecomps
- Model changes/alternatives: none (Model 11.1 is the base model)
- Stock status: projected 2022 spawning biomass = 49% of $B_{100\%}$
- Mohn's $\rho = -0.01$
- Author's risk table (no reduction from maxABC):

| Year | Assess | PopDy | EnvEco | FishPerf |
|---|---|---|---|---|
| 2019 | 1 | 1 | 1 | 1 |
| 2021 | 1 | 1 | 1 | 1 |

- The Team accepted the author's recommended model, risk levels, and harvest specifications

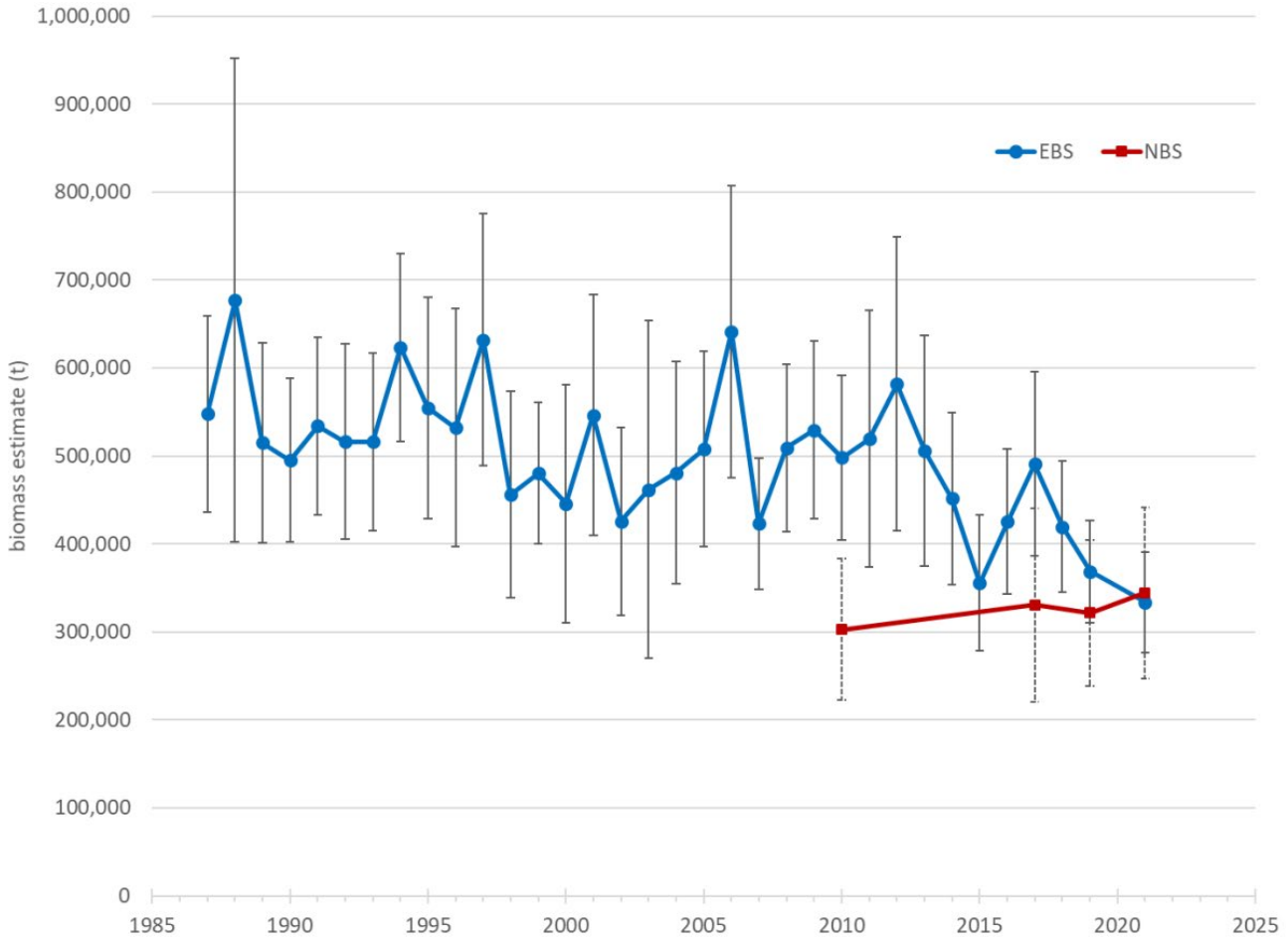
# Alaska plaice, continued

- Catch time series (red line is author's recommended 2022 ABC)



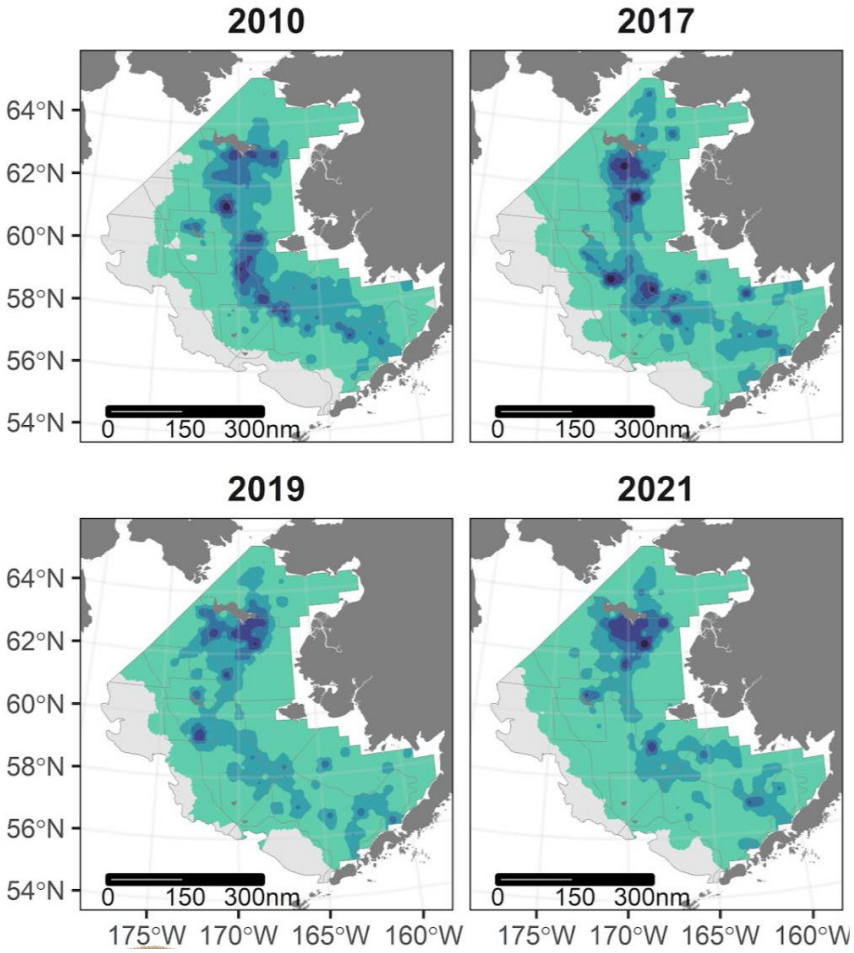

# Alaska plaice, continued

- EBS and NBS survey biomass time series (note NBS>EBS in 2021)



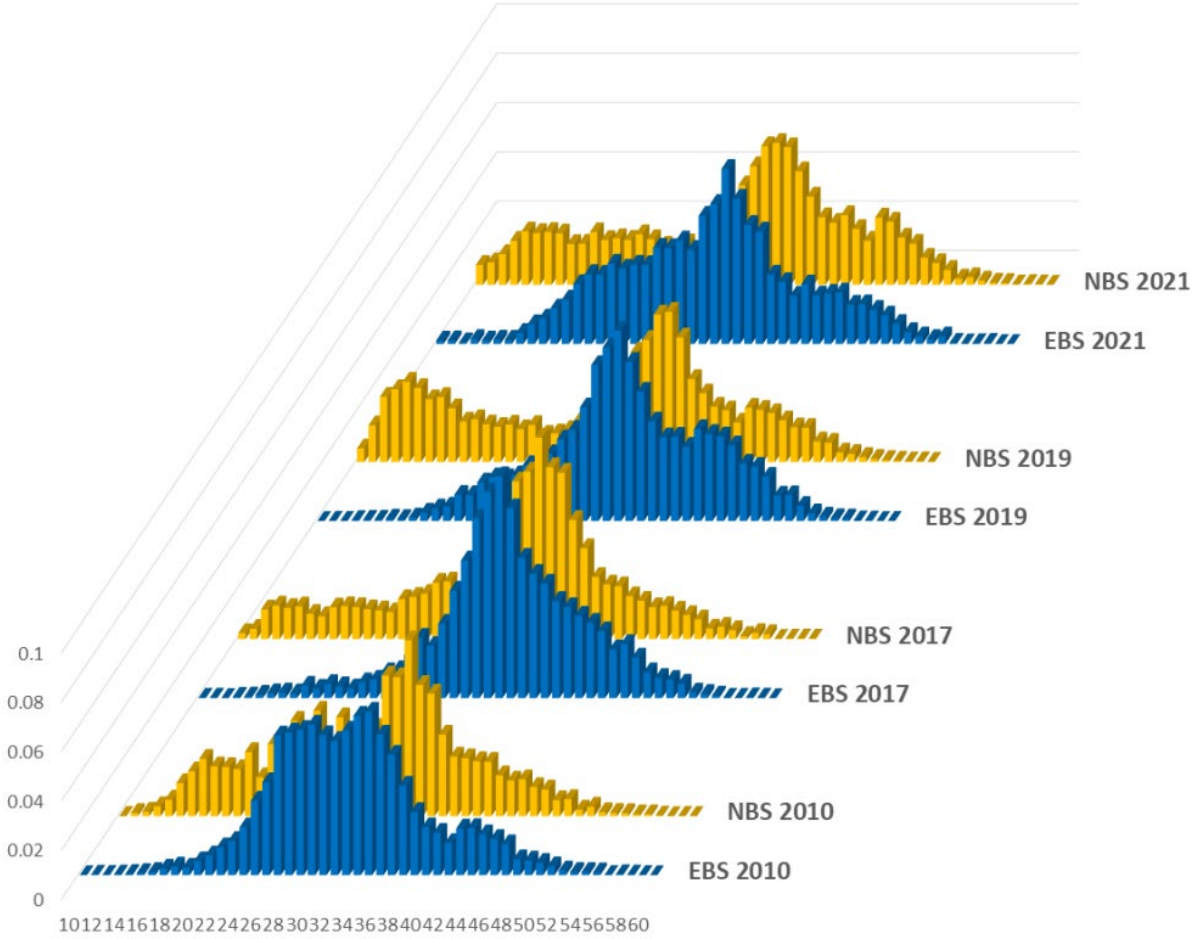

# Alaska plaice, continued

- Survey CPUE in recent NBS survey years



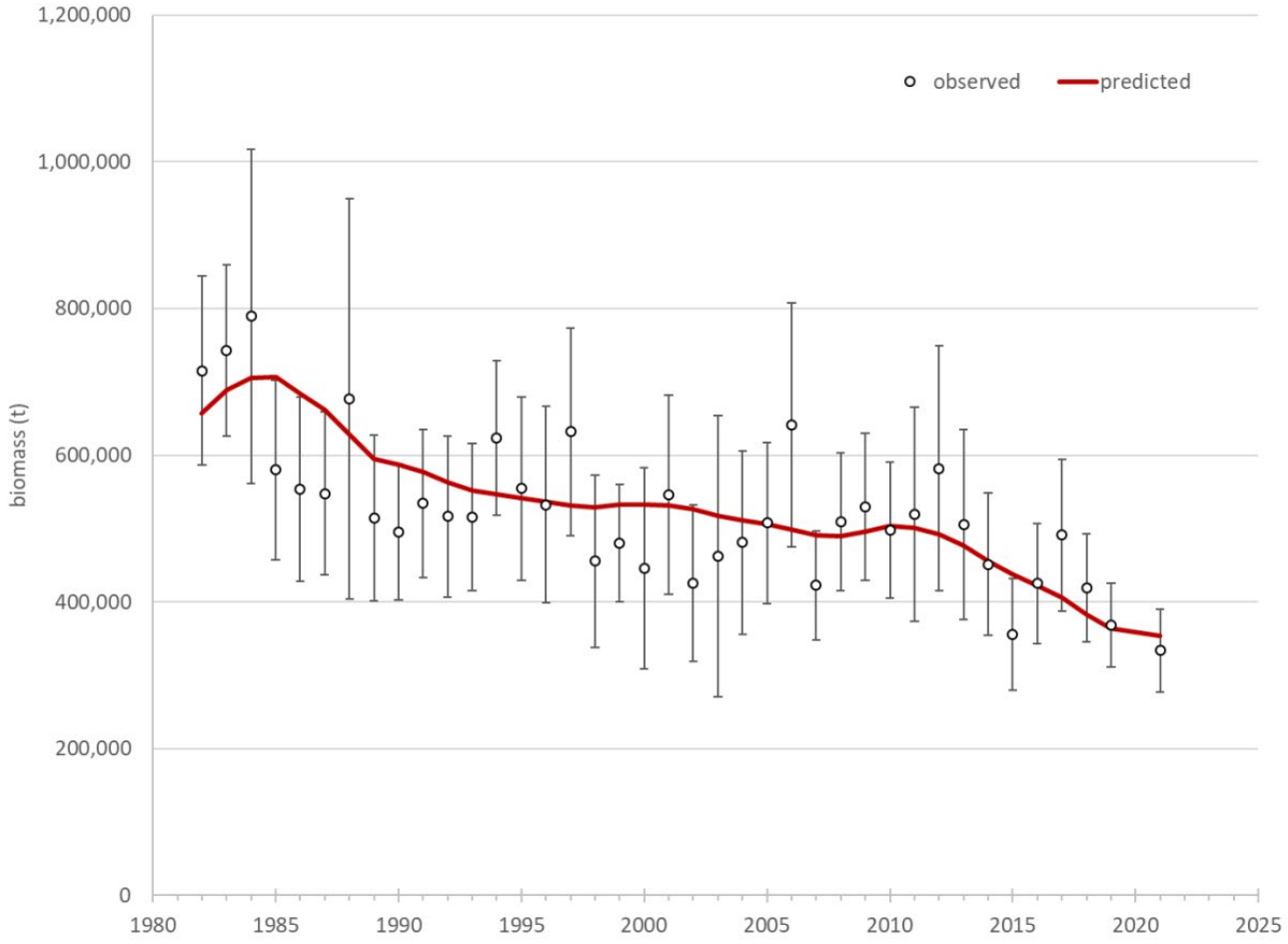

# Alaska plaice, continued

- Size compositions in recent NBS survey years



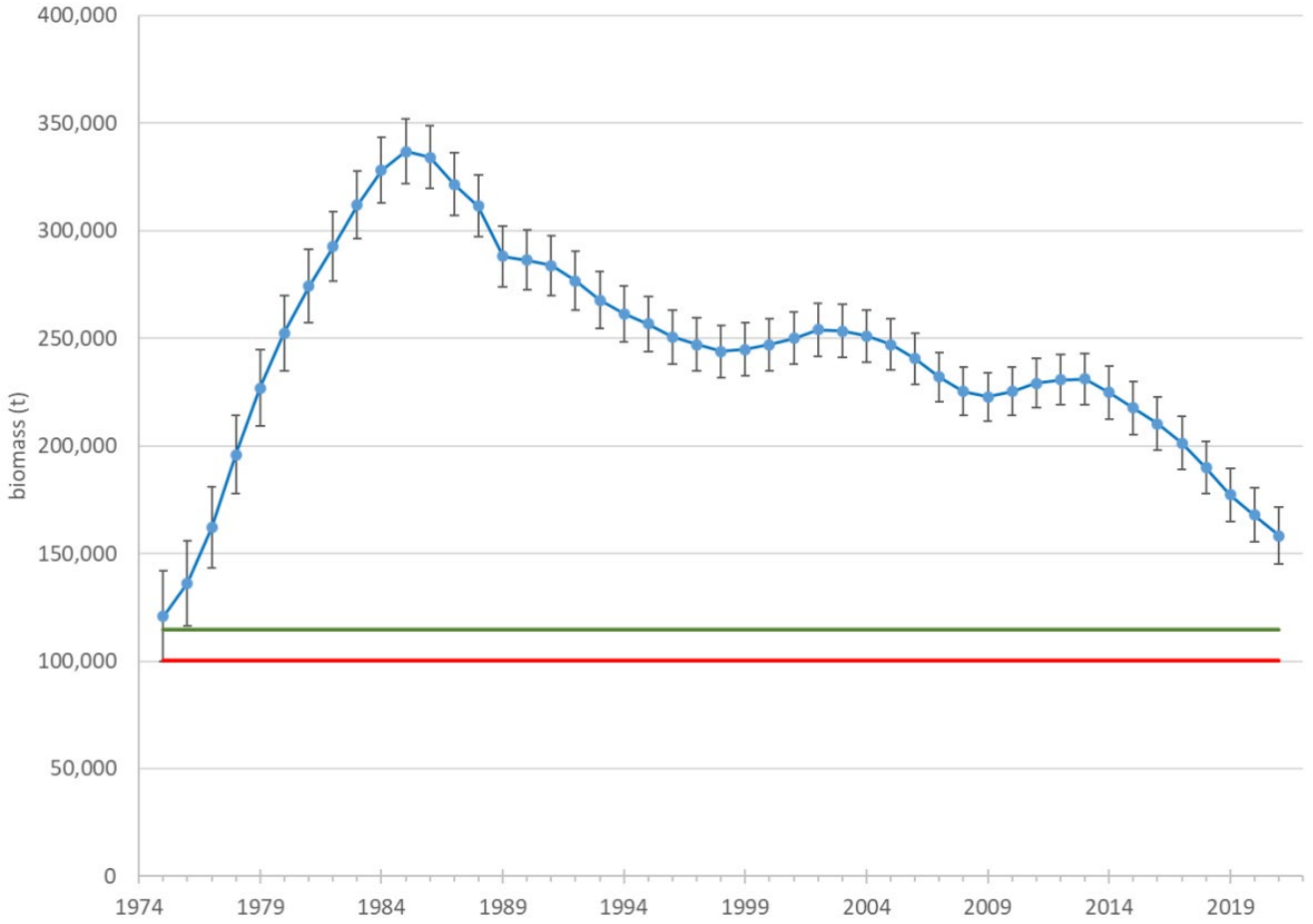

# Alaska plaice, continued

- Fit to EBS survey biomass



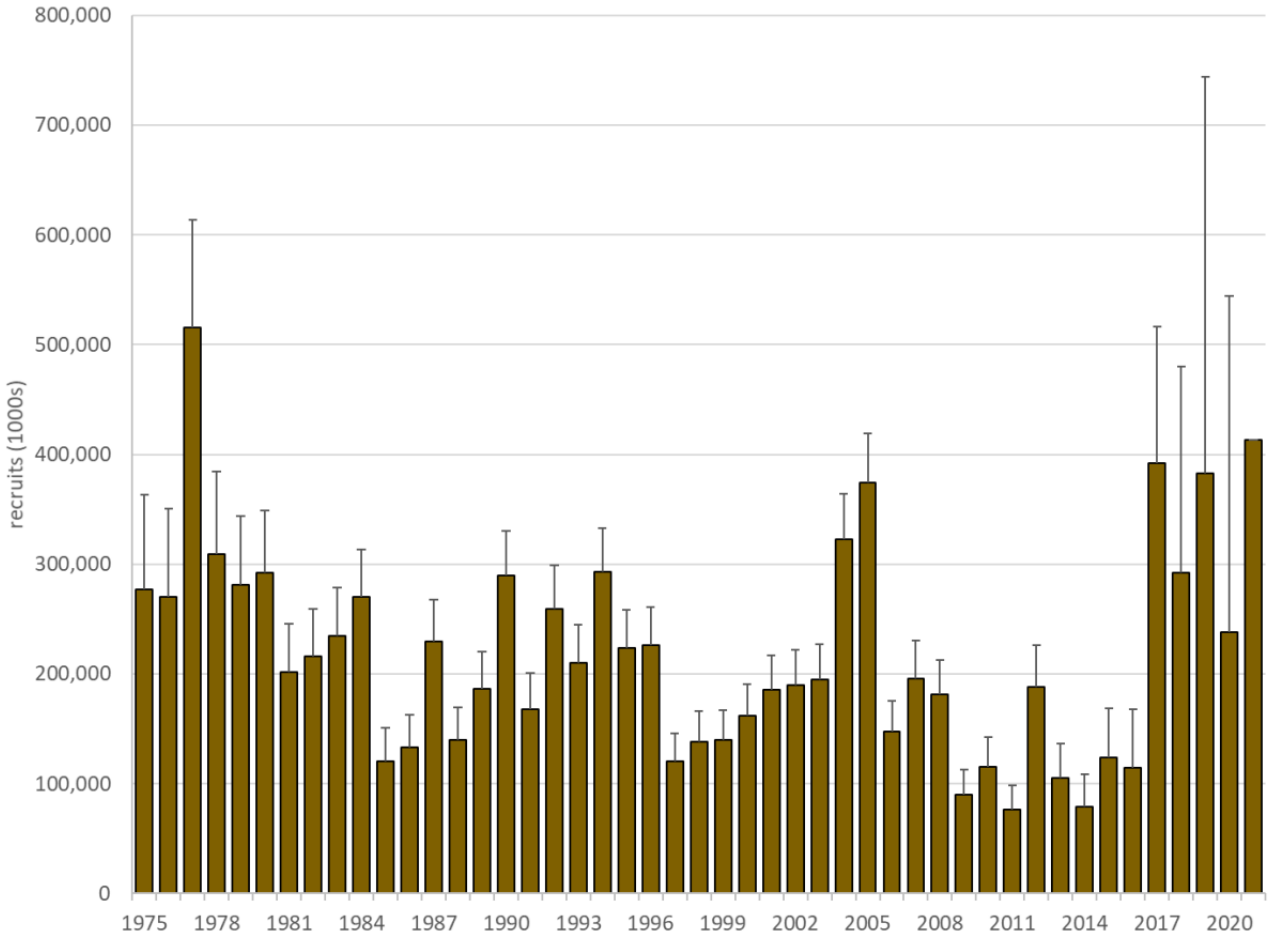

# Alaska plaice, continued

- Female spawning biomass (blue), $B_{40\%}$ (green), $B_{35\%}$ (red)



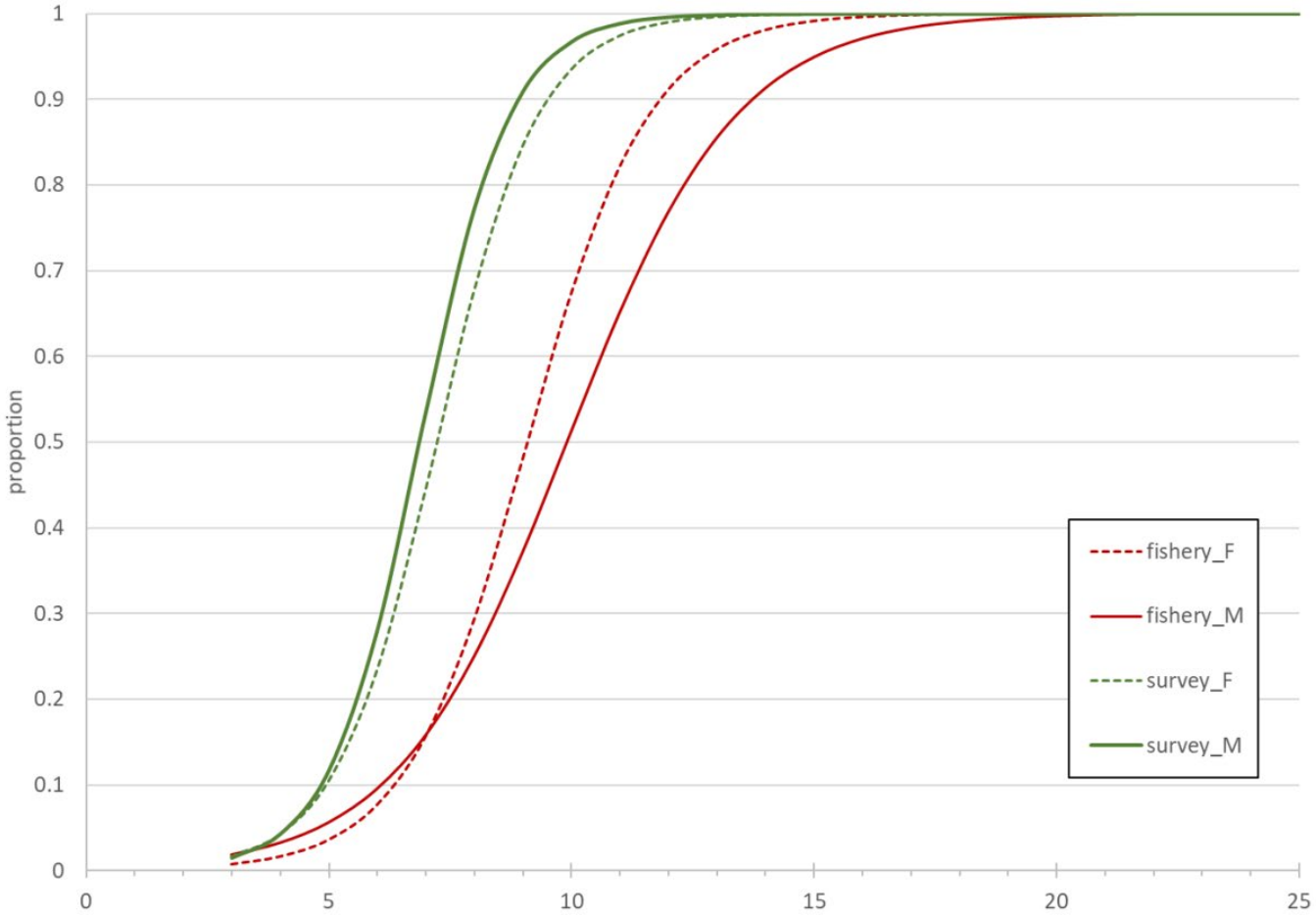

# Alaska plaice, continued

- Age 3 recruitment



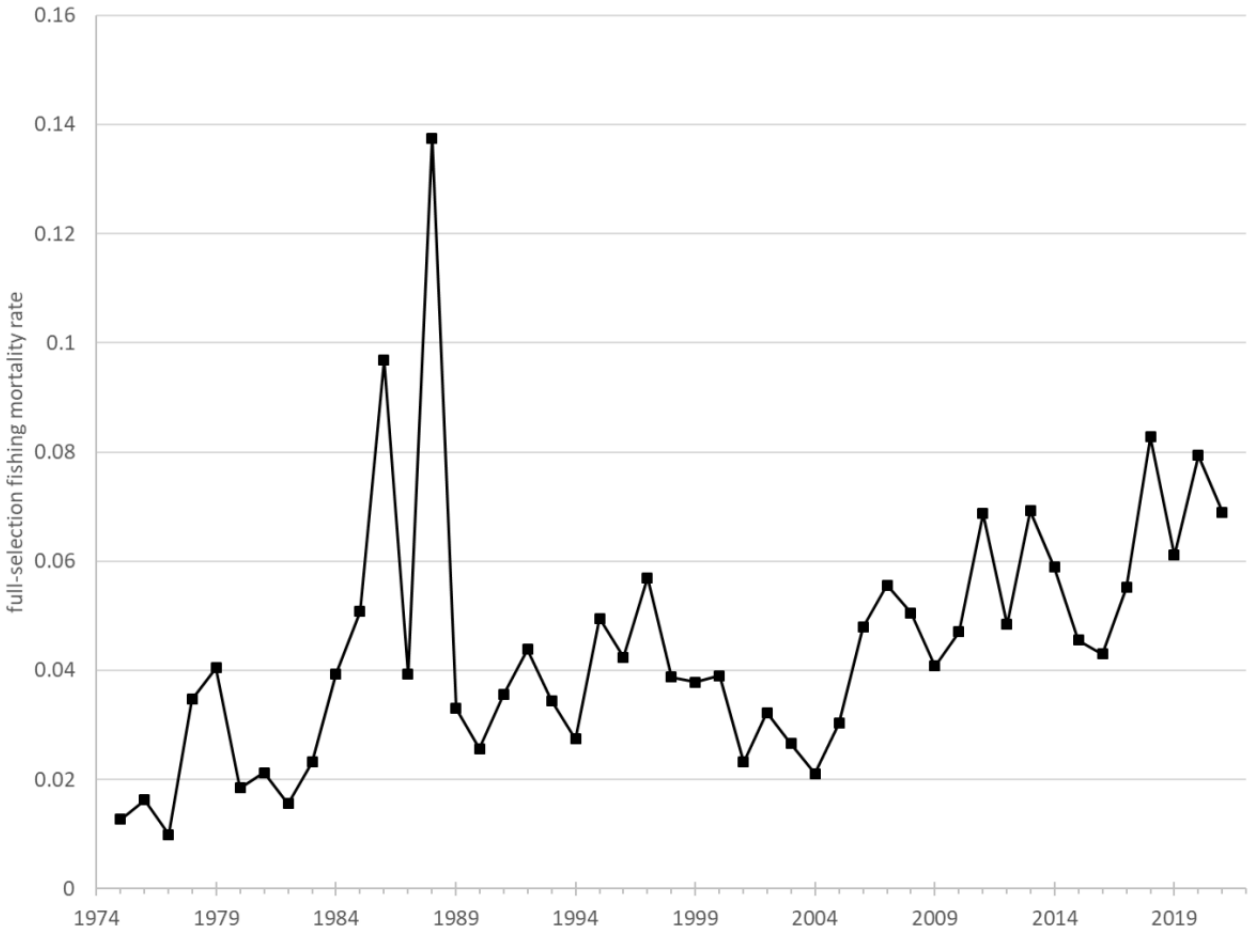

# Alaska plaice, continued

- Selectivity (fishery and survey; female and male)



# Alaska plaice, continued

- Full-selection fishing mortality




# Alaska plaice, continued

- The Team discussed the carrying capacity of the NBS, the presence of small Alaska plaice in the NBS, and the population decline in the EBS, apparently due to warming temperatures
- Author noted that the distribution appears to be continuous throughout the Bering Sea and that the increases in the NBS are not surprising given that Alaska plaice are a cold adapted species
- The Team asked about potential for a future model to include the NBS
- Author responded that the survey results suggest including the NBS, but he could also understand the rationale not to include the NBS in previous models, as there is no fishing in the NBS
- The Team recommends that authors explore the relationship of the southern part of the stock in the EBS to the northern part of the stock in the NBS and consider developing models that include the NBS data

# Alaska plaice, continued

| Quantity | Last asmt. | This asmt. | Change |
|---|---|---|---|
| M | 0.13 | 0.13 | 0.00 |
| 2021 tier | 3a | n/a | none |
| 2022 tier | 3a | 3a | none |
| 2021 age+ biomass | 427,587 | n/a | 0.04 |
| 2022 age+ biomass | 430,164 | 442,946 | 0.03 |
| 2021 spawning biomass | 166,528 | n/a | -0.15 |
| 2022 spawning biomass | 160,150 | 141,838 | -0.11 |
| B100% | 335,172 | 286,587 | -0.14 |
| B40% | 134,069 | 114,635 | -0.14 |
| B35% | 117,310 | 100,306 | -0.14 |
| 2022 FOFL | 0.160 | 0.170 | 0.06 |
| 2022 FABC | 0.132 | 0.140 | 0.06 |
| 2021 OFL | 37,924 | n/a | 0.04 |
| 2022 OFL | 36,928 | 39,305 | 0.06 |
| 2021 ABC | 31,657 | n/a | 0.03 |
| 2022 ABC | 30,815 | 32,697 | 0.06 |

# Chapter 2A: AI Pacific cod

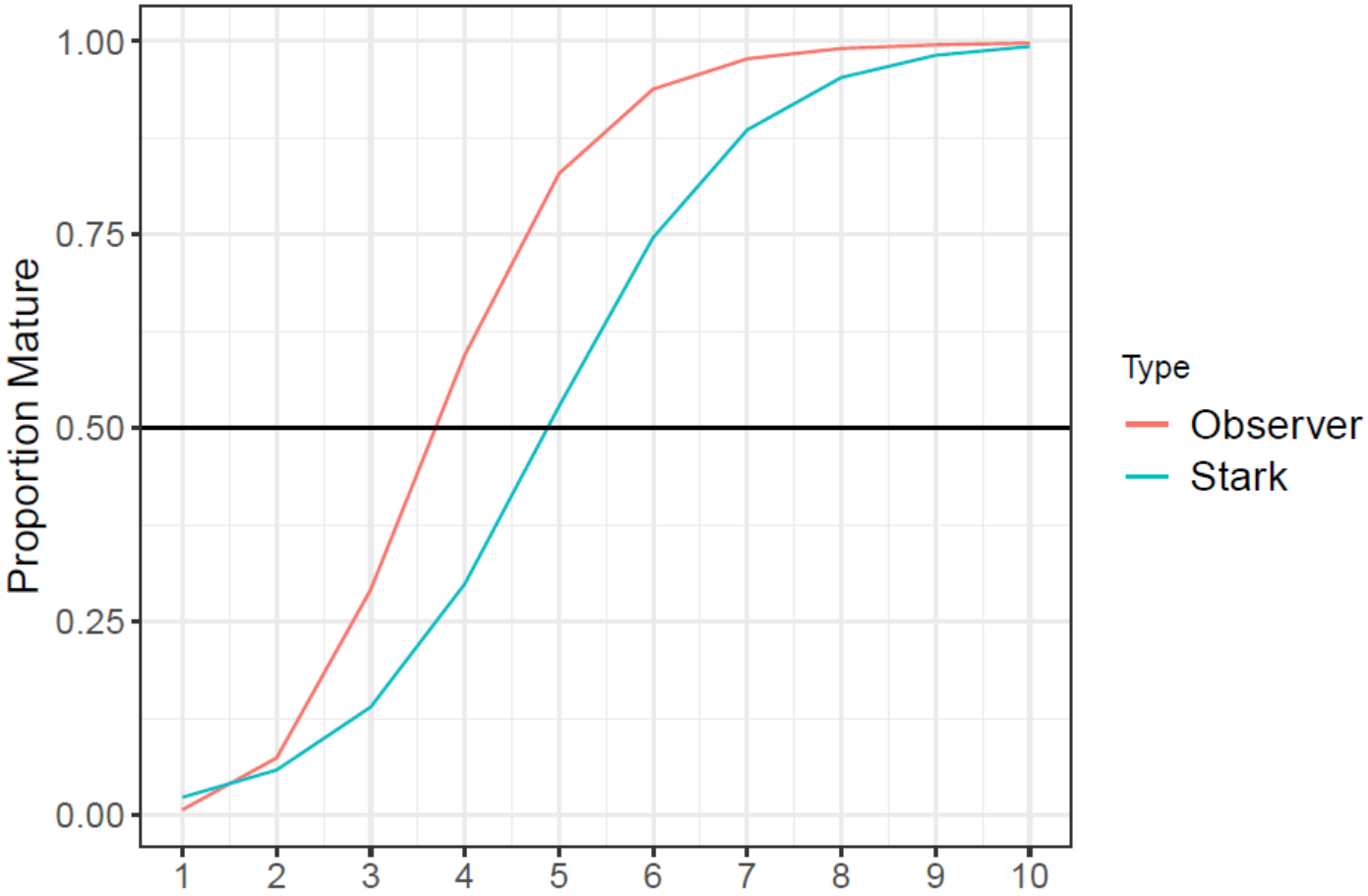
- >1 model: yes; change from base: yes (author), no (Team); risk>1: yes
- New data: none (Tier 5), fishery sizecomps for 2019-2021 (Tier 3)
- Model changes/alternatives:
  - Model 13.4: Tier 5 random effects model (base)
    - Team's preferred model
  - Model 19.0: author's baseline model
    - $M=0.34$, maturity schedule based on observer data
    - Author's preferred model at time of Team presentation
  - Model 19.0a: same as 19.0, except with Stark (2007) maturity
  - Model 19.0b: same as 19.0, except with $M=0.40$
    - Author's current preferred model
  - (Models 19.0, 19.0a, and 19.0b were presented in 2019 and this year in Sept., but numbering of 19.0a and 19.0b has switched since Sept.)

# AI Pacific cod, continued

- Features of Model 19.0:
  - One fishery, one gear type, one season per year
  - Single sex model, 1:1 male female ratio
  - Logistic, age-based selectivity for both the fishery and survey
  - External estimation of length at age and weight at age
  - Ageing error matrix for ages 1 through 10+
  - All parameters constant except recruitment and fishing mortality
  - Internal estimation of fishing mortality, catchability, and selectivity
  - Recruitment estimated as a mean with lognormal deviations
  - Maturity at age estimated externally from observer data
  - Natural mortality fixed at 0.34 for consistency with past assessments

# AI Pacific cod, continued

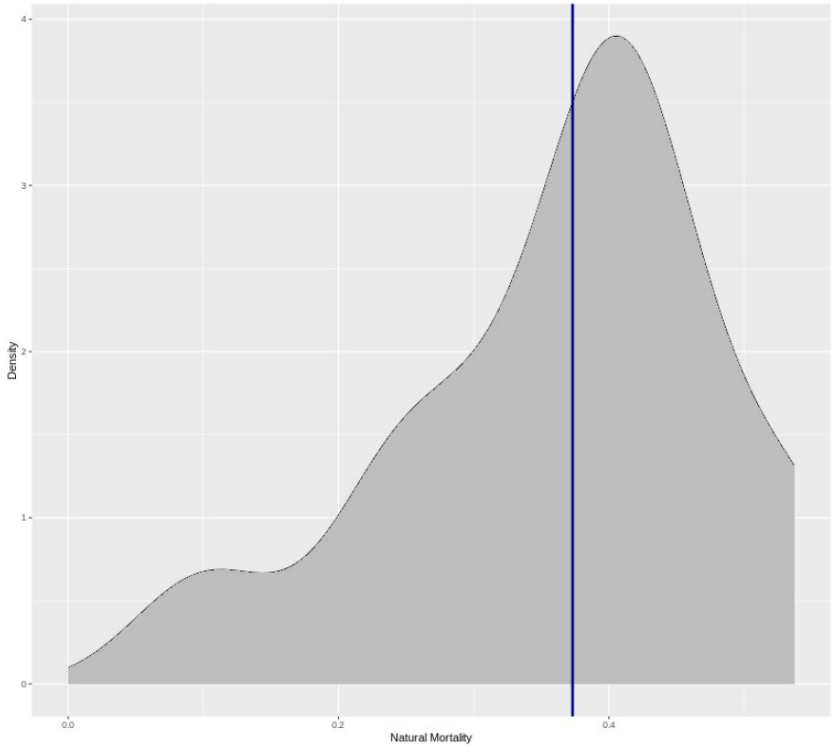
- Alternative maturity schedules



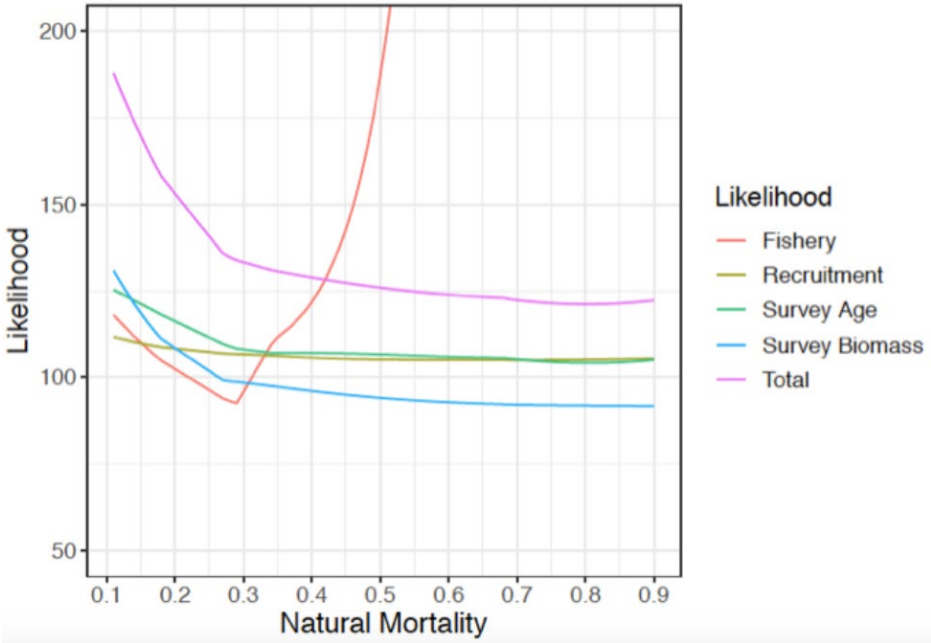
# AI Pacific cod, continued

- Alternative natural mortality rates

## "Barefoot ecologist" PDF




## Likelihood profile (Model 19.0)



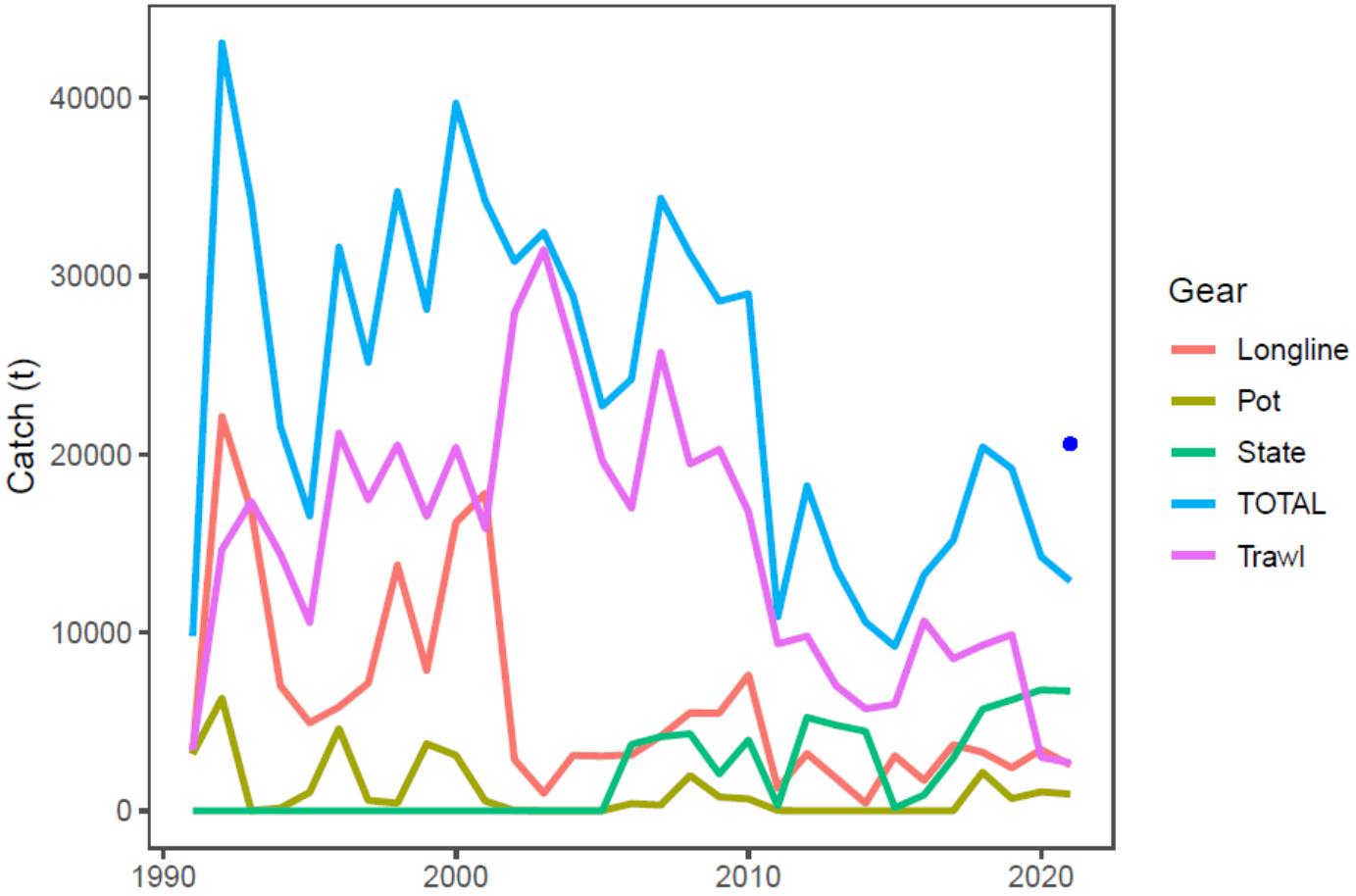
# AI Pacific cod, continued

- Author recommends Model 19.0b, because:
  - Lower Mohn's $\rho$ (0.154 versus for 0.225 for Models 19.0 and 19.0a)
  - Lower negative log likelihood

| | Model 19.0 | Model 19.0a | Model 19.0b |
|---|---|---|---|
| Likelihood Component | Base Model | Stark (2007) maturity | M=0.40 |
| Recruitment | 5.91 | 5.91 | 5.424 |
| Survey age | 56.055 | 56.055 | 56.228 |
| Survey biomass | 16.309 | 16.309 | 13.932 |
| Catch | 0.002 | 0.002 | 0.001 |
| Fishery length | 47.231 | 47.231 | 46.768 |
| Total | 125.507 | 125.507 | 122.354 |

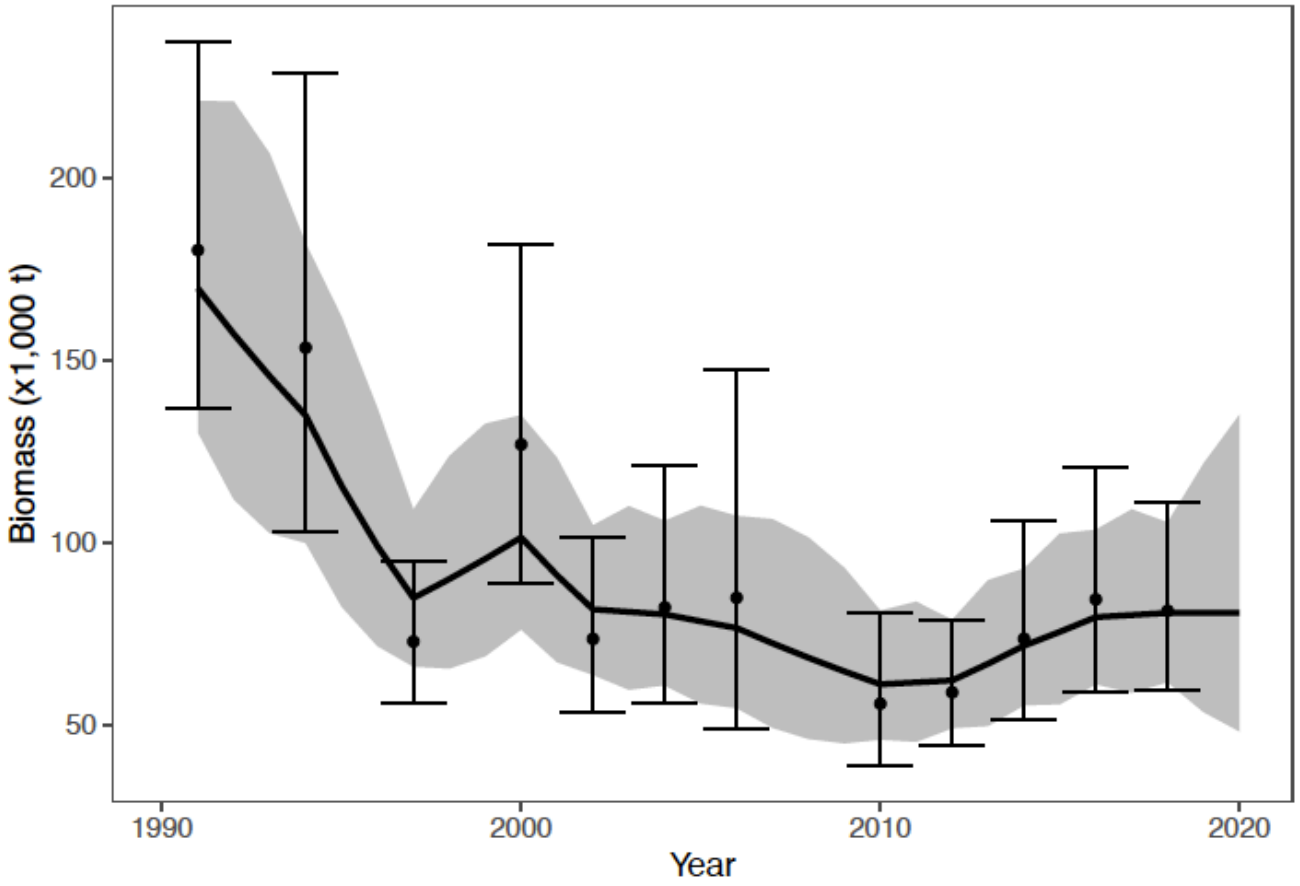
# AI Pacific cod, continued

- Catch time series



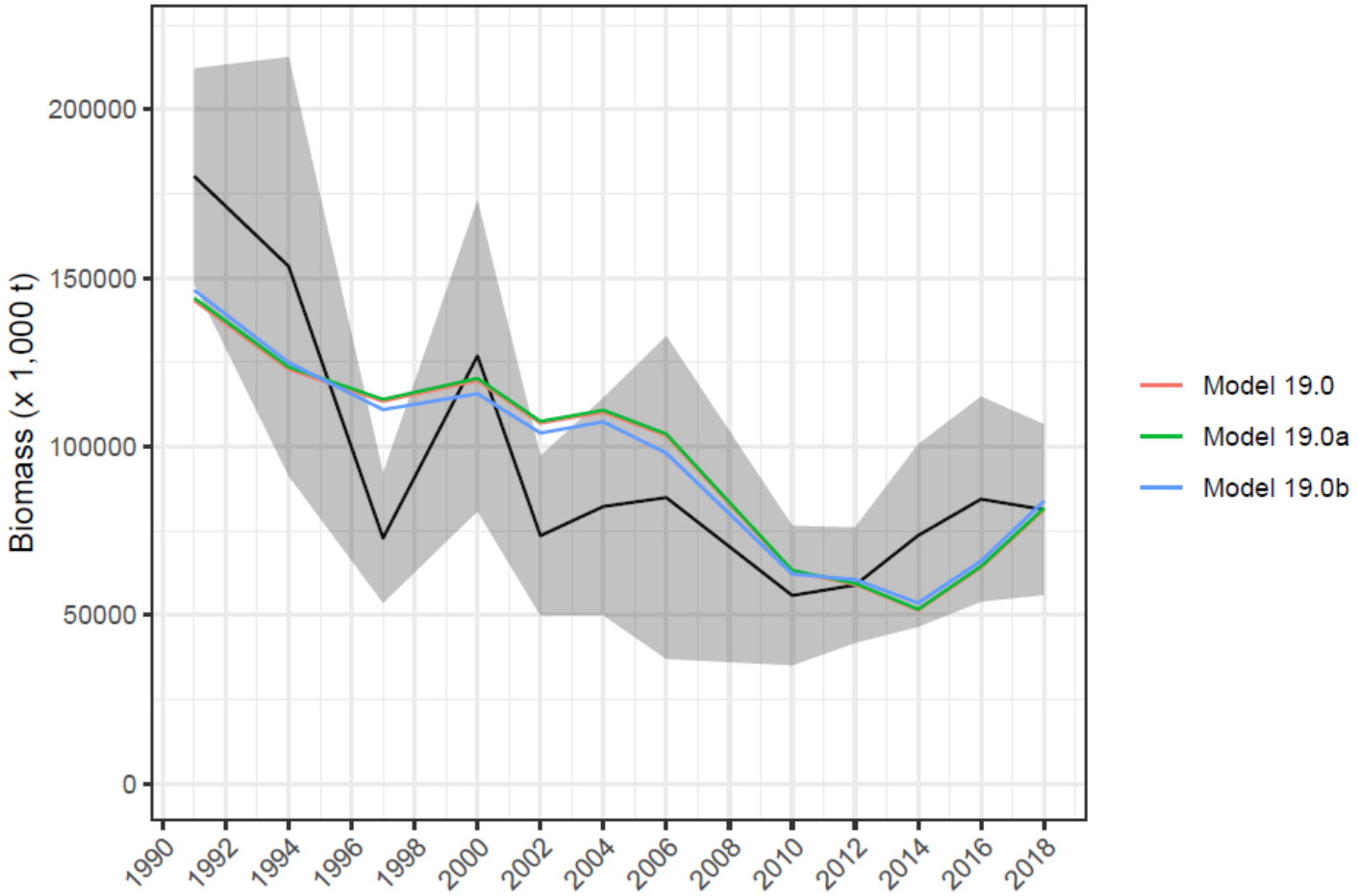
# AI Pacific cod, continued

- Fit to survey biomass data (Tier 5 random effects model)



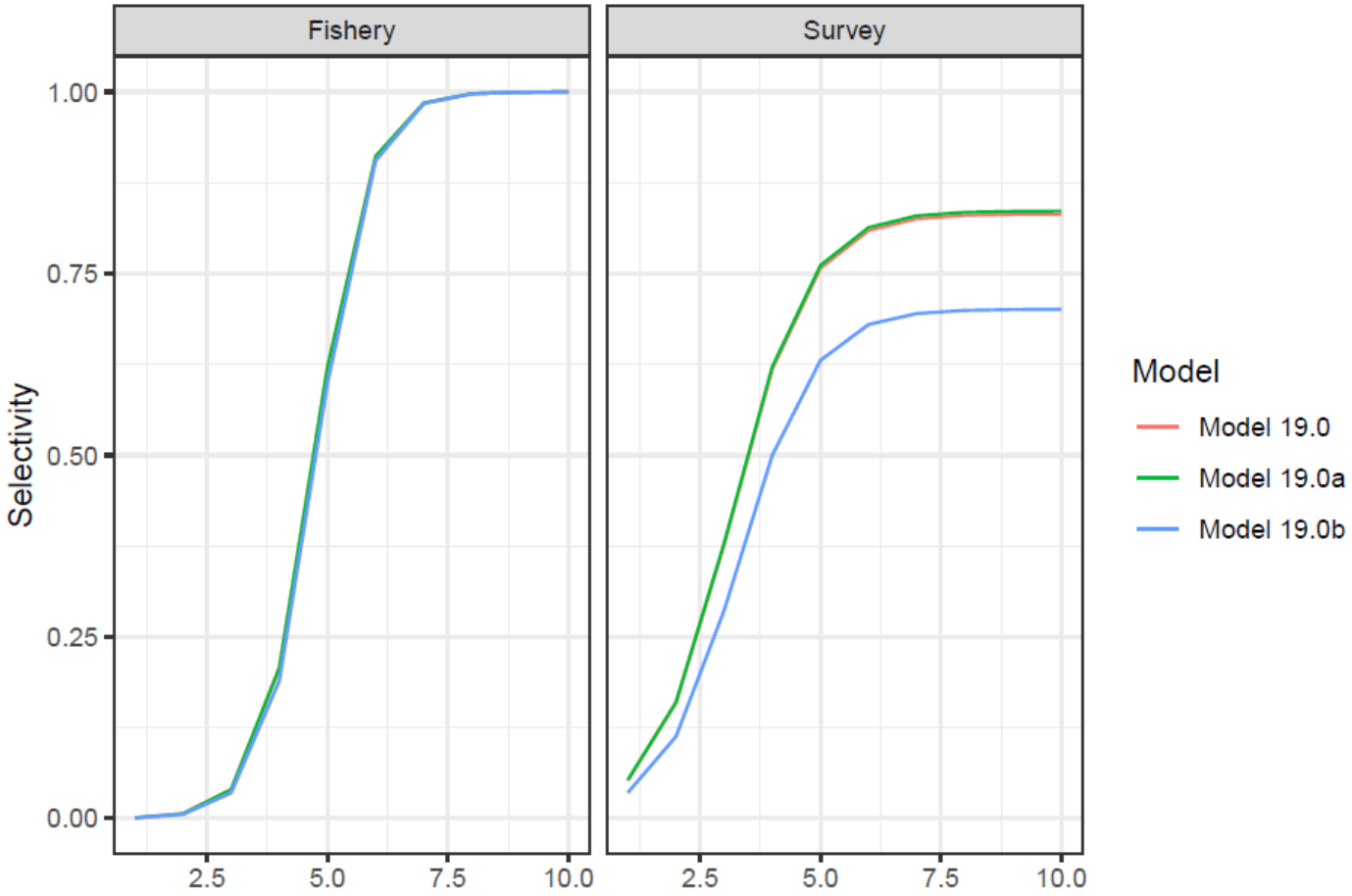
# AI Pacific cod, continued

- Fits to survey biomass data (age-structured models)



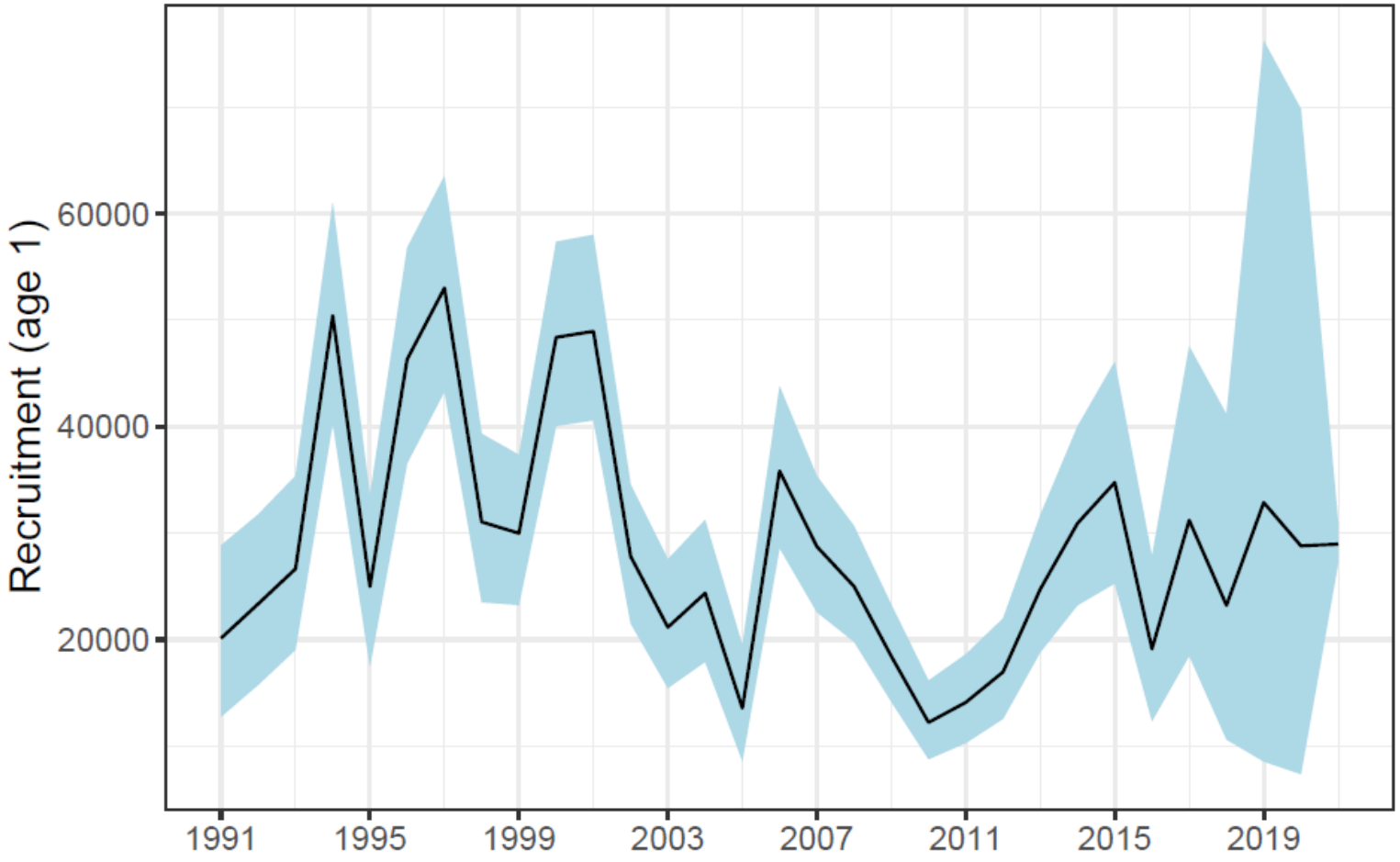

# AI Pacific cod, continued

- Product of selectivity and catchability (age-structured models)



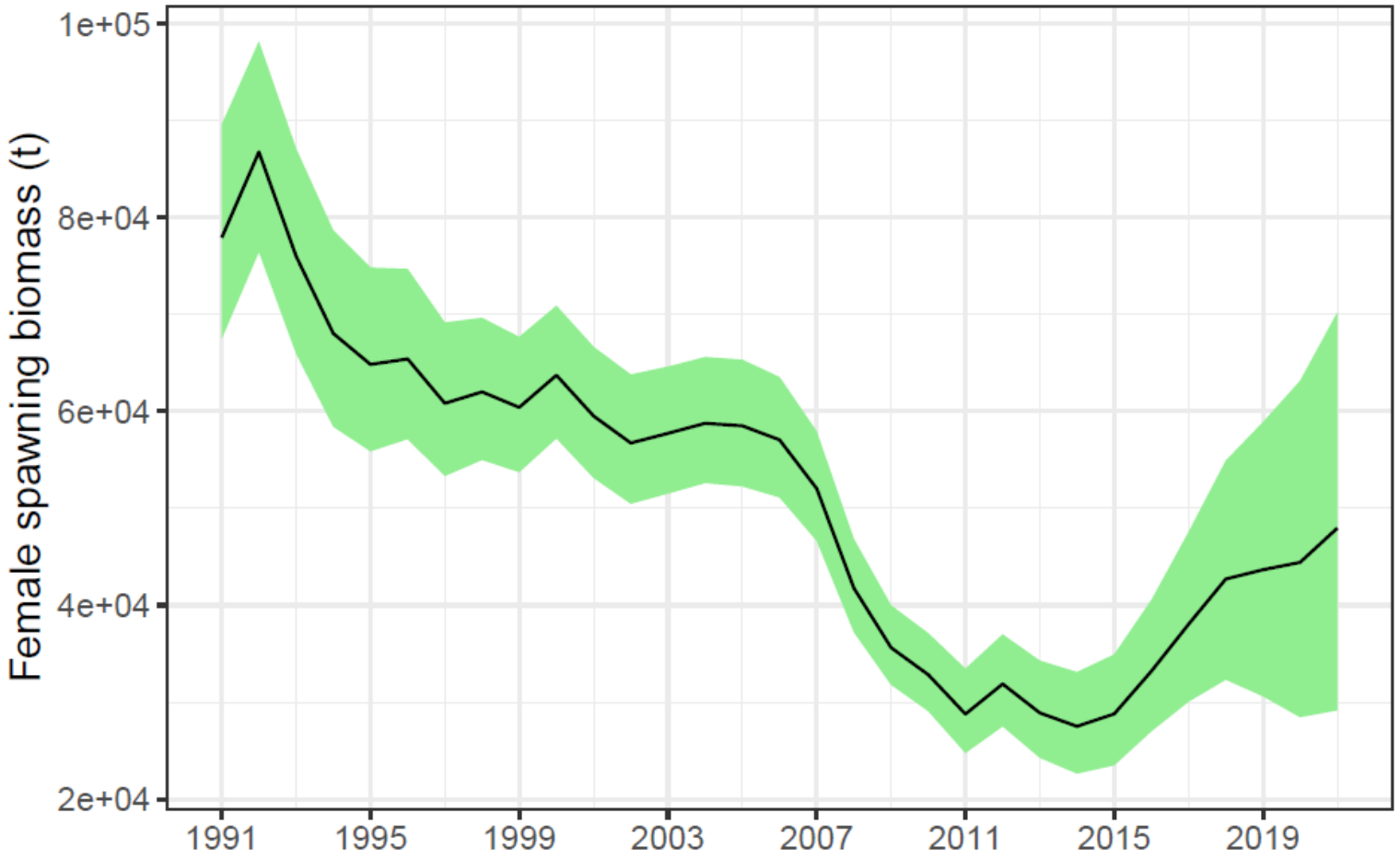
# AI Pacific cod, continued

- Estimated age 1 recruitment (Model 19.0b)



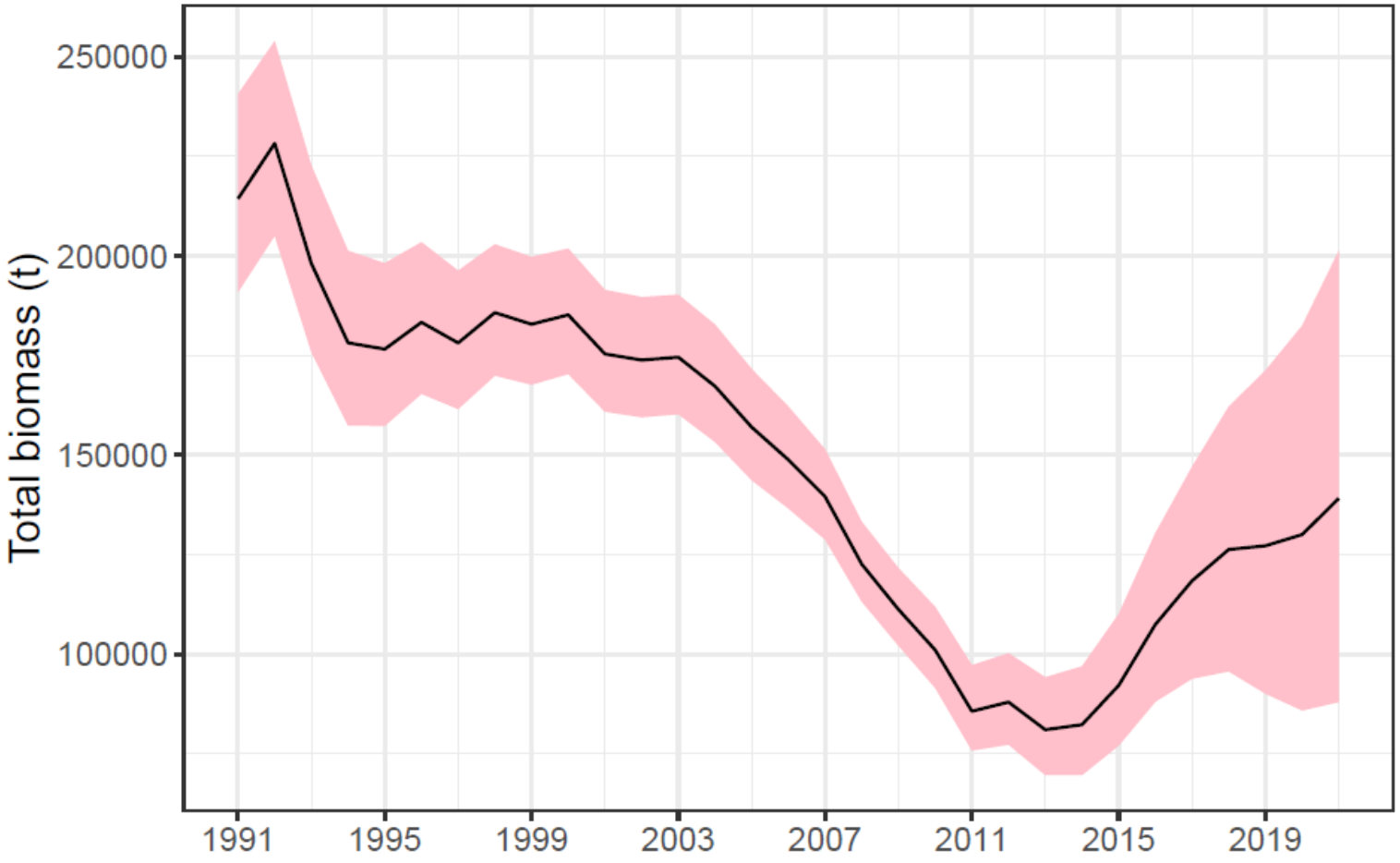

# AI Pacific cod

- Estimated female spawning biomass (Model 19.0b)




# AI Pacific cod, continued

- Total biomass (Model 19.0b)




# AI Pacific cod, continued

- Stock trend:
  - Tier 5 RE model:
    - Survey biomass has increased continuously since the all-time low observed in 2010, but is still 11% below average
  - Model 19.0b:
    - Age 1+ biomass reached a minimum of 107,329 t in 2014 and has since increased steadily to 172,761 t in 2021
    - 2022 spawning biomass is projected to be 59% of $B_{100\%}$

# AI Pacific cod, continued

- Author's risk table:

| Year | Assess | PopDy | EnvEco | FishPerf |
|---|---|---|---|---|
| 2019 | 1 | 1 | 2 | 1 |
| 2020 | 1 | 1 | 2 | 1 |
| 2021 | 2 | 1 | 2 | 1 |

  - Assessment risk increased because of the lack of recent survey data and the fact that the age-structured models are fairly new
  - (Note that the minutes indicate an author score of 2 for fishery performance, but the author revised her score after the meeting)
- 2022 Tier 3a OFL = 51,913 (up 89%), maxABC = 42,402 (up 106%)
- Author suggests a 51% reduction from the 2022 Tier 3a maxABC, giving an ABC equal to maxABC from the Tier 5 RE model (20,600 t)

# AI Pacific cod, continued

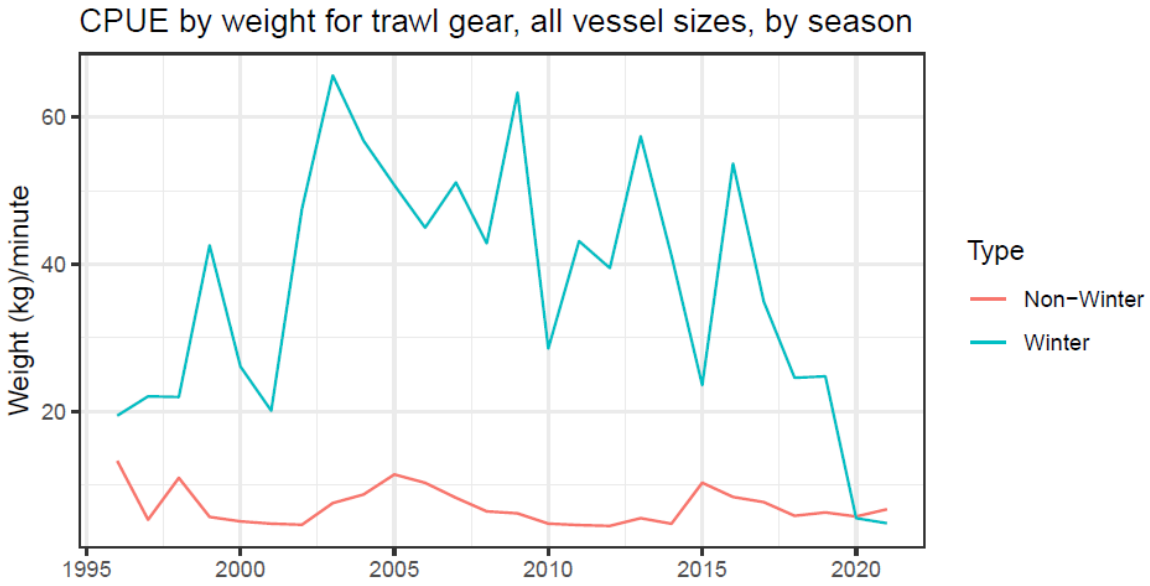
- Instead, the Team recommends retaining the Tier 5 RE model to specify the 2022 and 2023 OFL and maxABC
  - The Team recognizes that using Tier 5 with 2018 survey results is outdated, especially when the age-structured models predict an increasing trend in biomass
  - However, the Tier 3 projections would be similarly limited by outdated survey data, with the only recent data included in the models being fishery sizecomps; also, the age-structured models tend to overestimate spawning biomass in the terminal year
  - The Team was uncertain whether the age-structured models, without new survey data, were an improvement over Tier 5
  - The Team encourages the author to conduct sensitivity analyses after the 2022 survey data are included

# AI Pacific cod, continued

- The Team does not recommend a reduction from the maxABC
  - The risk levels suggested by the author were based on the Tier 3 model recommended in the assessment
  - The Team felt that using the Tier 5 model for OFL and maxABC addressed one of the reasons the Assessment Considerations were listed as Level 2
  - Therefore, using Tier 5 warranted a change from Level 2 to Level 1 for Assessment Considerations, and no reduction from maxABC
  - In summary, rather than moving to a new model and then using the risk table to justify using the ABC from the base model, the Team felt it was more straightforward simply to retain the base model for now

# AI Pacific cod, continued

- The Team commended the author for addressing Team and SSC recommendations and noted that data weighting remains to be explored
- Fishery CPUE indices revealed mixed results with a decrease in trawl winter CPUE, but no such decline in other fishery or season CPUE




- Author noted that the fishery CPUE trends were likely unreliable

# AI Pacific cod, continued

- The Team recommends further examination of fishery CPUE, beginning with methods to control for changes in the fisheries and management. Joining current efforts looking at CPUE analyses of other Pacific cod stocks may be beneficial.
- The Team recommends further exploration of age-structured models given that there is likely to be an Aleutian Islands trawl survey in 2022
- The Team also recommends that authors investigate other sources of fishery-independent data for application in Tier 5, or to fit these within age-structured models. This effort might begin with a re-examination of previous explorations involving use of the AFSC and IPHC longline survey indices (viz., the 2016 CIE review and Models 16.2, 16.3, and 16.4 from the 2016 assessment)

# AI Pacific cod, continued

**2a. AI Pacific cod (Team)**

| Quantity | Last asmt. | This asmt. | Change |
|---|---|---|---|
| M | 0.34 | 0.34 | 0.00 |
| 2021 tier | 5 | n/a | none |
| 2022 tier | 5 | 5 | none |
| Biomass | 80,700 | 80,700 | 0.00 |
| 2022 FOFL | 0.34 | 0.34 | 0.00 |
| 2022 FABC | 0.255 | 0.255 | 0.00 |
| 2021 OFL | 27,400 | n/a | 0.00 |
| 2022 OFL | 27,400 | 27,400 | 0.00 |
| 2021 ABC | 20,600 | n/a | 0.00 |
| 2022 ABC | 20,600 | 20,600 | 0.00 |

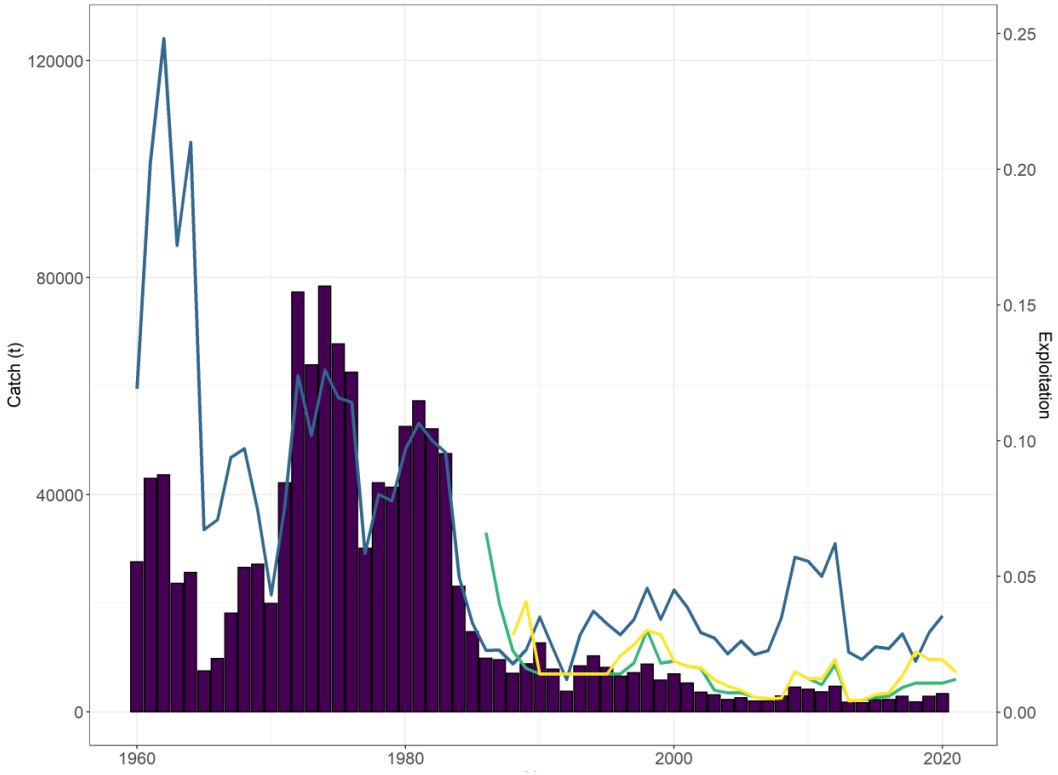
# AI Pacific cod, continued

**2a. AI Pacific cod (author)**

| Quantity | Last asmt. | This asmt. | Change |
|---|---|---|---|
| M | 0.34 | 0.40 | 0.18 |
| 2021 tier | 5 | n/a | none |
| 2022 tier | 5 | 3a | ↑ |
| 2021 age+ biomass | 80,700 | n/a | 1.22 |
| 2022 age+ biomass | 80,700 | 179,370 | 1.22 |
| 2021 spawning biomass | n/a | n/a | n/a |
| 2022 spawning biomass | n/a | 59,722 | n/a |
| B100% | n/a | 100,508 | n/a |
| B40% | n/a | 40,203 | n/a |
| B35% | n/a | 35,177 | n/a |
| 2022 FOFL | 0.34 | 0.892 | 1.62 |
| 2022 FABC | 0.26 | 0.287 | 0.13 |
| 2021 OFL | 27,400 | n/a | 0.89 |
| 2022 OFL | 27,400 | 51,913 | 0.89 |
| 2021 ABC | 20,600 | n/a | 0.00 |
| 2022 ABC | 20,600 | 20,600 | 0.00 |

# Chapter 5: Greenland turbot (partial)

- New model(s): no; change from base: no; risk>1: n/a
- Stock status: projected 2022 spawning biomass = 57% of $B_{100\%}$
- Catch (bars), catch/biomass (blue), ABC (yellow), TAC (green):

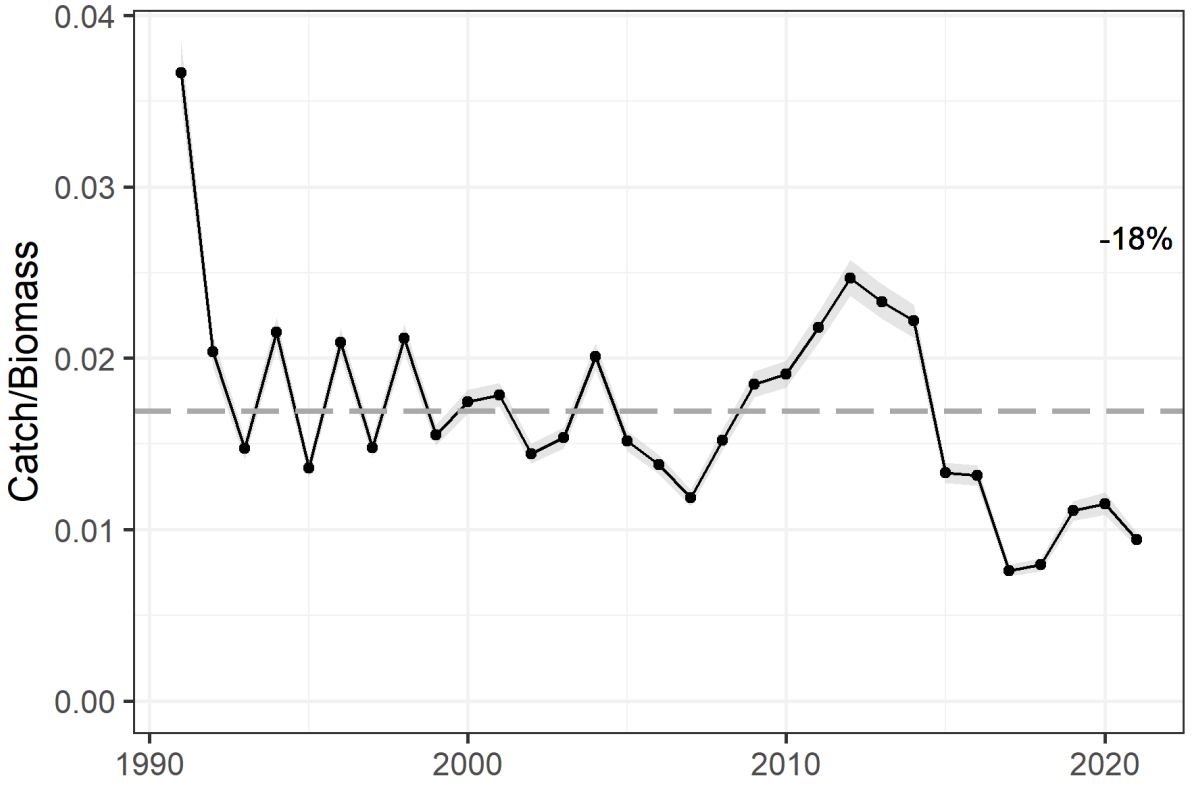



# Greenland turbot, continued

| Quantity | Last asmt. | This asmt. | Change |
|---|---|---|---|
| M | 0.112 | 0.112 | 0.00 |
| 2021 tier | 3a | n/a | none |
| 2022 tier | 3a | 3a | none |
| 2021 age+ biomass | 87,849 | n/a | -0.04 |
| 2022 age+ biomass | 79,382 | 84,341 | 0.06 |
| 2021 spawning biomass | 51,914 | n/a | -0.03 |
| 2022 spawning biomass | 47,197 | 50,361 | 0.07 |
| B100% | 89,054 | 89,054 | 0.00 |
| B40% | 35,622 | 35,622 | 0.00 |
| B35% | 31,169 | 31,169 | 0.00 |
| 2022 FOFL | 0.22 | 0.22 | 0.00 |
| 2022 FABC | 0.18 | 0.18 | 0.00 |
| 2021 OFL | 8,568 | n/a | -0.10 |
| 2022 OFL | 7,181 | 7,687 | 0.07 |
| 2021 ABC | 7,326 | n/a | -0.10 |
| 2022 ABC | 6,139 | 6,572 | 0.07 |

# Chapter 6: arrowtooth flounder (partial)

- New model(s): no; change from base: no; risk>1: n/a
- Stock status: projected 2022 spawning biomass = 91% of $B_{100\%}$
- Catch/biomass time series:



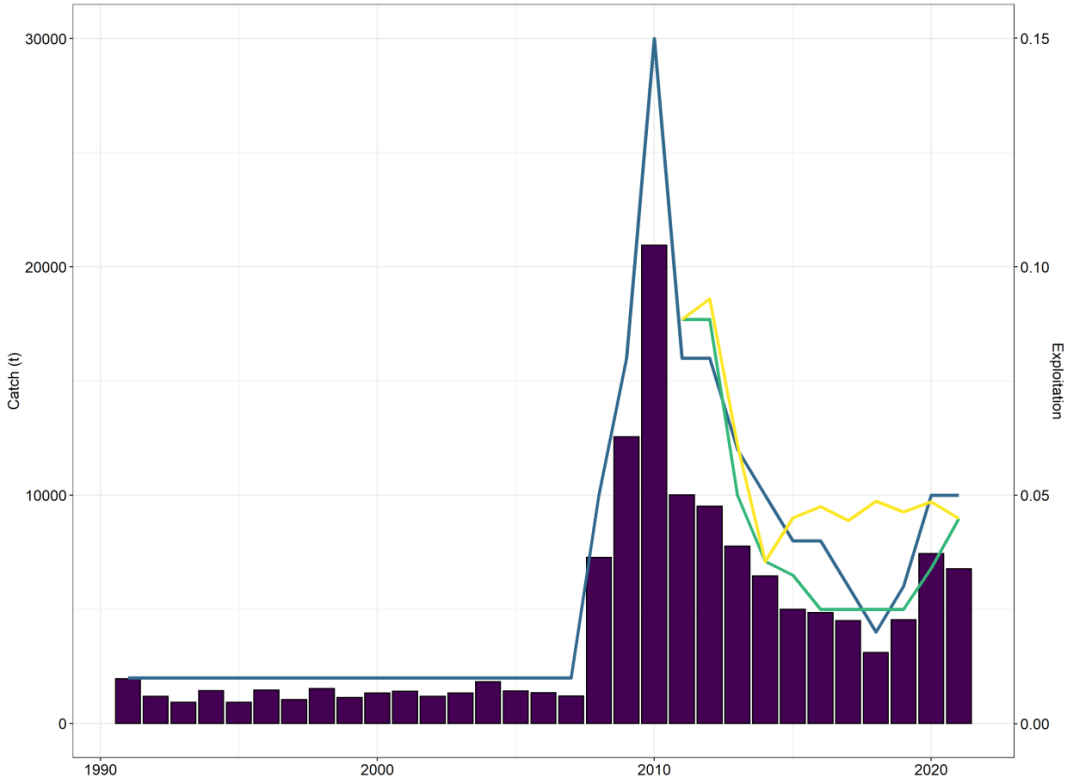

# Arrowtooth flounder, continued

| Quantity | Last asmt. | This asmt. | Change |
|---|---|---|---|
| M | 0.20/0.35 | 0.20/0.35 | 0.00 |
| 2021 tier | 3a | n/a | none |
| 2022 tier | 3a | 3a | none |
| 2021 age+ biomass | 923,646 | n/a | 0.00 |
| 2022 age+ biomass | 921,074 | 921,690 | 0.00 |
| 2021 spawning biomass | 497,556 | n/a | 0.02 |
| 2022 spawning biomass | 509,208 | 509,672 | 0.00 |
| B100% | 558,826 | 558,826 | 0.00 |
| B40% | 223,530 | 223,530 | 0.00 |
| B35% | 195,589 | 195,589 | 0.00 |
| 2022 FOFL | 0.160 | 0.160 | 0.00 |
| 2022 FABC | 0.135 | 0.135 | 0.00 |
| 2021 OFL | 90,873 | n/a | 0.04 |
| 2022 OFL | 94,368 | 94,445 | 0.00 |
| 2021 ABC | 77,349 | n/a | 0.04 |
| 2022 ABC | 80,323 | 80,389 | 0.00 |



# Chapter 7: Kamchatka flounder (partial)

- New model(s): no; change from base: no; risk>1: n/a
- Stock status: projected 2022 spawning biomass = 55% of $B_{100\%}$
- Catch (bars), catch/biomass (blue), ABC (yellow), TAC (green)

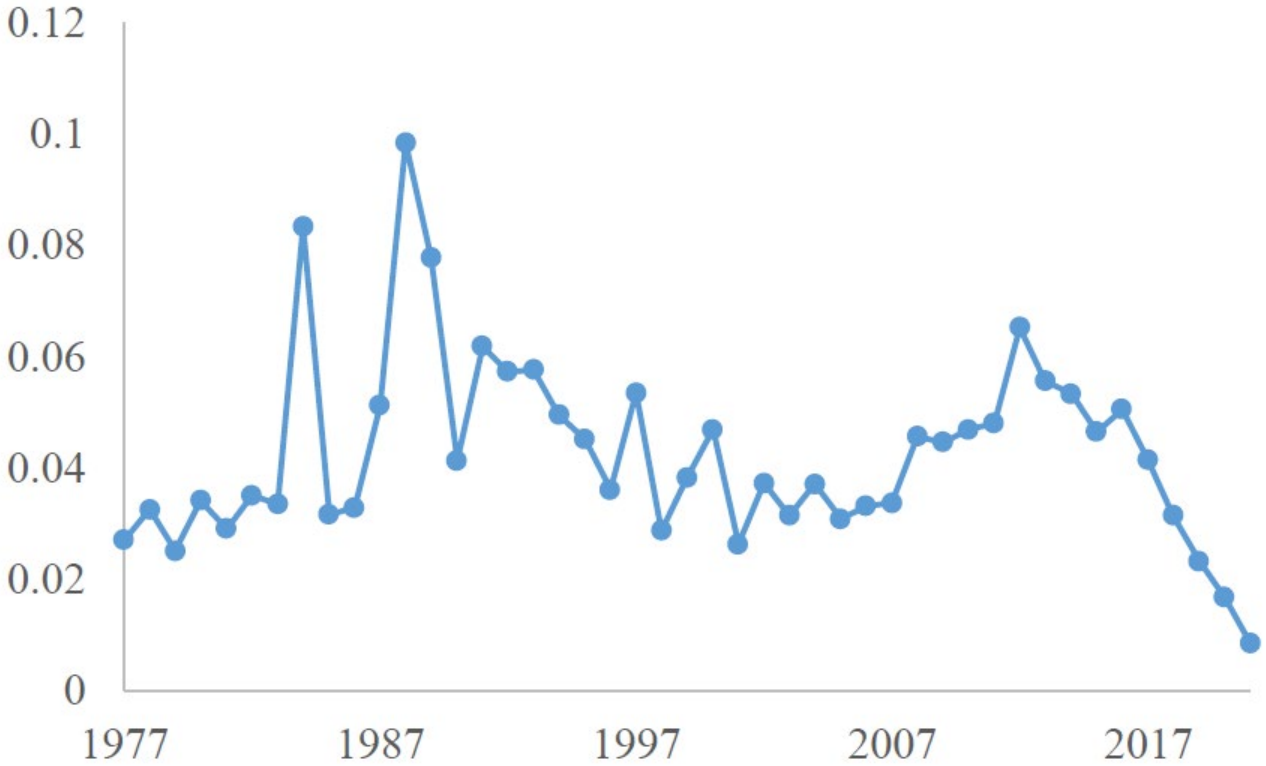



# Kamchatka flounder, continued

| Quantity | Last asmt. | This asmt. | Change |
|---|---|---|---|
| M | 0.11 | 0.11 | 0.00 |
| 2021 tier | 3a | n/a | none |
| 2022 tier | 3a | 3a | none |
| 2021 age+ biomass | 144,671 | n/a | 0.00 |
| 2022 age+ biomass | 143,248 | 143,983 | 0.01 |
| 2021 spawning biomass | 54,341 | n/a | 0.03 |
| 2022 spawning biomass | 55,256 | 55,701 | 0.01 |
| B100% | 101,376 | 101,376 | 0.00 |
| B40% | 40,550 | 40,550 | 0.00 |
| B35% | 35,482 | 35,482 | 0.00 |
| 2022 FOFL | 0.108 | 0.108 | 0.00 |
| 2022 FABC | 0.090 | 0.090 | 0.00 |
| 2021 OFL | 10,630 | n/a | 0.03 |
| 2022 OFL | 10,843 | 10,903 | 0.01 |
| 2021 ABC | 8,982 | n/a | 0.03 |
| 2022 ABC | 9,163 | 9,214 | 0.01 |

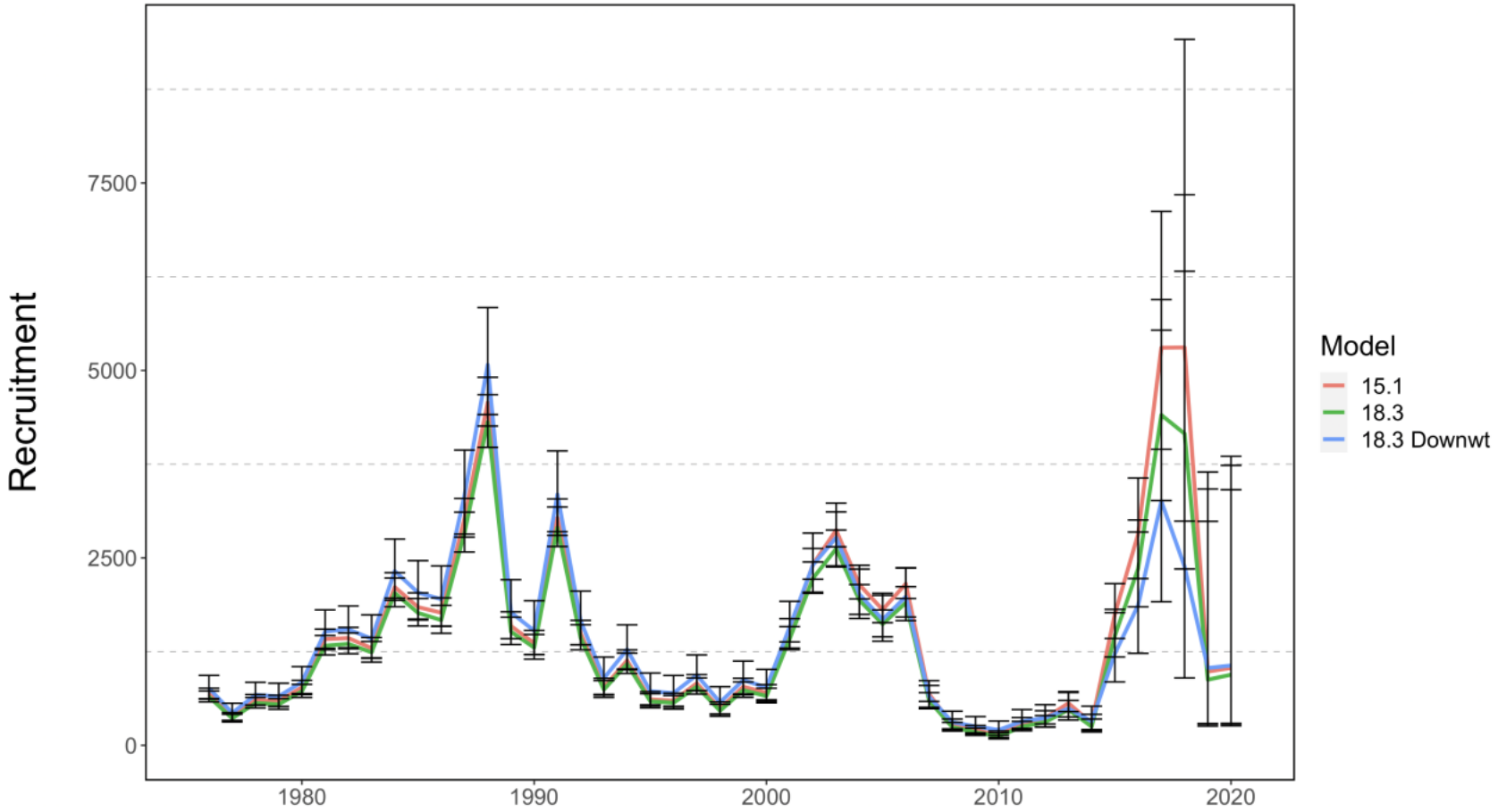
# Chapter 8: northern rock sole (partial)

- New model(s): no; change from base: no; risk>1: n/a
- Stock status: projected 2022 spawning biomass = 60% of $B_{100\%}$
- Catch/biomass time series:




# Northern rock sole, continued

- Age 1 recruitment (from last year's assessment; Model 18.3 is base)

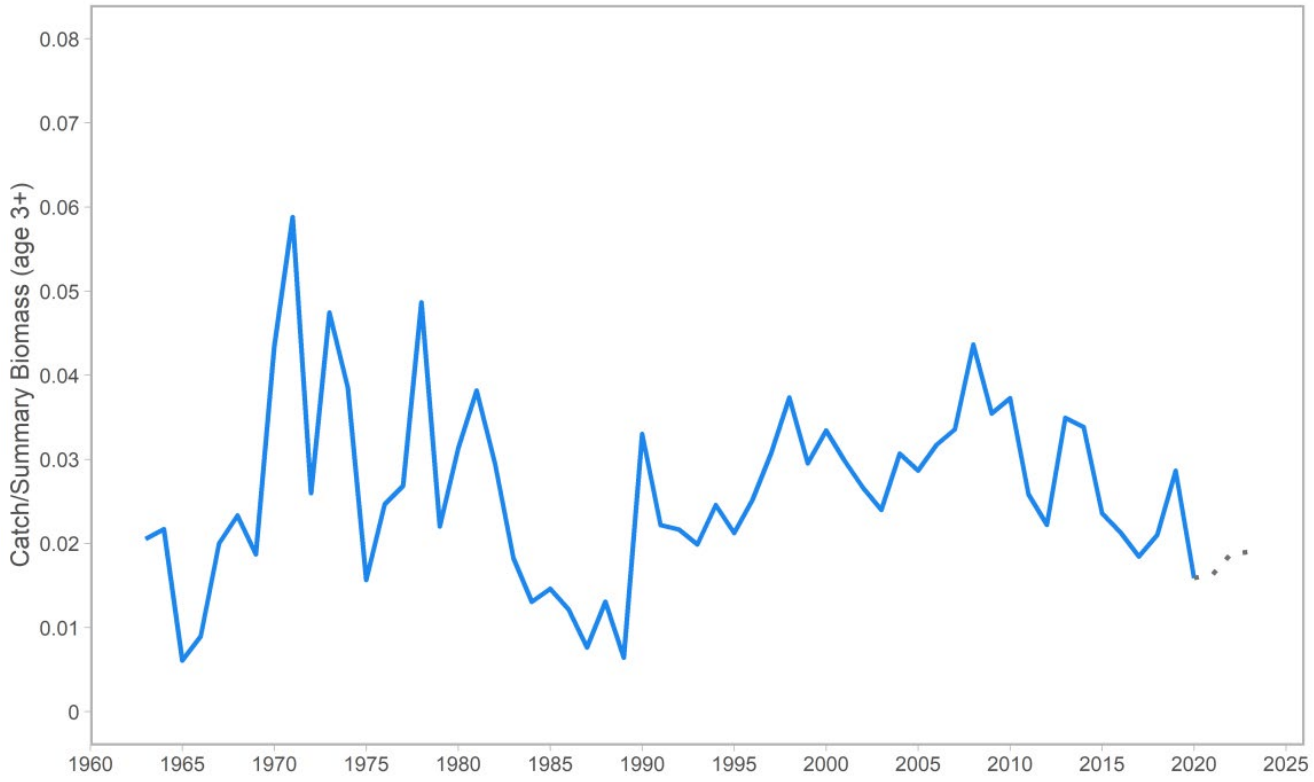


# Northern rock sole, continued

| Quantity | Last asmt. | This asmt. | Change |
|---|---|---|---|
| M (male/female) | 0.15/0.17 | 0.15/0.17 | 0.00 |
| 2021 tier | 1a | n/a | none |
| 2022 tier | 1a | 1a | none |
| 2021 age+ biomass | 923,197 | n/a | 0.47 |
| 2022 age+ biomass | 1,359,440 | 1,361,360 | 0.00 |
| 2021 spawning biomass | 294,627 | n/a | -0.02 |
| 2022 spawning biomass | 286,381 | 287,600 | 0.00 |
| B0 | 476,820 | 476,820 | 0.00 |
| Bmsy | 158,972 | 158,972 | 0.00 |
| 2022 FOFL | 0.157 | 0.157 | 0.00 |
| 2022 FABC | 0.152 | 0.152 | 0.00 |
| 2021 OFL | 145,180 | n/a | 0.47 |
| 2022 OFL | 213,783 | 214,084 | 0.00 |
| 2021 ABC | 140,306 | n/a | 0.47 |
| 2022 ABC | 206,605 | 206,896 | 0.00 |

# Chapter 9: flathead sole (partial)

- New model(s): no; change from base: no; risk>1: n/a
- Stock status: projected 2022 spawning biomass = 76% of $B_{100\%}$
- Catch/biomass time series:




# Flathead sole, continued

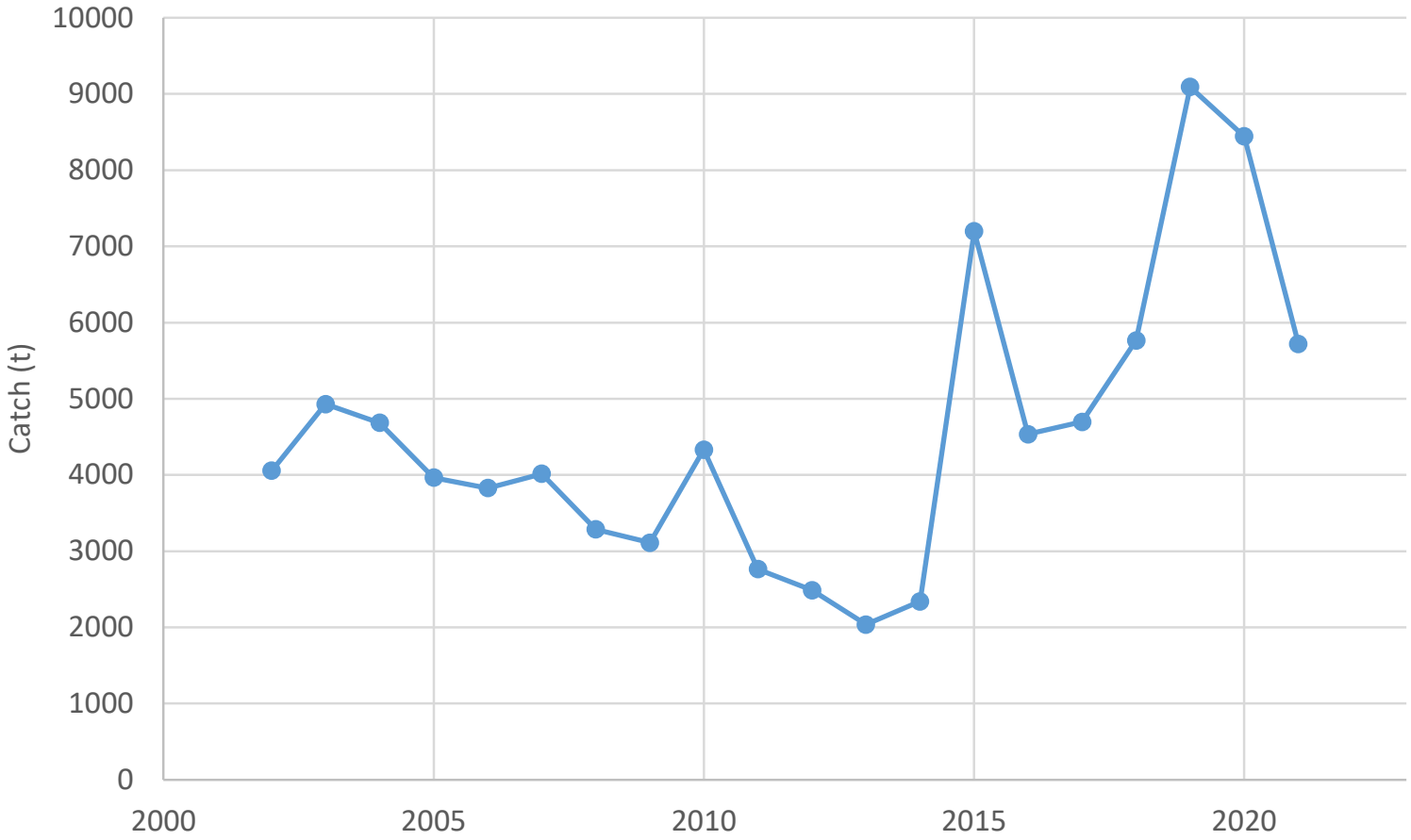
| Quantity | Last asmt. | This asmt. | Change |
|---|---|---|---|
| M | 0.20 | 0.20 | 0.00 |
| 2021 tier | 3a | n/a | none |
| 2022 tier | 3a | 3a | none |
| 2021 age+ biomass | 602,497 | n/a | 0.01 |
| 2022 age+ biomass | 608,576 | 608,631 | 0.00 |
| 2021 spawning biomass | 150,433 | n/a | 0.03 |
| 2022 spawning biomass | 154,906 | 155,379 | 0.00 |
| B100% | 203,658 | 203,658 | 0.00 |
| B40% | 81,463 | 81,463 | 0.00 |
| B35% | 71,280 | 71,280 | 0.00 |
| 2022 FOFL | 0.46 | 0.46 | 0.00 |
| 2022 FABC | 0.37 | 0.37 | 0.00 |
| 2021 OFL | 75,863 | n/a | 0.03 |
| 2022 OFL | 77,763 | 77,967 | 0.00 |
| 2021 ABC | 62,567 | n/a | 0.03 |
| 2022 ABC | 64,119 | 64,288 | 0.00 |

# Chapter 13: northern rockfish

- New model(s): yes; change from base: yes; risk>1: yes
- New data: 2019 and 2020 fishery agecomps
- Model changes/alternatives:
  - Model 16.1a: current base model
  - Model 21: same as 16.1a, except the age at which survey selectivity is constrained to approximate 1.0 is increased from 15 to 30
    - Team and SSC had requested that the author address "the issues concerning the restrictive priors on key parameters in the model and exploring alternatives for estimating survey selectivity"
- Author recommends adoption of Model 21 because it provides more flexibility for the data to determine the shape of the selectivity curve, while still conforming to the assumption of asymptotic selectivity (i.e., by achieving selectivity close to 1.0 well before the age+ group (40 years))

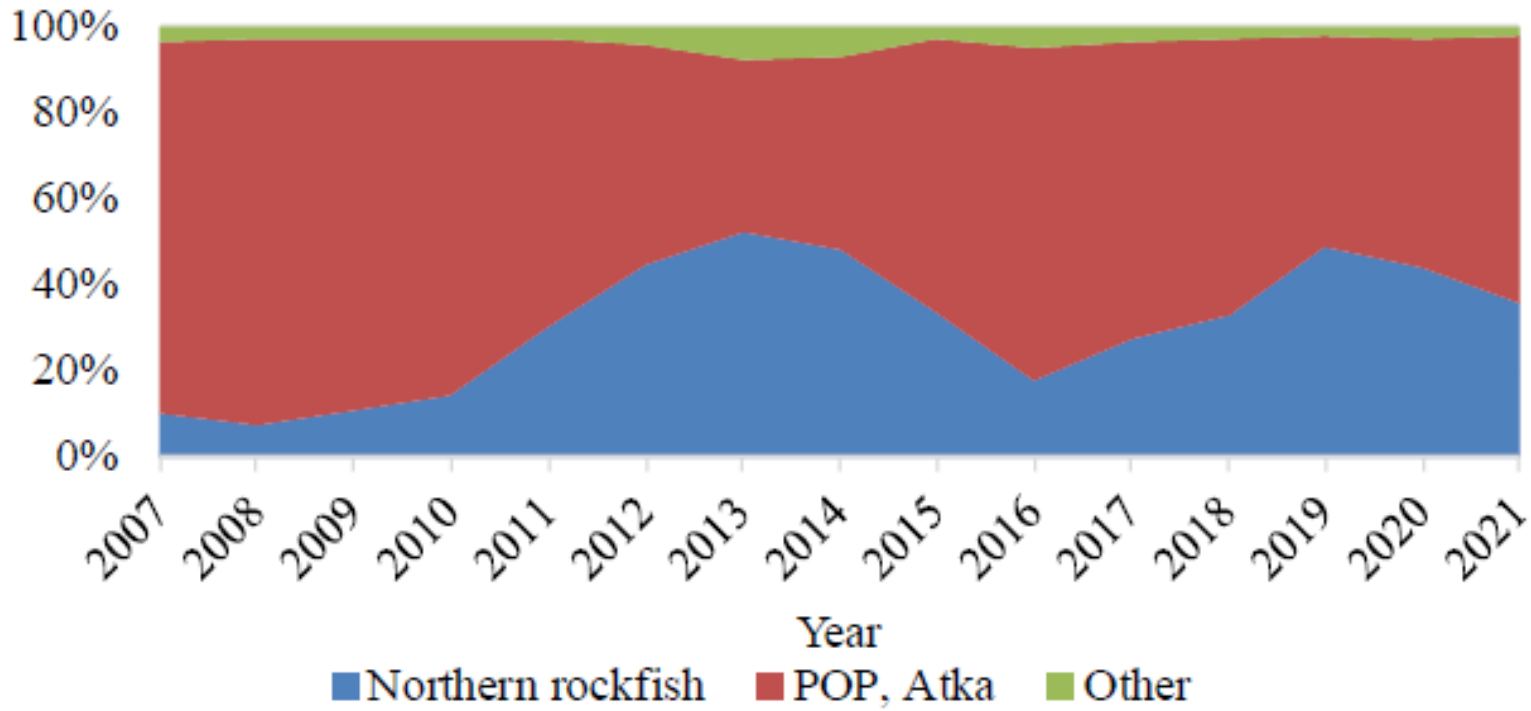
# Northern rockfish, continued

- Catch time series




# Northern rockfish, continued

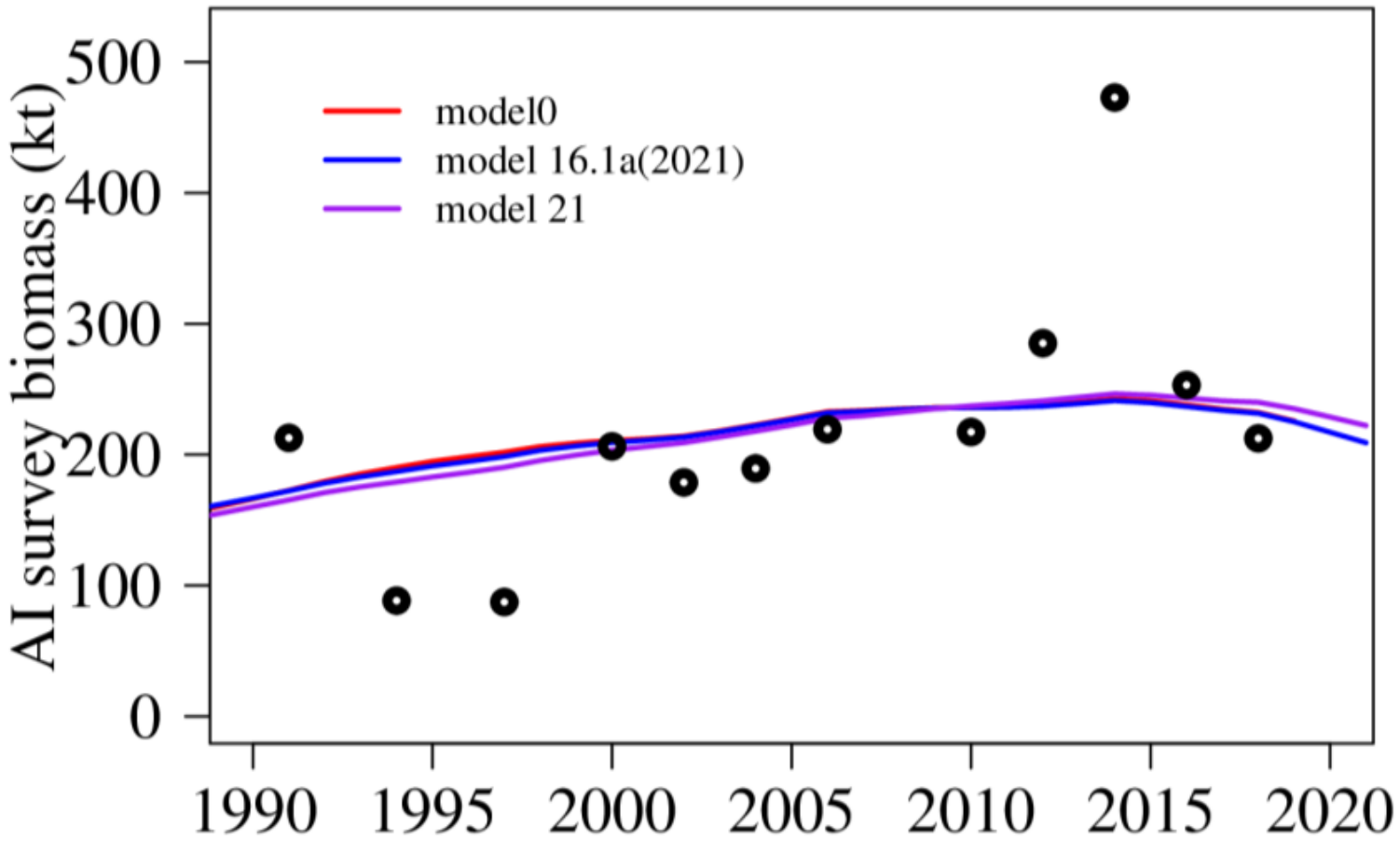
- Proportion of catch consisting of northern rockfish, by target fishery




- Proportion since 2016 roughly parallels total northern rockfish catch
- Number of tows targeting northerns in 2019-20 > 2x previous years

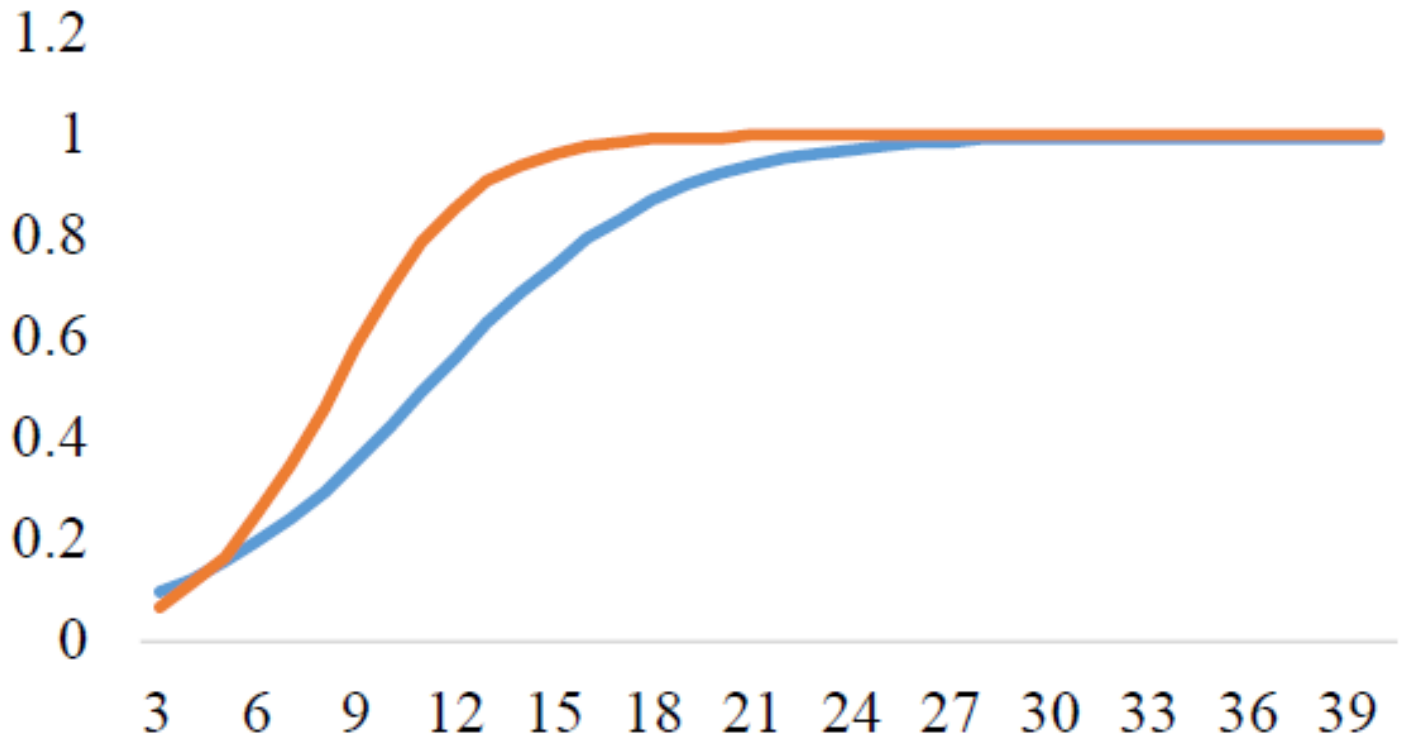
# Northern rockfish, continued

- Fits to survey biomass



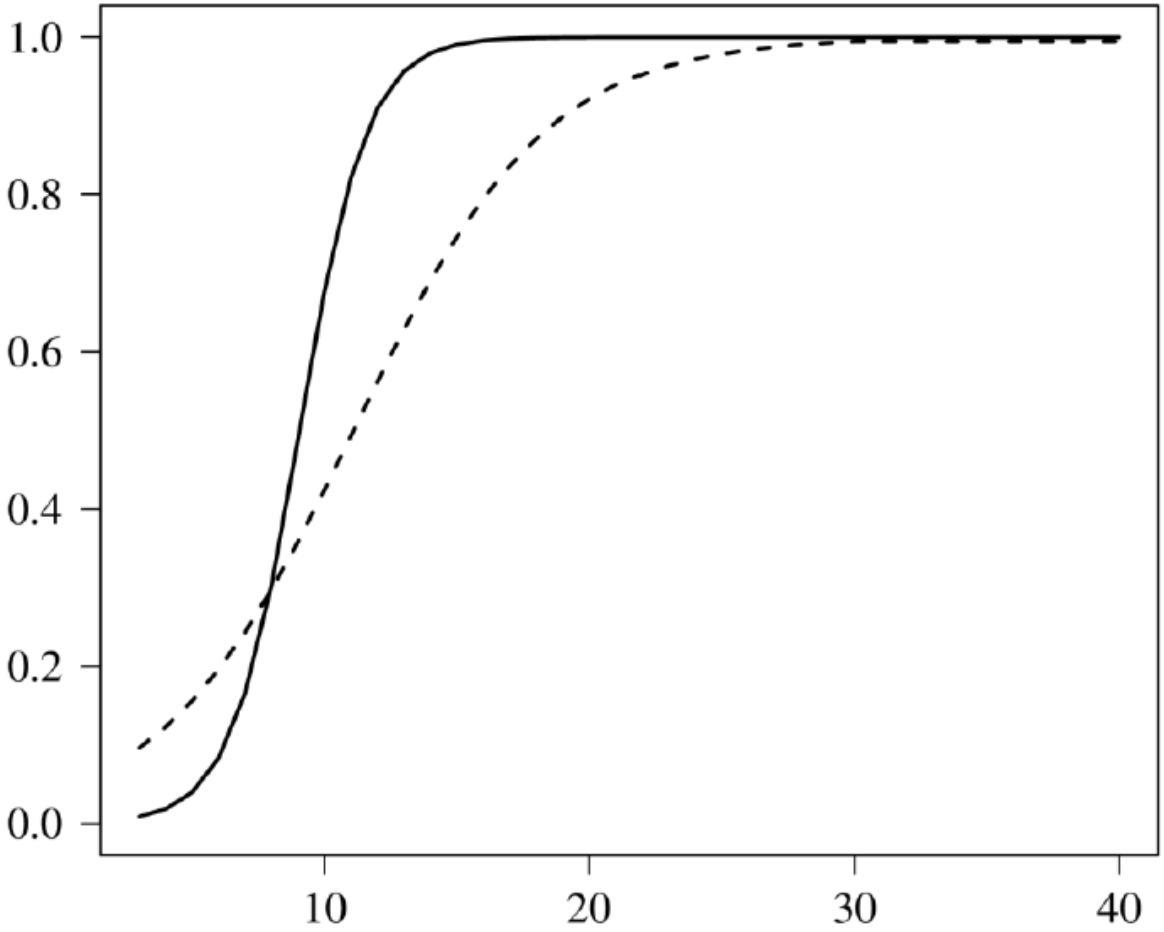
# Northern rockfish, continued

- Survey selectivity: 2019 Model 16.0a (orange), 2021 Model 21 (blue)



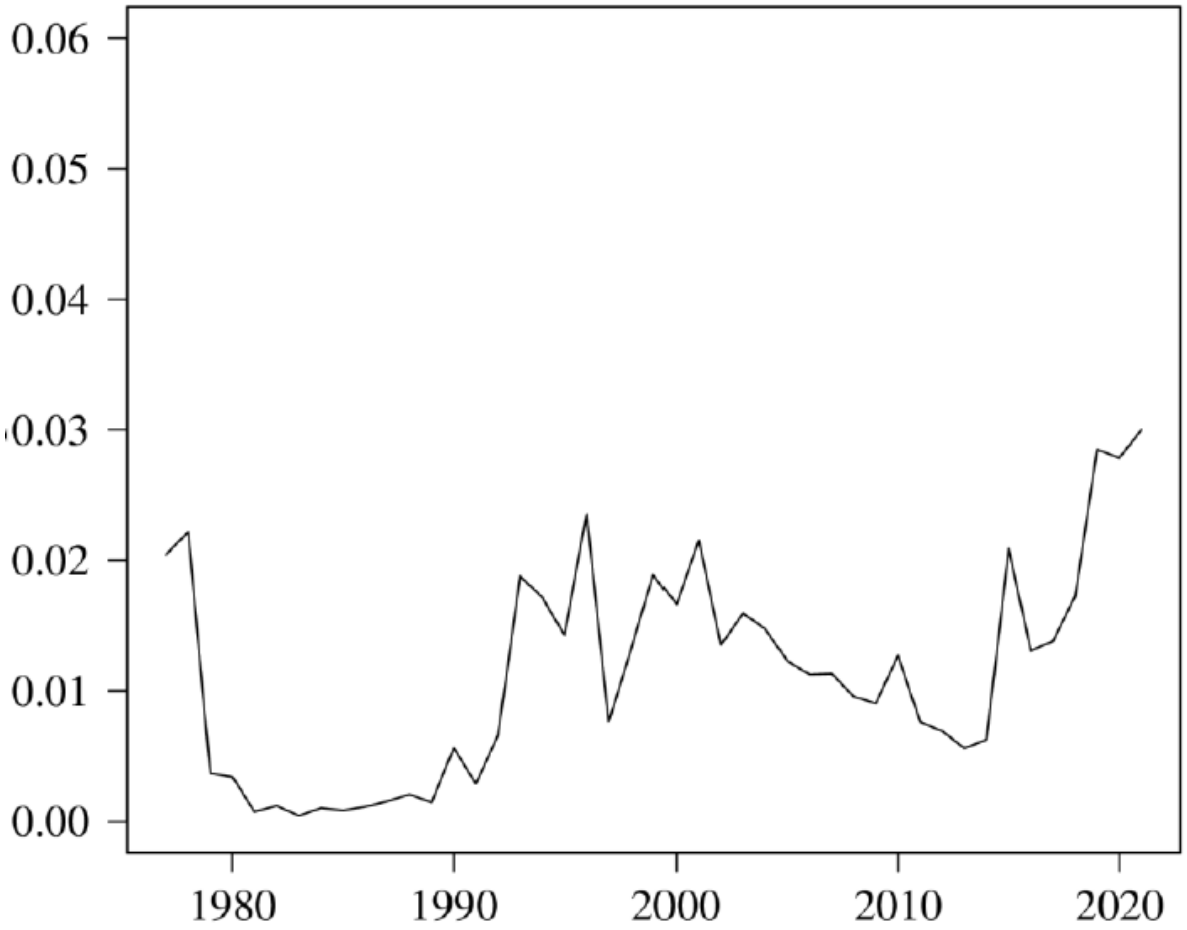

# Northern rockfish, continued

- Fishery selectivity (solid) and survey selectivity (dashed), Model 21



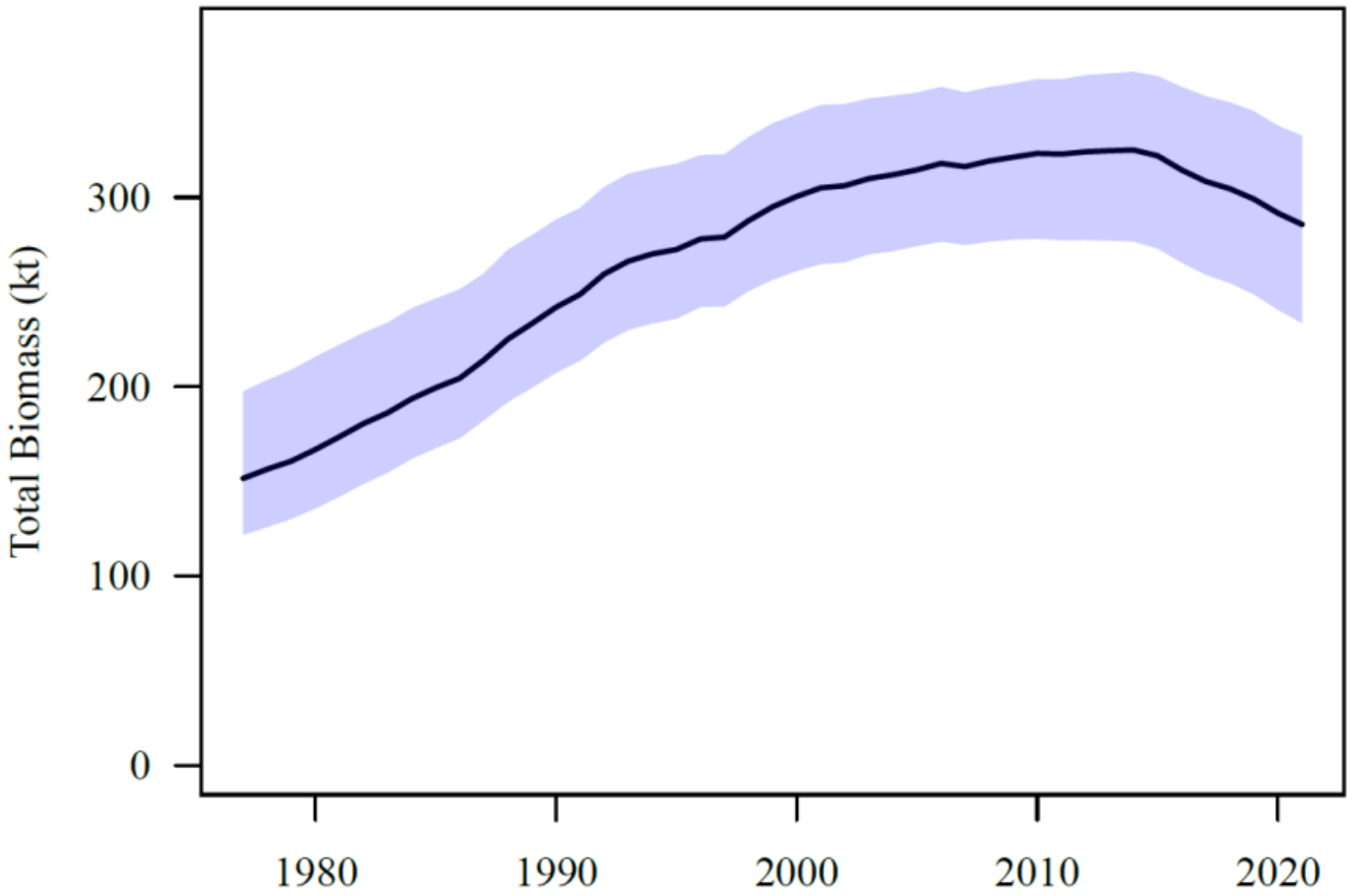

# Northern rockfish, continued

- Full-selection fishing mortality (Model 21)



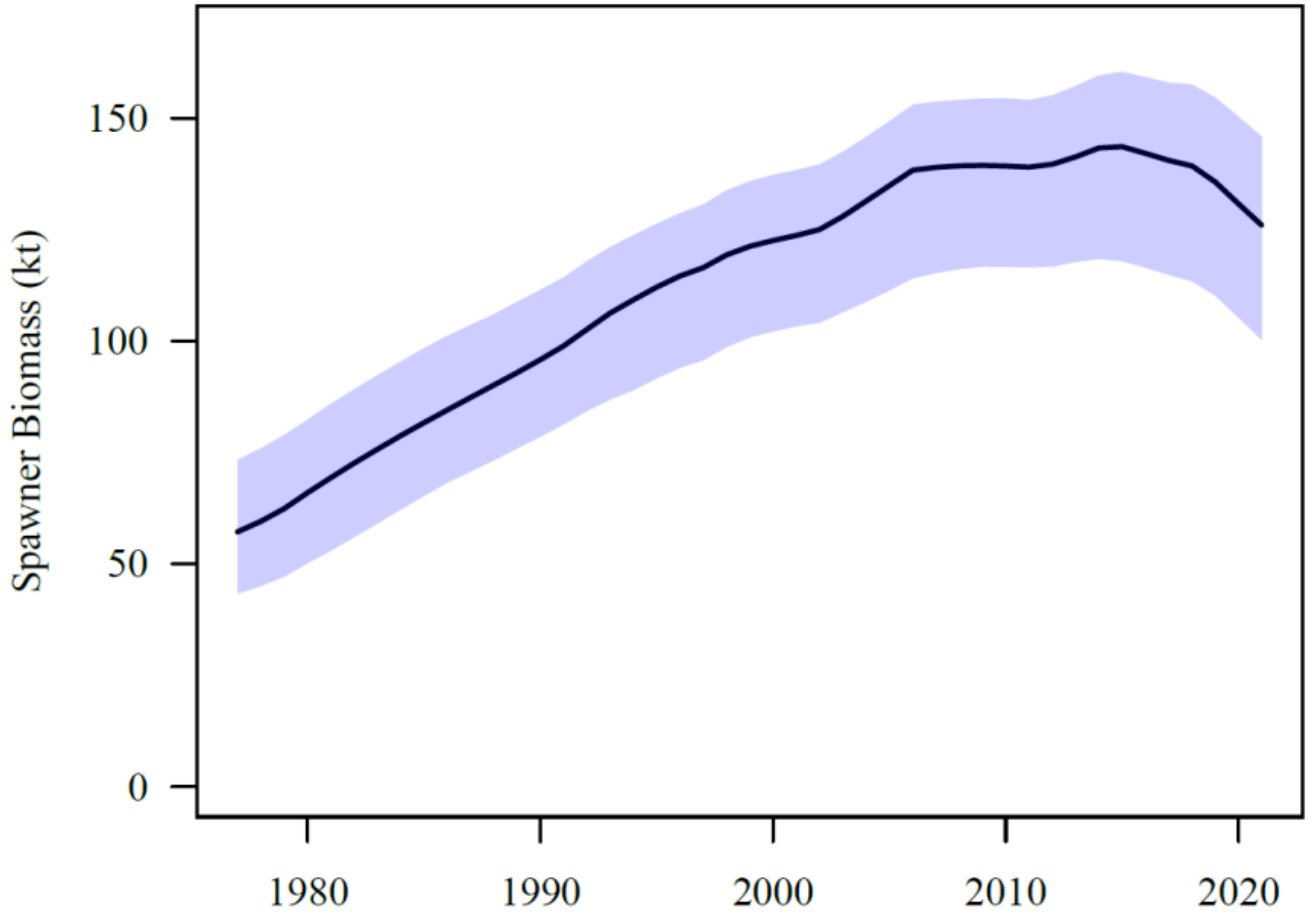
# Northern rockfish, continued

- Total biomass (Model 21)



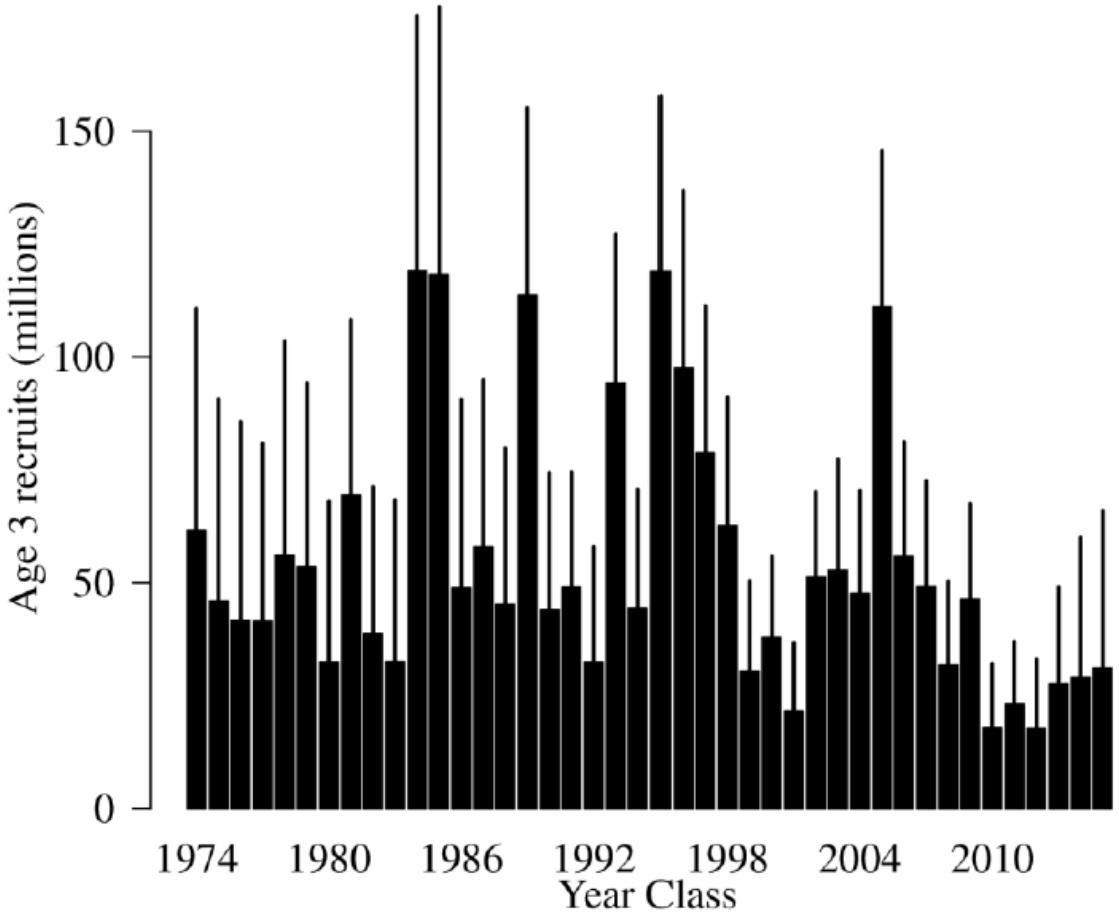
# Northern rockfish, continued

- Spawning biomass (Model 21)




# Northern rockfish, continued

- Age 3 recruitment (Model 21)




# Northern rockfish, continued

- Stock status: projected 2022 spawning biomass = 71% of $B_{100\%}$
- Mohn's $\rho = -0.18$
- Author's risk table:

| Year | Assess | PopDy | EnvEco | FishPerf |
|---|---|---|---|---|
| 2019 | 2 | 1 | 2 | 1 |
| 2021 | 2 | 1 | 1 | 1 |

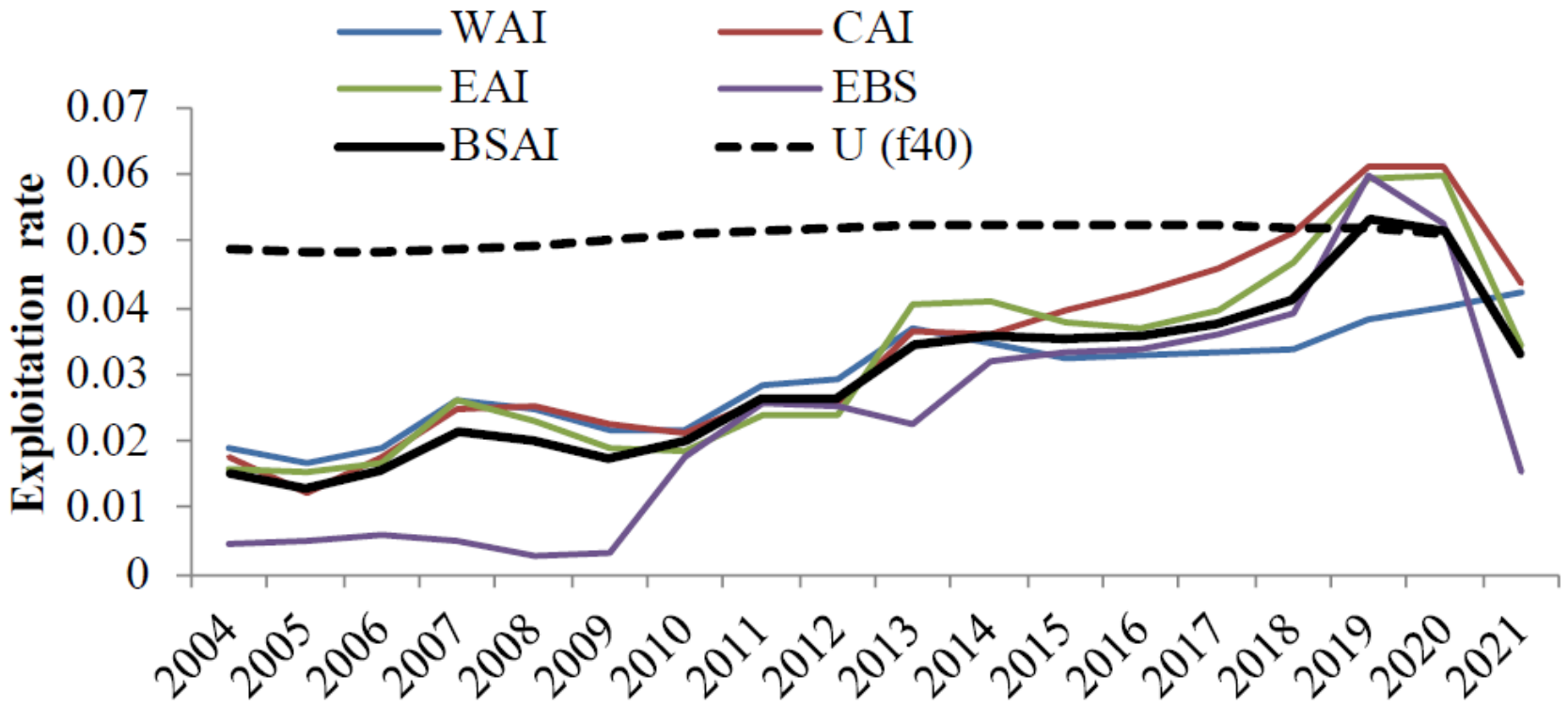
  - Environmental/ecosystem risk decreased because increased reproductive success of seabirds suggests broad prey availability
  - Author recommends no reduction from maxABC
- The Team accepted the author's recommended model, risk levels, and harvest specifications

# Northern rockfish, continued

| Quantity | Last asmt. | This asmt. | Change |
|---|---|---|---|
| M | 0.048 | 0.054 | 0.13 |
| 2021 tier | 3a | n/a | none |
| 2022 tier | 3a | 3a | none |
| 2021 age+ biomass | 244,600 | n/a | 0.14 |
| 2022 age+ biomass | 240,022 | 279,584 | 0.16 |
| 2021 spawning biomass | 107,003 | n/a | 0.13 |
| 2022 spawning biomass | 103,467 | 121,126 | 0.17 |
| B100% | 159,850 | 171,768 | 0.07 |
| B40% | 63,940 | 68,707 | 0.07 |
| B35% | 55,947 | 60,119 | 0.07 |
| 2022 FOFL | 0.075 | 0.085 | 0.13 |
| 2022 FABC | 0.061 | 0.069 | 0.13 |
| 2021 OFL | 18,917 | n/a | 0.24 |
| 2022 OFL | 18,221 | 23,420 | 0.29 |
| 2021 ABC | 15,557 | n/a | 0.24 |
| 2022 ABC | 14,984 | 19,217 | 0.28 |

# Chapter 12: Pacific ocean perch (partial)

- New model(s): no; change from base: no; risk>1: n/a
- Stock status: projected 2022 spawning biomass = 51% of $B_{100\%}$
- Catch/biomass time series:



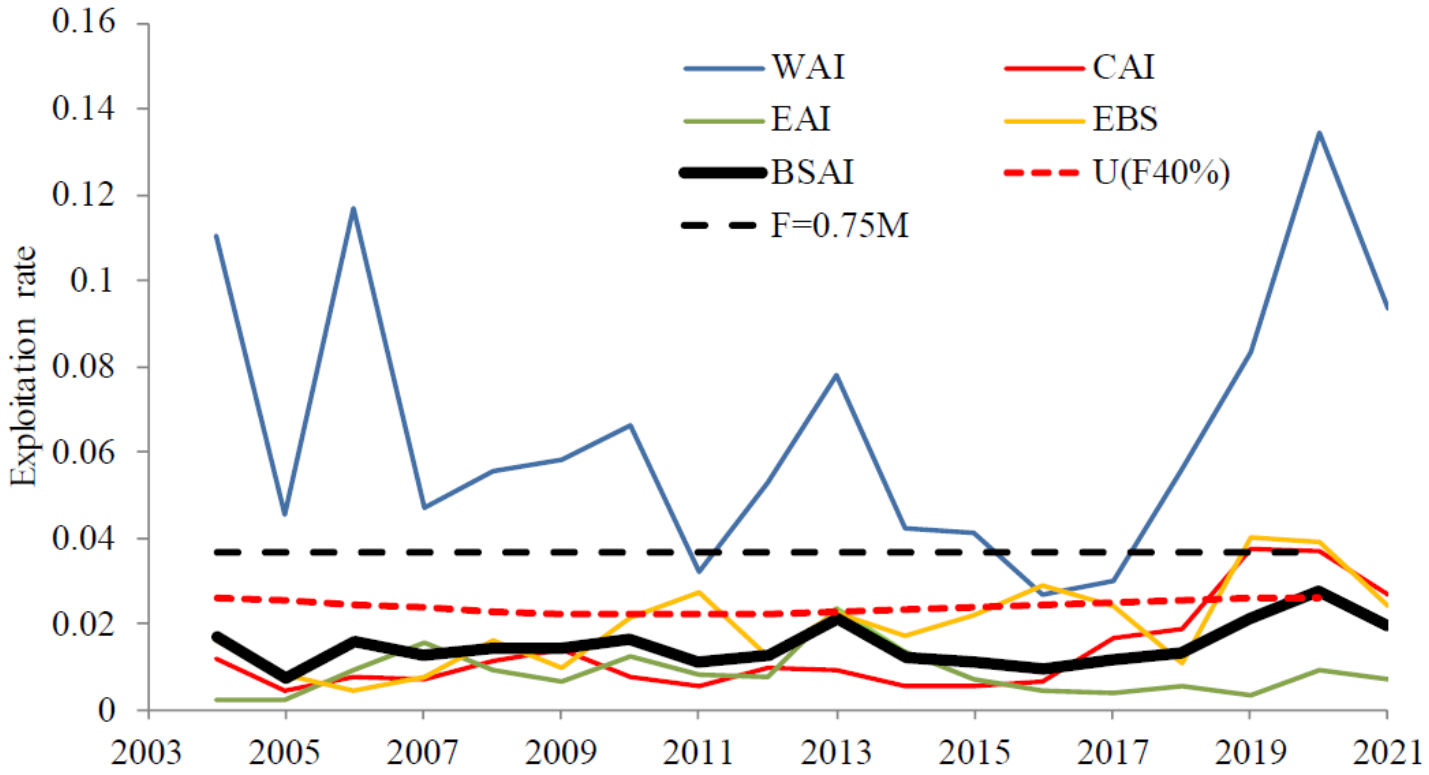

# Pacific ocean perch, continued

| Quantity | Last asmt. | This asmt. | Change |
|---|---|---|---|
| M | 0.056 | 0.056 | 0.00 |
| 2021 tier | 3a | n/a | none |
| 2022 tier | 3a | 3a | none |
| 2021 age+ biomass | 756,011 | n/a | -0.02 |
| 2022 age+ biomass | 735,367 | 738,710 | 0.00 |
| 2021 spawning biomass | 310,036 | n/a | -0.03 |
| 2022 spawning biomass | 297,091 | 299,232 | 0.01 |
| B100% | 584,747 | 584,747 | 0.00 |
| B40% | 233,899 | 233,899 | 0.00 |
| B35% | 204,661 | 204,661 | 0.00 |
| 2022 FOFL | 0.089 | 0.089 | 0.00 |
| 2022 FABC | 0.073 | 0.073 | 0.00 |
| 2021 OFL | 44,376 | n/a | -0.04 |
| 2022 OFL | 42,384 | 42,605 | 0.01 |
| 2021 ABC | 37,173 | n/a | -0.04 |
| 2022 ABC | 35,503 | 35,688 | 0.01 |



# Chapter 14: blackspotted/rougheye (partial)

- New model(s): no; change from base: no; risk>1: n/a
- Stock status: projected 2022 AI spawning biomass = 39% of $B_{100\%}$
- Catch/biomass time series:




# Blackspotted/rougheye rockfish, continued

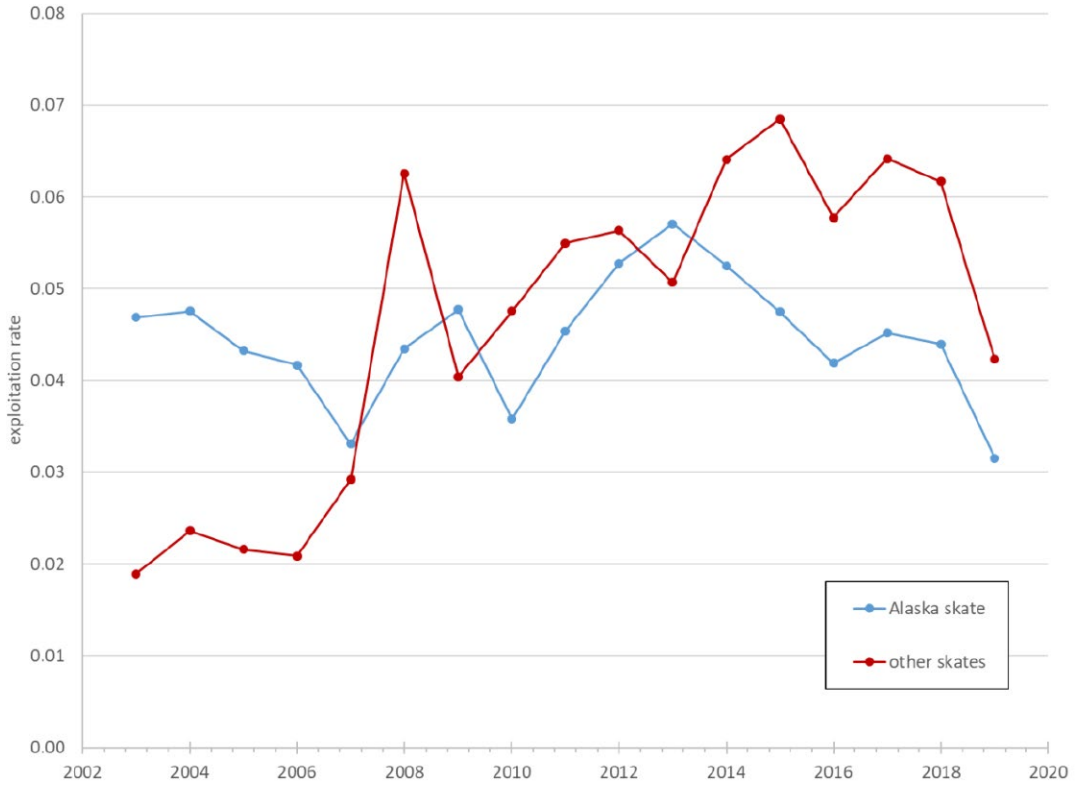
| Quantity **(AI portion)** | Last asmt | This asmt | Change |
|---|---|---|---|
| M | 0.049 | 0.049 | 0.00 |
| 2021 tier | 3b | n/a | none |
| 2022 tier | 3b | 3b | none |
| 2021 age+ biomass | 17,632 | n/a | 0.01 |
| 2022 age+ biomass | 17,729 | 17,774 | 0.00 |
| 2021 spawning biomass | 3,372 | n/a | 0.03 |
| 2022 spawning biomass | 3,457 | 3,468 | 0.00 |
| B100% | 8,811 | 8,811 | 0.00 |
| B40% | 3,524 | 3,524 | 0.00 |
| B35% | 3,083 | 3,083 | 0.00 |
| 2022 FOFL | 0.038 | 0.039 | 0.03 |
| 2022 FABC | 0.032 | 0.033 | 0.03 |
| 2021 OFL | 509 | n/a | 0.04 |
| 2022 OFL | 528 | 531 | 0.01 |
| 2021 ABC | 432 | n/a | 0.05 |
| 2022 ABC | 450 | 453 | 0.01 |

# Blackspotted/rougheye, continued

| Quantity **(EBS portion)** | Last asmt. | This asmt. | Change |
|---|---|---|---|
| M | 0.049 | 0.049 | 0.00 |
| 2021 tier | n/a | n/a | none |
| 2022 tier | 5 | 5 | none |
| Biomass | 1,371 | 1,371 | 0.00 |
| 2022 FOFL | 0.049 | 0.049 | 0.00 |
| 2022 FABC | 0.037 | 0.037 | 0.00 |
| 2021 OFL | 67 | n/a | 0.00 |
| 2022 OFL | 67 | 67 | 0.00 |
| 2021 ABC | 50 | n/a | 0.00 |
| 2022 ABC | 50 | 50 | 0.00 |

# Chapter 18: skates (partial)

- New model(s): no; change from base: no; risk>1: n/a
- Stock status: projected 2022 AK skate spawning biomass = 68% of $B_{100\%}$
- Catch/biomass time series:




# Skates, continued

| Quantity **(Alaska skate)** | Last asmt. | This asmt. | Change |
|---|---|---|---|
| M | 0.13 | 0.13 | 0.00 |
| 2021 tier | 3a | n/a | none |
| 2022 tier | 3a | 3a | none |
| 2021 age+ biomass | 504,691 | n/a | -0.03 |
| 2022 age+ biomass | 484,731 | 489,868 | 0.01 |
| 2021 spawning biomass | 123,390 | n/a | -0.01 |
| 2022 spawning biomass | 119,498 | 121,575 | 0.02 |
| B100% | 178,425 | 178,425 | 0.00 |
| B40% | 71,370 | 71,370 | 0.00 |
| B35% | 62,449 | 62,449 | 0.00 |
| 2022 FOFL | 0.092 | 0.092 | 0.00 |
| 2022 FABC | 0.079 | 0.079 | 0.00 |
| 2021 OFL | 38,580 | n/a | -0.04 |
| 2022 OFL | 36,655 | 37,073 | 0.01 |
| 2021 ABC | 33,219 | n/a | -0.04 |
| 2022 ABC | 31,560 | 31,920 | 0.01 |

# Skates, continued

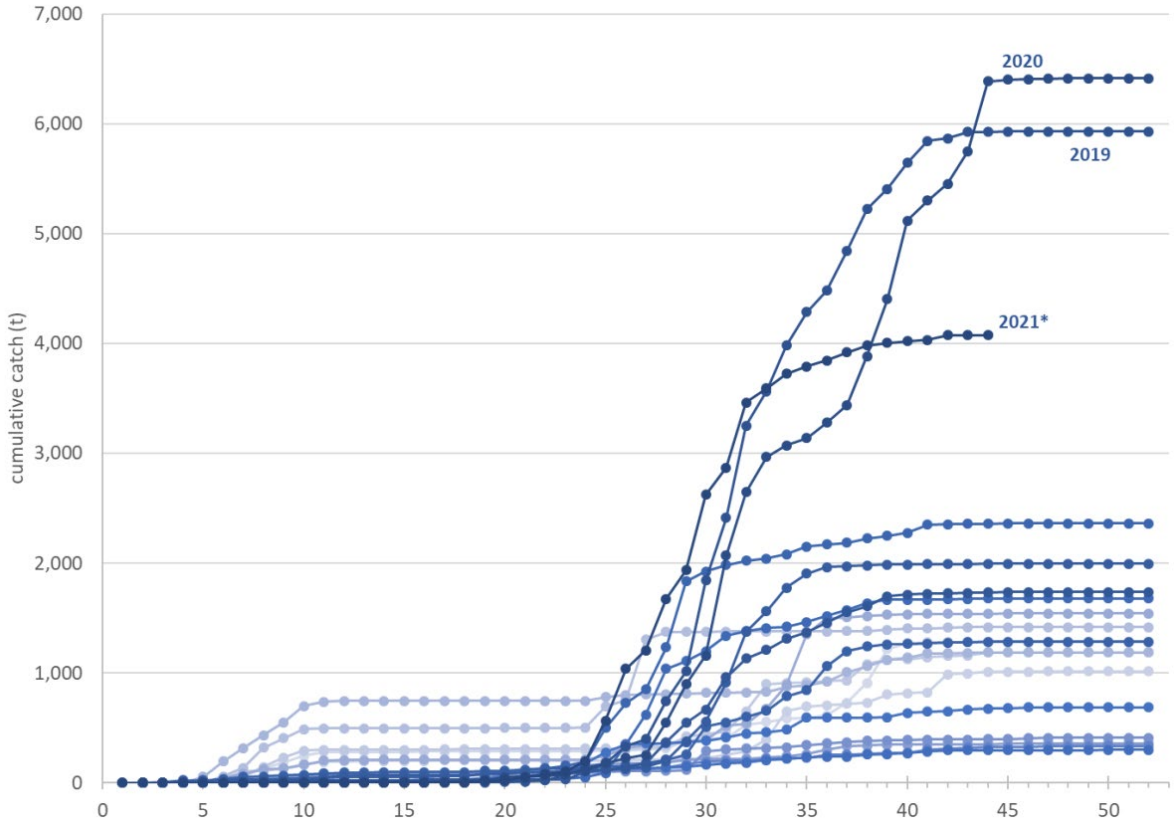
| Quantity **(other skates)** | Last asmt. | This asmt. | Change |
|---|---|---|---|
| M | 0.10 | 0.10 | 0.00 |
| 2021 tier | 5 | n/a | none |
| 2022 tier | 5 | 5 | none |
| Biomass | 107,174 | 107,174 | 0.00 |
| 2022 FOFL | 0.10 | 0.10 | 0.00 |
| 2022 FABC | 0.075 | 0.075 | 0.00 |
| 2021 OFL | 10,717 | n/a | 0.00 |
| 2022 OFL | 10,717 | 10,717 | 0.00 |
| 2021 ABC | 8,038 | n/a | 0.00 |
| 2022 ABC | 8,038 | 8,038 | 0.00 |

# Forage species

- Olav Ormseth presented the forage fish report
  - Thank you, Olav, for many years of work on these and other species!
- Some potentially concerning trends are evident:
  - Squid catches have increased dramatically since squid were moved to the “ecosystem component” category of the FMP
  - “FMP forage fish” survey biomass has been much lower in each of the last four years than previously
- The Team discussed coordination with ESR reports and data streams as well as the potential for a combined forage fish report across both the BSAI and GOA, similar to Grenadiers

# Forage species, continued

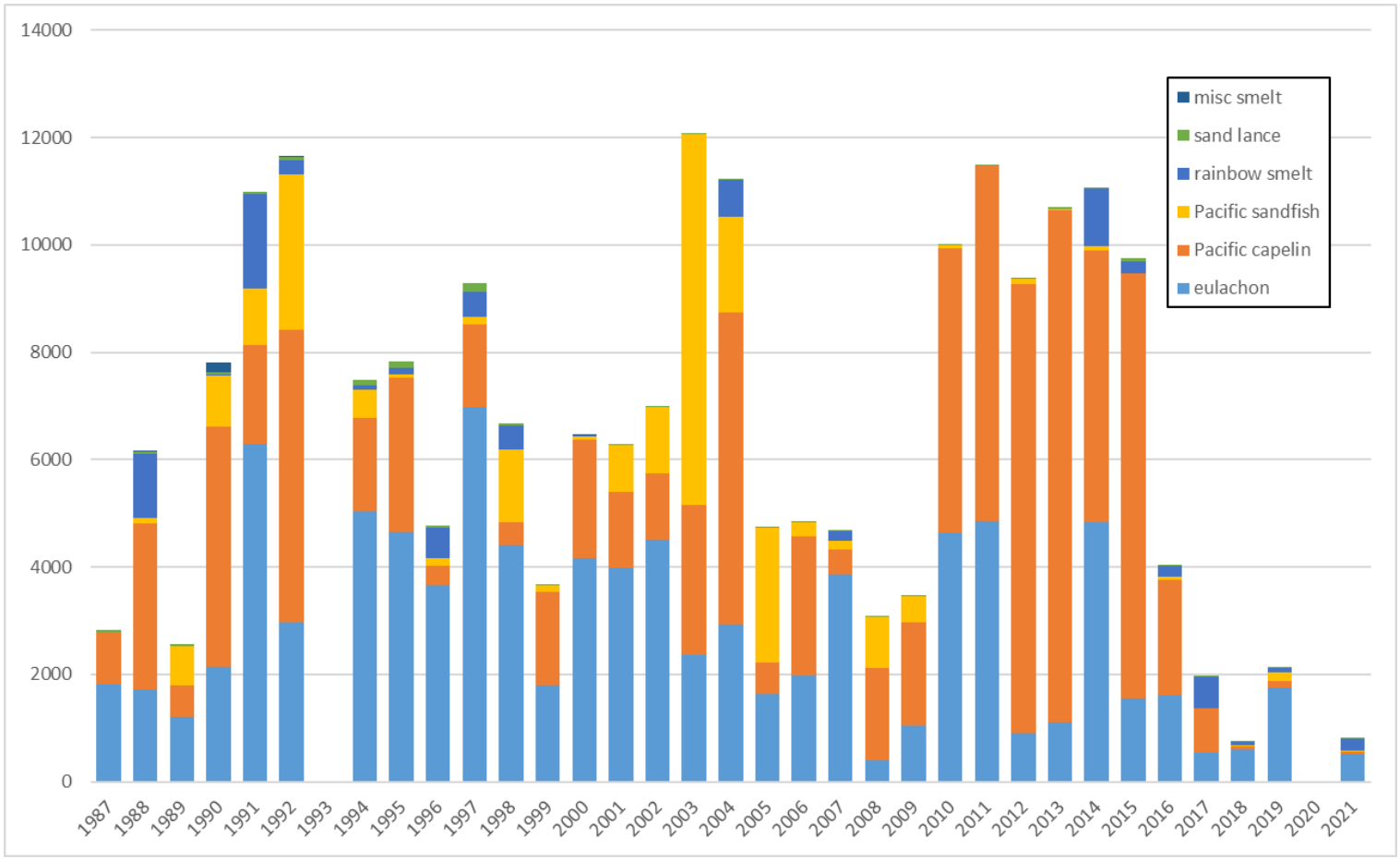
- Cumulative weekly squid catch by year




- Note: 2016-2018 OFL was 6,912 t (= 1977-1981 average catch)

# Forage species, continued

- EBS trawl survey biomass: “FMP forage fish” only




# Forage species, continued

- The Team also received a presentation regarding the analyses to investigate moving squid to the ecosystem component in 2017
  - At the time, the decision was contingent on the assumption that the current levels of squid catch were close to the levels that would be realized if squid were moved to the ecosystem component
- The Team discussed calculations for the range of anticipated catch levels and what might be considered low exploitation relative to the actual biomass of the squid population
  - It was noted that there are new ecosystem models in development (e.g., size-spectrum model) and a synthesis of current information could be used to develop a more realistic baseline
- The author also noted that several subject matter experts have discussed the potential for a discussion on the future of the forage species report and coordination with the forage information in the ESR

# Forage species, continued

- The Team recommends a forage species workshop where scientists, members of the Teams, SSC, and Council staff discuss 1) surveying and population estimation of forage species, 2) importance of forage to different managed species (e.g., evaluate the suite of current food web models), 3) questions about how climate change may impact forage biomass and exploitation rates, 4) how best to report on changing populations, scientific knowledge about forage species, and the dependence of other species on them; including timing, frequency, and scope of the report, and 5) potential resulting management measures from shift in bycatch or spatial distribution of the forage base
- The Team recommends coordinating with the editors of the ESR to reduce redundancy in reporting between the forage and ESR report and consider a combined forage species report for Alaska rather than the two separate regional reports

# Recommended harvest specifications

| Species | Area | 2021 OFL | 2021 ABC | 2021 TAC | Catch as of 11/6/2021 | Plan Team Final 2022 OFL | Plan Team Final 2022 ABC | Plan Team Final 2022 TAC | Plan Team Final 2023 OFL | Plan Team Final 2023 ABC |
|---|---|---|---|---|---|---|---|---|---|---|
| Pollock | EBS | 2,594,000 | 1,626,000 | 1,375,000 | 1,373,712 | 1,469,000 | 1,111,000 | | 1,704,000 | 1,289,000 |
| | AI | 61,856 | 51,241 | 19,000 | 1,635 | 61,264 | 50,752 | | 61,379 | 50,825 |
| | Bogoslof | 113,479 | 85,109 | 250 | 50 | 113,479 | 85,109 | | 113,479 | 85,109 |
| Pacific cod | BS | 147,949 | 123,805 | 111,380 | 105,537 | 183,012 | 153,383 | | 180,909 | 151,709 |
| | AI | 27,400 | 20,600 | 13,796 | 7,023 | 27,400 | 20,600 | | 27,400 | 20,600 |
| Sablefish | BSAI/GOA | 60,426 | 29,558 | | | 40,432 | 34,521 | | 42,520 | 36,318 |
| | BS | n/a | 3,396 | 3,396 | 3,961 | | 5,264 | | | 6,529 |
| | AI | n/a | 4,717 | 4,717 | 1,425 | | 6,463 | | | 7,786 |
| Yellowfin sole | BSAI | 341,571 | 313,477 | 200,000 | 104,669 | 377,071 | 269,649 | | 382,035 | 274,787 |
| Greenland turbot | BSAI | 8,568 | 7,326 | 6,025 | 1,586 | 7,687 | 6,572 | | 6,698 | 5,724 |
| | BS | n/a | 6,176 | 5,125 | 1,129 | | 5,540 | | | 4,825 |
| | AI | n/a | 1,150 | 900 | 457 | | 1,032 | | | 899 |
| Arrowtooth flounder | BSAI | 90,873 | 77,349 | 15,000 | 8,286 | 94,445 | 80,389 | | 97,944 | 83,389 |
| Kamchatka flounder | BSAI | 10,630 | 8,982 | 8,982 | 6,561 | 10,903 | 9,214 | | 11,115 | 9,393 |
| Northern rock sole | BSAI | 145,180 | 140,306 | 54,500 | 13,898 | 214,084 | 206,896 | | 280,621 | 271,199 |
| Flathead sole | BSAI | 75,863 | 62,567 | 25,000 | 9,898 | 77,967 | 64,288 | | 80,034 | 65,988 |
| Alaska plaice | BSAI | 37,924 | 31,657 | 24,500 | 15,653 | 39,305 | 32,697 | | 39,685 | 32,998 |
| Other flatfish | BSAI | 22,919 | 17,189 | 6,500 | 2,510 | 22,919 | 17,189 | | 22,919 | 17,189 |
| Pacific Ocean perch | BSAI | 44,376 | 37,173 | 35,899 | 32,112 | 42,605 | 35,688 | | 40,977 | 34,322 |
| | BS | n/a | 10,782 | 10,782 | 8,679 | | 10,352 | | | 9,956 |
| | EAI | n/a | 8,419 | 8,419 | 7,442 | | 8,083 | | | 7,774 |
| | CAI | n/a | 6,198 | 6,198 | 5,885 | | 5,950 | | | 5,722 |
| | WAI | n/a | 11,774 | 10,500 | 10,107 | | 11,303 | | | 10,870 |
| Northern rockfish | BSAI | 18,917 | 15,557 | 13,000 | 6,045 | 23,420 | 19,217 | | 22,594 | 18,538 |
| Blackspotted/Rougheye Rockfish | BSAI | 576 | 482 | 482 | 513 | 598 | 503 | | 615 | 517 |
| | EBS/EAI | n/a | 313 | 313 | 211 | | 326 | | | 334 |
| | CAI/WAI | n/a | 169 | 169 | 302 | | 177 | | | 183 |
| Shortraker rockfish | BSAI | 722 | 541 | 500 | 521 | 722 | 541 | | 722 | 541 |
| Other rockfish | BSAI | 1,751 | 1,313 | 916 | 900 | 1,751 | 1,313 | | 1,751 | 1,313 |
| | BS | n/a | 919 | 522 | 332 | n/a | 919 | | n/a | 919 |
| | AI | n/a | 394 | 394 | 568 | n/a | 394 | | n/a | 394 |
| Atka mackerel | BSAI | 85,580 | 73,590 | 62,257 | 58,571 | 91,870 | 78,510 | | 84,440 | 71,990 |
| | EAI/BS | n/a | 25,760 | 25,760 | 22,598 | | 27,260 | | | 25,000 |
| | CAI | n/a | 15,450 | 15,450 | 15,272 | | 16,880 | | | 15,470 |
| | WAI | n/a | 32,380 | 21,047 | 20,701 | | 34,370 | | | 31,520 |
| Skates | BSAI | 49,297 | 41,257 | 18,000 | 18,729 | 47,790 | 39,958 | | 46,475 | 38,824 |
| Sharks | BSAI | 689 | 517 | 200 | 354 | 689 | 517 | | 689 | 517 |
| Octopuses | BSAI | 4,769 | 3,576 | 700 | 161 | 4,769 | 3,576 | | 4,769 | 3,576 |
| Total | BSAI | 3,945,315 | 2,747,727 | 2,000,000 | 1,774,309 | 2,953,182 | 2,322,082 | | 3,253,770 | 2,564,366 |