

# Assessment of the Flathead Sole Stock in the Gulf of Alaska

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## Executive Summary

The Gulf of Alaska flathead sole stock is typically assessed every four years and was last assessed in 2017. In years without a full assessment, we present an executive summary to recommend harvest levels for the next two years. Please refer to the 2017 full stock assessment report for further information regarding the assessment model (Turnock et al., 2017, available online at <https://www.afsc.noaa.gov/REFM/Docs/2017/GOAflathead.pdf>). A full stock assessment was scheduled for 2021, but due to limited staff resources, the full stock assessment will be postponed.

Flathead 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 2017 flathead sole assessment model (Turnock et al. 2017), together with updated catch information for 2017-2020, and estimated catches for 2021 and 2022-2023 to predict stock status for flathead sole in 2022 and 2023 and to make ABC recommendations for those years. Projections are conducted using numbers-at-age for flathead sole from age 3-21+ and historical recruitment of age 3 individuals is used to calculate OFLs and ABCs.

### Summary of Changes in Assessment Inputs

*Changes in input data:* The updated information for this partial assessment includes replacing the estimated 2020 catch with the final catch value from the Alaska Regional Office ([https://www.fisheries.noaa.gov/sites/default/files/akro/car110\\_goa2020.html](https://www.fisheries.noaa.gov/sites/default/files/akro/car110_goa2020.html)) (1,911 t), and estimating the 2021-2023 catches. The 2021 projected catch was calculated as the current catch of 10/28/2021 added to the average 10/28/2021 – December 31 catches over the previous 5 years (totaling 673 t). The 2022 and 2023 projected catches were calculated as the average catch over the previous 5 years (2,251 t). Note that in the projection model, the estimated catches for the present and two future years are input in place of maxABC, which is appropriate given that recent catches are much less than the maximum ABC for this stock.

### Summary of Results

The ABC for flathead sole is 40,175 t in 2022 and 40,046 t in 2023 and the OFL is 48,928 t in 2022 and 48,757 t in 2023. The new ABC recommendation and OFL values are similar to those developed in 2020 for 2022 (39,851 t and 48,534 t, respectively). The principal reference values are shown in the following table.

Quantity	As estimated or <i>specified last year for:</i>		As estimated or <i>recommended this year for:</i>	
	2021	2022	2022*	2023*
<i>M</i> (natural mortality rate)	0.2	0.2	0.2	0.2
Tier	3a	3a	3a	3a
Projected total (3+) biomass (t)	280,980	278,418	279,975	276,796
Projected Female spawning biomass (t)	95,338	96,833	97,614	97,876
<i>B</i> <sub>100%</sub>	91,551	91,551	91,551	91,551
<i>B</i> <sub>40%</sub>	36,620	36,620	36,620	36,620
<i>B</i> <sub>35%</sub>	32,043	32,043	32,043	32,043
<i>F</i> <sub>OFL</sub>	0.36	0.36	0.36	0.36
<i>maxF</i> <sub>ABC</sub>	0.28	0.28	0.28	0.28
<i>F</i> <sub>ABC</sub>	0.28	0.28	0.28	0.28
OFL (t)	47,982	48,534	48,928	48,757
maxABC (t)	39,377	39,851	40,175	40,046
ABC (t)	39,377	39,851	40,175	40,046
<b>Status</b>	As determined <i>this year</i> for:			
	2019	2020	2020	2021
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 catches of 673 t used in place of maximum permissible ABC for 2021 and 2,251 t used in place of maximum permissible ABC for 2022 and 2023. The 2021 projected catch was calculated as the current catch as of October 28, 2021 added to the average October 28 – December 31 catches over the 5 previous years. The 2022 and 2023 projected catch was calculated as the average catch over the previous 5 years.

### Area Apportionment

Area apportionment for ABC of flathead sole is currently based on the proportion of survey biomass projected for each area in 2021 and 2022 using the survey averaging random effects model developed by the survey averaging working group. The recommended ABC area apportionment percentages are listed below; values are presented using the apportionment model results from 2020 as well as from 2021, which include an additional year of survey data. Slight discrepancies in totals (<10t) may occur due to rounding.

Quantity	Western		Central		West Yakutat		Southeast		Total
	2020	2021	2020	2021	2020	2021	2020	2021	
Area Apportionment	36.08%	36.73%	52.89%	54.84%	6.16%	3.76%	4.86%	4.67%	
2022 ABC (t)	14,492	14,755	21,243	22,033	2,474	1,511	1,952	1,876	40,175
2023 ABC (t)	14,445	14,708	21,176	21,962	2,466	1,506	1,946	1,870	40,046

## Literature Cited

Turnock, B.J., McGilliard, C.R., and Palsson, W. 2017. 8. Assessment of the Flathead Sole 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, P.O. Box 103136, Anchorage AK 99510

## Tables

Table 1. Total catch (t) of GOA flathead sole by area. Catch for 2021 is current up to October 28, 2021. Columns left blank indicate confidential catch information by area. Bolded years are not used in the base model.

Year	Total Catch	Western Gulf	Central Gulf	Eastern Gulf
1978	452			
1979	165			
1980	2,068			
1981	1,070			
1982	1,368			
1983	1,080			
1984	549			
1985	320			
1986	147			
1987	151			
1988	520			
1989	747			
1990	1,447			
1991	1,237	199	1,036	2
1992	2,315	355	1,947	13
1993	2,824			
1994	2,525			
1995	2,180	589	1,563	28
1996	3,074	807	2,166	101
1997	2,441			
1998	1,731			
1999	897	186	687	25
2000	1,548			
2001	1,912			
2002	2,146			
2003	2,459	525	1,934	0
2004	2,398			
2005	2,552	611	1,941	0
2006	3,142	462	2,679	1
2007	3,130	666	2,462	2
2008	3,446			
2009	3,663	303	3,359	1
2010	3,865	462	3,403	0
2011	2,732	393	2,338	0
2012	2,167	277	1,890	0
2013	2,819	588	2,230	0
2014	2,557	219	2,337	1
2015	2,001	199	1,802	1
2016	2,422	228	2,191	2
2017	2,050	73	1,978	0
<b>2018</b>	2,202	150	2,051	0
<b>2019</b>	2,668	210	2,457	0
<b>2020</b>	1,911	100	1,811	0
<b>2021</b>	586	70	516	0

Table 2. Flathead sole survey biomass (Bio, t) and coefficient of variation (CV) by year and regulatory area. Bolded years are not included in base model.

Year	Total		Western		Central		Eastern	
	Bio	CV	Bio	CV	Bio	CV	Bio	CV
1984	249,341	0.12	45,100	0.41	158,539	0.14	45,703	0.18
1987	177,546	0.11	33,603	0.19	113,483	0.13	30,459	0.33
1990	243,055	0.12	58,740	0.19	161,257	0.16	23,059	0.31
1993	188,579	0.13	57,760	0.21	113,976	0.19	16,843	0.19
1996	205,521	0.09	66,732	0.18	122,730	0.11	16,059	0.16
1999	207,590	0.12	49,636	0.21	139,356	0.15	18,598	0.45
2001	153,594	0.12	68,164	0.20	85,430	0.14		
2003	257,294	0.08	67,055	0.13	170,852	0.10	19,388	0.14
2005	213,213	0.08	59,458	0.17	142,043	0.09	11,712	0.30
2007	281,402	0.08	78,361	0.16	177,641	0.11	25,400	0.28
2009	225,377	0.11	80,115	0.21	128,910	0.14	16,351	0.34
2011	235,639	0.09	76,049	0.16	128,428	0.12	31,162	0.34
2013	201,233	0.09	62,131	0.19	121,063	0.11	18,039	0.27
2015	218,548	0.08	67,665	0.18	126,200	0.09	24,684	0.14
2017	236,588	0.11	99,009	0.19	123,087	0.14	14,493	0.30
<b>2019</b>	185,840	0.09	66,710	0.17	94,280	0.13	24,849	0.24
<b>2021</b>	180,000	0.11	46,234	0.21	103,880	0.15	29,886	0.26

## Figures

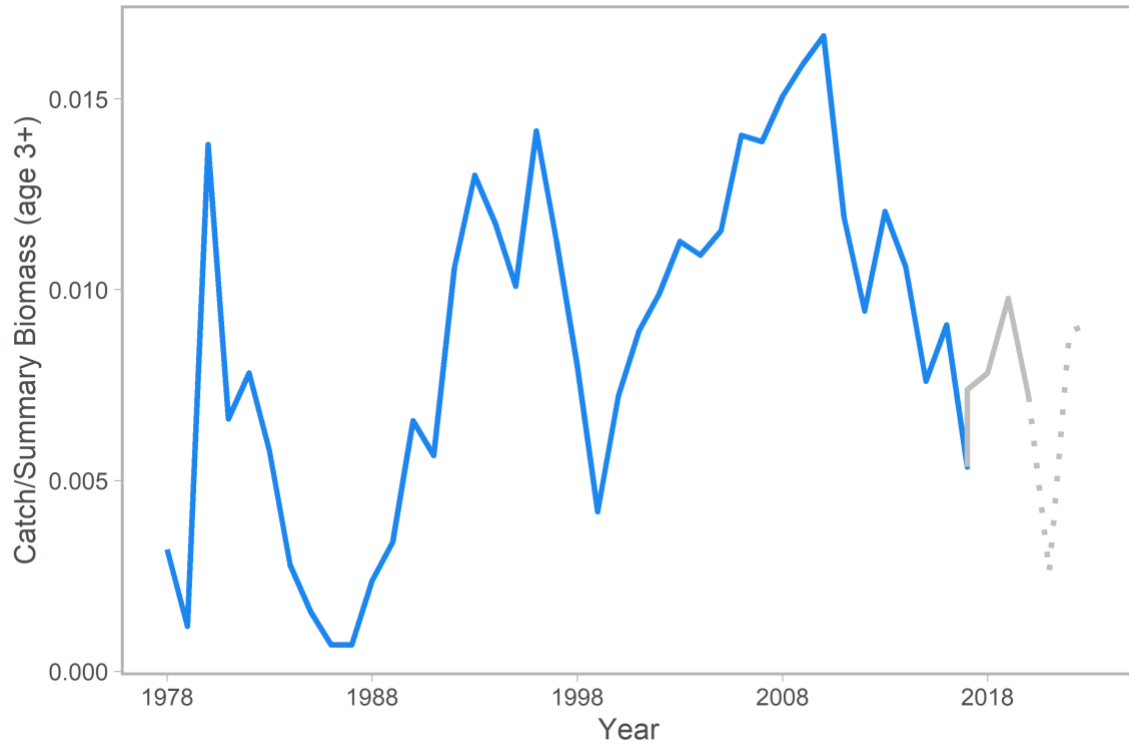


Figure 1. Catch to total biomass ratio using total biomass for age 3+ individuals for GOA flathead sole. Values represented in grey are not included in the base case model. Dotted grey lines are projected values for 2021-2023.