7. Assessment of the Arrowtooth Flounder Stock in the Gulf of Alaska

S. Kalei Shotwell, Grant D. Adams, Dana H. Hanselman, Paul von Szalay, and Benjamin C. Williams

November 2024

This report may be cited as: Shotwell, S.K., Adams, G.D., Hanselman, D.H., von Szalay, P., and Williams, B.C. 2024. Assessment of the arrowtooth flounder stock in the Gulf of Alaska. *In*: Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska. North Pacific Fishery Management Council, Anchorage, AK. Available from https://www.npfmc.org/library/safe-reports/.

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, Gulf of Alaska (GOA) flatfish stocks were assessed on a biennial stock assessment schedule to coincide with the availability of new survey data. Following a prioritization review, it was recommended that GOA 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 recommend 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. 2021). The next full assessment is scheduled for 2025.

We use a statistical age-structured model as the primary assessment tool for the GOA 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 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 2019 (Model 19.0) that was updated with new data in 2021 in the last full assessment (Shotwell et al., 2021).

Summary of Updated Catch

There were no changes made to the last full 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 was available up to August 31, 2024. The remaining 2024 catch was estimated by increasing the observed catch by an expansion factor of 1.11, which accounts for the average fraction of catch taken after August 31 in the last three complete years (2021-2023). This expansion factor increased from last year's expansion factor of 1.04 and resulted in an estimated total catch for 2024 of 12,726 t. To estimate future catches, we updated the yield ratio to 0.11, 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 0.15 and was multiplied by the projected ABCs from the updated projection model to generate estimated catches of 12,770 t in 2025 and 11,278 t in 2026.

Summary of Results

ABC recommendation
The projected total biomass for 2025 is 1,316,560 t. The recommend ABC for 2025 is 119,547 t which equals the maximum allowable ABC under Tier 3a. This ABC is a 0.2 % increase compared to the 2024 ABC of 119,249 t and a 0.5% increase from the projected 2025 ABC of 118,912 t from the last year's assessment (Shotwell et al., 2023).

The 2024 GOA-wide OFL for arrowtooth flounder is 142,832 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)	1,295,410	1,311,810	1,316,560	1,341,280
Projected female spawning biomass (t)	698,842	695,299	699,407	696,032
$B_{100\%}$	1,018,700	1,018,700	1,018,700	1,018,700
$B_{40\%}$	407,478	407,478	407,478	407,478
$B_{35\%}$	356,544	356,544	356,544	356,544
F_{OFL}	0.225	0.225	0.225	0.225
maxF_{ABC}	0.185	0.185	0.185	0.185
F_{ABC}	0.185	0.185	0.185	0.185
OFL (t)	142,485	142,074	**142,832**	143,347
*max*ABC (t)	119,249	118,912	119,547	119,985
ABC (t)	119,249	118,912	**119,547**	119,985
	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 12,726 t for 2024 and estimates of 12,770 t and 11,278 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 9,182 t, which is less than the 2023 OFL of 142,749 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 699,075 t and 696,032 t, respectively. Both estimates are well above the estimate of B35% at 356,544 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 GOA 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	Western	Central	West Yakutat	East Yakutat/SE	Gulf-wide Total	Gulf-wide ABC	Gulf-wide TAC
2023	394	8,708	35	45	9,182	119,485	94,286
2024	96	11,325	26	18	11,464	119,249	94,141

Catch of arrowtooth flounder decreased in all areas except central GOA where it increased in 2024 compared to 2023. The western and east Yakutat / southeast GOA catches were the lowest in the time series while catch in the other areas were all well below the long-term mean (see Table 7.3 in Shotwell et al., 2021 for catch history). To date in 2024, about 85% of the catch was in the arrowtooth flounder fishery, 10% in the rockfish fisheries, 2% in the shallow water flatfish fishery, 1% in the Pacific cod fishery, 1% in the halibut fishery, and the remainder in the pollock and sablefish fisheries. 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. 2021) 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 0.0071 in 2023 to 0.024 in 2014 (Figure 7.1). The arrowtooth flounder catch/biomass ratio had been steadily increasing for most of the time series until 2021 where there was a sharp decline (Figure 7.1).

Survey Trends

The most recent Alaska Fisheries Science Center (AFSC) GOA bottom trawl survey was conducted in 2023. The GOA arrowtooth flounder biomass estimate was 1,192,608 t for 2023, which was 5% higher than the 2021 survey, but still below the long-term average for the time series (Figure 7.2). Geostatistical model (vector autoregressive spatio-temporal or VAST with lognormal observation error) estimates were also provided for arrowtooth flounder from the GOA bottom trawl survey. These estimates were very similar in trend to the design-based estimates but had reduced error over most years.

Area Apportionment

The following table shows the recommended ABC apportionment for 2025 and 2026. Please refer to the *Area Allocation of Harvests* section of the last full assessment (Shotwell *et al.* 2021) for information regarding the apportionment rationale for GOA arrowtooth flounder.

		Western	Central	WestYakutat	EastYakutat	Total
Area Apportionment		28.1%	57.1%	5.6%	9.2%	100%
2025	ABC (t)	33,593	68,261	6,695	10,998	119,547
2025	OFL (t)					142,832
2026	ABC (t)	33,716	68,511	6,719	11,039	119,985
2026	OFL (t)					143,347

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., Spies, I., Ianelli, J., Aydin, K., Hanselman, D.H., Palsson, W., Siwicke, K., Sullivan, J., and Yasumiishi, E. (2021) Assessment of the arrowtooth flounder stock in the Gulf of Alaska. *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., Hanselman, D., Siwicke, K., Spies, I. and Sullivan, J. (2023) Assessment of the arrowtooth flounder stock in the Gulf of Alaska. *In*: Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska. North Pacific Fishery Management Council, Anchorage, AK.

Figures

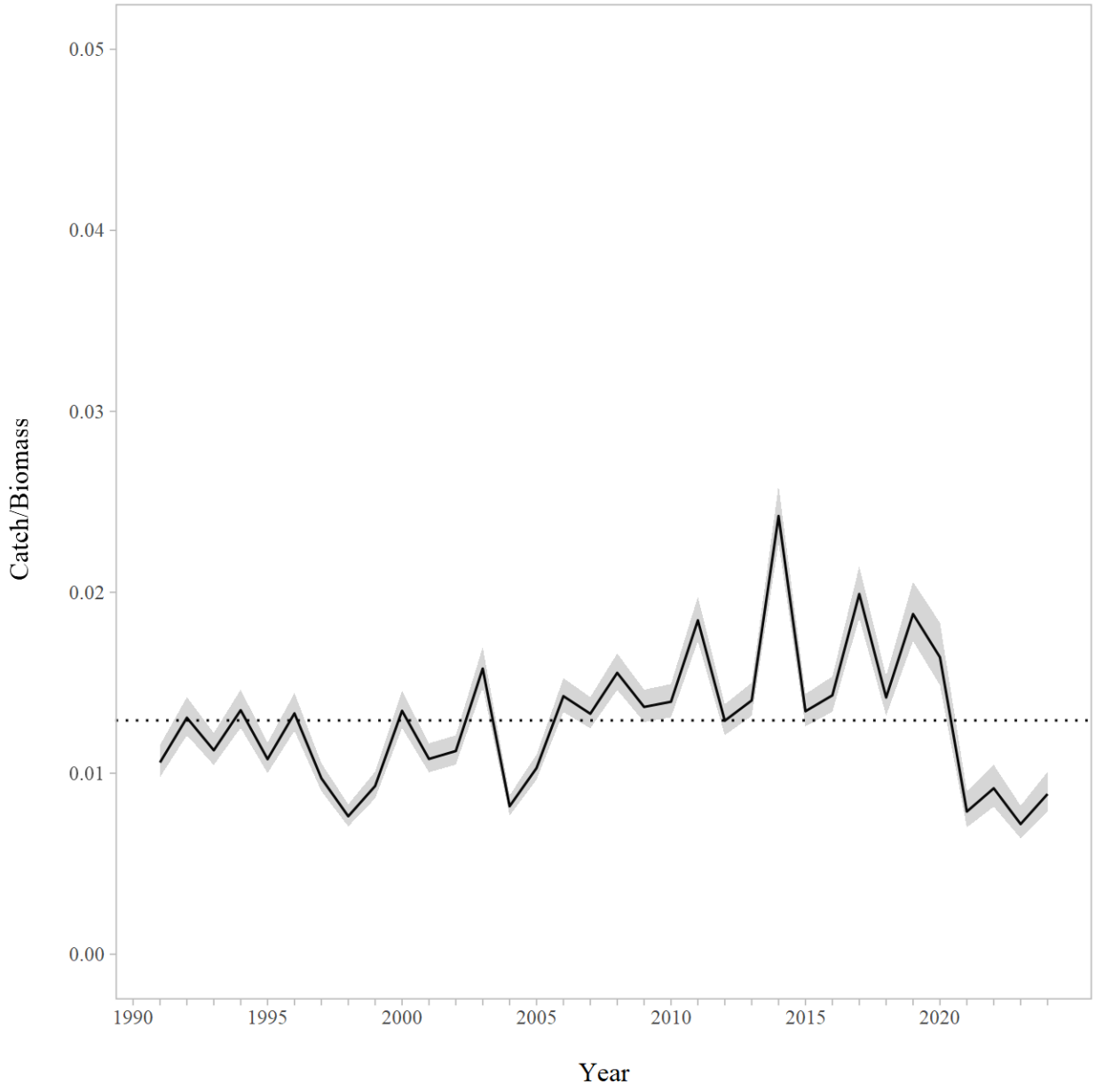

Figure 7.1. Gulf of Alaska arrowtooth flounder catch/age 4+ biomass ratio with approximate 95% confidence intervals. Observed catch values were used for 1991-2023, the 2024 catch values were estimated using an expansion factor. The horizontal dashed line is the mean value for the entire dataset.

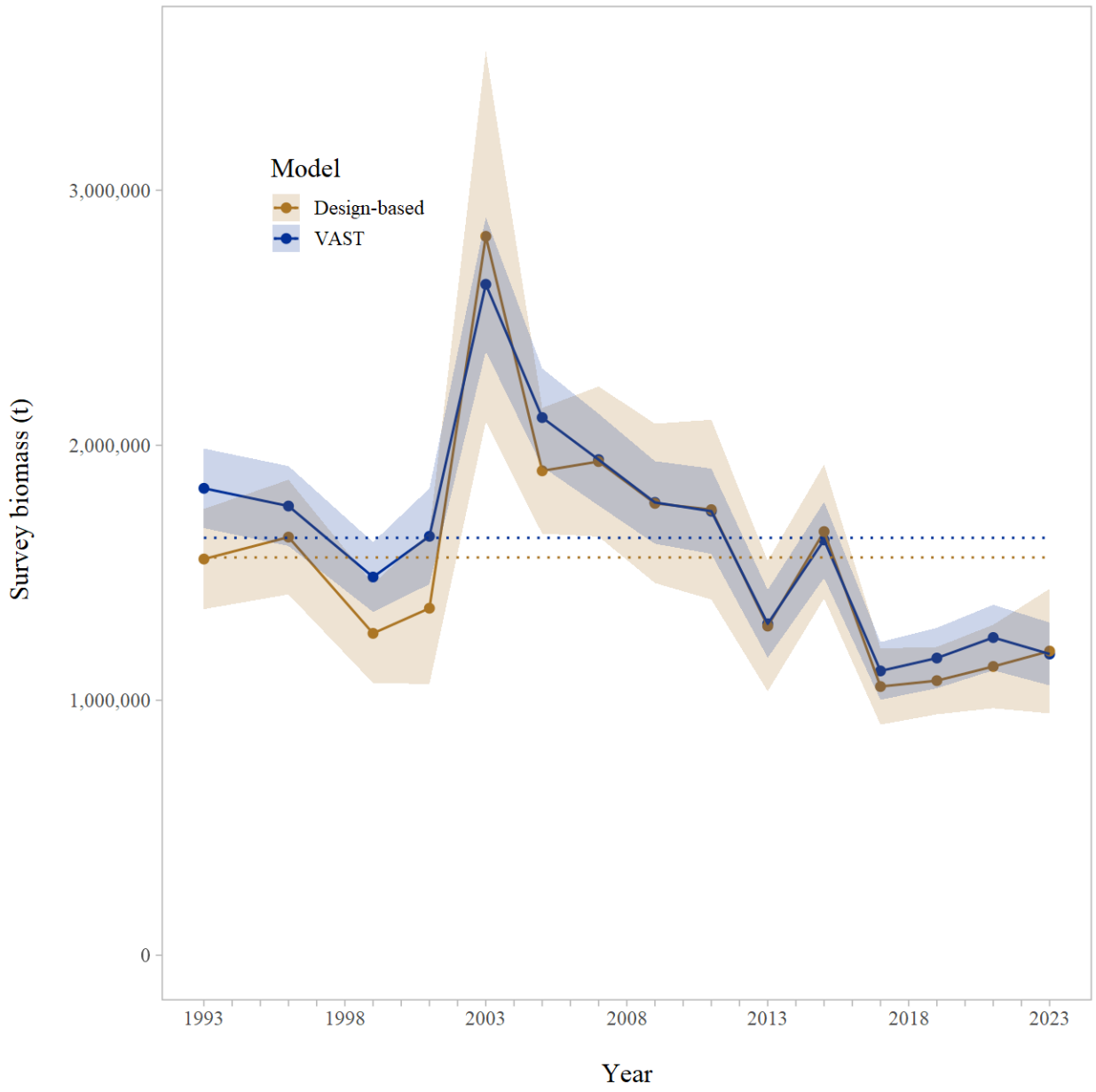

Figure 7.2. Geostatistical model (VAST) and design-based model estimates of trawl survey abundance for arrowtooth flounder in the Gulf of Alaska. Shaded areas are 95% confidence intervals, the dashed lines are the data means.