CHAPTER 14

Assessment of the Blackspotted and Rougheye Rockfish Stock Complex in the Bering Sea/Aleutian Islands

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Executive Summary

In 2005, BSAI rockfish were moved to a biennial assessment schedule to coincide with the frequency of trawl surveys in the Aleutian Islands (AI) and the eastern Bering Sea (EBS) slope. These surveys occur in even years, and for these years a full assessment of blackspotted and rougheye rockfish in the BSAI area will be conducted. The 2014 full assessment can be found at http://www.afsc.noaa.gov/REFM/docs/2014/BSAIrougheye.pdf. In years without a scheduled Aleutian Island survey, an "update" is produced by revising the recent catch data and re-running the projection model using the results from the previous full assessment as a starting point. Therefore, this update does not incorporate any changes to the 2014 assessment methodology, but does include updated catch estimates for 2014-2016.

Summary of Changes in Assessment Inputs

Changes in input data: The new information for this update is replacing the estimated 2014 catch with the final catch value, and revising the 2015 catch estimate. The blackspotted/rougheye complex is currently assessed by combining an age-structured population model applied to the fishery and survey data from the AI management area with a Tier 5 approach of smoothing recent survey biomass estimates in the EBS management area. The 2014 AI catch was 173 t, a 9.7% decrease from the estimate of 192 t that was used in the 2014 projection. The 2015 AI catch through October 17th was 144 t. The estimated 2015 AI catch of 146 t is obtained by summing the total 2015 through September (139 t) and the product of: 1) the remaining amount of catch under the BSAI ABC (285 t); 2) an estimate of the recent proportion of the remaining ABC which has been caught (5%, based on 2013 and 2014 data), and 3) an estimate of the proportion of the Oct.-Dec. BSAI catch that will occur in the AI subarea (44%, based on 2013 and 2014 catch data). The estimated 2015 catch is 42% smaller than the value of 282 estimated in the 2014 projection model. The 2016 catch was obtained from the projection model and was based on a fishing mortality rate equal to the average of the rates estimated for 2014 and 2015.

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

Summary of Results

For the 2016 fishery, the maximum ABC and OFL for the AI portion of the stock is 528 t and 649 t, respectively, based on the updated projection model. The maximum ABC for 2016 ABC is 26% greater than the 2015 ABC of 420 and 1% greater than the projected 2016 ABC of 522 from the 2014 projection model. The ABC for the AI portion of the stock has increased from the 2015 ABC due to the increase in F_{abc}, which has occurred because the stock status relative to $B_{40\%}$ has increased and the F_{abc} from the sloping portion of the F control rule is closer to $F_{40\%}$. A summary of the updated projection model results for the AI portion of the stock is shown below.

	As estimated or *specified* last year for:		As estimated or *recommended* this year for:	
Quantity	2015	2016	2016	2017
M (natural mortality rate)	0.033	0.033	0.033	0.033
Tier	3b	3b	3b	3b
Projected total (age 3+) biomass	40,391	42,445	42,605	44,682
Female spawning biomass (t)				
Projected	7,932	9,002	9,076	10,307
$B_{100\%}$	28,507	28,507	28,507	28,507
$B_{40\%}$	11,403	11,403	11,403	11,403
$B_{35\%}$	9,977	9,977	9,977	9,977
F_{OFL}	0.039	0.045	0.045	0.051
$maxF_{ABC}$	0.032	0.036	0.037	0.042
F_{ABC}	0.032	0.036	0.037	0.042
OFL (t)	516	642	649	811
maxABC (t)	420	522	528	661
ABC (t)	420	522	528	661
	As determined last year for:		As determined this year for:	
Status	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

The available survey biomass estimates for EBS blackspotted/rougheye rockfish includes the southern Bering Sea (SBS) portion of the AI survey and the EBS slope survey estimates. A Tier 5 approach of averaging survey these biomass estimates (using a random walk random effects model) has been used to compute the contribution to the ABC and OFL from this portion of the stock. Because new survey data has not been collected since the 2014 assessment, the resulting OFL and ABC values for the EBS portion of the stock are identical to those from 2014. A summary of the updated projection model results for the EBS portion of the stock is shown below.

Quantity	As estimated or *specified last* year for: 2015	2016	As estimated or *recommended this* year for: 2016	2017
M (natural mortality rate)	0.033	0.033	0.033	0.033
Tier	5	5	5	5
Biomass (t)	1,339	1,339	1,339	1,339
F_{OFL}	0.033	0.033	0.033	0.033
$maxF_{ABC}$	0.0248	0.0248	0.0248	0.0248
F_{ABC}	0.0248	0.0248	0.0248	0.0248
OFL (t)	44	44	44	44
maxABC (t)	33	33	33	33
ABC (t)	33	33	33	33
Status	As determined *last* year for: 2013	2014	As determined *this* year for: 2014	2015
Overfishing	No	n/a	No	n/a

The revised overall BSAI ABC and OFL are shown below.

Quantity/Status	As estimated or *specified* last year for: 2015	2016	As estimated or *recommended* this year for: 2016	2017
OFL (t)	560	686	693	855
ABC (t)	453	555	561	694

The BSAI blackspotted/rougheye rockfish stock complex was not subjected to overfishing in 2014. Based upon the age-structured model for the AI portion of the stock, BSAI blackspotted/rougheye rockfish is not overfished nor approaching an overfished condition.

Area Apportionment

The ABC for BSAI blackspotted/rougheye rockfish is currently apportioned among two areas: 1) the western and central Aleutian Islands (WAI and CAI, respectively) and 2) the eastern Aleutian Islands (EAI) and eastern Bering Sea (EBS). The EBS area contains the southern Bering Sea (SBS) area and the EBS slope The apportionments are based on a random walk random effects model to smooth 1991-2014 survey time series. The estimates of 2014 survey biomass by subarea obtained from the random effects smoother are shown below.

	Area					
	WAI	CAI	EAI	AI subarea	SBS	EBS slope
Estimated biomass (from RE model)	566	3,152	1,425	5,143	321	1,018
Proportion of AI biomass	11.0%	61.3%	27.7%			

The ABC for the WAI/CAI are obtained by multiplying the recommended AI ABC by the proportion of AI smoothed biomass in the WAI/CAI areas. The ABC for the EAI/EBS area is obtained by multiplying the recommended AI ABC by the proportion of AI smoothed biomass in the EAI area, and adding this to the Tier 5 values of ABC for the EBS shown above.

Apportionment among the AI subareas

In December, 2013, the SSC requested information *"for consideration of separating the WAI ABC from the other sub-areas."* In October, 2014, the SSC recommended "*that the current stock structure policy be clarified to include a requirement for a recommended area specific catch level when a stock or stock complex is elevated to the level of 'concern'"*. In September, 2015, the assessment authors and the BSAI Plan Team noted that the exploitation rate in the EBS management area (based on the smoothed estimates of survey biomass) has been increasing recently, and are now comparable to the exploitation rates in the western AI. Given these concerns over subarea exploitation rates, the potential ABCs for the AI subareas using the proportions of smoothed biomass are shown below.

	WAI	CAI	EAI	EBS
ABC (2016)	58	324	146	33
ABC (2017)	73	405	183	33

Summary for the Plan Team

The following summary table gives the projected OFLs and apportioned ABCs for 2016 and 2017, and the recent OFLs, ABCs, TACs, and catches.

Area/subarea	Year	Total Biomass (t)[1]	OFL	ABC	TAC	Catch[2]
BSAI	2014	30,476	505	475	475	197
	2015	41,780	560	453	349	173
	2016	43,944	693	561	n/a	n/a
	2017	46,201	855	694	n/a	n/a
Western/Central Aleutian Islands	2014			239	239	99
	2015			304	200	112
	2016			382	n/a	n/a
	2017			478	n/a	n/a
Eastern AI/Eastern Bering Sea	2014			177	177	98
	2015			149	149	61
	2016			179	n/a	n/a
	2017			216	n/a	n/a

[1] Total biomass from AI age-structured projection model and survey biomass estimates from EBS.
[2] Catch as of October 17, 2015.

Responses to SSC and Plan Team Comments on Assessments in General

(Joint Plan Team, November, 2014) *For assessments involving age-structured models, this year's CIE review of BSAI and GOA rockfish assessments included three main recommendations for future research:*

1. *Selectivity/fit to plus group (e.g., explore dome-shaped selectivity, cubic splines)*
2. *Reevaluation of natural mortality*
3. *Alternative statistical models for survey data (e.g., GAM, GLM, hurdle models)*

The Team agreed that development of alternative survey estimators is a high priority, but concluded that this priority is not specific to rockfish, and should be explored in a Center-wide initiative (see "Alternative statistical models for survey data" under Joint Team minutes). For the remaining two items, the Team recommended that selectivity and fit to the plus group should be given priority over reevaluation of the natural mortality rate.

Selectivity curves and natural mortality rates were evaluated in the 2014 assessment. The development of alternative survey estimators (i.e., model-based standardization of survey catch data) affects all NPFMC assessments that use survey data. Potential methodologies have been discussed in a limited number of meetings in 2014 among AFSC scientists, and between AFSC scientists and NWFSC scientists. Recently, scientists at the NWFSC has developed geostatistical models for survey standardization. Evaluation of survey standardization models is expected to continue in 2016.

Responses to SSC and Plan Team Comments Specific to this Assessment

(BSAI Plan Team, November, 2013) *The Team recommended that the authors continue to examine how the estimates of the random effects model (including process error variance) are impacted by changes in survey estimates and variances. The Team also recommended reconsideration of split-tier management of this stock complex.*

The effects of changes in survey estimates and variances on the smoothed estimates obtained from the random effects model have been evaluated with the Plan Team workgroup on survey averaging, where the latest efforts have evaluated using life-history information to constrain the estimate of process error variance (and thus the "smoothness" of the estimates from the random walk smoother).

We also agree that the split-tier management should be evaluated in the 2016 assessment.

(BSAI Plan Team, November, 2014) *The Team expressed concern that the estimates of biomass from the model do not have much similarity to the trend in survey biomass estimates and recommend that the authors attempt to reconcile this discrepancy in future assessments.*

The survey biomass data for blackspotted/rougheye rockfish varies substantially (in percentage terms) between years without a trend, which the exception of a low biomass estimate and coefficient of variation for the 2014 survey. Fitting the survey biomass trend more precisely would suggest that the stock biomass was relatively stable until ~ 2005, at which point it would begin to decline to match the 2014 biomass estimate. However, the survey age composition data indicates the strong presence of the 1998 and 1999 year classes, despite these year classes not being fully selected by the survey. Due to low natural mortality, these strong year classes would be expected to increase the biomass in recent years, and are thus inconsistent with the survey biomass estimates. In the 2014 assessment, an iterative weighting procedure was used to assign weights to the fishery and survey age and length composition data. Alternative iterative weighting procedures for the composition data could be evaluated in future

assessments. However, given the lack of signal in the overall AI survey biomass estimates it may be possible that even low weights given to the composition data would result similar trends in model survey biomass estimates.

Data Gaps and Research Priorities

The 2013 CIE review of Alaska rockfish assessments highlighted several areas which warrant further attention, including estimation of key model parameters such as natural mortality and maturity, the functional form and estimation of selectivity, and weighting of data (including reconstructed catch data). Evaluation of fishery selectivity was examined in the 2014 assessment. In addition, a CIE comment that had high emphasis was whether trawl survey biomass estimates sufficiently accounted for aggregated spatial distributions, and several alternatives were proposed including zero-inflated statistical distributions and GAM or GLM modeling. The analysis of trawl survey data will likely be a subject of rockfish assessment scientists in the near future, and would ideally also involve scientists from the RACE survey division. Finally, estimation of trawl survey catchability is a research priority for rockfish assessments, and should benefit from ongoing studies examining the relative densities of rockfish in trawlable and untrawlable grounds.