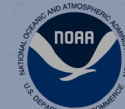
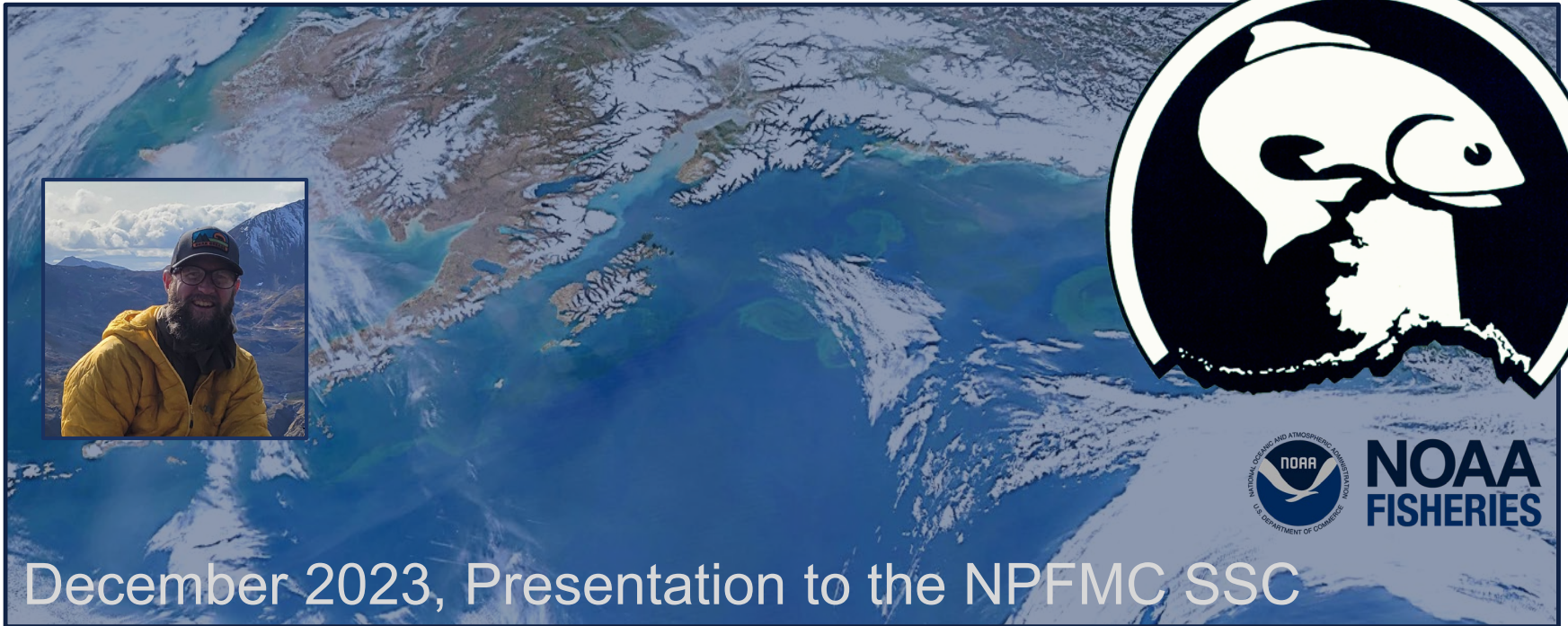


GOA PACIFIC COD

PETE HULSON, STEVE BARBEAUX, BRIDGET FERRISS, KATY ECHAVE, JULIE NIELSEN, S. KALEI SHOTWELL, BEN LAUREL, AND INGRID SPIES

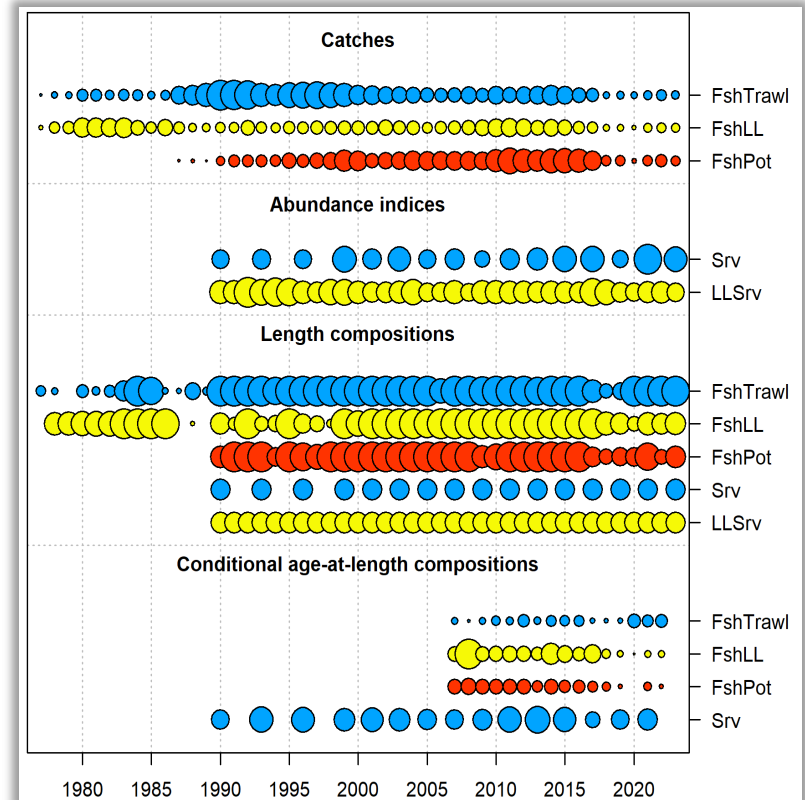


NOAA
FISHERIES

December 2023, Presentation to the NPFMC SSC

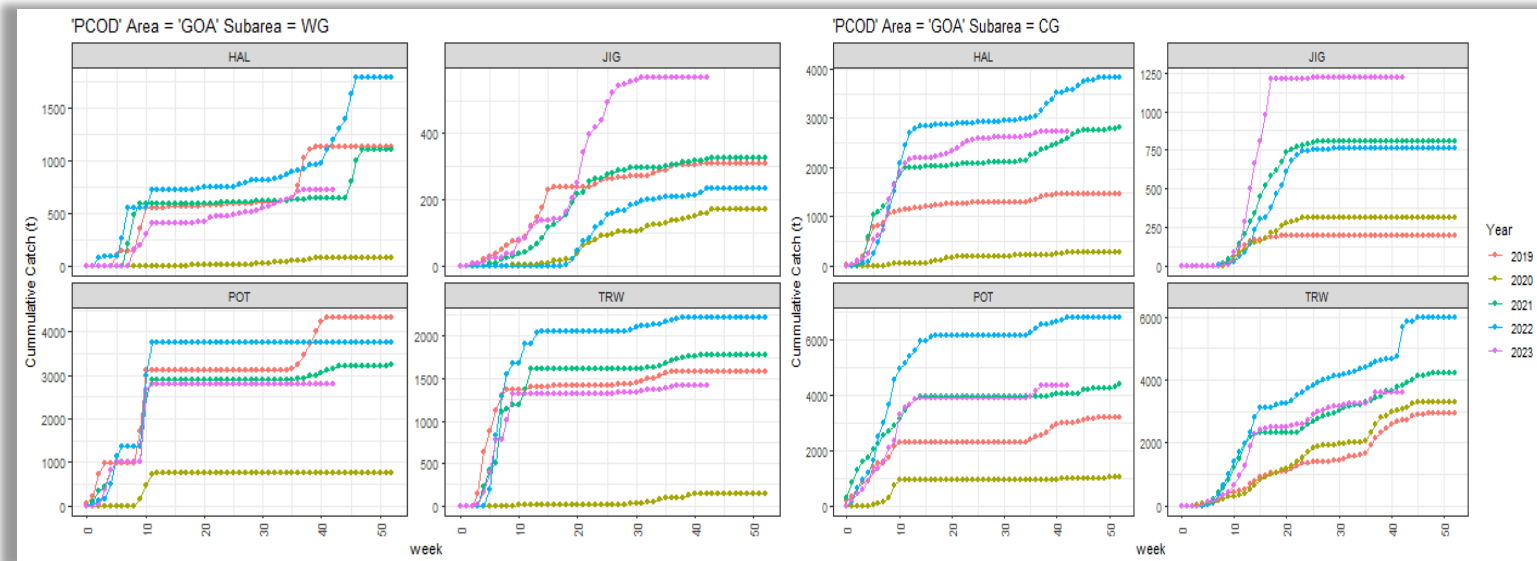
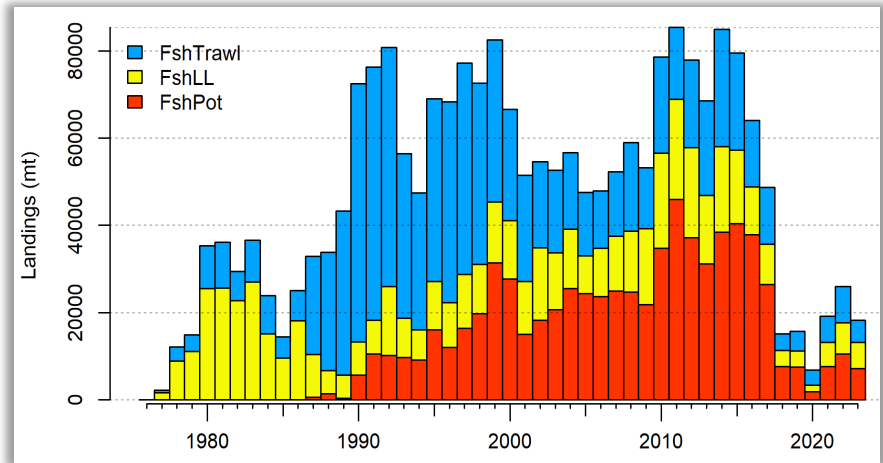
DATA OVERVIEW

Data	Years
Federal and state fishery catch, by gear type	2022, 2023
Federal and state fishery length composition, by gear type	2022, 2023
Federal fishery conditional age-at-length	2022
GOA NMFS bottom trawl survey abundance and length composition	2023
AFSC Sablefish Longline survey Pacific cod RPNs and length composition	2023
CFSR bottom temperature indices	2023



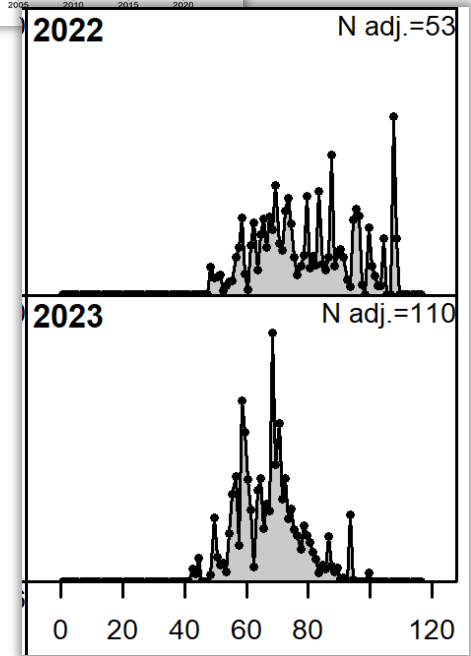
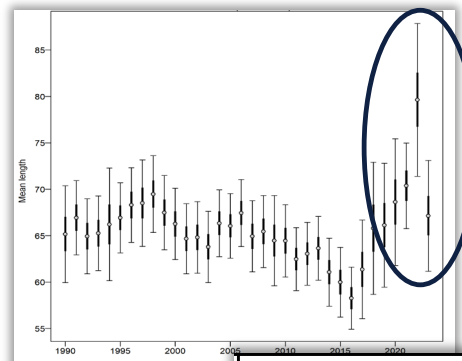
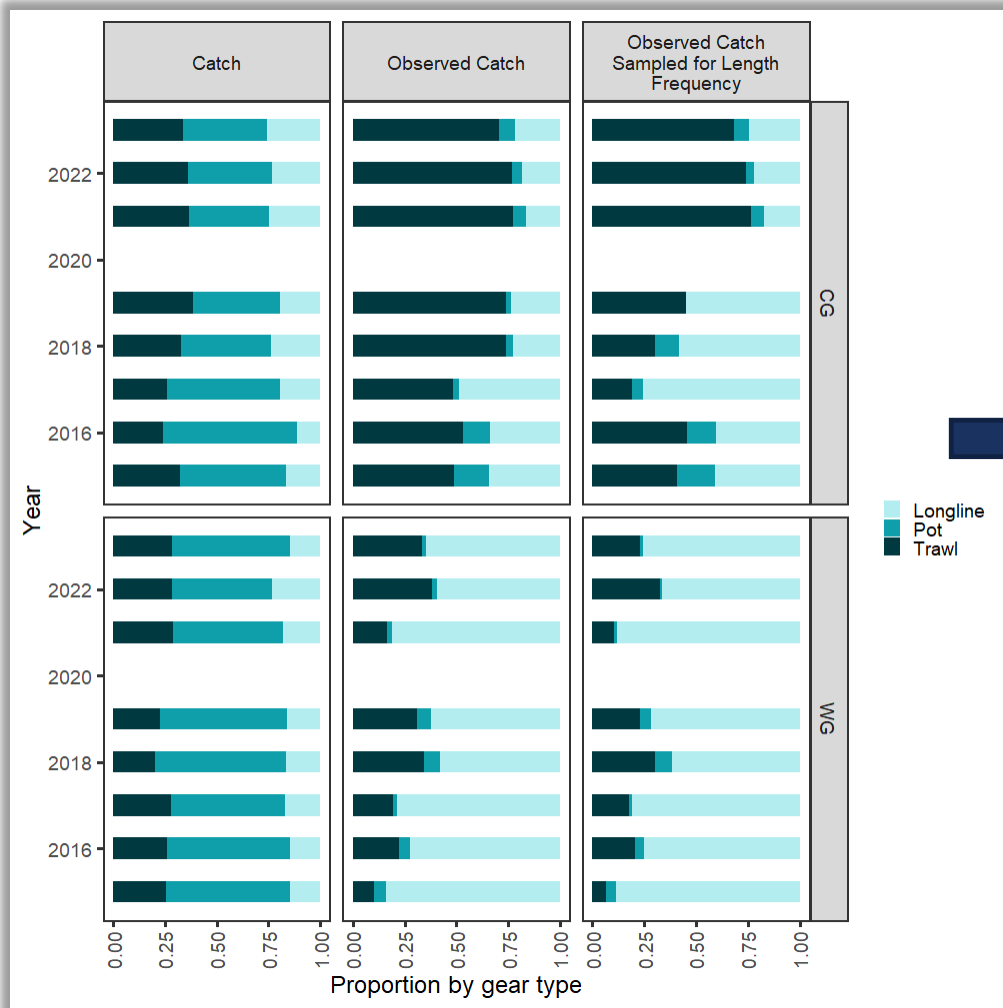
DATA - CATCH

- Decreased since 2022
- Pot majority > LL > Trawl
- Large jig increase compared to previous years, others similar to what was seen in 2021



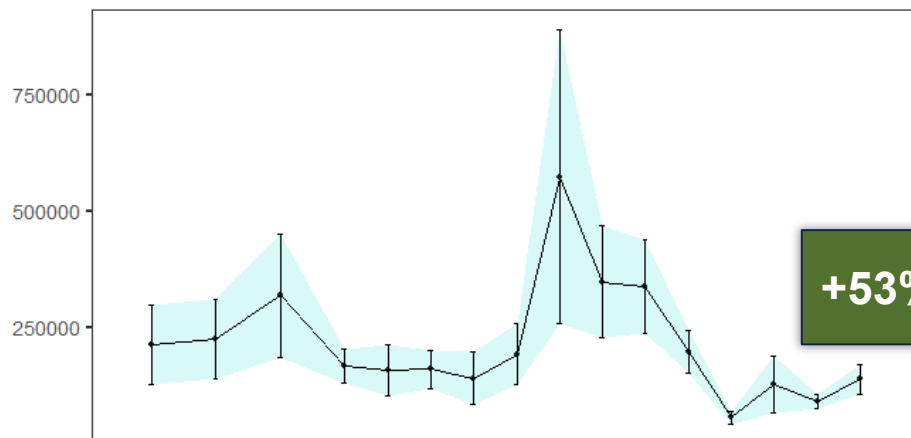
DATA – POT FLEET SAMPLING

- Pot fleet underrepresented in both observed catch and length frequency



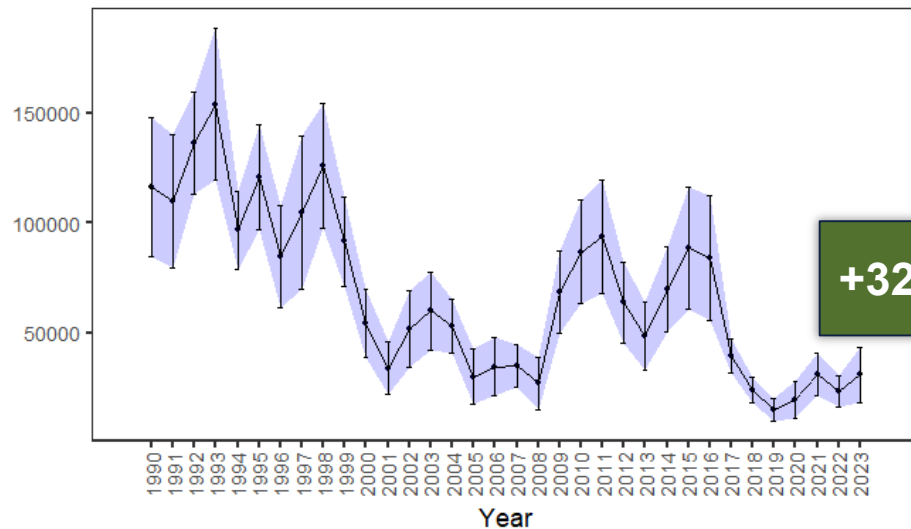
INDICES – FITTED

AFSC trawl survey numbers (1000s)

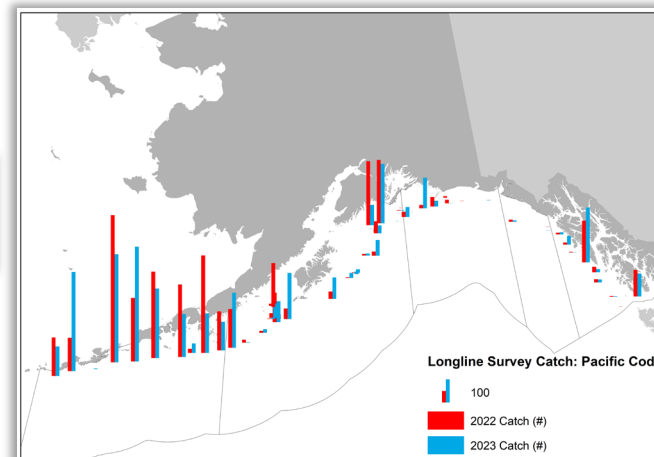
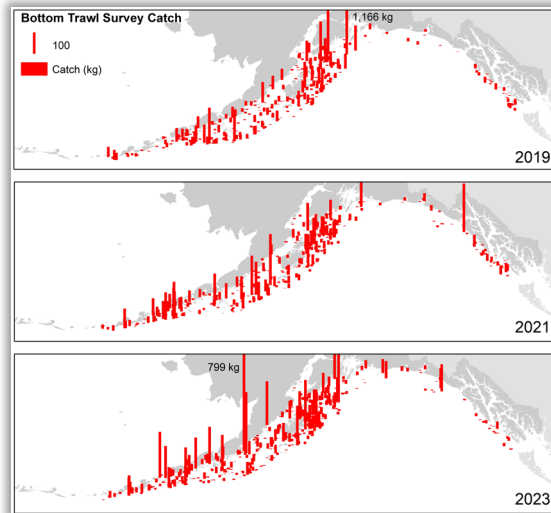


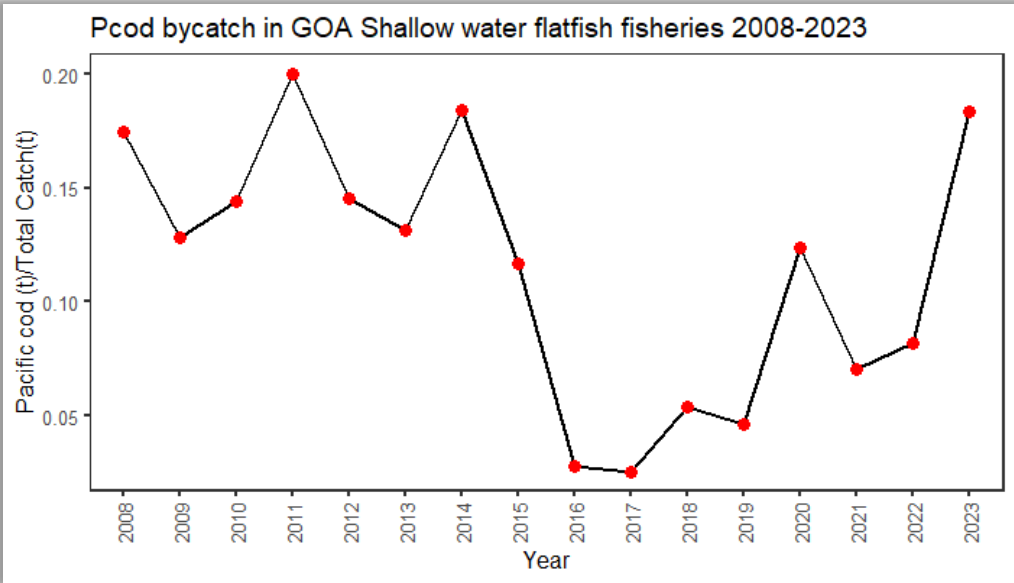
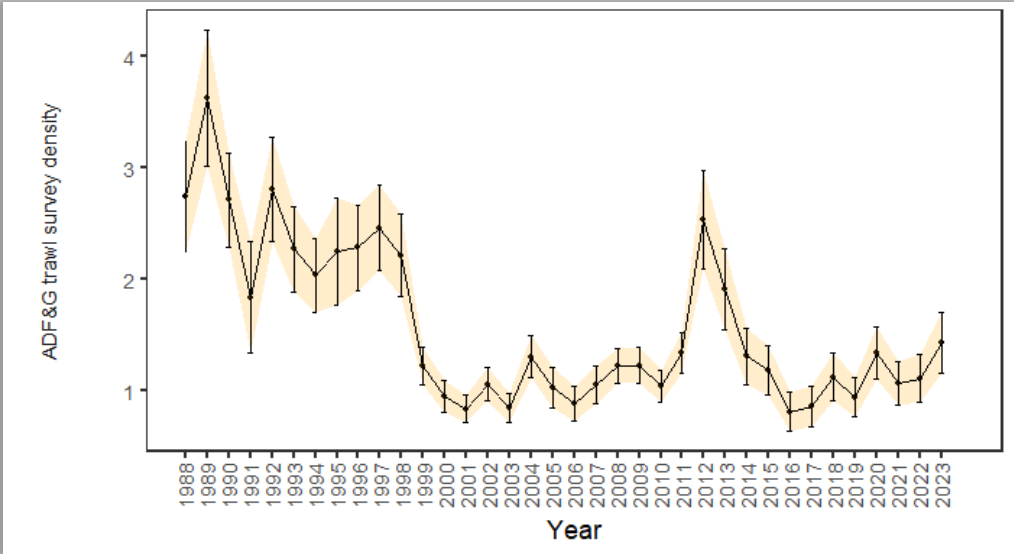
+53%

AFSC longline survey RPNs

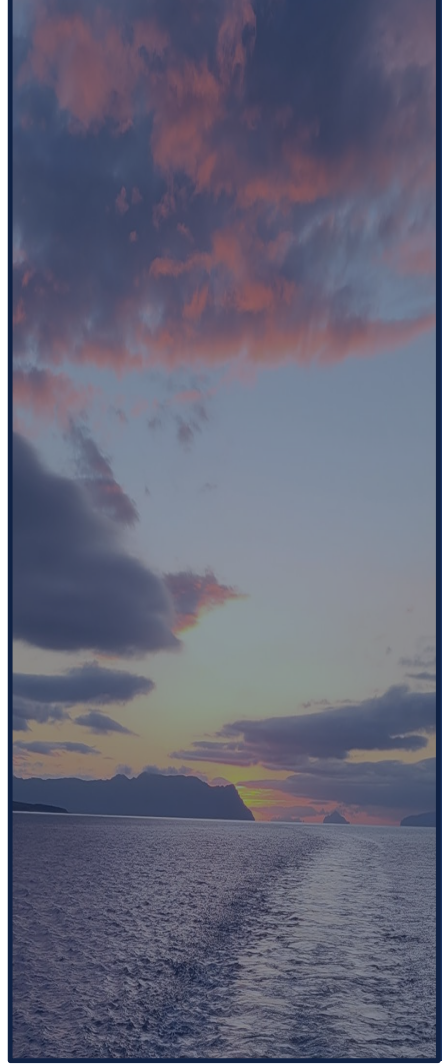


+32%



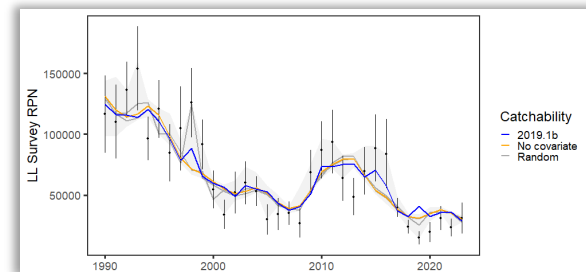
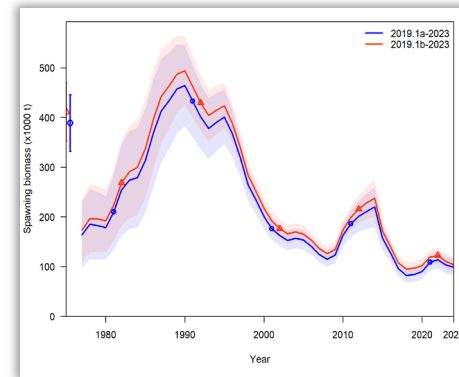


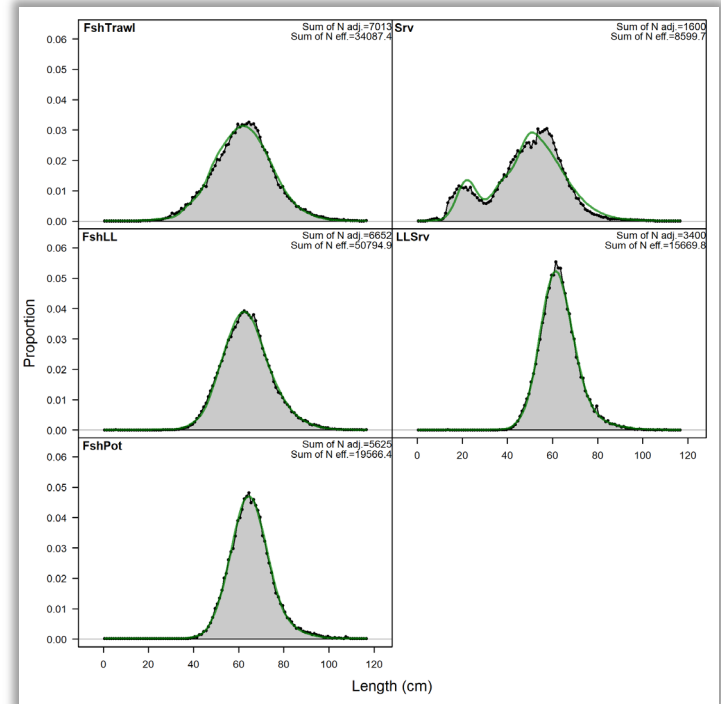
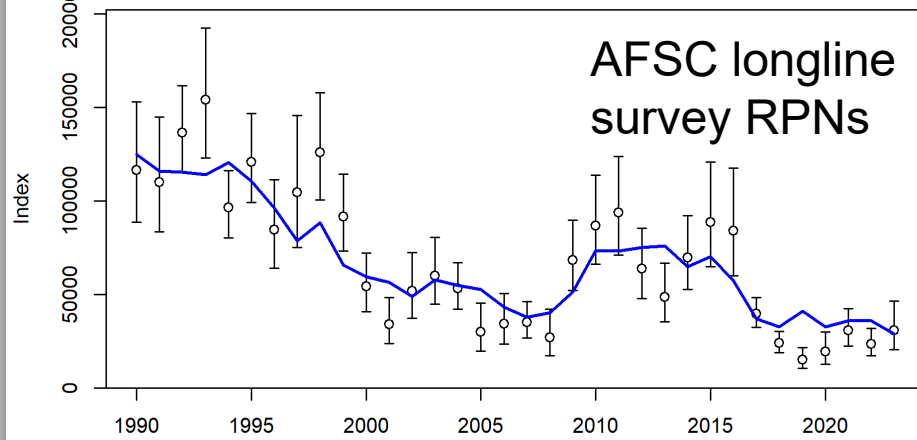
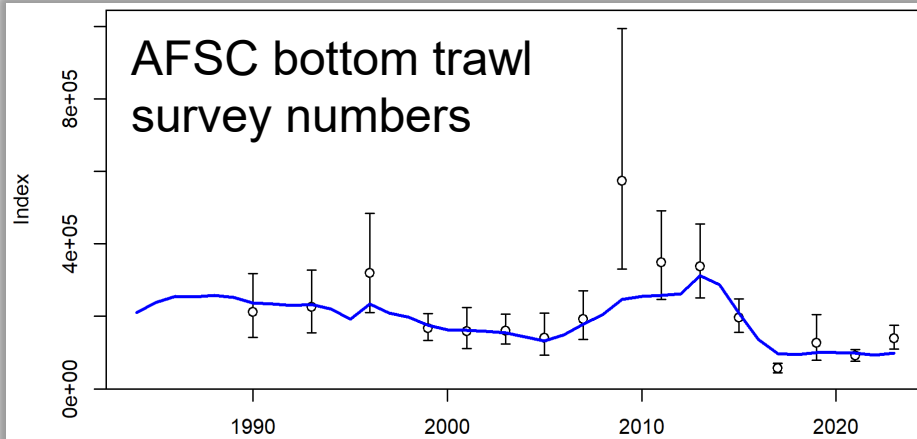
INDICES – MONITORED



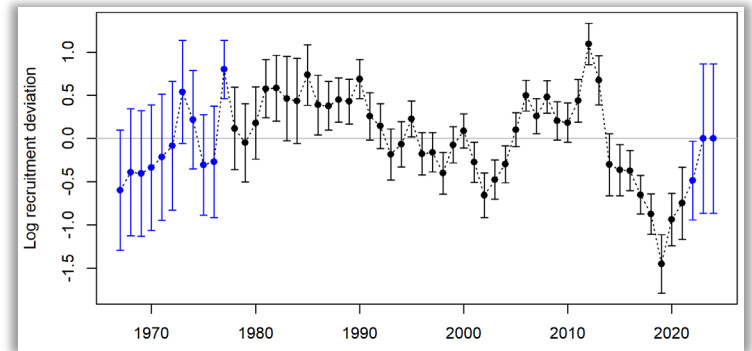
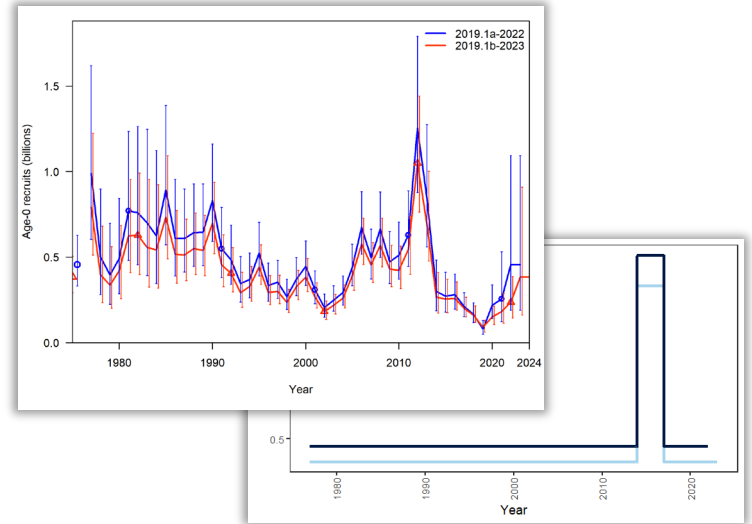
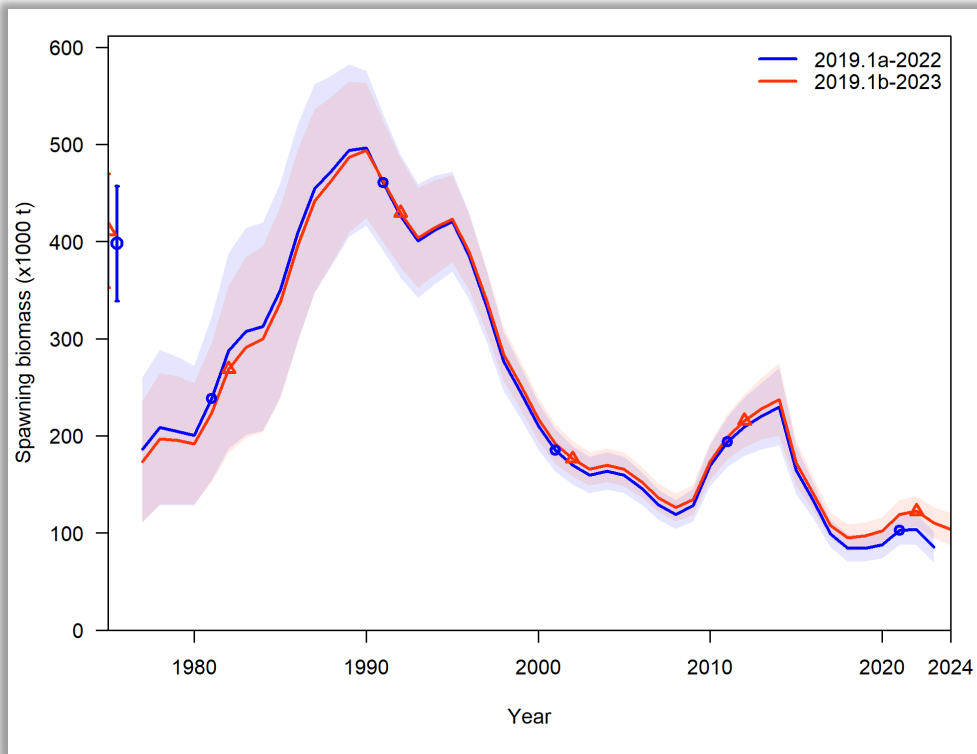
2023 ASSESSMENT OVERVIEW

- Weighting of conditional age-at-length from 1 (19.1a) to 0.001 (19.1b) – small change in model results
- Tested LL survey q environmental link
- Responses to PT and SSC included in SAFE and PT presentation

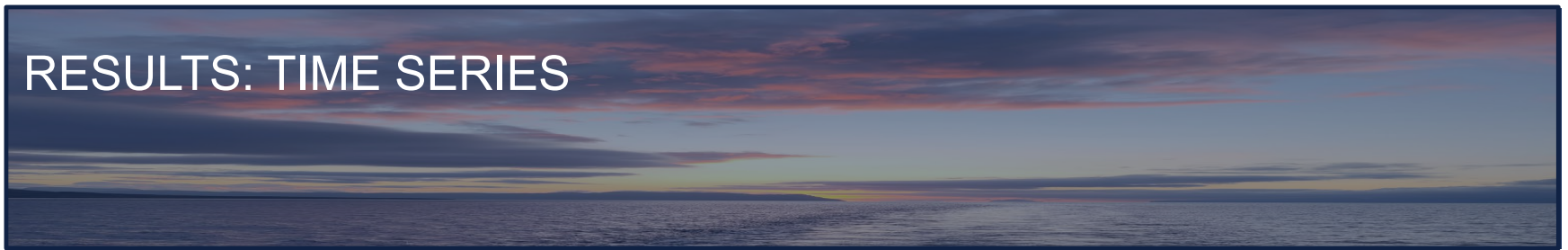


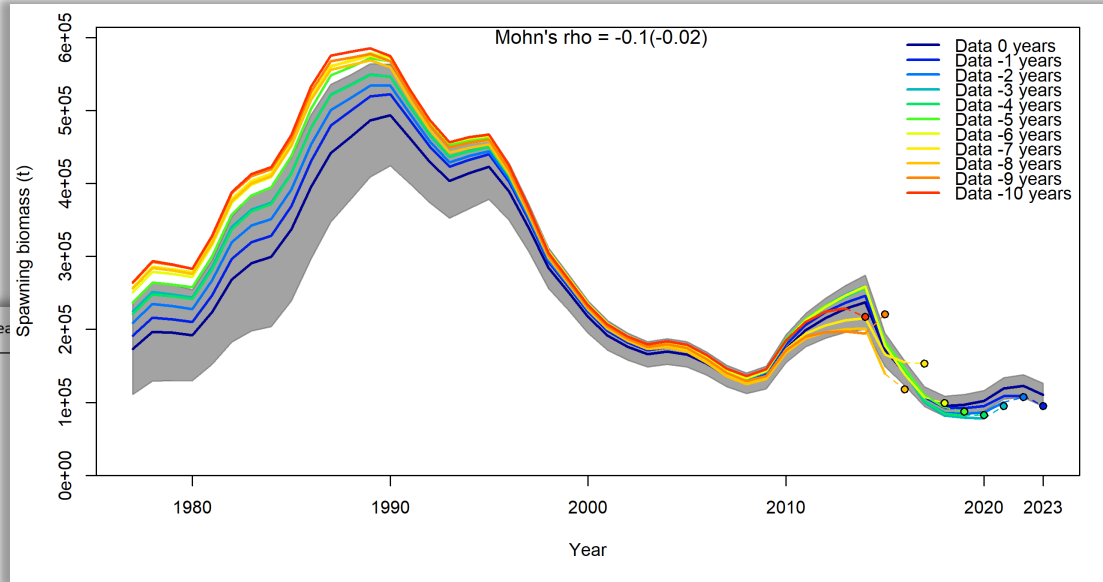
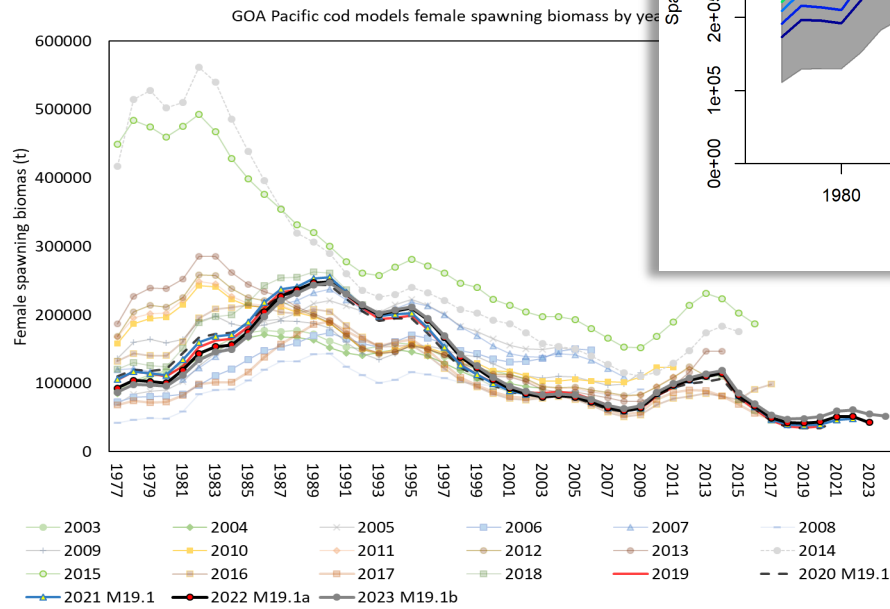


RESULTS: DATA FITS



RESULTS: TIME SERIES



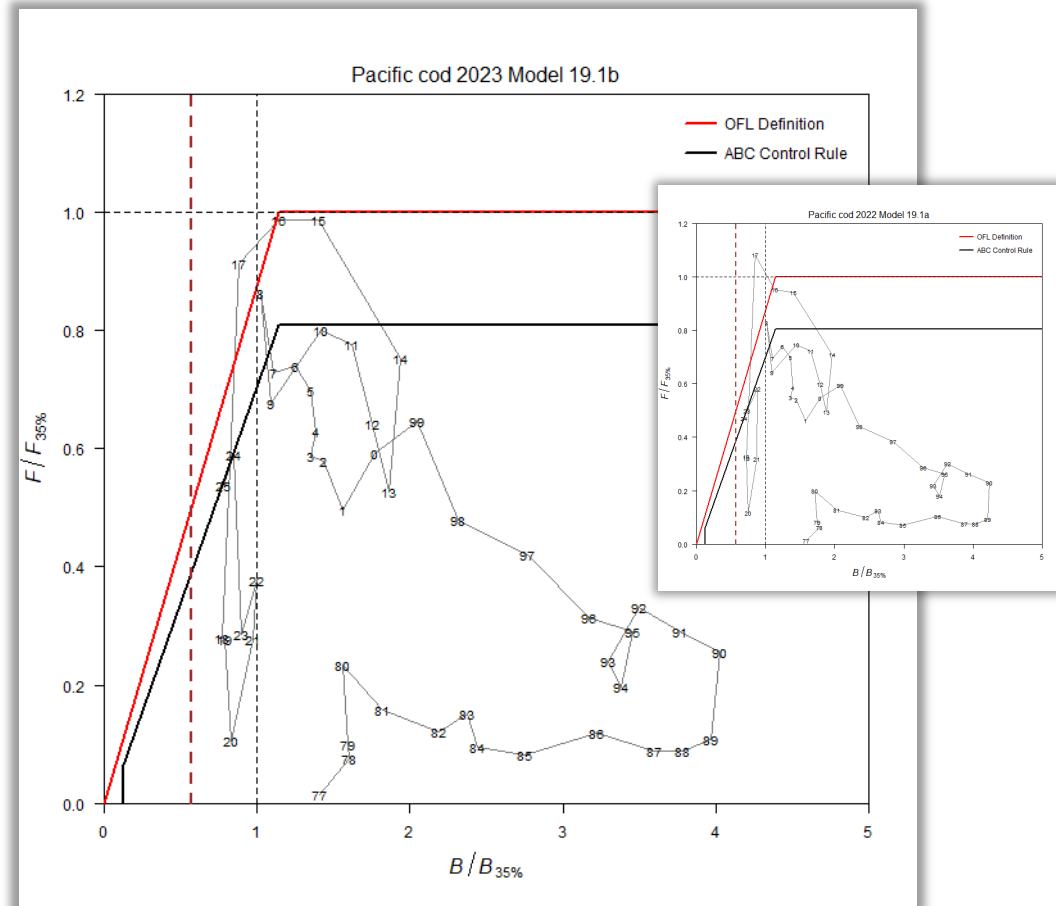


- Low recent SSB retrospective pattern in both model and data (but increased from 2022)

RESULTS: RETROSPECTIVES

STOCK STATUS

- Tier 3b: on the ramp
- Moving down the ramp from 24 to 25 (but up the ramp from 2022 assessment)
- Estimated to be above $B_{20\%}$ (dashed red line), 2024 = $B_{29.6\%}$
- Projected to decrease to $B_{27\%}$ in 2025



RISK TABLE

■ Assessment considerations:

- Fits to data reasonable – keep eye on LL survey fit
- Below average recruitment estimated in last 7 years, and has undesirable retrospective pattern (balanced by decreasing M estimates) – projections sensitive to these results, but not in the short term
- Negative SSB retrospective pattern – but that’s not bad, and not large
- There are sources of uncertainty in this assessment, but nothing that is outside the norm for any of our assessments
- Description of level 2: *“Major problems with the stock assessment; very poor fits to data; high level of uncertainty; strong retrospective bias.”* – not the case here
- Lower Assessment considerations from Level 2 to Level 1

RISK TABLE

- **Pop dy considerations:**

- Low levels of biomass persists – this continues to be a **major** concern, primarily because of how close to biomass reference limits we are
- As estimated by the model, recruitment has been below average since 2014
- We've learned population is sensitive to environmental conditions

- **Discussion:**

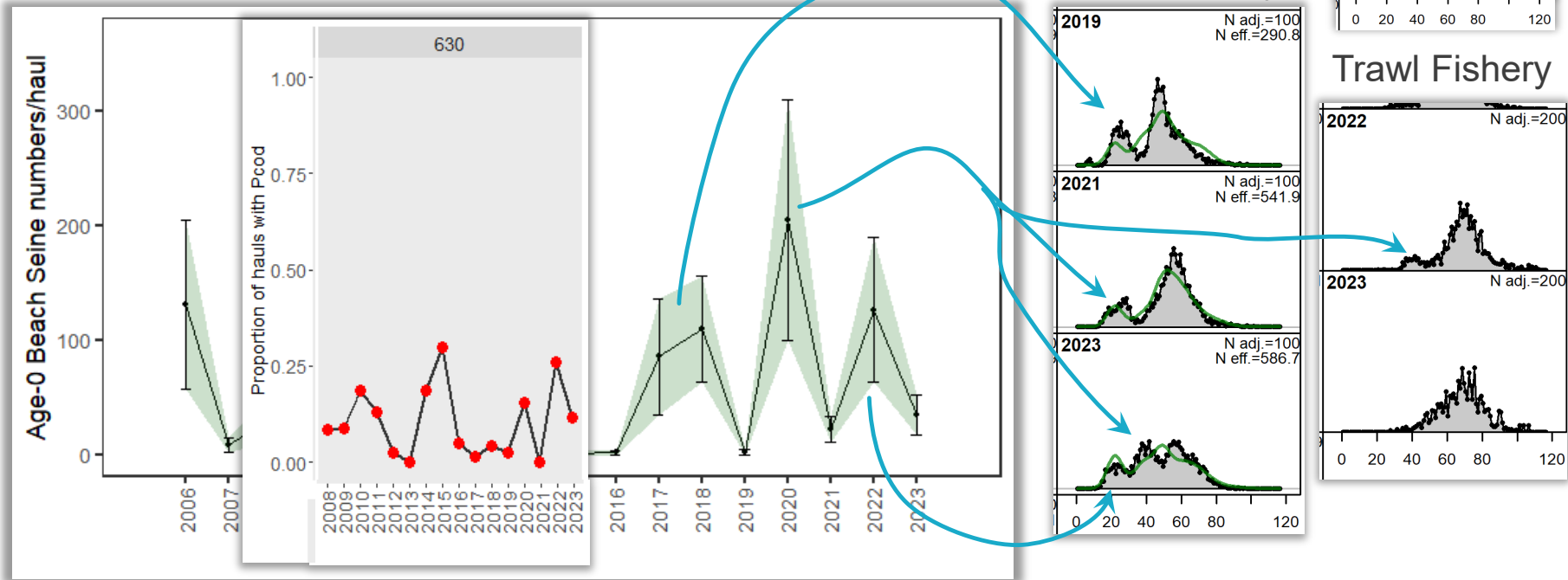
1. Dig into recruitment: is there any evidence of recent recruitment in data, have we been here before, and what are the consequences?
2. Dig into relationship between pop'n size/recruitment with past environmental conditions, how has the pop'n responded?



RISK TABLE

- **Pop dy considerations: Recruitment**

- Is there any evidence of recent recruitment in data?



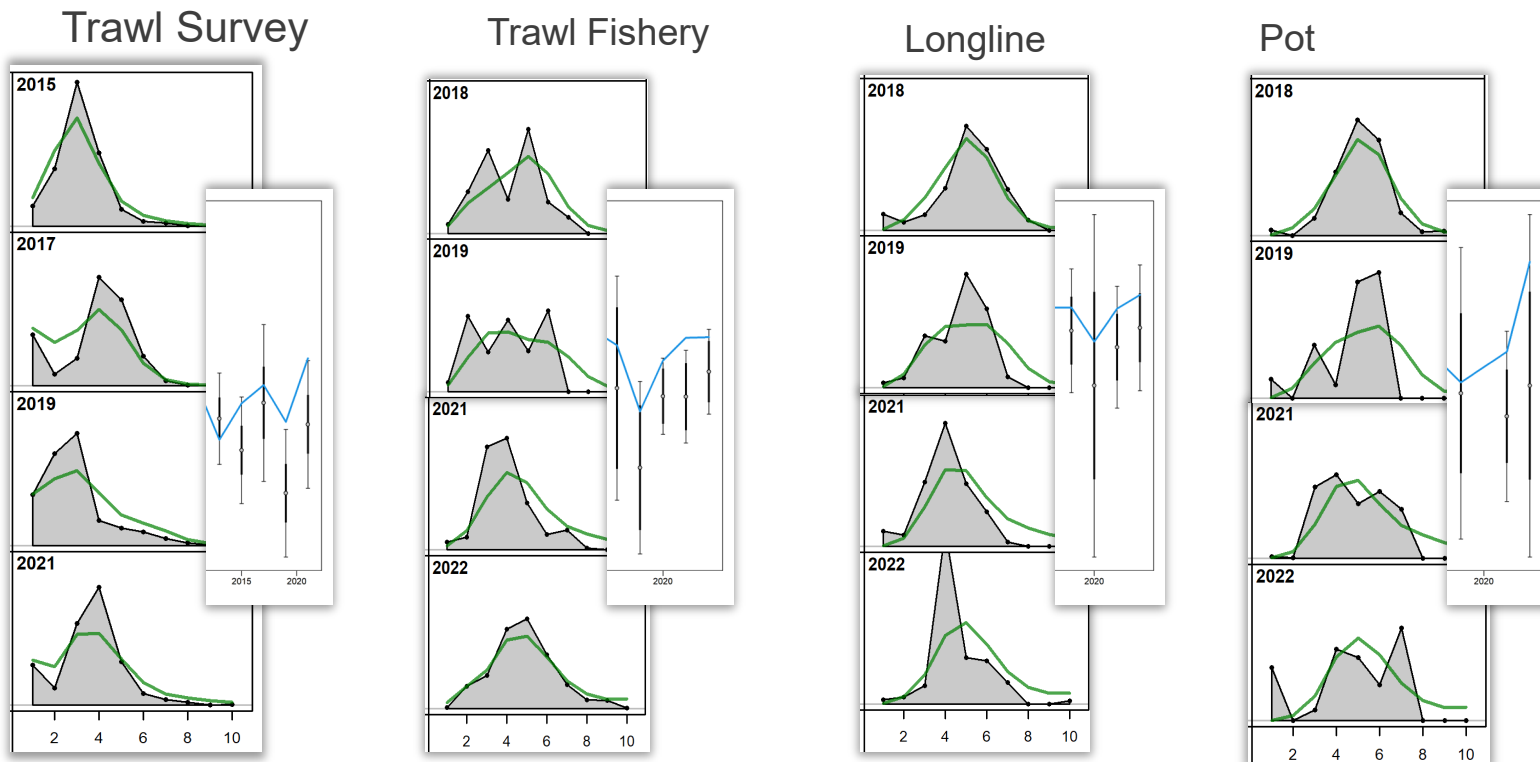
- 2017/18, 2020, and 2022 shows up in length comps, notably in trawl fishery



RISK TABLE

■ Pop dy considerations: Recruitment

- Is there any evidence of recent recruitment in data?



- Consistent underestimation of recent age +3 abundance
- Estimated mean age > observed mean age



RISK TABLE

■ Pop dy considerations: Recruitment

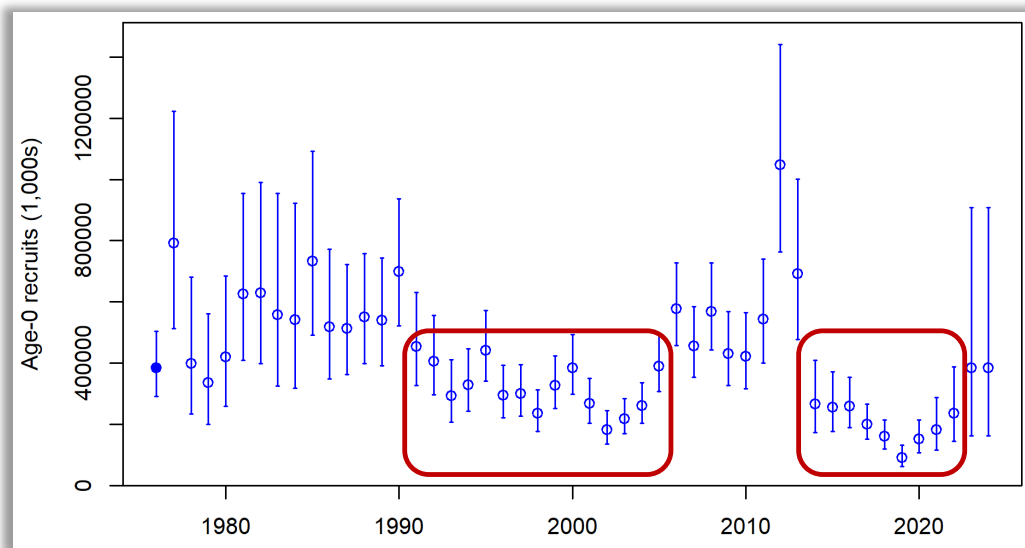
- Is there any evidence of recent recruitment in data? Yes
 - Age-0 index and mid-water Pollock line up for at least the 2020 and 2022 year classes
 - These year classes are also seen in Trawl survey length comp data (with 2017/2018 as well), 2020 emerged in Trawl fishery
- Is the model fitting it? No
 - Fit to recent year classes in Trawl length comp data fit poorly (mostly in sense that model expects less than what is in data)
 - Consistent underestimation of abundance of age 3-4 in age comp data for all data sources
 - Consistent overestimation of mean age (meaning, the model estimates less younger fish than observed)
- Summary: considerable uncertainty in accuracy of model estimates of recent recruitment



RISK TABLE

- **Pop dy considerations: Recruitment**

- Have we been here before?



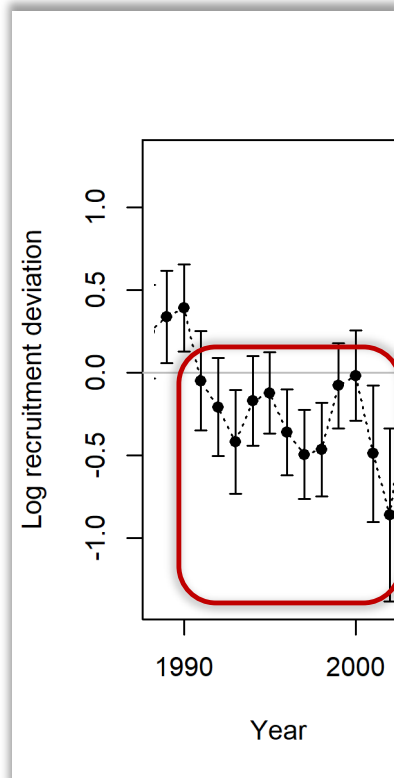
- 2019 draws eye to how low it is, but others similar in scale to what was seen in late 90s – early 00s

RISK TABLE

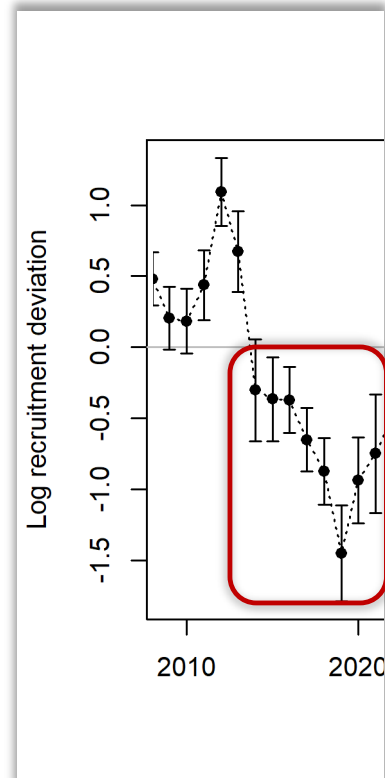
- **Pop dy considerations: Recruitment**

- Have we been here before?
- Data retrospective: 12 consecutive below avg recruitment with data through 2004

2004 assessment



2023 assessment



RISK TABLE

■ Pop dy considerations: Recruitment

- Have we been here before?
- Model retrospective: 11 of 14 years with below avg recruitment in 2005 assessment

2005 assessment

(Thompson and Dorn, 2005)

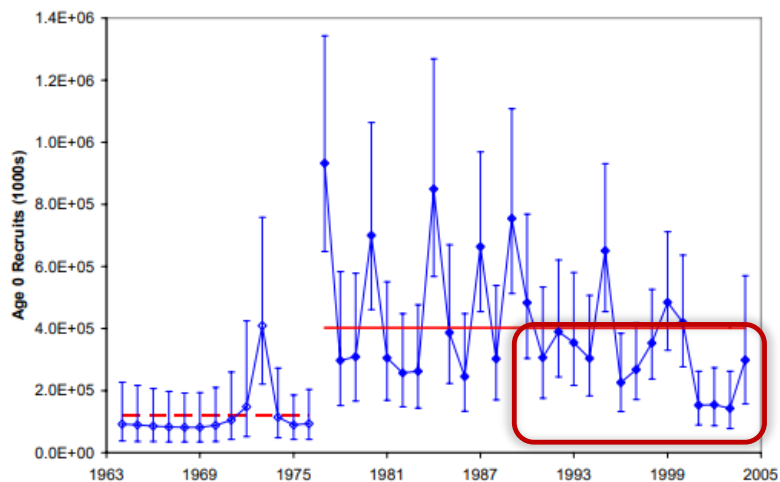
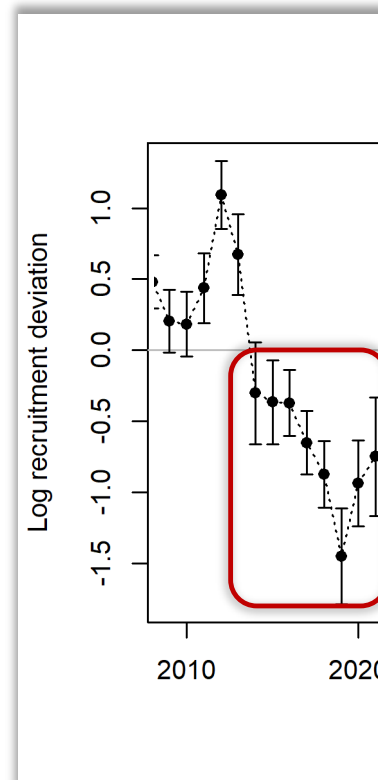


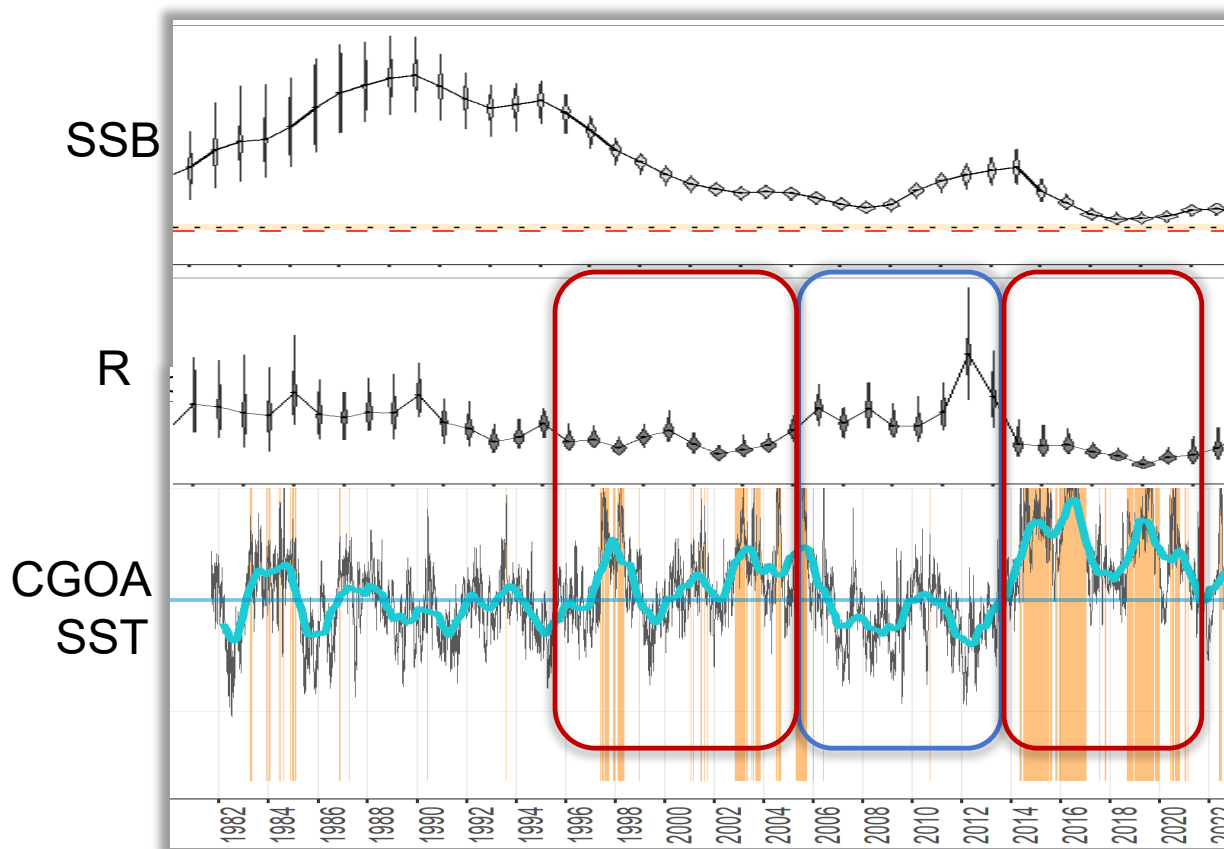
Figure 2.13—Time series of GOA Pacific cod recruitment at age 0, with 95% confidence intervals, as estimated by Model 3.

2023 assessment



RISK TABLE

- Pop dy considerations: Recruitment
 - Have we been here before?



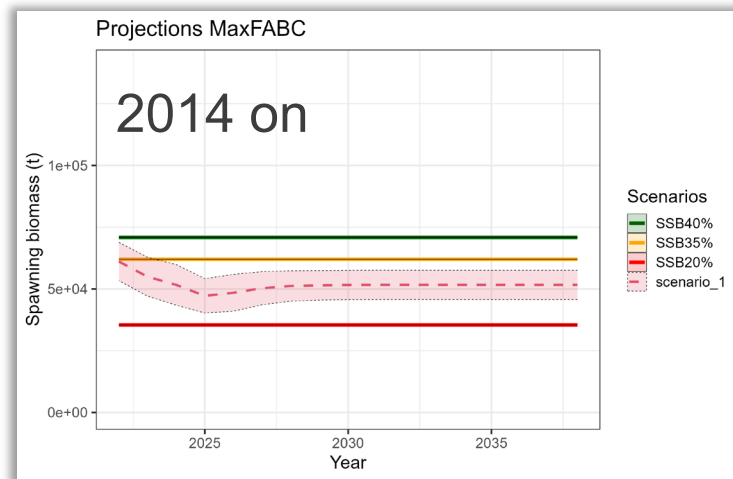
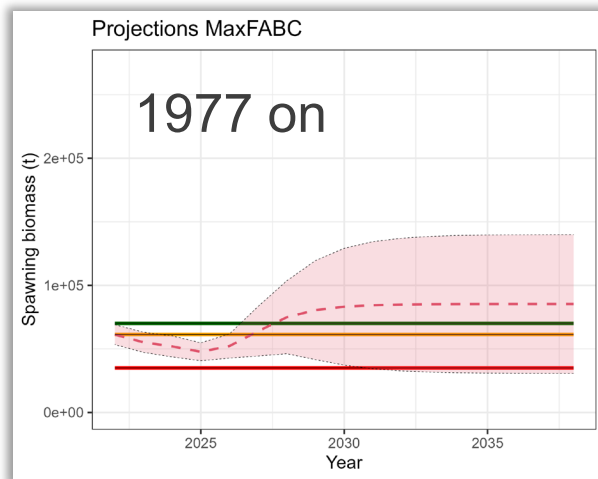
RISK TABLE

■ Pop dy considerations: Recruitment

- Have we been here before? Yes
 - String of below avg recruitment 1990s to mid-2000s
- What happened?
 - Favorable environmental conditions led to above average recruitment after mid-2000s and SSB subsequently increased
 - Recent environmental conditions more extreme than in recent history
 - Hard to say whether favorable environmental conditions could return
- Summary: considerable uncertainty in projected environmental conditions, and relationship with recruitment and stock increase/decrease

RISK TABLE

- Pop dy considerations: Recruitment
 - What are the consequences? SSB
 - Use mean recruitment from 2014 on in projections

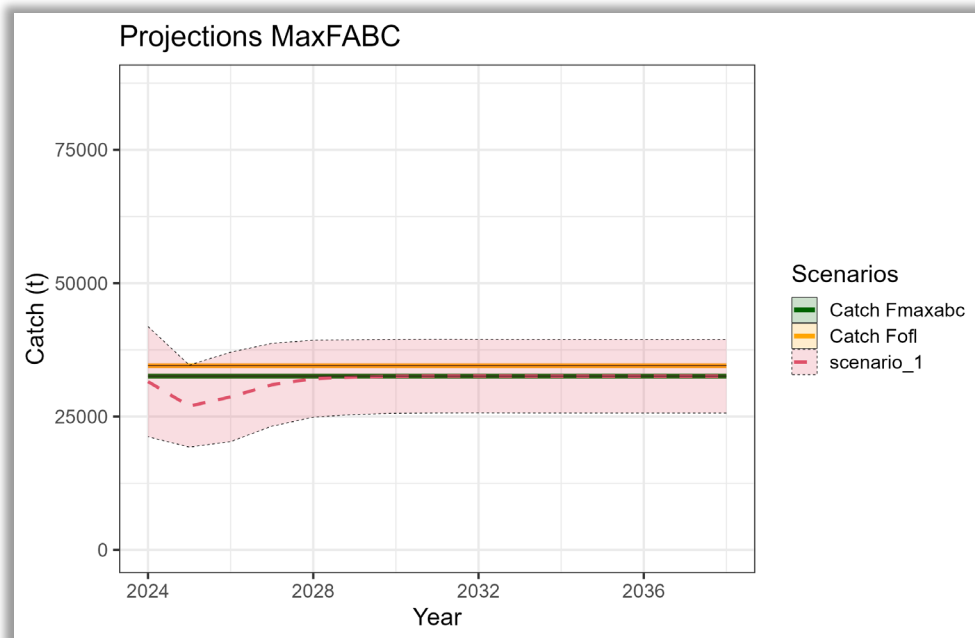


- Short term consequences: ~ 2% difference in 2024 ABC
- Long term consequences: never get back to $B_{35\%}$, hover around $B_{29\%}$

RISK TABLE

- **Pop dy considerations: Recruitment**

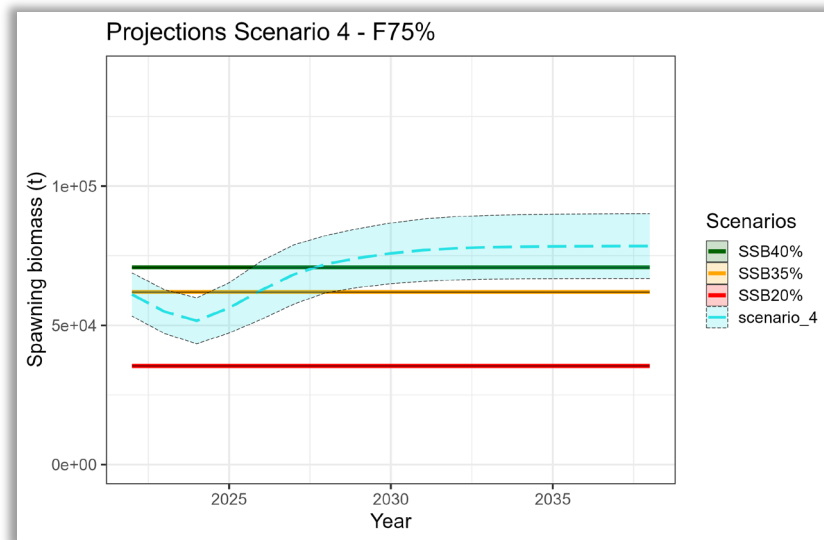
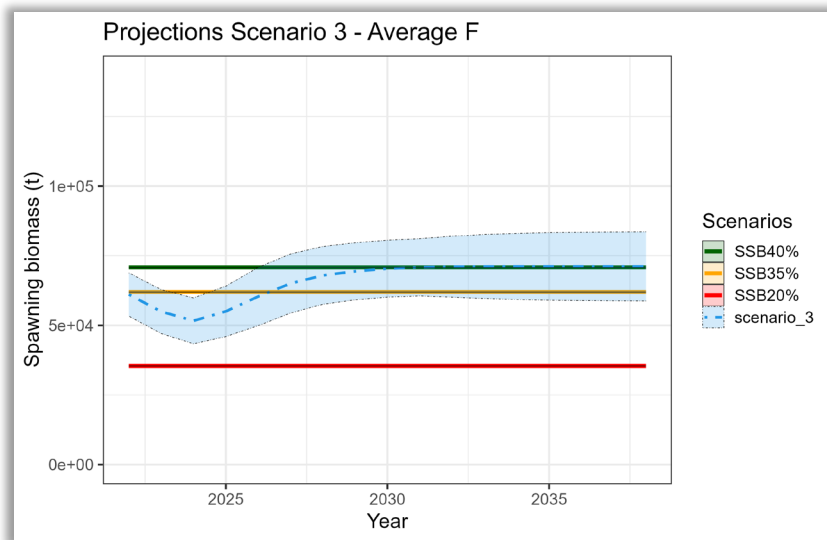
- What are the consequences? ABC
- With recent mean recruitment, projected ABC dips in short term, then hovers around 30,000 t



RISK TABLE

■ Pop dy considerations: Recruitment

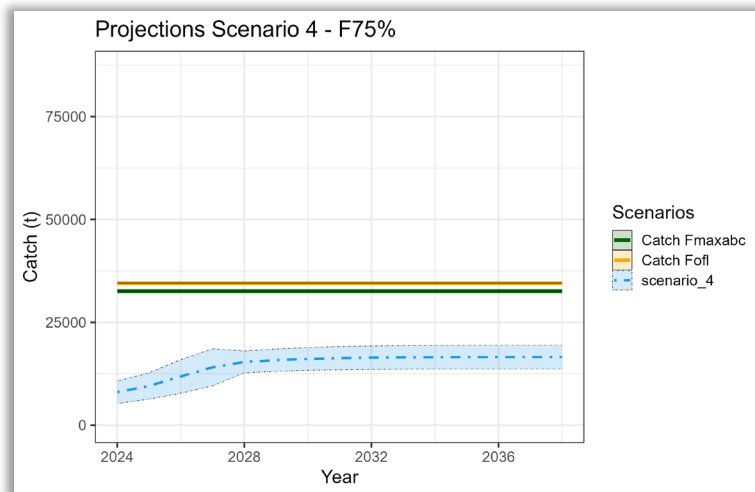
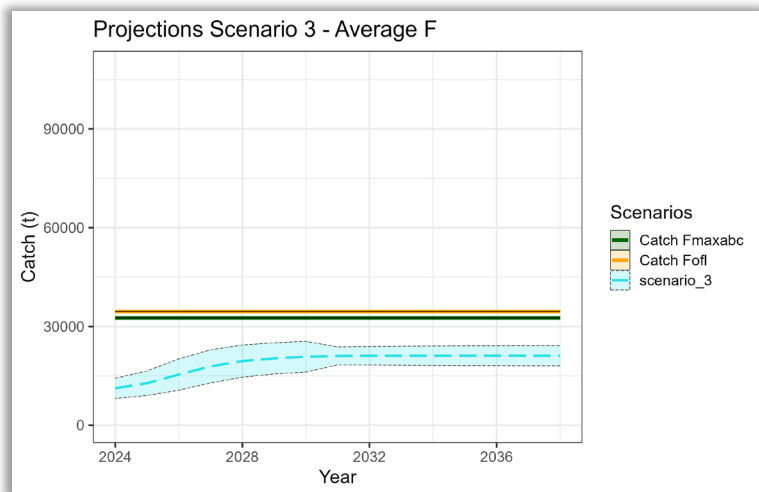
- If recent mean recruitment here to stay, is there a way to rebuild?
- 2 scenarios rebuild to at or above $B_{40\%}$



RISK TABLE

- **Pop dy considerations: Recruitment**

- If recent mean recruitment here to stay, is there a way to rebuild?
- 2 scenarios rebuild to at or above $B_{40\%}$



- Avg F: 2024 ABC ~ 11,000 t, long term ~21,000 t
- F75%: 2024 ABC ~ 8,000 t, long term ~ 16,500 t
- But, is recent mean recruitment here to stay?

RISK TABLE

- **Pop dy considerations:**
 - Low levels of biomass persists – this continues to be a **major** concern, primarily because of how close to biomass reference limits we are
 - As estimated by the model, recruitment has been below average since 2014
 - We've learned population is sensitive to environmental conditions
- Level 2: “*Stock trends are highly unusual; very rapid changes in stock abundance, or highly atypical recruitment patterns.*”
- Level 3: “*Stock trends are unprecedented; More rapid changes in stock abundance than have ever been seen previously, or a very long stretch of poor recruitment compared to previous patterns.*”
- Based on evidence available, rank at Level 2

ABC/OFL RECOMMENDATIONS

- Do we reduce from maxABC?
 - Low levels of biomass will remain a concern until (if) pop'n rebuilds
 - Recent recruitment estimates concerning, but, there's evidence model isn't fitting recent year classes well, and, in terms of magnitude of recruitment, we've been here before
 - Information provided as to consequences of low recent recruitment becoming the norm, and associated catches to rebuild, but, there is substantial uncertainty associated with long term projections
 - What is risk to stock of doing major damage based on the 2024 ABC recommendation?
 - If we have a major environmental event in the next year or two, is reducing ABC this year going to mitigate the pop'n decline? Would reduction in catches around 2015 have mitigated pop'n crash?
 - Will pop'n decrease next year? Possibly, but the model will track any decrease or increase
 - Keep in mind: stock in Tier 3b, reduction in ABC has already occurred

ABC/OFL RECOMMENDATIONS

- Do we reduce from maxABC?
- Historical context:
 - Short-term (with Model 2019.1 series):
 - 2021 → 2022 ↑**39%**, 2022 → 2023 ↓**25%**, recommended 2023 → 2024 ↑**31%**
 - Used to determine stock $<B_{20\%}$ in 2020
 - Long-term (with what we estimate from model now):
 - Avg SSB from 2018-2023 24% smaller than 2006-2010,
 - Avg ABC from 2018-2023 (taking out 2020) 64% smaller than 2006-2010
- **Recommendation:** no reduction from maxABC

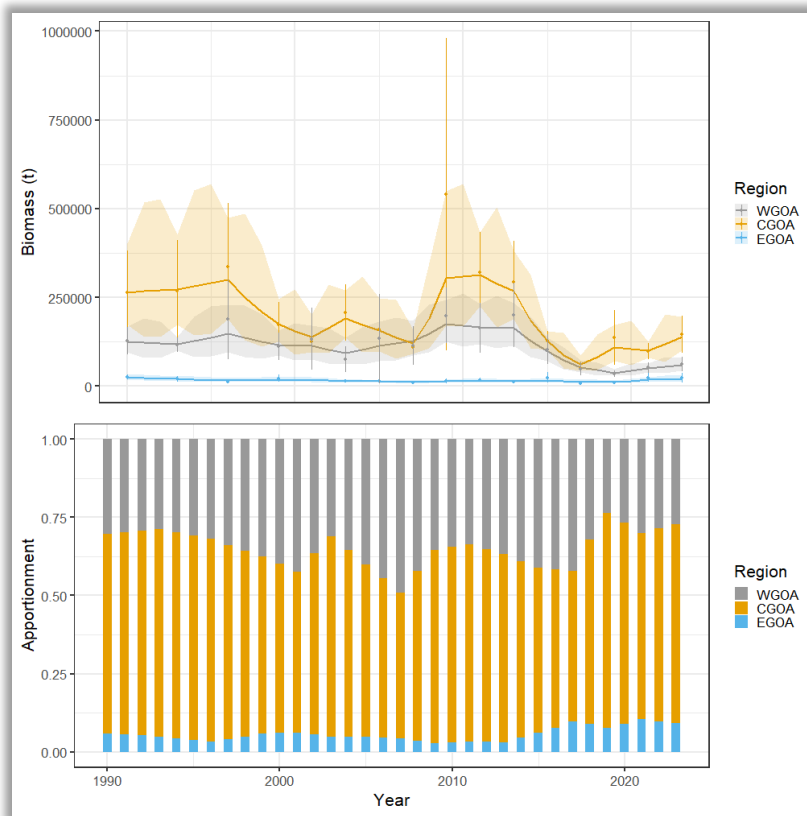
APPORTIONMENT

↑17%

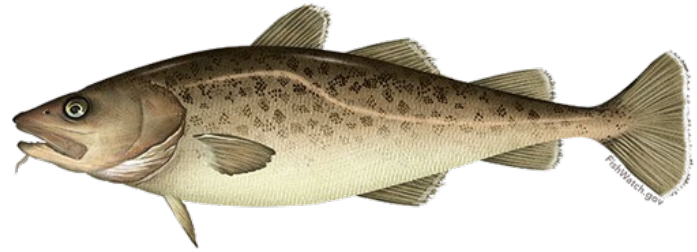
↑39%

↑26%

	Western	Central	Eastern	Total
Random effects area apportionment	27.1%	63.8%	9.1%	100%
2024 ABC	8,745	20,590	2,937	32,272
2025 ABC	7,638	17,981	2,565	28,184

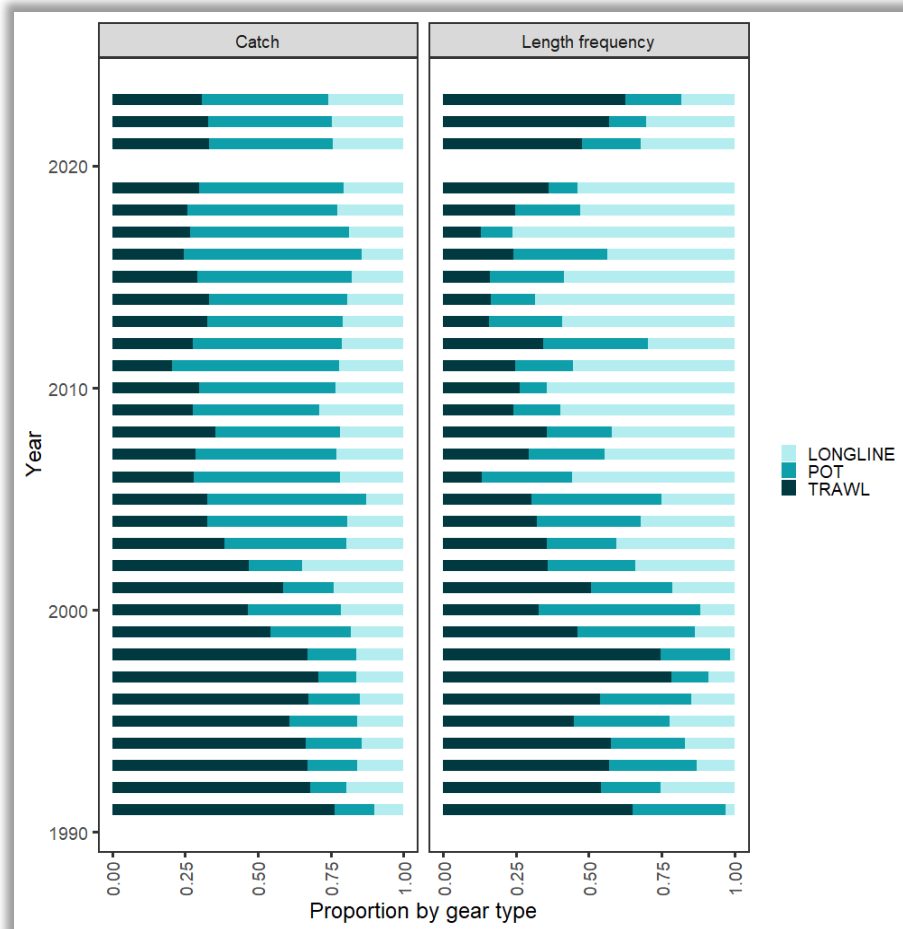


QUESTIONS?



DATA – CATCH COMPS

- 1st pass evaluating observed effort of Pot fleet: distribution of length samples



DATA – CATCH COMPS

- 2nd pass evaluating observed effort by gear type (Trawl, Longline, Pot):
 - Relative proportion of catch by gear type: gear specific catch divided by total annual catch
 - Relative proportion of observed catch by gear type:
 - Step 1: for each gear type, divide observed catch (extrapolated weight summed across hauls, converted to mt) by total catch
 - Step 2: with proportions from Step 1, compute relative proportions across gear types
 - Simple example: 10% of total catch observed for gear type 1, 5% of total catch observed for gear type 2 => 66% of relative proportion of observed catch is for gear type 1, 33% for gear type 2. If the observed catch rates were the same (i.e., 50/50), then the catch is observed proportional to the overall relative catch by gear type – so what we're looking for is an even split among gear types
 - Relative proportion of observed catch sampled for length frequency by gear type:
 - Same procedure as for observed catch, but use observed catch from hauls that have length frequency sampling



DATA – CATCH COMPS

- Pot fleet underrepresented in both observed catch and length frequency

