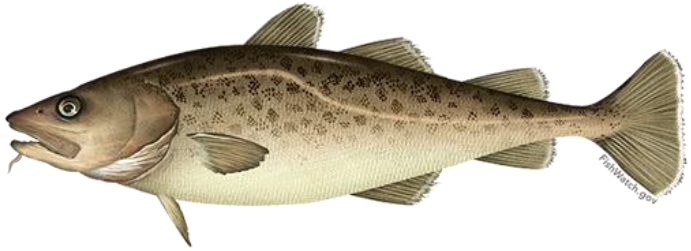
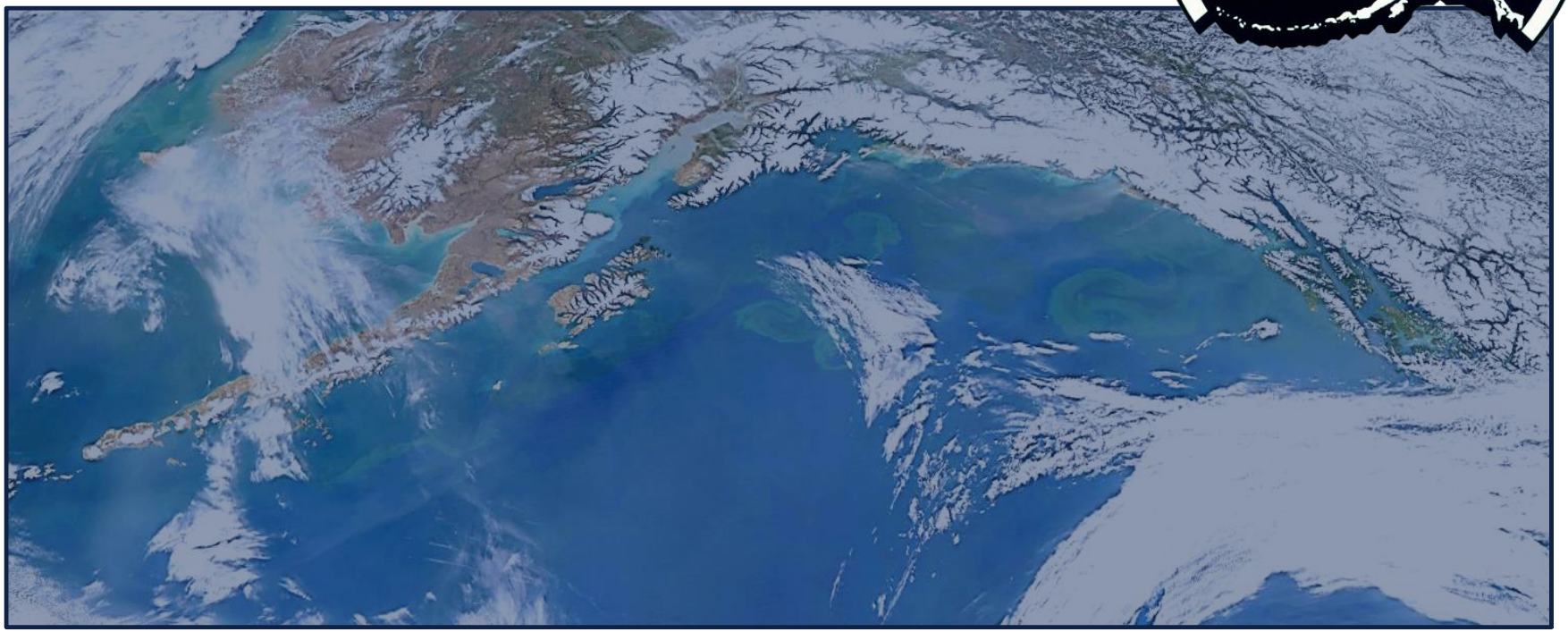


GOA PACIFIC COD

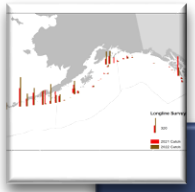
PETE HULSON, STEVE BARBEAUX, BRIDGET FERRISS, SUSANNE MCDERMOTT, AND INGRID SPIES – NOVEMBER 2022



STOCK OVERVIEW

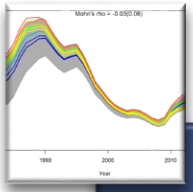
- GOA Pacific cod: Tier 3b
- 2023 projected spawning biomass to be at $B_{25.5\%}$
- No changes to model. Updated data since 2022, added state catch from 1997 – 2002
- PT/SSC comments not addressed this year (so not included)

OUTLINE



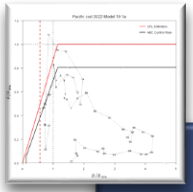
Data

- Fishery
- Surveys
- Other



Results

- Model fits
- Params
- Derived quantities

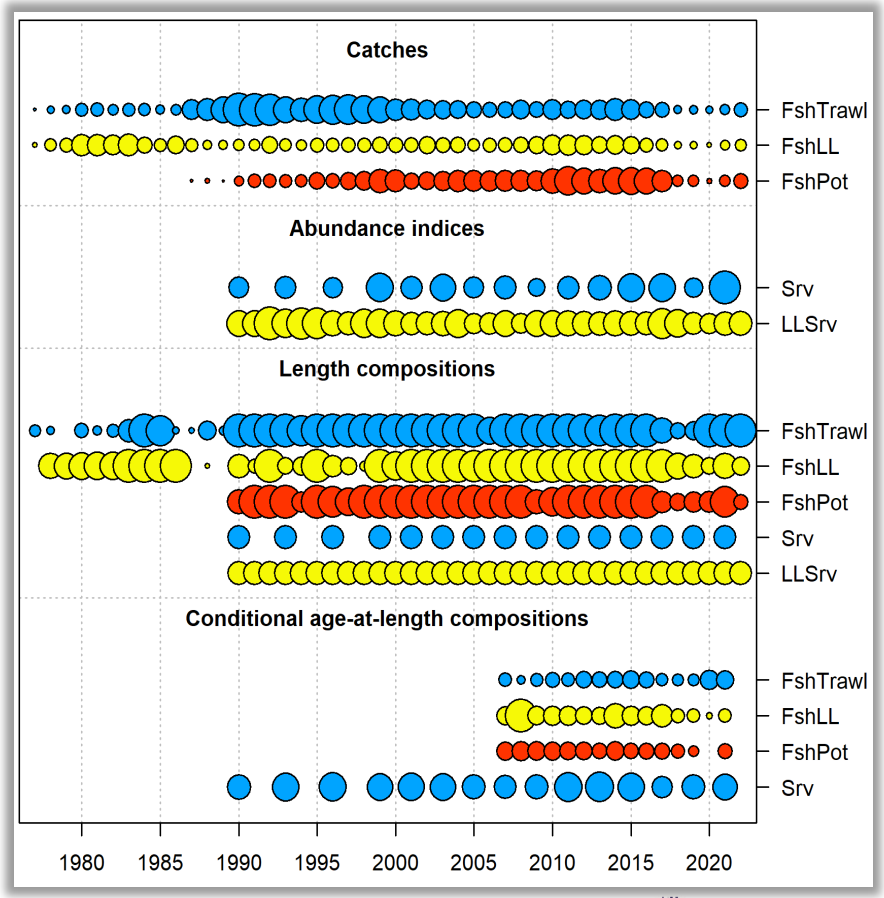


Recommendations

- Risk table
- ABC/OFL

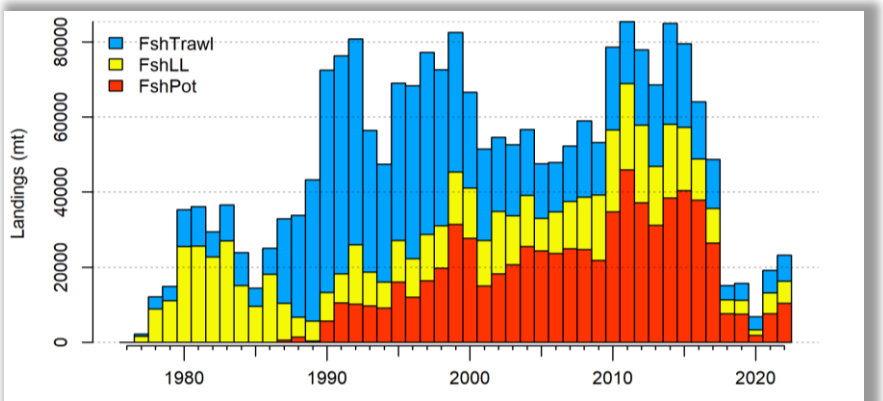
DATA

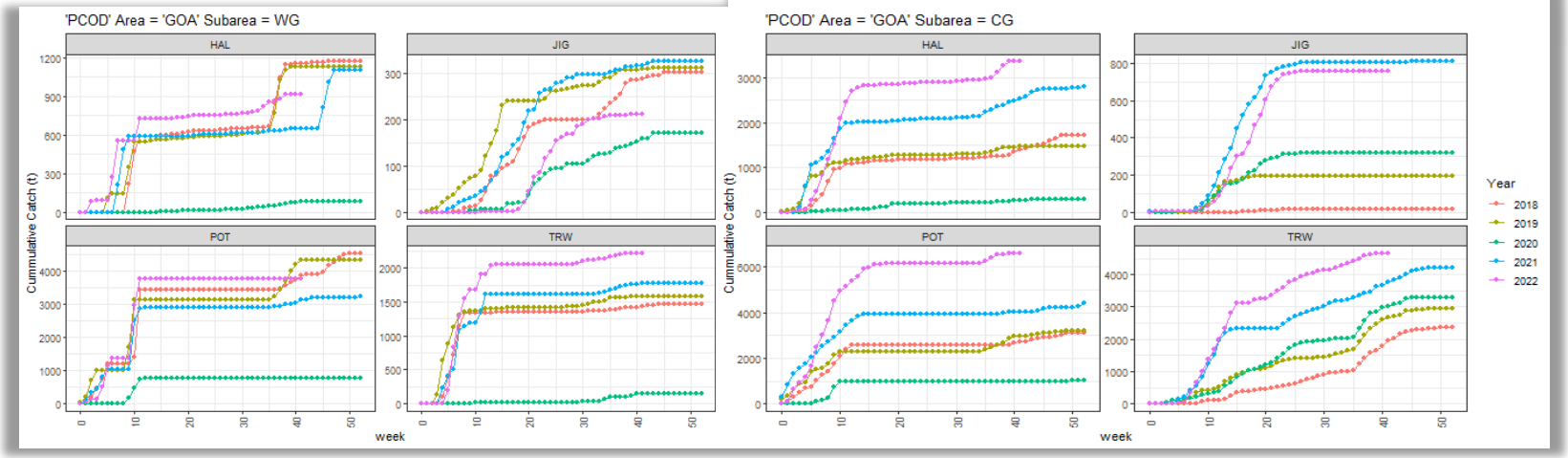
Data	Years
Federal and state fishery catch, by gear type	2021, 2022
Federal and state fishery catch-at-length, by gear type	2021, 2022
AFSC Sablefish Longline survey Pacific cod Relative Population Numbers	2022
GOA NMFS bottom trawl survey conditional age-at-length	2021
AFSC Sablefish Longline survey Pacific Cod length composition	2022
Federal fishery conditional age-at-length	2021
CFSR bottom temperature indices	2022



DATA - CATCH

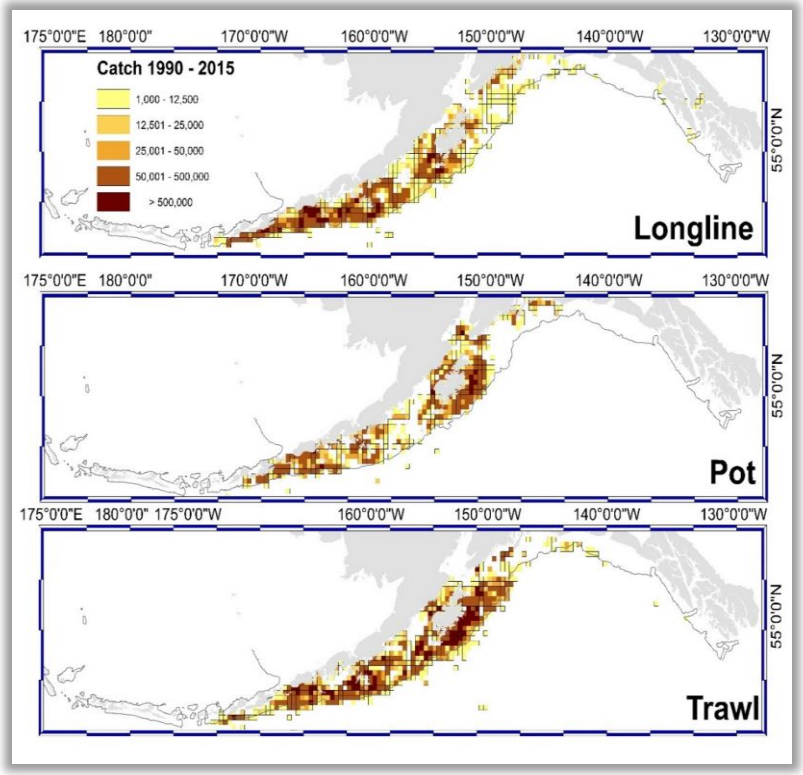
- Increased since 2021
- Pot majority > Trawl > LL
- CG greatest increase compared to last year

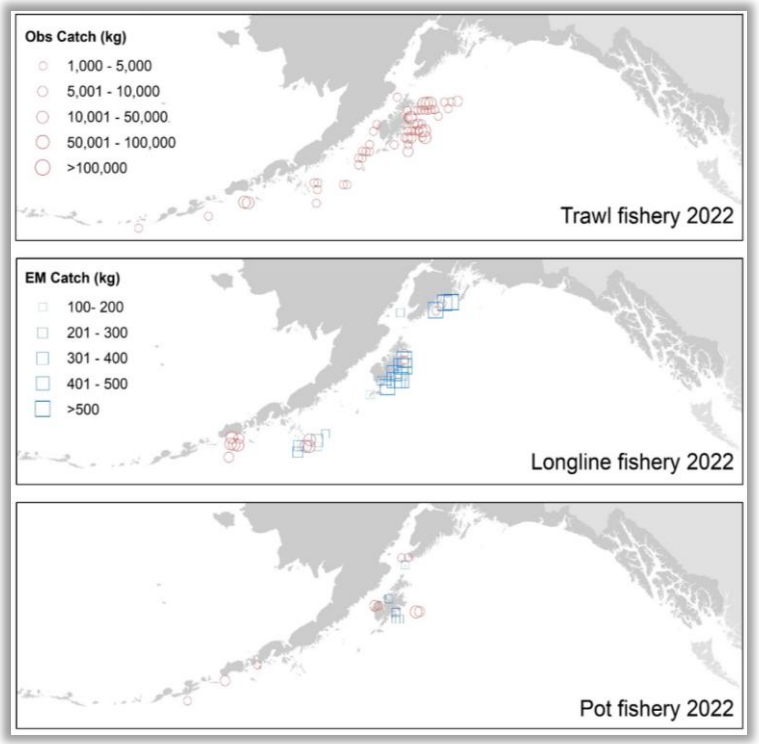




DATA – CATCH DISTRIBUTION

- Recent catch seems to be constricting to core areas compared to historical





DATA – STATE CATCH

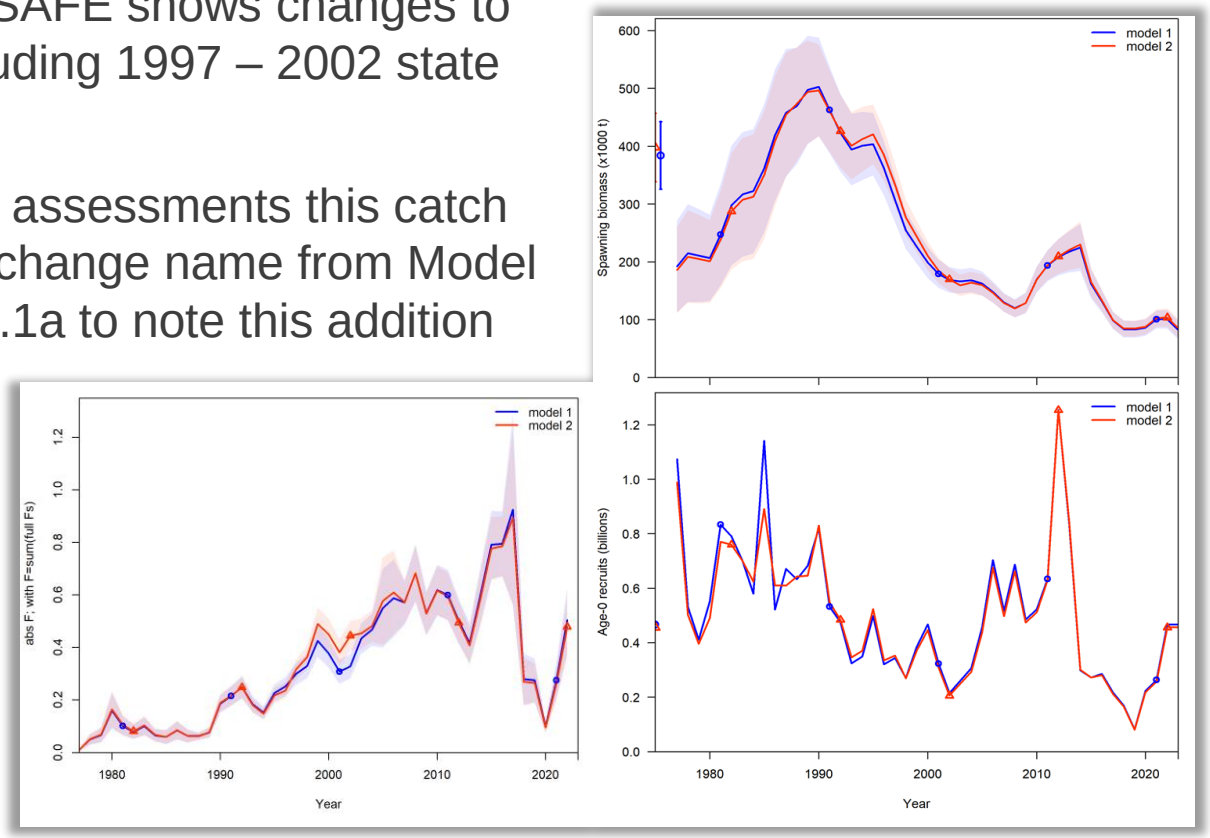
- Noticed 1997 – 2002 state catch reported in SAFE table, but not in model time series (11 – 22% of total catch)…
- Has to do with data tables/sources we're pulling from

Table 2.1. Catch (t) for 1991 through 2022 by jurisdiction and gear type (as of 2022-10-25)

	Federal					State				
Year	Trawl	Long-line	Pot	Other	Subtotal	Long-line	Pot	Other	Subtotal	T
1991	58,092	7,630	10,464	115	76,301	0	0	0	0	7
1992	54,593	15,675	10,154	325	80,747	0	0	0	0	8
1993	37,806	8,963	9,708	11	56,488	0	0	0	0	5
1994	31,447	6,778	9,161	100	47,486	0	0	0	0	4
1995	41,875	10,978	16,055	77	68,985	0	0	0	0	6
1996	45,990	10,196	12,040	53	68,279	0	0	0	0	6
1997	48,406	10,978	9,065	26	68,475	0	7,368	1,327	8,695	7
1998	41,570	10,012	10,510	29	62,121	0	9,183	1,320	10,503	7
1999	37,167	12,363	19,015	70	68,615	0	12,410	1,518	13,928	8
2000	25,443	11,660	17,351	54	54,508	0	10,399	1,644	12,043	6
2001	24,383	9,910	7,171	155	41,619	0	7,829	2,083	9,912	5
2002	19,810	14,666	7,694	176	42,346	0	10,578	1,714	12,292	5
2003	18,884	9,525	12,765	161	41,335	62	7,943	3,242	11,247	5

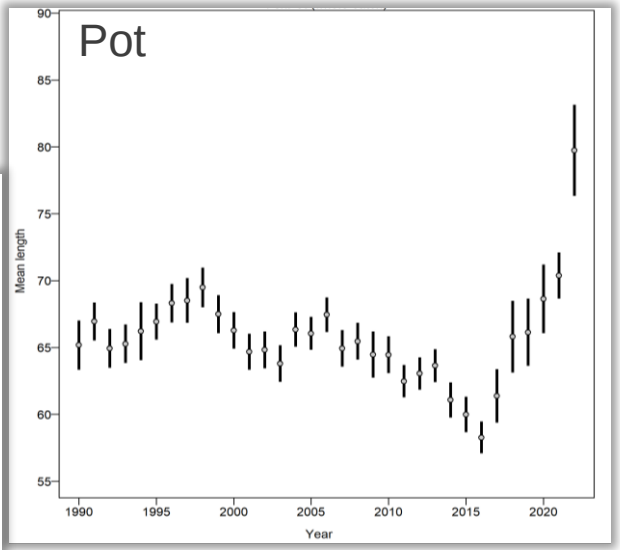
DATA – STATE CATCH

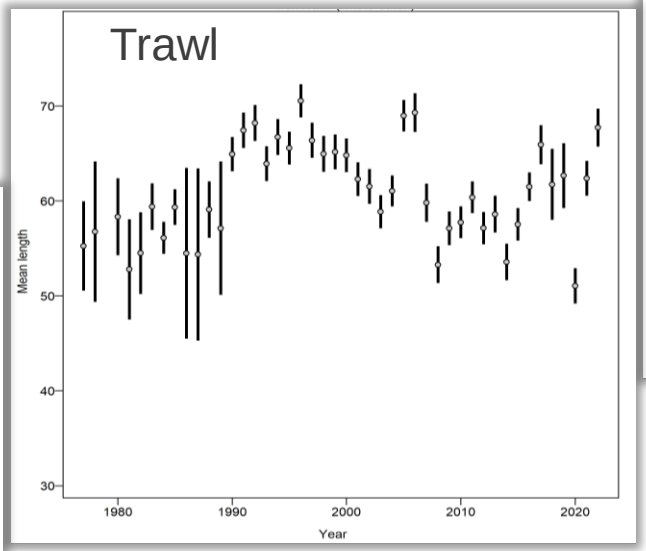
- Appendix 2.2 of SAFE shows changes to model when including 1997 – 2002 state catch
- In this and future assessments this catch will be included, change name from Model 19.1 to Model 19.1a to note this addition

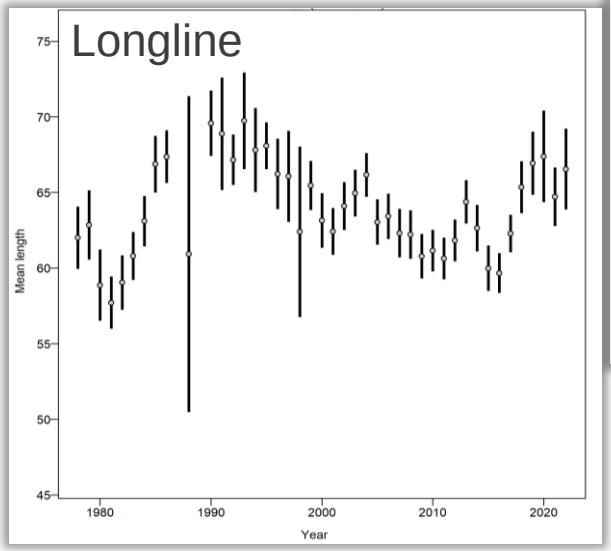


DATA – CATCH COMPS

- In general, mean length increasing in fishery
- Significantly larger mean length resulted in Pot fishery

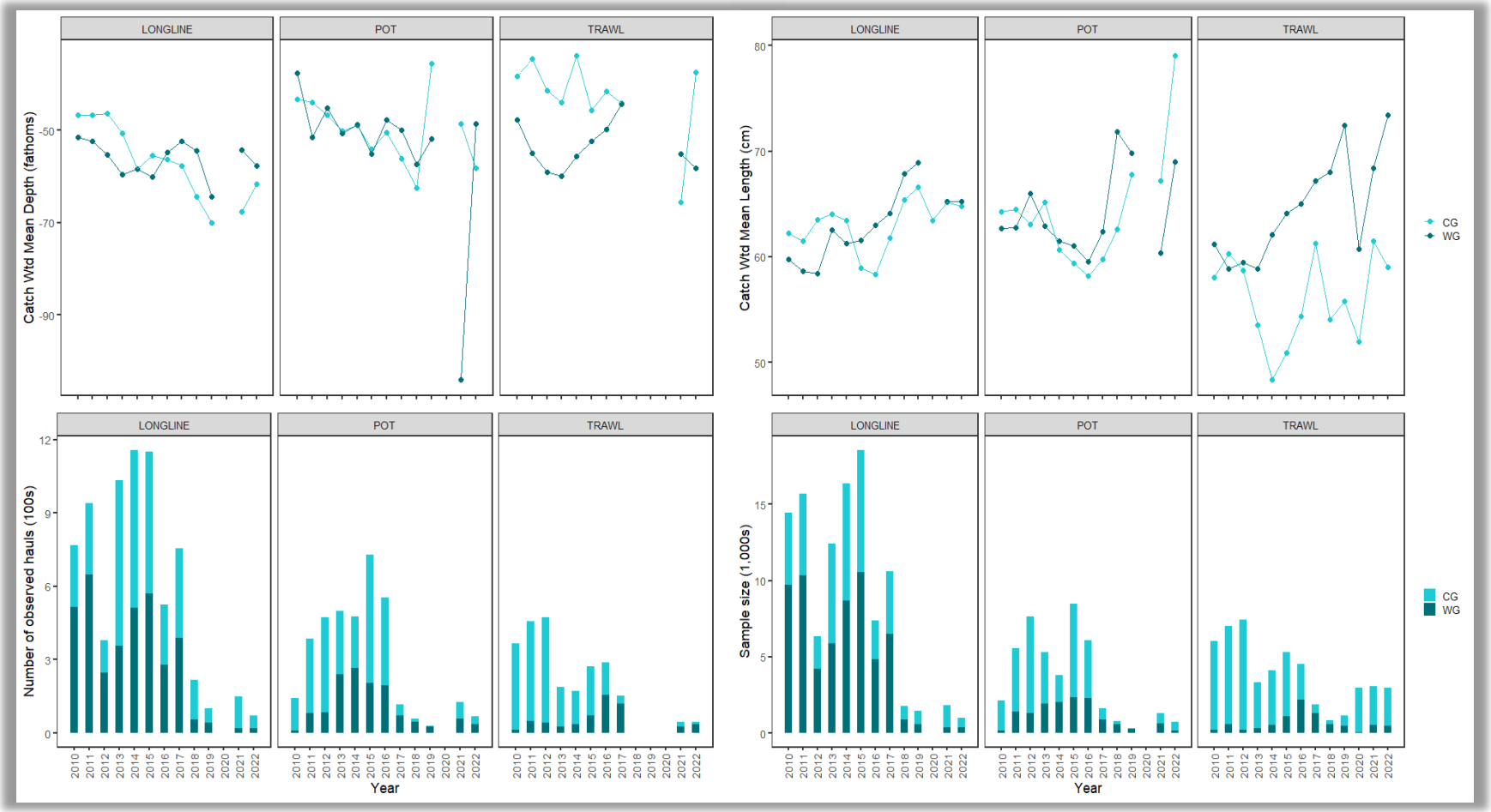




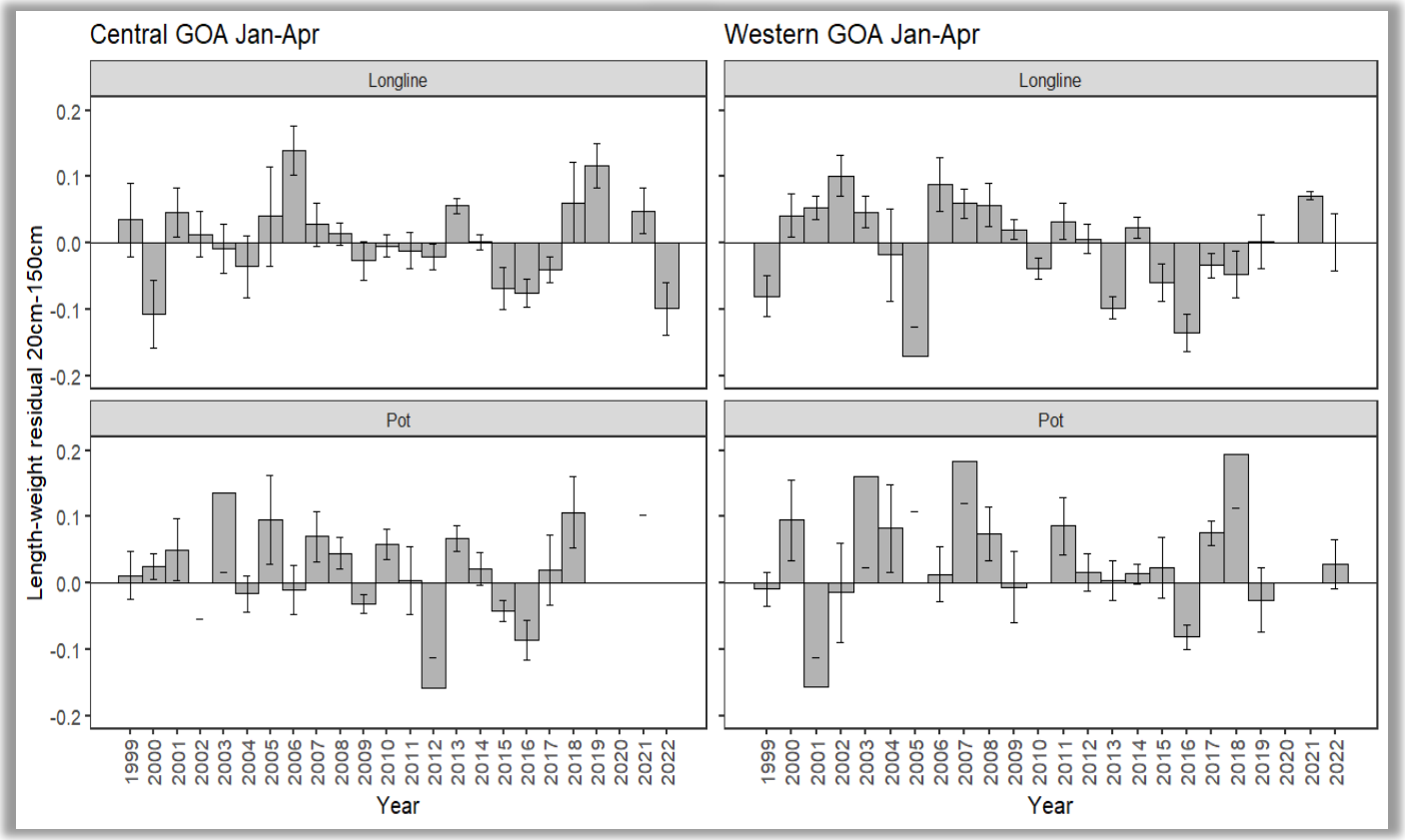


DATA – CATCH COMPS

- In general, moving deeper
- Pot length driven by CG samples, may be some catch left in WG

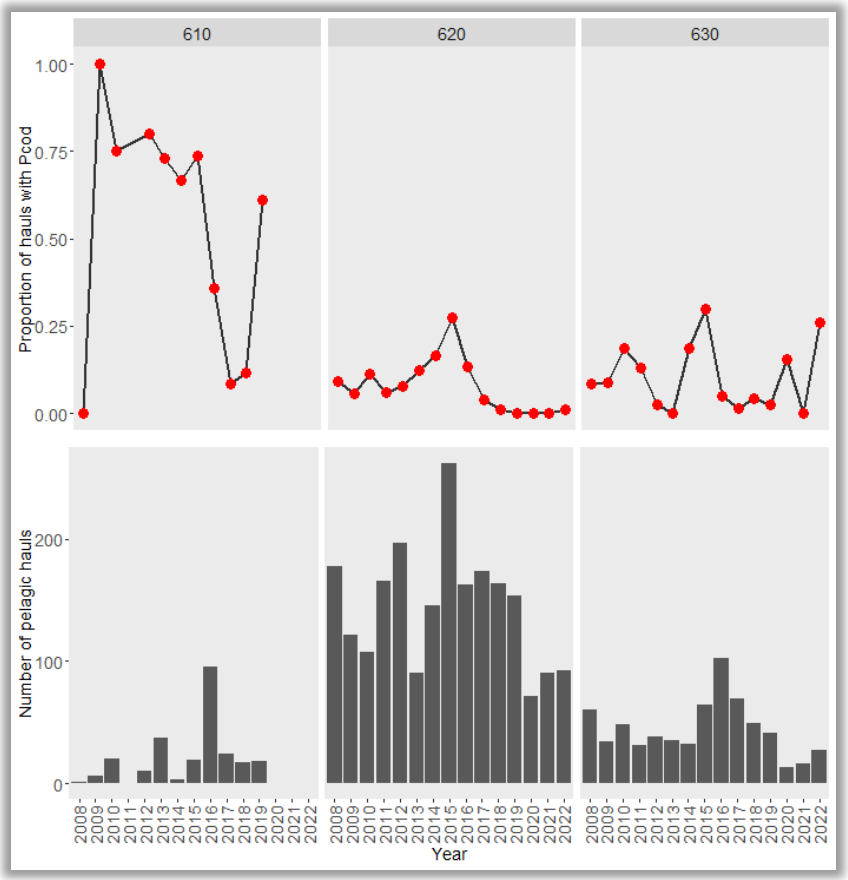


DATA – CATCH CONDITION

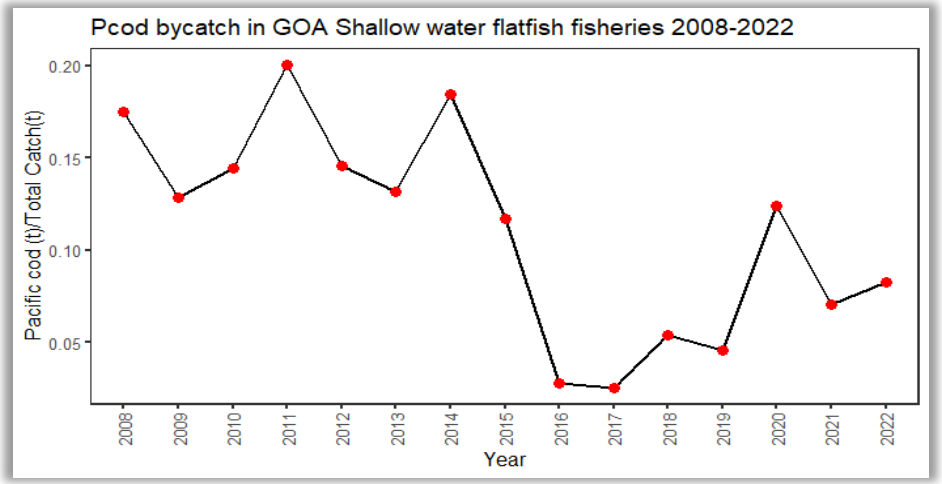


- Avg in WG, below avg in CG Longline

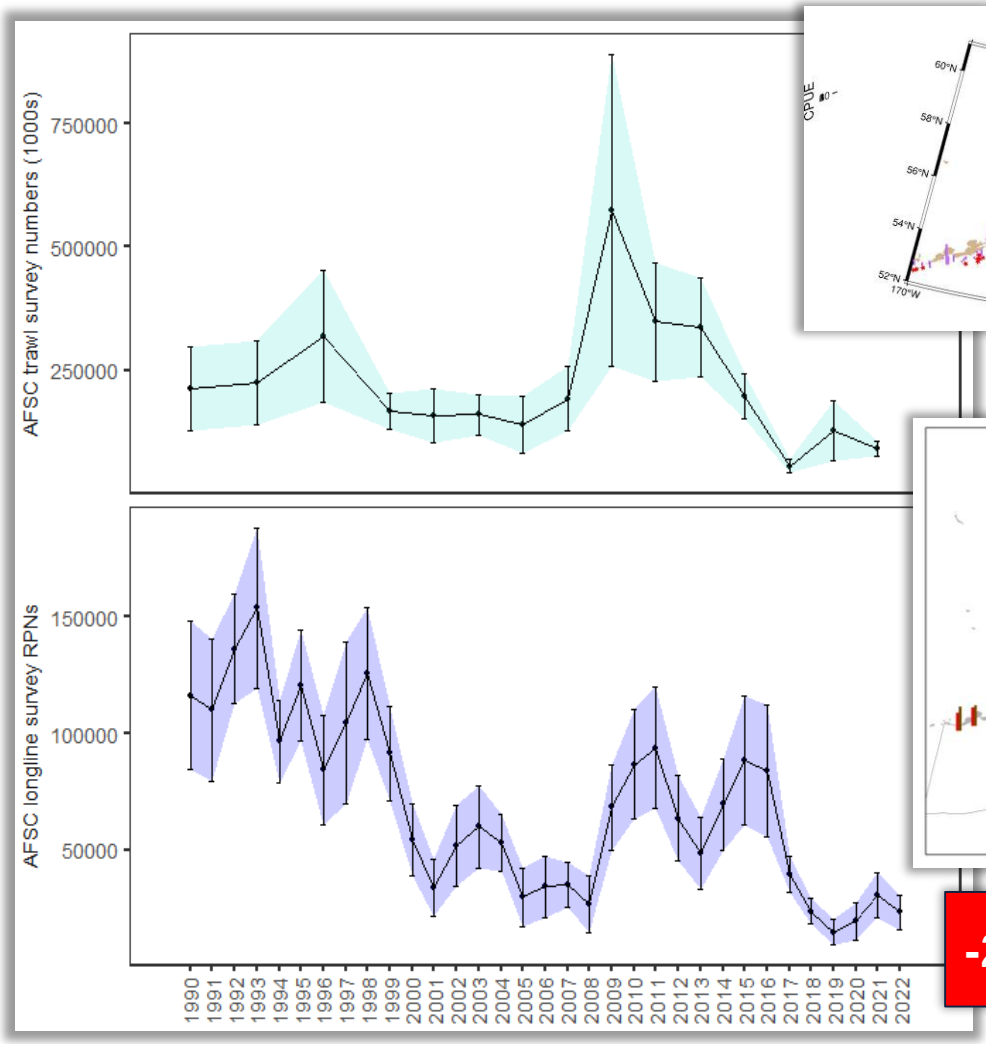
DATA – UNINTENTIONAL CATCH

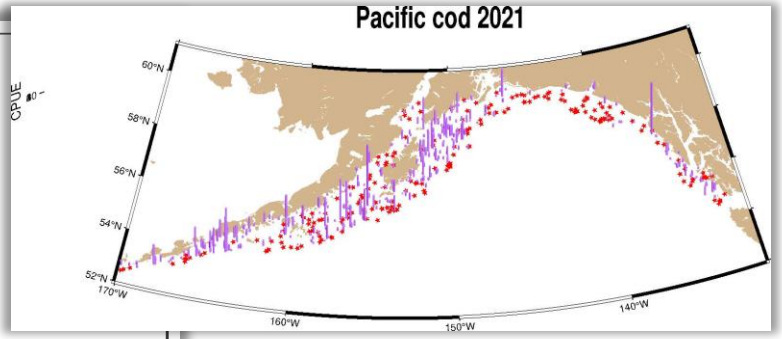


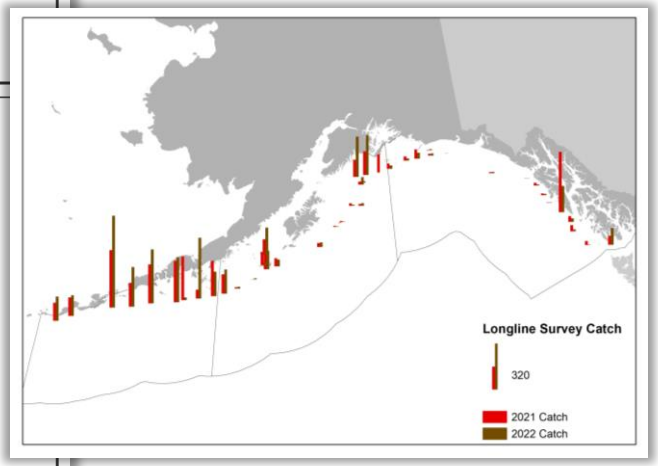
- Getting Pcod in pelagic trawls
- SWF bycatch on increasing trend



SURVEYS – FITTED

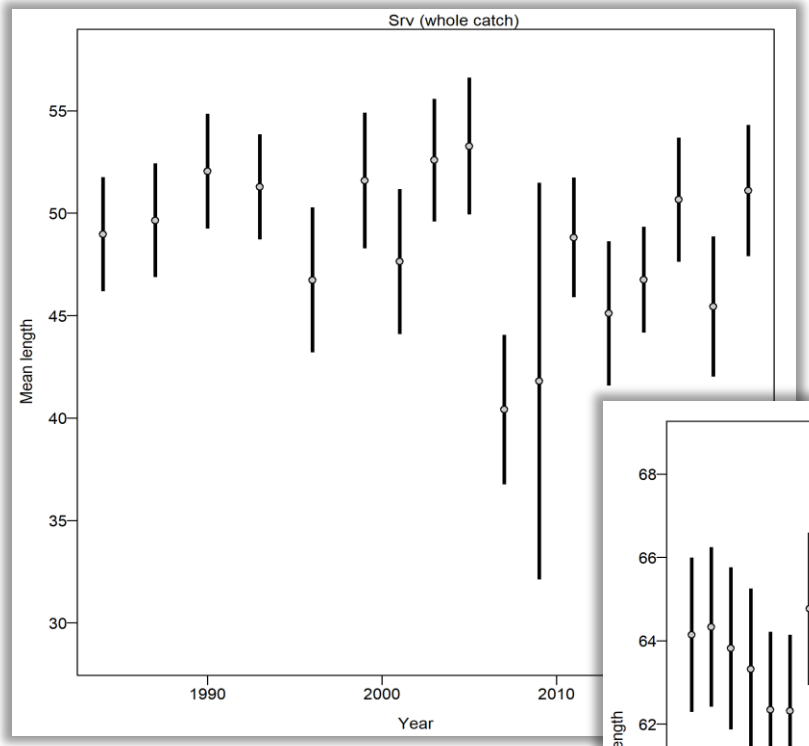




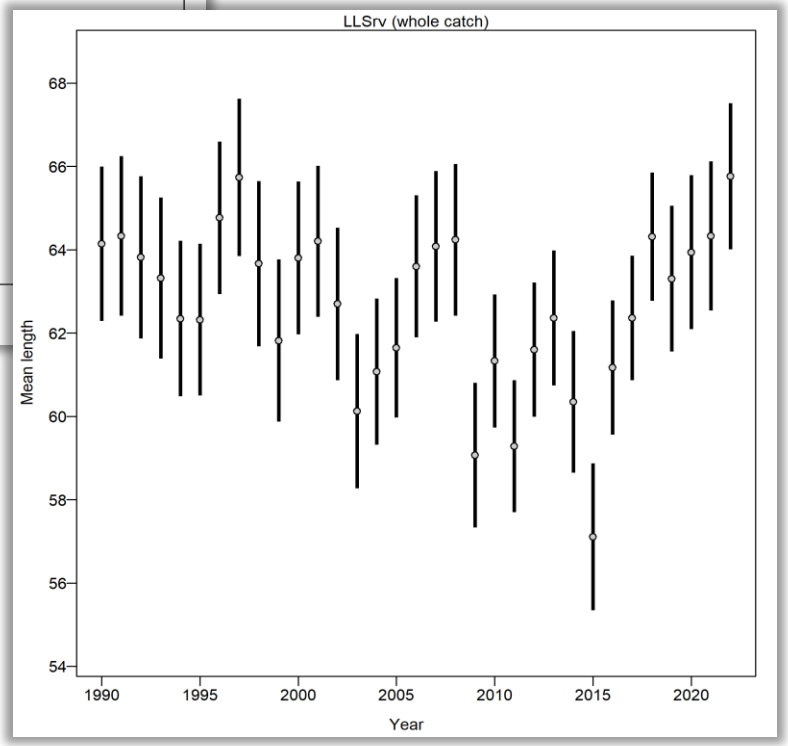


-24%

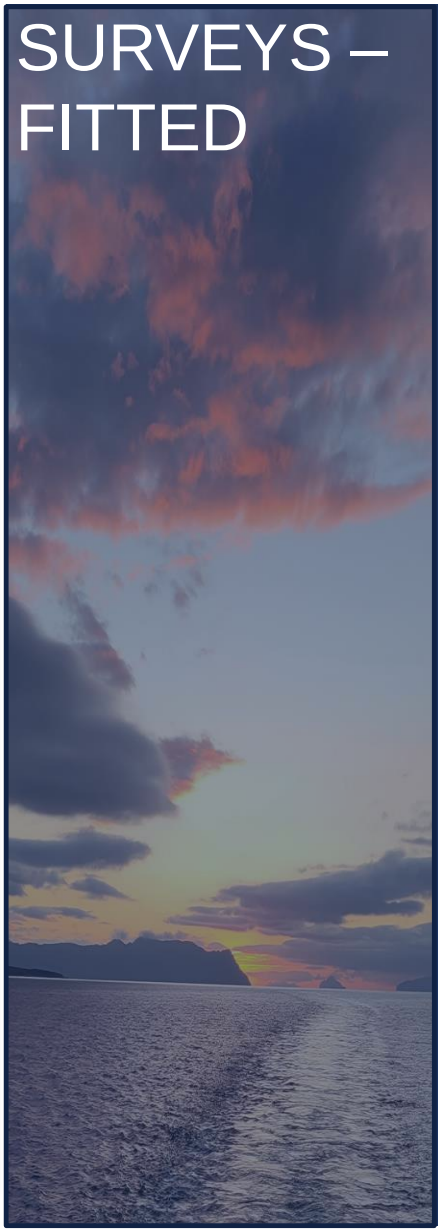
SURVEYS – FITTED



- Trawl survey mean length variable

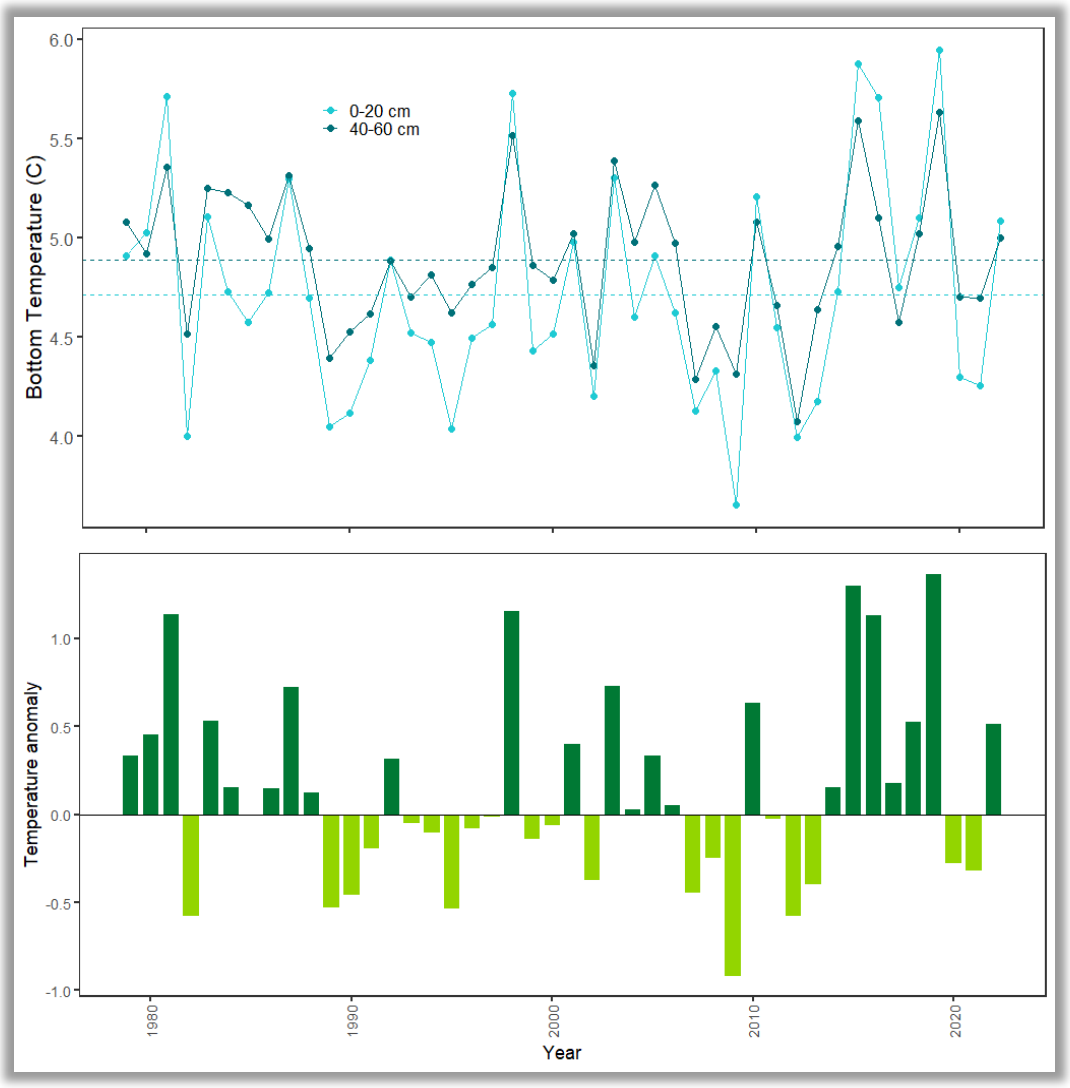


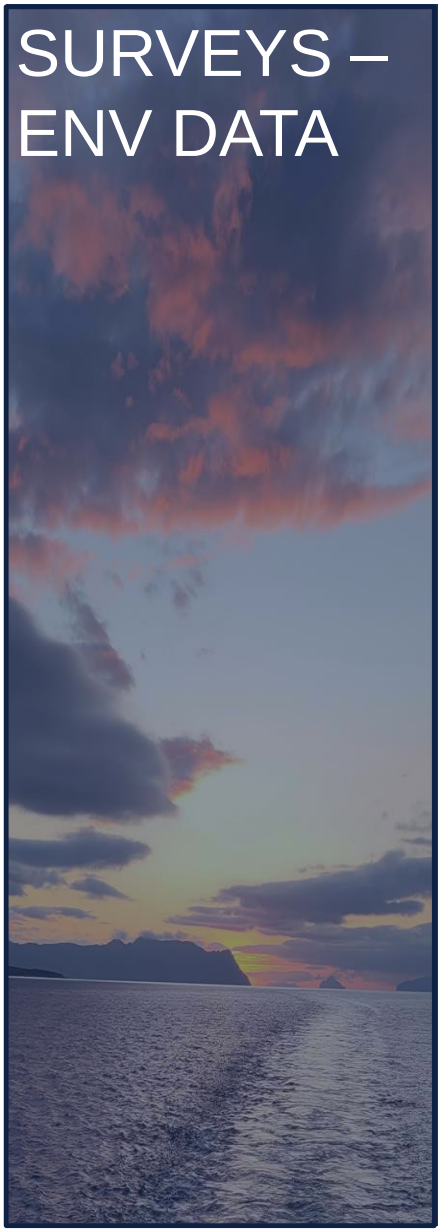
- Longline survey mean length increasing



SURVEYS – ENV DATA

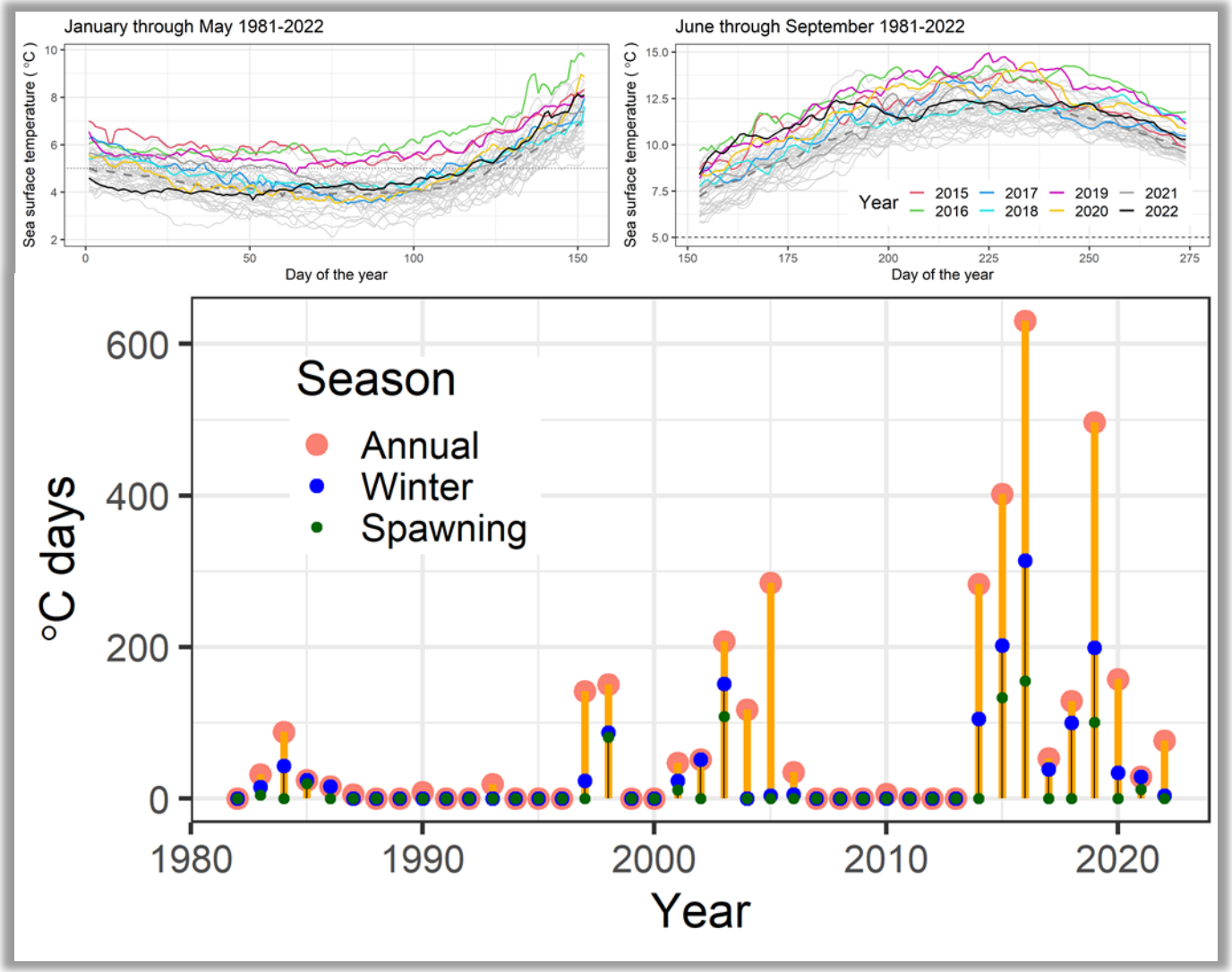
- Bottom temperature above mean in 2022

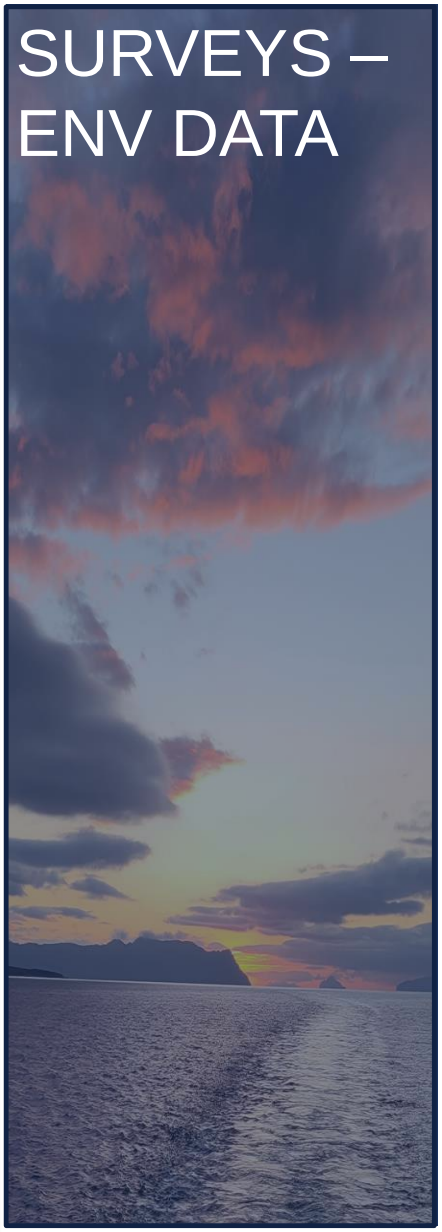




SURVEYS – ENV DATA

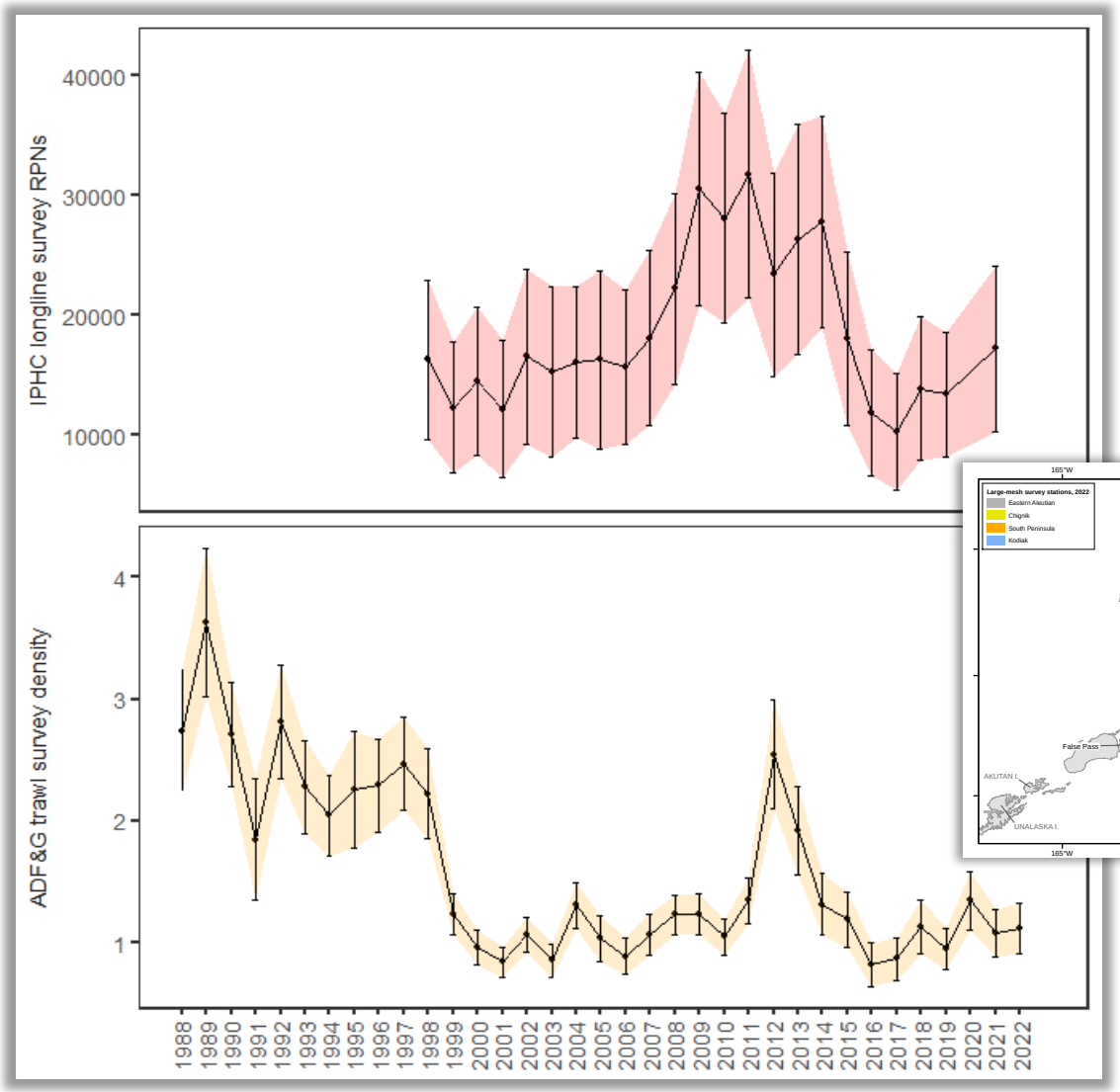
- Avg to above avg sea surface temperature
- No marine heat wave days during winter/spawning

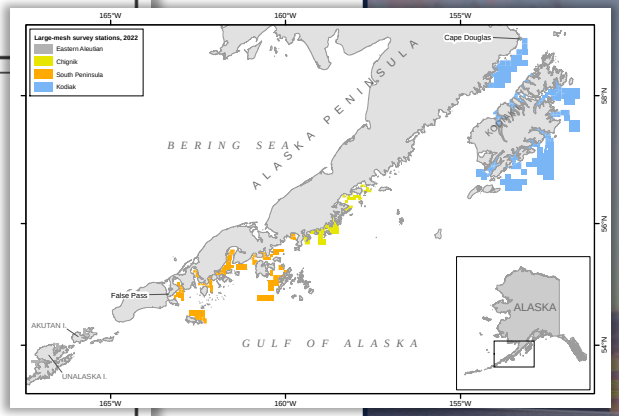




SURVEYS – MONITORED

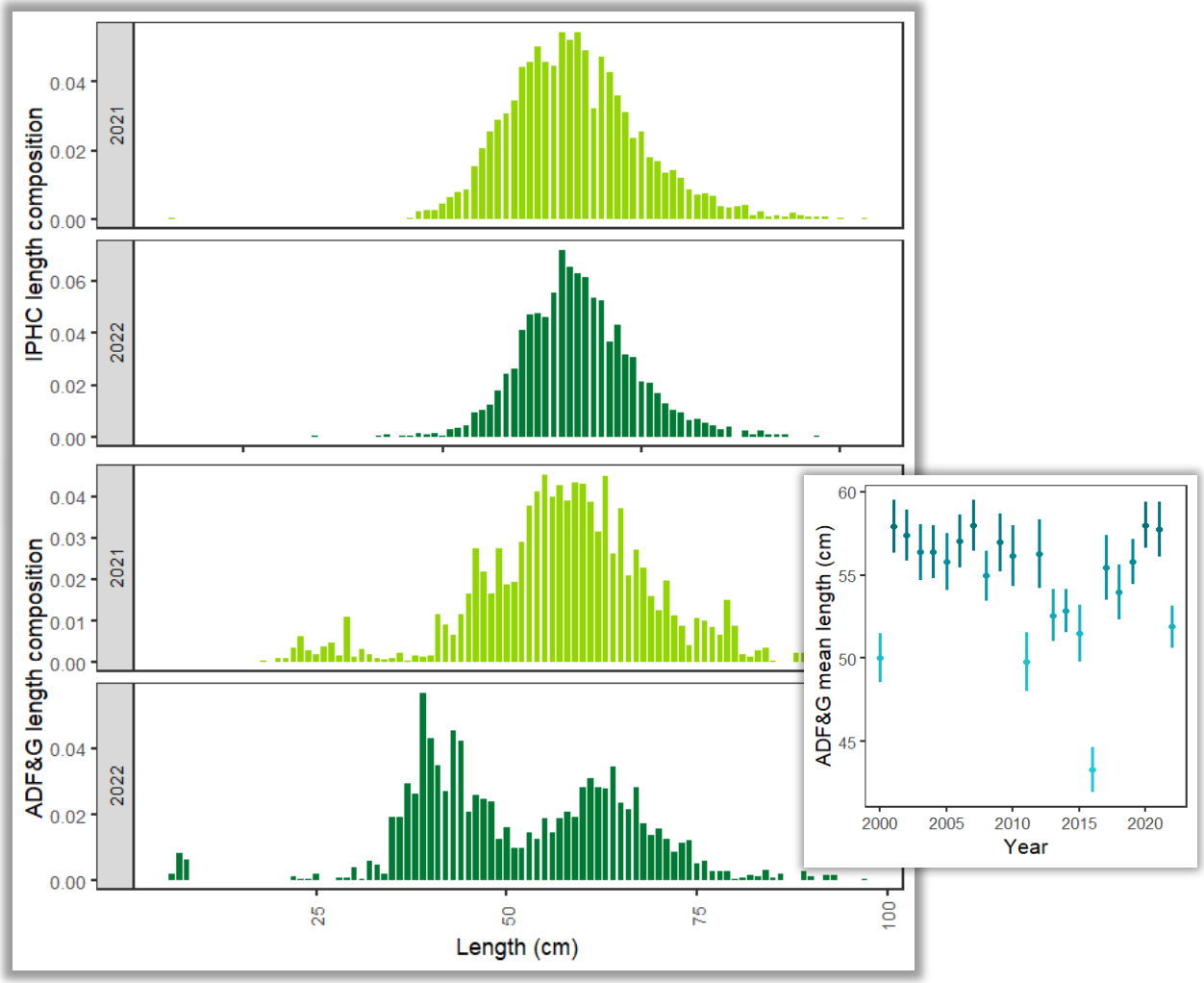
- Both IPHC and ADF&G on increasing trend

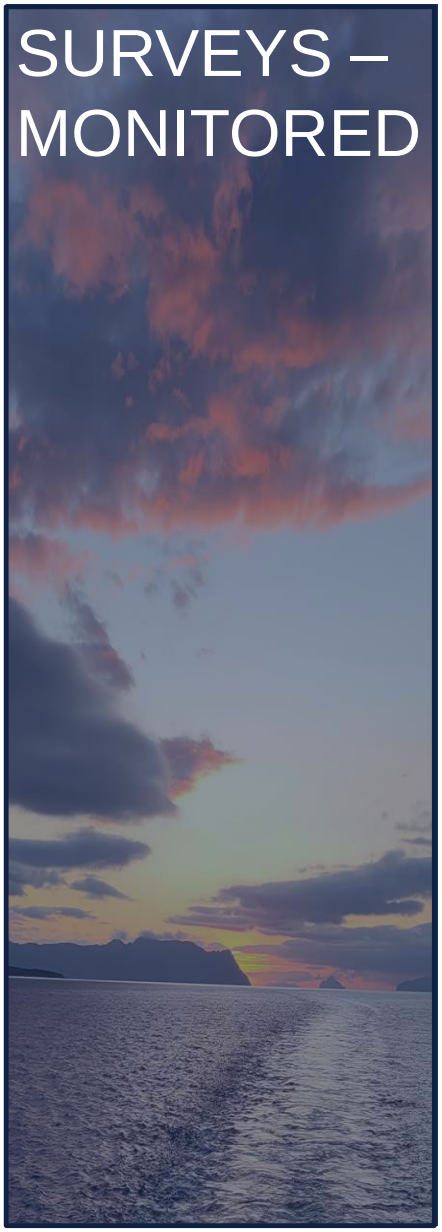




SURVEYS – MONITORED

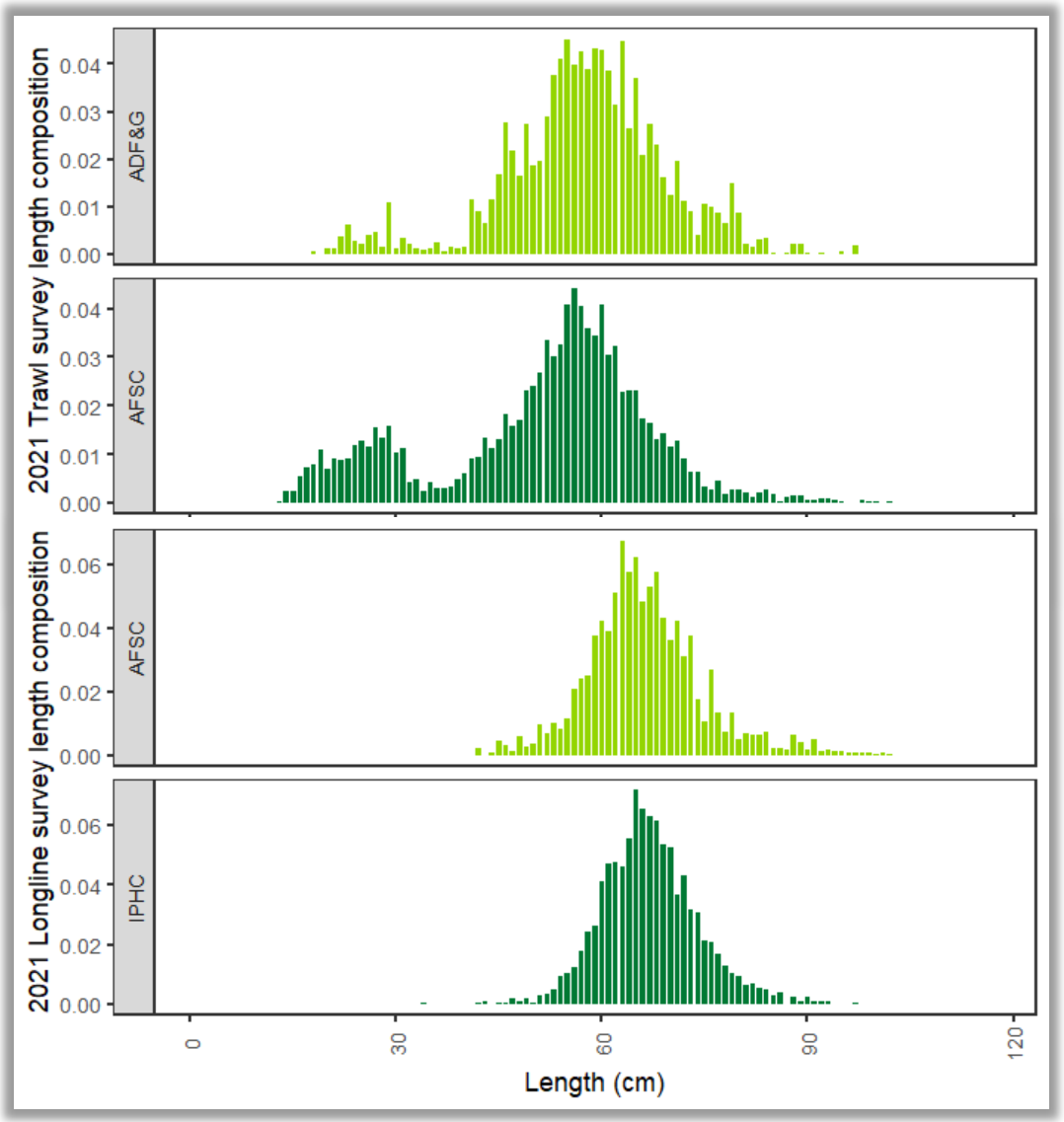
- IPHC – adult pop'n
- ADF&G – picking up 2020 year class (particularly around Kodiak

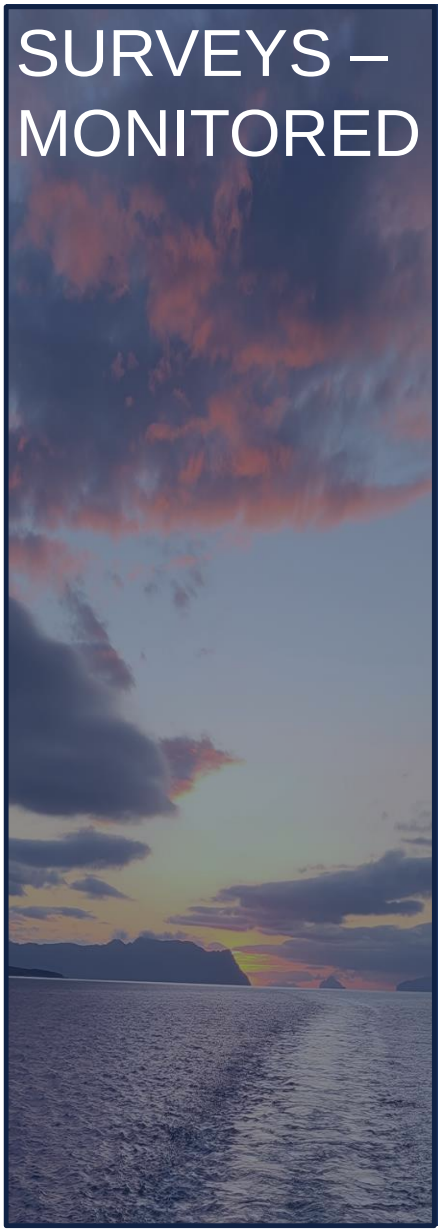




SURVEYS – MONITORED

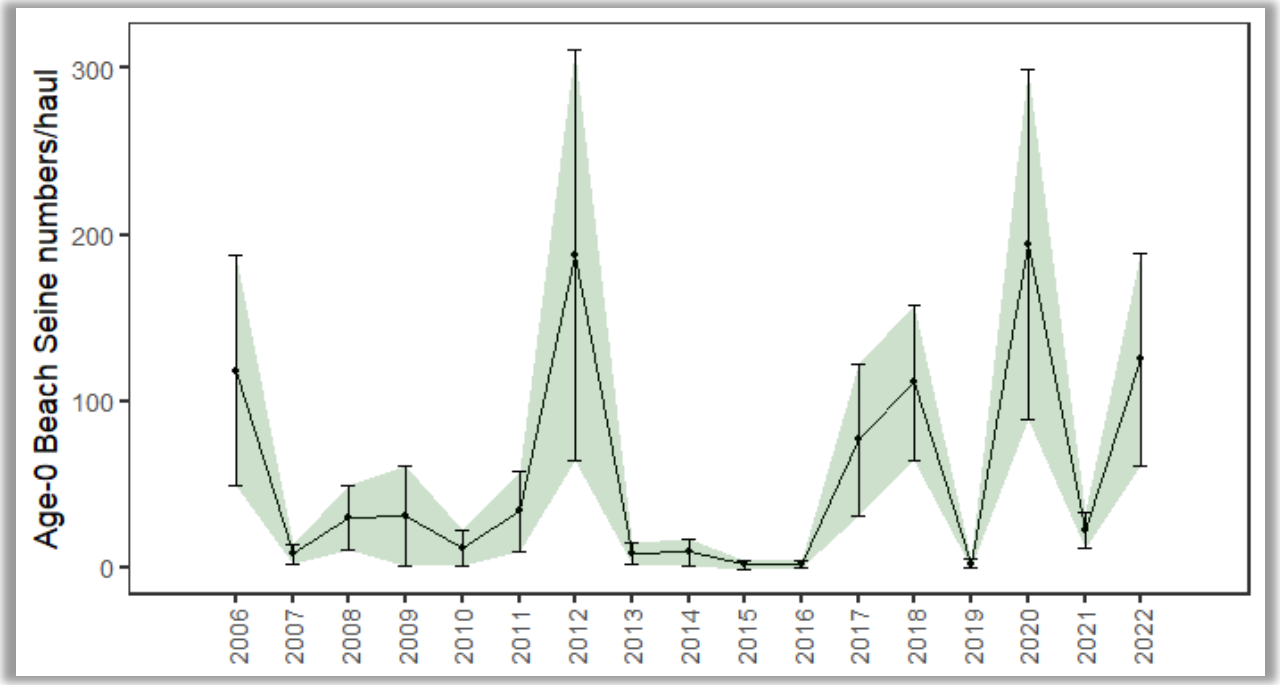
- Similarities in most recent length comps by survey gear types



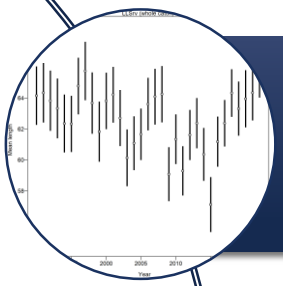


SURVEYS – MONITORED

- Increased 2022 year class

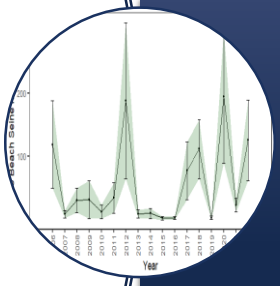


DATA – SUMMARY



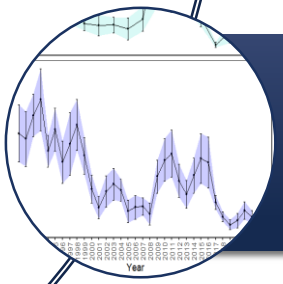
Mean length increasing

- Fishery trending towards deeper water
- No small fish in length comps

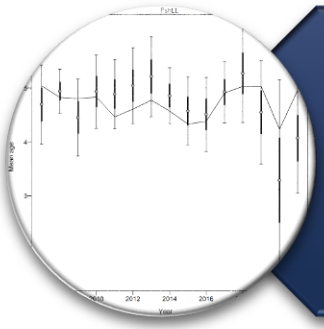


Increasing/positive trends

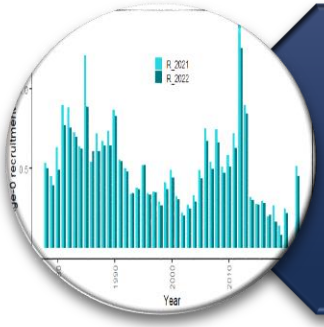
- IPHC, ADF&G, SWF bycatch all indicate increasing trends and see different aspects of pop'n
- 4 of 6 most recent years in age-0 survey larger year classes, or, not 0
- Last 3 years don't have a lot of marine heat wave days



Longline survey RPNs decreased



Data fits



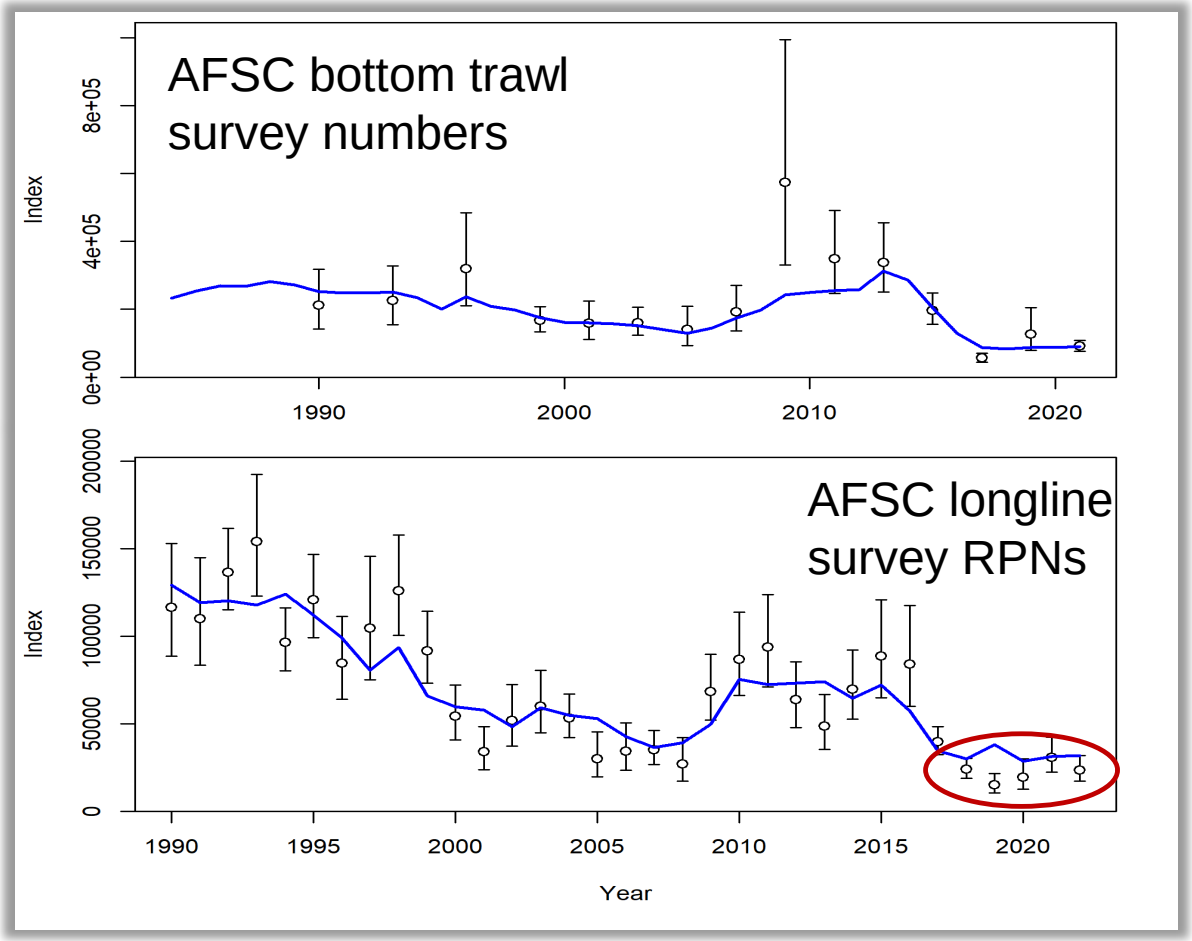
Model estimates

Summary

RESULTS

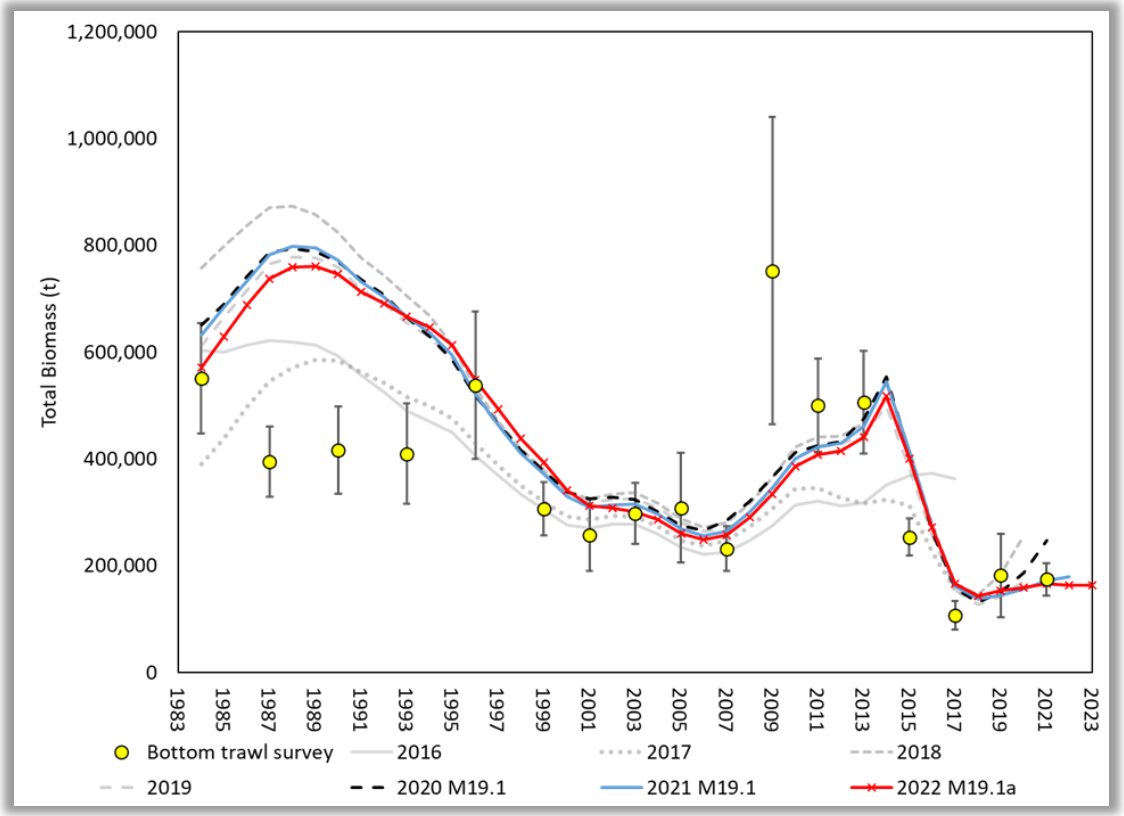
RESULTS: DATA FITS

- Continuing to fit 2021trawl survey precisely
- Expecting larger RPN from longline survey in 4 of last 5 years

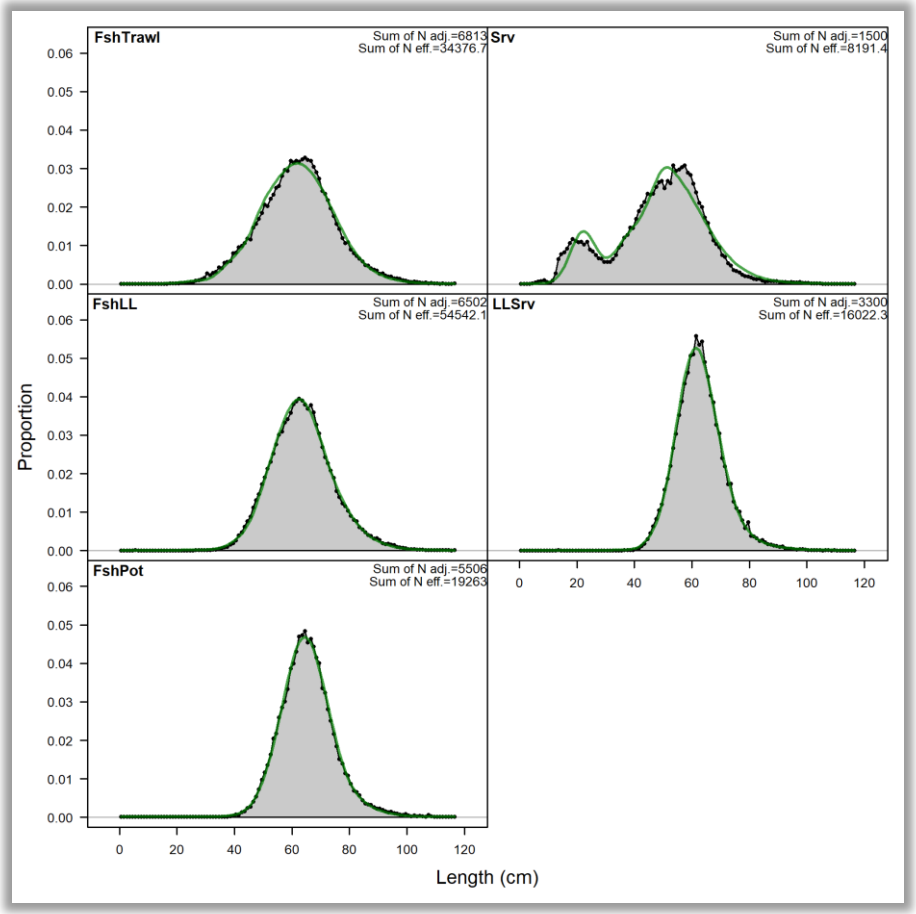


RESULTS: DATA FITS

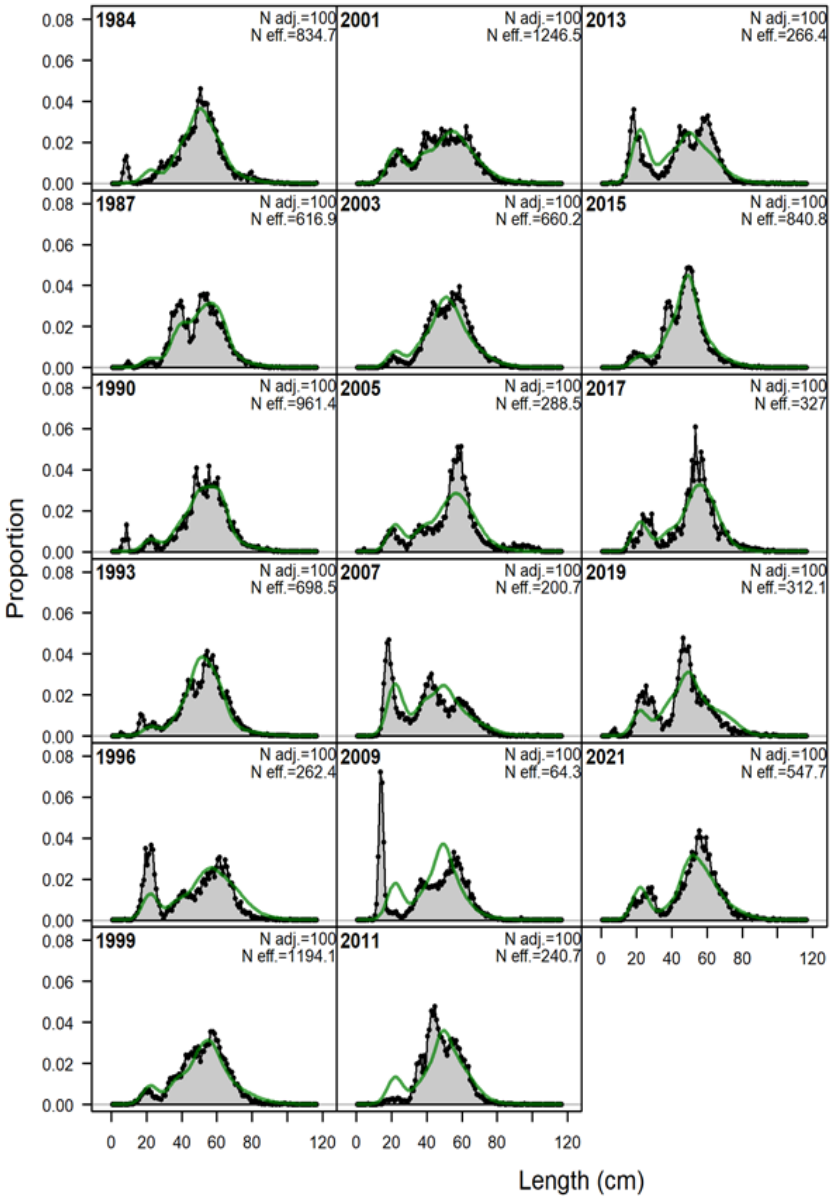
- Model retrospective ‘fit’ to biomass variable across assessments
- Slight downward turn in 2022 assessment

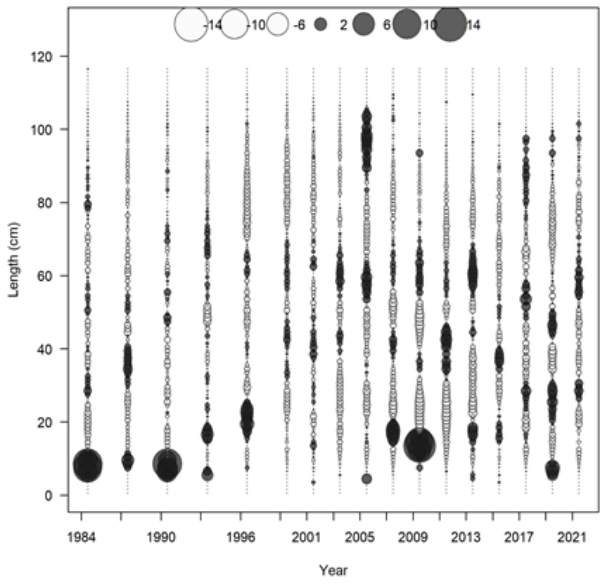


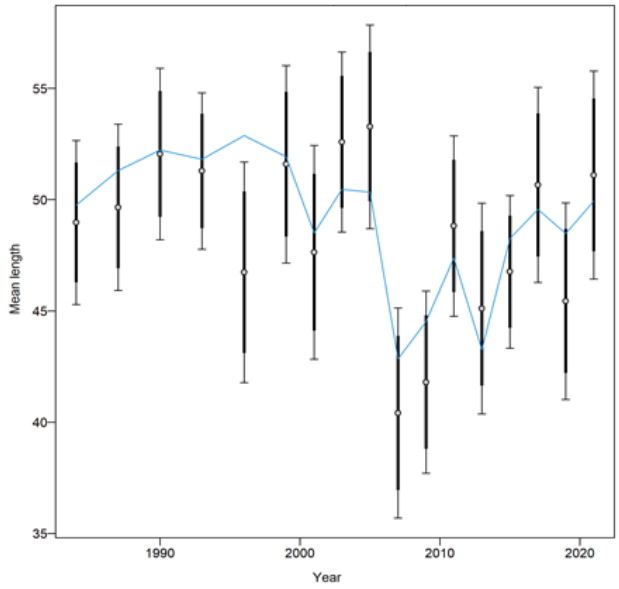
- In general, length comps fit well by model



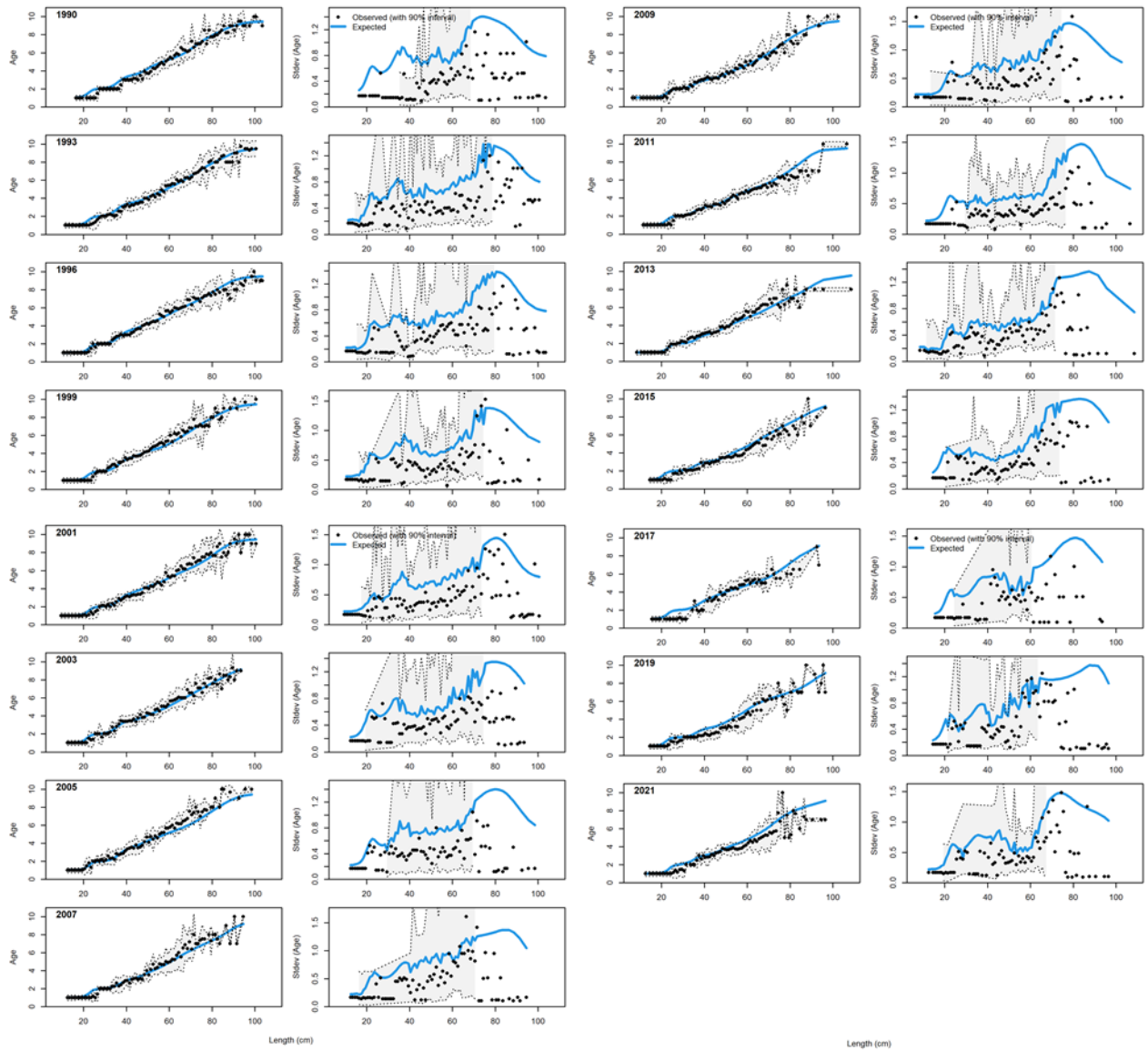
RESULTS: DATA FITS



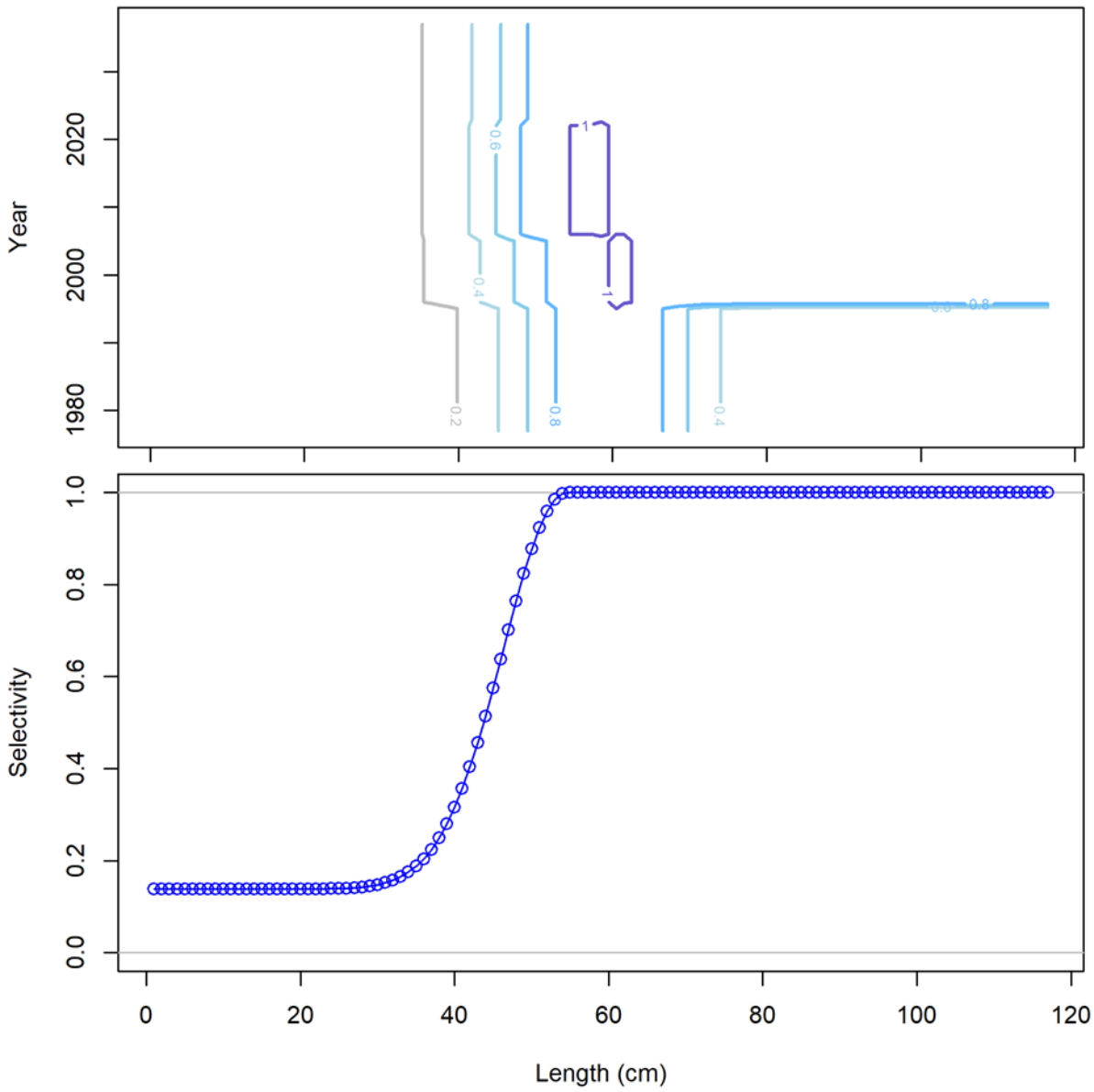


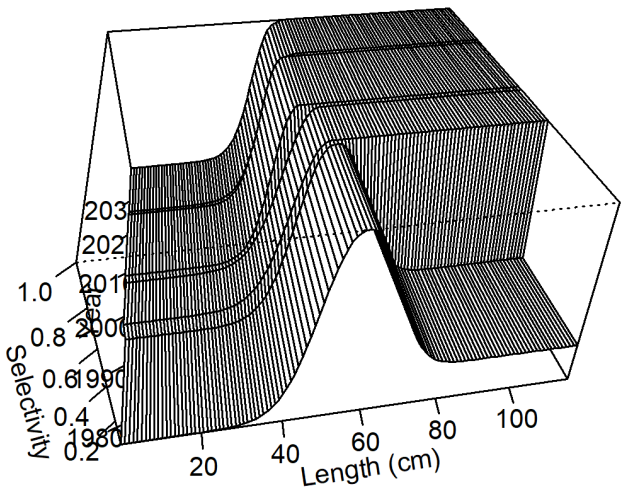


- AFSC bottom trawl survey length comps

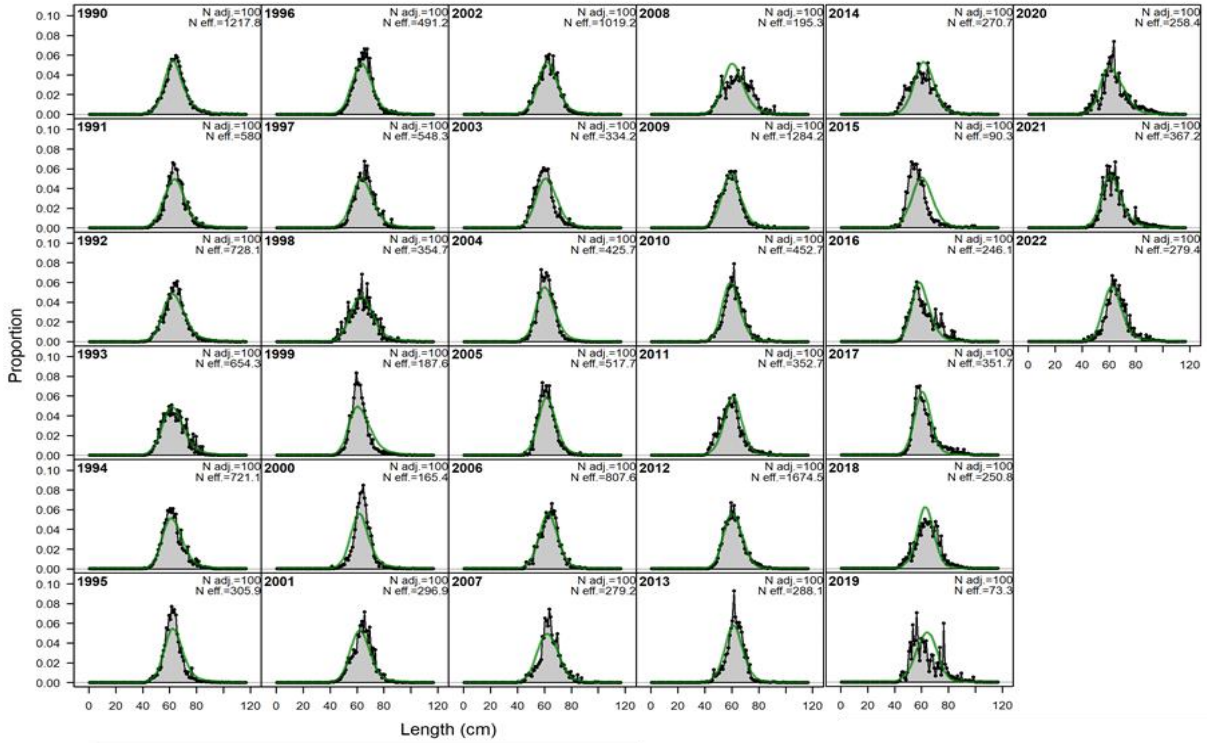


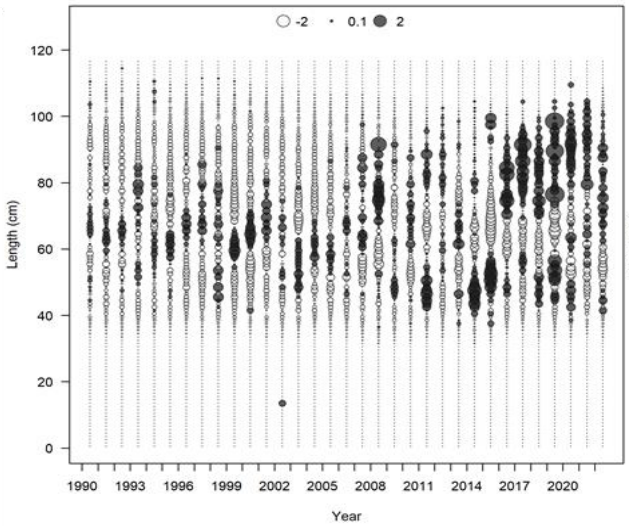
- AFSC bottom trawl survey conditional age-at-length

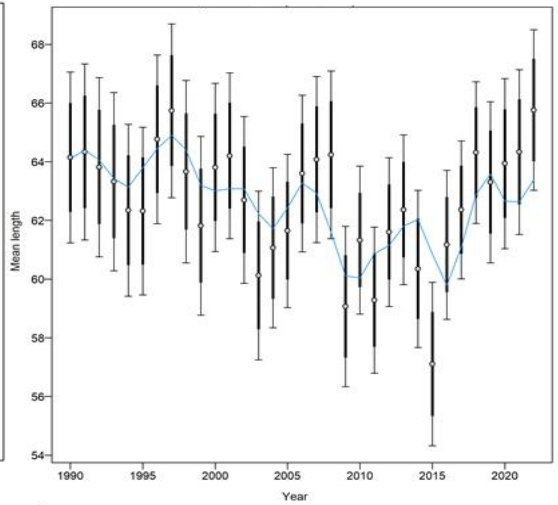




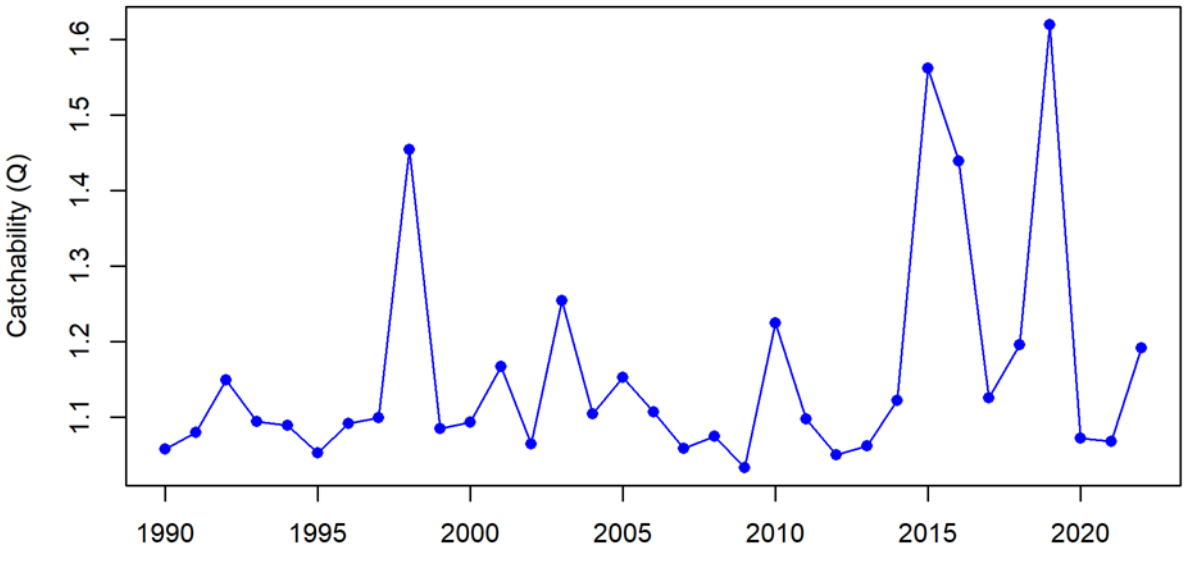
- AFSC bottom trawl survey selectivity

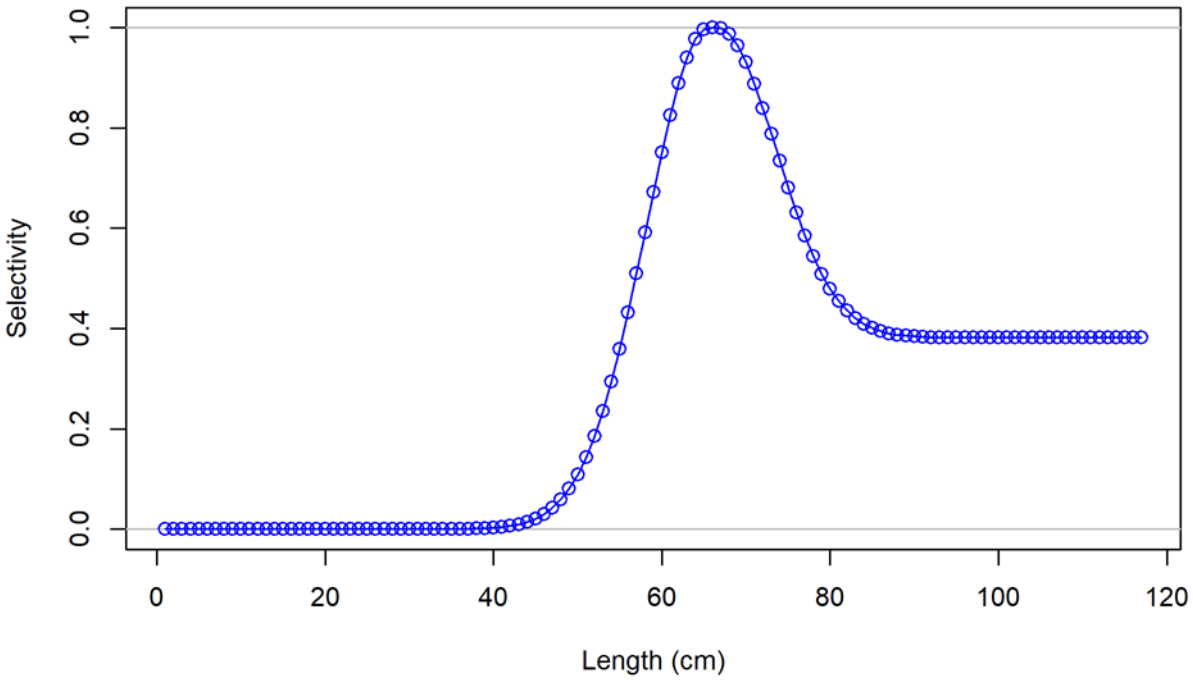




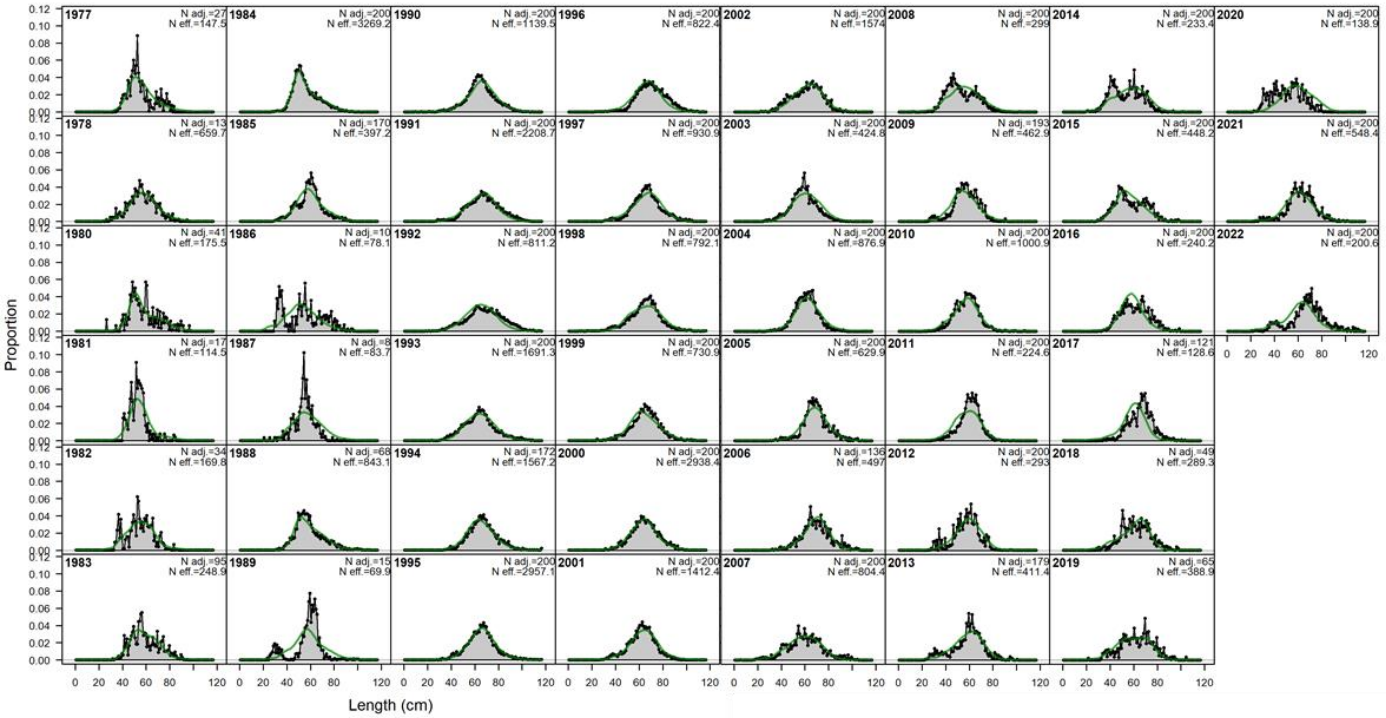


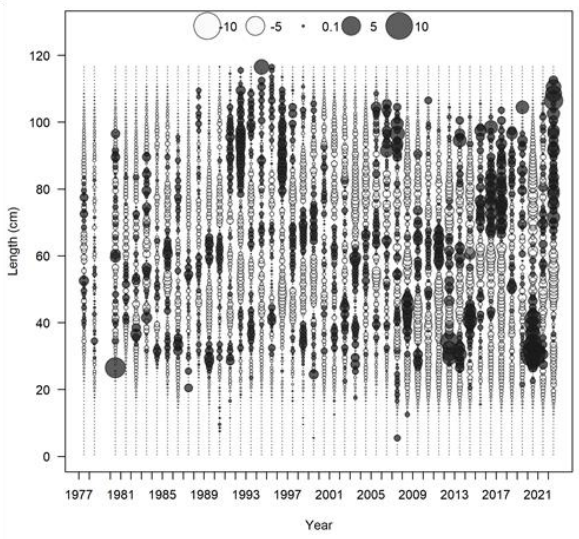
- AFSC longline survey length comps

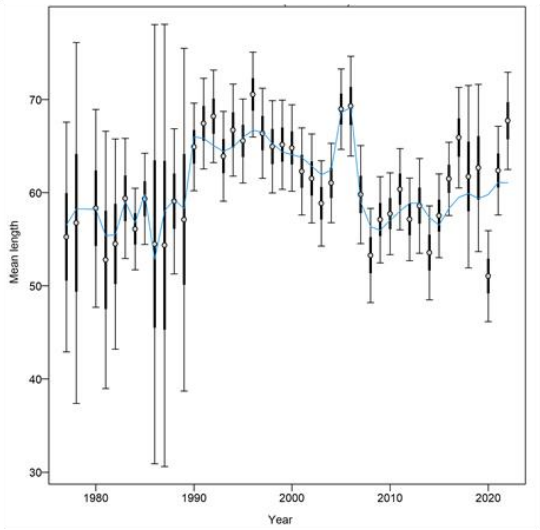




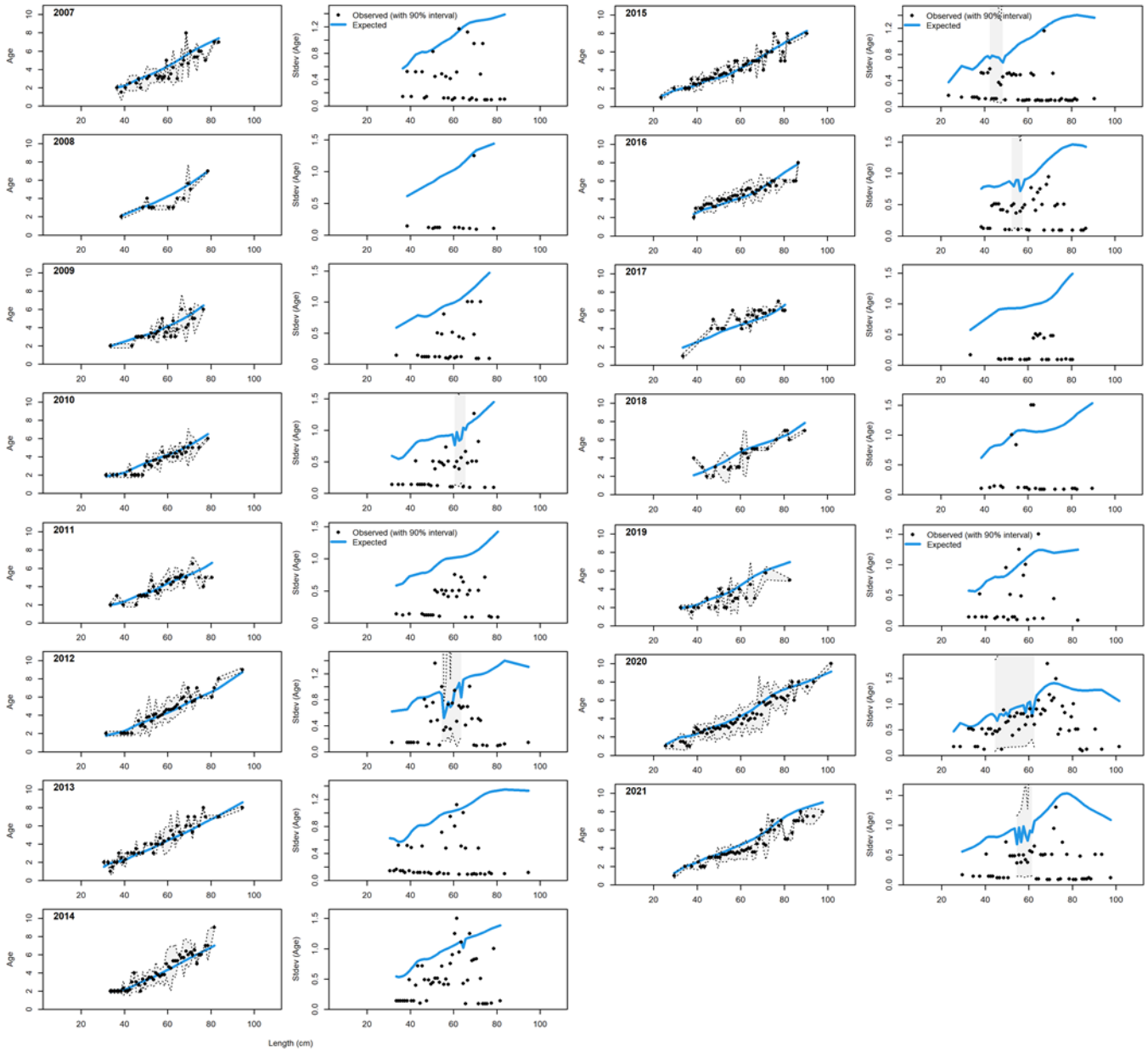
- AFSC longline survey catchability and selectivity



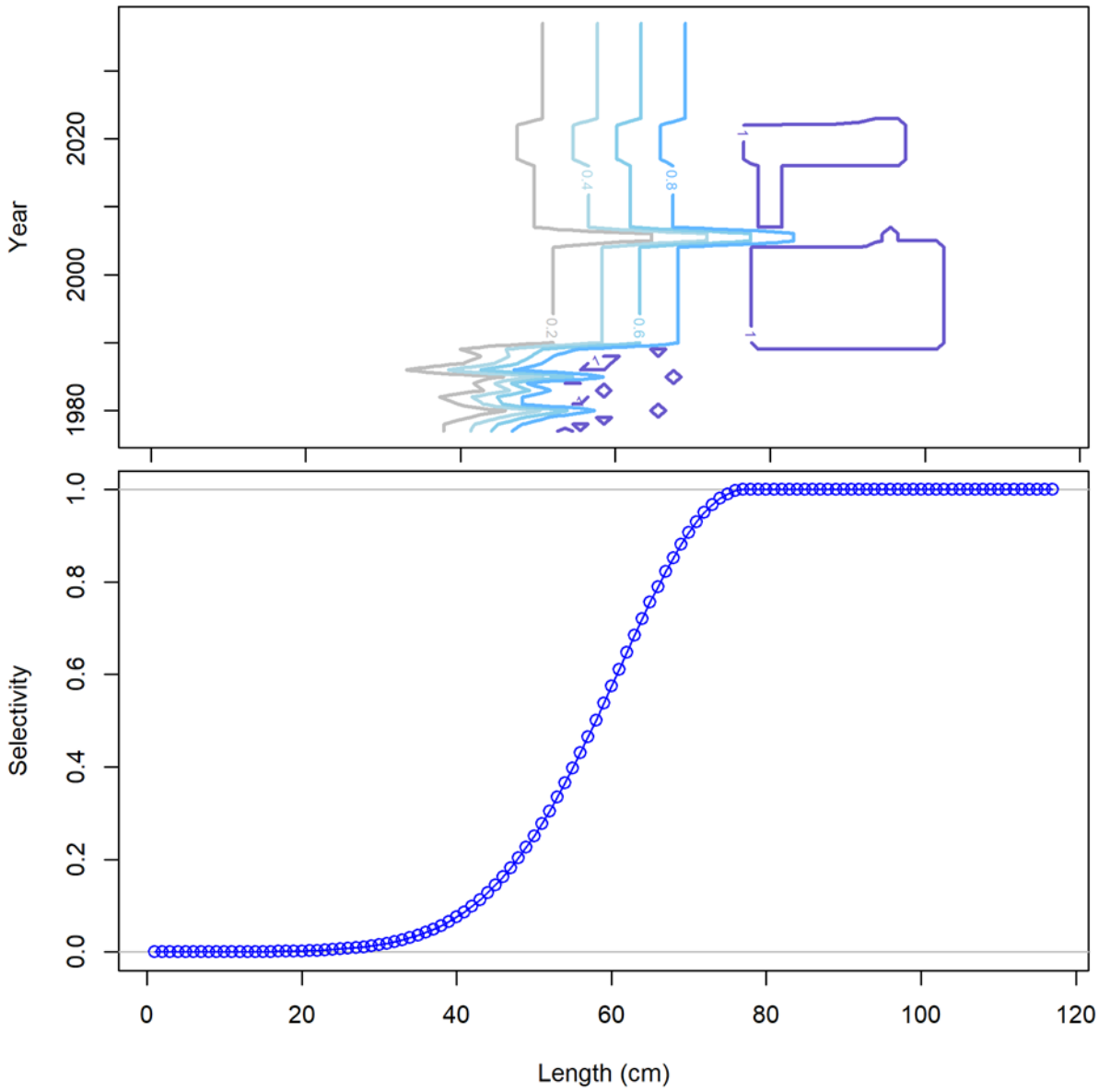


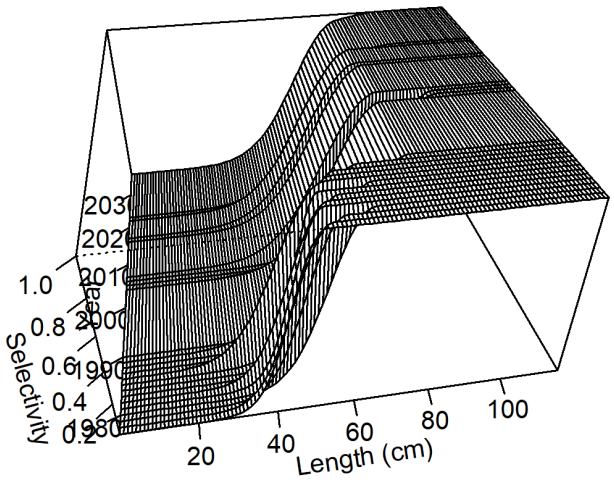


- Trawl fishery length comps

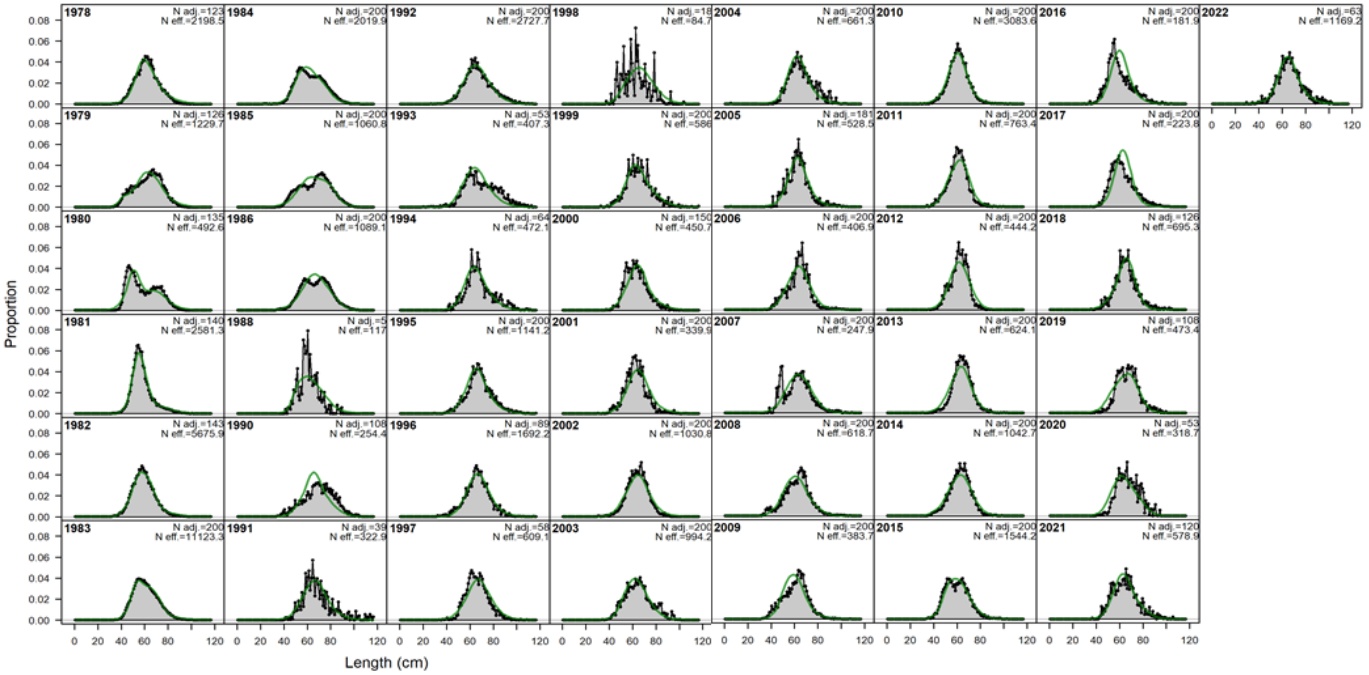


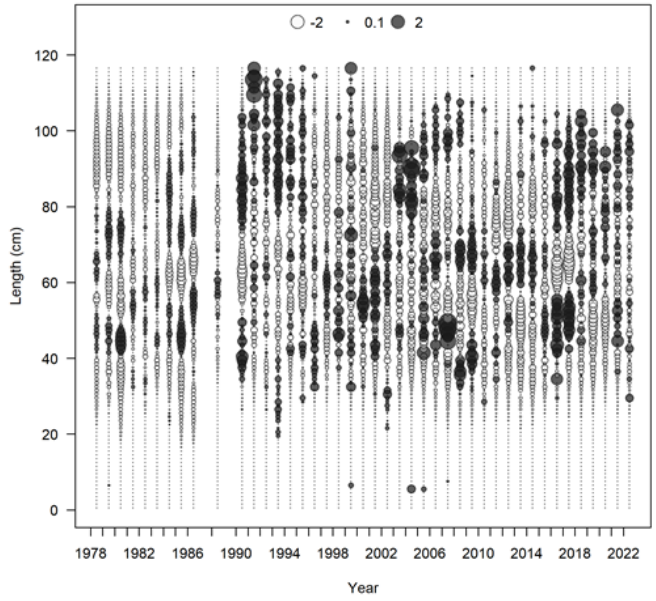
- Trawl fishery conditional age-at-length

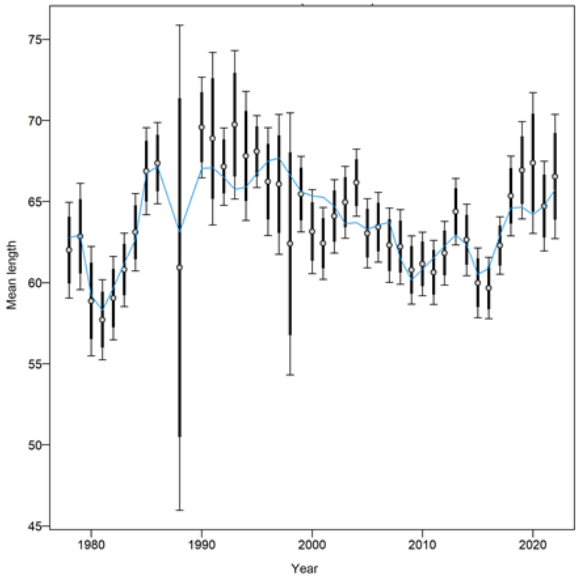




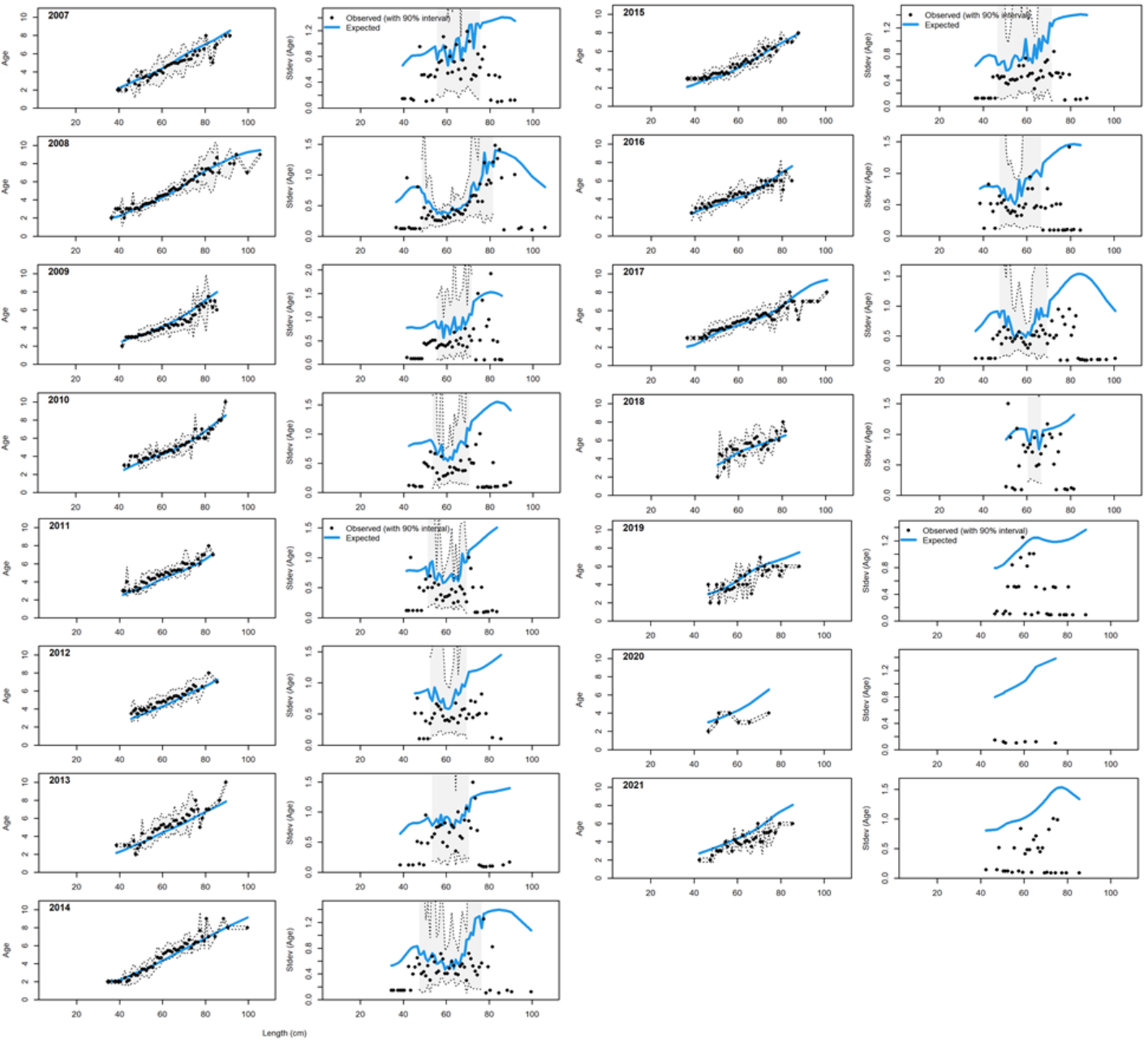
- Trawl fishery selectivity



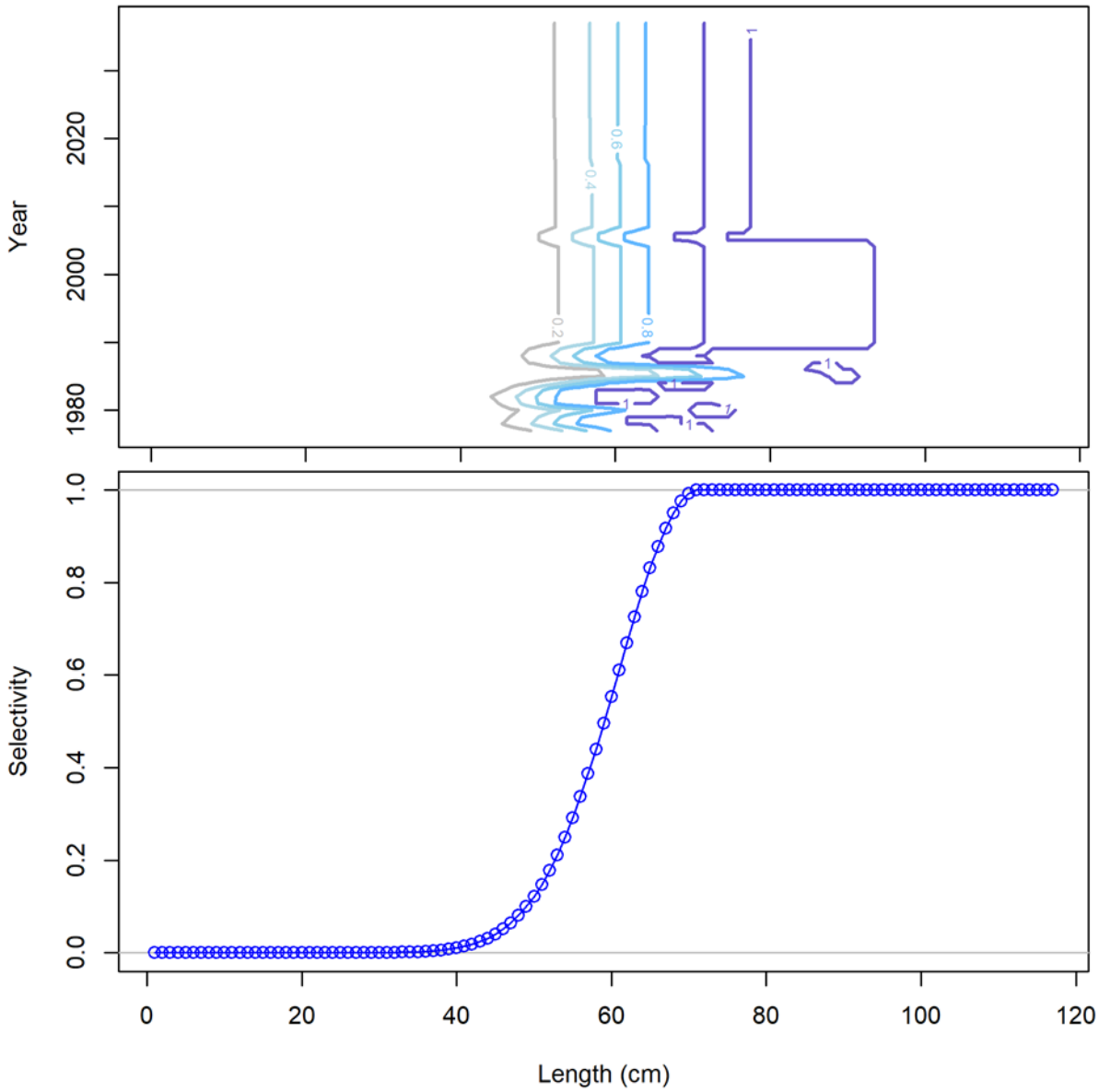


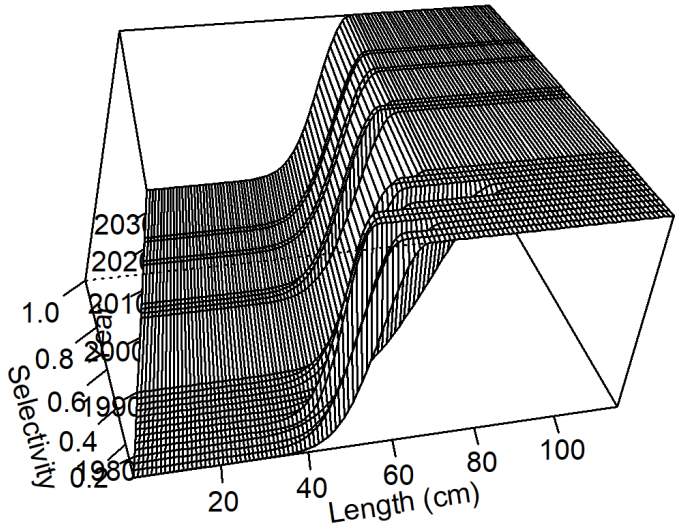


- Longline fishery length comps

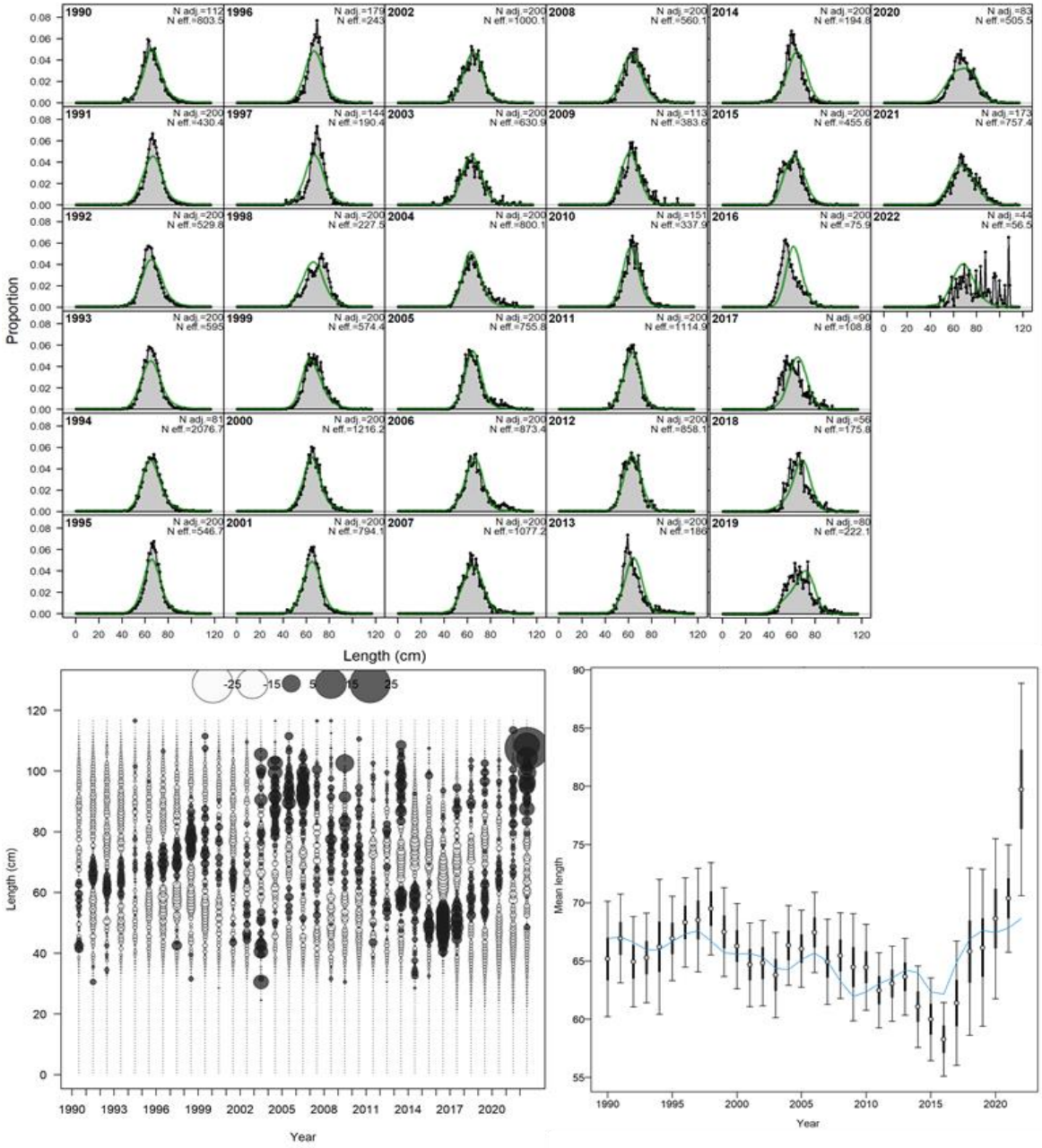


- Longline fishery conditional age-at-length

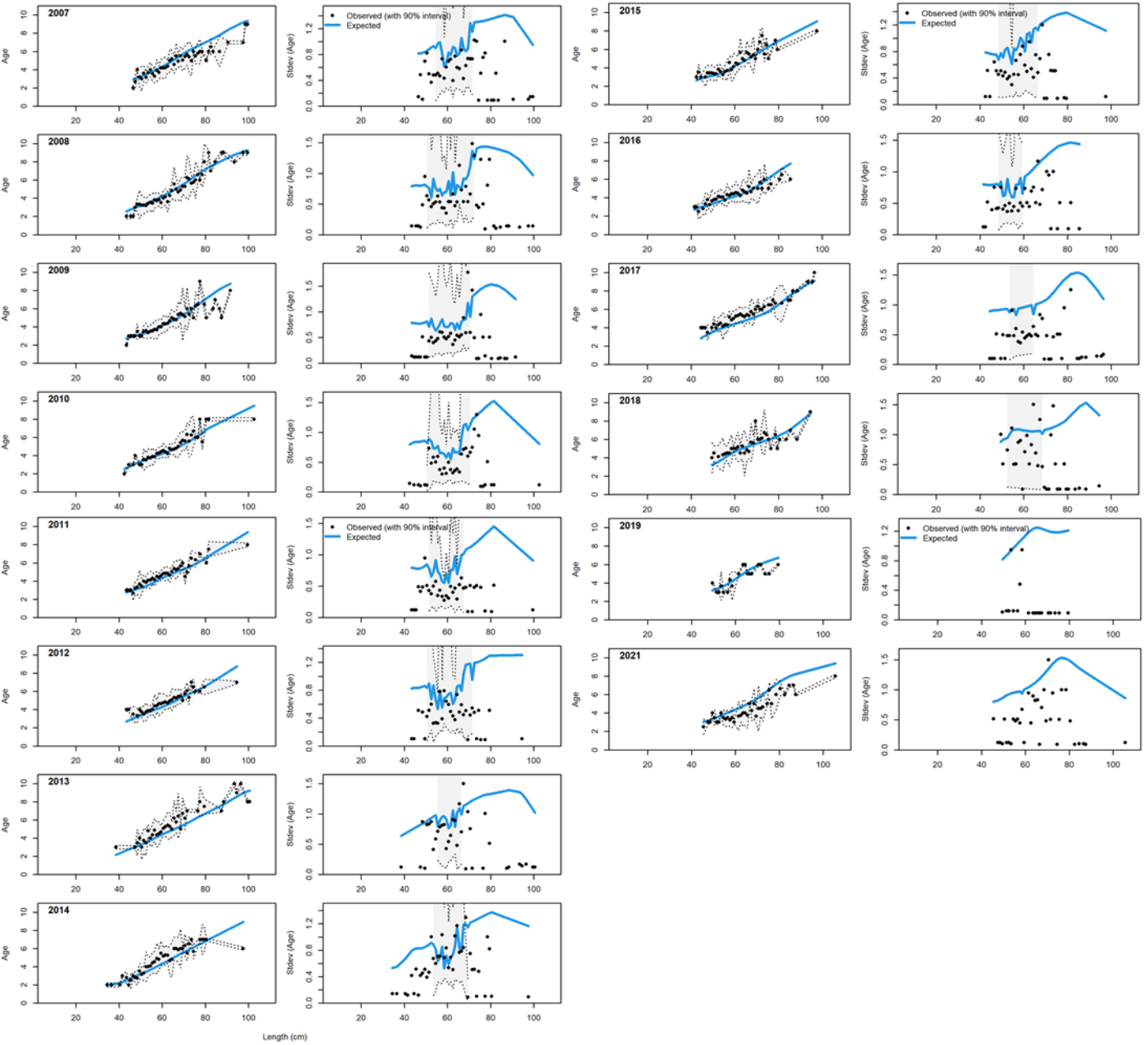




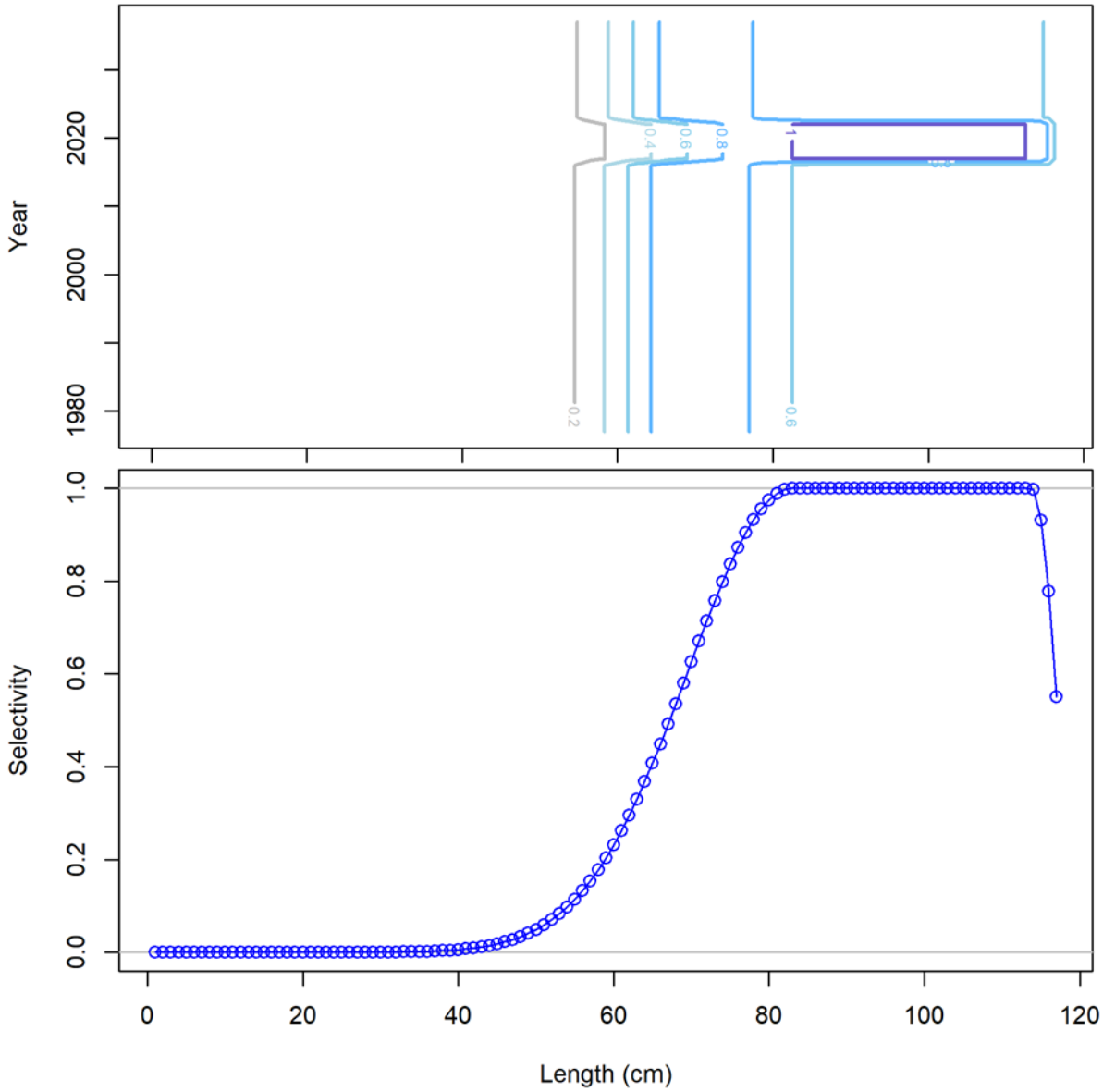
- Longline fishery selectivity

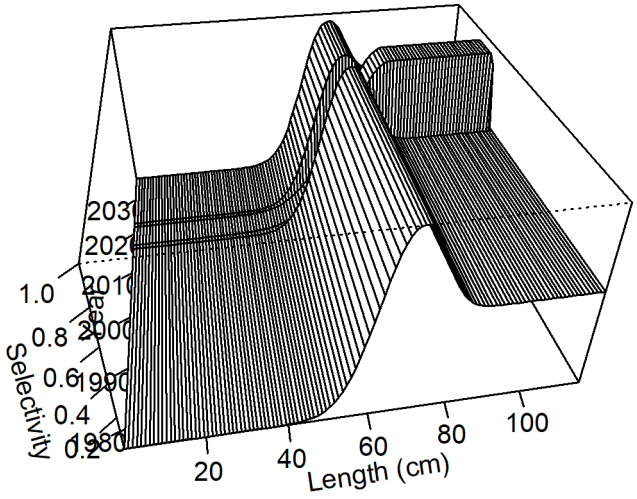


- Pot fishery length comps



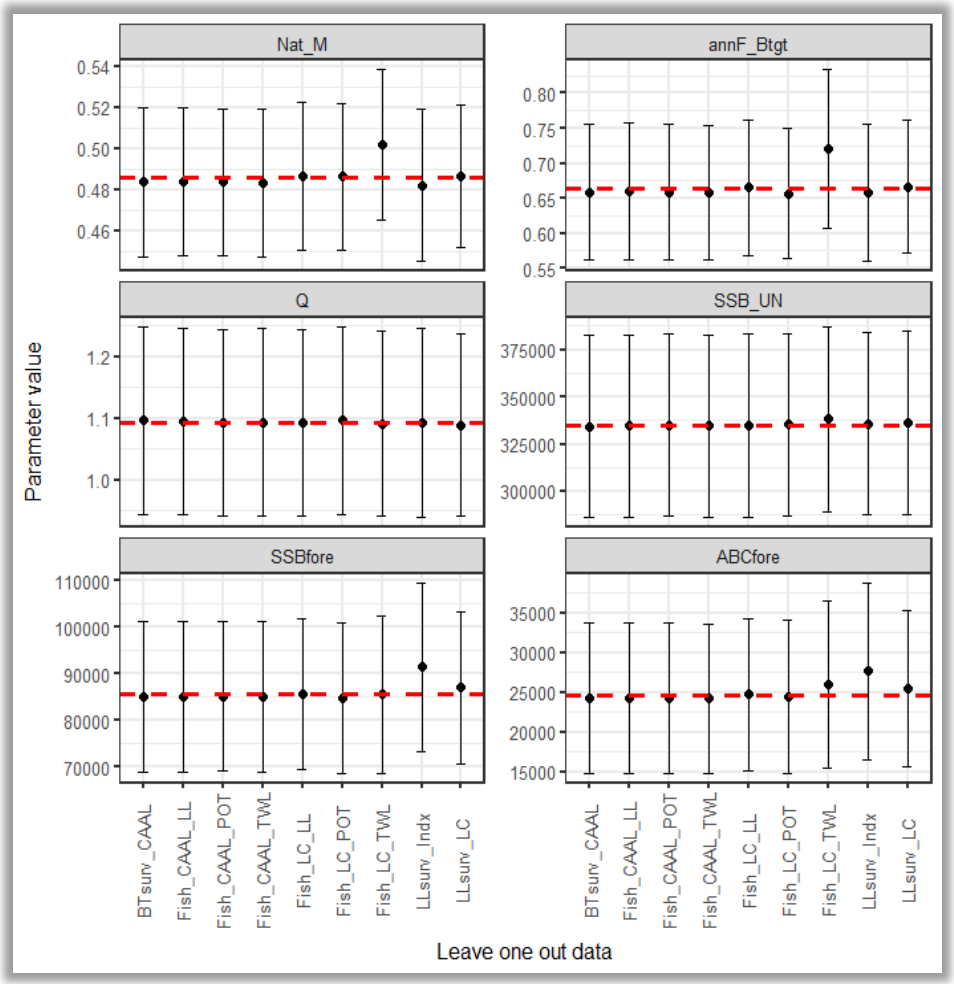
- Pot fishery condition age-at-length

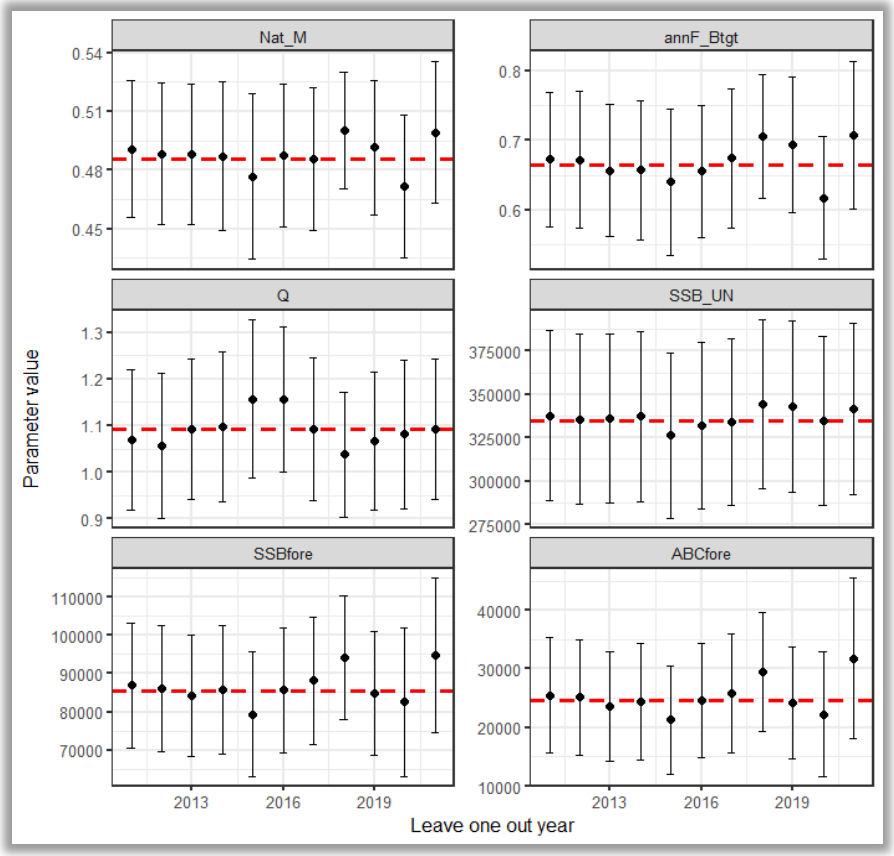




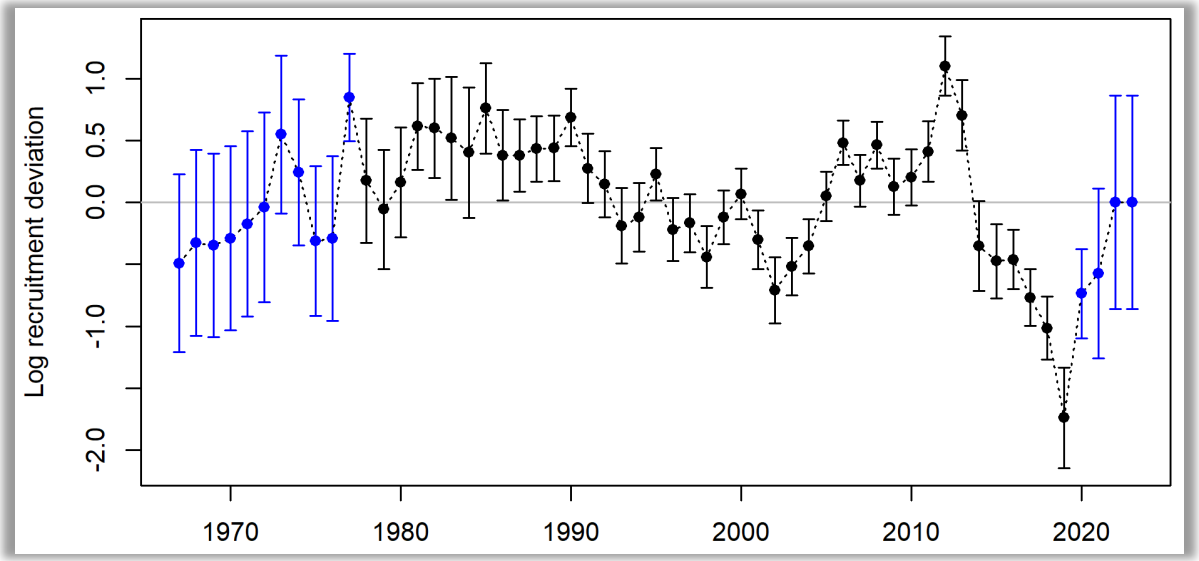
- Pot fishery selectivity

- Model diagnostics:
  - Leave-one-out: 2022 influential, w/in that LL survey index on biomass, Trawl length comp on mortalities
  - Jitter: (CV of 0.05 and 50 runs) 45 of the 50 converged; 78% at MLE

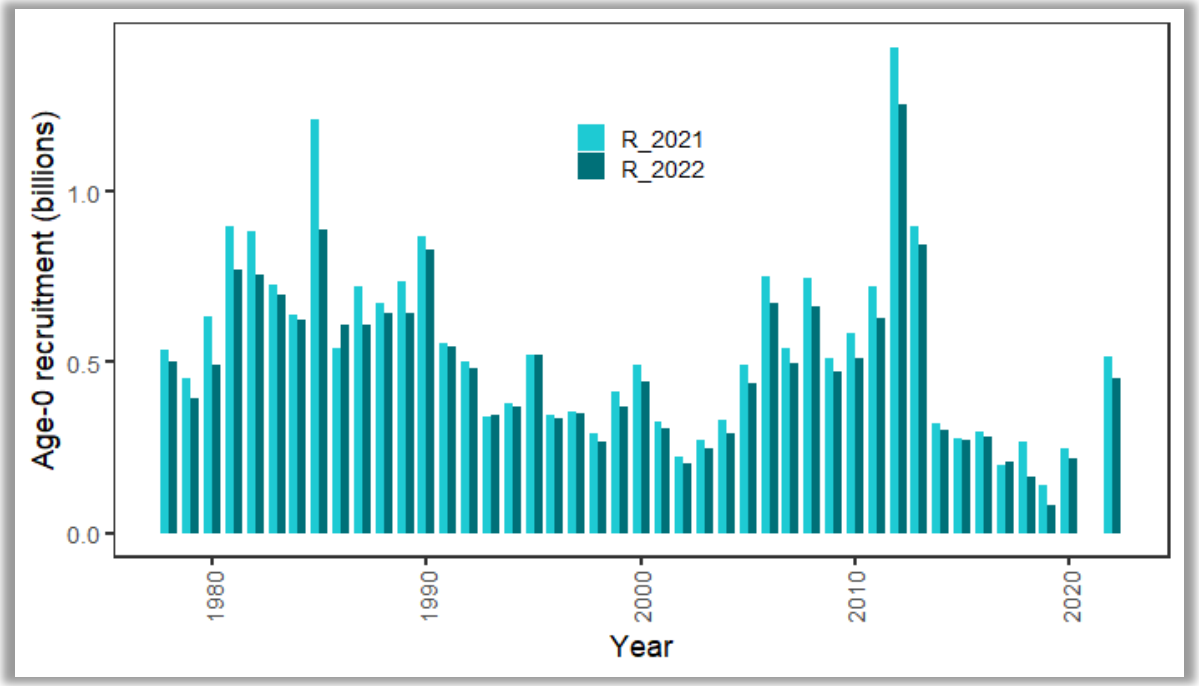


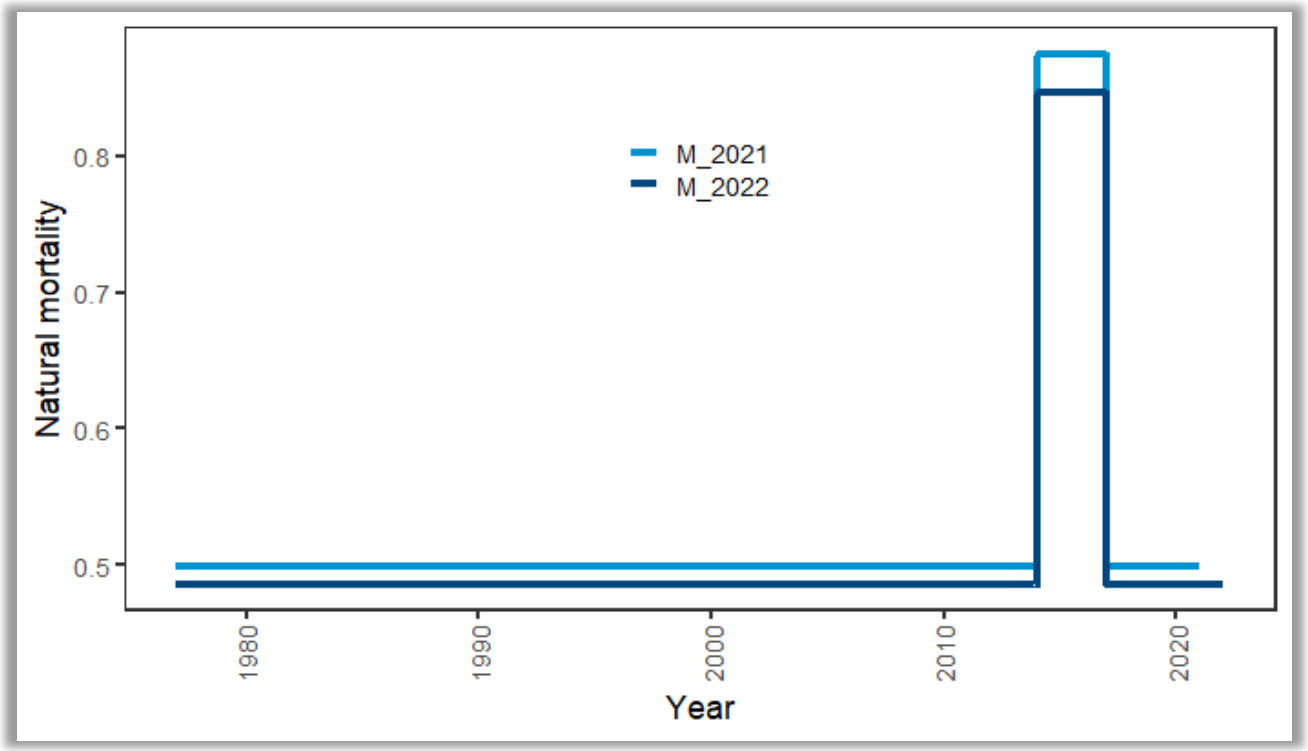


- Below average recruitment since 2014 (following a stanza of above avg recruitment)



- Recruitment decreased across the board in the 2022 assessment compared to 2021

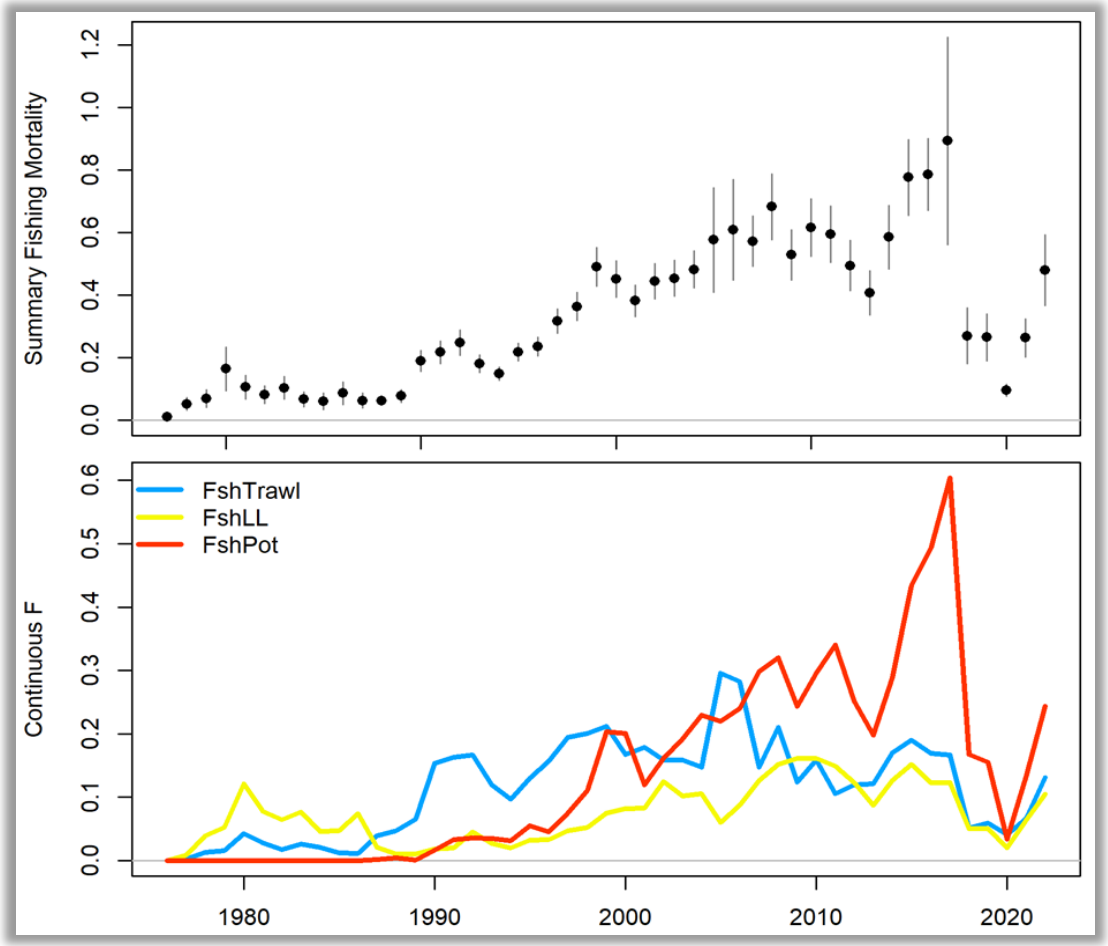




- M decreased in 2022 assessment compared to 2021

RESULTS: PARAMETER ESTIMATES

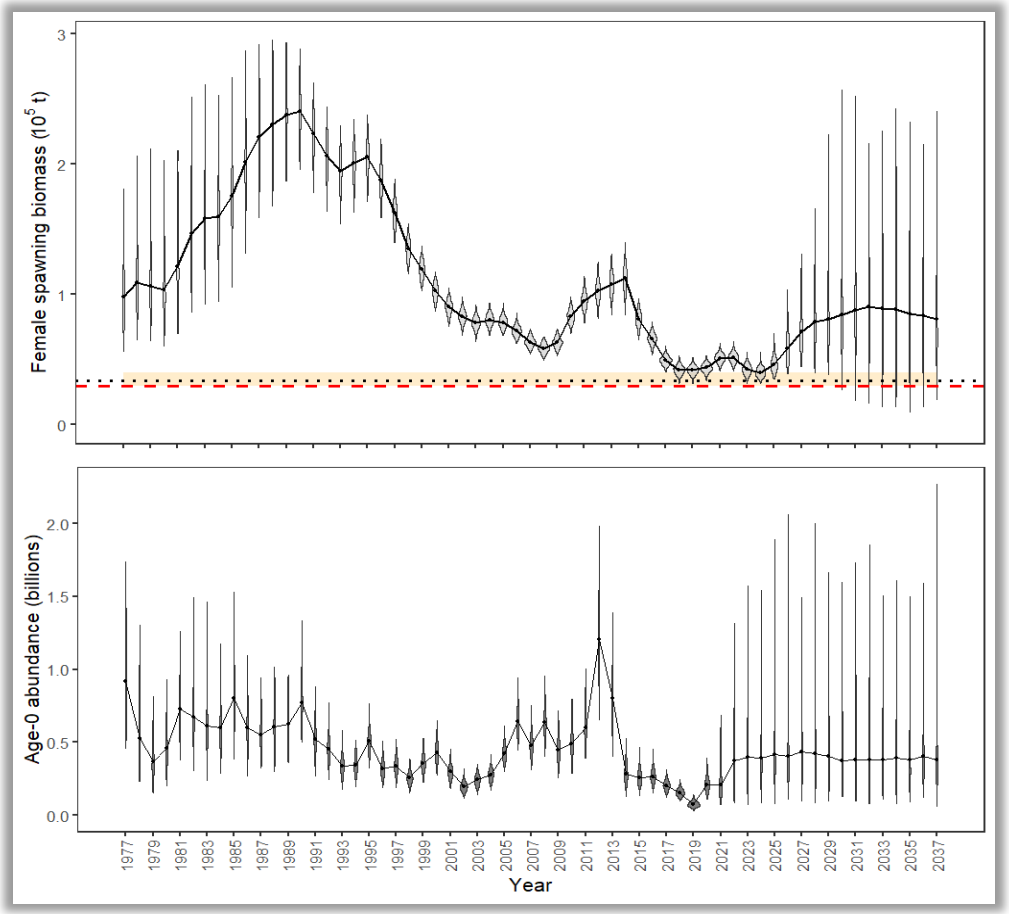
- F increased in 2022 for all fleets, Pot fleet continues to be primary source of mortality



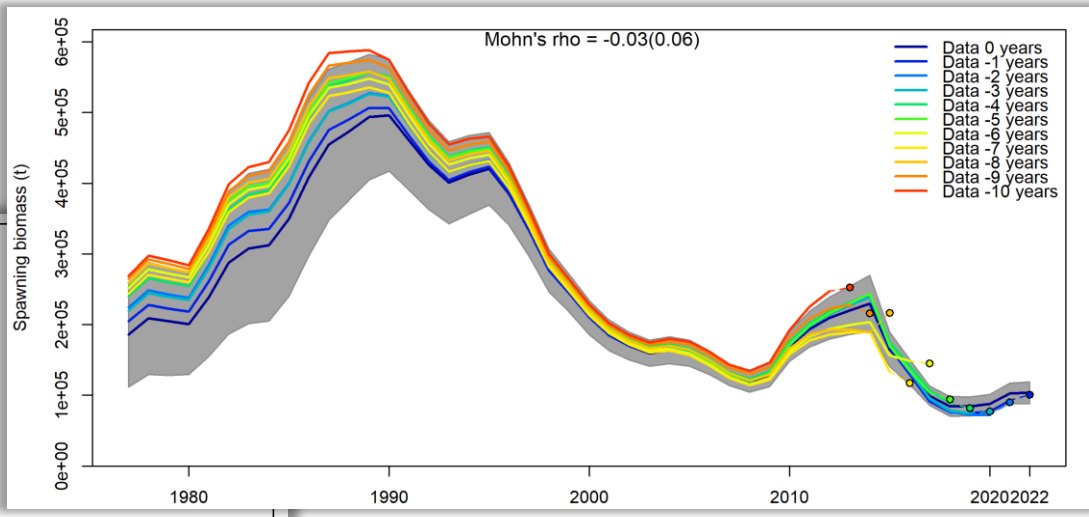
RESULTS: PARAMETER ESTIMATES

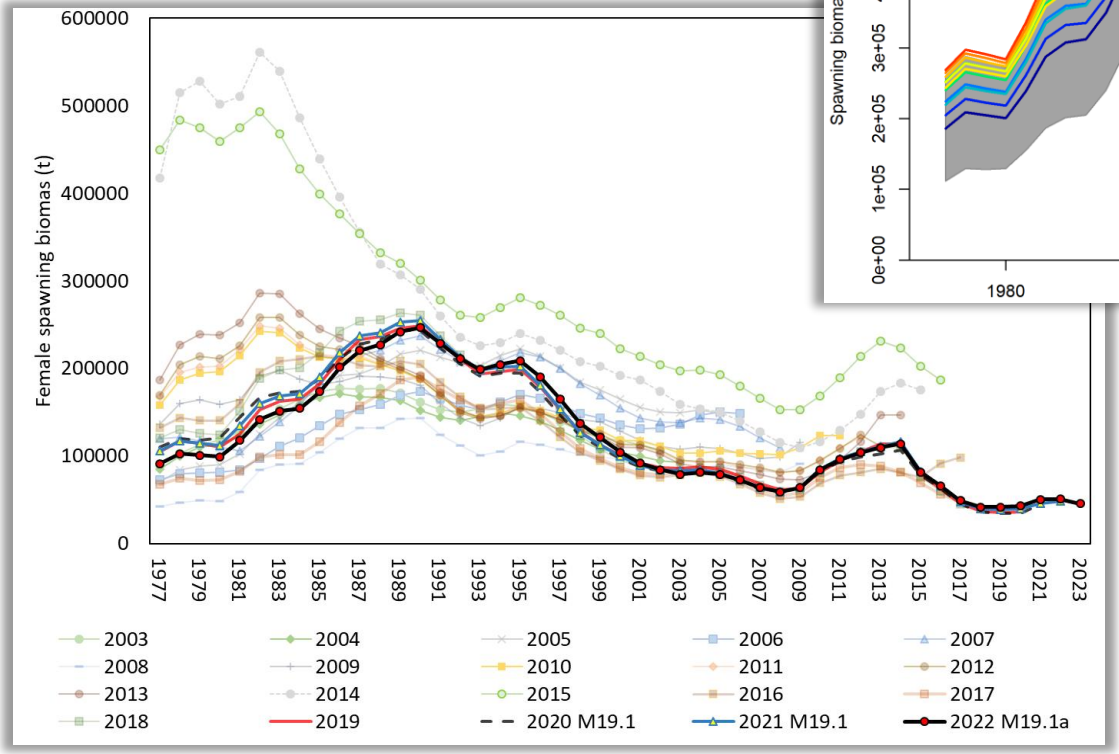
- SSB skipping along $B_{20\%}$, projected to increase after 2024

- Low recent recruitment estimates with precision, projected average recruitment larger than recent recruitments



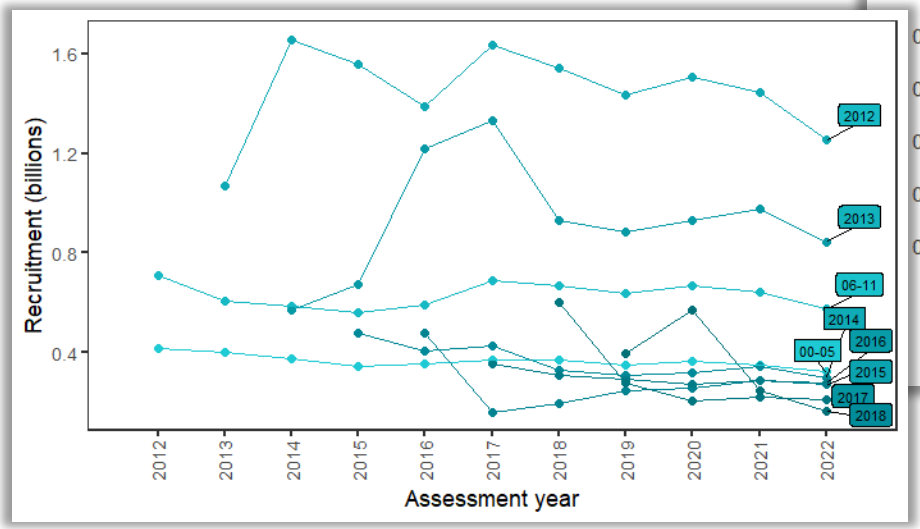
RESULTS: TIME SERIES

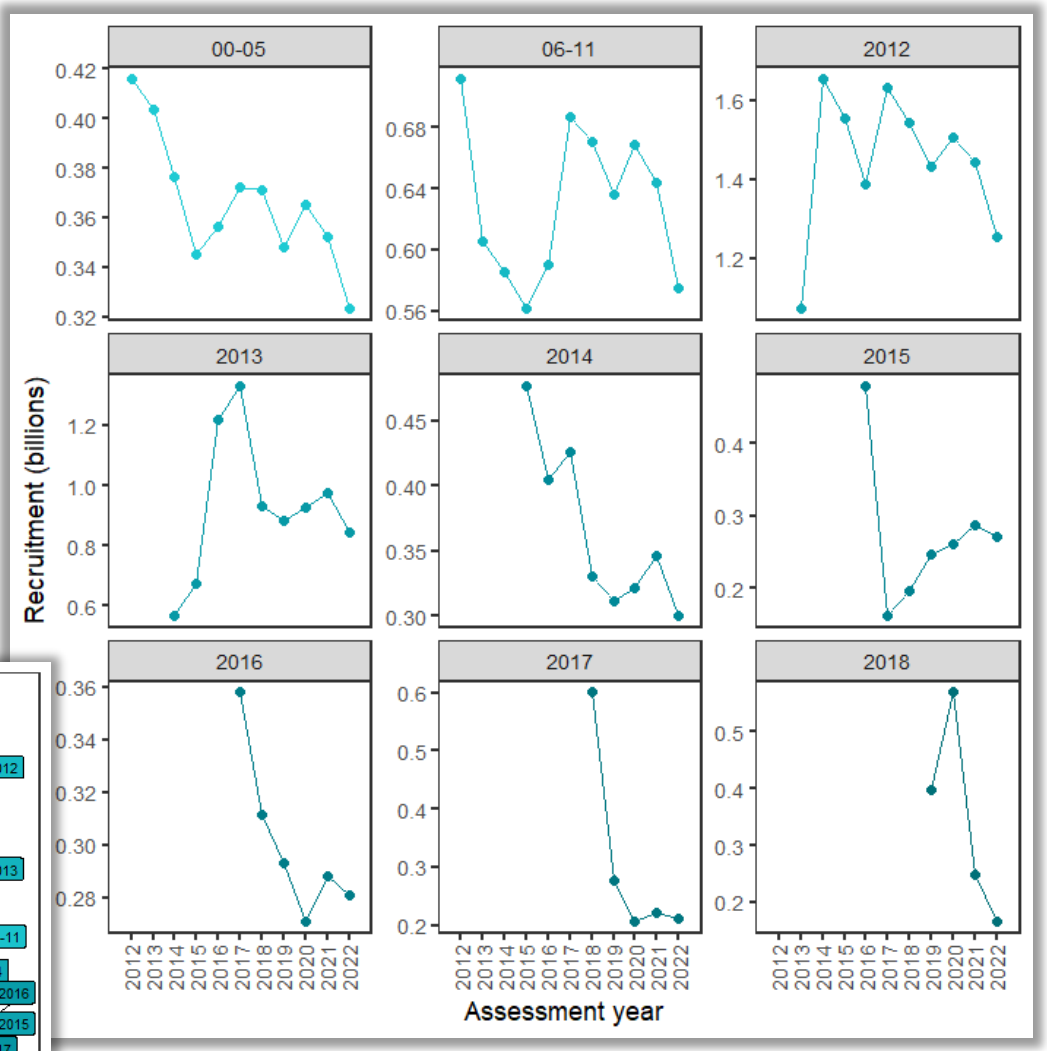




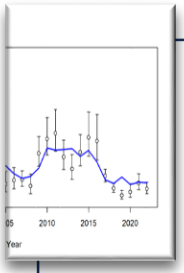
- Low recent SSB retrospective pattern in both model and data

- Large positive retrospective pattern in recruitment: continues to decrease year-class strength as data added

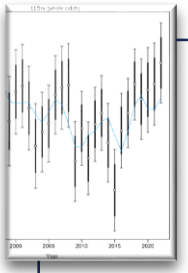




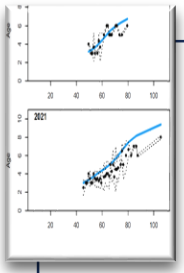
RESULTS - SUMMARY



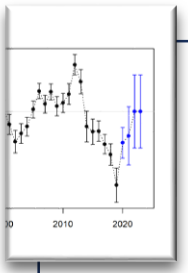
Model fitting bottom trawl, consistently expecting larger RPNs than what has been observed



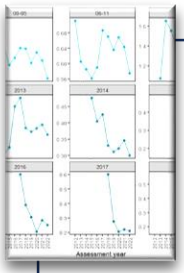
Fitting comp data relatively well, not fitting increase in mean length



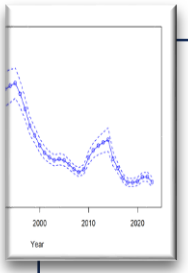
Conditional age-at-length fit degrading with new data



Estimating below average year-class strength since 2014



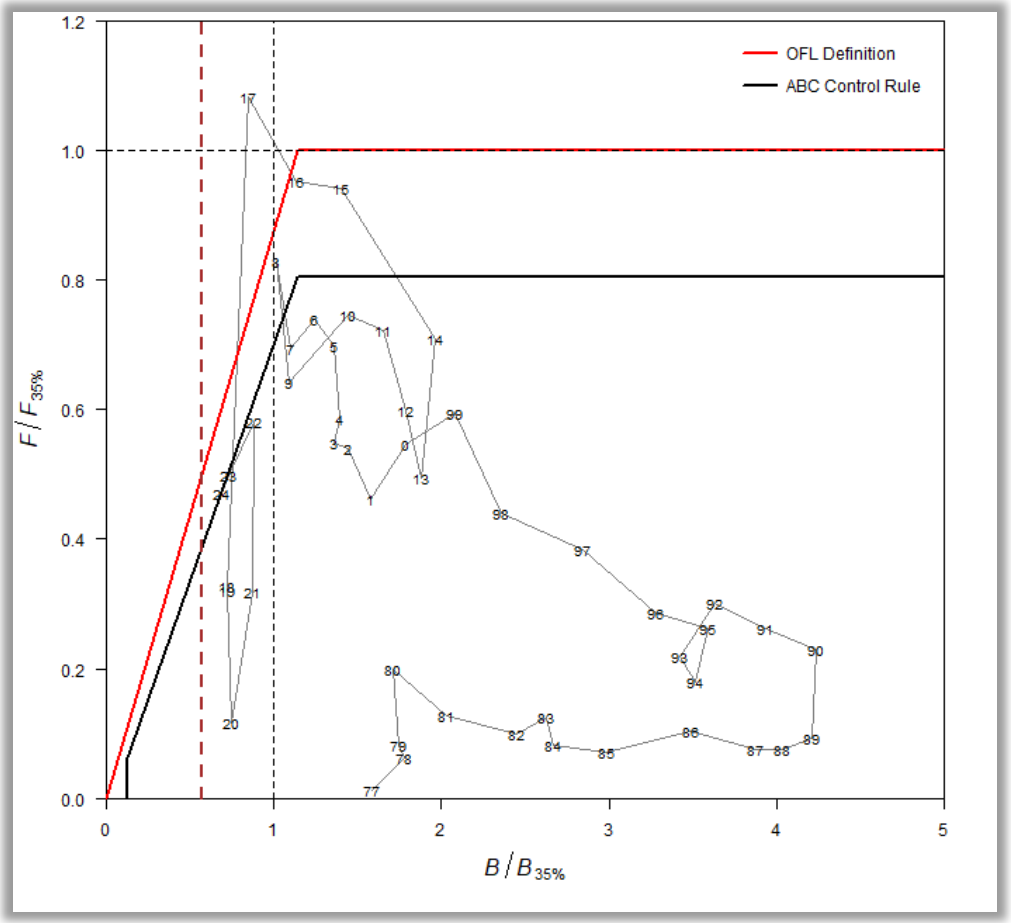
Large retrospective pattern in estimated year-class strength, continues to decrease with each assessment



Projecting spawning biomass to decrease through 2024, then increase (if average recruitment realized from 2022 on)

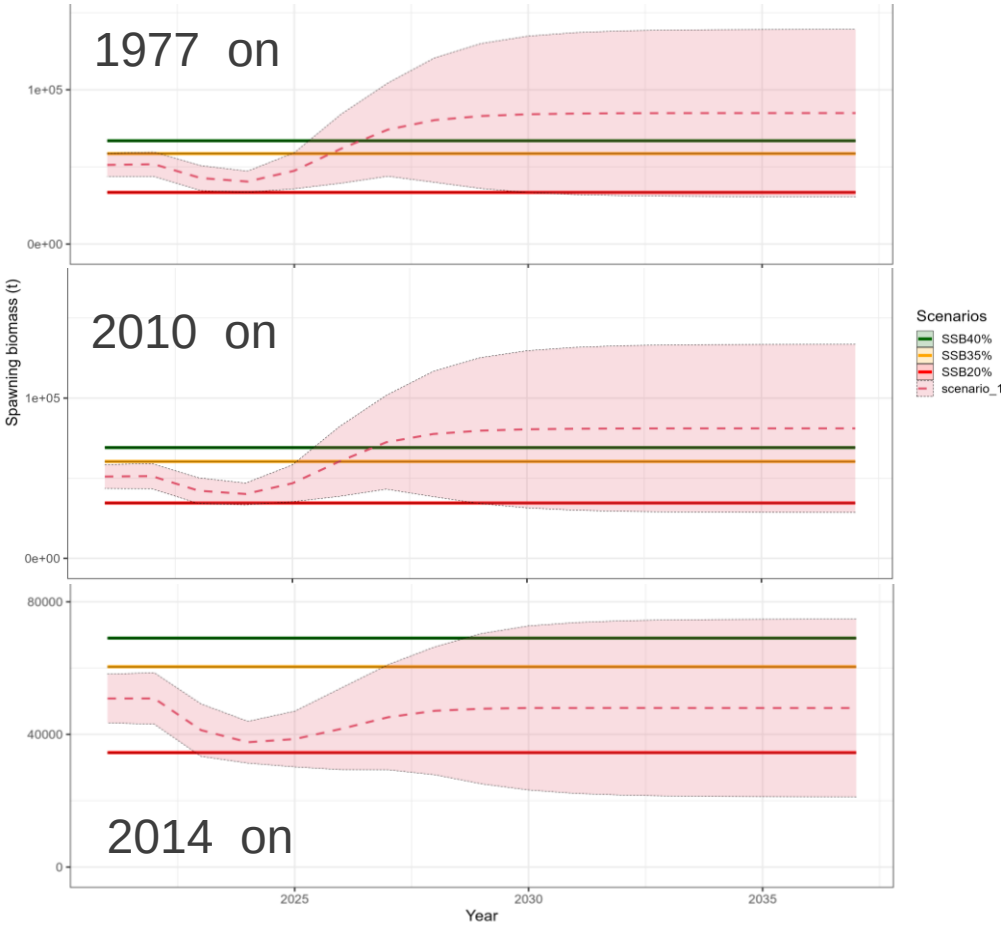
STOCK STATUS

- Tier 3b: on the ramp
- Moving down the ramp from 22 to 24
- Estimated to be above $B_{20\%}$ (dashed red line), 2023 = $B_{25.5\%}$
- Projected to decrease to $B_{24\%}$ in 2024



RISK TABLE

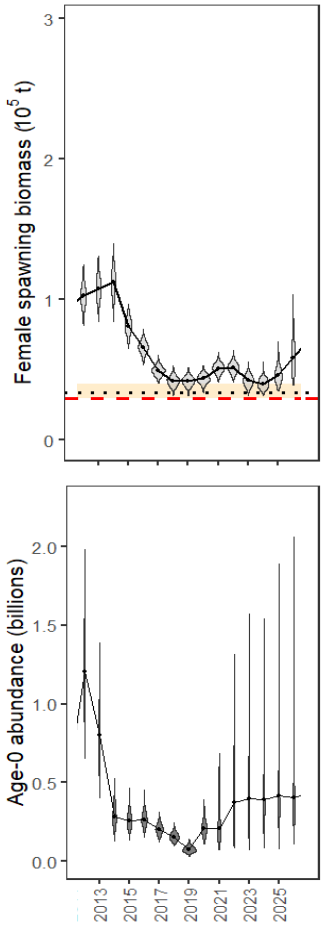
- Assessment considerations:
  - Positive residual pattern in Longline survey RPNs
  - Below average recruitment estimated in last 7 years, and has undesirable retrospective pattern
  - Projected average recruitment hasn't been estimated since 2013
  - Mid- to long-term outlook of stock sensitive to recruitment assumptions used in projections
  - Due to these concerns: Level 2



	Status quo	2010 on	2014 on
2023 ABC	24,634	23,263	22,177

RISK TABLE

- Pop dy considerations:
  - Persistently low spawning biomass
  - Persistently low recruitmen
  - Level 2



- Environmental/ecosystem considerations:
  - Conditions have improved compared to recent past
  - Level 1
- Fishery performance:
  - Basin effect occurring?
  - Will look at spatial constriction of catch
  - Level 1

RISK TABLE

Assessment-related considerations	Population dynamics considerations	Environmental/ ecosystem considerations	Fishery Performance
Level 2: Substantially increased concern	**Level 2: Substantially increased concern**	Level 1: Normal	Level 1: Normal

- Overall:
  - No recommendations to reduce from maxABC
  - But, will continue to monitor assessment and population dynamics considerations

RECOMMENDATIONS

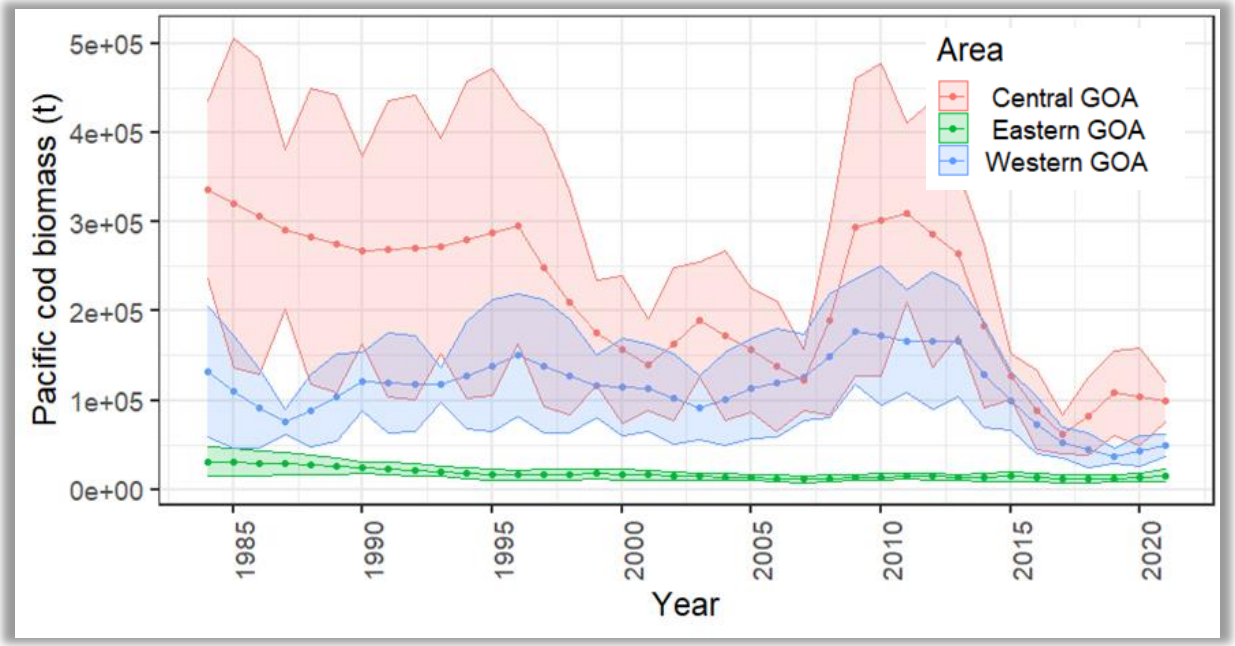
- Recommend Model 19.1a for 2023: 24% reduction in 2023 ABC compared to 2022

Quantity	As estimated or *specified last* year for: 2022	2023	As estimated or *specified this* year for: 2023	2024
M (natural mortality rate)	0.50	0.50	0.49*	0.49*
Tier	3b	3b	3b	3b
Projected total (age 0+) biomass (t)	178,961	199,841	163,477	193,510
Female spawning biomass (t)				
Projected	48,061	44,530	42,764	40,489
$B_{100\%}$	165,508	165,508	167,414	167,414
$B_{40\%}$	66,203	66,203	66,966	66,966
$B_{35\%}$	57,928	57,928	58,595	58,595
F_{OFL}	0.62	0.57	0.51	0.48
$maxF_{ABC}$	0.50	0.46	0.41	0.39
F_{ABC}	0.50	0.46	0.41	0.39
OFL (t)	39,555	34,673	**29,737**	27,507
maxABC (t)	32,811	28,708	24,634	22,683
ABC (t)	32,811	28,708	**24,634**	22,683
Status	As determined *last* year for: 2020	2021	As determined *this* year for: 2021	2022
Overfishing	No	n/a	No	n/a
Overfished	n/a	No	n/a	No
Approaching overfished	n/a	No	n/a	No

APPORTIONMENT

- No new data, no change to apportionment

	Western	Central	Eastern	Total
Random effects area apportionment	30.3%	60.2%	9.5%	100%
2023 ABC	7,464	14,830	2,340	24,634
2024 ABC	6,873	13,655	2,155	22,683



FUTURE WORK

- Take another look at fit to longline survey
- Pick up and investigate environmental link to growth again
- Possibly look at 2 index REMA model for apportionment
- Start having real conversations about how we use recruitment in projections and reference points

QUESTIONS?