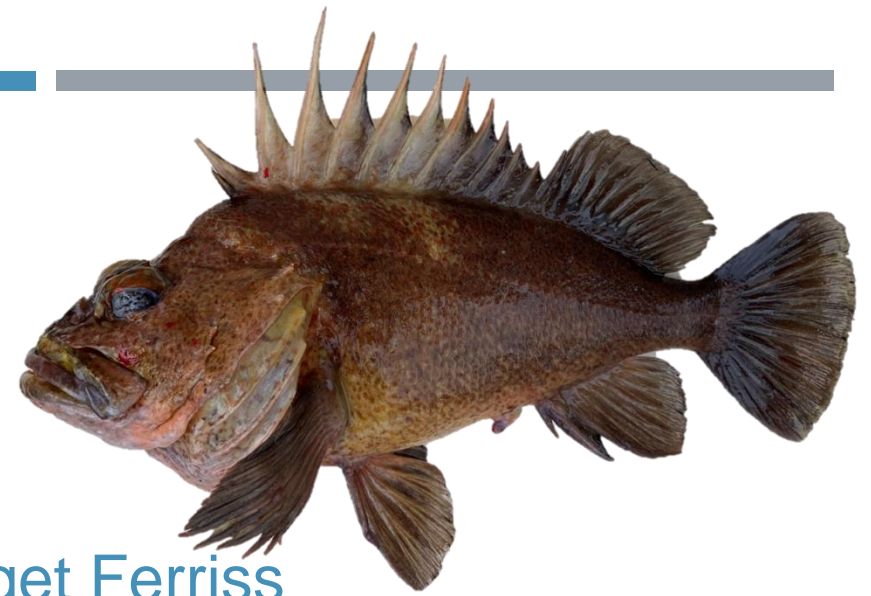


# Gulf of Alaska Dusky Rockfish Stock



Kristen Omori, Ben Williams, Pete Hulson, and Bridget Ferriss



November, 2024  
Presentation to the Plan Team



# Stock Overview

## Gulf of Alaska Dusky rockfish (*Sebastes variabilis*)



- Tier: 3a
- 'Pelagic Shelf Rockfish'
- Distributed throughout the GOA
- Assessment type: Operational full
- Status
  - Not overfished/ no overfishing



# PT/ SSC Comments – Specific to Assessment

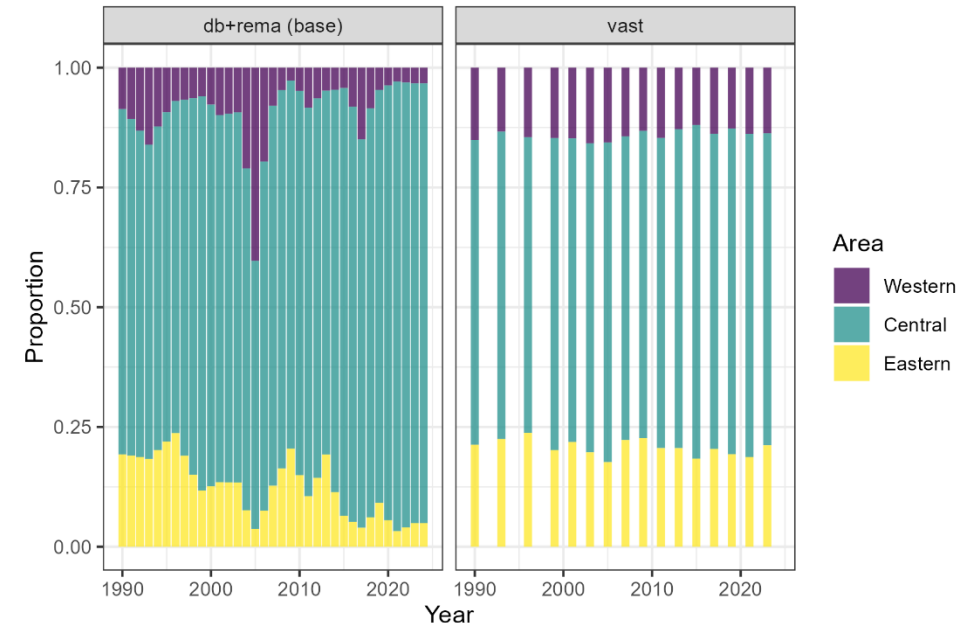
SSC recommends that the authors (December 2021)

## ■ Apportionment recommendations:

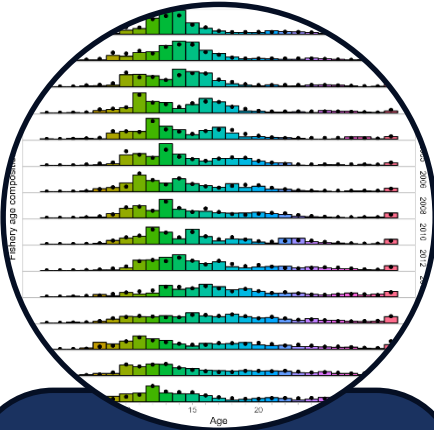
- ✓ ■ “evaluating the use of VAST estimates of survey biomass for apportionments.” (PT, Dec. 2022)
- ✓ ■ “investigate alternative apportionment methods that provide stability while also satisfying subarea-level biological concerns.” (SSC, Dec. 2022)
- “further evaluate and recommend an allocation method to further subdivide the EGOA allocated ABC into West Yakutat and Southeast subareas when using VAST since the current allocation method for the design-based estimator is not easily replicated in the model-based framework.” (PT/ SSC, Oct. 2024)

- Status quo uses weighted survey average method of the CVs

- ✓ ■ Addition of Pearson residuals

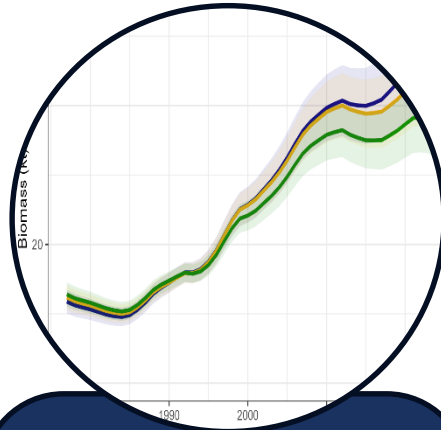


# Assessment Evaluation Overview

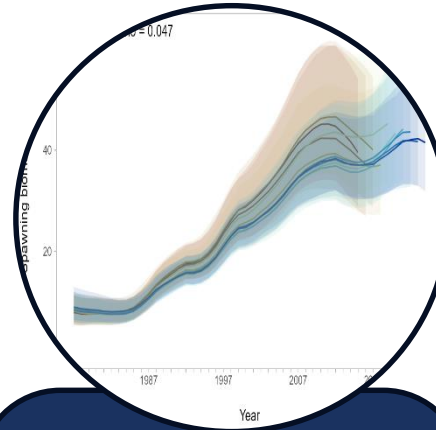


## Data

Inputs  
Evaluation

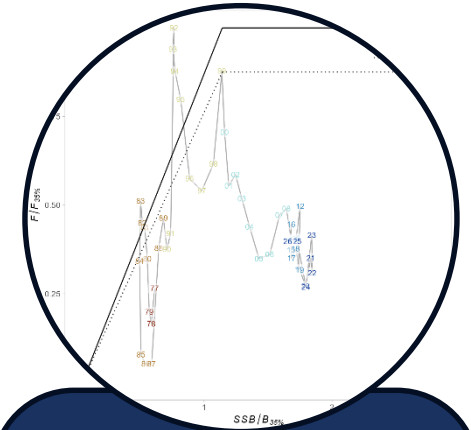


Model  
Structure  
& Updates



## Results

Data fits  
Estimates  
Diagnostics



## Recs

Stock Status  
Risk Table  
ABC & OFL  
Apportionment





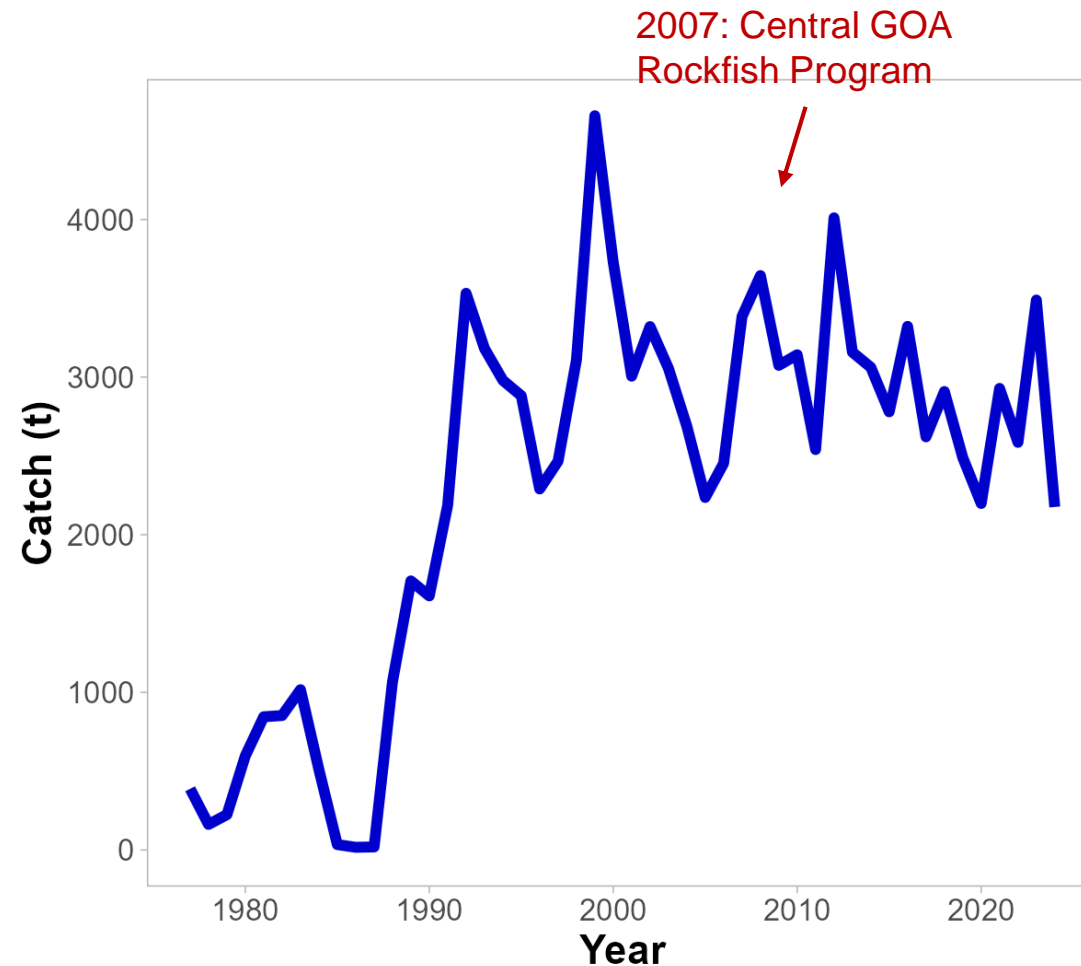
# Data Summary

Source	Data	Years
NMFS Groundfish survey	Survey biomass	1990-1999 (triennial), 2001-2021 (biennial), <b>2023*</b>
	Age composition	1990-1999 (triennial), 2003-2021 (biennial), <b>2023*</b>
U.S. trawl fishery	Catch	1977-2022, <b>2023-2024*</b>
	Age composition	1998-2002, 2004-2006, 2008-2020 (biennial), <b>2022*</b>
	Length composition	1991-1997, 2003, 2007-2021 (biennial), <b>2023*</b>



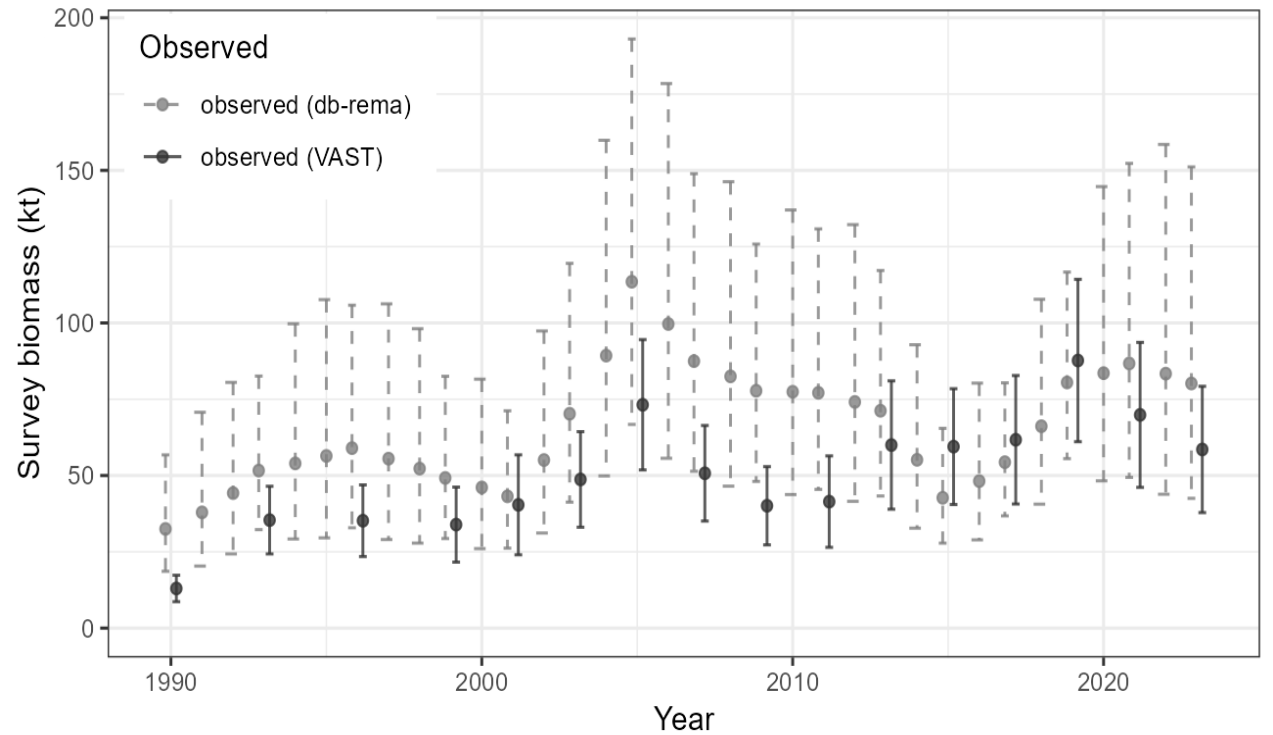
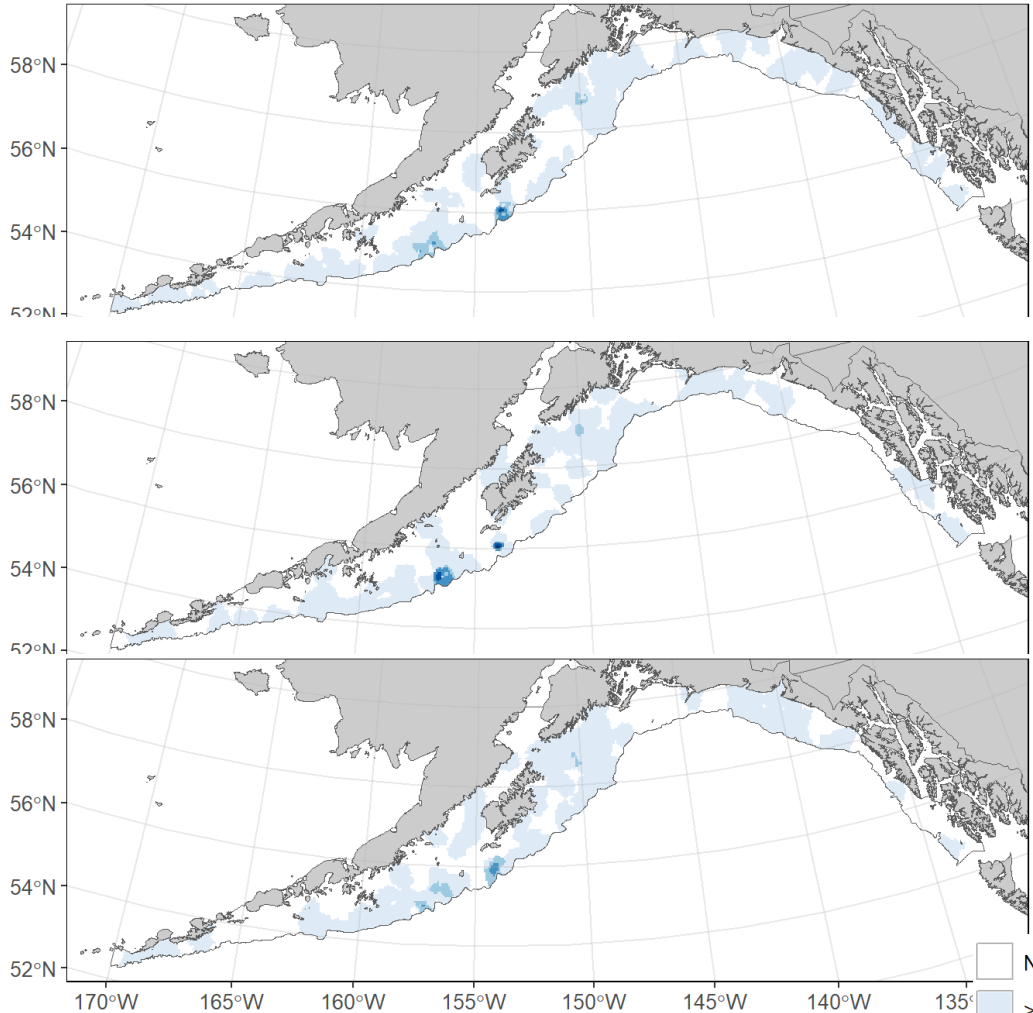
# Data – Catch

- ~ 99% of total catches comes from trawl fishery
- Last 10 years: average of 2,750 t
- 2024 fishery catches low:
  - **-37%** from 2023
  - -16% from 2022



# Data – GOA Trawl Survey

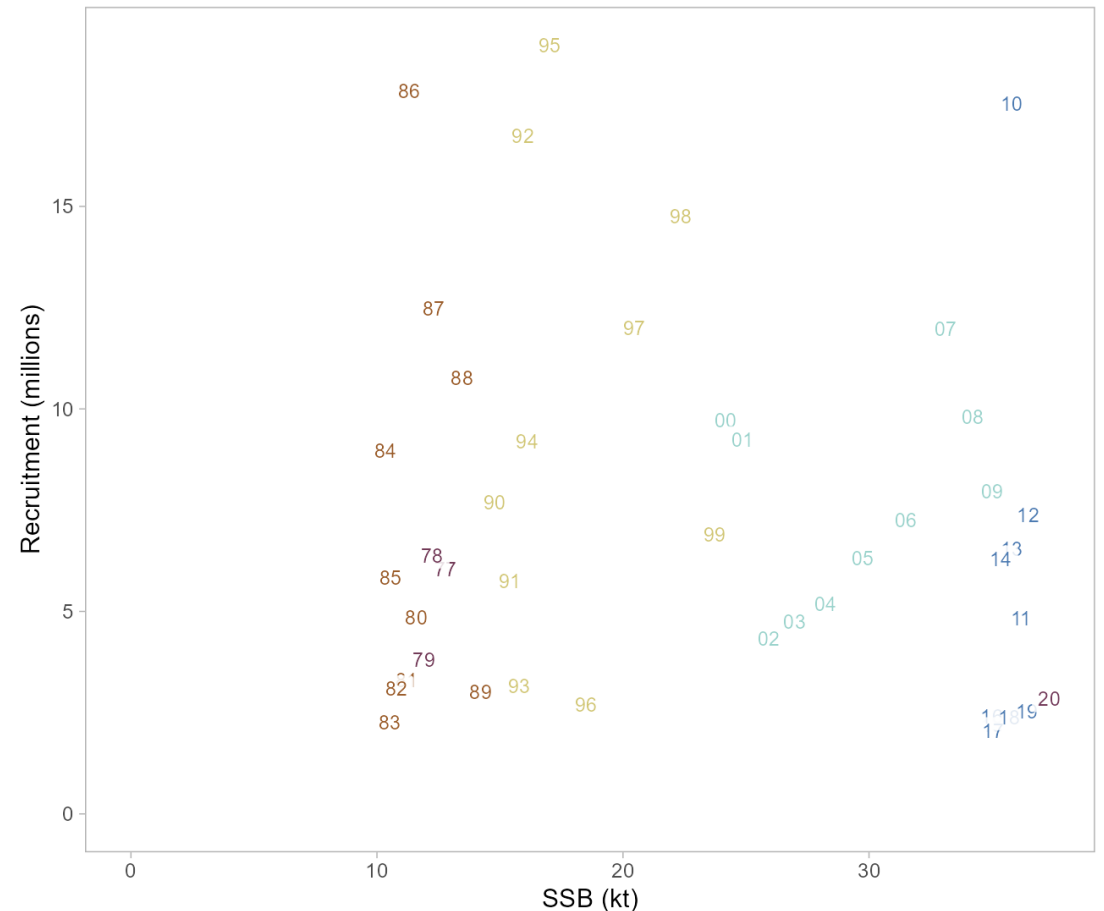
2023  
2021  
2019



# Model Structure and Updates

## General Model Structure

- Bespoke, ADMB rockfish model
- VAST survey biomass estimates with lognormal error
- Recruits at age-4
- 2022 'base' model (m22.3a)
  - length bins: 21 – 52+
  - ages: 4 – 30+
- Natural mortality: 0.07
- Estimates mean recruitment (with recruitment devs)





# Model Structure and Updates

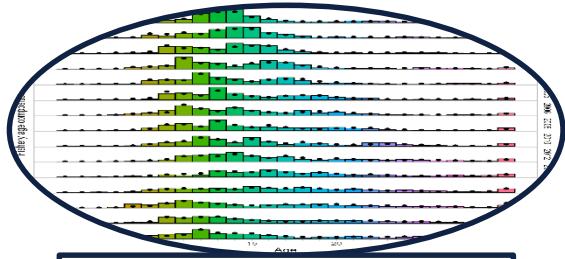
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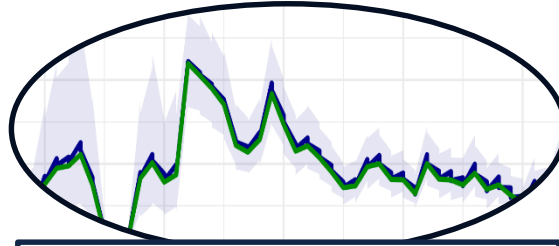
## Model Updates (m22.5a)

- Trawl survey biomass likelihood → lognormal error structure
- Average recruitment estimate was adjusted to align with the modeled recruitment age

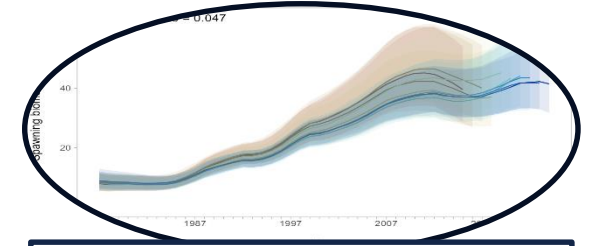
# Model Results



Data Fits



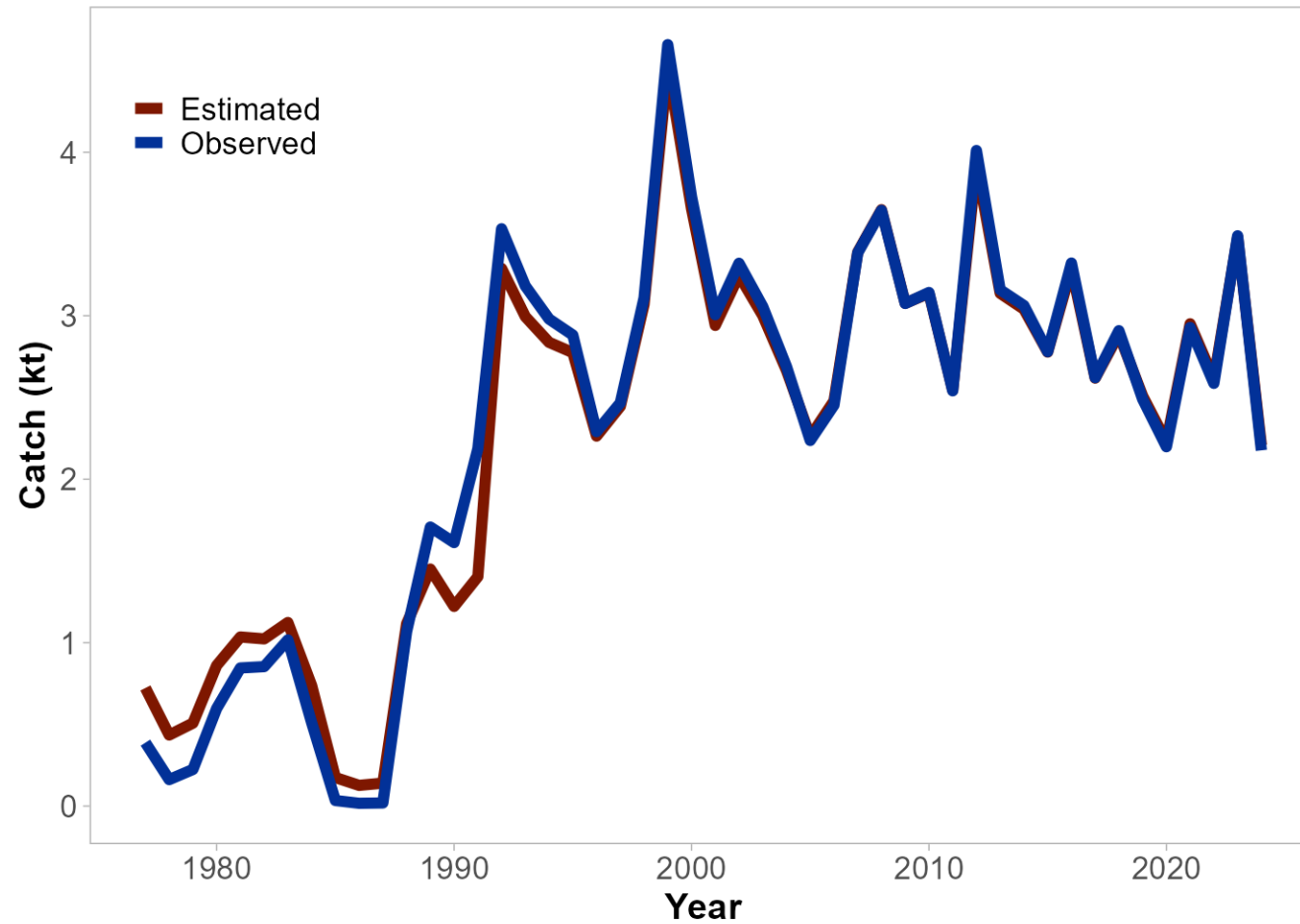
Estimates and  
Time Series



Diagnostics

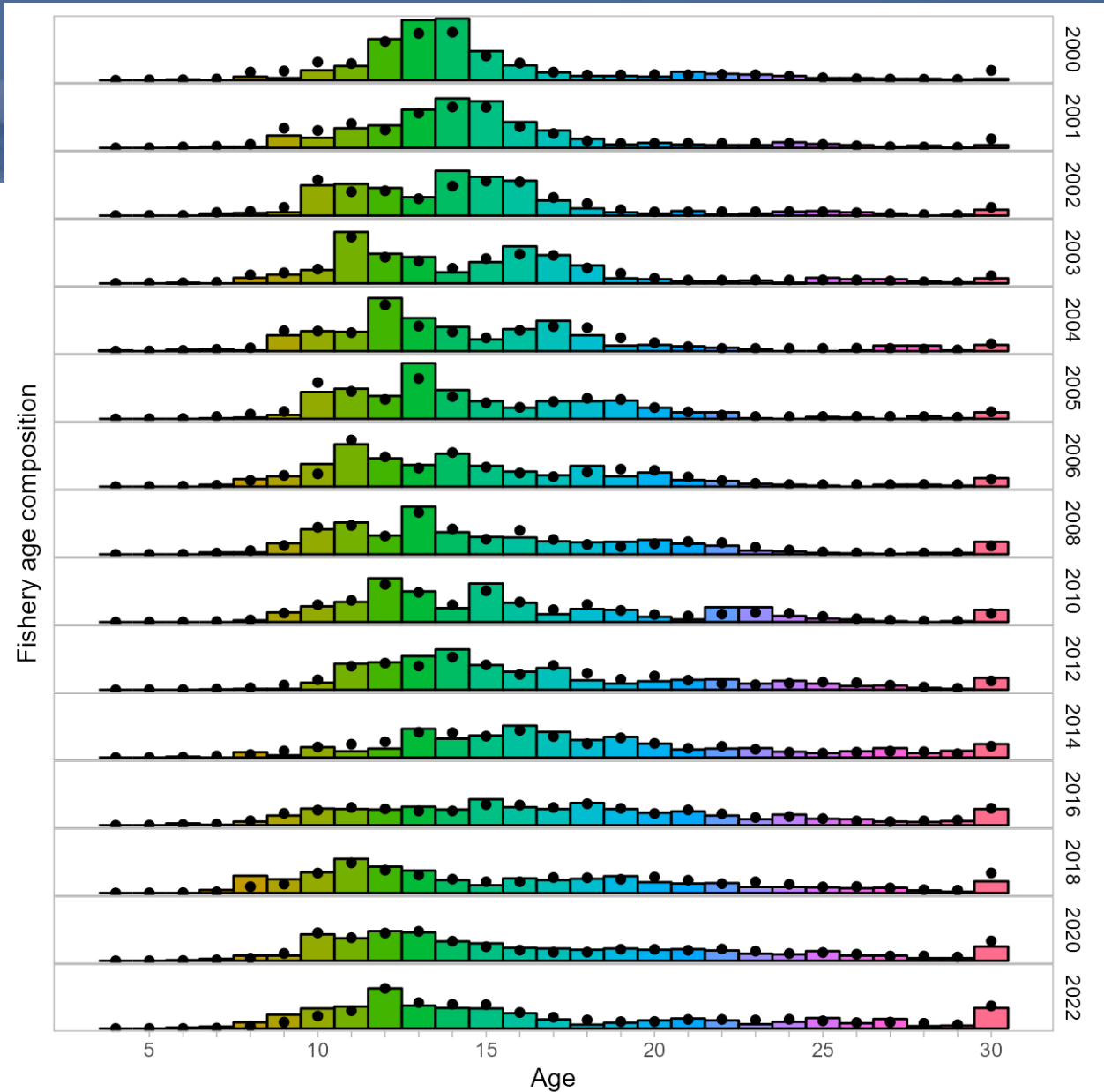
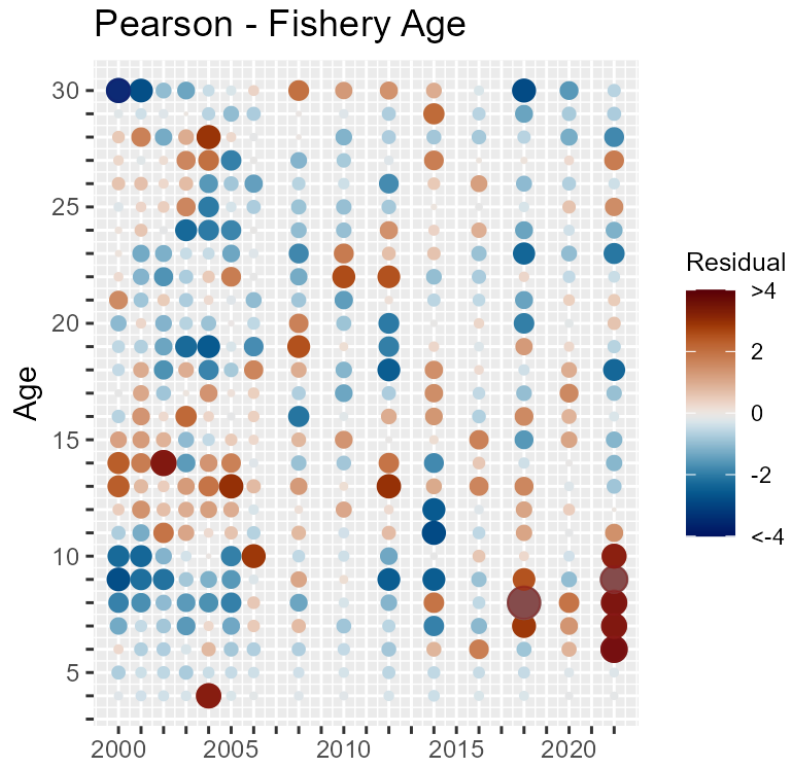


# Results – Data Fits



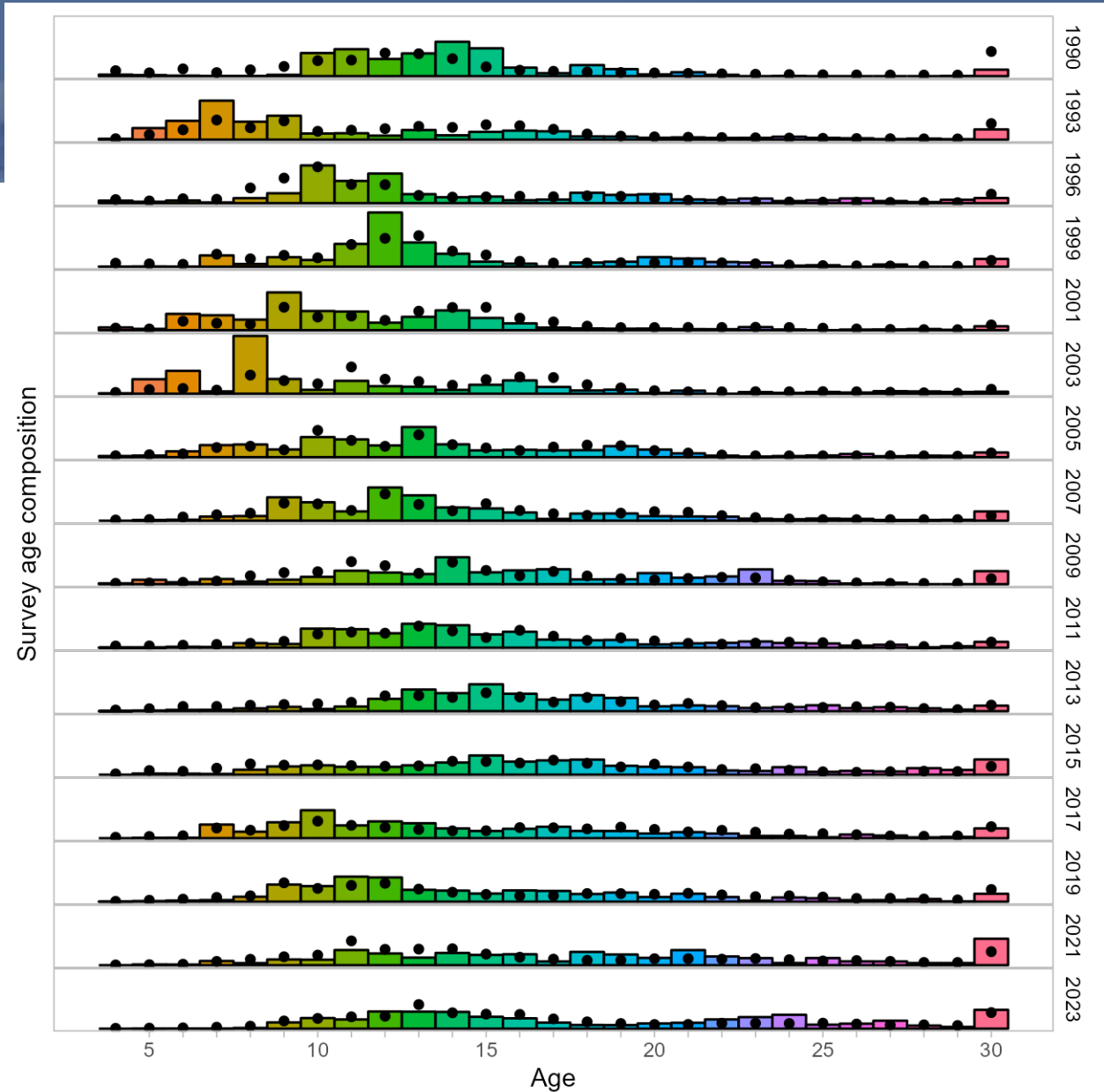
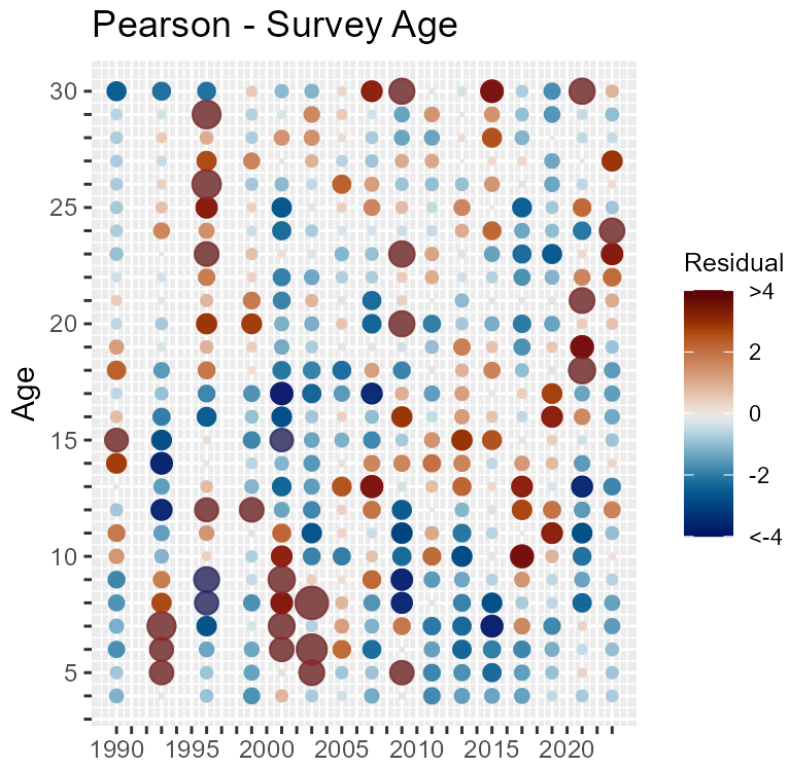
# Results – Data Fits

- Overall, fishery ages fit well



# Results – Data Fits

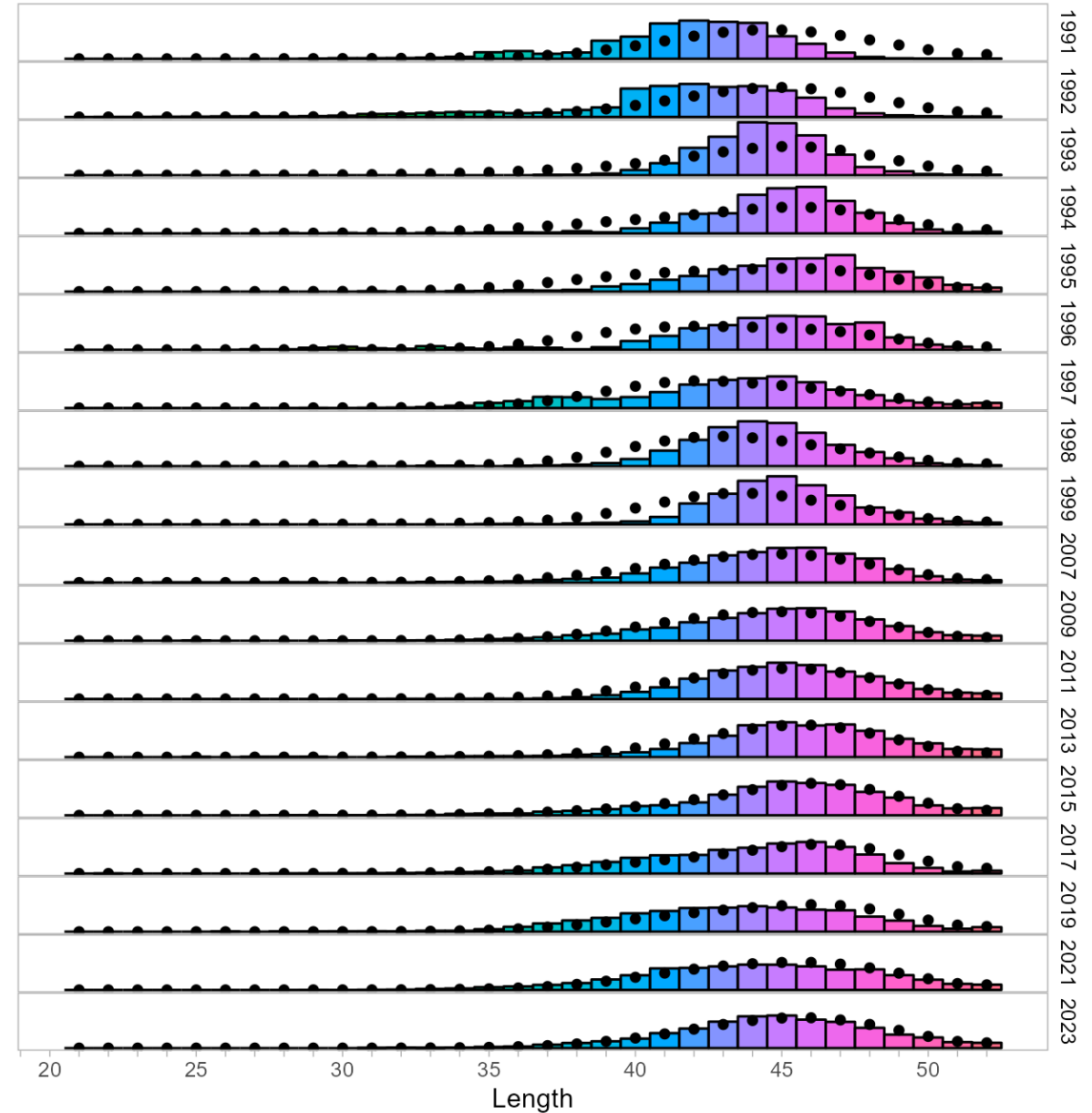
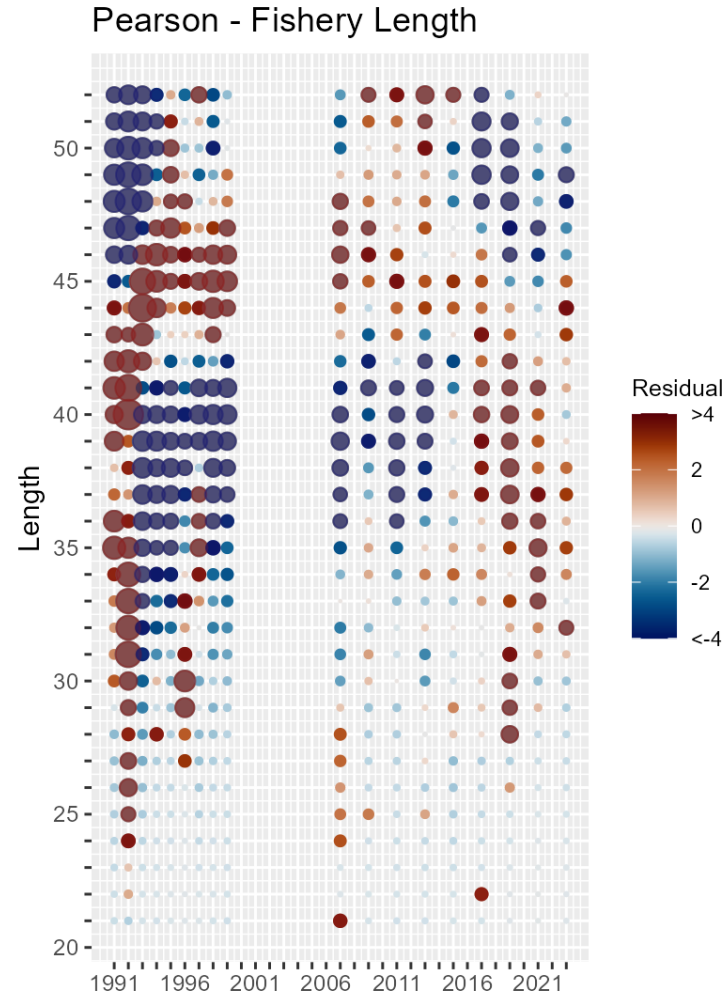
- Overall, survey ages fit well, particularly in later years



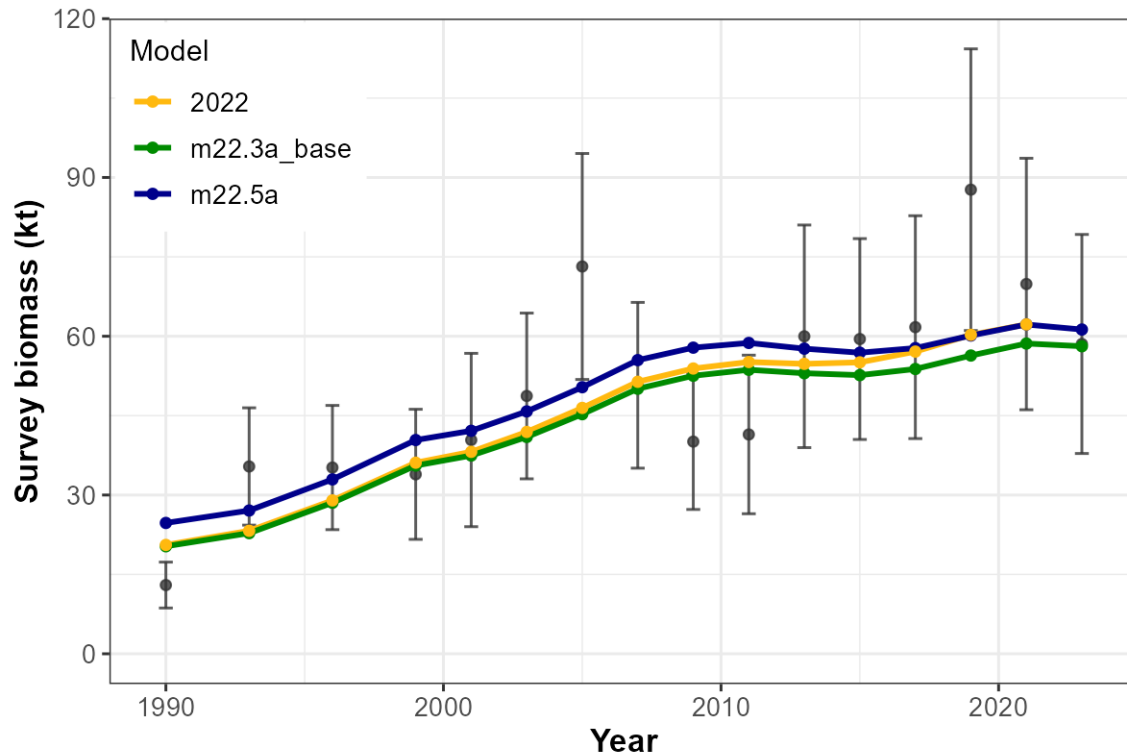


# Results – Data Fits

- Fishery lengths fit in second half of time series, but did not fit as well in earlier years



# Results – Data Fits



- Estimated trawl survey biomass from recommended model fit better
- 2023 survey estimates are similar to 2021
- 5% difference between recommended (m22.5a) and base model with new data (m22.3a\_base)
- -1.5% from 2022

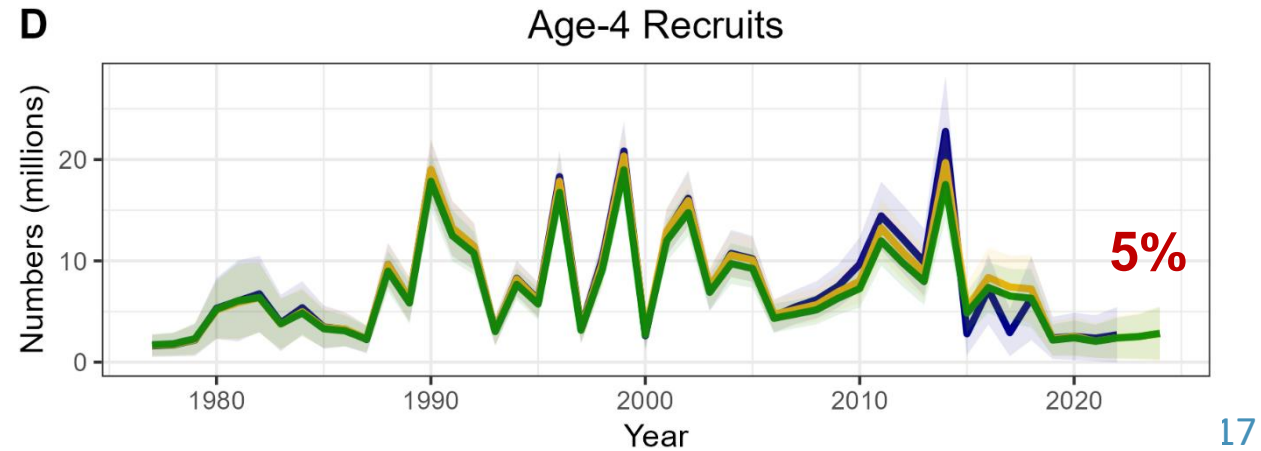
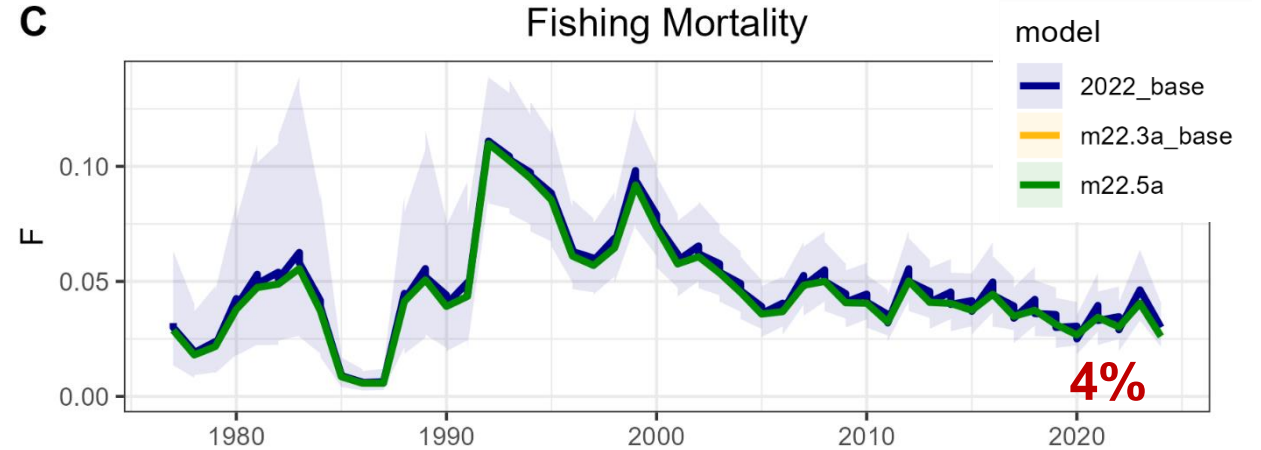
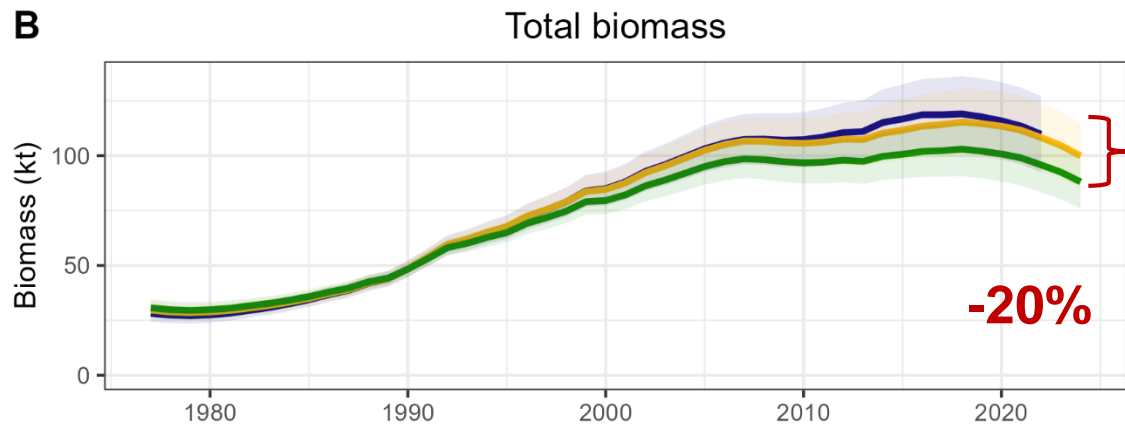
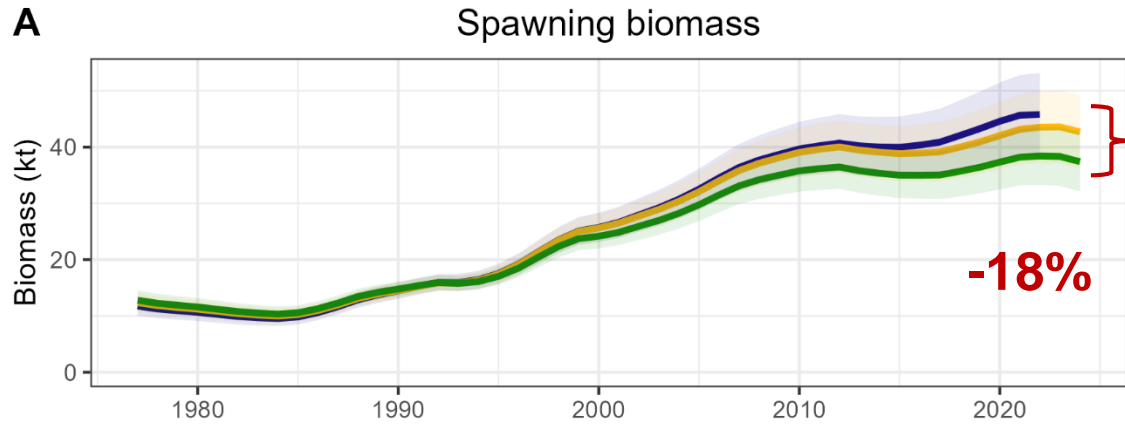


# Results – Parameter Estimates

Parameter Estimates	base	m22.3a	m22.5a
# parameters	133	137	137
sigmaR	1.00	0.96	0.90
q	0.64	0.63	0.76
avg rec	2.70	2.82	2.84
a50	10.23	10.04	10.06
F40	0.09	0.09	0.09
Total Biomass	107,186	97,325	85,862
SSB	44,468	41,170	35,972
B100	65,565	62,394	59,467
B40	26,226	24,958	23,787
ABC	7,921	7,247	6,338



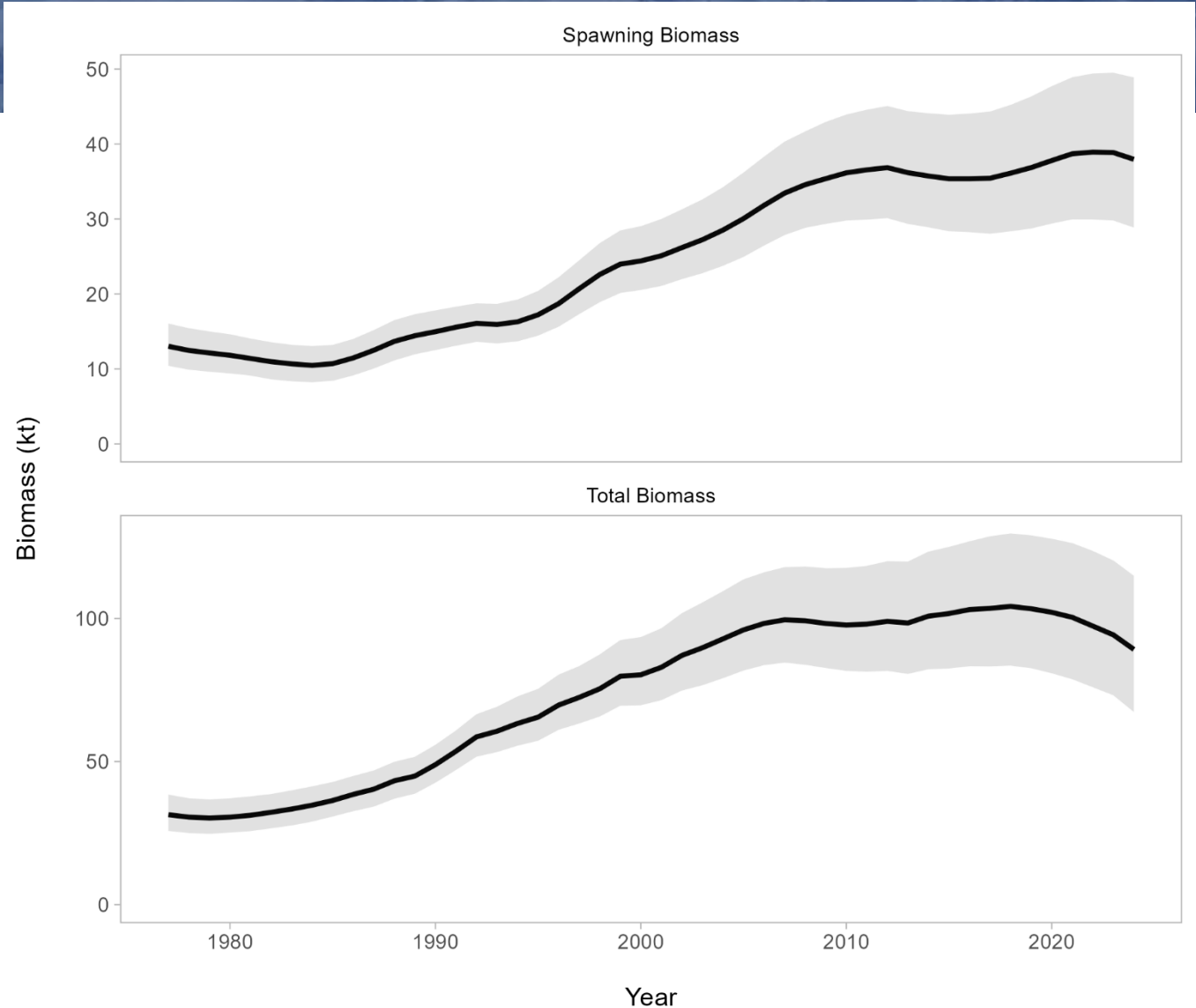
# Results – Time Series



# Results – Time Series

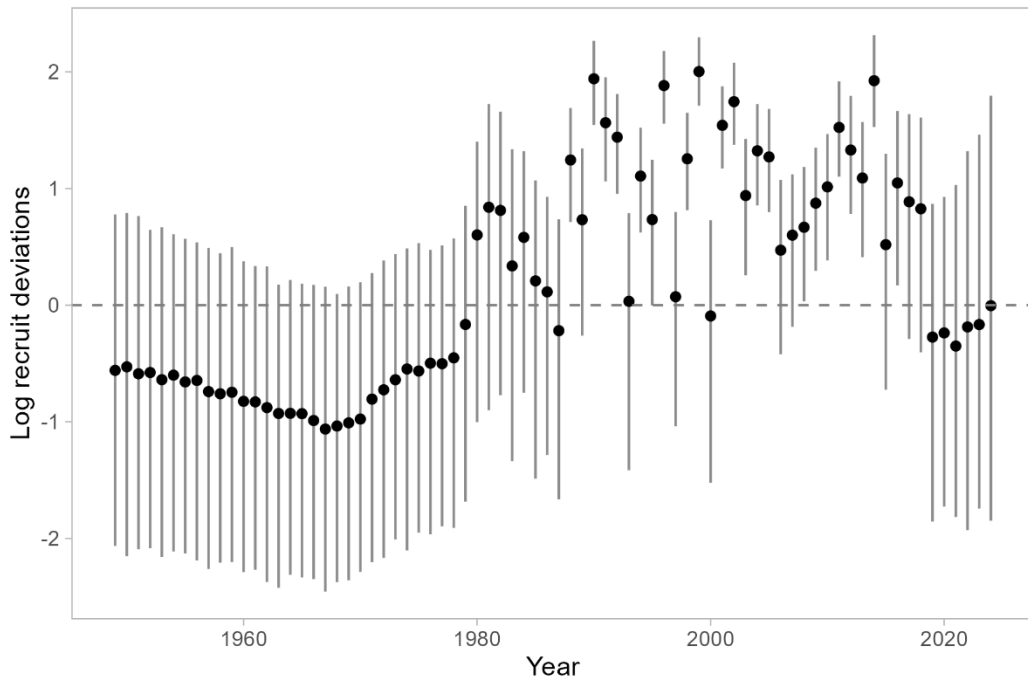
Based on recommended model:

- 2024 Spawning Biomass:
  - -3% change from 2022
  - -2% change from 2023
- 2024 Total Biomass:
  - -8% change from 2022
  - -5% change from 2023

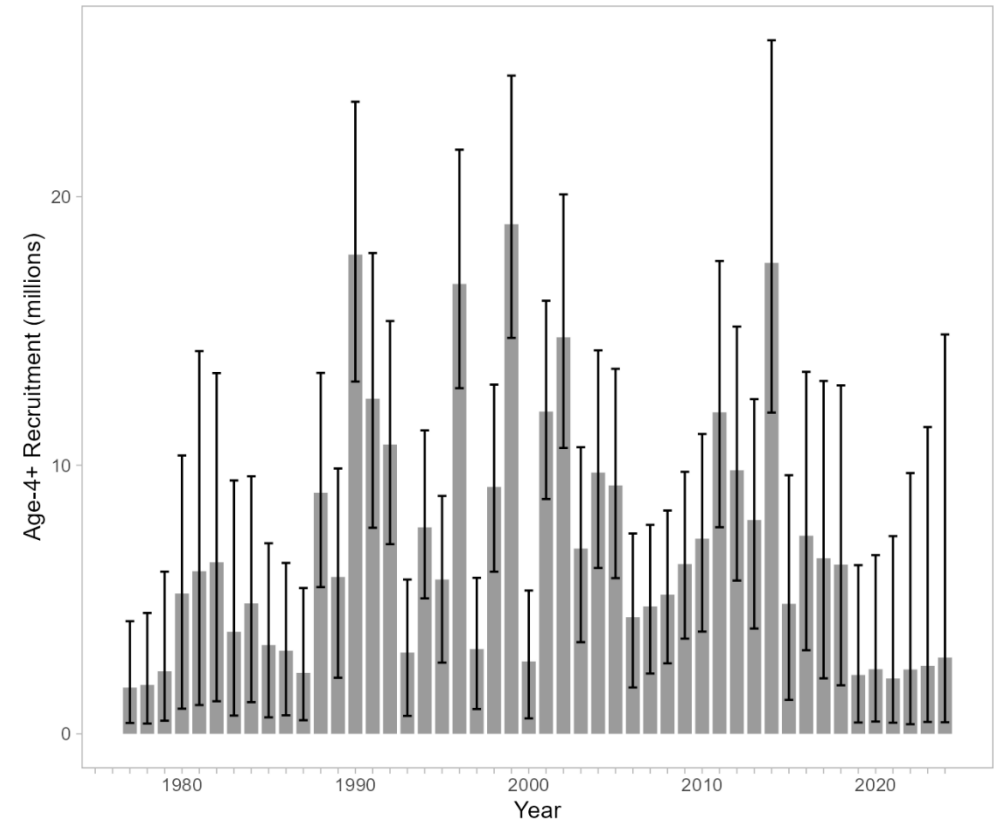




# Results – Time Series



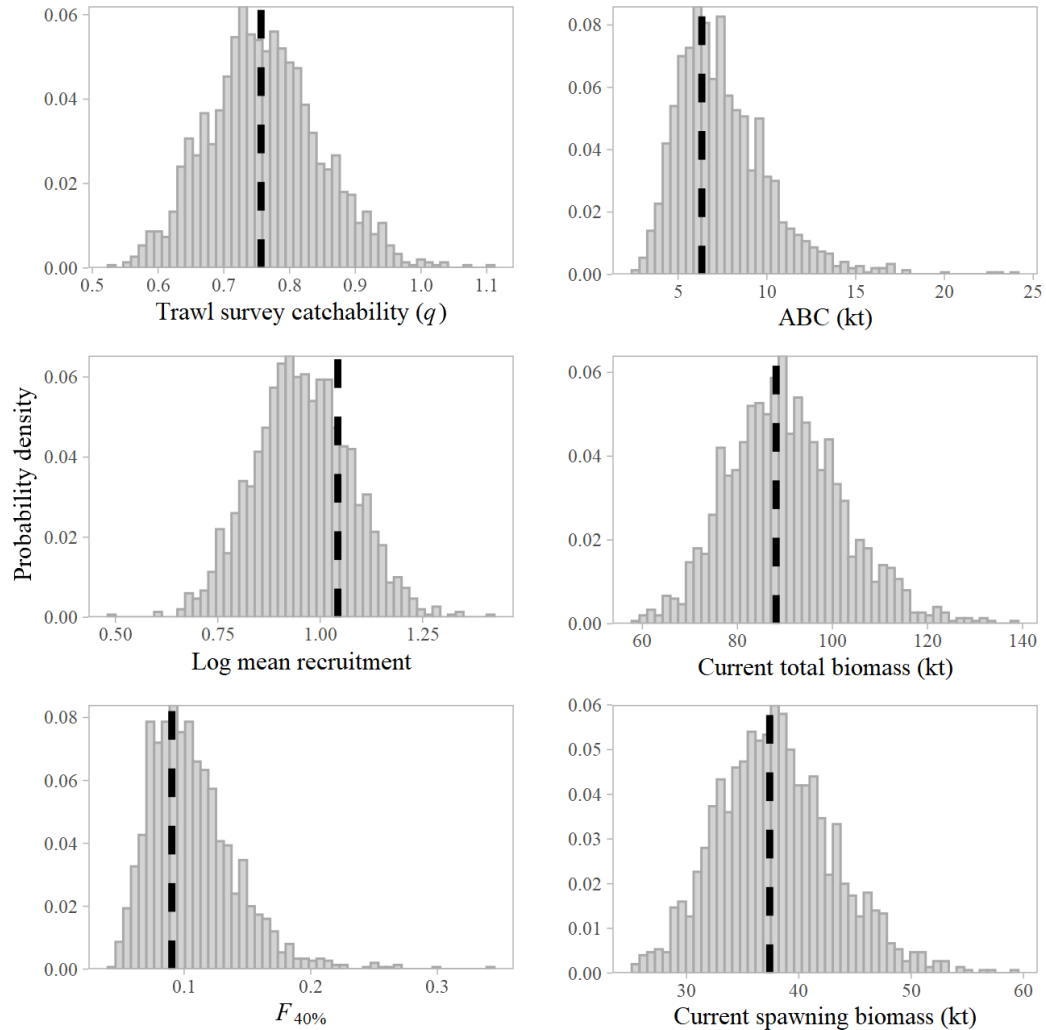
- Based on average recruitment:
  - 2022 → 2.70
  - 2024 recommended model → 2.84



- High recruitment uncertainty

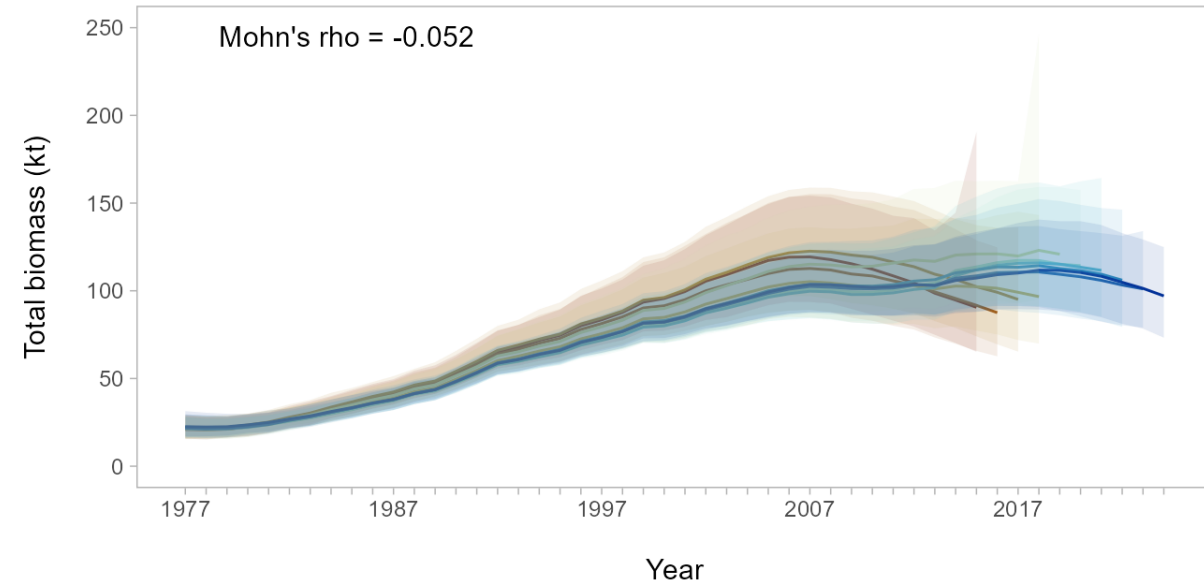
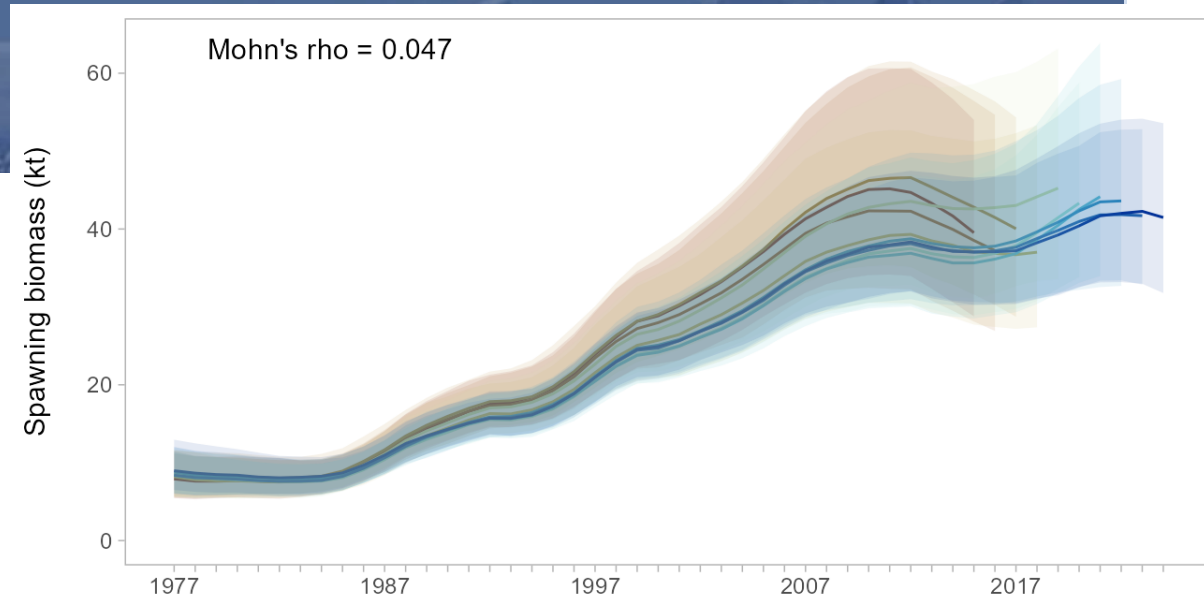


# Results – Model diagnostics

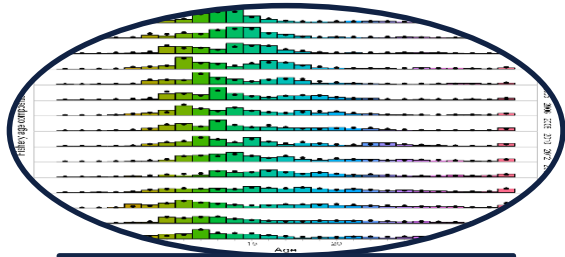


# Results – Model diagnostics

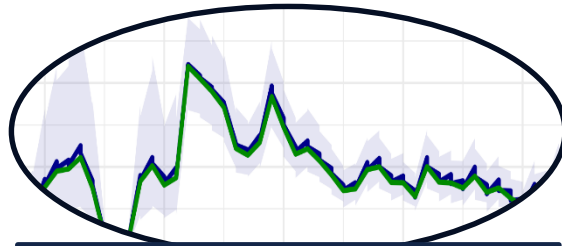
- Retrospective pattern
  - Low Mohn's rho, but shows 2 different patterns
  - Consistent estimated biomass in last 5 years of peels (< 5 years are removed), i.e., no pattern exists
  - Early peels (> 5 years removed), overestimation of spawning biomass
  - Total biomass similar response, but delayed
- Vast index?



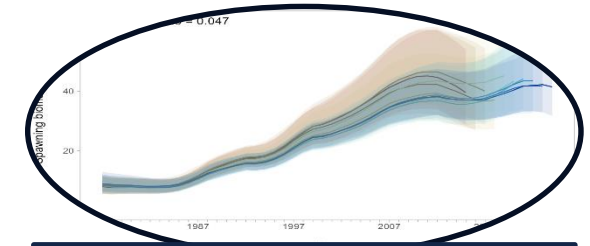
# Results – Summary



Data Fits



Estimates and Time Series



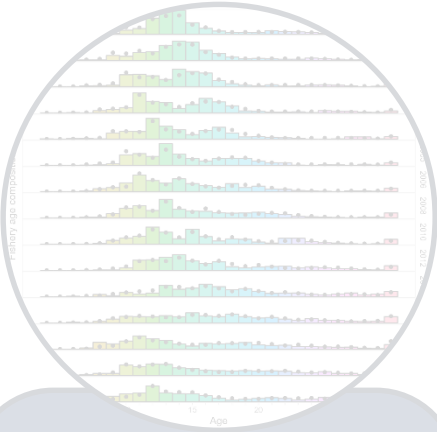
Diagnostics

- Model appeared to fit data
- Differences in survey estimates were primarily due to model changes
- Data compositions fit pretty well in general especially in later years
  - Length composition in early years did not fit as well.

- No dramatic changes in biomass estimates,  $F$ , recruitment from 2022
- Decrease in total and spawning biomass mainly due to model changes, and some data updates
- Recruitment is highly uncertain

- Most parameter estimates from MLE, aligned with MCMC results
- Retrospective pattern:
  - 5+ years are removed = overestimation of spawning biomass
  - < 5 years peels = no pattern

# Assessment Evaluation Overview

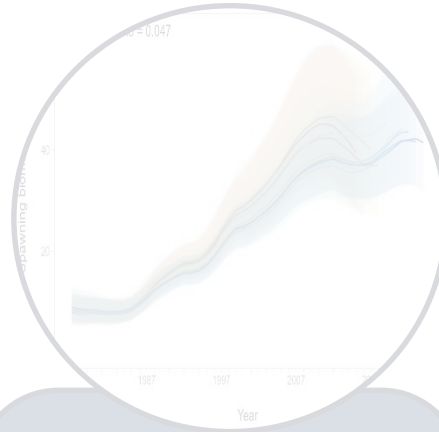


## Data

Inputs  
Evaluation

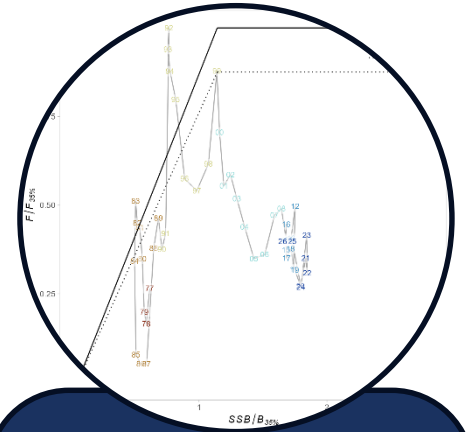


## Model Structure & Updates



## Results

Data fits  
Estimates  
Diagnostics



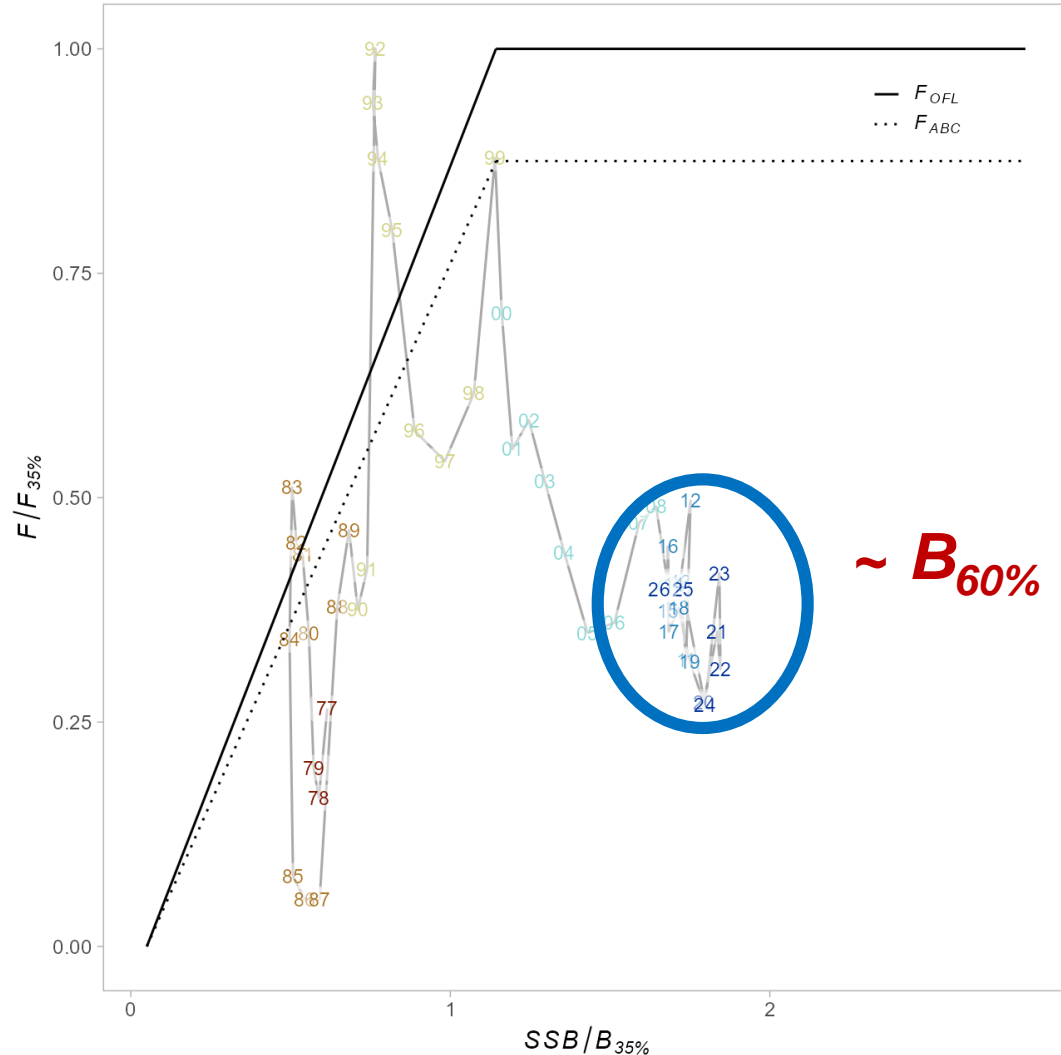
## Recs

Stock Status  
Risk Table  
ABC & OFL  
Apportionment





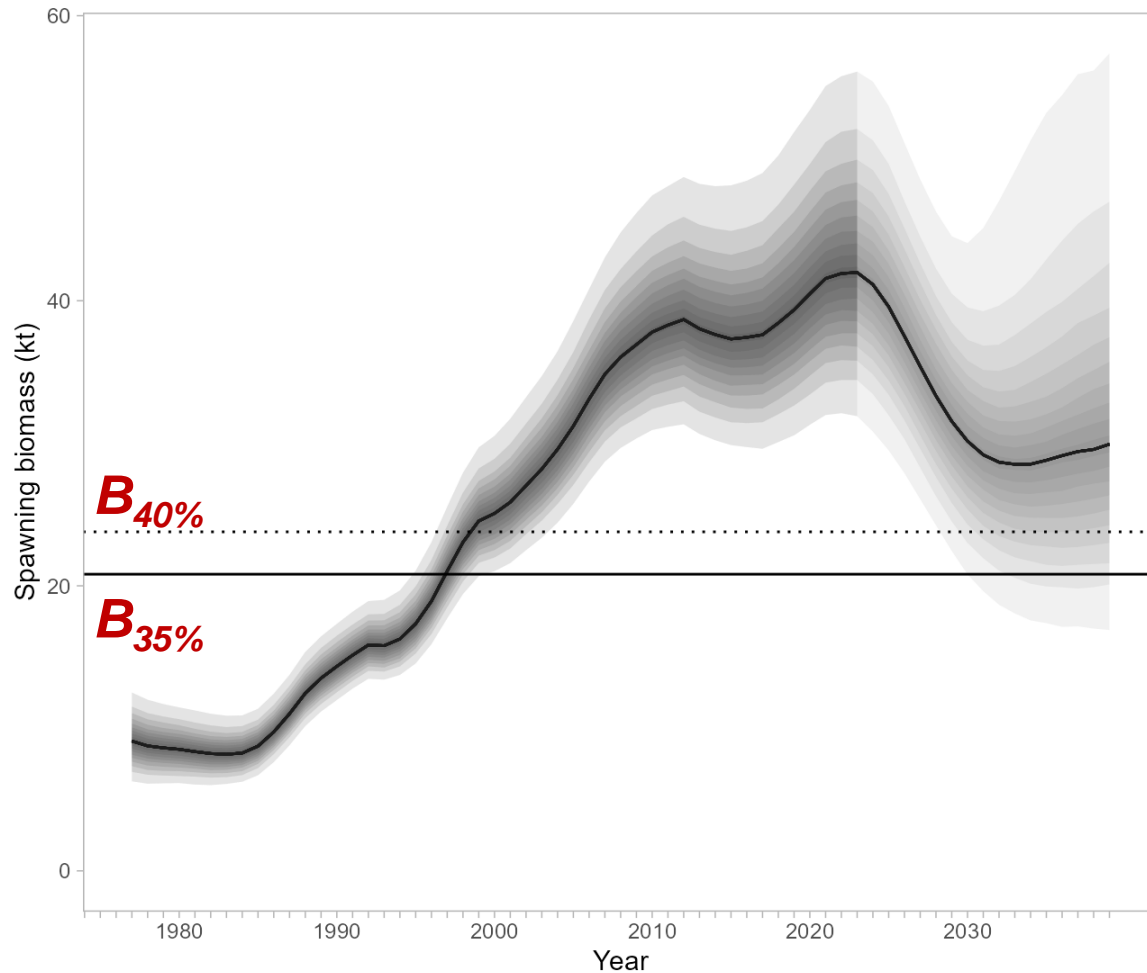
# Recommendations – Stock Status



- Not overfished
- No overfishing occurring
- Not approaching overfished condition



# Recommendations – Stock Status



- Not overfished
- No overfishing occurring
- Not approaching overfished condition



# Recommendations – Risk Table

Assessment-related considerations	Population dynamics considerations	Environmental/ ecosystem considerations	Fishery-informed stock considerations
Level 2: Increased concern	Level 1: Normal	Level 1: Normal	Level 1: Normal
<ul style="list-style-type: none"> <li>• Decent data fits (except length comps)</li> <li>• High recruitment uncertainty</li> <li>• Sensitive to the scaling of the VAST index</li> <li>• Bimodal pattern in retrospective analysis</li> </ul>	<ul style="list-style-type: none"> <li>• No dramatic changes from last assessment</li> <li>• Unknown levels of skip spawning</li> </ul>	<ul style="list-style-type: none"> <li>• No concerning conditions</li> </ul>	<ul style="list-style-type: none"> <li>• Catch in 2024 is low from fishery not targeting rockfish (not biological reasons)</li> <li>• ~ 50% of ABC/ TAC caught</li> </ul>

**No reduction in ABC recommended**

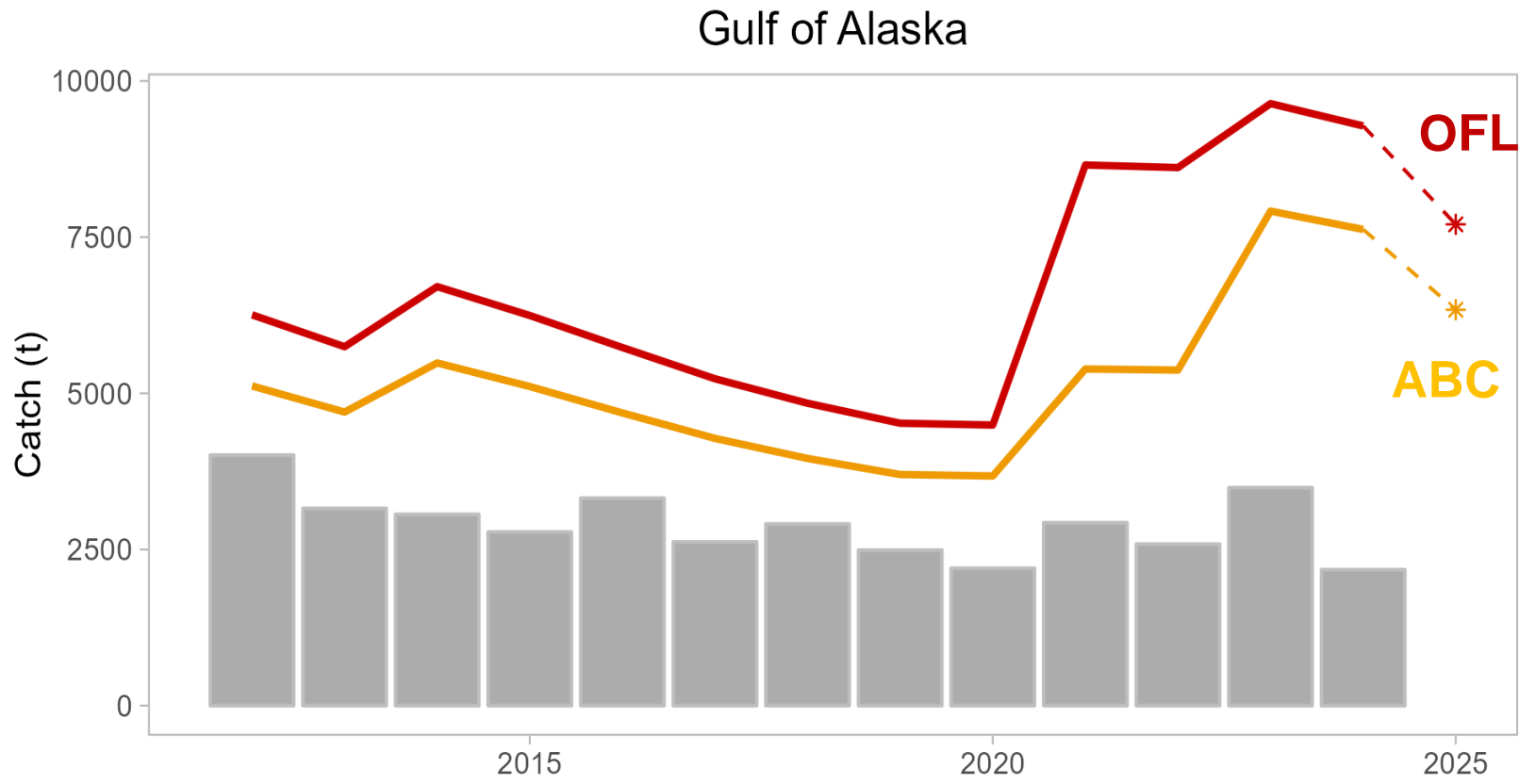
# Recommendations – ABC/ OFL

Quantity/Status	As estimated or <i>specified</i> last year for:		As estimated or <i>recommended</i> this year for:	
	2024	2025	2025*	2026*
M (natural mortality)	0.07	0.07	0.07	0.07
Tier	3a	3a	3a	3a
Projected total (age 4+) biomass (t)	103,997	100,827	85,912	83,297
Projected female spawning biomass (t)	43,197	41,200	35,982	34,478
B <sub>100%</sub>	65,565	65,565	59,467	59,467
B <sub>40%</sub>	26,226	26,226	23,787	23,787
B <sub>35%</sub>	22,948	22,948	20,813	20,813
F <sub>OFL</sub>	0.112	0.112	0.111	0.111
maxF <sub>ABC</sub>	0.091	0.091	0.09	0.09
F <sub>ABC</sub>	0.091	0.091	0.09	0.09
OFL (t)	9,281	8,796	<b>7,705</b>	7,319
maxABC (t)	7,624	7,225	6,338	6,021
ABC (t)	7,624	7,225	<b>6,338</b>	6,021

Based on the recommended model (m22.5a), **17% decrease** in ABC from 2024 to 2025



# Recommendations – ABC/ OFL



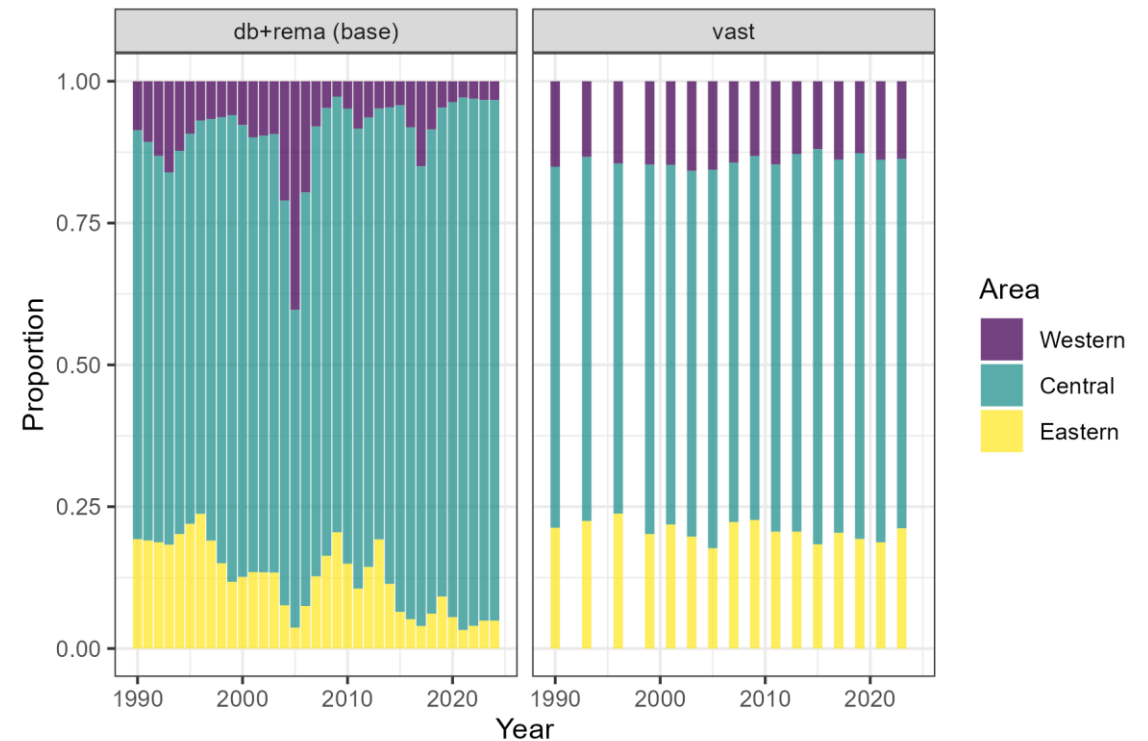
Based on the recommended model (m22.5a), **17% decrease** in ABC from 2024 to 2025



# Recommendations – Apportionment

For Western, Central, and Eastern: (presented in September PT\*)

- Status quo: design-based model smoothed by REMA
- Recommended apportionment method: VAST (with lognormal error and independent years)
  - Less year to year variability
  - Compared to status quo, higher portion in WG and EG, lower in CG
- Not presenting SSC suggestion (adding RW or AR1 to VAST model)



\*Based on latest 2023 trawl survey, no new data added between Sept. PT and Nov. PT meetings



# Recommendations – Apportionment

Recommended apportionment method (VAST)

		Western	Central	Eastern	Total
Year	Area Apportionment	13.7%	65.1%	21.2%	100%
2025	ABC (t)	868	4,128	1,342	6,338
2025	OFL (t)				7,705
2026	ABC (t)	824	3,922	1,275	6,021
2026	OFL (t)				7,319



# Recommendations – Apportionment

## Eastern GOA split (West Yakutat and Southeast Outside)

- Status quo method presented
  - Weighted survey average method using CVs from the design-based estimator
  - West Yakutat: 0.69
  - Southeast Outside: 0.31
- PT/ SSC suggestion to investigate other options for EGOA split
  - Postponed

		W. Yakutat	Southeast Outside
2025	ABC (t)	926	416
2026	ABC (t)	880	395



# Recommendations – Apportionment (STATUS QUO)

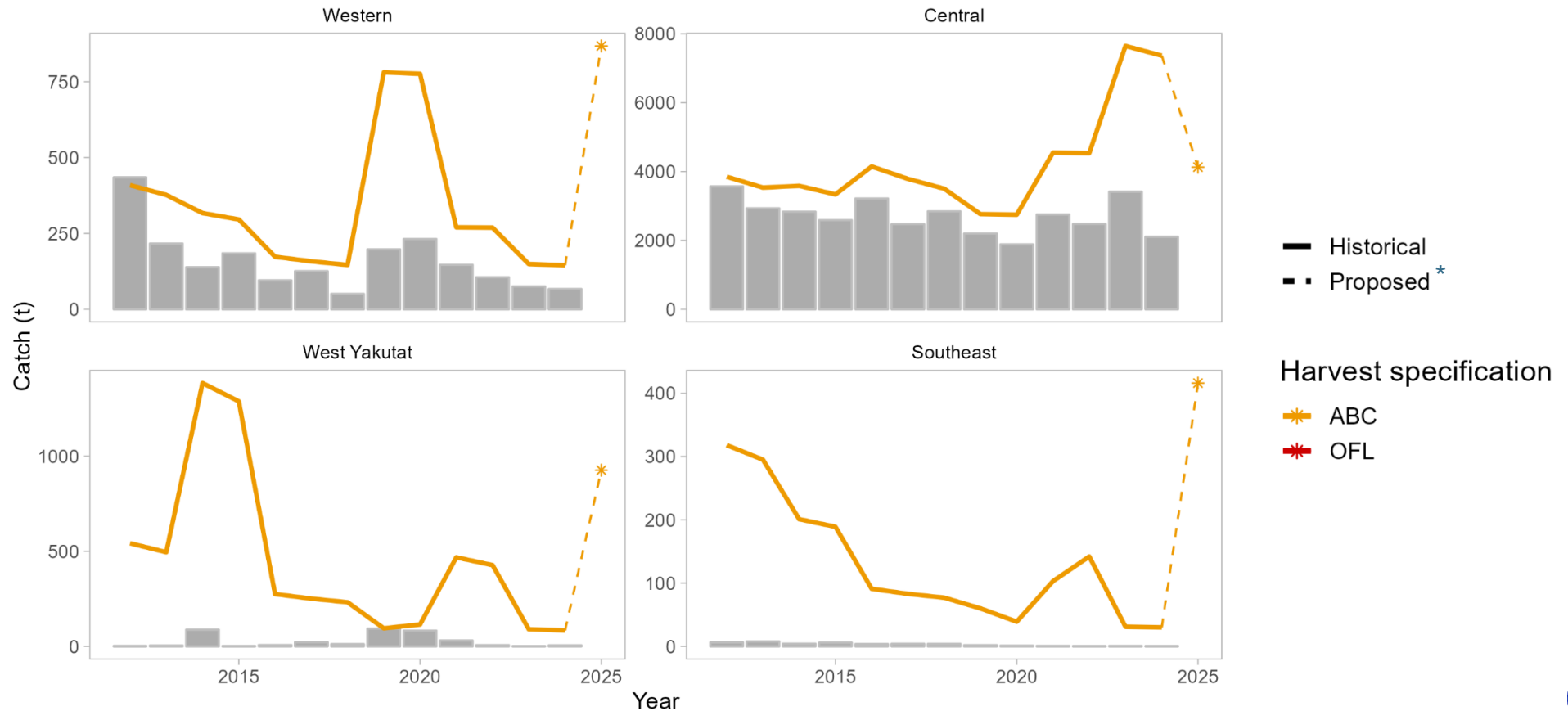
Status quo using design-based method with recommended VAST in “( )”

		Western	Central	Eastern	Total
Year	Area Apportionment	3.3% (13.7%)	91.8% (65.1%)	4.9% (21.2%)	100%
GOA	2025	209 (868)	5,818 (4,128)	311 (1,342)	6,338
	2025				7,705
	2026	199 (824)	5,527 (3,922)	295 (1,275)	6,021
	2026				7,319

		West Yakutat	Southeast Outside
EGOA	2025	215 (926)	96 (416)
	2026	204 (880)	91 (395)



# Recommendations – Apportionment



\*Based on author recommended apportionment (VAST model)



# Data Gaps & Future Work

- Modeling updates:

- Investigating data reweighting
- Exploration of recruitment parameters ( $\sigma_r$ )
- Input sample size work
  - Length composition
- OSA residuals

- Other things to consider:

- Maturity (skip spawning)
- Moving to rTMB



- Apportionment

- Explore VAST options for GOA apportionment methodology
- EGOA split → discussion of a unified way for the GOA rockfish stocks





# Questions?



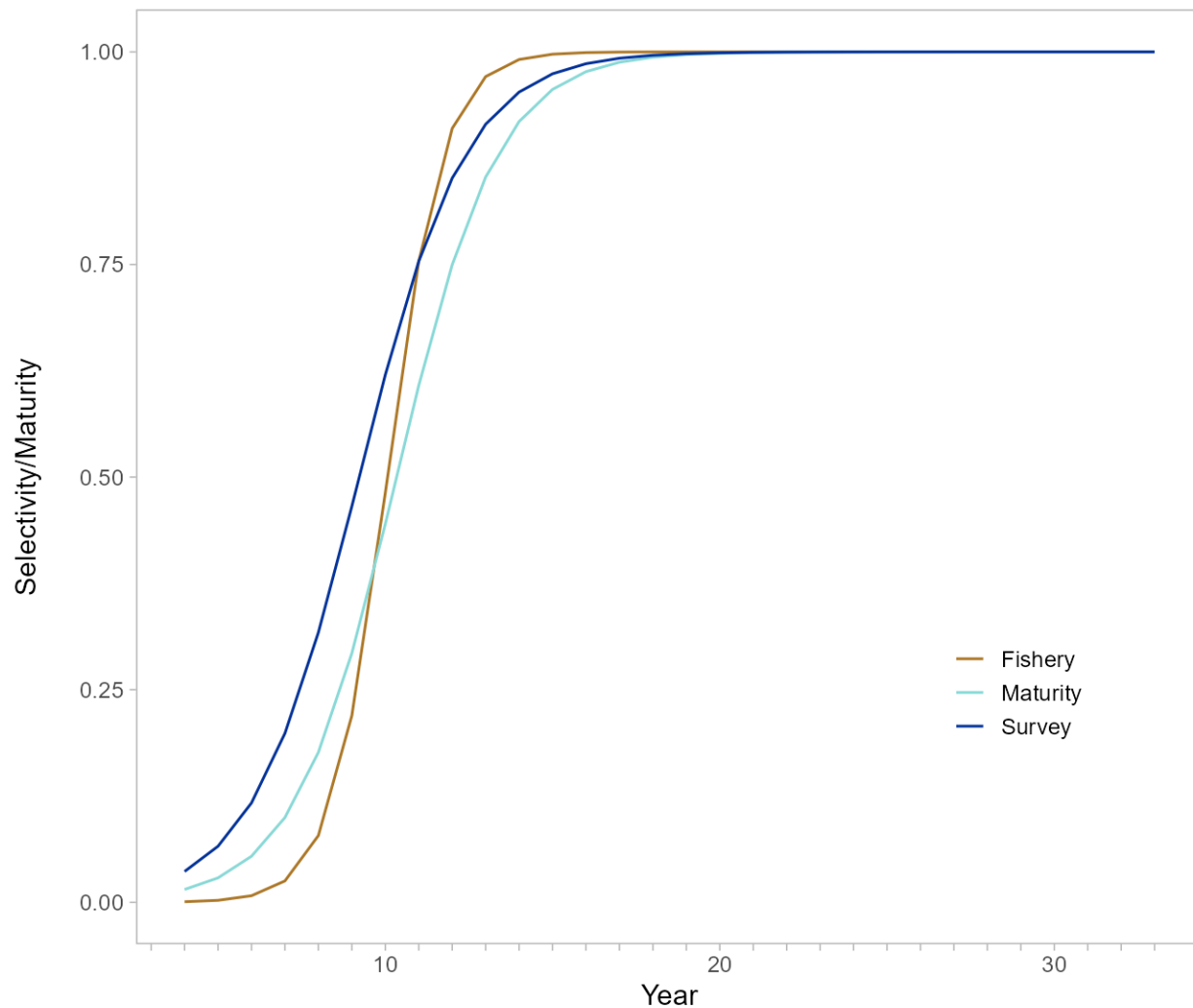
Contact:

[kristen.omori@noaa.gov](mailto:kristen.omori@noaa.gov)

Special thanks to:  
GAP team  
Alaska Regional Office  
AKFIN team  
Observers  
Survey teams



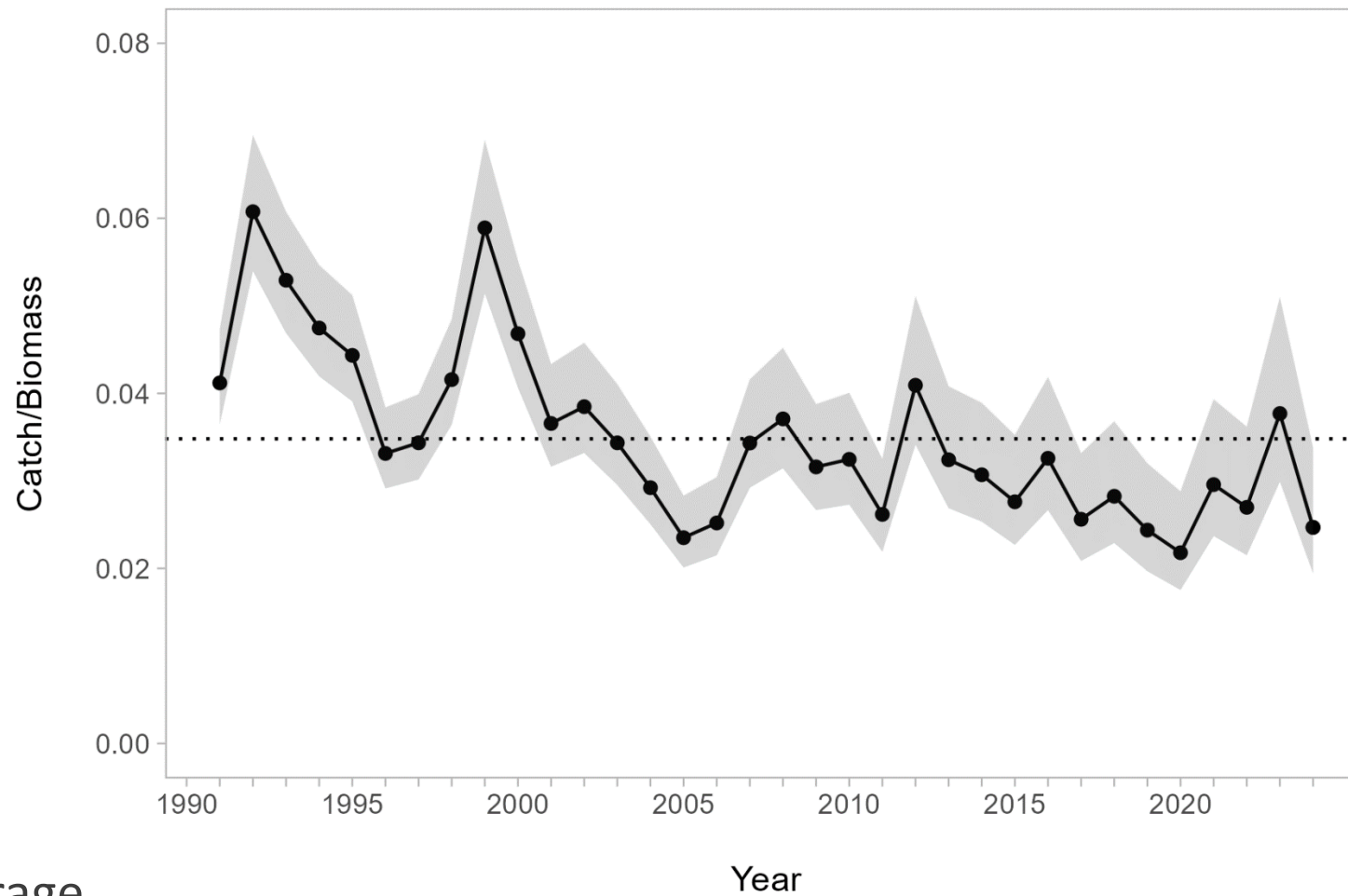
# Results – Parameter Estimates



- Age at 50% maturity: 10.1
- Age at 50% selection:
  - Survey = 8.7
  - Fishery = 10.4
- Fully selected by:
  - Survey = 18
  - Fishery = 15



# Results – Time Series



Dashed line = average

