12. Assessment of the Dusky Rockfish Stock in the Gulf of Alaska

Kristen L. Omori and Benjamin C. Williams

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Executive Summary

Gulf of Alaska (GOA) dusky rockfish (*Sebastes variabilis*) have historically been assessed on a biennial stock assessment schedule to coincide with the availability of new trawl survey data (odd year surveys). In 2016 (Hollowed *et al.* 2016), the Alaska Fisheries Science Center (AFSC) participated in a stock assessment prioritization process. It was recommended that GOA dusky rockfish remain on a biennial stock assessment schedule with a full stock assessment produced in even years and a harvest projection produced in odd years. 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.

Dusky rockfish in the GOA are classified as a Tier 3 stock and are assessed using a statistical age-structured 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 include total catch biomass, fishery age and size compositions, trawl survey abundance estimates, and trawl survey age compositions.

Description of Updated Data

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 2022 (2,586 t) and new estimated catches for 2023-2025. Catch data were queried on 2023-10-10. The 2023 catch was estimated by increasing the observed catch by an expansion factor of 1.04, which accounts for the average fraction of catch taken after October 10 in the last three complete years (2020-2022). This expansion factor remained the same from last year's expansion factor of 1.04 and resulted in an estimated catch for 2023 of 3,580 t (Figure 12-1). To estimate future catches, we updated the yield ratio to 0.54, which was the average ratio of catch to ABC for the last three complete catch years. This yield ratio was multiplied by the projected ABCs from the updated projection model to generate catches of 4,124 t in 2024 and 3,752 t in 2025. The survey trends indicate a small decrease in 2023 (Figure 12-2).

Changes in the assessment methodology: There were no changes from the 2022 assessment (Williams *et al.* 2022) as this is an off-cycle year.

Summary of Results

ABC recommendation

The projected total biomass for 2024 is 103,997 t. The recommended ABC for 2024 is 7,624 t, the maximum allowable ABC under Tier 3a. This ABC is a -4% decrease compared to the 2023 ABC of 7,917 and a 1% increase from the projected 2024 ABC from the last year's assessment.

The 2024 GOA-wide OFL for dusky rockfish is 9,281 t.

The stock is not being subject to overfishing, is not currently overfished, nor is it approaching a condition of being overfished. These status reports with respect to overfishing are based on current and past catch and biomass estimates. More specifically, the official catch estimate for the most recent complete year (2022) is 2,586 t, which is less than the 2022 OFL of 8,614 t. Therefore, the stock is not being subjected to overfishing. A stock is defined as 'not overfished' for the most current year (2023) if the stock biomass is *above* the minimum stock size threshold ($B_{35\%}$) and is 'not approaching a condition of being overfished' if the projected estimated biomass (for 2025) is expected to be *above* $B_{35\%}$. The estimates of spawning biomass for 2023 and 2025 are 44,622 t and 41,200 t, which are both well above $B_{35\%}$ of 22,948 t; thus, the stock is not currently overfished, nor is it approaching a condition of being overfished.

Reference values for dusky rockfish are summarized in the following table with the recommended OFL and ABC values in bold:

	As estimated or **specified** *last* year for:		As estimated or **recommended** *this* year for:	
Quantity	2023	2024	2024[*]	2025[*]
M (natural mortality)	0.07	0.07	0.07	0.07
Tier	3a	3a	3a	3a
Projected total (age 4+) biomass (t)	107,160	104,627	103,997	100,827
Projected female spawning biomass (t)	44,651	44,651	43,197	41,200
$B_{100\%}$	65,565	65,565	65,565	65,565
$B_{40\%}$	26,226	26,226	26,226	26,226
$B_{35\%}$	22,948	22,948	22,948	22,948
F_{OFL}	0.11	0.11	0.112	0.112
$maxF_{ABC}$	0.09	0.09	0.091	0.091
F_{ABC}	0.09	0.09	0.091	0.091
OFL (t)	9,638	9,154	**9,281**	8,796
maxABC (t)	7,917	7,520	7,624	7,225
ABC (t)	7,917	7,520	**7,624**	7,225
	As determined *last* year for:		As determined *this* year for:	
Status	2022	2023	2023	2024
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 an estimated catch of 3,580 t for 2023 and estimates of 4,124 t and 3,752 t used in place of maximum permissible ABC for 2024 and 2025.

Fishery Trends

Updated catch data (t) for dusky rockfish in the Gulf of Alaska as of October 10, 2023 from NMFS AKRO CAS accessed through the Alaska Fisheries Information Network (AKFIN) database (http://www.akfin.org), are summarized in the following table:

Year	Western GOA	Central GOA	Eastern GOA		Gulf-wide Total	Gulf-wide ABC	Gulf-wide TAC
			West Yakutat	E. Yak/ Southeast			
2022	105	2,474	6	<1	2,586	5,372	5,372
2023	63	3,377	1	1	3,442	7,917	7,917

Overall, catch trends in the GOA and in each management area have been relatively stable over time. The vast majority of catch comes from the Central GOA, with very little catch contributed from the Eastern GOA areas (West Yakutat and East Yakutat/ Southeast). The catch from 2023 is higher than in 2022, but less than the GOA ABC and TAC.

Area Allocation of Harvests

The following table shows the recommended ABC apportionment for 2024 and 2025. Please refer to the *Area Allocation of Harvests* section of last year's assessment (Williams *et al.* 2022) for information regarding the apportionment rationale for GOA dusky rockfish.

		Western	Central	Eastern	Total
Area Apportionment		1.9%	96.6%	1.5%	100%
2024	ABC (t)	145	7,365	114	7,624
2024	OFL (t)				9,281
2025	ABC (t)	137	6,979	109	7,225
2025	OFL (t)				8,796

Amendment 41 prohibited trawling in the Eastern area east of 140° W longitude. The ratio of biomass still obtainable in the W. Yakutat area (between 147° W and 140° W) is 0.74. This results in the following apportionment to the W. Yakutat area:

		W. Yakutat	E. Yakutat/Southeast
2024	ABC (t)	84	30
2025	ABC (t)	81	28

Responses to SSC and Plan Team Comments on Assessments in General

"The SSC supports the JGPT's recommendation that stock assessment authors transition from the ADMB RE variants to the rema framework, which implements the same model variants in a single framework with several improvements." (SSC, Oct 2022)

The REMA model is currently used for catch apportionment to management areas. However, the current REMA model uses design-based regional survey biomass estimates as inputs. As this assessment uses VAST estimated survey biomass (i.e., model-based estimates), instead of design-based, examinations of changing to regional VAST biomass estimates as inputs to the REMA model will be explored in the next full assessment.

Responses to SSC and Plan Team Comments Specific to this Assessment

"SSC supports the author and GOA GPT recommendation to investigate proper variance attribution of VAST indices within the assessment model, and to explore model sensitivity to data weighting." (December 2022)

"The SSC continues to recommend research investigating skip spawning." (December 2022)

"The SSC recommends the authors investigate alternative apportionment methods that provide stability while also satisfying subarea-level biological concerns." (December 2022)

"Finally, the SSC requests bubble plots of Pearson residuals for all age and length data including the sign and scale of residuals to help in evaluating fit." (December 2022)

The authors intend to explore the following for next year's (2024) operational full stock assessment: 1) investigate proper variance attribution of VAST indices, 2) examine model sensitivity to data-weighting, 3) explore uncertainty in recruitment due to skip spawning, and 4) investigate alternative apportionment methods.

The 2024 operational full assessment will include bubble plots of Pearson residuals for age and length data to evaluate the fit.

References

Hollowed, A.B., K. Aydin, K. Blackhart, M. Dorn, D. Hanselman, J. Heifetz, S. Kasperski, S. Lowe, and K. Shotwell. 2016. Discussion paper stock assessment prioritization for the North Pacific Fishery Management Council: Methods and Scenarios. Report to NPFMC Groundfish Plan Teams. September 2016. https://www.npfmc.org/wp-content/PDFdocuments/meetings/AFSCHQ_Discussion_Paper.pdf.

Williams, B., Hulson, P.-J., Lunsford, C. and Ferriss, B. (2022) Assessment of the dusky 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.
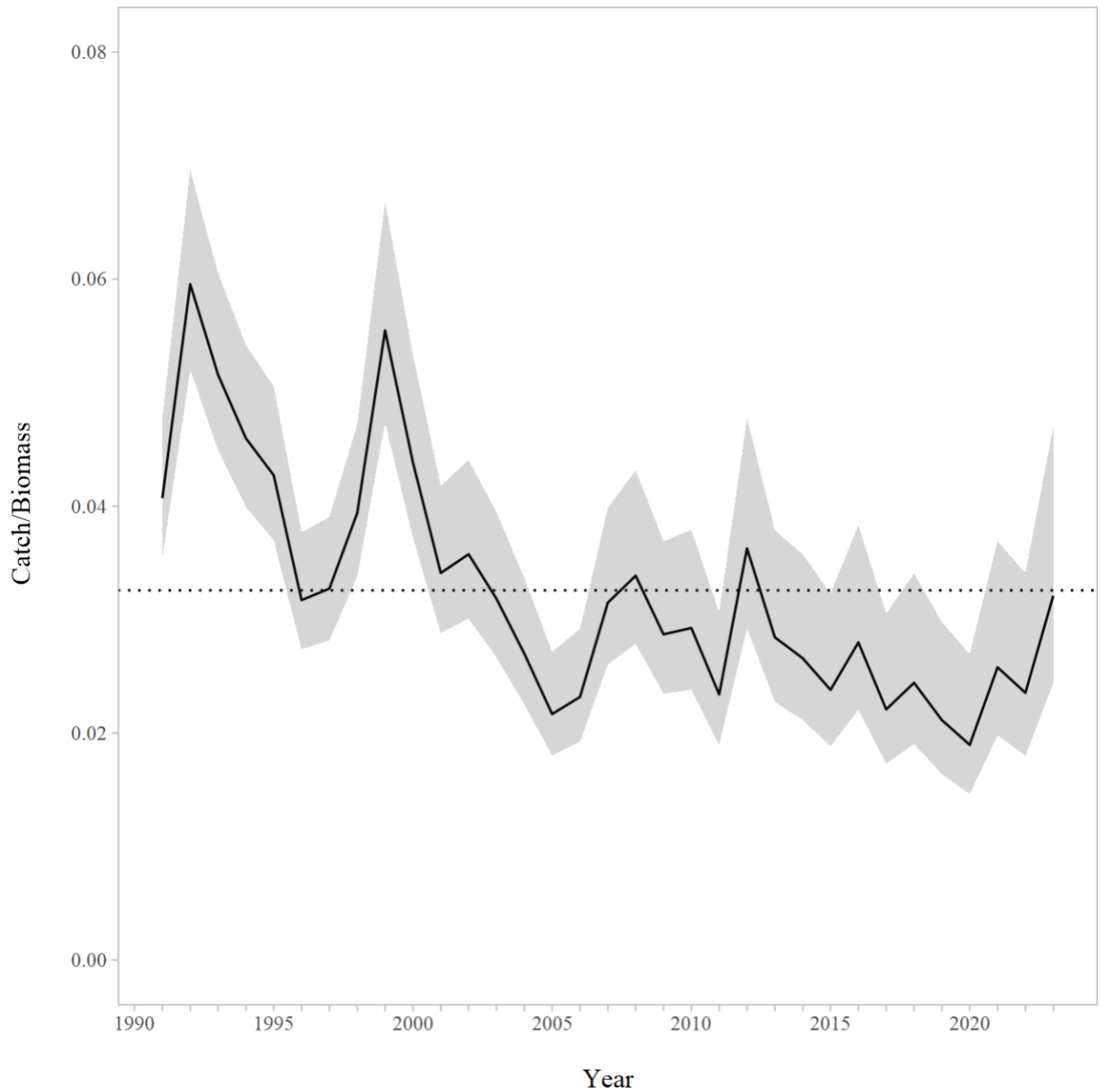
Figures

Figure 12-1. Gulf of Alaska dusky rockfish catch/age 4+ biomass ratio with approximate 95% confidence intervals. Observed catch values were used for 1991-2022, the 2023 catch values were estimated using an expansion factor. The horizontal dashed line is the mean value for the entire dataset.
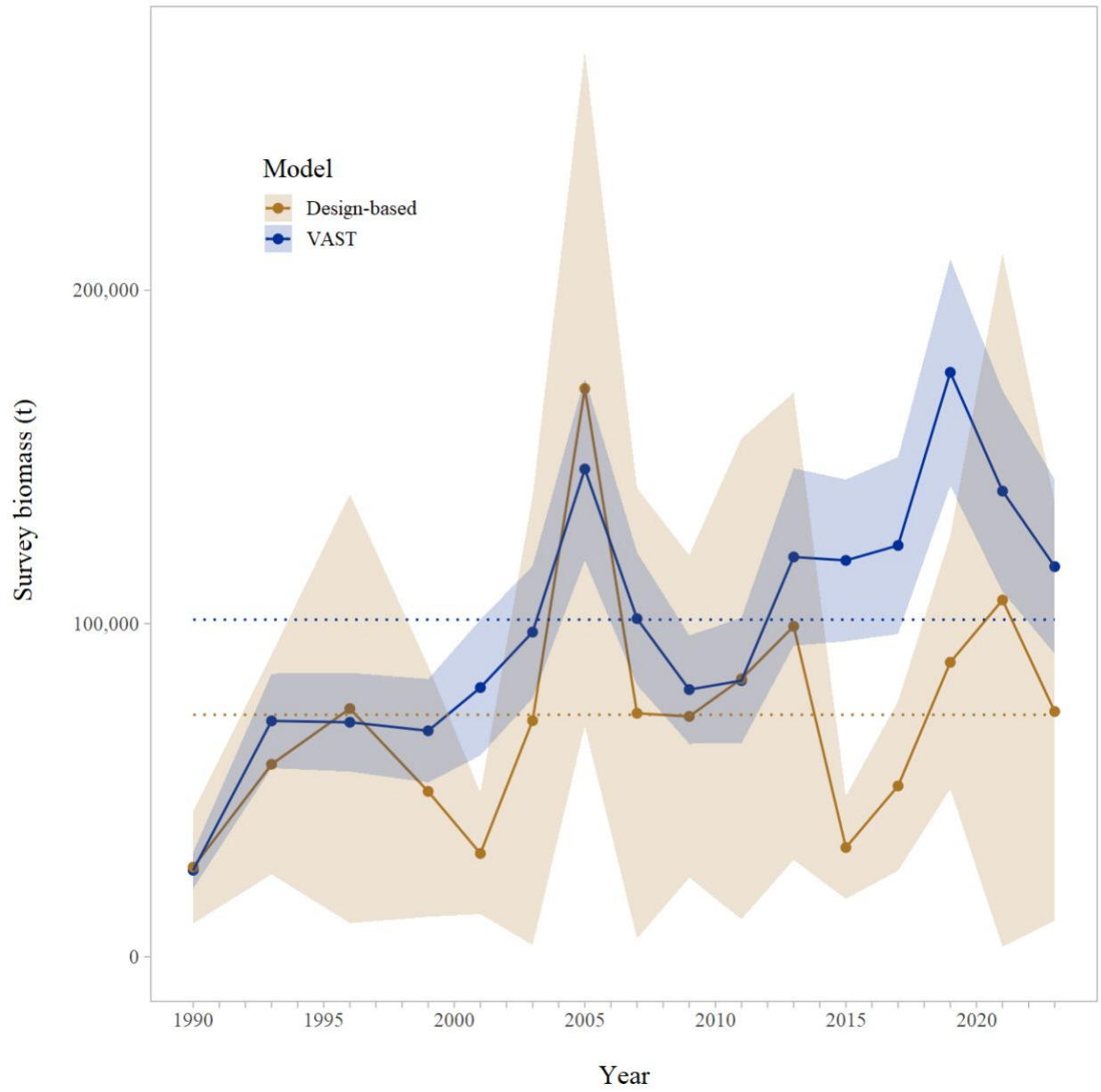
Figure 12-2. Geostatistical model (VAST with lognormal observation error) and design-based model estimates of trawl survey abundance for dusky rockfish in the Gulf of Alaska. Shaded areas are 95% confidence intervals, the dashed lines are the data means.