GOA Deepwater Flatfish Update Assessment

Carey R. McGilliard and Bridget Ferriss
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Catches over time dominated by Dover sole

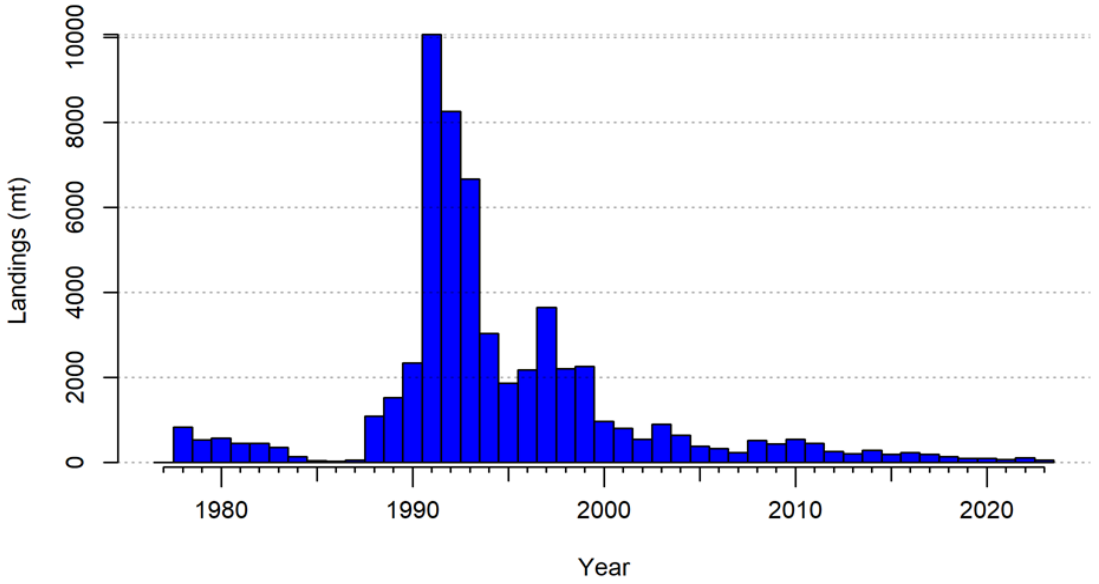
- No formal catch recording for deepsea sole
- Kamchatka split from Arrowtooth in 2011
  - No average catch available 1978-1995 for typical Tier 6 calculations)
  - PT and SSC agreed on max(catches) as Tier 6 OFL
- Unidentified grouped with Dover for Tier 3 assessment

Year	Greenland turbot	Dover sole	Unidentified	Total
1978	51	827		878
1979	24	530		554
1980	57	570		627
1981	8	457		465
1982	23	457		480
1983	145	354		499
1984	18	132		150
1985	0	43		43
1986	0	23		23
1987	44	56		100
1988	256	1,087		1,343
1989	56	1,521		1,577
1990	0	2,348		2,348
1991			10,196	10,196
1992			8,497	8,497
1993	19	1,869	1,935	6,706
1994	3	2,538	537	3,078
1995	78	1,416	721	2,215
1996	6	1,485	704	2,195
1997	3	2,676	996	3,674
1998	10	2,111	168	2,289
1999	6	1,833	447	2,285
2000	5	813	167	985
2001	4	654	146	804
2002	4	411	146	560
2003	3	899	51	902
2004	1	646	41	647
2005	1	378	41	379
2006	10	327	74	337
2007	1	235	47	236
2008	4	517	53	521
2009	0	435	42	435
2010	0	546		546

Year	Greenland turbot	Dover sole	Kamchatka Flounder	Total
2011	3	453	12	467
2012	0	260	4	265
2013	15	216	15	245
2014	3	284	69	356
2015	26	198	35	259
2016	4	231	5	240
2017	8	188	67	263
2018	3	144	40	186
2019	7	92	14	113
2020		97	15	112
2021	9	67	20	96
2022	18	116	13	147
2023	22	56	20	98

Catches over time dominated by Dover sole

- Dover sole catches are very low throughout time (1-3% of ABC in recent years)
- Big catch in 1991 (10,196 t)
- Catches below 1,000 t since 2000
- Catches mostly in 100-500m, some in 500-700m
- Catches primarily in Central GOA
- Increasing proportion in discards:
  - 10% in 1998
  - ~90% in past 3 years



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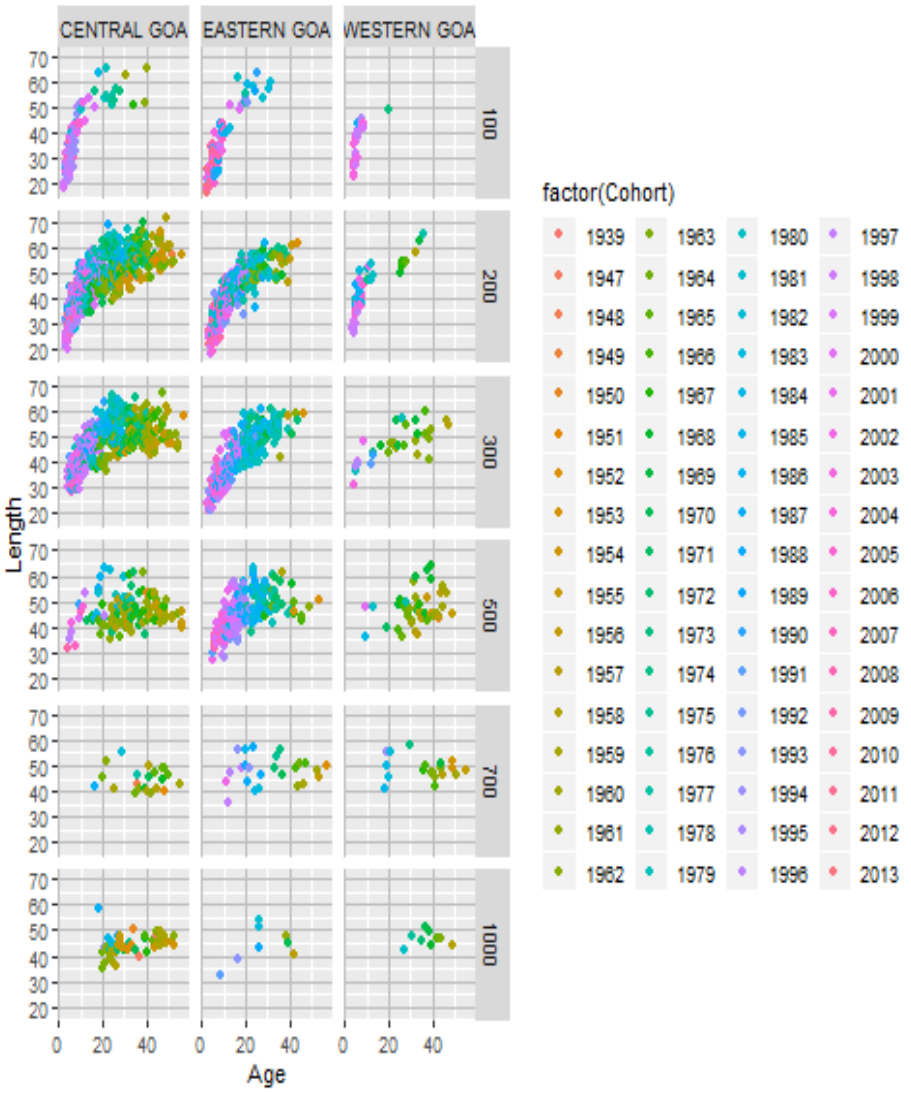
Dover sole life history

- Long-lived (plus group 59+)
- Exhibit ontogenetic movement from shallow to deep waters
- Fish found in 700-1000m depths
- Complex time- and spatially-varying growth patterns



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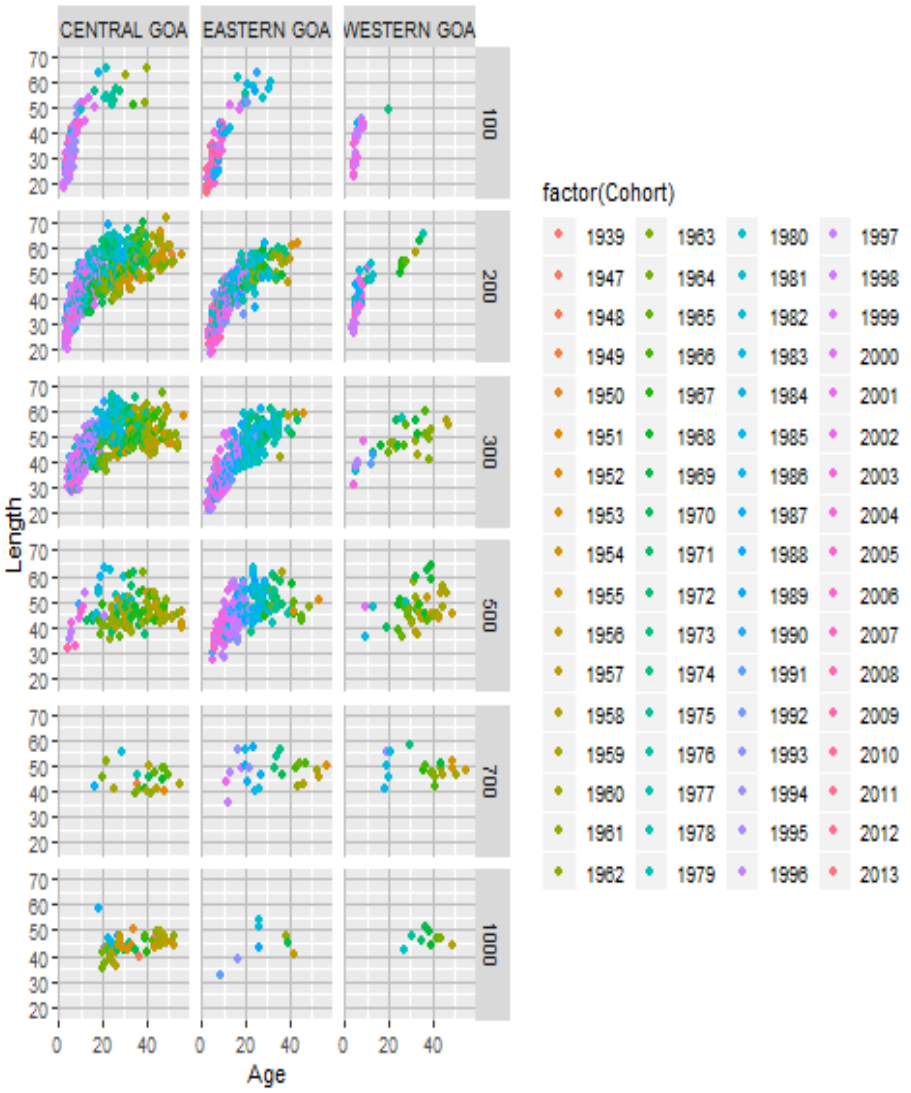

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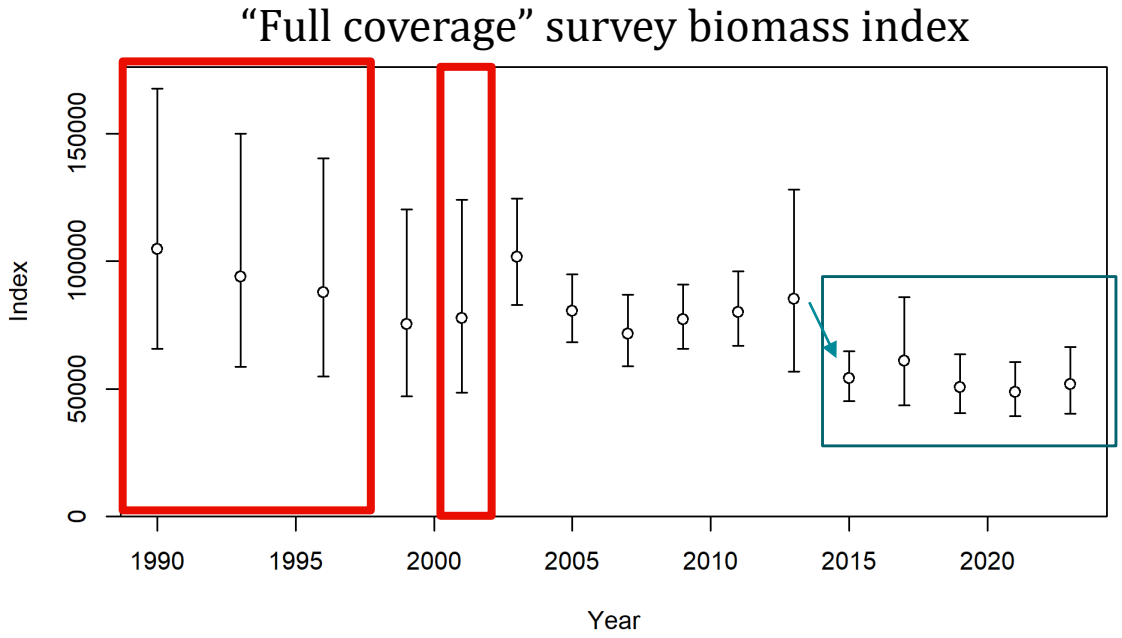
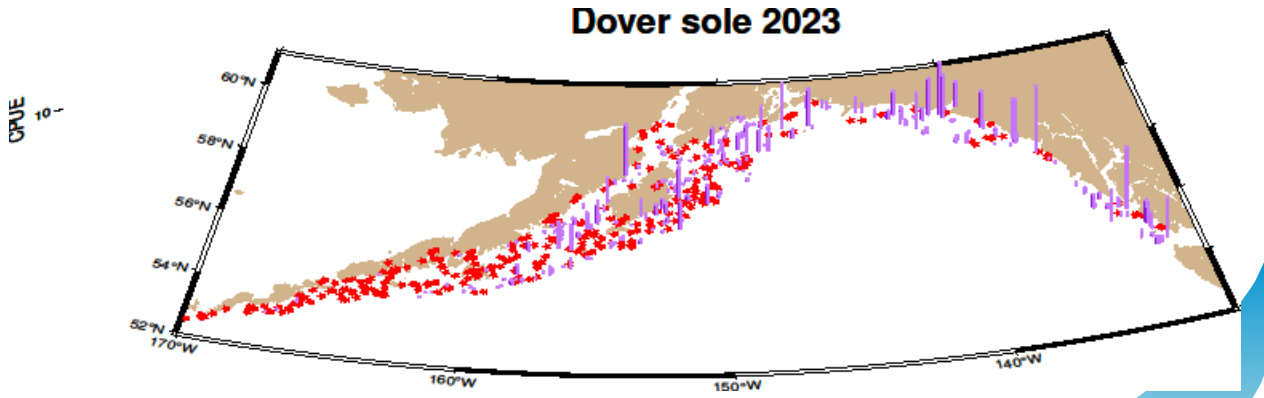
Survey Trends

- A shift to lower survey biomass 2015-2023
- REMA used to fill in gaps in missing survey depth/area strata



- Highest CPUE in Central GOA (similar to other years)



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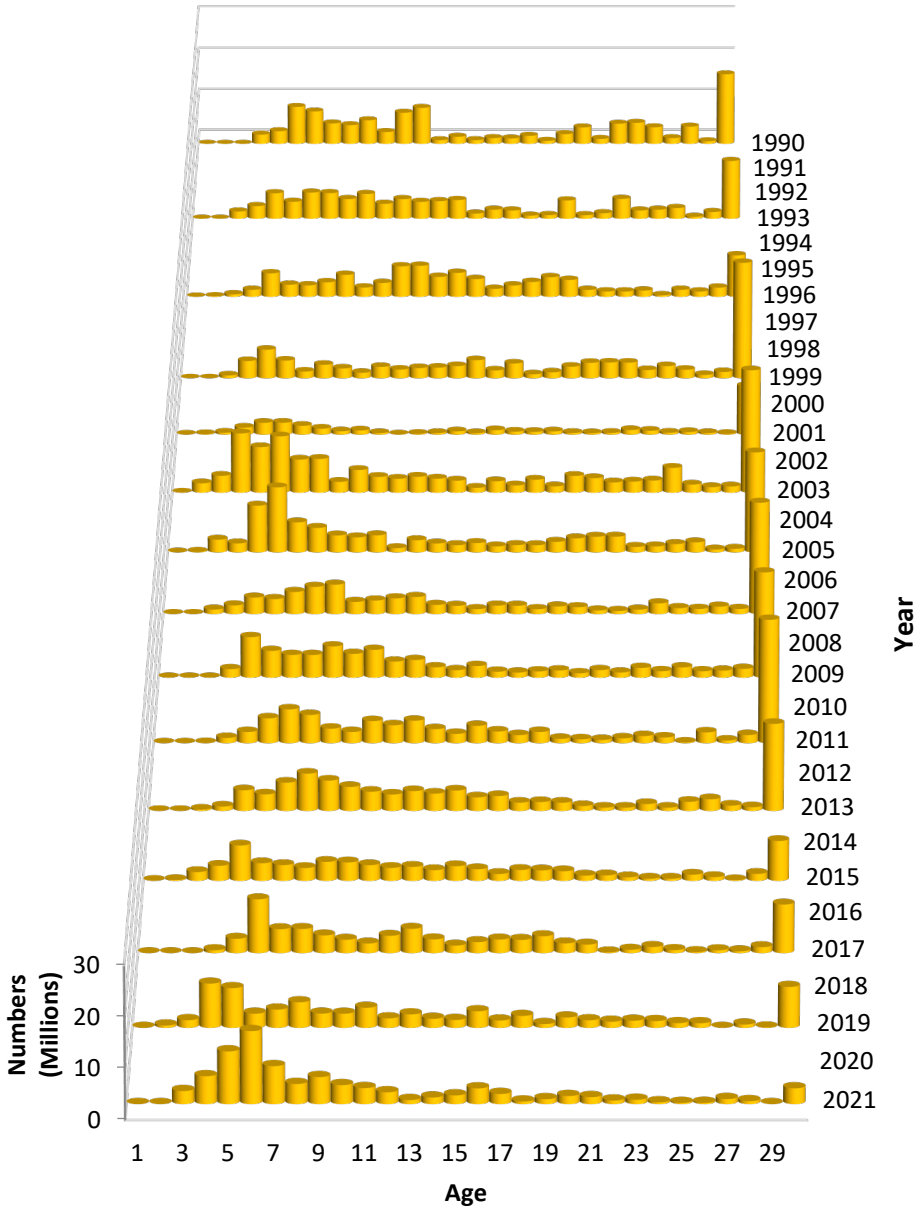
Survey Trends

- Decline in fish age 30+ from 2015-2023
- Large new year classes, especially 2015



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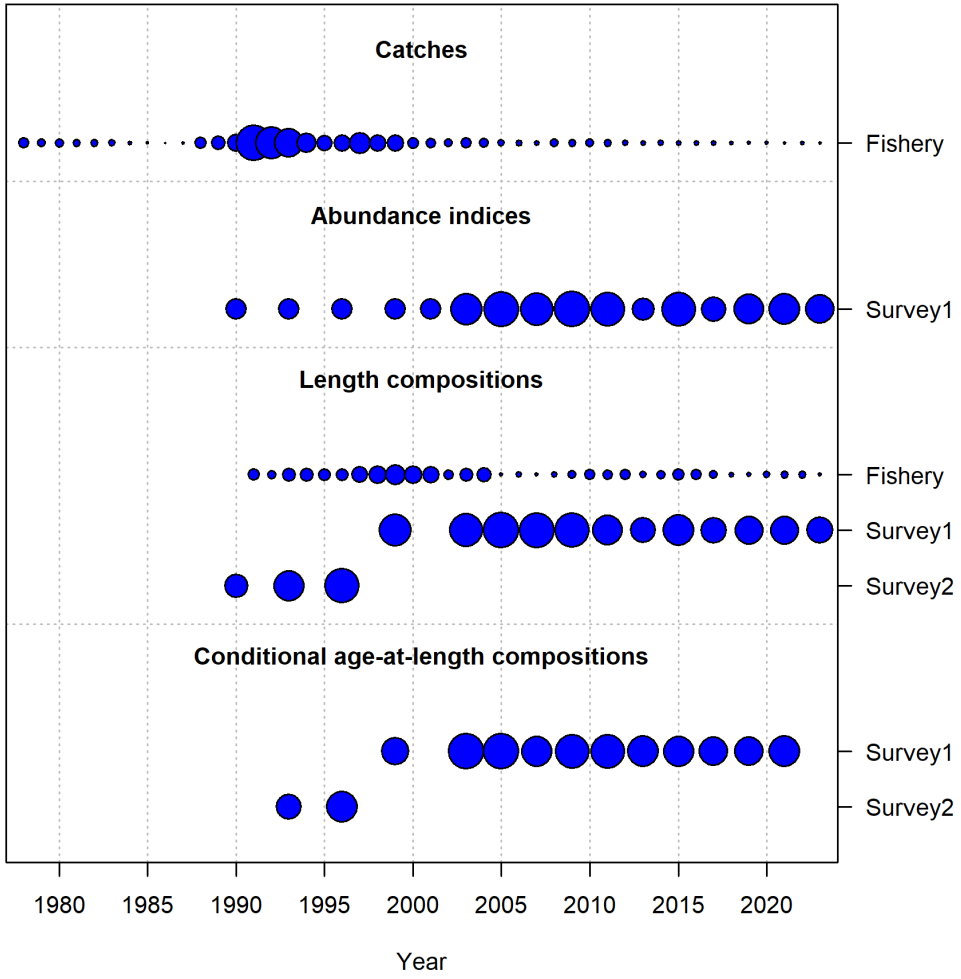
Data for Assessment Model

- Size of dot shows:
- Relative size of catches
- Relative precision for indices
- Relative to sample size for comps



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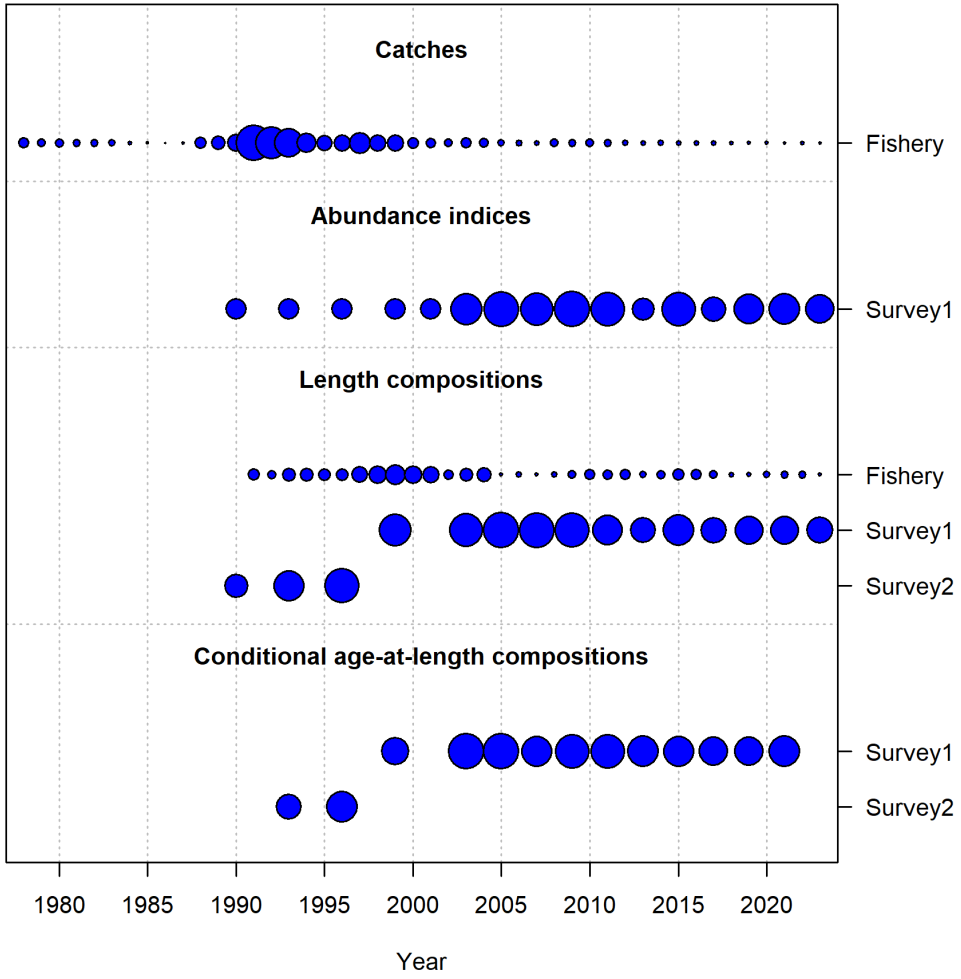

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2019 Model: Model 19.3

Basic setup:

- Shallow-coverage survey years modeled = separate survey fleet
- REMA to fill in estimates for missing depth/area strata in biomass index
- All years of biomass index are considered “full-coverage” survey within the model

2019 Model: Model 19.3

Fitting to lower survey biomass in 2015-present:

- Estimated natural mortality for females and males with broad prior
- Used a model without time blocks to estimate historical q (estimate not changed for 2023 assessment)
- Estimated natural mortality for 1978-2013 and 2014-2019 blocks
- Estimated q for 2014-2023 block

2019 Model: Model 19.3

Other parameters estimated:

- Von-Bertalanffy growth parameters and CV in length-at-age
- Asymptotic double-normal fishery selex
- Asymptotic double-normal full-coverage survey selex
- Asymptotic double normal female shallow-coverage survey selex
- Dome-shaped double normal male shallow-coverage survey selex

2023 Update Assessment uses Model 19.3 with two minor tweaks

- Variance estimates in years with missing survey strata = largest variance estimate for survey biomass
- Model 19.3.1:
  - Uses new survey biomass variance estimates
  - Francis re-weighting, adjusted so that shallow-coverage comp weights = full-coverage comp weights

Bridging Models

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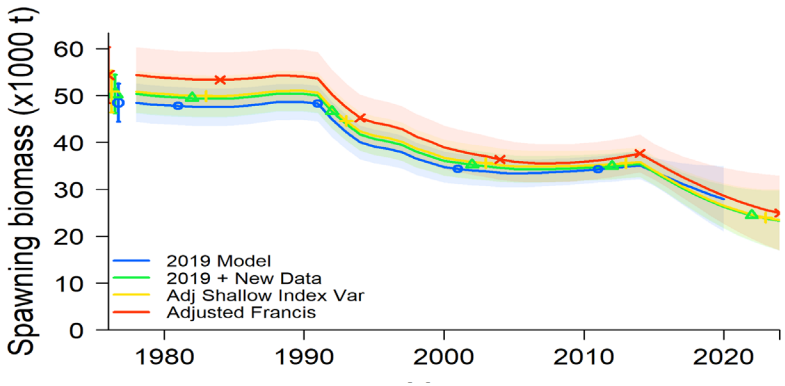
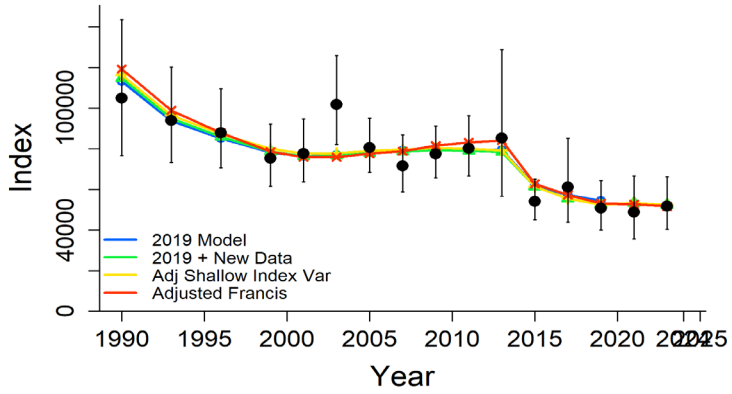
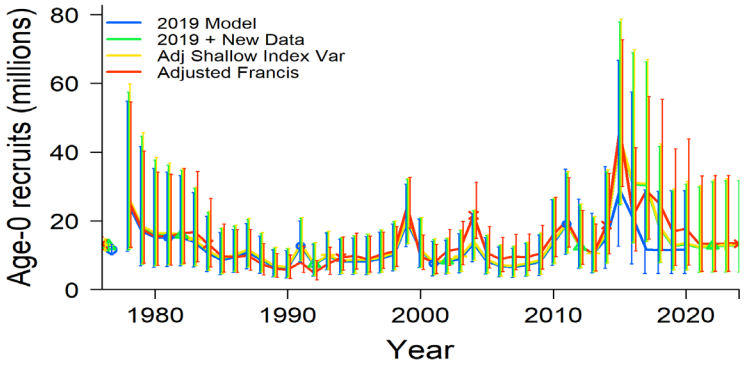
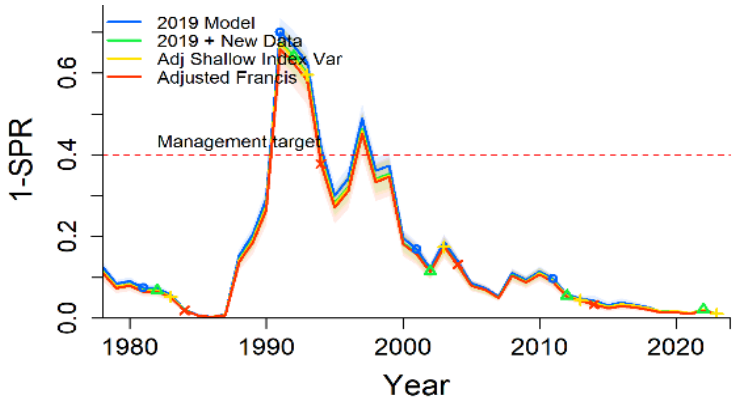
Bridging Model Comparison









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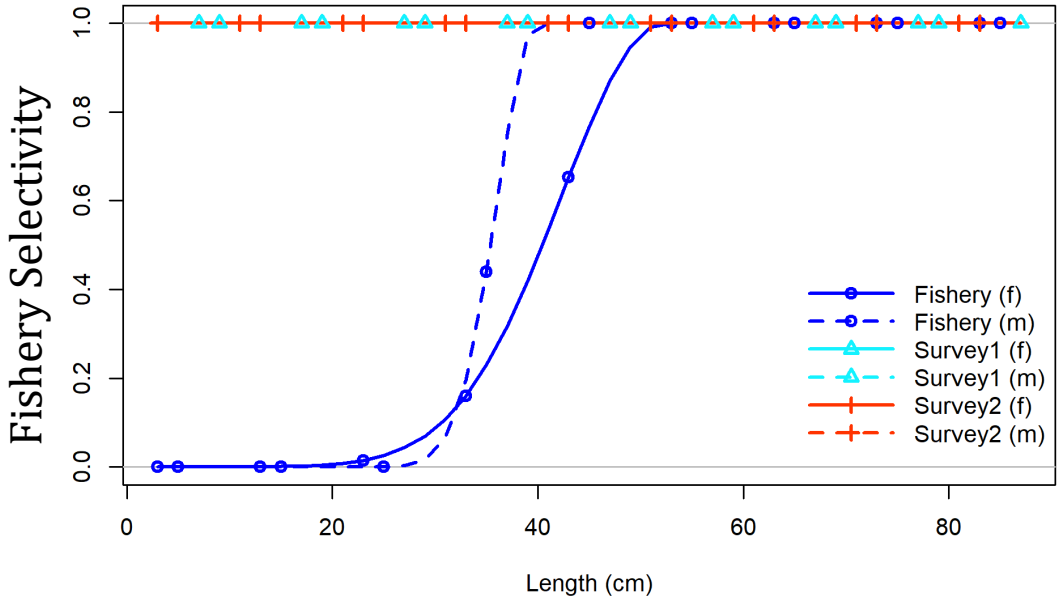
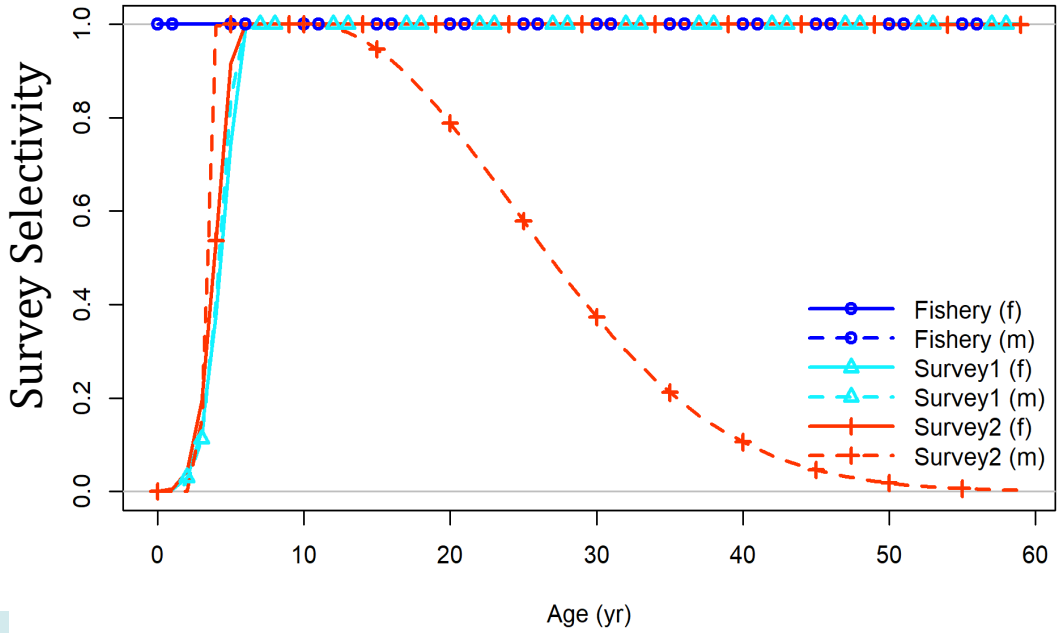
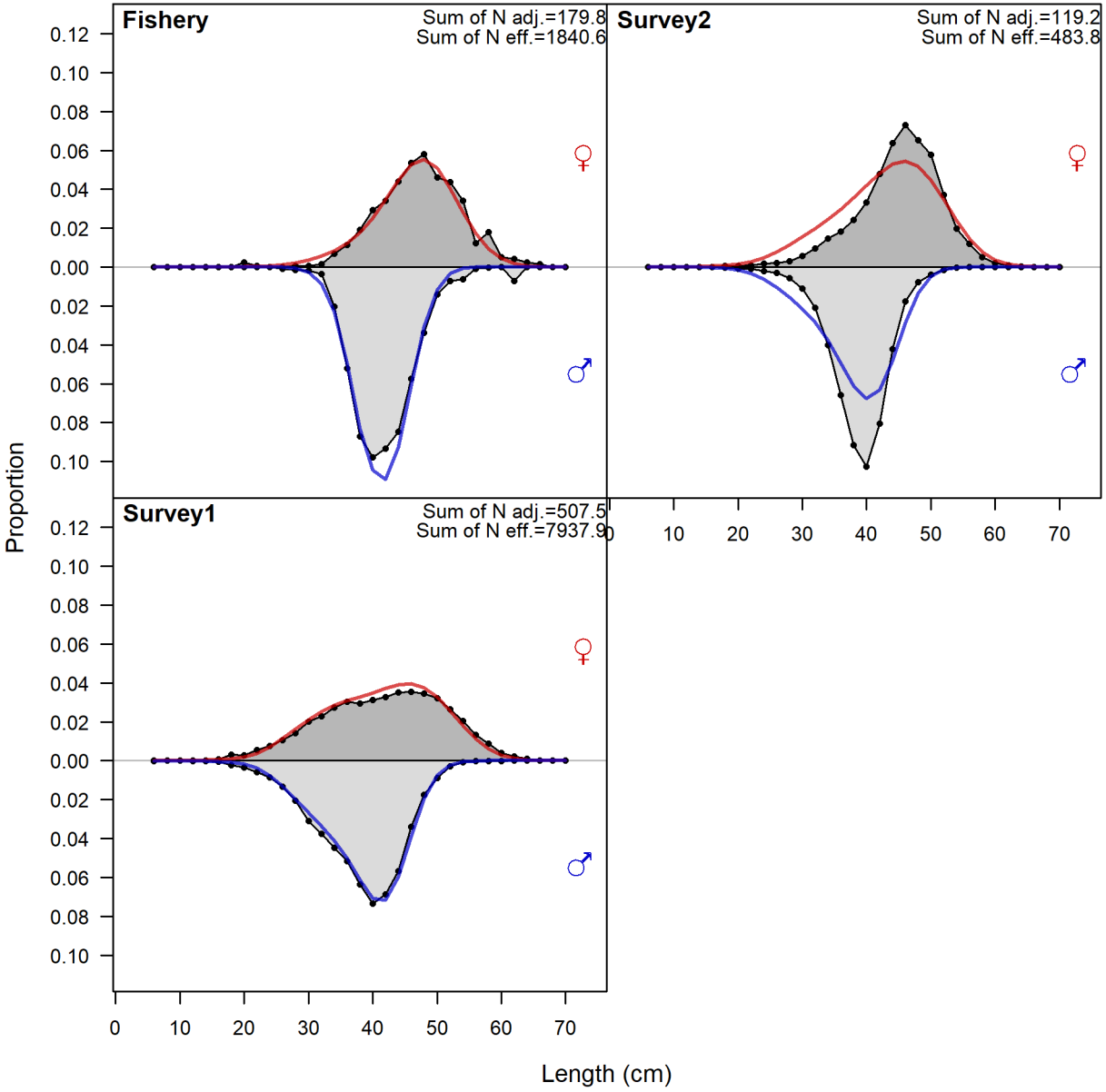
Model 19.3.1: Selectivity





Model 19.3.1: Aggregated fits to length compositions



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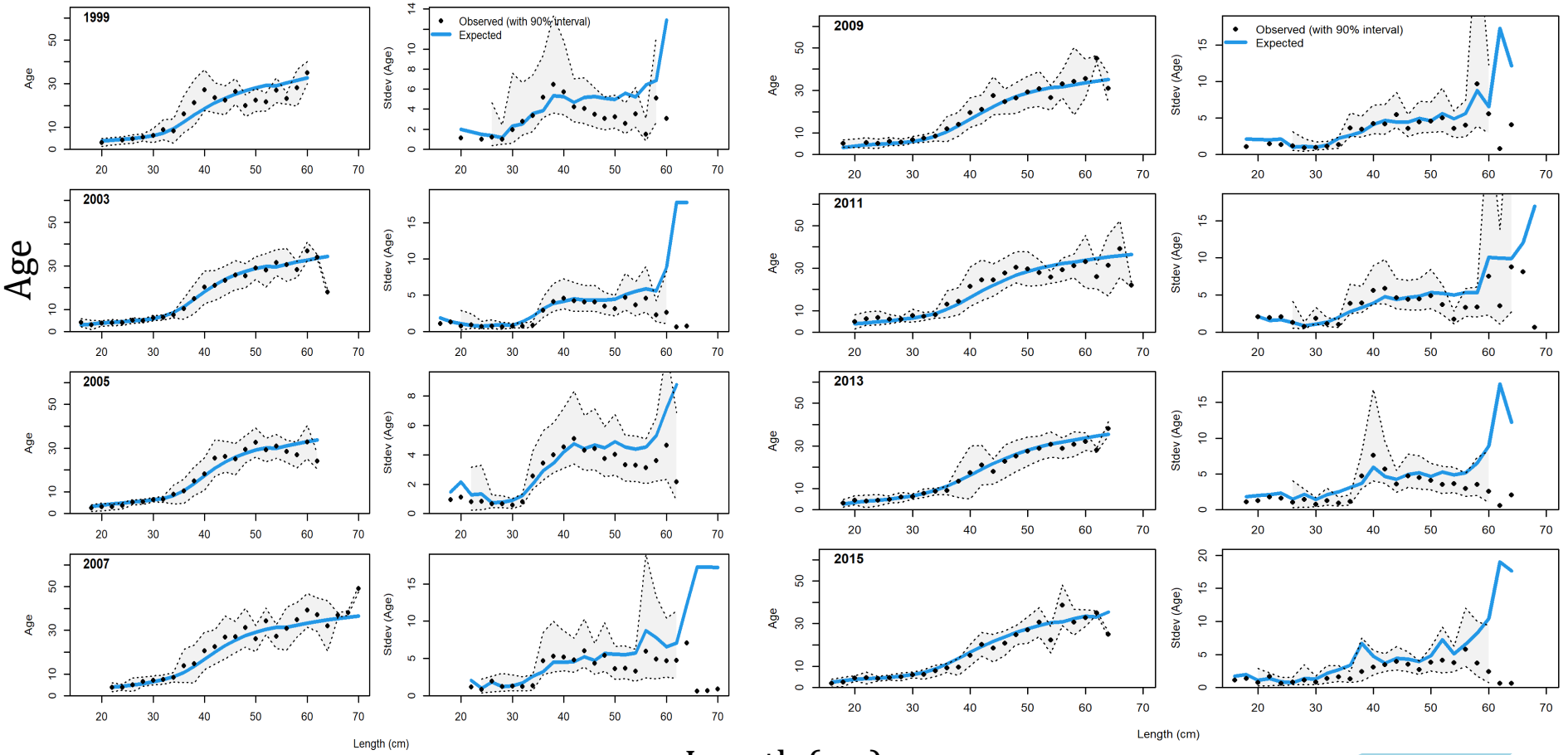
Model 19.3.1:
Yearly fits to conditional age-at-length data



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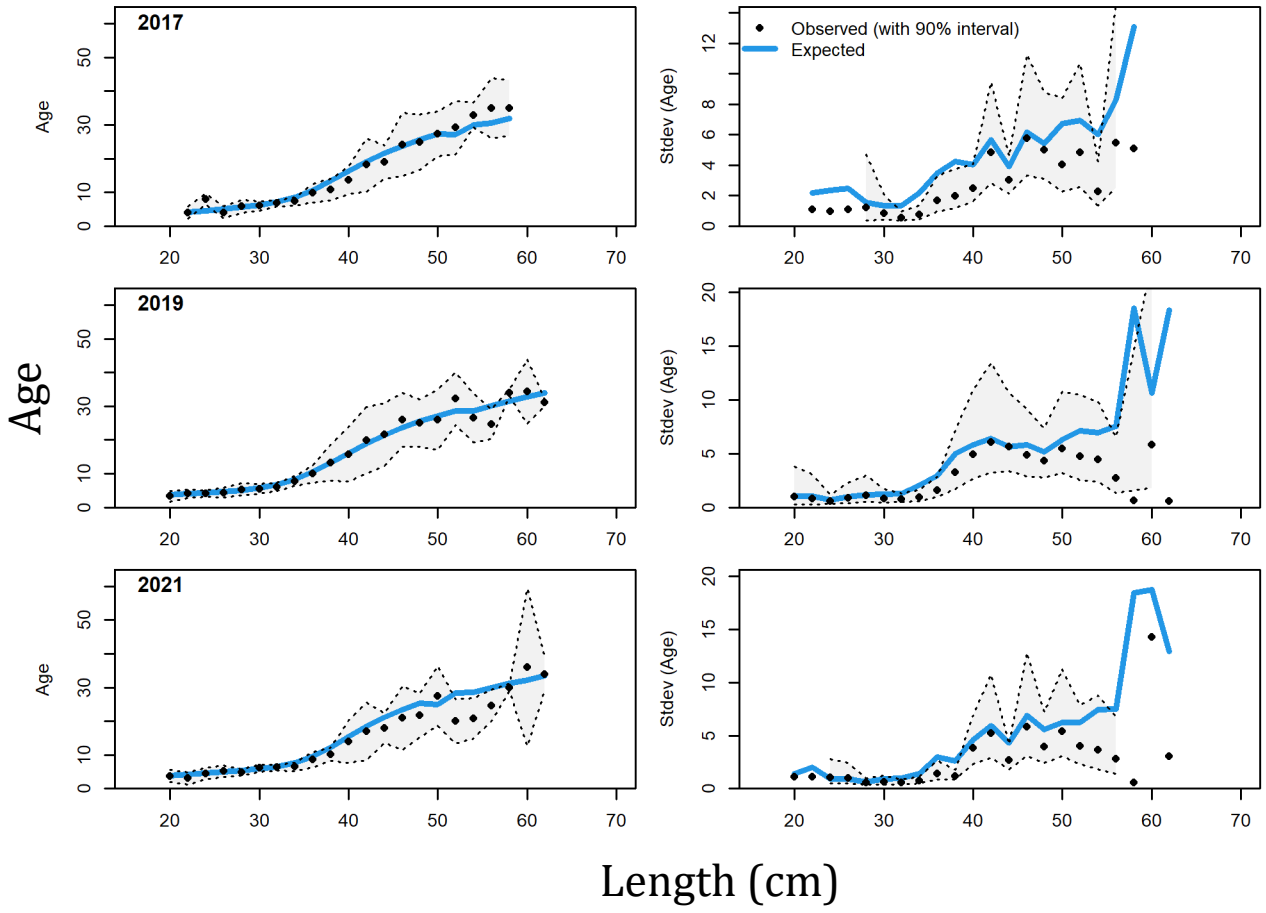

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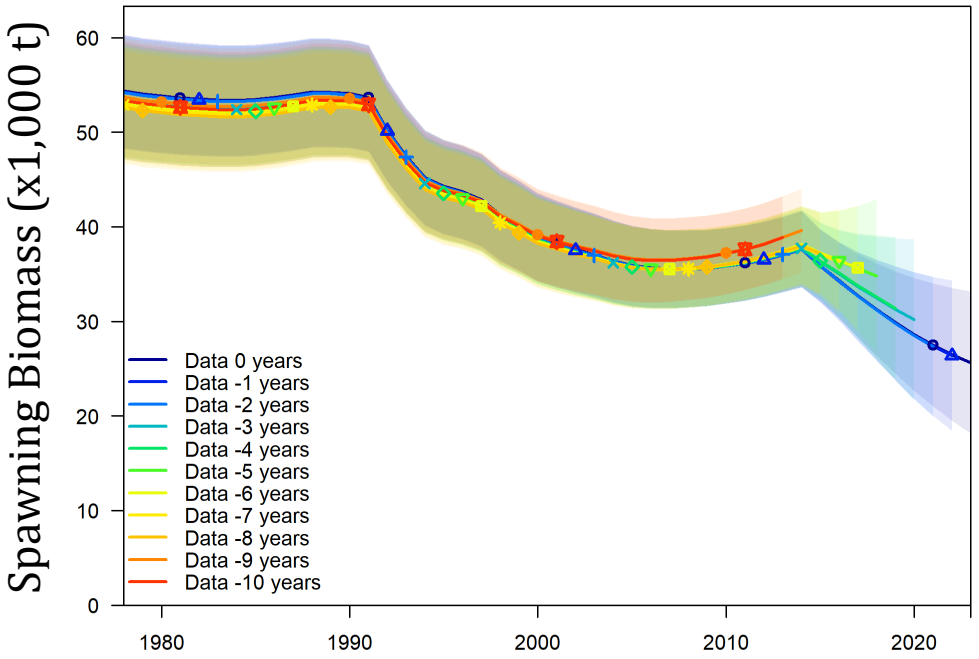
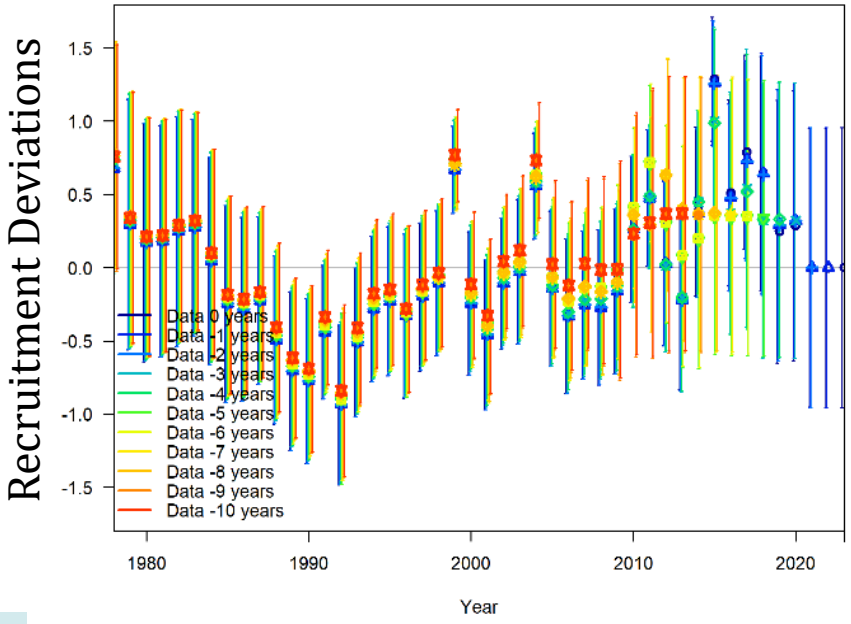
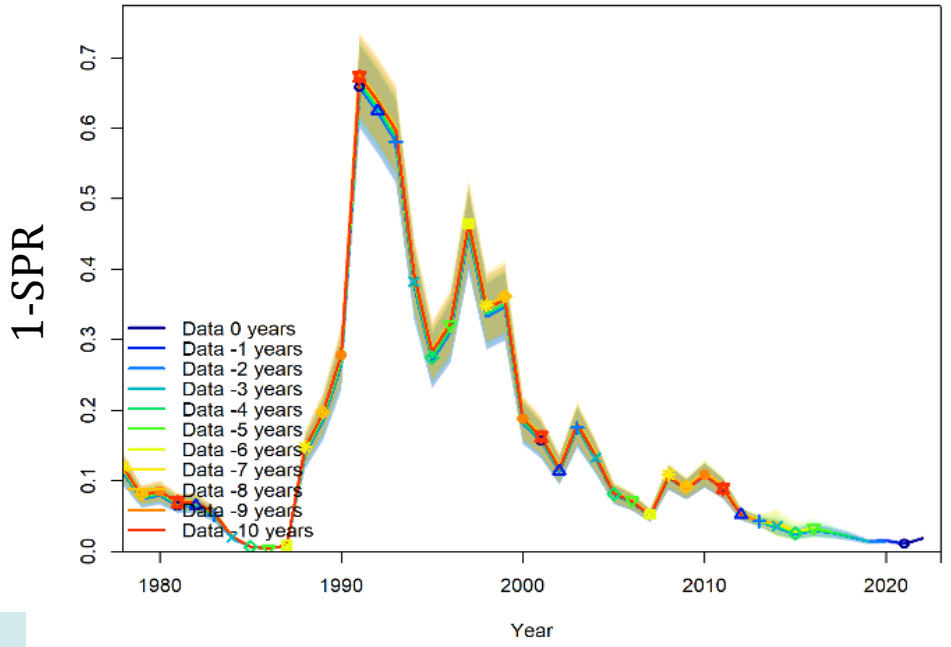
Model 19.3.1: Retrospective Patterns







Model 19.3.1:
Risk Table Summary: no reduction in ABC

- Assessment considerations: 2
  - Cohort-specific and spatial patterns in growth not taken into account in Dover assessment model + no fishery age data
  - Missing survey depth/area strata
  - Fixed descending limbs for fishery (male and female) and shallow-survey (female) selectivity curves
- Population dynamics: 1
- Ecosystem: 1
- Fishery Performance: 1

Model 19.3.1: Specifications

- Greenland turbot historical catches and OFL were updated based on updated catch time series from Catch Accounting System
- Kamchatka flounder OFL = max(catches 2011-present)
- Projection model for Dover sole using output from age-structured model using age 3 recruits
- 5-yr average catch of 103 t used in place of ABC for 2023-2025

Species	Quantity	As estimated or *specified last* year for: 2023	2024	As estimated or *recommended this* year for: 2024*	2025
Dover sole	*M* (natural mortality rate)	0.119(f), 0.113(m)	0.119(f), 0.113(m)	0.129(f), 0.128(m)	0.129(f), 0.128(m)
	Tier	3a	3a	3a	3a
	Projected total (3+) biomass (t)	81,328	79,578	86,182	84,080
	Projected Female spawning biomass (t)	25,717	25,215	24,938	24,375
	$B_{100\%}$	19,032	19,032	15,968	15,968
	$B_{40\%}$	7,613	7,613	6,387	6,387
	$B_{35\%}$	6,661	6,661	5,589	5,589
	F_{OFL}	0.11	0.11	0.15	0.15
	$maxF_{ABC}$	0.09	0.09	0.12	0.12
	F_{ABC}	0.09	0.09	0.12	0.12
	OFL (t)	6,605	6,489	8,263	8,133
	maxABC (t)	5,581	5,484	6,969	6,860
	ABC (t)	5,581	5,484	6,969	6,860
Greenland turbot	Tier	6	6	6	6
	OFL (t)	238	238	49*	49*
	maxABC (t)	179	179	37	37
	ABC (t)	179	179	37	37
Kamchatka flounder	Tier	6	6	6	6
	OFL (t)	69	69	69	69
	maxABC (t)	51.75	51.75	52	52
	ABC (t)	51.75	51.75	52	52
Deepsea sole	Tier	6	6	6	6
	OFL (t)	6	6	6	6
	maxABC (t)	4	4	4	4
	ABC (t)	4	4	4	4
Deepwater Flatfish Complex	OFL (t)	6,918	6,802	8,387	8,257
	maxABC (t)	5,816	5,719	7,062	6,953
	ABC (t)	5,816	5,719	7,062	6,953
	Status	As determined *last* year for: 2021	2022	As determined *this* year for: 2022	2023

Model 19.3.1: Area Apportionment

- Percentages for Dover sole updated using 2023 REMA estimates
- Percentages for Tier 6 species based average proportion of survey biomass by area over most recent 19 years
- Greenland turbot only found in Western GOA over past 19 years
- Average survey biomass of Kamchatka flounder has shifted into the Central GOA from Western in recent years

Species	Year	Western	Central	West Yakutat	Southeast	Total
		2.6%	37.5%	26.6%	33.2%	100.0%
Dover Sole	2024	183	2,617	1,856	2,313	6,969
	2025	180	2,576	1,827	2,277	6,860
		100.0%	0.0%	0.0%	0.0%	100.0%
Greenland Turbot	2024	37	0	0	0	37
	2025	37	0	0	0	37
		32.1%	67.9%			100.0%
Kamchatka Flounder	2024	17	35	0	0	52
	2025	17	35	0	0	52
		0.0%	74.9%	11.2%	13.9%	100.0%
Deepsea Sole	2024	0	3	0	1	4
	2025	0	3	0	1	4
Deepwater Flatfish	**2024**	**237**	**2,655**	**1,856**	**2,314**	**7,062**
	2025	**234**	**2,614**	**1,827**	**2,278**	**6,953**