2023 BSAI Northern rockfish (Operational Update)

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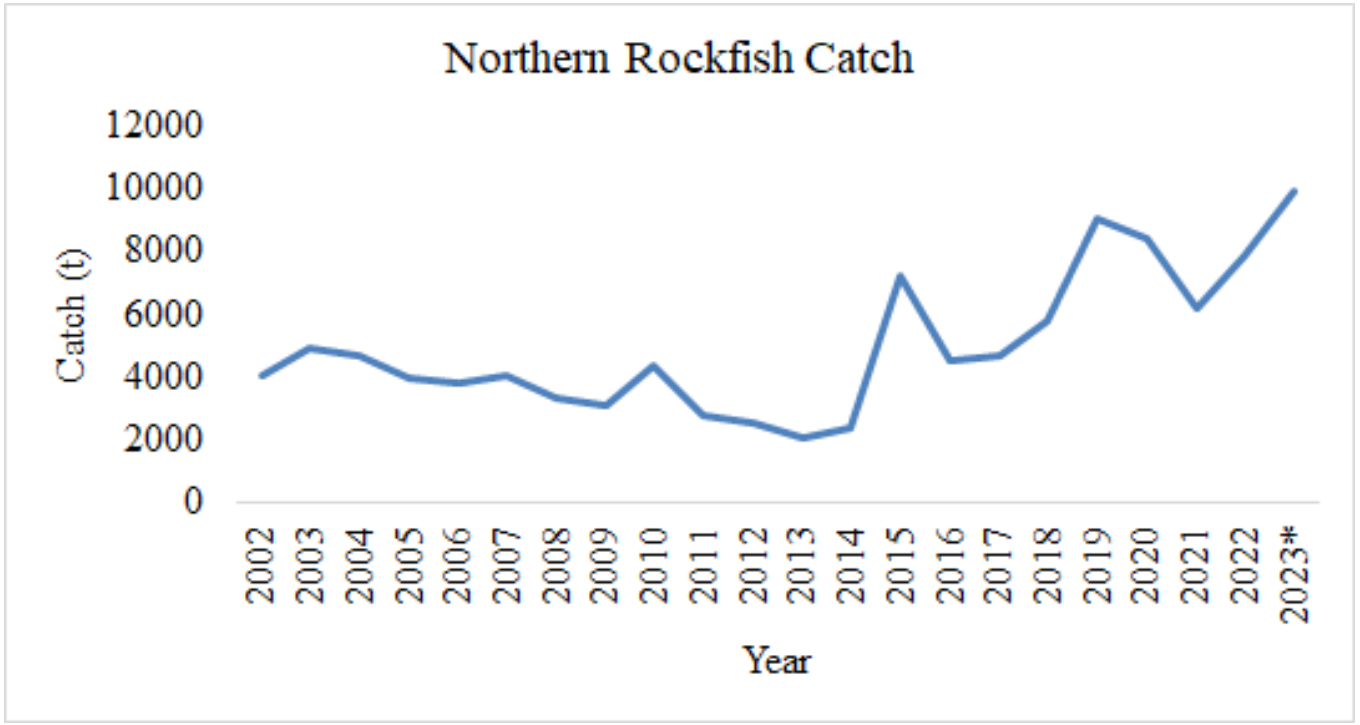
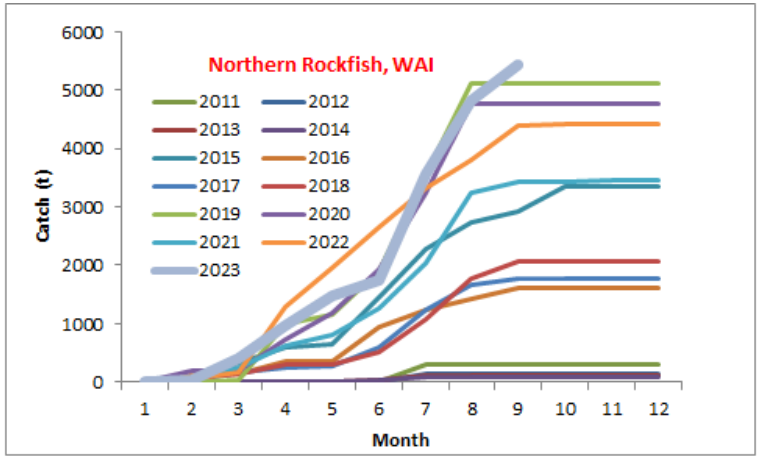
BSAI Northern Rockfish Outline

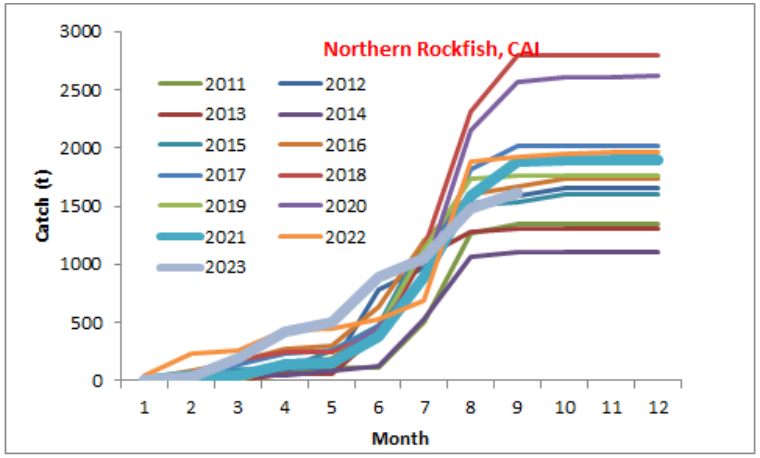
1) Catch information
2) New data (2021 fishery age comps, 2022 fishery length comps, 2022 AI survey age comps and biomass estimate) and updated weights at age
3) Responses to comments
    1) Check of EBS shelf survey biomass estimates
    2) Ageing error update
    3) Stock structure
4) Model fits to data
5) Retrospective analysis
6) Exploitation rates
7) Risk Table
8) Management recommendations

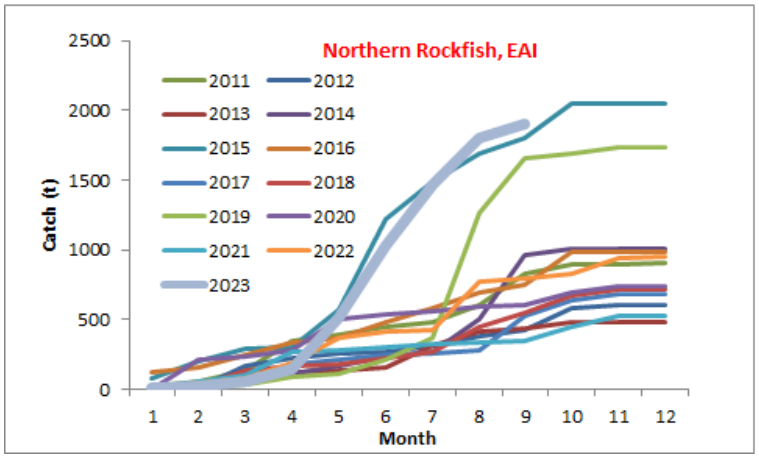
Catches have been increasing since 2013. 2023 catch is largest on record (dating to 1977)

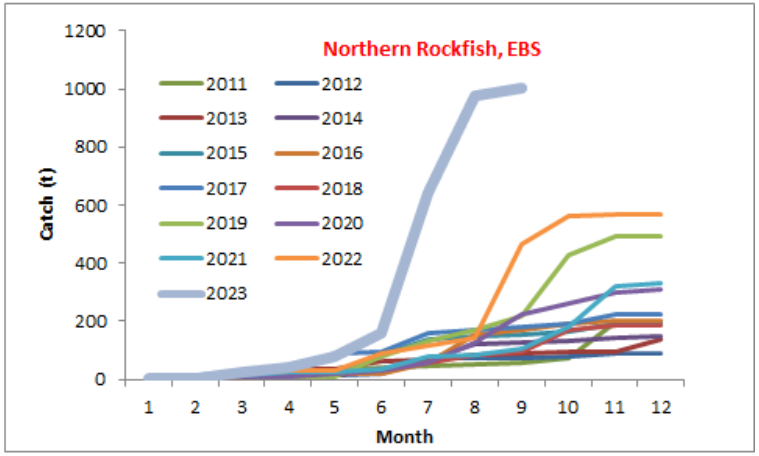


Northern rockfish, catch by month and area





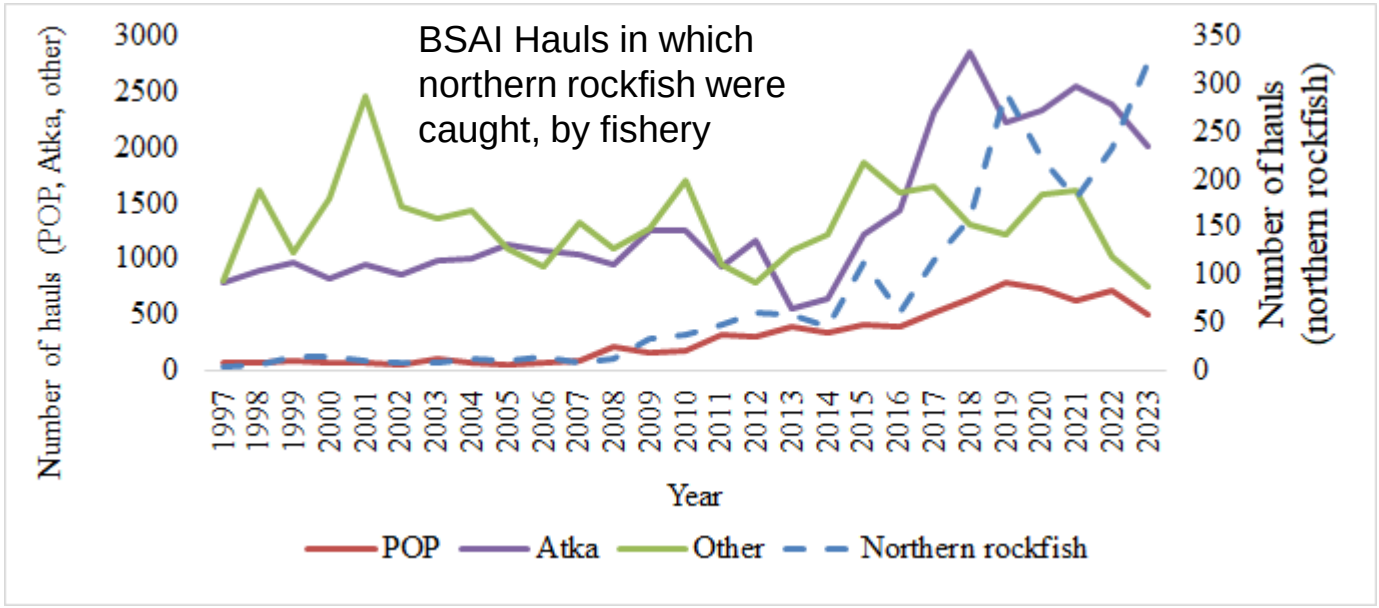




Rockfish hauls identified as targeting northern rockfish

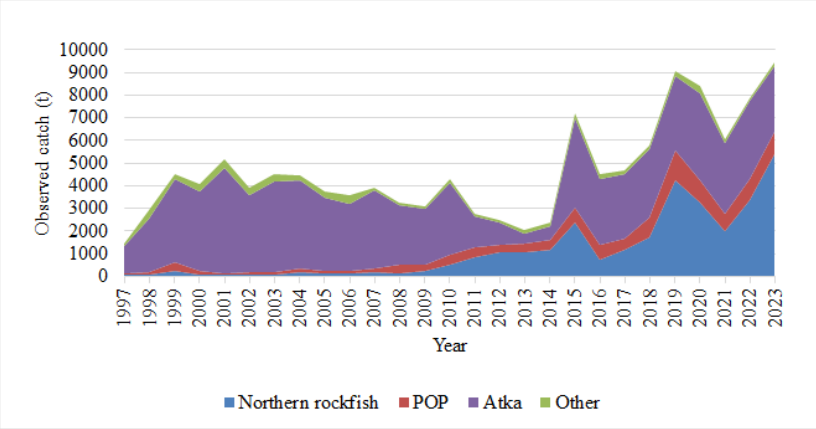
From Observer data, with rockfish hauls determined by the Alaska Regional Office. Northern rockfish hauls are rockfish hauls in which northern rockfish in the dominant rockfish species in the catch

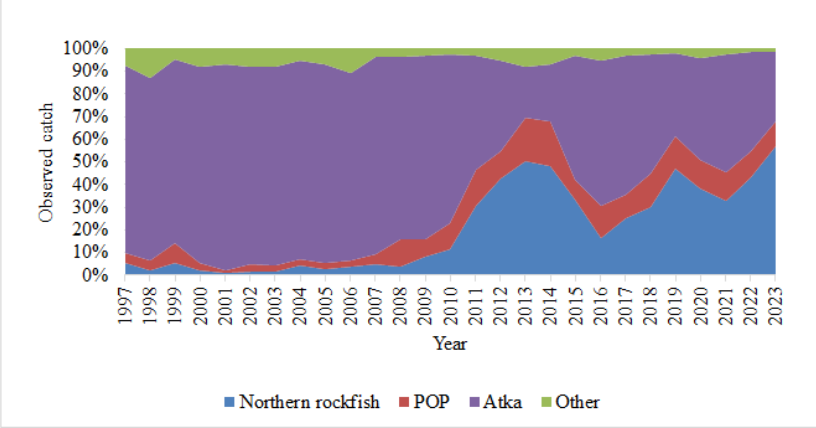
Number of tows that in which northern rockfish is the target species has increased since 1907



Observed catch by target fishery (for observed hauls)

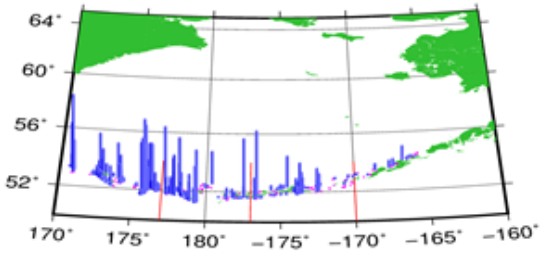
Hauls targeting northern rockfish account for a large portion of the observed catch



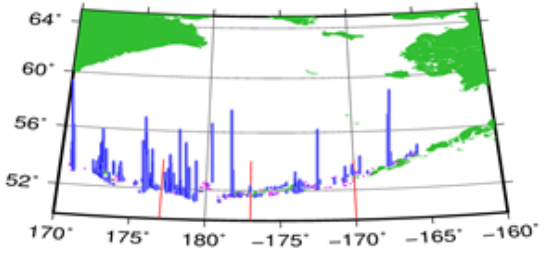


Survey abundance and distribution

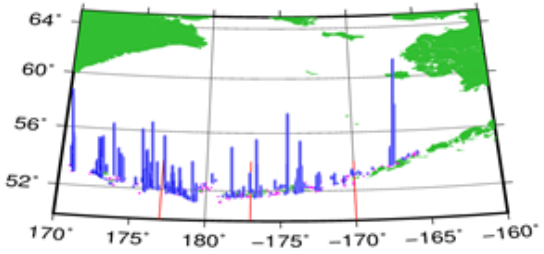
2016 AI Survey Northern Rockfish CPUE (scaled wgt/km^2)



2018 AI Survey Northern Rockfish CPUE (scaled wgt/km^2)

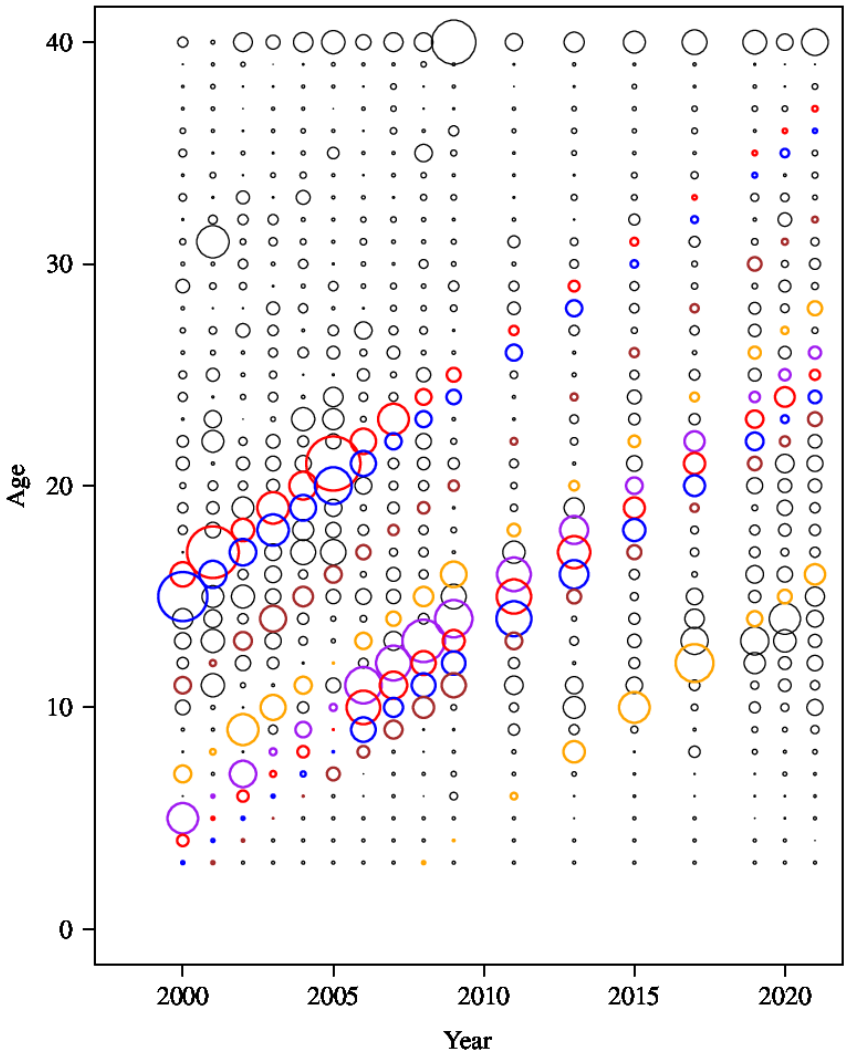


2022 AI Survey Northern Rockfish CPUE (scaled wgt/km^2)



Year	WAI	CAI	EAI	SBS	Total
2010	143,953 (0.29)	51,331 (0.40)	21,846 (0.50)	189 (0.52)	217,319 (0.22)
2012	216,325 (0.65)	52,674 (0.40)	15,615 (0.60)	550 (0.73)	285,164 (0.50)
2014	346,392 (0.38)	48,049 (0.44)	76,787 (0.79)	1,668 (0.80)	472,895 (0.31)
2016	124,310 (0.21)	78,869 (0.37)	48,382 (0.52)	1,656 (0.55)	253,217 (0.18)
2018	98,756 (0.24)	59,500 (0.40)	20,096 (0.63)	34,120 (0.70)	212,472 (0.20)
2022	122,692 (0.24)	32,212 (0.46)	73,987 (0.47)	58,425 (0.76)	287,315 (0.23)

New fishery age comp data (2021)



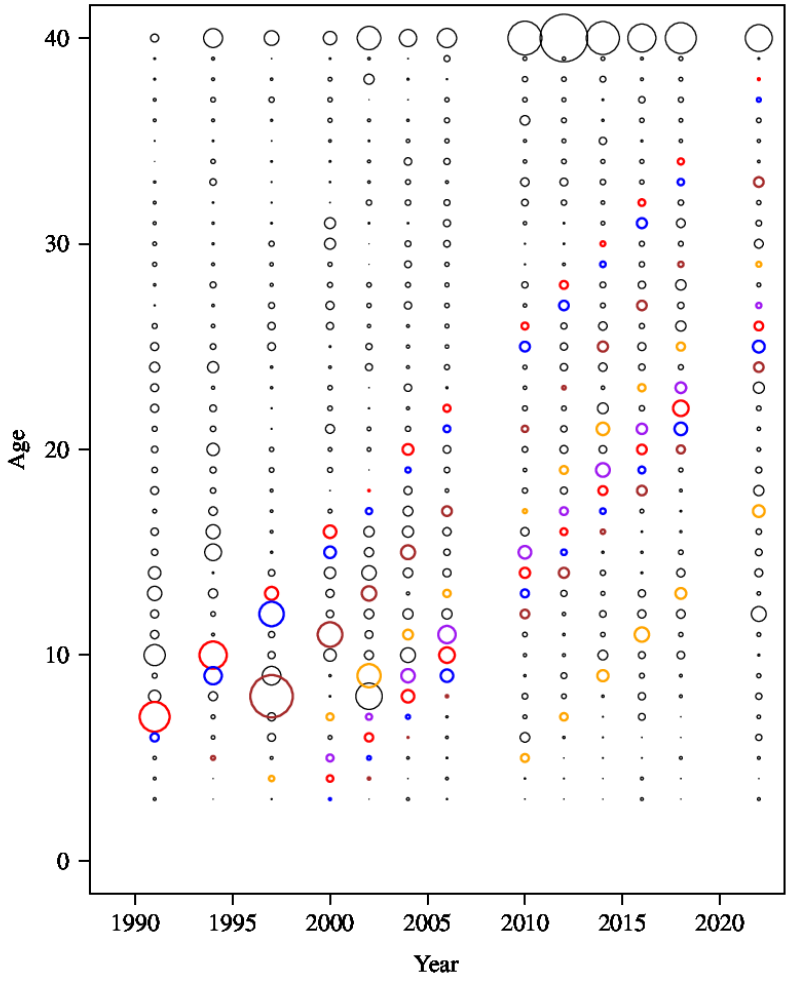
1984
1985

1989

1993
1995
1996
1997
1998

2005

New survey age comp data (2022)



1984
1985

1989

1993
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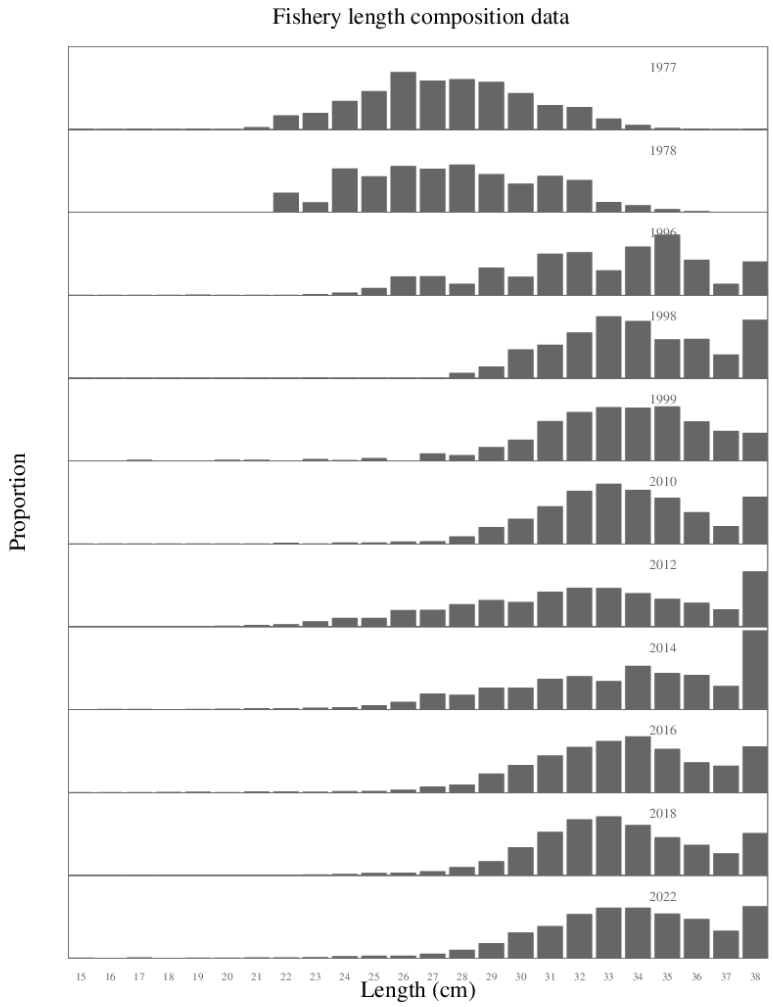
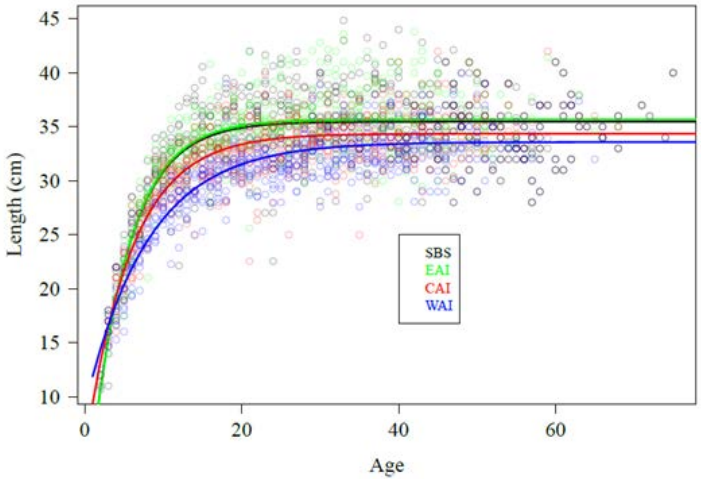
2005

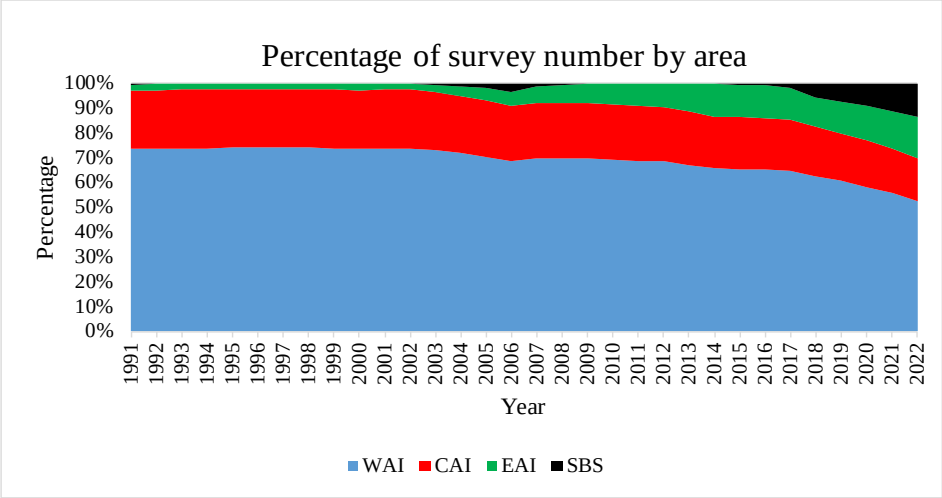
New fishery length comp data (2022)



Size at age, AI survey



Area-specific growth curves are similar to previous assessments, but now relatively more fish in the EAI and SBS

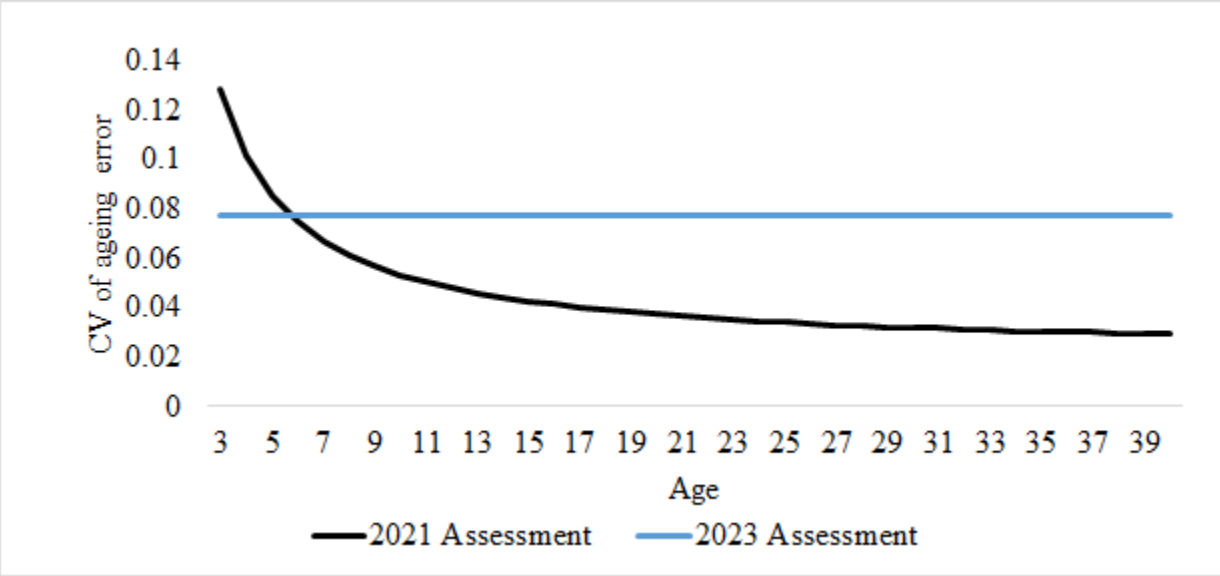


Responses to Plan Team/SSC comments

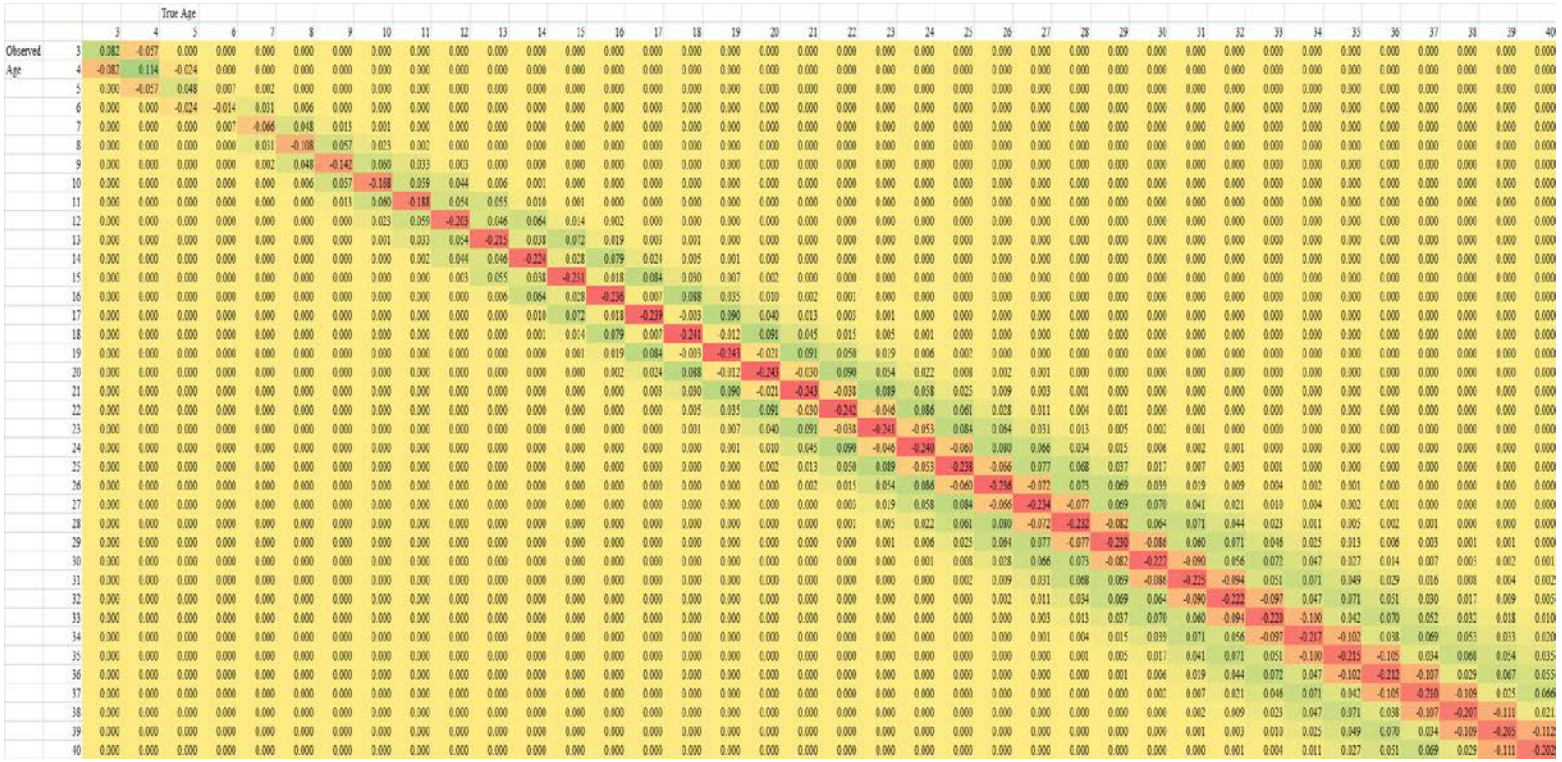
- SSC (December, 2021) *Finally, as the SSC reiterates its request that the aging error matrix be updated with data from the BSAI*

- Ageing error updated using the Punt et al. (2008) maximum likelihood model, based on BSAI double reads from 1980 – 2022 (n = 3213)

CV of ageing error

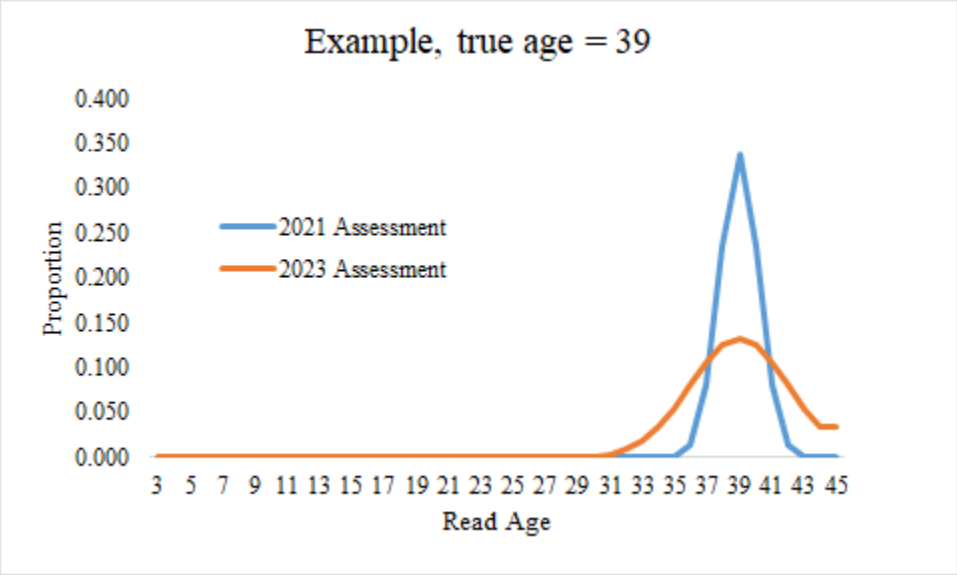


Difference in ageing error matrices, 2021 and 2023 assessments

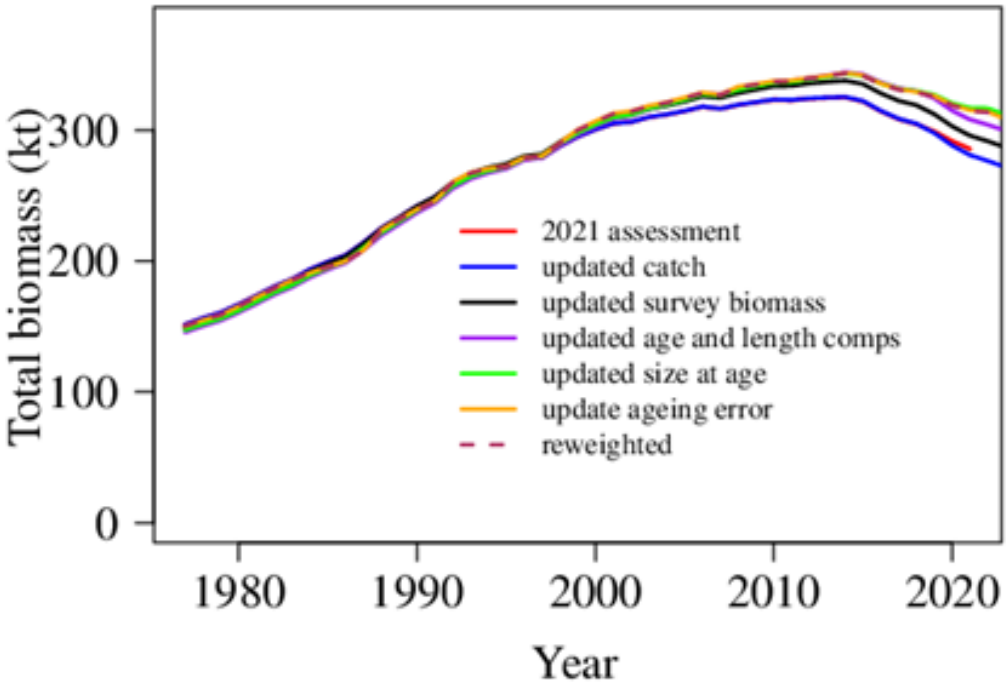


		True Age																																				
		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Observed Age	3	0.082	-0.057	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	-0.087	0.114	-0.024	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	5	0.000	-0.057	0.048	0.007	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	6	0.000	0.000	-0.024	-0.014	0.011	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	7	0.000	0.000	0.000	0.007	-0.066	0.048	0.013	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	8	0.000	0.000	0.000	0.000	0.031	-0.108	0.057	0.023	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	9	0.000	0.000	0.000	0.000	0.002	0.048	-0.142	0.060	0.033	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	10	0.000	0.000	0.000	0.000	0.000	0.006	0.057	-0.188	0.059	0.044	0.006	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	11	0.000	0.000	0.000	0.000	0.000	0.000	0.011	0.060	-0.188	0.054	0.055	0.010	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.023	0.059	-0.203	0.046	0.064	0.014	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	13	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.033	0.054	-0.215	0.038	0.072	0.019	0.003	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	14	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.044	0.046	-0.224	0.028	0.079	0.024	0.005	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	15	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.055	0.038	-0.231	0.018	0.084	0.030	0.007	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	16	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.064	0.028	-0.236	0.007	0.088	0.035	0.010	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	17	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.072	0.018	-0.239	-0.003	0.090	0.040	0.013	0.003	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.014	0.079	0.007	-0.241	-0.012	0.091	0.045	0.015	0.005	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	19	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.019	0.084	-0.003	-0.243	-0.021	0.091	0.050	0.019	0.006	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	20	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.024	0.088	-0.012	-0.243	-0.030	0.090	0.054	0.022	0.008	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	21	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.030	0.090	-0.021	-0.243	-0.031	0.089	0.058	0.025	0.009	0.003	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	22	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.035	0.091	-0.030	0.242	-0.046	0.086	0.061	0.028	0.011	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	23	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.007	0.040	0.091	-0.038	-0.241	-0.053	0.084	0.064	0.031	0.013	0.005	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	24	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.010	0.045	0.090	-0.046	-0.240	-0.060	0.080	0.066	0.034	0.015	0.006	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.013	0.059	0.089	-0.053	-0.238	-0.066	0.077	0.068	0.037	0.017	0.007	0.003	0.001	0.000	0.000	0.000	0.000	0.000	0.000
	26	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.011	0.054	0.086	-0.060	-0.236	-0.072	0.075	0.069	0.039	0.019	0.009	0.004	0.002	0.001	0.000	0.000	0.000	0.000
	27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.019	0.058	0.084	-0.066	-0.234	-0.077	0.069	0.070	0.041	0.021	0.010	0.004	0.002	0.001	0.000	0.000	0.000
	28	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.005	0.022	0.061	0.080	-0.072	-0.232	-0.082	0.064	0.071	0.044	0.023	0.011	0.005	0.002	0.001	0.000	0.000
	29	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.006	0.025	0.061	0.077	-0.077	-0.230	-0.086	0.060	0.071	0.046	0.025	0.013	0.006	0.003	0.001	0.000
	30	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.008	0.028	0.066	0.075	-0.082	-0.227	-0.090	0.056	0.072	0.047	0.027	0.014	0.007	0.003	0.002	0.001
	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.009	0.031	0.068	0.069	-0.084	-0.225	-0.094	0.051	0.071	0.049	0.029	0.016	0.008	0.004	0.002
	32	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.011	0.034	0.069	0.064	-0.090	-0.222	-0.097	0.047	0.071	0.051	0.030	0.017	0.009	0.005
	33	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.013	0.037	0.070	0.060	-0.094	-0.223	-0.100	0.042	0.070	0.052	0.032	0.018	0.010
	34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.004	0.015	0.039	0.071	0.056	-0.097	-0.217	-0.102	0.038	0.069	0.053	0.033	0.020
	35	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.005	0.017	0.041	0.071	0.051	-0.110	-0.215	-0.105	0.034	0.068	0.054	0.035
	36	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.006	0.019	0.044	0.072	0.047	-0.102	-0.212	-0.107	0.029	0.067	0.055
	37	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.007	0.021	0.048	0.071	0.042	-0.105	-0.210	-0.109	0.025	0.066
	38	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.009	0.023	0.047	0.071	0.038	-0.107	-0.207	-0.111	0.021
	39	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.010	0.025	0.049	0.070	0.034	-0.109	-0.205	-0.112
	40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.004	0.011	0.027	0.051	0.069	0.029	-0.111	-0.202

Example difference, age 39



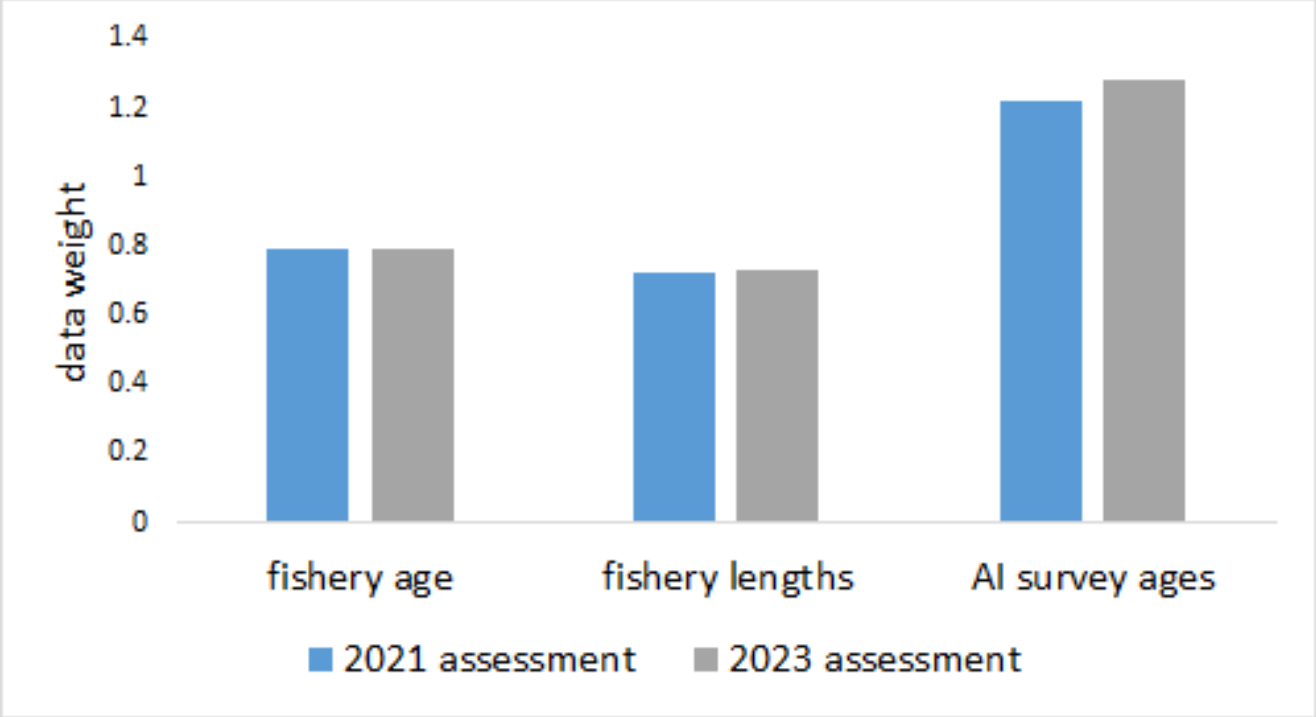
“Bridging” plot (total biomass)



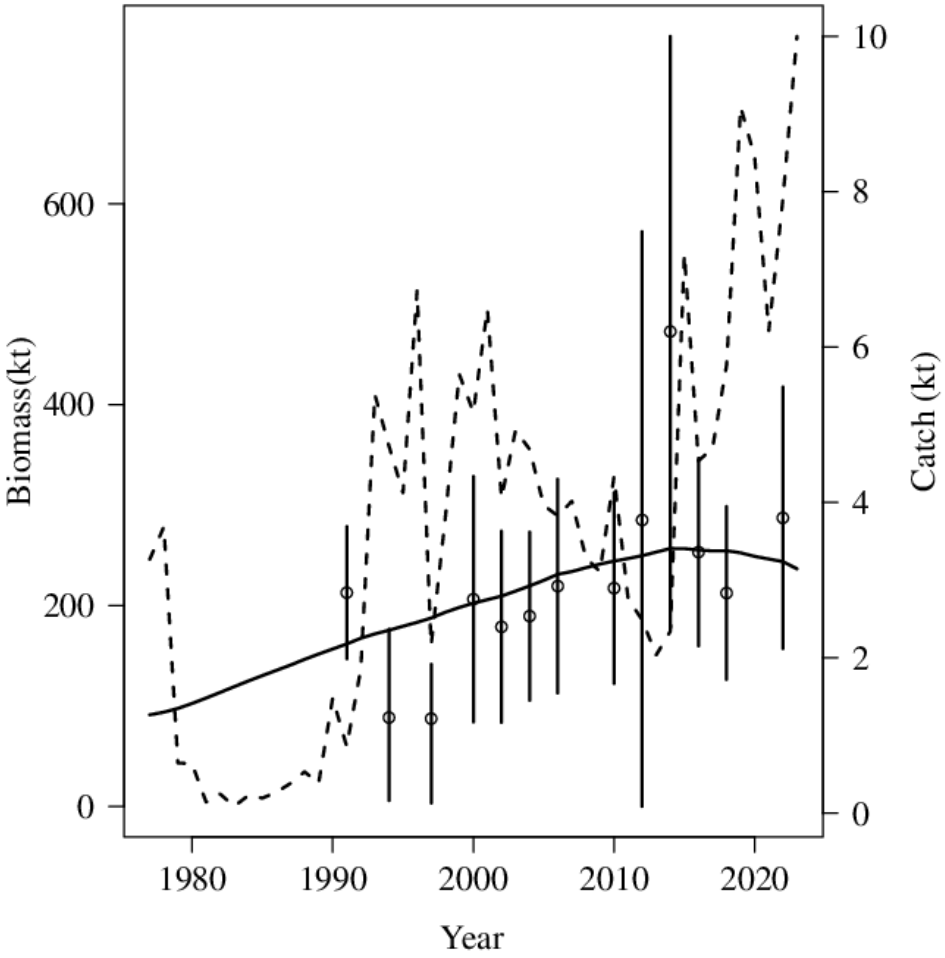
Likelihood components (iterative data weighting applied for each model)

	Model 21 (2021)	Model 21 (2023)
Negative log-likelihood		
Data components		
AI survey biomass	8.43	8.77
Catch biomass	0.00	0.00
Fishery age comp	237.93	257.77
Fishery length comp	75.33	84.10
AI survey age comp	172.67	198.34
Maturity	7.21	7.21
Priors and penalties		
Recruitment	-5.72	-2.91
Prior on survey q	0.00	0.00
Prior on M	0.23	0.35
penalty on survey sel	1.61	1.54
Fishing mortality penalty	5.73	5.91
Total negative log-likelihood	503.42	561.08
Parameters	135	139
Root mean square error		
AI survey biomass	0.375	0.355
Recruitment	0.571	0.622
Fishery age comp	0.015	0.015
Fishery length comp	0.030	0.029
AI survey age comp	0.017	0.016
Estimated key quantities		
M	0.054	0.052
standard deviation	0.005	0.004
CV	0.088	0.085
2023 total biomass		308,010
standard deviation		32,138
CV		0.10

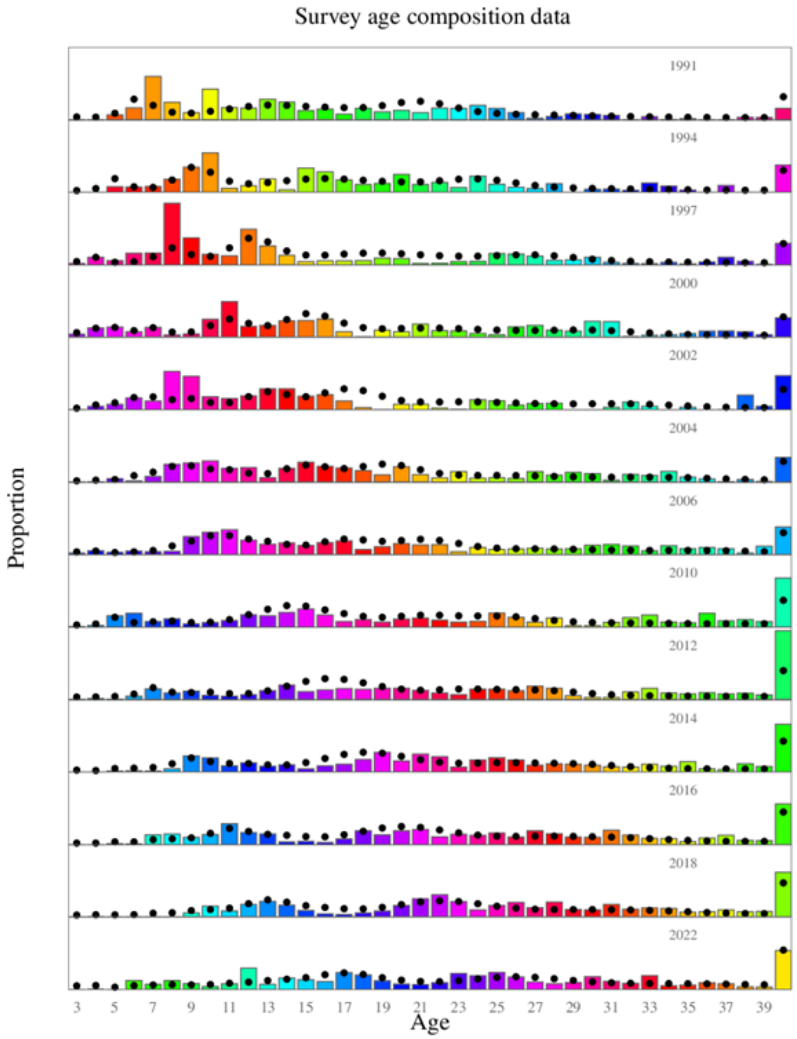
Weights for age/length composition data



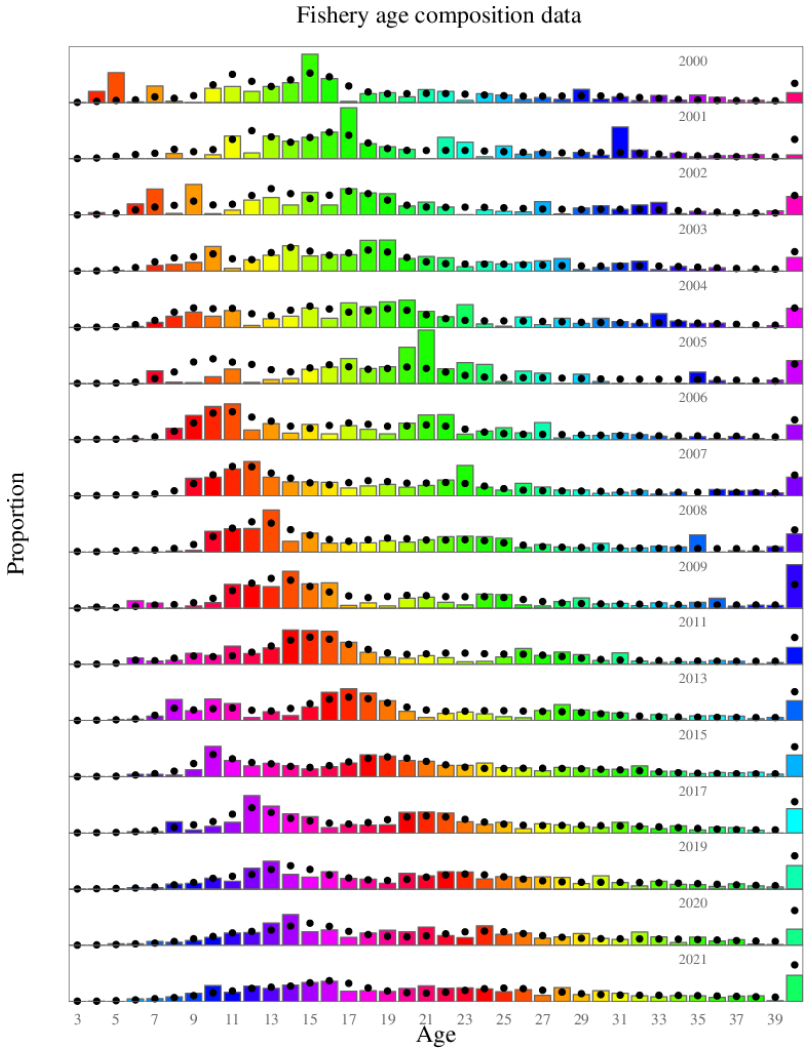
Catch, and fit to the AI survey



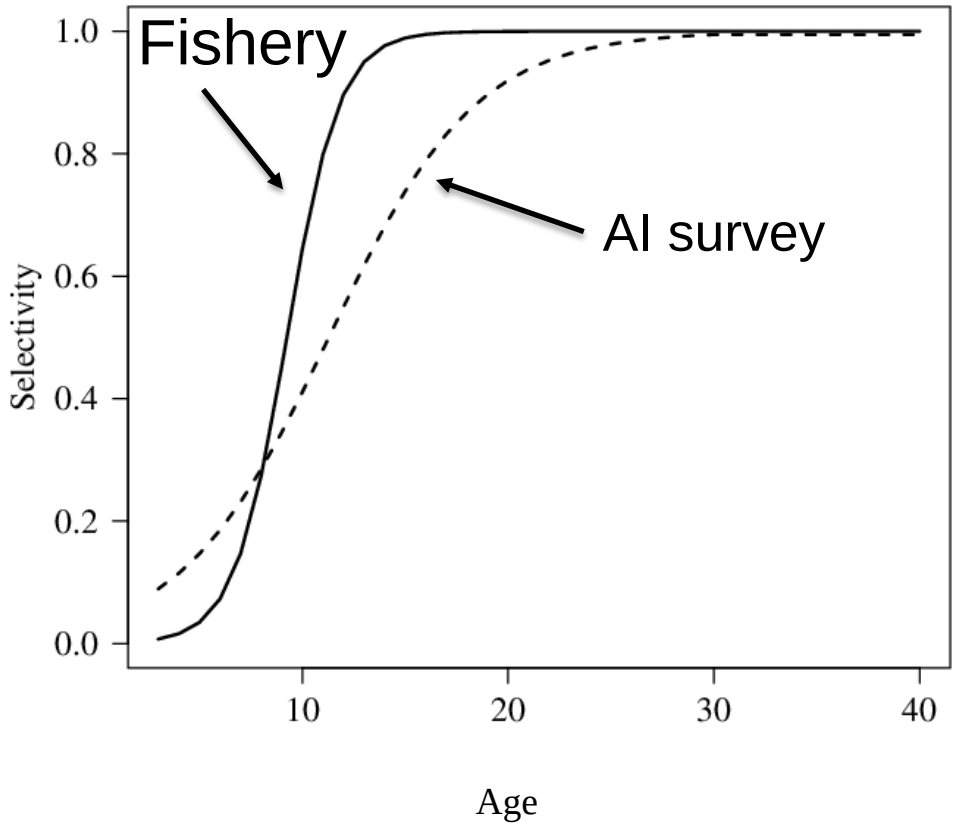
Survey age comps



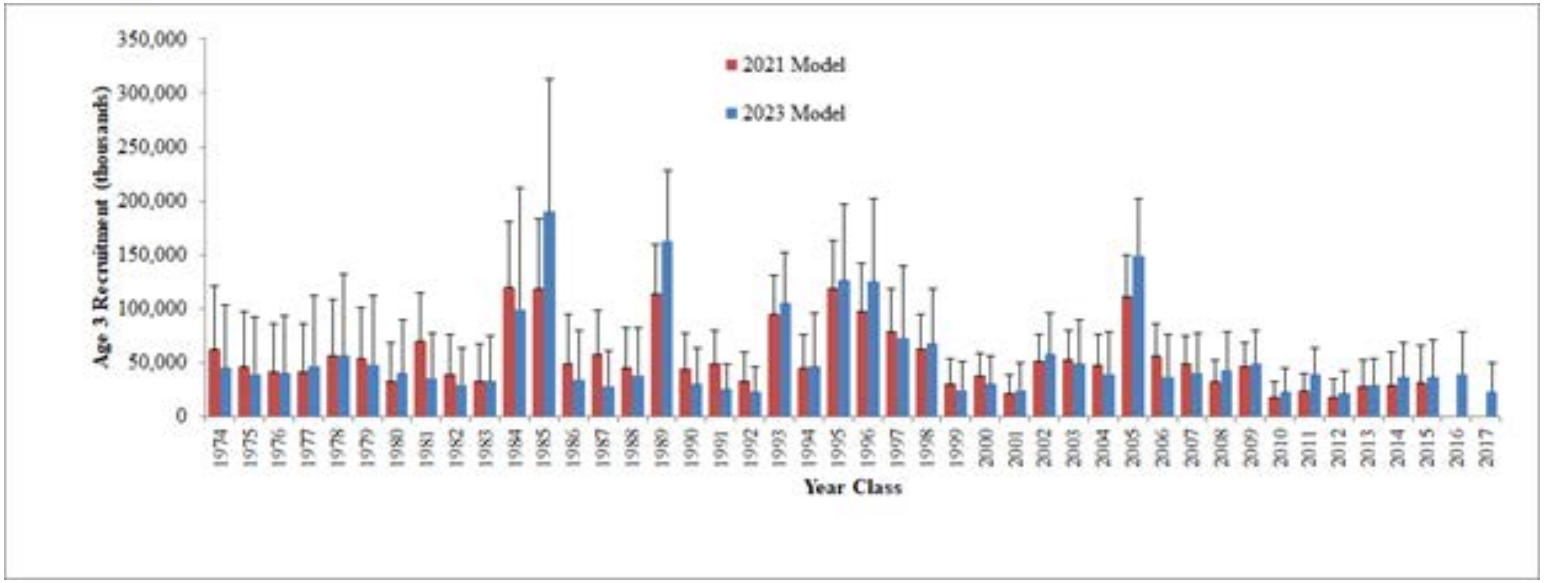
Fishery age composition



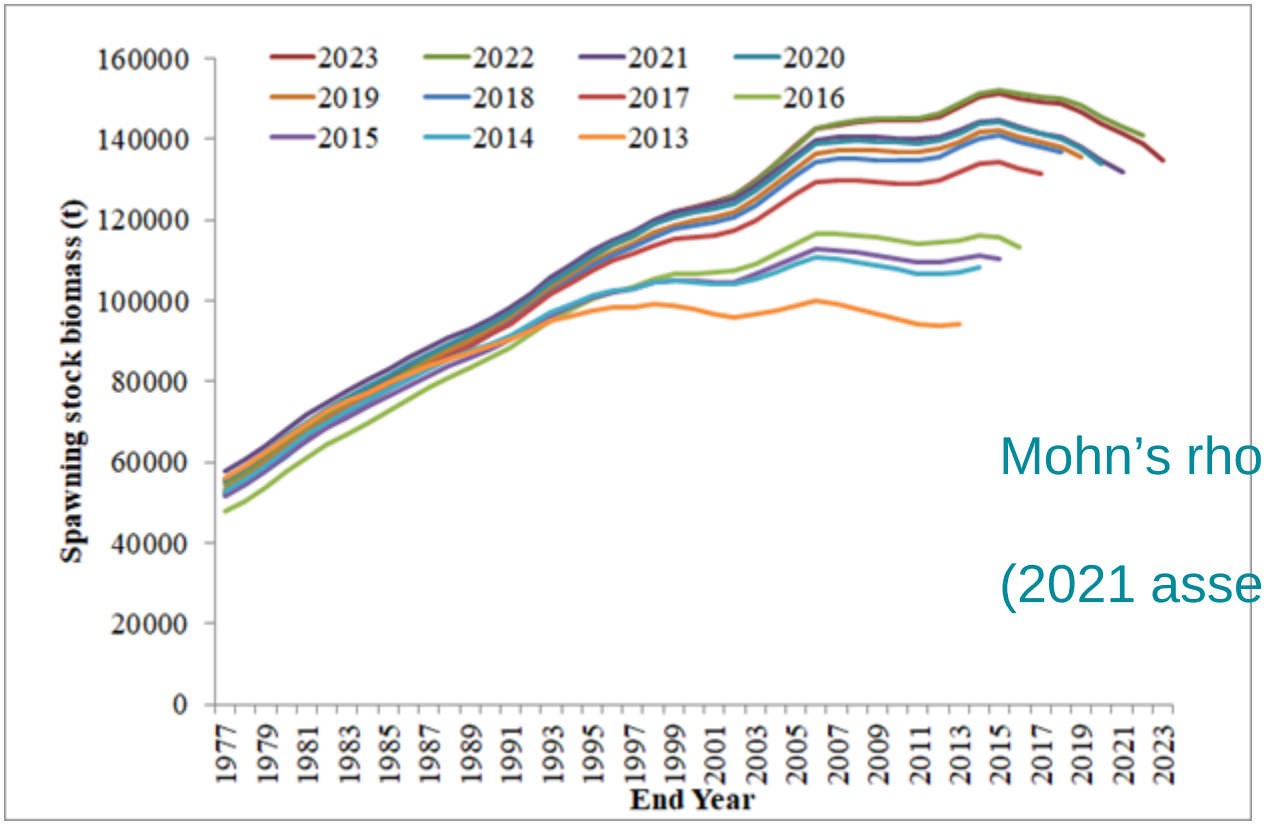
Fishery and survey selectivity curves



Recruitment



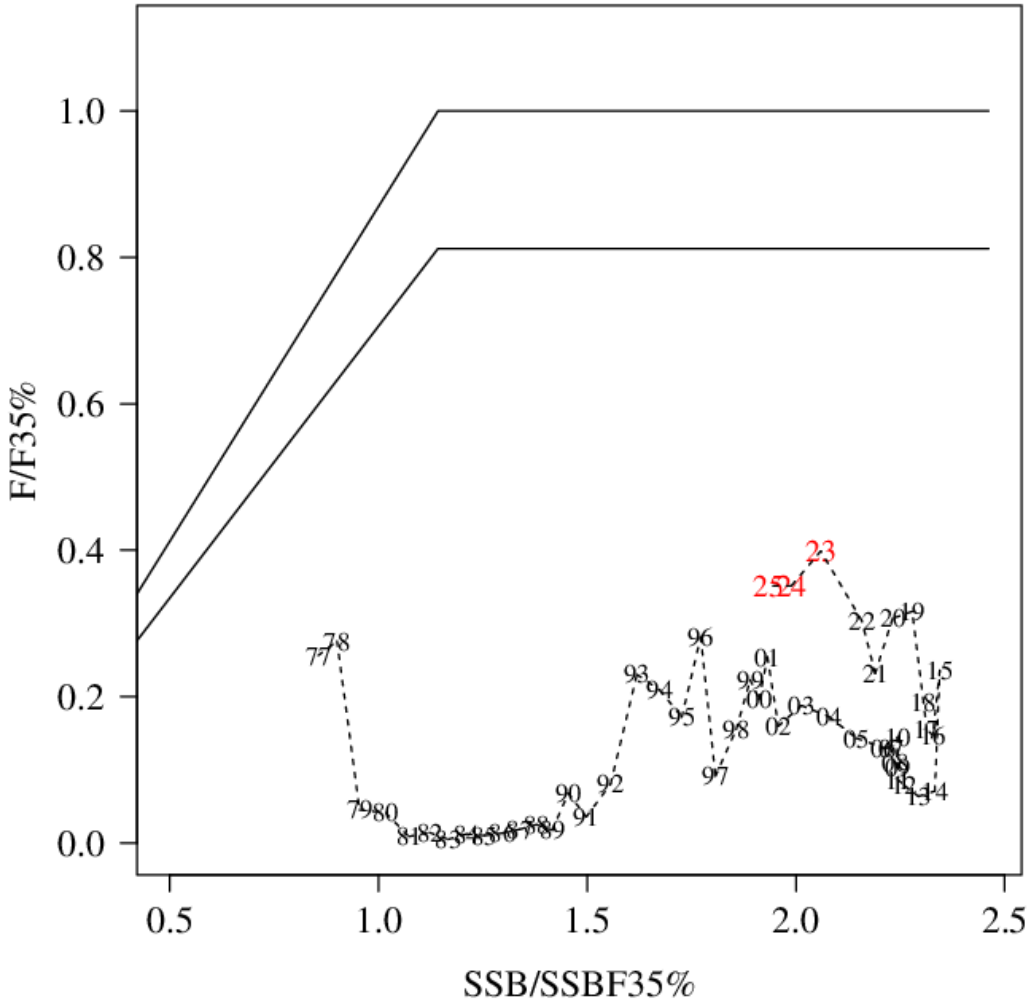
Retrospective pattern



Mohn's rho = -0.16

(2021 assessment: -0.18)

Phase plane plot



Responses to Plan Team/SSC comments

- BSAI Plan Team (September, 2023) *The Teams noted the continuing evidence for stock structure and concerns over risks to stock biomass and productivity from disproportionate harvesting. The lack of spatial harvest regulations would not prevent spatially disproportionate harvesting, which has occurred for other BSAI rockfish such as Pacific ocean perch and blackspotted/rougheye rockfish. However, the low rates of harvest for BSAI northern rockfish suggests that this risk has not yet been realized. **The Team recommends this information be included in the risk table for the November assessment and that the author and Team continue to monitor this stock for potential spatial concerns.***

- SSC (October, 2023) *The SSC supports the BSAI GPT recommendation that the stock structure information be included in the risk table for November and to continue to monitor the stock for potential spatial concerns.*

Risk Table

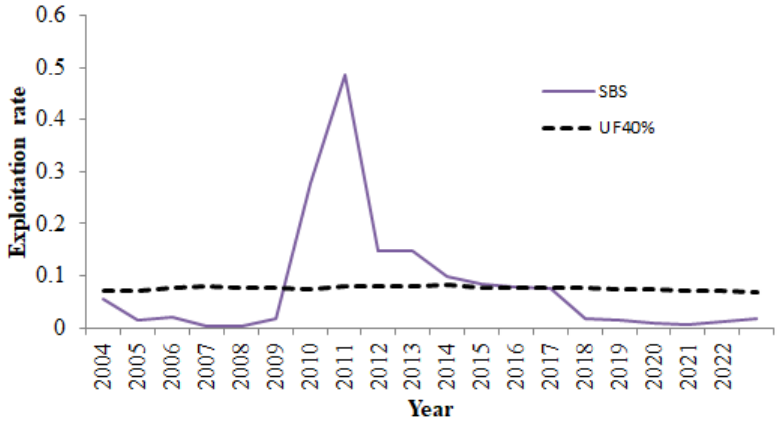
Assessment-related considerations	*Population dynamics considerations*	*Environmental/ ecosystem considerations*	*Fishery Performance considerations*	*Overall score (highest of the individual scores)*
Level 2: Major Concern	Level 2: Major Concern	Level 1: No Concern	Level 1: No Concern	Level 2: Major Concern

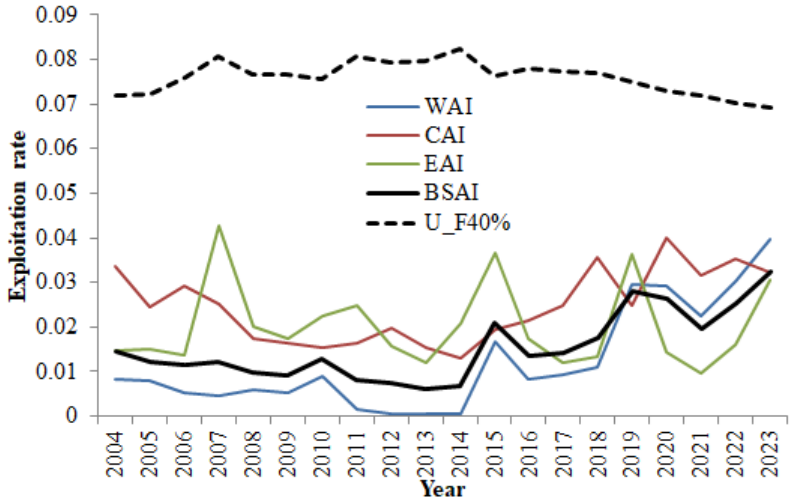
We do not recommend a reduction from the max ABC

Assessment related considerations: Several key parameters strongly constrained by prior distributions; retrospective bias.

Population dynamics considerations: The spatial management of the stock is not consistent with the spatial structure of the stock. The recent increased catches and relatively high proportion of catch taken in targeted tows, when combined with the lack of spatial harvest management, increases the risk of disproportionately high subarea harvest rates in the future, which could result in unusual spatial patterns in stock trends and a potentially limited capacity to rebuild quickly locally depleted areas.

Exploitation rates





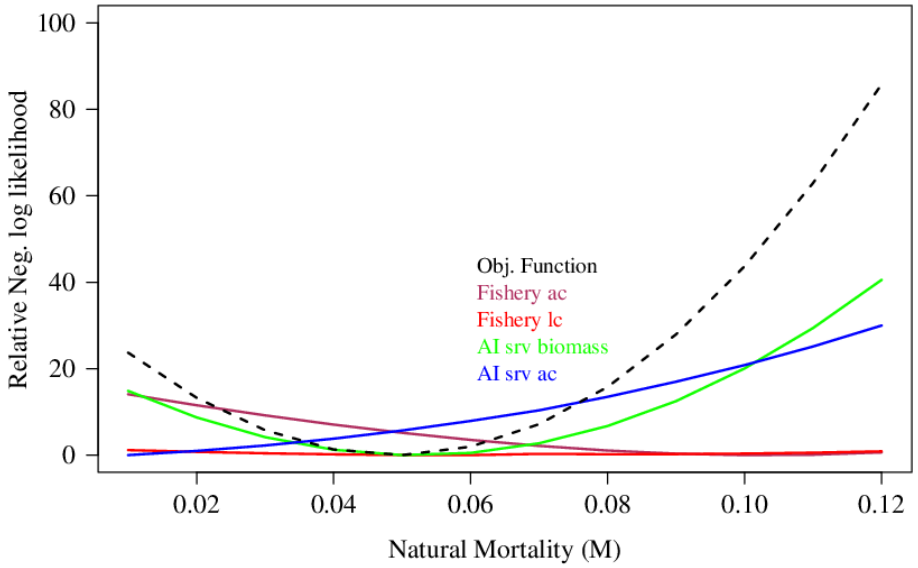
Reference points and ABCs

Quantity	As estimated or specified last year for: 2023	2024	As estimated or recommended this year for: 2024*	2025*
M (natural mortality rate)	0.054	0.054	0.052	0.052
Tier	3a	3a	3a	3a
Projected total (age 3+) biomass (t)	277,133	273,414	297,189	292,686
Female spawning biomass (t)				
Projected	118,251	115,209	128,229	124,651
$B_{100\%}$	171,768	171,768	187,268	187,268
$B_{40\%}$	68,707	68,707	74,907	74,907
$B_{35\%}$	60,119	60,119	65,544	65,544
F_{OFL}	0.085	0.085	0.086	0.085
$maxF_{ABC}$	0.069	0.069	0.070	0.069
F_{ABC}	0.069	0.069	0.070	0.069
OFL (t)	22,776	22,105	23,556	22,838
maxABC (t)	18,687	18,135	19,274	18,685
ABC (t)	18,687	18,135	19,274	18,685
Status	As determined last year for: for: 2021	2022	As determined this year 2022	2023
Overfishing	No	n/a	No	n/a
Overfished	n/a	No	n/a	No
Approaching overfished	n/a	No	n/a	No

Future research plans

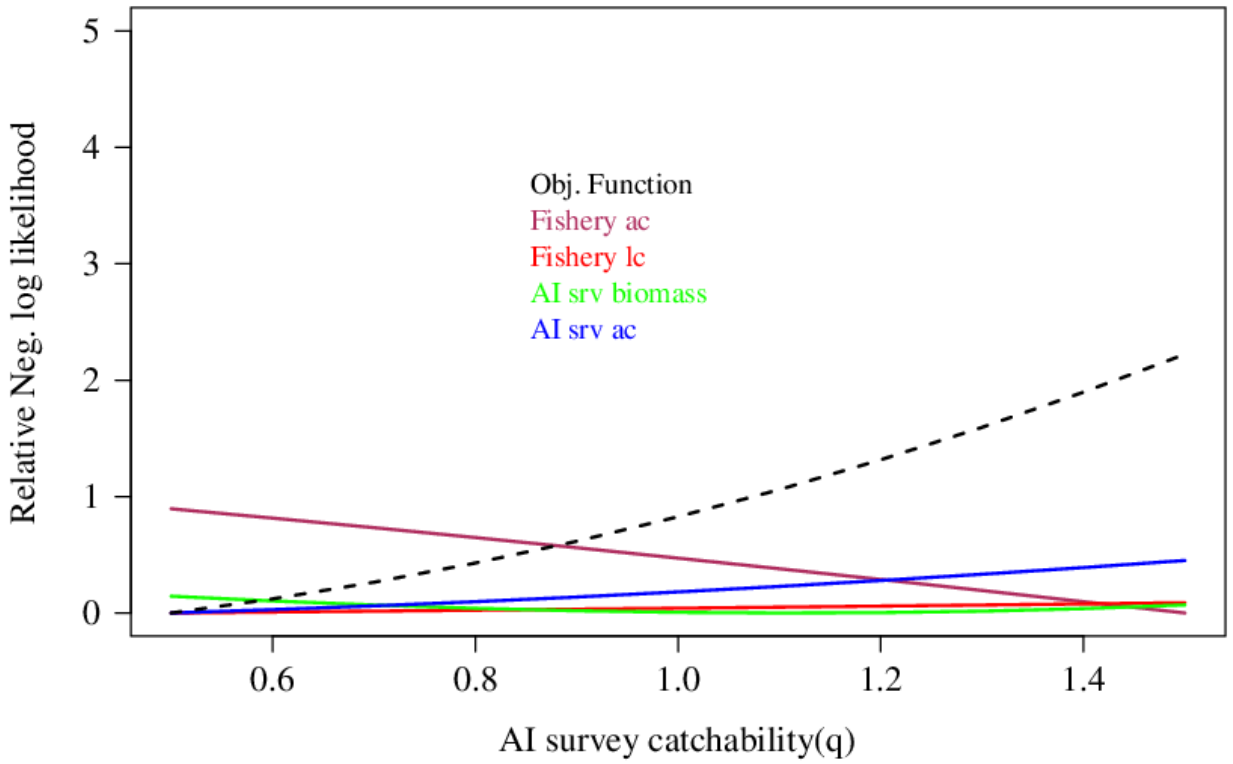
- Explore alternatives for estimating survey selectivity

Extra slides – M profile



Inconsistent information in the data regarding M

Extra slides – q profile



Little information in the data regarding q