4. Assessment of the Shallow-water Flatfish Stock Complex in the Gulf of Alaska

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Executive Summary

In 2017, the scheduled frequency for some stock assessments was changed in response to the National Stock Assessment Prioritization effort. The new schedule moved shallow water flatfish to a 4-year assessment cycle, with partial assessments for 'off' years. This year we present a partial assessment consisting of an executive summary including recent fishery catch, survey results, and recommend harvest levels for the next two years. Please refer to the 2017 full stock assessment report for further information regarding the shallow-water flatfish stock complex (Turnock et al. 2017, https://www.afsc.noaa.gov/refm/stocks/plan_team/2017/GOAshallowflat.pdf).

The shallow-water flatfish (SWF) stock complex in the Gulf of Alaska (GOA) includes Alaska plaice (*Pleuronectes quadrituberculatus*), butter sole (*Pleuronectes isolepis*), English sole (*Parophrys vetulus*), sand sole (*Psettichthys melanostictus*), starry flounder (*Platichthys stellatus*), yellowfin sole (*Pleuronectes asper*), northern rock sole (*Lepidopsetta ploystra*), and southern rock sole (*Lepidopsetta bilineata*). Northern rock sole and southern rock sole are Tier 3 species and assessed separately from the other shallow-water flatfish. The OFL and ABC for the SWF complex are calculated as the sum of the Tier 3 rock sole assessment values and the Tier 5 other shallow water flatfish assessment values.

In 2019, the random effects model (Spencer et al. 2013) was fit to the Gulf of Alaska bottom trawl survey biomass data for 1984-2019 to estimate current biomass for each of the Tier 5 species within the SWF complex. The 2001 survey data were excluded because the eastern area was not surveyed. The random effects model was also fit to total SWF survey biomass summed over the Tier 5 species. The biomass estimates from the species-specific random effects models were adjusted so that the sum of species was equal to the result from the random effects model fit to total Tier 5 species survey biomass. The adjusted biomass estimates were used to develop species-specific OFLs and ABCs. The OFL and ABC estimates were carried over from 2019 for the SWF speciess and added to the management advice from the 2020 projection model for northern rock sole and southern rock sole (Bryan and Palsson 2020) to provide a SWF complex OFL and ABC.

The apportionment by area was estimated by fitting the random effects model to the survey biomass summed for all species (including Tier 3 rock sole) by area and estimating the percent biomass by area. This was done in 2019 and remains unchanged because new survey data were not available since 2020 is an off-survey year.

Summary of Changes in Assessment Inputs

Changes in the input data: Changes were not made to data inputs.

Changes in the assessment methodology: Changes were not made to the assessment model.

Summary of Results

The recommended 2021 maximum ABC for the shallow-water flatfish stock complex is 56,164 t. This represents 1% increase from the specified 2020 ABC. The 2021 ABC less than 1% lower than the projected 2021 ABC from last year. The following table summarizes the reference values and the recommended ABC and OFL values in bold. Overfishing is not occurring, since the total SWF catch (2,867 t) in 2019 is less than the OFL (68,309 t) in 2019.

	As estimated or *specified last* year for:		As estimated or *recommended this* year for:	
Quantity	2020	2021	2021	2022
M (natural mortality rate)[1]	0.2	0.2	0.2	0.2
Tier	3a and 5	3a and 5	3a and 5	3a and 5
Biomass (t)	339,593	343,461	342,226	346,312
F_{OFL}	*	*	*	*
$maxF_{ABC}$	*	*	*	*
F_{ABC}	*	*	*	*
OFL (t)	68,010	69,129	**68,841**	69,691
maxABC (t)	55,463	56,409	**56,164**	56,883
ABC (t)	55,463	56,409	**56,164**	56,883
Status	As determined *last* year for:		As determined *this* year for:	
	2018	2019	2019	2020
Overfishing	No	NA	No	NA

* See Bryan and Palsson 2020 for values for northern and southern rock sole. [1] Northern rock sole male M=0.253, southern rock sole male M= 0.262, all other M=0.2.

The species specific biomass estimates from the Tier 3 projection model for the rock soles and from the 2019 random effects model fit to the species-specific survey data for the other shallow water flatfish and the associated OFLs and ABCs are summarized in the following table.

						As *specified last* year for:				As *recommended this* year for:			
						2020		2021		2021		2022	
Species	Tier	FABC	FOFL	2020 Biomass[1]	2021 Biomass[1]	ABC	OFL	ABC	OFL	ABC	OFL	ABC	OFL
Northern rock sole	3a	0.382	0.462	94,619	94,612	17,655	20,962	17,897	21,246	17,756	21,080	17,851	21,191
Southern rock sole	3a	0.271	0.326	142,193	144,833	22,390	26,491	23,094	27,326	22,990	27,204	23,614	27,943
Yellowfin sole	5	0.15	0.2	31,259	31,259	4,689	6,252	4,689	6,252	4,689	6,252	4,689	6,252
Butter sole	5	0.15	0.2	14,304	14,304	2,146	2,861	2,146	2,861	2,146	2,861	2,146	2,861
Starry flounder	5	0.15	0.2	30,605	30,605	4,591	6,121	4,591	6,121	4,591	6,121	4,591	6,121
English sole	5	0.15	0.2	16,943	16,943	2,541	3,389	2,541	3,389	2,541	3,389	2,541	3,389
Sand sole	5	0.15	0.2	2,673	2,673	401	535	401	535	401	535	401	535
Alaska plaice	5	0.15	0.2	6,997	6,997	1,050	1,399	1,050	1,399	1,050	1,399	1,050	1,399
Total				339,593	342,226	55,463	68,010	56,409	69,129	56,164	68,841	56,883	69,691

[1] 2019 estimate from random effects model fit to survey biomass estimates except northern and southern rock sole. Total biomass of northern and southern rock sole is the age 0+ biomass from the projection model (Bryan and Palsson 2020).

Fishery trends

Catch-biomass ratios were derived for each species using catch data provided by the Alaska Regional Office Catch Accounting System (1993-2019) and estimated species-specific biomass provided by the 2019 random effects model fit with Gulf of Alaska bottom trawl survey data for the Tier 5 SWF species and the Tier 3 projection model for northern and southern rock sole (Table 4.1 and Figure 4.1). Overall the ratios have been low for all species. Butter sole had the highest exploitation rates of all of the SWF species, which peaked in 2010 at ~0.1 and has been variable but generally declining since. The ratios for northern rock sole are second to butter sole and are followed by southern rock sole.

Survey trends

Survey trends remain unchanged as this was an on survey year from the Gulf of Alaska bottom trawl survey.

Area Allocation of Harvest

The apportionment by area was estimated by fitting the random effects model to the survey biomass summed for all species (including Tier 3 rock sole) by area and estimating the percent biomass in 2019 by area. The following table shows the recommended apportioned 2021 and 2022 SWF ABC and OFL levels that include Tier 3a estimates from projections for northern and southern rock sole (Bryan and Palsson 2020).

Area Apportionment	Central 50%	Southeast 2%	Western 43%	W. Yakutat 5%	Total 100%
2021 Area ABC (t)	28,082	1,123	24,151	2,808	56,164
2022 Area ABC (t)	28,442	1,137	24,460	2,844	56,883

Summaries for Plan Team

Stock/Assemblage	Area	2020 OFL	2020 ABC	2020 TAC	2020 Catch[1]	2021 OFL	2021 ABC	2022 OFL	2022 ABC
Shallow-water flatfish	W	--	23,849	13,250	74	--	24,151	--	24,460
	C	--	27,732	27,732	2,791	--	28,082	--	28,442
	WYAK	--	2,773	2,773	<1	--	2,808	--	2,844
	SEO	--	1,109	1,109	1.47	--	1,123	--	1,137
	Total	68,010	55,463			68,841	56,164	69,691	56,883

[1]As of Oct. 30, 2020.

Responses to SSC and Plan Team Comments on Assessments in General

"*The SSC requests that all authors fill out the risk table in 2019…"* (SSC December 2018)

"*…risk tables only need to be produced for groundfish assessments that are in 'full' year in the cycle."* (SSC, June 2019)

"*The SSC recommends the authors complete the risk table and note important concerns or issues associated with completing the table*." (SSC, October 2019)

As this is an 'off' year for this assessment we do not provide a risk table and will follow guidance from the PT and SSC as to what to include in the next full assessment.

Responses to SSC and Plan Team Comments Specific to this Assessment

There were no specific comments for this assessment. Comments directed towards northern and southern rock sole are addressed in Bryan and Palsson (2018).

References

Bryan, M. and W. Palsson. 2020. Assessment of the northern and southern rock sole (*Lepidopsetta polyxystra and bilineata*) stocks in the Gulf of Alaska for 2020. In: Stock Assessment and Fishery Evaluation Report for Groundfish Resources in the Gulf of Alaska. North Pacific Fishery Management Council, Anchorage, AK, USA.

Bryan, M. and W. Palsson. 2019. Assessment of the northern and southern rock sole (*Lepidopsetta polyxystra and bilineata*) stocks in the Gulf of Alaska for 2019. In: Stock Assessment and Fishery Evaluation Report for Groundfish Resources in the Gulf of Alaska. North Pacific Fishery Management Council, Anchorage, AK, USA.

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Bryan, M, Z.T. A'mar and W. Palsson. 2017. Assessment of the northern and southern rock sole (*Lepidopsetta polyxystra and bilineata*) stocks in the Gulf of Alaska for 2017. In: Stock Assessment and Fishery Evaluation Report for Groundfish Resources in the Gulf of Alaska. North Pacific Fishery Management Council, Anchorage, AK, USA.

Spencer, P., J. Ianelli, G. Thompson, J. Heifetz. 2013. Report of the working group on methods for averaging surveys: *Updated through 2013.* Unpublished report.

Turncock, B.J, M. Bryan, and T.K. Wilderbuer. 2017. Assessment of the shallow-water flatfish stock complex in the Gulf of Alaska. In: Stock Assessment and Fishery Evaluation Report for Groundfish Resources in the Gulf of Alaska. North Pacific Fishery Management Council, Anchorage, AK, USA.

Tables

Table 4.1 Catch-biomass ratios by species.

Year	Alaska plaice	butter sole	English sole	northern rock sole	sand sole	southern rock sole	starry flounder	yellowfin sole
1993	0.00	0.01	0.00	0.04	0.00	0.02	0.00	0.00
1994	0.00	0.01	0.00	0.02	0.03	0.01	0.00	0.00
1995	0.01	0.01	0.00	0.02	0.02	0.01	0.00	0.00
1996	0.01	0.02	0.00	0.04	0.01	0.02	0.02	0.00
1997	0.01	0.02	0.00	0.03	0.08	0.02	0.01	0.00
1998	0.00	0.01	0.00	0.02	0.00	0.01	0.00	0.00
1999	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.00
2000	0.00	0.04	0.00	0.03	0.01	0.02	0.01	0.00
2001	0.00	0.03	0.00	0.03	0.02	0.01	0.00	
2002	0.00	0.04	0.00	0.03	0.01	0.02	0.00	0.00
2003	0.00	0.03	0.00	0.02	0.00	0.01	0.00	0.00
2004	0.00	0.02	0.00	0.01	0.00	0.01	0.00	0.00
2005	0.00	0.02	0.00	0.02	0.00	0.01	0.00	0.00
2006	0.00	0.05	0.00	0.03	0.00	0.01	0.01	0.00
2007	0.00	0.07	0.00	0.04	0.00	0.02	0.00	0.00
2008	0.00	0.07	0.00	0.04	0.00	0.02	0.00	0.00
2009	0.00	0.09	0.00	0.04	0.00	0.02	0.00	0.00
2010	0.00	0.10	0.00	0.02	0.00	0.01	0.00	0.00
2011	0.00	0.03	0.00	0.02	0.00	0.01	0.00	0.00
2012	0.00	0.05	0.00	0.02	0.00	0.01	0.01	0.00
2013	0.00	0.07	0.00	0.03	0.01	0.01	0.00	0.00
2014	0.00	0.05	0.00	0.02	0.00	0.01	0.01	0.00
2015	0.00	0.02	0.00	0.02	0.00	0.01	0.01	0.00
2016	0.00	0.03	0.00	0.02	0.00	0.01	0.00	0.00
2017	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.00
2018	0.00	0.03	0.01	0.01	0.00	0.01	0.00	0.00
2019	0.00	0.01	0.01	0.01	0.00	0.01	0.00	0.00

Figures

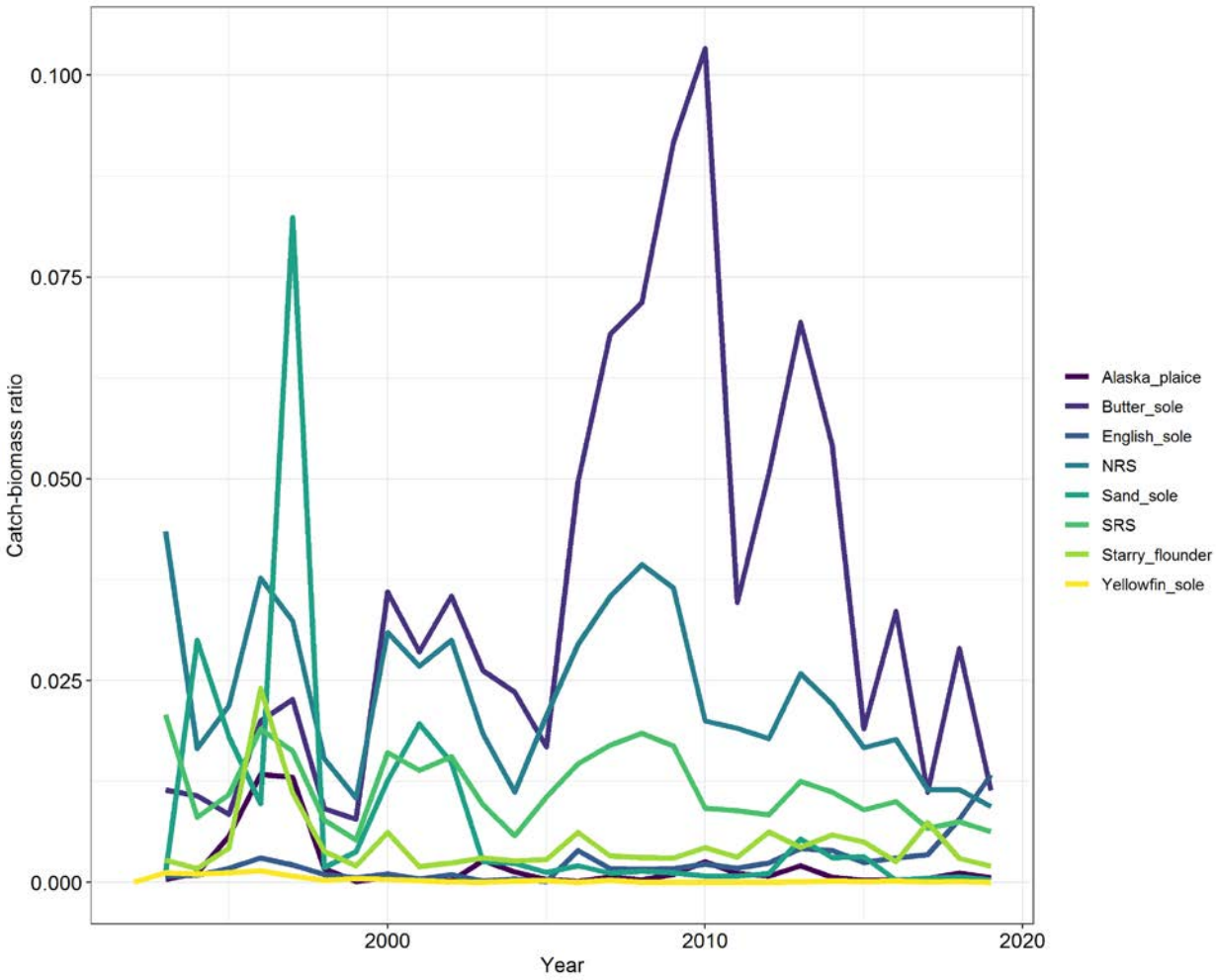

Figure 4.1. Catch-biomass ratios for shallow water flatfish including northern and southern rock sole from 1993 until 2019. The ratios were derived from species-specific catch obtained from the AKRO Catch Accounting System and total biomass estimates from the random effects model for the Tier 5 shallow water flatfish species and the Tier 3 projection model for northern and southern rock sole.