Status of Yelloweye Rockfish off the U.S. West Coast in 2025

Morgan A. Johnston*[1], R. Claire Rosemond*[2], Elizabeth Perl[3], Alison Whitman[4], Matheus de Barros[5], Juliette Champagnat[5], Abby Schamp[5], Samantha Schiano[6] and Fabio Prior Caltabellotta[7]

1. Oregon State University, 1500 SW Jefferson Way, Corvallis, OR, 97331
2. NOAA Fisheries Northwest Fisheries Science Center, 2032 SE OSU Drive Building 955, Newport, OR, 98112-2097
3. ECS Federal in support of NMFS OST, East-West Hwy, Silver Spring, MD, 22031
4. Oregon Department of Fish and Wildlife, 2040 SE Marine Science Drive, Newport, OR, 97365
5. University of Washington, 1410 NE Campus Pkwy, Seattle, WA, 98195
6. ECS Federal in support of NMFS OST, 2750 Prosperity Ave #600, Fairfax, VA, 22031
7. Washington Department of Fish and Wildlife, 1111 Washington St SE, Olympia, WA, 98504-3150

U.S. Department of Commerce
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Northwest Fisheries Science Center

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*These authors contributed equally to this work.

Disclaimer

Executive Summary

Stock

Yelloweye Rockfish (*Sebastes ruberrimus*) are found from the Gulf of Alaska to northern Baja California in Mexico across the northeastern Pacific Ocean. Their core distribution is from southeast Alaska to central California on the west coast of the United States. Yelloweye Rockfish are strongly associated with rocky bottom habtiat and adults are considered to be solitary and sedentary after settlement. Given the general perception of the sedentary nature of Yelloweye Rockfish adults and the moderate amount of mixing that occurs during the pelagic larval stage, the previous Yelloweye Rockfish assessment modeled the West coast population as a two-area assessment (California and a combined Oregon-Washington area) with a common stock recruitment relationship. This update assessment maintains this basic structure.

Catches

Catches for Yelloweye Rockfish have averaged over 20 mt in recent years (Figure i, Table i **not sure if correct table?**). Yelloweye Rockfish was declared overfished in 2002 and remains under a rebuilding plan that substantially limits catch. However, as other rockfish stocks have rebuilt and Yelloweye Rockfish has progressed under it's rebuilding plan, catches have slowly increased in recent years, primarily in the Oregon-Washington non-trawl fleet and the recreational fleets.

Table i: Recent catches (mt) by fleet and total catch (mt) summ

Year	1_CA_TWL (mt)	2_CA_NONTWL (mt)	3_CA_REC (mt)	4_ORWA_TWL (mt)	5_ORWA_NONTWL
2015	0.00	0.40	2.00	0.00	0.00
2016	0.00	0.00	1.00	0.00	0.00
2017	0.01	1.23	4.52	0.00	0.00
2018	0.00	0.00	4.99	0.00	0.00
2019	0.04	0.00	6.16	0.00	0.00
2020	0.13	0.00	1.95	0.00	0.00
2021	0.12	2.43	3.96	0.00	0.00
2022	0.10	5.60	3.80	0.00	0.00
2023	0.09	1.83	9.59	0.00	0.00
2024	0.19	0.00	4.65	0.00	0.00
2015	0.00	0.00	0.00	0.03	3.15
2016	0.00	0.00	0.00	0.07	2.59
2017	0.00	0.00	0.00	0.24	6.97
2018	0.00	0.00	0.00	0.54	6.38
2019	0.00	0.00	0.00	0.59	7.43
2020	0.00	0.00	0.00	0.32	7.51
2021	0.00	0.00	0.00	0.39	7.97
2022	0.00	0.00	0.00	0.76	15.55
2023	0.00	0.00	0.00	0.40	20.64

2024	0.00	0.00	0.00	0.44	3.09

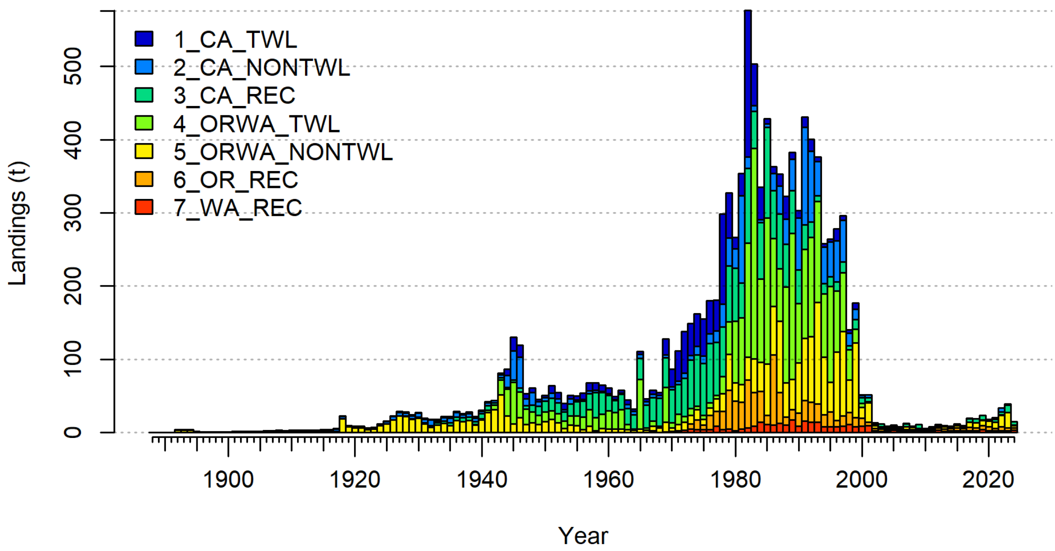

Figure i: Landings in metric tons (mt) by year for each fleet.

Data and Assessment

The last assessment for Yelloweye Rockfish occurred in 2017. This update assessment extends the data used in the 2017 assessment through 2024. Data includes catch, length and age data from seven fishery fleets and multiple indices of abundance in California and Oregon/Washington. Two new historical catch reconstructions from Oregon and Washington were incorporated. Four indices of abundance were updated for this assessment, including two recreational fishery indices in Oregon, the West Coast Groundfish Bottom Trawl Survey, and the IPHC longline survey. In addition, sample sizes and assignment of aging error were corrected in the compositional data. No new data were considered in this update assessment.

Stock biomass and dynamics

The model estimates that the stock was below the minimum stock size threshold in the late 1990s and was lowest in the early 2000s before increasing over the last 20 years (Figure ii). The 2024 relative estimated spawning output is just below the management target threshold.

Table ii: Estimated recent trend in spawning output and the fraction of unfished spawning output and the 95 percent confidence intervals.

Year	Spawning output	Lower Interval (mt)	Upper Interval (mt)	Fraction Unfished	Lower Interval	Upper Interval
2015	263.55	206.64	320.46	0.233	0.198	0.269
2016	273.78	215.04	332.53	0.242	0.206	0.279
2017	285.38	224.61	346.15	0.253	0.215	0.290
2018	297.29	234.27	360.31	0.263	0.224	0.302
2019	310.98	245.40	376.55	0.275	0.235	0.315
2020	326.09	257.63	394.56	0.289	0.247	0.330
2021	343.67	271.94	415.40	0.304	0.261	0.347
2022	362.88	287.55	438.22	0.321	0.276	0.366
2023	382.50	303.26	461.73	0.339	0.292	0.385
2024	402.94	319.54	486.34	0.357	0.308	0.406
2025	426.87	339.09	514.65	0.378	0.327	0.429

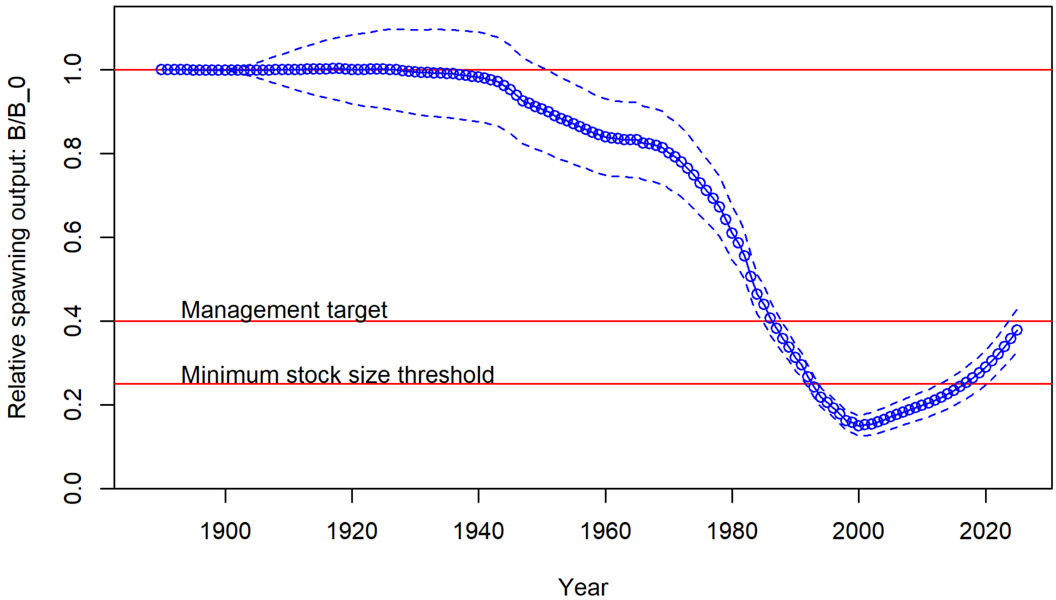

Figure ii: Estimated time series of relative spawning output for the base model.

Recruitment

Table iii: Estimated recent trend in recruitment (1,000s) and recruitment deviations and the 95 percent confidence intervals.

Year	Recruit-ment (1,000s)	Lower Interval (1,000s)	Upper Interval (1,000s)	Recruit-ment Deviations	Lower Interval	Upper Interval
2015	326	183	581	0.711	0.143	1.278
2016	228	120	433	0.328	-0.318	0.974
2017	117	55	249	-0.358	-1.132	0.416
2018	114	53	245	-0.412	-1.205	0.380
2019	119	54	261	-0.390	-1.207	0.427
2020	119	52	271	-0.413	-1.273	0.446
2021	157	66	373	-0.164	-1.076	0.748
2022	179	73	441	-0.058	-1.011	0.895
2023	184	74	457	-0.043	-1.004	0.918
2024	195	77	496	0.000	-0.980	0.980
2025	197	78	502	0.000	-0.980	0.980

Exploitation status

Table iv: Estimated recent trend in relative fishing intensity (1-SPR)/(1-SPR50%), where SPR is the spawning potential ratio, and the exploitation rate, along with the 95 percent confidence intervals for both quantities.

Year	(1-SPR)/(1-SPR50%)	Lower Interval (SPR)	Upper Interval (SPR)	Exploitation Rate	Lower Interval (Rate)	Upper Interval (Rate)
2015	0.268	0.220	0.317	0.004	0.003	0.005
2016	0.192	0.156	0.227	0.003	0.002	0.004
2017	0.390	0.323	0.457	0.006	0.005	0.008
2018	0.349	0.288	0.410	0.006	0.004	0.007
2019	0.407	0.339	0.476	0.007	0.005	0.008
2020	0.297	0.246	0.347	0.005	0.004	0.006
2021	0.338	0.279	0.397	0.005	0.004	0.006
2022	0.483	0.405	0.560	0.008	0.007	0.010
2023	0.527	0.444	0.610	0.009	0.007	0.011
2024	0.221	0.181	0.262	0.003	0.003	0.004

Ecosystem considerations

Reference points

Table v: Summary of reference points and management quantities, including estimates of the 95 percent confidence intervals. SO is spawning output, SPR is the spawning potential ratio, and MSY is maximum sustainable yield.

Reference Point	Estimate	Lower Interval	Upper Interval
Unfished Spawning output	1,129.7	992.2	1,267.2
Unfished Age 8+ Biomass (mt)	9,803	8,612	10,995
Unfished Recruitment (R0)	229	201	257
2025 Spawning output	427	339	515
2025 Fraction Unfished	0.378	0.327	0.429
Reference Points Based SO40%	—	—	—
Proxy Spawning output SO40%	452	397	507
SPR Resulting in SO40%	0.459	0.459	0.459
Exploitation Rate Resulting in SO40%	0.026	0.026	0.027
Yield with SPR Based On SO40% (mt)	115	101	130
Reference Points Based on SPR Proxy for MSY	—	—	—
Proxy Spawning output (SPR50)	503	442	565
SPR50	0.500	—	—
Exploitation Rate Corresponding to SPR50	0.023	0.023	0.023
Yield with SPR50 at SO SPR (mt)	111	97	124
Reference Points Based on Estimated MSY Values	—	—	—
Spawning output at MSY (SO MSY)	327	287	367
SPR MSY	0.359	0.358	0.361
Exploitation Rate Corresponding to SPR MSY	0.036	0.036	0.037

MSY (mt)	121	106	136

Management performance

Table vi: Recent trend in the overfishing limits (OFL), the acceptable biological catches (ABCs), the annual catch limits (ACLs), and the total dead catch (landings + discards) all in metric tons (mt).

Year	OFL (mt)	ABC (mt)	ACL (mt)	Total dead catch (mt)
2015	52	43	18	12
2016	52	43	19	9
2017	57	47	20	20
2018	58	48	20	19
2019	82	74	48	24
2020	84	77	49	18
2021	97	83	50	21
2022	NA	NA	NA	34
2023	90	75	52	39
2024	91	76	53	15

Harvest projections

Table vii: Potential OFLs (mt), ABCs (mt), ACLs (mt), the buffer between the OFL and ABC, estimated spawning output, and fraction of unfished spawning output with adopted OFLs and ACLs and assumed catch for the first two years of the projection period.

Year	Adopted OFL (mt)	Adopted ACL (mt)	Assumed Catch (mt)	OFL (mt)	Buffer	ABC (mt)	ACL (mt)	Spawning output
2025	106	56	49	—	—	—	—	426.872
2026	108	57	50	—	—	—	—	448.229
2027	—	—	—	115	0.873	101	101	469.510
2028	—	—	—	117	0.864	101	101	484.882
2029	—	—	—	118	0.856	101	101	498.647
2030	—	—	—	119	0.848	101	101	510.374
2031	—	—	—	120	0.840	100	100	519.893
2032	—	—	—	120	0.832	100	100	527.282
2033	—	—	—	120	0.824	99	99	532.813
2034	—	—	—	120	0.817	98	98	536.854
2035	—	—	—	120	0.809	97	97	539.777
2036	—	—	—	121	0.801	97	97	541.941

Decision table

Table viii: !expr if(eval_tables) decision_table_cap

Mgmt	Year	Catch	Low Spawn	Low Frac	Base Spawn	Base Frac	High Spawn	High Frac
A	2023	12	132.23	0.303	132.23	0.303	132.23	0.303
	2024	5	141.21	0.204	141.21	0.204	141.21	0.204
	2025	19	151.20	0.346	151.20	0.346	151.20	0.346
	2026	19	160.10	0.231	160.10	0.231	160.10	0.231
	2027	28	168.95	0.387	168.95	0.387	168.95	0.387
	2028	28	176.67	0.255	176.67	0.255	176.67	0.255
	2029	28	183.75	0.420	183.75	0.420	183.75	0.420
	2030	28	190.02	0.274	190.02	0.274	190.02	0.274
	2031	28	195.41	0.447	195.41	0.447	195.41	0.447
	2032	28	199.94	0.289	199.94	0.289	199.94	0.289
	2033	28	203.70	0.466	203.70	0.466	203.70	0.466
	2034	28	206.82	0.299	206.82	0.299	206.82	0.299
	2023	28	250.27	0.573	250.27	0.573	250.27	0.573
	2024	10	261.73	0.378	261.73	0.378	261.73	0.378
	2025	30	275.68	0.631	275.68	0.631	275.68	0.631
	2026	31	288.13	0.416	288.13	0.416	288.13	0.416
	2027	73	300.56	0.688	300.56	0.688	300.56	0.688
	2028	73	308.21	0.445	308.21	0.445	308.21	0.445
	2029	73	314.90	0.720	314.90	0.720	314.90	0.720
	2030	73	320.35	0.463	320.35	0.463	320.35	0.463
	2031	72	324.48	0.742	324.48	0.742	324.48	0.742
	2032	72	327.34	0.473	327.34	0.473	327.34	0.473
	2033	71	329.11	0.753	329.11	0.753	329.11	0.753
	2034	70	330.03	0.477	330.03	0.477	330.03	0.477
B	2023	12	132.23	0.303	132.23	0.303	132.23	0.303
	2024	5	141.21	0.204	141.21	0.204	141.21	0.204
	2025	19	151.20	0.346	151.20	0.346	151.20	0.346
	2026	19	160.10	0.231	160.10	0.231	160.10	0.231
	2027	28	168.95	0.387	168.95	0.387	168.95	0.387
	2028	28	176.67	0.255	176.67	0.255	176.67	0.255
	2029	28	183.75	0.420	183.75	0.420	183.75	0.420
	2030	28	190.02	0.274	190.02	0.274	190.02	0.274
	2031	28	195.41	0.447	195.41	0.447	195.41	0.447
	2032	28	199.94	0.289	199.94	0.289	199.94	0.289
	2033	28	203.70	0.466	203.70	0.466	203.70	0.466
	2034	28	206.82	0.299	206.82	0.299	206.82	0.299
	2023	28	250.27	0.573	250.27	0.573	250.27	0.573
	2024	10	261.73	0.378	261.73	0.378	261.73	0.378
	2025	30	275.68	0.631	275.68	0.631	275.68	0.631
	2026	31	288.13	0.416	288.13	0.416	288.13	0.416
	2027	73	300.56	0.688	300.56	0.688	300.56	0.688
	2028	73	308.21	0.445	308.21	0.445	308.21	0.445
	2029	73	314.90	0.720	314.90	0.720	314.90	0.720
	2030	73	320.35	0.463	320.35	0.463	320.35	0.463
	2031	72	324.48	0.742	324.48	0.742	324.48	0.742
	2032	72	327.34	0.473	327.34	0.473	327.34	0.473
	2033	71	329.11	0.753	329.11	0.753	329.11	0.753
	2034	70	330.03	0.477	330.03	0.477	330.03	0.477
C	2023	12	132.23	0.303	132.23	0.303	132.23	0.303
	2024	5	141.21	0.204	141.21	0.204	141.21	0.204
	2025	19	151.20	0.346	151.20	0.346	151.20	0.346
	2026	19	160.10	0.231	160.10	0.231	160.10	0.231
	2027	28	168.95	0.387	168.95	0.387	168.95	0.387
	2028	28	176.67	0.255	176.67	0.255	176.67	0.255
	2029	28	183.75	0.420	183.75	0.420	183.75	0.420
	2030	28	190.02	0.274	190.02	0.274	190.02	0.274
	2031	28	195.41	0.447	195.41	0.447	195.41	0.447

ADW - decision tables not needed until after review

Scientific uncertainty

Research and data needs

Rebuilding projections

1 Introduction

Yelloweye Rockfish (*Sebastes ruberrimus*) are found from the Gulf of Alaska to northern Baja California in Mexico across the northeastern Pacific Ocean (Hart 1973; Love, Yoklavich, and Thorsteinson 2002). Their core distribution is from southeast Alaska to central California on the west coast of the United States (Love, Yoklavich, and Thorsteinson 2002). Yelloweye Rockfish in Puget Sound are considered isolated from the coastal waters population (W. Stewart I.J 2009) and have been listed as threatened under the Endangered Species Act since 2010 (Drake et al. 2010).

Yelloweye Rockfish are strongly associated with rocky bottom habtiat, particularly areas of high relief (Love, Yoklavich, and Thorsteinson 2002), and adults are considered to be solitary and sedentary after settlement (Coombs 1979; DeMott 1983). However, new tagging studies suggest that adult Yelloweye Rockfish exhibit larger scale movement patterns more commonly than preivously considered (Hannah and Rankin 2011; Rasmuson et al. 2025).

There has been little advancement on information pertaining to the stock structure of Yelloweye Rockfish since the previous benchmark assessment. As noted in Gertseva and Cope (2017), there is evidence of genetic diferences between Canadian waters (Strait of Georgia) and West coast coastal populations of Yelloweye Rockfish, but no evidence of differentiation across coastal populations (Siegle and Yamanaka 2013). Gao and Wallace (2010) found that there was complete mixing of offspring from Oregon and Washington waters using otolith isotope analyses, indicating a single spawning stock in this portion of the Yelloweye Rockfish stock. Given the general perception of the sedentary nature of Yelloweye Rockfish adults and the moderate amount of mixing that occurs during the pelagic larval stage, the previous Yelloweye Rockfish assessment modeled the West coast population as a two-area assessment (California and a combined Oregon-Washington area) with a common stock recruitment relationship (Gertseva and Cope 2017). This update assessment maintains this basic structure.

Map of scope of assessment - not needed for update

1.1 Life History

This section is not required for an update assessment; please refer to the most recent full assessment (Gertseva and Cope 2017) for additional information.

1.2 Ecosystem considerations

This section is not required for an update assessment; please refer to the most recent full assessment (Gertseva and Cope 2017) for additional information.

1.3 Fishery description

This section is not required for an update assessment; please refer to the most recent full assessment (Gertseva and Cope 2017) for additional information.

1.4 Management History

This section is not required for an update assessment; please refer to the most recent full assessment (Gertseva and Cope 2017) for additional information.

1.5 Management performance

Yelloweye Rockfish removals have been substantially reduced since its designation as overfished in 2002 through a variety of management measures that eliminated retention in recreational fisheries, limited commercial retention, created broad spatial closures, and implemented new gear restrictions that reduced trawling in rocky habitats. Many of these restrictions remain in effect, though as Yelloweye Rockfish and other groundfish stocks have begun to rebuild, some manaegment measures have been modified or removed in recent years. These include some additional allocations to recreational fisheries that remain constrained by Yelloweye Rockfish estimated discard mortality, the recent removal of the Yelloweye Rockfish Conservation Areas (RCA) for the trawl sector off of California and Oregon, and eliminating some gear restrictions in the RCAs for the non-trawl sector.

Recent trends in total catch relative to management guidelines is available in Table 1 and shows that total catch of Yelloweye Rockfish has remained below both the OFLs and ACLs in each year since the previous assessment. Catch in Table 1 combines the two areas in this model as catch limits for Yelloweye Rockfish are managed as a single coastwide unit and includes both landings and estimated discard mortality. As in the previous assessment, total catches for each fleet in this update include both landings and estimated dead discard mortality.

1.6 Fisheries off Canada and Alaska

This section is not required for an update assessment; please refer to the most recent full assessment (Gertseva and Cope 2017) for additional information.

2 Data

A summary of available data by type and fleet used in the Yelloweye Rockfish assessment is available in Figure 1. Data that have changed from the previous 2017 assessment are summarized below. No new data sources were considered in this update assessment.

Removals:

- Post-2016 landings and discards were added for all three states for the commercial and recreational fleets.
- A new Oregon historical recreational catch reconstruction was incorporated, which covered 1979 - 2000.
- A new Washington historical recreational catch reconstruction was provided by WDFW and included changes to data from 1990-2016.

Composition Data:

- Length and age composition data were added from 2017 - 2024 for all states for the commercial and recreational fleets.
- Length and age composition data were also extended for the West Coast Groundfish Bottom Trawl Survey (WCGBTS) and the IPHC Longline survey.
- Some length and age composition data from the 2017 assessment had minor errors in how sample numbers were calculated, ageing error assignment, and doubled age samples and thus needed to be fixed. See Section 2.1.2 below.

Indices of Abundance:

- Indices that were updated with more recent data and/or updated methodology include:
  - Oregon Onboard Observer (2001 - 2024)
  - Oregon ORBS Dockside (release only) (2004-2024)
  - WCGBTS (2003 - 2024)
  - IPHC Longline Survey (2002 - 2024)

Biological Data:

- Length-weight relationship parameters were updated to include all the recent (2017 - 2024) fishery-independent data.
- Ageing error matrices were unchanged but some Oregon recreation ages were assigned the wrong ageing error and were corrected based on ODFW recommendations.

2.1 Fishery-Dependent Data

Updated fishery-dependent data, including removals, length and age compositions, and indices of abundance, are detailed below.

2.1.1 Landings

A summary of total removals are provided in Table 2 and Figure 2.

Recent commercial landings (2017-2024) were obtained from PacFIN for California, Oregon and Washington. For the period from 2016 through 2023, updated West Coast Groundfish Observer Program (WCGOP) discard estimates were added to PacFIN landings by adding the annual dead discard mortality rate for the commercial sector in the Groundfish Expanded Mortality Multi-year (GEMM) recorded discards to obtain the total catch of Yelloweye Rockfish within commercial fleets.

Bycatch for the At-Sea Pacific Hake fleet (A-SHOP) was updated from 2017 through 2024.

Recreational removals from RecFIN were updated for California, Oregon and Washington from 2017 - 2024. RecFIN removals include an estimate of discard mortality and represent total estimated removals. The Oregon Department of Fish and Wildlife (ODFW) provided updated historical recreational removals for Oregon from 1979 through 2000(Whitman (2024)). The Washington Department of Fish and Wildlife (WDFW) provided updated historical recreational removals (1967-1989) and WDFW Ocean Sampling Program (OSP) estimates (1990-2001). The historical recreational removals for 1971, 1974, and 1979 were not available and were filled in as the average of the two preceding and two following years. Historical data were filtered to marine catch areas 1-4. For OSP catch estimates, data included marine catch areas 1-4, up to the Bonilla-Tatoosh line. WDFW also provided updated catch estimates for 2002-2004, which did not include discard mortality. To adjust for this, we multiplied the average mortality rate from the following five years (2005-2009) by the total discards to calculate total mortality for those years.

2.1.2 Fishery-Dependent Length and Age Compositions

Updated length composition data for commercial catches (trawl and non-trawl) were available from PacFIN (extracted April 4, 2025) and from WCGOP for all three states. These include the years 2017 - 2024 for PacFIN data and 2017 - 2023 for WCGOP data. Updated recreational length composition data were available from RecFIN (extracted

April 4, 2025) for all three states, and include years 2017 - 2024. Additionally, updated length compositions from the California On-Board CPFV Observer Sampling Program and from the Ocean Recreational Fishery Survey (ORFS, previously the Oregon onboard recreational observer program), both of which measure fish discarded at sea, were also available up through 2024 on RecFIN.

New commercial age composition data from PacFIN and WDGCOP for 2017-2024 was included for Oregon and Washington. No new commercial age data were available from California. New recreational age composition data was available from RecFIN from 2017 - 2024 for Washington only (extracted May 13, 2025). These data were collected in the WDFW Ocean Sampling Program (OSP). There were also some historical updates to Oregon and Washington recreational age data provided by the state representatives.

In addition to extending the length data time series, we also fixed minor data errors found in the 2017 assessment. For length composition data, years with small samples sizes (N = 1) were excluded. There were no changes in how commercial length sample numbers were calculated. However, all recent recreational fleet length data were missing the total number of trips information used to calculate the number of samples. Using data from the 2017 assessment, we built fleet-specific linear regressions to approximate the relationship of samples to the number of fish. Then, we applied that regression to the total number of fish for data between 2017 and 2024 to estimate the number of samples. A future benchmark assessment should investigate how to get the number of sampled trips from RecFIN to calculate the number of samples using the I. J. Stewart and Hamel (2014) method.

We also found that conditional-age-at-length (CAAL) data from the 2017 assessment had all sample sizes and relative proportions doubled, potentially from when Yelloweye Rockfish was changed from a two-sex to single-sex model. For most fleets this was not a problem because the proportions of age-at-length counts were the same, however, some of the commercial fleets included discard age proportions that were not doubled, leading to small differences in proportions. To fix the CAAL data so it accurately represented the number of fish in each age class, we either rebuilt the entire fleet's CAAL data frame using the most recently pulled information from PacFIN and RecFIN, or divided the number of samples or relative proportions in each length bin by two. How these problems were treated for each fleet specifically is detailed below, including other minor data changes. Otherwise, length and age composition data are unchanged from the previous assessment; please refer to the most recent benchmark assessment (Gertseva and Cope 2017) for additional information.

2.1.2.1 Fleet Specific Changes in the Compositional Data

Fleet 2. California Non-Trawl:

- For ages, all the CAAL and marginal ages (used to explore fits only, not included in the likelihood) data were recalculated using the most recent age data pulled from PacFIN and WCGOP, to account for age doubling in 2017.

Fleet 3. California Recreational:

- CAAL data for 1979-1984 were doubled, so the number of samples and age-at-length proportions were divided by two.
- CAAL data for 2009-2016 were doubled, but the raw data we received from RecFIN were correct, without doubled ages, so this time series was replaced with newly pulled data.
- We then re-built the marginal age data from the updated CAAL for both time periods because there were errors in previous data entry and sample number calculations.

Fleet 4. Oregon/Washington Trawl & Fleet 5. Oregon/Washington Non-Trawl:

- Both the OR/WA commercial fleets had all CAAL and marginal age (not included in the likelihood) data recalculated using the most recent age data pulled from PacFIN and WCGOP, to account for age doubling in 2017.

Fleet 6. Oregon Recreational:

- CAAL data sample sizes and proportions were doubled so numbers from 1979 - 2017 were divided by two.
- We included 2015 unsexed ages.
- We also reassigned the aging error for this fleet for the correct years. The ODFW data representative confirmed that all fish from 1979-2002 were aged by WDFW (ageing error 1), and fish from 2009-2016 were aged by the NWFSC (ageing error 2). No new ages since 2016 were provided. Marginal data were then recalculated from the updated CAAL so that the ageing error labels and number of samples matched.

Fleet 7. Washington Recreational:

- All age data from 1998 to 2024 were replaced with the most recent data provided in RecFIN, following the recommendation of the WDFW representative. CAAL and the marginal age data were calculated using this data.

2.1.3 Indices of Abundance

Two fishery-dependent indices of abundance were updated with new data and up-to-date methodology. These are detailed below. Otherwise, indices of abundances are unchanged from the previous assessment; please refer to the most recent benchmark assessment (Gertseva and Cope 2017) for additional information.

2.1.3.1 Oregon Onboard Observer CPUE, 2001 – 2024 -

The Oregon Onboard Observer (now Ocean Recreational Fisheries Survey, or ORFS) index was updated from the previous Yelloweye Rockfish assessment, and updated drift-level catch-per-unit-effort data was obtained from ODFW through the end of 2024. The database contains information on catch by species (number of retained and released fish), effort (angler hours), sample depth, and bag limits and other relevant regulations (Monk et al. 2013).

The unfiltered data set contained 18,410 drifts. Multiple standardized filters are applied to remove outliers and data unsuitable for an index. These filters are very similar to filters applied in 2017 and include drifts without data needed for CPUE information, long drifts (above 95th percentile), drifts in deeper waters (more than 64fm, 99th percentile), drifts that were targeting primarily mid-water species, and drifts outside of the legal fishing depth (with a five fm buffer). Additionally, years with extremely low sample sizes ($<$50) were excluded. Finally, drifts on charters from Port Orford were removed due to small sample sizes. The final filtered data set included 6,839 trips with a 6.1% encounter rate for Yelloweye Rockfish Table 3.

Covariates evaluated included year, month, port, the open depths to fishing (all depths or inside 20/30/40fm), and a five fm-binned depth of drift covariate. This is in contrast to the 2017 index, which was only able to evaluate a year covariate. The covariates listed above are standard to evaluate for this index in other assessments. Negative binomial models were fit using sdmTMB (version 0.6.0; Anderson et al. (2024)) to the drift-level data (catch with a log offset for adjusted angler hours). A model without the open fishing depths or month was selected as the best fit model by AIC Table 4. Acceptable diagnostics for the model were achieved, as evidenced by passing the sanity function in sdmTMB (Figure 3). The index of abundance is shown in Figure 4. A comparison to the ORFS index used in the previous assessment indicates that despite the change in modeling approach and the covariates included, most years overlap between the two indices and similar trends are observed Figure 5. The updated index has reduced within-year variance and a lack of extreme swings in the standardized index value (e.g. 2013) relative to the index from 2017.

2.1.3.2 Oregon ORBS Dockside (release only) CPUE, 2004-2024

The Ocean Recreational Boat Survey (ORBS) dockside index for Oregon was updated for this assessment. CPUE, expressed in terms of fish per angler-hour, was calculated by multiplying the number of anglers and the total trip time, minus the boat type-specific travel time. The database contains information on released fish by species (number of angler-reported released fish), effort (angler hours), sample location (port where data were collected), date, bag limits and other relevant regulations, boat type (charter or private), and trip type (e.g., bottom associated fish).

The unfiltered data set contained 504,128 trips from 2001 - 2024. Since the previous Yelloweye assessment, multiple data filters have been standardized, which are very similar to the 2017 assessment, and are applied to ORBS trip-level data to remove outliers and data unsuitable for an index. For this index, the time period was restricted to years when retention of Yelloweye Rockfish was prohibited, which began on January 1, 2004. There were two differences in the filtering in this updated index. First, the previous index began in 2005, which was determined to be an error in the timing of the implementation of prohibited status for Yelloweye. Given that prohibition was in effect on January 1, the year 2004 is included in this updated index. The second difference in filtering is the elimination of the Stephens-MacCall filter in the updated index. This filter has not been used for several assessment cycles, based on a recommendation from NWFSC staff (pers. comm. A. Whitman, ODFW). The final dataset included 133,039 trips from 2004 – 2024 with an overall encounter rate of 7.4% Table 5.

Covariates evaluated included year, month, port, the open depths to fishing (all depths or inside 20/30/40 fm), and boat type. These are the same covariates evaluated in the 2017 ORBS index, apart from the open depths of the fishery. The final model in 2017 included boat type, port and year. Negative binomial models were fit in sdmTMB (Version 0.6.0) to the trip-level data (catch with a log offset for adjusted angler hours). The final model selected includes year, month, port, boat type and open fishery depths, which was the best fit model by AIC in this series Table 6. Acceptable diagnostics for the model were achieved, as evidenced by passing the sanity function in sdmTMB.(Figure 6). The index of abundance in shown in Figure 7. ODFW no longer maintains the deltaGLM code that was used to develop the 2017 index and so the index was updated to use the currently accepted modeling approach for PFMC groundfish assessments (sdmTMB, version 0.6.0; Anderson et al. (2024)). To bridge this change, the 2017 model index structure was applied to the current dataset using sdmTMB and compared to the deltaGLM index used in the 2017 assessment and the current recommended updated index in Figure 8. There are some differences observed in 2005 – 2009 between the deltaGLM index and the two sdmTMB indices; however, this appears to be largely driven by the updated modeling approach.

2.2 Fishery-Independent Data

Two sources of fishery-independent data were updated: the West Coast Groundfish Bottom Trawl Survey and the IPHC Longline survey.

2.2.1 West Coast Bottom Trawl Survey (WCGBTS)

The WCGBTS survey methods are most recently described in detail in Keller, Wallace, and Methot (2017). Geostatistical models of biomass density were fit to survey data from the WCGBTS using Template Model Builder (TMB) (Kristensen et al. 2016) via the Species Distribution Models with Template Model Builder (`sdmTMB`) R package (Anderson et al. 2024) as configured within the indexwc R package (Johnson et al. 2025). These models can account for latent spatial factors with a constant spatial Gaussian random field and spatiotemporal deviations to evolve as a random walk Guassian random field (Thorson et al. 2015). Delta-gamma and delta-lognormal distributions were investigated. Results are only shown for the model that led to the best model diagnostics, defined as similar distributions of theoretical normal quantiles and model quantiles (Figure 9), high precision, lack of extreme predictions, and low Akaike information criterion (AIC). Estimates of biomass from this best model were predicted using a grid based on available survey locations.

The final model used a delta model with a lognormal distribution for the catch-rate component. A logit-link was used for encounter probability and a log-link for positive catch rates. The response variable was catch (mt) with an offset of area swept (km^2) to account for differences in effort. Fixed effects were estimated for each year and pass. The index was estimated for the area north of $42°10'$ (Oregon and Washington) to be consistent with the previous assessment. The data were truncated to depths shallower than 325 m prior to modeling given that there were zero positive encounters in depths deeper than 325 m. The prediction grid was also truncated to only include available survey locations in depths between 55–325 m to limit extrapolating beyond the data and edge effects. Spatial variation was included in the encounter probability and the positive catch rate model. Spatial variation was approximated using 200 knots, where more knots led to non-estimable standard errors because the positive encounters are too sparse to support the dense spatiotemporal structure. Anisotropy was not estimated.

The biomass estimates produced for this assessment using sdmTMB are comparable to the biomass estimates produced in the previous benchmark assessment (Figure 10). The index is relatively flat with a peak in 2014, but variation is high throughout the time series (Figure 11).

2.2.2 IPHC Setline Survey

The IPHC has conducted an annual longline survey for Pacific halibut off the coast of Oregon and Washington (IPHC area "2A") since 1997 (no surveys were performed in 1998 or 2000). Beginning in 1999, this has been a fixed station design, with roughly 1,800 hooks deployed at each of 84 locations. Before 1999, station locations were not fixed, and, therefore, those years are not used in the index. Rockfish bycatch, mainly yelloweye, was recorded during this survey, although values for 1999 and 2001 are estimates based on subsampling the first 20 hooks of each 100-hook skate. The gear used to conduct this survey, while designed specifically to efficiently sample Pacific halibut, is similar to that used in some earlier line fisheries that targeted adult Yelloweye Rockfish. Some variability in exact sampling location is unavoidable, and leeway is given in the IPHC methods to center the set on the target coordinates but to allow wind and currents to dictate the actual direction in which the gear is deployed. This can result in different habitats accessed at each fixed location among years. The number of skates used can also differ from year to year; skates hauled (i.e., 100 hooks/skate) are thus used as the unit of effort for all years. This has been the standard effort used in past Yelloweye Rockfish stock assessments.

New to this assessment is the consideration of eight additional survey stations (1527 to 1534) conducted in a collaborative effort between IPHC and WDFW from 2007-2009, 2013-2019 and 2021-2023. These stations are arranged around IPHC station 1082 (one of the more notable stations to encounter Yelloweye Rockfish). Only the summer months are considered here to match the time of year sampled by the IPHC survey. Survey sets at the WDFW stations used three skates with 100 hooks each for most years, except for 2021 - 2023, where a total of four skates were used. Like the IPHC survey, effort was standardized to 100 hooks/skate. These stations were integrated into the IPHC stations when calculating the index of abundance. The full survey used in this assessment combined all stations in Oregon and Washington into a single index. Data were first filtered to remove all depths with few or no encounters, and then we excluded stations that rarely encountered Yelloweye Rockfish (averaging less than one encounter a year). This left a total of 11 stations for analysis. Both filtering levels increased the percentage of encounters from an initial 11% to 80%.

A log-normal generalized linear model with a log link in the sdmTMB R package (Anderson et al. 2024) was used to standardize the CPUE. Model selection using the Akaike Information Criteria for small samples (AICc) was conducted to select which variables were included in the model. The final model included year, station, and depth as explanatory variables. Diagnostic tools to ensure the model fit was satisfactory included checking whether the hessian matrix is positive definite, the presence of extreme eigenvalues, and if the non-linear minimizer suggests convergence. These diagnostics were conducted with the sanity function in the sdmTMB package. The updated index is compared to the index used in 2017 in Figure 13.

2.2.3 Fishery-Independent Length and Age Compositions

Updated length and age composition data were available for the two updated fishery-independent surveys. Compositional data from 2017 through 2024 were updated for WCGBTS were obtained using functions from the indexwc R package (Johnson et al. 2025). The IPHC survey compositional data were provided by WDFW.

A summary of sampling efforts (number of hauls and number of individual fish) in all surveys is provided in **Table X** and **Table X**. Updated year-specific length frequency distributions generated for each survey are shown in Figure 14 and Figure 15, respectively. Updated year-specific CAAL frequencies for each survey are shown in Figure 16 and Figure 17 for the WCGBTS and Figure 18 and Figure 19.

2.3 Biological Parameters and Data

The approach to natural mortality, maturity and fecundity were unchanged from the previous assessment (Gertseva and Cope 2017). All of these biological parameters used in the assessment were estimated outside the model or obtained from literature. Therefore, uncertainty reported for the stock assessment results does not include any uncertainty in these quantities (however, some were investigated via sensitivity analyses described later in this report). The parameters for the length-weight relationship were updated to include the most recent data from 2017 - 2024. The parameters derived from this analysis were as follows: $= 7.183309 \cdot 10\text{-}6$, and $= 3.244801$ (Figure 20). Aging error matrices were unchanged.

3 Assessment model

3.1 History of modeling approaches

This section is not required for an update assessment; please refer to the most recent full assessment (Gertseva and Cope 2017) for additional information.

3.2 Responses to SSC Groundfish Subcommittee requests

To be completed after SSC GFSC review.

3.3 Model Structure and Assumptions

3.3.1 Model Changes from the Last Assessment

A list of changes that were made to the model compared to the previous assessment (Gertseva and Cope 2017) are listed below.

ADW - what do we need to update after new WA catches incorporated into base? Plus it seems like this section should go after the platform/structure section, and we need to double check we're limiting repetition with the model results section.

- Data
  - Detailed information on specific updates and changes to the data incldued in the model are included in Section 2 but are summarized below.
  - The landings time series was corrected and updated through the end of 2024 for California, Oregon and Washington.
  - Length and age compositions from all fishery removal and index fleets were updated through 2024.
  - Some indices of abundance were updated with recent data, where available, and re-analyzed using more up-to-date methods. Two fishery-dependent indices from Oregon were updated, along with the fishery-independent indices, the WCBTS and the IPHC setline survey.
- Biology

  - No changes were made to the biological parameterization of the model; however, the length-weight relationship was updated to include the most recent data. -No changes were made to the aging error matrices estimated for the previous assessment; however, the designated matrix for several years of Oregon recreational ages were corrected.

- Recruitment

  - The bias adjustment ramp was updated to end with the last year of removals (2024) and begin to ramp to zero two years prior (2022)

- Software and Workflow

  - Update SS3 3.30.23.2 - As seen in Figures Figure 21 and Figure 22, updating to the most recent version of the SS3 executable had no discernible impact on model results.
  - Use most up-to-date R packages to process input and output files for the assessment, including **nwfscDiag, r4ss, and pacfintools**.
  - Created a public github repository for Yelloweye Rockfish ("sebastes_ruberrimus_2025") to provide a transparent and reproducible system for processing the data and creating the model and assessment document

The iterative impact of the updated catch, composition and indices of abundance on the model are shown in Figure 23 and Figure 24. Overall, there was little impact on the model results when updating and extending the catch time series and when updating the indices of abundance. However, the addition of the new fishery length composition data decreased the spawning output (Figure 23). When the new age composition data were added, there was a slight increase in the scale of the population but was overall very similar to the model with the new length composition data (Figure 25 and Figure 26). There was very little impact on the model results when tuning the compositional data and updating the bias adjustment ramp (Figure 27 and Figure 28). The impact of the updated lenght-weight relationship is evalated as a sensitivity.

3.3.2 Modeling Platform and Structure

The assessment was updated to use the most recent version of Stock Synthesis 3 (Version 3.30.23.2 - available online). Bridging between SS versions is discussed in Section Section 3.3.1.

Briefly, the Yelloweye Rockfish model is a coastwide, single-sex two-area model. California is Area 1, and Oregon and Washington are combined into Area 2, due to differences in potential exploitation rates by area over time. Yelloweye Rockfish compositional data are primarily reported as both sexes combined, and therefore, the previous assessment used a single sex model to facilitate the use of all available data. Growth is assumed to be the same in both areas, though future benchmark assessments may want to re-evaluate this assumption if more spatially-explicit data become available. The modeling period starts in the first year of available catches from historical reconstructions (1889) and the stock is assumed to be at an unfished equilibrium prior to that time. No changes were made to the fleet structure of the model. Fishery removals were divided among seven area- and sector-specific fleets. Estimated discard mortality was added to landings and included in the model as fleet-specific total removals. Length compositions for discarded and retained fish were combined as well. Data weighting was done using the Francis method (Francis 2011) but the McAllister-Ianelli method was explored as a sensitivity. More detailed information on the model structure and justification is available in Gertseva and Cope (2017) and summarized in **?@tbl-table_config**. (ADW - DO WE NEED MORE DETAIL HERE?)

3.3.3 Model Parameters

** ADW - update the code here to be sure we're getting the proper base model. also do we need any more fig's from the base? **

The base model had r sum(mod_out$ parameters $Phase > 0) estimatedparameters (talliedbytypein@tbl-table_parcounts). Asingle-sexgrowthcurvewasestimated (@fig-growth). Naturalmortalitywasfixed, asin$
$recruitrelationshipwaskeptfixedat 0.718, matchingthe 2017 assessment. Estimatingsteepnesswasevaluate$
RdevYrLast) were forced to sum to zero and the bias adjustment ranmp was updated (Figure 30).

Length, age, and age-at-length composition data weights were tuned using the Francis method (Francis 2011, **?@tbl-table_compweight**). All selectivity was assumed to be length-based and used a double-normal functional form. Selectivities for all fleets was estimated to be asymptotic (Figure 31), though selectivity for the California Onboard Observer CPUE was mirrored to the California recreational fleet. Selectivity was constant through time. Dome-shaped selectivity and various time blocks for specific fleets were explored in Gertseva and Cope (2017) but not re-evaluted in this update assessment.

Aging error matrices were estimated outside the assessment model and were unchanged from the previous assessment, with the exception of correcting the designated error matrix in some years for the Oregon recreational ages.

Additional standard error was estimated for all indices with the exception of the WCBTS.

3.3.4 Key Assumptions and Structural Choices

This section is not required for an update assessment; please refer to the most recent full assessment (Gertseva and Cope 2017) for additional information.

3.4 Base Model Results

3.4.1 Parameter Estimates

The list of the all the parameters used in the assessment model and their values (either fixed or estimated) is provided in **Table X**. The growth parameters estimated within the model are reasonable, commensurate with inspection of the raw data and consistent with what we know about the species. These parameters are relatively precisely estimated, in terms of the asymptotic standard error estimates. Figure 29 shows the estimated growth curve. Spawning output-at-length is shown in Figure 32. Spawning output in the assessment is expressed in millions of eggs.

Estimated stock-recruit function for the assessment model is shown in **?@fig-SR_curve**. Estimated recruitment deviations are shown Figure 34. Recruitment of yelloweye rockfish was estimated to be quite variable over time, and the estimated stock-recruit function predicts a relatively wide range of cohort sizes over the observed range of spawning biomass. The model output recruitment variance (RMSE = 0.48) is consistent with the fixed input recruitment variance (R = 0.5).

Length-based selectivity curves estimated in the assessment are shown for all fleets together in Figure 31. Estimated selectivity curves for the fishing fleets indicate that the recreational fleets access somewhat smaller fish than the commercial fisheries. This pattern is most pronounced in Oregon, and also as expected, since recent charter fishing selectivity has shifted shoreward where there is a higher density of smaller fish. Addition of the charter vessel length data did not appreciably change the estimate for the California recreational selectivity pattern and so the selectivity for the two series was not separated. All fleets for which curves were allowed to be dome-shaped (commercial trawl and non-trawl fleets) were estimated to be asymptotic. Estimated selectivity curves for the IPHC survey indicate a selection of the largest yelloweye available, and select the least amount of smaller yelloweye rockfish (Figure 35). The NWFSC trawl survey selected far more smaller yelloweye among all surveys (Figure 36). That the triennial survey selectivity was shifted to the largest fish but also selected some very small fish is likely an artifact of the very noisy composition data from that survey (Figure 37).

3.4.2 Fits to the Data

Model fits to the fishery CPUE and survey indices are presented in Figure 38 through Figure 45. The base model predicted a decreasing trend in the triennial survey between 1980 and 2004 (Figure 43) and a slightly increasing trend for the NWFSC trawl survey between 2003 and 2024 (Figure 44). The model predicted a relatively flat trend through the IPHC survey index despite the upward trend seen in the last three years as of this update (Figure 45). The triennial survey index indicated a population decrease in 1992 and lower estimates (compared with pre-1992) persisted through the end of the index time series. This decrease in the abundance index coincided with decrease in number of biological samples collected from this survey. No changes have been implemented to the triennial survey between 1989 and 1992. In 1995, the survey timing slightly shifted from early fall to mid-summer, approximately a month earlier that previous surveys. This shift in timing, however, seems unlikely to impact our understanding of yelloweye rockfish abundance trends during that period, given the sedentary life history of the species. Additionally, the change in the index trend was observed before the slight shift in survey timing. The California MRFSS recreational CPUE index tracked the decline in observations through the 1990s (Figure 38), and a slight increase in abundance was predicted in the Oregon MRFSS/ORBS recreational index during the 2000s (Figure 39). The Oregon recreational observer index showed a small and very uncertain increasing trend in the 2000s (Figure 42). The California CPFV charter series index indicated a relatively flat trajectory prior to 1992 with a drop in stock abundance from 1992 on (Figure 41). The model predicted a decreasing trend for the Washington Recreational index despite the relatively large variances on many of the observations, which does not match the relative stability of the index from 1982 to the early 2000s (Figure 40).

The model fitted length data aggregated across years reasonably well for all fleets (Figure 46). The model fits to length frequency distributions by fleet across years are shown in **add length comps by fleet/year - ADW - suggest these are all not needed, are there specific fleets we should highlight?**. Pearson residuals for the fits by fleet and year are shown in Figure 47 and Figure 48. The length data are very sparse in many years and the quality of fit varies among years and fleets, reflecting the differences in the quantity and quality of the data. However, neither length composition data nor the Pearson residuals, which reflect the noise in the data both within and among years, exhibit obvious patterns for any fleet. The data for fishing fleets are particularly poor after 2002 after retention of yelloweye rockfish was prohibited in most fleets and limited in trawl fleets. Input sample sizes for length composition data were tuned down using the Francis data weighting method **add weighting table**. Francis weighting fits to the mean lengths for each fleet by year (with 95% confidence intervals) are shown in **Figure X** through **Figure X** (**ADW note - we don't normally include these in the report - do we need them?**).

The fits to age data are shown in **Figure X** through **Figure X**, **ADW - I would**

suggest we don't include the ghost age comps and we don't normally include ALL of the CAAL - do we have a fleet where we can focus on this? with the "ghost" marginal age compositions shown to aid in visual interpretation of these fits. These "ghost" age compositions do not contribute to the likelihood and do not affect model fit in any way. Input sample sizes for conditional age-at-length composition data were also tuned down using Francis data weighting method. The Francis weighting index fit of the conditional age-at-length data for each fleet by year (with 95% confidence intervals) are shown in **Figure X** through **Figure X - ADW - again, these are probably not all necessary - let's focus on a specific fleet**.

3.4.3 Population Trajectory

The estimated time series of spawning output for the entire stock and by area are shown in Figure 49 and Figure 50, respectively. Spawning output relative to SB0 for the entire stock and by area are shown in **?@fig-status_combined** and **?@fig-status_area**. Total biomass, summary biomass and recruitment are shown in Figure 51, Figure 52 and Figure 53, respectively. Trends in total and summary biomass, absolute and relative spawning output track one another very closely. The spawning output of Yelloweye Rockfish started to decline in the 1940s during World War II, but are estimated to have been lightly exploited until the mid-1970s when catches increased and a rapid decline in biomass and spawning output began. The combined relative spawning output reached a minimum of 16% of unexploited levels in 2000 (Figure 49). Yelloweye Rockfish spawning output and relative status is estimated to have been gradually increasing since that time, in response to large reductions in harvest. However, the aggregate spawning output estimates do not convey the spatial heterogeneity included via the area-specific dynamics. Relative spawning output has differed between the two areas modelled in the assessment, with the California resource estimated to have a lower unfished equilibrium spawning output and estimated to be more depleted in 2025 than the Oregon and Washington resource (**?@fig-status_area**).

Recruitment appears to be relatively dynamic over time, with several elevated peaks over time estimated in the age-0 recruits (Figure 53). An initial peak in the mid-1940s is followed by a two periods of elevated recruitment in the 1970s and early 1980s and another period centered around the 2010s. This trend is consistent with the previous assessment, apart from the most recent elevated time period, which estimated a sole peak in 2001 and several other peaks of smaller magnitude starting in 2005. Recuits for this assessment appear to have extended and increased this more recent time period starting in 2005, with a peak in 2008 and 2013 and shifts the peak in 2001 to 2002. Recruitment in the late 2010s was estimated to be lower, but a more recent increase is seen starting in 2020.

3.5 Model Diagnostics

3.5.1 Convergence

Model convergence was evaluated by starting the minimization process from dispersed values of the maximum likelihood estimates to determine if the model found a better minimum. Starting parameters were jittered using the jitter function built into Stock Synthesis, using a jitter input of 0.10. This was repeated 50 times with 78% of runs returning to the base model likelihood. A better, lower negative log-likelihood, model fit was not found. The spread of this search indicates that the jitter was sufficient to search a large portion of the likelihood surface, and that the base model is at a global minimum (Figure 54). Through the jittering and the likelihood profiles, we are confident that the base model, as presented, represents the best fit to the data given the assumptions made. There were no difficulties in inverting the Hessian to obtain estimates of variability. The final gradient was 0.00087.

3.5.2 Sensitivity Analyses

3.5.2.1 Sensitivity to assumptions about model structure

Sensitivity analyses to examine the impact of different assumptions about model structure on management quantities included a model with an estimated natural mortality rate (M), one with estimated steepness (h) of the stock-recruit relationship, and one using the 2017 length-weight relationship. Summaries of model results for these sensitivities are presented in **?@tbl-sens-mod-results**.

The estimated natural mortality was slightly higher than that of the base model (~ 0.053 compared to ~ 0.044 from the base model). Steepness was estimated much higher at 0.905, similar to what the 2017 assessment estimated, which would otherwise indicate recruitment is less dependent on the spawning stock biomass, especially at small stock sizes. However, steepness values close to 1 are implausible for slow growing rockfish, supporting the decision to fix steepness at 0.718.

Model results are sensitive to whether natural mortality and steepness are estimated or fixed, with the alternative models estimating a higher spawning output and a lower depletion status when compared to the base mode (Figure 55 and Figure 56). However, outputs of the model using the 2017 length-weight relationship showed the base model is not sensitive to this update, with very similar spawning outputs between the base and alternative model (Figure 55 to Figure 56).

3.5.2.2 Sensitivity to data set choice and weighting schemes

Sensitivity analyses to data set choices to examine the impact of including different data streams were conducted by selectively removing each data source using emphasis factors, as well as by including different weighting schemes for composition data. Summaries of model results for these sensitivities are presented in Tables XX to XX. Among these, the base model appears to be most sensitive to removing length compositions, which show a significantly different biomass trajectory and a more optimistic estimate of stock status at the end of the time series (Figure 57 and Figure 58). Removing all age compositions, IPHC age compositions only, and applying the McAllister & Ianelli weighting scheme also result in slightly more optimistic estimates of stock status at the end of the time series compared to the base model (Figure 57 and Figure 58). Furthermore, models with all abundance and IPHC indices removed resulted in slightly less optimistic estimates of spawning output and stock status at the end of the time series (Figure 59 and Figure 60). Models removing the remaining indices consecutively did not show large differences in the final stock status estimate. A summary of the relative changes in management quantities from all sensitivity models is shown in Figure 61.

3.5.3 Retrospective Analysis

A retrospective analysis was conducted by running the base model with data removed for the past 5 years. Comparisons of the time series of absolute and relative spawning output and recruitment deviations time series for the runs are shown in Figure 62, Figure 63, and Figure 64, respectively. Recruitment deviations were more positive as years were removed. However, the change is not large, indicating that the new data are consistent with previous values or the sample sizes are too small to have any impact.

General trends in relative depletion (or spawning output) have been relatively stable across assessments (Figure 65), with a decline throughout the later half of the 1900's as the stock was fished down, followed by a reversal in the overall status after substantial catch restrictions were implemented in 2002. Across the most recent assessments, the 2017 assessment (Gertseva and Cope 2017) appears to have the most pessimistic depletion across the stock decline in the 1900s but otherwise, the relative depletion trend appears to be similar across the 2011, 2017 and the 2025 assessment as the stock has rebounded from its lowest status.

3.5.4 Likelihood Profiles

Likelihood profiles were conducted for natural mortality (M), stock-recruit steepness (h), and equilibrium recruitment ($\ln R_0$). These likelihood profiles were conducted by fixing the parameter of interest at specific values and estimating the remaining parameters based on the fixed parameter value.

In the assessment, M was fixed at the value of 0.044, based on Hamel's prior. The profile analysis over M showed that the negative log-likelihood was minimized with a value around 0.052 (Figure 66), which is close to what was assumed in the assessment. The time series of absolute and relative spawning output associated with different values of M ranging from 0.03 to 0.06 are shown in Figure 67.

In the base model h is fixed at 0.718, like the 2017 assessment, because much higher values (e.g. 0.9) are implausible given the life-history of slow growing rockfish. The likelihood profile for h shows that the negative log-likelihood for the base model declines with increasing h to a value around 0.7, notably different from the sensitivity analysis (Figure 68). Time series of relative unfished biomass associated with different values of h ranging from 0.25 to 1.0 are shown in Figure 69.

A likelihood profile analysis for $\ln(R_0)$ shows a strongly informed initial recruitment value in the base model (Figure 70). Most of the information for this parameter is coming from the length data. Within the length composition likelihood component, all sources of length compositions are equally informative. The index and age data are relatively uninformative. Changes in $\ln(R_0)$ results in relatively small changes in the scale of the population (Figure 71 and Figure 72) compared to the 2017 assessment model.

3.6 Unresolved Problems and Major Uncertainties

4 Management

4.1 Reference Points

This assessment estimates that the stock of Yelloweye Rockfish off the continental U.S. Pacific Coast is currently at **XXX%** of its unexploited level. This is above the overfished threshold of SB25%, but below the management target of SB40% of unfished spawning biomass. Both areas are above the overfished level of 25%. The assessment estimates that the coastwide spawning output of Yelloweye Rockfish dropped below the SB40% target for the first time in 1986 and below the overfished SB25% threshold in 1993, as a result of intense fishing by commercial and recreational fleets. It continued to decline and reached 14.2% of its unfished output in 2000 (**Table XX**). The same year, the stock was declared overfished. Since then, the spawning output has slowly increased due to management regulations implemented to foster stock rebuilding.

Reference points for the base model are summarized in **Table XX**. Unfished spawning stock output for Yelloweye Rockfish was estimated to be **XXXX** million eggs (95% confidence interval: **XXXX-XXXX** million eggs). The stock is declared overfished if the current spawning output is estimated to be below the minimum stock size threshold (MSST) of 25% of unfished level (SB25%). The management target for Yelloweye Rockfish is defined as 40% of the unfished spawning output (SB40%), which is estimated by the model to be **XXX** million eggs (95% confidence interval: **XXX-XXX**), which corresponds to an exploitation rate of 0.025. This harvest rate provides an equilibrium yield of **XXX** mt at SB40% (95% confidence interval: **XX-XXX** mt). The model estimate of maximum sustainable yield (MSY) is **XXX** mt (95% confidence interval: **XXX-XXX** mt). The estimated spawning stock output at MSY is **XXX** million eggs (95% confidence interval: XXX-XXX million eggs). The exploitation rate corresponding to the estimated SPRMSY of F36% is 0.034.

This assessment estimates that the 2024 SPR is **XX%**. The SPR used for setting the OFL is 50%, while the SPR-based management fishing mortality target **specified in the current rebuilding plan and used to determine the ACL is 76%. Relative exploitation rates (calculated as catch/biomass of age-8 and older fish) are estimated to have been below 1% during the last decade**. This assessment estimates that Yelloweye Rockfish was fished beyond the relative SPR ratio (calculated as 1-SPR/1-SPRTarget=0.5) between 1977 and 2000. The equilibrium yield curve is shown in **Figure XX**.

4.2 Harvest Projections and Decision Tables

The base model estimate for 2025 spawning depletion is **XX%**. The primary axis of uncertainty about this estimate used in the decision table was based on natural mortality. Natural mortality in the assessment model is fixed at the median of the Hamel prior (0.044 y-1), estimated using the maximum age of 123 years. Natural mortality value for high state of nature was calculated to correspond to 97 years of age, which is the 99th percentile of the age data available for the assessment; this value was 0.056 y-1. The natural mortality value for low state of nature was calculated to correspond to 147 years of age, which is the maximum age reported for the Yelloweye Rockfish; this value was 0.037 y-1.

We explored different approaches to identify alternative natural mortality values, including using the 12.5 and 87.5 percentiles of the Hamel prior distribution. However, this approach yielded values that were considered to be not realistic. For instance, the 12.5 percentile value of 0.031y-1 corresponded to an age of 175 years, which substantially exceeds the oldest Yelloweye Rockfish individual ever reported.

Twelve-year forecasts for each state of nature were calculated for two catch scenarios (**Table XX**). One scenario assumes 2025-2026 catches to be 60% of year-specific ACL values, and 2027-2036 catches to be 60% of removals calculated using current rebuilding SPR of 76% applied to the base model. The second catch scenario assumes 2025-2026 removals to be equal to year-specific ACLs, and 2027-2036 catches calculated using current rebuilding SPR of 76% applied to the base model.

4.3 Evaluation of Scientific Uncertainty

The model estimated uncertainty around the 2025 spawning biomass for the model **is = XX**. The uncertainty around the OFL in 2025 **is = XX**. Each of these are likely underestimates of overall uncertainty due to the necessity to fix several key population dynamics parameters (e.g., steepness, recruitment variance) and also because there is no explicit incorporation of model structural uncertainty (although see the decision table for alternative states of nature).

4.4 Regional management considerations

Yelloweye Rockfish is modelled in two areas (California and Oregon-Washington) in this assessment. Current population status does differ by area and may be valuable information for making management and allocation decisions (**ts10_Relative_spawning_output**).

4.5 Research and Data Needs

Please refer to the 2017 benchmark assessment for a detailed list of research and data needs for Yelloweye Rockfish (**cite last assessment**). In addition to those, the following research and recommendations could improve the ability of future stock assessments to determine the status and productivity of the Yelloweye Rockfish population:

- USE ONLY ONE INDEX FOR OR REC (CHOOSE ORFS?) and refinement of the ORFS index analysis. Choosing orfs over orbs because it's a longer time period and orfs and orbs sample the same fishery.
- Continue using the methods that we developed for the IPHC index (using sdmTMB).
- In the model structure, consider expanding age bins for the IPHC data to capture the population dynamics of a long-lived species. (max age in model?) (max age in data)?

4.6 Acknowledgements

4.7 References

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5 Tables

5.1 Introduction

Table 1: Recent trend in the overfishing limits (OFL), the acceptable biological catches (ABCs), the annual catch limits (ACLs), and the total dead catch (landings + discards) all in metric tons (mt).

Year	OFL (mt)	ABC (mt)	ACL (mt)	Total dead catch (mt)
2015	52	43	18	12
2016	52	43	19	9
2017	57	47	20	20
2018	58	48	20	19
2019	82	74	48	24
2020	84	77	49	18
2021	97	83	50	21
2022	NA	NA	NA	34
2023	90	75	52	39
2024	91	76	53	15

5.2 Data

Table 2: Time series of yelloweye rockfish catches by fleet used in the
fleets include yelloweye bycatch in foreign POP and in a
fisheries. Years 1967 - 1974, 1979, and 2002 - 2004 do not
Catch in MT as that information is not available.

Year	CA trawl (mt)	CA non-trawl (mt)	CA sport (mt)	OR-WA trawl (mt)	OR-WA non-trawl (mt)	OR sport (
1889	0.000	0.000	0.000	0.000	0.040	[illegible]
1890	0.020	0.070	0.000	0.000	0.040	[illegible]
1891	0.030	0.130	0.000	0.000	0.070	[illegible]
1892	0.050	0.200	0.000	0.000	3.640	[illegible]
1893	0.060	0.260	0.000	0.000	3.550	[illegible]
1894	0.080	0.330	0.000	0.000	3.550	[illegible]
1895	0.090	0.390	0.000	0.000	0.920	[illegible]
1896	0.110	0.460	0.000	0.000	0.220	[illegible]
1897	0.120	0.520	0.000	0.000	0.220	[illegible]
1898	0.140	0.590	0.000	0.000	0.130	[illegible]
1899	0.160	0.660	0.000	0.000	0.230	[illegible]
1900	0.170	0.720	0.000	0.000	0.300	[illegible]
1901	0.190	0.790	0.000	0.000	0.390	[illegible]
1902	0.200	0.850	0.000	0.000	0.480	[illegible]
1903	0.220	0.920	0.000	0.000	0.560	[illegible]
1904	0.230	0.980	0.000	0.000	0.730	[illegible]
1905	0.250	1.050	0.000	0.000	0.740	[illegible]
1906	0.260	1.110	0.000	0.000	0.830	[illegible]
1907	0.280	1.180	0.000	0.000	0.910	[illegible]
1908	0.300	1.250	0.000	0.000	1.950	[illegible]
1909	0.310	1.310	0.000	0.000	1.090	[illegible]
1910	0.330	1.380	0.000	0.000	1.180	[illegible]
1911	0.340	1.440	0.000	0.000	1.260	[illegible]
1912	0.360	1.510	0.000	0.000	1.350	[illegible]
1913	0.370	1.570	0.000	0.000	1.440	[illegible]
1914	0.390	1.640	0.000	0.000	1.530	[illegible]
1915	0.400	1.700	0.000	0.000	2.230	[illegible]
1916	0.420	1.770	0.000	0.000	1.700	[illegible]
1917	0.660	2.960	0.000	0.000	1.790	[illegible]
1918	0.770	3.480	0.000	0.000	18.540	[illegible]
1919	0.540	1.620	0.000	0.000	7.610	[illegible]
1920	0.550	1.840	0.000	0.000	6.570	[illegible]
1921	0.450	1.850	0.000	0.000	6.330	[illegible]
1922	0.390	1.680	0.000	0.000	4.380	[illegible]
1923	0.420	1.790	0.000	0.000	5.100	[illegible]
1924	0.240	2.580	0.000	0.000	9.290	[illegible]
1925	0.170	3.690	0.000	0.000	11.480	[illegible]
1926	0.620	4.250	0.000	0.000	17.480	[illegible]
1927	1.050	4.870	0.000	0.000	22.790	[illegible]
1928	1.340	4.180	0.640	0.000	22.090	[illegible]
1929	1.580	4.070	1.290	0.000	17.730	[illegible]
1930	1.470	5.300	1.480	0.000	19.500	[illegible]
1931	0.880	4.740	1.970	0.000	11.690	[illegible]
1932	1.050	7.080	2.470	0.020	7.330	[illegible]

1933	1.630	2.810	2.960	0.010	10.300	
1934	1.610	4.170	3.450	0.000	12.660	
1935	1.680	6.310	3.950	0.010	9.690	
1936	1.490	6.600	4.440	0.030	16.650	
1937	1.770	4.310	5.270	0.060	14.820	
1938	1.670	4.690	5.180	0.000	16.350	
1939	1.730	4.710	4.530	0.090	10.630	
1940	1.600	2.970	6.510	2.060	17.140	
1941	1.160	4.190	6.020	3.170	27.380	
1942	0.270	3.100	3.200	5.950	31.380	
1943	2.050	3.840	3.060	20.810	51.220	
1944	8.360	16.520	2.510	36.510	22.600	
1945	18.540	40.020	3.350	56.890	11.520	
1946	16.330	41.420	5.760	34.850	20.680	
1947	7.090	9.190	4.590	21.420	10.950	
1948	6.490	16.810	9.180	15.140	13.380	
1949	3.720	6.170	11.880	12.640	11.210	
1950	3.420	4.610	14.490	13.690	14.780	
1951	9.910	7.070	17.160	12.020	17.960	
1952	8.700	5.440	15.000	12.790	13.060	
1953	8.570	3.190	12.850	9.960	5.610	
1954	4.990	6.780	16.170	12.810	10.250	
1955	5.610	1.830	19.510	13.130	9.710	
1956	8.580	1.810	21.900	16.990	4.340	
1957	10.490	4.070	21.710	22.960	8.510	
1958	10.340	3.050	33.840	18.380	2.390	
1959	8.610	1.640	29.230	19.940	5.410	
1960	7.480	2.240	20.860	25.200	4.920	
1961	3.560	1.690	16.350	22.720	4.910	
1962	3.680	1.750	20.810	26.400	5.160	
1963	6.020	5.610	21.800	7.170	4.100	
1964	3.120	4.560	18.960	1.950	3.110	
1965	3.860	5.510	29.110	67.880	4.680	
1966	3.620	4.450	31.600	3.030	3.240	
1967	6.170	4.380	31.890	6.820	6.600	
1968	3.780	3.890	37.660	2.970	5.660	
1969	21.800	3.910	40.620	47.760	13.080	
1970	24.220	3.470	45.790	7.050	4.310	
1971	41.770	4.730	40.720	13.650	8.340	
1972	56.220	7.440	52.360	7.350	10.860	
1973	43.620	5.890	66.480	9.520	11.460	
1974	44.800	11.590	70.150	4.410	14.460	1
1975	50.310	9.930	71.130	5.360	7.650	
1976	45.270	13.390	80.630	6.910	10.150	1
1977	42.510	14.950	72.780	4.970	17.020	1
1978	123.440	30.760	67.890	23.640	24.100	2
1979	61.020	38.310	76.310	44.580	49.100	5
1980	15.480	26.580	72.510	83.950	24.960	4
1981	30.200	119.500	47.000	91.340	23.950	3
1982	199.930	15.590	102.000	156.080	31.450	6
1983	56.650	7.680	51.000	287.290	45.950	4
1984	44.030	4.420	77.000	113.980	39.390	4
1985	7.420	4.230	124.000	200.040	69.720	1
1986	9.890	23.430	65.000	92.920	66.150	9

1987	16.840	38.000	75.000	71.750	97.080	4
1988	30.570	34.950	58.000	130.640	47.450	1
1989	9.380	42.370	59.000	199.340	41.400	1
1990	10.080	70.260	46.250	81.070	68.950	1
1991	13.980	133.070	33.500	121.380	85.620	2
1992	15.830	96.850	20.750	135.660	89.870	2
1993	6.180	46.590	8.000	137.960	138.250	2
1994	4.700	49.780	14.000	86.000	79.290	1
1995	3.690	47.680	13.000	131.320	40.430	2
1996	16.320	56.180	12.000	83.880	93.250	
1997	6.200	57.060	15.000	80.130	115.540	1
1998	4.100	17.640	5.000	41.180	45.050	1
1999	8.660	13.730	13.000	18.940	102.000	1
2000	0.730	3.310	8.000	5.070	15.040	1
2001	0.620	3.900	5.000	1.630	26.310	
2002	0.360	0.030	2.000	1.590	4.150	
2003	0.130	0.050	4.000	0.550	2.240	
2004	0.020	0.750	1.000	0.500	2.380	
2005	0.020	0.730	1.000	1.240	1.660	
2006	0.004	0.200	1.000	1.420	2.160	
2007	0.000	0.930	4.000	0.090	3.680	
2008	0.017	0.640	1.000	0.160	3.430	
2009	0.022	0.190	5.000	0.090	2.180	
2010	0.060	0.040	1.000	0.080	0.860	
2011	0.000	0.200	2.000	0.060	1.210	
2012	0.003	0.880	2.000	0.060	1.910	
2013	0.009	0.560	1.000	0.110	2.940	
2014	0.055	0.020	1.000	0.030	2.160	
2015	0.003	0.400	2.000	0.030	3.150	
2016	0.003	0.000	1.000	0.070	2.590	
2017	0.011	1.229	4.524	0.244	6.974	
2018	0.001	0.000	4.994	0.541	6.379	
2019	0.039	0.000	6.160	0.589	7.429	
2020	0.128	0.000	1.946	0.321	7.515	
2021	0.117	2.432	3.956	0.391	7.972	
2022	0.095	5.603	3.801	0.764	15.552	
2023	0.087	1.826	9.588	0.400	20.635	
2024	0.191	0.000	4.649	0.440	3.086	

Table 3: Summary of trips with and without yellowtail rockfish from ORFS index

year	tripsWithTarget	tripsWOTarget	totalTrips	percentpos
2001	11	334	345	0.03
2004	12	334	346	0.03
2005	10	392	402	0.02
2006	24	385	409	0.06
2007	20	478	498	0.04
2008	29	449	478	0.06
2009	23	285	308	0.07
2010	12	324	336	0.04
2011	20	317	337	0.06
2012	46	519	565	0.08
2013	31	391	422	0.07
2014	29	367	396	0.07
2015	10	312	322	0.03
2017	23	388	411	0.06
2022	11	216	227	0.05
2023	25	418	443	0.06
2024	54	540	594	0.09

Table 4: Model selection for top model covariate combinations considered for the ORFS index

Gf_opendepth	Lgdepthbin	Month	Port	Year	Effort.Offset	Df	Log.Likelihood	AICc	Delta
-	Incl.	-	Incl.	Incl.	Incl.	28	-1401.1	2858.5	0.0
-	Incl.	Incl.	Incl.	Incl.	Incl.	35	-1394.6	2859.6	1.2
Incl.	Incl.	-	Incl.	Incl.	Incl.	31	-1399.3	2861.0	2.5
Incl.	Incl.	Incl.	Incl.	Incl.	Incl.	38	-1394.3	2865.1	6.7
-	Incl.	Incl.	-	Incl.	Incl.	29	-1464.0	2986.3	127.8
-	Incl.	-	-	Incl.	Incl.	22	-1473.2	2990.5	132.1
Incl.	Incl.	Incl.	-	Incl.	Incl.	32	-1463.7	2991.7	133.2
Incl.	Incl.	-	-	Incl.	Incl.	25	-1472.2	2994.5	136.1
-	-	Incl.	Incl.	Incl.	Incl.	31	-1497.3	3056.9	198.5
Incl.	-	-	Incl.	Incl.	Incl.	27	-1502.7	3059.6	201.1

Table 5: Summary of trips with and without yellowtail rockfish from ORBS index

year	tripsWithTarget	tripsWOTarget	totalTrips	percentpos
2004	111	3399	3510	0.03
2005	281	6561	6842	0.04
2006	278	6729	7007	0.04
2007	262	4588	4850	0.05
2008	273	5342	5615	0.05
2009	219	5430	5649	0.04
2010	287	5948	6235	0.05
2011	337	5203	5540	0.06
2012	415	5067	5482	0.08
2013	602	6655	7257	0.08
2014	429	5426	5855	0.07
2015	483	7945	8428	0.06
2016	328	6608	6936	0.05
2017	642	6653	7295	0.09
2018	681	6530	7211	0.09
2019	693	5610	6303	0.11
2020	802	6369	7171	0.11
2021	582	5256	5838	0.10
2022	628	5896	6524	0.10
2023	840	5992	6832	0.12
2024	680	5979	6659	0.10

Table 6: Model selection for top model covariate combinations considered for the ORFS index

Boattype	Gf_opendepth	Month	Port	Tgt.bag	Year	Effort.Offset	Df	Log.Likelihood	AICc	Delta
Incl.	Incl.	Incl.	Incl.	Incl.	Incl.	Incl.	48	-45351.5	90799.1	0.0
Incl.	Incl.	Incl.	Incl.	-	Incl.	Incl.	44	-45369.4	90826.8	27.7
Incl.	-	Incl.	Incl.	Incl.	Incl.	Incl.	45	-45389.1	90868.2	69.2
Incl.	Incl.	-	Incl.	Incl.	Incl.	Incl.	37	-45414.1	90902.2	103.1
Incl.	-	Incl.	Incl.	-	Incl.	Incl.	41	-45413.6	90909.2	110.2
Incl.	Incl.	-	Incl.	-	Incl.	Incl.	33	-45427.8	90921.6	122.6
Incl.	-	-	Incl.	Incl.	Incl.	Incl.	34	-45554.1	91176.1	377.1
Incl.	-	-	Incl.	-	Incl.	Incl.	30	-45583.4	91226.9	427.8
-	Incl.	Incl.	Incl.	Incl.	Incl.	Incl.	47	-45634.6	91363.3	564.3
-	Incl.	Incl.	Incl.	-	Incl.	Incl.	43	-45650.9	91387.7	588.7

Table 7: Summary of sampling effort within triennial survey, with total and yelloweye positive hauls summarized by area.

	CA		OR-WA	
	Number of hauls	Number of positive hauls	Number of hauls	Number of positive hauls
1980	68	1	263	13
1983	96	1	416	26
1986	95	2	389	27
1989	147	7	300	30
1992	135	2	310	25
1995	123	1	241	7
1998	129	0	260	14
2001	129	0	246	15
2004	103	3	185	9

Table 8: Summary of sampling effort within NWFSC trawl survey, with total and yelloweye positive hauls summarized by area.

	CA		ORWA	
	Number of hauls	positive.Number of hauls	Number of hauls	positive.Number of hauls
2003	268	2	274	17
2004	247	1	223	7
2005	345	2	296	11
2006	346	1	293	12
2007	355	3	332	9
2008	382	2	298	13
2009	389	5	292	6
2010	413	1	300	14
2011	381	3	314	10
2012	389	2	306	12
2013	248	3	220	10
2014	0	0	311	19
2015	383	2	283	11
2016	383	5	309	20
2017	385	3	320	16
2018	396	5	305	19
2019	0	0	161	9
2021	382	4	302	16
2022	359	3	275	15
2023	365	4	296	10
2024	348	3	310	19

```
# Do we need this?
#| label: tbl-filtering-CA-MRFSS
#| echo: false
#| warning: false
#| tbl-cap: "Filtering levels and resultant data from the California MRFSS recreational i
```

```
# Do we need this?
#| label: tbl-model-selection-CA-MRFSS
#| echo: false
#| warning: false
#| tbl-cap: "Delta-GLM model selection for the California MRFSS recreational index. Gray
```

```
# Do we need this?
#| label: tbl-filtering-CA-CPFV
#| echo: false
#| warning: false
#| tbl-cap: "Filtering levels and resultant data from the California CPFV recreational in
```

```
# Do we need this?
#| label: tbl-model-selection-CA-MRFSS
#| echo: false
#| warning: false
#| tbl-cap: "Delta-GLM model selection for the California CPFV recreational index. Gray b
```

```
# Do we need this?
#| label: tbl-filtering-OR-onboard
#| echo: false
#| warning: false
#| tbl-cap: "Filtering levels and resultant data from the Oregon onboard recreational inc
```

```
# Do we need this?
#| label: tbl-filtering-OR-MRFSS
#| echo: false
#| warning: false
#| tbl-cap: "Filtering levels and resultant data from the Oregon MRFSS recreational index
```

```
# Do we need this?
#| label: tbl-filtering-OR-ORBS
#| echo: false
#| warning: false
#| tbl-cap: "Filtering levels and resultant data from the Oregon ORBS dockside index."
```

```
# Do we need this?
#| label: tbl-model-selection-ORBS
#| echo: false
#| warning: false
#| tbl-cap: "Delta-GLM model selection for the Oregon ORBS dockside index. Gray bar indic
```

```
# Do we need this?
#| label: tbl-filtering-WA-dockside
#| echo: false
#| warning: false
#| tbl-cap: "Filtering levels and resultant data from the Washington dockside recreationa
```

```
# Do we need this?
#| label: tbl-model-selection-WA-dockside
#| echo: false
#| warning: false
#| tbl-cap: "Delta-GLM model selection for the Washington dockside recreational index. Gr
```

5.3 Model results

Table 9: Specifications and structure of the model.

Section	Configuration
Maximum age	100
Sexes	Sexes combined
Population bins	8-88 cm by 2 cm bins
Summary biomass (mt) age	8+
Number of areas	2
Number of seasons	1
Number of growth patterns	1
Start year	1889
End year	2024
Data length bins	10-74 cm by 2 cm bins
Data age bins	0-65 by 1 year

Table 10: Estimated parameters in the model.

Type	Count
Growth mean	3
Growth variability	2
Stock-recruit	1
Rec. dev. time series	136
Rec. dev. forecast	12
Index	7
Index time-variation	1
Size selectivity	25

Table 11: Parameter estimates, estimation phase, parameter bounds, estimation status, estimated standard deviation (SD), prior information [distribution(mean, SD)] used in the base model.

Label	Value	Phase	Bounds	Status	SD	Prior
NatM_break_1_Fem_GP_1	0.0439	-1	(0.01, 0.15)	fixed		none
L_at_Amin_Fem_GP_1	1.47	2	(0.01, 35)	ok	0.581	none
L_at_Amax_Fem_GP_1	61.4	2	(40, 120)	ok	0.225	none
VonBert_K_Fem_GP_1	0.076	1	(0.01, 0.2)	ok	0.00132	none
CV_young_Fem_GP_1	0.148	3	(0.01, 0.5)	ok	0.00679	none
CV_old_Fem_GP_1	0.0642	7	(0.01, 0.5)	ok	0.00194	none
Wtlen_1_Fem_GP_1	7.18e-06	-50	(-3, 3)	fixed		none
Wtlen_2_Fem_GP_1	3.24	-50	(-3, 4)	fixed		none
Mat50%_Fem_GP_1	42.1	-50	(38, 45)	fixed		none
Mat_slope_Fem_GP_1	-0.402	-50	(-3, 3)	fixed		none
Eggs_scalar_Fem_GP_1	7.22e-08	-6	(-3, 3e+05)	fixed		none
Eggs_exp_len_Fem_GP_1	4.04	-6	(-3, 39000)	fixed		none
RecrDist_GP_1	1	-50	(0, 2)	fixed		none
RecrDist_Area_1	0	-50	(-4, 4)	fixed		none
RecrDist_Area_2	0.46	3	(-4, 4)	ok	0.0224	none
RecrDist_month_1	1	-50	(0, 2)	fixed		none
CohortGrowDev	1	-50	(0, 2)	fixed		none
FracFemale_GP_1	0.5	-99	(1e-06, 1)	fixed		none
SR_LN(R0)	5.44	3	(3, 15)	ok	0.0621	none
SR_BH_steep	0.718	-3	(0.2, 1)	fixed		none
SR_sigmaR	0.5	-2	(0, 5)	fixed		none
SR_regime	0	-50	(-5, 5)	fixed		none
SR_autocorr	0	-50	(-1, 2)	fixed		none
Early_RecrDev_1889	0.0197	7	(-5, 5)	dev	0.505	normal(0.00, 0.5
Early_RecrDev_1890	0.0204	7	(-5, 5)	dev	0.505	normal(0.00, 0.5
Early_RecrDev_1891	0.0211	7	(-5, 5)	dev	0.505	normal(0.00, 0.5
Early_RecrDev_1892	0.0219	7	(-5, 5)	dev	0.505	normal(0.00, 0.5
Early_RecrDev_1893	0.0226	7	(-5, 5)	dev	0.505	normal(0.00, 0.5
Early_RecrDev_1894	0.0234	7	(-5, 5)	dev	0.505	normal(0.00, 0.5
Early_RecrDev_1895	0.0242	7	(-5, 5)	dev	0.506	normal(0.00, 0.5
Early_RecrDev_1896	0.0251	7	(-5, 5)	dev	0.506	normal(0.00, 0.5
Early_RecrDev_1897	0.0259	7	(-5, 5)	dev	0.506	normal(0.00, 0.5
Early_RecrDev_1898	0.0269	7	(-5, 5)	dev	0.506	normal(0.00, 0.5
Early_RecrDev_1899	0.0278	7	(-5, 5)	dev	0.506	normal(0.00, 0.5
Early_RecrDev_1900	0.0288	7	(-5, 5)	dev	0.507	normal(0.00, 0.5
Early_RecrDev_1901	0.0298	7	(-5, 5)	dev	0.507	normal(0.00, 0.5
Early_RecrDev_1902	0.0309	7	(-5, 5)	dev	0.507	normal(0.00, 0.5
Early_RecrDev_1903	0.032	7	(-5, 5)	dev	0.507	normal(0.00, 0.5
Early_RecrDev_1904	0.0332	7	(-5, 5)	dev	0.507	normal(0.00, 0.5
Early_RecrDev_1905	0.0344	7	(-5, 5)	dev	0.508	normal(0.00, 0.5
Early_RecrDev_1906	0.0357	7	(-5, 5)	dev	0.508	normal(0.00, 0.5
Early_RecrDev_1907	0.0371	7	(-5, 5)	dev	0.508	normal(0.00, 0.5
Early_RecrDev_1908	0.0387	7	(-5, 5)	dev	0.509	normal(0.00, 0.5
Early_RecrDev_1909	0.0403	7	(-5, 5)	dev	0.509	normal(0.00, 0.5
Early_RecrDev_1910	0.0421	7	(-5, 5)	dev	0.509	normal(0.00, 0.5
Early_RecrDev_1911	0.0439	7	(-5, 5)	dev	0.51	normal(0.00, 0.5
Early_RecrDev_1912	0.0459	7	(-5, 5)	dev	0.51	normal(0.00, 0.5
Early_RecrDev_1913	0.0479	7	(-5, 5)	dev	0.51	normal(0.00, 0.5

Early_RecrDev_1914	0.0498	7	(-5, 5)	dev	0.511	normal(0.00, 0.5
Early_RecrDev_1915	0.0514	7	(-5, 5)	dev	0.511	normal(0.00, 0.5
Early_RecrDev_1916	0.0526	7	(-5, 5)	dev	0.511	normal(0.00, 0.5
Early_RecrDev_1917	0.0531	7	(-5, 5)	dev	0.511	normal(0.00, 0.5
Early_RecrDev_1918	0.0524	7	(-5, 5)	dev	0.511	normal(0.00, 0.5
Early_RecrDev_1919	0.0503	7	(-5, 5)	dev	0.51	normal(0.00, 0.5
Early_RecrDev_1920	0.0464	7	(-5, 5)	dev	0.509	normal(0.00, 0.5
Early_RecrDev_1921	0.0404	7	(-5, 5)	dev	0.507	normal(0.00, 0.5
Early_RecrDev_1922	0.0322	7	(-5, 5)	dev	0.505	normal(0.00, 0.5
Early_RecrDev_1923	0.0216	7	(-5, 5)	dev	0.502	normal(0.00, 0.5
Early_RecrDev_1924	0.00893	7	(-5, 5)	dev	0.498	normal(0.00, 0.5
Early_RecrDev_1925	-0.0055	7	(-5, 5)	dev	0.494	normal(0.00, 0.5
Early_RecrDev_1926	-0.021	7	(-5, 5)	dev	0.491	normal(0.00, 0.5
Early_RecrDev_1927	-0.0367	7	(-5, 5)	dev	0.487	normal(0.00, 0.5
Early_RecrDev_1928	-0.0517	7	(-5, 5)	dev	0.483	normal(0.00, 0.5
Early_RecrDev_1929	-0.0652	7	(-5, 5)	dev	0.48	normal(0.00, 0.5
Early_RecrDev_1930	-0.0768	7	(-5, 5)	dev	0.477	normal(0.00, 0.5
Early_RecrDev_1931	-0.0866	7	(-5, 5)	dev	0.475	normal(0.00, 0.5
Early_RecrDev_1932	-0.0952	7	(-5, 5)	dev	0.472	normal(0.00, 0.5
Early_RecrDev_1933	-0.104	7	(-5, 5)	dev	0.47	normal(0.00, 0.5
Early_RecrDev_1934	-0.114	7	(-5, 5)	dev	0.468	normal(0.00, 0.5
Early_RecrDev_1935	-0.127	7	(-5, 5)	dev	0.465	normal(0.00, 0.5
Early_RecrDev_1936	-0.142	7	(-5, 5)	dev	0.462	normal(0.00, 0.5
Early_RecrDev_1937	-0.158	7	(-5, 5)	dev	0.458	normal(0.00, 0.5
Early_RecrDev_1938	-0.172	7	(-5, 5)	dev	0.455	normal(0.00, 0.5
Early_RecrDev_1939	-0.184	7	(-5, 5)	dev	0.453	normal(0.00, 0.5
Early_RecrDev_1940	-0.188	7	(-5, 5)	dev	0.452	normal(0.00, 0.5
Early_RecrDev_1941	-0.184	7	(-5, 5)	dev	0.452	normal(0.00, 0.5
Early_RecrDev_1942	-0.168	7	(-5, 5)	dev	0.454	normal(0.00, 0.5
Early_RecrDev_1943	-0.137	7	(-5, 5)	dev	0.459	normal(0.00, 0.5
Early_RecrDev_1944	-0.0854	7	(-5, 5)	dev	0.468	normal(0.00, 0.5
Early_RecrDev_1945	-0.00578	7	(-5, 5)	dev	0.483	normal(0.00, 0.5
Early_RecrDev_1946	0.105	7	(-5, 5)	dev	0.506	normal(0.00, 0.5
Early_RecrDev_1947	0.237	7	(-5, 5)	dev	0.535	normal(0.00, 0.5
Early_RecrDev_1948	0.349	7	(-5, 5)	dev	0.56	normal(0.00, 0.5
Early_RecrDev_1949	0.355	7	(-5, 5)	dev	0.555	normal(0.00, 0.5
Early_RecrDev_1950	0.224	7	(-5, 5)	dev	0.522	normal(0.00, 0.5
Early_RecrDev_1951	0.0376	7	(-5, 5)	dev	0.483	normal(0.00, 0.5
Early_RecrDev_1952	-0.138	7	(-5, 5)	dev	0.451	normal(0.00, 0.5
Early_RecrDev_1953	-0.277	7	(-5, 5)	dev	0.428	normal(0.00, 0.5
Early_RecrDev_1954	-0.372	7	(-5, 5)	dev	0.414	normal(0.00, 0.5
Early_RecrDev_1955	-0.421	7	(-5, 5)	dev	0.407	normal(0.00, 0.5
Early_RecrDev_1956	-0.425	7	(-5, 5)	dev	0.405	normal(0.00, 0.5
Early_RecrDev_1957	-0.385	7	(-5, 5)	dev	0.408	normal(0.00, 0.5
Early_RecrDev_1958	-0.305	7	(-5, 5)	dev	0.415	normal(0.00, 0.5
Early_RecrDev_1959	-0.203	7	(-5, 5)	dev	0.421	normal(0.00, 0.5
Early_RecrDev_1960	-0.15	7	(-5, 5)	dev	0.42	normal(0.00, 0.5
Early_RecrDev_1961	-0.23	7	(-5, 5)	dev	0.413	normal(0.00, 0.5
Early_RecrDev_1962	-0.39	7	(-5, 5)	dev	0.4	normal(0.00, 0.5
Early_RecrDev_1963	-0.508	7	(-5, 5)	dev	0.391	normal(0.00, 0.5
Early_RecrDev_1964	-0.502	7	(-5, 5)	dev	0.39	normal(0.00, 0.5
Early_RecrDev_1965	-0.351	7	(-5, 5)	dev	0.397	normal(0.00, 0.5
Early_RecrDev_1966	-0.164	7	(-5, 5)	dev	0.404	normal(0.00, 0.5
Early_RecrDev_1967	-0.0525	7	(-5, 5)	dev	0.424	normal(0.00, 0.5

Early_RecrDev_1968	0.131	7	(-5, 5)	dev	0.43	normal(0.00, 0.5
Early_RecrDev_1969	0.223	7	(-5, 5)	dev	0.454	normal(0.00, 0.5
Early_RecrDev_1970	0.414	7	(-5, 5)	dev	0.508	normal(0.00, 0.5
Early_RecrDev_1971	0.895	7	(-5, 5)	dev	0.389	normal(0.00, 0.5
Early_RecrDev_1972	0.281	7	(-5, 5)	dev	0.472	normal(0.00, 0.5
Early_RecrDev_1973	-0.0147	7	(-5, 5)	dev	0.425	normal(0.00, 0.5
Early_RecrDev_1974	0.0884	7	(-5, 5)	dev	0.429	normal(0.00, 0.5
Early_RecrDev_1975	0.477	7	(-5, 5)	dev	0.372	normal(0.00, 0.5
Early_RecrDev_1976	0.281	7	(-5, 5)	dev	0.421	normal(0.00, 0.5
Early_RecrDev_1977	0.225	7	(-5, 5)	dev	0.367	normal(0.00, 0.5
Early_RecrDev_1978	-0.108	7	(-5, 5)	dev	0.397	normal(0.00, 0.5
Early_RecrDev_1979	0.144	7	(-5, 5)	dev	0.393	normal(0.00, 0.5
Main_RecrDev_1980	0.358	7	(-5, 5)	dev	0.411	normal(0.00, 0.5
Main_RecrDev_1981	0.425	7	(-5, 5)	dev	0.46	normal(0.00, 0.5
Main_RecrDev_1982	0.505	7	(-5, 5)	dev	0.434	normal(0.00, 0.5
Main_RecrDev_1983	0.175	7	(-5, 5)	dev	0.475	normal(0.00, 0.5
Main_RecrDev_1984	0.415	7	(-5, 5)	dev	0.423	normal(0.00, 0.5
Main_RecrDev_1985	0.241	7	(-5, 5)	dev	0.418	normal(0.00, 0.5
Main_RecrDev_1986	-0.0942	7	(-5, 5)	dev	0.379	normal(0.00, 0.5
Main_RecrDev_1987	-0.342	7	(-5, 5)	dev	0.343	normal(0.00, 0.5
Main_RecrDev_1988	-0.627	7	(-5, 5)	dev	0.327	normal(0.00, 0.5
Main_RecrDev_1989	-0.776	7	(-5, 5)	dev	0.311	normal(0.00, 0.5
Main_RecrDev_1990	-0.856	7	(-5, 5)	dev	0.301	normal(0.00, 0.5
Main_RecrDev_1991	-0.942	7	(-5, 5)	dev	0.305	normal(0.00, 0.5
Main_RecrDev_1992	-0.773	7	(-5, 5)	dev	0.319	normal(0.00, 0.5
Main_RecrDev_1993	-0.0887	7	(-5, 5)	dev	0.259	normal(0.00, 0.5
Main_RecrDev_1994	-0.227	7	(-5, 5)	dev	0.279	normal(0.00, 0.5
Main_RecrDev_1995	-0.931	7	(-5, 5)	dev	0.324	normal(0.00, 0.5
Main_RecrDev_1996	-0.964	7	(-5, 5)	dev	0.311	normal(0.00, 0.5
Main_RecrDev_1997	-0.756	7	(-5, 5)	dev	0.327	normal(0.00, 0.5
Main_RecrDev_1998	-0.268	7	(-5, 5)	dev	0.336	normal(0.00, 0.5
Main_RecrDev_1999	0.154	7	(-5, 5)	dev	0.291	normal(0.00, 0.5
Main_RecrDev_2000	-0.413	7	(-5, 5)	dev	0.367	normal(0.00, 0.5
Main_RecrDev_2001	-0.258	7	(-5, 5)	dev	0.368	normal(0.00, 0.5
Main_RecrDev_2002	0.916	7	(-5, 5)	dev	0.194	normal(0.00, 0.5
Main_RecrDev_2003	0.0491	7	(-5, 5)	dev	0.36	normal(0.00, 0.5
Main_RecrDev_2004	-0.362	7	(-5, 5)	dev	0.363	normal(0.00, 0.5
Main_RecrDev_2005	0.0358	7	(-5, 5)	dev	0.314	normal(0.00, 0.5
Main_RecrDev_2006	0.537	7	(-5, 5)	dev	0.288	normal(0.00, 0.5
Main_RecrDev_2007	0.568	7	(-5, 5)	dev	0.344	normal(0.00, 0.5
Main_RecrDev_2008	1.05	7	(-5, 5)	dev	0.262	normal(0.00, 0.5
Main_RecrDev_2009	0.807	7	(-5, 5)	dev	0.309	normal(0.00, 0.5
Main_RecrDev_2010	0.753	7	(-5, 5)	dev	0.276	normal(0.00, 0.5
Main_RecrDev_2011	0.492	7	(-5, 5)	dev	0.291	normal(0.00, 0.5
Main_RecrDev_2012	0.371	7	(-5, 5)	dev	0.335	normal(0.00, 0.5
Main_RecrDev_2013	1.18	7	(-5, 5)	dev	0.208	normal(0.00, 0.5
Main_RecrDev_2014	0.451	7	(-5, 5)	dev	0.358	normal(0.00, 0.5
Main_RecrDev_2015	0.711	7	(-5, 5)	dev	0.29	normal(0.00, 0.5
Main_RecrDev_2016	0.328	7	(-5, 5)	dev	0.33	normal(0.00, 0.5
Main_RecrDev_2017	-0.358	7	(-5, 5)	dev	0.395	normal(0.00, 0.5
Main_RecrDev_2018	-0.412	7	(-5, 5)	dev	0.404	normal(0.00, 0.5
Main_RecrDev_2019	-0.39	7	(-5, 5)	dev	0.417	normal(0.00, 0.5
Main_RecrDev_2020	-0.413	7	(-5, 5)	dev	0.439	normal(0.00, 0.5
Main_RecrDev_2021	-0.164	7	(-5, 5)	dev	0.465	normal(0.00, 0.5

Main_RecrDev_2022	-0.0578	7	(-5, 5)	dev	0.486	normal(0.00, 0.5
Main_RecrDev_2023	-0.0431	7	(-5, 5)	dev	0.49	normal(0.00, 0.5
Late_RecrDev_2024	0	8	(-5, 5)	dev	0.5	normal(0.00, 0.5
ForeRecr_2025	0	8	(-5, 5)	dev	0.5	normal(0.00, 0.5
ForeRecr_2026	0	8	(-5, 5)	dev	0.5	normal(0.00, 0.5
ForeRecr_2027	0	8	(-5, 5)	dev	0.5	normal(0.00, 0.5
ForeRecr_2028	0	8	(-5, 5)	dev	0.5	normal(0.00, 0.5
ForeRecr_2029	0	8	(-5, 5)	dev	0.5	normal(0.00, 0.5
ForeRecr_2030	0	8	(-5, 5)	dev	0.5	normal(0.00, 0.5
ForeRecr_2031	0	8	(-5, 5)	dev	0.5	normal(0.00, 0.5
ForeRecr_2032	0	8	(-5, 5)	dev	0.5	normal(0.00, 0.5
ForeRecr_2033	0	8	(-5, 5)	dev	0.5	normal(0.00, 0.5
ForeRecr_2034	0	8	(-5, 5)	dev	0.5	normal(0.00, 0.5
ForeRecr_2035	0	8	(-5, 5)	dev	0.5	normal(0.00, 0.5
ForeRecr_2036	0	8	(-5, 5)	dev	0.5	normal(0.00, 0.5
LnQ_base_3_CA_REC(3)	-9.16	-1	(-15, 15)	fixed		none
Q_extraSD_3_CA_REC(3)	0.132	5	(0, 5)	ok	0.0808	none
LnQ_base_6_OR_REC(6)	-10.8	-1	(-15, 15)	fixed		none
Q_extraSD_6_OR_REC(6)	1.04	5	(0, 5)	ok	0.149	none
LnQ_base_7_WA_REC(7)	-8.81	-1	(-20, 15)	fixed		none
Q_extraSD_7_WA_REC(7)	0.406	5	(0, 5)	ok	0.0803	none
LnQ_base_8_CACPFV(8)	-9.2	-1	(-15, 15)	fixed		none
Q_extraSD_8_CACPFV(8)	0.0794	5	(0, 5)	ok	0.0711	none
LnQ_base_9_OR_RECOB(9)	-11.3	-1	(-15, 15)	fixed		none
Q_extraSD_9_OR_RECOB(9)	0.166	5	(0, 5)	ok	0.0795	none
LnQ_base_10_TRI_ORWA(10)	-1.46	-1	(-15, 15)	fixed		none
Q_extraSD_10_TRI_ORWA(10)	0.13	5	(0, 5)	ok	0.119	none
LnQ_base_11_NWFSC_ORWA(11)	-0.85	-1	(-15, 15)	fixed		none
Q_extraSD_11_NWFSC_ORWA(11)	0	-5	(0, 5)	fixed		none
LnQ_base_12_IPHC_ORWA(12)	-0.544	-1	(-15, 15)	fixed		none
Q_extraSD_12_IPHC_ORWA(12)	0.551	5	(0, 5)	ok	0.106	none
LnQ_base_6_OR_REC(6)_BLK2add_2005	-0.598	1	(-4, 4)	ok	7820	none
Size_DblN_peak_1_CA_TWL(1)	44	4	(20, 60)	ok	3.29	none
Size_DblN_top_logit_1_CA_TWL(1)	-15	-5	(-15, 4)	fixed		none
Size_DblN_ascend_se_1_CA_TWL(1)	5.13	4	(-1, 9)	ok	0.402	none
Size_DblN_descend_se_1_CA_TWL(1)	18.3	5	(-1, 30)	ok	152	none
Size_DblN_start_logit_1_CA_TWL(1)	-999	-4	(-1000, 9)	fixed		none
Size_DblN_end_logit_1_CA_TWL(1)	-999	-5	(-1000, 9)	fixed		none
Size_DblN_peak_2_CA_NONTWL(2)	44.4	4	(20, 60)	ok	2.48	none
Size_DblN_top_logit_2_CA_NONTWL(2)	-15	-5	(-15, 4)	fixed		none
Size_DblN_ascend_se_2_CA_NONTWL(2)	5.18	4	(-1, 9)	ok	0.284	none
Size_DblN_descend_se_2_CA_NONTWL(2)	17.4	5	(-1, 30)	ok	172	none
Size_DblN_start_logit_2_CA_NONTWL(2)	-999	-4	(-1000, 9)	fixed		none
Size_DblN_end_logit_2_CA_NONTWL(2)	-999	-5	(-1000, 9)	fixed		none
Size_DblN_peak_3_CA_REC(3)	41.8	4	(20, 60)	ok	1.36	none
Size_DblN_top_logit_3_CA_REC(3)	-15	-5	(-15, 4)	fixed		none
Size_DblN_ascend_se_3_CA_REC(3)	5.22	4	(-1, 9)	ok	0.144	none
Size_DblN_descend_se_3_CA_REC(3)	20	-5	(-1, 30)	fixed		none
Size_DblN_start_logit_3_CA_REC(3)	-999	-4	(-1000, 9)	fixed		none
Size_DblN_end_logit_3_CA_REC(3)	-999	-5	(-1000, 9)	fixed		none
Size_DblN_peak_4_ORWA_TWL(4)	41.9	4	(20, 60)	ok	2.98	none
Size_DblN_top_logit_4_ORWA_TWL(4)	-15	-5	(-15, 4)	fixed		none
Size_DblN_ascend_se_4_ORWA_TWL(4)	5.49	4	(-1, 9)	ok	0.338	none
Size_DblN_descend_se_4_ORWA_TWL(4)	18.1	5	(-1, 30)	ok	155	none

Size_DblN_start_logit_4_ORWA_TWL(4)	-999	-4	(-1000, 9)	fixed		none
Size_DblN_end_logit_4_ORWA_TWL(4)	-999	-5	(-1000, 9)	fixed		none
Size_DblN_peak_5_ORWA_NONTWL(5)	50.7	4	(20, 60)	ok	1.48	none
Size_DblN_top_logit_5_ORWA_NONTWL(5)	-15	-5	(-15, 4)	fixed		none
Size_DblN_ascend_se_5_ORWA_NONTWL(5)	5.42	4	(-1, 9)	ok	0.148	none
Size_DblN_descend_se_5_ORWA_NONTWL(5)	20	-5	(-1, 30)	fixed		none
Size_DblN_start_logit_5_ORWA_NONTWL(5)	-999	-4	(-1000, 9)	fixed		none
Size_DblN_end_logit_5_ORWA_NONTWL(5)	-999	-5	(-1000, 9)	fixed		none
Size_DblN_peak_6_OR_REC(6)	36.8	4	(20, 60)	ok	1.31	none
Size_DblN_top_logit_6_OR_REC(6)	-15	-5	(-15, 4)	fixed		none
Size_DblN_ascend_se_6_OR_REC(6)	4.15	4	(-1, 9)	ok	0.286	none
Size_DblN_descend_se_6_OR_REC(6)	12	-5	(-1, 30)	fixed		none
Size_DblN_start_logit_6_OR_REC(6)	-999	-4	(-1000, 9)	fixed		none
Size_DblN_end_logit_6_OR_REC(6)	-999	-5	(-1000, 9)	fixed		none
Size_DblN_peak_7_WA_REC(7)	42.7	6	(20, 60)	ok	2.75	none
Size_DblN_top_logit_7_WA_REC(7)	-15	-5	(-15, 4)	fixed		none
Size_DblN_ascend_se_7_WA_REC(7)	4.31	6	(-1, 9)	ok	0.518	none
Size_DblN_descend_se_7_WA_REC(7)	20	-5	(-1, 30)	fixed		none
Size_DblN_start_logit_7_WA_REC(7)	-999	-4	(-1000, 9)	fixed		none
Size_DblN_end_logit_7_WA_REC(7)	-999	-5	(-1000, 9)	fixed		none
Size_DblN_peak_9_OR_RECOB(9)	35.1	4	(20, 60)	ok	1.61	none
Size_DblN_top_logit_9_OR_RECOB(9)	-15	-5	(-15, 4)	fixed		none
Size_DblN_ascend_se_9_OR_RECOB(9)	4.6	4	(-1, 9)	ok	0.29	none
Size_DblN_descend_se_9_OR_RECOB(9)	20	-5	(-1, 30)	fixed		none
Size_DblN_start_logit_9_OR_RECOB(9)	-999	-4	(-1000, 9)	fixed		none
Size_DblN_end_logit_9_OR_RECOB(9)	-999	-5	(-1000, 9)	fixed		none
Size_DblN_peak_10_TRI_ORWA(10)	80	4	(20, 80)	HI	0.905	none
Size_DblN_top_logit_10_TRI_ORWA(10)	-15	-5	(-15, 4)	fixed		none
Size_DblN_ascend_se_10_TRI_ORWA(10)	7.08	4	(-1, 9)	ok	0.266	none
Size_DblN_descend_se_10_TRI_ORWA(10)	12	-5	(-1, 30)	fixed		none
Size_DblN_start_logit_10_TRI_ORWA(10)	-999	-4	(-1000, 9)	fixed		none
Size_DblN_end_logit_10_TRI_ORWA(10)	-999	-5	(-1000, 9)	fixed		none
Size_DblN_peak_11_NWFSC_ORWA(11)	48.6	4	(20, 60)	ok	5.45	none
Size_DblN_top_logit_11_NWFSC_ORWA(11)	-15	-5	(-15, 4)	fixed		none
Size_DblN_ascend_se_11_NWFSC_ORWA(11)	6.21	4	(-1, 9)	ok	0.379	none
Size_DblN_descend_se_11_NWFSC_ORWA(11)	20	-5	(-1, 30)	fixed		none
Size_DblN_start_logit_11_NWFSC_ORWA(11)	-999	-4	(-1000, 9)	fixed		none
Size_DblN_end_logit_11_NWFSC_ORWA(11)	-999	-5	(-1000, 9)	fixed		none
Size_DblN_peak_12_IPHC_ORWA(12)	54	4	(20, 60)	ok	1.22	none
Size_DblN_top_logit_12_IPHC_ORWA(12)	-15	-5	(-15, 4)	fixed		none
Size_DblN_ascend_se_12_IPHC_ORWA(12)	4.14	4	(-1, 9)	ok	0.235	none
Size_DblN_descend_se_12_IPHC_ORWA(12)	20	-5	(-1, 30)	fixed		none
Size_DblN_start_logit_12_IPHC_ORWA(12)	-999	-4	(-1000, 9)	fixed		none
Size_DblN_end_logit_12_IPHC_ORWA(12)	-999	-5	(-1000, 9)	fixed		none

Table 12: Data weightings applied to compositions according to the `Francis` method. `Obs.` refers to the number of unique composition vectors included in the likelihood. `N input` and `N adj.` refer to the sample sizes of those vectors before and after being adjusted by the the weights. `CAAL` is conditional age-at-length data.

Type	Fleet	Francis	Obs.	Mean N input	Mean N adj.	Sum N adj.
Length	1_CA_TWL	0.521	38	9.9	5.2	196.8
Length	2_CA_NONTWL	0.287	44	34.9	10.0	441.1
Length	3_CA_REC	0.528	42	45.8	24.2	1015.7
Length	4_ORWA_TWL	0.255	29	37.2	9.5	275.3
Length	5_ORWA_NONTWL	0.362	31	79.3	28.7	888.4
Length	6_OR_REC	0.360	43	52.5	18.9	813.3
Length	7_WA_REC	1.000	26	7.3	7.3	188.6
Length	8_CACPFV	0.553	32	37.6	20.8	665.1
Length	9_OR_RECOB	0.539	20	25.6	13.8	275.9
Length	10_TRI_ORWA	0.453	7	11.2	5.1	35.7
Length	11_NWFSC_ORWA	0.525	21	16.1	8.4	177.3
Length	12_IPHC_ORWA	0.887	21	28.7	25.5	535.1
CAAL	2_CA_NONTWL	1.000	42	1.4	1.4	58.0
CAAL	3_CA_REC	1.000	102	1.5	1.5	153.0
CAAL	4_ORWA_TWL	1.000	353	4.2	4.2	1486.0
CAAL	5_ORWA_NONTWL	0.221	266	8.9	2.0	520.6
CAAL	6_OR_REC	1.000	195	4.1	4.1	798.0
CAAL	7_WA_REC	1.000	177	3.6	3.6	643.0
CAAL	11_NWFSC_ORWA	1.000	382	2.3	2.3	870.0
CAAL	12_IPHC_ORWA	0.086	531	16.0	1.4	733.7

Table 13: Time series of population estimates from the base model.

Year	Total Biomass (mt)	Spawning output	Total Biomass 8+ (mt)	Fraction Unfished	Age-0 Recruits (1,000s)	Total Mortality (mt)	(1-SPR)/(1-SPR_-50%)	Exploitation Rate
1889	9947	1129.70	9803	1.000	234	0	0.000	0.000
1890	9947	1129.70	9803	1.000	234	0	0.001	0.000
1891	9947	1129.68	9803	1.000	234	0	0.002	0.000
1892	9947	1129.66	9803	1.000	234	0	0.027	0.000
1893	9944	1129.19	9799	1.000	235	0	0.027	0.000
1894	9941	1128.74	9795	0.999	235	0	0.027	0.000
1895	9938	1128.28	9792	0.999	235	0	0.010	0.000
1896	9937	1128.13	9790	0.999	235	1	0.006	0.000
1897	9938	1128.05	9791	0.999	235	1	0.006	0.000
1898	9940	1127.97	9792	0.998	236	1	0.006	0.000
1899	9941	1127.91	9794	0.998	236	1	0.008	0.000
1900	9943	1127.85	9796	0.998	236	1	0.009	0.000
1901	9945	1127.81	9798	0.998	236	1	0.010	0.000
1902	9947	1127.80	9800	0.998	236	1	0.011	0.000
1903	9950	1127.82	9802	0.998	237	1	0.012	0.000
1904	9953	1127.89	9805	0.998	237	1	0.014	0.000
1905	9956	1127.99	9808	0.998	237	1	0.014	0.000
1906	9959	1128.14	9811	0.999	238	1	0.016	0.000
1907	9962	1128.33	9814	0.999	238	1	0.017	0.000
1908	9966	1128.56	9818	0.999	238	2	0.025	0.000
1909	9969	1128.70	9820	0.999	239	2	0.019	0.000
1910	9973	1128.99	9824	0.999	239	2	0.020	0.000
1911	9977	1129.30	9828	1.000	240	2	0.021	0.000
1912	9981	1129.63	9832	1.000	240	2	0.023	0.000
1913	9986	1129.98	9836	1.000	241	2	0.024	0.000
1914	9990	1130.36	9841	1.001	241	2	0.025	0.000
1915	9995	1130.74	9845	1.001	241	2	0.030	0.000
1916	10000	1131.07	9849	1.001	242	2	0.027	0.000
1917	10005	1131.49	9854	1.002	242	4	0.038	0.000
1918	10009	1131.77	9858	1.002	242	4	0.148	0.000
1919	9996	1130.02	9845	1.000	241	2	0.066	0.000
1920	9996	1129.86	9845	1.000	240	2	0.061	0.000
1921	9998	1129.84	9847	1.000	239	2	0.059	0.000
1922	10001	1129.91	9849	1.000	237	2	0.044	0.000
1923	10006	1130.28	9854	1.001	234	2	0.050	0.000
1924	10010	1130.59	9859	1.001	231	3	0.082	0.000
1925	10010	1130.39	9859	1.001	228	4	0.103	0.000
1926	10006	1129.86	9856	1.000	225	5	0.146	0.000
1927	9996	1128.55	9847	0.999	221	6	0.185	0.001
1928	9979	1126.56	9831	0.997	217	6	0.183	0.001
1929	9962	1124.68	9816	0.996	214	7	0.163	0.001
1930	9948	1123.29	9804	0.994	212	8	0.182	0.001
1931	9931	1121.57	9788	0.993	209	8	0.130	0.001
1932	9920	1120.89	9780	0.992	207	11	0.122	0.001
1933	9910	1120.38	9772	0.992	205	7	0.120	0.001
1934	9898	1119.87	9762	0.991	203	9	0.147	0.001
1935	9880	1118.81	9746	0.990	200	12	0.146	0.001
1936	9861	1117.71	9729	0.989	197	13	0.193	0.001
1937	9833	1115.58	9702	0.987	194	11	0.176	0.001
1938	9805	1113.65	9676	0.986	191	12	0.186	0.001
1939	9773	1111.33	9646	0.984	188	11	0.148	0.001

Table 13: Time series of population estimates from the base model. *(continued)*

Year	Total Biomass (mt)	Spawning output	Total Biomass 8+ (mt)	Fraction Unfished	Age-0 Recruits (1,000s)	Total Mortality (mt)	(1-SPR)/(1-SPR_-50%)	Exploitation Rate
1940	9746	1109.52	9620	0.982	187	11	0.203	0.001
1941	9708	1106.45	9583	0.979	188	11	0.271	0.001
1942	9656	1101.75	9533	0.975	191	7	0.278	0.001
1943	9600	1096.55	9479	0.971	196	9	0.460	0.001
1944	9506	1086.72	9386	0.962	206	27	0.526	0.003
1945	9406	1076.07	9287	0.953	223	62	0.727	0.007
1946	9261	1060.06	9142	0.938	248	64	0.675	0.007
1947	9127	1045.13	9007	0.925	283	21	0.366	0.002
1948	9061	1037.76	8937	0.919	316	32	0.407	0.004
1949	8988	1029.25	8858	0.911	317	22	0.323	0.002
1950	8933	1022.37	8796	0.905	278	23	0.358	0.003
1951	8877	1014.69	8729	0.898	230	34	0.431	0.004
1952	8814	1005.32	8654	0.890	193	29	0.384	0.003
1953	8767	996.97	8594	0.883	167	25	0.293	0.003
1954	8740	990.40	8559	0.877	152	28	0.364	0.003
1955	8707	982.70	8527	0.870	144	27	0.360	0.003
1956	8678	975.47	8514	0.863	144	32	0.383	0.004
1957	8648	968.37	8506	0.857	149	36	0.470	0.004
1958	8604	960.44	8483	0.850	161	47	0.456	0.006
1959	8558	953.54	8452	0.844	178	39	0.452	0.005
1960	8513	948.15	8415	0.839	188	31	0.438	0.004
1961	8469	944.34	8375	0.836	173	22	0.370	0.003
1962	8433	942.70	8339	0.834	147	26	0.425	0.003
1963	8385	940.60	8289	0.833	131	33	0.324	0.004
1964	8348	940.05	8246	0.832	131	27	0.238	0.003
1965	8319	940.67	8213	0.833	153	38	0.720	0.005
1966	8208	931.46	8100	0.825	184	40	0.324	0.005
1967	8159	928.90	8054	0.822	205	42	0.412	0.005
1968	8094	924.00	7997	0.818	246	45	0.379	0.006
1969	8031	918.70	7939	0.813	269	66	0.802	0.008
1970	7893	904.03	7798	0.800	325	73	0.530	0.009
1971	7800	893.71	7693	0.791	525	87	0.660	0.011
1972	7682	879.98	7559	0.779	283	116	0.711	0.015
1973	7545	862.88	7404	0.764	210	116	0.801	0.016
1974	7409	844.20	7247	0.747	232	127	0.848	0.017
1975	7271	823.72	7085	0.729	341	131	0.787	0.019
1976	7151	804.04	6947	0.712	279	139	0.925	0.020
1977	7018	781.57	6798	0.692	262	130	0.979	0.019
1978	6895	759.46	6675	0.672	187	222	1.198	0.033
1979	6667	724.88	6506	0.642	239	176	1.434	0.027
1980	6422	688.59	6267	0.610	293	115	1.401	0.018
1981	6246	661.23	6077	0.585	312	197	1.500	0.032
1982	5990	626.65	5812	0.555	334	318	1.723	0.055
1983	5520	570.52	5363	0.505	236	115	1.775	0.022
1984	5128	523.04	4977	0.463	295	125	1.643	0.025
1985	4910	495.73	4760	0.439	245	136	1.767	0.028
1986	4605	459.46	4435	0.407	173	98	1.726	0.022
1987	4370	430.64	4189	0.381	133	130	1.721	0.031
1988	4151	403.85	3972	0.357	98	124	1.714	0.031
1989	3964	381.13	3797	0.337	83	111	1.805	0.029
1990	3718	352.43	3575	0.312	75	127	1.714	0.035
1991	3549	332.72	3413	0.295	68	181	1.836	0.053

Table 13: Time series of population estimates from the base model. *(continued)*

Year	Total Biomass (mt)	Spawning output	Total Biomass 8+ (mt)	Fraction Unfished	Age-0 Recruits (1,000s)	Total Mortality (mt)	(1-SPR)/(1-SPR_-50%)	Exploita-tion Rate
1992	3248	301.04	3142	0.266	78	133	1.859	0.042
1993	2969	272.41	2890	0.241	151	61	1.850	0.021
1994	2704	245.14	2641	0.217	127	68	1.790	0.026
1995	2548	231.01	2495	0.204	61	64	1.820	0.026
1996	2378	216.64	2328	0.192	58	84	1.840	0.036
1997	2188	200.68	2137	0.178	69	78	1.874	0.037
1998	1973	181.86	1917	0.161	108	27	1.650	0.014
1999	1907	177.32	1843	0.157	164	35	1.744	0.019
2000	1800	168.24	1731	0.149	91	12	1.168	0.007
2001	1814	171.24	1758	0.152	107	10	1.116	0.005
2002	1830	173.72	1782	0.154	347	2	0.430	0.001
2003	1883	179.89	1827	0.159	148	4	0.423	0.002
2004	1937	186.11	1870	0.165	99	2	0.289	0.001
2005	2000	192.54	1916	0.170	149	2	0.307	0.001
2006	2067	198.82	1971	0.176	249	1	0.235	0.001
2007	2139	205.28	2044	0.182	260	5	0.398	0.002
2008	2213	211.19	2095	0.187	423	2	0.257	0.001
2009	2295	217.42	2154	0.192	337	5	0.338	0.002
2010	2382	223.59	2280	0.198	322	1	0.167	0.000
2011	2485	230.50	2370	0.204	251	2	0.217	0.001
2012	2598	237.73	2447	0.210	224	3	0.286	0.001
2013	2722	245.33	2535	0.217	509	2	0.235	0.001
2014	2858	253.92	2654	0.225	248	1	0.197	0.000
2015	3007	263.55	2786	0.233	326	2	0.268	0.001
2016	3166	273.78	2970	0.242	228	1	0.192	0.000
2017	3338	285.38	3152	0.253	117	6	0.390	0.002
2018	3512	297.29	3331	0.263	114	5	0.349	0.001
2019	3695	310.98	3501	0.275	119	6	0.407	0.002
2020	3877	326.09	3664	0.289	119	2	0.297	0.001
2021	4065	343.67	3915	0.304	157	7	0.338	0.002
2022	4248	362.88	4108	0.321	179	9	0.483	0.002
2023	4412	382.50	4313	0.339	184	12	0.527	0.003
2024	4564	402.94	4488	0.357	195	5	0.221	0.001
2025	4732	426.87	4651	0.378	197	19	0.595	0.004
2026	4856	448.23	4769	0.397	200	19	0.588	0.004
2027	4971	469.51	4874	0.416	202	28	0.921	0.006
2028	5026	484.88	4916	0.429	203	28	0.915	0.006
2029	5072	498.65	4955	0.441	204	28	0.910	0.006
2030	5110	510.37	4990	0.452	205	28	0.905	0.006
2031	5142	519.89	5018	0.460	206	28	0.899	0.006
2032	5168	527.28	5043	0.467	206	28	0.894	0.006
2033	5190	532.81	5064	0.472	207	28	0.888	0.006
2034	5209	536.85	5082	0.475	207	28	0.884	0.006
2035	5226	539.78	5098	0.478	207	28	0.878	0.006
2036	5241	541.94	5112	0.480	207	28	0.872	0.006
1889	9947	1129.70	9803	1.000	234	0	0.000	0.000
1890	9947	1129.70	9803	1.000	234	0	0.001	0.000
1891	9947	1129.68	9803	1.000	234	0	0.002	0.000
1892	9947	1129.66	9803	1.000	234	4	0.027	0.000
1893	9944	1129.19	9799	1.000	235	4	0.027	0.000
1894	9941	1128.74	9795	0.999	235	4	0.027	0.000
1895	9938	1128.28	9792	0.999	235	1	0.010	0.000

Table 13: Time series of population estimates from the base model. *(continued)*

Year	Total Biomass (mt)	Spawning output	Total Biomass 8+ (mt)	Fraction Unfished	Age-0 Recruits (1,000s)	Total Mortality (mt)	(1-SPR)/(1-SPR_-50%)	Exploita-tion Rate
1896	9937	1128.13	9790	0.999	235	0	0.006	0.000
1897	9938	1128.05	9791	0.999	235	0	0.006	0.000
1898	9940	1127.97	9792	0.998	236	0	0.006	0.000
1899	9941	1127.91	9794	0.998	236	0	0.008	0.000
1900	9943	1127.85	9796	0.998	236	0	0.009	0.000
1901	9945	1127.81	9798	0.998	236	0	0.010	0.000
1902	9947	1127.80	9800	0.998	236	0	0.011	0.000
1903	9950	1127.82	9802	0.998	237	1	0.012	0.000
1904	9953	1127.89	9805	0.998	237	1	0.014	0.000
1905	9956	1127.99	9808	0.998	237	1	0.014	0.000
1906	9959	1128.14	9811	0.999	238	1	0.016	0.000
1907	9962	1128.33	9814	0.999	238	1	0.017	0.000
1908	9966	1128.56	9818	0.999	238	2	0.025	0.000
1909	9969	1128.70	9820	0.999	239	1	0.019	0.000
1910	9973	1128.99	9824	0.999	239	1	0.020	0.000
1911	9977	1129.30	9828	1.000	240	1	0.021	0.000
1912	9981	1129.63	9832	1.000	240	1	0.023	0.000
1913	9986	1129.98	9836	1.000	241	1	0.024	0.000
1914	9990	1130.36	9841	1.001	241	2	0.025	0.000
1915	9995	1130.74	9845	1.001	241	2	0.030	0.000
1916	10000	1131.07	9849	1.001	242	2	0.027	0.000
1917	10005	1131.49	9854	1.002	242	2	0.038	0.000
1918	10009	1131.77	9858	1.002	242	19	0.148	0.002
1919	9996	1130.02	9845	1.000	241	8	0.066	0.001
1920	9996	1129.86	9845	1.000	240	7	0.061	0.001
1921	9998	1129.84	9847	1.000	239	6	0.059	0.001
1922	10001	1129.91	9849	1.000	237	4	0.044	0.000
1923	10006	1130.28	9854	1.001	234	5	0.050	0.001
1924	10010	1130.59	9859	1.001	231	9	0.082	0.001
1925	10010	1130.39	9859	1.001	228	11	0.103	0.001
1926	10006	1129.86	9856	1.000	225	17	0.146	0.002
1927	9996	1128.55	9847	0.999	221	23	0.185	0.002
1928	9979	1126.56	9831	0.997	217	22	0.183	0.002
1929	9962	1124.68	9816	0.996	214	18	0.163	0.002
1930	9948	1123.29	9804	0.994	212	20	0.182	0.002
1931	9931	1121.57	9788	0.993	209	12	0.130	0.001
1932	9920	1120.89	9780	0.992	207	7	0.122	0.001
1933	9910	1120.38	9772	0.992	205	10	0.120	0.001
1934	9898	1119.87	9762	0.991	203	13	0.147	0.001
1935	9880	1118.81	9746	0.990	200	10	0.146	0.001
1936	9861	1117.71	9729	0.989	197	17	0.193	0.002
1937	9833	1115.58	9702	0.987	194	15	0.176	0.002
1938	9805	1113.65	9676	0.986	191	16	0.186	0.002
1939	9773	1111.33	9646	0.984	188	11	0.148	0.001
1940	9746	1109.52	9620	0.982	187	19	0.203	0.002
1941	9708	1106.45	9583	0.979	188	31	0.271	0.003
1942	9656	1101.75	9533	0.975	191	37	0.278	0.004
1943	9600	1096.55	9479	0.971	196	72	0.460	0.008
1944	9506	1086.72	9386	0.962	206	59	0.526	0.006
1945	9406	1076.07	9287	0.953	223	68	0.727	0.007
1946	9261	1060.06	9142	0.938	248	56	0.675	0.006
1947	9127	1045.13	9007	0.925	283	32	0.366	0.004

Table 13: Time series of population estimates from the base model. *(continued)*

Year	Total Biomass (mt)	Spawning output	Total Biomass 8+ (mt)	Fraction Unfished	Age-0 Recruits (1,000s)	Total Mortality (mt)	(1-SPR)/(1-SPR_-50%)	Exploita-tion Rate
1948	9061	1037.76	8937	0.919	316	29	0.407	0.003
1949	8988	1029.25	8858	0.911	317	24	0.323	0.003
1950	8933	1022.37	8796	0.905	278	28	0.358	0.003
1951	8877	1014.69	8729	0.898	230	30	0.431	0.003
1952	8814	1005.32	8654	0.890	193	26	0.384	0.003
1953	8767	996.97	8594	0.883	167	16	0.293	0.002
1954	8740	990.40	8559	0.877	152	23	0.364	0.003
1955	8707	982.70	8527	0.870	144	23	0.360	0.003
1956	8678	975.47	8514	0.863	144	21	0.383	0.003
1957	8648	968.37	8506	0.857	149	31	0.470	0.004
1958	8604	960.44	8483	0.850	161	21	0.456	0.002
1959	8558	953.54	8452	0.844	178	25	0.452	0.003
1960	8513	948.15	8415	0.839	188	30	0.438	0.004
1961	8469	944.34	8375	0.836	173	28	0.370	0.003
1962	8433	942.70	8339	0.834	147	32	0.425	0.004
1963	8385	940.60	8289	0.833	131	11	0.324	0.001
1964	8348	940.05	8246	0.832	131	5	0.238	0.001
1965	8319	940.67	8213	0.833	153	73	0.720	0.009
1966	8208	931.46	8100	0.825	184	6	0.324	0.001
1967	8159	928.90	8054	0.822	205	16	0.412	0.002
1968	8094	924.00	7997	0.818	246	9	0.379	0.001
1969	8031	918.70	7939	0.813	269	62	0.802	0.008
1970	7893	904.03	7798	0.800	325	13	0.530	0.002
1971	7800	893.71	7693	0.791	525	25	0.660	0.003
1972	7682	879.98	7559	0.779	283	22	0.711	0.003
1973	7545	862.88	7404	0.764	210	33	0.801	0.004
1974	7409	844.20	7247	0.747	232	36	0.848	0.005
1975	7271	823.72	7085	0.729	341	23	0.787	0.003
1976	7151	804.04	6947	0.712	279	41	0.925	0.006
1977	7018	781.57	6798	0.692	262	51	0.979	0.007
1978	6895	759.46	6675	0.672	187	77	1.198	0.011
1979	6667	724.88	6506	0.642	239	151	1.434	0.023
1980	6422	688.59	6267	0.610	293	152	1.401	0.024
1981	6246	661.23	6077	0.585	312	157	1.500	0.026
1982	5990	626.65	5812	0.555	334	259	1.723	0.045
1983	5520	570.52	5363	0.505	236	388	1.775	0.072
1984	5128	523.04	4977	0.463	295	210	1.643	0.042
1985	4910	495.73	4760	0.439	245	293	1.767	0.062
1986	4605	459.46	4435	0.407	173	265	1.726	0.060
1987	4370	430.64	4189	0.381	133	223	1.721	0.053
1988	4151	403.85	3972	0.357	98	199	1.714	0.050
1989	3964	381.13	3797	0.337	83	272	1.805	0.072
1990	3718	352.43	3575	0.312	75	176	1.714	0.049
1991	3549	332.72	3413	0.295	68	250	1.836	0.073
1992	3248	301.04	3142	0.266	78	267	1.859	0.085
1993	2969	272.41	2890	0.241	151	316	1.850	0.109
1994	2704	245.14	2641	0.217	127	189	1.790	0.072
1995	2548	231.01	2495	0.204	61	200	1.820	0.080
1996	2378	216.64	2328	0.192	58	194	1.840	0.083
1997	2188	200.68	2137	0.178	69	218	1.874	0.102
1998	1973	181.86	1917	0.161	108	113	1.650	0.059
1999	1907	177.32	1843	0.157	164	141	1.744	0.077

Table 13: Time series of population estimates from the base model. *(continued)*

Year	Total Biomass (mt)	Spawning output	Total Biomass 8+ (mt)	Fraction Unfished	Age-0 Recruits (1,000s)	Total Mortality (mt)	(1-SPR)/(1-SPR_-50%)	Exploitation Rate
2000	1800	168.24	1731	0.149	91	40	1.168	0.023
2001	1814	171.24	1758	0.152	107	42	1.116	0.024
2002	1830	173.72	1782	0.154	347	11	0.430	0.006
2003	1883	179.89	1827	0.159	148	8	0.423	0.004
2004	1937	186.11	1870	0.165	99	7	0.289	0.004
2005	2000	192.54	1916	0.170	149	8	0.307	0.004
2006	2067	198.82	1971	0.176	249	7	0.235	0.003
2007	2139	205.28	2044	0.182	260	8	0.398	0.004
2008	2213	211.19	2095	0.187	423	7	0.257	0.003
2009	2295	217.42	2154	0.192	337	6	0.338	0.003
2010	2382	223.59	2280	0.198	322	5	0.167	0.002
2011	2485	230.50	2370	0.204	251	6	0.217	0.002
2012	2598	237.73	2447	0.210	224	8	0.286	0.003
2013	2722	245.33	2535	0.217	509	8	0.235	0.003
2014	2858	253.92	2654	0.225	248	7	0.197	0.003
2015	3007	263.55	2786	0.233	326	10	0.268	0.003
2016	3166	273.78	2970	0.242	228	8	0.192	0.003
2017	3338	285.38	3152	0.253	117	14	0.390	0.004
2018	3512	297.29	3331	0.263	114	14	0.349	0.004
2019	3695	310.98	3501	0.275	119	17	0.407	0.005
2020	3877	326.09	3664	0.289	119	16	0.297	0.004
2021	4065	343.67	3915	0.304	157	14	0.338	0.004
2022	4248	362.88	4108	0.321	179	24	0.483	0.006
2023	4412	382.50	4313	0.339	184	28	0.527	0.006
2024	4564	402.94	4488	0.357	195	10	0.221	0.002
2025	4732	426.87	4651	0.378	197	30	0.595	0.006
2026	4856	448.23	4769	0.397	200	31	0.588	0.006
2027	4971	469.51	4874	0.416	202	73	0.921	0.015
2028	5026	484.88	4916	0.429	203	73	0.915	0.015
2029	5072	498.65	4955	0.441	204	73	0.910	0.015
2030	5110	510.37	4990	0.452	205	73	0.905	0.015
2031	5142	519.89	5018	0.460	206	72	0.899	0.014
2032	5168	527.28	5043	0.467	206	72	0.894	0.014
2033	5190	532.81	5064	0.472	207	71	0.888	0.014
2034	5209	536.85	5082	0.475	207	70	0.884	0.014
2035	5226	539.78	5098	0.478	207	69	0.878	0.014
2036	5241	541.94	5112	0.480	207	68	0.872	0.013

Label	Base	CA.REC.index	OR.REC.index	WA.REC.index	CA.CPFV.index	ORBS.index	AFSC.triennial.index	NWF tom.t dex
Diff. in likelihood from base model								
Total	0	4.24	-26.23	4.15	-160.13	-103.85	-25.46	-1461
Index	0	4.109	-26.403	3.972	6.761	3.485	1.172	5.527
Length comp	0	0.08	0.09	-2.33	-163.47	-99	-24.41	-83.5
Age comp	0	0.04	-0.72	2.46	-5.2	-8.42	-2.26	-1378
Recruitment	0	-0.042	0.843	-0.028	1.772	0.12	0.059	-4.75
Parm priors	0	0	0	0	0	0	0	0
Estimates of key parameters								
Recruitment unfished thousands	229.328	224.516	237.639	219.483	234.057	230.024	230.61	231.8
log(R0)	5.435	5.414	5.471	5.391	5.456	5.438	5.441	5.446
M Female	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044
L at Amax Female	61.4	61.4	61.4	61.4	61.4	61.4	61.3	61.5
Estimates of derived quantities								
Unfished age 4+ bio 1000 mt	9.803	9.6	10.159	9.378	10.009	9.849	9.846	9.944
B0 trillions of eggs	1129.7	1106.36	1170.65	1080.56	1153.48	1135.74	1133.93	1143.
B2025 trillions of eggs	426.872	406.706	458.975	385.859	448.198	439.599	434.007	433.6
Fraction unfished 2025	0.378	0.368	0.392	0.357	0.389	0.387	0.383	0.379
Fishing intensity 2024	0.221	0.231	0.208	0.241	0.212	0.216	0.218	0.222

Label	Base	CA.REC.index	OR.REC.index	WA.REC.index	CA.CPFV.index	ORBS.index	AFSC.triennial.index	NWF tom.t dex
Diff. in likelihood from base model								
Total	0	4.24	-26.23	4.15	-160.13	-103.85	-25.46	-1461
Index	0	4.109	-26.403	3.972	6.761	3.485	1.172	5.527
Length comp	0	0.08	0.09	-2.33	-163.47	-99	-24.41	-83.5
Age comp	0	0.04	-0.72	2.46	-5.2	-8.42	-2.26	-1378
Recruitment	0	-0.042	0.843	-0.028	1.772	0.12	0.059	-4.75
Parm priors	0	0	0	0	0	0	0	0
Estimates of key parameters								
Recruitment unfished thousands	229.328	224.516	237.639	219.483	234.057	230.024	230.61	231.8
log(R0)	5.435	5.414	5.471	5.391	5.456	5.438	5.441	5.446
M Female	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044
L at Amax Female	61.4	61.4	61.4	61.4	61.4	61.4	61.3	61.5
Estimates of derived quantities								
Unfished age 4+ bio 1000 mt	9.803	9.6	10.159	9.378	10.009	9.849	9.846	9.944
B0 trillions of eggs	1129.7	1106.36	1170.65	1080.56	1153.48	1135.74	1133.93	1143.
B2025 trillions of eggs	426.872	406.706	458.975	385.859	448.198	439.599	434.007	433.6
Fraction unfished 2025	0.378	0.368	0.392	0.357	0.389	0.387	0.383	0.379
Fishing intensity 2024	0.221	0.231	0.208	0.241	0.212	0.216	0.218	0.222

Table 16: Summary of reference points and management quantities, including estimates of the 95 percent confidence intervals. SO is spawning output, SPR is the spawning potential ratio, and MSY is maximum sustainable yield.

Reference Point	Estimate	Lower Interval	Upper Interval
Unfished Spawning output	1,129.7	992.2	1,267.2
Unfished Age 8+ Biomass (mt)	9,803	8,612	10,995
Unfished Recruitment (R0)	229	201	257
2025 Spawning output	427	339	515
2025 Fraction Unfished	0.378	0.327	0.429
Reference Points Based SO40%	—	—	—
Proxy Spawning output SO40%	452	397	507
SPR Resulting in SO40%	0.459	0.459	0.459
Exploitation Rate Resulting in SO40%	0.026	0.026	0.027
Yield with SPR Based On SO40% (mt)	115	101	130
Reference Points Based on SPR Proxy for MSY	—	—	—
Proxy Spawning output (SPR50)	503	442	565
SPR50	0.500	—	—
Exploitation Rate Corresponding to SPR50	0.023	0.023	0.023
Yield with SPR50 at SO SPR (mt)	111	97	124
Reference Points Based on Estimated MSY Values	—	—	—
Spawning output at MSY (SO MSY)	327	287	367
SPR MSY	0.359	0.358	0.361
Exploitation Rate Corresponding to SPR MSY	0.036	0.036	0.037
MSY (mt)	121	106	136

5.4 Management

Table 17: Potential OFLs (mt), ABCs (mt), ACLs (mt), the buffer between the OFL and ABC, estimated spawning output, and fraction of unfished spawning output with adopted OFLs and ACLs and assumed catch for the first two years of the projection period.

Year	Adopted OFL (mt)	Adopted ACL (mt)	Assumed Catch (mt)	OFL (mt)	Buffer	ABC (mt)	ACL (mt)	Spawning output
2025	106	56	49	—	—	—	—	427
2026	108	57	50	—	—	—	—	448
2027	—	—	—	115	0.873	101	101	470
2028	—	—	—	117	0.864	101	101	485
2029	—	—	—	118	0.856	101	101	499
2030	—	—	—	119	0.848	101	101	510
2031	—	—	—	120	0.840	100	100	520
2032	—	—	—	120	0.832	100	100	527
2033	—	—	—	120	0.824	99	99	533
2034	—	—	—	120	0.817	98	98	537
2035	—	—	—	120	0.809	97	97	540
2036	—	—	—	121	0.801	97	97	542

Table 18: TODO: UPDATE PLACEHOLDER DECISION TABLE CAPTION COPIED FROM PETRALE SOLE. Decision table with 10-year projections. 'Mgmt' refers to the three management scenarios (A) the default harvest control rule $P^* = 0.45$, (B) harvest control rule with a lower $P^* = 0.40$. In each case the 2023 and 2024 catches are fixed at the ACLs which have been set for that year with estimated fleet allocation provided by the GMT. The alternative states of nature ('Low', 'Base', and 'High' as discussed in the text) are provided in the columns, with Spawning Output ('Spawn', in trillions of eggs) and Fraction of unfished spawning output ('Frac') provided for each state.

Mgmt	Year	Catch	Low Spawn	Low Frac	Base Spawn	Base Frac	High Spawn	High Frac
A	2023	12	132.23	0.303	132.23	0.303	132.23	0.303
	2024	5	141.21	0.204	141.21	0.204	141.21	0.204
	2025	19	151.20	0.346	151.20	0.346	151.20	0.346
	2026	19	160.10	0.231	160.10	0.231	160.10	0.231
	2027	28	168.95	0.387	168.95	0.387	168.95	0.387
	2028	28	176.67	0.255	176.67	0.255	176.67	0.255
	2029	28	183.75	0.420	183.75	0.420	183.75	0.420
	2030	28	190.02	0.274	190.02	0.274	190.02	0.274
	2031	28	195.41	0.447	195.41	0.447	195.41	0.447
	2032	28	199.94	0.289	199.94	0.289	199.94	0.289
	2033	28	203.70	0.466	203.70	0.466	203.70	0.466
	2034	28	206.82	0.299	206.82	0.299	206.82	0.299
	2023	28	250.27	0.573	250.27	0.573	250.27	0.573
	2024	10	261.73	0.378	261.73	0.378	261.73	0.378
	2025	30	275.68	0.631	275.68	0.631	275.68	0.631
	2026	31	288.13	0.416	288.13	0.416	288.13	0.416
	2027	73	300.56	0.688	300.56	0.688	300.56	0.688
	2028	73	308.21	0.445	308.21	0.445	308.21	0.445
	2029	73	314.90	0.720	314.90	0.720	314.90	0.720
	2030	73	320.35	0.463	320.35	0.463	320.35	0.463
	2031	72	324.48	0.742	324.48	0.742	324.48	0.742
	2032	72	327.34	0.473	327.34	0.473	327.34	0.473
	2033	71	329.11	0.753	329.11	0.753	329.11	0.753
	2034	70	330.03	0.477	330.03	0.477	330.03	0.477
B	2023	12	132.23	0.303	132.23	0.303	132.23	0.303
	2024	5	141.21	0.204	141.21	0.204	141.21	0.204
	2025	19	151.20	0.346	151.20	0.346	151.20	0.346
	2026	19	160.10	0.231	160.10	0.231	160.10	0.231
	2027	28	168.95	0.387	168.95	0.387	168.95	0.387
	2028	28	176.67	0.255	176.67	0.255	176.67	0.255
	2029	28	183.75	0.420	183.75	0.420	183.75	0.420
	2030	28	190.02	0.274	190.02	0.274	190.02	0.274
	2031	28	195.41	0.447	195.41	0.447	195.41	0.447
	2032	28	199.94	0.289	199.94	0.289	199.94	0.289
	2033	28	203.70	0.466	203.70	0.466	203.70	0.466
	2034	28	206.82	0.299	206.82	0.299	206.82	0.299
	2023	28	250.27	0.573	250.27	0.573	250.27	0.573
	2024	10	261.73	0.378	261.73	0.378	261.73	0.378
	2025	30	275.68	0.631	275.68	0.631	275.68	0.631
	2026	31	288.13	0.416	288.13	0.416	288.13	0.416
	2027	73	300.56	0.688	300.56	0.688	300.56	0.688
	2028	73	308.21	0.445	308.21	0.445	308.21	0.445
	2029	73	314.90	0.720	314.90	0.720	314.90	0.720
	2030	73	320.35	0.463	320.35	0.463	320.35	0.463
	2031	72	324.48	0.742	324.48	0.742	324.48	0.742
	2032	72	327.34	0.473	327.34	0.473	327.34	0.473
	2033	71	329.11	0.753	329.11	0.753	329.11	0.753
	2034	70	330.03	0.477	330.03	0.477	330.03	0.477
C	2023	12	132.23	0.303	132.23	0.303	132.23	0.303
	2024	5	141.21	0.204	141.21	0.204	141.21	0.204

#Figures

#Figures

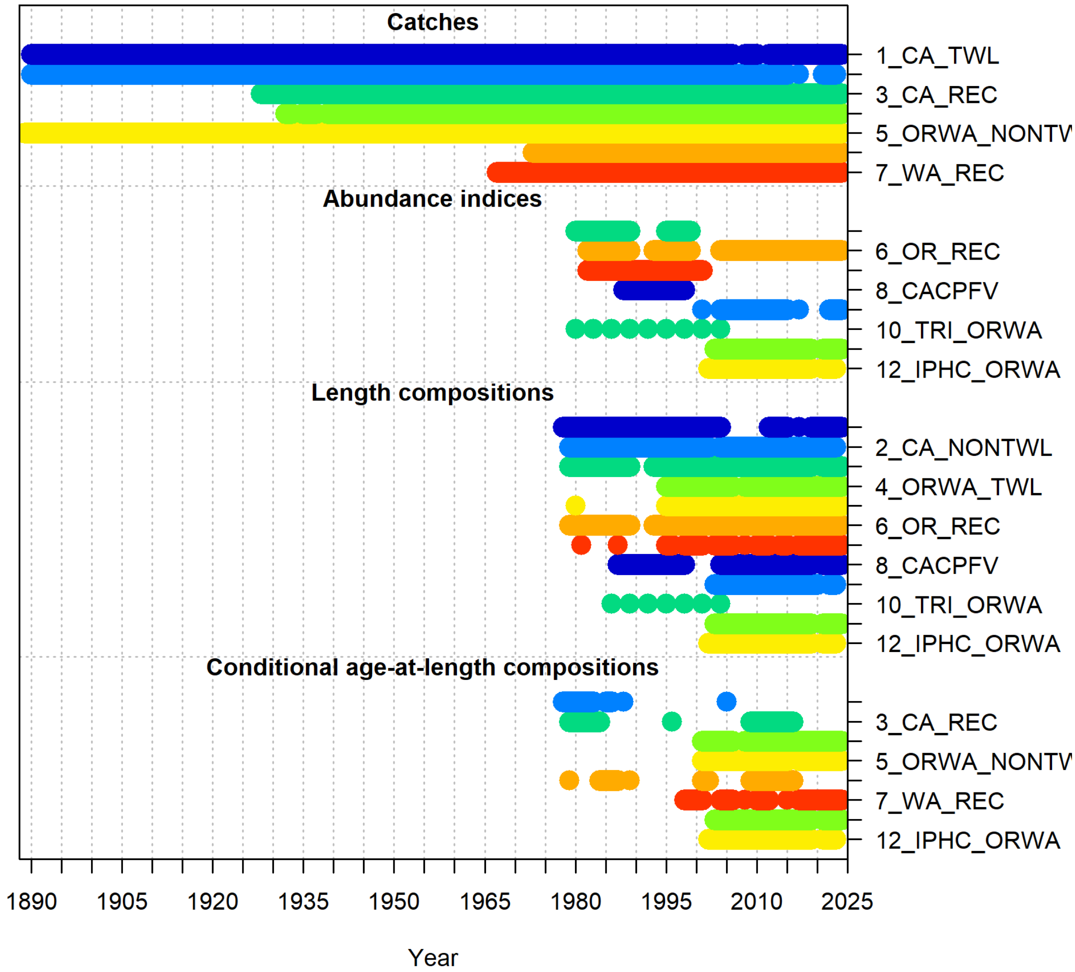

Figure 1: Summary of data sources used in the base model.

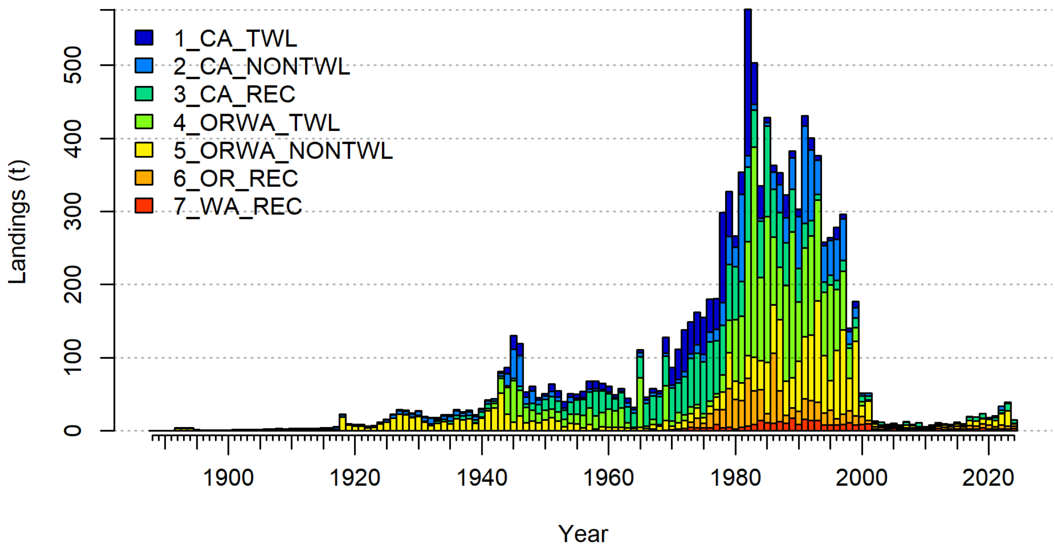

Figure 2: Landings (mt) by year and fleet.

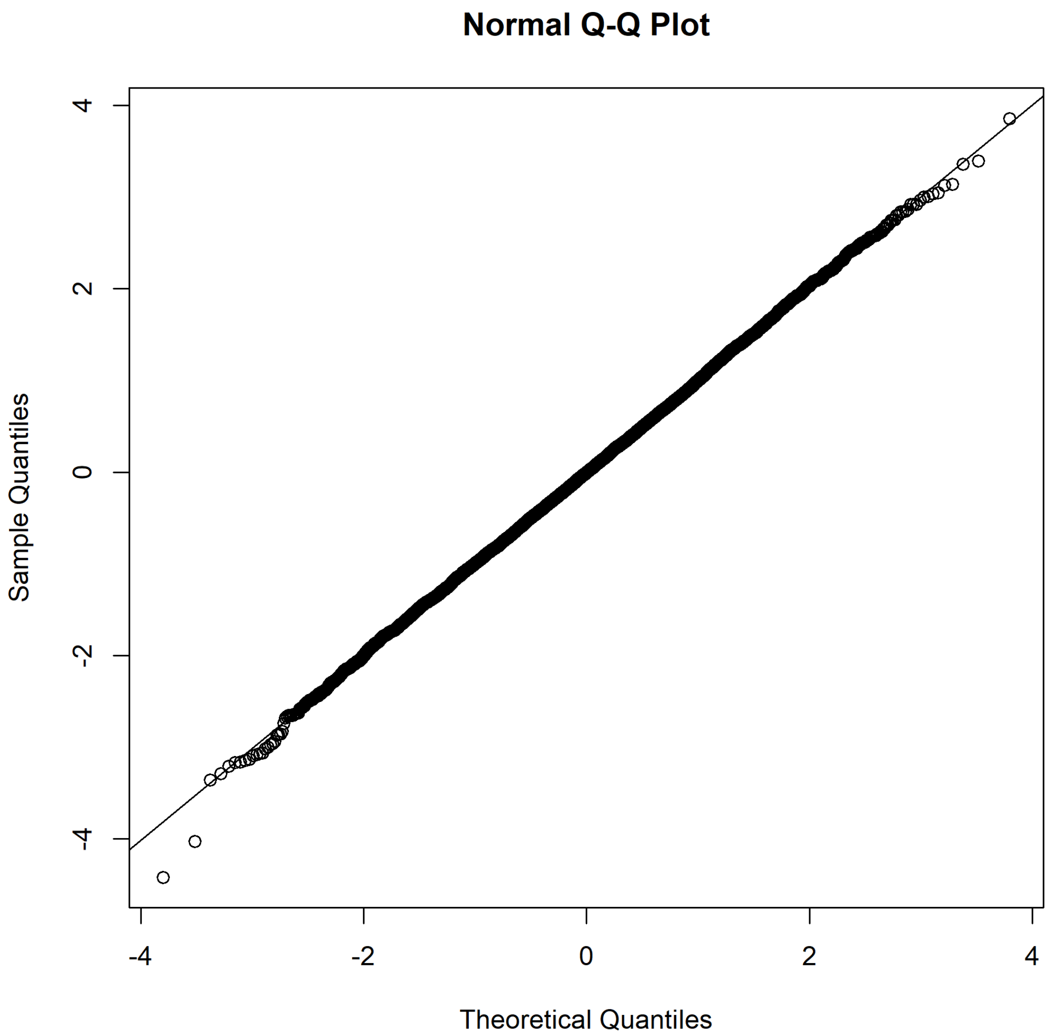

Figure 3: Quantile-quantile plot for the sdmTMB model fit for the Oregon Onboard Observer (ORFS) index.

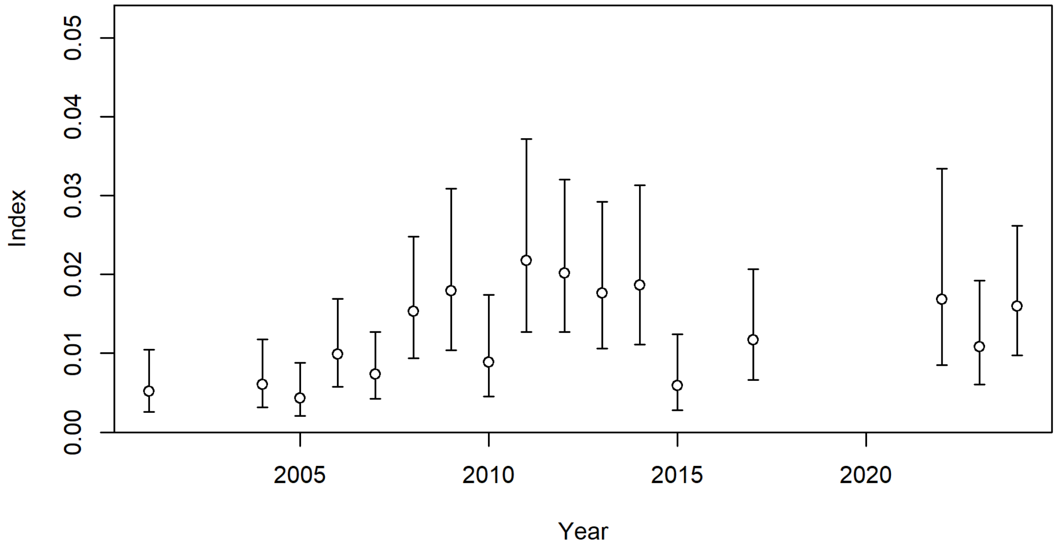

Figure 4: Annual relative index of abundance for the Oregon Onboard Observer (ORFS) index.

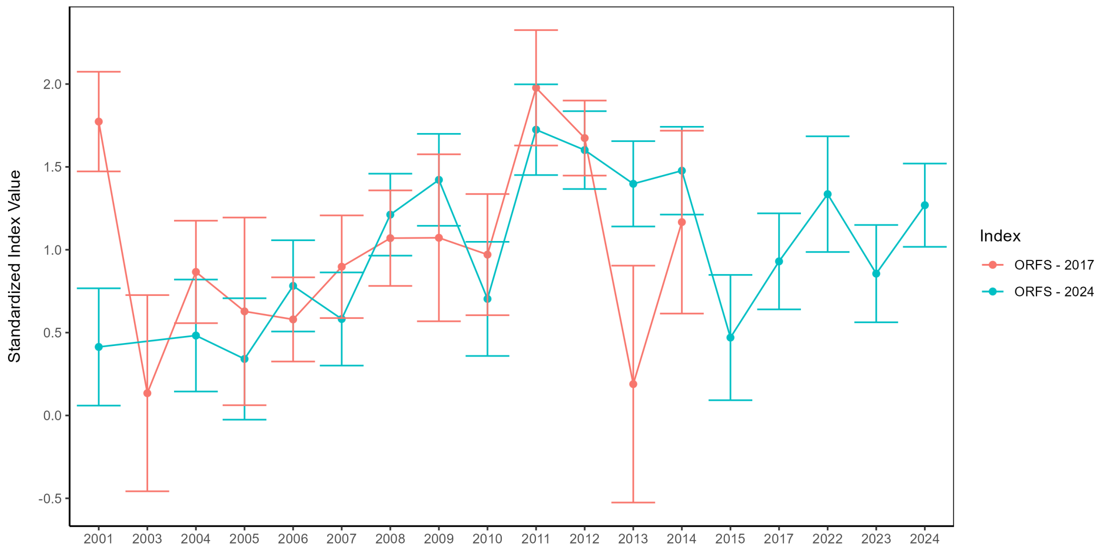

Figure 5: Comparison of Oregon Onboard Observer indices from the 2017 and the current assessment.

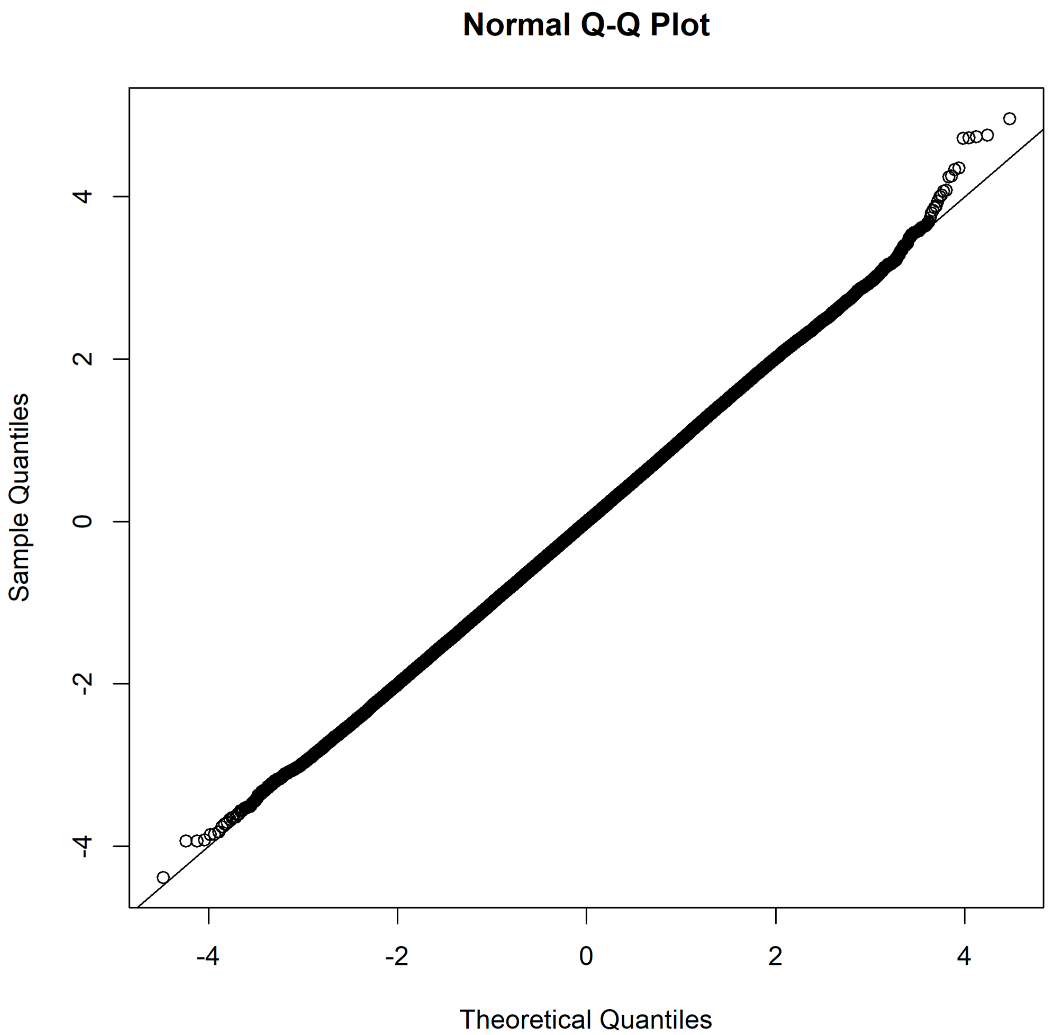

Figure 6: Quantile-quantile plot for the sdmTMB model fit for the updated portion of the Oregon recreational (ORBS) index.

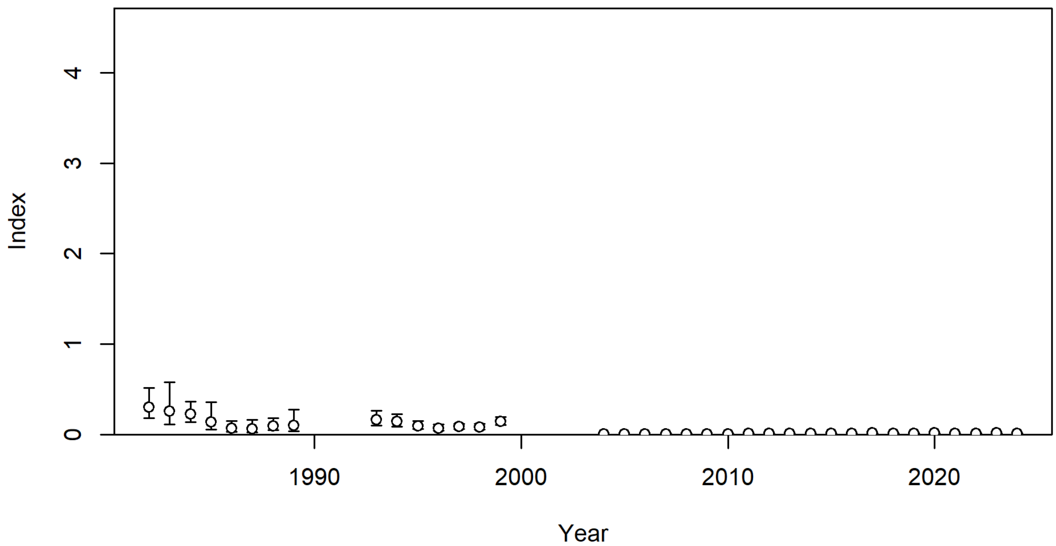

Figure 7: Annual relative index of abundance for the Oregon recreational index, including both MRFSS (1980 - 1999) and ORBS (2004 - 2024) indices.

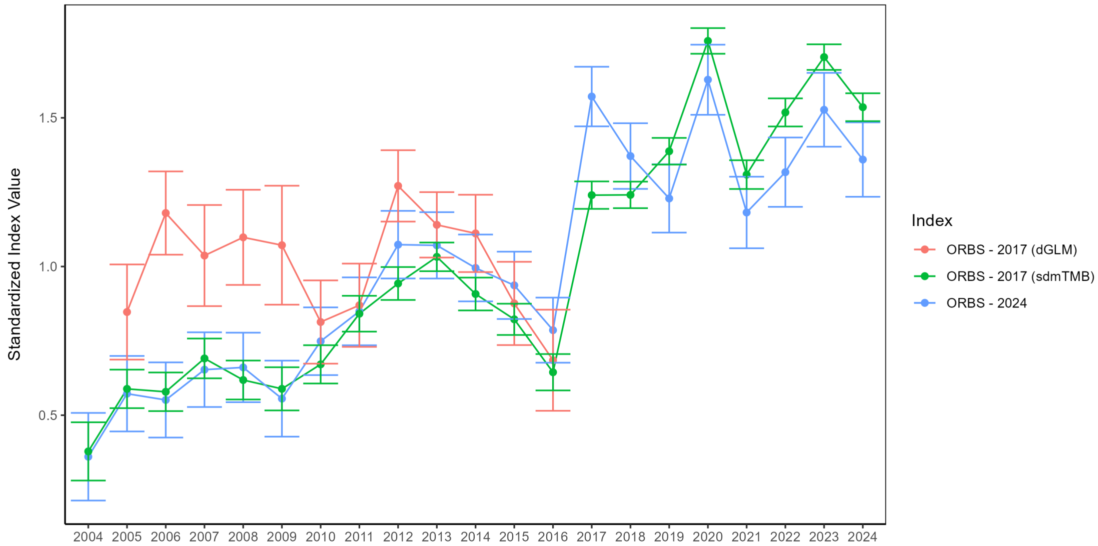

Figure 8: Comparison of the 2017 ORBS index (delta-GLM), the 2017 ORBS model (implemented in sdmTMB), and the current ORBS index (sdmTMB).

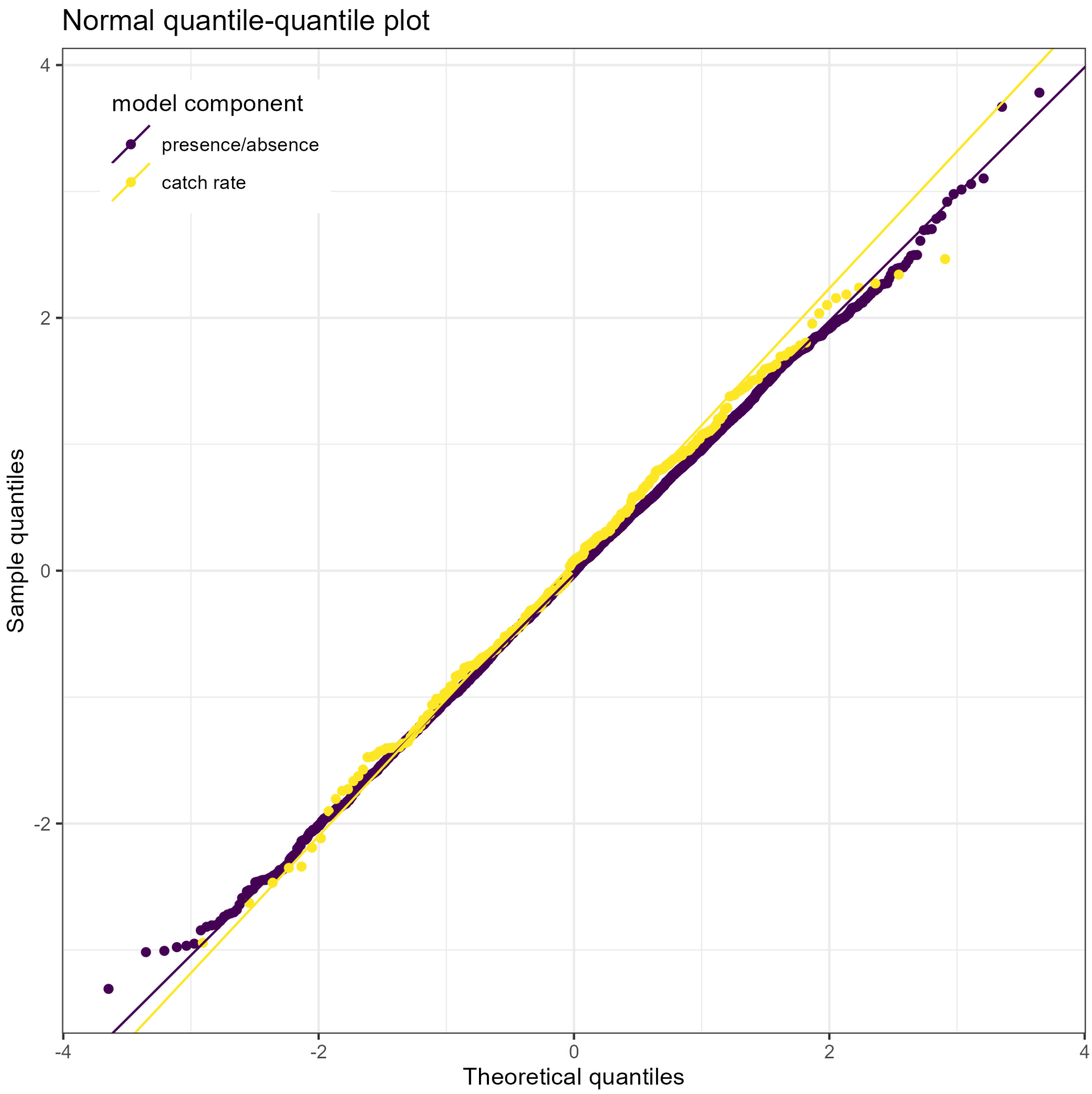

Figure 9: Quantile-quantile plot for the sdmTMB model fit for the NWFSC West Coast Groundfish Bottom Trawl Survey (WCGBTS) index.

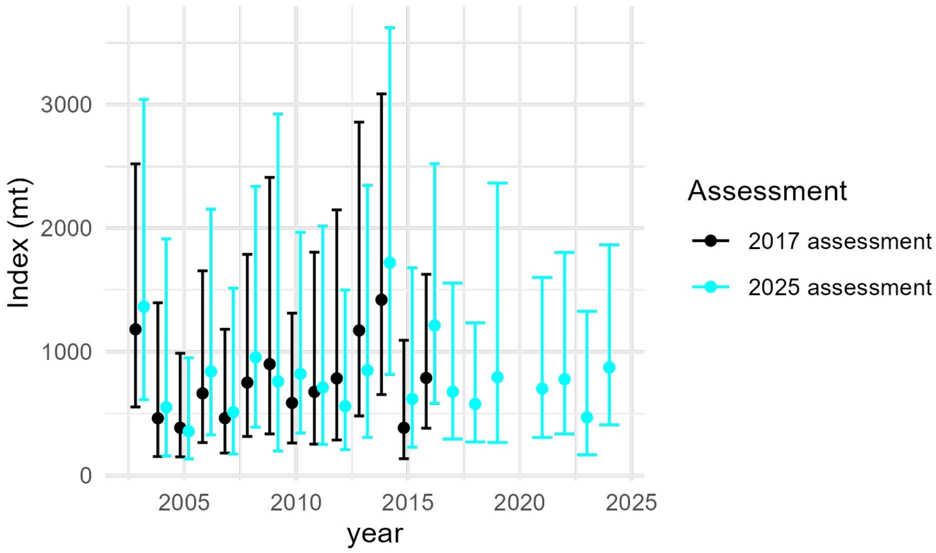

Figure 10: Comparison of the 2017 NWFSC West Coast Groundfish Bottom Trawl Survey (WCGBTS) and the current WCBTS index of abundance.

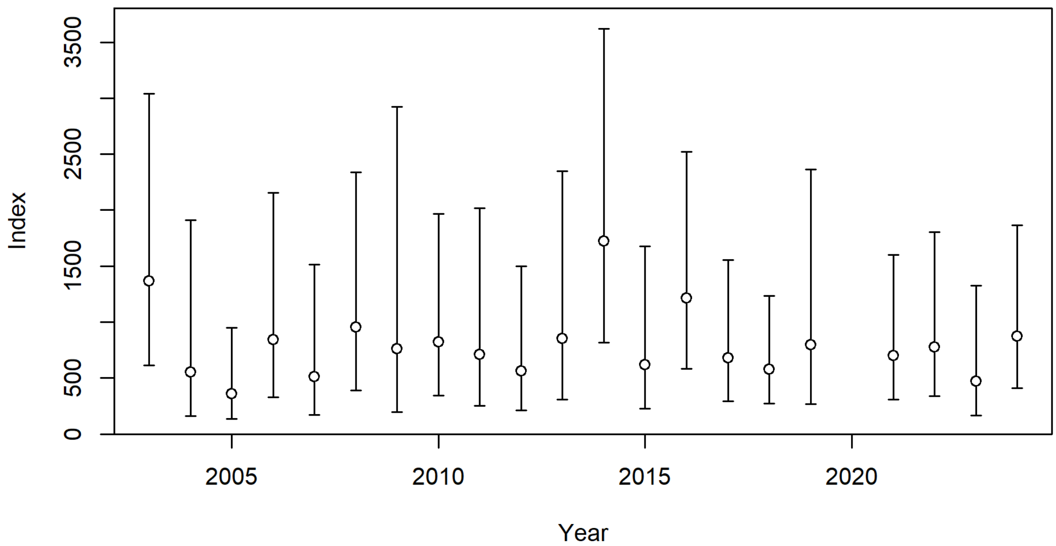

Figure 11: Annual relative index of abundance for the West Coast Groundfish Bottom Trawl Survey (WCGBTS).

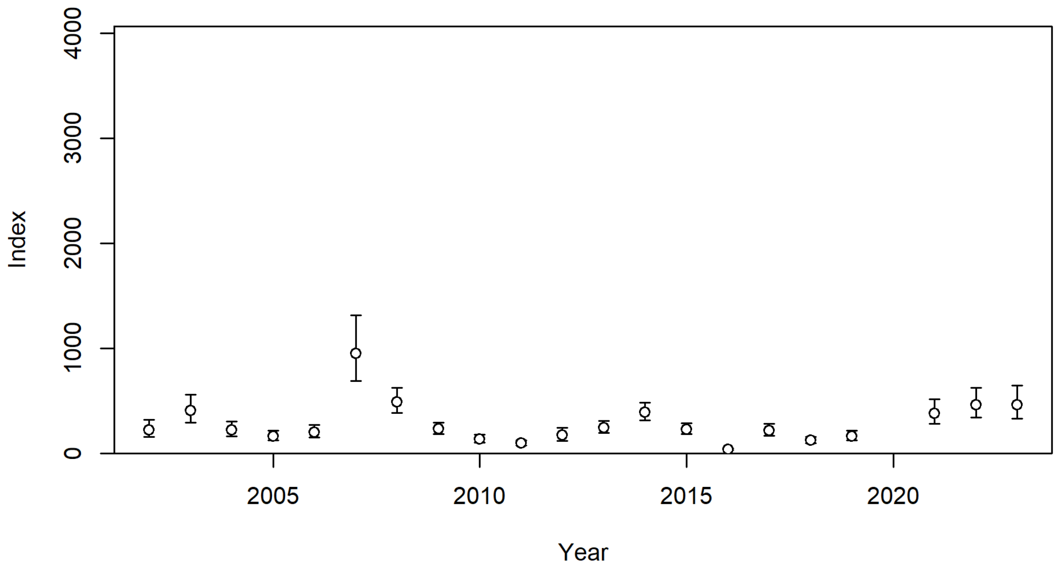

Figure 12: Annual relative index of abundance for the IPHC longline survey.

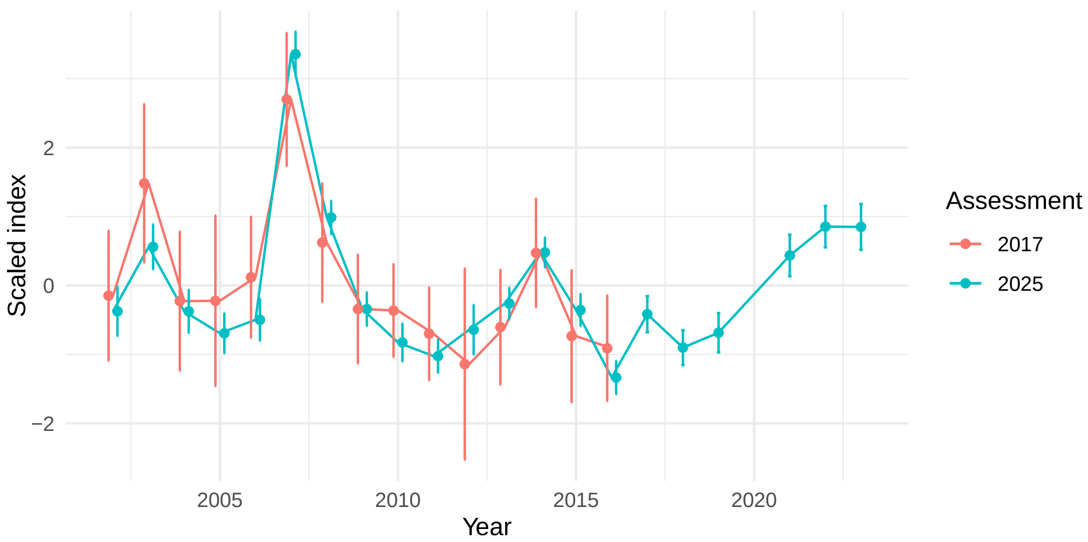

Figure 13: Comparison of the 2017 and the current IPHC index of abundance.

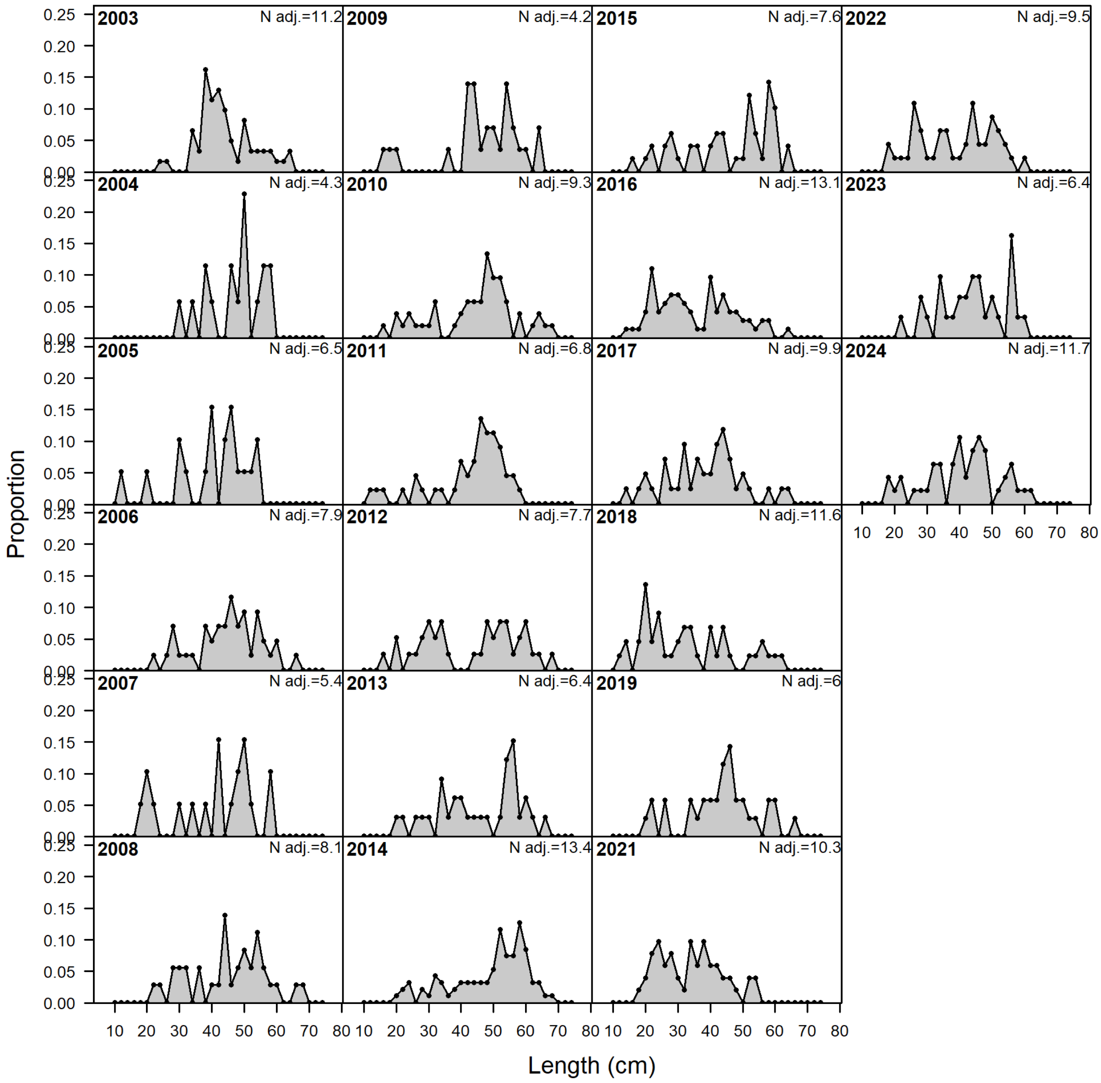

Figure 14: Annual length composition data for the WCBTS.

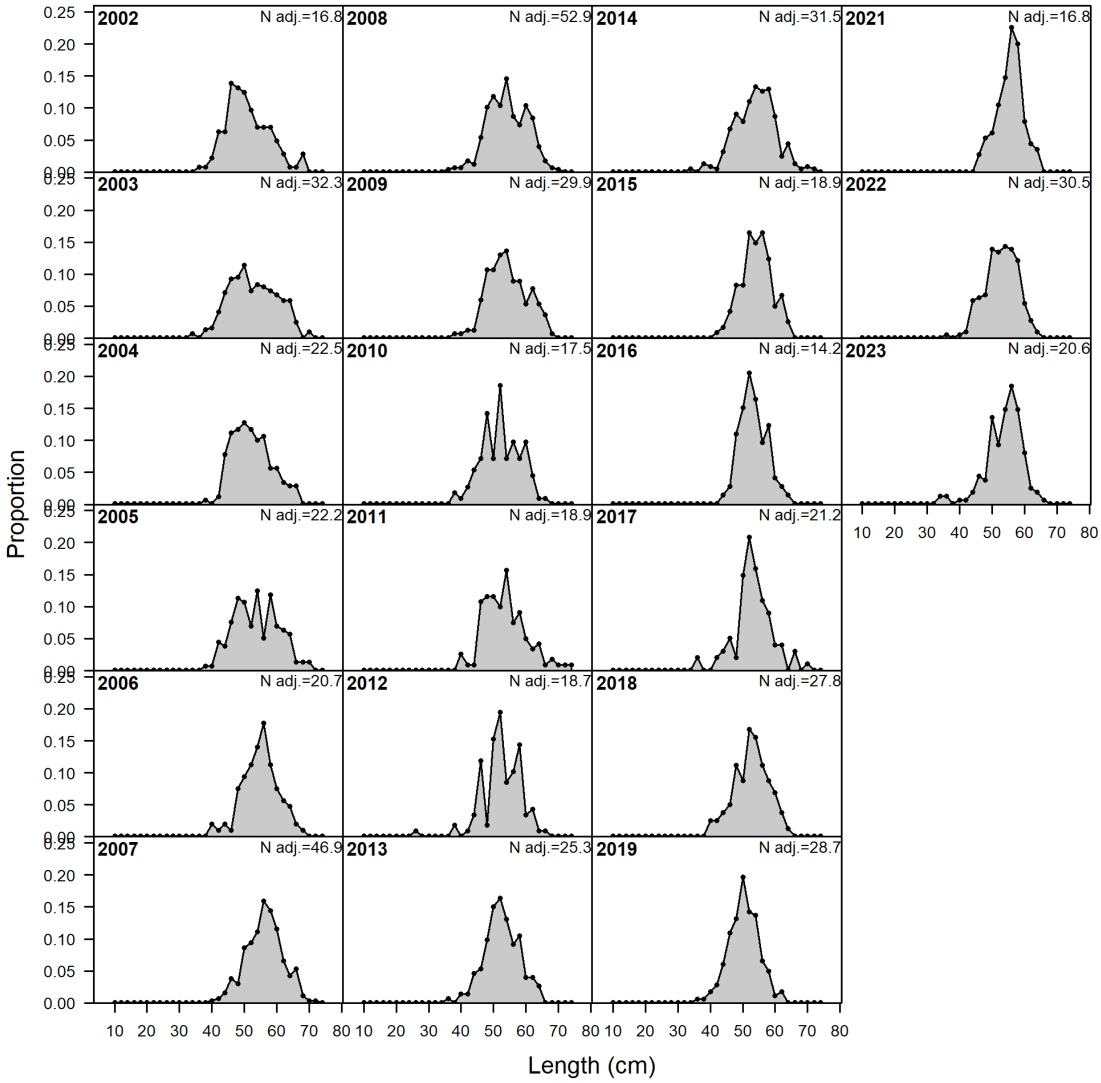

Figure 15: Annual length composition data from the IPHC longline survey.

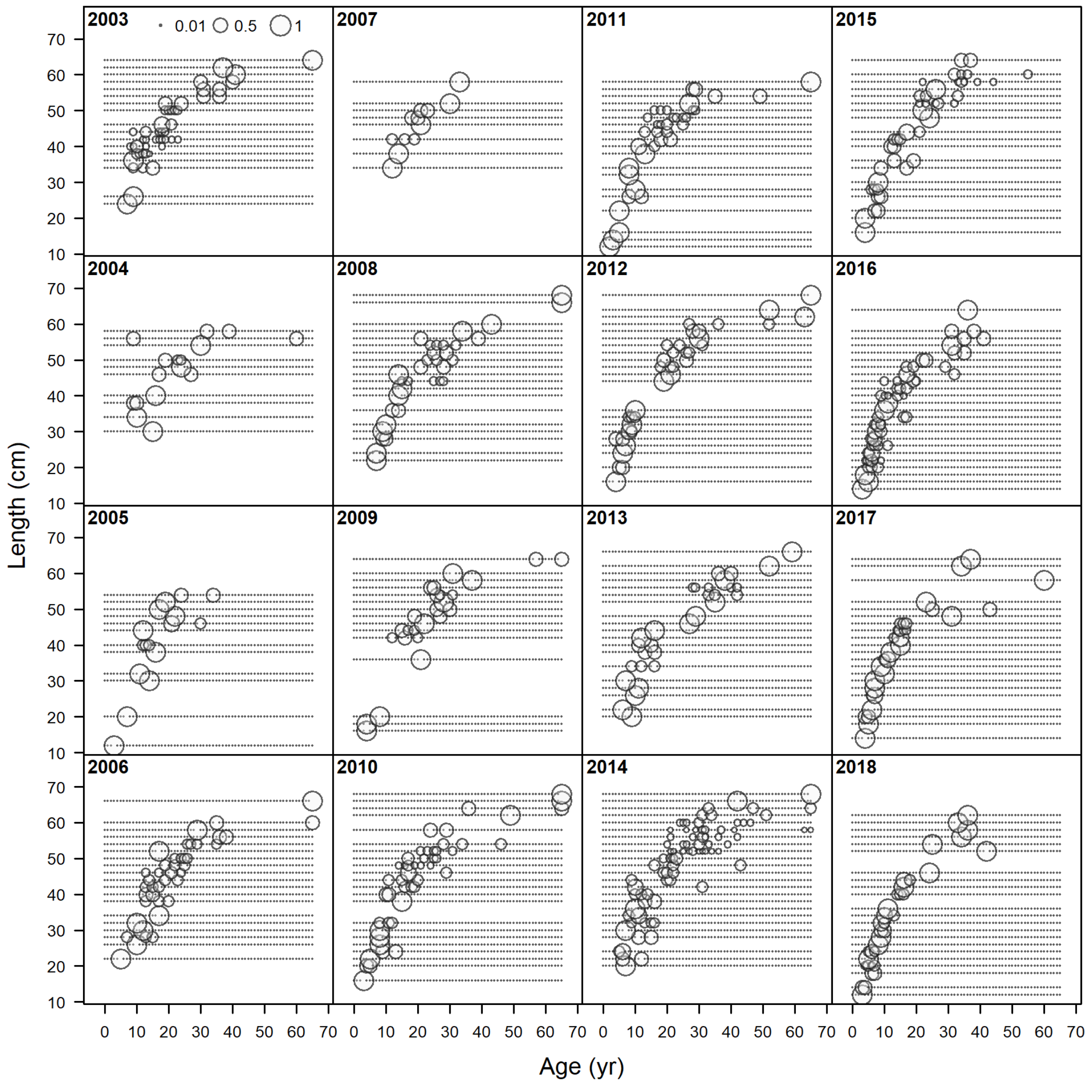

Figure 16: Annual unsexed conditional age-at-length data for the WCBTS (1 of 2).

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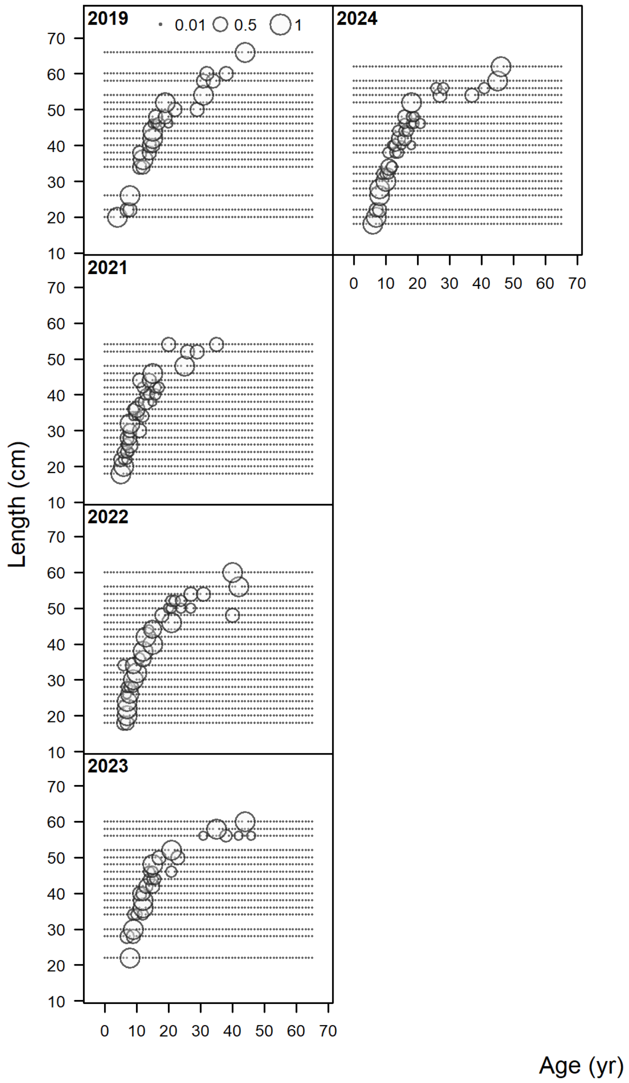

Figure 17: Annual unsexed conditional age-at-length data for the WCBTS (2 of 2).

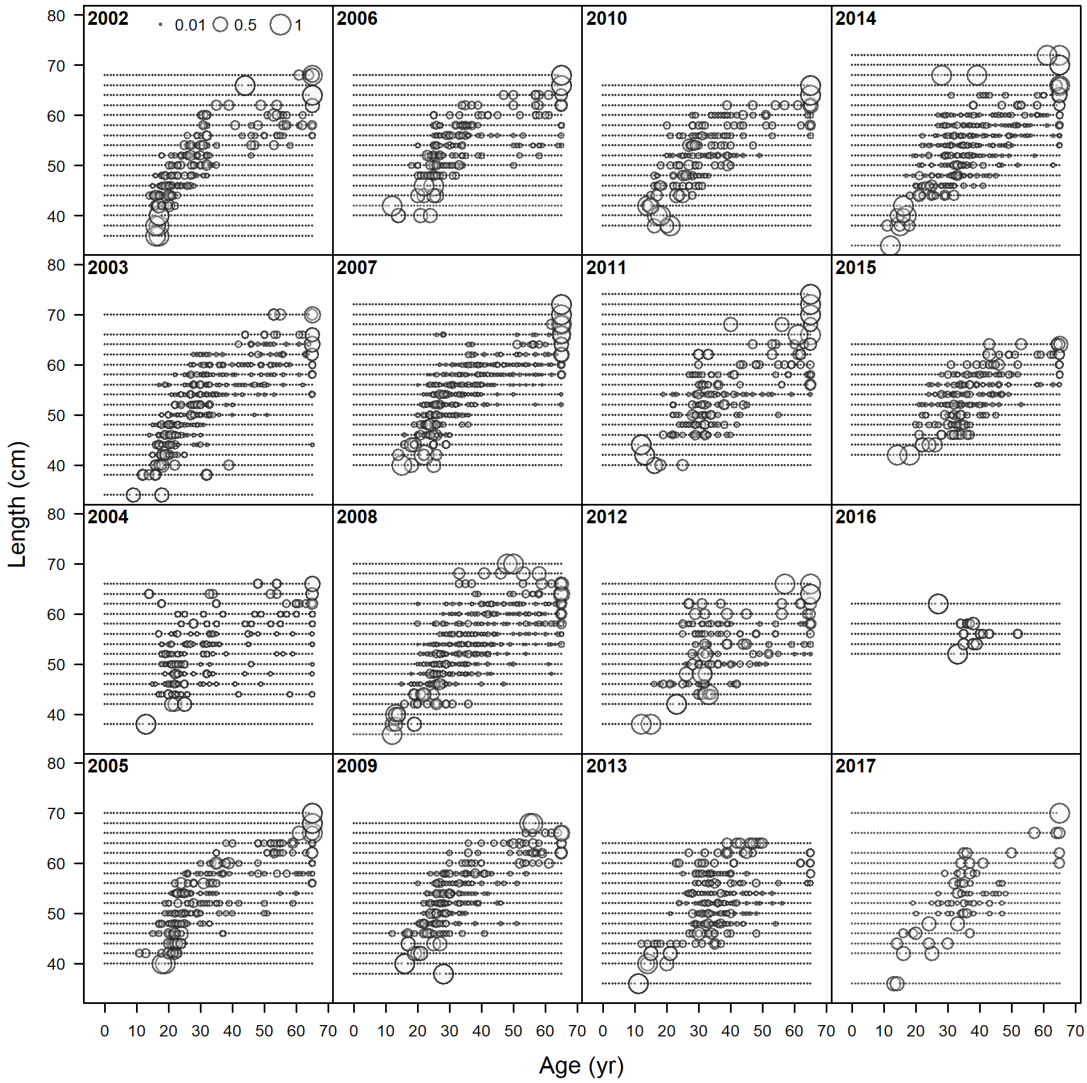

Figure 18: Annual unsexed conditional age-at-length data for the IPHC (1 of 2).

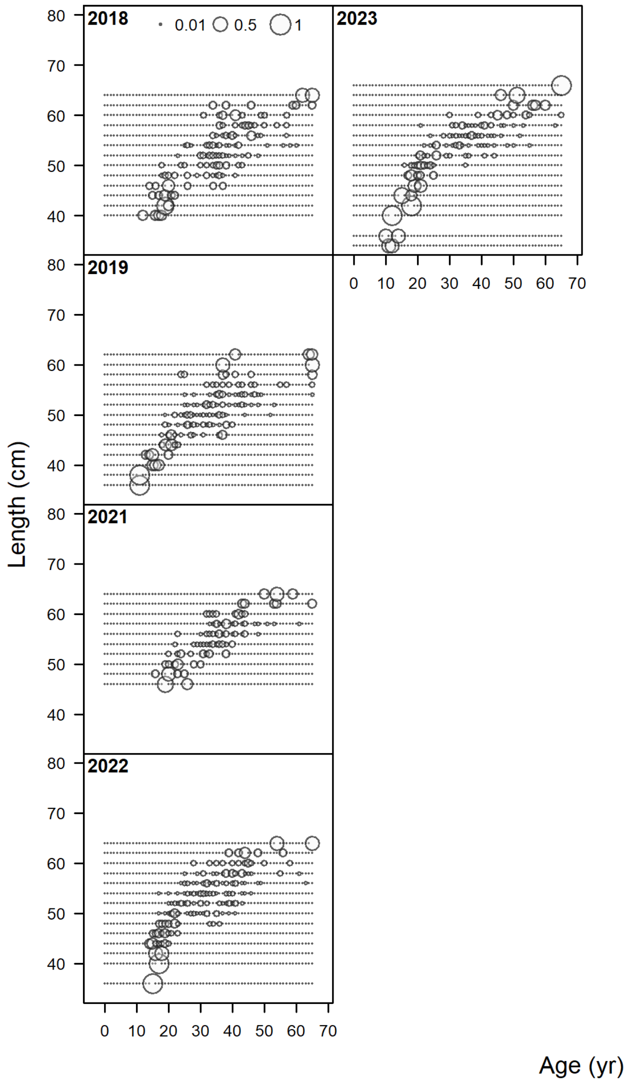

Figure 19: nnual unsexed conditional age-at-length data for the IPHC (1 of 2).

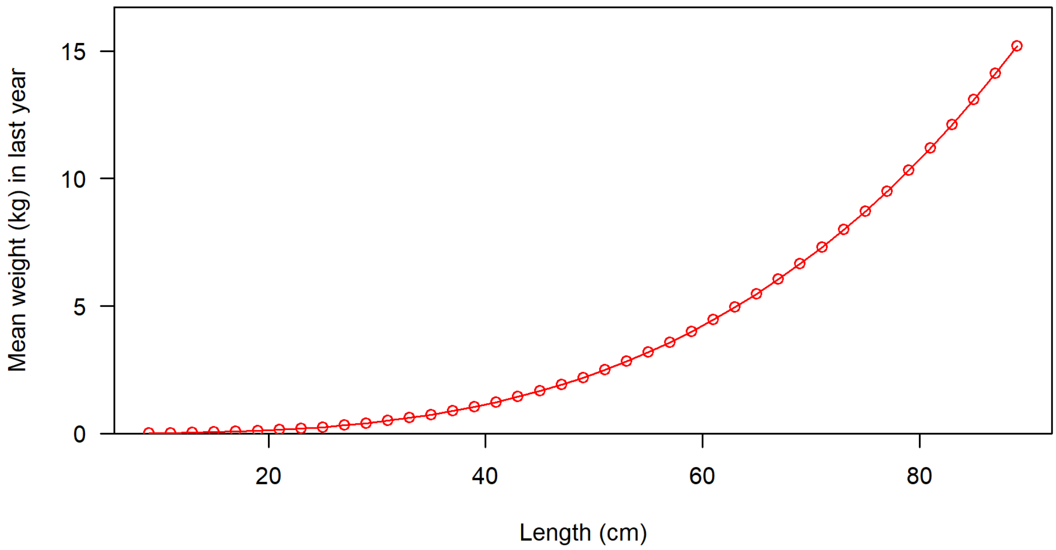

Figure 20: Updated weight-at-length relationship.

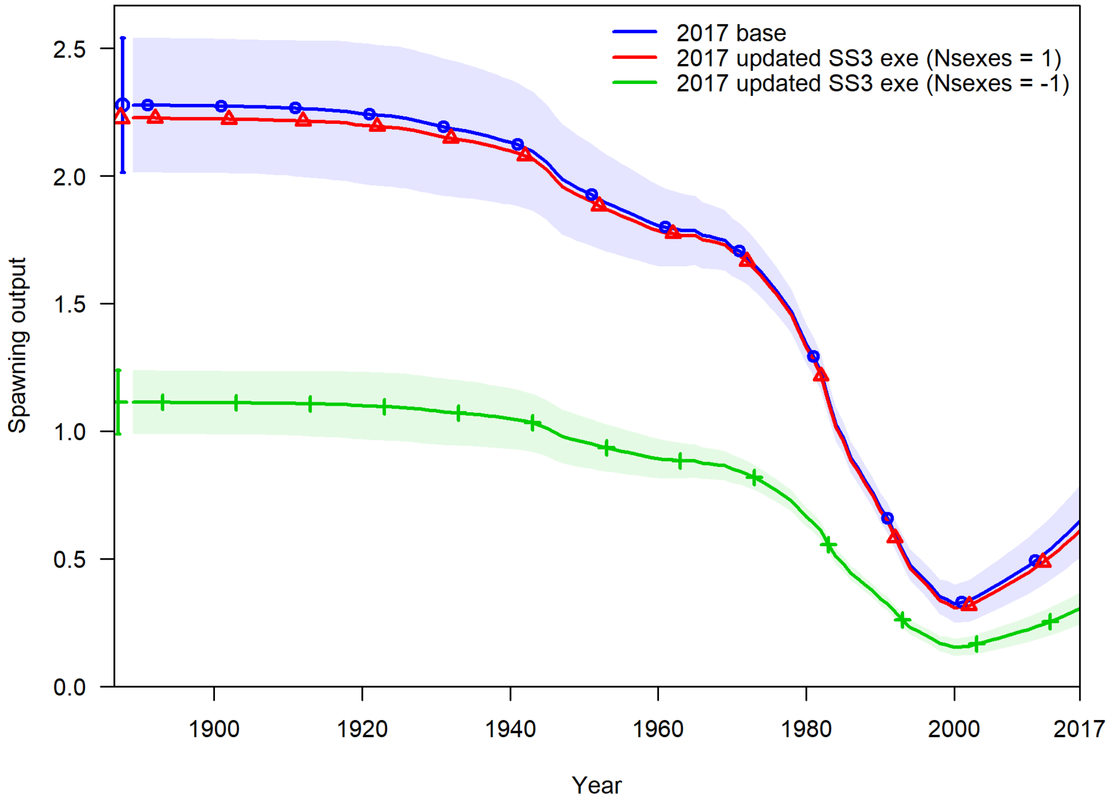

Figure 21: Comparison of the spawning output for the 2017 model with the updated SS3 executable and a single-sex model.

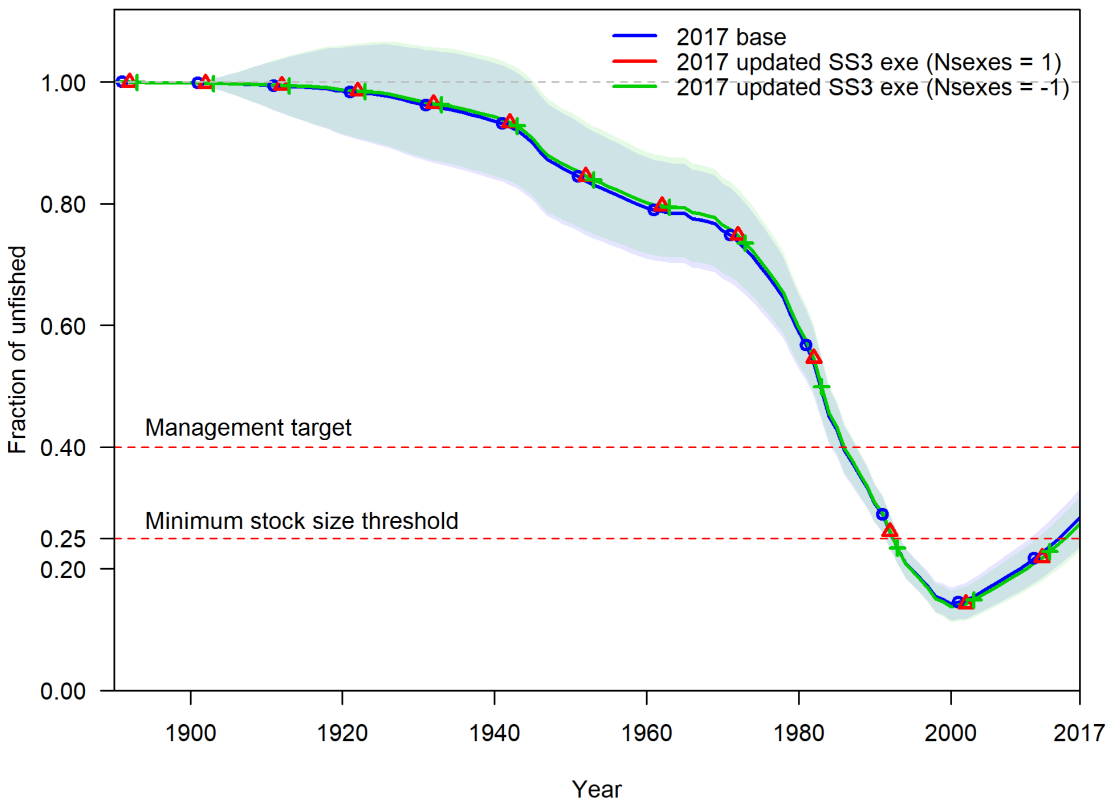

Figure 22: Comparison of the stock status for the 2017 model with the updated SS3 executable and a single-sex model.

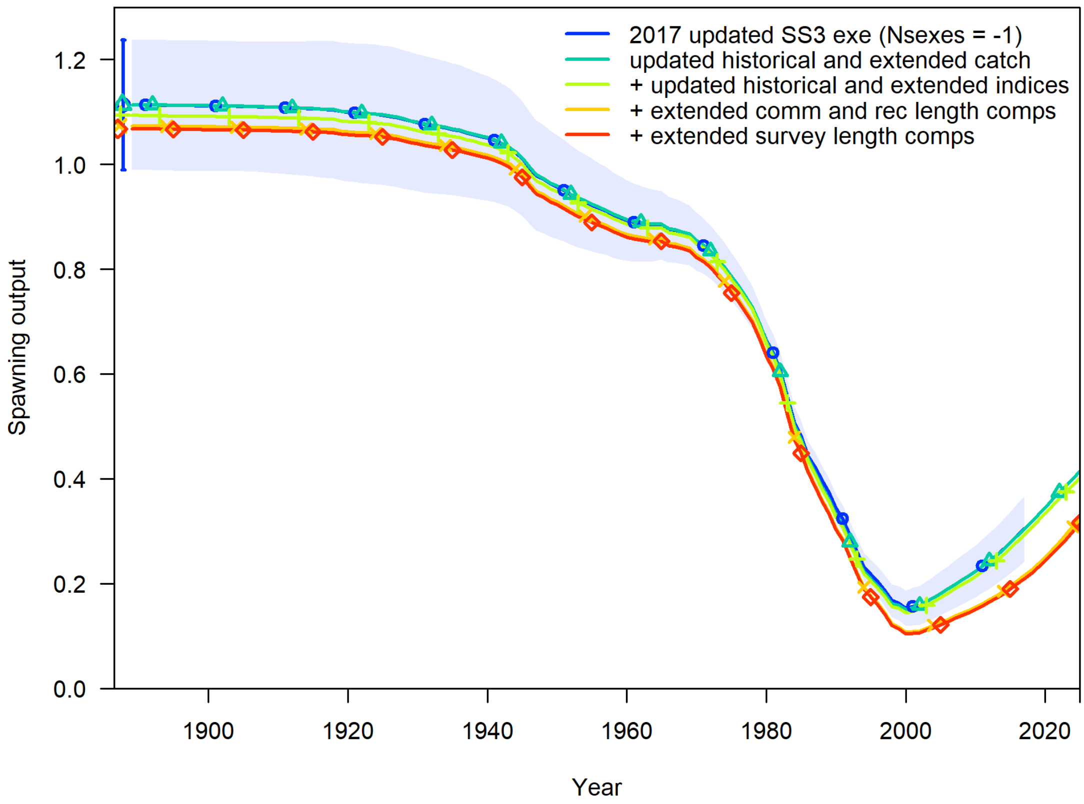

Figure 23: Comparison of the spawning output of the 2017 model with an updated SS3 executable (blue), updated catch data (dark green), updated indices (light green), new fishery length composition data (orange), and survey length composition data (red).

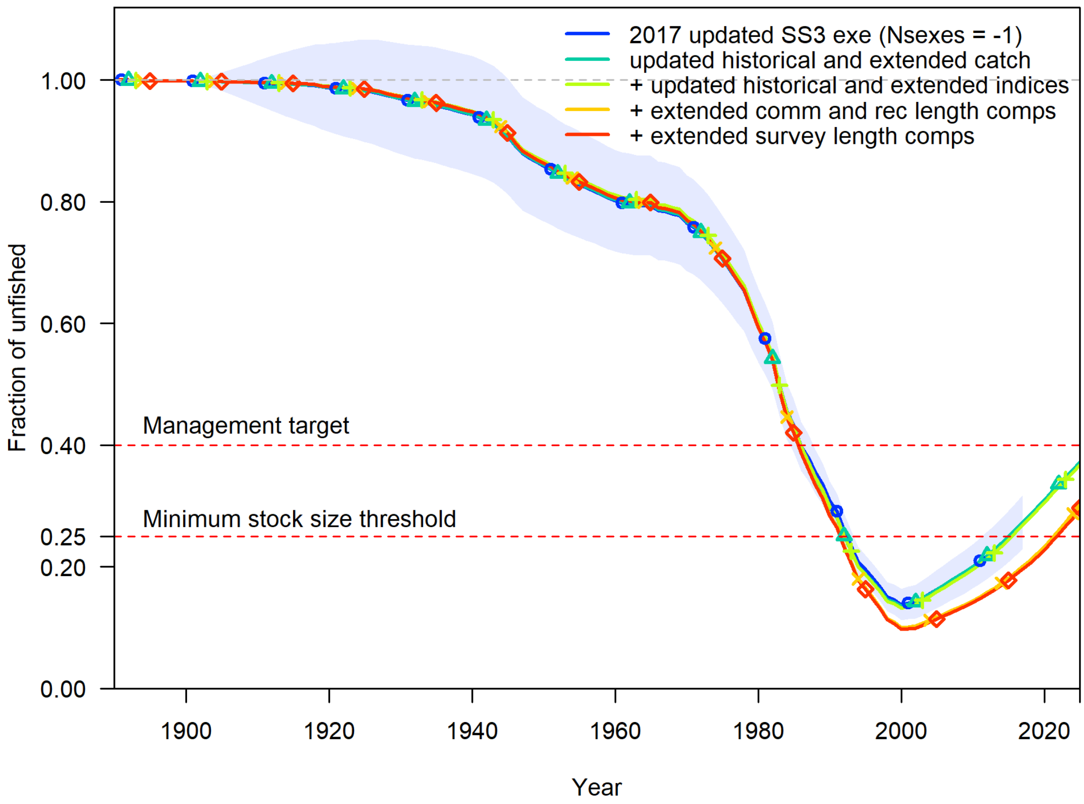

Figure 24: Comparison of the stock status of the 2017 model with an updated SS3 executable (blue), updated catch data (dark green), updated indices (light green), new fishery length composition data (orange), and survey length composition data (red).

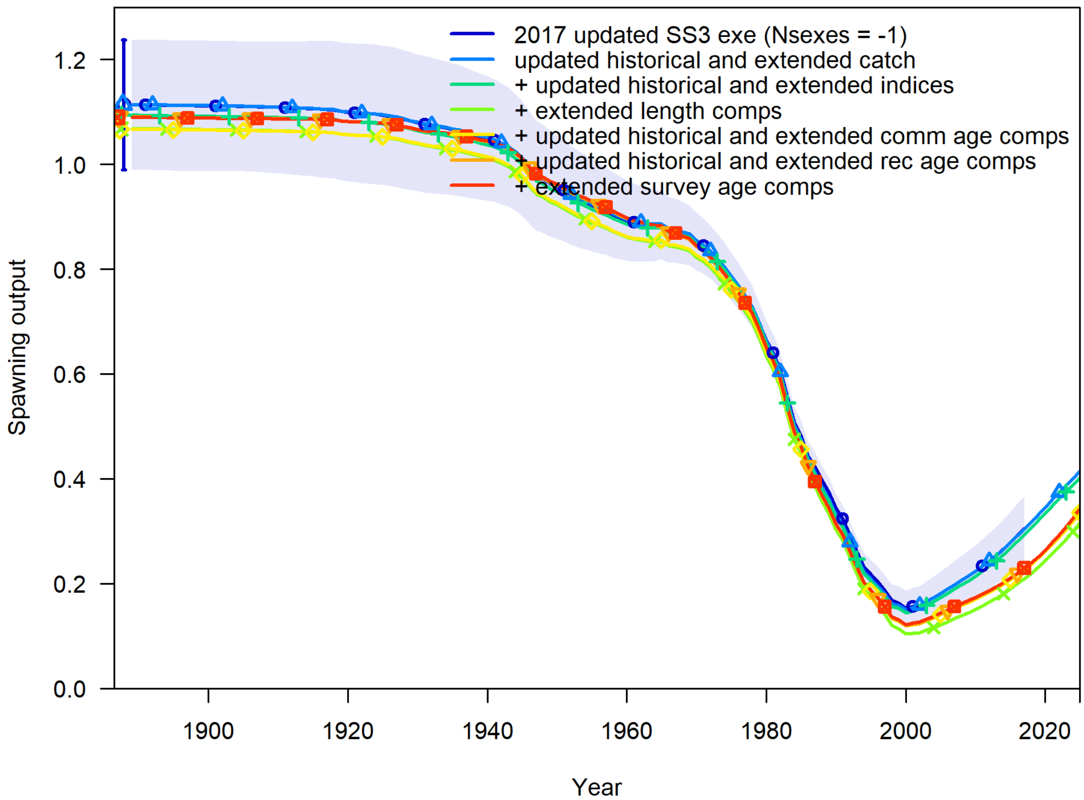

Figure 25: Comparison of the spawning output of the 2017 model with an updated SS3 executable (blue), updated catch data (light blue), updated indices (dark green), new fishery length composition data (light green), and commercial (yellow), recreational (orange), and survey (red) age composition data.

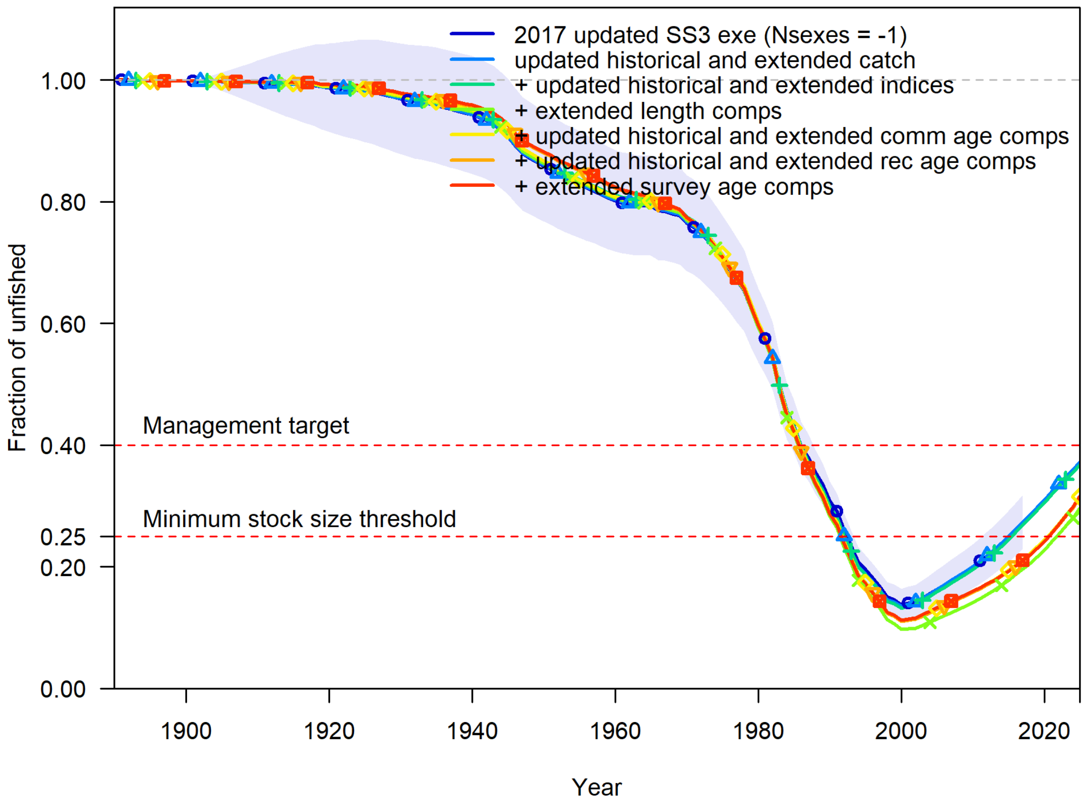

Figure 26: Comparison of the stock status of the 2017 model with an updated SS3 executable (blue), updated catch data (light blue), updated indices (dark green), new fishery length composition data (light green), and commercial (yellow), recreational (orange), and survey (red) age composition data.

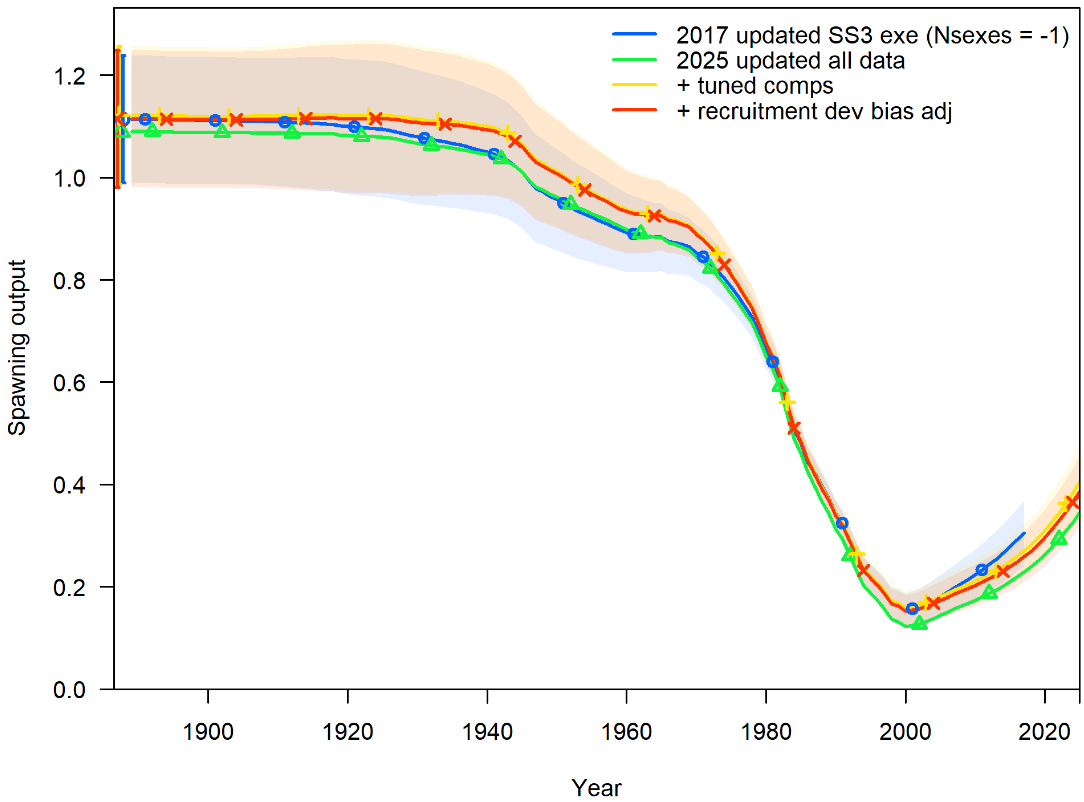

Figure 27: Comparison of the spawning output of the 2017 model with an updated SS3 executable (blue), 2025 model with all available updated data (green), with tuned compositional data (yellow), and with the updated recruitment bias adjustment ramp (red).

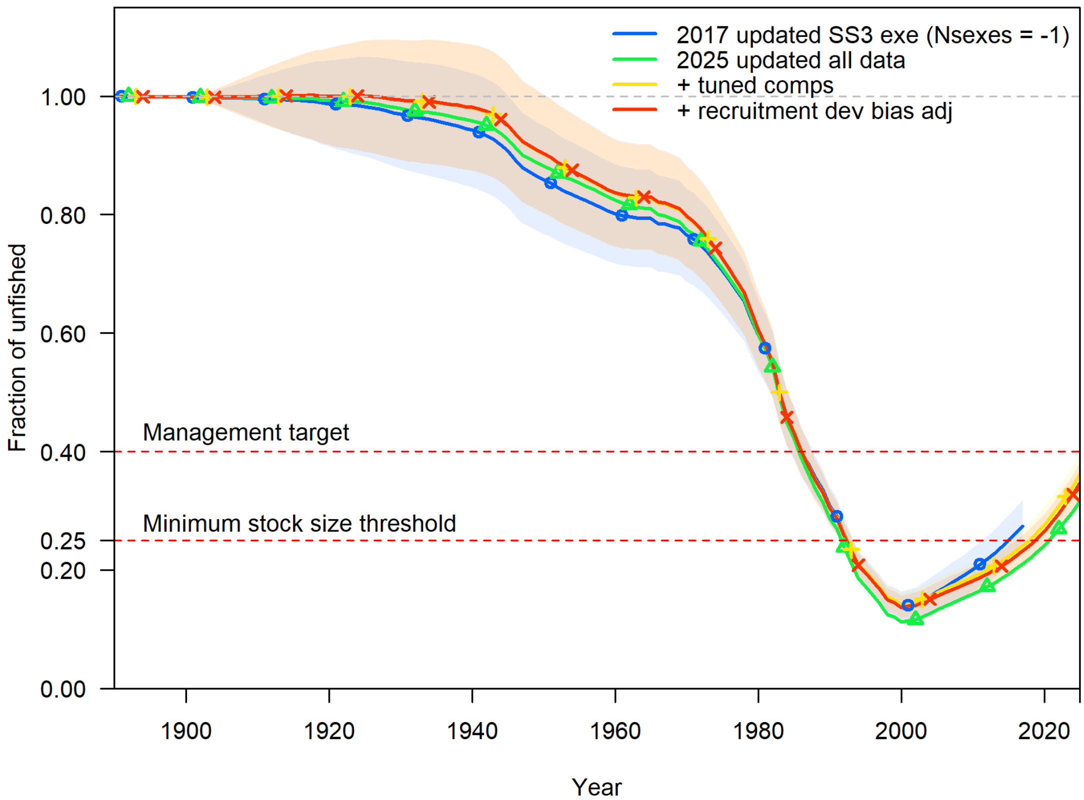

Figure 28: Comparison of the stock status of the 2017 model with an updated SS3 executable (blue), 2025 model with all available updated data (green), with tuned compositional data (yellow), and with the updated recruitment bias adjustment ramp (red).

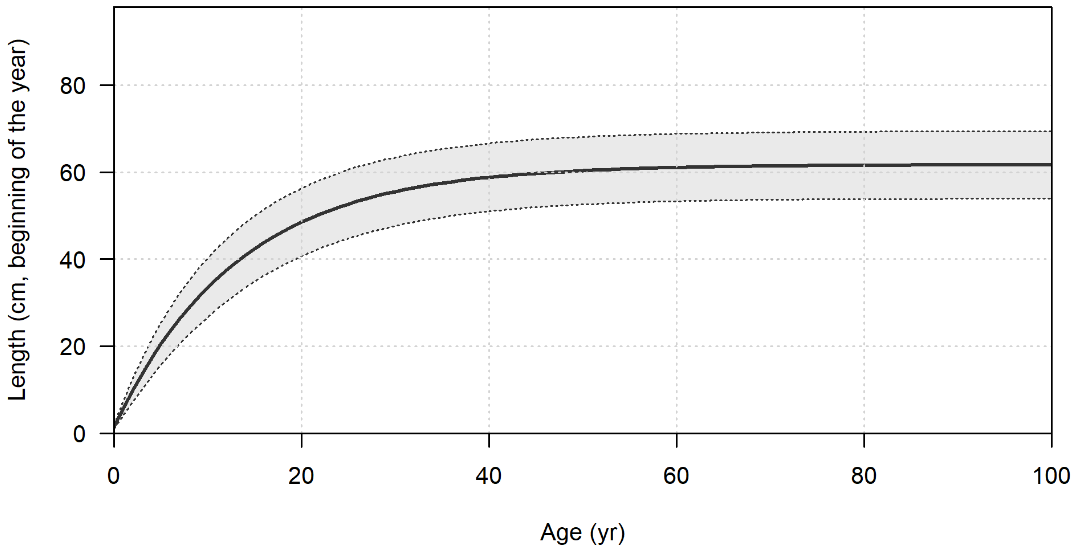

Figure 29: Length at age in the beginning of the year in the ending year of the model.

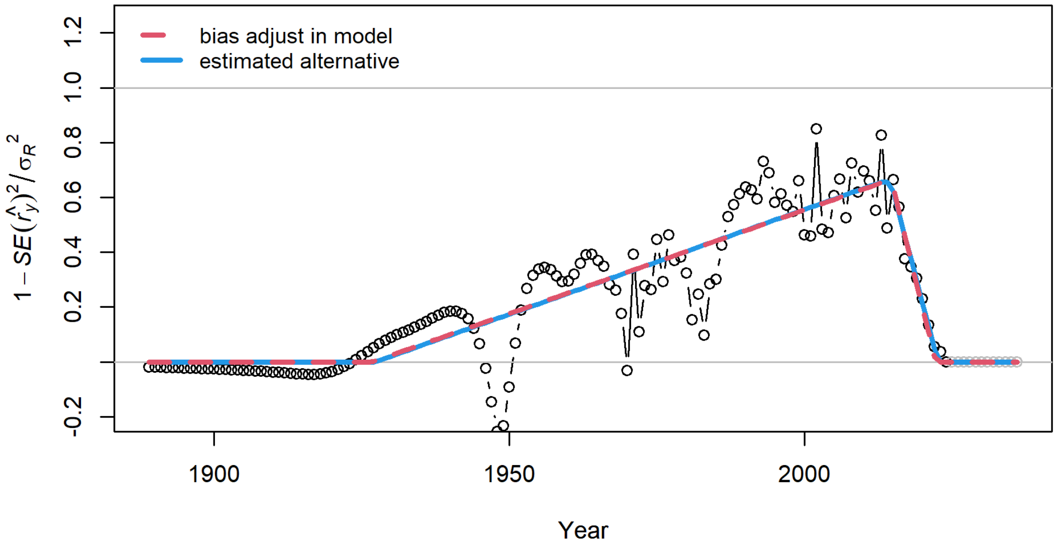

Figure 30: Points are transformed variances. Red line shows current settings for bias adjustment specified in the control file. Blue line shows least squares estimate of alternative bias adjustment relationship for recruitment deviations.

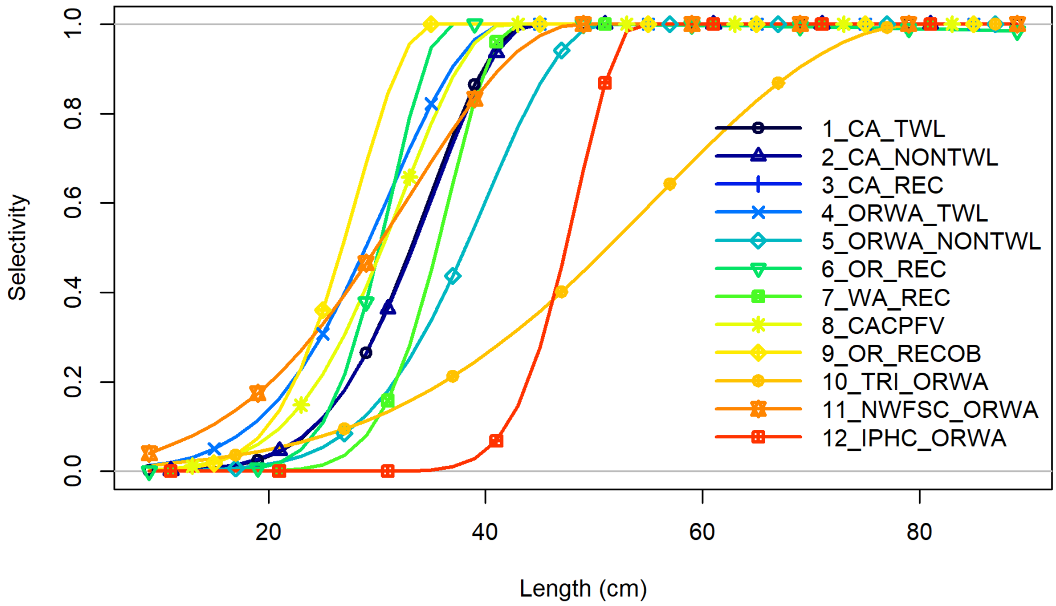

Figure 31: Estimated selectivity at length for all fleets.

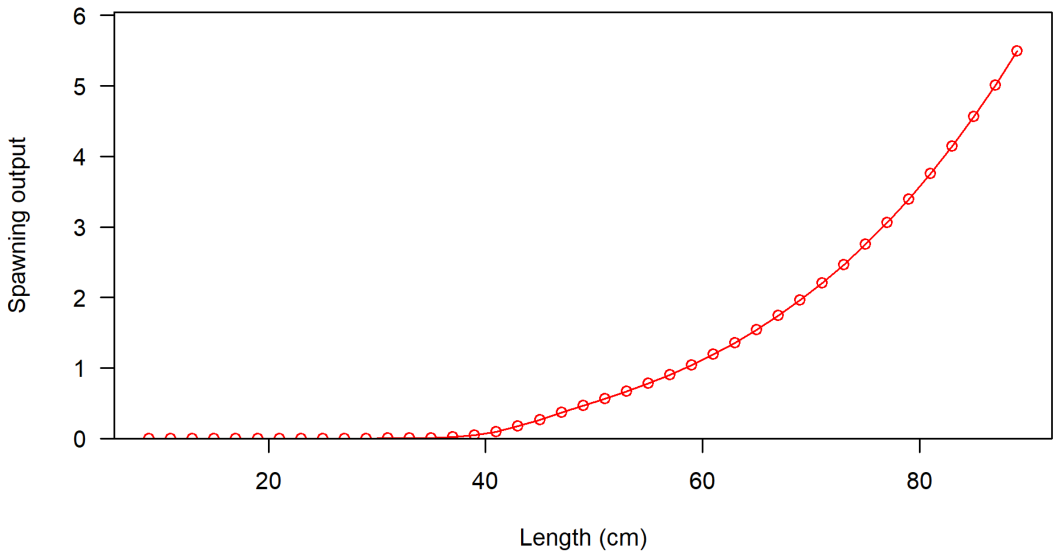

Figure 32: Spawning output at length.

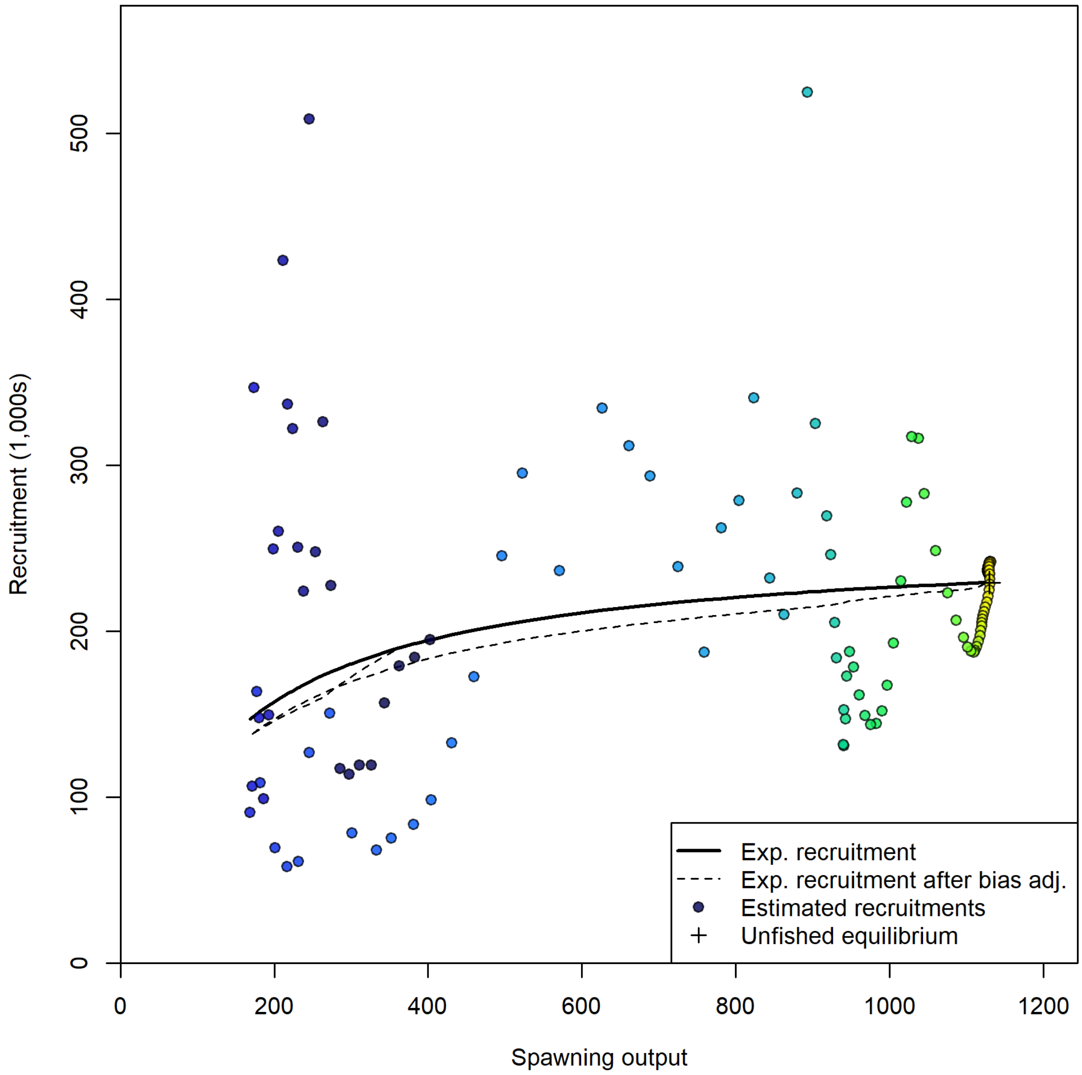

Figure 33: Stock-recruit curve. Point colors indicate year, with warmer colors indicating earlier years and cooler colors in showing later years.

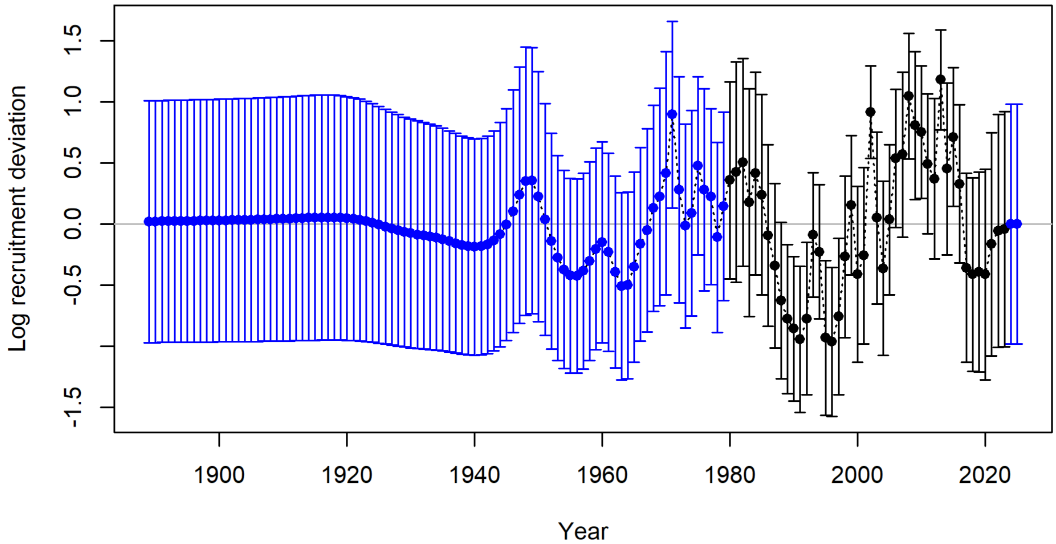

Figure 34: Estimated recruitment deviations with 95% intervals.

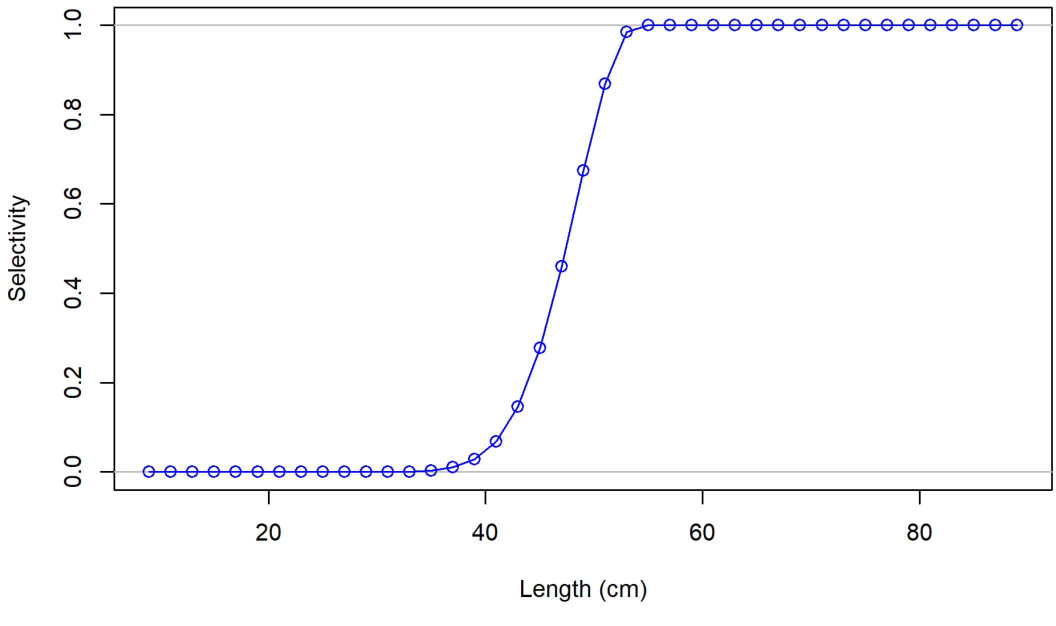

Figure 35: Estimated selectivity for the IPHC longline survey for Oregon/Washington (Fleet 12).

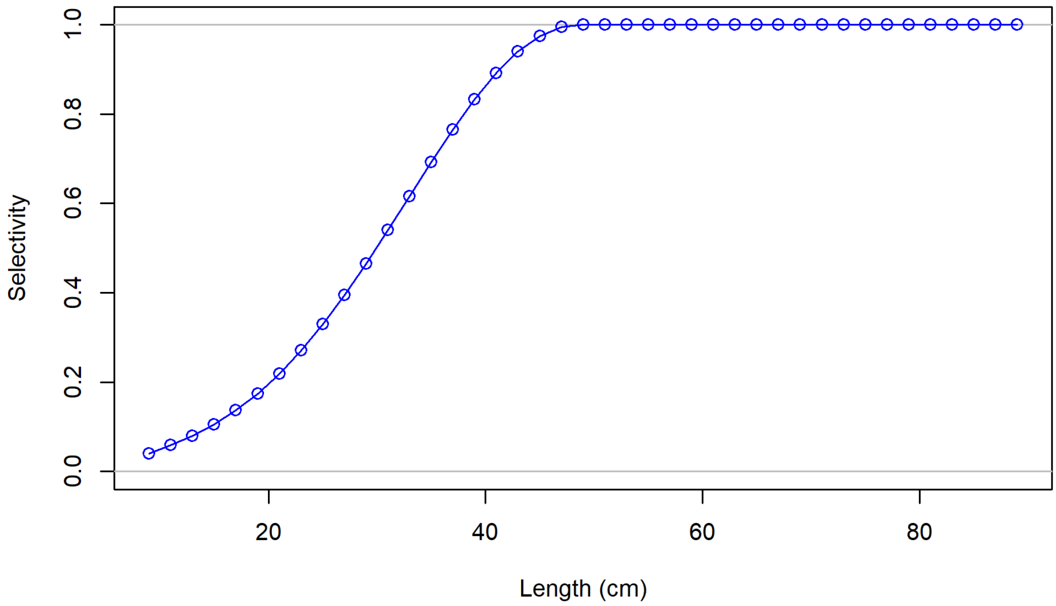

Figure 36: Estimated selectivity for the WCBTS for Oregon/Washington (Fleet 11).

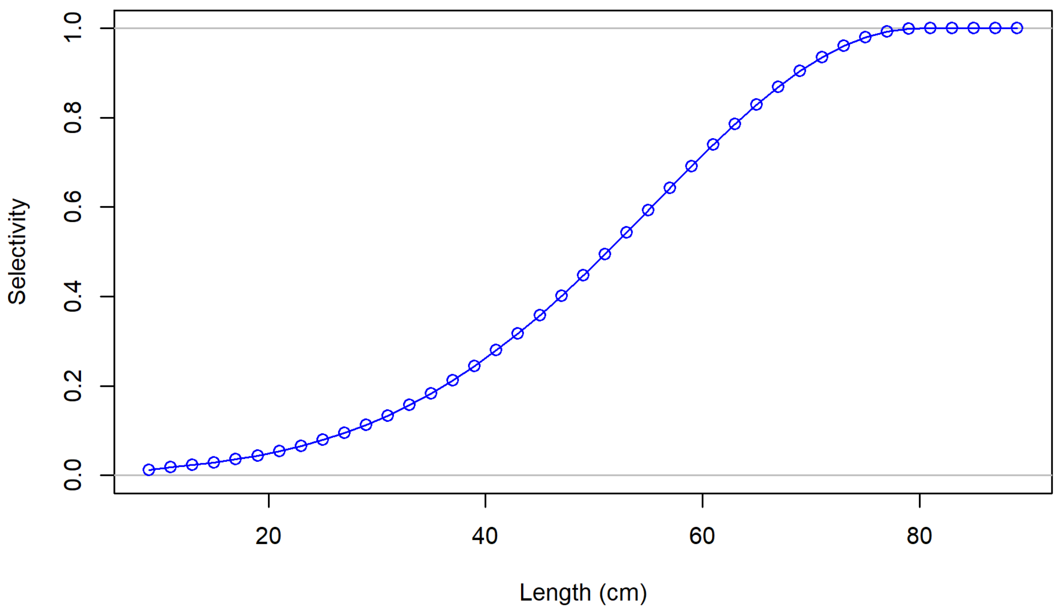

Figure 37: Estimated selectivity for the Triennial bottom trawl survey for Oregon/Washington (Fleet 10).

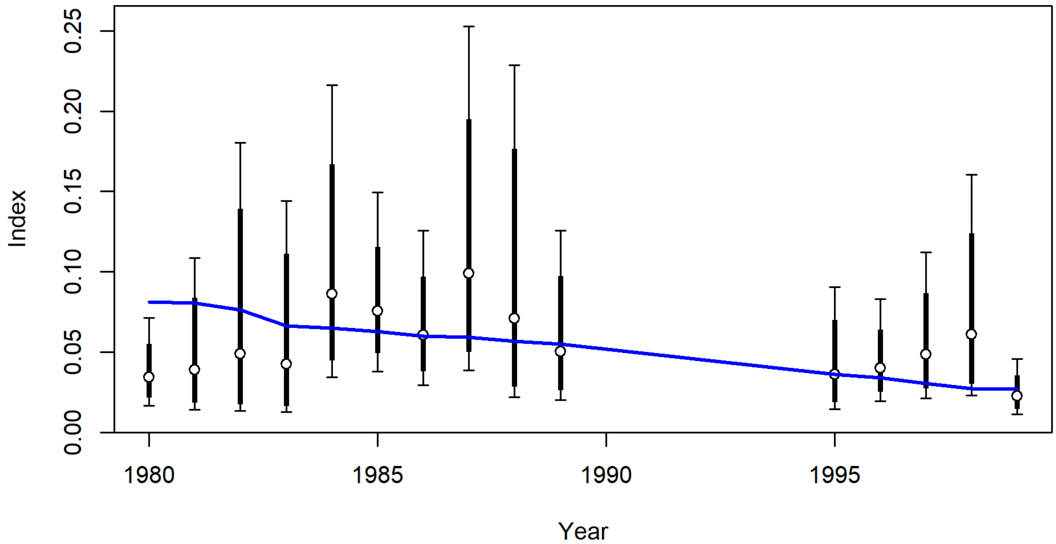

Figure 38: Fit to the California MRFSS recreational index.

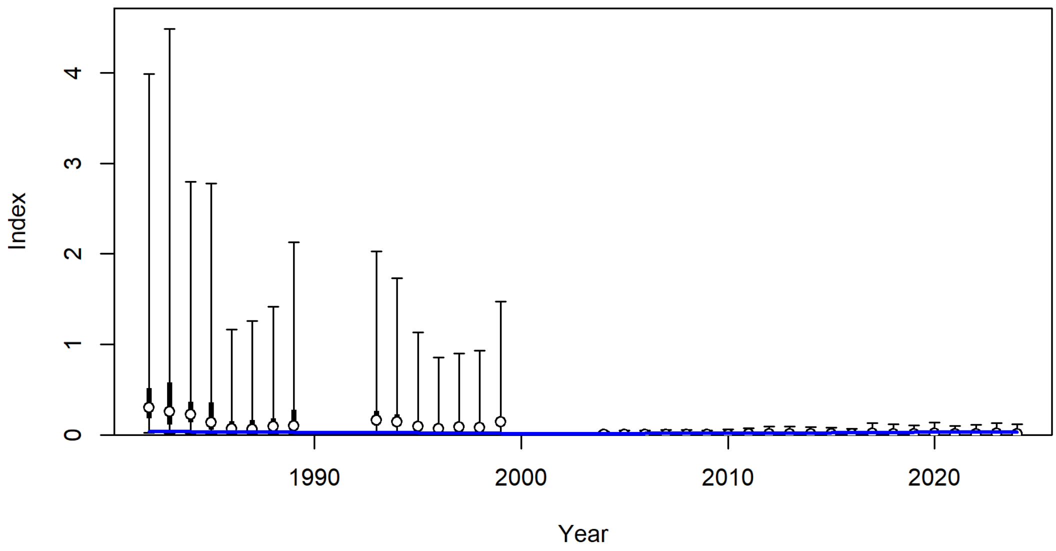

Figure 39: Fit to the Oregon recreational index.

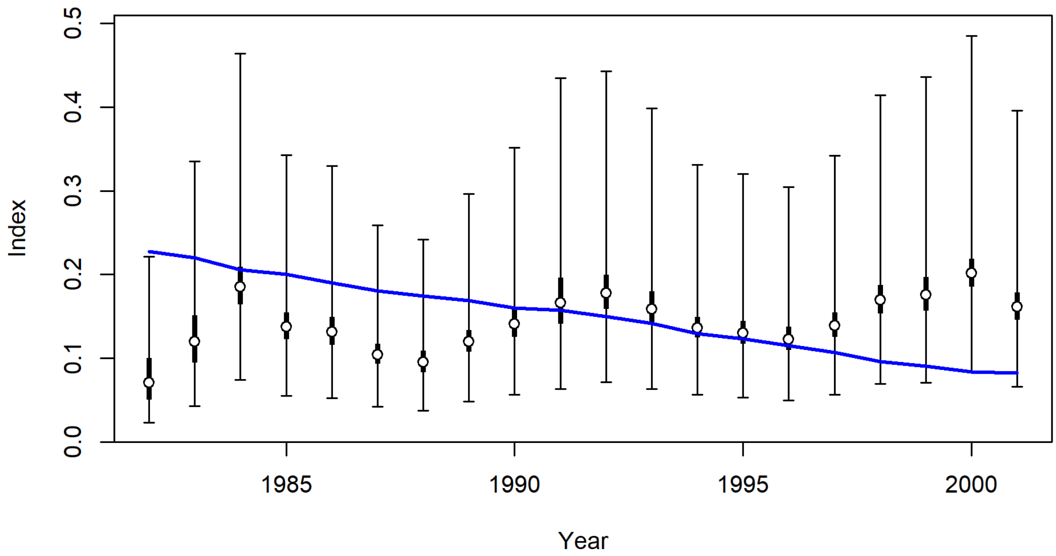

Figure 40: Fit to the Washington recreational index.

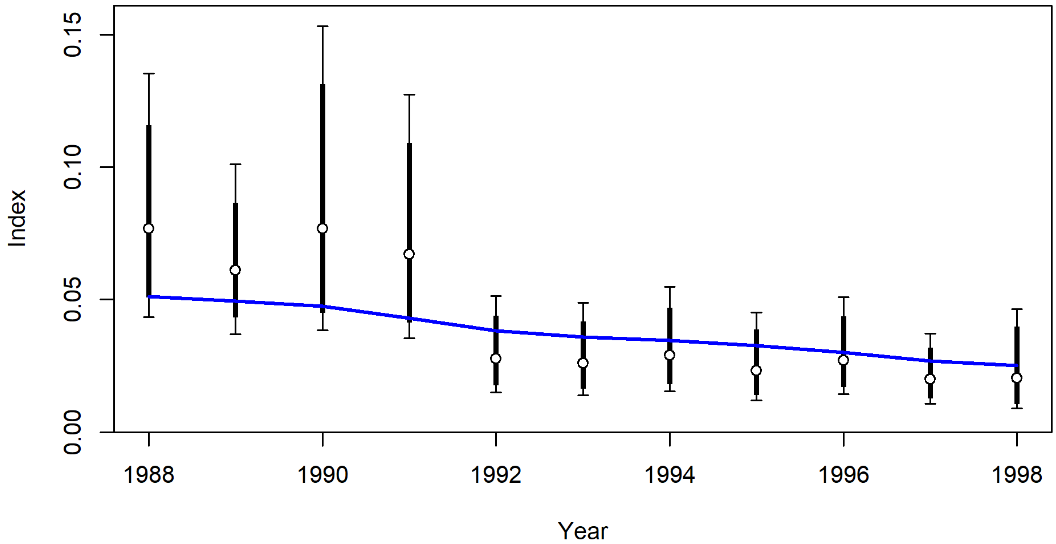

Figure 41: Fit to the California CPFV observer index.

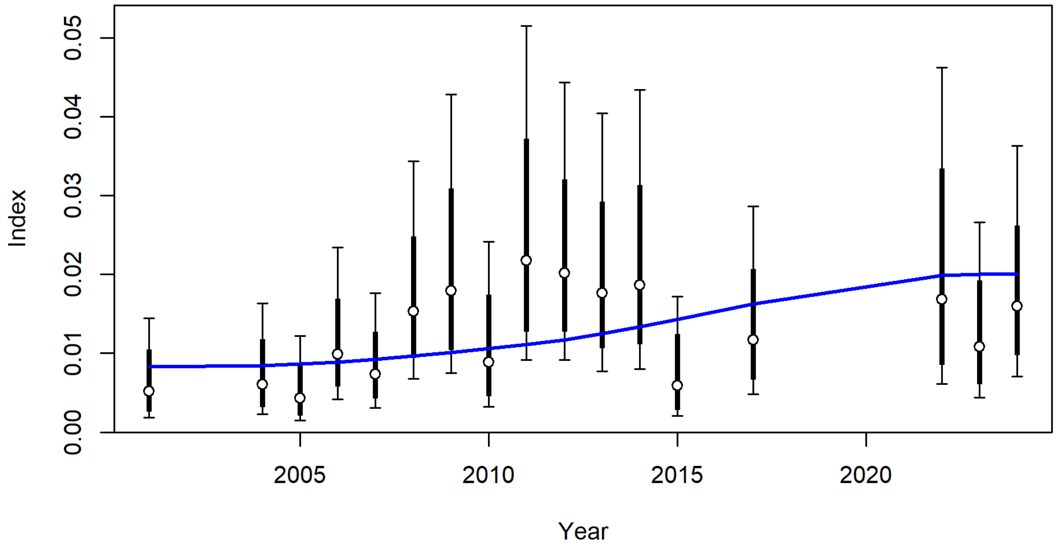

Figure 42: Fit to the Oregon onboard observer (ORFS) index.

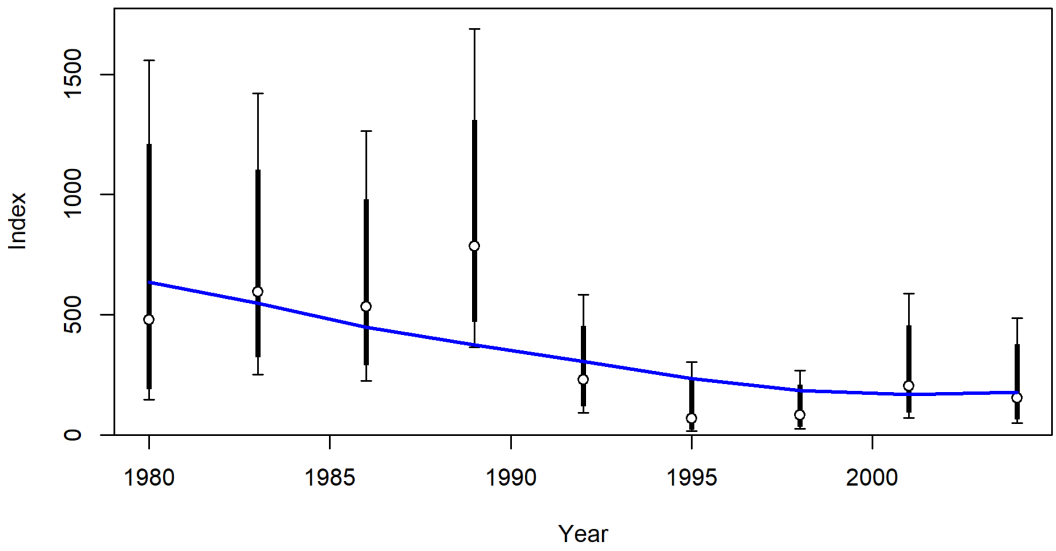

Figure 43: Fit to the Triennial survey index.

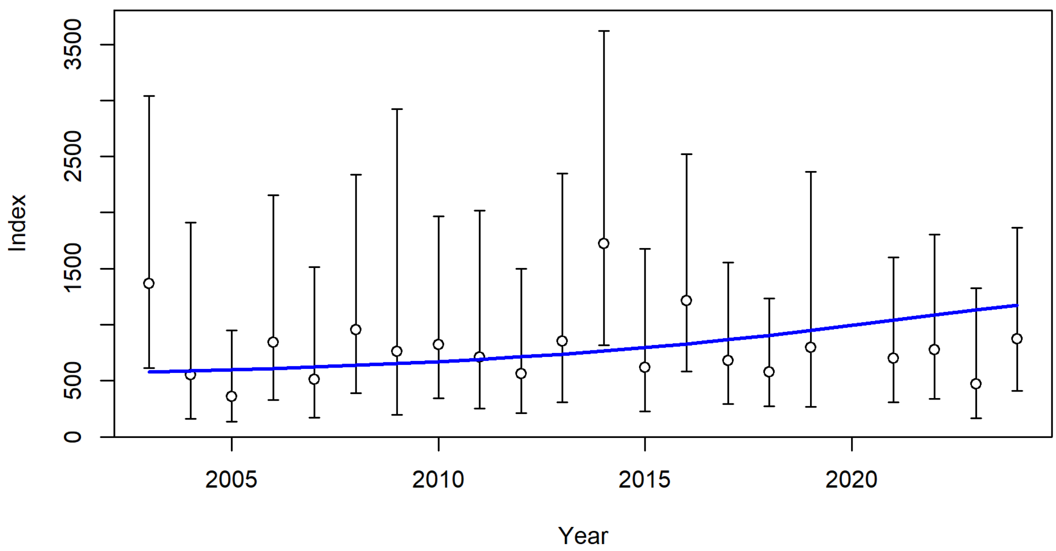

Figure 44: Fit to the WCBTS index.

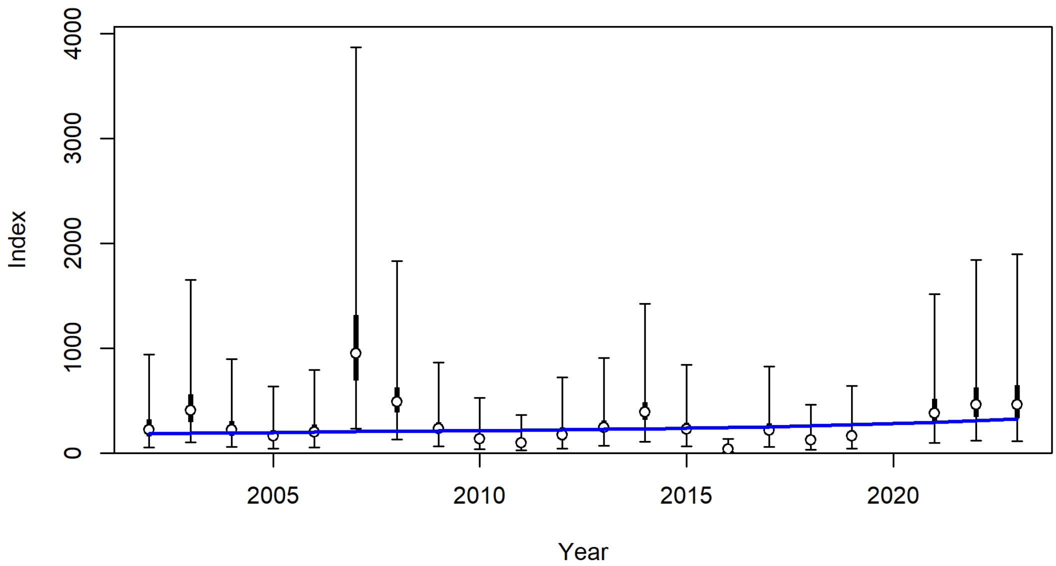

Figure 45: Fit to the IPHC survey index.

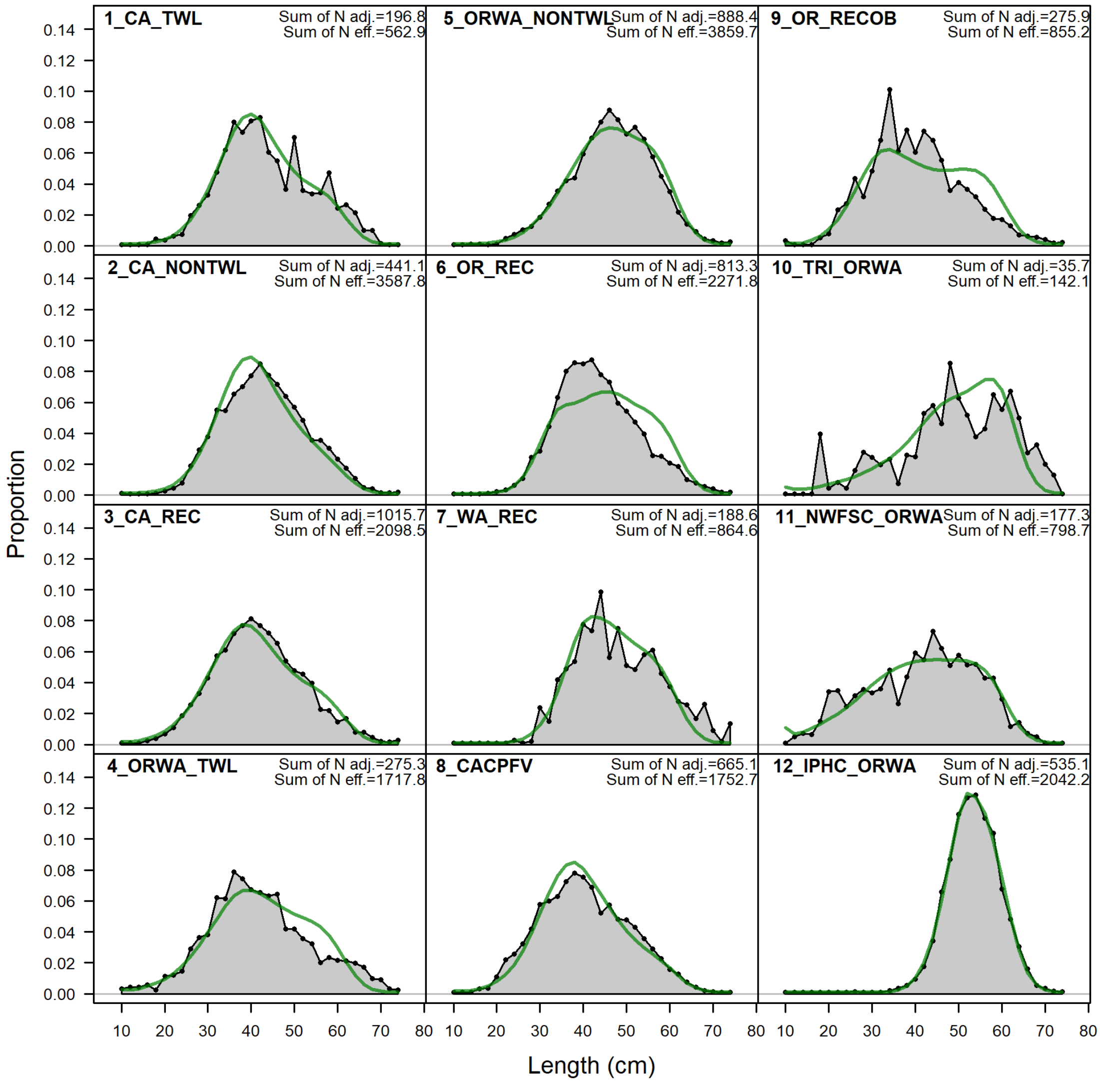

Figure 46: Fit to length composition data, aggregated across time by fleet.

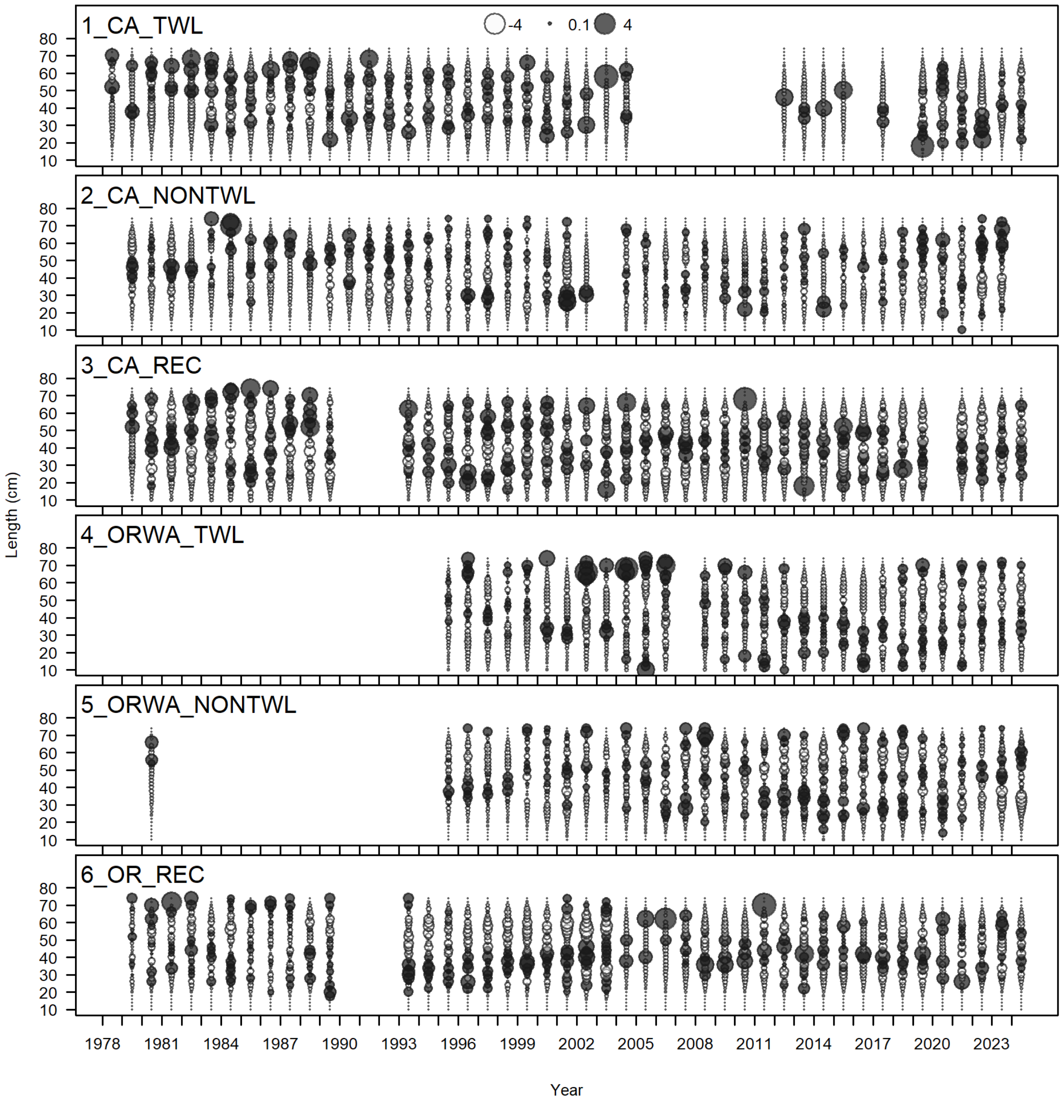

Figure 47: Pearson residuals, comparing across fleets, for length composition data (1 of 2). Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected).

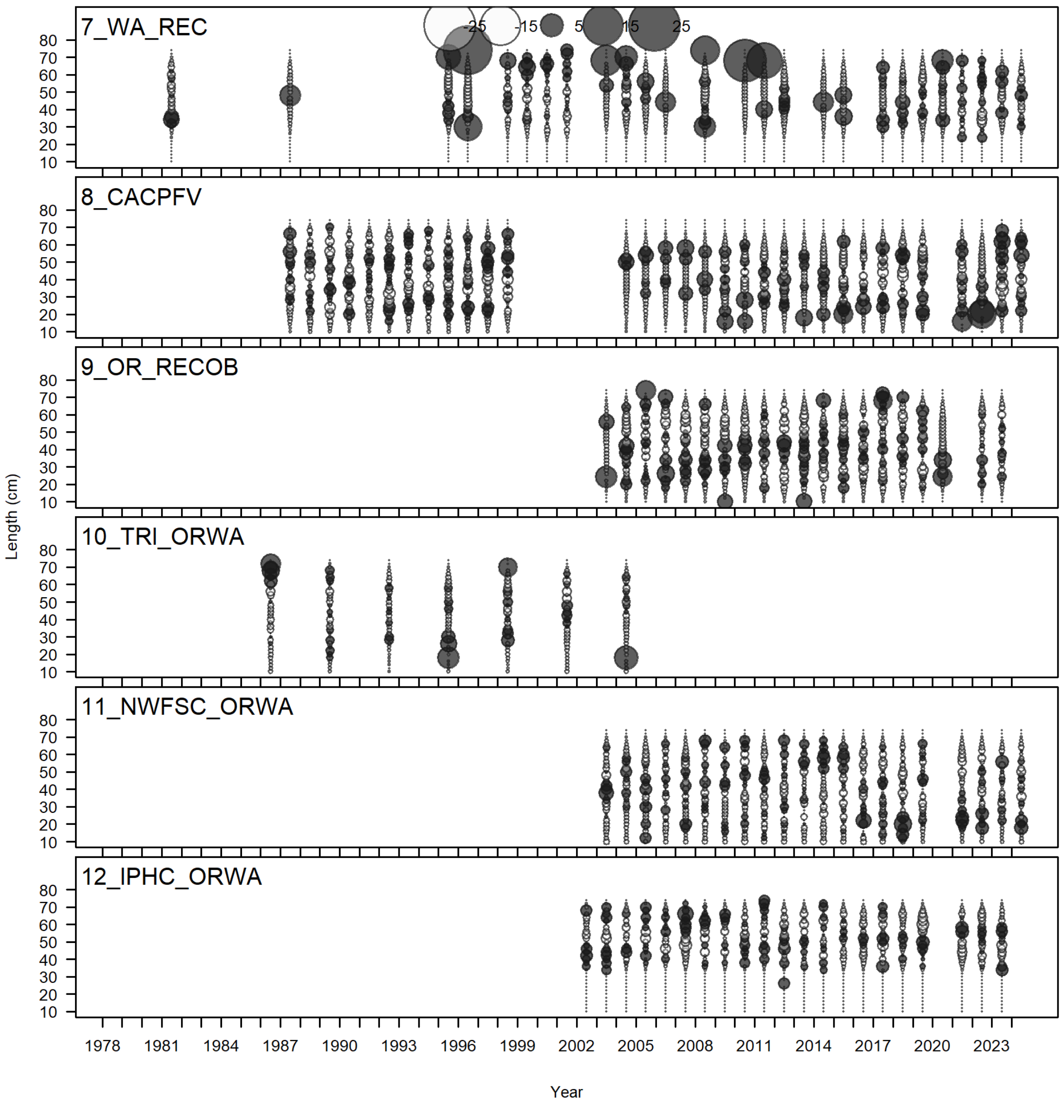

Figure 48: Pearson residuals, comparing across fleets, for length composition data (2 of 2). Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected).

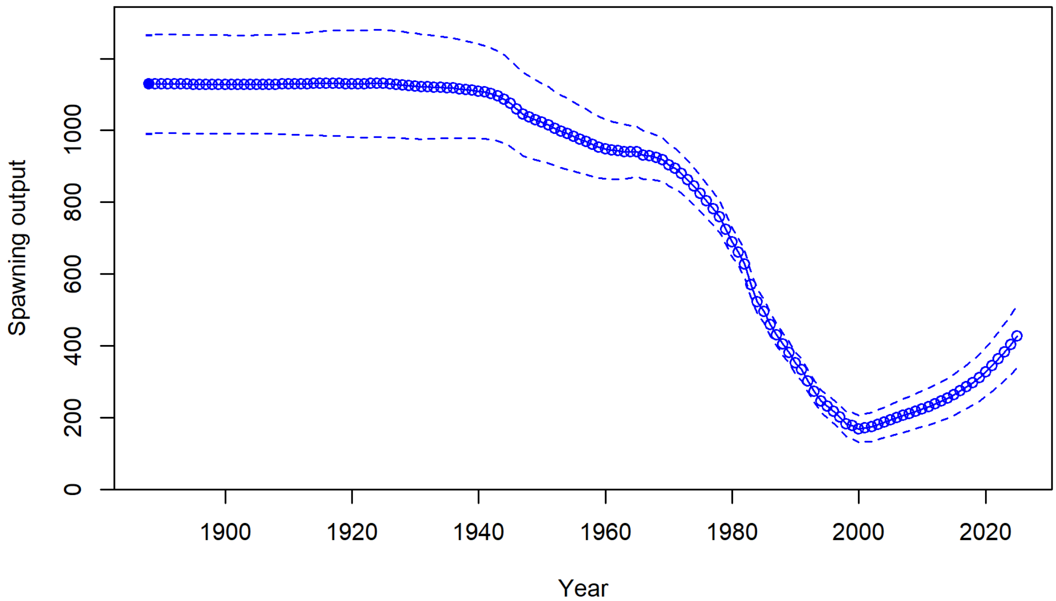

Figure 49: Estimated spawning output over time for both areas combined.

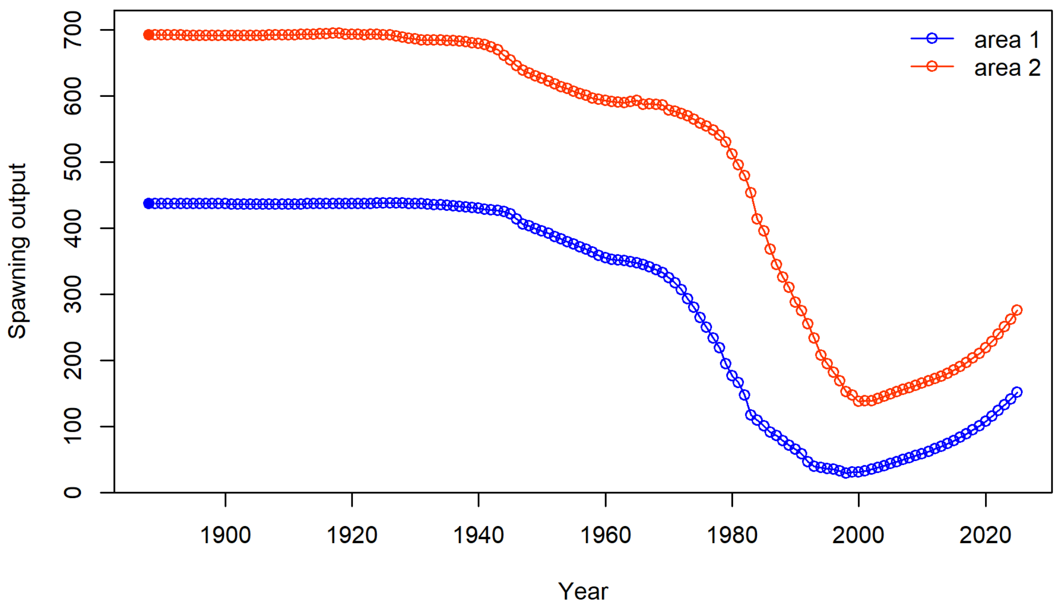

Figure 50: Estimated spawning output over time and by area (Area 1 is California, Area 2 is Oregon/Washington combined).

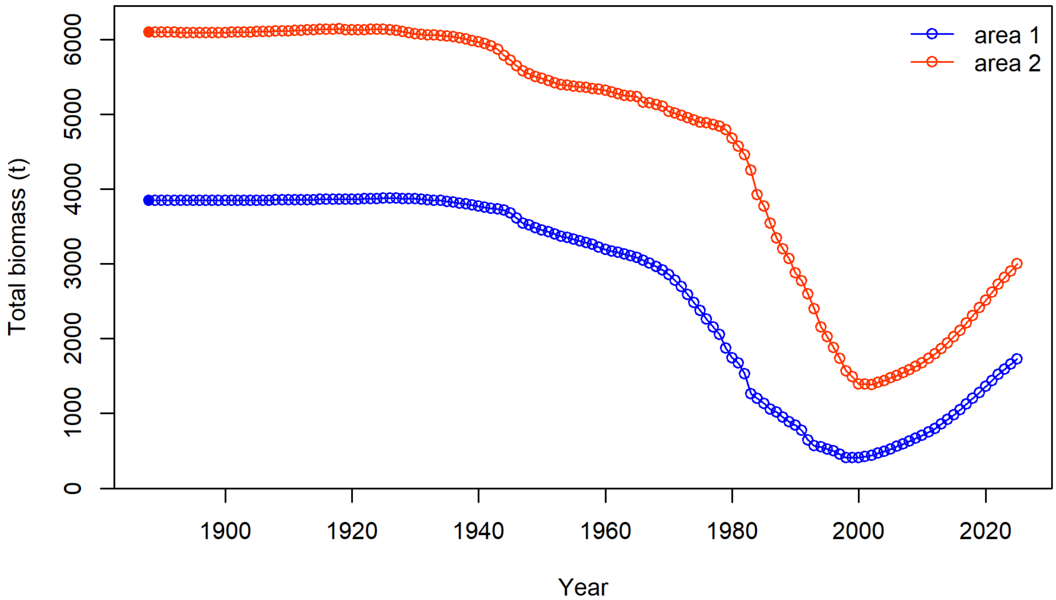

Figure 51: Total biomass (t) over time and by area (Area 1 is California, Area 2 is Oregon/Washington combined).

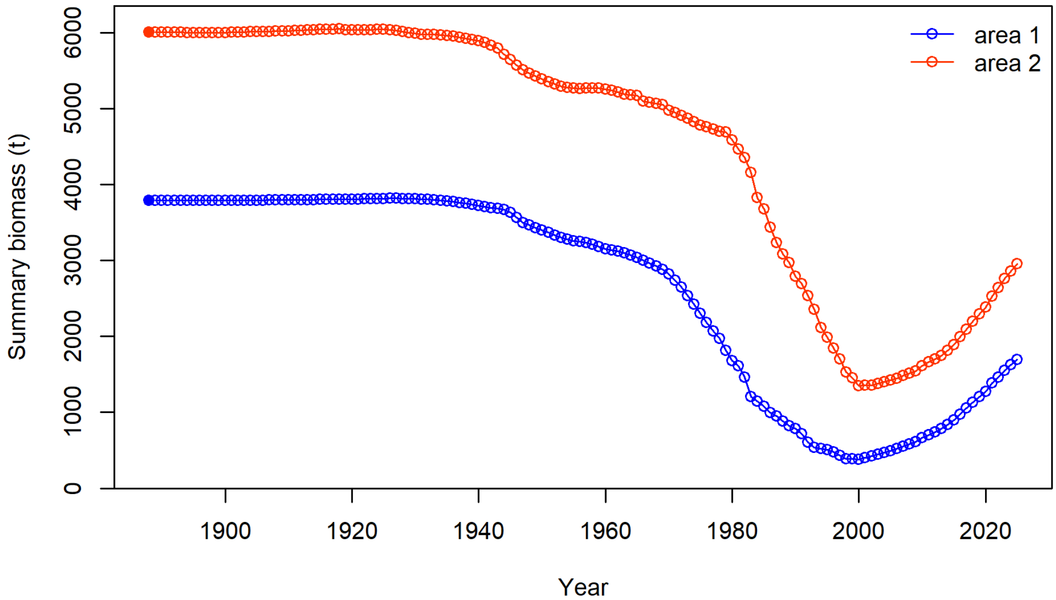

Figure 52: Summary biomass (t) over time and by area (Area 1 is California, Area 2 is Oregon/Washington combined).

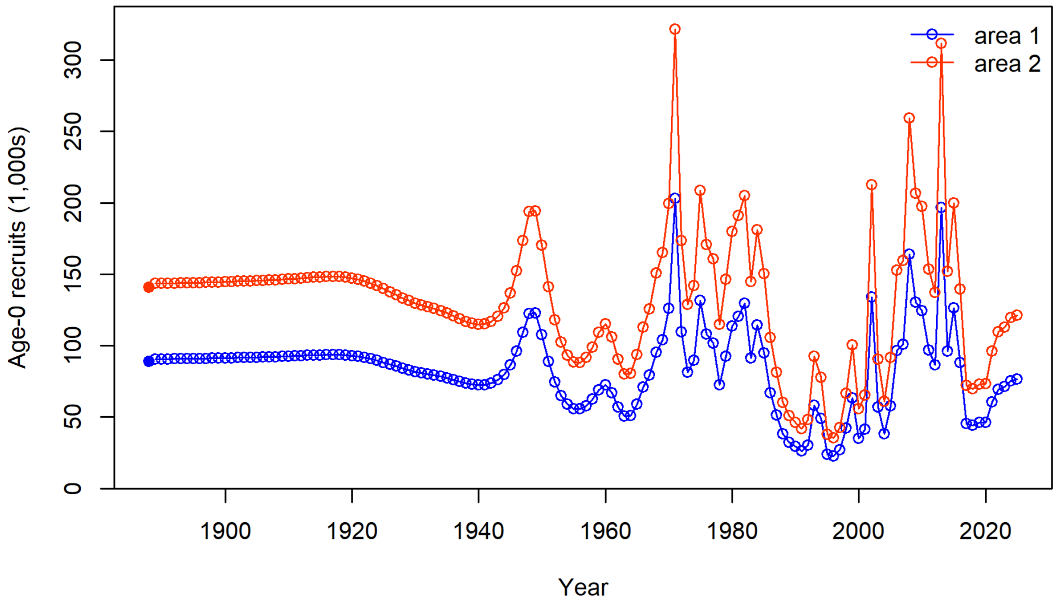

Figure 53: Age 0 recruits (1000s) over time and by area (Area 1 is California, Area 2 is Oregon/Washington combined).

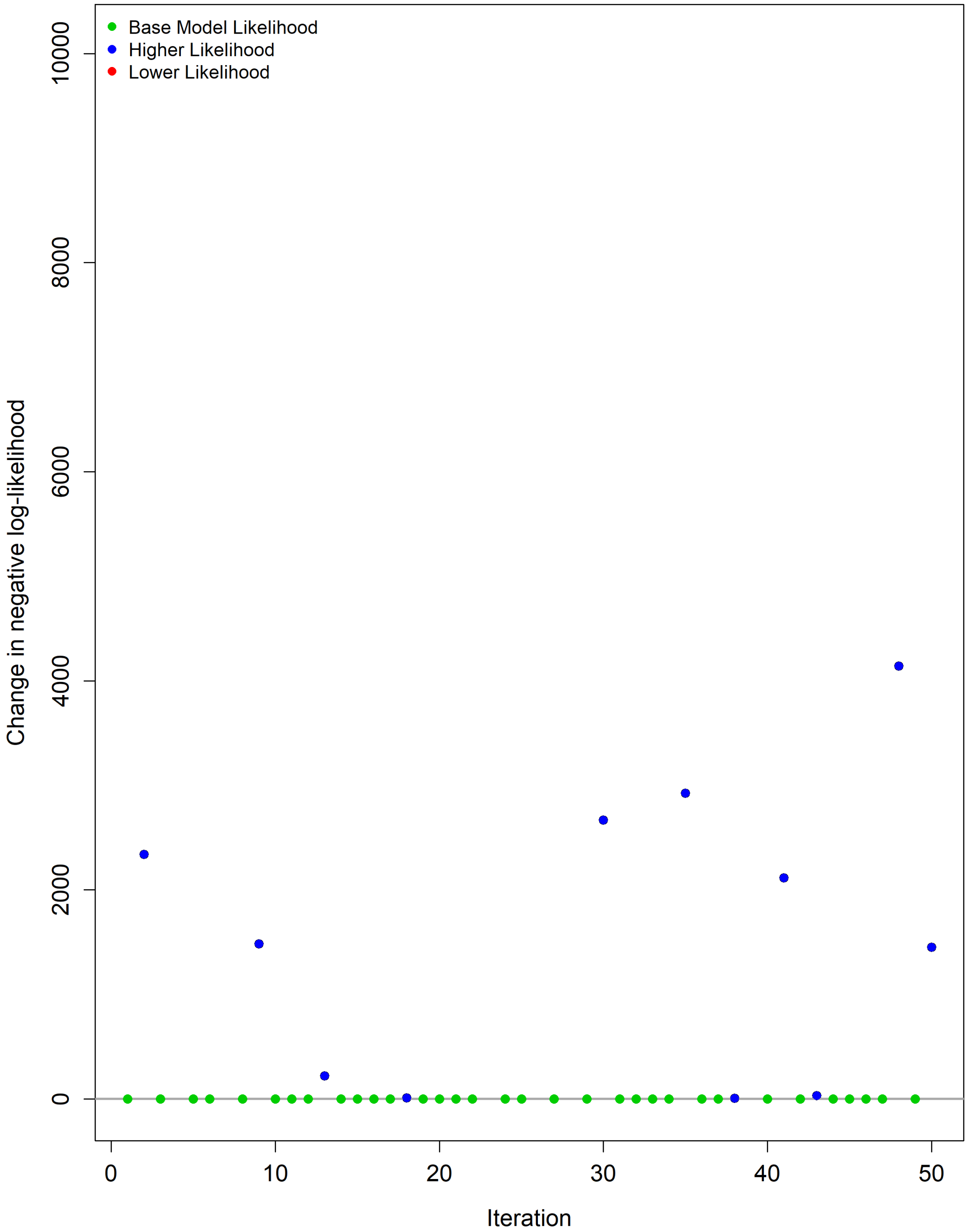

Figure 54: Results from 50 base model runs when starting parameters values are jittered by 0.1 units. Horizontal line indicates base model value.

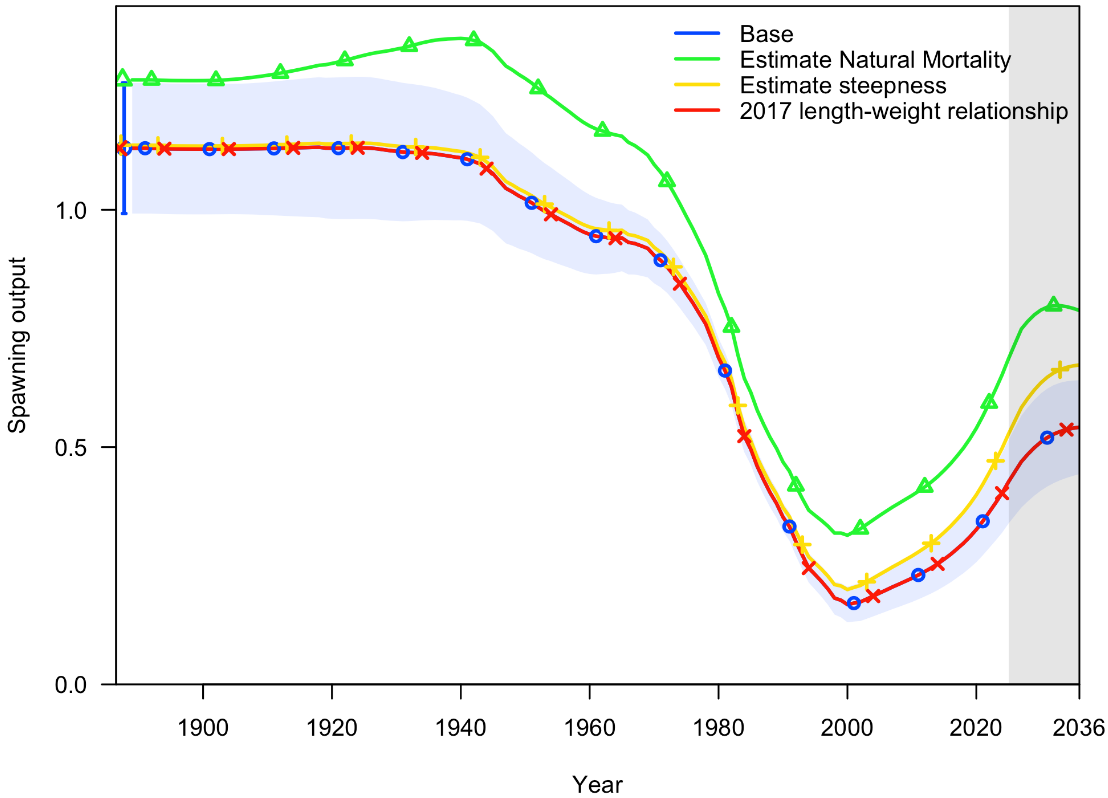

Figure 55: Spawning output across model structure sensitivities.

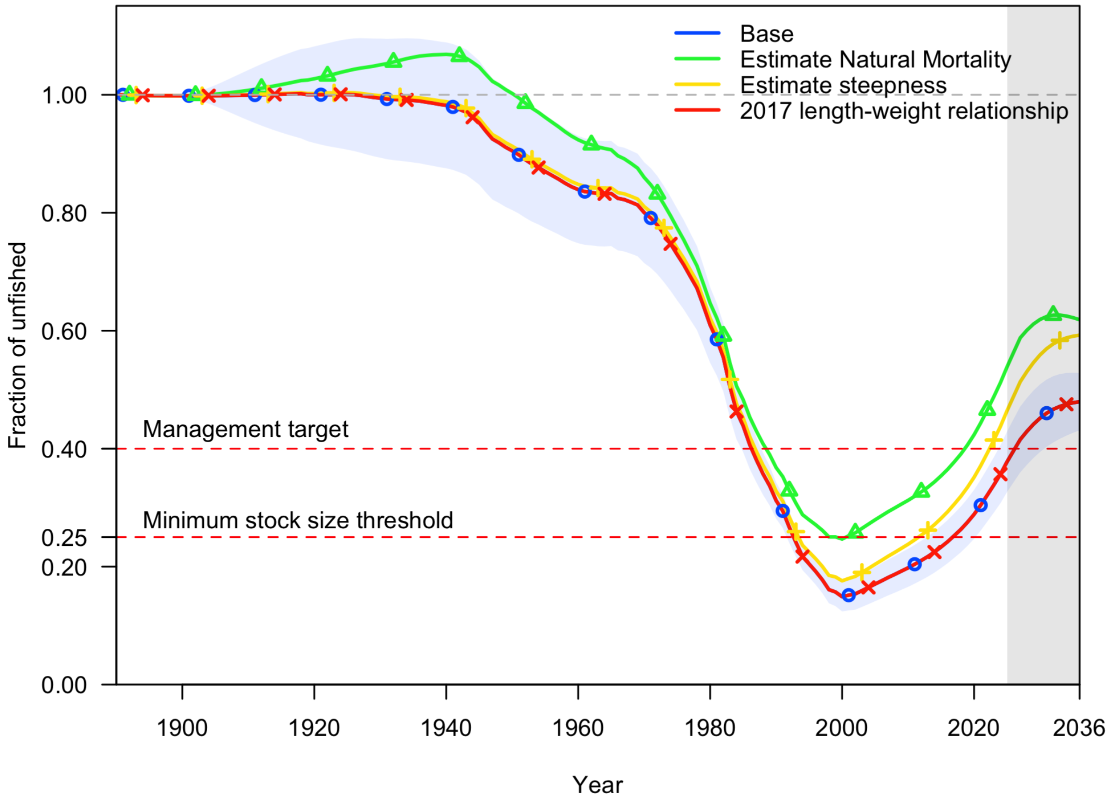

Figure 56: Relative spawning output across model structure sensitivities.

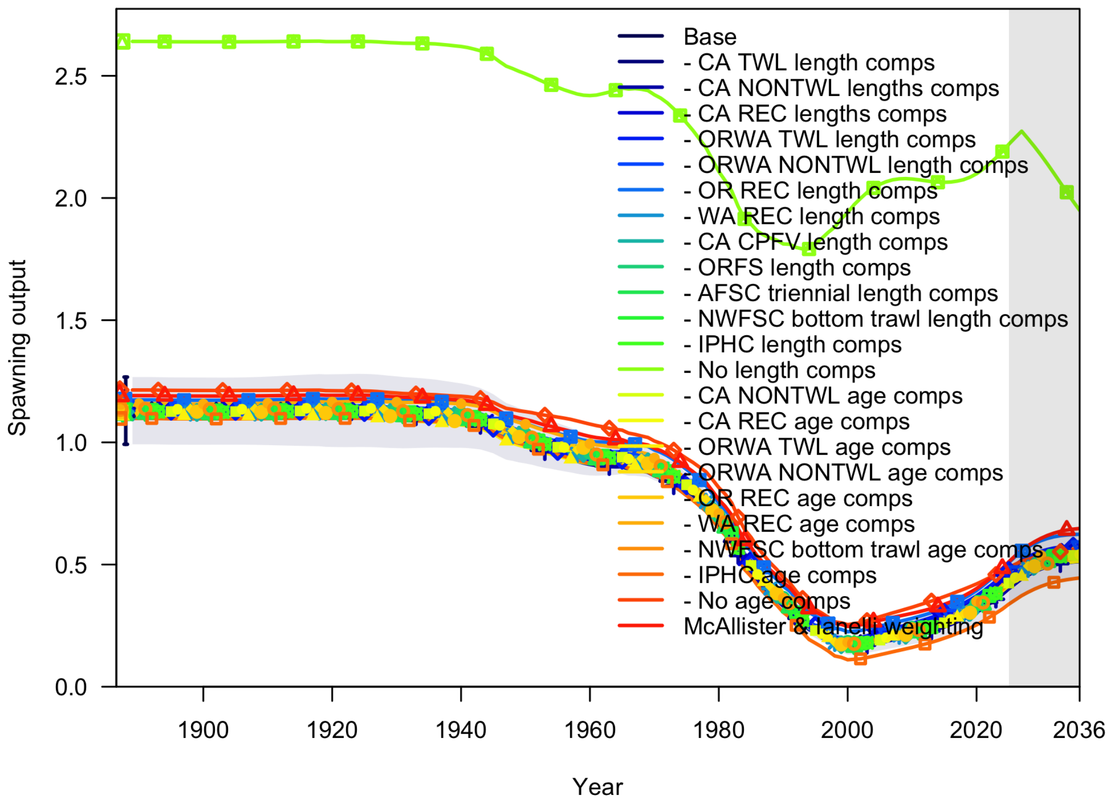

Figure 57: Spawning output across dataset inclusion sensitivities.

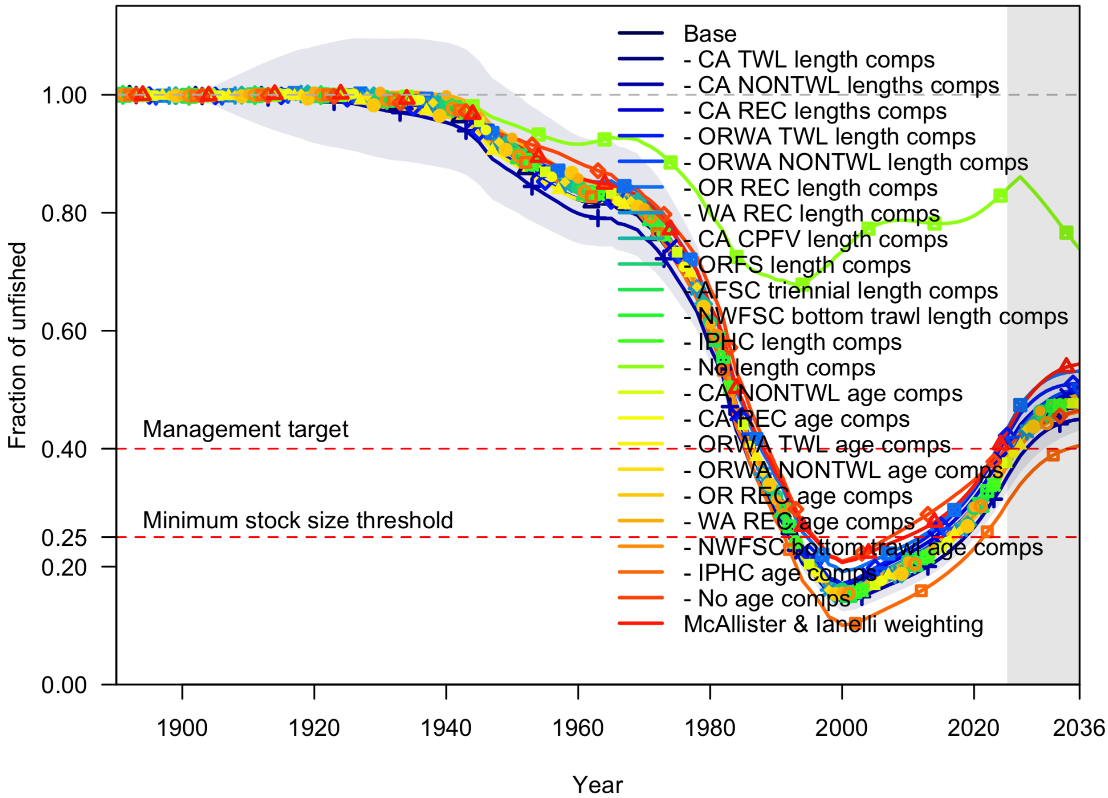

Figure 58: Relative spawning output across dataset inclusion sensitivities.

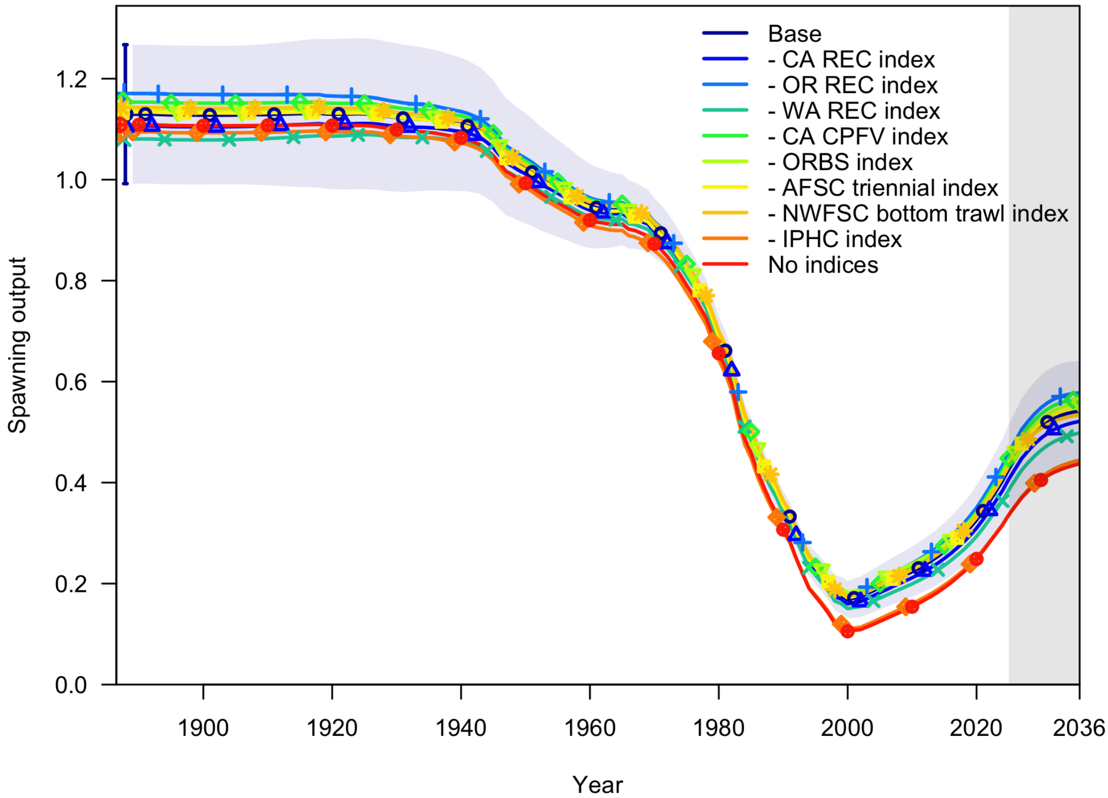

Figure 59: Spawning output across index inclusion sensitivities.

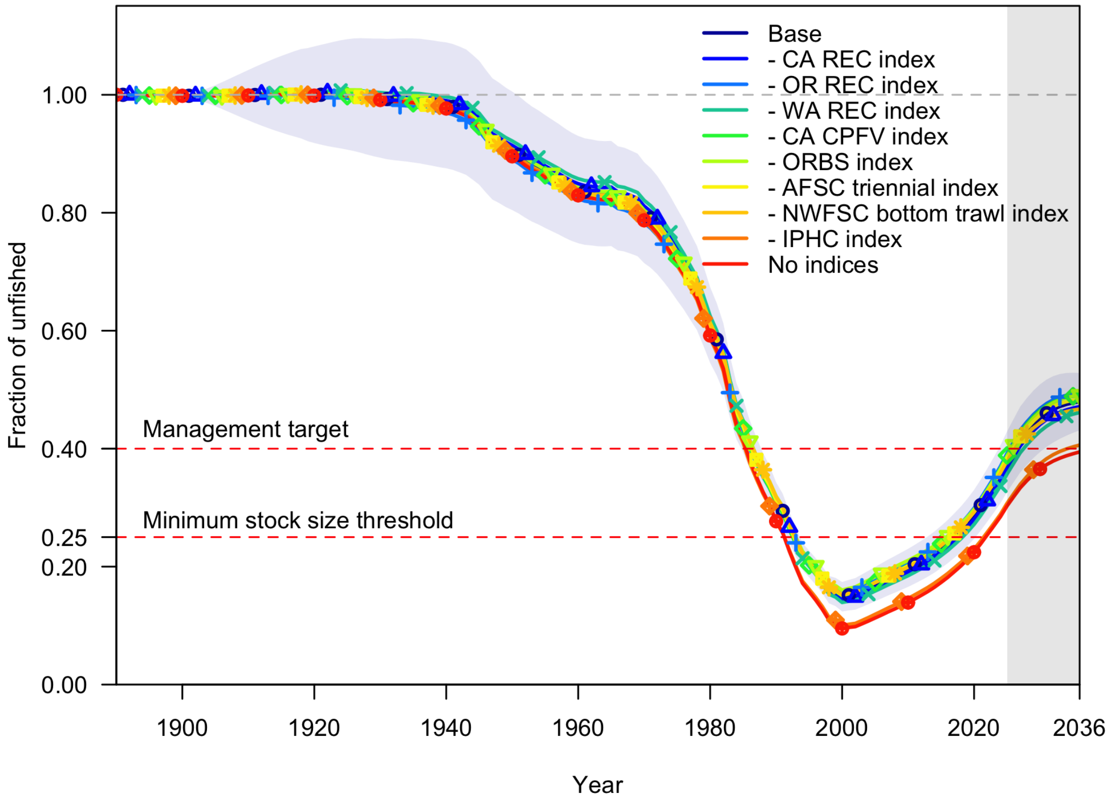

Figure 60: Relative spawning output across index inclusion sensitivities.

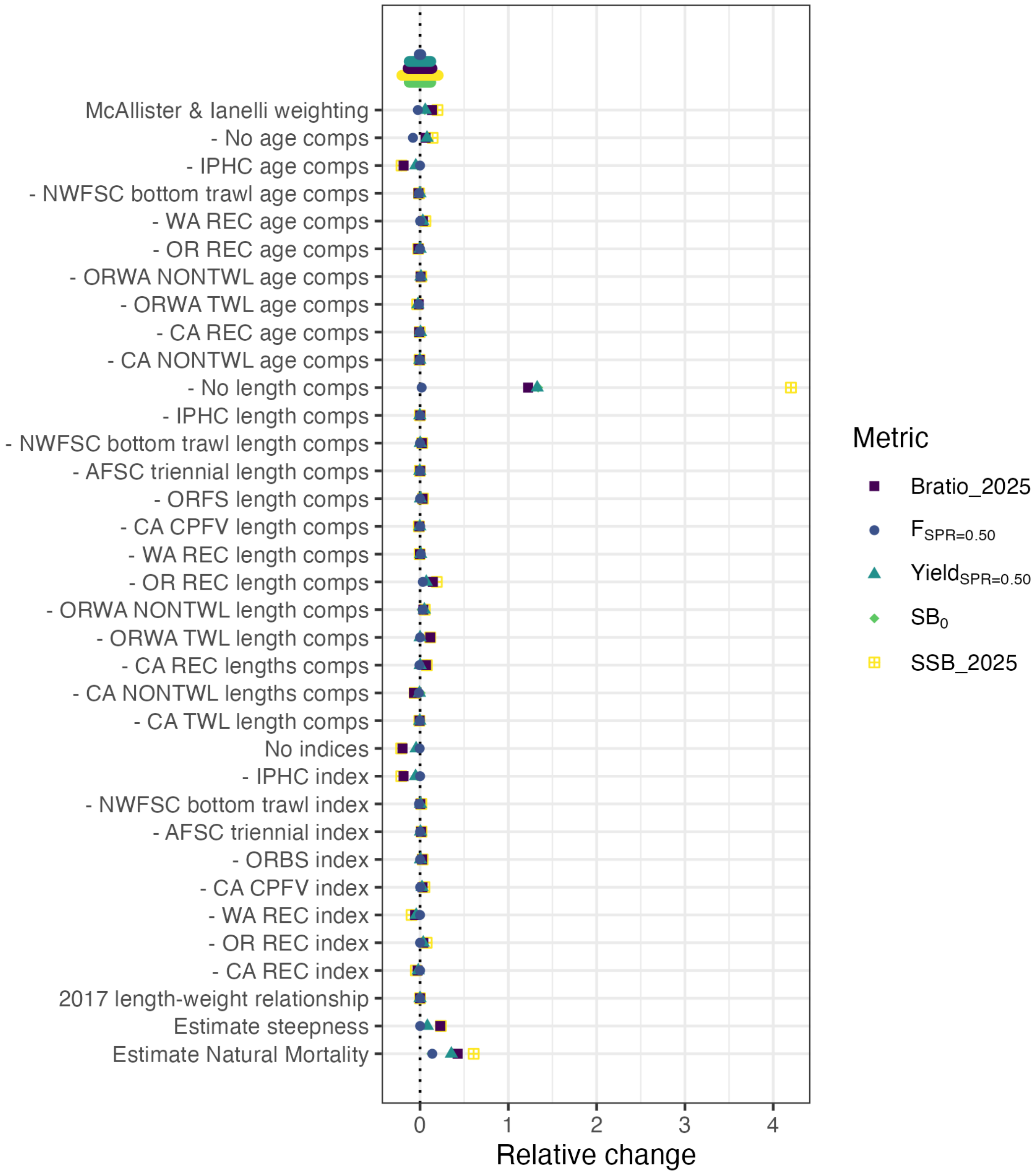

Figure 61: Relative change in management quantities across models conducted as sensitivities.

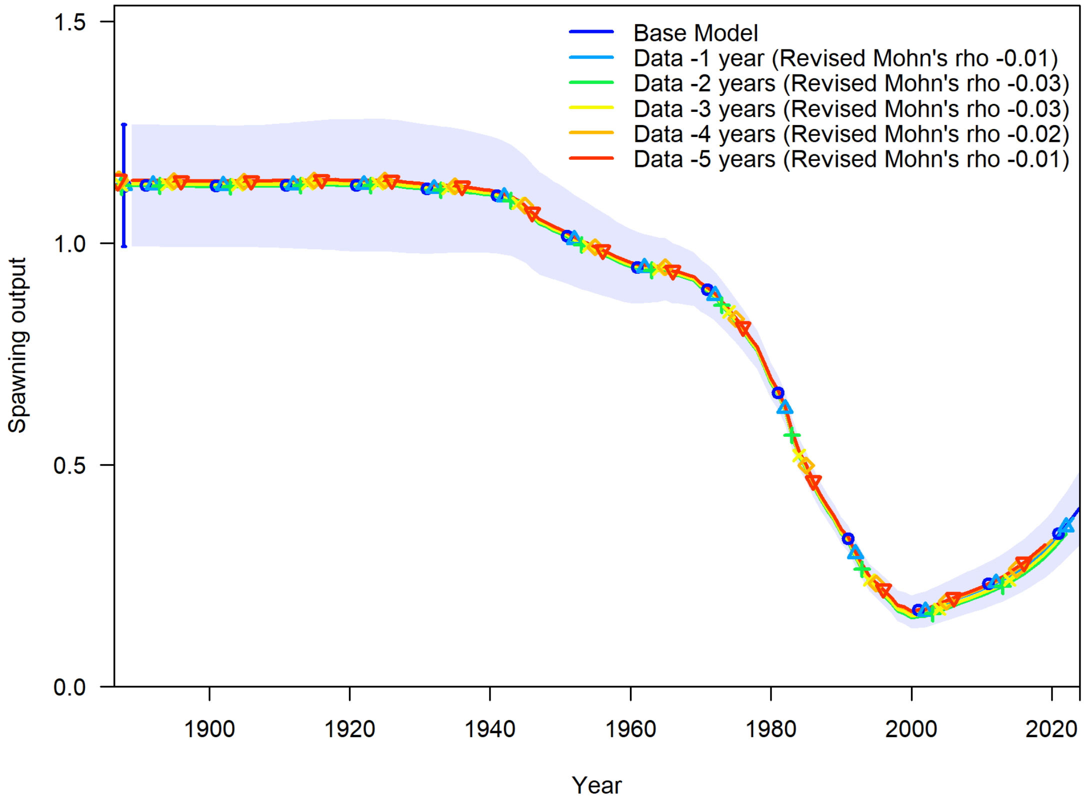

Figure 62: Results of retrospective analysis. Spawning output time series of this assesment base model are proved with ~95% interval.

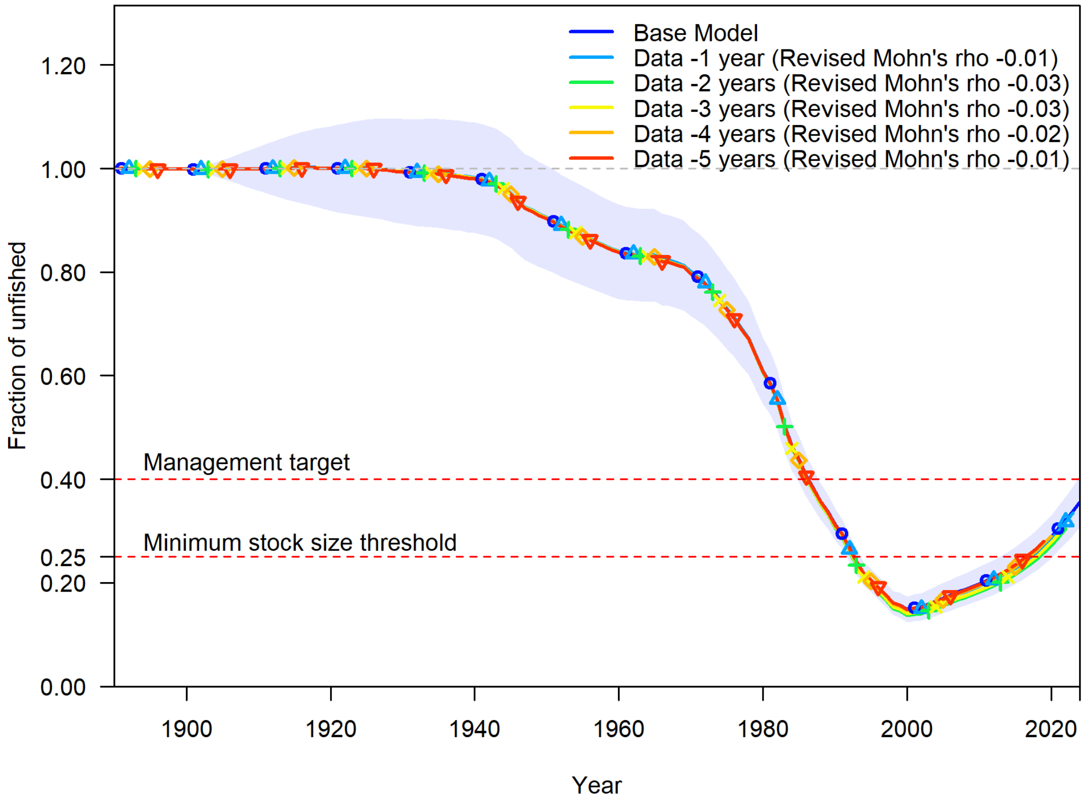

Figure 63: Results of retrospective analysis. Relative spawning output time series of this assesment base model are proved with ~95% interval.

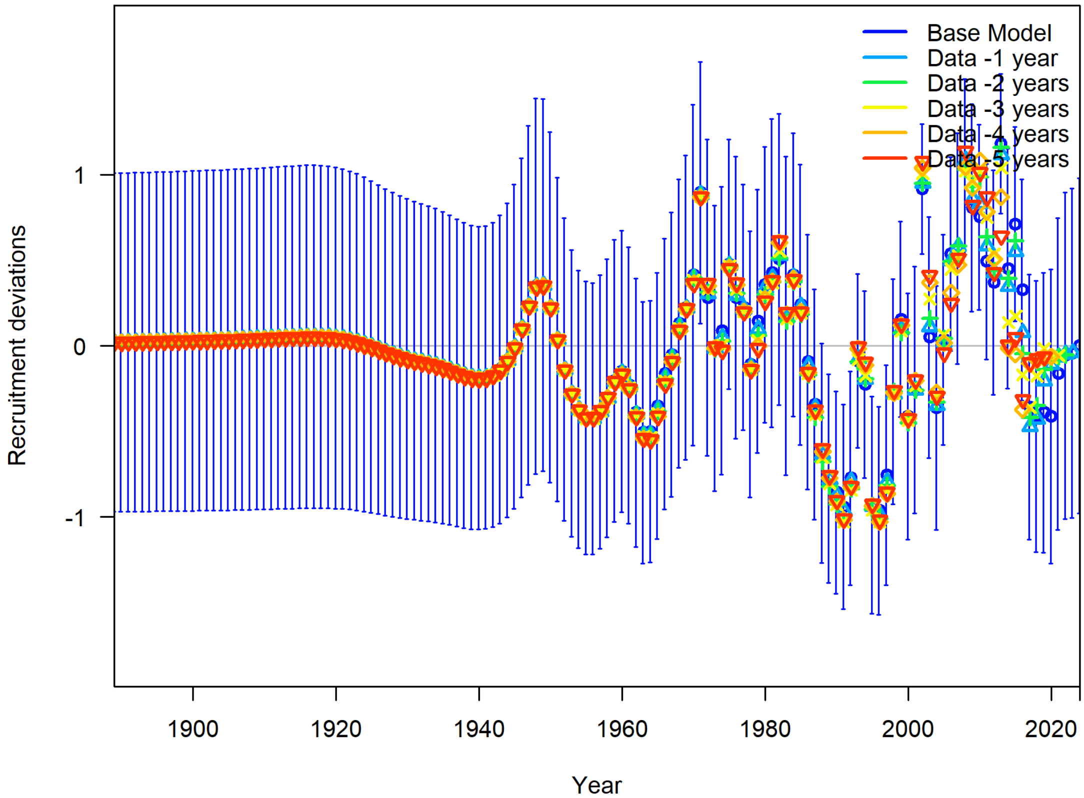

Figure 64: Recruitment deviation time series for each scenario of the retrospective analysis.

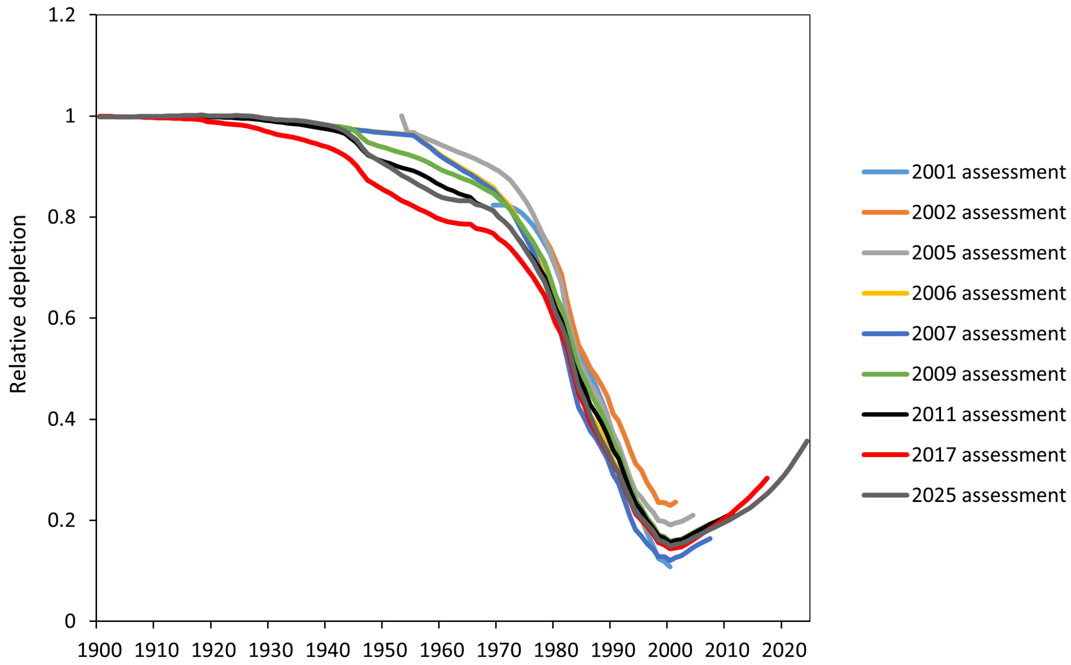

Figure 65: Relative depletion (spawning output) across Yelloweye Rockfish assessments over time.

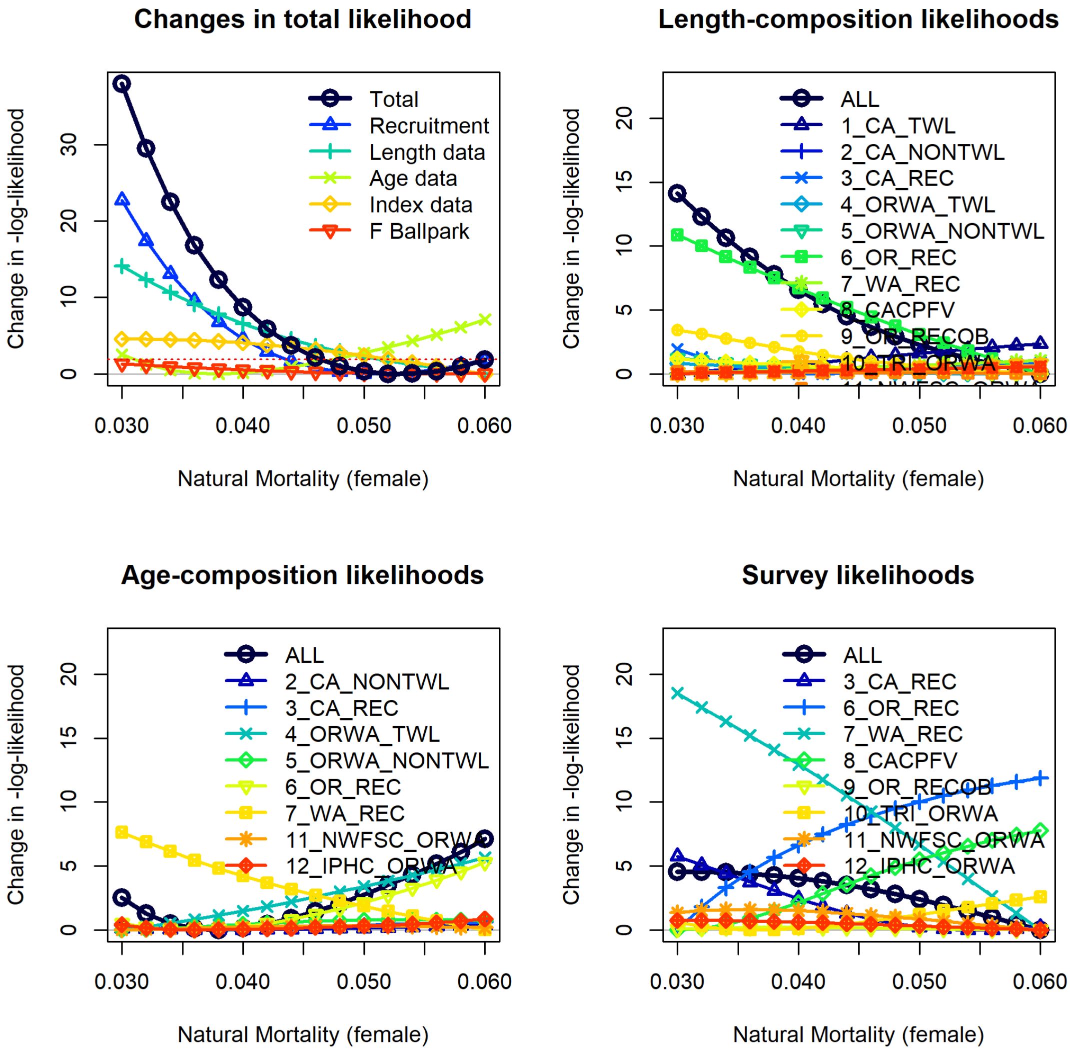

Figure 66: Negative log-likelihood profile for each data component and in total given different values of natural mortality ranging from 0.03 to 0.06 in increments of 0.002.

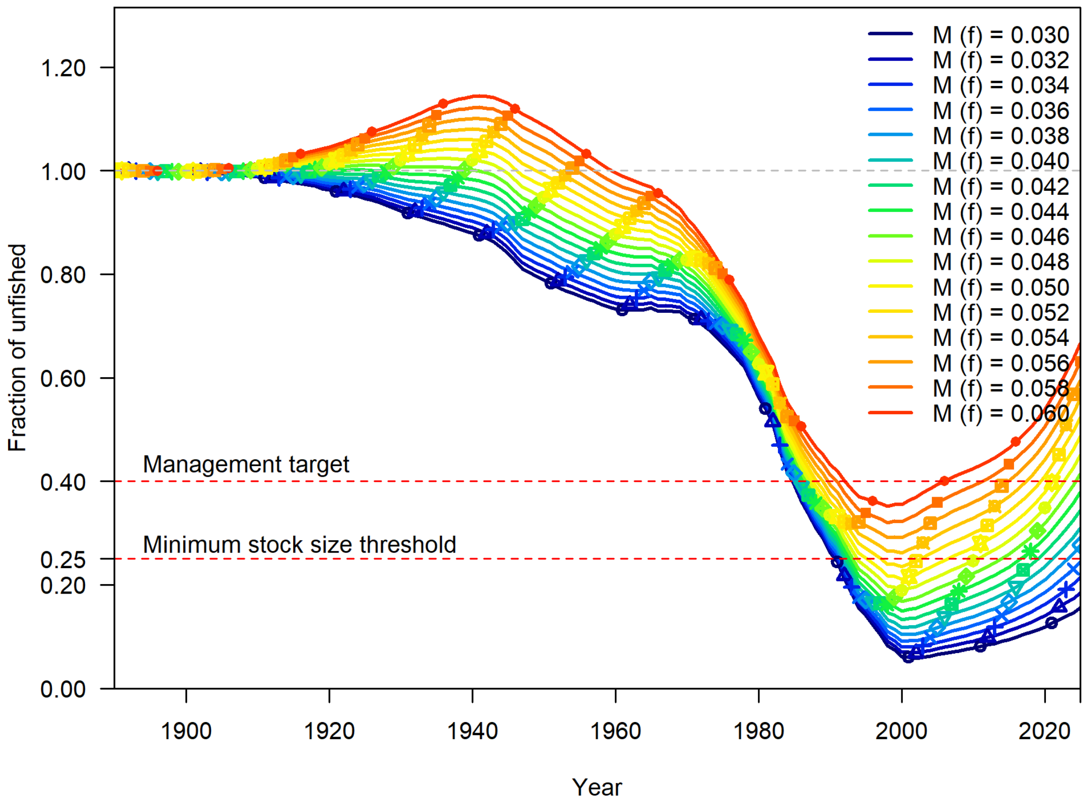

Figure 67: Time series of fraction of unfished biomass output associated with different values of natural mortality ranging from 0.03 to 0.06 in increments of 0.002.

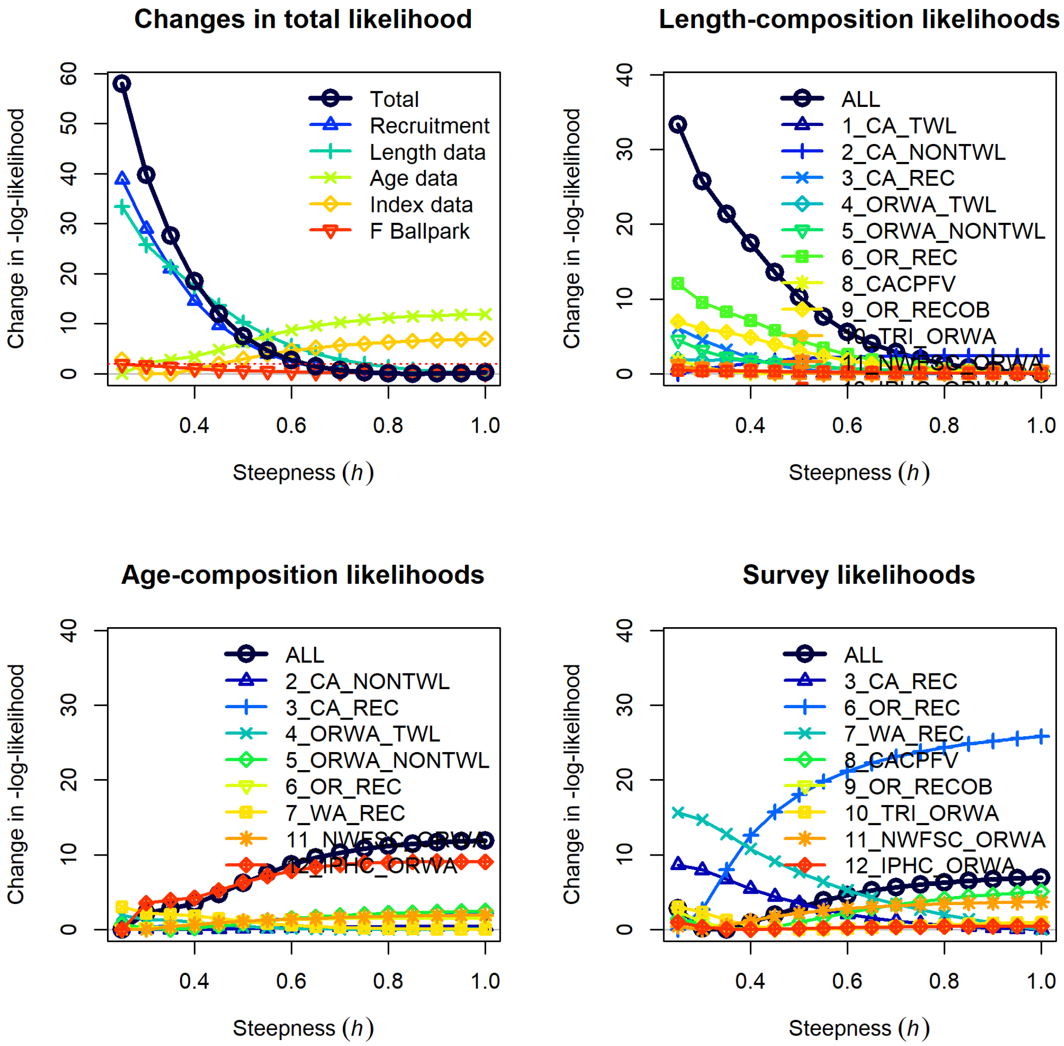

Figure 68: Negative log-likelihood profile for each data component and in total given different values of stock-recruit steepness ranging from 0.25 to 1.0 by increments of 0.05.

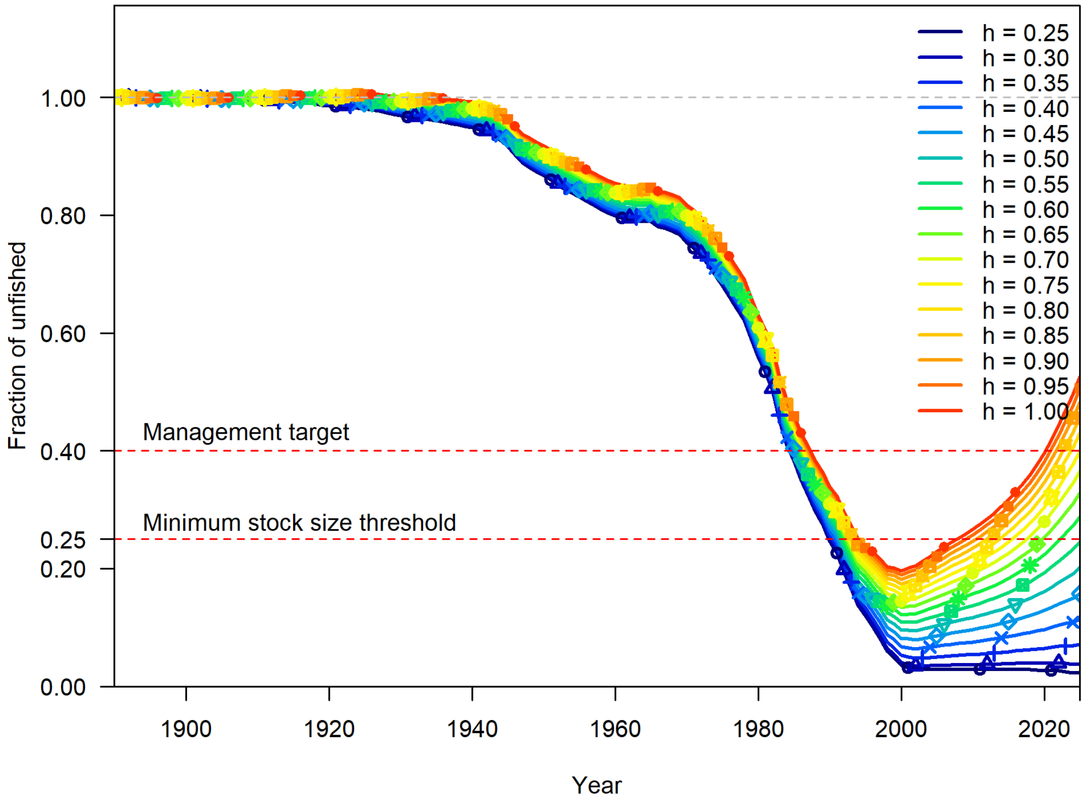

Figure 69: Time series of fraction of unfished biomass output associated with different values of steepness ranging from 0.25 to 1.0 in increments of 0.05.

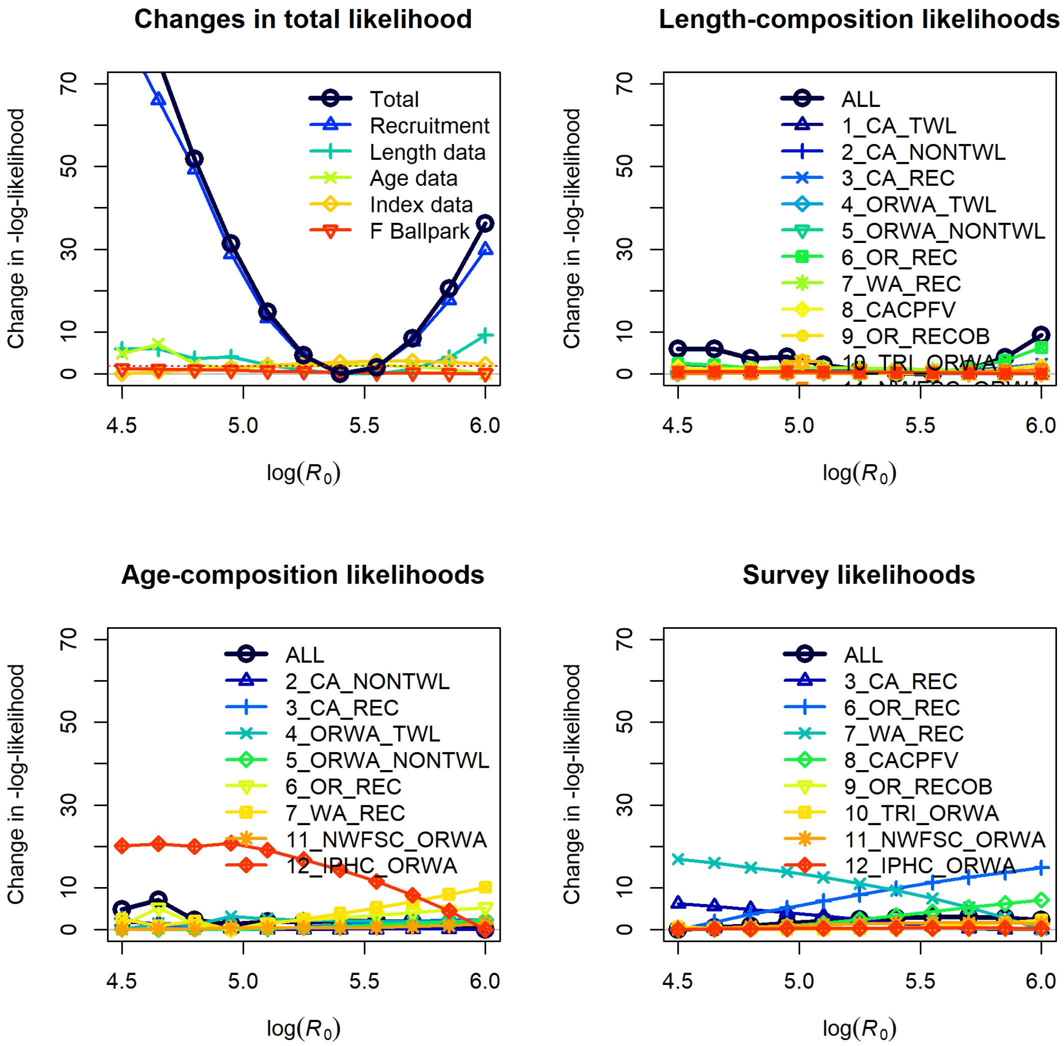

Figure 70: Negative log-likelihood profile for each data component and in total given different values of log initial recruitment (lnR0) ranging from 4.5 to 6.0 by increments of 0.15.

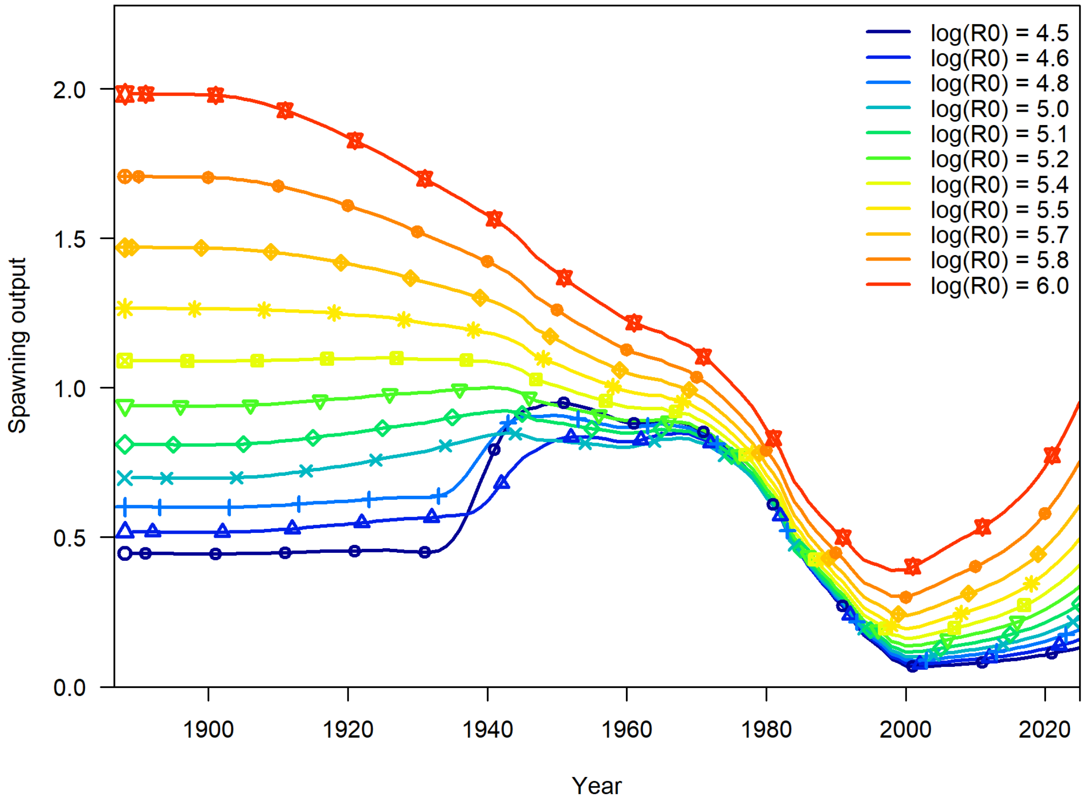

Figure 71: Spawning output as profiled over values of lnR0.

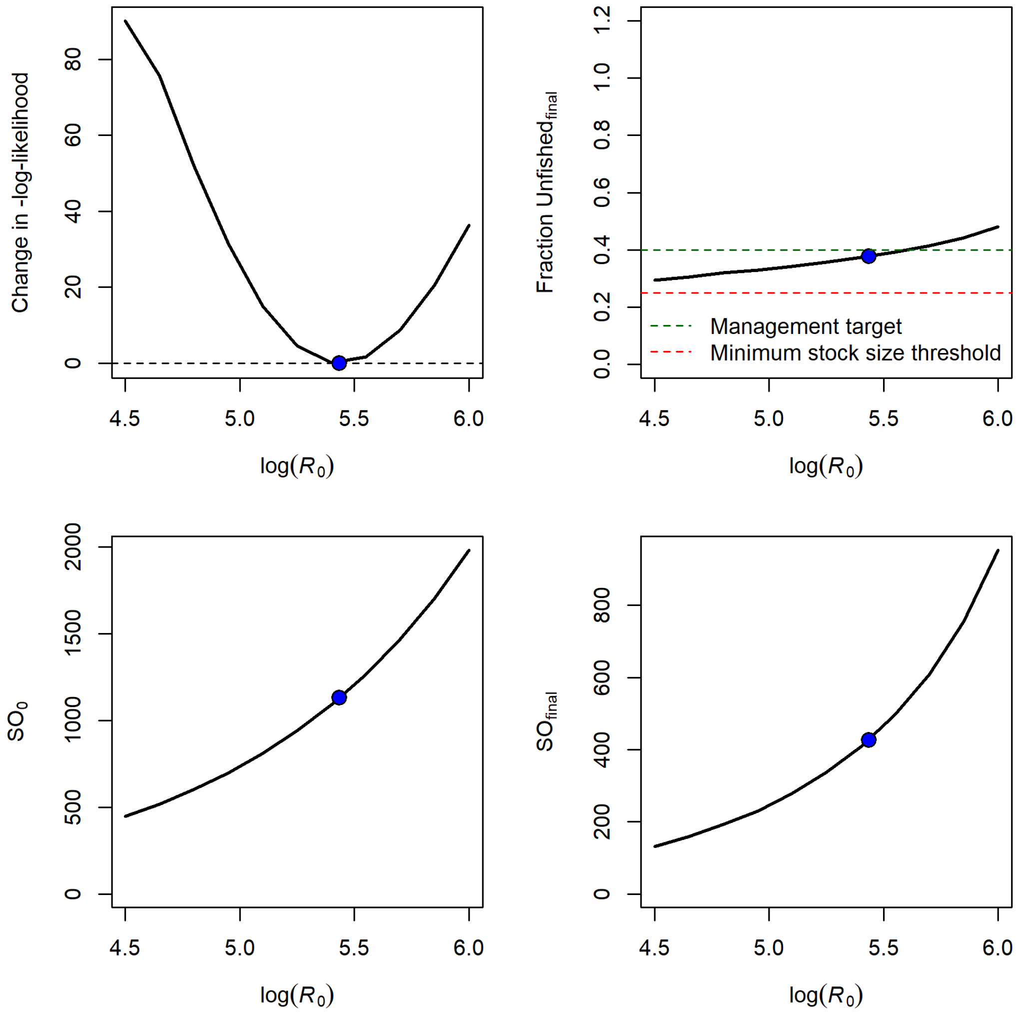

Figure 72: Likelihood profile (top left panel) for log initial recruitment (lnR0), with associated changes in stock status in the current year (SB_2025/SB_0; top right panel), initial spawning biomass (SB_0; bottom left panel), and current year spawning biomass (SB_2025; bottom right panel). Points indicate the base model MLE estimate.