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

Kari H. Fenske, Chris R. Lunsford, Peter-John F. Hulson, Dana H. Hanselman, and S. Kalei Shotwell

November 2017

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 2015 full stock assessment report for further information regarding the assessment model (Lunsford et al., 2015, available online at http://www.afsc.noaa.gov/REFM/docs/2015/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 updated 2016 catch (3,328 t) and new estimated catches for 2017-2019. The 2017 catch was estimated by increasing the official catch as of September 30, 2017, by an expansion factor of 3.8%, which represents the average additional catch taken after September 30 in the last three complete years (2014-2016). This expansion factor was lower than last year's expansion factor of 5.1%. This results in an estimated catch for 2017 of 2,542 t. To estimate future catches, we updated the yield ratio (0.60), which was the average of the ratio of catch to ABC for the last three complete catch years (2014-2016). This yield ratio was multiplied by the projected ABCs for 2018 and 2019 from the updated projection model to generate catches of 2,391 t for 2018 and 2,088 t for 2019. The yield ratio was nearly identical to last year's ratio of 0.59.

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

Summary of Results

The dusky rockfish catch/biomass ratio has ranged from 0.02-0.06 since 1991 (Figure 12-1). The 2017 projected catch/biomass ratio (exploitation rate) is 20% less than for 2016 but similar to 2013-2015. For the catch/biomass ratio, catch data for 2017 are projected from September 30, 2017 using the 3.8% expansion factor. Biomass data for 1991-2015 are the 2015 full stock assessment estimates of age 4+ total biomass; age 4+ total biomass estimates for 2016-2017 are based upon the 2017 projection model output,

which incorporates complete catch data for 2015 and 2016, and the expanded estimate of 2017 catches. The approximate 95% confidence interval values are calculated assuming a normal distribution of biomass estimated in the 2015 full stock assessment for 1991-2015; standard error values for 2016-2017 are from the 2015 full assessment projections.

ABC recommendation

For the 2018 fishery, we recommend the maximum allowable ABC of **3,957** t from the updated projection model. This ABC is 8% lower than the 2017 ABC of 4,278 t and nearly identical to the ABC of 3,954 t projected for 2018 in the 2016 projections.

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 2016 catch compared to OFL. The official total catch for 2016 is 3,328 t which is less than the 2016 OFL of 5,733 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 2017 and 2019. The estimates of spawning biomass for 2017 and 2019 from the current year (2017) projection model are 23,201 t and 20,151 t, respectively. Both estimates are above the $B_{35\%}$ estimate of 17,244 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:	
	2017	2018	2018*	2019*
M (natural mortality rate)	0.07	0.07	0.07	0.07
Tier	3a	3a	3a	3a
Projected total (ages 4+) biomass (t)	57,307	56,068	56,103	55,704
Projected female spawning biomass (t)	23,178	21,554	21,559	20,151
$B_{100\%}$	49,268	49,268	49,268	49,268
$B_{40\%}$	19,707	19,707	19,707	19,707
$B_{35\%}$	17,244	17,244	17,244	17,244
F_{OFL}	0.121	0.121	0.121	0.121
$maxF_{ABC}$	0.098	0.098	0.098	0.098
F_{ABC}	0.098	0.098	0.098	0.098
OFL (t)	5,233	4,837	**4,841**	4,488
maxABC (t)	4,278	3,954	**3,957**	3,668
ABC (t)	4,278	3,954	**3,957**	3,668
Status	As determined *last* year for:		As determined *this* year for:	
	2015	2016	2016	2017
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 2,391 t and 2,088 t used in place of maximum permissible ABC for 2018 and 2019.

Fishery trends

Updated catch data (t) for dusky rockfish in the GOA as of September 30, 2017 (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	West Yakutat	E. Yakutat/ Southeast	Gulfwide Total	Gulfwide ABC	Gulfwide TAC
2016	96	3,217		7	8	3,328	4,686	4,686
2017	111	2,312		22	5	2,450	4,278	4,278

Survey trends
Biomass estimates are available from the 2017 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 model in 2015, and the abundance index was updated using 2017 survey data. Figure 12-2 shows the geostatistical model compared to the design-based biomass estimator. The geostatistical estimator estimates a 3% increase in abundance since 2015 and is above the long-term mean. The design-based estimator estimates a 56% increase since 2015, yet is below the long term mean, and continues the trend of large inter-annual variability.

Area Allocation of Harvests

The following table shows the recommended ABC apportionment for 2018 and 2019. The apportionment percentages are the same as in the last full assessment. Please refer to the 2015 full stock assessment report for information regarding the apportionment rationale for GOA dusky rockfish.

	Western	Central	Eastern	Total
Area Apportionment	3.69%	88.50%	7.81%	100%
2018 Area ABC (t)	**146**	**3502**	**309**	**3,957**
2019 Area ABC (t)	**135**	**3,246**	**287**	**3,668**

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
2018 Area ABC (t)	**232**	**77**
2019 Area ABC (t)	**215**	**72**

Recommended area apportionments of ABC are 146 t for the Western area, 3,502 t for the Central area, 232 t for the West Yakutat area, and 77 t for the East Yakutat/Southeast Outside area. The 2018 Gulf-wide OFL for dusky rockfish is **4,841 t.**

Summaries for Plan Team

Species	Year	Biomass[1]	OFL	ABC	TAC	Catch[2]
Dusky Rockfish	2016	60,072	5,733	4,686	4,686	3,328
	2017	57,307	5,233	4,278	4,278	2,450
	2018	56,103	4,841	3,957		
	2019	55,704	4,488	3,668		

Stock/ Assemblage	Area	2017				2018		2019	
		OFL	ABC	TAC	Catch[2]	OFL	ABC	OFL	ABC
Dusky Rockfish	W		158	158	111		146		135
	C		3,786	3,786	2,312		3,502		3,246
	WYAK		251	251	22		232		215
	EYAK/SEO		83	83	5		77		72
	E		--	--	--				
	Total	5,233	4,278	4,278	2,450	4,841	3,957	4,488	3,668

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

[2]Current as of September 30, 2017. 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

"In an effort improve record keeping as assessment authors formulate various stock status evaluation models, the Plan Team has recommended a systematic cataloging convention. Any new model that diverges substantial from the currently accepted model will be marked with the two-digit year and a "0" version designation (e.g., 16.0 for a model from 2016). Variants that incorporate major changes are then distinguished by incremental increases in the version integer (e.g., 16.1 then 16.2), and minor changes are identified by the addition of a letter designation (e.g., 16.1a). The SSC recommends this method of model naming and notes that it should reduce confusion and simplify issues associated with tracking model development over time." (SSC December 2016)

The dusky rockfish assessment will begin using this convention in 2018 with the recommended model from 2015 (Model 15.5).

"…The SSC also recommends explicit consideration and documentation of ecosystem and stock assessment status for each stock, perhaps following the framework suggested below, during the December Council meeting to aid in identifying areas of concern." (SSC October 2017)

A newly proposed framework for considering ecosystem and socioeconomic factors has been submitted as an appendix in some assessments this year. This is an attempt to document these factors with respect to stock status and also provide indicators for continued monitoring to identify areas of concern. These reports are currently submitted as an appendix and in future years it is anticipated that they would be available for all stocks as the framework is adaptable for data-limited to data-rich stocks. We plan to evaluate and potentially incorporate this new ecosystem/socioeconomic report as an appendix when it becomes available for the dusky rockfish stock.

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 the only current assessment using these methods, the recommendations from the working group will be important for us to consider in the next full assessment.

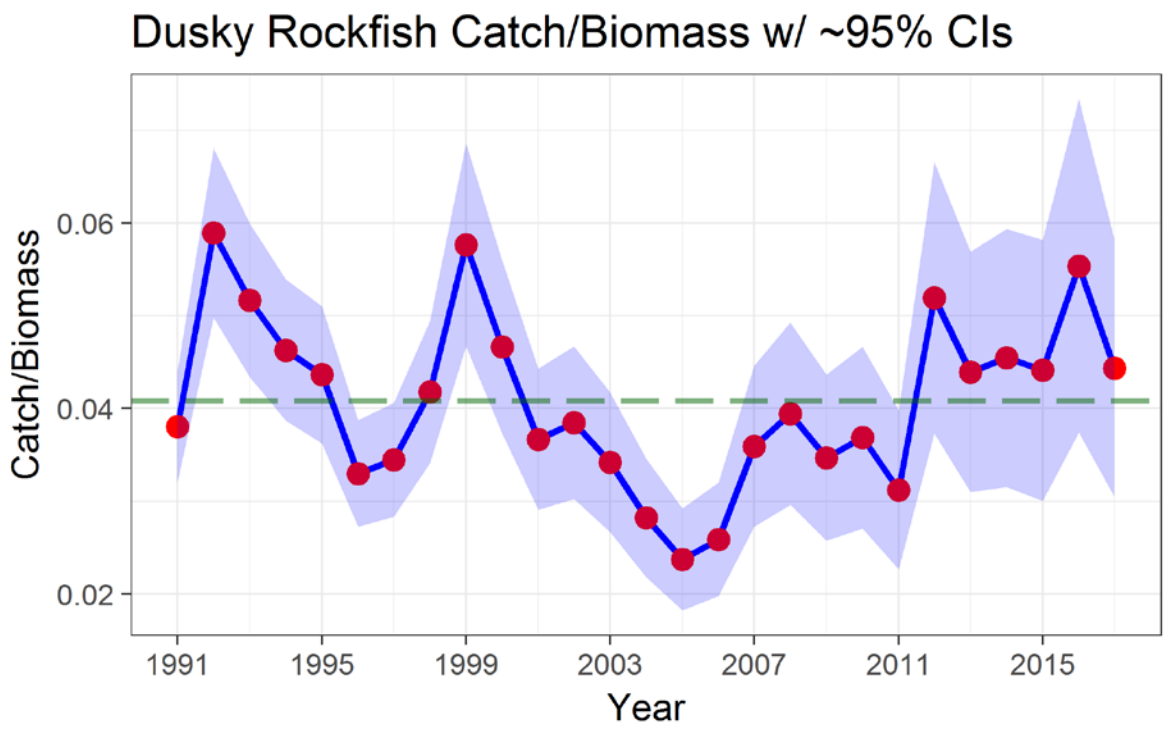

Figure 12-1. GOA Dusky rockfish catch/biomass ratio with approximate 95% confidence intervals. Biomass is age 4+ biomass from the age structured assessment model.

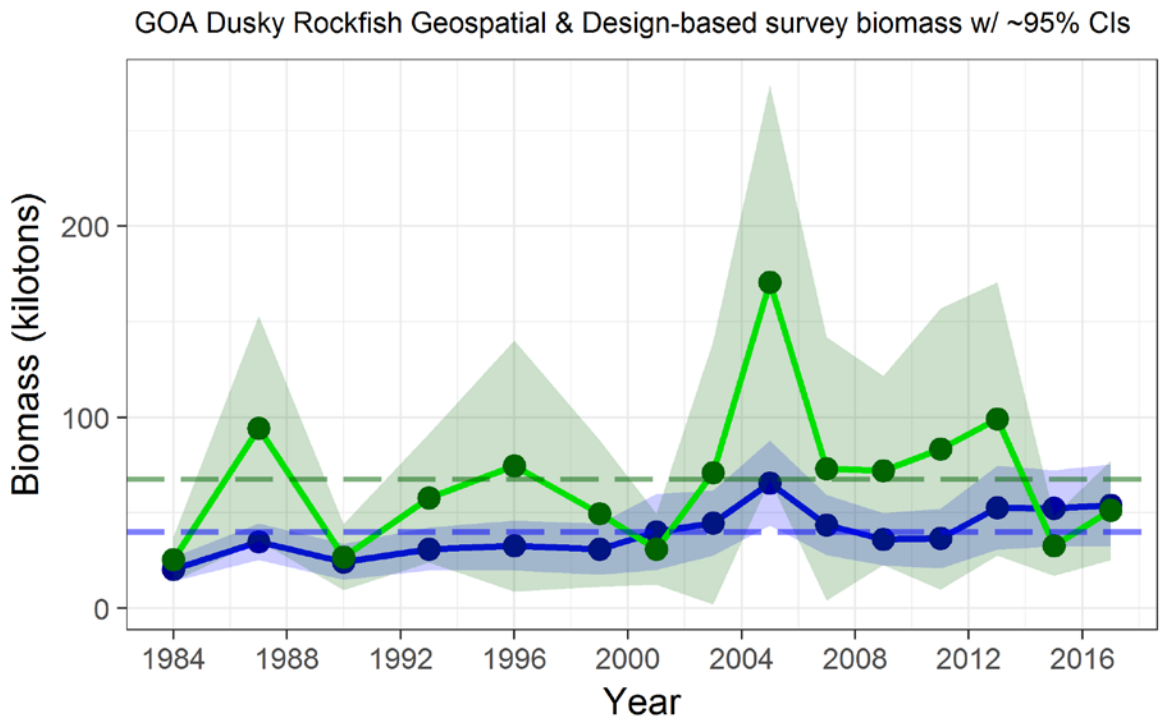

Figure 12-2. Comparison of dusky rockfish abundance estimates from Gulf of Alaska trawl survey using the geostatistical abundance estimator (blue) and the design based estimator (green), with approximate 95% confidence intervals.