Chapter 7

Assessment of the Kamchatka Flounder stock in the Bering Sea and Aleutian Islands

By

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Executive Summary

An age-structured assessment is presented for Kamchatka flounder and is an update assessment of the 2024 stock assessment. Structural changes were not made to the model. Differences between the 2022 assessment and the current assessment were due to changes in the data inputs (see summary below).

Summary of changes in assessment input

1) Estimates of catch were updated for all years. The 2024 catch was estimated using an expansion factor of 1.03 that was derived from the 5-yr average proportion of Kamchatka flounder caught as of September 23rd.

2) The 2023 fishery length composition data were added to the assessment.

3) The 2023 and 2024 EBS shelf bottom trawl survey biomass and length composition estimates were added to the assessment.

4) The 2024 Aleutian Island bottom trawl survey biomass and length composition estimated were added to the assessment.

The assessment methodology remained unchanged.

Summary of Results

The table below summarizes the assumed natural mortality, projected 2025 and 2026, age 2+ total biomass, spawning stock biomass (SSB), and management reference points. SSB has a declining trend between 1991 and 2012 and has been relatively flat since. Estimates of SSB between 2012 and 2022 are slightly lower (~2% average) than the previous assessment. Age-2 recruitment has varied over time, with a peak in 2004, followed by a smaller peak in 2010. Estimates from the current assessment are lower than the 2022 assessment between 2010 and 2020 (~11% lower on average) and demonstrate a general decline in recruitment. Hence average recruitment is also lower over the full time series (~4% lower), leading to a reduction in the reference points.

	Tier 3 assessment model			
Quantity	As estimated last year for 2024	2025	As estimated this year for 2025	2026
M (natural mortality rate)	0.11	0.11	0.11	0.11
Tier	3a	3a	3a	3a
Projected total (age 2+) biomass (t)	119,565	116,651	106,850	104,888
Projected female spawning biomass	47,849	47,330	44,883	44,051
Projected				
$B_{100\%}$	94,370	94,370	85,751	85,751
$B_{40\%}$	37,748	37,748	34,300	34,300
$B_{35\%}$	33,029	33,029	30,013	30,013
F_{OFL}	0.103	0.103	0.101	0.101
$maxF_{ABC}$	0.086	0.086	0.085	0.085
F_{ABC}	0.086	0.086	0.085	0.085
OFL (t)	8,850	8,687	8,019	7,790
maxABC (t)	7,498	7,360	6,800	6,606
ABC (t)	7,498	7,360	6,800	6,606
Status	As determined *last* year for: 2023	2023	As determined *this* year for: 2023	2024
Overfishing	no	n/a	no	n/a
Overfished	n/a	no	n/a	no
Approaching overfished	n/a	no	n/a	no

**Based on model 16.0b. The 2024 preliminary catch was set equal to the extrapolated end of year catch (4,955 t) in place of maximum ABC. Catch in 2025 and 2026 was set equal to 5,773 t, which is the was estimated from the 5-yr average proportion of ABC achieved (77%) and the 2024 ABC (7,498 t).*

ABC is for the entire BSAI and not apportioned between the Bering Sea and Aleutian Islands.

Responses to SSC and Plan Team Comments on Assessments in General

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." (Plan Team, November 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."

(SSC, December 2023)

"*The SSC requests that when Bayesian model output is reported, basic convergence diagnostics are also presented.*" (SSC, December 2023)

A risk table is presented in the Harvest Recommendations section. After completing this exercise, we do not recommend ABC be reduced below maximum permissible ABC.

Responses to SSC and Plan Team Comments Specific to this Assessment

The SSC would encourage the examination of catchability and temperature.

This will be done during the next full assessment.

The SSC supports the PT recommendations that the age-length transition matrix be re-examined in the next full assessment and the re-examination of the assumptions made regarding historical species compositions between arrowtooth and Kamchatka flounders.

This will be addressed during the next full assessment

The SSC suggest the author explore incorporating aging error into the assessment given the improvements seen in the arrowtooth flounder assessment.

This will be examined during the next full assessment.

Introduction

BSAI Kamchatka flounder has been classified as a Tier 3 stock since 2013. Prior to 2013, Kamchatka flounder was assessed using the Tier 5 methodology and relied on trawl survey biomass from the Bering Sea shelf, Bering Sea slope and the Aleutian Islands and an estimate of natural mortality. ABC and OFL were determined from a 7-year averaging technique of survey biomass.

Kamchatka flounder (*Atheresthes evermanni*) is a relatively large flatfish which is distributed from Northern Japan through the Sea of Okhotsk to the Western Bering Sea north to Anadyr Gulf (Wilimovsky et al. 1967) and east to the eastern Bering Sea shelf and south of the Alaska Peninsula (there is also a catch record from California). In U.S. waters, they are found in commercial concentrations in the Aleutian Islands where they generally decrease in abundance from west to east (Zimmerman and Goddard 1996). They are also present in Bering Sea slope waters but are absent in survey catches east of Chirikof Island.

In the eastern part of their range, Kamchatka flounder overlap with arrowtooth flounder (*Atheresthes stomias*), a species that is similar in appearance. The two were not routinely distinguished in the commercial catches until 2008 and not consistently separated in the trawl survey catches until 1991. Hence, Kamchatka flounder were included in the arrowtooth flounder stock assessment and managed as a species complex (Wilderbuer et al. 2009). Managing the two species as a complex became undesirable in 2010 due to the emergence of a directed fishery for Kamchatka flounder in the BSAI management area. Since the ABC was determined by the large amount of arrowtooth flounder relative to Kamchatka flounder (the complex was about 93% arrowtooth flounder), there was concern about overharvesting Kamchatka flounder. Arrowtooth flounder and Kamchatka flounder, have been managed separately since 2011.

Fishery

Catch History

The catch of Kamchatka flounder was combined in catch records for arrowtooth flounder and Greenland turbot (*Reinhardtius hippoglossoides*) in the 1960s. The fisheries for Greenland turbot intensified during the 1970s and the bycatch of arrowtooth flounder and Kamchatka flounder is assumed to have also increased. Catches of these species decreased after implementation of the MFCMA and the Kamchatka flounder resource remained lightly exploited. The combined catches of Kamchatka flounder and arrowtooth flounder averaged 12,933 t from 1977-2008 (Table 7-1). It is assumed that only a small fraction (<10%) of this catch was Kamchatka flounder. The decline in catch resulted from catch restrictions placed on the fishery for Greenland turbot and phasing out of the foreign fishery in the U.S. EEZ. Catches for arrowtooth and Kamchatka flounder were not differentiated by species until 2011, and are reported by the Alaska Regional Office as a blend of vessel reported catch and observer at-sea sampling of the catch. However, the observer program has consistently identified the two species from catches aboard trawl vessels since 2008. Observer sampling has indicated that the proportion of Kamchatka flounder in the combined catch has steadily increased from 10% before 2008 to 54% in 2010 (see Fishery catch and length composition section for the method used to derive these values).

Year	Percent of combined catch
2008	34%
2009	42%
2010	54%

The increase in harvest was due to the development of a foreign market for Kamchatka flounder, which has now become a fishery target. Based on the above observer-derived percentages, the 2010 estimated catch of Kamchatka flounder was 20,960 t and represents the highest catch of the time series (Table 7-1, Figure 7-1). Catch declined between 2010 and 2018 and increased to 8,369 t in 2022 and declined to 6,950 t in 2023. Kamchatka flounder catch was 4, 811 t as of September 23, 2024. Catch has generally been below TAC, except in 2020 when catch was 10% higher than TAC. Over the past 5 years, approximately 97% of the Kamchatka flounder catch has been captured by late September. The catch as of September 23rd was expanded by a factor of 1.03 to obtain a preliminary 2024 catch equal to 4,955 t (Table 7-1).

Kamchatka flounder are mainly caught between May and August and to a lesser extent between September and November (Figure 7- 2). A larger proportion of the catch has been from the Aleutian Islands (AI; mainly from area 541), except in years 2014 - 2017 and 2019 (Figure 7-3a, b).

Data

The data used in this assessment includes the following:

Fishery catch	1991-2024
Shelf survey biomass estimates and standard error	1991-2019, 2021-2024
Slope survey biomass estimates and standard error	2002, 2004, 2008, 2010, 2012, 2016
Aleutian Islands survey biomass and S.E.	1991, 1994, 1997, 2000, 2002, 2004, 2006, 2010, 2012, 2014, 2016, 2018, 2022, 2024
Shelf survey length composition	1991-2019, 2021-2024
Slope survey length composition	2004, 2008, 2016
Aleutian Islands survey length composition	1991, 1994, 1997, 2000, 2002, 2004, 2006, 2012, 2014
Fishery length data	2008 – 2011, 2018-2023
Slope survey age data	2002, 2012
Aleutian Islands survey age data	2010, 2016, 2018, 2022

Fishery catch and length composition

Kamchatka flounder was not speciated in the Catch Accounting System until 2011 and was reported as part of the arrowtooth flounder and Kamchatka flounder species group. As such, the catch of the species group is split using proportions derived from the RACE bottom trawl surveys and the Fishery Monitoring Analysis (FMA) Division.

Catches from 1991-2007 were estimated assuming that Kamchatka flounder comprised 10% of the combined total catch during this time period. At this time, Kamchatka was not consistently identified by the observer program, but was consistently identified by the RACE bottom trawl surveys. As such, the ratio between Kamchatka and arrowtooth flounder was derived from the survey data for 1991-2007 (Figure 7- 4). Beginning in 2008, the observed species proportions from the NMFS Observer Program were applied to the total combined Kamchatka-arrowtooth catch for 2008-2010 (i.e., 34%, 42%, and 54%). The ratios were derived from the extrapolated survey haul weights for Kamchatka and arrowtooth flounder from the NORPAC Catch Report Table on AKFIN. The ratio estimator is as follows:

$$P_y = \frac{\sum_h Kam_{h,y}}{\sum_h ATF_{h,y} + Kam_{h,y}},$$

Where, P_y is the proportion of Kamchatka in year y, $Kam_{h,y}$ is the extrapolated weight of Kamchatka flounder in haul h in year y, and ATF is the extrapolated weight of arrowtooth flounder. This estimator is in-line with the current speciation practices used by the AKRO.

Kamchatka catches as reported in the CAS from 2011 to 2022 were used in the assessment model. The end of year catch for 2024 was derived from the 5-year average proportion of Kamchatka captured by the 39th week of the year and the reported catch in that same week. Over the past 5 years, approximately 97% of the Kamchatka flounder catch has occurred by the 39th week. For this assessment, the 2024 catch was extrapolated to the end of the year by an expansion factor of 1.03 and was set equal to 4,955 t (Table 7-1, Figure 7-1).

A comparison of the catch estimates used in the 2022 assessment and this assessment indicate the estimates were generally unchanged (Figure 7-1).

Length data from the fishery from years 2008-2011 and 2018-2024 are used in the assessment (Table 7-2, Figure 7-5). Kamchatka flounder were not identified as a species from which to take sex/lengths between 2012 and 2017 and explains the lack of data in those years (B. Mason, personal communication, November 4, 2024). Sampling increased in years 2018-2022 and resulted in substantially more samples compared to 2008-2011. The sex-specific length frequency distributions are fairly consistent between 2018 and 2022 for both females and males.

Biomass and composition estimates from Trawl Surveys

Biomass estimates for Kamchatka flounder from the eastern Bering Sea shelf and slope bottom trawl surveys and the bottom trawl survey in the Aleutian Islands region are shown in Table 7-3. Reliable estimates of Kamchatka flounder in the Aleutian Islands survey start in 1991 and are used in the assessment.

The survey biomass estimates were updated for this assessment. The EBS shelf bottom trawl survey biomass and CV estimates were the same as in the 2022 assessment and include estimates for years 2023 and 2024 (Figure 7-6). Kamchatka flounder biomass on the EBS shelf has been variable over time, with an increasing trend between 1999 and 2007, a fairly stable period between 2008 and 2014, and a declining trend since 2015. Biomass increased slightly in 2024 by 14% from the 2023 biomass estimate. Although the biomass estimates in 2023 and 2024 were some of the lowest observed, lower biomass was observed in the late 1990s and early 2000s. The EBS shelf BTS was cancelled in 2020 due to the COVID pandemic; therefore there is a missing observation in 2020.

The Aleutian Islands BTS was conducted in 2024. Biomass increased by ~75% in 2024 (Figure 7-6). Although 2024 survey biomass, 29,726 t, is up from 2023 in the Aleutian Islands, biomass is below the 1991 -2024 average of 35,978 t and has been since 2016.

The EBS slope bottom trawl survey has not been conducted since 2016. EBS slope survey area estimates were updated this year, which led to an unperceivable change in the biomass estimates (Figure 7-6). The slope biomass increased between 2004 and 2012 and then declined in 2016.

Population level length composition estimates for the three trawl surveys are shown by year and sex in Figure 7-7, Figure 7-8, and Figure 7-9. The length composition from all three surveys were updated for this assessment. The lengths from the EBS shelf are generally smaller and represent younger Kamchatka than those observed on the slope. The EBS shelf survey length composition estimates suggest several recruitment events prior to 1991, in the early 2000s, and 2010 (Figure 7-7). There is also evidence of the early 2000s cohort in the slope survey length composition estimates between 2008 and 2016 (Figure 7-8). The length distributions from the Aleutian Island bottom trawl survey have multiple modes compared to the length distributions from the EBS and reflect year classes moving through the population (Figure 7-9). There is some evidence of recruitment in 2004, 2010, 2016, 2018, and 2022.

Sex-specific age composition data from the EBS slope and Aleutian Islands bottom trawl surveys are included in the assessment (Figure 7-10). The age data from the Aleutian Islands survey in years 2010, 2016, 2018, and 2022 and the age data from the EBS Slope survey in years 2002 and 2012 are used in the assessment. The length composition estimates in these years are not used in the assessment. There is evidence of a higher proportion of younger fish from the AI bottom trawl survey than the EBS slope survey.

Biological data

The RACE bottom trawl surveys provide data on age and length composition of the population, growth rates, and length-weight relationships.

The length-at-age data are shown in Figure 7-11. The relationships derived for the 2022 assessment are used in this assessment. The oldest fish aged was a 58 year old male. The oldest female fish was 48 years old. The growth parameters values used in this assessment are as follows:

Sex	L_∞	k	t_0
Female	79.60	0.098	-0.802
Males	60.73	0.149	-0.452

The sex-specific, age-length transition matrices derived for the 2022 assessment were used for this assessment. Age was converted to length assuming that age-at-length is normally-distributed with sex-specific mean length-at-age given by the von Bertalanffy equation using the parameters given above. As was done in the previous assessments, a CV of 0.08 was applied to all ages to provide the uncertainty in growth for the transition matrices. The sex-specific transition matrices are shown in Figure 7-12.

The sex-specific length-weight relationships used in the assessment are as follows:

Males: $W = 3.912 \times 10^{-3} L^{3.22351}$

Females: $W = 3.185 \times 10^{-3} L^{3.28894}$,

where weight is in grams and length is in centimeters (Figure 7-13). Weight-at-age was derived from the length-weight and von Bertalanffy growth relationships derived from the RACE surveys' specimen data.

Maturity was determined in a study by Stark (2011) from a histological examination of ovary samples collected in the Bering Sea (Table 7-4).

Natural mortality is fixed in the assessment model and is set equal to 0.11 for females and males. The fixed estimate of natural mortality is based on the results of a likelihood profile analysis done in 2016.

Analytic Approach

Model Structure

The assessment model used this year remains unchanged from the final 2022 stock assessment, model 16.0b and uses the AD Model Builder software to model the population dynamics of Bering Sea and Aleutian Islands Kamchatka flounder starting in 1991. Population size in numbers at age a in year t was modeled as:

$$N_{a,t} = N_{a-1,t-1} e^{Z_{a-1,t-1}}, \; 2 < a < A \text{ and } 1991 < t < T$$

where Z is the sum of instantaneous fishing mortality ($F_{a,t}$) and natural mortality (M), A is the maximum age modeled in the population, and T is the terminal year of the assessment (i.e., 2022). All derived parameters are sex-specific, but this subscript was dropped for simplicity.

Natural mortality, M, was fixed at 0.11 for both sexes in the assessment model, following the assumption made in the 2016 assessment. During the 2016 assessment, M was estimated as a free parameter but the model would not converge and likelihood profiling was conducted to identify the fixed value.

Fishing mortality is a function of fishery selectivity at age ($selex_a$), average fishing mortality (μ_f), and a year-specific random deviation (ε_t):

$$F_{a,t} = selex_a e^{\mu_f \varepsilon_t}.$$

Average fishing mortality and the annual deviations are estimated model parameters. Sex-specific, age-based relationships were used to model fishery selectivity and assumed constant over time. Fishery selectivity was assumed to be asymptotic and modeled using a logistic selectivity pattern. This assumption was made because the directed fishery for Kamchatka flounder presumably targets larger fish (Figure 7- 5). The logistic slope parameter was fixed and the parameter describing the inflection of the curve was estimated for both female and male selectivity. The low sampling intensity for length measurements from the fishery may not provide sufficient information for the model to reliably estimate fishery selectivity. The input sample size for fitting this data was set at a low level (25).

The maximum age modeled in this assessment is 25 and represents a plus-group consisting of fish age 25 and older. The numbers at age for the plus group are modeled as:

$$N_{A,t} = N_{A-1,t-1} e^{Z_{A-1,t-1}} + N_{A,t-1} e^{Z_{A,t-1}}.$$

The numbers at age in the first year are modeled as:

$$N_{a,syr} = e^{\ln \bar{R} - M(a-1) + \tau_{syr-a}}, 2 < a < A$$

$$N_{A,syr} = \frac{e^{\ln \bar{R} - M(a-1) + \tau_{syr-a}}}{1 - e^{-M}}, a = A$$

where $\bar{R}$ is the mean number of age-2 recruits and τ is an age specific random deviation assumed to be normally distributed with a mean of zero and a standard deviation equal to σ_r, the recruitment standard deviation.

Age-2 recruitment after the first year is modeled as:

$$N_{2,t} = e^{\ln \bar{R} + \tau_t},$$

where τ_t is a random deviation assumed to be normally distributed with a mean of zero and a standard deviation equal to σ_r. Hence, the estimated recruitment parameters include the 24 τ parameters in 1991 (ages 2-25), the 33 recruitment deviation (τ_t) estimates for 1992-2024 and the mean log recruitment.

Catch at age is modeled using the Baranov catch equation:

$$C_{a,t} = \frac{F_{a,t}}{Z_{a,t}} (1 - e^{-Z_{a,t}}) N_{a,t}$$

and converted to weight by multiplying by the weight-at-age, w_a, which was estimated outside of the model.

The predicted length composition data (fishery and survey) were calculated by multiplying the numbers at age by a transition matrix that gives the proportion of each age in each length bin. Predicted trawl survey biomass in year *t* was modeled as:

$$B_{t,surv} = q_{surv} \sum_a N_{a,t} selex_{a,surv} w_a,$$

Where q_{surv} is the survey specific catchability. It was assumed that the shelf, slope and Aleutian Islands surveys measure non-overlapping segments of the Kamchatka flounder stock and all are treated as relative indices of abundance. Catchability parameters were estimated for the EBS shelf and Aleutian Islands surveys. The slope survey catchability was fixed at 0.18, as was done in previous assessments.

Sex-specific, age-based relationships were used to model survey selectivity. Selectivity was assumed constant over time. The survey length data indicate that fish less than about 4 years old (< 30 cm) are found mostly on the Bering Sea shelf and to some extent in the Aleutian Islands (Figure 7-7, Figure 7-9). Males and females from 30-50 cm are found on the shelf and in deeper waters of the Aleutian Islands and Bering Sea slope waters, and males and females > 50 cm are mainly found at depths below 200 meters. Sex-specific dome-shaped selectivity using a double logistic pattern was freely estimated for males and females in the shelf survey due to the lack of larger fish there. Selectivity for the slope and Aleutian Islands surveys were assumed to be asymptotic for both sexes and were modeled using a logistic pattern. The two parameters describing the slope and inflection of the logistic pattern were estimated for both sexes and surveys.

Data weighting

Data weights in the model are not based on a formal data-weighting method. The weights for the bottom trawl survey biomass estimates are set equal to the annual standard deviations. The multinomial input sample sizes reflect a down weighting of the fishery length composition estimates relative to the trawl surveys and the trawl surveys were equally weighted. The input sample sizes were 25 for the fishery composition data and 200 for the trawl surveys, respectively. The fishery length composition estimates were given less weight than the survey length composition estimates due to the limited sampling frequency and minimal number of samples collected from the fishery. A multinomial input sample size of 200 was used for the slope and Aleutian Islands age composition estimates. An emphasis factor of 300 was used to ensure the model fit the observed catch data with minimal observation error.

Parameters Estimated Outside of the Assessment Model

The parameters estimated outside of the model include the von Bertalanffy growth parameters, the age-length conversion matrix, the length-weight relationship, weight at age, and maturity.

Parameters Estimated Inside the Assessment Model

The suite of parameters estimated by the base model are classified by the following likelihood components:

Data Component	Distribution assumption
Trawl fishery length composition	Multinomial
Shelf survey population length composition	Multinomial
Slope survey population length composition	Multinomial
Slope survey age composition (2002 and 2012)	Multinomial
Aleutian Islands survey length composition	Multinomial
Aleutian Islands age composition (2010)	Multinomial
Trawl survey biomass estimates and S.E.	Log normal
Slope survey biomass estimates and S.E.	Log normal
Aleutian Islands biomass estimates and S.E.	Log normal

The total log likelihood is the sum of the likelihoods for each data component. The model allows for the individual likelihood components to be weighted by an emphasis factor. Equal emphasis was placed on fitting all data components for this assessment with the exception that a large emphasis was placed on fitting the fishery catch.

A summary of the number of parameters estimated in the model are:

Parameters	Number
Recruitment parameters	
Log(Mean recruitment)	1
Recruitment deviations (1991: ages 2-25, 1992-2024)	57
Fishing mortality parameters	
Log(mean F)	1
Annual deviations (1991 – 2024)	34
Selectivity parameters	
Fishery	2
Shelf survey	8
Slope survey	4
Aleutian Islands survey	4
Catchability parameters	
Shelf survey	1
Aleutian Islands survey	1

Results

Model Evaluation and Associated Uncertainty

The fit to the EBS slope bottom trawl survey biomass and Aleutian Islands bottom trawl survey biomass were similar to the 2022 assessment (Figure 7-14, middle and bottom panels). The model fits the 2008 and 2016 EBS slope biomass estimates relatively well, while overestimating biomass in 2002 and 2004 and underestimating biomass in 2010 and 2012. The slope biomass increased between 2008 and 2012, which the model misses. The model fit to the Aleutian Island survey biomass is also rather flat, which is likely due to the large annual survey uncertainty (Figure 7-14, bottom panels). Model fit to the last several years of the Aleutian Islands index is better than all other years.

The fit to the EBS shelf bottom trawl biomass estimates were similar among to the previous assessment for the majority of the time series (Figure 7-14, top panel). The model is able to predict the initial decline in biomass and the increase between 2000 and 2005 fairly well. It then underestimates the remaining increase in 2006 and 2007 before predicting the declining trend between 2008 and 2012. The model then estimates a relatively flat trend between 2013 and 2019, before predicting the declining trend between 2019 and 2024. The 2024 model better estimates the downward trend between 2017 and 2022, but still underestimates biomass between 2014 and 2016. Similar to the 2022 assessment, there is some pattern in the residuals. The model overestimates biomass between 1995 and 2003, underestimates biomass between 2004 and 2016, and overestimates the last several years of the time series. This might indicate catchability has changed over time.

Comparatively, the model fit to the EBS shelf bottom trawl survey length data is quite good compared to the model fit to the EBS slope survey and the Aleutian Islands survey (Figure 7-15 - Figure 7-21). The fits to the annual length distributions demonstrate fairly good fit, as well as the residuals and overall fit to the EBS shelf survey length data (Figure 7-15 - Figure 7-17). The OSA and Pearson residuals show some residual pattern overtime, with potential mis-estimation of a cohort from the 2000s (Figure 7-17). Additionlly, the fit to the overall length data indicates some underestimation of the smallest females and males (Figure 7-15, Figure 7-17).

The model fit to the EBS slope bottom trawl survey length composition generally underestimates the model of the overall length distributions for female and males (Figure 7-15, Figure 7-19). The misfit of the mode is consistent in all years for males (Figure 7-18). The length data from the Aleutian Islands survey has multiple modes, which were difficult to estimate (Figure 7-20, Figure 7-21). The worst fits to the female length data were in 2000 and 2002. The model expected more 55 cm – 75 cm and females than observed in 2000 and a greater proportion of smaller and fewer larger females in 2002 (Figure 7-20). The model also expected fewer large males in 1994, 2012, 2014, and 2024 than observed. Overall, the mode underestimated the modes of the length distributions for both sexes in the Aleutian Islands and the larger males (Figure 7-15, Figure 7-21).

Fishery sampling for Kamchatka was more prominent between 2018 and 2024 than in previous years. The model consistently underestimates the peak of the distribution (between 40cm and 60cm) and overestimates lengths larger than 60 cm for both sexes (Figure 7-22, Figure 7-23). The fit to the later data is much improved compared to the early years in the time series (Figure 7-22).

The model was able to better fit the EBS slope survey age composition than the Aleutian Islands survey age composition data (Figure 7-24, Figure 7-25). The model was able to estimate the overall EBS slope age distribution fairly well, while underestimating the peak (2-5 year old females and 2-6 year old males) and overestimating the plus group. The fit to the Aleutian Islands survey age composition generally captured the shape of the distribution, but underestimated the peak and plus group while overestimating the ages in between (Figure 7-25).

The estimated selectivity curves indicate that the shelf survey captures younger individuals than the slope and Aleutian Islands surveys and the fishery (Figure 7-26). The EBS shelf trawl survey electivity was higher for younger males than females and more domed at older ages for males. Selectivity was asymptotic for the fishery and EBS slope survey. Age at 50% selectivity (~7) and full selection was younger for females than males in the fishery. The opposite was true for the EBS slope trawl survey selectivity, where age at 50% maturity for males was ~4 and 5.5 for females. The Aleutian Island survey selectivity for males and females was somewhat linear and higher for males than females across all ages. The selectivity from the 2024 assessment had an increased age at 50% maturity. When new data were added to the model, the upper parameter bound for female age at 50% maturity was encountered. The authors fixed this parameter to 23, as it was between the parameter bound and the previous estimate of age at 50% maturity in the 2022 assessment. This effectively lowered the selectivity curve.

Growth is fixed in this model; therefore, any misspecification in growth will likely show up in selectivity. The length at age data from the EBS and AI suggest that there may be differences in growth. The authors suggest that for the next assessment, an analysis of whether there is sufficient sample sizes to determine whether there are regional growth differences. If sample sizes are adequate and there are regional differences in growth, this should be accounted for in the assessment model going forward.

A retrospective analysis was conducted to evaluate inconsistencies in the model outcomes with the inclusion of new data. The results are summarized in the Retrospective analysis section, but they indicate that the retrospective pattern has become more pronounced than the 2022 assessment (Figure 7- 30).

Time Series Results

The trends in SSB, total biomass, and age-2 recruitment from the current assessment are similar to the 2022 assessment (Figure 7- 27). Spawning stock biomass and total biomass estimates from the current assessment are <1% lower between 1991 and 2013 and 2-3% lower between 2014 and 2024 when compared to the 2022 assessment estimates (Table 7- 6). This corresponds to a ~1% and 9% average difference in recruitment over these time periods, respectively. The SSB and total biomass confidence intervals from the 2022 assessment and current assessment overlap and the mean estimates from the current assessment are within the 2022 assessment confidence intervals, indicating little difference between the models when new data were added.

The lower estimate of recruitment between 2014 and 2024, is largely due to the 2023 and 2024 EBS shelf data. The 2023 and 2024 shelf survey biomass estimates continue a declining trend in biomass. The 2022 model overestimated the 2021 and 2022 biomass estimates, whereas the current model better fits these two data points and follows the declining trend in biomass. Removing the two newest years of EBS shelf survey data leads to recruitment estimates that are more similar to the 2022 assessment.

The trend in SSB generally declines between 1991 and 2016, increases until 2020 where it then levels off (Table 7- 6, Figure 7- 27). Total biomass also has a declining trend between 1991 and 2003, increases until 2008, declines between 2009 and 2015 and is then relatively flat. The estimated numbers at age show that there was a strong 2002 cohort, which is shown as age-2 recruits in 2004 (Table 7- 7). Other strong cohorts are estimated to be from 2008 and 2014 that appear as 2 year olds in 2010 and 2016. All of these cohorts have matured or are maturing (age at 50% maturity is ~10 years old) and are either vulnerable or entering an age at which they are vulnerable to the fishery (age at 50% selectivity is ~7 years old). The increase in catch follows an increase in TAC in the last two years and may help explain the leveling off or decline in SSB and total biomass seen in 2021 and 2022.

Model estimates of fishing mortality follow the catch history, where we assume that the stock was lightly harvested 1991 to 2007 (Table 7- 8, Figure 7- 28). As the fishery developed for Kamchatka flounder, fishing mortality peaked in 2010, where F = 0.22. Fishing mortality declined between 2011 and 2018 and ranged between 0.12 and 0.04. Fishing mortality increased between 2019 and 2022, which follows the increasing trend in TAC. For the last 5 years fishing mortality has averaged 0.08. This is below the $F_{40\%}$ value of 0.086.

Convergence Status and Criteria

Convergence was determined by successful inversion of the Hessian matrix. Using the hess_step option in ADMB, the maximum gradient component was reduced to 0 giving strong evidence for model convergence.

Projections and Harvest Recommendations

The reference fishing mortality rate for Kamchatka flounder is determined by the amount of reliable population information available (Amendment 56 of the Fishery Management Plan for the groundfish fishery of the Bering Sea/Aleutian Islands). Estimates of $B_{40\%}$, and $F_{40\%}$ were obtained from a spawner-per-recruit analysis. Assuming that the average age-2 recruitment from 1991-2022 estimated in this assessment represents a reliable estimate of equilibrium recruitment, then an estimate of $B_{40\%}$ is calculated as the product of $SPR_{40\%}$ * equilibrium recruits. Since reliable estimates of 2024 spawning biomass (B), $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist and $B>B_{40\%}$, the reference fishing mortality for Kamchatka flounder is defined in tier 3a of Amendment 56. For this tier, F_{ABC} is constrained to be $\leq F_{40\%}$, and F_{OFL} is defined as $F_{35\%}$. The values of these quantities are:

2025 SSB estimate (B)	=	44, 883 t
$B_{40\%}$	=	34,300 t
$F_{40\%}$	=	0.085
F_{ABC}	=	0.085
$F_{35\%}$	=	0.101
F_{OFL}	=	0.101

The estimated catch level for year 2023 associated with the overfishing level of F = 0.101 is 8,019 t. **The 2025 recommended ABC associated with F_{ABC} of 0.085 is 6,800 t.**

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 seven harvest scenarios designed to satisfy the requirements of

Amendment 56, the National Environmental Policy Act, and the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA).

For each scenario, the projections begin with the vector of 2024 numbers at age estimated in the assessment. This vector is then projected forward to the beginning of 2025 using the schedules of natural mortality and selectivity described in the assessment and the best available estimate of total (year-end) catch for 2024. Over the last 5-years, the fishery has caught approximately 97% its total catch by the 39th week of the year (the week of September 23rd in 2024). The catch as of this date was expanded by 3% to estimate the end of the year catch, 5,773 t. TAC has been set equal to ABC over the last 4 years. Catch for years 2025 and 2026 in the projection model were set equal to the product of the 2024 ABC and the average percent of ABC achieved in the last 5 years, approximately 77%. 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 will be used in an Environmental Assessment prepared in conjunction with the final SAFE. These five scenarios, which are designed to provide a range of harvest alternatives that are likely to bracket the final TAC for 2023, are as follows ("*max* F_{ABC}" refers to the maximum permissible value of F_{ABC} under Amendment 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 all future 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 *2025* recommended in the assessment, to the maxF_{ABC} for *2025*, and catches for *assessment 2025 and 2026* are estimated at their most likely values given the *2025 and 2026* 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 *2019* to *2023* average F. (Rationale: For some stocks, TAC can be well below ABC, and recent average F may provide a better indicator of F_{TAC} than 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.).
>
> *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.)

The recommended F_{ABC} and the maximum F_{ABC} are equivalent in this assessment, and projections of the mean Kamchatka flounder harvest and spawning stock biomass for the scenarios are shown in Table 7-9.

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 *2025* or 2) above 1/2 of its MSY level in *2025* and expected to be above its MSY level in *2034* under this scenario, then the stock is not overfished.)

Scenario 7: In *2025 and 2026*, *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 *2026* or 2) above 1/2 of its MSY level in *assessment yr+1* and expected to be above its MSY level in *2036* under this scenario, then the stock is not approaching an overfished condition.).

SSB in 2025 and 2026 are above MSY therefore this stock is not considered to be overfished and is not approaching overfishing.

Risk Table and ABC Recommendation

Overview

"The following template is used to complete the risk table:

Risk Table Levels of Concern

	Assessment-related considerations	*Population dynamics considerations*	*Ecosystem considerations*	*Fishery-informed stock considerations*
Level 1: Normal	Typical to moderately increased uncertainty/minor unresolved issues in assessment.	Stock population dynamics (e.g., recruitment, growth, natural mortality) are typical for the stock and recent trends are within normal range.	No apparent ecosystem concerns related to biological status (e.g., environment, prey, competition, predation), or minor concerns with uncertain impacts on the stock.	No apparent concerns related to biological status (e.g., stock abundance, distribution, fish condition), or few minor concerns with uncertain impacts on the stock.
Level 2: Increased concern	Substantially increased assessment uncertainty/ unresolved issues, such as residual patterns and substantial retrospective patterns, especially positive ones.	Stock population dynamics (e.g., recruitment, growth, natural mortality) are unusual; trends increasing or decreasing faster than has been seen recently, or patterns are atypical.	Indicator(s) with adverse signals related to biological status (e.g., environment, prey, competition, predation).	Several indicators with adverse signals related to biological status (e.g., stock abundance, distribution, fish condition).
Level 3: Extreme Concern	Severe assessment problems; very poor fits to important data; high level of uncertainty; very	Stock population dynamics (e.g., recruitment, growth, natural mortality) are extremely unusual;	Indicator(s) showing a combined frequency (low/high) and magnitude(low/high) to cause severe adverse signals a) across the	Multiple indicators with strong adverse signals related to biological status (e.g., stock abundance,

	strong retrospective patterns, especially positive ones.	very rapid changes in trends, or highly atypical patterns compared to previous patterns.	same trophic level as the stock, and/or b) up or down trophic levels (i.e., predators and prey of the stock) that are likely to impact the stock.	distribution, fish condition), a) across different sectors, and/or b) different gear types.

The table is applied by evaluating the severity of four types of considerations that could be used to support a scientific recommendation to reduce the ABC from the maximum permissible. These considerations are stock assessment considerations, population dynamics considerations, ecosystem considerations, and fishery performance. Examples of the types of concerns that might be relevant include the following:

1. "Assessment-related considerations—data-inputs: biased ages, skipped surveys, lack of fishery-independent trend data; model fits: poor fits to fits to fishery or survey data, inability to simultaneously fit multiple data inputs; model performance: poor model convergence, multiple minima in the likelihood surface, parameters hitting bounds; estimation uncertainty: poorly-estimated but influential year classes; retrospective bias in biomass estimates.

2. "Population dynamics considerations—decreasing biomass trend, poor recent recruitment, inability of the stock to rebuild, abrupt increase or decrease in stock abundance.

3. "Ecosystem considerations—adverse trends in environmental/ecosystem indicators, ecosystem model results, decreases in ecosystem productivity, decreases in prey abundance or availability, increases or increases in predator abundance or productivity.

4. "Fishery-informed stock considerations—fishery CPUE is showing a contrasting pattern from the stock biomass trend, unusual spatial pattern of fishing, changes in the percent of TAC taken, changes in the duration of fishery openings."

Assessment-related considerations

The EBS shelf bottom trawl survey has been declining since 2015, although in 2024 biomass increased by 14 % from 2023. The model has a particularly difficult time estimating this decline as data is removed in a retrospective analysis and in turn the catchability estimate declines with each peel leading to an increasing retrospective pattern from year to year. The retrospective pattern increased from 2022, $\rho2024 = 0.137$ whereas $\rho2022 = 0.116$.

Given the increased retrospective pattern the authors suggest that this is a Level 2 concern.

Population dynamics considerations

Spawning stock biomass has been declining in recent years (Table 7-6, Figure 7-27), but remains above $B_{35\%}$. This has corresponded with increased catch through 2022 and declines in EBS Shelf survey biomass and Aleutian Island survey biomass. Survey biomass and numbers in both regions increased in 2024 from the previous survey year's biomass (14% and 73% on EBS shelf and 75% and 42% in the Aleutian Islands), but are still below the 1991-2024 average. The increase in population numbers suggests a potential recruitment event.

Although the stock has exhibited a general decline there are indications of recruitment; therefore, we consider this a Level 1 concern.

Ecosystem considerations

Environmental processes:

The eastern Bering Sea (EBS) experienced a prolonged period of above-average thermal conditions from 2014 through 2021. Since 2021, and continuing from August 2023–August 2024, thermal conditions in the EBS have been close to historical baselines of many metrics. There have been no sustained marine heatwaves over the southeastern or northern Bering Sea shelves since January 2021 (Callahan and Lemagie, 2024), and observed (Rohan and Barnett, 2024) and modeled (Kearney, 2024) EBS bottom temperatures were mostly near-normal over the past year. Sea surface temperatures (SSTs) and bottom temperatures were near the long-term means in all regions by summer 2024. Notable deviations include (i) warm SSTs in the outer domain from fall 2023 through spring 2024 and (ii) unusually warm bottom temperatures in the northern outer domain since spring 2024 that may indicate an intrusion of shelf water (Callahan et al., 2024).

In the Aleutian Islands in 2024, winter SST stayed above the long term mean, but spring conditions cooled and were close to the long term mean. Later in summer up to 75% of the western Aleutian Islands was under MHW status. Bottom temperatures were close to the 1991-2012 mean (Howard and Laman, 2024).

Atmospheric conditions are one of the primary drivers that impact the oceanographic setting in the EBS. Both the North Pacific Index (NPI) and Aleutian Low Index (ALI) provide complementary views of the atmospheric pressure system in the North Pacific. During winter 2023-2024, the NPI was average (Siddon, 2024) and the strength and location of the Aleutian Low Pressure System were both near climatological averages (Overland and Wang, 2024). Thus, despite delayed formation of sea ice in fall 2023 (Thoman, 2024), cold winds from the Arctic helped advance sea ice to near-normal extent by mid-winter. Near-normal sea ice extent and thickness (Thoman, 2024b, 2024c) may have contributed to a cold pool (<2°C water) of average spatial extent (Siddon, 2024), though the footprint of the coldest waters (<0°C) in 2024 was 75% smaller than in 2023 (Rohan and Barnett, 2024b).

Kamchatka flounder (KF) have similar distributions as Arrowtooth flounder within the BSAI. Adult KF tend to avoid the cold pool, with contractions in years with larger cold pool spatial extent over the shelf and expansions in years with smaller cold pool extent. The 2024 cold pool was close to average in spatial extent and KF were distributed over the outer domain during the standard bottom trawl survey (data not shown).

Kamchatka flounder is a winter-spawning flatfish; increased young-of-the-year recruitment is correlated to years with onshore winds during the larval period. The along- and cross-slope wind components along the Bering shelf break may be informative to understanding the larval dispersal in the upper ocean. December 2023 had significant along-shelf winds (to the southeast) that could have driven offshore Ekman transport. Weaker, but more sustained winds that also favored offshore transport occurred from March to May 2024 (Hennon, 2024), which overlaps with the KF larval period. In the 2024 bottom trawl survey, KF biomass increased 14% from 2023 to 2024 while abundance increased 72%; this could indicate a strong recent recruitment event for this stock.

For projections into 2025, the National Multi-Model Ensemble (NMME) predicts that SSTs over the EBS are expected to be near normal (anomalies within <0.5°C of the 1982–2010 baseline) (Lemagie, 2024). With the expected transition to La Niña, cooler conditions in the EBS may follow. Relatively cool SSTs may contribute to earlier formation of sea ice than has been observed over the last several years (Thoman, 2024b).

Metrics of ocean acidification include Ωarag and pH. Summer 2024 bottom water Ωarag conditions were similar to 2023 while pH was slightly more acidic; the most corrosive bottom waters were found in slope waters and over the northwest shelf (Pilcher et al., 2024).

Prey:
Juvenile KF are zooplanktivores. Spring trends in pelagic prey (i.e., zooplankton) distribution and abundance are likely more important for small life stages of KF, as by late-summer the fish have settled out of the pelagic environment. The Rapid Zooplankton Assessment in the southeastern Bering Sea (SEBS) in spring noted moderate abundance of small copepods, but low abundance of large copepods along the middle shelf (higher in the outer shelf) and near-zero abundance of euphausiids in the RZA, which is typical for the spring (Kimmel et al., 2024).

In the Aleutian Islands, both measurements from the continuous plankton recorder and seabird reproductive success are used to evaluate zooplankton availability. Planktivorous auklets had above average reproductive success in the western Aleutians in the past few years but this year reproductive success was below the long term mean in the Western Aleutian Islands, suggesting lower zooplankton prey availability. Data from the Continuous Plankton Recorders (updated through 2023) showed copepod community size has been decreasing in general, which may indicate a prevalence of smaller sized species (Ostle and Batten, 2024). The biomass of mesozooplankton increased and was above the long-term mean in 2023.

Common prey items for adult KF are juvenile walleye pollock and benthic prey such as eel pouts and shrimp. The estimated abundance of larval pollock sampled in spring increased from near the end of the last cold stanza (2012) through the warm stanza (2014, 2016, 2018) to a time-series maximum in 2024 (Rogers et al., 2024). By late summer, age-0 pollock CPUE estimates in the middle domain of the SEBS and NBS regions were lower than estimates from the recent warm period (2014–2021) but slightly higher than estimates from the cold period (2007–2013) (Andrews et al., 2024). In the inner domain, age-0 pollock were the most numerous non-salmonid species collected in the ADF&G nearshore survey (Garcia et al., 2024). In the NBS, CPUE estimates of age-0 pollock have remained low compared to the SEBS (Andrews et al., 2024). Since 2022, with cooler SSTs, age-0 pollock weights and energy density have been low while % lipid has been average (Page et al., 2024). Eelpout biomass has increased in the SEBS since 2021 and was above the long-term mean in 2024 (Buser and Rohan, 2024).
Condition factor has not been regularly estimated for KF during the bottom trawl survey, although a recent study found that their condition was generally higher with warmer bottom temperature (Grüss et al., 2020).

Competitors:
Greenland turbot, arrowtooth flounder, and Pacific halibut can be considered competitors based on overlap in their ecological niches as large upper-trophic predatory flatfish. These species are included within the apex predator guild. The biomass of apex predators measured during the standard bottom trawl survey in 2024 was nearly equal to their value in 2023 and below their long term mean (Siddon, 2024). Within that guild, turbot and Pacific halibut biomass declined while arrowtooth flounder increased 26% from 2023 to 2024 (Siddon, 2024). Given that ATF biomass greatly exceeds the biomass of KF in the southeastern Bering Sea, an increase in competition for habitat or prey resources, driven by increases in ATF biomass, may impact KF. In the Aleutians, apex predators have been decreasing in the past several years, decreasing the expected competition for prey with Kamchatka flounder (Ortiz and Zador 2024).

Predators:
Predators of juvenile KF are not well known, but likely include fur seals, Pacific cod, skates, and sleeper sharks. Predators of adult KF are also not well known, but likely include toothed whales. The apex

predator guild includes Pacific cod and in 2024 was nearly equal to their value in 2023 and below their long term mean. The trend in the apex predator guild is largely driven by Pacific cod, which decreased 5.5% from 2023 (Siddon, 2024). Other predators of KF include northern fur seals, skates, sleeper sharks, and toothed whales and potentially harbor seals in the Aleutian islands; unfortunately, no indicators of population trends for these species were available. Based on limited information available, trends in predator abundances suggest no increased predation concern for KF in the southeastern Bering Sea.

Summary for *Environmental/Ecosystem considerations:*

- **Environment:** The EBS shelf experienced oceanographic conditions that were largely average based on historical time series of multiple metrics over the past year (August 2023 - August 2024). The cold pool was average in extent over the shelf. Winds favored offshore Ekman transport from March through May that may have hindered transport to suitable nearshore nursery habitat, but indications of a strong recent recruitment event were detected in 2024.
- **Prey:** Sufficient prey may have been available for juvenile KF (i.e., small copepods) and adult KF (i.e., larval and juvenile pollock, eelpouts) over the SEBS shelf in 2024.
- **Competition:** Trends in competitor biomass were mixed over the SEBS in 2024, though an increase in ATF biomass may result in increased competition for habitat or prey resources.
- **Predation:** Based on limited information available, trends in predator abundances suggest no increased predation concern for KF in the southeastern Bering Sea.

Together, the most recent data available suggest an ecosystem risk Level 1 – Normal: "No apparent ecosystem concerns related to biological status (e.g., environment, prey, competition, predation), or minor concerns with uncertain impacts on the stock."

Fishery-informed stock considerations

TAC was consistently specified below ABC between 2012 and 2020 and has been set equal to ABC since 2021. On average, 82% of the TAC and 65% of the ABC has been caught by the fishery annually since 2011. As of October 28, 2024, 65% of the TAC and ABC had been achieved. At this time, there are no serious concerns about fishery performance and the authors suggest this as a Level 1 concern.

Summary and ABC recommendation

Summarize the results of the previous subsections in a table.

Assessment-related considerations	*Population dynamics considerations*	*Environmental/ ecosystem considerations*	*Fishery Performance considerations*
Level 2- increased assessment uncertainty/unresolved concerns	Level 1 – No increased concerns	Level 1- no increased concerns	Level 1- no increased concerns

An additional reduction in ABC is not warranted for this stock.

Status Determination

The Kamchatka stock is neither overfished nor approaching an overfished condition. With regard to assessing the current stock level, the expected stock size in the year 2026 of scenario 42,732 t, is above $B_{35\%}$, 30,013 t (Table 7- 9). With regard to whether the stock is likely to be in an overfished condition in the near future, the expected stock size in the year 2036 of scenario 7 is also greater than $B_{35\%}$. Figure 7-29 shows the relationship between the estimated time-series of female spawning biomass and fishing mortality and the tier 3 control rule for Kamchatka flounder. The simulation results for the 7 harvest scenarios are shown in Table 7- 9. Given the results, Kamchatka are not currently overfished or approaching overfishing.

The *F* that would have produced a catch for last year equal to last year's OFL was 0.098.

Retrospective analysis

A retrospective analysis was conducted by removing data for an entire year for 10 years. The model was then refit to the model for each annual removal. Retrospective patterns of female spawning biomass, total biomass, fishing mortality, and recruitment were evaluated.

Female spawning biomass and total biomass was greater than the reference model (full 2024 assessment model) for each peel, except the first peel that was lower than the reference (Figure 7-30, top-left panel). The Mohn's rho statistics computed for female spawning biomass and total biomass were 0.137 and 0.228. The estimates of age-2 recruits were also generally greater than the reference model. Fishing mortality exhibited little change given the strong emphasis on fitting the model to the observed catch. Compared to the 2022 assessment (Figure 7-31) a stronger retrospective pattern is observed. An evaluation of the catchability estimates indicate that the EBS shelf bottom trawl survey catchability estimate declines with each backward peel, which is a driving factor in the retrospective pattern. The authors will evaluate approaches to better estimate EBS shelf bottom trawl survey catchability during the next full assessment.

Ecosystem Considerations

Predators of Kamchatka flounder

Kamchatka flounder have rarely been found in the stomachs of other groundfish species in samples collected by the Alaska Fisheries Science Center. Their presence has only been documented in 17 stomach samples from the BSAI where the predators included Pacific cod, pollock, Pacific halibut, arrowtooth flounder and two sculpin species.

Kamchatka flounder predation

The prey of Kamchatka flounder can be discerned from 152 stomachs collected in 1983 (Yang and Livingston 1986). The principle diet was composed of walleye pollock, shrimp (mostly Crangonidae) and euphausids. Pollock was the most important prey item for all sizes of fish, ranging from 56 to 86% of the total stomach content weight. An examination of diet overlap with arrowtooth flounder indicated that these two congeneric species basically consume the same resources. Therefore the following sections are from the arrowtooth flounder assessment but pertain to Kamchatka flounder.

Fishery Effects on the Ecosystem

The direct impact on the Kamchatka fishery on the ecosystem is through bycatch. Table 7-10 summarizes the non-target catch by the Kamchatka flounder fishery since 2015. The highest non-target catch is of giant grenadier and since 2019 squid have been caught in some abundance. The bycatch of prohibited species is summarized in Table 7-11. The main prohibited species co-occurring with Kamchatka catch is golden king crab followed by snow crab and tanner crab.

Data Gaps and Research Priorities

Several improvements should be explored during future assessment cycles:

1. The current age-length transition matrix assumes the relationship between CV and age is constant and should be re-evaluated. We should also evaluate estimating growth internally in the model

from the survey length at age observations. These estimates can then be used in combination with the full complement with length data observations from the various data sources.

2. The EBS shelf bottom trawl length composition data is a consistent and numerous data sources and the model may be overfitting to these data and creating patterns in the survey biomass residuals and other composition data. A formal data weighting method (e.g., Francis re-weighting) should be evaluated.
3. Current input survey sample size should be updated using the afscISS R package. When this approach is available for fishery composition data, they should also be used.
4. Ageing error is not accounted for in this assessment and should be considered during the next assessment and may help to resolve conflicts between the length and age data.
5. The growth relationship, weight-at-age, and the age-length matrix were derived using the available age-length and length-weight data from the RACE bottom trawl surveys (2010-2020). The data were aggregated given that there were no obvious qualitative differences between regions (Bering Sea and Aleutian Islands). There was some conflict between the length and age data and the data should be re-examined to ensure that regional differences in growth are not being obscured. Additionally several new years of otoliths from the EBS shelf, EBS slope, and AI bottom trawl surveys have been aged in the past year. The new data should be used in the next assessment and will strengthen our ability to identify potential regional differences.
6. We will evaluate models accounting for a relationship between catchability and cold pool extent during the next full assessment.

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Tables

Table 7- 1. Total combined catch (t) of arrowtooth and Kamchatka flounder in the eastern Bering Sea and Aleutian Islands region, 1970 - 2024. Kamchatka flounder (Kam) catches from 1991 to 2007 were assumed to be 10% of the total. Catches in 2008, 2009, and 2010 were assumed to be 31%, 45%, and 55% of the total, respectively. Catches from 2011 to 2018 are as reported for Kamchatka flounder. The 2024 Kamchatka catch is an estimate extrapolated to the year end. The Kamchatka specific OFL, ABC, and TAC since 2011 are also reported.

Year	Total	Kam	OFL	ABC	TAC	Percent Total	Percent ABC	Percent TAC
1970	12,872	-	-	-	-	-	-	-
1971	19,373	-	-	-	-	-	-	-
1972	14,446	-	-	-	-	-	-	-
1973	12,922	-	-	-	-	-	-	-
1974	24,668	-	-	-	-	-	-	-
1975	21,616	-	-	-	-	-	-	-
1976	19,176	-	-	-	-	-	-	-
1977	11,489	-	-	-	-	-	-	-
1978	10,140	-	-	-	-	-	-	-
1979	14,357	-	-	-	-	-	-	-
1980	18,364	-	-	-	-	-	-	-
1981	17,113	-	-	-	-	-	-	-
1982	11,518	-	-	-	-	-	-	-
1983	13,969	-	-	-	-	-	-	-
1984	9,452	-	-	-	-	-	-	-
1985	7,447	-	-	-	-	-	-	-
1986	7,181	-	-	-	-	-	-	-
1987	4,859	-	-	-	-	-	-	-
1988	19,990	-	-	-	-	-	-	-
1989	7,306	-	-	-	-	-	-	-
1990	13,058	-	-	-	-	-	-	-
1991	19,510	1,951	-	-	-	10	-	-
1992	11,897	1,190	-	-	-	10	-	-
1993	9,299	930	-	-	-	10	-	-
1994	14,338	1,434	-	-	-	10	-	-
1995	9,284	928	-	-	-	10	-	-
1996	14,654	1,465	-	-	-	10	-	-
1997	10,469	1,047	-	-	-	10	-	-
1998	15,237	1,524	-	-	-	10	-	-
1999	11,378	1,138	-	-	-	10	-	-

Table 7-1. Continued.

Year	Total	Kam	OFL	ABC	TAC	Percent Total	Percent ABC	Percent TAC
2000	13,230	1,323	-	-	-	10	-	-
2001	14,058	1,406	-	-	-	10	-	-
2002	11,855	1,185	-	-	-	10	-	-
2003	13,253	1,325	-	-	-	10	-	-
2004	18,185	1,818	-	-	-	10	-	-
2005	14,243	1,424	-	-	-	10	-	-
2006	13,442	1,344	-	-	-	10	-	-
2007	11,916	1,192	-	-	-	10	-	-
2008	21,370	7,266	-	-	-	34	-	-
2009	29,900	12,558	-	-	-	42	-	-
2010	38,815	20,960	-	-	-	54	-	-
2011	30,628	10,053	23,600	17,700	17,700	33	57	57
2012	32,235	9,594	24,800	18,600	17,700	30	52	54
2013	28,843	7,836	16,300	12,200	10,000	27	64	78
2014	26,194	6,568	8,270	7,100	7,100	25	93	93
2015	16,793	5,072	10,500	9,000	6,500	30	56	78
2016	16,409	4,924	11,100	9,500	5,000	30	52	98
2017	11,516	4,582	10,360	8,880	5,000	40	52	92
2018	10,409	3,166	11,347	9,737	5,000	30	33	63
2019	14,955	4,581	10,965	9,260	5,000	31	49	92
2020	18,352	7,478	11,495	9708	6,800	41	77	110
2021	15,681	6,667	10,630	8,982	8,982	43	74	74
2022	16,226	8,369	10,903	9,214	9,214	52	91	91
2023	14,225	6,950	8,946	7,579	7,579	49	92	92
2024	-	4,955	8,850	7,498	7,498	-	-	-

Table 7- 2. Number of Kamchatka flounder fishery length observations.

Year	Males	Females	Total
2008	63	136	199
2009	46	59	105
2010	391	536	927
2011	123	250	373
2018	1514	2146	3660
2019	2954	5217	8171
2020	3984	6899	10883
2021	3345	7047	10392
2022	4439	7710	12149
2023	4891	7937	12828
2024	2078	3456	5534
Total	24402	42036	66438

Table 7- 3. Estimated Kamchatka flounder biomass and coefficient of variation (CV) from the three BSAI bottom trawl surveys (shelf, slope, and Aleutian Islands). Reliable estimates of Kamchatka flounder biomass are available after 1991 when Kamchatka and arrowtooth flounder were consistently differentiated and are used in the assessment.

Year	Shelf biomass (t)	Shelf CV	Slope biomass (t)	Slope CV	AI biomass (t)	AI CV
1983	-	-	-	-	1130.7	0.18
1984	-	-	-	-	-	-
1985	-	-	-	-	-	-
1986	-	-	-	-	587.3	0.22
1987	40.1	1	-	-	-	-
1988	13677.1	0.23	-	-	-	-
1989	17009.58	0.17	-	-	-	-
1990	32703.14	0.14	-	-	-	-
1991	37511.2	0.11	-	-	16262.6	0.27
1992	44764.3	0.1	-	-	-	-
1993	40223.97	0.08	-	-	-	-
1994	52461.81	0.12	-	-	49197.40	0.38
1995	28371.65	0.1	-	-	-	-
1996	24942.55	0.09	-	-	-	-
1997	19497.7	0.1	-	-	37695.30	0.25
1998	23898.99	0.09	-	-	-	-
1999	18993.02	0.14	-	-	-	-
2000	21383.52	0.11	-	-	28535.09	0.23
2001	31081.49	0.09	-	-	-	-
2002	23485.84	0.12	18745.40	0.11	49107.53	0.27
2003	27575.06	0.11	-	-	-	-
2004	30114.53	0.09	14803.61	0.10	39276.55	0.23
2005	46214.62	0.07	-	-	-	-
2006	61352.13	0.08	-	-	45370.38	0.24
2007	65003.4	0.08	-	-	-	-
2008	58013.57	0.09	24952.11	0.18	-	-
2009	49299.6	0.1	-	-	-	-
2010	58102.3	0.07	27982.64	0.10	53962.14	0.37
2011	45960.77	0.09	-	-	-	-
2012	42716.94	0.08	32857.89	0.21	35099.86	0.38
2013	46115.71	0.08	-	-	-	-
2014	57785.5	0.09	-	-	45156.74	0.36
2015	60135.39	0.06	-	-	-	-
2016	55136.47	0.06	21471.16	0.10	27967.81	0.23
2017	47893.29	0.06	-	-	-	-
2018	43845.29	0.05	-	-	29308.31	0.28
2019	44636.46	0.08	-	-	-	-
2020	-	-	-	-	-	-
2021	32856.21	0.07	-	-	-	-
2022	29699.16	0.09	-	-	17024.98	0.26
2023	24874.89	0.08	-	-	-	-
2024	28362.09	0.10	-	-	29725.77	0.52

Table 7- 4. Estimated maturity at age for female Kamchatka flounder (Stark 2011).

age	proportion mature
2	0.00
3	0.01
4	0.01
5	0.02
6	0.05
7	0.10
8	0.18
9	0.31
10	0.48
11	0.66
12	0.80
13	0.89
14	0.94
15	0.97
16	0.99
17	0.99
18	1.00
19	1.00
20	1.00
21	1.00
22	1.00
23	1.00
24	1.00
25	1.00

Table 7- 5. Key parameter estimates and standard deviations from Models 16.0b (2022) and current assessment.

	Model 16.0b (2022)		Model 16.0 (2024)	
Parameter	Value	std.dev	Value	std.dev
q1	1.04	0.05	1.08	0.06
q3	0.57	0.06	0.62	0.07
fish_sel50_f	6.74	0.27	6.62	0.26
fish_sel50_m	7.41	0.29	7.33	0.29
ShelfSrv_slope_f1	1.07	0.19	1.10	0.21
ShelfSrv_sel50_f1	1.42	0.25	1.46	0.29
ShelfSrv_slope_f2	0.38	0.05	0.37	0.05
ShelfSrv_sel50_f2	7.21	0.96	6.78	1.19
ShelfSrv_slope_m1	1.09	0.30	1.14	0.33
ShelfSrv_sel50_m1	0.79	0.22	0.79	0.22
ShelfSrv_slope_m2	0.51	0.07	0.51	0.07
ShelfSrv_sel50_m2	7.50	0.58	7.33	0.63
SlopeSrv_slope_f	1.17	0.16	1.18	0.16
SlopeSrv_sel50_f	5.52	0.21	5.49	0.21
SlopeSrv_slope_m	1.81	0.26	1.81	0.26
SlopeSrv_sel50_m	4.13	0.17	4.12	0.17
AIsrv_slope_f	0.09	0.01		
AISrv_slope_f	20.00	0.00	0.08	0.01
AISrv_slope_m	0.13	0.01	0.12	0.01
AISrv_sel50_m	12.41	1.03	13.33	1.13
log_avg_fmort	-3.54	0.05	-3.49	0.05
fmort_dev 1991	-0.57	0.07	-0.64	0.07
fmort_dev 1992	-1.07	0.06	-1.14	0.06
fmort_dev 1993	-1.33	0.06	-1.40	0.06
fmort_dev 1994	-0.91	0.05	-0.98	0.05
fmort_dev 1995	-1.36	0.05	-1.43	0.05
fmort_dev 1996	-0.90	0.05	-0.97	0.05
fmort_dev 1997	-1.23	0.05	-1.29	0.05
fmort_dev 1998	-0.83	0.05	-0.89	0.05
fmort_dev 1999	-1.09	0.05	-1.16	0.05
fmort_dev 2000	-0.91	0.05	-0.97	0.05
fmort_dev 2001	-0.82	0.05	-0.88	0.05
fmort_dev 2002	-0.96	0.04	-1.02	0.04
fmort_dev 2003	-0.82	0.04	-0.88	0.04
fmort_dev 2004	-0.49	0.04	-0.55	0.04
fmort_dev 2005	-0.72	0.04	-0.78	0.04
fmort_dev 2006	-0.77	0.04	-0.83	0.04
fmort_dev 2007	-0.89	0.04	-0.95	0.04
fmort_dev 2008	0.91	0.04	0.85	0.04
fmort_dev 2009	1.47	0.04	1.41	0.04
fmort_dev 2010	2.05	0.05	1.99	0.04
fmort_dev 2011	1.38	0.05	1.33	0.04
fmort_dev 2012	1.36	0.05	1.31	0.05
fmort_dev 2013	1.20	0.05	1.15	0.05
fmort_dev 2014	1.06	0.05	1.02	0.05
fmort_dev 2015	0.81	0.05	0.77	0.05
fmort_dev 2016	0.77	0.05	0.72	0.05
fmort_dev 2017	0.66	0.05	0.62	0.05
fmort_dev 2018	0.24	0.05	0.20	0.05
fmort_dev 2019	0.57	0.05	0.54	0.05
fmort_dev 2020	1.06	0.05	1.04	0.05
fmort_dev 2021	0.94	0.06	0.93	0.05
fmort_dev 2022	1.20	0.06	1.17	0.06
fmort_dev 2023			1.00	0.06
fmort_dev 2024			0.68	0.06

Table 7-5 continued.

	Model 16.0b (2022)		Model 16.0 (2024)	
Parameter	Value	std.dev	Value	std.dev
mean_log_rec	8.73	0.08	8.72	0.09
rec_dev age-2	0.50	0.28	0.55	0.31
rec_dev age-3	-0.23	1.61	-0.28	1.95
rec_dev age-4	-0.49	1.55	-0.49	1.80
rec_dev age-5	-0.74	1.53	-0.67	1.70
rec_dev age-6	-0.86	1.50	-0.77	1.65
rec_dev age-7	-0.90	1.46	-0.83	1.62
rec_dev age-8	-0.92	1.43	-0.86	1.60
rec_dev age-9	-0.85	1.40	-0.82	1.61
rec_dev age-10	-0.73	1.38	-0.70	1.64
rec_dev age-11	-0.04	1.10	-0.54	1.70
rec_dev age-12	-0.46	1.33	-0.35	1.69
rec_dev age-13	-0.57	1.34	-0.43	1.67
rec_dev age-14	0.74	0.46	0.77	0.51
rec_dev age-15	0.75	0.40	0.76	0.44
rec_dev age-16	-0.65	0.76	-0.61	0.80
rec_dev age-17	0.15	0.43	0.18	0.45
rec_dev age-18	0.06	0.41	0.08	0.43
rec_dev age-19	0.00	0.38	0.02	0.40
rec_dev age-20	0.31	0.31	0.33	0.32
rec_dev age-21	0.87	0.20	0.89	0.21
rec_dev age-22	0.72	0.17	0.74	0.17
rec_dev age-23	-0.03	0.19	-0.01	0.19
rec_dev age-24	-0.49	0.18	-0.48	0.19
rec_dev age-25	-0.55	0.17	-0.55	0.17
rec_dev 1992	0.00	0.12	0.01	0.13
rec_dev 1993	-0.58	0.15	-0.58	0.15
rec_dev 1994	-1.14	0.18	-1.14	0.19
rec_dev 1995	-0.79	0.16	-0.79	0.16
rec_dev 1996	-0.27	0.13	-0.27	0.14
rec_dev 1997	0.27	0.11	0.28	0.11
rec_dev 1998	0.12	0.12	0.13	0.12
rec_dev 1999	0.20	0.11	0.20	0.12
rec_dev 2000	-0.61	0.17	-0.61	0.17
rec_dev 2001	-0.22	0.15	-0.23	0.15
rec_dev 2002	0.61	0.11	0.60	0.12
rec_dev 2003	1.00	0.11	1.02	0.11
rec_dev 2004	1.55	0.09	1.54	0.10
rec_dev 2005	0.42	0.12	0.41	0.12
rec_dev 2006	-0.31	0.15	-0.30	0.15
rec_dev 2007	0.01	0.13	0.01	0.14
rec_dev 2008	-0.04	0.14	-0.05	0.14
rec_dev 2009	0.08	0.14	0.11	0.14
rec_dev 2010	1.03	0.10	1.02	0.10
rec_dev 2011	0.57	0.12	0.52	0.13
rec_dev 2012	0.66	0.11	0.65	0.11
rec_dev 2013	0.04	0.14	0.00	0.14
rec_dev 2014	0.44	0.12	0.41	0.12
rec_dev 2015	0.63	0.11	0.51	0.12
rec_dev 2016	0.71	0.11	0.60	0.11
rec_dev 2017	0.11	0.15	0.04	0.14
rec_dev 2018	0.33	0.14	0.07	0.14
rec_dev 2019	0.07	0.21	0.03	0.15
rec_dev 2020	0.84	0.15	0.35	0.13
rec_dev 2021	-0.82	0.32	-0.71	0.19
rec_dev 2022	-0.52	0.32	-0.44	0.19
rec_dev 2023			0.44	0.16
rec_dev 2024			0.26	0.20

Table 7-6. Estimated total biomass (ages 2+), female spawning biomass, and age-2 recruitment. Estimates of 2025 and 2026 total biomass and spawning stock biomass (SSB) are from the projection model.

	16.0b (2022)							16.0b (2024)						
Year	Total biomass	SSB	SSB lb	SSB ub	Rec	Rec lb	Rec ub	Total biomass	SSB	SSB lb	SSB ub	Rec	Rec lb	Rec ub
1991	154,935	72,447	61,054	85,966	7.1	5.22	9.66	156,801	73,407	61,812	87,176	7,055	5,190	9,591
1992	153,775	71,516	60,941	83,926	12.39	10.07	15.24	155,568	72,449	61,692	85,082	12,290	9,995	15,113
1993	152,881	71,348	61,470	82,812	6.92	5.29	9.05	154,592	72,262	62,218	83,928	6,859	5,246	8,968
1994	151,536	71,816	62,547	82,458	3.96	2.81	5.56	153,155	72,718	63,294	83,545	3,907	2,781	5,487
1995	148,982	72,472	63,741	82,400	5.62	4.22	7.48	150,499	73,363	64,487	83,461	5,543	4,164	7,380
1996	146,458	73,573	65,303	82,890	9.42	7.5	11.82	147,861	74,449	66,045	83,922	9,294	7,409	11,658
1997	143,327	74,016	66,163	82,800	16.24	13.69	19.27	144,606	74,867	66,891	83,794	16,075	13,560	19,055
1998	140,668	74,001	66,534	82,305	13.97	11.49	17	141,814	74,815	67,236	83,248	13,843	11,388	16,828
1999	137,820	72,956	65,866	80,810	15.07	12.53	18.12	138,826	73,721	66,531	81,689	14,937	12,439	17,936
2000	135,371	71,561	64,835	78,985	6.73	4.92	9.2	136,234	72,266	65,451	79,789	6,634	4,863	9,052
2001	132,893	69,643	63,272	76,654	9.89	7.56	12.95	133,610	70,280	63,833	77,378	9,715	7,429	12,705
2002	131,070	67,436	61,409	74,054	22.8	19.1	27.22	131,619	68,002	61,911	74,693	22,253	18,660	26,539
2003	130,819	65,371	59,666	71,623	33.57	28.42	39.66	131,217	65,866	60,107	72,177	33,745	28,673	39,714
2004	133,145	63,443	58,035	69,354	58	51.52	65.32	133,338	63,861	58,413	69,819	56,833	50,550	63,898
2005	136,104	61,656	56,510	67,271	18.69	15.3	22.84	136,081	61,996	56,822	67,641	18,392	15,074	22,441
2006	140,287	60,645	55,706	66,022	9.07	6.98	11.8	140,050	60,903	55,950	66,294	9,077	7,009	11,756
2007	144,898	60,112	55,335	65,302	12.52	9.96	15.75	144,444	60,285	55,510	65,472	12,293	9,799	15,423
2008	149,415	60,143	55,483	65,195	11.85	9.26	15.17	148,753	60,229	55,586	65,259	11,629	9,116	14,835
2009	147,318	57,564	52,995	62,526	13.37	10.44	17.13	146,481	57,571	53,040	62,488	13,579	10,705	17,225
2010	140,451	53,515	48,988	58,461	34.65	29.84	40.24	139,428	53,448	48,983	58,320	33,822	29,212	39,160
2011	124,950	46,535	41,989	51,573	21.75	17.64	26.82	123,726	46,387	41,931	51,317	20,631	16,736	25,432
2012	121,172	45,678	40,954	50,947	23.78	19.82	28.55	119,713	45,388	40,778	50,519	23,379	19,605	27,880
2013	117,876	44,871	39,932	50,422	12.82	10.01	16.43	116,160	44,435	39,633	49,818	12,230	9,608	15,566
2014	116,675	44,247	39,113	50,054	19.15	15.72	23.33	114,678	43,683	38,709	49,296	18,352	15,208	22,146
2015	117,051	43,655	38,377	49,660	23.06	19.01	28	114,656	42,988	37,888	48,775	20,396	16,919	24,589
2016	119,316	43,713	38,318	49,869	25.18	20.85	30.44	116,385	42,953	37,752	48,870	22,292	18,718	26,547
2017	121,490	44,180	38,662	50,486	13.79	10.5	18.12	117,948	43,317	38,011	49,363	12,641	10,016	15,955
2018	123,906	45,380	39,702	51,871	17.2	13.22	22.38	119,536	44,382	38,937	50,588	13,060	10,360	16,464
2019	127,363	47,752	41,863	54,469	13.29	8.85	19.96	122,135	46,575	40,946	52,978	12,543	9,576	16,430
2020	129,522	49,480	43,375	56,443	28.6	21.75	37.64	122,880	48,083	42,271	54,694	17,250	13,701	21,718
2021	127,701	49,459	43,162	56,676	5.45	2.93	10.16	119,660	47,784	41,818	54,600	5,979	4,162	8,589
2022	126,067	49,667	43,171	57,141	7.38	3.97	13.72	116,634	47,629	41,513	54,645	7,899	5,558	11,227
2023								111,736	46,356	40,114	53,570	19,001	14,149	25,516
2024								108,189	45,584	39,210	52,995	15,756	10,779	23,031
2025								106,850	44,883					
2026								104,888	44,051					

Table 7-7. Estimated numbers (millions) of a) females and b) males from model 16.0b.
a)

	age																						
1991	4	3	5	9	10	5	3	3	3	1	4	4	1	1	1	1	0	0	0	0	0	0	0	8
1992	6	3	3	4	8	9	4	3	3	3	1	4	3	1	1	1	1	0	0	0	0	0	0	7
1993	3	6	3	3	4	7	8	4	3	2	2	1	3	3	1	1	1	0	0	0	0	0	0	7
1994	2	3	5	3	2	3	7	7	3	2	2	2	1	3	3	1	1	1	0	0	0	0	0	6
1995	3	2	3	4	2	2	3	6	6	3	2	2	2	1	3	2	1	1	0	0	0	0	0	6
1996	5	2	2	2	4	2	2	3	5	5	3	2	2	2	1	2	2	1	1	0	0	0	0	5
1997	8	4	2	1	2	4	2	2	2	5	5	2	2	1	1	1	2	2	1	0	0	0	0	5
1998	7	7	4	2	1	2	3	2	2	2	4	4	2	1	1	1	1	2	2	0	0	0	0	5
1999	7	6	6	3	2	1	2	3	1	1	2	4	4	2	1	1	1	0	2	2	0	0	0	4
2000	3	7	6	6	3	2	1	2	2	1	1	2	3	3	2	1	1	1	0	1	1	0	0	4
2001	5	3	6	5	5	3	1	1	1	2	1	1	2	3	3	1	1	1	1	0	1	1	0	4
2002	11	4	3	5	4	5	2	1	1	1	2	1	1	1	3	3	1	1	1	1	0	1	1	4
2003	17	10	4	2	5	4	4	2	1	1	1	2	1	1	1	2	2	1	1	1	1	0	1	4
2004	28	15	9	3	2	4	4	4	2	1	1	1	2	1	1	1	2	2	1	1	1	1	0	5
2005	9	25	14	8	3	2	4	3	3	2	1	1	1	1	1	1	1	2	2	1	1	1	1	4
2006	5	8	23	12	7	3	2	3	3	3	1	1	0	1	1	1	1	1	2	2	1	1	0	4
2007	6	4	7	20	11	6	2	2	3	2	3	1	1	0	1	1	1	1	1	1	1	1	0	4
2008	6	6	4	7	18	10	6	2	1	3	2	2	1	1	0	1	1	0	0	1	1	1	1	4
2009	7	5	5	3	6	16	8	5	2	1	2	2	2	1	1	0	0	1	0	0	1	1	1	4
2010	17	6	5	4	3	5	14	7	4	1	1	2	1	1	1	0	0	0	1	0	0	0	1	4
2011	10	15	5	4	4	2	4	11	5	3	1	1	1	1	1	1	0	0	0	0	0	0	0	3
2012	12	9	14	5	4	3	2	4	9	4	2	1	1	1	1	1	0	0	0	0	0	0	0	3
2013	6	10	8	12	4	3	3	2	3	7	3	2	1	0	1	1	1	0	0	0	0	0	0	3
2014	9	5	9	7	11	4	3	2	1	2	6	3	2	1	0	1	1	1	0	0	0	0	0	2
2015	10	8	5	8	7	10	3	2	2	1	2	5	2	1	0	0	1	0	0	0	0	0	0	2
2016	11	9	7	4	7	6	8	3	2	2	1	2	4	2	1	0	0	0	0	0	0	0	0	2
2017	6	10	8	7	4	7	5	7	2	2	1	1	1	3	2	1	0	0	0	0	0	0	0	2
2018	7	6	9	7	6	3	6	4	6	2	1	1	1	1	3	1	1	0	0	0	0	0	0	1
2019	6	6	5	8	7	5	3	5	4	5	2	1	1	1	1	2	1	1	0	0	0	0	0	1
2020	9	6	5	5	7	6	5	3	4	3	5	2	1	1	1	1	2	1	1	0	0	0	0	1
2021	3	8	5	5	4	6	5	4	2	4	3	4	1	1	1	0	1	2	1	0	0	0	0	1
2022	4	3	7	4	4	4	5	4	3	2	3	2	3	1	1	1	0	1	1	1	0	0	0	1
2023	10	4	2	6	4	4	3	5	4	3	2	2	2	3	1	1	1	0	0	1	1	0	0	1
2024	8	9	3	2	6	4	3	3	4	3	2	1	2	2	2	1	0	0	0	0	1	0	0	1

Table 7-7. continued.

b)

	age																						
1991	4	3	5	9	10	5	3	3	3	1	4	4	1	1	1	1	0	0	0	0	0	0	0	8
1992	6	3	3	4	8	9	4	3	3	3	1	4	3	1	1	1	1	0	0	0	0	0	0	7
1993	3	6	3	3	4	7	8	4	3	2	2	1	3	3	1	1	1	0	0	0	0	0	0	7
1994	2	3	5	3	2	3	7	7	3	2	2	2	1	3	3	1	1	1	0	0	0	0	0	6
1995	3	2	3	4	2	2	3	6	6	3	2	2	2	1	3	2	1	1	0	0	0	0	0	6
1996	5	2	2	2	4	2	2	3	5	5	3	2	2	2	1	2	2	1	1	0	0	0	0	5
1997	8	4	2	1	2	4	2	2	2	5	5	2	2	1	1	1	2	2	1	0	0	0	0	5
1998	7	7	4	2	1	2	3	2	2	2	4	4	2	1	1	1	1	2	2	0	0	0	0	5
1999	7	6	6	3	2	1	2	3	1	1	2	4	4	2	1	1	1	0	2	2	0	0	0	4
2000	3	7	6	6	3	2	1	2	3	1	1	2	3	3	2	1	1	1	0	1	1	0	0	4
2001	5	3	6	5	5	3	1	1	1	2	1	1	2	3	3	2	1	1	1	0	1	1	0	4
2002	11	4	3	5	4	5	2	1	1	1	2	1	1	1	3	3	1	1	1	1	0	1	1	4
2003	17	10	4	2	5	4	4	2	1	1	1	2	1	1	1	2	2	1	1	1	1	0	1	4
2004	28	15	9	3	2	4	4	4	2	1	1	1	2	1	1	1	2	2	1	1	1	1	0	5
2005	9	25	14	8	3	2	4	3	3	2	1	1	1	1	1	1	1	2	2	1	1	1	1	4
2006	5	8	23	12	7	3	2	3	3	3	1	1	0	1	1	1	1	1	2	2	1	1	0	4
2007	6	4	7	20	11	6	2	2	3	2	3	1	1	0	1	1	1	1	1	1	1	1	0	4
2008	6	6	4	7	18	10	6	2	1	3	2	2	1	1	0	1	1	0	0	1	1	1	1	4
2009	7	5	5	3	6	16	9	5	2	1	2	2	2	1	1	0	0	1	0	0	1	1	1	4
2010	17	6	5	4	3	5	14	7	4	2	1	2	1	1	1	0	0	0	1	0	0	0	1	4
2011	10	15	5	4	4	3	4	12	6	3	1	1	1	1	1	1	0	0	0	0	0	0	0	3
2012	12	9	14	5	4	3	2	4	10	5	2	1	1	1	1	1	0	0	0	0	0	0	0	3
2013	6	10	8	12	4	3	3	2	3	8	4	2	1	0	1	1	1	0	0	0	0	0	0	3
2014	9	5	9	7	11	4	3	3	2	3	6	3	2	1	0	1	1	1	0	0	0	0	0	2
2015	10	8	5	8	7	10	3	3	2	1	2	5	2	1	0	0	1	0	0	0	0	0	0	2
2016	11	9	7	4	7	6	9	3	2	2	1	2	4	2	1	0	0	0	0	0	0	0	0	2
2017	6	10	8	7	4	7	5	7	3	2	2	1	2	4	2	1	0	0	0	0	0	0	0	2
2018	7	6	9	7	6	3	6	5	6	2	2	1	1	1	3	1	1	0	0	0	0	0	0	1
2019	6	6	5	8	7	5	3	5	4	6	2	1	1	1	1	3	1	1	0	0	0	0	0	1
2020	9	6	5	5	7	6	5	3	5	3	5	2	1	1	1	1	2	1	1	0	0	0	0	1
2021	3	8	5	5	4	6	5	4	2	4	3	4	1	1	1	0	1	2	1	0	0	0	0	1
2022	4	3	7	5	4	4	6	4	3	2	3	2	3	1	1	1	0	1	2	1	0	0	0	1
2023	10	4	2	6	4	4	3	5	4	3	2	3	2	3	1	1	1	0	1	1	1	0	0	1
2024	8	9	3	2	6	4	3	3	4	3	2	1	2	2	2	1	1	0	0	0	1	0	0	1

Table 7-8. Annual fishing mortality at full selection and exploitation rates for Kamchatka flounder.

	16.0b (2022)		16.0b (2024)	
Year	F	Exploitation	F	Exploitation
1991	0.02	0.01	0.02	0.01
1992	0.01	0.01	0.01	0.01
1993	0.01	0.01	0.01	0.01
1994	0.01	0.01	0.01	0.01
1995	0.01	0.01	0.01	0.01
1996	0.01	0.01	0.01	0.01
1997	0.01	0.01	0.01	0.01
1998	0.01	0.01	0.01	0.01
1999	0.01	0.01	0.01	0.01
2000	0.01	0.01	0.01	0.01
2001	0.01	0.01	0.01	0.01
2002	0.01	0.01	0.01	0.01
2003	0.01	0.01	0.01	0.01
2004	0.02	0.01	0.02	0.01
2005	0.01	0.01	0.01	0.01
2006	0.01	0.01	0.01	0.01
2007	0.01	0.01	0.01	0.01
2008	0.07	0.05	0.07	0.05
2009	0.13	0.09	0.13	0.08
2010	0.23	0.15	0.22	0.15
2011	0.12	0.08	0.12	0.08
2012	0.11	0.08	0.11	0.08
2013	0.1	0.07	0.10	0.07
2014	0.08	0.06	0.08	0.06
2015	0.07	0.04	0.07	0.04
2016	0.06	0.04	0.06	0.04
2017	0.06	0.04	0.06	0.04
2018	0.04	0.03	0.04	0.03
2019	0.05	0.04	0.05	0.04
2020	0.08	0.06	0.09	0.06
2021	0.07	0.05	0.08	0.06
2022	0.10	0.07	0.10	0.07
2023	-	-	0.08	0.06
2024	-	-	0.06	0.05

Table 7-9. Projections of catch (t), total biomass (t), spawning biomass (t), and fishing mortality rate for each of the seven management scenarios and for assessment model (model 16.b).

		1				
Year	SSB	Total Biomass	F	Catch	OFL	ABC
2025	44,883	106,850	0.07	5,773	8,019	6,800
2026	44,051	104,888	0.07	5,773	7,790	6,606
2027	42,846	103,216	0.09	6,374	7,517	6,374
2028	41,068	101,284	0.09	6,086	7,177	6,086
2029	39,325	100,042	0.09	5,870	6,924	5,870
2030	37,792	99,386	0.09	5,748	6,780	5,748
2031	36,638	99,146	0.09	5,696	6,719	5,696
2032	35,927	99,166	0.09	5,687	6,708	5,687
2033	35,591	99,394	0.09	5,682	6,701	5,682
2034	35,502	99,745	0.08	5,663	6,677	5,663
2035	35,589	100,208	0.08	5,661	6,675	5,661
2036	35,769	100,732	0.08	5,674	6,692	5,674
		2				
Year	SSB	Total Biomass	F	Catch	OFL	ABC
2025	44,883	106,850	0.07	5,773	8,019	6,800
2026	44,051	104,888	0.07	5,773	7,790	6,606
2027	42,846	103,216	0.09	6,374	7,517	6,374
2028	41,068	101,284	0.09	6,086	7,177	6,086
2029	39,325	100,042	0.09	5,870	6,924	5,870
2030	37,792	99,386	0.09	5,748	6,780	5,748
2031	36,638	99,146	0.09	5,696	6,719	5,696
2032	35,927	99,166	0.09	5,687	6,708	5,687
2033	35,591	99,394	0.09	5,682	6,701	5,682
2034	35,502	99,745	0.08	5,663	6,677	5,663
2035	35,589	100,208	0.08	5,661	6,675	5,661
2036	35,769	100,732	0.08	5,674	6,692	5,674

Table 7-9. Continued. Projections of catch (t), total biomass (t), spawning biomass (t), and fishing mortality rate for each of the seven management scenarios and for assessment model (model 16.b).

			3			
Year	SSB	Total Biomass	F	Catch	OFL	ABC
2025	44,883	106,850	0.07	5,773	8,019	6,358
2026	44,051	104,888	0.07	5,773	7,790	6,177
2027	42,866	103,216	0.08	5,961	7,517	5,961
2028	41,315	101,708	0.08	5,721	7,215	5,721
2029	39,773	100,826	0.08	5,544	6,993	5,544
2030	38,414	100,474	0.08	5,451	6,877	5,451
2031	37,411	100,497	0.08	5,421	6,839	5,421
2032	36,834	100,745	0.08	5,429	6,849	5,429
2033	36,617	101,174	0.08	5,456	6,882	5,456
2034	36,624	101,682	0.08	5,491	6,905	5,491
2035	36,774	102,238	0.08	5,528	6,918	5,528
2036	36,992	102,808	0.08	5,564	6,936	5,564
			4			
Year	SSB	Total Biomass	F	Catch	OFL	ABC
2025	44,883	106,850	0.07	5,773	8,019	3,469
2026	44,051	104,888	0.07	5,773	7,790	3,370
2027	42,995	103,216	0.04	3,252	7,517	3,252
2028	42,937	104,486	0.04	3,227	7,460	3,227
2029	42,777	106,061	0.04	3,224	7,456	3,224
2030	42,675	107,890	0.04	3,257	7,534	3,257
2031	42,812	109,867	0.04	3,316	7,672	3,316
2032	43,285	111,888	0.04	3,390	7,842	3,390
2033	44,050	113,935	0.04	3,468	8,023	3,468
2034	44,973	115,917	0.04	3,545	8,201	3,545
2035	45,979	117,820	0.04	3,619	8,371	3,619
2036	46,990	119,620	0.04	3,688	8,529	3,688
			5			
Year	SSB	Total Biomass	F	Catch	OFL	ABC
2025	44,883	106,850	0.07	5,773	8,019	0
2026	44,051	104,888	0.07	5,773	7,790	0
2027	43,146	103,216	0.00	0	7,517	0
2028	44,894	107,821	0.00	0	7,754	0
2029	46,545	112,583	0.00	0	8,034	0
2030	48,225	117,459	0.00	0	8,385	0
2031	50,107	122,375	0.00	0	8,787	0
2032	52,305	127,246	0.00	0	9,215	0
2033	54,787	132,063	0.00	0	9,648	0
2034	57,407	136,724	0.00	0	10,070	0
2035	60,087	141,217	0.00	0	10,477	0
2036	62,730	145,507	0.00	0	10,863	0

Table 7-9. Continued. Projections of catch (t), total biomass (t), spawning biomass (t), and fishing mortality rate for each of the seven management scenarios and for assessment model (model 16.b).

		6				
Year	SSB	Total Biomass	F	Catch	OFL	ABC
2025	44,775	106,850	0.10	8,019	8,019	8,019
2026	42,732	102,576	0.10	7,587	7,587	7,587
2027	40,560	99,116	0.10	7,153	7,153	7,153
2028	38,353	96,538	0.10	6,753	6,753	6,753
2029	36,275	94,808	0.10	6,455	6,455	6,455
2030	34,494	93,783	0.10	6,276	6,276	6,276
2031	33,167	93,258	0.10	5,985	5,985	5,985
2032	32,429	93,257	0.10	5,840	5,840	5,840
2033	32,143	93,613	0.09	5,809	5,809	5,809
2034	32,127	94,125	0.09	5,826	5,826	5,826
2035	32,272	94,707	0.09	5,868	5,868	5,868
2036	32,488	95,304	0.09	5,920	5,920	5,920
		7				
Year	SSB	Total Biomass	F	Catch	OFL	ABC
2025	44,834	106,850	0.09	6,800	8,019	8,019
2026	43,452	103,832	0.09	6,527	7,698	7,698
2027	41,812	101,420	0.10	7,358	7,358	7,358
2028	39,495	98,548	0.10	6,933	6,933	6,933
2029	37,301	96,546	0.10	6,612	6,612	6,612
2030	35,402	95,274	0.10	6,414	6,414	6,414
2031	33,953	94,527	0.10	6,225	6,225	6,225
2032	33,043	94,204	0.10	6,025	6,025	6,025
2033	32,614	94,304	0.10	5,942	5,942	5,942
2034	32,483	94,623	0.09	5,920	5,920	5,920
2035	32,536	95,062	0.09	5,933	5,933	5,933
2036	32,681	95,553	0.09	5,965	5,965	5,965

Table 7-10. Non-target catch (t) when Kamchatka flounder were fishery targets, 2015-2023.

Species Group Name	2023	2022	2021	2020	2019	2018	2017	2016	2015
Benthic urochordata	0.36	0.04		0.04	0.07	0.25			
Bivalves	0.00			0.01		0.00	0.00		
Bristlemouths			0.00	0.00	0.00		0.00	0.00	0.00
Brittle star unidentified	0.035	0.01	0.01	0.22	0.93	0.00	0.05		
Capelin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Corals	1.20	1.57	0.67	0.14	0.35		0.14	1.34	0.37
Bryozoans - Corals Bryozoans Unidentified									
Eelpouts	15.90	6.79	4.53	4.74	2.58	0.62	2.71	2.52	1.49
Eulachon	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Giant Grenadier	1,308.5	605.9	700.0	995.4	1889.	1248.	3012.	76.8	171.6
Greenlings	0.04		0.00			0.00			
Grenadier - Rattail Grenadier Unidentified	5.69	272.2			118.2			2.14	0.41
Hermit crab unidentified	0.01	0.02		0.03	0.01	0.00		0.00	0.00
Invertebrate unidentified						0.00			
Lanternfishes (myctophidae)	0.04	0.52	0.44	0.06	0.00		0.00		0.30
Misc crabs	0.37	0.07	0.01	1.39	1.00	0.03	0.05	0.12	0.03
Misc crustaceans		0.03			0.00	0.00		0.00	0.27
Misc deep fish		0.30	0.10	0.00	0.00	0.00	0.00		
Misc fish	9.54	9.43	7.29	4.32	2.97	0.56	0.36	1.45	0.32
Misc inverts (worms etc)	0.01	0.01	0.01	0.01					

Table 7-10. Continued.

Species Group Name	2023	2022	2021	2020	2019	2018	2017	2016	2015
Other osmerids	0.00		0.00			0.00	0.00	0.00	0.00
Pacific Sand lance	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pandalid shrimp	0.27	0.18	0.16	0.28	0.48	0.04	0.04	0.28	0.13
Polychaete unidentified	0.00		0.00		0.01		0.00		
Saffron Cod	0.00	0.00	0.00				0.00	0.00	0.00
Sculpin	35.04	42.09	13.44	0.00	0.00	0.00	0.00	0.00	0.00
Scypho jellies	2.11	0.18	1.31	1.17	0.78	0.03	0.00	0.68	
Sea anemone unidentified	2.36	0.45	0.11	2.82	2.82	0.87	0.47		0.14
Sea pens whips				0.07				0.00	
Sea star	4.46	1.83	0.55	4.18	6.33	2.42	0.40	0.83	1.70
Snails	0.19	0.05	0.02	0.13	0.13	0.03			
Sponge unidentified	6.136	6.46	2.57	2.73	4.04	0.46	1.57	6.55	11.54
Squid	429.78	92.29	146.64	82.65	36.72	0.00	0.00	0.00	0.00
State-managed Rockfish				0.00	0.00	0.00	0.00	0.00	0.00
Stichaeidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
urchins dollars cucumbers	0.964	0.34	0.05	0.16	0.26	0.07	0.16		0.12

Table 7-11. Prohibited species catch when Kamchatka flounder were fishery targets, 2015-2023. Catch of halibut is in tons and crab, herring, and salmon are in number of fish.

Species Group Name	2023	2022	2021	2020	2019	2018	2017	2016	2015
Bairdi Tanner Crab	210	128	5	620	306	8	101	0	0
Blue King Crab	0	0	0	0	0	0	0	0	0
Chinook Salmon	24	0	0	0	0	0	0	0	0
Golden (Brown) King Crab	2,852	3,014	1,010	1,998	2,670	631	3,259	4,000	3,052
Halibut	86	71	81	72	55	9	33	22	58
Herring	0	0	0	0	0	0	0	0	0
Non-Chinook Salmon	56	71	0	0	0	0	0	0	85
Opilio Tanner (Snow) Crab	61	0	0	190	1,188	457	0	0	0
Red King Crab	65	0	0	0	37	0	0	378	0

Table 7-12. Noncommercial catch of Kamchatka flounder in a) numbers and b) weight (kg), 2015-2023.

a)

Number Collection program	2015	2016	2017	2018	2019	2020	2021	2022	2023
AFSC Annual Longline Survey					302	381	505	362	374
Aleutian Island Bottom Trawl Survey		4,336		4,865				2,788	
Atka Tagging Survey									
Bering Sea Slope Survey		2,976							
Eastern Bering Sea Bottom Trawl Survey	4,434	4,512	4,113	3,298	2,840		2,133	1,747	1,504
IPHC Annual Longline Survey					0	0		0	1
Northern Bering Sea Bottom Trawl Survey			3	9	3		1		
Pollock EFP 11-01									
St. Matthews Crab Survey			1						
Summer EBS Survey with Russia									

Table 7-12. Continued.

b)

Weight (kg) Collection program	Year 2015	2016	2017	2018	2019	2020	2021	2022	2023
AFSC Annual Longline Survey					564	1,014	1,095	958	719
Aleutian Island Bottom Trawl Survey		3,095		5,016				1,767	
Atka Tagging Survey									
Bering Sea Slope Survey		4,196							
Eastern Bering Sea Bottom Trawl Survey	2,222	2,069	1,869	1,603	1,638		1,218	1,179	958
IPHC Annual Longline Survey	94	38	451	235	215	9		325	
Northern Bering Sea Bottom Trawl Survey			3	11	2		1		
Pollock EFP 11-01									
St. Matthews Crab Survey			3						
Summer EBS Survey with Russia									

Figures

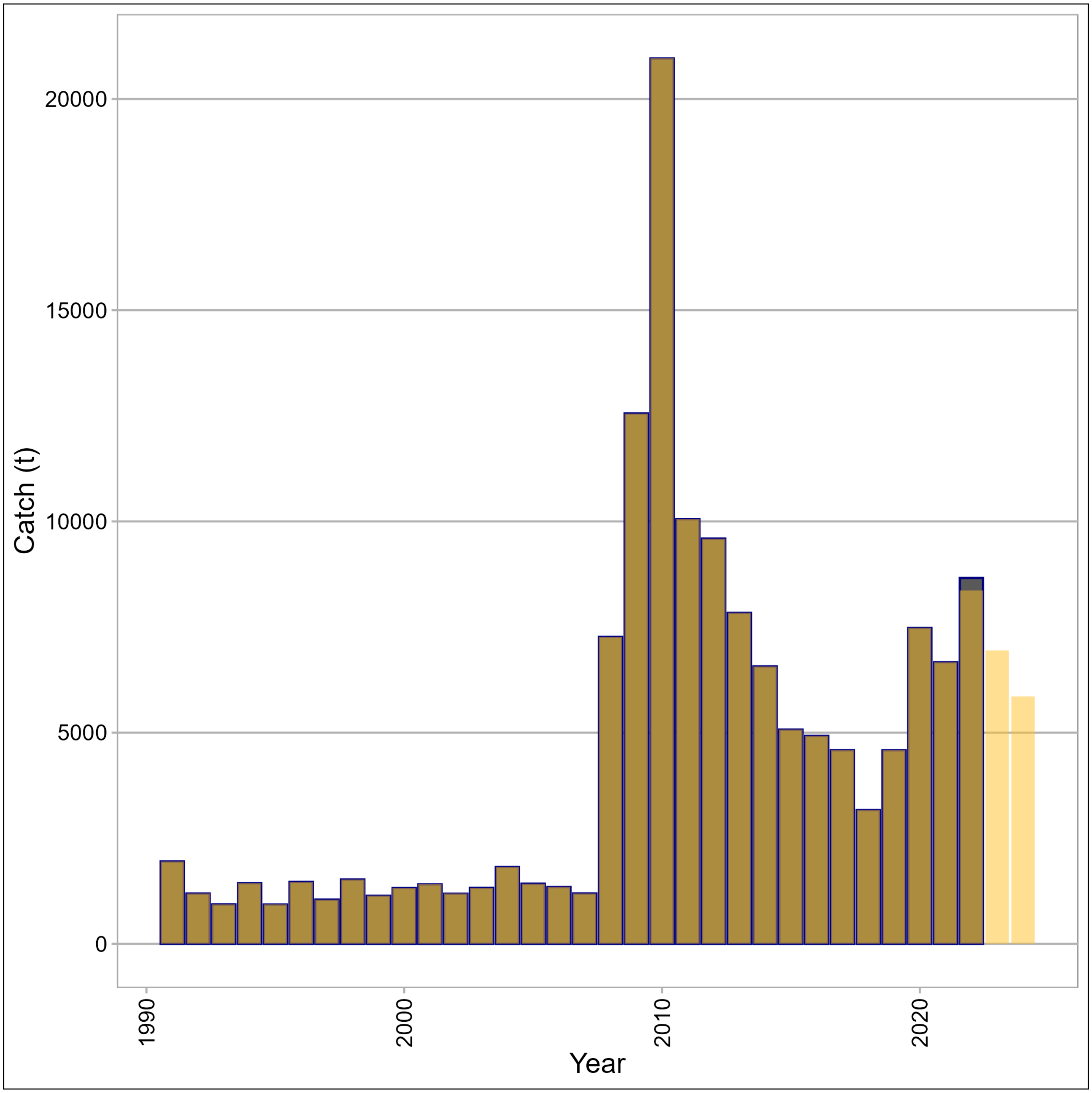


Figure 7-1. Catch in metric tons from the 2022 assessment (blue) and the updated data for the 2024 assessment (yellow). The 2024 catch is a preliminary and is extrapolated from the catch on September 23, 2024 (4,811) and an expansion factor of 1.03.

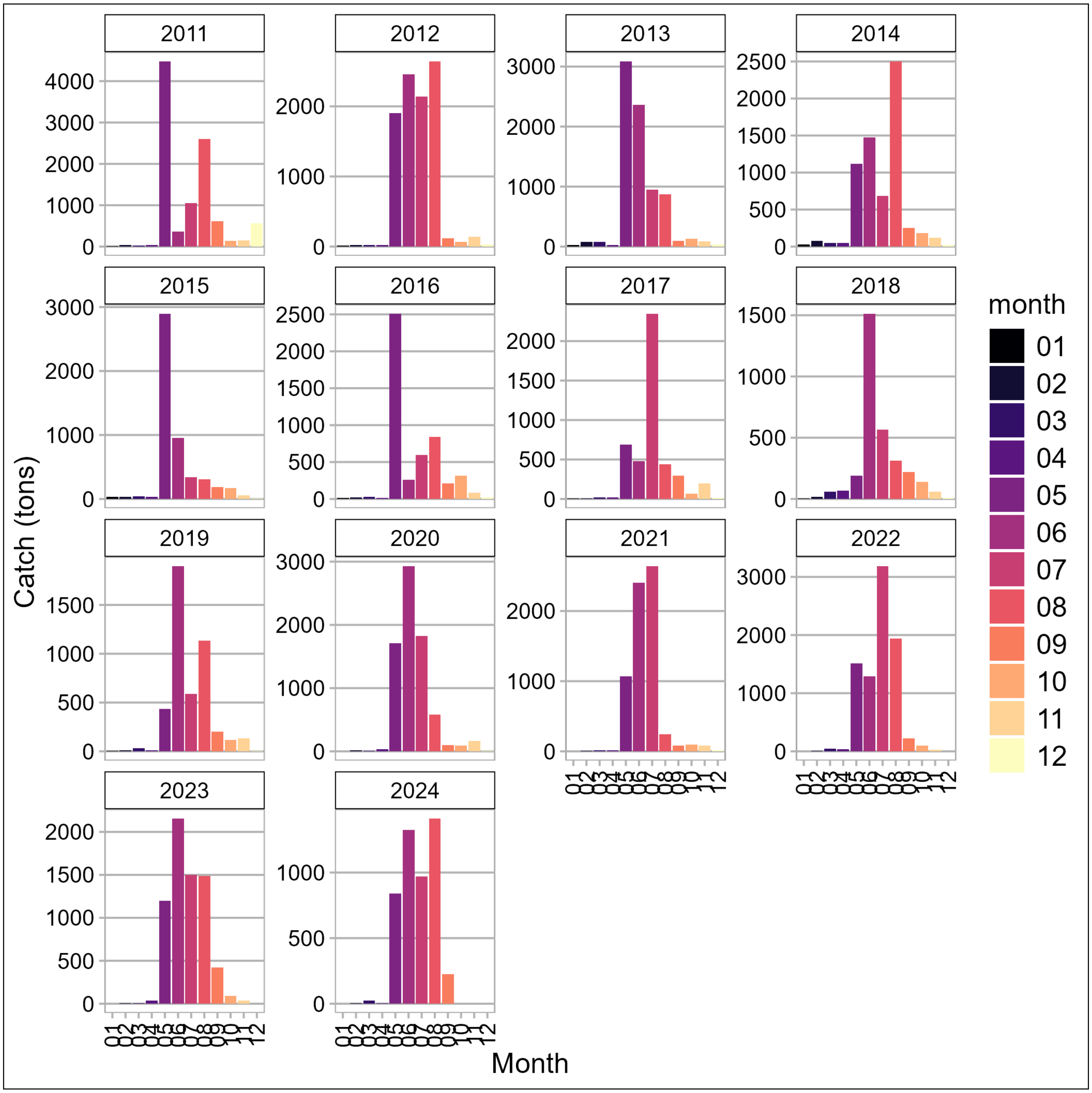
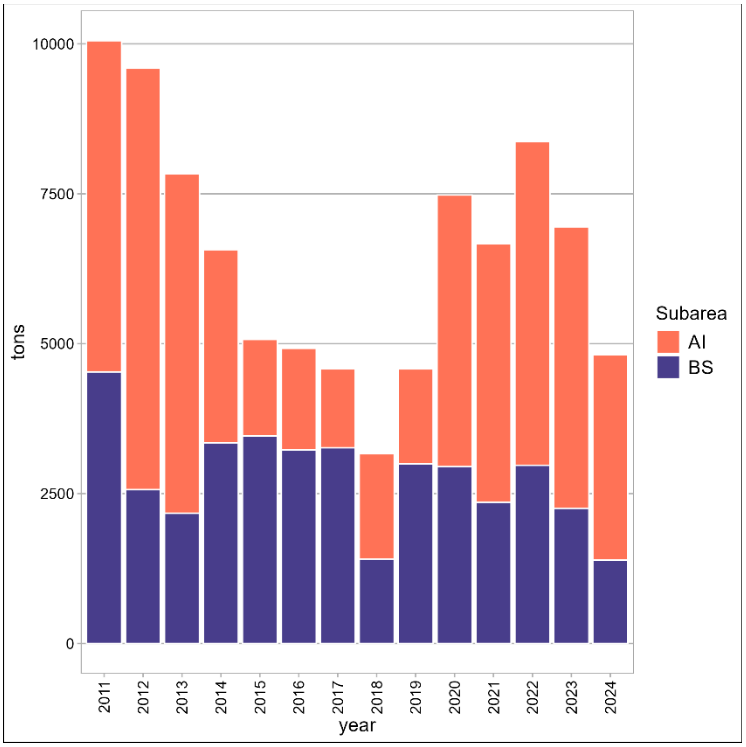


Figure 7-2. Kamchatka flounder catch (t) by month from Alaska Regional Office catch reports for years 2011-2022. The 2022 data are through October 24, 2022.

a)



b)

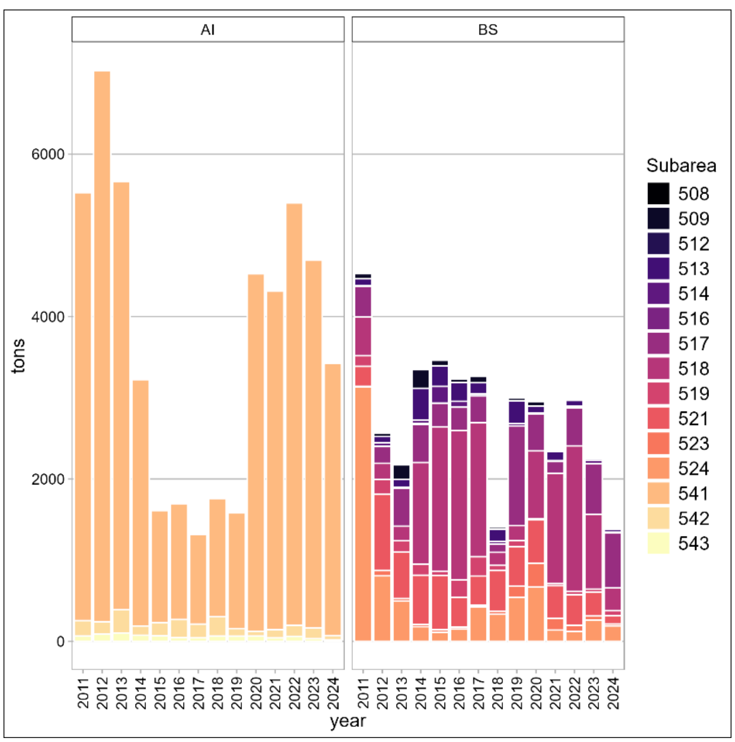


Figure 7-3. Proportion of Kamchatka catch by a) region and b) NMFS area. Color scale defines area.

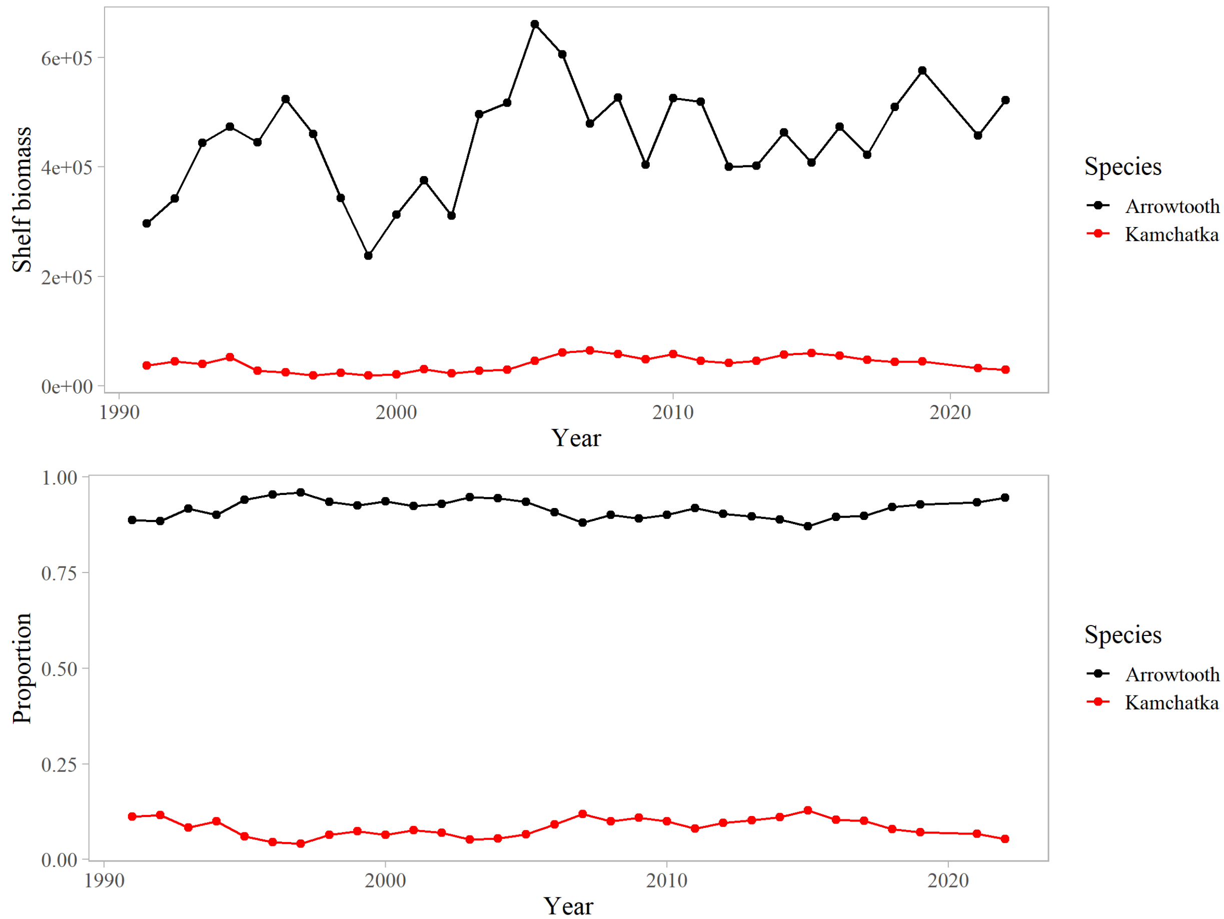


Figure 7-4. RACE EBS trawl survey biomass (t) estimates for arrowtooth flounder and Kamchatka flounder (top panel) and their annual proportions (bottom panel).

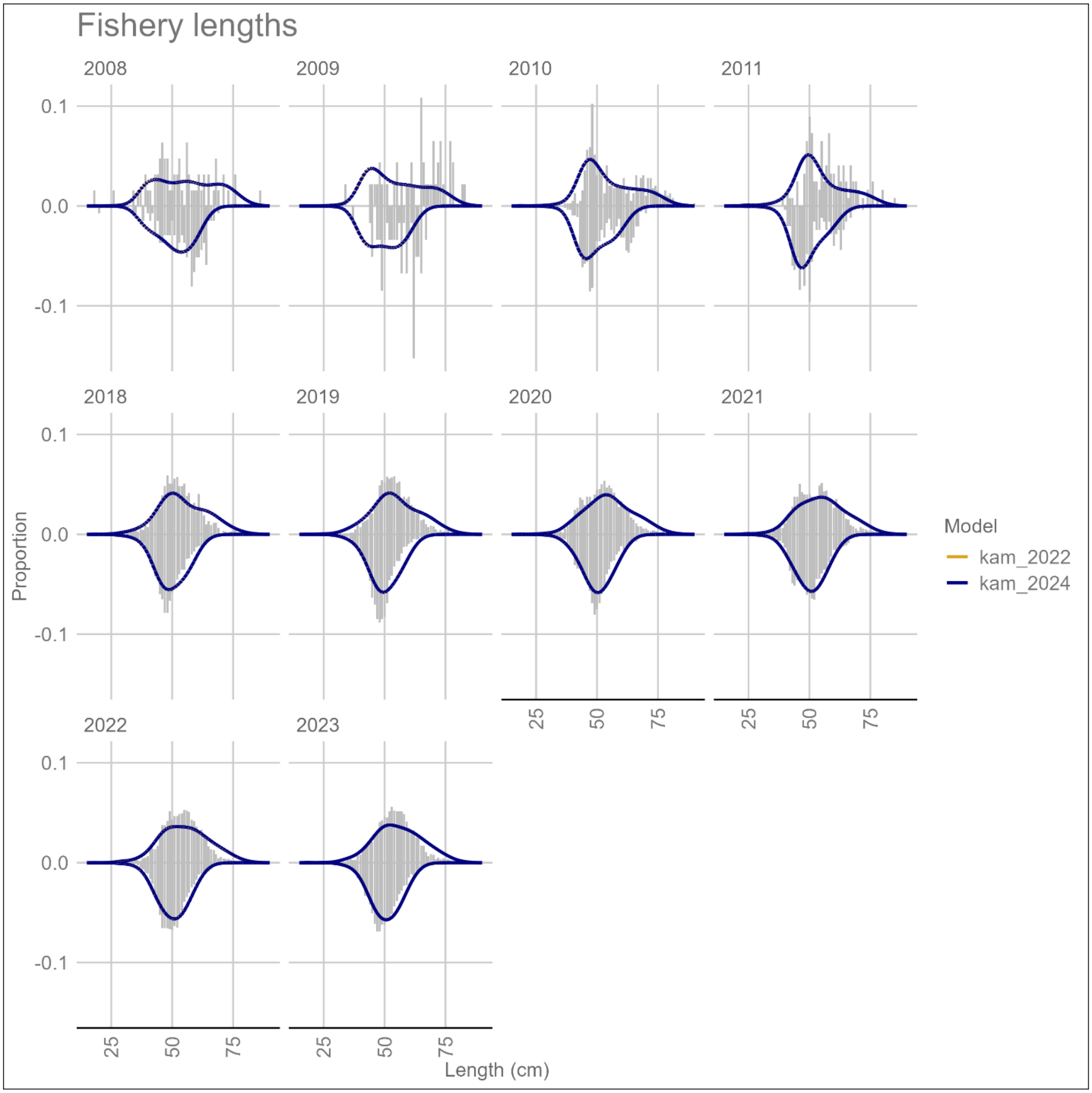


Figure 7-5. Fishery length composition data and model fit. Proportions sum to one across sex, where females are represented by positive numbers and males are represented by negative numbers. An annual input sample size of 25 per year is used for the fishery length composition data.

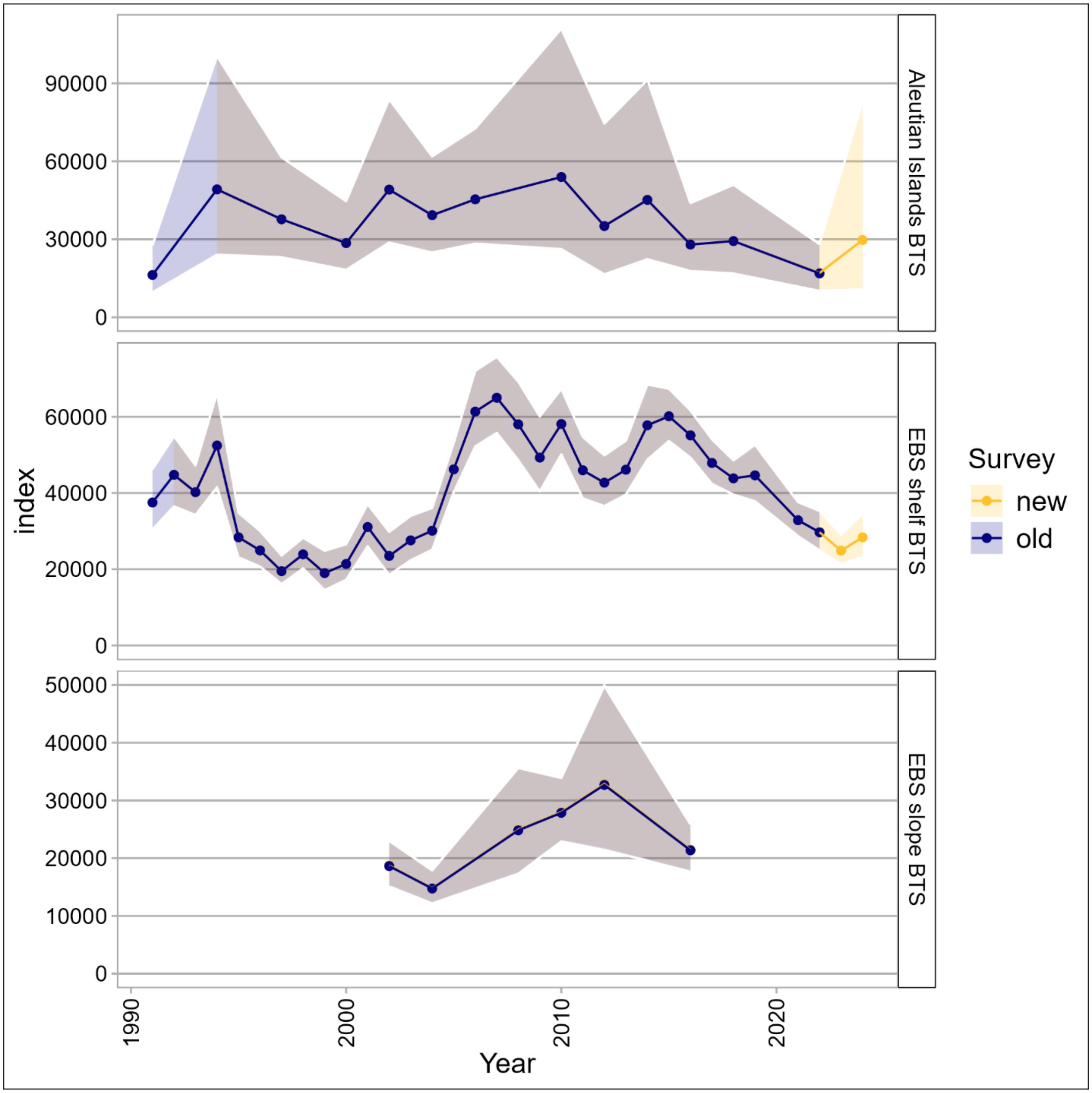


Figure 7-6. The biomass (t) estimates from the AFSC bottom trawl surveys used in the 2022 assessment and the 2024 (current) assessment.

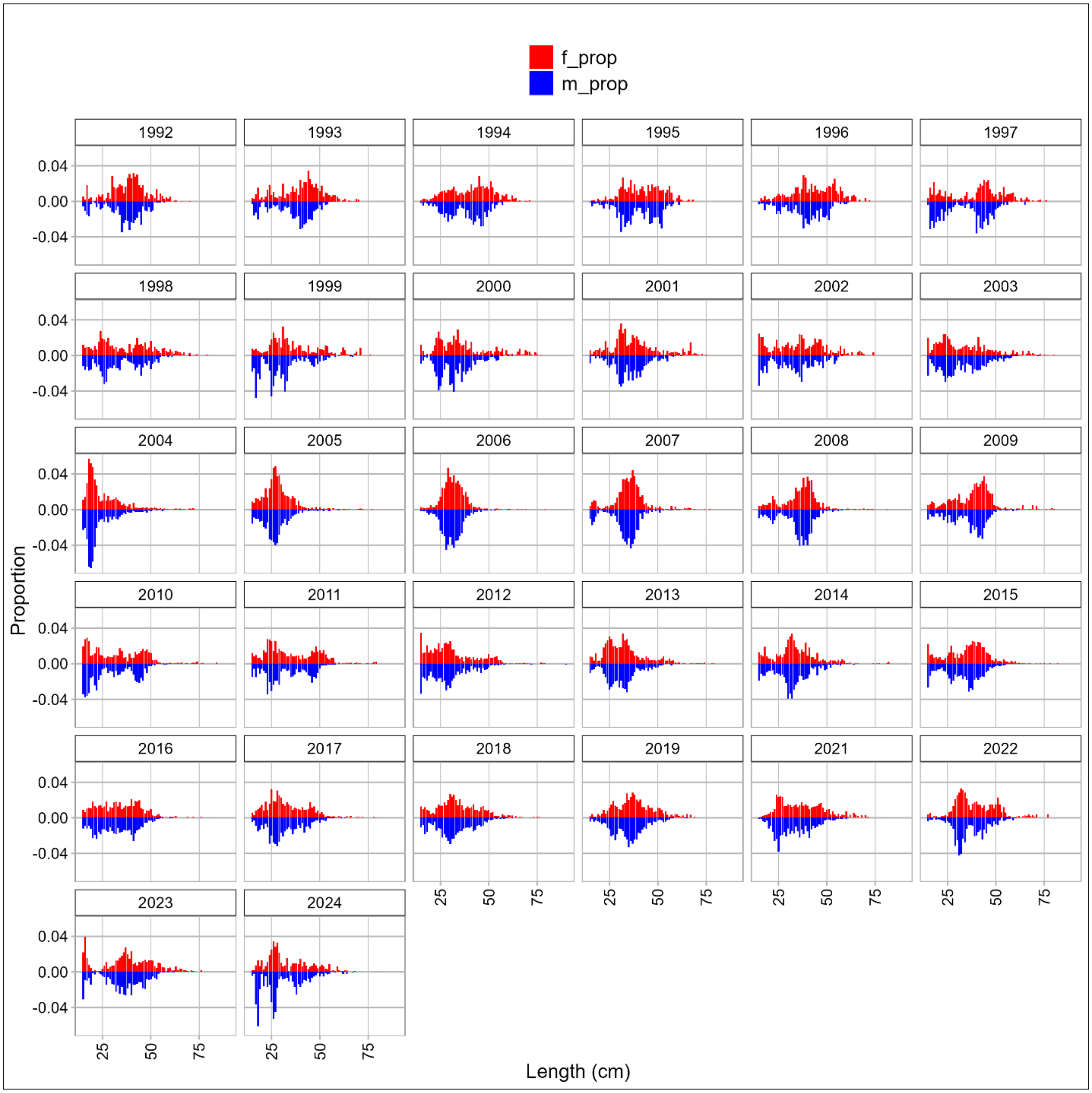


Figure 7-7. The EBS Shelf Bottom trawl survey length composition data normalized to one across sexes. Females are represented by positive numbers and males are shown as negative numbers.

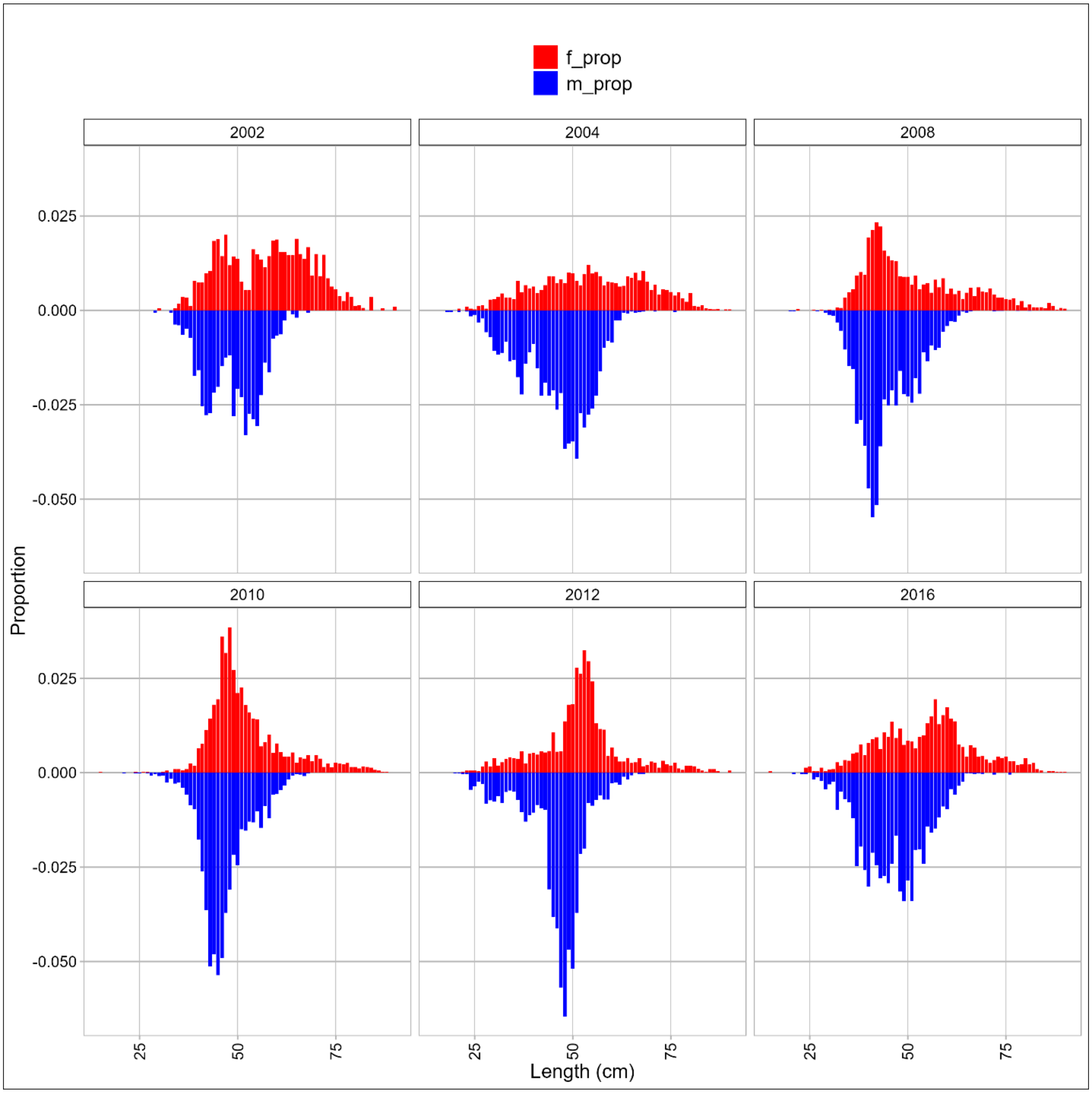


Figure 7-8. The EBS Slope Bottom Trawl Survey length composition data normalized to one across sex.

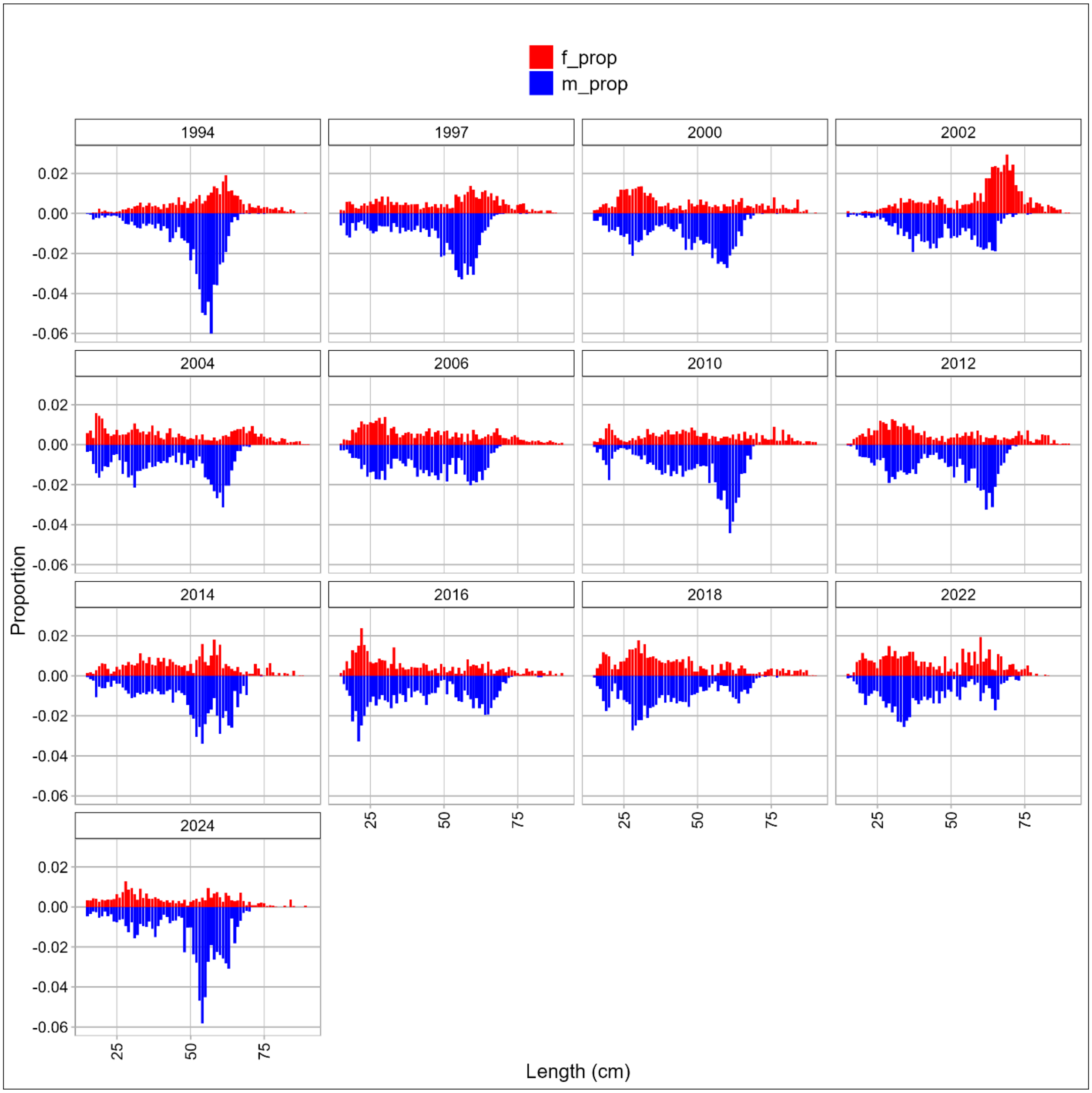
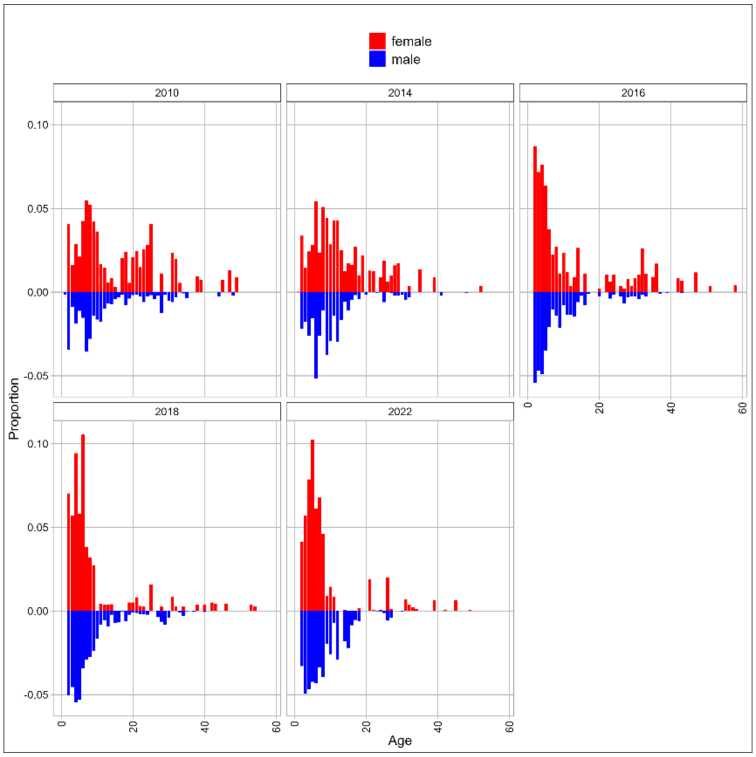


Figure 7-9. The Aleutian Islands Bottom Trawl Survey length composition data normalized to one across sexes.

a)



b)

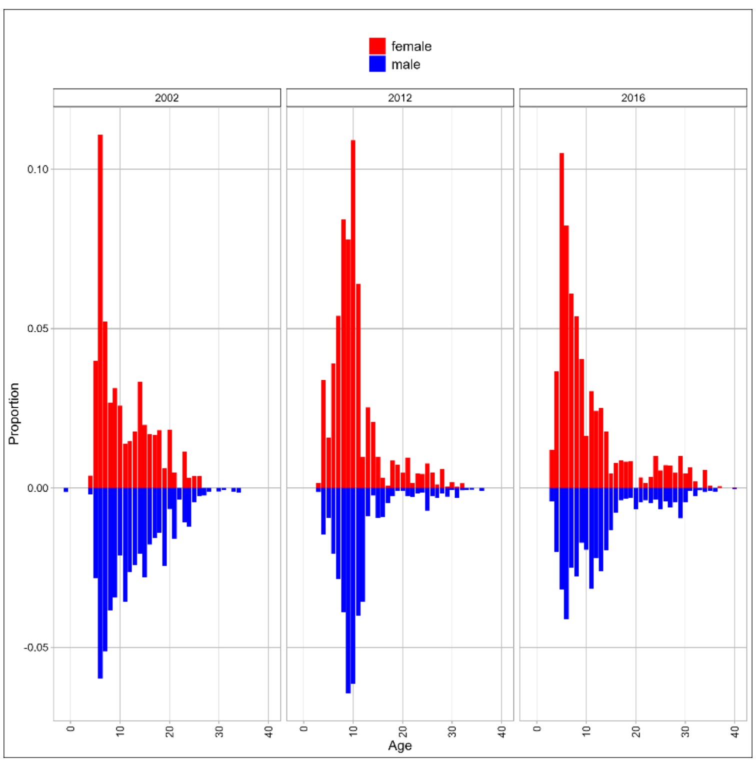
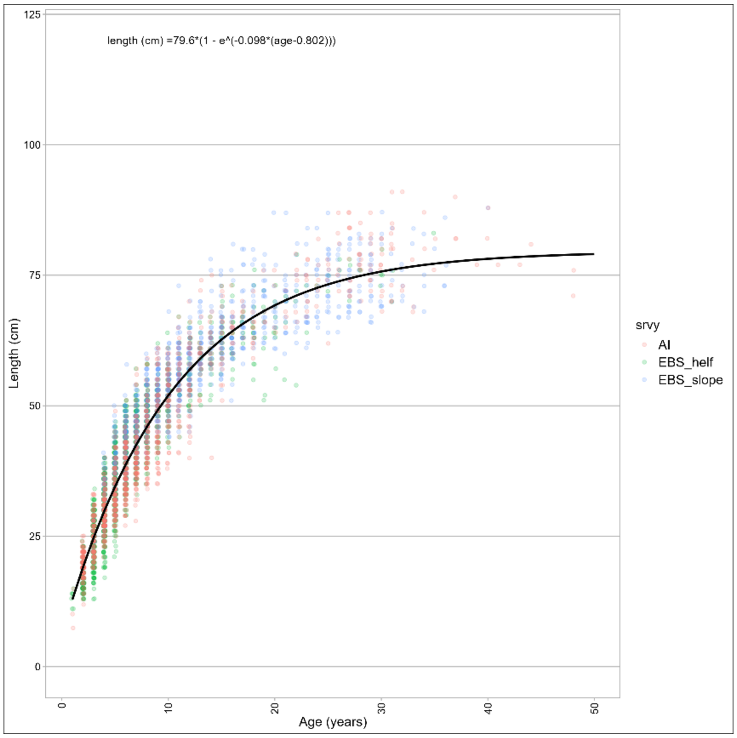


Figure 7-10. Normalized age compositions from a) the Aleutian Islands bottom trawl survey and b) the EBS slope bottom trawl survey by sex and year.

a)



b)

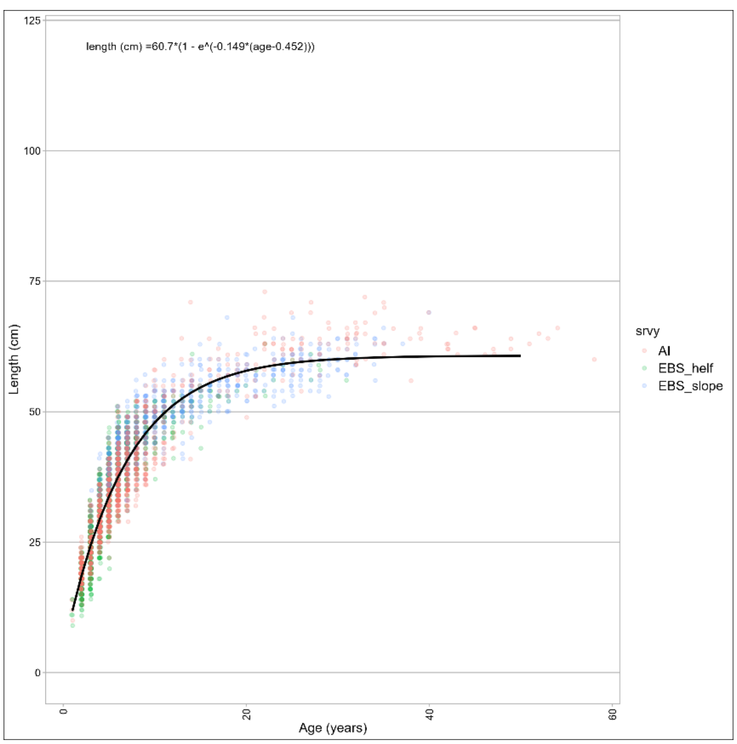
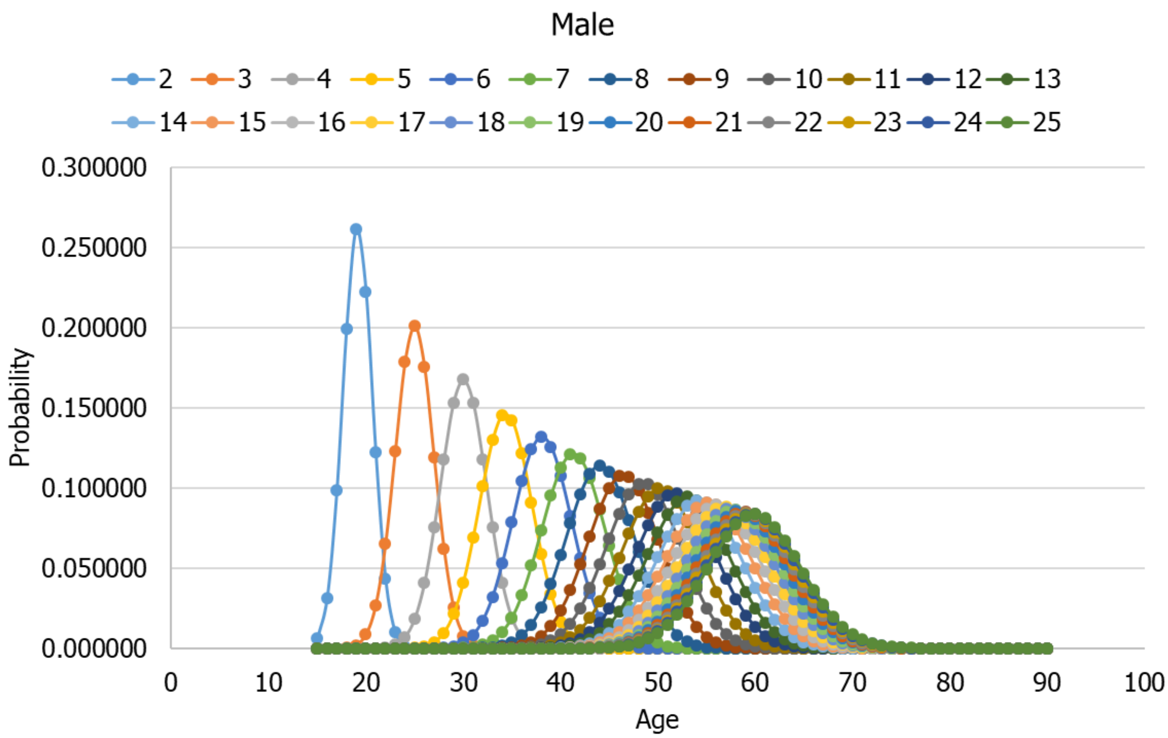


Figure 7- 11. von Bertalanffy growth model fits to a) female and b) male length at age data. Red points represent the AI survey, green points represent the EBS shelf survey, and blue points represent the EBS slope survey.

a)



b)

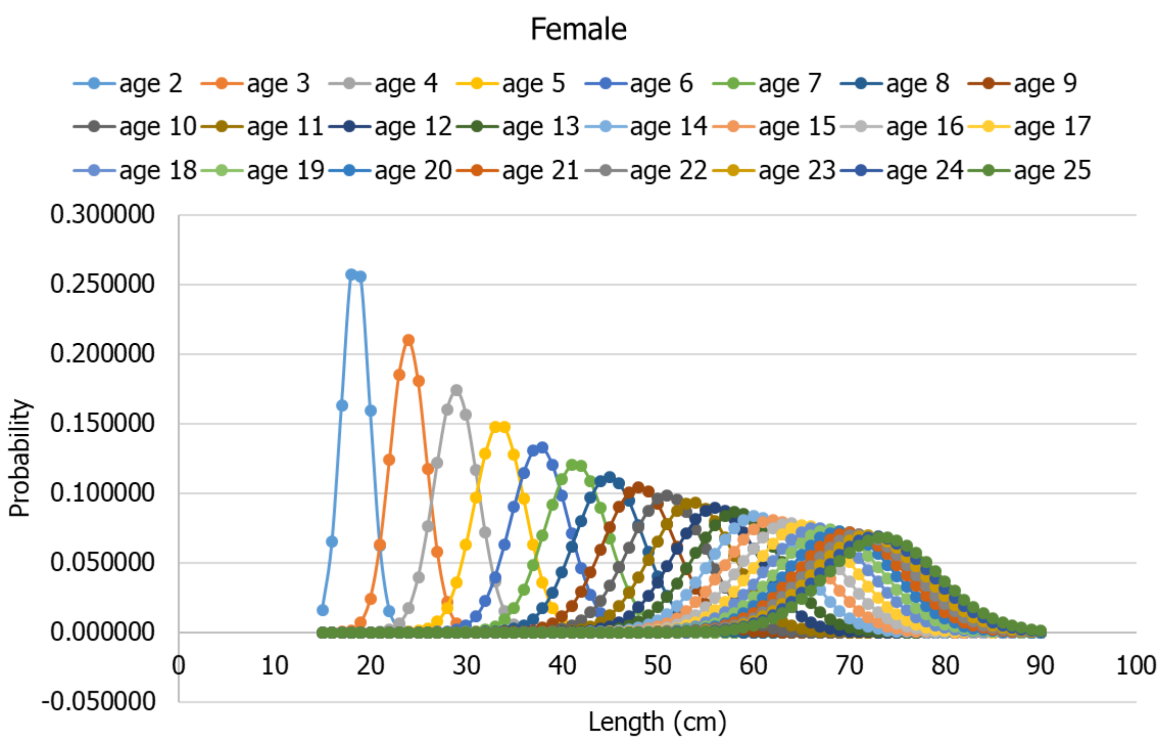


Figure 7-12. Age-length transition matrices assuming an 8% CV for all ages for a) males and b) females.

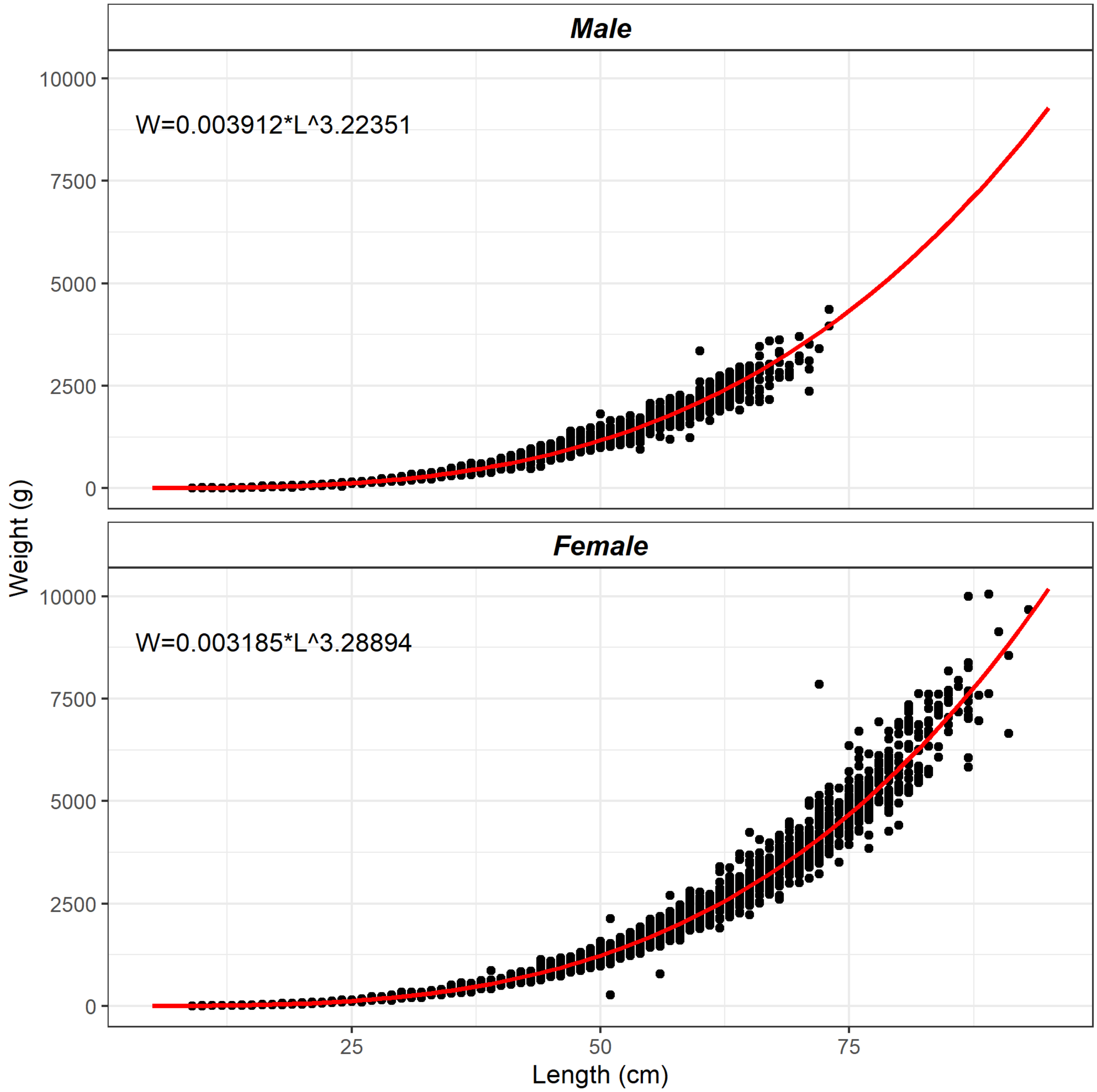


Figure 7-13. Sex-specific Kamchatka flounder length-weight relationships.

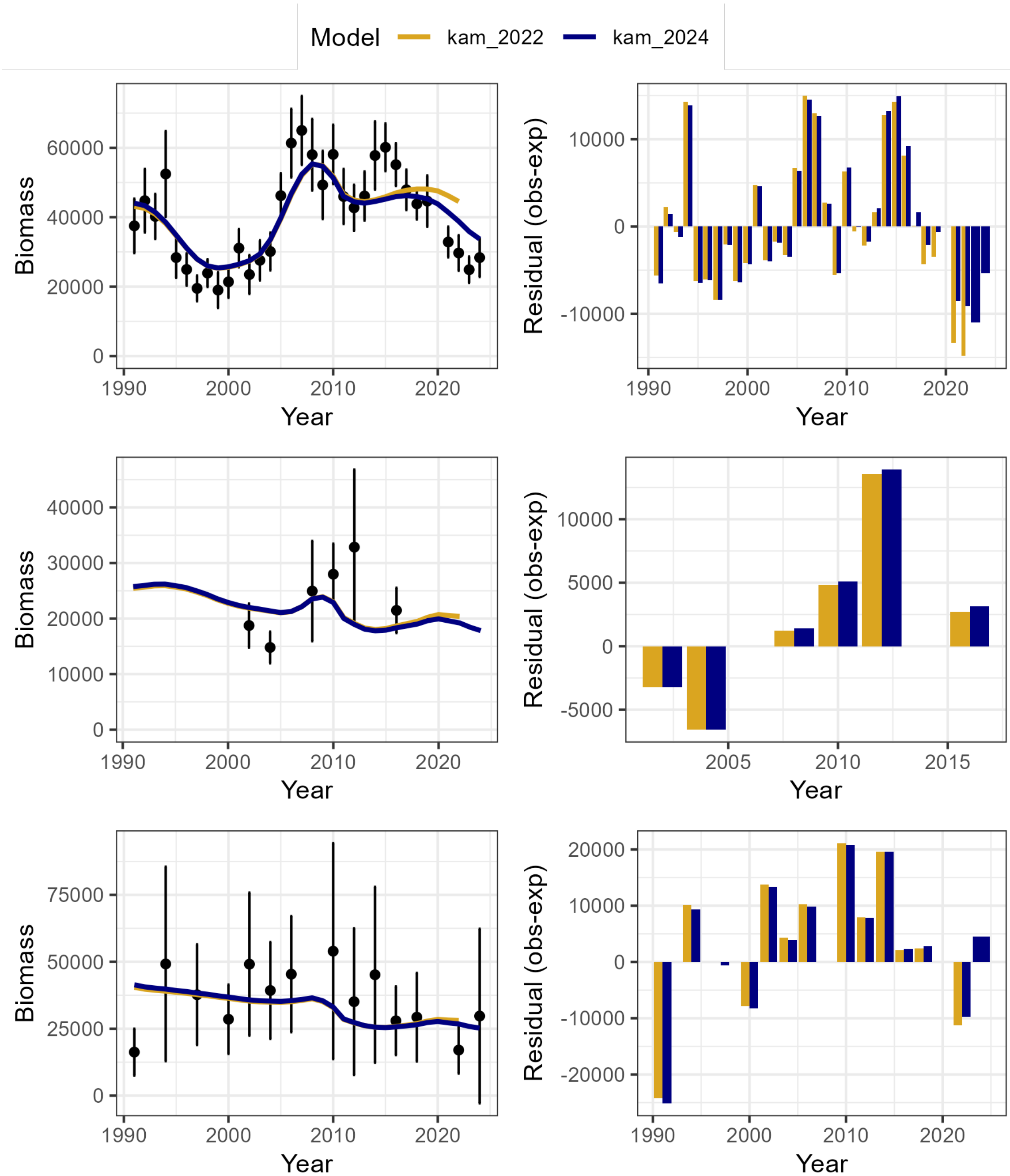


Figure 7-14. Model fit to the EBS shelf (top panels), EBS slope (middle panels), and the Aleutian Islands (bottom panels) bottom trawl survey biomass estimates and corresponding residuals for models and the 2020 assessment and current assessment. Root mean square error values are reported in Table 7-8.

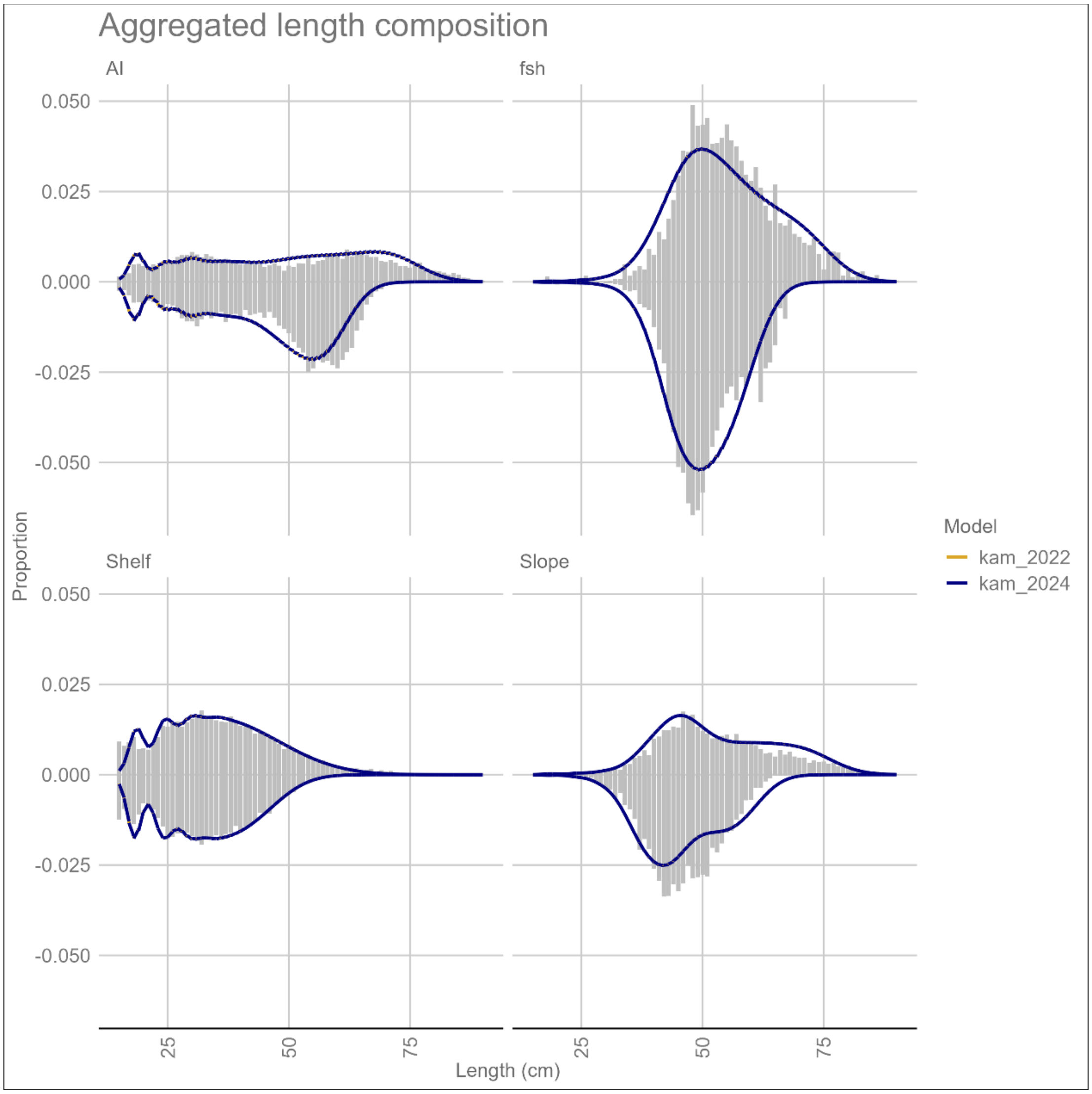


Figure 7-15. Fits to the aggregated Aleutian Islands bottom trawl survey (AI), fishery (fsh), EBS shelf bottom trawl survey (Shelf) and EBS slope bottom trawl survey (Slope) length composition data. Females lengths are represented by positive values and males are represented by negative values.

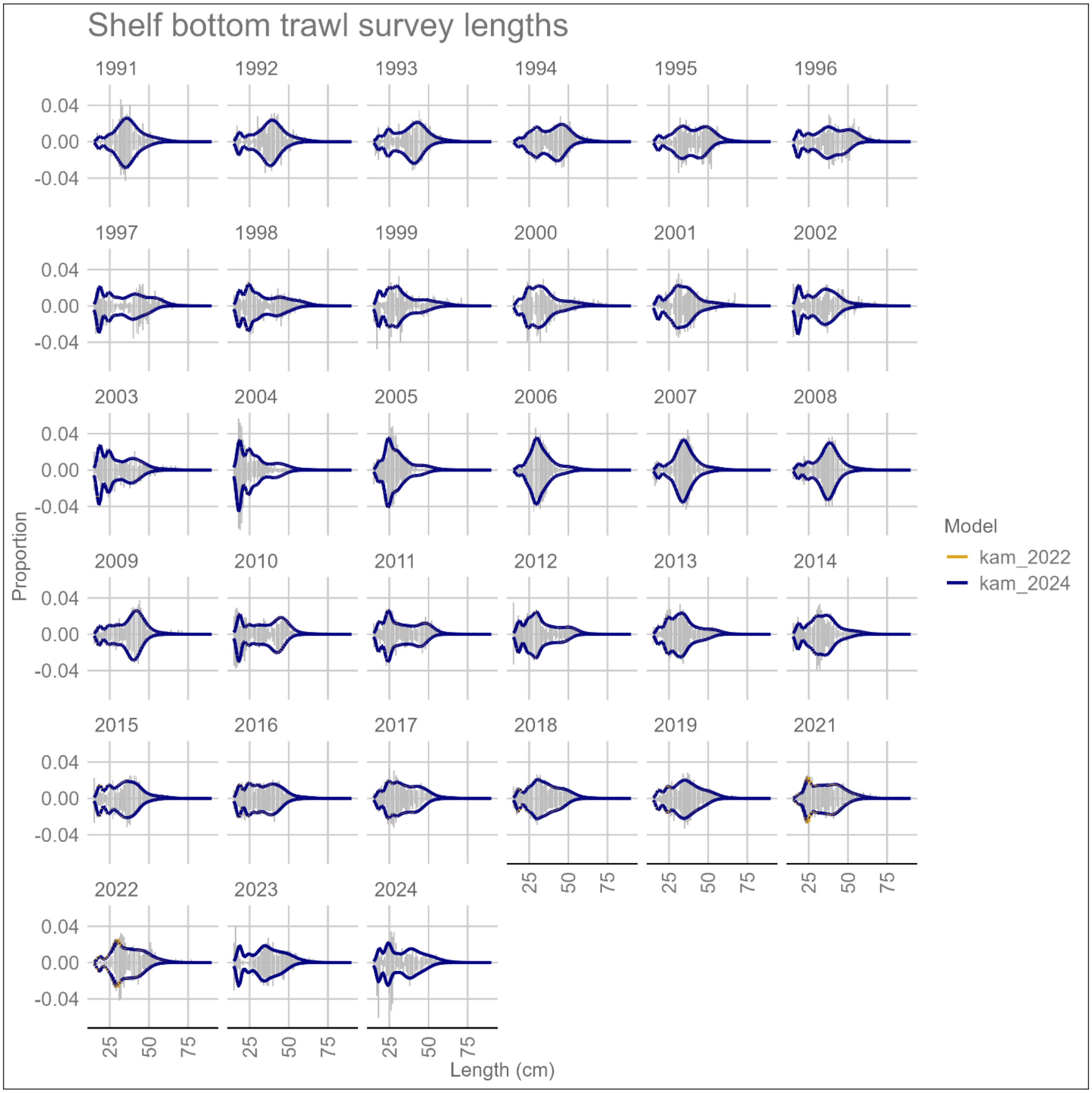


Figure 7-16. Fits to the EBS shelf bottom trawl survey annual length composition. Females lengths are represented by positive values and males are represented by negative values.

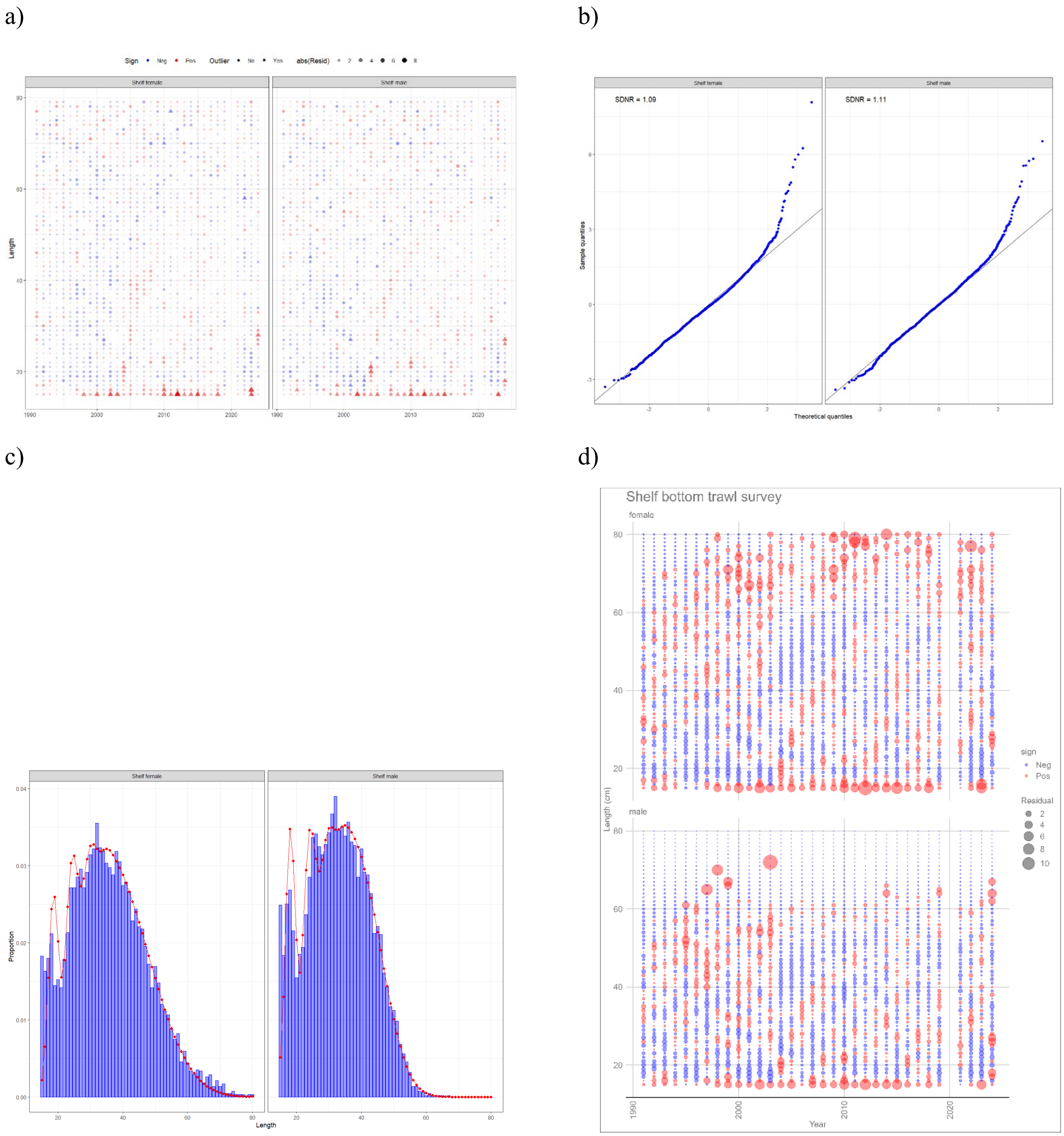


Figure 7-17. a) OSA residuals, b) q-q plot, c) overall fit, and d) Pearson residuals for the EBS shelf bottom trawl survey length composition data.

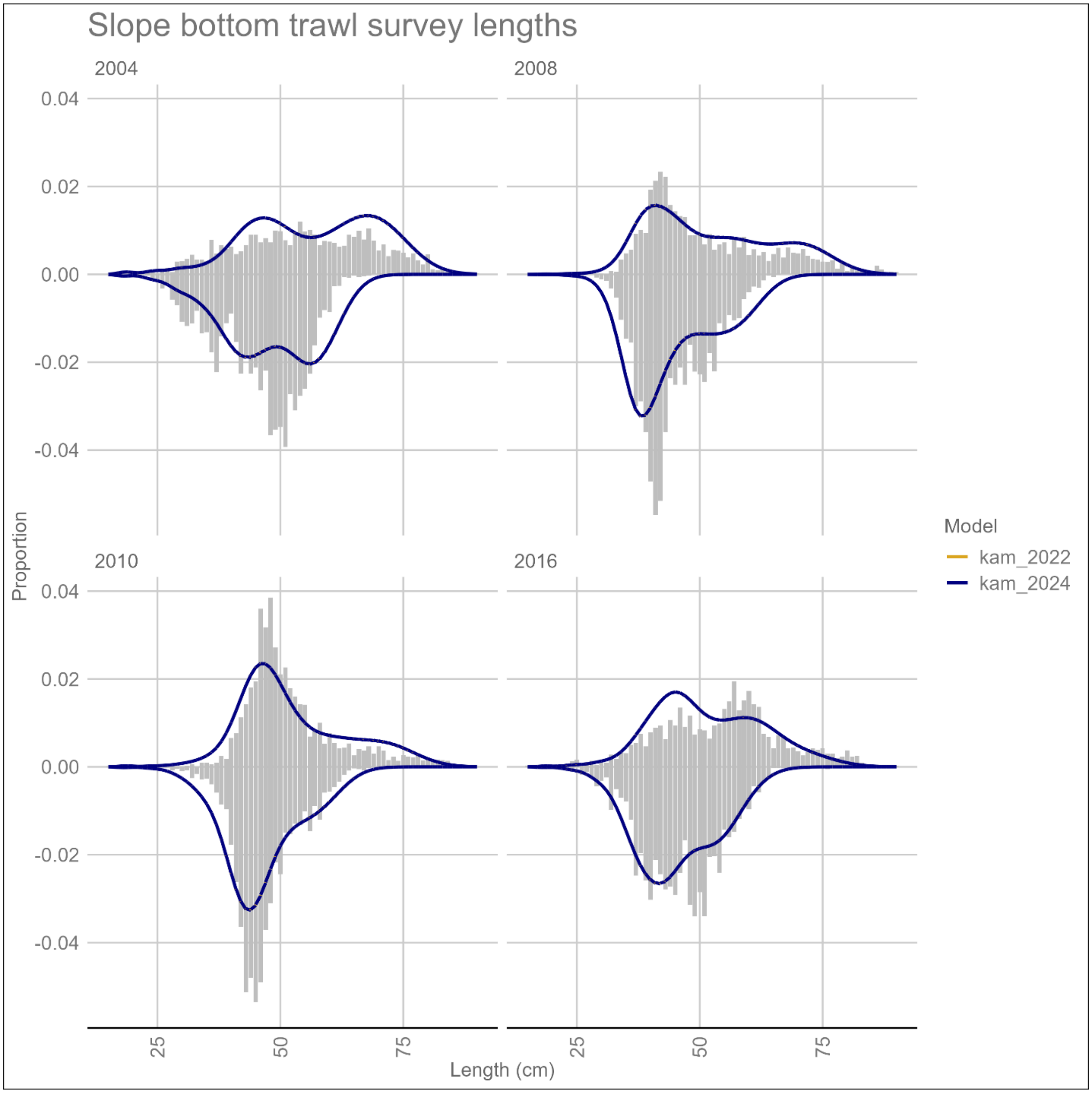


Figure 7-18. Fits to the EBS slope bottom trawl survey annual length composition data. Females lengths are represented by positive values and males are represented by negative values.

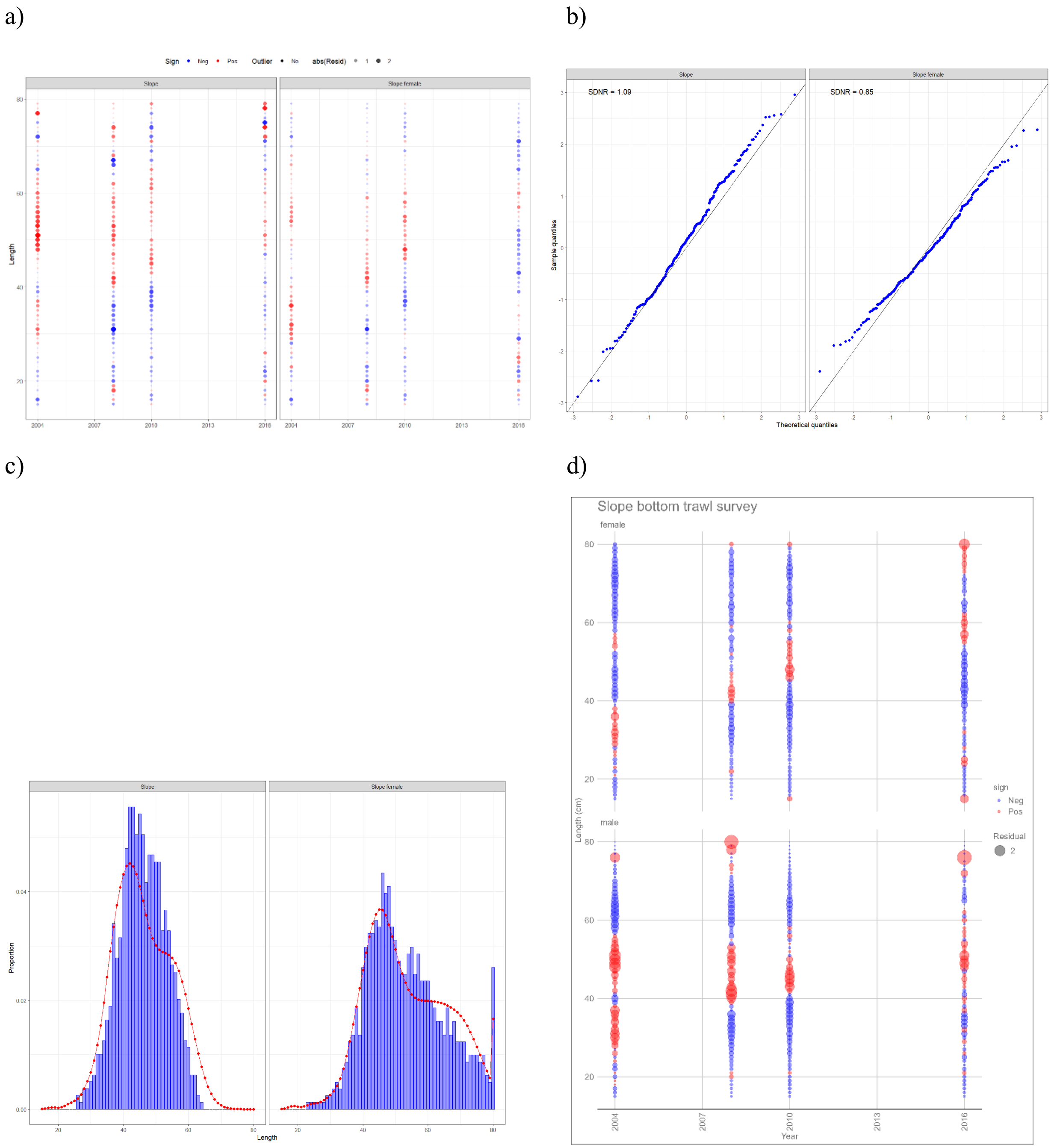


Figure 7-19. a) OSA residuals, b) q-q plot, c) overall fit, and d) Pearson residuals for the EBS slope bottom trawl survey length composition data.

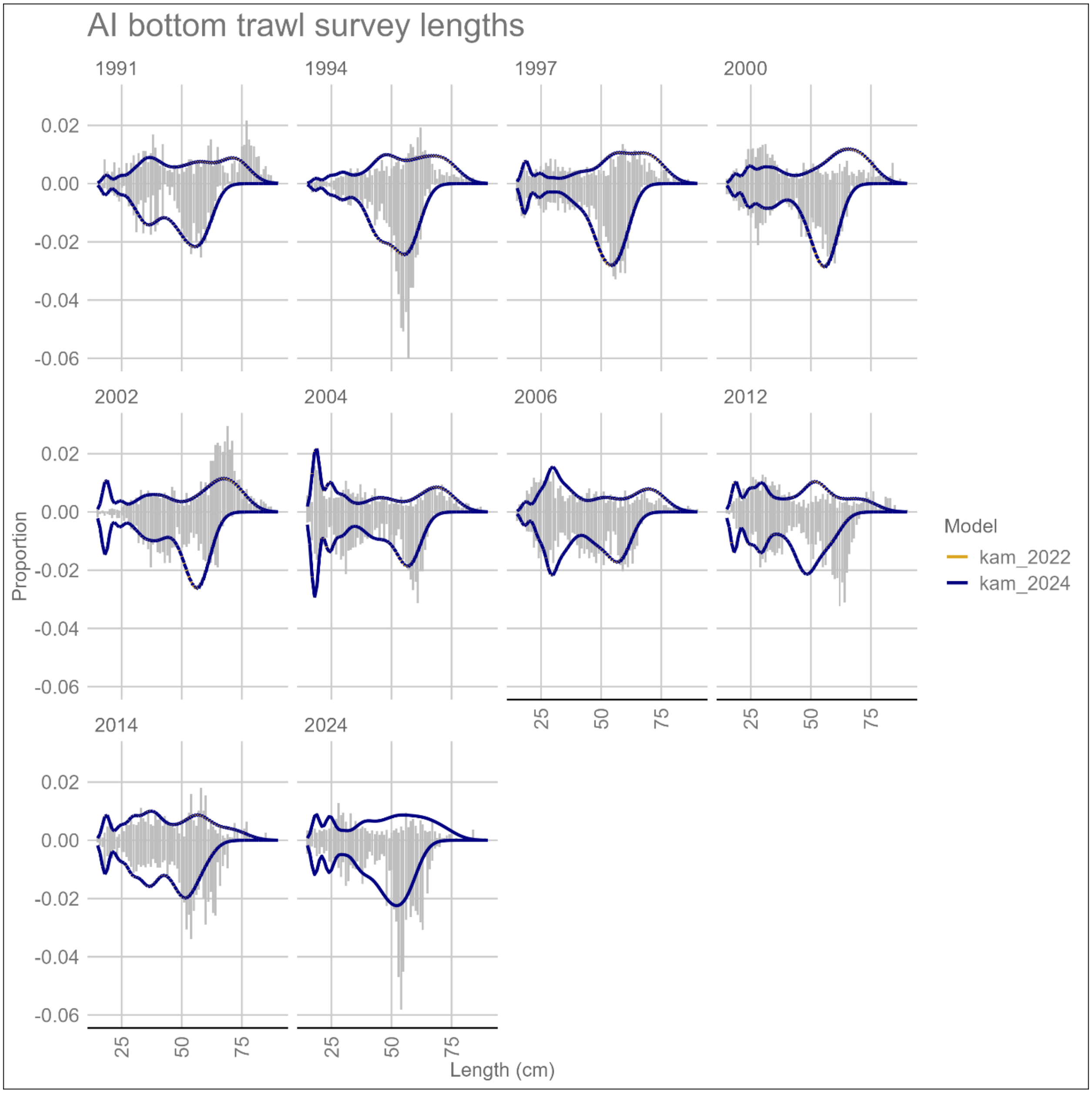


Figure 7-20. Fits to the Aleutian Islands bottom trawl survey annual length composition data. Females lengths are represented by positive values and males are represented by negative values.

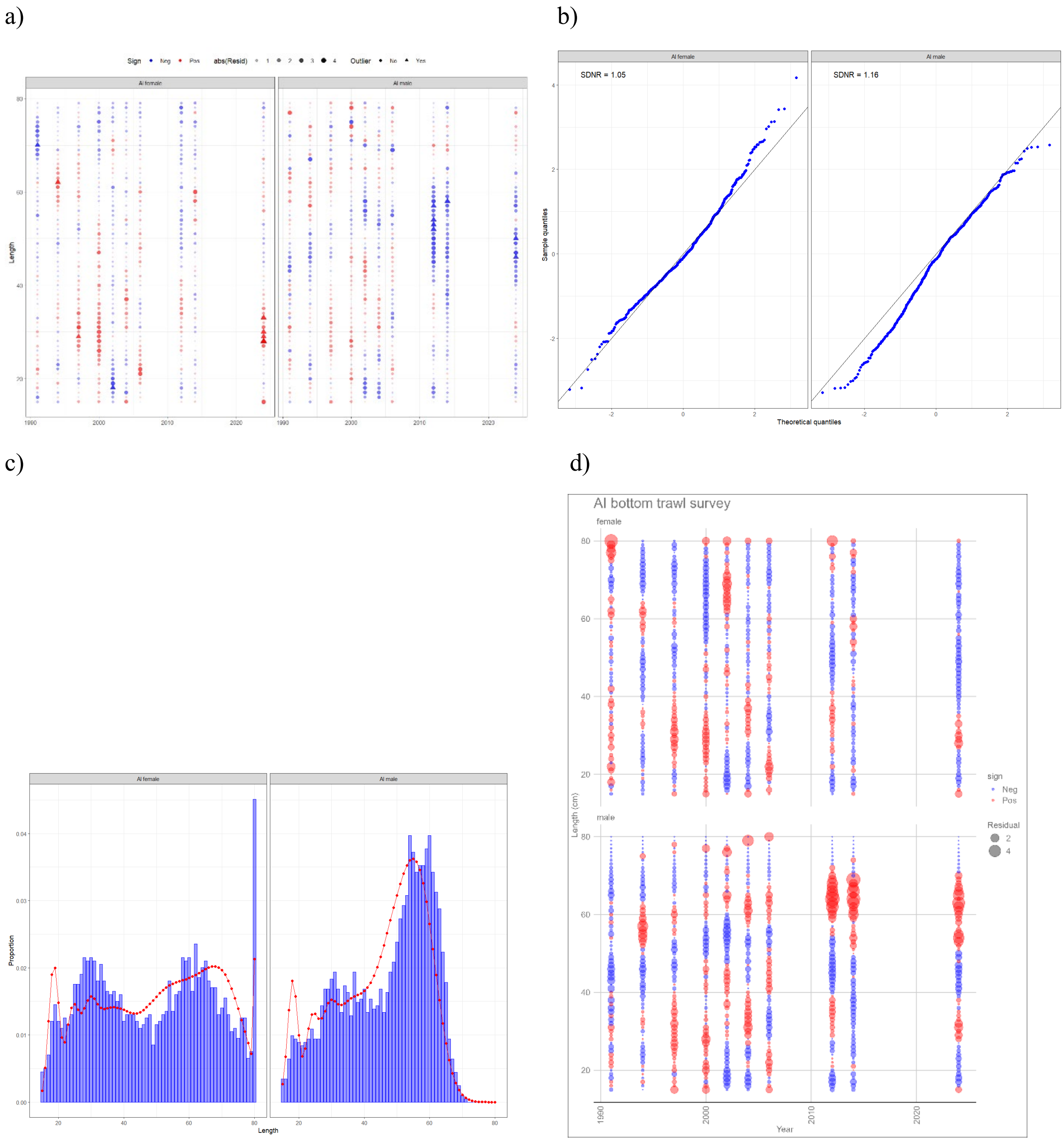


Figure 7-21. a) OSA residuals, b) q-q plot, c) overall fit, and d) Pearson residuals for the AI bottom trawl survey length composition data.

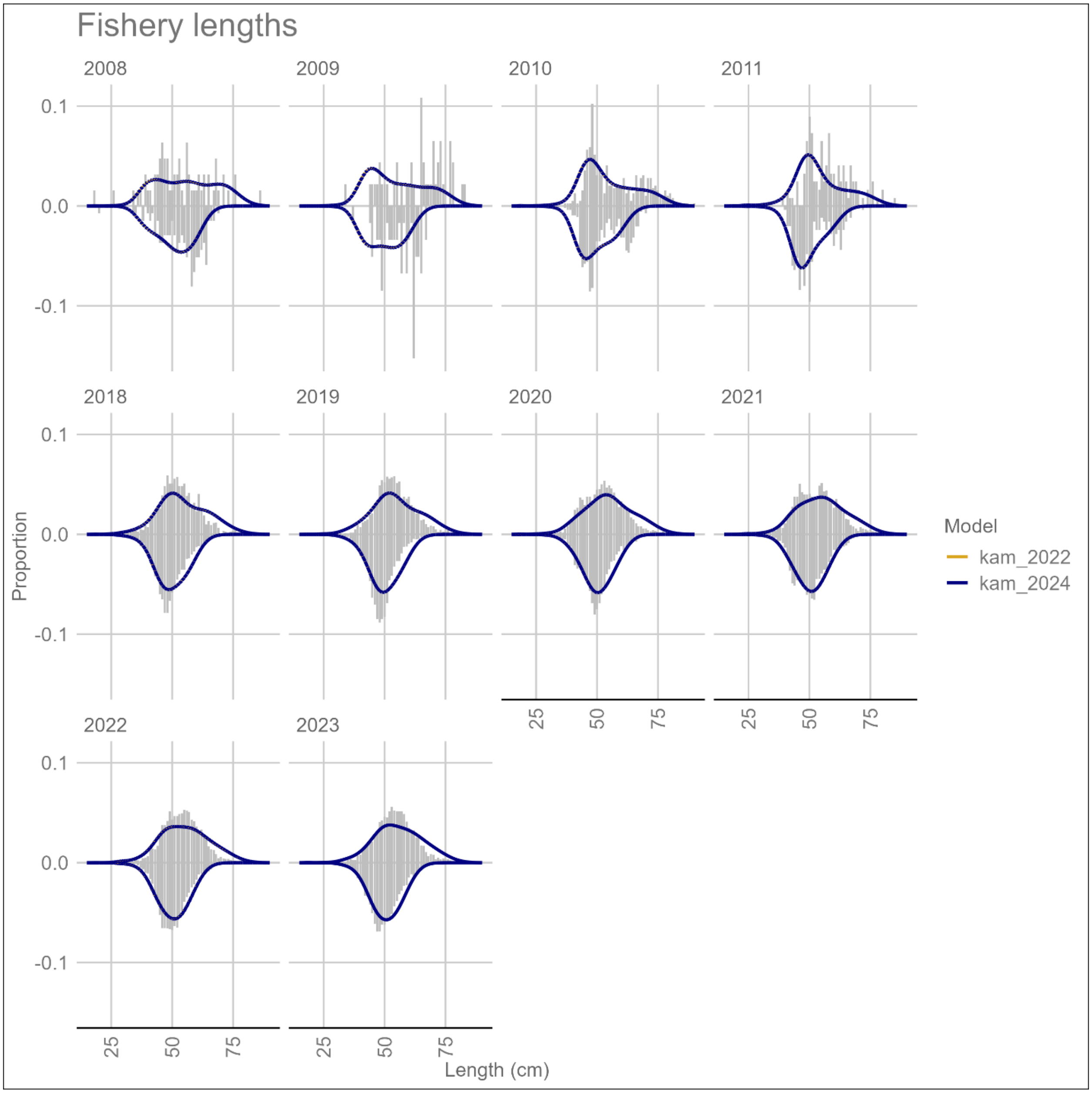


Figure 7-22. Fits to the fishery annual length composition data. Females lengths are represented by positive values and males are represented by negative values.

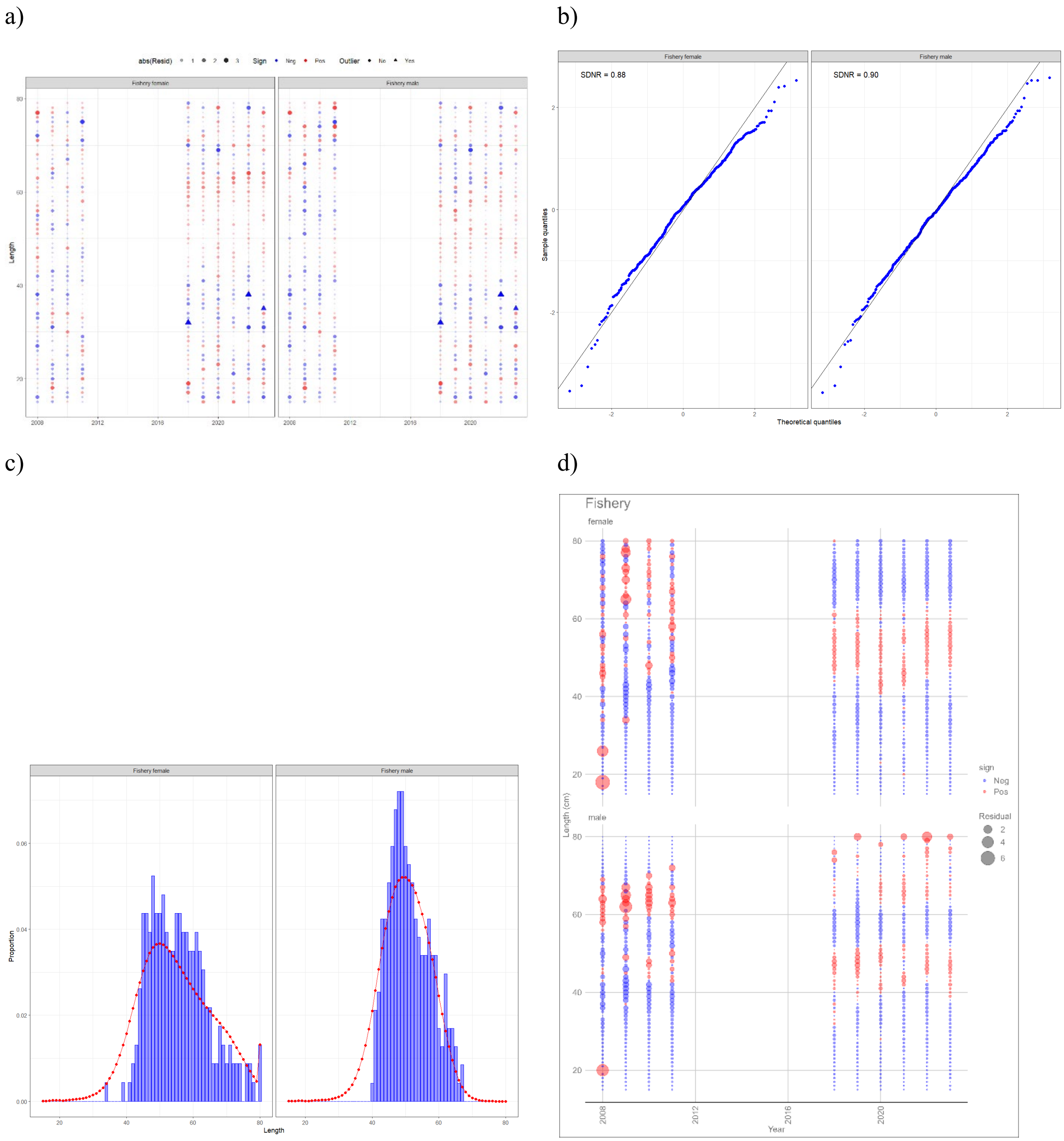
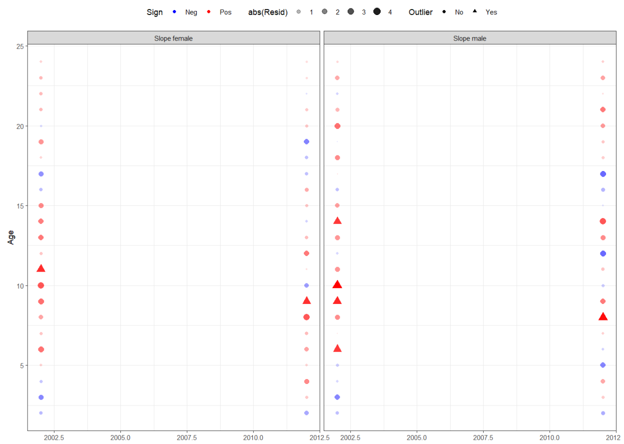
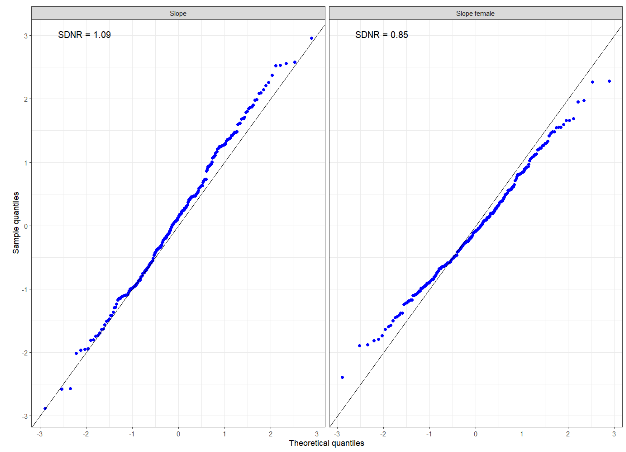


Figure 7-23. a) OSA residuals, b) q-q plot, c) overall fit, and d) Pearson residuals for the fishery length composition data.

a)



b)



c)

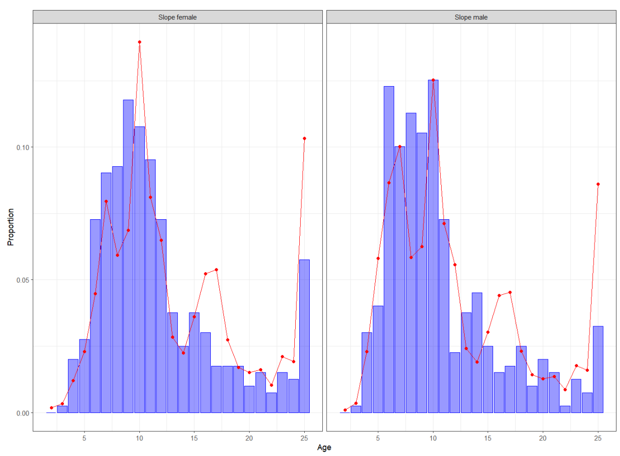
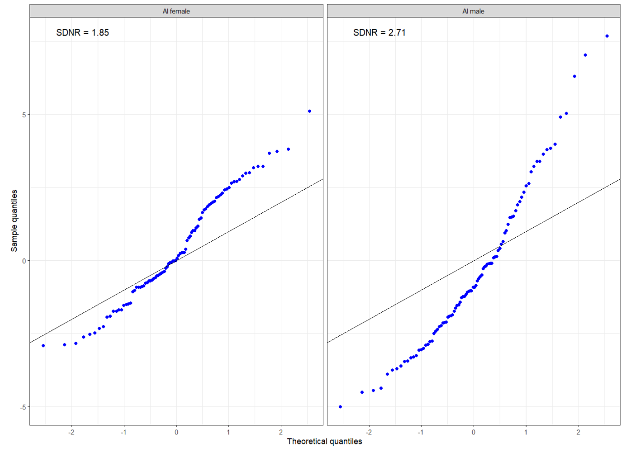


Figure 7-24. a) OSA residuals, b) q-q plot, c) overall fit to the EBS slope bottom trawl survey age composition data.

a)

b)



c)

Figure 7-25. a) OSA residuals, b) q-q plot, c) overall fit to the AI bottom trawl survey age composition data.

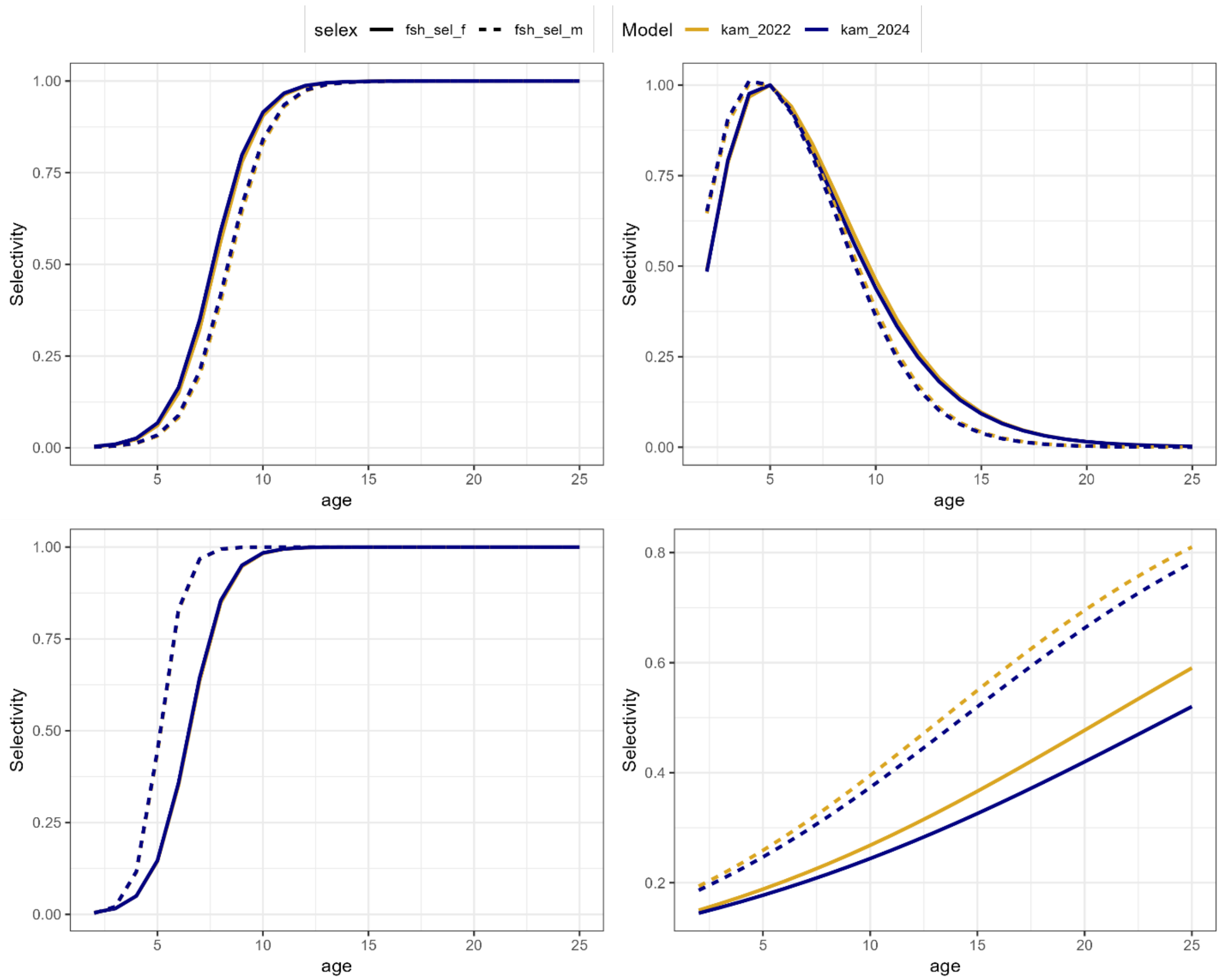


Figure 7-26. Estimated sex-specific selectivity from 2022 assessment and current assesment. Fishery (top left panel), EBS shelf survey (top right panel), EBS slope survey (bottom left panel), and Aleutian Islands (bottom right panel). Dashed lines are male selectivity curves and sold lines are female selectivity curves.

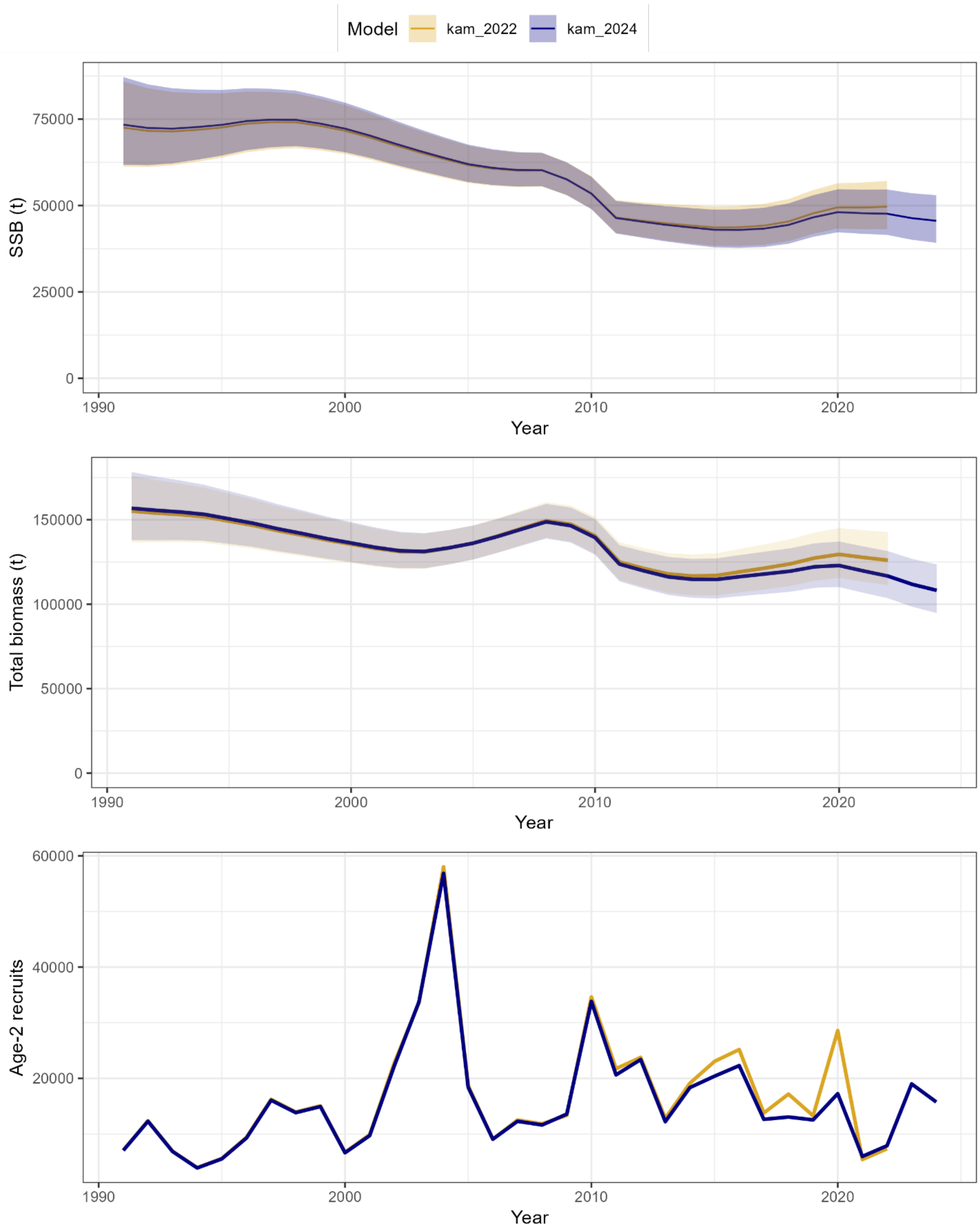


Figure 7-27. Estimates of female spawning biomass, sex-specific numbers, total biomass, and age-2 recruits, and total biomass from the 2022 assessment and the current assessment.The shaded regions represent the 95% confidence interval.

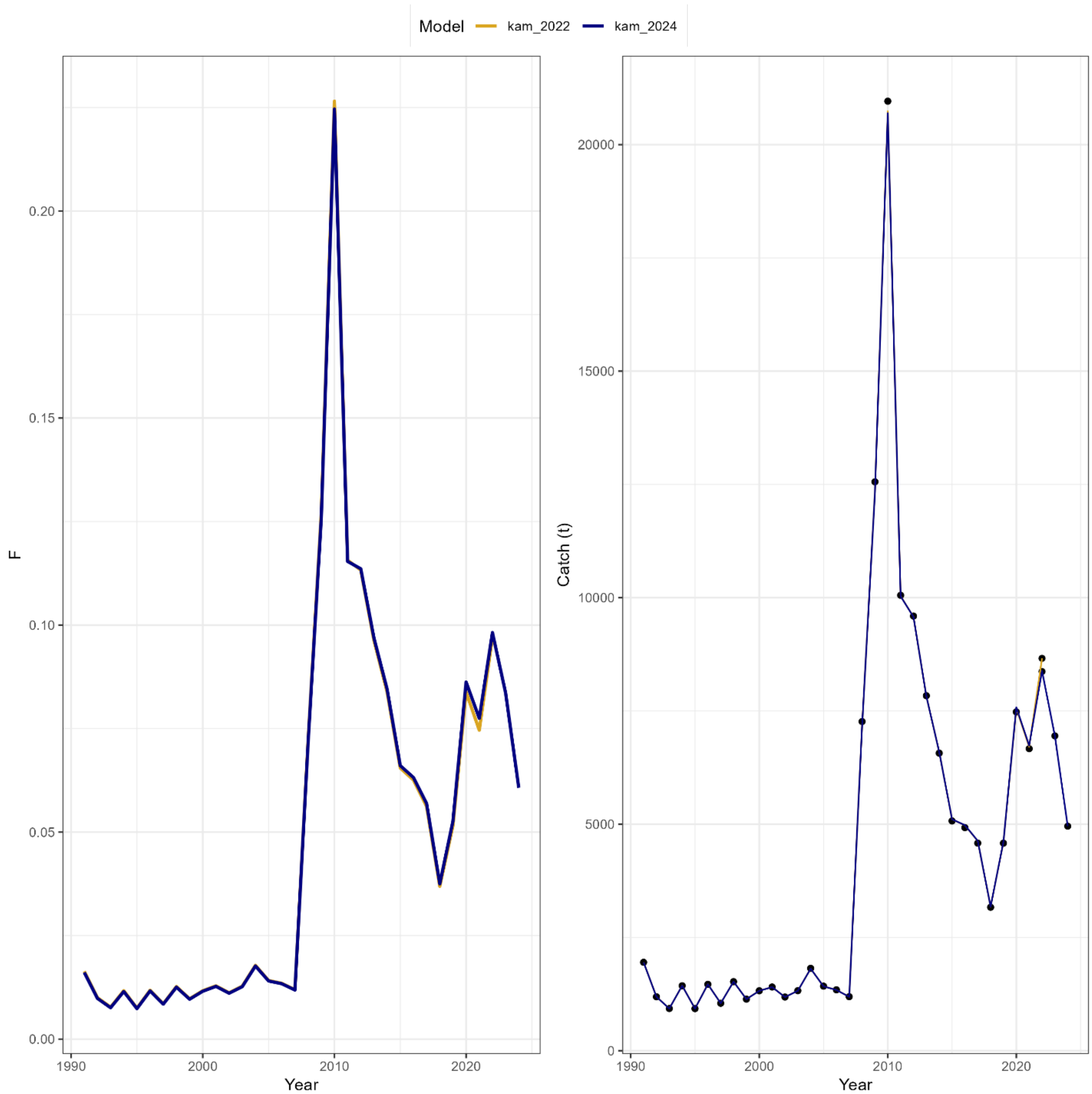


Figure 7-28. Estimate of fishing mortality and model fit to the catch data for the 2022 assessment and current assessment.

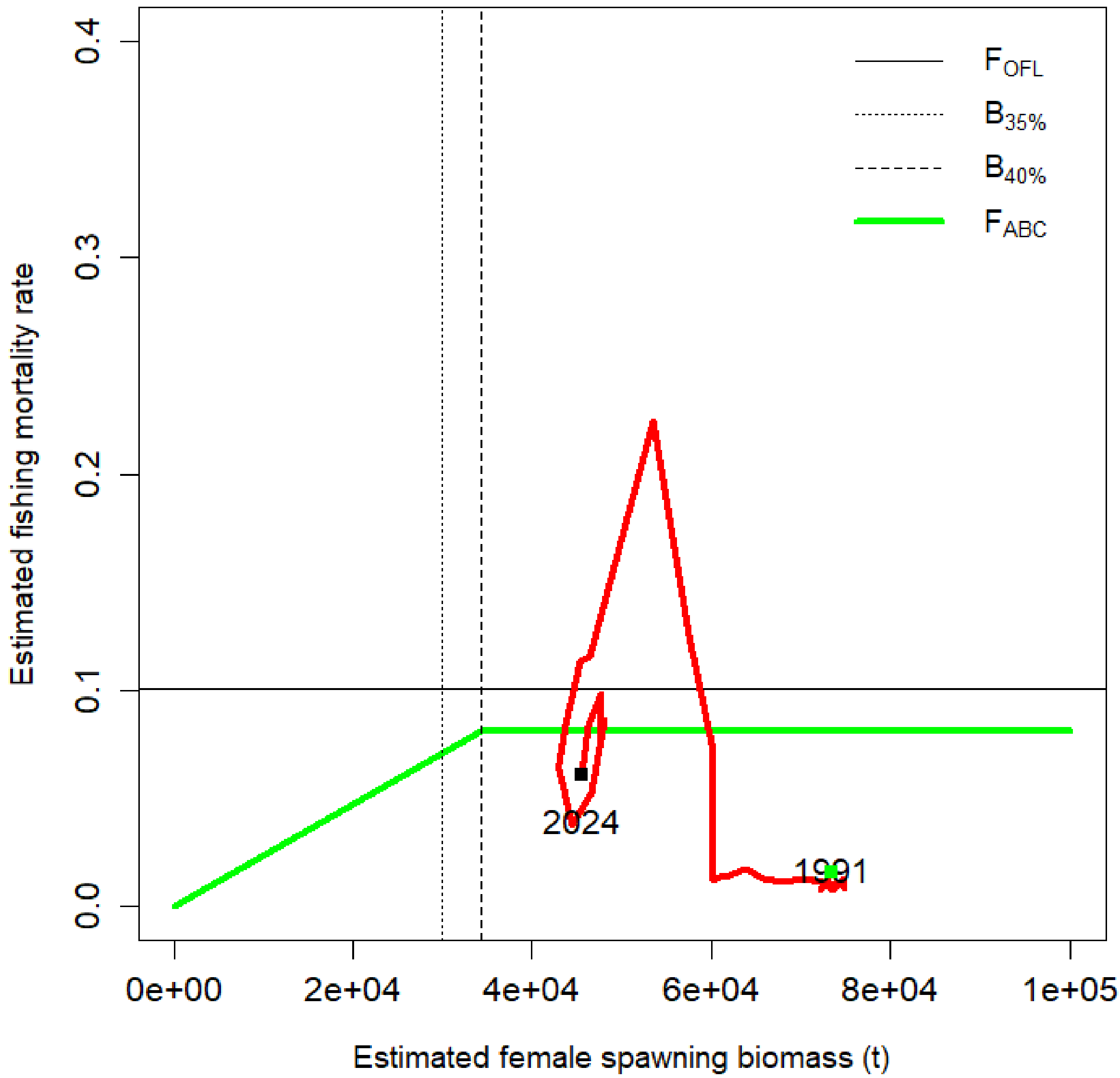
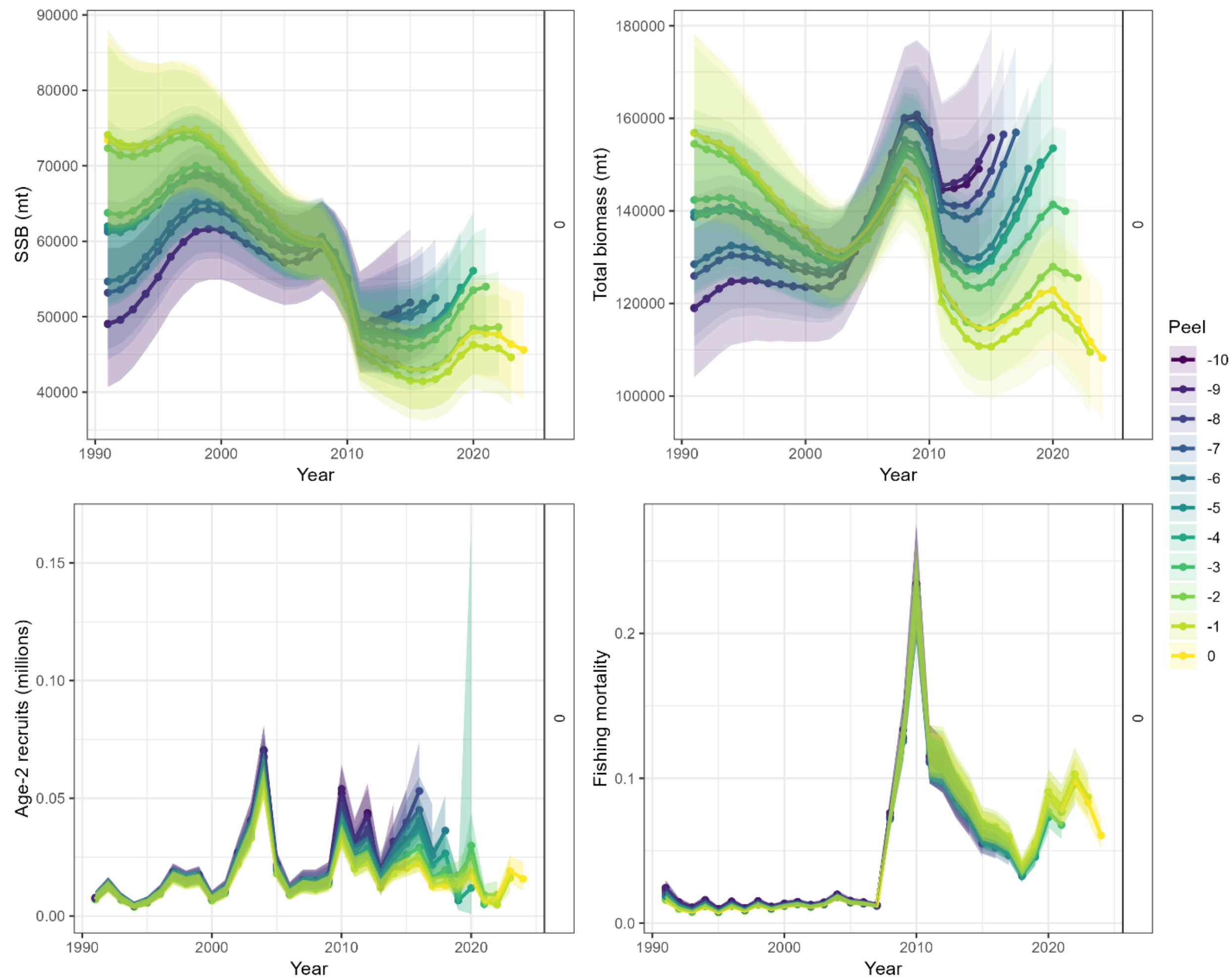


Figure 7-29. Phase plane plot of Kamchatka flounder female spawning stock biomass (t) and fishing mortality from Model 16.0b, current assessment.



Model	Mohn's rho SSB	Total biomass	Recruitment	F
16.0b (2022)	0.116	0.210	0.383	-0.102
16.0b (2024)	0.137	0.228	0.498	-0.117

Figure 7-30. Retrospective patterns in total biomass, female spawning biomass, average full selection fishing mortality, and age-2 recruits for model 16.0b, current (2024) assessment. Mohn's rho is reported for Models 16.0b (2024) and 16.0b (2022).

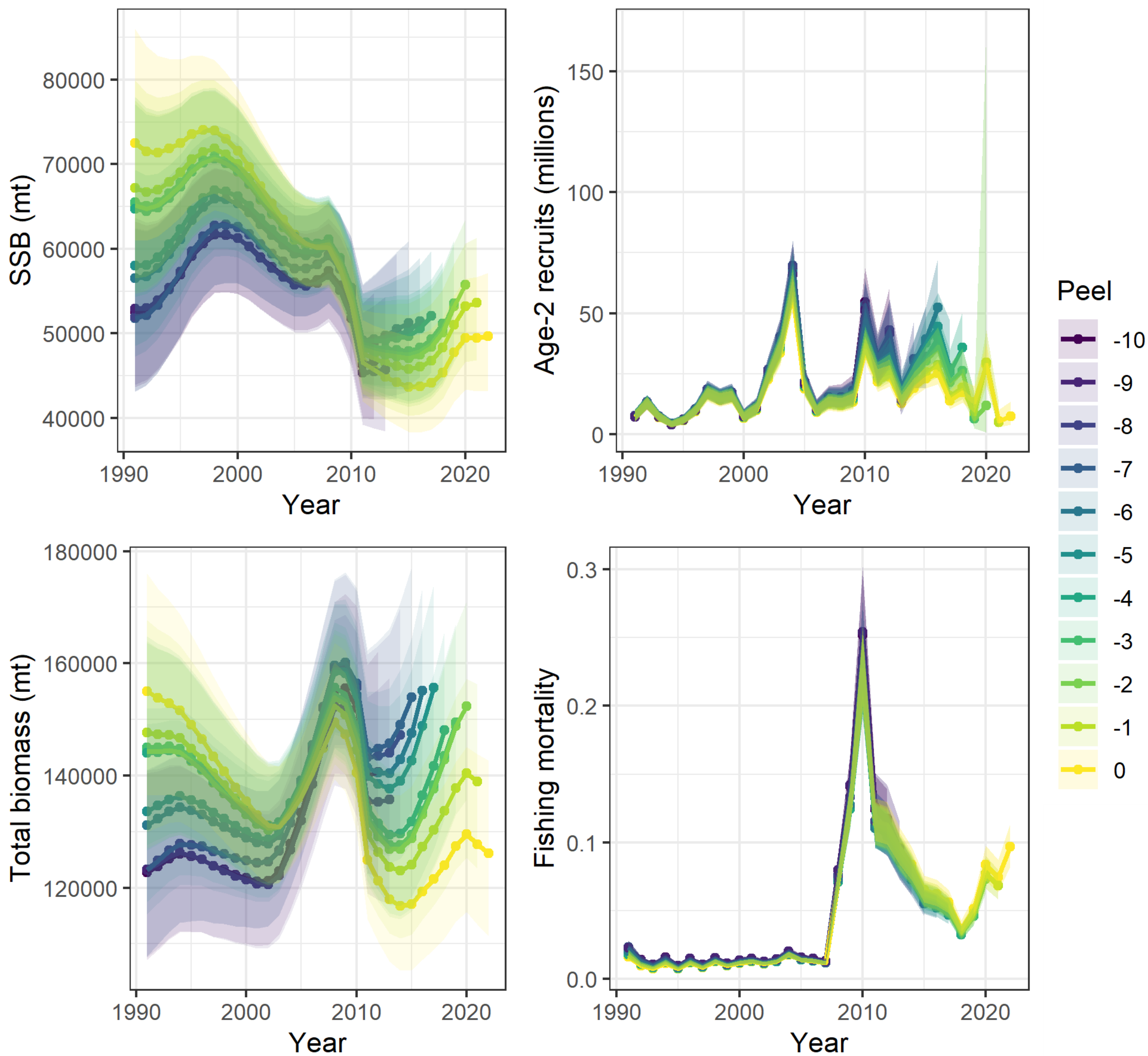


Figure 7-31. Retrospective patterns in total biomass, female spawning biomass, average full selection fishing mortality, and age-2 recruits from the 2022 assessment for comparison purposes.