9. Assessment of the Pacific ocean perch 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 (Hulson et al., 2017, available online at http://www.afsc.noaa.gov/REFM/Docs/2017/GOApop.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 Pacific ocean perch 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 2017 catch and new estimated catches for 2018-2020.

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

Summary of Results

New estimates for this year's projection model are an updated 2017 catch of 23,880 t, and new estimated 2018-2020 catches of 24,706 t, 27,000 t, and 26,041 t, respectively. The 2018 catch was estimated by expanding the October 6 catch by a factor of 1.094 using the last three complete catch years (2015-2017) to project catch through the end of the 2018 fishing year. To more accurately estimate future catch, an updated yield ratio of 0.95 was computed using the average of the ratio of catch to ABC for the last three complete catch years (2015-2017). The updated yield ratio was then multiplied against the projected ABCs for 2019 and 2020 from the 2017 assessment model to estimate future catches. The yield ratio was larger than last year's ratio of 0.92 and the expansion factor was slightly higher than last year's expansion factor of 1.089.

For the 2019 fishery, we recommend the maximum allowable ABC of **28,555** t from the updated projection model. This ABC is 2% less than the 2018 ABC and 0.2% less than the projected 2019 ABC from last year's assessment. The corresponding reference values for Pacific ocean perch are summarized in the following table, with the recommended ABC and OFL values in bold. Overfishing is not occurring, the stock is not overfished, and it is not approaching an overfished condition.

The Pacific ocean perch catch/biomass ratio has ranged from less than 0.01 to 0.05 between 1991 and 2018 (Figure 9-1). Since 2013, the catch/biomass ratio has been increasing. This is mainly a result of the fishery fully taking the ABC in all the areas where trawling is allowed.

Quantity	As estimated or specified *last* year for:		As estimated or recommended *this* year for:	
	2018	2019	2019	2020[1]
M (natural mortality)	0.066	0.066	0.066	0.066
Tier	3a	3a	3a	3a
Projected total (age 2+) biomass (t)	511,934	497,600	496,922	481,608
Projected Female spawning biomass	180,150	177,539	176,934	172,345
$B_{100\%}$	293,621	293,621	293,621	293,621
$B_{40\%}$	117,448	117,448	117,448	117,448
$B_{35\%}$	102,767	102,767	102,767	102,767
F_{OFL}	0.113	0.113	0.113	0.113
$maxF_{ABC}$	0.094	0.094	0.094	0.094
F_{ABC}	0.094	0.094	0.094	0.094
OFL (t)	34,762	34,010	**33,951**	32,876
maxABC (t)	29,236	28,605	**28,555**	27,652
ABC (t)	29,236	28,605	**28,555**	27,652
Status	As determined *last* year for:		As determined *this* year for:	
	2016	2017	2017	2018
Overfishing	No	n/a	No	n/a
Overfished	n/a	No	n/a	No
Approaching overfished	n/a	No	n/a	No

[1]Projected ABCs and OFLs for 2019 and 2020 are derived using estimated catch for 2018, and projected catches for 2019 and 2020 based on realized catches from 2015-2017. This calculation is in response to management requests to obtain more accurate projections.

Updated catch data (t) for Pacific ocean perch in the Gulf of Alaska as of October 6, 2018 (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	West Yakutat	E. Yakutat/ Southeast	Gulfwide Total	Gulfwide ABC	Gulfwide TAC
2017	2,682	18,442	2,757	< 1	23,881	23,918	23,918
2018	3,210	16,030	3,352	< 1	22,592	29,236	29,236

Area Apportionment

The apportionment percentages are the same as in the 2018 full assessment. The following table shows the recommended apportionment for 2019 and 2020 from the random effects model.

Area Apportionment	Western 11.3%	Central 68.8%	Eastern 19.9%	Total 100%
2019 Area ABC (t)	**3,227**	**19,646**	**5,682**	**28,555**
2020 Area ABC (t)	**3,125**	**19,024**	**5,503**	**27,652**

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 the same as last year at 0.58. This results in the following apportionment of the Eastern Gulf area:

	W. Yakutat (WYAK)	E. Yakutat/Southeast (SEO)	Total
2019 Area ABC (t)	**3,296**	**2,386**	**5,682**
2020 Area ABC (t)	**3,192**	**2,311**	**5,503**

In 2012, the Plan Team and SSC recommended combined OFLs for the Western, Central, and West Yakutat areas (W/C/WY) because the original rationale of an overfished stock no longer applied. However, because of concerns over stock structure, the OFL for SEO remained separate to ensure this unharvested OFL was not utilized in another area. The Council adopted these recommendations. This results in the following apportionment for the W/C/WYK area:

	Western/Central/W. Yakutat (W/C/WY)	E. Yakutat/Southeast (SEO)	Total
2019 Area OFL (t)	**31,113**	**2,838**	**33,951**
2020 Area OFL (t)	**30,128**	**2,748**	**32,876**

Summaries for Plan Team

Species	**Year**	**Biomass[1]**	**OFL**	**ABC**	**TAC**	**Catch[2]**
Pacific ocean perch	2017	445,672	27,826	23,918	23,918	23,881
	2018	511,924	34,762	29,236	29,236	22,592
	2019	496,922	33,951	28,555		
	2020	481,608	32,876	27,652		

Stock	**Area**	**2018**				**2019**		**2020**	
		OFL	**ABC**	**TAC**	**Catch[2]**	**OFL**	**ABC**	**OFL**	**ABC**
Pacific ocean perch	W		3,312	3,312	3,210		3,227		3,125
	C		20,112	20,112	16,030		19,646		19,024
	WYAK		3,371	3,371	3,352		3,296		3,192
	SEO	2,902	2,441	2,441	0	2,838	2,386	2,748	2,311
	W/C/WY	31,860				31,113		30,128	
	Total	34,762	29,236	29,236	22,592	33,951	28,555	32,786	27,652

[1]Total biomass (age 2+) from the age-structured model

[2]Current as of October 6, 2018, Source: NMFS Alaska Regional Office via the Alaska Fisheries Information Network (AKFIN).

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 2017. Since this is a partial assessment, we only respond to priority comments in the executive summary. We will respond to remaining and future comments in the next full assessment.

The SSC recommends that, for those sets of environmental and fisheries observations that support the inference of an impending severe decline in stock biomass, the issue of concern be brought to the SSC, with an integrated analysis of the indices in future stock assessment cycles. To be of greatest value, to the extent possible, this information should be presented at the October Council meeting so that there is sufficient time for the Plan Teams and industry to react to the possible reduction in fishing opportunity. (SSC, October 2017)

To facilitate a coordinated response to this request, the co-chairs and coordinators of the BSAI and GOA Groundfish Plan Teams, with concurrence from stock assessment program leadership at the AFSC, have suggested that authors address it by using the previous year's Ecosystem Status Report (ESR) as follows:

> "No later than the summer of each year, the lead author of each assessment should review the previous year's ESR and determine whether any factor or set of factors described in that ESR implies an impending severe decline in stock/complex biomass, where "severe decline" means a decline of at least 20% (or any alternative value that may be established by the SSC), and where biomass is measured as spawning biomass for Tiers 1-3 and survey biomass as smoothed by the standard Tier 5 random effects model for Tiers 4-5. If an author determines that an impending severe decline is likely and if that decline was not anticipated in the most recent stock assessment, he or she should summarize that evidence in a document that will be reviewed by the respective Team in September of that year and by the SSC in October of that year, including a description of at least one plausible mechanism linking the factor or set of factors to an impending severe decline in biomass, and also including an estimate or range of estimates regarding likely impacts on ABC. In the event that new survey or relevant ESR data become available after the document is produced but prior to the October Council meeting of that year, the document should be amended to include those data prior to its review by the SSC, and the degree to which they corroborate or refute the predicted severe decline should be noted, with the estimate or range of estimates regarding likely impacts on ABC modified in light of the new data as necessary."

Report a consistent metric (or set of metrics) to describe fish condition among assessments and ecosystem documents where possible. (SSC, December 2017)

The length-weight residual method is reported for POP in the ESR, we will also try to provide these data in the 2019 SAFE.

Projections ... clearly illustrate the lack of uncertainty propagation in the 'proj' program used by assessment authors. The SSC encourages authors to investigate alternative methods for projection that incorporate uncertainty in model parameters in addition to recruitment deviations. Further, the SSC noted that projections made on the basis of fishing mortality rates (Fs) only will tend to underestimate the uncertainty (and perhaps introduce bias if the population distribution is skewed). Instead, a two-stage approach that first includes a projection using F to find the catch associated with that F and then a second projection using that fixed catch may produce differing results that may warrant consideration. (SSC, December 2017)

The POP model has for many years evaluated the full parameter uncertainty by conducting projections within the assessment model and using MCMC sampling from the posterior. However, the suggested method by the SSC is not directly implemented for POP. We do note, though, that there is still no application available for stocks in tier 3 for the current or future uncertainty distributions produced in the assessment as requested by the SSC. When this becomes available, we will use these revised projection methods for assessment of POP.

"The SSC also recommends explicit consideration and documentation of ecosystem and stock assessment status for each stock ... during the December Council meeting to aid in identifying stocks of concern." (SSC October 2017)

This comment was further clarified during the December 2017 SSC meeting and then re-clarified during the June 2018 SSC meeting. In the interest of efficiency, the clarification from the December 2017 minutes is not included here. The relevant portion of the clarification from the June 2018 minutes reads as follows:

"This request was recently clarified by the SSC by replacing the terms 'ecosystem status' and 'stock assessment status' with 'Ecosystem Status Report information' and 'Stock Assessment Information,' where the potential determinations for each will consist of 'Okay' and 'Not Okay,' and by issuing the following guidance:

- *The SSC clarifies that 'stock assessment status' is a fundamental requirement of the SAFEs and is not really very useful to this exercise, because virtually all stocks are never overfished nor is overfishing occurring.*
- *Rather the SSC suggests that recent trends in recruitment and stock abundance could indicate warning signs well before a critical official status determination is reached. It may also be useful to consider some sort of ratio of how close a stock is to a limit or target reference point (e.g., B/B35). Thus, additional results for the stock assessments will need to be considered to make the 'Okay' or 'Not Okay' determinations.*
- *The SSC retracts its previous request for development of an ecosystem status for each stock/complex. Instead, while considering ecosystem status report information, it may be useful to attempt to develop thresholds for action concerning broad-scale ecosystem changes that are likely to impact multiple stocks/complexes.*
- *Implementation of these stock and ecosystem determinations will be an iterative process and will require a dialogue between the stock assessment authors, Plan Teams, ecosystem modelers, ESR editors, and the SSC."*

"The SSC recognized that because formal criteria for these categorizations have not been developed by the PT, they will not be presented in December 2018." (SSC October 2018)

The iterative process described in the final bullet above was scheduled to begin at this year's September meeting of the Joint BSAI and GOA Plan Teams. However, no formal criteria for these categorizations were developed by the Plan Teams. We will provide determinations for Pacific ocean perch when these formal criteria are established.

"Stock assessment authors are encouraged to work with ESR analysts to identify a small subset of indicators prior to analysis, and preferably based on mechanistic hypotheses." (SSC October 2018)

The Ecosystem Status Report (ESR) was examined for indications of an impending severe decline for Pacific ocean perch and none were found. An indicator of fish condition was the second lowest on record for Pacific ocean perch in 2017 (Boldt, Rooper, and Hoff), the smallest indicator of fish condition was in 1999. It is unclear, however, if this indicator has a strong relationship with population abundance, thus, a negative residual in fish condition may not indicate an impending decline.

"The SSC reminds authors of the need to balance the desire to improve model fit with increased risk of model misspecification." (SSC December 2017)
Clarification: *"In the absence of strict objective guidelines, the SSC recommends that thorough documentation of model evaluation and the logical basis for changes in model complexity be provided in all cases."* (SSC June 2018)

We will continue to provide documentation of model evaluation and logical bases of all recommended model complexity changes for Pacific ocean perch.

"The Team recommended that the authors simply report in words or a table whether catches exceed ABC as an indicator for "partial update" stocks. (Plan Team November 2017)

In this partial assessment, we report catches for last year and this year along with ABC to determine whether catches exceed ABC (please see **Summaries for Plan Team** table above for more details)

The SSC supports the PT recommendation to make the use of model-based survey estimates at the individual author's discretion for 2018. (SSC October 2018)

We plan on evaluating the model-based survey estimates of biomass in the 2019 full assessment.

"The Teams recommend that the appropriate use, or non-use, of new model based estimates in this assessment cycle be left to individual authors' discretion. The Teams further recommend that, if an author chooses to incorporate these into the assessment, the assessment should also contain appropriate comparative models and a full set of diagnostics." (Plan Team September 2018)

"The SSC supports the PT recommendation to make the use of model-based survey estimates at the individual author's discretion for 2018." (SSC October 2018)

We will be investigating the potential for model-based survey biomass estimates in the full 2019 assessment.

The SSC also noted that, in order to save resources, authors should not conduct additional assessments beyond the prioritized schedule unless they specifically trigger one or more of the criteria identified. (SSC October 2018)

In the interest of resource conservation, we will not conduct additional assessments unless one of the criteria identified is triggered.

SSC and Plan Team Comments Specific to this Assessment

The Plan Team supports these future research topics, and additionally recommends:
1. *investigation of natural mortality, as the current estimate of 0.066 is higher than the expected value from the prior distribution (0.05) and may be constraining the model*
2. *re-evaluation of the age-plus group, as changes to the model and input data have occurred since this was previously evaluated*
3. *continued evaluation of methods for weighting for the compositional data as new models are developed and/or changes are made to input data.*

(Plan Team, November 2018)

We will investigate these suggestions in the 2019 full assessment.
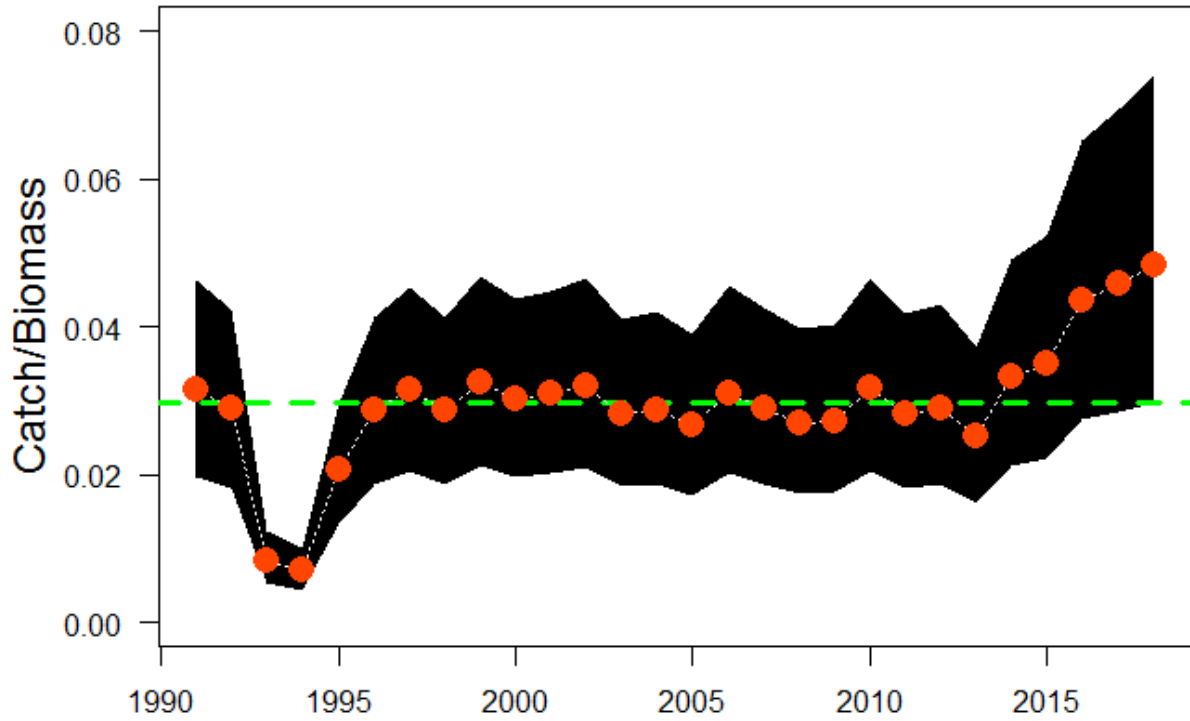
Figures

Figure 9-1. Catch divided by age 2+ total biomass from the age-structured model (point estimates shown by orange circles) with 95% sampling error confidence intervals (black shaded area) for Gulf of Alaska Pacific ocean perch from 1991-2018. Green dashed line is the average of time-series.