Eastern Bering Sea pollock stock assessment

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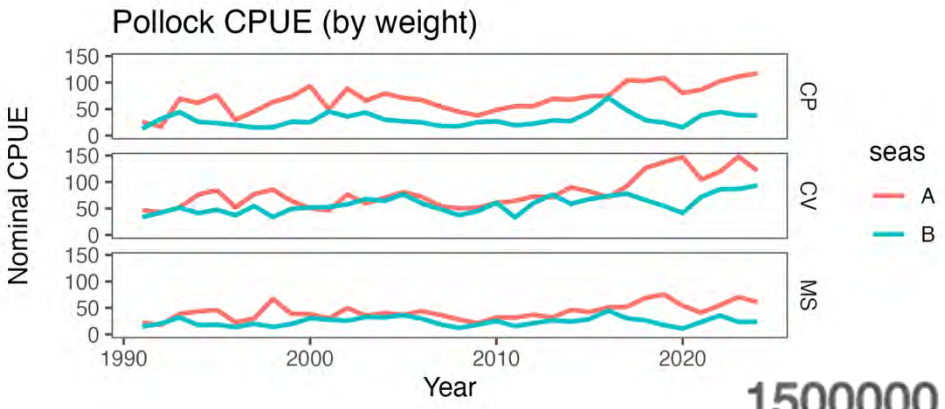
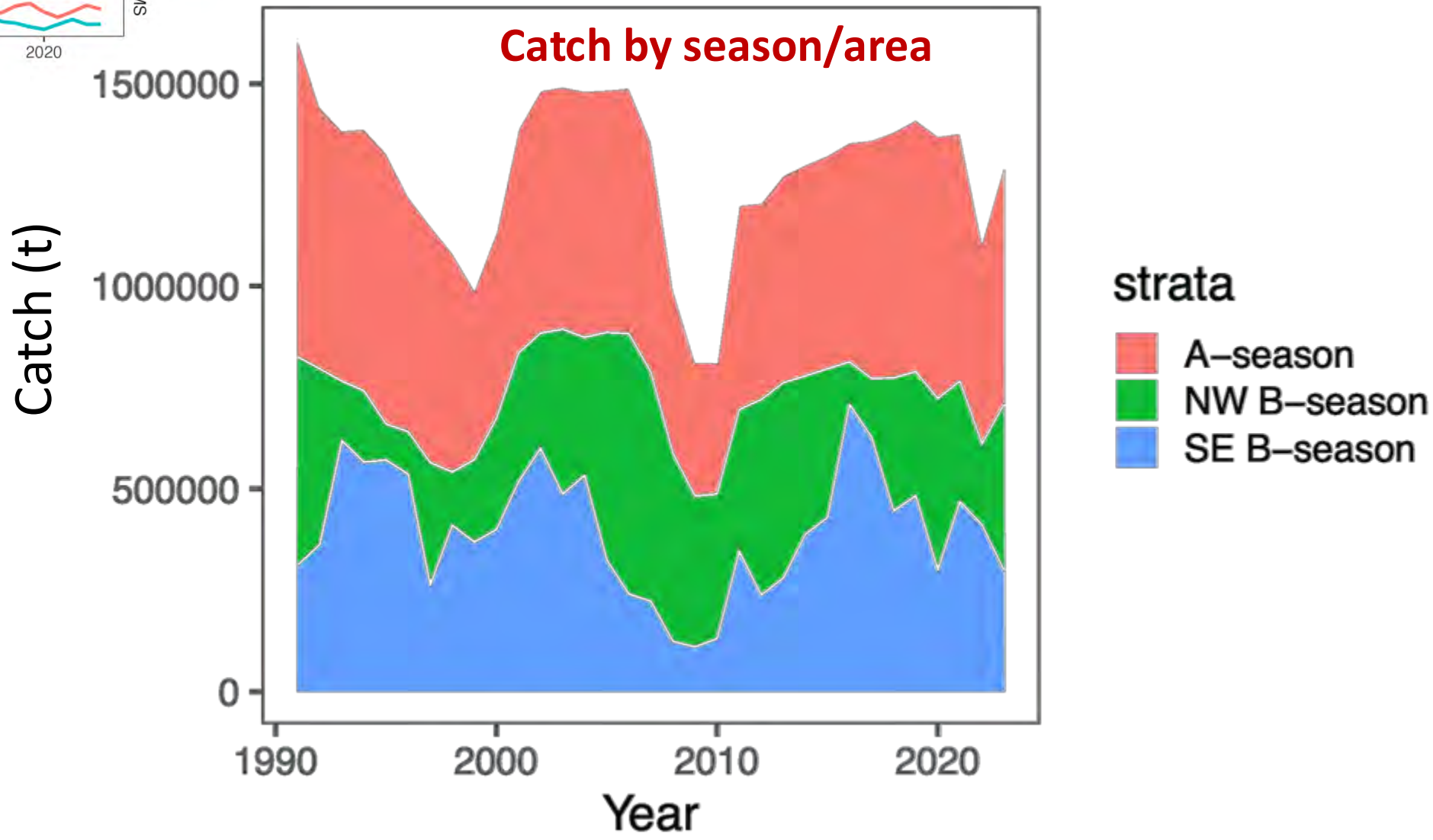
Alaska Fisheries Science Center

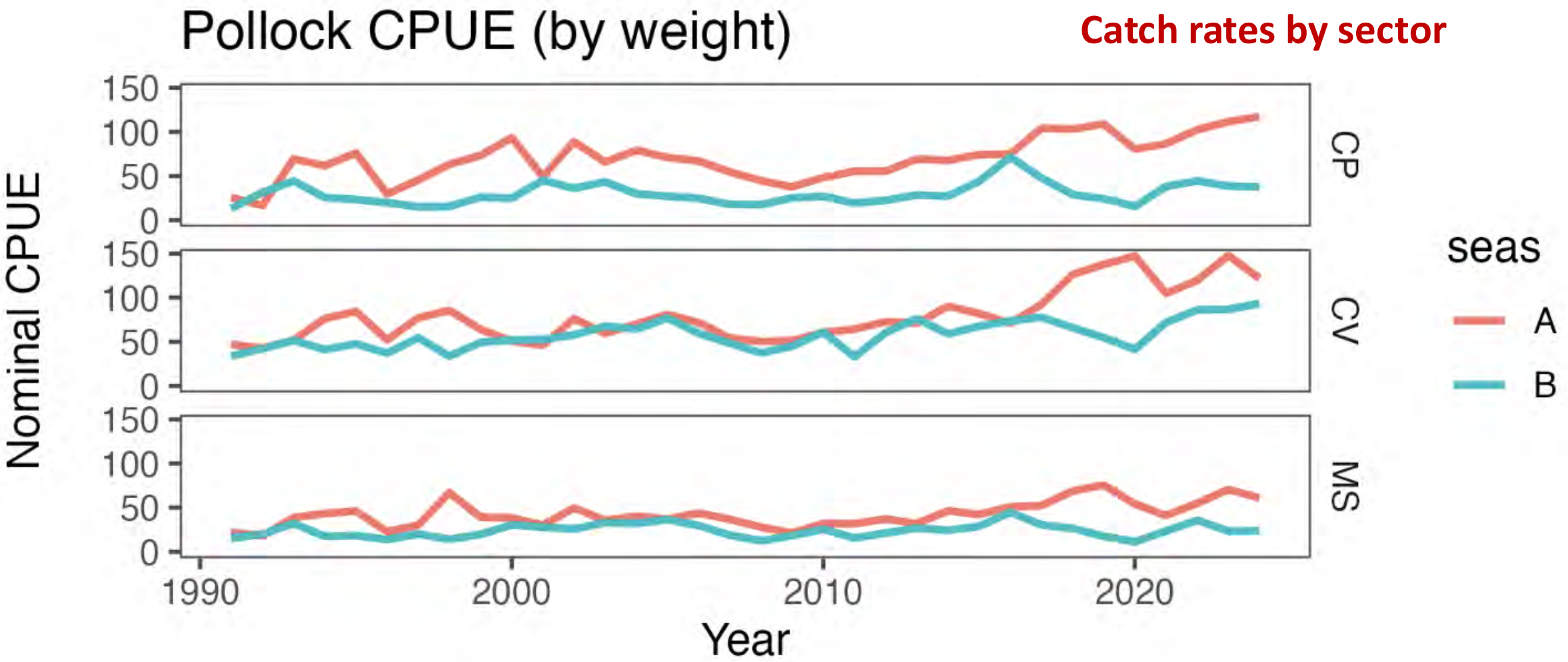
Fishing conditions





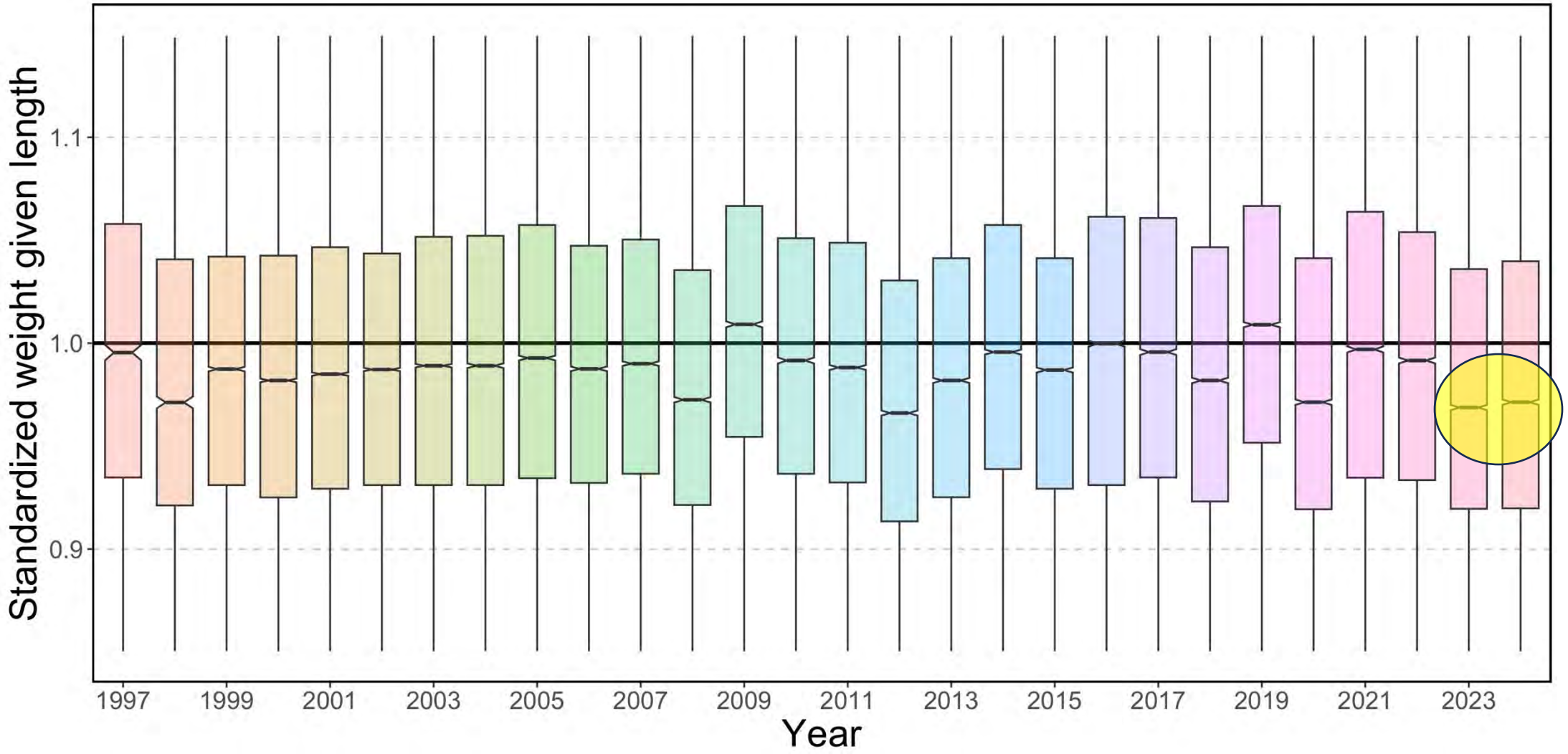
Fishing conditions

Catch rates by sector



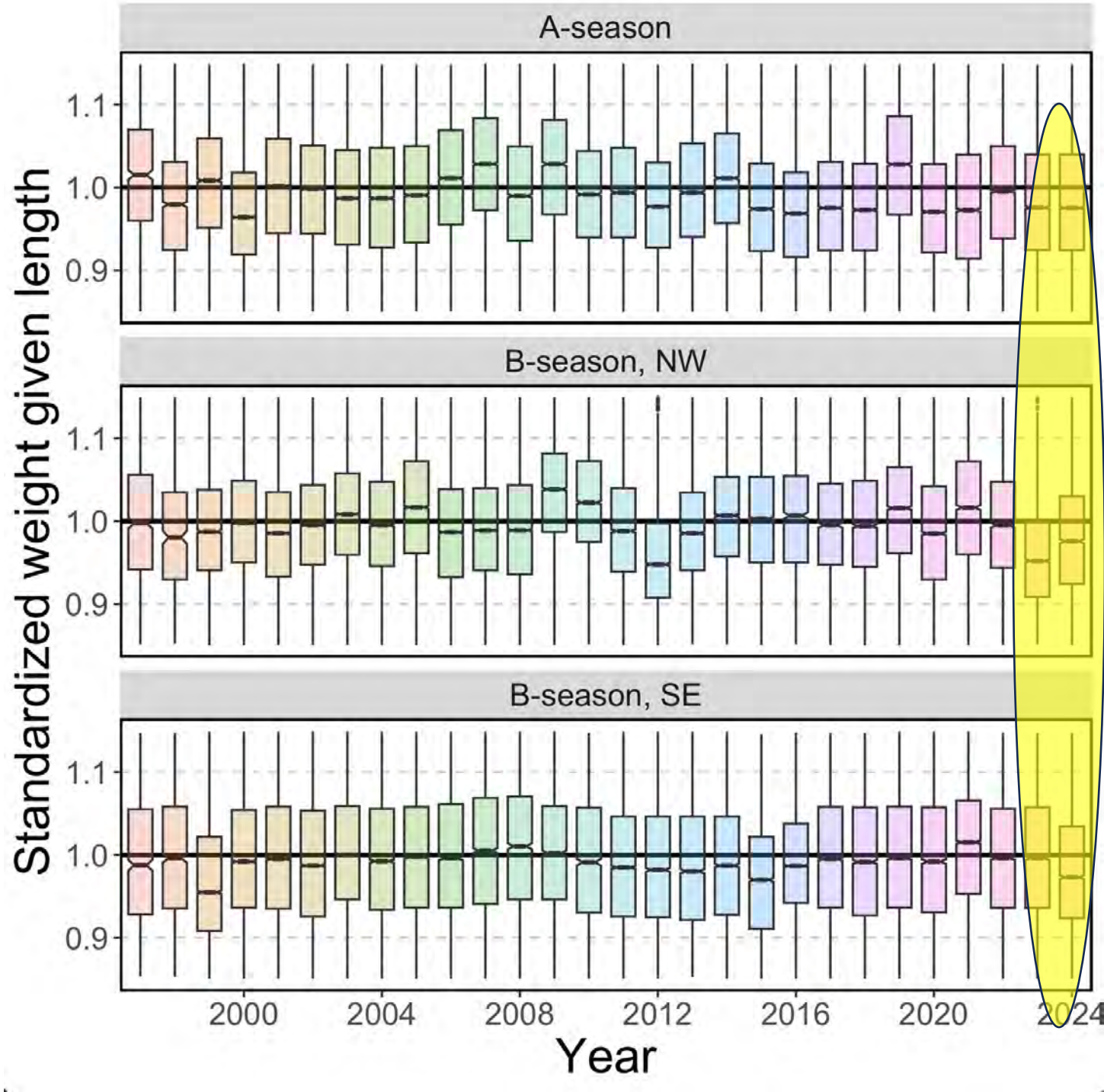
Fishery data on pollock “condition”

- Relative [figure 26 updated in SAFE chapter]



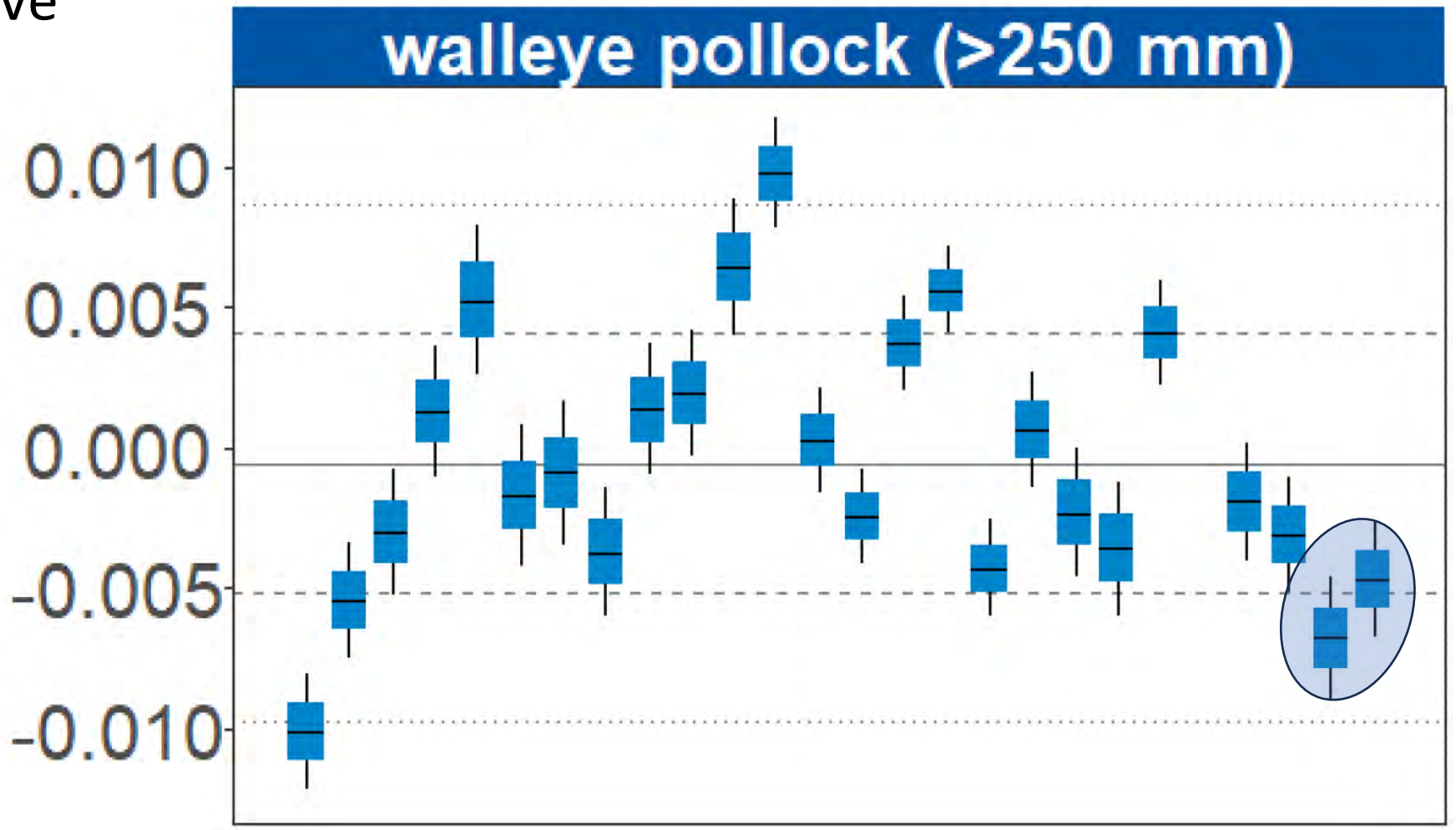
Fishery data on pollock “condition”

- Relative
  [figure 25 updated in SAFE chapter]

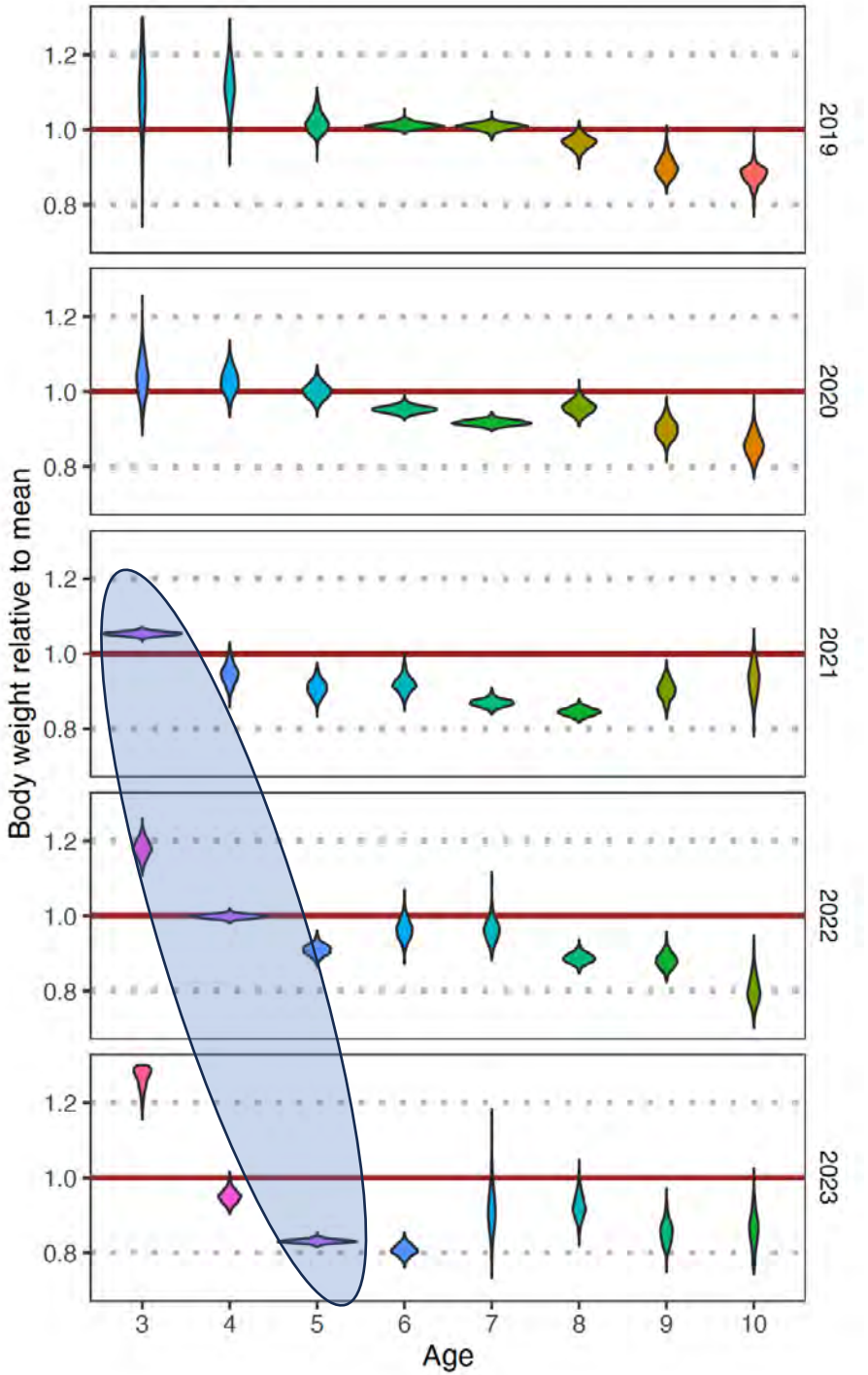


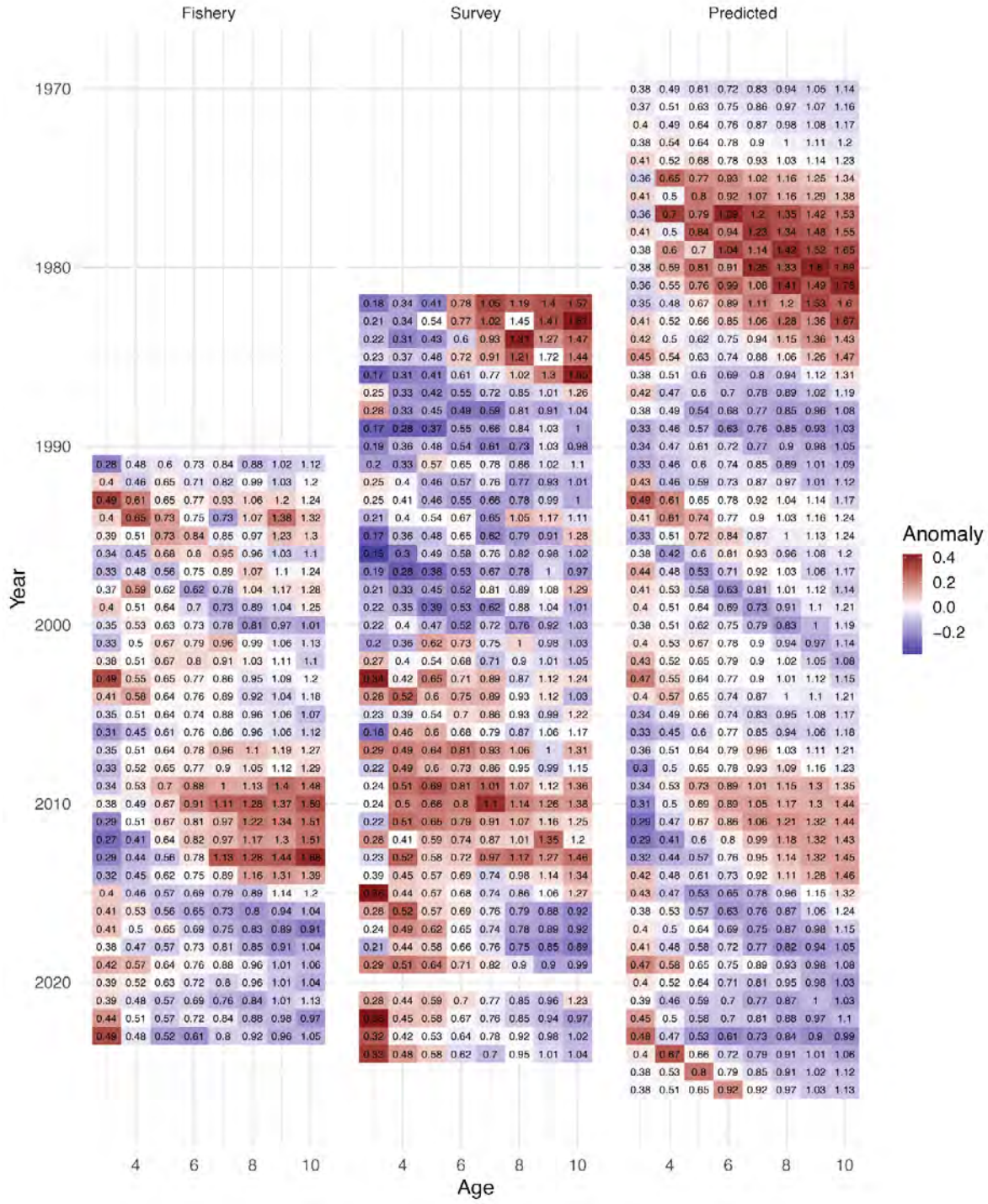
Survey data on pollock condition…

- Relative

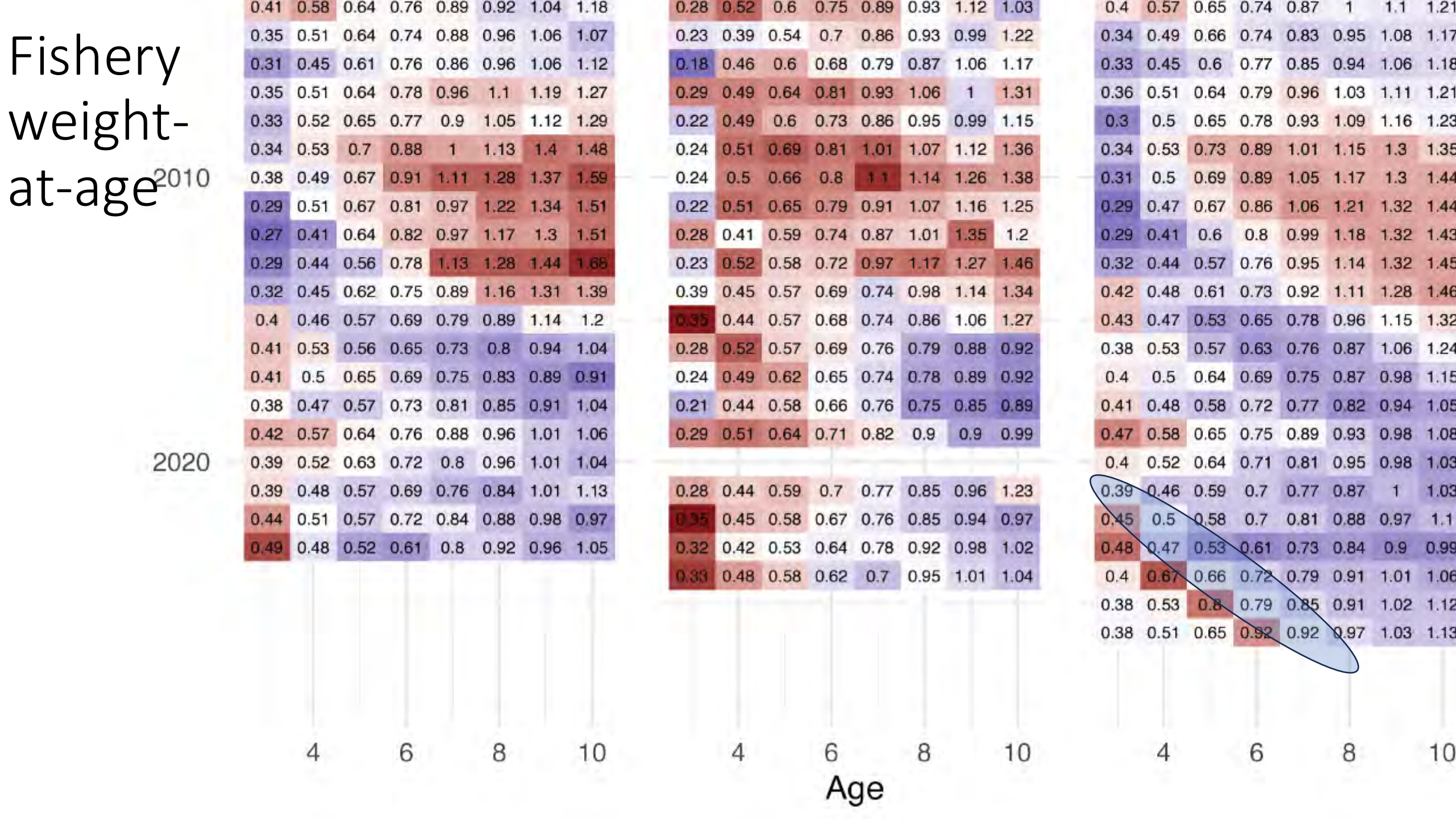


Fishery weight-at-age

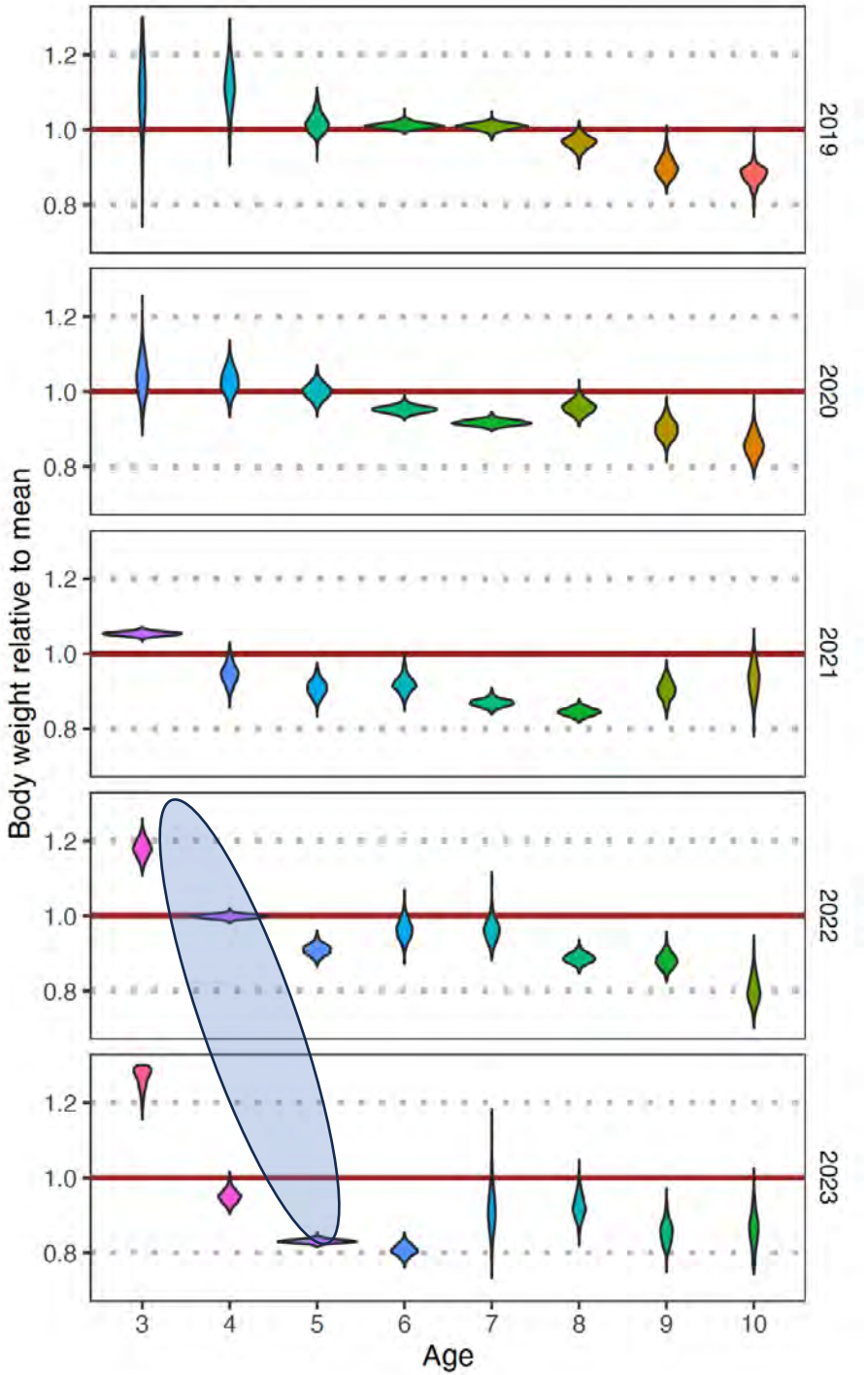


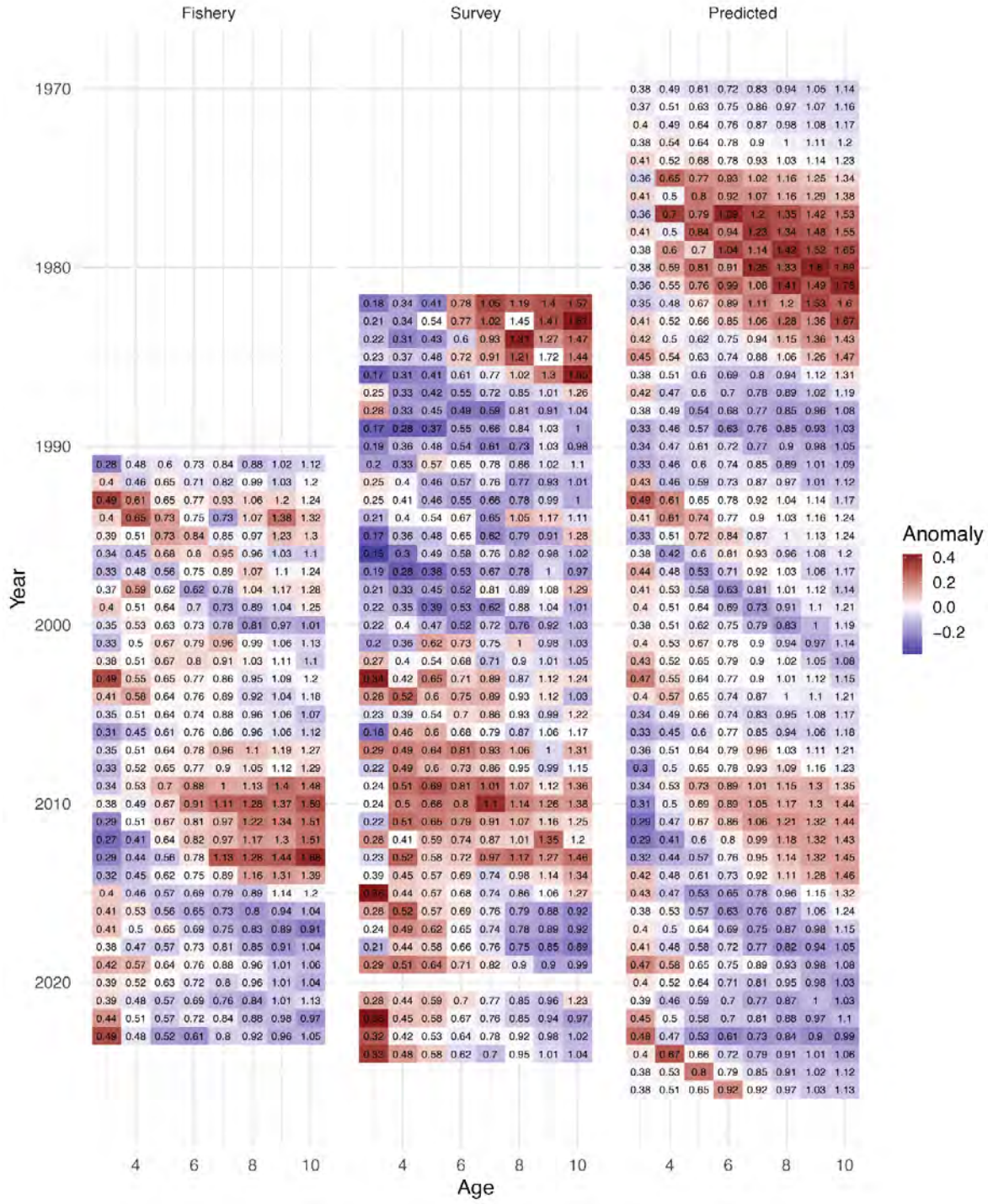


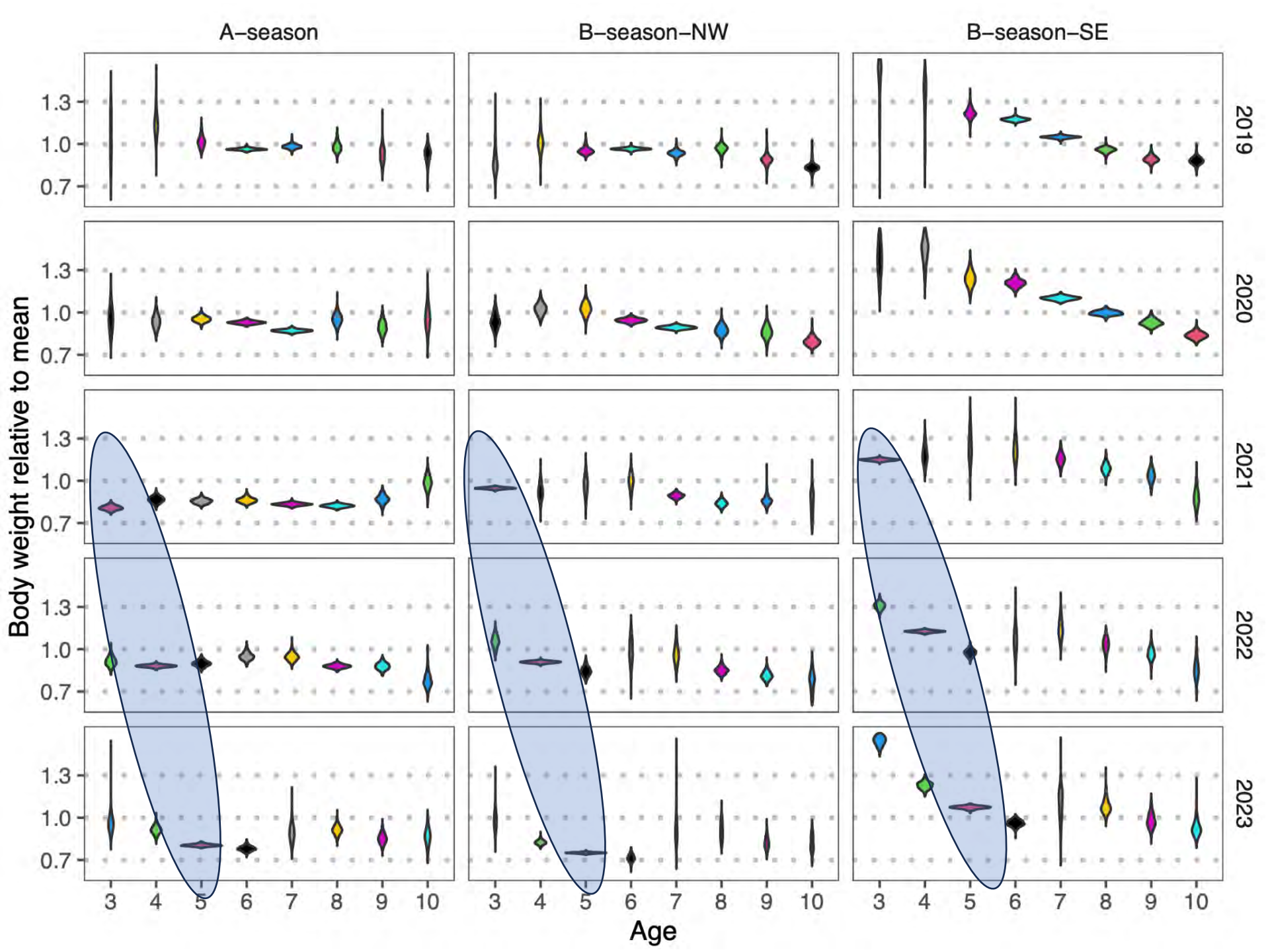
Fishery weight-at-age



Fishery weight-at-age

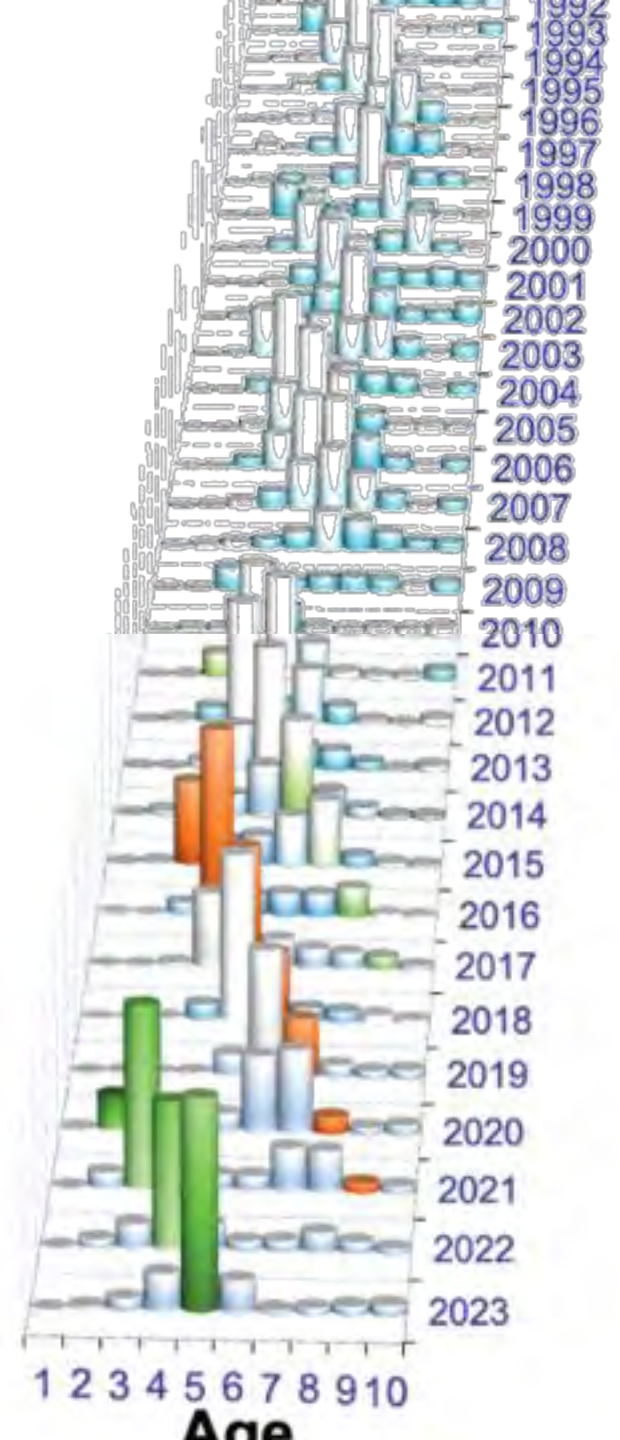


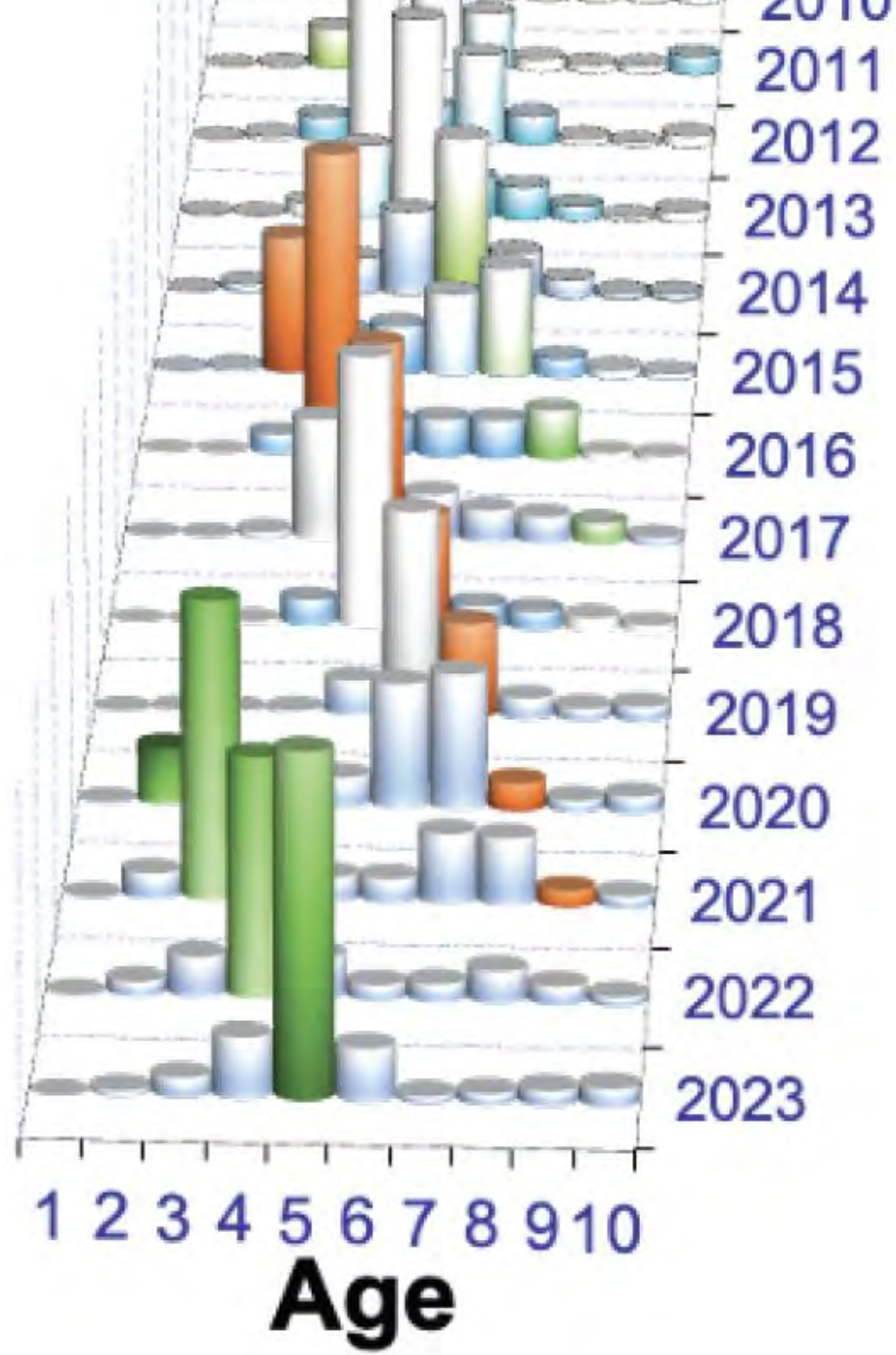




Fishery weight-at-age by season and area

Fishery catch-at-age



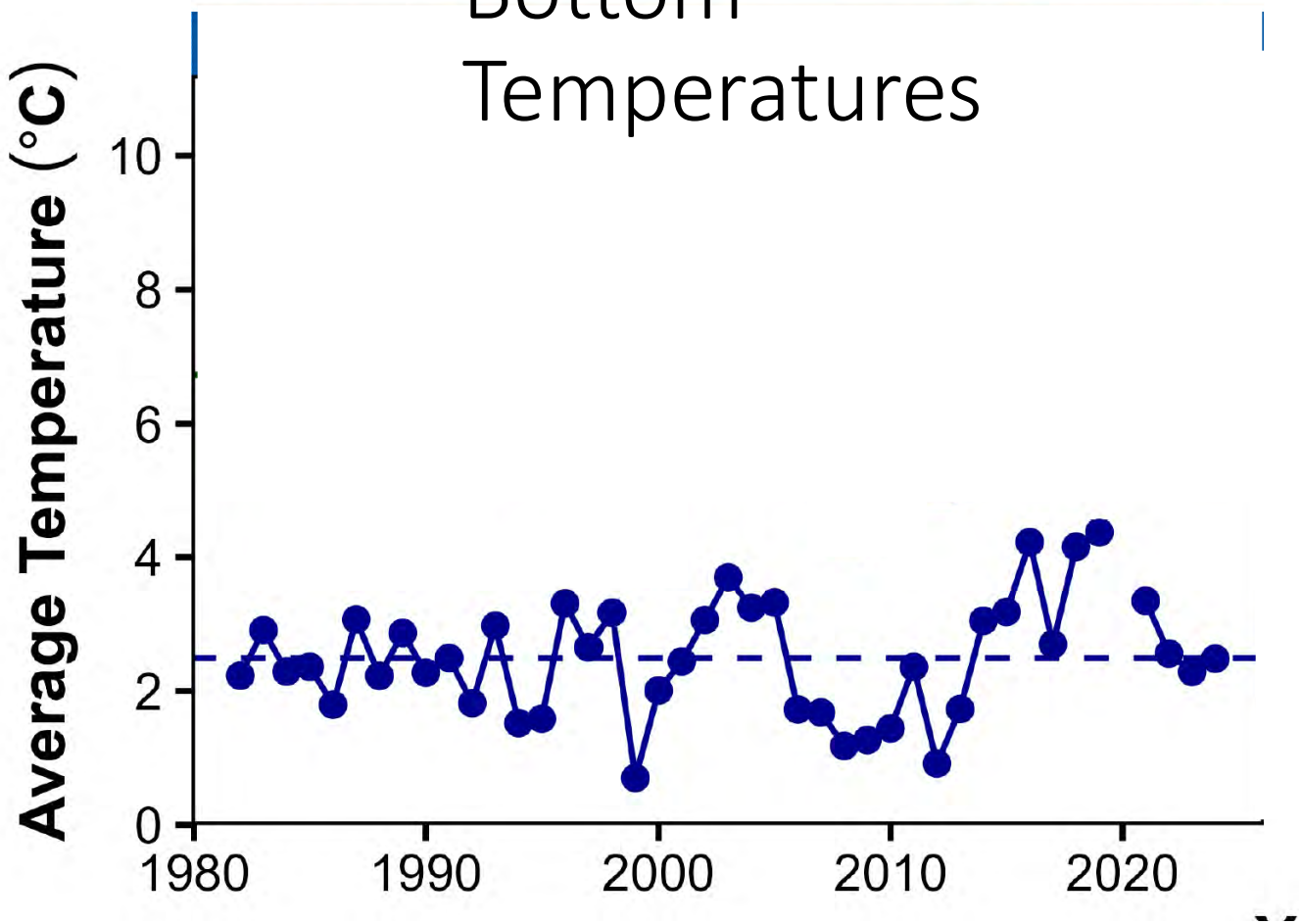

2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
1 2 3 4 5 6 7 8 9 10
Age

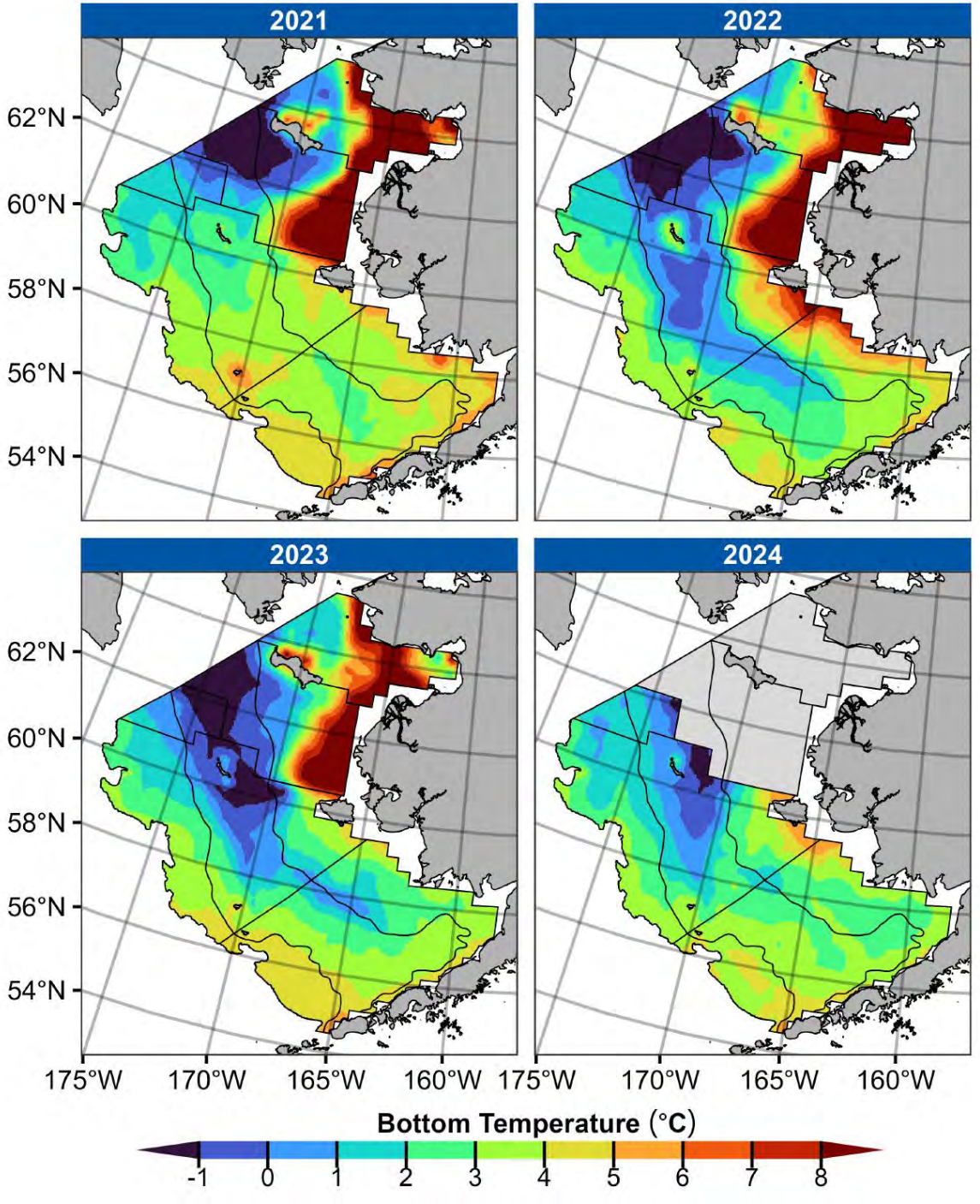
Survey work

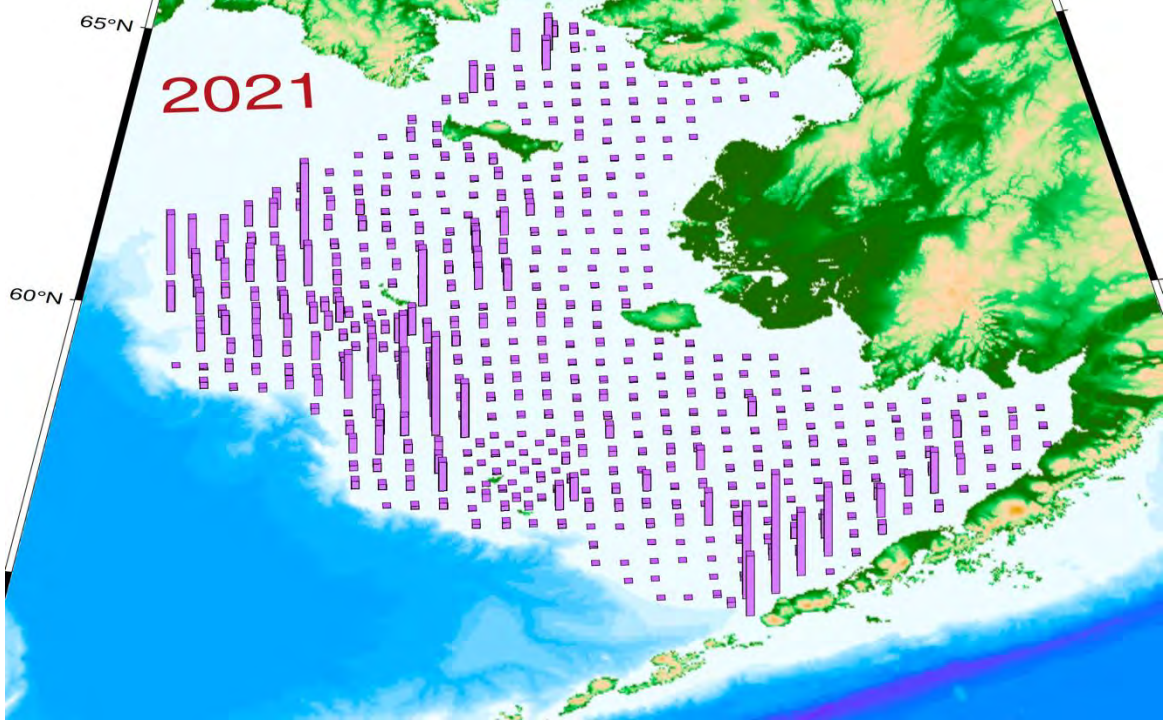
FV *Alaska Knight*
2010-present
12th year

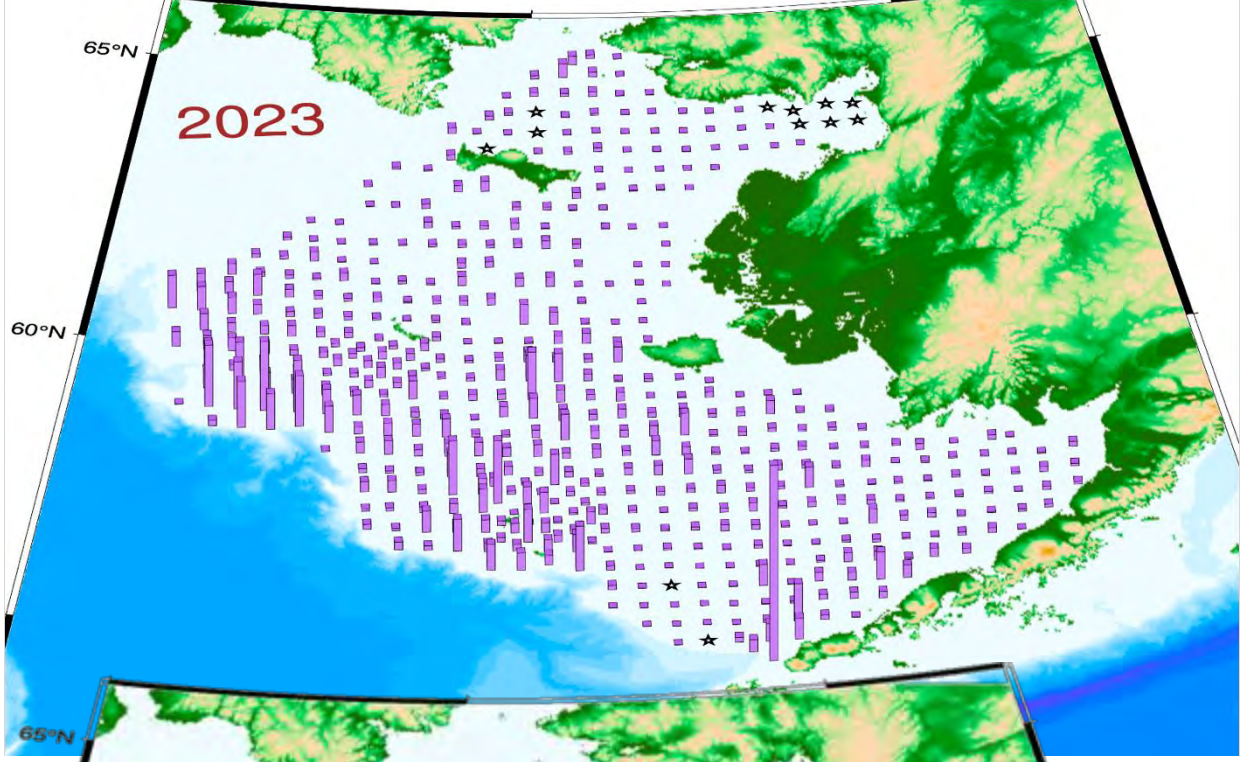
FV *Northwest Explorer*
2023
1st year

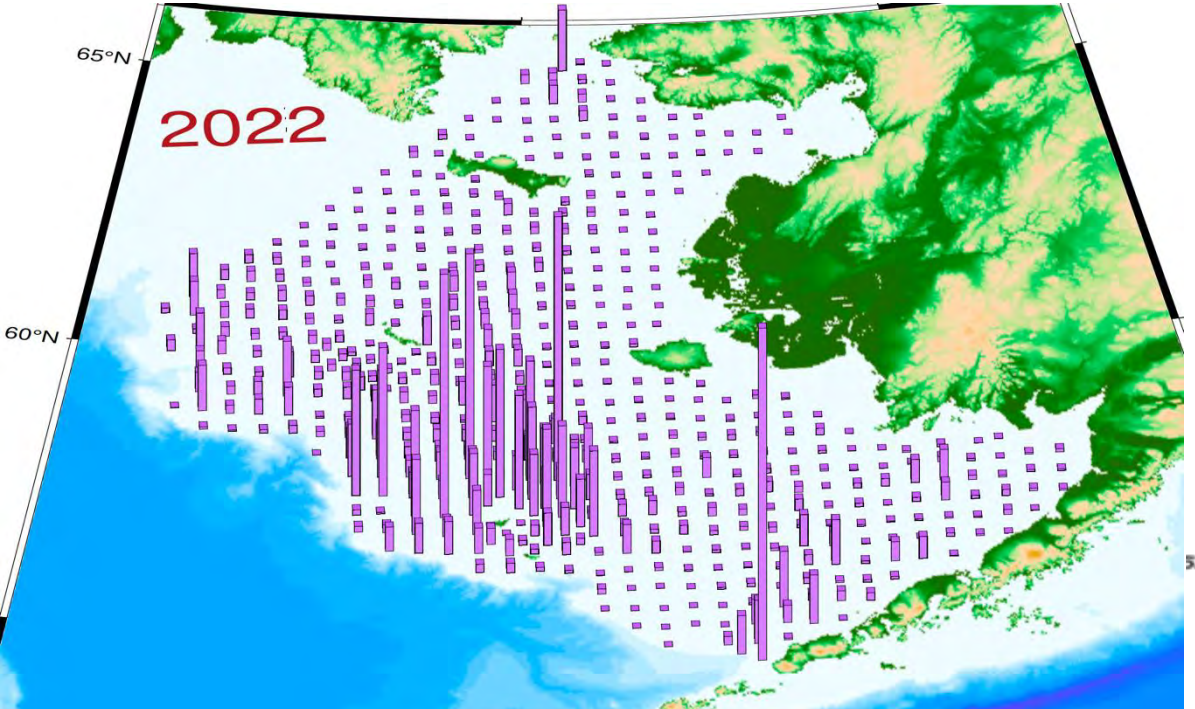
Survey Bottom Temperatures

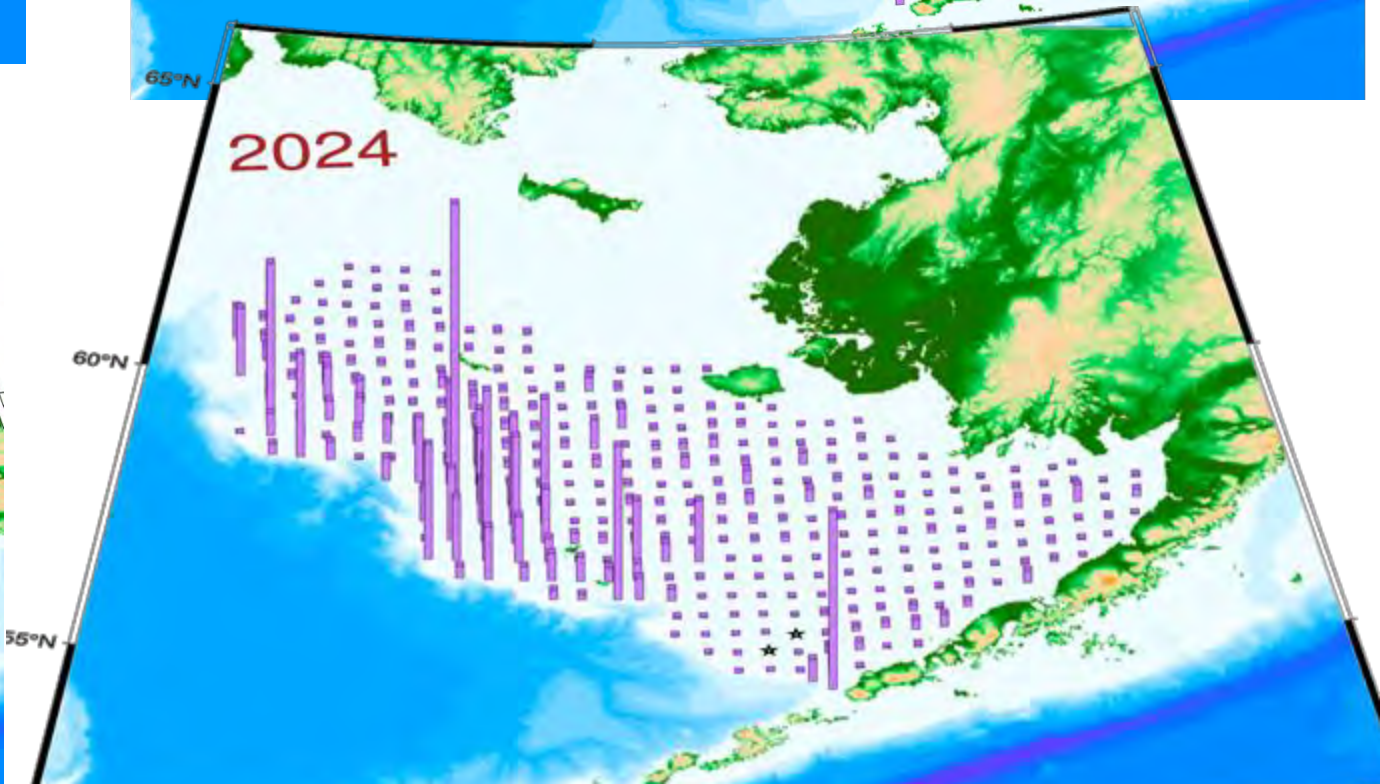





65°N
2021
60°N

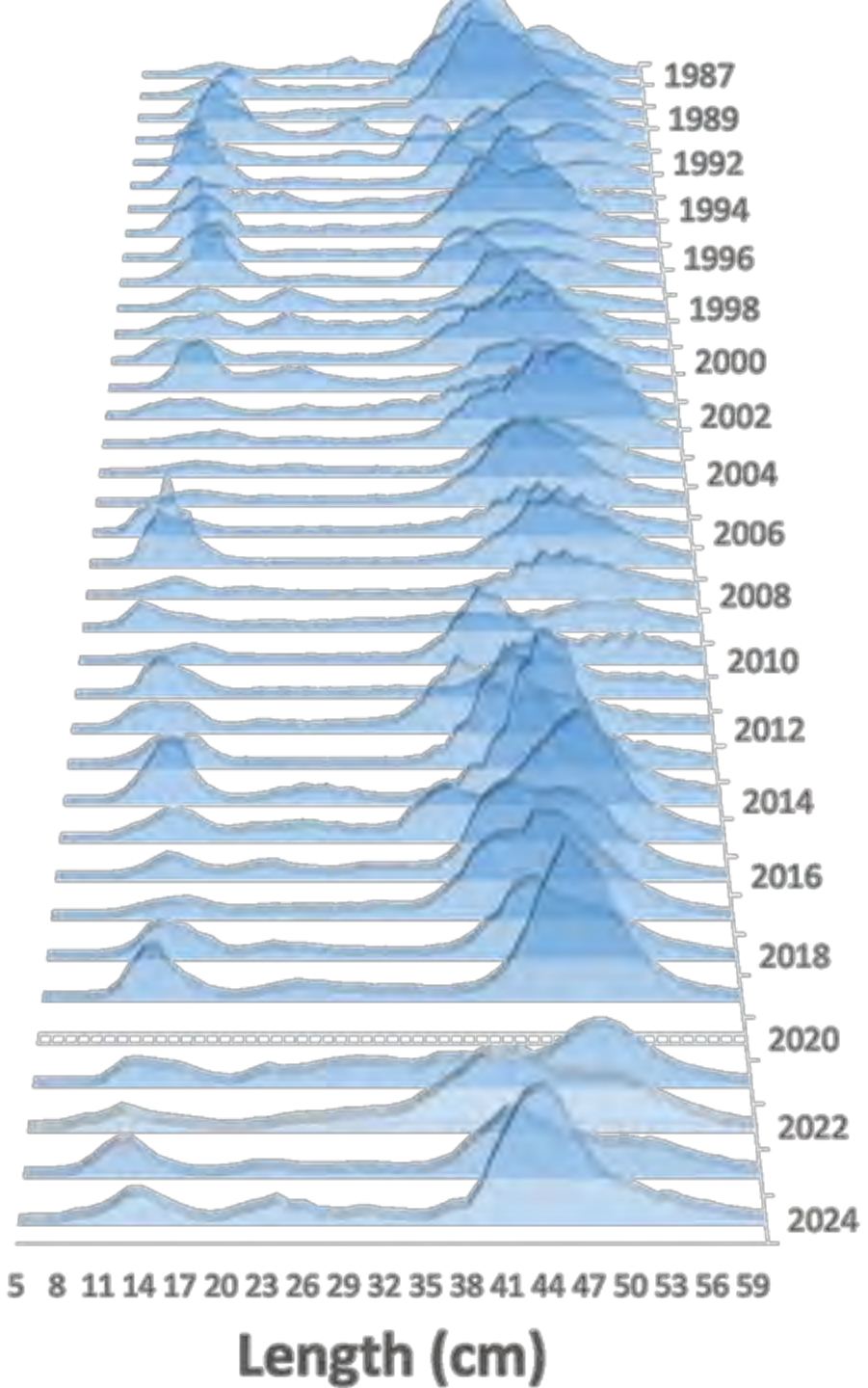

65°N
2023
60°N


65°N
2022
60°N


65°N
2024
60°N
55°N

Bottom-trawl survey

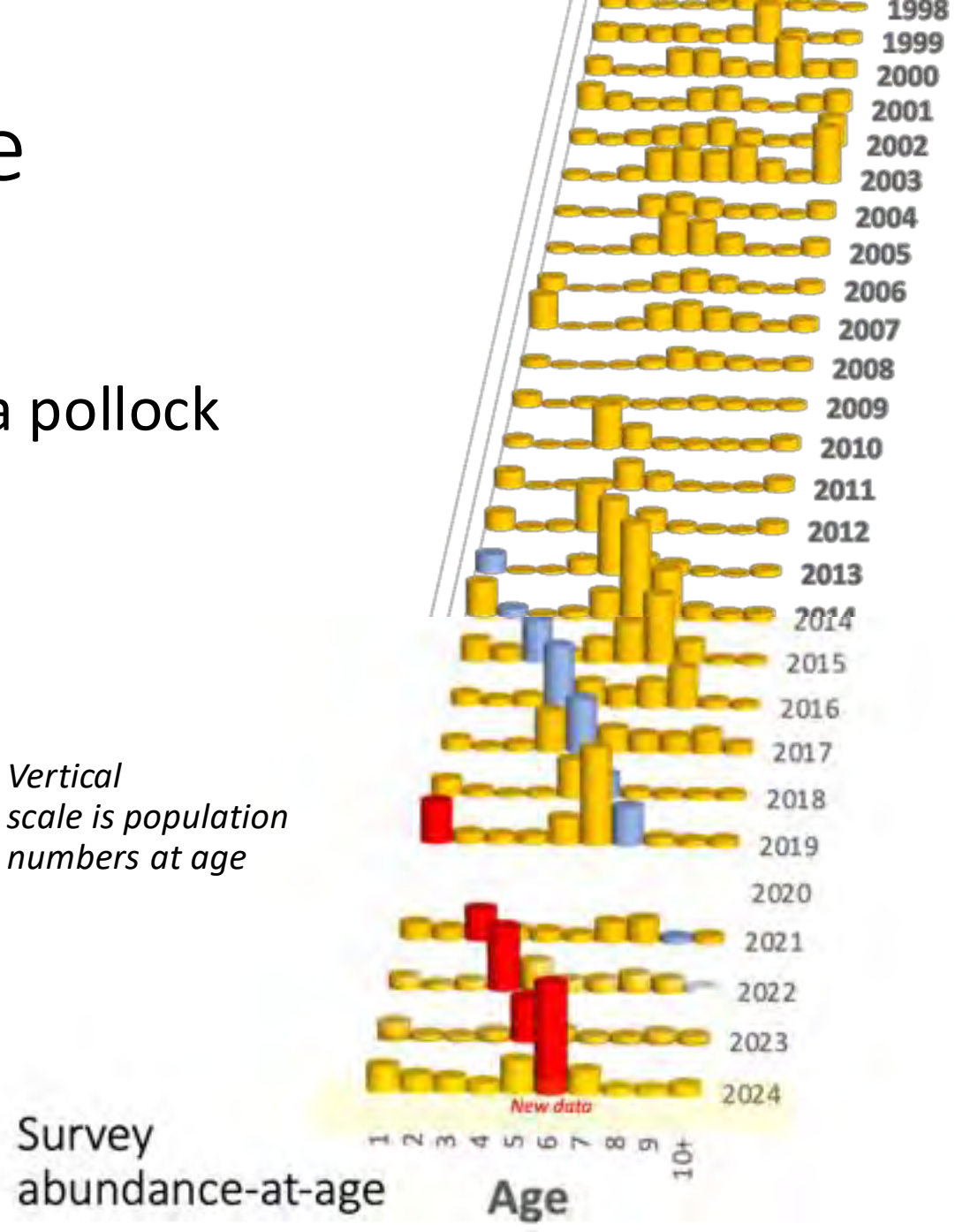
- Abundance at length



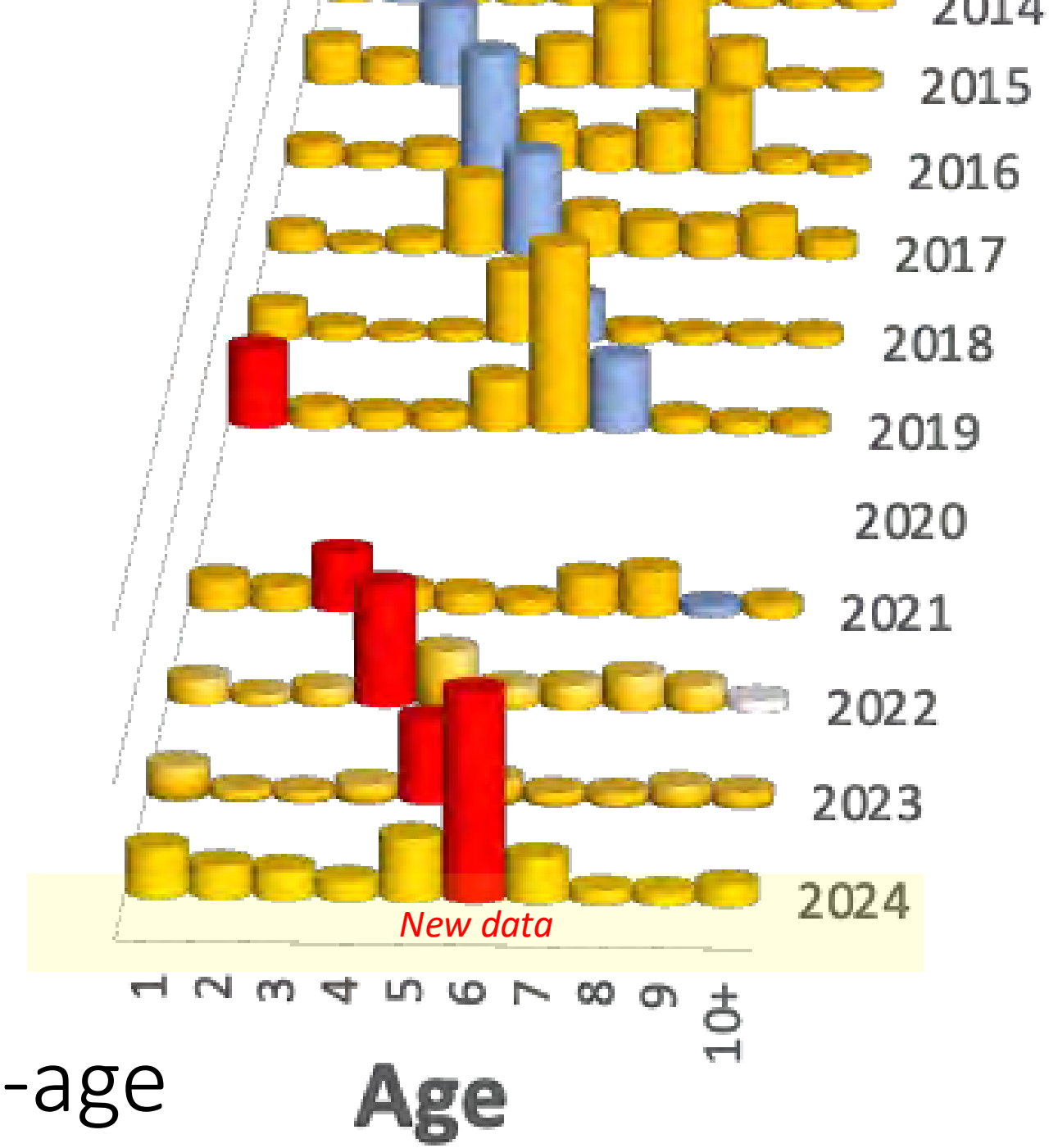
Survey abundance-at-age

- Eastern Bering Sea pollock

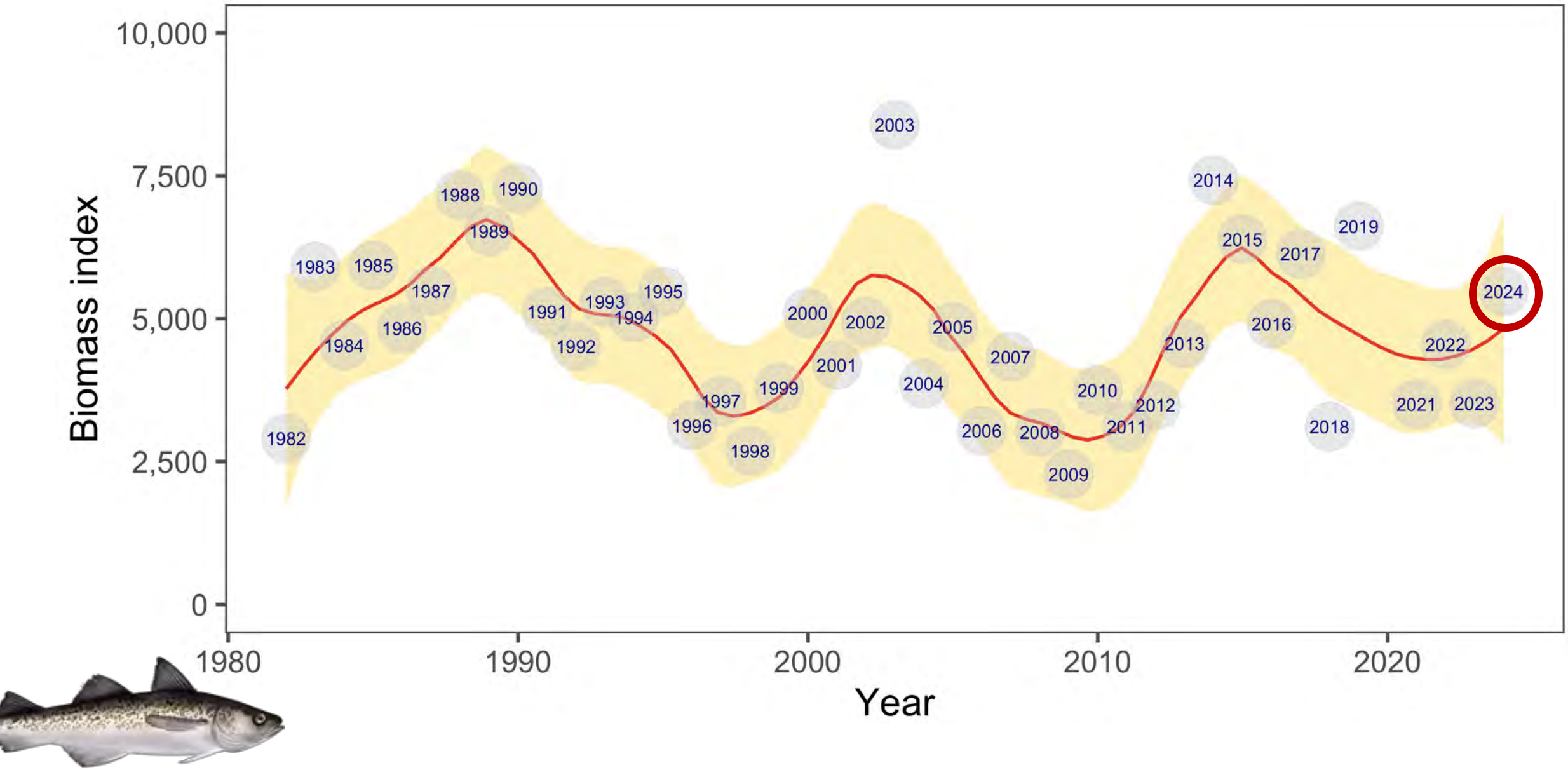
Vertical scale is population numbers at age



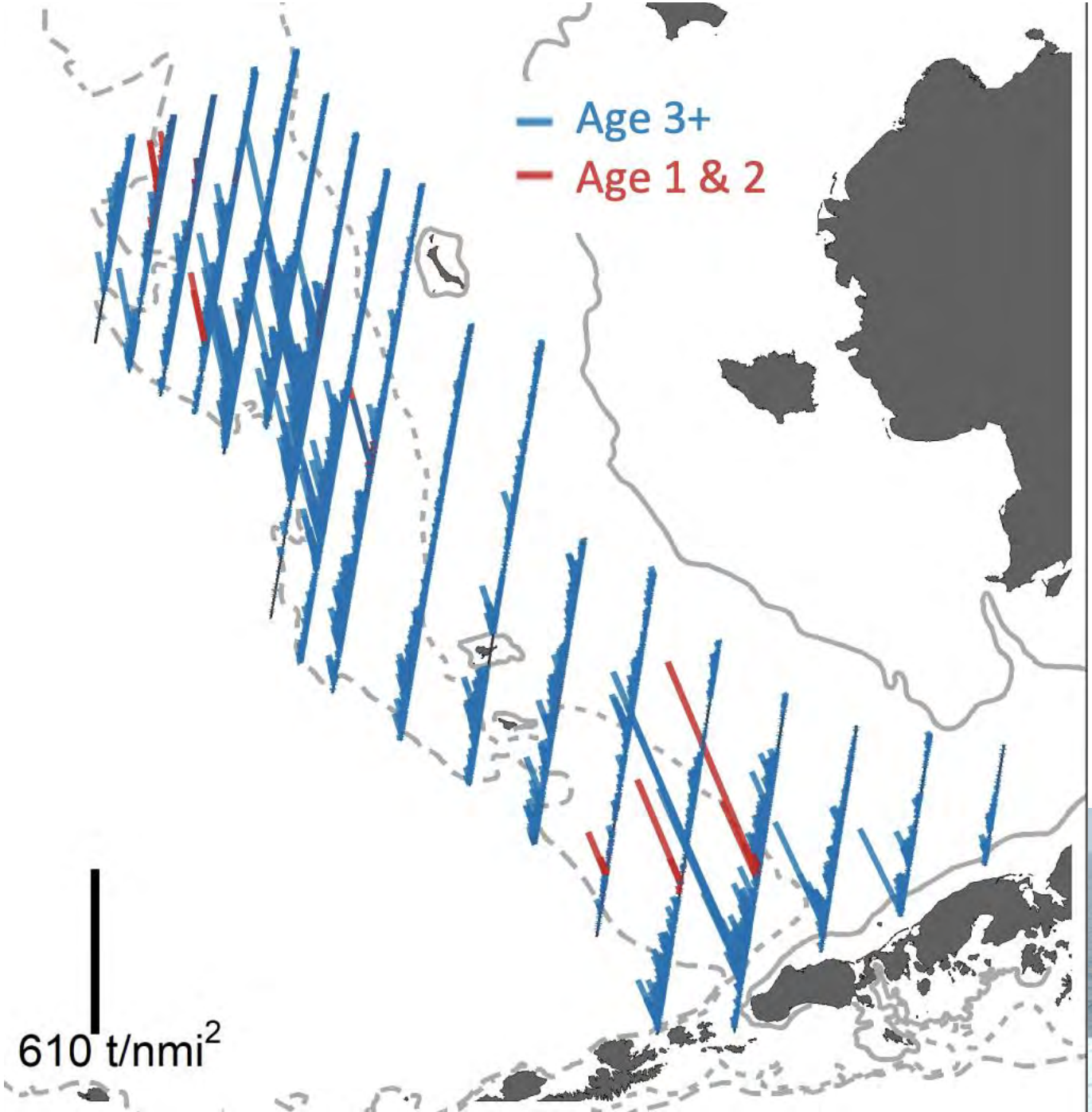
Survey abundance-at-age



E. Bering Sea bottom trawl survey

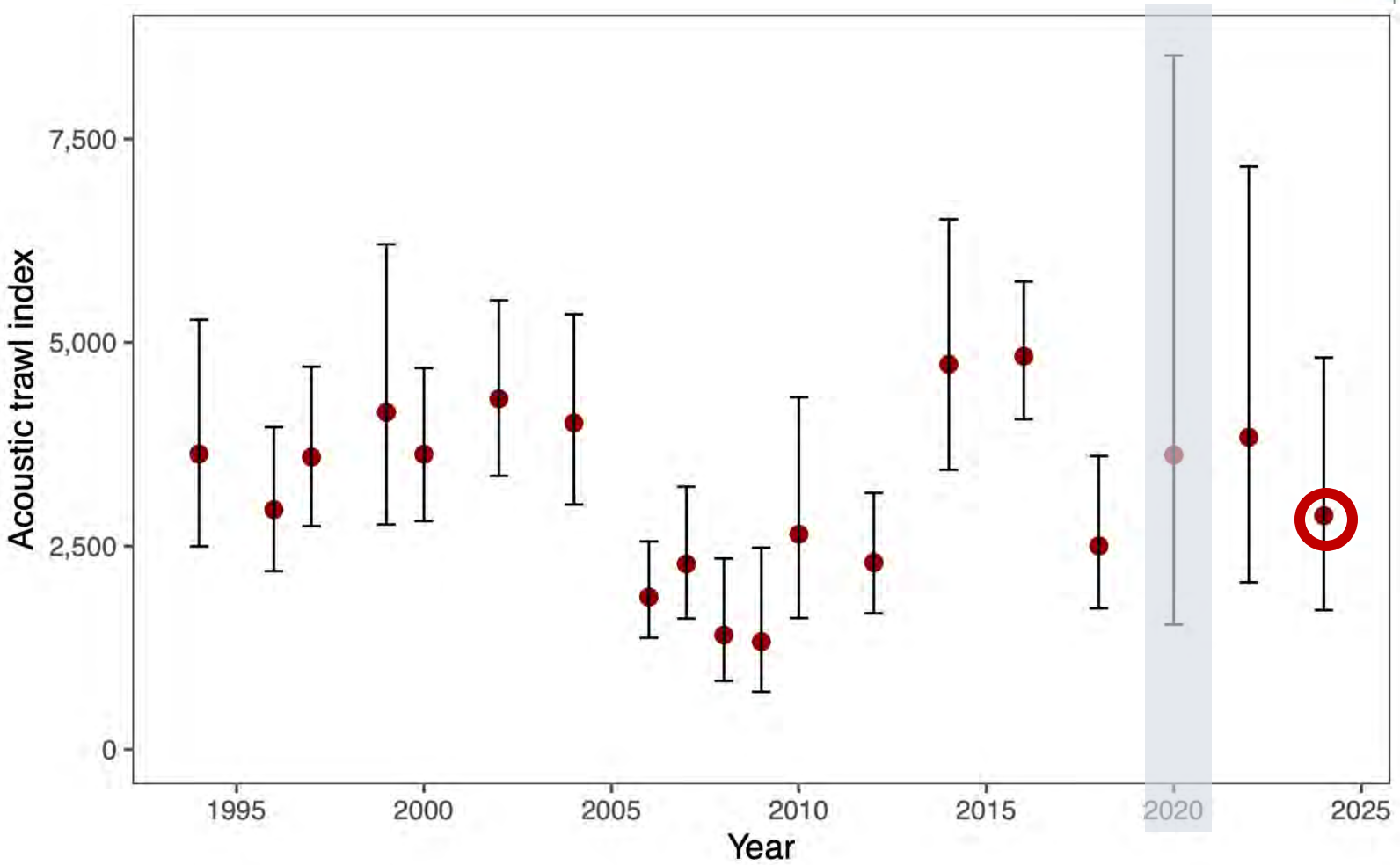


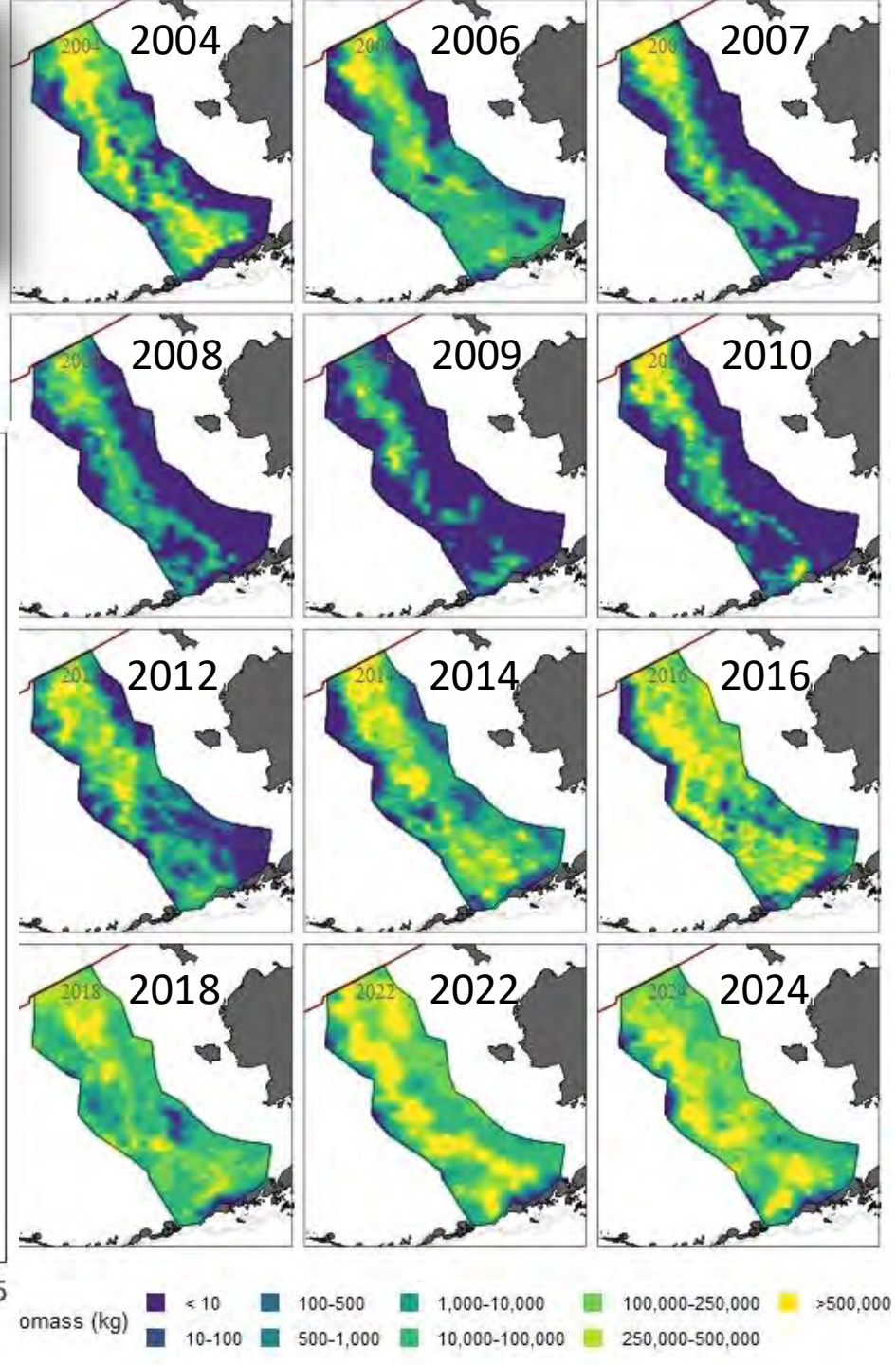
Acoustic survey-NOAA Ship



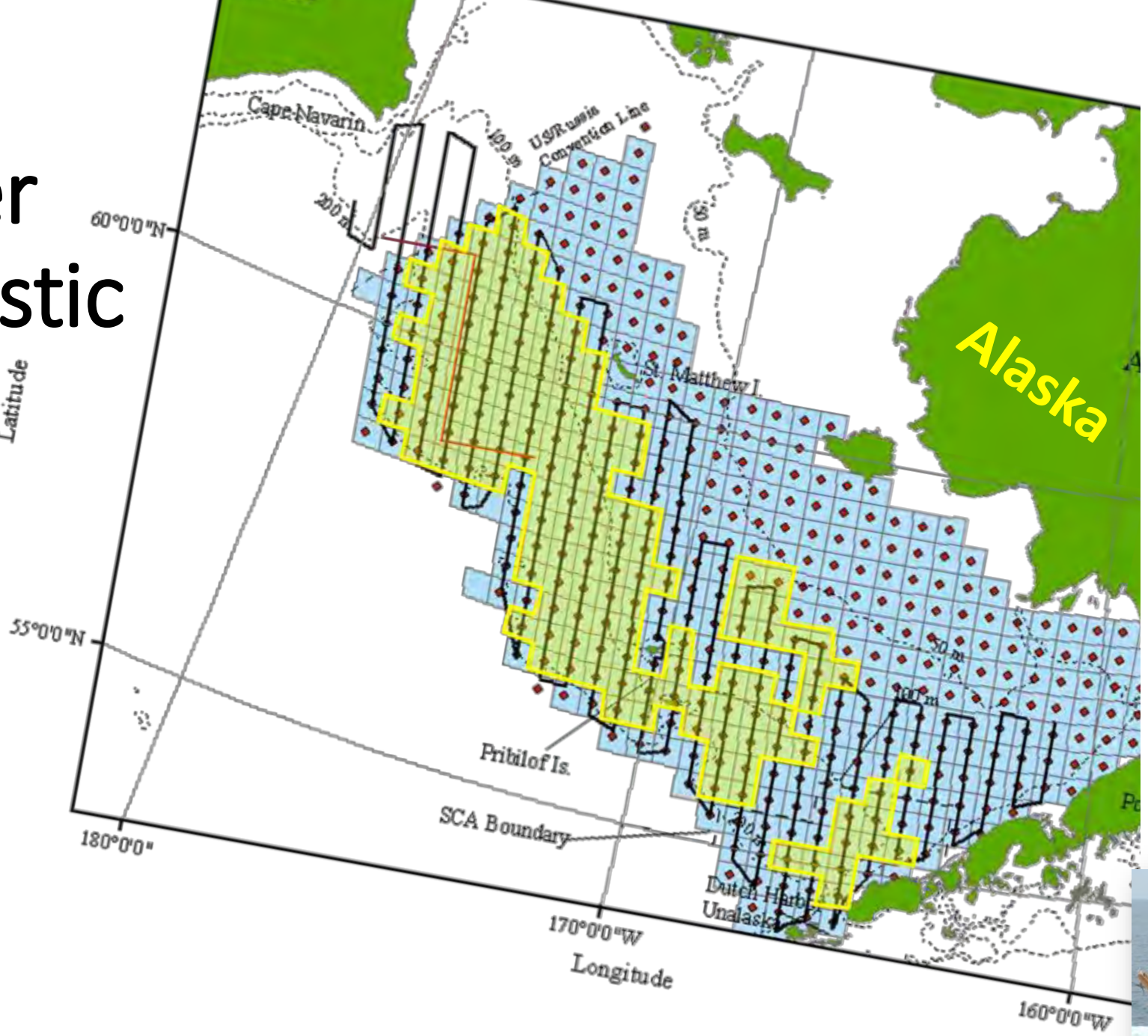
New survey this summer

Acoustic-trawl survey (ATS)

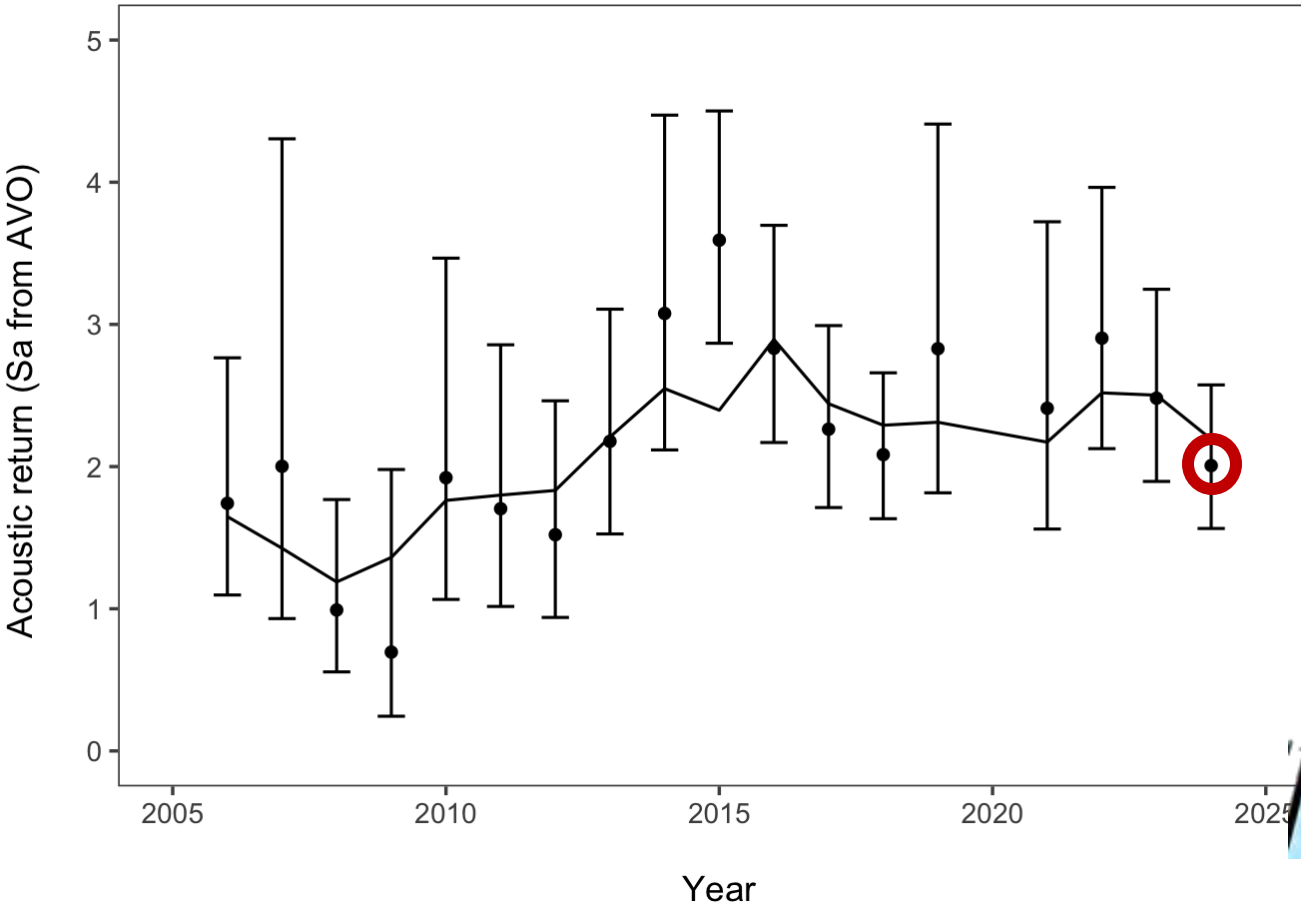


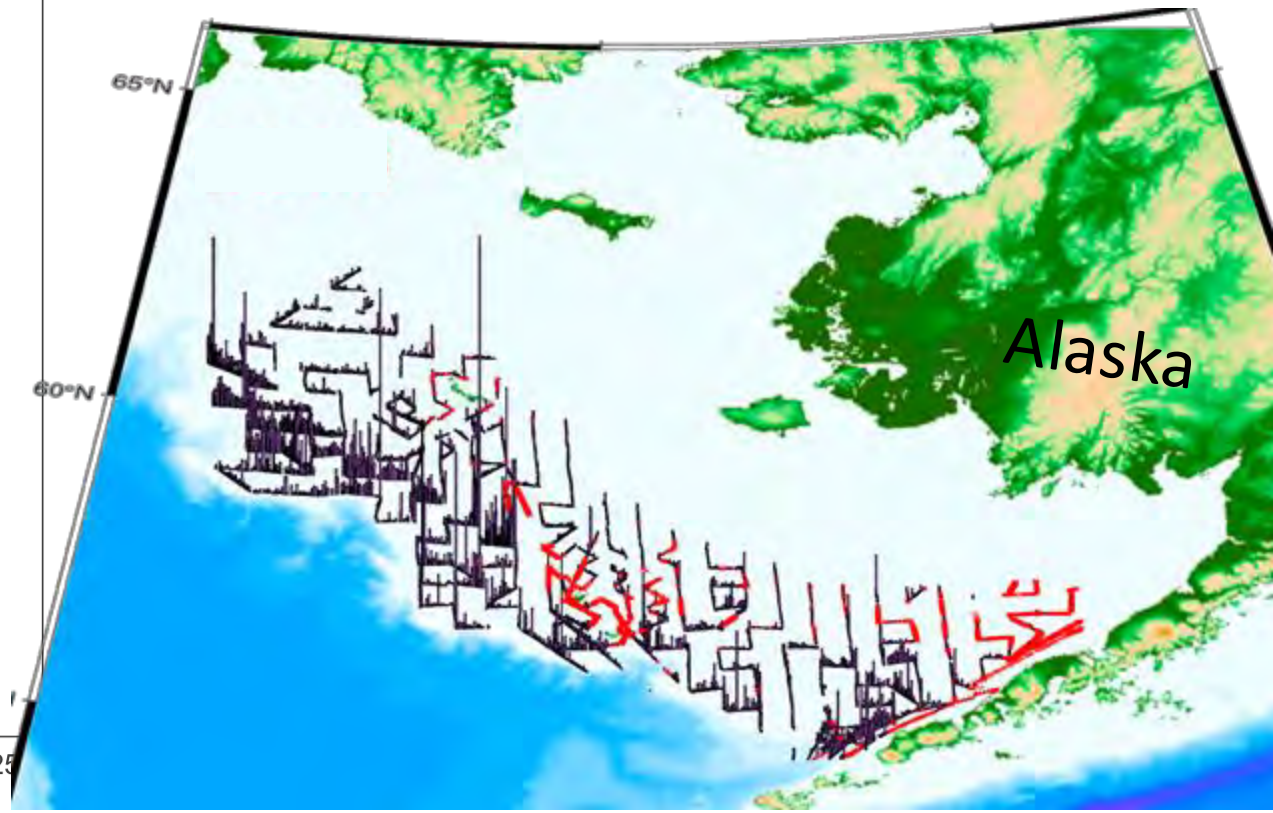


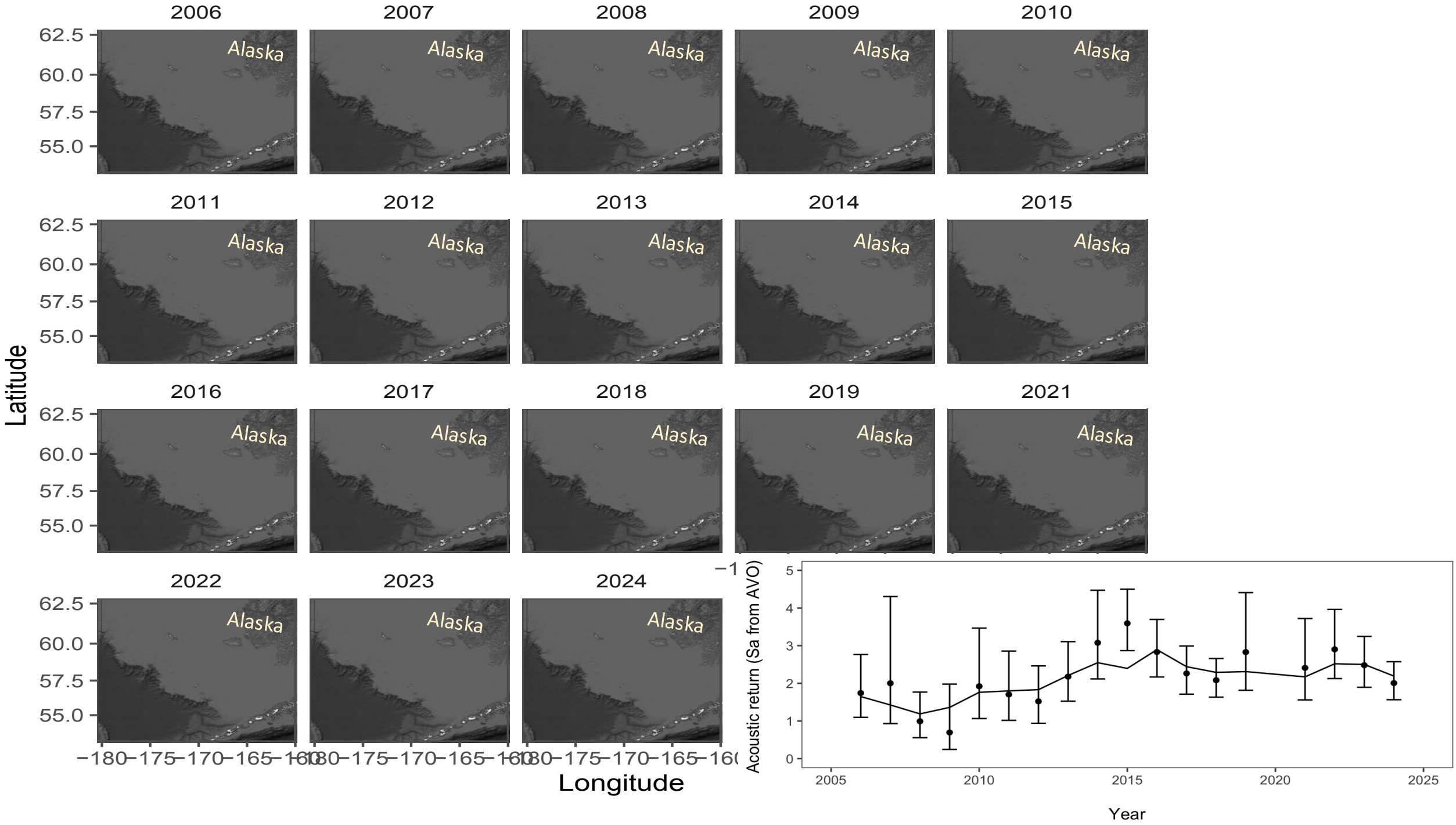
Other acoustic data

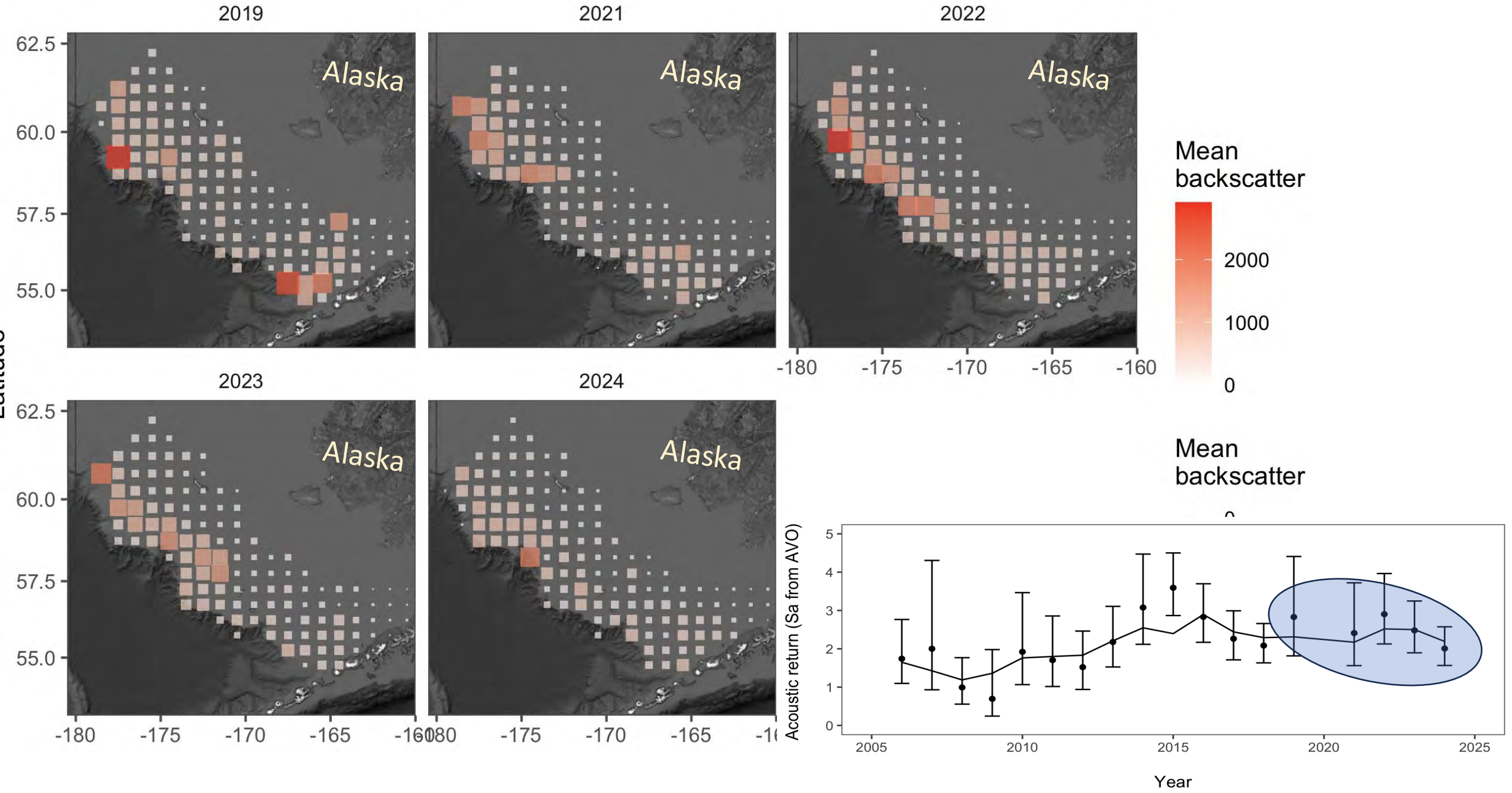


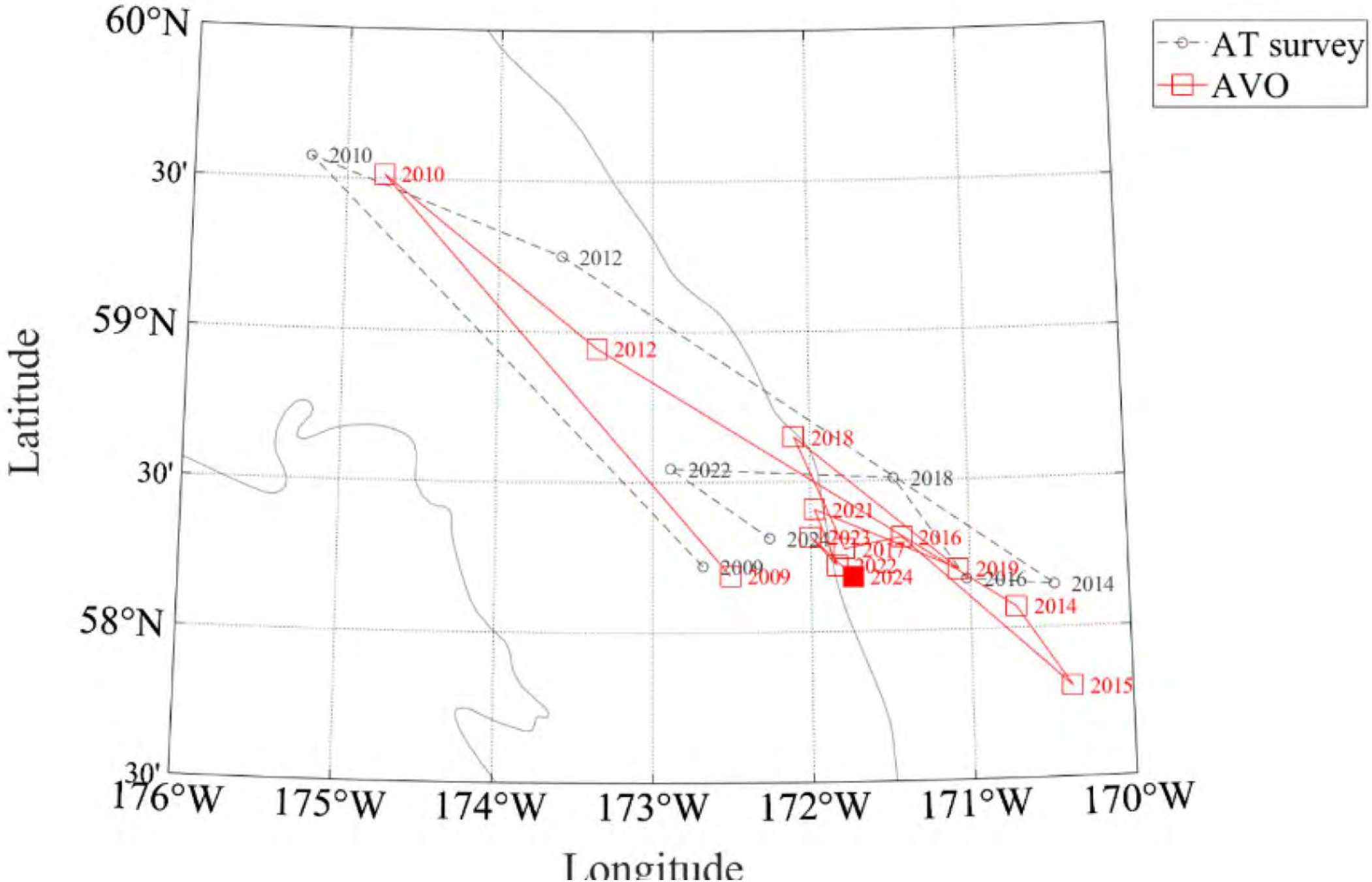
Opportunistic acoustic survey results






2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2021
2022
2023
2024
Alaska
62.5
60.0
57.5
55.0
Latitude
−180
−175
−170
−165
Longitude
Acoustic return (Sa from AVO)
0
1
2
3
4
5
2005
2010
2015
2020
2025
Year


2019
2021
2022
2023
2024
Alaska
62.5
60.0
57.5
55.0
-180
-175
-170
-165
-160
Mean backscatter
2000
1000
0
Mean backscatter
Acoustic return (Sa from AVO)
5
4
3
2
1
0
2005
2010
2015
2020
2025
Year


AT survey
AVO
60°N
30'
59°N
30'
58°N
30'
Latitude
176°W
175°W
174°W
173°W
172°W
171°W
170°W
Longitude
2010
2010
2012
2012
2018
2022
2018
2021
2023
2016
2017
2022
2024
2009
2009
2019
2016
2014
2014
2015

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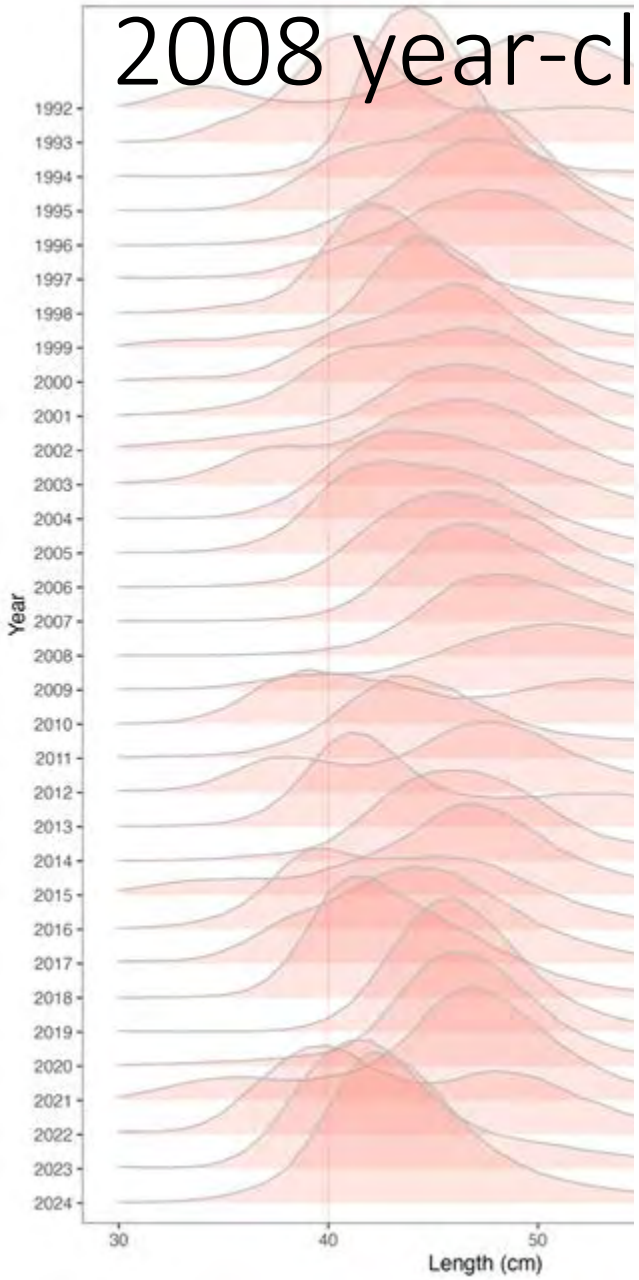
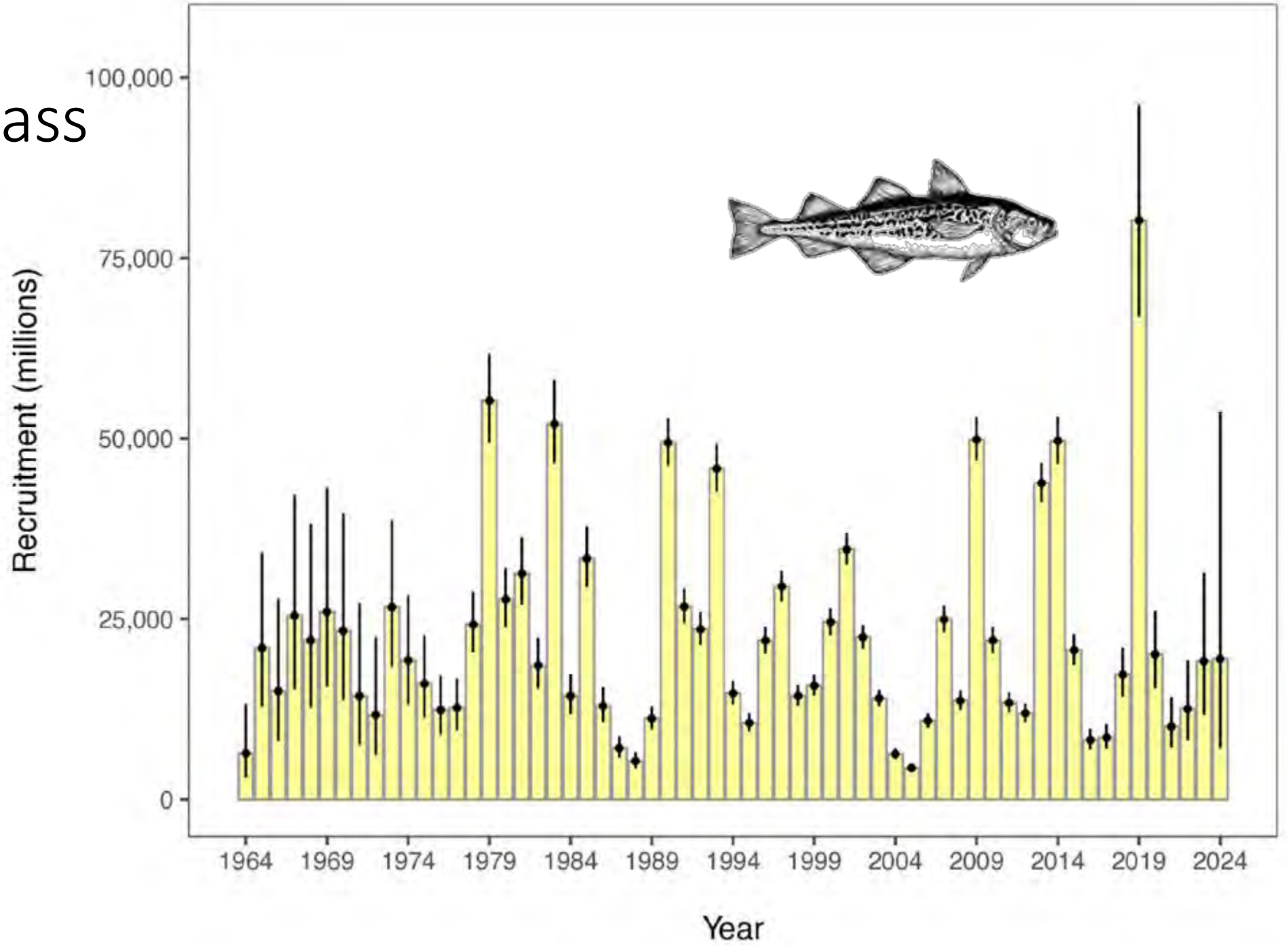
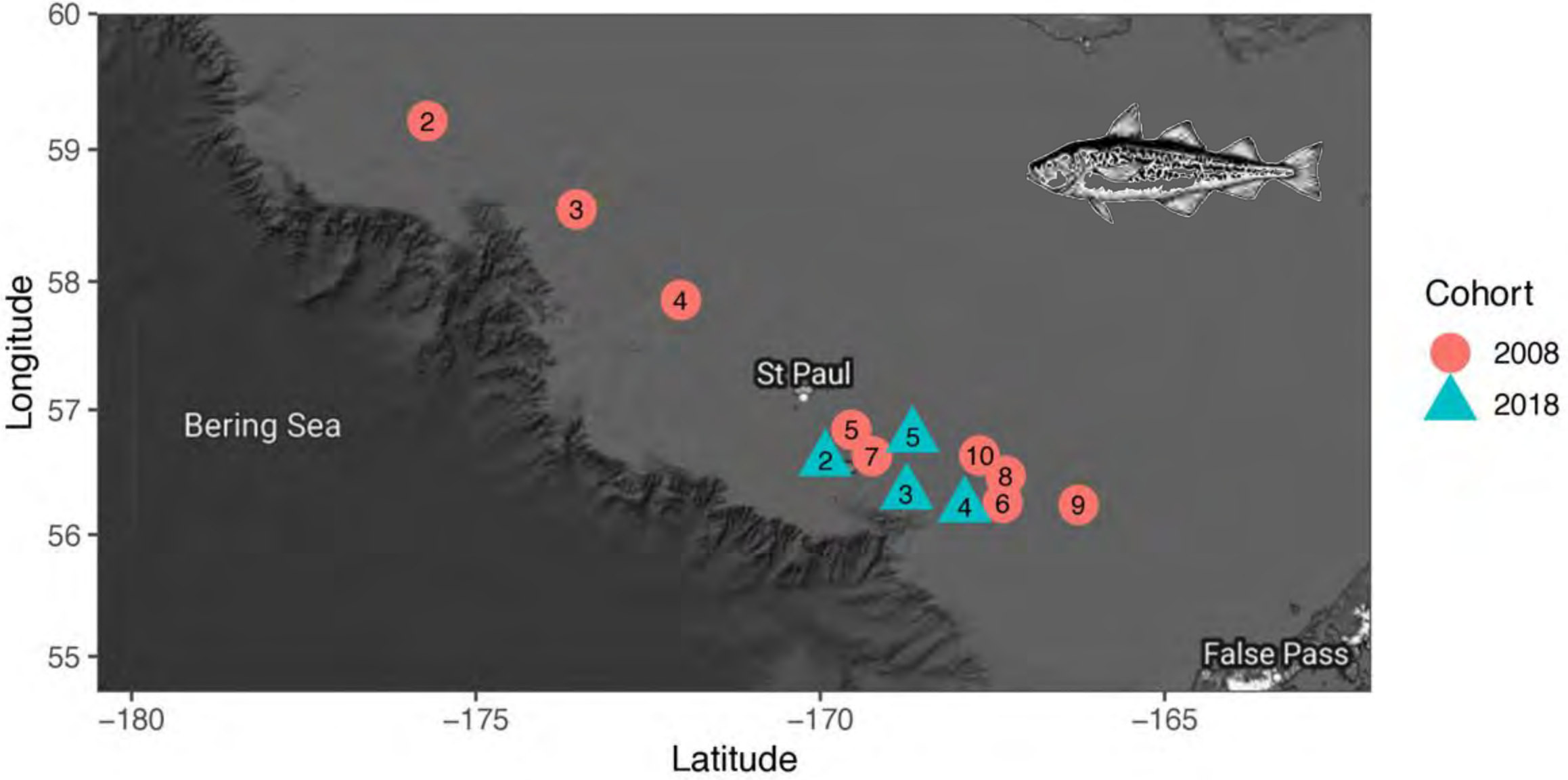
2008 year-class





EBS Pollock


60
59
58
57
56
55
Longitude
−180
−175
−170
−165
Latitude
Bering Sea
St Paul
False Pass
2
3
4
5
7
10
8
6
9
2
5
3
4
Cohort
2008
2018

EBS Pollock

2018 year-class uncertainty impact on 2025 SSB

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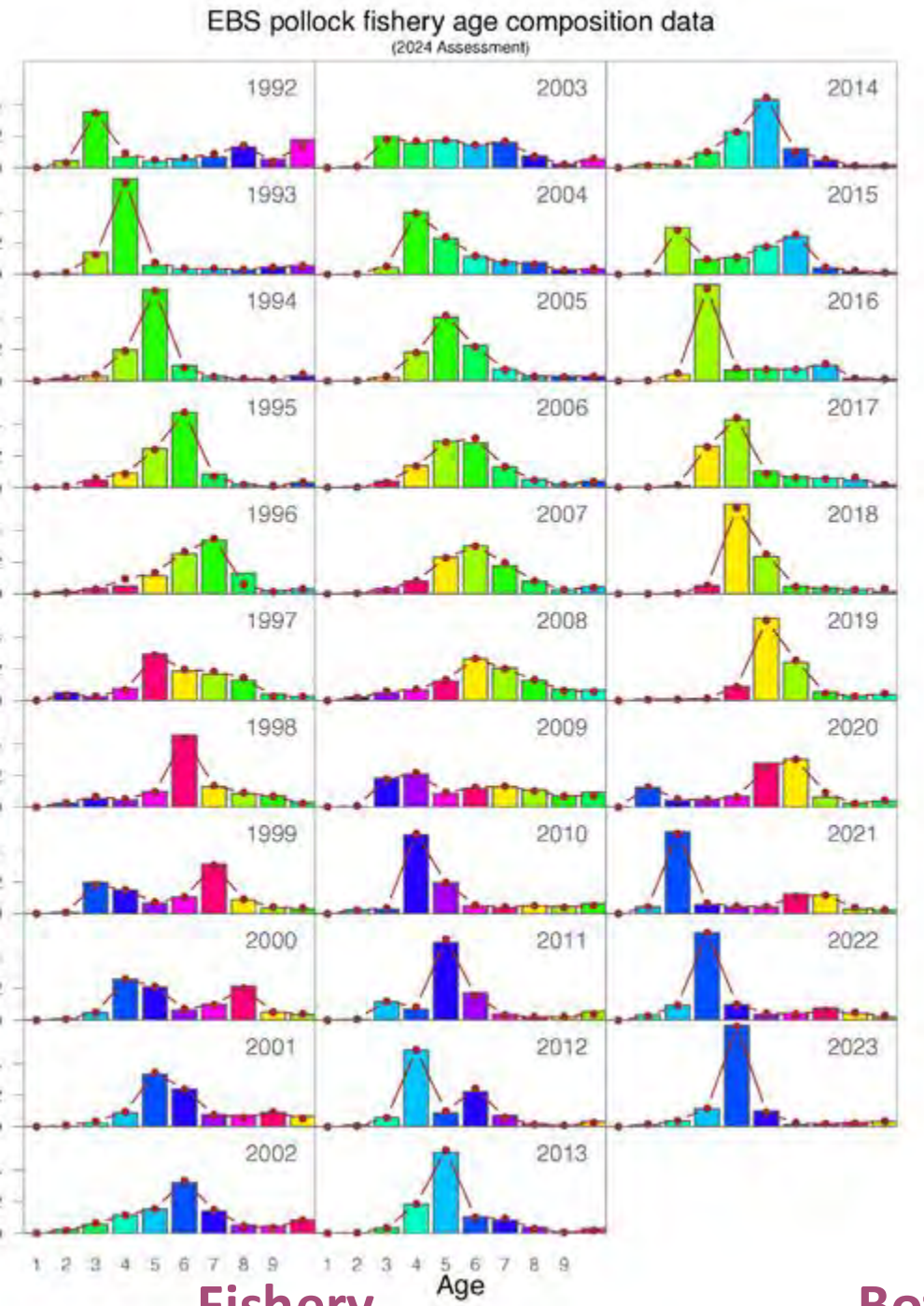
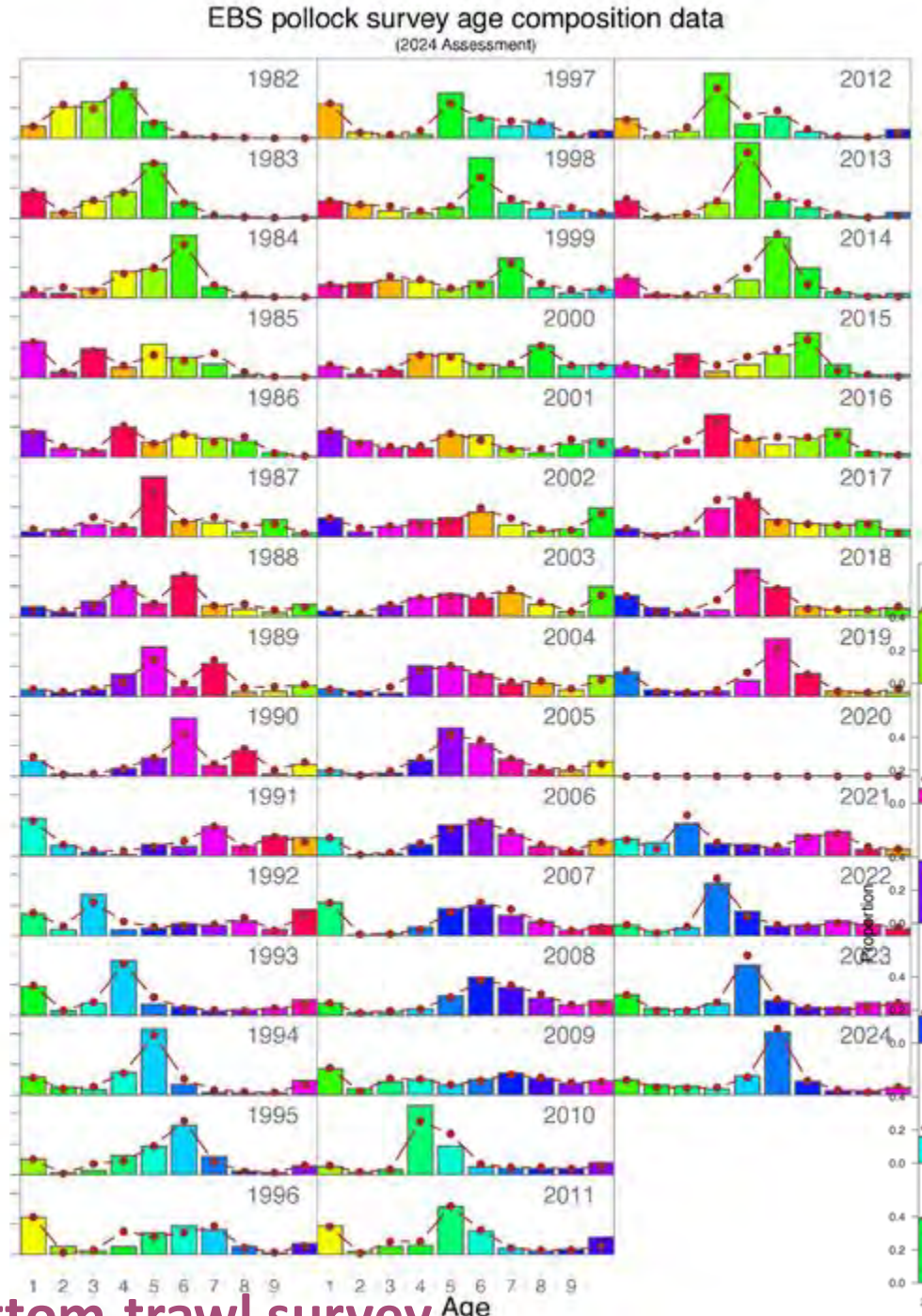
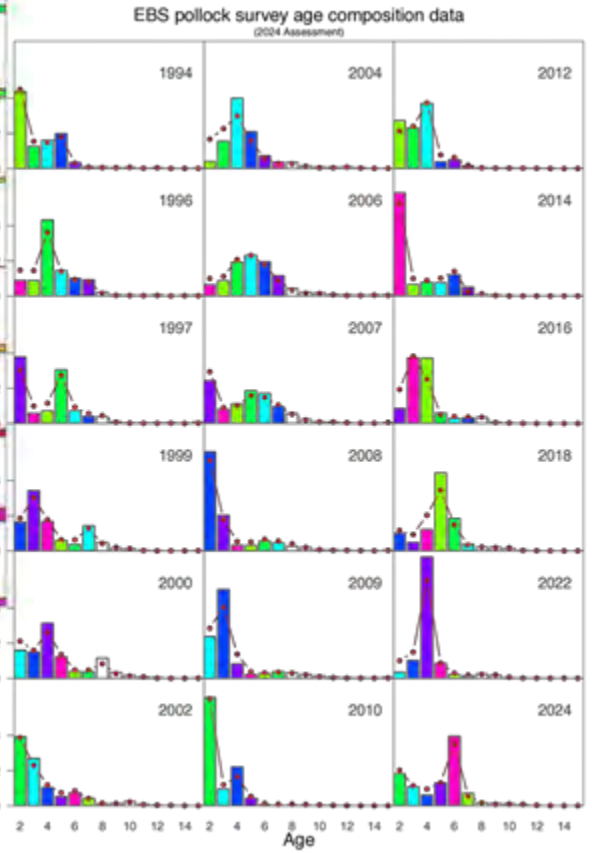
2018 year-class uncertainty impact on 2025 SSB



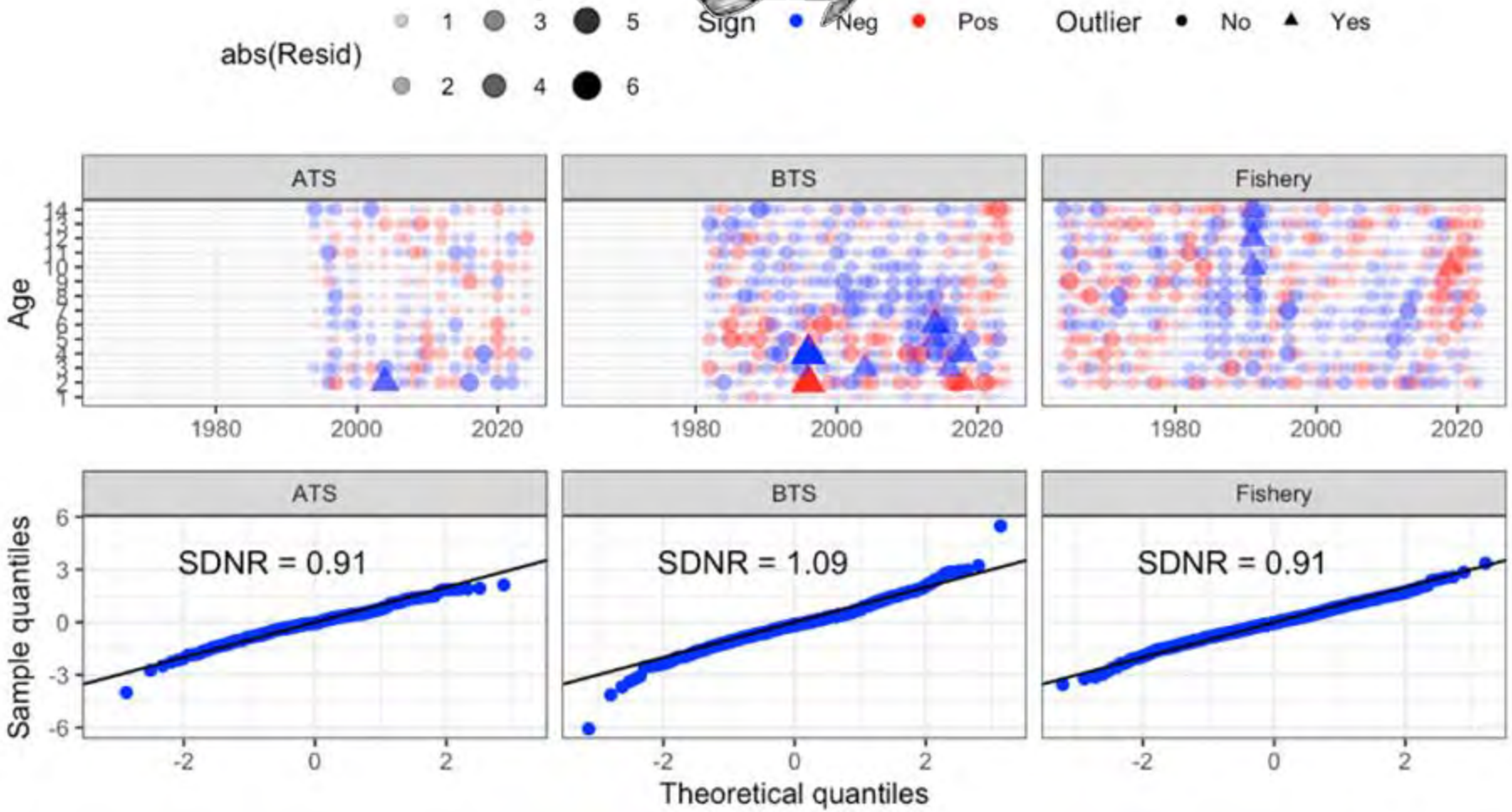
Fishery



Bottom-trawl survey

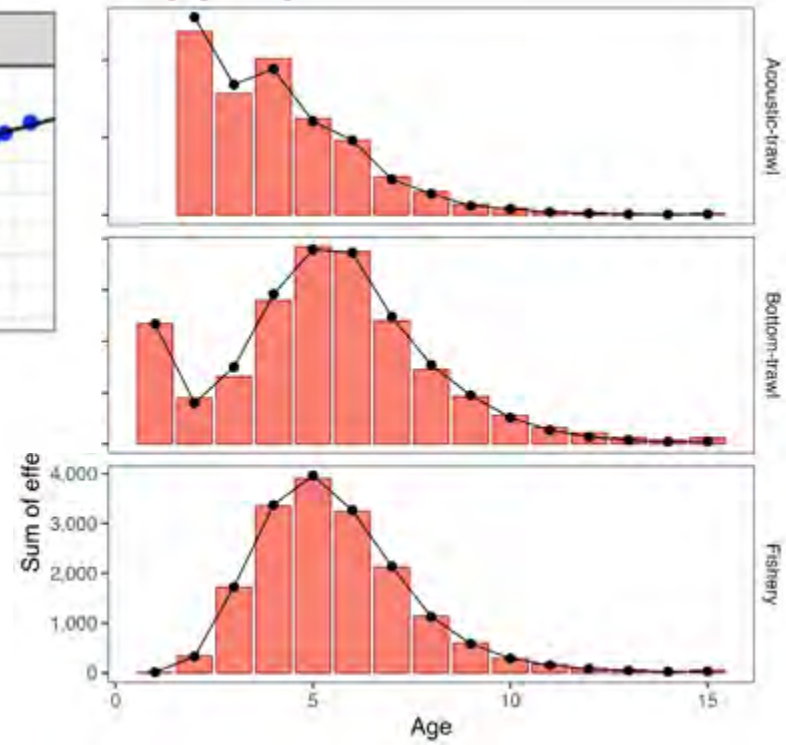


EBS Pollock

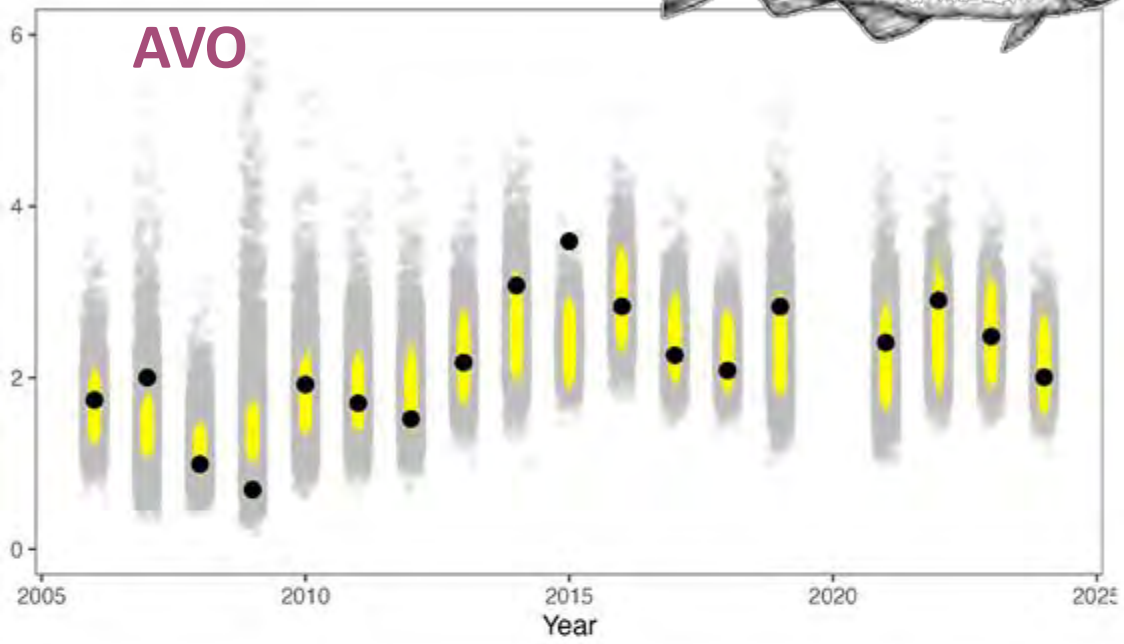


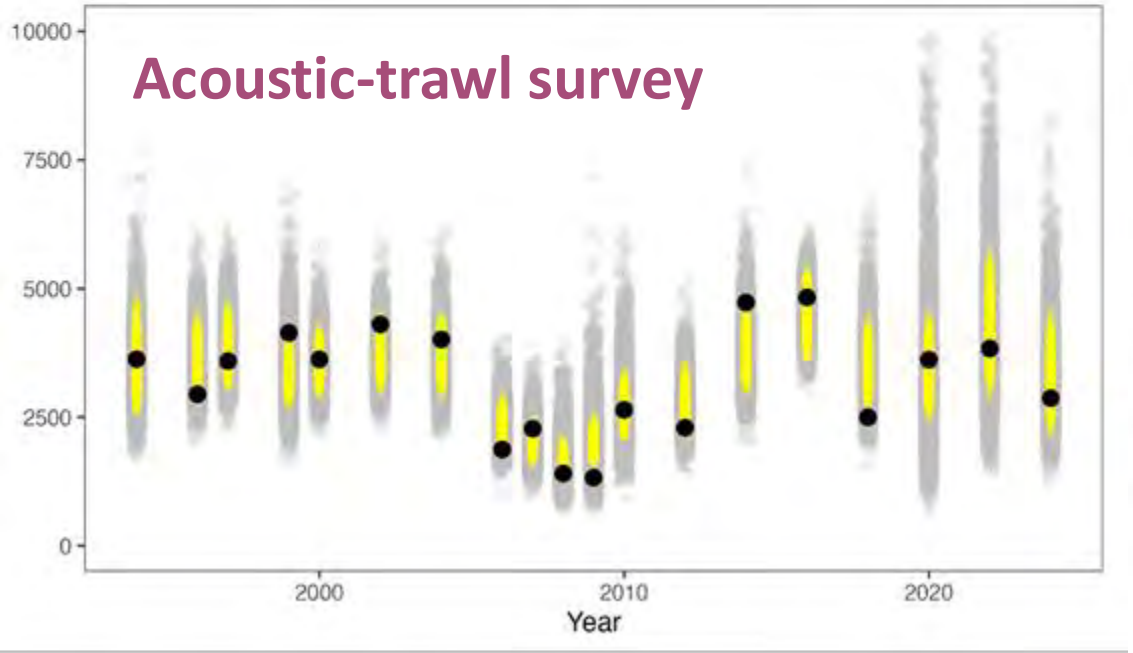
Residual analyses

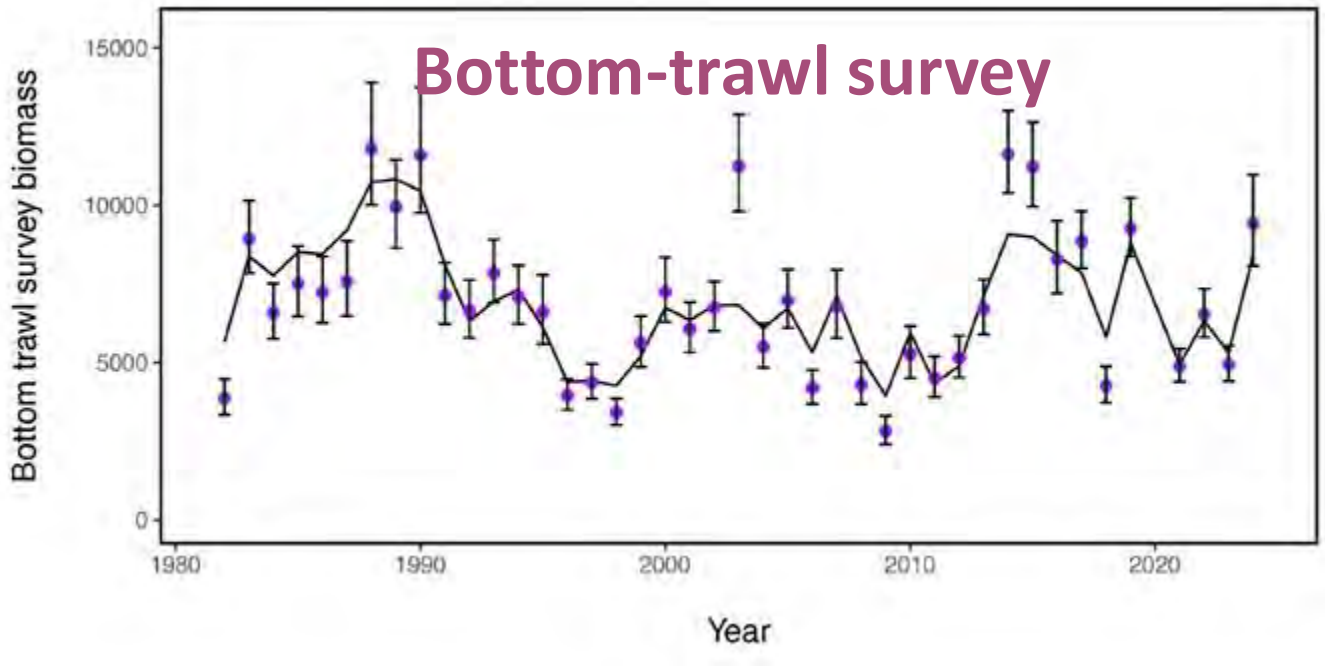
Aggregate model fits



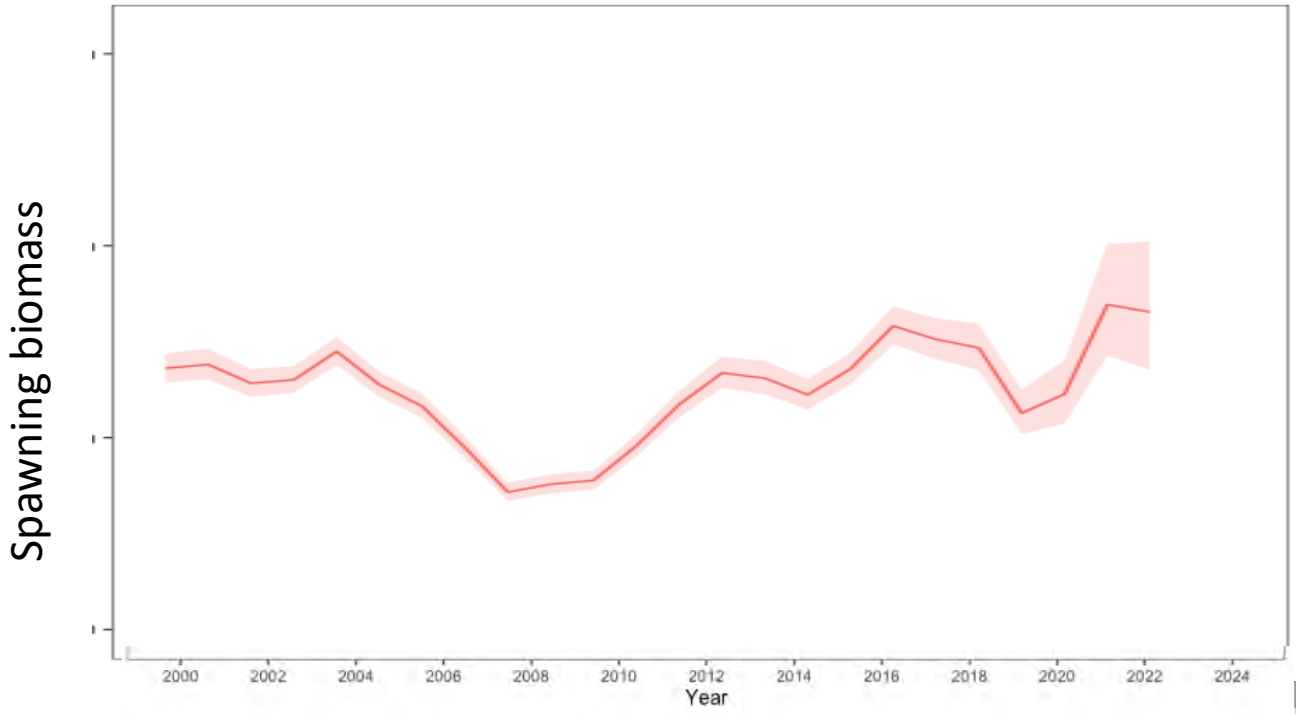
EBS Pollock

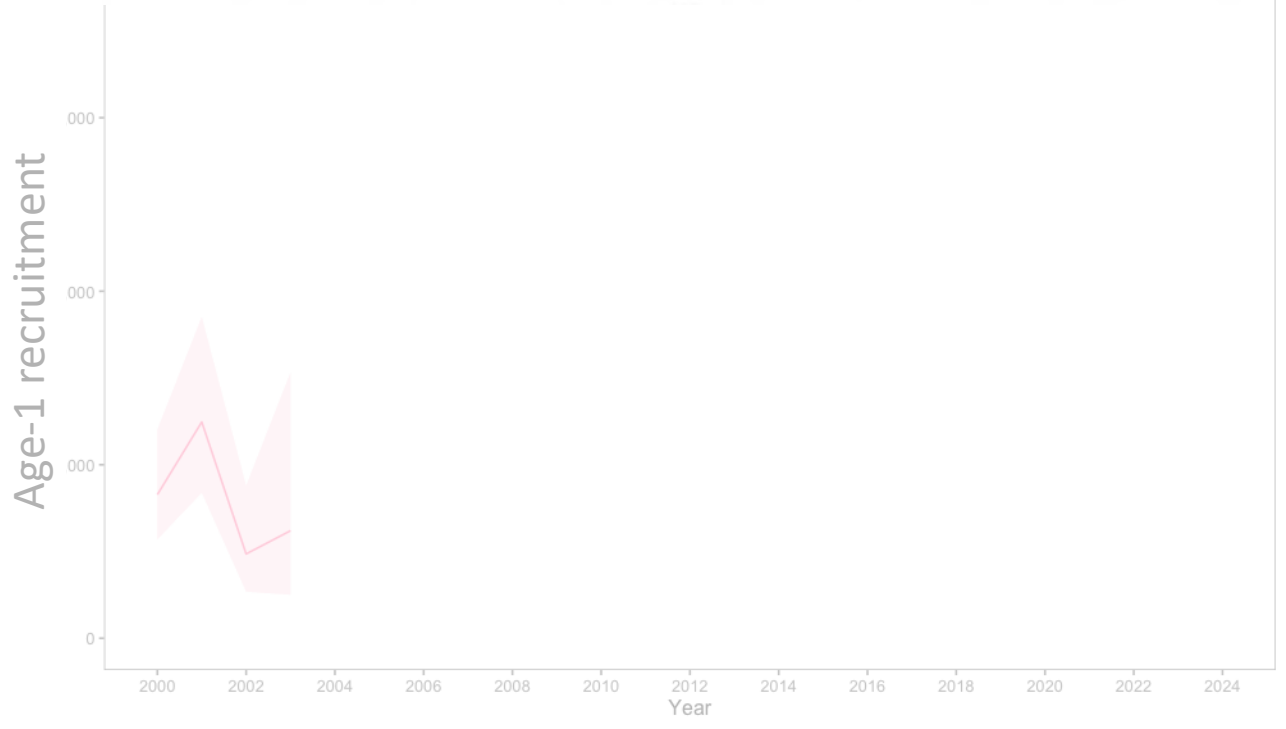

AVO
6
4
2
0
2005
2010
2015
2020
2025
Year


Acoustic-trawl survey
10000
7500
5000
2500
0
2000
2010
2020
Year

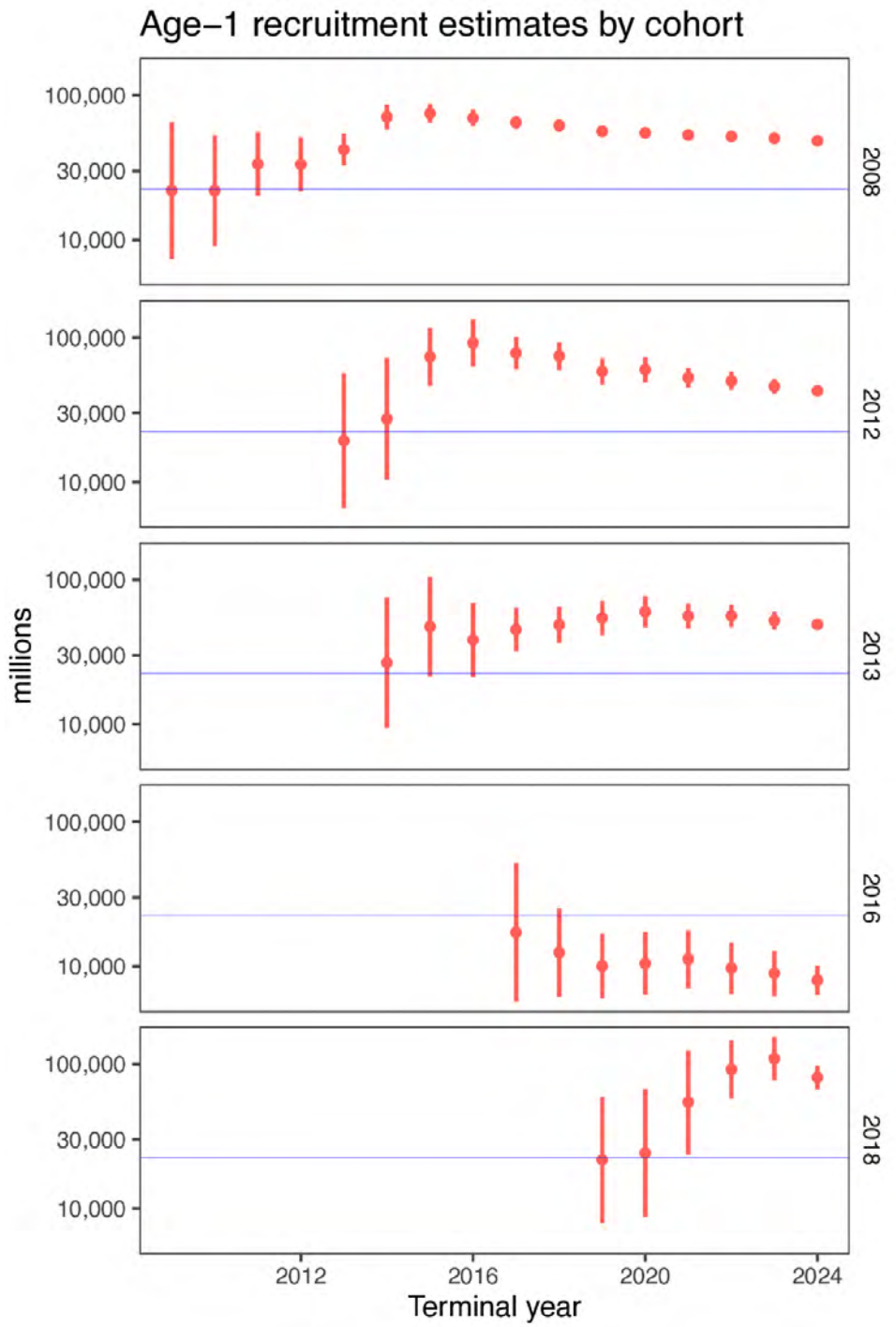

Bottom-trawl survey
Bottom trawl survey biomass
15000
10000
5000
0
1980
1990
2000
2010
2020
Year

Retrospective patterns

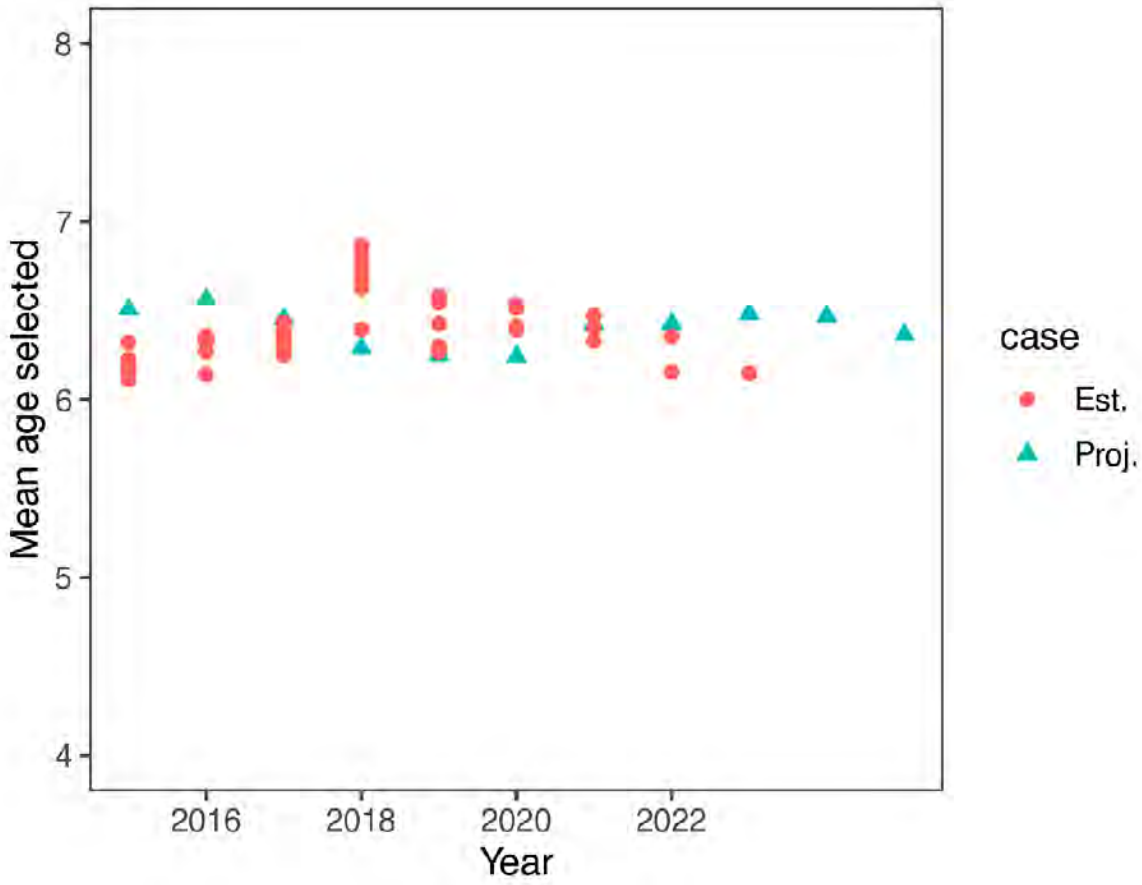


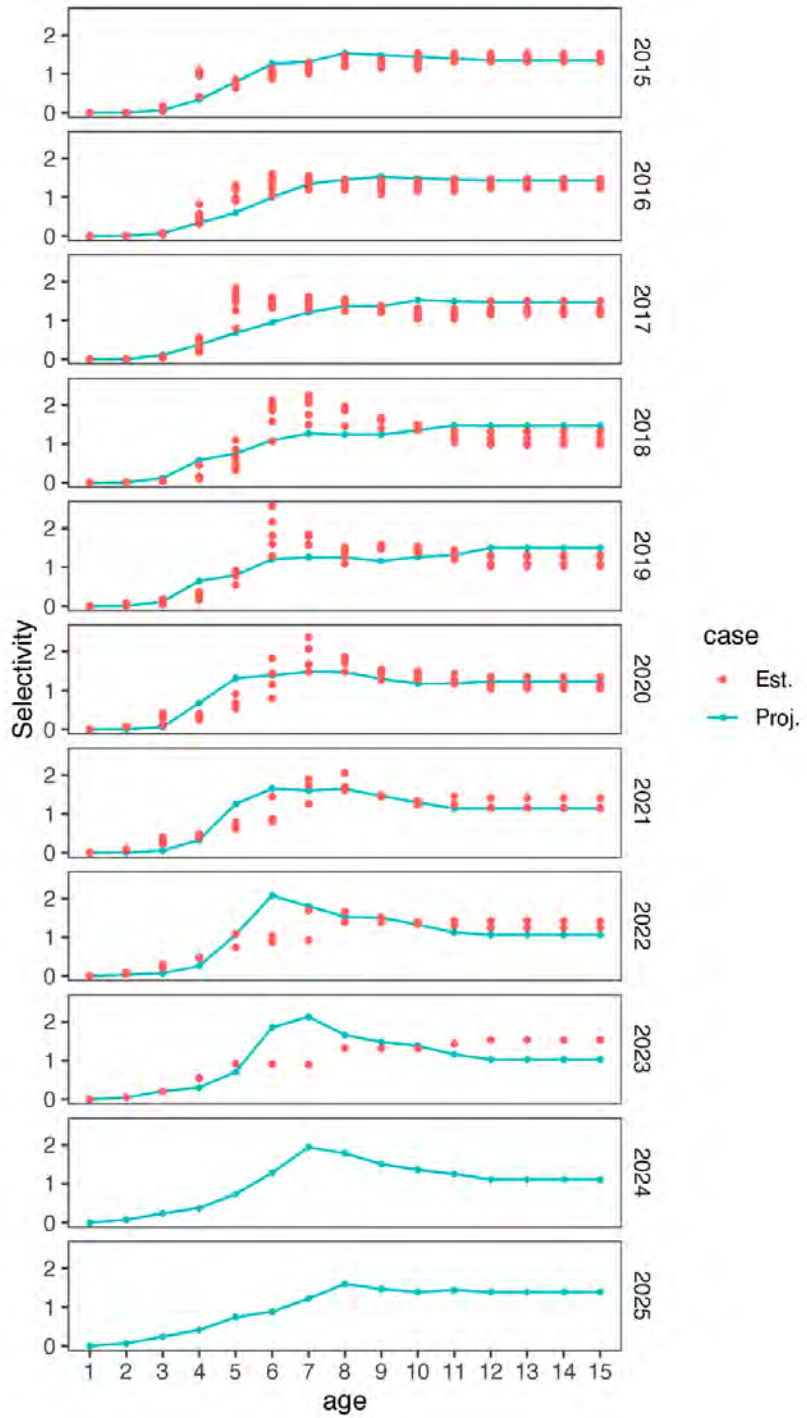


Retrospective patterns by cohort



Retrospective selectivities





Retrospective selectivities

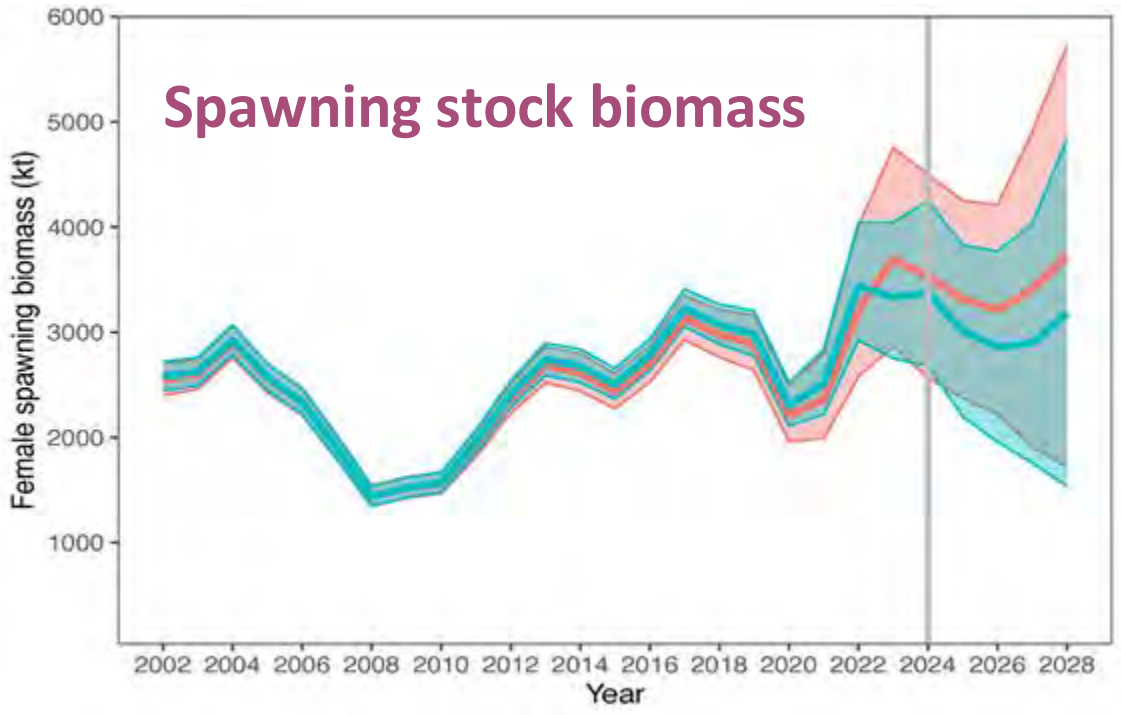
1. The selectivity estimates from the most recent year was used for projections. (**most-recent**)
2. The selectivity estimates from the most recent 2-year mean was used for projections. (**2-yr-avg**)
3. The selectivity estimates from the most recent 3-year mean was used for projections. (**3-yr-avg**)
4. The selectivity estimates from the most recent 4-year mean was used for projections. (**4-yr-avg**)
5. The selectivity estimates from the most recent 5-year mean was used for projections. (**5-yr-avg**)

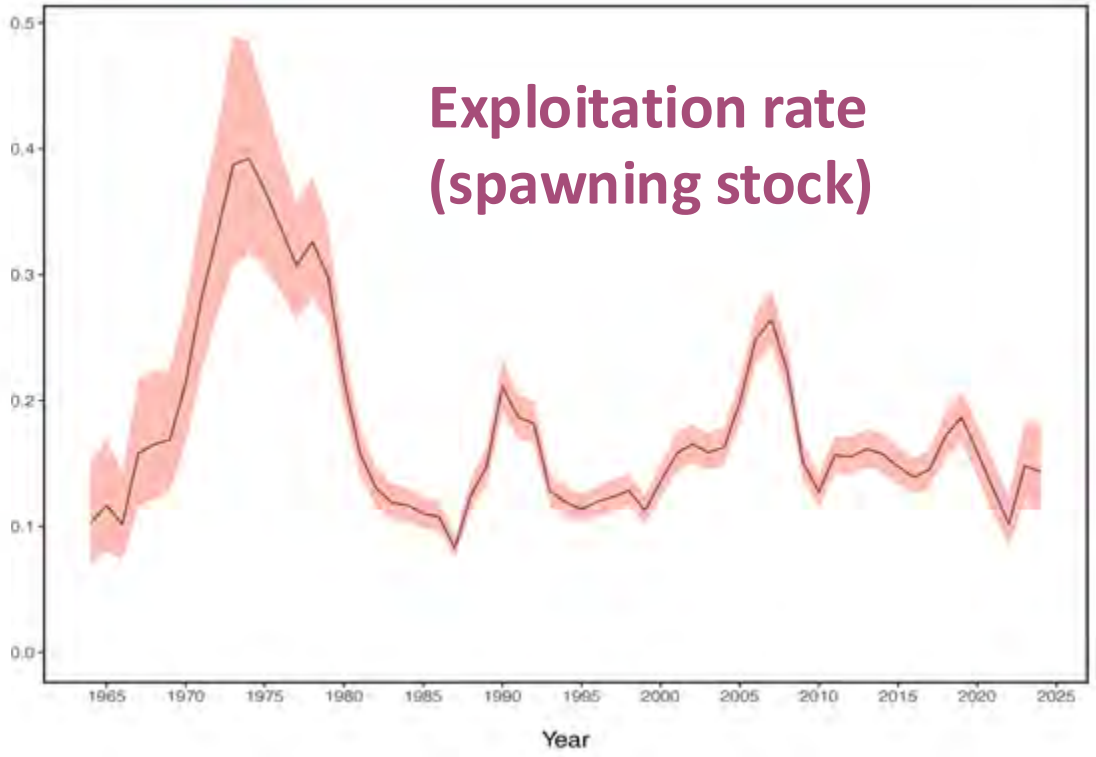
To judge which of these is most appropriate, we compute Mohn's ρ and compare the projected $F_{35\%}$ rate with the annual estimates in later years. For example, in the terminal (retrospective) year 2015 we have estimates of $F_{35\%}$ based on the 2016 expected selectivity (using the above scenarios). We can then compare the "final" estimate of the 2016 selectivity as estimated this year (2024) and go back and compute the $F_{35\%}$ using that year's selectivity. We each retrospective projection $\sum(F_{35\%}^{proj,i} - F_{35\%}^{full,i})^2$ given each of the five scenari above.

Years averaged	Sums of squares
1	23.28
2	22.72
3	22.35
4	22.07
5	22.05

EBS Pollock

Stock status





What about productivity estimates?

- Tier 1 versus Tier 3?

Stock-recruit relationship sensitivities

Time series length

Temperature

Priors (on steepness)

Form (e.g., Ricker versus Beverton-Holt)

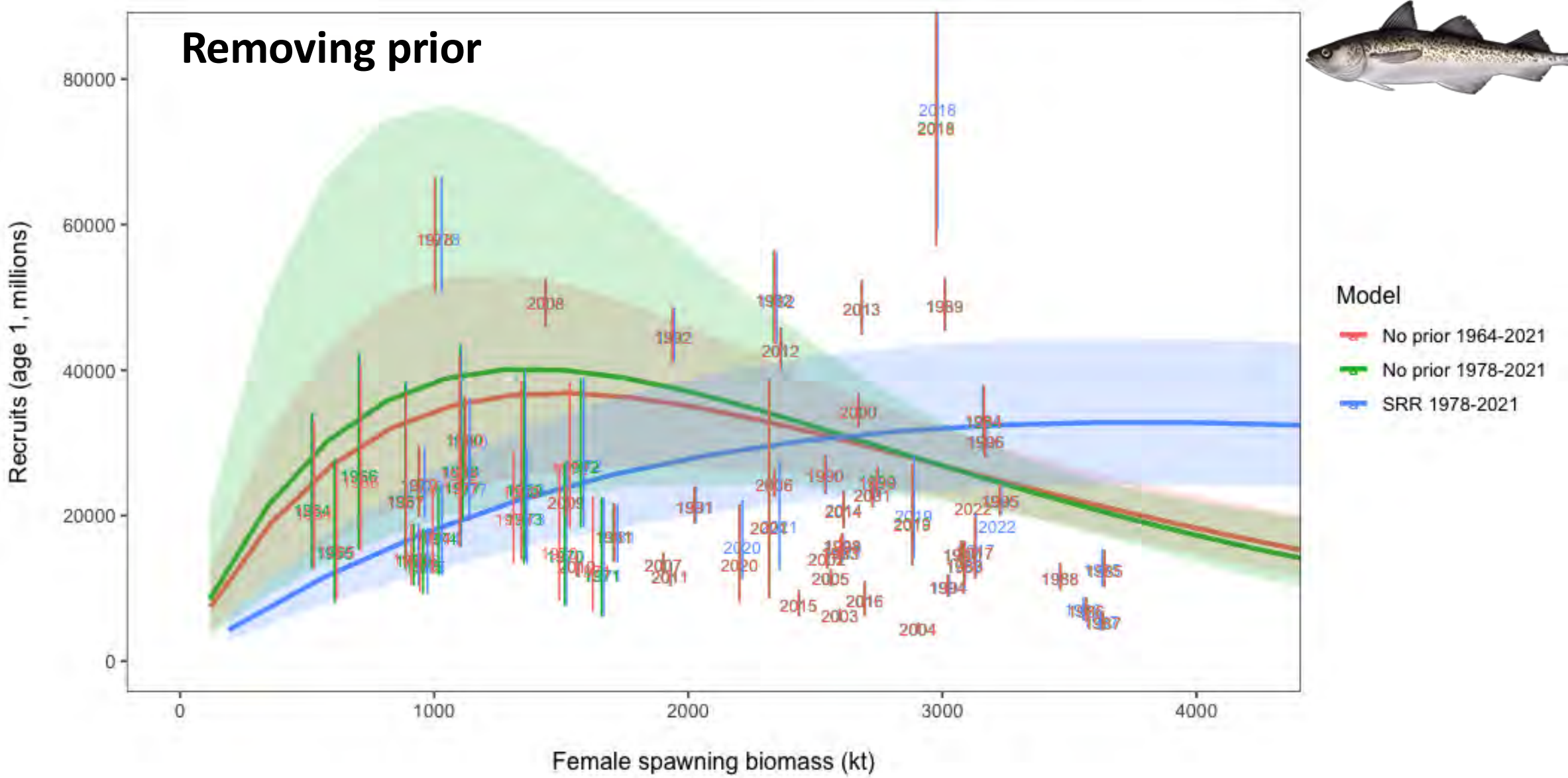
Selectivity

σ_R

Shorter period model (SRR 1978-2021) compared to full time series

Model with and without temperature covariate

Removing prior

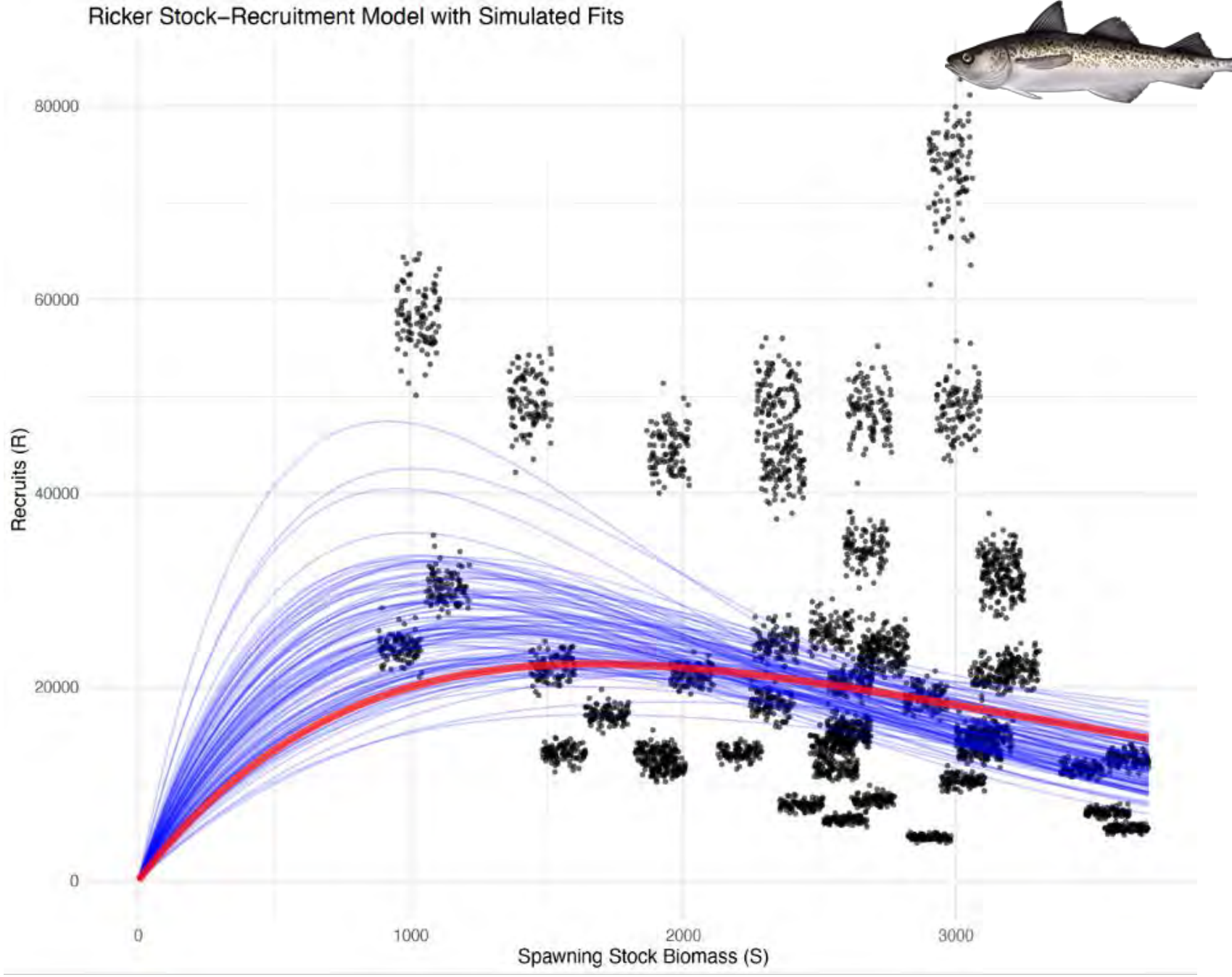


…and estimation period length

Simulation test

Red: original curve estimated

Dots: simulated random “data” used to fit blue curves



Specified variability about the SRR

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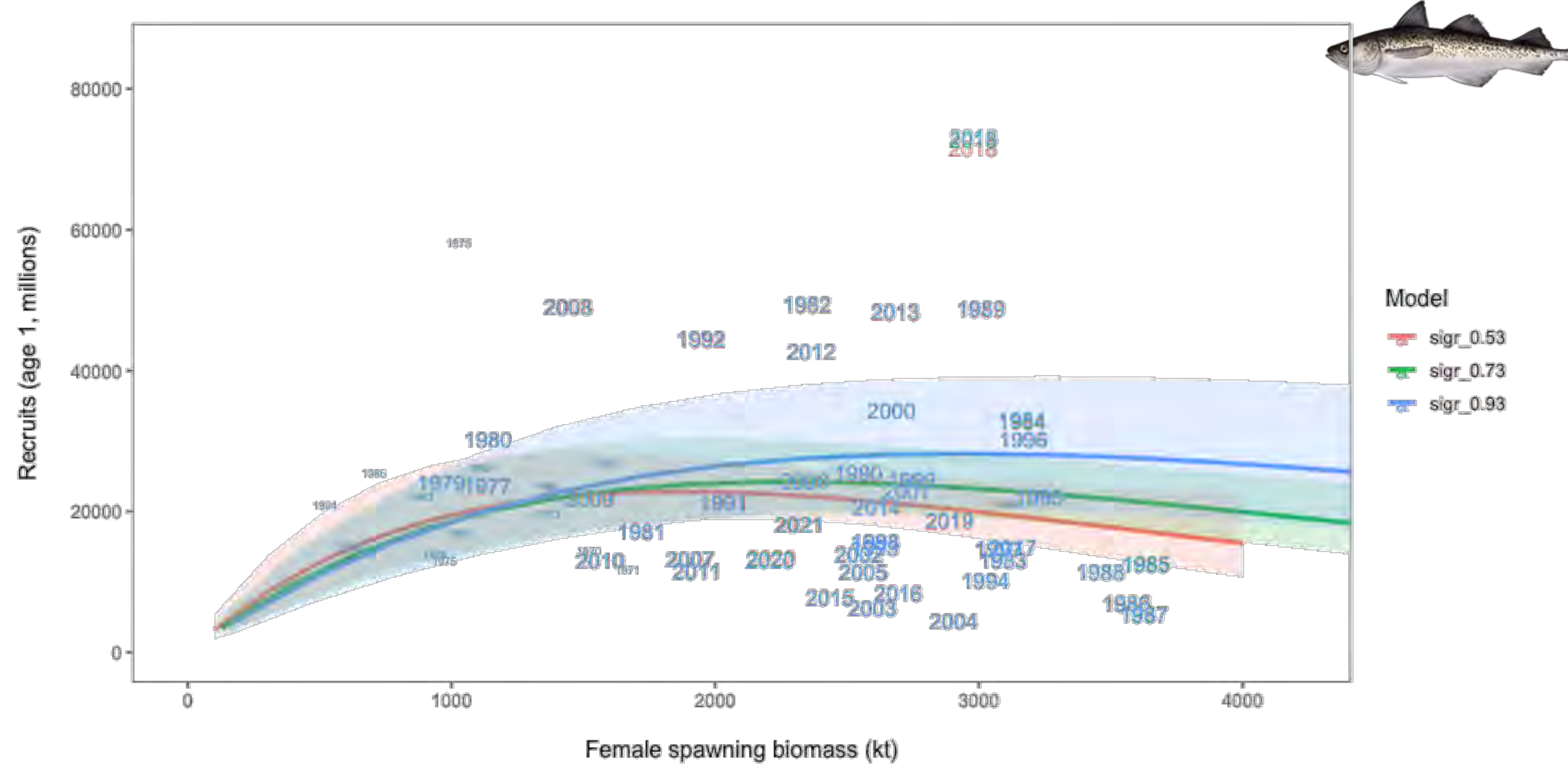
Negative log-likelihood profile of σ_R for the different components used to tune the model



SRR curves as estimated in the 2023 assessment for different fixed values of sigmaR.

Specified variability about the SRR

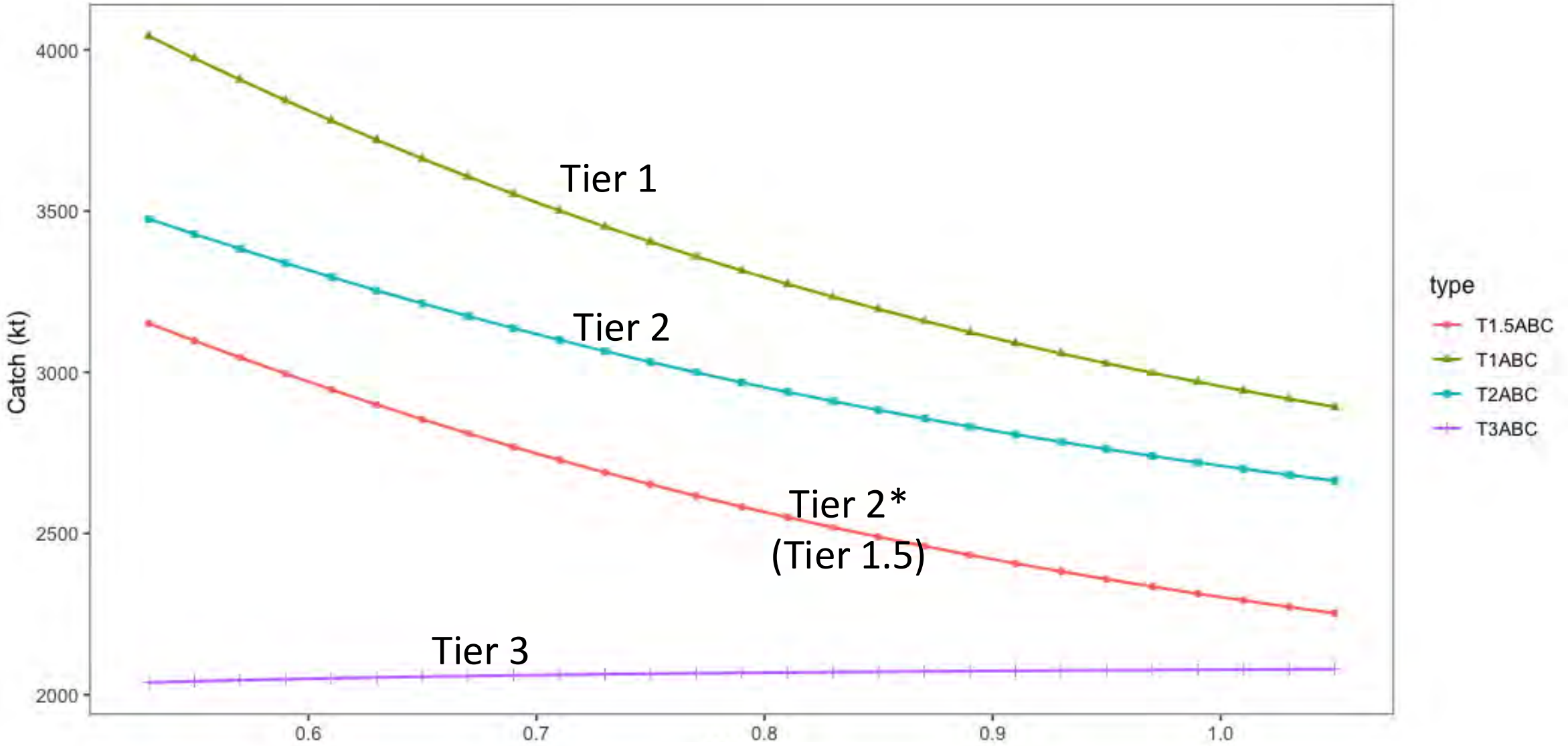


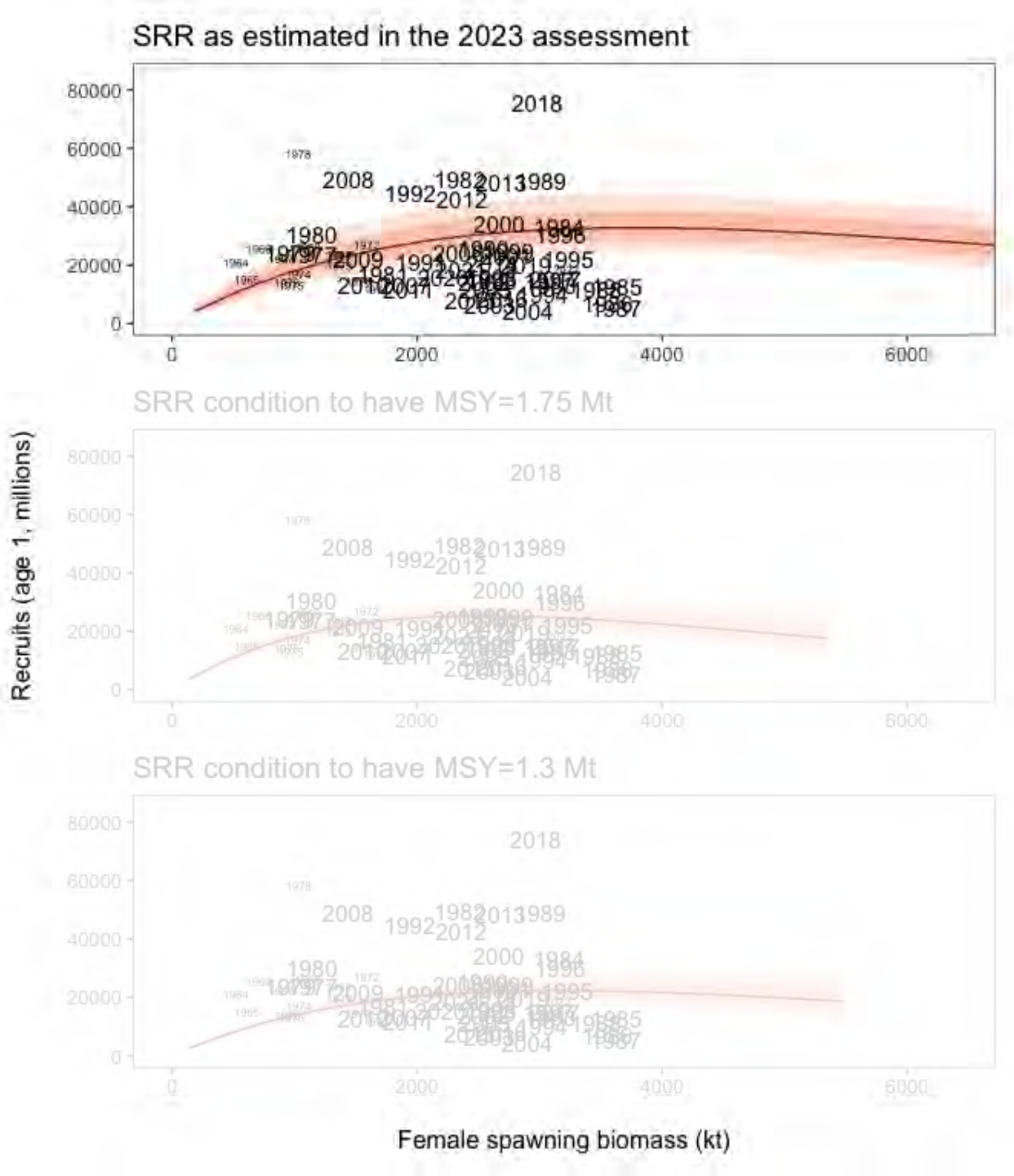
Figure 10: Impact of σ_R on the ABC values from the 2023 assessment.

Conditioning the stock-recruitment relationship to have F_{MSY} equal to $F_{35\%}$

Figure 19: Model results comparing last year's selected model (SRR 1978-2021) with one where the SRR was conditioned such that F_{MSY} was equal to the SPR rate of F_{35}. The vertical bars represent the 95% confidence intervals for the age-1 recruitment.

Considerations of pollock and ecosystem role

Invert the question…what does a productivity curve look like if historical catches at F_{MSY} ?



Summary

Aspects of SRR suggest Tier 3 more appropriate

- No fault of data extent, rather historical stock and recruitment estimates uninformative
- Tier 1
  - Relies on priors (F_{MSY}~$F_{35\%}$)
  - Production aspect near origin on limited observations
  - Risk aversion basis depends on uncertainty (pdf)
  - Tier 2 has same issues related to SRR

Tier 3 more appropriate?

- No fault of data extent, rather historical stock and recruitment estimates uninformative
- Tier 1
  - Relies on priors (F_{MSY}~$F_{35\%}$)
  - Production aspect near origin on limited observations
  - Risk aversion basis depends on uncertainty (pdf)
- Tier 2
  - Still relies on SRR / steepness at origin

Tier 1 version

	As estimated or *specified* *last* year for:		As estimated or *recommended* *this* year for:	
Quantity	2024	2025	2025	2026
M (natural mortality rate, ages 3+)	0.3	0.3	0.3	0.3
Tier	1a	1a	1a	1a
Projected total (age 3+) biomass (t)	10,184,000 t	9,437,000 t	8,526,000 t	8,075,000 t
Projected female spawning biomass (t)	3,518,000 t	3,255,000 t	3,118,000 t	3,342,000 t
B_0	6,728,000 t	6,728,000 t	5,975,000 t	5,975,000 t
B_{msy}	2,689,000 t	2,689,000 t	2,310,000 t	2,310,000 t
F_{OFL}	0.422	0.422	0.523	0.523
$maxF_{ABC}$	0.379	0.379	0.443	0.443
F_{ABC}	0.33	0.33	0.402	0.402
OFL	3,162,000 t	3,449,000 t	4,383,000 t	3,785,000 t
$maxABC$	2,837,000 t	3,095,000 t	3,715,000 t	3,209,000 t
ABC	2,313,000 t	2,401,000 t	2,417,000 t	2,036,000 t
Status	2022	2023	2023	2024
Overfishing	No	n/a	No	n/a
Overfished	n/a	No	n/a	No
Approaching overfished	n/a	No	n/a	No

Tier 3 version

	As estimated or *specified* *last* year for:		As estimated or *recommended* *this* year for:	
Quantity	2024	2025	2025	2026
M (natural mortality rate, ages 3+)	0.3	0.3	0.3	0.3
Tier	1a	1a	3a	3a
Projected total (age 3+) biomass (t)	10,184,000 t	9,437,000 t	8,526,000 t	8,075,000 t
Projected female spawning biomass (t)	3,518,000 t	3,255,000 t	3,118,000 t	3,342,000 t
B_0	6,728,000 t	6,728,000 t	5,902,000 t	5,902,000 t
B_{msy}	2,689,000 t	2,689,000 t	2,066,000 t	2,066,000 t
F_{OFL}	0.422	0.422	0.513	0.513
$maxF_{ABC}$	0.379	0.379	0.394	0.394
F_{ABC}	0.33	0.33	0.394	0.394
OFL	3,162,000 t	3,449,000 t	2,957,000 t	2,496,000 t
$maxABC$	2,837,000 t	3,095,000 t	2,417,000 t	2,036,000 t
ABC	2,313,000 t	2,401,000 t	2,417,000 t	2,036,000 t
Status	2022	2023	2023	2024
Overfishing	No	n/a	No	n/a
Overfished	n/a	No	n/a	No
Approaching overfished	n/a	No	n/a	No

CIE review coming 1st half of 2025