4.1 Assessment of Northern and Southern rock sole (*Lepidopsetta polyxstra* and *bilineata*) stocks in the Gulf of Alaska

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November 2020

Executive Summary

The Gulf of Alaska (GOA) northern and southern rock sole assessment is conducted on a 4-year assessment cycle following the stock assessment prioritization schedule. During years when a full assessment is not completed, a partial assessment is conducted. A partial assessment is provided this year. The last full assessment was completed in 2017 and marked the first year of the new assessment schedule. The 2017 full assessment can be found online (Bryan et al. 2017, https://www.afsc.noaa.gov/REFM/Docs/2017/GOAnsrocksole.pdf).

A statistical catch-at-age model configured in Stock Synthesis 3 is used as the primary assessment tool for GOA northern and southern rock sole, which qualify as Tier 3 stocks. The model is run separately for each species. The data used in the assessment model includes fishery catch, the GOA trawl survey biomass, fishery and survey size composition, and survey conditional age-at-length. The full assessment model was not run this year. The projection model was updated with new catch data and run to provide updated management advice.

Summary of Changes in Assessment Inputs

Changes in the input data: New input data added to the projection model included a final 2019 catch estimate and a preliminary projected total catch estimate for 2020. Northern and southern rock sole are not differentiated in the commercial catch data. Total rock sole catches are assumed to be comprised of 50% northern rock sole and 50% southern rock sole. The 2019 catch used in the projection model was increased to 1,086 t from 880 t. The 2020 catch input, 1531.48 t, was estimated by expanding half of the October 30 total rock sole catch by a factor of 1.082. This expansion factor was estimated as the 5-year (2015-2019) average proportion of catch as of October 26th through the end of the fishing year.

Changes in the assessment methodology: No changes were made to the assessment model.

Summary of Results

The recommended 2021 maximum allowable ABC for northern rock sole is 17,756 t, and for southern rock sole is 22,990 t from the updated projection model. For northern rock sole, this represents a less than 1% increase from the 2020 ABC and a less than 1% decrease in the 2021 ABC from last year's projection model. The southern rock sole 2021 ABC represents a 3% increase from the 2020 ABC and a less than 1% increase in the 2021 ABC from last year's projection model. The tables on following pages summarize the biological reference points and the recommended ABC and OFL values for northern rock sole and southern rock sole (shown in bold).

Northern Rock Sole

Quantity	As estimated or *recommended last* year for: 2020	2021	As estimated or *recommended this* year for: 2021	2022
M (natural mortality rate; female, male)	0.2, 0.253*	0.2, 0.253*	0.2, 0.253*	0.2, 0.253*
Tier	3a	3a	3a	3a
Projected total (age 0+) biomass (t)	94,619	95,275	94,612	94,614
Projected Female spawning biomass (t)	47,701	46,643	47,694	46,330
$B_{100\%}$	51,387	51,387	51,387	51,387
$B_{40\%}$	20,555	20,555	20,555	20,555
$B_{35\%}$	17,985	17,985	17,985	17,985
F_{OFL}	0.462	0.462	0.462	0.462
$maxF_{ABC}$	0.382	0.382	0.382	0.382
F_{ABC}	0.382	0.382	0.382	0.382
OFL (t)	20,962	21,246	**21,080**	21,191
maxABC (t)	17,655	17,897	**17,756**	17,851
ABC (t)	17,655	17,897	**17,756**	17,851
	As determined *last* year for:		As determined *this* year for:	
Status	2018	2019	2019	2020
Overfishing	No	n/a	No	n/a
Overfished	n/a	No	n/a	No
Approaching overfished	n/a	No	n/a	No

*Male natural mortality was estimated.

Southern Rock Sole

Quantity	As estimated or *specified last* year for: 2020	2021	As estimated or *recommended this* year for: 2021	2022
M (natural mortality rate; female, male)	0.2, 0.262*	0.2, 0.262*	0.2, 0.262*	0.2, 0.262*
Tier				
Projected total (age 0+) biomass (t)	142,193	145,405	144,833	148,917
Projected Female spawning biomass (t)	71,643	71,340	72,973	73,930
$B_{100\%}$	93,518	93,518	93,518	93,518
$B_{40\%}$	37,407	37,407	37,407	37,407
$B_{35\%}$	32,731	32,731	32,731	32,731
F_{OFL}	0.326	0.326	0.326	0.326
$maxF_{ABC}$	0.271	0.271	0.271	0.271
F_{ABC}	0.271	0.271	0.271	0.271
OFL (t)	**26,491**	27,326	**27,204**	27,943
maxABC (t)	**22,390**	23,094	**22,990**	23,614
ABC (t)	**22,390**	23,094	**22,990**	23,614
	As determined *last* year for:		As determined *this* year for:	
Status	2018	2019	2019	2020
Overfishing	No	n/a	No	n/a
Overfished	n/a	No	n/a	No
Approaching overfished	n/a	No	n/a	No

*Male natural mortality was estimated.

Overfishing is not occurring, the stock is not overfished, and it is not approaching an overfished condition. Status is determined by comparing the most recent complete year (2019) of official catch to the OFL and comparing the projected spawning biomass relative to $B_{35\%}$. The official rock sole, total catch for 2019 (2,172 t) is less than the combined 2019 OFL (47,453 t) indicating overfishing is not occurring. Spawning biomass is projected to be above $B_{35\%}$ for 2020-2022; hence, the stock is not overfished and it is not approaching an overfished condition.

Survey biomass has been declining since 2009 (Figure 4.1). Compared to 2017, the 2019 biomass estimates declined by 28% and 7% for northern rock sole and southern rock sole, respectively.

Catch-biomass ratios were derived from the reported catch obtained from the National Marine Fisheries Service's Alaska Regional Office Catch Accounting System and total biomass estimates from the assessment model for 1993 through 2019. The 2020 ratio was derived from the preliminary 2020 catch estimate and the total biomass from the projection model. The northern rock sole catch-biomass ratio ranged from less than 0.01 to 0.04 and southern rock sole exploitation rate ranged between 0.005 and 0.02 from 1993 to 2008 (Table 4.1 and Figure 4.2). Both have been generally declining since 2008.

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 and 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

Spawning biomass reference levels were based on average age-0 recruitment for the period 1977-2017. Reference points should not include terminal years since there are no data for age-0 recruits in 2017, and the Plan Teams have developed a method for determining how many terminal years to remove from the reference point calculations, which should be applied in the future.

This was corrected in 2018. The terminal year for age-0 recruits in the projections was 2014.

In the next full assessment in four years, the author is requested to provide an equation and rationale for the input sample size calculation applied to the conditional age-at-length data; it was not clear how this calculation was performed or why this would be a function of the length samples and not purely the age samples.

This will be addressed in the next full assessment.

Tables

Table 4.1. Catch to biomass ratios for Gulf of Alaska northern and southern rock sole. The ratios were derived from catch obtained from NMFS AKRO Catch Accounting System and total biomass estimates from the assessment model for 1993 through 2017. The 2018 and 2019 ratios were derived from the official catch and total biomass from the projection model, and the 2020 ratio was derived from the preliminary 2020 catch estimate and the total biomass from the projection model.

Year	Northern rock sole	Southern rock sole
1993	0.044	0.021
1994	0.017	0.008
1995	0.022	0.011
1996	0.038	0.019
1997	0.032	0.016
1998	0.015	0.008
1999	0.010	0.005
2000	0.031	0.016
2001	0.027	0.014
2002	0.030	0.016
2003	0.018	0.010
2004	0.011	0.006
2005	0.021	0.011
2006	0.029	0.015
2007	0.035	0.017
2008	0.039	0.018
2009	0.036	0.017
2010	0.020	0.009
2011	0.019	0.009
2012	0.018	0.008
2013	0.026	0.013
2014	0.022	0.011
2015	0.017	0.009
2016	0.018	0.010
2017	0.011	0.007
2018	0.012	0.008
2019	0.012	0.008
2020	0.016	0.012

Figures

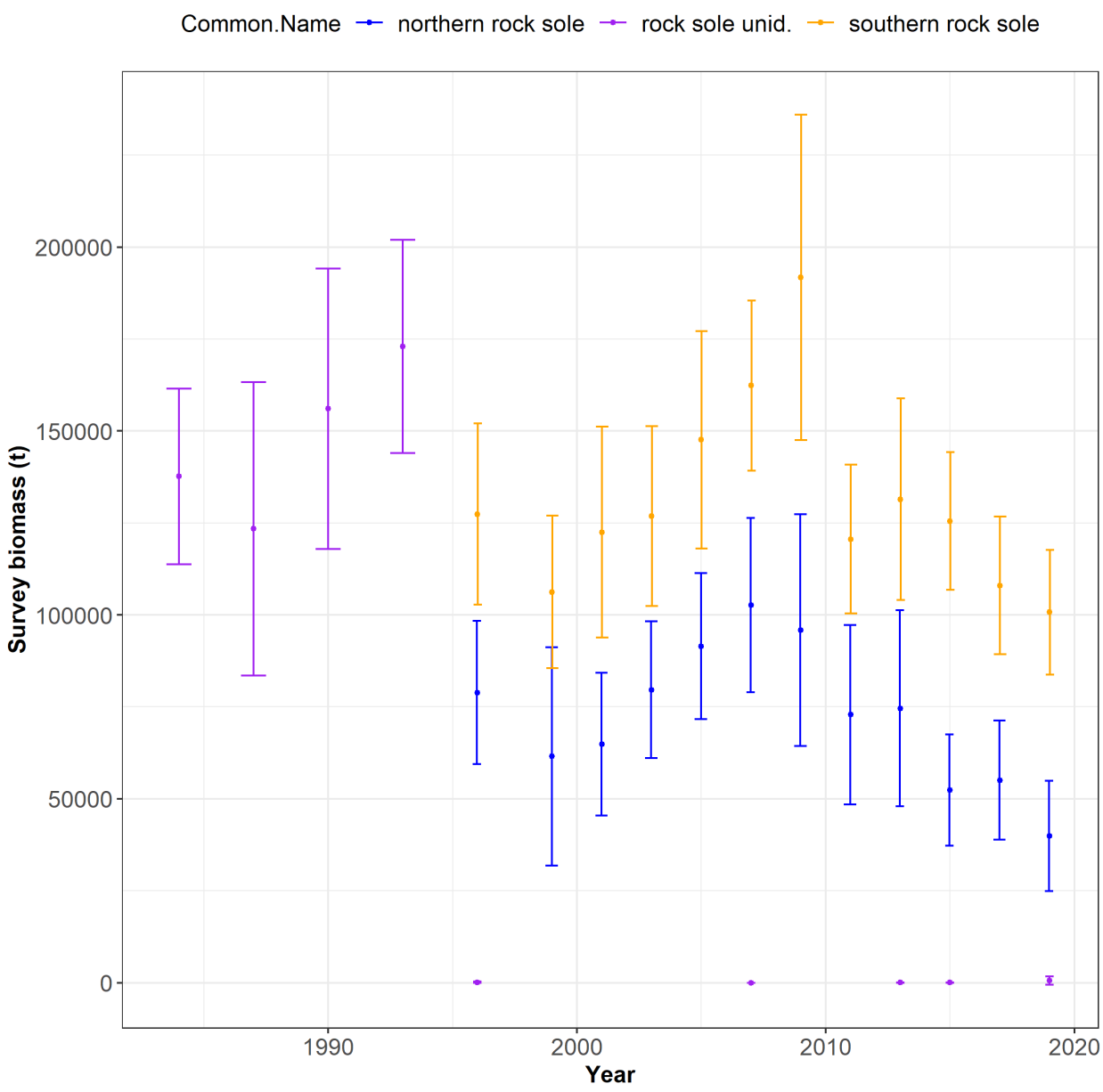

Figure 4.1. Northern rock sole (NRS), southern rock sole (SRS), and unidentified rock sole (URS) biomass estimates from the Gulf of Alaska trawl survey (1985-2019).

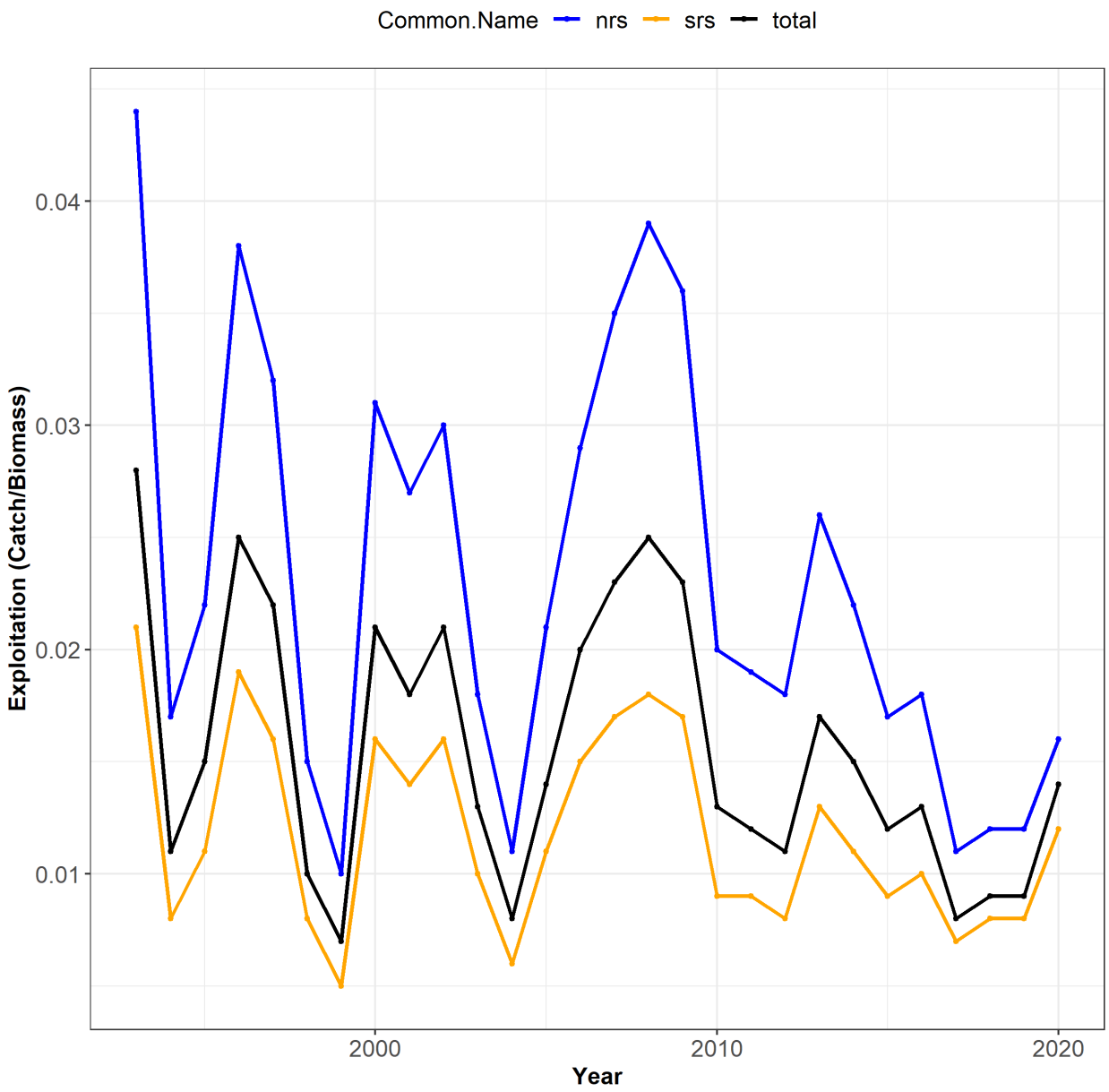

Figure 4.2. Catch-biomass ratios (exploitation) for Gulf of Alaska northern and southern rock sole from 1993-2020. The ratios were derived from catch obtained from NMFS AKRO Catch Accounting System and total biomass estimates from the assessment model for 1993 through 2017. The 2018 and 2019 ratios were derived from the official catch and total biomass from the projection model and the 2020 ratio was derived from the preliminary 2020 catch estimate and the total biomass from the projection model.