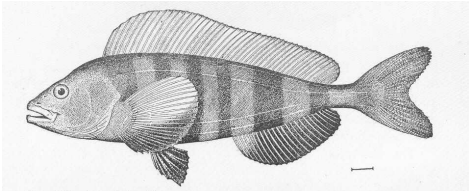
17. Assessment of the Atka mackerel stock in the Bering Sea and Aleutian Islands

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Executive Summary

In 2026, the BSAI Atka mackerel assessment is presented as an update. We use the most recent approved assessment model (Model 16.0b), cite the most recent full assessment for background information (Lowe and Ianelli, 2022), and respond to Plan Team and SSC comments when possible, carrying the rest forward for the next full assessment. Relative to the last assessment (Sullivan et al., 2024), the following changes have been made:

Summary of Changes in Assessment Inputs

Changes in the input data

1. Catches have been updated through 2025 and estimated total catch for 2026 was set equal to the TAC 82,941 t.
2. The 2026 AI bottom trawl survey biomass estimate was added.
3. The 2024 AI bottom trawl survey age composition data were added.
4. The 2024 and 2025 fishery age composition data were added.
5. The estimated average selectivity for 2021-2025 was used for projections.
6. Projected catches for 2027 and 2028 are 76,927 t and 69,453 t, respectively. We assume that approximately 85% of the BSAI-wide ABC is likely to be taken under the revised Steller Sea Lion Reasonable and Prudent Alternatives (SSL RPAs) implemented in 2015. This percentage was applied to the 2027 and 2028 maximum permissible ABCs in the projections, and those reduced amounts were assumed to be caught in order to estimate the 2027 and 2028 ABC and OFL values.

Summary of Changes in Assessment Methodology

This is an update assessment, and therefore there were no changes in the model configuration.

Summary of Results

Model 16.0b estimates that female spawning biomass has generally declined since the historical peak in 2005, reflecting the influence of several exceptionally strong year classes in the late 1990s and early 2000s. More recently, spawning biomass is estimated to have increased from approximately 116,000 t in 2021-2022 to 169,261 t in 2025, slightly above the 1977-2026 model average of 165,111 t, before declining to 159,275 t in 2026, approximately 3.5% below the long-term average. Recruitment remains highly variable, with recent estimates revised relative to the 2024 assessment. In particular, the estimated strength of the 2021 year class increased by 95%, while the 2022 year class decreased by 39%. Despite these revisions, the overall spawning biomass trajectory remains broadly consistent with the 2024 assessment.

Female spawning biomass is projected to decline to 130,354 t in 2027 and 117,795 t in 2028, but remain above $B_{40\%}$ (108,221 t), placing BSAI Atka mackerel in Tier 3a. We recommend the maximum permissible ABCs of 90,502 t for 2027 and 81,709 t for 2028, with corresponding OFLs of 106,757 t and 96,414 t.

The following table shows key management quantities for 2027 and 2028.

	As estimated or *specified in 2024* for:		As estimated or *recommended this* year for:	
Quantity	2025	2026	2027*	2028*
M (natural mortality rate)	0.30	0.30	0.30	0.30
Tier	3a	3a	3a	3a
Projected total (age 1+) biomass (t)	627,115	605,644	585,881	570,826
Projected female spawning biomass (t)	119,853	106,274	130,354	117,795
$B_{100\%}$	264,734	264,734	270,552	270,552
$B_{40\%}$	105,894	105,894	108,221	108,221
$B_{35\%}$	92,657	92,657	94,693	94,693
F_{OFL}	0.64	0.64	0.44	0.44
$maxF_{ABC}$	0.53	0.53	0.37	0.37
F_{ABC}	0.53	0.53	0.37	0.37
OFL (t)	122,622	107,889	106,757	96,414
maxABC (t)	103,247	92,361	90,502	81,709
ABC (t)	103,247	92,361	90,502	81,709
	As determined *in 2024* for:		As determined *this* year for:	
Status	2023	2024	2025	2026
Overfishing	No	n/a	No	n/a
Overfished	n/a	No	n/a	No
Approaching overfished	n/a	No	n/a	No

*Projections are based on estimated total catch of 76,927 t and 69,453 t in place of maximum permissible ABC for 2027 and 2028, respectively.

Area apportionment: Biologically-informed Recommended Distributions (BRDs)

Biologically-informed recommended distributions (BRDs; formerly subarea ABCs) for 2027 and 2028 are estimated using the random effects (REMA) model. BRDs provide a recommended spatial distribution of the BSAI-wide ABC and do not constitute separate area-specific ABCs.

Area	Proportion	2027 ABC	2028 ABC
541+SBS	0.530	48,010	43,345
542	0.224	20,233	18,268
543	0.246	22,259	20,096
BSAI Total	1.00	90,502	81,709

Responses to SSC and Plan Team Comments on Assessments in General

From the October 2026 SSC report:

To maintain standardization across the upcoming Tier 1-3 stock assessments in November, the SSC recommends all authors to adopt consistent average F methodologies for years 3-5 when producing these five-year projection scenarios. The SSC supports the GOA-GPT recommendation to streamline the projection scenarios table to only the scenarios that are needed for management

Response: We received guidance to postpone inclusion of the five-year table until consistent guidance has been provided to authors.

When REMA models are used to estimate the BRDs for tier 3 assessments, the SSC requests that basic documentation be routinely provided, including model configuration, convergence status, parameter estimates and plots showing fits to survey observations. SSC, October 2026
Response: We agree and include this information in the "Spatial Apportionment: Biologically-informed Recommended Distributions (BRDs)" section.

Specifically, for the stocks where the Council requests information related to flexibility in spatial apportionments, either identified by the Council in October 2025 or if the Council identifies additional stocks at this October 2026 meeting, the SSC requests that assessment authors include in December 2026:

1. *A table showing BRDs (from 2026) and subarea ABCs (from 2025 and earlier) for the last 10 years, their associated CV if available, and the catch within each region.*
2. *State whether a stock structure template has been completed for the stock, and, if so, a link to the document.*
3. *Describe other factors relevant to spatial allocation, such as longevity, movement rates, natural mortality, discard mortality, etc.*

Response: BSAI Atka mackerel have not been identified by the Council as a BRD stock; however, some of these requests are also reflected in the new AFSC SAFE guidelines. Therefore, we point reviewers to the revised "Spatial Apportionment: Biologically-informed Recommended Distributions (BRDs)" section and Table 17.2 for this information.

From the December 2024 SSC report:

The SSC appreciates the emerging use of OSA residuals for assessing model fits to compositional data and encourages stock assessment authors to work towards a standardized approach to presenting these residuals, possibly alongside Pearson residuals (if appropriate). The SSC also encourages authors to

include some text regarding the interpretation of OSA residuals until reviewers develop more familiarity with the approach. In cases where there are large discrepancies between Pearson and OSA residuals, a diagnosis of why they may be so different would be helpful.

Response: AFSC scientists developed the afscOSA R package to provide a consistent and reproducible framework for calculating, visualizing, and interpreting one-step-ahead residual diagnostics for compositional data across AFSC stock assessments. The package implements OSA residual calculations using compResidual and provides standardized diagnostics including aggregate composition fits, Q-Q plots, OSA and Pearson residual plots, and summary statistics for evaluating model fit. OSA diagnostics were applied to the fishery and survey age composition data in this assessment.

Responses to SSC and Plan Team Comments Specific to the Atka Mackerel Assessment

This is an update assessment. Any outstanding comments will be addressed in the next full assessment.

From the December 2024 SSC Report

An operational update assessment was presented for Atka mackerel. The last full assessment was presented in 2022. In 2023, the Atka mackerel assessment frequency changed to biennial and future operational assessments will be presented in even years to coincide with the AI trawl survey. Harvest projections will be presented in odd years. The assessment is also transitioning to a new lead assessment author. The SSC thanks outgoing author Sandra Lowe for her work on this assessment and species over the years. There was no public testimony.

In this update assessment, there were no changes to the model configuration and a single model was presented. New data include updated catches, AI bottom trawl survey biomass from 2024, and age compositions from the 2022 AI survey and 2022 – 2023 fishery. The authors added a very informative analysis to explore the impact of the new data to the model by sequentially adding datasets.

The base model (16.0b) from 2022 and this model with updated data performed similarly. The largest differences include changes in recruitment magnitudes (a decrease in the 2017 and 2018 year classes and an increase in the 2019 year class) and a shift in fishery selectivity towards younger fish. These results are typical for this model, which utilizes time-varying selectivity to account for management changes that have significantly impacted fishery operations over time. Mohn's rho is low and slightly negative. The addition of the OSA residuals diagnostics to this assessment indicate that model fits to the age compositions from both the survey and the fishery are acceptable.

The projected 2025 SSB is above B40%, placing Atka mackerel in Tier 3a for management. Risk table scores were elevated to Level 2 in one category, Ecosystem /Environmental Considerations. ***The SSC supports the author and BSAI GPT recommended 2025 and 2026 OFLs and ABCs with no reduction from maxABC.***

The current assessment provided two methodologies for apportionment among the AI subareas, including the four-year weighted average used in the last full assessment and the random effects (REMA) model. ***The SSC concurs with the authors and BSAI GPT to use the REMA model for apportionment of the ABC.***

The Atka mackerel assessment will undergo a CIE review in 2026. The SSC supports the authors' planned explorations regarding the fit to the survey age compositions, because the model has difficulty fitting two contrasting time periods, and the impact of new data on fishery selectivity and F.

This model estimates a penalty on recruitment variability (sigmaR). Similar to SSC comments for the current sablefish assessment, the ***SSC notes that the maximum likelihood estimate of this parameter can be negatively biased and requests the authors consider new approaches to estimating sigmaR.***

Finally, ***the SSC supports the development of an ESP for Atka mackerel, as recommended by the BSAI GPT, and appreciates the inclusion of the Economic Performance report as an appendix to the assessment.***

Response: In 2026 we did not do a full assessment or a CIE due to the government shutdown and staffing constraints. I have carried these comments forward to be prioritized for the next full assessment.

From the November 2024 BSAI Plan Team report:

Jane Sullivan presented the Tier 3 operational update assessment for Atka mackerel (Model 16.0b). The Team discussed the dynamics of the fishery, which appear to be largely driven by management actions, and which have included Amendment 80 and Steller sea lion closures. One of the authors noted that decoupling the biology of the stock from fishery management effects continues to be a challenge.

The Team noted that in general this appears to be a dynamic stock that experiences "high highs", and "low lows." While it has always rebounded from low biomass estimates in the past with strong singular recruitment events, there is no guarantee this will always occur. Ecosystem uncertainties, including recent warming in the Aleutians, are a cause for potential concern. The author noted this uncertainty in the Risk Table with a score of 2 for ecosystem concerns, but did not recommend a reduction from maximum permissible ABC. A Team member suggested that the authors consider such avenues as Integrated Ecosystem Research Project (IERP) for future research.

The Team recommended the continued development of an Ecosystem Socioeconomic Profile (ESP) for this stock to be brought forward with the next assessment. *The author also noted that a CIE review is likely to occur in 2026, which will focus on addressing poor fits to the survey age composition data, possibly through the application of selectivity timeblocks, and exploring how adding new data changes fishery selectivity and F.*

The Team discussed the random effects model apportionment strategy and noted that the 4-survey weighted average used in the previous assessment was intended as a stop-gap and that the intent had been to return to the random effects model approach. The Team agreed with the author that this is the most scientifically defensible and consistent method to determine apportionment.

The Team agreed with the authors' assessment (Model 16.0b), Risk Table scores, and harvest recommendations.

Response: We presented a draft ESP in September 2025 and will bring that forward again in a future cycle.

From the December 2022 SSC report:

"*The SSC appreciates the author's work and recommends continued development of this assessment in the following areas:*
● *Testing the sensitivity and value of implementing a stock-recruitment relationship within this Tier 3 model.*

● *Exploration of why fishery ages have such a large effect on biomass estimates, given they should primarily affect fishery selectivity and the estimated recruitment history.*

● *Plot and calculate correlation of shared years of fishery ages and survey ages to evaluate if the high variability in fishery selectivity is reasonable, compared to survey selectivity.*

● *Explore whether this assessment would be a good candidate for biennial schedule given that new survey data are available on a biennial basis.*

Response: The BSAI Atka mackerel assessment has been moved to a biennial schedule on even years when the Aleutian Islands bottom trawl survey is conducted. I retained these comments to be addressed during a full assessment cycle.

The SSC reiterates several previous SSC recommendations:
● *The BSAI GPT recommended, and the SSC supports, that the authors continue research into possible reasons for dome-shaped fishery and survey selectivity patterns, including senescence or differential distribution by age.*

● *The SSC highlighted the sensitivity of projections and* F_{OFL} *estimates to the assumed selectivity for future years in this assessment and reiterated its recommendation from December 2021 that BSAI Atka mackerel would be a good case study to examine when the GPTs develop guidance to assessment authors on what selectivity to use in projections for Tier 1-3 stocks with time-varying selectivity (see General Groundfish Stock Assessment Comments in the SSC December 2021 Report, p. 13)*."

Response: I retained these comments to be addressed during a full assessment cycle.

From the November 2022 BSAI Plan Team report:

The Team encouraged future research on apportionment and determining methods that may incorporate fishery performance, such as duration or number of tows as a standardizing factor, other data sources, or alternative methods.

Response: I retained this comment to be addressed during a full assessment cycle.

Introduction

Native Names: Atka mackerel were named for Atka Island (Atx̂ax̂ in the Aleut language), the largest island of the Andreanof Islands in the Aleutian archipelago.

Atka mackerel (*Pleurogrammus monopterygius*) are commercially and ecologically important groundfish distributed across the North Pacific Ocean, with their greatest abundance in Alaskan waters occurring throughout the Aleutian Islands (AI). They are an important prey species for Steller sea lions (*Eumetopias jubatus*) and other marine predators and support a highly utilized directed trawl fishery. This update assessment summarizes life history characteristics relevant to stock assessment and management; a more comprehensive description of their biology, distribution, and stock structure is provided in the last full assessment (Lowe and Ianelli, 2022).

Atka mackerel inhabit rocky, high-current habitats and exhibit pronounced spatial variation in growth and reproductive biology. Fish in the eastern AI attain larger sizes-at-age than those in the central and western AI, a pattern attributed primarily to regional differences in prey quality (Lowe et al., 1998; Rand et al., 2010). Female maturity-at-length also varies geographically, with estimated lengths at 50% maturity of 34.9 cm in the eastern AI and 32.8 cm in the central AI. In contrast, maturity-at-age did not differ significantly between regions, with a combined estimate of 3.47 years at 50% maturity (Cooper et al.,

2010). Maturity-at-length also varied significantly among years, whereas temporal variation in maturity-at-age was not statistically significant. Females from the eastern AI exhibit higher potential and realized fecundity at length or age than those from the central AI, primarily due to differences in the number of egg batches produced rather than batch size (McDermott et al., 2011). Although assessed as a single Bering Sea and Aleutian Islands (BSAI) stock, these geographic differences in life history traits and strong site fidelity suggest potentially important regional differences in population dynamics (Lowe and Ianelli, 2022; Sullivan et al., 2025).

Atka mackerel exhibit a distinctive reproductive strategy involving substrate spawning and male parental care. Spawning occurs from late July through mid-October, followed by an extended brooding period during which males guard adhesive eggs on rocky substrates (Lauth et al., 2007a, 2007b). Larvae undergo a pelagic phase, and juveniles are poorly observed until recruiting to the bottom trawl survey and fishery around age 3. Environmental conditions, prey availability, and larval transport may influence early survival and recruitment, but these processes remain poorly understood (Sullivan et al., 2025).

Their patchy distribution, diel vertical migration, and association with untrawlable habitats complicate abundance estimation from bottom trawl surveys (Nichol and Somerton, 2002; Lowe and Ianelli, 2022). These characteristics, together with regional differences in productivity and uncertain recruitment dynamics, present challenges for interpreting abundance trends and estimating stock dynamics. The proposed Atka mackerel Ecosystem and Socioeconomic Profile (ESP; Sullivan et al., 2025) provides a framework for investigating these uncertainties through spatially and life-stage-specific ecosystem indicators.

Management units

Amendment 28 to the BSAI Fishery Management Plan became effective in mid-1993 and divided the Aleutian subarea into three districts at 177°W and 177°E for the purposes of spatially apportioning Total Allowable Catches (TAC). Since 1994, the BSAI Atka mackerel TAC has been allocated to three regions (541 Eastern Aleutians, 542 Central Aleutians, and 543 Western Aleutians).

Fishery and Management History

Catch and Fishery Overview

The BSAI Atka mackerel fishery is prosecuted almost exclusively by the Amendment 80 catcher/processor fleet using bottom trawl gear. Fishing is highly localized, primarily in the Aleutian Islands at depths less than 200 m, reflecting the species' schooling behavior and spatial distribution. BSAI Atka mackerel support a highly lucrative fishery, with a first-wholesale value of $94 million in 2024 (Dame, 2025). The fishery has operated under a catch share program since implementation of Amendment 80 in 2008. A detailed description of historical fishery development is provided in Lowe and Ianelli (2022).

Historical catches, ABCs, OFLs, and total allowable catches (TACs) are presented in Tables 17.1 and 17.2. In recent years, catches have generally approached the TAC. Nominal catch per unit effort (CPUE), fishing effort, and catch by management area are shown in Figure 17.1. These indices reflect both fishery performance and regulatory constraints and should not be interpreted as direct measures of stock abundance.

Management

The BSAI Atka mackerel fishery is managed across three Aleutian Islands management areas: Eastern Aleutians (541, combined with the southern Bering Sea), Central Aleutians (542), and Western Aleutians

(543). Spatial management was established to distribute fishing effort and reduce the potential for localized depletion. Harvest allocations are informed by the spatial distribution of survey biomass, as described in the Spatial Apportionment section.

Directed trawl fishing is restricted to two seasons: the A season (January 20-June 10) and B season (June 10-December 31). Seasonal allowances for the Amendment 80 sector, BSAI trawl limited access sector, and Community Development Quota (CDQ) reserve are apportioned equally between the two seasons. Unharvested A-season allowances may be carried forward to the B season, subject to spatial restrictions within Steller sea lion protection areas. These temporal restrictions, together with spatial management measures, influence the distribution of fishing effort and catch throughout the year.

Fishing activity is further constrained by measures implemented to protect Steller sea lions and their critical habitat. The revised reasonable and prudent alternatives (RPAs) implemented in 2015 established spatial closures and harvest restrictions, including a requirement that the Area 543 TAC not exceed 65% of the Area 543 ABC. In Areas 542 and 543, Atka mackerel catch within designated waters extending 0-20 nautical miles from specified Steller sea lion sites west of 178°W is limited to 60% of the annual area TAC, with this allowance divided equally between the A and B seasons. Additional protections include trawl exclusion zones around rookeries and haulouts and restrictions on the use of unharvested A-season allowances within designated protection areas.

Habitat conservation measures further restrict bottom trawling in the Aleutian Islands. Amendment 78, implemented in 2006, established the Aleutian Islands Habitat Conservation Area, Aleutian Islands Coral Habitat Protection Areas, and Bowers Ridge Habitat Conservation Zone. Amendment 80, implemented in 2008, established a catch share program for the non-American Fisheries Act trawl catcher/processor sector, including the directed Atka mackerel fishery.

Collectively, these spatial, temporal, and sector-specific management measures influence the distribution and realization of catch and are relevant to interpreting catch and fishery CPUE by region (Figure 17.1). A detailed description of historical management measures and regulatory changes is provided in Lowe and Ianelli (2022).

Bycatch and Discards

The Atka mackerel fishery incidentally catches other federally managed groundfish species, including Pacific ocean perch (*Sebastes alutus*), northern rockfish (*Sebastes polyspinis*), Pacific cod (*Gadus macrocephalus*), walleye pollock (*Gadus chalcogrammus*), and other species (Table 17.3). There is also bycatch of non-target species in the ecosystem group, including the following: fish, such as grenadiers and sculpin; habitat areas of particular concern (HAPC) biota, such as sponges, corals, bryozoans, and other benthic invertebrates; and seabirds, such as fulmars, shearwaters, storm petrels, and auklets (Table 17.3). Prohibited species catch (PSC), including crab, salmon, and Pacific halibut (*Hippoglossus stenolepis*) are presented in Table 17.4. Additional information on historical bycatch, PSC, and associated management considerations is provided in Lowe and Ianelli (2022). Noncommercial removals, including survey and other research catches, are presented in Appendix 17A.

Atka mackerel are primarily harvested in the directed fishery, with relatively small incidental catches in other groundfish fisheries, principally trawl fisheries targeting Pacific cod and rockfish. Most Atka mackerel discards occur in the directed fishery, although discard rates have historically been low, generally 1-3% since 2009. Discard rates in the southern Bering Sea have been higher, reflecting incidental catch in other fisheries. Updated discards by management area are presented in Table 17.5.

Data

The BSAI Atka mackerel assessment uses the following data in the assessment model:

Source	Data	Years
NMFS Aleutian Islands groundfish bottom trawl surveys	Survey biomass	1991, 1994, 1997, 2000, 2002 2004, 2006, 2010, 2012, 2014, 2016, 2018, 2022, 2024, 2026
	Age Composition	1991, 1994, 1997, 2000 2002, 2004, 2006, 2010, 2012, 2014, 2016, 2018, 2022, 2024
U.S. Atka mackerel trawl fisheries	Catch	1977-2026
	Age Composition	1977-2025 (except 1989)

Fishery Data

Fishery inputs to Model 16.0b include total catch biomass (1977-2026) and annual age compositions (1977-2025, excluding 1989). Total catch estimates, which include discards, were obtained from the Alaska Region's Catch Accounting System (CAS; Tables 17.1 and 17.2). During 2021-2025, annual Atka mackerel catch averaged approximately 96% of TAC, with the majority of catch taken in the directed Amendment 80 fishery. Catch in 2025 was 80,613 t, representing 98.3% of the 82,000 t TAC (Table 17.1). The 2026 catch estimate and assumptions used for projections are described in the Projections and Harvest Recommendations section.

Fishery age compositions are developed from observer length measurements and otolith age readings using age-length keys, as described in Lowe and Ianelli (2022). The 2026 assessment incorporates new fishery age compositions for 2024 and 2025 (Table 17.6; Figure 17.2). Table 17.6 reports the observed proportions-at-age and model input sample sizes (ISS), which determine the relative weighting of annual compositions in the likelihood. Observed and predicted age compositions are compared in Figure 17.2. Observer sampling information, including numbers of fish measured and aged, is summarized in Table 17.7. Fishery weight-at-age estimates used to calculate expected catch biomass are presented in Table 17.8. Additional information on historical sampling methods and catch-at-age estimation is provided in Lowe and Ianelli (2022).

Survey Data

The assessment uses biomass estimates and age compositions from the AI bottom trawl survey. Survey biomass estimates are available for 1991-2026, and survey age compositions extend through 2024 (Tables 17.9 and 17.10; Figure 17.3). The new 2026 survey estimated BSAI Atka mackerel biomass at 554,902 t (CV = 25.6%), compared with 574,769 t (CV = 24.5%) in 2024. The 2026 estimate was based on 372 survey hauls. The 3.5% decrease between surveys is small relative to the uncertainty of the estimates (Table 17.9).

Survey length measurements and otolith age readings are used to estimate age compositions and weight-at-age. The 2026 assessment adds the 2024 survey age composition, which is characterized by a high proportion of age-3 fish (Table 17.10; Figure 17.5). Year-specific survey weight-at-age estimates and the population weight-at-age schedule used to calculate biomass are provided in Table 17.11. The 2026

survey weight-at-age schedule was assumed equal to 2024 because age data from the 2026 survey were not yet available.

Survey biomass for spatial apportionment

Regional design-based survey biomass estimates are also used to inform BRDs among the eastern Aleutian Islands and southern Bering Sea (541+SBS), central Aleutian Islands (542), and western Aleutian Islands (543). Regional estimates and their sampling variability are presented in Table 17.9 and Figure 17.4.

Analytic Approach

The 2026 update assessment uses Model 16.0b, implemented in the Assessment Model for Alaska (AMAK) in AD Model Builder (Fournier and Archibald, 1982; Fournier, 1998). The model configuration is unchanged from the previous assessment. This section summarizes model assumptions and parameterizations; detailed equations, model development, and historical sensitivity analyses are provided in Lowe and Ianelli (2022).

Model Structure

Model 16.0b is an age-structured population dynamics model with 11 age groups (ages 1–11+), fitted to total catch biomass, fishery and survey age compositions, and the AI bottom trawl survey biomass index. Population numbers-at-age are estimated from 1977 through 2026, with annual catch calculated using the Baranov catch equation. The objective function combines lognormal likelihoods for catch and survey biomass, multinomial likelihoods for age compositions, and penalties and priors on selected model parameters. Appendix 17C and Tables 17C-1–17C-3 in Lowe and Ianelli (2022) provide a description of the variables used, and the equations describing the population dynamics of Atka mackerel as they relate to the available data.

Parameters Estimated Outside the Assessment Model

Natural mortality (M) is fixed at 0.30 across ages based on a meta-analysis of life history information by Lowe and Fritz (1997). Recruitment follows a Beverton-Holt stock-recruitment relationship with steepness (h) fixed at 0.8, implying that at 20% of the unfished spawning stock size, an expected value of 80% of the unfished recruitment level will result. Likelihood profiles on both M and h are presented in the Model Evaluation section.

Female maturity-at-age is fixed using McDermott and Lowe (1997; Table 17.12). An ageing-error conversion matrix is used to convert population numbers-at-age to expected catch-at-age. The ageing-error matrix was not updated in 2026; details are provided in Lowe and Ianelli (2022).

Annual survey and fishery weight-at-age matrices are used to convert estimated numbers-at-age to biomass. Annual weights-at-age are calculated using year-specific age-length keys to estimate length distributions at age, which are combined with corresponding weight-at-length estimates (De Robertis and Williams, 2008). Separate fishery and survey weight-at-age schedules are estimated from their respective sampling data (Tables 17.11 and 17.8).

Population weight-at-age is calculated as the average of the most recent three survey years with age data (2018, 2022, and 2024; Table 17.11). The 2026 survey weight-at-age schedule is assumed to be equal to 2024, while fishery weight-at-age for projections is based on the average of the most recent three years with age data (2023, 2024, and 2025; Table 17.8). The three weight-at-age schedules serve distinct purposes in the assessment and harvest projections. Survey weight-at-age is used to calculate expected survey biomass, whereas fishery weight-at-age converts estimated and projected catch-at-age to catch biomass. Population weight-at-age is used to calculate total population biomass and female spawning

biomass, incorporating maturity-at-age and survival to the spawning period. In the projection model, population weight-at-age contributes to the calculation of spawning biomass and fishing mortality reference points, while fishery weight-at-age is used to convert projected catch-at-age into ABC and OFL in biomass units. Consequently, differences among these schedules can influence harvest advice through their effects on estimated abundance, spawning biomass, and projected catch biomass.

Parameters Estimated Inside the Assessment Model

Fishing mortality and fishery selectivity

Fishing mortality is parameterized as the product of annual fishing mortality (F) and age-specific fishery selectivity. Fishery selectivity is represented by a smoothed, nonparametric function of age, with age-specific coefficients estimated within the model. Unlike a prescribed parametric form, such as logistic selectivity, this formulation allows selectivity to take a variety of shapes, including dome-shaped patterns.

Fishery selectivity is allowed to vary annually. The estimated age-specific coefficients are regularized through penalties that constrain curvature across ages, the extent of declining selectivity at older ages (dome-shaped selectivity), and interannual changes in selectivity. Curvature is penalized using second differences of log selectivity, while the interannual variability penalty controls the flexibility of selectivity among years. Selectivity coefficients are assumed constant for ages 10 and older. The parameter governing interannual variation in fishery selectivity (σ_{f_sel}) is set to 0.35 in Model 16.0b, following the Francis (2011) tuning approach described in previous assessments (Lowe and Ianelli, 2022). The degree of dome-shaped selectivity is also constrained through a penalty with $\sigma_d = 0.30$.

Fishery selectivity is normalized separately within each year to have an arithmetic mean of one across all modeled ages (1–11+), establishing a reference scale for estimating annual F. This normalization avoids confounding between the overall scale of selectivity and fishing mortality without requiring any single age to be fully selected. Consequently, individual selectivity estimates may exceed one and represent relative vulnerability to the fishery rather than absolute capture probabilities.

For harvest projections, fishery selectivity is represented by the average estimated selectivity over the five most recent complete years (2021-2025). The resulting selectivity vector is rescaled to have a maximum of one before being supplied to the projection model. This establishes a conventional fully selected reference scale for calculating fishing mortality reference points, including $F_{40\%}$ and $F_{35\%}$, while preserving the relative pattern of vulnerability across ages.

Survey selectivity and catchability

Survey selectivity is also estimated using a smoothed, nonparametric function of age, allowing a flexible age-specific shape rather than imposing a fixed parametric selectivity curve. The survey selectivity parameters are constrained by penalties on curvature and declining selectivity at older ages. Unlike fishery selectivity, survey selectivity is assumed constant through time.

Survey selectivity is normalized to have an arithmetic mean of one across ages 4-10, establishing a reference scale for estimating survey catchability (q). This normalization avoids confounding between the overall scale of selectivity and catchability without requiring any single age to be fully selected. Consequently, survey selectivity estimates may exceed one and represent relative vulnerability to the survey gear rather than absolute capture probabilities.

Survey catchability is estimated as a time-invariant scalar with a normal prior on log-scale q with mean zero and a standard deviation of 0.2. The combined effects of survey selectivity and catchability determine the expected survey biomass and age compositions.

Recruitment

Model 16.0b assumes a Beverton-Holt stock-recruitment relationship based on Francis (1992), with h fixed at 0.8 as described in the previous section. Unfished recruitment (R_0), mean log recruitment, annual recruitment deviations, and recruitment variability (σ_R) are estimated within the model. The model estimates σ_R on the log scale, with a weak prior centered at 0.6 (standard deviation of 15 on the log scale). Annual recruitment is parameterized as the exponential of mean log recruitment plus a year-specific deviation.

The Beverton-Holt relationship is used to calculate expected recruitment from spawning biomass, with R_0 and fixed steepness determining the shape and scale of the relationship. For the specified stock-recruitment period (1977-2023), squared differences between the logarithms of estimated and expected recruitment are penalized in the objective function, with the strength of the penalty determined by σ_R. An additional regularity penalty shrinks annual recruitment deviations toward zero, corresponding to the estimated mean log recruitment. Recruitment deviations in the terminal years are also subject to a variance-based penalty governed by σ_R. These penalties constrain recruitment estimates while allowing departures from both the mean recruitment level and the Beverton-Holt expectation.

Data weighting

Fishery and survey age compositions are fitted using multinomial likelihoods with input sample sizes (ISS) that determine their relative contributions to the objective function (Tables 17.6 and 17.10). Fishery ISS vary by year based on sampling intensity, with earlier years assigned fixed values. Survey ISS are based on sampling effort and adjusted using the Francis (2011) weighting approach. Model 16.0b also uses the Francis weighting approach to inform the penalty governing interannual variation in fishery selectivity ($\sigma_{f_sel} = 0.35$).

Results

Model Results

As an update assessment, the 2026 analysis retained Model 16.0b without changes to model configuration. Overall, biomass trajectories were consistent with the 2024 assessment, although recent recruitment and spawning biomass estimates were revised with the addition of new data (Table 17.13). The largest recruitment revisions were a 95% increase in the estimated strength of the 2021 year class and a 39% decrease in the 2022 year class. Despite these changes, historical biomass trends remained similar between assessments. Model results and evaluation are presented below.

Time series results

Estimated fishery and survey selectivity are presented in Table 17.14 and Figures 17.6 and 17.7. Estimated population numbers-at-age, total biomass, female spawning biomass, recruitment, and fishing mortality are provided in Tables 17.15-17.19 and Figures 17.8-17.10. The estimated time series are broadly consistent with the 2024 assessment, although recent estimates have been revised following the addition of new survey and fishery data.

Female spawning biomass increased from a recent low of approximately 116,000 t in 2021 and 2022 to 169,261 t in 2025, before declining to 159,275 t in 2026 (Table 17.16; Figure 17.8). The 2024 spawning biomass estimate increased by 13% relative to the previous assessment, from 128,919 t to 145,902 t (Table 17.16). The largest revision to recent recruitment was for the 2021 year class (age-1 recruitment in 2022), which increased by 95%, from 685 million to 1,336 million fish; conversely, the 2022 year class decreased by 39%, from 450 million to 275 million fish (Table 17.18; Figure 17.8). Mean recruitment over 1978-2024 (the time period used for projections) was 561 million age-1 fish, similar to the previous assessment.

The five-year average fishery selectivity for 2021-2025 was used for projections (Table 17.14; Figure 17.7). Recent fully selected fishing mortality estimates ranged from 0.17 to 0.32 during 2021-2025, with an estimated F of 0.21 in 2026 (Table 17.19; Figure 17.10). Fishing mortality remained below the current $F_{35\%}$ reference point throughout this period.

Fits to the data

Model 16.0b provided generally adequate fits to the fishery catch, bottom trawl survey biomass index, and fishery and survey age compositions (Figures 17.2, 17.3, and 17.5). Predicted catches closely matched observed catches throughout the time series. The model captured the general magnitude and temporal variation in the survey biomass index, although discrepancies were evident in individual years. Fits to fishery and survey age compositions generally represented the dominant age classes and temporal variation in age structure.

One-step-ahead (OSA) residual diagnostics were used to further evaluate fits to fishery and survey age compositions (Figure 17.11). Aggregate observed age proportions were generally consistent with model expectations for both datasets, and residual bubble plots did not reveal persistent patterns of misfit across years or ages. Fishery OSA residuals approximately followed the expected standard-normal distribution, whereas survey residuals exhibited lower dispersion than expected (SDNR ≈ 0.82). The survey diagnostics were calculated using Francis-adjusted input sample sizes, which reduced the aggregate survey sample size by approximately 44% relative to the original inputs. Consequently, the low survey residual dispersion may partly reflect the reduced weighting of the survey age compositions. Although the aggregate effective sample sizes were lower than the input sample sizes for fishery compositions and higher for survey compositions, these diagnostics are influenced by both data weighting and model fit and do not independently establish optimal composition weights.

Parameter estimates, with uncertainty

Model 16.0b estimated 625 parameters, including recruitment deviations, annual fishing mortality, and time-varying fishery selectivity coefficients. The estimated survey catchability coefficient was 1.81 (SE = 0.30). Survey selectivity is normalized to an arithmetic mean of one across ages 4-10, rather than a maximum of one, and the resulting selectivity coefficients are multiplied by q when predicting survey biomass. Consequently, q and the age-specific selectivity coefficients are relative scaling parameters and cannot be interpreted independently as absolute capture probabilities. Nevertheless, uncertainty in survey availability, catchability, and selectivity contributes to uncertainty in the absolute scale of estimated population biomass.

Estimated recruitment standard deviation was 0.50 (SE = 0.05). The estimated mean recruitment parameter was approximately 431 million age-1 fish (SE = 55 million). Key parameter estimates and associated standard errors are summarized in Table 17.13, with uncertainty in derived quantities illustrated in the corresponding biomass and recruitment figures.

Model Evaluation

Convergence status and criteria

Convergence of Model 16.0b was supported by a maximum gradient component of $< 1\times10^{-10}$ following two inverse-Hessian Newton steps after standard optimization, with negligible changes in the objective function and parameter estimates. All estimated parameters were within their specified bounds, although the fishing mortality estimates for 1982 and 1983 remained close to their lower bounds, a pattern also present in the previous assessment. A jitter analysis was conducted to evaluate sensitivity of the solution to starting values (Figure 17.12). All jitter runs, initialized from parameter values randomly perturbed by

10%, returned to essentially the same negative log-likelihood, supporting the numerical stability of the estimated solution.

Likelihood profiles on key parameters

Conditional likelihood profiles were developed for *M* and steepness *h*, which are fixed at 0.30 and 0.80, respectively, in Model 16.0b (Figures 17.13 and 17.14). The total negative log-likelihood decreased by approximately 20 units as *M* increased from 0.30 to 0.60, whereas a smaller improvement of approximately 0.8 units was observed as *h* increased from 0.80 to 0.95. Neither profile exhibited an interior minimum within the evaluated ranges.

Decomposition of the likelihood indicated that the improvement in the *M* profile was primarily associated with improved fits to fishery age compositions, with additional contributions from survey biomass, survey age compositions, recruitment penalties, and the catchability prior. This suggests potential tension between the assumed *M* and the observed age compositions, although confounding with selectivity and recruitment limits the biological interpretation of the profile. The *h* profile reflected opposing changes in the fishery age composition likelihood and recruitment penalties, resulting in relatively little change in the total objective function. These results highlight sensitivity to fixed productivity assumptions, particularly *M*, but do not independently establish preferable biological parameter values.

The likelihood profiles indicate sensitivity to assumptions about *M* and the stock-recruitment relationship. Although the *M* profile favors values higher than the fixed $M = 0.30$, the biological plausibility of these estimates warrants further investigation given Atka mackerel longevity and potential confounding among *M*, recruitment, and time-varying selectivity. Similarly, the limited contrast in spawning biomass, particularly at low stock sizes, may constrain the information available to evaluate the assumed Beverton-Holt stock-recruitment relationship. Future model development should examine alternative *M* and recruitment parameterizations, including their interactions with selectivity, to better characterize structural uncertainty in population scale and productivity.

Sensitivity to model specification

The sensitivity of Model 16.0b to time-varying fishery selectivity was evaluated by comparing the accepted interannual selectivity constraint ($\sigma_{f_sel} = 0.35$) with more constrained ($\sigma_{f_sel} = 0.20$) and more flexible ($\sigma_{f_sel} = 0.50$) configurations. Both sensitivity configurations produced similar historical trajectories of spawning biomass, recruitment, and fishing mortality (Figure 17.15). However, recent estimates were sensitive to selectivity assumptions. Estimated age-1 recruitment in 2022 ranged from 7% below to 11% above the accepted model estimate, while female spawning biomass in 2026 ranged from 153,386 to 171,081 t, compared with 159,275 t in the accepted model (−3.7% to +7.4%). Fully selected fishing mortality in 2026 was approximately 7-11% higher in the sensitivity configurations relative to the accepted model.

These results indicate that assumptions governing interannual variation in fishery selectivity can influence recent estimates of recruitment, spawning biomass, and fishing mortality, although the overall historical trajectories remain broadly consistent across configurations. The sensitivity configurations were used to evaluate structural uncertainty and were not carried forward into harvest projections.

Retrospective analysis

A retrospective analysis consists of dropping the data year-by-year from the current model and provides an evaluation of the stability of the current model as new data are added. The estimated Mohn's ρ for female spawning biomass was -0.085, indicating slight negative retrospective pattern but little evidence of systematic inconsistency in recent stock biomass estimates (Figure 17.16). However, after data from 2012-2014 were dropped from the model, the retrospective peels show a consistent and substantial

positive pattern. Lowe et al. (2017) determined that this pattern can be explained by the influence of the survey age compositions on survey selectivity estimates. The recent period of data has relatively large numbers of Atka mackerel in the survey age plus group in some years (e.g., 2014, 2018, 2022; Figure 17.5); therefore, estimates of survey selectivity are approaching an asymptotic shape (Figure 17.10). However, for the retrospective peels which ignore those recent years of data, the survey selectivity becomes much more dome-shaped, hence the early period biomass estimates were estimated to be higher.

Historical assessment retrospective

Figure 17.17 shows a comparison of female spawning biomass trajectories from even year assessments between 2010 and 2026. The Atka mackerel assessment has shown a high level of consistency throughout time despite uncertainty in stock scale. Similar to the within model retrospective analysis, uncertainty in scale begins in the mid-2010s and is attributed to a change in the survey age composition and the estimated shape of survey selectivity.

Projections and Harvest Recommendations

Results and recommendations in this section pertain to the authors' recommended Model 16.0b.

Amendment 56 Reference Points

Amendment 56 to the BSAI Groundfish Fishery Management Plan (FMP) defines "overfishing level" (OFL), the fishing mortality rate used to set OFL (F_{OFL}), the maximum permissible ABC, and the fishing mortality rate used to set the maximum permissible ABC ($max\ F_{ABC}$). The fishing mortality rate used to set ABC (F_{ABC}) may be less than this maximum permissible level, but not greater. The overfishing and maximum allowable ABC fishing mortality rates are given in terms of percentages of unfished female spawning biomass ($F_{SPR\%}$), on fully selected age groups. The associated long-term mean female spawning biomass that would be expected under average estimated recruitment from 1978-2024 (561 million age-1 recruits) and F equal to $F_{40\%}$ and $F_{35\%}$ are denoted $B_{40\%}$ and $B_{35\%}$, respectively. The Tiers require reference point estimates for biomass level determinations. We present the following reference points for BSAI Atka mackerel for Tier 3 of Amendment 56. For our analysis, we computed the following values from Model 16.0b results based on recruitment from post-1976 spawning events:

$B_{100\%}$ = 270,552 t female spawning biomass
$B_{40\%}$ = 108,221 t female spawning biomass
$B_{35\%}$ = 94,693 t female spawning biomass

Specification of OFL and Maximum Permissible ABC

In the current assessment, Model 16.0b is configured with time-varying selectivity. We use a 5-year average (2021-2025) fishery selectivity to reflect recent conditions for projections and computing ABC which gives:

Fishing mortality-based reference points	
$max\ F_{ABC} = F_{40\%}$	0.37
$F_{OFL} = F_{35\%}$	0.44

For projections, we assumed a total 2026 year end catch of 82,941 t, equal to the 2026 TAC. We then assumed that approximately 85% of the BSAI-wide ABC is likely to be taken under the revised SSL RPAs. Therefore, the projection software was run iteratively, and this percentage was applied to the 2027

and 2028 maximum permissible ABCs in order to get the catch needed to calculate the ABC for the following year. Using this approach, the projected catches for 2027 and 2028 were determined to be 76,927 t and 69,453 t, respectively.

It is important to note that for BSAI Atka mackerel, projected female spawning biomass calculations depend on the harvest strategy because spawning biomass is estimated at peak spawning (August). Thus, projections incorporate 7 months of the specified fishing mortality rate. The projected 2027 female spawning biomass (SSB_{2027}) is estimated to be 130,354 t given assumed 2026 catch and 7 months of the estimated 2027 catch reflecting the SSL RPA adjustment to the 2027 ABC.

The projected 2027 female spawning biomass estimate is above the $B_{40\%}$ value of 108,221 t, placing BSAI Atka mackerel in **Tier 3a**. The projected 2028 female spawning biomass estimate is also above $B_{40\%}$, placing Atka mackerel in **Tier 3a**. The 2027 and 2028 maximum permissible ABC and OFL values under Tier 3a are:

Year	Max ABC (t)	F_{ABC}	OFL (t)	F_{OFL}	SSB (t)	Tier
2027	90,502	0.37	106,757	0.44	130,354	3a
2028	81,709	0.37	96,414	0.44	117,795	3a

The historical relationship between spawning biomass relative to $B_{35\%}$ and fishing mortality relative to F_{OFL} is illustrated as a phase plane plot in Figure 17.18.

Standard Harvest Scenarios and Projection Methodology

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). We use the Standard Projection Model (SPM; https://github.com/afsc-assessments/spmR).

For each scenario, the projections begin with the vector of 2026 numbers-at-age estimated in the assessment. This vector is then projected forward to the beginning of 2040 using a fixed value of natural mortality of 0.3, the recent schedule of selectivity estimated in the assessment (in this case the average 2021-2025 selectivity), and the best available estimate of total (year-end) catch for 2026 (in this case assumed to be 82,941 t equal to TAC). As previously described, the 2027 and 2028 catches are reduced to accommodate Steller sea lion RPA TAC reductions. **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 projection year, recruitment is sampled from an inverse-Gaussian distribution parameterized using historical recruitment estimates from the assessment, rather than directly from the Beverton-Holt stock-recruitment relationship used in the assessment likelihood. Spawning biomass is computed each year based on the time of peak spawning (August) and the maturity and population weight schedules described in the assessment. Total catch is assumed to equal the catch associated with the respective harvest scenario in all years, except that in the first two years of the projection, a lower catch may be specified for stocks where catch is typically below ABC (as is the case for Atka mackerel). This projection scheme is run 1,000 times to obtain distributions of possible future stock sizes, fishing mortality rates, and catches.

Scenarios 1-5 additionally assume catches of 76,927 t and 69,453 t in 2027 and 2028, respectively, before applying scenario-specific harvest rules beginning in 2029. Scenarios 6 and 7 apply their respective status-determination harvest rules beginning in 2027. Scenario 3 uses the 2021-2025 average fully selected fishing mortality of 0.2496 provided by the assessment model. The first five scenarios provide a range of harvest alternatives intended to bracket plausible future harvest levels. These scenarios are defined as follows:

Scenario 1: In all future years after the first two projection 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 after the first two projection years, F is set equal to a constant fraction ("author's F") of max F_{ABC}, where this fraction is equal to the ratio of the F_{ABC} value for assessment 2027 recommended in the assessment, to the $maxF_{ABC}$ for assessment 2027, and catches for assessment 2027 and 2028 are estimated at their most likely values given the assessment 2027 and 2028 recommended ABCs under this scenario. (Rationale: When F_{ABC} is set at a value below max F_{ABC}, it is often set at the value recommended in the stock assessment; also, catch tends not to equal ABC exactly.)

Scenario 3: In all future years after the first two projection years, F is set equal to the average of the five most recent years (2021-2025; 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: In all future years after the first two projection years, the upper bound on F_{ABC} is set equal to $F_{60\%}$. (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 after the first two projection years, F is set equal to zero. (Rationale: In extreme cases, TAC may be set at a level close to zero.)

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

Scenario 6: In all future years, F is set equal to F_{OFL}. (Rationale: This scenario determines whether a stock is overfished. If the stock is 1) above its MSY level in 2026 or 2) above 1/2 of its MSY level in 2026 and expected to be above its MSY level in 2036 under this scenario, then the stock is not overfished.)

Scenario 7: In 2027 and 2028, F is set equal to max F_{ABC}, and in all subsequent years, F is set equal to F_{OFL}. (Rationale: This scenario determines whether a stock is approaching an overfished condition. If the stock is 1) above its MSY level in 2028 or 2) above 1/2 of its MSY level in 2027 and expected to be above its MSY level in 2038 under this scenario, then the stock is not approaching an overfished condition).

Results from scenarios 1-7 are presented in Table 17.20. Mean spawning biomass is projected to decline under full exploitation scenarios, remain stable under average F (Scenario 3), and increase under F=0 and other low exploitation scenarios. We project expected catches to decrease through 2028, and then increase slightly under Scenario 2, though Scenario 2 does not account for SSL RPAs past 2028.

Stochastic projections of catch and female spawning biomass under Scenario 2 are presented in Figure 17.19, illustrating the range of potential future stock trajectories under the recommended harvest strategy. Mean projected spawning biomass declines to 130,354 t in 2027 and 117,795 t in 2028 but remains above $B_{40\%}$ (108,221 t) in both years.

Status Determination

Under the MSFCMA, the Secretary of Commerce is required to report on the status of each U.S. fishery with respect to overfishing. This assessment reports the answer to three questions: 1) Is the stock being subjected to overfishing? 2) Is the stock currently overfished? 3) Is the stock approaching an overfished condition?

The catch estimate for the most recent complete year (2025) is 80,613 t, which is less than the 2025 OFL of 122,622 t. Therefore, BSAI Atka mackerel is not subject to overfishing.

Scenarios 6 and 7 are used to make the MSFCMA's other required status determination as follows:

Under scenario 6, spawning biomass is estimated to be 155,562 t in 2026, which is above $B_{35\%}$ (94,693 t). Therefore, BSAI Atka mackerel is not currently overfished.

Under scenario 7, projected mean spawning biomass in 2028 is 110,246 t, which is above $B_{35\%}$ (94,693 t). Therefore, BSAI Atka mackerel is not approaching an overfished condition.

F_{limit}

The fishing mortality that would have produced a catch in 2025 equal to the 2025 OFL is 0.387.

Risk Table and ABC Recommendation

Since 2020, the SSC has requested that full or update assessments fill out a risk table with assessment, population dynamics, environmental and ecosystem, and fishery performance considerations to inform potential reductions from maximum permissible ABC. The guidelines for risk table definitions are now available to reference in the Introduction to the BSAI SAFE.

Assessment considerations (Level 1)

Model 16.0b has been used for the BSAI Atka mackerel assessment since the 2016 assessment. Historical spawning biomass trajectories remain broadly consistent across assessments (Figure 17.17). The model provides adequate fits to the available data, including fishery and survey age compositions, although variability in survey biomass and uncertainty in survey selectivity remain important limitations. OSA residual diagnostics indicate generally acceptable composition fits, with some evidence of underdispersion in the survey age compositions (Figure 17.8).

The recent retrospective pattern is small (Mohn's $\rho = -0.085$; Figure 17.16), although larger historical positive retrospective bias remains associated with changes in survey selectivity as survey age compositions are removed. Sensitivity analyses indicate that recent recruitment, spawning biomass, and fishing mortality estimates are moderately sensitive to assumptions governing time-varying fishery selectivity (Figure 17.15). Likelihood profiles also indicate sensitivity to the fixed $M = 0.30$ assumption (Figure 17.13). These represent ongoing assessment uncertainties but do not indicate a substantial deterioration in model performance. **We therefore rate assessment-related concerns as Level 1.**

Population dynamics considerations (Level 1)
With contributions from Ivonne Ortiz

Recent ecosystem indicators suggest mixed conditions for Atka mackerel early life stages (AI Ecosystem Status Report, ESR; Ortiz, 2026). Relatively cool summer temperatures and low pink salmon abundance may have been favorable, whereas declining zooplankton biomass and shifts in prey community size raise uncertainty about food availability and quality. Marine heatwaves during the late summer and fall spawning and brooding period may also affect reproductive success, as elevated temperatures at nesting depths could alter embryonic development rates, hatch timing, and egg survival. However, the extent to which these environmental conditions influence early survival and recruitment remains poorly understood (ESP, Sullivan et al., 2025).

Recent recruitment and biomass trends are within the range of historical stock dynamics. Female spawning biomass increased from approximately 116,000 t in 2021-2022 to 159,275 t in 2026, approximately 3.5% below the 1977-2026 average of 165,111 t (Figure 17.7). There is no evidence of an unusually rapid decline or atypical recruitment pattern warranting increased concern. **We therefore rate population dynamics-related concerns as Level 1.**

Environmental/Ecosystem considerations (Level 2)
With contributions from Ivonne Ortiz

Recent ecosystem indicators suggest continued adverse conditions for adult Atka mackerel in the Aleutian Islands (AI ESR; Ortiz, 2026). Adult Atka mackerel condition remained below historical levels in 2026, continuing the negative condition signal observed in 2024. Declining zooplankton biomass and shifts toward smaller copepod taxa suggest potentially unfavorable prey conditions, while the sustained high biomass of Pacific ocean perch and northern rockfish indicates continued potential for interspecific competition. Although bottom temperatures have generally declined from their 2016 peaks, temperatures remain elevated in the western Aleutians.

Together, these indicators suggest persistent ecosystem pressures that may affect adult growth, condition, and reproductive potential, although their effects on stock productivity have not been established. A primary objective of the proposed Atka mackerel ESP (Sullivan et al., 2025) is to evaluate these hypothesized relationships, particularly the roles of prey availability and quality, competition, and regional environmental variability in shaping stock dynamics. **Given the persistence of multiple adverse indicators, we retain the environmental/ecosystem concern rating of Level 2.**

Fishery performance considerations (Level 1)

Atka mackerel catches have remained relatively consistent over the past decade, and annual catches have approached TAC in most years (Tables 17.1 and 17.2). Catch in 2025 was approximately 80,613 t, or 98% of TAC. Nominal fishery CPUE increased in area 541 during 2025 and 2026 alongside a reduction in fishing effort (Figure 17.1). However, spatial restrictions and fleet behavior complicate interpretation of nominal CPUE as an abundance indicator, and development of standardized fishery CPUE would improve interpretation of fishery performance.

Prohibited species catch of Bairdi Tanner crab increased substantially in 2025; however, detailed catch data and discussions with industry and inseason management biologists indicate that the increase was concentrated in early spring fishing in the eastern AI and appears to be anomalous (Table 17.4; R. Christiansen, Ocean Peace, Inc., and S. Whitney and A. Olson, AKRO, pers. comm.). Overall, available information does not indicate unusual fishery behavior or resource-use patterns that suggest increased risk to the Atka mackerel stock. **We therefore rate fishery performance-related concerns as Level 1.**

These results are summarized in the table below:

Assessment-related considerations	*Population dynamics considerations*	*Environmental/ ecosystem considerations*	*Fishery Performance considerations*
Level 1: Typical to moderately increased uncertainty/minor unresolved issues in assessment.	Level 1: Stock trends are typical for the stock; recent recruitment is within normal range.	Level 2: Multiple indicators showing consistent adverse signals a) across the same trophic level as the stock, and/or b) up or down trophic levels (i.e., predators and prey of the stock)	Level 1: No apparent fishery/resource-use performance and/or behavior concerns

ABC Recommendation

Although the risk table identifies sustained Level 2 environmental/ecosystem concerns, the extent to which these conditions affect Atka mackerel productivity and future stock dynamics remains uncertain. The developing Atka mackerel ESP aims to provide a framework for evaluating these hypothesized relationships and identifying ecosystem indicators relevant to Atka mackerel recruitment, growth, and reproductive potential. Given that recent recruitment and biomass trends remain within the range of historical stock dynamics, and that there are no elevated risks in the other risk table categories, we do not recommend reducing ABC below the maximum permissible levels at this time. **The recommended 2027 ABC is 90,502 t, based on the Tier 3a $F_{40\%}$ of 0.37, with a corresponding OFL of 106,757 t based on $F_{35\%}$ of 0.44. The recommended 2028 ABC is 81,709 t, with a corresponding OFL of 96,414 t.**

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

Atka mackerel are managed as a single stock in the BSAI, with recommended harvests spatially distributed among the eastern Aleutian Islands and Bering Sea (541+SBS), central Aleutian Islands (542), and western Aleutian Islands (543; Table 17.2). Amendment 28 to the BSAI Fishery Management Plan established the three Aleutian Islands management districts in 1993 to distribute fishing effort and reduce the potential effects of localized depletion.

Spatial management and stock structure: Genetic studies indicate limited population differentiation across the Aleutian Islands (Lowe et al., 1998; Canino et al., 2010), and the Joint Groundfish Plan Teams classified stock structure concern as “Little” in 2014, following a stock structure evaluation. However, Atka mackerel exhibit regional differences in growth, maturity at length, and fecundity (Rand et al., 2010; Cooper et al., 2010; McDermott et al., 2011). Adult movement among localized aggregations is limited (McDermott et al., 2005; McDermott et al., 2014), while connectivity likely occurs primarily through dispersal during early life stages. Consequently, genetic connectivity does not preclude regional demographic differences or localized depletion. Spatially explicit harvest distributions are therefore biologically justified to distribute fishing mortality relative to regional biomass and reduce the potential for localized depletion, consistent with the objectives of Amendment 28 and subsequent Steller sea lion protection measures.

BRD estimation and recommendations: We recommend using the random effects (REMA) model to estimate BRDs for 2027 and 2028, consistent with the method adopted in the 2024 assessment. REMA is fit to bottom trawl survey biomass estimates from the three Aleutian Islands management areas using a log-scale random walk process with survey observation uncertainty and a single estimated process error parameter shared across areas. The estimated process error standard deviation was 0.49 (SE=0.10), and the maximum gradient component was 4.98×10^{-9}, indicating satisfactory convergence. Regional survey biomass observations and REMA estimates are shown in Figure 17.4.

We recommend the following BRDs based on the REMA model:

Area	Proportion	2027 ABC	2028 ABC
541+SBS	0.530	48,010	43,345
542	0.224	20,233	18,268
543	0.246	22,259	20,096
BSAI Total	1.00	90,502	81,709

The REMA approach was reinstated in 2024 following temporary use of a four-survey weighted average in response to an anomalously low central Aleutian Islands survey biomass estimate in 2018. We continue to recommend REMA because it accounts for survey observation uncertainty and temporal variability when estimating regional biomass distributions.

Ecosystem Considerations

Atka mackerel are an important component of the Aleutian Islands marine ecosystem, serving as both consumers of zooplankton and prey for groundfish, seabirds, and marine mammals, particularly Steller sea lions. Their distribution, growth, reproductive success, and recruitment are likely influenced by environmental variability, prey availability, competition, and predation. Detailed descriptions of these interactions and historical ecosystem conditions are provided in Lowe and Ianelli (2022). The proposed Atka mackerel Ecosystem and Socioeconomic Profile (ESP; Sullivan et al., 2025) provides a species-specific framework for understanding these processes. A full Atka mackerel ESP is planned for a future assessment cycle. In the interim, recent ecosystem indicators from the 2026 Aleutian Islands ESR (Ortiz, 2026) are evaluated in the Risk Table and ABC Recommendation section.

Ecosystem Effects on BSAI Atka mackerel

Environmental conditions and prey availability

The Aleutian Islands exhibit strong longitudinal gradients in oceanography, habitat, and productivity, transitioning from more coastal and shelf-influenced conditions in the east to more oceanic conditions in the west (Coyle, 2005; Hunt and Stabeno, 2005; Ortiz, 2007; Stabeno et al., 1999; Stabeno et al., 2009). Circulation through island passes, eddies, and vertical mixing influence the transport and availability of nutrients and zooplankton prey. Regional differences in prey composition and quality have been linked to variation in Atka mackerel growth and reproductive potential (Rand et al., 2010; McDermott et al., 2011). Temperature may also affect energetic demands and the duration of embryonic development (Lauth et al., 2007a).

Recent ecosystem observations indicate mixed environmental and biological conditions (AI ESR; Ortiz, 2026). Although temperatures in 2026 were generally closer to historical averages than during the sustained warm period beginning around 2013, regional differences persisted, particularly in the western Aleutians. Available plankton indicators showed below-average mesozooplankton biomass and copepod community size in 2025, while Atka mackerel body condition declined in the 2026 bottom trawl survey. These observations suggest potential limitations in prey availability or quality, although their effects on recruitment and stock productivity have not been established.

Competition and predation

Atka mackerel share zooplankton prey resources with other pelagic foragers, including Pacific ocean perch, northern rockfish, and pink salmon. Pacific ocean perch and northern rockfish have become dominant components of the Aleutian Islands pelagic-forager biomass, potentially influencing

competition for shared prey resources. Eastern Kamchatka pink salmon have also been associated with reductions in large-copepod abundance and alternating patterns in Atka mackerel otolith growth (Batten et al., 2018; Matta et al., 2020). Pink salmon abundance was relatively low in 2026, potentially reducing competition during this period, although the strength of these interactions remains uncertain.

Atka mackerel are important prey for Steller sea lions, harbor seals, piscivorous groundfish, and seabirds (summarized in Lowe and Ianelli, 2022). Recent seabird reproductive observations suggest spatial variation in foraging conditions, with generally more favorable signals in the eastern than western Aleutians (Ortiz, 2026). However, relationships between predator abundance, consumption, and Atka mackerel population dynamics remain poorly understood.

Atka Mackerel Fishery Effects on the Ecosystem

The importance of Atka mackerel as prey for Steller sea lions and their limited movement among local aggregations create the potential for localized reductions in prey availability associated with fishing. Spatial and seasonal fishery restrictions, including trawl exclusion zones around Steller sea lion rookeries, are intended to reduce this risk. Tagging and CPUE analyses indicate that the effectiveness of these measures varies with local abundance and movement patterns (McDermott et al., 2005, 2016; Rand et al., 2019).

Bottom-contact fishing may also affect benthic habitats, including rocky spawning areas and emergent epifauna. Potential effects include disturbance of nesting habitat and incidental catch of benthic organisms, although these effects have not been quantified specifically for the Atka mackerel stock. Historical discussion of fishery interactions with Steller sea lions and benthic habitats is provided in Lowe and Ianelli (2022).

Incidental catch in the directed Atka mackerel fishery includes other groundfish species, non-target fish and invertebrates, and habitat-associated organisms (Table 17.3). The non-target catch includes habitat areas of particular concern (HAPC) biota, such as sponges, corals, bryozoans, and other benthic invertebrates. Incidental catch of these organisms varies among years, and the ecological consequences of these removals have not been quantified for the Atka mackerel fishery. Seabird bycatch, including northern fulmars, shearwaters, auklets, and storm petrels, is also reported in Table 17.3. Prohibited species catch, including crab, salmon, and Pacific halibut, is summarized in Table 17.4. Atka mackerel discards and associated discard rates by management area are presented in Table 17.5. These tables document fishery interactions with non-target species and habitat-associated organisms, while additional historical context is provided in Lowe and Ianelli (2022).

Data Gaps and Research Priorities

- A high priority for the next full assessment is transitioning Model 16.0b from ADMB to a TMB-based platform. Atka mackerel has been bridged to both SPoRC and Rceattle, although a preferred platform has not been selected. SPoRC offers spatial modeling capabilities, while Rceattle offers multispecies interactions and incorporates dynamic structural equation modeling (DSEM) for evaluating ecosystem indicators identified in the proposed ESP (Sullivan et al., 2025). Both platforms would support alternative time-varying fishery selectivity parameterizations, including random effects with estimated interannual variability.
- Another high priority for the next assessment is continuing development of the Atka mackerel ESP. Environmental/ecosystem considerations have been rated Level 2 in two consecutive assessments (2024 and 2026), highlighting the need to better understand potential ecosystem influences on stock productivity. Stock-specific condition indicators will be developed using both bottom trawl survey and fishery-dependent data, with methods that appropriately account for

spatial and temporal variation, sampling design, and differences in biological sampling and fish size. These indicators could provide more representative measures of changes in Atka mackerel condition and help evaluate hypothesized relationships among prey availability and quality, competition, environmental variability, and stock productivity. Continued ESP development will support more informative Risk Table evaluations and identify ecosystem indicators that may be incorporated into future stock assessments.

- A priority for the next full assessment includes reviewing current biological inputs and composition weighting. In particular, we would like to explore using AFSC R packages like *afsciss* and *sampler*. Given regional growth differences, the spatial representativeness of biological samples and potential bias in stock-wide weight-at-age warrant evaluation.
- A proposed cooperative research project with UAF and fishing industry representatives would develop standardized fishery CPUE as a complementary abundance index to the highly variable biennial Aleutians trawl survey. Potential applications include improving assessment precision, informing spatial biomass distributions and BRDs, and evaluating Steller sea lion trawl exclusion boundaries.

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Tables

Table 17.1. Time series of Bering Sea/Aleutian Islands Atka mackerel catches (including discards and CDQ catches), corresponding Acceptable Biological Catches (ABC), Total Allowable Catches (TAC), and Overfishing Levels (OFL) set by the North Pacific Fishery Management Council from 1978 to the present. Catches, ABCs, TACs, and OFLs are in metric tons. Data sourced from NMFS Regional Office Catch Accounting System via the Alaska Fisheries Information Network (AKFIN) and various NPFMC reports.

Year	Catch	ABC	TAC	OFL
1977	21,763	[a]	[a]	
1978	24,249	24,800	24,800	
1979	23,264	24,800	24,800	
1980	20,488	24,800	24,800	
1981	19,688	24,800	24,800	
1982	19,874	24,800	24,800	
1983	11,726	25,500	24,800	
1984	36,055	25,500	35,000	
1985	37,860	37,700	37,700	
1986	31,990	30,800	30,800	
1987	30,061	30,800	30,800	
1988	22,084	21,000	21,000	
1989	17,994	24,000	20,285	
1990	22,206	24,000	21,000	
1991	26,626	24,000	24,000	
1992	48,532	43,000	43,000	435,000
1993	66,006	117,100	32,000	771,100
1994	65,360	122,500	68,000	484,000
1995	81,554	125,000	80,000	335,000
1996	103,942	116,000	106,157	164,000
1997	65,842	66,700	66,700	81,600
1998	57,097	64,300	64,300	134,000
1999	56,237	73,300	66,400	148,000
2000	47,230	70,800	70,800	119,000
2001	61,563	69,300	69,300	138,000
2002	45,288	49,000	49,000	82,300
2003	58,060	63,000	60,000	99,700
2004	60,563	66,700	63,000	78,500
2005	62,014	124,000	63,000	147,000
2006	61,883	110,000	63,000	130,000
2007	58,747	74,000	63,000	86,900

Year	Catch	ABC	TAC	OFL
2008	58,082	60,700	60,700	71,400
2009	72,807	83,800	76,400	99,400
2010	68,647	74,000	74,000	88,200
2011	51,822	85,300	53,080	101,000
2012	47,829	81,400	50,763	96,500
2013	23,181	50,000	25,920	57,700
2014	30,951	64,131	32,322	74,492
2015	53,277	106,000	54,500	125,297
2016	54,485	90,340	55,000	104,749
2017	64,446	87,200	65,000	107,200
2018	70,387	92,000	71,000	108,600
2019	57,471	68,500	57,951	79,200
2020	58,884	70,100	59,305	81,200
2021	61,354	73,590	62,257	85,580
2022	58,107	78,510	66,481	98,870
2023	66,613	98,588	69,282	118,787
2024	72,179	95,358	72,987	111,684
2025	80,613	103,247	82,000	122,622
2026	68,021[b]	92,361	82,941	107,889

[a]Atka mackerel was not a reported species group until 1978.
[b]2026 catch accessed October 8, 2026. Projected total year catch is assumed equal to the 2026 TAC of 82,941 t.

Table 17.2. Time series of Bering Sea/Aleutian Islands Atka mackerel catch by region, with corresponding subarea Acceptable Biological Catch (ABC), which are called Biologically-informed Recommended Distributions (BRD) starting in 2026, ABCs, and Total Allowable Catches (TAC) set by the North Pacific Fishery Management Council from 2015 to the present. Catches, ABCs, and TACs are in metric tons. Data sourced from NMFS Regional Office Catch Accounting System via the Alaska Fisheries Information Network (AKFIN) and various NPFMC reports.

Year	Name	BS/EAI	CAI	WAI	Total
2015	Subarea ABC/ABC	38,492	33,108	34,400	106,000
	TAC	27,000	17,000	10,500	54,500
	Catch	26,351	16,672	10,253	53,277
2016	Subarea ABC/ABC	30,832	27,216	32,292	90,340
	TAC	28,500	16,000	10,500	55,000
	Catch	28,360	15,795	10,330	54,485
2017	Subarea ABC/ABC	34,890	30,330	21,980	87,200
	TAC	34,500	18,000	12,500	65,000
	Catch	34,264	17,748	12,433	64,446
2018	Subarea ABC/ABC	36,820	32,000	23,180	92,000
	TAC	36,500	21,000	13,500	71,000
	Catch	36,079	20,889	13,419	70,387
2019	Subarea ABC/ABC	23,970	14,390	30,140	68,500
	TAC	23,970	14,390	19,591	57,951
	Catch	23,709	14,320	19,441	57,471
2020	Subarea ABC/ABC	24,535	14,721	30,844	70,100
	TAC	24,535	14,721	20,049	59,305
	Catch	24,291	14,596	19,997	58,884
2021	Subarea ABC/ABC	25,760	15,450	32,380	73,590
	TAC	25,760	15,450	21,047	62,257
	Catch	25,183	15,308	20,863	61,354
2022	Subarea ABC/ABC	27,260	16,880	34,370	78,510
	TAC	27,260	16,880	22,341	66,481
	Catch	19,138	16,761	22,208	58,107
2023	Subarea ABC/ABC	43,281	17,351	37,956	98,588
	TAC	27,260	17,351	24,671	69,282
	Catch	24,862	17,210	24,541	66,613
2024	Subarea ABC/ABC	41,723	16,754	36,882	95,358
	TAC	32,260	16,754	23,973	72,987
	Catch	31,771	16,615	23,793	72,179
2025	Subarea ABC/ABC	46,649	26,511	30,087	103,247
	TAC	39,000	24,443	18,557	82,000
	Catch	37,875	24,289	18,449	80,613
2026 [a]	BRD/ABC	41,731	23,716	26,914	92,361
	TAC	41,731	23,716	17,494	82,941
	Catch	27,772	22,821	17,428	68,021

[a]2026 catch accessed October 8, 2026. Projected total year catch is assumed equal to the 2026 TAC of 82,941 t.

Table 17.3. Incidental catch of Fishery Management Plan (FMP) species (upper table) and non-target species (bottom table) in the directed Atka mackerel fishery, 2016-2025. Sculpin were moved out of the FMP in 2020, and therefore they appear in both tables. All catch is in metric tons except seabirds, which are counts. Species are listed in descending order based on cumulative catch during the period. Seabird catches, which have been aggregated due to confidentiality reasons, include Northern Fulmars, Shearwaters, Auklets, and Storm Petrels.

FMP Species Group	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Pacific Ocean Perch	7,763	6,945	9,140	6,871	6,977	7,816	8,519	7,866	9,021	9,593
Northern Rockfish	2,941	3,071	3,865	4,361	4,682	3,858	4,502	5,002	4,753	5,592
Pacific Cod	2,512	3,940	3,361	2,226	2,202	1,965	2,486	2,350	2,753	2,875
Pollock	451	506	910	589	521	457	1,453	1,793	2,031	2,742
Skates	662	719	863	491	487	400	383	354	322	250
Other Rockfish	313	385	598	320	357	394	439	352	278	300
Kamchatka Flounder	400	389	442	429	188	251	228	124	592	994
Sculpin	304	477	386	341	308	0	0	0	0	0
Arrowtooth Flounder	223	132	353	98	181	225	229	218	974	793
Rock Sole	57	72	105	77	67	65	101	75	98	138
Sablefish	13	56	101	42	56	241	221	209	373	316
Rougheye Rockfish	35	38	79	76	98	144	133	167	197	252
Greenland Turbot	46	45	28	49	19	57	24	3	62	66
Shortraker Rockfish	13	14	25	18	38	28	33	29	32	25
Other Flatfish	9	11	11	10	13	39	23	19	25	12

Non-target Species Group	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Misc fish	123.1	185.9	177.5	115.3	119.2	118.1	111.2	122.0	96.5	101.5
Grenadiers	97.0	59.7	64.9	106.8	68.6	88.2	37.2	45.4	177.8	233.8
Sponge	75.6	150.2	153.5	173.0	110.5	81.7	80.8	94.4	51.5	49.0
Urchins/Dollars/Cucumbers/Sea Stars	10.4	18.3	29.3	30.6	14.4	11.2	17.7	18.0	12.8	16.1
Misc invertebrates	6.9	0.1	0.7	4.7	4.5	38.4	0.9	10.5	0.5	4.1
Red Tree Coral & Other Bryozoans	6.9	9.6	15.5	13.5	8.0	6.4	8.7	16.6	4.5	8.3
Other Misc fish	2.0	2.5	4.0	2.2	4.3	4.5	8.8	6.4	6.5	6.5
Anemones	1.4	2.0	1.5	1.5	0.9	1.8	2.1	0.5	0.5	3.5
Scypho jellies	1.3	0.4	15.3	9.5	3.9	3.3	3.8	5.7	5.9	2.7
Snails	0.3	0.5	0.8	1.1	1.3	1.0	1.1	4.8	0.9	1.1
Misc crustaceans	0.2	0.1	0.3	0.0	0.1	0.0	0.3	0.2	0.0	0.4
Pandalid shrimp	0.2	0.2	0.2	0.2	0.1	0.3	0.2	0.2	0.1	0.2
Squid	0.0	0.0	0.0	8.8	8.5	15.8	17.1	14.0	105.7	46.8
Sculpins	0.0	0.0	0.0	0.0	0.0	328.7	376.2	555.1	387.5	301.2
Northern Fulmars/Shearwaters/Storm Petrels, Auklets	184	156	553	891	195	1,000	323	602	424	807

Table 17.4. Prohibited species catch in the BSAI Atka mackerel fishery, 2016-2025. Estimates are reported in metric tons for halibut and herring, and counts of fish for crab and salmon.

Species group name	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Golden King Crab	2,898	1,409	7,074	14,236	2,107	4,012	1,728	3,660	1,798	9,047
Non-Chinook Salmon	1,162	1,611	1,507	3,640	1,194	1,511	1,255	2,860	2,014	1,261
Chinook Salmon	535	1,109	652	532	680	354	1,192	699	48	48
Red King Crab	348	239	239	149	131	0	0	0	0	0
Halibut	121	171	203	111	69	86	144	128	104	78
Bairdi Tanner Crab	0	44	0	0	0	0	0	7	240	13,262
Blue King Crab	0	0	0	0	0	0	0	0	0	0
Herring	0	0	0	0	0	0	0	0	0	0
Opilio Tanner (Snow) Crab	0	0	0	40	9	0	0	0	0	0
Total Halibut & Herring (t)	121	171	203	111	69	86	144	128	104	78
Total Numbers Crab & Salmon	4,943	4,412	9,472	18,598	4,121	5,877	4,174	7,225	4,100	23,618

Table 17.5. Estimated discarded and total catch (t) of Atka mackerel with associated discard rates in all BSAI fisheries by management area (541=eastern Aleutians, 542=central Aleutians, 543=western Aleutians, and SBS=Southern Bering Sea).

Year	Value	541	542	543	SBS
2003	Discarded catch	703	4,839	4,099	3,419
	Total catch	6,336	27,564	19,088	5,072
	Discard rate	11%	18%	21%	67%
2004	Discarded catch	520	3,615	3,021	4,717
	Total catch	3,681	30,176	19,547	7,159
	Discard rate	14%	12%	15%	66%
2005	Discarded catch	305	1,496	867	1,344
	Total catch	3,661	35,516	19,297	3,540
	Discard rate	8%	4%	4%	38%
2006	Discarded catch	232	1,391	261	1,149
	Total catch	4,246	39,921	14,553	3,164
	Discard rate	5%	3%	2%	36%
2007	Discarded catch	169	1,260	238	386
	Total catch	19,922	26,941	8,880	3,005
	Discard rate	1%	5%	3%	13%
2008	Discarded catch	18	746	395	89
	Total catch	18,719	22,926	16,045	392
	Discard rate	0%	3%	2%	23%
2009	Discarded catch	439	1,722	740	45
	Total catch	26,173	30,137	16,253	244
	Discard rate	2%	6%	5%	18%
2010	Discarded catch	384	2,354	1,195	48
	Total catch	23,458	26,389	18,650	151
	Discard rate	2%	9%	6%	32%
2011	Discarded catch	467	886	205	214
	Total catch	39,681	10,714	205	1,222
	Discard rate	1%	8%	100%	18%
2012	Discarded catch	308	723	195	113
	Total catch	36,345	10,323	195	966
	Discard rate	1%	7%	100%	12%
2013	Discarded catch	149	416	119	9
	Total catch	15,630	7,284	120	147
	Discard rate	1%	6%	99%	6%
2014	Discarded catch	43	86	240	18
	Total catch	21,054	9,520	242	136
	Discard rate	0%	1%	99%	14%
2015	Discarded catch	182	391	98	128
	Total catch	26,078	16,672	10,253	273
	Discard rate	1%	2%	1%	47%
2016	Discarded catch	115	143	65	103
	Total catch	28,000	15,795	10,330	359
	Discard rate	0%	1%	1%	29%
2017	Discarded catch	129	130	109	23
	Total catch	33,946	17,748	12,433	318
	Discard rate	0%	1%	1%	7%
2018	Discarded catch	294	146	132	114
	Total catch	34,940	20,889	13,419	1,139
	Discard rate	1%	1%	1%	10%
2019	Discarded catch	134	139	236	99
	Total catch	22,534	14,320	19,441	1,175

Year	Value	541	542	543	SBS
	Discard rate	1%	1%	1%	8%
2020	Discarded catch	214	115	185	188
	Total catch	23,227	14,596	19,997	1,064
	Discard rate	1%	1%	1%	18%
2021	Discarded catch	222	109	249	127
	Total catch	23,940	15,308	20,863	1,223
	Discard rate	1%	1%	1%	10%
2022	Discarded catch	155	164	273	96
	Total catch	16,469	16,761	22,208	2,669
	Discard rate	1%	1%	1%	4%
2023	Discarded catch	210	366	333	122
	Total catch	22,581	17,210	24,541	2,281
	Discard rate	1%	2%	1%	5%
2024	Discarded catch	249	189	219	42
	Total catch	30,923	16,616	23,793	848
	Discard rate	1%	1%	1%	5%
2025	Discarded catch	379	340	272	33
	Total catch	37,643	24,289	18,449	233
	Discard rate	1%	1%	1%	14%

Table 17.6. BSAI Atka mackerel fishery age composition data with input sample sizes (ISS). These data were used in fitting the age-structured model. Too few fish were sampled in 1989 to construct an age-length key.

Year	ISS	1	2	3	4	5	6	7	8	9	10	11+
1977	25	0.000	0.091	0.418	0.266	0.201	0.016	0.005	0.003	0.000	0.000	0.000
1978	25	0.000	0.029	0.651	0.168	0.100	0.041	0.006	0.004	0.001	0.000	0.000
1979	25	0.000	0.000	0.094	0.564	0.273	0.046	0.023	0.000	0.000	0.000	0.000
1980	25	0.000	0.000	0.446	0.208	0.254	0.059	0.021	0.008	0.005	0.000	0.000
1981	50	0.000	0.000	0.167	0.531	0.000	0.050	0.252	0.000	0.000	0.000	0.000
1982	50	0.000	0.000	0.006	0.079	0.779	0.116	0.020	0.000	0.000	0.000	0.000
1983	50	0.000	0.000	0.105	0.079	0.140	0.588	0.088	0.000	0.000	0.000	0.000
1984	50	0.000	0.002	0.019	0.143	0.138	0.211	0.426	0.043	0.019	0.000	0.000
1985	50	0.000	0.011	0.268	0.148	0.158	0.101	0.092	0.196	0.021	0.005	0.000
1986	50	0.000	0.007	0.228	0.129	0.088	0.106	0.090	0.116	0.197	0.021	0.017
1987	50	0.000	0.014	0.269	0.196	0.118	0.049	0.061	0.056	0.044	0.174	0.020
1988	50	0.000	0.009	0.223	0.504	0.138	0.040	0.034	0.014	0.022	0.005	0.011
1989	-	-	-	-	-	-	-	-	-	-	-	-
1990	47	0.000	0.058	0.252	0.434	0.158	0.059	0.027	0.004	0.003	0.001	0.006
1991	6	0.000	0.000	0.139	0.217	0.261	0.191	0.132	0.035	0.006	0.012	0.007
1992	3	0.000	0.000	0.035	0.779	0.111	0.052	0.023	0.000	0.000	0.000	0.000
1993	2	0.000	0.000	0.143	0.193	0.409	0.128	0.071	0.044	0.006	0.006	0.000
1994	28	0.000	0.000	0.095	0.070	0.239	0.371	0.048	0.085	0.054	0.031	0.006
1995	23	0.000	0.001	0.151	0.246	0.072	0.137	0.242	0.029	0.043	0.058	0.022
1996	22	0.000	0.000	0.022	0.390	0.134	0.087	0.119	0.194	0.017	0.021	0.016
1997	5	0.000	0.000	0.175	0.048	0.677	0.038	0.016	0.007	0.036	0.004	0.000
1998	27	0.000	0.000	0.120	0.169	0.164	0.269	0.120	0.043	0.038	0.057	0.020
1999	74	0.000	0.015	0.014	0.499	0.115	0.092	0.129	0.068	0.023	0.019	0.023
2000	94	0.000	0.008	0.134	0.096	0.401	0.113	0.065	0.126	0.029	0.012	0.015
2001	66	0.000	0.021	0.229	0.151	0.097	0.303	0.091	0.051	0.043	0.009	0.006
2002	68	0.000	0.023	0.267	0.299	0.093	0.046	0.191	0.038	0.018	0.020	0.006
2003	146	0.000	0.007	0.183	0.453	0.189	0.054	0.030	0.064	0.007	0.005	0.008
2004	131	0.000	0.001	0.178	0.274	0.384	0.107	0.021	0.014	0.019	0.000	0.003
2005	147	0.000	0.013	0.036	0.323	0.249	0.265	0.089	0.014	0.002	0.008	0.000
2006	139	0.000	0.033	0.155	0.053	0.312	0.188	0.210	0.038	0.005	0.003	0.002
2007	143	0.000	0.025	0.216	0.128	0.059	0.219	0.175	0.137	0.030	0.008	0.002
2008	163	0.000	0.058	0.141	0.180	0.081	0.067	0.213	0.112	0.124	0.017	0.006
2009	168	0.000	0.037	0.255	0.126	0.160	0.070	0.068	0.133	0.066	0.070	0.014
2010	156	0.000	0.014	0.159	0.396	0.110	0.114	0.054	0.032	0.066	0.039	0.015
2011	115	0.000	0.015	0.044	0.256	0.326	0.097	0.071	0.017	0.040	0.065	0.070
2012	154	0.000	0.002	0.096	0.046	0.275	0.270	0.074	0.042	0.035	0.031	0.129
2013	112	0.000	0.023	0.109	0.293	0.067	0.217	0.172	0.037	0.019	0.012	0.050
2014	153	0.000	0.010	0.503	0.058	0.173	0.061	0.086	0.061	0.009	0.012	0.026
2015	219	0.000	0.007	0.189	0.152	0.123	0.154	0.080	0.165	0.090	0.023	0.017
2016	236	0.000	0.002	0.100	0.345	0.122	0.104	0.118	0.056	0.101	0.043	0.009

Year	ISS	1	2	3	4	5	6	7	8	9	10	11+
2017	200	0.000	0.011	0.022	0.235	0.323	0.127	0.110	0.057	0.037	0.037	0.040
2018	215	0.000	0.007	0.111	0.039	0.287	0.318	0.089	0.065	0.043	0.018	0.024
2019	200	0.000	0.017	0.044	0.181	0.086	0.251	0.263	0.079	0.039	0.025	0.016
2020	200	0.000	0.009	0.166	0.124	0.165	0.079	0.179	0.187	0.050	0.025	0.016
2021	200	0.000	0.007	0.081	0.290	0.141	0.133	0.060	0.127	0.116	0.027	0.018
2022	225	0.000	0.010	0.299	0.153	0.179	0.097	0.086	0.039	0.077	0.043	0.018
2023	210	0.002	0.057	0.154	0.384	0.110	0.124	0.047	0.045	0.022	0.036	0.019
2024	174	0.000	0.003	0.468	0.196	0.192	0.053	0.051	0.014	0.010	0.005	0.007
2025	133	0.000	0.017	0.024	0.536	0.161	0.145	0.044	0.052	0.013	0.006	0.004

Table 17.7. Numbers of Atka mackerel length-weight data, length frequency, and aged samples based on NMFS observer data 1990-2025.

Year	Number of length-weight samples	Length frequency records	Number of aged samples
1990	731	8,618	718
1991	356	7,423	349
1992	90	13,532	86
1993	58	12,476	58
1994	913	13,384	837
1995	1,054	19,653	972
1996	1,039	24,758	680
1997	126	13,412	123
1998	733	15,060	705
1999	1,633	12,349	1,444
2000	2,697	9,207	1,659
2001	3,331	19,711	935
2002	3,129	19,273	820
2003	4,070	22,251	1,008
2004	4,205	24,937	977
2005	4,494	25,349	1,024
2006	4,184	23,972	1,085
2007	2,096	22,294	917
2008	1,883	19,621	922
2009	2,374	26,024	971
2010	2,472	26,767	879
2011	1,976	20,351	720
2012	2,613	26,810	934
2013	1,178	12,224	640
2014	1,355	14,214	1,061
2015	2,492	25,704	1,687
2016	2,819	29,108	1,868
2017	4,927	48,865	1,319
2018	3,745	63,365	1,581
2019	2,699	47,745	1,510
2020	2,797	51,285	2,111
2021	2,707	55,082	1,205
2022	2,597	50,001	1,026
2023	2,552	52,396	997
2024	2,561	53,299	947
2025	2,355	48,103	742

Table 17.8. Year-specific fishery weight-at-age (kg) values used to obtain expected fishery catch biomass. The 2026 fishery weight-at-age and projection period weight-at-age for the fishery is assumed to be the average of the last three years with available age data (2023-2025). Between 1998 and 1999, there was a shift from the foreign to the domestic fishery.

	1	2	3	4	5	6	7	8	9	10	11+
1977	0.069	0.132	0.225	0.306	0.400	0.470	0.507	0.379	0.780	0.976	1.072
1978	0.069	0.072	0.225	0.300	0.348	0.388	0.397	0.371	0.423	0.976	1.072
1979	0.069	0.496	0.319	0.457	0.476	0.475	0.468	0.546	0.780	0.976	1.072
1980	0.069	0.365	0.317	0.450	0.520	0.585	0.630	0.546	0.780	0.976	1.072
1981	0.069	0.365	0.317	0.450	0.520	0.585	0.630	0.546	0.780	0.976	1.072
1982	0.069	0.365	0.273	0.443	0.564	0.695	0.795	0.546	0.780	0.976	1.072
1983	0.069	0.365	0.359	0.499	0.601	0.686	0.810	0.546	0.780	0.976	1.072
1984	0.069	0.297	0.410	0.617	0.707	0.777	0.802	0.890	0.910	0.976	1.072
1985	0.069	0.302	0.452	0.552	0.682	0.737	0.775	0.807	1.007	1.011	1.072
1986	0.069	0.146	0.334	0.528	0.546	0.786	0.753	0.829	0.858	0.954	1.052
1987	0.069	0.265	0.435	0.729	0.908	0.859	0.964	1.023	1.054	1.088	1.098
1988	0.069	0.196	0.351	0.470	0.564	0.624	0.694	0.783	0.818	0.850	1.064
1989	0.069	0.295	0.440	0.577	0.739	0.838	0.664	0.817	0.906	1.010	1.065
1990	0.069	0.362	0.511	0.728	0.877	0.885	0.985	1.386	1.039	1.445	1.442
1991	0.069	0.230	0.207	0.540	0.729	0.685	0.655	0.755	1.014	0.743	1.021
1992	0.069	0.230	0.390	0.607	0.715	0.895	0.973	0.839	0.865	0.916	1.010
1993	0.069	0.230	0.572	0.626	0.682	0.773	0.826	0.782	1.041	0.812	1.010
1994	0.069	0.150	0.363	0.568	0.649	0.697	0.777	0.749	0.744	0.736	0.922
1995	0.069	0.092	0.228	0.520	0.667	0.687	0.691	0.707	0.721	0.641	0.909
1996	0.069	0.188	0.294	0.474	0.633	0.728	0.743	0.770	0.799	0.846	0.973
1997	0.069	0.230	0.397	0.664	0.686	0.862	0.904	0.971	0.884	0.951	1.108
1998	0.069	0.230	0.296	0.494	0.580	0.644	0.682	0.775	0.707	0.798	0.858
1999	0.069	0.240	0.406	0.568	0.707	0.755	0.839	0.979	1.170	1.141	0.961
2000	0.069	0.215	0.497	0.594	0.689	0.734	0.778	0.854	0.813	0.904	0.988
2001	0.069	0.224	0.418	0.563	0.719	0.765	0.841	0.826	0.946	0.912	1.109
2002	0.069	0.253	0.293	0.459	0.600	0.601	0.723	0.722	0.791	0.851	0.940
2003	0.069	0.208	0.304	0.420	0.539	0.667	0.747	0.731	0.669	0.824	0.996
2004	0.069	0.176	0.316	0.444	0.567	0.624	0.679	0.810	0.728	0.916	1.015
2005	0.069	0.247	0.406	0.480	0.536	0.558	0.657	0.966	1.184	0.942	1.010
2006	0.069	0.265	0.393	0.503	0.551	0.613	0.647	0.714	0.848	0.856	0.984
2007	0.069	0.247	0.437	0.547	0.715	0.697	0.768	0.778	0.776	1.272	1.033
2008	0.069	0.265	0.388	0.540	0.615	0.727	0.719	0.700	0.798	0.786	0.998
2009	0.069	0.215	0.395	0.494	0.605	0.667	0.734	0.745	0.770	0.816	0.813
2010	0.069	0.204	0.362	0.565	0.583	0.673	0.684	0.758	0.723	0.762	0.803
2011	0.069	0.220	0.445	0.640	0.807	0.753	0.770	0.798	0.931	0.913	0.899
2012	0.069	0.230	0.374	0.509	0.612	0.658	0.713	0.772	0.822	0.894	0.949
2013	0.069	0.266	0.280	0.606	0.677	0.740	0.867	0.822	0.803	0.822	1.093
2014	0.069	0.316	0.569	0.634	0.709	0.735	0.840	0.838	0.791	0.942	0.923
2015	0.069	0.178	0.375	0.604	0.620	0.679	0.702	0.736	0.770	0.763	0.864
2016	0.069	0.249	0.455	0.552	0.680	0.679	0.706	0.720	0.767	0.764	0.754
2017	0.069	0.257	0.458	0.627	0.646	0.756	0.783	0.796	0.838	0.809	0.857
2018	0.069	0.292	0.511	0.695	0.744	0.708	0.783	0.819	0.839	0.852	0.835
2019	0.069	0.426	0.595	0.665	0.769	0.783	0.746	0.847	0.811	0.818	0.862
2020	0.069	0.391	0.555	0.599	0.730	0.793	0.824	0.810	0.833	0.815	0.880
2021	0.069	0.412	0.547	0.699	0.728	0.797	0.842	0.880	0.842	0.919	0.876
2022	0.069	0.412	0.547	0.699	0.728	0.797	0.842	0.880	0.842	0.919	0.876
2023	0.069	0.289	0.557	0.725	0.800	0.823	0.886	0.906	0.910	0.903	0.981
2024	0.069	0.289	0.557	0.725	0.800	0.823	0.886	0.906	0.910	0.903	0.981
2025	0.069	0.505	0.423	0.547	0.630	0.685	0.748	0.812	0.790	0.781	0.916
2026	0.069	0.347	0.471	0.596	0.667	0.710	0.774	0.838	0.802	0.819	0.870

Table 17.9 Design-based estimates of Atka mackerel biomass with coefficients of variation (*CV*) and number of hauls by area from the Aleutian Islands (AI) bottom trawl survey (WAI=western AI; CAI=central AI; EAI=eastern AI; SBS=southern Bering Sea).

Year	Quantity	WAI	CAI	EAI	SBS	Total
1991	*Biomass (t)*	343,426	287,593	77,218	61	708,299
1994		327,242	83,784	208,379	66,603	686,007
1997		134,367	186,813	45,137	95,680	461,997
2000		179,680	330,255	919	2,044	512,897
2002		253,671	331,824	190,817	59,883	836,195
2004		376,414	269,071	244,043	267,556	1,157,084
2006		101,098	278,036	350,206	12,308	741,648
2010		255,419	198,874	372,429	103,529	930,251
2012		133,588	109,130	33,149	1,009	276,876
2014		215,235	204,868	302,383	1,443	723,928
2016		156,433	133,022	158,525	186	448,166
2018		134,766	26,615	168,188	25,645	355,213
2022		212,694	107,714	351,139	716	672,263
2024		151,374	163,575	113,577	146,244	574,769
2026		130,263	119,482	272,334	32,822	554,902
1991	*CV*	18%	17%	83%	37%	14%
1994		57%	48%	44%	99%	32%
1997		56%	36%	68%	99%	31%
2000		51%	34%	74%	88%	28%
2002		32%	24%	58%	99%	20%
2004		24%	35%	33%	43%	17%
2006		35%	24%	55%	44%	28%
2010		58%	28%	74%	86%	35%
2012		28%	27%	46%	77%	18%
2014		29%	50%	43%	73%	24%
2016		56%	54%	50%	39%	31%
2018		34%	29%	57%	70%	30%
2022		31%	50%	59%	55%	33%
2024		30%	24%	43%	81%	25%
2026		55%	38%	41%	73%	26%
1991	*Number of hauls*	56	91	129	55	331
1994		69	114	133	64	380
1997		92	116	136	52	396
2000		113	110	138	58	419
2002		107	114	132	61	414
2004		124	130	112	53	419
2006		112	110	91	44	357
2010		118	128	121	51	418
2012		120	113	132	55	420
2014		134	110	122	44	410
2016		135	114	127	43	419
2018		129	120	126	45	420
2022		108	112	131	47	398
2024		88	80	104	35	307
2026		100	91	130	51	372

Table 17.10. BSAI Atka mackerel Aleutian Islands bottom trawl survey age composition data with input sample sizes (ISS). These data were used in fitting the age-structured model.

Year	ISS	1	2	3	4	5	6	7	8	9	10	11+
1991	24	0.000	0.040	0.575	0.067	0.164	0.058	0.074	0.015	0.007	0.000	0.000
1994	27	0.000	0.018	0.206	0.129	0.218	0.226	0.061	0.076	0.026	0.035	0.005
1997	29	0.000	0.034	0.329	0.185	0.190	0.081	0.035	0.048	0.066	0.006	0.026
2000	30	0.000	0.214	0.083	0.030	0.268	0.078	0.086	0.142	0.048	0.020	0.031
2002	30	0.000	0.043	0.526	0.288	0.049	0.013	0.045	0.020	0.007	0.008	0.001
2004	30	0.000	0.028	0.305	0.243	0.271	0.068	0.020	0.030	0.019	0.006	0.010
2006	26	0.000	0.043	0.107	0.054	0.185	0.209	0.271	0.101	0.015	0.000	0.012
2010	30	0.000	0.033	0.289	0.291	0.058	0.062	0.026	0.029	0.068	0.054	0.090
2012	30	0.000	0.087	0.256	0.106	0.262	0.154	0.032	0.027	0.017	0.010	0.048
2014	29	0.000	0.102	0.141	0.141	0.122	0.080	0.158	0.137	0.034	0.021	0.065
2016	30	0.000	0.042	0.285	0.303	0.082	0.064	0.064	0.023	0.046	0.064	0.028
2018	30	0.000	0.046	0.157	0.034	0.174	0.228	0.115	0.062	0.094	0.024	0.066
2022	29	0.000	0.005	0.251	0.104	0.119	0.112	0.110	0.062	0.108	0.089	0.040
2024	22	0.000	0.000	0.328	0.154	0.199	0.109	0.088	0.055	0.030	0.016	0.022

Table 17.11. Year-specific survey and the population weight-at-age (kg) values used to obtain expected survey catch biomass and population biomass. The 2026 values are assumed equal to 2024, and the population weight-at-age values are equal to the average of the most recent three surveys with age data (2018, 2022, and 2024).

	1	2	3	4	5	6	7	8	9	10	11+
1991	0.045	0.185	0.449	0.637	0.652	0.751	0.811	0.693	1.053	1.764	1.011
1994	0.045	0.177	0.450	0.653	0.738	0.846	0.941	0.988	0.906	0.907	0.885
1997	0.045	0.191	0.486	0.686	0.753	0.805	0.887	0.970	0.919	1.375	0.988
2000	0.045	0.130	0.387	0.623	0.699	0.730	0.789	0.810	0.792	0.864	1.031
2002	0.045	0.139	0.342	0.615	0.720	0.837	0.877	0.773	0.897	0.955	1.126
2004	0.045	0.138	0.333	0.497	0.609	0.739	0.816	0.956	0.928	0.745	0.968
2006	0.045	0.158	0.332	0.523	0.516	0.675	0.764	0.719	0.855	1.653	0.991
2010	0.045	0.161	0.369	0.633	0.667	0.744	0.974	1.075	0.981	1.041	1.244
2012	0.045	0.161	0.360	0.517	0.627	0.705	0.762	0.820	0.863	0.809	0.949
2014	0.045	0.162	0.465	0.524	0.662	0.709	0.856	0.951	0.920	0.808	1.017
2016	0.045	0.189	0.370	0.480	0.696	0.744	0.759	0.892	0.910	0.917	0.887
2018	0.069	0.161	0.481	0.593	0.751	0.771	0.891	0.896	0.971	0.973	0.981
2022	0.053	0.157	0.461	0.639	0.743	0.726	0.831	0.870	0.949	0.948	0.991
2024	0.053	0.201	0.369	0.540	0.585	0.649	0.747	0.701	0.830	0.881	0.946
2026	0.053	0.201	0.369	0.540	0.585	0.649	0.747	0.701	0.830	0.881	0.946
Population WAA	0.058	0.173	0.437	0.591	0.693	0.715	0.823	0.822	0.917	0.934	0.973

Table 17.12. Schedules of age and length specific maturity of Atka mackerel from McDermott and Lowe (1997) by Aleutian Islands subareas. Eastern - 541, Central - 542, and Western - 543. The proportion mature at age vector is used in the stock assessments, whereas the proportion mature at length by area is provided as reference.

	INPFC Area				
Length (cm)	541	542	543	Age	Proportion mature
25	0	0	0	1	0
26	0	0	0	2	0.04
27	0	0.01	0.01	3	0.22
28	0	0.02	0.02	4	0.69
29	0.01	0.04	0.04	5	0.94
30	0.01	0.07	0.07	6	0.99
31	0.03	0.14	0.13	7	1
32	0.06	0.25	0.24	8	1
33	0.11	0.4	0.39	9	1
34	0.2	0.58	0.56	10	1
35	0.34	0.73	0.72		
36	0.51	0.85	0.84		
37	0.68	0.92	0.92		
38	0.81	0.96	0.96		
39	0.9	0.98	0.98		
40	0.95	0.99	0.99		
41	0.97	0.99	0.99		
42	0.99	1	1		
43	0.99	1	1		
44	1	1	1		
45	1	1	1		
46	1	1	1		
47	1	1	1		
48	1	1	1		
49	1	1	1		
50	1	1	1		

Table 17.13. Estimates of key results for BSAI Atka mackerel from the 2024 assessment (Model 16.0b) and the current 2026 assessment (Model 16.0b). Coefficients of variation (*CV*) for some key reference values are given, appearing directly below.

Assessment Model	**2024 (Model 16.0b)**	**2026 (Model 16.0b)**
Scaling parameters		
Survey catchability (Estimated)	1.8	1.8
Steepness (Fixed)	0.8	0.8
SigmaR (Estimated)	0.48	0.50
Natural mortality (Fixed)	0.3	0.3
Fishery Average Effective *N*	225	235
Survey Average Effective *N*	103	96
RMSE Survey	0.314	0.297
Number of Parameters	601	625
-log Likelihoods		
Survey index	12.47	12.14
Catch biomass	0.06	0.06
Fishery age comp	147.56	151.23
Survey age comp	29.60	30.77
Sub total	189.70	194.20
-log Penalties		
Recruitment	-1.44	2.52
Selectivity constraint	105.81	111.11
Prior	3.95	4.42
Sub Total	108.32	118.06
Total	298.02	312.26
Fishing mortalities (full selection)		
Estimated F_{2024}	0.26	0.17
$F_{40\%}$	0.53	0.37
Stock abundance		
Initial Biomass (t, 1977)	683,113	672,889
CV	16%	16%
Assessment year total biomass (t)	584,610	615,258
CV	18%	17%
2006 year class (millions at age-1)	821	806
CV	11%	10%
2017 year class (millions at age-1)	536	521
CV	18%	15%
2021 year class (millions at age-1)	685	1,336
CV	31%	18%

Table 17.14. Estimates of Atka mackerel annual (1977-2025) fishery and survey selectivity-at-age, rescaled to have a maximum of 1.0 for presentation. The 2026 fishery selectivity is set equal to 2025, and the average fishery selectivity over 2021-2025 is used for projections and computation of ABC. Survey selectivity is assumed constant over time.

	1	2	3	4	5	6	7	8	9	10	11+
Fishery 1977	0.007	0.075	0.538	1.000	0.945	0.564	0.340	0.203	0.122	0.087	0.087
Fishery 1978	0.007	0.073	0.622	0.934	1.000	0.664	0.405	0.232	0.135	0.095	0.095
Fishery 1979	0.007	0.052	0.383	1.000	0.954	0.659	0.436	0.239	0.133	0.091	0.091
Fishery 1980	0.007	0.052	0.332	0.890	1.000	0.762	0.593	0.291	0.149	0.100	0.100
Fishery 1981	0.008	0.057	0.355	0.725	0.946	0.969	1.000	0.367	0.176	0.119	0.119
Fishery 1982	0.006	0.043	0.216	0.513	1.000	0.911	0.591	0.281	0.149	0.101	0.101
Fishery 1983	0.006	0.043	0.243	0.546	0.843	1.000	0.651	0.303	0.167	0.113	0.113
Fishery 1984	0.006	0.046	0.272	0.649	0.897	1.000	0.768	0.393	0.219	0.141	0.141
Fishery 1985	0.006	0.056	0.468	0.866	0.999	1.000	0.814	0.534	0.325	0.198	0.198
Fishery 1986	0.007	0.056	0.465	0.848	1.000	0.985	0.907	0.714	0.477	0.265	0.265
Fishery 1987	0.006	0.054	0.418	0.932	1.000	0.908	0.850	0.705	0.489	0.330	0.330
Fishery 1988	0.005	0.043	0.354	1.000	0.882	0.699	0.648	0.531	0.386	0.261	0.261
Fishery 1989	0.006	0.048	0.356	0.986	1.000	0.796	0.699	0.573	0.424	0.311	0.311
Fishery 1990	0.005	0.046	0.374	1.000	0.972	0.771	0.700	0.579	0.443	0.333	0.333
Fishery 1991	0.006	0.043	0.263	0.795	1.000	0.912	0.794	0.646	0.498	0.396	0.396
Fishery 1992	0.006	0.040	0.222	0.690	1.000	0.996	0.882	0.735	0.582	0.475	0.475
Fishery 1993	0.005	0.034	0.183	0.546	0.882	1.000	0.905	0.782	0.631	0.519	0.519
Fishery 1994	0.005	0.030	0.162	0.487	0.845	1.000	0.952	0.888	0.726	0.584	0.584
Fishery 1995	0.005	0.028	0.146	0.480	0.760	0.937	1.000	0.945	0.788	0.644	0.644
Fishery 1996	0.004	0.025	0.129	0.431	0.700	0.888	1.000	0.995	0.795	0.653	0.653
Fishery 1997	0.004	0.024	0.132	0.434	0.753	0.874	0.992	1.000	0.838	0.691	0.691
Fishery 1998	0.003	0.022	0.122	0.458	0.720	0.826	0.957	1.000	0.842	0.680	0.680
Fishery 1999	0.003	0.020	0.128	0.495	0.635	0.758	0.870	1.000	0.798	0.611	0.611
Fishery 2000	0.002	0.017	0.161	0.446	0.619	0.733	0.868	1.000	0.735	0.538	0.538
Fishery 2001	0.002	0.017	0.163	0.480	0.695	0.828	1.000	0.992	0.733	0.528	0.528
Fishery 2002	0.002	0.018	0.135	0.449	0.654	0.788	1.000	0.890	0.639	0.469	0.469
Fishery 2003	0.003	0.021	0.182	0.478	0.732	0.867	1.000	0.950	0.645	0.478	0.478
Fishery 2004	0.003	0.030	0.231	0.593	0.826	0.920	1.000	0.927	0.679	0.497	0.497
Fishery 2005	0.003	0.040	0.279	0.625	0.814	0.896	1.000	0.836	0.635	0.480	0.480
Fishery 2006	0.003	0.054	0.479	0.647	0.809	0.878	1.000	0.845	0.676	0.514	0.514
Fishery 2007	0.003	0.054	0.494	0.714	0.707	0.790	1.000	0.878	0.708	0.516	0.516
Fishery 2008	0.003	0.047	0.389	0.655	0.703	0.842	1.000	0.938	0.847	0.543	0.543
Fishery 2009	0.003	0.034	0.247	0.568	0.765	0.841	1.000	0.916	0.776	0.573	0.573
Fishery 2010	0.003	0.028	0.179	0.552	0.772	0.961	1.000	0.913	0.819	0.609	0.609
Fishery 2011	0.003	0.024	0.149	0.386	0.687	0.951	1.000	0.911	0.949	0.871	0.871
Fishery 2012	0.002	0.019	0.129	0.293	0.491	0.752	0.867	0.846	0.911	1.000	1.000
Fishery 2013	0.002	0.021	0.213	0.454	0.505	0.678	0.833	0.882	0.964	1.000	1.000
Fishery 2014	0.002	0.019	0.482	0.341	0.522	0.654	0.654	0.820	1.000	0.936	0.936
Fishery 2015	0.001	0.013	0.120	0.274	0.417	0.587	0.751	1.000	0.974	0.690	0.690
Fishery 2016	0.001	0.011	0.075	0.244	0.315	0.492	0.701	0.870	1.000	0.600	0.600
Fishery 2017	0.001	0.013	0.087	0.252	0.397	0.557	0.824	0.881	1.000	0.765	0.765
Fishery 2018	0.001	0.015	0.122	0.257	0.482	0.644	0.748	0.986	1.000	0.760	0.760
Fishery 2019	0.001	0.016	0.119	0.355	0.536	0.686	0.874	0.990	1.000	0.754	0.754
Fishery 2020	0.001	0.016	0.157	0.368	0.507	0.661	0.769	1.000	0.944	0.693	0.693
Fishery 2021	0.001	0.015	0.161	0.451	0.564	0.629	0.749	0.923	1.000	0.660	0.660
Fishery 2022	0.001	0.019	0.240	0.496	0.538	0.689	0.759	0.914	1.000	0.686	0.686
Fishery 2023	0.002	0.027	0.296	0.711	0.760	0.795	0.858	0.991	1.000	0.784	0.784
Fishery 2024	0.002	0.032	0.428	0.893	0.945	0.948	0.935	1.000	0.923	0.754	0.754
Fishery 2025	0.002	0.029	0.231	0.753	1.000	0.947	0.890	0.930	0.763	0.602	0.602
Fishery 2026	0.002	0.029	0.231	0.753	1.000	0.947	0.890	0.930	0.763	0.602	0.602
Fishery Projection Yrs	0.002	0.025	0.278	0.680	0.786	0.833	0.876	1.000	0.992	0.732	0.732
Survey All Yrs	0.005	0.060	0.334	0.485	0.502	0.595	0.829	1.000	0.952	0.803	0.803

Table 17.15. Estimated BSAI Atka mackerel begin-year numbers at age in millions, 1977-2026.

Year	1	2	3	4	5	6	7	8	9	10	11
1977	328.7	528.5	342.2	129.0	101.2	61.8	53.6	44.2	34.6	26.5	87.6
1978	1,879.2	243.3	386.9	232.8	81.6	64.5	41.9	37.6	31.7	25.1	83.4
1979	470.1	1,390.6	178.2	260.0	149.0	51.7	43.1	29.1	26.9	23.0	79.2
1980	275.9	348.0	1,025.0	127.1	174.7	100.5	35.9	30.6	21.1	19.7	75.1
1981	300.2	204.3	256.8	741.1	88.3	120.3	70.4	25.5	22.2	15.4	69.7
1982	191.7	222.3	150.9	186.8	528.9	62.3	84.8	49.6	18.5	16.3	62.7
1983	260.2	142.0	164.3	110.6	134.7	371.9	44.0	60.9	36.2	13.6	58.2
1984	282.3	192.7	105.0	120.8	80.4	97.1	266.6	31.9	44.7	26.7	53.0
1985	457.0	209.0	142.0	75.4	83.1	53.9	64.2	181.1	22.6	32.3	58.1
1986	393.2	338.2	153.5	98.2	49.1	53.1	34.4	42.2	123.9	16.0	65.0
1987	543.7	291.0	248.5	106.1	64.0	31.3	33.9	22.2	28.1	85.5	57.6
1988	422.5	402.5	214.3	175.4	70.5	42.2	20.9	22.8	15.2	19.6	102.0
1989	1,167.8	312.8	296.6	152.1	115.3	47.0	28.8	14.3	15.8	10.7	87.4
1990	562.0	864.8	231.0	214.5	105.4	79.7	33.0	20.3	10.2	11.4	71.1
1991	314.9	416.2	638.9	167.4	149.7	73.7	56.4	23.4	14.6	7.4	59.9
1992	510.1	233.1	307.1	461.8	115.1	101.0	50.1	38.8	16.3	10.3	48.1
1993	828.0	377.6	171.9	221.6	315.4	75.8	66.5	33.5	26.4	11.3	40.9
1994	337.1	612.8	278.1	123.3	149.0	199.7	47.0	42.0	21.6	17.5	35.2
1995	355.3	249.5	451.0	198.8	82.1	91.7	118.8	28.2	25.6	13.6	34.3
1996	828.0	262.8	183.0	317.5	124.6	46.6	49.0	62.1	15.0	14.4	28.4
1997	187.7	612.2	192.3	126.9	188.6	64.4	21.9	21.7	27.6	7.4	22.7
1998	290.2	138.9	450.3	136.9	82.5	111.3	36.7	12.0	11.9	15.9	18.1
1999	691.2	214.7	102.1	318.8	85.6	46.8	60.7	19.1	6.2	6.5	19.6
2000	1,556.6	511.7	158.2	72.9	204.7	52.8	27.9	35.0	10.6	3.6	16.2
2001	1,010.5	1,152.5	377.2	112.1	47.7	127.8	31.9	16.2	19.7	6.4	12.6
2002	1,114.6	748.0	848.7	264.1	70.2	27.8	71.0	16.7	8.5	11.3	11.7
2003	238.3	825.3	551.5	606.0	173.1	43.6	16.6	40.0	9.7	5.3	15.0
2004	314.8	176.4	608.3	391.3	400.7	107.8	26.3	9.7	23.7	6.2	13.4
2005	418.7	233.1	130.0	433.6	262.5	258.5	68.4	16.5	6.1	15.6	13.4
2006	298.2	310.0	171.6	92.0	290.1	170.3	165.5	43.1	10.6	4.1	19.9
2007	806.4	220.7	227.5	116.9	60.9	186.5	108.2	102.9	27.5	7.0	16.2
2008	702.2	597.1	162.0	154.5	76.4	39.8	120.3	67.2	65.3	18.0	15.7
2009	217.3	519.9	437.8	110.2	99.2	48.5	24.6	71.6	40.6	40.2	22.2
2010	481.3	160.8	380.6	297.6	67.0	56.3	26.8	12.8	38.6	22.9	37.9
2011	339.3	356.2	118.0	265.5	183.2	38.3	30.2	14.2	7.0	21.7	36.7
2012	532.6	251.2	262.5	84.6	180.5	116.4	22.9	17.9	8.6	4.2	35.6
2013	1,037.8	394.3	185.0	187.3	57.5	115.8	69.2	13.2	10.4	4.9	22.0
2014	785.2	768.6	291.4	133.7	131.6	40.2	79.2	46.5	8.8	6.9	17.7
2015	206.2	581.6	568.0	202.7	94.8	91.1	27.3	53.9	31.0	5.7	16.1
2016	441.2	152.7	429.1	405.1	137.7	61.5	56.0	16.0	29.1	16.8	13.0
2017	295.0	326.7	112.7	309.7	275.5	91.3	38.3	32.4	8.7	15.1	17.9
2018	521.4	218.5	241.0	81.1	210.7	178.4	56.0	21.5	17.8	4.6	18.9
2019	295.3	386.1	161.0	171.4	55.1	132.9	106.6	32.3	11.5	9.5	13.5
2020	703.2	218.7	284.8	115.6	115.5	35.4	81.9	62.5	18.4	6.5	13.9
2021	445.7	520.7	161.2	201.1	76.4	73.2	21.4	47.9	34.0	10.2	12.2
2022	1,336.2	330.0	383.9	113.5	129.0	47.3	44.4	12.5	26.4	18.3	13.4
2023	275.2	989.5	243.2	265.2	72.7	81.6	28.7	26.3	7.1	14.6	19.3
2024	451.9	203.8	728.5	168.2	166.6	45.2	50.3	17.4	15.5	4.2	20.9
2025	425.8	334.7	150.1	502.8	107.5	105.6	28.6	31.9	10.9	9.9	16.4
2026	430.7	315.3	246.2	105.2	311.1	62.7	62.4	17.1	18.9	6.7	16.8

Table 17.16. Estimates of Atka mackerel biomass in metric tons with approximate lower and upper 95% confidence bounds for age 1+ biomass and female spawning biomass (labeled as LCI and UCI; computed for period 1977-2026 from the recommended Model 16.0b.

	Age-1+ Biomass (t)			Female Spawning Biomass (t)		
Year	Estimate	LCI	UCI	Estimate	LCI	UCI
1977	672,889	491,809	920,641	169,689	121,297	237,385
1978	760,064	550,000	1,050,360	173,105	121,023	247,600
1979	822,173	587,962	1,149,680	182,223	124,850	265,960
1980	957,632	679,904	1,348,810	207,049	142,877	300,043
1981	931,616	658,898	1,317,210	268,236	186,012	386,805
1982	840,516	593,309	1,190,730	281,668	194,160	408,616
1983	724,973	513,045	1,024,440	249,627	172,418	361,412
1984	655,210	466,623	920,015	219,327	150,513	319,604
1985	574,666	410,202	805,071	178,317	120,800	263,220
1986	533,235	381,453	745,410	151,803	101,527	226,975
1987	527,839	382,676	728,066	137,554	92,483	204,590
1988	538,054	397,957	727,470	136,425	93,478	199,103
1989	600,208	461,306	780,934	141,790	99,875	201,296
1990	673,136	536,814	844,077	153,180	111,865	209,755
1991	769,118	629,248	940,078	172,844	131,902	226,494
1992	773,614	640,610	934,232	203,776	161,375	257,317
1993	749,088	626,067	896,283	204,178	162,333	256,809
1994	709,644	595,126	846,197	176,212	138,940	223,483
1995	691,427	578,184	826,849	158,164	123,686	202,252
1996	627,178	517,348	760,324	141,212	107,926	184,764
1997	542,753	436,009	675,630	123,791	92,345	165,945
1998	538,728	429,345	675,977	115,905	85,429	157,253
1999	499,605	393,389	634,499	123,422	91,076	167,254
2000	551,575	439,594	692,082	113,877	82,632	156,939
2001	689,724	560,799	848,288	106,072	76,162	147,730
2002	891,740	737,384	1,078,410	140,307	105,461	186,667
2003	981,809	820,549	1,174,760	203,719	159,736	259,813
2004	970,662	813,676	1,157,930	246,091	196,844	307,657
2005	847,709	708,113	1,014,820	253,009	204,225	313,446
2006	727,664	603,941	876,733	220,216	176,019	275,510
2007	650,540	537,762	786,969	179,771	141,926	227,707
2008	633,936	523,622	767,491	154,381	120,428	197,908
2009	638,019	525,264	774,978	133,657	102,499	174,287
2010	610,989	496,355	752,097	136,539	104,210	178,896
2011	543,146	433,814	680,033	141,772	107,955	186,180
2012	527,570	419,524	663,442	129,714	97,369	172,804
2013	546,179	433,265	688,519	128,598	96,995	170,497
2014	640,150	513,300	798,349	135,516	103,518	177,404
2015	727,664	585,478	904,381	147,096	112,413	192,480
2016	732,719	584,141	919,087	176,546	135,198	230,540
2017	659,787	519,197	838,447	184,793	140,022	243,880

	Age-1+ Biomass (t)			Female Spawning Biomass (t)		
Year	Estimate	LCI	UCI	Estimate	LCI	UCI
2018	597,785	462,760	772,208	159,703	117,351	217,339
2019	535,774	407,007	705,278	138,349	98,697	193,931
2020	532,151	401,976	704,481	124,693	86,788	179,153
2021	520,243	390,754	692,643	116,839	79,817	171,033
2022	594,168	449,628	785,173	115,785	78,677	170,396
2023	643,068	485,226	852,256	124,592	85,498	181,562
2024	721,212	538,479	965,954	145,902	101,963	208,777
2025	680,399	501,680	922,784	169,261	116,432	246,060
2026	615,258	439,310	861,675	159,275	105,419	240,644

Table 17.17. Estimates of BSAI Atka mackerel age 3+ biomass (t) and female spawning biomass (t) from the current recommended assessment model, Model 16.0b (1977-2026) compared to results from Model 16.0b in the 2024 assessment.

	Age-3+ Biomass (t)		Female Spawning Biomass (t)	
Year	2024 assessment	Current	2024 assessment	Current
1977	578,266	562,292	170,875	169,689
1978	629,250	608,372	175,561	173,105
1979	572,682	554,222	185,499	182,223
1980	922,756	881,342	212,336	207,049
1981	912,716	878,765	275,655	268,236
1982	820,784	790,886	290,528	281,668
1983	696,145	685,240	251,319	249,627
1984	604,898	605,406	217,022	219,327
1985	518,541	511,862	178,672	178,317
1986	454,549	451,793	150,390	151,803
1987	453,910	445,785	137,266	137,554
1988	449,573	443,789	135,172	136,425
1989	489,265	477,982	142,146	141,790
1990	502,947	490,774	154,461	153,180
1991	701,837	678,764	175,549	172,844
1992	727,017	703,538	208,081	203,776
1993	655,478	635,478	208,927	204,178
1994	597,406	583,983	178,348	176,212
1995	643,123	627,548	159,832	158,164
1996	551,513	533,417	145,225	141,212
1997	442,693	425,918	127,669	123,791
1998	518,700	497,776	119,330	115,905
1999	438,718	422,150	127,495	123,422
2000	388,490	372,275	118,192	113,877
2001	449,701	431,429	108,772	106,072
2002	736,471	697,336	146,183	140,307
2003	872,982	825,165	214,330	203,719
2004	971,830	921,788	258,178	246,091
2005	811,998	782,970	261,191	253,009
2006	672,385	656,646	224,192	220,216
2007	576,388	565,318	181,426	179,771
2008	499,206	489,701	155,800	154,381
2009	556,564	535,424	136,810	133,657
2010	578,868	555,097	140,494	136,539
2011	482,599	461,739	147,364	141,772
2012	472,695	453,057	134,431	129,714
2013	433,565	417,443	132,050	128,598
2014	482,821	461,397	140,118	135,516
2015	648,861	615,034	153,386	147,096
2016	719,472	680,567	185,370	176,546
2017	618,098	586,062	194,527	184,793
2018	556,411	529,583	166,493	159,703
2019	474,773	451,762	143,791	138,349
2020	482,396	453,304	132,066	124,693
2021	428,738	404,176	124,287	116,839
2022	477,406	459,141	121,525	115,785
2023	455,855	455,863	125,178	124,592
2024	505,910	659,607	128,919	145,902
2025	-	597,674	-	169,261
2026	-	535,598	-	159,275

Table 17.18. Estimates of age-1 BSAI Atka mackerel recruitment (millions of recruits) with standard errors (SE) from the recommended assessment model, Model 16.0b, compared to results from Model 16.0b in the 2024 assessment.

Year	2024 Estimate	2024 SE	Current Estimate	Current SE
1977	338	82	329	80
1978	1901	379	1879	369
1979	478	109	470	107
1980	283	69	276	67
1981	308	72	300	70
1982	198	50	192	48
1983	267	63	260	61
1984	289	66	282	64
1985	466	98	457	95
1986	401	91	393	89
1987	552	115	544	113
1988	426	95	423	94
1989	1171	175	1168	173
1990	570	113	562	112
1991	321	74	315	73
1992	513	93	510	93
1993	832	120	828	118
1994	343	65	337	64
1995	361	62	355	60
1996	837	108	828	104
1997	191	38	188	37
1998	293	51	290	49
1999	703	96	691	92
2000	1574	167	1557	158
2001	1021	112	1011	107
2002	1123	112	1115	107
2003	242	39	238	38
2004	319	43	315	42
2005	425	51	419	49
2006	303	41	298	39
2007	821	89	806	81
2008	715	85	702	78
2009	223	37	217	34
2010	490	66	481	61
2011	347	51	339	47
2012	542	74	533	68
2013	1058	130	1038	116
2014	802	104	785	94
2015	213	37	206	35
2016	462	73	441	66
2017	315	56	295	49
2018	536	94	521	80
2019	294	59	295	50
2020	676	131	703	108
2021	390	91	446	79
2022	685	212	1336	242
2023	450	184	275	75
2024	447	187	452	169
2025	-	-	426	179
2026	-	-	431	183
Average 78-22	559	Average 78-24	561	
Median 78-22	465	Median 78-24	446	

Table 17.19. Estimates of full-selection fishing mortality rates (*F*) and exploitation rates (catch/age-3+ biomass) for BSAI Atka mackerel from the recommended assessment model, Model 16.0b. Equivalent estimates from the 2024 assessment are shown for comparison.

Year	2024 *F*	Current *F*	2024 Catch/Biomass	Current Catch/Biomass
1977	0.153	0.159	0.038	0.039
1978	0.151	0.157	0.039	0.040
1979	0.095	0.098	0.041	0.042
1980	0.071	0.073	0.022	0.023
1981	0.050	0.052	0.022	0.022
1982	0.051	0.052	0.024	0.025
1983	0.032	0.033	0.017	0.017
1984	0.111	0.113	0.060	0.060
1985	0.145	0.149	0.073	0.074
1986	0.145	0.150	0.070	0.071
1987	0.112	0.116	0.066	0.067
1988	0.117	0.120	0.049	0.050
1989	0.066	0.068	0.037	0.038
1990	0.058	0.059	0.044	0.045
1991	0.092	0.094	0.038	0.039
1992	0.116	0.118	0.067	0.069
1993	0.175	0.178	0.101	0.104
1994	0.217	0.220	0.109	0.112
1995	0.344	0.349	0.127	0.130
1996	0.504	0.513	0.188	0.195
1997	0.295	0.302	0.149	0.155
1998	0.359	0.370	0.110	0.115
1999	0.280	0.289	0.128	0.133
2000	0.268	0.277	0.122	0.127
2001	0.338	0.348	0.137	0.143
2002	0.265	0.272	0.061	0.065
2003	0.231	0.238	0.067	0.070
2004	0.163	0.167	0.062	0.066
2005	0.159	0.163	0.076	0.079
2006	0.171	0.175	0.092	0.094
2007	0.173	0.176	0.102	0.104
2008	0.215	0.218	0.116	0.119
2009	0.341	0.349	0.131	0.136
2010	0.326	0.336	0.119	0.124
2011	0.216	0.223	0.107	0.112
2012	0.277	0.293	0.101	0.106
2013	0.109	0.117	0.053	0.056
2014	0.123	0.130	0.064	0.067
2015	0.307	0.317	0.082	0.087
2016	0.335	0.352	0.076	0.080
2017	0.320	0.338	0.104	0.110
2018	0.314	0.333	0.127	0.133
2019	0.253	0.268	0.121	0.127
2020	0.294	0.308	0.122	0.130
2021	0.302	0.320	0.143	0.152

Year	2024 *F*	Current *F*	2024 Catch/Biomass	Current Catch/Biomass
2022	0.284	0.292	0.122	0.127
2023	0.265	0.232	0.146	0.146
2024	0.264	0.165	0.127	0.109
2025	-	0.239	-	0.135
2026	-	0.211	-	0.127

Table 17.20. Projected catch (t), fully selected fishing mortality (F), and female spawning biomass (SSB, t) for the seven standard harvest scenarios. Projections incorporate a specified catch of 82,941 t in 2026. Scenarios 1-5 additionally assume catches of 76,927 t and 69,453 t in 2027 and 2028, respectively, before applying scenario-specific harvest rules beginning in 2029. Scenarios 6 and 7 apply their respective status-determination harvest rules beginning in 2027. Scenario 3 uses the 2021-2025 average fully selected fishing mortality of 0.2496 provided by the assessment model. The values for $B_{100\%}$, $B_{40\%}$, and $B_{35\%}$ are 270,552 t, 108,221 t, and 94,693 t, respectively.

Expected Catch (t)							
Year	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
2027	76,927	76,927	76,927	76,927	76,927	106,757	90,502
2028	69,453	69,453	69,453	69,453	69,453	84,855	78,819
2029	76,664	76,664	55,773	21,259	0	72,720	80,632
2030	72,647	72,647	57,626	23,924	0	74,488	77,364
2031	73,477	73,477	59,962	26,343	0	77,757	78,788
2032	76,311	76,311	62,756	28,734	0	81,407	81,781
2033	77,838	77,838	64,689	30,519	0	83,460	83,557
2034	78,420	78,420	65,787	31,783	0	83,866	83,887
2035	78,634	78,634	66,302	32,560	0	83,922	83,929
2036	78,769	78,769	66,670	33,078	0	83,889	83,893
2037	78,545	78,545	66,720	33,377	0	83,584	83,586
2038	78,185	78,185	66,562	33,499	0	83,157	83,158
2039	78,147	78,147	66,495	33,584	0	83,118	83,118
2040	78,637	78,637	66,801	33,782	0	83,649	83,649
Fishing Mortality							
Year	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
2027	0.31	0.31	0.31	0.31	0.31	0.44	0.37
2028	0.31	0.31	0.31	0.31	0.31	0.42	0.37
2029	0.35	0.35	0.25	0.09	0.00	0.38	0.40
2030	0.34	0.34	0.25	0.09	0.00	0.38	0.39
2031	0.34	0.34	0.25	0.09	0.00	0.38	0.39
2032	0.34	0.34	0.25	0.09	0.00	0.39	0.39
2033	0.34	0.34	0.25	0.09	0.00	0.39	0.39
2034	0.34	0.34	0.25	0.09	0.00	0.39	0.39
2035	0.34	0.34	0.25	0.09	0.00	0.39	0.39
2036	0.34	0.34	0.25	0.09	0.00	0.39	0.39
2037	0.34	0.34	0.25	0.09	0.00	0.39	0.39
2038	0.34	0.34	0.25	0.09	0.00	0.39	0.39
2039	0.34	0.34	0.25	0.09	0.00	0.39	0.39
2040	0.34	0.34	0.25	0.09	0.00	0.39	0.39
Female Spawning Biomass (t)							
Year	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
2027	130,354	130,354	130,354	130,354	130,354	122,429	126,779
2028	117,795	117,795	117,795	117,795	117,795	102,595	110,246
2029	106,837	106,837	111,914	120,116	125,033	93,287	98,399
2030	106,089	106,089	117,270	138,142	151,820	95,227	97,436
2031	108,102	108,102	123,228	154,701	176,904	98,206	99,082
2032	110,492	110,492	128,484	168,635	198,811	100,687	101,025
2033	112,454	112,454	132,632	179,789	217,194	102,382	102,511

2034	113,154	113,154	134,846	187,427	231,110	102,782	102,836
2035	113,156	113,156	135,857	192,554	241,583	102,602	102,625
2036	113,364	113,364	136,704	196,415	249,778	102,738	102,748
2037	113,306	113,306	137,045	198,978	255,825	102,654	102,658
2038	112,934	112,934	136,851	200,295	259,818	102,303	102,304
2039	112,724	112,724	136,727	201,183	262,737	102,132	102,132
2040	113,063	113,063	137,139	202,277	265,357	102,509	102,510

Figures

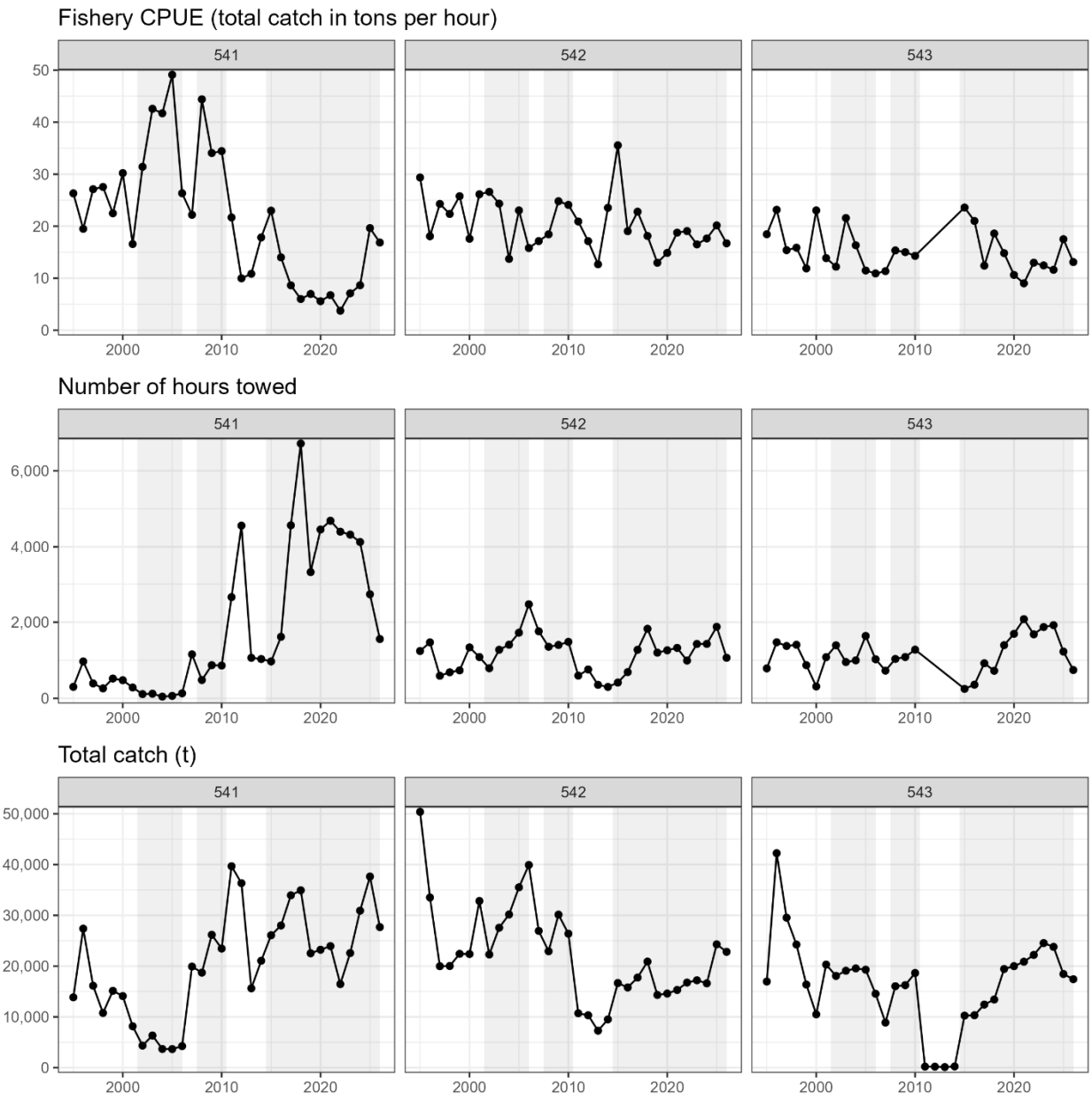


Figure 17.1. Nominal fishery catch per unit effort (CPUE) as defined by total catch in metric tons per hour towed (top), total number of hours towed (middle), and total catch in metric tons (bottom) in the Eastern Aleutians (541), Central Aleutians (542), and Western Aleutians (543) for Bering Sea and Aleutian Islands Atka mackerel. Alternating background shading between white and light grey in each panel represents major changes to management in the Atka mackerel fishery as described in the Management history section.

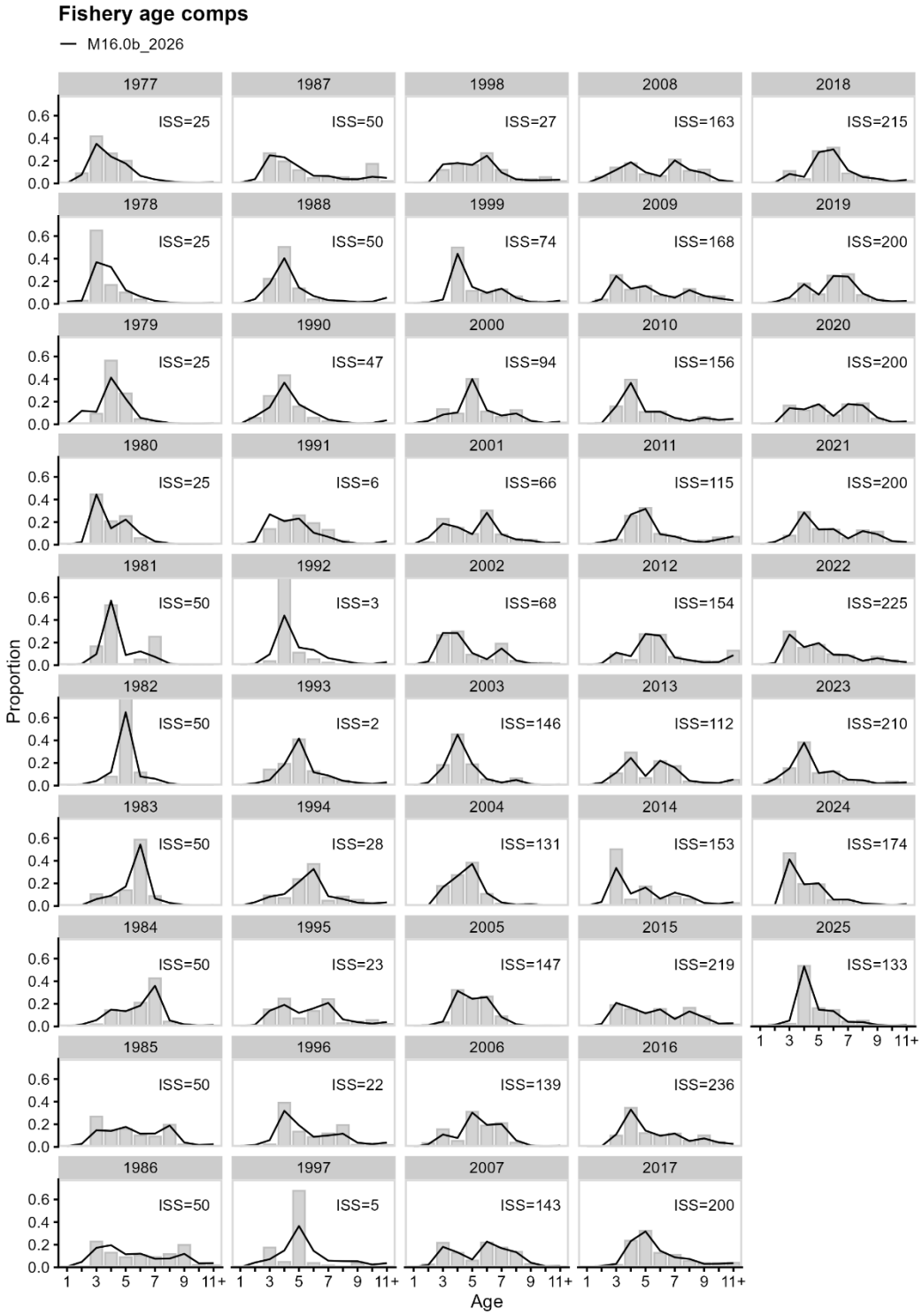


Figure 17.2. Observed and predicted Atka mackerel fishery proportions-at-age for BSAI Atka mackerel, 1977-2025. Lines are the model predictions and columns are the observed proportions-at-age with corresponding input sample sizes (ISS) for each year.

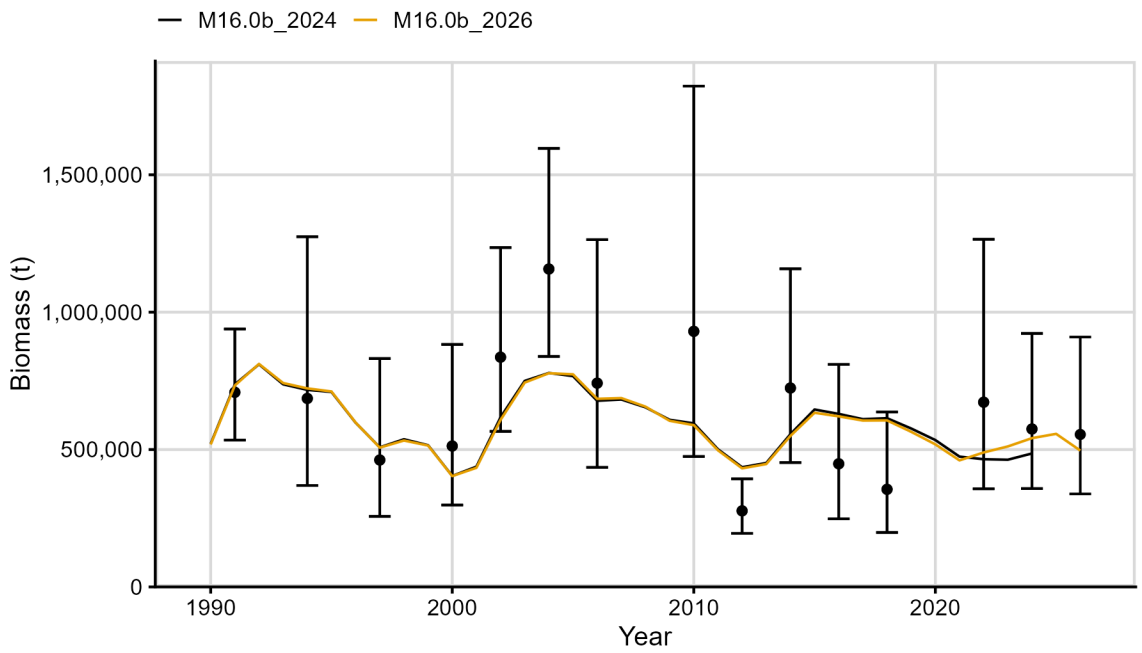


Figure 17.3. Observed (dots) and predicted (trend line) survey biomass estimates (t) for Bering Sea/Aleutian Islands Atka mackerel from the recommended model this year (M16.0b_2026) and the last full assessment (M16.0b_2024). Error bars represent the 95% confidence intervals of the survey biomass estimates based on the log standard error (coefficient of variation on the arithmetic scale) assumed in the stock assessment.

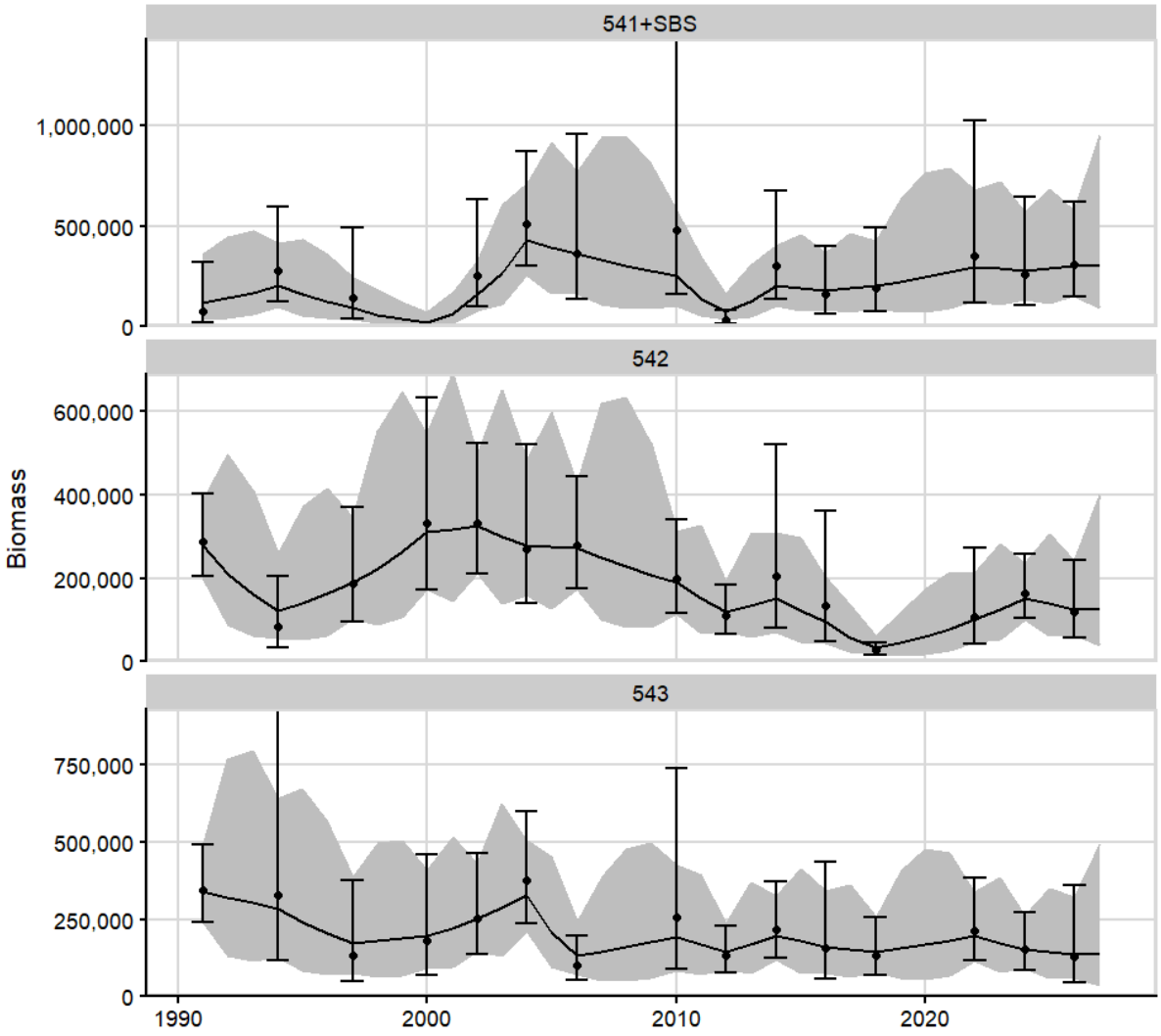


Figure 17.4. Atka mackerel bottom trawl survey biomass by subarea 1991-2026 with random effects model fitting for area apportionment purposes.

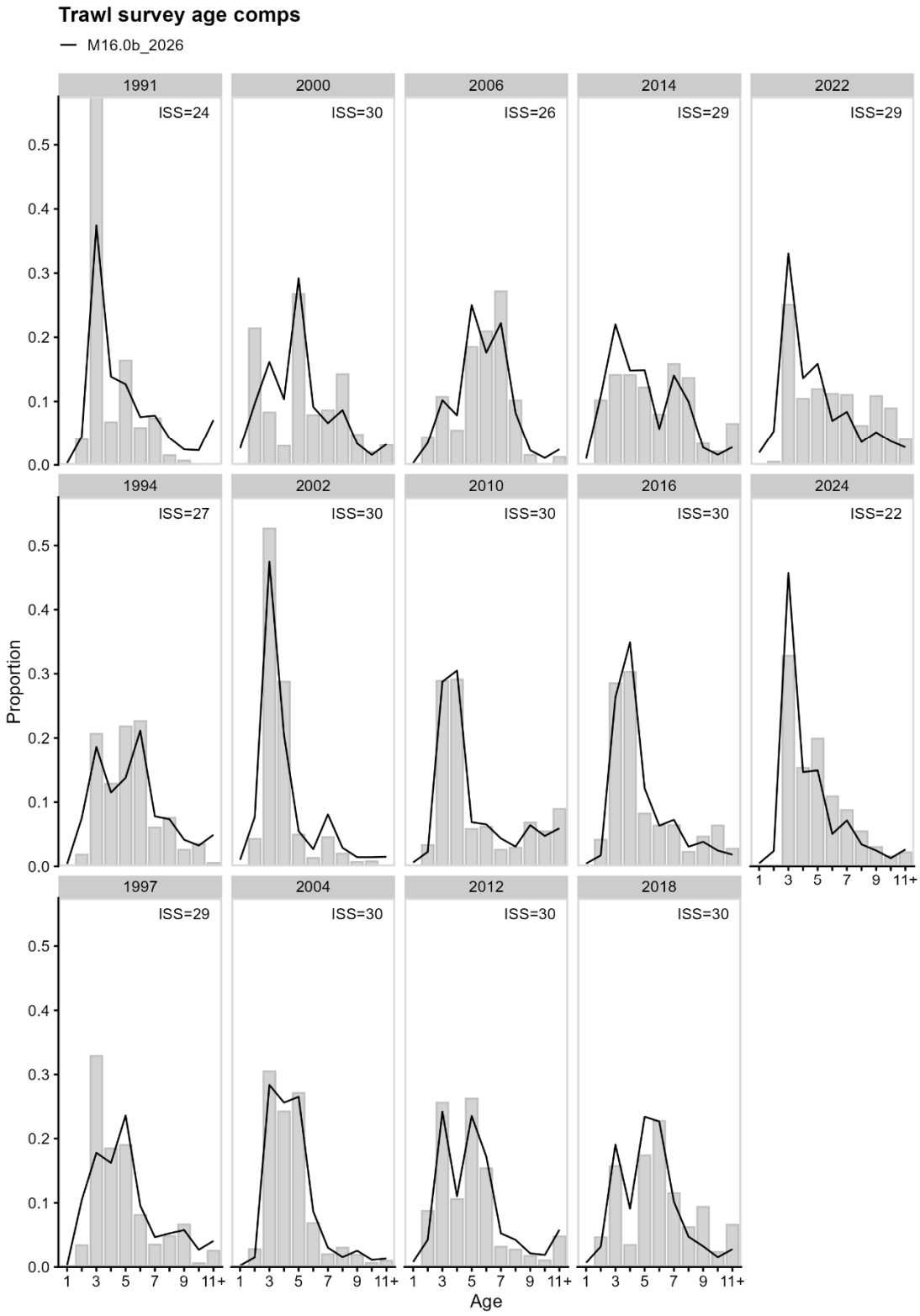


Figure 17.5. Observed and predicted survey proportions-at-age for BSAI Atka mackerel, 1991-2024. Lines are the model predictions and columns are the observed proportions-at-age with corresponding input sample sizes (ISS) for each year.

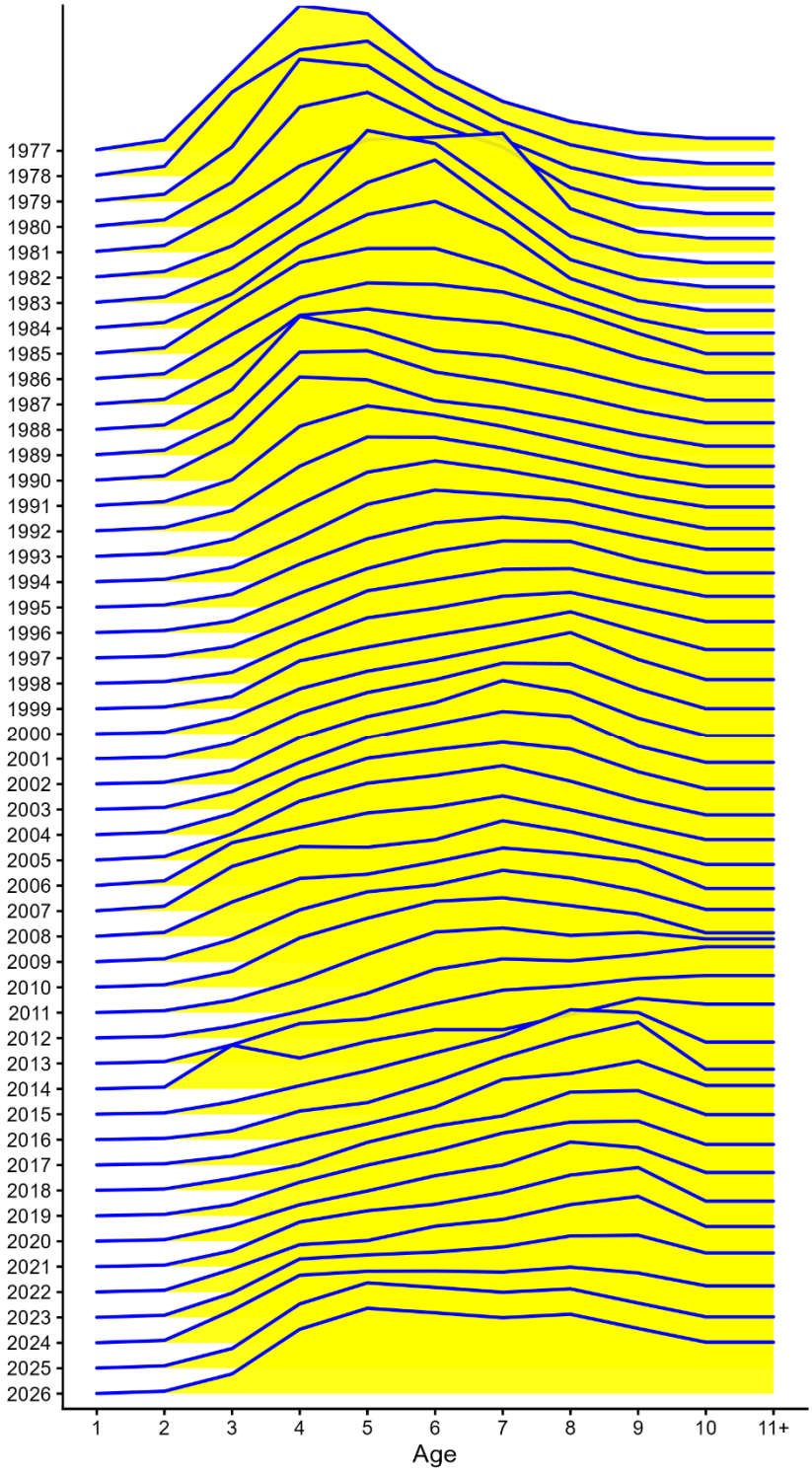


Figure 17.6. Fishery selectivity estimates over time for BSAI Atka mackerel from the recommended model (Model 16.0b).

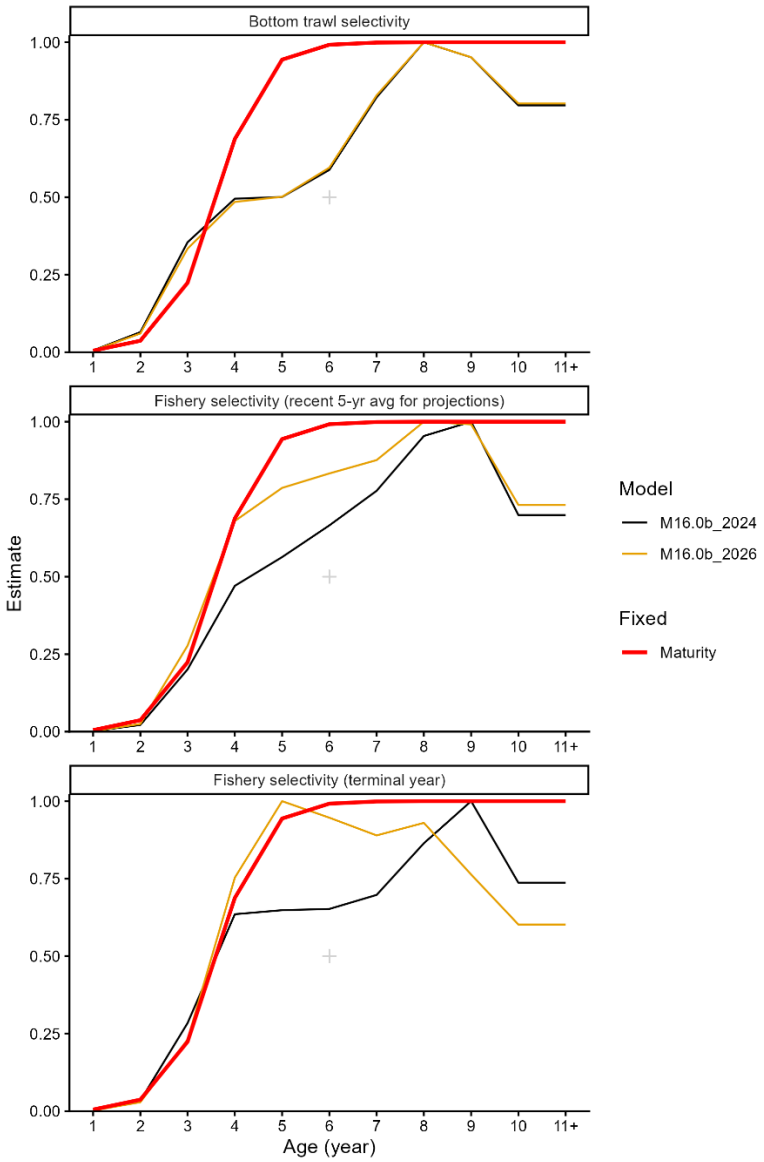


Figure 17.7. Estimated bottom trawl survey selectivity (top panel), estimated fishery selectivity for projections, which uses the average of the most recent 5 years (middle panel), and fishery selectivity in the terminal year, which is based on the most recent year with age data fishery selectivity patterns in the current assessment (bottom panel) for the last full assessment (M16.0b_2024) and the current assessment (M16.0b_2026). Each panel includes maturity-at-age schedules for BSAI Atka mackerel, which are fixed in Model 16.0b and have not changed between assessments.

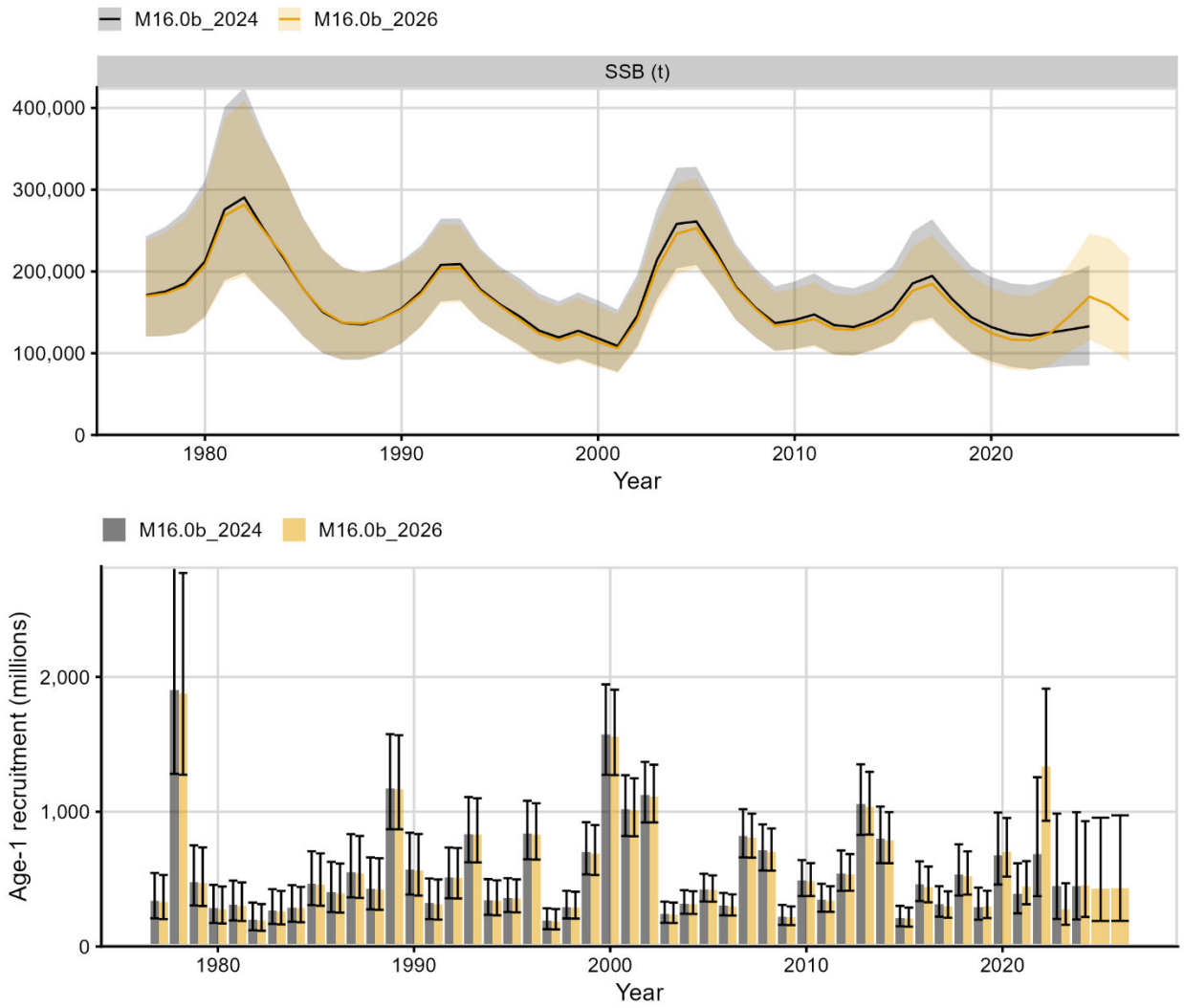


Figure 17.8. Time series of estimated Aleutian Islands Atka mackerel female spawning biomass (t) with approximate 95% confidence bounds (top), and recruitment at age-1 (millions, bottom) from the current assessment (M16.0b_2026) compared to the last full assessment (M16.0b_2024).

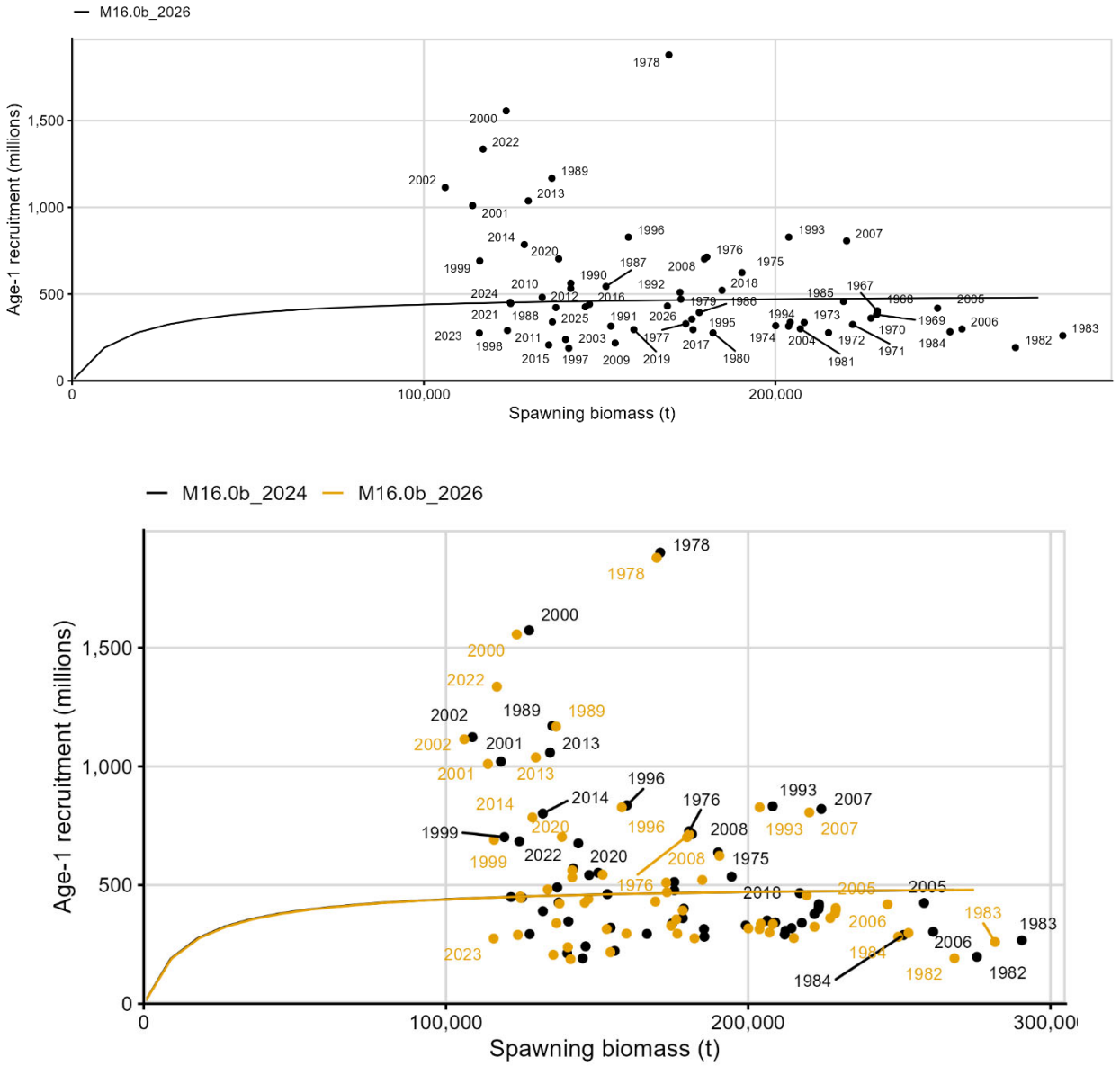


Figure 17.9 Estimated age 1 recruits (millions) versus female spawning biomass (t) for BSAI Atka mackerel. Solid line indicates Beverton-Holt stock recruitment curve (with steepness *h*=0.8). The top graph shows only estimates from the current assessment (M16.0b_2026), while the bottom graph shows a comparison of the current assessment to the last full assessment (M16.0b_2024).

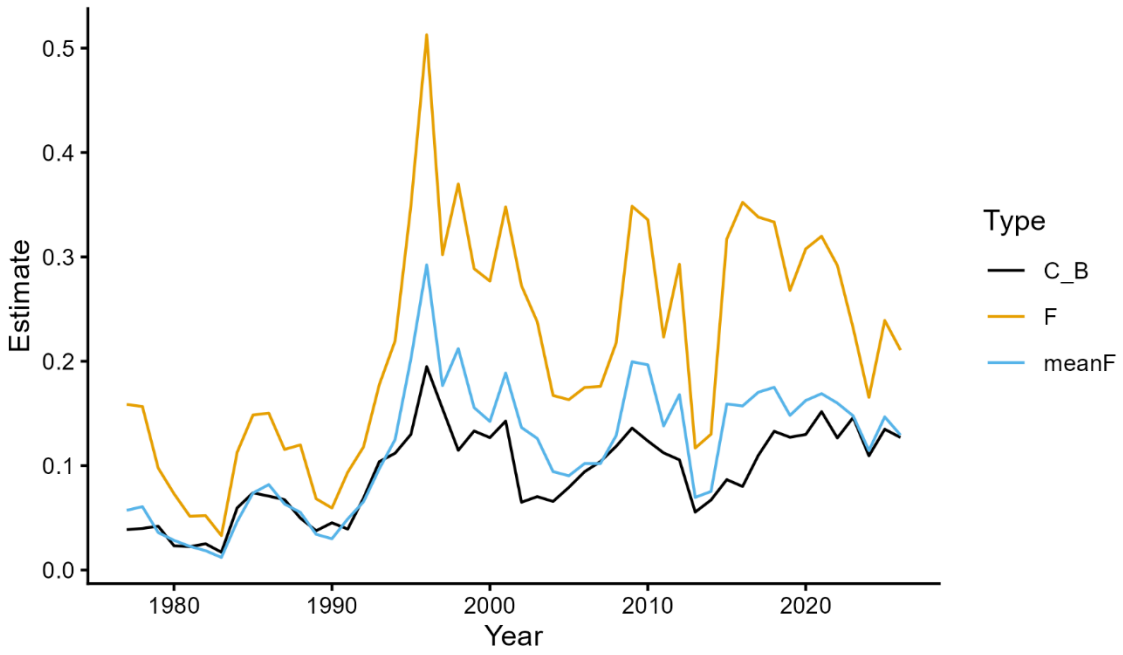


Figure 17.10 Estimated time series of the current recommended Model 16.0b mean and full-selection fishing mortality and catch/biomass (C_B) exploitation rates of BSAI Atka mackerel, 1977-2026. Catch/biomass rates are the ratios of catch to beginning year age 3+ biomass.

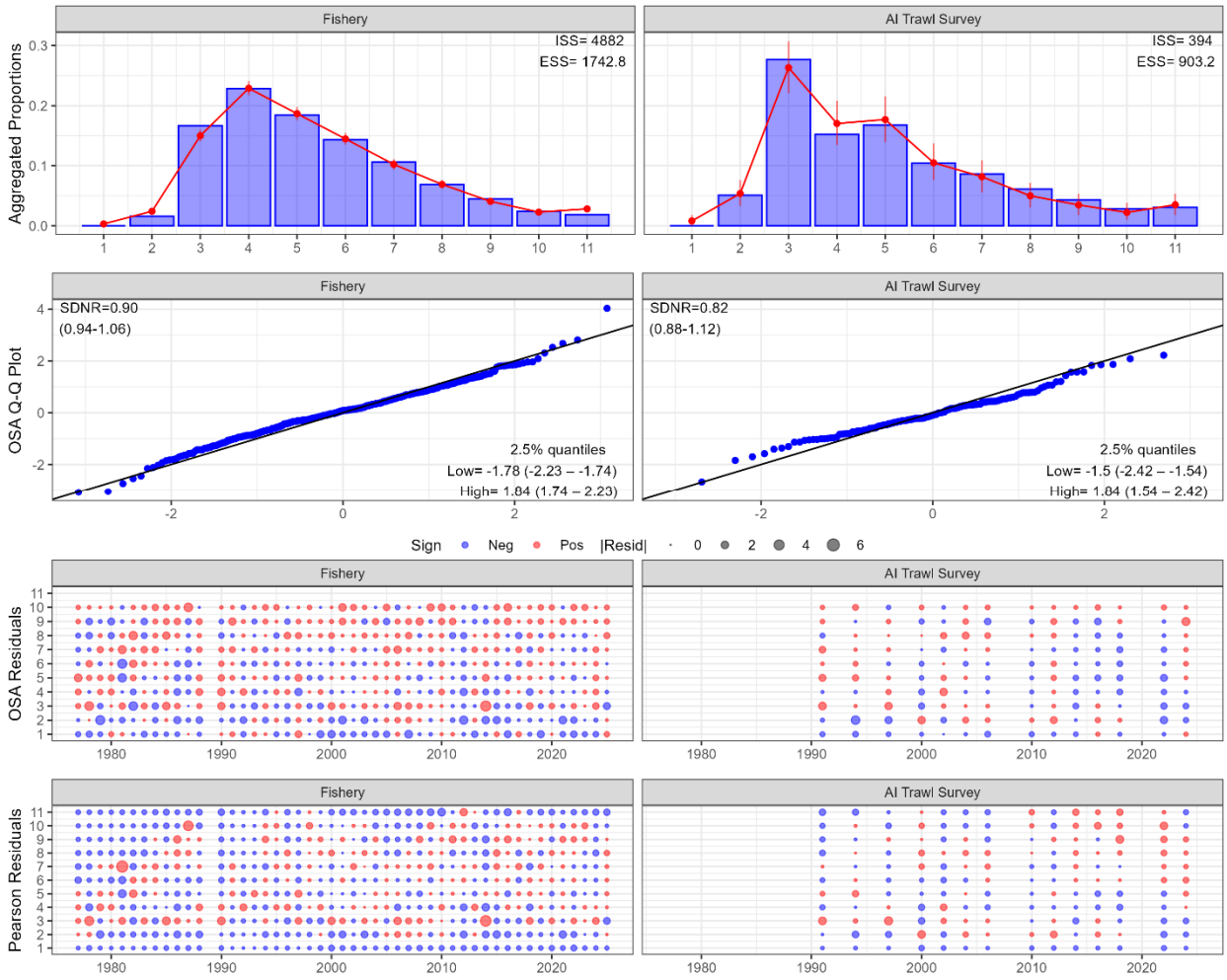


Figure 17.11. A suite of visual and statistical diagnostic tools used to evaluate whether observed composition data reasonably align with fitted assessment model expectations as implemented in the afscOSA package. For each fleet (column) the top panel displays sample-size-weighted aggregate observations (histograms) alongside model expectation (red points) and 95% expected data intervals (red bars), designed to identify systematic misfits such as misspecified selectivity. Q-Q plots (second row) of One-Step Ahead (OSA) residuals (blue points) evaluate distribution correctness, supplemented by reported standard deviation of normalized residuals (SDNR) and tail quantile statistics with 95% confidence intervals. OSA (third row) and Pearson (fourth row) residual bubble plots detect temporal or cohort misfit and can be used to identify causes of misfit detected in the previous panels. In accordance with recent guidance (Kapur et al., 2025), these combined visual and statistical outputs are intended to provide context rather than serving as rigid pass/fail model rejection thresholds. Further guidance can be found in Stewart and Monnahan (2025) and at https://noaa-afsc.github.io/afscOSA/#interpretation-and-use-of-diagnostics.

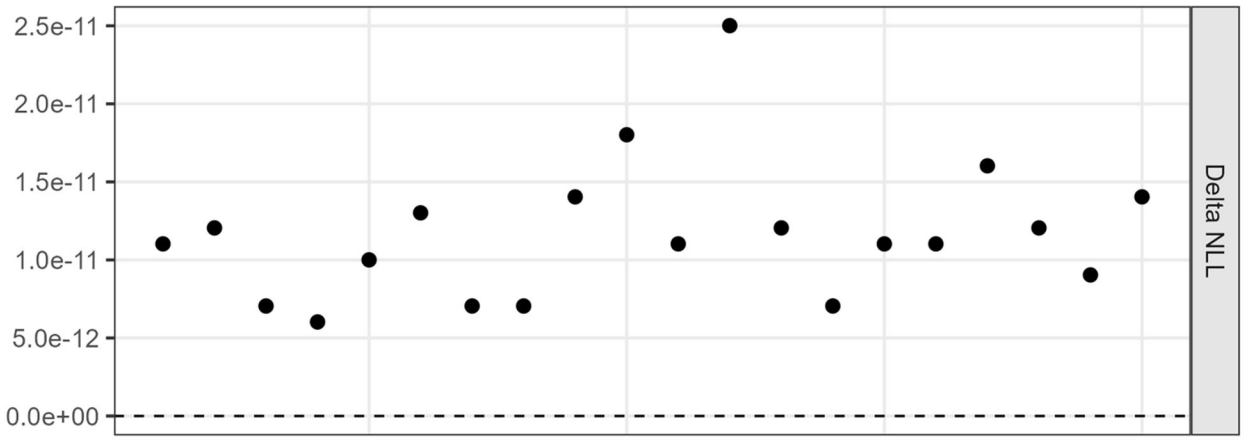


Figure 17.12. Results of a jitter analysis for Model 16.0b in the 2026 BSAI Atka mackerel assessment. The model was restarted 20 times from parameter values randomly perturbed by 10% from the maximum likelihood estimates (MLE). Points show the change in negative log-likelihood relative to the MLE solution (delta NLL).

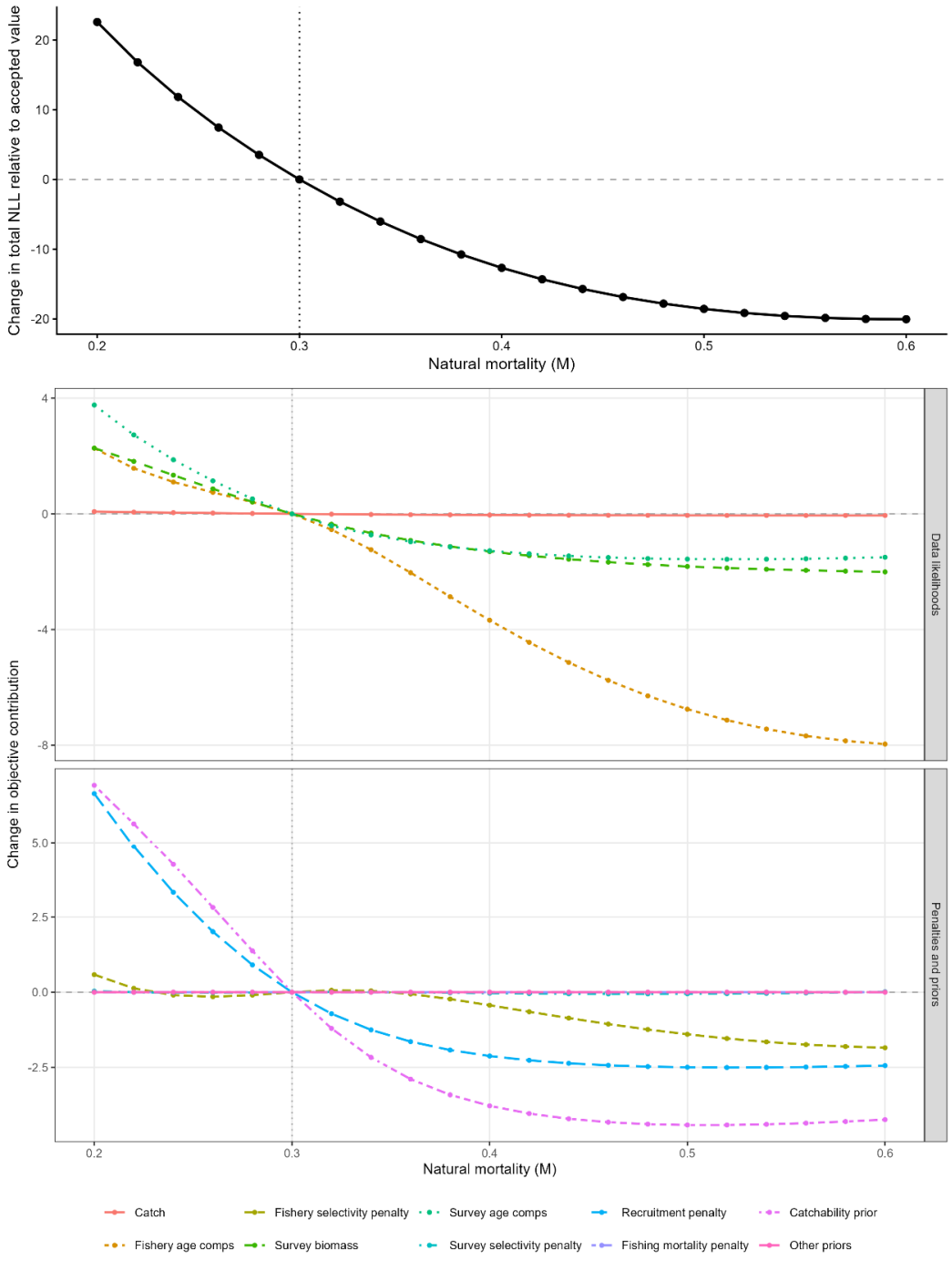


Figure 17.13. Conditional likelihood profile for natural mortality (M) in the 2026 BSAI Atka mackerel assessment (Model 16.0b). The upper panel shows the change in total negative log-likelihood (ΔNLL) relative to the minimum observed across the evaluated range (M = 0.20–0.60). The lower panels show changes in individual data likelihoods, penalties, and priors relative to the fixed model value (M = 0.30), indicated by the vertical dotted line. Negative values indicate improvements in fit or reductions in penalty contributions relative to the accepted model.

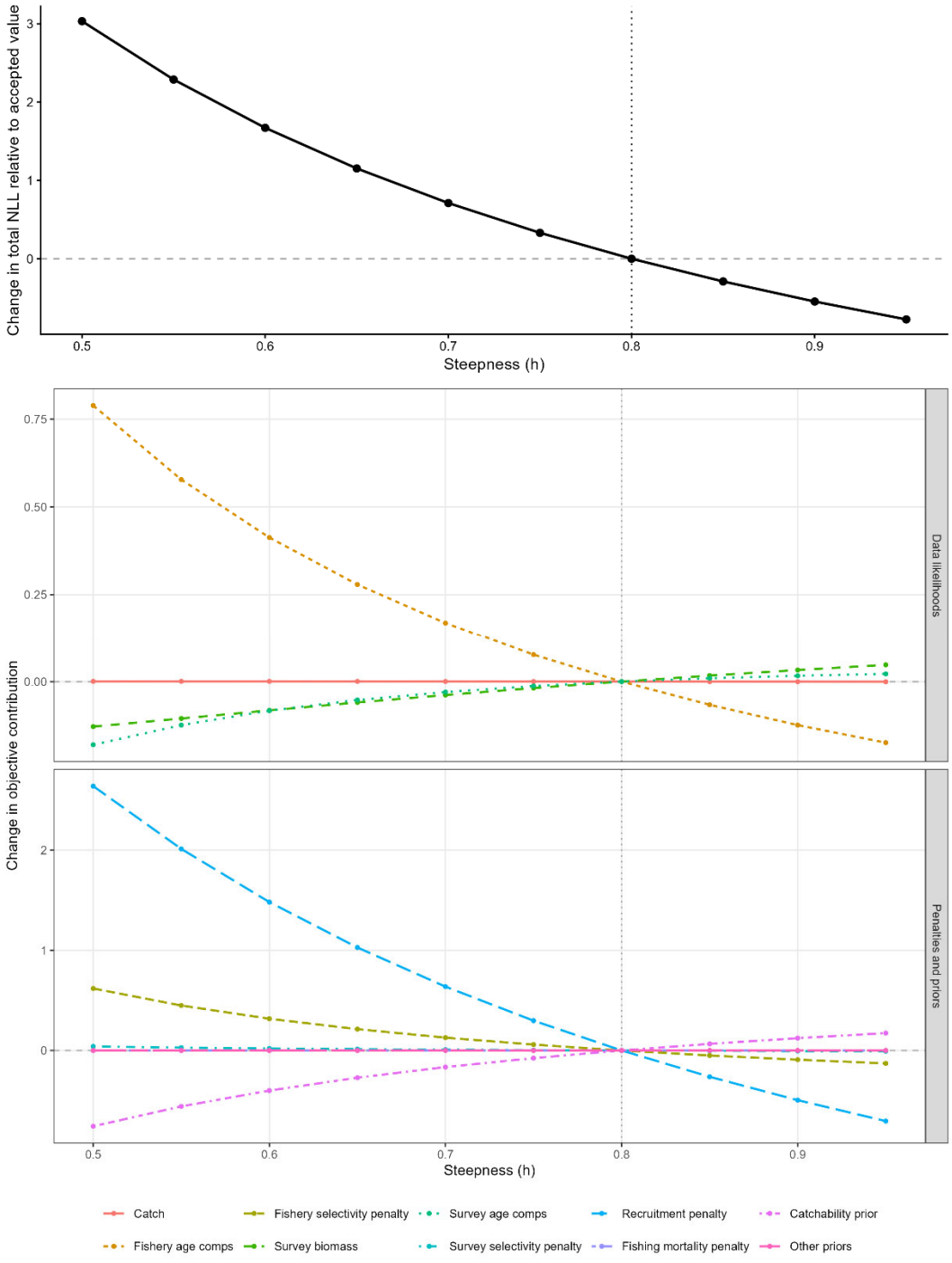


Figure 17.14. Conditional likelihood profile for steepness (h) in the 2026 BSAI Atka mackerel assessment (Model 16.0b). The upper panel shows the change in total negative log-likelihood (ΔNLL) relative to the minimum observed across the evaluated range (h = 0.5–0.99). The lower panels show changes in individual data likelihoods, penalties, and priors relative to the fixed model value (h = 0.8), indicated by the vertical dotted line. Negative values indicate improvements in fit or reductions in penalty contributions relative to the accepted model.

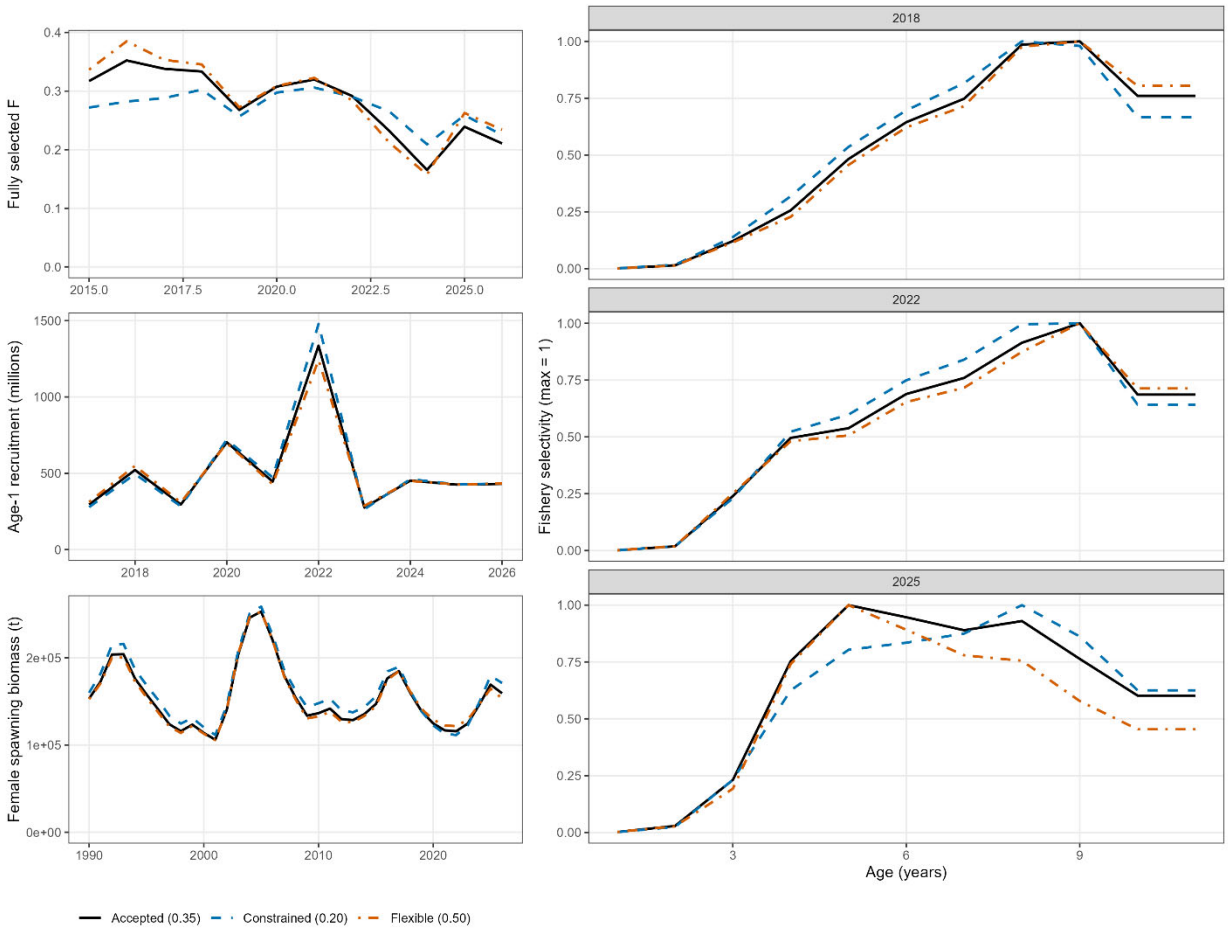


Figure 17.15. Sensitivity of fully selected fishing mortality, age-1 recruitment, female spawning biomass, and fishery selectivity-at-age in 2018, 2022, and 2025 to alternative assumptions about interannual variation in fishery selectivity. The accepted Model 16.0b (σ_{f_sel}=0.35) is compared with more constrained (σ_{f_sel}=0.2) and more flexible (σ_{f_sel}=0.5) configurations. Fishery selectivity is rescaled to a maximum of one within each year for presentation.

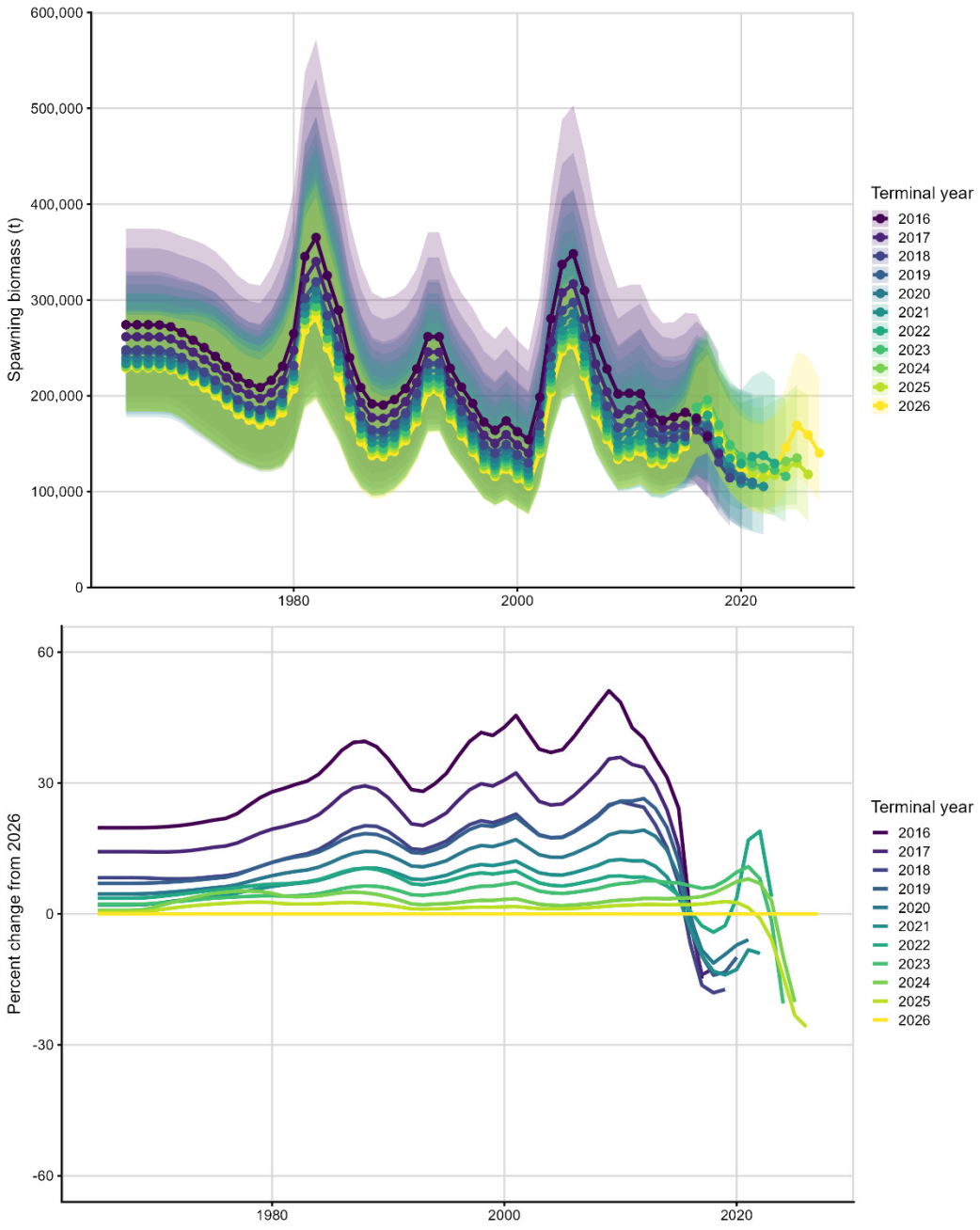


Figure 17.16. Retrospective plots showing the BSAI Atka mackerel spawning biomass over time (top) and the percent change from the terminal year of the assessment (bottom) over 10 different "peels". Mohn's rho was -0.085.

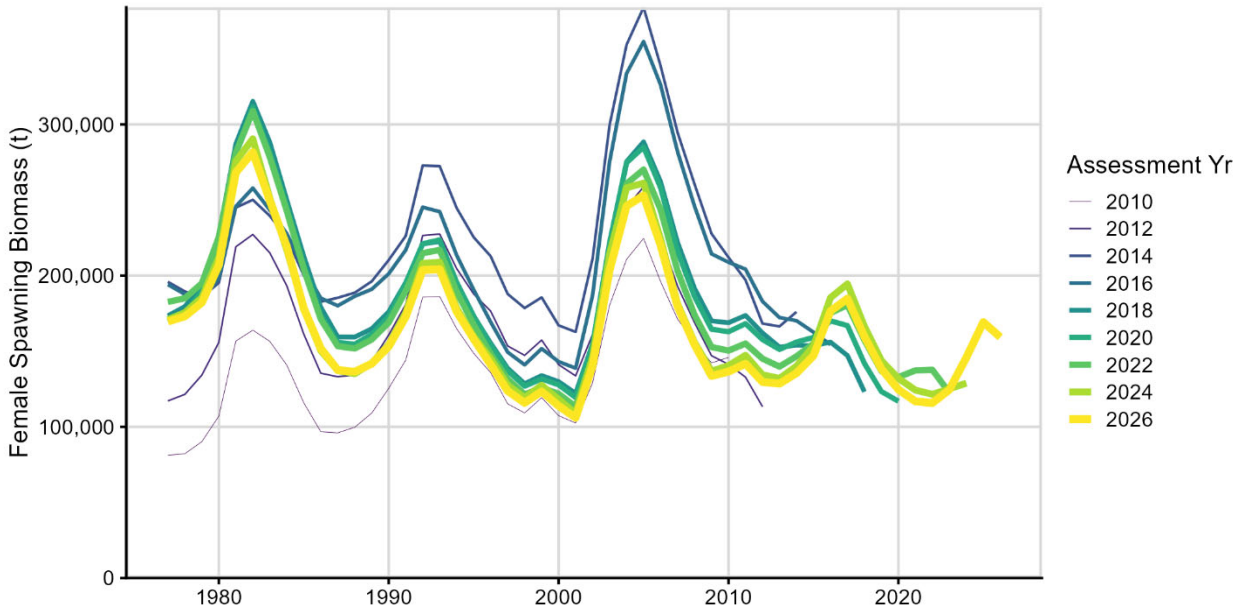


Figure 17.17. A comparison of female spawning biomass (t) trajectories from even year assessments, 2010-2026.

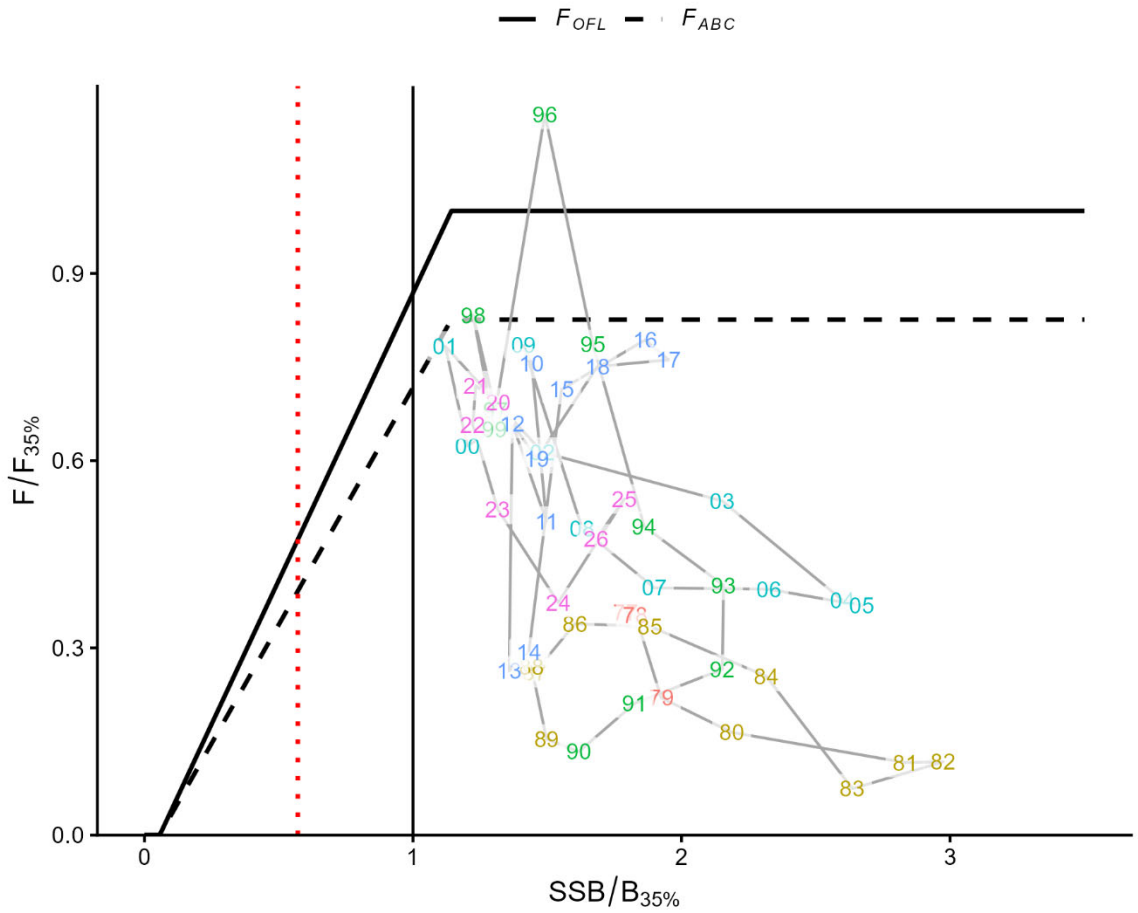


Figure 17.18. Aleutian Islands Atka mackerel spawning biomass relative to $B_{35\%}$ and fishing mortality relative to F_{OFL} (1977-2026). The vertical solid black line at $SSB/B_{35\%} = 1$ represents $B_{35\%}$, and the vertical dotted red line represents $B_{20\%}$, a threshold below which further stellar sea lion protections are triggered. The ratio of fishing mortality to F_{OFL} is calculated using the estimated selectivity pattern in that year. Estimates of spawning biomass and $B_{35\%}$ are based on current estimates of weight-at-age and mean recruitment. Because these estimates change as new data become available, this figure can only be used in a general way to evaluate management performance relative to biomass and fishing mortality reference levels.

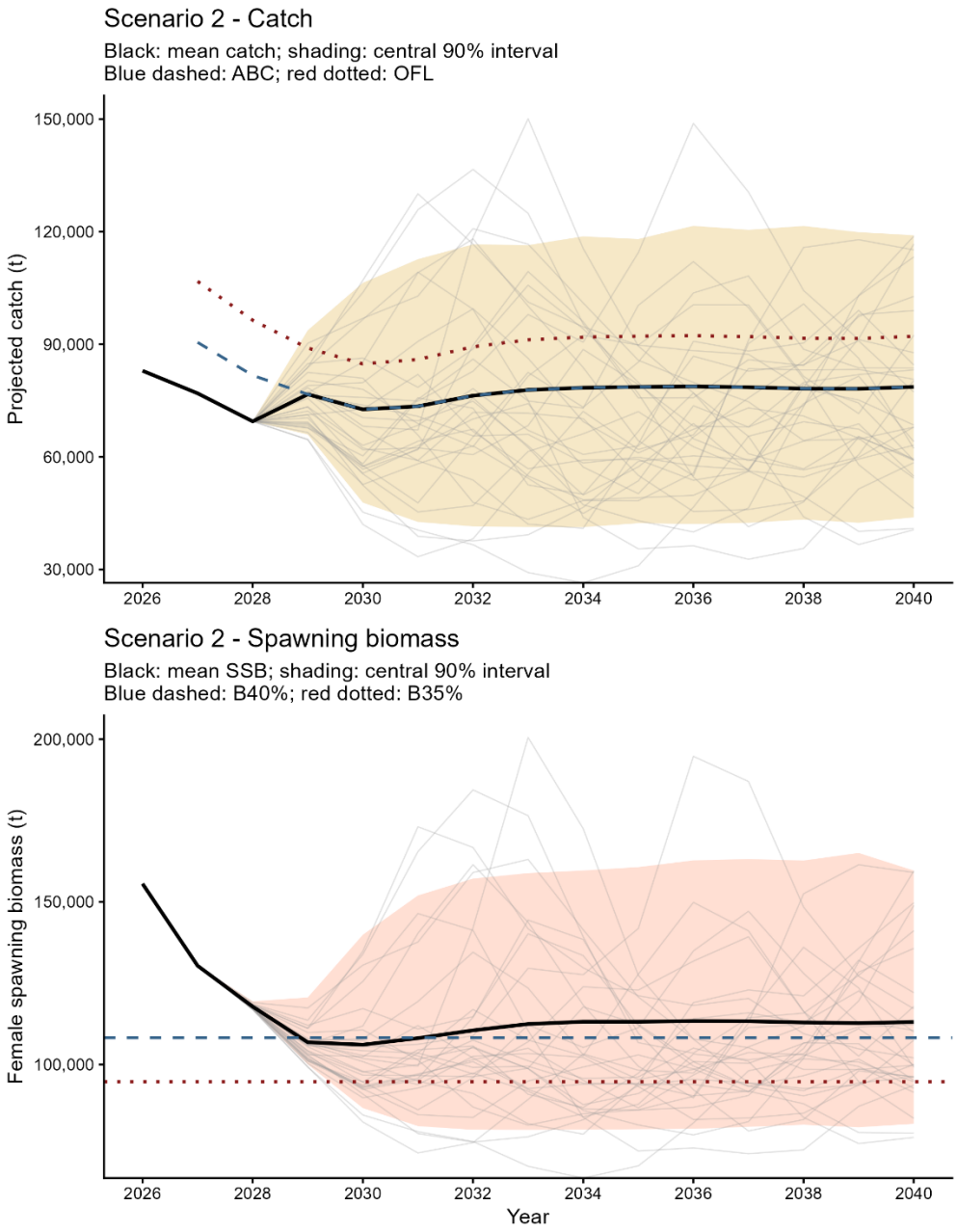


Figure 17.19. Stochastic projections of catch (upper panel) and female spawning biomass (lower panel) for BSAI Atka mackerel under harvest Scenario 2 using Model 16.0b. Solid black lines indicate mean projected values across 1,000 simulations, and shaded regions represent the central 90% simulation intervals. Thin gray lines represent a subset of 30 individual stochastic trajectories. Dashed and dotted lines in the upper panel indicate annual maximum permissible ABC and OFL, respectively; corresponding lines in the lower panel indicate $B_{40\%}$ and $B_{35\%}$. Projections assume specified catches of 82,941 t in 2026, 76,927 t in 2027, and 69,453 t in 2028. Subsequent catches follow Scenario 2 harvest specifications.

Appendix 17A Supplemental catch data

Kristen Omori

In order to comply with the Annual Catch Limit (ACL) requirements, a new dataset was generated to help estimate total catch and removals from NMFS stocks in Alaska.

The dataset represents the non-commercial removals and estimates total available removals that do not occur during directed groundfish fishing activities. These include removals incurred during research, subsistence, personal use, recreational, and exempted fishing permit activities, but do not include removals taken in fisheries other than those managed under the groundfish FMP. These estimates represent additional sources of removals to the existing Catch Accounting System (CAS) estimates. Estimates for Atka mackerel from this dataset are shown along with trawl survey removals from 2000-2025 in Table 17A-1. These removals were not incorporated in the stock assessment.

Table 17A-1. Total removals of BSAI Atka mackerel (t) from activities not related to directed fishing, since 2000. "Trawl" refers to a combination of the NMFS echo-integration, small-mesh, large-mesh, and Aleutian Islands bottom trawl surveys, and occasional short-term research projects involving trawl gear. "Other" refers to recreational, personal use, and subsistence harvest.

Year	Source	Trawl	NMFS Longline Survey	IPHC Longline Survey	Other	Total
2000	AFSC	105				105
2001	AFSC	0				0
2002	AFSC	171				171
2003	AFSC	0				0
2004	AFSC	240				240
2005	AFSC	0				0
2006	AFSC	99				99
2007	AFSC	0				0
2008	AFSC	0				0
2009	AFSC	0				0
2010	AFSC	140				140
2011	AFSC	1,535				1,535
2012	AFSC	62				62
2013	AFSC	6				6
2014	AFSC	111				111
2015	AFSC	4				4
2016	AFSC	78				78
2017	AFSC	2				2
2018	AFSC	71				71
2019	AFSC	<1				<1
2020	AFSC	0				0
2021	AFSC	<1				<1
2022	AFSC	104				104
2023	AFSC	3				3
2024	AFSC	91				91
2025	AFSC	4				4