6. Assessment of the Arrowtooth Flounder Stock in the Bering Sea and Aleutian Islands

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Executive Summary

The scheduled frequency for some stock assessments was recently changed in response to a review of the National Stock Assessment Prioritization effort (Methot 2015; Hollowed et al. 2016). In previous years, BSAI flatfish stocks were assessed on a biennial stock assessment schedule to coincide with the availability of new survey data. Following the prioritization review, it was recommended that Bering Sea and Aleutian Islands (BSAI) arrowtooth flounder (*Atheresthes stomias*) change to a quadrennial stock assessment schedule with a full stock assessment produced every four years and a harvest projection produced in alternate years. For this off-cycle year, we present a harvest projection assessment consisting of an executive summary with recent fishery catch and survey trends as well as recommended harvest levels for the next two years. Please refer to last full stock assessment and fishery evaluation (SAFE) report for further information regarding the stock assessment methodology (Shotwell et al. 2022). The next full assessment is scheduled for 2026.

We use a statistical age-structured model as the primary assessment tool for the BSAI arrowtooth flounder stock which qualifies as a Tier 3a stock. This assessment consists of a population dynamics model, which uses survey and fishery data to generate a historical time series of population estimates, and a projection model, which uses results from the population dynamics model to predict future population estimates and recommended harvest levels. The data sets used in this assessment include total catch biomass, fishery size compositions, bottom trawl survey biomass estimates, bottom trawl survey bottom water temperatures, bottom trawl survey age compositions, and bottom trawl survey size compositions when age compositions are not available. For an off-cycle year, we do not re-run the assessment model. Instead, we update the projection model with new catch information. This incorporates the most current catch information without re-estimating model parameters and biological reference points. We use the assessment base model from 2018 (Model 18.9) that was updated with new data in 2022 in the last full assessment (Shotwell et al., 2022).

Summary of Updated Catch

There were no changes made to the assessment model inputs as this is an off-cycle year. New data added to the projection model included updated catch data from 2022-2023 and newly estimated catches for 2024-2026. New catch data were available up to August 31, 2024. The remaining 2024 catch was estimated by increasing the observed catch by an expansion factor of 1.351, which accounts for the average fraction of catch taken after August 31, 2024 in the last three complete years (2021-2023). This expansion factor increased from last year's expansion factor of 1.11 and resulted in an estimated total

catch for 2024 of 9,476 t. To estimate future catches, we updated the yield ratio to 0.10, which was the average ratio of catch to ABC for the last three complete catch years. This yield ratio decreased from last year's yield ratio of 0.12 and was multiplied by the projected ABCs from the updated projection model to generate catches of 8,900 t in 2025 and 7,780 t in 2026.

Summary of Results

ABC recommendation
The projected total biomass for 2025 is 908,977 t. The recommend ABC for 2025 is 88,683 t, the maximum allowable ABC under Tier 3a. This ABC is a 1.1% increase compared to the 2024 ABC of 87,690 and a 0.2% increase from the projected 2025 ABC of 88,548 t from the last year's assessment (Shotwell et al., 2023).

The 2024 GOA-wide OFL for arrowtooth flounder is 104,428 t.

Reference values for arrowtooth flounder are summarized in the following table:

	As estimated or *specified last* year for:		As estimated or *recommended this* year for:	
Quantity/Status	2024	2025	2025*	2026*
M (natural mortality – female, male)	0.2, 0.35	0.2, 0.35	0.2, 0.35	0.2, 0.35
Tier	3a	3a	3a	3a
Projected total (age 1+) biomass (t)	921,062	907,809	908,977	898,546
Projected female spawning biomass (t)	539,030	559,145	560,110	572,274
$B_{100\%}$	561,219	561,219	561,219	561,219
$B_{40\%}$	224,487	224,487	224,487	224,487
$B_{35\%}$	196,427	196,427	196,427	196,427
F_{OFL}	0.174	0.174	0.174	0.174
maxF_{ABC}	0.146	0.146	0.146	0.146
F_{ABC}	0.146	0.146	0.146	0.146
OFL (t)	103,280	104,270	**104,428**	102,472
*max*ABC (t)	87,690	88,548	88,683	87,035
ABC (t)	87,690	88,548	**88,683**	87,035
	As determined *last* year for:		As determined *this* year for:	
Status	2023	2024	2024	2025
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 an estimated catch of 9,476 t for 2024 and estimates of 8,900 t and 7,780 t used in place of maximum permissible ABC for 2025 and 2026.

The stock is not being subject to overfishing, is not currently overfished, nor is it approaching a condition of being overfished.

The tests for evaluating these three statements on status determination require examining the official total catch from the most recent complete year and the current model projections of spawning biomass relative to B35% for 2024 and 2026. The official total catch for 2023 is 7,279 t, which is less than the 2023 OFL of 98,787 t; therefore, the stock is not being subjected to overfishing. The estimates of spawning biomass for 2024 and 2026 from the current year (2024) projection model are 539,029 t and 572,274 t,

respectively. Both estimates are well above the estimate of B35% at 196,427 t and, therefore, the stock is not currently overfished nor approaching an overfished condition.

Fishery Trends

Updated catch data (t) for arrowtooth flounder in the BSAI as of August 31, 2024 (NMFS Alaska Regional Office Catch Accounting System via the Alaska Fisheries Information Network (AKFIN) database, http://www.akfin.org) are summarized in the following table:

Year	Bering Sea	Aleutian Islands	Total	ABC	TAC
2023	5,113	2,165	7,279	83,852	15,000
2024	3,179	3,835	7,014	87,690	14,000

Catch of arrowtooth flounder decreased in the Bering Sea but increased in the Aleutian Islands in 2024 compared to 2023. The Bering Sea catch is the lowest in the time series while the Aleutian Islands catch has increased above the long-term mean and is now greater than the Bering Sea catch for the first time in over a decade (see Table 6.2 in Shotwell et al., 2022 for catch history). To date in 2024, about 53% of the catch was in the Arrowtooth and Kamchatka flounder fishery, 12% in the flathead sole, rock sole, yellowfin sole, and other flatfish fisheries, 11% in the atka mackerel fishery, 9% in the rockfish fisheries, 7% in the Pacific cod fishery, 5% in the sablefish fishery, and 3% in the pollock fishery. Currently, "off-year" assessments are required to present a catch to biomass ratio, which is calculated as the catch divided by the total age 1+ biomass from the last full assessment model (Shotwell et al. 2022) and total biomass from the projection model for years following the last full assessment year. The catch to biomass ratio for 1991-2024 has ranged from 0.0073 in 2024 to 0.036 in 1991 (Figure 6.1). The arrowtooth flounder catch/biomass ratio had been steadily decreasing since 2012 (Figure 6.1).

Survey Trends

The most recent Alaska Fisheries Science Center (AFSC) eastern Bering Sea (EBS) bottom trawl shelf survey and Aleutian Islands bottom trawl survey were conducted in 2024. However, information on the survey estimates were not available at the time of this report so we show the results for the EBS bottom trawl shelf survey in 2023. The EBS arrowtooth flounder biomass estimate was 462,575 (t) for 2023, which was 11% lower than the 2022 survey, but slightly above the long-term average for the time series (Figure 6.2).

References

Hollowed, A.B., K. Aydin, K. Blackhart, M. Dorn, D. Hanselman, J. Heifetz, S. Kasperski, S. Lowe, and K. Shotwell. (2016) Discussion paper stock assessment prioritization for the North Pacific Fishery Management Council: Methods and Scenarios. Report to NPFMC Groundfish Plan Teams. September 2016. https://www.npfmc.org/wp-content/PDFdocuments/meetings/AFSC-HQ_Discussion_Paper.pdf.

Methot Jr., Richard D. (editor). (2015) Prioritizing fish stock assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/SPO-152, 31 p.

Shotwell, S., Bryan, M., Hanselman, D., Markowitz, M., Siddon, E., Spies, I. and Sullivan, J. (2022) Assessment of the arrowtooth flounder stock in the Bering Sea and Aleutian Islands. *In*: Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska. North Pacific Fishery Management Council, Anchorage, AK.

Shotwell, S.K., Hanselman, D.H., and Williams, B.C. (2023) Assessment of the arrowtooth flounder stock in the Bering Sea and Aleutian Islands. *In*: Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea and Aleutian Islands. North Pacific Fishery Management Council, Anchorage, AK.

Figures

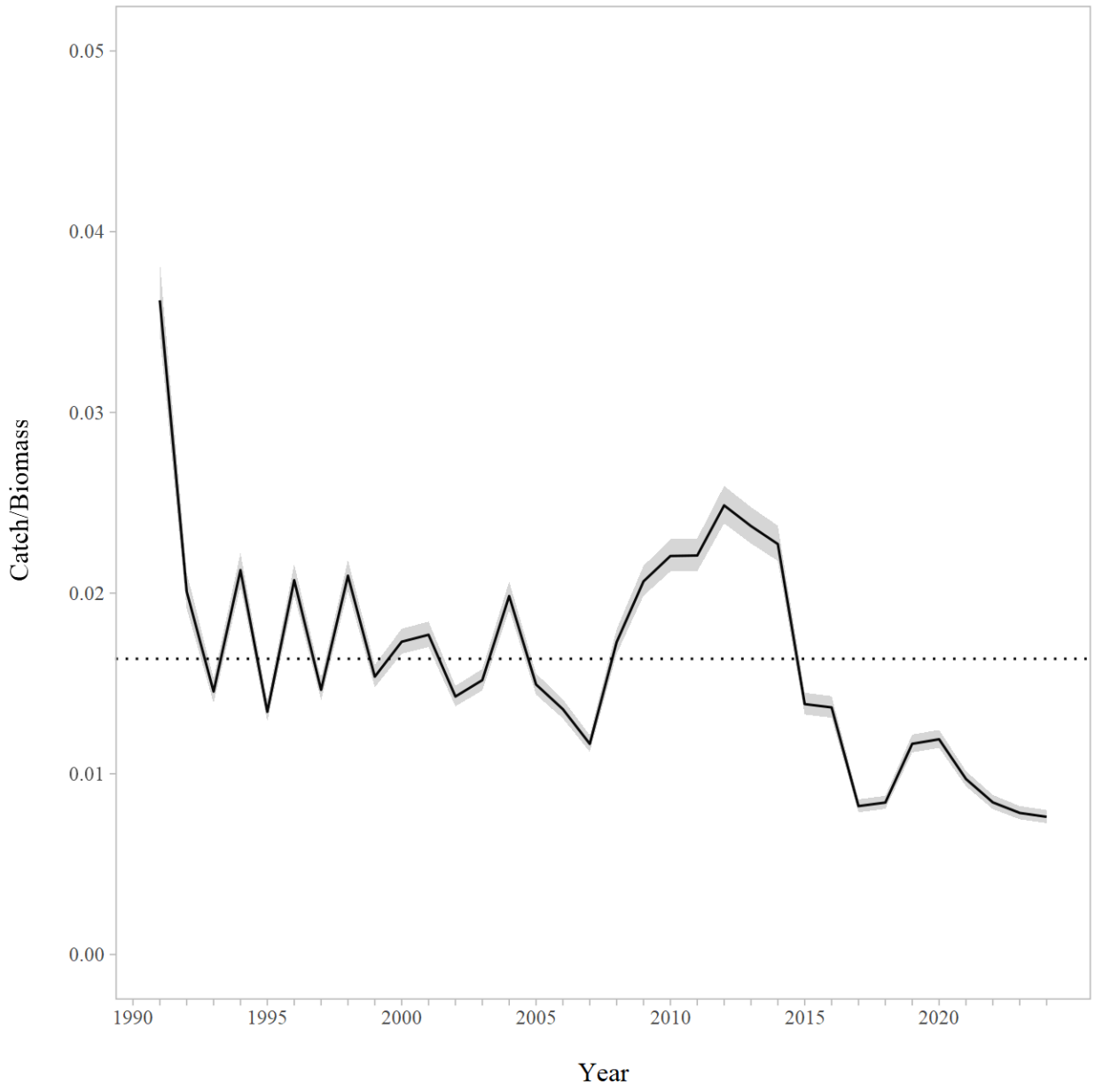

Figure 6.1. Bering Sea and Aleutian Islands (BSAI) arrowtooth flounder catch/age 4+ biomass ratio with approximate 95% confidence intervals. Observed catch values were used for 1991-2023, the 2024 catch values were estimated using an expansion factor. The horizontal dashed line is the mean value for the entire dataset.

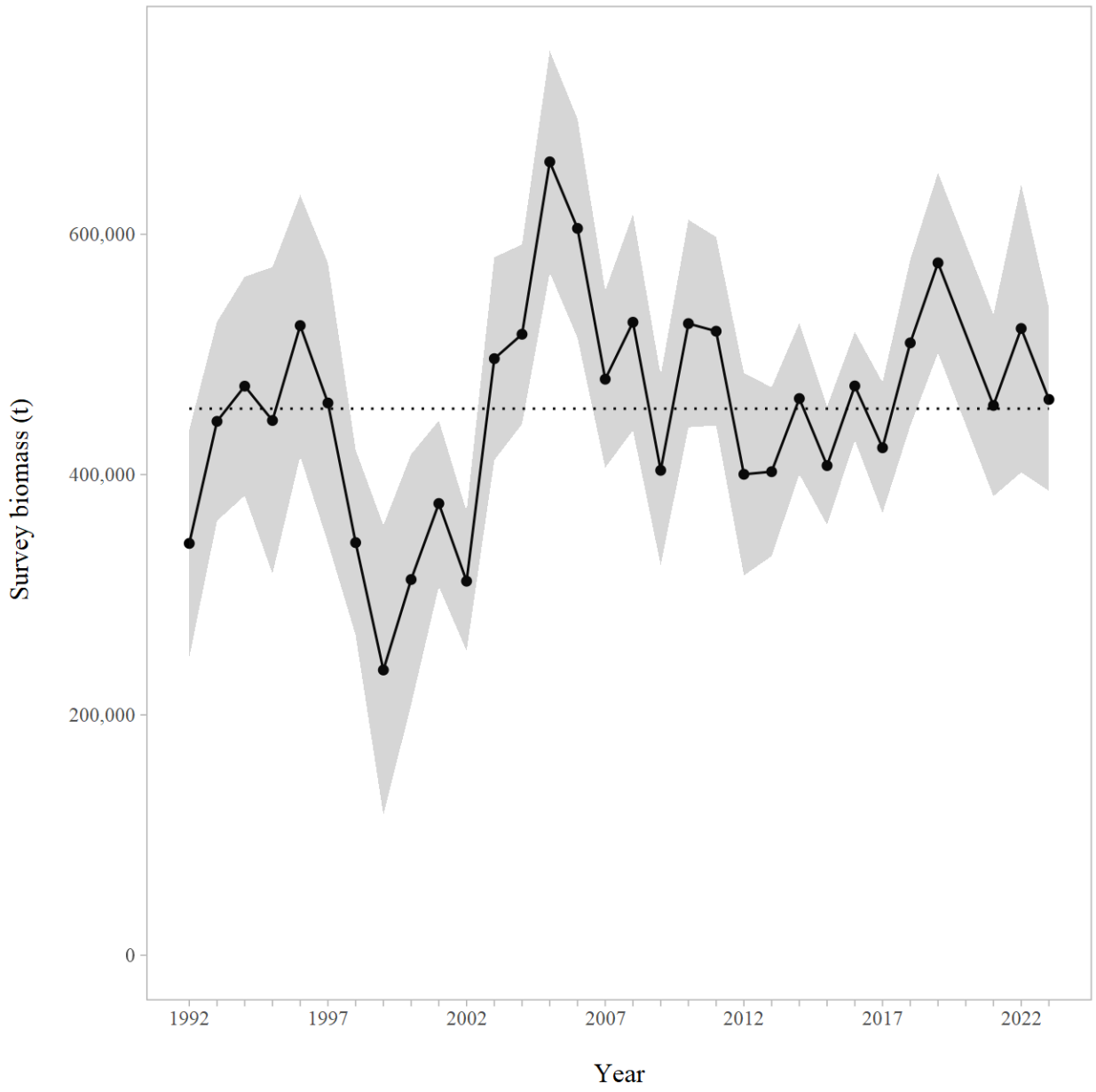

Figure 6.2. Design-based model estimates of trawl survey abundance for arrowtooth flounder in the BSAI. Shaded areas are 95% confidence intervals, the horizontal dashed line is the mean value for the entire dataset.