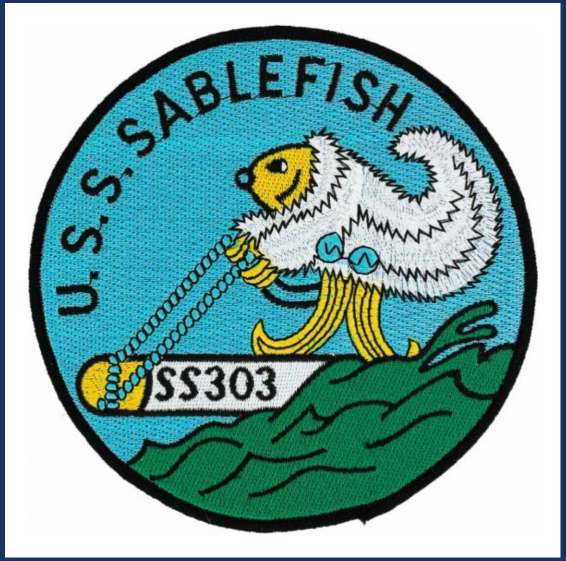
Alaskan Sablefish
Groundfish Joint Plan Team

Dan Goethel, Matt Cheng, Katy Echave, Craig Marsh,
Cara Rodgveller, Kalei Shotwell, and Kevin Siwicke

November, 2023



Appendices

Appendix 3C. Ecosystem and Socioeconomic Profile of the Sablefish stock in Alaska - Report Card

S. Kalei Shotwell (Editor)

Katy Echave, Bridget Ferriss, Dan Goethel, Chris Lunsford, Krista Oke, Elizabeth Siddon, Kevin Siwicke, Jane Sullivan, Marysia Szymkowiak, and Ben Williams (Team)

November 2023

With Contributions from:

Anna Ableman, Mayumi Arimitsu, Steve Barbeaux, Matt Callahan, Curry Cunningham, Brian Garber-Yonts, Dana Hanselman, Jean Lee, Jens Nielsen, Clare Ostle, Patrick Ressler, Cara Rodgveller, Kally Spalinger

Appendix 3D. Sablefish Bycatch in the Eastern Bering Sea

Kevin A. Siwicke and Katy B. Echave

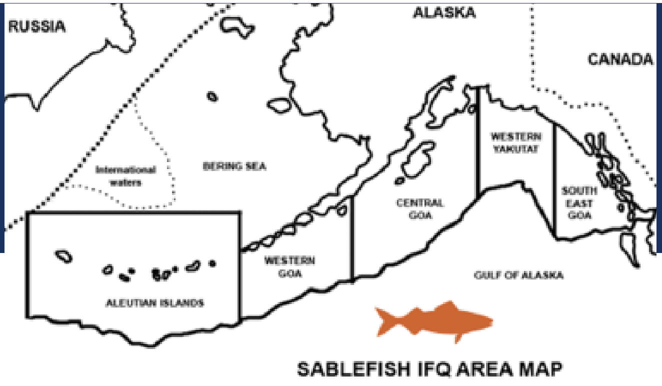
Appendix 3E. Catch Rates and Observations from the Fixed Gear Fleet

Cara Rodgveller and Matthew Cheng

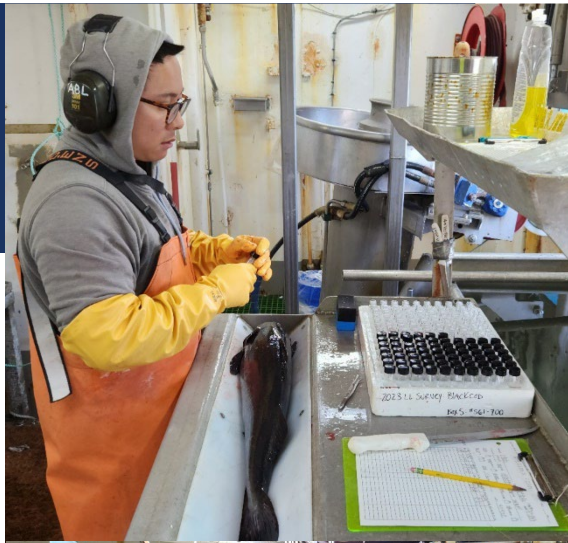
Appendix 3F. Observer Coverage and Sampling of the Sablefish Stock

Cara Rodgveller, Matt Callahan, Cindy Tribuzio

Overview



- Tier: 3a
- Area: Alaska-wide stock (GOA, BS, AI)
- Update assessment(+) with minor changes to input data and model parametrization compared to SSC accepted model *21.12*:
  - *Model 23.1*: removed the 1984 and 1987 trawl survey data
  - *Model 23.2*: incorporated all non-commercial catch, per SSC request
  - *Model 23.3*: updated/rectified the stock-recruit bias correction
  - *Model 23.4*: implemented a standardized CPUE index that combined data from both the hook-and-line and pot gear types (Cheng et al., 2023)
  - *Model 23.5* (author recommended): integrated all updates from models *23.1—23.4*



Summary

- Survey indices leveling off, but population growth continues
- **Max ABC = 47,146 t** (+7,000 t from 2023 ABC)
  - Only ~70% utilization in recent years
- Apportionment based on 5-year average survey biomass proportions by area (no stair step)

Year	2023				2024		2025	
Region	OFL_w	ABC_w	TAC	Catch*	OFL_w	ABC_w**	OFL_w	ABC_w**
BS	--	8,417	7,996	4,851	--	11,450	--	11,499
AI	--	8,884	8,440	1,924	--	13,100	--	13,156
GOA	--	23,201	23,201	13,581	--	22,596	--	22,695
WGOA	--	4,473	4,473	2,357	--	4,699	--	4,719
CGOA	--	9,921	9,921	5,547	--	9,651	--	9,693
**WYAK	--	3,205	3,205	2,068	--	2,926	--	2,940
**EY/SEO	--	5,602	5,602	3,610	--	5,320	--	5,343
Total	47,390	40,502	39,637	20,357	55,084	47,146	55,317	47,350

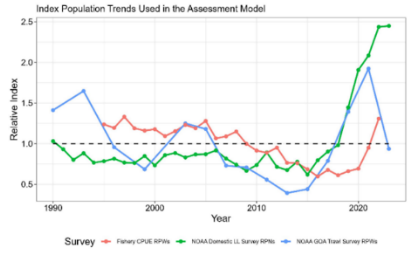
*As of October 10, 2023 **After 95:5 trawl split and whale depredation

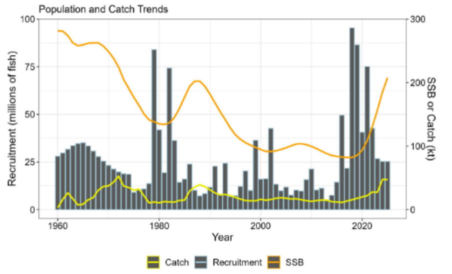
NOAA FISHERIES

2023 Alaskan Sablefish SAFE (*Anoplopoma fimbria*)

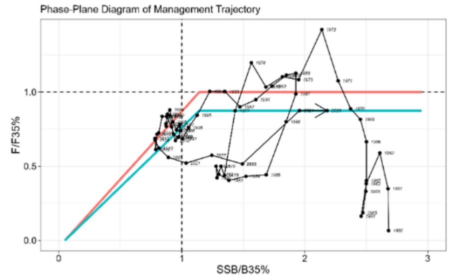
Data and Stock Assessment Model

- Following steady increases in abundance and biomass indices since 2015, the 2023 NOAA longline survey abundance was stable matching the 2022 value, the NOAA Gulf of Alaska trawl survey declined precipitously, and the fixed gear fishery CPUE continued to increase.
- The author proposed model (*23.5*) integrated minor data refinements and parametrization updates, but the main structure was consistent with the previously accepted model (*21.12*).
- The biomass and SSB continue to increase, while recruitment has been at or above the mean since 2014.





Stock Status and ABC Recommendations



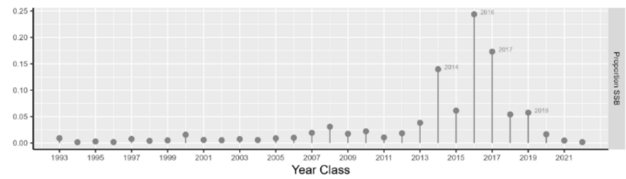
Quantity	2022 SAFE (Projections for 2023)	2023 SAFE (Projections for 2024)
$B_{100\%}$	305,595	299,901
$B_{40\%}$	122,238	119,960
$SSB_{(Terminal\_Yr+1)}$	159,788	185,079
$SSB_{(Terminal\_Yr+1)}/B_{100\%}$	52%	62%
$F_{ABC(Terminal\_Yr+1)}$	0.081	0.086
$ABC_{w(Terminal\_Yr+1)}$	40,502	47,146
$OFL_{w(Terminal\_Yr+1)}$	47,390	55,084

*SSB projections are based on specified catch for the terminal year. ABC_w and OFL_w are the recommended values after whale depredation has been taken into account.

- The resource is *not overfished* and *overfishing is not occurring*.
- Recent ABCs have not been fully utilized with catch averaging ~70% of the ABC over the last 3 years.
- The ABC increased by 16% due to continued maturation and growth (in weight) of the population.

Other Considerations

- The population age-structure remains contracted relative to historic levels.
- 2014 – 2020 year classes comprise > 75% of projected 2024 SSB.



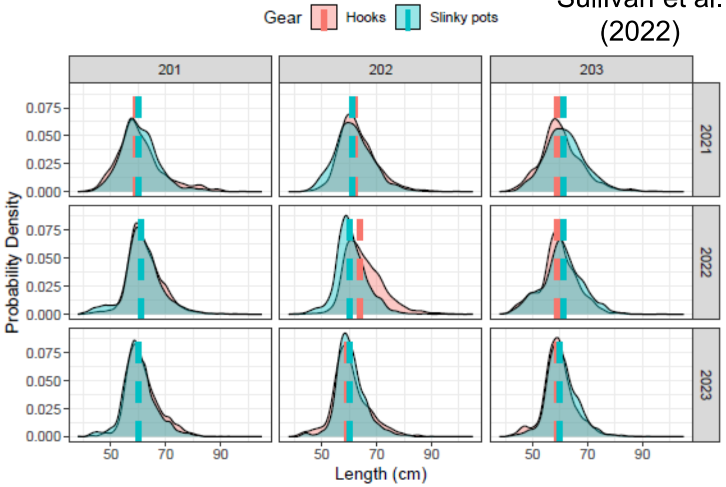
SSC Comments

- *Given the relatively small magnitude of estimated whale depredation, the SSC supports only periodic updates of this information, but continued inclusion of the mortality in the assessment and projected ABC calculations.*
  - The catch-in-areas database was not updated in time for the assessment, so whale depredation estimates were held constant at 2022 values.
- *The SSC recommends including other sources of mortality (e.g., recreational and research catches) noting that they are of a comparable magnitude to whale depredation.*
  - Model *23.2* and *23.5* now include all non-commercial catch (i.e., LL survey, trawl survey, IPHC survey, and ADFG sport fishery catch not associated with NSEI and SSEI fisheries).

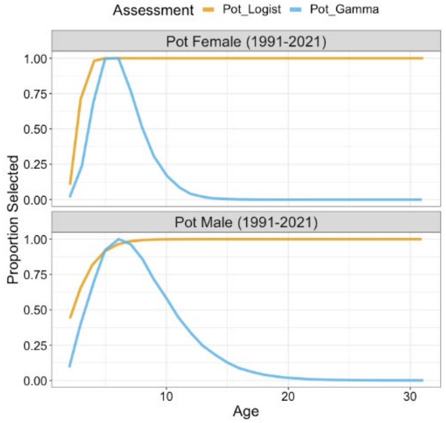
Year	Total	Non-Comm.
2000	15,894	324
2001	14,435	370
2002	15,205	457
2003	16,797	386
2004	17,896	376
2005	16,951	366
2006	15,904	353
2007	16,284	326
2008	14,857	305
2009	13,364	302
2010	12,275	339
2011	13,328	341
2012	14,144	272
2013	13,851	240
2014	11,806	259
2015	11,179	246
2016	10,472	248
2017	12,552	285
2018	14,494	246
2019	16,912	360
2020	19,416	381
2021	21,748	481
2022	27,420	512
2023	20,762	405

SSC Comments

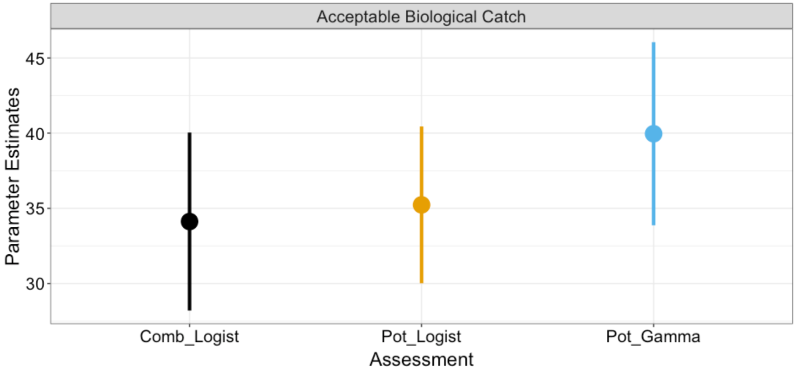
- *The SSC recommends side-by-side comparisons of size and age distributions from the two gear types to better understand potential differences in selectivity. The SSC would also like to see a model that allows for separate fleets to evaluate impacts on assessment results. This investigation should be a high priority for the next assessment.*
  - Since 2018, age and length compositions have been similar
    - Results from experimental legs of the LL survey also agree
  - A fleet disaggregated assessment was presented in September (M. Cheng) and demonstrated limited impact on catch projections
    - Sample size limitations hindered selectivity estimation for pot gear



Sullivan et al. (2022)

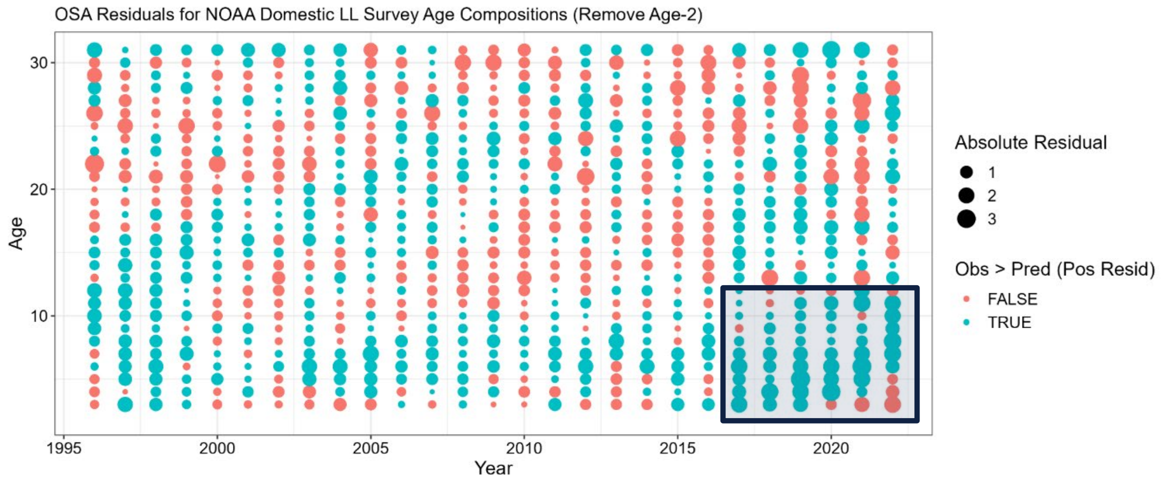


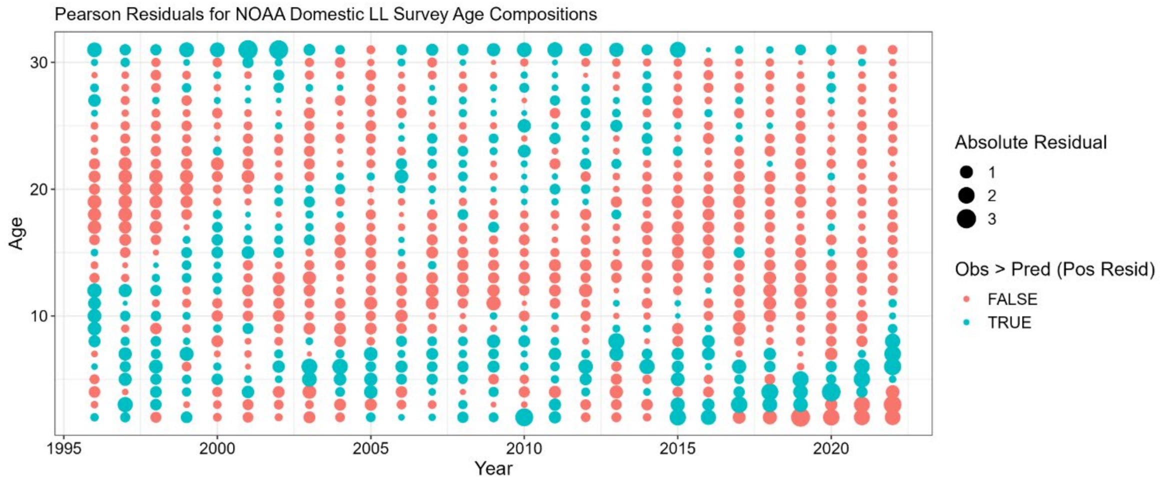
Cheng et al. (Accepted, Fish. Res.)



SSC Comments

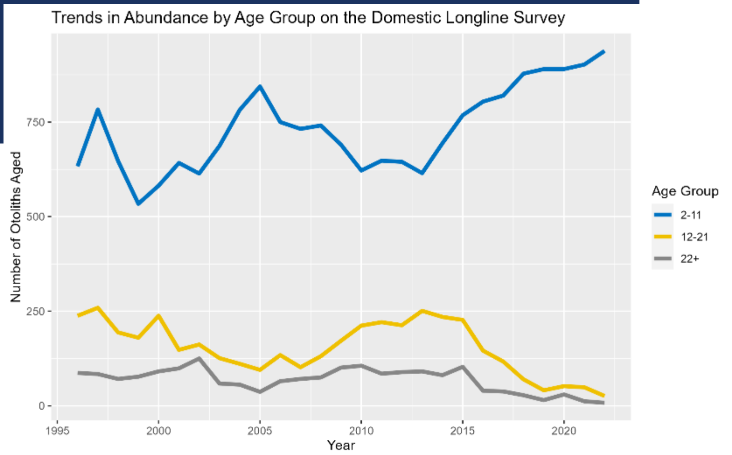
- *Provide bubble plots of Pearson residuals for all age and length data including the sign and scale of residuals.*
  - A comparison of Pearson and One-step-ahead residuals were provided in the SAFE.
  - OSA are deemed more appropriate for compositional data that assume a multinomial distribution.
  - Moderate residual patterns exist, which have been documented in recent SAFEs.
    - Overestimation of initial year class strength followed by subsequent underestimation at intermediate ages.

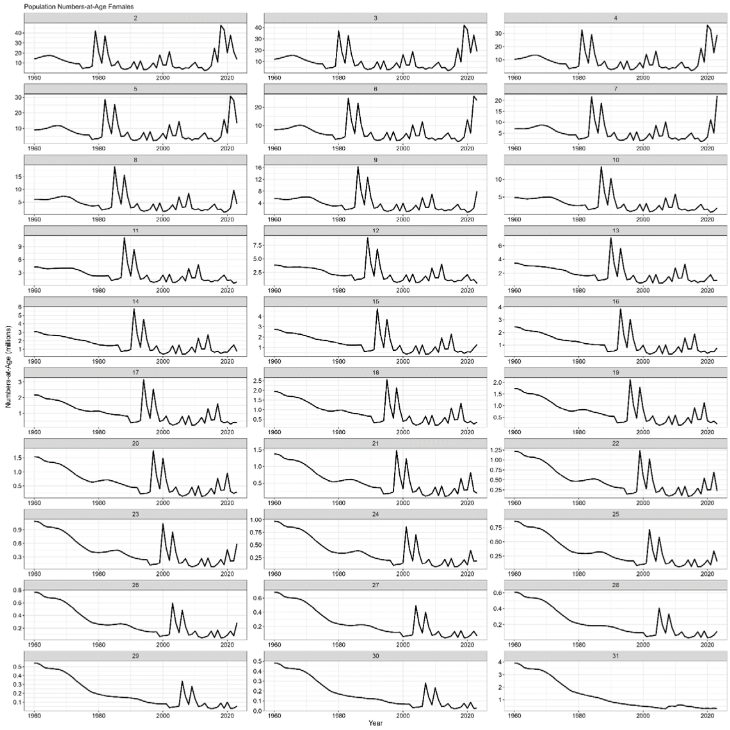




PT Comments

- *The Teams recommended an evaluation of trends in abundance of the plus age group from the longline survey and fixed gear fishery along with a figure showing the plus group absolute abundance.*
    - Numbers-at-age by sex and year are provided in the SAFE.
- *It may be more appropriate to implement an 'index' fishery that utilizes a time-invariant selectivity and density-weighted compositions (i.e., where the composition data by region is weighted by the CPUE and not the catch) along with the associated CPUE.*
    - *No changes made*: the limited impact of the CPUE index on assessment estimates made this a relatively low priority (as does uncertainty in future availability of CPUE data).





Data Summary

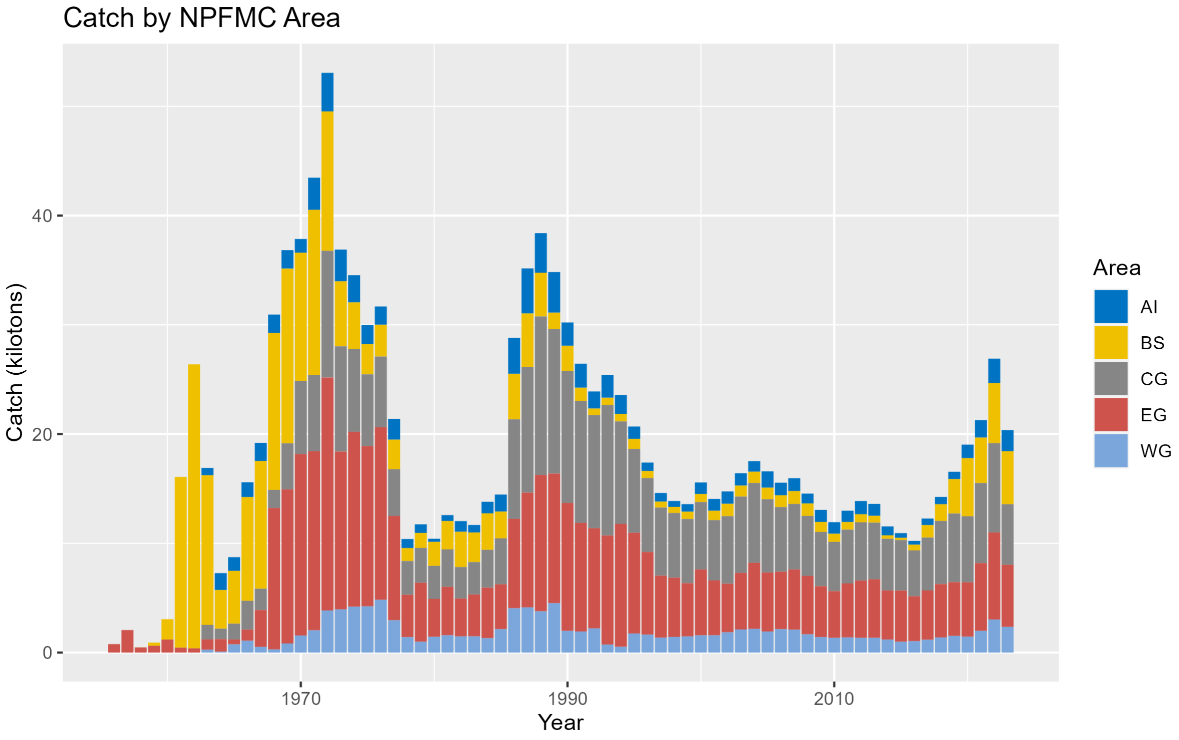
- New data for 2023 in bold

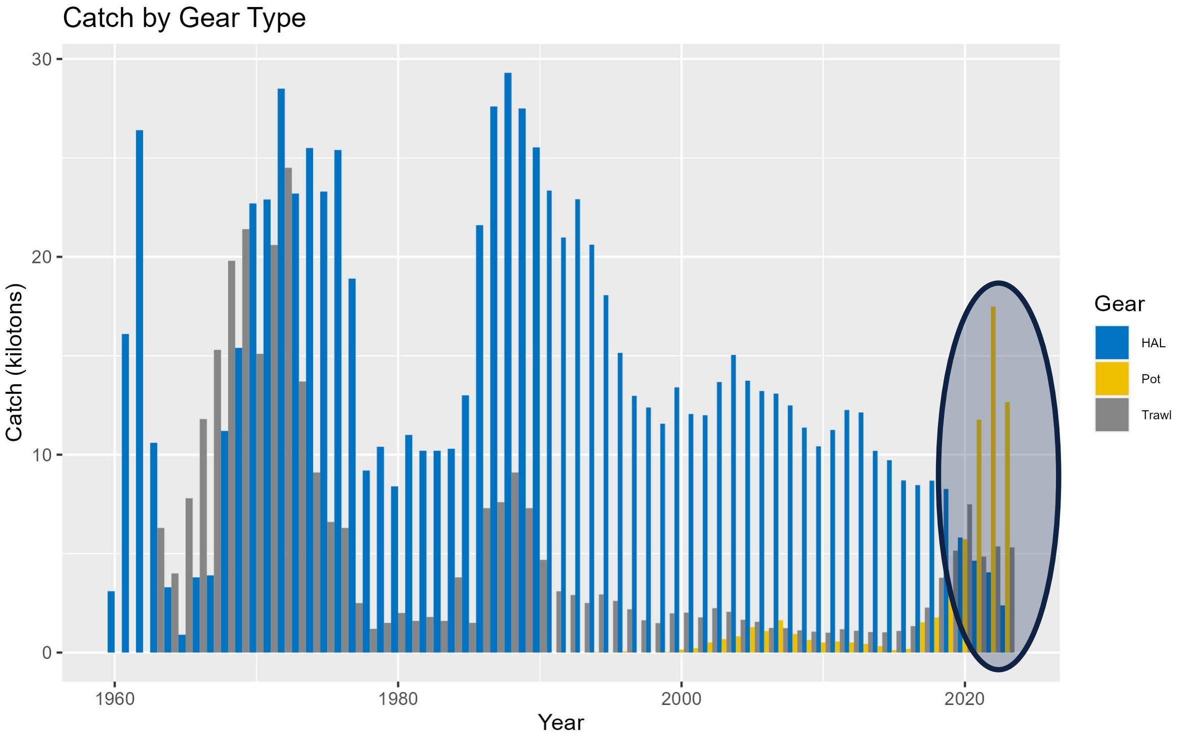
Source	Data	Years
Fixed Gear Fisheries	Catch	1960 – **2023**
Trawl Fisheries	Catch	1960 – **2023**
Non-Commercial Catch	Catch	1977 – **2023**
Japanese Longline Fishery	Catch-per-Unit-Effort (CPUE)	1964 – 1981
U.S. Fixed Gear Fisheries	CPUE, Length	1990 – **2022**
	Age	1999 – **2022**
U.S. Trawl Fisheries	Length	1990,1991,1999, 2005 – **2022**
Japan-U.S. Cooperative Longline Survey	RPNs, Length	1979 - 1994
	Age	1981, 1983, 1985, 1987, 1989, 1991, 1993
NOAA Domestic Longline Survey	RPNs, Length	1990 – **2023**
	Age	1996 – **2022**
NOAA GOA Trawl Survey	Biomass index	1990, 1993, 1996, 1999, 2003, 2005, 2007, 2009, 2011, 2013, 2015, 2017, 2019, 2021, **2023**
	Lengths	1990, 1993, 1996, 1999, 2003, 2005, 2007, 2009, 2011, 2013, 2015, 2017, 2019, 2021, **2023**

CPUE is now combined gear and standardized

Catch

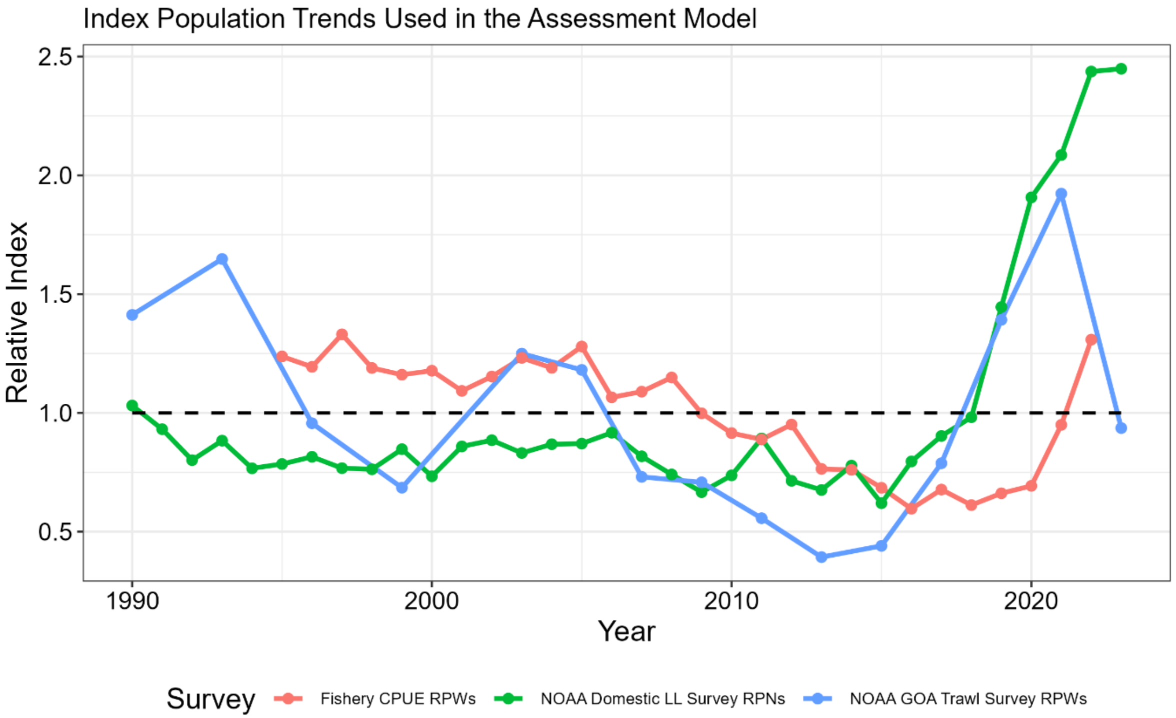
- Catch by pot gear is consistently majority source of recent removals
- Pot catch > 80% of fixed gear catch since 2022





Indices

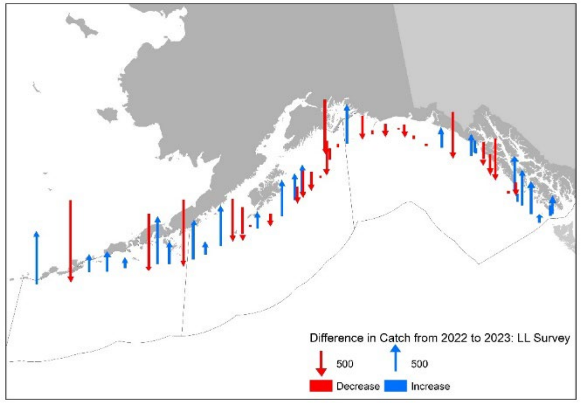
- Longline survey numbers were steady at time series high values, but trawl survey biomass decreased significantly
- BSAI constitutes > 50% of survey numbers again in 2023

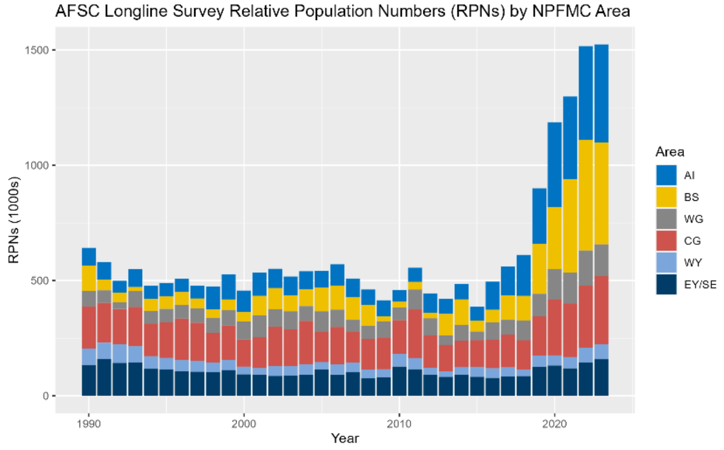


LL Survey: No Change

CPUE Index: 27% Increase

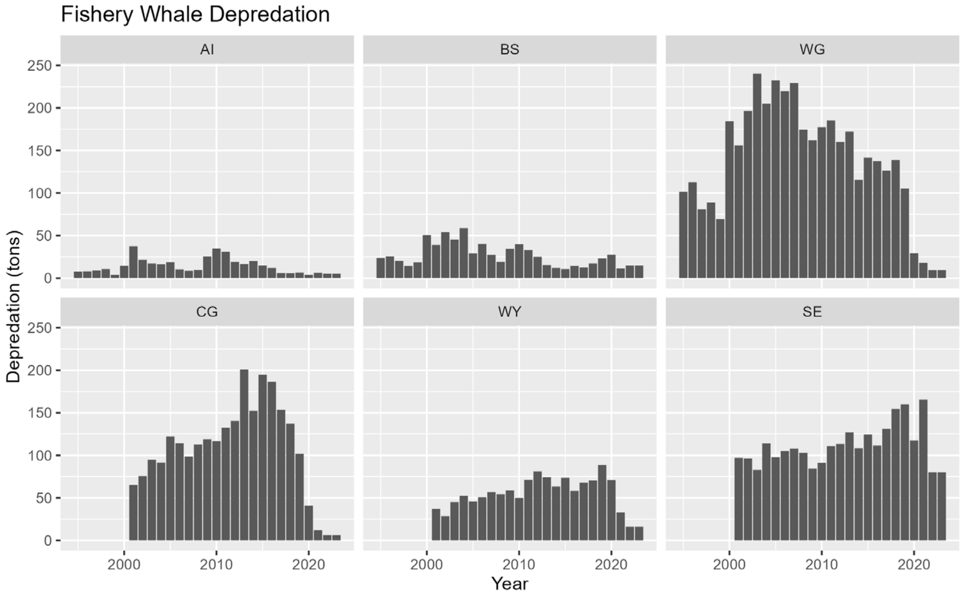
Trawl Survey: 50% Decline

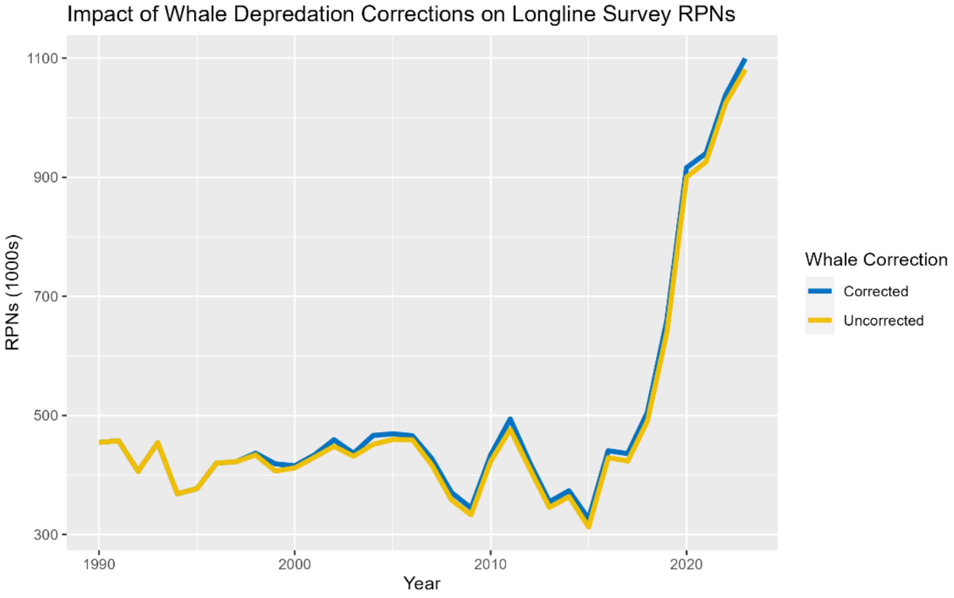




Whale Depredation

- Fishery whale depredation not updated (full update in 2022)
  - 2023 values held constant at 2022 values due to issues updating required database (catch-in-areas)
  - Limited depredation due to rapid transition to pot gear (no assumed depredation)
- Depredation on longline survey is low (28 stations with observed depredation in 2023)





*Note figure does not include non-surveyed area interpolations

Model Structure (*21.12*)

- 1 area, sex-disaggregated, age structured (SCAA in ADMB)
  - Years 1960 to 2023
  - Ages 2 – 31+
- Biological parameters input (length-,weight-, maturity-at-age)
- Natural mortality estimated with prior (time-/age-invariant)
- No stock-recruit functional form, assume yearly deviations from average recruitment
  - Recruitment at age-2, assume a 50:50 sex ratio at birth
  - Terminal year recruitment (2021 year class) fixed at average value
  - Use recruit deviations to estimate initial age structure (i.e., year classes born prior to 1960)
- Each fleet (fishery and survey) has independent, sex-specific selectivity (with some shared parameters across time blocks and sexes)
  - Longline survey and fixed gear fishery assume logistic selectivity with 2016 time block and a post-IFQ (1995) fishery block
  - Trawl survey selectivity assumes power function (exponential decay)
  - Trawl fishery assumes domed selectivity (gamma function)
- Catchability parameters freely estimated for each index (including CPUE)
- Fishing mortality estimated with yearly deviations for each fleet

Model Variants

- Update assessment(+) with minor changes to input data and model parametrization compared to SSC accepted model *21.12*:
  - *Model 23.1*: removed the 1984 and 1987 trawl survey data
  - *Model 23.2*: incorporated all non-commercial catch, per SSC request
  - ***Model 23.3***: minor parametrization updates including:
    - Rectified the stock-recruit bias correction (fix coding bug, implement Methot and Taylor, 2011, bias correction, estimate σ_R, and add input variance term for initial age structure)
    - Allowed selectivity parameter sharing to improve stability (share parameters between early time block of fixed gear fishery/LL survey with Japanese fishery/survey, respectively)
    - Removed unnecessarily estimated fishing mortality parameters (deviations for trawl fishery when no catch, reference point parameters for projections)
  - *Model 23.4*: implemented a standardized CPUE index that combined data from both the hook-and-line and pot gear types (Cheng et al., 2023)
  - *Model 23.5* (author recommended): integrated all updates from models *23.1—23.4*

Adjusting for bias due to variability of estimated recruitments in fishery assessment models

Richard D. Methot, Jr. and Ian G. Taylor

Model Structure Difference (*23.5* v. *21.12*)

- Underlying structure essentially unchanged
  - Parameter estimation updates in model *23.5*:
    - Remove 1 fishery selectivity parameter (historic Japanese LL fishery)
    - Remove 2 survey selectivity parameters (historic Japanese Coop LL Survey)
    - Remove 3 trawl fishery fishing mortality deviation parameters (1960 – 1963 where no catch reported)
    - Remove 3 reference point fishing mortality parameters ($F_{35\%}$, $F_{40\%}$, and $F_{50\%}$)
    - Remove 1 catchability parameter (pre-IFQ fishery CPUE; standardized index begins in 1995, post-IFQ)
    - Add 1 recruitment variance parameter

2023 Model *23.5*

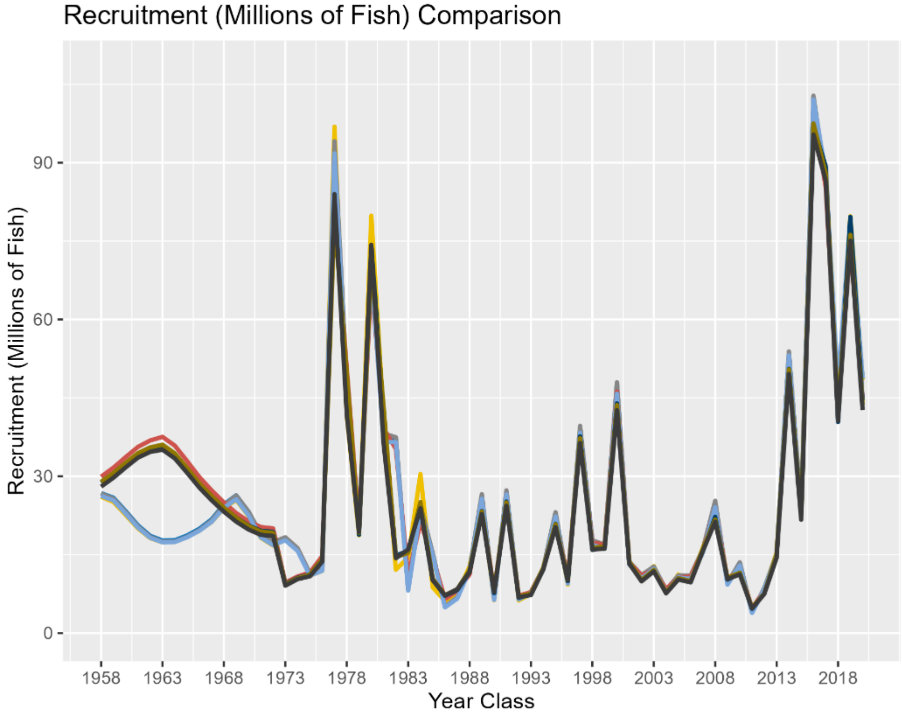
Parameter Name	Symbol	Number of Parameters
Catchability	q	6
Mean Recruitment	μ_r	1
Recruitment Variance	σ_R	1
Natural Mortality	M	1
Recruitment Deviations	τ_y	91
Average Fishing Mortality	μ_f	2
Fishing Mortality Deviations	φ_y	125
Fishery Selectivity	fs_a	14
Survey Selectivity	ss_a	8
Total		249

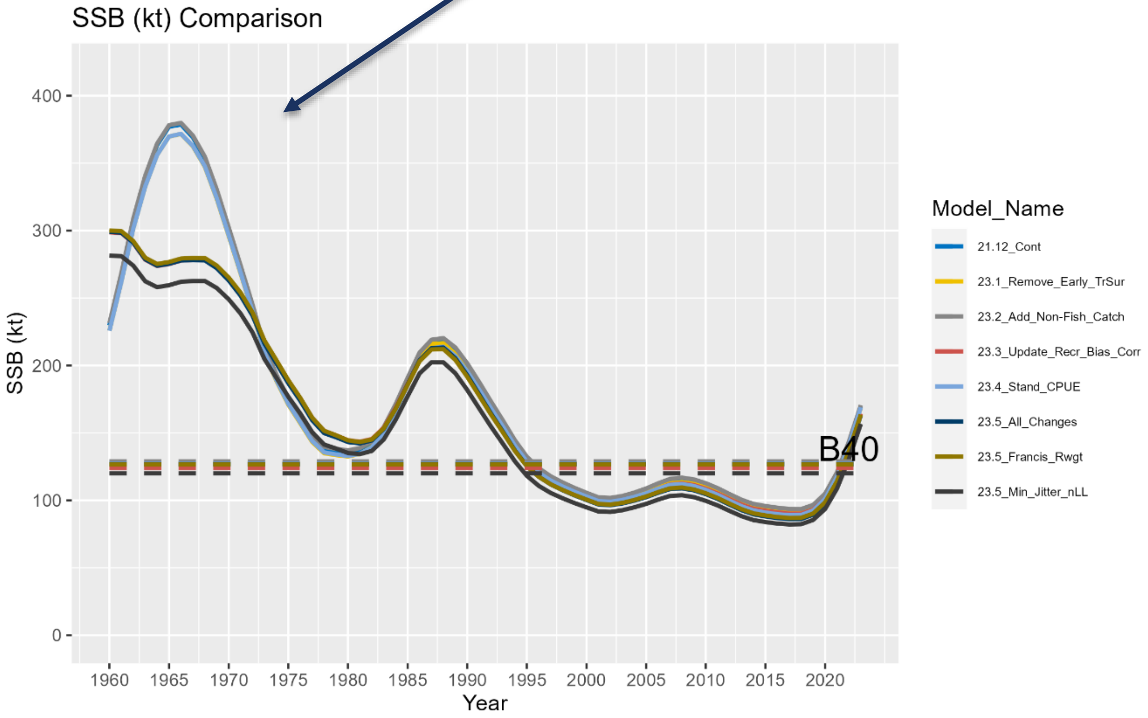
2022 Model *21.12*

Parameter Name	Symbol	Number of Parameters
Catchability	q	7
Mean recruitment	μ_r	1
Natural mortality	M	1
SSB-per-recruit levels	$F_{35\%}, F_{40\%}, F_{50\%}$	3
Recruitment deviations	τ_y	90
Average fishing mortality	μ_f	2
Fishing mortality deviations	φ_y	126
Fishery selectivity	fs_a	15
Survey selectivity	ss_a	10
Total		255

Model Bridging

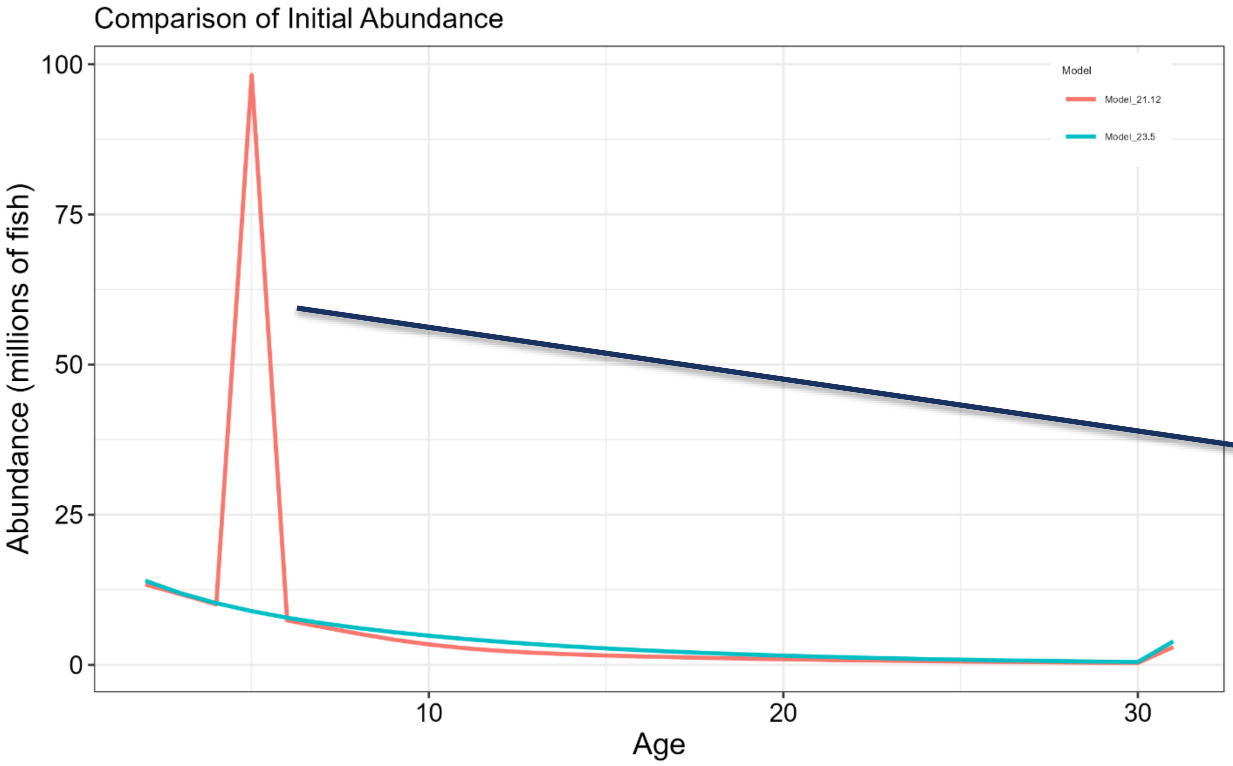
- Data updates led to minor scaling differences with model *21.12*
- Parametrization updates (*23.3*) led to more realistic initial trends in SSB
- No observed differences in data fits

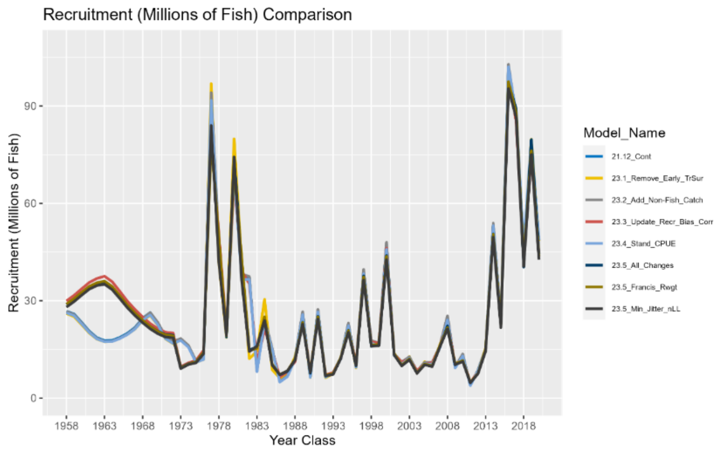


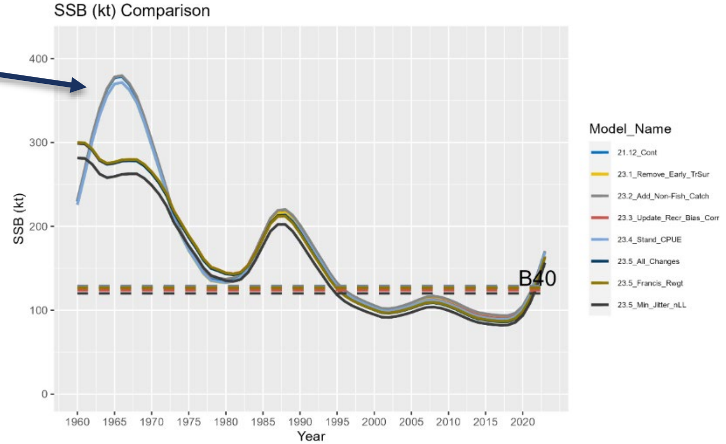


Model Bridging

- Parametrization updates (*23.3*) led to more realistic initial abundance estimates AND initial trends in SSB

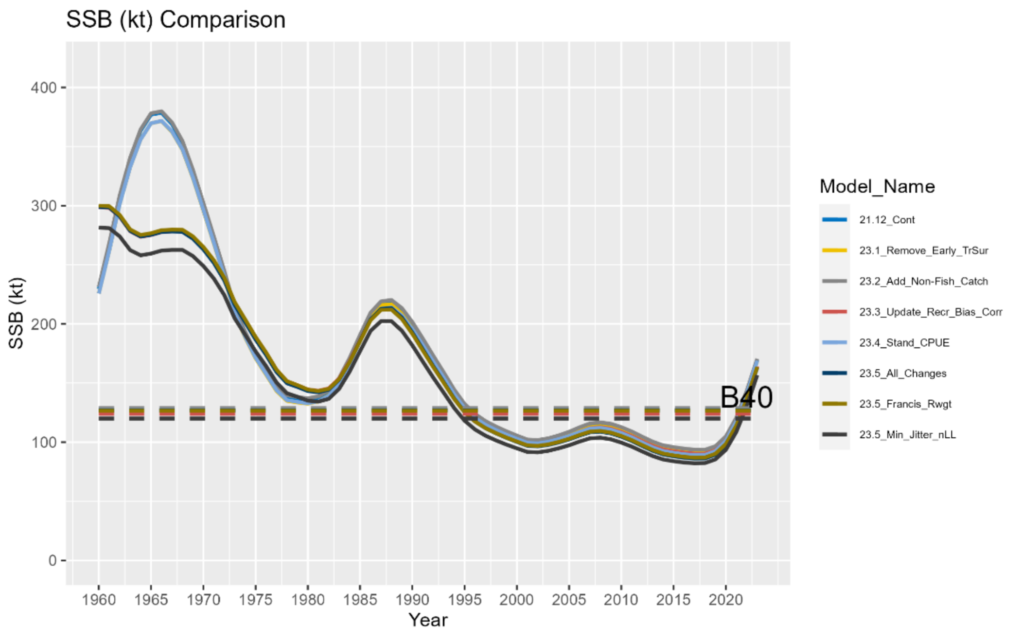






Final Author Recommended Model

- Model *23.5* with Francis reweighting and based on the run from a jitter analysis with best fit to data
- Further downward scaling on mean recruitment and SSB
- No difference in ABC from model *21.12*

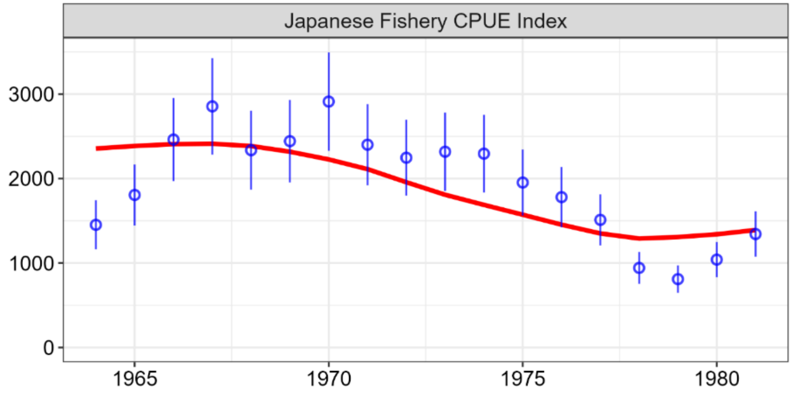


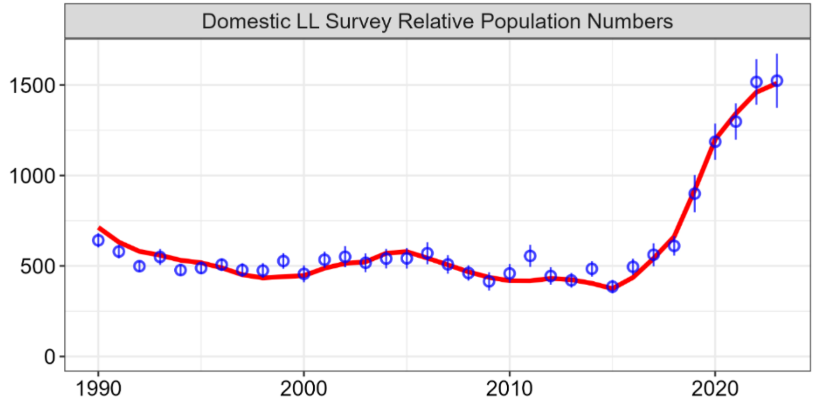
Francis Weights

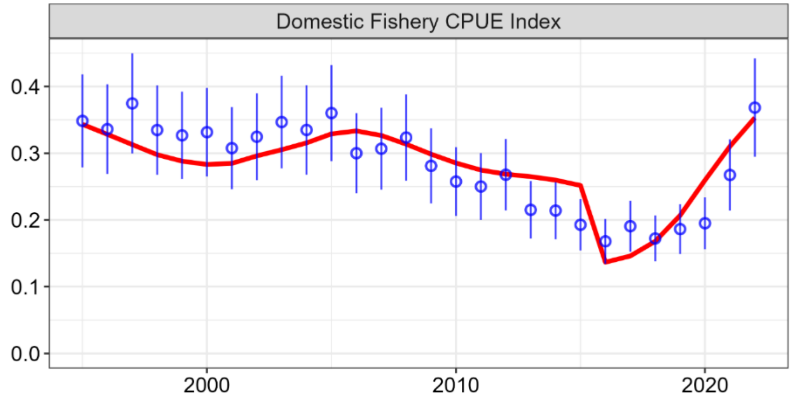
Data Source	2022 (Model *21.12*)	2023 (Model *23.5*)
Fixed Gear Catch	50.000	50.000
Trawl Catch	50.000	50.000
Longline Survey RPN	0.448	0.448
Coop Survey RPN	0.448	0.448
Fixed Gear Fishery CPUE	0.448	0.448
Japan Longline Fishery CPUE	0.448	0.448
Trawl Survey RPW	0.448	0.448
Fixed Gear Age Composition	0.799	0.798
Longline Survey Age Composition	3.961	3.724
Coop Longline Survey Age Composition	1.142	1.272
Fixed Gear Fishery Length Composition Males	5.592	5.216
Fixed Gear Fishery Length Composition Females	5.099	4.945
Trawl Fishery Size Composition Males	0.272	0.255
Trawl Fishery Size Composition Females	0.372	0.350
Longline Survey Size Composition Males	1.389	1.115
Longline Survey Size Composition Females	1.658	1.500
Coop Survey Size Composition Males	1.086	0.902
Coop Survey Size Composition Females	1.622	1.268
Trawl Survey Size Composition Males	0.599	0.450
Trawl Survey Size Composition Females	0.773	0.673

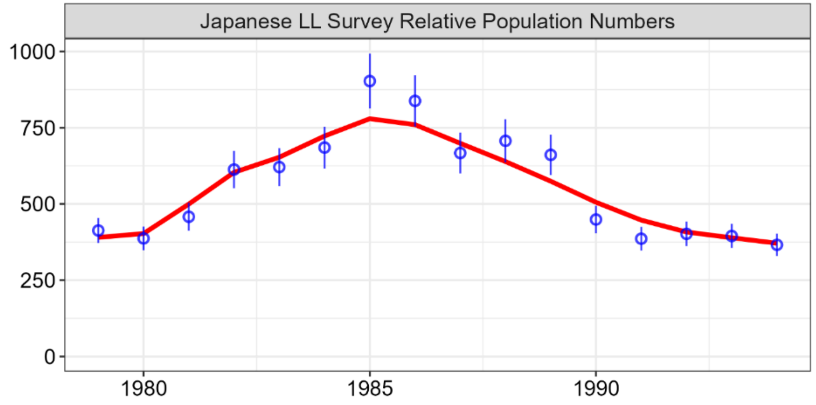
Fit to Indices

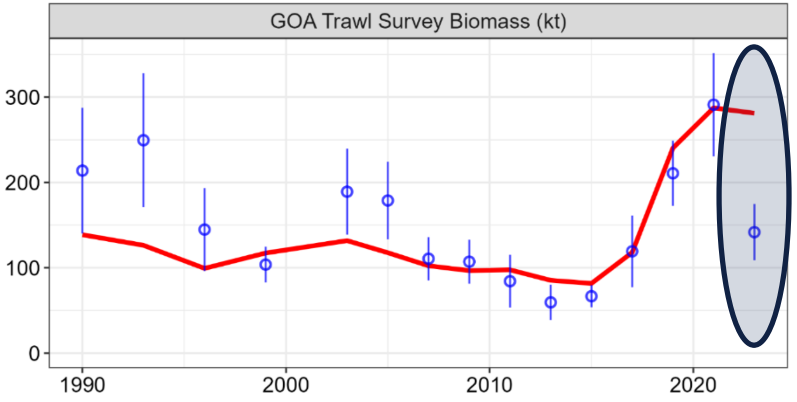
- Generally adequate fits to indices of abundance
- Trouble fitting NOAA GOA trawl survey especially 2023 decline





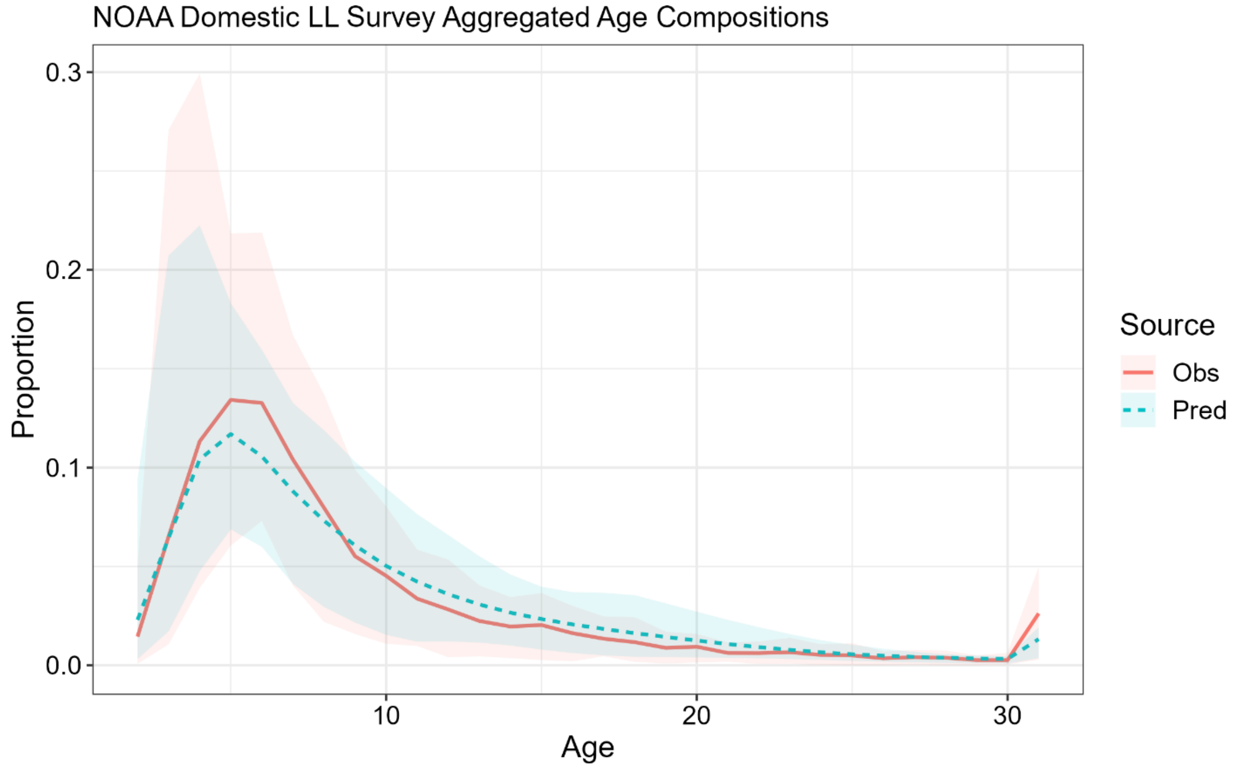


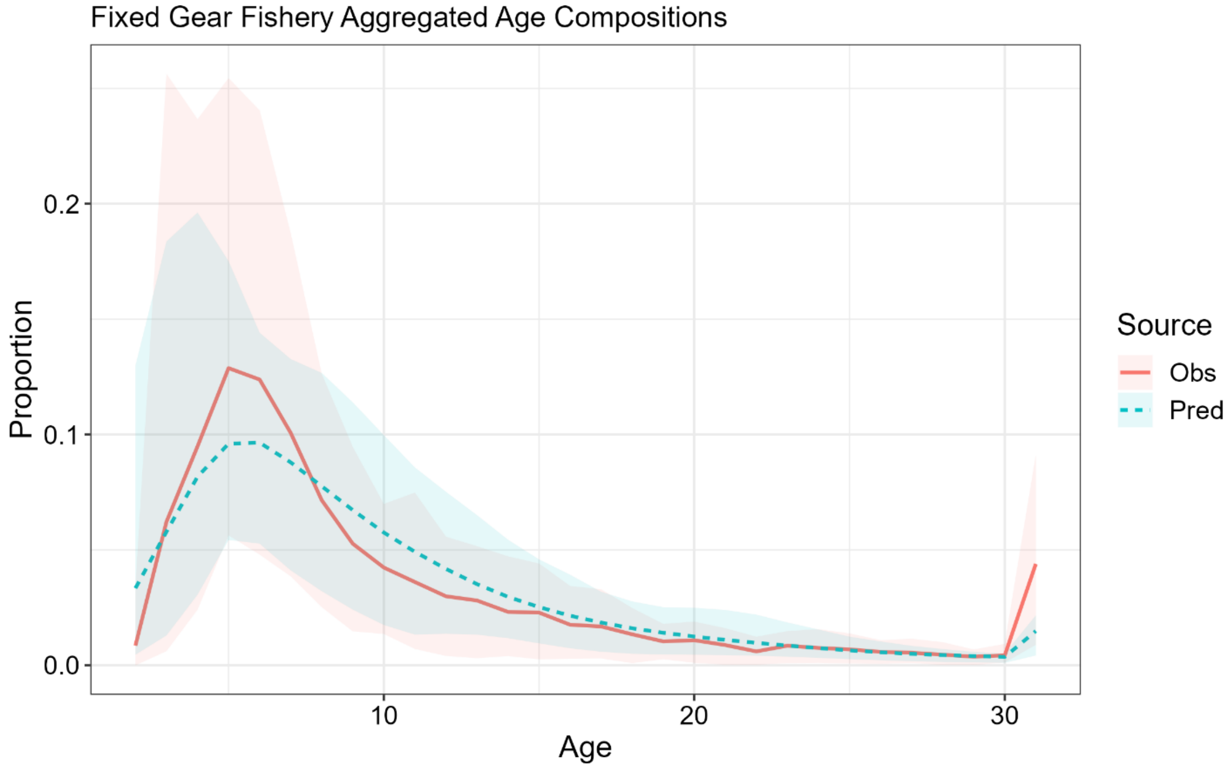




Fit to Compositional Data

- Continued trend of overestimating abundance at age-2 and underestimating at ages 4 – 6

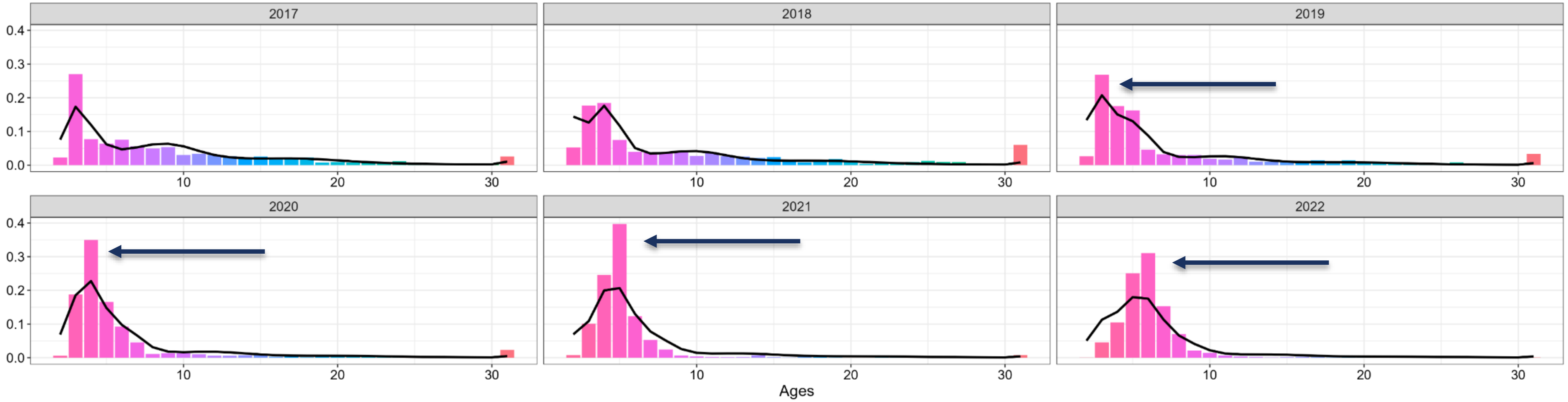




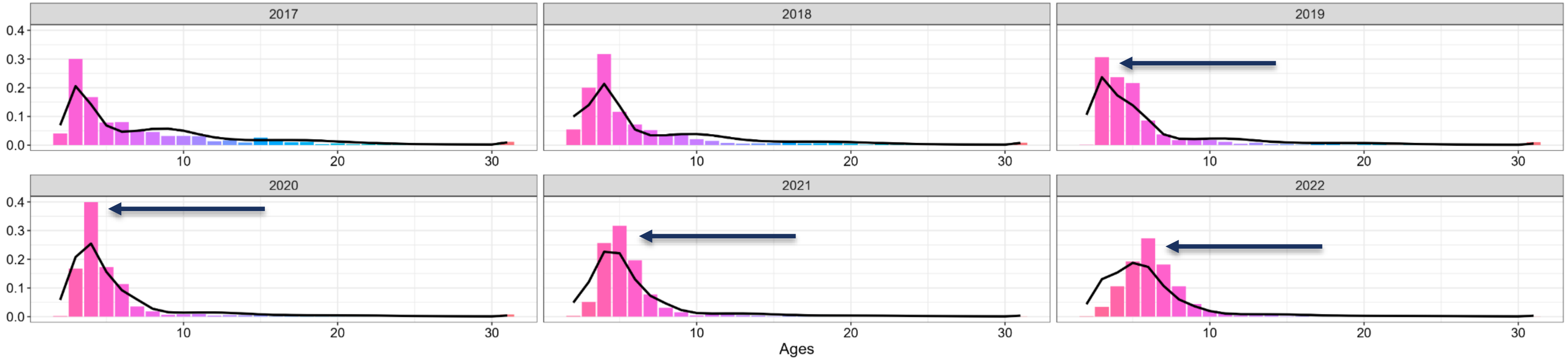
Fit to Compositional Data

- Habitually underestimating 2016 year class as it ages

Fixed Gear Fishery Ages

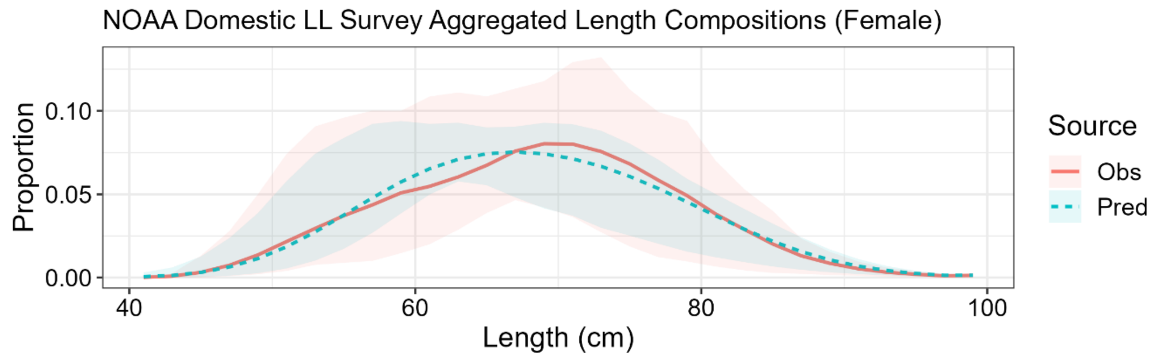


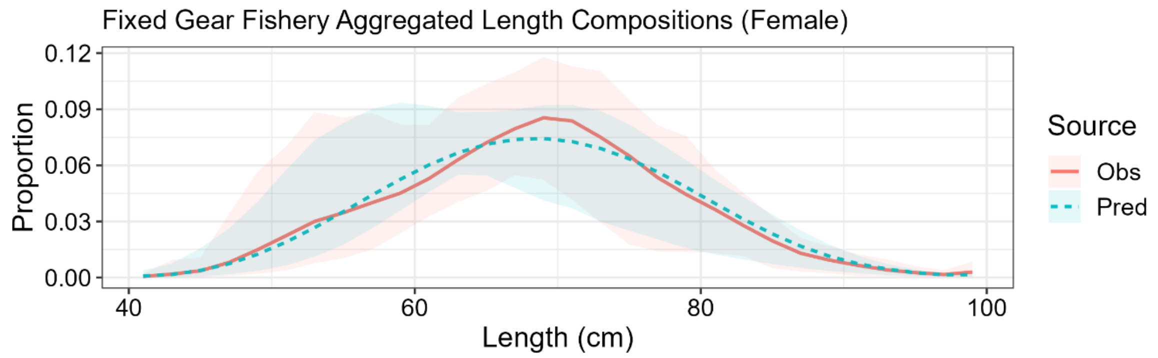
LL Survey Ages

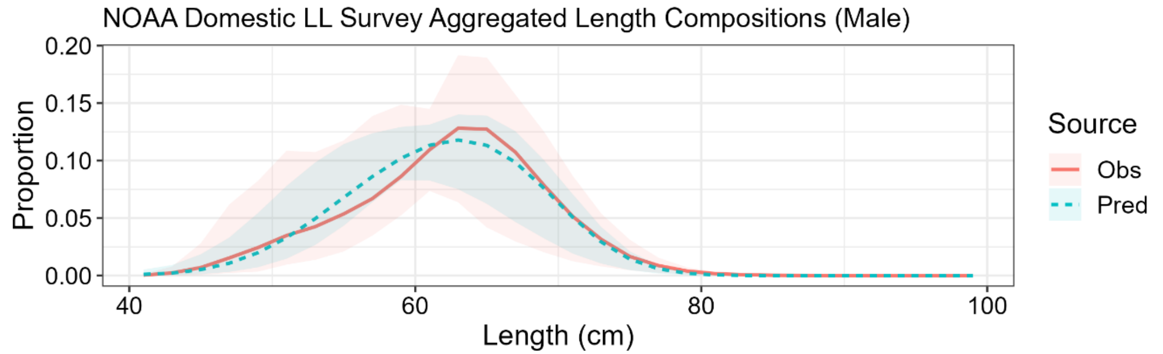


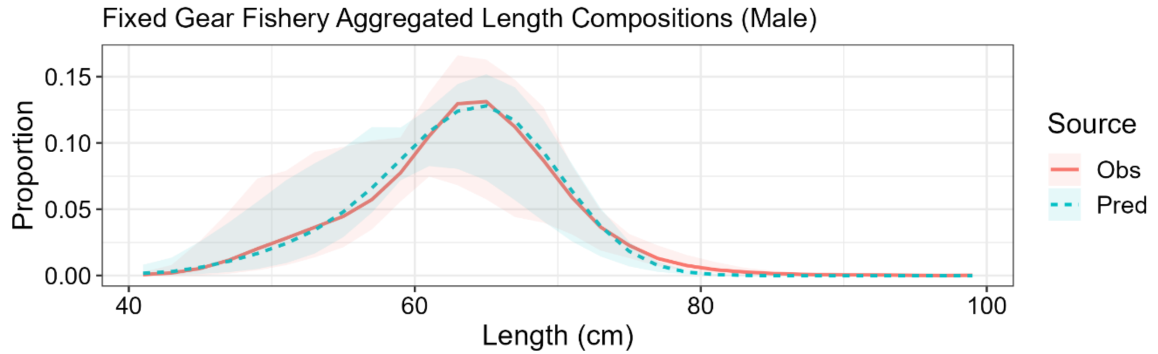
Fit to Compositional Data

- Likely overfitting fishery length compositions
- Underestimating smaller sizes and overestimating larger sizes in recent years (in contrast to age comps)
  - Unknown impact of fitting sex-aggregated age compositions compared to sex disaggregated length compositions



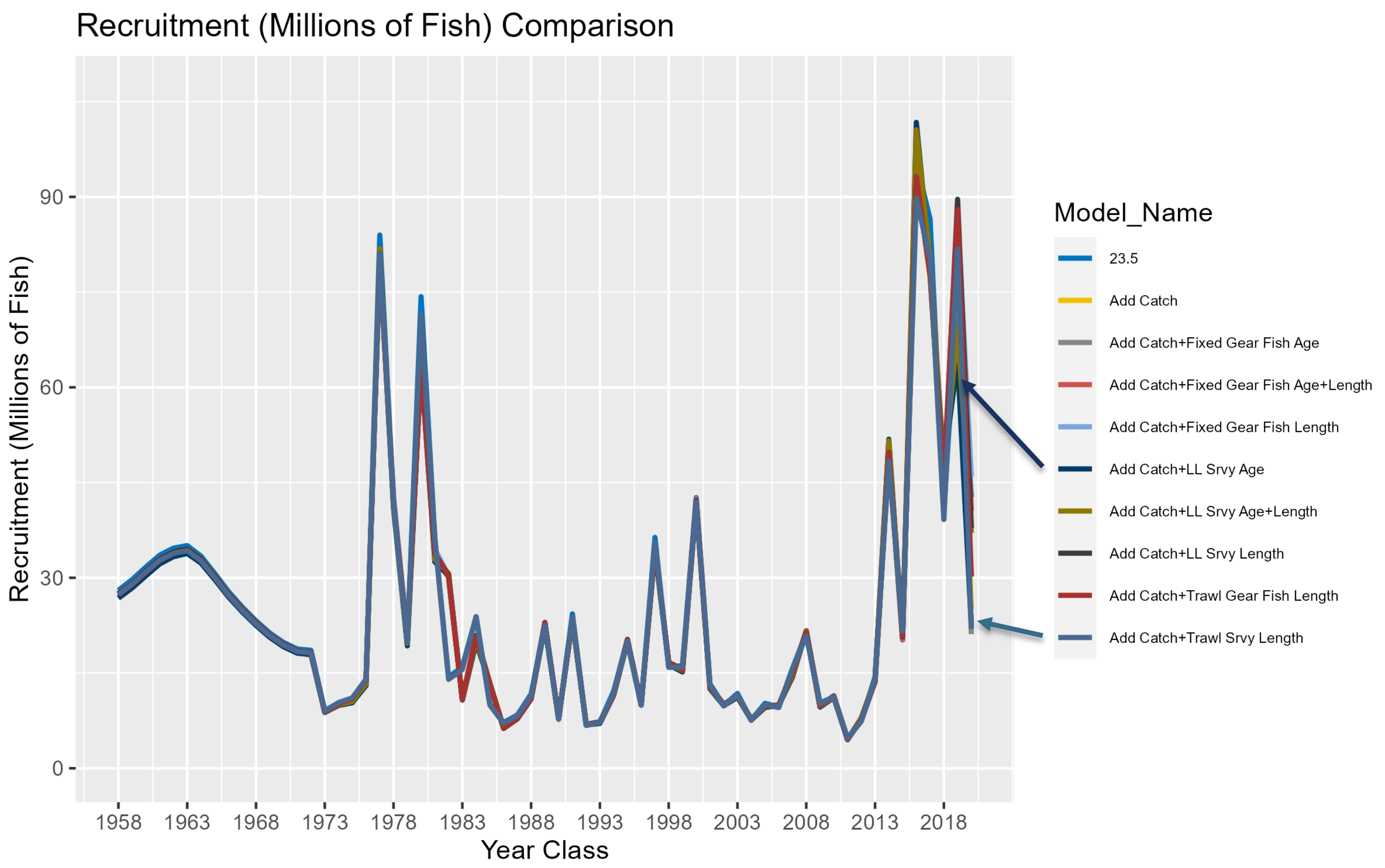






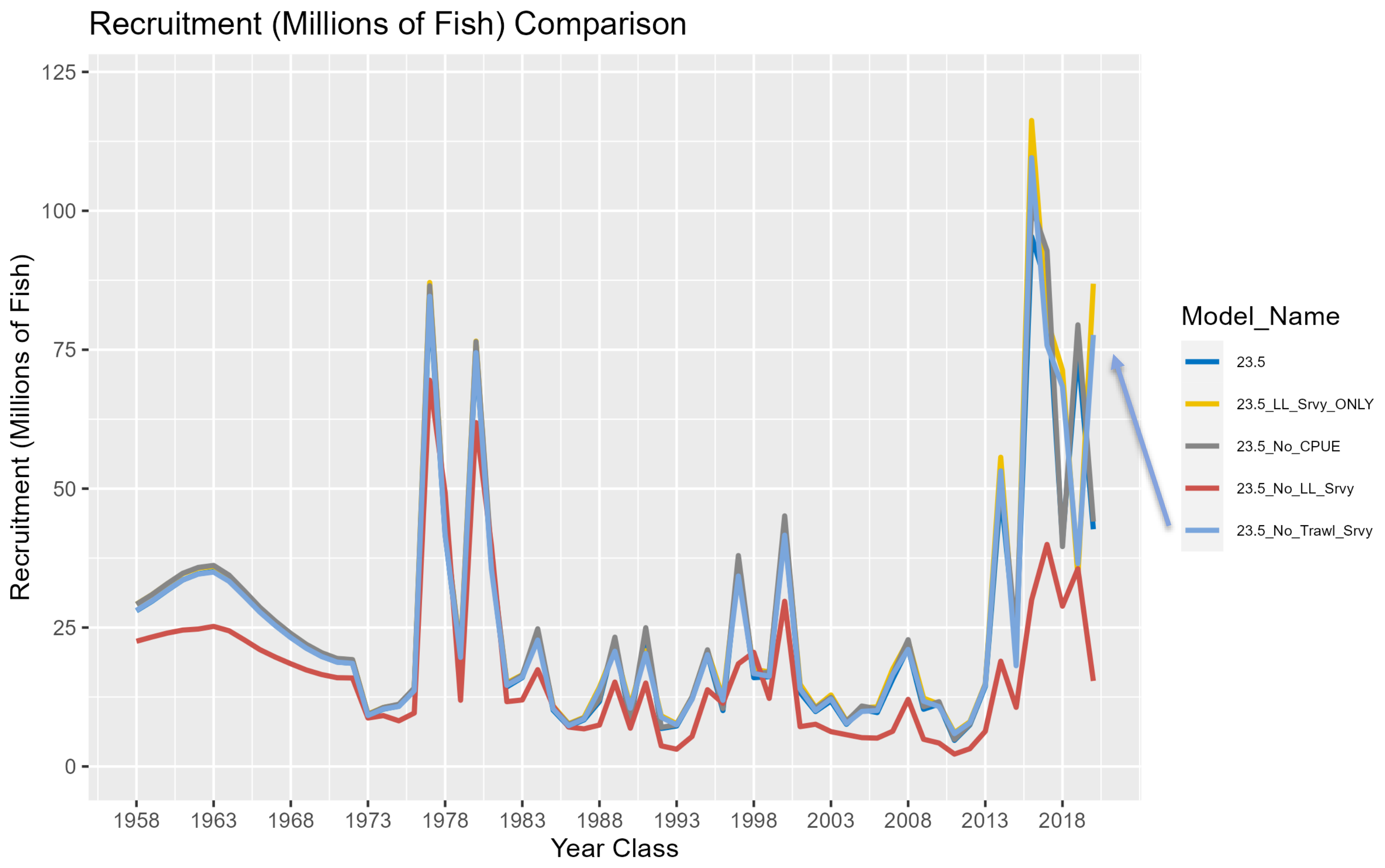
Impact of Data Updates

- LL survey age data continues to downgrade 2019 cohort
- 2023 trawl survey resulting in lower estimates of 2020 cohort
- Trawl survey first indicator of magnitude of recent year classes, but disagreement with LL survey



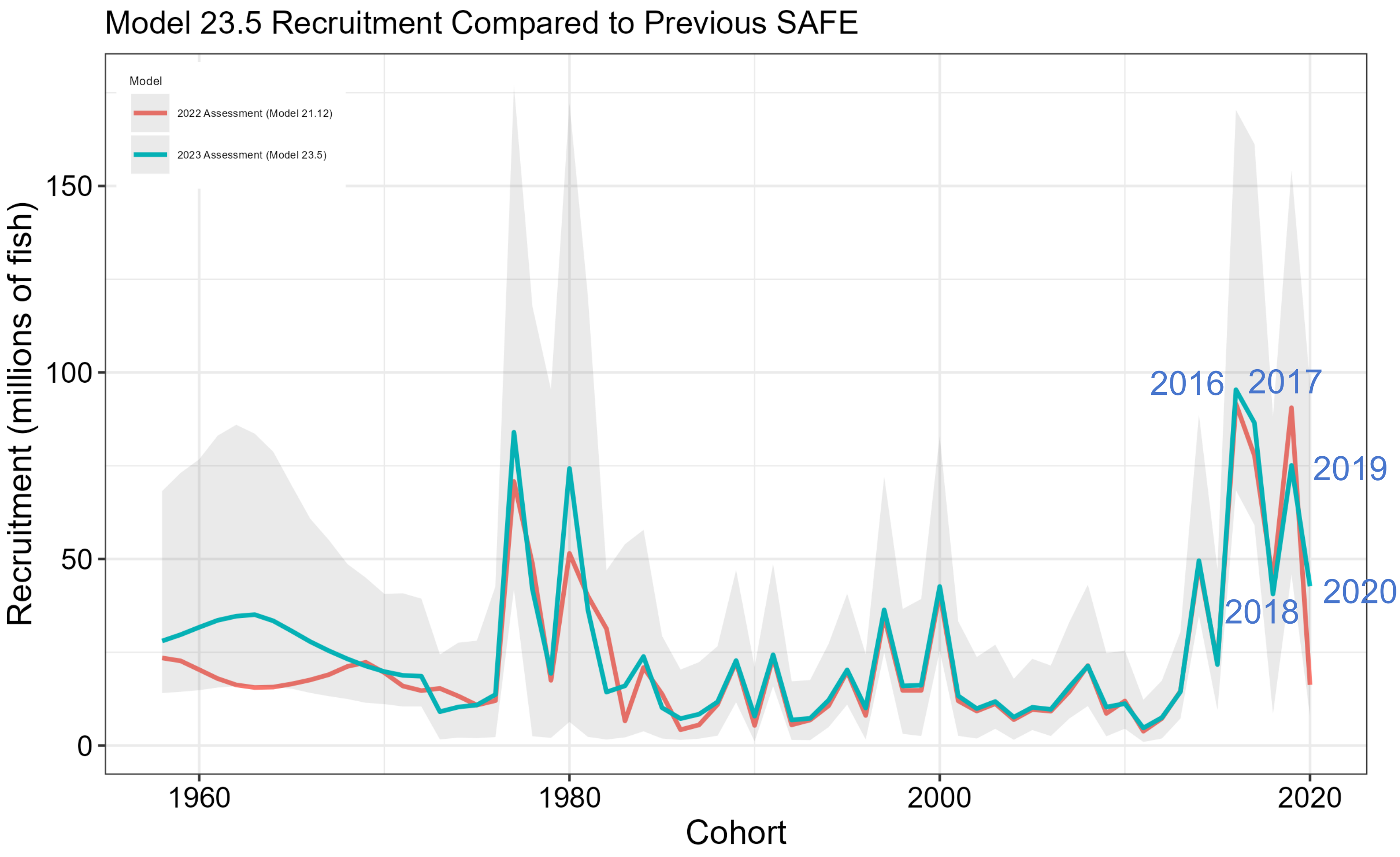
Index Sensitivity

- Longline survey is primary driver of productivity/scale
- Trawl survey is primary driver of recent recruitment
  - 2019 and 2020 cohorts demonstrate opposite signals in trawl vs. LL survey compositional data



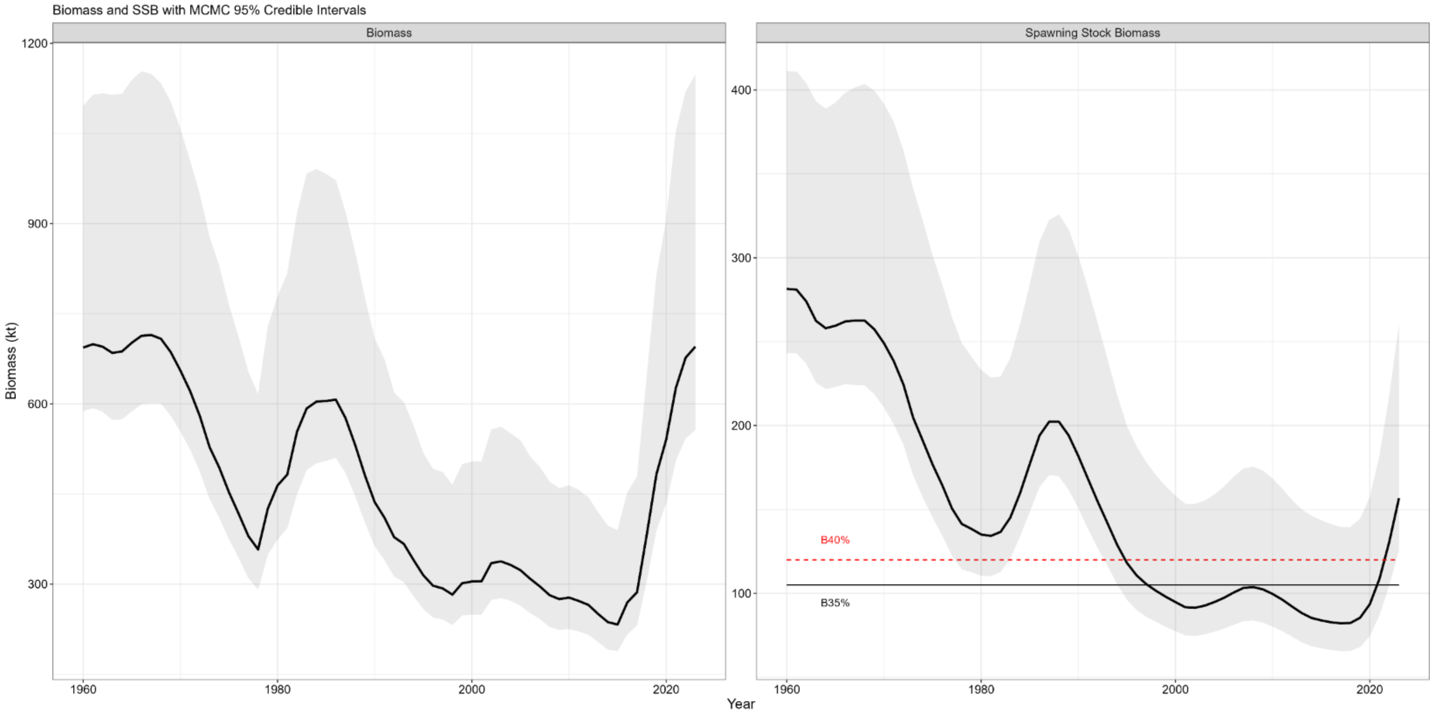
Recruitment

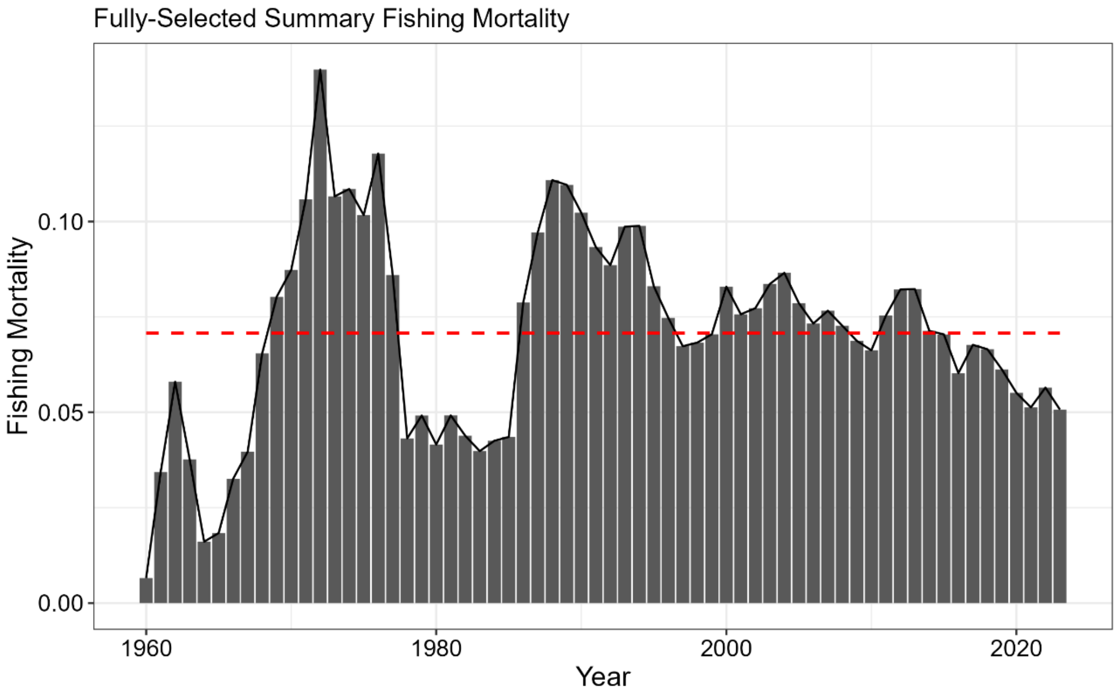
- 2016 likely the largest year class on record
- 2017 and 2019 also appear to be large year classes
  - Uncertainty sorting out exactly which recent year classes are large
- Current series of recruitment emulates late 1970s



Biomass and Fishing Mortality

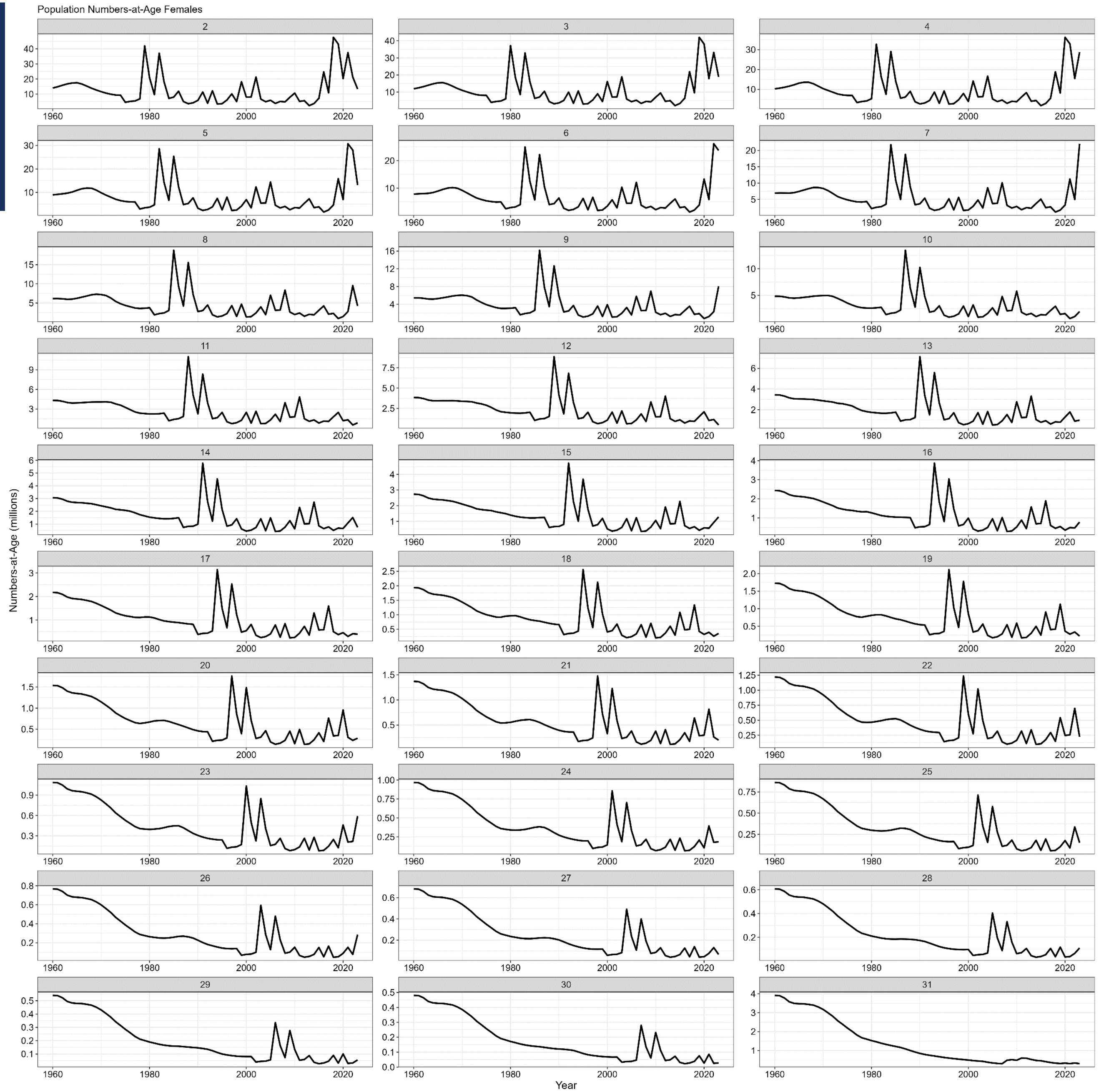
- At $B_{52\%}$ in 2023
- Projected to be at $B_{62\%}$ in 2024
- Fishing mortality remains at low levels ($< F_{ABC}$)





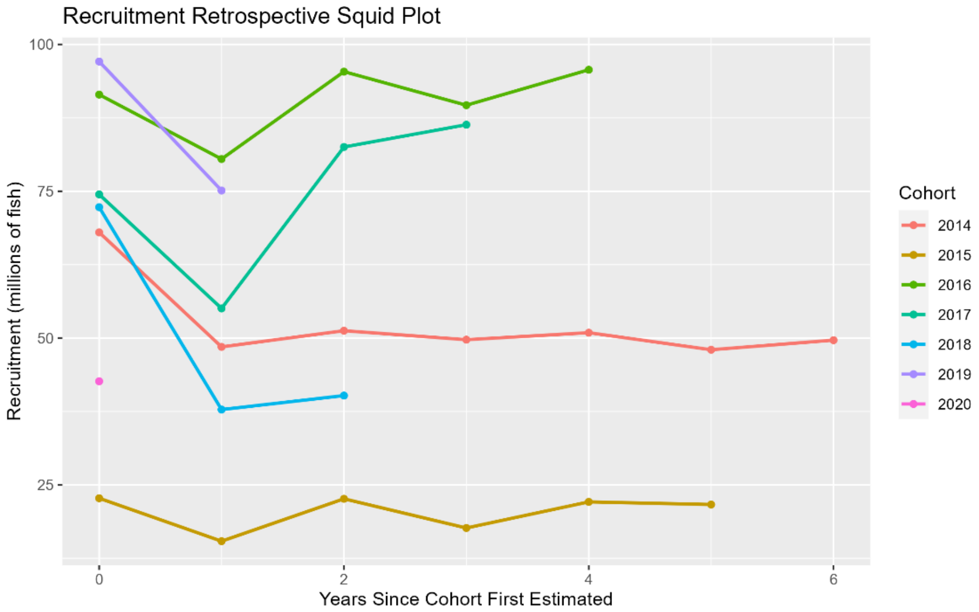
Age Structure

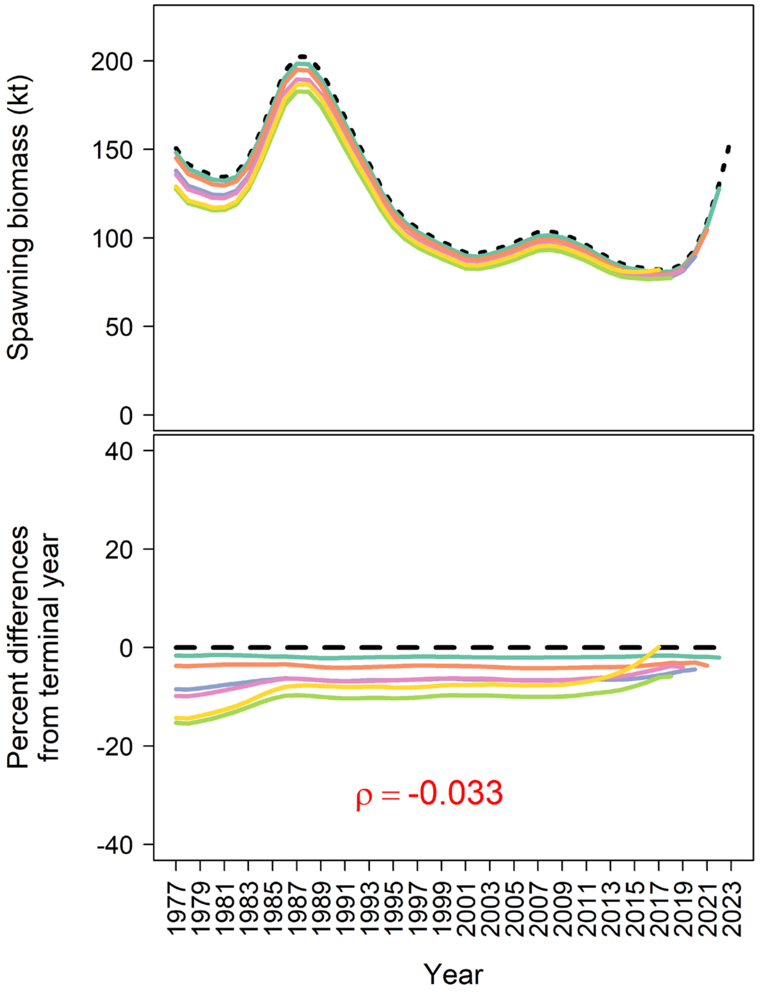
- Compared to historic age structure, there are now more young fish and much fewer older fish
- Age truncation still an issue that warrants monitoring



Retrospective Analysis

- Limited retrospective bias
- Slight underestimation of SSB
- Estimation pattern in recent year class (2016, 2017, 2019?)
  - Initial estimate is downgraded, then increases around age-5
    - Around age when first observed at large numbers in fishery and LL survey ages

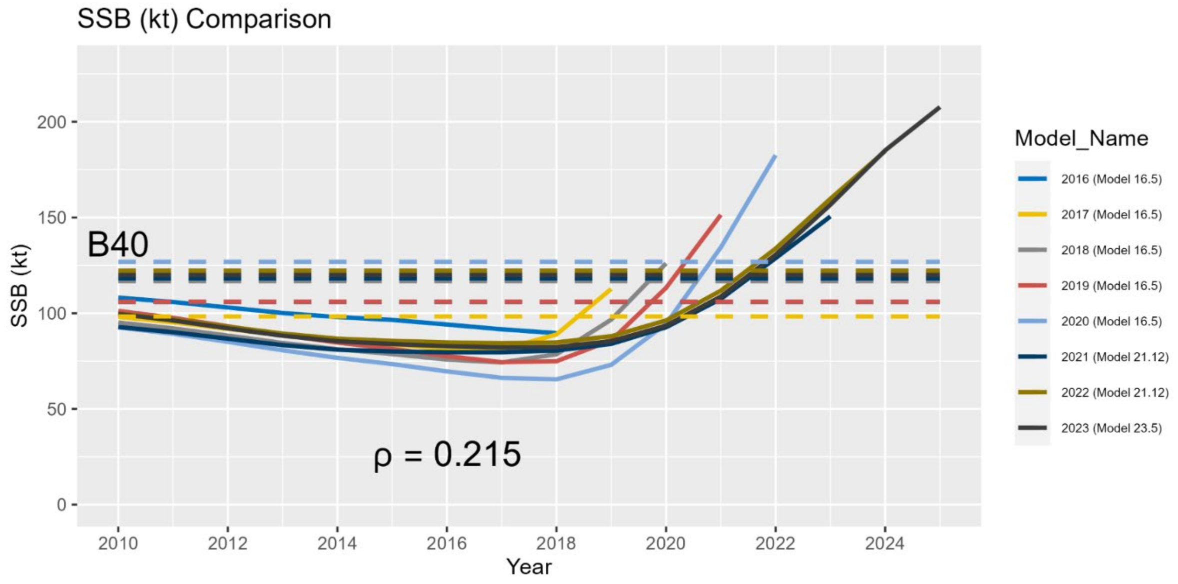




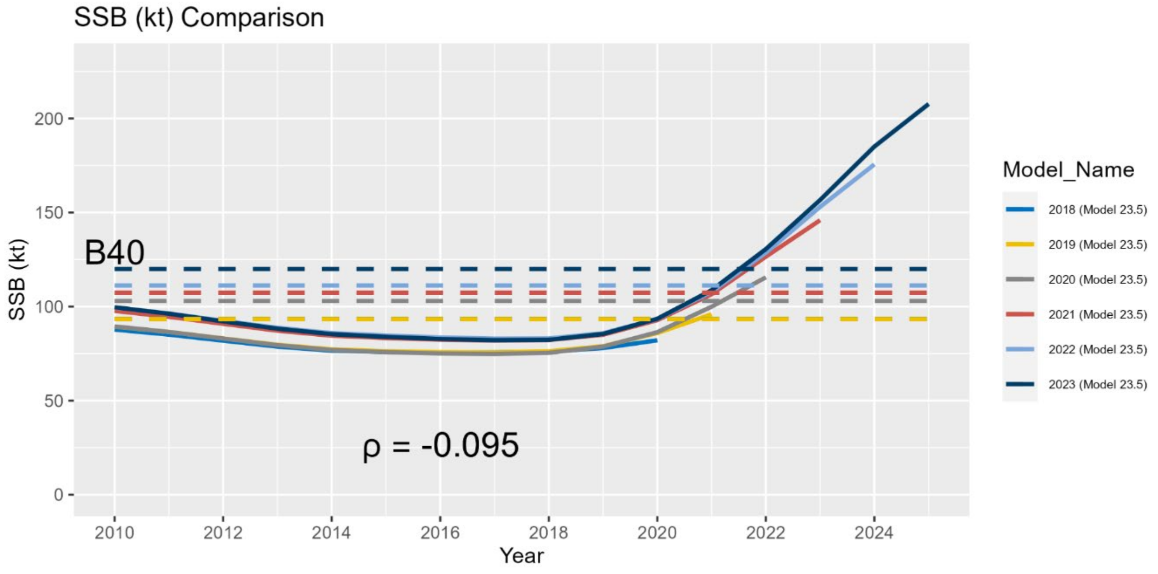
Assessment and Projection Consistency

- Model *23.5* very consistent with previous iterations of *21.12* and itself
- Slight underestimation in SSB as new data added
- Projections are remarkably consistent with realized SSB

All Models Used For Management Advice



Model 23.5 Only

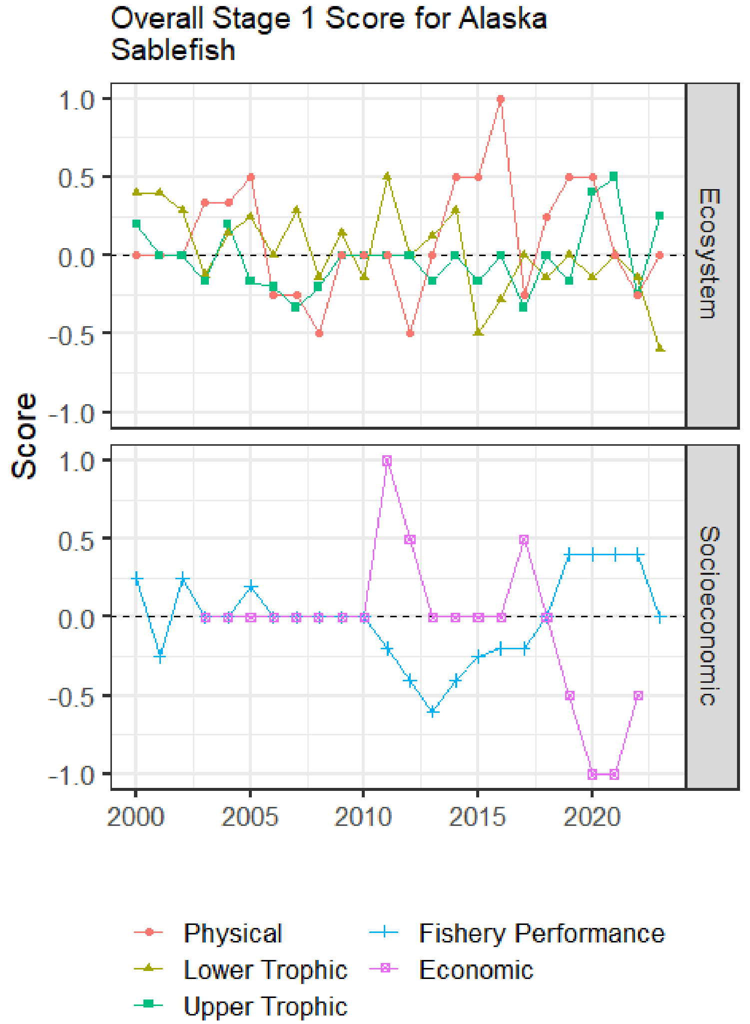


Assessment Summary

- Model fitting (most) indices well, but consistently underestimating age compositions from recent year classes (i.e., 2016)
- Assessment model may be slightly underestimating SSB and 2016 year class
  - No strong retrospective bias and projections appear consistent
- Population continues to grow rapidly
  - SSB now outpacing biomass growth as recent year classes mature
- Recent productivity remains high, with 2016, 2017, and 2019 being three of the largest year classes on record
- Age structure is slowly expanding
  - Population primarily consists of young, immature fish

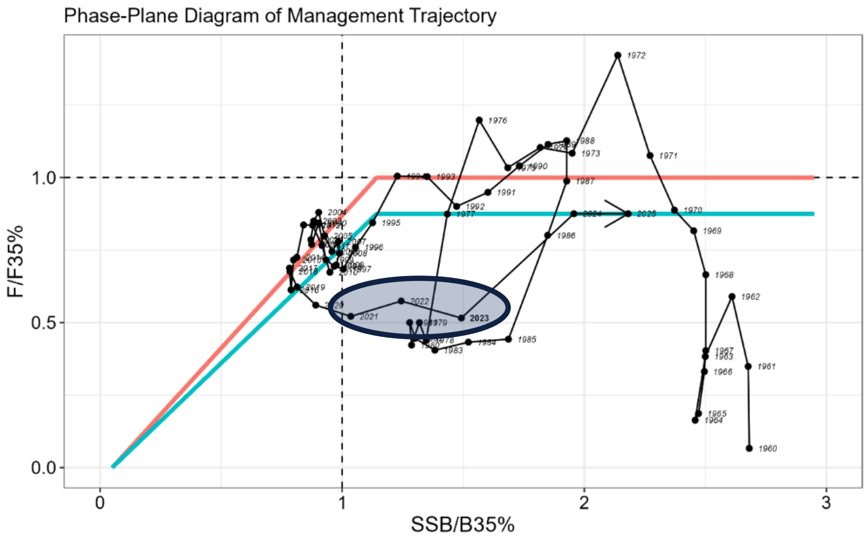
Risk Table

- **Assessment (Level 1)**: Uncertainty in recent year classes, but no retrospective patterns or diagnostic issues.
- **Population (Level 1)**: Age structure still truncated and dominated by younger, immature ages classes (recent cohorts are > 75% of SSB).
- **Ecosystem (Level 1)**: Cooler than optimal temperatures, adequate foraging for juveniles/adults, increased competition (pink salmon), and above average adult condition.
- **Fishery (Level 2)**: Rapid transition in gear used (> 80% of fixed gear catch from pots), not fully utilizing the ABC (~70% harvested), and market conditions remain poor
    - **Level 2 – Major Concern:** given the extent of recent rapid change and limited analysis of socio-economic drivers of resource utilization



Harvest Recommendations

- 2024 Author's ABC = Max ABC = **47,146 t**
  - +16% (+7,000 t) from 2023 ABC
  - If harvested, it would represent the *2nd highest* removals all-time
  - Quadrupling of quota since 2016 (11,795 t)
  - ~70% harvested in recent years, only 66% as of Oct. 10



Quantity/Status	As estimated or specified *last* year for (model *21.12*): 2023*	2024*	As estimated or recommended *this* year for (model *23.5*): 2024**	2025**
M (natural mortality rate, estimated)	0.105	0.105	0.113	0.113
Tier	3a	3a	3a	3a
Projected total (age 2+) biomass (t)	678,562	675,058	700,353	691,260
Projected female spawning biomass (t)	159,788	186,126	185,079	209,500
$B_{100\%}$	305,595	305,595	299,901	299,901
$B_{40\%}$	122,238	122,238	119,960	119,960
$B_{35\%}$	106,958	106,958	104,965	104,965
F_{OFL}	0.096	0.096	0.101	0.101
$maxF_{ABC}$	0.081	0.081	0.086	0.086
F_{ABC}	0.081	0.081	0.086	0.086
OFL (t)	47,857	49,040	55,385	55,620
OFL_w (t)^	**47,390**	**48,561**	**55,084**	**55,317**
max ABC (t)	40,861	41,876	47,367	47,572
ABC (t)	40,861	41,876	47,367	47,572
ABC_w (t)^	**40,502**	**41,539**	**47,146**	**47,350**
Status	As determined *last* year for: 2021	2022	As determined *this* year for: 2022	2023
Overfishing	No	n/a	No	n/a
Overfished	n/a	No	n/a	No
Approaching overfished	n/a	No	n/a	No

**The 2023 SAFE projections were based on specified catches of 31,500 t in 2024 and 30,800 t in 2025 (a yield ratio of 0.66 was assumed based on a 2023 specified catch of 27,200 t and an ABC of 40,500 t). Similarly, the 2025 ABC is based on removals equivalent to the 2024 specified catch.

^ABC_w and OFL_w are the final author recommended ABCs and OFLs after accounting for whale depredation.

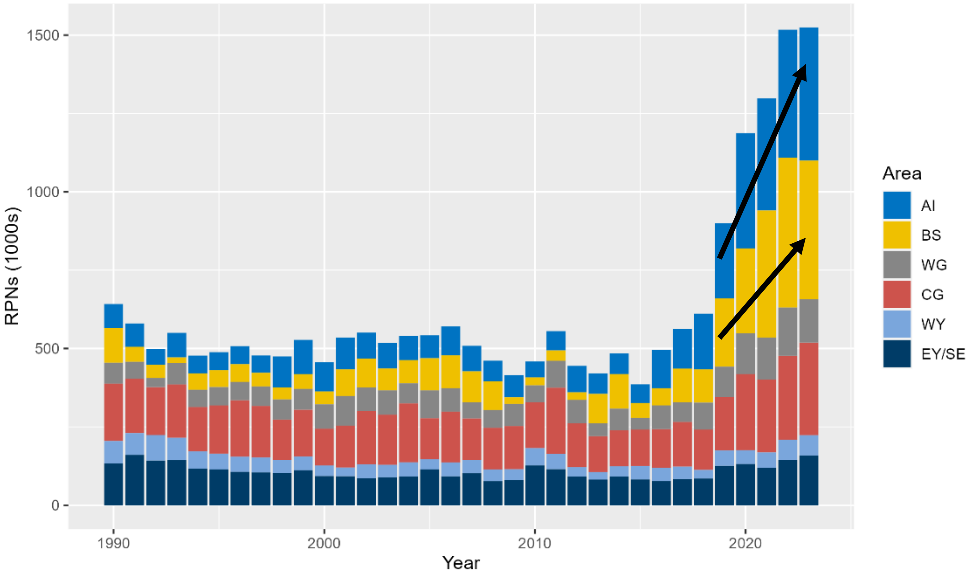
Apportionment

- Based on 5-year average of regional longline survey biomass proportions
  - Meant to address biological concerns (localized depletion) and avoid extreme fluctuations in regional quotas
  - Updated yearly with new survey data
- BSAI constitutes > 50% of survey biomass in 2023

Year	2023				2024		2025	
Region	OFL_w	ABC_w	TAC	Catch*	OFL_w	ABC_w**	OFL_w	ABC_w**
BS	--	8,417	7,996	4,851	--	11,450	--	11,499
AI	--	8,884	8,440	1,924	--	13,100	--	13,156
GOA	--	23,201	23,201	13,581	--	22,596	--	22,695
WGOA	--	4,473	4,473	2,357	--	4,699	--	4,719
CGOA	--	9,921	9,921	5,547	--	9,651	--	9,693
**WYAK	--	3,205	3,205	2,068	--	2,926	--	2,940
**EY/SEO	--	5,602	5,602	3,610	--	5,320	--	5,343
Total	47,390	40,502	39,637	20,357	55,084	47,146	55,317	47,350

*As of October 10, 2023
**After 95:5 trawl split and whale depredation

AFSC Longline Survey Relative Population Numbers (RPNs) by NPFMC Area

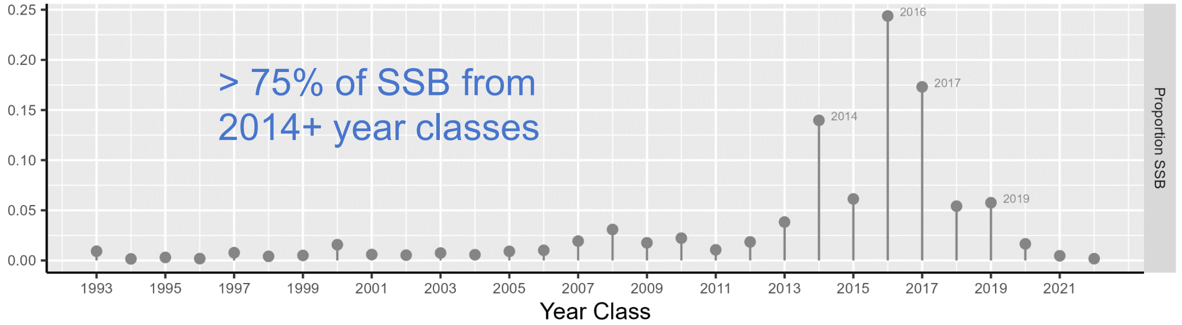


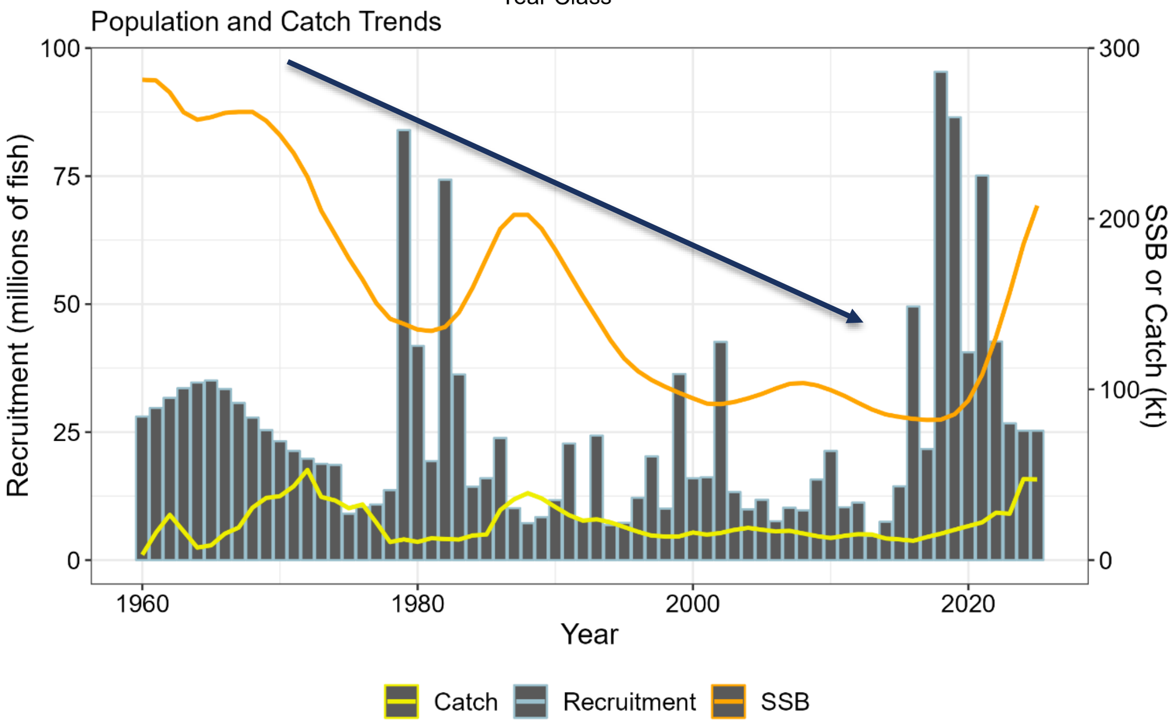
Growing Pains

- A maximum catch strategy will likely maintain long-term downward trend, *if* recruitment reverts to average conditions
- Capped management procedures could be considered to **help protract the age structure**
- **Alternate SSB metrics** (e.g., ABI_{MSY}) would help avoid age truncation (Griffiths et al., 2023)

Including older fish in fisheries management: A new age-based indicator and reference point for exploited fish stocks

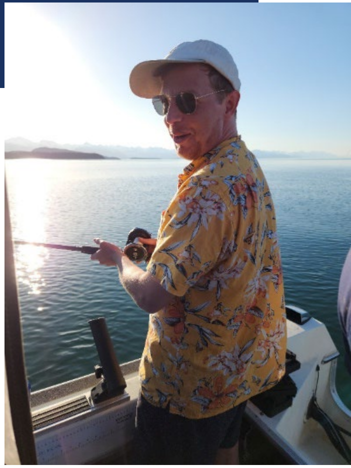
Christopher A. Griffiths | Henning Winker | Valerio Bartolino | Håkan Wennhage | Alessandro Orio | Massimiliano Cardinale

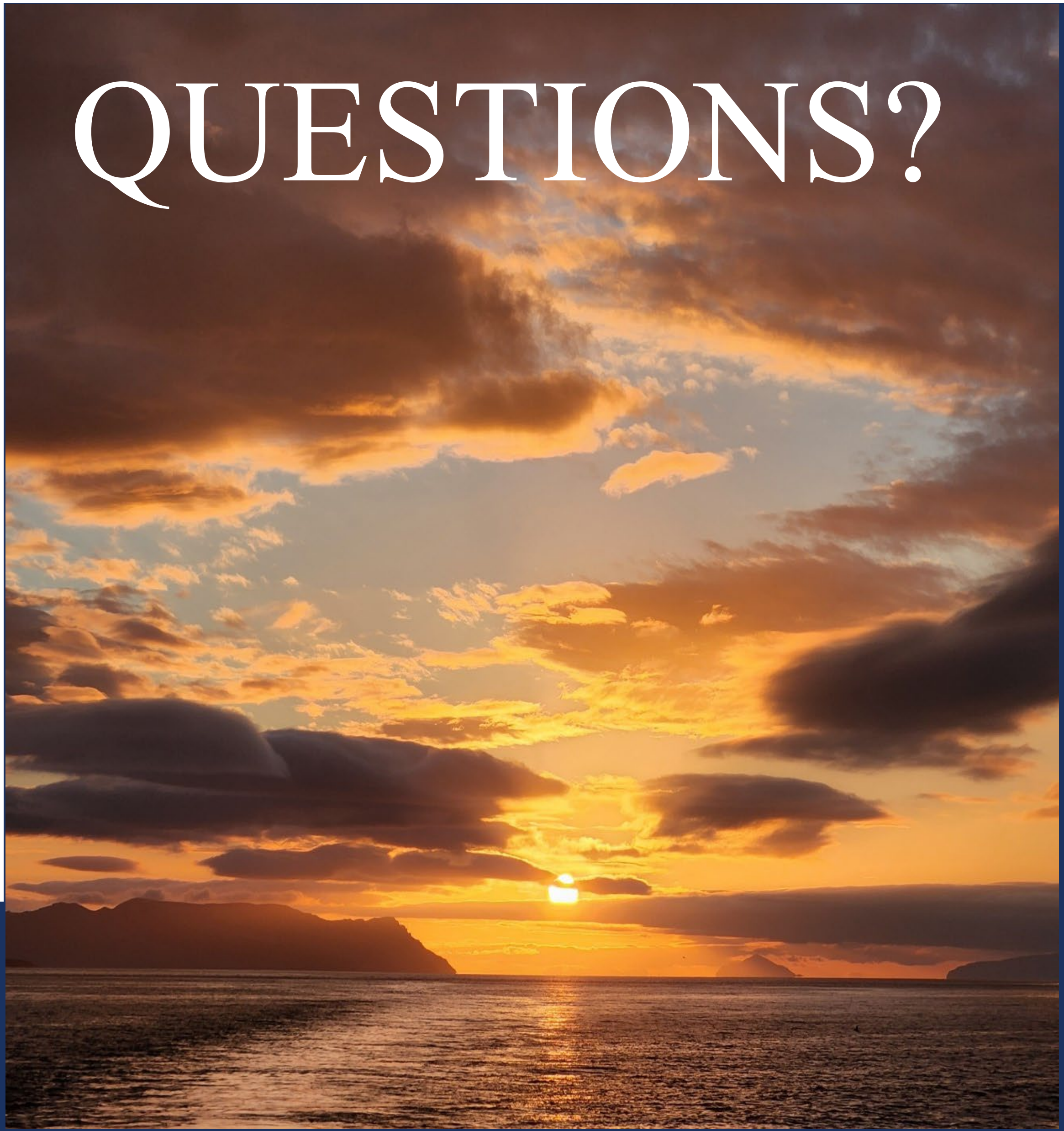




Ongoing Concerns and Future Directions

- Rapid transition to pot gear (> 85% of fixed gear catch)
- Influx of small fish
  - NPFMC Small sablefish release amendment
  - Decreasing economic value and flooded markets
- Research:
  - Closed-loop simulation of HCRs (B. Williams/C. Cunningham)
    - Post-doc search ongoing, but initial model development underway
  - Spatial Modeling (C. Marsh, former NOAA post-doc)
    - TMB model likely to replace current ADMB model in coming years
    - Spatial assessment nearly complete, will serve as companion model to single region assessment (e.g., updated yearly)
  - Sablefish assessment good practices (M. Cheng, Ph.D candidate at UAF)
    - Identify best approaches for dealing with time-varying selectivity, fleet structure, and sex-specific dynamics
    - Will implement findings in updated TMB assessment model in coming years
  - Forecasting recruitment (K. Oke, NOAA post-doc)
    - Identify predictors of recruitment to improve terminal year and near-term projected year class strength
  - Ongoing work to analyze sablefish satellite tagging (K. Echave/K. Siwicke)

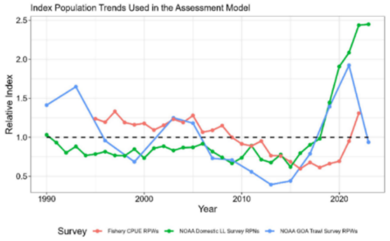


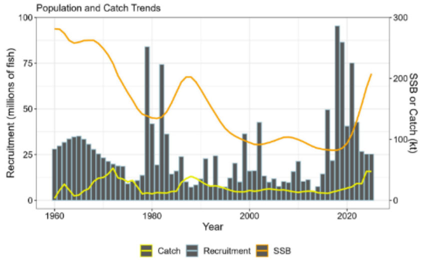


2023 Alaskan Sablefish SAFE (*Anoplopoma fimbria*)

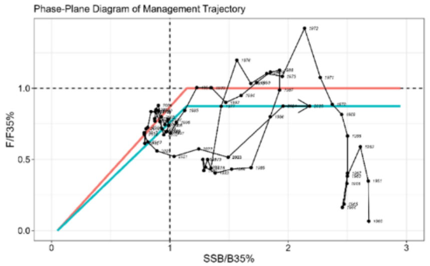
Data and Stock Assessment Model

- Following steady increases in abundance and biomass indices since 2015, the 2023 NOAA longline survey abundance was stable matching the 2022 value, the NOAA Gulf of Alaska trawl survey declined precipitously, and the fixed gear fishery CPUE continued to increase.
- The author proposed model (*23.5*) integrated minor data refinements and parametrization updates, but the main structure was consistent with the previously accepted model (*21.12*).
- The biomass and SSB continue to increase, while recruitment has been at or above the mean since 2014.





Stock Status and ABC Recommendations



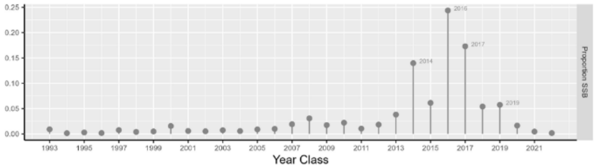
Quantity	2022 SAFE (Projections for 2023)	2023 SAFE (Projections for 2024)
$B_{100\%}$	305,595	299,901
$B_{40\%}$	122,238	119,960
$SSB_{(Terminal\_Yr+1)}$	159,788	185,079
$SSB_{(Terminal\_Yr+1)}/B_{100\%}$	52%	62%
$F_{ABC(Terminal\_Yr+1)}$	0.081	0.086
$ABC_{w(Terminal\_Yr+1)}$	40,502	47,146
$OFL_{w(Terminal\_Yr+1)}$	47,390	55,084

*SSB projections are based on specified catch for the terminal year. ABC_w and OFL_w are the recommended values after whale depredation has been taken into account.

- The resource is *not overfished* and *overfishing is not occurring.*
- Recent ABCs have not been fully utilized with catch averaging ~70% of the ABC over the last 3 years.
- The ABC increased by 16% due to continued maturation and growth (in weight) of the population.

Other Considerations

- The population age-structure remains contracted relative to historic levels.
- 2014 – 2020 year classes comprise > 75% of projected 2024 SSB.



Sablefish Simulation Study Postdoctoral Research Opportunity

Postdoctoral Researcher

University of Alaska Fairbanks, College of Fisheries and Ocean Sciences

Principal Investigators: Curry Cunningham (UAF), Ben Williams (NOAA-AFSC), Daniel Goethel (NOAA-AFSC), Pete Hulson (NOAA-AFSC), and Chris Lunsford (NOAA-AFSC)

Location: This position will be located in Juneau, Alaska, at the University of Alaska Fairbanks, co-located with the NOAA-AFSC lab. *Remote work options may be available.*

Project Title: Optimizing Harvest for Long-lived and Spasmodic Species: Comparing Performance of Alternate Harvest Control Rules and Minimum Size Limits for Alaskan Sablefish through Management Strategy Evaluation

Project Description: Recent ecosystem changes in the North Pacific have led to significant changes in population and fishery dynamics, including extreme recruitment patterns, shifting species distributions, and increasing utilization of novel gear types. As the North Pacific ecosystem and fisheries undergo rapid alterations, it has fostered increased interest in exploring the robustness of current North Pacific Fishery Management Council (NPFMC) harvest control rules along with potential alternate management options (e.g., size limits) using simulation analysis. ***The goal of this postdoctoral fellowship*** is to explore and evaluate key uncertainties in Alaska fisheries management processes by implementing a management strategy evaluation tailored to sablefish (*Anoplopoma fimbria*) in Alaskan waters, which represents a dynamic and high profile case study. The candidate will build upon an existing simulation framework to explore alternative management approaches and their ability to meet biological and fishery performance objectives. This fellowship will be a direct collaboration with the Marine Ecology and Stock Assessment (MESA) Program at the NOAA Alaska Fisheries Science Center, and will provide opportunities for stakeholder engagement and interactions with the North Pacific Fishery Management Council process.

Qualifications: A Ph.D. in fisheries, resource management, biostatistics, or a related field is required. The successful applicant will be highly motivated and creative; have a background in fisheries, quantitative population dynamics, or stock assessment. The applicant should have expertise in R programming, and experience with (or an interest in learning) non-linear function minimizers including AD Model Builder or Template Model Builder. Candidates should be comfortable communicating with our team of NOAA stock assessment scientists, fishery stakeholders, and policy makers.

Funding: We offer 1.5 years of funding ($75,000/year, plus benefits). This research is funded by the NOAA Alaska Fisheries Science Center through Cooperative Institute for Climate, Ocean, & Ecosystem Studies (CICOES).

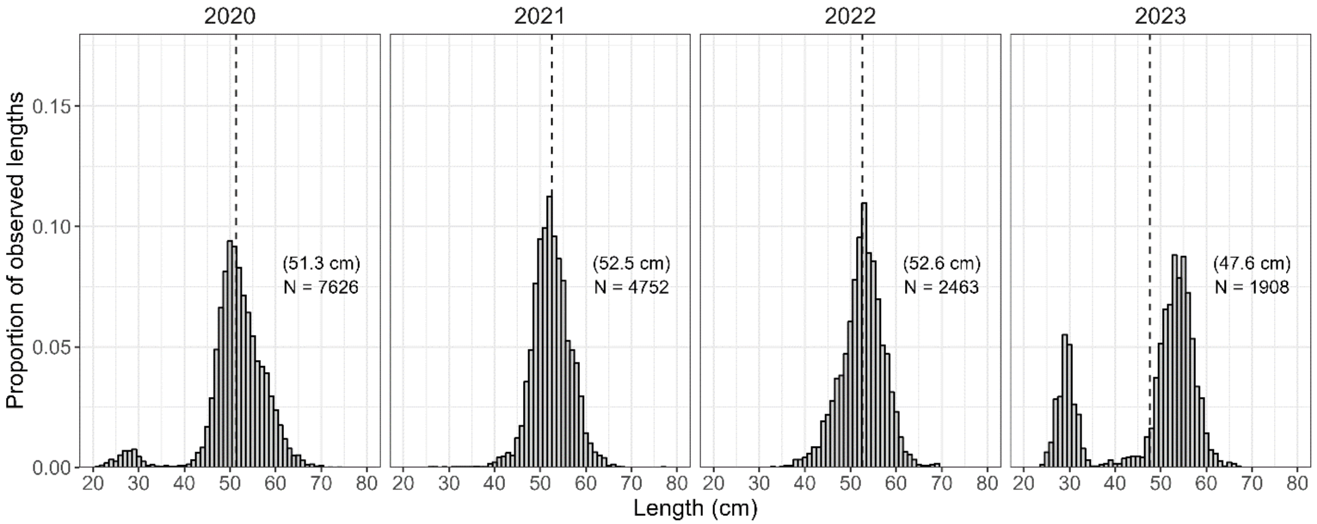
Closing Date: October 31, 2023

Start Date: Winter/Spring 2024. Timing is flexible and remote work options will be considered depending on circumstances, particularly at the project start.

To Apply: E-mail the following to Drs. Curry Cunningham (cjcunningham@alaska.edu) and Ben Williams (ben.williams@noaa.gov): (1) cover letter describing your interest and qualifications; (2) CV or resume; and (3) contact information for ***three*** references. Deadline: October 31, 2023.

EBS Trawl Catch and Recruitment Signals

- 2021 year class small based on 2022 length composition data from EBS trawl gears
- 2022 year class large based on preliminary 2023 pelagic trawl fishery length comps
- High 2023 catch of age-1 fish in the 0 to 100 m depth range of the pelagic trawl fishery

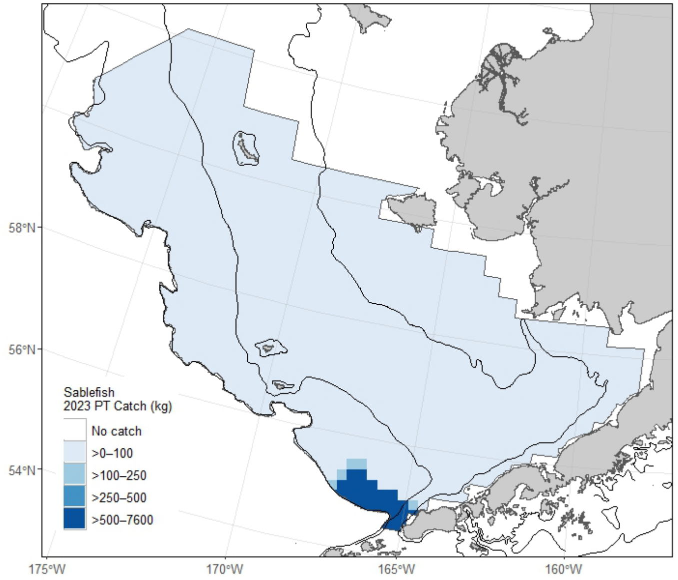


Proportions of sablefish lengths measured by observers in Eastern Bering Sea pelagic trawl fisheries. The vertical dashed line indicates the mean length each year (value shown in parentheses, with sample size, N, below).

Appendix 3D. Sablefish Bycatch in the Eastern Bering Sea

Kevin A. Siwicke and Katy B. Echave

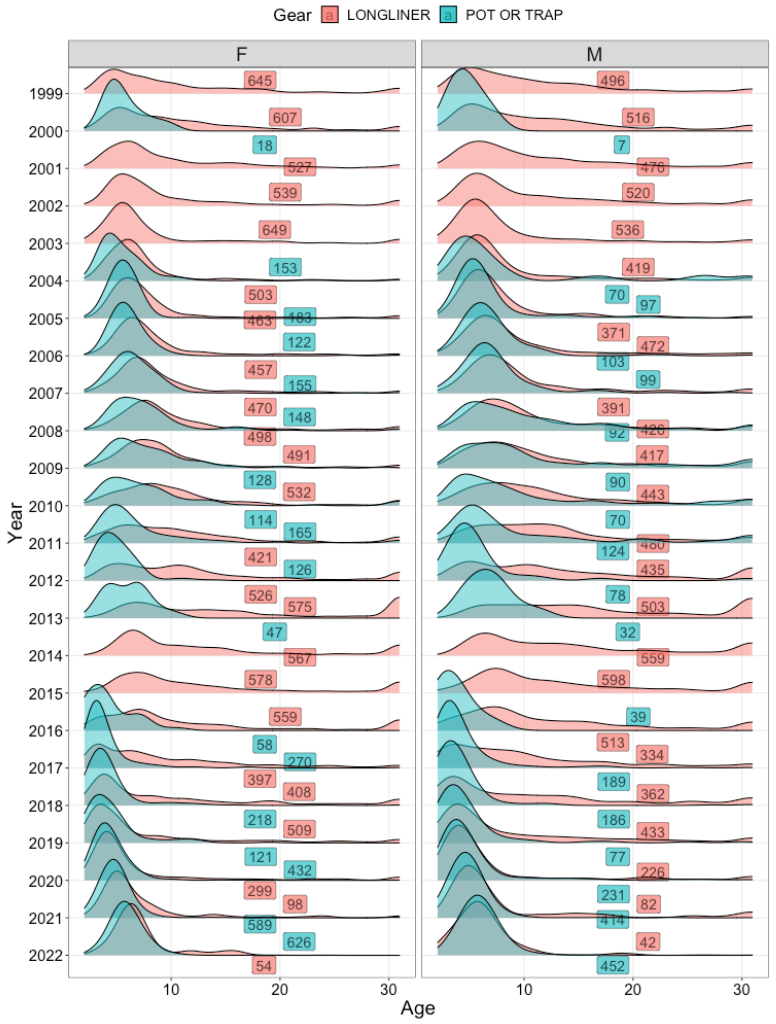
Spatial distribution of observed sablefish catch in weight occurring in pelagic trawl gear in the eastern Bering Sea in 2023.

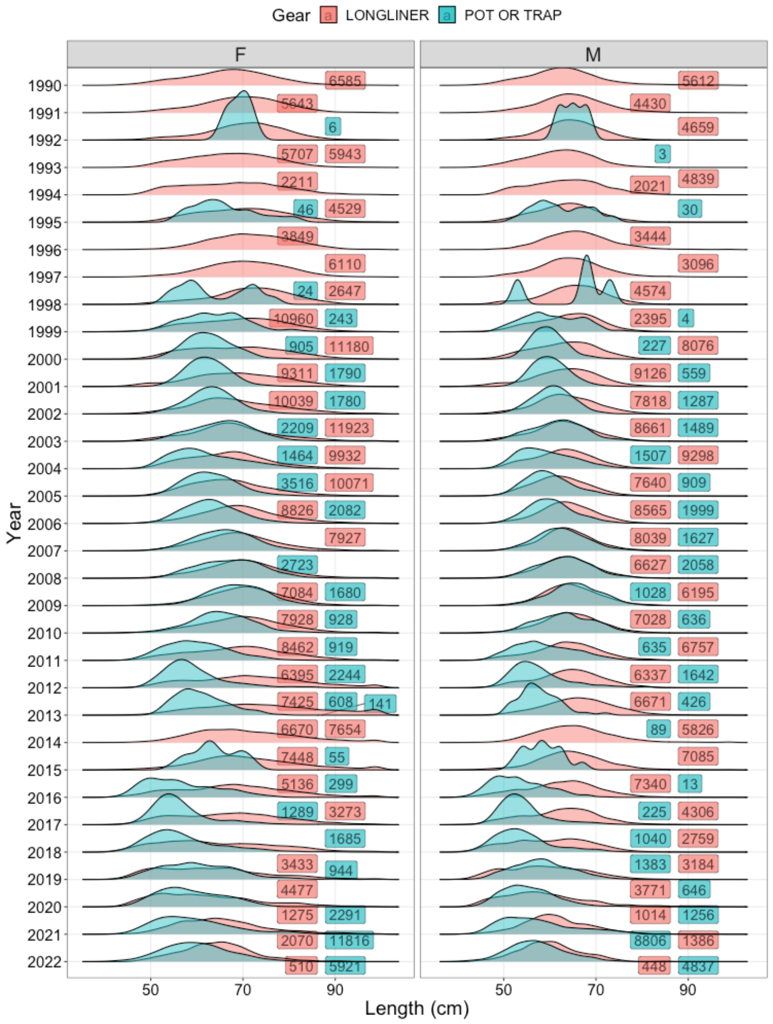


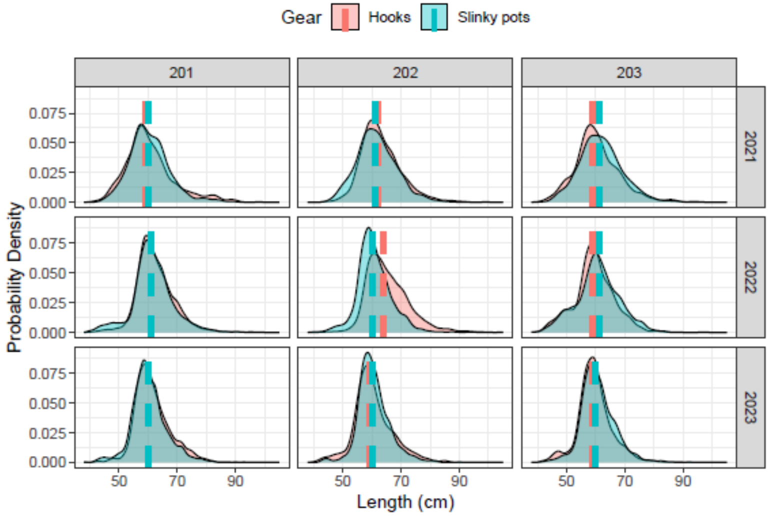
Catch

	By Area								By Gear				
Year	Total	AI	BS	WGOA	CGOA	EGOA	WY	EY/SEO	Non-Comm	HAL	Trawl	Pot	% Trawl
2010	12,275	1,048	752	1,354	4,512	4,270	1,579	2,692	339	10,422	1,005	510	8
2011	13,328	1,027	707	1,395	4,922	4,936	1,902	3,034	341	11,251	1,180	556	9
2012	14,144	1,205	744	1,352	5,328	5,243	2,033	3,210	272	12,259	1,102	511	8
2013	13,851	1,082	635	1,358	5,187	5,349	2,102	3,246	240	12,134	1,037	439	7
2014	11,806	813	314	1,194	4,736	4,489	1,671	2,817	259	10,195	1,025	326	9
2015	11,179	422	210	998	4,626	4,677	1,866	2,811	246	9,721	1,090	122	10
2016	10,472	340	531	1,052	4,195	4,106	1,651	2,455	248	8,701	1,336	187	13
2017	12,552	588	1,150	1,181	4,838	4,510	1,694	2,816	285	8,464	2,272	1,531	18
2018	14,494	664	1,536	1,389	5,778	4,881	1,861	3,019	246	8,690	3,780	1,778	26
2019	16,912	663	3,162	1,533	6,280	4,915	1,802	3,113	360	8,268	5,154	3,130	30
2020	19,416	1,232	5,329	1,462	6,041	4,971	1,835	3,137	381	5,813	7,493	5,730	39
2021	21,748	1,578	4,169	1,994	7,325	6,201	2,329	3,872	481	4,644	4,853	11,771	22
2022	27,420	2,230	5,514	3,028	8,165	7,971	2,750	5,221	512	4,056	5,366	17,485	20
2023	20,762	1,924	4,851	2,357	5,547	5,677	2,068	3,610	405	2,384	5,316	12,657	26

Pot vs. HAL Gear Age and Length Comparisons

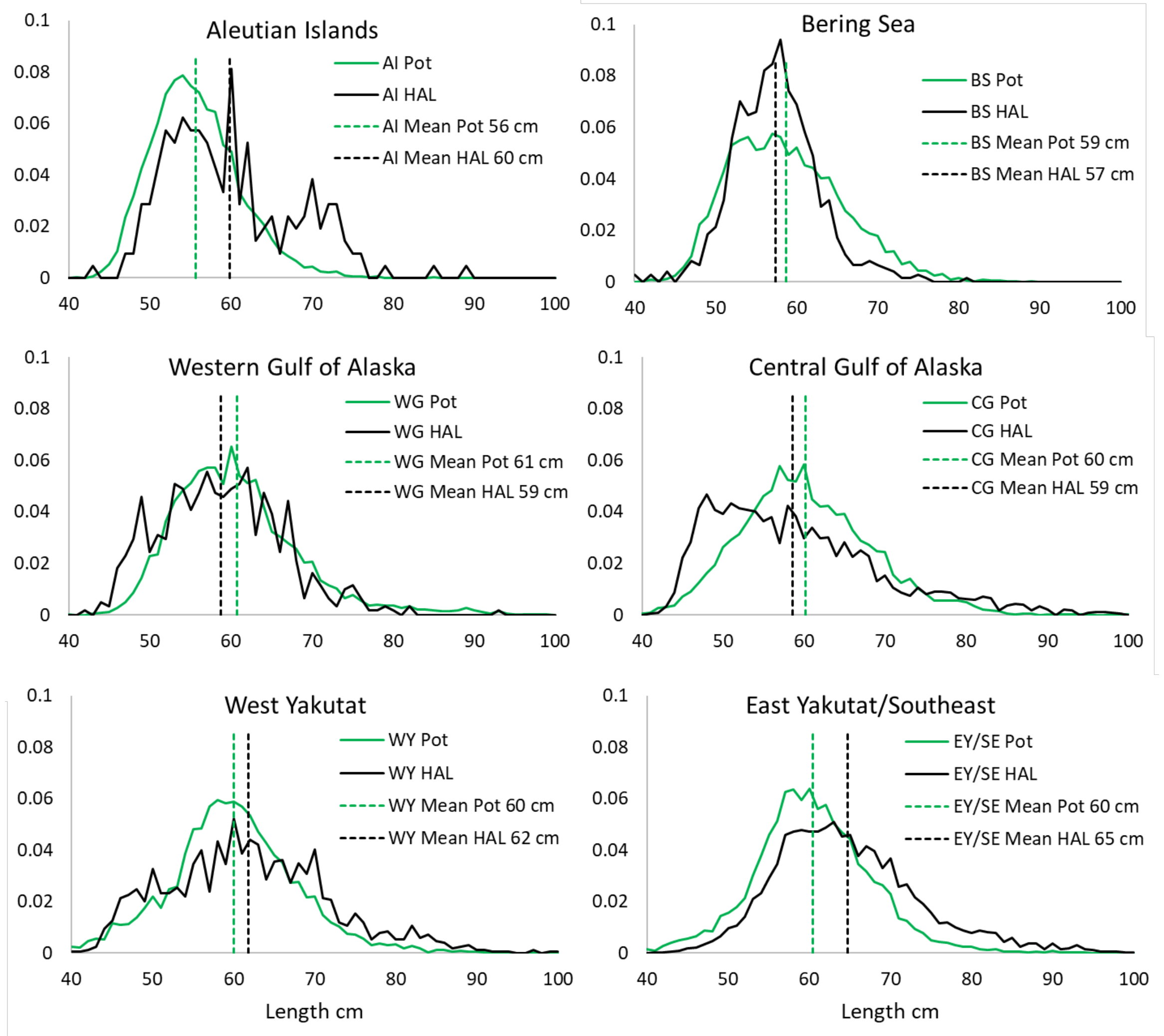






Sullivan et al. (2022)

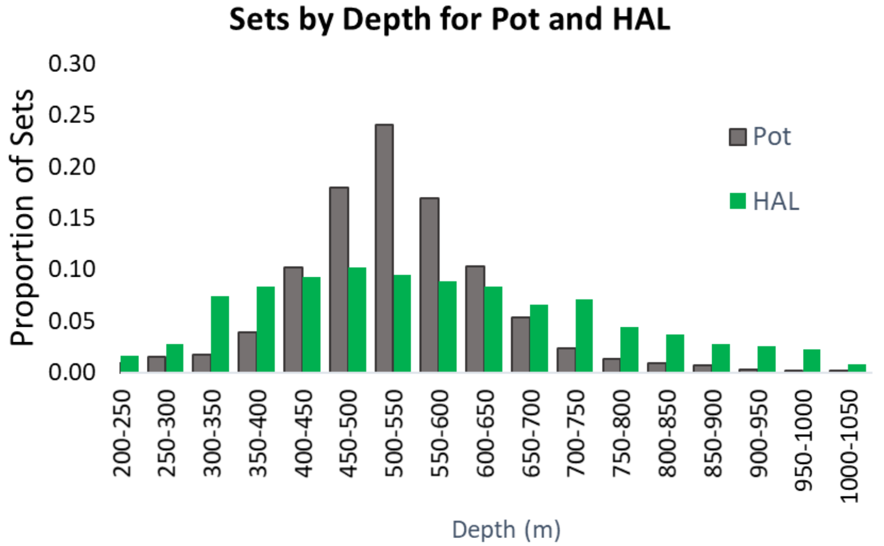
Pot vs. HAL Gear Age and Length Comparisons



Proportion of sablefish at each length sampled by observers in pot and hook-and-line (HAL) fisheries by FMP subareas for 2020-2023.

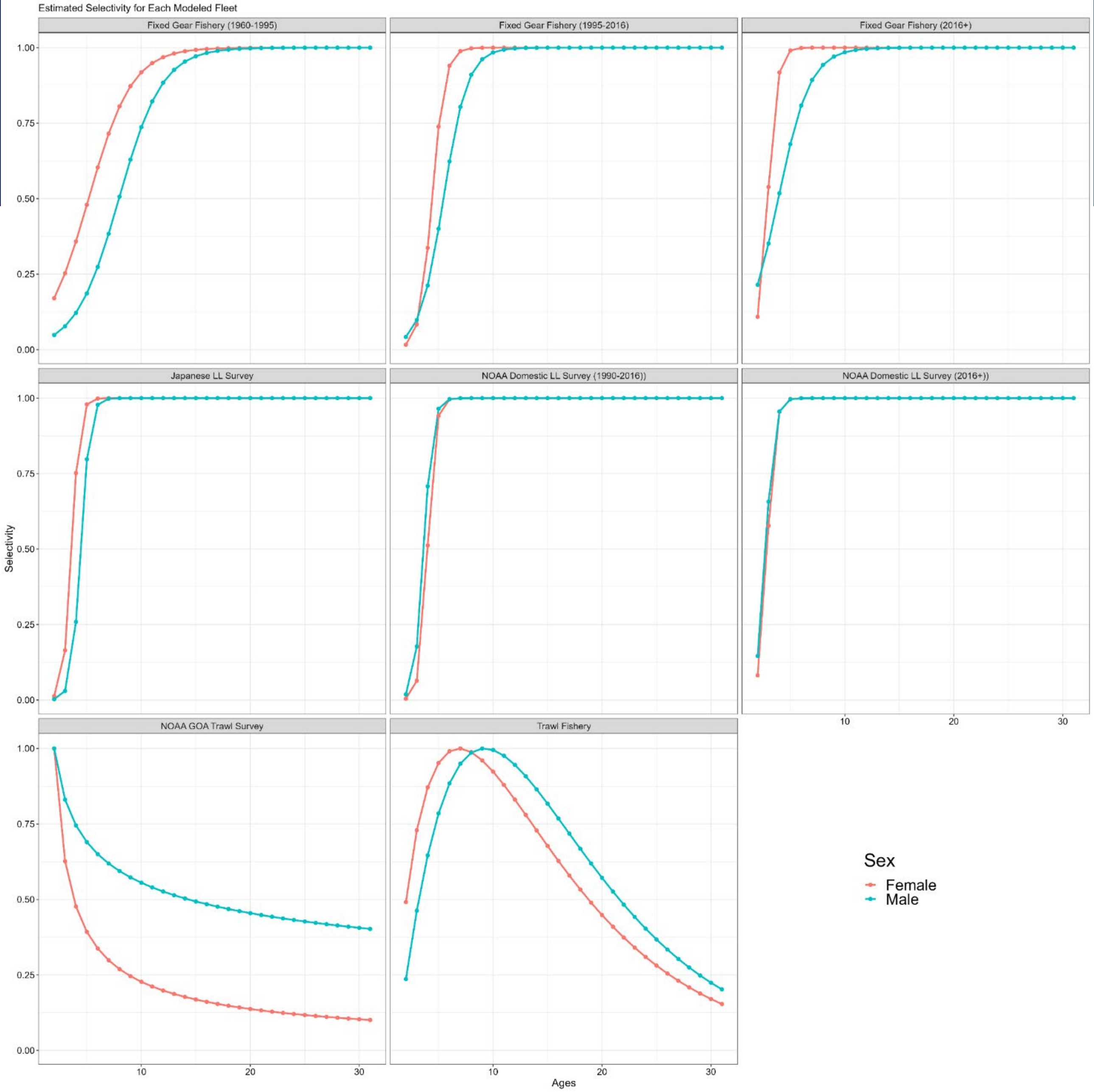
Appendix 3E. Catch Rates and Observations from the Fixed Gear Fleet

Cara Rodgveller and Matthew Cheng



Depths of observed pot and hook-and-line (HAL) sets from 2020-2023 in the Gulf of Alaska. Total number of pot sets is 4,083 and 1,822 hook-and-line sets.

Selectivity



Other PT Tables

Year	West Yakutat	E. Yakutat/ Southeast
2024	2,926	5,320
2025	2,940	5,343

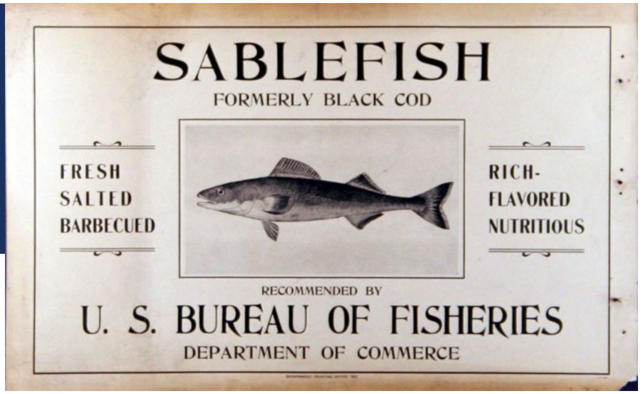
Area	AI	BS	WG	CG	WY*	EY*	Total
2023 ABC	8,892	8,450	4,533	9,972	2,970	6,044	40,861
2024 ABC	13,108	11,474	4,718	9,670	2,683	5,714	47,367
2020 - 2022 Mean Depredation	5	18	19	20	40	121	222
Ratio 2024:2023 ABC	1.47	1.36	1.04	0.97	0.90	0.95	1.16
Deduct 3-Year Adjusted Mean	-7	-24	-20	-19	-36	-114	-221
**2024 ABC_w	13,100	11,450	4,699	9,651	2,647	5,599	47,146

Area	AI	BS	WG	CG	WY*	EY*	Total
2023 ABC	8,892	8,450	4,533	9,972	2,970	6,044	40,861
2025 ABC	13,165	11,524	4,739	9,712	2,695	5,739	47,572
2020 - 2022 Mean Depredation	5	18	19	20	40	121	222
Ratio 2025:2023 ABC	1.5	1.4	1.0	1.0	0.9	0.9	1.2
Deduct 3-Year Adjusted Mean	-8	-24	-20	-19	-36	-115	-222
**2025 ABC_w	13,156	11,499	4,719	9,693	2,659	5,624	47,350

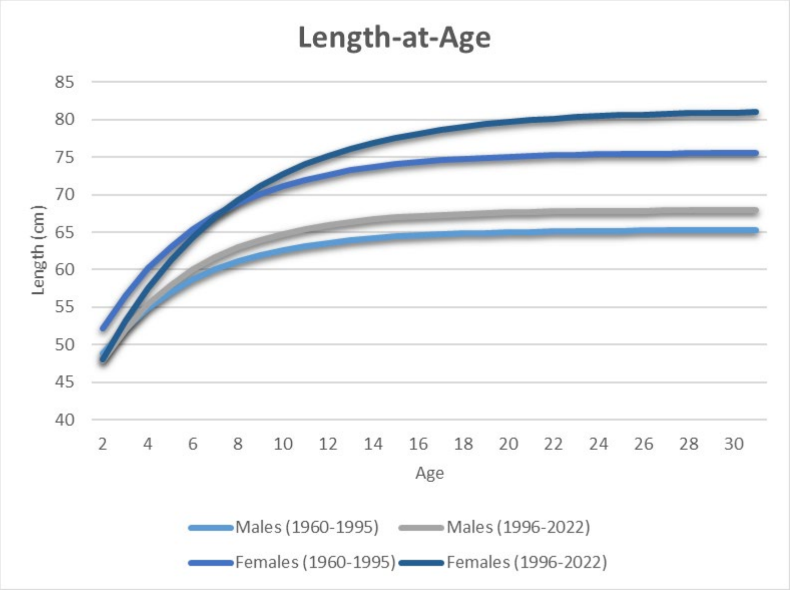
Year	2024	2025
OFL	55,385	55,620
3-Year Mean Depredation	222	222
Inflation Factor (Projected % Increase)	1.36	1.36
Deduct 3-Year Mean	-302	-303
*OFL_w	55,084	55,317

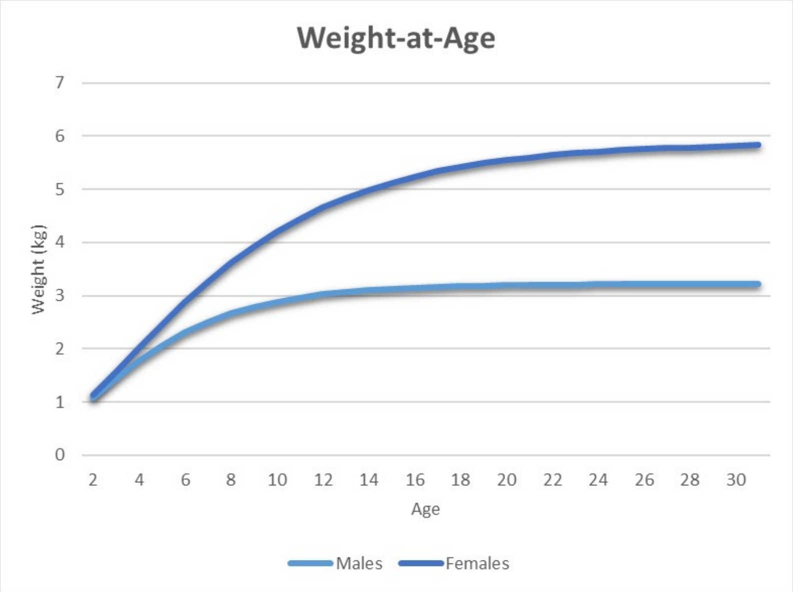
Area	Year	Biomass (4+)*	OFL**	ABC#	TAC	Catch^
GOA	2022	240,600	--	22,794	22,794	15,291
	2023	317,000	--	23,201	23,201	13,581
	2024	337,300	--	22,596	--	--
	2025	330,200		22,695	--	--
BS	2022	168,000	--	5,264	5,264	4,548
	2023	151,000	--	8,417	7,996	4,851
	2024	194,100	--	11,450	--	--
	2025	190,000	--	11,499	--	--
AI	2022	121,200	--	6,463	6,463	2,067
	2023	153,000	--	8,884	8,440	1,924
	2024	169,900	--	13,100	--	--
	2025	166,300	--	13,156	--	--

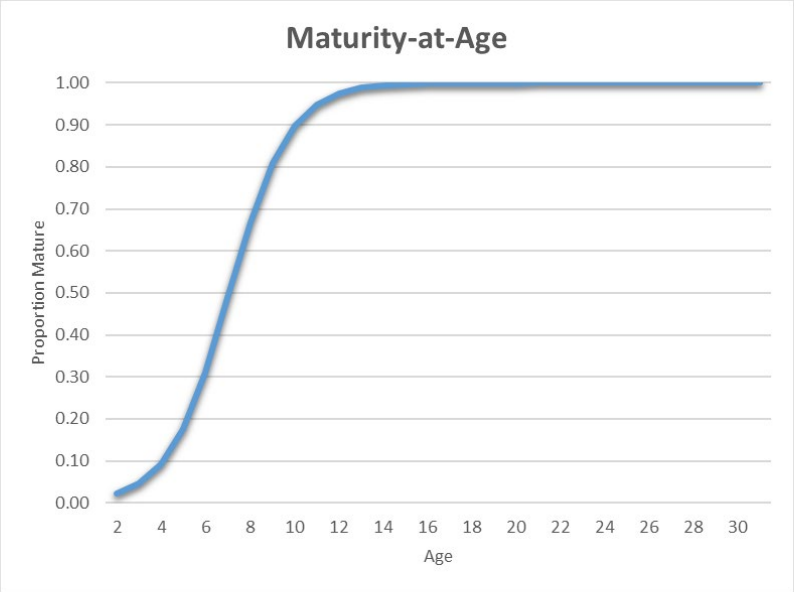
Biological Inputs



- Updated in 2021
  - Two growth time blocks (pre-/post-1995)
  - One weight time block due to unreliable weight data prior to 1996
  - One maturity time block based on histological samples
- Ageing error incorporated based on known-age otoliths
- Internally convert catch-at-age to catch-at-length using input size-at-age conversions

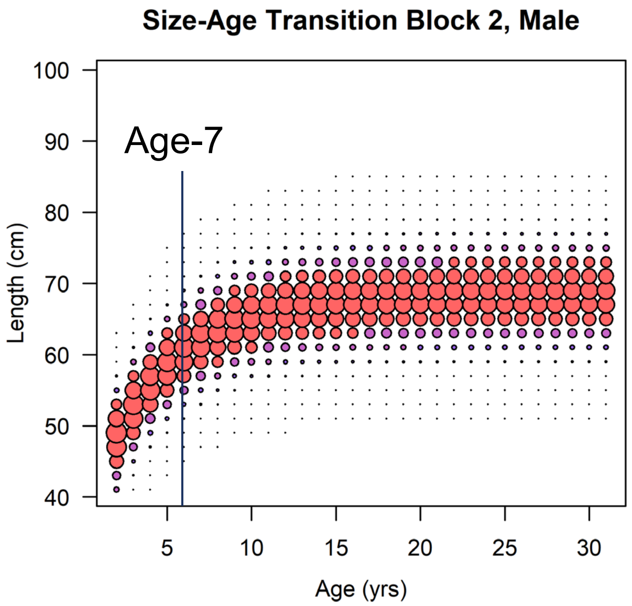






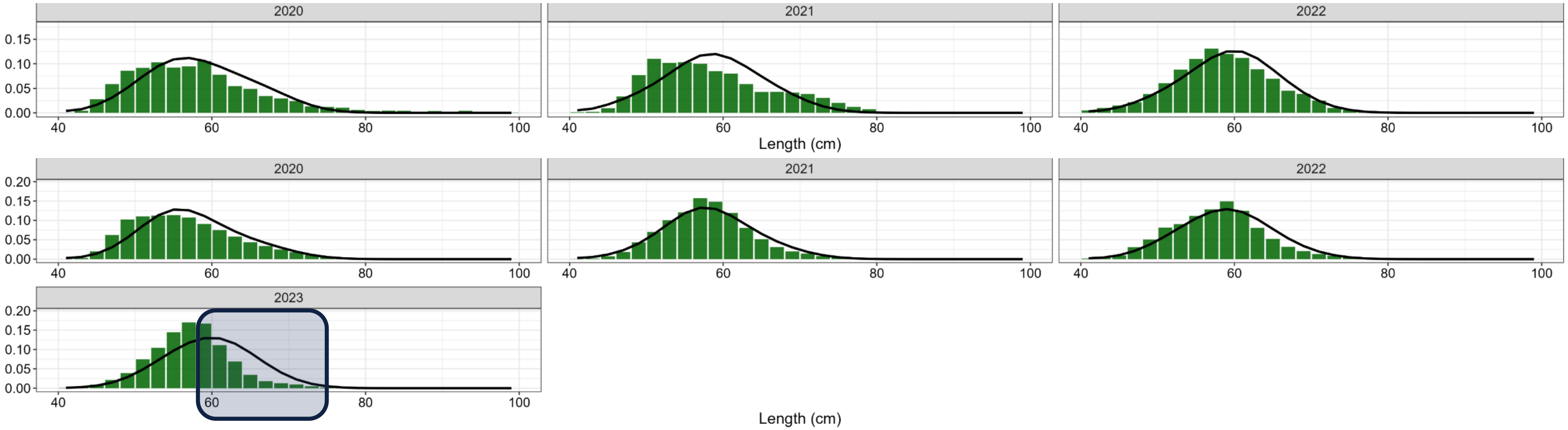
Fit to Compositional Data

- Recent pattern of underestimating proportion of small fish and overestimating proportion of larger fish
  - Based on age compositions and size of 2016 year class, model is expecting higher proportion of 60cm+ fish
  - Indicative(?) of changing dynamics (e.g., reduced growth or reduced availability) or discrepancies in the age and length data?



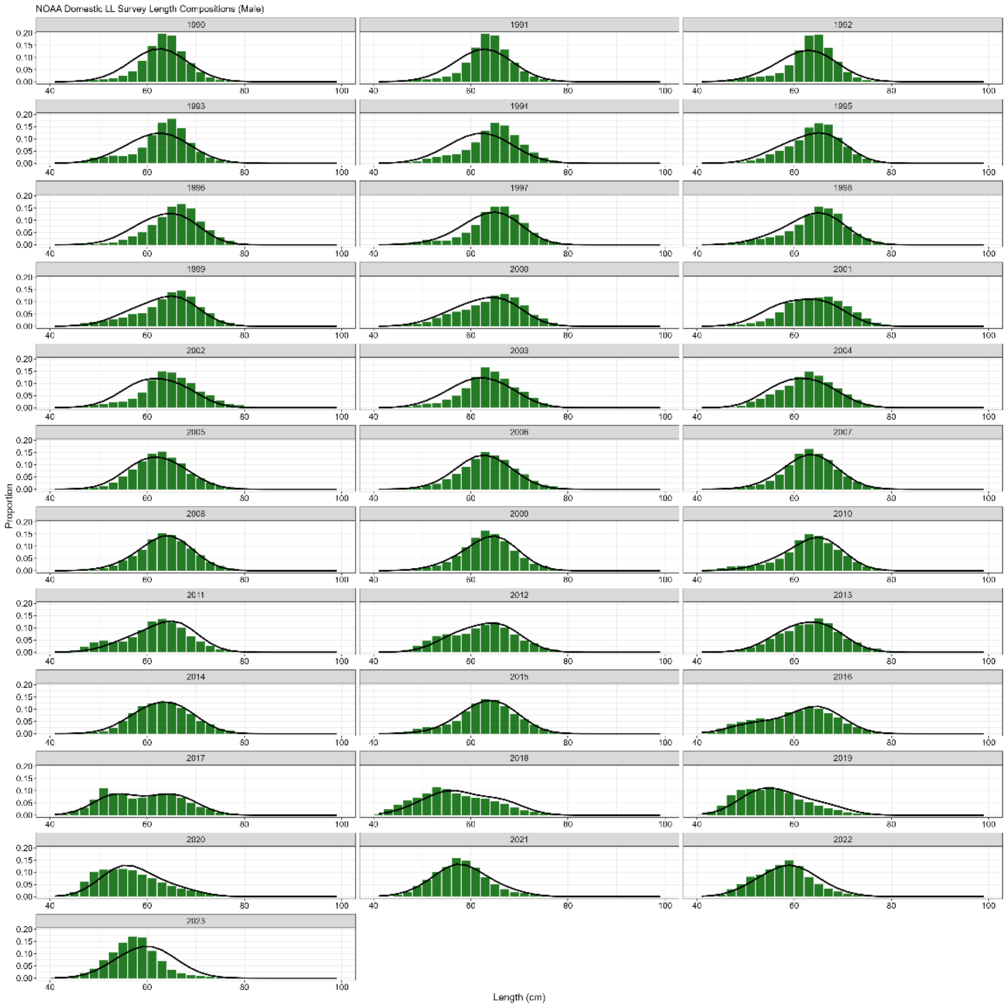
Fixed Gear Fishery Males

Longline Survey Males

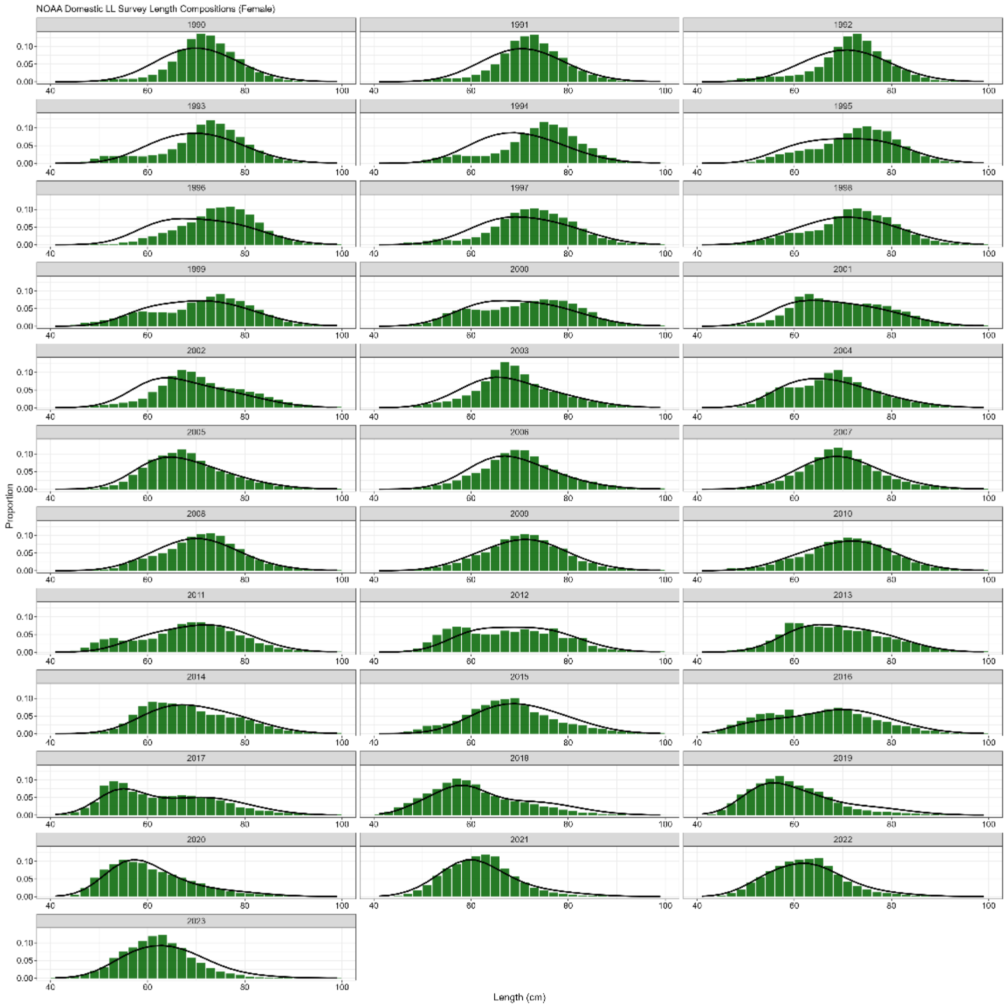


Fit to Compositional Data: LL Survey Lengths

Males

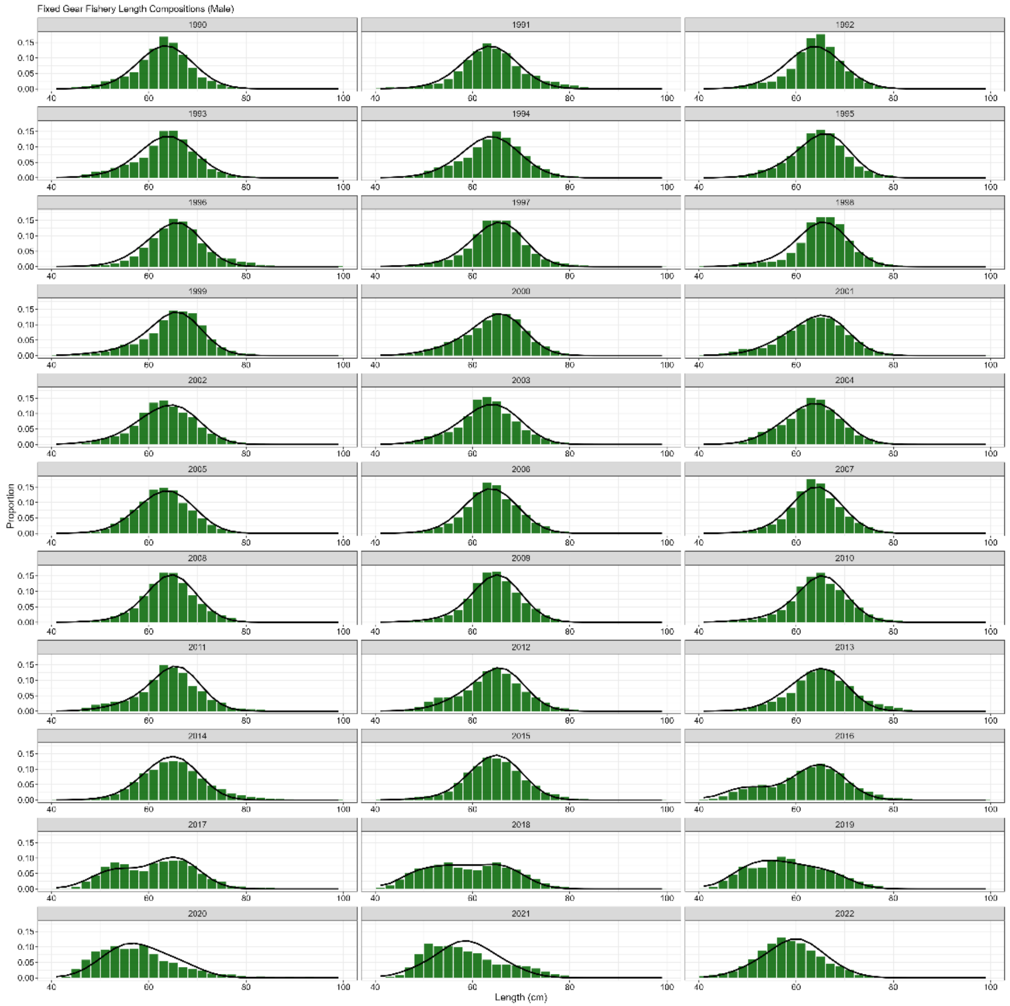


Females

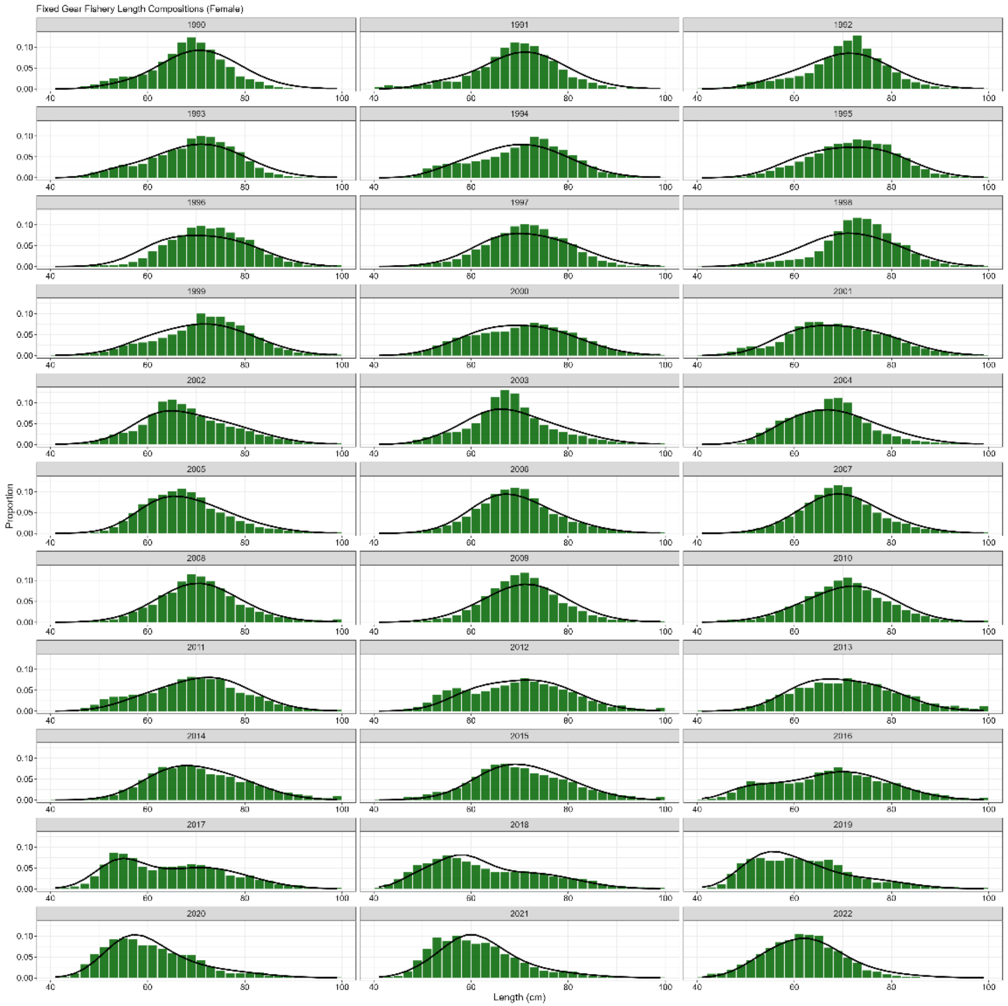


Fit to Compositional Data: Fixed Gear Fishery Lengths

Males

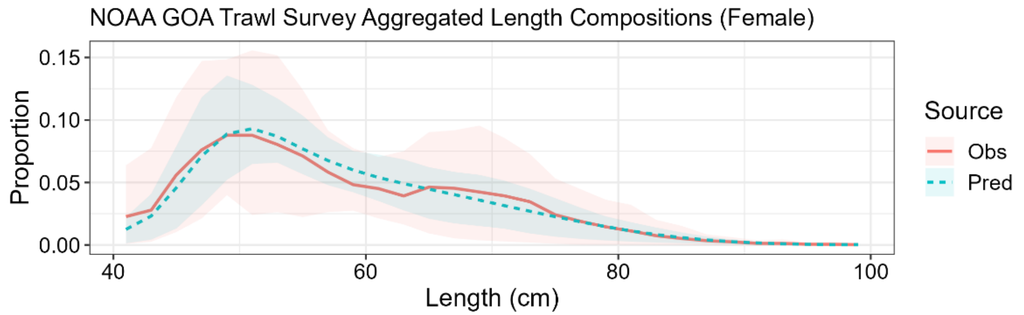


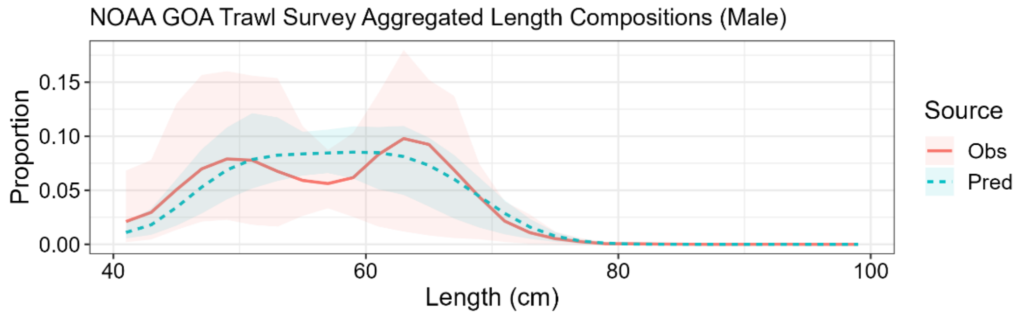
Females



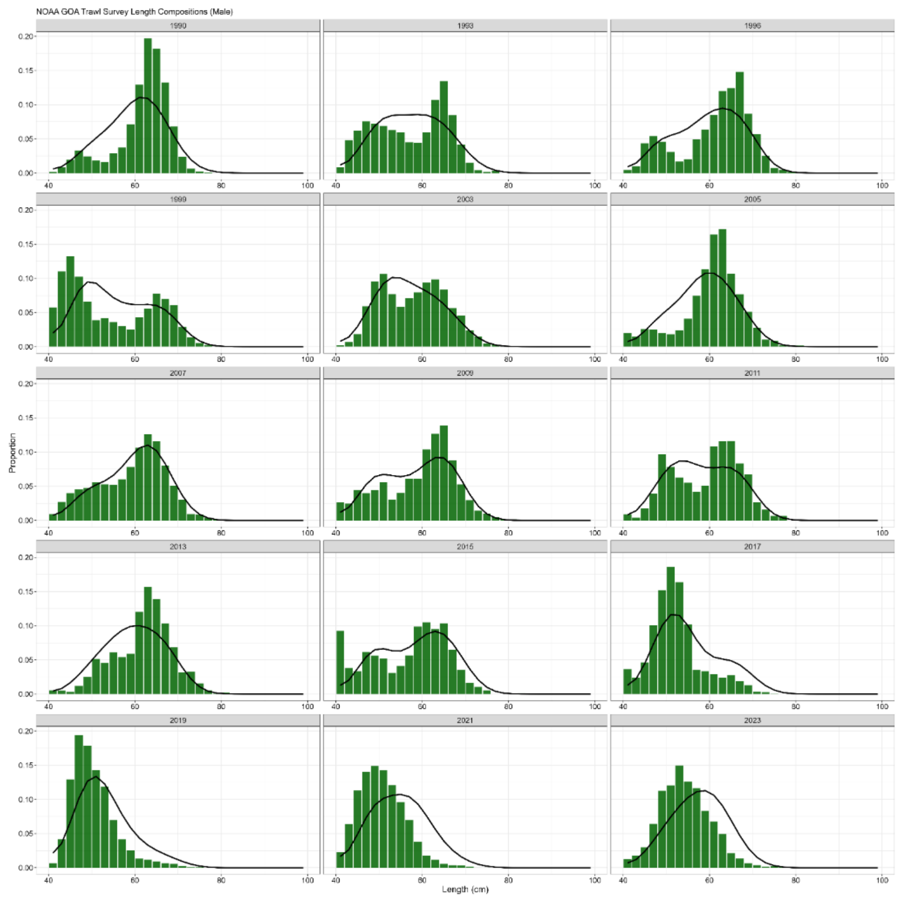
Fit to Compositional Data: GOA Trawl Survey

- Is NOAA GOA trawl survey still a reliable indicator of juvenile sablefish biomass?
  - Only use stations < 500m
  - Does not reliably catch adult sablefish
  - Primary habitat and entire range (BSAI) not sampled



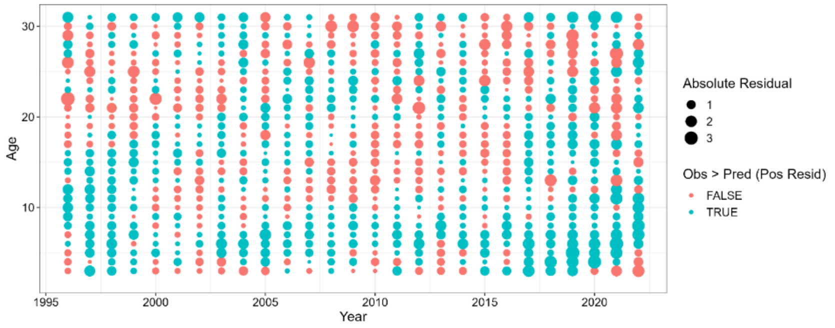


Males

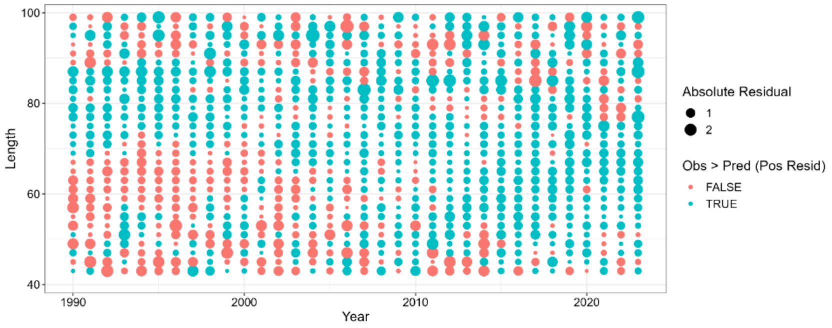


OSA and Pearson Residuals: LL Survey

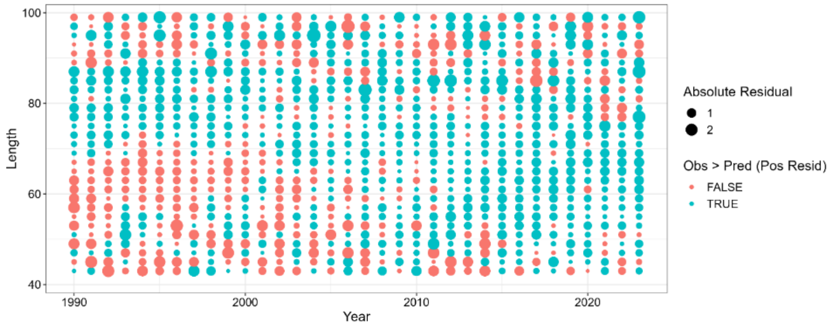
OSA Residuals for NOAA Domestic LL Survey Age Compositions (Remove Age-2)



OSA Residuals for NOAA Domestic LL Survey Female Length Compositions (Remove 41cm Bin)

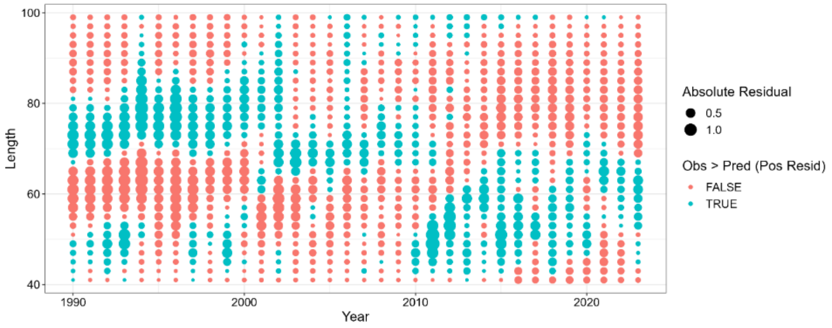


OSA Residuals for NOAA Domestic LL Survey Female Length Compositions (Remove 41cm Bin)

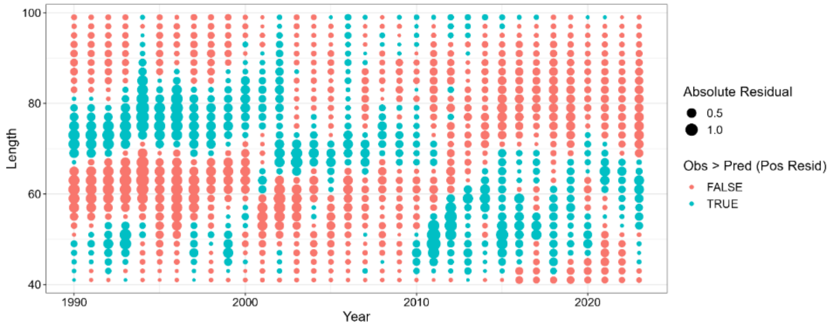


Pearson Residuals for NOAA Domestic LL Survey Age Compositions

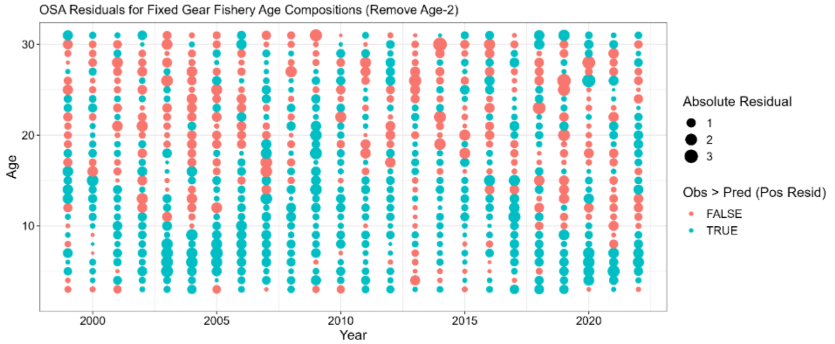
Pearson Residuals for NOAA Domestic LL Survey Female Length Compositions

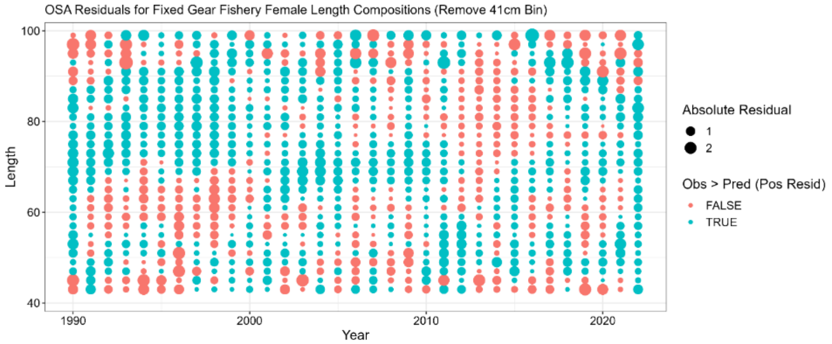


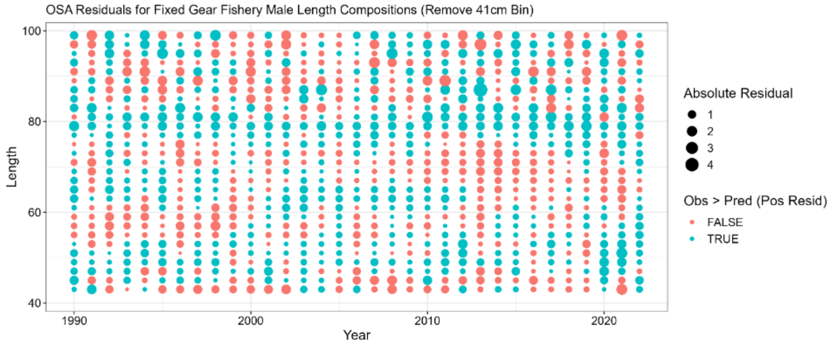
Pearson Residuals for NOAA Domestic LL Survey Female Length Compositions

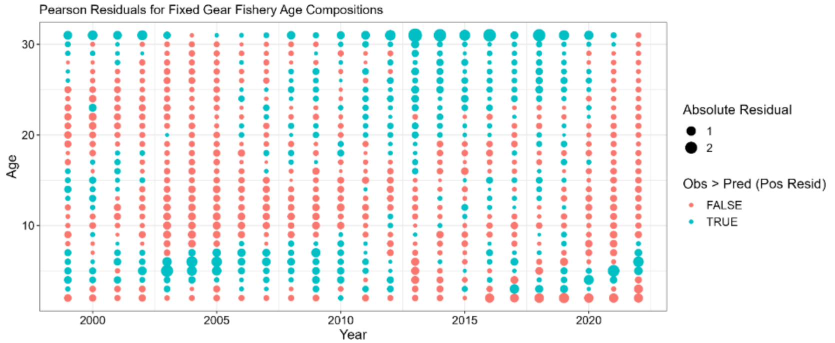


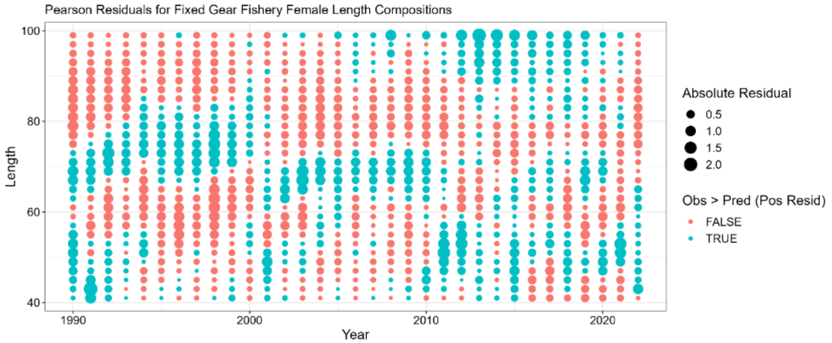
OSA and Pearson Residuals: Fixed Gear Fishery

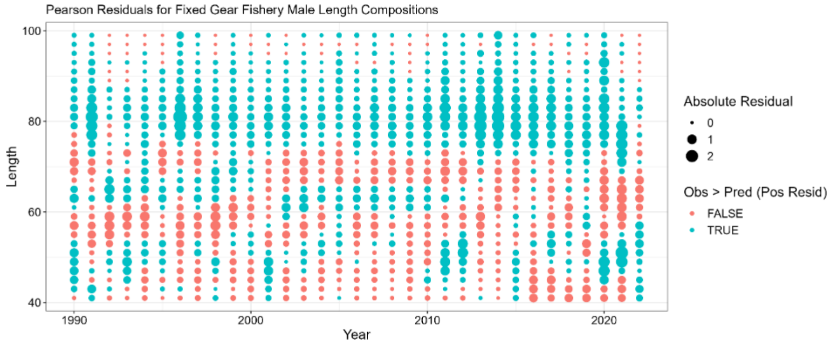




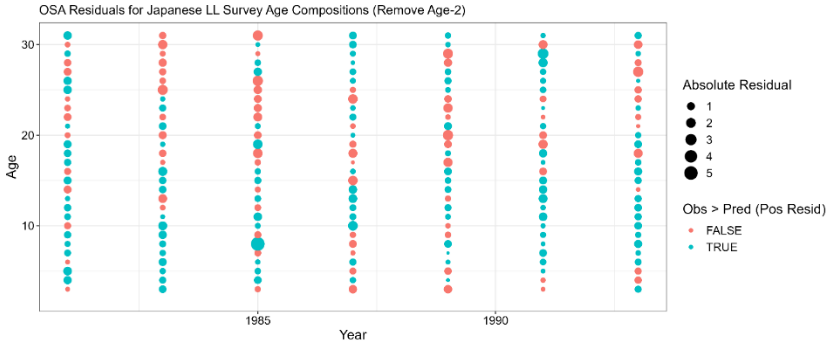


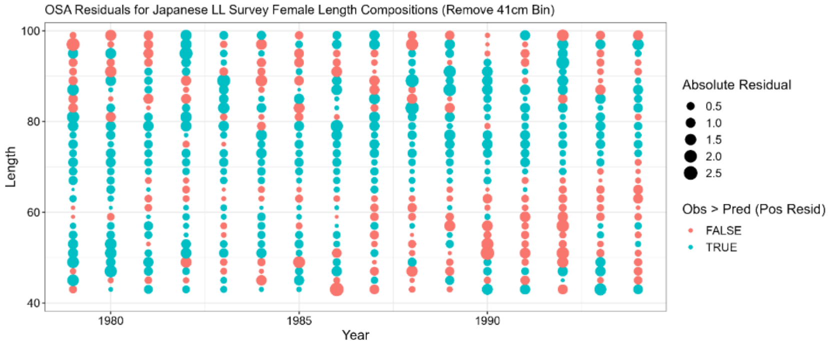


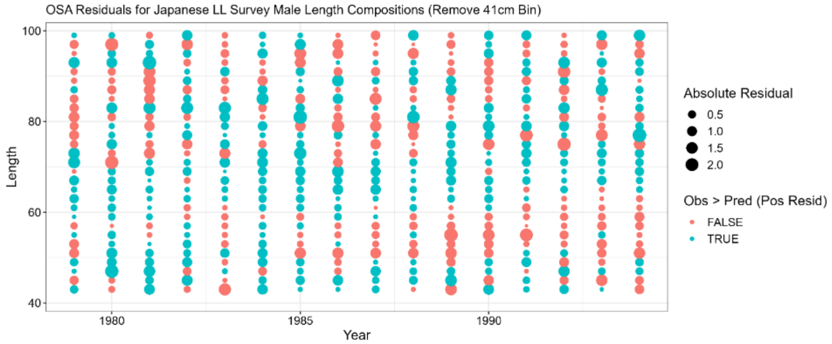


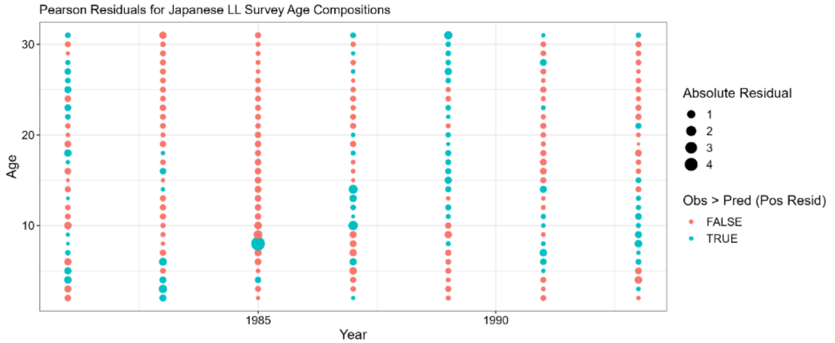


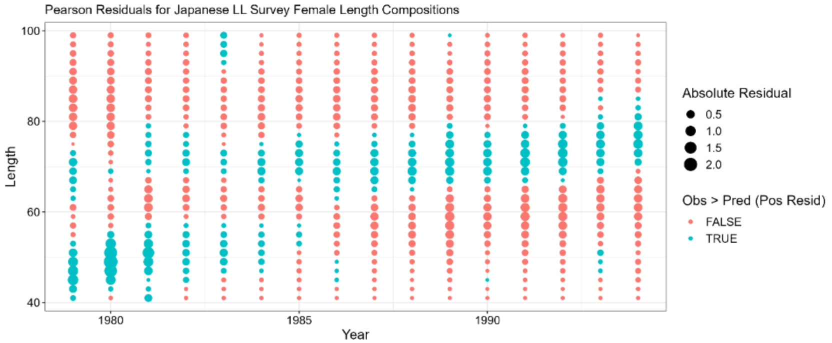
OSA and Pearson Residuals: Japanese Coop LL Survey

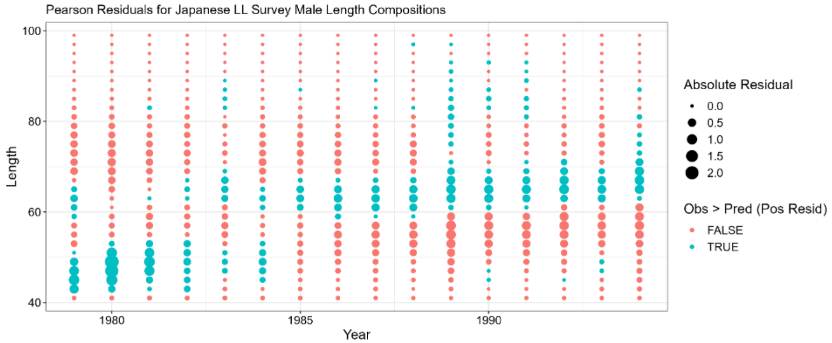




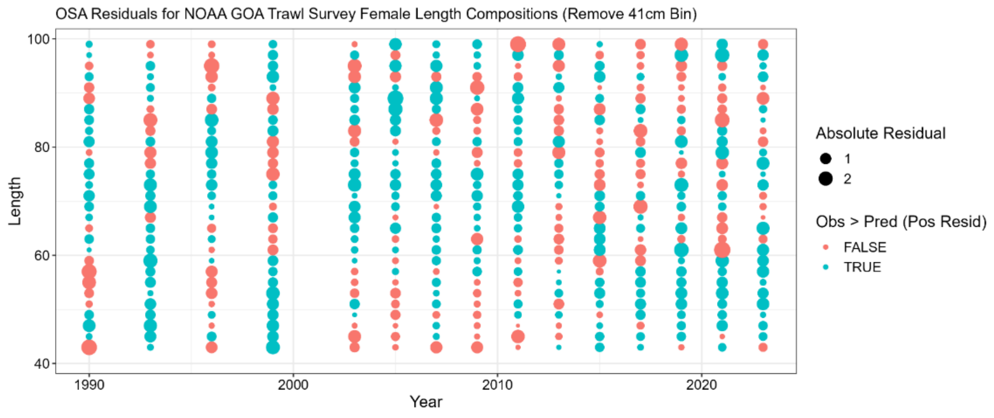


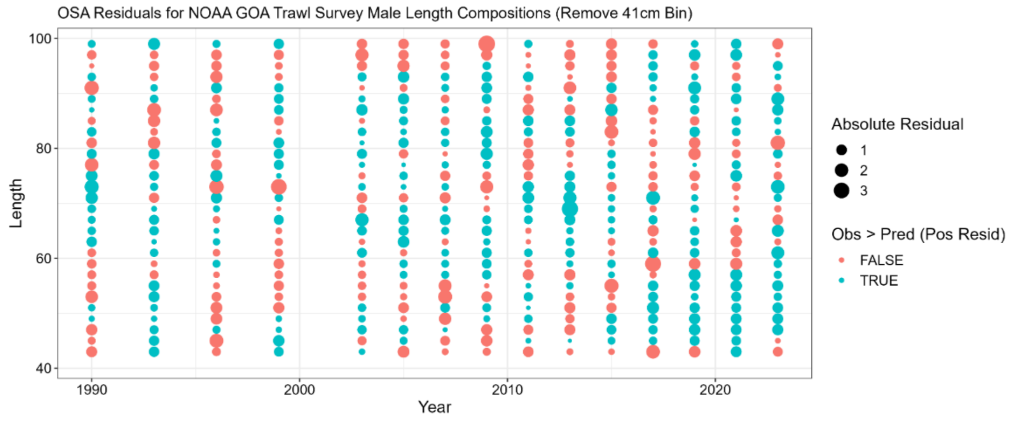


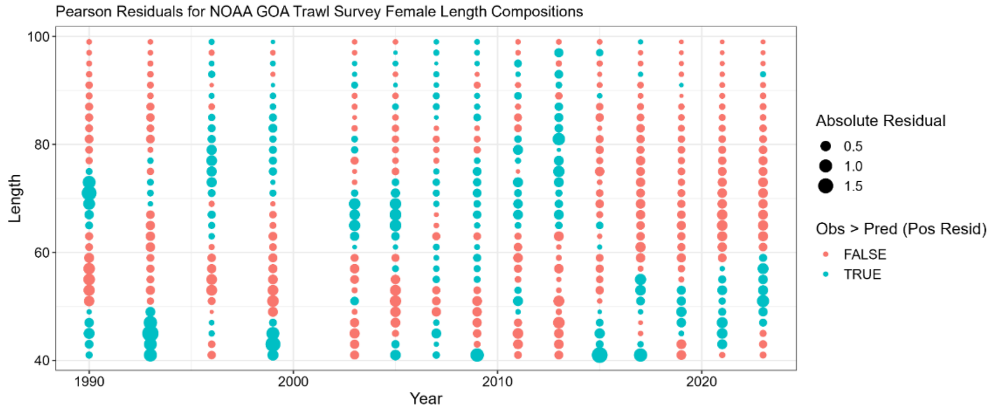


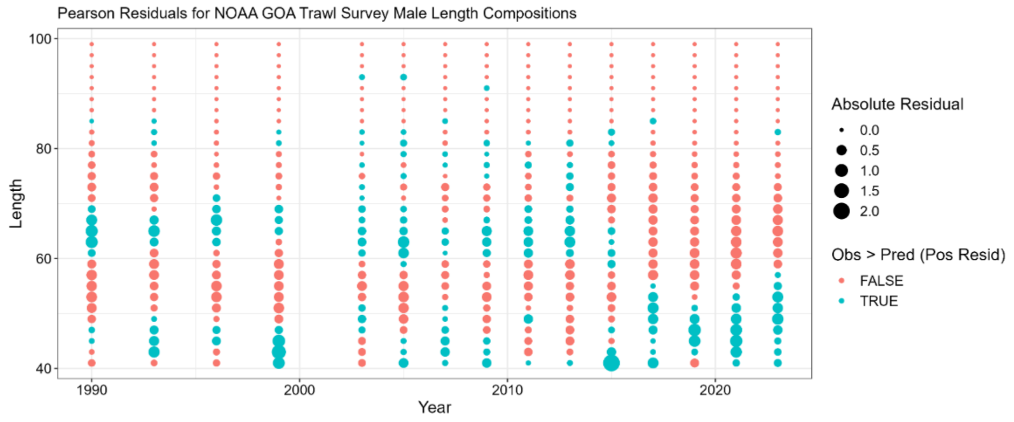


OSA and Pearson Residuals: NOAA GOA Trawl Survey



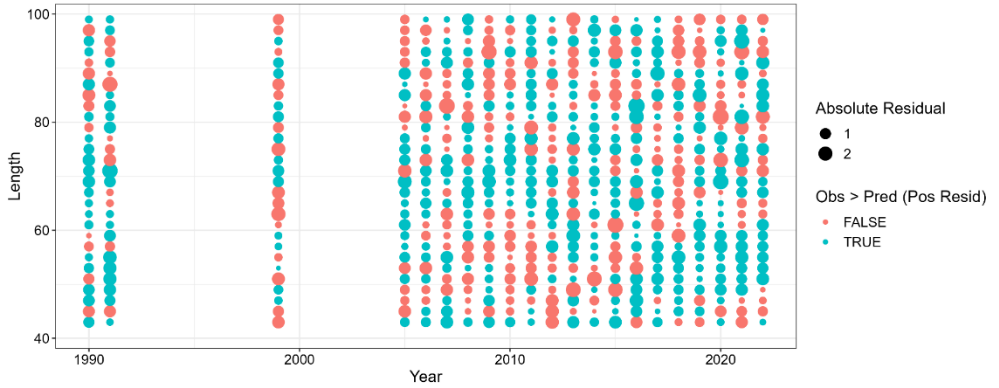




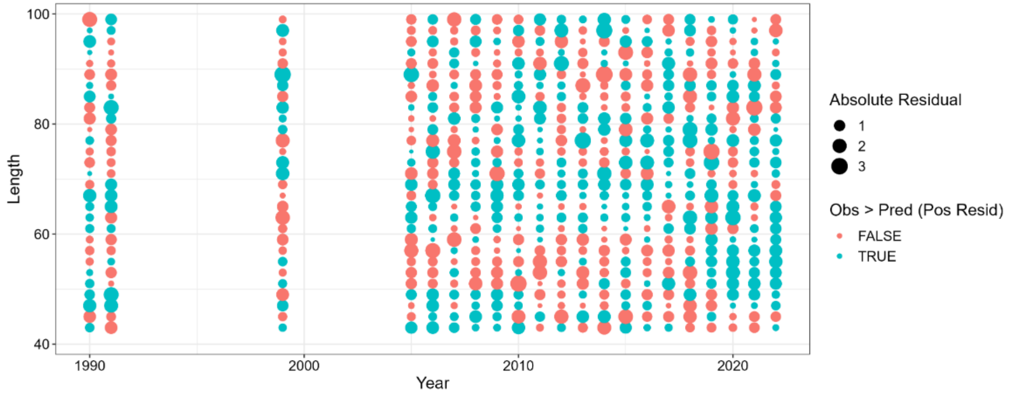


OSA and Pearson Residuals: Trawl Fishery

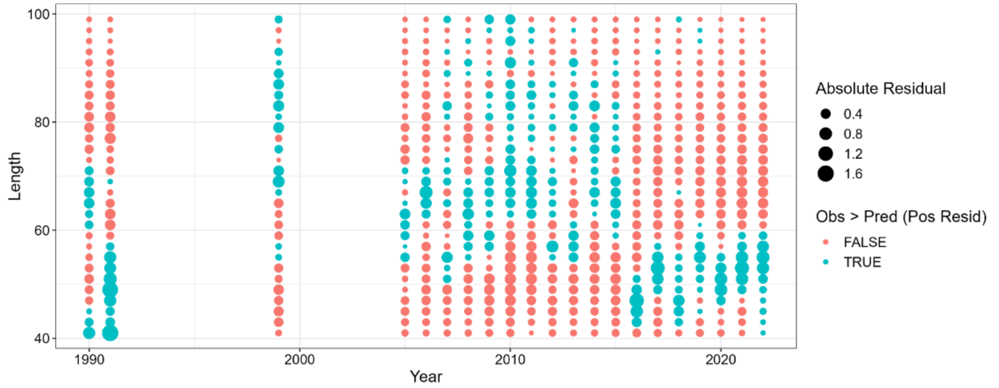
OSA Residuals for Trawl Fishery Female Length Compositions (Remove 41cm Bin)



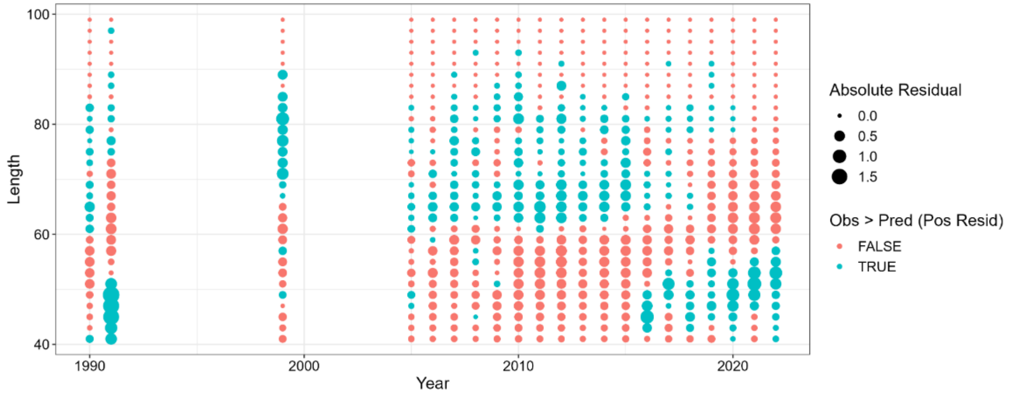
OSA Residuals for Trawl Fishery Male Length Compositions (Remove 41cm Bin)



Pearson Residuals for Trawl Fishery Female Length Compositions



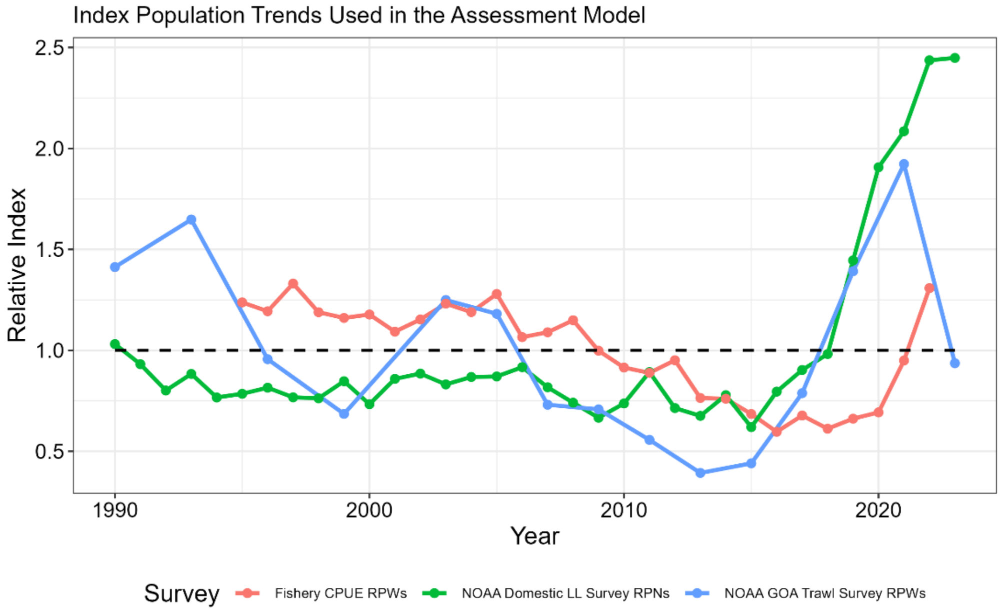
Pearson Residuals for Trawl Fishery Male Length Compositions



Summary Slides for SSC

Data

- Indices indicate leveling off of population growth
- BSAI constitutes > 50% of survey numbers again in 2023
- 2016 year class continues to dominate the compositional data



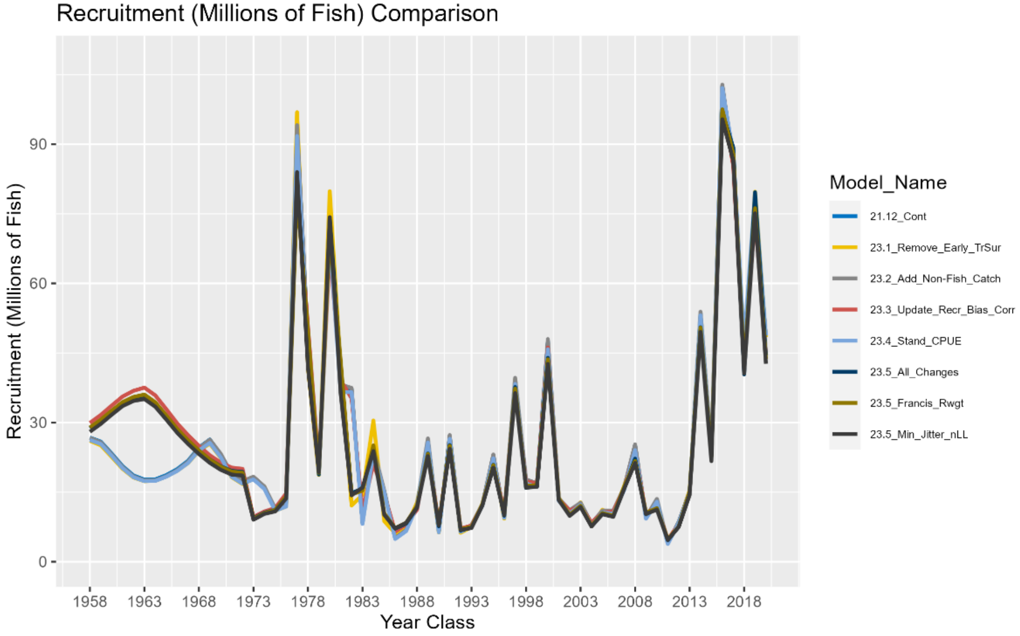
LL Survey: No Change

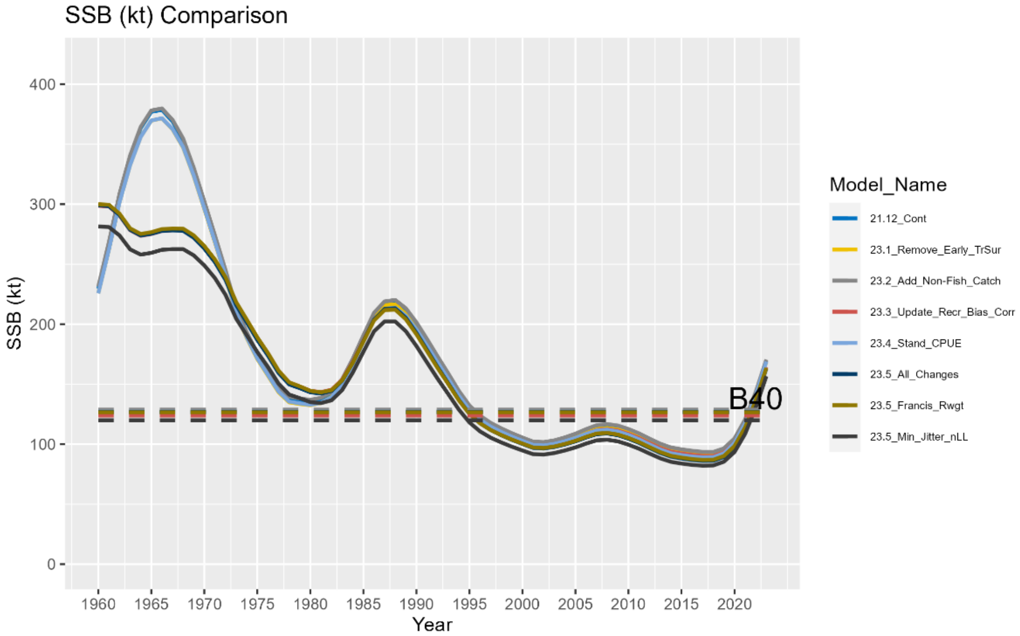
CPUE Index: 27% Increase

Trawl Survey: 50% Decline

Model Variants

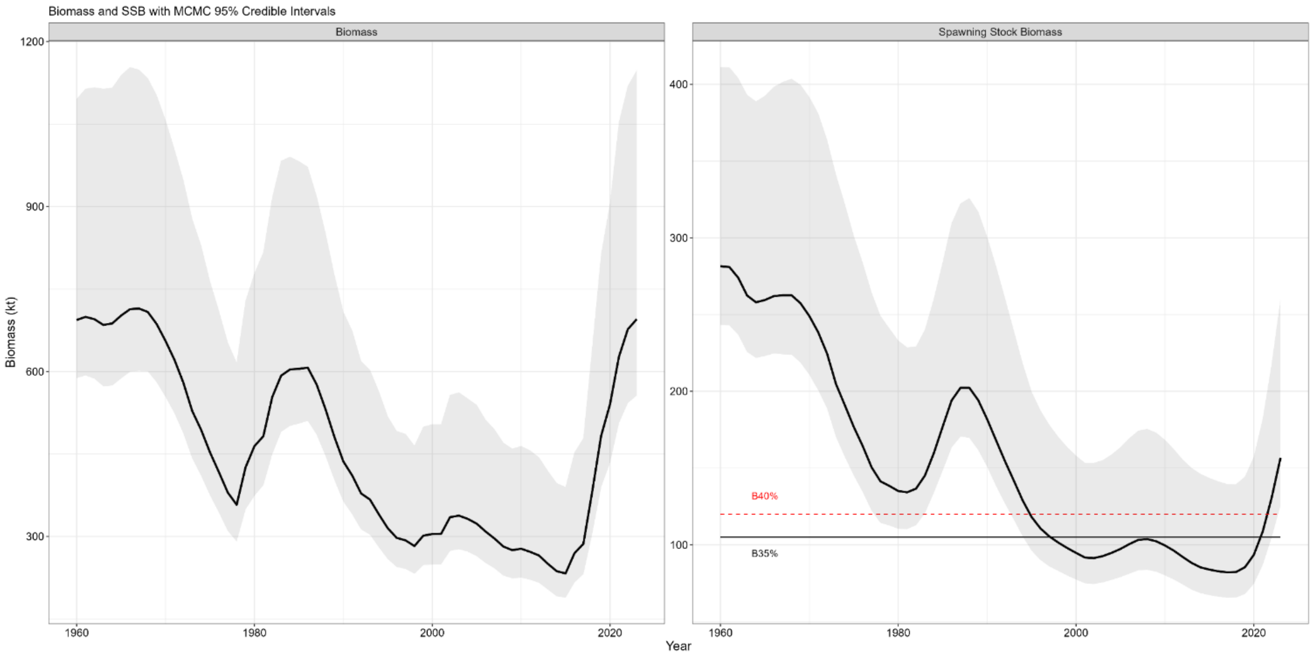
- Update assessment(+) with minor changes to data and parametrization compared to *21.12*:
  - *Model 23.1*: removed the 1984 and 1987 trawl survey data
  - *Model 23.2*: incorporated non-commercial catch (SSC)
  - *Model 23.3*: minor parametrization updates including:
    - Implemented Methot and Taylor (2011) bias correction
    - Allowed further selectivity parameter sharing to improve stability
    - Removed unnecessarily estimated fishing mortality parameters
  - *Model 23.4*: implemented the combined gear, standardized CPUE index (Cheng et al., 2023)
  - ***Model 23.5* (author recommended)**: integrated all updates, applied Francis reweighting, and utilized results of jitter analysis
- *No major impacts or changes in data fits*

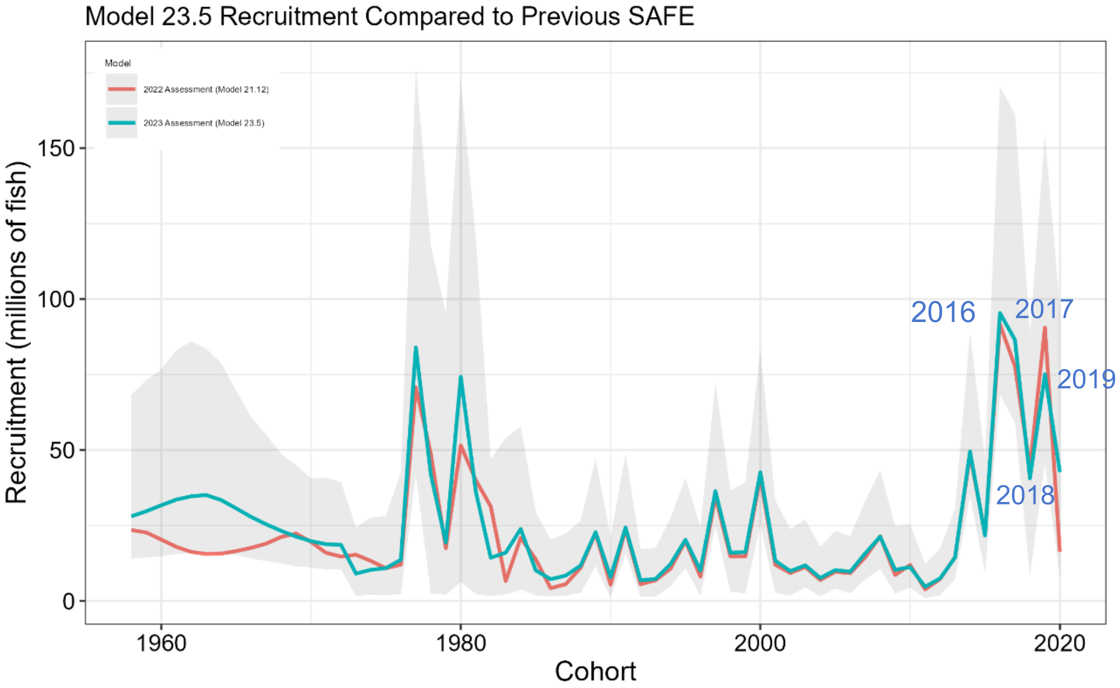




Time Series Trends

- At $B_{52\%}$ in 2023
- Projected to be at $B_{62\%}$ in 2024
- Fishing mortality remains at low levels (< F_{ABC})
- 2016, 2017, and 2019 year classes are 3 of the largest on record





Summary

- Survey indices leveling off, but population growth continues
- **Max ABC = 47,146 t** (+7,000 t from 2023 ABC)
  - Only ~70% utilization in recent years
- Apportionment based on 5-year average survey biomass proportions by area (no stair step)

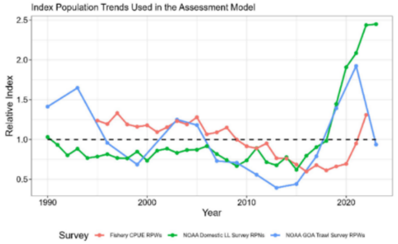
Year	2023				2024		2025	
Region	OFL_w	ABC_w	TAC	Catch*	OFL_w	ABC_w**	OFL_w	ABC_w**
BS	--	8,417	7,996	4,851	--	11,450	--	11,499
AI	--	8,884	8,440	1,924	--	13,100	--	13,156
GOA	--	23,201	23,201	13,581	--	22,596	--	22,695
WGOA	--	4,473	4,473	2,357	--	4,699	--	4,719
CGOA	--	9,921	9,921	5,547	--	9,651	--	9,693
**WYAK	--	3,205	3,205	2,068	--	2,926	--	2,940
**EY/SEO	--	5,602	5,602	3,610	--	5,320	--	5,343
Total	47,390	40,502	39,637	20,357	55,084	47,146	55,317	47,350

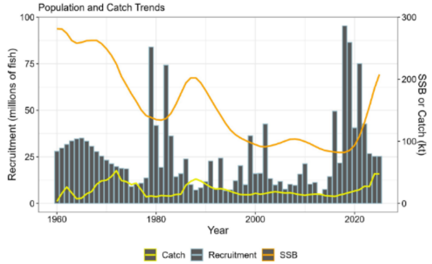
*As of October 10, 2023 **After 95:5 trawl split and whale depredation

2023 Alaskan Sablefish SAFE (*Anoplopoma fimbria*)

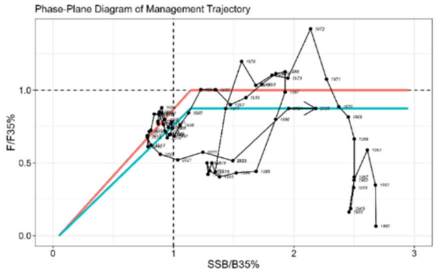
Data and Stock Assessment Model

- Following steady increases in abundance and biomass indices since 2015, the 2023 NOAA longline survey abundance was stable matching the 2022 value, the NOAA Gulf of Alaska trawl survey declined precipitously, and the fixed gear fishery CPUE continued to increase.
- The author proposed model (*23.5*) integrated minor data refinements and parametrization updates, but the main structure was consistent with the previously accepted model (*21.12*).
- The biomass and SSB continue to increase, while recruitment has been at or above the mean since 2014.





Stock Status and ABC Recommendations



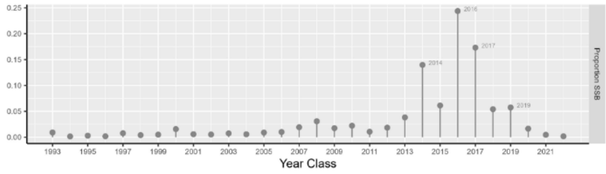
Quantity	2022 SAFE (Projections for 2023)	2023 SAFE (Projections for 2024)
$B_{100\%}$	305,595	299,901
$B_{40\%}$	122,238	119,960
$SSB_{(Terminal\_Yr+1)}$	159,788	185,079
$SSB_{(Terminal\_Yr+1)}/B_{100\%}$	52%	62%
$F_{ABC(Terminal\_Yr+1)}$	0.081	0.086
$ABC_{w(Terminal\_Yr+1)}$	40,502	47,146
$OFL_{w(Terminal\_Yr+1)}$	47,390	55,084

*SSB projections are based on specified catch for the terminal year. ABC_w and OFL_w are the recommended values after whale depredation has been taken into account.

- The resource is *not overfished* and *overfishing is not occurring.*
- Recent ABCs have not been fully utilized with catch averaging ~70% of the ABC over the last 3 years.
- The ABC increased by 16% due to continued maturation and growth (in weight) of the population.

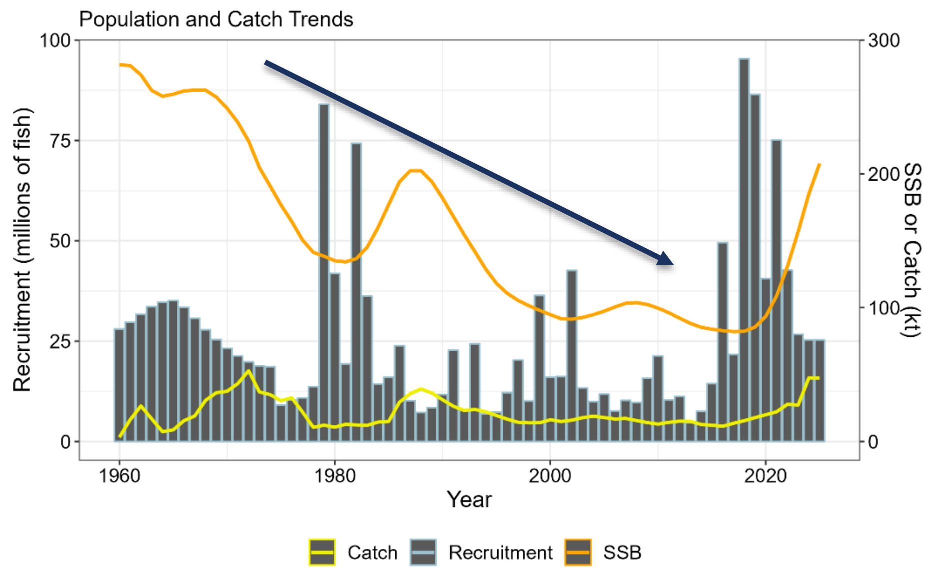
Other Considerations

- The population age-structure remains contracted relative to historic levels.
- 2014 – 2020 year classes comprise > 75% of projected 2024 SSB.



Ongoing Concerns and Future Directions

- Rapid transition to pot gear (> 85% of fixed gear catch)
- Influx of small fish
  - Decreasing economic value and flooded markets
  - NPFMC small sablefish release amendment ongoing
  - A maximum catch strategy will likely maintain long-term downward SSB trend, *if* recruitment reverts to average conditions
  - Greater than 75% of 2024 SSB from 2014 – 2020 year classes



- Research:
  - Closed-loop simulation of HCRs (B. Williams/C. Cunningham)
  - Spatial Modeling (C. Marsh, former NOAA post-doc)
  - Sablefish assessment good practices (M. Cheng, UAF)
  - Forecasting recruitment (K. Oke, NOAA post-doc)
  - Ongoing work to analyze sablefish satellite tagging (K. Echave/K. Siwicke)