6. Assessment of the Rex Sole Stock in the Gulf of Alaska (Executive Summary)

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6.1 Introduction

In 2006, the Gulf of Alaska rex sole (*Glyptocephalus zachirus*) stock was moved to a biennial stock assessment schedule to coincide with the expected receipt of new survey data. A discussion at the September 2006 Groundfish Plan Team meetings concluded the following two important points for updating information in off-year assessments:

1) Anytime the assessment model is re-run and presented in the SAFE Report, a full assessment document **must** be produced.
2) The single-species projection model **may** be re-run using new fishery catch data without re-running the assessment model.

Thus, on alternate (even) years, parameter values from the previous year's assessment model and total catch information for the current and previous year are used to make projections via the single species projection model for the following two years and to recommend ABC levels for those years.

Although the GOA Groundfish Survey was successfully conducted this year, results from the survey did not become available to assessment authors until October 1. Because assessment authors were subsequently furloughed from Oct. 1-17 as part of the 2013 federal government shutdown, it was not deemed possible for this stock to complete a full assessment incorporating the new survey data prior to the start of the assessment review process. Instead, the author was instructed to update the assessment by running the single-species projection mode for this stock using the latest fishery catch data without re-running the assessment model (option 2 above, as if it were an off year for the survey).

Thus, the single species projection model was run using parameter values from the accepted 2011 assessment model, together with updated catch information for 2011-2013, to predict adult biomass for rex sole in 2014 and 2015. The 2011 assessment model is documented in Stockhausen et al. 2011[1]. As per recent assessments for rex sole, predicted adult biomass in 2014 and 2015 was then used to make ABC and OFL recommendations for those years based on Tier 5 calculations.

6.2 New information and projection

As noted above, the 2013 GOA Groundfish Survey was conducted this summer. A preliminary examination of the results of the survey indicates that total survey biomass for rex sole increased by 6% from 95,134 t in 2011 to 100,978 t in 2013 (Table 1). Most of this increase occurred in the Southeast.

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 Groundfish 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. New information available this year to update the projection model consists of the total catch for 2012 (2,425 t) and the current catch for 2013 (3,378 t as of Oct. 12, 2013). Briefly, the projection model was run to generate estimates of total (age 3+) biomass for 2014-2015. In order to do this, estimates for the total catches to be taken in 2013 and 2014 are required

[1]Stockhausen, W., M. Wilkins and M. Martin. 2011. 6. Assessment of the Rex Sole Stock in the Gulf of Alaska. In: Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska. North Pacific Fishery Management Council, PO Box 103136, Anchorage, AK. http://www.afsc.noaa.gov/REFM/docs/2011/GOArex.pdf.

(the 2013 fishery was still underway when this analysis was performed). The total catch for 2013 was estimated by dividing the current catch (as of Oct. 12, 2013) by the ratio of the catch in the same week in 2012 (week 41) to the final 2012 catch. The estimated final catch for 2013 (3,733 t) was also used as the estimate for the final 2014 catch. The resulting estimates of total biomass in 2013 and 2014 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 2014 and 2015 were not available from the projection model. The OFLs and maximum permissible ABCs for 2014 (updated from last year's assessment) and 2015 (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 2014 (updated) and 2015 (new) are 9,341 t and 9,155 t, respectively, while the OFLs are 12,207 t for 2014 and 11,963 t for 2015. Not surprisingly, the updated OFL and maximum permissible ABC values for 2014 are quite similar to those proposed last year for 2014 (12,362 t and 9,460 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 $B_{35\%} = 0.35 \cdot B_{100\%}$ (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 (2013) spawning stock biomass. Because the estimated spawning stock biomass for 2013 (52,807 t) is greater than $B_{35\%}$ (19,434 t), the stock is not considered overfished. Because the 2012 catch was less than the 2012 ABC (i.e., 2,425 t < 9,612 t), overfishing is not occurring.

Because the stock appears to be healthy and is only lightly exploited, the author's recommended ABCs for 2014 and 2015 are the maximum permissible ones. The principal reference values for this update and from last year's assessment are summarized in the following table, with the recommended values for 2014 in bold:

Quantity	As estimated or specified last year (2012) for:		As estimated or recommended this year (2013) for:	
	2013	2014	**2014**	**2015**
M (natural mortality)	0.17	0.17	**0.17**	**0.17**
Specified/recommended tier	5	5	**5**	**5**
Biomass (adult; t)	86,684	85,778	**84,702**	83,012
F_{OFL} =M	0.170	0.170	**0.170**	0.170
max F_{ABC} =0.75*M	0.128	0.128	**0.128**	0.128
recommended F_{ABC}	0.128	0.128	**0.128**	0.128
OFL (t)	12,492	12,362	**12,207**	11,963
max ABC (t)	9,560	9,460	**9,341**	9,155
ABC (t)	9,560	9,460	**9,341**	9,155
Status	**As determined last year (2012) for:**		**As determined this year (2013) for:**	
	2011	2012	**2012**	**2013**
Overfishing	no	n/a	**no**	n/a
$B_{35\%}$		19,434		**19,434**
Female spawning biomass (t)		53,164		**52,807**
Overfished	n/a	no	**n/a**	no

6.3 Area Apportionment

The area apportionments are based on the distribution of biomass from the 2011 GOA bottom trawl survey. The following table shows the recommended ABC area apportionment for 2014-2015:

	Western	Central	West Yakutat	Southeast Outside	Total
Area Apportionment	13.6%	66.7%	8.7%	11.0%	100.0%
2014 ABC (t)	1,270	6,231	813	1,027	9,341
2015 ABC (t)	1,245	6,106	796	1,008	9,155

6.4 Research Priorities

The rex sole fishery is, at present, primarily a bycatch fishery that takes mainly older, larger fish. As a consequence, 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 because quantities such as $F_{40\%}$ ($=F_{ABC}$ in Tier 3a) will be sensitive to the characteristics of the resulting fishery selectivity curves. Monitoring fishery size and age compositions will be crucial.

6.5 Summaries for Plan Team

Species	Year	Biomass[1]	OFL[2,3]	ABC[2,3,4]	TAC[2,3,4]	Catch[5]
Rex sole	2011	86,974	12,499	9,565	9,565	2,876
	2012	87,162	12,561	9,612	9,612	2,425
	2013	86,684	12,492	9,560	9,560	3,378
	2014	84,702	12,207	9,341		
	2015	83,012	11,963	9,155		

[1] Adult biomass from the assessment and projection models.
[2] http://www.fakr.noaa.gov/sustainablefisheries/specs11_12/goa_table1.pdf
[3] http://www.fakr.noaa.gov/sustainablefisheries/specs12_13/goa_table1.pdf
[4] http://www.fakr.noaa.gov/sustainablefisheries/specs13_14/goa_table1.pdf
[5] As of Oct. 12, 2013.

Stock/ Assemblage	Area	2013 OFL[1]	2013 ABC[1]	2013 TAC[1]	2013 Catch[2]	2014 OFL[3]	2014 ABC[3]	2015 OFL[3]	2015 ABC[3]
Rex sole	W	--	1,300	1,300	98	--	1,270	--	1,245
	C	--	6,376	6,376	3,280	--	6,231	--	6,106
	WYAK	--	832	832	0	--	1,028	--	1,007
	SEO	--	1,052	1052	0	--	812	--	797
	Total	12,492	9,560	9,560	3,378	12,207	9,341	11,963	9,155

[1] http://www.fakr.noaa.gov/sustainablefisheries/specs13_14/goa_table1.pdf
[2] As of Oct. 12, 2013.
[3] Based on Tier 5 calculations using adult biomass estimates from the assessment and projection models.

Tables

Table 1. Survey biomass (t) by management sub-area for GOA rex sole. [Note: the 2001 survey was not conducted in the West Yakutat and Southeast areas.]

Year	Western Gulf	Central Gulf	West Yakutat	Southeast	Total	Std. Dev	Max Depth (m)
1984	6,672	40,688	9,209	4,102	60,670	6,023	1000
1987	8,801	39,722	11,160	4,144	63,826	5,906	1000
1990	6,765	75,147	12,745	3,569	98,225	10,731	500
1993	10,700	55,310	15,761	5,140	86,911	6,211	500
1996	9,419	43,778	9,855	9,705	72,757	5,301	500
1999	12,755	42,750	10,138	9,326	74,969	8,655	1000
2001	9,571	41,687	--	--	51,258	4,404	500
2003	13,265	57,973	10,566	18,093	99,897	7,559	700
2005	12,768	60,600	11,539	16,351	101,257	8,195	1000
2007	11,614	76,490	5,914	9,758	103,776	9,646	1000
2009	19,780	82,091	11,318	11,555	124,744	9,608	1000
2011	12,964	63,490	8,296	10,385	95,134	7,211	700
2013	13,877	64,188	8,521	14,392	100,978	13,923	700