CHAPTER 12

Assessment of Pacific ocean perch in the Bering Sea/Aleutian Islands

by

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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 Pacific ocean perch (POP) in the BSAI area is conducted. The 2014 full assessment can be found at http://www.afsc.noaa.gov/REFM/docs/2014/BSAIpop.pdf. In years without a scheduled Aleutian Islands 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 includes replacing the estimated 2014 catch with the final catch value and revising the 2015 catch estimate. The 2014 catch was 32,383 t, 3.9% higher than the estimate of 31,162 t that was used in the 2014 projection. The 2015 catch through October 10th, 2015 was 25,079 t. The estimated 2015 catch of 32,029 t was obtained by summing the reported 2015 through September (24,338 t) and the product of the remaining amount of catch under the ABC (10,650 t) and an estimate of the proportion of the remaining Oct-Dec ABC which has been caught in recent years (72%, based on 2013 and 2014 data). The estimated 2015 catch is 6.7% larger than the value of 30,029 estimated in the 2014 projection model. The estimated 2016 catch is assumed to result from fishing at the estimated 2015 F.

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, we recommend the maximum ABC of 33,320 t and an OFL of 40,529 t based on the updated projection model. The recommended 2016 ABC is 4.8% less than the 2015 ABC of 34,988 and 0.7% less than the projected 2016 ABC of 33,550 from the 2014 projection model. A summary of the updated projection model results 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)	0.062	0.062	0.062	0.062
Tier	3a	3a	3a	3a
Projected total (age 3+) biomass	577,967	561,090	557,886	542,162
Female spawning biomass (t)				
Projected	234,426	223,744	222,369	211,339
$B_{100\%}$	423,008	423,008	423,008	423,008
$B_{40\%}$	169,203	169,203	169,203	169,203
$B_{35\%}$	148,053	148,053	148,053	148,053
F_{OFL}	0.109	0.109	0.109	0.109
$maxF_{ABC}$	0.089	0.089	0.089	0.089
F_{ABC}	0.089	0.089	0.089	0.089
OFL (t)	42,558	40,809	40,529	38,589
maxABC (t)	34,988	33,550	33,320	31,724
ABC (t)	34,988	33,550	33,320	31,724
Status	As determined last year for: 2013	2014	As determined this year for: 2014	2015
Overfishing	No	n/a	No	n/a
Overfished	n/a		n/a	No
Approaching overfished	n/a		n/a	No

BSAI POP was not subjected to overfishing in 2014, and is not overfished or approaching an overfished condition.

Area Apportionment

The ABC for BSAI Pacific ocean perch is currently apportioned among four areas: the western, central, and eastern Aleutian Islands, and eastern Bering Sea, with the apportionments based on a random walk random effects model to smooth the survey time series. The estimated proportion of the stock in each subarea is shown below.

	WAI	CAI	EAI	EBS
Estimated 2014 biomass (from random effects model)	311,678	236,416	254,448	268,506
Proportion of biomass	29.1%	22.1%	23.8%	25.0%

Summaries for the Plan Team

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

Area	Year	Age 3 Bio (t)	OFL	ABC	TAC	Catch[1]
BSAI	2014	639,505	39,585	33,122	33,122	32,383
	2015	577,967	42,558	34,988	32,021	25,079
	2016	557,886	40,529	33,320	n/a	n/a
	2017	542,162	38,589	31,724	n/a	n/a
Eastern Bering Sea	2014			7,684	7,684	7,436
	2015			8,771	8,021	3,033
	2016			8,353	n/a	n/a
	2017			7,953	n/a	n/a
Eastern Aleutian Islands	2014			9,246	9,246	9,024
	2015			8,312	8,000	7,327
	2016			7,916	n/a	n/a
	2017			7,537	n/a	n/a
Central Aleutian Islands	2014			6,594	6,594	6,439
	2015			7,223	7,000	6,324
	2016			7,355	n/a	n/a
	2017			7,003	n/a	n/a
Western Aleutian Islands	2014			9,598	9,598	9,485
	2015			10,182	9,000	8,395
	2016			9,696	n/a	n/a
	2017			9,232	n/a	n/a

[1]Catch through October 10, 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, natural mortality rates, and improving the fit to the plus group 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

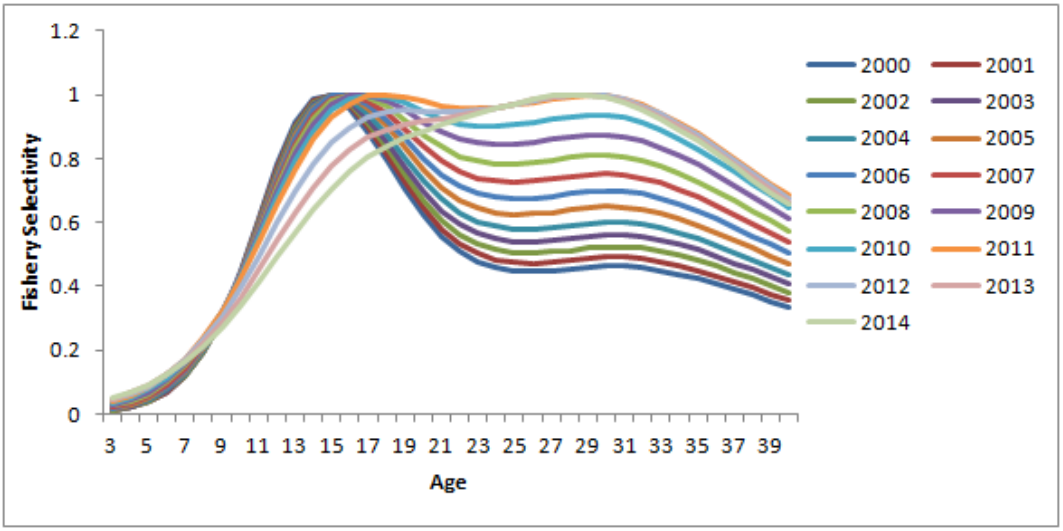
(SSC, December, 2014) *The SSC provides the following recommendations to the assessment author;*

- ☐ *Evaluate whether fishery CPUE data (1968-1979) is necessary and consider removing it in future models.*
- ☐ *Examine the evidence supporting the selectivity changes in the most recent years in the model. The shift from dome-shaped to asymptotic selectivity around 2010 appears to correspond with a divergence in modeled and survey estimated biomass.*
- ☐ *Explore a better prior for catchability through empirical studies and determine how to use the EBS slope survey biomass estimates.*
- ☐ *Explore estimates of biological parameters like maturity to see if there are trends in these estimates.*
- ☐ *Continue to evaluate potential sources for the retrospective trend including the impacts of estimating survey catchability in the model.*
- ☐ *Explore potential causes for survey biomass residual pattern*

These issues will be explored beginning in the 2016 full assessment. Here are some preliminary responses.

1) The historical fishery CPUE data are not well-documented in the assessment, and agree that it effect on the model should be evaluated.

2) Use of a smoothing spline for fishery selectivity results in gradual changes over time, which may not have been apparent from the graph in the 2014 assessment. In the recent period from 2000-2014, the degree of selection for age older than 20 years is lowest in 2000 and gradually increases:



The evidence for changes in fishery selectivity was evaluated in the 2014 assessment by examining the fishery and survey age composition data. The relative age composition of old fish (i.e., within the plus group of 40+ years) is lower in the fishery than the survey in the 1990s, suggesting that the catchability for these old fish is higher in the survey than the fishery. Around 2010, the proportion of older fish in the survey and fishery are more equal to each other. Assuming that the survey selectivity has not changed over time, these data suggest changes in the "dome-shapedness" of the fishery.

Although the specific mechanisms for these changes are not clear, the 2014 assessment does document temporal changes in the areas and depths where POP are caught. In the early 1990s, POP were primary capture in the eastern Aleutian Islands, and the use of sub-area ABCs beginning in the mid-1990s has spread the catch more evenly through the Aleutian Islands. Additionally, the mean depth of captured has appeared to increase in the western and central Aleutian Islands. These data will be updated and explored in greater detail in future assessments.

3) A current research study using acoustic and optic technology to estimate the densities of rockfish in trawlable and untrawlable grounds. Because the survey catchability coefficient for rockfish is a function of the difference in density between the trawlable and untrawlable habitat (i.e., the "availability"), these data should help inform a prior distribution of survey catchability.

We agree that incorporating the EBS slope survey data should be evaluated for BSAI POP, and other BSAI rockfish species.

4) Evaluation of trends in maturity estimates requires ongoing maturity sampling, which does not currently exist. Ongoing sampling may occur in the future as the result of the efforts of the MARVLS (Maturity Assessment, Reproductive Viability, and Life Strategies) workgroup. Evaluation of trends in growth parameters are examined each full assessment year, and have not been observed to date.

5) Both the source of the retrospective trend and the survey biomass residual pattern are strongly influenced by the series of recent survey biomass estimate (2010, 2012, 2014), which are very large relative to survey estimates from earlier years. Given the longevity number of age classes for POP, the model cannot reconcile the rapid rise in survey biomass estimates with the fishery and survey age and length composition data. This pattern of survey biomass residuals occurred

for a variety of fishery selectivity functions that were evaluated in the 2014 assessment. We will continue to investigate this issue in future assessments.

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. 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.