13. Assessment of the Rougheye and Blackspotted rockfish stock complex 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 trawl survey data. For Gulf of Alaska rockfish in off-cycle (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 stock assessment model (Shotwell et al., 2015, available online at http://www.afsc.noaa.gov/REFM/Docs/2015/GOArougheye.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 the Gulf of Alaska (GOA) rougheye and blackspotted (RE/BS) rockfish complex which qualifies as a Tier 3 stock. 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 sets used in this assessment include total catch biomass, fishery age and size compositions, trawl and longline survey abundance estimates, trawl survey age compositions, and longline survey size compositions. 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 estimate (550 t) and new catch estimates for 2016-2018. The 2016 catch was estimated by increasing the official catch as of October 8, 2016, by an expansion factor of 2.3%, which represents the average fraction of catch taken after October 8 in the last three complete years (2013-2015). This expansion factor decreased from last year's expansion factor of 3.2% and resulted in an estimated catch for 2016 of 628 t. To estimate future catches, we updated the yield ratio to 0.52, 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 from the updated projection model to generate catches of 685 t in 2017 and 668 t in 2018. The yield ratio was slightly lower than last year's ratio of 0.53.

Changes in the 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 1,327 t from the updated projection model. This ABC is very similar to last year's ABC of 1,328 t and slightly more than last year's projected 2017 ABC of 1,325 t. Reference values for GOA RE/BS rockfish are summarized in the following table, with the recommended ABC and OFL values for 2017 in bold.

Quantity	As estimated or *specified last* year for:		As estimated or *recommended this* year for:*	
	2016	2017	2017	2018
M (natural mortality rate)	0.036	0.036	0.036	0.036
Tier	3a	3a	3a	3a
Projected total (ages 3+) biomass (t)	41,864	41,597	41,650	41,403
Projected female spawning biomass (t)	13,804	13,733	13,754	13,685
$B_{100\%}$	20,566	20,566	20,566	20,566
$B_{40\%}$	8,226	8,226	8,226	8,226
$B_{35\%}$	7,198	7,198	7,198	7,198
F_{OFL}	0.048	0.048	0.048	0.048
$maxF_{ABC}$	0.040	0.040	0.040	0.040
F_{ABC}	0.040	0.040	0.040	0.040
OFL (t)	**1,596**	1,592	**1,594**	1,583
maxABC (t)	1,328	1,325	1,327	1,318
ABC (t)	**1,328**	1,325	**1,327**	1,318
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 an updated catch of 550 t for 2015, an estimated catch of 628 t for 2016, and estimates of 685 t and 668 t used in place of maximum permissible ABC for 2017 and 2018. These calculations are in response to management requests to obtain more accurate projections.

The stock is not being subject to overfishing, is not currently overfished, nor is it approaching a condition of being overfished. The tests for evaluating these three statements on status determination require examining the official total catch from the most recent complete year and the current model projections of spawning biomass relative to $B_{35\%}$ for 2016 and 2018. The official total catch for 2015 is 550 t which is less than the 2015 OFL of 1,345 t; therefore, the stock is not being subjected to overfishing. The estimates of spawning biomass for 2016 and 2018 from the current year (2016) projection model are 13,808 t and 13,685 t, respectively. Both estimates are well above the estimate of $B_{35\%}$ at 7,198 t and, therefore, the stock is not currently overfished nor approaching an overfished condition.

Fishery Trends

Updated catch data (t) for RE/BS 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	Gulfwide Total	Gulfwide ABC	Gulfwide TAC
2015	45	348	157	550	1,122	1,122
2016	39	462	112	613	1,328	1,328

Gulfwide catch of rougheye and blackspotted rockfish remains relatively stable in all areas, with some decrease in the longline fisheries and increase in the trawl fisheries in 2016. The majority of the RE/BS rockfish catch remains in the rockfish and sablefish fisheries.

Survey Trends

The 2016 longline survey abundance estimate (relative population number or RPN) decreased about 22% from the 2015 estimate and is slightly below the long-term mean (Figure 1). Estimates by area were all consistently down with the largest decrease in the East Yakutat/Southeast Outside region. This information was not used for updating the 2016 projection model for RE/BS rockfish as this was an off-cycle year.

Area Allocation of Harvests

The apportionment percentages are the same as in the 2015 full assessment. The following table shows the recommended apportionment for 2017 and 2018. Please refer to the last full stock assessment for information regarding the apportionment rationale for RE/BS rockfish.

Method	Area Allocation		Western GOA	Central GOA	Eastern GOA	Total
Three Survey Weighted Average			7.9%	53.2%	38.9%	100%
	2017	Area ABC (t)	**105**	**706**	**516**	**1,327**
		OFL (t)				**1,594**
	2018	Area ABC (t)	**104**	**702**	**512**	**1,318**
		OFL (t)				**1,583**

Since 2005, the total allowable catches (TACs) for RE/BS rockfish have not been fully taken, and are generally between 20-60% of annual quotas. Specifically in the Western GOA, where recent overages have occurred for several other species of rockfish, catches for RE/BS rockfish have remained between 20-40% of potential Western GOA apportionment since 2011.

Summaries for Plan Team

Species	Year	Biomass[1]	OFL	ABC	TAC	Catch[2]
RE/BS complex	2015	36,584	1,345	1,122	1,122	550
	2016	41,864	1,596	1,328	1,328	613
	2017	41,650	1,594	1,327		
	2018	41,403	1,583	1,318		

Stock/ Assemblage	Area	2016 OFL	2016 ABC	2016 TAC	2016 Catch[2]	2017 OFL	2017 ABC	2018 OFL	2018 ABC
RE/BS complex	W		105	105	45		105		104
	C		707	707	348		706		702
	E		516	516	157		516		512
	Total	1,596	1,328	1,328	550	1,594	1,327	1,583	1,318

[1]Total biomass (ages 3+) 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

In this section, we list new or outstanding comments on assessments in general from the last full assessment in 2015. Since this is an off-cycle year we only respond to priority comments in the executive summary. We will respond to remaining and future comments in the next full assessment.

"Secondly, a few assessments incorporate multiple indices that could also be used for apportionment. The Team recommends an evaluation on how best to tailor the RE model to accommodate multiple indices." (Plan Team, November 2015)

"Finally, an area apportionment approach using the RE model which specifies a common "process error" has been developed and should be considered. This may help in some situations where observation errors are particularly high and/or vary between regions" (Plan Team, November 2015)

In last year's assessment, we included both the weighted survey average and the random effects model approach for estimating apportionment for RE/BS rockfish. Please see the *Area Allocation of Harvests* subsection in **Harvest Recommendations** section of the 2015 assessment for further details regarding these apportionment methods. We recommended continuing with the status quo (three survey weighted average) apportionment for RE/BS rockfish until a multiple survey option was available for the random effects model. The assessment model utilizes both trawl and longline survey data to adequately sample the RE/BS population; therefore, using both surveys indices for apportionment should provide for a better reflection of the RE/BS spatial population abundance over either the status quo three year survey average or the one survey index random effects model. We continue to recommend the status quo rather than switching the apportionment scheme until the multiple survey option is developed. We will also consider the common "process error" approach in the next full assessment as sampling error does differ by region and survey for RE/BS rockfish.

"*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)

A working group is currently being formed to investigate the criteria for use of the geostatistical generalized linear mixed model, developed by Thorson et al. 2015, within assessments performed by the AFSC. This method uses available catch data more efficiently than conventional design-based estimators resulting in reducing the interannual variability in the biomass estimates. Some authors of the RE/BS rockfish assessment will be participating in this working group, and we will consider use of this new method in future assessments for RE/BS rockfish. However, some of the current issues with the design-based trawl survey estimates are alleviated in the RE/BS assessment because we include the longline survey estimates that sample where the trawl survey cannot.

"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)
"*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 RE/BS 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

In this section, we list new or outstanding comments specific to RE/BS rockfish from the last full assessment in 2015. Since this is an off-cycle year we only respond to priority comments in the executive summary. We will respond to remaining and future comments in the next full assessment.

"The Team recommends exploring apportionment methods (such as the random effects model) for the next full assessment." (Plan Team, November 2015)

Please refer to the response in the previous section regarding application of the random effects model to the RE/BS rockfish stock complex.

"The retrospective pattern for M4a is poor (Mohn's ρ = -0.371) and the SSC requests that the author explores the reason for this result." (SSC, December 2015)
"As in previous years, the SSC encourages the author to explore methods to improve species identification in the fishery. The observed differences in spatial distributions and growth suggest that these rougheye and blackspotted rockfish should be assessed separately once the information is sufficient to make this change. With this in mind, the SSC requests that the author evaluate the available information to separately assess the two stocks and where there are data gaps." (SSC, December 2015)

Please refer to the "Current Research" subsection in the "Evidence of Stock Structure" section of the Introduction in last year's SAFE report for an update on the available data for evaluating misidentification rates and differing life history characteristics for the two species. Additionally, a comparison of the misidentification rates for the 2009, 2013, and 2015 trawl surveys was recently completed (Figure 2). Overall misidentification rates were 23%, 13%, and 18% for the three years, respectively. There appears to be continued improvement for correctly identifying blackspotted rockfish in the field (from 31% to 9%), while the opposite seems to be occurring for rougheye rockfish with increased misidentification rates over the three surveys (6% to 25%).

We will continue to monitor the progress of evaluating the data from these special projects and may extend this sampling protocol to commercial fisheries as a one year special project requested of the Observer Program. Additionally, a promising approach using otolith morphology combined with genetics may enable the species composition in historical samples to be assessed. Such information will help determine the utility and cost-effectiveness of a split-species complex model or separate species models for examining if one species may be at greater risk to overfishing. At present, the area-specific harvest rates for RE/BS rockfish have been on average low and catches have consisted of approximately half the ABC in recent years. We consider current management specifications for this non-targeted complex to be sufficiently precautionary under current fishing practices and will continue to model rougheye and blackspotted rockfish as if they are a single species.

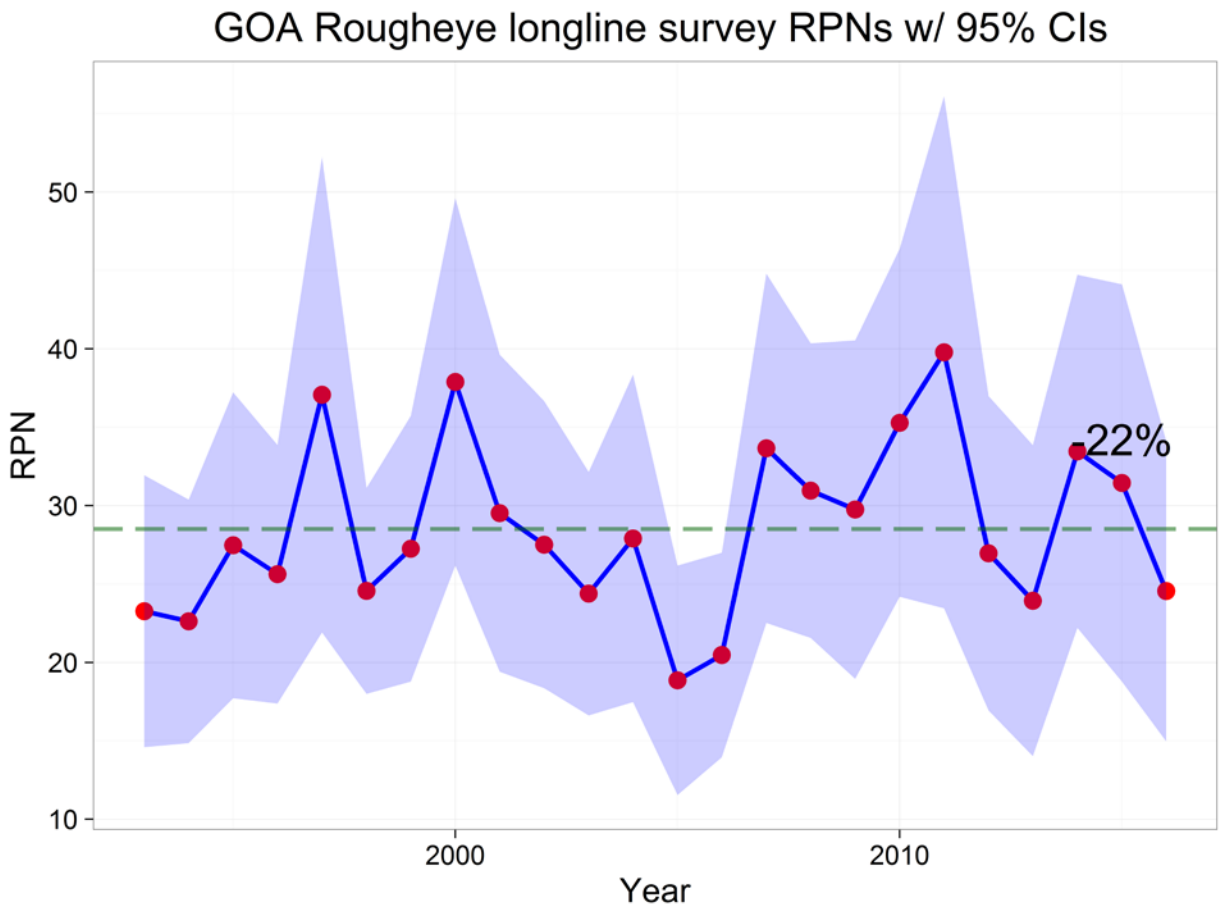

Figure 1. AFSC longline survey relative population numbers (RPN in thousands, point estimates in red circles) with 95% sampling error confidence intervals for GOA RE/BS rockfish (shaded area) from 1993-2016. Green dotted line is long-term average for the time series. Text percentage is the decrease of the 2016 RPN from the 2015 RPN.

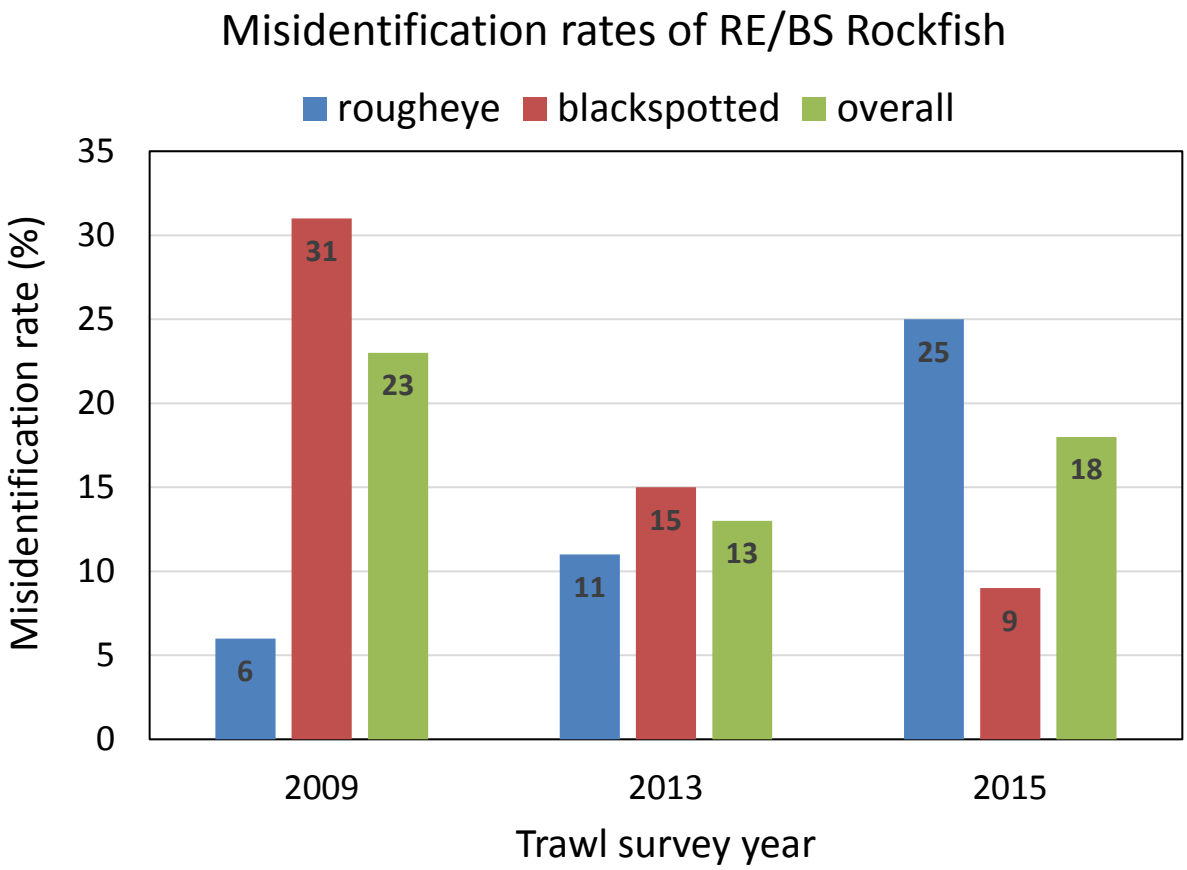

Figure 2: Misidentification rates of rougheye and blackspotted rockfish for three bottom trawl surveys in the Gulf of Alaska (2009, 2013, 2015). Text values in bars indicate actual rate.

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