# GOA Pollock Updates

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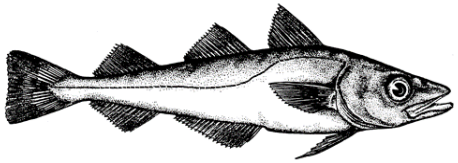


# Assessment methodology history

- 2020 – No changes (19.1)
- 2021 – Transition from Dorn to Monnahan (19.1)
- 2022 – Estimate summer AT selex + consistent $\sigma_R$ (19.1a)
- 2023 – Migration to TMB (23)
- 2024 – CIE: Revised data weighting, covariate on catchability, remove age 1 & 2 indices, Dirichlet-multinomial (23d)
- 2025 – Updated AT data, added priors, overall minor changes (23e)

# Road map for today

- Proposed changes:
  - Transitioning from bespoke TMB to Rceattle platform
  - Model 26a: Rceattle bridged version of 23e + $\sigma_R$ estimated
  - **Model 26b: 26a + ESP-DSEM linkage to recruitment (recommended)**
- Issues: index misfit, data conflict, scale uncertainty
- Research updates

# Stock + assessment overview

- W/C/WYK is a Tier 3 (West of 140W) – typical catch 135 kt
- Stock is healthy: B45, big recent cohorts
- Single-sex, single-fleet, ages 1-10+
- Empirical weight at age
- Fishery selectivity: double-logistic w/ time-varying ascending
- Fitted to 4 surveys
  - NMFS winter (Shelikof) + summer (coast wide) acoustic
  - NMFS & ADF&G summer bottom trawl
- Time-varying *q* for Shelikof (covariate) and ADF&G (RW)
- Dirichlet-multinomial for composition weighting

# Rceattle transition: Motivation

- Is a next-generation generic state-space assessment platform designed for AFSC stocks and needs (Adams et al. 2021)
- Has all features we need now:
  - Operational: flexible population dynamics options, modern diagnostics (internal OSA), SAFE guideline requirements (sensitivities, etc.)
  - Research: multispecies, simulation + MSE ready, etc.
  - DSEM module linked to recruitment
- Development by AFSC staff, so in our control for feature development
- Accepted for operational use for GOA ATF, various multispecies applications
- Why not SPoRC? Equally impressive option, but space issues not as pertinent for GOA pollock. DSEM and multispecies aspects preferred.

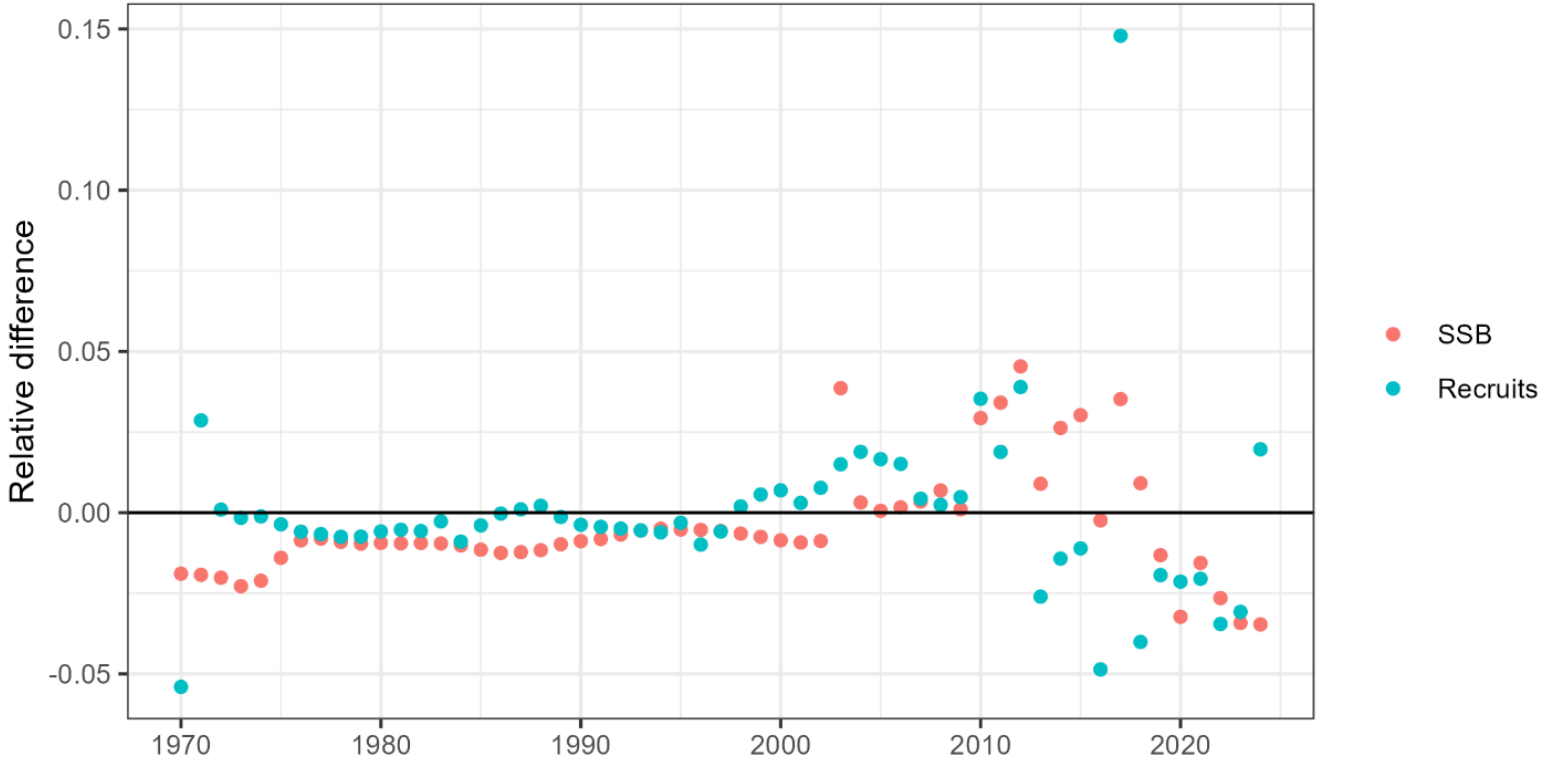
# Rceattle bridging: model 23f

Bridging to Rceattle required several small changes to 23e

- Fixed minor bug in initial NAA, and use $\sigma_R$ as the penalty.
- Added a lognormal bias correction on total catch.
- Switched to a more standard random-walk parameterization
- Re-normalized ageing error and composition data to sum to 1

**Had minimal impact on management quantities compared to 23e.**

# Rceattle bridging: model 23f



# Model updates: Rceattle models proposed

- Changes in 23f should be done in any case.
- Rceattle port of 23f match to machine precision. We call this model 26 as it's a change of software
- **26a: Model 26, but with $\sigma_R$ estimated**
- **26b: Model 26a + a DSEM module**
- Model 26b is recommended for operational use.

# Model 26b: DSEM linkage details

- We propose DSEM (Thorson et al. 2024) as an interface for ecosystem-linkages
- Model 26b is based on published research (Champagnat et al. 2026)
- Incorporates 8 ESP variables directly into the assessment
- Earlier versions of this were previewed in 2024 and encouraged by PT & SSC
- We plan to continue using mean recruitment for management

**Causal Models as a Scientific Framework for Next-Generation Ecosystem and Climate-Linked Stock Assessments**

J. Champagnat[1,2] | C. C. Monnahan[3] | J. Y. Sullivan[4] | James T. Thorson[3] | S. K. Shotwell[4] | L. Rogers[3] | A. E. Punt[1]

# Model 26b: DSEM linkage details

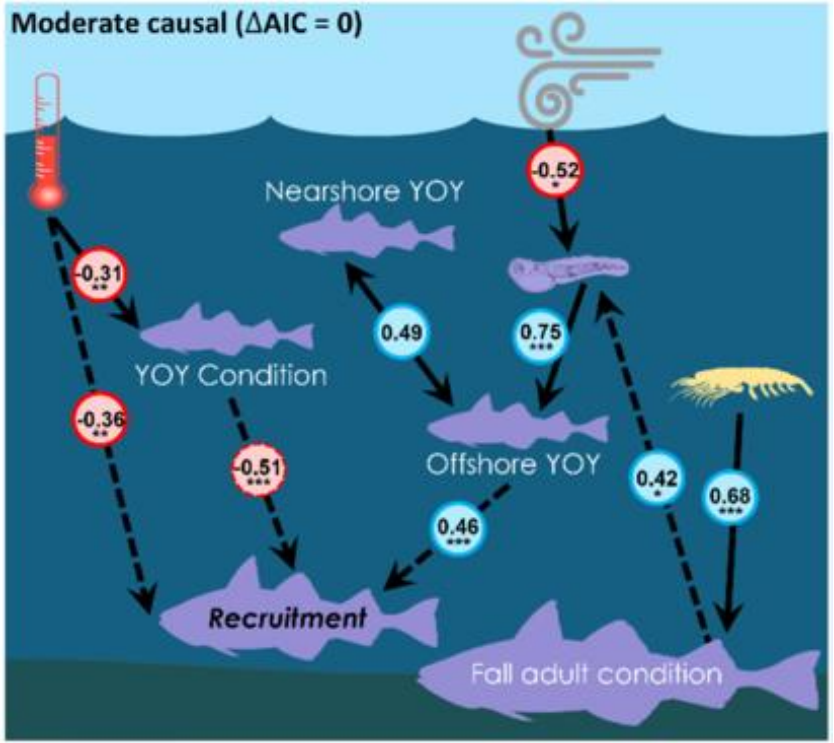
| Variable name | Description of data and proposed mechanism relating to recruitment |
|---|---|
| Spring SST | Spring (April-May) daily sea surface temperatures (SST) for the western and central (combined) |
| Wind | Mean springtime (April-May) north/south surface wind strength |
| Euphausiids | Summer euphausiid abundance from the Alaska Fishery Science Center (AFSC) acoustic survey |
| Fall adult condition | Fall body condition for adults from the pollock fishery sampled by observers. |
| Larvae | Spring pollock larvae catch-per-unit-of-effort (CPUE) from the EcoFOCI spring survey. |
| Offshore YOY | Summer young-of-the-year (YOY) pollock CPUE from the EcoFOCI summer survey. |
| Nearshore YOY | Summer CPUE of YOY pollock from the AFSC beach seine survey in the Kodiak region. |
| YOY Condition | Summer body condition for YOY pollock from EcoFOCI summer survey. |
| Euph Diet | Proportion-by-weight of euphausiids in the diets of juvenile (age 1+) GOA pollock from summer bottom-trawl surveys. |
| Copepod | Summer large copepods from the EcoFOCI summer survey. |

# Model 26b: DSEM linkage details

Champagnat et al. (2026)

- DSEM added to Rceattle and confirmed results with new data/model.
- “Moderate” complexity DAG recommended
- Strong statistical performance
- DSEM now can do non-linear and non-stationary effects (Thorson and Kristensen 2026)

| Model | No. pars | ΔAIC | $\sigma_R$ | % Reduction in unexplained variance |
|---|---|---|---|---|
| iid | 219 | 31.4 | 1.02 | 0.0 |
| AR1 | 220 | 28.1 | 0.96 | 10.1 |
| Regression | 220 | 22.7 | 0.78 | 41.4 |
| Simple causal | 224 | 9.6 | 0.59 | 65.8 |
| Moderate causal | 228 | 0.0 | 0.61 | 64.0 |
| Complex causal | 230 | 11.4 | 0.59 | 65.8 |



# Model 26b: Pros and cons

Pros:

- Builds toward mechanistic understanding of recruitment
- Improves short-term projections of recruitment
- Formalizes inclusion of varied ESP data and team expertise
- Fulfils national mandates (NS1) and ESP goals (Shotwell et al. 2023)

Cons:

- Increases code complexity and (slightly) slower model estimation
- Harder to validate, interpret outputs
- Could complicate risk table usage, projections, HCR. Exacerbates challenges with simpler climate-linked approaches.

# Model results and validation

The following model results are with data through 2025 only. Also incorporates acoustic data updates (McGowan et al. 2026)

- 23e: 2025 accepted model
- 26a: Model 26, but with $\sigma_R$ estimated
- 26b: Model 26a + a DSEM module

Overall: All models estimate well, are stable, and have very similar estimates and management outcomes.

# Model results and validation

| Model | Description | SSB (2025) | B0 | B40 | B35 | FOFL | FABC | OFL (2026) | ABC (2026) |
|---|---|---|---|---|---|---|---|---|---|
| 23e | 2025 accepted model | 262,552 | 580,000 | 232,000 | 203,000 | 0.326 | 0.275 | 210,648 | 181,084 |
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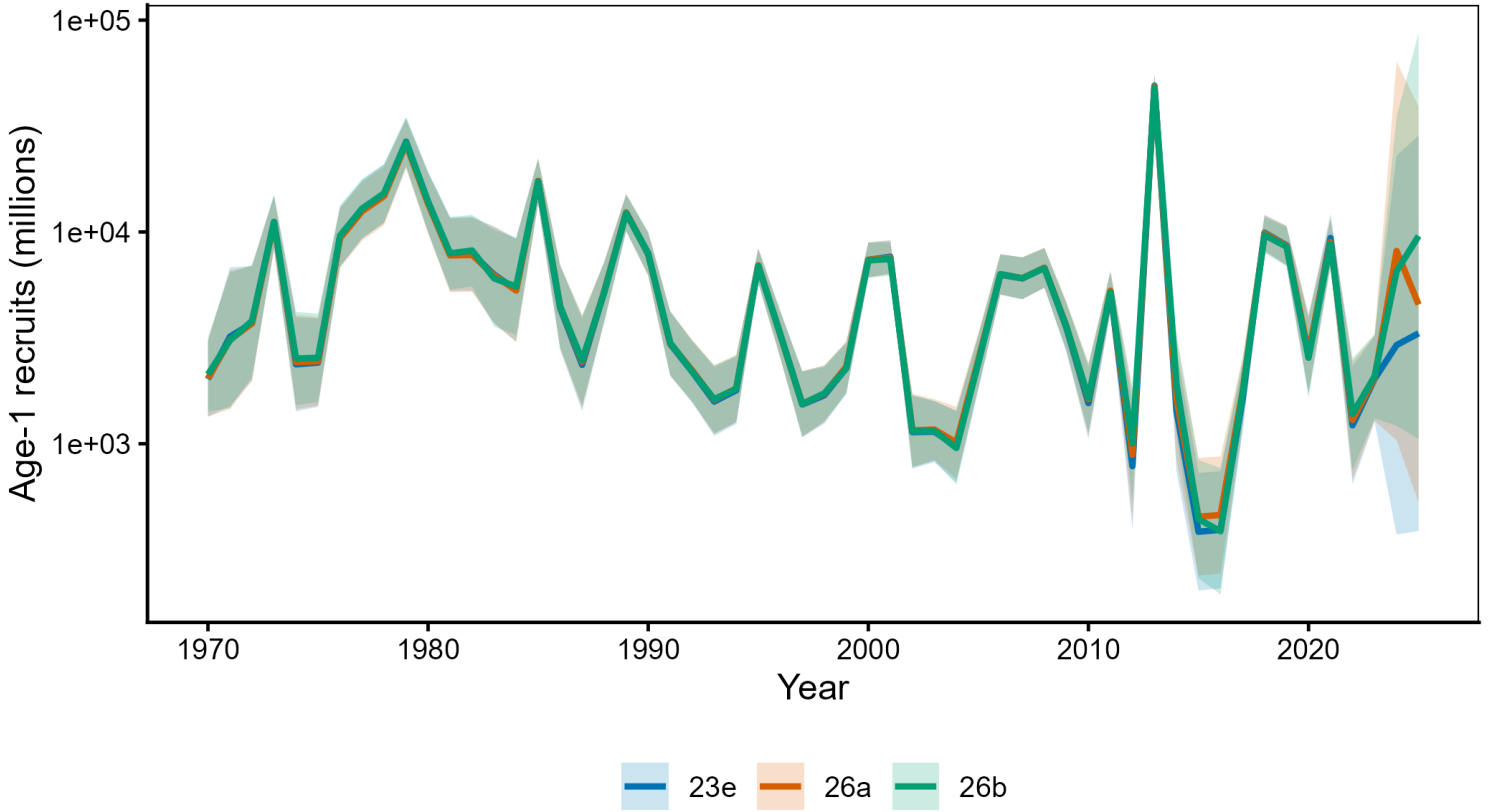
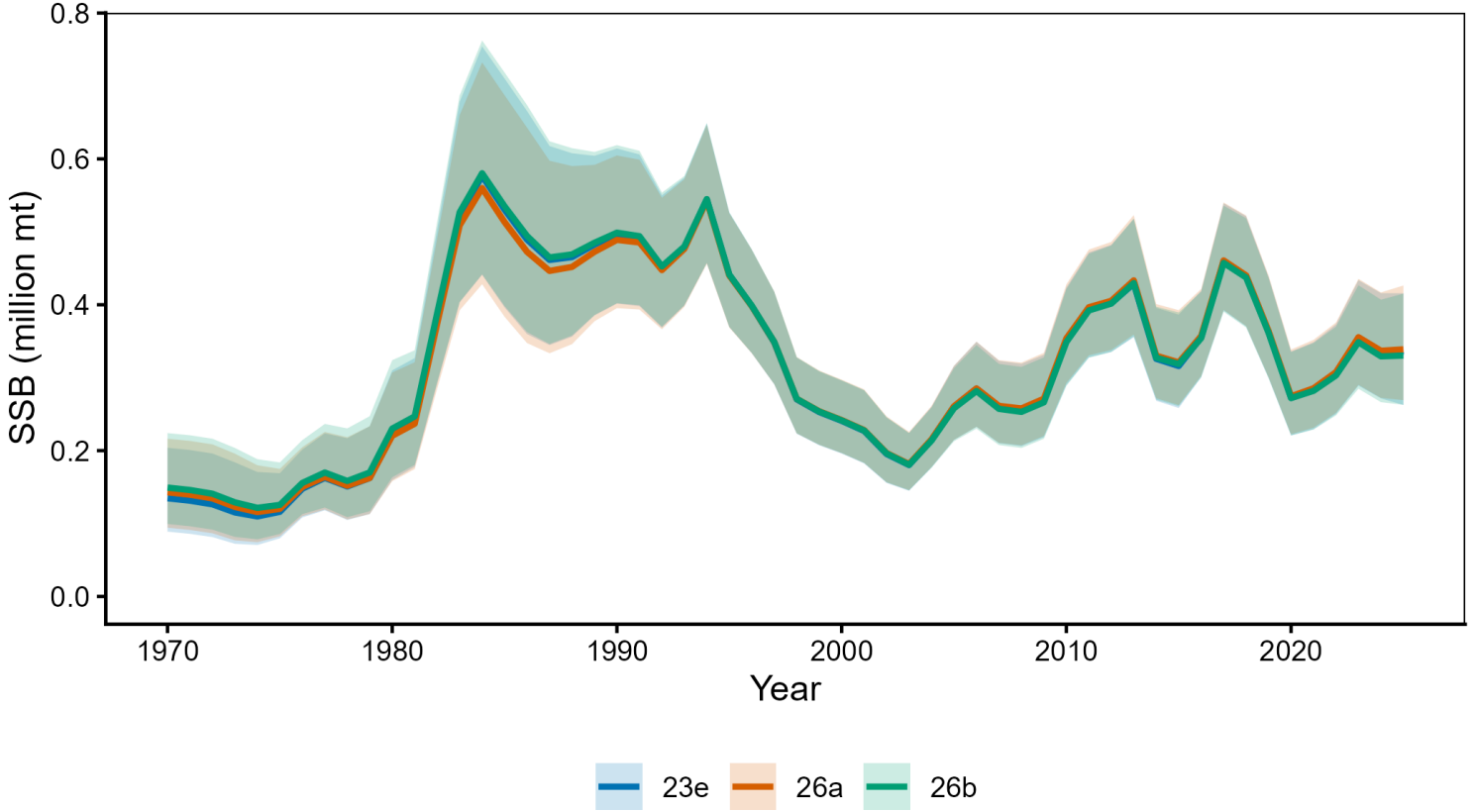
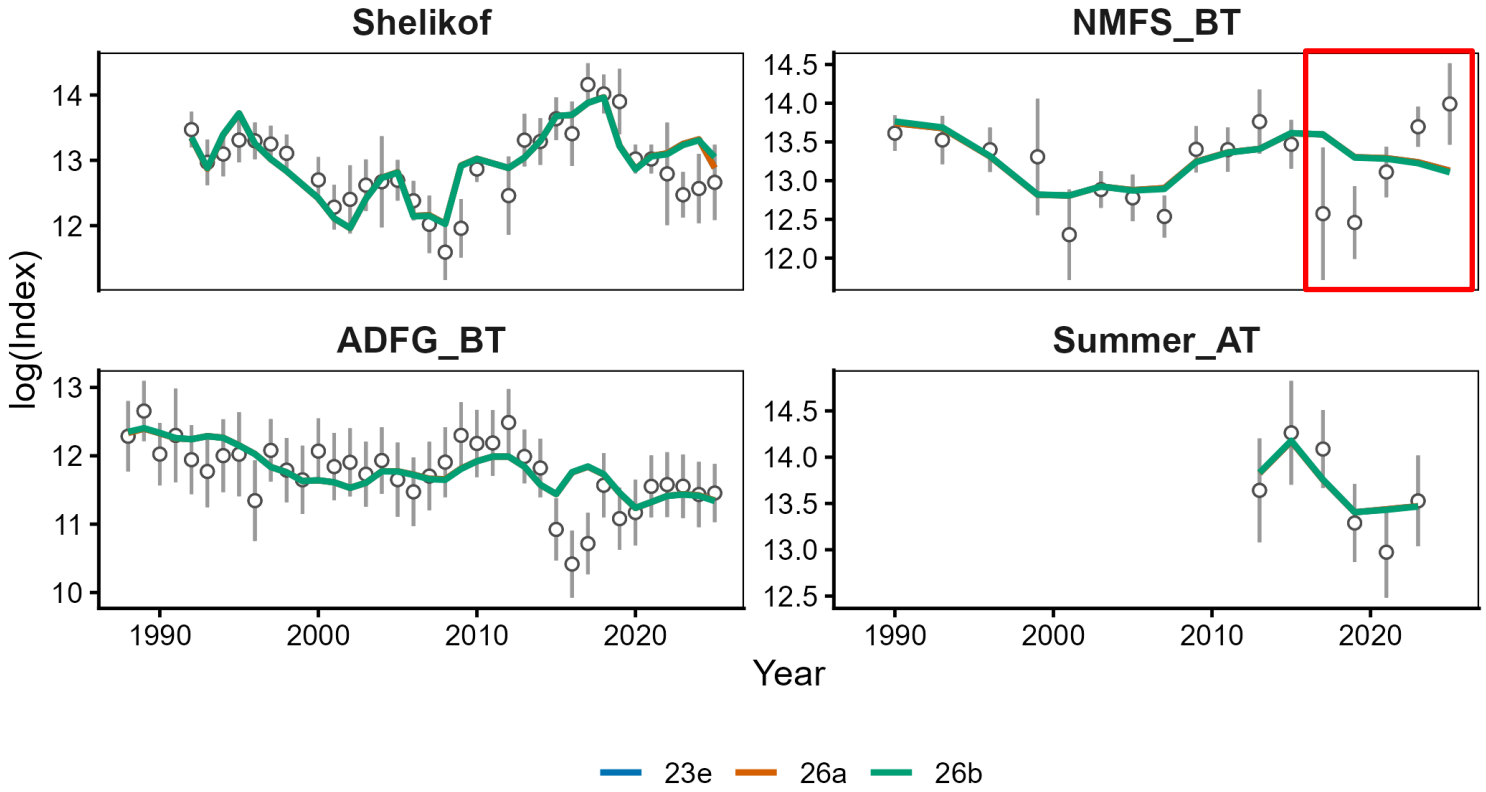
# Model results: recruitment



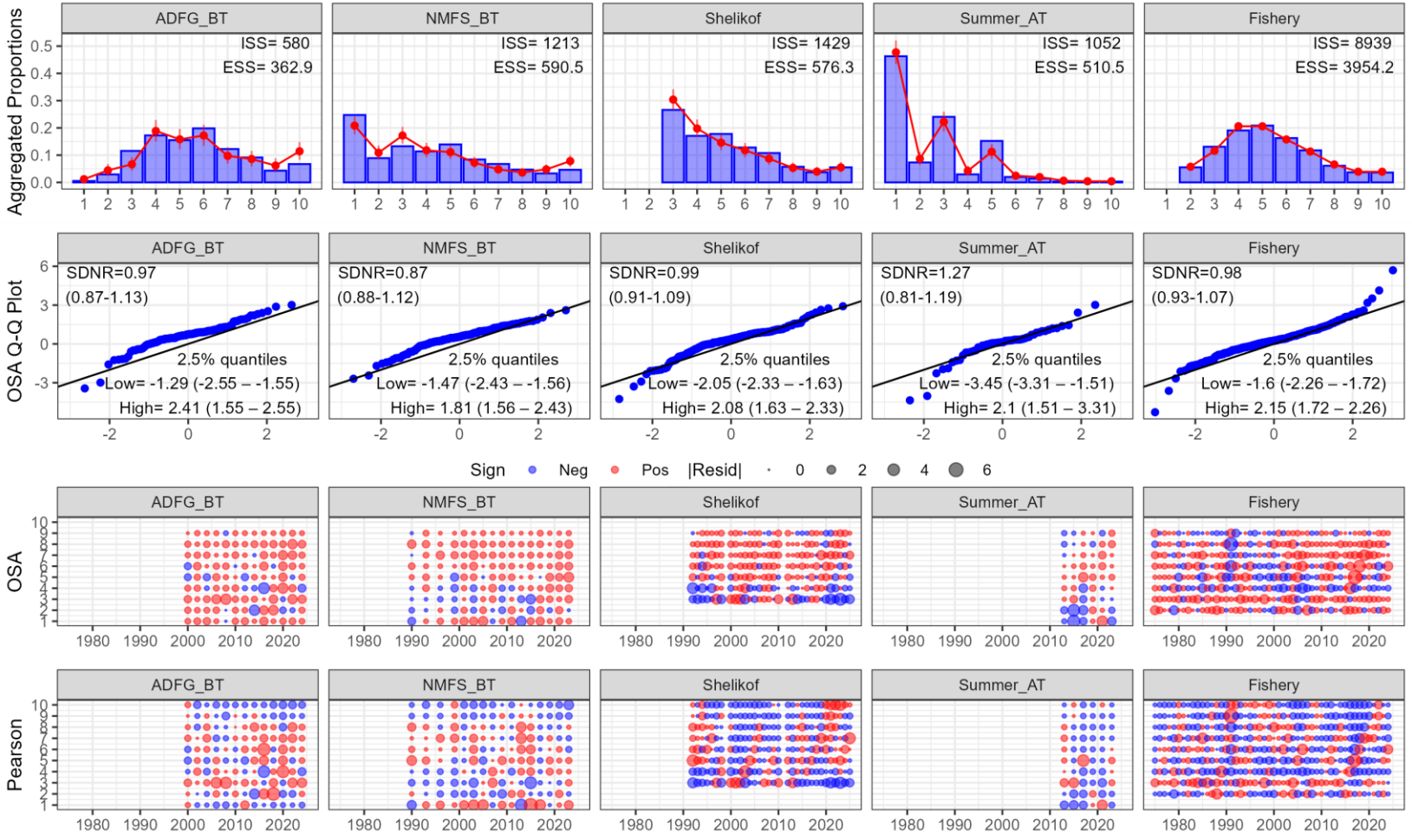
# Model results: recruitment



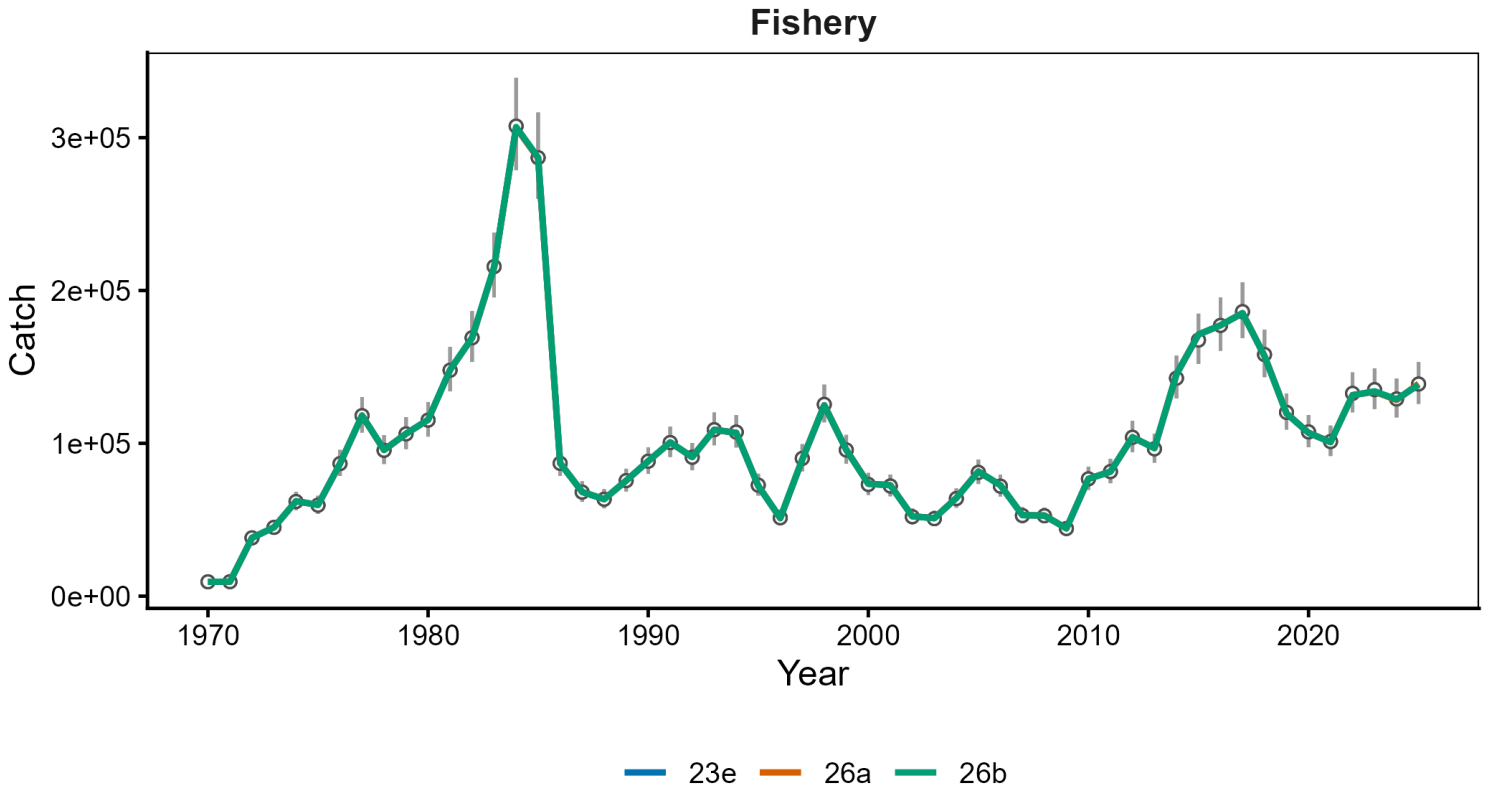
# Model results: Index fits



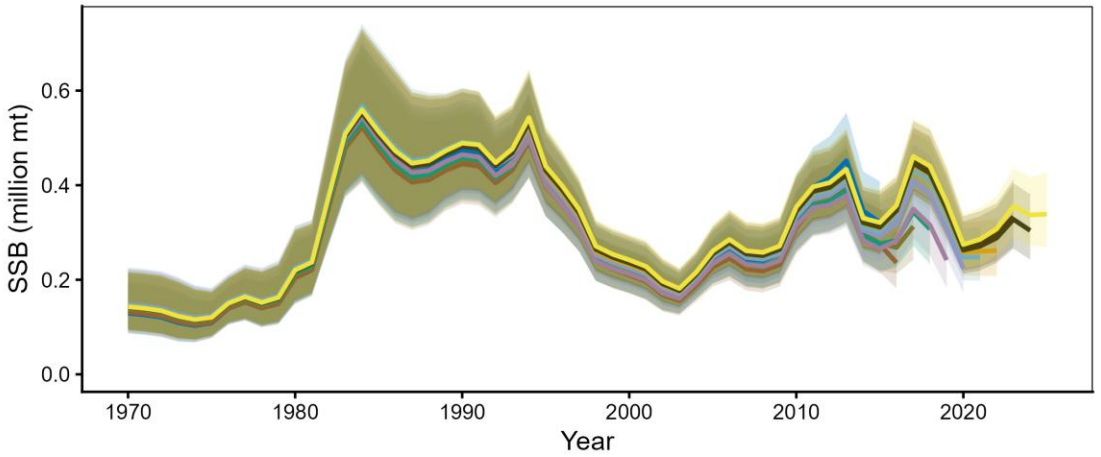
**26b**


Aggregated Proportions
ADFG_BT
ISS= 580
ESS= 362.9
NMFS_BT
ISS= 1213
ESS= 590.5
Shelikof
ISS= 1429
ESS= 576.3
Summer_AT
ISS= 1052
ESS= 510.5
Fishery
ISS= 8939
ESS= 3954.2
OSA Q-Q Plot
SDNR=0.97
(0.87-1.13)
2.5% quantiles
Low= -1.29 (-2.55 – -1.55)
High= 2.41 (1.55 – 2.55)
SDNR=0.87
(0.88-1.12)
Low= -1.47 (-2.43 – -1.56)
High= 1.81 (1.56 – 2.43)
SDNR=0.99
(0.91-1.09)
Low= -2.05 (-2.33 – -1.63)
High= 2.08 (1.63 – 2.33)
SDNR=1.27
(0.81-1.19)
Low= -3.45 (-3.31 – -1.51)
High= 2.1 (1.51 – 3.31)
SDNR=0.98
(0.93-1.07)
Low= -1.6 (-2.26 – -1.72)
High= 2.15 (1.72 – 2.26)
Sign Neg Pos |Resid| 0 2 4 6
OSA
Pearson

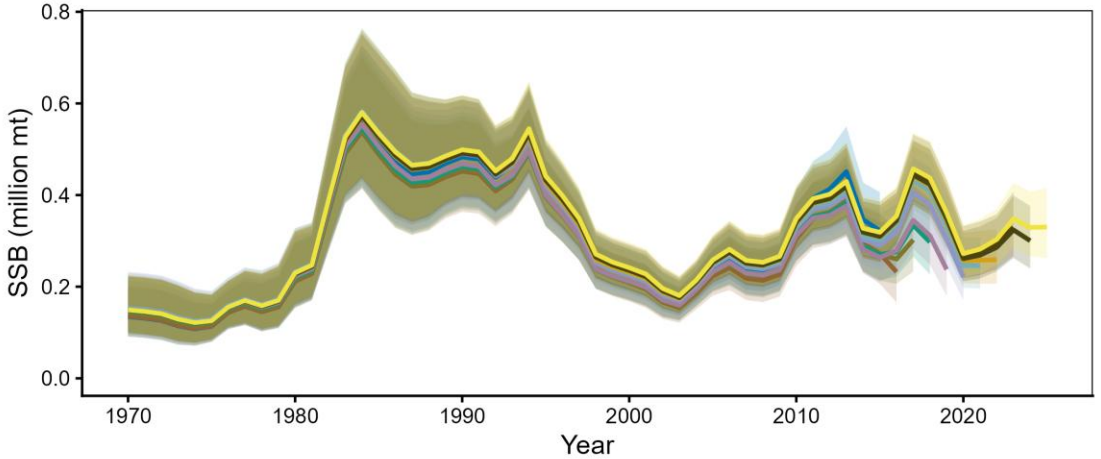
# Model results: Catch fits



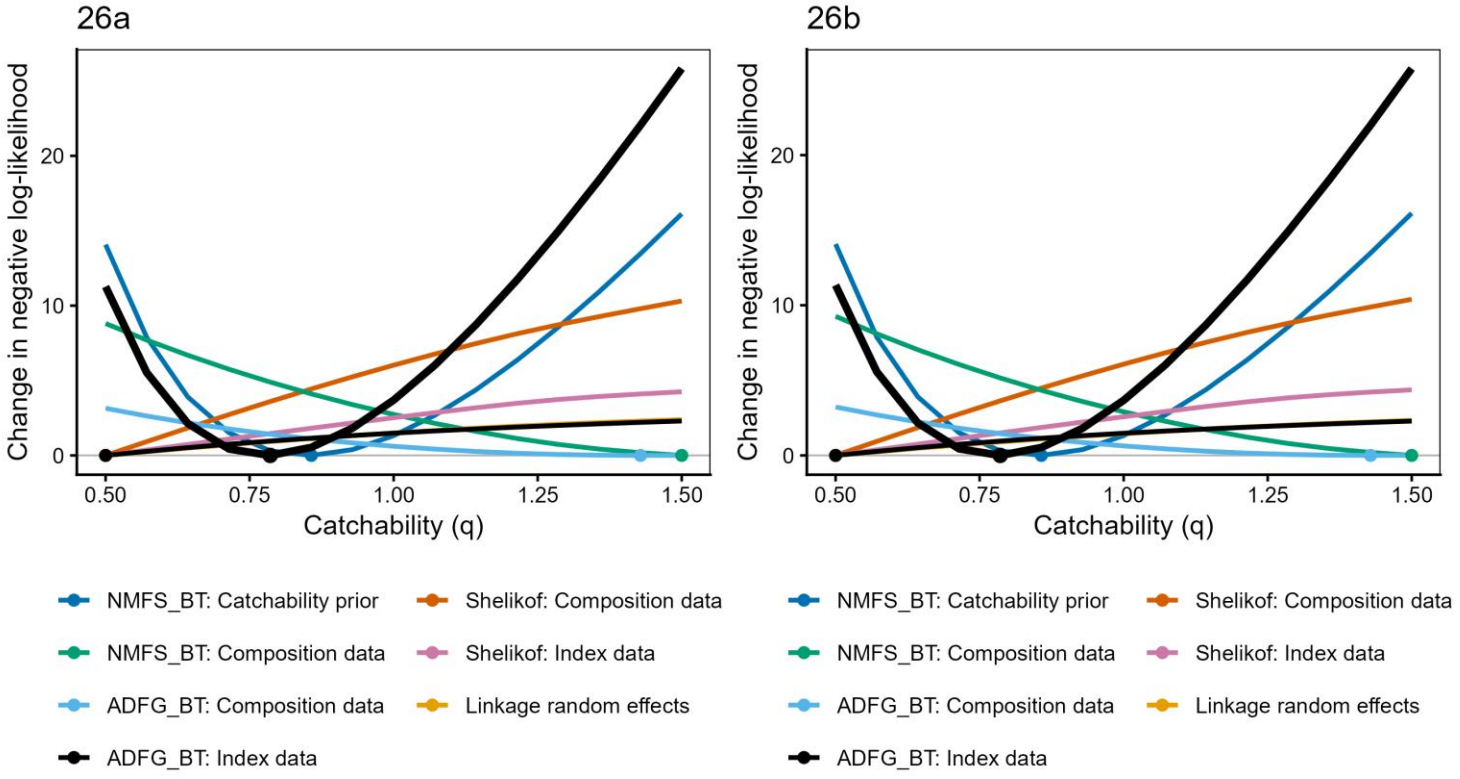
26a: Mohn’s rho= -0.247




26b: Mohn’s rho= -0.250

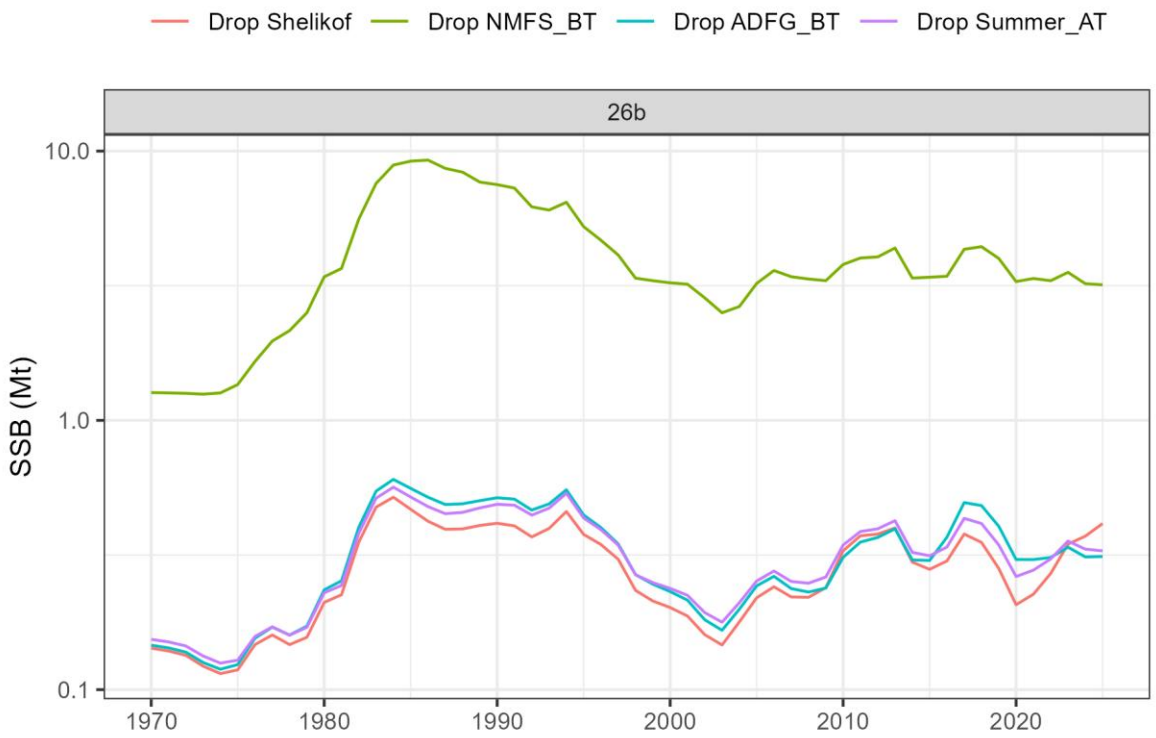


# Model validation: likelihood profile on NMFS BT q



# Model validation: effects of dropping surveys

- Big change in scale when dropping the NMFS BT survey
- Longstanding issue with scale being informed strongly by prior on catchability for NMFS BT
- Otherwise fairly stable trend
- *See Sep 2024 doc for further analysis and thoughts about estimates of catchability*

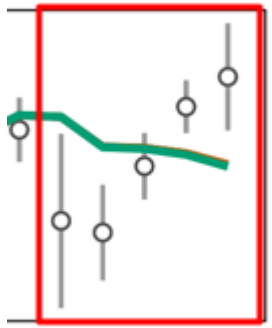


# End of model results and validation

- Questions on model fits, results, validation etc.?
- …Besides NMFS BT misfit which is next

# Investigations of misfit to the NMFS BT

- The 2025 biomass estimate is the highest on record and continues poor fit for 5 surveys

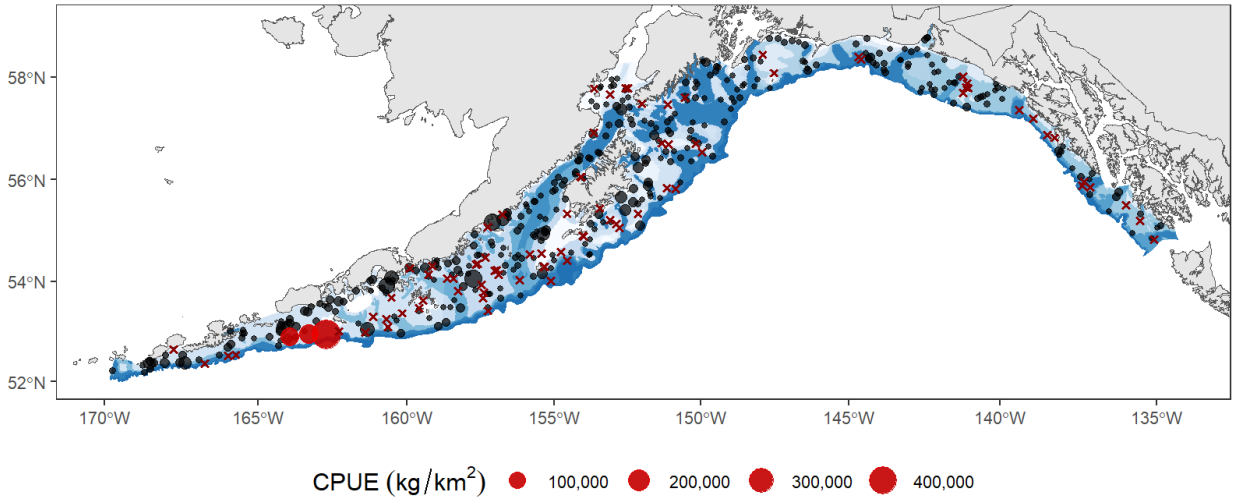


We explored two hypotheses about the cause of the misfit

1. EBS fish increasingly coming into GOA in 610
2. Fish are increasingly on bottom and available to the BT gear

# Influence of large tows in 2025

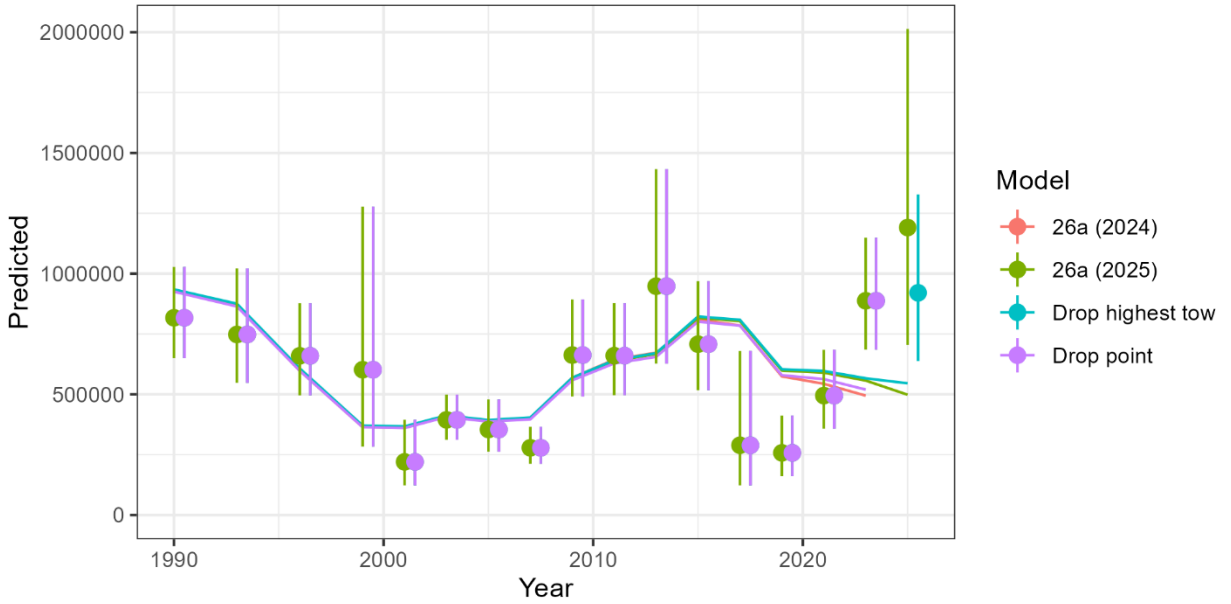
- Three very large tows in 610
- Adjacent to Unimak Pass
- Without the largest tow biomass and CV drop by 23% and 30% respectively




Big thanks to Megsie Siple and Zack Oyafuso

# Influence of large tows in 2025

- Fit models without the point, or the largest tow removed
- Dropping the highest tow **increases** SSB
- Lower biomass, but also more weight so pulls it up more



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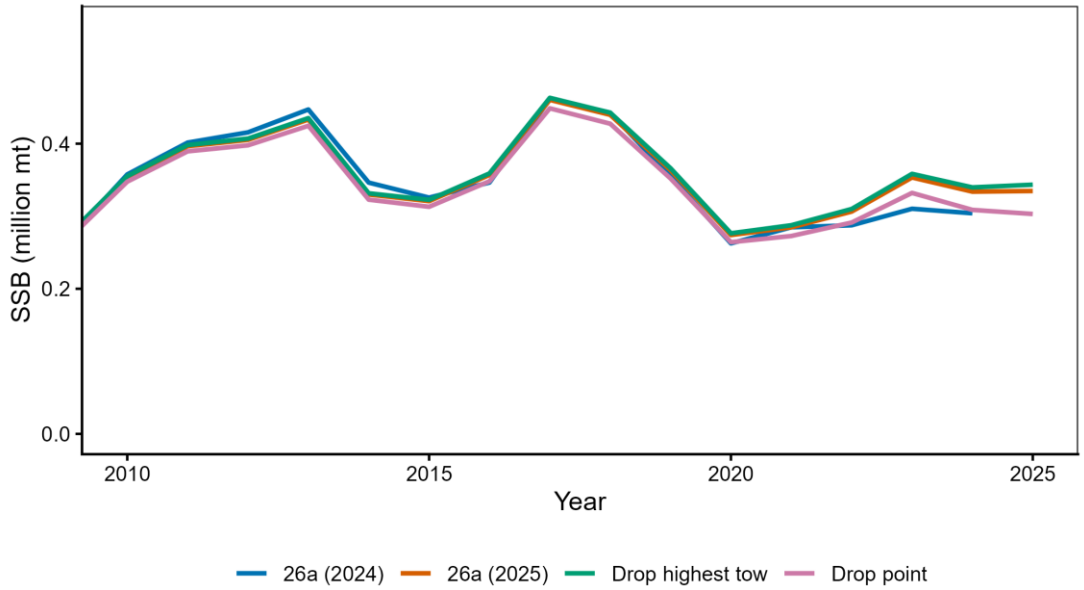


# Influence of large tows in 2025

- Could these be EBS fish? Maybe?
- They are large tows, but not unprecedented, and BT sees a lot of pollock in 610
- Raises big issues about stock connectivity and structure
- Have plans to work with AGP to test stock ID using otolith morphology or FT-NIRS
- Will hopefully have something preliminary by 2027
- **For now, recommend leaving data as is.**

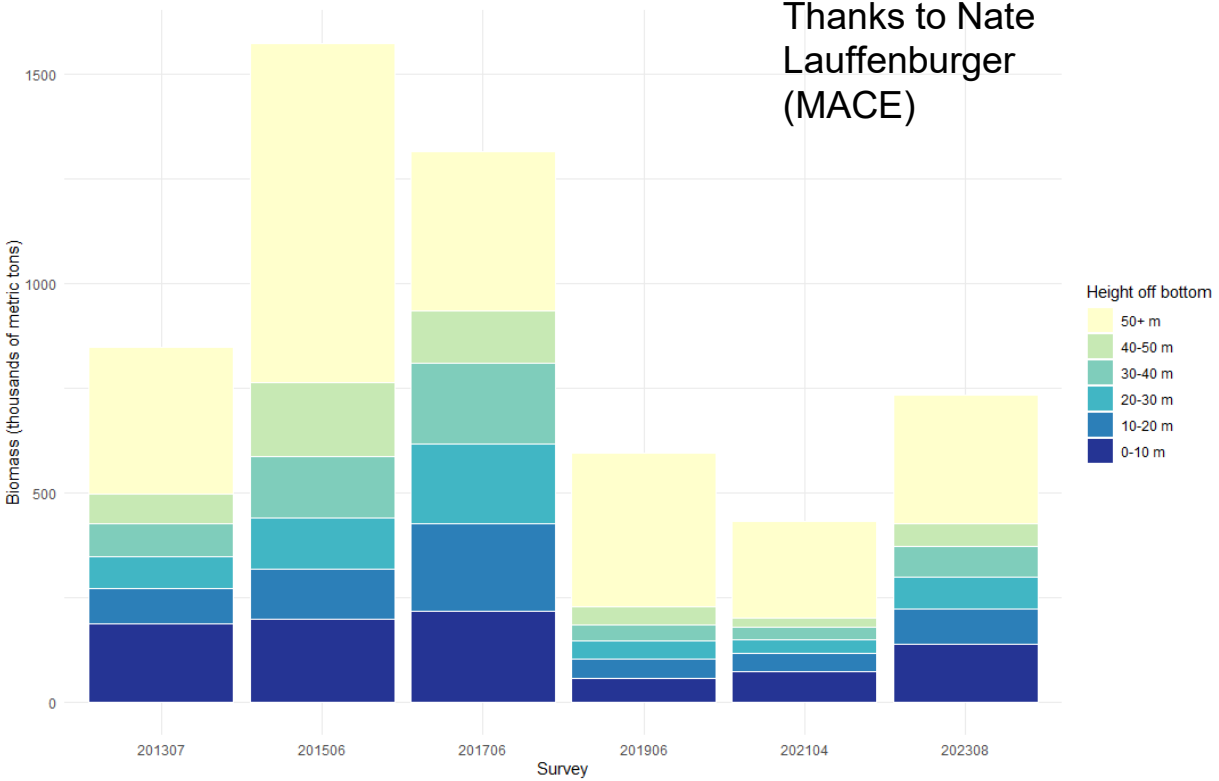
# Shifts in vertical availability

- Bottom trawl gear miss pollock above the “effective fishing height” (EFH)
- Time-invariant catchability implies the portion of the stock below the EFH (vertical availability) is constant
- A trend down in the water column would appear as an increase in the estimates (and violate *q* assumption)
- Monnahan et al. (2021) found substantial changes in availability in the EBS. **What about the GOA?**

# Shifts in vertical availability

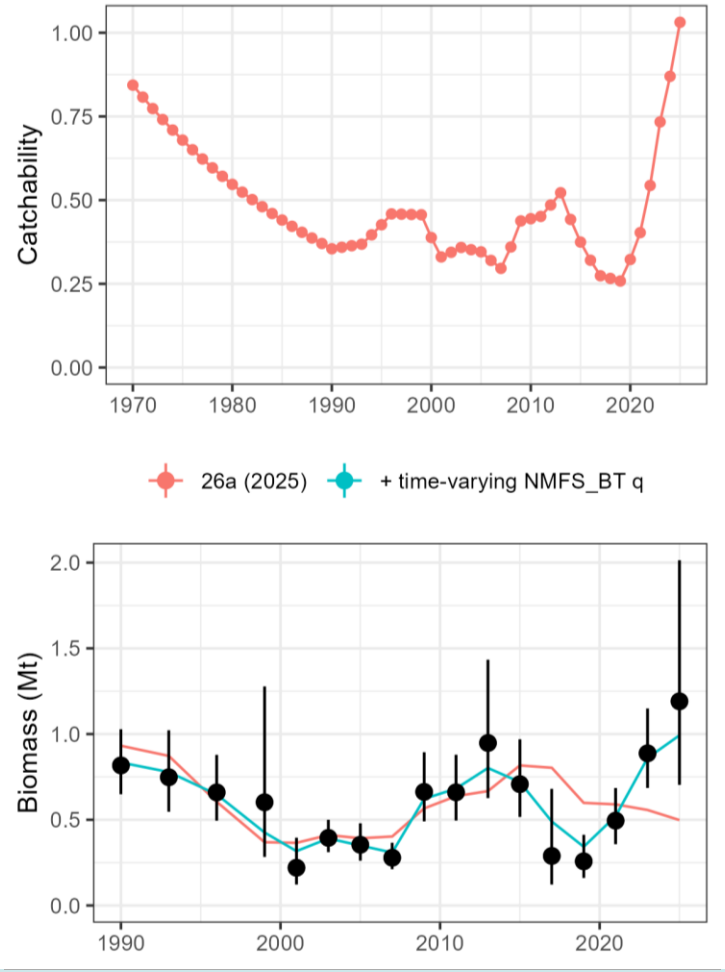
- No equivalent GOA analysis
- But can look at summer AT data for clues
- Very large variation in biomass above 10m
- Implies time-varying vertical availability

Thanks to Nate Lauffenburger (MACE)



# Shifts in vertical availability

- What happens if TV catchability is freely estimated?
- Use Rceattle's state-space RW approach
- Unreasonable variation in q?
- Not proposed, info only!



# Shifts in vertical availability: summary

- We have plans to model GOA vertical distribution in 2027
- Will give best information about vertical availability
- Limited by AT summer survey which was cancelled in 2025 and no longer planned
- Seems clear that there will be some variability, but doubtful it explains all of the NMFS BT misfit. A larger story here.

# Concerns + discussion + research updates

- Continued issues with scale without the NMFS BT
- Data conflict (profile likelihoods)
- Plus group too low? – **will explore for next year**
- Some issues in composition fits
  - Should I use time-varying age-based survey selectivity?
  - Growth variation + constant gear => variation in age-based selex
- **PT request**: *try to include additional surveyed areas not currently included in the winter survey index estimates*
  - Ongoing research. An analytical plan is in place, expect results 2027.

# Discussion points for DSEM workflow

How to develop sets of DAGs? How many? What levels of complexity?

*We suggest that the ESP team lead development of DAGs in coordination with the assessment lead, and emphasize the value of the team's scientific expertise and familiarity with the data to guide causal hypothesis generation. We caution against DAGs with large numbers of variables, instead focusing on a small set of variables likely to be most influential. We also caution that using short time series can lead to unexpected behavior and model instability.*

# Discussion points for DSEM workflow

How often should the set of DAGs be revisited and preferred model changed?

*We suggest that new DAGs should only be considered in years with full ESPs. We also believe that all variables in the DAG should be in the ESP.*

How to select and validate a causal DAG?

*We believe model selection should consider multiple aspects of performance: (1) AIC can be used for overall predictive performance of **all variables** in the DAG. The analyst must be careful to include the superset of all variables in every DAG (see discussion of 'inactive' variables in Champagnat et al. (2026)) for AIC to be comparable among non-nested models. AIC tends to select overly complex models and so alternatives should be investigated. (2) The reduction in unexplained recruitment variation is another key metric as it is interpretable and focuses on the process of interest. (3) Skill-testing of projected recruitments via leave-future-out shows which DAG would be most useful for management advice. This analysis may be limited by short time series. These three tools quantify different aspects of performance and can often disagree.*

# Discussion points for DSEM workflow

1. How to modify the risk table since some variables are now in the assessment itself?
2. Do we use short-term projections of recruitment for ABC/OFL calculations?
3. Do we modify the HCR?

# Summary for 2026

- Move to Rceattle has clear advantages
- DSEM module (26b) has strong statistical support, initial step to full integration of ESP into assessment
  - Solves some issues, raises others
- Very poor fit to NMFS BT, investigation in process
- Lack of summer AT survey moving forward hinders the assessment

# 2026 recommendations

- **We recommend model 26b for use in 2026**
- **Use mean recruitment for ABC calculations**

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