

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



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## **Executive Summary**

### **Stock**

This update assessment reports the status of Yelloweye Rockfish (*Sebastodes ruberrimus*) off the U.S. West Coast using data through 2024. Yelloweye Rockfish 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 habitat 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, conducted in 2017, 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 necessarily maintains this same structure.

### **Catches**

Catches for Yelloweye Rockfish have averaged over 20mt in recent years (Figure i, Table i). 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 its rebuilding plan, catches have slowly increased in recent years, primarily in the Oregon-Washington non-trawl fleet and the recreational fleets.

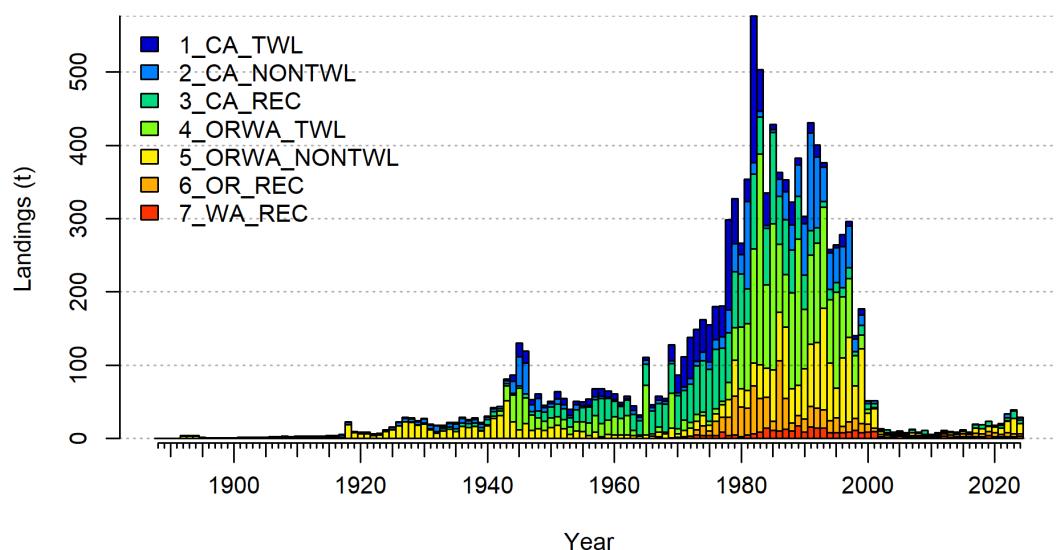


Figure i: Yelloweye Rockfish landing history in metric tons (mt) between 1889 and 2024 for each fleet.

Table i: Recent catches (mt) by fleet and total catch (mt) summed across fleets.

Year	CA.TWL	CA.NONTWL	CA.REC	ORWA.TWL	ORWA.NONTWL	OR.REC	WA.REC	Catch
2015	0.00	0.40	2.00	0.03	3.15	4.26	2.27	12.11
2016	0.00	0.00	1.00	0.07	2.59	2.84	2.61	9.11
2017	0.01	1.23	4.52	0.24	6.97	4.27	2.59	19.84
2018	0.00	0.00	4.99	0.54	6.38	4.01	2.62	18.54
2019	0.04	0.00	6.16	0.59	7.43	5.04	4.26	23.51
2020	0.13	0.00	1.95	0.32	7.52	6.00	2.24	18.15
2021	0.12	2.43	3.96	0.39	7.97	3.34	2.52	20.73
2022	0.10	5.60	3.80	0.76	15.55	5.20	2.62	33.64
2023	0.09	1.83	9.59	0.40	20.64	3.84	2.85	39.23
2024	0.19	0.00	4.65	0.44	3.09	3.66	2.91	14.94

## 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. This assessment uses the stock assessment framework Stock Synthesis (SS3 Version 3.30.23.2) by Methot and Wetzel (2013). 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 (WCGBTS), and the International Pacific Halibut Commission (IPHC) longline survey. In addition, sample sizes and assignment of aging error were corrected in the compositional data. No new data streams were considered in this update assessment.

## Stock biomass and dynamics

The Yelloweye Rockfish assessment uses estimates of fecundity (eggs-at-length) from the Dick et al. (2017) method, and spawning output is reported in millions of eggs. The unexploited level of spawning stock output is estimated to be 1190 million eggs (95% confidence interval: 1,045.7–1,328.5 million eggs) (Figure ii). At the beginning of 2025, the spawning stock output is estimated to be 477.63 million eggs (95% confidence interval: 381–566 million eggs), which represents 40.1% of the unfished spawning output level.

Estimated relative spawning output 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. The 2024 estimated relative spawning output follows an increasing trajectory and is slightly below the management target threshold (Figure ii, Figure iii). Though Yelloweye Rockfish are considered a single stock due to their population's even genetic and spatial structure throughout their range, this assessment is modeled with two areas (California and Oregon-Washington). Current population status differs by area which may be valuable information for making management and allocation decisions (Figure iv).

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

Year	Spawning output	Lower Interval.	Upper Interval.	Fraction Unfished	Lower Interval	Upper Interval
2015	293.07	233.20	352.95	0.246	0.211	0.282
2016	304.71	242.84	366.58	0.256	0.220	0.293
2017	317.87	253.80	381.94	0.267	0.230	0.305
2018	331.52	265.00	398.05	0.279	0.240	0.317
2019	347.17	277.86	416.48	0.292	0.252	0.332
2020	364.48	292.01	436.95	0.306	0.265	0.348
2021	384.48	308.44	460.51	0.323	0.280	0.366
2022	406.33	326.37	486.28	0.341	0.296	0.387

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2023	428.74	344.53	512.94	0.360	0.313	0.408
2024	452.09	363.37	540.81	0.380	0.330	0.430
2025	477.63	384.18	571.08	0.401	0.349	0.453

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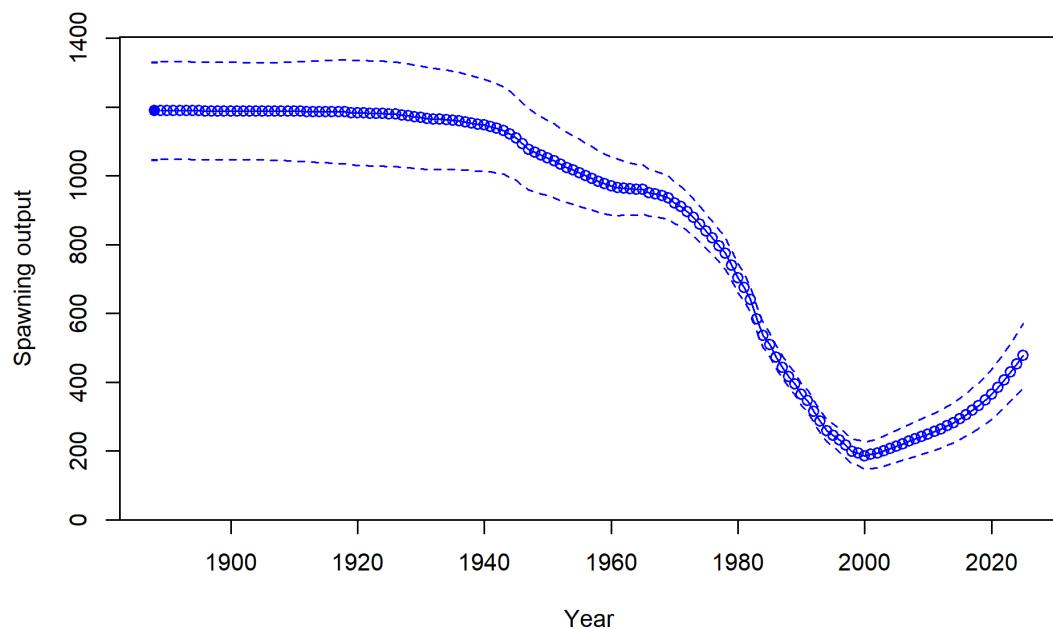


Figure ii: Time series of estimated spawning output (in million eggs) for the base model (circles) with ~ 95% interval (dashed lines). Spawning output is expressed in million eggs.

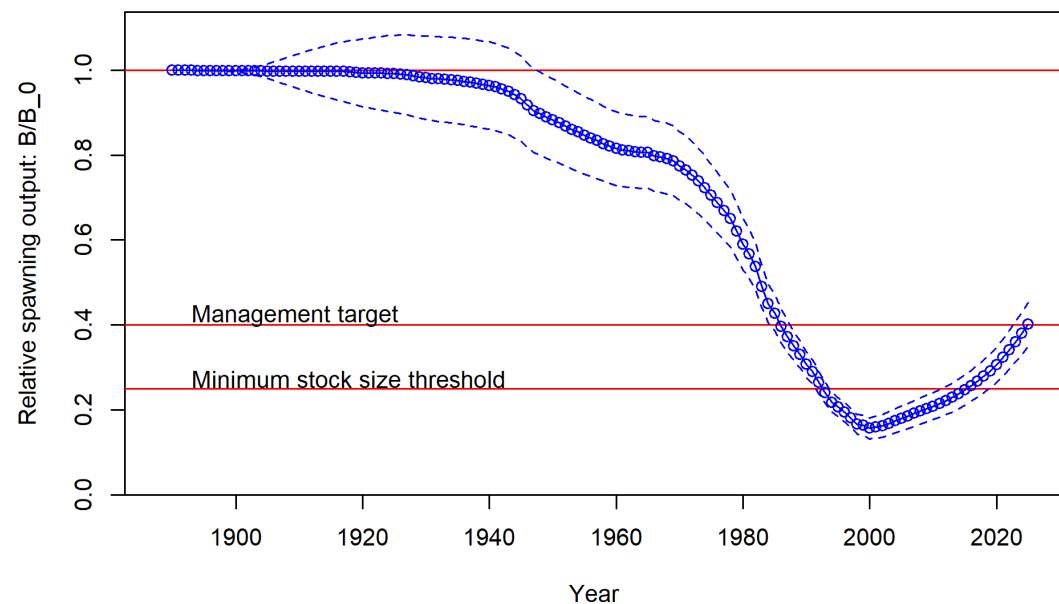


Figure iii: Time series of estimated relative spawning output for the base model.

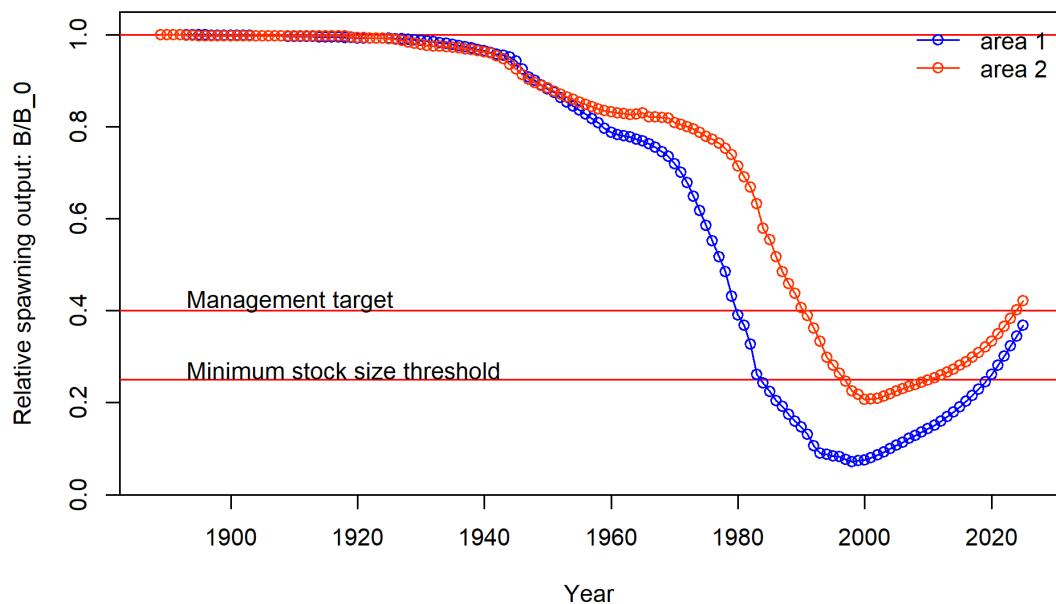


Figure iv: Time series of relative spawning output estimated by area (area 1= California, area 2 = Oregon and Washington).

## Recruitment

The largest estimated recruitment events were in 1971, followed by more recently, in 2013 and 2008 (Figure v, Figure vi, Table iii). Trends in recruitment are largely consistent with the previous assessment, apart from the most recent elevated time period that is more informed with additional length and age composition data. Recruits for this assessment appear to have extended this more recent time period starting in 2005, with peaks in 2008 and 2013, and lower recruitment in 2017.

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	359	200	643	0.729	0.153	1.306
2016	242	126	467	0.315	-0.347	0.977
2017	121	56	259	-0.404	-1.193	0.386
2018	115	53	250	-0.472	-1.276	0.331
2019	118	54	262	-0.467	-1.291	0.357
2020	117	51	267	-0.501	-1.364	0.362
2021	153	64	364	-0.259	-1.172	0.655
2022	174	70	429	-0.154	-1.107	0.800
2023	179	72	445	-0.141	-1.102	0.819
2024	209	82	531	0.000	-0.980	0.980
2025	211	83	537	0.000	-0.980	0.980



Figure v: Time series of estimated yelloweye rockfish recruitments for the base model (circles) with approximate 95% intervals (vertical lines).

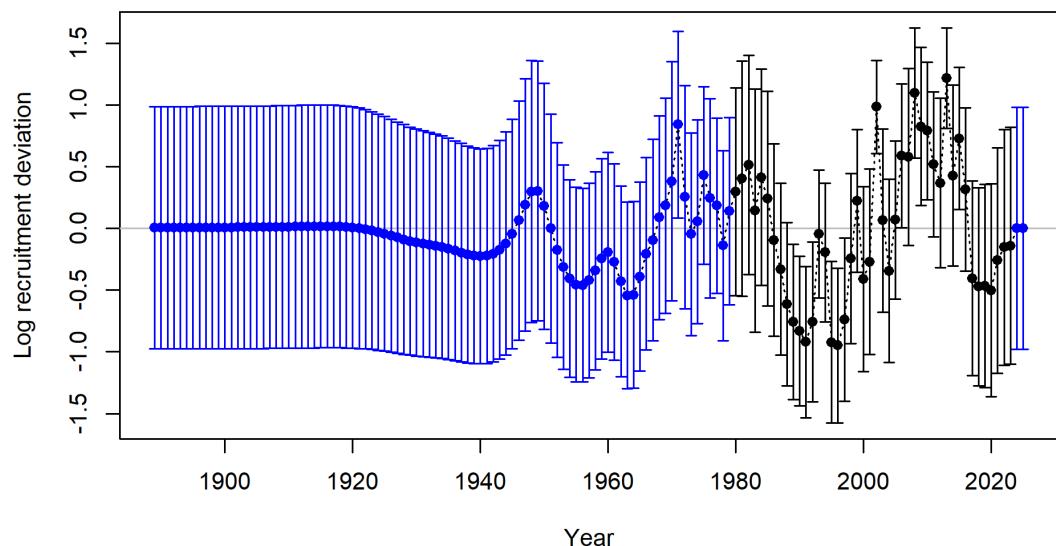


Figure vi: Estimated recruitment deviations with 95% intervals.

### Exploitation status

This assessment estimates that the stock of Yelloweye Rockfish off the continental U.S. Pacific Coast is currently at 40.1% of its unexploited level. This is above the overfished threshold of SB25%, and slightly below the management target SB40% of unfished spawning biomass. Fishing intensity increased throughout the 1900s as the stock was fished down, until stabilizing at peak intensity between the mid1980s and late 1990s and substantially decreasing in the late 1990s and early 2000s. Fishing intensity has since been relatively stable (Figure vii, Table iv).

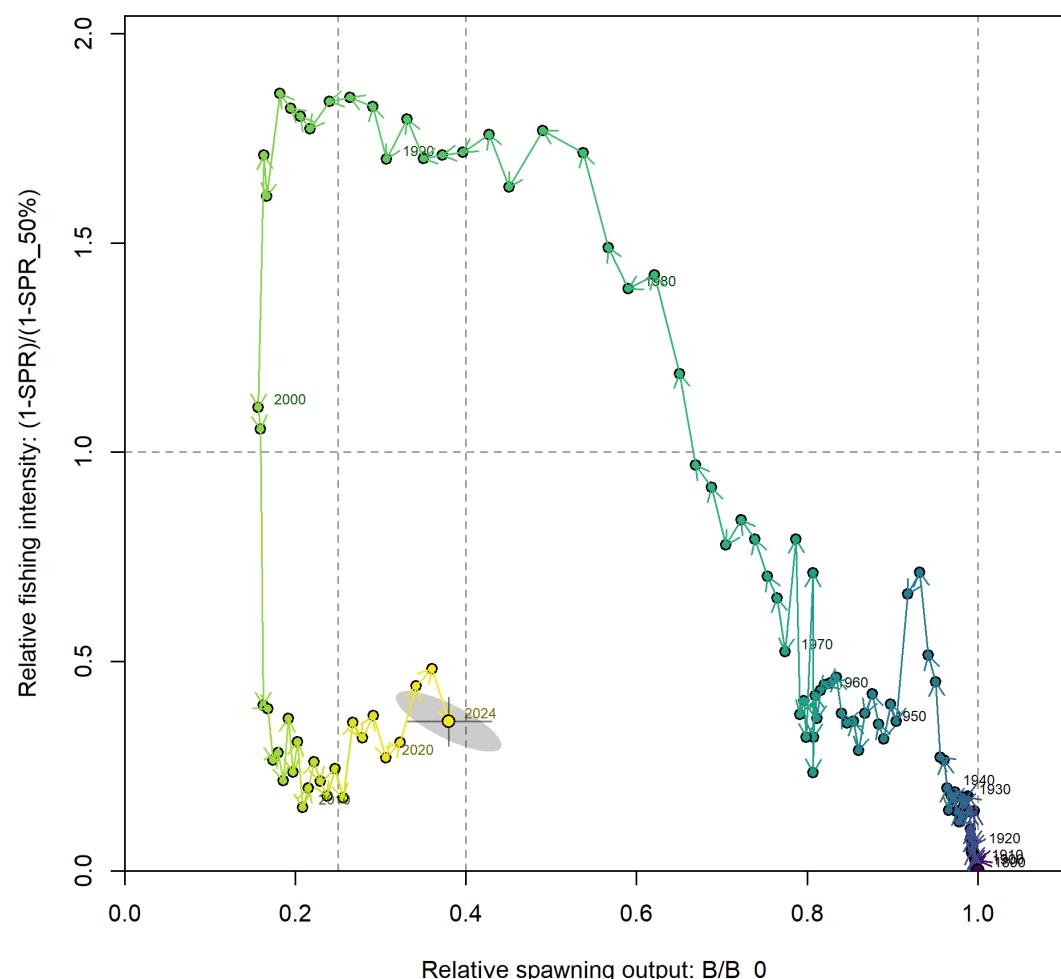


Figure vii: Phase plot of fishing intensity versus fraction unfished.

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	0.244	0.201	0.286	0.004	0.003	0.005
2016	0.174	0.143	0.204	0.003	0.002	0.003
2017	0.355	0.296	0.414	0.006	0.005	0.007
2018	0.317	0.264	0.370	0.005	0.004	0.006
2019	0.371	0.310	0.431	0.006	0.005	0.007
2020	0.270	0.225	0.314	0.004	0.004	0.005
2021	0.306	0.255	0.358	0.005	0.004	0.006
2022	0.441	0.372	0.509	0.007	0.006	0.009
2023	0.482	0.408	0.555	0.008	0.007	0.010
2024	0.357	0.299	0.414	0.006	0.005	0.007

### Ecosystem considerations

No ecosystem or environmental data was used in the previous Yelloweye Rockfish assessment and no new data were considered for this update assessment.

### Reference points

A list of estimates of the current state of the population, as well as reference points based on 1) a target unfished spawning output of 40%, 2) a spawning potential ratio of 0.5, and 3) the model estimate of maximum sustainable yield, are all listed in Table v. Unfished spawning stock output for Yelloweye Rockfish was estimated to be 1190 million eggs (95% confidence interval: 1,045.7-1,328.5 million eggs). The management target for Yelloweye Rockfish is defined as 40% of the unfished spawning output (SB40%), which is estimated by the model to be 475 million eggs (95% confidence interval: 418-531), which corresponds to an exploitation rate of 0.026. This harvest rate provides an equilibrium yield of 121 mt at SB40% (95% confidence interval: 107-136 mt). The equilibrium yield curve is shown in Figure viii.

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	1,190.0	1,048.1	1,331.9
Unfished Age 8+ Biomass (mt)	10,331	9,101	11,561
Unfished Recruitment (R0)	242	213	271
2025 Spawning output	478	384	571
2025 Fraction Unfished	0.401	0.349	0.453
Reference Points Based SO40%	—	—	—
Proxy Spawning output SO40%	476	419	533
SPR Resulting in SO40%	0.458	0.458	0.458
Exploitation Rate Resulting in SO40%	0.026	0.026	0.027
Yield with SPR Based On SO40% (mt)	122	108	137
Reference Points Based on SPR Proxy for MSY	—	—	—
Proxy Spawning output (SPR50)	531	468	594
SPR50	0.500	—	—
Exploitation Rate Corresponding to SPR50	0.023	0.023	0.023
Yield with SPR50 at SO SPR (mt)	117	103	131
Reference Points Based on Estimated MSY Values	—	—	—
Spawning output at MSY (SO MSY)	343	303	384
SPR MSY	0.358	0.356	0.359
Exploitation Rate Corresponding to SPR MSY	0.037	0.036	0.037
MSY (mt)	128	113	143

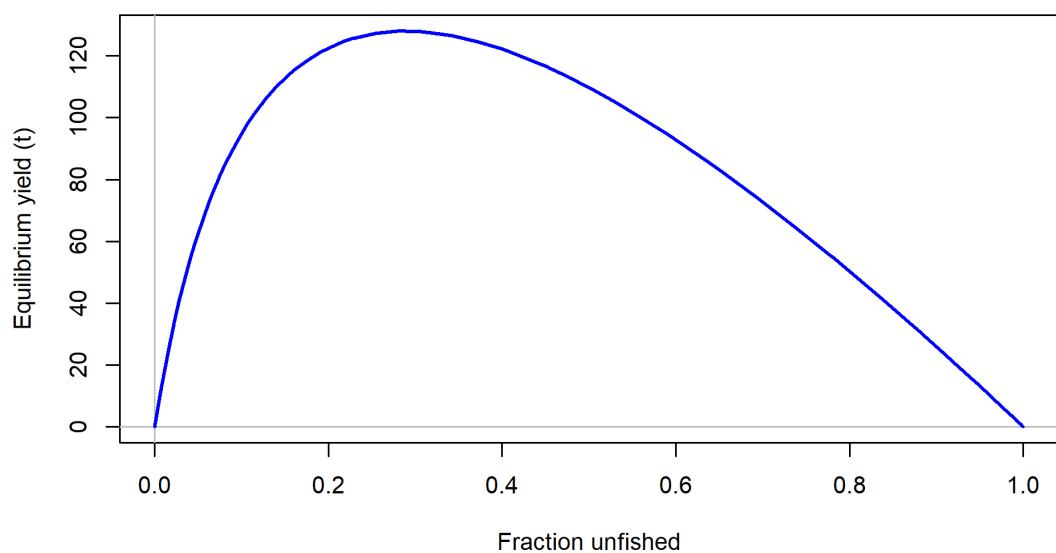


Figure viii: Equilibrium yield curve (derived from reference point values) for the base model. Values are based on 2024 fishery selectivity and distribution with steepness fixed at 0.718. The relative spawning output is relative to unfished spawning biomass.

## Management performance

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 overfishing limit (OFL) and annual catch limit (ACL) 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.

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)	Catch (mt)
2015	52.0	43.0	18.0	12.11
2016	52.0	43.0	19.0	9.11
2017	56.9	47.4	20.0	19.84
2018	57.5	47.9	20.0	18.54
2019	81.5	74.4	48.0	23.51
2020	84.2	76.9	49.0	18.15
2021	97.5	83.5	50.0	20.73
2022	98.1	83.2	51.0	33.64
2023	89.6	75.3	52.0	39.23
2024	91.2	75.9	53.3	14.94

## Harvest projections

This section will be updated after SSC GFSC review.

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	Fraction Unfished
2025	105.8	55.8	45.7	—	—	—	—	477.630	0.401
2026	108.3	56.6	46.4	—	—	—	—	502.268	0.422
2027	—	—	—	129.3	0.873	112.9	112.9	526.772	0.443
2028	—	—	—	130.9	0.864	113.1	113.1	543.555	0.457
2029	—	—	—	132.0	0.856	113.0	113.0	558.406	0.469
2030	—	—	—	132.7	0.848	112.6	112.6	570.839	0.480
2031	—	—	—	133.1	0.840	111.8	111.8	580.654	0.488
2032	—	—	—	133.3	0.832	110.9	110.9	587.932	0.494
2033	—	—	—	133.2	0.824	109.8	109.8	592.973	0.498
2034	—	—	—	133.1	0.817	108.8	108.8	596.202	0.501
2035	—	—	—	132.9	0.809	107.6	107.6	598.069	0.503
2036	—	—	—	132.8	0.801	106.3	106.3	599.025	0.503

## Decision table

This section will be updated after SSC GFSC review.

Table viii: Decision table with 10-year projections. ‘Mgmt’ refers to the three management scenarios (A) the default harvest control rule  $P = 0.45$ . In each case the 2025 and 2026 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 millions 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	2025	46	330.67	0.289	477.63	0.401	839.65	0.603
	2026	46	347.96	0.305	502.27	0.422	878.58	0.630
	2027	99	365.20	0.320	526.77	0.443	916.84	0.658
	2028	98	376.44	0.329	543.56	0.457	946.40	0.679
	2029	97	386.47	0.338	558.41	0.469	972.47	0.698
	2030	96	394.93	0.346	570.84	0.480	994.20	0.713
	2031	94	401.71	0.352	580.65	0.488	1011.25	0.726
	2032	92	406.85	0.356	587.93	0.494	1023.78	0.735
	2033	91	410.56	0.359	592.97	0.498	1032.35	0.741
	2034	89	413.15	0.362	596.20	0.501	1037.71	0.745
	2035	87	414.93	0.363	598.07	0.503	1040.63	0.747
	2036	85	416.25	0.364	599.03	0.503	1041.85	0.748

## Scientific uncertainty

The model estimated uncertainty around the 2025 spawning biomass with a standard deviation = 0.027. The uncertainty around the OFL in 2025 has a standard deviation = 11.546. Each of these are likely underestimates of overall uncertainty due to the necessity to fix several key population dynamics parameters (e.g. steepness and recruitment variance) and also because there is no explicit incorporation of model structural uncertainty (although see the decision table for alternative states of nature).

## Research and data needs

Please refer to the 2017 benchmark assessment for a detailed list of research and data needs for Yelloweye Rockfish (Gertseva and Cope (2017)). 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:

- Continue refining the ORFS index analysis and ultimately use either the ORBS or ORFS index to describe the CPUE trends in the Oregon recreational fishery after 2000.
- Expand the IPHC age composition bins to an older maximum age for the IPHC age composition data to spread out the distribution of length data in the oldest age bins for conditional age-at-length.

### **Rebuilding projections**

This section will be updated after SSC GFSC review.

## 1 Introduction

Yelloweye Rockfish (*Sebastodes 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 (I. J. Stewart, Wallace, and McGilliard 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 habitat, 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 previously 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 differences between Canadian waters (Strait of Georgia) and West coast coastal populations of Yelloweye Rockfish, but no evidence of differentiation across coastal populations (Siegle et al. 2013). Gao et al. (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.

### 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**

Since the 2017 assessment, catch restrictions for Yelloweye Rockfish have continued, though as the stock has begun to recover, the rebuilding plan has allowed for small catch increases that have slightly loosened the constraining impact of this species. However, this section is not required for an update assessment; please refer to the most recent full assessment (Gertseva and Cope 2017) and Section [1.5](#) 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 management 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 Area (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 OFL and ACL 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 coast wide 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 or been added since 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 Washington Department of Fish and Wildlife (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 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, or 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 Oregon Department of Fish and Wildlife Oregon Recreational Boat Survey (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 in the 2017 assessment 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 [Pacific Fisheries Information Network \(PacFIN\)](#) 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. At this time no WCGOP data were available for 2024, so we used the average total discard for 2021-2023 to approximate total 2024 discards for each commercial fleet.

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

Recreational removals from [Recreational Fishery Information Network \(RecFIN\)](#) 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 discard 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 WCGOP 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 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, for all recent recreational fleet length data, the total number of trips information used to calculate the number of samples was not available. 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 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 removing 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 [Species Distribution Models with Template Model Builder](#) (`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 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 is 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 Pacific Fishery Management Council (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 data set 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 [sdmTMB](#) R package (Anderson et al. 2024) as configured within the [indexwrc](#) 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 Gaussian 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 ( $\text{km}^2$ ) 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 degrees North (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 `nwfscSurvey` R package (Wetzel, Johnson, and Hicks 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 7 and Table 8. 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

Several biological parameters used in the assessment were estimated outside the model or obtained from literature. Their values were treated in the model as fixed, and 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). These parameters include length-weight relationship parameters, maturity and fecundity parameters, natural mortality, and ageing error. The methods used to derive these parameters in the assessment are described below.

### 2.3.1 Length-Weight Relationship

The parameters for the length-weight relationship were updated to include the most recent WCGBTS data from 2017 - 2024. Length-weight curves were fitted using this equation:

$$W = 7.18331 \times 10^{-6} L^{3.2448}$$

Where  $W$  is individual weight (kg) and  $L$  is total natural length (cm) (Figure 20).

### 2.3.2 Maturity

The length at maturity relationship remained unchanged from the 2017 assessment. They used a functional maturity approach to assess individual maturity and account for possible false spawning events (Gertseva and Cope 2017). Figure 21 shows the logistic curve applied in this assessment.

### 2.3.3 Fecundity

The fecundity-at-length relationship also remained unchanged from the 2017 assessment and was developed by Dick et al. (2017) using a hierarchical Bayesian modeling framework. The fecundity was assumed to be related to female body size:

$$F = aL^b$$

Where  $F$  is fecundity (number of eggs),  $L$  is fish length (cm), and  $a$  and  $b$  are constant coefficients. For Yelloweye Dick et al. (2017) estimated  $a = 7.21847 \times 10^{-8}$  and  $b = 4.043$ .

### 2.3.4 Natural Mortality

The 2025 base model used the 2017 assessment's initial value of natural Mortality ( $M$ ) which was estimated based on Owen S. Hamel (2015).

Aging error matrices were unchanged.

## 2.4 Environmental and ecosystem data

No environmental or ecosystem data were used in the 2017 assessment (Gertseva and Cope 2017) and no new data sources were considered for this update assessment.

## 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

The 2017 assessment was a benchmark assessment reviewed by a STAR panel and the PFMC SSC, and therefore, the Groundfish Subcommittee of the PFMC SSC did not review the 2017 assessment. No Yelloweye Rockfish benchmark or update assessments have been conducted since.

Responses to the 2025 GFSC review of this update assessment will be added following their review.

### 3.3 Model Structure and Assumptions

#### 3.3.1 Description of New Modeling Approaches

This section is not required for an update assessment.

#### 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 3.3.3.

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; the areas are separated because of differences in potential exploitation rates by area over time. Yelloweye Rockfish compositional data are primarily reported as both sexes combined, and therefore, the 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. Both growth and

initial recruitment parameters were estimated internally, while all other biological parameters were fixed. 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). More detailed information on the model structure and justification is available in Gertseva and Cope (2017) and summarized in Table 9.

### 3.3.3 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.

- Data:
  - Detailed information on specific updates and changes to the data included in the model are included in Section 2 but are summarized below.
  - The removals time series were corrected and updated through the end of 2024 for California, Oregon and Washington. Overall, there was little change in the model results when updating and extending the catch time series, even after changes in the historical catch (Figure 22 and Figure 23). Though, the age 8+ biomass increased more for the most recent years than the forecasted estimates from 2017 (Figure 24).
  - Indices of abundance were updated with recent data, where available, and re-analyzed using more up-to-date methods. Updating indices lead to a slight decrease in  $\ln(R_0)$ , reducing the spawning output by very little (Figure 25).
  - Length and age compositions from all fishery removal and index fleets were updated and tuned through 2024. The addition of composition data greatly increased  $\ln(R_0)$ , which led to an increase in the spawning output, particularly for 1920-1980 (Figure 26). This new data also changed the pattern of the recruitment deviations significantly from 1990-2024 (Figure 27). From 1990-2005 recruitment was lower than predicted in the last assessment, then from 2006-2016 recruitment was higher than the last assessment, and finally recruitment dropped very low for 2017-2021. Due to these lower estimated recruitment in recent years, the recovery curve slowed (Figure 26).
- Fleet structure:
  - No changes were made to the fleet structure.
- 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 from the WGBTS and did not change the model fit. The impact of updating the length-weight relationship is evaluated as a sensitivity.
- Recruitment:
  - The control file settings for the bias adjustment were updated to improve the fit of the bias adjustment relationship for recruitment deviations (Methot and Taylor 2011).
- Selectivity and Catchability:
  - The end year for all time blocks was extended to 2024.
  - All final updates in the control, starter, and forecast files showed little to no additional change in the model, with the exception of the updated parameterization of the catchability offset for the Oregon recreational index, which increased spawning output and final stock status (Figure 28 and Figure 29 - UPDATE THESE PLOTS).
- Software and Workflow:
  - Updating to SS3 3.30.23.2 and to the most recent version of the SS3 executable had no discernable impact on model results (Figure 30).
  - 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 ([available online](#)).

### 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.

### 3.3.5 Priors

The natural mortality prior standard deviation was updated to be consistent with methods described in Owen S. Hamel and Cope (2022).

### 3.3.6 Data Weighting

Length data from the WCGBTS and fishery discards, conditional age-at-length compositions from the WCGBTS, and marginal age compositions from the fishery fleets and other surveys were fit and appropriately weighted using an iterative approach. The Francis (2011) method was used twice with two iterations to tune the length and age data simultaneously (Table 10). For conditional-age-at-length data, it was assumed that each age was a random sample within the length bin, and thus, the model started with a sample size equal to the number of fish in that length bin. A sensitivity is included to examine differences in parameter estimates when data weighting was implemented using the McAllister and Ianelli (1997) method, which is based on the harmonic mean.

Additional variance was estimated and added to the input variance for all indices with the exception of the WCGBTS.

### 3.3.7 Model Parameters

The base model had 189 estimated parameters (tallied by type in Table 11). A single-sex growth curve was estimated (Figure 31). Natural mortality was fixed, as in the 2017 assessment. Unfished recruitment and the distribution of recruits between areas are estimated. Steepness of the stock-recruit relationship was fixed at 0.72, updated from the 2017 assessment which was fixed at 0.718. Estimating steepness was evaluated as a sensitivity. As is current practice, recruitment deviations during the “main” period (from 1980 to 2023) were forced to sum to zero and the bias adjustment ramp was updated (Figure 32).

Catchability parameters, we extended the time block on catchability parameter for the OR rec index to 2004 to encompass additional data. To fit these data we estimated the catchability offset between MRFFS and ORBS, both are in fleet 6. In order to estimate it we set Float to 0 and Phase to 1.

All selectivities were assumed to be length-based and used a double-normal functional form. Selectivities for all fleets were estimated to be asymptotic (Figure 33), though selectivity for the California Onboard Observer CPUE was mirrored to the California recreational fleet. Selectivities were constant through time. Dome-shaped selectivity and various time blocks for specific fleets were explored in Gertseva and Cope (2017) but not re-evaluated in this update assessment.

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

## 3.4 Base Model Results

### 3.4.1 Base Model Selection

As a supplement to the model results figures included in this report and described below, a full set of diagnostic plots created by the {r4ss} package (Taylor et al. 2021) is available at [online](#) along with the Stock Synthesis input files.

### 3.4.2 Parameter Estimates

Estimated and fixed parameter values are shown in Table 12. Unfished recruitment was estimated at 5.48847. Yelloweye length at age 70 (the second reference age) equals 61.3623. Figure 31 shows the estimated growth curve. Spawning output-at-length is shown in Figure 34. Spawning output in the assessment is expressed in millions of eggs.

Estimated stock-recruit function for the assessment model is shown in Figure 35. Estimated recruitment deviations are shown Figure 36. Recruitment of Yelloweye Rockfish was estimated to be variable over time, with the most recent years experiencing slightly lower than average recruitment after periods of low and high recruitment during the late 1980s to the early 2000s, and late 2000s to late 2010s, respectively. Reflecting these variable recruitment patterns, 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 ( $R = 0.5$ ) (Methot and Taylor 2011).

Length-based selectivity curves estimated in the assessment are shown for all fleets together in Figure 33. Estimated selectivity curves for the fishing fleets indicate that the recreational fleets access somewhat smaller fish than the commercial fisheries. 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. The WCGBTS selected smaller Yelloweye among all the fishery-independent surveys.

### 3.4.3 Fits to the Data

Model fits to the fishery CPUE and survey indices are presented in Figure 37 through Figure 44, and log scale plots were used to see finer changes. Model fits to the indices generally fall within the uncertainty intervals but do not capture the temporal dynamics of each index, most notably in the WCGBTS and in the IPHC survey.

The model fitted length data aggregated across years reasonably well for all fleets (Figure 45). Pearson residuals for the fits by fleet and year are shown in Figure 46 and Figure 47. The length data are very sparse in many years and model fit varies among years and fleets, reflecting the differences in the quantity of the data. For example, lengths for the IPHC survey, the California recreational, and OR/WA non-trawl fleets, which also have the highest input sample sizes, are fit by the model relatively well.

The fits to the mean age by fleet are generally acceptable and are responsive to short-term temporal changes (Figure 49 - Figure 55), with the exception of the IPHC survey, where the model predicts a lower mean age than the data suggest. Pearson residuals by year and fleet show strong residual patterns but are difficult to interpret given the general lack of age data. See the [GitHub repository](#) for individual Pearson residual plots.

### 3.4.4 Population Trajectory

The estimated time series of spawning output for the entire stock and by area are shown in Figure 56 and Figure 57, respectively. Spawning output relative to unfished spawning output for the entire stock and by area are shown in Figure 58 and Figure 59. Total biomass, summary biomass and recruitment are shown in Figure 60, Figure 61 and Figure 62, 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 0.156161 of unexploited levels in 2000 (Figure 56). Yelloweye Rockfish spawning output and relative status is estimated to have been gradually increasing since that time, in response to large reductions in harvest and spatial area closures. This trend is similar to the 2017 assessment, however, they estimated a quicker recovery in biomass since 2002 than the 2025 model. 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 (Figure 59).

Recruitment has been relatively dynamic over time, with several large peaks and troughs estimated in the age-0 recruits (Figure 62). Compared to the 2017 recruitment, our model estimates larger deviations from zero in the low period before 2000 and the high period after 2000, and estimates above average recruitment up until 2015. In 2016, and to 2024, the recruitment estimates drop below zero, though with the 95% intervals widely overlapping zero. Due to limited age data and protracted age distribution it can be hard to assign recruitment events to specific years, and we end up with autocorrelated patterns based on ages as inferred from lengths. There are some autocorrelated peaks and troughs in recruitment in the 1940s and 50s but those early patterns in recruitment are not very meaningful. The above average recruitment starting in 2020 is also not biologically meaningful because there

are no composition data to inform the estimates, and they are pulled by the recruitment deviation prior to zero. The more extreme swings in low to high periods for 1990-2015 and the extended low recruitment starting in 2016 are likely driving the slower recovery rate of Yelloweye Rockfish relative to the 2017 predictions. However, there are no data to inform the most recent years when recruits are not yet selected by the fisheries.

### 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 63). 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 Table 18.

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 the maximum of 1.0, 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 0.72.

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 model (Figure 64 and Figure 65). 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.

### 3.5.2.2 Sensitivity to dataset choice and weighting schemes

Sensitivity analyses to dataset 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 Table 14, Table 15, Table 15 and Table 17. Among these, the base model appears to be most sensitive to removing all 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 68 through Figure 69). 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 70 and Figure 71). 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 72 and Figure 73). 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 74, and without the removal of all length composition data in Figure 75.

### 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 76, Figure 77, and Figure 78, 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 79), 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 80), 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 81.

In the base model,  $h$  is fixed at the mean of the meta-analytic steepness prior, 0.718, which is the same as in the 2017 assessment; much higher values (e.g. 0.9) are considered 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 82). Time series of relative unfished biomass associated with different values of  $h$  ranging from 0.25 to 1.0 are shown in Figure 83.

A likelihood profile analysis for  $\ln(R_0)$  shows a strongly informed initial recruitment value in the base model (Figure 84). 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 85 and Figure 86) compared to the 2017 assessment model.

## 3.6 Unresolved Problems and Major Uncertainties

Main life history parameters, such as natural mortality and stock-recruit curve steepness, generally contribute significant uncertainty to stock assessments. These values were fixed in this assessment, as they were in the benchmark assessment because the benchmark model was unable to reliably estimate these quantities (Gertseva and Cope 2017). These quantities are essential for understanding the dynamics of the stock and determining projected rebuilding. Alternative values of these parameters were explored through both sensitivity and likelihood profile analyses. Maturity parameters were fixed in this assessment, as they were in benchmark assessment (Gertseva and Cope 2017). Maturity schedules are generally estimated outside of the assessment, and the maturity estimates were not updated since the benchmark assessment. These parameters, once updated, may influence estimates of spawning stock output.

Although significant progress has been made in reconstructing historical landings, early catches of Yelloweye Rockfish continue to be uncertain.

The model fits to the indices generally fall within uncertainty intervals but do not capture the temporal dynamics of each index, thus the indices may not be as informative as they would be if the temporal dynamics were fit well. In addition, the fishery-independent indices available (e.g., the WCGBTS and IPHC indices) do not target Yelloweye Rockfish specifically and, thus, may not be the most appropriate indicator of abundance dynamics.

## 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 40.1% of its unexploited level. This is above the overfished threshold of SB25%, and slightly 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 13). 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 19. Unfished spawning stock output for Yelloweye Rockfish was estimated to be 1190 million eggs (95% confidence interval: 1,045.7-1,328.5 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 475 million eggs (95% confidence interval: 418-531 million eggs), which corresponds to an exploitation rate of 0.026. This harvest rate provides an equilibrium yield of 121 mt at SB40% (95% confidence interval: 107-136 mt). The model estimate of maximum sustainable yield (MSY) is 127 mt (95% confidence interval: 112-142 mt). The estimated spawning stock output at MSY is 344 million eggs (95% confidence interval: 303-384 million eggs). The exploitation rate corresponding to the estimated SPRMSY of F36% is 0.036.

This assessment estimates that the 2024 SPR is 64.3% (Figure 87). 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% (when the SPR is greater than this value, the exploitation is below the target). 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 88.

### 4.2 Harvest Projections and Decision Tables

The base model estimate for 2025 spawning depletion is 40.1%. 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.

Twelve-year forecasts for each state of nature were calculated (Table 21).

### 4.3 Evaluation of Scientific Uncertainty

The model estimated uncertainty around the 2025 spawning biomass with a standard deviation = 0.027. The uncertainty around the OFL in 2025 has a standard deviation = 11.546. Each of these are likely underestimates of overall uncertainty due to the necessity to fix several key population dynamics parameters (e.g. steepness and 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 modeled 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 (Figure 89).

### 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 (Gertseva and Cope (2017)). 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:

- Continue refining the ORFS index analysis and ultimately use either the ORBS or ORFS index to describe the CPUE trends in the Oregon recreational fishery after 2000.
- Expand the IPHC age composition bins to an older maximum age for the IPHC age composition data to spread out the distribution of length data in the oldest age bins for conditional age-at-length.

## **5 Acknowledgements**

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## 7 Tables

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)	Catch (mt)
2015	52.0	43.0	18.0	12.11
2016	52.0	43.0	19.0	9.11
2017	56.9	47.4	20.0	19.84
2018	57.5	47.9	20.0	18.54
2019	81.5	74.4	48.0	23.51
2020	84.2	76.9	49.0	18.15
2021	97.5	83.5	50.0	20.73
2022	98.1	83.2	51.0	33.64
2023	89.6	75.3	52.0	39.23
2024	91.2	75.9	53.3	14.94

Table 2: Time series of yelloweye rockfish catches by fleet used in the assessment. Trawl fleets include yelloweye bycatch in foreign POP and in at-sea Pacific hake fisheries. Years 1967 - 1974, 1979, and 2002 - 2004 do not include WA Sport 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 (mt)	WA sport (mt)	WA sport (1000s fish)	Catch (mt)
1889	0.000000	0.000000	0.000	0.000000	0.0400	0.00	0	0.000	0.040
1890	0.020000	0.07000	0.000	0.000000	0.0400	0.00	0	0.000	0.130
1891	0.030000	0.13000	0.000	0.000000	0.0700	0.00	0	0.000	0.230
1892	0.050000	0.20000	0.000	0.000000	3.6400	0.00	0	0.000	3.890
1893	0.060000	0.26000	0.000	0.000000	3.5500	0.00	0	0.000	3.870
1894	0.080000	0.33000	0.000	0.000000	3.5500	0.00	0	0.000	3.960
1895	0.090000	0.39000	0.000	0.000000	0.9200	0.00	0	0.000	1.400
1896	0.110000	0.46000	0.000	0.000000	0.2200	0.00	0	0.000	0.790
1897	0.120000	0.52000	0.000	0.000000	0.2200	0.00	0	0.000	0.860
1898	0.140000	0.59000	0.000	0.000000	0.1300	0.00	0	0.000	0.860
1899	0.160000	0.66000	0.000	0.000000	0.2300	0.00	0	0.000	1.050
1900	0.170000	0.72000	0.000	0.000000	0.3000	0.00	0	0.000	1.190
1901	0.190000	0.79000	0.000	0.000000	0.3900	0.00	0	0.000	1.370
1902	0.200000	0.85000	0.000	0.000000	0.4800	0.00	0	0.000	1.530
1903	0.220000	0.92000	0.000	0.000000	0.5600	0.00	0	0.000	1.700
1904	0.230000	0.98000	0.000	0.000000	0.7300	0.00	0	0.000	1.940
1905	0.250000	1.05000	0.000	0.000000	0.7400	0.00	0	0.000	2.040
1906	0.260000	1.11000	0.000	0.000000	0.8300	0.00	0	0.000	2.200
1907	0.280000	1.18000	0.000	0.000000	0.9100	0.00	0	0.000	2.370
1908	0.300000	1.25000	0.000	0.000000	1.9500	0.00	0	0.000	3.500
1909	0.310000	1.31000	0.000	0.000000	1.0900	0.00	0	0.000	2.710
1910	0.330000	1.38000	0.000	0.000000	1.1800	0.00	0	0.000	2.890
1911	0.340000	1.44000	0.000	0.000000	1.2600	0.00	0	0.000	3.040
1912	0.360000	1.51000	0.000	0.000000	1.3500	0.00	0	0.000	3.220
1913	0.370000	1.57000	0.000	0.000000	1.4400	0.00	0	0.000	3.380
1914	0.390000	1.64000	0.000	0.000000	1.5300	0.00	0	0.000	3.560
1915	0.400000	1.70000	0.000	0.000000	2.2300	0.00	0	0.000	4.330
1916	0.420000	1.77000	0.000	0.000000	1.7000	0.00	0	0.000	3.890
1917	0.660000	2.96000	0.000	0.000000	1.7900	0.00	0	0.000	5.410
1918	0.770000	3.48000	0.000	0.000000	18.5400	0.00	0	0.000	22.790

1919	0.540000	1.62000	0.000	0.000000	7.6100	0.00	0	0.000	9.770
1920	0.550000	1.84000	0.000	0.000000	6.5700	0.00	0	0.000	8.960
1921	0.450000	1.85000	0.000	0.000000	6.3300	0.00	0	0.000	8.630
1922	0.390000	1.68000	0.000	0.000000	4.3800	0.00	0	0.000	6.450
1923	0.420000	1.79000	0.000	0.000000	5.1000	0.00	0	0.000	7.310
1924	0.240000	2.58000	0.000	0.000000	9.2900	0.00	0	0.000	12.110
1925	0.170000	3.69000	0.000	0.000000	11.4800	0.00	0	0.000	15.340
1926	0.620000	4.25000	0.000	0.000000	17.4800	0.00	0	0.000	22.350
1927	1.050000	4.87000	0.000	0.000000	22.7900	0.00	0	0.000	28.710
1928	1.340000	4.18000	0.640	0.000000	22.0900	0.00	0	0.000	28.250
1929	1.580000	4.07000	1.290	0.000000	17.7300	0.00	0	0.000	24.670
1930	1.470000	5.30000	1.480	0.000000	19.5000	0.00	0	0.000	27.750
1931	0.880000	4.74000	1.970	0.000000	11.6900	0.00	0	0.000	19.280
1932	1.050000	7.08000	2.470	0.020000	7.3300	0.00	0	0.000	17.950
1933	1.630000	2.81000	2.960	0.010000	10.3000	0.00	0	0.000	17.710
1934	1.610000	4.17000	3.450	0.000000	12.6600	0.00	0	0.000	21.890
1935	1.680000	6.31000	3.950	0.010000	9.6900	0.00	0	0.000	21.640
1936	1.490000	6.60000	4.440	0.030000	16.6500	0.00	0	0.000	29.210
1937	1.770000	4.31000	5.270	0.060000	14.8200	0.00	0	0.000	26.230
1938	1.670000	4.69000	5.180	0.000000	16.3500	0.00	0	0.000	27.890
1939	1.730000	4.71000	4.530	0.090000	10.6300	0.00	0	0.000	21.690
1940	1.600000	2.97000	6.510	2.060000	17.1400	0.00	0	0.000	30.280
1941	1.160000	4.19000	6.020	3.170000	27.3800	0.00	0	0.000	41.920
1942	0.270000	3.10000	3.200	5.950000	31.3800	0.00	0	0.000	43.900
1943	2.050000	3.84000	3.060	20.810000	51.2200	0.00	0	0.000	80.980
1944	8.360000	16.52000	2.510	36.510000	22.6000	0.00	0	0.000	86.500
1945	18.540000	40.02000	3.350	56.890000	11.5200	0.00	0	0.000	130.320
1946	16.330000	41.42000	5.760	34.850000	20.6800	0.00	0	0.000	119.040
1947	7.090000	9.19000	4.590	21.420000	10.9500	0.00	0	0.000	53.240
1948	6.490000	16.81000	9.180	15.140000	13.3800	0.00	0	0.000	61.000
1949	3.720000	6.17000	11.880	12.640000	11.2100	0.00	0	0.000	45.620
1950	3.420000	4.61000	14.490	13.690000	14.7800	0.00	0	0.000	50.990
1951	9.910000	7.07000	17.160	12.020000	17.9600	0.00	0	0.000	64.120
1952	8.700000	5.44000	15.000	12.790000	13.0600	0.00	0	0.000	54.990
1953	8.570000	3.19000	12.850	9.960000	5.6100	0.00	0	0.000	40.180
1954	4.990000	6.78000	16.170	12.810000	10.2500	0.00	0	0.000	51.000
1955	5.610000	1.83000	19.510	13.130000	9.7100	0.00	0	0.000	49.790
1956	8.580000	1.81000	21.900	16.990000	4.3400	0.00	0	0.000	53.620

1957	10.490000	4.07000	21.710	22.960000	8.5100	0.00	0	0.000	67.740
1958	10.340000	3.05000	33.840	18.380000	2.3900	0.00	0	0.000	68.000
1959	8.610000	1.64000	29.230	19.940000	5.4100	0.00	0	0.000	64.830
1960	7.480000	2.24000	20.860	25.200000	4.9200	0.00	0	0.000	60.700
1961	3.560000	1.69000	16.350	22.720000	4.9100	0.00	0	0.000	49.230
1962	3.680000	1.75000	20.810	26.400000	5.1600	0.00	0	0.000	57.800
1963	6.020000	5.61000	21.800	7.170000	4.1000	0.00	0	0.000	44.700
1964	3.120000	4.56000	18.960	1.950000	3.1100	0.00	0	0.000	31.700
1965	3.860000	5.51000	29.110	67.880000	4.6800	0.00	0	0.000	111.040
1966	3.620000	4.45000	31.600	3.030000	3.2400	0.00	0	0.000	45.940
1967	6.170000	4.38000	31.890	6.820000	6.6000	0.00	-	0.781	55.860
1968	3.780000	3.89000	37.660	2.970000	5.6600	0.00	-	0.152	53.960
1969	21.800000	3.91000	40.620	47.760000	13.0800	0.00	-	0.372	127.170
1970	24.220000	3.47000	45.790	7.050000	4.3100	0.00	-	0.570	84.840
1971	41.770000	4.73000	40.720	13.650000	8.3400	0.00	-	0.902	109.210
1972	56.220000	7.44000	52.360	7.350000	10.8600	0.00	-	1.180	134.230
1973	43.620000	5.89000	66.480	9.520000	11.4600	7.40	-	1.486	144.370
1974	44.800000	11.59000	70.150	4.410000	14.4600	12.78	-	1.378	158.190
1975	50.310000	9.93000	71.130	5.360000	7.6500	6.24	4.39	1.393	155.010
1976	45.270000	13.39000	80.630	6.910000	10.1500	19.38	4.57	1.454	180.300
1977	42.510000	14.95000	72.780	4.970000	17.0200	19.91	9.33	2.991	181.470
1978	123.440000	30.76000	67.890	23.640000	24.1000	24.52	4.57	1.480	298.920
1979	61.020000	38.31000	76.310	44.580000	49.1000	52.62	-	1.742	321.940
1980	15.480000	26.58000	72.510	83.950000	24.9600	40.43	2.61	0.873	266.520
1981	30.200000	119.50000	47.000	91.340000	23.9500	37.20	4.77	1.623	353.960
1982	199.930000	15.59000	102.000	156.080000	31.4500	65.06	6.76	2.332	576.870
1983	56.650000	7.68000	51.000	287.290000	45.9500	46.08	9.15	3.205	503.800
1984	44.030000	4.42000	77.000	113.980000	39.3900	41.86	15.24	5.433	335.920
1985	7.420000	4.23000	124.000	200.040000	69.7200	12.72	11.46	4.133	429.590
1986	9.890000	23.43000	65.000	92.920000	66.1500	95.62	10.99	4.017	364.000
1987	16.840000	38.00000	75.000	71.750000	97.0800	41.64	13.66	5.048	353.970
1988	30.570000	34.95000	58.000	130.640000	47.4500	10.78	10.57	3.957	322.960
1989	9.380000	42.37000	59.000	199.340000	41.4000	13.48	18.39	6.980	383.360
1990	10.080000	70.26000	46.250	81.070000	68.9500	17.57	9.107	3.548	303.287
1991	13.980000	133.07000	33.500	121.380000	85.6200	27.81	16.58	6.459	431.940
1992	15.830000	96.85000	20.750	135.660000	89.8700	27.55	14.963	5.829	401.473
1993	6.180000	46.59000	8.000	137.960000	138.2500	25.52	15.191	5.918	377.691
1994	4.700000	49.78000	14.000	86.000000	79.2900	16.19	8.774	3.418	258.734

1995	3.690000	47.68000	13.000	131.320000	40.4300	20.49	8.581	3.343	265.191	
1996	16.320000	56.18000	12.000	83.880000	93.2500	8.29	9.244	3.601	279.164	
1997	6.200000	57.06000	15.000	80.130000	115.5400	14.18	9.444	3.679	297.554	
1998	4.100000	17.64000	5.000	41.180000	45.0500	16.22	12.17	4.741	141.360	
1999	8.660000	13.73000	13.000	18.940000	102.0000	12.25	10.055	3.532	178.635	
2000	0.730000	3.31000	8.000	5.070000	15.0400	10.69	11.211	3.826	54.051	
2001	0.620000	3.90000	5.000	1.630000	26.3100	4.69	10.678	4.116	52.828	
2002	0.360000	0.03000	2.000	1.590000	4.1500	3.11	-	0.901	11.240	
2003	0.130000	0.05000	4.000	0.550000	2.2400	3.32	-	0.664	10.290	
2004	0.020000	0.75000	1.000	0.500000	2.3800	1.54	-	1.104	6.190	
2005	0.020000	0.73000	1.000	1.240000	1.6600	2.13	4.14	1.306	10.920	
2006	0.004000	0.20000	1.000	1.420000	2.1600	1.72	1.551	0.493	8.055	
2007	0.000000	0.93000	4.000	0.090000	3.6800	2.13	2.297	0.731	13.127	
2008	0.017000	0.64000	1.000	0.160000	3.4300	2.12	1.964	0.623	9.331	
2009	0.022000	0.19000	5.000	0.090000	2.1800	1.88	1.937	0.636	11.299	
2010	0.060000	0.04000	1.000	0.080000	0.8600	1.95	2.421	0.788	6.411	
2011	0.000000	0.20000	2.000	0.060000	1.2100	2.17	2.738	0.886	8.378	
2012	0.003000	0.88000	2.000	0.060000	1.9100	3.19	3.968	1.279	12.011	
2013	0.009000	0.56000	1.000	0.110000	2.9400	3.22	2.449	0.809	10.288	
2014	0.055000	0.02000	1.000	0.030000	2.1600	2.73	3.279	1.089	9.274	
2015	0.003000	0.40000	2.000	0.030000	3.1500	4.26	2.818	0.996	12.661	
2016	0.003000	0.00000	1.000	0.070000	2.5900	2.84	3.278	1.167	9.781	
2017	0.011000	1.22900	4.524	0.244000	6.9740	4.27	3.2	1.184	20.452	
2018	0.001000	0.00000	4.994	0.541000	6.3790	4.01	3.226	1.219	19.151	
2019	0.039000	0.00000	6.160	0.589000	7.4290	5.04	3.795	2.009	23.052	
2020	0.128000	0.00000	1.946	0.321000	7.5150	6.00	1.844	1.066	17.754	
2021	0.117000	2.43200	3.956	0.391000	7.9720	3.34	2.556	1.209	20.764	
2022	0.095000	5.60300	3.801	0.764000	15.5520	5.20	3.217	1.261	34.232	
2023	0.087000	1.82600	9.588	0.400000	20.6350	3.84	3.374	1.368	39.750	
2024	0.194333	3.27333	4.649	0.493333	13.5127	3.66	3.131	1.386	28.914	

Table 3: Summary of trips with and without Yelloweye 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 Yelloweye 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 ORBS 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 yellow-eye 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

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: 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 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	0.519	38	9.9	5.2	196.0
Length	2_CA_NONTWL	0.287	44	34.9	10.0	440.7
Length	3_CA_REC	0.524	42	45.8	24.0	1008.7
Length	4_ORWA_TWL	0.255	29	37.2	9.5	275.4
Length	5_ORWA_NONTWL	0.374	31	79.3	29.6	917.9
Length	6_OR_REC	0.364	43	52.5	19.1	820.6
Length	7_WA_REC	1.000	26	7.3	7.3	188.6
Length	8_CACPFV	0.560	32	37.6	21.0	673.5
Length	9_OR_REC	0.541	20	25.6	13.9	277.1
Length	10_TRI_ORWA	0.455	7	11.2	5.1	35.9
Length	11_NWFSC_ORWA	0.511	21	16.1	8.2	172.5
Length	12_IPHC_ORWA	0.892	21	28.7	25.6	538.2
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	0.222	266	8.9	2.0	523.4
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	0.088	531	16.0	1.4	748.8

Table 11: 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	8
Index time-variation	1
Size selectivity	25

Table 12: 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	1.55	2	(0.01, 35)	ok	0.582	none
L_at_Amax_Fem_GP_1	61.4	2	(40, 120)	ok	0.225	none
VonBert_K_Fem_GP_1	0.0759	1	(0.01, 0.2)	ok	0.00133	none
CV_young_Fem_GP_1	0.148	3	(0.01, 0.5)	ok	0.00676	none
CV_old_Fem_GP_1	0.0644	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	0.473	3	(-4, 4)	ok	0.0235	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)	5.49	3	(3, 15)	ok	0.0608	none
SR_BH_stEEP	0.72	-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	0.00546	7	(-5, 5)	dev	0.501	normal(0.00, 0.50)
Early_RecrDev_1890	0.00565	7	(-5, 5)	dev	0.501	normal(0.00, 0.50)
Early_RecrDev_1891	0.00585	7	(-5, 5)	dev	0.501	normal(0.00, 0.50)
Early_RecrDev_1892	0.00604	7	(-5, 5)	dev	0.501	normal(0.00, 0.50)
Early_RecrDev_1893	0.00625	7	(-5, 5)	dev	0.501	normal(0.00, 0.50)
Early_RecrDev_1894	0.00646	7	(-5, 5)	dev	0.501	normal(0.00, 0.50)
Early_RecrDev_1895	0.00667	7	(-5, 5)	dev	0.501	normal(0.00, 0.50)
Early_RecrDev_1896	0.0069	7	(-5, 5)	dev	0.501	normal(0.00, 0.50)
Early_RecrDev_1897	0.00713	7	(-5, 5)	dev	0.501	normal(0.00, 0.50)
Early_RecrDev_1898	0.00737	7	(-5, 5)	dev	0.501	normal(0.00, 0.50)

Early_RecrDev_1899	0.00762	7	(-5, 5)	dev	0.501	normal(0.00, 0.50)
Early_RecrDev_1900	0.0079	7	(-5, 5)	dev	0.501	normal(0.00, 0.50)
Early_RecrDev_1901	0.00818	7	(-5, 5)	dev	0.501	normal(0.00, 0.50)
Early_RecrDev_1902	0.0085	7	(-5, 5)	dev	0.501	normal(0.00, 0.50)
Early_RecrDev_1903	0.00881	7	(-5, 5)	dev	0.501	normal(0.00, 0.50)
Early_RecrDev_1904	0.00916	7	(-5, 5)	dev	0.501	normal(0.00, 0.50)
Early_RecrDev_1905	0.00955	7	(-5, 5)	dev	0.501	normal(0.00, 0.50)
Early_RecrDev_1906	0.00998	7	(-5, 5)	dev	0.501	normal(0.00, 0.50)
Early_RecrDev_1907	0.0105	7	(-5, 5)	dev	0.501	normal(0.00, 0.50)
Early_RecrDev_1908	0.0111	7	(-5, 5)	dev	0.501	normal(0.00, 0.50)
Early_RecrDev_1909	0.0118	7	(-5, 5)	dev	0.502	normal(0.00, 0.50)
Early_RecrDev_1910	0.0126	7	(-5, 5)	dev	0.502	normal(0.00, 0.50)
Early_RecrDev_1911	0.0135	7	(-5, 5)	dev	0.502	normal(0.00, 0.50)
Early_RecrDev_1912	0.0145	7	(-5, 5)	dev	0.502	normal(0.00, 0.50)
Early_RecrDev_1913	0.0155	7	(-5, 5)	dev	0.502	normal(0.00, 0.50)
Early_RecrDev_1914	0.0164	7	(-5, 5)	dev	0.502	normal(0.00, 0.50)
Early_RecrDev_1915	0.0171	7	(-5, 5)	dev	0.502	normal(0.00, 0.50)
Early_RecrDev_1916	0.0173	7	(-5, 5)	dev	0.502	normal(0.00, 0.50)
Early_RecrDev_1917	0.0169	7	(-5, 5)	dev	0.502	normal(0.00, 0.50)
Early_RecrDev_1918	0.0155	7	(-5, 5)	dev	0.501	normal(0.00, 0.50)
Early_RecrDev_1919	0.0127	7	(-5, 5)	dev	0.5	normal(0.00, 0.50)
Early_RecrDev_1920	0.00827	7	(-5, 5)	dev	0.499	normal(0.00, 0.50)
Early_RecrDev_1921	0.00191	7	(-5, 5)	dev	0.497	normal(0.00, 0.50)
Early_RecrDev_1922	-0.00657	7	(-5, 5)	dev	0.495	normal(0.00, 0.50)
Early_RecrDev_1923	-0.0172	7	(-5, 5)	dev	0.492	normal(0.00, 0.50)
Early_RecrDev_1924	-0.0298	7	(-5, 5)	dev	0.489	normal(0.00, 0.50)
Early_RecrDev_1925	-0.0441	7	(-5, 5)	dev	0.485	normal(0.00, 0.50)
Early_RecrDev_1926	-0.0593	7	(-5, 5)	dev	0.482	normal(0.00, 0.50)
Early_RecrDev_1927	-0.0748	7	(-5, 5)	dev	0.478	normal(0.00, 0.50)
Early_RecrDev_1928	-0.0896	7	(-5, 5)	dev	0.475	normal(0.00, 0.50)
Early_RecrDev_1929	-0.103	7	(-5, 5)	dev	0.472	normal(0.00, 0.50)
Early_RecrDev_1930	-0.115	7	(-5, 5)	dev	0.469	normal(0.00, 0.50)
Early_RecrDev_1931	-0.124	7	(-5, 5)	dev	0.467	normal(0.00, 0.50)
Early_RecrDev_1932	-0.133	7	(-5, 5)	dev	0.464	normal(0.00, 0.50)
Early_RecrDev_1933	-0.142	7	(-5, 5)	dev	0.462	normal(0.00, 0.50)
Early_RecrDev_1934	-0.153	7	(-5, 5)	dev	0.46	normal(0.00, 0.50)
Early_RecrDev_1935	-0.165	7	(-5, 5)	dev	0.457	normal(0.00, 0.50)
Early_RecrDev_1936	-0.18	7	(-5, 5)	dev	0.454	normal(0.00, 0.50)

Early_RecrDev_1937	-0.196	7	(-5, 5)	dev	0.451	normal(0.00, 0.50)
Early_RecrDev_1938	-0.21	7	(-5, 5)	dev	0.448	normal(0.00, 0.50)
Early_RecrDev_1939	-0.221	7	(-5, 5)	dev	0.446	normal(0.00, 0.50)
Early_RecrDev_1940	-0.225	7	(-5, 5)	dev	0.445	normal(0.00, 0.50)
Early_RecrDev_1941	-0.221	7	(-5, 5)	dev	0.445	normal(0.00, 0.50)
Early_RecrDev_1942	-0.205	7	(-5, 5)	dev	0.447	normal(0.00, 0.50)
Early_RecrDev_1943	-0.174	7	(-5, 5)	dev	0.452	normal(0.00, 0.50)
Early_RecrDev_1944	-0.122	7	(-5, 5)	dev	0.461	normal(0.00, 0.50)
Early_RecrDev_1945	-0.0435	7	(-5, 5)	dev	0.475	normal(0.00, 0.50)
Early_RecrDev_1946	0.0644	7	(-5, 5)	dev	0.495	normal(0.00, 0.50)
Early_RecrDev_1947	0.192	7	(-5, 5)	dev	0.521	normal(0.00, 0.50)
Early_RecrDev_1948	0.298	7	(-5, 5)	dev	0.541	normal(0.00, 0.50)
Early_RecrDev_1949	0.303	7	(-5, 5)	dev	0.537	normal(0.00, 0.50)
Early_RecrDev_1950	0.18	7	(-5, 5)	dev	0.509	normal(0.00, 0.50)
Early_RecrDev_1951	-0.000643	7	(-5, 5)	dev	0.474	normal(0.00, 0.50)
Early_RecrDev_1952	-0.174	7	(-5, 5)	dev	0.444	normal(0.00, 0.50)
Early_RecrDev_1953	-0.312	7	(-5, 5)	dev	0.422	normal(0.00, 0.50)
Early_RecrDev_1954	-0.406	7	(-5, 5)	dev	0.409	normal(0.00, 0.50)
Early_RecrDev_1955	-0.456	7	(-5, 5)	dev	0.402	normal(0.00, 0.50)
Early_RecrDev_1956	-0.46	7	(-5, 5)	dev	0.4	normal(0.00, 0.50)
Early_RecrDev_1957	-0.421	7	(-5, 5)	dev	0.402	normal(0.00, 0.50)
Early_RecrDev_1958	-0.343	7	(-5, 5)	dev	0.409	normal(0.00, 0.50)
Early_RecrDev_1959	-0.245	7	(-5, 5)	dev	0.414	normal(0.00, 0.50)
Early_RecrDev_1960	-0.194	7	(-5, 5)	dev	0.413	normal(0.00, 0.50)
Early_RecrDev_1961	-0.273	7	(-5, 5)	dev	0.406	normal(0.00, 0.50)
Early_RecrDev_1962	-0.429	7	(-5, 5)	dev	0.395	normal(0.00, 0.50)
Early_RecrDev_1963	-0.544	7	(-5, 5)	dev	0.386	normal(0.00, 0.50)
Early_RecrDev_1964	-0.538	7	(-5, 5)	dev	0.385	normal(0.00, 0.50)
Early_RecrDev_1965	-0.39	7	(-5, 5)	dev	0.392	normal(0.00, 0.50)
Early_RecrDev_1966	-0.206	7	(-5, 5)	dev	0.398	normal(0.00, 0.50)
Early_RecrDev_1967	-0.0938	7	(-5, 5)	dev	0.416	normal(0.00, 0.50)
Early_RecrDev_1968	0.0875	7	(-5, 5)	dev	0.422	normal(0.00, 0.50)
Early_RecrDev_1969	0.184	7	(-5, 5)	dev	0.445	normal(0.00, 0.50)
Early_RecrDev_1970	0.383	7	(-5, 5)	dev	0.494	normal(0.00, 0.50)
Early_RecrDev_1971	0.841	7	(-5, 5)	dev	0.385	normal(0.00, 0.50)
Early_RecrDev_1972	0.254	7	(-5, 5)	dev	0.461	normal(0.00, 0.50)
Early_RecrDev_1973	-0.0456	7	(-5, 5)	dev	0.419	normal(0.00, 0.50)
Early_RecrDev_1974	0.055	7	(-5, 5)	dev	0.421	normal(0.00, 0.50)

Early_RecrDev_1975	0.431	7	(-5, 5)	dev	0.367	normal(0.00, 0.50)
Early_RecrDev_1976	0.245	7	(-5, 5)	dev	0.412	normal(0.00, 0.50)
Early_RecrDev_1977	0.185	7	(-5, 5)	dev	0.362	normal(0.00, 0.50)
Early_RecrDev_1978	-0.14	7	(-5, 5)	dev	0.393	normal(0.00, 0.50)
Early_RecrDev_1979	0.14	7	(-5, 5)	dev	0.388	normal(0.00, 0.50)
Main_RecrDev_1980	0.299	7	(-5, 5)	dev	0.429	normal(0.00, 0.50)
Main_RecrDev_1981	0.403	7	(-5, 5)	dev	0.487	normal(0.00, 0.50)
Main_RecrDev_1982	0.516	7	(-5, 5)	dev	0.453	normal(0.00, 0.50)
Main_RecrDev_1983	0.143	7	(-5, 5)	dev	0.503	normal(0.00, 0.50)
Main_RecrDev_1984	0.415	7	(-5, 5)	dev	0.447	normal(0.00, 0.50)
Main_RecrDev_1985	0.242	7	(-5, 5)	dev	0.444	normal(0.00, 0.50)
Main_RecrDev_1986	-0.094	7	(-5, 5)	dev	0.397	normal(0.00, 0.50)
Main_RecrDev_1987	-0.33	7	(-5, 5)	dev	0.356	normal(0.00, 0.50)
Main_RecrDev_1988	-0.614	7	(-5, 5)	dev	0.337	normal(0.00, 0.50)
Main_RecrDev_1989	-0.757	7	(-5, 5)	dev	0.32	normal(0.00, 0.50)
Main_RecrDev_1990	-0.833	7	(-5, 5)	dev	0.31	normal(0.00, 0.50)
Main_RecrDev_1991	-0.921	7	(-5, 5)	dev	0.313	normal(0.00, 0.50)
Main_RecrDev_1992	-0.757	7	(-5, 5)	dev	0.33	normal(0.00, 0.50)
Main_RecrDev_1993	-0.0467	7	(-5, 5)	dev	0.264	normal(0.00, 0.50)
Main_RecrDev_1994	-0.195	7	(-5, 5)	dev	0.287	normal(0.00, 0.50)
Main_RecrDev_1995	-0.922	7	(-5, 5)	dev	0.333	normal(0.00, 0.50)
Main_RecrDev_1996	-0.949	7	(-5, 5)	dev	0.319	normal(0.00, 0.50)
Main_RecrDev_1997	-0.739	7	(-5, 5)	dev	0.338	normal(0.00, 0.50)
Main_RecrDev_1998	-0.244	7	(-5, 5)	dev	0.352	normal(0.00, 0.50)
Main_RecrDev_1999	0.224	7	(-5, 5)	dev	0.295	normal(0.00, 0.50)
Main_RecrDev_2000	-0.41	7	(-5, 5)	dev	0.383	normal(0.00, 0.50)
Main_RecrDev_2001	-0.27	7	(-5, 5)	dev	0.383	normal(0.00, 0.50)
Main_RecrDev_2002	0.985	7	(-5, 5)	dev	0.192	normal(0.00, 0.50)
Main_RecrDev_2003	0.0639	7	(-5, 5)	dev	0.378	normal(0.00, 0.50)
Main_RecrDev_2004	-0.344	7	(-5, 5)	dev	0.379	normal(0.00, 0.50)
Main_RecrDev_2005	0.0686	7	(-5, 5)	dev	0.326	normal(0.00, 0.50)
Main_RecrDev_2006	0.588	7	(-5, 5)	dev	0.297	normal(0.00, 0.50)
Main_RecrDev_2007	0.58	7	(-5, 5)	dev	0.367	normal(0.00, 0.50)
Main_RecrDev_2008	1.1	7	(-5, 5)	dev	0.269	normal(0.00, 0.50)
Main_RecrDev_2009	0.826	7	(-5, 5)	dev	0.327	normal(0.00, 0.50)
Main_RecrDev_2010	0.791	7	(-5, 5)	dev	0.285	normal(0.00, 0.50)
Main_RecrDev_2011	0.52	7	(-5, 5)	dev	0.3	normal(0.00, 0.50)
Main_RecrDev_2012	0.369	7	(-5, 5)	dev	0.35	normal(0.00, 0.50)

Main_RecrDev_2013	1.22	7	(-5, 5)	dev	0.208	normal(0.00, 0.50)
Main_RecrDev_2014	0.429	7	(-5, 5)	dev	0.375	normal(0.00, 0.50)
Main_RecrDev_2015	0.729	7	(-5, 5)	dev	0.294	normal(0.00, 0.50)
Main_RecrDev_2016	0.315	7	(-5, 5)	dev	0.338	normal(0.00, 0.50)
Main_RecrDev_2017	-0.404	7	(-5, 5)	dev	0.403	normal(0.00, 0.50)
Main_RecrDev_2018	-0.472	7	(-5, 5)	dev	0.41	normal(0.00, 0.50)
Main_RecrDev_2019	-0.467	7	(-5, 5)	dev	0.42	normal(0.00, 0.50)
Main_RecrDev_2020	-0.501	7	(-5, 5)	dev	0.44	normal(0.00, 0.50)
Main_RecrDev_2021	-0.259	7	(-5, 5)	dev	0.466	normal(0.00, 0.50)
Main_RecrDev_2022	-0.154	7	(-5, 5)	dev	0.486	normal(0.00, 0.50)
Main_RecrDev_2023	-0.141	7	(-5, 5)	dev	0.49	normal(0.00, 0.50)
Late_RecrDev_2024	0	8	(-5, 5)	dev	0.5	normal(0.00, 0.50)
ForeRecr_2025	0	8	(-5, 5)	dev	0.5	normal(0.00, 0.50)
ForeRecr_2026	0	8	(-5, 5)	dev	0.5	normal(0.00, 0.50)
ForeRecr_2027	0	8	(-5, 5)	dev	0.5	normal(0.00, 0.50)
ForeRecr_2028	0	8	(-5, 5)	dev	0.5	normal(0.00, 0.50)
ForeRecr_2029	0	8	(-5, 5)	dev	0.5	normal(0.00, 0.50)
ForeRecr_2030	0	8	(-5, 5)	dev	0.5	normal(0.00, 0.50)
ForeRecr_2031	0	8	(-5, 5)	dev	0.5	normal(0.00, 0.50)
ForeRecr_2032	0	8	(-5, 5)	dev	0.5	normal(0.00, 0.50)
ForeRecr_2033	0	8	(-5, 5)	dev	0.5	normal(0.00, 0.50)
ForeRecr_2034	0	8	(-5, 5)	dev	0.5	normal(0.00, 0.50)
ForeRecr_2035	0	8	(-5, 5)	dev	0.5	normal(0.00, 0.50)
ForeRecr_2036	0	8	(-5, 5)	dev	0.5	normal(0.00, 0.50)
LnQ_base_3_CA_REC(3)	-9.2	-1	(-15, 15)	fixed		none
Q_extraSD_3_CA_REC(3)	0.122	5	(0, 5)	ok	0.078	none
LnQ_base_6_OR_REC(6)	-9.14	1	(-15, 15)	ok	0.111	none
Q_extraSD_6_OR_REC(6)	0.0842	5	(0, 5)	ok	0.029	none
LnQ_base_7_WA_REC(7)	-8.85	-1	(-20, 15)	fixed		none
Q_extraSD_7_WA_REC(7)	0.383	5	(0, 5)	ok	0.0763	none
LnQ_base_8_CACPFV(8)	-9.25	-1	(-15, 15)	fixed		none
Q_extraSD_8_CACPFV(8)	0.0966	5	(0, 5)	ok	0.0746	none
LnQ_base_9_OR_REC(9)	-11.4	-1	(-15, 15)	fixed		none
Q_extraSD_9_OR_REC(9)	0.165	5	(0, 5)	ok	0.0792	none
LnQ_base_10_TRI_ORWA(10)	-1.51	-1	(-15, 15)	fixed		none
Q_extraSD_10_TRI_ORWA(10)	0.14	5	(0, 5)	ok	0.122	none
LnQ_base_11_NWFSC_ORWA(11)	-0.957	-1	(-15, 15)	fixed		none
Q_extraSD_11_NWFSC_ORWA(11)	0	-5	(0, 5)	fixed		none

LnQ_base_12_IPHC_ORWA(12)	-0.648	-1	(-15, 15)	fixed		none
Q_extraSD_12_IPHC_ORWA(12)	0.552	5	(0, 5)	ok	0.107	none
LnQ_base_6_OR_REC(6)_BLK2add_2004	-2.67	1	(-4, 4)	ok	0.112	none
Size_DblIN_peak_1_CA_TWL(1)	44	4	(20, 60)	ok	3.31	none
Size_DblIN_top_logit_1_CA_TWL(1)	-15	-5	(-15, 4)	fixed		none
Size_DblIN_ascend_se_1_CA_TWL(1)	5.13	4	(-1, 9)	ok	0.404	none
Size_DblIN_descend_se_1_CA_TWL(1)	18.3	5	(-1, 30)	ok	152	none
Size_DblIN_start_logit_1_CA_TWL(1)	-999	-4	(-1000, 9)	fixed		none
Size_DblIN_end_logit_1_CA_TWL(1)	-999	-5	(-1000, 9)	fixed		none
Size_DblIN_peak_2_CA_NONTWL(2)	44.7	4	(20, 60)	ok	2.49	none
Size_DblIN_top_logit_2_CA_NONTWL(2)	-15	-5	(-15, 4)	fixed		none
Size_DblIN_ascend_se_2_CA_NONTWL(2)	5.2	4	(-1, 9)	ok	0.281	none
Size_DblIN_descend_se_2_CA_NONTWL(2)	17.4	5	(-1, 30)	ok	172	none
Size_DblIN_start_logit_2_CA_NONTWL(2)	-999	-4	(-1000, 9)	fixed		none
Size_DblIN_end_logit_2_CA_NONTWL(2)	-999	-5	(-1000, 9)	fixed		none
Size_DblIN_peak_3_CA_REC(3)	41.7	4	(20, 60)	ok	1.35	none
Size_DblIN_top_logit_3_CA_REC(3)	-15	-5	(-15, 4)	fixed		none
Size_DblIN_ascend_se_3_CA_REC(3)	5.21	4	(-1, 9)	ok	0.144	none
Size_DblIN_descend_se_3_CA_REC(3)	20	-5	(-1, 30)	fixed		none
Size_DblIN_start_logit_3_CA_REC(3)	-999	-4	(-1000, 9)	fixed		none
Size_DblIN_end_logit_3_CA_REC(3)	-999	-5	(-1000, 9)	fixed		none
Size_DblIN_peak_4_ORWA_TWL(4)	41.9	4	(20, 60)	ok	3.04	none
Size_DblIN_top_logit_4_ORWA_TWL(4)	-15	-5	(-15, 4)	fixed		none
Size_DblIN_ascend_se_4_ORWA_TWL(4)	5.49	4	(-1, 9)	ok	0.343	none
Size_DblIN_descend_se_4_ORWA_TWL(4)	18.2	5	(-1, 30)	ok	151	none
Size_DblIN_start_logit_4_ORWA_TWL(4)	-999	-4	(-1000, 9)	fixed		none
Size_DblIN_end_logit_4_ORWA_TWL(4)	-999	-5	(-1000, 9)	fixed		none
Size_DblIN_peak_5_ORWA_NONTWL(5)	50.9	4	(20, 60)	ok	1.48	none
Size_DblIN_top_logit_5_ORWA_NONTWL(5)	-15	-5	(-15, 4)	fixed		none
Size_DblIN_ascend_se_5_ORWA_NONTWL(5)	5.44	4	(-1, 9)	ok	0.147	none
Size_DblIN_descend_se_5_ORWA_NONTWL(5)	20	-5	(-1, 30)	fixed		none
Size_DblIN_start_logit_5_ORWA_NONTWL(5)	-999	-4	(-1000, 9)	fixed		none
Size_DblIN_end_logit_5_ORWA_NONTWL(5)	-999	-5	(-1000, 9)	fixed		none
Size_DblIN_peak_6_OR_REC(6)	36.7	4	(20, 60)	ok	1.27	none
Size_DblIN_top_logit_6_OR_REC(6)	-15	-5	(-15, 4)	fixed		none
Size_DblIN_ascend_se_6_OR_REC(6)	4.14	4	(-1, 9)	ok	0.28	none
Size_DblIN_descend_se_6_OR_REC(6)	12	-5	(-1, 30)	fixed		none
Size_DblIN_start_logit_6_OR_REC(6)	-999	-4	(-1000, 9)	fixed		none

Size_DbIN_end_logit_6_OR_REC(6)	-999	-5	(-1000, 9)	fixed		none
Size_DbIN_peak_7_WA_REC(7)	42.8	6	(20, 60)	ok	2.75	none
Size_DbIN_top_logit_7_WA_REC(7)	-15	-5	(-15, 4)	fixed		none
Size_DbIN_ascend_se_7_WA_REC(7)	4.32	6	(-1, 9)	ok	0.518	none
Size_DbIN_descend_se_7_WA_REC(7)	20	-5	(-1, 30)	fixed		none
Size_DbIN_start_logit_7_WA_REC(7)	-999	-4	(-1000, 9)	fixed		none
Size_DbIN_end_logit_7_WA_REC(7)	-999	-5	(-1000, 9)	fixed		none
Size_DbIN_peak_9_OR_REC(9)	35.1	4	(20, 60)	ok	1.63	none
Size_DbIN_top_logit_9_OR_REC(9)	-15	-5	(-15, 4)	fixed		none
Size_DbIN_ascend_se_9_OR_REC(9)	4.61	4	(-1, 9)	ok	0.292	none
Size_DbIN_descend_se_9_OR_REC(9)	20	-5	(-1, 30)	fixed		none
Size_DbIN_start_logit_9_OR_REC(9)	-999	-4	(-1000, 9)	fixed		none
Size_DbIN_end_logit_9_OR_REC(9)	-999	-5	(-1000, 9)	fixed		none
Size_DbIN_peak_10_TRI_ORWA(10)	80	4	(20, 80)	HI	0.899	none
Size_DbIN_top_logit_10_TRI_ORWA(10)	-15	-5	(-15, 4)	fixed		none
Size_DbIN_ascend_se_10_TRI_ORWA(10)	7.08	4	(-1, 9)	ok	0.264	none
Size_DbIN_descend_se_10_TRI_ORWA(10)	12	-5	(-1, 30)	fixed		none
Size_DbIN_start_logit_10_TRI_ORWA(10)	-999	-4	(-1000, 9)	fixed		none
Size_DbIN_end_logit_10_TRI_ORWA(10)	-999	-5	(-1000, 9)	fixed		none
Size_DbIN_peak_11_NWFSC_ORWA(11)	48.9	4	(20, 60)	ok	5.59	none
Size_DbIN_top_logit_11_NWFSC_ORWA(11)	-15	-5	(-15, 4)	fixed		none
Size_DbIN_ascend_se_11_NWFSC_ORWA(11)	6.23	4	(-1, 9)	ok	0.386	none
Size_DbIN_descend_se_11_NWFSC_ORWA(11)	20	-5	(-1, 30)	fixed		none
Size_DbIN_start_logit_11_NWFSC_ORWA(11)	-999	-4	(-1000, 9)	fixed		none
Size_DbIN_end_logit_11_NWFSC_ORWA(11)	-999	-5	(-1000, 9)	fixed		none
Size_DbIN_peak_12_IPHC_ORWA(12)	54	4	(20, 60)	ok	1.21	none
Size_DbIN_top_logit_12_IPHC_ORWA(12)	-15	-5	(-15, 4)	fixed		none
Size_DbIN_ascend_se_12_IPHC_ORWA(12)	4.14	4	(-1, 9)	ok	0.233	none
Size_DbIN_descend_se_12_IPHC_ORWA(12)	20	-5	(-1, 30)	fixed		none
Size_DbIN_start_logit_12_IPHC_ORWA(12)	-999	-4	(-1000, 9)	fixed		none
Size_DbIN_end_logit_12_IPHC_ORWA(12)	-999	-5	(-1000, 9)	fixed		none

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	10484	1190.00	10331	1.000	243	0	0.000	0.000
1890	10484	1189.99	10331	1.000	243	0	0.001	0.000
1891	10483	1189.98	10331	1.000	243	0	0.002	0.000
1892	10483	1189.95	10331	1.000	243	0	0.025	0.000
1893	10480	1189.49	10327	1.000	243	0	0.025	0.000
1894	10476	1189.03	10323	0.999	243	0	0.026	0.000
1895	10472	1188.57	10319	0.999	243	0	0.009	0.000
1896	10472	1188.42	10318	0.999	244	1	0.005	0.000
1897	10471	1188.34	10318	0.999	244	1	0.006	0.000
1898	10471	1188.26	10318	0.999	244	1	0.006	0.000
1899	10471	1188.19	10318	0.998	244	1	0.007	0.000
1900	10471	1188.10	10318	0.998	244	1	0.008	0.000
1901	10471	1188.01	10318	0.998	244	1	0.009	0.000
1902	10471	1187.92	10318	0.998	244	1	0.010	0.000
1903	10471	1187.82	10318	0.998	244	1	0.011	0.000
1904	10471	1187.73	10318	0.998	244	1	0.013	0.000
1905	10471	1187.62	10317	0.998	244	1	0.014	0.000
1906	10471	1187.53	10317	0.998	244	1	0.015	0.000
1907	10471	1187.44	10317	0.998	244	1	0.016	0.000
1908	10470	1187.34	10317	0.998	245	2	0.023	0.000
1909	10469	1187.13	10315	0.998	245	2	0.018	0.000
1910	10469	1187.03	10315	0.998	245	2	0.019	0.000
1911	10469	1186.93	10315	0.997	245	2	0.020	0.000
1912	10468	1186.82	10314	0.997	245	2	0.022	0.000
1913	10468	1186.71	10314	0.997	246	2	0.023	0.000
1914	10467	1186.59	10313	0.997	246	2	0.024	0.000
1915	10467	1186.47	10313	0.997	246	2	0.029	0.000
1916	10466	1186.27	10312	0.997	246	2	0.026	0.000
1917	10466	1186.14	10311	0.997	246	4	0.036	0.000
1918	10464	1185.85	10309	0.997	246	4	0.142	0.000
1919	10445	1183.51	10290	0.995	245	2	0.063	0.000
1920	10440	1182.75	10285	0.994	244	2	0.059	0.000
1921	10436	1182.11	10281	0.993	242	2	0.056	0.000
1922	10432	1181.54	10277	0.993	240	2	0.043	0.000
1923	10430	1181.25	10276	0.993	237	2	0.048	0.000
1924	10428	1180.90	10274	0.992	234	3	0.078	0.000
1925	10421	1180.01	10268	0.992	230	4	0.099	0.000
1926	10411	1178.78	10258	0.991	226	5	0.141	0.000
1927	10394	1176.75	10242	0.989	223	6	0.178	0.001
1928	10370	1174.02	10220	0.987	219	6	0.176	0.001
1929	10346	1171.40	10198	0.984	216	7	0.157	0.001
1930	10325	1169.24	10179	0.983	213	8	0.175	0.001
1931	10300	1166.75	10156	0.980	211	8	0.125	0.001
1932	10282	1165.28	10140	0.979	209	11	0.117	0.001
1933	10264	1163.97	10124	0.978	207	7	0.116	0.001
1934	10245	1162.64	10107	0.977	205	9	0.142	0.001
1935	10219	1160.75	10084	0.975	202	12	0.141	0.001
1936	10193	1158.80	10059	0.974	199	13	0.187	0.001
1937	10156	1155.81	10024	0.971	195	11	0.170	0.001
1938	10121	1153.01	9990	0.969	192	12	0.181	0.001
1939	10082	1149.81	9952	0.966	190	11	0.143	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	10047	1147.12	9919	0.964	189	11	0.197	0.001
1941	10001	1143.17	9875	0.961	190	11	0.264	0.001
1942	9942	1137.58	9818	0.956	193	7	0.271	0.001
1943	9879	1131.49	9756	0.951	198	9	0.450	0.001
1944	9778	1120.78	9657	0.942	209	27	0.514	0.003
1945	9671	1109.25	9550	0.932	225	62	0.712	0.006
1946	9519	1092.38	9398	0.918	250	64	0.661	0.007
1947	9379	1076.61	9257	0.905	284	21	0.357	0.002
1948	9306	1068.42	9180	0.898	315	32	0.397	0.004
1949	9227	1059.12	9096	0.890	316	22	0.315	0.002
1950	9166	1051.47	9027	0.884	279	23	0.350	0.002
1951	9104	1043.03	8955	0.876	232	34	0.422	0.004
1952	9036	1032.92	8874	0.868	195	29	0.376	0.003
1953	8983	1023.86	8809	0.860	170	25	0.287	0.003
1954	8950	1016.60	8768	0.854	154	28	0.357	0.003
1955	8912	1008.23	8731	0.847	146	27	0.352	0.003
1956	8878	1000.35	8712	0.841	146	32	0.375	0.004
1957	8842	992.62	8699	0.834	151	36	0.461	0.004
1958	8793	984.06	8670	0.827	163	47	0.448	0.005
1959	8742	976.55	8634	0.821	180	39	0.444	0.005
1960	8692	970.54	8593	0.816	189	31	0.431	0.004
1961	8644	966.11	8548	0.812	174	22	0.364	0.003
1962	8603	963.88	8508	0.810	149	26	0.418	0.003
1963	8551	961.17	8453	0.808	132	33	0.319	0.004
1964	8509	960.06	8406	0.807	133	27	0.234	0.003
1965	8477	960.12	8370	0.807	154	38	0.711	0.005
1966	8363	950.38	8253	0.799	185	40	0.319	0.005
1967	8309	947.34	8203	0.796	207	42	0.406	0.005
1968	8241	941.98	8143	0.792	247	45	0.373	0.006
1969	8174	936.24	8081	0.787	272	66	0.792	0.008
1970	8034	921.14	7937	0.774	331	73	0.523	0.009
1971	7937	910.42	7829	0.765	522	87	0.652	0.011
1972	7817	896.31	7692	0.753	290	116	0.703	0.015
1973	7677	878.83	7534	0.739	214	116	0.791	0.015
1974	7538	859.79	7374	0.723	236	127	0.838	0.017
1975	7398	838.94	7209	0.705	342	131	0.778	0.018
1976	7276	818.93	7069	0.688	283	139	0.915	0.020
1977	7141	796.14	6918	0.669	265	130	0.969	0.019
1978	7016	773.72	6794	0.650	191	222	1.187	0.033
1979	6787	738.84	6622	0.621	250	176	1.423	0.027
1980	6541	702.27	6383	0.590	291	115	1.390	0.018
1981	6364	674.66	6192	0.567	320	197	1.489	0.032
1982	6108	639.85	5927	0.538	355	318	1.715	0.054
1983	5637	583.50	5477	0.490	241	115	1.768	0.021
1984	5246	535.86	5091	0.450	311	125	1.633	0.025
1985	5029	508.45	4874	0.427	259	136	1.759	0.028
1986	4724	472.11	4549	0.397	182	98	1.716	0.022
1987	4491	443.26	4305	0.372	141	130	1.710	0.030
1988	4275	416.46	4088	0.350	105	124	1.702	0.030
1989	4092	393.78	3915	0.331	90	111	1.795	0.028
1990	3849	365.16	3700	0.307	81	127	1.701	0.034
1991	3684	345.58	3541	0.290	73	181	1.826	0.051

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
1992	3388	314.08	3276	0.264	84	133	1.848	0.041
1993	3114	285.72	3030	0.240	166	61	1.837	0.020
1994	2855	258.83	2786	0.218	139	68	1.772	0.025
1995	2704	245.18	2647	0.206	66	64	1.802	0.024
1996	2540	231.39	2485	0.194	63	84	1.822	0.034
1997	2356	216.06	2300	0.182	75	78	1.857	0.034
1998	2147	197.94	2085	0.166	120	27	1.611	0.013
1999	2086	194.15	2016	0.163	189	35	1.709	0.018
2000	1985	185.83	1909	0.156	99	12	1.107	0.006
2001	2005	189.60	1944	0.159	114	10	1.056	0.005
2002	2028	192.82	1975	0.162	403	2	0.394	0.001
2003	2086	199.71	2024	0.168	163	4	0.387	0.002
2004	2148	206.64	2072	0.174	109	2	0.264	0.001
2005	2218	213.77	2123	0.180	167	2	0.281	0.001
2006	2293	220.73	2184	0.185	284	1	0.215	0.001
2007	2374	227.86	2267	0.191	285	5	0.364	0.002
2008	2457	234.43	2324	0.197	483	2	0.235	0.001
2009	2550	241.33	2389	0.203	372	5	0.308	0.002
2010	2649	248.18	2535	0.209	362	1	0.151	0.000
2011	2765	255.84	2636	0.215	279	2	0.197	0.001
2012	2892	263.91	2723	0.222	242	3	0.260	0.001
2013	3034	272.49	2822	0.229	571	2	0.213	0.001
2014	3187	282.19	2958	0.237	263	1	0.179	0.000
2015	3355	293.08	3106	0.246	359	2	0.244	0.001
2016	3535	304.71	3317	0.256	242	1	0.174	0.000
2017	3729	317.87	3520	0.267	121	6	0.355	0.002
2018	3925	331.52	3724	0.279	115	5	0.317	0.001
2019	4130	347.17	3918	0.292	118	6	0.371	0.002
2020	4335	364.48	4100	0.306	117	2	0.270	0.001
2021	4545	384.48	4384	0.323	153	7	0.306	0.001
2022	4749	406.33	4599	0.341	174	9	0.441	0.002
2023	4932	428.74	4829	0.360	179	12	0.482	0.002
2024	5102	452.09	5024	0.380	209	8	0.357	0.002
2025	5270	477.63	5190	0.401	211	19	0.515	0.004
2026	5411	502.27	5324	0.422	213	19	0.509	0.004
2027	5539	526.77	5443	0.443	216	31	0.921	0.006
2028	5590	543.56	5480	0.457	217	31	0.915	0.006
2029	5631	558.41	5512	0.469	218	31	0.910	0.006
2030	5662	570.84	5537	0.480	219	31	0.905	0.006
2031	5686	580.65	5553	0.488	220	31	0.899	0.006
2032	5704	587.93	5569	0.494	220	31	0.894	0.006
2033	5717	592.97	5581	0.498	220	31	0.889	0.006
2034	5726	596.20	5590	0.501	221	31	0.884	0.006
2035	5733	598.07	5596	0.503	221	31	0.878	0.005
2036	5739	599.03	5601	0.503	221	31	0.873	0.005
1889	10484	1190.00	10331	1.000	243	0	0.000	0.000
1890	10484	1189.99	10331	1.000	243	0	0.001	0.000
1891	10483	1189.98	10331	1.000	243	0	0.002	0.000
1892	10483	1189.95	10331	1.000	243	4	0.025	0.000
1893	10480	1189.49	10327	1.000	243	4	0.025	0.000
1894	10476	1189.03	10323	0.999	243	4	0.026	0.000
1895	10472	1188.57	10319	0.999	243	1	0.009	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%)	Exploitation Rate
1896	10472	1188.42	10318	0.999	244	0	0.005	0.000
1897	10471	1188.34	10318	0.999	244	0	0.006	0.000
1898	10471	1188.26	10318	0.999	244	0	0.006	0.000
1899	10471	1188.19	10318	0.998	244	0	0.007	0.000
1900	10471	1188.10	10318	0.998	244	0	0.008	0.000
1901	10471	1188.01	10318	0.998	244	0	0.009	0.000
1902	10471	1187.92	10318	0.998	244	0	0.010	0.000
1903	10471	1187.82	10318	0.998	244	1	0.011	0.000
1904	10471	1187.73	10318	0.998	244	1	0.013	0.000
1905	10471	1187.62	10317	0.998	244	1	0.014	0.000
1906	10471	1187.53	10317	0.998	244	1	0.015	0.000
1907	10471	1187.44	10317	0.998	244	1	0.016	0.000
1908	10470	1187.34	10317	0.998	245	2	0.023	0.000
1909	10469	1187.13	10315	0.998	245	1	0.018	0.000
1910	10469	1187.03	10315	0.998	245	1	0.019	0.000
1911	10469	1186.93	10315	0.997	245	1	0.020	0.000
1912	10468	1186.82	10314	0.997	245	1	0.022	0.000
1913	10468	1186.71	10314	0.997	246	1	0.023	0.000
1914	10467	1186.59	10313	0.997	246	2	0.024	0.000
1915	10467	1186.47	10313	0.997	246	2	0.029	0.000
1916	10466	1186.27	10312	0.997	246	2	0.026	0.000
1917	10466	1186.14	10311	0.997	246	2	0.036	0.000
1918	10464	1185.85	10309	0.997	246	19	0.142	0.002
1919	10445	1183.51	10290	0.995	245	8	0.063	0.001
1920	10440	1182.75	10285	0.994	244	7	0.059	0.001
1921	10436	1182.11	10281	0.993	242	6	0.056	0.001
1922	10432	1181.54	10277	0.993	240	4	0.043	0.000
1923	10430	1181.25	10276	0.993	237	5	0.048	0.000
1924	10428	1180.90	10274	0.992	234	9	0.078	0.001
1925	10421	1180.01	10268	0.992	230	11	0.099	0.001
1926	10411	1178.78	10258	0.991	226	17	0.141	0.002
1927	10394	1176.75	10242	0.989	223	23	0.178	0.002
1928	10370	1174.02	10220	0.987	219	22	0.176	0.002
1929	10346	1171.40	10198	0.984	216	18	0.157	0.002
1930	10325	1169.24	10179	0.983	213	20	0.175	0.002
1931	10300	1166.75	10156	0.980	211	12	0.125	0.001
1932	10282	1165.28	10140	0.979	209	7	0.117	0.001
1933	10264	1163.97	10124	0.978	207	10	0.116	0.001
1934	10245	1162.64	10107	0.977	205	13	0.142	0.001
1935	10219	1160.75	10084	0.975	202	10	0.141	0.001
1936	10193	1158.80	10059	0.974	199	17	0.187	0.002
1937	10156	1155.81	10024	0.971	195	15	0.170	0.001
1938	10121	1153.01	9990	0.969	192	16	0.181	0.002
1939	10082	1149.81	9952	0.966	190	11	0.143	0.001
1940	10047	1147.12	9919	0.964	189	19	0.197	0.002
1941	10001	1143.17	9875	0.961	190	31	0.264	0.003
1942	9942	1137.58	9818	0.956	193	37	0.271	0.004
1943	9879	1131.49	9756	0.951	198	72	0.450	0.007
1944	9778	1120.78	9657	0.942	209	59	0.514	0.006
1945	9671	1109.25	9550	0.932	225	68	0.712	0.007
1946	9519	1092.38	9398	0.918	250	56	0.661	0.006
1947	9379	1076.61	9257	0.905	284	32	0.357	0.003

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
1948	9306	1068.42	9180	0.898	315	29	0.397	0.003
1949	9227	1059.12	9096	0.890	316	24	0.315	0.003
1950	9166	1051.47	9027	0.884	279	28	0.350	0.003
1951	9104	1043.03	8955	0.876	232	30	0.422	0.003
1952	9036	1032.92	8874	0.868	195	26	0.376	0.003
1953	8983	1023.86	8809	0.860	170	16	0.287	0.002
1954	8950	1016.60	8768	0.854	154	23	0.357	0.003
1955	8912	1008.23	8731	0.847	146	23	0.352	0.003
1956	8878	1000.35	8712	0.841	146	21	0.375	0.002
1957	8842	992.62	8699	0.834	151	31	0.461	0.004
1958	8793	984.06	8670	0.827	163	21	0.448	0.002
1959	8742	976.55	8634	0.821	180	25	0.444	0.003
1960	8692	970.54	8593	0.816	189	30	0.431	0.004
1961	8644	966.11	8548	0.812	174	28	0.364	0.003
1962	8603	963.88	8508	0.810	149	32	0.418	0.004
1963	8551	961.17	8453	0.808	132	11	0.319	0.001
1964	8509	960.06	8406	0.807	133	5	0.234	0.001
1965	8477	960.12	8370	0.807	154	73	0.711	0.009
1966	8363	950.38	8253	0.799	185	6	0.319	0.001
1967	8309	947.34	8203	0.796	207	16	0.406	0.002
1968	8241	941.98	8143	0.792	247	9	0.373	0.001
1969	8174	936.24	8081	0.787	272	62	0.792	0.008
1970	8034	921.14	7937	0.774	331	13	0.523	0.002
1971	7937	910.42	7829	0.765	522	25	0.652	0.003
1972	7817	896.31	7692	0.753	290	22	0.703	0.003
1973	7677	878.83	7534	0.739	214	33	0.791	0.004
1974	7538	859.79	7374	0.723	236	36	0.838	0.005
1975	7398	838.94	7209	0.705	342	23	0.778	0.003
1976	7276	818.93	7069	0.688	283	41	0.915	0.006
1977	7141	796.14	6918	0.669	265	51	0.969	0.007
1978	7016	773.72	6794	0.650	191	77	1.187	0.011
1979	6787	738.84	6622	0.621	250	151	1.423	0.023
1980	6541	702.27	6383	0.590	291	152	1.390	0.024
1981	6364	674.66	6192	0.567	320	157	1.489	0.025
1982	6108	639.85	5927	0.538	355	259	1.715	0.044
1983	5637	583.50	5477	0.490	241	388	1.768	0.071
1984	5246	535.86	5091	0.450	311	210	1.633	0.041
1985	5029	508.45	4874	0.427	259	293	1.759	0.060
1986	4724	472.11	4549	0.397	182	265	1.716	0.058
1987	4491	443.26	4305	0.372	141	223	1.710	0.052
1988	4275	416.46	4088	0.350	105	199	1.702	0.049
1989	4092	393.78	3915	0.331	90	272	1.795	0.069
1990	3849	365.16	3700	0.307	81	176	1.701	0.048
1991	3684	345.58	3541	0.290	73	250	1.826	0.071
1992	3388	314.08	3276	0.264	84	267	1.848	0.081
1993	3114	285.72	3030	0.240	166	316	1.837	0.104
1994	2855	258.83	2786	0.218	139	189	1.772	0.068
1995	2704	245.18	2647	0.206	66	200	1.802	0.076
1996	2540	231.39	2485	0.194	63	194	1.822	0.078
1997	2356	216.06	2300	0.182	75	218	1.857	0.095
1998	2147	197.94	2085	0.166	120	113	1.611	0.054
1999	2086	194.15	2016	0.163	189	141	1.709	0.070

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	1985	185.83	1909	0.156	99	40	1.107	0.021
2001	2005	189.60	1944	0.159	114	42	1.056	0.022
2002	2028	192.82	1975	0.162	403	11	0.394	0.006
2003	2086	199.71	2024	0.168	163	8	0.387	0.004
2004	2148	206.64	2072	0.174	109	7	0.264	0.003
2005	2218	213.77	2123	0.180	167	8	0.281	0.004
2006	2293	220.73	2184	0.185	284	7	0.215	0.003
2007	2374	227.86	2267	0.191	285	8	0.364	0.003
2008	2457	234.43	2324	0.197	483	7	0.235	0.003
2009	2550	241.33	2389	0.203	372	6	0.308	0.002
2010	2649	248.18	2535	0.209	362	5	0.151	0.002
2011	2765	255.84	2636	0.215	279	6	0.197	0.002
2012	2892	263.91	2723	0.222	242	8	0.260	0.003
2013	3034	272.49	2822	0.229	571	8	0.213	0.003
2014	3187	282.19	2958	0.237	263	7	0.179	0.003
2015	3355	293.08	3106	0.246	359	10	0.244	0.003
2016	3535	304.71	3317	0.256	242	8	0.174	0.002
2017	3729	317.87	3520	0.267	121	14	0.355	0.004
2018	3925	331.52	3724	0.279	115	14	0.317	0.004
2019	4130	347.17	3918	0.292	118	17	0.371	0.004
2020	4335	364.48	4100	0.306	117	16	0.270	0.004
2021	4545	384.48	4384	0.323	153	14	0.306	0.003
2022	4749	406.33	4599	0.341	174	24	0.441	0.005
2023	4932	428.74	4829	0.360	179	28	0.482	0.006
2024	5102	452.09	5024	0.380	209	21	0.357	0.004
2025	5270	477.63	5190	0.401	211	27	0.515	0.005
2026	5411	502.27	5324	0.422	213	27	0.509	0.005
2027	5539	526.77	5443	0.443	216	82	0.921	0.015
2028	5590	543.56	5480	0.457	217	82	0.915	0.015
2029	5631	558.41	5512	0.469	218	82	0.910	0.015
2030	5662	570.84	5537	0.480	219	82	0.905	0.015
2031	5686	580.65	5553	0.488	220	81	0.899	0.015
2032	5704	587.93	5569	0.494	220	80	0.894	0.014
2033	5717	592.97	5581	0.498	220	79	0.889	0.014
2034	5726	596.20	5590	0.501	221	78	0.884	0.014
2035	5733	598.07	5596	0.503	221	77	0.878	0.014
2036	5739	599.03	5601	0.503	221	76	0.873	0.014

Table 14: Base model sensitivity to the removal of data sources (indices).

Label	Base	- CA REC	- OR REC	- WA REC	- CA CPFV	- ORFS	- Triennial	- WCG-BTS	- IPHC	No indices
<b>Diff. in likelihood from base model</b>										
Total	0	4.67	29.12	5.15	-163.01	-103.81	-25.74	-1460.39	-957.26	-2664.61
Index	0	4.893	29.269	5.761	5.574	4.043	0.897	4.76	0.932	NA
Length comp	0	0.11	0.48	-2.23	-165.77	-99.48	-24.5	-81.58	-67.71	-437.753
Age comp	0	-0.02	0.09	2.29	-5.05	-8.32	-2.3	-1379.01	-889.55	-2276.84
Recruitment	0	-0.334	-0.722	-0.741	2.242	-0.01	0.183	-4.526	-1.172	-5.148
Parm priors	0	0	0	0	0	0	0	0	0	0
<b>Estimates of key parameters</b>										
Recruitment unfished thousands	241.887	237.747	238.639	231.896	246.229	242.162	243.372	244.802	222.331	209.223
log(R0)	5.488	5.471	5.475	5.446	5.506	5.49	5.495	5.5	5.404	5.343
M Female	0.044	0.044	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	62.4	62.7
<b>Estimates of derived quantities</b>										
Unfished age 4+ bio 1000 mt	10.331	10.156	10.194	9.9	10.52	10.358	10.382	10.489	9.916	9.454
B0 millions of eggs	1190	1169.99	1174.29	1140.22	1211.93	1193.95	1195.11	1205.33	1162.9	1111.28
B2025 millions of eggs	477.63	459.638	464.736	434.657	499.77	488.3	485.989	484.887	391.733	339.272
Fraction unfished 2025	0.401	0.393	0.396	0.381	0.412	0.409	0.407	0.402	0.337	0.305
Fishing intensity 2024	0.357	0.368	0.365	0.385	0.343	0.35	0.351	0.357	0.428	0.484

Table 15: Base model sensitivity to the removal of data sources (length compositional data - 1 of 2).

Label	Base	- CA TWL	- CA NON- TWL	- CA REC	- ORWA TWL	- ORWA NON- TWL	- OR REC	- WA REC
<b>Diff. in likelihood from base model</b>								
Total	0	<b>-139.43</b>	<b>-109.74</b>	<b>-271.06</b>	<b>-93.92</b>	<b>-95.57</b>	<b>-194.67</b>	<b>-119.41</b>
Index	0	0.235	<b>-1.775</b>	<b>-0.893</b>	<b>-1.404</b>	<b>-0.586</b>	<b>-2.52</b>	<b>-0.162</b>
Length comp	0	<b>-136.54</b>	<b>-97.36</b>	<b>-263.41</b>	<b>-84.08</b>	<b>-88.64</b>	<b>-173.64</b>	<b>-116.68</b>
Age comp	0	<b>-3.43</b>	<b>-15.27</b>	<b>-9.08</b>	<b>-4.56</b>	<b>-5.8</b>	<b>-18.88</b>	<b>-2.76</b>
Recruitment	0	0.305	4.435	2.435	<b>-3.845</b>	<b>-0.547</b>	0.428	0.193
Parm priors	0	0	0	0	0	0	0	0
<b>Estimates of key parameters</b>								
Recruitment unfished thousands	241.887	240.231	243.282	243.821	241.236	244.452	247.886	242.171
log(R0)	5.488	5.482	5.494	5.496	5.486	5.499	5.513	5.49
M Female	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044
L at Amax Female	61.4	61.3	61.3	61.3	61.2	61.4	61.3	61.2
<b>Estimates of derived quantities</b>								
Unfished age 4+ bio 1000 mt	10.331	10.24	10.38	10.41	10.278	10.468	10.661	10.304
B0 millions of eggs	1190	1178.36	1194.97	1198.67	1182.05	1207.27	1231.32	1184.65
B2025 millions of eggs	477.63	471.102	447.839	511.303	520.246	500.739	543.75	475.296
Fraction unfished 2025	0.401	0.4	0.375	0.427	0.44	0.415	0.442	0.401
Fishing intensity 2024	0.357	0.36	0.371	0.341	0.333	0.344	0.322	0.361

Table 16: Base model sensitivity to the removal of data sources (length compositional data - 2 of 2).

Label	Base	- CA CPFV	- ORFS	- Triennial	- WCG- BTS	- IPHC	No length comps
<b>Diff. in likelihood from base model</b>							
Total	0	-169.32	-108.27	-26.84	-66.36	-55.02	-1480.61
Index	0	-0.05	-0.517	0.051	-0.339	-0.08	-16.679
Length comp	0	-165.81	-99.39	-25.21	-65.86	-52.19	-1387.28
Age comp	0	-5.16	-8.03	-1.64	-0.4	-3.41	-78.02
Recruitment	0	1.653	-0.303	-0.02	0.26	0.66	0.188
Parm priors	0	0	0	0	0	0	0
<b>Estimates of key parameters</b>							
Recruitment unfished thousands	241.887	240.462	242.106	241.355	242.363	241.152	383.142
log(R0)	5.488	5.483	5.489	5.486	5.49	5.485	5.948
M Female	0.044	0.044	0.044	0.044	0.044	0.044	0.044
L at Amax Female	61.4	61.4	61.4	61.3	61.4	61.3	61.4
<b>Estimates of derived quantities</b>							
Unfished age 4+ bio 1000 mt	10.331	10.277	10.357	10.295	10.353	10.298	16.697
B0 millions of eggs	1190	1184.01	1193.73	1185.09	1192.46	1186.1	1935.01
B2025 millions of eggs	477.63	473.383	490.053	476.66	488.707	477.218	1450.16
Fraction unfished 2025	0.401	0.4	0.411	0.402	0.41	0.402	0.749
Fishing intensity 2024	0.357	0.359	0.349	0.357	0.351	0.356	0.163

Table 17: Base model sensitivity to the removal of data sources (age compositional data).

Label	Base	- CA NON- TWL	- CA REC	- ORWA TWL	- ORWA NON- TWL	- OR REC	- WA REC	- WCG- BTS	- IPHC	No age comps
<b>Diff. in likelihood from base model</b>										
Total	0	<b>-126.99</b>	<b>-338.81</b>	<b>-1631.1</b>	<b>-435.31</b>	<b>-1020.72</b>	<b>-813.89</b>	<b>-1398.96</b>	<b>-899.62</b>	<b>-6628.94</b>
Index	0	0.079	0.284	<b>-0.634</b>	0.256	0.912	<b>-0.952</b>	<b>-0.684</b>	4.295	1.068
Length comp	0	<b>-1.02</b>	<b>-5.06</b>	<b>-16.08</b>	<b>-3.06</b>	<b>-8.19</b>	<b>-5.31</b>	<b>-14.72</b>	<b>-15.03</b>	<b>-77.93</b>
Age comp	0	<b>-126.67</b>	<b>-333.22</b>	<b>-1610.46</b>	<b>-433.04</b>	<b>-1010.16</b>	<b>-806.67</b>	<b>-1378.25</b>	<b>-887.3</b>	<b>-6526.61</b>
Recruitment	0	0.635	<b>-0.785</b>	<b>-3.912</b>	0.533	<b>-3.299</b>	<b>-0.916</b>	<b>-5.283</b>	<b>-1.82</b>	<b>-25.344</b>
Parm priors	0	0	0	0	0	0	0	0	0	0
<b>Estimates of key parameters</b>										
Recruitment unfished thousands	241.887	241.952	244.735	242.069	243.986	244.196	250.708	243.671	222.982	274.842
log(R0)	5.488	5.489	5.5	5.489	5.497	5.498	5.524	5.496	5.407	5.616
M Female	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044
L at Amax Female	61.4	61.4	61.3	61.7	61.3	61.3	61.1	61.5	62.4	60.8
<b>Estimates of derived quantities</b>										
Unfished age 4+ bio 1000 mt	10.331	10.32	10.411	10.185	10.418	10.351	10.61	10.441	9.945	11.047
B0 millions of eggs	1190	1188.12	1197.32	1169.27	1200.16	1189.66	1217.61	1199.98	1166.44	1228.11
B2025 millions of eggs	477.63	475.113	475.18	461.464	485.851	469.622	502.097	471.858	393.043	469.146
Fraction unfished 2025	0.401	0.4	0.397	0.395	0.405	0.395	0.412	0.393	0.337	0.382
Fishing intensity 2024	0.357	0.358	0.358	0.372	0.35	0.359	0.341	0.365	0.427	0.316

Table 18: Base model sensitivity to model parameters and specifications.

Label	Base	Est. M	Est. steepness	2017 LW relationship
<b>Diff. in likelihood from base model</b>				
Total	0	-5.64	-3.33	0
Index	0	-3.174	-1.576	0
Length comp	0	-4.67	-3.35	0
Age comp	0	3.93	2.65	0
Recruitment	0	-1.488	-0.911	0
Parm priors	0	0	0	0
<b>Estimates of key parameters</b>				
Recruitment unfished thousands	241.887	392.064	240.801	241.887
log(R0)	5.488	5.971	5.484	5.488
M Female	0.044	0.053	0.044	0.044
L at Amax Female	61.4	61.4	61.4	61.4
<b>Estimates of derived quantities</b>				
Unfished age 4+ bio 1000 mt	10.331	11.865	10.281	10.331
B0 millions of eggs	1190	1316.36	1184.16	1190
B2025 millions of eggs	477.63	724.664	639.998	477.63
Fraction unfished 2025	0.401	0.551	0.54	0.401
Fishing intensity 2024	0.357	0.215	0.276	0.357

Table 19: 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	1,190.0	1,048.1	1,331.9
Unfished Age 8+ Biomass (mt)	10,331	9,101	11,561
Unfished Recruitment (R0)	242	213	271
2025 Spawning output	478	384	571
2025 Fraction Unfished	0.401	0.349	0.453
Reference Points Based SO40%	—	—	—
Proxy Spawning output SO40%	476	419	533
SPR Resulting in SO40%	0.458	0.458	0.458
Exploitation Rate Resulting in SO40%	0.026	0.026	0.027
Yield with SPR Based On SO40% (mt)	122	108	137
Reference Points Based on SPR Proxy for MSY	—	—	—
Proxy Spawning output (SPR50)	531	468	594
SPR50	0.500	—	—
Exploitation Rate Corresponding to SPR50	0.023	0.023	0.023
Yield with SPR50 at SO SPR (mt)	117	103	131
Reference Points Based on Estimated MSY Values	—	—	—
Spawning output at MSY (SO MSY)	343	303	384
SPR MSY	0.358	0.356	0.359
Exploitation Rate Corresponding to SPR MSY	0.037	0.036	0.037
MSY (mt)	128	113	143

Table 20: 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	Fraction Unfished
2025	105.8	55.8	45.7	—	—	—	—	477.6	0.401
2026	108.3	56.6	46.4	—	—	—	—	502.3	0.422
2027	—	—	—	129.3	0.873	112.9	112.9	526.8	0.443
2028	—	—	—	130.9	0.864	113.1	113.1	543.6	0.457
2029	—	—	—	132.0	0.856	113.0	113.0	558.4	0.469
2030	—	—	—	132.7	0.848	112.6	112.6	570.8	0.480
2031	—	—	—	133.1	0.840	111.8	111.8	580.7	0.488
2032	—	—	—	133.3	0.832	110.9	110.9	587.9	0.494
2033	—	—	—	133.2	0.824	109.8	109.8	593.0	0.498
2034	—	—	—	133.1	0.817	108.8	108.8	596.2	0.501
2035	—	—	—	132.9	0.809	107.6	107.6	598.1	0.503
2036	—	—	—	132.8	0.801	106.3	106.3	599.0	0.503

Table 21: Decision table with 10-year projections. ‘Mgmt’ refers to the three management scenarios (A) the default harvest control rule  $P = 0.45$ . In each case the 2025 and 2026 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 millions 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	2025	46	330.67	0.289	477.63	0.401	839.65	0.603
	2026	46	347.96	0.305	502.27	0.422	878.58	0.630
	2027	99	365.20	0.320	526.77	0.443	916.84	0.658
	2028	98	376.44	0.329	543.56	0.457	946.40	0.679
	2029	97	386.47	0.338	558.41	0.469	972.47	0.698
	2030	96	394.93	0.346	570.84	0.480	994.20	0.713
	2031	94	401.71	0.352	580.65	0.488	1011.25	0.726
	2032	92	406.85	0.356	587.93	0.494	1023.78	0.735
	2033	91	410.56	0.359	592.97	0.498	1032.35	0.741
	2034	89	413.15	0.362	596.20	0.501	1037.71	0.745
	2035	87	414.93	0.363	598.07	0.503	1040.63	0.747
	2036	85	416.25	0.364	599.03	0.503	1041.85	0.748

## 8 Figures

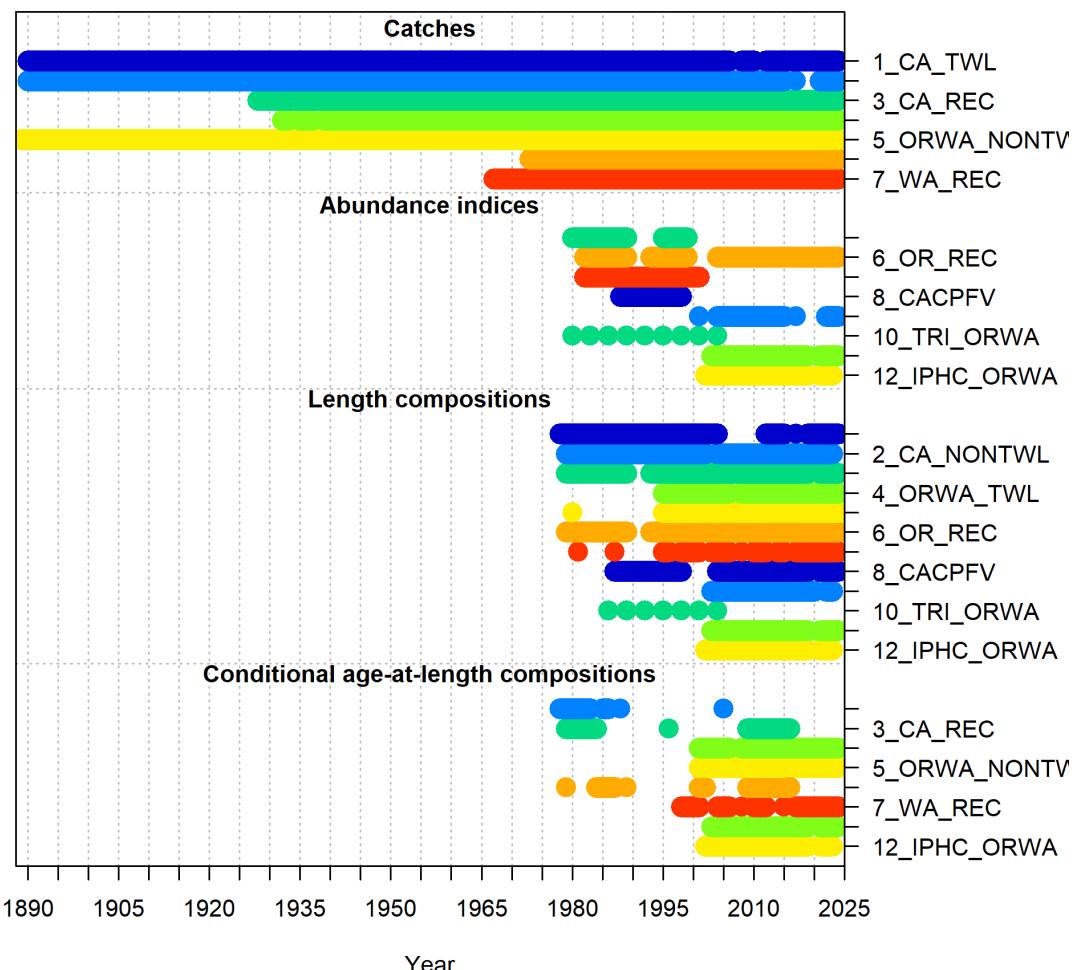


Figure 1: Summary of data sources used in the base model.

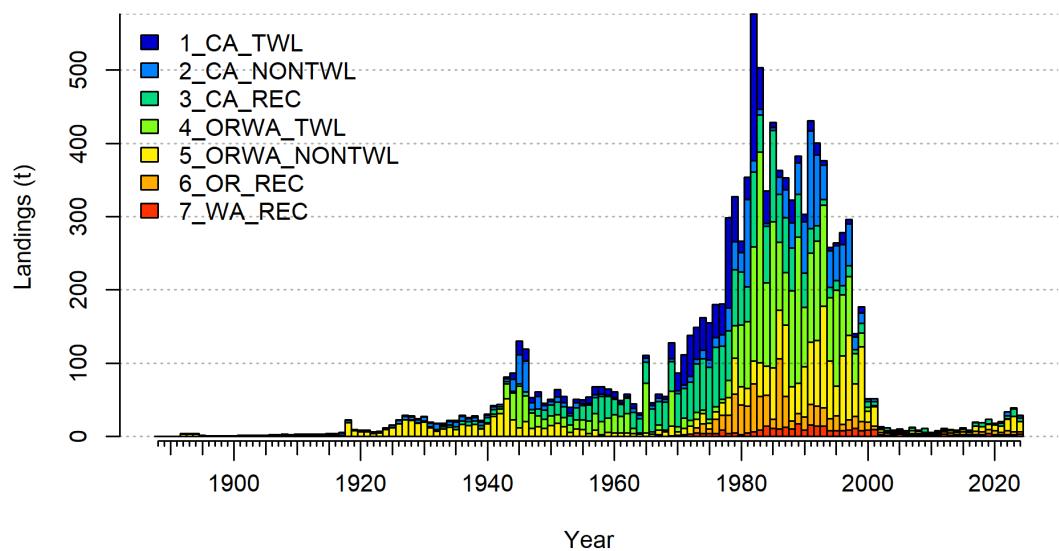


Figure 2: Yelloweye Rockfish landing history in metric tons (mt) between 1889 and 2024 for each fleet.

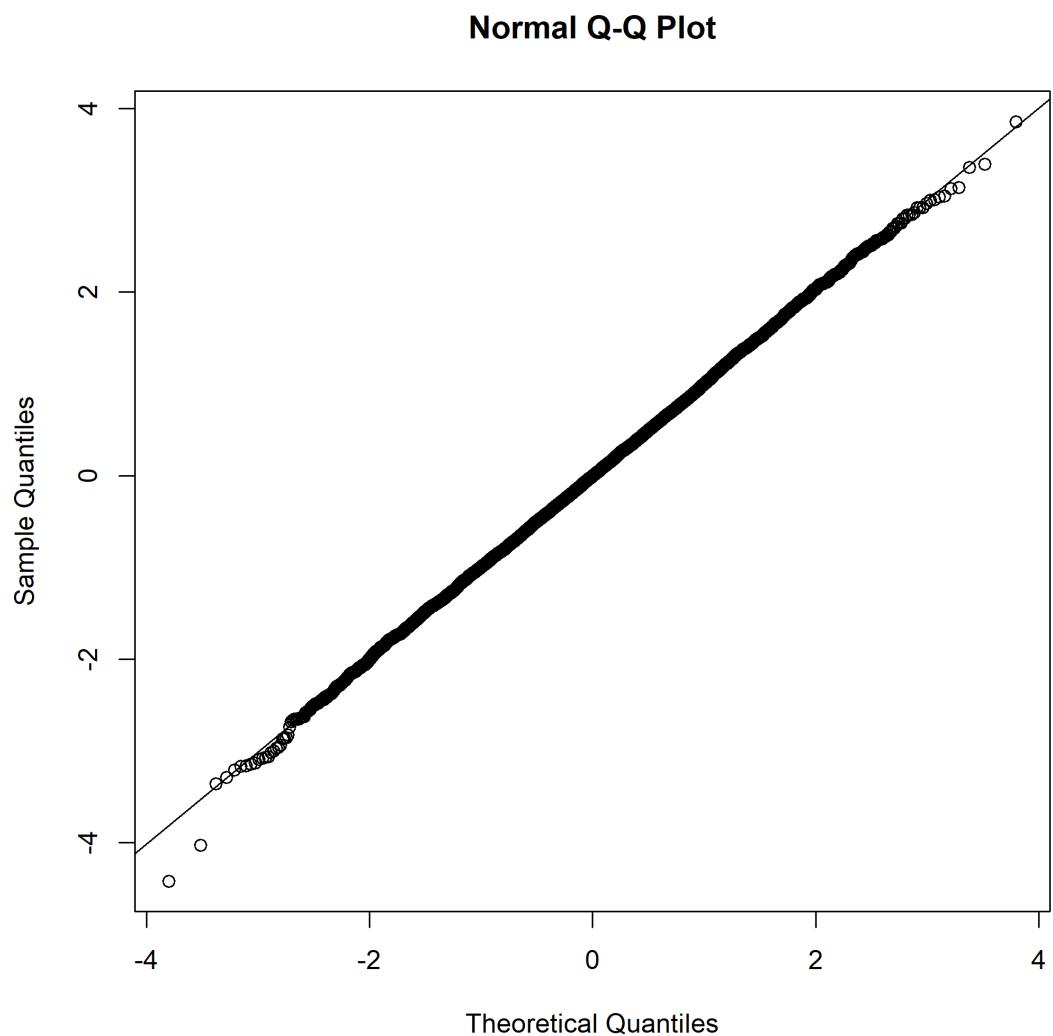


Figure 3: Quantile-quantile plot for the sdmTMB model fit for the Oregon Onboard Observer (ORFS) index.

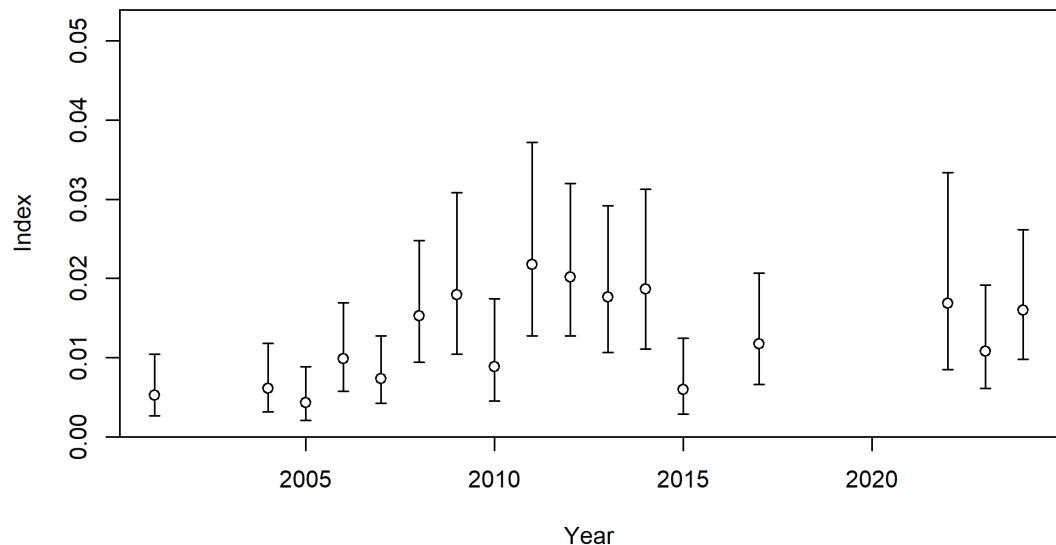


Figure 4: Annual relative index of abundance for the Oregon Onboard Observer (ORFS) index.

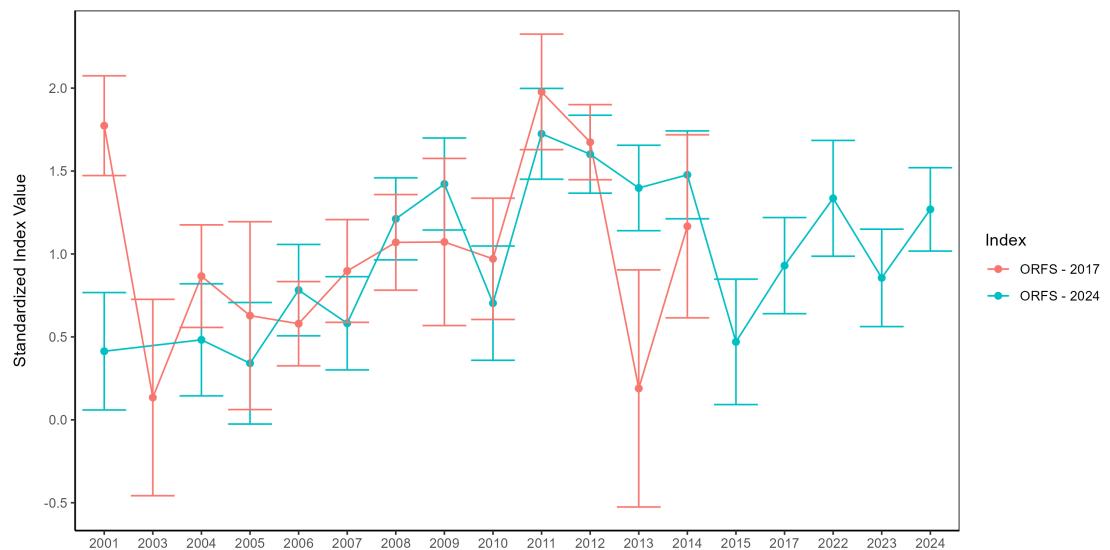


Figure 5: Comparison of Oregon Onboard Observer indices from the 2017 and the current assessment.

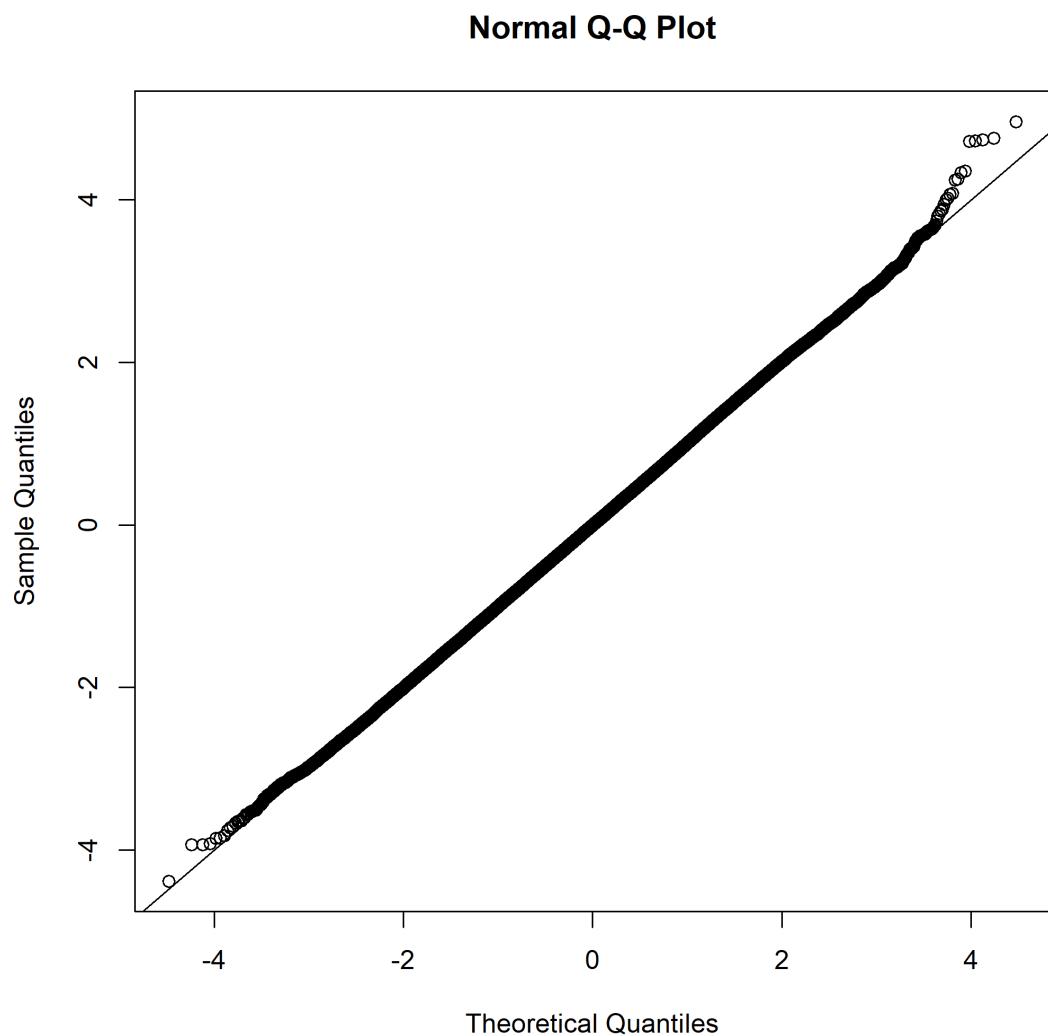


Figure 6: Quantile-quantile plot for the sdmTMB model fit for the updated portion of the Oregon recreational (ORBS) index.

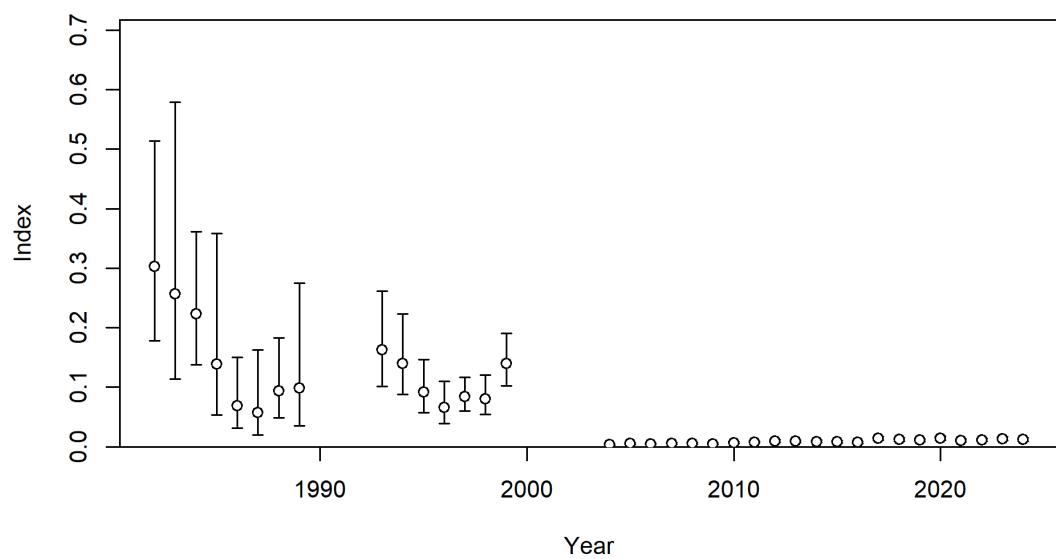


Figure 7: Annual relative index of abundance for the Oregon recreational index, including both MRFSS (1980 - 1999) and ORBS (2004 - 2024) indices.

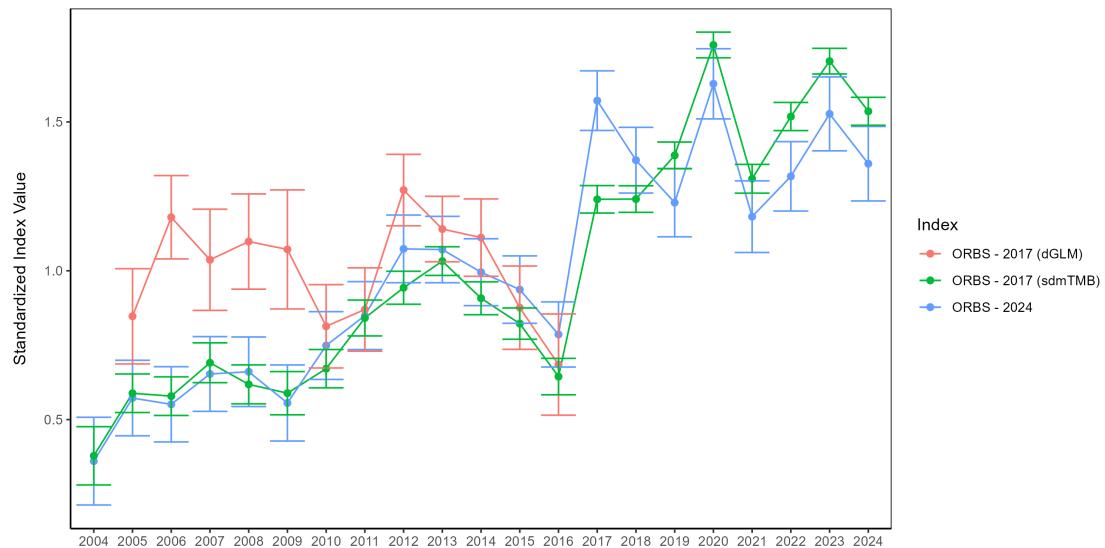


Figure 8: Comparison of the 2017 ORBS index (delta-GLM), the 2017 ORBS model (with the current dataset and implemented in sdmTMB), and the current ORBS index (sdmTMB).

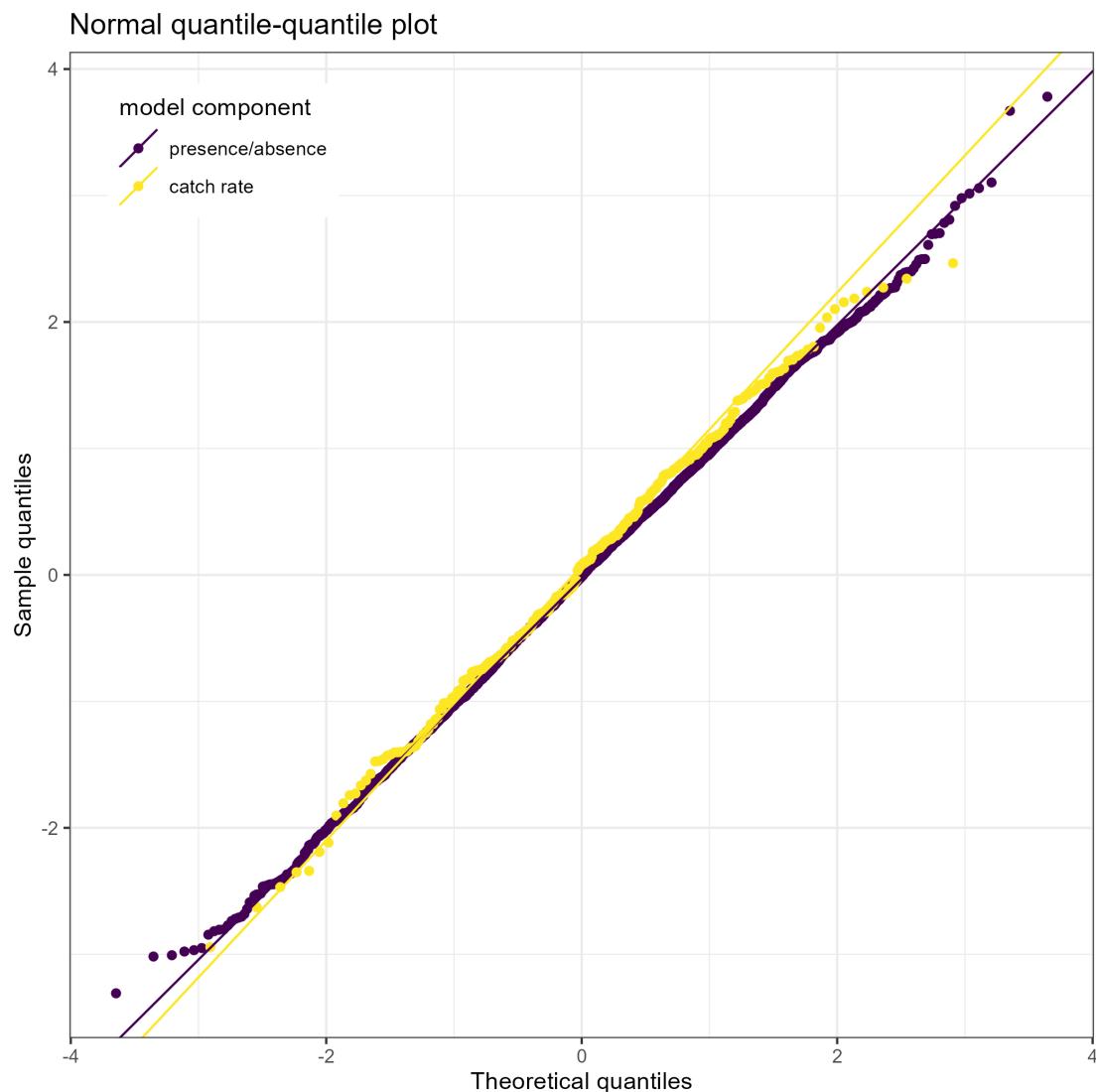


Figure 9: Quantile-quantile plot for the sdmTMB model fit for the NWFSC West Coast Groundfish Bottom Trawl Survey (WCGBTS) index.

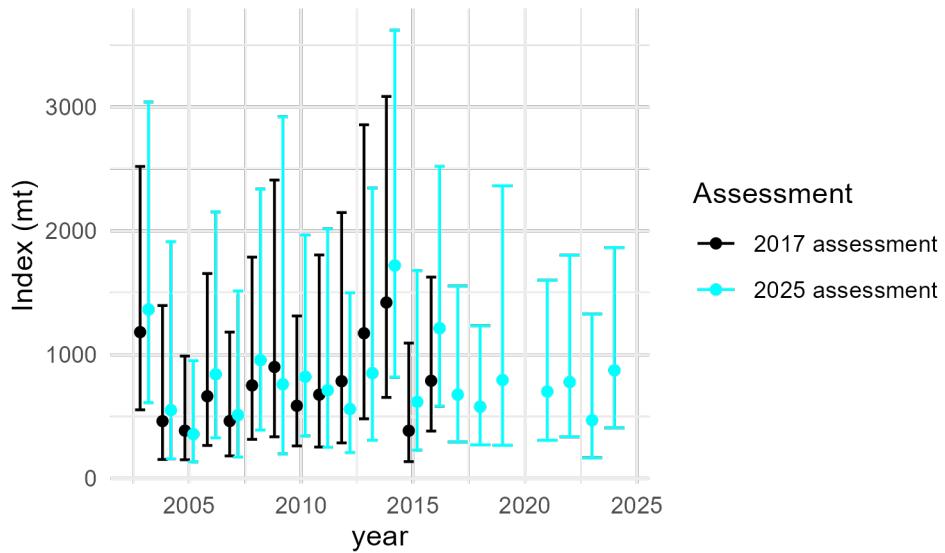


Figure 10: Comparison of the 2017 NWFSC West Coast Groundfish Bottom Trawl Survey (WCGBTS) and the current WCBTS index of abundance.

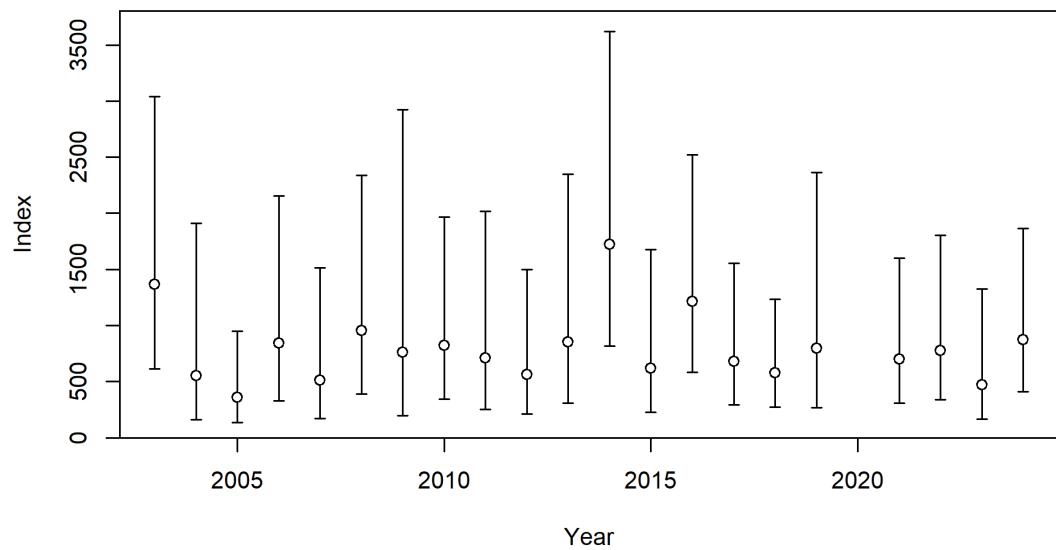


Figure 11: Annual relative index of abundance for the West Coast Groundfish Bottom Trawl Survey (WCGBTS).

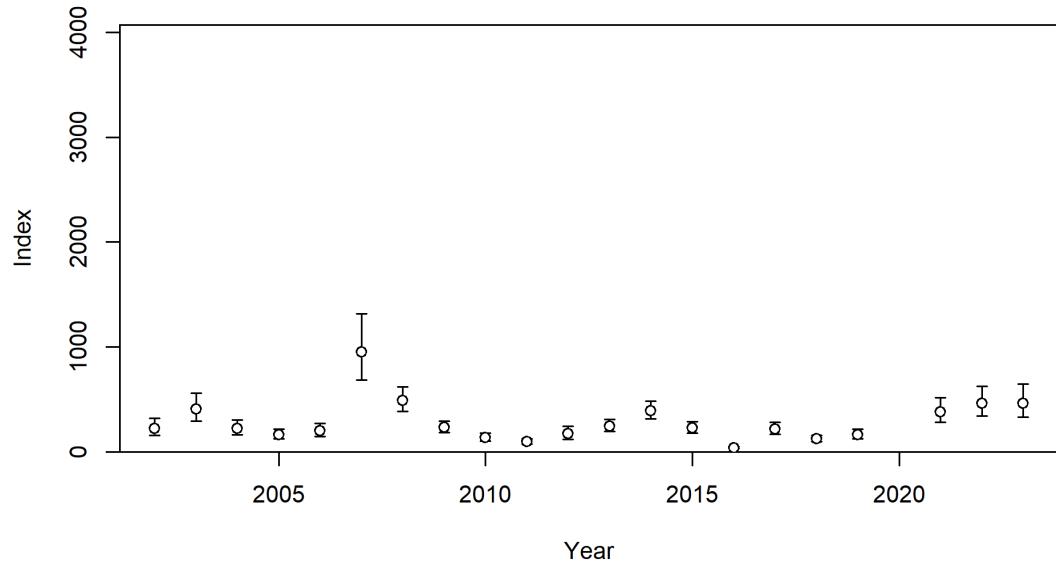


Figure 12: Annual relative index of abundance for the IPHC longline survey.

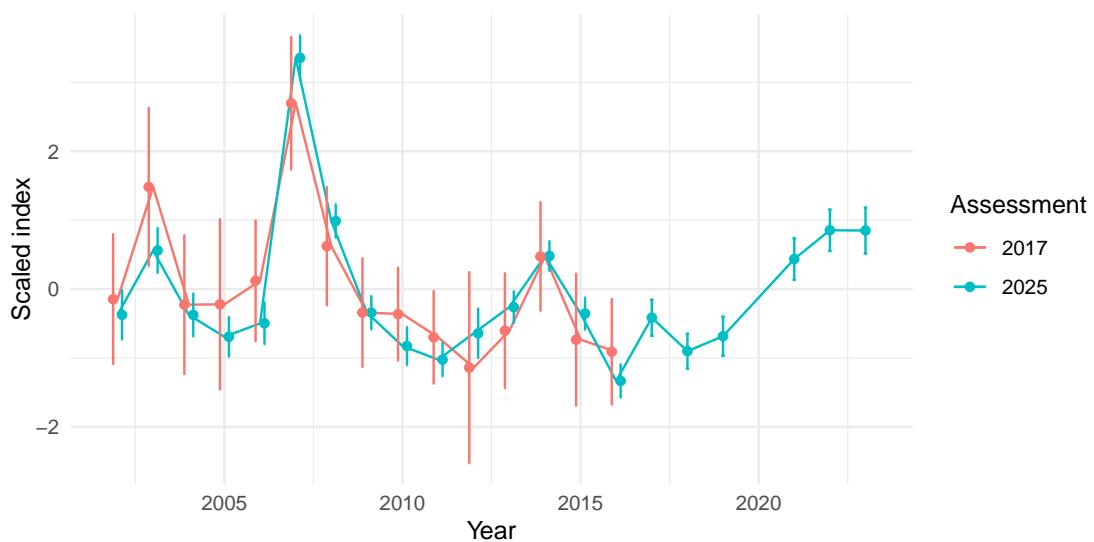


Figure 13: Comparison of the 2017 and the current IPHC index of abundance.

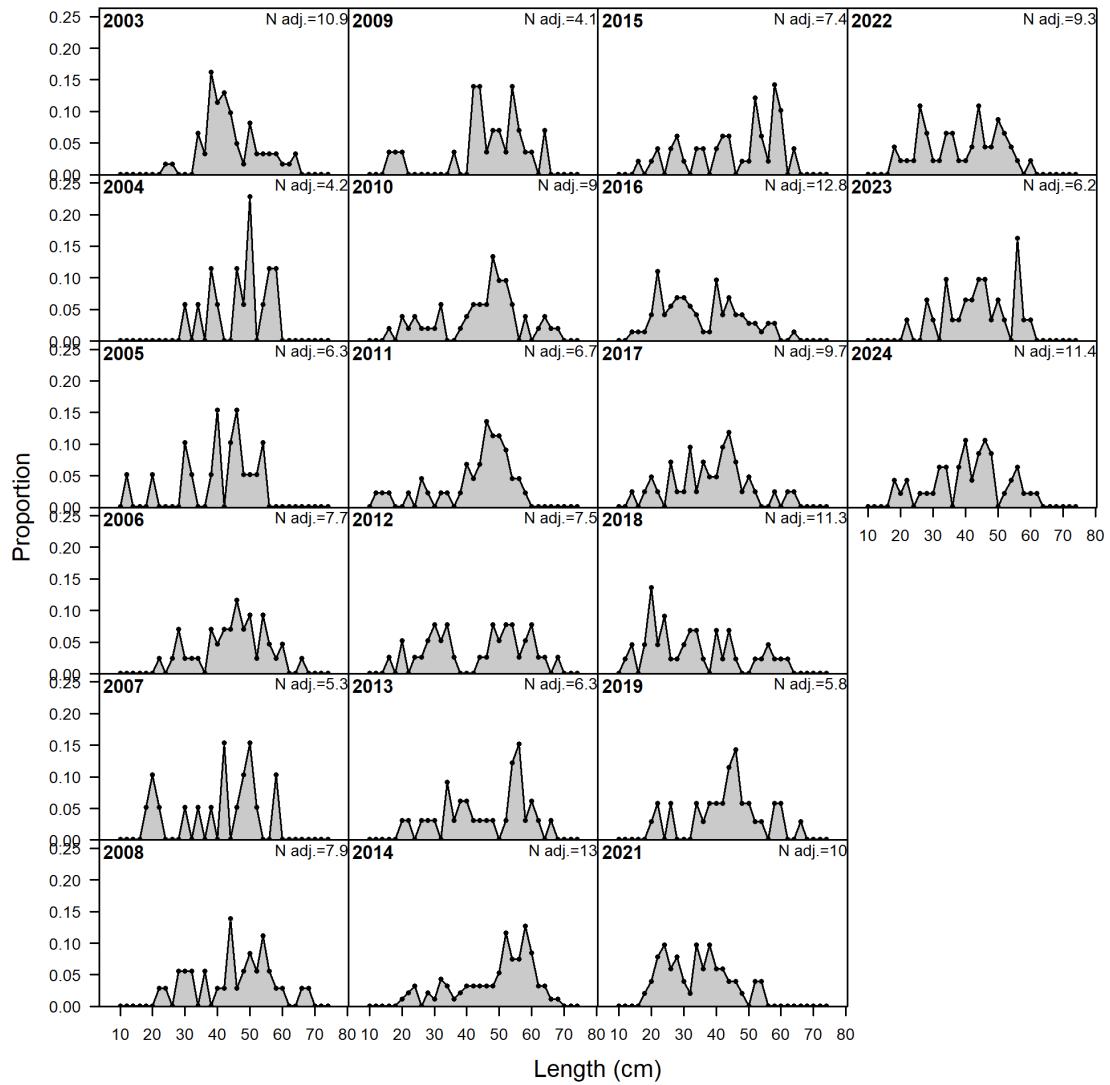


Figure 14: Annual length composition data for the WCBTS.

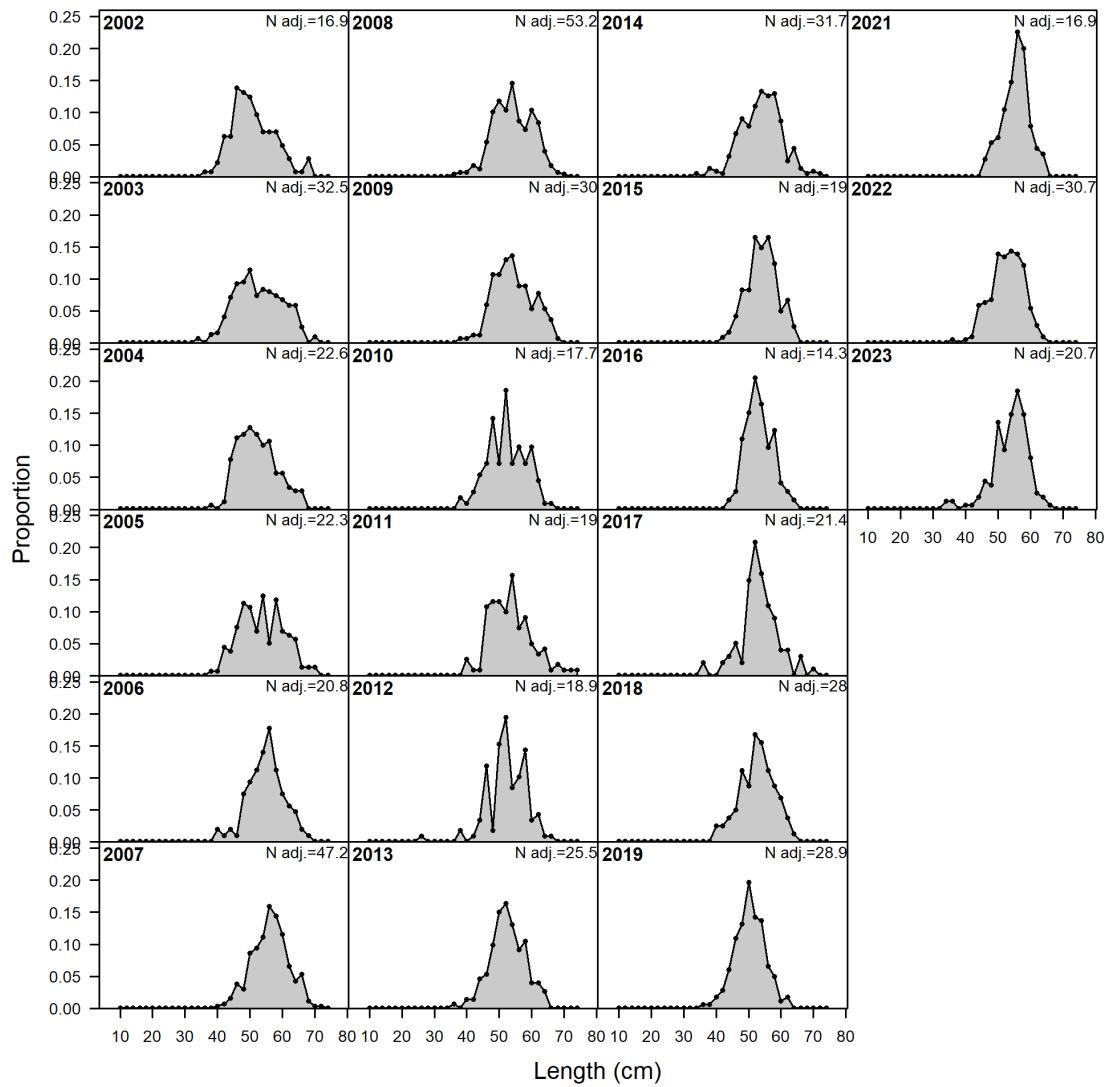


Figure 15: Annual length composition data from the IPHC longline survey.

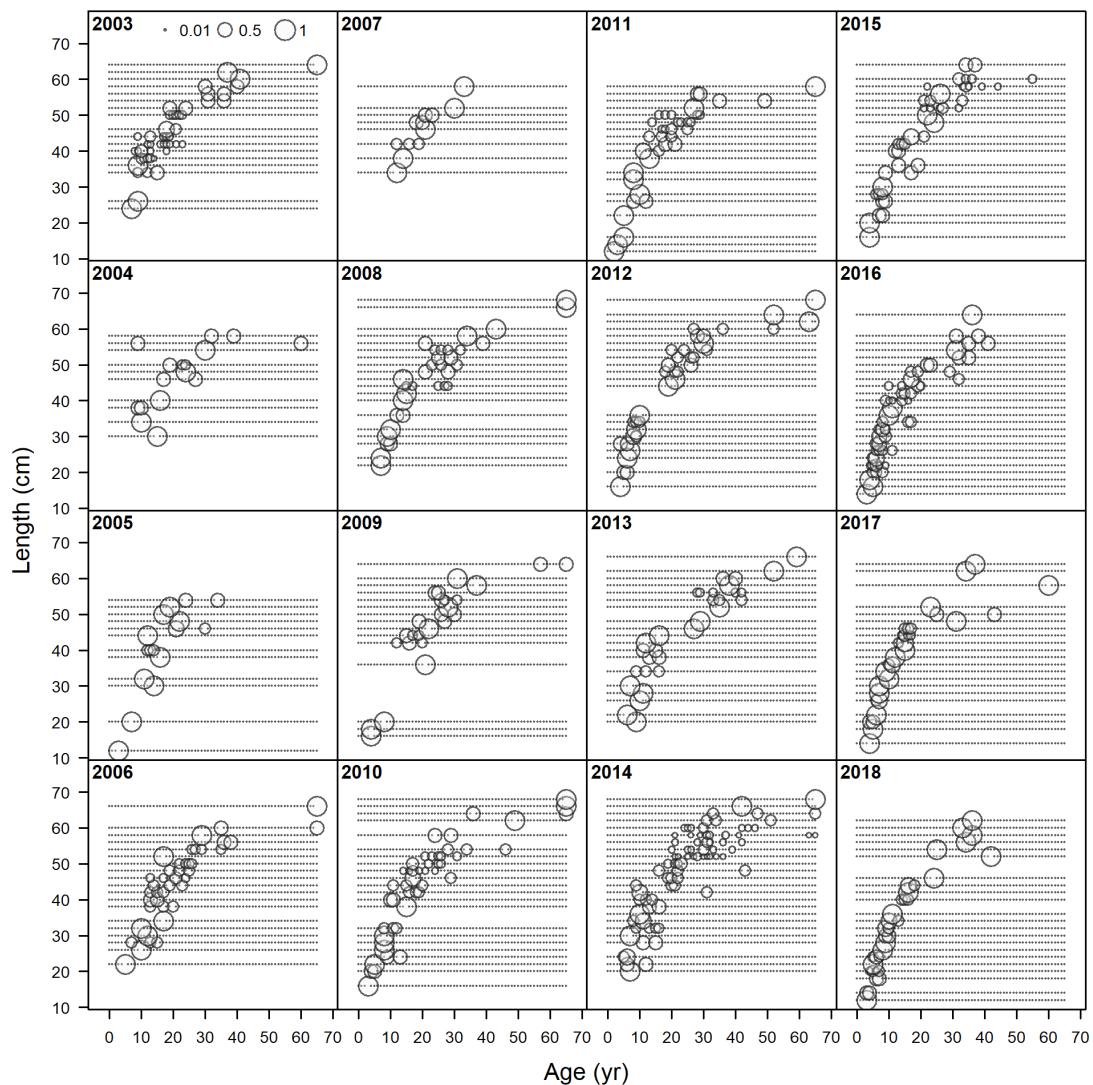


Figure 16: Annual unsexed conditional age-at-length data for the WCBTS (1 of 2).

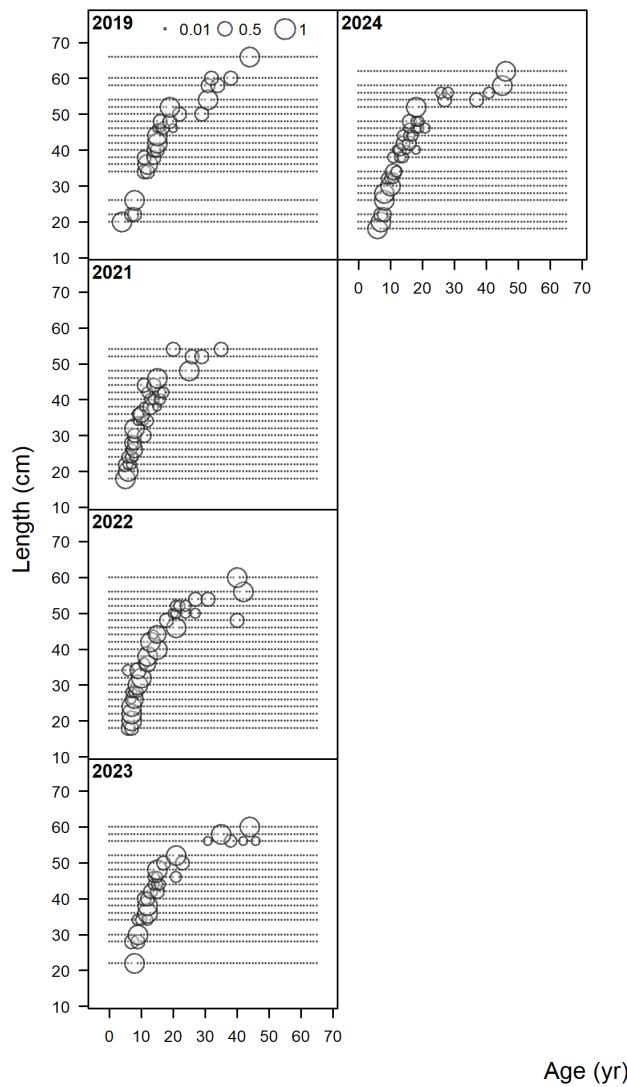


Figure 17: Annual unsexed conditional age-at-length data for the WCBTS (2 of 2).

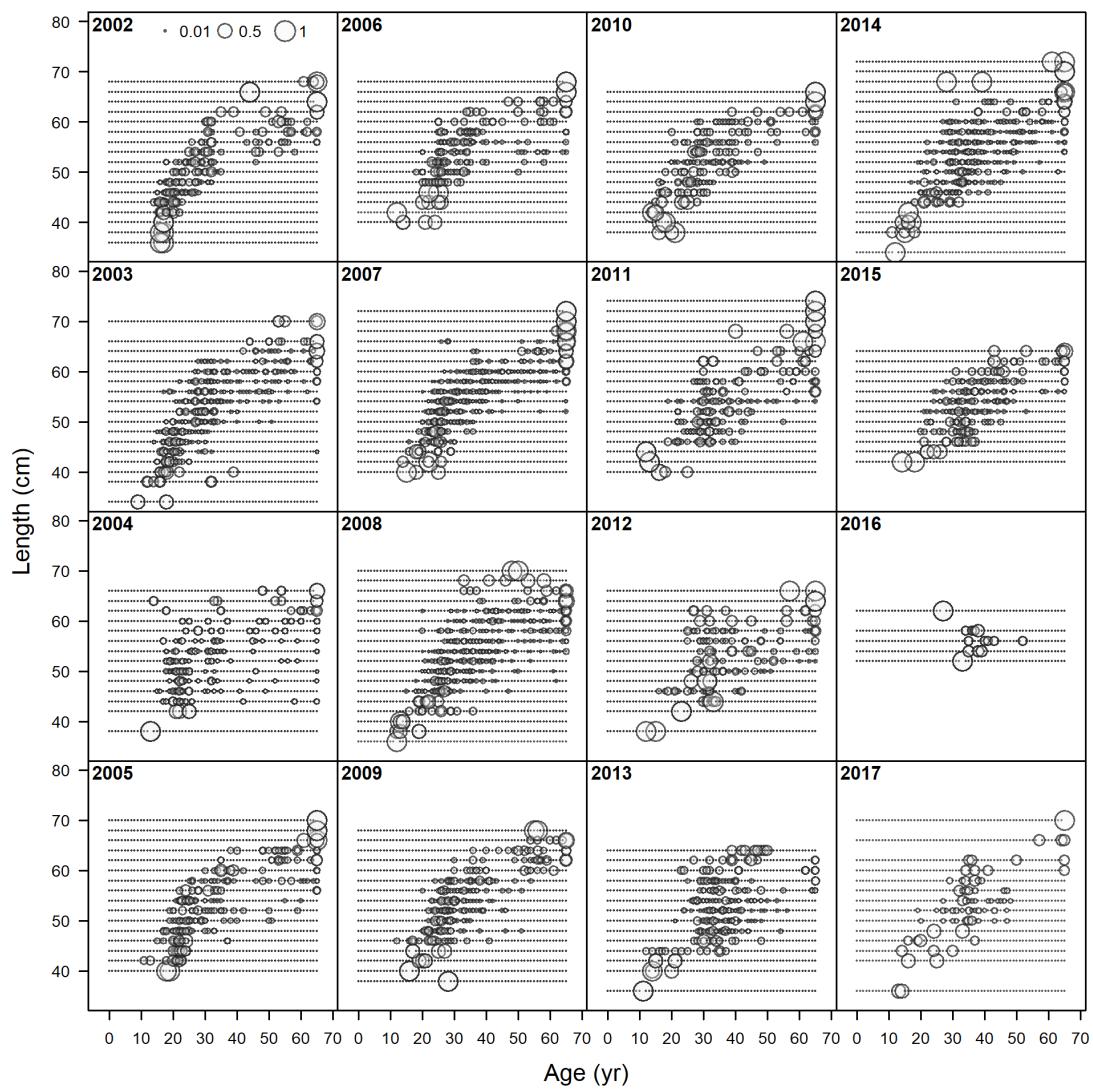


Figure 18: Annual unsexed conditional age-at-length data for the IPHC (1 of 2).

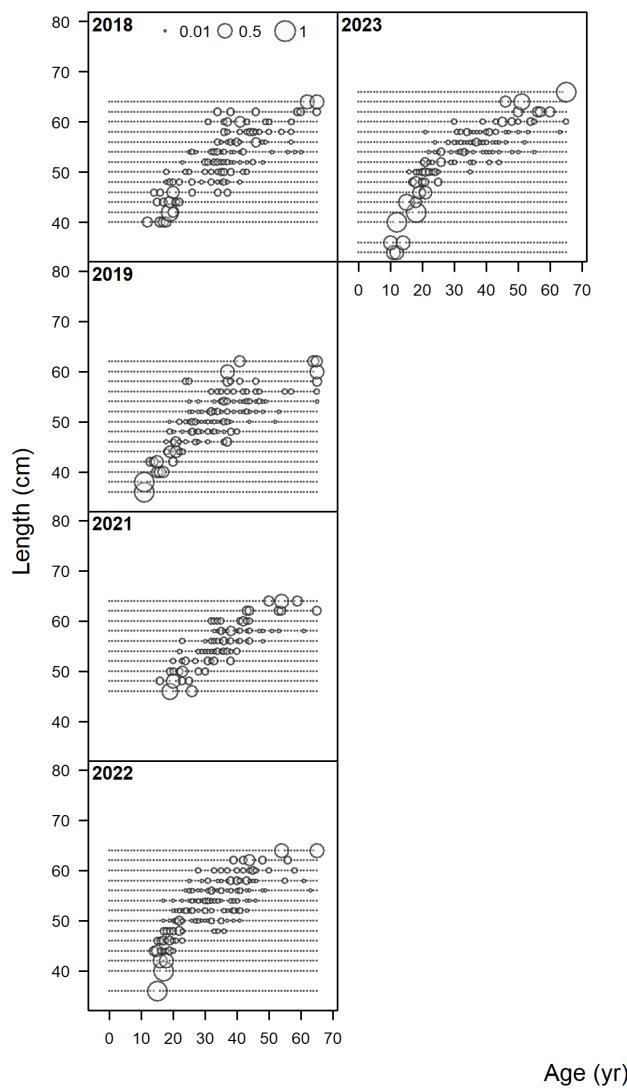


Figure 19: Annual unsexed conditional age-at-length data for the IPHC (1 of 2).

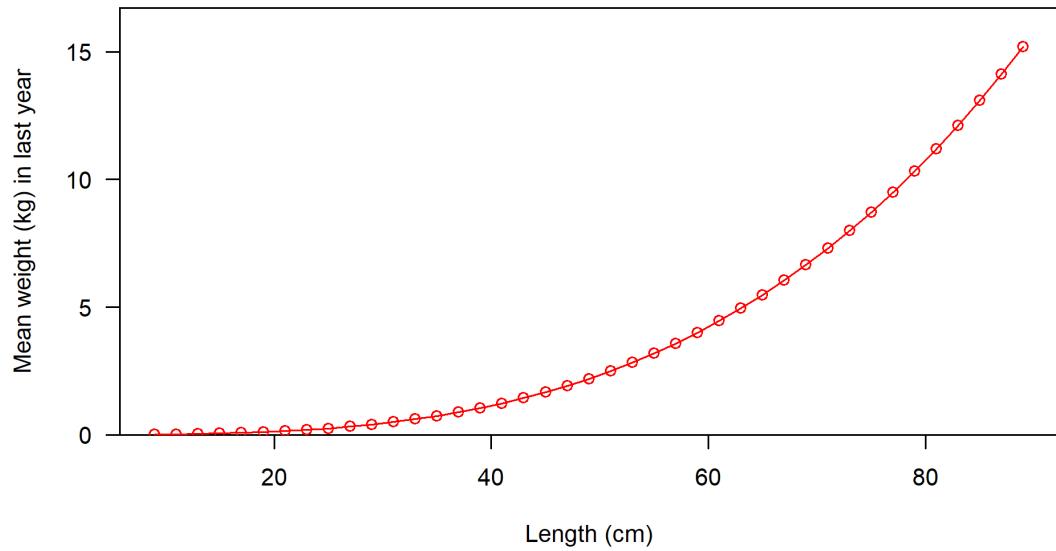


Figure 20: Updated weight-at-length relationship.

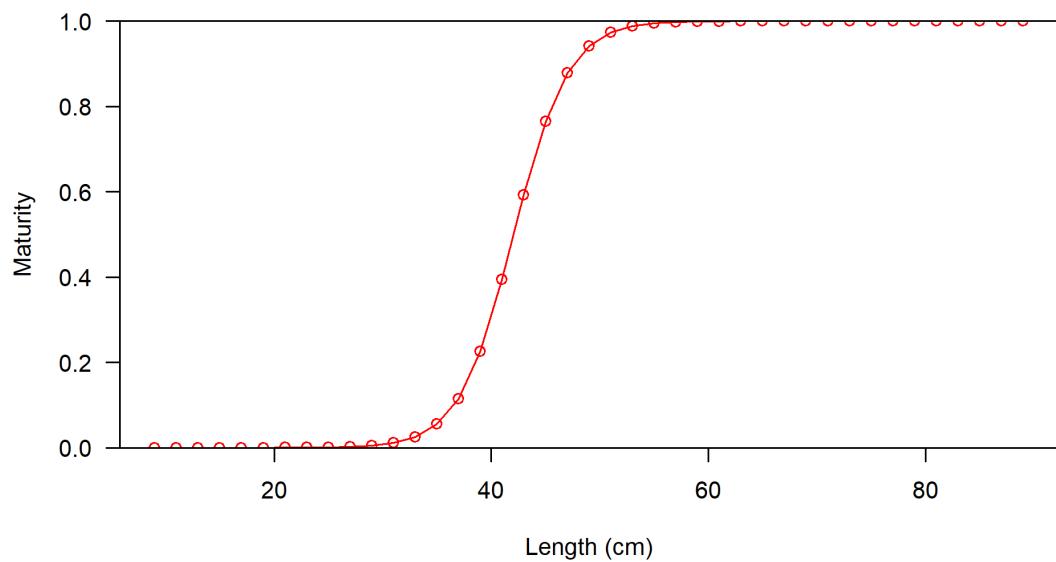


Figure 21: Maturity at length relationship used in the base model for Yelloweye Rockfish.

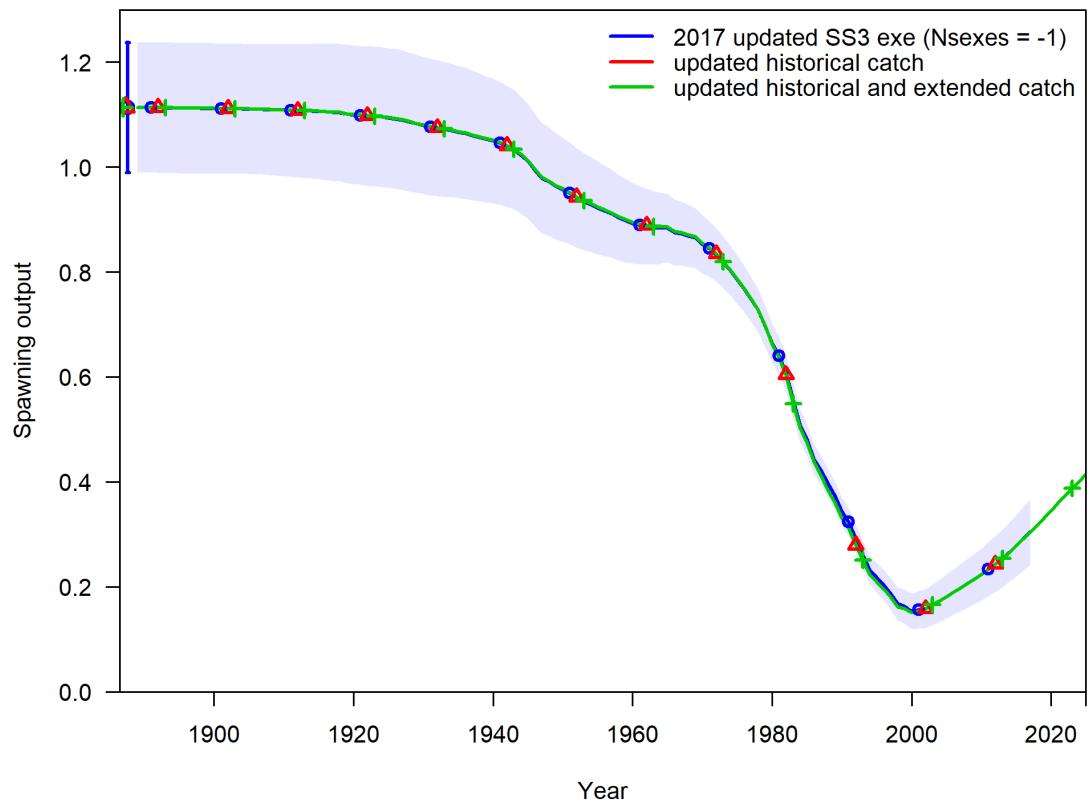


Figure 22: Comparison of the spawning output (millions of eggs) of the 2017 model with an updated SS3 executable (blue), updated historical catch data (red), and catch extened to 2024 (green).

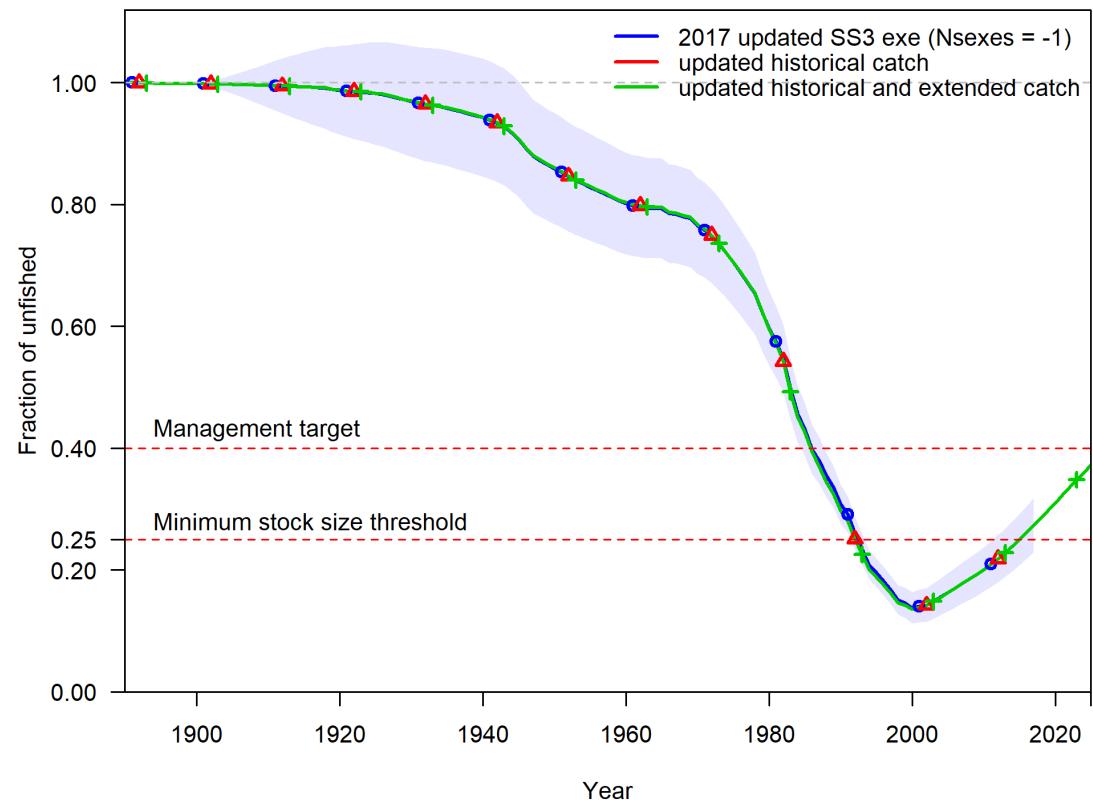


Figure 23: Comparison of the stock status of the 2017 model with an updated SS3 executable (blue), updated historical catch data (red), and catch extended to 2024 (green) relative to the management target and minimum stock size threshold.

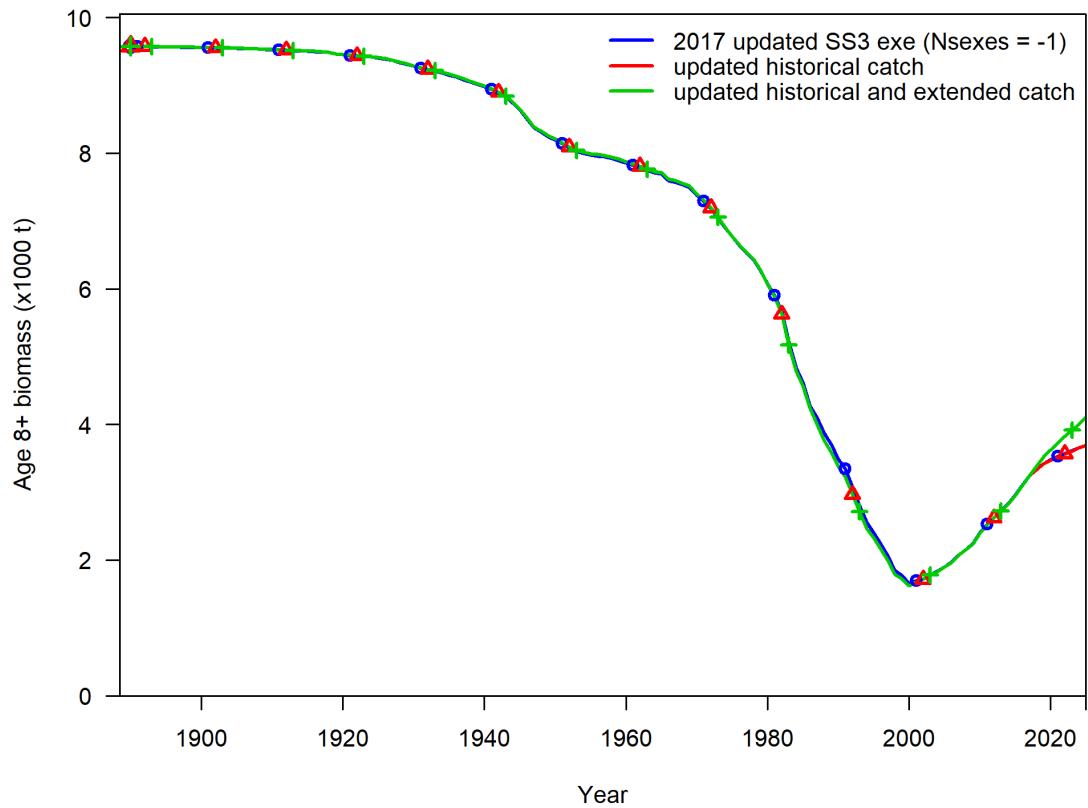


Figure 24: Comparison of adult Yelloweye Rockfish biomass of the 2017 model with an updated SS3 executable (blue), updated historical catch data (red), and catch extened to 2024 (green).

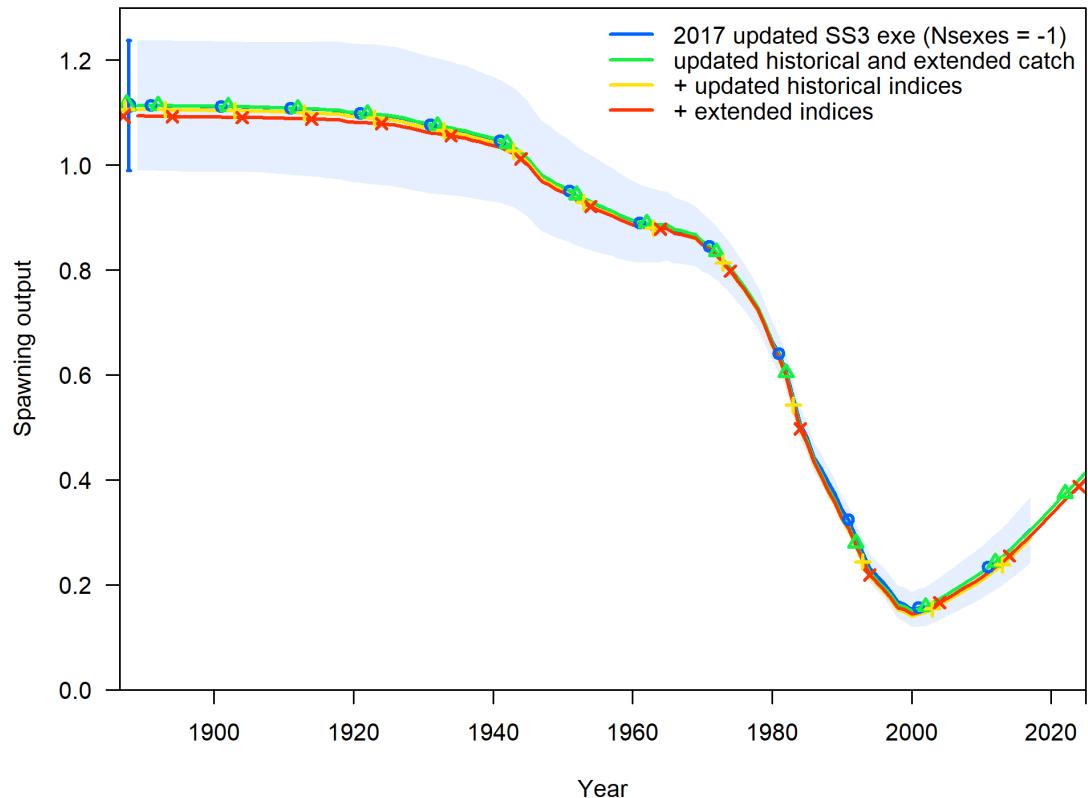


Figure 25: Comparison of the spawning output (millions of eggs) of the 2017 model with an updated SS3 executable (blue), updated and extended historical catch data (green), updated historical indices (yellow), and indices extended to 2024 (red).

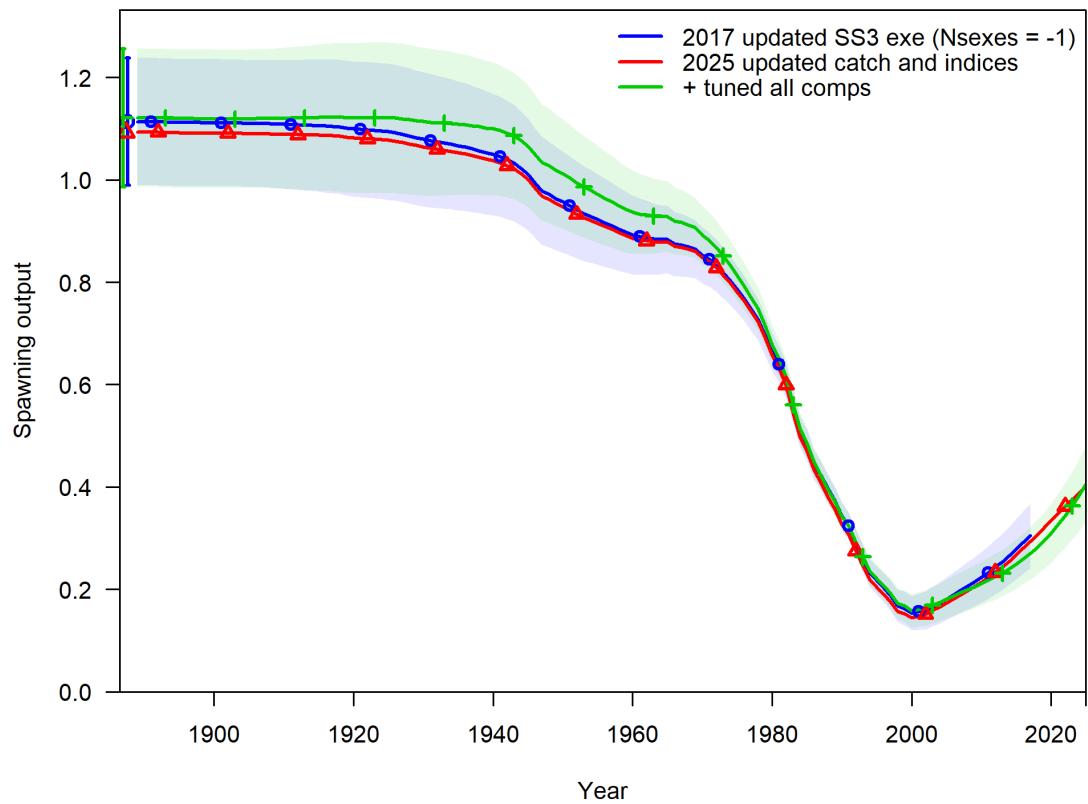


Figure 26: Comparison of the spawning output (millions of eggs) of the 2017 model with an updated SS3 executable (blue), updated and extended catch and indices (red), and all tuned length and age composition data (green).

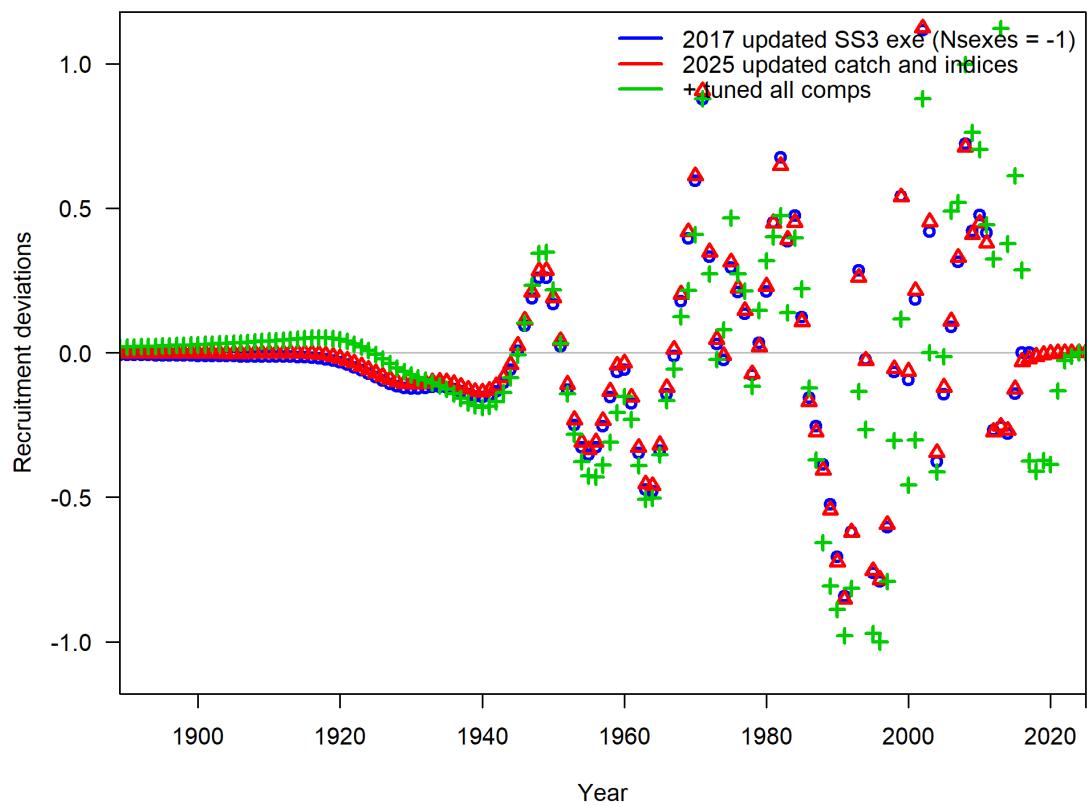


Figure 27: Recruitment deviation time-series comparing an updated SS3 executable (blue), updated and extended catch and indices (red), and all tuned length and age composition data (green).

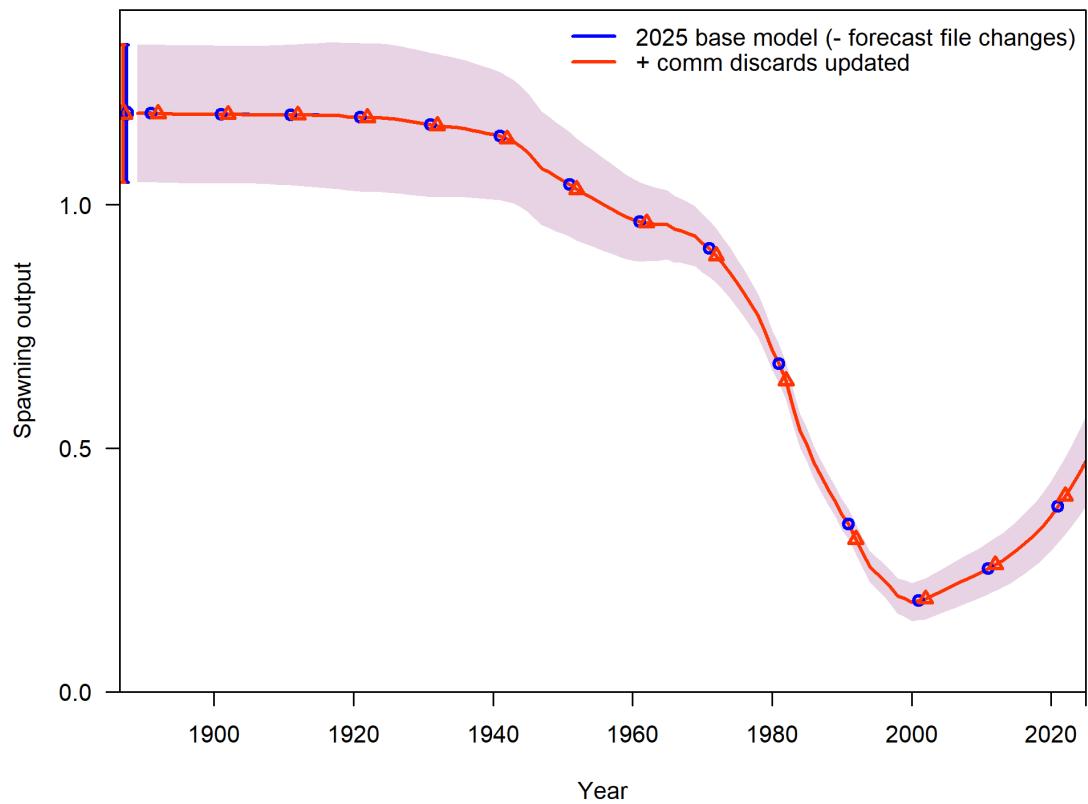


Figure 28: Comparison of the spawning output (millions of eggs) of the 2017 model with an updated SS3 executable (blue), updated and extended and tuned data (red), and the proposed 2025 base model after all final bridging steps (green).

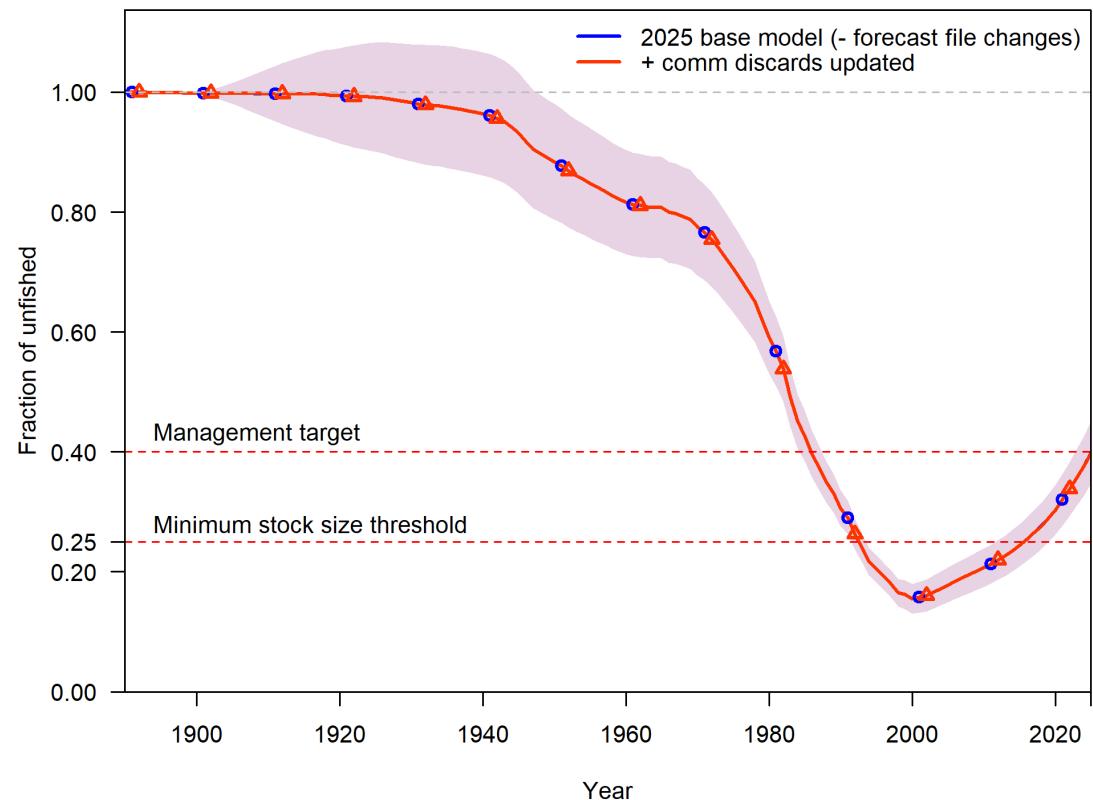


Figure 29: Comparison of the stock status output of the 2017 model with an updated SS3 executable (blue), updated and extended and tuned data (red), and the proposed 2025 base model after all final bridging steps (green) relative to the management target and minimum stock size threshold.

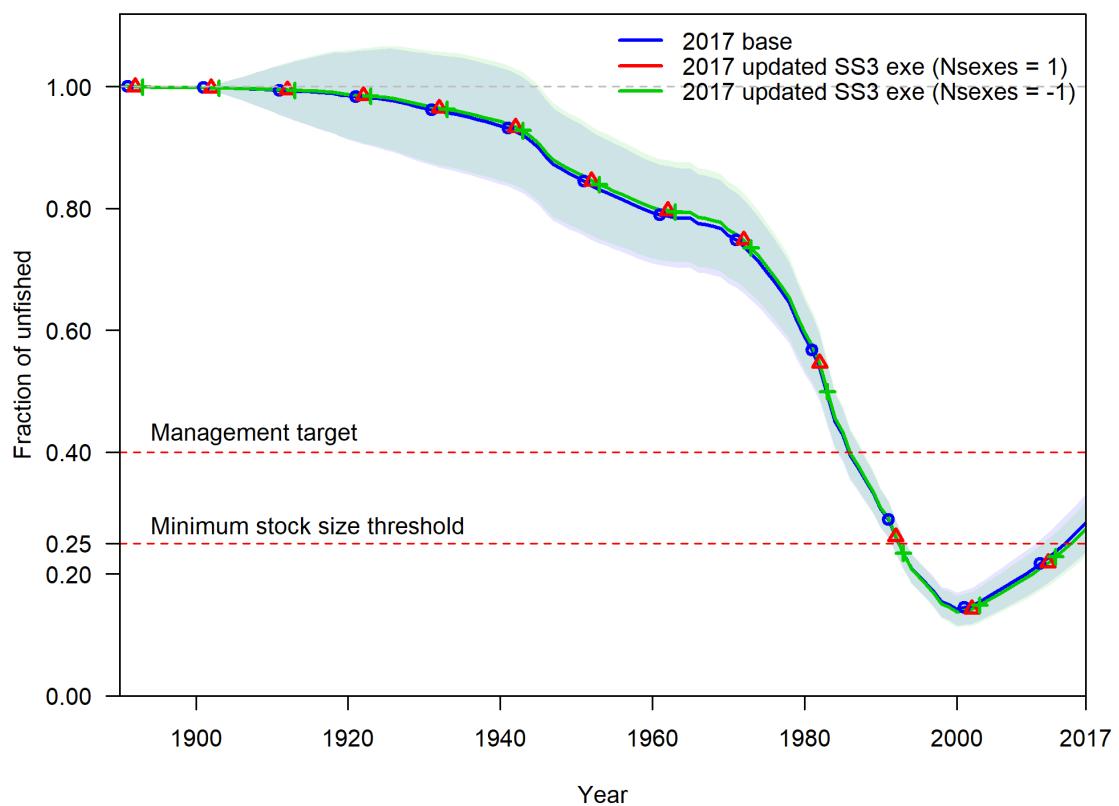


Figure 30: Comparison of the stock status for the 2017 model with the updated SS3 executable and a single-sex model.

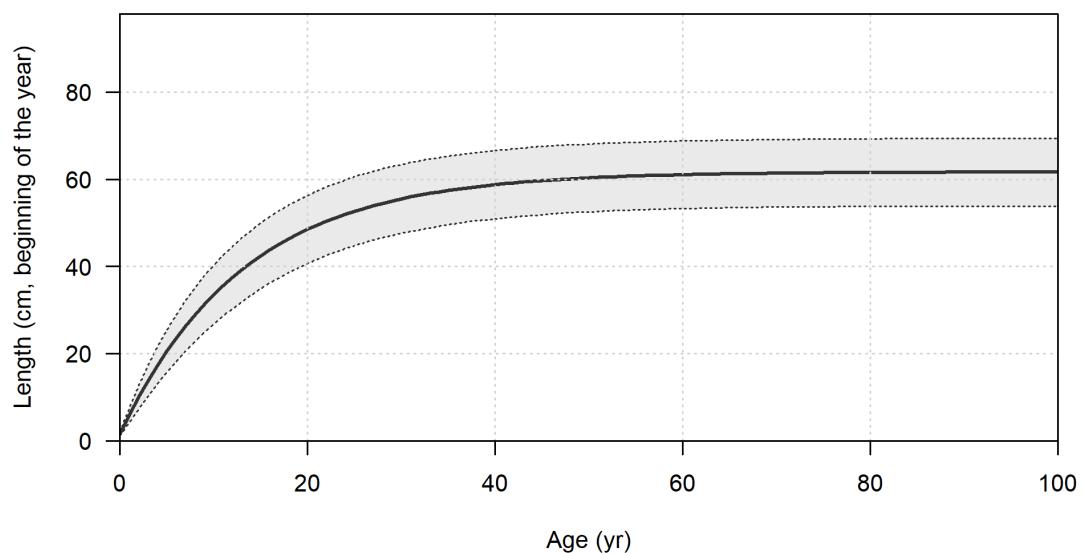


Figure 31: Length at age in the beginning of the year in the ending year of the model.

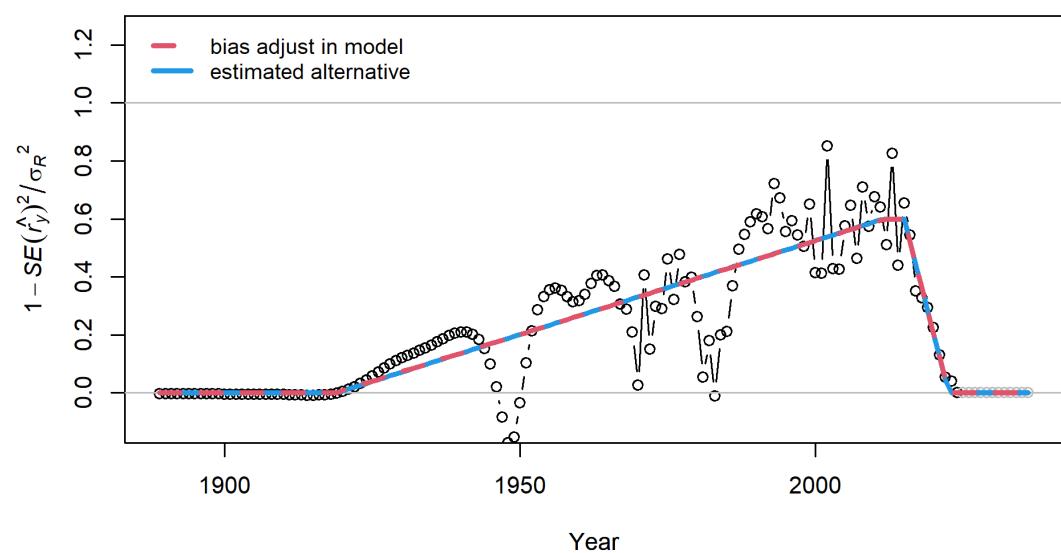


Figure 32: Points are transformed variances. Red line shows current settings for bias adjustment specified in the control file. Blue line shows least squares estimate of alternative bias adjustment relationship for recruitment deviations.

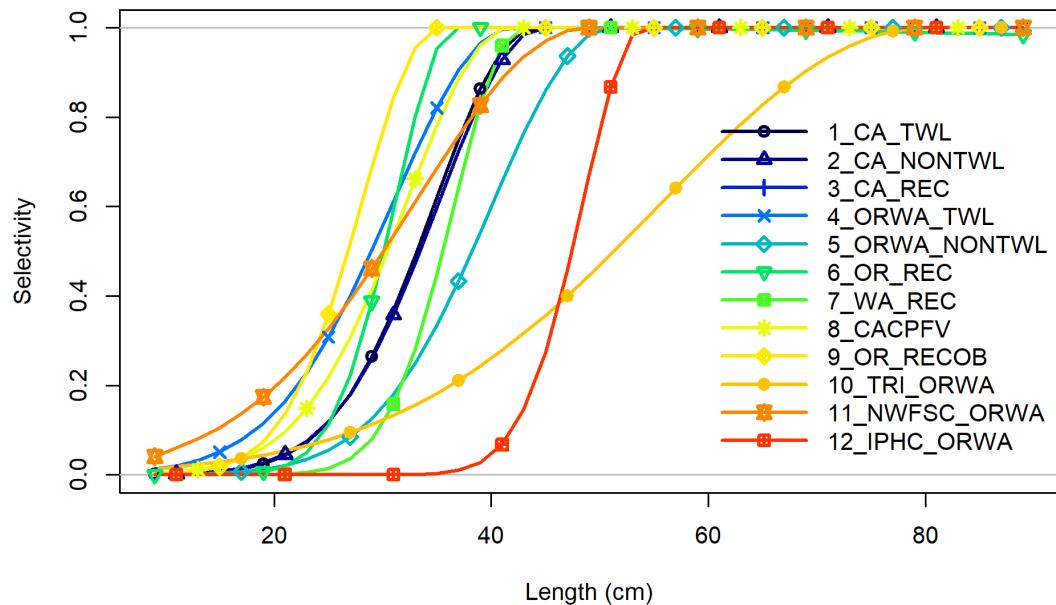


Figure 33: Estimated selectivity at length for all fleets.

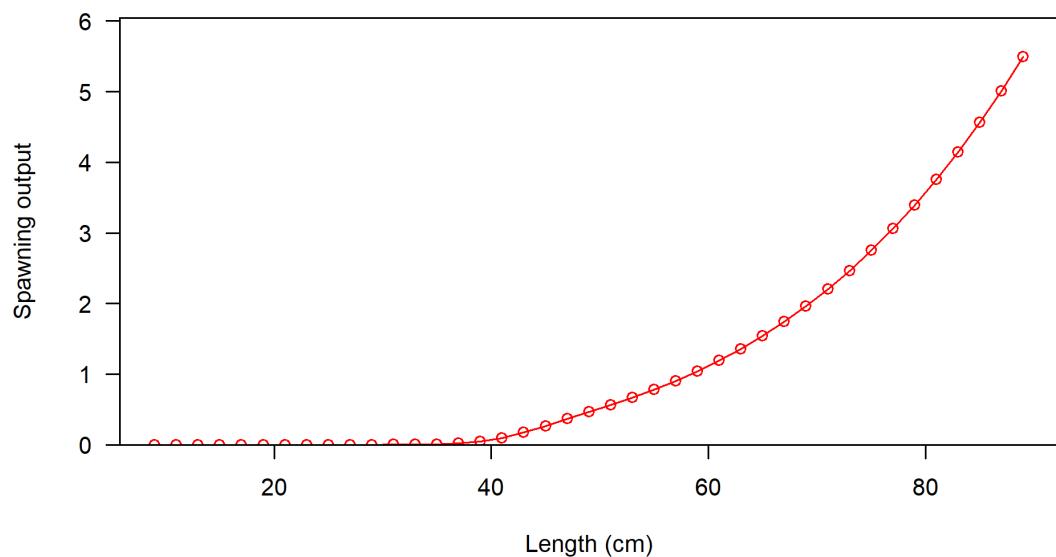


Figure 34: Spawning output (millions of eggs) at length.

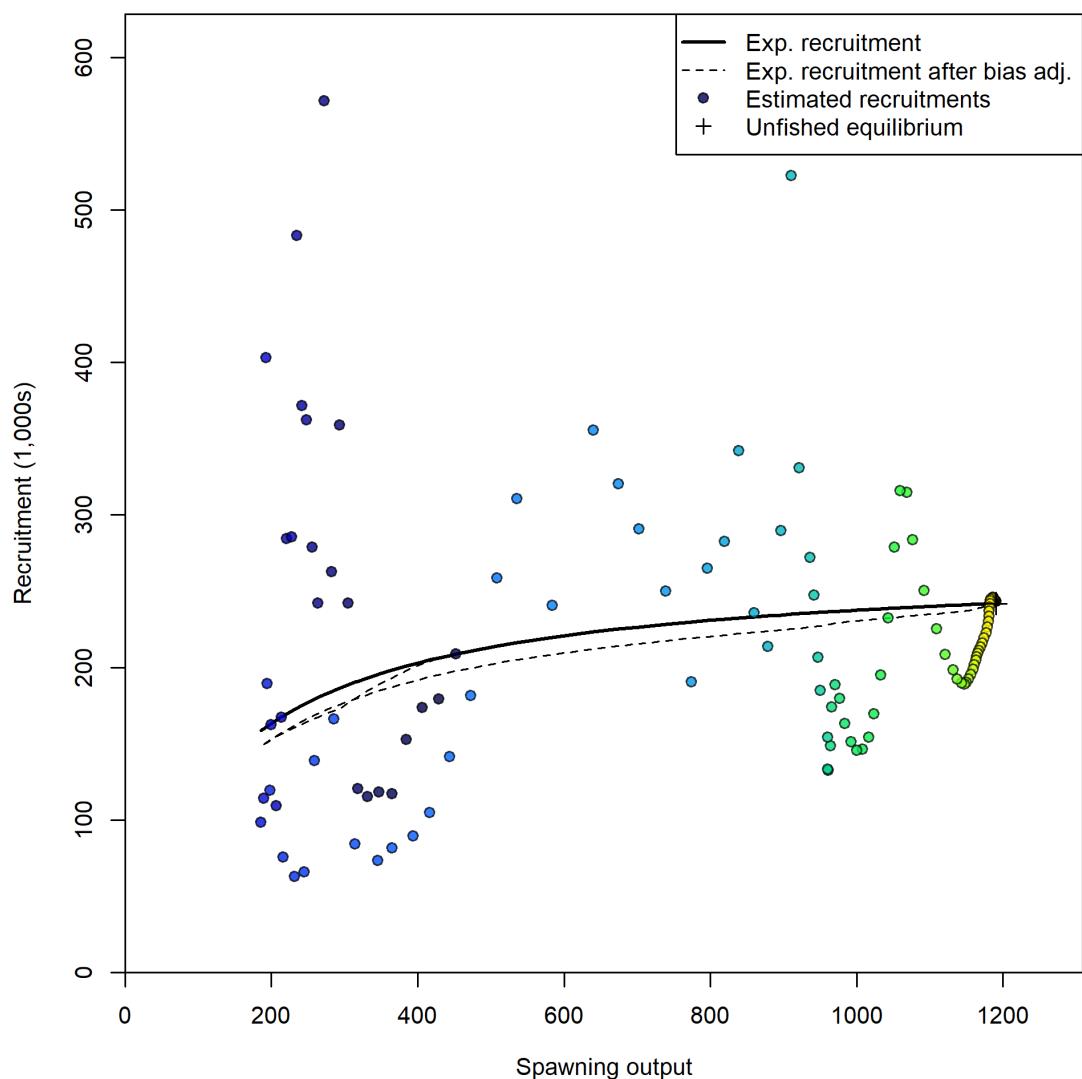


Figure 35: Stock-recruit curve. Point colors indicate year, with warmer colors indicating earlier years and cooler colors in showing later years.

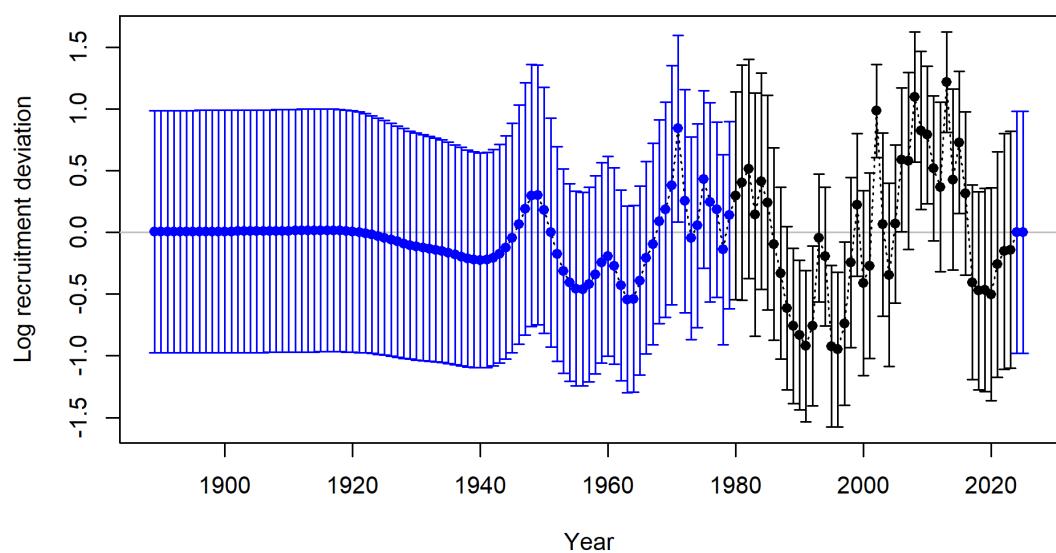


Figure 36: Estimated recruitment deviations with 95% intervals.

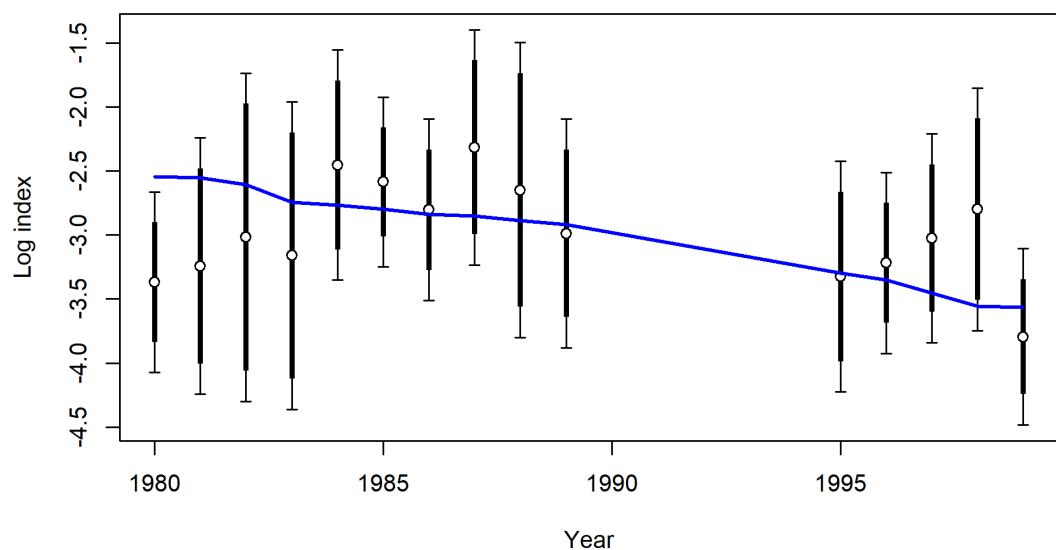


Figure 37: Fit to the California MRFSS recreational index.

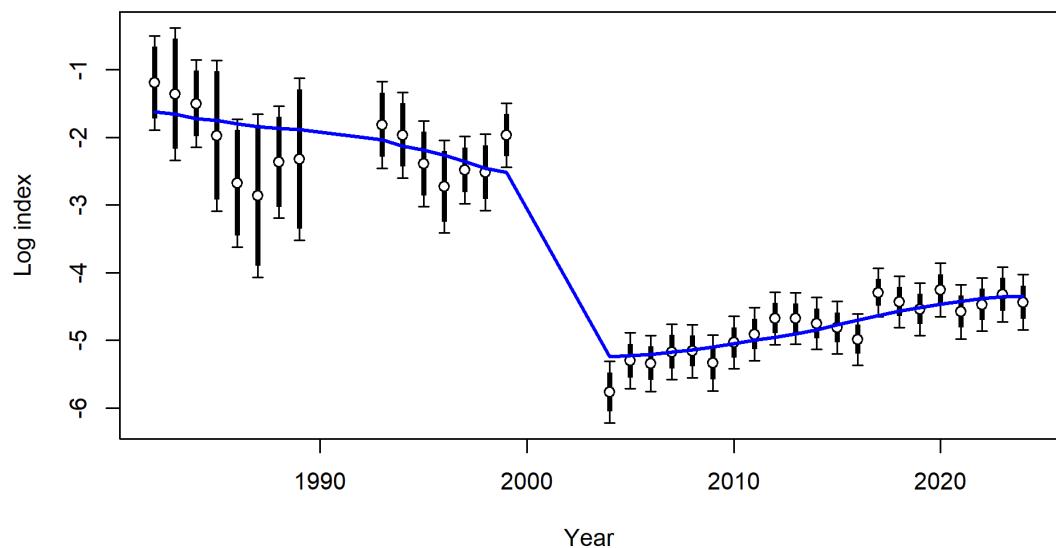


Figure 38: Fit to the Oregon recreational index.

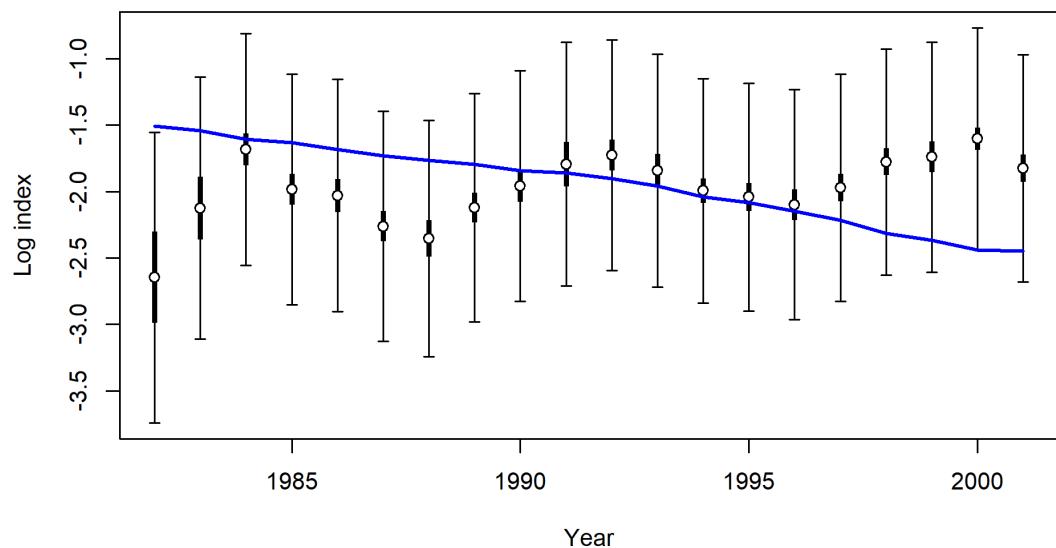


Figure 39: Fit to the Washington recreational index.

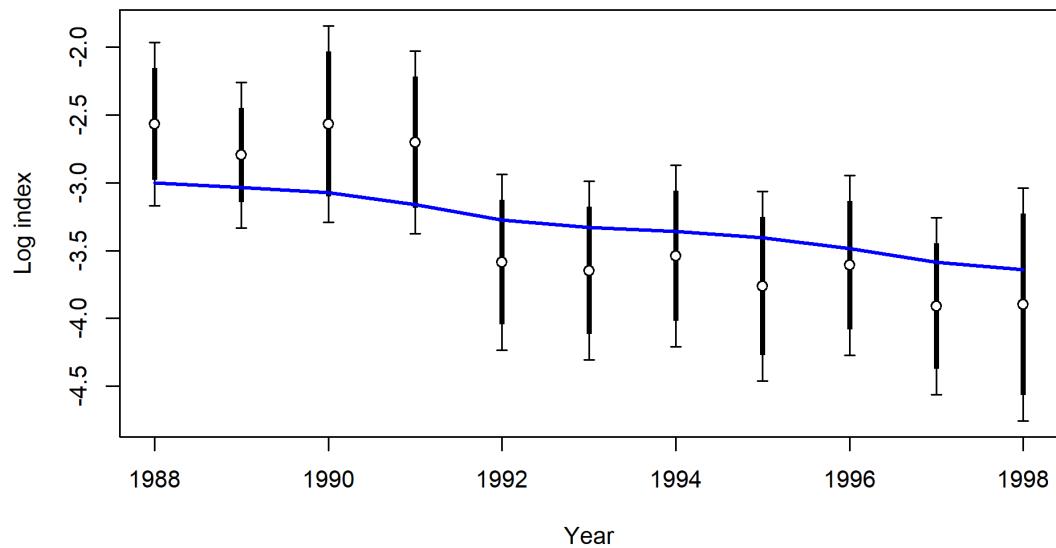


Figure 40: Fit to the California CPFV observer index.

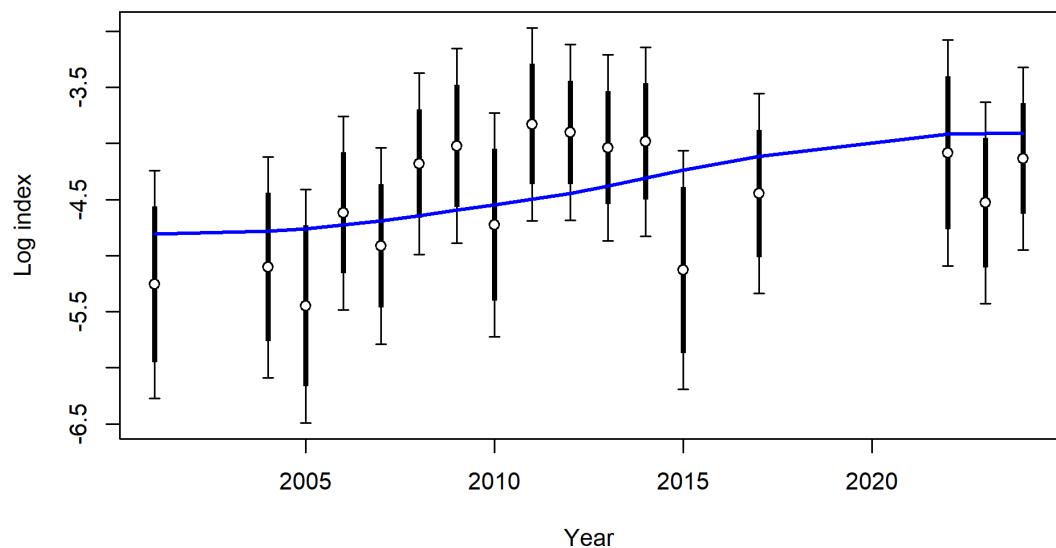


Figure 41: Fit to the Oregon onboard observer (ORFS) index.

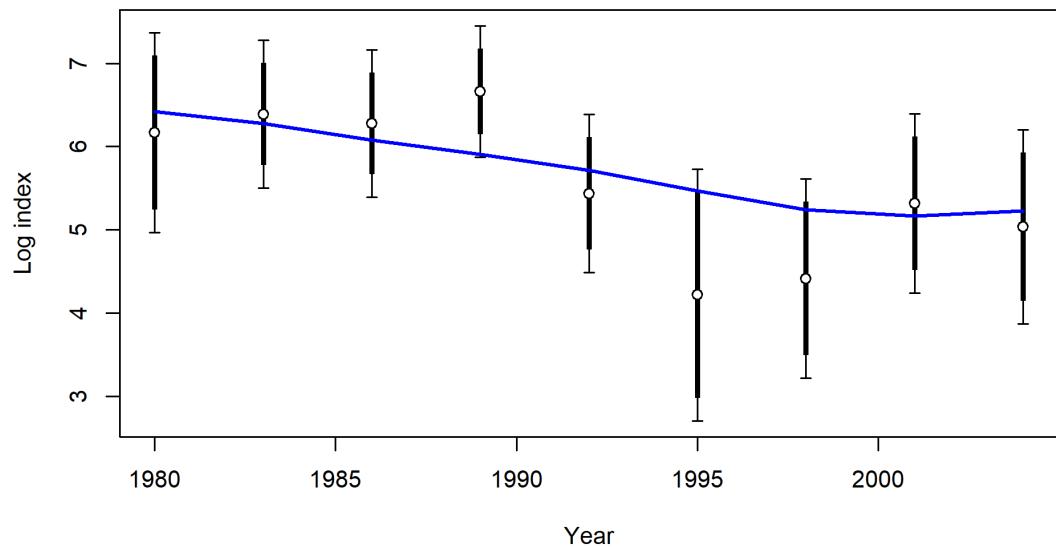


Figure 42: Fit to the Triennial survey index.

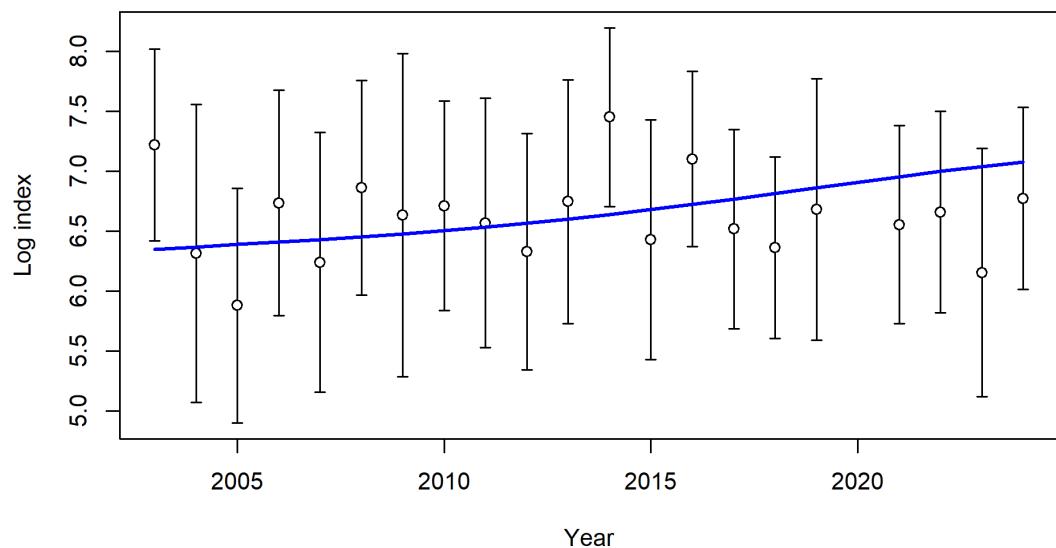


Figure 43: Fit to the WCBTS index.

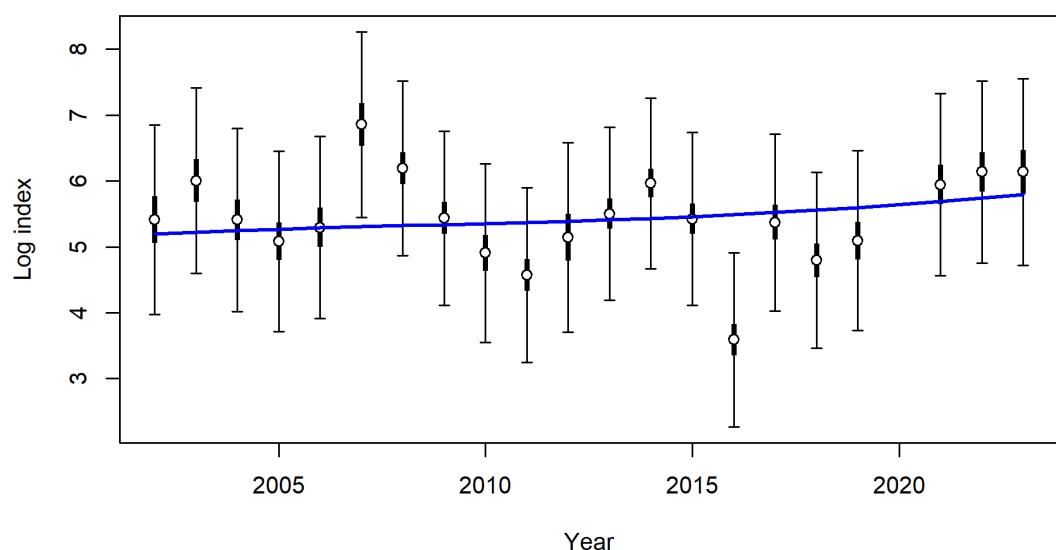


Figure 44: Fit to the IPHC survey index.

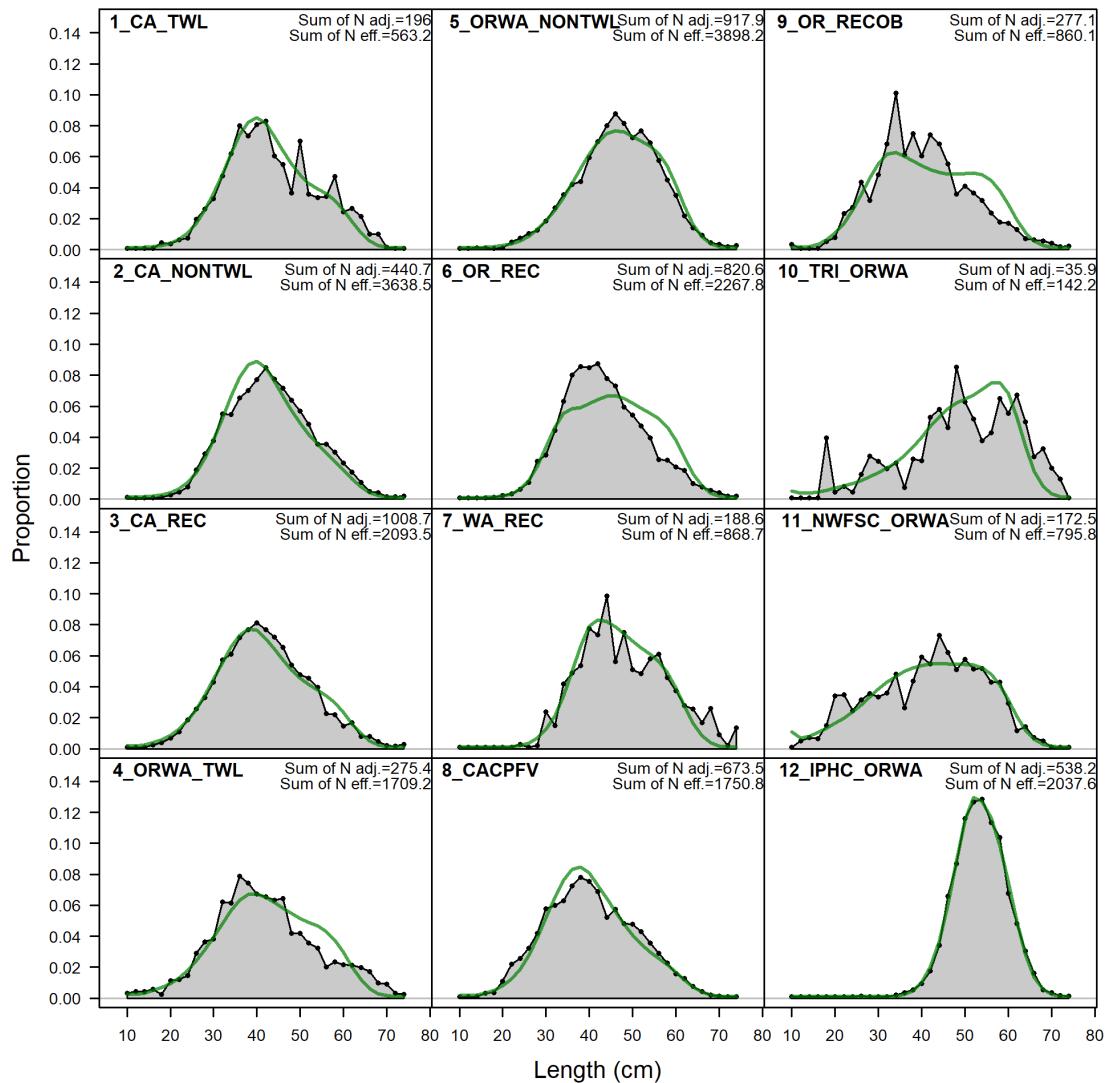


Figure 45: Fit to length composition data, aggregated across time by fleet.

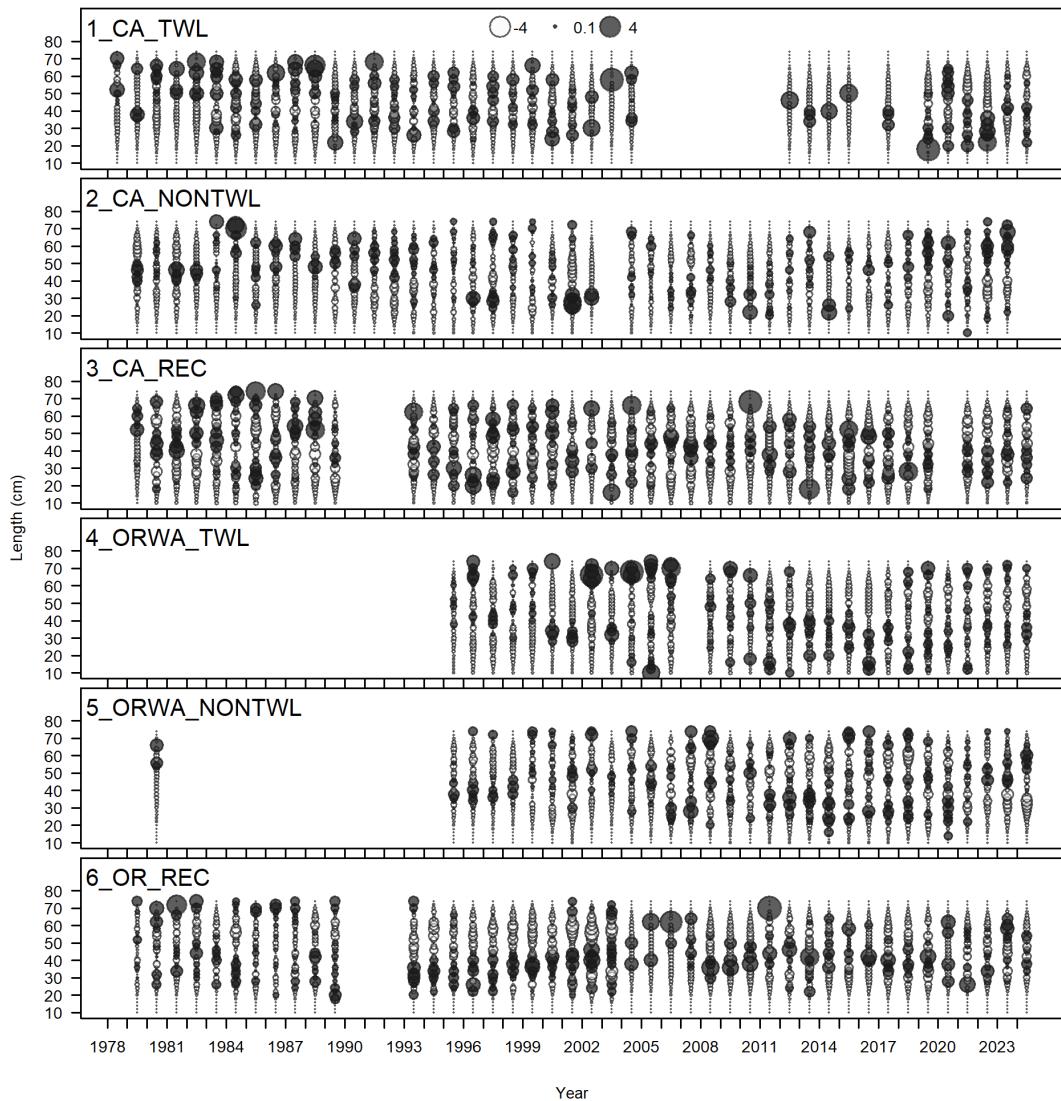


Figure 46: Pearson residuals, comparing across fleets, for length composition data (1 of 2). Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected).

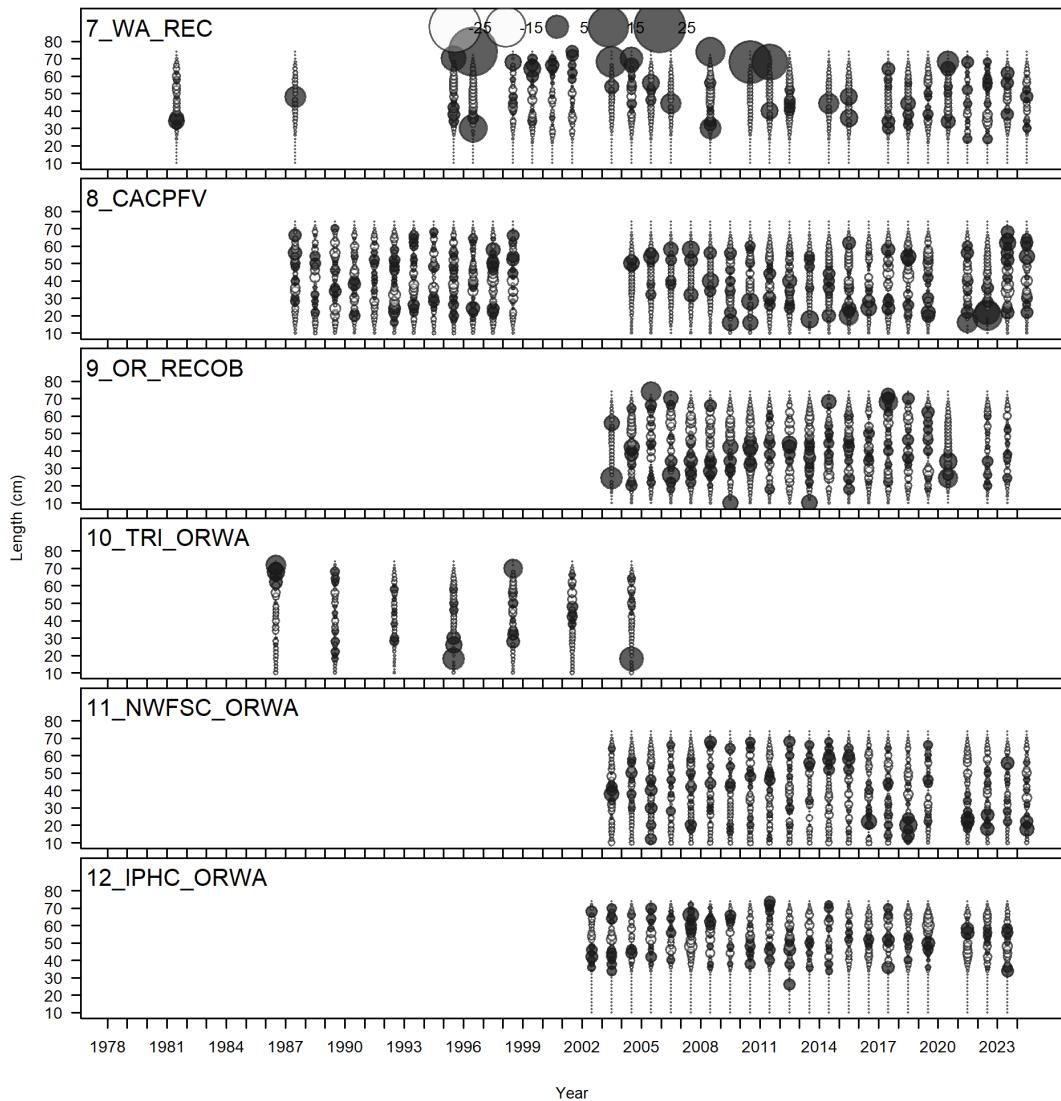


Figure 47: Pearson residuals, comparing across fleets, for length composition data (2 of 2). Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected).

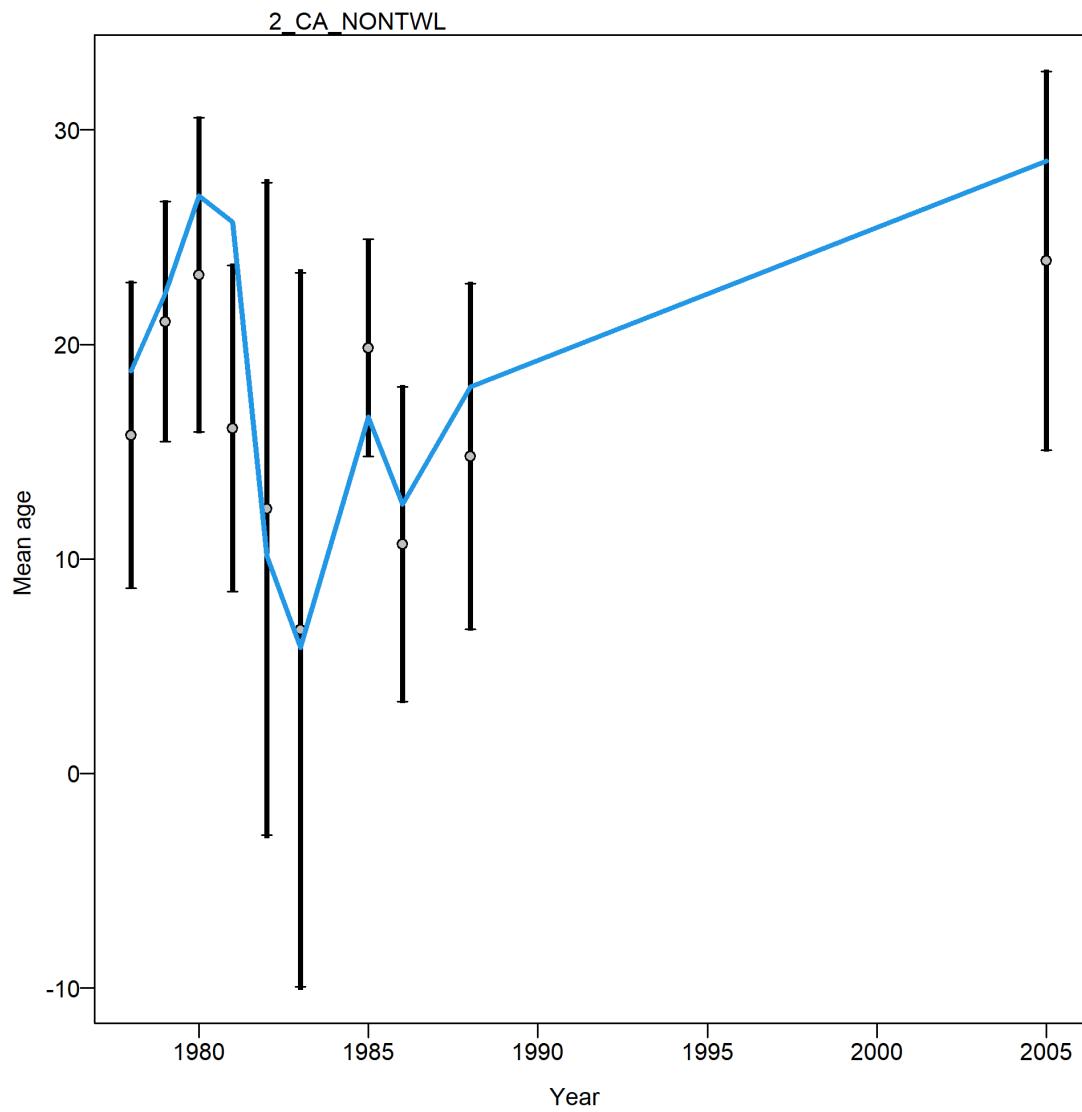


Figure 48: Mean age from conditional data (aggregated across length bins) for the CA NONTWL fleet with 95% confidence intervals based on input sample sizes. The blue line is the model expectation.

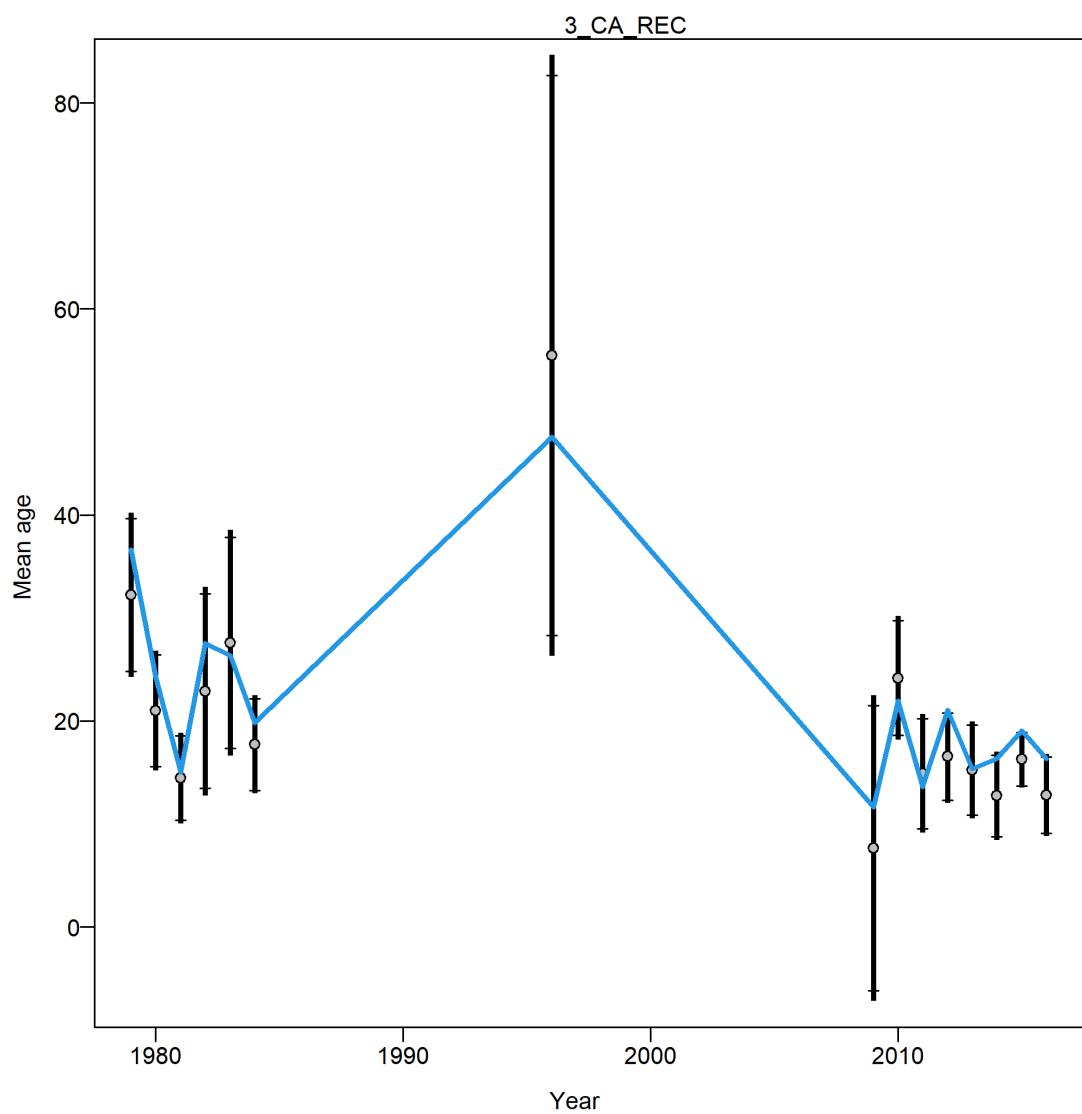


Figure 49: Mean age from conditional data (aggregated across length bins) for the CA REC fleet with 95% confidence intervals based on input sample sizes. The blue line is the model expectation.

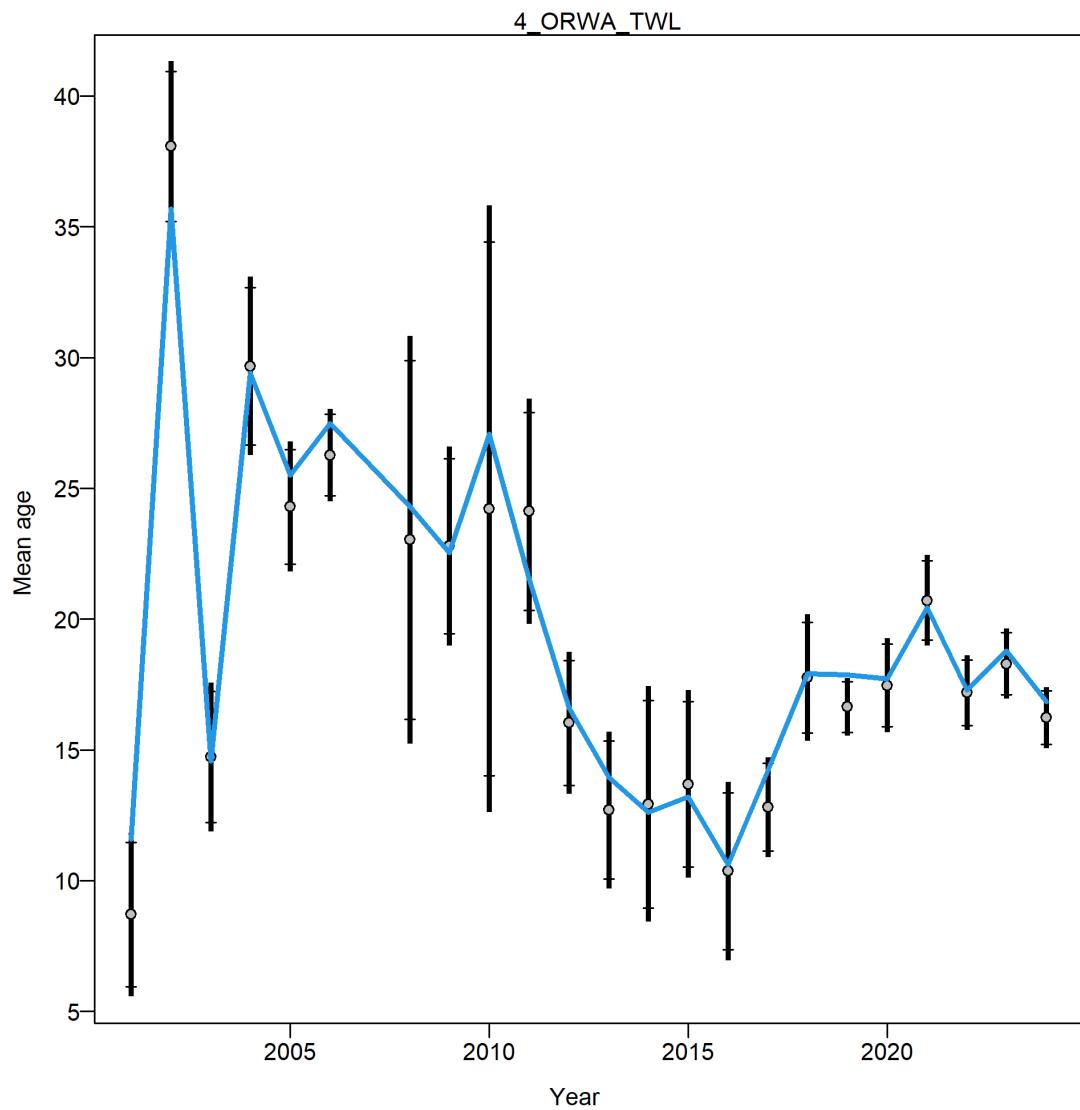


Figure 50: Mean age from conditional data (aggregated across length bins) for the ORWA TWL fleet with 95% confidence intervals based on input sample sizes. The blue line is the model expectation.

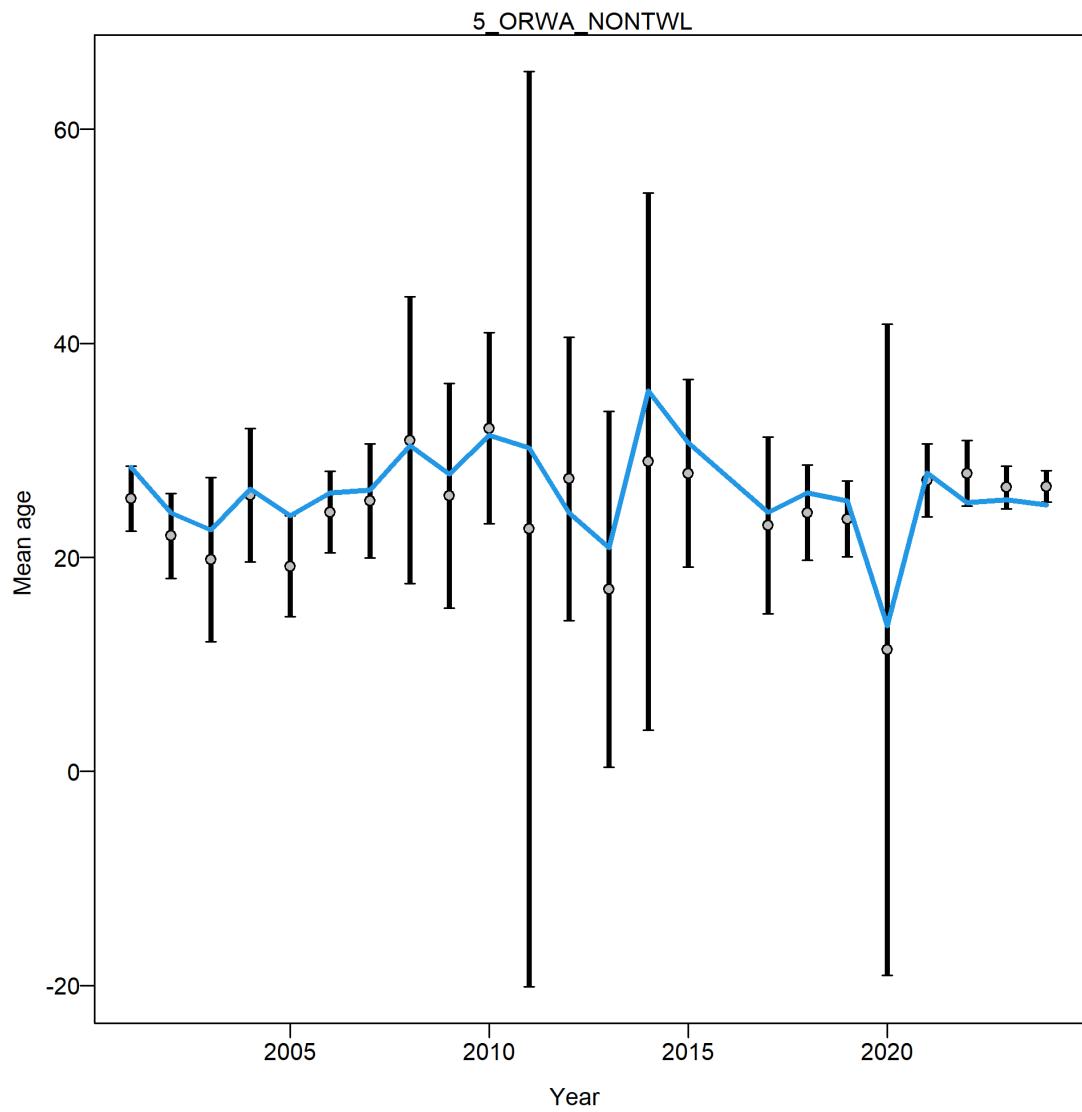


Figure 51: Mean age from conditional data (aggregated across length bins) for the ORWA NONTWL fleet with 95% confidence intervals based on input sample sizes. The blue line is the model expectation.

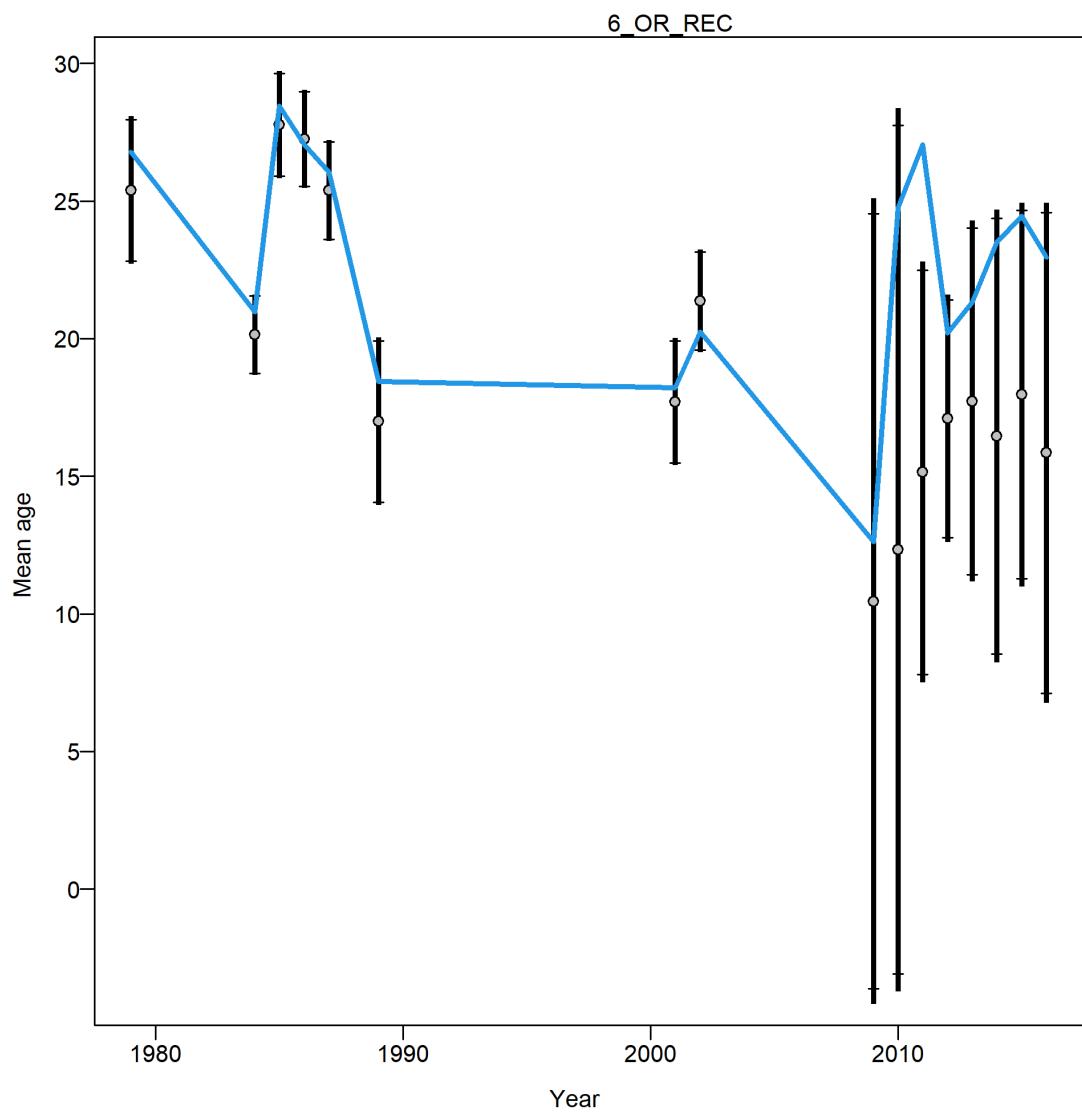


Figure 52: Mean age from conditional data (aggregated across length bins) for the ORWA REC fleet with 95% confidence intervals based on input sample sizes. The blue line is the model expectation.

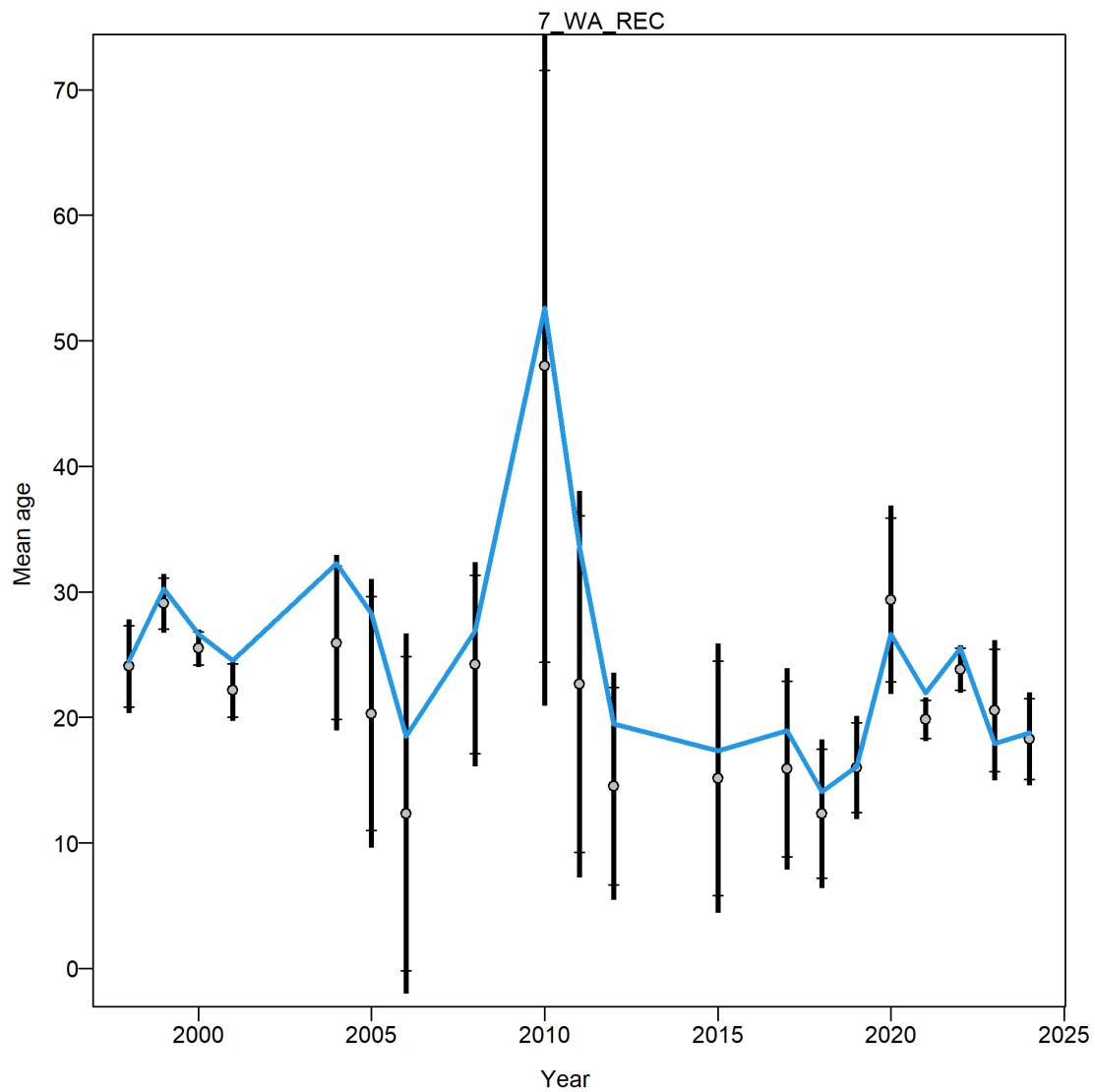


Figure 53: Mean age from conditional data (aggregated across length bins) for the WA REC fleet with 95% confidence intervals based on input sample sizes. The blue line is the model expectation.

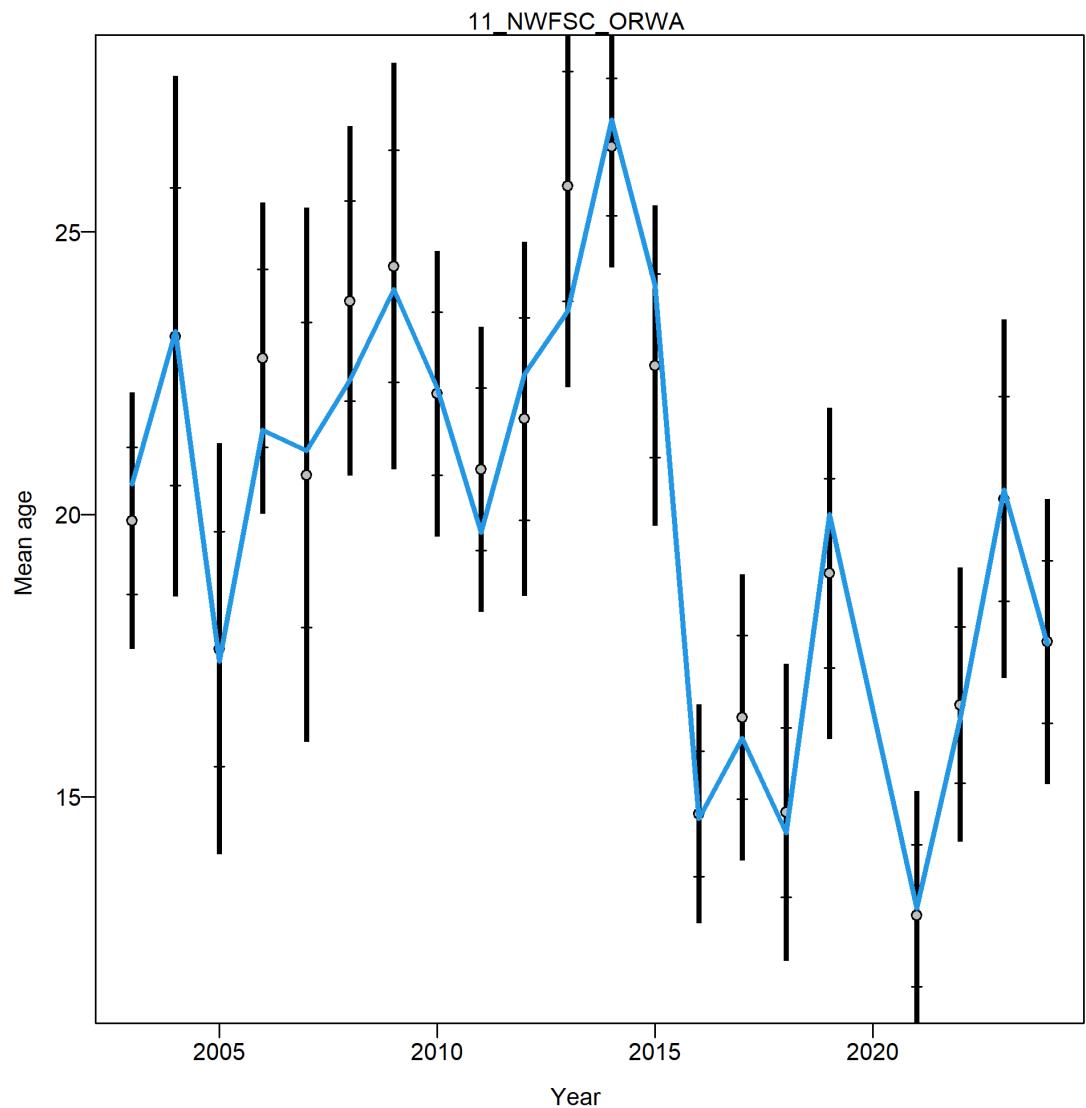


Figure 54: Mean age from conditional data (aggregated across length bins) for the WCGBTS with 95% confidence intervals based on input sample sizes. The blue line is the model expectation.

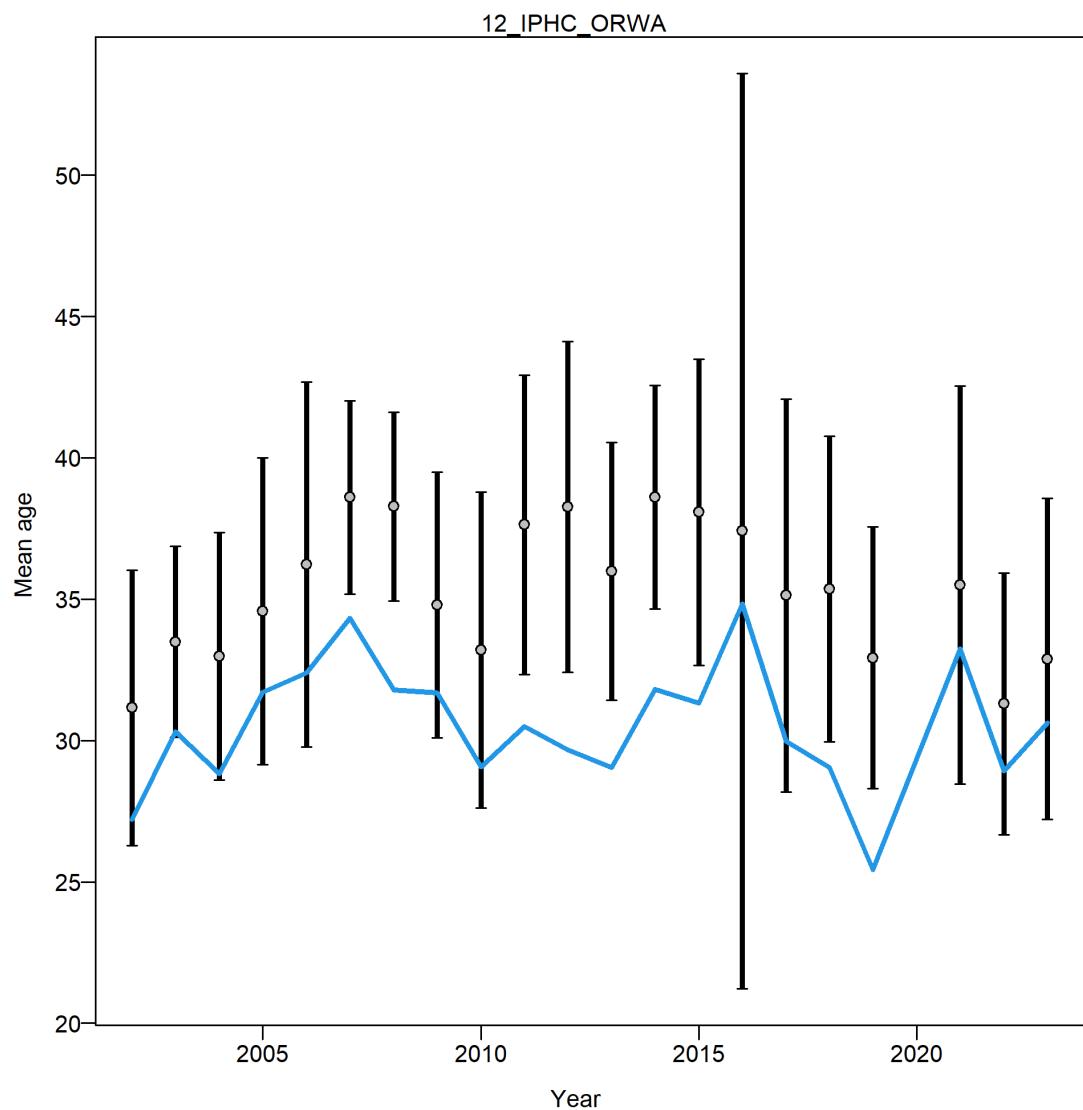


Figure 55: Mean age from conditional data (aggregated across length bins) for the IPHC survey with 95% confidence intervals based on input sample sizes. The blue line is the model expectation.

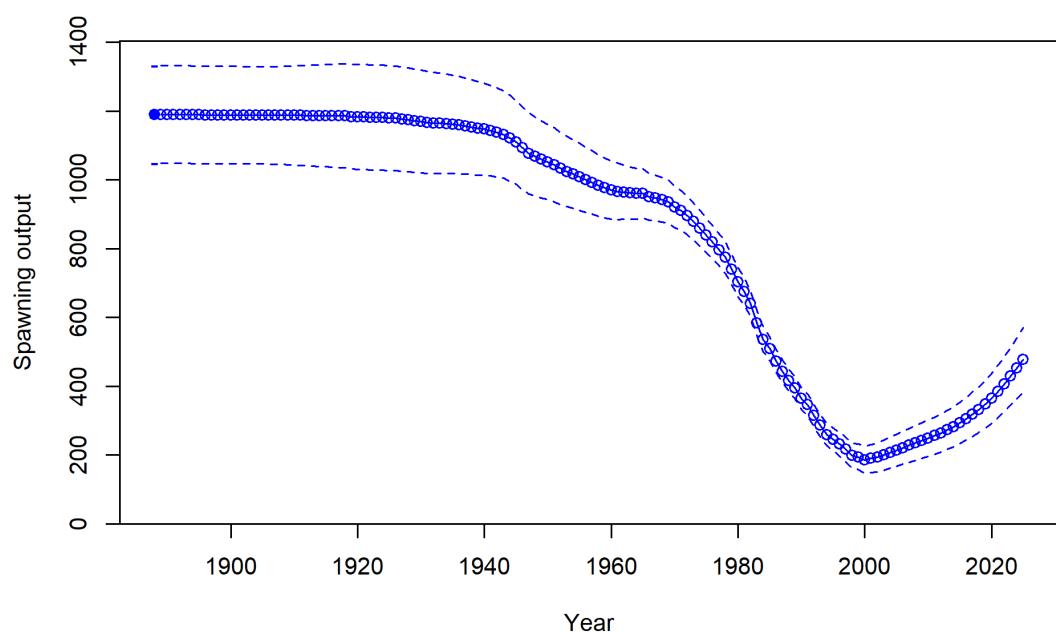


Figure 56: Estimated spawning output (millions of eggs) over time for both areas combined.

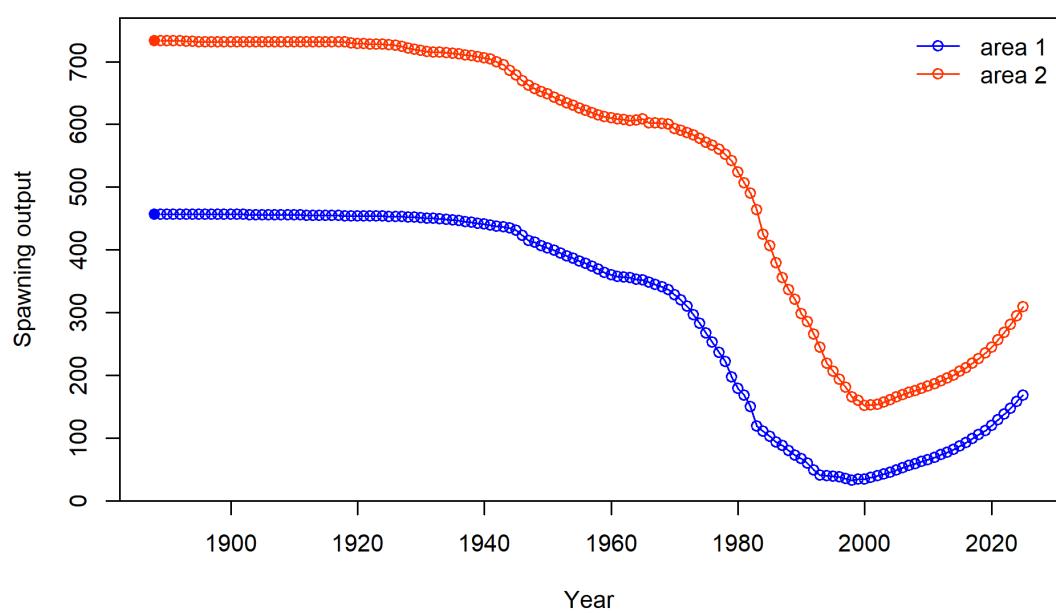


Figure 57: Estimated spawning output (millions of eggs) over time and by area (Area 1 is California, Area 2 is Oregon/Washington combined).

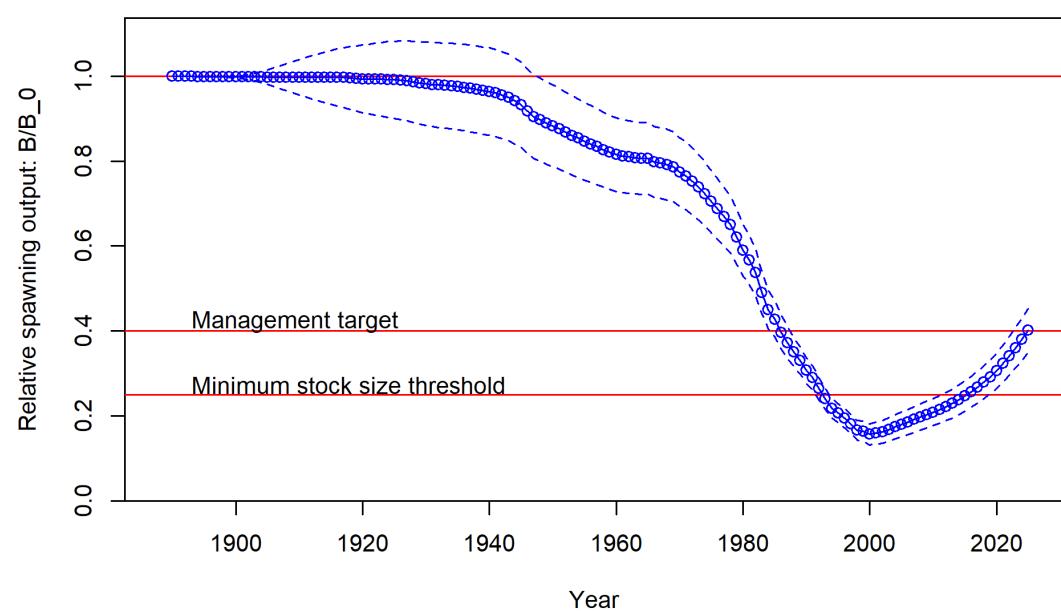


Figure 58: Time series of relative spawning output estimated in the assessment model (solid line) with  $\sim 95\%$  interval (dashed lines).

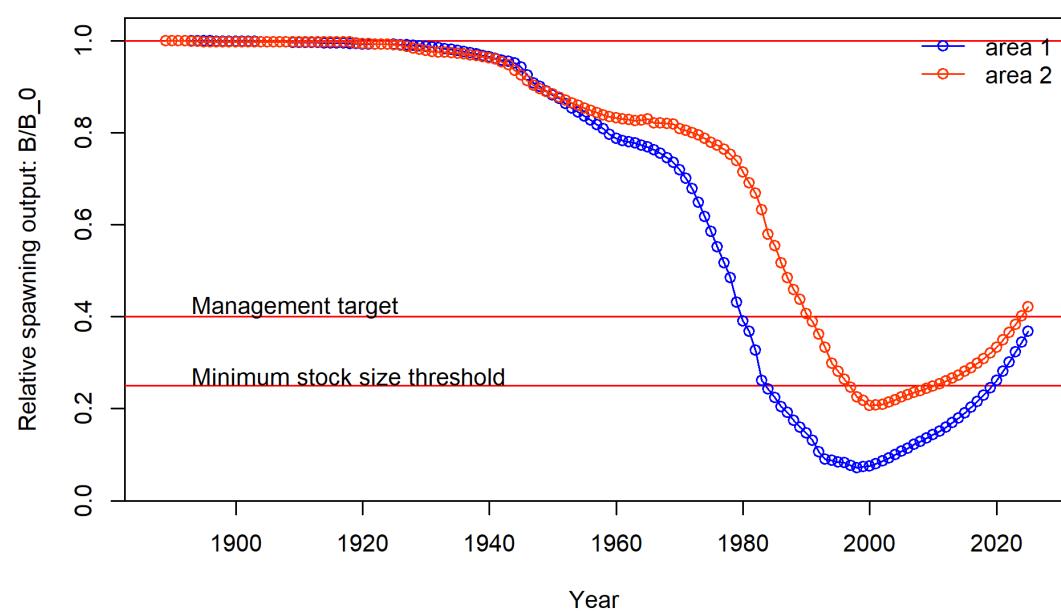


Figure 59: Time series of relative spawning output estimated by area (area 1= California, area 2 = Oregon and Washington).

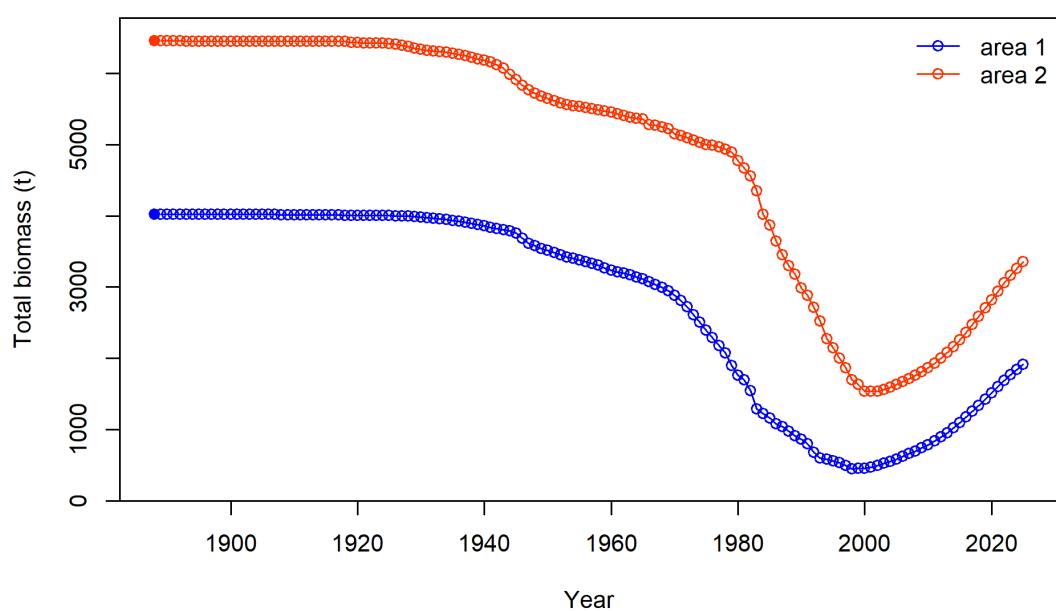


Figure 60: Total biomass (t) over time and by area (Area 1 is California, Area 2 is Oregon/Washington combined).

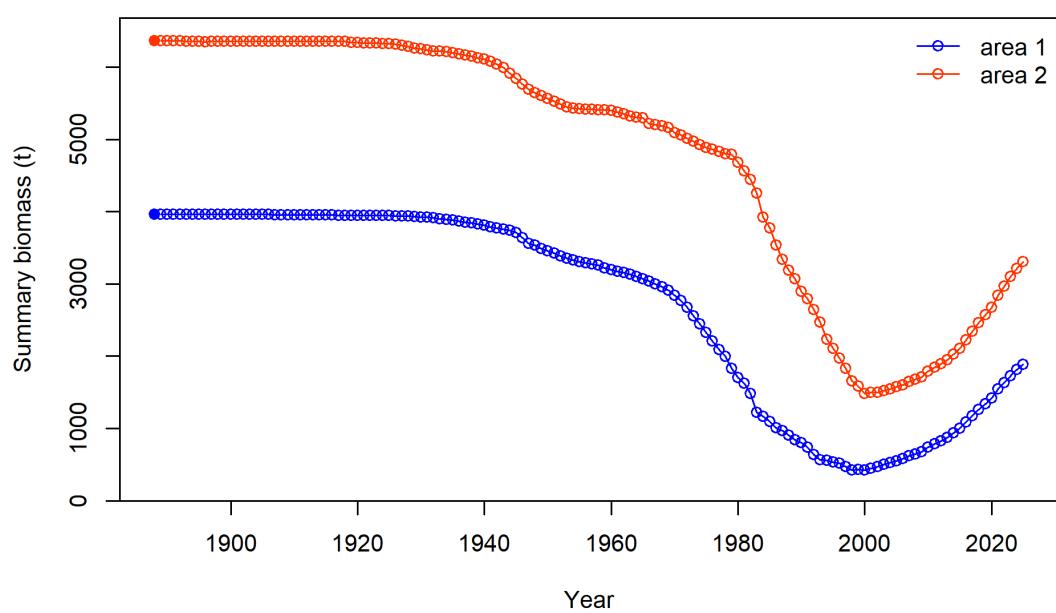


Figure 61: Summary biomass (t) over time and by area (Area 1 is California, Area 2 is Oregon/Washington combined).

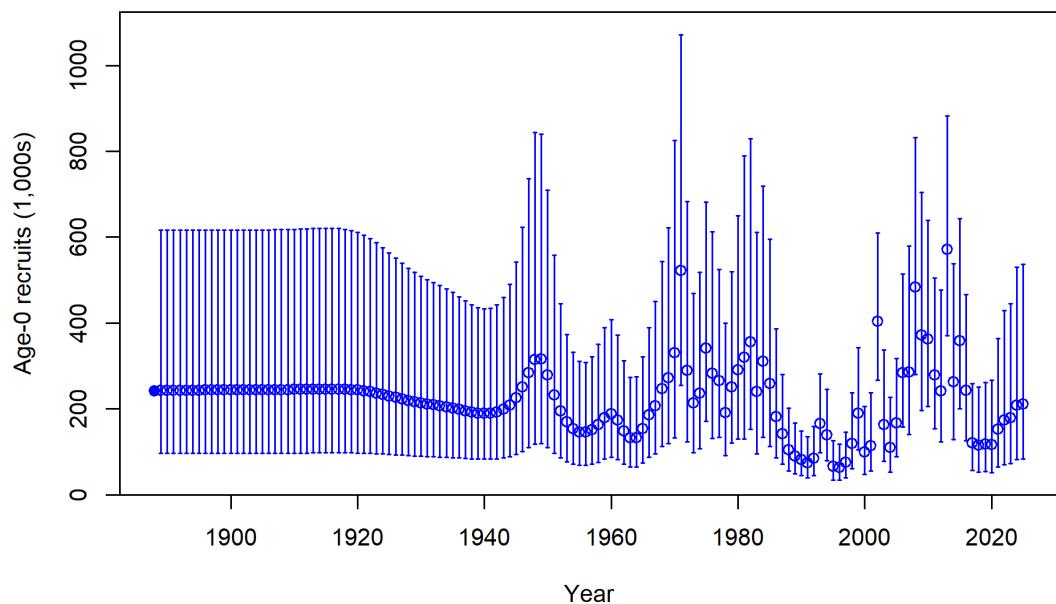


Figure 62: Time series of recruitment estimated in the assessment model with  $\sim 95\%$  interval.

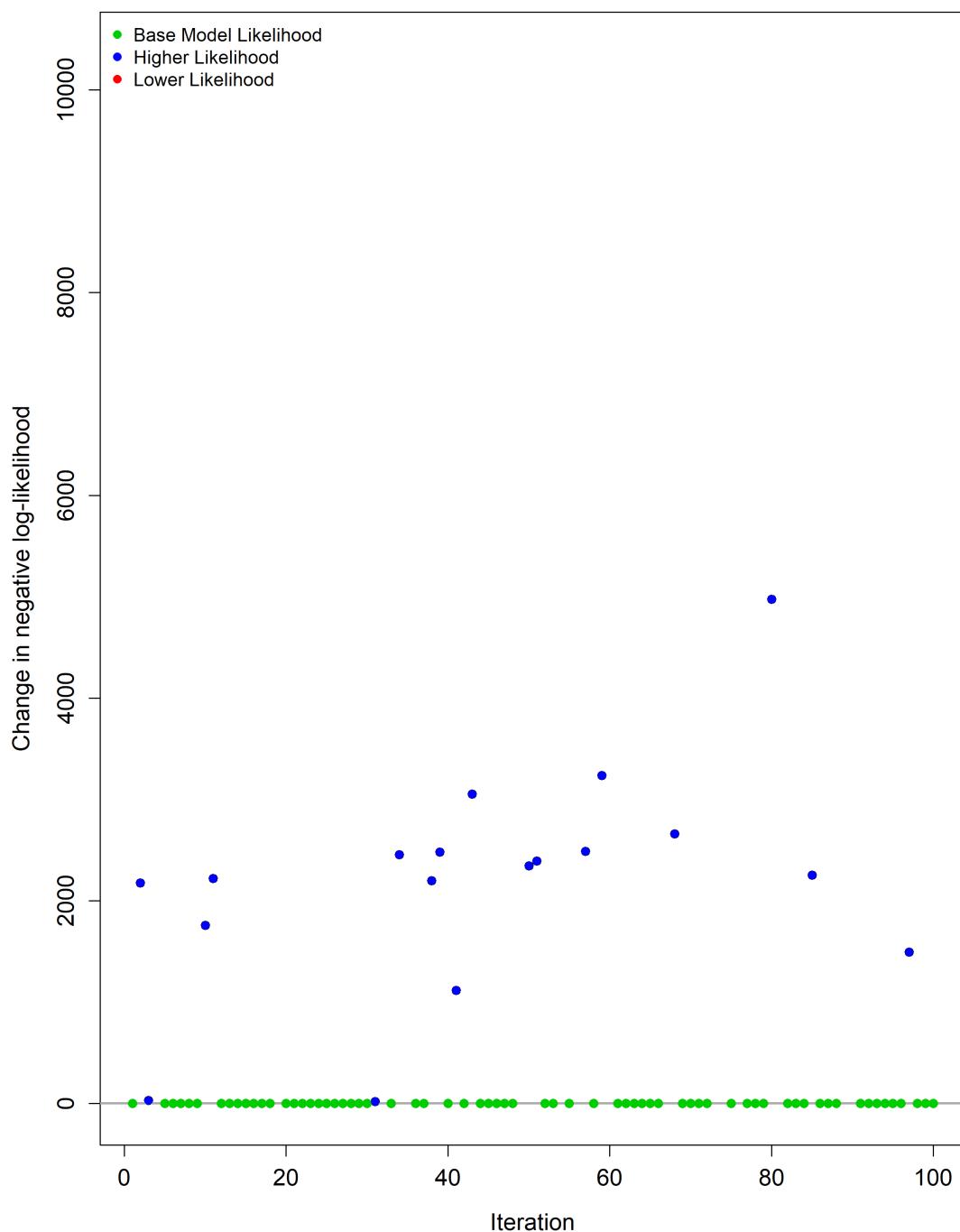


Figure 63: Results from 50 base model runs when starting parameters values are jittered by 0.1 units. Horizontal line indicates base model value.

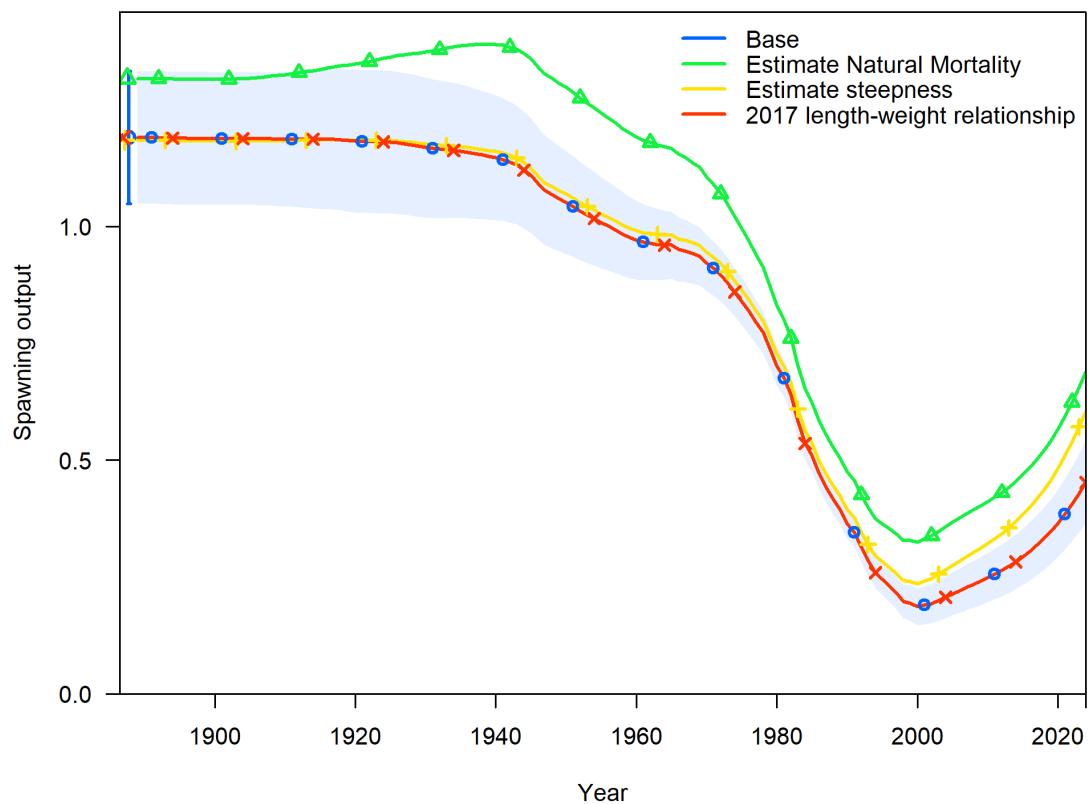


Figure 64: Spawning output (millions of eggs) across model structure sensitivities.

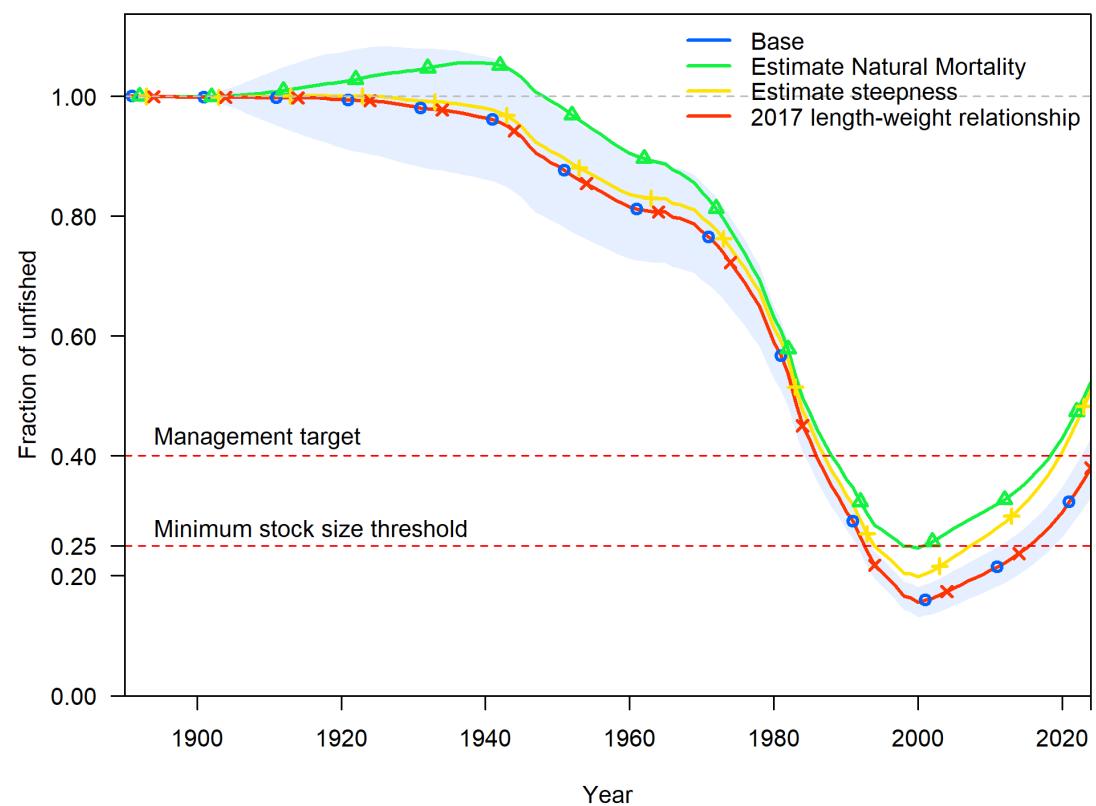


Figure 65: Relative spawning output across model structure sensitivities.

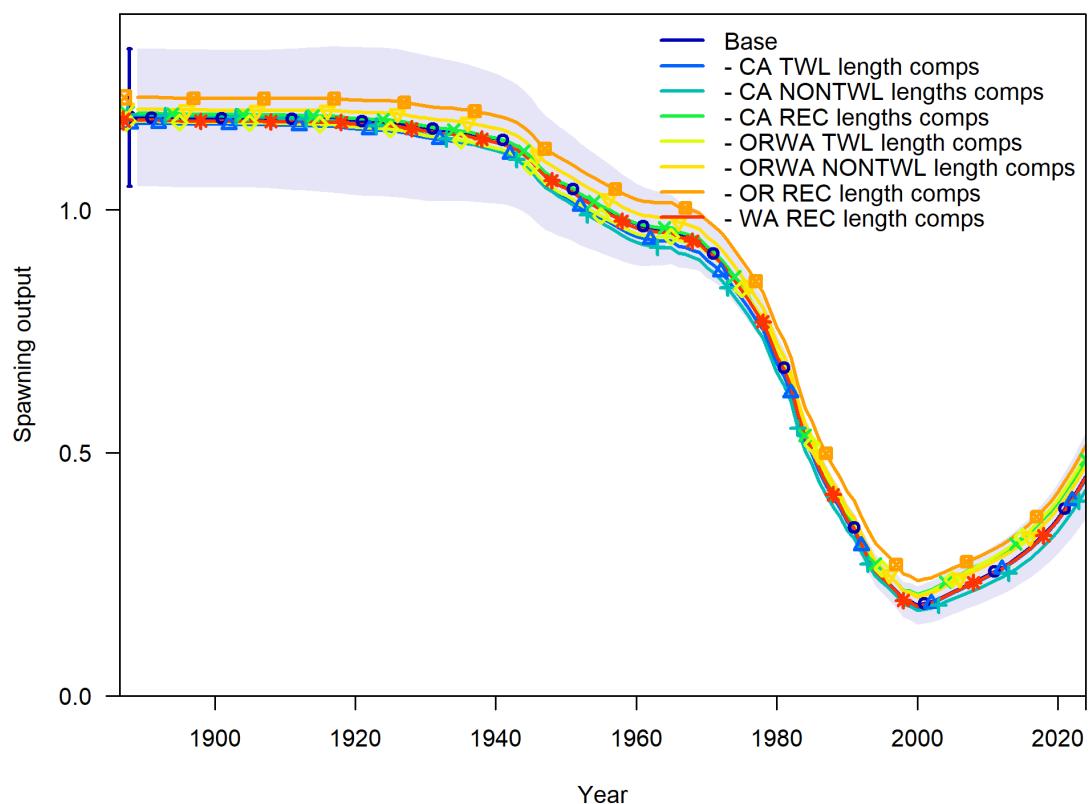


Figure 66: Spawning output (millions of eggs) across length composition sensitivities (1 of 2).

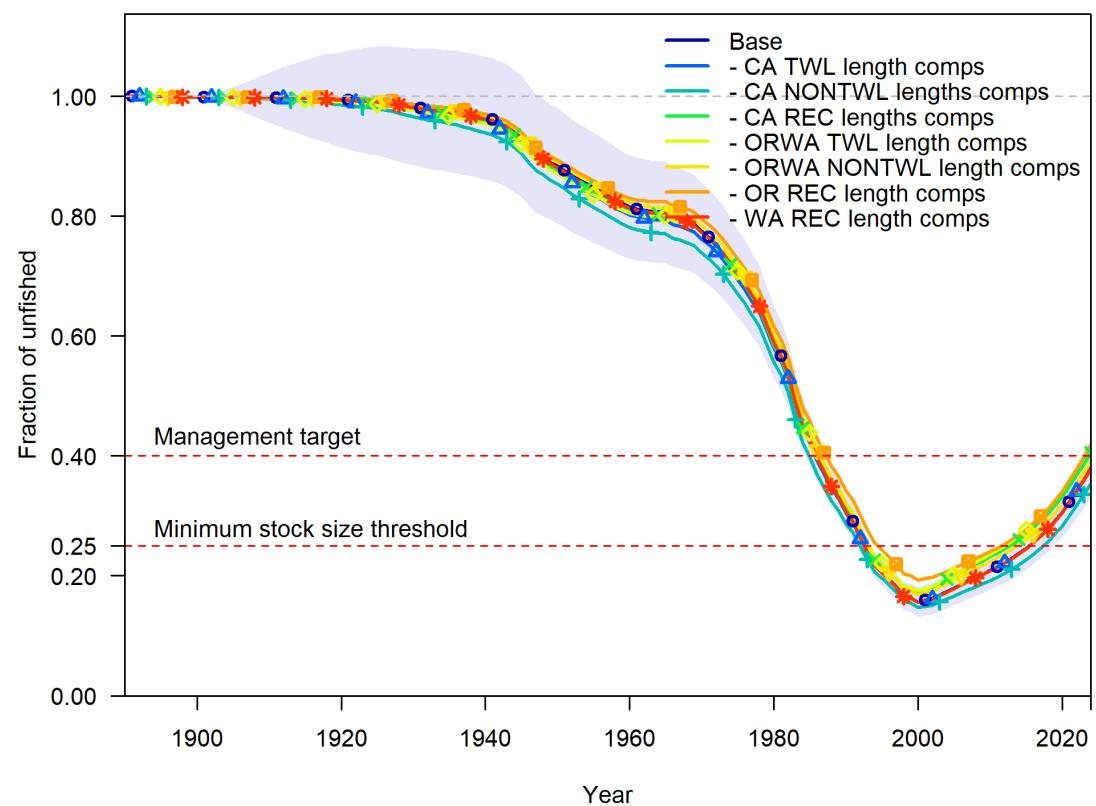


Figure 67: Relative spawning output across length composition inclusion sensitivities (1 of 2).

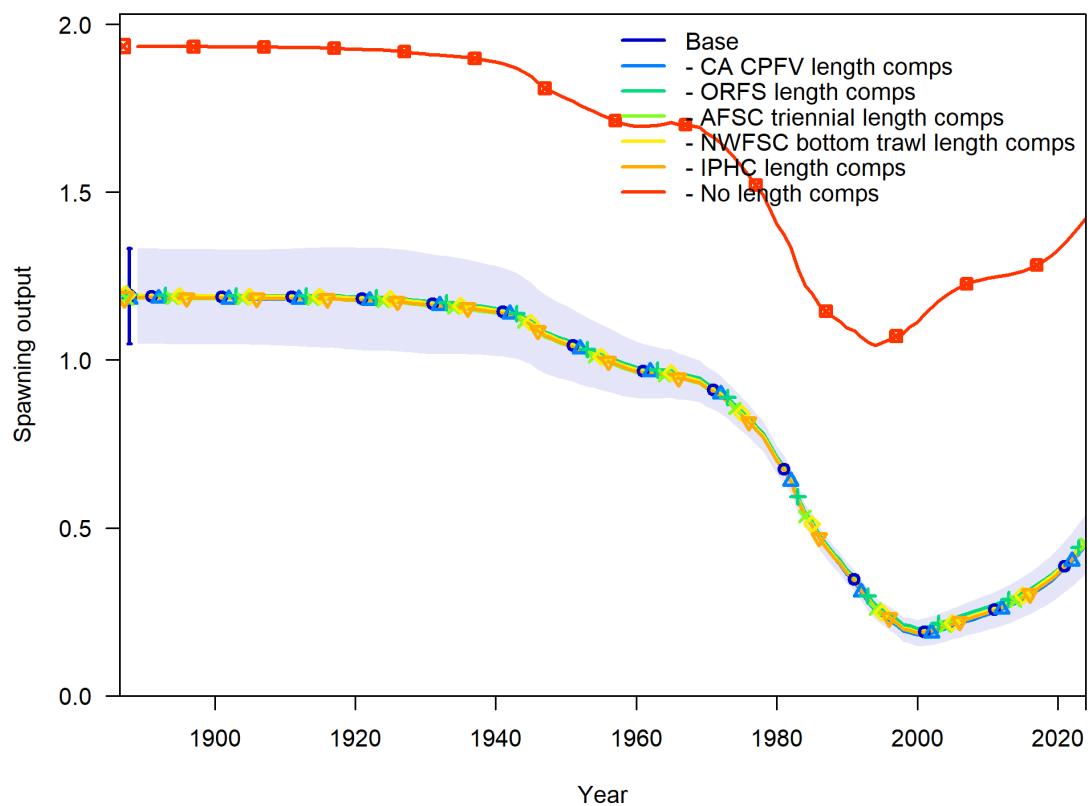


Figure 68: Spawning output (millions of eggs) across length composition inclusion sensitivities (2 of 2).

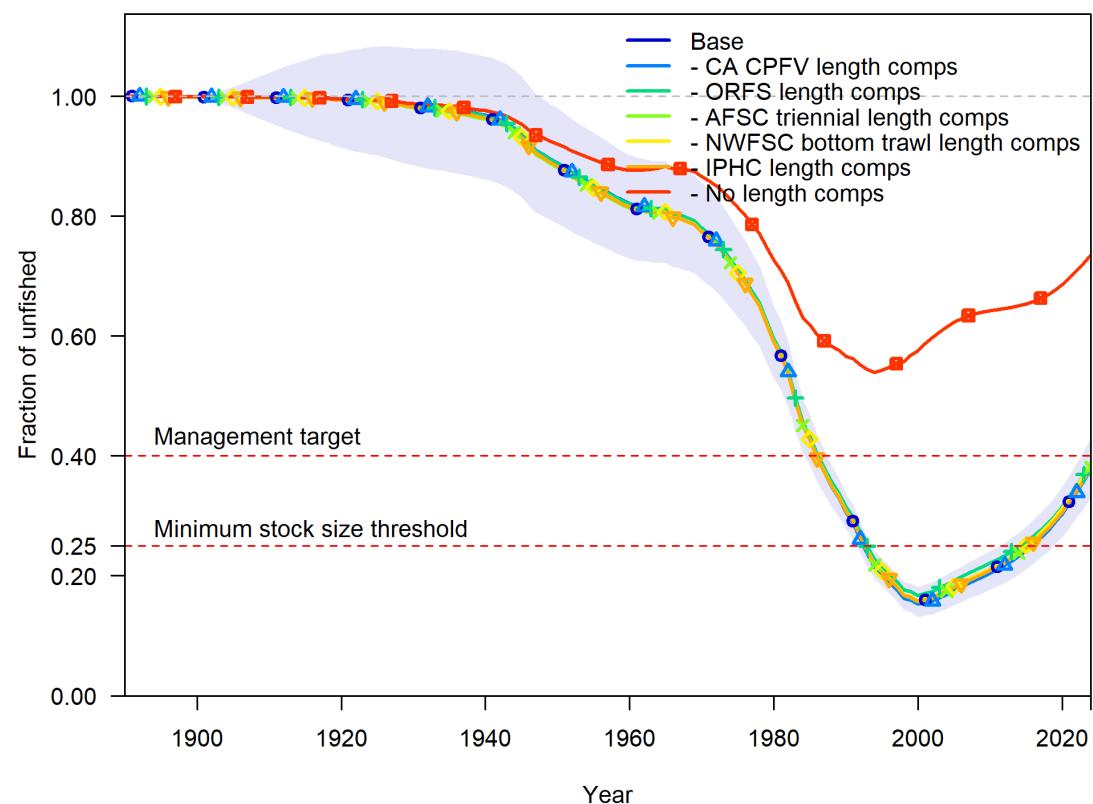


Figure 69: Relative spawning output across length composition inclusion sensitivities (2 of 2).

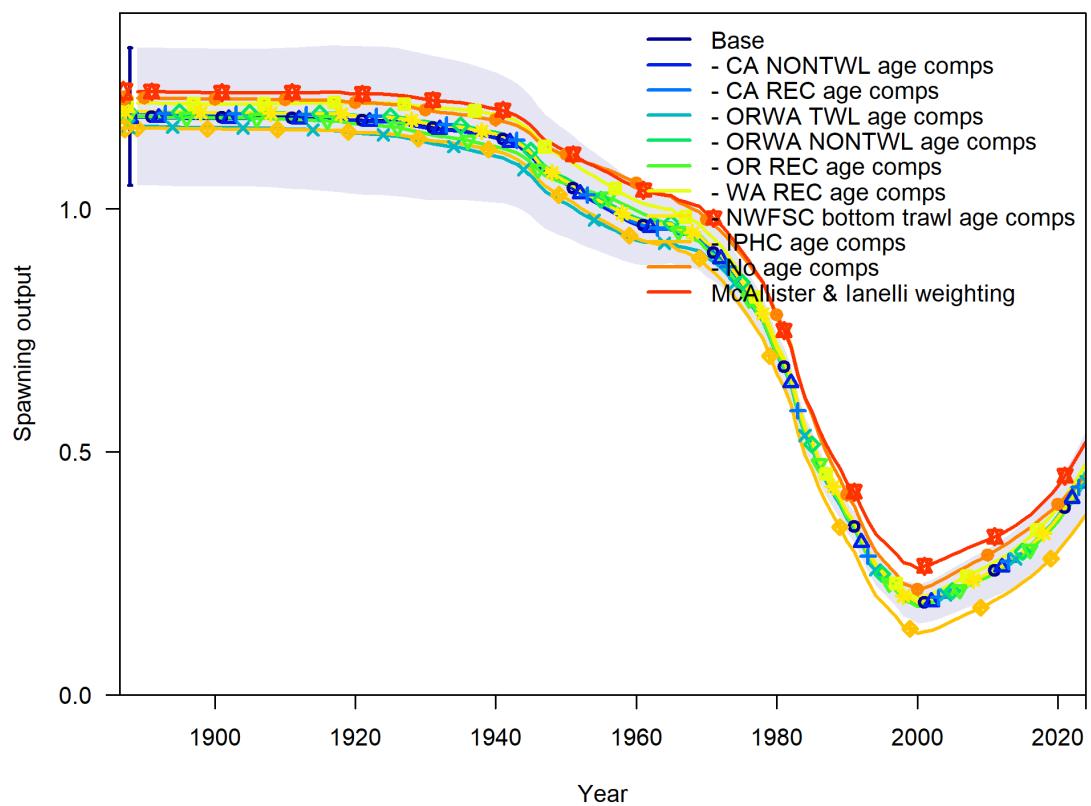


Figure 70: Spawning output (millions of eggs) across age composition inclusion sensitivities.

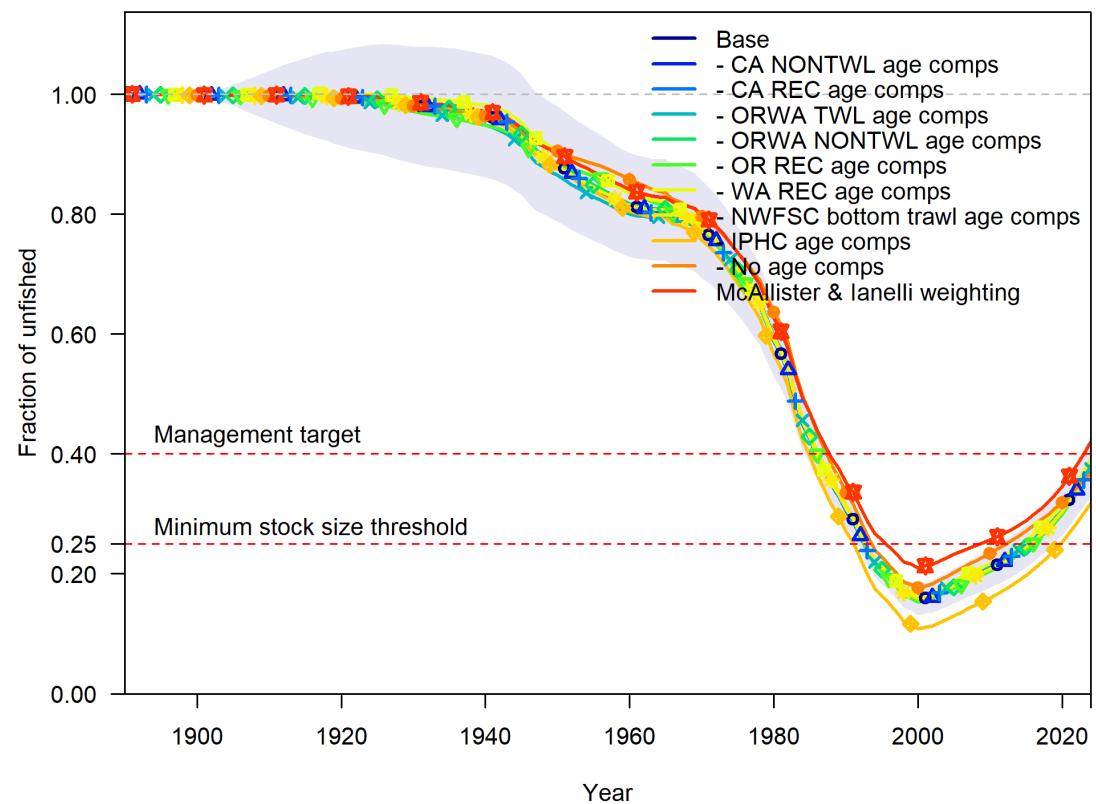


Figure 71: Relative spawning output across age composition inclusion sensitivities.

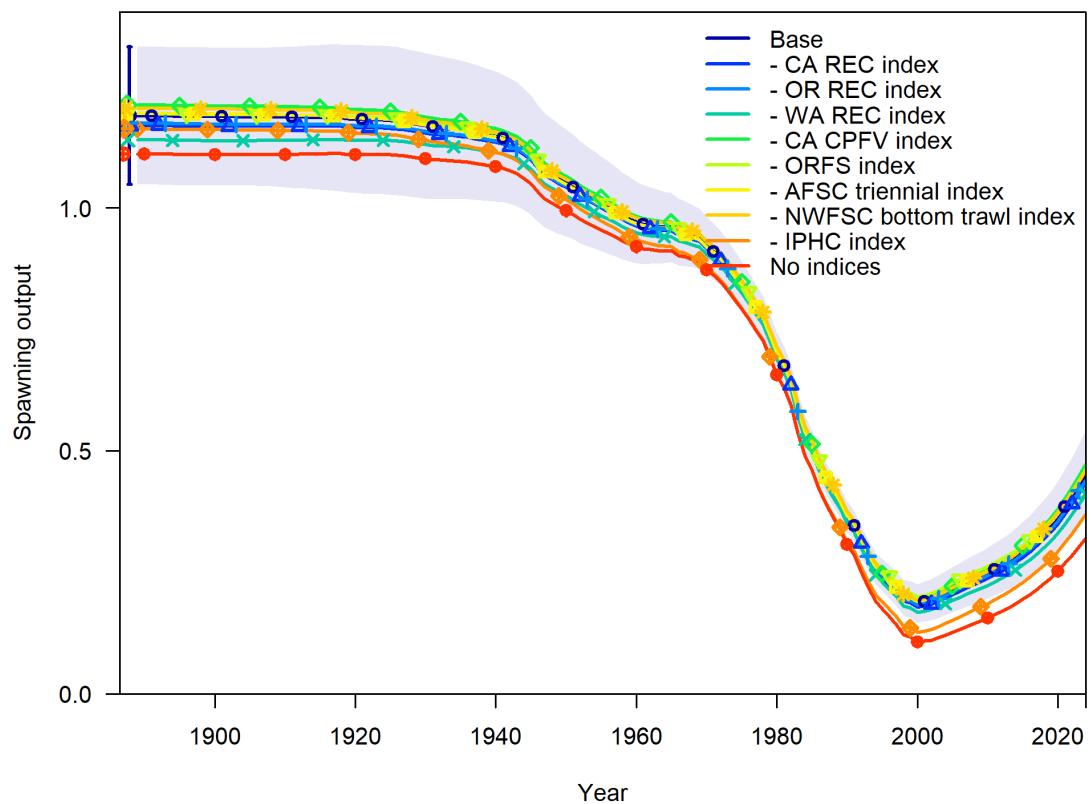


Figure 72: Spawning output (millions of eggs) across index inclusion sensitivities.

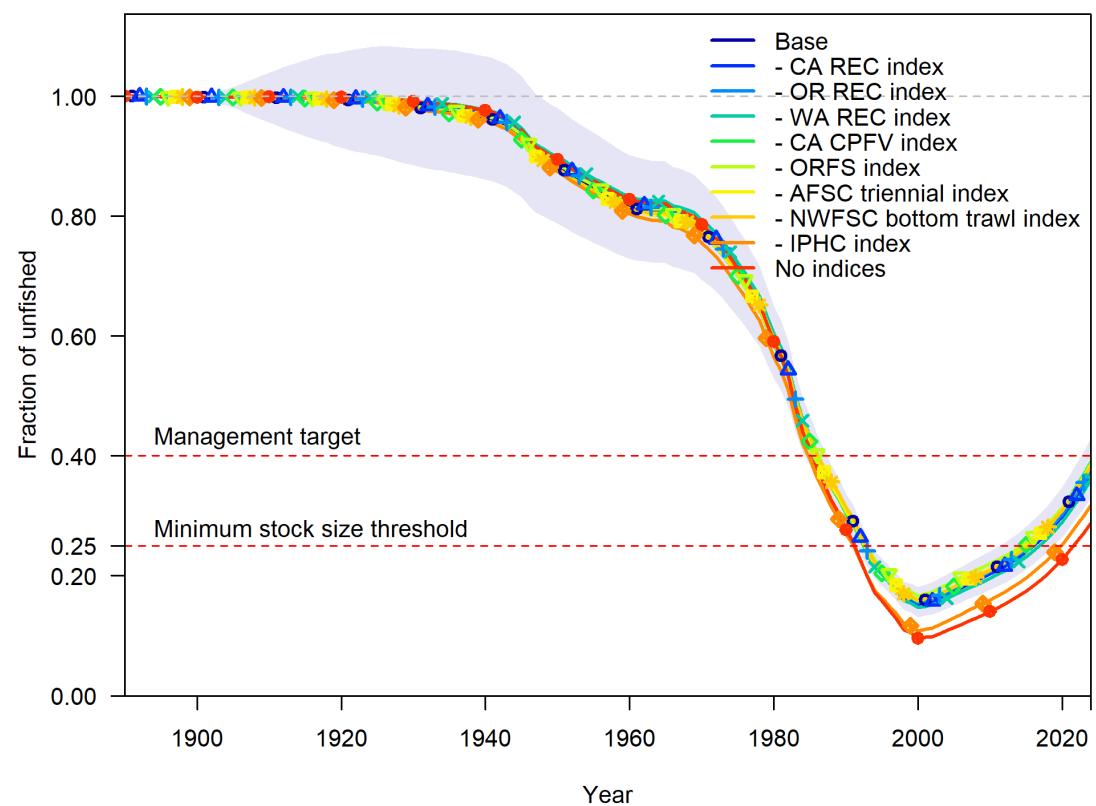


Figure 73: Relative spawning output across index inclusion sensitivities.

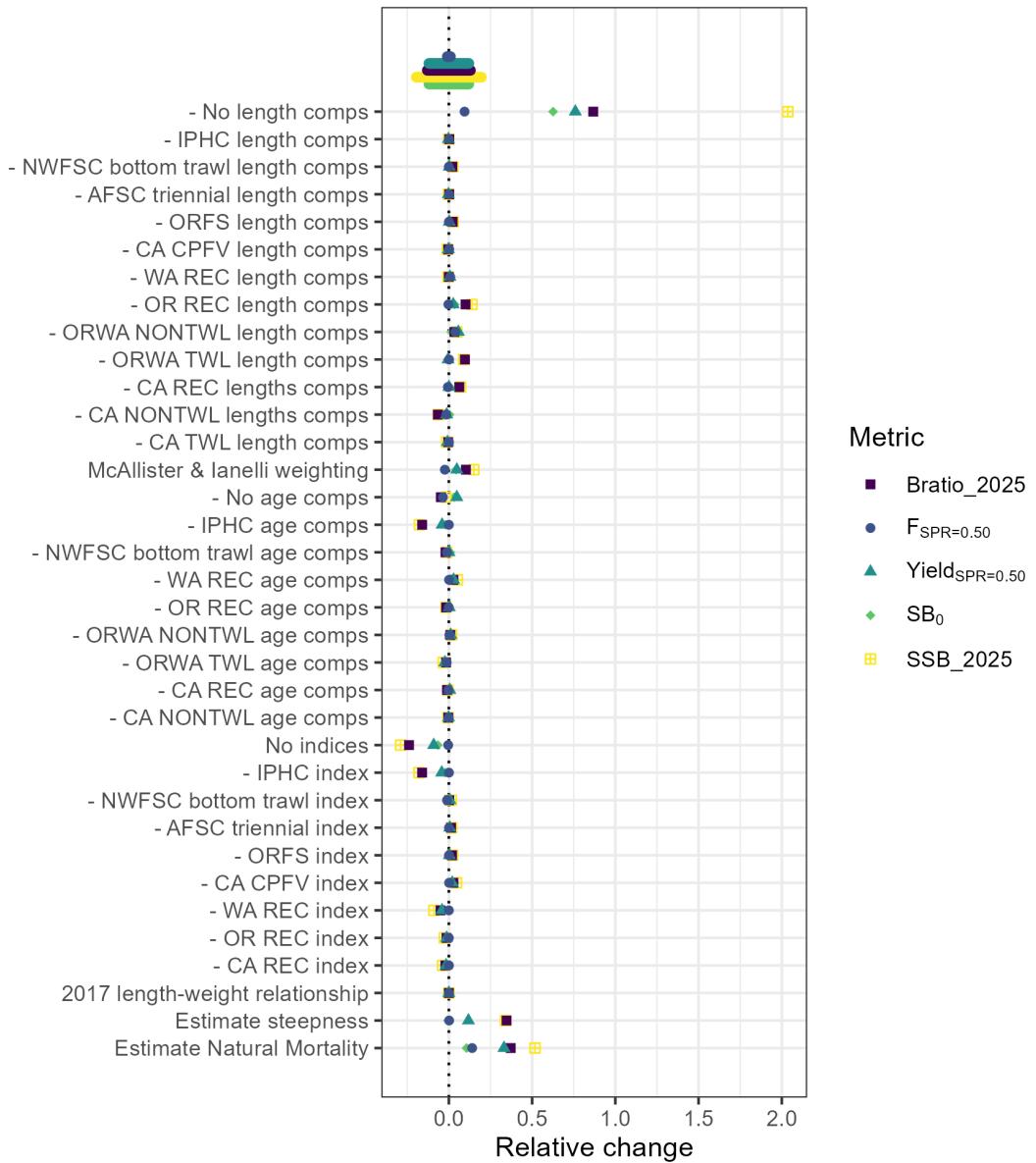


Figure 74: Relative change in management quantities across models conducted as sensitivities.

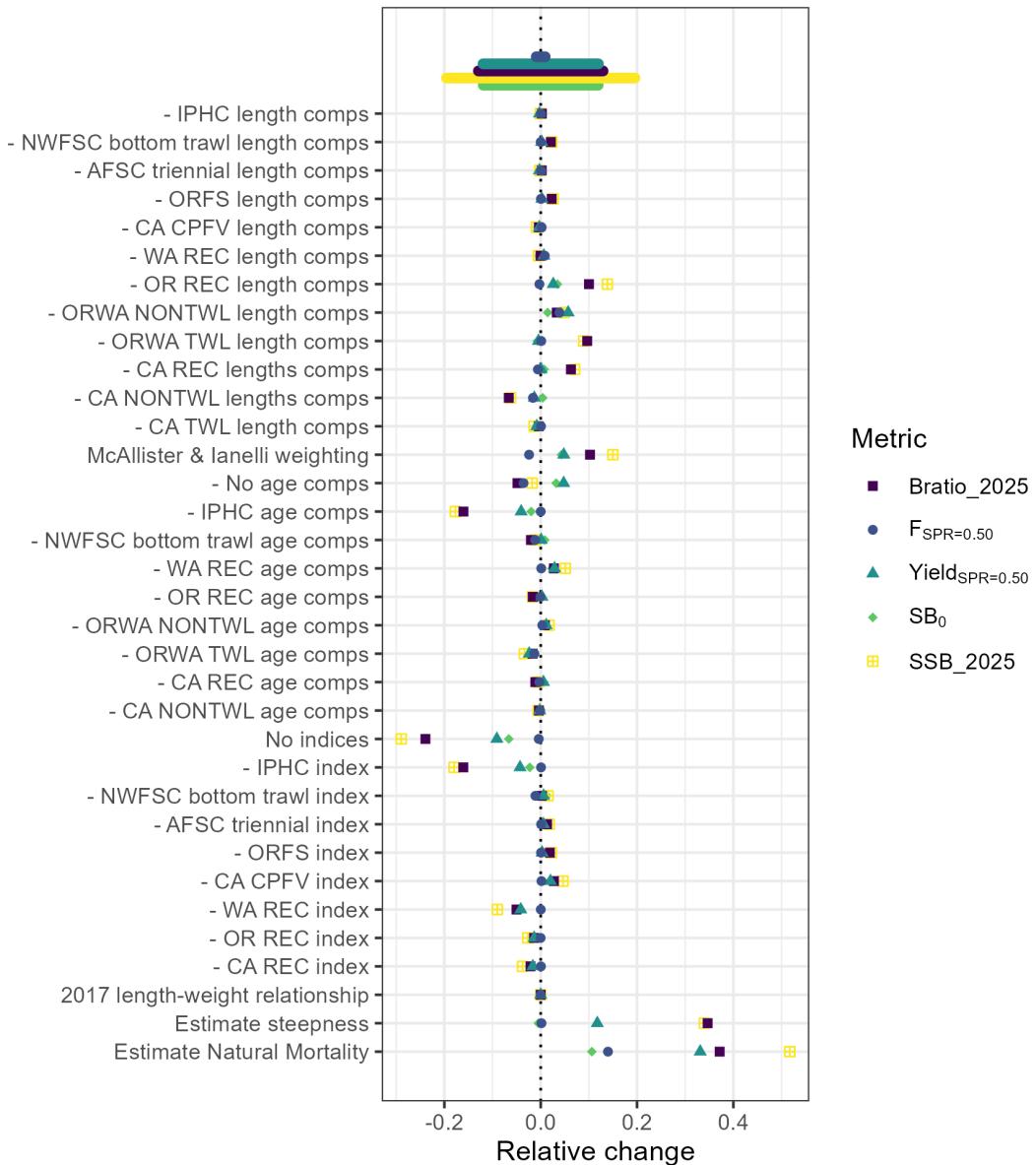


Figure 75: Relative change in management quantities across models conducted as sensitivities, without the removal of all length composition data.

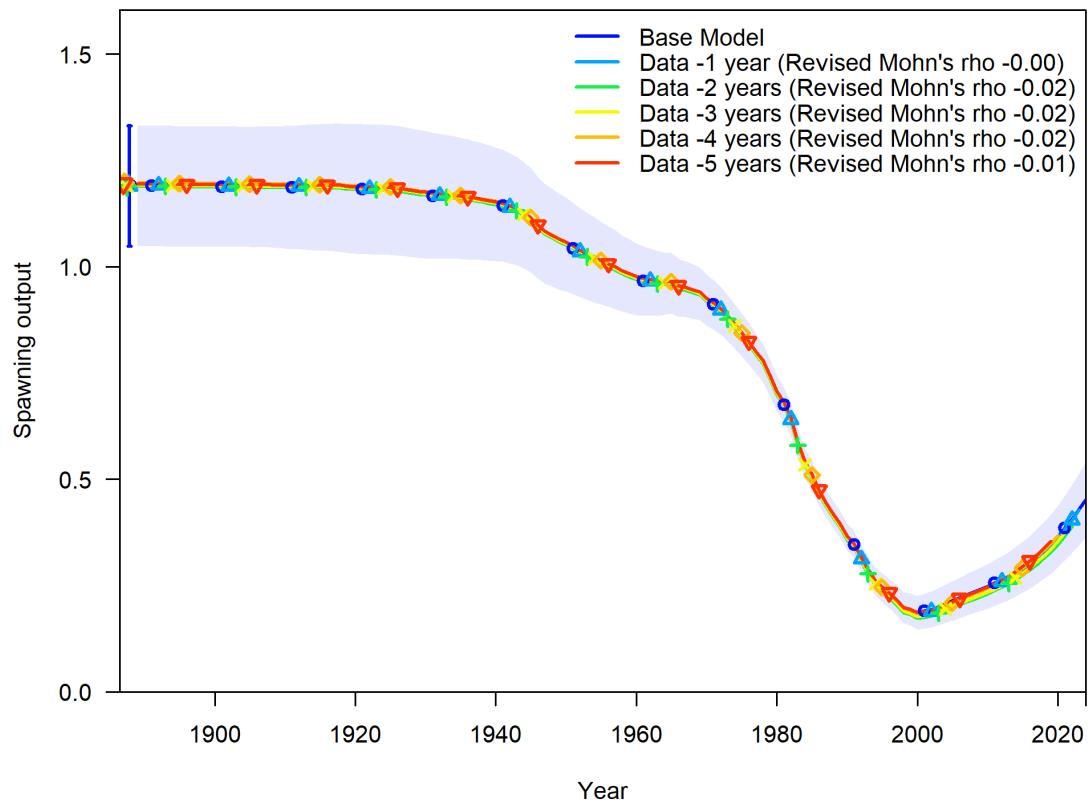


Figure 76: Results of retrospective analysis. Spawning output (millions of eggs) time series of this assesment base model are proved with ~95% interval.

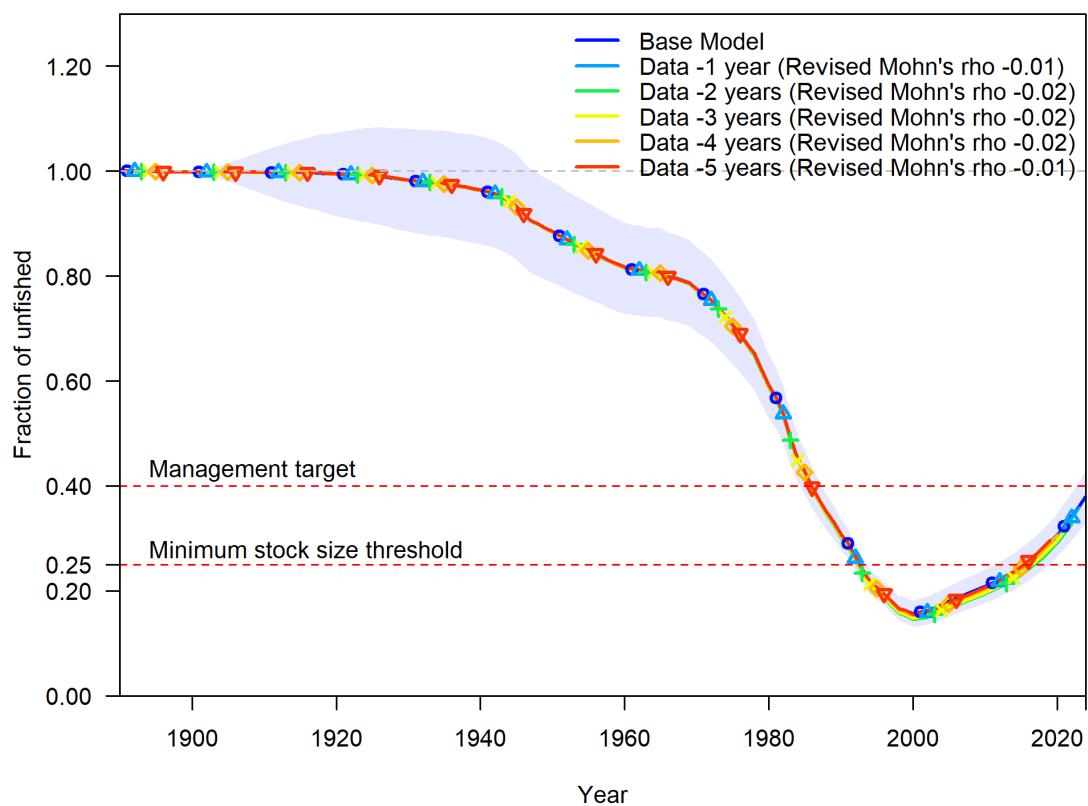


Figure 77: Results of retrospective analysis. Relative spawning output time series of this assessment base model are proved with ~95% interval.

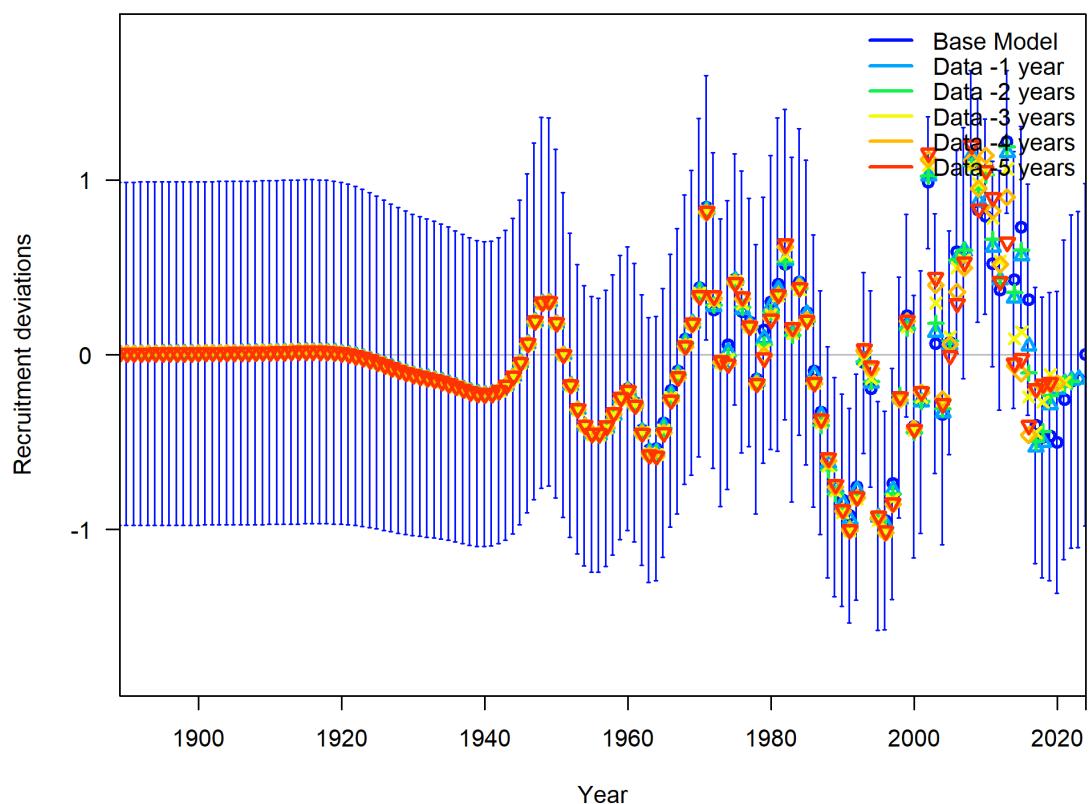


Figure 78: Recruitment deviation time series for each scenario of the retrospective analysis.

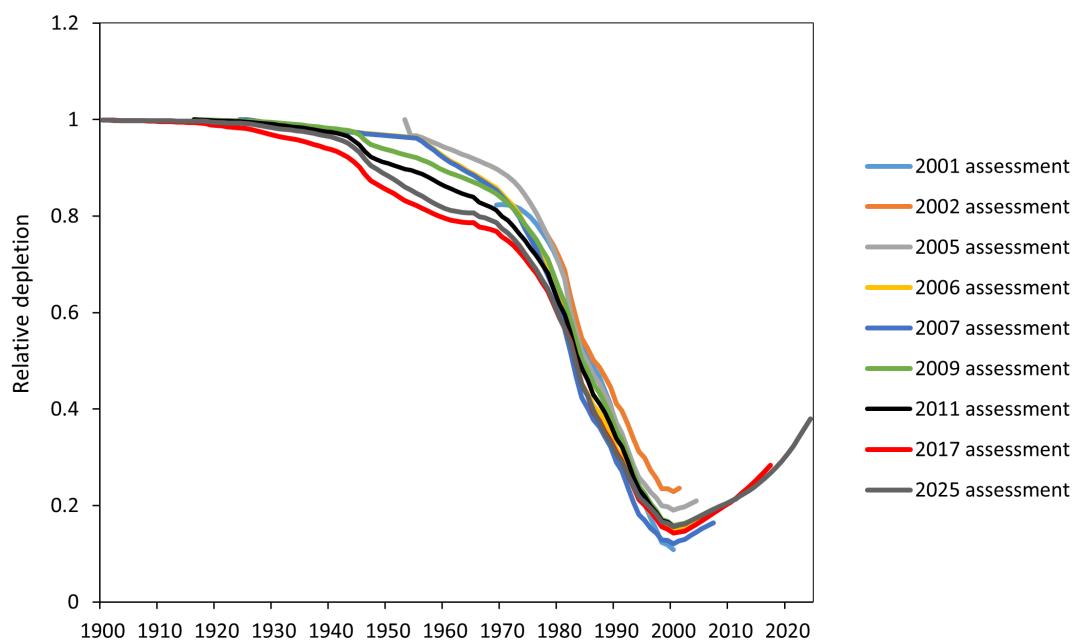


Figure 79: Relative depletion (spawning output) across Yelloweye Rockfish assessments over time.

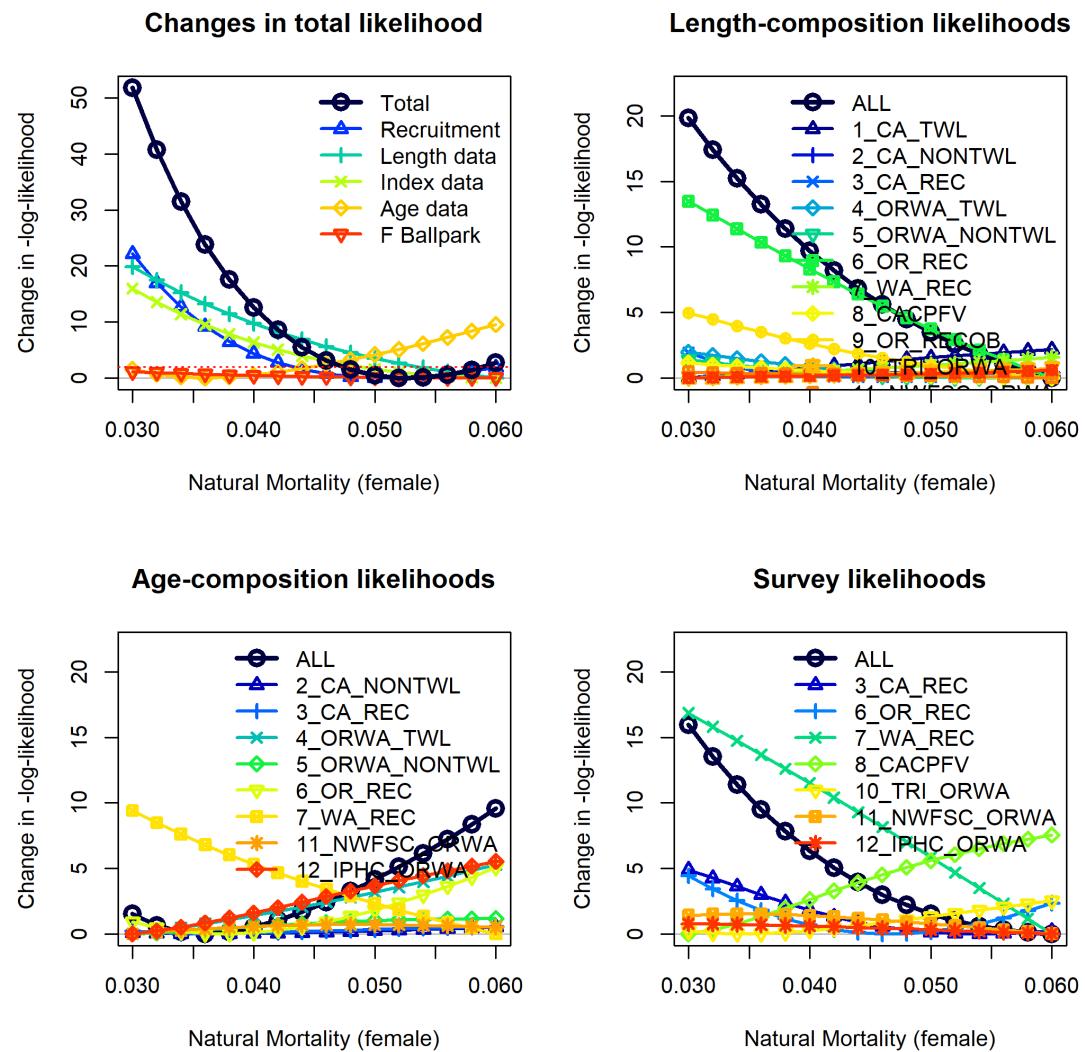


Figure 80: Negative log-likelihood profile for each data component and in total given different values of natural mortality ranging from 0.03 to 0.06 in increments of 0.002.

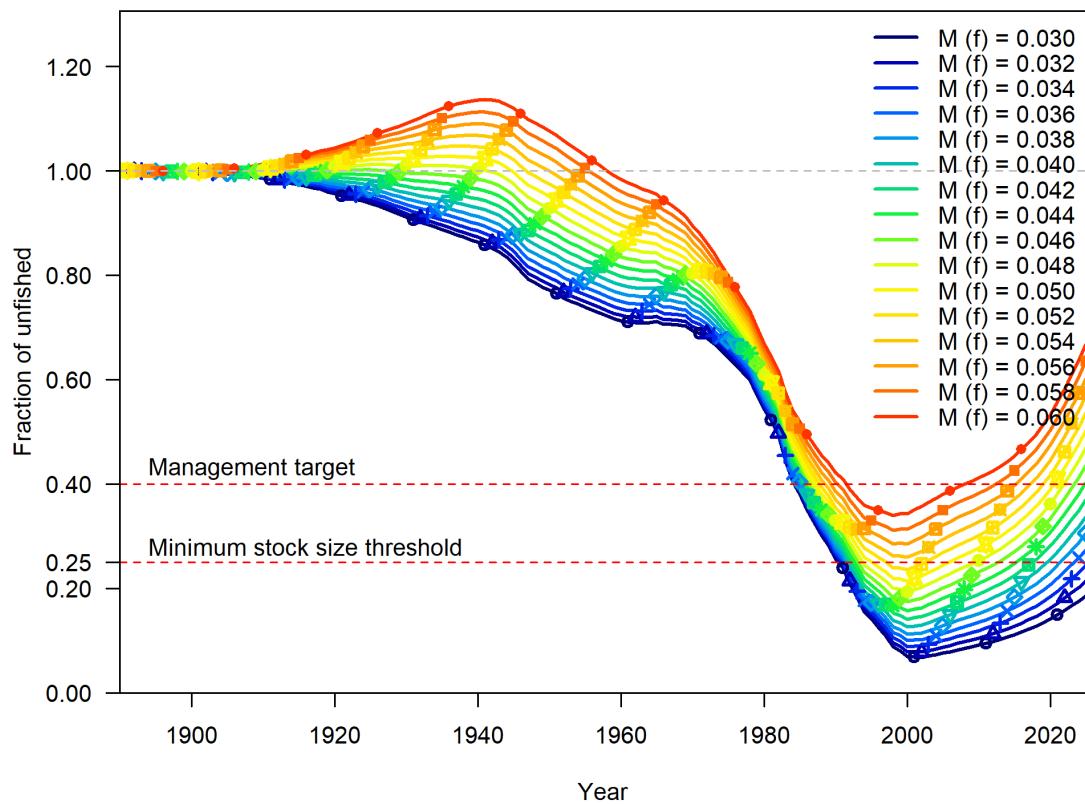


Figure 81: Time series of fraction of unfished biomass output associated with different values of natural mortality ranging from 0.03 to 0.06 in increments of 0.002.

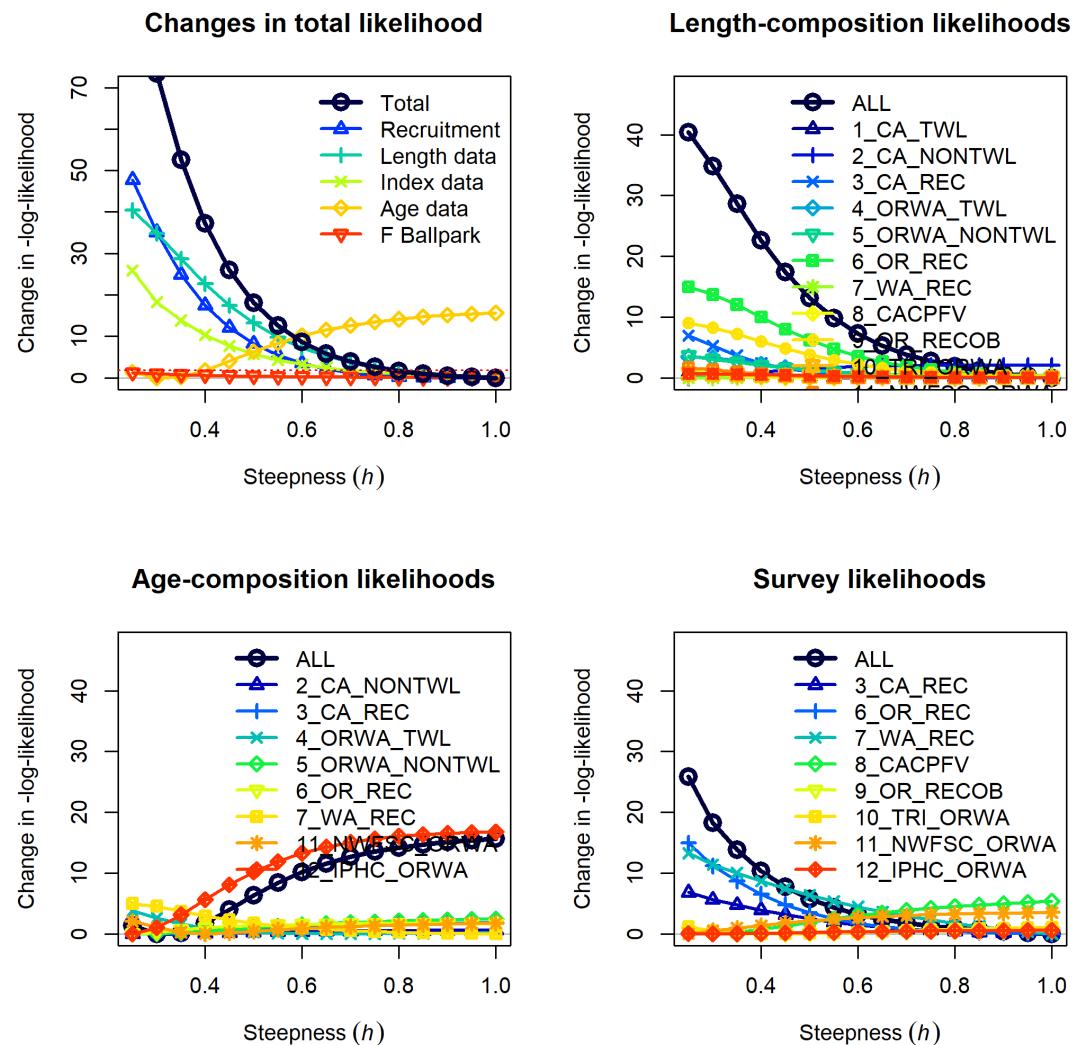


Figure 82: Negative log-likelihood profile for each data component and in total given different values of stock-recruit steepness ranging from 0.25 to 1.0 by increments of 0.05.

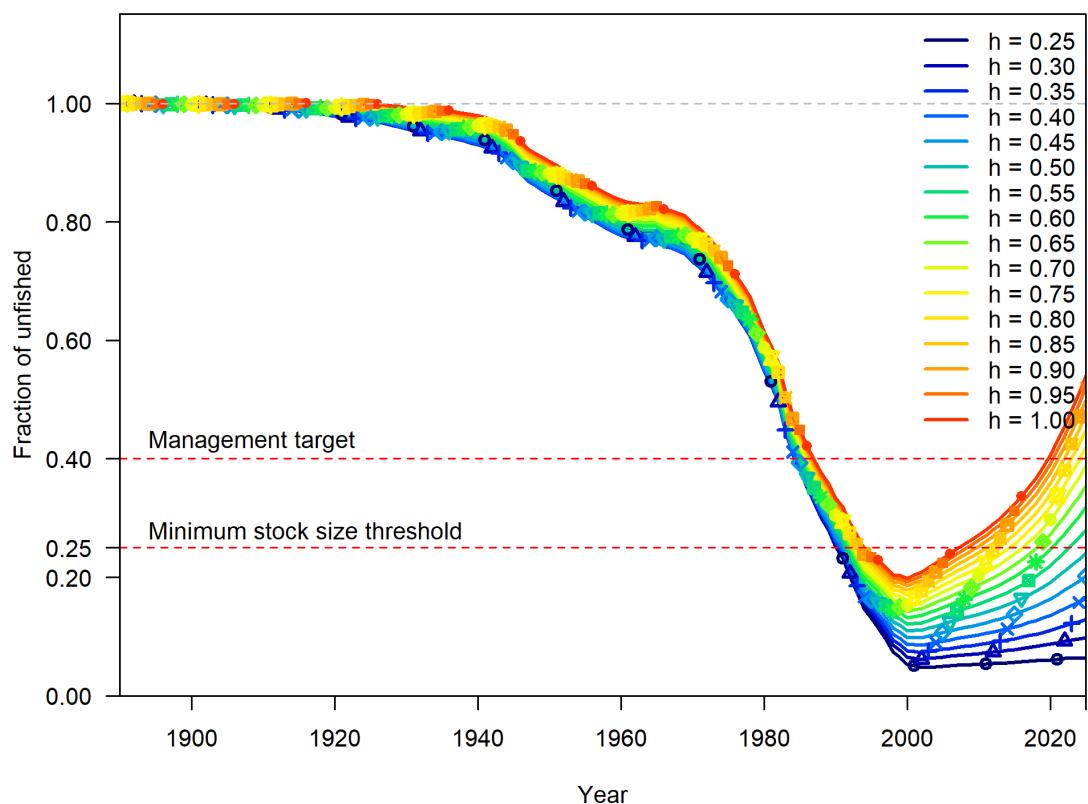


Figure 83: Time series of fraction of unfished biomass output associated with different values of steepness ranging from 0.25 to 1.0 in increments of 0.05.

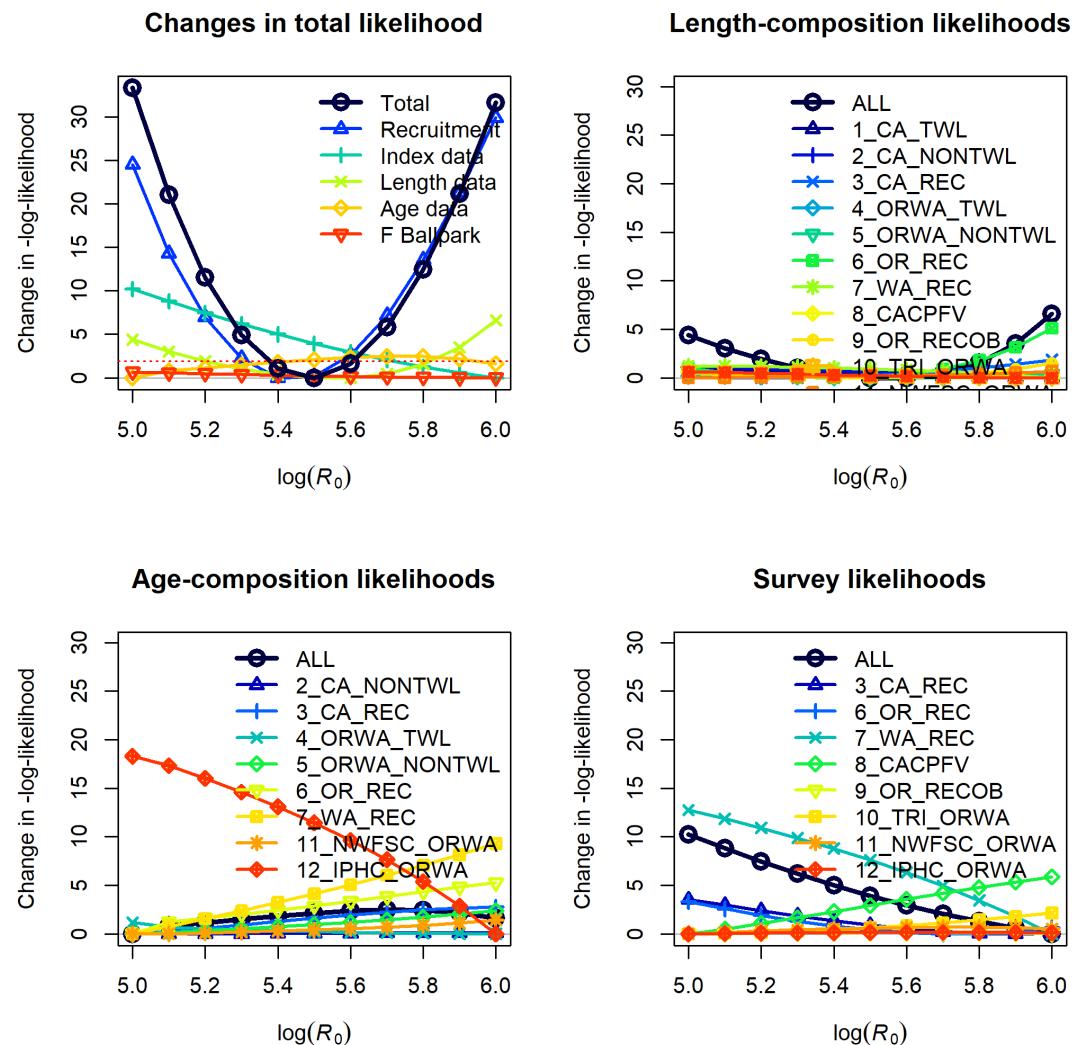
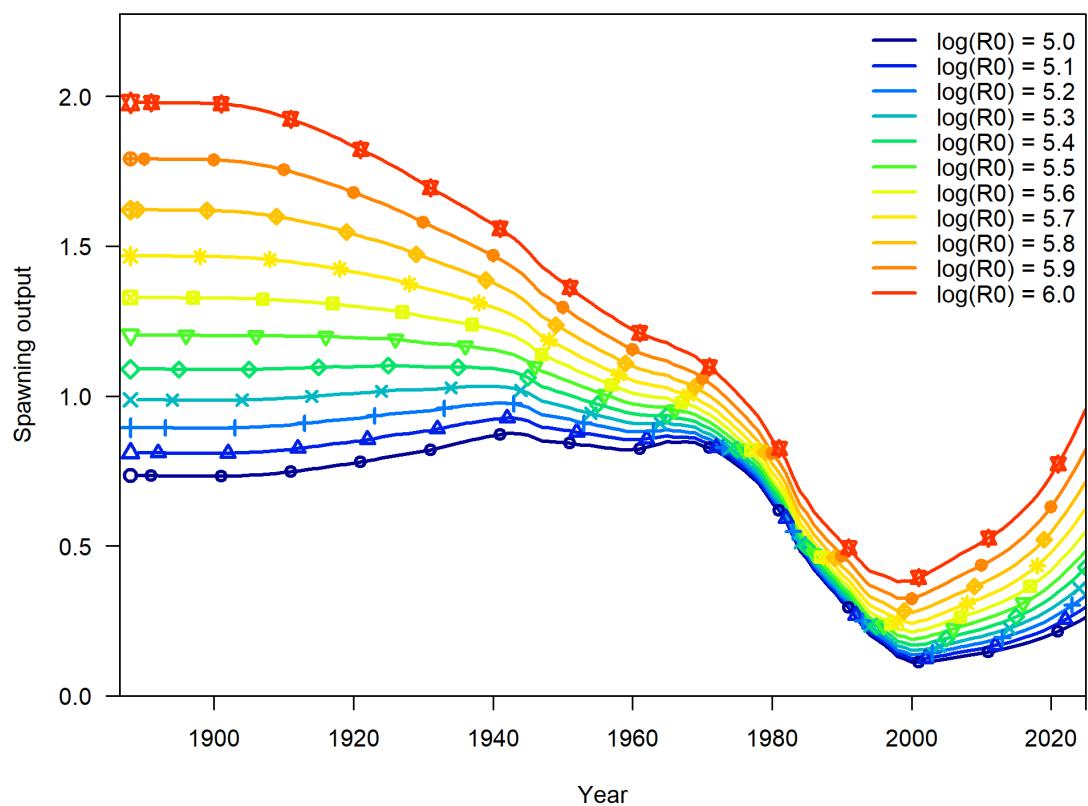


Figure 84: Negative log-likelihood profile for each data component and in total given different values of log initial recruitment ( $\ln R_0$ ) ranging from 4.5 to 6.0 by increments of 0.15.

Figure 85: Spawning output (millions of eggs) as profiled over values of  $\ln R_0$ .

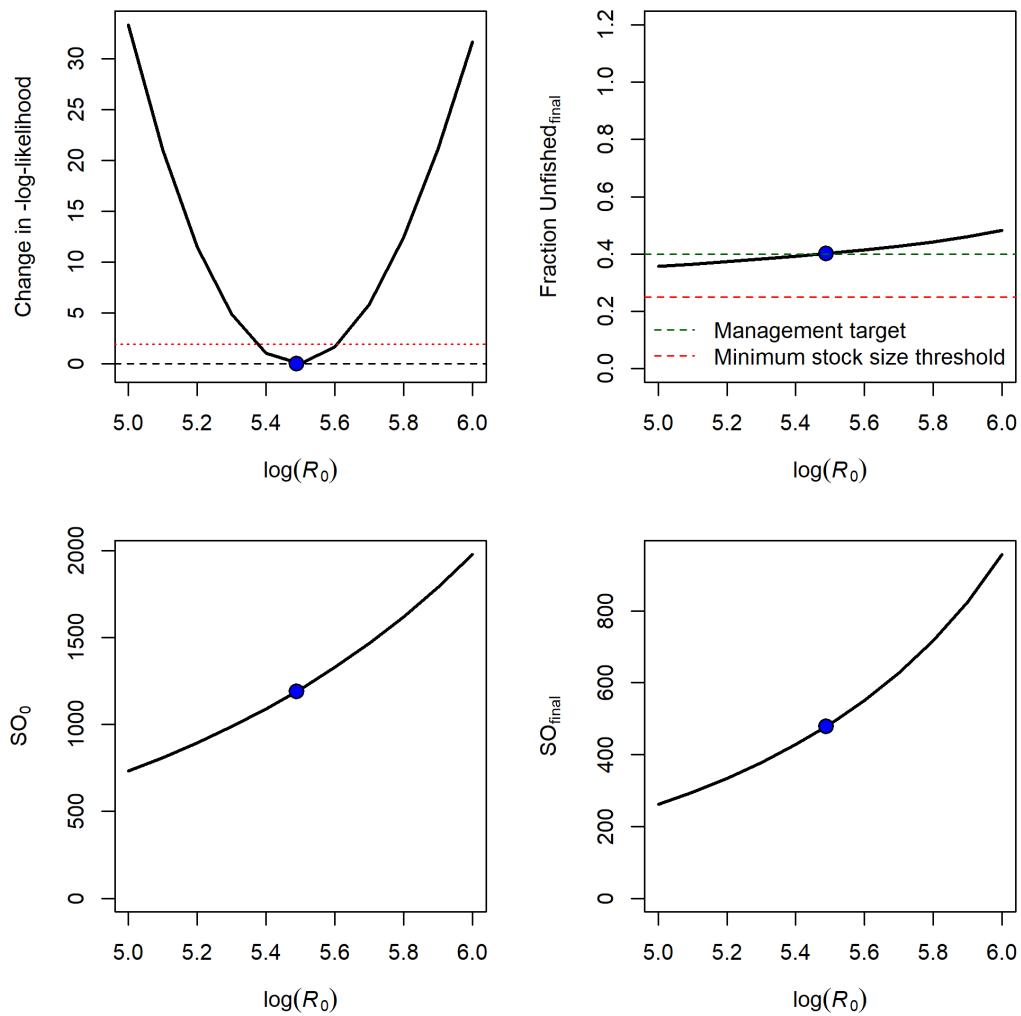


Figure 86: Likelihood profile (top left panel) for log initial recruitment ( $\ln R_0$ ), with associated changes in stock status in the current year ( $SB_{2025}/SB_0$ ; top right panel), initial spawning biomass ( $SB_0$ ; bottom left panel), and current year spawning biomass ( $SB_{2025}$ ; bottom right panel). Points indicate the base model MLE estimate.

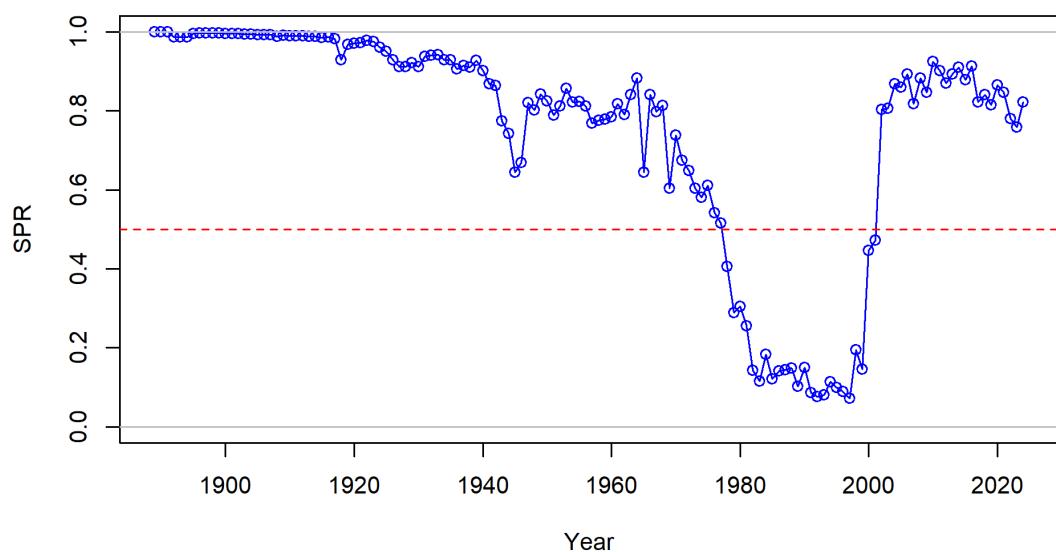


Figure 87: Time series of estimated SPR

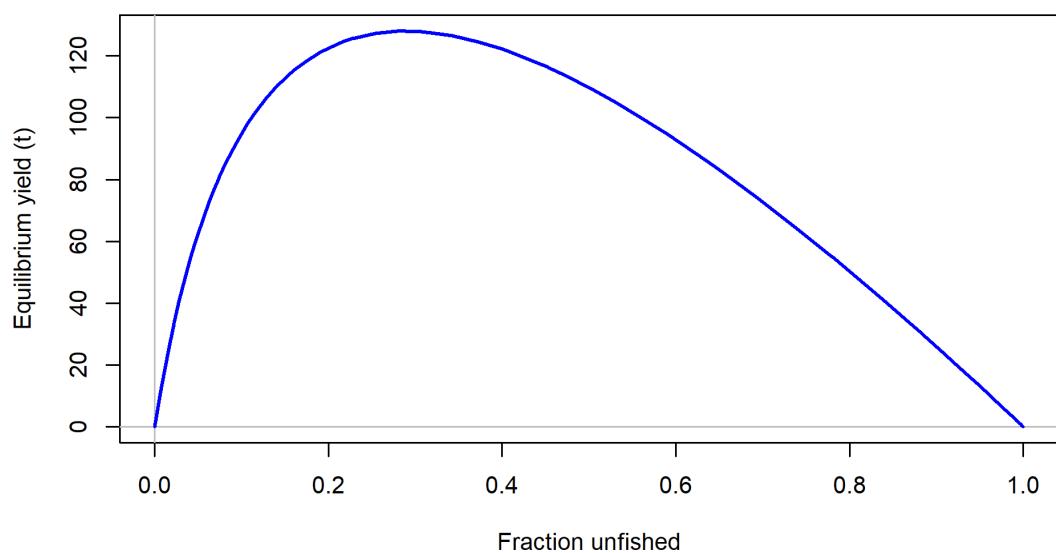


Figure 88: Equilibrium yield curve (derived from reference point values) for the base model. Values are based on 2024 fishery selectivity and distribution with steepness fixed at 0.718. The relative spawning output is relative to unfished spawning biomass.

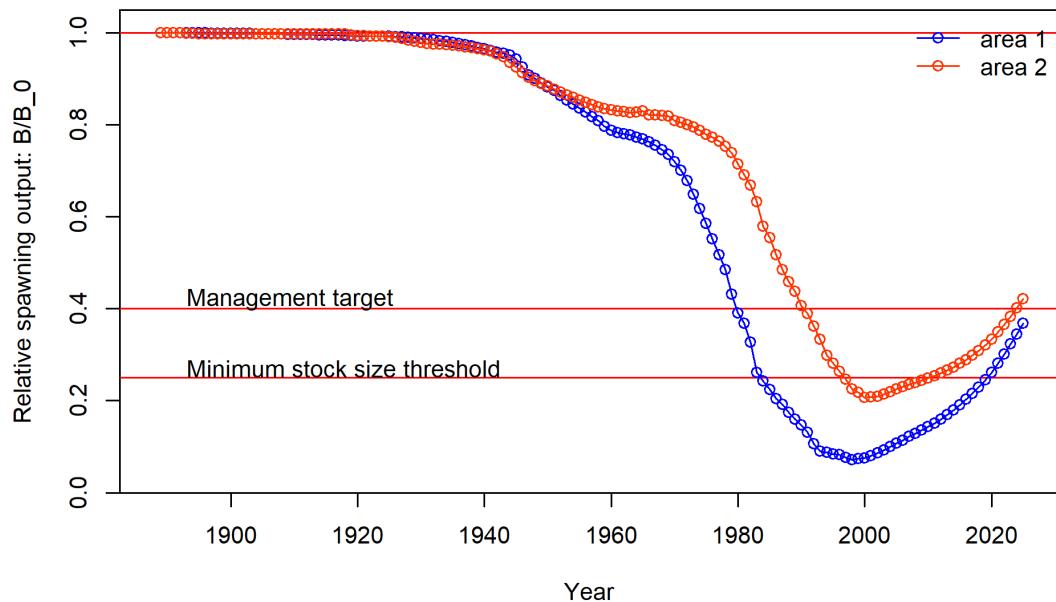


Figure 89: Time series of relative spawning output estimated by area (area 1 = California, area 2 = Oregon and Washington).

## Acronyms

**ACL** annual catch limit. [xvi](#), [2](#), [23](#)

**AIC** Akaike information criterion. [9](#)

**CAAL** conditional age-at-length. [5](#), [6](#), [11](#)

**GEMM** Groundfish Expanded Mortality Multi-Year. [4](#)

**TMB** Template Model Builder. [9](#)

**IPHC** International Pacific Halibut Commission. [v](#), [3](#), [8](#), [9](#), [10](#), [20](#)

**MSST** minimum stock size threshold. [23](#)

**ODFW** Oregon Department of Fish and Wildlife. [4](#)

**OFL** overfishing limit. [xvi](#), [xviii](#), [2](#), [24](#)

**ORBS** Oregon Department of Fish and Wildlife Oregon Recreational Boat Survey. [3](#), [8](#)

**OSP** WDFW Ocean Sampling Program. [4](#), [5](#)

**PacFIN** Pacific Fisheries Information Network. [4](#), [5](#), [6](#)

**PFMC** Pacific Fishery Management Council. [8](#)

**RCA** Rockfish Conservation Area. [2](#)

**RecFIN** Recreational Fishery Information Network. [4](#), [5](#), [6](#)

**sdmTMB** Species Distribution Models with Template Model Builder. [7](#), [8](#), [9](#), [10](#)

**WCGBTS** West Coast Groundfish Bottom Trawl Survey. [v](#), [3](#), [9](#), [10](#), [11](#)

**WCGOP** West Coast Groundfish Observer Program. [4](#), [5](#), [6](#)

**WDFW** Washington Department of Fish and Wildlife. [3](#), [4](#), [6](#), [10](#)