6. Assessment of the Rex Sole Stock in the Gulf of Alaska

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Executive Summary

Rex sole (*Glyptocephalus zachirus)* are assessed on a biennial stock assessment schedule to coincide with the availability of new survey data. For Gulf of Alaska rex sole in alternate (even) years we present an executive summary to recommend harvest levels for the next two years. A new, full assessment was expected in 2013, but an executive summary was presented instead due to the government furlough on Oct. 1-17, 2013. Please refer to the 2011 full stock assessment report for further information regarding the assessment model (Stockhausen et al. 2011), available online at http://www.afsc.noaa.gov/REFM/docs/2011/GOArex.pdf). A full stock assessment document with updated assessment and projection model results will be presented in next year's SAFE report.

GOA rex sole is currently managed as a Tier 5 species because reliable estimates of $F_{35\%}$ and $F_{40\%}$ (required for Tier 3 management) are not available for this stock. However, rather than using biomass estimates from the NMFS bottom trawl survey to calculate ABC and OFL in the standard Tier 5 calculations, the assessment uses a Tier 3-type age-structured assessment model and projection model to estimate total adult biomass for use in the Tier 5 calculations. The single species projection model was run using parameter values from the accepted 2011 accepted assessment model (Stockhausen et. al.2011), together with updated catch information for 2011 - 2014, to predict stock status for rex sole in 2015 and 2016 and to make ABC recommendations for those years. An executive summary was also presented in 2013 due to the government furlough on Oct. 1-17, 2013. A full assessment will be conducted in 2015.

Summary of Changes in Assessment Inputs

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 2013 catch and new estimated catches for 2014-2016. Additionally, new apportionments were computed based on the 2013 NMFS bottom trawl survey biomass estimates.

Summary of Results

New information available this year to update the projection model consists of the total catch for 2013 (3,707 t) and the current catch for 2014 (3,474 t as of October 18, 2014). The projection model was run to generate estimates of total (age 3+) biomass for 2015-2016. In order to do this, estimates for the total catches to be taken in 2015 and 2016 are required (the 2014 fishery was still underway when this analysis was performed). The total catch for 2014 was estimated by dividing the current catch (as of October 18, 2014) by the ratio of the catch in the same week in 2013 to the final 2013 catch. The estimated final catch for 2014 (3,812 t) was also used as the estimate for the final 2015 catch. The resulting estimates of total biomass in 2015 and 2016 from the projection model were then converted to adult biomass using a conversion factor determined from the 2011 assessment model, because numbers-at-age for 2015 and 2016 were not available from the projection model. The OFLs and maximum permissible ABCs for 2015 (updated from last year's assessment) and 2016 (new this year) were then calculated based on Tier 5 specifications for F_{OFL} (=M) and *max* F_{ABC} (=0.75M) using the estimates of adult biomass at the start of each year, M=0.17, and the Baranov catch equation. The maximum permissible ABCs for 2015 (updated) and 2016 (new) are 9,150 t and 8,979 t, respectively, and the OFLs are 11,957 t for 2015 and 11,733 t for 2016. Not surprisingly, the updated OFL and maximum permissible ABC values for 2015 are quite similar to those proposed last year for 2015 (11,963 t and 9,155 t, respectively).

Although it is not possible to use a Tier 3 approach to making harvest recommendations for rex sole because estimates of $F_{35\%}$ and $F_{40\%}$ are not considered reliable, the SSC has decided that it is possible to use a Tier 3 approach for determining overfished status because the estimate of $B_{35\%}$ (i.e., 35% of the unfished spawning stock biomass) is considered reliable (it does not depend on the fishery selectivity), as is the estimate of current (2014) spawning stock biomass. Because the estimated spawning stock biomass for 2014 (53,164 t) is greater than $B_{35\%}$ (19,434 t), the stock is not considered overfished. Because the 2013 catch was less than the 2013 ABC (i.e. 3,707 t < 9,560 t), overfishing is not occurring.

Because the stock appears to be healthy and is only lightly exploited, the author's recommended ABCs for 2015 and 2016 are the maximum permissible ones. The principal reference values for this update and from last year's assessment are summarized in the following table:

Quantity	As estimated or *specified last* year for:		As estimated or *recommended this* year for:	
	2014	2015	2015*	2016*
M (natural mortality rate)	0.17	0.17	0.17	0.17
Tier	5	5	5	5
Projected total (3+) biomass (t)	84,702	83,012	82,972	81,414
Female spawning biomass (t)	53,164	52,807	49,804	48,554
$B_{100\%}$	55,393	55,393	55,393	55,393
$B_{40\%}$	22,159	22,159	22,159	22,159
$B_{35\%}$	19,434	19,434	19,434	19,434
$F_{OFL}=M$	0.170	0.170	0.17	0.17
$maxF_{ABC}=0.75*M$	0.128	0.128	0.128	0.128
F_{ABC}	0.128	0.128	0.128	0.128
OFL (t)	12,207	11,963	11,957	11,733
maxABC (t)	9,341	9,155	9,150	8,979
ABC (t)	9,341	9,155	9,150	8,979
Status	As determined in 2013 for:		As determined in 2014 for:	
	2012	2013	2013	2014
Overfishing	no	n/a	no	n/a
Overfished	n/a	no	n/a	no

*Projections are based on estimated catches of 3,812 t used in place of maximum permissible ABC for 2015 and 2016.

Area Apportionment

Area apportionment for ABC is currently based on the relative abundance (biomass) of rex sole found within each management area in the last GOA groundfish survey, which occurred in 2013. The recommended ABC area apportionment percentages differ slightly from those used in 2013 because area

apportionment in the 2013 rex sole update assessment was based on the 2011 survey. The following table shows the recommended area apportionments for 2015 and 2016:

Quantity	Western	Central	West Yakutat	Southeast	Total
Area Apportionment	13.74%	63.57%	8.44%	14.25%	100.00%
2015 ABC (t)	1,258	5,816	772	1,304	9,150
2016 ABC (t)	1,234	5,707	758	1,280	8,979

Responses to SSC and Plan Team Comments on Assessments in General

SSC Dec 2013: "During public testimony, it was proposed that assessment authors should consider projecting the reference points for the future two years (e.g., 2014 and 2015) on the phase diagrams. It was suggested that this forecast would be useful to the public. The SSC agrees. The SSC appreciated this suggestion and asks the assessment authors to do so in the next assessment."
An additional two projection years will be included on future phase diagrams for the GOA rex sole stock.

GPT, Sept 2013: The Teams recommend retaining use of the mean to estimate the central tendency in recruitment, at least for the time being.
The mean is used to estimate the central tendency in recruitment in this assessment.

GPT, Sept. 2013: The Teams recommend that authors choose a method <for catch estimation when doing stock projections> that appears to be appropriate for their stock, and this method be clearly documented. The Teams recommend authors establish their best available estimate of catch in the current year and the next two years. The Teams recommend that authors should also document how those projected catches were determined in the Harvest Recommendations section (ideally Scenario 2).
The methods for catch estimation used for the projections used in this update are based on the author's best available estimate in the current year and next two years. The methods for catch estimation are documented in the text of this update.

Responses to SSC and Plan Team Comments Specific to this Assessment

The SSC and GPT didn't make comments specific to this assessment in 2011-2013.

Data Gaps and Research Priorities

The rex sole fishery is primarily a bycatch fishery that takes mainly older, larger fish. Current estimates of optimum harvest levels based on Tier 3 calculations (e.g., at $F_{40\%}$ harvest rates) are very large but highly uncertain. The rex sole fishery should continue to be monitored to assess whether a directed rex sole fishery has developed; quantities such as $F_{40\%}$ (=F_{ABC} in Tier 3a) will be sensitive to the characteristics of the resulting fishery selectivity curves. More information should be collected on fishery size and age compositions to inform selectivity parameters and potentially improve estimates of harvest rates.

Future plans include constructing a rex sole assessment using Stock Synthesis (SS3), which will allow for exploration of alternative selectivity formulations, stock-recruit curves, time-varying effects, and spatial effects. Inclusion of additional data sources could be explored, such as inclusion of ADF&G small mesh survey data. Alternative data-weighting approaches and inclusion of ageing error could be explored as well.

Lastly, the assessment would benefit from an exploration of ways to better account for scientific uncertainty, especially uncertainty associated with parameters that are currently fixed in the model.

Summaries for Plan Team

Year	Biomass[1]	OFL[2]	ABC[2]	TAC[2]	Catch[3]
2013	86,684	12,492	9,560	9,560	3,707
2014	84,702	12,207	9,341	9,341	3,474
2015	82,972	11,957	9,150		
2016	81,414	11,733	8,979		

1. Age 3+ biomass from the assessment and projection models
2. From http://alaskafisheries.noaa.gov/frules/79fr12890.pdf and http://alaskafisheries.noaa.gov/frules/78fr13162.pdf
3. As of October 18, 2014

Area	2014				2015		2016	
	OFL[1]	ABC[1]	TAC[1]	Catch[3]	OFL[2]	ABC[2]	OFL[2]	ABC[2]
W	--	1,270	1,270	110	--	1,258	--	1,234
C	--	6,231	6,231	3,363	--	5,816	--	5,707
WYAK	--	813	813	1	--	772	--	758
SE	--	1,027	1,027	0	--	1,304	--	1,280
Total	12,207	9,341	9,341	3,474	11,957	9,150	11,733	8,979

1. From http://alaskafisheries.noaa.gov/frules/79fr12890.pdf
2. From assessment and projection model
3. Catch as of October 18, 2014