

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

S. Kalei Shotwell, Dana H. Hanselman, and Benjamin C. Williams

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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, Bering Sea and Aleutian Island (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 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 the last full stock assessment and fishery evaluation (SAFE) report for further information regarding the stock assessment (Shotwell *et al.* 2022).

We use a statistical age-structured model as the primary assessment tool for the BSAI arrowtooth flounder stock which qualifies as a Tier 3 stock. This assessment consists of a population 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 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 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, but do update the projection model with new catch information. This incorporates the most current catch information without re-estimating model parameters and biological reference points. As with last year, we use the full assessment base model from 2018 (Model 18.9).

### Description of Updated Catch

There were no changes from the 2022 assessment model (Shotwell *et al.* 2022) as this is an off-cycle year. New data added to the projection model included updated catch data from 2021-2022 and new estimated catches for 2023-2025. Catch data were loaded on October 23, 2023. The 2023 catch was estimated by increasing the observed catch by an expansion factor of 1.109, which accounts for the average fraction of catch taken after October 23 in the last three complete years (2020-2022). This expansion factor decreased from last year's expansion factor of 1.13 and resulted in an estimated catch for 2023 of 7,175 t. To estimate future catches, we updated the yield ratio to 0.12, 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 0.13

and was multiplied by the projected ABCs from the updated projection model to generate catches of 10,701 t in 2024 and 9,689 t in 2025.

## Summary of Results

### ABC recommendation

The projected total biomass for 2024 is 921,062 t. The recommend ABC for 2024 is 87,690 t, the maximum allowable ABC under Tier 3a. This ABC is a 4.6% increase compared to the 2023 ABC of 83,852 and a 0.2% increase from the projected 2024 ABC from the last year's assessment.

The 2024 BSAI OFL for arrowtooth flounder is 103,280 t.

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

Quantity/Status	As estimated or <i>specified</i> <i>last year for:</i>		As estimated or <i>recommended this year for:</i>	
	2023	2024	2024*	2025*
M (natural mortality)**	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)	929,274	919,797	921,062	907,809
Projected female spawning biomass (t)	514,577	537,999	539,030	559,145
B <sub>100%</sub>	561,219	561,219	561,219	561,219
B <sub>40%</sub>	224,487	224,487	224,487	224,487
B <sub>35%</sub>	196,427	196,427	196,427	196,427
F <sub>OFL</sub>	0.174	0.174	0.174	0.174
maxF <sub>ABC</sub>	0.146	0.146	0.146	0.146
F <sub>ABC</sub>	0.146	0.146	0.146	0.146
OFL (t)	98,787	103,070	<b>103,280</b>	104,270
maxABC (t)	83,852	87,511	87,690	88,548
ABC (t)	83,852	87,511	<b>87,690</b>	88,548
Status	As determined <i>last year for:</i>		As determined <i>this year for:</i>	
	2022	2023	2023	2024
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 7,175 t for 2023 and estimates of 10,701 t and 9,689 t used in place of maximum permissible ABC for 2024 and 2025.

\*\*Natural mortality rate is 0.2 for females, 0.35 for males.

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 B<sub>35%</sub> for 2023 and 2025. The official total catch for 2022 is 7,857 t, which is less than the 2022 OFL of 94,445 t; therefore, the stock is not being subjected to overfishing. The estimates of spawning biomass for 2023 and 2025 from the current year (2023) projection model are 514,817 t and 559,145 t, respectively. Both estimates are well above the estimate of B<sub>35%</sub> 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 October 23, 2023 (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
2022	5,993	1,864	7,857	80,389	20,000
2023	4,353	2,117	6,470	83,852	15,000

Catch of arrowtooth flounder decreased in the Bering Sea but increased in the Aleutian Islands in 2023 compared to 2022. The Bering Sea catch is the lowest in the time series while the Aleutian Islands is slightly below the long-term mean. About 48% of the catch was in the Arrowtooth and Kamchatka flounder fishery, 26% in the yellowfin sole, flathead sole, and other flatfish fisheries, 9% in the rockfish fisheries, 8% in the Pacific cod fishery, 3% 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 assessment model and 2023 total biomass from the projection model (Shotwell et al. 2022). The catch to biomass ratio for 1991-2023 has ranged from 0.0077 in 2023 to 0.037 in 1991 (Figure 6.1). The arrowtooth flounder catch/biomass ratio had been steadily decreasing since 2012 (Figure 6.1).

### *Survey Trends*

The Alaska Fisheries Science Center (AFSC) eastern Bering Sea (EBS) bottom trawl shelf survey was conducted 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

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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.

## Figures

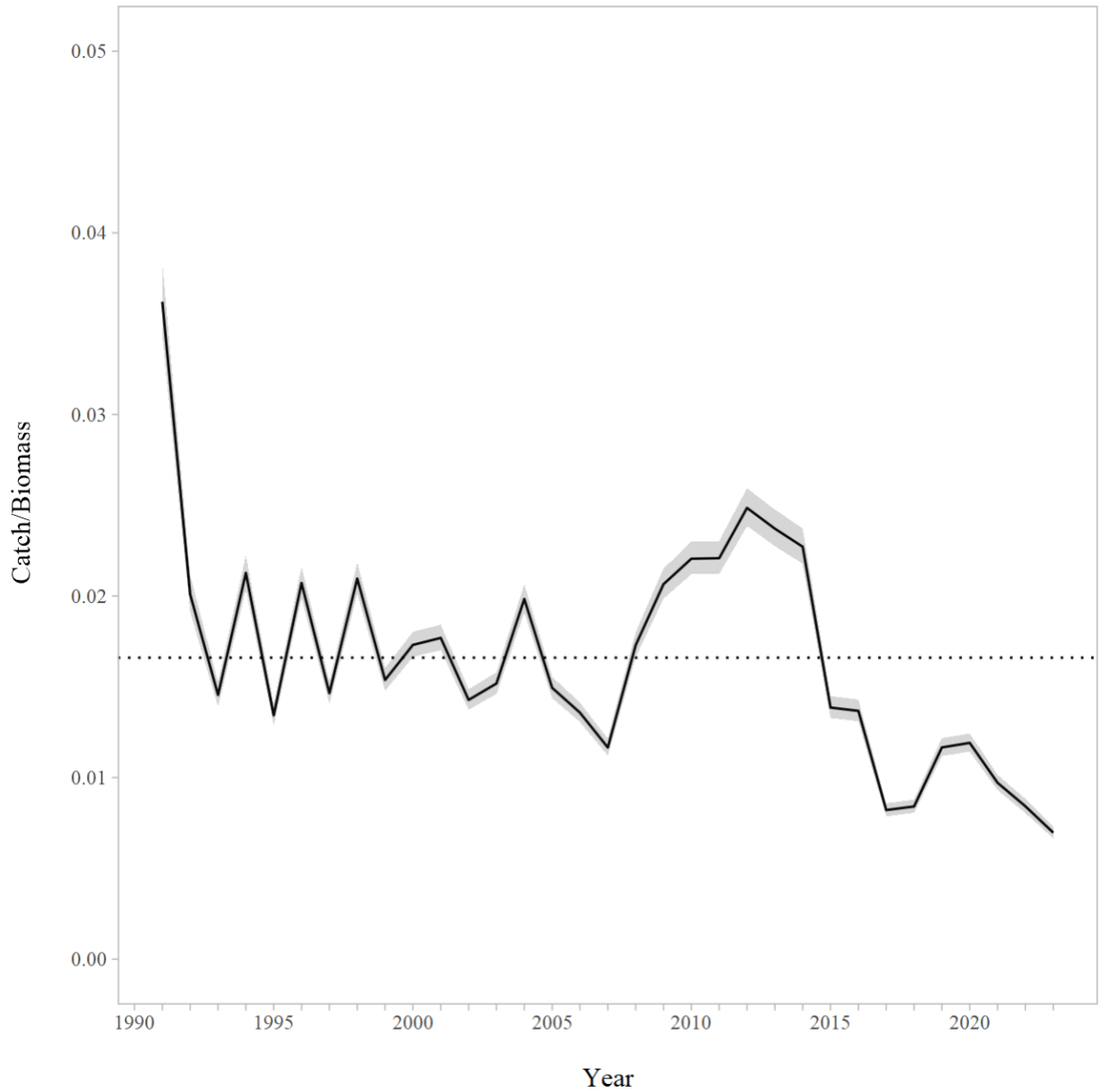


Figure 6.1. Bering Sea and Aleutian Islands (BSAI) arrowtooth flounder catch/age 1+ biomass ratio with approximate 95% confidence intervals. Observed catch values were used for 1991-2022, the 2023 catch values were estimated using an expansion factor. The horizontal dashed line is the mean value for the entire dataset.

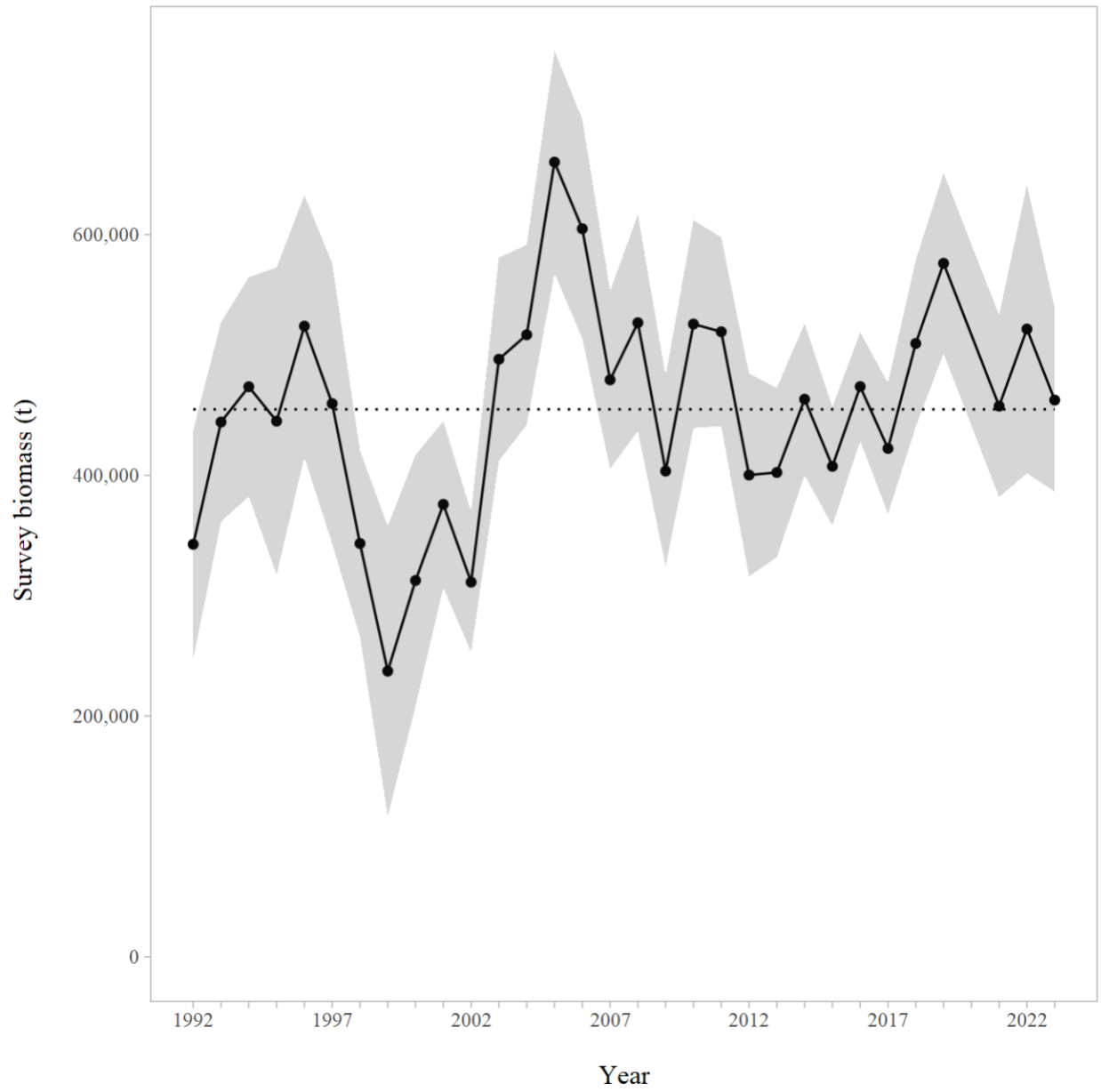


Figure 6.2. Design-based model estimates of trawl survey abundance for arrowtooth flounder in the BSAI. Shaded areas are 95% confidence intervals, the dashed lines are the data means.