6. Assessment of the rex sole stock in the Gulf of Alaska

By

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The last operational full assessment for GOA rex sole was in 2021 and a full description of the final Model 21.0 can be found in the 2021 SAFE document:
https://www.fisheries.noaa.gov/resource/data/2021-assessment-rex-sole-stock-gulf-alaska

Appendices:

Appendix A: Non-commercial catches

Appendix B: GOA Rex Sole 2026: Bridging Model 25.0 and Model 25.1 to SPoRC

Appendix C: September 2025 proposed Models and Responses to CIE Reviewers

Appendix D: CIE GOA rex sole discussion paper for the 2025 CIE Review

Appendix E: Excel table of survey and fishery length and age composition data, and age-length data used as inputs to the assessment

Appendix F: Excel table of numbers-at-age by area and sex estimated by Model 25.1 in 2026

Executive Summary

A full, age-structured assessment is presented for GOA rex sole. Prior to 2017, the biomass estimates of the assessment were used to calculate OFLs and ABCs using a Tier 5 management approach because F_{OFL} and F_{ABC} reference points estimated from the assessment were thought to be unreliable. In September 2017, newly available historical fishery age data were added to the assessment that substantially improved reliability of estimates of F_{OFL} and F_{ABC}. Therefore, all estimates from the assessment were used to calculate OFLs and ABCs using a Tier 3a management approach from the 2017 assessment to the present.

Summary of Changes in Assessment Inputs

The following data sources were updated with newest years of data:

(1) 2012-2026 catch biomass was added to the model
(2) 2021 catch biomass was updated to reflect final (rather than projected) catches
(3) 2022-2026 fishery length composition data were added to the model and 2021 fishery length composition data were updated to reflect October – December catches
(4) 2021-2024 fishery age composition data were added to the model
(5) 2023 and 2025 GOA trawl survey biomass estimates were added to the model
(6) 2023 and 2025 GOA trawl survey length composition data were added to the model
(7) 2021, 2023, and 2025 GOA trawl survey age-at-length data were added to the model
(8) Iterative data weighting (Francis 2011) was conducted and updated after the addition of new data.

Summary of Changes in Assessment Methodology

(1) Fishery age composition data are calculated using methods from the sampler repository.
(2) The logspace standard error corresponding to survey biomass data in the Eastern GOA was updated to correct a smaller error where CV was used in place of logspace standard error in the 2021 assessment
(3) The 1984 and 1987 survey biomass data for the Eastern GOA were inadvertently included in the 2021 assessment and have been removed.
(4) An ageing error matrix specific to GOA rex sole was added to the model

Summary of Results

The key results of the assessment, based on the author's preferred (base case) model, are compared to the key specifications from 2024 in the table below. A Tier 3a approach was used to calculate recommended quantities for the 2021 assessment. Three tables are presented. The first shows quantities for the entire GOA, showing quantities as specified in the 2024 harvest projections and quantities recommended for the 2026 assessment using a Tier 3a approach. The second table describes the Western-Central GOA where length-at-age is larger than for the Eastern GOA, based on a Tier 3a approach. The third table shows quantities for the Eastern GOA, also based on a Tier 3a approach.

Table 1. Relevant management quantities for the GOA rex sole stock. Area-specific management quantities in Table 2-Table 3 are summed where possible to calculate the quantities in this table.

Quantity	As estimated or *specified this* year for: 2025	2026	As estimated or *recommended this* year for: 2027	2028
M (natural mortality rate)	0.17	0.17	0.17	0.17
Tier	3a	3a	3a	3a
Projected total (3+) biomass (t)	129,835	129,082	98,311	97,271
Female spawning biomass (t)	61,695	61,649	48,911	47,195
$B_{100\%}$	See area-specific tables below		See area-specific tables below	
$B_{40\%}$				
$B_{35\%}$				
F_{OFL}				
$maxF_{ABC}$				
F_{ABC}				
OFL (t)	26,002	25,743	19,523	18,683
maxABC (t)	21,387	21,173	16,077	15,381
ABC (t)	21,387	21,173	16,077	15,381
Status	As determined *last* year for: 2023	2024	As determined *this* year for: 2025	2026
Overfishing	no	n/a	no	n/a
Overfished	n/a	no	n/a	no
Approaching overfished	n/a	no	n/a	no

Table 2. Relevant management quantities for the Western-Central GOA area modeled

Quantity: (Western-Central GOA)	As estimated or *specified this* year for:		As estimated or *recommended this* year for:	
	2025	2026	2027	2028
M (natural mortality rate)	0.17	0.17	0.17	0.17
Tier	3a	3a	3a	3a
Projected total (3+) biomass (t)	104,776	104,311	79,489	78,746
Female spawning biomass (t)	50,756	50,811	40,304	38,952
$B_{100\%}$	46,850	46,850	41,255	41,255
$B_{40\%}$	18,740	18,740	16,502	16,502
$B_{35\%}$	16,398	16,398	14,439	14,439
F_{OFL}	0.28	0.28	0.28	0.28
$maxF_{ABC}$	0.23	0.23	0.22	0.22
F_{ABC}	0.23	0.23	0.22	0.22
OFL (t)	20,747	20,572	15,575	14,925
maxABC (t)	17,080	16,935	12,839	12,300
ABC (t)	17,080	16,935	12,839	12,300
Status	As determined *last* year for:		As determined *this* year for:	
	2023	2024	2025	2026
Overfishing	no	n/a	no	n/a
Overfished	n/a	no	n/a	no
Approaching overfished	n/a	no	n/a	no

* Projections are based on estimated catches of 1,242 t and 514 t that was used in place of maximum permissible ABC for 2026 and 2027-2028, respectively. The 2026 estimated catches were calculated by dividing the current realized catches from January 1 to August 29 for 2026 by the long-term mean proportion of annual catches occurring between January 1 and August 29. The 2027-2028 estimated catches were set equal to the average GOA rex sole catches over the 5 previous years.

Table 3. Relevant management quantities for the Eastern GOA area modeled

Quantity: (Eastern GOA)	As estimated or *specified this* year for: 2025	2026	As estimated or *recommended this* year for: 2027	2028
M (natural mortality rate)	0.17	0.17	0.17	0.17
Tier	3a	3a	3a	3a
Projected total (3+) biomass (t)	25,059	24,771	18,822	18,525
Female spawning biomass (t)	10,939	10,838	8,607	8,243
$B_{100\%}$	8,998	8,998	7,823	7,823
$B_{40\%}$	3,599	3,599	3,129	3,129
$B_{35\%}$	3,149	3,149	2,738	2,738
F_{OFL}	0.31	0.31	0.3	0.3
$maxF_{ABC}$	0.25	0.25	0.24	0.24
F_{ABC}	0.25	0.25	0.24	0.24
OFL (t)	5,255	5,171	3,948	3,758
maxABC (t)	4,307	4,238	3,238	3,081
ABC (t)	4,307	4,238	3,238	3,081
Status	As determined *last* year for: 2023	2024	As determined *this* year for: 2025	2026
Overfishing	no	n/a	no	n/a
Overfished	n/a	no	n/a	no
Approaching overfished	n/a	no	n/a	no

* Projections are based on estimated catches. The 2026 estimated catches were calculated by dividing the current realized catches from January 1 to August 29 for 2026 by the long-term mean proportion of annual catches occurring between January 1 and August 29. The 2027-2028 estimated catches were set equal to the average GOA rex sole catches over the 5 previous years. Catches in the Eastern GOA are often confidential.

Spatial Apportionment: Biologically-informed Recommended Distributions (BRDs) (Previously Area Allocation of ABC)

The table below shows BRDs for 2027 and 2028 by area. Recommended ABCs apply only at the stock level. The portion of the recommended ABC corresponding to the Western-Central area (based on model estimates) are apportioned based on random effects model predictions of the proportion of Western-Central survey biomass in the Western and Central areas, respectively, in 2027-2028. Likewise, the portion of the recommended ABC corresponding to the Eastern area (based on model estimates) are apportioned based on random effects model predictions of the proportion Eastern survey biomass in the West Yakutat and Southeast areas, respectively. The random effects model was implemented in the rema package (Sullivan et al. 2022, https://github.com/afsc-assessments/rema).

Table 4. Biologically-informed recommended distributions by NMFS statistical area for GOA rex sole

Quantity	Western	Central	Total Western-Central	West Yakutat	Southeast	Total Eastern
Proportion	21.7%	78.3%	100.0%	47.3%	52.7%	100.0%
2027 (t)	2,786	10,053	12,839	1,532	1,706	3,238
2028 (t)	2,669	9,631	12,300	1,457	1,624	3,081

5 Year Projections

Table 5 and Table 6 show five-year projections for the Western-Central and Eastern GOA, respectively, based on area-specific estimated catch for 2026 (the same as those assumed for developing Table 2-Table 3), the ABCs from Table 2-Table 3 for 2027-2028, and average *F* used for 2021-2025 for 2029-2031. The ABC values are calculated using the definition in the GOA FMP.

Table 5. Five-year projections assuming fixed catches in 2027-2028 equal to the Western-Central portion of the ABC in those years, and fishing at the average *F* estimated by the assessment model from 2021-2025.

Year	Fixed Catch	OFL	ABC	Mean SSB	Mean Relative SSB
2027	12,839	15,575	12,839	40,304	0.98
2028	12,300	12,282	10,120	32,090	0.78
2029	538	9,818	8,085	25,369	0.61
2030	570	10,404	8,568	26,314	0.64
2031	604	11,023	9,078	27,615	0.67

Table 6. Five-year projections assuming fixed catches in 2027-2028 equal to the Eastern portion of the ABC in those years, and fishing at the average *F* estimated by the assessment model from 2021-2025.

Year	Fixed Catch	OFL	ABC	Mean SSB	Mean Relative SSB
2027	3,238	3,948	3,238	8,607	1.10
2028	3,081	3,013	2,470	6,626	0.85
2029	-	2,315	1,897	5,043	0.64
2030	-	2,468	2,022	5,263	0.67
2031	-	2,626	2,152	5,553	0.71

Responses to SSC and Plan Team Comments on Assessments in General

Sept 2025, PT: The Team appreciates the greater use of Input Sample Size (ISS) for age and length composition data from surveys. The Team also recommended that authors continue to work with other research partners to develop methods and software to develop an ISS for fishery age and length composition samples.
An R package is in development (pers. comm. Hulson) for calculating fishery input sample sizes for age and length composition data. The 2026 GOA rex sole model utilizes the number of hauls as the yearly input sample sizes for survey and fishery age- and length-composition data currently and will explore use of input sample size for all sources of composition data when the fishery ISS package is ready for use.

Sept 2025, PT: Multiple GOA assessments may use, or could potentially use, water temperature covariates, and the Team recommended that authors continue to collaborate across assessments to develop a temperature product using spatial delta correction that calibrates numerical models (e.g., HYCOM) and in situ measurements.

The 2026 GOA rex sole assessment model does not use water temperature covariates. Relationships between GOA rex sole dynamics and environmental covariates could be explored for future assessments.

Nov 2023, PT: "*The Team recommended as a best practice that appendices be linked in the front of the document (as with the sablefish assessment) to allow for an easier review of the appendices.*"
The appendices are linked separately in the Plan Team Agenda and are listed in the front of the document.

SSC, December 2023, Combined recommendations on the risk table:
"*The SSC continues to support a three-category risk table with categories normal, increased, and extreme, and requests that the category descriptions be revised to cover the range covered by the original table.*"

"*The SSC reiterates that only fishery performance indicators that provide some inference regarding biological status of the stock should be used.*"

"*The SSC recommends that the risk tables consider potential future risks when these can be anticipated.*"

"*When risk scores are reported, the SSC requests that a brief justification for each score be provided, even when that score indicates no elevated risk.*"

We follow these requests in the risk table section of the document.

Responses to SSC and Plan Team Comments Specific to this Assessment

Sept 2025, PT: The Team supported Carey's recommendation to bring forward Models 25.0 and 25.1 in November for management quantities.

Models 25.0 and 25.1 are presented in this document. Model 25.1 includes an age error matrix based on analysis of GOA rex sole age reads, and is presented as the base case model.

Oct 2025, SSC: The SSC agrees with the GOA GPT and the author's recommendation to bring forward Model 25.0 and Model 25.1 in November/December for management. The SSC also supports the research priorities list provided by the author, recognizing the potential of bringing to November the following short-term priorities: sensitivity runs for steepness, sigmaR, age at 50% maturity, and alternative data weighting approaches.

This assessment document brings forward Model 25.1 as a base case and Model 25.0 as an alternative. Appendix D provided sensitivity runs for older and younger ages at 50% maturity. The 2021 assessment provided a comparison of McAllister-Ianelli and Francis data weighting approaches. As an appendix, we present a bridging to an alternative assessment framework for this two-area model in sporc. Using sporc for future assessments, we will continue to explore steepness, sigmaR, and data weighting approaches. These explorations can be presented at the next opportunity for presenting new alternative models for GOA rex sole.

December 2017, The SSC recommends that the author prioritize the inclusion of an aging error matrix in the model for next year, which might further improve the fit to the age composition data.

Model 25.1 includes an ageing error matrix that is estimated from GOA rex sole age reader data.

Introduction

Rex sole (*Glyptocephalus zachirus*) is a right-eyed flatfish occurring from southern California to the Bering Sea and ranging from shallow water (<100m) to about 800 meters depth (Mecklenburg et al., 2002). They are most abundant at depths between 100 and 200m and are found throughout the Gulf of Alaska (GOA), with the highest biomass found in the Central GOA.

Rex sole appear to exhibit latitudinal changes in growth rates and size at sexual maturity. Abookire (2006) found marked differences in growth rates and female size at maturity between stocks in the GOA and off the coast of Oregon. Size at sexual maturity was greater for fish in the GOA than in Oregon, as was size-at-age. However, these trends offset each other such that age-at-maturity was similar between the two regions. McGilliard and Palsson (2017) found that rex sole in the Western and Central GOA tend to grow to larger maximum sizes than those in the Eastern GOA.

Rex sole are batch spawners with a protracted spawning season in the GOA (Abookire, 2006). The spawning season for rex sole spans at least 8 months, from October to May. Eggs are fertilized near the sea bed, become pelagic, and probably require a few weeks to hatch (Hosie et al. 1977). Hatched eggs produce pelagic larvae that are about 6 mm in length and are thought to spend up to 9 months in a pelagic stage in the northern GOA before settling out to the bottom as 5 cm juveniles (Abookire and Bailey 2006). Rex sole are found offshore in the GOA during the spawning season and larvae are broadly distributed over the slope and shelf. Rex sole are one of several GOA flatfish species with larvae that exhibit cross-shelf transport, moving to several nearshore nursery areas where they remain as juveniles (Bailey et al. 2008, Abookire and Bailey 2006). Several flatfish species in the Gulf of Alaska, including rex sole, Dover sole, Pacific halibut, and arrowtooth flounder have shown synchrony in recruitment patterns over time that have been linked to an environmental indicator related to sea surface height (Stachura et al. 2014).

Rex sole are benthic feeders, preying primarily on amphipods, polychaetes, and some shrimp.

Management units and stock structure

In 1993 rex sole was split out of the deep-water management category because of concerns regarding the Pacific ocean perch bycatch in the rex sole target fishery. The stock within the GOA is managed as a unit stock but with area-specific ABC and TAC apportionments to avoid the potential for localized depletion. Little is known on the stock structure of this species. However, otoliths exhibit two distinct growth patterns (pers. Comm. D. Anderl 2015) and data shown in this assessment show that length older ages in the Eastern GOA is smaller than those for the Western and Central areas.

Fishery

Rex sole in the Gulf of Alaska are caught in a directed fishery using bottom trawl gear. Typically, approximately 7 months of fishing occur between January and November and the greatest proportion of catches typically occur in the second quarter of the year (Table 9-Table 11). Catches of rex sole occur primarily in the Western and Central management area in the Gulf (statistical areas 610 and 620 + 630, respectively), with the greatest proportion of catch in the Central region (Table 9 & Table 12). Recruitment to the fishery begins at about age 5.

In 2021, the GOA groundfish trawl catcher vessel (CV) fishery was closed to directed fishing of non-pollock species from March 25-August 24. This occurred because the Chinook salmon PSC limit was reached in the Western GOA trawl CV Pacific cod fishery. This closure, along with other market pressures (potentially some due to COVID) led to very low catches of GOA rex sole in 2021 (301) as compared to other years (Table 9).

Catch is currently reported for rex sole by management area (Table 9). Catches for rex sole were estimated from 1982 to 1994 by multiplying the deepwater flatfish catch by the fraction of rex sole in the observed catch. Catches increased from a low of 93 t in 1986 to a high of 5,874 t in 1996, then declined to 1,464 t in 2004. The 2009 catch (4,753 t) was the largest since 1996. Catches declined after 1996, but increased to 3,577 t in 2014. Catches have increased since 2021 and catch as of August 22, 2026 is 1,071 t.

The catch of rex sole is widely distributed along the outer margin of the continental shelf in the central and western portions of the Gulf (Table 9) and few, if any, catches occur in the Eastern Gulf.

Historical specifications from 1995-2026 are shown in Table 13. The ABC for rex sole has been specified as the TAC in each year since 1997. The fishery catches from 2010-2014 ranged from 25-39% of the TAC and ABC. From 2016-2020 the fishery catches ranged from 8-21% of the TAC. Since 2021, between 2% and 5% of the of the ABC and TAC have been caught.

Estimates of retained and discarded catch (t) in the rex sole fishery since 1995 were calculated from discard rates observed from at-sea sampling and industry reported retained catch (Table 13). Retention of rex sole is high and has generally been over 95%, with the lowest retention on record in 2021 when catches were very low (301 t).

Data

The following data were included in the assessment model:

Table 7. Data sources and years used in the assessment model.

Source	Data	Years
NMFS Groundfish Survey	Survey Biomass	1984-1999 (triennial); 2001-2025 (biennial)
	Ages Conditioned on Length	1984, 1987, 1993, 1999; 2001-2025 (biennial)
	Age Composition*	1984, 1987, 1993, 1999; 2001-2025 (biennial)
	Length Composition	1984-1999 (triennial); 2001-2025 (biennial)
U.S. Trawl Fisheries	Catch	1982-Aug 29, 2026
	Length Composition+	1982-1984, 1990-2026
	Age Composition	1992,1995,1999,2003,2005,2007,2009,2010,2012 2014-2024

*Not included in the objective function; +Not included in the objective function in years when fishery age compositions are available

Fishery Data

This assessment used (1) fishery catches from 1982 through August 29, 2026 (Table 9, Figure 1), (2) the proportion of individuals caught by length group and sex for the years specified in the table above (through August 22, 2026; Appendix E) and (3) estimates of the proportion of individuals caught by age group and sex for the years specified in the table above. Unsexed individuals were excluded from the fishery length- and age-data.

Here, we use an approach that is standard for many AFSC assessments based on Kimura (1989), where length distributions are randomly sampled from hauls and ports, lengths are translated to ages through a year-specific age-length key for the entire fishery (which for GOA rex occurs only in the Western-Central GOA), and chosen substrata (if any) are weighted by corresponding catch weight. This analysis uses the afsc-assessments “sampler” repository (https://github.com/afsc-assessments/sampler). A wide variety of strata can be identified to weight age distributions by the strata-specific catch biomass (optional), but we assume one strata for the fishery in this assessment. The 2017 assessment (McGilliard and Palsson 2017) showed figures of fishery length-at-age data by cohort by year, management area, season, and type of sample (port vs haul). Some older cohorts appear to be smaller than older fish in newer cohorts. These older cohorts appear to be sampled at the port. No obvious area-specific differences in length-at-age can be seen from these plots. However, the fishery does not operate in the Eastern GOA. There is some variation in length-at-age by season. Future assessments could explore seasonal strata for calculating fishery age compositions.

Sample sizes for the length and age compositions were set to the number of fishery hauls for which length or age data were collected, respectively, excluding unsexed individuals (Appendix E). In cases where length or age samples were collected at a port and the number of hauls from which the age data originated was missing for that port sample, the mean number of hauls per port sample (9 hauls) was used.

Survey Data

This assessment used estimates of total biomass for rex sole in the Gulf of Alaska from triennial (1984-1999) and biennial (2001-2021) groundfish surveys conducted by the AFSC’s Resource Assessment and Conservation Engineering (RACE) division to provide an index of population abundance (Table 14). The preferred model separated estimates of biomass for eastern GOA from biomass estimates from the western and central regions (Table 14). Although survey depth coverage has been inconsistent for depth strata > 500 m, the fraction of the rex sole stock occurring in these depth strata is typically small, so the survey estimates of total biomass were not corrected for missing depth strata (Figure 2). Survey biomass has fluctuated on decadal time scales. From an initial low of ~60,000 t in 1984, estimated biomass increased to a high of almost 100,000 t in 1990, then declined during the 1990s to slightly above 70,000 t. Subsequently, survey biomass increased once again and was above 100,000 t in the 2005-2009 period. In the period from 2011 – 2017, the survey biomass was slightly lower, between 87,313 t and 101,000 t. The survey biomass for 2026 was 112,824 t. Consistently over time, survey biomass has been greatest in the Central GOA and smallest in the Western GOA, but occurs in all three regions (Central, Eastern, and Western GOA).

Estimates of the total number of individuals by length group (length compositions) from each RACE GOA groundfish survey were included in the assessment. Estimates of the distribution of ages in each year were plotted, but were not included in the objective function of any model runs, as raw age data by length were included in the model rather than age compositions (a conditional age-at-length approach).

Survey age data were available for all survey years. The age data for 1990 were excluded from the model because the underlying ages may be biased due to the age reading technique (surface age reading) used to process the otoliths.

Number of hauls for which length samples exist was used as effective sample size for length composition data. Number of otoliths aged was used as effective sample size for conditional age-at-length data. Samples collected in the Eastern GOA were entered separately from data in the Western-Central GOA.

Figure 3 shows a map of residuals from single-area sex-specific von-Bertalanffy growth curves. These figures indicate that older fish in the Eastern GOA are smaller than those in the Western and Central GOA for both males and females. Fewer very large fish (and fewer fish in general) occur at depths of 500m and deeper. Additionally, there is a small amount of variation in length-at-age over time.

Analytic Approach

Model Structure

The assessment was a split sex, age-structured statistical catch-at-age model implemented in Stock Synthesis version 3.3.25.1 (SS3) using a maximum likelihood approach. SS equations can be found in Methot and Wetzel (2013) and further technical documentation is outlined in Methot (2009). Additionally, we present a bridging exercise from ss3 to the SPoRC assessment framework in Appendix B (Cheng et al., 2026). Age classes included in the model run from age 0 to 20. The oldest age class in the model, age 20, serves as a plus group. Age at recruitment was set at 3 for the purpose of projections and calculation of management quantities, as few rex sole are observed before age 3. Survey catchability was fixed at 1.0 in previous models and was estimated with a prior based on herding experiments in the current assessment.

Age-based double-normal functions without a descending limb (instead of a logistic function) were used to model fishery and survey selectivity for all model runs. The double-normal formulation was used because the SS3 modeling framework does not currently include the option of estimating sex-specific, age-based logistic selectivity where both male and female selectivity maintain a logistic shape.

The most recent accepted model was Model 21.0 (McGilliard and Palsson 2021), which is presented this year with the addition of new data, as well as several housekeeping updates, as Model 25.0 (see Appendix C and Appendix D for more details). Model 25.1 is identical to Model 25.0 except for the inclusion of an ageing error matrix based on a time-series of age read data for GOA rex sole.

All models presented are configured with 2-areas (Eastern GOA and Western-Central GOA) with separate growth curves estimated based on survey data from each area. The models use fishery age compositions, as well as survey age-length data fit using a conditional age-at-length approach, where the likelihood components are used to fit to the proportion of observed individuals at age within each length bin. The survey data are split by region: the Eastern GOA and Western-Central GOA. Survey biomass estimates, length composition data, and conditional age-at-length data were input separately for these two regions. A single survey catchability parameter is fit and shared across the two areas. A time-invariant parameter is estimated to specify the proportion of recruits that settle in the Eastern GOA. Therefore, the models assume that recruitment in the Eastern GOA follows the same trends across years as for recruitment in the Western-Central GOA. All fishery data are input to the model and associated with only the Western-Central GOA. Survey selectivity parameters and growth parameters (von-Bertalanffy k, L_{max}, and L_{min}, and the CV of the youngest and oldest fish) were estimated for each of the two regions separately. Male survey selectivity was nearly identical to female survey selectivity in 2017 preliminary model runs (McGilliard and Palsson 2017) and therefore male and female survey selectivity is set to be equal in all model configurations. This model was implemented because fits to fishery length and age composition data were particularly poor in all one-area models that incorporated the newly available historical fishery age data (which were presented in 2017); an examination of survey and fishery length-age data showed that fish in the Eastern GOA do not grow as large as fish in the Western-Central GOA (McGilliard and Palsson 2017). The fishery only operates in the Western-Central GOA. The 2017 analysis showed that single-area model fits showed an expectation of more small fish and fewer large fish in the fishery than were observed. Model fits to all age and length composition data were substantially improved by accounting for differences in growth in the Eastern GOA as compared to the Western and Central GOA by using a two-area model configuration (see McGilliard and Palsson 2017 for more details).

Other approaches were considered in 2017 to account for the difference in growth between the Western-Central GOA and the Eastern GOA, as follows, including (1) conducting an assessment for the Western-Central GOA and using data for this region only; this method was not used because ABCs and OFLs are specified for the entire GOA and not just the Western-Central region; (2) conducting the model with survey biomass observations for the entire GOA and survey length and age data for only the Western-Central region; this method was not used because it is a mis-specification or a “hack” that could lead to biased estimates; (3) conducting separate models for the Western-Central GOA and the Eastern GOA and summing model results; this method was not used because it would require the estimation of many more parameters (including yearly recruitment deviations and yearly fishing mortality for two separate regions) and important information shared by the two areas could not be used to inform the models. In addition, distribution of recruits among areas could not be taken into account, which could lead to bias in situations where fishing intensity varies among areas (Cope and Punt 2011); (4) conducting a model with two areas and a separate growth curve in each area (as for 17.2), but estimating yearly deviations in the proportion of recruits that settle in the Eastern GOA. Model runs using this method (assuming a standard deviation of 0.5 for the distribution of deviations in proportion of fish settling in the Eastern GOA) did not improve fits to the data despite allowing the model to estimate many more parameters. Therefore, it was concluded that estimating a single, non-time-varying parameter to describe the proportion of recruits settling in the Eastern GOA (an assumption that the recruitment signal among areas is related) is reasonable.

Fishery and Survey Selectivity

The fishery and survey selectivity curves were estimated using age-based double-normal functions without a descending limb (instead of a logistic function). The SS3 modeling framework does not currently include the option of estimating sex-specific, age-based logistic selectivity where both male and female selectivity maintain a logistic shape (as was used in the previous assessment models prior to moving the model to SS). The 2015 assessment (McGilliard et al. 2015) discusses the logistic and double normal selectivity curves in detail in the context of converting the model to Stock Synthesis. Survey selectivity was made the same for males and females after preliminary model runs showed that male and female survey selectivity were estimated to be nearly identical. Fishery selectivity was sex-specific and the fishery occurred only in the Western-Central GOA. Very little data exist to inform fishery selectivity curves for the Eastern GOA because trawling is not permitted in most of the Eastern GOA. Yearly catches in the Eastern GOA are typically negligible (Table 9).

Recruitment Deviations

Recruitment deviations were estimated for an early period from 1965-1981 and a current period from 1982-2023 with a $\sigma_R = 0.6$ and were set to mean recruitment for 2024-2026 (little information exists on 0-1 year old GOA rex sole and recruitment cannot be estimated reliably for these years).

Data Weighting

Effective sample sizes for all length and age composition data were set to the number of hauls for which lengths were measured for length compositions and number of hauls for which ages were measured for age compositions (Pennington and Volstad 1994). Effective sample size for conditional age-at-length data was set at the number of individuals. Data sources were weighted relative to one another using the Francis (2011) method for all models, with values listed in Table 16.

Parameters Estimated Outside the Assessment Model

Natural mortality

Male and female natural mortality were fixed and equal to 0.17, as for previous assessments (McGilliard et al. 2015, McGilliard and Palsson 2017).

Weight-at-Age Relationship

The weight-at-age relationship was that used in the previous assessments (e.g. McGilliard and Palsson 2017) and is based on the weight-length relationship $w_L = \alpha L^{\beta}$ and the parameters of the von-Bertalanffy growth curve. The parameters of the weight-length relationship are as follows:

	α	β
Females	1.35E-06	3.44963
Males	2.18E-06	3.30571

Maturity

Abookire (2006) modeled female rex sole size-at-maturity using a logistic model, obtaining a value for size at 50% maturity of 351.7 mm with a slope of 0.0392 mm^{-1}. About half of the maturity samples were obtained from fishery catches and half from research trawls during 2000-2001. Using the mean length-at-age relationship estimated from the 1984-1996 survey data, the age at 50%-maturity was estimated at 5.7 years and the slope was equal to -1.113. Estimates of mean size-at-age for the maturity samples were similar to those for mean size-at-age estimated from the survey data (Turnock et al., 2005).

Parameters Estimated Inside the Assessment Model

Parameters estimated within all models were the log of unfished recruitment (R_0), log-scale recruitment deviations, yearly fishing mortality, sex- and area-specific parameters of the von-Bertalanffy growth curve, the CV in length-at-age of age 2 and age 20 fish, and selectivity parameters for the fishery and survey. The selectivity parameters are described in greater detail in Table 17. Survey selectivity parameters were not sex-specific and two survey selectivity curves were estimated; one for the Eastern GOA and one for the Western-Central GOA. Fishery selectivity parameters for were estimated by sex and for the Western-Central GOA only. Survey catchability was estimated within all models.

Growth

Sex-specific growth parameters ($L_{amax=20+}$, $L_{amin=2}$, k, CV of length-at-age at age 2, CV of length-at-age at age 20+) were estimated inside the assessment model for all models, these growth parameters were estimated separately for the Eastern GOA and for the Western-Central GOA for a total of 4 sets of estimated growth parameters (female Eastern GOA, male Eastern GOA, female Western-Central GOA, male Western-Central GOA).

Catchability

Catchability was estimated within a normal prior: ~N(1.2, 0.175), based on herding studies for rex sole (Somerton and Munro 2001).

Results

Model Evaluation

Comparison of models

Model 25.0 and 25.1 show very similar likelihood estimates (Table 18) and estimate nearly identical spawning biomass and fishing intensity over time (Figure 5), which is slightly lower than estimates from the 2021 assessment from the early 2000s to 2021. There are small differences in recruitment estimates across models, with very similar trends across time (Figure 5). The addition of adding an ageing error matrix that accounts for variability in age reads (Model 25.1) leads to a small smoothing effect in recruitment estimates, as is expected. A large 2015 year-class was estimated by all models, with larger-than-average year classes in 2016 and 2017 (Figure 5, Table 30). Recruitment deviations are very similar across models as well (Figure 6). Estimates of growth and selectivity parameters are very similar across models as well (Figure 7,Table 19, Table 20).

Fits to the survey index data for Models 25.0 and 25.1 are similar (Figure 4). The decrease in survey biomass in 2023 and 2025 in the Western-Central GOA and the increase in survey biomass in the Eastern GOA in 2025 cannot be fully explained by any of the models presented. Plausible explanations for these shifts are discussed below under “The base case model (Model 25.1).” Time-aggregated fits of the von-Bertalanffy growth curve to age-length data, and corresponding 95% asymptotic confidence intervals are nearly identical across models (Figure 8, Table 19). Time-aggregated fits to fishery and survey length composition data are nearly identical across models as well (Figure 9). Time-aggregated fits to fishery age data show a difference in fits to fishery age data at age 7 for females and age 6 for males between Model 25.1 (with an ageing error matrix) and Model 25.0 (without the age error matrix), where Model 25.1 achieves a better fit for those ages (Figure 10). Additionally, there are small differences in the time-aggregated estimated proportion of age 17-20+ individuals caught in the fishery across models (Figure 10).

Table 21 shows estimated mean recruitment (which is lnR0 in this model, as steepness is set equal to 1 and a dev vector is used for recruitment deviations), catchability, and the time-invariant recruitment allocation parameter across models. The addition of an ageing error matrix shifted the estimate of catchability in real-space from 1.17 (for the 2021 accepted model) to 1.25 (for Model 25.1). The standard deviation of log-space catchability estimates is relatively large (0.091-0.1). The proportion of individuals recruiting to the eastern GOA range is estimated to be 0.29 in real-space across all models. Estimated mean recruitment is lower in Model 25.1 (87,737 in real-space) than for Model 25.0 (93,901) and for the 2021 accepted model (103,084).

The base case model (Model 25.1)

Model 25.1 is presented as the base case (or author’s preferred) model for the 2026 assessment, as it improves the representation of uncertainty in the model by explicitly accounting for variability among age reads of GOA rex sole otoliths (Appendix A). Model 25.1 converged with a final gradient of 2.38431e-06 and with a total likelihood value of 774 consistently in a jitter analysis including 500 model runs. Estimated survey biomass was larger than the observed survey biomass in the Western-Central GOA in 2025 (and smaller than observed survey biomass in 2023), the two most recent data points. In addition, the estimated survey biomass in the eastern GOA was larger than observed in both 2023 and in 2025 (Figure 4).

Figure 12-Figure 13 shows model fits to yearly fishery length and age composition data, respectively. Fits to fishery length and age comps are generally reasonable, but vary over time. However, fits to fishery length composition data in 2025 and fits to age composition data for 2023-2024 show residual patterns. The expected 2025 fishery length composition does not explain the high proportion of observed females of intermediate length (35-45cm; Figure 12), and the expected 2023-2024 age composition predicts a larger proportion of females of intermediate age (age 6-9) than were observed (Figure 13).

Figure 14-Figure 15 show yearly fits to survey length composition data for the Western-Central and Eastern GOA, respectively. The model generally fits the survey length composition data very well, but the model estimates of the proportion of 35-45cm females in the Western-Central GOA are smaller than proportion observed (Figure 14). In the Eastern GOA, in 2025 fewer females of length 25-35cm were observed than estimated, and there were many more 28-35cm males observed than expected (Figure 15).

Figure 16-Figure 19 and Figure 20-Figure 23 show the yearly observed and estimated survey mean age-at-length and standard deviations corresponding to the mean estimates for the Western-Central GOA and Eastern GOA, respectively. There is some variability in model fits to survey mean age-at-length across years, but with many years showing very good fits to the data. However, in 2025 there were more old, small fish in the data than were predicted by the model in the Western-Central GOA (Figure 19). In the Eastern GOA, there is a general pattern from 2015 onward where mean age-at-length data points for older fish were bigger fish than expected for their age (Figure 15).

In summary, the current model configuration is not fully explaining the observed population dynamics in 2025, and to some extent in 2023-2024 (for fishery ages), but explains the dynamics over the historical period reasonably well, with some variation over time in fits to conditional age-at-length data. One explanation for mismatches in fits to mean age-at-length data for 2025 is that there may have been more exchange between the two areas of fish representing each growth pattern, and in particular movement of fish from the Eastern GOA to the Western-Central GOA. A survey re-design occurred in 2025 where the number of strata were reduced to improve stability and variance estimates and the strata were newly aligned with NMFS statistical areas, rather than INPFC area definitions; it is plausible that the survey re-design may have contributed to differences between historical and 2025 fits to the data, noting that simulation analysis showed that the redesign was unlikely to introduce bias in biomass estimates (Laman et al., 2025). . There may be additional explanations for the dynamics observed in 2025. The model estimates time-invariant growth and it may be worthwhile to do further exploration of whether time-varying growth is occurring in future assessments. In Appendix B we present a transition from the ss3 modeling framework to the Stochastic Population Model Over Regional Components (SPoRC) modeling framework (Cheng et al., 2026). The SPoRC modeling framework is able to maintain the two-area configuration of the current model, while offering additional features, such as alternative assumptions for recruitment allocation across areas and sex-specific adult movement dynamics. Given the difference between the Western-Central and Eastern GOA in fishing intensity, it may be possible to explore hypotheses about time-varying and spatially-varying dynamics for the stock.

Time Series Results

Age 3 recruitment, age 0 recruitment, and standard deviations of age 0 recruitment are presented in Table 30. Total biomass for ages 3+, spawning stock biomass, and standard deviations of spawning stock biomass estimates for the previous and current assessments are presented in Table 31.

Female and male estimates of numbers-at-age for the current assessment are shown Appendix F.

Figure 24 shows spawning stock biomass estimates and corresponding asymptotic 95% confidence intervals.

Retrospective analysis

Spawning stock biomass and corresponding 95% asymptotic confidence intervals from a retrospective analysis extending back 10 years using Model 25.1 are shown in Figure 25. A relatively small retrospective pattern exists for spawning biomass, with higher end-year values for spawning biomass estimated when omitting 3-5 years of data. These differences correspond with shifts in selectivity parameter estimates over peels. Mohn's ρ for spawning biomass, recruitment, and fishing mortality are as follows:

Spawning Biomass	Recruitment	Fishing Mortality
0.045	0.19	-0.038

Harvest Recommendations

A Tier 3a management approach was used for rex sole harvest recommendations. The reference fishing mortality rate for rex sole is determined by the amount of reliable population information available (Amendment 56 of the Fishery Management Plan for the groundfish fishery of the Gulf of Alaska). Estimates of $F_{40\%}$, $F_{35\%}$, and $SPR_{40\%}$ were obtained from a spawner-per recruit analysis separately for the Western-Central GOA and the Eastern GOA. Assuming that the average recruitment of age 3 individuals from 1982-2026 in each area estimated in this assessment represents a reliable estimate of equilibrium recruitment, then an estimate of $B_{40\%}$ is calculated as the product of $SPR_{40\%}$ times the equilibrium number of recruits. Since reliable estimates of the spawning biomass (B), $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist and $B>B_{40\%}$, the rex sole reference fishing mortality is defined in Tier 3a. For this tier, F_{ABC} is constrained to be $\leq F_{40\%}$, and F_{OFL} is defined to be $F_{35\%}$. The values of these quantities are:

Table 8. Summary of 2027 management-related quantities

	Western-Central GOA	Eastern GOA
SSB 2027	40,304	8,607
B_{40}	16,502	3,129
F_{40}	0.22	0.24
$maxF_{ABC}$	0.22	0.24
B_{35}	14,439	2,738
F_{35}	0.28	0.30
F_{OFL}	0.28	0.30

Because the rex sole stock has not been overfished in recent years and the stock biomass is relatively high, it is not recommended to adjust F_{ABC} downward from its upper bound.

A standard set of projections is required for each stock managed under Tiers 1, 2, or 3, of Amendment 56. This set of projections encompasses harvest scenarios designed to satisfy the requirements of Amendment 56, the National Environmental Policy Act, and the Magnuson-Stevens Act (MSA). The software used for projections was spmR: https://github.com/afsc-assessments/spmR. Documentation with examples for spmR can be found at https://afsc-assessments.github.io/spmR/index.html. For each scenario, the projections begin with the vector of 2026 numbers-at-age estimated in the assessment. This vector is then projected forward to the beginning of 2027 using the schedules of natural mortality and selectivity described in the assessment and the best available estimate of total (year-end) catch for 2026. In each subsequent year, the fishing mortality rate is prescribed on the basis of the spawning biomass in that year and the respective harvest scenario. In each year, recruitment is drawn from an inverse Gaussian distribution whose parameters consist of maximum likelihood estimates determined from recruitments estimated in the assessment. Spawning biomass is computed in each year based on the time of peak spawning and the maturity and weight schedules described in the assessment. Total catch is assumed to equal the catch associated with the respective harvest scenario in all years. This projection scheme is run 1000 times to obtain distributions of possible future stock sizes, fishing mortality rates, and catches.

Five of the seven standard scenarios are designed to provide a range of harvest alternatives that are likely to bracket the final TACs for the next 2 fishing years and are as follows ("max F_{ABC}" refers to the maximum permissible value of F_{ABC} under Amendments 56.

> *Scenario 1*: In all future years, F is set equal to max F_{ABC}. (Rationale: Historically, TAC has been constrained by ABC, so this scenario provides a likely upper limit on future TACs.)
>
> *Scenario 2*: In the event that catch is likely to be less than the recommended ABC in either of the first two projection years, *Scenario 2* must be conducted, using the best estimates of catch in those two years (otherwise, *Scenario 2* can be omitted if the author's recommended ABCs for the next two years are equal to the maximum permissible ABCs). In all future years after the first two projection years, F is set equal to a constant fraction ("author's F") of max F_{ABC}, where this fraction is equal to the ratio of the F_{ABC} value for *2027* recommended in the assessment, to the maxF_{ABC} for *2027*, and catches for *2027* and *2028* are estimated at their most likely values given the assessment *2027 and 2028* recommended ABCs under this scenario. (Rationale: When F_{ABC} is set at a value below max F_{ABC}, it is often set at the value recommended in the stock assessment; also, catch tends not to equal ABC exactly.)
>
> *Scenario 3*: In all future years, F is set equal to the *2021* to *assessment 2025* average F. (Rationale: For some stocks, TAC (and catch) can be well below ABC, and recent average F may provide a better indicator of future catches than those from F_{TAC} or F_{ABC}.)
>
> *Scenario 4 (optional)*: In all future years, the upper bound on F_{ABC} is set at a selected fraction of F_{ABC}. (Rationale: This scenario provides a likely lower bound on F_{ABC} that still allows future harvest rates to be adjusted downward when stocks fall below reference levels.). This scenario is optional and is up to the author's discretion. If *Scenario 4* is presented, state the selected fraction of F_{ABC} used in the projection.
>
> *Scenario 5*: In all future years, F is set equal to zero. (Rationale: In extreme cases, TAC may be set at a level close to zero.)

Two other scenarios are needed to satisfy the MSFCMA's requirement to determine whether a stock is currently in an overfished condition or is approaching an overfished condition. These two scenarios are as follows (for Tier 3 stocks, the MSY level is defined as $B_{35\%}$):

> *Scenario 6*: In all future years, F is set equal to F_{OFL}. (Rationale: This scenario determines whether a stock is overfished. If the stock is 1) above its MSY level in *2027* or 2028) above 1/2 of its MSY level in *2027* and expected to be above its MSY level in *2036* under this scenario, then the stock is not overfished.)
>
> *Scenario 7*: In *2027 and 2028*, F is set equal to max F_{ABC}, and in all subsequent years, F is set equal to F_{OFL}. (Rationale: This scenario determines whether a stock is approaching an overfished

condition. If the stock is 1) above its MSY level in *2028* or 2) above 1/2 of its MSY level in *2027* and expected to be above its MSY level in *2038* under this scenario, then the stock is not approaching an overfished condition.).

Scenario 6 and 7 results for the Western-Central GOA area

The results of these two scenarios indicate that the Western-GOA subpopulation is not overfished and is not approaching an overfished condition. With regard to assessing the current subpopulation biomass level, the expected subpopulation size in the year 2027 of scenario 6 is 40,304 t, more than 2 times $B_{35\%}$ (14,439 t). Thus, the subpopulation is not currently overfished. With regard to whether the subpopulation is approaching an overfished condition, the expected spawning subpopulation size in the year 2038 of scenario 7 (15,722 t) is greater than $B_{35\%}$; thus, the subpopulation is not approaching an overfished condition.

Scenario 6 and 7 results for the Eastern GOA area

The results of these two scenarios indicate that the subpopulation is not overfished and is not approaching an overfished condition. With regard to assessing the current subpopulation biomass level, the expected subpopulation size in the year 2027 of scenario 6 is 8,607 t, more than 2 times *B35%* (2,738 t). Thus the subpopulation is not currently overfished. With regard to whether the subpopulation is approaching an overfished condition, the expected spawning subpopulation size in the year 2038 of scenario 7 (2,976 t) is greater than $B_{35\%}$; thus, the subpopulation is not approaching an overfished condition.

Status determination of the GOA rex sole stock

The results for Scenarios 6 and 7 for the Western-Central and Eastern GOA subpopulations show that neither subpopulation is overfished or approaching an overfished condition. Therefore, the GOA rex sole stock is not overfished or approaching an overfished condition.

Spatial Apportionment: Biologically-informed Recommended Distributions (BRDs; Previously Area Allocation of ABC)

The Table 4 (repeated below for ease of reading) shows BRDs by area for the next two years. The recommended ABC applies only at the stock level. The portion of the recommended ABC corresponding to the Western-Central area (based on model estimates) is apportioned based on random effects model predictions of the proportion of Western-Central survey biomass in the Western and Central areas, respectively, in the next two years. Likewise, the portion of the recommended ABC corresponding to the Eastern area (based on model estimates) is apportioned based on random effects model predictions of the proportion Eastern survey biomass in the West Yakutat and Southeast areas, respectively. The random effects model was implemented in rema (Sullivan et al., 2022).

Table 4, repeated: Biologically-informed recommended distributions of ABC by NMFS statistical area for GOA rex sole

Quantity	Western	Central	Total Western-Central	West Yakutat	Southeast	Total Eastern
Proportion	21.7%	78.3%	100.0%	47.3%	52.7%	100.0%
2027 (t)	2,786	10,053	12,839	1,532	1,706	3,238
2028 (t)	2,669	9,631	12,300	1,457	1,624	3,081

Risk Table

Overview

The following template is used to complete the risk table: A general description of guidance and the risk table template that applies to all risk tables is included in the SAFE Introduction. In this section we apply the risk table framework to our current knowledge about the GOA rex sole stock in 2026.

Assessment considerations

The GOA rex sole assessment data inputs of survey biomass, survey length composition, survey conditional age-at-length, and fishery age and length composition, are generally adequate. One concern is that the fishery selectivity curve and maturity curve are estimated to be similar (Figure 7). Therefore, a small shift in either curve could have a substantial impact on reference points. Alternative ages at 50% maturity were explored in the discussion paper presented at the CIE review (Appendix D). A second concern is that the current survey biomass estimated by the model just within the uncertainty bounds of the asymptotic 95% confidence interval about the most recent survey data point for the Western-Central and Eastern GOA, with the model overestimating 2025 survey biomass in the Western-Central GOA and underestimating survey biomass in the Eastern GOA. A third concern is that the quality of fits to some conditional age-at-length data fluctuate over time, indicating that there may be a time-varying pattern in growth that is not currently modeled. Future analysis could continue to improve accounting for uncertainty within the model by exploring estimation of natural mortality within the model. The fact that maturity-at-age is similar to fishery selectivity-at-age is potentially impactful. Therefore, the assessment considerations column of the risk table is assigned a 2 for “substantially increased assessment uncertainty/ unresolved issues.”

Population dynamics considerations

Population dynamics are within the historical range. Therefore, we assign a risk level of 1 for population dynamics considerations.

Environmental/Ecosystem considerations

The most recent data available suggest an ecosystem risk Level 1 – Normal: “No apparent environmental/ecosystem concerns.” This score is informed by ecosystem conditions for rex sole recruiting to the fishery in 2027 (2020-2022 cohorts) and 2026/2027 adult ecosystem conditions. Overall, ocean temperatures were within range for rex sole life stages. The 2025 survey showed average to below average prey abundance, and moderate levels of competition and predation. The 2026 Ecosystem Status Report has not been produced at the time of this writing and primary sources of information include past Ecosystem Status Reports and the 2026 NOAA Alaska Fisheries Science Center Preview of Ecosystem and Economic Conditions workshop (PEEC 2026).

<u>Environmental Processes:</u> Thermal conditions for age-0 rex sole from 2020-2022 were challenging (the year 2020 was warmth at depth) to beneficial (periods of warm sea surface temperatures) and adult thermal conditions have been challenging (2025 warmth at depth) to average. The 2020 age-0 rex sole may have benefitted from warmer ocean conditions (warmer SST in the later half of year) and increased cross-shelf and along-shelf transport (stronger eddies) 2020 (Ferriss, 2020). GOA ocean spring temperatures and transport fluctuated in 2021 and 2022 but were not extreme in any direction. Limited data in 2026 reflect approximately average sea surface temperatures (cooled from 2025) but potentially warm water at depth on the shelf (Callahan, PEEC 2026 and Danielson, PEEC 2026). El Niño conditions may become apparent in the GOA during the winter and spring of 2027, including potentially warmer surface waters, increased eddy intensity, and changes in the forage prey base. There are no documented direct connections between El Niño events and rex sole population dynamics, however age-0 survival

may increase with warmer sea surface temperatures, providing conditions that may make a strong 2027 age class more likely.

Prey: Prey of rex sole include primarily shrimp, amphipods, and worms. Prey availability and nutritional quality appeared to be approximately average in 2025. There is potential for lower prey availability in 2027 due to El Niño conditions. Shrimp biomass in 2025 (as estimated by the AFSC bottom trawl survey; Friedman 2025, in Ferriss 2025) was approximately average. Biomass of marine worms in 2025 remained low but relatively unchanged since 2019 (as estimated by non-target catch from groundfish fisheries, Whitehouse & Gaichas 2025, in Ferriss 2025). Amphipods in Icy Strait, SE Alaska, had above average lipid anomalies (Fergusson and Strasburger, 2025, in Ferriss 2025). The mean body condition of adult rex sole was below average in the summer of 2025, similar to 2021 and 2017, indicating potentially reduced quality and quantity of prey resources (Prohaska and Rohan, 2025, in Ferriss 2025). Adult condition was average in 2023 and 2019. There are no early indications of prey limitations in the GOA shelf system that would impact adult rex sole (PEEC 2026).

Predators & Competitors: Predators of rex sole include primarily sharks, skates, rays, lingcod, arrowtooth flounder, and some species of rockfish (Kemper et al. 2017). There may be an increase in predation pressure from the gradually increasing arrowtooth flounder population, however that population remains relatively low (Shotwell et al., 2026). There is potential for decreased competition for zooplankton from low returns of pink salmon in 2026. Predators of rex sole include primarily sharks, skates, rays, lingcod, arrowtooth flounder, and some species of rockfish. Survey-based estimates of GOA arrowtooth flounder populations have been gradually increasing since a low in 2017, but still remain below the long-term mean (Shotwell et al., 2023). Survey-based estimates of GOA skates in 2023 remain relatively unchanged since 2021. Lingcod and sharks are not well monitored in the GOA.

Fishery performance

There are no known concerns about the ABC for the species based on fishery performance. Therefore, the fishery performance column of the risk table is assigned a 1 for “No apparent fishery/resource-use performance and/or behavior concerns.”

Summary and ABC recommendation

Assessment-related considerations	*Population dynamics considerations*	*Environmental/ ecosystem considerations*	*Fishery Performance considerations*
Level 2: substantially increased concerns	Level 1: substantially increased concerns	Level 1: no increased concerns	Level 1: no increased concerns

Based on these scores, the authors do not recommend a reduction in ABC for 2027.

F_{limit}

The fishing mortality that is predicted to result from fishing the OFL in 2025 is F_{limit} = 0.46.

Ecosystem Considerations

Ecosystem effects on the stock

Also see the “Environmental/Ecosystem Considerations” description for the Risk Table above.

Prey availability/abundance trends

Based on results from two ecosystem models for the Gulf of Alaska (Ferriss et al., in press, Surma et al., in preparation), adult rex sole occupy a trophic level of 3.5 in the western and eastern GOA (Figure 28). In the western GOA, their primary prey include infauna (primarily polychaetes and miscellaneous worms), euphausiids, mysids, benthic amphipods, Tanner crab, shrimp, and other motile epifauna (Figure 29). In the eastern GOA, adult rex sole feed primarily on various motile epifauna and infauna, in addition to mysids and euphausiids. The model is parameterized with rex sole food habits data from NOAA bottom trawl surveys in the GOA from 1990–2013 (when available), some of which is also summarized in (Yang, 1993; Yang and Nelson, 2000). Little to no information is available to assess trends in abundance for the major benthic prey species of rex sole (but see Reum et al., 2025 for methods that could be used to explore this for GOA species in the future). Future research may include the exploration of temporal trends in rex sole food habits.

Predator population trends

Important predators on rex sole in the Gulf of Alaska include arrowtooth flounder (*Atheresthes stomias*), northern elephant seals (*Mirounga angustirostris, eastern GOA only*), harbor seals (*Phoca vitulina*), northern fur seals (*Callorhinus ursinus*; western GOA only), Pacific sleeper sharks (*Somniosus pacificus*), Pacific cod (*Gadus macrocephalus*), walleye pollock (*G. chalcogrammus*), Pacific halibut (*Hippoglossus stenolepis*), and seabirds. Additional predators on juvenile rex sole in the eastern GOA include salmon (*Oncorhynchus* spp.), and gelatinous carnivores (Figure 30). According to the ecosystem models, a large proportion of rex sole mortality in the GOA is not due to predation or fishing.

Fishery Effects on the Ecosystem

Table 32-Table 34 show the contribution of the GOA rex sole fishery to bycatch of FMP, non-target, ecosystem, and prohibited species. No birds were recorded as bycatch in the GOA rex sole fishery. The 2021 data are current up to September 3, 2026.

Data gaps and research priorities

Updated information on maturity-at-age for GOA rex sole would reduce uncertainty in the maturity curve relative to the fishery selectivity curve, as this is important for the determination of F_{OFL} and F_{ABC} for this stock. Further exploration of natural mortality rates for GOA rex sole could be conducted. Estimating natural mortality within the assessment would better account for uncertainty. Further analysis could explore time-varying growth for GOA rex sole, outside of the assessment model, or by way of using yearly and area-specific empirical weight-at-age instead of estimating growth within the assessment model. Given the fits to 2025 survey data, further analysis could explore time-varying availability and adult movement by area using the SPoRC assessment framework. The SPoRC framework could be used to explore additional assumptions about juvenile and adult connectivity of GOA rex sole between the Western-Central and Eastern GOA over time and would integrate the model configuration with the projections.

This assessment showed that growth curves in the Eastern GOA differ from those in the Western and Central GOA. The age and growth laboratory previously noted that GOA rex sole otoliths appear to show two different patterns for the same age and year of fish, corroborating the results of this assessment. Further research could be conducted to determine whether the two growth patterns represent two genetic sub-stocks or one genetic sub-stock where environmental conditions or other ecosystem dynamics contribute to different growth rates in the two regions modeled in this assessment.

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Tables

Table 9. Fishery catches for GOA rex sole. Catch for 2026 is through August 22, 2026.

Year	Total Catch	Year	Total Catch
1982	959	2010	3,669
1983	595	2011	2,878
1984	365	2012	2,443
1985	154	2013	3,700
1986	93	2014	3,577
1987	1,151	2015	1,957
1988	1,192	2016	1,749
1989	599	2017	1,484
1990	1,269	2018	1,750
1991	4,636	2019	1,612
1992	3,000	2020	1,238
1993	3,000	2021	301
1994	3,642	2022	696
1995	4,021	2023	412
1996	5,945	2024	559
1997	3,296	2025	604
1998	2,671	2026	1,071
1999	3,059		
2000	3,592		
2001	2,943		
2002	3,017		
2003	3,499		
2004	1,467		
2005	2,180		
2006	3,295		
2007	2,851		
2008	2,707		
2009	4,753		

Table 10. Proportion of catch by gear 1994 to August 22, 2026.

Year	Pelagic trawl	Non-Pelagic Trawl
1996	0.00	1.00
1997	0.01	0.99
1998	0.00	1.00
1999	0.00	1.00
2000	0.00	1.00
2001	0.02	0.98
2002	0.01	0.99
2003	0.00	1.00
2004	0.02	0.98
2005	0.01	0.99
2006	0.02	0.98
2007	0.01	0.99
2008	0.01	0.99
2009	0.00	1.00
2010	0.01	0.99
2011	0.00	1.00
2012	0.01	0.99
2013	0.00	1.00
2014	0.01	0.99
2015	0.01	0.99
2016	0.01	0.99
2017	0.00	1.00
2018	0.01	0.99
2019	0.01	0.99
2020	0.00	1.00
2021	0.05	0.95
2022	0.02	0.98
2023	0.07	0.93
2024	0.02	0.98
2025	0.02	0.98
2026	0.00	1.00

Table 11. Proportion of catch by quarter 1994-August 22, 2026.

Year	Quarter 1	Quarter 2	Quarter 3	Quarter 4
1994	0.14	0.38	0.35	0.13
1995	0.24	0.47	0.19	0.10
1996	0.33	0.33	0.22	0.12
1997	0.44	0.25	0.10	0.21
1998	0.31	0.48	0.17	0.04
1999	0.25	0.48	0.18	0.08
2000	0.20	0.58	0.15	0.07
2001	0.19	0.62	0.13	0.06
2002	0.14	0.67	0.16	0.04
2003	0.13	0.59	0.17	0.11
2004	0.17	0.51	0.26	0.05
2005	0.34	0.40	0.23	0.03
2006	0.24	0.29	0.31	0.15
2007	0.31	0.38	0.14	0.18
2008	0.23	0.43	0.24	0.10
2009	0.22	0.37	0.24	0.17
2010	0.17	0.52	0.09	0.21
2011	0.20	0.49	0.17	0.15
2012	0.20	0.45	0.19	0.16
2013	0.23	0.61	0.03	0.13
2014	0.20	0.66	0.05	0.08
2015	0.10	0.58	0.07	0.26
2016	0.22	0.48	0.08	0.22
2017	0.17	0.47	0.14	0.22
2018	0.14	0.57	0.05	0.24
2019	0.19	0.58	0.03	0.19
2020	0.12	0.73	0.05	0.09
2021	0.02	0.26	0.30	0.42
2022	0.01	0.71	0.21	0.07
2023	0.03	0.62	0.21	0.14
2024	0.01	0.49	0.12	0.38
2025	0.11	0.53	0.12	0.23
2026	0.33	0.48	0.19	NA

Table 12. Proportion of catch by NMFS area for 1994-August 22, 2026.

Year	610	620	630	640	650
1994	0.01	0.37	0.60	0.02	0.00
1995	0.05	0.34	0.56	0.04	0.00
1996	0.09	0.52	0.35	0.03	0.00
1997	0.21	0.52	0.22	0.04	0.01
1998	0.16	0.30	0.52	0.01	0.00
1999	0.20	0.45	0.33	0.01	0.01
2000	0.25	0.33	0.42	0.00	0.00
2001	0.15	0.37	0.49	0.00	0.00
2002	0.13	0.49	0.38	0.00	0.00
2003	0.22	0.49	0.29	0.00	0.00
2004	0.36	0.17	0.47	0.00	0.00
2005	0.26	0.37	0.36	0.00	0.00
2006	0.11	0.45	0.44	0.00	0.00
2007	0.14	0.27	0.59	0.00	0.00
2008	0.07	0.26	0.67	0.00	0.00
2009	0.07	0.50	0.43	0.00	0.00
2010	0.04	0.42	0.54	0.00	0.00
2011	0.05	0.39	0.56	0.00	0.00
2012	0.09	0.36	0.55	0.00	0.00
2013	0.03	0.35	0.62	0.00	0.00
2014	0.04	0.28	0.69	0.00	0.00
2015	0.04	0.44	0.52	0.00	0.00
2016	0.10	0.32	0.58	0.00	0.00
2017	0.03	0.62	0.35	0.00	0.00
2018	0.05	0.30	0.65	0.00	0.00
2019	0.05	0.25	0.71	0.00	0.00
2020	0.03	0.39	0.58	0.00	0.00
2021	0.05	0.52	0.43	0.01	0.00
2022	0.06	0.31	0.63	0.00	0.00
2023	0.06	0.59	0.35	0.00	0.00
2024	0.04	0.39	0.57	0.00	0.00
2025	0.02	0.41	0.57	0.00	0.00
2026	0.01	0.37	0.61	0.00	0.00

Table 13. Historical catch specifications, percent of the catch retained, and percent of the TAC and ABC caught from 1995-2026. Total catch in 2026 is the catch up to August 22, 2026.

Year	OFL (t)	ABC (t)	TAC (t)	Total Catch	% Retained	% of TAC caught	% of ABC Caught
1995	13,091	11,210	9,690	3,628	90%	37%	32%
1996	13,091	11,210	9,690	5,202	95%	54%	46%
1997	11,920	9,150	9,150	2,438	92%	27%	27%
1998	11,920	9,150	9,150	2,195	97%	24%	24%
1999	11,920	9,150	9,150	2,393	96%	26%	26%
2000	12,300	9,440	9,440	2,702	97%	29%	29%
2001	12,300	9,440	9,440	2,507	95%	27%	27%
2002	12,320	9,470	9,470	2,619	95%	28%	28%
2003	12,320	9,470	9,470	2,726	95%	29%	29%
2004	16,480	12,650	12,650	940	92%	7%	7%
2005	16,480	12,650	12,650	1,603	91%	13%	13%
2006	12,000	9,200	9,200	2,944	95%	32%	32%
2007	11,900	9,100	9,100	2,438	98%	27%	27%
2008	11,933	9,132	9,132	2,522	97%	28%	28%
2009	11,756	8,996	8,996	4,410	99%	49%	49%
2010	12,714	9,729	9,729	3,534	97%	36%	36%
2011	12,499	9,565	9,565	2,746	97%	29%	29%
2012	12,561	9,612	9,612	2,228	98%	23%	23%
2013	12,492	9,560	9,560	3,596	99%	38%	38%
2014	12,207	9,341	9,341	3,450	99%	37%	37%
2015	11,957	9,150	9,150	1,882	98%	21%	21%
2016	9,791	7,493	7,493	1,575	96%	21%	21%
2017	10,860	8,311	8,311	1,434	96%	17%	17%
2018	18,706	15,373	15,373	1,665	96%	11%	11%
2019	17,889	14,692	14,692	1,536	95%	10%	10%
2020	18,127	14,878	14,878	1,201	95%	8%	8%
2021	18,779	15,416	15,416	301	85%	2%	2%
2022	23,302	19,141	19,141	696	90%	4%	4%
2023	25,135	20,664	20,664	412	93%	2%	2%
2024	25,978	21,364	21,364	559	94%	3%	3%
2025	26,002	21,387	21,387	604	96%	3%	3%
2026	25,743	21,173	21,173	1,071	96%	5%	5%

Table 14. GOA rex sole survey biomass for the Western-Central GOA and for the Eastern GOA. No samples were taken in the Eastern GOA in 2001.

	Western & Central GOA		Eastern GOA	
Year	Biomass	Log Standard Error	Biomass	Log Standard Error
1990	81,800	0.12	16,226	0.23
1993	66,026	0.08	20,714	0.14
1996	53,001	0.09	18,965	0.12
1999	55,286	0.15	17,653	0.12
2001	51,212	0.09		
2003	71,087	0.09	25,941	0.15
2005	73,282	0.10	26,242	0.14
2007	88,026	0.10	14,846	0.18
2009	101,782	0.08	22,385	0.22
2011	75,908	0.09	18,206	0.12
2013	78,022	0.17	21,240	0.18
2015	64,759	0.09	21,369	0.22
2017	77,171	0.16	19,760	0.18
2019	66,294	0.12	23,390	0.17
2021	86,008	0.09	24,330	0.14
2023	74,511	0.11	17,552	0.14
2025	78,988	0.13	33,836	0.28

Table 15. Survey biomass by NMFS statistical area and corresponding coefficient of variation (CVs), as used as inputs to the REMA model to calculate Biological Recommended Distributions.

	Western GOA		Central GOA		West Yakutat GOA		Southeast GOA	
Year	Biomass	CV	Biomass	CV	Biomass	CV	Biomass	CV
1990	6,736	0.22	75,064	0.13	11,206	0.29	5,020	0.43
1993	10,775	0.20	55,250	0.09	14,260	0.17	6,454	0.25
1996	9,250	0.27	43,751	0.09	6,987	0.19	11,979	0.15
1999	12,603	0.52	42,683	0.12	7,010	0.19	10,644	0.15
2001	9,587	0.14	41,625	0.10				
2003	13,199	0.13	57,888	0.10	7,814	0.27	18,127	0.18
2005	12,767	0.20	60,515	0.11	7,572	0.26	18,670	0.17
2007	11,589	0.15	76,437	0.12	4,020	0.34	10,826	0.21
2009	19,793	0.14	81,989	0.09	9,532	0.34	12,853	0.29
2011	12,487	0.16	63,421	0.10	6,596	0.20	11,610	0.15
2013	13,878	0.22	64,144	0.20	6,117	0.34	15,123	0.21
2015	15,884	0.14	48,875	0.11	9,451	0.33	11,918	0.30
2017	20,032	0.19	57,139	0.20	6,839	0.30	12,921	0.22
2019	17,314	0.16	48,980	0.15	8,082	0.28	15,308	0.21
2021	15,520	0.15	70,488	0.11	8,211	0.25	16,119	0.18
2023	13,158	0.20	61,353	0.12	6,575	0.23	10,977	0.18
2025	22,099	0.33	56,889	0.13	24,249	0.39	9,587	0.23

Table 16. Relative weighting of data sources relative to one another. The weights follow the Francis (2011) methodology. “Western-Central Survey” and “Eastern Survey” refer to the Gulf of Alaska bottom trawl survey data, split by the NMFS regulatory area border between the Central and Eastern GOA.

Data source	Type	2021 Accepted Model	Model 25.0	Model 25.1
Fishery	Length	0.03	0.05	0.06
Western-Central Survey	Length	0.79	0.53	0.51
Eastern Survey	Length	0.40	0.48	0.46
Fishery	Age	0.32	0.51	0.55
Western-Central Survey	Age	0.08	0.08	0.08
Eastern Survey	Age	0.10	0.12	0.12

Table 17. Configuration of fishery and survey age-based, sex-specific double-normal selectivity curves used in the assessment. A numeric value indicates the fixed value of a parameter.

Double-normal selectivity parameters	**Fishery**	**Survey**
Peak: beginning size for the plateau	Estimated	Estimated
Width: width of plateau	30	30
Ascending width (log space)	Estimated	Estimated
Descending width (log space)	8	8
Initial: selectivity at smallest length or age bin	0	0
Final: selectivity at largest length or age bin	999	999
Male Peak Offset	Estimated	Estimated
Male ascending width offset (log space)	Estimated	Estimated
Male descending width offset (log space)	0	0
Male "Final" offset (transformation required)	0	0
Male apical selectivity	1	1

Table 18. Likelihood components for each model. The likelihoods can be compared as they estimate the same parameters, utilize the same data input, and differ only in the values for ageing uncertainty, where Model 25.0 uses the identity matrix to represent ageing error and Model 25.1 uses a matrix of estimates of age-read uncertainty.

Likelihood Component	Model 25.0	Model 25.1
TOTAL	747	774
Survey	-35.08	-33.28
Length_comp	171	168
Age_comp	618	641
Recruitment	-6.51	-2.23

Table 19. Estimates of growth parameters for the 2021 accepted model, Model 25.0, and Model 25.1. Length at ages 2 and 20 are in cm. "WC" denotes the Western-Central GOA and "E" denotes the Eastern GOA

	Estimates						Standard Deviations					
	2021 Model		Model 25.0		Model 25.1		2021 Accepted Model		Model 25.0		Model 25.1	
Parameter	WC	E	WC	E	WC	E	WC	E	WC	E	WC	E
Length at age 2 (f)	14.764	14.283	14.652	14.470	13.812	13.059	0.817	1.539	0.863	1.447	0.928	1.723
Length at age 20 (f)	46.828	36.732	46.789	36.758	47.066	36.864	0.359	0.592	0.361	0.541	0.368	0.547
Von Bertalanffy k (f)	0.279	0.298	0.277	0.299	0.274	0.306	0.014	0.036	0.014	0.033	0.014	0.034
CV in length at age 2 (f)	0.175	0.174	0.176	0.179	0.160	0.157	0.014	0.031	0.014	0.027	0.016	0.033
CV length at age 20 (f)	0.090	0.098	0.090	0.096	0.087	0.096	0.004	0.010	0.004	0.008	0.004	0.009
Length at age 2 (m)	15.053	15.024	15.020	14.624	14.012	13.453	0.926	1.756	1.012	1.560	1.035	1.787
Length at age 20 (m)	41.023	34.641	41.028	34.657	41.209	34.736	0.274	0.493	0.292	0.393	0.293	0.395
Von Bertalanffy k (m)	0.319	0.306	0.318	0.314	0.318	0.319	0.018	0.042	0.019	0.035	0.018	0.036
CV length at age 2 (m)	0.194	0.189	0.194	0.192	0.176	0.184	0.016	0.031	0.016	0.027	0.018	0.031
CV length at age 20 (m)	0.073	0.079	0.072	0.076	0.070	0.075	0.004	0.009	0.004	0.007	0.004	0.007

Table 20. Estimates of selectivity parameters for the accepted model from 2021, Model 25.0, and Model 25.1 (the base case).

		Estimates			StdDev		
		2021 Model	Model 25.0	Model 25.1	2021 Model	Model 25.0	Model 25.1
Fishery	Peak: beginning size for the plateau	7.707	7.764	7.30951	0.339972	0.259	0.279
	Ascending width (f; log)	1.374	1.489	0.928321	0.244517	0.174	0.273
	Male peak offset	-1.469	-1.194	-1.05681	0.432529	0.332	0.370
	Male ascending width offset (ln)	-0.530	-0.340	-0.31941	0.378509	0.260	0.411
Survey	Peak: beginning size for plateau, WC	5.968	5.945	5.933	0.238	0.233	0.246
	Ascending width (ln), WC	1.680	1.660	1.620	0.124	0.128	0.136
	Peak: beginning size for the plateau, E	5.08487	5.18949	5.12783	0.373004	0.33577	0.346229
	Ascending width (log), E	1.27785	1.30957	1.19891	0.270701	0.239657	0.264152

Table 21. Model estimates and corresponding standard deviations (StDevs) for the log of unfished recruitment (equal to mean recruitment), recruitment allocation between the Western-Central GOA and the Eastern GOA, and the catchability parameter (q) in logspace.

	Estimates			StDevs		
Parameter	2021 Accepted Model	Model 25.0	Model 25.1	2021 Accepted Model	Model 25.0	Model 25.1
Recruitment proportion to Eastern GOA*	-0.875	-0.897	-0.899	0.060	0.058	0.058
Mean recruitment (log)	11.543	11.448	11.382	0.086	0.078	0.080
Catchability (log)	0.155	0.193	0.221	0.100	0.091	0.091

*A non-time-varying recruitment allocation parameter determines the proportion of total recruitment that settles in each area of the model, which is parameterized as *exp(Est)/(exp(Est)+1)*. Therefore, both models estimate that 0.29 is the proportion of recruits each year that settle in the Eastern GOA and 0.71 is the proportion of recruits that settle in the Western-Central area each year.

Table 22. Estimated yearly age-0 recruitment deviations for the current base case model. Recruitment deviations are fixed at 0 for years 2023 onward, as little to no information exists to inform recruitment deviations in these years.

Type	Year	Recruitment Deviation	StDev
Early	1965	-0.003	0.598
Early	1966	-0.003	0.597
Early	1967	-0.003	0.596
Early	1968	-0.002	0.596
Early	1969	0.001	0.595
Early	1970	0.006	0.594
Early	1971	0.018	0.595
Early	1972	0.041	0.596
Early	1973	0.027	0.592
Early	1974	0.038	0.592
Early	1975	0.111	0.596
Early	1976	0.157	0.585
Early	1977	-0.003	0.562
Early	1978	-0.131	0.534
Early	1979	-0.189	0.519
Early	1980	-0.225	0.510
Early	1981	-0.211	0.511
Main	1982	-0.122	0.515
Main	1983	0.190	0.561
Main	1984	0.569	0.524
Main	1985	0.393	0.510
Main	1986	0.353	0.444
Main	1987	0.544	0.332
Main	1988	-0.261	0.394
Main	1989	-0.839	0.390
Main	1990	-0.412	0.316
Main	1991	-0.639	0.348
Main	1992	-0.687	0.344
Main	1993	-0.298	0.282
Main	1994	-0.386	0.296
Main	1995	-0.556	0.329
Main	1996	-0.054	0.269
Main	1997	0.515	0.218
Main	1998	0.709	0.219

Type	Year	Recruitment Deviation	StDev
Main	1999	0.947	0.179
Main	2000	0.265	0.252
Main	2001	-0.161	0.279
Main	2002	0.015	0.271
Main	2003	0.779	0.176
Main	2004	0.116	0.341
Main	2005	1.010	0.162
Main	2006	-0.180	0.359
Main	2007	0.024	0.254
Main	2008	-0.601	0.329
Main	2009	-0.573	0.328
Main	2010	0.026	0.244
Main	2011	-0.206	0.282
Main	2012	-0.684	0.335
Main	2013	-0.811	0.352
Main	2014	-0.010	0.287
Main	2015	1.283	0.154
Main	2016	0.752	0.271
Main	2017	0.425	0.314
Main	2018	0.065	0.340
Main	2019	-0.002	0.321
Main	2020	-0.261	0.346
Main	2021	-0.716	0.407
Main	2022	-0.523	0.437

Table 23. Estimated fishing mortality for the current base case model.

Year	Estimate	StdDev
1982	0.015	0.002
1983	0.009	0.001
1984	0.006	0.001
1985	0.003	0.000
1986	0.002	0.000
1987	0.020	0.002
1988	0.021	0.002
1989	0.011	0.001
1990	0.021	0.002
1991	0.077	0.007
1992	0.050	0.004
1993	0.050	0.004
1994	0.064	0.005
1995	0.078	0.007
1996	0.132	0.012
1997	0.084	0.008
1998	0.076	0.007
1999	0.094	0.009
2000	0.119	0.012
2001	0.104	0.011
2002	0.105	0.012
2003	0.108	0.012
2004	0.037	0.004
2005	0.046	0.005
2006	0.064	0.006
2007	0.056	0.006

Year	Estimate	StdDev
2007	0.053	0.005
2008	0.090	0.009
2009	0.067	0.007
2010	0.049	0.005
2011	0.041	0.004
2012	0.065	0.007
2013	0.069	0.007
2014	0.041	0.004
2015	0.038	0.004
2016	0.033	0.004
2017	0.042	0.005
2018	0.040	0.005
2019	0.029	0.003
2020	0.006	0.001
2021	0.011	0.001
2022	0.006	0.001
2023	0.008	0.001
2024	0.009	0.001
2025	0.013	0.001
2026	0.033	0.004

Table 24. Projected spawning biomass for the Western-Central GOA for the seven harvest scenarios listed in the "Harvest Recommendations" section.

Year	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
2026	41,908	41,908	41,908	41,908	41,908	41,908	41,908
2027	40,304	40,304	40,304	40,304	40,304	40,304	40,304
2028	38,952	38,952	38,952	38,952	38,952	30,574	32,090
2029	38,008	38,008	38,008	38,008	38,008	24,339	26,558
2030	31,336	31,336	37,457	34,798	37,896	20,659	22,171
2031	26,765	26,765	37,282	32,466	38,113	18,450	19,462
2032	23,624	23,624	37,295	30,734	38,475	17,183	17,795
2033	21,483	21,483	37,404	29,442	38,893	16,549	16,905
2034	20,067	20,067	37,556	28,474	39,316	16,234	16,438
2035	19,147	19,147	37,703	27,723	39,701	16,056	16,171
2036	18,523	18,523	37,800	27,106	40,004	15,925	15,988
2037	18,085	18,085	37,839	26,584	40,221	15,812	15,846
2038	17,766	17,766	37,832	26,138	40,367	15,704	15,722

Table 25. Projected fishing mortality for the Western-Central GOA for the seven harvest scenarios listed in the "Harvest Recommendations" section.

Year	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
2026	0.02	0.02	0.02	0.02	0.02	0.02	0.02
2027	0.01	0.01	0.01	0.01	0.01	0.28	0.22
2028	0.01	0.01	0.01	0.01	0.01	0.28	0.22
2029	0.22	0.22	0.01	0.10	0.00	0.28	0.28
2030	0.22	0.22	0.01	0.10	0.00	0.28	0.28
2031	0.22	0.22	0.01	0.10	0.00	0.27	0.27
2032	0.22	0.22	0.01	0.10	0.00	0.25	0.25
2033	0.22	0.22	0.01	0.10	0.00	0.24	0.24
2034	0.21	0.21	0.01	0.10	0.00	0.24	0.24
2035	0.21	0.21	0.01	0.10	0.00	0.23	0.23
2036	0.20	0.20	0.01	0.10	0.00	0.23	0.23
2037	0.20	0.20	0.01	0.10	0.00	0.23	0.23
2038	0.20	0.20	0.01	0.10	0.00	0.23	0.23

Table 26. Projected catch for the Western-Central GOA for the seven harvest scenarios listed in the "Harvest Recommendations" section.

Year	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
2026	1,242	1,242	1,242	1,242	1,242	1,242	1,242
2027	514	514	514	514	514	15,575	12,839
2028	514	514	514	514	514	11,698	10,120
2029	12,095	12,095	806	5,701	-	9,427	10,282
2030	10,071	10,071	804	5,277	-	8,149	8,725
2031	8,660	8,660	805	4,955	-	7,172	7,656
2032	7,683	7,683	807	4,708	-	6,440	6,747
2033	6,949	6,949	811	4,523	-	6,091	6,267
2034	6,397	6,397	815	4,386	-	5,931	6,028
2035	6,024	6,024	819	4,275	-	5,822	5,877
2036	5,776	5,776	821	4,183	-	5,748	5,778
2037	5,594	5,594	821	4,102	-	5,681	5,696
2038	5,463	5,463	820	4,030	-	5,619	5,627

Table 27. Projected spawning biomass for the Eastern GOA subpopulation for the seven harvest scenarios listed in the "Harvest Recommendations" section.

Year	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
2026	8,972	8,972	8,972	8,972	8,972	8,972	8,972
2027	8,607	8,607	8,607	8,607	8,607	8,607	8,607
2028	8,243	8,243	8,243	8,243	8,243	6,273	6,626
2029	7,990	7,990	7,990	7,990	7,990	4,844	5,341
2030	6,399	6,399	7,863	7,181	7,863	4,028	4,353
2031	5,337	5,337	7,814	6,592	7,814	3,550	3,759
2032	4,625	4,625	7,804	6,154	7,804	3,281	3,403
2033	4,151	4,151	7,814	5,827	7,814	3,149	3,217
2034	3,844	3,844	7,832	5,582	7,832	3,084	3,121
2035	3,648	3,648	7,850	5,392	7,850	3,046	3,066
2036	3,518	3,518	7,859	5,239	7,859	3,018	3,029
2037	3,428	3,428	7,857	5,112	7,857	2,995	3,000
2038	3,365	3,365	7,849	5,007	7,849	2,973	2,976

Table 28. Projected fishing mortality for the Eastern GOA subpopulation for the seven harvest scenarios listed in the “Harvest Recommendations” section.

Year	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
2026	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2027	0.00	0.00	0.00	0.00	0.00	0.30	0.24
2028	0.00	0.00	0.00	0.00	0.00	0.30	0.24
2029	0.24	0.24	0.00	0.11	0.00	0.30	0.30
2030	0.24	0.24	0.00	0.11	0.00	0.30	0.30
2031	0.24	0.24	0.00	0.11	0.00	0.29	0.30
2032	0.24	0.24	0.00	0.11	0.00	0.27	0.28
2033	0.24	0.24	0.00	0.11	0.00	0.26	0.27
2034	0.23	0.23	0.00	0.11	0.00	0.26	0.26
2035	0.22	0.22	0.00	0.11	0.00	0.25	0.26
2036	0.22	0.22	0.00	0.11	0.00	0.25	0.25
2037	0.22	0.22	0.00	0.11	0.00	0.25	0.25
2038	0.21	0.21	0.00	0.11	0.00	0.25	0.25

Table 29. Projected catch for the Eastern GOA subpopulation for the seven harvest scenarios listed in the “Harvest Recommendations” section.

Year	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
2026	C	C	C	C	C	C	C
2027	C	C	C	C	C	3,948	3,238
2028	C	C	C	C	C	2,851	2,470
2029	3,013	3,013	-	1,400	-	2,225	2,455
2030	2,430	2,430	-	1,270	-	1,875	2,024
2031	2,033	2,033	-	1,171	-	1,620	1,739
2032	1,766	1,766	-	1,096	-	1,438	1,511
2033	1,572	1,572	-	1,039	-	1,352	1,392
2034	1,431	1,431	-	997	-	1,312	1,333
2035	1,337	1,337	-	963	-	1,284	1,296
2036	1,276	1,276	-	936	-	1,267	1,273
2037	1,231	1,231	-	913	-	1,250	1,253
2038	1,201	1,201	-	893	-	1,236	1,238

Table 30. Time series of recruitment at ages 3 and 0 and standard deviation of age 0 recruits for the previous and current assessments.

	2021 Assessment			*2026 Assessment*		
Year	**Recruits (Age 3)**	**Recruits (Age 0)**	**Std. dev**	**Recruits (Age 3)**	**Recruits (Age 0)**	**Std. dev**
1982	36,555	99,500	30,702	39,249	68,819	36,296
1983	45,057	118,585	31,644	37,672	93,540	53,307
1984	43,716	125,315	27,803	37,987	135,840	70,990
1985	59,749	130,443	24,500	41,326	113,347	58,264
1986	71,210	108,074	19,904	56,171	108,395	48,755
1987	75,251	118,684	20,098	81,571	130,555	43,116
1988	78,330	65,628	13,599	68,064	58,031	23,223
1989	64,897	48,337	10,848	65,090	32,489	12,893
1990	71,268	50,551	10,922	78,397	49,799	15,789
1991	39,410	40,675	9,501	34,848	39,678	13,997
1992	29,026	46,939	10,119	19,509	37,818	13,246
1993	30,355	50,140	10,605	29,904	55,801	15,900
1994	24,425	50,660	10,295	23,827	51,081	15,456
1995	28,186	60,607	11,005	22,709	43,100	14,521
1996	30,108	78,852	13,038	33,509	71,195	19,802
1997	30,420	133,868	18,427	30,674	125,829	28,683
1998	36,393	164,493	21,121	25,881	152,646	35,424
1999	47,349	163,131	20,858	42,753	193,817	37,288
2000	80,385	118,422	16,145	75,559	97,975	25,857
2001	98,775	88,968	13,238	91,664	63,962	18,422
2002	97,957	83,691	13,200	116,386	76,269	21,531
2003	71,110	151,127	20,581	58,833	163,837	30,681
2004	53,424	124,309	19,192	38,409	84,399	29,916
2005	50,255	183,425	24,700	45,799	206,355	35,557
2006	90,750	93,541	16,162	98,383	62,775	23,386
2007	74,646	84,870	14,806	50,681	76,965	20,202
2008	110,144	53,419	11,048	123,915	41,214	14,039
2009	56,170	51,098	10,952	37,696	42,389	14,410
2010	50,963	67,972	13,647	46,217	77,124	19,761
2011	32,077	70,248	14,244	24,749	61,180	18,067
2012	30,684	47,978	11,365	25,455	37,924	13,188
2013	40,817	38,586	10,623	46,312	33,392	12,206
2014	42,183	74,952	19,267	36,739	74,440	22,473
2015	28,810	320,967	54,036	22,773	271,100	47,148
2016	23,170	211,759	57,034	20,052	159,443	45,521
2017	45,007	147,545	57,830	44,700	121,957	39,698
2018	192,738	100,522	51,115	162,794	90,310	31,777
2019	127,159	96,598	51,777	95,744	87,587	29,195
2020	88,599	103,085	8,896	73,235	67,555	24,261
2021	60,363	103,085		54,231	42,862	18,113
2022				52,596	52,026	23,648
2023				40,566	87,736	7,001
2024				25,738	87,736	7,001
2025				31,242	87,736	7,001
2026				52,685	87,736	
Average	59,697	101,766		52,495	89,017	

Table 31. Time series of total and spawning biomass and standard deviation of spawning biomass (Std_Dev) for the previous and current assessments, with projected values for 2027 and 2028 using Scenario 1.

	2021 Assessment			*2026 Assessment*		
Year	**Total Biomass (age 3+)**	**Spawning Biomass**	**Stdev_SPB**	**Total Biomass (age 3+)**	**Spawning Biomass**	**Stdev_SPB**
1982	90,005	43,946	5,216	99,167	47,957	6,176
1983	87,858	42,480	4,944	96,485	47,276	5,937
1984	86,486	41,430	4,680	93,941	46,447	5,646
1985	86,915	40,728	4,441	91,772	45,434	5,306
1986	89,356	40,462	4,245	91,006	44,395	4,943
1987	93,298	40,759	4,115	92,894	43,509	4,593
1988	97,327	41,275	4,060	94,655	42,539	4,292
1989	100,943	42,664	4,075	96,989	42,519	4,057
1990	105,283	44,987	4,135	101,042	43,872	3,902
1991	106,275	47,068	4,198	101,966	45,392	3,830
1992	101,560	46,990	4,220	96,951	45,066	3,774
1993	97,134	47,025	4,176	92,489	45,148	3,684
1994	91,360	45,892	4,051	86,799	44,063	3,540
1995	84,650	43,238	3,851	79,890	41,301	3,336
1996	77,830	39,709	3,611	73,307	37,652	3,099
1997	69,731	34,962	3,366	65,497	32,869	2,866
1998	65,497	32,008	3,141	60,855	29,937	2,658
1999	63,552	29,825	2,954	58,387	27,823	2,486
2000	64,894	28,004	2,823	58,846	26,002	2,361
2001	69,433	26,800	2,775	62,225	24,558	2,296
2002	76,964	27,377	2,850	70,368	24,747	2,333
2003	83,720	29,691	3,081	77,069	26,740	2,518
2004	87,984	33,198	3,447	80,821	30,173	2,846
2005	92,355	37,971	3,848	84,811	35,132	3,229
2006	97,373	41,476	4,174	89,905	38,683	3,533
2007	100,540	43,086	4,383	91,720	39,984	3,701
2008	106,661	44,339	4,528	97,919	40,900	3,806
2009	110,043	45,991	4,689	100,606	42,334	3,935
2010	109,469	47,089	4,889	99,756	43,203	4,100
2011	107,045	48,762	5,086	97,080	44,685	4,268
2012	103,354	49,830	5,197	93,220	45,585	4,359
2013	99,490	49,511	5,172	89,862	45,036	4,321
2014	94,215	47,120	5,034	84,837	42,502	4,187
2015	88,332	44,116	4,837	79,191	39,532	4,014
2016	83,471	41,982	4,636	74,656	37,624	3,854
2017	80,181	40,045	4,450	71,675	35,928	3,710
2018	89,283	38,424	4,288	77,969	34,386	3,573
2019	100,243	37,515	4,209	85,478	33,336	3,493
2020	110,746	39,239	4,381	93,212	34,466	3,598
2021	118,571	44,594	4,931	99,428	38,569	3,967
2022	99,428	41,906	--	104,515	44,163	4,447
2023	101,606	46,224	--	106,455	48,388	4,829
2024				105,655	50,868	5,046
2025				103,010	51,569	5,120
2026				100,667	50,879	5,086

2027		98,311	48,911	--
2028		97,271	47,195	--

Table 32. Proportion of all non-target catch weight by species caught by the directed GOA rex sole fishery from 2022-2026. Birds (recorded in numbers) have not been recorded as bycatch in the GOA rex sole fishery. "C" indicates confidential data.

Species Group Name	2022	2026
Brittle star unidentified		C
Hermit crab unidentified	C	C
Misc crabs		C
Misc crustaceans	C	
Misc fish	C	C
Pandalid shrimp	C	0.0437
Sculpin	C	C
Scypho jellies		C
Sea anemone unidentified		C
Sea pens whips		C
Sea star	C	0.0001
Smelt (Family Osmeridae)	C	C
Snails	C	C
Squid	C	
Stichaeidae		0.0475
urchins dollars cucumbers		C

Table 33. Proportion of all FMP other species bycatch by weight caught by the GOA rex sole target fishery in 2022-2026. "C" indicates that the data are confidential.

Species Common Name	Retained/Discarded	2022	2026
octopus, North Pacific	Retained		C
shark, spiny dogfish	Discarded	C	
skate, big	Discarded	C	C
skate, big	Retained	C	C
skate, longnose	Discarded	C	C
skate, longnose	Retained	C	C
skate, other	Discarded	C	0.0001

Table 34. Proportion of prohibited species catch (where catch is in metric tons for halibut and herring and in counts of fish for crab and salmon) by species from the GOA rex sole target fishery. “C” indicates that the data are confidential.

Species Group Name	2026 PSCNQ Estimate	2026 Halibut Mortality	2022 PSCNQ Estimate	2022 Halibut Mortality
Bairdi Tanner Crab	0.0033		C	
Blue King Crab	N/A		C	
Chinook Salmon	0.0300		C	
Golden (Brown) King Crab	0.0034		C	
Halibut	0.0053	0.0056	C	C
Herring	0.0001		C	
Non-Chinook Salmon	0.0056		C	
Opilio Tanner (Snow) Crab	N/A		C	
Red King Crab	N/A		C	

Figures

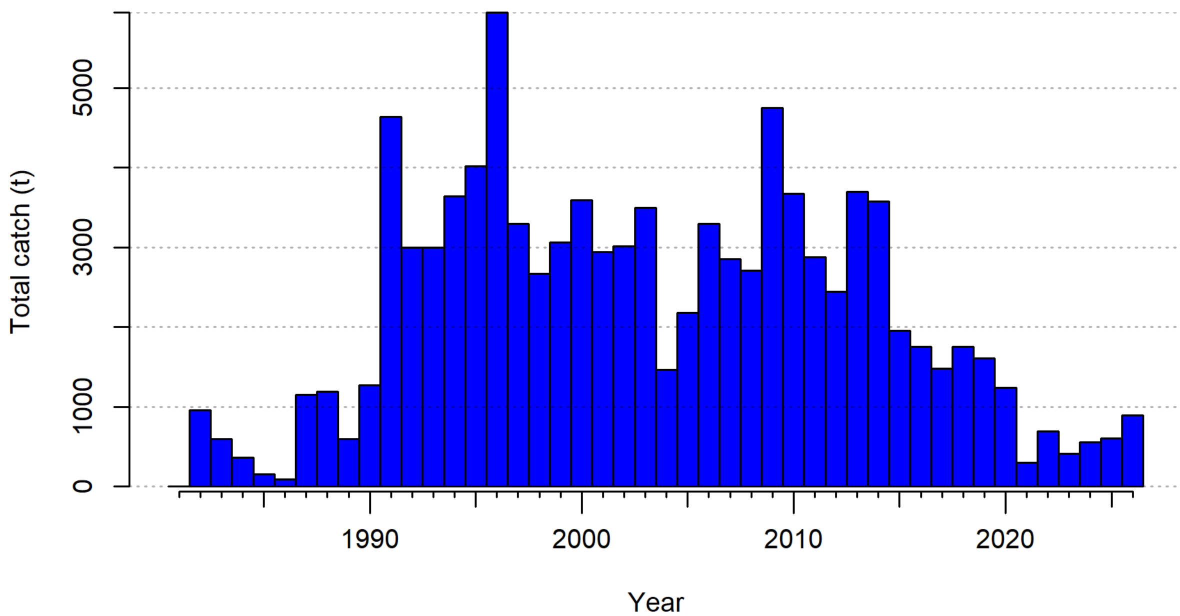

Figure 1. Fishery catches for GOA rex sole, 1982-2026. Catch for 2026 is through August 22, 2026.

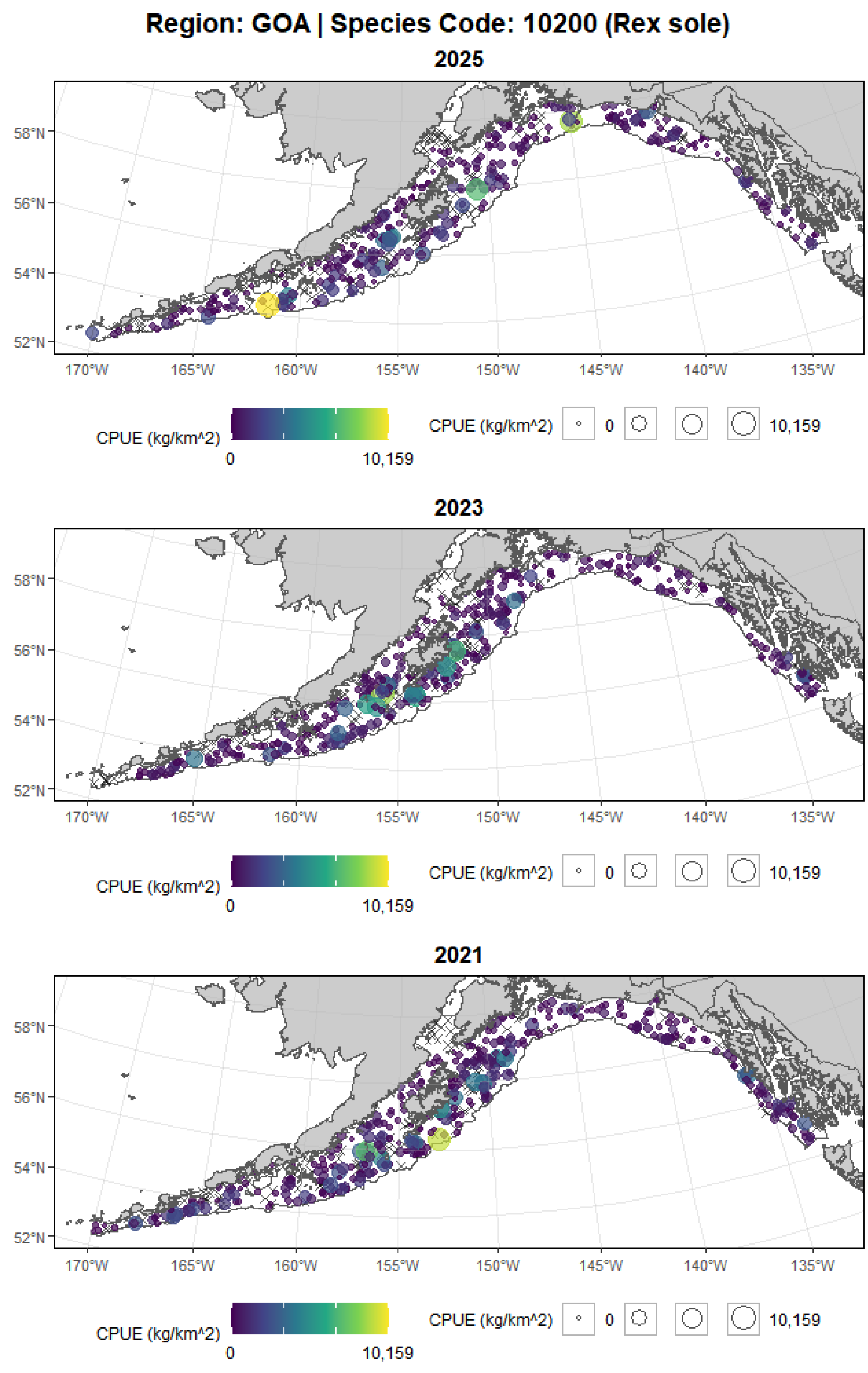

Figure 2. Survey CPUE by area for GOA rex sole in 2025, 2023, and 2021.

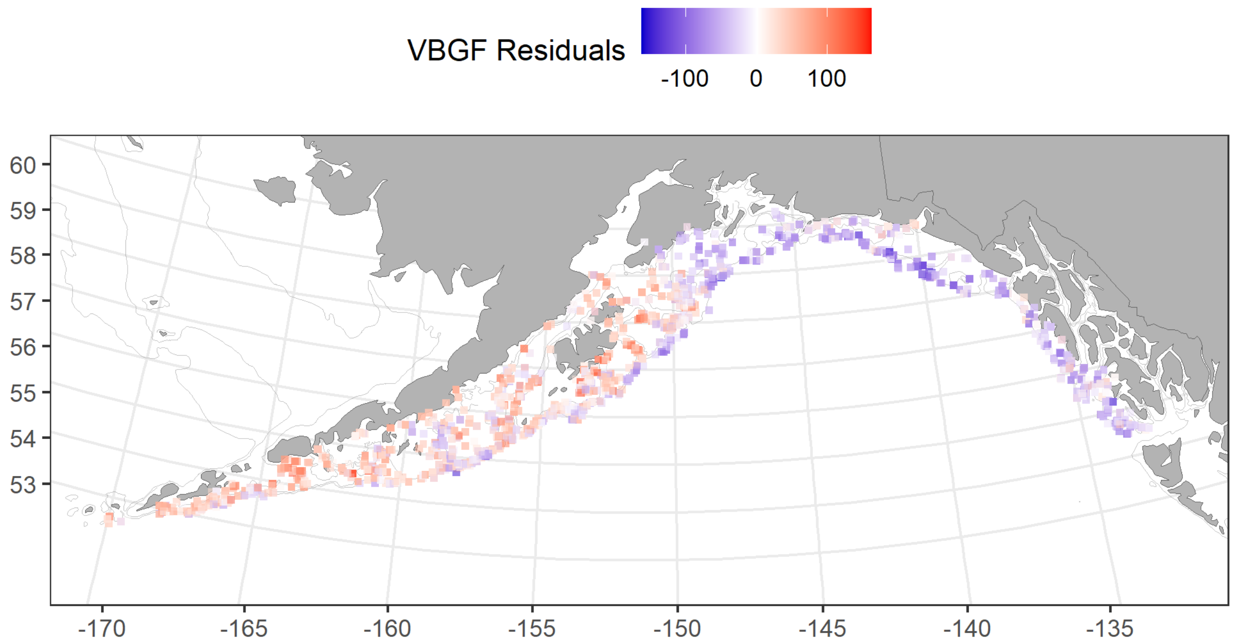

Figure 3. Residuals from single-area von-Bertalanffy growth curves fit to survey age-length data plotted by location for males and females combined. Positive residuals are plotted in red indicating data points where length-at-age was larger than the mean and negative residuals are plotted in blue and indicate data points that are smaller than the mean. The points are shaded to indicate the size of the residuals (residuals are not standardized).

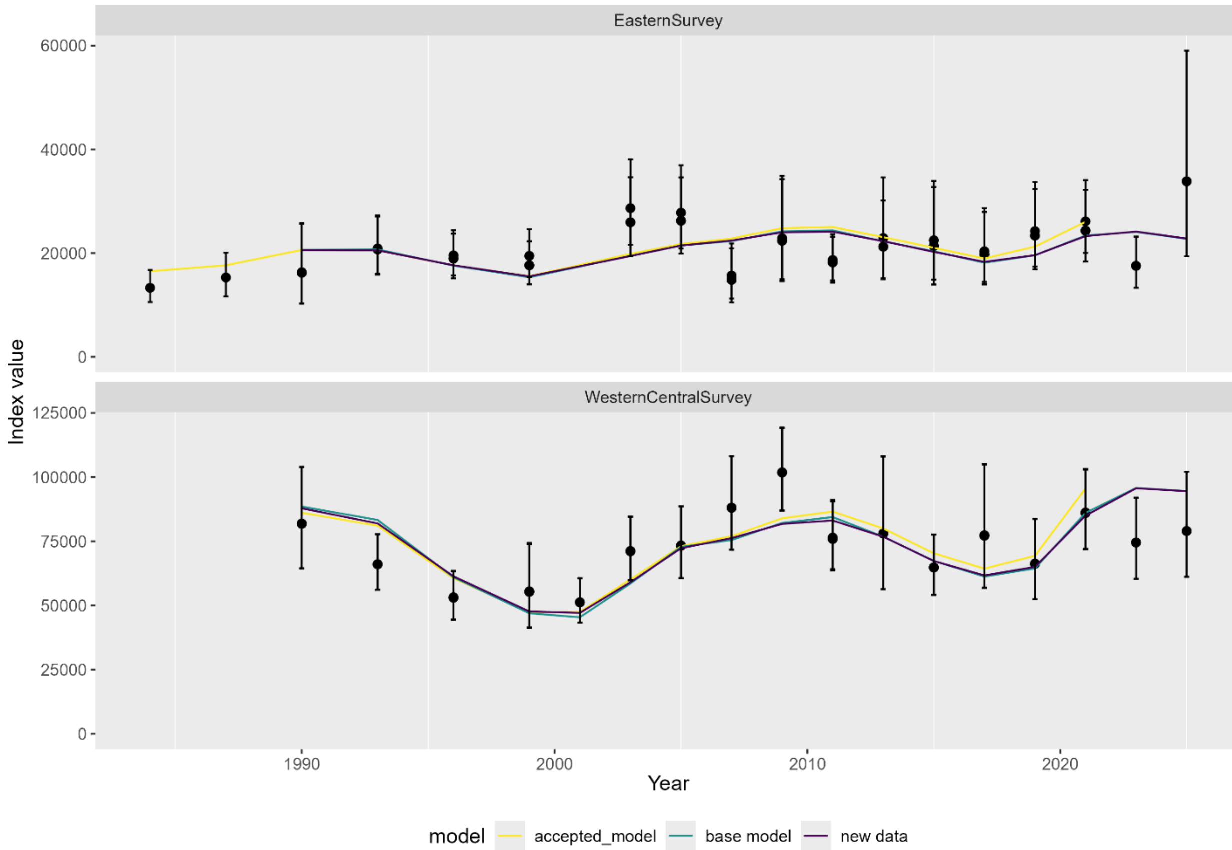

Figure 4. Observed (black dots) and predicted (lines) index of survey biomass for the Western-Central (bottom) and Eastern GOA (top) index of biomass. Vertical black lines show 95% confidence intervals about the observations. The 2021 accepted model (yellow), the base model (Model 25.1; turquoise), and Model 25.0 (purple).

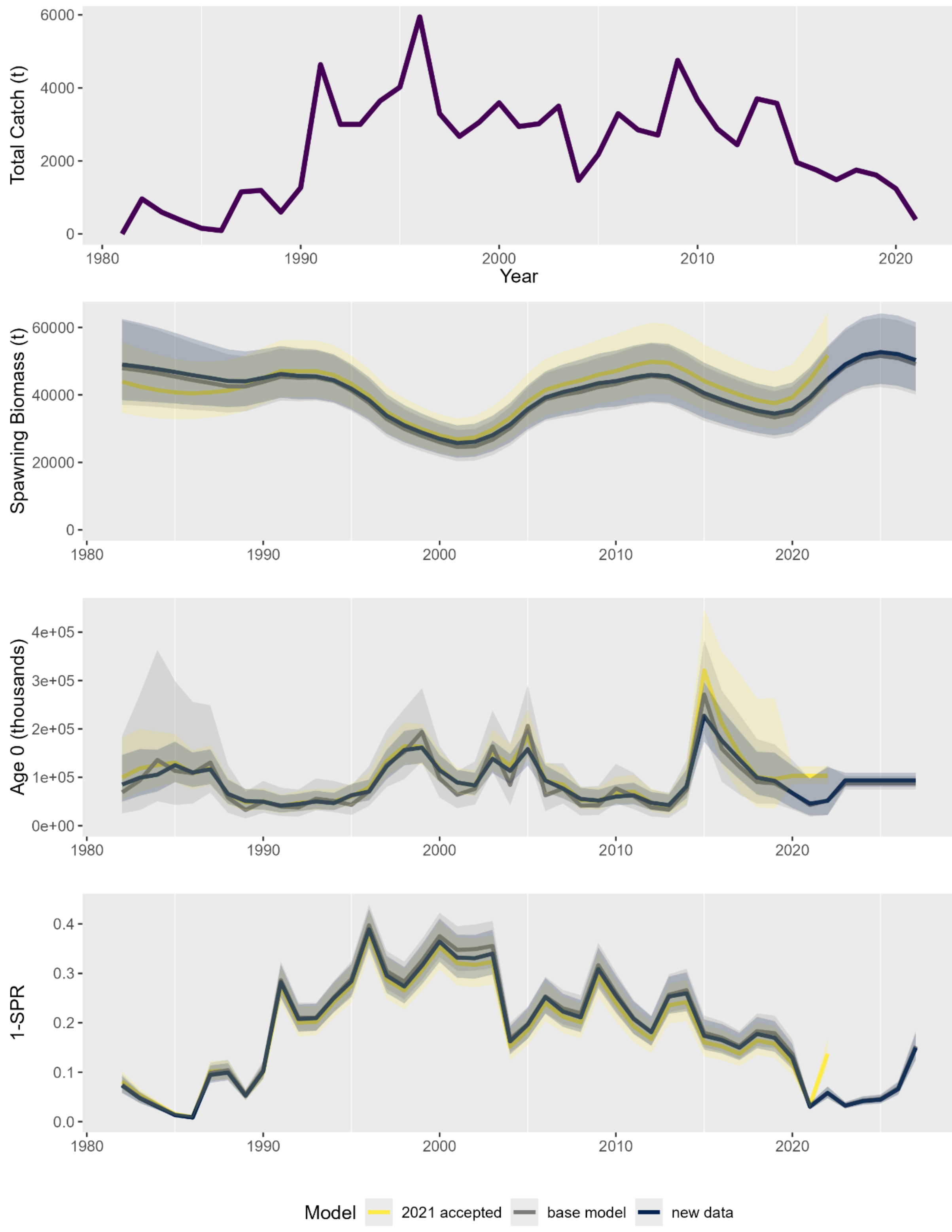

Figure 5. A comparison of estimates for total catch, spawning biomass, age-0 recruitment, and fishing intensity (1-the spawning potential ratio) and corresponding 95% asymptotic confidence intervals for the 2021 accepted model, Model 25.1 (the base model), and Model 25.0.

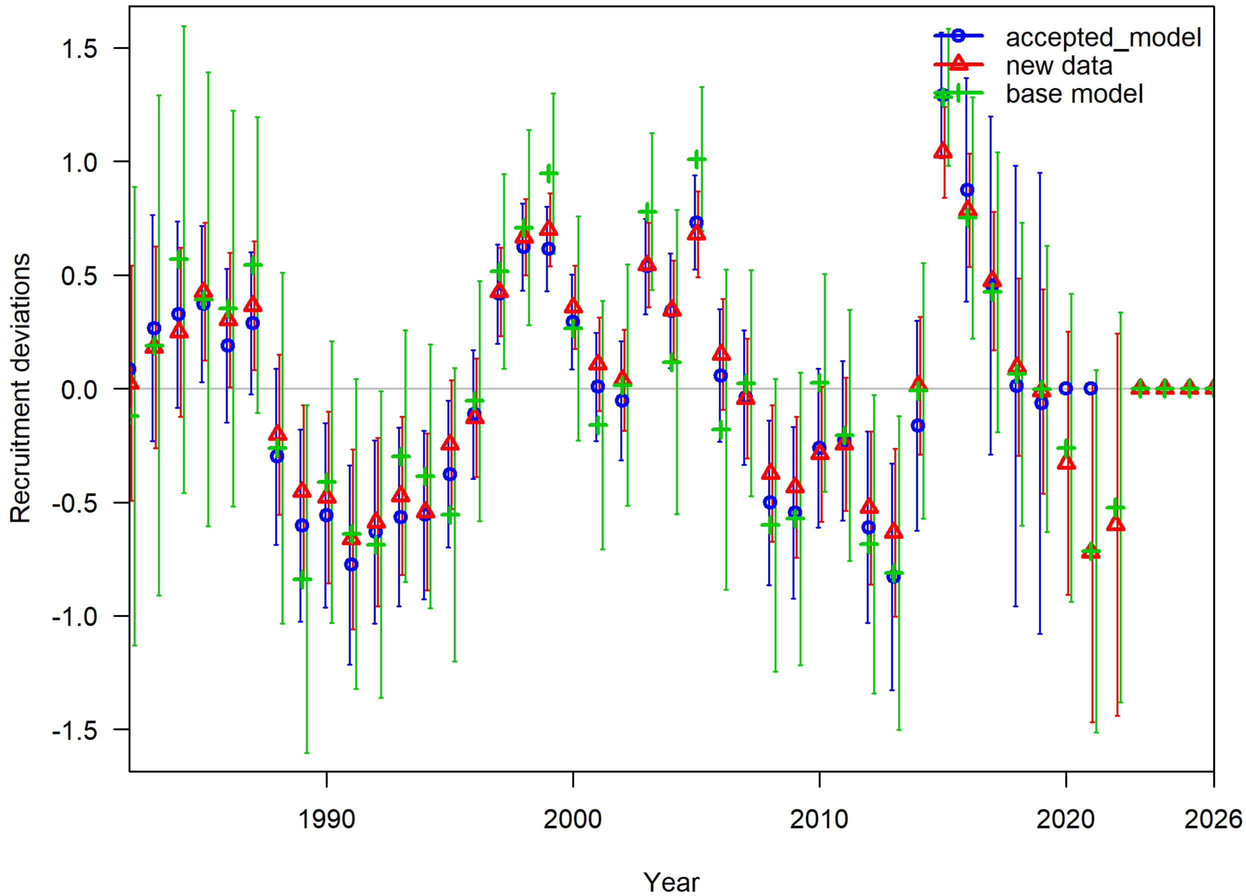

Figure 6. Estimates of recruitment deviations and corresponding 95% asymptotic confidence intervals for the 2021 accepted model, Model 25.0 (new data and housekeeping items), and Model 25.1 (base model).

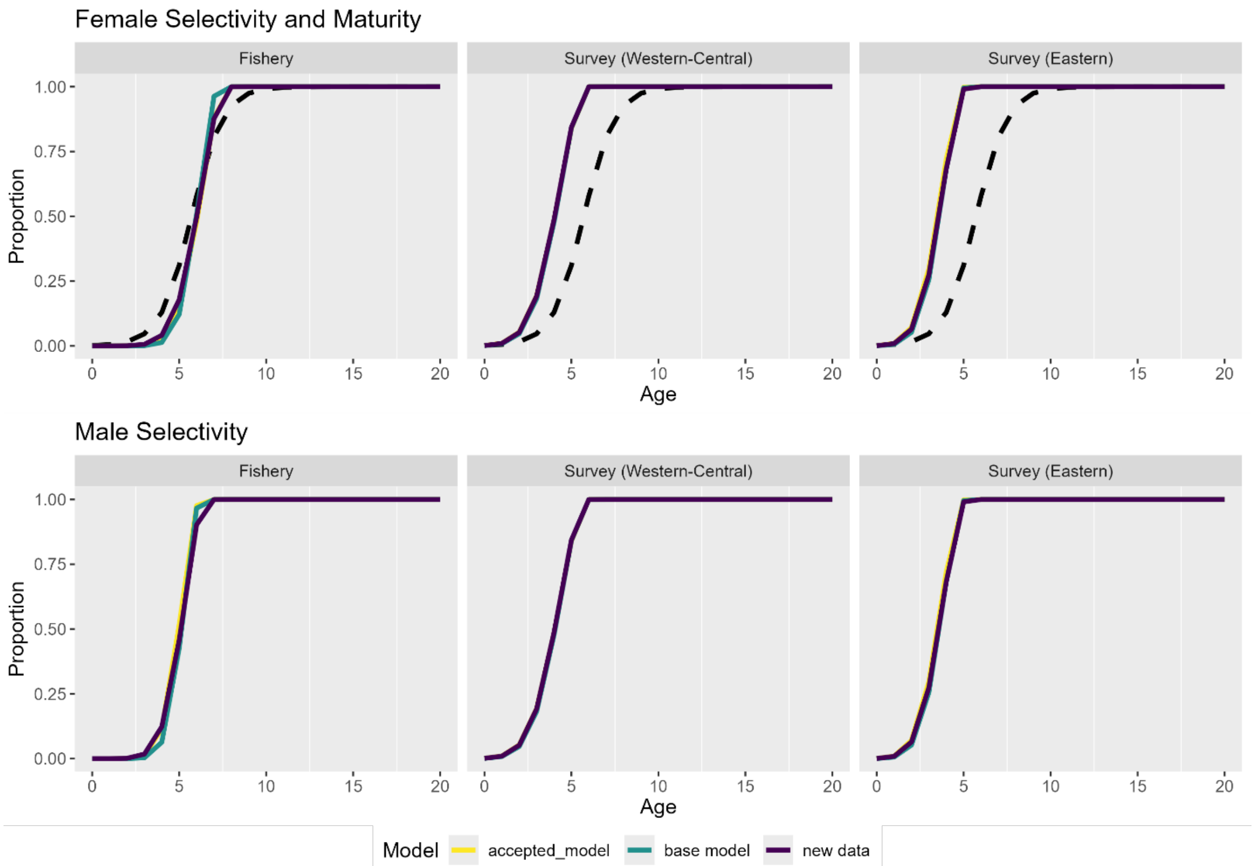

Figure 7. Fishery and survey selectivity-at-age across models for males (lower panel) and females (upper panel). Maturity-at-age (dashed black lines) is overlaid on female selectivity.

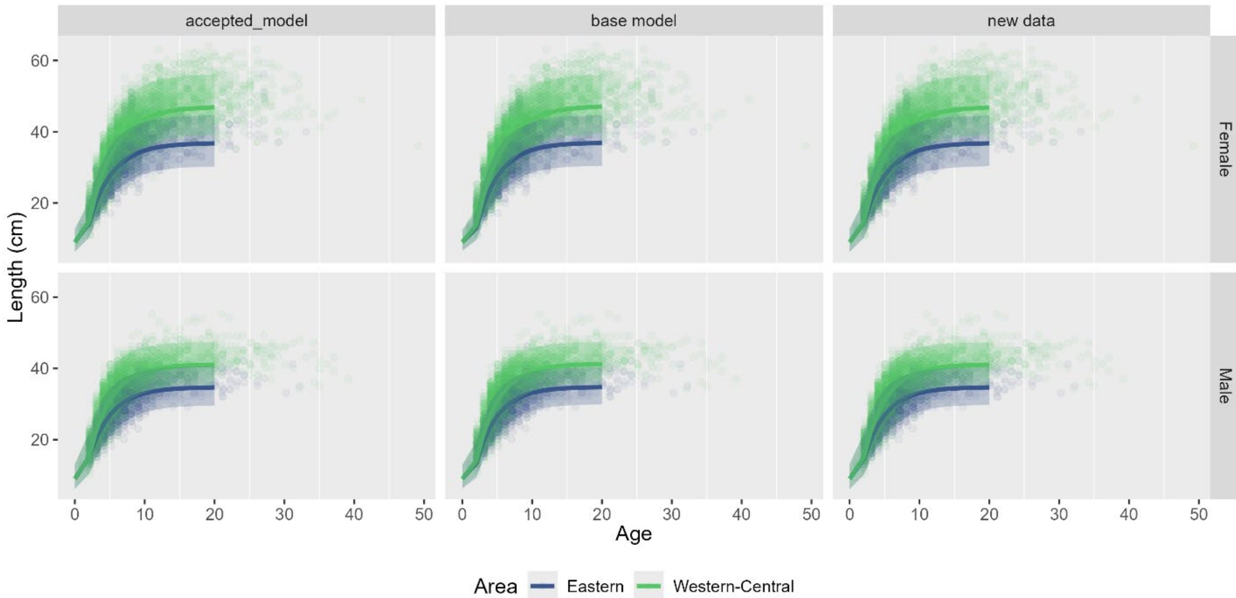

Figure 8. Observed (dots) and predicted (lines) length-at-age for the 2021 accepted model, Model 25.1 (the base model), and Model 25.0 (new data and housekeeping items). Separate growth curves were estimated within the assessment model by sex and by area for the Western-Central GOA and for the Eastern GOA. Females are shown on the upper panels (green dots), and males are shown on the lower panels (blue dots). Dotted lines show 95% confidence intervals based on CVs of 2 year old and 20 year old fish.

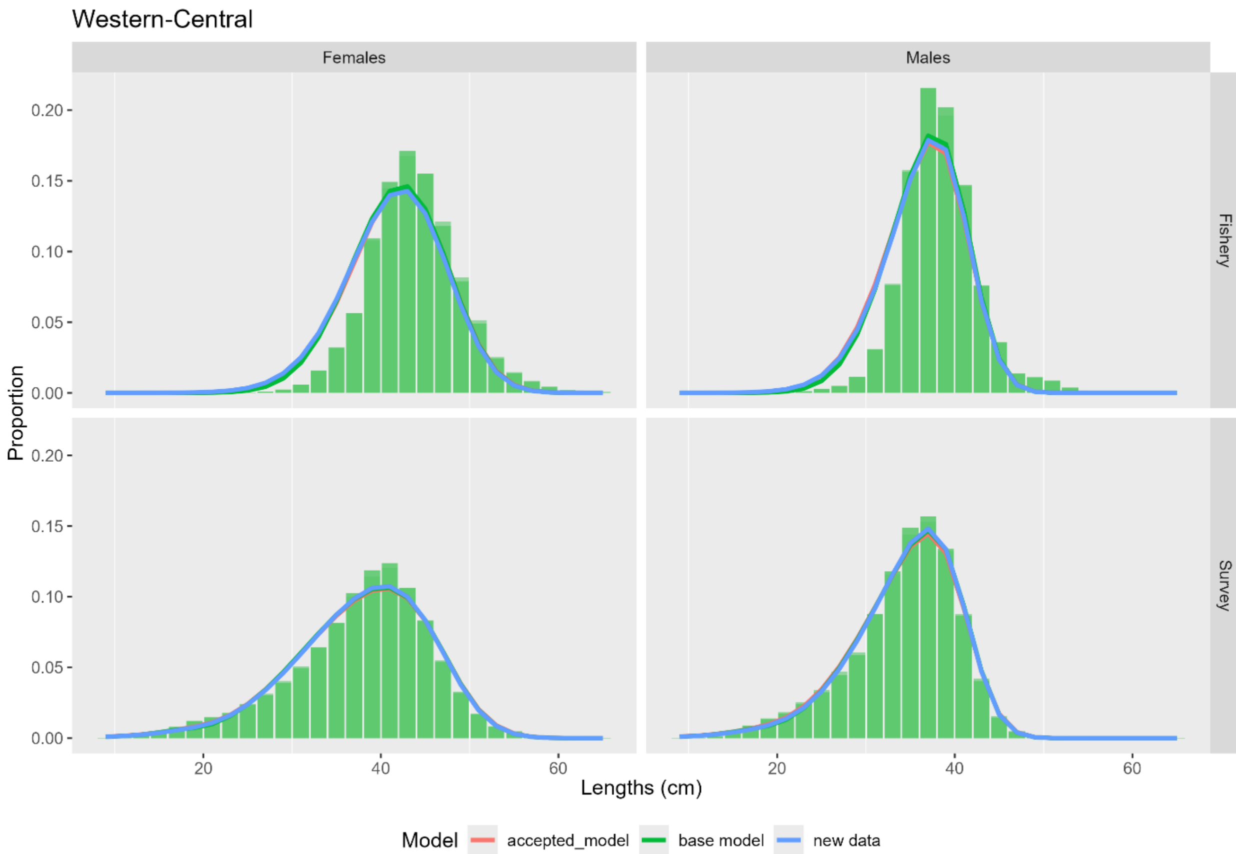

Figure 9. Predicted (lines) and observed (green bars) length compositions, aggregated over time for the 2021 accepted model, Model 25.1 (new data and housekeeping items), and Model 25.1 (the base model).

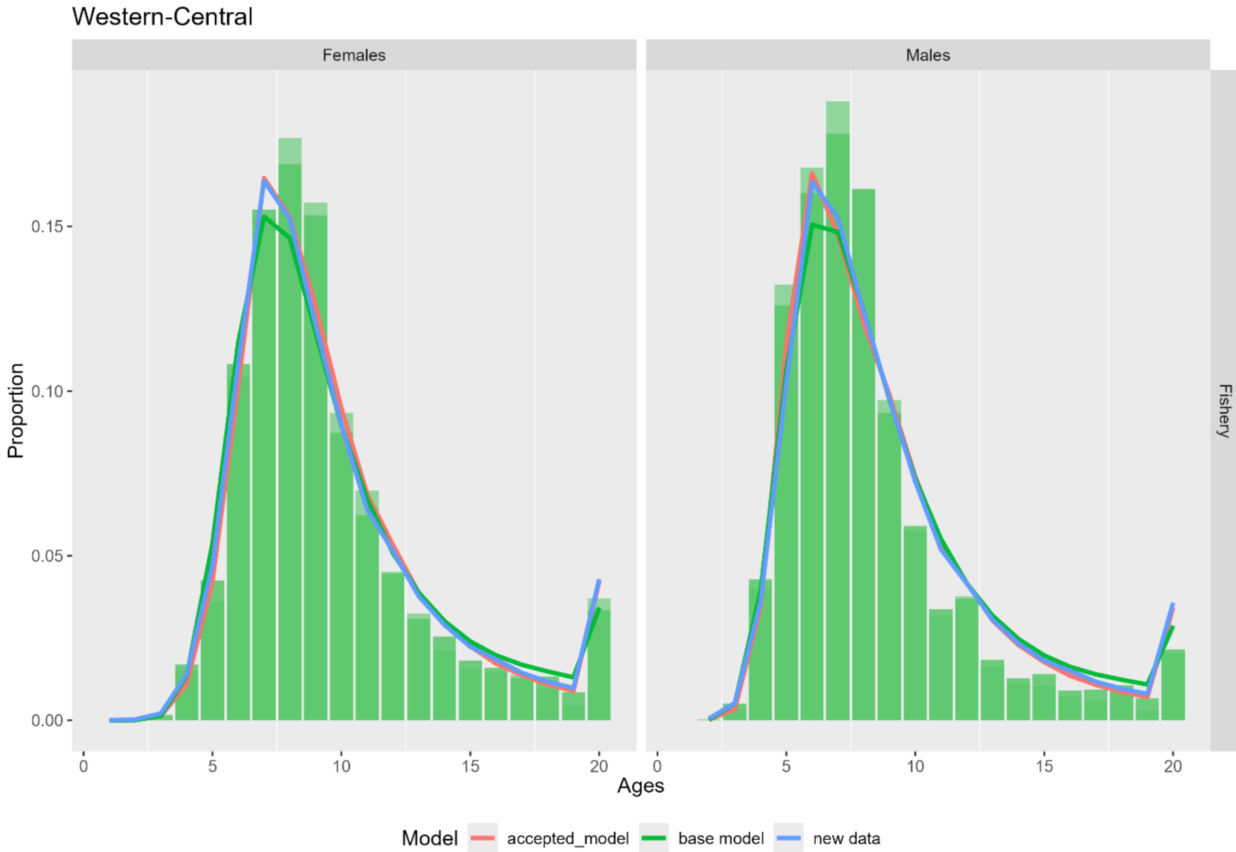

Figure 10. Predicted (lines) and observed (green bars) fishery age compositions for the 2025 accepted model.

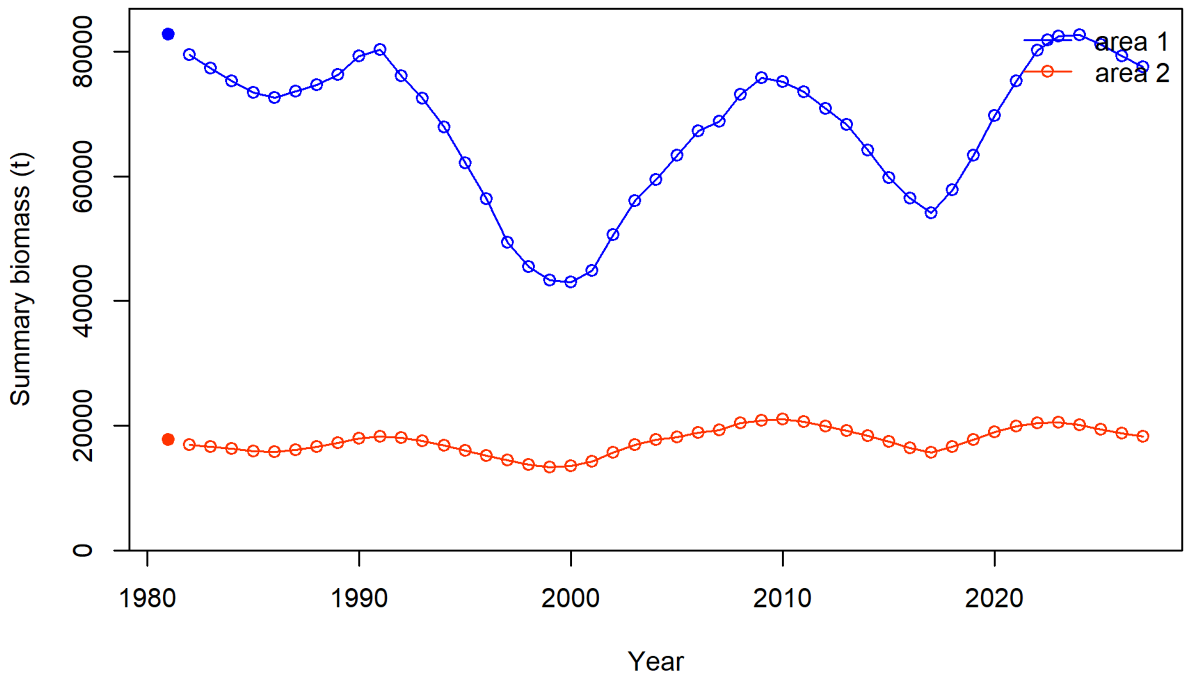

Figure 11. Total age 3+ biomass (t; specified as the definition of "Summary biomass") by area for the base case model (Model 25.1). Blue lines indicate the Western-Central GOA and red lines indicate the Eastern GOA.

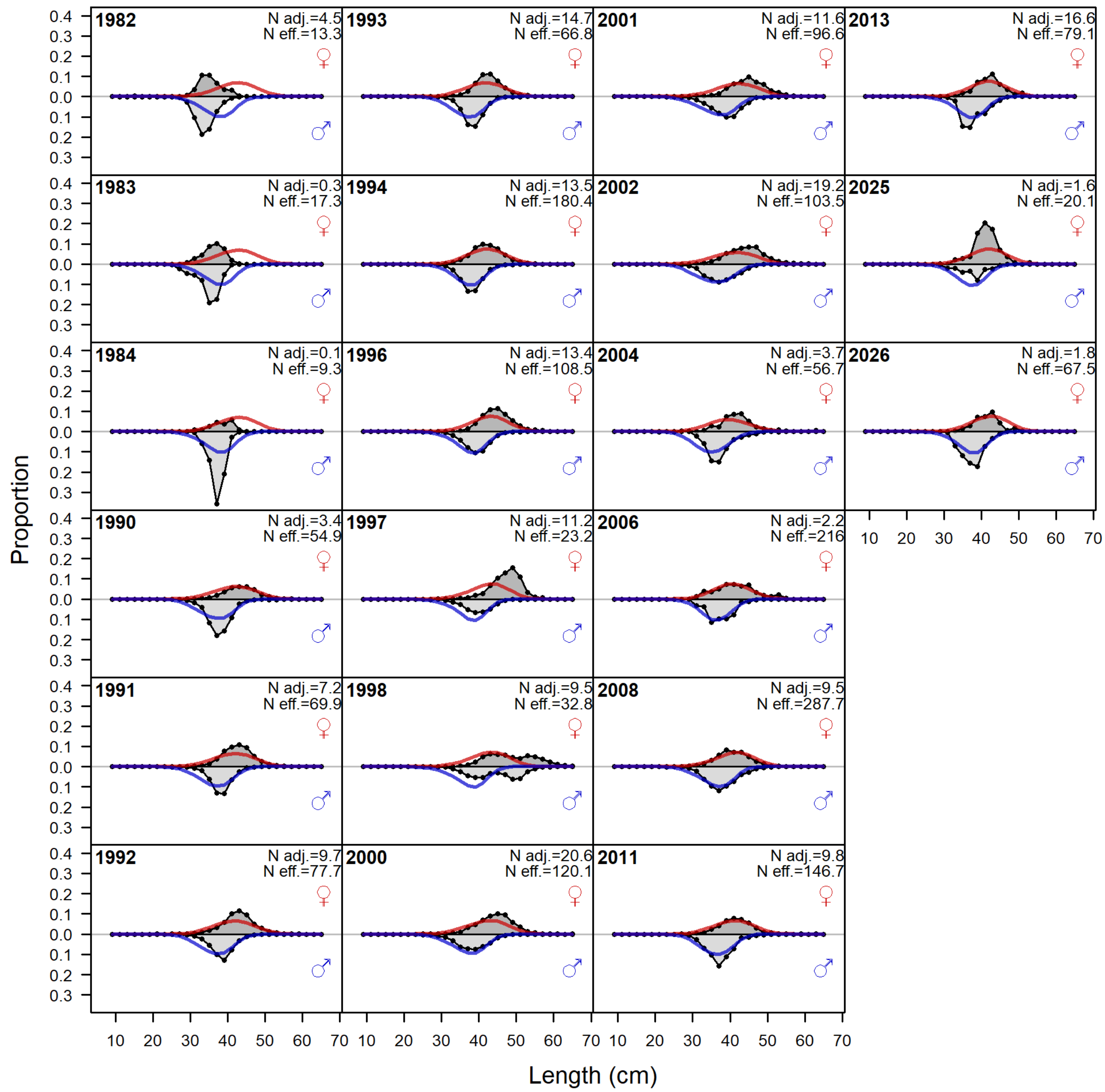

Figure 12. Observed (grey filled area and black line) and expected (red and blue lines) fishery length compositions in years without fishery age composition data for males (blue lines) and females (red lines). The plots show results for the base case model, Model 25.1. The labels in the upper right corner of each plot indicate the input sample size after data-weighting occurs (N adj). N eff. is the calculated effective sample size used in the McAllister-Ianelli tuning method.

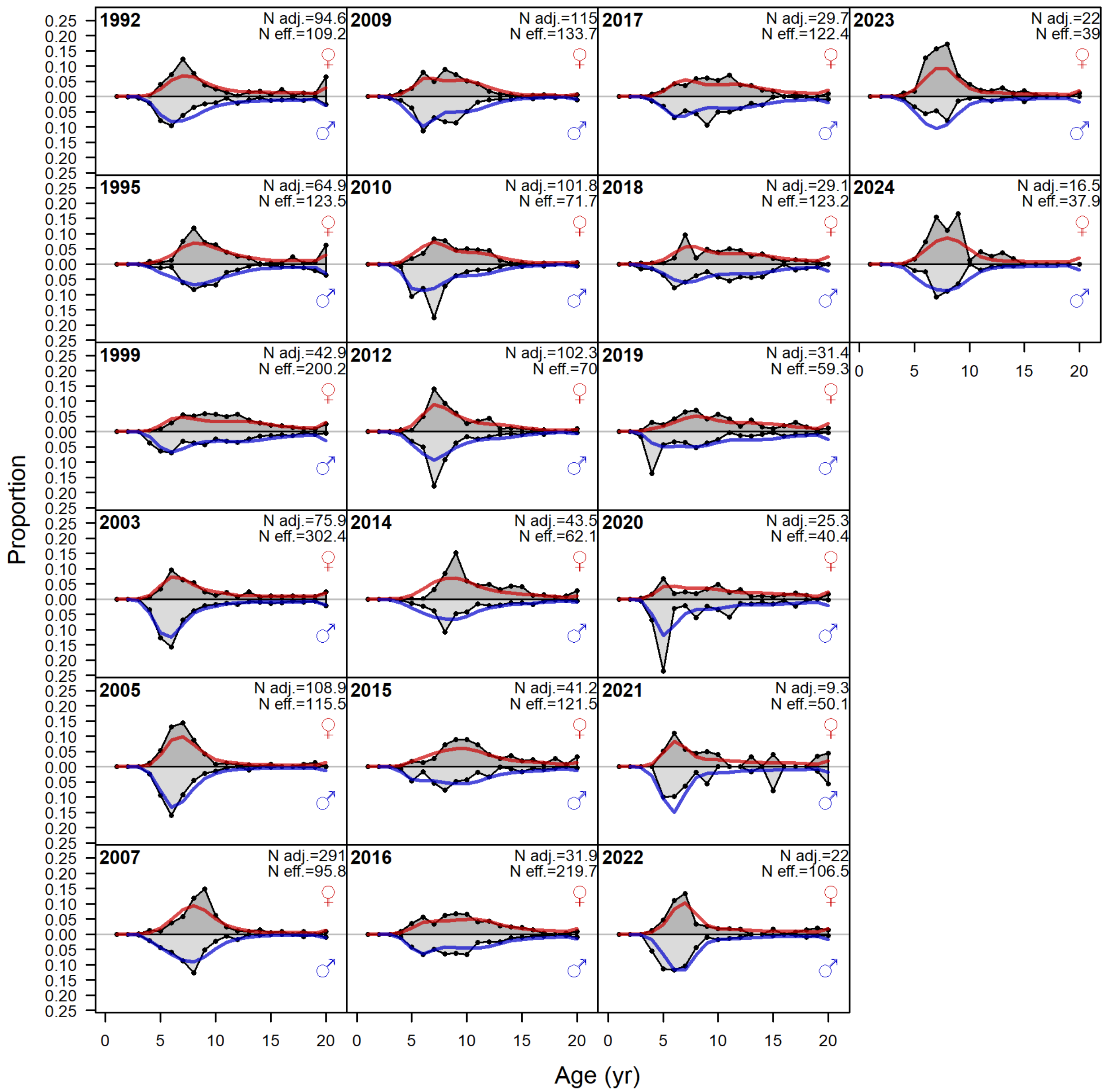

Figure 13. Observed (grey filled area and black line) and expected (red and blue lines) fishery age compositions for all available years of data (spanning 1992-2024) for males (blue lines) and females (red lines). The plots show the base case model, Model 25.1. The labels in the upper right corner of each plot indicate the input sample size after data-weighting occurs (N adj). N eff. is the calculated effective sample size used in the McAllister-Ianelli tuning method.

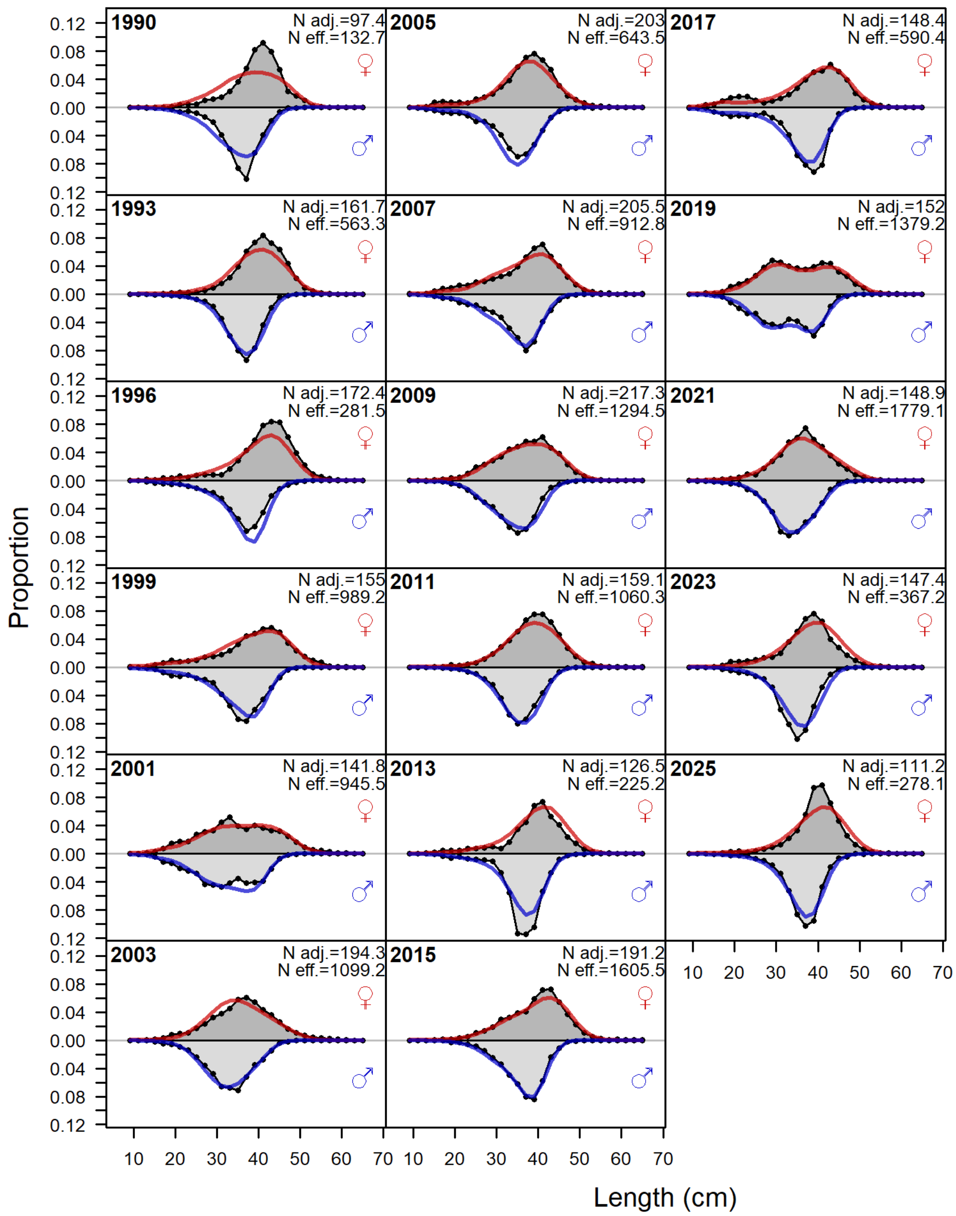

Figure 14. Observed (grey filled area and black line) and expected (red and blue lines) yearly survey length compositions for the Western-Central (non-Eastern) GOA for all years of survey data for males (blue lines) and females (red lines). The plots show the base case model, Model 25.1. The labels in the upper right corner of each plot indicate the input sample size after data-weighting occurs (N adj). N eff. is the calculated effective sample size used in the McAllister-Ianelli tuning method.

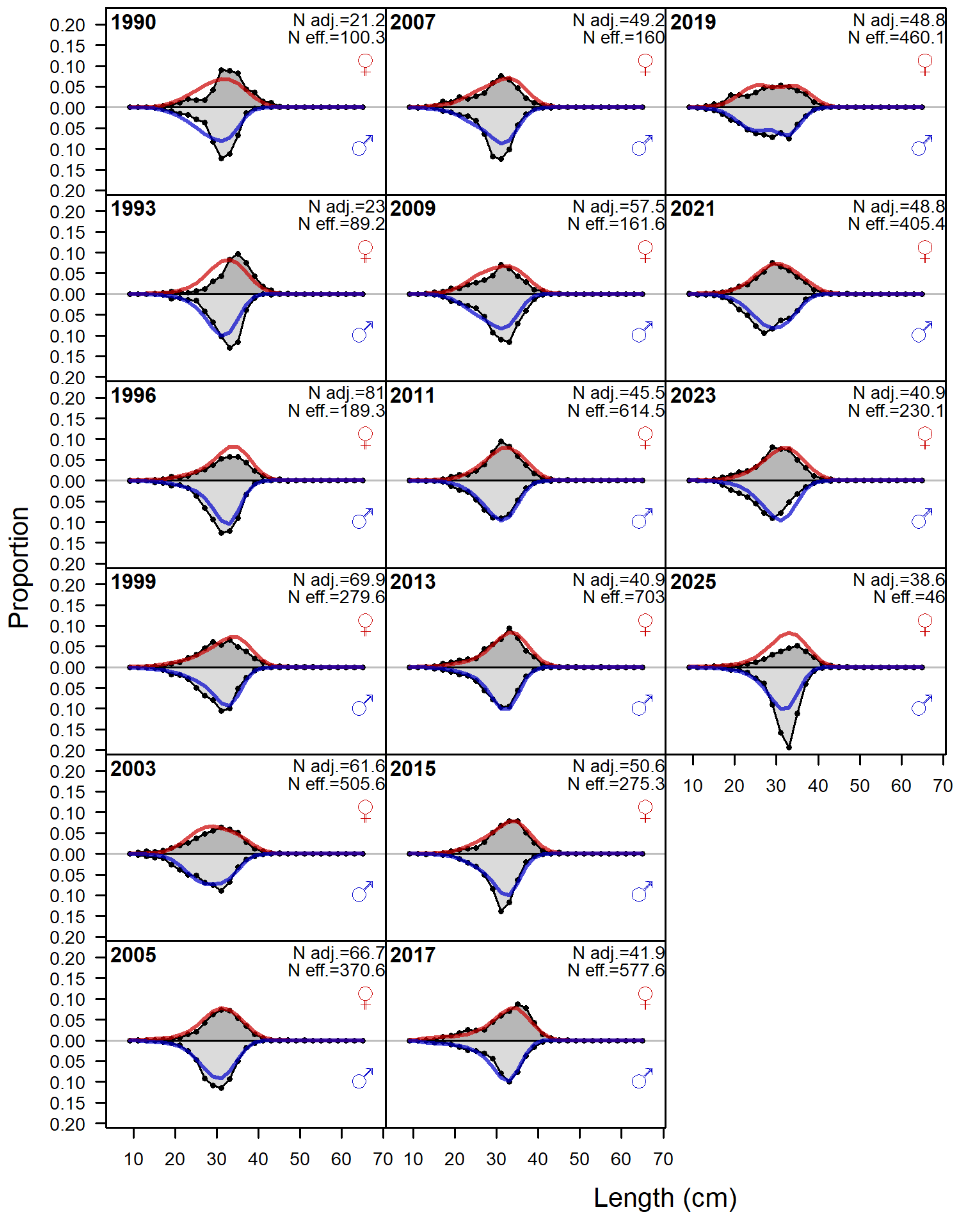

Figure 15. Observed (grey filled area and black line) and expected (red and blue lines) survey length compositions for the Eastern GOA for all years of survey data for males (blue lines) and females (red lines). The plots show the base case run, Model 25.1 The labels in the upper right corner of each plot indicate the input sample size after data-weighting occurs (N adj). N eff. is the calculated effective sample size used in the McAllister-Ianelli tuning method.

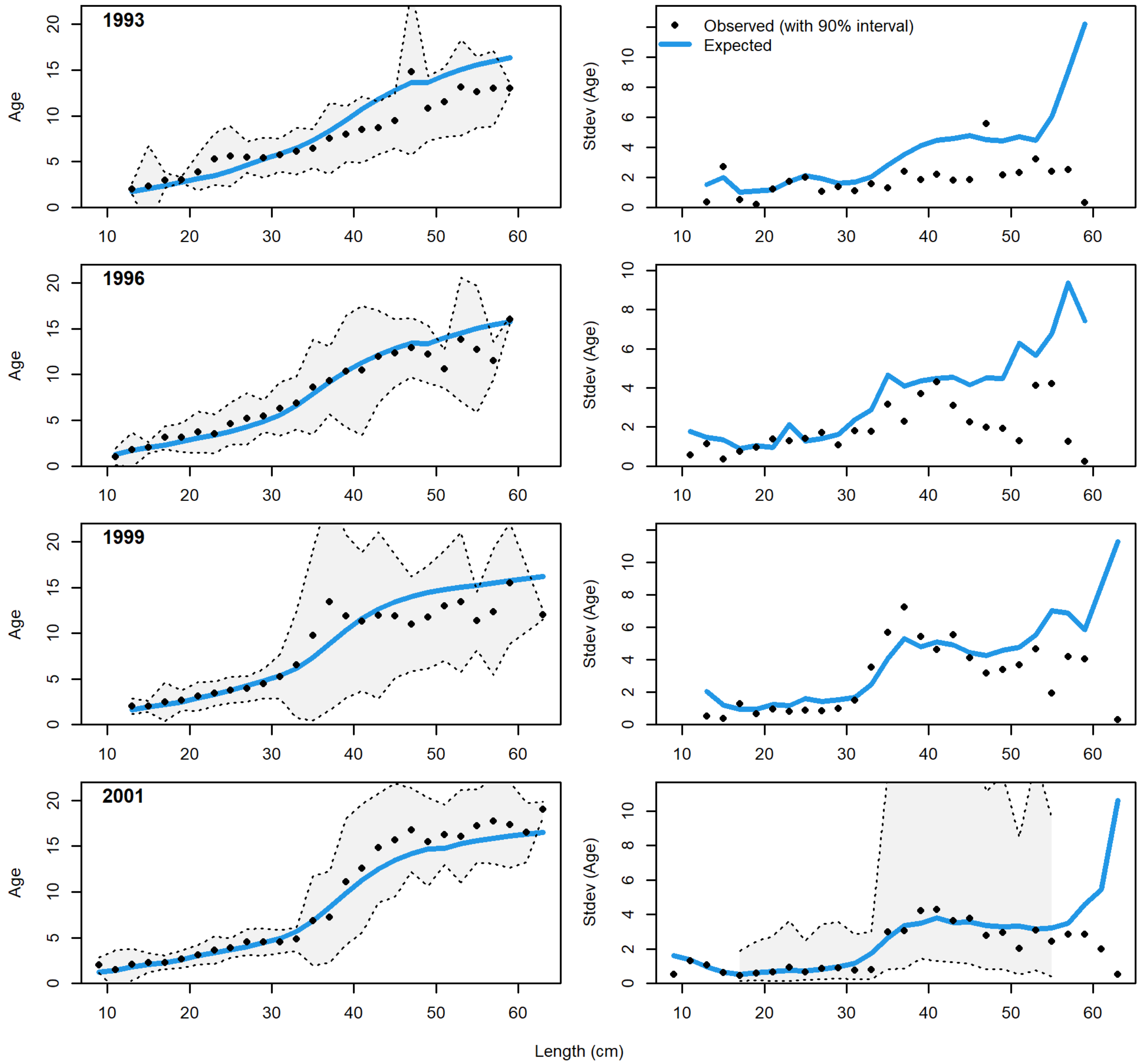

Figure 16. Observed and expected mean age-at-length for both females and males in the Western-Central (Non-Eastern) GOA with 90% intervals about observed age-at-length (left panels) and observed and expected standard deviation in age-at-length (right panels). The plots show the base case model, Model 25.1 for years 1993-2001.

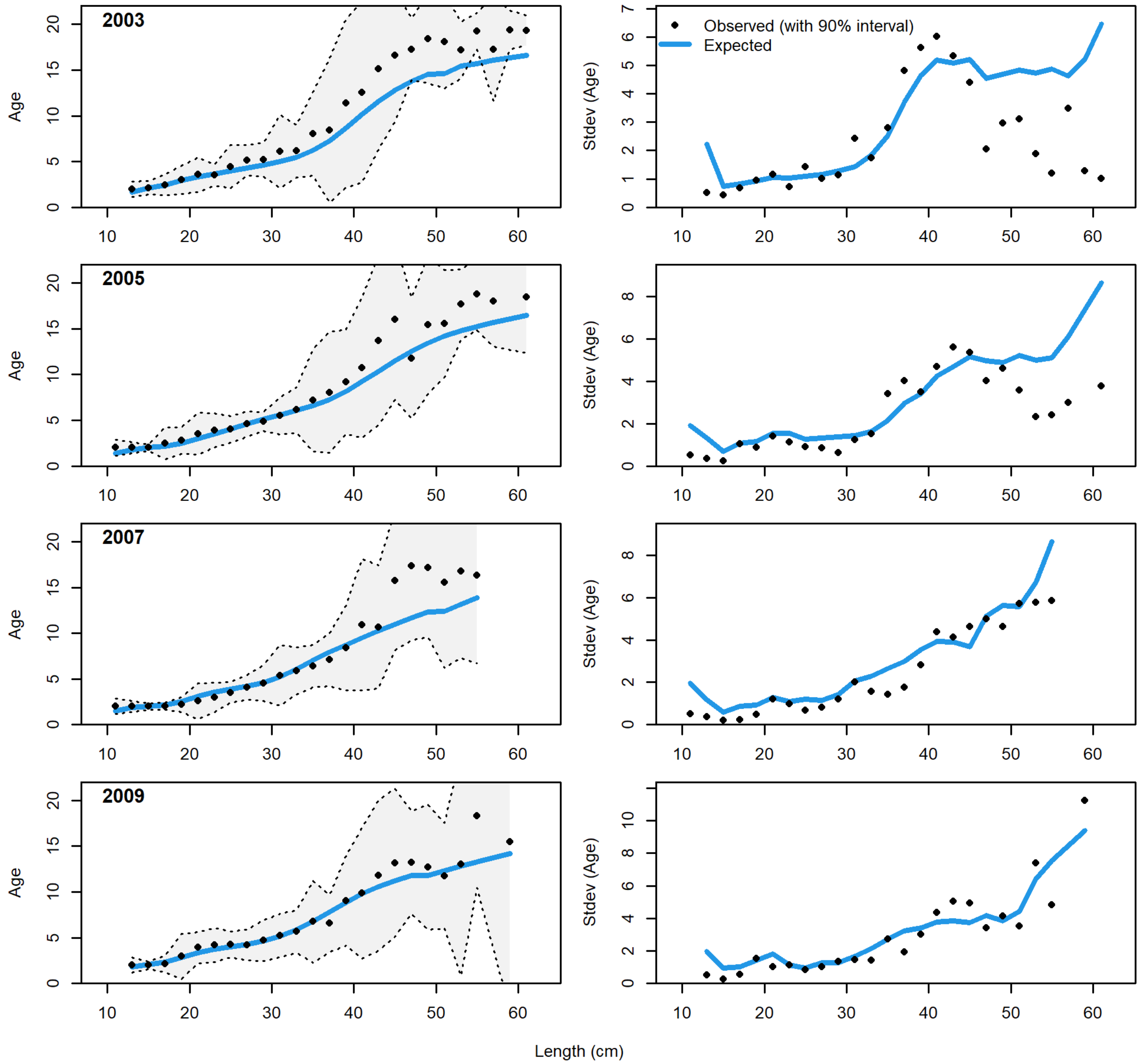

Figure 17. As for Figure 16 (Western-Central conditional age-at-length observations and fits for Model 25.1), but for years 2003-2009.

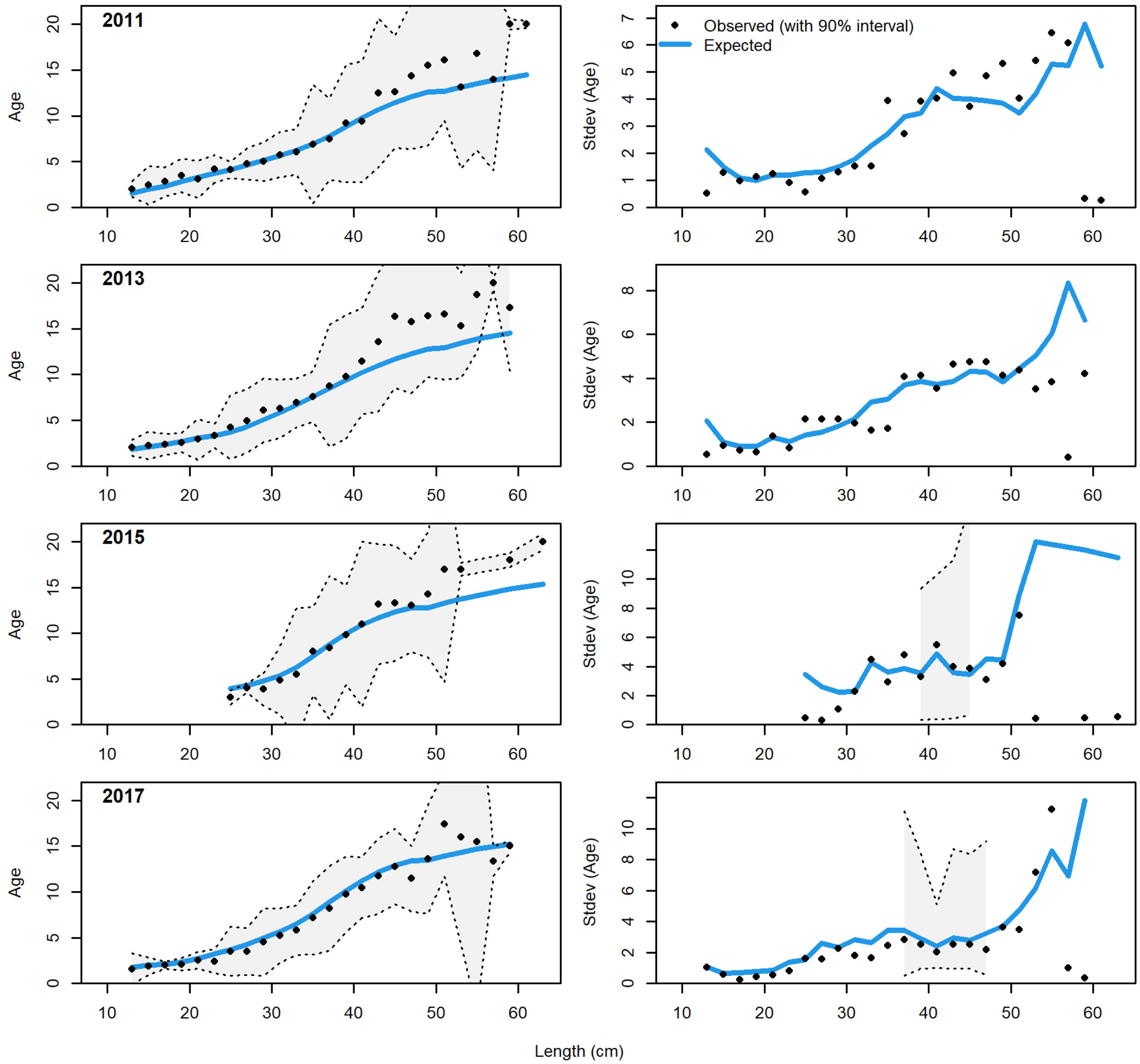

Figure 18. As for Figure 16 (Western-Central conditional age-at-length observations and fits for Model 25.1), but for years 2011-2017.

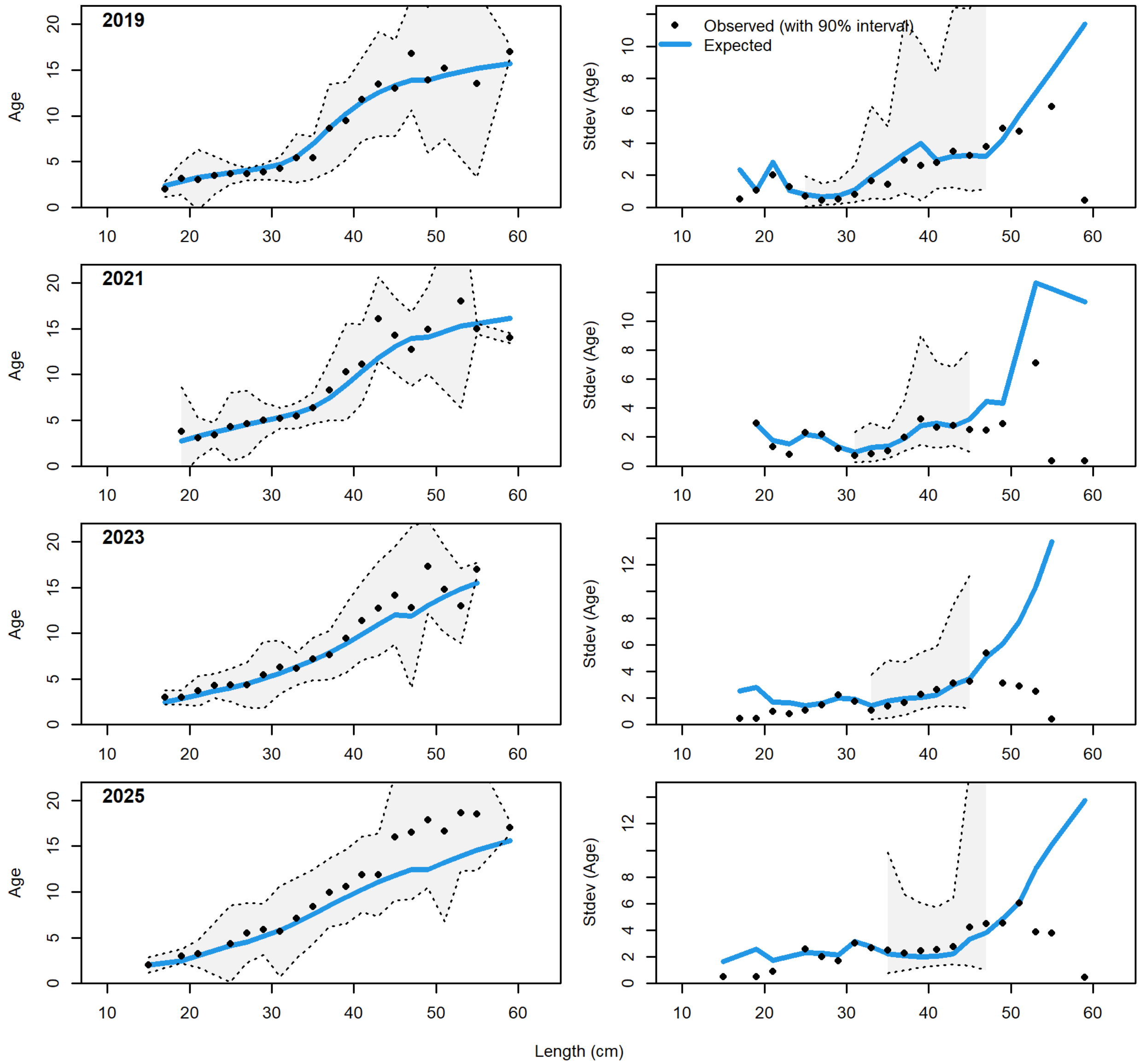

Figure 19. As for Figure 16 (Western-Central conditional age-at-length observations and fits for Model 25.1), but for years 2019-2025.

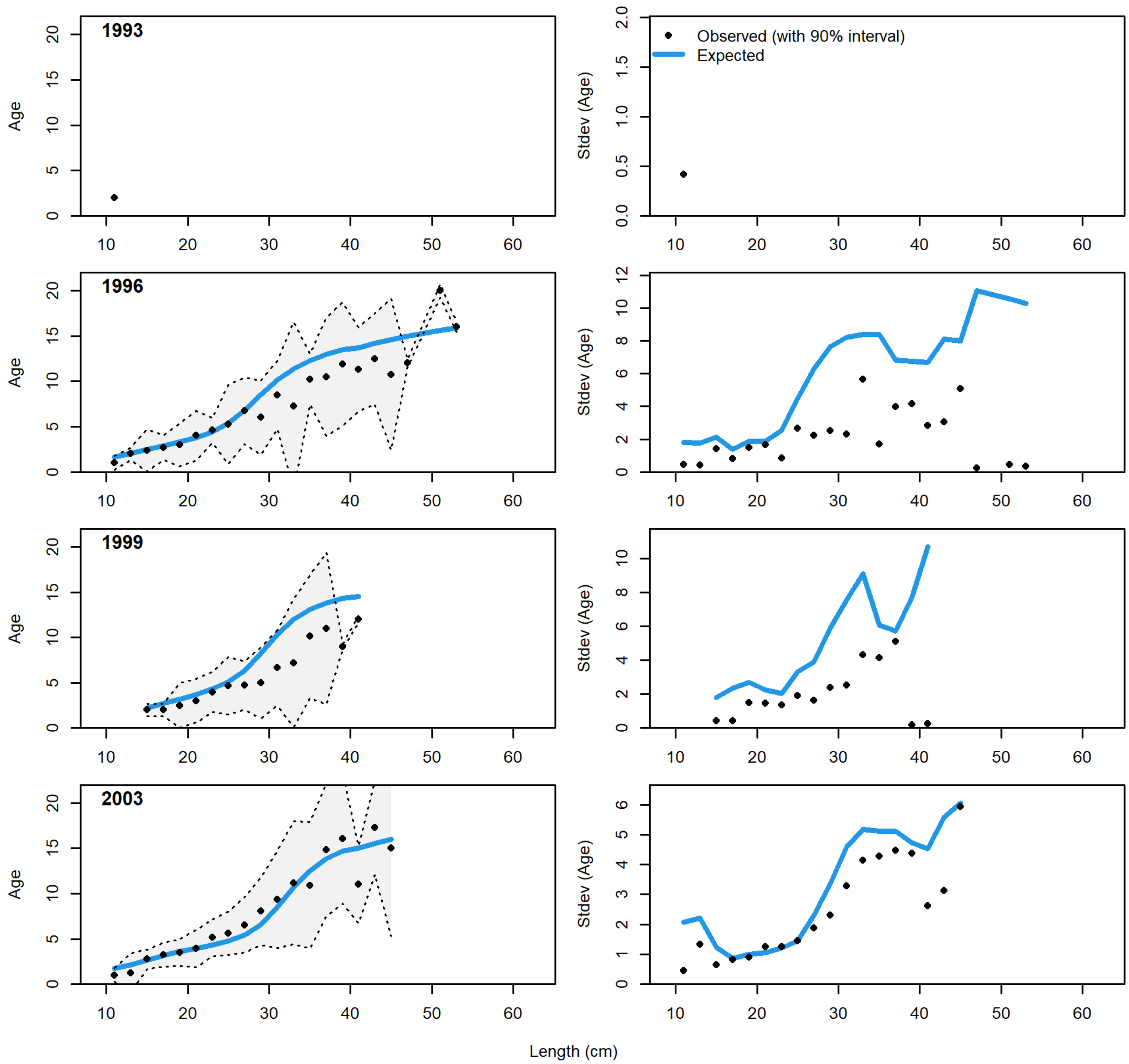

Figure 20. Observed and expected mean age-at-length for both females and males in the Eastern GOA with 90% intervals about observed age-at-length (left panels) and observed and expected standard deviation in age-at-length (right panels). The plots show results for the base case model, Model 25.1. for years 1993-2003.

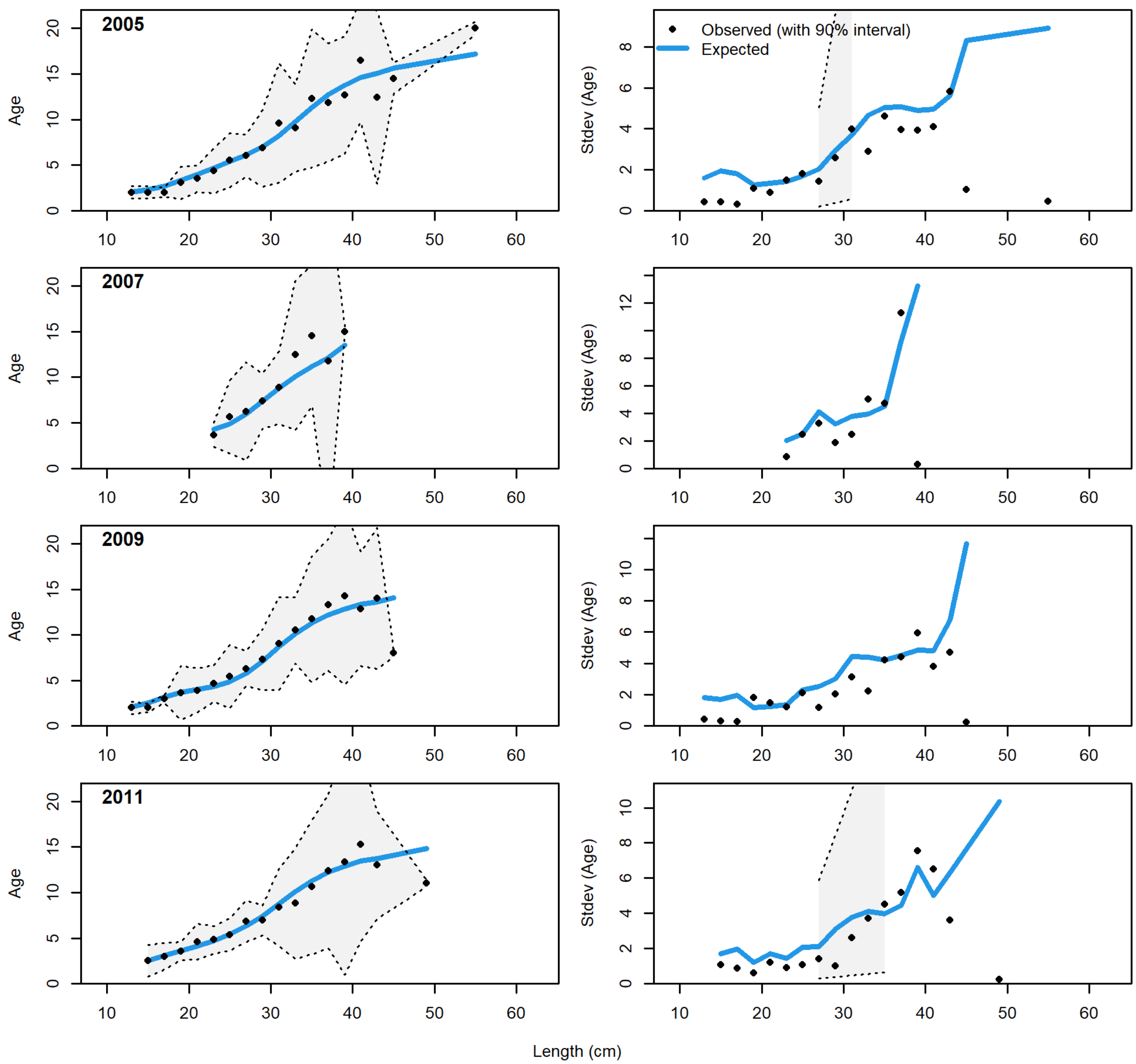

Figure 21. As for Figure 21 (Eastern GOA conditional age-at-length observations and fits for Model 25.1), but for years 2005-2011.

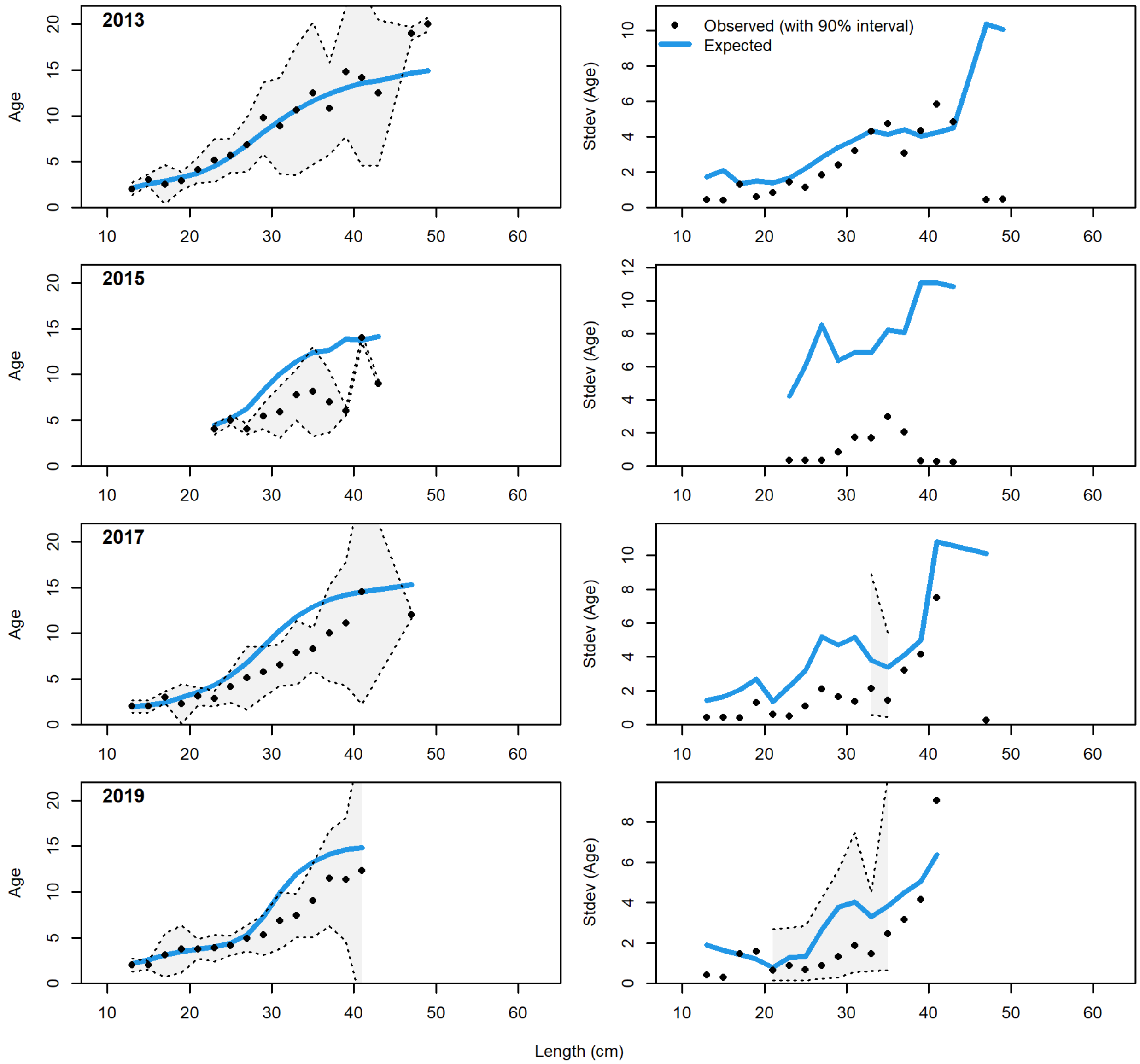

Figure 22. As for Figure 21 (Eastern GOA conditional age-at-length observations and fits for Model 25.1), but for years 2013-2019.

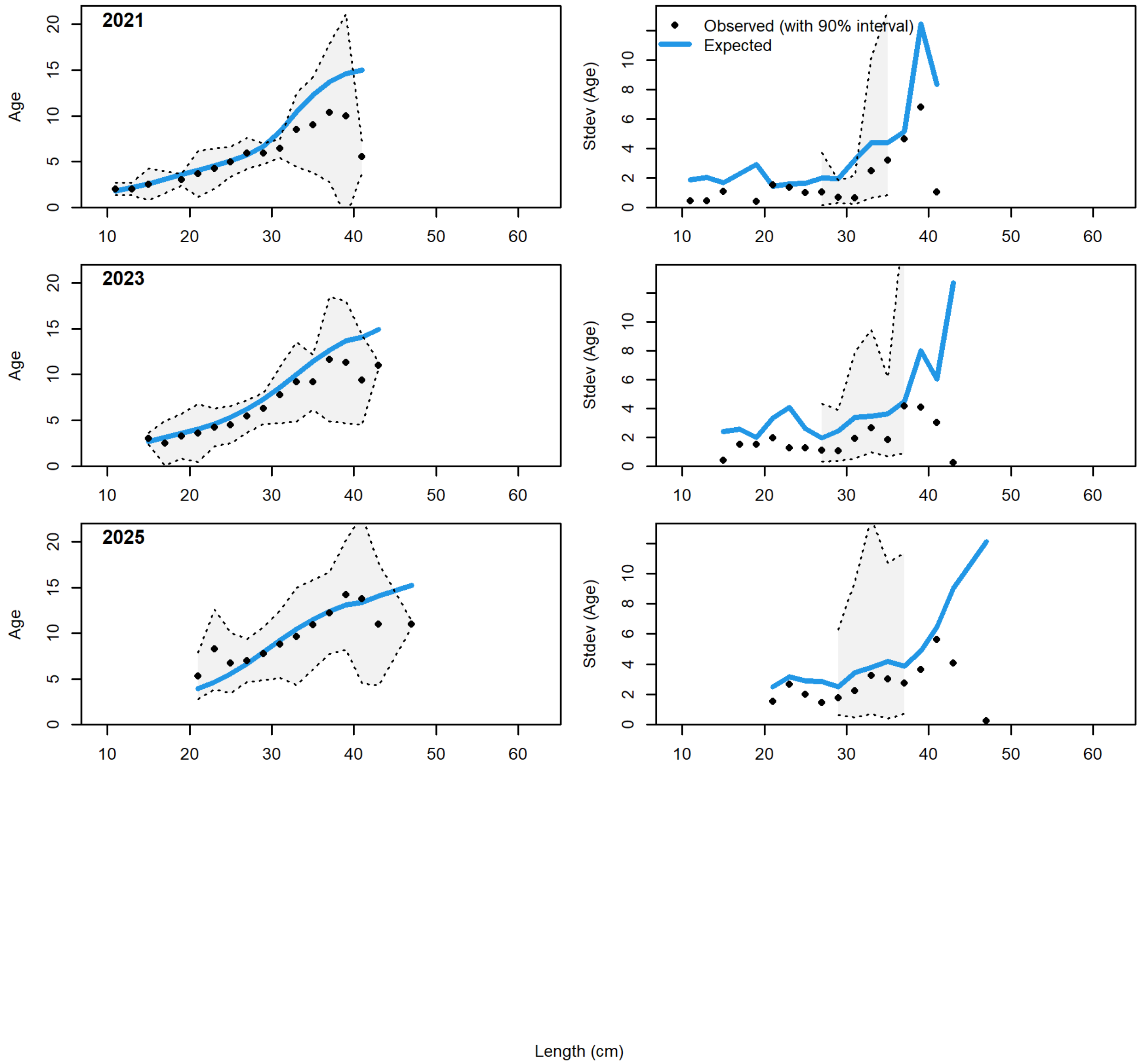

Figure 23. As for Figure 21 (Eastern GOA conditional age-at-length observations and fits for Model 25.1), but for years 2021-2025.

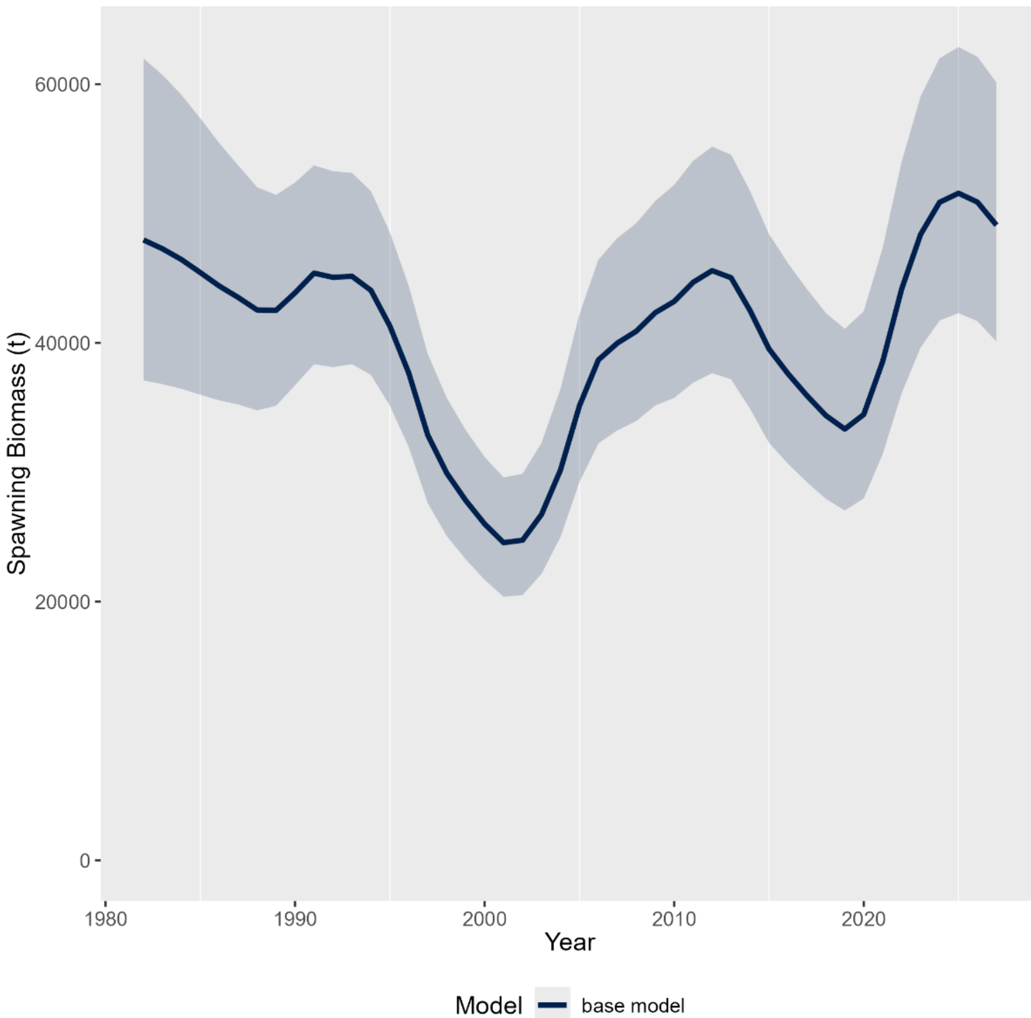

Figure 24. Spawning stock biomass (solid blue line) and 95% asymptotic confidence intervals (shaded region) for the base case assessment model (Model 25.1).

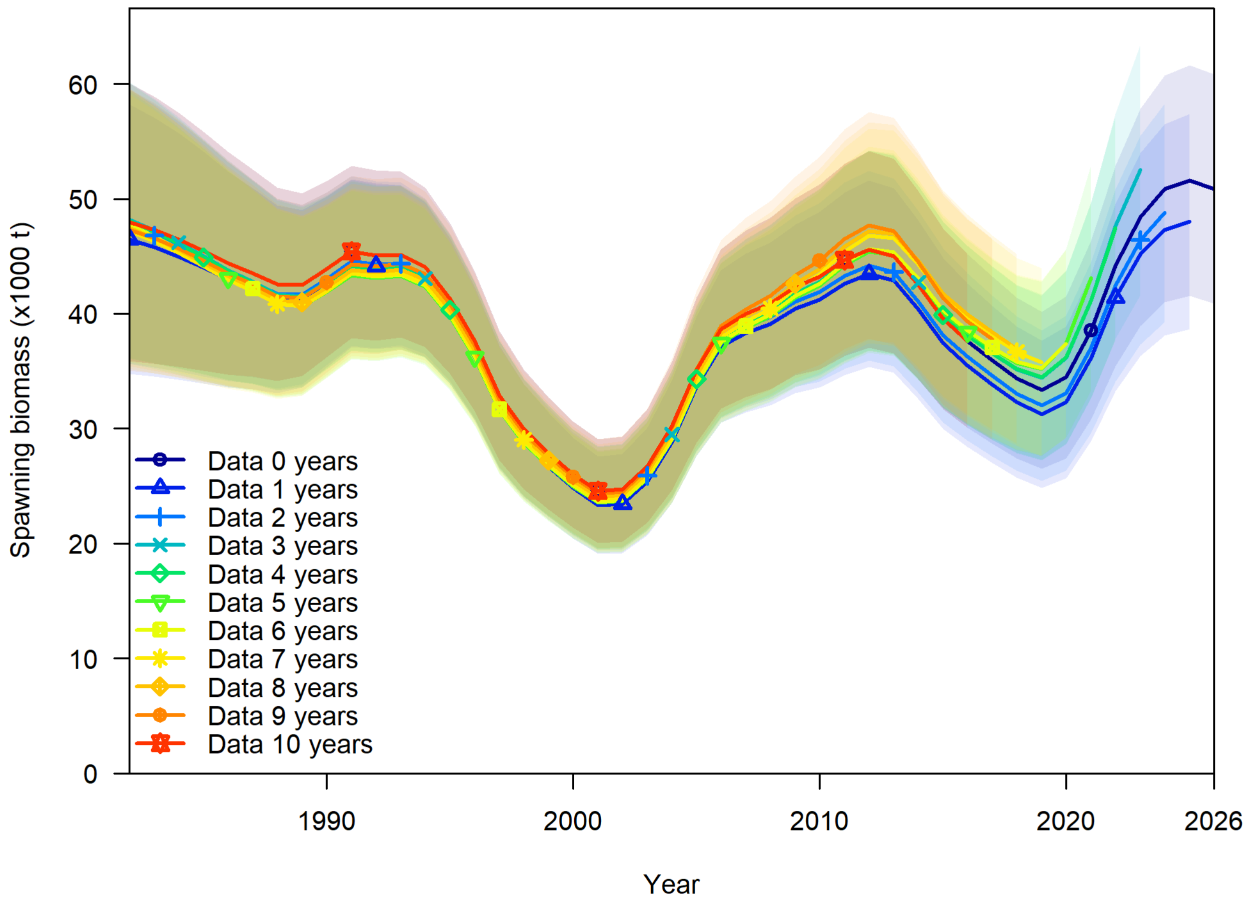

Figure 25. Spawning stock biomass for retrospective model runs leaving out 0 to 10 years of the most recent data for Model 25.1. Vertical lines show corresponding 95% asymptotic confidence intervals.

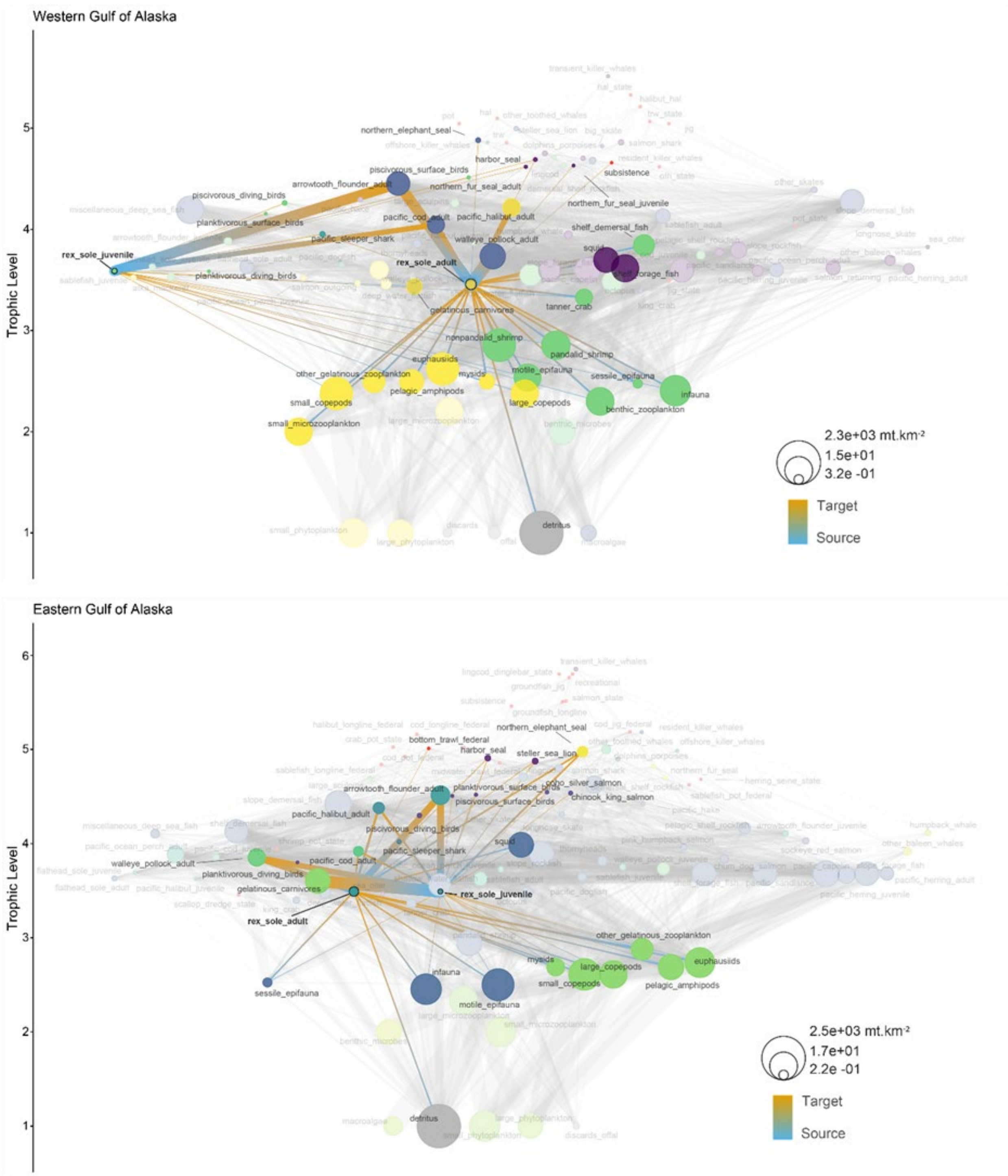

Figure 26. Diagrams of the rex sole food web in the western (top) and eastern Gulf of Alaska (bottom) based on Ecopath model results. Nodes highlight key predators and prey (their radii are scaled to the functional group biomass). The nodes are color-coded according to the edge betweenness cluster analysis. Edges indicate source, or prey, and target, or predator, The thickness of the edges represents the transfer of energy in the food web.

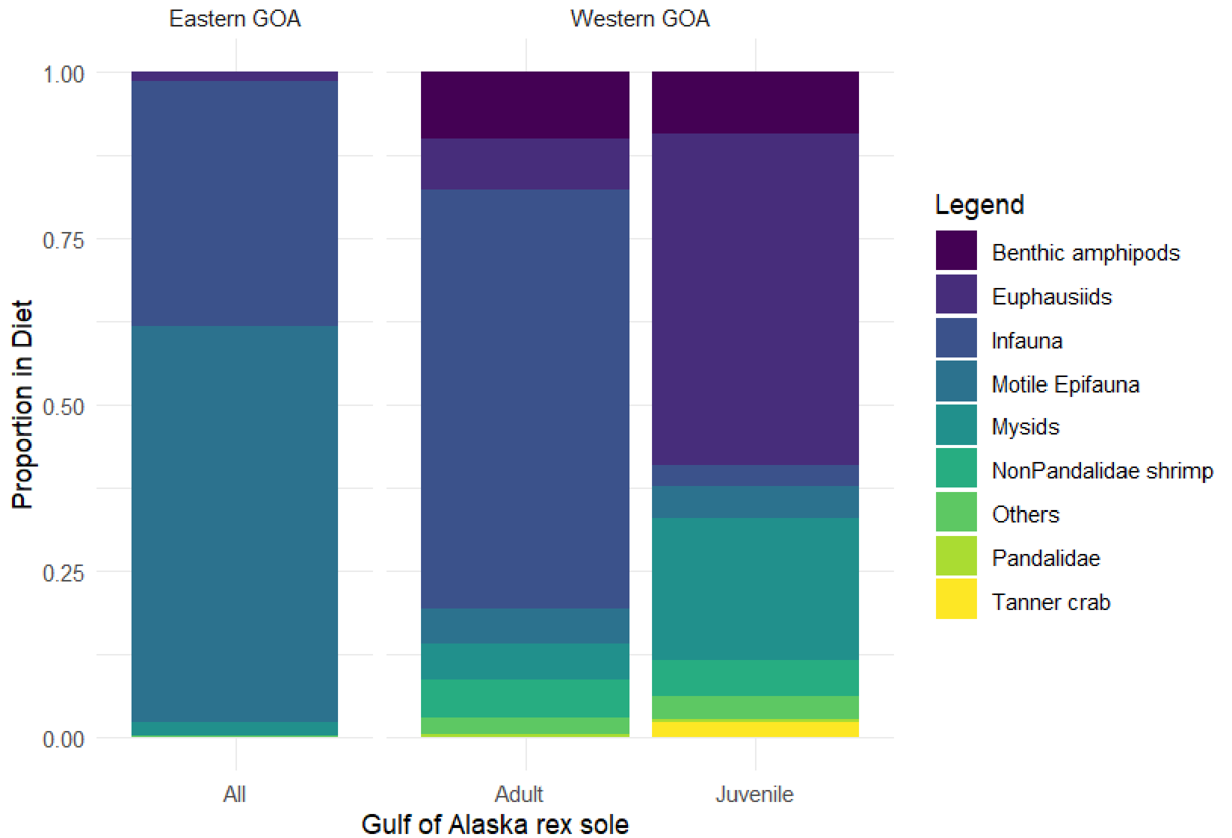

Figure 27. Proportion of key prey species in rex sole juvenile and adult diets in the western and eastern Gulf of Alaska based on Ecopath model results. Juvenile and adult diet compositions were combined in the eastern GOA due to small sample size for juvenile rex sole.

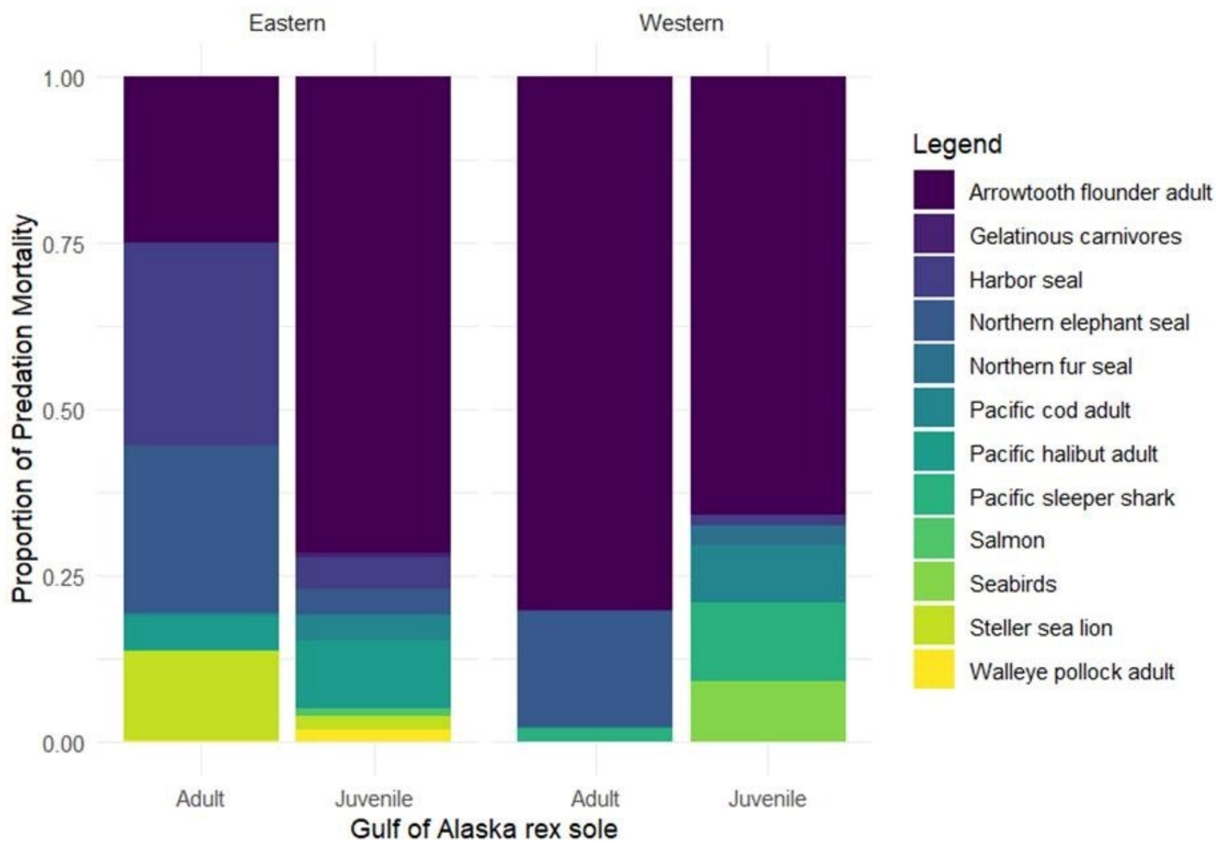

Figure 28. Proportions of juvenile and adult rex sole predation mortality by predator group in the western and eastern Gulf of Alaska, based on Ecopath model results.

Appendix 6A: Non-Commercial Catches of GOA Rex Sole

Table 35. ADF&G Sources of non-commercial catch of GOA rex sole.

Years	Kachemak Bay Large Mesh Trawl Survey	Kodiak Scallop Dredge	Large-Mesh Trawl Survey	Prince William Sound Large Mesh Trawl Survey	Prince William Sound Sablefish Tagging	Scallop Dredge Survey	Small-Mesh Trawl Survey	Subsistence Fishery	Yakutat Scallop Dredge	Total ADF&G
1989										
1991								393		393
1992										
1994										
1995										
1998			283			2				285
1999			843							843
2000			380			0	106			486
2001			1,294							1,294
2002			506			2				507
2003			1,964				285			2,249
2004			625			0	128			754
2005			1,468			3	267			1,738
2006			307			12	265			584
2007			771			1	100			871
2008			229							229
2009			1,075			1				1,076
2010			5,453			0	342			5,795
2011			4,368				147			4,515
2012			3,829			0	63			3,892
2013			3,924				78			4,002
2014			1,810				137			1,948
2015			1,894		1		111			2,006
2016			1,328			3	44			1,375
2017	686	77	1,398	409			67		52	2,689
2018			3,974				39			4,013
2019			5,437			0	61			5,498
2020			4,135			19	257			4,411
2021			4,440				1			4,442
2022			4,840				11			4,851
2023			4,985				29			5,014
2024			5,184				16			5,200

Table 36. Other NMFS Sources of non-commercial catch of GOA rex sole.

Years	AFSC Annual Longline Survey	GOA Shelf and Slope Walleye Pollock Acoustic-Trawl Survey	Gulf of Alaska Bottom Trawl Survey	Salmon EFP 13-01	Shelikof Acoustic Survey	Shumigans Acoustic Survey	Summer Acoustic-Trawl Survey of Walleye Pollock in the Gulf of Alaska	Winter Acoustic-Trawl Survey of Walleye Pollock in Shelikof Strait and Vicinity	Total
1989	2								2
1992	1								1
1994	5								5
1995	1								1
2010					9	36			45
2011			5,751						5,751
2012	1								1
2013	2		5,022	130					5,154
2014				184					184
2015			7,679						7,679
2016									
2017		5	4,950						4,955
2018									
2019			4,482					4	4,486
2020	4								4
2021	1	18	5,888						5,907
2023			4,690				5		4,695

Appendix 6B: GOA Rex Sole 2026: Bridging Model 25.0 and Model 25.1 to SPoRC

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September 2026

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Overview

The following document bridges the two candidate models of the 2026 Gulf of Alaska rex sole assessment, Model 25.0 and Model 25.1, from Stock Synthesis 3 (SS3) into SPoRC. Both models 25.0 and 25.1 use the same data, through August 2026, but differ in how ageing error is incorporated. Model 25.0 has an ageing error standard deviation of 0.001 at every age, which is an identity matrix, while Model 25.1 replaces the identity matrix with an ageing error matrix.

The SPoRC model specified is configured in the same way as the SS3 model: two area, two sex, single season, one fishery in the Western-Central area, a bottom trawl survey in each area, growth estimated per area and sex from the survey's conditional age-at-length, and no movement.

Table 1: Data sources shared by Model 25.0 and Model 25.1, with the number of observations and the likelihood used for each.

Source	Years	Observations	Likelihood
Catch, Western-Central GOA	1982–2026	45	Lognormal, CV 0.01
Survey biomass, both	1990–2025	33	Lognormal

areas			
Fishery length compositions	1982–2026	40	Multinomial
Fishery age compositions	1992–2024	20	Multinomial
Survey length compositions, both areas	1990–2025	33	Multinomial
Survey conditional age-at-length, both areas	1993–2025	584 length bins	Multinomial

Spatial recruitment assumptions

Recruitment is pooled and then apportioned, as in the SS3 model. Thus, one mean recruitment level is estimated for the stock as a whole, one deviation series is shared by both areas, and the total is split between them by a single time-invariant apportionment parameter. SPoRC puts that split on a multinomial logit with the Western-Central area as the reference, so two areas leave one free parameter and the two areas' recruitment series stay proportional to each other in every year.

Both models place 0.2920 of recruitment in the Eastern area, with a standard error of 0.0119, against 0.2928 in Model 25.0 of the assessment and 0.2927 in Model 25.1, leaving 0.7080 in Western-Central (Table 6, Table 7).

Stock Synthesis compared to SPoRC

In the following sections, we compare both models 25.0 and 25.1 from SS3 to SPoRC.

Starting at the assessment's estimate

In this exercise, every parameter is set to the assessment's estimate and each model is then evaluated without optimizing. These are the recruitment and early deviations, log fishing mortality as a mean plus deviations reproducing the hybrid solve, the shared catchability, and the growth and selectivity parameters in SPoRC's transforms.

Before anything is optimized, differences in derived quantities are minimal:

Table 2: Maximum absolute percent difference between SPoRC and the assessment in derived quantities, with every parameter fixed at the assessment's estimate and nothing optimized.

	Model 25.0	Model 25.1
Spawning biomass, both areas	3.9×10^{-3} %	4.6×10^{-3} %

Numbers at age	3.9×10^{-3} %	5.0×10^{-3} %

Likewise, differences in negative log likelihood components prior to model optimization are minimal. We note some differences in the following because SPoRC writes each likelihood component as a proper density whereas ss3 drops normalizing constants, so the following comparison drops SPoRC's normalizing constants that to maintain comparability when calculating residuals and residual percentages in Table 3 and Table 4.

Model 25.0

Table 3: Model 25.0 negative log likelihood by component at the assessment's estimate. The constant is the normalizing term the assessment drops, and the residual is what remains once it is subtracted.

Component	SPoRC	Assessment	Difference	Constant	Residual	Residual (%)
Survey indices	-2.7981	-33.0262	30.2281	30.3250	-0.0969	-0.29 %
Length compositions	186.0935	185.9850	0.1085	0	0.1085	+0.06 %
Age compositions, marginal and conditional	619.3754	619.2270	0.1484	0	0.1484	+0.02 %
Catchability prior	-1.00665	0.00497	-1.01162	-1.01162	-3.3×10^{-7}	~ 0
Catch	-165.8802	~ 0	-165.8802	fixed difference		
Recruitment deviations	49.4522	-6.4379	55.8900	fixed difference		

Model 25.1

Table 4: Model 25.1 negative log likelihood by component at the assessment's estimate. The constant is the normalizing term the assessment drops, and the residual is what remains once it is subtracted.

Component	SPoRC	Assessment	Difference	Constant	Residual	Residual (%)
Survey indices	-0.9724	-30.9902	30.0178	30.3250	-0.3071	-0.99 %
Length compositions	184.7914	184.6840	0.1074	0	0.1074	+0.06 %
Age compositions, marginal and conditional	642.1962	642.0350	0.1612	0	0.1612	+0.03 %

Catchability prior	-1.00513	0.00649	-1.01162	-1.01162	3.4×10^{-7}	~ 0
Catch	-165.8799	~ 0	-165.8799	fixed difference		
Recruitment deviations	53.7187	-2.1714	55.8900	fixed difference		

The residual is what is left after subtracting the constant, and the percent column expresses the residual relative to the ss3 assessment's component. Compositions and the catchability prior land within a tenth of a unit in both models.

The survey index residual is -0.10 units in Model 25.0 and -0.31 in Model 25.1, due in part to differences in how survey timing is structured in SS3 and SPoRC (see sections below).

Fitting and comparison

Each model is re-fit from the 2025 estimates as starting values. 134 parameters: the assessment's own 89 parameters plus the 45 annual fishing mortalities that the hybrid solve computes rather than estimates. After re-fitting the model, differences in key quantities again remain negligible:

Table 5: Percent difference between the refitted SPoRC model and the assessment across the 1982 to 2026 time series, by model and area.

	Median	Maximum
Spawning biomass, Western-Central GOA, 25.0	+0.67 %	1.37 %
Spawning biomass, Eastern GOA, 25.0	+0.06 %	1.26 %
Spawning biomass, Western-Central GOA, 25.1	+0.78 %	1.55 %
Spawning biomass, Eastern GOA, 25.1	+0.22 %	1.28 %
Numbers at age 3, Western-Central GOA, 25.1	+0.17 %	2.53 %
Numbers at age 3, Eastern GOA, 25.1	-0.16 %	2.44 %

Comparison of estimated parameters with SS3

The table in the following shows each framework's estimate and standard error. Recruitment scale, catchability and the apportionment are on the natural scale; selectivity is on the assessment's own double-normal scale.

Model 25.0

Table 6: Model 25.0 parameter estimates with standard errors in parentheses. Recruitment scale, catchability and apportionment are on the natural scale; selectivity is on the assessment's double-normal scale.

Parameter	SPoRC	SS3	Difference (%)
R0 (thousands of recruits)	90588 (10119)	93611 (7226)	-3.23
Survey catchability	1.205 (0.109)	1.170 (0.104)	+2.93
Eastern recruitment fraction	0.2920 (0.0119)	0.2928 (0.0117)	-0.28
L1, Western-Central female	14.545 (0.863)	14.579 (0.864)	-0.23
L1, Eastern female	14.441 (1.446)	14.469 (1.447)	-0.19
L2, Western-Central female	46.776 (0.349)	46.789 (0.350)	-0.03
L2, Eastern female	36.745 (0.540)	36.755 (0.541)	-0.03
K, Western-Central female	0.2809 (0.0143)	0.2802 (0.0143)	+0.25
K, Eastern female	0.2995 (0.0333)	0.2987 (0.0332)	+0.26
CV young, Western-Central female	0.1762 (0.0143)	0.1763 (0.0143)	-0.05
CV young, Eastern female	0.1785 (0.0272)	0.1785 (0.0272)	-0.01
CV old, Western-Central female	0.0890 (0.0040)	0.0889 (0.0040)	+0.09
CV old, Eastern female	0.0964 (0.0084)	0.0963 (0.0084)	+0.12
L1, Western-Central male	14.859 (1.013)	14.898 (1.015)	-0.26
L1, Eastern male	14.593 (1.559)	14.621 (1.560)	-0.19
L2, Western-Central male	41.009 (0.282)	41.020 (0.283)	-0.03
L2, Eastern male	34.645 (0.393)	34.654 (0.393)	-0.03
K, Western-Central male	0.3252 (0.0192)	0.3243 (0.0192)	+0.25
K, Eastern male	0.3146 (0.0351)	0.3138 (0.0350)	+0.25
CV young, Western-Central male	0.1943 (0.0162)	0.1944 (0.0162)	-0.05
CV young, Eastern male	0.1922 (0.0266)	0.1923 (0.0265)	-0.03
CV old, Western-Central male	0.0720 (0.0039)	0.0719 (0.0039)	+0.12

CV old, Eastern male	0.0764 (0.0070)	0.0763 (0.0070)	+0.16
Fishery peak	7.798 (0.253)	7.804 (0.253)	-0.08
Fishery ascending width	1.485 (0.170)	1.486 (0.170)	-0.11
Fishery male peak offset	-1.150 (0.322)	-1.149 (0.322)	-0.06
Fishery male ascend offset	-0.3070 (0.2483)	-0.3059 (0.2478)	-0.34
WC survey peak	5.853 (0.230)	5.877 (0.232)	-0.42
WC survey ascending width	1.619 (0.129)	1.629 (0.129)	-0.59
Eastern survey peak	5.191 (0.336)	5.200 (0.337)	-0.17
Eastern survey ascending width	1.311 (0.240)	1.314 (0.239)	-0.21

Model 25.1

Table 7: Model 25.1 parameter estimates with standard errors in parentheses, laid out as in Table 6.

Parameter	SPoRC	SS3	Difference (%)
R0 (thousands of recruits)	86169 (9727)	87492 (6912)	-1.51
Survey catchability	1.239 (0.113)	1.207 (0.108)	+2.64
Eastern recruitment fraction	0.2920 (0.0119)	0.2927 (0.0118)	-0.23
L1, Western-Central female	13.641 (0.934)	13.695 (0.933)	-0.40
L1, Eastern female	13.000 (1.730)	13.047 (1.728)	-0.35
L2, Western-Central female	47.030 (0.354)	47.053 (0.355)	-0.05
L2, Eastern female	36.845 (0.546)	36.858 (0.547)	-0.04
K, Western-Central female	0.2797 (0.0142)	0.2785 (0.0141)	+0.41
K, Eastern female	0.3078 (0.0341)	0.3068 (0.0341)	+0.33
CV young, Western-Central female	0.1598 (0.0159)	0.1599 (0.0158)	-0.08
CV young, Eastern female	0.1565 (0.0330)	0.1569 (0.0329)	-0.23
CV old, Western-	0.0868 (0.0040)	0.0867 (0.0040)	+0.14

Central female			
CV old, Eastern female	0.0961 (0.0086)	0.0960 (0.0086)	+0.15
L1, Western-Central male	13.777 (1.043)	13.835 (1.042)	-0.42
L1, Eastern male	13.400 (1.788)	13.444 (1.787)	-0.32
L2, Western-Central male	41.173 (0.281)	41.191 (0.282)	-0.04
L2, Eastern male	34.721 (0.394)	34.732 (0.395)	-0.03
K, Western-Central male	0.3273 (0.0185)	0.3259 (0.0184)	+0.42
K, Eastern male	0.3203 (0.0356)	0.3193 (0.0356)	+0.31
CV young, Western-Central male	0.1758 (0.0181)	0.1759 (0.0180)	-0.06
CV young, Eastern male	0.1834 (0.0306)	0.1837 (0.0305)	-0.14
CV old, Western-Central male	0.0708 (0.0038)	0.0706 (0.0039)	+0.18
CV old, Eastern male	0.0750 (0.0070)	0.0749 (0.0070)	+0.21
Fishery peak	7.340 (0.278)	7.349 (0.279)	-0.12
Fishery ascending width	0.9160 (0.2717)	0.9206 (0.2712)	-0.50
Fishery male peak offset	-0.9869 (0.3567)	-0.9848 (0.3564)	-0.21
Fishery male ascend offset	-0.2434 (0.3878)	-0.2399 (0.3858)	-1.46
WC survey peak	5.814 (0.241)	5.852 (0.244)	-0.65
WC survey ascending width	1.565 (0.138)	1.581 (0.138)	-1.05
Eastern survey peak	5.125 (0.347)	5.135 (0.349)	-0.18
Eastern survey ascending width	1.199 (0.265)	1.202 (0.265)	-0.32

Growth agrees within 0.45 percent and selectivity within 1.5 percent in both models. The two scale parameters move the most, recruitment scale by -3.2 percent and catchability by +2.9 percent, and both stay well within one standard error of the assessment's estimates.

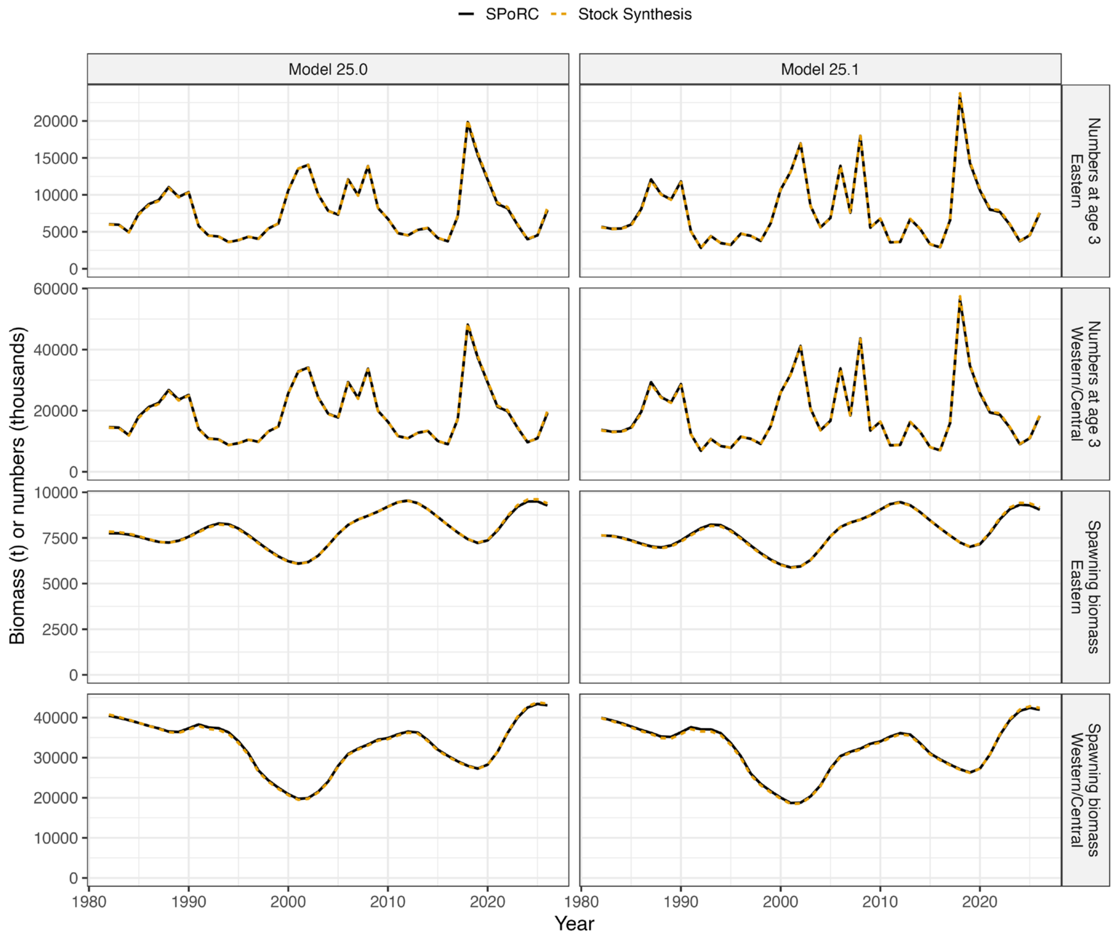

Figure 1: Spawning biomass and numbers at age 3 from SPoRC (black) and Stock Synthesis (orange), by area and model.

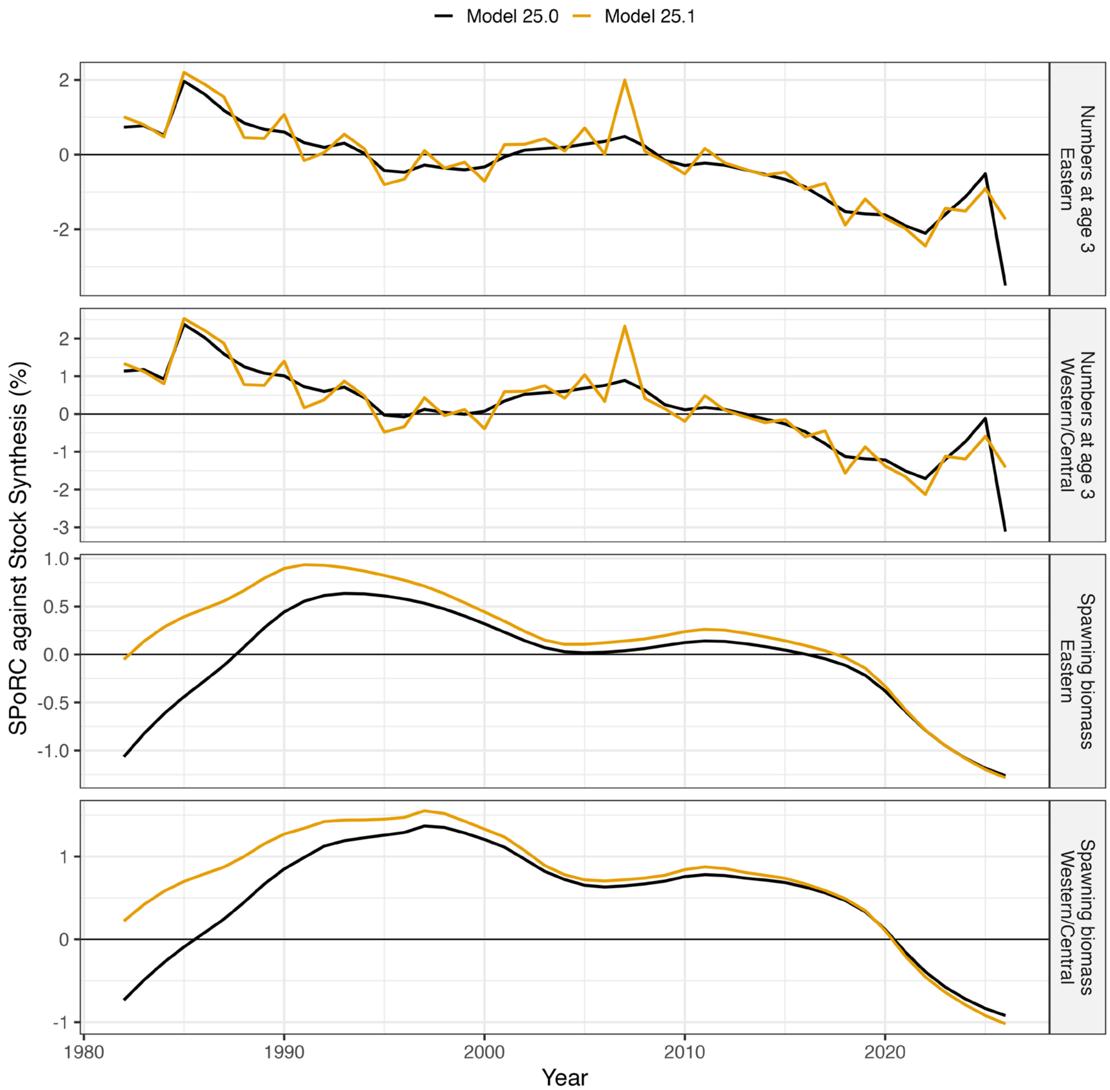

Figure 2: Percent difference of SPoRC against Stock Synthesis for the series in Figure 1, both models overlaid.

Why do differences arise?

The recruitment deviation vector

Additionally, the optimized model falls about 1.5 units below the assessment's estimate in both models, with the recruitment scale landing a few percent lower, the deviations slightly higher, and the derived time series changing negligibly. Based on initial investigations, the likely cause is the recruitment deviation vector: the assessment constrains its deviations to sum to zero, so its R_0 is tied to the mean recruitment of the deviation years, while SPoRC estimates the deviations freely under the penalty.

The survey index month (resolved in the main 2026 assessment document)

Stock Synthesis times each observation on its own, and at the time of this analysis, the timing of the survey biomass index was specified as occurring at the start of the year, while the survey comp and age-length data were specified as occurring in July. By contrast, SPoRC has one survey timing per fleet, shared by the index and the compositions, so it cannot split the two. This difference helped to identify an error in assessment model inputs, and the timing of all survey data components is specified as occurring in July for final runs in the main document. If time allows, we will re-run the SS3-SPoRC model comparison with the final 2026 models for presentation.

Projections

Tier 3 reference points and a fourteen-year projection are shown below. The ABC fishing mortality is the rate leaving 40 percent of spawning biomass per recruit and the OFL rate leaves 35 percent, both worked out separately for each area, and the control rule reduces fishing mortality once spawning biomass falls below the 40 percent reference point.

Reference points, in tonnes of spawning biomass:

Table 8: Tier 3 reference points by model and area, spawning biomass in tonnes.

Model	Area	$B_{100\%}$	$B_{40\%}$	$B_{35\%}$	F_{ABC}	F_{OFL}
25.0	Western/Central	41952	16781	14683	0.228	0.283
25.0	Eastern	8048	3219	2817	0.247	0.309
25.1	Western/Central	41164	16466	14407	0.226	0.281
25.1	Eastern	7871	3148	2755	0.245	0.308

The first two projected years, in tonnes:

Table 9: Projected biomass and catch specifications for the first two projected years, by model and area, in tonnes.

Model	Area	Year	Total biomass	Spawning biomass	ABC	OFL
25.0	Western/Central	2027	81858	41408	13488	16365
25.0	Western/Central	2028	81169	40002	12942	15708
25.0	Eastern	2027	19260	8907	3409	4155
25.0	Eastern	2028	18983	8534	3250	3963
25.1	Western/Central	2027	79398	40343	13033	15831

25.1	Western/Central	2028	78515	38948	12458	15136
25.1	Eastern	2027	18645	8681	3297	4024
25.1	Eastern	2028	18318	8308	3131	3823

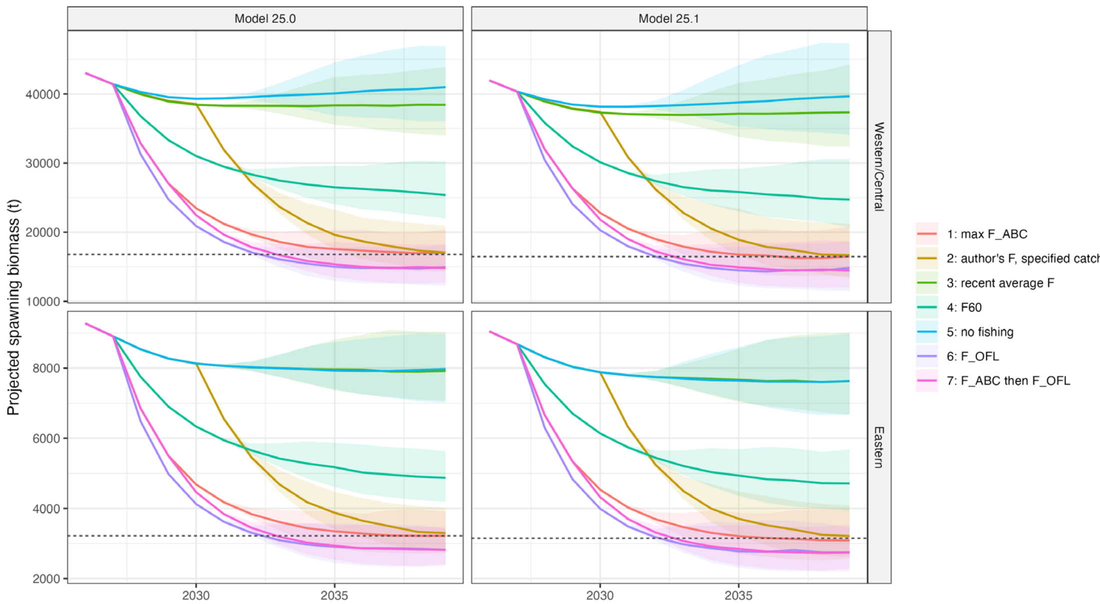

Figure 3: Projected spawning biomass under the seven Alaska alternatives, by area and model. Lines are medians and ribbons span the 10th to 90th percentile of 250 recruitment realisations; the dashed line is $B_{40\%}$.

6. Proposed models for the assessment of the rex sole stock in the Gulf of Alaska

By

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September 2025

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Executive Summary

A full, age-structured assessment will be presented in November 2025 for GOA rex sole. Here we present small, but necessary updates to improve the quality of the model. The GOA rex sole assessment is a Tier 3a two-area model with growth estimated separately in each area.

Summary of Changes in Assessment Inputs

The following data sources were updated with newest years of data:

(1) 2022-2024 catch biomass was added to the model
(2) 2021 catch biomass was updated to reflect final (rather than projected) 2021 catches
(3) 2022-2024 fishery length composition data were added to the model and 2021 fishery length composition data were updated to reflect October – December 2021 catches
(4) 2021-2022 fishery age composition data were added to the model
(5) 2023 GOA trawl survey biomass estimate was added to the model
(6) 2023 GOA trawl survey length composition data were added to the model
(7) Note: no new GOA trawl survey age-at-length data were added to the model (not aged yet at time of analysis)

Summary of Changes in Assessment Methodology

(1) Fishery age composition data were processed using "sampler" code (see CIE discussion paper)
(2) Survey biomass logspace standard errors were corrected (the 2021 assessment mistakenly used CV instead of logspace standard error, which were slightly different; see CIE discussion paper)
(3) Age double reads were analyzed and an ageing error matrix accounting for ageing uncertainty was added to the model
(4) An alternative model was run fixing historical catchability and natural mortality prior to 2022 and estimating catchability and natural mortality from 2022 onwards to account for a low survey biomass estimate in 2023. This approach has limitations and we discuss using alternative models to inform management quantities via the risk table framework instead.

Responses to SSC and Plan Team Comments on Assessments in General

GOA PT, November 2021: The Team recommends all GOA authors evaluate any bottom trawl survey information used in their assessment prior to 1990 including the 1984 and 1987 surveys and conduct sensitivity analyses to evaluate their usefulness to the assessment. This may apply for Aleutian Islands surveys but this was only raised during GOA assessment considerations.

The 2021 assessment excluded most 1984 and 1987 survey data, but mistakenly included survey biomass estimates for the Eastern GOA. We removed the 1984 and 1987 data points (see CIE review discussion paper) and they are excluded in the new base case run presented here.

Responses to SSC and Plan Team Comments Specific to this Assessment

GOA PT, November 2021: The Team supports the author's research priorities, encourages further discussion on the utility of conducting maturity studies across the entire GOA, and endorses the author's intent to develop an ageing error matrix and further explore natural mortality rates.

The appended CIE review discussion paper includes several sensitivity analyses: estimating male natural mortality and assuming that age at 50% maturity is 2 years younger or 2 years older than the current maturity curve in the model. In this document, we present a model run using a newly-calculated ageing error matrix to the model. Further maturity field studies have not been conducted to date.

SSC, November 2021 (suggestions): The authors discussed several research priorities, including development of an aging error matrix (SSC recommendation in 2017), exploration of natural mortality rates, updated information on maturity-at-age, and research into mechanisms behind the different growth patterns between Western-Central GOA and Eastern GOA (e.g., genetic and/or environmental). The SSC supports these areas of future work. The SSC notes that differences in growth patterns between these areas are also observed in other species and suggests that exploration into this phenomenon be done within a broader context that includes other flatfish species that may, or may not, display a similar pattern.

See response to GOA PT, November 2021 comment. Exploration of differences in growth patterns across space for flatfish species in the GOA is underway.

Responses to 2025 CIE reviewer comments

Addressing uncertainty in natural mortality *– reviewers suggested estimating natural mortality with a prior. Ideas included basing a prior on Hamel and Cope (2022), considering whether natural mortality is linked to predation, and considering time-varying natural mortality.*

The CIE discussion paper (Appendix 6A) did a sensitivity analysis estimating male M in both areas while continuing to fix female M, and shows small differences in natural mortality between sexes (0.18 yr^{-1} for males, while female natural mortality is fixed at 0.17 yr^{-1}. It is possible that there is some information in the data on M, particularly if the age of the plus group is extended in future models, given the history of light exploitation for the stock, and only in the Western-Central GOA. The Eastern GOA is essentially unexploited. However, there are some limitation in Stock Synthesis 3 for estimating natural mortality within the two-area setup. In particular, there are 4 natural mortality parameters (for the two areas and two sexes) and they are estimated completely separately by area with no ability to assume one natural mortality for females that applies to both areas, for instance. Perhaps the best first step is to conduct joint likelihood profiles for natural mortality and survey catchability, where all natural mortality parameters are set equal to one another.

Further exploration of diet data and potential environmental impacts contributing to time-varying natural mortality could be explored as well, but may be longer-term goals.

***Evaluate steepness parameter assumptions and alternatives** – One reviewer commented that a steepness of 1 is appropriate given the lack of information about recruitment at very low spawning biomass values (not observed to date). Two reviewers commented that assuming a steepness of 1 is a strong assumption. Their recommendations included conducting a sensitivity analysis, or using a lower fixed value (h = 0.72 from FishLife) due to asymmetric risk concerns outlined in Hordyk et al. (2019).*

A sensitivity analysis setting steepness to 0.72 (and/or other values) can be done for the November 2025 assessment. We agree that there is little information on steepness in the data, given that we have never observed this stock at low spawning biomass values.

***Dealing with impacts of uncertainty in maturity-at-age** – Reviewers agreed that the impact of uncertainty in maturity-at-age (shown in sensitivity analyses provided to them in a discussion paper - Appendix 6A) should be considered in ABC decision rules. Two reviewers suggested ensemble modeling to account for the uncertainty in maturity. Reviewers agreed that additional maturity-at-age data should be collected in the future.*

We intend to bring forward the sensitivity analyses for maturity-at-age that were presented in Appendix 6A via the Risk Table framework for the November SAFE for the purpose of considering this large source of uncertainty for GOA rex sole in ABC decision rules. Ensemble modeling has been considered for other stocks in this region, but requires decisions about model weighting in addition to substantial discussion time in reviewer forums. We suggest using a similar approach to that used for BSAI Northern rock sole in 2022, where the OFL from a sensitivity analysis was used as the reduced ABC to reduce the probability that the true, but unknown OFL exceeds the ABC. (A previous SSC recommendation for all stocks requested that authors consider the probability that the true, but unknown OFL exceeds the ABC.) We are open to alternative suggestions for accounting for uncertainty in maturity-at-age in ABC determination.

***Add additional model diagnostics** – one reviewer recommended a number of additional model diagnostics that may be helpful, including runs tests, hindcast cross-validation MASE, forecast skill, likelihood profiles and production functions, and using Kell et al. (2024) to define model selection criteria.*

We agree that additional model diagnostics would be useful. The November SAFE will include as many additional diagnostics as possible within the time constraints.

***Data weighting considerations**- Reviewers found the Francis (2011) data weighting to be appropriate, and suggested exploring more than one data-weighting method to determine the impact to model results, such as McAllister-Ianelli and Dirichlet-Multinomial methods. One reviewer suggested changing sigmaR to 0.636 from 0.6, following the value in Thorson et al. (2014) for flatfish. Another review suggested exploring the interaction of data weighting with values of sigmaR and natural mortality.*

We agree that exploring and discussing the impact of more than one data-weighting approach would be useful and will aim to do this for the November SAFE. We can also do a sensitivity analysis changing sigmaR to 0.636. Exploring the interaction of data weighting with values of sigmaR and natural mortality is a worthwhile, but longer term goal.

***Data considerations** – All reviewers agreed that creating a GOA rex sole-specific aging error matrix would be useful. In addition, reviewers agreed that it would be useful to collect more maturity data over a broad spatial range in the Gulf of Alaska. Two reviewers suggested using model-based survey indices. Other recommendations included re-estimating weight-length relationships for each new assessment,* *adding the ADF&G small mesh survey to the assessment, and doing additional herding studies to inform survey catchability.*

We've created and included an ageing error matrix for this document. We may be able to re-estimate the weight-length relationship for the November SAFE document, however previous data explorations of the weight-length relationship (conducted in 2017) showed little change in this relationship over time. Including the ADF&G small mesh survey and using model-based indices may be feasible on a shorter-time scale for the 2029 full assessment. We agree that collecting additional data to inform maturity-at-age is a high priority for this stock, as resources allow. The fishing industry has been willing to help with this effort in the past, but it appears that we need collections to occur on research surveys with higher selectivity for smaller, younger fish. Collecting further maturity and herding data may be longer term goals given current constraints on resources.

Explore time-varying biological processes with appropriate prioritization *– Two reviewers recommended investigating time-varying growth, selectivity, and/or natural mortality noting that these explorations may allow for better fits to fishery composition data. One reviewer suggested exploring environmental relationships with natural mortality and recruitment as well as time-varying predation mortality. One reviewer suggested using a time-block for estimating time-varying growth may be a simple approach.*

The 2029 assessment may be able to explore approaches to estimating time-varying selectivity, growth, and natural mortality (likely in that priority order). We could explore whether sufficient diet data exist to analyze predation mortality. The GOACLIM multi-species and end-to-end ecosystem models may be able to inform environmental and predation influences likely to impact GOA rex sole as well, as a medium to long-term goal.

Stock structure and movement dynamics *– Reviewers generally agreed that the analysis of spatial breaks in growth patterns presented in Appendix 6A showed that the growth break for GOA rex sole is similar to split between management areas used to structure the two-area model and that using the split between the Central and Eastern GOA to define the model is both adequate and the most reasonable method. One reviewer suggested estimating time-varying recruitment allocation between the two areas. Another reviewer suggested conducting a simulation study to determine the impact of the slight mismatch between the management area break and the growth break locations. This reviewer also suggested exploring potential movement between Canada and the GOA, using Canadian data on survey biomass to inform this analysis.*

We agree that using the current methodology, using the split between the Eastern and Central GOA to define the two areas of the model is the most reasonable assumption, given the spatial resolution and structure of the data. In 2017 we conducted a model run using time-varying recruitment allocation, which showed little variation in the value of the recruitment allocation parameter over time. We could explore and hypothesize about the meaning of similar or differing trends in survey biomass between the two countries, but this may not be sufficient information to change the assumptions of the current model. A simulation study for this stock is likely a longer term goal.

Introduction

Rex sole (*Glyptocephalus zachirus*) is a right-eyed flatfish occurring from southern California to the Bering Sea and ranging from shallow water (<100m) to about 800 meters depth (Mecklenburg et al., 2002). They are most abundant at depths between 100 and 200m and are found throughout the Gulf of Alaska (GOA), with the highest biomass found in the Central GOA.

Rex sole appear to exhibit latitudinal changes in growth rates and size at sexual maturity. Abookire (2006) found marked differences in growth rates and female size at maturity between stocks in the GOA and off the coast of Oregon. Size at sexual maturity was greater for fish in the GOA than in Oregon, as was size-at-age. However, these trends offset each other such that age-at-maturity was similar between the two regions. McGilliard and Palsson (2017) found that rex sole in the Western and Central GOA tend to grow to larger maximum sizes than those in the Eastern GOA.

Rex sole are batch spawners with a protracted spawning season in the GOA (Abookire, 2006). The spawning season for rex sole spans at least 8 months, from October to May. Eggs are fertilized near the sea bed, become pelagic, and probably require a few weeks to hatch (Hosie et al. 1977). Hatched eggs produce pelagic larvae that are about 6 mm in length and are thought to spend up to 9 months in a pelagic stage in the northern GOA before settling out to the bottom as 5 cm juveniles (Abookire and Bailey 2006). Rex sole are found offshore in the GOA during the spawning season and larvae are broadly distributed over the slope and shelf. Rex sole are one of several GOA flatfish species with larvae that exhibit cross-shelf transport, moving to several nearshore nursery areas where they remain as juveniles (Bailey et al. 2008, Abookire and Bailey 2006). Several flatfish species in the Gulf of Alaska, including rex sole, Dover sole, Pacific halibut, and arrowtooth flounder have shown synchrony in recruitment patterns over time that have been linked to an environmental indicator related to sea surface height (Stachura et al. 2014).

Rex sole are benthic feeders, preying primarily on amphipods, polychaetes, and some shrimp.

Management units and stock structure

In 1993 rex sole was split out of the deep-water management category because of concerns regarding the Pacific ocean perch bycatch in the rex sole target fishery. The stock within the GOA is managed as a unit stock but with area-specific ABC and TAC apportionments to avoid the potential for localized depletion. Little is known on the stock structure of this species. However, otoliths exhibit two distinct growth patterns (pers. Comm. D. Anderl 2015) and data shown in this assessment show that length of older ages in the Eastern GOA is smaller than those for the Western and Central areas.

Fishery

Please see the most recent full stock assessment for more information about the GOA rex sole fishery: https://apps-afsc.fisheries.noaa.gov/Plan_Team/2021/GOArex.pdf.

Data

The following data were included in the assessment model:

Source	Data	Years
NMFS Groundfish Survey	Survey Biomass	1984-1999 (triennial); 2001-2023 (biennial)
	Ages Conditioned on Length	1984, 1987, 1993, 1999; 2001-2019 (biennial)
	Age Composition*	1984, 1987, 1993, 1999; 2001-2019 (biennial)
	Length Composition	1984-1999 (triennial); 2001-2023 (biennial)
U.S. Trawl Fisheries	Catch	1982-2024
	Length Composition+	1982-1984, 1990-2024
	Age Composition	1992,1995,1999,2003,2005,2007,2009,2010,2012 2014-2022

*Not included in the objective function; +Not included in the objective function in years when fishery age compositions are available

Fishery Data

This assessment used (1) fishery catches from 1982-2024 (Table 1, Figure 2), (2) the proportion of individuals caught by length group and sex for the years specified in the table above) and (3) estimates of the proportion of individuals caught by age group and sex for the years specified in the table above. Unsexed individuals were assumed to be 50% female and 50% male the fishery length- and age-data in the two runs presented in this document. See Appendix A for a bridge from the assumption of the accepted 2021 model (Model 21.0), which excluded unsexed individuals from comp data.

Both model runs in this discussion paper use an updated approach to calculating fishery age compositions from the 2021 accepted model. The updated approach standard for many AFSC assessments based on Kimura (1989), where length distributions are randomly sampled from hauls and ports, lengths are translated to ages through an age-length key for the entire fishery (which for GOA rex occurs only in the Western-Central GOA), and chosen substrata (if any) are weighted by corresponding catch weight. This updated analysis uses the afsc-assessments “sampler” repository (https://github.com/afsc-assessments/sampler). For more details, see the “Bridging Analysis,” subsection “Processing of fishery data” in Appendix 6A (the discussion paper provided for the 2025 CIE review).

Sample sizes for the length and age compositions were set to the number of fishery hauls for which length or age data were collected, respectively. As the bridging analysis run updates fishery age composition data to include unsexed fish, the yearly input sample sizes for fishery length and age data were updated from the 2021 accepted model to reflect the number of hauls from which the data originated, including these unsexed individuals.

SS3 input files including all fishery data used for each model run in this paper and in Appendix 6A can be found at: https://github.com/noaa-afsc/goa_rex.

Survey Data

This assessment used estimates of total biomass for rex sole in the Gulf of Alaska from triennial (1984-1999) and biennial (2001-2021) groundfish surveys conducted by the AFSC’s Resource Assessment and Conservation Engineering (RACE) division to provide an index of population abundance (Table 2). The preferred model separated estimates of biomass for eastern GOA from biomass estimates from the western and central regions (Table 2). Although survey depth coverage has been inconsistent for depth strata > 500 m, the fraction of the rex sole stock occurring in these depth strata is typically small, so the survey estimates of total biomass were not corrected for missing depth strata.

Estimates of the total number of individuals by length group (length compositions) from each RACE GOA groundfish survey were included in the assessment. Additionally, the assessment model fits to conditional age-at-length data. Survey age data were available for all survey years except for 2021. The age data for 1990 were excluded from the model because the underlying ages may be biased due to the age reading technique (surface age reading) used to process the otoliths.

Number of hauls for which length samples exist was used as effective sample size for length composition data. Number of otoliths aged was used as effective sample size for conditional age-at-length data. Samples collected in the Eastern GOA were entered separately from data in the Western-Central GOA.

Both Models presented in this paper make small corrections from the survey data used in the 2021 assessment, which are described in an analysis bridging from the 2021 model to an updated base case (Appendix 6A).

SS3 input files including all survey data used for each model run in this paper and in Appendix 6A can be found at: https://github.com/noaa-afsc/goa_rex.

Analytic Approach

Model Structure

The assessment was a split sex, age-structured statistical catch-at-age model implemented in Stock Synthesis version 3.3 (SS) using a maximum likelihood approach. SS3 equations can be found in Methot and Wetzel (2013) and further technical documentation is outlined in Methot (2009). Age classes included in the model run from age 0 to 20. The oldest age class in the model, age 20, serves as a plus group. Age at recruitment was set at 3 for the purpose of projections and calculation of management quantities, as few rex sole are observed before age 3.

The model has 2-areas (Eastern GOA and Western-Central GOA) with separate growth curves estimated based on survey data from each area. The model used newly available fishery age and a conditional age-at-length approach and split the survey data by region: the Eastern GOA and Western-Central GOA. Survey biomass estimates, length composition data, and conditional age-at-length data were input separately for these two regions. A non-time-varying parameter was estimated to specify the proportion of recruits that settle in the Eastern GOA. Therefore, the model assumes that the Eastern and Western-Central GOA have a similar recruitment pattern among years. All fishery data were input to the model and associated with only the Western-Central GOA. Survey selectivity parameters and growth parameters (von-Bertalanffy k, L_{max}, and L_{min}, and the CV of the youngest and oldest fish) were estimated for each of the two regions separately. The two-area configuration was implemented because fits to fishery length and age composition data were particularly poor in all one-area models that incorporated the newly available historical fishery age data (which were presented in 2017); an examination of survey and fishery length-age data showed that fish in the Eastern GOA do not grow as large as fish in the Western-Central GOA. The fishery only operates in the Western-Central GOA. In 2017 when the two-area configuration was first implemented, we hypothesized that model fits showing an expectation of more small fish and fewer large fish in the fishery than were observed could be caused by a lack of accounting for differences in growth in the Eastern GOA as compared to the Western and Central GOA (see McGilliard and Palsson 2017 for more details).

In this paper we add one model run to a bridging exercise conducted for the 2025 CIE review (Appendix 6A, “Bridging Analysis”) by estimating an ageing error matrix based on double-reads for GOA rex sole and including it in the bridged model. Therefore, the run in the Appendix 6A bridging analysis called “sampler survbio edits and new data” will be called Model 25.0 and will be considered as an updated “base case” here. A run adding an ageing error matrix for GOA rex sole to Model 25.0 (the updated base case; “sampler survbio edits and new data” in Appendix 6A) will be called Model 25.1. Models 25.0 and 25.1 include the years 1982-2024, and all available data as of February 2025.

Fishery and Survey Selectivity

The fishery and survey selectivity curves were estimated using age-based double-normal functions without a descending limb (instead of a logistic function). The SS3modeling framework does not currently include the option of estimating sex-specific, age-based logistic selectivity where both male and female selectivity maintain a logistic shape (as was used in the previous assessment models prior to moving the model to SS3). The 2015 assessment (McGilliard et al. 2015) discusses the logistic and double normal selectivity curves in detail in the context of converting the model to Stock Synthesis 3. Survey selectivity was made the same for males and females after preliminary model runs showed that male and female survey selectivity were estimated to be nearly identical. Fishery selectivity was sex-specific and the fishery occurred only in the Western-Central GOA. Very little data exist to inform fishery selectivity curves for the Eastern GOA because trawling is not permitted in most of the Eastern GOA. Yearly catches in the Eastern GOA are typically 3 t or less (Table 1).

Recruitment Deviations

Recruitment deviations were estimated for an early period from 1965-1981 and a current period from 1982-2019 with a $\sigma_R = 0.6$ and were set to mean recruitment for 2023-2024 (little information exists on 0-1 year old GOA rex sole and recruitment cannot be estimated reliably for these years).

Data Weighting

Effective sample sizes for all length and age composition data were set to the number of hauls for which lengths were measured for length compositions and number of hauls for which ages were measured for age compositions (Pennington and Volstad 1994). Effective sample size for conditional age-at-length data was set at the number of individuals. Data sources were weighted relative to one another using the Francis (2011) method for all models presented.

The Eastern GOA and Western-Central GOA length composition data shared a variance adjustment in all models. Likewise, the conditional age-at-length data shared a variance adjustment across areas; the number of hauls for which length samples existed in each region provided a weighting for data from each region relative to the other region.

SS3 input files for each model run included in this paper and in Appendix 6A can be found at: https://github.com/noaa-afsc/goa_rex.

Parameters Estimated Outside the Assessment Model

Natural mortality

Male and female natural mortality were fixed and equal to 0.17, as for previous assessments. See Appendix 6A for a sensitivity analysis where the impact of estimating male natural mortality in each area on management quantities was explored.

Weight-at-Age Relationship

The weight-at-age relationship was that used in the previous assessments (e.g. McGilliard and Palsson 2017) and is based on the weight-length relationship $w_L = \alpha L^{\beta}$ and the parameters of the von-Bertalanffy growth curve. The parameters of the weight-length relationship are as follows:

	α	β
Females	1.35E-06	3.44963
Males	2.18E-06	3.30571

Maturity

Abookire (2006) modeled female rex sole size-at-maturity using a logistic model, obtaining a value for size at 50% maturity of 351.7 mm with a slope of 0.0392 mm^{-1}. About half of the maturity samples were obtained from fishery catches and half from research trawls during 2000-2001. Using the mean length-at-age relationship estimated from the 1984-1996 survey data, the age at 50%-maturity was estimated at 5.7 years and the slope was equal to -1.113. Estimates of mean size-at-age for the maturity samples were similar to those for mean size-at-age estimated from the survey data (Turnock et al., 2005).

See Appendix 6A for sensitivity analyses where the impact of smaller and larger age-at-50% maturity on management quantities was explored.

Ageing error

Age double reads for GOA rex sole were analyzed for uncertainty between readers using the TMB implementation of the R package AgeingError: https://github.com/pfmc-assessments/AgeingError. All available age data were included for the survey and the fishery. We assumed that the data were unbiased in the absence of an age validation study. We pooled the data over readers (with simply a primary and second reader), fleets, time, and age-read method and assumed a constant coefficient of variation for ageing precision. We included the ageing imprecision matrix shown in Table 4 in Model 25.1. The maximum gradient from the analysis was -0.000613.

Parameters Estimated Inside the Assessment Model

Parameters estimated within all models were the log of unfished recruitment (R_0), log-scale recruitment deviations, yearly fishing mortality, sex- and area-specific parameters of the von-Bertalanffy growth curve, the CV in length-at-age of age 2 and age 20 fish, and selectivity parameters for the fishery and survey. The selectivity parameters are described in greater detail in the most recent full operational assessment: https://apps-afsc.fisheries.noaa.gov/Plan_Team/2021/GOArex.pdf. Survey selectivity parameters were not sex-specific and two survey selectivity curves were estimated; one for the Eastern GOA and one for the Western-Central GOA. Fishery selectivity parameters for were estimated by sex and for the Western-Central GOA only. Catchability was estimated within Model 21.0.

Growth

Sex-specific growth parameters ($L_{amax=20+}$, $L_{amin=2}$, k, CV of length-at-age at age 2, CV of length-at-age at age 20+) were estimated inside the assessment model for all models, these growth parameters were estimated separately for the Eastern GOA and for the Western-Central GOA for a total of 4 sets of estimated growth parameters (female Eastern GOA, male Eastern GOA, female Western-Central GOA, male Western-Central GOA).

See Appendix 6A for an analysis of how closely the location of the break between growth patterns aligns with the Western-Central and Eastern management areas that are modeled for the assessment.

Catchability

Survey catchability was estimated within all models with a normal prior: ~N(1.2, 0.175), based on herding studies for rex sole (Somerton and Munro 2001). Survey catchability is assumed to be equal across the two areas.

Results

Model Evaluation

Comparison of models

Figure 1-Figure 6 show comparisons of population dynamics for Models 25.0 and 25.1, as well as fits to survey biomass data, time-aggregated fits to survey length composition and conditional age-at-length data, as well as time-aggregated fits to fishery length and age-composition data.

Adding an ageing-error matrix to the model leads to very similar fits to survey biomass indices between the two models (Figure 1), as well as similar trajectories in spawning biomass and fishing intensity (Figure 2). The addition of ageing uncertainty primarily impacts uncertainty in recruitment estimates prior to 2013 and the trajectory of recruitment estimates is similar, though more variable over time for Model 25.1 (with the ageing error matrix; Figure 2, third panel). Fits to time-aggregated conditional age-at-length data look similar for Models 25.0 and 25.1 (Figure 3) with slight differences in estimates of length-at-age-3 in the two areas and CV in length-at-age-3 (Table 3). Additionally, Figure 4 shows that selectivity curves are the same across models, except for a small, but discernible difference in fishery selectivity between the two models for both females and males. Fits to time-aggregated female and male fishery and survey length composition data are almost the same, with very small differences for fits to the fishery length composition data. The largest difference in fits to data between Models 25.0 and 25.1 is for fits to time-aggregated fishery age composition data (Figure 6), where fits to data are slightly worse when accounting for ageing uncertainty (Model 25.1). In Model 25.1 underestimates the proportion of age 7 fish more so than for Model 25.0 (without an ageing error matrix) and overestimates the proportion of age 15-19 fish more so than in Model 25.0. There are also some slight differences between the two models in the proportion of the population estimated to be in the plus group (Figure 6). The estimate of survey catchability is slightly different between the models as well, with a real-space value of 1.087 for Model 25.0 and 1.093 for Model 25.1 (Table 3).

Additional results are available at: https://github.com/noaa-afsc/goa_rex.

Time Series Results

Given the similarities across models in spawning biomass, recruitment, and fishing intensity in the Appendix 6A bridging analysis and between Model 25.0 and Model 25.1 (Figure 2, Appendix 6A Figure A2) and the nature of model changes as minor, but necessary updates, an updated set of time series results will be provided in November 2025.

Harvest Recommendations

Harvest projections for Tier 3a GOA rex sole will be presented in the November SAFE document. Please see the most recent accepted full assessment for GOA rex sole for a full description of methodology for harvest recommendations: https://apps-afsc.fisheries.noaa.gov/Plan_Team/2021/GOArex.pdf.

Ecosystem Considerations

Please see the most recent accepted assessment for an analysis of ecosystem considerations: https://apps-afsc.fisheries.noaa.gov/Plan_Team/2021/GOArex.pdf.

Data gaps and research priorities

Short term priorities (potentially feasible for November 2025):

- Sensitivity runs for steepness, sigmaR, age-at-50%-maturity, and alternative data weighting approaches

- A joint likelihood profile over survey catchability and natural mortality
- Alternative data weighting
- Additional model diagnostics, prioritizing those in the AFSC guidelines
- Re-estimation of the weight-length relationship

Medium-term priorities (potentially feasible for 2029 or 2033 stock assessments):

- Estimating natural mortality with a prior (but note the limitations of SS3 in the context of a two-area model discussed in "Responses to CIE Reviewer Comments"
- Explore time-varying selectivity, growth, and natural mortality (one at a time)
- Explore the interaction between data weighting, sigmaR, and M (or update to an assessment framework that estimates sigmaR)
- Include the ADF&G small mesh survey
- Explore links between predation and natural mortality
- Explore relationships between environmental variables and population dynamics

Long-term priorities (these require additional resources):

- New maturity studies
- New herding studies
- Use of model-based indices (this may be a medium-term priority if GAP has the resources)
- New work on stock structure, including simulation analysis of the impact of the slight mismatch between the spatial break in growth patterns and the model's area delineations that follow the Western-Central and Eastern management area definitions

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Tables

Table 1. Fishery catches for GOA rex sole by management area. Asterisk denotes that 2025 catch is current as of September 1, 2025

Year	Total Catch	Western Gulf	Central Gulf	Eastern Gulf
1982	959			
1983	595			
1984	365			
1985	154			
1986	93			
1987	1,151			
1988	1,192			
1989	599			
1990	1,269			
1991	4,636			
1992	3,000			
1993	3,000			
1994	3,642	49	3,508	85
1995	4,021	220	3,628	174
1996	5,945	552	5,202	191
1997	3,296	681	2,438	177
1998	2,671	440	2,195	36
1999	3,059	603	2,393	63
2000	3,585	883	2,702	Confidential
2001	2,942	435	2,507	Confidential
2002	3,017	398	2,619	Confidential
2003	3,499	772	2,726	2
2004	1,467	527	940	0
2005	2,179	576	1,603	Confidential

2006	3,295	350	2,944	0
2007	2,851	411	2,438	1
2008	2,707	185	2,522	Confidential
2009	4,753	342	4,410	1
2010	3,669	134	3,534	2
2011	2,878	131	2,746	1
2012	2,443	215	2,228	Confidential
2013	3,700	104	3,596	0
2014	3,577	126	3,450	1
2015	1,957	76	1,882	Confidential
2016	1,749	172	1,575	3
2017	1,484	48	1,434	2
2018	1,750	83	1,665	2
2019	1,612	74	1,536	2
2020	1,238	36	1,201	1
2021	301	14	285	2
2022	696	40	655	0
2023	412	23	389	1
2024	559	23	536	Confidential
2025*	463	11	452	Confidential

Table 2. GOA rex sole survey biomass for the Western-Central GOA and for the Eastern GOA. No samples were taken in the Eastern GOA in 2001.

Year	Biomass	Log Standard Error	Biomass	Log Standard Error
1990	81,912	0.08	16,313	0.15
1993	66,071	0.05	20,901	0.09
1996	53,197	0.06	19,560	0.07
1999	55,504	0.10	19,464	0.08
2001	51,258	0.06		
2003	71,238	0.06	28,659	0.10
2005	73,365	0.06	27,795	0.10
2007	88,128	0.07	15,672	0.11
2009	101,872	0.05	22,873	0.14
2011	76,453	0.06	18,681	0.08
2013	78,065	0.11	22,913	0.14
2015	64,839	0.06	22,474	0.14
2017	77,368	0.10	20,352	0.12
2019	66,171	0.08	24,243	0.11
2021	86,209	0.06	26,124	0.09
2023	74,636	0.07	17,897	0.09

Table 3. Estimated time-invariant parameters for Models 25.0 and 25.1, excluding selectivity parameters. “WC” indicates the Western-Central GOA and “E” indicates the Eastern GOA.

	Estimate		Standard Deviation	
Parameter	Model 25.0	Model 25.1	Model 25.0	Model 25.1
M (female; WC)	0.170	0.170	NA	NA
Length at age 3 (female; WC)	14.719	13.863	0.811	0.904
Length-at-age-20 (female; WC)	46.576	46.742	0.343	0.348
VonBert K (female; WC))	0.284	0.284	0.014	0.015
CV of length-at-age-3 (female; WC)	0.174	0.161	0.014	0.016
CV of length-at-age-20 (female; WC)	0.091	0.090	0.004	0.004
M (female; E)	0.170	0.170	NA	NA
Length-at-age-3 (female; E)	14.746	13.724	1.592	1.900
Length-at-age-20 (female; E)	36.807	36.902	0.618	0.622
VonBert K (female; E)	0.288	0.293	0.037	0.039
CV of length-at-age-3 (female; E)	0.173	0.158	0.030	0.035
CV of length-at-age-20 (female; E)	0.096	0.095	0.010	0.010
M (male; WC)	0.170	0.170	NA	NA
Length-at-age-3 (male; WC)	15.105	14.143	0.931	0.989
Length-at-Age-20 (male; WC)	40.869	40.992	0.269	0.269
VonBert K (male; WC)	0.323	0.324	0.018	0.018
CV in length-at-age-3 (male; WC)	0.191	0.176	0.016	0.018
CV in length-at-age-20 (male; WC)	0.074	0.073	0.004	0.004
M (male; E)	0.170	0.170	NA	NA
Length-at-age-3 (male; E)	15.516	14.684	1.759	1.962
Length-at-age20 (male; E)	34.645	34.727	0.480	0.479
VonBert K (male; E)	0.297	0.299	0.042	0.043
CV in length-at-age-3 (male; E)	0.188	0.182	0.029	0.032
CV in length-at-age-20 (male; E)	0.079	0.077	0.009	0.009
Recruitment allocation to E	-0.833	-0.828	0.049	0.050
ln(R0)	11.562	11.532	0.084	0.086
ln(q)	0.083	0.089	0.096	0.097

Table 4. Ageing imprecision estimated based on GOA rex sole double age reads, included in Model 25.1.

Age	CV
1	0.13
2	0.26
3	0.39
4	0.51
5	0.64
6	0.77
7	0.90
8	1.03
9	1.16
10	1.29
11	1.41
12	1.54
13	1.67
14	1.80
15	1.93
16	2.06
17	2.19
18	2.31
19	2.44
20	2.57

Figures

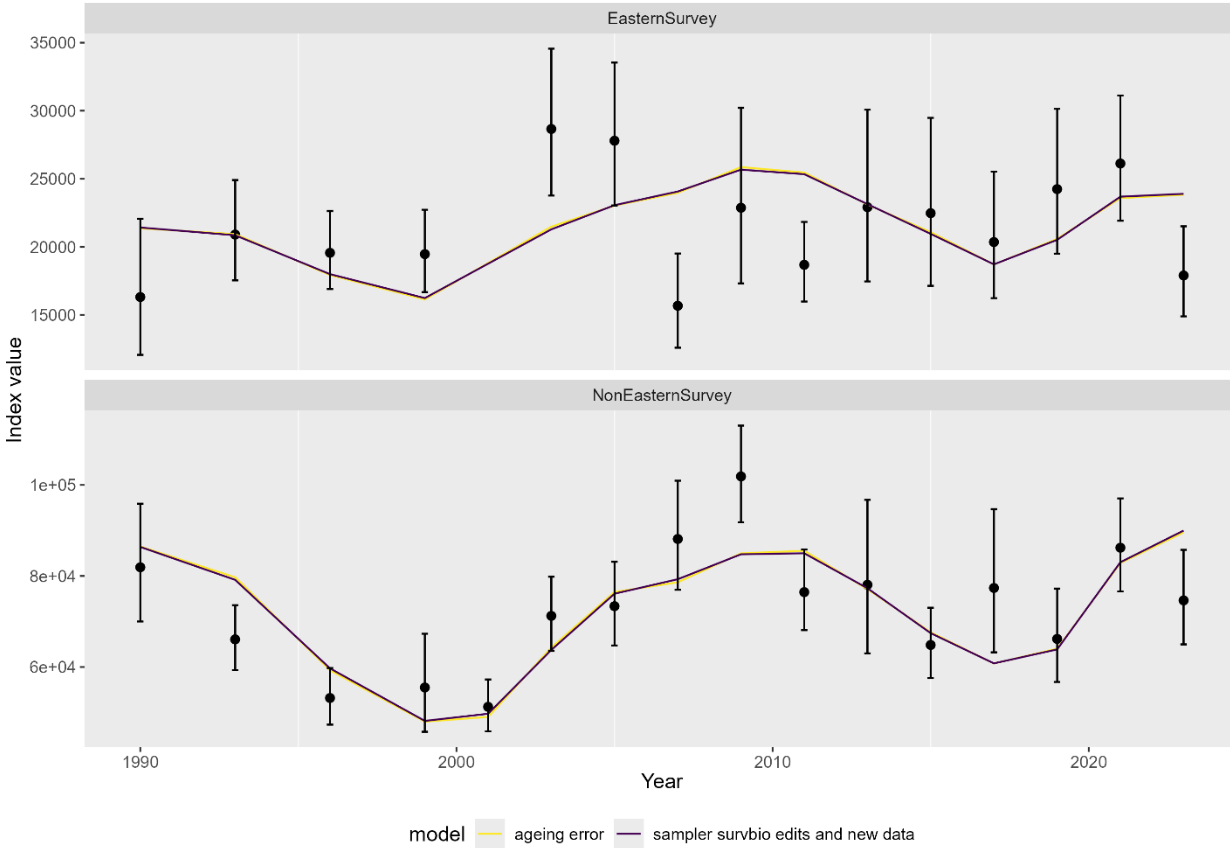

Figure 1. Observed (black dots) and predicted (lines) index of survey biomass for the Eastern GOA (top panel) and the Western-Central GOA ("NonEasternSurvey;" bottom panel) for Model 25.0 (sampler survbio and new data) and Model 25.1 (ageing error). Vertical lines show 95% lognormal uncertainty intervals.

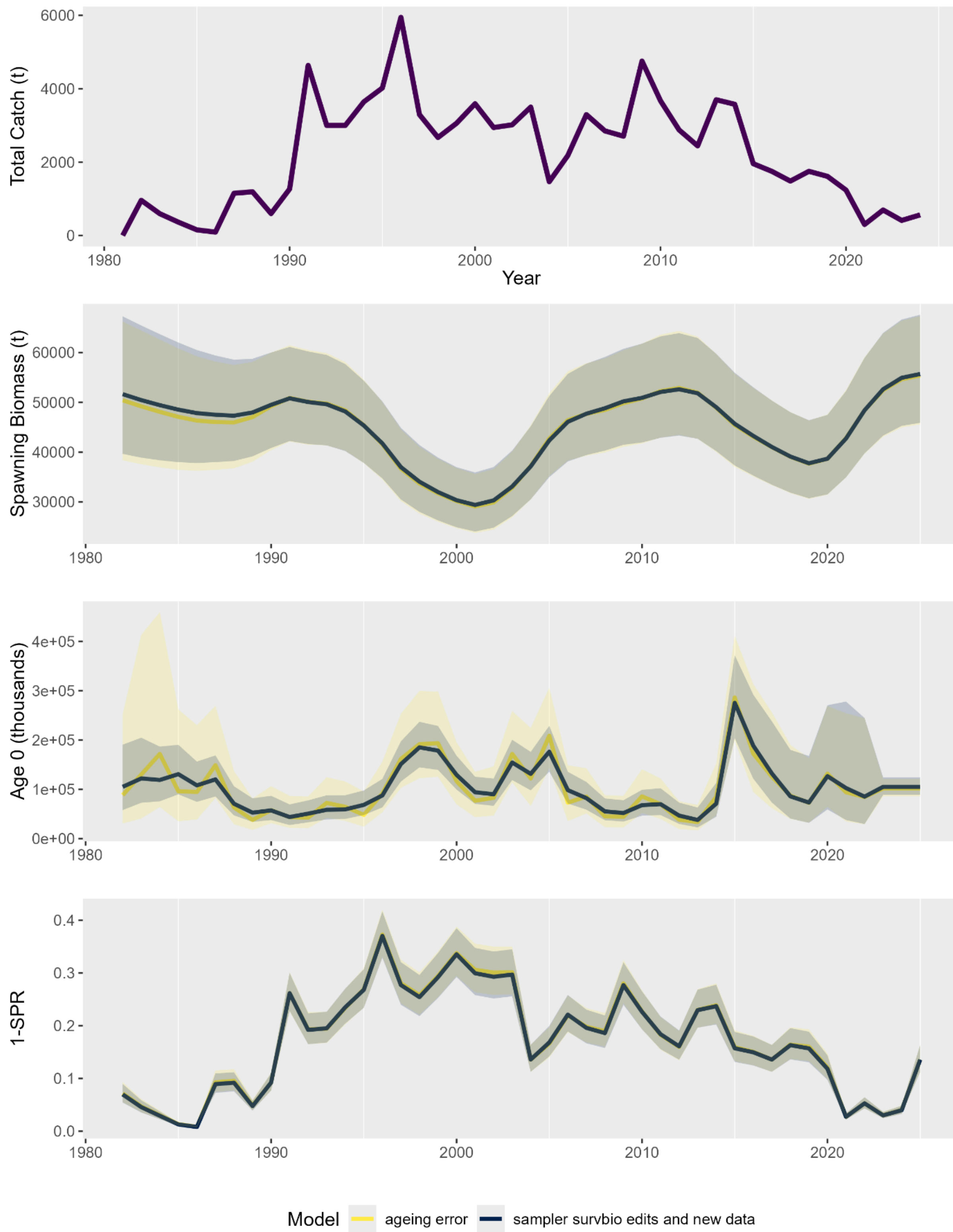

Figure 2. Observed catches and estimated spawning biomass, recruitment, and fishing intensity (1-spawning potential ratio) for Model 25.0 (sampler survbio and new data) and Model 25.1 (ageing error). Shaded areas indicate 95% asymptotic uncertainty intervals.

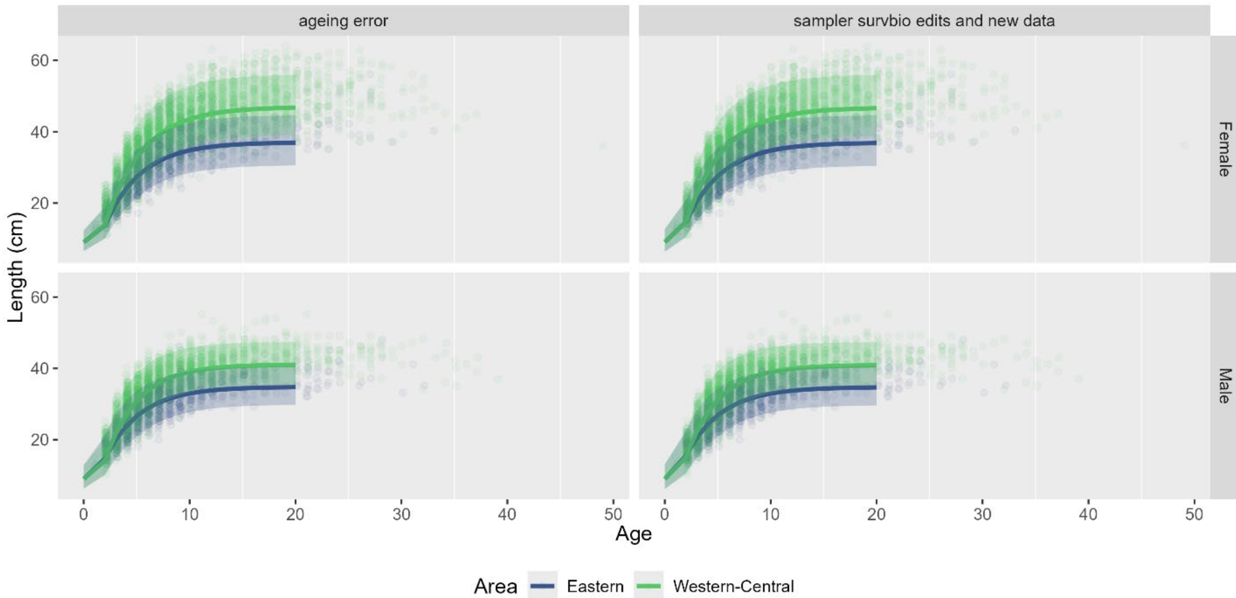

Figure 3. Raw bottom trawl survey data length-at-age by area and sex, overlaid with mean length-at-age for each model (columns) and 90% asymptotic uncertainty intervals around the means (shaded areas) for Model 25.0 (sampler survbio and new data) and Model 25.1 (ageing error). The Eastern GOA is shown in green and the Western-Central GOA is shown in blue.

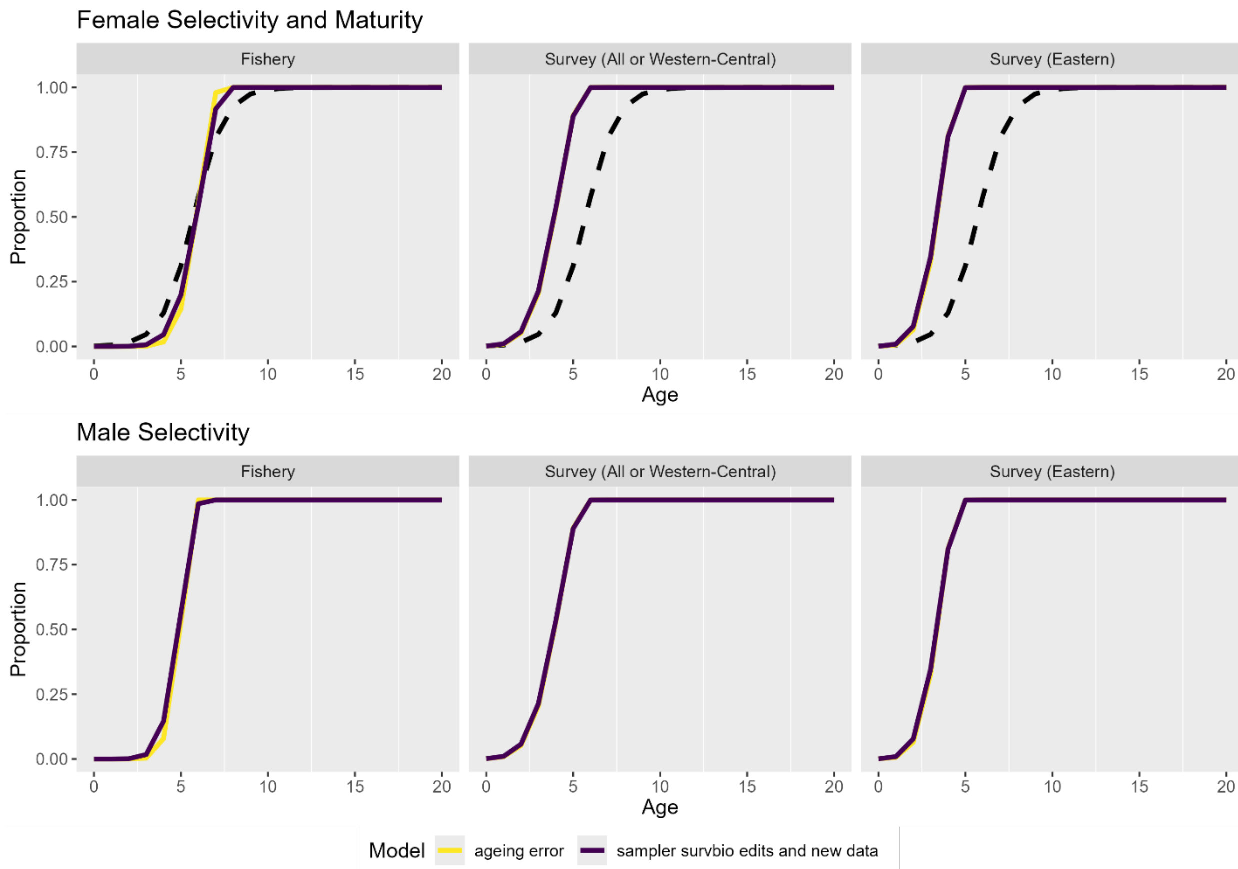

Figure 4. Fishery and survey selectivity-at-age across models for males and females for Model 25.0 (labeled "sampler survbio edits and new data) and Model 25.1 (labeled ageing error). Plots for females are overlaid on the maturity-at-age curve. A listing of selectivity parameter configurations can be found in the 2021 assessment document in Table 9 (https://apps-afsc.fisheries.noaa.gov/Plan_Team/2021/GOArex.pdf).

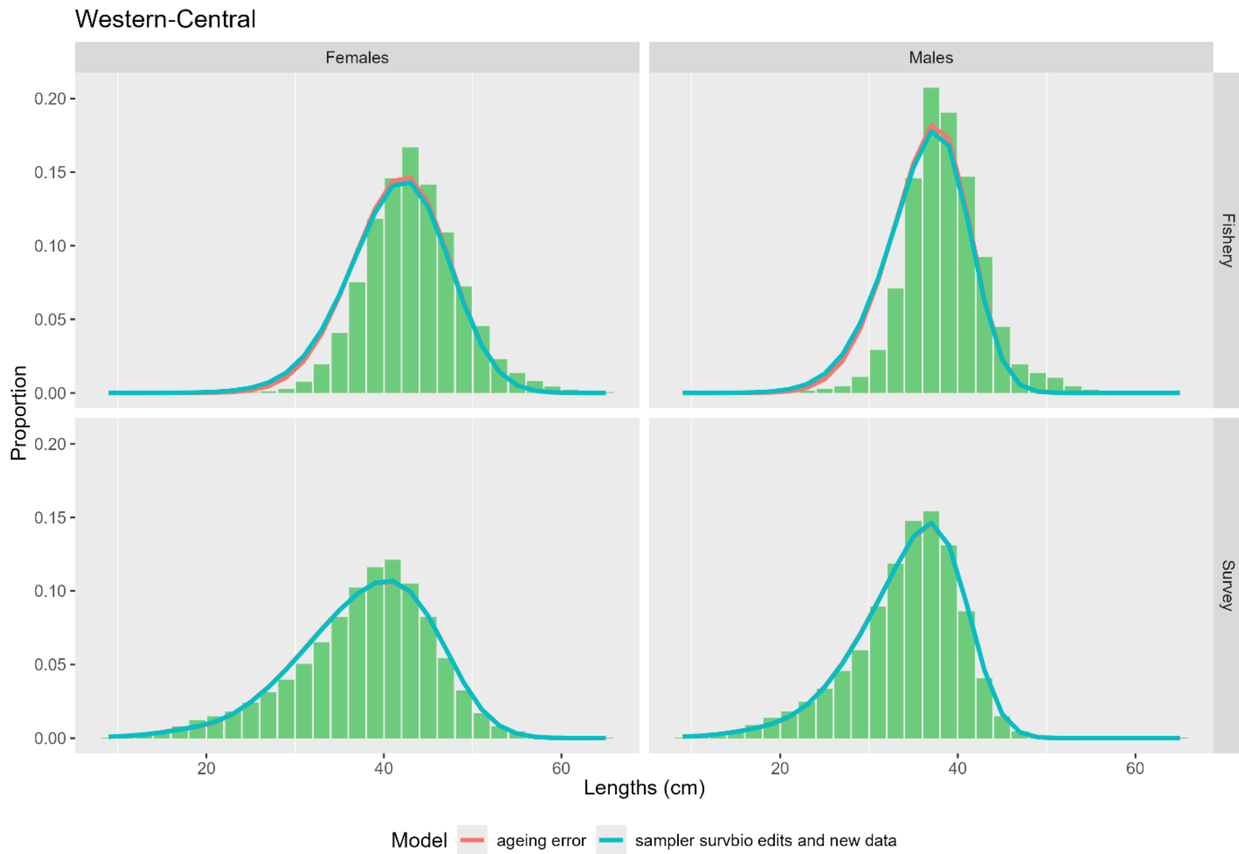

Figure 5. Fits (lines) to female and male fishery length composition with data aggregated by year (green shaded regions) for Model 25.0 (labeled sampler and survbio edits) and Model 25.1 (labeled ageing error).

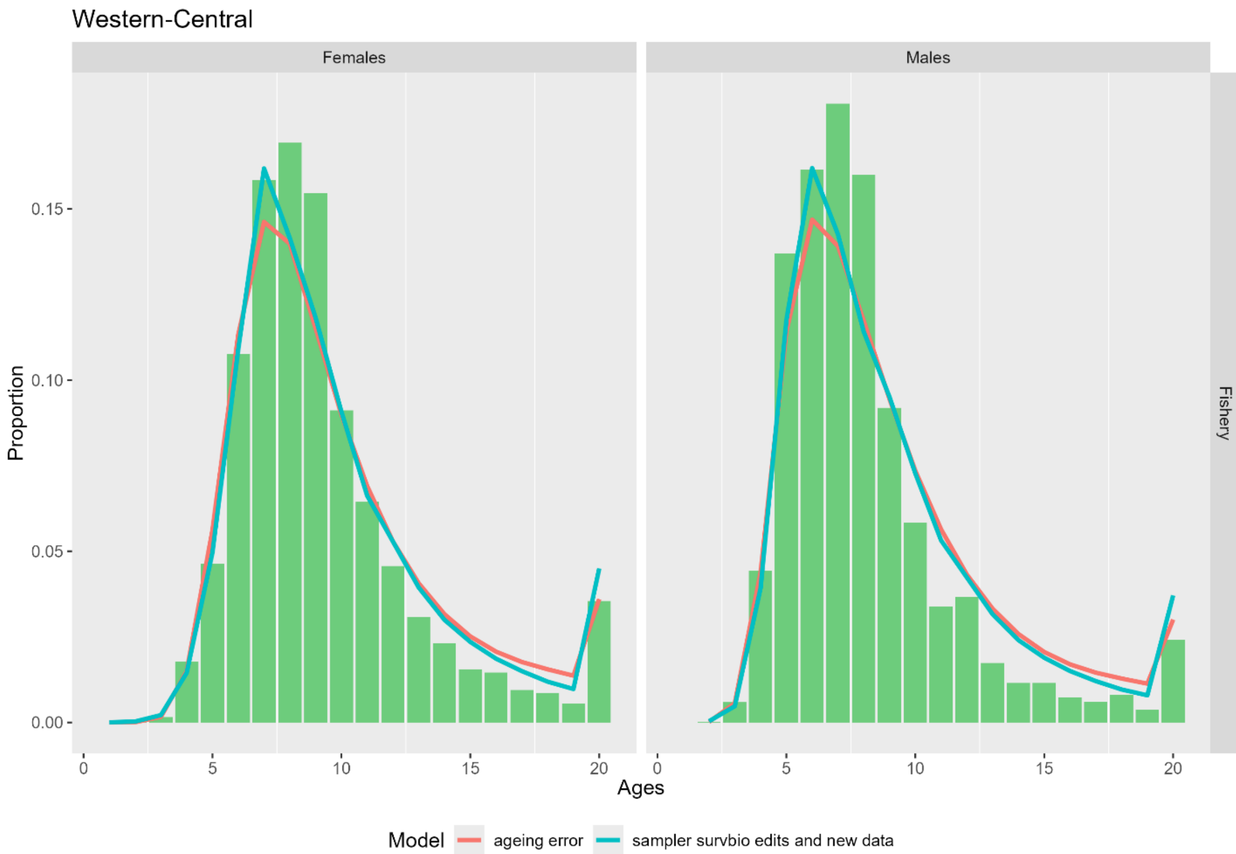

Figure 6. Fits (lines) to female and male fishery age composition with data aggregated by year (green shaded regions) for Model 25.0 (labeled sampler survbio edits and new data) and Model 25.1 (labeled ageing error). The fishery occurs only in the Western-Central GOA.

Appendix 6A refers to the Discussion paper for 2025 CIE Review (posted in Sept 2026 as Appendix D)

Additional analyses and discussion of the Gulf of Alaska rex sole stock assessment

February 2025
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This document provides additional discussion and model runs to accompany the 2021 operational stock assessment for Gulf of Alaska rex sole and was prepared for the Center for Independent Experts review in 2025. First, we present a bridging analysis (section below entitled "Bridging Analysis") that (1) re-calculates all fishery age composition data using a slightly modified approach than that used in the 2021 operational assessment, consistent with other AFSC assessment methods, (2) addresses necessary corrections to survey biomass data inputs, and (3) updates the model with new years of data that became available after the 2021 assessment cycle. We use the updated model that incorporates all changes presented in the bridging analysis as a basis to conduct sensitivity analyses for age-at-50%-maturity and estimation of male natural mortality in both areas. Lastly, we use the R package growthbreaks (https://github.com/afsc-assessments/growthbreaks), for defining spatial breaks in growth patterns to explore how well the NMFS regulatory area definitions used to define the two areas in the GOA rex sole model align with the spatial changes in growth patterns observed for the stock. Input files for the 2021 operational model and additional model runs presented in this document are available here: https://github.com/noaa-afsc/goa_rex.

Bridging Analysis

Processing of fishery data (labeled "sampler" run in figure legends)

Many older fishery age samples are port samples lacking information about the haul from which they came. Therefore, previous assessments considered approaches that would allow the use of all port samples (old port samples and any available new port samples that are missing haul information) along with the haul-level samples. Two methods utilized have been: (1) raw fishery age samples and (2) calculating proportions at age by calculating the raw length frequency of the haul or port from which the samples originated and using an age-length key to translate these distributions to numbers-at-age by haul or port, then summing over hauls and ports for a distribution of numbers-at-age (and subsequently calculating proportion-at-age). Here, we use an approach that is standard for many AFSC assessments based on Kimura (1989), where length distributions are randomly sampled from hauls and ports, lengths are translated to ages through an age-length key for the entire fishery (which for GOA rex occurs only in the Western-Central GOA), and chosen substrata (if any) are weighted by corresponding catch weight. This updated analysis uses the afsc-assessments "sampler" repository (https://github.com/afsc-assessments/sampler). A wide variety of strata can be identified to weight age distributions by the strata-specific catch biomass (optional). The "sampler" code has been accepted by the Plan Team and the North Pacific Fishery Management Council's Scientific and Statistical Committee (SSC); the method is currently used to calculate fishery age composition data for the Eastern Bering Sea (EBS) and GOA pollock stock assessments, as well as assessments for EBS Pacific cod, BSAI northern rock sole, and BSAI yellowfin sole. We did not conduct further analysis using raw fishery age samples in the model, as fishery age samples have not always been truly random (Faunce et al. 2021).

In addition, while the GOA rex sole assessment currently excludes unsexed fish from fishery length and age composition calculations, the Sampler code includes these individuals and assumes that half are female and half are male. Therefore, the run including fishery ages calculated by Sampler includes unsexed fish for both fishery length and age compositions. This run of the Sampler code assumes only one strata, while the 2021 operational model stratified by quarter and NMFS area.

There were four years for which the input sample size in the 2021 operational assessment (set to the estimated number of hauls from which fishery age data originated) where the number of hauls was not a whole number. This seems to have been a purposeful calculation done in 2017 and updated in 2021. However, I could not track down these calculations for the updated analysis. As the bridging analysis run updates fishery age composition data to include unsexed fish, the yearly input sample sizes for fishery age data were updated to reflect the number of hauls from which fishery age data originated, including these unsexed individuals. The input sample sizes are now whole numbers.

In summary, four changes were made to the fishery age composition data inputs, as follows: (1) random sampling from hauls and ports using Sampler, (2) accepting the assumption in the Sampler code to include unsexed fish that are assigned half female and half male, (3) only including one strata in these calculations, and (4) updating the yearly input sample sizes to the number of hauls (as a whole number) from which fishery age data originated to include hauls where ages for unsexed fish were collected. Though we don't show each change to fishery age data separately, collectively they make little difference to model outcomes (Figure 2-Figure 4).

Survey biomass data corrections (labeled "sampler and survbio edits" in figure legends)

There are two errors that were found in the input files for the 2021 operational assessment during the process of updating data for this discussion paper. First, the 2021 operational assessment used the coefficient of variation (CV) corresponding to survey biomass estimates as a model input for all years and areas instead of the standard error in logspace that is expected by ss3 ($\sqrt{(\ln{(1+(CV)^2})}$). The standard errors in logspace are smaller than the CVs. Secondly, the 2021 operational model accidentally fit to survey biomass estimates for the Eastern GOA for 1984 and 1987. The Plan Team had decided to omit 1984 and 1987 survey data across all assessments due to differences in sampling methodology in those years. All new data runs omit the 1984 and 1987 Eastern GOA survey biomass indices. Adding to the model that incorporates new fishery age data inputs, we conduct a model run that uses the correct standard error in logspace for survey biomass data and exludes survey biomass estimates in the Eastern GOA for 1984 and 1987. Thus, this step of the bridging analysis clarifies the impact of the survey biomass data input errors that appeared in the 2021 operational assessment.

Figure 1 shows the survey indices with corresponding uncertainty in the index observations and fits to the survey indices for the bridging analysis. Correcting the uncertainty in observations to be the logspace standard error leads to smaller uncertainty intervals around the data points. In addition, omitting the years 1984 and 1987 from the survey index in the Eastern GOA (as was originally intended) leads to smaller estimates of catchability (q = 1.17-1.19 in bridging models excluding corrections to survey biomass data and q = 1.08 in bridging models including corrections to survey biomass data; Table 1). In turn, models that incorporate corrections to the survey biomass index data estimate higher historical spawning biomass values than for models without these corrections and slightly lower estimates of fishing intensity (1-SPR) historically (Figure 2).

Next, the following data were added to the model, in addition to the re-processed fishery age data from Sampler and incorporation of corrections to survey biomass data inputs:

- Catch biomass for 2022-2024, and updated end-of-year catch biomass for 2021
- Fishery length composition data for 2022-2024
- Gulf of Alaska Bottom Trawl survey biomass data for 2023
- Gulf of Alaska Bottom Trawl survey length composition data for 2023

For the 2025 operational assessment, we expect to have additional survey biomass data for 2025, catches for January – October 2025, newly-aged fishery age data for 2022-2024 and newly-aged conditional-age-at-length data from the GOA Bottom Trawl survey for 2021 and 2023. Figure 1 shows that the fits to historical survey biomass data are generally very similar with and without new data. However the survey biomass index in 2023 was low in both the Western-Central and Eastern GOA (Figure 1). Figure 2 shows that catches remained low from 2022-2024 and cannot explain the low values for survey biomass in 2023. Survey biomass values have declined and remained low in recent years for multiple flatfish species. A similar (but more persistent) shift to lower survey biomass has occurred for GOA Dover sole that could not be explained by fishing (there is almost no fishing for GOA Dover sole). Here, we stop to explain the approach in the 2023 GOA Dover sole assessment (https://apps-afsc.fisheries.noaa.gov/Plan_Team/2023/GOAdeepflat.pdf) for fitting to the recent shift in survey biomass in a way that accounts for uncertainty about why it occurred, as we seek feedback on how we might account for such a shift for GOA rex sole if the 2025 survey biomass is similar to that in 2023.

This paragraph on GOA Dover sole is simply meant as food for thought. This is NOT a GOA Dover sole document. The GOA Dover assessment document notes that a change in catchability and/or natural mortality could have occurred that led to persistent low survey biomass values. Because there is little fishing for Dover sole, estimating both female and male natural mortality appears to be feasible and is estimated within the model. The Dover model therefore uses a time block for recent years, where both recent catchability and natural mortality are estimated separately from historical values; this accounts for hypotheses that lower survey biomass in recent years may have been influenced by a change in catchability and/or a change in natural mortality. In the Dover model, it was not feasible to estimate historical and recent catchability along with historical and recent natural mortality. Therefore, a model was run for reference that used only data prior to the change to lower survey biomass values and estimated catchability and natural mortality without time blocks; the estimated value for historical catchability from the historical reference model was then used as a fixed value in the most recent assessment for historical catchability. In summary, the most recent GOA Dover sole model fixes historical catchability and estimates recent catchability, historical and recent natural mortality.

We do not include any model runs for GOA rex sole using the GOA Dover assessment approach for catchability and natural mortality because we still expect another survey biomass value before the 2025 assessment occurs, and it is possible that survey biomass values for 2025 will be higher than the 2023 values. In addition, the GOA rex sole model includes male and female natural mortality parameters for each of the two areas. There is not a way in ss3 to mirror natural mortality across areas that we know of, and it may not be accurate to do so, given growth differences. We welcome ideas on alternative assessment methods for accounting for a series of recent low biomass values in flatfish assessments that cannot be explained by fishing.

Growth, selectivity, catchability, mean recruitment, and recruitment allocation parameters are essentially unaffected by the addition of new data (Table 1, Figure 3-Figure 4). Likewise fits to time-aggregated fishery age and length composition data (Figure 5-Figure 6) are unaffected by the addition of available new data. Fits to fishery length composition data consistently miss larger fish that are observed and estimate a higher proportion of smaller fish than are observed (Figure 5), while time-aggregated fits to fishery age composition data estimate fewer 7-8 year old fish than were observed and more older fish than were observed (Figure 6). The fact that the fits to time-aggregated length and age composition data are skewed in opposite directions is, we think, a reflection of an imperfect line between the Western-Central GOA and the Eastern GOA and the possibility that there is some small amount of movement between the two areas. The 2017 operational stock assessment (https://apps-afsc.fisheries.noaa.gov/REFM/Docs/2017/GOArex.pdf) discusses this mismatch in detail, comparing one- and two-area models, and shows that the mismatch between fits to time-aggregated fishery age and length composition data are substantially reduced by the two-area model approach and the explicit estimation of growth in the two areas separately. However, the area delineation in the current (two-area) assessment, which follows the NMFS regulatory area definitions for the Western-Central GOA and the Eastern GOA may not be a perfect representation of the where the growth patterns diverge in space. We include further discussion of this issue as the last section of this discussion paper. Secondly, there are some small fish that occur in the Western-Central GOA (see Figure 8 from the operational assessment), especially those furthest offshore.

Table 1. Estimated time-invariant parameters for models in the bridging analysis, excluding selectivity parameters. "WC" indicates the Western-Central GOA and "E" indicates the Eastern GOA.

	Estimates				Standard Deviations			
Parameter	2021 model	sampler	sampler and survbio edits	sampler survbio edits and new data	2021 model	sampler	sampler and survbio edits	sampler survbio edits and new data
M (female; WC)	0.17	0.17	0.17	0.17	NA	NA	NA	NA
Length at age 3 (female; WC)	14.76	14.75	14.69	14.72	0.817	0.819	0.829	0.811
Length-at-age-20 (female; WC)	46.58	46.58	46.58	46.54	0.343	0.343	0.343	0.339
VonBert K (female; WC))	0.28	0.28	0.28	0.28	0.014	0.014	0.015	0.014
CV of length-at-age-3 (female; WC)	0.18	0.18	0.18	0.17	0.014	0.014	0.014	0.014
CV of length-at-age-20 (female; WC)	0.09	0.09	0.09	0.09	0.004	0.004	0.004	0.004
M (female; E)	0.17	0.17	0.17	0.17	NA	NA	NA	NA
Length-at-age-3 (female; E)	14.28	14.27	14.53	14.75	1.539	1.540	1.571	1.592
Length-at-age-20 (female; E)	36.81	36.81	36.81	36.80	0.618	0.618	0.618	0.617
VonBert K (female; E)	0.30	0.30	0.29	0.29	0.036	0.036	0.036	0.037
CV of length-at-age-3 (female; E)	0.17	0.17	0.17	0.17	0.031	0.031	0.030	0.030
CV of length-at-age-20 (female; E)	0.10	0.10	0.10	0.10	0.010	0.010	0.010	0.010
M (male; WC)	0.17	0.17	0.17	0.17	NA	NA	NA	NA
Length-at-age-3 (male; WC)	15.10	15.10	15.10	15.20	0.931	0.931	0.931	0.945
Length-at-Age-20 (male; WC)	41.02	41.05	40.95	40.87	0.274	0.275	0.268	0.269
VonBert K (male; WC)	0.32	0.32	0.32	0.32	0.018	0.018	0.018	0.018
CV in length-at-age-3 (male; WC)	0.19	0.19	0.19	0.19	0.016	0.016	0.016	0.016
CV in length-at-age-20 (male; WC)	0.07	0.07	0.07	0.07	0.004	0.004	0.004	0.004
M (male; E)	0.17	0.17	0.17	0.17	NA	NA	NA	NA
Length-at-age-3 (male; E)	15.52	15.52	15.52	15.48	1.759	1.759	1.759	1.754
Length-at-age20 (male; E)	34.64	34.64	34.69	34.65	0.493	0.493	0.495	0.480
VonBert K (male; E)	0.31	0.31	0.30	0.30	0.042	0.042	0.042	0.042
CV in length-at-age-3 (male; E)	0.19	0.19	0.19	0.19	0.031	0.031	0.030	0.029
CV in length-at-age-20 (male; E)	0.08	0.08	0.08	0.08	0.009	0.009	0.009	0.009
Recruitment allocation to E	-0.87	-0.88	-0.82	-0.83	0.060	0.060	0.050	0.049
ln(R0)	11.54	11.54	11.60	11.56	0.086	0.086	0.084	0.084
ln(q)	0.16	0.17	0.08	0.08	0.100	0.100	0.097	0.096

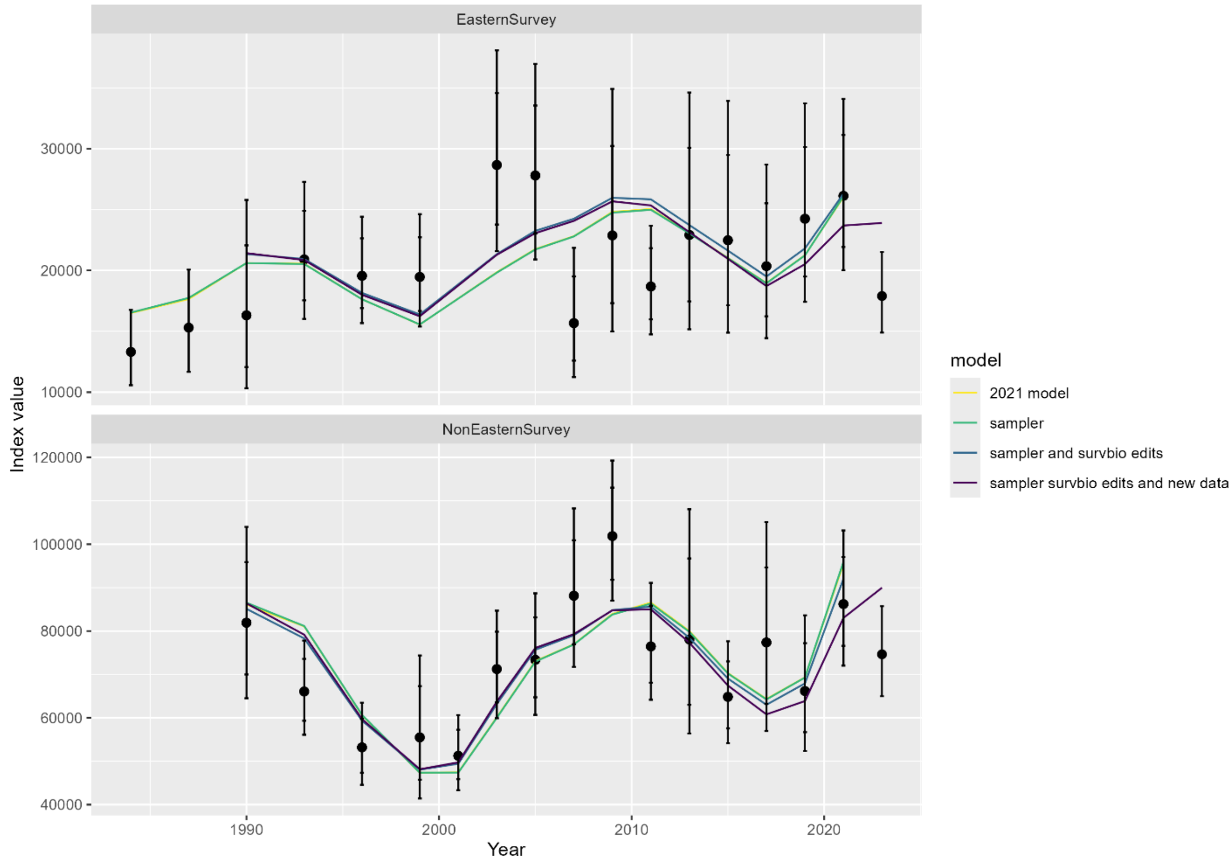

Figure 1. Observed (black dots) and predicted (lines) index of survey biomass for the Eastern GOA (top panel) and the Western-Central GOA ("NonEasternSurvey;" bottom panel) for the models in the bridging analysis. Vertical lines show 95% lognormal uncertainty intervals, with tick marks showing the smaller, correct uncertainty intervals used in models labeled "survbio edits," and the larger, incorrect uncertainty intervals used in the 2021 operational assessment. In addition, the Eastern Survey plot shows the 1984 and 1987 data points that were used in the objective function for the 2021 operational assessment, but were removed for runs with labels including "survbio edits."

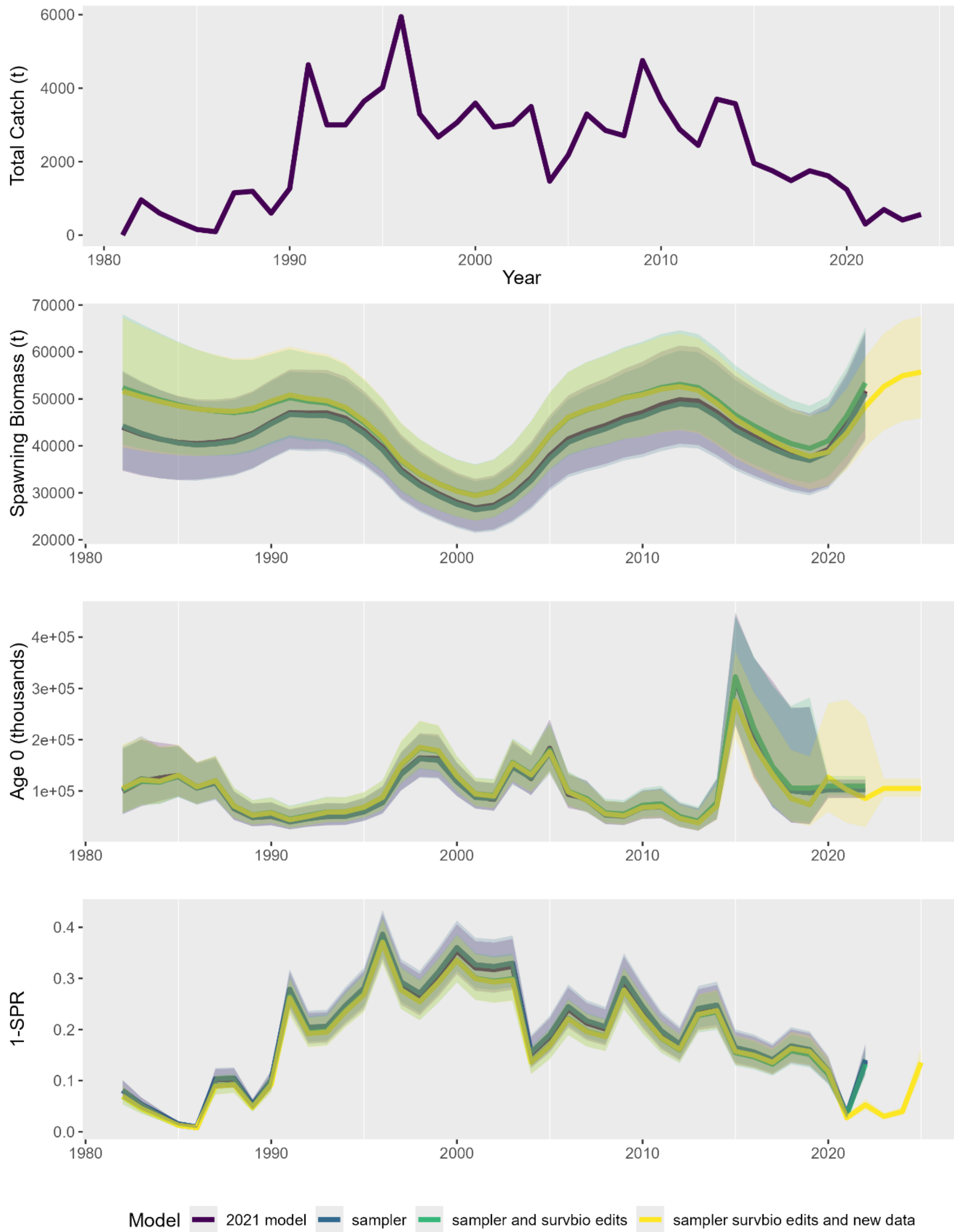

Figure 2. Observed catches and estimated spawning biomass, recruitment, and fishing intensity (1-spawning potential ratio) for the models included in the bridging analysis. Shaded areas indicate 95% asymptotic uncertainty intervals.

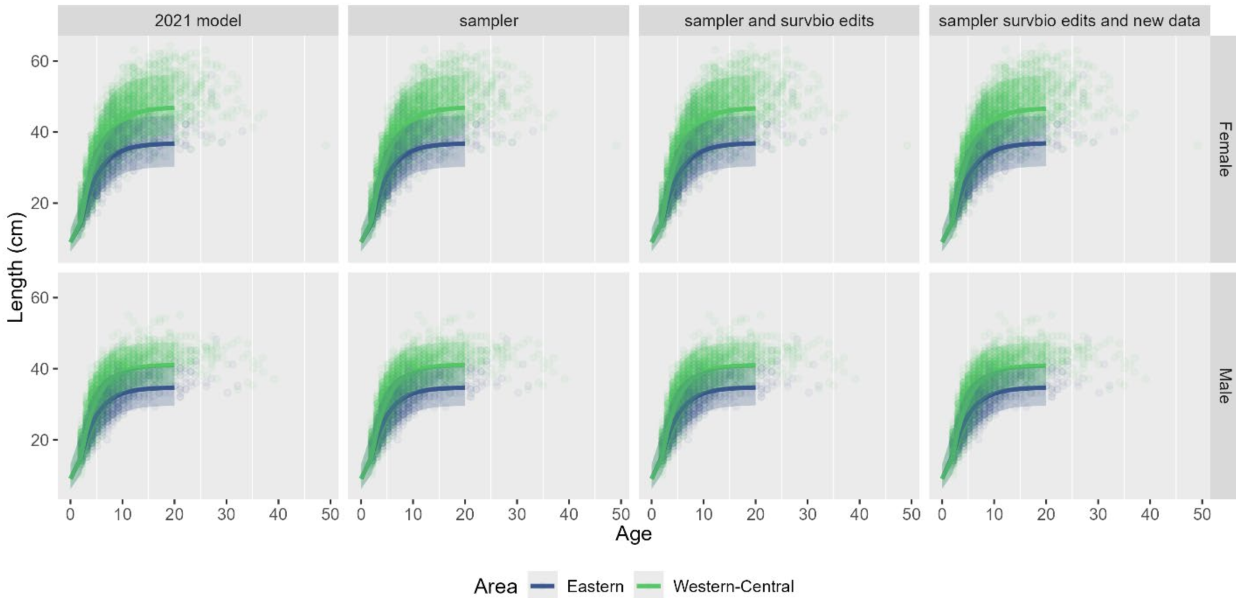

Figure 3. Raw bottom trawl survey data length-at-age by area and sex, overlaid with mean length-at-age for each model (columns) and 90% asymptotic uncertainty intervals around the means (shaded areas) for the models included in the bridging analysis. The Eastern GOA is shown in green and the Western-Central GOA is shown in blue.

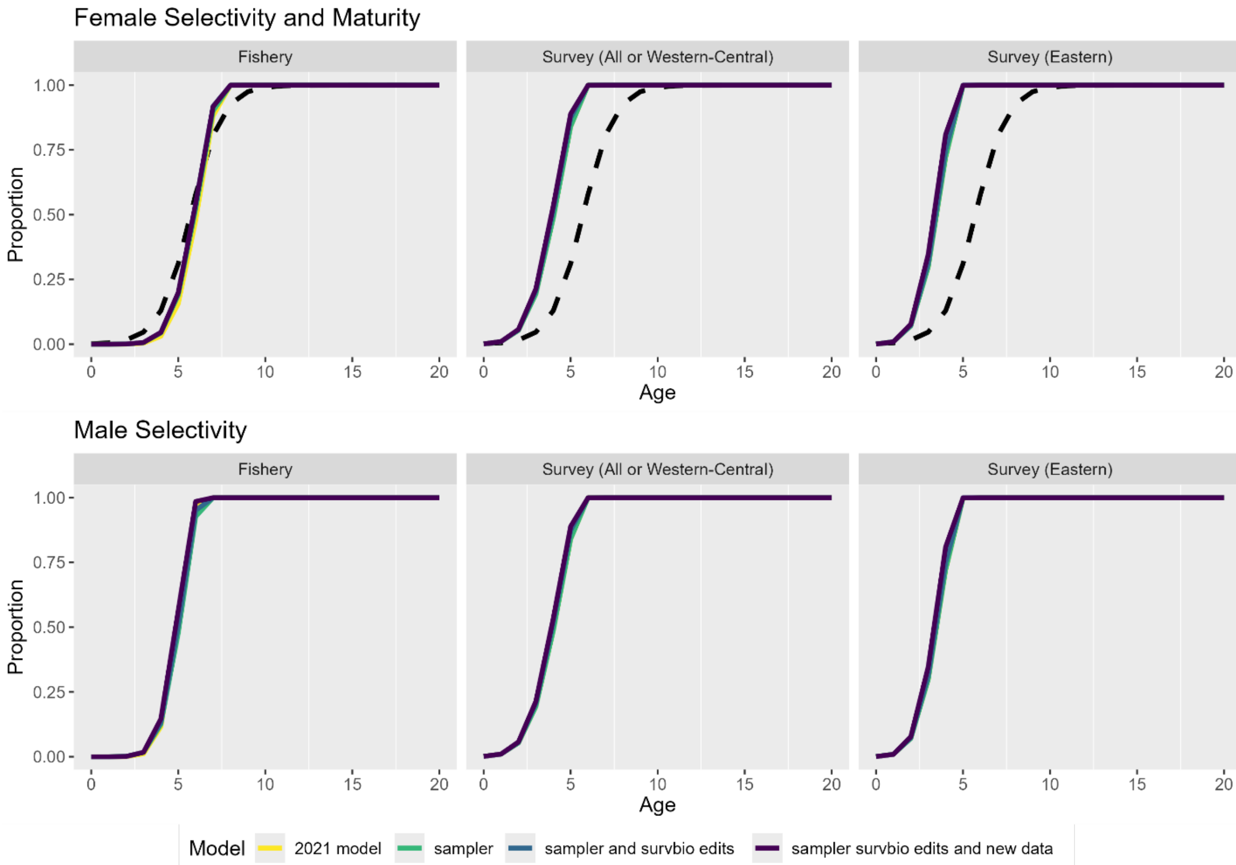

Figure 4. Fishery and survey selectivity-at-age across models for males and females for the models included in the bridging analysis. Plots for females are overlaid on the maturity-at-age curve. A listing of selectivity parameter configurations can be found in the 2021 assessment document in Table 9 (https://apps-afsc.fisheries.noaa.gov/Plan_Team/2021/GOArex.pdf).

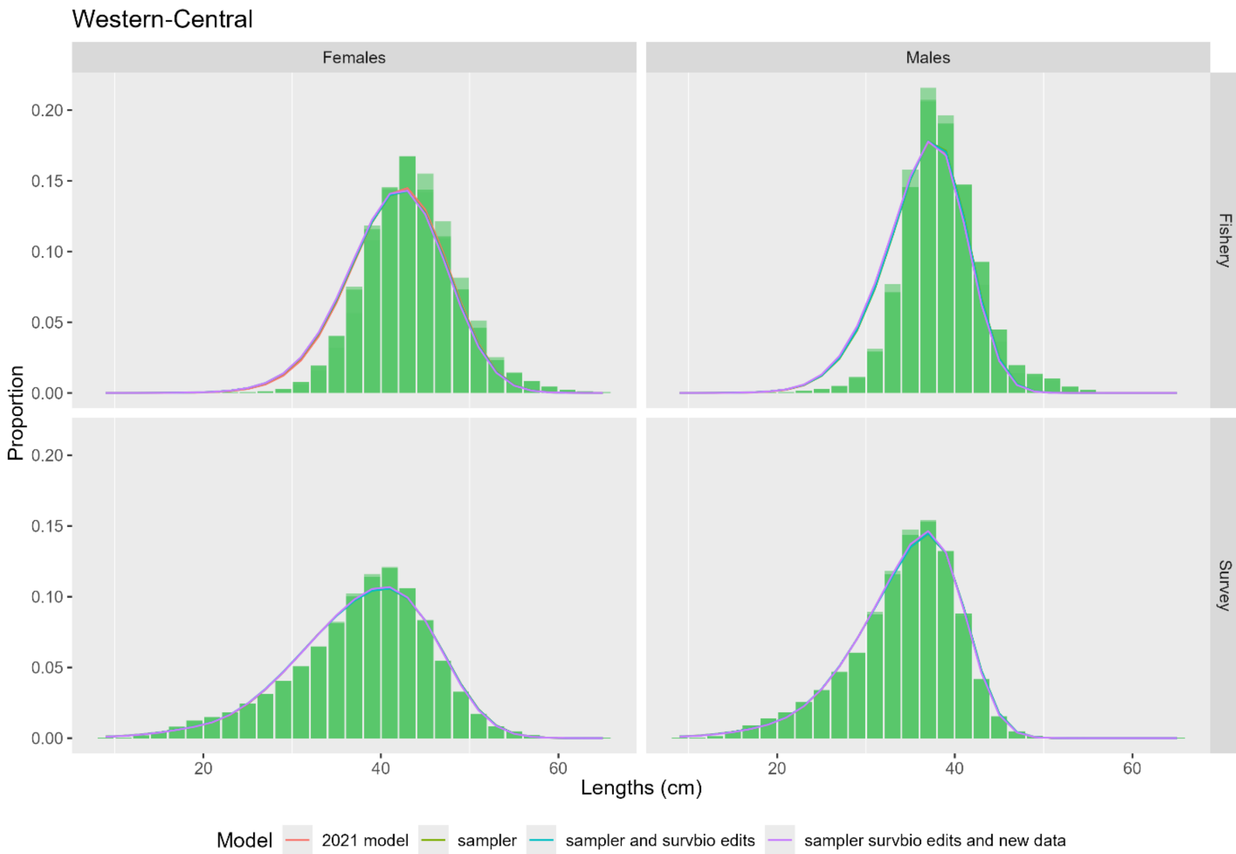

Figure 5. Fits (lines) to female and male fishery length composition with data aggregated by year (green shaded regions) for the models included in the bridging analysis.

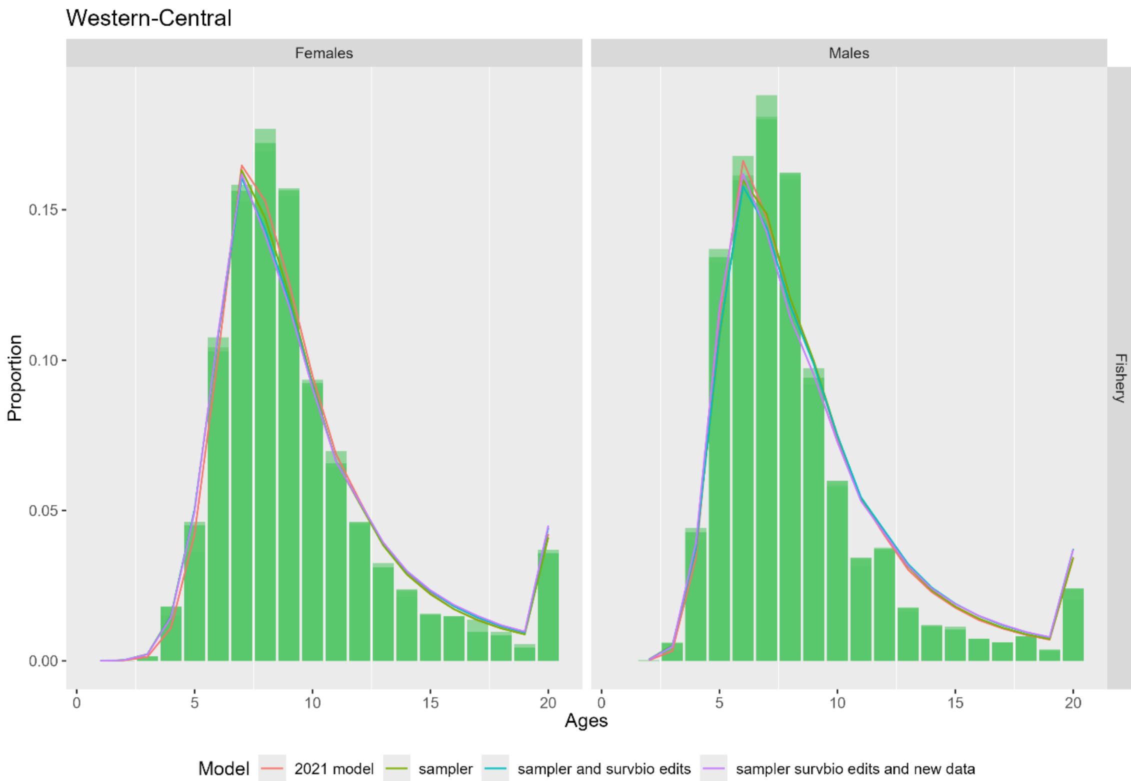

Figure 6. Fits (lines) to female and male fishery age composition with data aggregated by year (green shaded regions) for the models included in the bridging analysis. The fishery occurs only in the Western-Central GOA.

Sensitivity of the model to age-at-50%-maturity and impact of estimating male natural mortality in each area

Here, we show three sensitivity model runs. We use the model with all available new data ("sampler survbio edits new data" from the Bridging Analysis section) as a base model; we will refer to this model as the "new data" model or sometimes the "base model" in this section. Therefore, all sensitivity analysis runs include all available new data, use of sampler to process fishery age data, and all include the corrections to the survey biomass inputs.

We change the age-at-50%-maturity to be one year younger and then one year older, as well as a model run estimating male natural mortality in each area (female natural mortality is fixed). Maturity data exist only for one year, and from a very limited spatial range in the GOA. Stock synthesis 3 does not currently allow for mirroring of natural mortality estimates across areas. While natural mortality may differ by area, it is typically difficult to estimate one M value, much less 4 in an assessment model. However future analysis could do a likelihood profile, fixing female M in both areas to the same value in each iteration of the profile.
In summary we include the following runs in this section:

(1) "new data" – this model serves as the base for all of the sensitivity analyses conducted in this section. In the Bridging Analysis section, this model was labeled "sampler survbio edits new data."

(2) “early maturity” – as for “new data,” but shifting age-at-50%-maturity to occur one year earlier in the assessment (at age 4.7 instead of age 5.7).

(3) “late maturity” – as for “new data,” but shifting age-at-50%-maturity to occur one year later in the assessment (at age 6.7 instead of age 5.7).

(4) “estimate male M” – as for “new data,” but estimating male natural mortality within the model with a lognormal prior (with bias adjustment) with mean equal to 0.17 and a standard deviation of 0.2.

Table 2 shows the impact of shifted maturity and estimated male natural mortality on resulting management quantities. The estimate of survey catchability is lower for all models relative to the 2021 operational assessment (q = 1.09 after the addition of new data (with the updates to processing of fishery age data and survey biomass corrections; base model), as compared to q = 1.17 from the 2021 assessment). Estimates of male natural mortality (male M = 0.18 in each area) are slightly higher than the value of M = 0.17 from the base model, and the estimate of survey q is lower than for the base model (q = 1.01), which helps to explain why the ABC for the model estimating male M is lower than for the base model (Table 2).

Changing age-at-50%-maturity to be one year younger or older has a substantial impact on ABC, with values of 17,209 t and 12,693 t, respectively. These values can be used to inform uncertainty in the ABC for GOA rex sole. Our assessment process includes populating a qualitative “risk table” outside of the assessment model to inform any reductions from the maximum ABC value recommended from the model. In the risk table are 4 categories for assessing risk, one of which is “assessment concerns.” This is one potential route for including information about the impact of uncertainty about the maturity curve, where authors can specify on a scale of 1-3 their level of concern about assessment uncertainty; in turn, this can be used to justify lowering the ABC. Authors must decide on how much to lower the ABC and provide justification for doing so. The range of ABCs suggested by the maturity sensitivity analyses is substantial because the ages at which GOA rex sole recruit to the fishery are very similar to the ages at which maturity occurs (Figure 10). We welcome any ideas on how (or whether) to translate the range of ABCs provided by this sensitivity analysis into a reduced ABC for the stock. Impacts of the sensitivity runs on spawning biomass, recruitment and fishing intensity (1-SPR) are shown in Figure 7. Not surprisingly, a later age-at-50%-maturity leads to lower estimates of spawning biomass by approximately 5,000 t and slightly higher values for fishing intensity throughout history than for the base model (and likewise, earlier age-at-50%-maturity leads to higher estimates of spawning biomass by approximately 5,000 t and slightly lower values for fishing intensity throughout history). Estimated growth and selectivity curves are unaffected by changes to age-at-50% maturity and estimated male natural mortality (Figure 9-Figure 10), and fits to length and age composition data are likewise unaffected relative to the base model (Figure 11-Figure 12).

Table 2. Hypothetical executive summary table values for 2025 for the models in the sensitivity analysis, and also for specifications in the accepted 2024 operational harvest projections for specifying 2025 ABCs.

Quantity: (Western-Central GOA)	2025 from 2024 accepted table	2025 Accepted model, new data	2025, early maturity	2025, late maturity	2025, estimate male Ms
M (natural mortality rate)	0.17	0.17	0.17	0.17	0.17 (f), 0.18 (m)
q (catchability)	1.17	1.09	1.09	1.09	1.01
Projected total (3+) biomass (t)	104,776	95,633	95,633	95,633	102,948
Female spawning biomass (t)	50,756	45,335	48,949	41,118	51,123
$B_{100\%}$	46,850	46,488	50,038	42,394	50,874
$B_{40\%}$	18,740	18,595	20,015	16,958	20,350
$B_{35\%}$	16,398	16,271	17,513	14,838	17,806
F_{OFL}	0.28	0.27	0.33	0.22	0.27
$maxF_{ABC}$	0.23	0.22	0.26	0.18	0.22
F_{ABC}	0.23	0.22	0.26	0.18	0.22
OFL (t)	20,747	17,966	21,178	15,142	19,138
maxABC (t)	17,080	14,846	17,209	12,693	15,815
ABC (t)	17,080	14,846	17,209	12,693	15,815

Table 3. Estimated time-invariant parameters for models in the bridging analysis, excluding selectivity parameters. "WC" indicates the Western-Central GOA and "E" indicates the Eastern GOA.

	Estimates				Standard Deviations			
Parameter	new data	early maturity	late maturity	estimate male M	new data	early maturity	late maturity	estimate male M
M (female; WC)	0.17	0.17	0.17	0.17	NA	NA	NA	NA
Length at age 3 (female; WC)	14.72	14.72	14.72	14.68	0.811	0.811	0.811	0.802
Length-at-age-20 (female; WC)	46.58	46.58	46.58	46.54	0.343	0.343	0.343	0.339
VonBert K (female; WC)	0.28	0.28	0.28	0.28	0.014	0.014	0.014	0.014
CV of length-at-age-3 (female; WC)	0.17	0.17	0.17	0.17	0.014	0.014	0.014	0.014
CV of length-at-age-20 (female; WC)	0.09	0.09	0.09	0.09	0.004	0.004	0.004	0.004
M (female; E)	0.17	0.17	0.17	0.17	NA	NA	NA	NA
Length-at-age-3 (female; E)	14.75	14.75	14.75	14.75	1.592	1.592	1.592	1.596
Length-at-age-20 (female; E)	36.81	36.81	36.81	36.80	0.618	0.618	0.618	0.617
VonBert K (female; E)	0.29	0.29	0.29	0.29	0.037	0.037	0.037	0.037
CV of length-at-age-3 (female; E)	0.17	0.17	0.17	0.17	0.030	0.030	0.030	0.030
CV of length-at-age-20 (female; E)	0.10	0.10	0.10	0.10	0.010	0.010	0.010	0.010
M (male; WC)	0.17	0.17	0.17	0.18	NA	NA	NA	0.003
Length-at-age-3 (male; WC)	15.10	15.10	15.10	15.20	0.931	0.931	0.931	0.945
Length-at-Age-20 (male; WC)	40.87	40.87	40.87	40.98	0.269	0.269	0.269	0.277
VonBert K (male; WC)	0.32	0.32	0.32	0.32	0.018	0.018	0.018	0.019
CV in length-at-age-3 (male; WC)	0.19	0.19	0.19	0.19	0.016	0.016	0.016	0.016
CV in length-at-age-20 (male; WC)	0.07	0.07	0.07	0.07	0.004	0.004	0.004	0.004
M (male; E)	0.17	0.17	0.17	0.17	NA	NA	NA	0.007
Length-at-age-3 (male; E)	15.52	15.52	15.52	15.48	1.759	1.759	1.759	1.754
Length-at-age20 (male; E)	34.65	34.65	34.65	34.60	0.480	0.480	0.480	0.483
VonBert K (male; E)	0.30	0.30	0.30	0.30	0.042	0.042	0.042	0.042
CV in length-at-age-3 (male; E)	0.19	0.19	0.19	0.19	0.029	0.029	0.029	0.029
CV in length-at-age-20 (male; E)	0.08	0.08	0.08	0.08	0.009	0.009	0.009	0.009
Recruitment allocation to E	-0.83	-0.83	-0.83	-0.89	0.049	0.049	0.049	0.062
ln(R0)	11.56	11.56	11.56	11.66	0.084	0.084	0.084	0.089
ln(q)	0.08	0.08	0.08	0.01	0.096	0.096	0.096	0.099

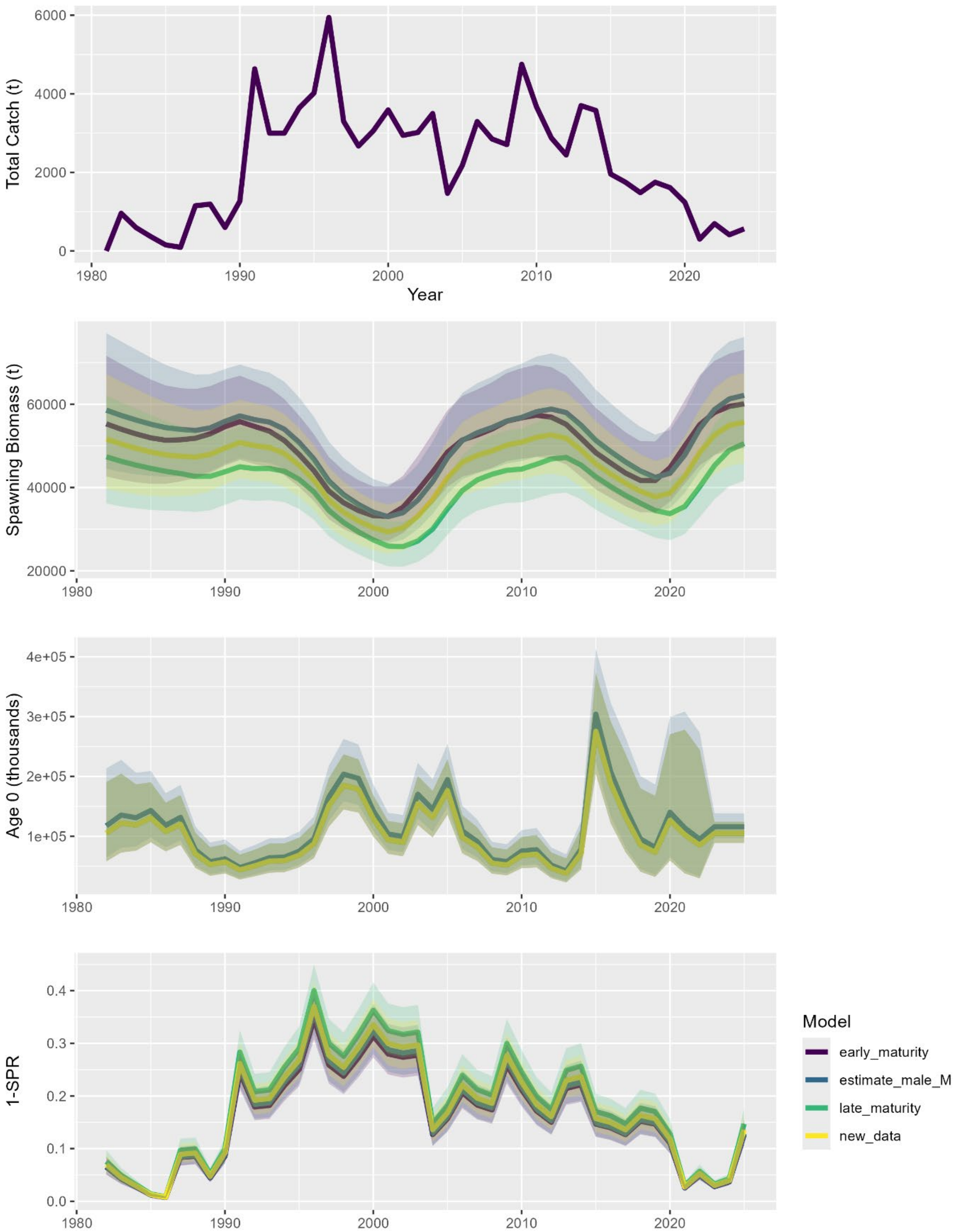

Figure 7. Observed catches and estimated spawning biomass, recruitment, and fishing intensity (1-spawning potential ratio) for each of the four alternative models with new data added. Shaded areas indicate 95% asymptotic uncertainty intervals.

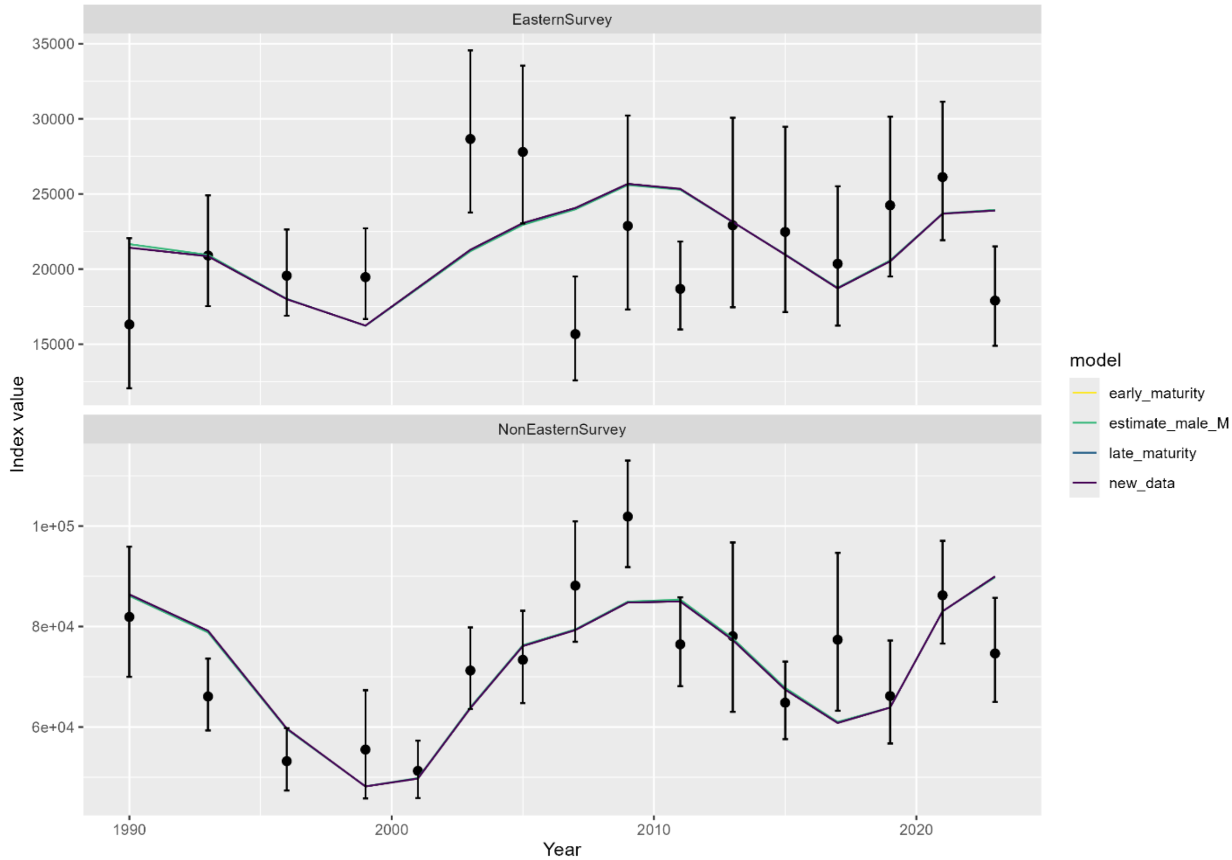

Figure 8. Observed (black dots) and predicted (lines) index of survey biomass for the Eastern GOA (top panel) and the Western-Central GOA ("NonEasternSurvey;" bottom panel) for the models in the sensitivity analysis. Vertical lines show 95% lognormal uncertainty intervals.

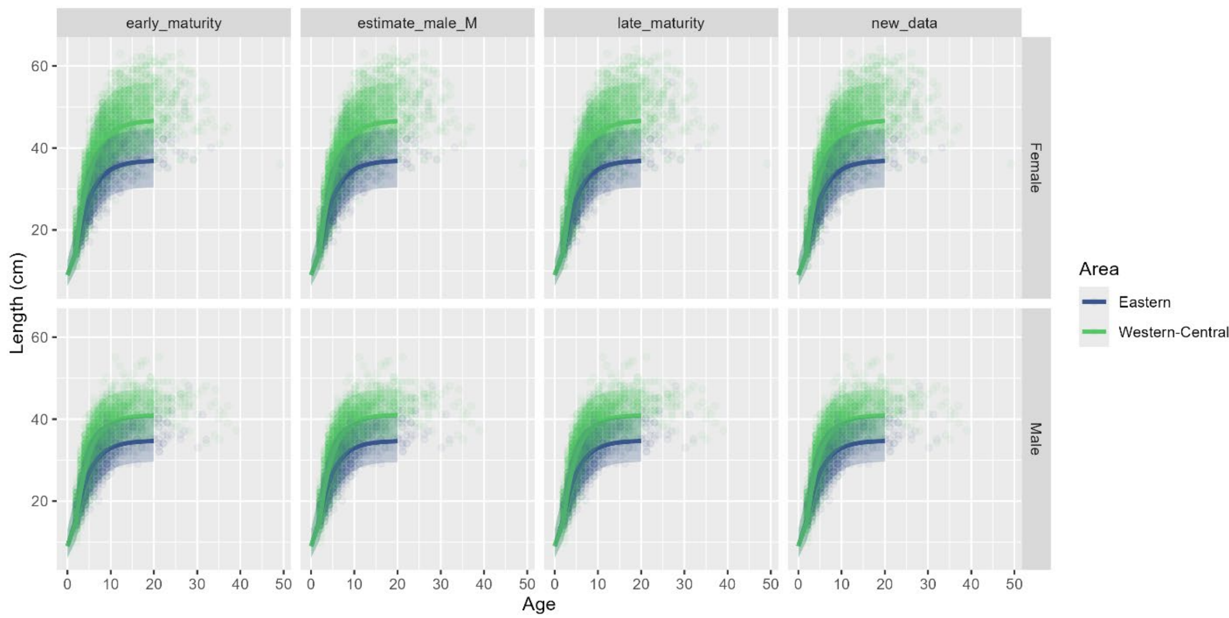

Figure 9. Raw bottom trawl survey data length-at-age by area and sex, overlaid with mean length-at-age for each model (columns) and 90% asymptotic uncertainty intervals around the means (shaded areas) for the models included in the sensitivity analysis. The Eastern GOA is shown in green and the Western-Central GOA is shown in blue.

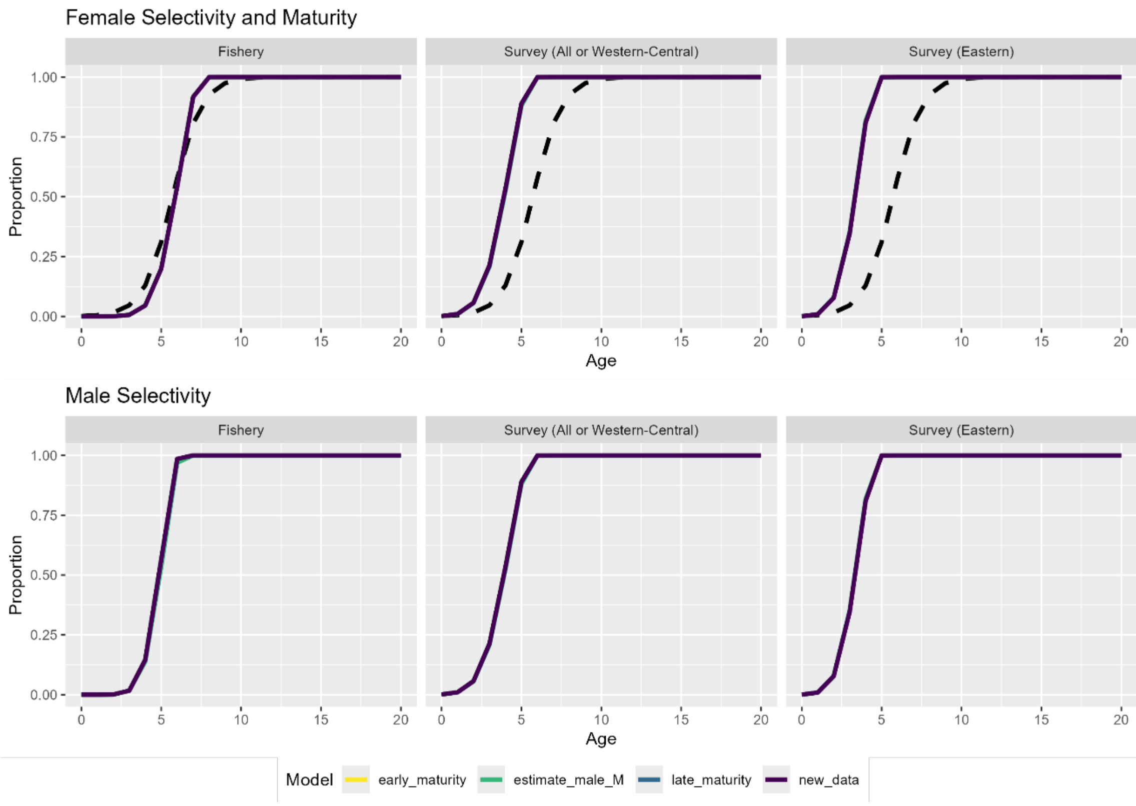

Figure 10. Fishery and survey selectivity-at-age across models included in the sensitivity analysis. A listing of selectivity parameter configurations can be found in the 2021 assessment document in Table 9 (https://apps-afsc.fisheries.noaa.gov/Plan_Team/2021/GOArex.pdf).

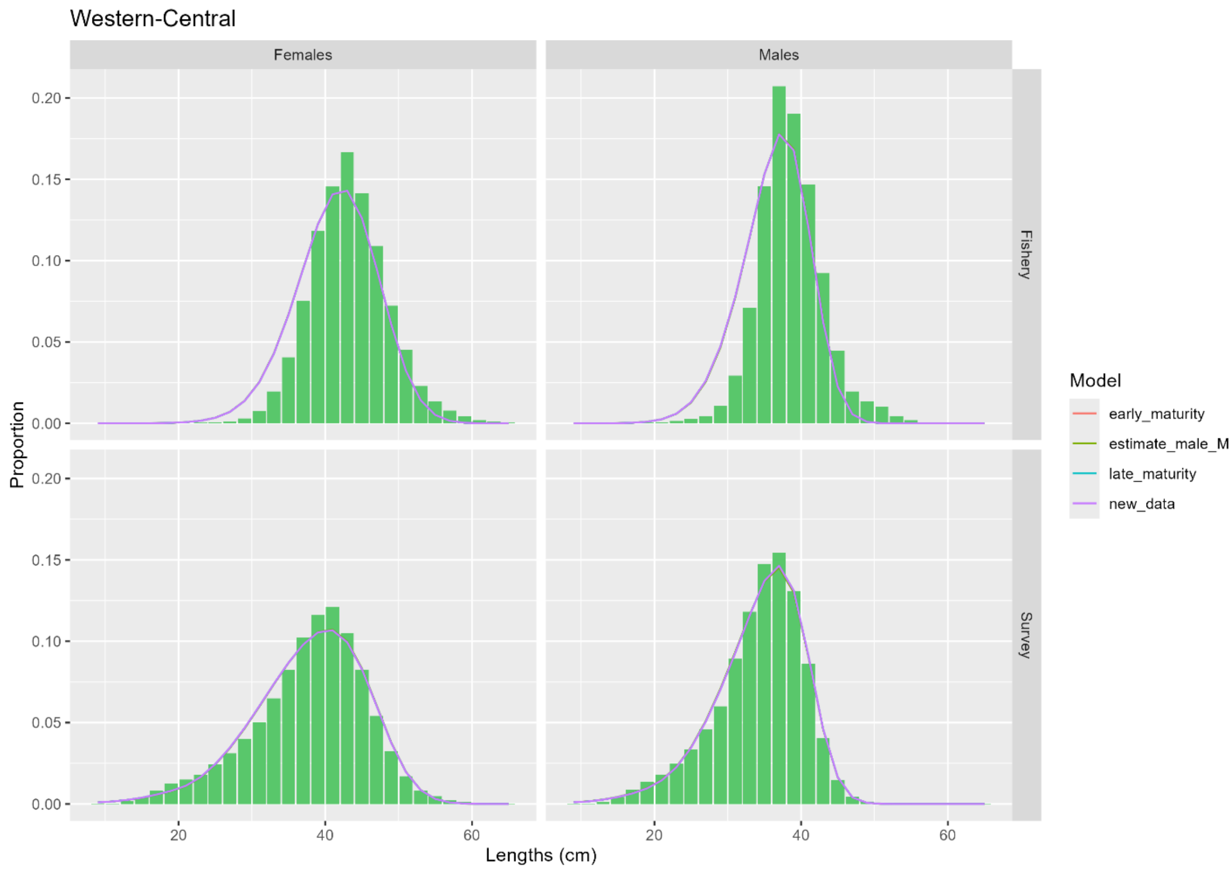

Figure 11. Fits (lines) to female and male fishery length composition with data aggregated by year (green shaded regions) for the models in the sensitivity analysis.

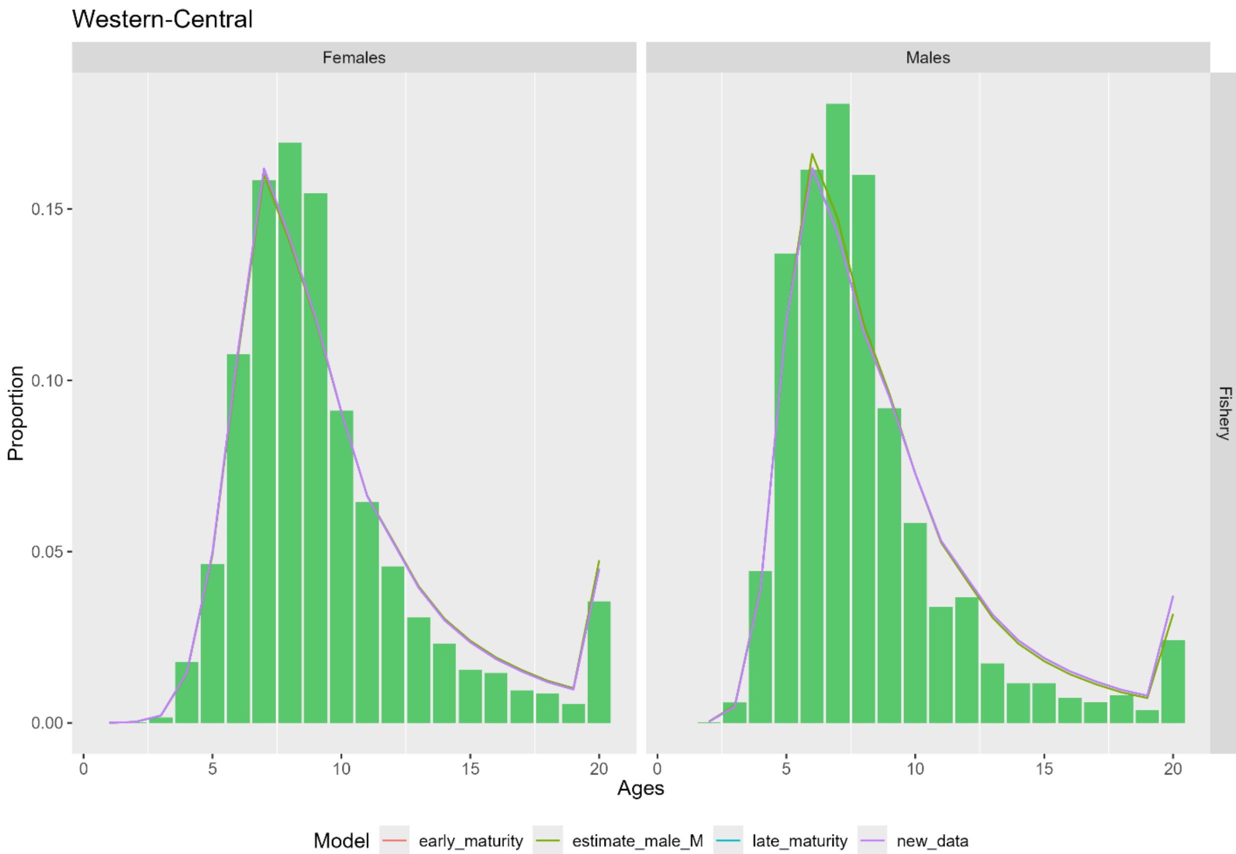

Figure 12. Fits (lines) to female and male fishery age composition with data aggregated by year (green shaded regions) for the models in the sensitivity analysis.

How well do the area delineations of "Western-Central" and "Eastern" GOA align with spatial breaks in growth patterns?

Description of GAM method

Kapur et al. (2020) introduced a GAM-based algorithm for detecting novel breakpoints in fish length-at-age. Briefly, the method fits a spatial smoother to length data for user-specified ages as a function of latitude, longitude and year, and evaluates the first derivative of the spatial smoothing function at the specified ages. The method labels a "breakpoint" at the latitude and/or longitude at which the first derivative achieves its highest value, so long as the corresponding confidence interval does not include zero. This method is intended for illustrative and inferential purposes.

Model explorations using the GAM method

We applied the method described in Kapur et al. (2020) using the R package growthbreaks (https://github.com/afsc-assessments/growthbreaks) to female length-at-age specimen data; this analysis focused on females with the assumption that female growth would have the strongest downstream effect on SSB. We first generated unique breakpoints based on the male and female data (separately) for ages 5, 10, and 15. The model detected breakpoints ranging from 150°W to 151°W and 55°N to 56°N. We re-aggregated and re-fit the von Bertalanffy growth curve at the spatial grouping that was specified by these growth breaks, and at four additional stratifications: 1) using a singular vertical break at 151°W; 2) using a singular horizontal break at 56°N, and 3) using a singular vertical break at 147°W, which corresponds to the delineation between the Western-Central and Eastern GOA NMFS regulatory areas, and is the area definition used in the assessment; 4) fitting to all data at once. All models were then compared using AIC.

This analysis revealed that among the models explored, the most parsimonious model was obtained by a singular vertical breakpoint at 151°W, which is just to the west of the definition used in the assessment (147°W; Table 4). Specifying a single vertical breakpoint at 151°W led to the best AIC value of the models included in the analysis and was a similar, but a slightly better fit to the data than the model specifying a breakpoint at 147°W which corresponds to the breakpoint in the assessment model (Table 4). The multi-area model suggested by the GAM detection method resulted in von Bertalanffy growth curves with very similar values for asymptotic length that were less distinct across latitudinal breaks than longitudinal breaks and suggested significant differences in the estimated value of the *k* parameter (Figure 13-Figure 15). Simplifying by only splitting the data into two areas east and west of 151°W led to significantly different parameter estimates for both asymptotic length and growth rate (Figure 17). These findings suggest that the length-at-age specimen data can be appropriately partitioned at vertical breakpoint at 151°W. However, the NMFS regulatory area definition is a split between the Western-Central GOA and the Eastern GOA at 147°W, and this definition is used to apportion catch limits across areas in the GOA. The AIC value for the model with a break at 147°W is slightly higher than for the model with the break at 151°W (a difference in AIC of 426), and is the second lowest AIC value of the models included (Table 4). Externally estimated von-Bertalanffy growth parameters using the 147°W split differ slightly from those calculated using the 151°W split, but are generally similar (Table 5). Given the use of the regulatory area definitions to specify area-specific catch limits, it may be difficult to use a breakpoint of 151°W.

Table 4. AIC values calculated for the growth breakpoint models, comparing model support for breaks in growth patterns between areas defined at 151°W, 147°W, 56°N, no break (Global growth curve), and multiple breakpoints (both 151°W and 56°N).

Model	AIC	dAIC
Break at 151°W	40,060	0
Break at 147°W (assessment)	40,485	426
Break at 56°N	41,183	1,123
Global growth curve	41,394	1,334
Multiple Regions (detected)	80,008	39,948

Table 5. Growth parameter estimates estimated using area definitions with no breakpoints (Global Estimates), a single breakpoint at 147°W (corresponding to the current assessment and NMFS regulatory areas), and a single breakpoint at 151°W (breakpoint with the lowest AIC value). The breakpoints analysis was conducted with lengths in mm.

	k		L_{inf}		Sigma		t0	
Area	est	sd	est	sd	est	sd	est	sd
147°W Western-Central	0.20	0.01	503.97	2.94	52.46	0.69	-0.16	0.08
151°W Western-Central	0.21	0.01	517.29	2.83	47.23	0.72	-0.09	0.08
Global Estimates	0.18	0.01	493.83	3.17	56.56	0.66	-0.42	0.09
147°W Eastern	0.20	0.01	412.98	5.42	41.84	1.12	-0.50	0.20
151°W Eastern	0.21	0.01	432.37	4.25	47.00	0.90	-0.20	0.13

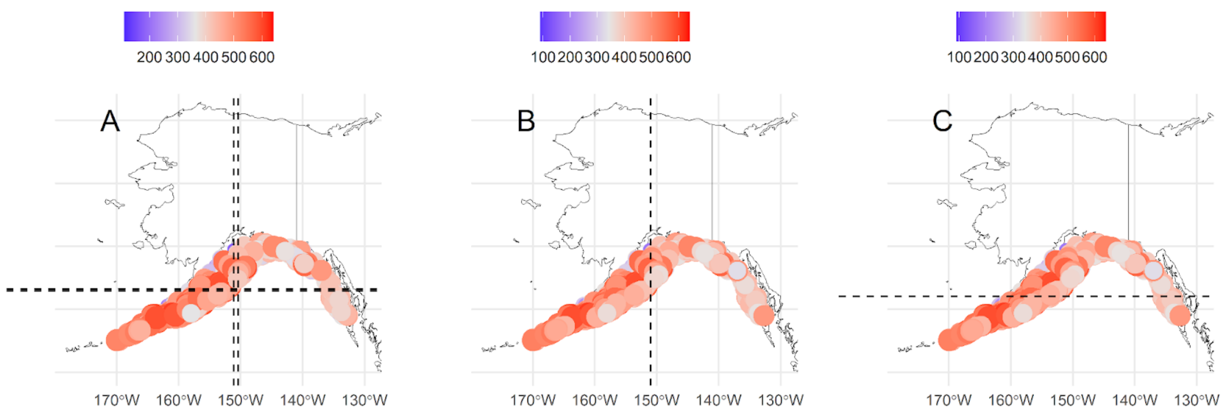

Figure 13. A) Breakpoints detected using the GAM-based clustering algorithm (Kapur et al., 2020) for female fish at ages 5, 10 and 15. B) Simplified breakpoint at 151°W as is used in the assessment model. C) Simplified breakpoint at 56°N explored for comparison. Colored points are observed lengths (in mm).

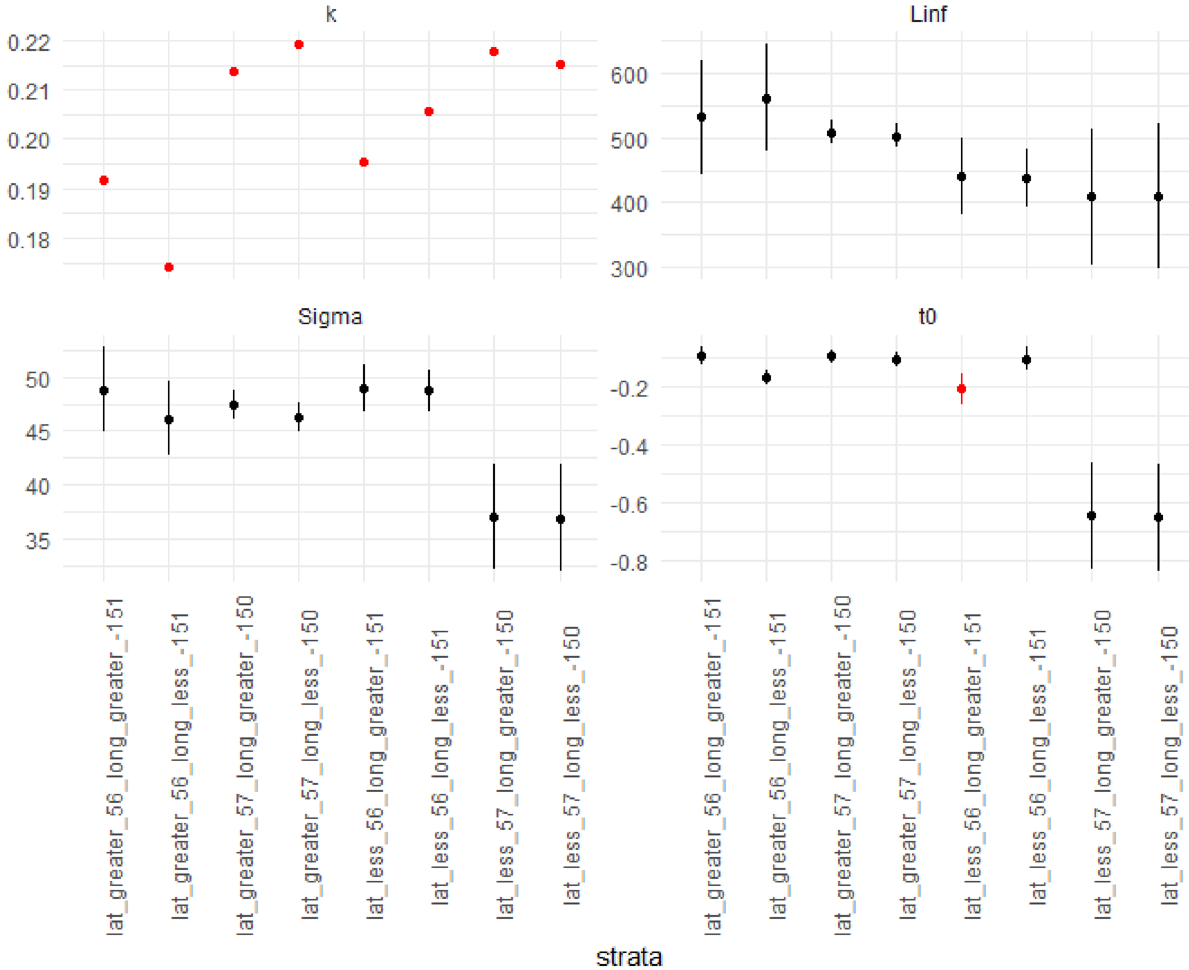

Figure 14. Von Bertalanffy parameter estimates and 95% uncertainty intervals using all detected breaks. Red points and error bars represent spatial strata for which parameter estimates were significantly different from at least one other area.

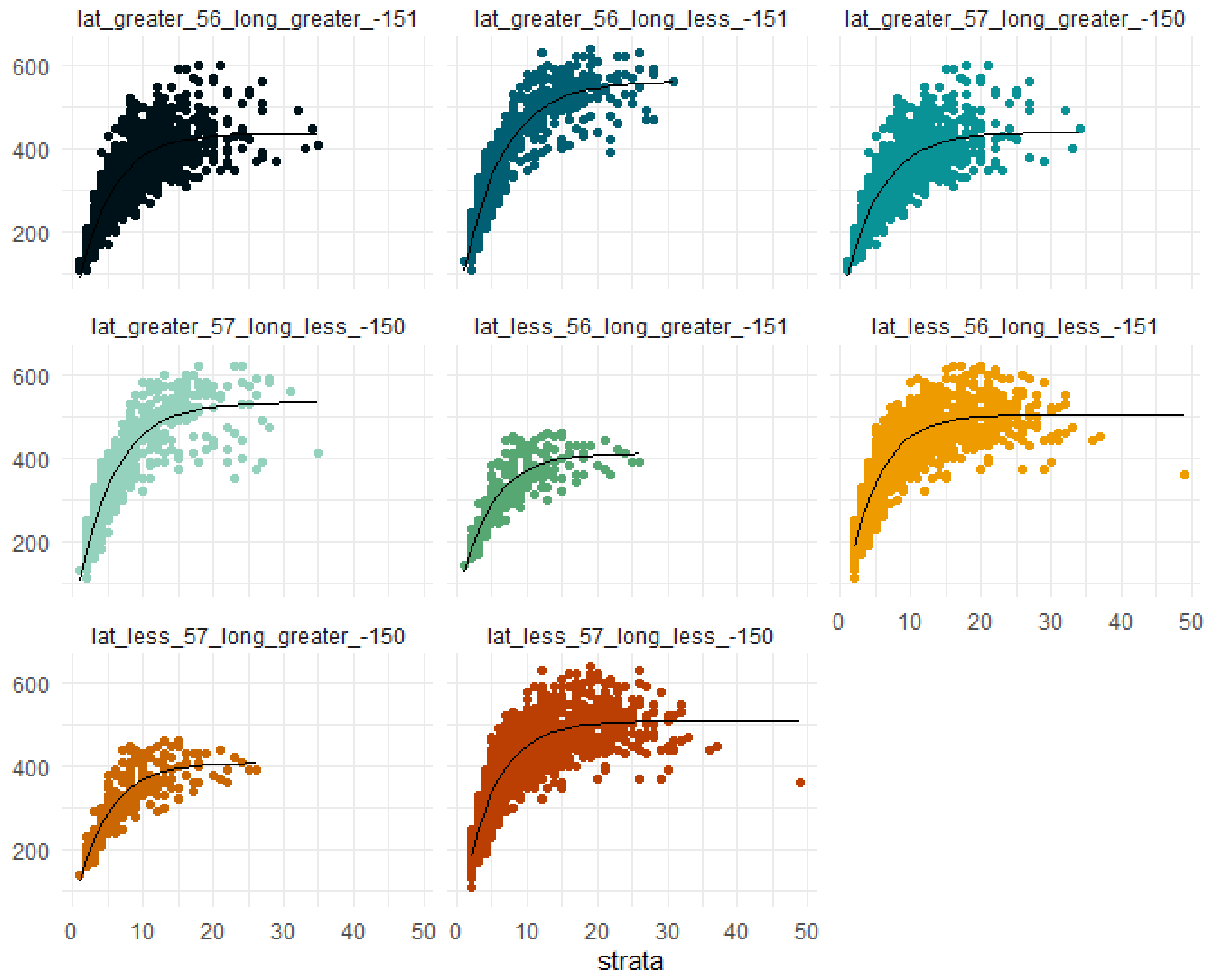

Figure 15. Estimated von Bertalanffy growth curves (solid lines) to female length-at-age data partitioned into spatial areas defined by detected breaks.

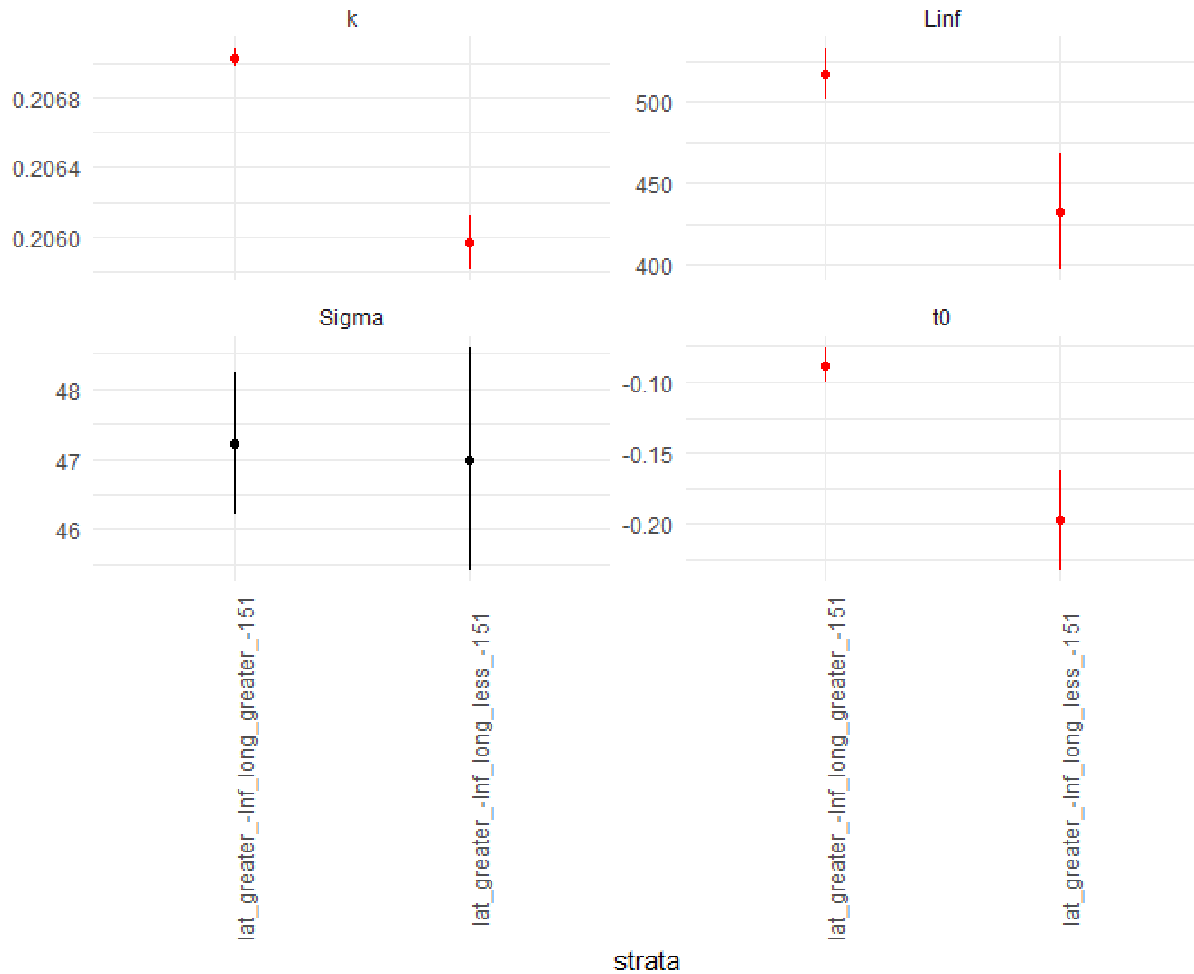

Figure 16. Von Bertalanffy parameter estimates and 95% uncertainty intervals for two-area hypothesis (as used in the assessment model). Red points and error bars represent spatial strata for which parameter estimates were significantly different from at least one other area.

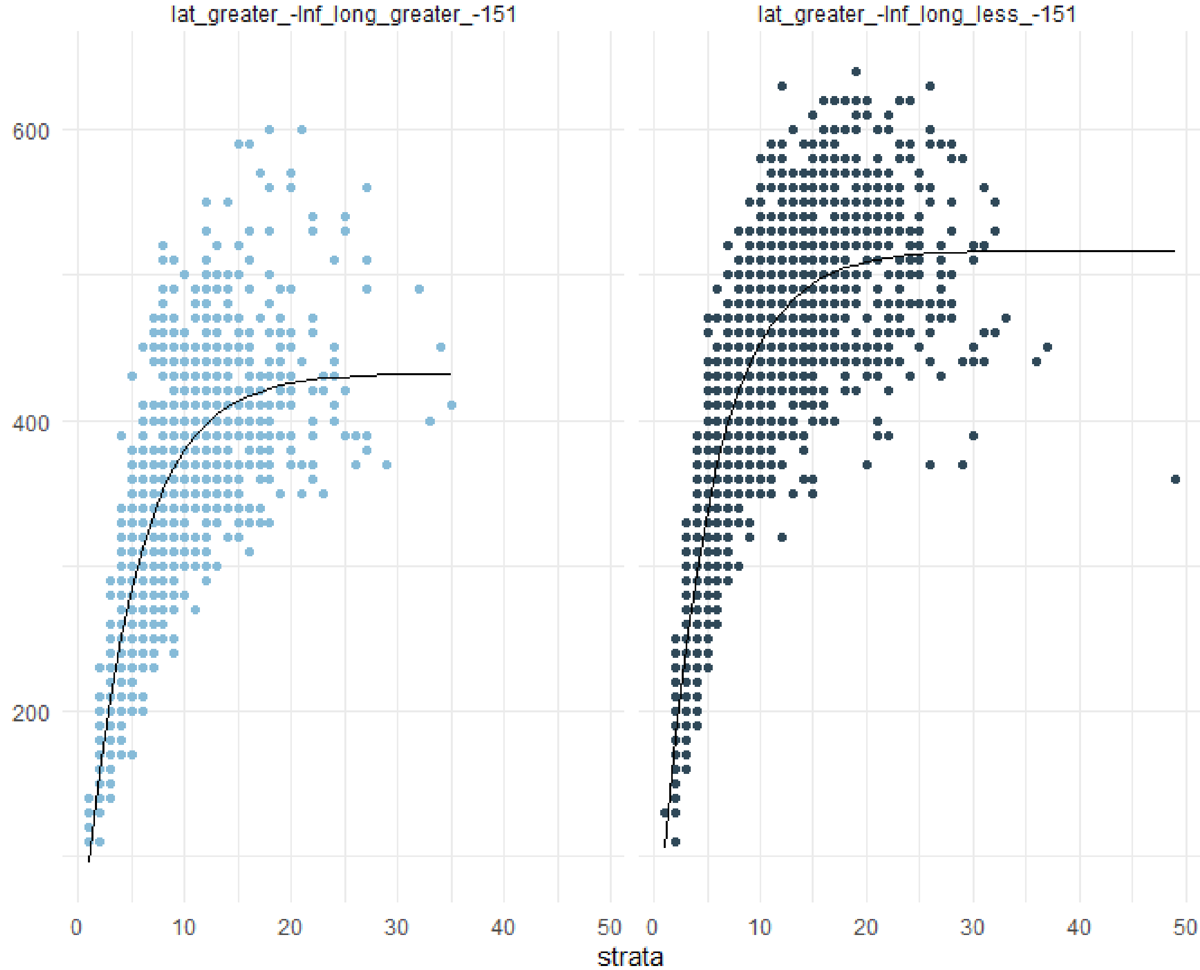

Figure 17. Estimated von Bertalanffy growth curves (solid lines) to female age-at-length data partitioned into two spatial areas (as used in the assessment model) east (left) and west (right) of 151°W.

Next steps

The authors aim to analyze double-read ages to calculate an ageing error matrix for this stock to analyze the impact of including ageing error on estimates of growth and on the model in general.

While the conditional age-at-length approach allows for estimation of growth within the stock assessment and allows uncertainty in growth to propagate through the assessment, the two-area model with internal growth estimation is a difficult setup for running MCMCs or exploring Bayesian assessment methods for this stock. However, the ADnuts package (https://github.com/Cole-Monnahan-NOAA/adnuts; Monnahan et al., 2019) may make this possible.

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Appendix E. Survey conditional age-at-length and survey and fishery composition data, GOA rex sole

Part a. GOA Bottom Trawl Survey conditional age-at-length data. "WC" is Western-Central and "E" is Eastern

Year	Fleet	Sex	Binned Length	Sample Size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1993	WC	f	13	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	WC	f	15	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	WC	f	17	5	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	WC	f	19	6	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	WC	f	21	6	0	0	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	WC	f	23	4	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	WC	f	25	4	0	0	0	0	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1993	WC	f	27	6	0	0	0	0	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	WC	f	29	10	0	0	0	2	3	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0
1993	WC	f	31	12	0	0	0	1	5	2	3	1	0	0	0	0	0	0	0	0	0	0	0	0
1993	WC	f	33	13	0	0	0	0	7	3	1	0	1	0	1	0	0	0	0	0	0	0	0	0
1993	WC	f	35	12	0	0	0	0	5	1	5	0	0	1	0	0	0	0	0	0	0	0	0	0
1993	WC	f	37	12	0	0	0	0	5	2	2	2	0	1	0	0	0	0	0	0	0	0	0	0
1993	WC	f	39	12	0	0	0	0	1	3	5	1	2	0	0	0	0	0	0	0	0	0	0	0
1993	WC	f	41	12	0	0	0	0	0	2	3	3	1	1	2	0	0	0	0	0	0	0	0	0
1993	WC	f	43	12	0	0	0	0	0	1	3	4	1	1	0	1	1	0	0	0	0	0	0	0
1993	WC	f	45	11	0	0	0	0	0	0	0	3	3	3	2	0	0	0	0	0	0	0	0	0
1993	WC	f	47	12	0	0	0	0	0	1	0	3	2	4	0	1	0	0	1	0	0	0	0	0
1993	WC	f	49	12	0	0	0	0	0	0	0	2	2	2	1	2	2	0	1	0	0	0	0	0
1993	WC	f	51	10	0	0	0	0	0	0	0	1	0	2	3	1	2	0	0	1	0	0	0	0
1993	WC	f	53	10	0	0	0	0	0	0	0	0	0	2	1	3	0	1	2	0	0	0	0	1
1993	WC	f	55	5	0	0	0	0	0	0	0	0	0	1	0	1	1	2	0	0	0	0	0	0
1993	WC	f	57	2	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
1993	WC	f	59	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1996	WC	f	11	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	WC	f	13	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	WC	f	15	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	WC	f	17	6	0	1	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	WC	f	19	6	0	2	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	WC	f	21	8	0	1	3	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	WC	f	23	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	WC	f	25	8	0	0	0	6	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	WC	f	27	9	0	0	0	4	2	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0
1996	WC	f	29	10	0	0	0	0	6	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	WC	f	31	8	0	0	0	1	2	2	2	0	1	0	0	0	0	0	0	0	0	0	0	0
1996	WC	f	33	10	0	0	0	0	1	3	1	1	4	0	0	0	0	0	0	0	0	0	0	0
1996	WC	f	35	6	0	0	0	0	0	2	1	1	0	1	1	0	0	0	0	0	0	0	0	0
1996	WC	f	37	10	0	0	0	0	0	1	0	1	4	3	1	0	0	0	0	0	0	0	0	0
1996	WC	f	39	10	0	0	0	0	0	1	1	0	0	1	4	0	0	0	0	1	1	1	0	0
1996	WC	f	41	10	0	0	0	0	0	2	2	0	2	1	0	0	0	0	0	0	1	0	1	1
1996	WC	f	43	10	0	0	0	0	0	0	0	1	1	2	2	3	0	1	0	0	0	0	0	0
1996	WC	f	45	12	0	0	0	0	0	0	0	1	0	3	0	3	3	0	1	0	0	0	1	0
1996	WC	f	47	10	0	0	0	0	0	0	0	1	0	1	1	1	0	4	1	0	1	0	0	0
1996	WC	f	49	10	0	0	0	0	0	0	0	0	1	0	3	2	1	2	1	0	0	0	0	0
1996	WC	f	51	5	0	0	0	0	0	0	0	0	0	3	1	1	0	0	0	0	0	0	0	0

Appendix E, part a , continued: Survey conditional age-at-length data, survey and fishery composition data

Year	Fleet	Sex	Binned Length	Sample Size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1996	WC	f	53	6	0	0	0	0	0	0	0	0	0	0	0	3	1	1	0	0	0	0	0	1
1996	WC	f	55	4	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	1	0	0
1996	WC	f	57	2	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
1996	WC	f	59	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0
1999	WC	f	15	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	WC	f	17	4	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	WC	f	19	7	0	2	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	WC	f	21	5	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	WC	f	23	7	0	0	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	WC	f	25	5	0	0	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	WC	f	27	8	0	0	2	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	WC	f	29	9	0	0	1	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	WC	f	31	12	0	0	1	2	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	WC	f	33	11	0	0	0	2	4	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0
1999	WC	f	35	8	0	0	0	0	1	2	1	0	1	1	1	0	0	0	0	0	0	0	0	1
1999	WC	f	37	7	0	0	0	0	1	0	1	0	0	1	0	1	0	0	0	0	0	0	0	3
1999	WC	f	39	10	0	0	0	1	0	3	1	0	0	0	1	1	0	1	1	0	0	0	0	1
1999	WC	f	41	9	0	0	0	0	1	2	0	0	1	0	2	0	1	1	0	0	0	0	0	1
1999	WC	f	43	9	0	0	0	0	1	0	0	0	3	0	2	0	1	0	0	0	0	1	0	1
1999	WC	f	45	10	0	0	0	0	0	0	2	1	0	1	0	0	1	1	1	1	1	0	0	1
1999	WC	f	47	10	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	1	0	0	0	1
1999	WC	f	49	8	0	0	0	0	0	0	0	0	1	1	1	2	2	0	0	0	0	0	0	1
1999	WC	f	51	7	0	0	0	0	0	0	0	0	2	1	0	0	2	0	0	0	1	0	0	1
1999	WC	f	53	5	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	1	0	1
1999	WC	f	55	3	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0
1999	WC	f	57	3	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0
1999	WC	f	59	4	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	1	0	0
1999	WC	f	63	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
2001	WC	f	11	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	WC	f	13	4	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	WC	f	15	7	0	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	WC	f	17	17	0	13	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	WC	f	19	17	0	6	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	WC	f	21	15	0	2	10	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	WC	f	23	14	0	3	5	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	WC	f	25	19	0	0	7	7	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	WC	f	27	18	0	0	3	7	7	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	WC	f	29	18	0	0	5	5	3	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	WC	f	31	20	0	0	1	10	5	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	WC	f	33	19	0	0	0	9	7	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2001	WC	f	35	17	0	0	0	4	3	4	1	0	2	0	1	0	0	1	0	0	0	0	0	1
2001	WC	f	37	17	0	0	0	1	7	3	2	1	3	0	0	0	0	0	0	0	0	0	0	0
2001	WC	f	39	20	0	0	0	1	3	3	2	3	1	1	0	0	2	0	0	1	0	0	0	3
2001	WC	f	41	18	0	0	0	0	1	1	3	3	2	2	2	0	0	0	1	2	0	1	0	0
2001	WC	f	43	20	0	0	0	0	0	1	1	1	5	0	0	1	1	1	0	0	0	6	0	3
2001	WC	f	45	18	0	0	0	0	0	0	3	1	1	0	1	2	3	0	1	0	0	0	2	4

Appendix E, part a , continued: Survey conditional age-at-length data, survey and fishery composition data

Year	Fleet	Sex	Binned Length	Sample Size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2001	WC	f	51	16	0	0	0	0	0	0	0	0	0	0	0	2	0	1	2	4	2	3	0	2
2001	WC	f	53	16	0	0	0	0	0	0	0	0	0	1	1	1	2	1	2	0	1	1	1	5
2001	WC	f	55	14	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2	2	2	0	1	5
2001	WC	f	57	11	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	3	1	4
2001	WC	f	59	6	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1
2001	WC	f	61	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0
2001	WC	f	63	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
2003	WC	f	13	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	WC	f	15	9	0	8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	WC	f	17	10	0	7	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	WC	f	19	10	0	4	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	WC	f	21	8	0	2	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	WC	f	23	9	0	0	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	WC	f	25	9	0	0	1	6	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	WC	f	27	9	0	0	0	4	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	WC	f	29	9	0	0	0	2	2	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	WC	f	31	10	0	0	0	3	3	1	2	0	0	0	0	1	0	0	0	0	0	0	0	0
2003	WC	f	33	10	0	0	0	1	4	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0
2003	WC	f	35	11	0	0	0	0	1	4	1	1	1	1	0	0	1	0	1	0	0	0	0	0
2003	WC	f	37	10	0	0	0	0	1	3	0	3	1	0	0	0	0	1	0	0	0	0	0	1
2003	WC	f	39	10	0	0	0	0	0	2	2	3	0	0	0	0	1	0	0	1	0	0	0	1
2003	WC	f	41	10	0	0	0	0	0	1	3	1	1	0	0	0	3	0	0	0	0	1	0	0
2003	WC	f	43	11	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0	0	1	0	1	5
2003	WC	f	45	10	0	0	0	0	0	1	0	0	1	0	1	0	0	1	1	0	2	0	0	3
2003	WC	f	47	12	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	1	2	1	5
2003	WC	f	49	10	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	3	1	3
2003	WC	f	51	9	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	1	5
2003	WC	f	53	8	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	2	2	0	2
2003	WC	f	55	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	4
2003	WC	f	57	7	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	3	1
2003	WC	f	59	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3
2003	WC	f	61	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1
2005	WC	f	11	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	WC	f	13	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	WC	f	15	5	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	WC	f	17	3	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	WC	f	19	5	0	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	WC	f	21	4	0	0	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	WC	f	23	5	0	0	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	WC	f	25	10	0	0	2	5	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	WC	f	27	11	0	0	1	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	WC	f	29	11	0	0	0	2	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	WC	f	31	12	0	0	0	2	4	3	2	0	1	0	0	0	0	0	0	0	0	0	0	0
2005	WC	f	33	12	0	0	0	1	5	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0
2005	WC	f	35	11	0	0	0	0	2	3	4	1	1	0	0	0	0	0	0	0	0	0	0	0
2005	WC	f	37	10	0	0	0	1	2	0	5	0	0	1	1	0	0	0	0	0	0	0	0	0

Appendix E, part a , continued: Survey conditional age-at-length data, survey and fishery composition data

Year	Fleet	Sex	Binned Length	Sample Size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2005	WC	f	39	12	0	0	0	0	1	1	2	4	2	0	0	2	0	0	0	0	0	0	0	0
2005	WC	f	41	11	0	0	0	0	0	2	1	0	2	2	1	0	0	0	1	1	0	0	0	1
2005	WC	f	43	11	0	0	0	0	0	0	2	1	1	0	3	0	0	0	0	1	0	0	0	3
2005	WC	f	45	10	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0	0	5
2005	WC	f	47	11	0	0	0	0	0	0	1	4	0	1	0	0	0	1	0	0	0	2	1	1
2005	WC	f	49	11	0	0	0	0	0	0	0	3	0	2	1	0	0	1	1	0	0	0	3	0
2005	WC	f	51	9	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	1	0	1	1	3
2005	WC	f	53	9	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	2	0	5
2005	WC	f	55	8	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	1	1	0	3
2005	WC	f	57	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	2
2005	WC	f	61	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
2007	WC	f	11	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	WC	f	13	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	WC	f	15	6	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	WC	f	17	5	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	WC	f	19	9	0	7	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	WC	f	21	6	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	WC	f	23	8	0	4	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	WC	f	25	7	0	0	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	WC	f	27	10	0	0	2	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	WC	f	29	10	0	0	2	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	WC	f	31	8	0	0	0	3	2	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0
2007	WC	f	33	10	0	0	0	2	2	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0
2007	WC	f	35	10	0	0	0	2	1	2	3	2	0	0	0	0	0	0	0	0	0	0	0	0
2007	WC	f	37	10	0	0	0	0	2	2	2	1	1	1	1	0	0	0	0	0	0	0	0	0
2007	WC	f	39	9	0	0	0	0	0	1	2	5	0	1	0	0	0	0	0	0	0	0	0	0
2007	WC	f	41	9	0	0	0	0	0	0	0	3	4	0	1	1	0	0	0	0	0	0	0	0
2007	WC	f	43	11	0	0	0	0	0	0	1	2	4	1	1	0	0	1	0	0	0	0	0	1
2007	WC	f	45	14	0	0	0	0	0	0	0	3	3	1	2	1	0	0	0	0	0	0	0	4
2007	WC	f	47	8	0	0	0	0	0	0	0	1	1	0	0	0	1	0	1	1	1	0	0	2
2007	WC	f	49	7	0	0	0	0	0	0	0	0	1	0	0	2	0	0	1	0	0	0	1	2
2007	WC	f	51	7	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	2	0	2
2007	WC	f	53	5	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	2
2007	WC	f	55	3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1
2009	WC	f	13	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	WC	f	15	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	WC	f	17	6	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	WC	f	19	5	0	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	WC	f	21	3	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	WC	f	23	7	0	0	1	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	WC	f	25	11	0	0	1	8	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	WC	f	27	8	0	0	2	5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	WC	f	29	11	0	0	0	7	1	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2009	WC	f	31	10	0	0	0	2	5	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	WC	f	33	10	0	0	0	1	5	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0
2009	WC	f	35	10	0	0	0	1	2	3	0	1	1	1	0	0	0	0	1	0	0	0	0	0

Appendix E, part a , continued: Survey conditional age-at-length data, survey and fishery composition data

Year	Fleet	Sex	Binned Length	Sample Size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2009	WC	f	37	10	0	0	0	0	2	4	1	0	1	2	0	0	0	0	0	0	0	0	0	0
2009	WC	f	39	11	0	0	0	0	0	2	0	3	2	3	0	0	0	0	0	0	0	0	0	1
2009	WC	f	41	10	0	0	0	0	0	3	1	2	1	1	0	1	1	0	0	0	0	0	0	0
2009	WC	f	43	10	0	0	0	0	0	2	1	1	1	1	1	1	2	0	0	0	0	0	0	0
2009	WC	f	45	11	0	0	0	0	0	0	1	4	3	0	1	2	0	0	0	0	0	0	0	0
2009	WC	f	47	9	0	0	0	0	0	0	0	2	2	0	1	1	1	0	1	0	0	1	0	0
2009	WC	f	49	10	0	0	0	0	0	0	0	0	2	2	2	0	1	0	0	1	0	0	2	0
2009	WC	f	51	8	0	0	0	0	0	0	0	1	1	0	2	2	1	0	0	0	0	1	0	0
2009	WC	f	53	4	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	1
2009	WC	f	55	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2
2009	WC	f	59	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
2011	WC	f	15	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	WC	f	17	5	0	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	WC	f	19	9	0	2	1	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	WC	f	21	7	0	2	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	WC	f	23	8	0	0	1	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	WC	f	25	9	0	0	0	8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	WC	f	27	11	0	0	1	5	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	WC	f	29	10	0	0	1	4	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	WC	f	31	9	0	0	0	2	1	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	WC	f	33	8	0	0	0	2	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	WC	f	35	9	0	0	0	2	1	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0
2011	WC	f	37	9	0	0	0	2	1	4	1	0	0	1	0	0	0	0	0	0	0	0	0	0
2011	WC	f	39	11	0	0	0	0	1	4	1	3	1	0	1	0	0	0	0	0	0	0	0	0
2011	WC	f	41	8	0	0	0	0	0	2	1	3	1	1	0	0	0	0	0	0	0	0	0	0
2011	WC	f	43	10	0	0	0	0	0	1	2	0	1	1	2	1	0	1	0	0	0	0	0	1
2011	WC	f	45	10	0	0	0	0	0	0	0	3	0	3	1	2	0	0	1	0	0	0	0	0
2011	WC	f	47	10	0	0	0	0	0	0	0	2	2	1	2	1	0	1	0	0	0	0	0	1
2011	WC	f	49	10	0	0	0	0	0	0	0	3	0	0	2	3	0	2	0	0	0	0	0	0
2011	WC	f	51	12	0	0	0	0	0	0	0	1	0	0	1	1	1	0	0	1	1	2	0	4
2011	WC	f	53	8	0	0	0	0	0	0	0	1	1	1	0	2	0	1	0	0	0	0	0	2
2011	WC	f	55	5	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	2
2011	WC	f	57	5	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	1	0	0	1
2011	WC	f	59	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
2011	WC	f	61	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
2013	WC	f	15	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	WC	f	17	6	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	WC	f	19	8	0	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	WC	f	21	4	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	WC	f	23	7	0	0	5	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	WC	f	25	7	0	0	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	WC	f	27	9	0	0	1	4	2	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2013	WC	f	29	9	0	0	2	0	0	1	2	4	0	0	0	0	0	0	0	0	0	0	0	0
2013	WC	f	31	9	0	0	1	1	1	3	1	0	1	1	0	0	0	0	0	0	0	0	0	0
2013	WC	f	33	7	0	0	0	0	0	4	1	2	0	0	0	0	0	0	0	0	0	0	0	0
2013	WC	f	35	9	0	0	0	0	0	1	4	4	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E, part a , continued: Survey conditional age-at-length data, survey and fishery composition data

Year	Fleet	Sex	Binned Length	Sample Size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2013	WC	f	37	8	0	0	0	0	0	1	1	5	1	0	0	0	0	0	0	0	0	0	0	0
2013	WC	f	39	9	0	0	0	0	0	2	2	2	1	1	0	0	0	0	0	0	1	0	0	0
2013	WC	f	41	11	0	0	0	0	0	0	3	2	1	0	1	0	2	1	1	0	0	0	0	0
2013	WC	f	43	11	0	0	0	0	0	0	0	2	2	2	1	0	0	2	1	0	0	0	0	1
2013	WC	f	45	9	0	0	0	0	0	0	0	1	0	1	1	1	0	1	1	0	0	1	0	2
2013	WC	f	47	9	0	0	0	0	0	0	0	0	1	0	1	1	1	1	0	2	1	0	0	1
2013	WC	f	49	11	0	0	0	0	0	0	0	0	2	1	1	0	1	2	2	0	1	0	0	1
2013	WC	f	51	8	0	0	0	0	0	0	0	0	0	0	1	0	0	3	0	0	0	0	0	4
2013	WC	f	53	6	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	1	0	0	1
2013	WC	f	55	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3
2013	WC	f	57	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
2013	WC	f	59	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1
2015	WC	f	25	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	WC	f	27	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	WC	f	29	4	0	0	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	WC	f	31	7	0	0	1	5	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2015	WC	f	33	4	0	0	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	WC	f	35	9	0	0	0	0	3	2	1	1	0	2	0	0	0	0	0	0	0	0	0	0
2015	WC	f	37	10	0	0	0	4	2	1	0	2	1	0	0	0	0	0	0	0	0	0	0	0
2015	WC	f	39	13	0	0	0	0	1	3	3	2	0	1	1	2	0	0	0	0	0	0	0	0
2015	WC	f	41	7	0	0	0	0	0	0	2	1	4	0	0	0	0	0	0	0	0	0	0	0
2015	WC	f	43	13	0	0	0	0	0	0	2	1	3	2	1	1	0	0	2	0	0	0	0	1
2015	WC	f	45	14	0	0	0	0	0	0	1	0	0	4	2	2	0	1	1	1	0	1	0	1
2015	WC	f	47	8	0	0	0	0	0	0	0	1	2	0	0	2	3	0	0	0	0	0	0	0
2015	WC	f	49	8	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	1	4	0	0	0
2015	WC	f	51	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
2015	WC	f	53	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
2015	WC	f	59	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
2015	WC	f	63	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2017	WC	f	13	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	WC	f	15	5	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	WC	f	17	5	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	WC	f	19	8	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	WC	f	21	11	0	7	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	WC	f	23	5	0	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	WC	f	25	6	0	3	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	WC	f	27	3	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	WC	f	29	5	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	WC	f	31	5	0	0	0	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	WC	f	33	10	0	0	0	2	3	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0
2017	WC	f	35	10	0	0	0	2	2	3	0	2	0	1	0	0	0	0	0	0	0	0	0	0
2017	WC	f	37	14	0	0	0	0	4	5	2	0	2	0	1	0	0	0	0	0	0	0	0	0
2017	WC	f	39	23	0	0	0	0	2	7	2	4	1	1	3	2	0	0	1	0	0	0	0	0
2017	WC	f	41	34	0	0	0	0	0	5	5	3	7	2	4	2	2	2	0	1	0	0	0	1
2017	WC	f	43	22	0	0	0	0	0	1	3	4	2	1	4	2	1	0	3	0	0	0	0	1
2017	WC	f	45	23	0	0	0	0	0	0	1	2	4	3	4	3	2	2	0	1	0	0	1	0

Appendix E, part a , continued: Survey conditional age-at-length data, survey and fishery composition data

Year	Fleet	Sex	Binned Length	Sample Size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2017	WC	f	47	16	0	0	0	0	0	0	1	2	0	3	3	2	1	0	1	1	1	0	0	1
2017	WC	f	49	12	0	0	0	0	0	0	0	0	1	2	2	0	1	2	1	1	0	0	0	2
2017	WC	f	51	7	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	1	0	3
2017	WC	f	53	4	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	2
2017	WC	f	55	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
2017	WC	f	57	3	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0
2017	WC	f	59	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
2019	WC	f	17	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	WC	f	19	7	0	1	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	WC	f	21	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	WC	f	23	7	0	2	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	WC	f	25	13	0	1	5	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	WC	f	27	21	0	0	8	12	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	WC	f	29	24	0	0	8	12	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	WC	f	31	23	0	0	2	16	3	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2019	WC	f	33	19	0	0	1	12	2	0	0	1	1	1	0	1	0	0	0	0	0	0	0	0
2019	WC	f	35	21	0	0	0	14	2	1	0	2	0	1	1	0	0	0	0	0	0	0	0	0
2019	WC	f	37	18	0	0	0	3	2	3	3	2	0	1	1	1	0	0	1	0	0	0	0	1
2019	WC	f	39	14	0	0	0	1	1	3	1	2	3	1	0	2	0	0	0	0	0	0	0	0
2019	WC	f	41	26	0	0	0	0	0	3	4	5	1	0	3	3	3	1	1	0	1	0	1	0
2019	WC	f	43	21	0	0	0	0	0	0	4	1	1	4	3	2	1	0	0	0	0	0	2	3
2019	WC	f	45	19	0	0	0	0	0	0	1	2	0	4	3	3	1	1	0	1	1	0	0	2
2019	WC	f	47	18	0	0	0	0	0	0	2	1	1	2	1	1	1	1	2	1	1	0	0	4
2019	WC	f	49	10	0	0	0	0	0	0	0	1	1	0	1	3	0	0	1	0	0	0	0	3
2019	WC	f	51	5	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	1
2019	WC	f	55	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0
2019	WC	f	59	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
2021	WC	f	19	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2021	WC	f	21	3	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2021	WC	f	25	3	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2021	WC	f	27	4	0	0	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2021	WC	f	29	10	0	0	1	4	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2021	WC	f	31	23	0	0	0	7	8	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2021	WC	f	33	21	0	0	0	5	11	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2021	WC	f	35	37	0	0	0	3	8	17	4	0	2	2	1	0	0	0	0	0	0	0	0	0
2021	WC	f	37	40	0	0	0	1	11	12	5	2	3	1	1	2	1	0	0	0	0	0	1	0
2021	WC	f	39	29	0	0	0	0	4	13	2	3	1	1	0	1	1	0	0	0	1	0	0	2
2021	WC	f	41	31	0	0	0	0	1	8	5	1	1	1	3	2	2	3	1	0	0	1	2	0
2021	WC	f	43	36	0	0	0	0	0	2	1	4	4	2	2	6	3	3	2	2	1	1	0	3
2021	WC	f	45	24	0	0	0	0	0	0	2	0	2	3	2	4	2	2	3	1	2	0	0	1
2021	WC	f	47	11	0	0	0	0	0	0	0	0	0	1	1	1	2	3	0	1	1	0	0	1
2021	WC	f	49	11	0	0	0	0	0	0	0	0	0	1	0	0	4	0	2	0	2	1	0	1
2021	WC	f	53	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
2021	WC	f	55	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
2021	WC	f	59	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
2023	WC	f	19	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E, part a , continued: Survey conditional age-at-length data, survey and fishery composition data

Year	Fleet	Sex	Binned Length	Sample Size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2023	WC	f	21	3	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2023	WC	f	25	7	0	0	1	2	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2023	WC	f	27	7	0	0	2	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2023	WC	f	29	6	0	0	0	2	2	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2023	WC	f	31	9	0	0	0	2	2	1	2	1	1	0	0	0	0	0	0	0	0	0	0	0
2023	WC	f	33	22	0	0	0	4	2	9	3	2	2	0	0	0	0	0	0	0	0	0	0	0
2023	WC	f	35	22	0	0	0	3	2	5	4	5	3	0	0	0	0	0	0	0	0	0	0	0
2023	WC	f	37	28	0	0	0	0	4	7	10	4	1	1	1	0	0	0	0	0	0	0	0	0
2023	WC	f	39	38	0	0	0	0	2	4	16	5	6	1	0	2	0	0	0	0	0	1	0	1
2023	WC	f	41	42	0	0	0	0	1	8	7	10	1	4	0	5	3	0	0	1	0	1	0	1
2023	WC	f	43	28	0	0	0	0	0	7	6	2	4	0	2	1	1	1	1	2	0	0	0	1
2023	WC	f	45	22	0	0	0	0	0	1	2	4	2	1	2	2	0	4	2	0	1	1	0	0
2023	WC	f	47	10	0	0	0	0	0	0	0	3	1	0	1	1	1	0	0	0	0	0	1	2
2023	WC	f	49	7	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	2	0	2
2023	WC	f	51	4	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	2	0	0	0	0
2023	WC	f	53	2	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
2023	WC	f	55	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
1993	WC	m	13	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	WC	m	15	3	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	WC	m	17	6	0	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	WC	m	19	5	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	WC	m	21	4	0	0	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	WC	m	23	6	0	0	1	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	WC	m	25	7	0	0	0	2	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	WC	m	27	8	0	0	0	2	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	WC	m	29	10	0	0	0	3	4	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1993	WC	m	31	11	0	0	0	1	5	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	WC	m	33	12	0	0	0	0	6	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0
1993	WC	m	35	11	0	0	0	0	1	6	2	1	1	0	0	0	0	0	0	0	0	0	0	0
1993	WC	m	37	12	0	0	0	0	1	1	3	1	2	1	2	0	0	1	0	0	0	0	0	0
1993	WC	m	39	12	0	0	0	0	0	2	2	0	2	3	3	0	0	0	0	0	0	0	0	0
1993	WC	m	41	13	0	0	0	0	1	1	2	3	2	2	0	1	0	0	1	0	0	0	0	0
1993	WC	m	43	9	0	0	0	0	0	1	1	1	2	4	0	0	0	0	0	0	0	0	0	0
1993	WC	m	45	8	0	0	0	0	0	1	0	2	2	0	1	1	1	0	0	0	0	0	0	0
1993	WC	m	47	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1996	WC	m	13	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	WC	m	15	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	WC	m	17	5	0	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	WC	m	19	8	0	0	5	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	WC	m	21	5	0	0	3	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	WC	m	23	4	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	WC	m	25	10	0	0	2	2	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	WC	m	27	4	0	0	1	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	WC	m	29	9	0	0	0	2	4	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	WC	m	31	13	0	0	0	1	4	1	3	4	0	0	0	0	0	0	0	0	0	0	0	0
1996	WC	m	33	9	0	0	0	0	3	4	0	0	2	0	0	0	0	0	0	0	0	0	0	0

Appendix E, part a , continued: Survey conditional age-at-length data, survey and fishery composition data

Year	Fleet	Sex	Binned Length	Sample Size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1996	WC	m	35	11	0	0	0	0	1	1	0	1	3	2	1	1	1	0	0	0	0	0	0	0
1996	WC	m	37	12	0	0	0	0	1	0	2	0	4	0	3	1	0	0	1	0	0	0	0	0
1996	WC	m	39	12	0	0	0	0	0	0	3	3	3	1	1	0	1	0	0	0	0	0	0	0
1996	WC	m	41	10	0	0	0	0	0	0	1	0	2	4	2	1	0	0	0	0	0	0	0	0
1996	WC	m	43	7	0	0	0	0	0	0	0	0	1	0	1	2	1	1	0	0	0	0	0	1
1996	WC	m	45	5	0	0	0	0	0	0	0	0	0	0	2	1	1	0	1	0	0	0	0	0
1996	WC	m	47	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1996	WC	m	55	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
1999	WC	m	13	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	WC	m	17	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	WC	m	19	5	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	WC	m	21	11	0	2	6	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	WC	m	23	10	0	0	7	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	WC	m	25	8	0	0	3	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	WC	m	27	8	0	0	2	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	WC	m	29	12	0	0	1	5	5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	WC	m	31	8	0	0	0	1	4	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0
1999	WC	m	33	11	0	0	0	1	5	1	0	0	3	0	0	0	0	0	0	0	0	0	0	1
1999	WC	m	35	10	0	0	0	1	0	0	3	1	0	1	0	2	0	0	0	0	1	0	1	0
1999	WC	m	37	9	0	0	0	0	0	1	1	0	1	0	0	0	1	0	1	0	3	0	0	1
1999	WC	m	39	10	0	0	0	0	0	1	0	0	0	1	1	1	2	1	0	0	1	0	0	2
1999	WC	m	41	8	0	0	0	0	0	0	0	0	0	4	2	0	0	0	1	0	0	0	1	0
1999	WC	m	43	4	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	1
1999	WC	m	45	6	0	0	0	0	0	0	0	1	1	2	0	0	1	0	0	1	0	0	0	0
1999	WC	m	47	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
1999	WC	m	49	2	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
1999	WC	m	51	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1999	WC	m	53	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
2001	WC	m	9	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	WC	m	13	5	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	WC	m	15	11	0	8	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	WC	m	17	15	0	11	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	WC	m	19	17	0	9	5	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	WC	m	21	19	0	4	9	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	WC	m	23	14	0	0	5	6	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	WC	m	25	17	0	0	6	9	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	WC	m	27	19	0	0	2	9	3	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	WC	m	29	18	0	0	2	7	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	WC	m	31	18	0	0	2	10	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	WC	m	33	19	0	0	0	8	6	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	WC	m	35	20	0	0	0	5	4	6	1	1	0	1	0	1	1	0	0	0	0	0	0	0
2001	WC	m	37	18	0	0	0	3	5	1	1	1	1	1	2	0	1	0	0	0	1	0	0	1
2001	WC	m	39	17	0	0	0	0	0	3	1	2	1	0	1	1	0	3	0	1	0	0	1	3
2001	WC	m	41	18	0	0	0	0	0	0	3	0	1	1	0	2	0	1	0	1	0	1	0	8
2001	WC	m	43	18	0	0	0	0	0	0	0	1	0	0	2	2	0	2	2	0	1	0	1	7
2001	WC	m	45	11	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	2	0	1	0	6

Appendix E, part a , continued: Survey conditional age-at-length data, survey and fishery composition data

Year	Fleet	Sex	Binned Length	Sample Size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2001	WC	m	47	6	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	1	0	0	2
2001	WC	m	49	3	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1
2003	WC	m	13	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	WC	m	15	6	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	WC	m	17	8	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	WC	m	19	10	0	2	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	WC	m	21	9	0	0	3	5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	WC	m	23	10	0	0	5	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	WC	m	25	10	0	0	3	2	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	WC	m	27	12	0	0	0	1	5	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	WC	m	29	11	0	0	1	2	4	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	WC	m	31	10	0	0	0	1	3	4	0	0	1	0	1	0	0	0	0	0	0	0	0	0
2003	WC	m	33	10	0	0	0	1	1	5	2	0	0	0	1	0	0	0	0	0	0	0	0	0
2003	WC	m	35	10	0	0	0	0	1	2	3	0	2	1	0	1	0	0	0	0	0	0	0	0
2003	WC	m	37	10	0	0	0	0	1	4	3	1	0	0	0	0	0	0	0	0	0	0	0	1
2003	WC	m	39	9	0	0	0	0	0	0	2	0	1	2	0	0	0	0	0	1	1	0	0	2
2003	WC	m	41	9	0	0	0	0	0	1	1	0	0	1	0	0	1	0	0	0	0	0	1	4
2003	WC	m	43	9	0	0	0	0	0	0	0	1	1	0	1	0	1	1	0	0	0	1	0	3
2003	WC	m	45	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	3
2003	WC	m	47	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	3	0	0
2003	WC	m	49	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
2003	WC	m	53	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
2005	WC	m	11	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	WC	m	13	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	WC	m	15	5	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	WC	m	17	5	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	WC	m	19	8	0	3	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	WC	m	21	9	0	1	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	WC	m	23	10	0	0	3	5	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	WC	m	25	12	0	1	2	6	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	WC	m	27	11	0	0	0	4	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	WC	m	29	13	0	0	1	1	9	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	WC	m	31	13	0	0	0	4	3	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	WC	m	33	11	0	0	0	2	1	4	1	2	1	0	0	0	0	0	0	0	0	0	0	0
2005	WC	m	35	10	0	0	0	1	0	5	2	0	0	1	0	0	0	0	0	0	0	0	0	1
2005	WC	m	37	12	0	0	0	0	2	2	2	2	0	1	1	0	0	0	0	1	0	0	0	1
2005	WC	m	39	12	0	0	0	0	0	2	4	0	1	0	1	1	0	0	0	2	0	1	0	0
2005	WC	m	41	10	0	0	0	0	0	2	2	1	0	1	0	0	0	2	1	0	0	0	0	1
2005	WC	m	43	11	0	0	0	0	0	0	1	2	0	0	1	1	0	0	1	0	0	0	0	5
2005	WC	m	45	9	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	1	0	0	5
2005	WC	m	47	3	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0
2005	WC	m	49	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1
2005	WC	m	51	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
2005	WC	m	53	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
2005	WC	m	55	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2007	WC	m	13	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E, part a , continued: Survey conditional age-at-length data, survey and fishery composition data

Year	Fleet	Sex	Binned Length	Sample Size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2007	WC	m	15	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	WC	m	17	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	WC	m	19	7	0	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	WC	m	21	7	0	4	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	WC	m	23	9	0	1	5	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	WC	m	25	11	0	0	6	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	WC	m	27	11	0	0	2	8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	WC	m	29	10	0	0	1	4	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	WC	m	31	12	0	0	0	5	2	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	WC	m	33	10	0	0	0	2	2	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0
2007	WC	m	35	11	0	0	0	0	1	5	3	1	1	0	0	0	0	0	0	0	0	0	0	0
2007	WC	m	37	11	0	0	0	0	1	3	4	3	0	0	0	0	0	0	0	0	0	0	0	0
2007	WC	m	39	11	0	0	0	0	0	1	3	2	2	2	0	0	0	0	0	0	0	1	0	0
2007	WC	m	41	9	0	0	0	0	0	0	0	1	4	0	0	0	0	0	0	1	2	0	0	1
2007	WC	m	43	8	0	0	0	0	0	0	0	4	0	2	0	0	0	0	0	0	1	0	1	0
2007	WC	m	45	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3
2007	WC	m	47	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
2007	WC	m	49	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
2009	WC	m	13	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	WC	m	15	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	WC	m	17	9	0	8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	WC	m	19	3	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	WC	m	21	6	0	0	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	WC	m	23	10	0	0	2	4	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	WC	m	25	9	0	0	1	5	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	WC	m	27	9	0	0	0	6	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	WC	m	29	10	0	0	0	7	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	WC	m	31	11	0	0	0	6	1	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0
2009	WC	m	33	11	0	0	0	2	4	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0
2009	WC	m	35	11	0	0	0	1	2	5	1	2	0	0	0	0	0	0	0	0	0	0	0	0
2009	WC	m	37	10	0	0	0	0	4	4	1	0	0	1	0	0	0	0	0	0	0	0	0	0
2009	WC	m	39	11	0	0	0	0	1	0	1	3	2	3	1	0	0	0	0	0	0	0	0	0
2009	WC	m	41	11	0	0	0	0	1	1	0	1	1	3	0	1	0	0	0	0	2	0	0	1
2009	WC	m	43	8	0	0	0	0	0	0	1	1	0	0	1	0	1	0	0	1	0	0	2	1
2009	WC	m	45	6	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	1	2
2009	WC	m	47	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
2011	WC	m	13	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	WC	m	15	3	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	WC	m	17	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	WC	m	19	10	0	2	3	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	WC	m	21	8	0	3	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	WC	m	23	8	0	0	2	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	WC	m	25	9	0	0	1	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	WC	m	27	10	0	0	0	5	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	WC	m	29	9	0	0	1	2	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	WC	m	31	10	0	0	0	3	1	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E, part a , continued: Survey conditional age-at-length data, survey and fishery composition data

Year	Fleet	Sex	Binned Length	Sample Size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2011	WC	m	33	12	0	0	0	1	1	5	1	4	0	0	0	0	0	0	0	0	0	0	0	0
2011	WC	m	35	10	0	0	0	1	1	3	2	1	0	1	0	0	0	0	0	0	0	0	0	1
2011	WC	m	37	11	0	0	0	0	0	1	2	2	2	2	0	2	0	0	0	0	0	0	0	0
2011	WC	m	39	9	0	0	0	0	0	0	2	1	1	0	3	0	0	0	0	1	0	0	0	1
2011	WC	m	41	10	0	0	0	0	0	0	1	2	1	2	1	1	0	0	1	0	0	0	0	1
2011	WC	m	43	9	0	0	0	0	0	0	1	0	0	0	1	1	2	1	0	0	0	0	1	2
2011	WC	m	45	7	0	0	0	0	0	0	0	0	0	0	1	0	2	1	0	1	1	0	0	1
2011	WC	m	47	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
2011	WC	m	49	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2013	WC	m	13	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	WC	m	15	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	WC	m	17	3	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	WC	m	19	7	0	1	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	WC	m	21	3	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	WC	m	23	6	0	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	WC	m	25	6	0	0	0	3	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2013	WC	m	27	8	0	0	1	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	WC	m	29	8	0	0	1	1	1	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0
2013	WC	m	31	10	0	0	0	0	2	5	1	2	0	0	0	0	0	0	0	0	0	0	0	0
2013	WC	m	33	11	0	0	0	0	1	4	2	2	1	1	0	0	0	0	0	0	0	0	0	0
2013	WC	m	35	11	0	0	0	0	0	4	2	1	2	1	0	1	0	0	0	0	0	0	0	0
2013	WC	m	37	12	0	0	0	0	1	2	2	1	2	0	1	0	0	1	1	0	0	0	0	1
2013	WC	m	39	10	0	0	0	0	0	1	1	2	0	1	0	0	3	1	0	0	1	0	0	0
2013	WC	m	41	10	0	0	0	0	0	1	0	1	0	0	0	1	3	1	0	3	0	0	0	0
2013	WC	m	43	9	0	0	0	0	0	0	0	1	0	0	1	0	1	1	1	0	0	0	1	3
2013	WC	m	45	7	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	5
2013	WC	m	47	4	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	2
2013	WC	m	49	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
2015	WC	m	29	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	WC	m	31	4	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	WC	m	33	16	0	0	0	1	8	3	0	0	1	2	0	0	0	0	0	1	0	0	0	0
2015	WC	m	35	6	0	0	0	0	1	0	0	1	2	0	1	0	1	0	0	0	0	0	0	0
2015	WC	m	37	13	0	0	0	0	1	0	2	0	2	3	1	0	1	0	0	1	0	1	0	1
2015	WC	m	39	14	0	0	0	0	0	0	1	2	1	2	2	1	2	0	2	0	0	0	0	1
2015	WC	m	41	11	0	0	0	0	0	0	1	1	0	1	1	0	1	3	0	0	0	0	1	2
2015	WC	m	43	9	0	0	0	0	0	0	0	0	0	1	1	0	0	1	2	0	0	2	2	0
2015	WC	m	45	6	0	0	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0	0	2
2015	WC	m	47	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
2017	WC	m	13	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	WC	m	15	4	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	WC	m	17	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	WC	m	19	5	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	WC	m	21	8	0	3	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	WC	m	23	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	WC	m	25	3	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	WC	m	27	3	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E, part a , continued: Survey conditional age-at-length data, survey and fishery composition data

Year	Fleet	Sex	Binned Length	Sample Size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2017	WC	m	29	4	0	0	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	WC	m	31	7	0	0	0	3	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	WC	m	33	12	0	0	1	1	3	3	3	1	0	0	0	0	0	0	0	0	0	0	0	0
2017	WC	m	35	20	0	0	0	1	0	4	2	6	3	2	0	1	1	0	0	0	0	0	0	0
2017	WC	m	37	18	0	0	0	0	1	1	2	4	3	1	2	1	0	0	2	0	1	0	0	0
2017	WC	m	39	24	0	0	0	0	0	1	3	0	2	5	5	3	0	1	1	0	1	1	0	1
2017	WC	m	41	29	0	0	0	0	0	0	1	4	7	4	2	3	3	0	1	2	0	0	0	2
2017	WC	m	43	17	0	0	0	0	0	0	0	1	1	2	0	4	4	1	2	0	0	1	0	1
2017	WC	m	45	3	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0
2017	WC	m	47	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2019	WC	m	19	11	0	3	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	WC	m	21	13	0	4	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	WC	m	23	10	0	2	2	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	WC	m	25	11	0	0	3	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	WC	m	27	12	0	0	5	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	WC	m	29	14	0	0	4	8	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	WC	m	31	25	0	0	4	17	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2019	WC	m	33	17	0	0	0	7	2	3	3	2	0	0	0	0	0	0	0	0	0	0	0	0
2019	WC	m	35	15	0	0	0	4	4	4	1	1	1	0	0	0	0	0	0	0	0	0	0	0
2019	WC	m	37	19	0	0	0	0	0	3	5	1	1	4	0	2	1	2	0	0	0	0	0	0
2019	WC	m	39	13	0	0	0	0	0	0	0	3	1	1	1	5	0	1	1	0	0	0	0	0
2019	WC	m	41	21	0	0	0	0	0	0	1	0	2	0	6	4	2	0	0	0	1	1	1	3
2019	WC	m	43	10	0	0	0	0	0	0	0	0	1	0	1	2	1	1	0	0	0	1	0	3
2019	WC	m	45	6	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	1	1
2019	WC	m	47	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2021	WC	m	19	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2021	WC	m	21	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2021	WC	m	23	5	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2021	WC	m	25	8	0	0	3	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2021	WC	m	27	15	0	0	1	4	5	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2021	WC	m	29	15	0	0	0	6	3	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2021	WC	m	31	35	0	0	0	7	14	10	3	1	0	0	0	0	0	0	0	0	0	0	0	0
2021	WC	m	33	29	0	0	0	3	7	13	3	2	1	0	0	0	0	0	0	0	0	0	0	0
2021	WC	m	35	26	0	0	0	3	5	12	0	1	2	1	2	0	0	0	0	0	0	0	0	0
2021	WC	m	37	28	0	0	0	0	2	7	2	1	3	6	2	0	1	2	0	0	0	0	1	1
2021	WC	m	39	15	0	0	0	0	0	1	2	1	2	0	1	0	3	1	0	0	0	2	0	2
2021	WC	m	41	24	0	0	0	0	1	2	0	1	3	1	2	2	1	4	3	2	0	0	0	2
2021	WC	m	43	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
2021	WC	m	45	3	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1
2021	WC	m	47	2	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
2021	WC	m	53	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2023	WC	m	17	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2023	WC	m	19	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2023	WC	m	21	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2023	WC	m	23	4	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2023	WC	m	25	7	0	0	1	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E, part a , continued: Survey conditional age-at-length data, survey and fishery composition data

Year	Fleet	Sex	Binned Length	Sample Size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2023	WC	m	27	7	0	0	1	3	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2023	WC	m	29	11	0	0	0	5	0	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0
2023	WC	m	31	13	0	0	0	1	2	4	2	4	0	0	0	0	0	0	0	0	0	0	0	0
2023	WC	m	33	33	0	0	0	6	4	10	8	3	2	0	0	0	0	0	0	0	0	0	0	0
2023	WC	m	35	40	0	0	0	2	0	7	15	8	1	2	3	0	2	0	0	0	0	0	0	0
2023	WC	m	37	29	0	0	0	0	3	6	6	6	1	0	3	0	2	0	0	2	0	0	0	0
2023	WC	m	39	22	0	0	0	0	1	3	2	4	1	0	3	2	2	1	0	0	0	0	0	3
2023	WC	m	41	20	0	0	0	0	0	2	2	2	0	0	1	1	1	2	1	1	0	3	0	4
2023	WC	m	43	11	0	0	0	0	0	0	0	0	0	0	1	0	1	3	0	0	2	2	0	2
2023	WC	m	45	7	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	1	1	2
1993	E	f	11	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	E	f	11	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	E	f	13	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	E	f	15	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	E	f	17	3	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	E	f	19	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	E	f	21	3	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	E	f	23	3	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	E	f	25	2	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	E	f	27	2	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
1996	E	f	29	2	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1996	E	f	31	2	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
1996	E	f	33	2	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	E	f	35	2	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
1996	E	f	37	3	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0
1996	E	f	39	3	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0
1996	E	f	41	3	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0
1996	E	f	43	2	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0
1996	E	f	45	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0
1996	E	f	47	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
1996	E	f	51	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1996	E	f	53	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
1999	E	f	15	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	E	f	19	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	E	f	21	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	E	f	23	4	0	0	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	E	f	25	3	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	E	f	27	5	0	0	0	3	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	E	f	29	4	0	0	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	E	f	31	3	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
1999	E	f	33	2	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
1999	E	f	35	4	0	0	0	0	0	0	1	1	0	1	0	1	0	0	0	0	0	0	0	0
1999	E	f	37	4	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
1999	E	f	39	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
1999	E	f	41	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
2003	E	f	13	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E, part a , continued: Survey conditional age-at-length data, survey and fishery composition data

Year	Fleet	Sex	Binned Length	Sample Size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2003	E	f	15	4	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	E	f	17	9	0	1	6	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	E	f	19	7	0	0	4	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	E	f	21	7	0	1	2	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	E	f	23	7	0	0	0	1	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	E	f	25	8	0	0	1	1	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	E	f	27	7	0	0	0	1	2	1	2	0	0	1	0	0	0	0	0	0	0	0	0	0
2003	E	f	29	8	0	0	0	0	2	1	2	2	0	0	0	0	1	0	0	0	0	0	0	0
2003	E	f	31	8	0	0	0	0	1	2	1	0	1	0	0	2	0	0	1	0	0	0	0	0
2003	E	f	33	8	0	0	0	0	0	2	1	0	1	0	0	1	0	0	0	2	1	0	0	0
2003	E	f	35	8	0	0	0	0	0	2	1	0	1	0	2	1	0	0	0	0	0	0	0	1
2003	E	f	37	7	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	1	0	3
2003	E	f	39	7	0	0	0	0	0	0	0	1	0	1	0	0	1	0	1	0	0	2	0	1
2003	E	f	41	7	0	0	0	0	0	0	0	0	2	3	0	0	1	0	0	1	0	0	0	0
2003	E	f	43	4	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	1
2003	E	f	45	3	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1
2005	E	f	17	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	E	f	19	6	0	2	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	E	f	21	7	0	0	5	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	E	f	23	8	0	0	2	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	E	f	25	8	0	0	1	0	2	3	0	1	1	0	0	0	0	0	0	0	0	0	0	0
2005	E	f	27	9	0	0	0	2	2	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0
2005	E	f	29	8	0	0	1	0	2	1	1	1	2	0	0	0	0	0	0	0	0	0	0	0
2005	E	f	31	9	0	0	0	0	2	1	1	1	2	1	0	0	0	1	0	0	0	0	0	0
2005	E	f	33	8	0	0	0	0	0	1	2	1	2	0	0	0	2	0	0	0	0	0	0	0
2005	E	f	35	8	0	0	0	0	1	0	0	3	0	0	1	0	1	0	1	0	1	0	0	0
2005	E	f	37	8	0	0	0	0	0	1	1	0	0	3	0	0	0	1	1	1	0	0	0	0
2005	E	f	39	8	0	0	0	0	0	0	0	2	0	1	0	1	1	1	0	0	0	0	1	1
2005	E	f	41	7	0	0	0	0	0	0	0	0	0	1	0	0	1	2	0	0	0	1	0	2
2005	E	f	43	5	0	0	0	0	0	0	0	1	1	1	0	0	0	0	1	0	0	0	0	1
2005	E	f	45	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
2005	E	f	55	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2007	E	f	23	3	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	E	f	25	4	0	0	0	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	E	f	27	3	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	E	f	29	8	0	0	0	1	3	1	0	2	1	0	0	0	0	0	0	0	0	0	0	0
2007	E	f	31	8	0	0	0	0	2	0	2	1	2	0	1	0	0	0	0	0	0	0	0	0
2007	E	f	33	9	0	0	0	0	1	0	2	0	3	2	0	1	0	0	0	0	0	0	0	0
2007	E	f	35	8	0	0	0	0	1	0	0	0	1	1	0	1	0	0	1	0	1	1	0	1
2007	E	f	37	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
2009	E	f	13	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	E	f	15	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	E	f	17	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	E	f	19	5	0	1	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	E	f	21	5	0	1	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	E	f	23	6	0	0	0	2	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E, part a , continued: Survey conditional age-at-length data, survey and fishery composition data

Year	Fleet	Sex	Binned Length	Sample Size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2009	E	f	25	4	0	0	0	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	E	f	27	7	0	0	0	0	2	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	E	f	29	9	0	0	0	0	2	4	0	0	1	1	0	1	0	0	0	0	0	0	0	0
2009	E	f	31	6	0	0	0	0	0	1	1	2	0	0	1	1	0	0	0	0	0	0	0	0
2009	E	f	33	7	0	0	0	0	0	0	1	2	1	0	1	0	2	0	0	0	0	0	0	0
2009	E	f	35	8	0	0	0	0	0	0	2	0	1	2	0	2	0	1	0	0	0	0	0	0
2009	E	f	37	7	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0	1	0	0	2
2009	E	f	39	6	0	0	0	0	0	0	0	2	0	1	0	1	1	0	0	0	0	0	0	1
2009	E	f	41	6	0	0	0	0	0	0	0	0	1	2	0	0	0	1	0	0	0	0	1	1
2009	E	f	43	3	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0
2009	E	f	45	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2011	E	f	15	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	E	f	17	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	E	f	19	6	0	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	E	f	21	4	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	E	f	23	8	0	0	2	2	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	E	f	25	6	0	0	0	1	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	E	f	27	10	0	0	0	0	2	3	3	1	1	0	0	0	0	0	0	0	0	0	0	0
2011	E	f	29	8	0	0	0	0	0	3	3	1	1	0	0	0	0	0	0	0	0	0	0	0
2011	E	f	31	8	0	0	0	0	1	1	4	0	1	0	0	0	0	0	1	0	0	0	0	0
2011	E	f	33	8	0	0	0	0	3	0	1	1	1	0	0	0	0	1	0	0	0	1	0	0
2011	E	f	35	9	0	0	0	0	0	0	2	3	0	1	1	0	1	0	0	0	0	0	0	1
2011	E	f	37	7	0	0	0	0	0	0	1	2	0	1	0	0	0	0	0	1	1	0	0	1
2011	E	f	39	3	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1
2011	E	f	41	5	0	0	0	0	0	0	1	0	1	1	0	0	1	1	0	0	0	0	0	0
2011	E	f	43	3	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0
2011	E	f	49	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2013	E	f	13	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	E	f	17	3	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	E	f	19	3	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	E	f	21	6	0	0	1	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	E	f	23	8	0	0	0	2	4	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
2013	E	f	25	8	0	0	0	0	3	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0
2013	E	f	27	8	0	0	0	1	2	3	0	1	1	0	0	0	0	0	0	0	0	0	0	0
2013	E	f	29	8	0	0	0	0	0	1	0	2	1	1	1	2	0	0	0	0	0	0	0	0
2013	E	f	31	8	0	0	0	0	0	2	0	3	1	0	2	0	0	0	0	0	0	0	0	0
2013	E	f	33	7	0	0	0	0	0	1	0	1	1	2	1	0	0	0	0	1	0	0	0	0
2013	E	f	35	8	0	0	0	0	0	0	1	1	1	1	2	0	0	1	0	0	0	0	0	1
2013	E	f	37	7	0	0	0	0	0	0	0	1	1	1	2	0	0	1	0	1	0	0	0	0
2013	E	f	39	8	0	0	0	0	0	0	0	0	2	1	0	2	0	1	0	0	0	0	0	2
2013	E	f	41	7	0	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0	0	0	3
2013	E	f	43	6	0	0	0	0	0	0	1	1	0	0	1	0	0	0	1	1	0	1	0	0
2013	E	f	47	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
2013	E	f	49	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2015	E	f	23	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	E	f	25	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E, part a , continued: Survey conditional age-at-length data, survey and fishery composition data

Year	Fleet	Sex	Binned Length	Sample Size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2015	E	f	27	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	E	f	29	3	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	E	f	31	3	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	E	f	33	3	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0
2015	E	f	35	2	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2015	E	f	37	2	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2015	E	f	41	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
2015	E	f	43	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2017	E	f	17	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	E	f	19	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	E	f	21	6	0	1	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	E	f	23	4	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	E	f	25	4	0	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	E	f	27	3	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	E	f	29	6	0	0	0	1	1	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0
2017	E	f	31	6	0	0	0	0	1	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	E	f	33	11	0	0	0	0	0	1	5	2	1	2	0	0	0	0	0	0	0	0	0	0
2017	E	f	35	13	0	0	0	0	1	2	2	3	3	1	0	1	0	0	0	0	0	0	0	0
2017	E	f	37	8	0	0	0	0	1	0	3	1	0	0	2	0	0	1	0	0	0	0	0	0
2017	E	f	39	5	0	0	0	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	0	0
2017	E	f	41	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
2017	E	f	47	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
2019	E	f	13	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	E	f	15	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	E	f	17	3	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	E	f	19	4	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	E	f	21	10	0	0	1	6	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	E	f	23	5	0	0	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	E	f	25	10	0	0	1	6	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	E	f	27	8	0	0	0	4	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	E	f	29	10	0	0	0	3	3	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2019	E	f	31	12	0	0	0	1	6	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	E	f	33	17	0	0	0	1	2	6	1	4	1	1	1	0	0	0	0	0	0	0	0	0
2019	E	f	35	11	0	0	0	0	2	0	3	2	0	1	2	1	0	0	0	0	0	0	0	0
2019	E	f	37	7	0	0	0	0	0	1	0	0	1	1	0	2	1	0	0	0	1	0	0	0
2019	E	f	39	5	0	0	0	0	0	0	0	1	1	0	1	1	0	0	0	1	0	0	0	0
2019	E	f	41	3	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1
2021	E	f	19	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2021	E	f	21	5	0	1	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2021	E	f	23	5	0	0	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2021	E	f	25	7	0	0	0	2	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2021	E	f	27	9	0	0	0	2	1	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0
2021	E	f	29	21	0	0	1	0	6	6	7	1	0	0	0	0	0	0	0	0	0	0	0	0
2021	E	f	31	15	0	0	0	0	0	9	5	1	0	0	0	0	0	0	0	0	0	0	0	0
2021	E	f	33	11	0	0	0	0	0	4	4	1	0	0	0	1	0	0	0	1	0	0	0	0
2021	E	f	35	11	0	0	0	1	1	2	2	2	1	0	0	2	0	0	0	0	0	0	0	0

Appendix E, part a , continued: Survey conditional age-at-length data, survey and fishery composition data

Year	Fleet	Sex	Binned Length	Sample Size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2021	E	f	37	7	0	0	0	0	0	1	0	1	0	1	1	0	1	0	0	1	0	1	0	0
2021	E	f	39	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2021	E	f	41	2	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2023	E	f	17	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2023	E	f	19	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2023	E	f	21	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2023	E	f	23	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2023	E	f	25	4	0	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2023	E	f	27	12	0	0	3	0	3	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2023	E	f	29	13	0	0	0	0	3	4	3	3	0	0	0	0	0	0	0	0	0	0	0	0
2023	E	f	31	11	0	0	0	0	1	2	5	2	1	0	0	0	0	0	0	0	0	0	0	0
2023	E	f	33	14	0	0	0	0	2	1	2	4	2	1	0	0	0	0	0	0	1	1	0	0
2023	E	f	35	15	0	0	0	0	2	0	3	4	3	1	0	1	1	0	0	0	0	0	0	0
2023	E	f	37	10	0	0	0	0	1	0	1	1	2	0	1	1	1	1	0	0	1	0	0	0
2023	E	f	39	3	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0
2023	E	f	41	5	0	0	0	0	0	0	0	3	1	0	0	0	0	1	0	0	0	0	0	0
2023	E	f	43	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
1996	E	m	15	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	E	m	17	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	E	m	19	2	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	E	m	21	3	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	E	m	23	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	E	m	25	2	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	E	m	27	2	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	E	m	29	2	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	E	m	31	2	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0
1996	E	m	33	2	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
1996	E	m	35	2	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
1996	E	m	37	2	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
1996	E	m	39	2	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
1996	E	m	45	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
1999	E	m	17	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	E	m	19	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	E	m	21	2	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	E	m	23	5	0	0	1	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	E	m	25	4	0	0	0	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	E	m	27	5	0	0	1	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	E	m	29	4	0	0	0	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
1999	E	m	31	5	0	0	0	0	1	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0
1999	E	m	33	6	0	0	0	0	1	1	3	0	0	0	0	1	0	0	0	0	0	0	0	0
1999	E	m	35	5	0	0	0	0	1	0	0	0	0	1	0	1	0	2	0	0	0	0	0	0
1999	E	m	37	4	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0
1999	E	m	39	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
2003	E	m	11	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	E	m	13	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	E	m	15	4	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E, part a , continued: Survey conditional age-at-length data, survey and fishery composition data

Year	Fleet	Sex	Binned Length	Sample Size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2003	E	m	17	7	0	1	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	E	m	19	8	0	0	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	E	m	21	8	0	0	3	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	E	m	23	8	0	0	1	3	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	E	m	25	8	0	0	0	1	1	3	2	0	1	0	0	0	0	0	0	0	0	0	0	0
2003	E	m	27	9	0	0	0	1	1	2	1	3	1	0	0	0	0	0	0	0	0	0	0	0
2003	E	m	29	8	0	0	0	0	0	1	1	2	2	0	1	1	0	0	0	0	0	0	0	0
2003	E	m	31	8	0	0	0	0	0	1	2	1	0	1	0	0	2	1	0	0	0	0	0	0
2003	E	m	33	8	0	0	0	0	0	1	1	0	1	0	2	0	0	1	1	0	1	0	0	0
2003	E	m	35	7	0	0	0	0	0	0	1	2	0	0	1	0	1	0	0	1	0	1	0	0
2003	E	m	37	4	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	1	0	0	0
2003	E	m	39	7	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0	4
2005	E	m	13	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	E	m	15	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	E	m	17	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	E	m	19	7	0	2	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	E	m	21	9	0	0	6	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	E	m	23	8	0	0	3	2	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
2005	E	m	25	8	0	0	2	1	3	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
2005	E	m	27	8	0	0	0	0	4	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0
2005	E	m	29	8	0	0	0	0	3	2	0	1	1	0	0	0	0	1	0	0	0	0	0	0
2005	E	m	31	8	0	0	0	0	1	0	2	0	0	1	1	0	1	0	0	1	0	0	0	1
2005	E	m	33	8	0	0	0	0	1	2	0	1	0	1	0	2	0	1	0	0	0	0	0	0
2005	E	m	35	8	0	0	0	0	0	0	1	0	1	0	1	0	1	0	0	2	0	0	0	2
2005	E	m	37	7	0	0	0	0	0	0	1	0	1	1	0	0	1	0	2	0	0	0	0	1
2005	E	m	39	6	0	0	0	0	0	0	0	0	2	1	0	0	1	0	1	0	0	1	0	0
2005	E	m	41	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2
2007	E	m	23	3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	E	m	25	8	0	0	1	1	1	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0
2007	E	m	27	6	0	0	0	0	1	0	1	2	1	1	0	0	0	0	0	0	0	0	0	0
2007	E	m	29	9	0	0	0	0	0	0	2	1	5	1	0	0	0	0	0	0	0	0	0	0
2007	E	m	31	9	0	0	0	0	0	0	0	3	1	1	3	0	0	0	1	0	0	0	0	0
2007	E	m	33	9	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	1	1	0	4
2007	E	m	35	7	0	0	0	0	0	0	0	0	1	0	0	0	1	1	1	0	0	0	0	3
2007	E	m	37	4	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	2
2007	E	m	39	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
2009	E	m	17	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	E	m	19	4	0	0	2	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	E	m	21	5	0	0	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	E	m	23	6	0	0	1	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	E	m	25	8	0	0	0	2	3	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0
2009	E	m	27	8	0	0	0	0	1	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0
2009	E	m	29	8	0	0	0	0	2	1	1	2	0	2	0	0	0	0	0	0	0	0	0	0
2009	E	m	31	7	0	0	0	0	0	2	0	1	1	1	0	1	0	0	1	0	0	0	0	0
2009	E	m	33	7	0	0	0	0	0	0	0	1	0	0	3	2	1	0	0	0	0	0	0	0
2009	E	m	35	9	0	0	0	0	0	1	0	0	1	1	1	1	1	0	0	0	0	0	1	2

Appendix E, part a , continued: Survey conditional age-at-length data, survey and fishery composition data

Year	Fleet	Sex	Binned Length	Sample Size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2009	E	m	37	6	0	0	0	0	0	0	0	0	0	1	0	2	0	1	1	0	1	0	0	0
2009	E	m	39	3	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2
2009	E	m	41	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
2011	E	m	15	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	E	m	17	6	0	1	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	E	m	19	5	0	0	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	E	m	21	7	0	0	0	4	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	E	m	23	7	0	0	0	0	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	E	m	25	7	0	0	0	1	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	E	m	27	8	0	0	0	0	2	2	0	2	1	1	0	0	0	0	0	0	0	0	0	0
2011	E	m	29	8	0	0	0	0	0	3	4	0	1	0	0	0	0	0	0	0	0	0	0	0
2011	E	m	31	8	0	0	0	0	0	2	0	1	2	1	1	1	0	0	0	0	0	0	0	0
2011	E	m	33	8	0	0	0	0	0	0	3	3	0	1	0	0	0	0	1	0	0	0	0	0
2011	E	m	35	8	0	0	0	0	0	0	3	1	1	1	0	0	0	0	0	0	0	0	0	2
2011	E	m	37	7	0	0	0	0	0	1	0	1	1	0	0	0	1	0	1	1	0	0	0	1
2011	E	m	39	4	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	1
2011	E	m	41	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2013	E	m	15	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	E	m	17	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	E	m	19	4	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	E	m	21	8	0	0	2	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	E	m	23	7	0	0	0	4	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	E	m	25	8	0	0	0	2	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	E	m	27	8	0	0	0	0	1	2	1	2	0	2	0	0	0	0	0	0	0	0	0	0
2013	E	m	29	8	0	0	0	0	0	0	1	1	3	0	2	0	0	0	0	1	0	0	0	0
2013	E	m	31	9	0	0	0	0	0	1	3	0	2	2	0	0	0	0	0	0	0	0	0	1
2013	E	m	33	9	0	0	0	0	0	0	2	2	1	0	1	1	0	0	0	0	0	0	1	1
2013	E	m	35	7	0	0	0	0	0	0	1	1	0	0	1	0	1	0	0	0	1	0	0	2
2013	E	m	37	7	0	0	0	0	0	1	0	2	0	1	0	1	0	2	0	0	0	0	0	0
2013	E	m	39	5	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	2
2013	E	m	41	4	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	1
2015	E	m	29	2	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	E	m	31	4	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
2015	E	m	33	6	0	0	0	0	0	0	2	1	3	0	0	0	0	0	0	0	0	0	0	0
2015	E	m	35	3	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0
2015	E	m	39	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	E	m	13	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	E	m	15	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	E	m	19	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	E	m	21	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	E	m	23	5	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	E	m	25	6	0	0	1	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	E	m	27	4	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	E	m	29	5	0	0	0	2	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	E	m	31	16	0	0	0	0	1	8	2	4	0	0	1	0	0	0	0	0	0	0	0	0
2017	E	m	33	19	0	0	0	0	1	6	5	3	1	1	1	0	0	0	0	0	0	0	0	1

Appendix E, part a , continued: Survey conditional age-at-length data, survey and fishery composition data

Year	Fleet	Sex	Binned Length	Sample Size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2017	E	m	35	12	0	0	0	0	0	2	2	2	2	3	0	1	0	0	0	0	0	0	0	0
2017	E	m	37	8	0	0	0	0	0	0	1	1	0	2	1	0	1	0	1	1	0	0	0	0
2017	E	m	39	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2017	E	m	41	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
2019	E	m	15	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	E	m	17	4	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	E	m	19	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	E	m	21	3	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	E	m	23	8	0	1	2	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	E	m	25	10	0	0	3	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	E	m	27	9	0	0	0	2	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	E	m	29	10	0	0	0	4	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	E	m	31	12	0	0	0	1	0	2	4	1	0	1	1	2	0	0	0	0	0	0	0	0
2019	E	m	33	17	0	0	0	2	0	2	6	0	3	1	2	1	0	0	0	0	0	0	0	0
2019	E	m	35	11	0	0	0	0	0	0	4	2	0	1	0	2	0	1	0	1	0	0	0	0
2019	E	m	37	6	0	0	0	0	0	0	0	0	2	1	0	1	0	0	2	0	0	0	0	0
2019	E	m	39	4	0	0	0	0	0	0	1	0	1	0	0	0	0	0	2	0	0	0	0	0
2021	E	m	11	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2021	E	m	13	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2021	E	m	15	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2021	E	m	19	4	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2021	E	m	21	8	0	0	4	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2021	E	m	23	12	0	0	1	6	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2021	E	m	25	12	0	0	1	3	3	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2021	E	m	27	24	0	0	0	1	8	9	5	1	0	0	0	0	0	0	0	0	0	0	0	0
2021	E	m	29	26	0	0	0	2	9	9	4	2	0	0	0	0	0	0	0	0	0	0	0	0
2021	E	m	31	17	0	0	0	0	3	8	4	1	1	0	0	0	0	0	0	0	0	0	0	0
2021	E	m	33	20	0	0	0	0	0	2	4	3	4	5	1	0	0	0	0	0	0	1	0	0
2021	E	m	35	8	0	0	0	0	0	1	1	2	0	0	2	1	0	0	0	0	0	0	0	1
2021	E	m	37	4	0	0	0	0	2	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
2021	E	m	39	2	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
2023	E	m	15	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2023	E	m	17	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2023	E	m	19	3	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2023	E	m	21	5	0	0	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2023	E	m	23	9	0	0	0	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2023	E	m	25	9	0	0	0	2	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2023	E	m	27	10	0	0	0	2	2	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0
2023	E	m	29	8	0	0	0	1	2	2	2	0	1	0	0	0	0	0	0	0	0	0	0	0
2023	E	m	31	20	0	0	0	0	1	1	6	5	3	2	0	0	0	1	0	0	1	0	0	0
2023	E	m	33	14	0	0	0	0	0	3	2	3	0	0	1	1	2	2	0	0	0	0	0	0
2023	E	m	35	9	0	0	0	0	0	1	1	0	3	0	0	2	2	0	0	0	0	0	0	0
2023	E	m	37	5	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	1	0	1
2023	E	m	39	4	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	0	0	0
2025	E	f	15	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2025	E	f	19	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix E, part a , continued: Survey conditional age-at-length data, survey and fishery composition data

Year	Fleet	Sex	Binned Length	Sample Size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2025	E	f	21	3	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2025	E	f	27	4	0	0	0	1	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2025	E	f	29	6	0	0	0	0	1	1	3	1	0	0	0	0	0	0	0	0	0	0	0	0
2025	E	f	31	4	0	0	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2025	E	f	33	8	0	0	0	0	1	4	2	0	0	1	0	0	0	0	0	0	0	0	0	0
2025	E	f	35	18	0	0	0	2	4	4	3	0	2	2	0	0	0	0	0	0	0	1	0	0
2025	E	f	37	27	0	0	0	0	2	1	3	4	5	6	5	0	0	0	0	0	1	0	0	0
2025	E	f	39	36	0	0	0	0	1	4	5	9	5	5	1	0	0	0	2	0	0	1	1	2
2025	E	f	41	41	0	0	0	0	3	5	3	8	5	5	2	3	2	1	1	2	0	0	0	1
2025	E	f	43	39	0	0	0	0	1	3	4	9	6	5	4	1	0	2	0	1	1	0	1	1
2025	E	f	45	19	0	0	0	0	0	1	1	2	5	1	3	0	0	0	0	1	0	1	3	1
2025	E	f	47	15	0	0	0	0	0	2	1	1	1	0	1	1	1	1	0	1	1	2	0	2
2025	E	f	49	9	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0	6
2025	E	f	51	6	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	3	1
2025	E	f	53	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2
2025	E	f	55	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
2025	E	f	59	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
2025	E	m	21	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2025	E	m	25	3	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2025	E	m	27	2	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2025	E	m	29	7	0	0	0	1	5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2025	E	m	31	11	0	0	0	2	3	2	1	1	1	0	1	0	0	0	0	0	0	0	0	0
2025	E	m	33	13	0	0	0	0	4	2	2	0	1	2	1	0	1	0	0	0	0	0	0	0
2025	E	m	35	25	0	0	0	0	0	1	4	3	4	5	1	6	0	1	0	0	0	0	0	0
2025	E	m	37	25	0	0	0	0	1	3	4	0	1	3	5	2	1	0	1	1	1	0	2	0
2025	E	m	39	20	0	0	0	0	0	2	2	2	3	2	1	0	1	1	1	2	1	0	2	0
2025	E	m	41	18	0	0	0	0	0	0	1	1	1	1	1	4	0	0	2	0	2	0	0	5
2025	E	m	43	9	0	0	0	0	0	0	2	0	1	1	0	0	0	0	0	1	1	0	1	2
2025	E	m	45	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2025	E	m	47	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2025	E	f	21	2	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2025	E	f	23	2	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2025	E	f	25	4	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
2025	E	f	27	7	0	0	0	0	2	1	1	1	2	0	0	0	0	0	0	0	0	0	0	0
2025	E	f	29	14	0	0	1	1	1	0	3	1	2	2	1	2	0	0	0	0	0	0	0	0
2025	E	f	31	10	0	0	0	0	0	2	1	2	2	1	1	0	1	0	0	0	0	0	0	0
2025	E	f	33	10	0	0	0	0	0	2	2	1	2	1	0	0	0	0	0	1	1	0	0	0
2025	E	f	35	9	0	0	0	0	0	0	2	1	4	0	0	1	1	0	0	0	0	0	0	0
2025	E	f	37	11	0	0	0	0	0	0	1	1	2	2	1	0	0	1	0	1	2	0	0	0
2025	E	f	39	7	0	0	0	0	0	0	0	0	2	1	2	0	0	0	0	0	1	0	0	1
2025	E	f	41	4	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	1
2025	E	f	43	2	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
2025	E	f	47	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2025	E	m	21	2	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2025	E	m	23	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2025	E	m	25	4	0	0	0	0	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0

2025	E	m	27	11	0	0	0	0	0	4	4	2	1	0	0	0	0	0	0	0	0	0	0	0
2025	E	m	29	14	0	0	0	0	1	4	4	1	2	1	1	0	0	0	0	0	0	0	0	0
2025	E	m	31	17	0	0	0	0	1	2	1	4	5	1	2	0	0	0	0	0	0	1	0	0
2025	E	m	33	15	0	0	0	0	0	2	2	2	4	1	0	1	1	0	0	0	2	0	0	0
2025	E	m	35	19	0	0	0	0	0	0	1	0	2	2	4	2	2	0	1	2	2	0	1	0
2025	E	m	37	6	0	0	0	0	0	0	0	0	1	0	1	1	1	0	0	2	0	0	0	0
2025	E	m	39	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0

Appendix E, part b. Length composition data used in the GOA rex sole assessment. "WC" is Western-Central GOA, "E" is Eastern GOA

The data are in proportions that sum to 1 over females and males combined, which provides information to the model on sex ratio

S is sample size within year, which was the number of hauls with age data or length data for age or length composition. data, respectively, including females and males

In years with only port information for fishery data, the number of hauls is estimated based on historical data indicating an average of nine hauls per port delivery.

Year	Fleet	Sex	S	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65
1977	Fishery	f	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.02	0.10	0.24	0.16	0.02	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1982	Fishery	f	75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.11	0.11	0.07	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1983	Fishery	f	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.05	0.09	0.10	0.08	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1984	Fishery	f	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.03	0.05	0.04	0.06	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1990	Fishery	f	56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.04	0.06	0.06	0.06	0.05	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
1991	Fishery	f	120	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.04	0.08	0.10	0.11	0.10	0.05	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
1992	Fishery	f	161	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.06	0.10	0.12	0.09	0.05	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
1993	Fishery	f	245	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.07	0.11	0.11	0.08	0.04	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
1994	Fishery	f	225	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.04	0.08	0.10	0.09	0.08	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1996	Fishery	f	224	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.04	0.08	0.11	0.11	0.09	0.05	0.03	0.01	0.01	0.01	0.00	0.00	0.00	0.00
1997	Fishery	f	186	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.04	0.05	0.13	0.21	0.26	0.31	0.22	0.07	0.02	0.01	0.00	0.00	0.00	0.00
1998	Fishery	f	158	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.05	0.06	0.06	0.06	0.05	0.04	0.05	0.05	0.04	0.02	0.01	0.01	0.00
2000	Fishery	f	343	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.03	0.05	0.07	0.09	0.10	0.09	0.06	0.04	0.01	0.01	0.00	0.00	0.00	0.00	0.00
2001	Fishery	f	194	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.04	0.06	0.08	0.10	0.07	0.06	0.03	0.02	0.01	0.00	0.00	0.00	0.00	0.00
2002	Fishery	f	320	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.03	0.05	0.07	0.08	0.09	0.08	0.05	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00
2004	Fishery	f	62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.02	0.08	0.09	0.09	0.05	0.02	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.00
2006	Fishery	f	36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.04	0.05	0.07	0.07	0.07	0.07	0.03	0.02	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.00
2008	Fishery	f	159	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.06	0.08	0.07	0.07	0.05	0.03	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2011	Fishery	f	164	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.04	0.07	0.08	0.07	0.06	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2013	Fishery	f	277	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.05	0.14	0.17	0.22	0.12	0.07	0.02	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2025	Fishery	f	27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.04	0.15	0.20	0.17	0.07	0.04	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
2026	Fishery	f	30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.07	0.07	0.10	0.04	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1990	WC Survey	f	191	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.04	0.06	0.08	0.09	0.08	0.05	0.02	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1993	WC Survey	f	317	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.02	0.04	0.06	0.07	0.08	0.07	0.06	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1996	WC Survey	f	338	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.02	0.03	0.04	0.06	0.08	0.08	0.08	0.06	0.04	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00
1999	WC Survey	f	304	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.04	0.05	0.05	0.06	0.05	0.03	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
2001	WC Survey	f	278	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.03	0.03	0.04	0.05	0.04	0.03	0.04	0.04	0.03	0.03	0.02	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
2003	WC Survey	f	381	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.06	0.06	0.05	0.04	0.04	0.03	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2005	WC Survey	f	398	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.04	0.06	0.07	0.08	0.07	0.05	0.03	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007	WC Survey	f	403	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.04	0.05	0.06	0.07	0.05	0.04	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Appendix E, part b continued. Length composition data used in the GOA rex sole assessment

Year	Fleet	Sex	S	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65
2009	WC Survey	f	426	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.02	0.03	0.03	0.04	0.05	0.06	0.06	0.06	0.05	0.04	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2011	WC Survey	f	312	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.04	0.05	0.07	0.07	0.07	0.06	0.05	0.03	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
2013	WC Survey	f	248	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.04	0.07	0.07	0.05	0.04	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2015	WC Survey	f	375	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.03	0.04	0.04	0.06	0.07	0.07	0.05	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2017	WC Survey	f	291	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.02	0.03	0.04	0.05	0.05	0.06	0.05	0.04	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
2019	WC Survey	f	298	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.04	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2021	WC Survey	f	292	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.06	0.05	0.04	0.02	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2023	WC Survey	f	289	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.04	0.05	0.07	0.08	0.07	0.04	0.03	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2025	WC Survey	f	218	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.03	0.06	0.09	0.10	0.07	0.05	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1990	E Survey	f	46	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.04	0.09	0.09	0.08	0.04	0.04	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1993	E Survey	f	50	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.03	0.04	0.08	0.10	0.08	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1996	E Survey	f	176	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.06	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1999	E Survey	f	152	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.05	0.06	0.05	0.07	0.05	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2003	E Survey	f	134	0.00	0.00	0.01	0.00	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.06	0.06	0.05	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2005	E Survey	f	145	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.02	0.04	0.06	0.07	0.07	0.05	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007	E Survey	f	107	0.00	0.00	0.00	0.00	0.02	0.01	0.03	0.02	0.03	0.03	0.06	0.08	0.07	0.05	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2009	E Survey	f	125	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.03	0.03	0.04	0.07	0.06	0.04	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2011	E Survey	f	99	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.04	0.07	0.09	0.08	0.06	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2013	E Survey	f	89	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.04	0.05	0.07	0.09	0.07	0.04	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2015	E Survey	f	110	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.03	0.05	0.07	0.08	0.08	0.05	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2017	E Survey	f	91	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.02	0.03	0.04	0.06	0.07	0.09	0.08	0.04	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2019	E Survey	f	106	0.00	0.00	0.00	0.01	0.01	0.03	0.03	0.03	0.04	0.05	0.05	0.05	0.05	0.04	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2021	E Survey	f	106	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.02	0.04	0.05	0.07	0.07	0.06	0.04	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2023	E Survey	f	89	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.05	0.08	0.08	0.07	0.05	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2025	E Survey	f	84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.04	0.05	0.05	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1977	Fishery	m	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.16	0.08	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1982	Fishery	m	75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.10	0.19	0.16	0.07	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1983	Fishery	m	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.05	0.05	0.08	0.19	0.17	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1984	Fishery	m	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.14	0.36	0.21	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1990	Fishery	m	56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.04	0.12	0.18	0.16	0.09	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1991	Fishery	m	120	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.06	0.13	0.13	0.07	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1992	Fishery	m	161	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.06	0.10	0.13	0.08	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1993	Fishery	m	245	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.06	0.14	0.15	0.09	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Appendix E, part b continued. Length composition data used in the GOA rex sole assessment

Year	Fleet	Sex	S	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65
1994	Fishery	m	225	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.07	0.13	0.13	0.07	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1996	Fishery	m	224	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.04	0.08	0.10	0.10	0.05	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1997	Fishery	m	186	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.03	0.05	0.10	0.13	0.12	0.10	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1998	Fishery	m	158	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.05	0.05	0.05	0.03	0.03	0.04	0.06	0.06	0.02	0.01	0.00	0.00	0.00	0.00	0.00
2000	Fishery	m	343	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.03	0.06	0.07	0.08	0.06	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2001	Fishery	m	194	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.05	0.08	0.10	0.10	0.06	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2002	Fishery	m	320	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.06	0.07	0.09	0.08	0.06	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2004	Fishery	m	62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.06	0.14	0.15	0.08	0.04	0.03	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2006	Fishery	m	36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.04	0.11	0.10	0.10	0.08	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2008	Fishery	m	159	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.06	0.10	0.12	0.09	0.07	0.04	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2011	Fishery	m	164	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.07	0.10	0.16	0.11	0.07	0.02	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2013	Fishery	m	277	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.30	0.30	0.17	0.17	0.08	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2025	Fishery	m	27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.04	0.03	0.08	0.03	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2026	Fishery	m	30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.07	0.12	0.16	0.17	0.07	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1990	WC Survey	m	191	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.04	0.06	0.09	0.10	0.06	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1993	WC Survey	m	317	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.06	0.08	0.09	0.08	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1996	WC Survey	m	338	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.04	0.05	0.07	0.07	0.04	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1999	WC Survey	m	304	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.04	0.05	0.07	0.08	0.06	0.05	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2001	WC Survey	m	278	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.04	0.04	0.05	0.04	0.04	0.04	0.04	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2003	WC Survey	m	381	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.04	0.05	0.07	0.07	0.07	0.05	0.04	0.03	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2005	WC Survey	m	398	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.04	0.06	0.07	0.07	0.05	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007	WC Survey	m	403	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.05	0.06	0.08	0.07	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2009	WC Survey	m	426	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.04	0.05	0.07	0.07	0.07	0.05	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2011	WC Survey	m	312	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.04	0.07	0.08	0.07	0.06	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2013	WC Survey	m	248	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.03	0.06	0.11	0.11	0.10	0.05	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2015	WC Survey	m	375	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.03	0.05	0.06	0.08	0.08	0.06	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2017	WC Survey	m	291	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.04	0.07	0.08	0.09	0.08	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2019	WC Survey	m	298	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.03	0.04	0.04	0.05	0.04	0.04	0.05	0.06	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2021	WC Survey	m	292	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.04	0.07	0.08	0.07	0.06	0.05	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2023	WC Survey	m	289	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.03	0.06	0.08	0.10	0.09	0.06	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2025	WC Survey	m	218	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.05	0.09	0.10	0.10	0.05	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1990	E Survey	m	46	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.04	0.08	0.12	0.11	0.07	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1993	E Survey	m	50	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.04	0.07	0.10	0.13	0.12	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Appendix E, part b continued. Length composition data used in the GOA rex sole assessment

Year	Fleet	Sex	S	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65
1996	E Survey	m	176	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.04	0.07	0.09	0.13	0.12	0.09	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1999	E Survey	m	152	0.00	0.00	0.00	0.00	0.01	0.02	0.02	0.03	0.05	0.07	0.08	0.11	0.10	0.05	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2003	E Survey	m	134	0.00	0.00	0.01	0.01	0.01	0.03	0.04	0.05	0.05	0.07	0.08	0.09	0.07	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2005	E Survey	m	145	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.03	0.05	0.09	0.11	0.11	0.09	0.05	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007	E Survey	m	107	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.06	0.12	0.13	0.10	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2009	E Survey	m	125	0.00	0.00	0.00	0.00	0.01	0.02	0.02	0.03	0.03	0.05	0.09	0.11	0.12	0.07	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2011	E Survey	m	99	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.05	0.07	0.09	0.09	0.08	0.05	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2013	E Survey	m	89	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.06	0.08	0.10	0.09	0.06	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2015	E Survey	m	110	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.05	0.09	0.14	0.12	0.06	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2017	E Survey	m	91	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.02	0.03	0.03	0.04	0.08	0.10	0.08	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2019	E Survey	m	106	0.00	0.00	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.07	0.06	0.08	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2021	E Survey	m	106	0.00	0.00	0.00	0.00	0.01	0.02	0.04	0.05	0.08	0.10	0.08	0.06	0.06	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2023	E Survey	m	89	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.04	0.06	0.08	0.09	0.08	0.05	0.03	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2025	E Survey	m	84	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.03	0.04	0.09	0.16	0.19	0.11	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Appendix E, part c. Fishery age composition data used in the GOA rex sole assessment

"S" indicates the relative yearly sample size used for females and males combined, set equal to the number of hauls with age data.
In years with only port information, the number of hauls is estimated based on historical data indicating an average of nine hauls per port delivery.
The data are in proportions that sum to 1 over females and males combined, which provides information to the model on sex ratio.

Year	Fleet	Sex	S	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1995	Fishery	f	118	0.000	0.000	0.000	0.009	0.006	0.013	0.076	0.118	0.071	0.065	0.040	0.027	0.020	0.001	0.004	0.004	0.025	0.003	0.008	0.062
1999	Fishery	f	78	0.000	0.000	0.000	0.003	0.011	0.028	0.056	0.052	0.058	0.057	0.050	0.057	0.038	0.030	0.022	0.019	0.014	0.010	0.009	0.026
2003	Fishery	f	138	0.000	0.000	0.000	0.007	0.032	0.096	0.064	0.054	0.024	0.012	0.022	0.007	0.024	0.007	0.010	0.008	0.010	0.008	0.008	0.024
2005	Fishery	f	198	0.000	0.000	0.000	0.011	0.053	0.130	0.143	0.087	0.041	0.008	0.012	0.006	0.007	0.000	0.007	0.000	0.000	0.009	0.013	0.000
2007	Fishery	f	529	0.000	0.000	0.002	0.013	0.010	0.038	0.058	0.118	0.149	0.062	0.023	0.010	0.008	0.015	0.005	0.008	0.000	0.009	0.000	0.008
2009	Fishery	f	209	0.000	0.000	0.003	0.016	0.027	0.080	0.049	0.088	0.073	0.052	0.042	0.018	0.008	0.006	0.000	0.004	0.007	0.002	0.000	0.006
2010	Fishery	f	185	0.000	0.000	0.000	0.001	0.019	0.036	0.082	0.078	0.046	0.050	0.047	0.045	0.013	0.003	0.005	0.000	0.004	0.000	0.000	0.005
2012	Fishery	f	186	0.000	0.000	0.000	0.006	0.005	0.049	0.140	0.094	0.060	0.028	0.034	0.044	0.010	0.011	0.009	0.007	0.007	0.000	0.000	0.009
2014	Fishery	f	79	0.000	0.000	0.000	0.000	0.001	0.001	0.031	0.085	0.153	0.060	0.045	0.048	0.031	0.042	0.040	0.013	0.014	0.008	0.011	0.029
2015	Fishery	f	75	0.000	0.000	0.000	0.003	0.018	0.013	0.027	0.072	0.089	0.089	0.072	0.040	0.026	0.037	0.019	0.023	0.010	0.027	0.007	0.032
2016	Fishery	f	58	0.000	0.000	0.000	0.008	0.035	0.056	0.034	0.061	0.066	0.066	0.041	0.042	0.028	0.023	0.021	0.014	0.003	0.000	0.002	0.009
2017	Fishery	f	54	0.000	0.000	0.000	0.007	0.021	0.041	0.036	0.060	0.061	0.053	0.070	0.038	0.037	0.021	0.018	0.000	0.008	0.000	0.000	0.010
2018	Fishery	f	53	0.000	0.001	0.004	0.003	0.004	0.020	0.097	0.021	0.048	0.039	0.051	0.046	0.026	0.033	0.018	0.009	0.015	0.009	0.006	0.000
2019	Fishery	f	57	0.000	0.000	0.003	0.031	0.023	0.042	0.065	0.070	0.043	0.058	0.041	0.017	0.037	0.015	0.010	0.019	0.031	0.015	0.005	0.012
2020	Fishery	f	46	0.000	0.000	0.002	0.017	0.068	0.018	0.024	0.019	0.033	0.049	0.021	0.032	0.008	0.011	0.006	0.014	0.019	0.012	0.000	0.016
2021	Fishery	f	17	0.000	0.000	0.000	0.000	0.050	0.110	0.056	0.043	0.049	0.039	0.000	0.000	0.033	0.000	0.040	0.000	0.000	0.000	0.035	0.043
2022	Fishery	f	40	0.000	0.000	0.000	0.012	0.047	0.111	0.133	0.034	0.026	0.018	0.018	0.015	0.000	0.000	0.017	0.000	0.006	0.014	0.020	0.015
2023	Fishery	f	40	0.000	0.000	0.000	0.012	0.018	0.128	0.157	0.173	0.069	0.040	0.021	0.020	0.029	0.011	0.019	0.007	0.000	0.000	0.000	0.011
2024	Fishery	f	30	0.000	0.000	0.000	0.000	0.017	0.074	0.153	0.110	0.166	0.014	0.040	0.026	0.037	0.018	0.000	0.000	0.000	0.000	0.000	0.000
1995	Fishery	m	118	0.000	0.000	0.000	0.008	0.011	0.010	0.061	0.083	0.067	0.068	0.027	0.019	0.005	0.001	0.005	0.008	0.007	0.011	0.021	0.036
1999	Fishery	m	78	0.000	0.000	0.000	0.037	0.064	0.069	0.031	0.037	0.042	0.024	0.031	0.035	0.023	0.014	0.012	0.010	0.012	0.003	0.009	0.005
2003	Fishery	m	138	0.000	0.000	0.000	0.035	0.127	0.157	0.069	0.037	0.021	0.018	0.013	0.018	0.007	0.010	0.013	0.013	0.006	0.011	0.007	0.022
2005	Fishery	m	198	0.000	0.000	0.000	0.025	0.094	0.161	0.093	0.045	0.022	0.014	0.003	0.000	0.011	0.000	0.002	0.000	0.000	0.002	0.002	0.000
2007	Fishery	m	529	0.000	0.000	0.004	0.022	0.044	0.060	0.088	0.127	0.053	0.023	0.007	0.018	0.000	0.003	0.000	0.001	0.000	0.008	0.000	0.011
2009	Fishery	m	209	0.000	0.000	0.005	0.012	0.036	0.113	0.069	0.082	0.086	0.048	0.019	0.011	0.008	0.008	0.000	0.006	0.001	0.004	0.000	0.010
2010	Fishery	m	185	0.000	0.000	0.000	0.008	0.105	0.079	0.176	0.072	0.038	0.025	0.019	0.019	0.007	0.000	0.008	0.000	0.006	0.000	0.000	0.005
2012	Fishery	m	186	0.000	0.000	0.001	0.001	0.031	0.050	0.179	0.092	0.037	0.016	0.025	0.017	0.010	0.008	0.008	0.002	0.008	0.000	0.000	0.003
2014	Fishery	m	79	0.000	0.000	0.000	0.002	0.014	0.023	0.038	0.108	0.047	0.042	0.015	0.021	0.020	0.011	0.012	0.017	0.006	0.002	0.004	0.006
2015	Fishery	m	75	0.000	0.000	0.000	0.007	0.047	0.017	0.054	0.077	0.049	0.043	0.018	0.034	0.002	0.007	0.017	0.005	0.009	0.005	0.000	0.004
2016	Fishery	m	58	0.000	0.000	0.000	0.010	0.042	0.067	0.050	0.065	0.063	0.066	0.027	0.025	0.025	0.013	0.010	0.006	0.007	0.000	0.005	0.010

Appendix E, part c continued. Fishery age composition data used in the GOA rex sole assessment

Year	Fleet	Sex	S	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2017	Fishery	m	54	0.000	0.000	0.000	0.015	0.032	0.069	0.046	0.056	0.093	0.051	0.051	0.038	0.022	0.027	0.001	0.000	0.002	0.000	0.008	0.008
2018	Fishery	m	53	0.000	0.001	0.015	0.015	0.036	0.077	0.059	0.038	0.024	0.042	0.055	0.042	0.043	0.042	0.020	0.000	0.019	0.013	0.010	0.000
2019	Fishery	m	57	0.000	0.000	0.016	0.137	0.042	0.033	0.035	0.053	0.036	0.025	0.003	0.012	0.014	0.009	0.003	0.014	0.009	0.010	0.006	0.004
2020	Fishery	m	46	0.000	0.000	0.005	0.068	0.237	0.031	0.022	0.062	0.023	0.035	0.059	0.013	0.015	0.010	0.015	0.004	0.024	0.002	0.000	0.003
2021	Fishery	m	17	0.000	0.000	0.000	0.000	0.099	0.098	0.064	0.019	0.057	0.000	0.000	0.000	0.016	0.000	0.079	0.000	0.000	0.000	0.014	0.056
2022	Fishery	m	40	0.000	0.000	0.000	0.055	0.113	0.118	0.105	0.043	0.011	0.017	0.015	0.011	0.000	0.000	0.005	0.000	0.002	0.010	0.005	0.005
2023	Fishery	m	40	0.000	0.000	0.000	0.006	0.033	0.056	0.047	0.079	0.015	0.006	0.005	0.015	0.005	0.000	0.016	0.000	0.000	0.000	0.000	0.000
2024	Fishery	m	30	0.000	0.000	0.000	0.000	0.020	0.024	0.107	0.089	0.065	0.000	0.018	0.007	0.006	0.006	0.000	0.000	0.000	0.000	0.000	0.000

Appendix F: of numbers-at-age by area and sex estimated by Model 25.1 in 2026. "WC" is Western-Central GOA; "E" is Eastern GOA.

Year	Area	Sex	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1982	WC	f	33,242	20,633	16,001	13,388	11,767	10,570	10,171	10,069	8,098	6,379	5,354	4,603	3,816	3,196	2,697	2,282	1,933	1,639	1,390	1,215	6,559
1983	WC	f	48,273	28,045	17,407	13,500	11,295	9,927	8,908	8,540	8,420	6,769	5,332	4,475	3,847	3,190	2,671	2,254	1,907	1,616	1,370	1,162	6,498
1984	WC	f	40,280	40,727	23,660	14,686	11,389	9,528	8,369	7,493	7,165	7,062	5,678	4,473	3,754	3,227	2,675	2,241	1,891	1,600	1,355	1,149	6,425
1985	WC	f	38,520	33,983	34,360	19,961	12,390	9,608	8,036	7,051	6,306	6,030	5,943	4,778	3,764	3,159	2,716	2,251	1,886	1,591	1,346	1,140	6,373
1986	WC	f	46,395	32,498	28,670	28,988	16,841	10,453	8,105	6,774	5,940	5,312	5,079	5,006	4,025	3,171	2,661	2,288	1,896	1,588	1,340	1,134	6,329
1987	WC	f	20,623	39,142	27,418	24,188	24,456	14,204	8,797	6,769	5,607	4,912	4,393	4,200	4,140	3,328	2,622	2,200	1,892	1,568	1,314	1,108	6,172
1988	WC	f	11,546	17,399	33,023	23,131	20,406	20,627	11,953	7,342	5,595	4,631	4,057	3,628	3,469	3,419	2,749	2,166	1,817	1,562	1,295	1,085	6,013
1989	WC	f	17,697	9,741	14,679	27,860	19,515	17,214	17,380	10,030	6,132	4,671	3,866	3,387	3,029	2,896	2,855	2,295	1,808	1,517	1,304	1,081	5,926
1990	WC	f	14,101	14,930	8,218	12,384	23,504	16,459	14,485	14,505	8,290	5,064	3,857	3,192	2,797	2,501	2,392	2,357	1,895	1,493	1,253	1,077	5,787
1991	WC	f	13,439	11,896	12,596	6,933	10,447	19,810	13,757	11,753	11,364	6,477	3,956	3,014	2,494	2,185	1,954	1,869	1,842	1,481	1,166	979	5,363
1992	WC	f	19,830	11,338	10,036	10,627	5,849	8,808	16,612	11,316	9,450	9,121	5,198	3,175	2,419	2,002	1,754	1,569	1,500	1,478	1,188	936	5,090
1993	WC	f	18,153	16,730	9,566	8,467	8,965	4,931	7,386	13,664	9,099	7,585	7,321	4,172	2,549	1,941	1,607	1,408	1,259	1,204	1,187	954	4,837
1994	WC	f	15,316	15,315	14,115	8,070	7,143	7,557	4,128	6,034	10,844	7,204	6,006	5,796	3,303	2,018	1,537	1,272	1,115	997	953	939	4,585
1995	WC	f	25,301	12,922	12,921	11,908	6,808	6,020	6,316	3,348	4,723	8,464	5,623	4,688	4,524	2,578	1,575	1,200	993	870	778	744	4,312
1996	WC	f	44,716	21,345	10,902	10,901	10,045	5,734	4,998	4,982	2,487	3,491	6,256	4,156	3,464	3,344	1,906	1,164	887	734	643	575	3,737
1997	WC	f	54,246	37,725	18,008	9,197	9,196	8,466	4,788	4,040	3,875	1,928	2,707	4,851	3,223	2,687	2,593	1,478	903	688	569	499	3,343
1998	WC	f	68,877	45,765	31,827	15,193	7,759	7,751	7,077	3,888	3,169	3,032	1,508	2,118	3,795	2,521	2,102	2,028	1,156	706	538	445	3,006
1999	WC	f	34,817	58,109	38,611	26,852	12,817	6,538	6,465	5,693	2,997	2,435	2,329	1,159	1,627	2,915	1,937	1,615	1,558	888	543	413	2,651
2000	WC	f	22,730	29,374	49,024	32,574	22,652	10,796	5,437	5,134	4,282	2,244	1,823	1,744	868	1,218	2,183	1,450	1,209	1,167	665	406	2,294
2001	WC	f	27,104	19,177	24,782	41,360	27,480	19,084	8,994	4,350	3,917	3,254	1,706	1,386	1,326	660	926	1,659	1,102	919	887	505	2,053
2002	WC	f	58,223	22,866	16,179	20,908	34,892	23,152	15,896	7,193	3,316	2,975	2,472	1,295	1,052	1,007	501	703	1,260	837	698	674	1,943
2003	WC	f	29,993	49,121	19,292	13,649	17,638	29,395	19,277	12,693	5,467	2,510	2,252	1,871	980	797	762	379	532	954	634	528	1,980
2004	WC	f	73,332	25,304	41,441	16,276	11,515	14,873	24,687	15,958	10,330	4,443	2,040	1,830	1,521	797	647	619	308	433	775	515	2,039
2005	WC	f	22,308	61,868	21,348	34,963	13,731	9,709	12,478	20,348	12,881	8,324	3,580	1,644	1,475	1,225	642	522	499	248	349	625	2,058
2006	WC	f	27,351	18,821	52,196	18,011	29,495	11,574	8,128	10,189	16,136	10,190	6,586	2,832	1,301	1,167	969	508	413	395	196	276	2,122
2007	WC	f	14,646	23,075	15,878	44,036	15,194	24,866	9,699	6,665	8,146	12,874	8,130	5,254	2,260	1,038	931	773	405	329	315	157	1,913
2008	WC	f	15,064	12,357	19,468	13,396	37,150	12,810	20,845	7,967	5,345	6,520	10,304	6,507	4,205	1,809	831	745	619	324	264	252	1,657
2009	WC	f	27,407	12,709	10,425	16,424	11,301	31,305	10,690	16,804	6,165	4,123	5,029	7,948	5,019	3,244	1,395	641	575	477	250	203	1,472
2010	WC	f	21,742	23,123	10,722	8,795	13,856	9,526	26,198	8,718	13,294	4,865	3,254	3,969	6,272	3,961	2,560	1,101	506	453	377	197	1,322
2011	WC	f	13,477	18,343	19,508	9,046	7,420	11,682	7,988	21,554	7,013	10,674	3,907	2,612	3,187	5,036	3,180	2,055	884	406	364	303	1,220
2012	WC	f	11,867	11,370	15,475	16,458	7,631	6,256	9,807	6,600	17,476	5,678	8,641	3,163	2,115	2,580	4,077	2,575	1,664	716	329	295	1,233
2013	WC	f	26,454	10,011	9,593	13,056	13,885	6,433	5,237	8,003	5,228	13,810	4,487	6,828	2,499	1,671	2,039	3,222	2,035	1,315	566	260	1,207
2014	WC	f	96,341	22,318	8,446	8,093	11,014	11,703	5,382	4,266	6,318	4,117	10,875	3,533	5,377	1,968	1,316	1,605	2,537	1,602	1,035	445	1,155
2015	WC	f	56,661	81,279	18,829	7,126	6,828	9,287	9,825	4,448	3,461	5,118	3,335	8,809	2,862	4,356	1,594	1,066	1,300	2,055	1,298	839	1,296
2016	WC	f	43,340	47,803	68,573	15,885	6,012	5,757	7,799	8,131	3,618	2,811	4,157	2,709	7,155	2,325	3,538	1,295	866	1,056	1,669	1,054	1,734

Appendix F, continued: numbers-at-age for Model 25.1 in 2026

Year	Area	Sex	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2017	WC	f	32,093	36,564	40,330	57,852	13,402	5,070	4,838	6,470	6,643	2,952	2,294	3,392	2,210	5,839	1,897	2,887	1,057	707	862	1,362	2,275
2018	WC	f	31,126	27,076	30,848	34,025	48,807	11,300	4,255	3,996	5,243	5,376	2,389	1,856	2,745	1,789	4,725	1,535	2,336	855	572	697	2,944
2019	WC	f	24,007	26,260	22,843	26,025	28,705	41,154	9,487	3,517	3,242	4,248	4,355	1,936	1,504	2,224	1,449	3,828	1,244	1,893	693	463	2,950
2020	WC	f	15,232	20,254	22,154	19,272	21,956	24,208	34,598	7,886	2,885	2,657	3,481	3,569	1,586	1,232	1,823	1,188	3,137	1,019	1,551	568	2,797
2021	WC	f	18,489	12,851	17,087	18,691	16,259	18,522	20,409	29,104	6,617	2,420	2,229	2,920	2,994	1,330	1,034	1,529	996	2,631	855	1,301	2,822
2022	WC	f	31,179	15,598	10,842	14,416	15,769	13,715	15,605	17,121	24,291	5,520	2,019	1,859	2,436	2,498	1,110	862	1,275	831	2,195	713	3,440
2023	WC	f	31,179	26,304	13,160	9,147	12,162	13,302	11,562	13,125	14,359	20,368	4,629	1,693	1,559	2,043	2,094	931	723	1,069	697	1,841	3,483
2024	WC	f	31,179	26,304	22,192	11,102	7,717	10,260	11,212	9,715	10,987	12,017	17,046	3,874	1,417	1,305	1,710	1,753	779	605	895	583	4,455
2025	WC	f	31,179	26,304	22,192	18,723	9,367	6,509	8,647	9,417	8,128	9,189	10,051	14,256	3,240	1,185	1,091	1,430	1,466	651	506	749	4,214
2026	WC	f	31,179	26,304	22,192	18,723	15,796	7,901	5,483	7,246	7,845	6,767	7,651	8,368	11,870	2,697	987	909	1,190	1,221	542	421	4,132
1982	E	f	13,529	8,397	6,512	5,449	4,789	4,303	4,147	4,129	3,343	2,635	2,211	1,901	1,576	1,320	1,114	942	798	677	574	502	2,709
1983	E	f	19,647	11,414	7,084	5,494	4,597	4,040	3,630	3,498	3,483	2,820	2,223	1,866	1,604	1,330	1,114	940	795	674	571	484	2,709
1984	E	f	16,393	16,575	9,629	5,977	4,635	3,878	3,409	3,063	2,952	2,939	2,379	1,875	1,574	1,353	1,122	940	793	671	568	482	2,694
1985	E	f	15,677	13,831	13,984	8,124	5,043	3,911	3,272	2,876	2,584	2,490	2,479	2,007	1,582	1,328	1,142	946	793	669	566	479	2,679
1986	E	f	18,882	13,226	11,668	11,798	6,854	4,254	3,299	2,760	2,426	2,180	2,101	2,092	1,694	1,335	1,120	963	798	669	564	477	2,665
1987	E	f	8,393	15,930	11,159	9,844	9,953	5,782	3,589	2,783	2,329	2,047	1,839	1,772	1,765	1,429	1,126	945	813	674	564	476	2,651
1988	E	f	4,699	7,081	13,440	9,414	8,305	8,397	4,878	3,028	2,348	1,965	1,727	1,552	1,495	1,489	1,205	950	797	685	568	476	2,638
1989	E	f	7,202	3,964	5,974	11,339	7,942	7,007	7,084	4,116	2,555	1,981	1,658	1,457	1,309	1,262	1,256	1,017	802	673	578	479	2,627
1990	E	f	5,739	6,076	3,345	5,040	9,566	6,701	5,911	5,977	3,472	2,155	1,671	1,398	1,229	1,104	1,064	1,060	858	676	568	488	2,621
1991	E	f	5,470	4,842	5,126	2,822	4,252	8,071	5,653	4,987	5,042	2,929	1,818	1,410	1,180	1,037	932	898	894	724	571	479	2,623
1992	E	f	8,071	4,615	4,085	4,325	2,381	3,587	6,809	4,769	4,208	4,254	2,471	1,534	1,190	995	875	786	758	754	611	481	2,617
1993	E	f	7,388	6,809	3,893	3,446	3,649	2,008	3,027	5,744	4,024	3,550	3,589	2,085	1,294	1,004	840	738	663	639	636	515	2,614
1994	E	f	6,234	6,233	5,744	3,284	2,907	3,078	1,694	2,553	4,846	3,395	2,995	3,028	1,759	1,092	847	708	623	559	539	537	2,640
1995	E	f	10,297	5,259	5,258	4,846	2,771	2,453	2,597	1,429	2,154	4,089	2,864	2,527	2,555	1,484	921	714	598	525	472	455	2,680
1996	E	f	18,199	8,687	4,437	4,436	4,089	2,338	2,069	2,191	1,206	1,817	3,449	2,416	2,132	2,155	1,252	777	603	504	443	398	2,645
1997	E	f	22,077	15,354	7,329	3,743	3,743	3,449	1,972	1,746	1,849	1,017	1,533	2,910	2,038	1,798	1,818	1,056	656	508	425	374	2,567
1998	E	f	28,032	18,626	12,953	6,183	3,158	3,158	2,910	1,664	1,473	1,560	858	1,294	2,455	1,720	1,517	1,534	891	553	429	359	2,481
1999	E	f	14,170	23,649	15,714	10,928	5,217	2,664	2,664	2,455	1,404	1,243	1,316	724	1,091	2,071	1,451	1,280	1,294	752	467	362	2,396
2000	E	f	9,251	11,955	19,952	13,257	9,220	4,401	2,248	2,248	2,071	1,184	1,048	1,110	611	921	1,748	1,224	1,080	1,092	634	394	2,327
2001	E	f	11,031	7,805	10,086	16,833	11,185	7,778	3,713	1,896	1,896	1,748	999	884	937	515	777	1,474	1,033	911	921	535	2,295
2002	E	f	23,696	9,306	6,585	8,509	14,201	9,436	6,562	3,133	1,600	1,600	1,474	843	746	790	435	655	1,244	871	769	777	2,388
2003	E	f	12,207	19,991	7,851	5,555	7,179	11,981	7,961	5,536	2,643	1,350	1,350	1,244	711	630	667	367	553	1,049	735	648	2,670
2004	E	f	29,845	10,298	16,866	6,624	4,687	6,057	10,108	6,716	4,671	2,230	1,139	1,139	1,049	600	531	562	310	466	885	620	2,800
2005	E	f	9,079	25,179	8,688	14,229	5,588	3,954	5,110	8,528	5,666	3,941	1,881	961	961	885	506	448	474	261	394	747	2,885
2006	E	f	11,132	7,660	21,243	7,330	12,005	4,715	3,336	4,311	7,195	4,781	3,325	1,587	811	810	747	427	378	400	220	332	3,065

Appendix F, continued: numbers-at-age for Model 25.1 in 2026

Year	Area	Sex	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2007	E	f	5,961	9,391	6,462	17,922	6,184	10,128	3,978	2,814	3,637	6,070	4,033	2,805	1,339	684	684	630	360	319	338	186	2,866
2008	E	f	6,131	5,029	7,923	5,452	15,120	5,217	8,545	3,356	2,374	3,068	5,121	3,403	2,366	1,130	577	577	532	304	269	285	2,574
2009	E	f	11,154	5,172	4,243	6,684	4,600	12,756	4,402	7,209	2,831	2,003	2,589	4,320	2,871	1,996	953	487	487	449	256	227	2,412
2010	E	f	8,849	9,411	4,364	3,579	5,639	3,881	10,762	3,714	6,082	2,389	1,690	2,184	3,645	2,422	1,684	804	411	411	378	216	2,227
2011	E	f	5,485	7,465	7,939	3,682	3,020	4,758	3,274	9,080	3,133	5,131	2,015	1,426	1,843	3,075	2,043	1,421	678	346	346	319	2,061
2012	E	f	4,830	4,627	6,298	6,698	3,106	2,548	4,014	2,762	7,660	2,643	4,329	1,700	1,203	1,554	2,594	1,724	1,199	572	292	292	2,008
2013	E	f	10,766	4,075	3,904	5,314	5,651	2,620	2,149	3,386	2,330	6,463	2,230	3,652	1,434	1,015	1,311	2,189	1,454	1,011	483	247	1,941
2014	E	f	39,209	9,083	3,438	3,294	4,483	4,768	2,211	1,813	2,857	1,966	5,452	1,881	3,081	1,210	856	1,106	1,847	1,227	853	407	1,845
2015	E	f	23,060	33,080	7,663	2,900	2,779	3,782	4,022	1,865	1,530	2,410	1,659	4,600	1,587	2,599	1,021	722	933	1,558	1,035	720	1,901
2016	E	f	17,639	19,455	27,908	6,465	2,447	2,344	3,191	3,393	1,574	1,291	2,034	1,399	3,881	1,339	2,193	861	609	788	1,314	873	2,211
2017	E	f	13,062	14,881	16,414	23,545	5,454	2,064	1,978	2,692	2,863	1,328	1,089	1,716	1,181	3,274	1,130	1,850	727	514	664	1,109	2,602
2018	E	f	12,668	11,020	12,555	13,848	19,864	4,602	1,742	1,669	2,271	2,415	1,120	919	1,447	996	2,762	953	1,561	613	434	561	3,131
2019	E	f	9,770	10,687	9,297	10,592	11,683	16,759	3,882	1,469	1,408	1,916	2,038	945	775	1,221	840	2,330	804	1,317	517	366	3,114
2020	E	f	6,199	8,243	9,016	7,843	8,936	9,856	14,139	3,275	1,240	1,188	1,616	1,719	797	654	1,030	709	1,966	678	1,111	436	2,936
2021	E	f	7,525	5,230	6,954	7,607	6,617	7,539	8,315	11,928	2,763	1,046	1,002	1,364	1,450	673	552	869	598	1,659	572	937	2,845
2022	E	f	12,689	6,348	4,412	5,867	6,418	5,583	6,360	7,015	10,064	2,331	882	845	1,151	1,224	567	465	733	505	1,399	483	3,191
2023	E	f	12,689	10,705	5,356	3,723	4,950	5,414	4,710	5,366	5,919	8,490	1,967	744	713	971	1,032	479	393	619	426	1,181	3,100
2024	E	f	12,689	10,705	9,032	4,518	3,141	4,176	4,568	3,974	4,527	4,993	7,163	1,659	628	602	819	871	404	331	522	359	3,611
2025	E	f	12,689	10,705	9,032	7,620	3,812	2,650	3,523	3,854	3,352	3,819	4,213	6,043	1,400	530	508	691	735	341	279	440	3,350
2026	E	f	12,689	10,705	9,032	7,620	6,429	3,216	2,235	2,972	3,251	2,828	3,222	3,554	5,098	1,181	447	428	583	620	287	236	3,197
1982	WC	m	33,242	20,633	16,001	13,388	11,767	10,563	10,125	10,002	8,094	6,379	5,354	4,603	3,816	3,196	2,697	2,282	1,933	1,639	1,390	1,215	6,559
1983	WC	m	48,273	28,045	17,407	13,500	11,294	9,922	8,876	8,466	8,360	6,765	5,332	4,475	3,847	3,190	2,671	2,254	1,907	1,616	1,370	1,162	6,498
1984	WC	m	40,280	40,727	23,660	14,686	11,389	9,525	8,350	7,447	7,101	7,012	5,675	4,473	3,754	3,227	2,675	2,241	1,891	1,600	1,355	1,149	6,425
1985	WC	m	38,520	33,983	34,360	19,961	12,390	9,607	8,027	7,027	6,267	5,976	5,901	4,775	3,764	3,159	2,716	2,251	1,886	1,591	1,346	1,140	6,373
1986	WC	m	46,395	32,498	28,670	28,988	16,841	10,452	8,100	6,762	5,919	5,279	5,034	4,971	4,023	3,171	2,661	2,288	1,896	1,588	1,340	1,134	6,329
1987	WC	m	20,623	39,142	27,418	24,188	24,455	14,190	8,743	6,703	5,592	4,895	4,365	4,163	4,111	3,327	2,622	2,200	1,892	1,568	1,314	1,108	6,172
1988	WC	m	11,546	17,399	33,023	23,131	20,405	20,604	11,864	7,226	5,536	4,619	4,043	3,606	3,438	3,395	2,748	2,166	1,817	1,562	1,295	1,085	6,013
1989	WC	m	17,697	9,741	14,679	27,860	19,514	17,204	17,305	9,908	6,033	4,622	3,856	3,375	3,010	2,870	2,834	2,294	1,808	1,517	1,304	1,081	5,926
1990	WC	m	14,101	14,930	8,218	12,384	23,503	16,441	14,383	14,301	8,182	4,982	3,817	3,184	2,787	2,486	2,370	2,341	1,894	1,493	1,253	1,077	5,787
1991	WC	m	13,439	11,896	12,596	6,933	10,445	19,733	13,425	11,266	11,173	6,393	3,892	2,982	2,488	2,178	1,942	1,852	1,829	1,480	1,166	979	5,363
1992	WC	m	19,830	11,338	10,036	10,627	5,848	8,784	16,298	10,793	9,042	8,968	5,131	3,124	2,393	1,997	1,748	1,559	1,486	1,468	1,188	936	5,090
1993	WC	m	18,153	16,730	9,566	8,467	8,964	4,918	7,255	13,103	8,663	7,258	7,198	4,118	2,508	1,921	1,603	1,403	1,251	1,193	1,178	953	4,837
1994	WC	m	15,316	15,315	14,115	8,070	7,142	7,532	4,039	5,757	10,374	6,859	5,746	5,699	3,260	1,985	1,521	1,269	1,111	991	945	933	4,584
1995	WC	m	25,301	12,922	12,921	11,908	6,807	5,996	6,148	3,161	4,493	8,097	5,353	4,485	4,448	2,545	1,550	1,187	990	867	773	737	4,306
1996	WC	m	44,716	21,345	10,902	10,901	10,042	5,695	4,781	4,564	2,336	3,321	5,985	3,957	3,315	3,288	1,881	1,145	877	732	641	571	3,728

Appendix F, continued: numbers-at-age for Model 25.1 in 2026

Year	Area	Sex	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1997	WC	m	54,246	37,725	18,008	9,197	9,194	8,427	4,635	3,718	3,539	1,811	2,575	4,641	3,068	2,571	2,549	1,459	888	680	568	497	3,334
1998	WC	m	68,877	45,765	31,827	15,193	7,758	7,720	6,884	3,635	2,909	2,769	1,417	2,015	3,630	2,400	2,011	1,994	1,141	695	532	444	2,997
1999	WC	m	34,817	58,109	38,611	26,852	12,814	6,506	6,258	5,306	2,793	2,235	2,127	1,089	1,548	2,789	1,844	1,545	1,532	877	534	409	2,643
2000	WC	m	22,730	29,374	49,024	32,574	22,645	10,729	5,217	4,705	3,973	2,091	1,673	1,593	815	1,159	2,088	1,381	1,157	1,147	656	400	2,285
2001	WC	m	27,104	19,177	24,782	41,360	27,473	18,979	8,658	3,979	3,576	3,020	1,589	1,272	1,211	620	881	1,587	1,049	879	872	499	2,041
2002	WC	m	58,223	22,866	16,179	20,908	34,882	23,024	15,311	6,599	3,022	2,716	2,293	1,207	966	919	471	669	1,205	797	668	662	1,929
2003	WC	m	29,993	49,121	19,292	13,649	17,633	29,228	18,548	11,632	4,995	2,288	2,056	1,736	914	731	696	356	506	912	603	505	1,961
2004	WC	m	73,332	25,304	41,441	16,276	11,514	14,841	24,270	15,094	9,454	4,060	1,859	1,671	1,411	743	594	566	289	412	742	490	2,005
2005	WC	m	22,308	61,868	21,348	34,963	13,729	9,686	12,279	19,587	12,163	7,618	3,271	1,498	1,346	1,137	598	479	456	233	332	598	2,011
2006	WC	m	27,351	18,821	52,196	18,011	29,491	11,536	7,951	9,735	15,496	9,622	6,027	2,588	1,185	1,065	899	473	379	361	185	262	2,063
2007	WC	m	14,646	23,075	15,878	44,036	15,192	24,792	9,503	6,355	7,767	12,363	7,677	4,808	2,065	946	850	718	378	302	288	147	1,856
2008	WC	m	15,064	12,357	19,468	13,396	37,145	12,775	20,453	7,620	5,087	6,216	9,895	6,144	3,848	1,653	757	680	574	302	242	230	1,603
2009	WC	m	27,407	12,709	10,425	16,424	11,299	31,161	10,374	15,824	5,878	3,924	4,795	7,632	4,739	2,969	1,275	584	525	443	233	187	1,414
2010	WC	m	21,742	23,123	10,722	8,795	13,854	9,492	25,552	8,205	12,487	4,638	3,096	3,784	6,023	3,740	2,343	1,006	461	414	350	184	1,263
2011	WC	m	13,477	18,343	19,508	9,046	7,419	11,651	7,841	20,550	6,588	10,026	3,724	2,486	3,038	4,836	3,003	1,881	808	370	332	281	1,162
2012	WC	m	11,867	11,370	15,475	16,458	7,631	6,243	9,659	6,357	16,638	5,334	8,117	3,015	2,013	2,460	3,915	2,431	1,523	654	299	269	1,168
2013	WC	m	26,454	10,011	9,593	13,056	13,882	6,411	5,122	7,649	5,023	13,147	4,215	6,414	2,383	1,590	1,944	3,094	1,921	1,203	517	237	1,136
2014	WC	m	96,341	22,318	8,446	8,093	11,012	11,661	5,252	4,043	6,024	3,956	10,353	3,319	5,051	1,876	1,253	1,531	2,436	1,513	948	407	1,081
2015	WC	m	56,661	81,279	18,829	7,126	6,827	9,267	9,669	4,260	3,275	4,879	3,204	8,386	2,688	4,091	1,520	1,015	1,240	1,973	1,225	768	1,205
2016	WC	m	43,340	47,803	68,573	15,885	6,011	5,746	7,693	7,864	3,460	2,660	3,963	2,603	6,812	2,184	3,323	1,234	824	1,007	1,603	995	1,602
2017	WC	m	32,093	36,564	40,330	57,852	13,400	5,061	4,779	6,285	6,417	2,824	2,171	3,234	2,124	5,559	1,782	2,712	1,007	672	822	1,308	2,120
2018	WC	m	31,126	27,076	30,848	34,025	48,801	11,276	4,194	3,873	5,086	5,193	2,285	1,756	2,617	1,719	4,498	1,442	2,195	815	544	665	2,774
2019	WC	m	24,007	26,260	22,843	26,025	28,702	41,067	9,350	3,403	3,138	4,120	4,207	1,851	1,423	2,120	1,392	3,644	1,168	1,778	660	441	2,786
2020	WC	m	15,232	20,254	22,154	19,272	21,955	24,170	34,220	7,670	2,789	2,571	3,376	3,448	1,517	1,166	1,738	1,141	2,986	957	1,457	541	2,644
2021	WC	m	18,489	12,851	17,087	18,691	16,259	18,516	20,342	28,710	6,433	2,339	2,157	2,832	2,892	1,273	978	1,457	957	2,505	803	1,222	2,672
2022	WC	m	31,179	15,598	10,842	14,416	15,768	13,707	15,547	16,977	23,952	5,367	1,951	1,799	2,363	2,413	1,062	816	1,216	799	2,090	670	3,249
2023	WC	m	31,179	26,304	13,160	9,147	12,162	13,298	11,534	13,039	14,235	20,084	4,501	1,636	1,509	1,981	2,023	890	684	1,020	670	1,752	3,286
2024	WC	m	31,179	26,304	22,192	11,102	7,716	10,256	11,181	9,655	10,912	11,913	16,808	3,766	1,369	1,263	1,658	1,693	745	573	853	560	4,217
2025	WC	m	31,179	26,304	22,192	18,723	9,366	6,507	8,620	9,354	8,075	9,126	9,964	14,058	3,150	1,145	1,056	1,387	1,416	623	479	714	3,995
2026	WC	m	31,179	26,304	22,192	18,723	15,795	7,896	5,459	7,180	7,788	6,724	7,599	8,296	11,704	2,623	954	879	1,155	1,179	519	399	3,921
1982	E	m	13,529	8,397	6,512	5,449	4,789	4,303	4,147	4,129	3,343	2,635	2,211	1,901	1,576	1,320	1,114	942	798	677	574	502	2,709
1983	E	m	19,647	11,414	7,084	5,494	4,597	4,040	3,630	3,498	3,483	2,820	2,223	1,866	1,604	1,330	1,114	940	795	674	571	484	2,709
1984	E	m	16,393	16,575	9,629	5,977	4,635	3,878	3,409	3,063	2,952	2,939	2,379	1,875	1,574	1,353	1,122	940	793	671	568	482	2,694
1985	E	m	15,677	13,831	13,984	8,124	5,043	3,911	3,272	2,876	2,584	2,490	2,479	2,007	1,582	1,328	1,142	946	793	669	566	479	2,679
1986	E	m	18,882	13,226	11,668	11,798	6,854	4,254	3,299	2,760	2,426	2,180	2,101	2,092	1,694	1,335	1,120	963	798	669	564	477	2,665

Appendix F, continued: numbers-at-age for Model 25.1 in 2026

Year	Area	Sex	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1987	E	m	8,393	15,930	11,159	9,844	9,953	5,782	3,589	2,783	2,329	2,047	1,839	1,772	1,765	1,429	1,126	945	813	674	564	476	2,651
1988	E	m	4,699	7,081	13,440	9,414	8,305	8,397	4,878	3,028	2,348	1,965	1,727	1,552	1,495	1,489	1,205	950	797	685	568	476	2,638
1989	E	m	7,202	3,964	5,974	11,339	7,942	7,007	7,084	4,116	2,555	1,981	1,658	1,457	1,309	1,262	1,256	1,017	802	673	578	479	2,627
1990	E	m	5,739	6,076	3,345	5,040	9,566	6,701	5,911	5,977	3,472	2,155	1,671	1,398	1,229	1,104	1,064	1,060	858	676	568	488	2,621
1991	E	m	5,470	4,842	5,126	2,822	4,252	8,071	5,653	4,987	5,042	2,929	1,818	1,410	1,180	1,037	932	898	894	724	571	479	2,623
1992	E	m	8,071	4,615	4,085	4,325	2,381	3,587	6,809	4,769	4,208	4,254	2,471	1,534	1,190	995	875	786	758	754	611	481	2,617
1993	E	m	7,388	6,809	3,893	3,446	3,649	2,008	3,027	5,744	4,024	3,550	3,589	2,085	1,294	1,004	840	738	663	639	636	515	2,614
1994	E	m	6,234	6,233	5,744	3,284	2,907	3,078	1,694	2,553	4,846	3,395	2,995	3,028	1,759	1,092	847	708	623	559	539	537	2,640
1995	E	m	10,297	5,259	5,258	4,846	2,771	2,453	2,597	1,429	2,154	4,089	2,864	2,527	2,555	1,484	921	714	598	525	472	455	2,680
1996	E	m	18,199	8,687	4,437	4,436	4,089	2,338	2,069	2,191	1,206	1,817	3,449	2,416	2,132	2,155	1,252	777	603	504	443	398	2,645
1997	E	m	22,077	15,354	7,329	3,743	3,743	3,449	1,972	1,746	1,849	1,017	1,533	2,910	2,038	1,798	1,818	1,056	656	508	425	374	2,567
1998	E	m	28,032	18,626	12,953	6,183	3,158	3,158	2,910	1,664	1,473	1,560	858	1,294	2,455	1,720	1,517	1,534	891	553	429	359	2,481
1999	E	m	14,170	23,649	15,714	10,928	5,217	2,664	2,664	2,455	1,404	1,243	1,316	724	1,091	2,071	1,451	1,280	1,294	752	467	362	2,396
2000	E	m	9,251	11,955	19,952	13,257	9,220	4,401	2,248	2,248	2,071	1,184	1,048	1,110	611	921	1,748	1,224	1,080	1,092	634	394	2,327
2001	E	m	11,031	7,805	10,086	16,833	11,185	7,778	3,713	1,896	1,896	1,748	999	884	937	515	777	1,474	1,033	911	921	535	2,295
2002	E	m	23,696	9,306	6,585	8,509	14,201	9,436	6,562	3,133	1,600	1,600	1,474	843	746	790	435	655	1,244	871	769	777	2,388
2003	E	m	12,207	19,991	7,851	5,555	7,179	11,981	7,961	5,536	2,643	1,350	1,350	1,244	711	630	667	367	553	1,049	735	648	2,670
2004	E	m	29,845	10,298	16,866	6,624	4,687	6,057	10,108	6,716	4,671	2,230	1,139	1,139	1,049	600	531	562	310	466	885	620	2,800
2005	E	m	9,079	25,179	8,688	14,229	5,588	3,954	5,110	8,528	5,666	3,941	1,881	961	961	885	506	448	474	261	394	747	2,885
2006	E	m	11,132	7,660	21,243	7,330	12,005	4,715	3,336	4,311	7,195	4,781	3,325	1,587	811	810	747	427	378	400	220	332	3,065
2007	E	m	5,961	9,391	6,462	17,922	6,184	10,128	3,978	2,814	3,637	6,070	4,033	2,805	1,339	684	684	630	360	319	338	186	2,866
2008	E	m	6,131	5,029	7,923	5,452	15,120	5,217	8,545	3,356	2,374	3,068	5,121	3,403	2,366	1,130	577	577	532	304	269	285	2,574
2009	E	m	11,154	5,172	4,243	6,684	4,600	12,756	4,402	7,209	2,831	2,003	2,589	4,320	2,871	1,996	953	487	487	449	256	227	2,412
2010	E	m	8,849	9,411	4,364	3,579	5,639	3,881	10,762	3,714	6,082	2,389	1,690	2,184	3,645	2,422	1,684	804	411	411	378	216	2,227
2011	E	m	5,485	7,465	7,939	3,682	3,020	4,758	3,274	9,080	3,133	5,131	2,015	1,426	1,843	3,075	2,043	1,421	678	346	346	319	2,061
2012	E	m	4,830	4,627	6,298	6,698	3,106	2,548	4,014	2,762	7,660	2,643	4,329	1,700	1,203	1,554	2,594	1,724	1,199	572	292	292	2,008
2013	E	m	10,766	4,075	3,904	5,314	5,651	2,620	2,149	3,386	2,330	6,463	2,230	3,652	1,434	1,015	1,311	2,189	1,454	1,011	483	247	1,941
2014	E	m	39,209	9,083	3,438	3,294	4,483	4,768	2,211	1,813	2,857	1,966	5,452	1,881	3,081	1,210	856	1,106	1,847	1,227	853	407	1,845
2015	E	m	23,060	33,080	7,663	2,900	2,779	3,782	4,022	1,865	1,530	2,410	1,659	4,600	1,587	2,599	1,021	722	933	1,558	1,035	720	1,901
2016	E	m	17,639	19,455	27,908	6,465	2,447	2,344	3,191	3,393	1,574	1,291	2,034	1,399	3,881	1,339	2,193	861	609	788	1,314	873	2,211
2017	E	m	13,062	14,881	16,414	23,545	5,454	2,064	1,978	2,692	2,863	1,328	1,089	1,716	1,181	3,274	1,130	1,850	727	514	664	1,109	2,602
2018	E	m	12,668	11,020	12,555	13,848	19,864	4,602	1,742	1,669	2,271	2,415	1,120	919	1,447	996	2,762	953	1,561	613	434	561	3,131
2019	E	m	9,770	10,687	9,297	10,592	11,683	16,759	3,882	1,469	1,408	1,916	2,038	945	775	1,221	840	2,330	804	1,317	517	366	3,114
2020	E	m	6,199	8,243	9,016	7,843	8,936	9,856	14,139	3,275	1,240	1,188	1,616	1,719	797	654	1,030	709	1,966	678	1,111	436	2,936
2021	E	m	7,525	5,230	6,954	7,607	6,617	7,539	8,315	11,928	2,763	1,046	1,002	1,364	1,450	673	552	869	598	1,659	572	937	2,845

Appendix F, continued: numbers-at-age for Model 25.1 in 2026

Year	Area	Sex	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2022	E	m	12,689	6,348	4,412	5,867	6,418	5,583	6,360	7,015	10,064	2,331	882	845	1,151	1,224	567	465	733	505	1,399	483	3,191
2023	E	m	12,689	10,705	5,356	3,723	4,950	5,414	4,710	5,366	5,919	8,490	1,967	744	713	971	1,032	479	393	619	426	1,181	3,100
2024	E	m	12,689	10,705	9,032	4,518	3,141	4,176	4,568	3,974	4,527	4,993	7,163	1,659	628	602	819	871	404	331	522	359	3,611
2025	E	m	12,689	10,705	9,032	7,620	3,812	2,650	3,523	3,854	3,352	3,819	4,213	6,043	1,400	530	508	691	735	341	279	440	3,350
2026	E	m	12,689	10,705	9,032	7,620	6,429	3,216	2,235	2,972	3,251	2,828	3,222	3,554	5,098	1,181	447	428	583	620	287	236	3,197