12. Assessment of the Dusky 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 survey data. The new schedule sets full assessments for dusky rockfish in the 'off' survey years (even years) and partial assessments for the 'on' survey years (odd years). For this year we present a partial assessment consisting of an executive summary including recent fishery catch and survey results, and recommend harvest levels for the next two years. Please refer to the 2018 full stock assessment report for further information regarding the assessment model (available online at https://archive.fisheries.noaa.gov/afsc/REFM/Docs/2018/GOA/GOAdusky.pdf). A full stock assessment document with updated assessment and projection model results will be presented in next year's SAFE report.

We use a statistical age-structured model as the primary assessment tool for GOA dusky rockfish which qualifies as a Tier 3 stock. The data sets used in the full assessment include total catch biomass, fishery age and size compositions, bottom trawl survey abundance estimates, and bottom trawl survey age compositions. The assessment model consists of a population model, which uses the 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. For a partial assessment year, we do not re-run the assessment model, but do update the projection model with new catch data. 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 since this is a partial assessment year. New data added to the projection model included final 2018 catch (2,909 t) and new estimated catches for 2019-2021. The 2019 catch was estimated by increasing the official catch as of September 28, 2019, by an expansion factor of 1.032, which represents the average additional catch taken after September 28 in the last three complete years (2016-2018). This expansion factor was smaller than last year's expansion factor of 1.038. This results in an estimated catch for 2019 of 2,263 t. To estimate future catches, we updated the yield ratio (0.69), 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 for 2020 and 2021 from the updated projection model to generate catches of 2,522 t for 2020 and 2,401 t for 2021. The new yield ratio was greater than last year's ratio of 0.60.

Changes in assessment methodology: There were no changes in assessment methodology since this was a partial assessment year.

Summary of Results

ABC recommendation

For the 2020 fishery, we recommend the maximum allowable ABC of **3,676** t from the updated projection model. This ABC is 0.6% lower than the 2019 ABC of 3,700 t and nearly identical to the ABC of 3,670 t projected for 2020 from the 2018 full assessment.

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 a stock is overfished is based on the 2018 catch compared to OFL. The official total catch for 2018 is 2,909 t which is less than the 2018 OFL of 4,841 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 2019 and 2021. The estimates of spawning biomass for 2019 and 2021 from the current year (2019) projection model are 20,362 t and 19,631 t, respectively. Both estimates are above the $B_{35\%}$ estimate of 16,218 t and, therefore, the stock is not currently overfished nor approaching an overfished condition.

Quantity	As estimated or *specified last* year for:		As estimated or *recommended this* year for:	
	2019	2020	2020*	2021*
M (natural mortality rate)	0.07	0.07	0.07	0.07
Tier	3a	3a	3a	3a
Projected total (ages 4+) biomass (t)	55,247	54,551	54,626	53,971
Projected female spawning biomass (t)	20,342	20,106	20,116	19,631
$B_{100\%}$	46,337	46,337	46,337	46,337
$B_{40\%}$	18,535	18,535	18,535	18,535
$B_{35\%}$	16,218	16,218	16,218	16,218
F_{OFL}	0.118	0.118	0.118	0.118
$maxF_{ABC}$	0.095	0.095	0.095	0.095
F_{ABC}	0.095	0.095	0.095	0.095
OFL (t)	4,521	4,484	**4,492**	4,396
maxABC (t)	3,700	3,670	**3,676**	3,598
ABC (t)	3,700	3,670	**3,676**	3,598
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 2,522 t and 2,401 t used in place of maximum permissible ABC for 2020 and 2021.

Fishery trends

Updated catch data (t) for dusky rockfish in the GOA as of September 28, 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	West Yakutat	E. Yakutat/ Southeast	Gulfwide Total	Gulfwide ABC	Gulfwide TAC
2018	50	2,840	12	7	2,909	3,957	3,957
2019	197	1,899	93	3	2,192	3,700	3,700

The dusky rockfish catch/biomass ratio has ranged from 0.03-0.07 since 1991 (Figure 12-1). The 2019 projected catch/biomass ratio (exploitation rate) is 20% less than the 2018 value. For the catch/biomass ratio, catch data for 2019 are projected from September 28, 2019 to the end of the year using the 1.032 expansion factor. Biomass from 1991-2018 are estimates of total biomass from the 2018 full stock assessment (age 4+) and estimates for 2019 are from the current 2019 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 dusky rockfish assessment model in 2015 to estimate survey biomass and was updated using 2019 survey data (Figure 12-2). The geostatistical model estimates a 42% increase in biomass from 2017 to 2019 and is above the long-term mean.

Area Allocation of Harvests

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

	Western	Central	Eastern	Total
Area Apportionment	21.1%	74.7%	4.2%	100%
2020 Area ABC (t)	**776**	**2,746**	**154**	**3,676**
2021 Area ABC (t)	**759**	**2,688**	**151**	**3,598**

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 0.75. This results in the following apportionment to the W. Yakutat area:

	W. Yakutat	E. Yakutat/Southeast
2020 Area ABC (t)	**115**	**39**
2021 Area ABC (t)	**113**	**38**

Summaries for Plan Team

Species	Year	Biomass[1]	OFL	ABC	TAC	Catch[2]
Dusky Rockfish	2018	56,103	4,841	3,957	3,957	2,909
	2019	55,247	4,521	3,700	3,700	2,192
	2020	54,626	4,492	3,676		
	2021	53,971	4,396	3,598		

Stock/ Assemblage	Area	2019 OFL	2019 ABC	2019 TAC	2019 Catch[2]	2020 OFL	2020 ABC	2021 OFL	2021 ABC
Dusky Rockfish	W		781	781	197		776		759
	C		2,764	2,764	1,899		2,746		2,688
	WY		95	95	93		115		113
	EY/SE		60	60	3		39		38
	Total	4,521	3,700	3,700	2,192	4,492	3,676	4,396	3,598

[1]Total biomass (ages 4+) from the age-structured model

[2]Current as of September 28, 2019. Source: NMFS Alaska Regional Office Catch Accounting System via the AKFIN database (http://www.akfin.org).

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)

In response to these three comments, we intend to provide a risk table as recommended by the SSC with the next full assessment (2020).

Responses to SSC and Plan Team Comments Specific to this Assessment

"The SSC strongly encourages further development of these approaches, which could be extended to include covariates such as depth or other habitat features to increase precision. Care should be taken to estimate biomass over the same area when comparing results between the design-based and geostatistical approach. The SSC also suggested that, when considering anisotropy in the model, that the most appropriate approach for the Gulf of Alaska may be to allow for differences in spatial correlation scales in the along-shelf and cross-shelf directions, respectively, rather than by latitude and longitude. It was suggested that modeling survey data could be a topic for the workshop in February 2018 to discuss options for moving from design-based estimators to geostatistical estimators across stocks.)." (SSC, October 2017)

A working group is currently investigating the criteria for use of the geostatistical generalized linear mixed model within assessments performed by the AFSC. Since the dusky model is one of several assessments using these methods, the recommendations from the working group will be important for us to consider in the next full assessment.

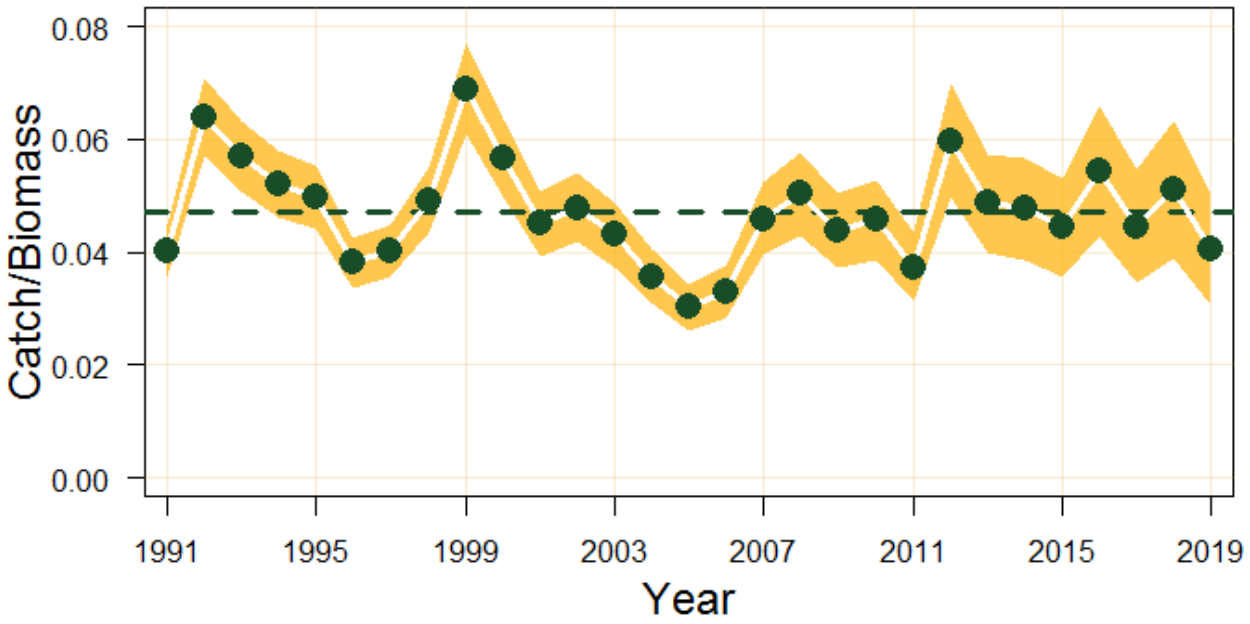

Figure 12-1. GOA Dusky rockfish catch/biomass ratio with approximate 95% confidence intervals. Biomass for 1991-2019 is age 4+ biomass as estimated and projected by the 2018 age structured assessment model. Catch is observed catch values for 1991-2018, and 2019 are catches estimated using the expansion factor.

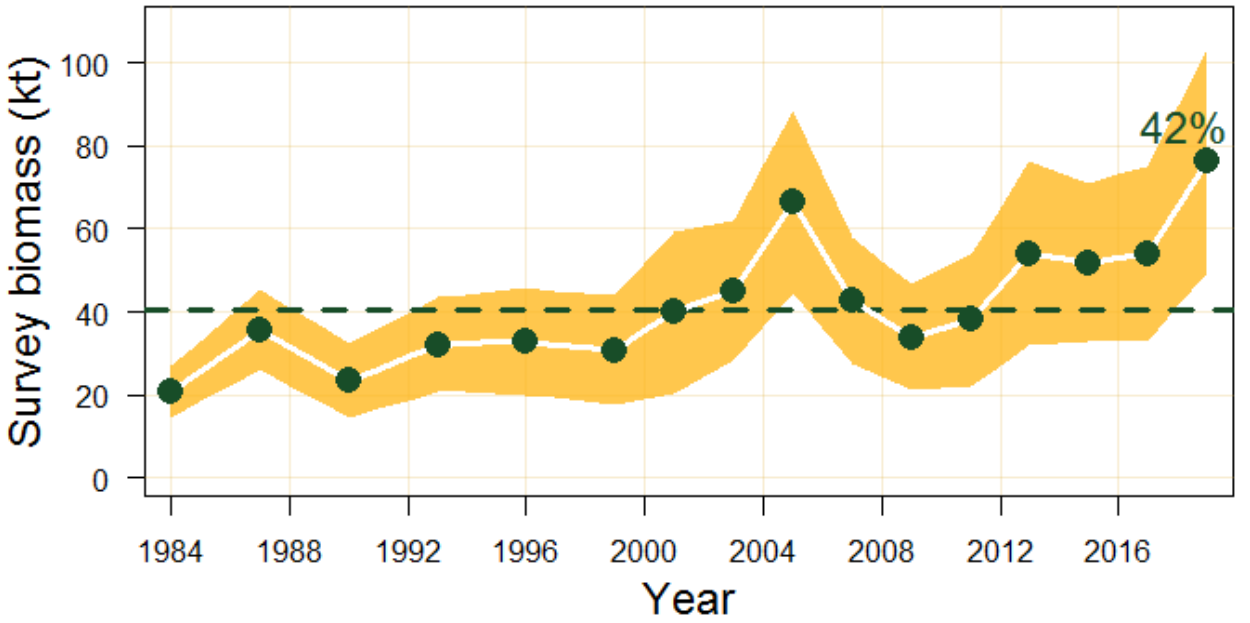

Figure 12-2. Model-based biomass index for GOA dusky rockfish from the NMFS bottom trawl survey, point estimates (in dark green circles) with 95% sampling error confidence intervals (shaded area), from 1984-2019. Dashed line is long-term average for the time series. Text percentage is the change of the 2019 index from the 2017 index.