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

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Executive Summary

Rockfish are assessed on a biennial stock assessment schedule to coincide with the availability of new survey data. For Gulf of Alaska rockfish in alternate (even) years we present an executive summary to recommend harvest levels for the next two years. Please refer to last year's 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 Gulf of Alaska dusky rockfish which qualifies as a Tier 3 stock. For an off-cycle year, 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 since this was an off-cycle year. New data added to the projection model included an updated 2015 catch (2,781 t) and new estimated catches for 2016-2018. The 2016 catch was estimated by increasing the official catch as of October 8, 2016, by an expansion factor of 5.1%, which represents the average additional catch taken after October 8 in the last three complete years (2013-2015). This resulted in an estimated catch for 2016 of 3,379 t. To estimate future catches, we updated the yield ratio (0.59), which was the average of the ratio of catch to ABC for the last three complete catch years (2013-2015). This yield ratio was multiplied by the projected ABCs for 2017 and 2018 from the updated projection model to generate catches of 2,530 t for 2017 and 2,249 t for 2018. The yield ratio was lower than last year's ratio of 0.67 whereas the expansion factor was higher than last year's expansion factor of 3.8%.

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

Summary of Results

For the 2017 fishery, we recommend the maximum allowable ABC of **4,278** t from the updated projection model. This ABC is 9% lower than the 2016 ABC of 4,686 t and nearly identical to the ABC of 4,284 t projected for 2017 in the 2015 assessment. Recommended area apportionments of ABC are 158 t for the Western area, 3,786 t for the Central area, 251 t for the West Yakutat area, and 83 t for the Southeast/Outside area. The 2017 Gulf-wide OFL for dusky rockfish is **5,233 t**.

Reference values for dusky rockfish are summarized in the following table, with the recommended ABC and OFL values in bold. The stock was not being subjected to overfishing last year, is not currently overfished, nor is it approaching a condition of being overfished.

Quantity	As estimated or *specified last* year for:		As estimated or *recommended this* year for:	
	2016	2017	2017*	2018*
M (natural mortality rate)	0.07	0.07	0.07	0.07
Tier	3a	3a	3a	3a
Projected total (ages 4+) biomass (t)	60,072	57,492	57,307	56,068
Projected female spawning biomass (t)	25,238	23,245	23,178	21,554
$B_{100\%}$	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)	5,733	5,253	**5,233**	4,837
maxABC (t)	4,686	4,284	**4,278**	3,954
ABC (t)	4,686	4,284	**4,278**	3,954
Status	As determined *last* year for:		As determined *this* year for:	
	2014	2015	2015	2016
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 2,530 t and 2,249 t used in place of maximum permissible ABC for 2017 and 2018.

Updated catch data (t) for dusky rockfish in the Gulf of Alaska as of October 8, 2016 (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
2015	184	2,588		2	7	2,781	5,109	5,109
2016	88	3,113		6	8	3,215	4,686	4,686

Area Apportionment

The following table shows the recommended apportionment for 2017. The apportionment percentages are the same as in the last full assessment. Please refer to last year's full stock assessment report for information regarding the apportionment rationale for dusky rockfish.

	Western	Central	Eastern	Total
Area Apportionment	3.69%	88.50%	7.81%	100%
2017 Area ABC (t)	**158**	**3,786**	**334**	**4,278**
2018 Area ABC (t)	**146**	**3,499**	**309**	**3,954**

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
2017 Area ABC (t)	**251**	**83**
2018 Area ABC (t)	**232**	**77**

Summaries for Plan Team

Species	Year	Biomass[1]	OFL	ABC	TAC	Catch[2]
Dusky Rockfish	2015	66,629	6,246	5,109	5,109	2,781
	2016	60,072	5,733	4,686	4,686	3,215
	2017	57,307	5,233	4,278		
	2018	56,068	4,837	3,954		

Stock/ Assemblage	Area	2016				2017		2018	
		OFL	ABC	TAC	Catch[2]	OFL	ABC	OFL	ABC
Dusky Rockfish	W		173	173	88		158		146
	C		4,147	4,147	3,113		3,786		3,499
	WYAK		275	275	6		251		232
	EYAK/SEO		91	91	8		83		77
	E		--	--	--				
	Total	5,733	4,686	4,686	3,215	5,233	4,278	4,837	3,954

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

[2]Current as of October 8, 2016. 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 Team recommends that a workgroup or subset of authors investigate applying the geostatistical approach to selected stocks. (Plan Team, November 2015)

The SSC supports the GOA PT recommendation to form a study group to explore the criteria necessary for adopting the geostatistical generalized linear mixed model approach in assessments. If this study group is formed, the SSC requests that the group be expanded to include BSAI assessment authors and members from the AFSC survey program. Among the many questions this group could address, the SSC suggests including the following questions:

1. Is the stratified random survey design used for the surveys correctly configured for application of the geostatistical approach?

2. Should the geostatistical approach be applied to all species or a select suite of species that exhibit aggregated spatial distributions and rockfish-like life histories? If application of this approach is recommended for only a subset of managed species, what life history characteristics or biological criteria would qualify a species for this approach?

3. What level of aggregation is necessary for application of the geostatistical approach?

4. If the geostatistical approach is adopted should results also be used for area apportionments?

(SSC, December 2015)

We have grouped these two comments together as they deal with the same topic. A working group is currently being formed and will investigate the criteria for use of the geostatistical generalized linear mixed model within assessments performed by the AFSC.

The Team recommends an evaluation on how best to tailor the RE model to accommodate multiple indices. (Plan Team, November 2015)

There is only a single fishery-independent index for dusky rockfish (AFSC bottom trawl survey), thus, for fishery-independent data sources this recommendation does not apply. However, one could investigate the use of a fishery-dependent index (e.g., CPUE). When recommendations are provided on how best to tailor the RE model to multiple indices they will be implemented into apportionment for this assessment.

Many assessments are currently exploring ways to improve model performance by re-weighting historic survey data. The SSC encourages the authors and PTs to refer to the forthcoming CAPAM data-weighting workshop report. (SSC, December 2015)

The SSC recommends that the Gulf of Alaska Groundfish Plan Team (GOA GPT), BSAI GPT, and CPT encourage the continued use of multiple approaches to data weighting (not just the Francis (2011) method, but also including the harmonic mean and others). (SSC, October 2016)

We have grouped these two comments together as they deal with the same topic. We agree with the SSC's recommendation and, as discussed below in the comments specific to this assessment, weighting investigations will be conducted prior to next year's full assessment taking into consideration the results of the CAPAM data-weighting workshop report.

Finally, an area apportionment approach using the RE model which specifies a common "process error" has been developed and should be considered. (Plan Team, November 2015)

A common "process error" approach will be considered in the apportionment for the next full assessment. Further investigations into apportionment that are specific to this assessment are discussed below.

The SSC requests that stock assessment authors bookmark their assessment documents and commends those that have already adopted this practice. (SSC, October 2016)

We have adopted the guideline SAFE document format for headings in both the full assessment and executive summaries for dusky rockfish. This should allow for development of a consistent table of contents across SAFE chapters in the future.

Responses to SSC and Plan Team Comments Specific to this Assessment

The Team recommends exploring adding an extra variance parameter for the survey index. (Plan Team, November 2015).

Without further analysis, the Team cautioned using priors on catchability parameter 'q' with geostatistical estimation. The central tendency of the probability distribution used in the geostatistical model may have a different interpretation. Similarly, weighting of composition data and the data themselves, should be evaluated, especially given alternative spatial abundances estimated using the geostatistical approach. (Plan Team, November 2015).

However, the SSC agreed with the PT recommendation to explore using the geostatistical model-based area-specific biomass estimates for area apportionments in future assessments. (SSC, December 2015).

We have grouped these two comments together as they deal with the same topic. A working group is currently being formed and will investigate 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.

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