



NOAA
FISHERIES

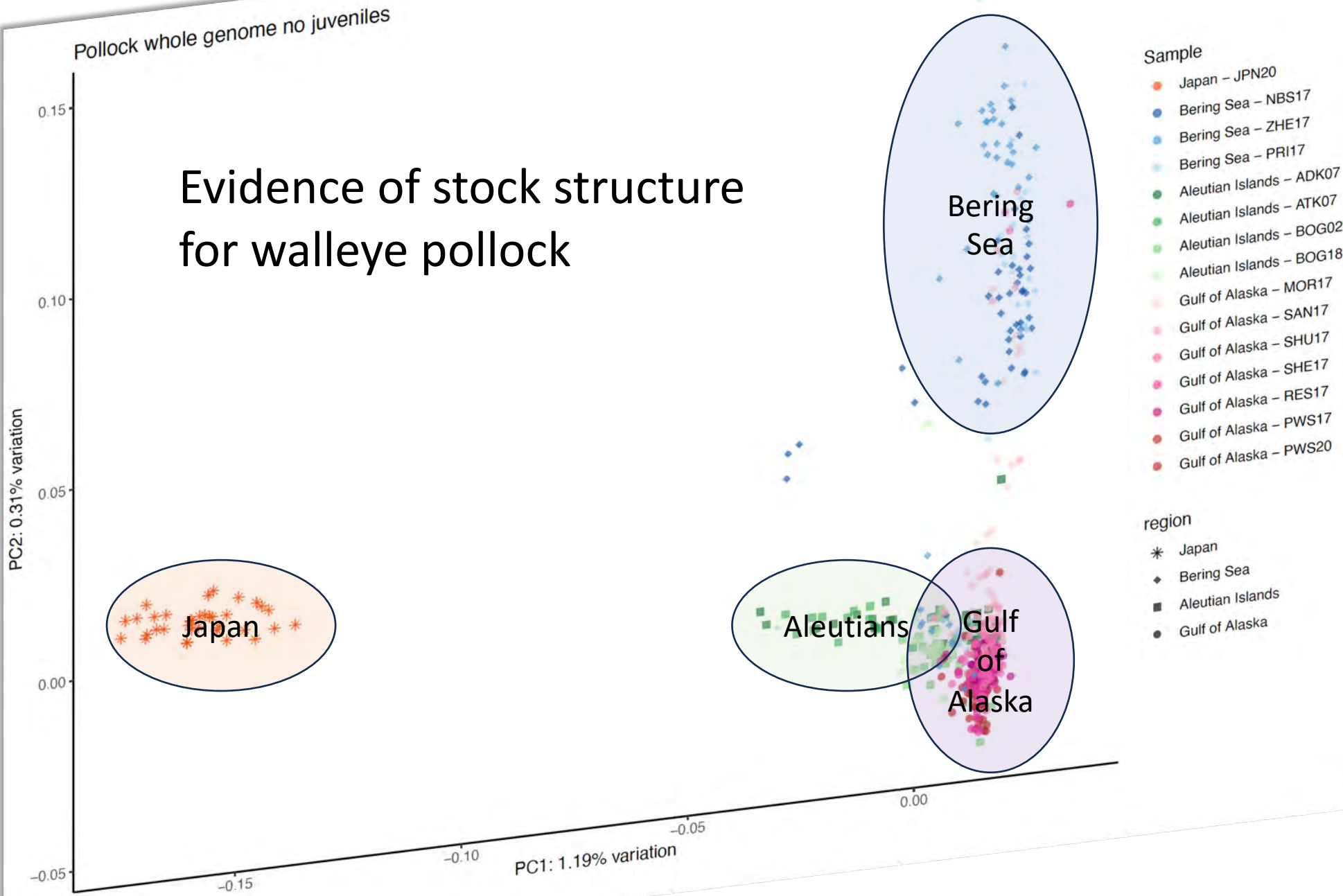
Eastern Bering Sea pollock stock assessment

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Nathan Lauffenburger, Carey McGilliard, Elizabeth Siddon
Alaska Fisheries Science Center



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Pollock whole genome no juveniles



Evidence of stock structure for walleye pollock

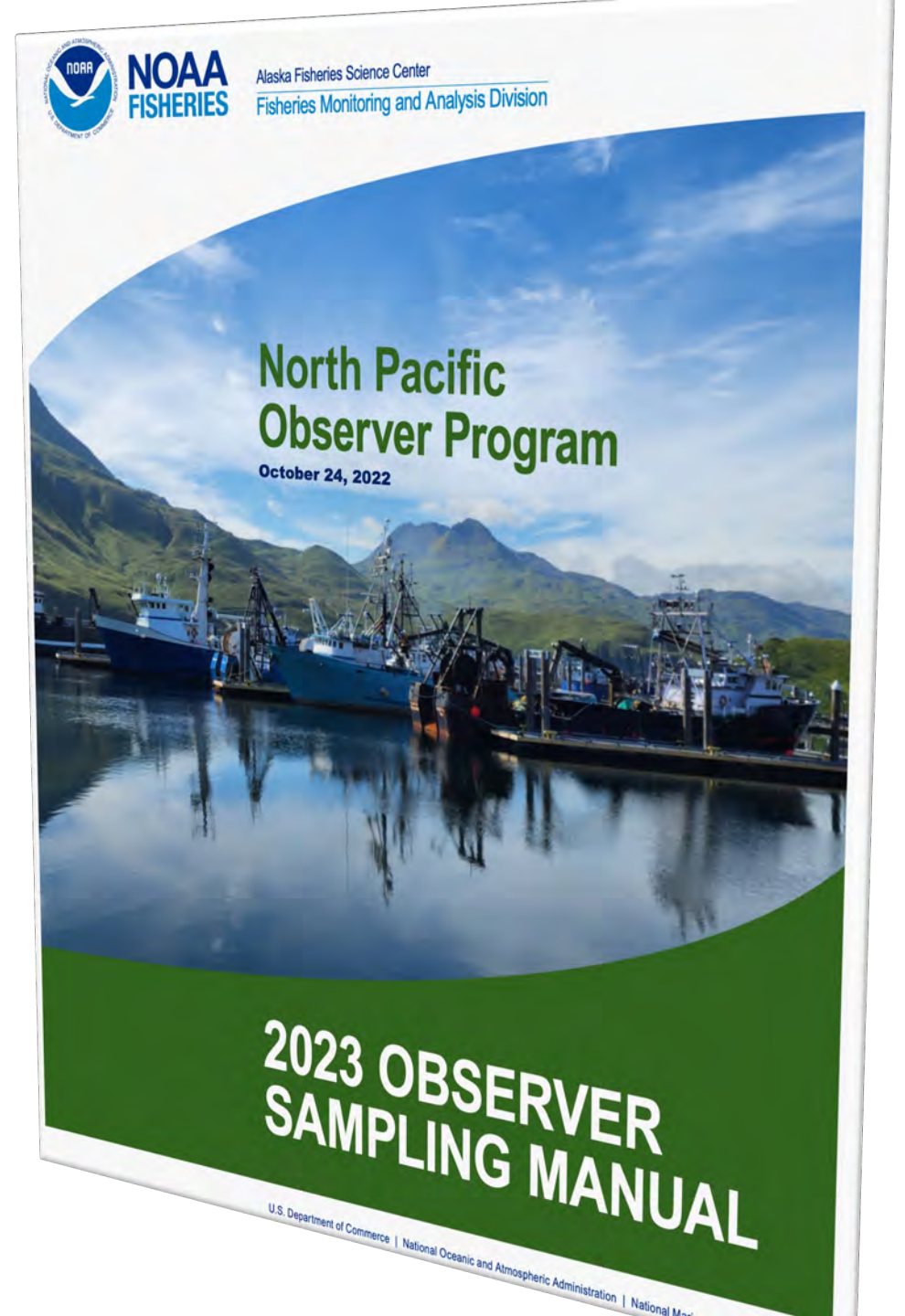
Pollock genetics

Thanks to Ingrid Spies and Sara Schaal

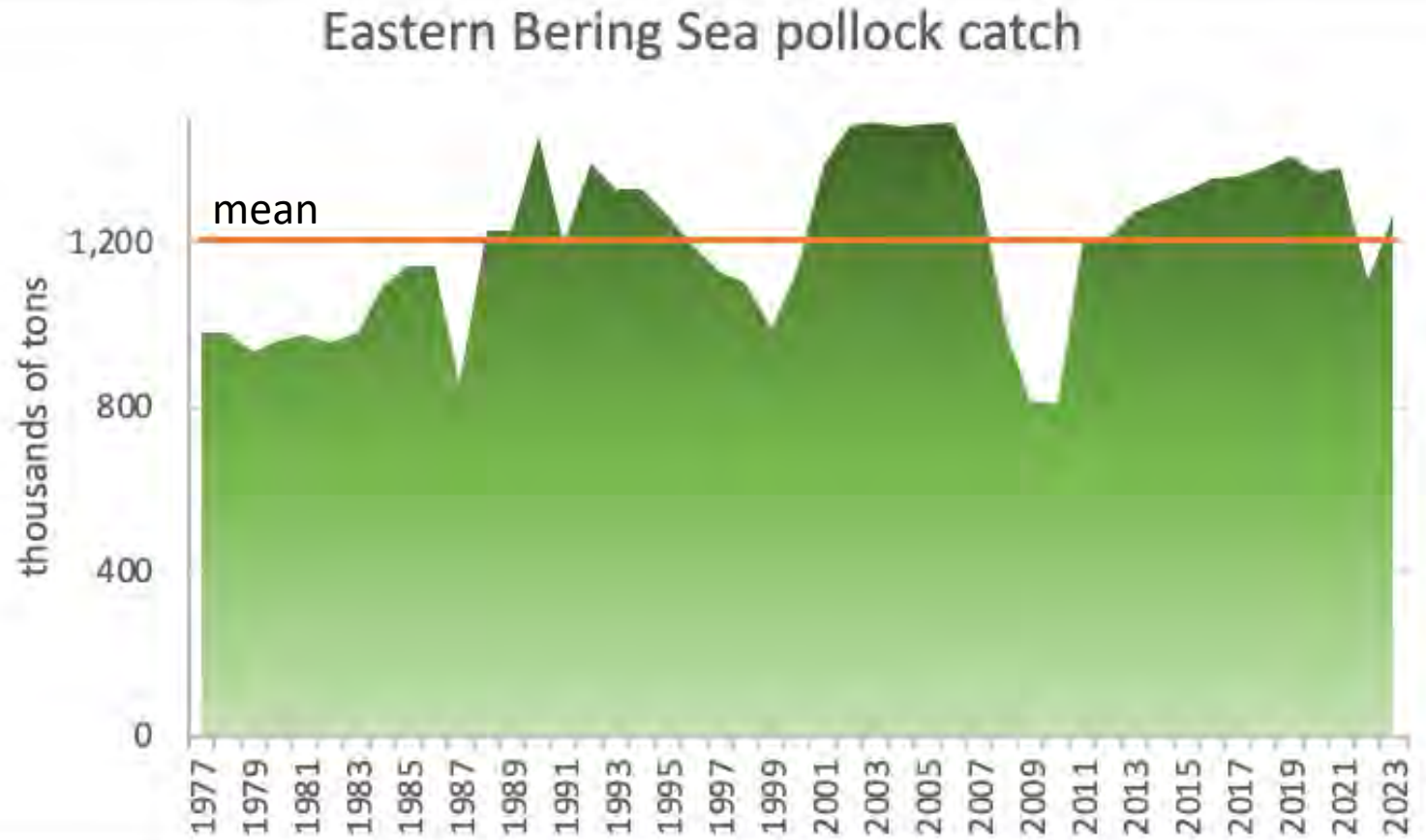
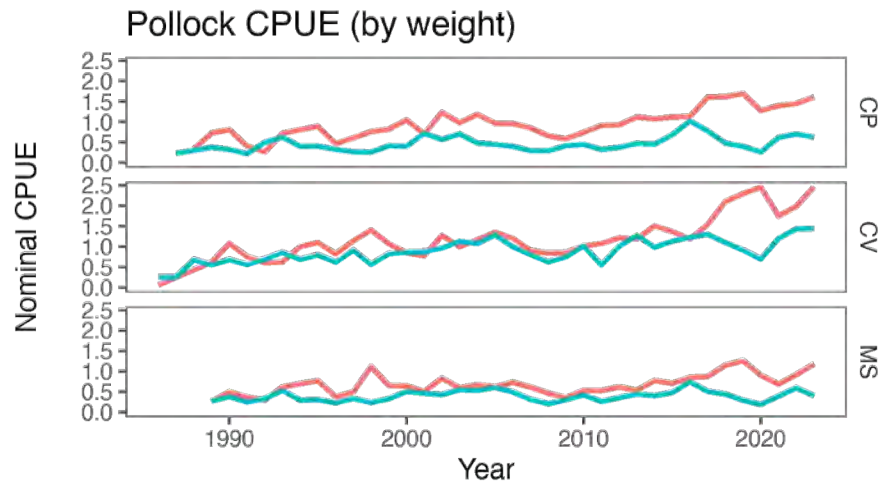
Observer coverage



Is extensive!

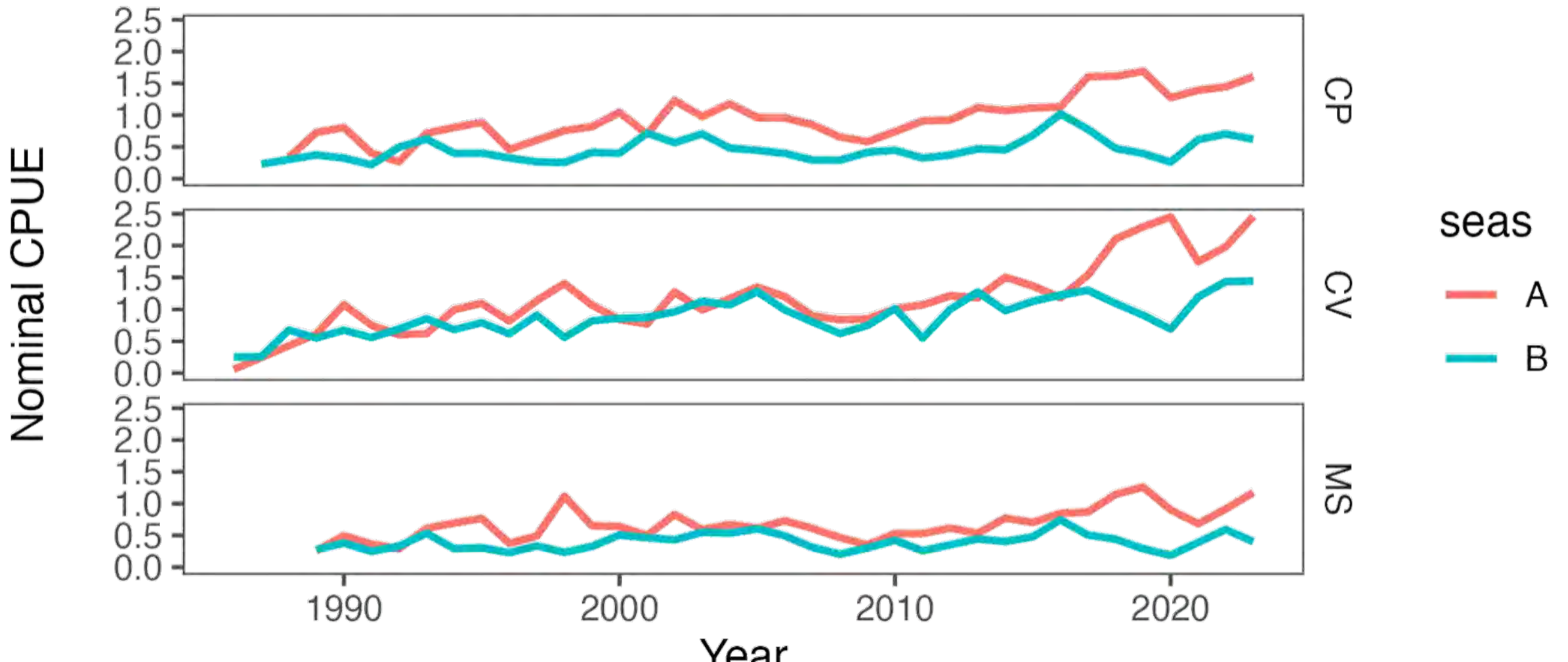


Fishing conditions

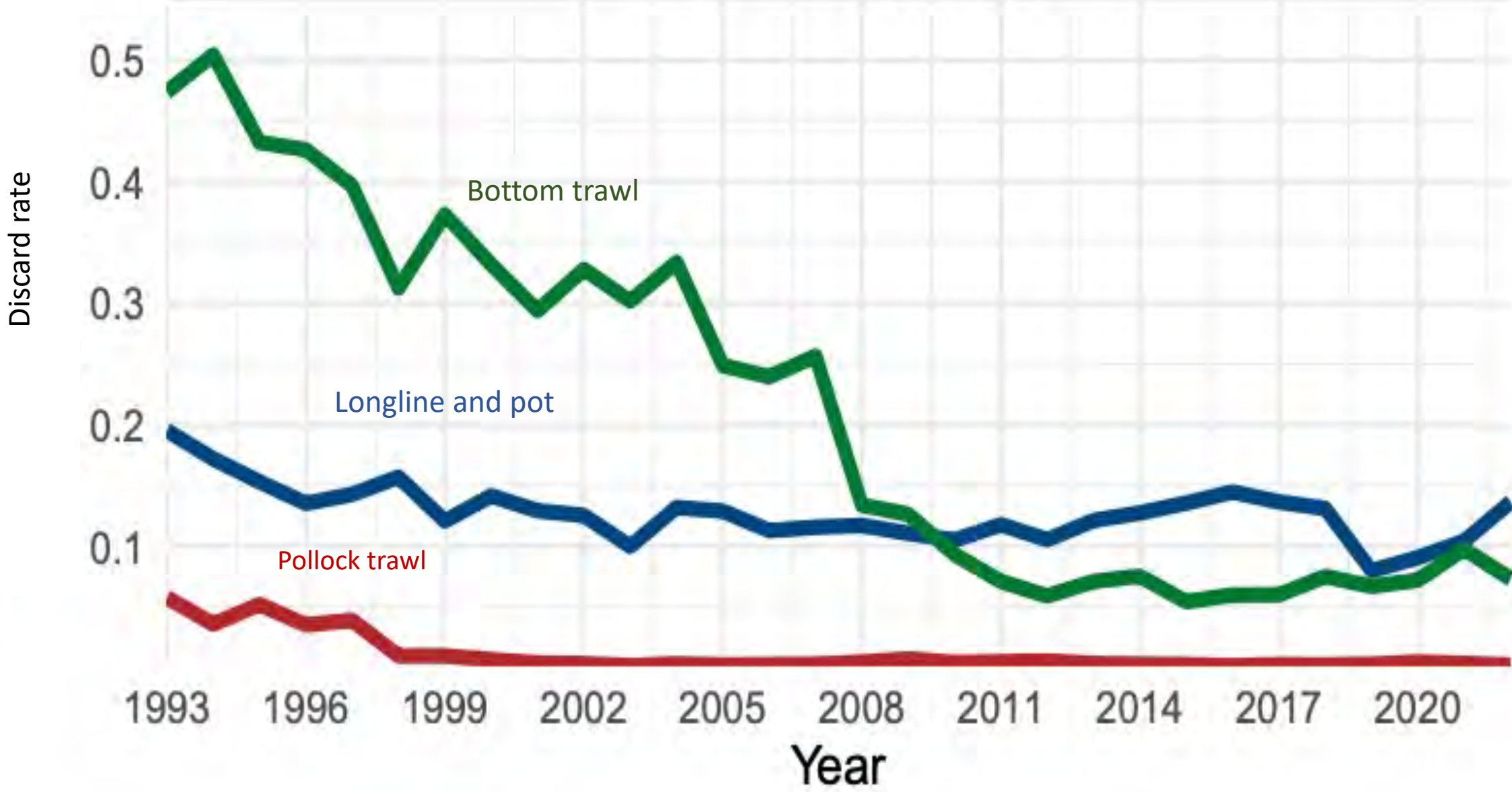


Fishing conditions

Pollock CPUE (by weight)



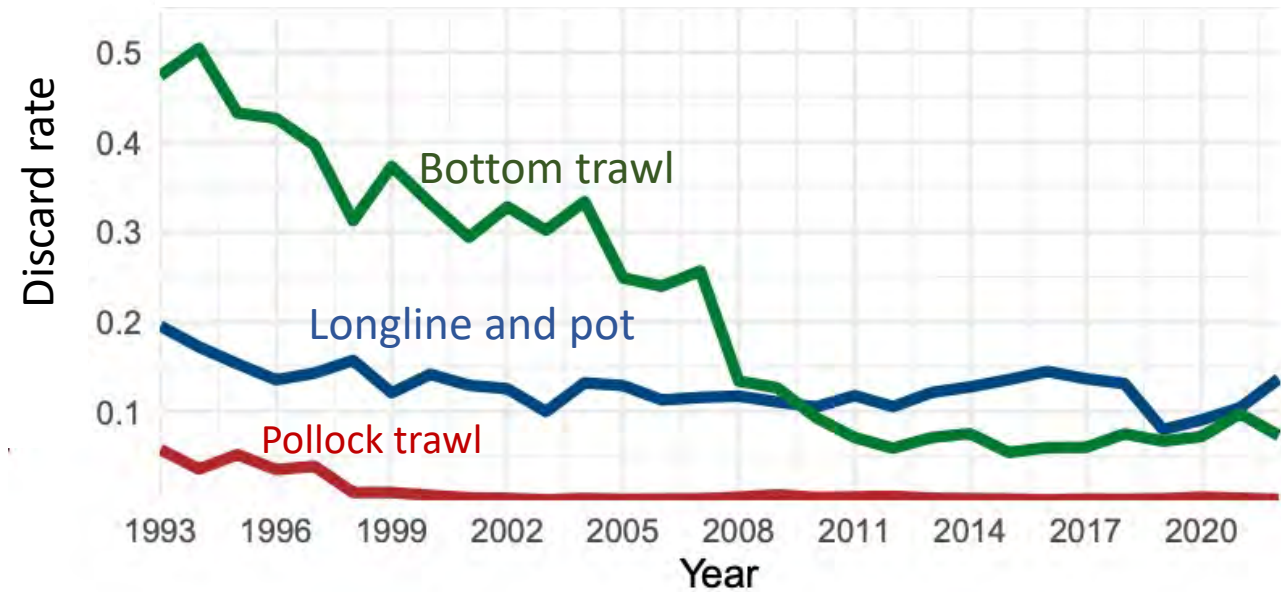
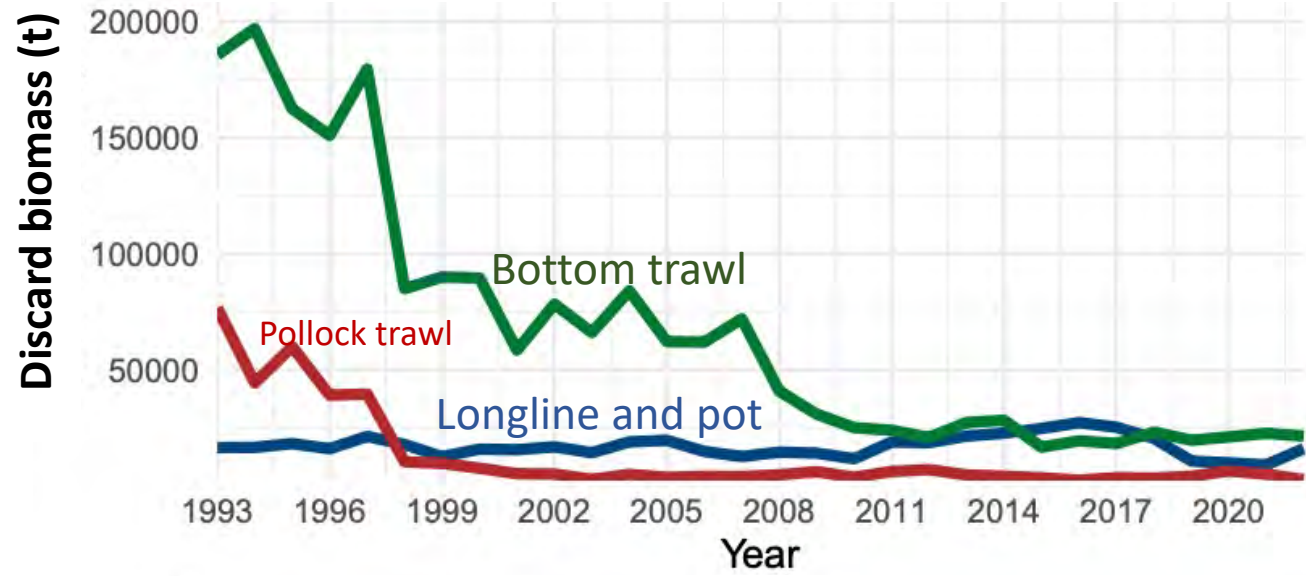
Fishery discard rates among “sectors” in the EBS



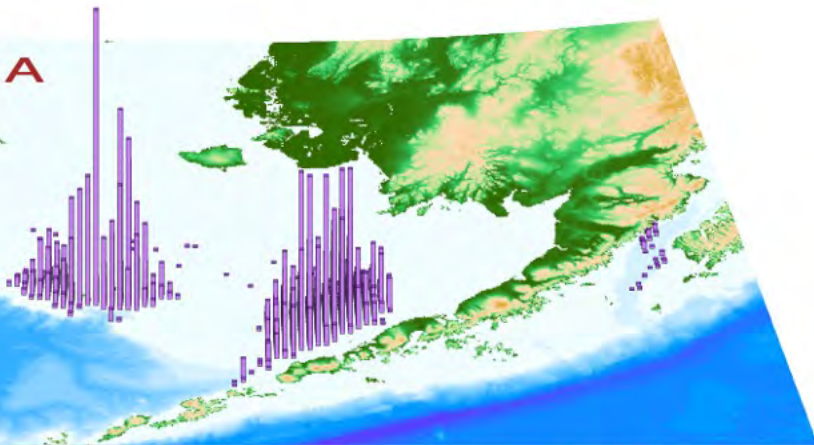
Tonnage also low in pollock fishery...

Table 3: Estimates of discarded and retained pollock (t) for the Northwest and Southeastern Bering Sea, 1991-2023. SE represents the EBS east of 170W, NW is the EBS west of 170W, source: NMFS Blend and catch-accounting system database. 2023 data are preliminary.

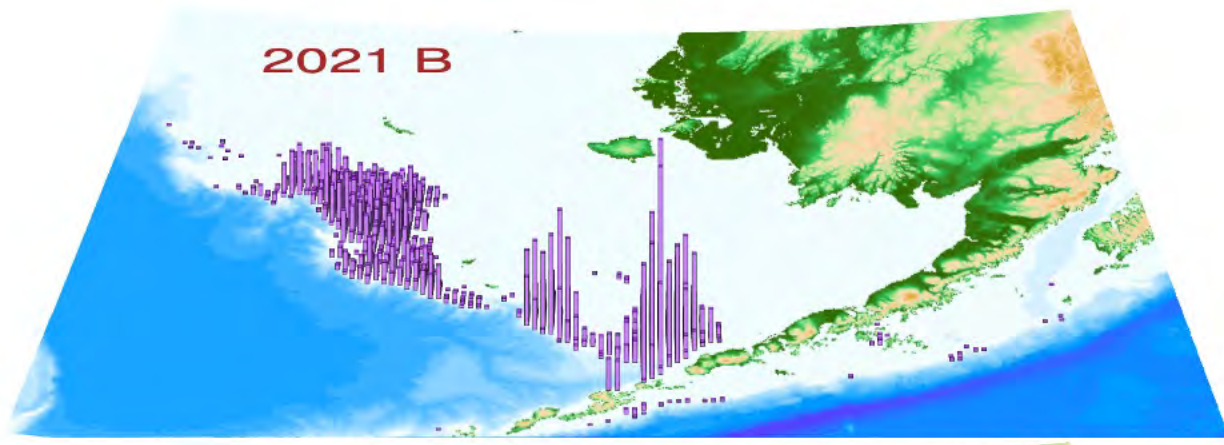
Year	NW Discarded	SE Discarded	NW Retained	SE Retained	Total	Discarded %
1991	48,257	66,792	493,852	586,763	1,195,664	9.6%
1992	57,578	71,194	502,163	759,365	1,390,299	9.3%
1993	26,100	83,986	206,073	1,010,443	1,326,602	8.3%
1994	16,084	88,098	160,693	1,064,476	1,329,352	7.8%
1995	9,715	87,492	82,226	1,084,814	1,264,247	7.7%
1996	4,838	71,368	101,100	1,015,474	1,192,781	6.4%
1997	22,557	71,032	281,986	748,858	1,124,433	8.3%
1998	1,581	14,291	130,934	957,098	1,103,903	1.4%
1999	1,912	26,912	204,786	756,071	989,680	2.9%
2000	1,942	19,678	291,591	819,499	1,132,710	1.9%
2001	2,450	14,874	422,770	947,103	1,387,197	1.2%
2002	1,441	19,430	319,002	1,140,904	1,480,776	1.4%
2003	2,959	13,795	554,629	919,397	1,490,779	1.1%
2004	2,781	20,380	387,763	1,069,628	1,480,552	1.6%
2005	2,586	14,838	678,282	787,316	1,483,022	1.2%
2006	3,677	11,877	657,147	815,330	1,488,031	1.0%
2007	3,769	12,334	622,484	715,915	1,354,502	1.2%
2008	1,643	5,968	506,237	476,730	990,578	0.8%
2009	1,936	4,014	450,596	354,238	810,784	0.7%
2010	1,270	2,490	553,802	252,623	810,186	0.5%
2011	1,376	3,444	449,773	744,438	1,199,031	0.4%
2012	1,190	4,080	585,154	614,791	1,205,214	0.4%
2013	1,225	4,084	573,869	691,582	1,270,760	0.4%
2014	1,786	12,556	437,391	845,684	1,297,417	1.1%
2015	2,418	7,055	622,907	689,193	1,321,574	0.7%
2016	1,036	8,124	184,574	1,158,948	1,352,681	0.7%
2017	1,356	6,848	179,803	1,171,173	1,359,181	0.6%
2018	2,005	9,170	328,590	1,039,523	1,379,288	0.8%
2019	1,979	7,126	305,202	1,095,040	1,409,346	0.6%
2020	2,450	9,364	504,370	851,053	1,367,236	0.9%
2021	1,534	12,379	350,715	1,011,629	1,376,258	1.0%
2022	3,538	9,925	203,091	889,124	1,105,677	1.0%
2023	3,660	8,820	405,467	841,214	1,259,161	1.0%
Mean	7,292	24,964	386,031	846,225	1,264,512	2.1%



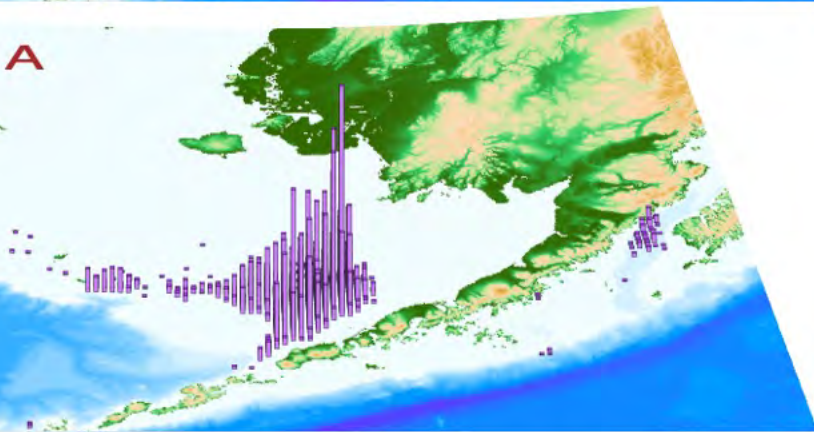
2021 A



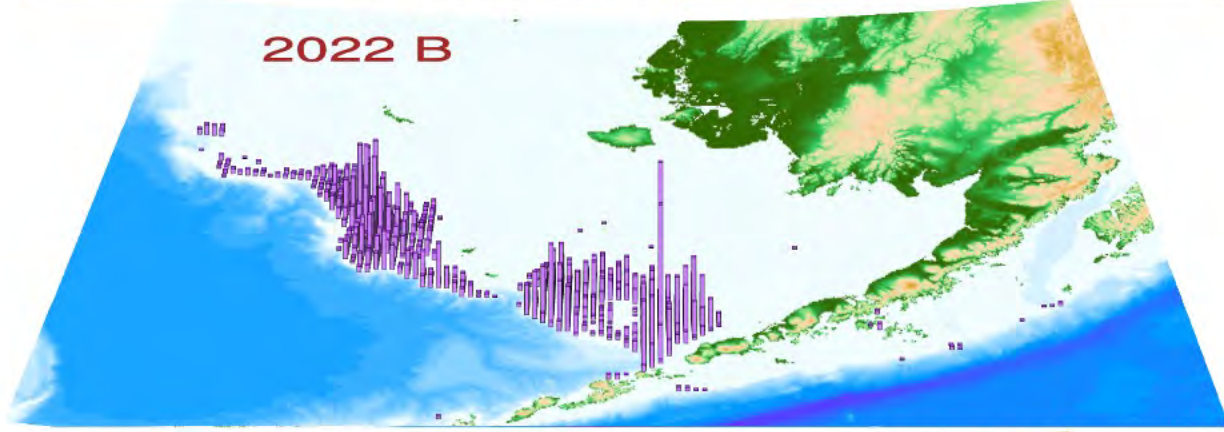
2021 B



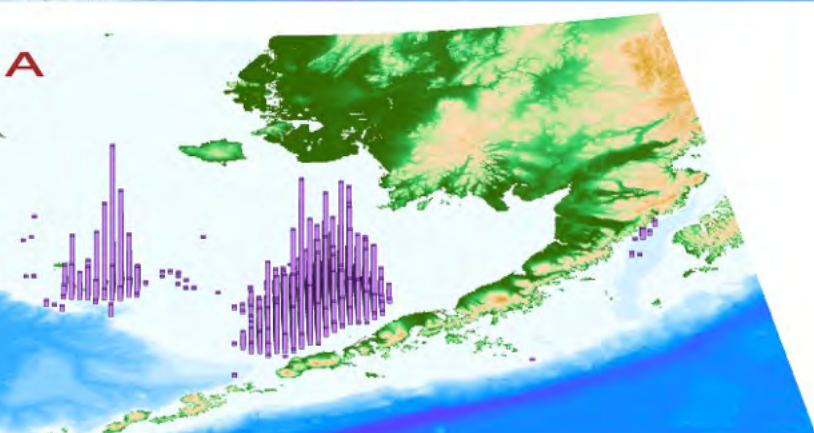
2022 A



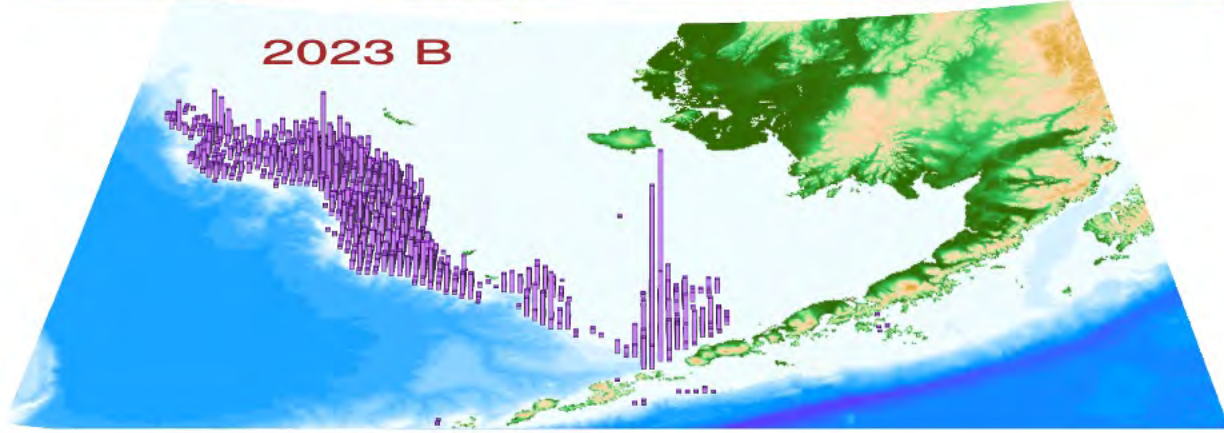
2022 B



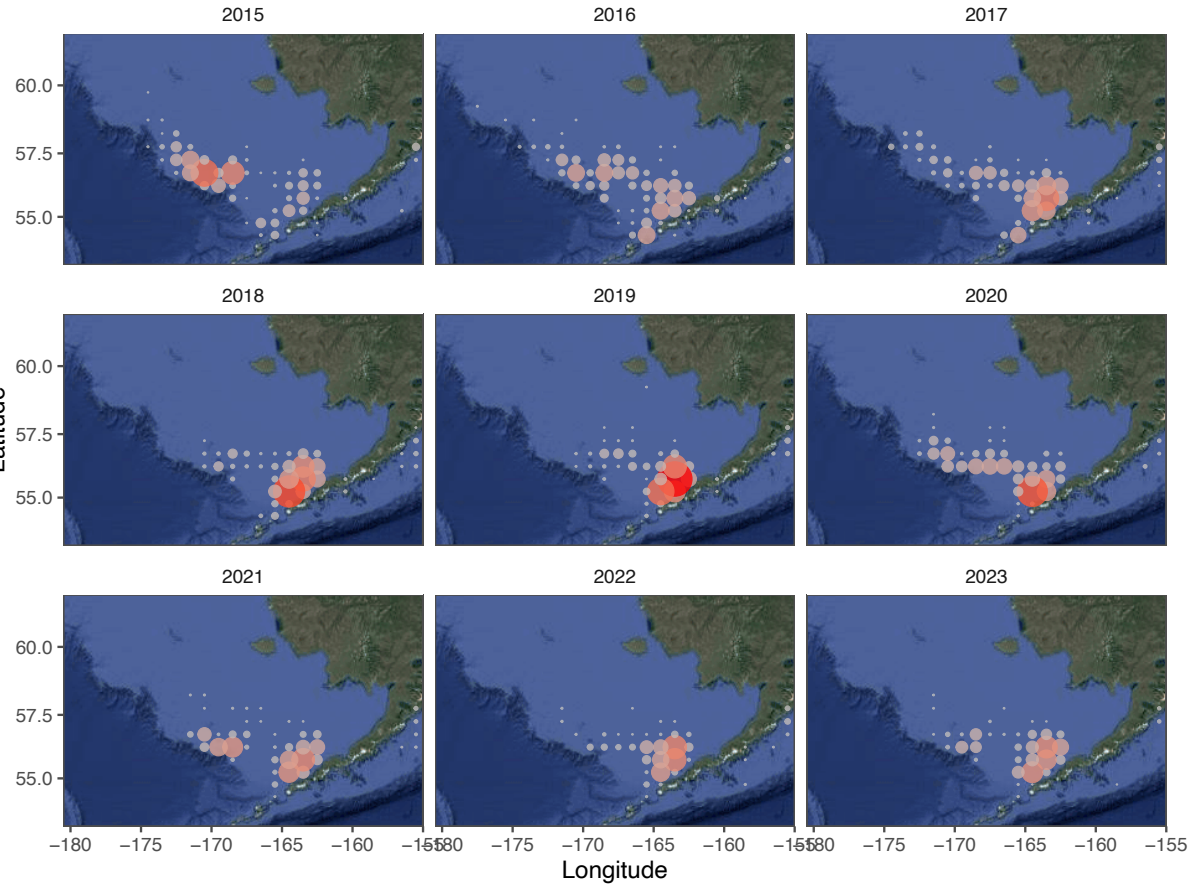
2023 A



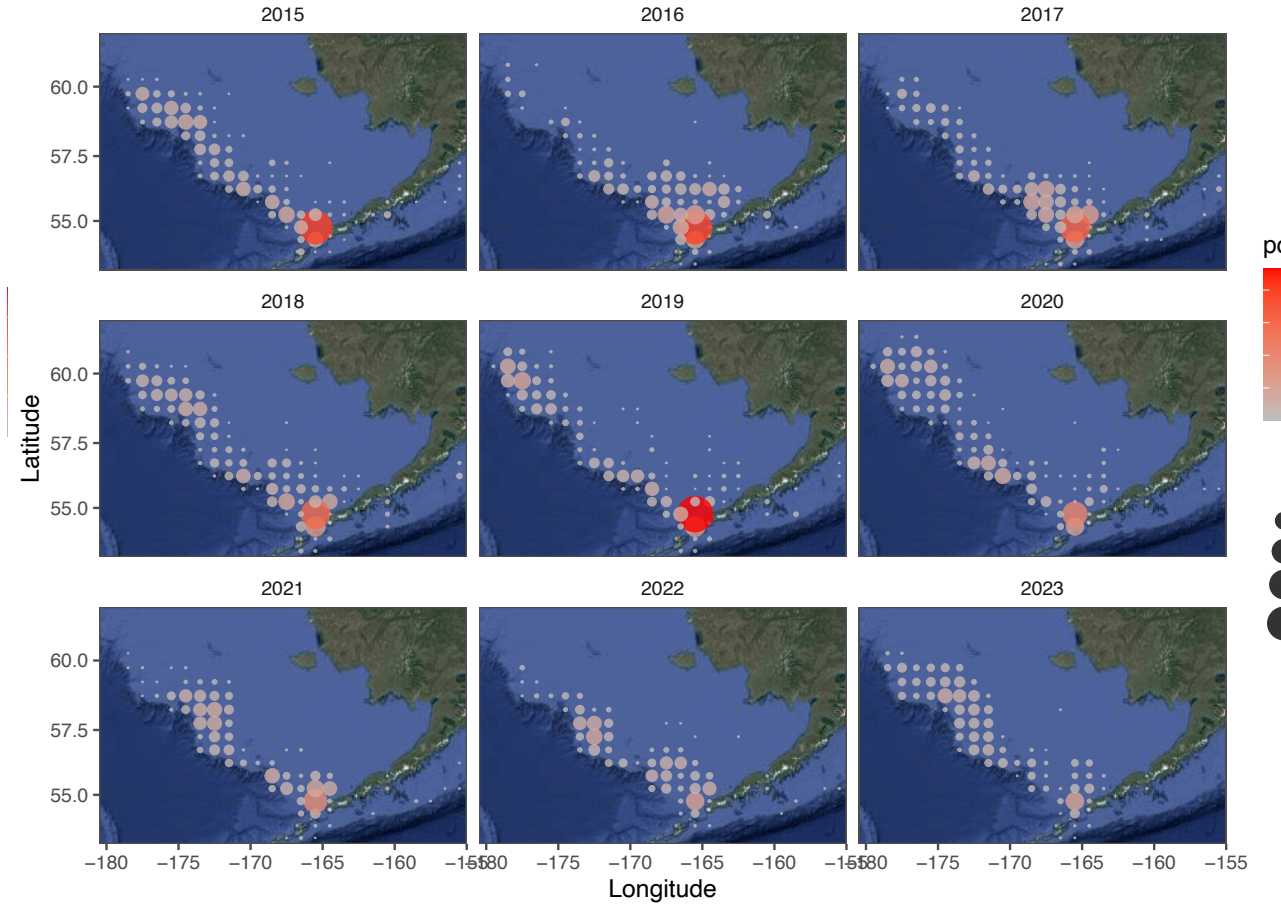
2023 B



pollock A season

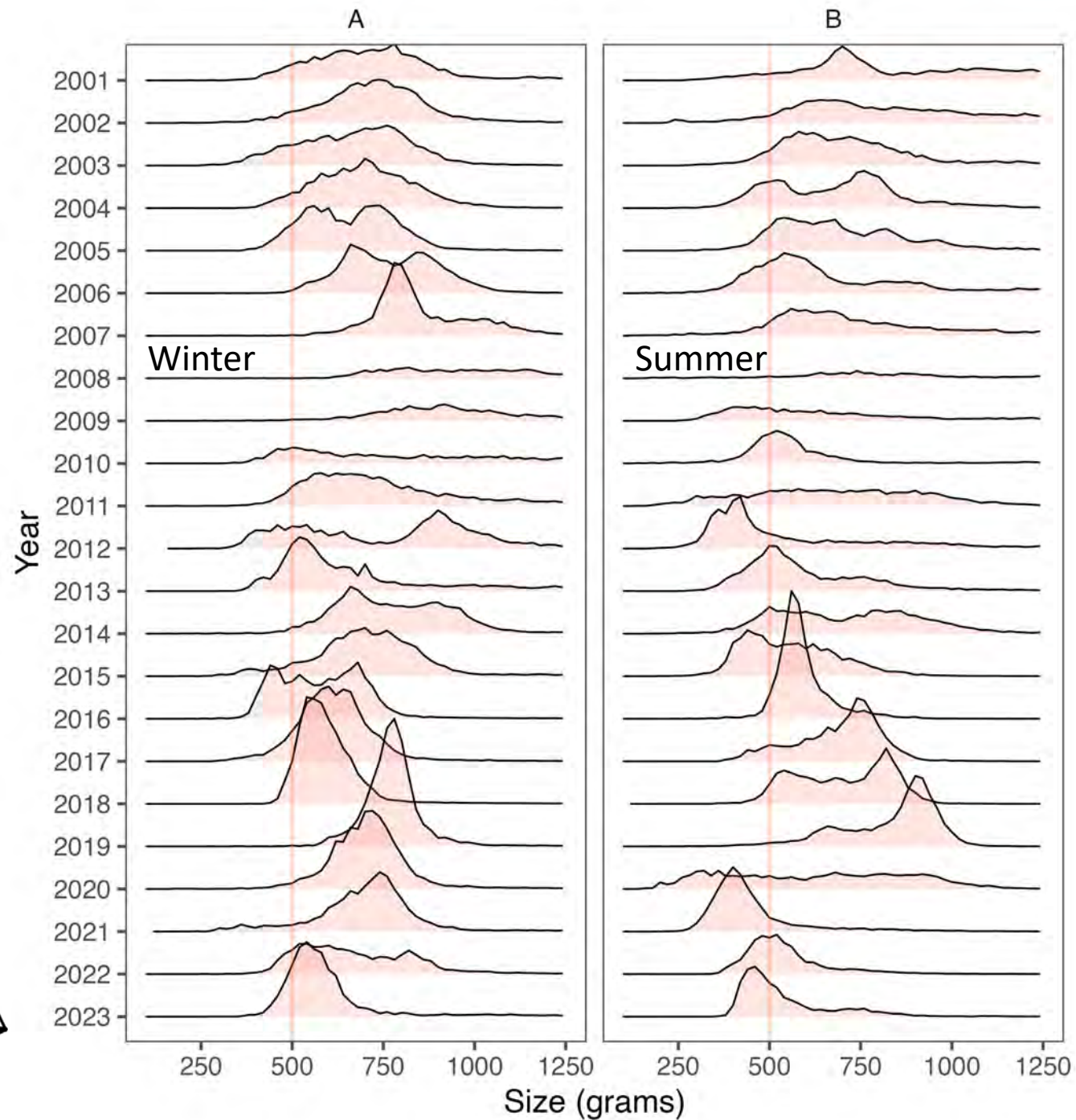


pollock B season



Bering Sea Pollock Fish conditions

Trends in weight frequency of catch



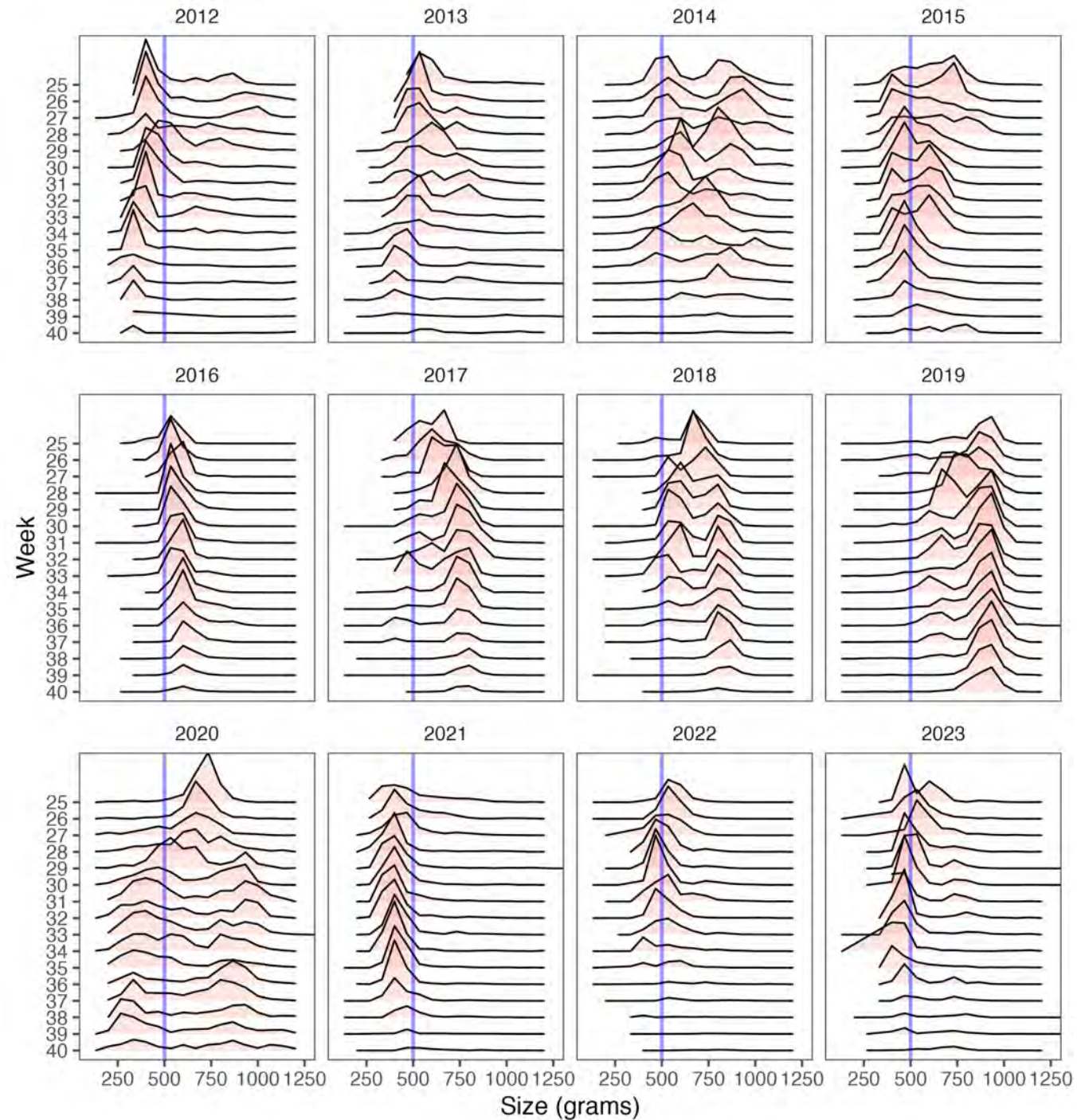
B-season

Tow-by-tow mean
weight frequency

Season progression
by week



2023 season
Consistent size
around 500 grams



Fishery data on pollock “condition”

- Relative

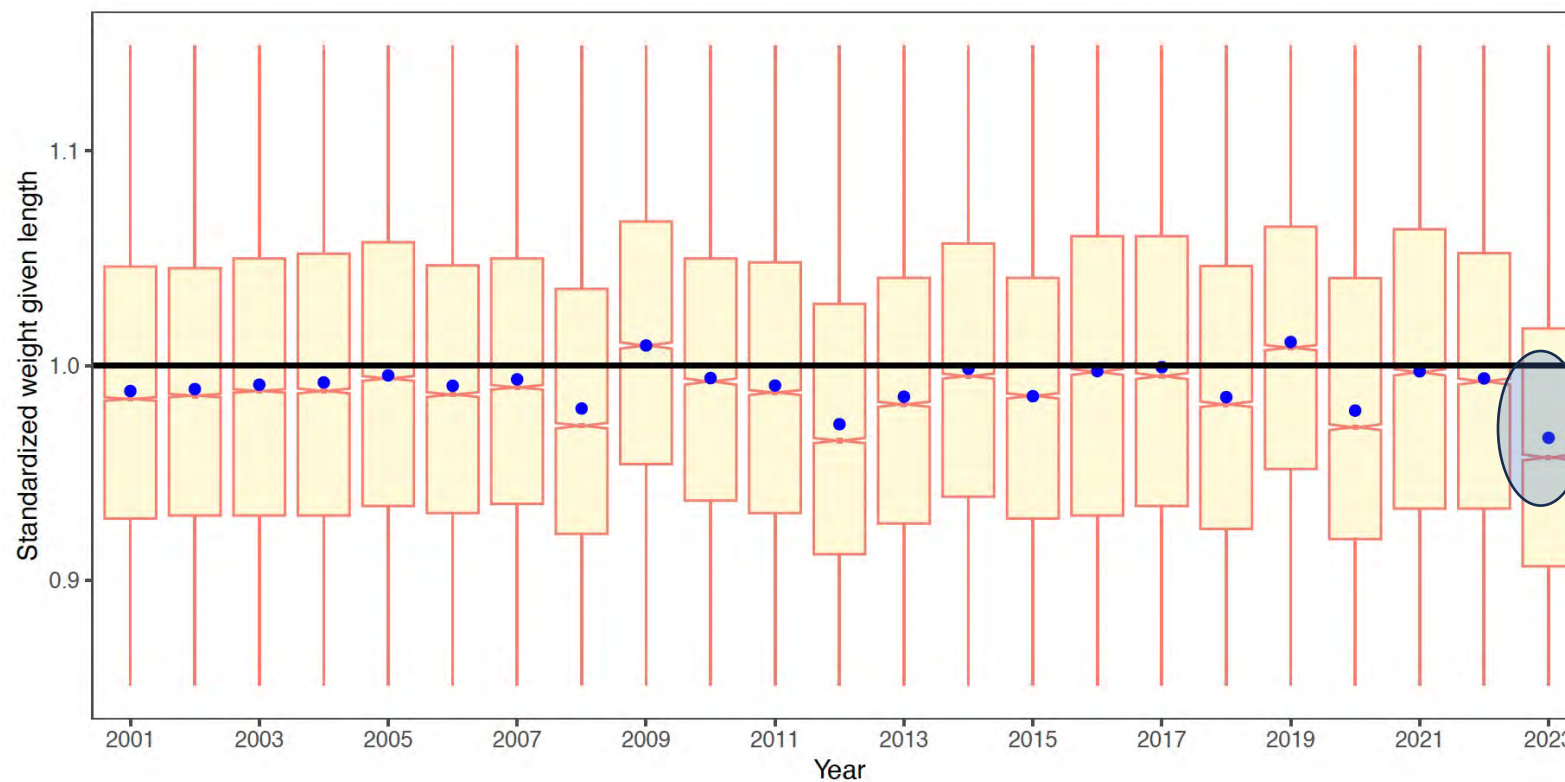
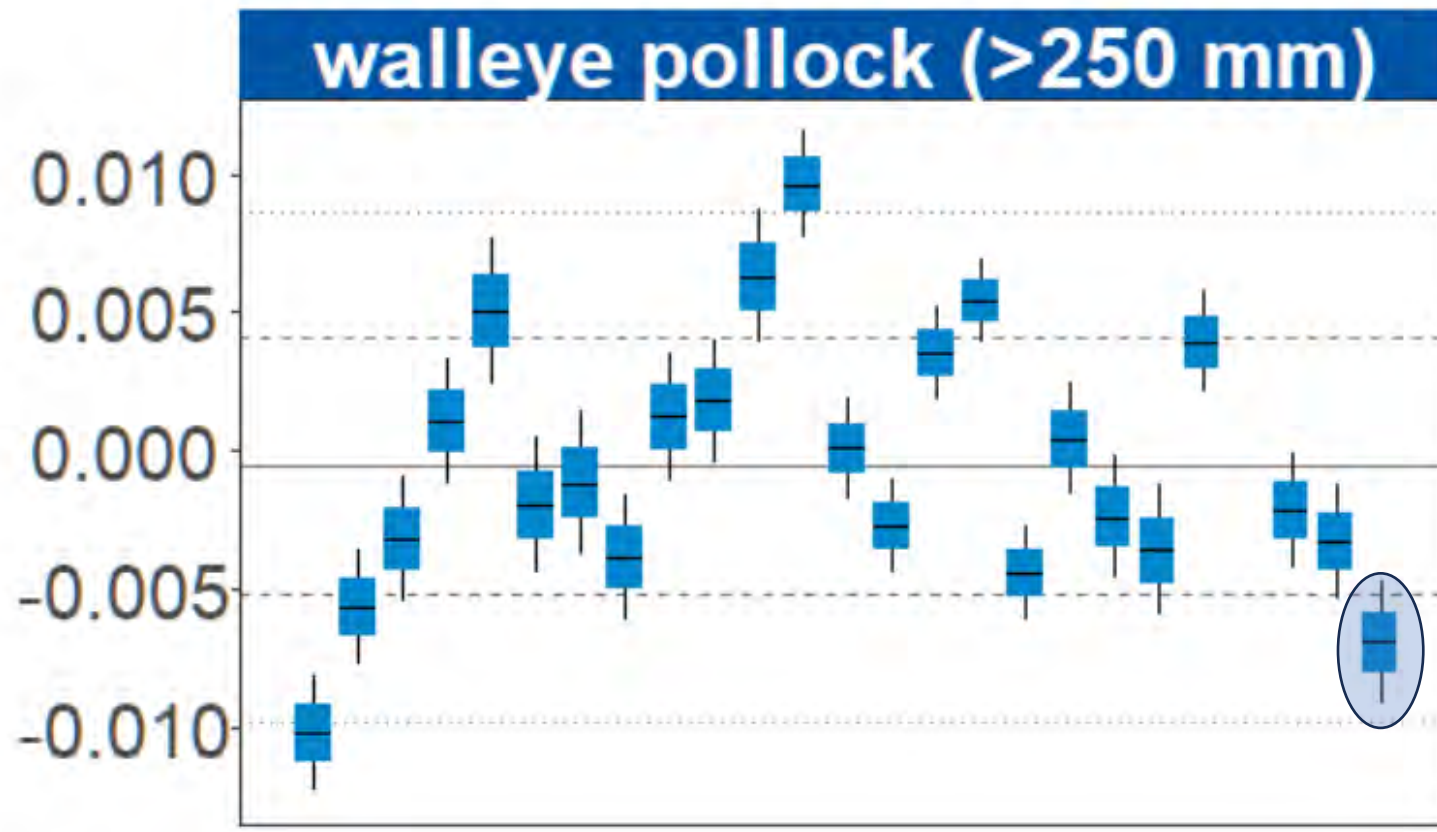
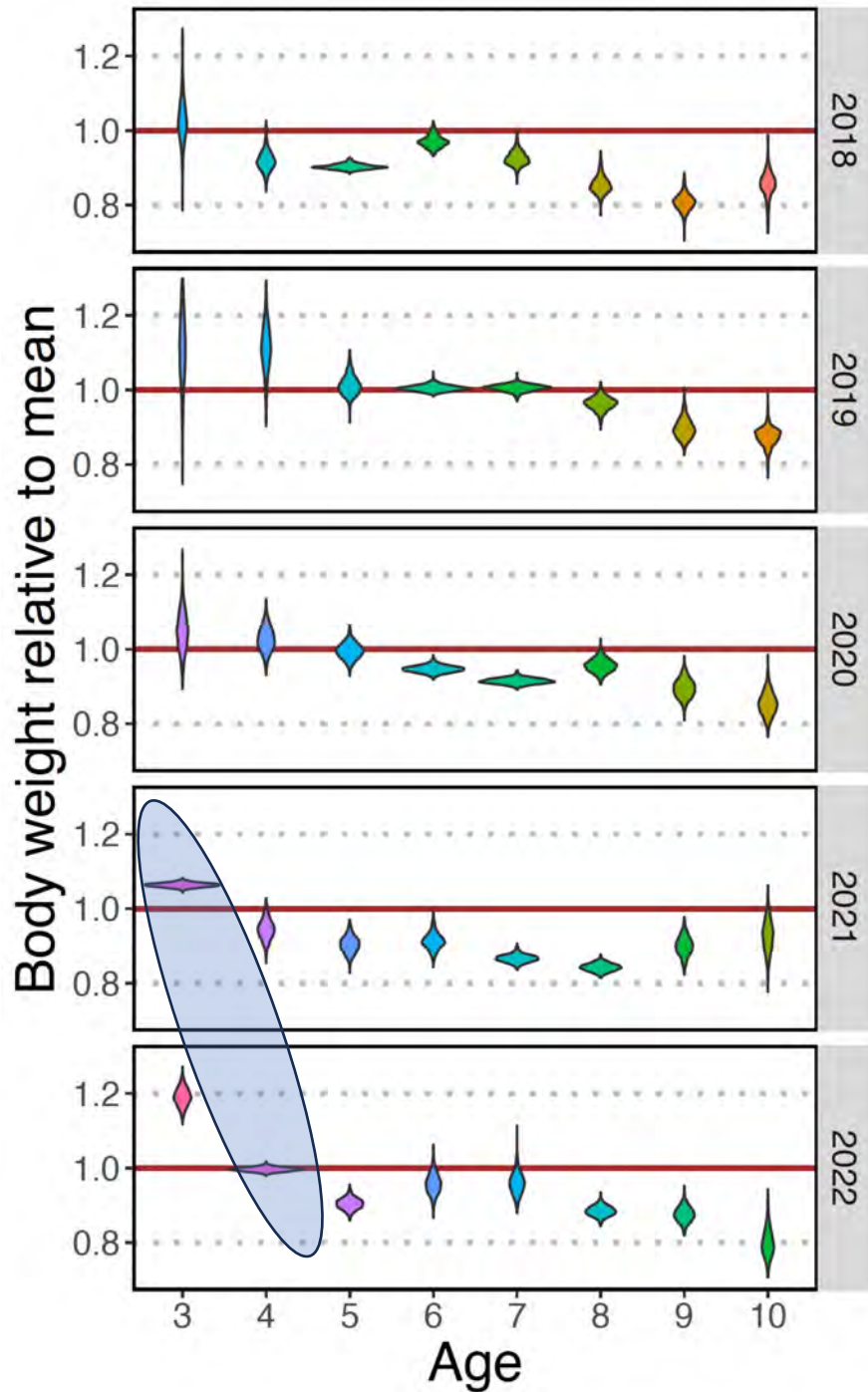


Figure 28: EBS pollock body mass (given length) anomaly (standardized by overall mean body mass at each length) by year, 1991–2023.

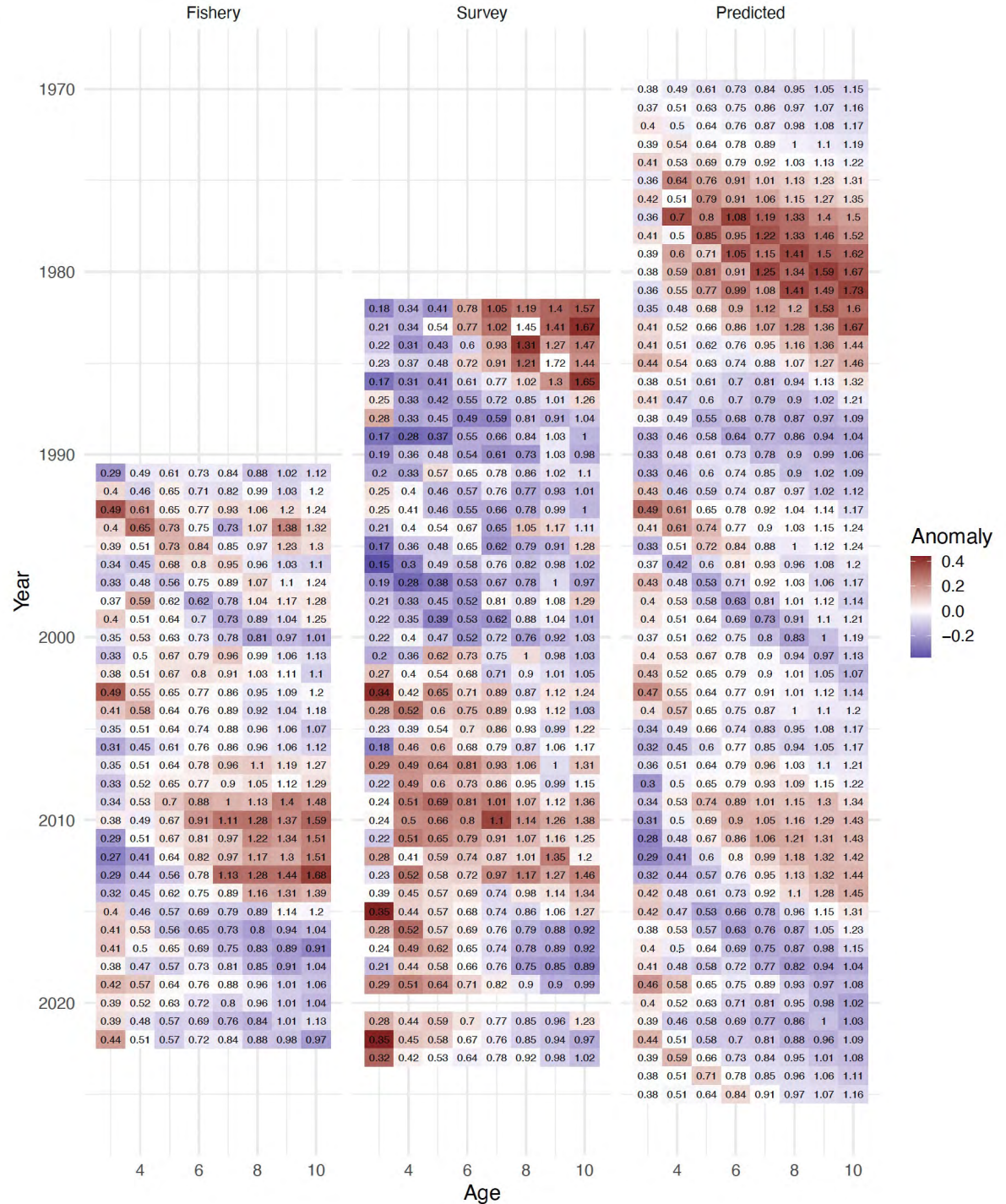
Survey data on pollock condition...

- Relative (from **Ecosystem Status Report**)

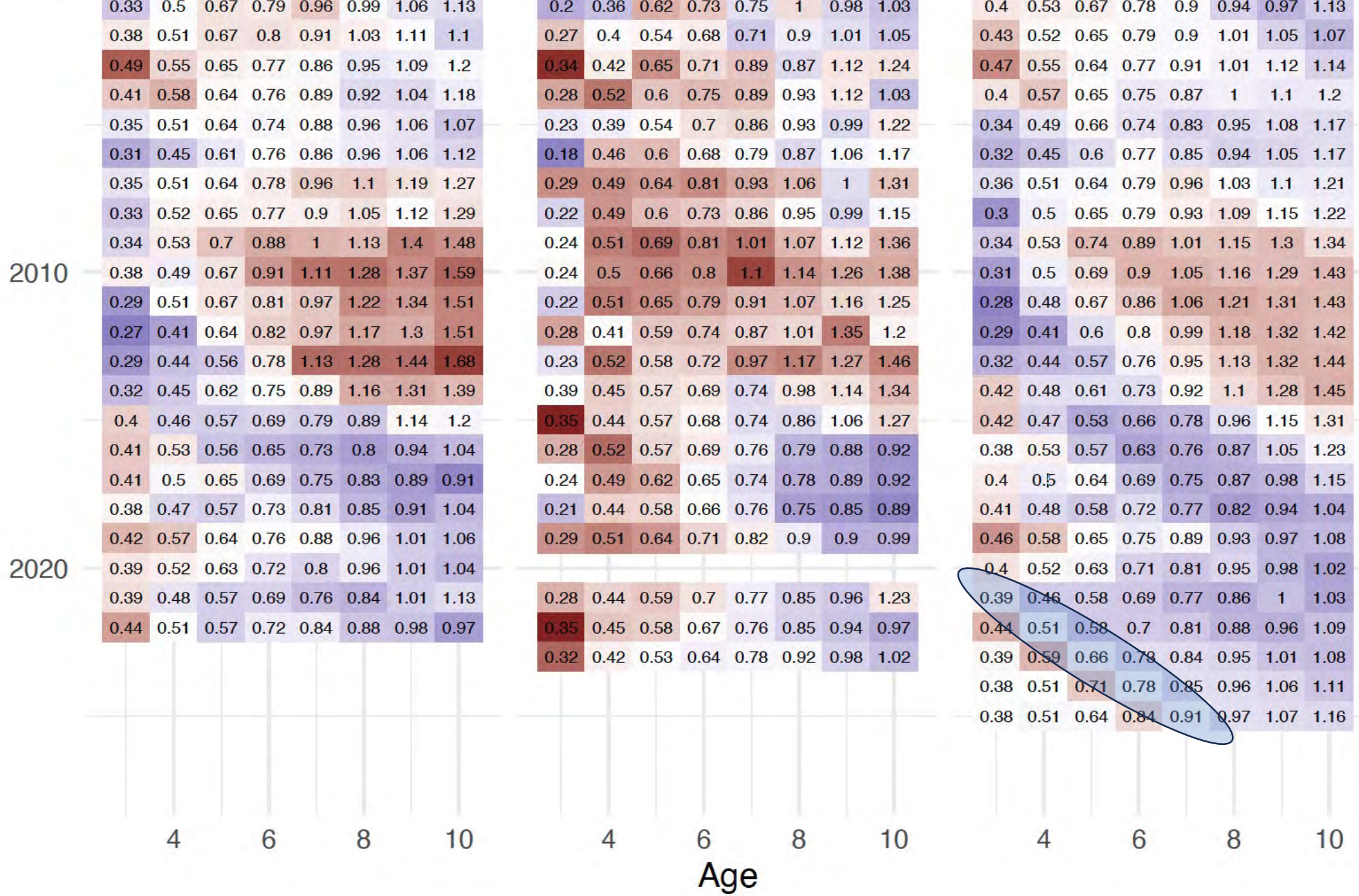


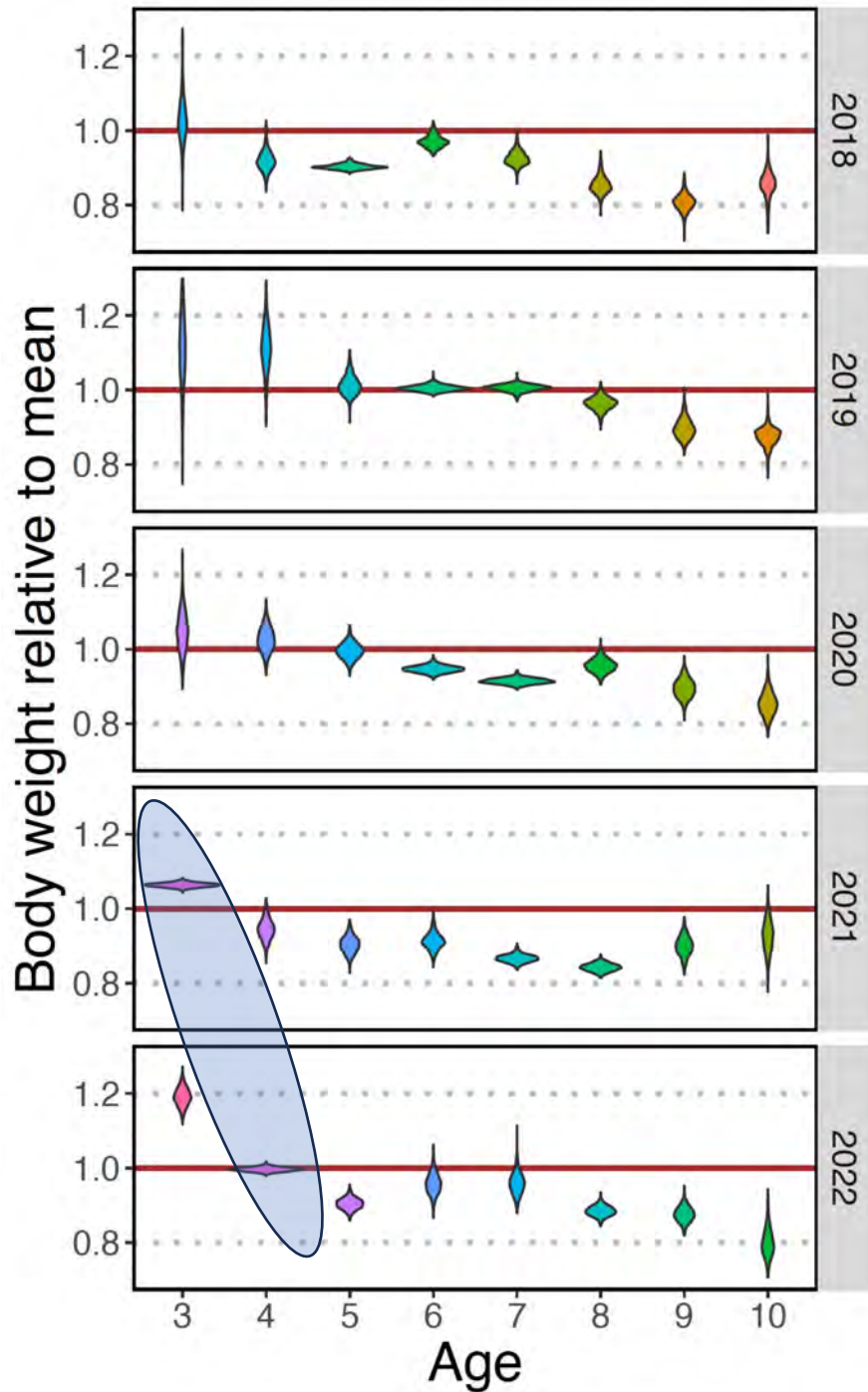


Fishery weight-at-age

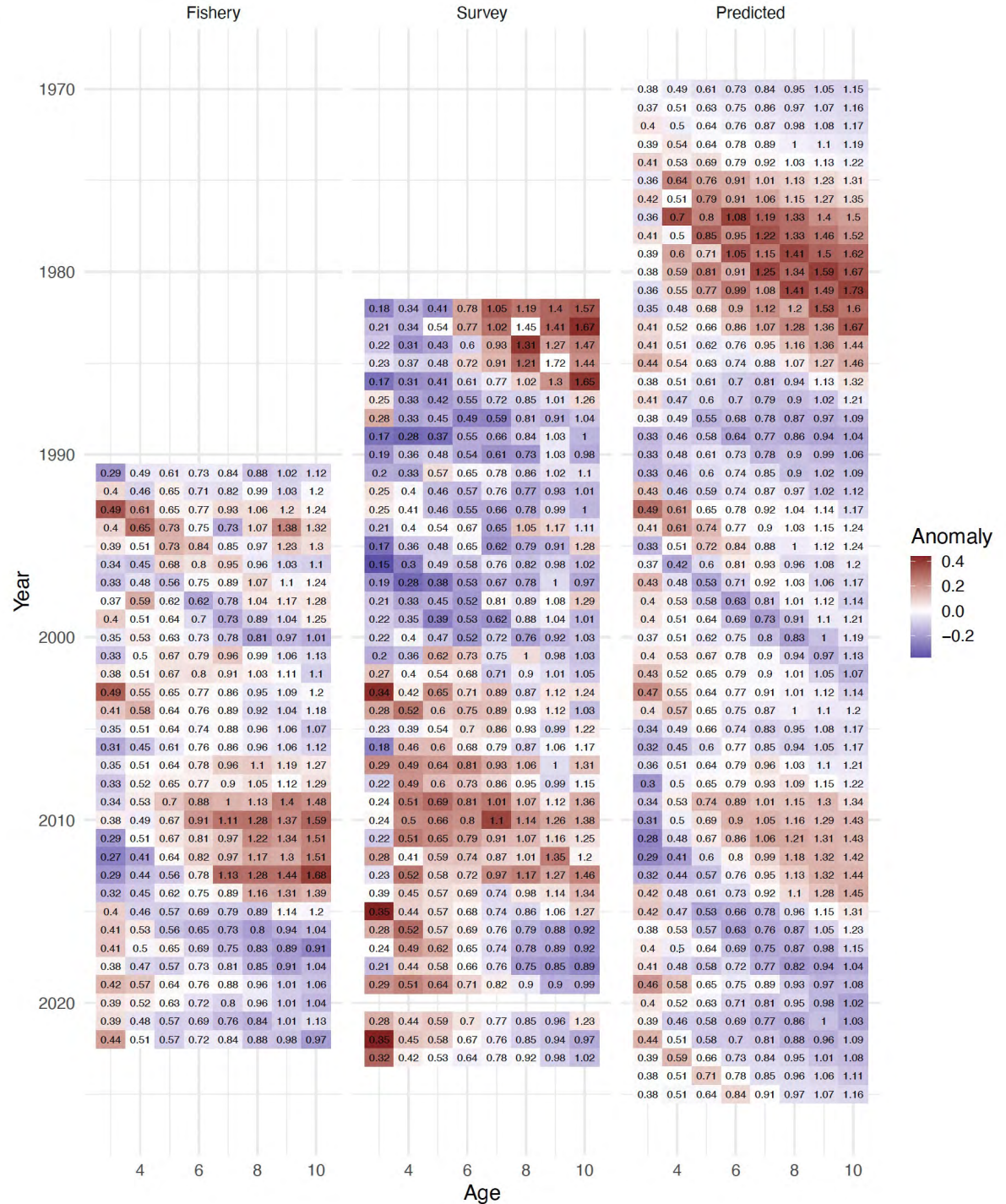


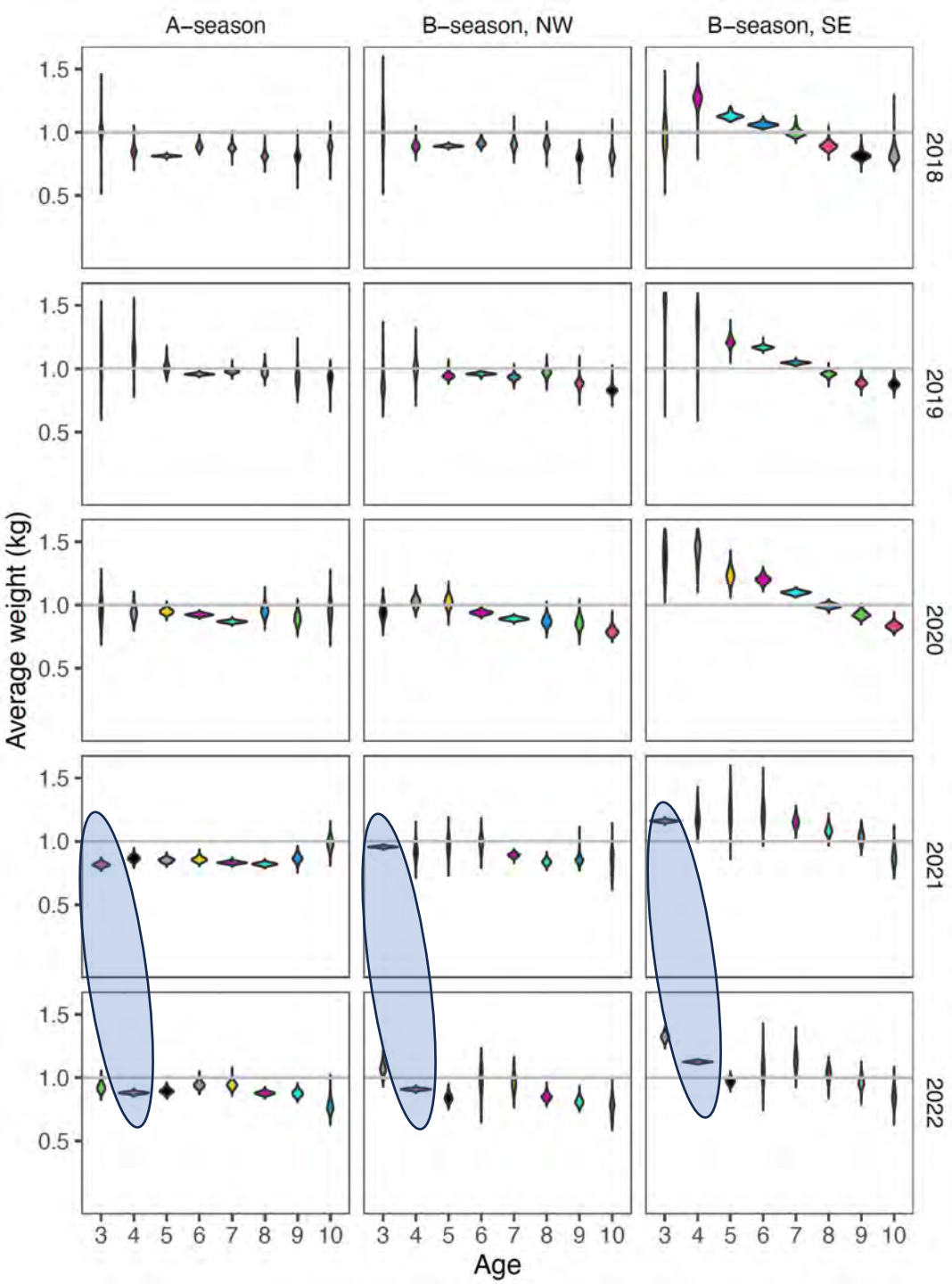
Fishery weight-at-age





Fishery weight-at-age





Fishery
weight-
at-age
by season
and area

Survey work

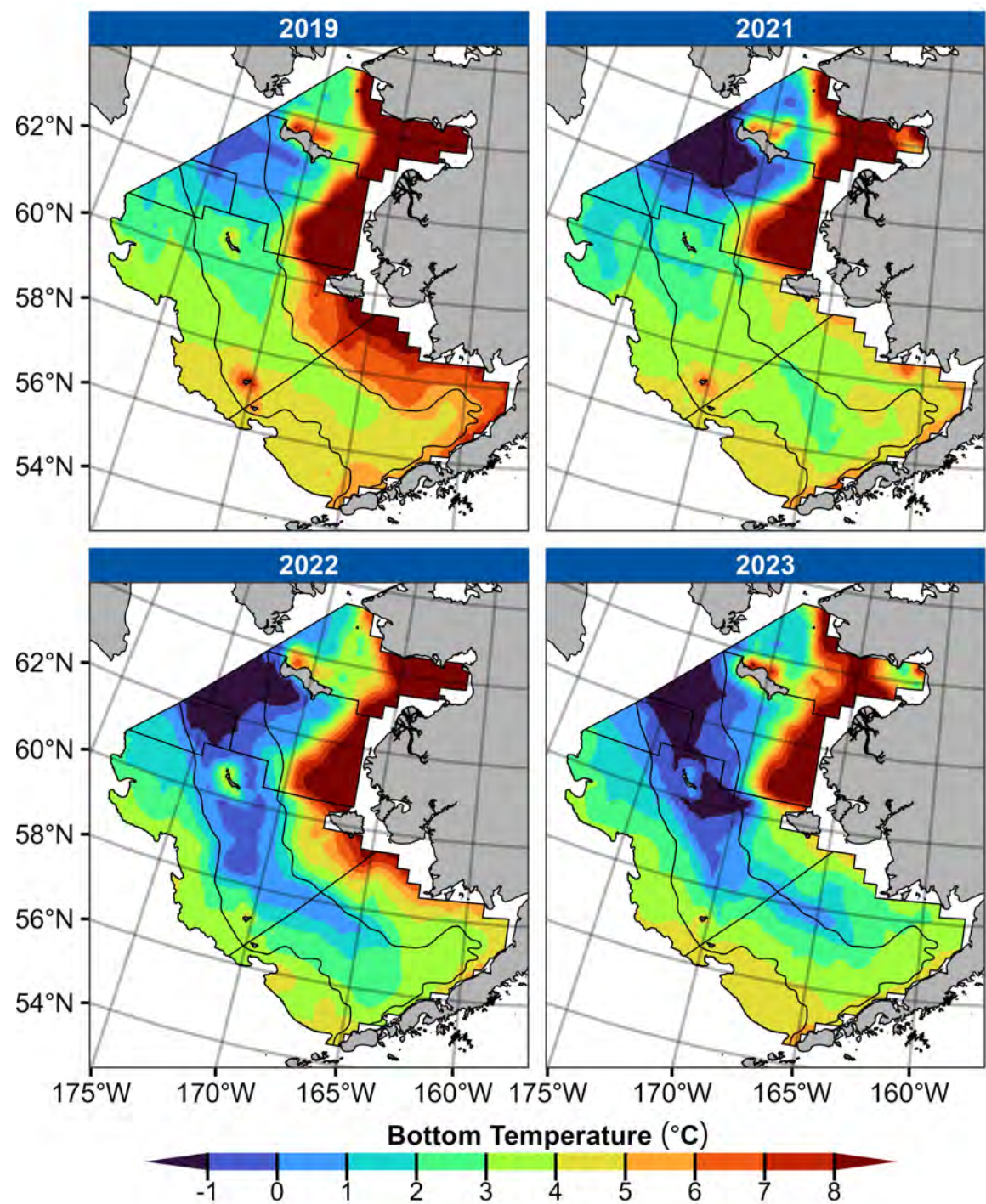
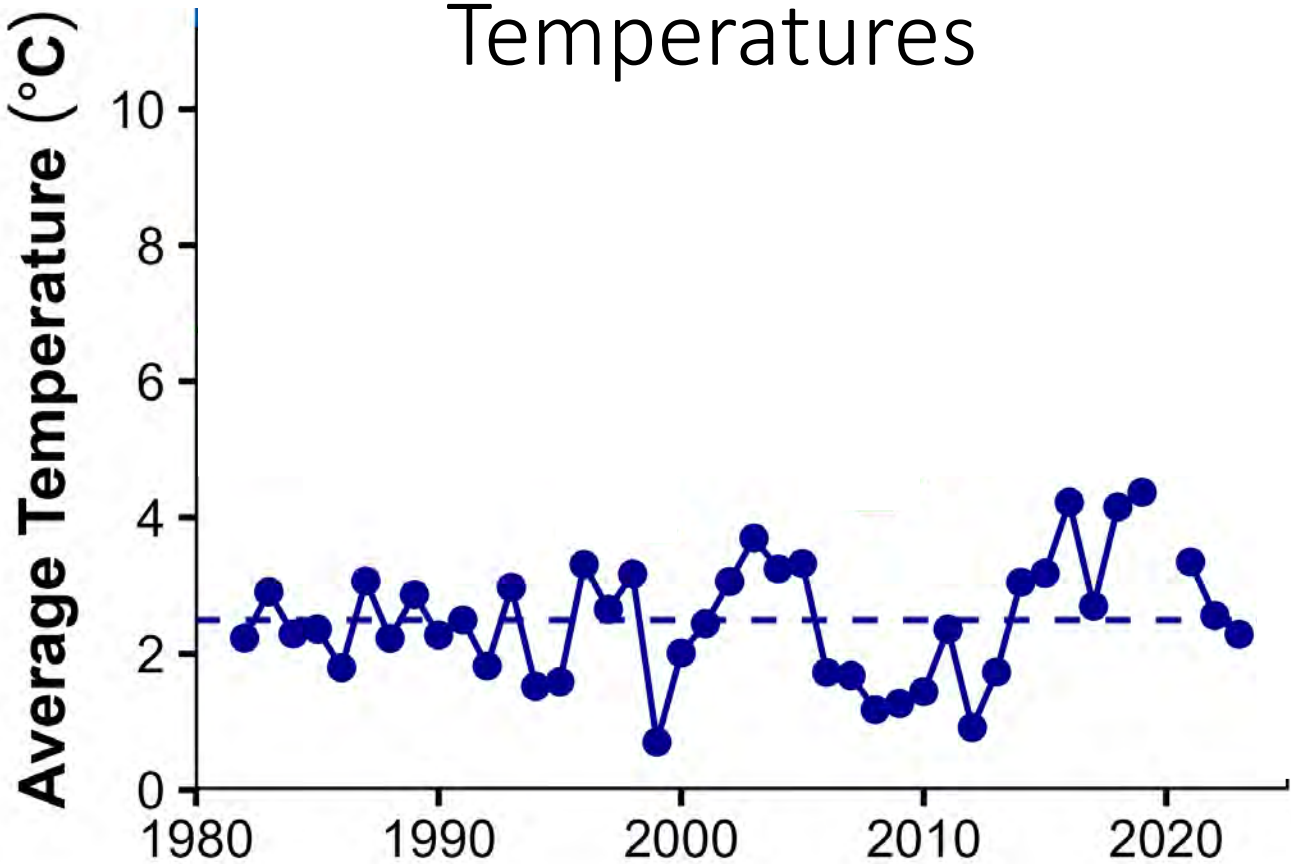


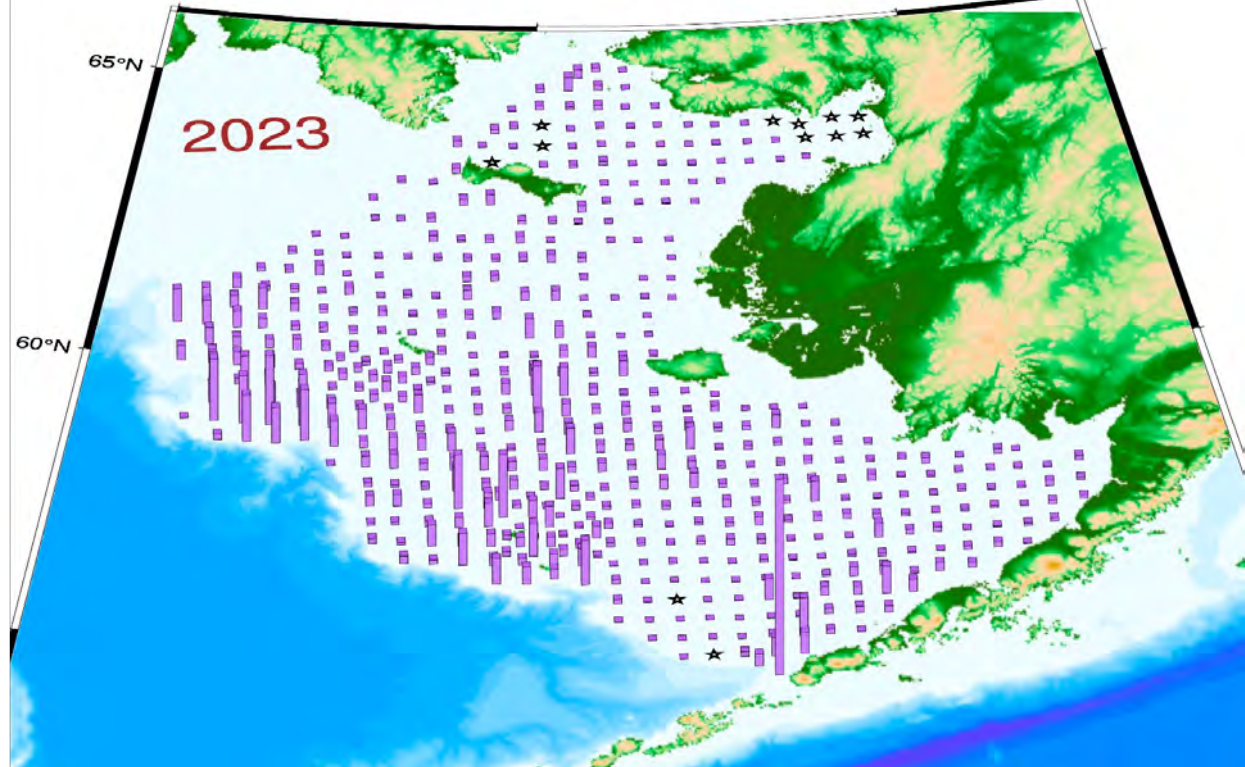
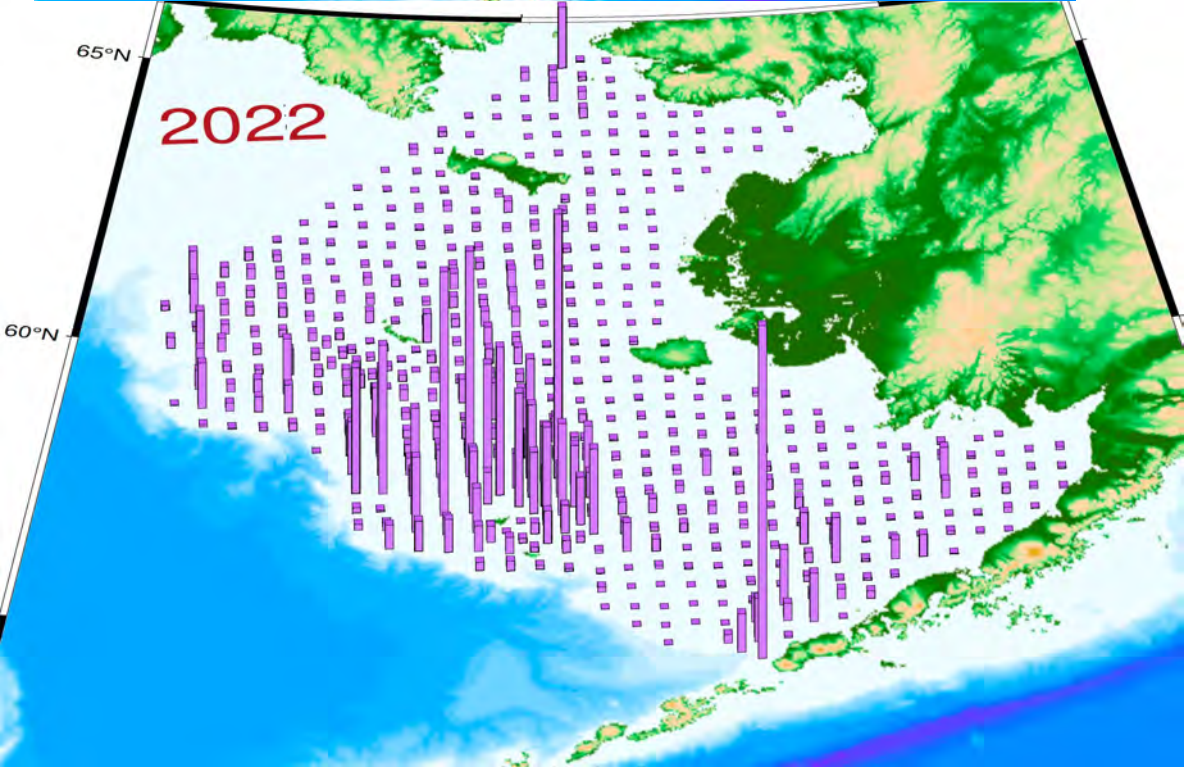
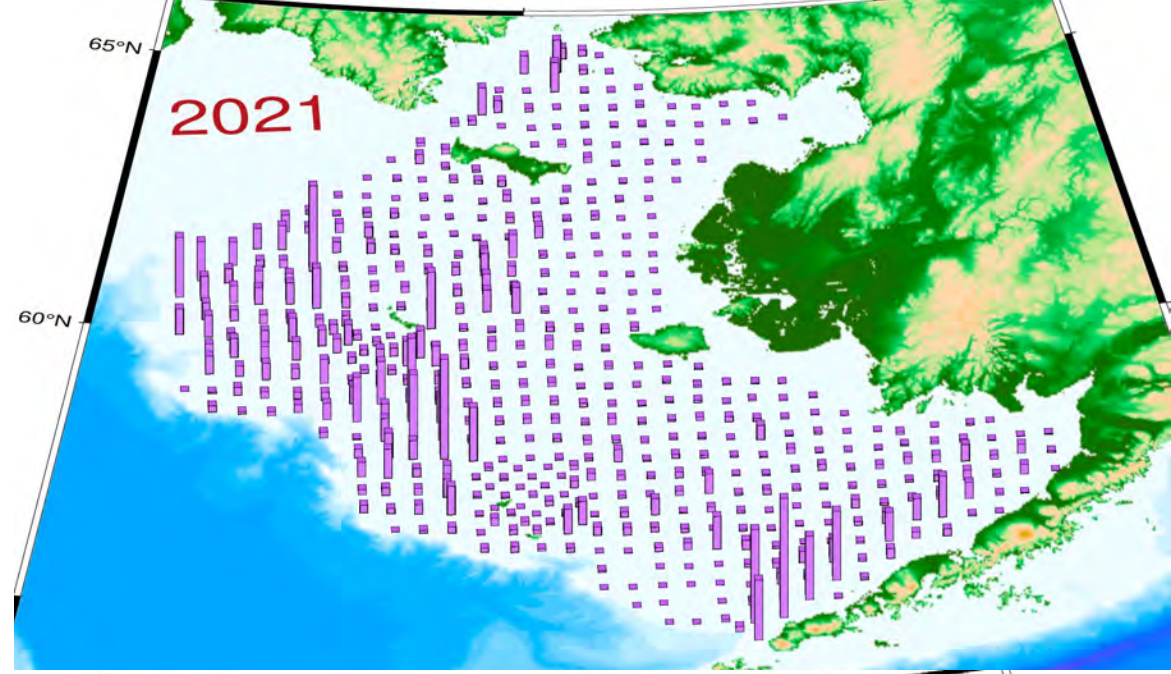
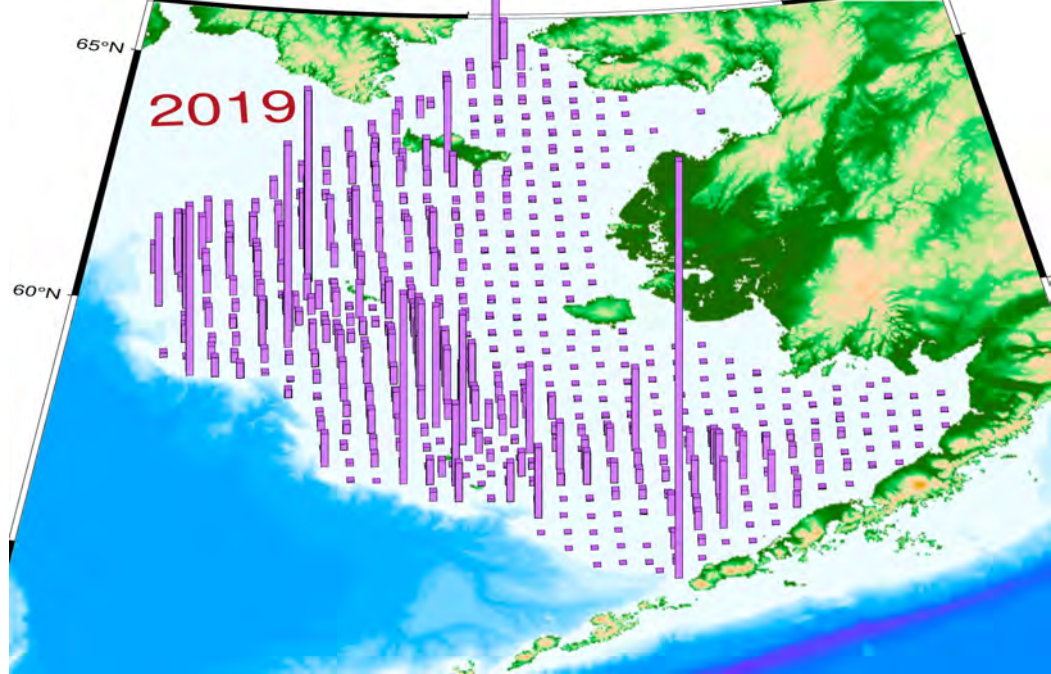
FV Alaska Knight
2010-present
12th year



FV Northwest Explorer
2023
1st year

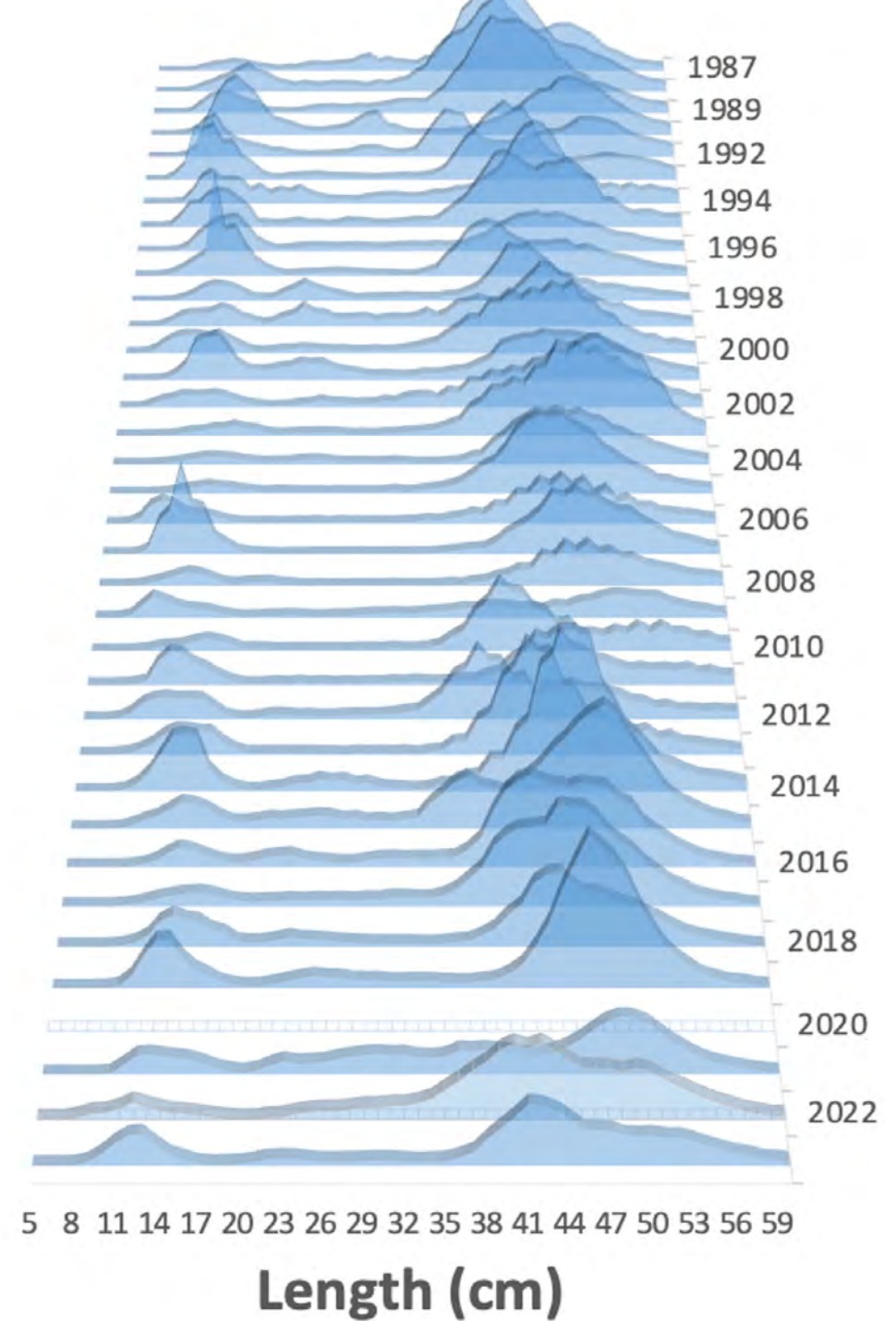
Survey Bottom Temperatures





Bottom-trawl survey

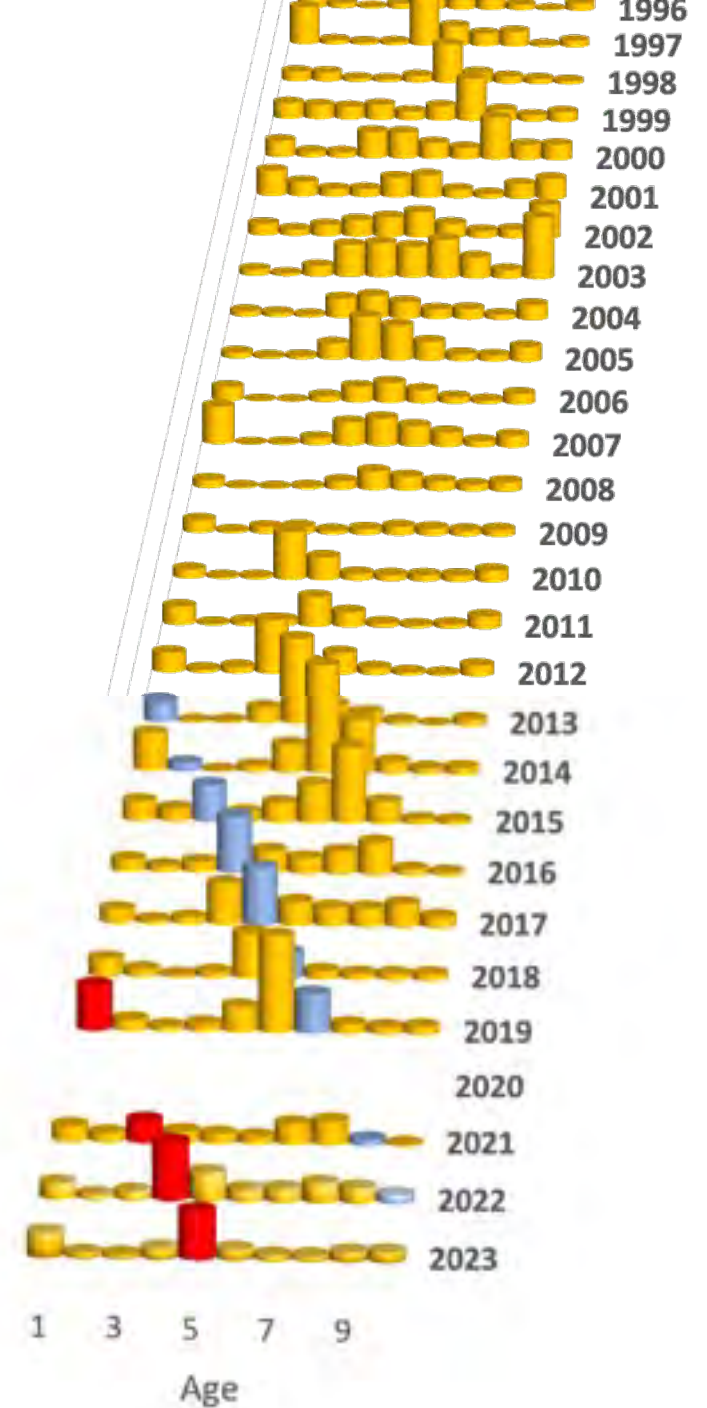
- Abundance at length

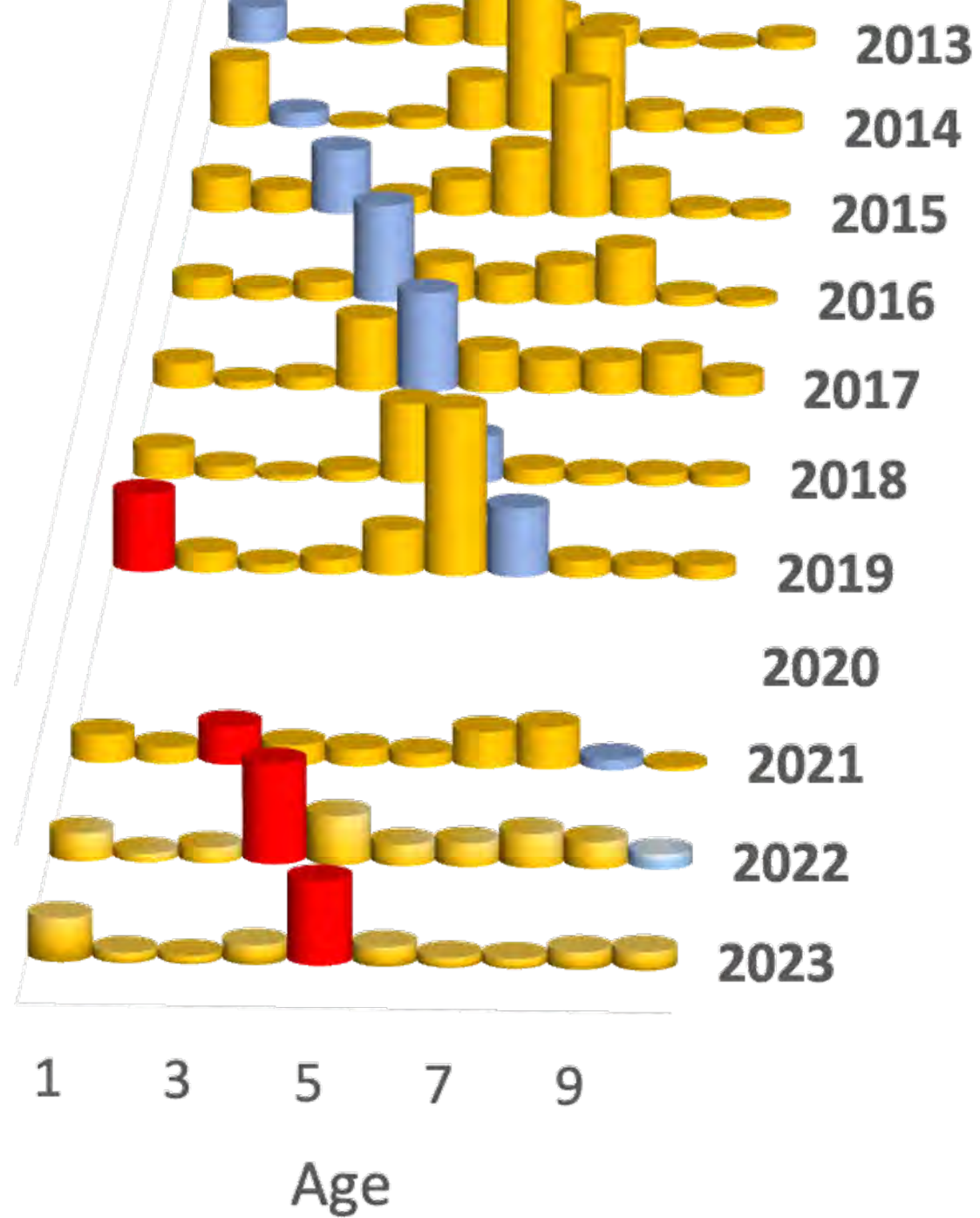


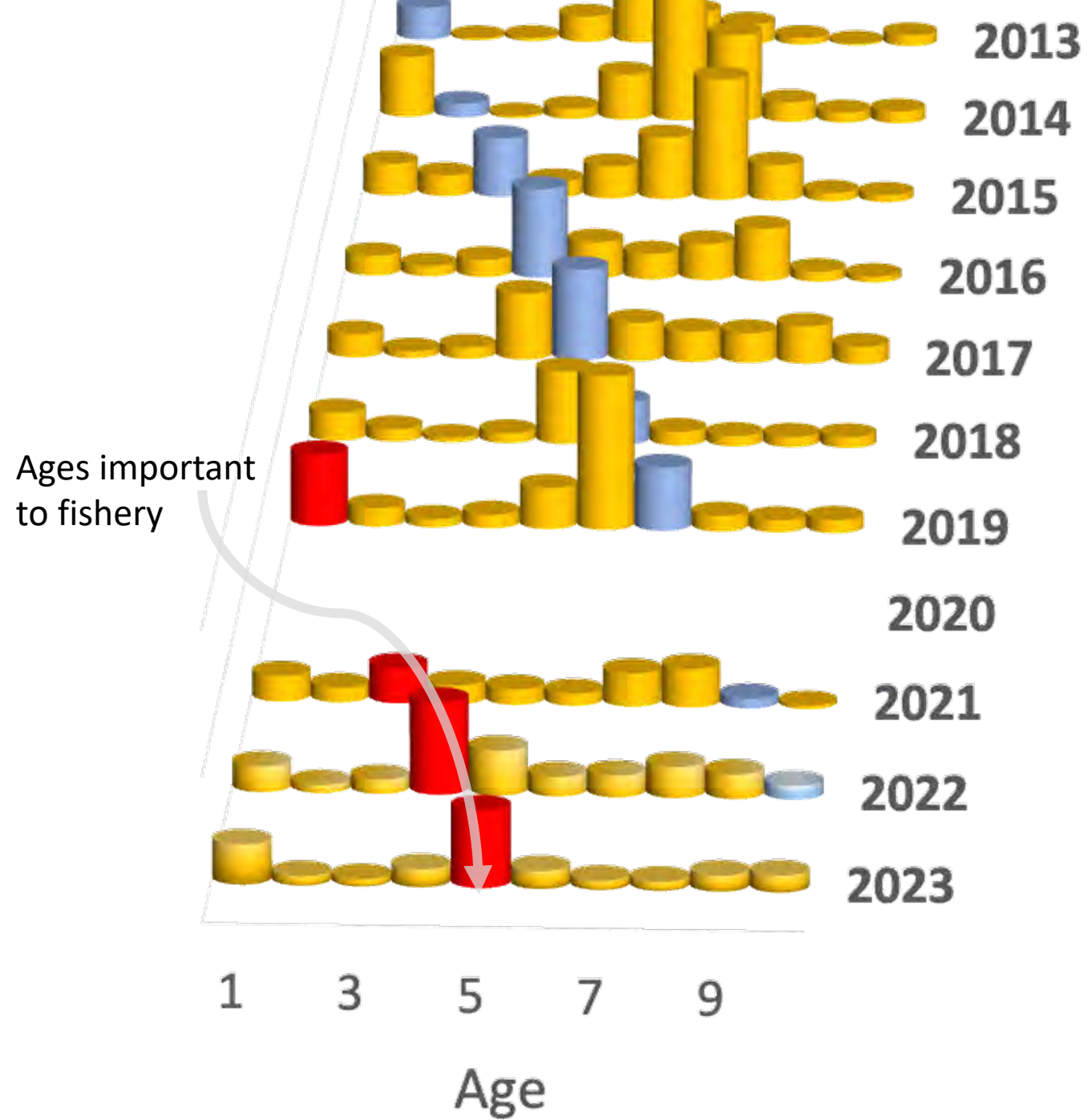
Survey abundance-at-age

- Eastern Bering Sea pollock

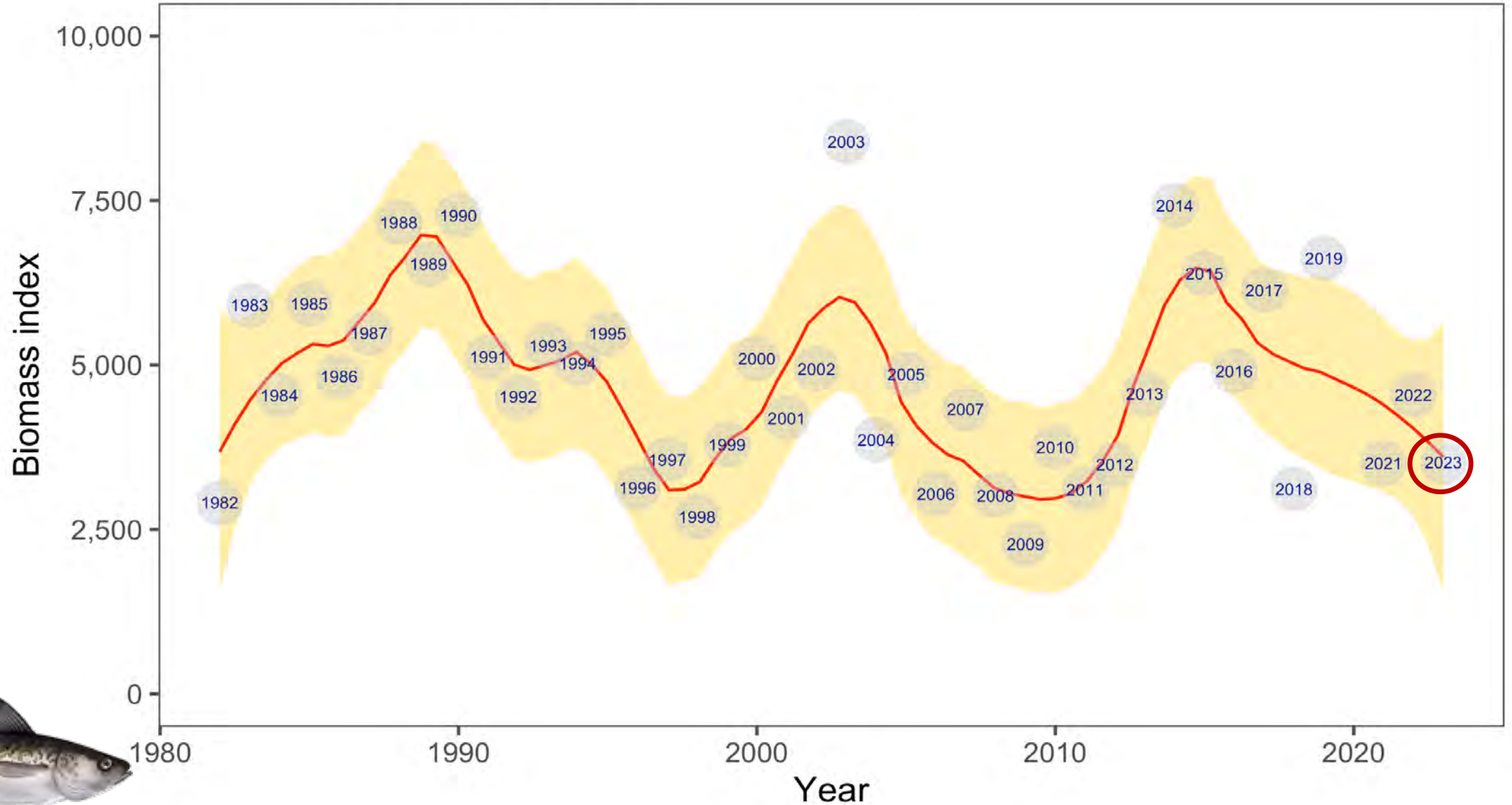
Vertical scale is population numbers at age





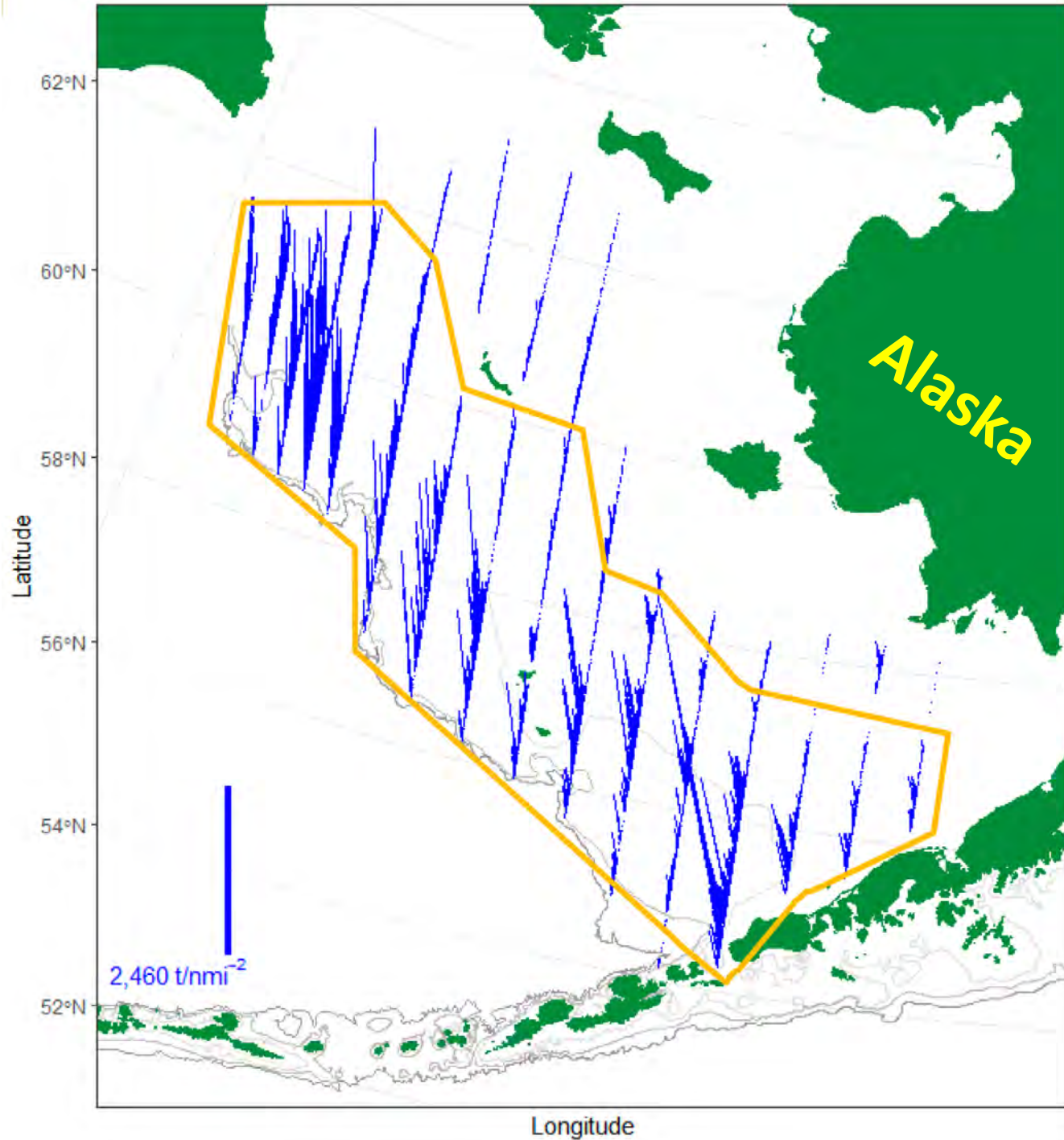


E. Bering Sea bottom trawl survey



Acoustic survey-NOAA Ship





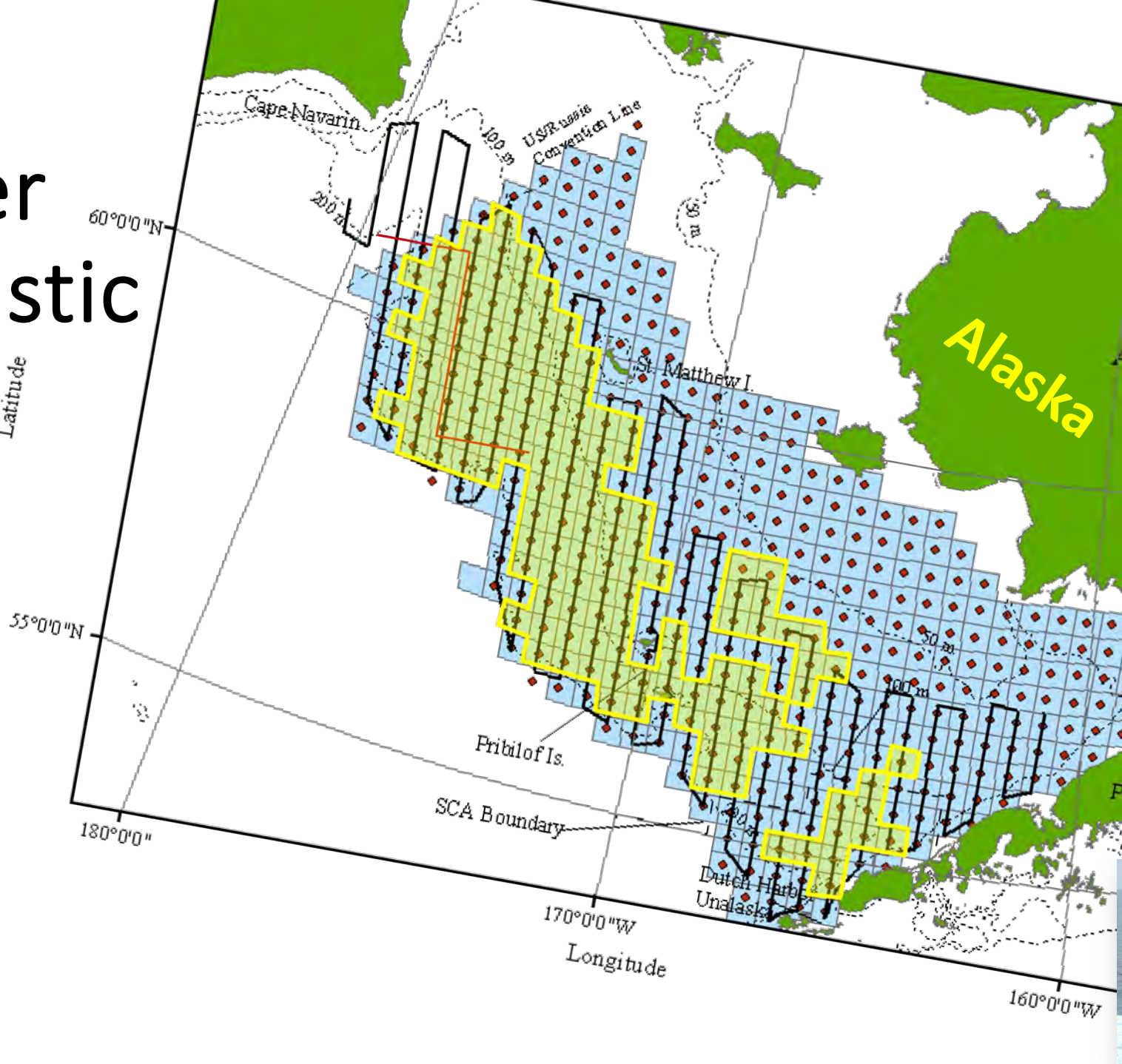
Most recent
in 2022

Last year's

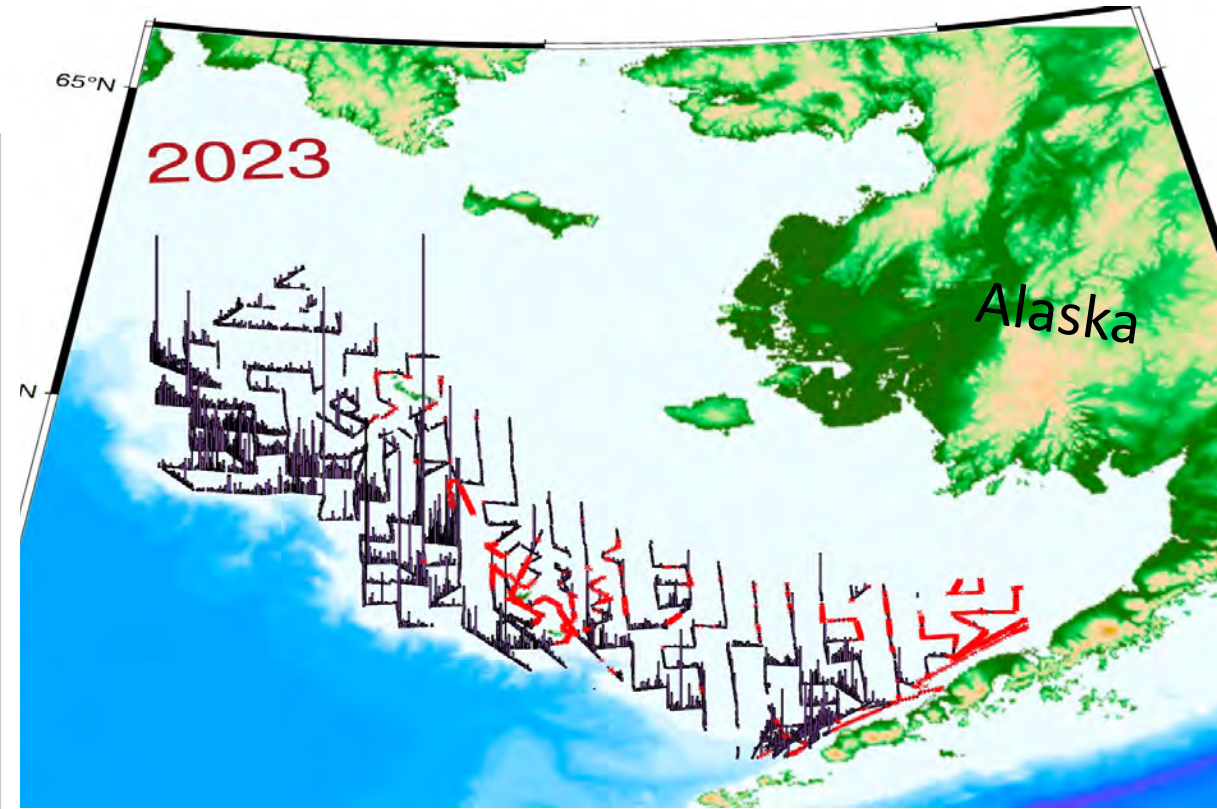
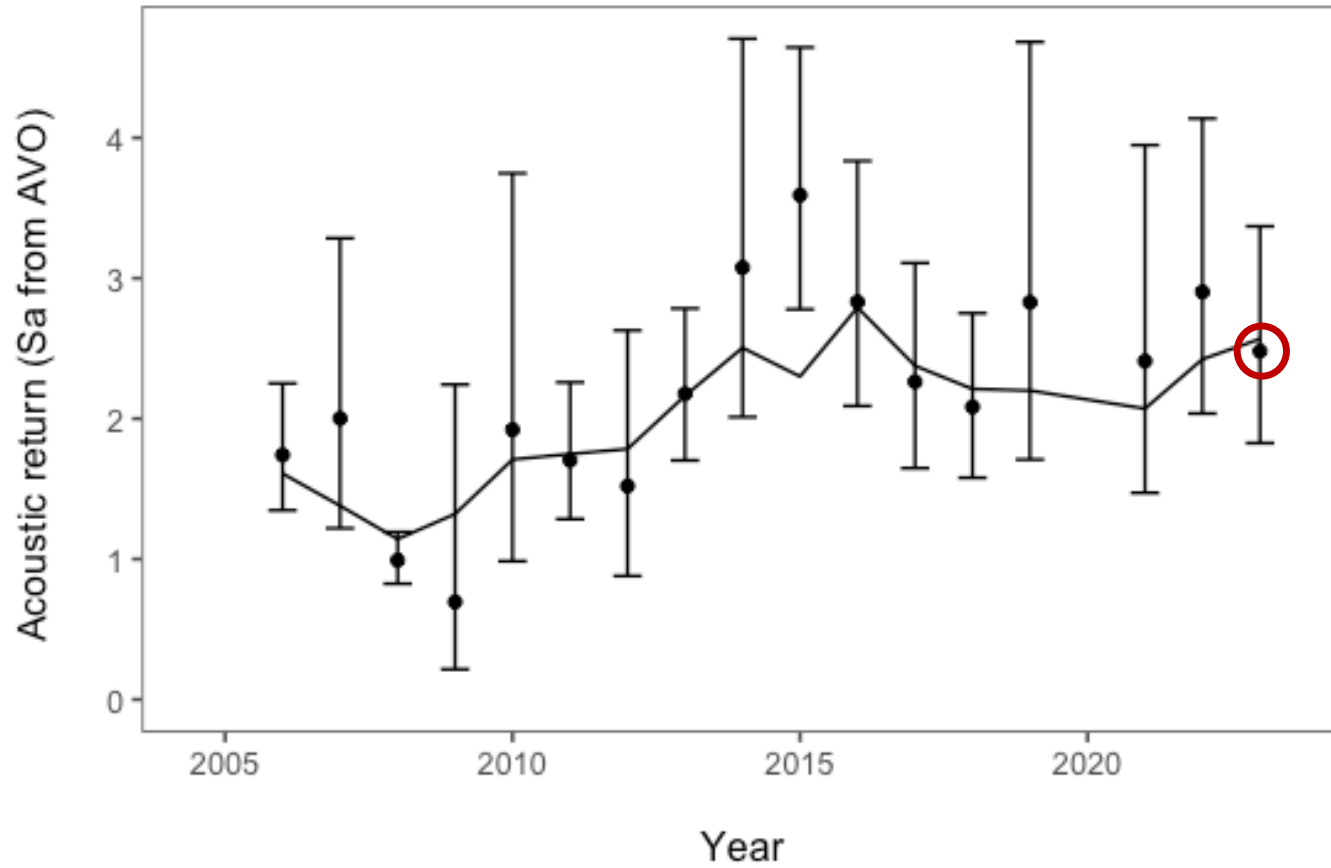


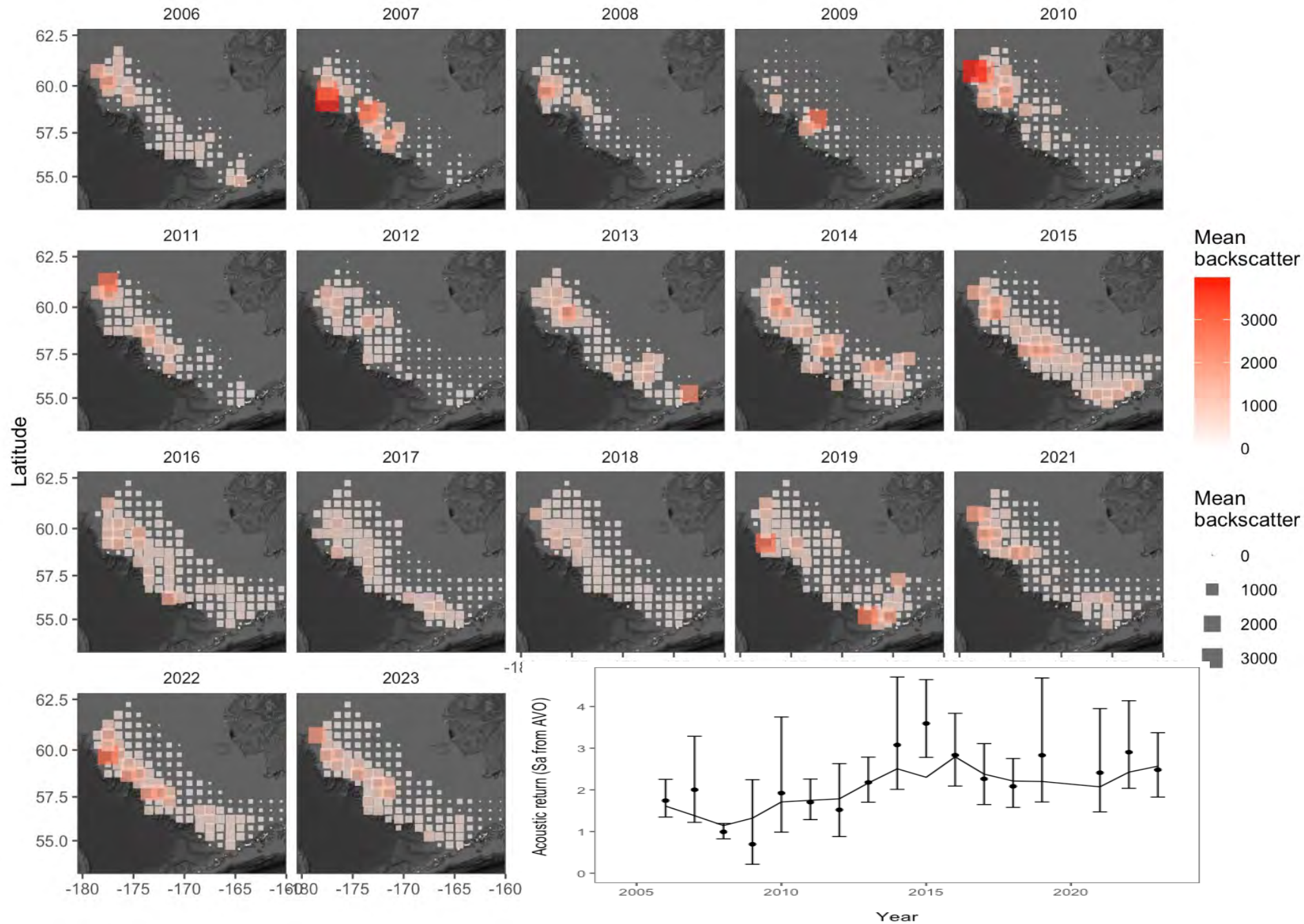
Other acoustic data

Latitude



Opportunistic acoustic survey results

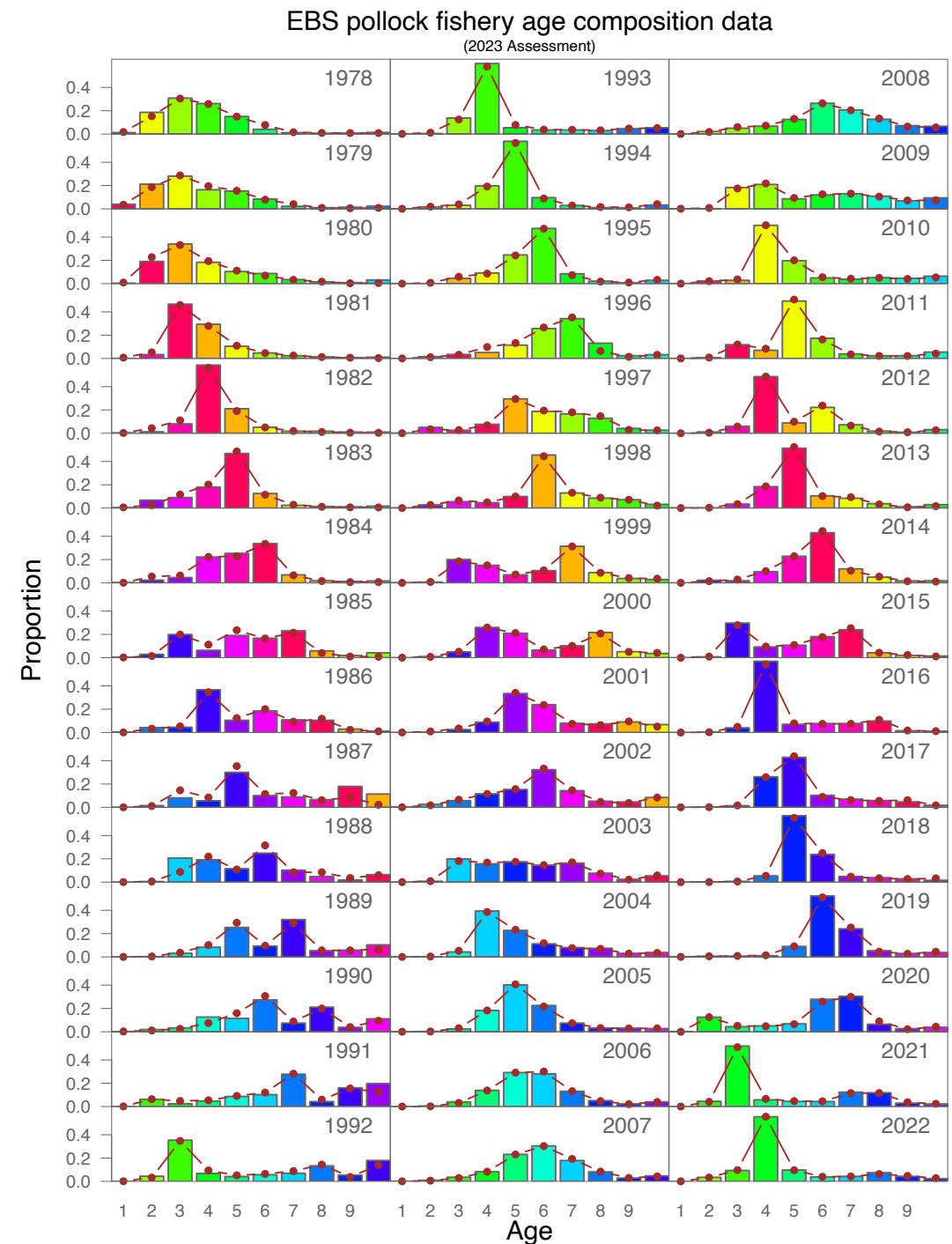




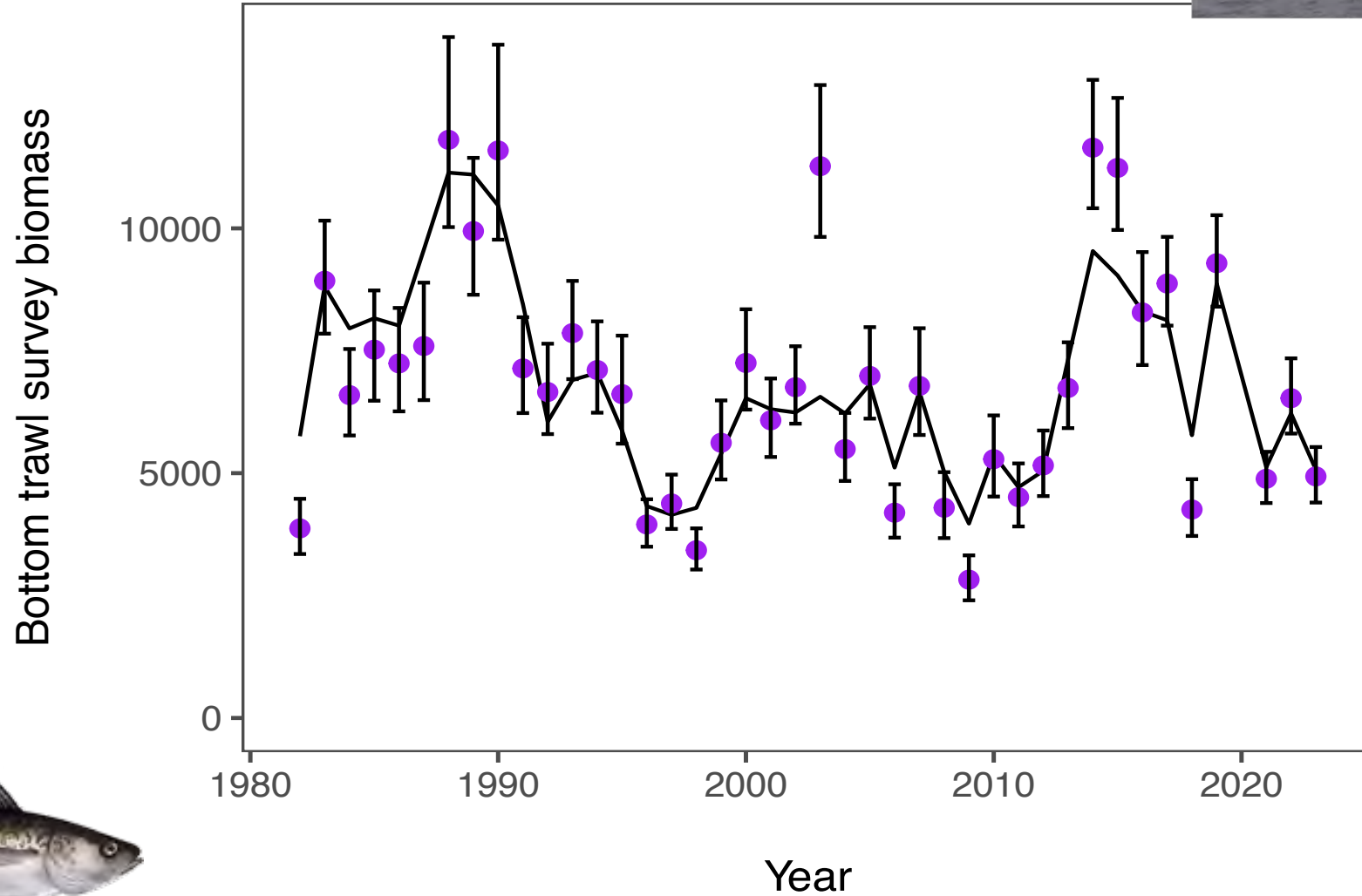
Model fits



Fishery age composition fits

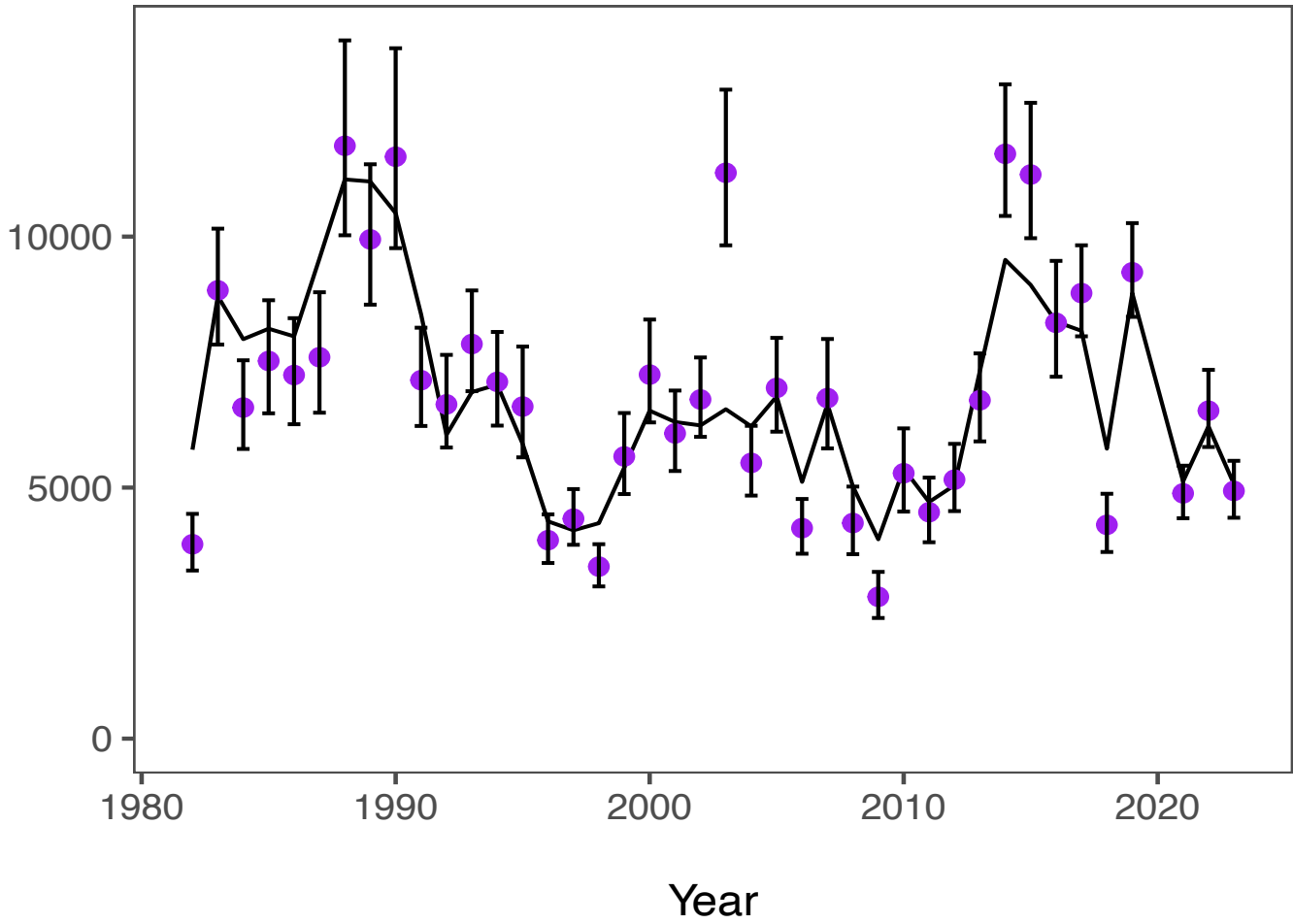


NMFS Bottom trawl survey...



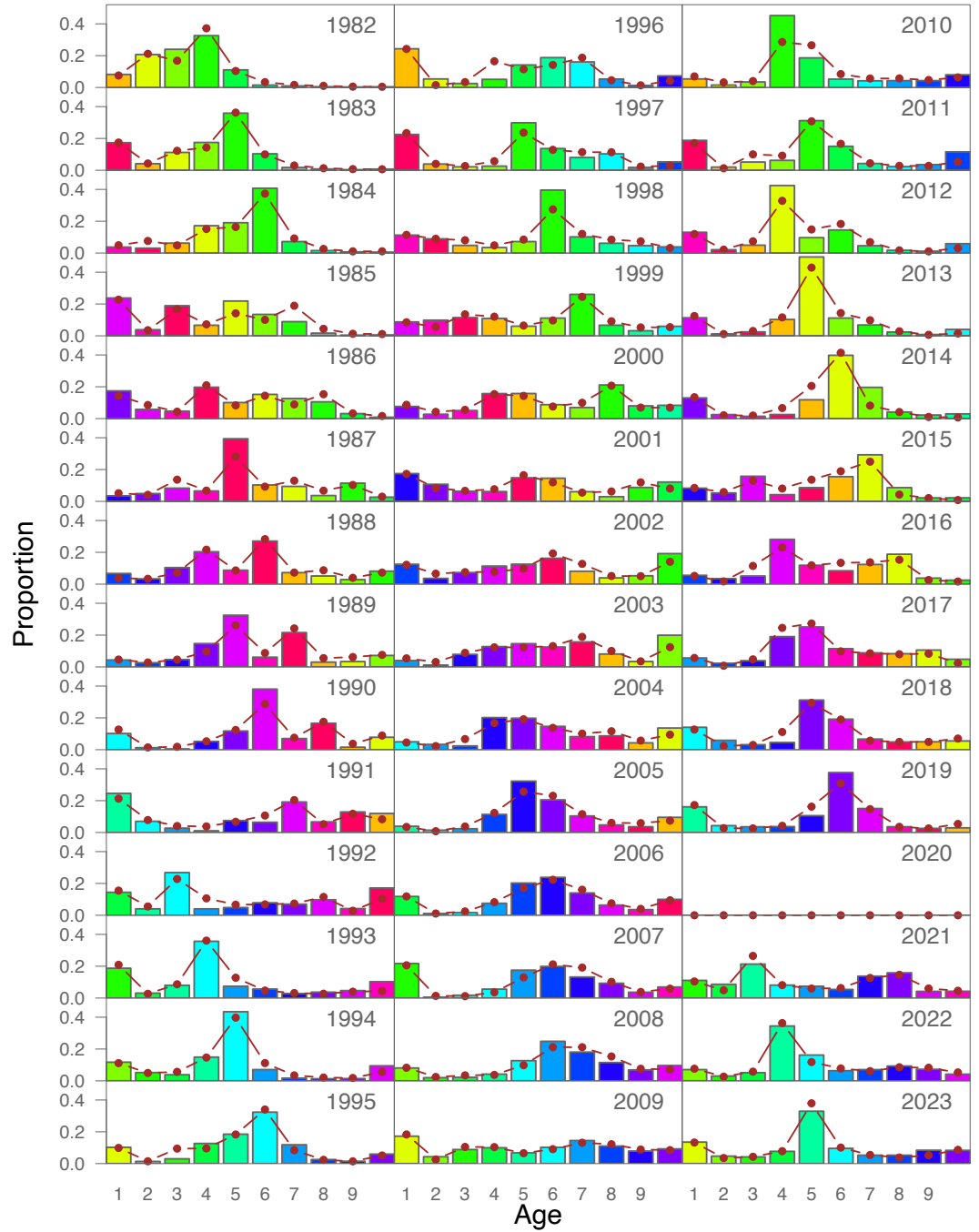
Bottom-trawl survey fits

Bottom trawl survey biomass

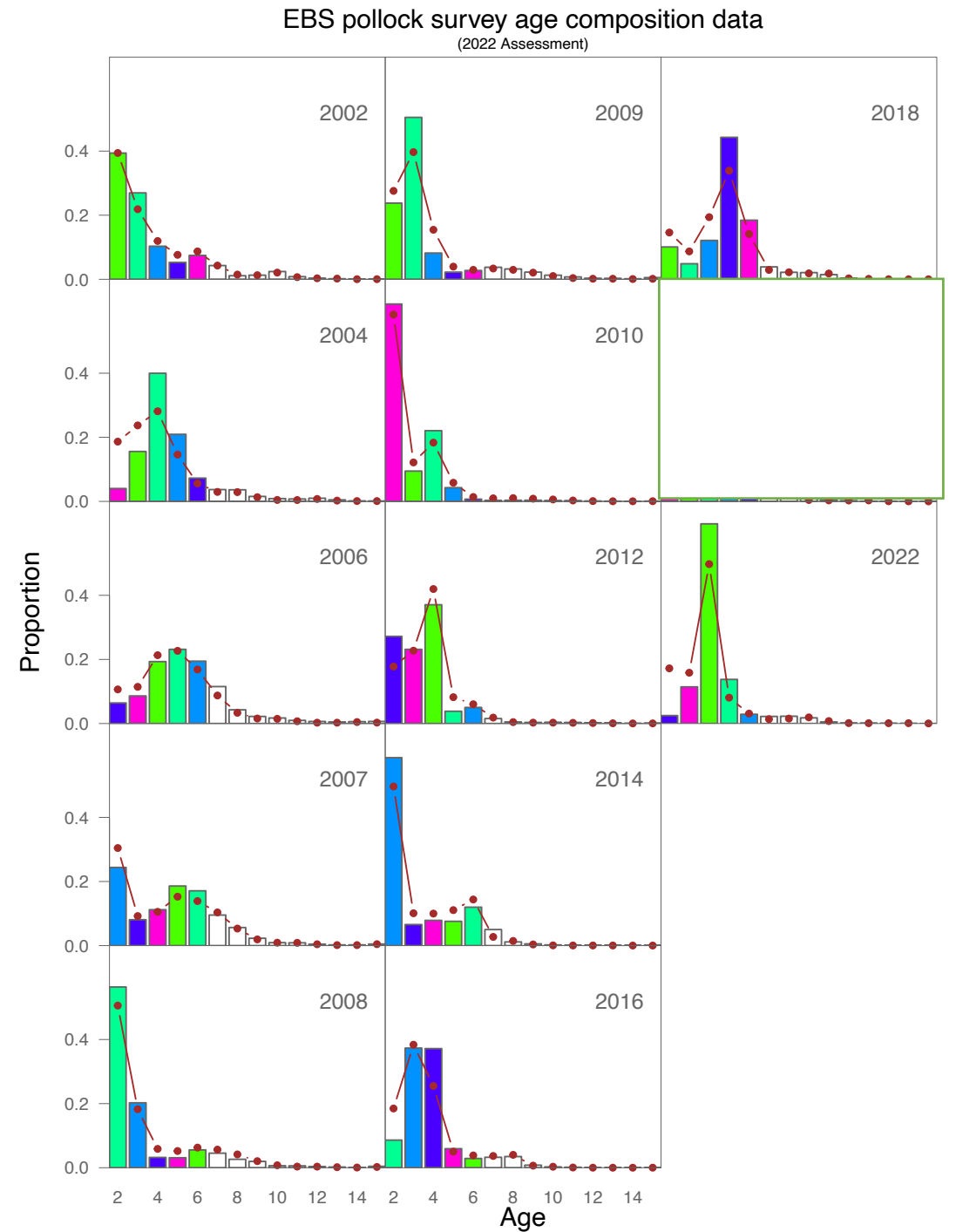
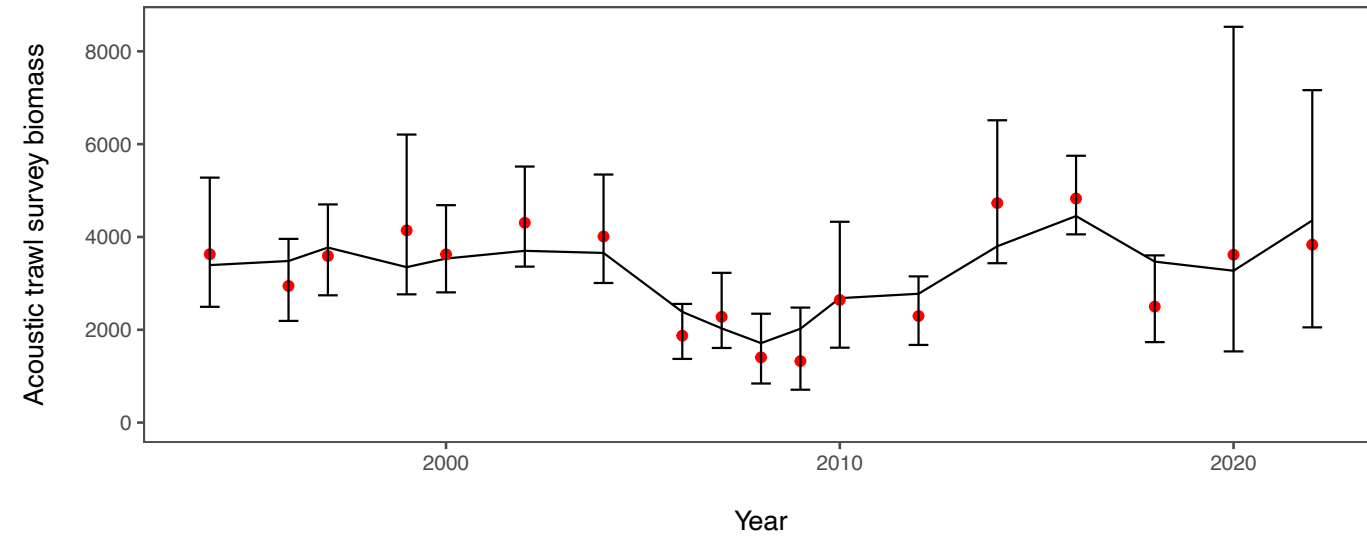


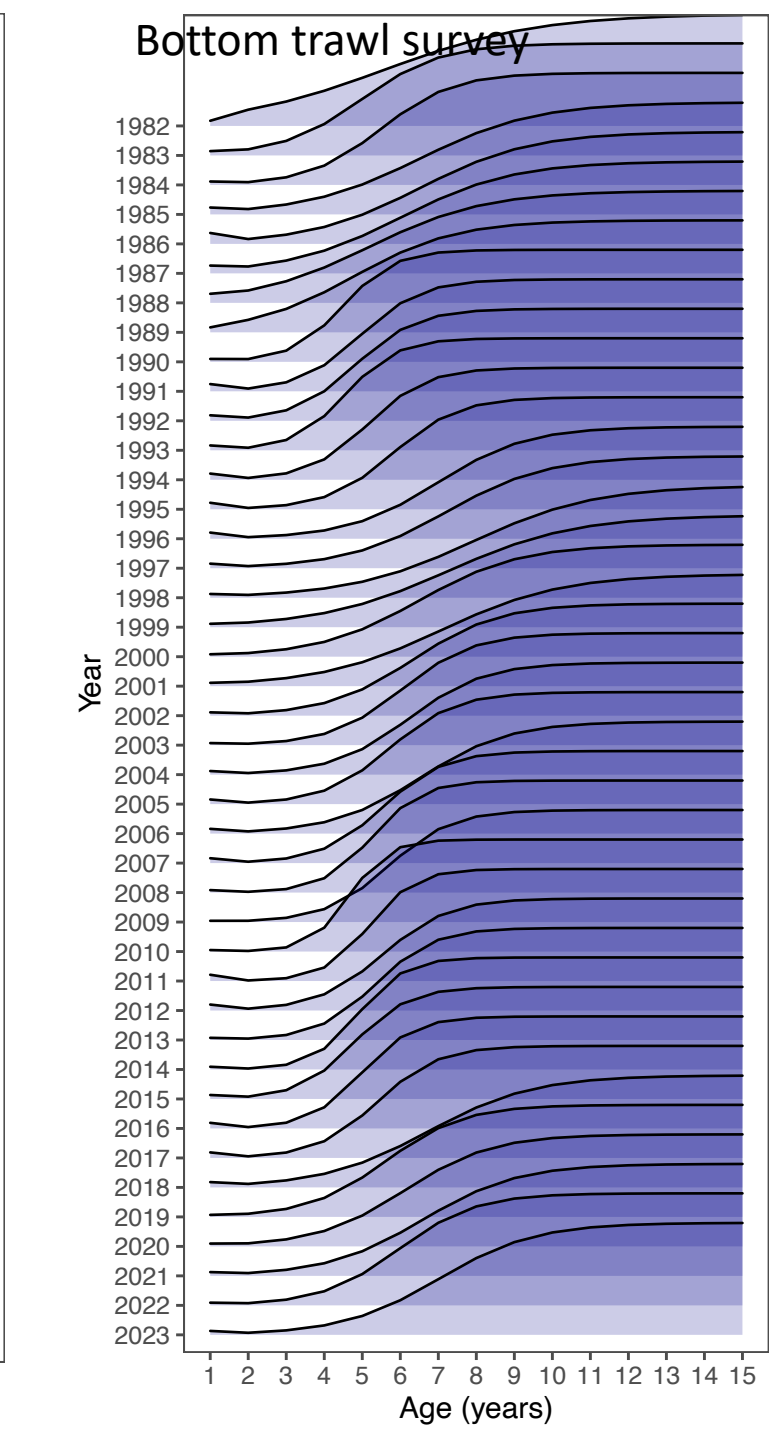
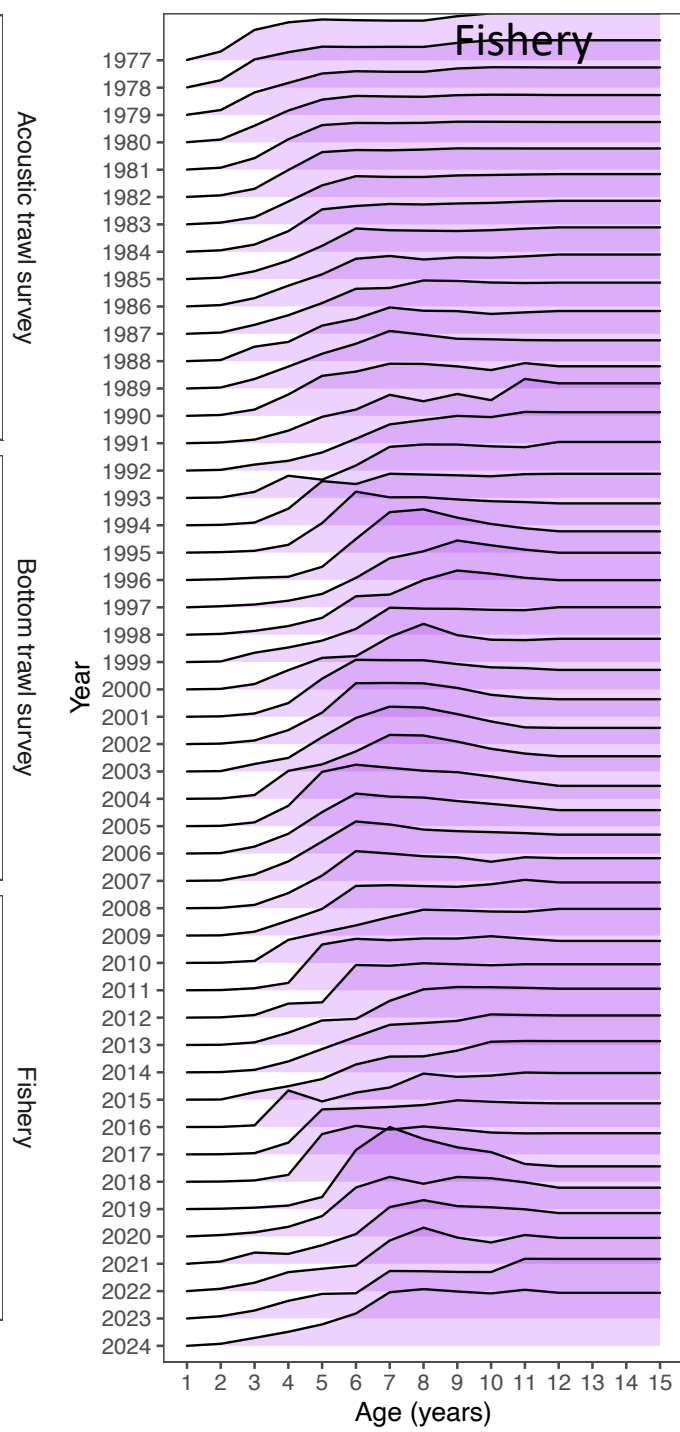
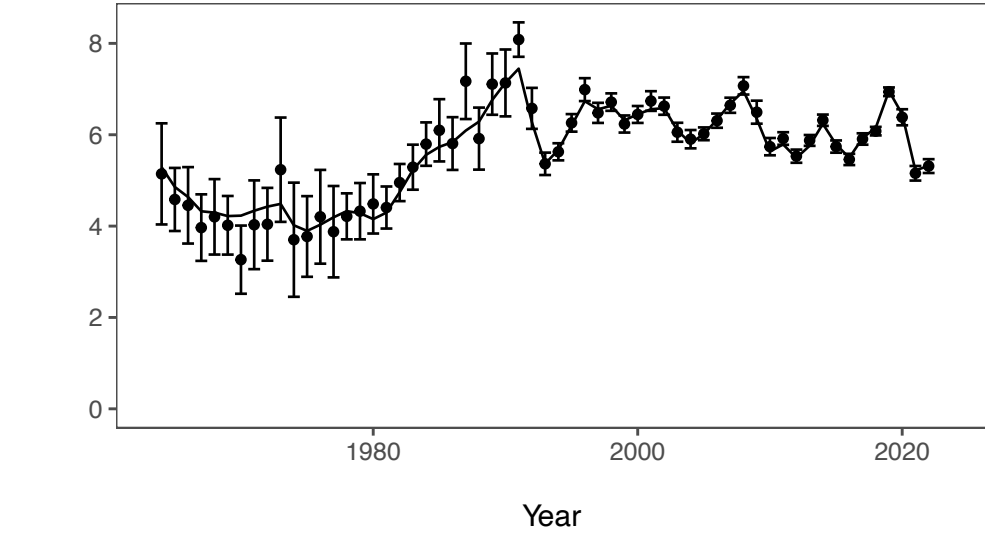
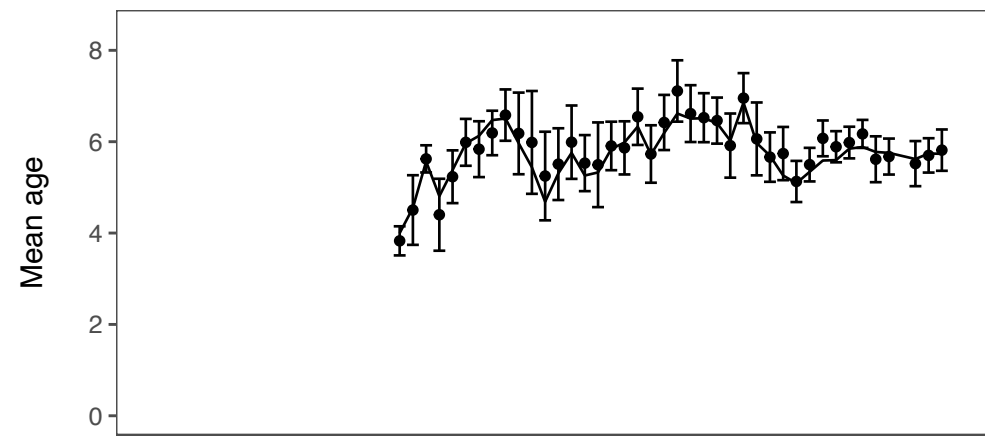
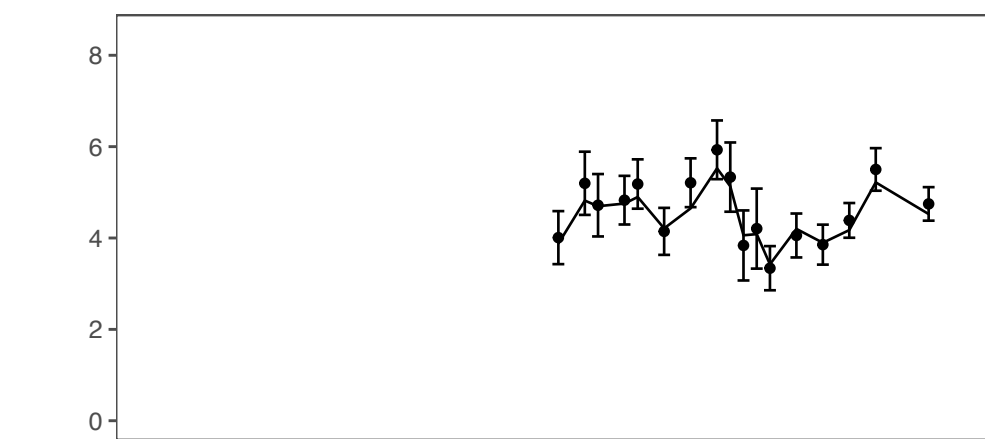
EBS pollock survey age composition data

(2023 Assessment)



Acoustic-trawl survey fits

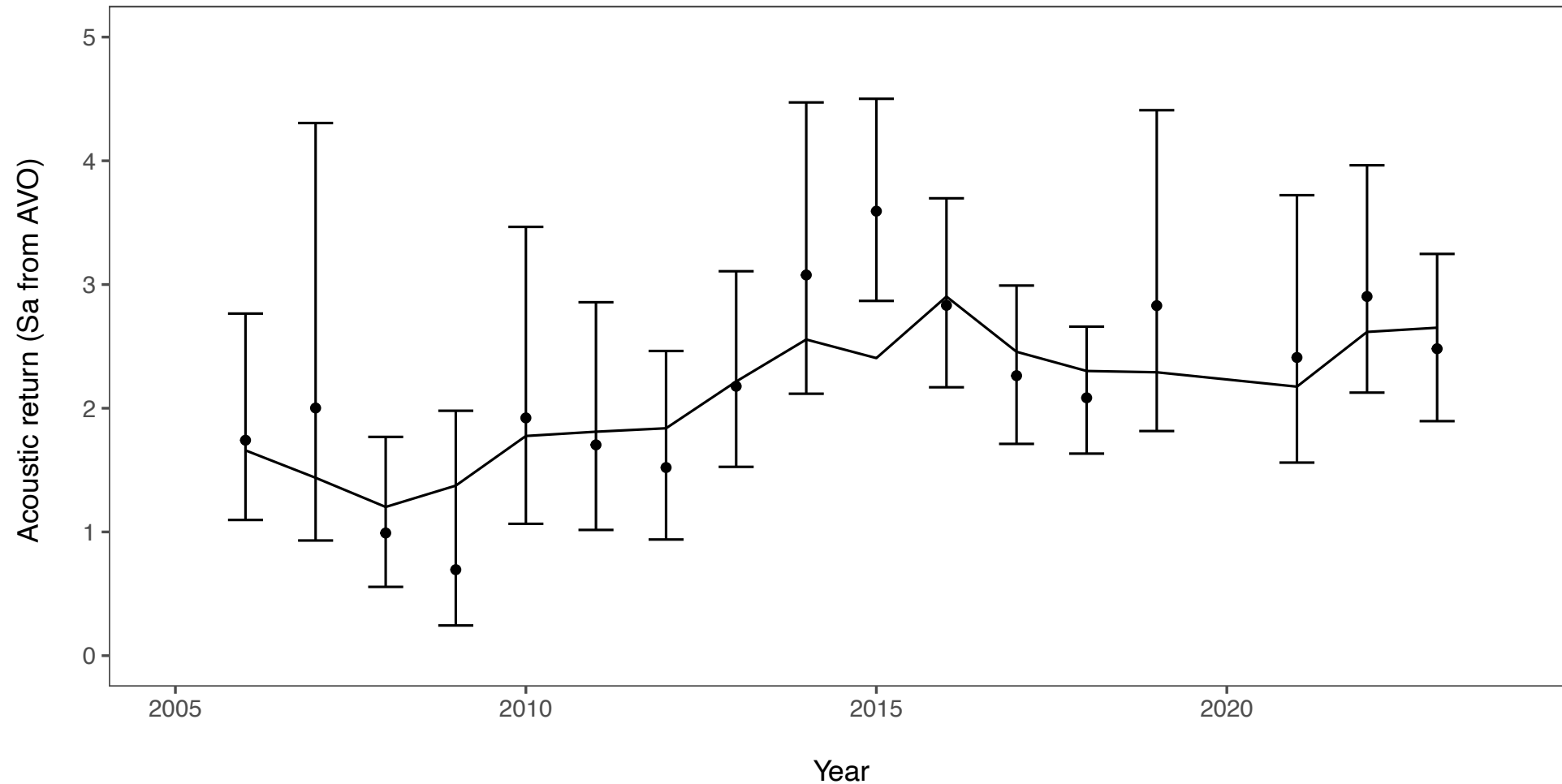




AVO Index



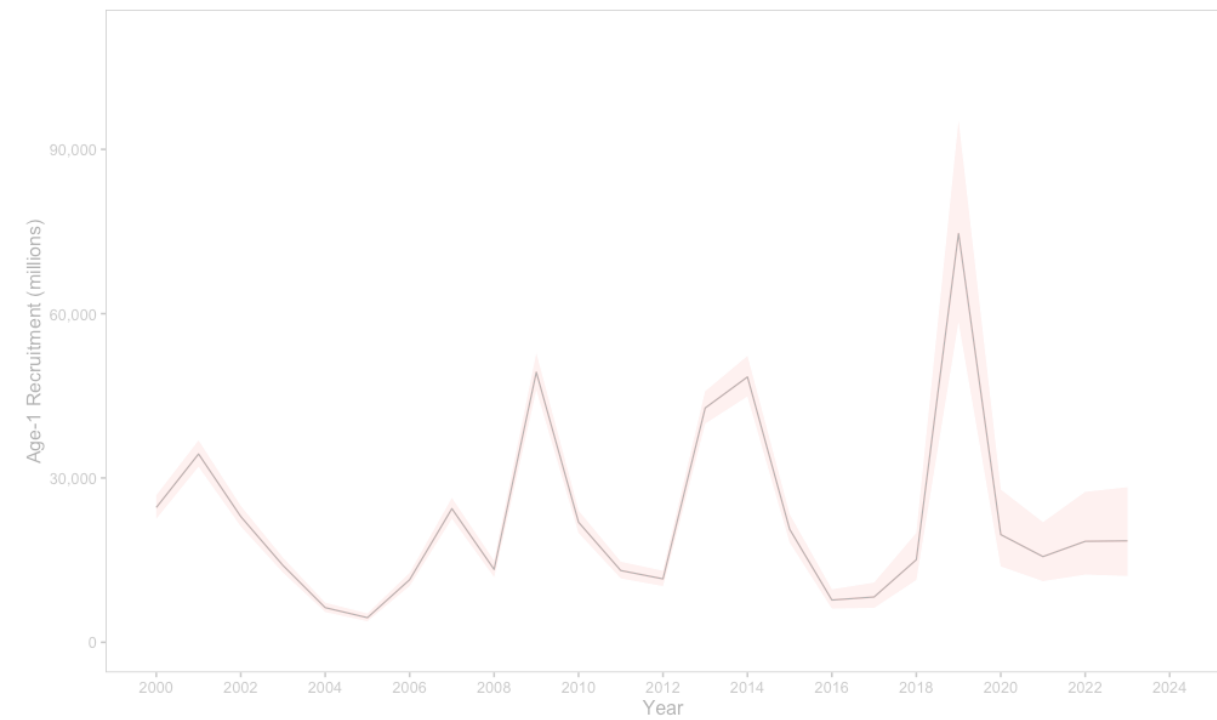
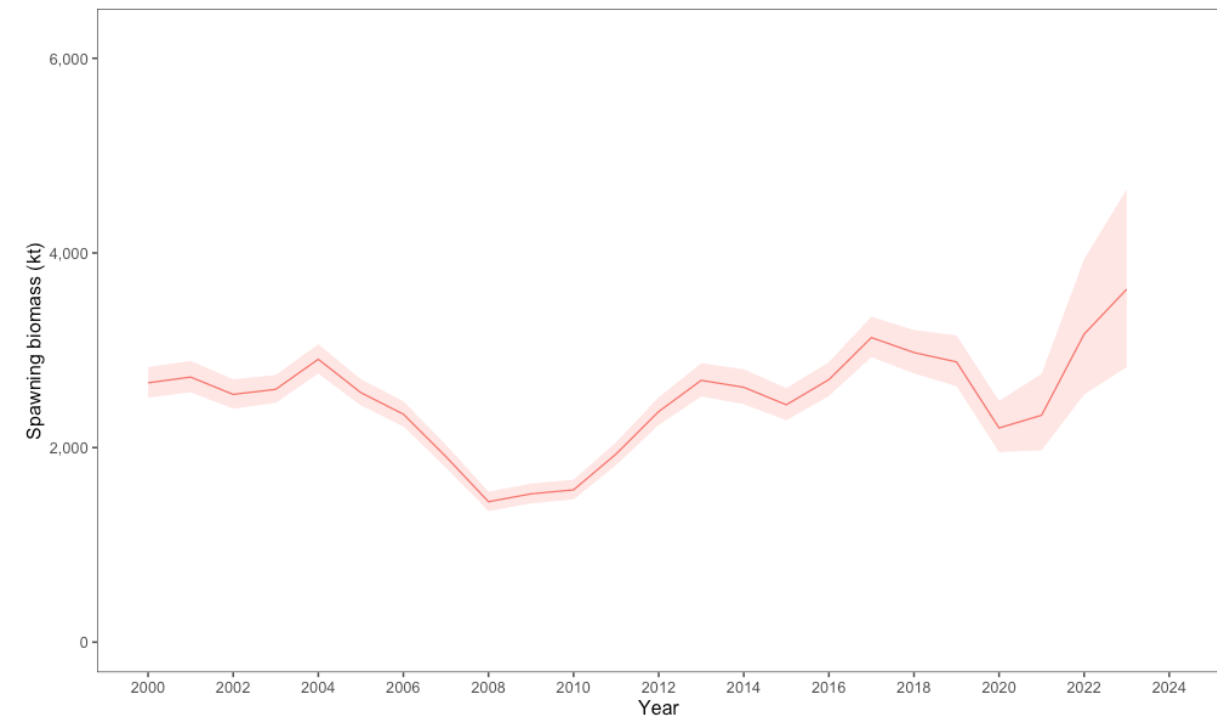
Acoustics collected opportunistically on bottom-trawl survey



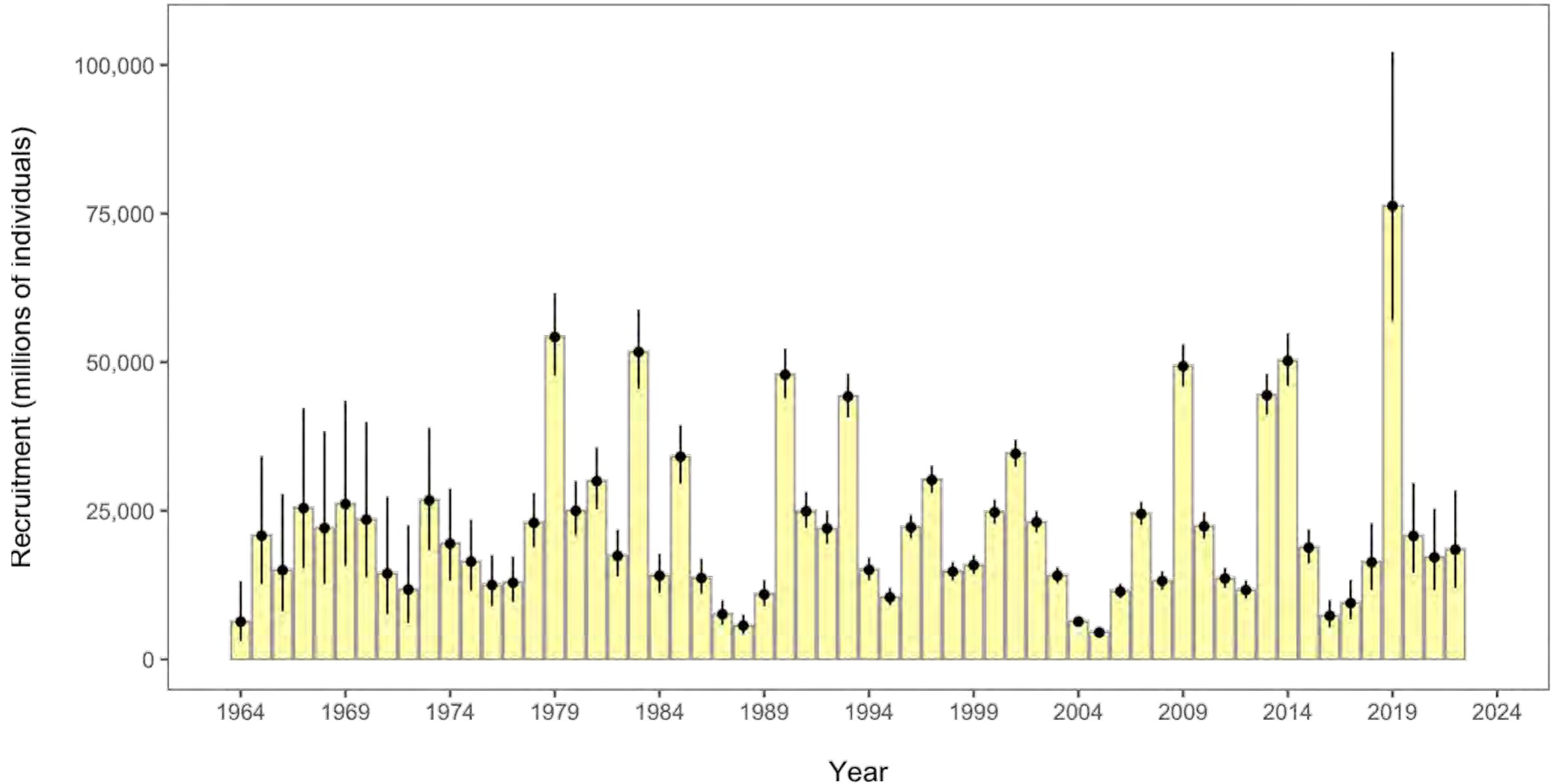
Diagnostics?



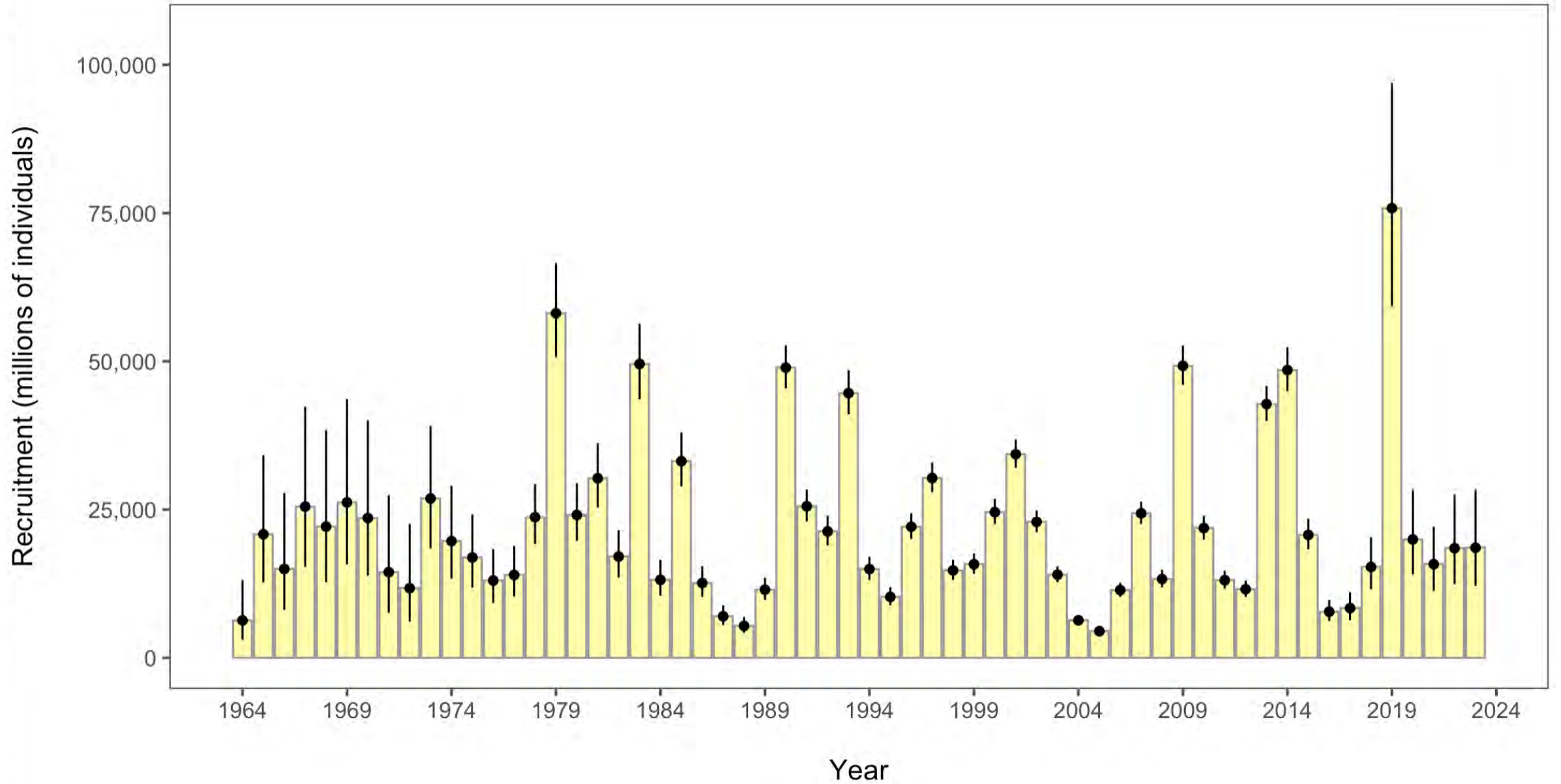
Retrospective patterns



Last year's estimated recruitment



This year's



Outlook for recruitment?

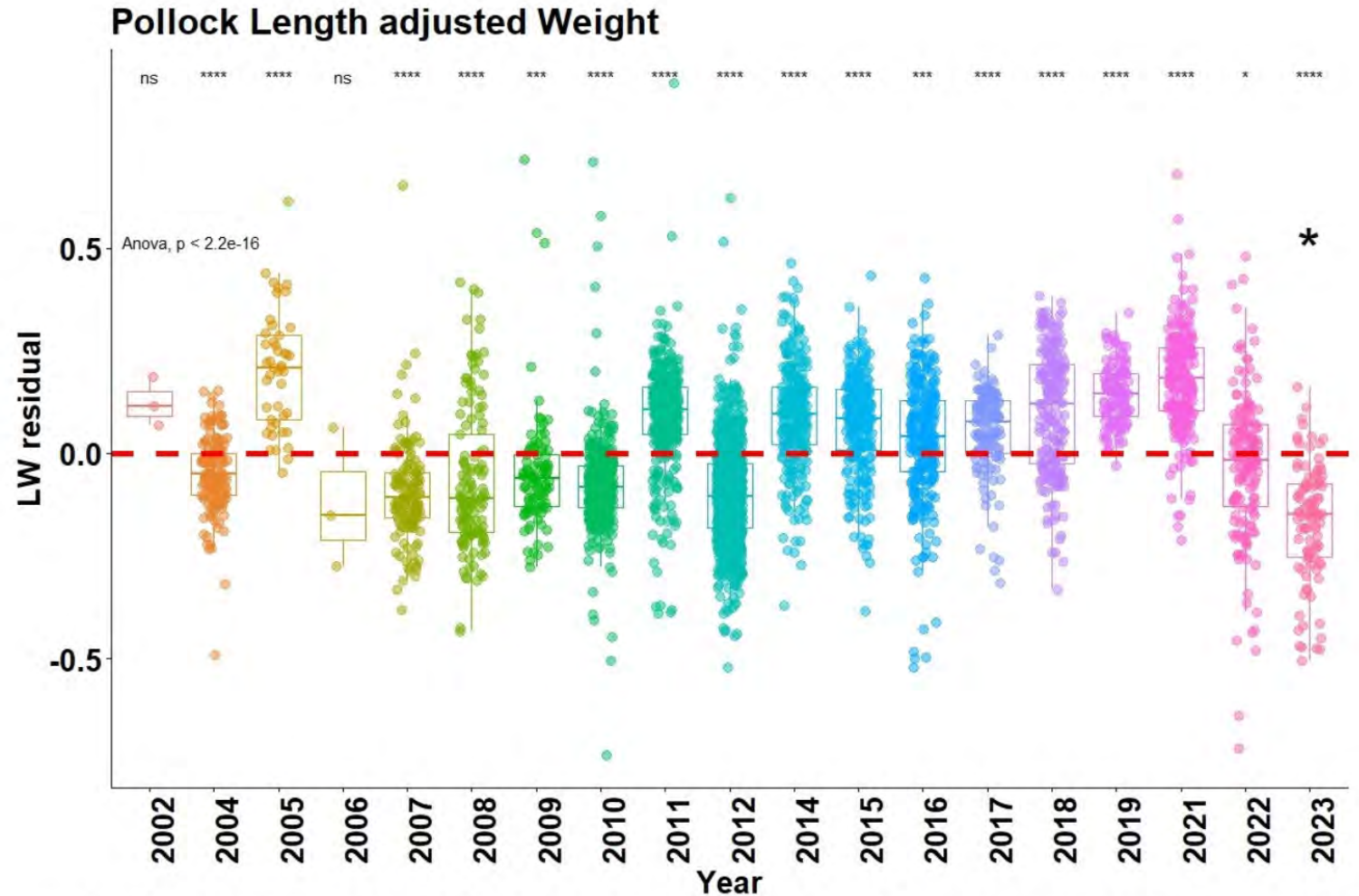


Figure 62: Annual length-weight residuals from log-transformed length-weight regressions for young-of-the-year walleye pollock. The horizontal line indicates the mean of all residuals, the significance of deviations from the mean are denoted by stars above the given year, and “ns” indicates not significant. Length is total length (mm) and mass is total body wet mass (grams). The asterisk above 2023 data indicates that these are preliminary results.

Spawning biomass outlook

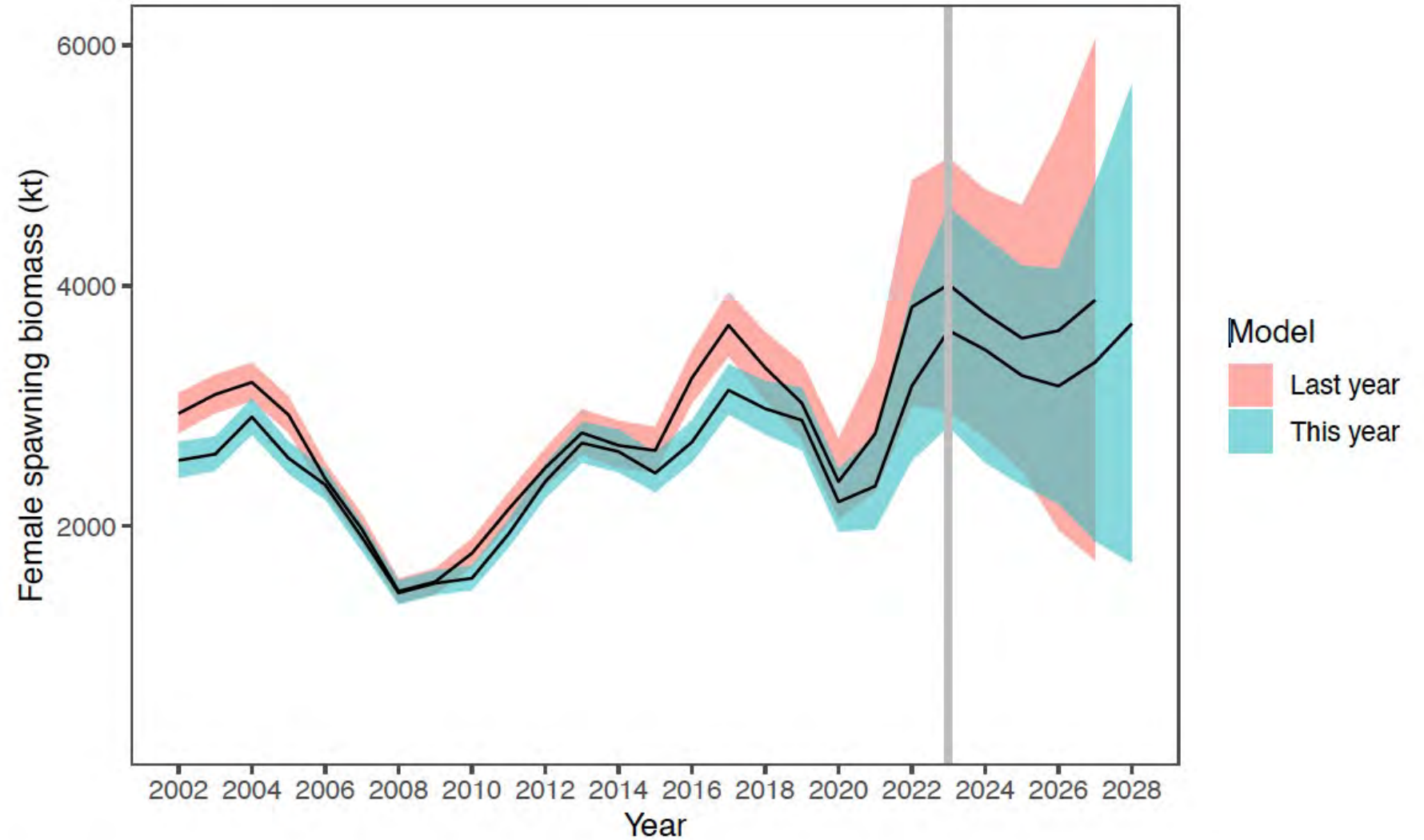


Figure 63: The estimated EBS pollock spawning stock biomass for model 20 last year and this with projections equal to the estimated fishing mortality from 2023.

Risk table

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These results are summarized as:

Assessment-related	Population dynamics	Considerations	Environmental ecosystem	Fisheries
Level 1: No concern	Level 1: No concern	Level 2: Major concern	Level 1: No concern	Level 1: No concern

Having a score at level 2 suggests that adjustments to the ABC may be prudent. In the past, the SSC has considered factors similar to those presented above and selected an ABC based on Tier 3 estimates. Last year the SSC requested examining Tier 2 values as an alternative. Unlike Tier 3, using Tier 2 would have a constant buffer relative to the Tier 1 value (at about 11%). Setting the ABC to Tier 3 levels provides a very large buffer but one that could be warranted given that the impact on subsequent spawning biomass levels will be much more variable and have a high probability of dropping below the target stock size and result in much reduced future ABCs under the current FMP. It is worth noting that fishing at the full Tier 1 ABC would imply a more than doubling of effort and well exceed the 2 million t groundfish catch limit. Even fishing at a full Tier 3 ABC shows there is a relatively high probability of falling below B_{MSY} values or proxies thereof. Under our standard scenarios, Alternative 3 shows trajectories if fishing effort is held equal to the recent 5-year average. It is noteworthy

shows trajectories if fishing effort is held equal to the recent 5-year average. It is noteworthy falling below B_{MSY} values or proxies thereof. Under our standard scenarios, Alternative 3 catch limit. Even fishing at a full Tier 3 ABC shows there is a relatively high probability of

Decision table description

Table 33: Details and explanation of the decision table factors selected in response to the Plan Team requests (as originally proposed in the 2012 assessment).

Term	Description	Rationale
$P[F_{2024} > F_{MSY}]$	Probability that the fishing mortality in 2024 exceeds F_{MSY}	OFL definition is based on F_{MSY}
$P[B_{2025} < B_{MSY}]$	Probability that the spawning biomass in 2025 is less than B_{MSY}	B_{MSY} is a reference point target and biomass in 2021 provides an indication of the impact of 2024 fishing
$P[B_{2026} < B_{MSY}]$	Probability that the spawning biomass in 2026 is less than B_{MSY}	B_{MSY} is a reference point target and biomass in 2024 provides an indication of the impact of fishing in 2024 and 2025
$P[B_{2026} < \bar{B}]$	Probability that the spawning biomass in 2025 is less than the 1978–2023 mean	To provide some perspective of what the stock condition might be relative to historical estimates after fishing in 2024.
$P[B_{2028} < \bar{B}]$	Probability that the spawning biomass in 2028 is less than the long term mean	To provide some perspective of what the stock condition might be relative to historical estimates after fishing in 2024.
$P[B_{2028} < B_{2024}]$	Probability that the spawning biomass in 2028 is less than that estimated for 2024	To provide a medium term expectation of stock status relative to 2024 levels
$P[B_{2026} < B_{20\%}]$	Probability that the spawning biomass in 2026 is less than $B_{20\%}$	$B_{20\%}$ had been selected as a Steller Sea Lion lower limit for allowing directed fishing
$P[p_{a_5,2026} > \bar{p}_{a_5}]$	Probability that in 2026 the proportion of age 1–5 pollock in the population exceeds the long-term mean	To provide some relative indication of the age composition of the population relative to the long term mean.
$P[D_{2025} < D_{1994}]$	Probability that the diversity of ages represented in the spawning biomass (by weight) in 2025 is less than the value estimated for 1994	To provide a relative index on the abundance of different age classes in the 2025 population relative to 1994 (a year identified as having low age composition diversity)
$P[D_{2028} < D_{1994}]$	Probability that the diversity of ages represented in the spawning biomass (by weight) in 2028 is less than the value estimated for 1994	To provide a medium-term relative index on the abundance of different age classes in the population relative to 1994 (a year identified as having low age composition diversity)
$P[E_{2024} > E_{2023}]$	Probability that the theoretical fishing effort in 2024 will be greater than that estimated in 2023.	To provide the relative effort that is expected (and hence some idea of costs).

Decision table estimates

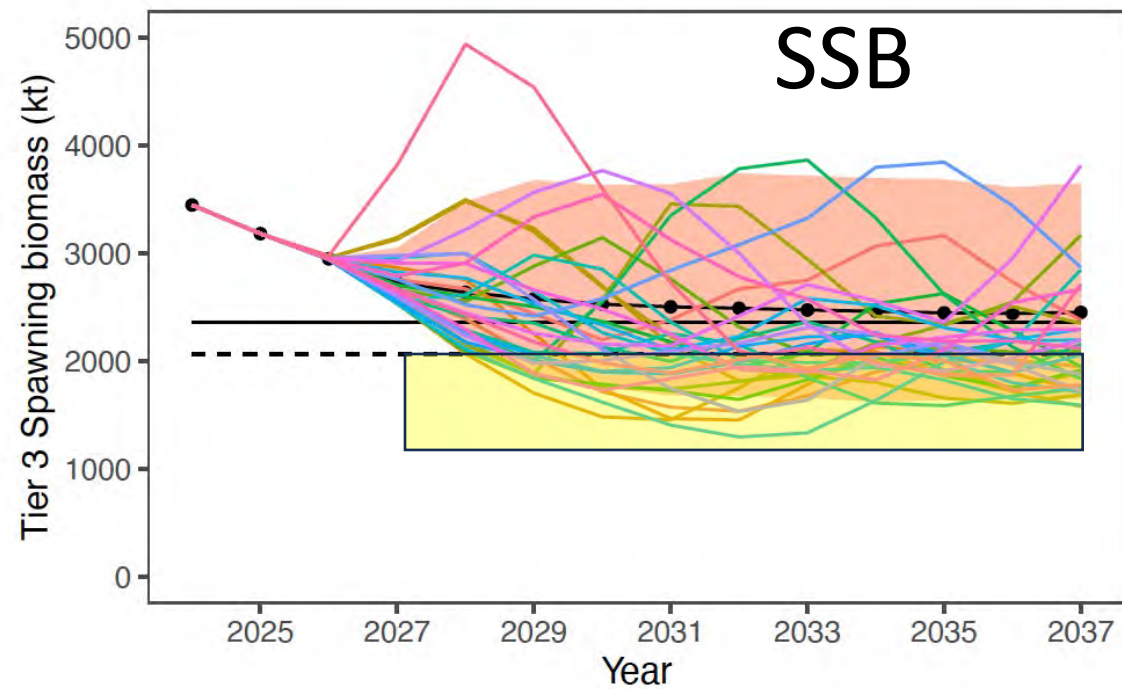
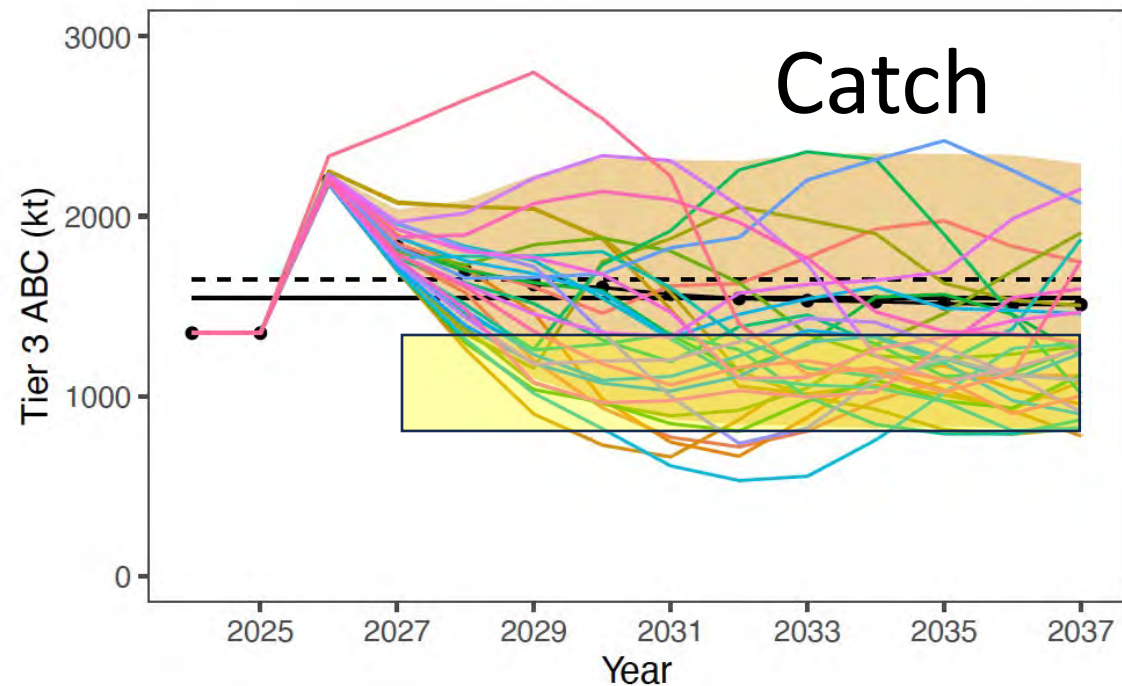
Table 34: Outcomes of decision (expressed as chances out of 100) given different 2024 catches (first row, in kt). Note that for the 2021 and later year-classes average values were assumed. Constant Fs based on the 2024 catches were used for subsequent years.

	10	850	1000	1260	1150	1300	1450	1600	Catch in kt for 2024
$P [F_{2024} > F_{MSY}]$	0	0	0	0	0	0	0	0	
$P [B_{2024} < B_{MSY}]$	9	17	20	24	22	25	28	31	
$P [B_{2025} < B_{MSY}]$	5	17	21	28	25	30	35	40	
$P [B_{2024} < \bar{B}]$	0	2	3	5	4	6	8	11	
$P [B_{2027} < \bar{B}]$	0	6	9	14	12	15	18	22	
$P [B_{2027} < B_{2023}]$	6	30	36	46	42	48	53	58	
$P [B_{2025} < B_{20\%}]$	0	0	0	1	0	1	1	1	
$P [p_{a_5,2024} > \bar{p}_{a_5}]$	7	42	48	58	54	60	64	68	
$P [D_{2024} < D_{1994}]$	2	2	2	2	2	2	2	2	
$P [D_{2027} < D_{1994}]$	0	1	2	4	3	4	6	8	
$P [E_{2024} > E_{2023}]$	0	4	15	43	31	47	61	71	

Some simple
projections

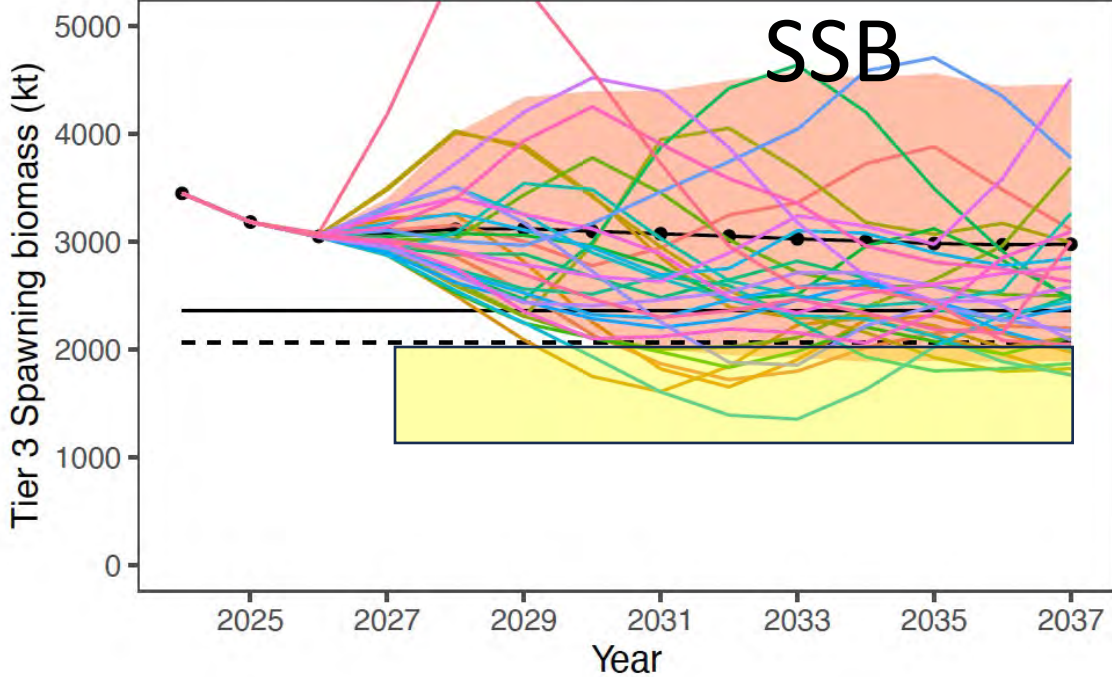
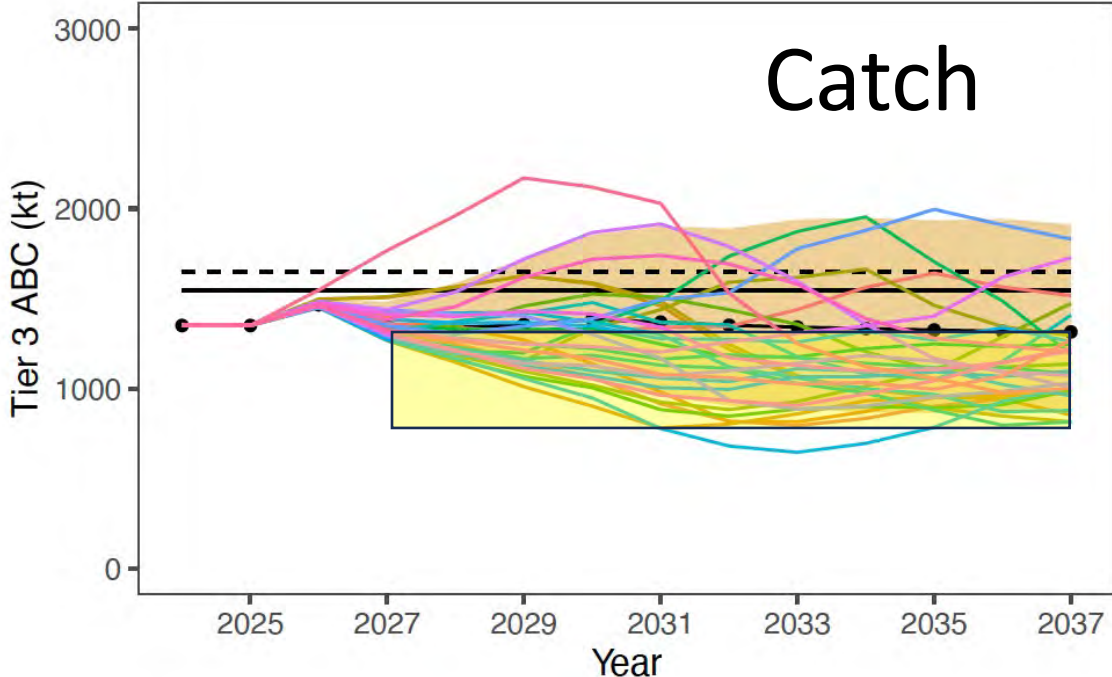
Tier 3-max permissible ABC

- Projections



Fishing at recent average F

- Projections



EBS pollock summary

Quantity	As estimated or <i>specified</i> <i>last year for:</i>		As estimated or <i>recommended</i> <i>this year for:</i>	
	2023	2024	2024	2025
M (natural mortality rate, ages 3+)	0.3	0.3	0.3	0.3
Tier	1a	1a	1a	1a
Projected total (age 3+) biomass (t)	12,389,000 t	11,445,000 t	10,184,000 t	9,437,000 t
Projected female spawning biomass (t)	4,171,000 t	3,944,000 t	3,518,000 t	3,255,000 t
B_0	6,653,000 t	6,653,000 t	6,728,000 t	6,728,000 t
B_{msy}	2,674,000 t	2,674,000 t	2,689,000 t	2,689,000 t
F_{OFL}	0.491	0.491	0.422	0.422
$maxF_{ABC}$	0.434	0.434	0.379	0.379
F_{ABC}	0.365	0.365	0.33	0.33
OFL	3,381,000 t	4,639,000 t	3,162,000 t	3,449,000 t
$maxABC$	2,987,000 t	4,099,000 t	2,837,000 t	3,095,000 t
ABC	1,910,000 t	2,275,000 t	2,313,000 t	2,401,000 t
Status	2021	2022	2022	2023
Overfishing	No	n/a	No	n/a
Overfished	n/a	No	n/a	No
Approaching overfished	n/a	No	n/a	No