10. Assessment of the Northern Rockfish stock in the Gulf of Alaska

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Executive summary

Gulf of Alaska northern rockfish (*Sebastes polyspinis*) have historically been assessed on a biennial stock assessment schedule to coincide with the availability of new trawl survey data (odd years). In 2017, the Alaska Fisheries Science Center (AFSC) participated in a stock assessment prioritization process. It was recommended that the Gulf of Alaska (GOA) northern rockfish remain on a biennial stock assessment schedule with a full stock assessment produced in even years and a partial stock assessment produced in odd years. For a partial assessment, the projection model is updated with new catch information and results are used to recommend harvest levels for the next two years. This incorporates the most current catch information without re-estimating model parameters and biological reference points.

The GOA northern rockfish is classified as a Tier 3 stock and is assessed using a statistical age-structure model. 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 used in this assessment includes total catch biomass, fishery age and size compositions, trawl survey abundance estimates, and trawl survey age compositions.

Summary of Changes in Assessment Inputs

Changes in the input data: There were no changes made to the assessment model inputs as this is an off-cycle year. New data added to the projection model included updated catch data from 2020 (2,385 t) and new estimated catches for 2021-2023. Catch data were queried on 2021-10-22. The 2021 catch was estimated by increasing the observed catch by an expansion factor of 1.045, which accounts for the average fraction of catch taken after October 22 in the last three complete years (2018-2020). This expansion factor results in an estimated catch for 2021 of 2,471 t. To estimate future catches, we updated the yield ratio to 0.6, which was the average ratio of catch to ABC for the last three complete catch years (2018-2020). This yield ratio was multiplied by the projected ABCs from the updated projection model to generate catches of 3,089 t in 2022 and 2,884 t in 2023.

Changes in assessment methodology: There were no changes from the 2020 assessment (Williams *et al.* 2020) since this is an off-cycle year.

Summary of Results

ABC recommendation
For the 2022 fishery, we recommend maximum allowable ABC of 5,147 t from the updated projection model. This ABC is a minor increase over the 2022 projected ABC of 5,100 t from the 2020 full assessment. The 2022 GOA-wide OFL is 6,143 t.

The stock is not being subject to overfishing, is not currently overfished, nor is it approaching a condition of being overfished. The test for determining whether overfishing is occurring is based on the 2020 catch compared to OFL. The official total catch for 2020 is 2,385 t which is less than the 2020 OFL of 6,396 t; therefore, the stock is not being subjected to overfishing. The tests for evaluating whether a stock is overfished or approaching a condition of being overfished require examining model projections of spawning biomass relative to $B_{35\%}$ for 2022 and 2023. The estimates of spawning biomass for 2022 and 2023 from the current year projection model are 40,474 t and 37,408 t, respectively. Both estimates are above the $B_{35\%}$ estimate of 29,691 t and, therefore, the stock is not currently overfished nor approaching an overfished condition.

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

	As estimated or specified *last* year for:		As estimated or specified *this* year for:	
Quantity/Status	2021	2022	2022*	2023*
M (natural mortality)	0.059	0.059	0.059	0.059
Tier	3a	3a	3a	3a
Projected total (age 2+) biomass (t)	102,715	99,957	100,371	96,045
Projected female spawning biomass (t)	42,791	40,462	40,474	37,408
$B_{100\%}$	84,832	84,832	84,832	84,832
$B_{40\%}$	33,933	33,933	33,933	33,933
$B_{35\%}$	29,691	29,691	29,691	29,691
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	6,396	6,088	**6,143**	5,874
maxABC (t)	5,358	5,100	**5,147**	4,921
ABC (t)	5,358	5,100	**5,147**	4,921
Status	As determined *last* year for:		As determined *this* year for:	
	2019	2020	2020	2021
Overfishing	No	n/a	No	n/a
Overfished	n/a	No	n/a	No
Approaching overfishing	n/a	No	n/a	No

*Projections are based on an estimated catch of 2,471 t for 2021, and estimates of 3,089 t and 2,884 t used in place of maximum permissible ABC for 2022 and 2023.

Fishery trends

Catch data for northern rockfish in the GOA were updated as of 2021-10-22 (NMFS Alaska Regional Office Catch Accounting System via the Alaska Fisheries Information Network [AKFIN] database,

www.akfin.org). The northern rockfish catch/biomass ratio has ranged from 0.015-0.038 since 1991 (Figure 10-1) and has been near 0.02 for the past four years. To calculate this catch/biomass ratio (exploitation rate) observed catches through 2020 and estimated catches for 2021 are divided by age 2+ biomass estimates. Biomass from 1991-2020 are from the 2020 full stock assessment and the estimate for 2021 is from the 2021 projection model. The approximate 95% confidence intervals are calculated assuming a normal distribution with standard errors estimated in the 2020 full stock assessment for 1991-2020 and a coefficient of variation in 2021 that is assumed the same as the estimate in the terminal year of the 2020 full assessment.

Survey trends

For informational purposes, updated trends from the 2021 bottom trawl survey are presented here for both a geostatistical model and a design-based model. A geostatistical model is approved for use in the northern rockfish assessment model for estimating survey biomass. This geostatistical model estimates a 33% decrease in biomass from the 2019 survey (Figure 10-2) and is below the long term mean. Large fluctuations in the northern rockfish biomass estimates have been observed for many survey years for both the design-based estimator and the model-based estimator.

Area Allocation of Harvest

The following table shows the recommended ABC apportionment for 2022 and 2023. The apportionment percentages are the same as in the last full assessment. Please refer to the 2020 full stock assessment report (Williams *et al.* 2020) for information regarding the apportionment rationale for GOA northern rockfish.

Area Apportionment	Western 37.76%	Central 62.22 %	Eastern 0.02%	Total 100%
2022 Area ABC (t)	1,944	3,202	1	5,147
2022 OFL (t)				6,143
2023 Area ABC (t)	1,859	3,061	1	4,921
2023 OFL (t)				5,874

*For management purposes the small ABC in the Eastern area is combined with the Other Rockfish complex

Summaries for Plan Team

Stock	Year	Biomass[1]	OFL	ABC	TAC	Catch
	2020	85,057	5,143	4,311	4,311	2,385
Northern	2021	102,715	6,396	5,357	5,357	2,365[2]
Rockfish	2022	100,371	6,143	5,147		
	2023	96,045	5,874	4,921		

		2021				2022		2023	
Stock	Area	OFL	ABC	TAC	Catch[2]	OFL	ABC	OFL	ABC
	W		2,023	2,023	698		1,944		1,859
Northern	C		3,334	3,334	1,667		3,202		3,061
Rockfish	E*						1		1
	Total	6,396	5,357	5,357	2,365	6,143	5,147	5,874	4,921

[1]Total biomass (age 2+) estimates from age-structured model.

[2]Current as of October 16, 2021. Source: NMFS Alaska Regional Office Catch Accounting System via the AKFIN database (http://www.akfin.org).

*For management purposes the small ABC in the Eastern area is combined with the Other Rockfish complex

Responses to SSC and Plan Team Comments on Assessments in General

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

A risk table will be provided in the next full assessment.

Responses to SSC and Plan Team Comments Specific to this Assessment

> *The Plan Team recommended the authors examine the high proportion of survey and commercial catch that are being assigned to the plus group age bin and investigate why fits to the fishery plus group are so poor. (November 2020)*

> *The SSC reiterates its 2018 request for the author to explore alternative binning for the plus group used in the assessment. (December 2020)*

The authors plan to explore options for plus group changes in the next full assessment.

> *The Team recommends evaluating how the definition of the length composition plus group, and alternative data-weighting methods, affect model performance." (Plan Team, November 2015); "Finally, the SSC notes the increasing proportion of fish in the fishery length composition plus-group and looks forward to seeing the results of the ongoing investigations into alternative length composition bin structures. The SSC also agrees with the high priority placed on improving maturity-at-age information for northern rockfish." (SSC, December 2018)*

The authors plan to explore the length composition plus group and alternative data-weighting methods in the next full assessment.

References

Williams, B.C., Hulson, P.-J.F., Lunsford, C.R. and Cunningham, C.J. (2020) Assessment of the Northern Rockfish 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, Anchorage, AK.

Figures

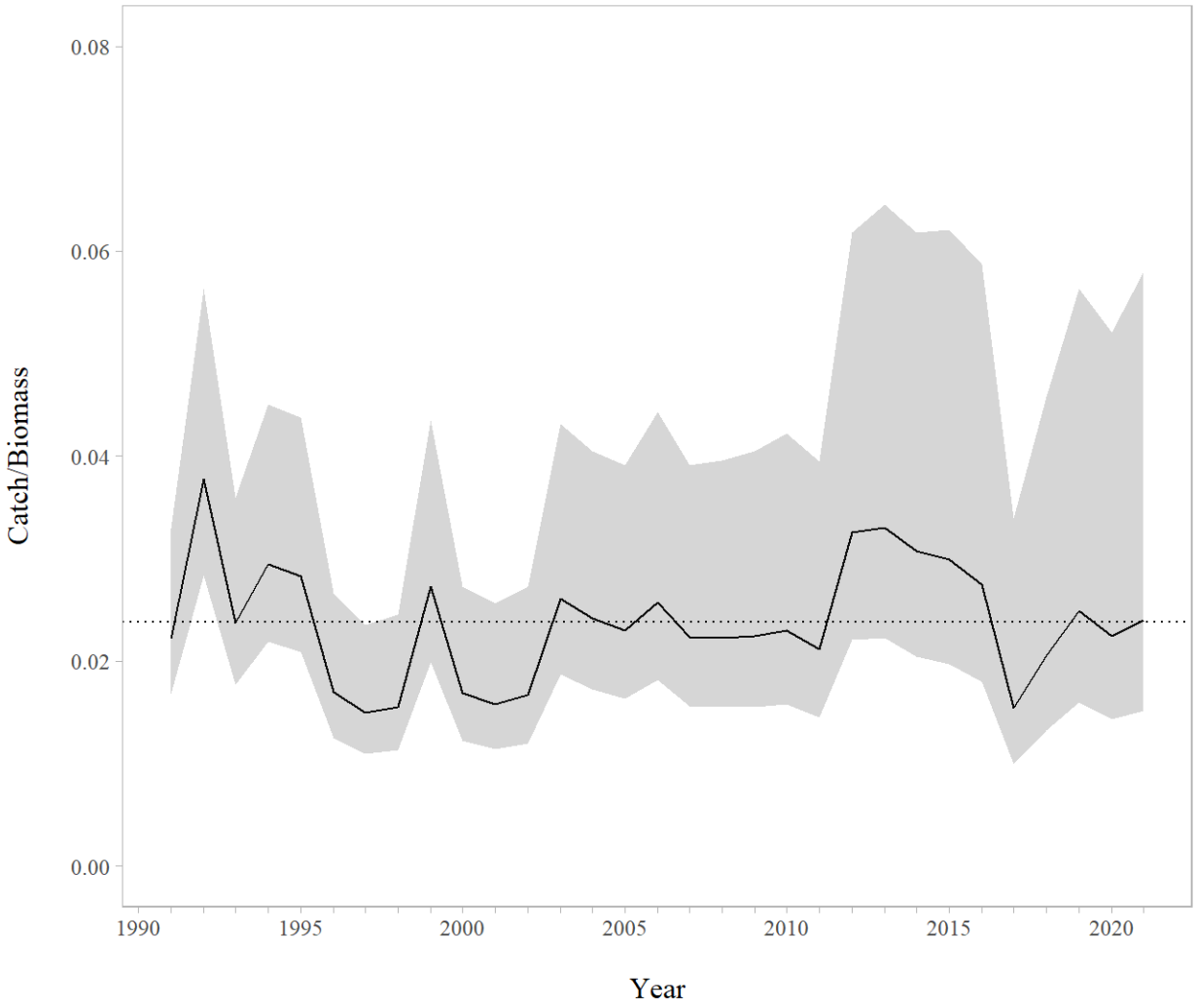

Figure 10-1. Gulf of Alaska northern rockfish catch/age 2+ biomass ratio with approximate 95% confidence intervals. Observed catch values were used for 1991-2020, the 2021 catch values were estimated using an expansion factor. The horizontal dashed line is the mean value for the entire dataset.

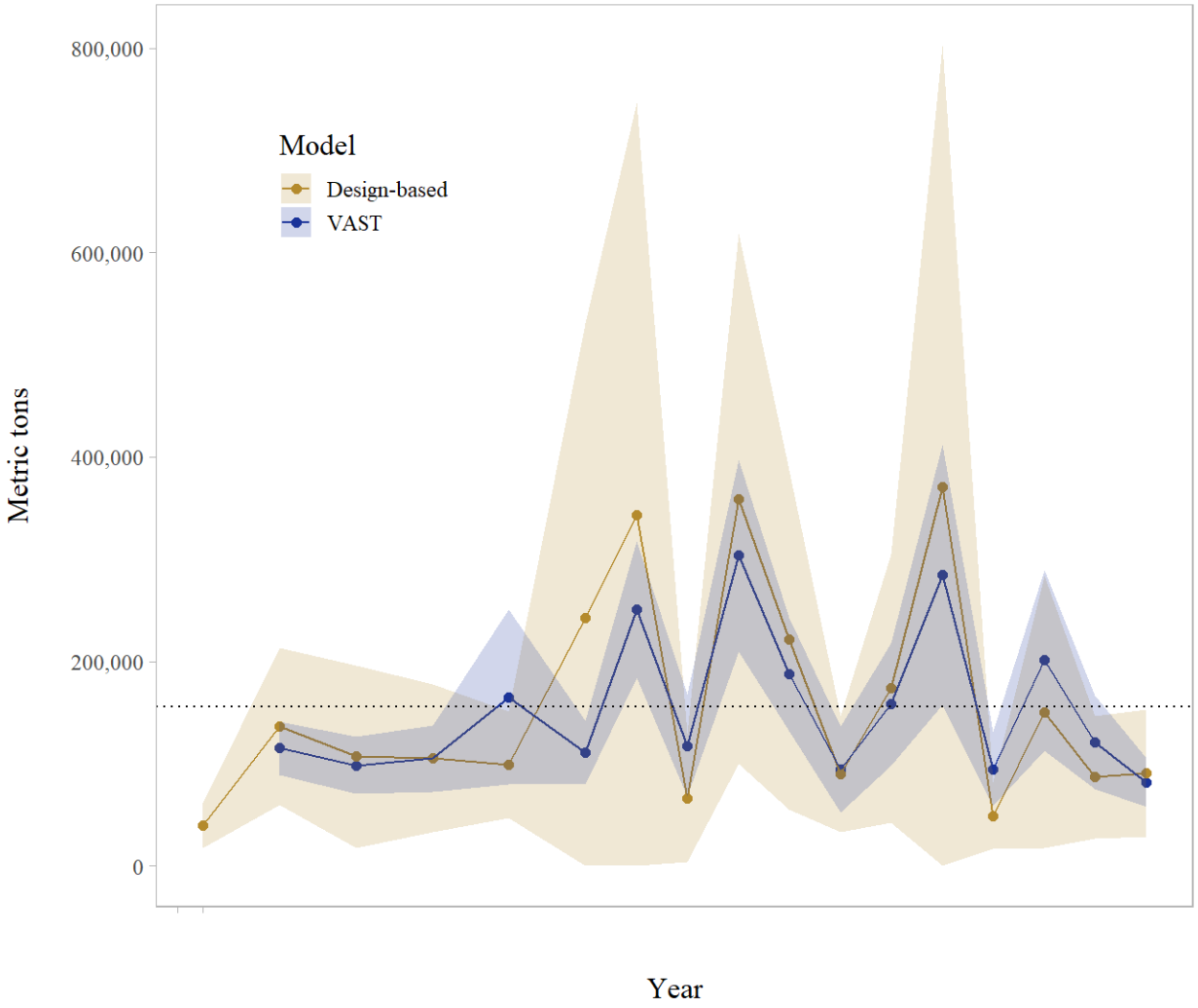

Figure 10-2. Geostatistical model (VAST) and design-based model estimates of trawl survey abundance for northern rockfish in the Gulf of Alaska. Shaded areas are 95% confidence intervals, the dashed line is the data mean (VAST).