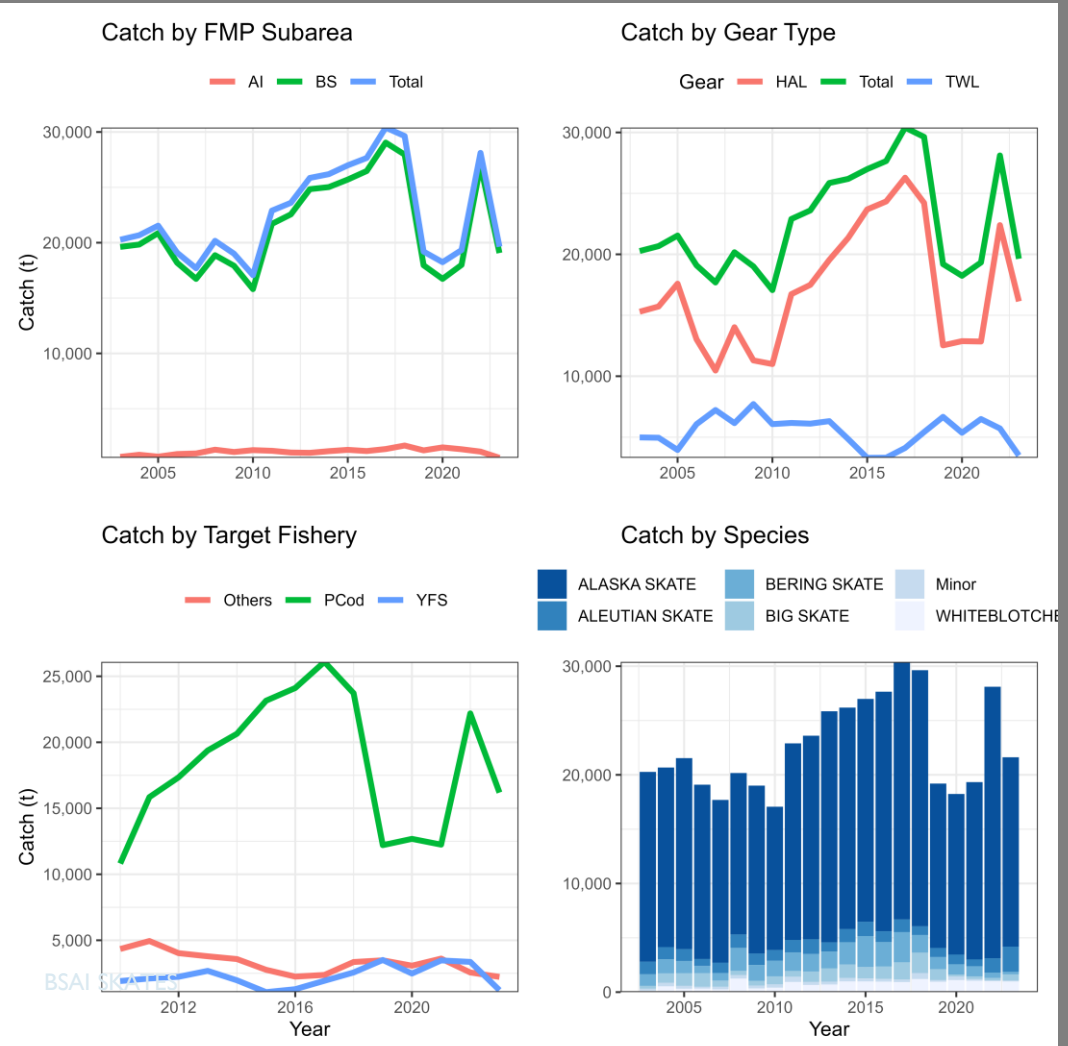
Alaska Skate Model

BSAI Groundfish Plan Team Presentation
September 2025

Cindy Tribuzio*, Mary Elizabeth Matta, Steve Barbeaux and Pete Hulson

BSAI SKATE STOCK COMPLEX OVERVIEW



- Tier 3 AK skate (shelf)
- Tier 5 everything else
- Bering Sea catch >> Aleutian Islands catch
- Primarily in hook-and-line fisheries
- Bycatch in Pacific cod, yellowfin sole to a lesser extent
- Complex catch is dominated by Alaska skate

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TIER 3 – ALASKA SKATE

- 2023 operational update
- Transition year
- PT/SSC Comments
  - Explore catchability tuned to temperature
  - Expand collection of ageing structures
  - Concern over leopard skate in AI
  - Updating M
  - Alaska skate stock structure

TIER 3 – ALASKA SKATE

- Model 14_2d
  - 2023 accepted model
- Not converged
  - Parameters hitting bounds
  - High parameter StDevs

Parameter	Value	Phase	Min	Max	Init	Status	Parm_StDev	Gradient	Pr_type	Afterbound
L_at_Amin_Fem_GP_1	14.9777000	1	-10.00	30.00	14.0250000	OK	0.8916780	-2.17936e-05	No_prior	OK
L_at_Amax_Fem_GP_1	102.0920000	1	70.00	150.00	101.9420000	OK	0.3879980	-2.98101e-05	No_prior	OK
VonBert_K_Fem_GP_1	0.3668030	4	0.05	0.50	0.3793320	OK	0.0114167	-1.22447e-05	No_prior	OK
Richards_Fem_GP_1	-1.0000000	1	-1.00	2.00	-1.0000000	LO	0.0000125	-1.24395e-07	No_prior	CHECK
CV_young_Fem_GP_1	0.3243550	3	0.05	0.35	0.3500000	OK	0.0344138	-7.91137e-07	No_prior	OK
CV_old_Fem_GP_1	0.0500000	3	0.05	0.25	0.0500000	LO	0.0000034	8.40732e-08	No_prior	CHECK
SR_LN(R0)	10.0913000	1	5.00	15.00	10.1403000	OK	0.0368806	-4.28718e-05	No_prior	OK
Size_DblN_peak_LGL(1)	92.3235000	2	7.60	126.20	86.4860000	OK	4.5193700	-7.53747e-08	No_prior	OK
Size_DblN_top_logit_LGL(1)	-1.1962200	3	-6.00	4.00	-0.6813640	OK	0.6782590	5.7798e-07	No_prior	OK
Size_DblN_ascend_se_LGL(1)	7.0483000	3	-1.00	9.00	6.7560700	OK	0.1768070	7.51258e-07	No_prior	OK
Size_DblN_descend_se_LGL(1)	0.1812690	3	-1.00	9.00	-0.1543420	OK	12.7812000	7.00645e-09	No_prior	OK
Size_DblN_start_logit_LGL(1)	-4.9976900	2	-5.00	9.00	-4.9981500	LO	0.0762034	1.82167e-07	No_prior	OK
Size_DblN_end_logit_LGL(1)	1.5078800	2	-5.00	9.00	1.5264700	OK	1.0632000	1.20787e-06	No_prior	OK
Size_DblN_peak_TWL(2)	73.0934000	2	7.60	126.20	58.1364000	OK	10.7844000	7.04145e-06	No_prior	OK
Size_DblN_top_logit_TWL(2)	-0.1701920	3	-6.00	4.00	-0.0409058	OK	0.5241100	-7.93022e-08	No_prior	OK
Size_DblN_ascend_se_TWL(2)	7.2154800	3	-1.00	9.00	6.2107300	OK	0.5614790	-8.16028e-06	No_prior	OK
Size_DblN_descend_se_TWL(2)	0.0749331	3	-1.00	9.00	4.0661000	OK	10.0401000	9.74676e-08	No_prior	OK
Size_DblN_start_logit_TWL(2)	-4.9973200	2	-5.00	9.00	-4.9965900	LO	0.0876296	-1.3558e-07	No_prior	OK
Size_DblN_end_logit_TWL(2)	0.7227370	2	-5.00	9.00	0.3858410	OK	0.5218510	-3.43403e-07	No_prior	OK
Size_DblN_peak_SURV(3)	60.0115000	2	7.60	126.20	57.2079000	OK	2.3561400	-9.59233e-06	No_prior	OK
Size_DblN_top_logit_SURV(3)	-1.1805100	3	-6.00	4.00	-1.2029700	OK	0.6668040	-3.18775e-07	No_prior	OK
Size_DblN_ascend_se_SURV(3)	6.3781000	3	-1.00	9.00	6.1427100	OK	0.1653610	1.2587e-05	No_prior	OK
Size_DblN_descend_se_SURV(3)	0.0754045	3	-1.00	9.00	2.8096500	OK	16.1174000	1.75015e-09	No_prior	OK
Size_DblN_start_logit_SURV(3)	-4.9994600	2	-5.00	9.00	-4.9996200	LO	0.0202051	-1.37385e-07	No_prior	CHECK
Size_DblN_end_logit_SURV(3)	3.2981300	2	-5.00	9.00	1.8822000	OK	1.7042900	-1.53685e-06	No_prior	OK

TIER 3 – ALASKA SKATE

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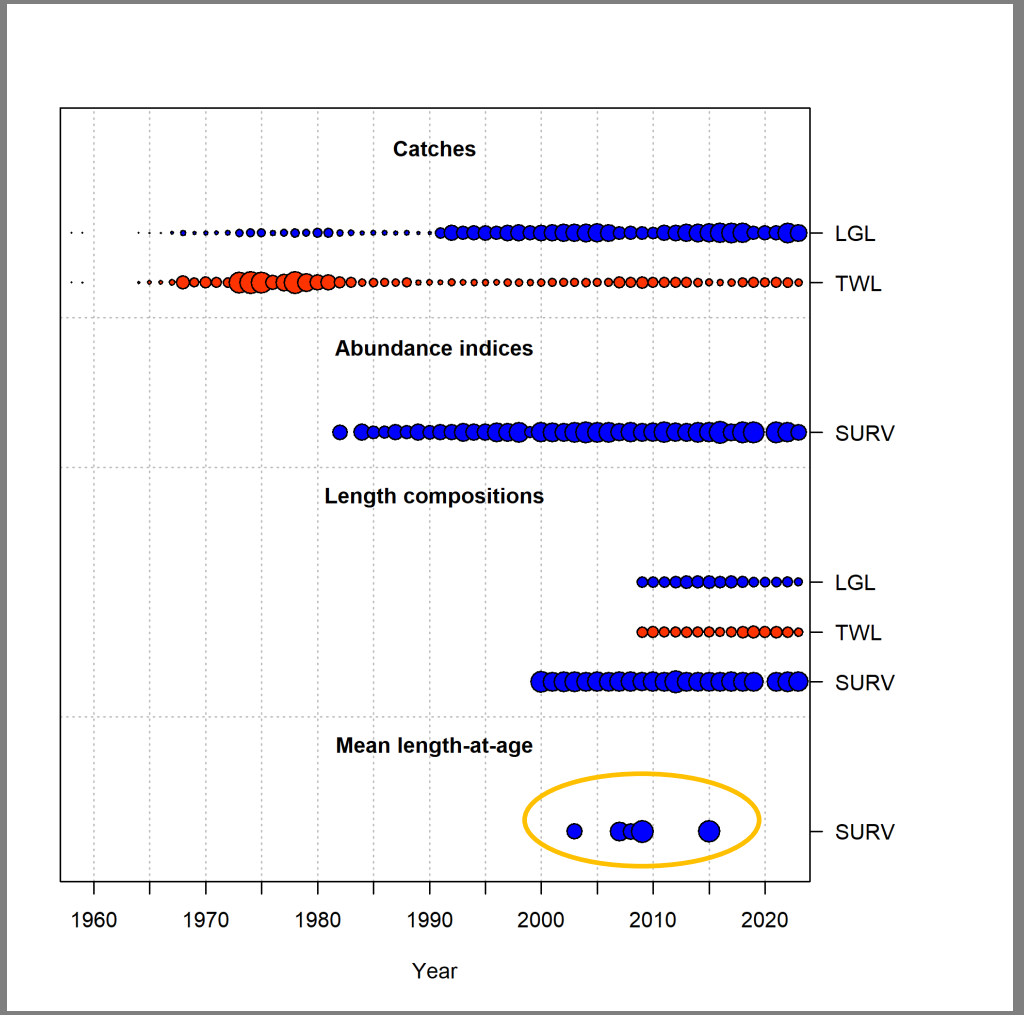
  - 2023 accepted model
- Not converged
  - Parameters hitting bounds
  - High parameter StDevs
- Relying on limited age data



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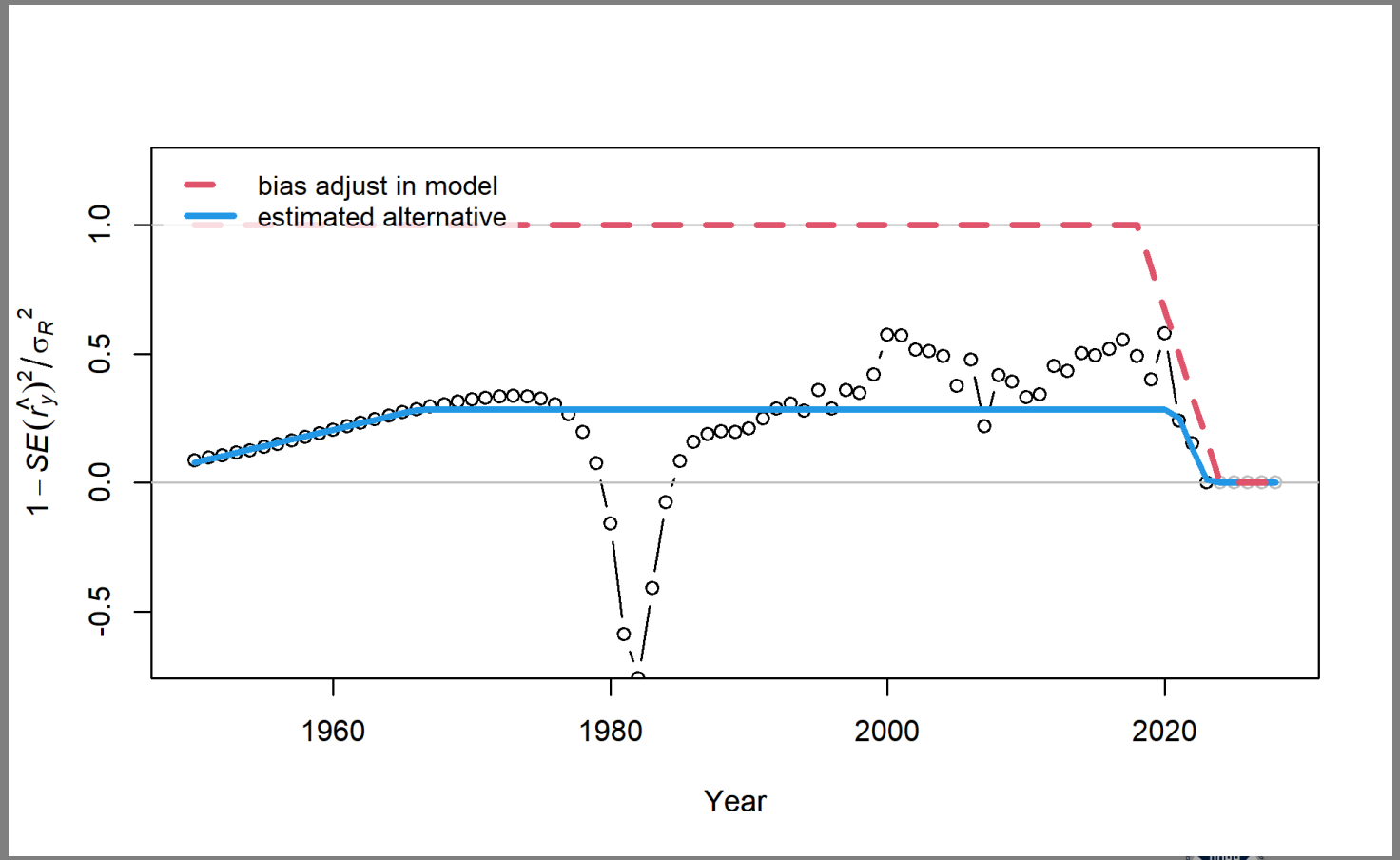
  - Recruitment ramp



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- Model 14_2d
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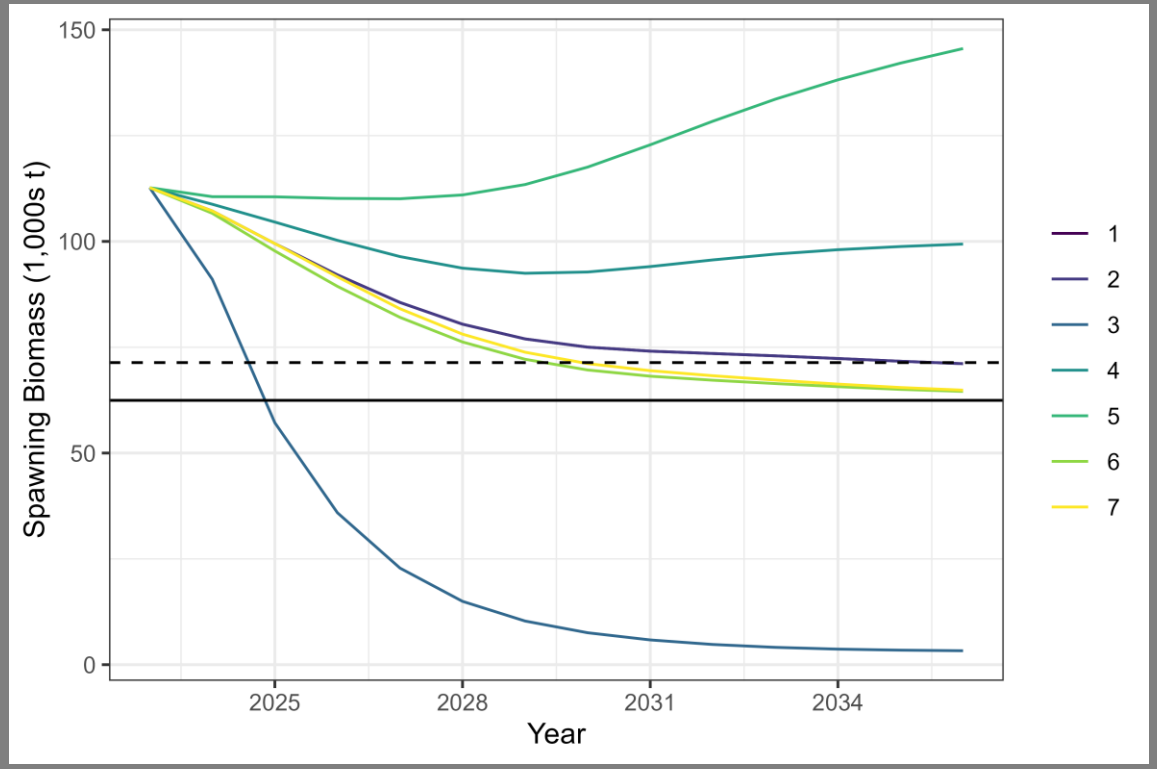
- Relying on limited age data
- Procedural errors
  - Recruitment ramp
  - Projections (fixed for Nov)



TIER 3 – ALASKA SKATE

Model 14_2d

- Statistical Catch at Age
- SS3
- Single sex

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- Two fleets
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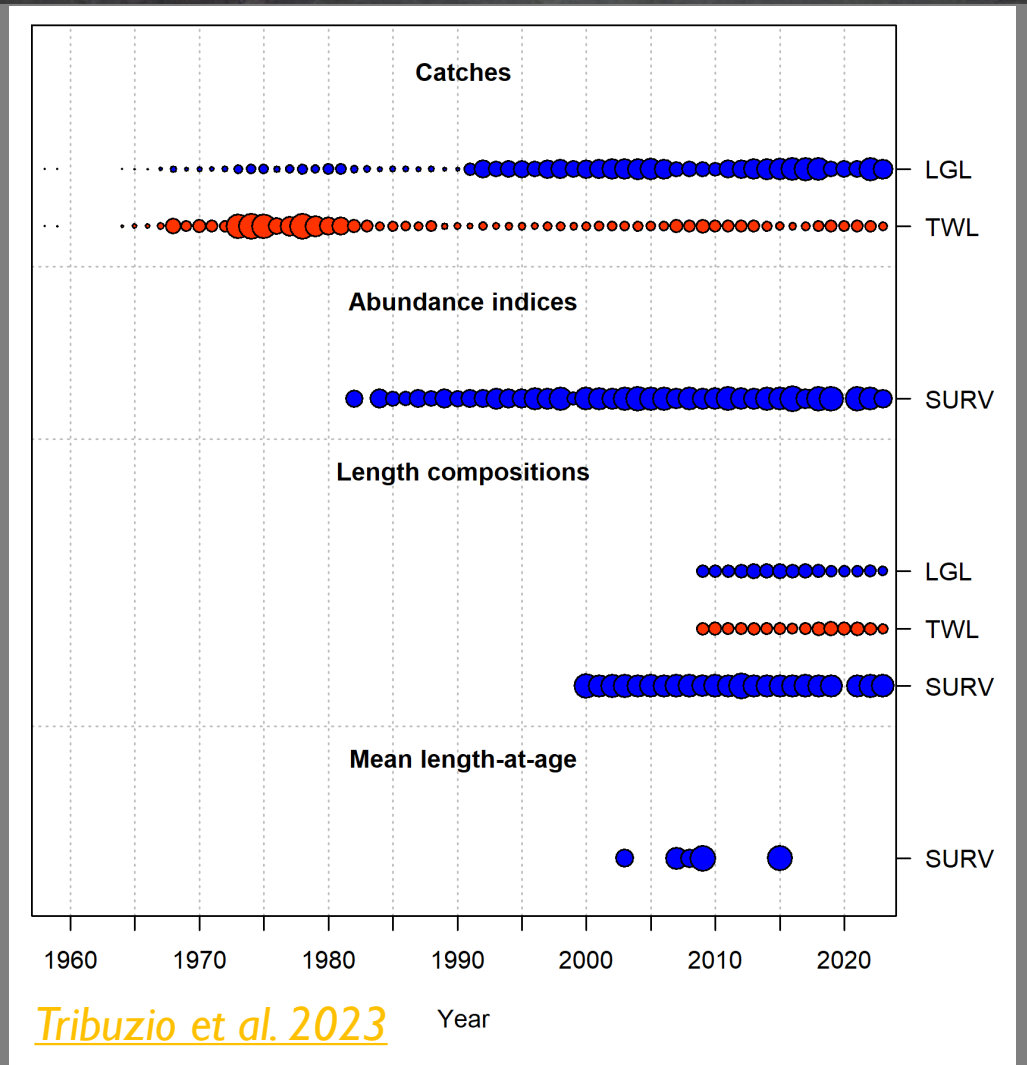

Tribuzio et al. 2023

Figure 18.3

TIER 3 – ALASKA SKATE

Model 14_2d

- Statistical Catch at Age
- SS3
- Single sex
- Two fleets
- One survey
- Parameters – fixed
  - See Table 18.6 for estimated parameters

Parameter	Value
natural mortality (M)	0.13
coefficient (a)	9.00×10^{-6}
exponent (b)	2.962
length at 50% maturity (a)	93.28
slope (b)	-0.548
Steepness	1
σ_R	0.4
ln catchability (q)	0
Initial longline fishery F	0
Initial trawl fishery F	0

Table 18.6

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TIER 3 – ALASKA SKATE

Model 14_2d

- Statistical Catch at Age
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- Two fleets
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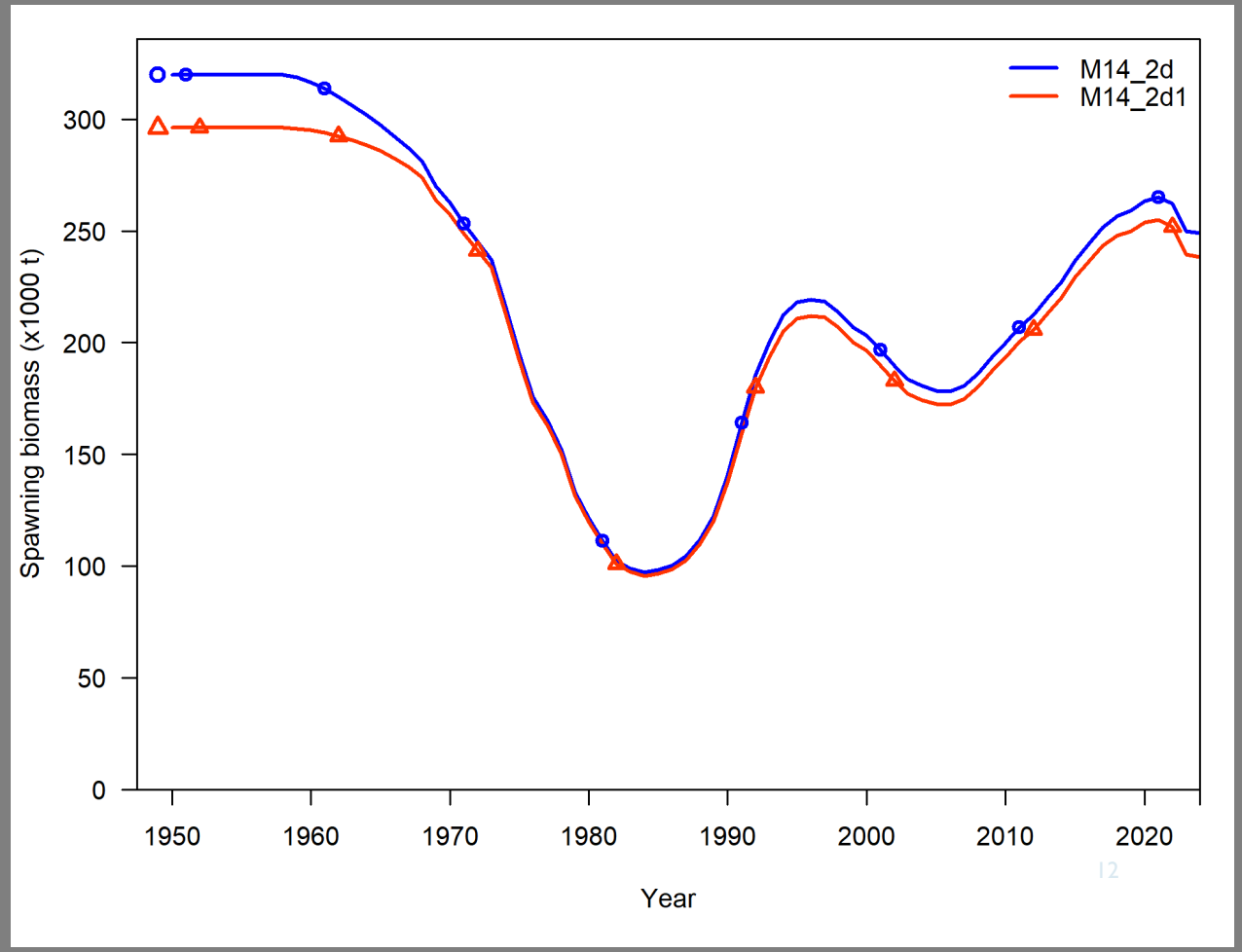
Tribuzio et al. 2023

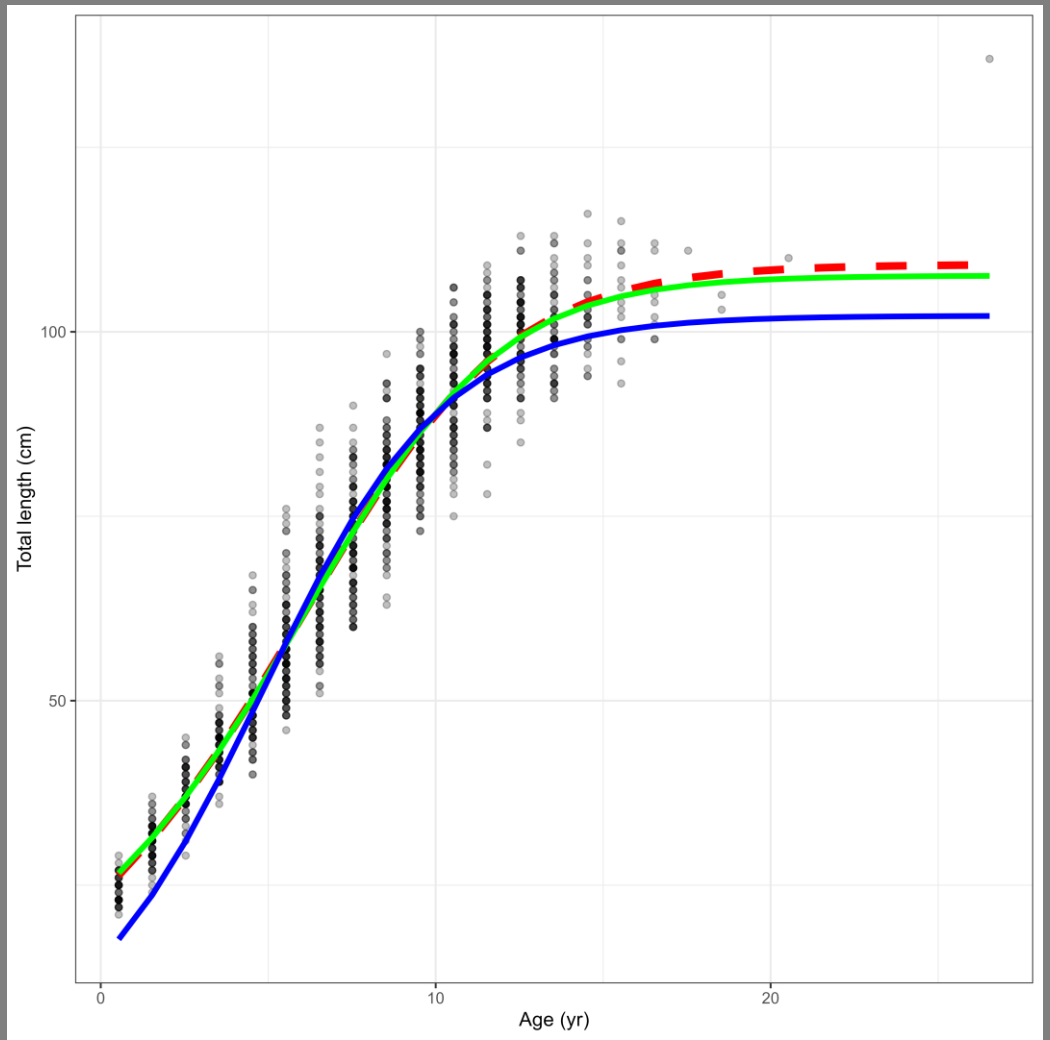
MODEL 14_2D1

- Updated SS3 version to v3.30.23.2
- Conducted recruitment ramp adjustments
- Minor changes:
  - Jitter at 10%
  - Maximum lambda = 1



MODEL 25_0

- Estimate growth outside of the model
- Included all available survey ages
  - Adjusted ages to represent mid-year age, not ages at Jan 1
  - One 26 year old individual
- A_1 = 0, age-0 animals are encountered
- A_2 = 15, based on the mean age at which L_{inf} is reached
- Used StDev at A_1 and A_2 instead of CV



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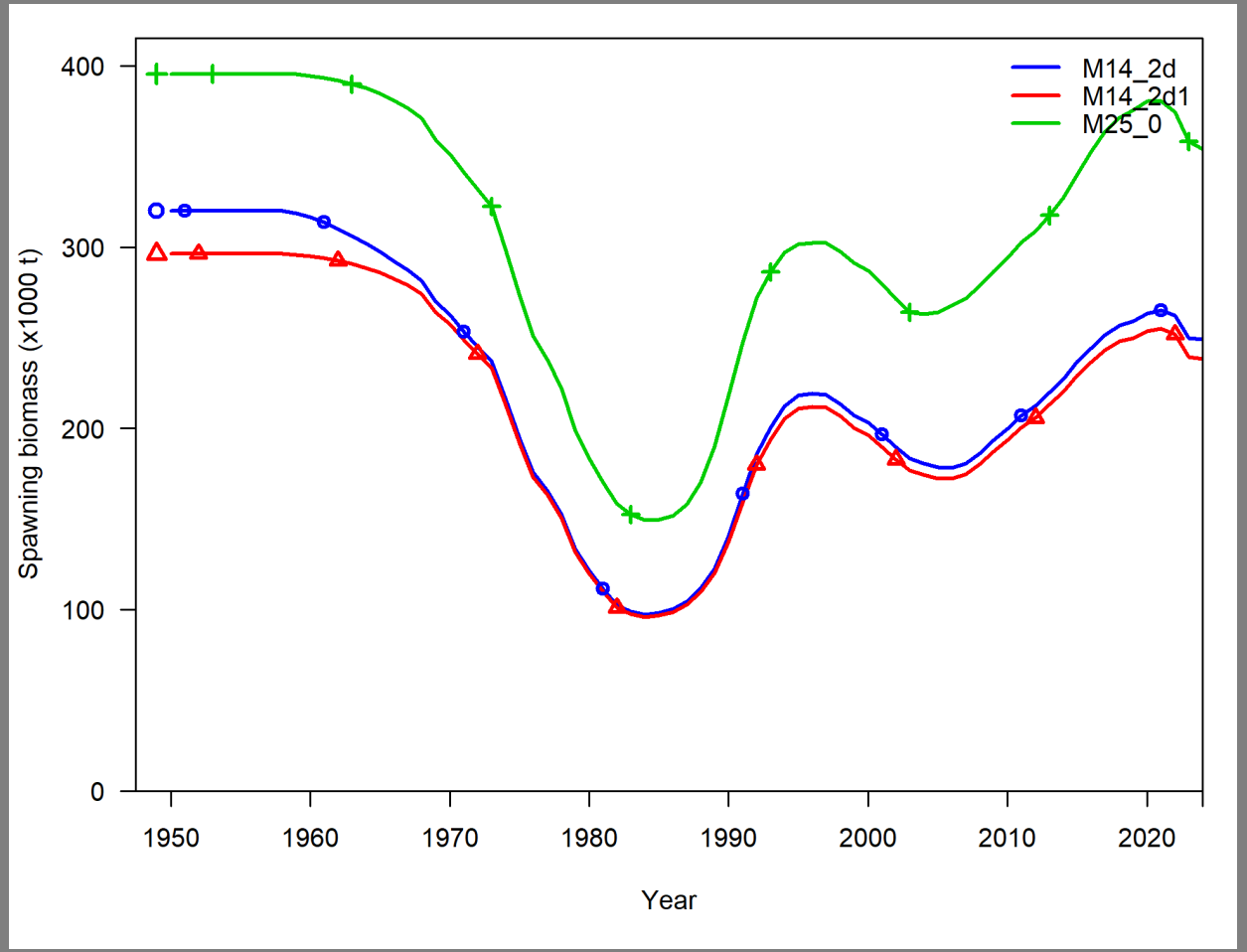
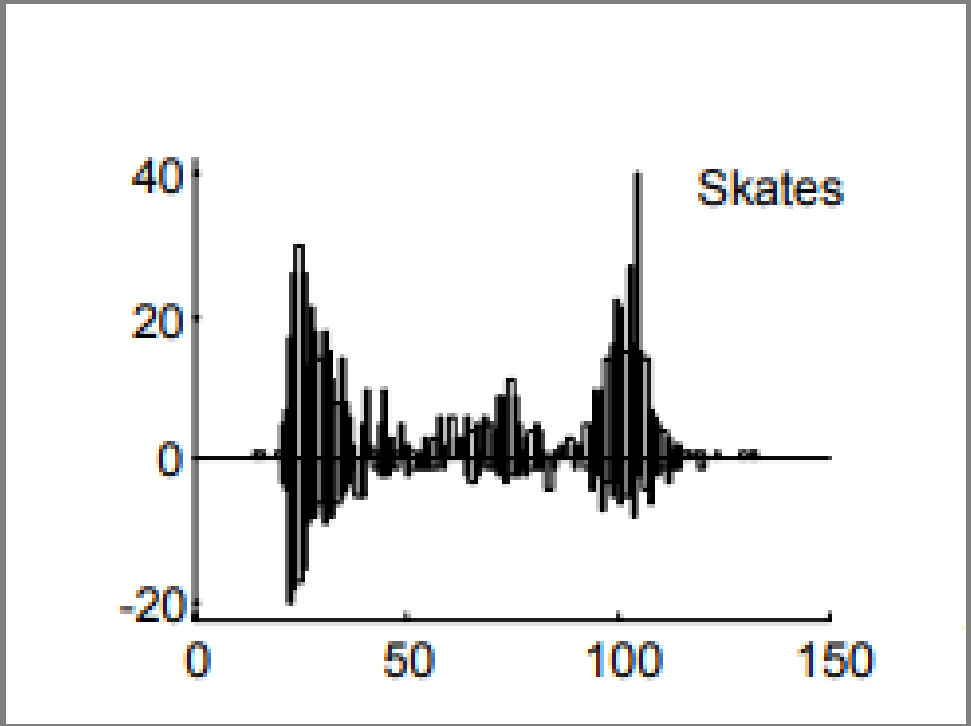
- Used StDev at A_1 and A_2 instead of CV
- Still not converged



MODEL 25_1

Catchability

- Data on survey catchability demonstrated skates escape the nets Kotwicki and Weinberg 2005
  - Estimated q = 0.836



Snipped from Kotwicki and Weinberg 2005. Bars above the horizontal axis are caught skates, those below are escaped skates.

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- First accepted model (2008) fixed q = 1 and used selectivity to mimic the size distributions from Kotwicki and Weinberg 2005.

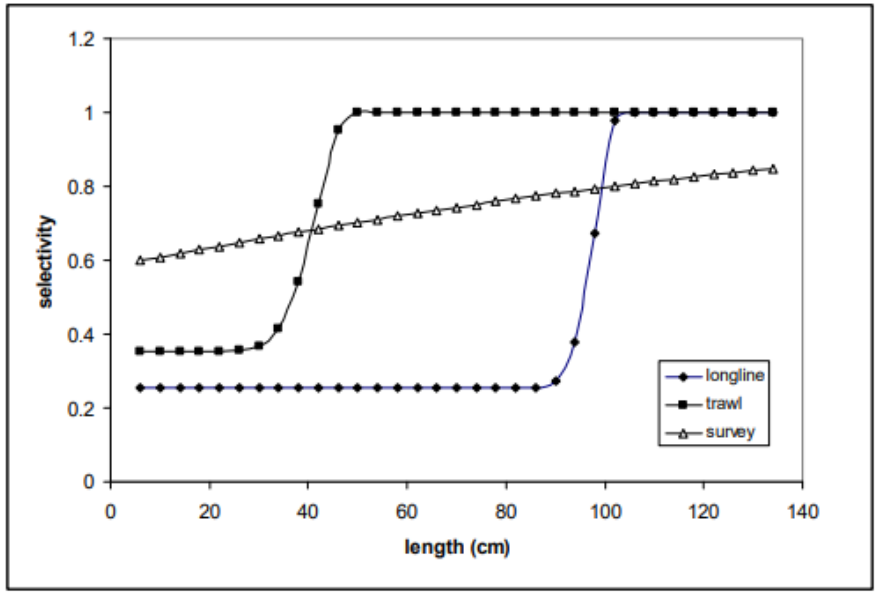

Figure 29. Length selectivities of the longline fishery, trawl fishery, and EBS shelf trawl survey.

Ormseth et al. 2008

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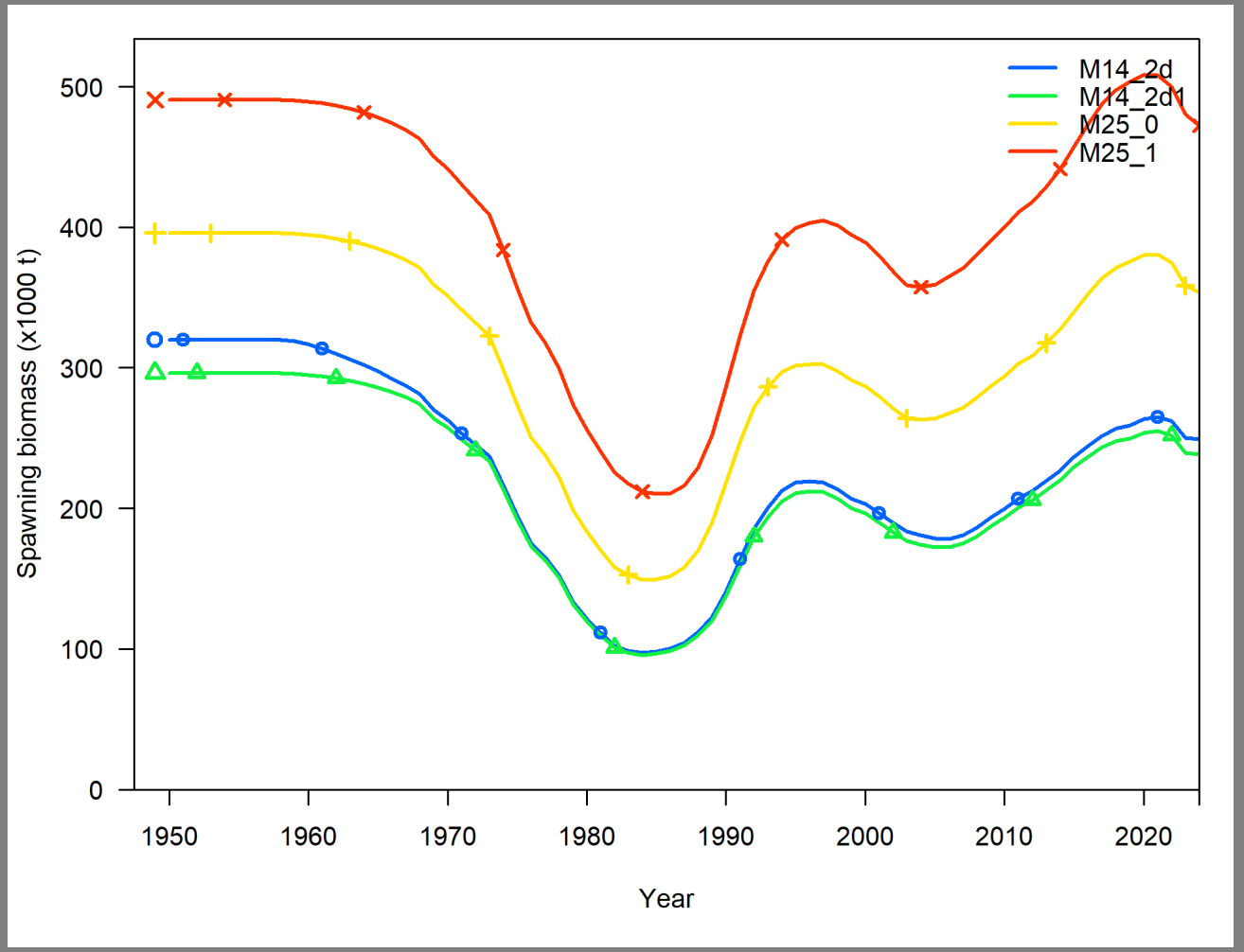
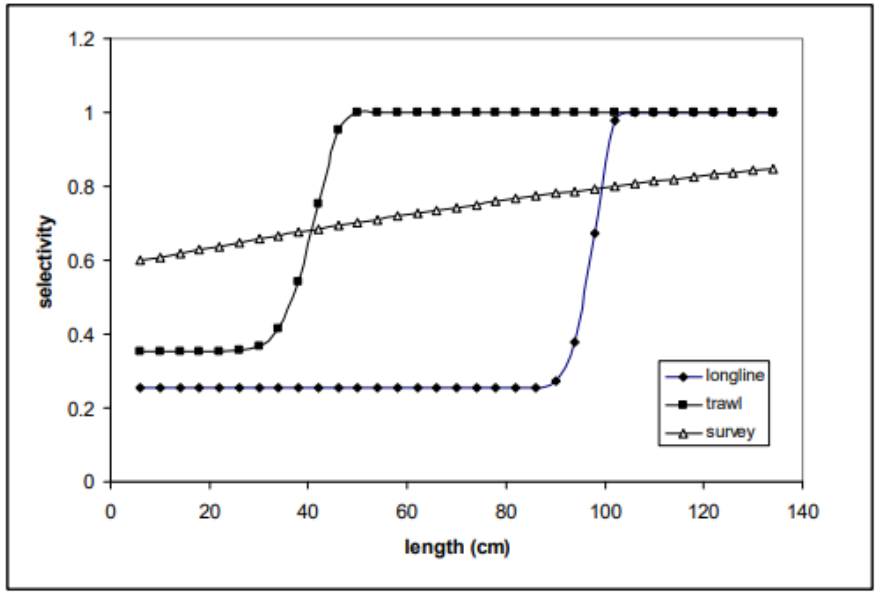


MODEL 25_2

Selectivities

- 2008 Parameterized selectivity to mimic the size distributions from Kotwicki and Weinberg 2005.



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MODEL 25_2

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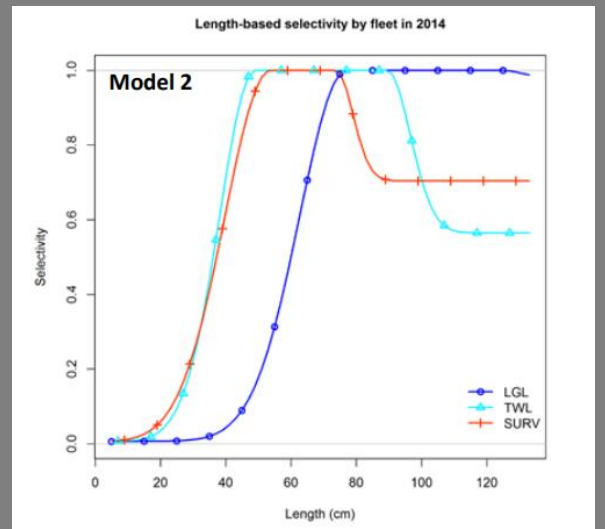
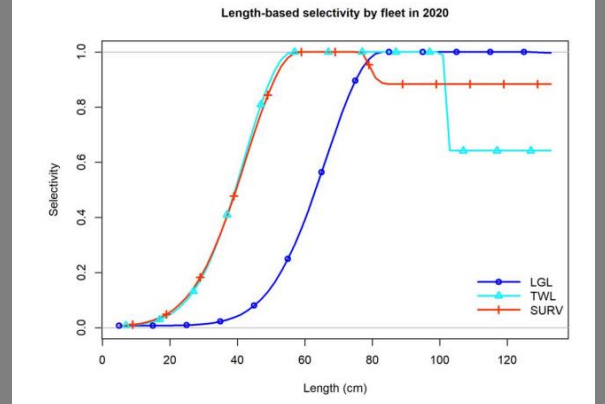
- 2008 Parameterized selectivity to mimic the size distributions from Kotwicki and Weinberg 2005.
- 2014 changed parameterizations
  - Start of model non-convergence



Ormseth 2014, Figure 18



Ormseth 2020

Figure 23. Selectivity functions estimated by model 14.2. LGL = longline fishery, TWL = trawl fishery, SURV = trawl survey.

MODEL 25_2

Selectivities

- 2008 Parameterized selectivity to mimic the size distributions from Kotwicki and Weinberg 2005.
- 2014 changed parameterizations
  - Start of model non-convergence
- 2023 version change changed the shape again

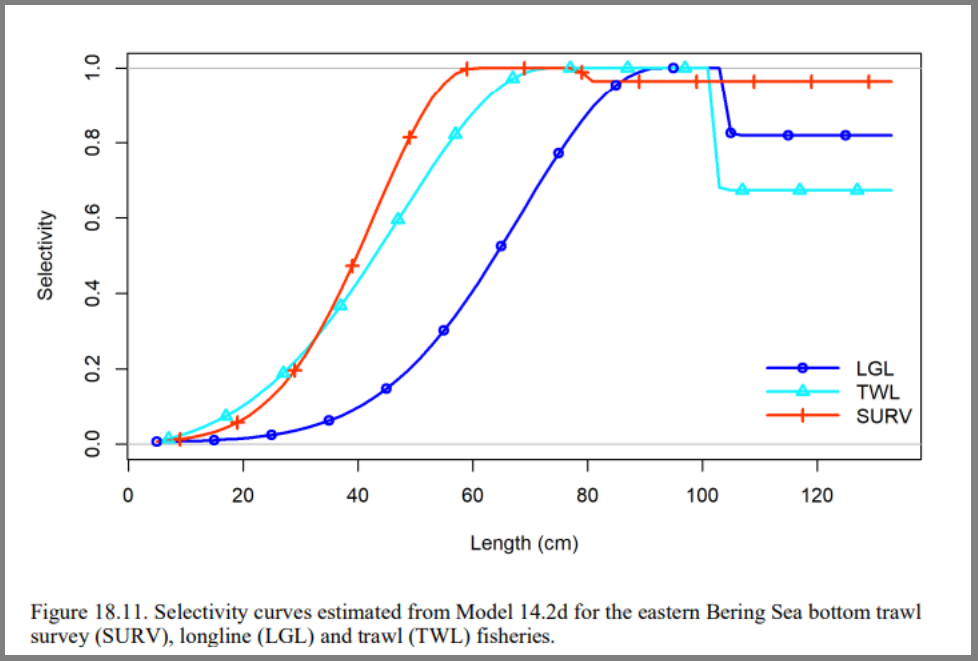
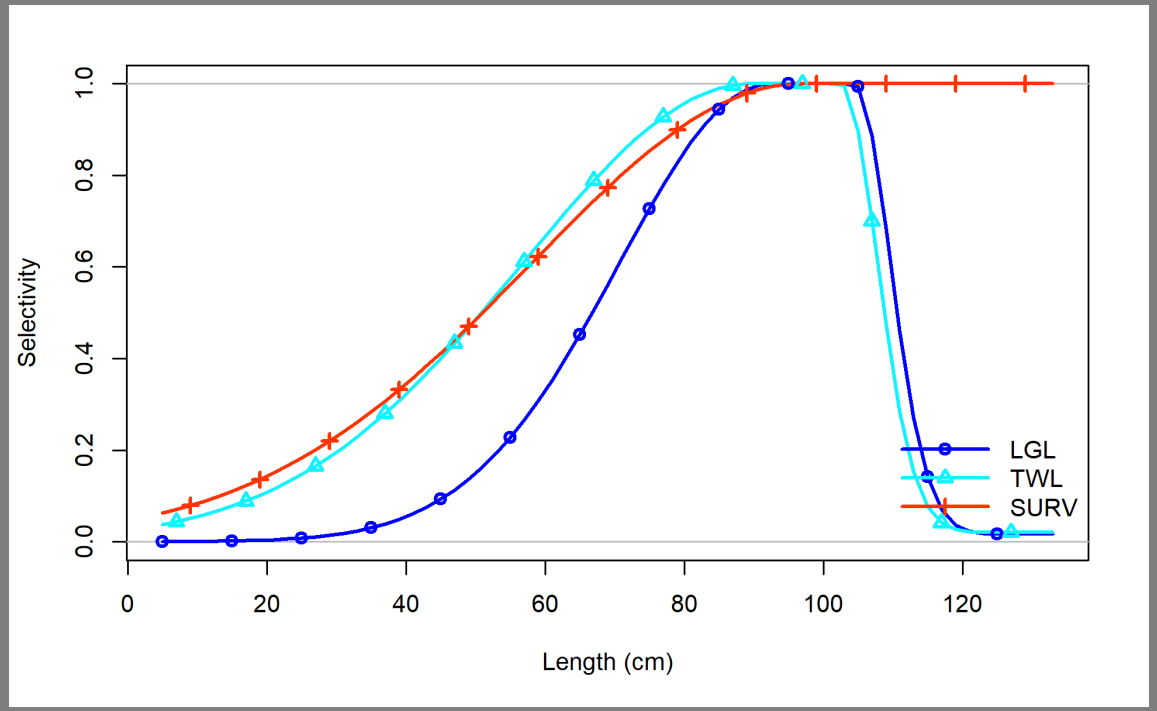


Figure 18.11. Selectivity curves estimated from Model 14.2d for the eastern Bering Sea bottom trawl survey (SURV), longline (LGL) and trawl (TWL) fisheries.

Tribuzio et al. 2023

MODEL 25_2

- Fixed survey selectivity to be logistic
- Fixed the starting values at 1 for all fleets
- Fixed the top width and descending limb width for all fleets



MODEL 25_2

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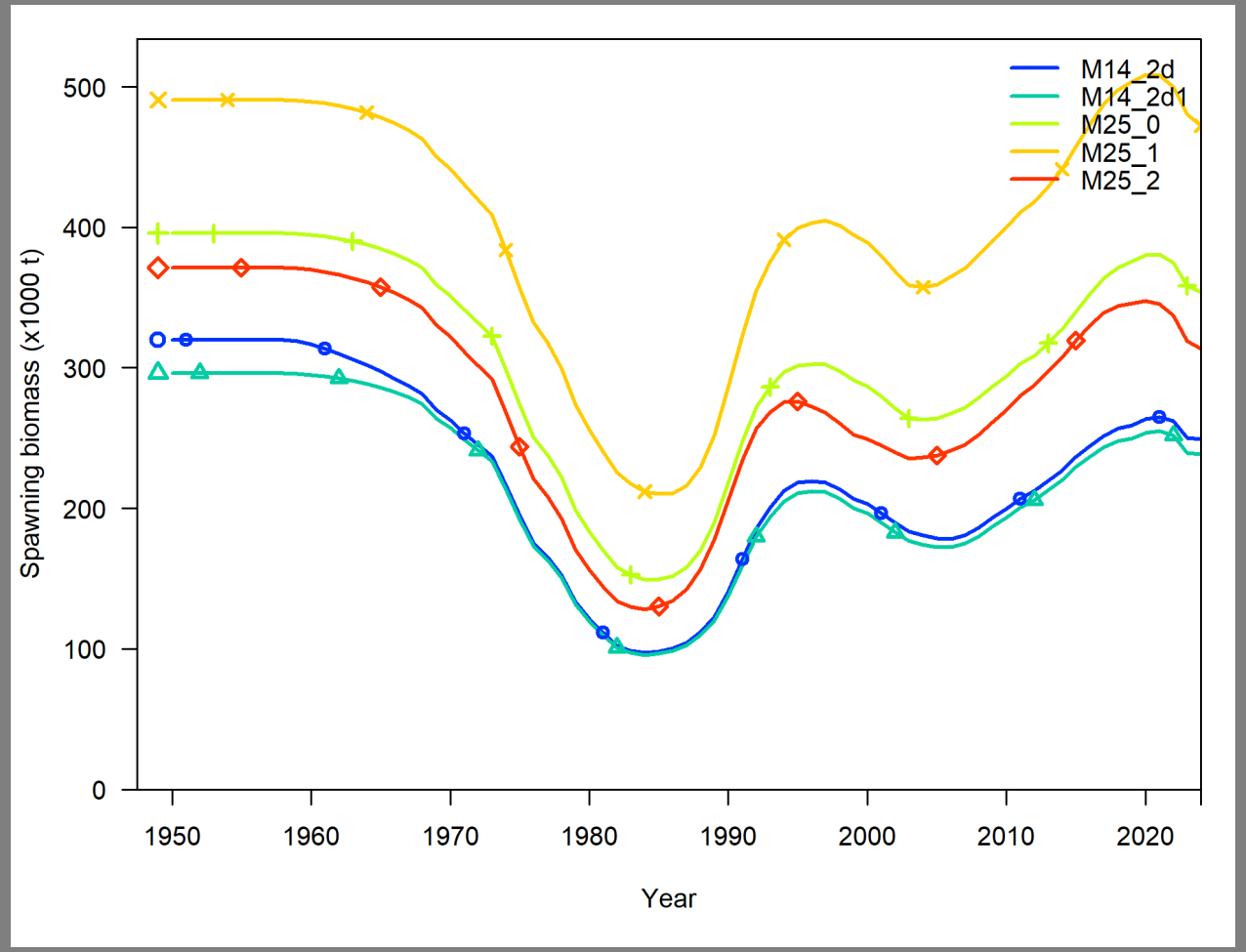
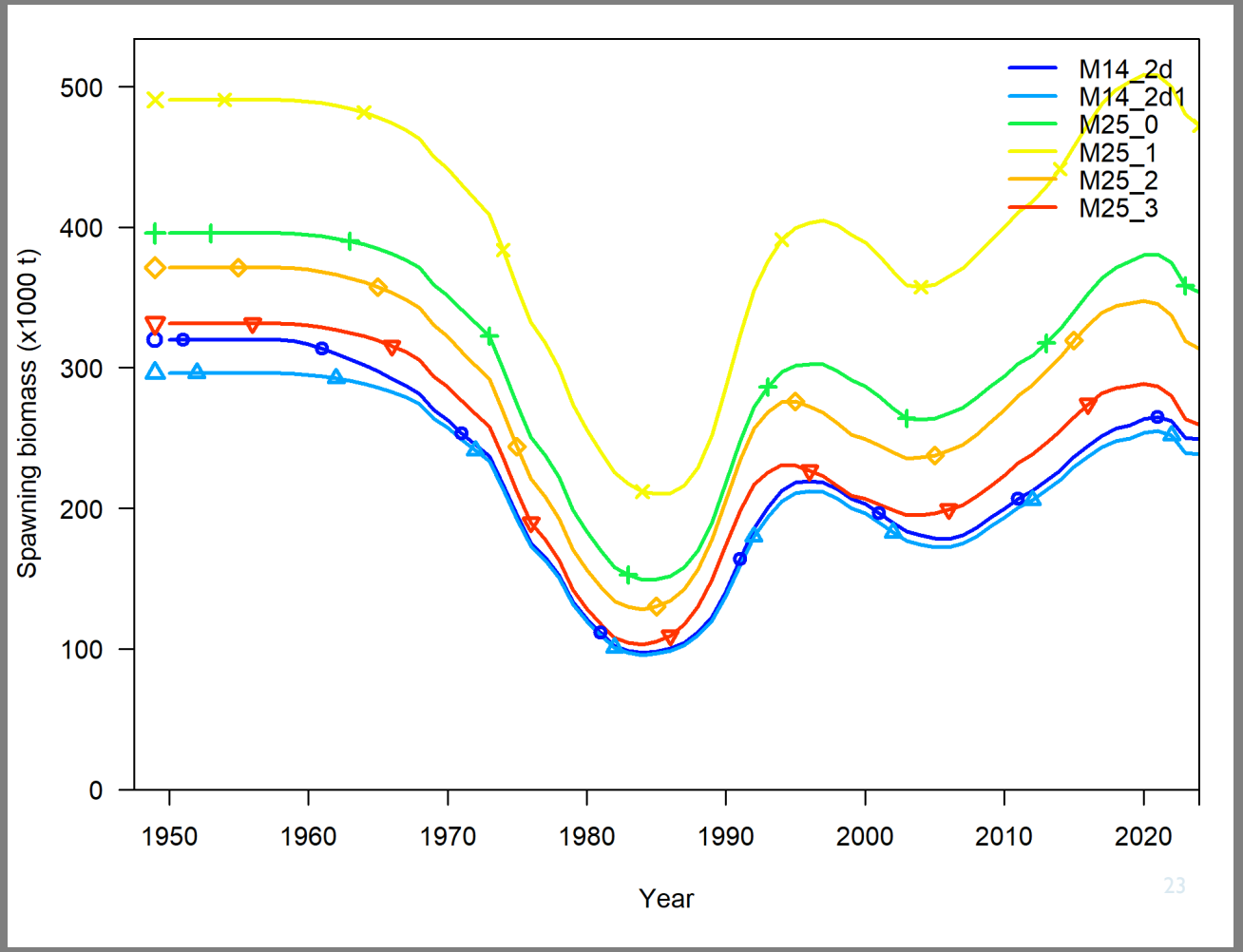
- CONVERGENCE!!!!



MODEL 25_3

- Same as Model 25_2 but with q = 1

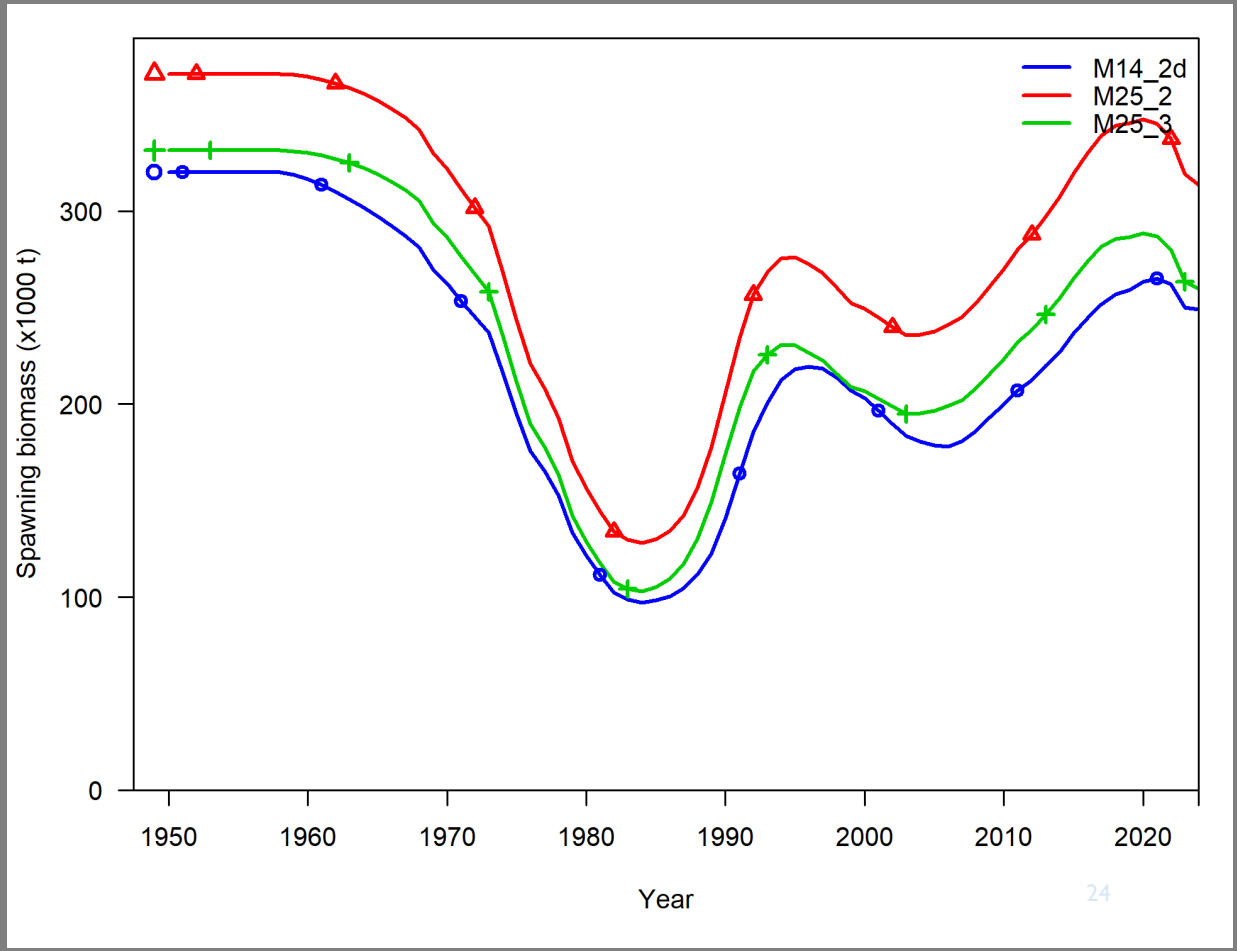


RESULTS

Model		Outcome
14_2d	2023 accepted	Not Converged
14_2d1	Updated version	Not Converged
25_0	Fixed growth	Not Converged
25_1	25_0 + catchability = 0.836	Not Converged
25_2	25_1 + selectivity	Converged
25_3	25_2 + catchability = 1	Converged

Author Recommends 25_2

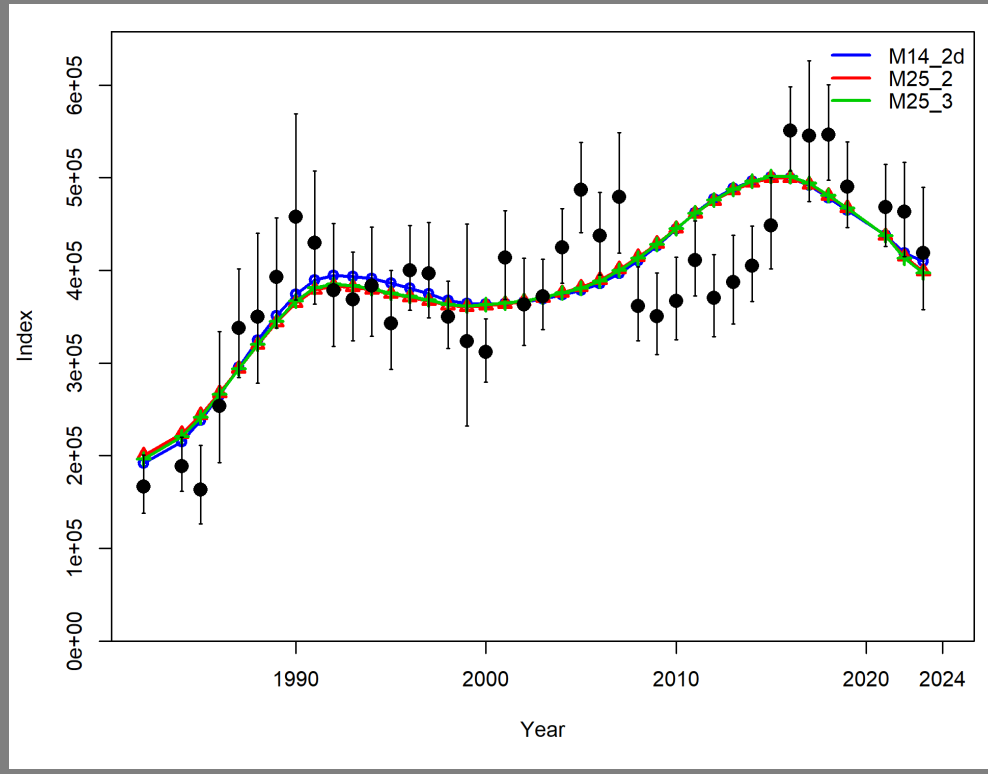
- Converges
- Data informed catchability

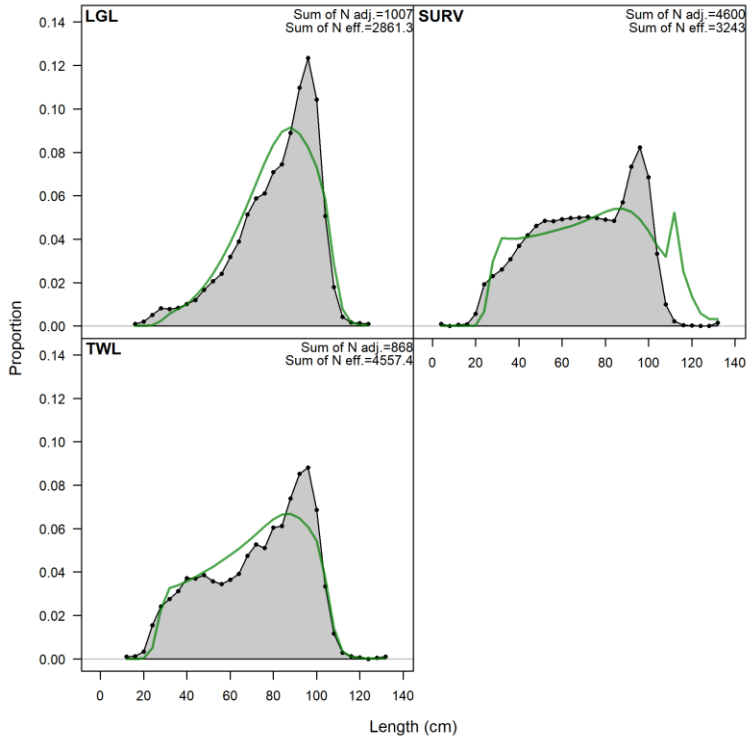


RESULTS

Concerns with 25_2 and 25_3

- Poor fit to survey index
- Poor fit to length comps





Questions on Tier 3 Alaska Skates

Up next: Other Options

OTHER OPTIONS

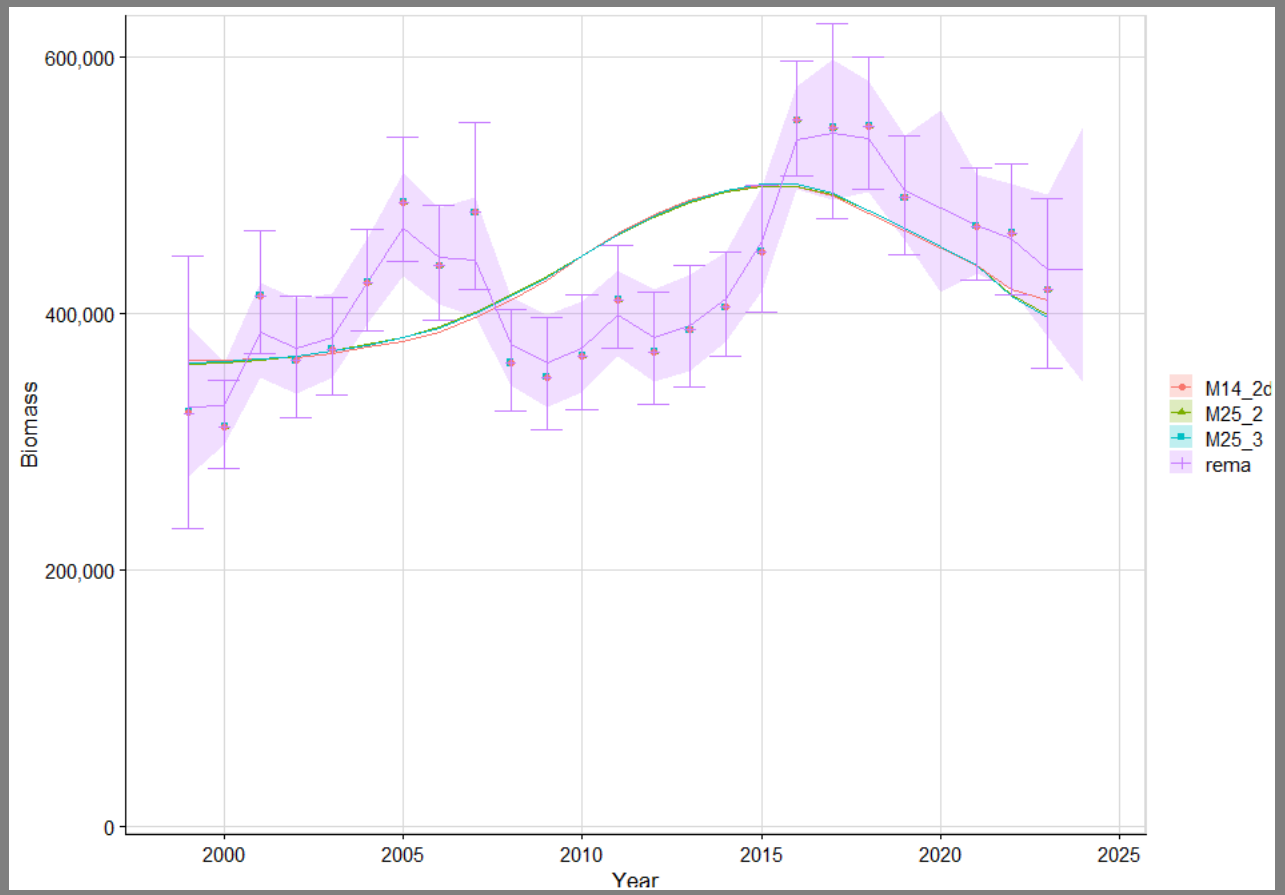
Alaska Skate Situation

- Limited age data
  - Fishery samples being collected (2025 onwards)
  - No capacity to age them
  - Age structured model with little age data, spanning a variety of ecosystem situations
- High volume of length data for all three fleets
- Northern Bering Sea

Other Options

- Tier 4 could be brought forward this year
- Tier 5 could be brought forward this year
- Other length based approaches for future explorations

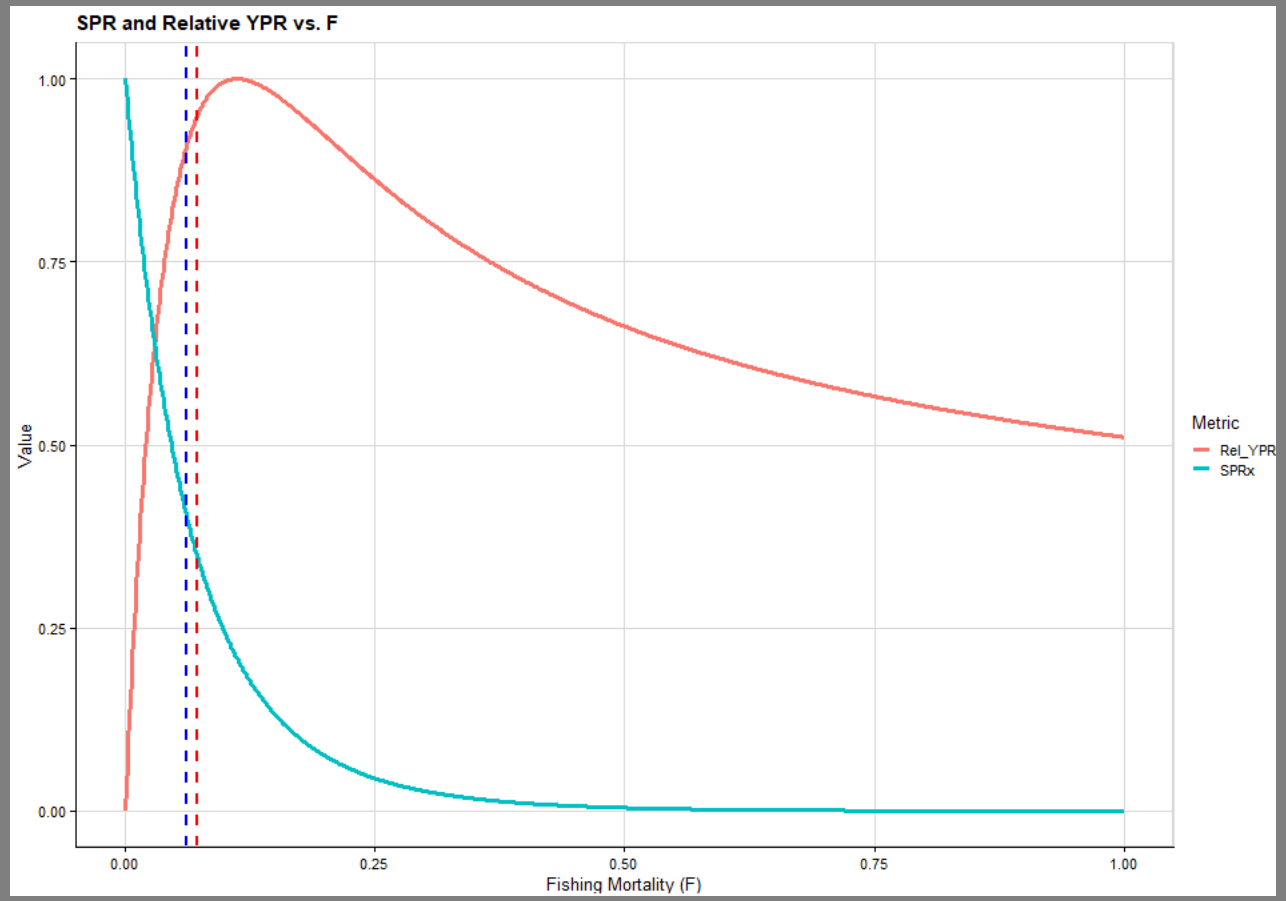
OTHER OPTIONS



Tier 4 or Tier 5

- Species is well sampled by the shelf survey
- Rema already done for it
- Data supported life history parameters
  - M
  - Age-at-Maturity
- Data supported selectivity assumptions

OTHER OPTIONS



Figures for demonstration, parameters not fully reviewed.
Tier 4 code credit to Jane Sullivan and Kristen Omori!

Tier 4 or Tier 5

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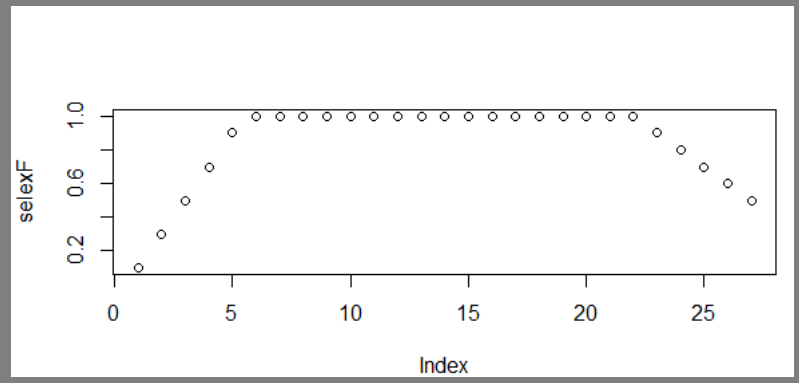

We now have the Kotwicki and Weinberg 2005 data to inform selectivity

OTHER OPTIONS

Alaska Skates EBS Shelf Only

Model	2024 FOFL	2024 FABC	2024 OFL	2024 ABC
14_2d	0.093	0.080	32,429	27,950
Tier 4	*0.072*	*0.062*	*31,259*	*26,918*
Tier 5	0.13	0.75	43,416	32,562

Tier 4 or Tier 5

- Species is well sampled by the shelf survey
- Data supported life history parameters
  - M
  - Age-at-Maturity
- Data supported selectivity assumptions

OTHER OPTIONS

Length Based Modelling (for future work)

- Need to investigate and test for AK skates
- Examples
  - State Space (thorny skates, Cadigan et al. 2025)
  - Length-based Integrated Mixed Effects (LIME, Rudd and Thorson 2018)
  - Length-based Spawning Potential Ratio (LBSPR, Hordyk et al. 2015)
  - Length-based Risk Analysis (LBRA, Ault et al. 2019)
  - Stock Synthesis Catch/Length (SS-CL, Rudd et al. 2021)
  - Length-based model comparisons (Chong et al. 2020)

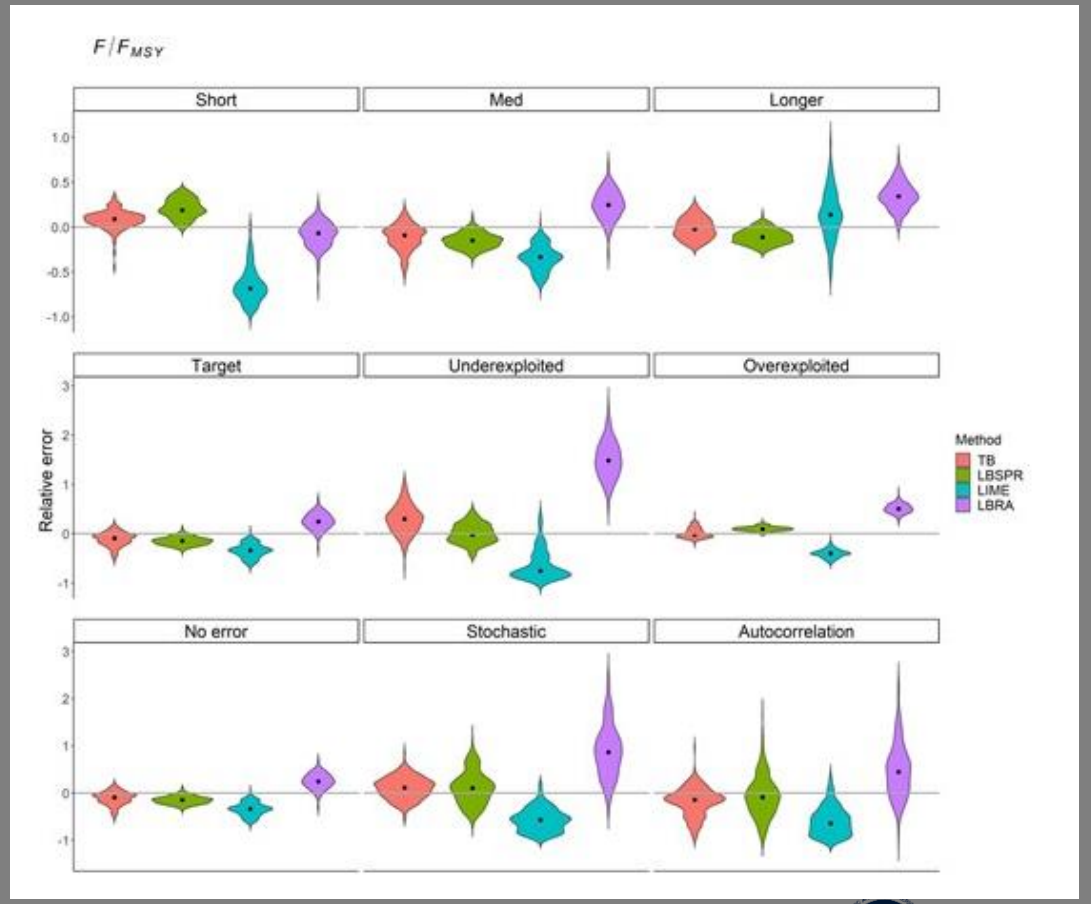

Figure 5. Chong et al. 2020

Questions, comments or feedback

Contact: cindy.tribuzio@noaa.gov

With special thanks to:

- Matt Cheng, Dan Goethel, Jane Sullivan and Kristen Omori
- MESA program support system