

5. Assessment of the Deepwater Flatfish Stock Complex in the Gulf of Alaska

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Executive Summary

Introduction

The Gulf of Alaska deepwater flatfish complex is assessed every four years and was last assessed in 2023. This year, year 4 of the 4-year cycle, we present a harvest projection to recommend harvest levels for the next two years. Please refer to the 2023 full stock assessment report for further information regarding the assessment model (McGilliard and Ferriss, 2023, available online at https://apps-afsc.fisheries.noaa.gov/Plan_Team/2023/GOAdeepflat.pdf). The deepwater flatfish complex consists of Dover sole, Greenland turbot, deepsea sole, and Kamchatka flounder.

Dover sole is assessed using an age-structured model and Tier 3 determination. Thus, the single species projection model was run using parameter values from the accepted 2023 Dover sole assessment model (McGilliard and Ferriss, 2023), together with updated catch information for 2023-2026, to predict stock status for Dover sole in 2027 and 2028 and to make ABC recommendations for those years. Projections are conducted using numbers-at-age for Dover sole from age 3-59+ and historical recruitment of age 3 individuals from 1978-2023 to calculate OFL's and ABC's.

Greenland turbot, Kamchatka flounder, and deepsea sole fall under Tier 6. ABC's and OFL's for these Tier 6 species are based on historical catch levels. The ABC and OFL for Greenland turbot and deepsea sole are based on the average catch over the years 1978-1995, and therefore these quantities are not updated. An exception occurred in 2023 when the historical average catch from 1978-1995 that defines the Tier 6 OFL for GOA Greenland turbot was updated to reflect the most recent reliable estimates of historical catch for this species from the Alaska Regional Office's Catch Accounting System.

The catch time series for Kamchatka flounder dates back to 2011, when it was separated from arrowtooth flounder in catch accounting and arrowtooth flounder was removed from the deepwater flatfish complex. In 2019, Kamchatka flounder was assigned a species-level OFL of 69 t based on the maximum historical catch as part of the deepwater flatfish complex. The Kamchatka flounder ABC and OFL are also not updated. ABC's and OFL's for the individual species in the deepwater flatfish complex are determined only as an intermediate step for the purpose of calculating complex-level OFL's and ABC's.

The survey biomass for Dover sole declined from 79,364 t in 2013 to 43,003 t in 2021, by almost 50%, and has since increased to 64,169 t in 2025 (Figure 1). The 2023 assessment model indicated that the decline between 2013 and 2021 was not due to fishing, as the maximum catch over the period 2013 to 2025 was 355 t. Additionally, Figure 2 shows that the catch to age-3 total biomass ratio reached a time-series high of 0.08 in the early 1990s and in recent years has been below 0.01. Catching the full ABC in

2027 and 2028 is predicted to lead to catch to biomass ratios close to 0.1 (though this could be impacted by the influence of factors outside of fishing on survey biomass).

Description of Updated Catch

Projections are based on realized catches for Dover sole of 65 t for 2026. The 2026 estimated catches were calculated by dividing the current realized catches from January 1 to August 1 for 2026 by the long-term mean proportion of annual catches occurring between January 1 and August 1. Estimated catches of 77 t were used in place of maximum permissible ABC for 2027-2029, which was the average catch over 2021-2025.

Summary of Results

As in McGilliard and Ferriss (2023), the species-level ABC is 37 t for Greenland turbot and the OFL is 49 t for both 2027 and 2028. The species-level ABC for Kamchatka flounder is 69 t and the OFL is 52 t. The species-level ABC for deepsea sole is 4 t and the OFL is 6 t for both 2027 and 2028. The species-level ABC for Dover sole is 6,609 t in 2027 and 6,462 t in 2028 and the OFL is 7,835 t in 2027 and 7,660 t in 2028. Based on the updated projection model results, the recommended complex-level ABC's for 2027 and 2028 are 6,702 t and 6,555 t, and the OFL's are 7,959 t and 7,784 t. The new ABC recommendation and OFL for 2027 are similar to those developed for 2027 in 2025. The principal reference values are shown in Table 1 (part a and b):

Table 1a. The OFL, maxABC, and ABC for the deepwater flatfish complex, with calculations shown for the component stocks that comprise the complex. The OFL, maxABC, and ABC are specified at the complex level only. Table 1b shows additional quantities for Dover sole, which is a Tier 3a species in the deepwater flatfish complex.

Species	Quantity	As estimated or <i>specified last year</i> for:		As estimated or <i>recommended this year</i> for:	
		2026	2027	2027	2028
Dover sole	Tier	3a	3a	3a	3a
	OFL (t)	7,994	7,830	7,835	7,660
	maxABC (t)	6,743	6,604	6,609	6,462
	ABC (t)	6,743	6,604	6,609	6,462
Greenland turbot	Tier	6	6	6	6
	OFL (t)	49	49	49	49
	maxABC (t)	37	37	37	37
	ABC (t)	37	37	37	37
Kamchatka flounder	Tier	6	6	6	6
	OFL (t)	69	69	69	69
	maxABC (t)	51.75	51.75	52	52
	ABC (t)	51.75	51.75	52	52
Deepsea sole	Tier	6	6	6	6
	OFL (t)	6	6	6	6
	maxABC (t)	4	4	4	4
	ABC (t)	4	4	4	4
Deepwater Flatfish Complex	OFL (t)	8,118	7,954	7,959	7,784
	maxABC (t)	6,836	6,697	6,702	6,555
	ABC (t)	6,836	6,697	6,702	6,555
	Status	As determined <i>last</i> year for:		As determined <i>this</i> year for:	
		2024	2025	2025	2026
	Overfishing	no	n/a	no	n/a
	Overfished	n/a	no	n/a	no
	Approaching overfished	n/a	no	n/a	no

Table 1b. Key quantities, including the Dover sole portion of the OFL, maxABC, and recommended ABC for the deepwater flatfish complex.

Species	Quantity	As estimated or <i>specified last year</i> for:		As estimated or <i>recommended this year</i> for:	
		2026	2027	2027	2028
Dover sole	M (natural mortality rate)	0.129(f), 0.128(m)	0.129(f), 0.128(m)	0.129(f), 0.128(m)	0.129(f), 0.128(m)
	Tier	3a	3a	3a	3a
	Projected total (3+) biomass (t)	82,048	80,044	80,097	78,128
	Projected Female spawning biomass (t)	23,964	23,616	23,625	23,333
	$B_{100\%}$	15,968	15,968	15,968	15,968
	$B_{40\%}$	6,387	6,387	6,387	6,387
	$B_{35\%}$	5,589	5,589	5,589	5,589
	F_{OFL}	0.15	0.15	0.15	0.15
	$maxF_{ABC}$	0.12	0.12	0.12	0.12
	F_{ABC}	0.12	0.12	0.12	0.12
	OFL (t)	7,994	7,830	7,835	7,660
	maxABC (t)	6,743	6,604	6,609	6,462
	ABC (t)	6,743	6,604	6,609	6,462

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

BRDs for deepwater flatfish are currently based on the proportion of survey biomass of Greenland turbot, Kamchatka flounder, and deepsea sole found within each management area as of the most recent full or update assessment (McGilliard and Ferriss 2021). Therefore, the observed survey biomass and coefficient of variation corresponding to observed survey biomass from 2001-2023 were used as inputs to a random effects model (REMA; Sullivan et al. 2022; <https://github.com/afsc-assessments/rema>) to estimate the proportion of biomass by NMFS statistical area for 2024-2025. An ABC exists only at the level of the complex (deepwater flatfish) and not for each species individually. The ABC by area for the deepwater flatfish complex is then the sum of the species-specific portions of the ABC.

The random effects model is used to fill in depth and area gaps in the Dover sole survey biomass by area and to calculate an area- and depth-specific estimate of current survey biomass as of the most recent full stock assessment (McGilliard and Ferriss 2023). These estimates are summed across depths and the resulting relative biomass in each management area is used as the basis for BRDs for the Dover sole portion of the deepwater complex. This method of calculating BRDs for deepwater flatfish was recommended by the GOA Plan Team in 2016 and was presented in the 2016 SAFE (McGilliard 2016; <https://apps-afsc.fisheries.noaa.gov/REFM/Docs/2016/GOAdeepflat.pdf>). The method was chosen because it accounts for time and area gaps in the survey for Dover sole, which comprises nearly all of the deepwater flatfish catch and moves to deeper waters ontogenetically, and explicitly accounts for differences in the spatial distributions of the component species. For instance, Greenland turbot are found exclusively in the Western region by the survey.

Table 2. Biologically-informed recommended distributions of recommended ABC for the deepwater flatfish complex with contributions from its component species.

Species	Year	Western	Central	West Yakutat	Southeast	Total
		2.6260%	37.5485%	26.6279%	33.1976%	100.0%
Dover Sole	2027	174	2,481	1,760	2,194	6,609
	2028	170	2,426	1,721	2,145	6,462
		100.0%	0.0%	0.0%	0.0%	100.0%
Greenland Turbot	2027	37	0	0	0	37
	2028	37	0	0	0	37
		32.1%	67.9%			100.0%
Kamchatka Flounder	2027	17	35	0	0	52
	2028	17	35	0	0	52
		0.0%	74.9%	11.2%	13.9%	100.0%
Deepsea Sole	2027	0	3	0	1	4
	2028	0	3	0	1	4
Deepwater Flatfish	2027	228	2,519	1,760	2,195	6,702
	2028	224	2,464	1,721	2,146	6,555

Five-Year Harvest Projections

Table 3. Five-year harvest projections for Dover sole using the species-specific projected ABC for catches in 2027 and 2028, and the five-year average F from 2021-2025 to project in years 2029-2031, as specified by Scenario 3 from the most recent GOA deepwater flatfish assessment (McGilliard and Ferriss 2023). The ABC value calculated for 2028 was based on projections assuming catches of 6,609 t in 2027, which is different from the estimated catches for 2027 used to calculate ABC for Table 1 (77 t). The large catches assumed for the five-year projections lead to a smaller ABC value for 2028 than the ABC value in Table 1.

Year	Expected Catch	OFL	ABC	Mean SSB	Mean Relative SSB
2027	6,609	7,835	6,609	23,625	1.48
2028	6,462	6,981	5,888	21,187	1.33
2029	61	6,183	5,215	18,882	1.18
2030	60	6,097	5,142	18,767	1.18
2031	60	6,016	5,074	18,632	1.17

Figures

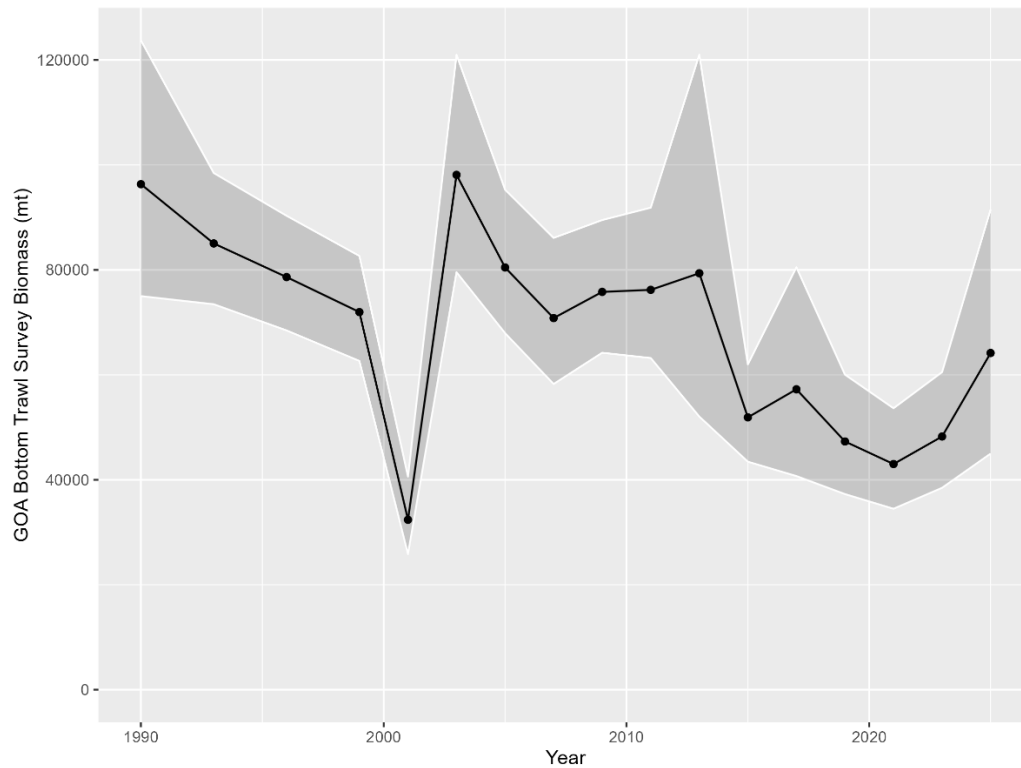


Figure 1. Gulf of Alaska Bottom Trawl Survey biomass (mt) for Dover sole from 1990-2025 (black dots) with 95% confidence intervals (grey shading).

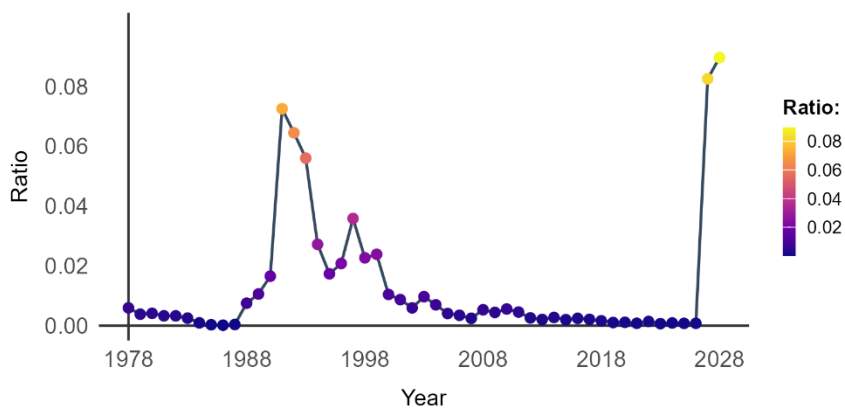


Figure 2. Ratio of total catch to total age 3 biomass from 1978 to 2028. Values for 2023-2028 originate from the projection model and catch estimation methods used for developing the Executive Summary table.

References

- McGilliard, C.R. and Ferriss, B. 2023. 5. Gulf of Alaska Deepwater Flatfish. In Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Gulf of Alaska. North Pacific Fishery Management Council, P.O. Box 103136, Anchorage AK 99510.
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- Sullivan, J., C. Monnahan, P. Hulson, J. Ianelli, J. Thorson, and A. Havron. 2022a. REMA: a consensus version of the random effects model for ABC apportionment and Tier 4/5 assessments. Plan Team Report, Joint Groundfish Plan Teams, North Pacific Fishery Management Council. 605 W 4th Ave, Suite 306 Anchorage, AK 99501. [Available through the Oct 2022 Joint GPT e-Agenda.](#)