10. Assessment of the Northern Rockfish stock 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. Prior to 2017, Gulf of Alaska (GOA) rockfish were assessed on a biennial stock assessment schedule to coincide with the availability of new trawl survey data. Under the new schedule, full assessments for northern rockfish will be conducted in even years and partial assessments will be presented in odd years. For Gulf of Alaska northern rockfish in 2019, we present a partial assessment to recommend harvest levels for the next two years. Please refer to the last full stock assessment report (2018) for further information regarding the assessment model (Cunningham et al., 2018, available online at https://www.afsc.noaa.gov/REFM/Docs/2018/GOA/GOAnork.pdf). A full stock assessment document with updated assessment and projection model results will be presented in next year's SAFE report (2020).

We use a statistical age-structured model as the primary assessment tool for GOA northern rockfish stock which qualifies as a Tier 3 stock. This assessment consists of a population 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 model to predict future population estimates and recommended harvest levels. The data sets used in this assessment include total catch biomass, fishery age and size compositions, trawl survey abundance estimates, and trawl survey age compositions. For a partial assessment, we do not re-run the assessment model, but do update the projection model with new catch information. This incorporates the most current catch information without re-estimating model parameters and biological reference points.

Summary of Changes in Assessment Inputs

Changes in the input data: There were no changes made to the assessment model inputs as this was an off-cycle year. New data added to the projection model included updated catch data from 2018 (2,354 t) and new estimated catches for 2019-2021. The 2019 catch was estimated by increasing the official catch as of October 7, 2019 by an expansion factor of 1.077, which accounts for the average fraction of catch taken after October 7 in the last three complete years (2016-2018). This expansion factor decreased from last year's expansion factor of 1.094 and resulted in an estimated catch for 2019 of 2,561 t. To estimate future catches, we updated the yield ratio to 0.66, which was the average of the ratio of catch to ABC for the last three complete catch years (2016-2018). This yield ratio was multiplied by the projected ABCs from the updated projection model to generate catches of 2,850 t in 2020 and 2,660 t in 2021. The yield ratio was lower than last year's ratio of 0.71.

Changes in the assessment methodology: There were no changes in assessment methodology since this was an off-cycle year.

Summary of Results

ABC recommendation

For the 2020 fishery, we recommend the maximum allowable ABC of **4,312** t from the updated projection model. This ABC is 4.8% less than last year's ABC of 4,529 t but larger than last year's 2020 projected ABC of 4,270 t. Recommended area apportionments of ABC are 1,133 t for the Western area, 3,178 t for the Central area, and 1 t for the Eastern area. The 2020 Gulf-wide OFL for northern rockfish is **5,143** t.

Reference values for northern rockfish are summarized in the following table, with the recommended ABC and OFL values in bold.

Quantity	As estimated or *specified last* year for:		As estimated or *recommended this* year for:	
	2019	2020	2020*	2021*
M (natural mortality rate)	0.059	0.059	0.059	0.059
Tier	3a	3a	3a	3a
Projected total (ages 2+) biomass (t)	87,409	84,326	85,057	83,108
Projected female spawning biomass (t)	36,365	34,046	34,410	32,435
$B_{100\%}$	76,199	76,199	76,199	76,199
$B_{40\%}$	30,480	30,480	30,480	30,480
$B_{35\%}$	26,670	26,670	26,670	26,670
F_{OFL}	0.073	0.073	0.073	0.073
$maxF_{ABC}$	0.061	0.061	0.061	0.061
F_{ABC}	0.061	0.061	0.061	0.061
OFL (t)	5,402	5,093	**5,143**	4,898
maxABC (t)	4,529	4,270	**4,312**	4,107
ABC (t)	4,529	4,270	**4,312**	4,107
Status	As determined *last* year for:		As determined *this* year for:	
	2017	2018	2018	2019
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 2,850 t and 2,660 t used in place of maximum permissible ABC for 2020 and 2021.

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 $B_{35\%}$ for 2019 and 2021. The official total catch for 2018 is 2,354 t, which is less than the 2018 OFL of 4,380 t; therefore, the stock is not being subjected to overfishing. The estimates of spawning biomass for 2019 and 2021 from the projection model used this year (2019) are 36,512 t and 32,435 t, respectively. Both estimates are above the estimate of $B_{35\%}$ at 26,670 t and, therefore, the stock is not currently overfished nor approaching an overfished condition.

Fishery Trends

Updated catch data (t) for northern rockfish in the Gulf of Alaska as of October 7, 2019 (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	Eastern	Gulfwide Total	Gulfwide ABC	Gulfwide TAC
2018	297	2,057		2,354	3,681	3,681
2019	819	1,558		2,377	4,528	4,528

Catch of northern rockfish in the Gulf of Alaska through October 7, 2019 of 2,377 t is significantly below the 2019 gulfwide TAC of 4,528 t and remains so even after accounting for the 7.7% of northern rockfish catch usually occurring after October 7. The majority of Gulf of Alaska northern rockfish catch remains in the Central region, although, the catch in the Western region increased in 2019 based upon the TAC increasing in this area.

The northern rockfish catch/biomass ratio has ranged from 0.017-0.041 between 1991 and 2019 (Figure 10.1). The 2019 projected catch/biomass ratio of 0.029 is 11% larger than that observed in 2018 (0.026). For the catch/biomass ratio, catch data for 2019 are projected based on observed catch through October 7, 2019 using the 1.077 expansion factor. Biomass from 1991-2018 are estimates of total biomass from the 2018 full stock assessment (age 2+) and estimates for 2019 are from the projection model. The approximate 95% confidence interval values are calculated assuming a normal distribution with standard errors estimated in the 2018 full stock assessment for 1991-2018 and a coefficient of variation in 2019 that is assumed the same as estimated in the terminal year of the full assessment (2018).

Survey Trends

Biomass estimates are available from the 2019 AFSC GOA bottom trawl survey. For informational purposes, updated survey trends are presented here. A geostatistical model was approved for use in the northern rockfish assessment model in 2018 to estimate survey biomass and was updated using 2019 survey data (Figure 10.2). The 2019 model-based bottom trawl survey biomass estimate of 138,926 mt is 1.3% larger than the 2017 biomass estimate.

Area Allocation of Harvests

The apportionment percentages are the same as in the 2018 full assessment. The following table shows the recommended apportionment of ABC and TAC for 2020 and 2021. Please refer to the 2018 full stock assessment report for information regarding the apportionment rationale for northern rockfish.

Method	Area Allocation		Western GOA	Central GOA	Eastern GOA*	Total
Random Effects Model			26.28%	73.70%	0.02%	100%
	2020	Area ABC (t)	**1,133**	**3,178**	**1**	**4,312**
	2021	Area ABC (t)	**1,079**	**3,027**	**1**	**4,107**

*For management purposes the small ABC in the Eastern area is combined with other rockfish.

Summaries for Plan Team

Species	Year	Biomass[1]	OFL	ABC*	TAC	Catch[2]
Northern rockfish	2018	74,748	4,380	3,685	3,685	2,354
	2019	87,409	5,402	4,528	4,528	2,377
	2020	85,057	5,143	4,312		
	2021	83,108	4,898	4,107		

Stock/ Assemblage	Area	2019				2020		2021	
		OFL	ABC	TAC	Catch[2]	OFL	ABC	OFL	ABC
Northern rockfish	W		1,190	1,190	819		1,133		1,079
	C		3,338	3,338	1,558		3,178		3,027
	E*						1		1
	Total	5,402	4,528	4,528	2,377	5,143	4,312	4,898	4,107

[1]Total biomass (ages 2+) from the age-structured model

[2]Current as of October 7, 2019. Source: NMFS Alaska Regional Office Catch Accounting System via the AKFIN database (http://www.akfin.org).

*For management purposes, the small ABC for northern rockfish in the Eastern Gulf of Alaska is combined with other rockfish. Thus, for 2019 the Eastern Gulf ABC (and associated TAC) is not reported in these tables, but the Eastern Gulf ABC for 2020 and 2021 are included as future recommendations.

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 goundfish 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 next year's full assessment.

SSC and Plan Team Comments Specific to this Assessment

The Team recommended

- *Examining the delta-GLM approach by survey strata to see if the stratum-specific estimates are affecting the differences in approaches (compared to the results from a GOA-wide model).*
- *Exploring using the covariance matrix from VAST in the stock assessment likelihood (i.e., to avoid using some variance inflation outside of the assessment).*

(Plan Team, November 2018)

We will examine these recommendations in the next full assessment.

Figures

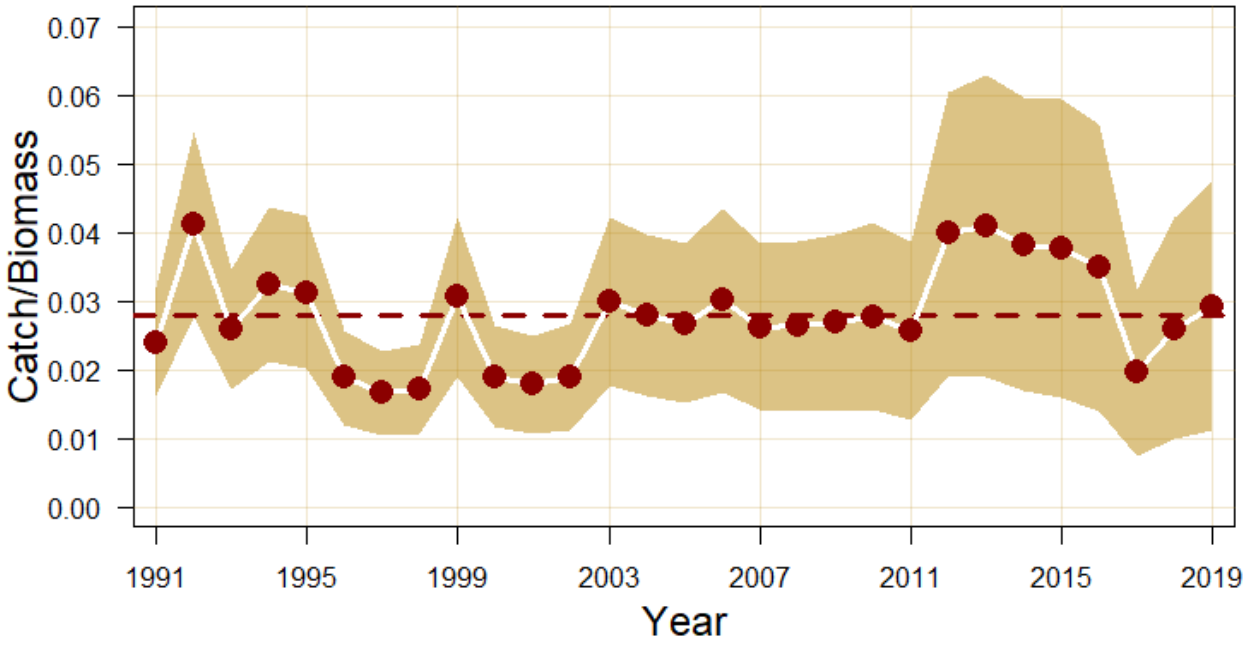

Figure 10.1. Modeled catch over total biomass (point estimates in red circles) with 95% sampling error confidence intervals (shaded area) for Gulf of Alaska northern rockfish from 1991-2019. Black dashed line is long-term average for the time series. Total biomass is ages 2+ from the age-structured model.

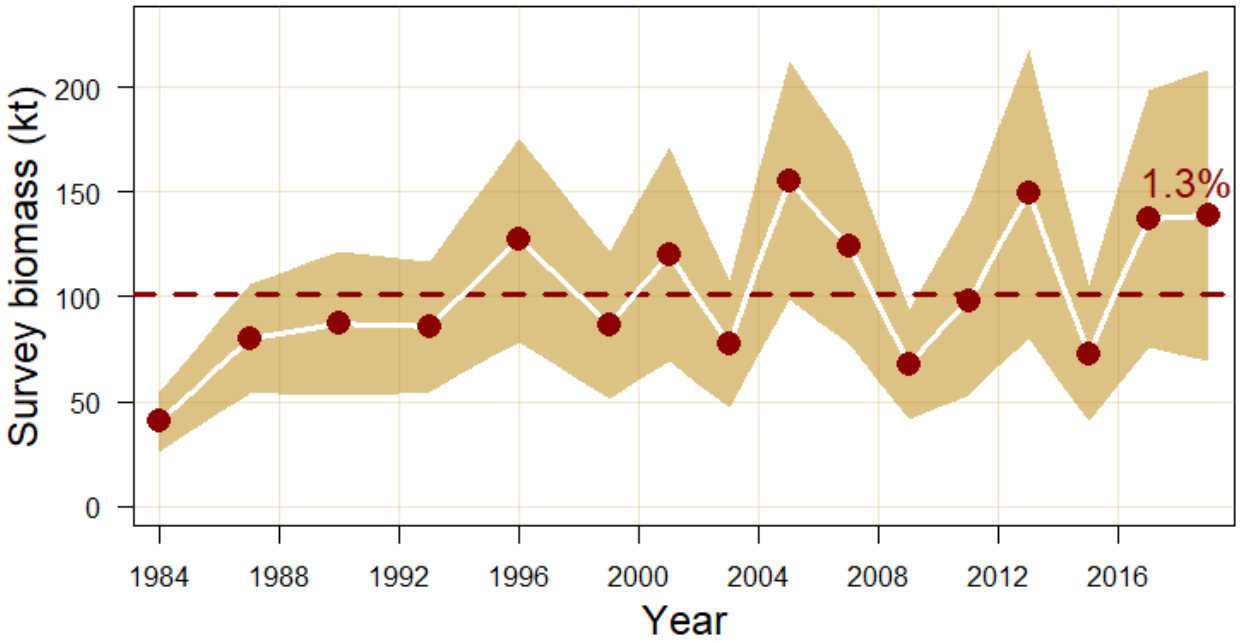

Figure 10.2. Model-based biomass index for GOA northern rockfish from the NMFS bottom trawl survey, point estimates in red circles) with 95% sampling error confidence intervals (shaded area), from 984-2019. Black dashed line is long-term average for the time series. Text percentage is the change of the 2019 index from the 2017 index.