19. Assessment of the Sculpin complex in the Gulf of Alaska

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Executive Summary

This document consists of an executive summary because no new survey data are available. It also includes specific responses to SSC and Plan Team comments.

Summary of Changes in Assessment Inputs

1). The GOA trawl survey is conducted in odd years, and was not conducted in 2014. There is no new survey data.

2). Complete catch is included for 2013, as well as partial catch for 2014 (through October 21, 2014).

The assessment methodology remained the same.

Summary of Results

	As estimated or *specified last* year for:		As estimated or *recommended this* year for:	
Quantity	2014	2015	2015	2016
M (natural mortality rate)[1]	0.222	0.222	0.222	0.222
Tier	5	5	5	5
Biomass (t)	33,550	33,550	33,550	33,550
F_{OFL}	0.222	0.222	0.222	0.222
$maxF_{ABC}$	0.166	0.166	0.166	0.166
F_{ABC}	0.166	0.166	0.166	0.166
OFL (t)	7,448	7,448	7,448	7,448
maxABC (t)	5,569	5,569	5,569	5,569
ABC (t)	5,569	5,569	5,569	5,569
	As determined *last* year for:		As determined *this* year for:	
Status	2012	2013	2013	2014
Overfishing		n/a		n/a

[1] *This is a sculpin complex average mortality rate, a biomass-weighted average of the instantaneous natural mortality rates for the four most abundant sculpins in the GOA: bigmouth (Hemitripterus bolini), great (Myoxocephalus polyacanthocephalus), plain (Myoxocephalus jaok), and yellow Irish lord (Hemilepidotus jordani).*

Area apportionment

GOA sculpins are managed with a single total allowable catch (TAC) for the entire Gulf of Alaska region; there is no area apportionment.

Responses to SSC and Plan Team Comments on Assessments in General

The SSC recommended in its December 2012 minutes that the authors consider whether it is possible to estimate M with at least two significant digits in all future stock assessments to increase validity of the estimated OFL.

Authors' response: Authors will continue to estimate M to three significant digits, as in past assessments.

Responses to SSC and Plan Team Comments Specific to this Assessment

The Team agreed that the sculpin complex ABC for 2014 be based on the previous method of using a four-year survey average (a 3-year average is applied to the BSAI sculpin assessment).

Authors' response: The authors will continue to use the 4-year average for GOA sculpin assessments.

At the November 2013 GOA plan team, there was some discussion of whether species-specific TAC calculations could be compared with catch estimates, but it appeared that delineating catches to individual species would require substantial additional effort due to a lack of comprehensive species identification. The Team recommended that species-specific catch estimates be presented along with species specific ABCs next year.

Authors' response: In response to Plan Team comments, species-specific catch and exploitation rate estimates are presented. Biomass estimates for plain, great, bigmouth sculpin, and yellow Irish lord are shown in Table 1. Table 2 provides a comparison of the proportion of plain, great, bigmouth sculpin, and yellow Irish lord caught in the fishery versus the survey. Total catch from the NMFS AKRO Blend/Catch Accounting System is shown in Table 3. Species-specific catch estimates and species-specific ABCs are provided in Table 4. Catch of plain, great, and bigmouth sculpin were below species-specific ABCs in 2012, 2013, and 2014 through October 13, 2014. There were no cases in which species-specific catches exceeded species-specific ABCs (Table 4).

The Team also recommended the author provide an executive summary for the 2014 assessment as no new data will be available but to include any outstanding Team or SSC recommendations with the summary.

Authors' response: This document is an executive summary that contains Plan Team and SSC recommendations.

The Team made a general recommendation that there should be an investigation into the use of ABC-methods based on survey biomass-weighted M calculations for species complexes. This approach appears to respond to declines in less productive species by increasing the target harvest rate for the complex, an undesirable response. An alternative to this biomass-weighted M approach may be desirable for the sculpin complex.

Authors' response: This is an important consideration, and two alternatives to the biomass-weighted M calculation are presented here: 1) a strict average of species-specific M estimates for the complex, 2) a biomass-weighted M that includes biomass estimates for the entire biomass time series.

The following table calculates weighted average M based on the biomass estimate from the past four research surveys.

	average biomass[1]	proportion of total biomass	M	weighted contribution to M	weighted average M
yellow Irish Lord	19,138	0.57	0.17	0.097	
great	7,654	0.23	0.28	0.064	
bigmouth	3,455	0.10	0.21	0.021	
plain	3,303	0.10	0.40	0.040	
					0.222

[1] Average survey biomass is the mean estimate of biomass from the last four surveys (2007, 2009, 2011, and 2013).

This standard method produces a weighted average M of 0.222. Using a strict average of the M estimates produces M=0.265. Another alternative is using the mean proportion of each species with respect to the total for the entire survey time series, from 2003-2013 (Table 1). This produces M=0.221. The authors' preferred method uses the proportion of each species from the entire time series. This method produces results that are insensitive to short-term changes in species composition.

The Team discussed the utility of using the random effects model for estimating survey biomass. Because the survey trend has been relatively flat over time, this approach produces results that are very similar to those from a four-year survey average. The Team discussed the need for a default method recommendation for applying the random effects approach for survey biomass estimation to species complexes. At issue is whether to apply this method to the aggregate survey data (which may provide a longer time-series in some cases where speciation was incomplete in early years), or to the individual species and then sum the results. A suggestion was made to explore simultaneous estimation for the individual species, and that this approach might be equally applicable to spatial strata for individual species. The Team recommends the survey averaging working group reconvene and provide guidance to authors regarding how to apply the random effects approach to species complexes and to regionally stratified estimates (i.e. Demersal Shelf Rockfish assessment) before the Team endorses the random effects method. The Team encourages the author to use the random effects approach, contingent on the survey averaging working group's recommendations.

Authors' response: There is no recommended method for applying the random effects model to stock complexes. In response to Plan Team comments, biomass was estimated using the random effects model. Estimates were performed two ways: 1) survey biomass estimates and variance were combined for plain, yellow Irish lord, bigmouth, and great sculpins, and provided to the model, and 2) the random effects model was run separately for each species and the results were combined. The results of separate model runs for each species are shown in Figure 1, and are compared with survey estimates. The two methods of estimating biomass are compared in Figure 2. The upper panel of Figure 2 provides results from the first method (all biomass and variance combined prior to running the model) and the lower panel compares both methods. The two methods provide very similar results. The total combined estimate of biomass for GOA sculpins in 2013 was 32,744 t (95% CI: 27,866 – 38,477) using method 1 and 32,614 (95% CI: 27,987 - 37,241) using method 2. The estimate of biomass from the standard method is 33,550 t (95% CI: 29,900 – 37,199).

Summaries for Plan Team

Year	Biomass	OFL	ABC	TAC	Catch[1]
2013	34,732	7,614	5,884	5,884	1,959
2014	33,550	7,448	5,569	5,569	1,290
2015	33,550	7,448	5,569		
2016	33,550	7,448	5,569		

[1] Current as of October 13, 2014, Source: NMFS AKRO Blend/Catch Accounting System.

Data Gaps and Research Priorities

Data gaps exist in sculpin species life history characteristics, spatial distribution and abundance in Alaskan waters. Most importantly no data on maximum age exists for the four main sculpin species in the GOA. Therefore, collections for age data on yellow Irish lord, great sculpin, bigmouth sculpin and plain sculpin are needed from the GOA. Over 90% of all sculpins caught in the fisheries of the GOA in surveys from 2004-2012 were from the genera *Myoxocephalus*, *Hemitripterus*, and *Hemilepidotus*. Collecting seasonal food habits data (with additional summer collections) would help to clarify the role of both large and small sculpin species within the GOA ecosystem. In addition, there is a need for GOA specific research on natural mortality of sculpin species. These data are necessary to improve management strategies for non-target species.

Tables

Table 1. Biomass estimates for plain sculpin, yellow Irish lord, great sculpin, and bigmouth sculpin, based on random effects model output.

Year	plain sculpin	yellow Irish lord	great sculpin	bigmouth sculpin
2003	2,162	13,692	6,914	5,340
2004	2,386	14,571	6,954	5,107
2005	2,633	15,507	6,995	4,884
2006	2,731	16,143	7,044	4,310
2007	2,832	16,805	7,092	3,803
2008	2,826	18,234	7,127	3,641
2009	2,819	19,783	7,162	3,486
2010	2,874	18,771	7,171	3,532
2011	2,931	17,810	7,180	3,579
2012	2,950	18,324	7,157	3,618
2013	2,970	18,853	7,134	3,657
Average proportion	0.09	0.55	0.23	0.13

Table 2. Composition of observed fishery catches, 2012-2014, and species composition of the 3-survey average biomass estimate of sculpin complex biomass, by species and/or genus. Fishery catch proportions are based on on fishery observer data. *Source: NORPAC database.* Most sculpins are not identified to species; therefore percentages represent relative proportions of those identified to species here.

taxon	GOA			
	fishery catch composition			proportion of average survey biomass
	2012	2013	2014	
Hemitripterus* spp.*				
H. bolini (bigmouth)	17%	14%	12%	13%
***Hemilepidotus* spp.**				
Hemilepidotus unidentified	11%	24%	24%	-
H. hemilepidotus (RIL)	<1%	1%	< 1%	-
H. jordani (YIL)	61%	51%	56%	55%
H. spinosus (BIL)	<1%	< 1%	< 1%	-
***Myoxocephalus* spp.**				
Myoxocephalus unidentified	1%	1%	<1%	-
M. verrucosus (warty)	<1%	<1%	<1%	-
M. jaok (plain)	<1%	<1%	<1%	9%
M. polyacanthocephalus (great)	10%	9%	6%	23%
Malacottus spp.				
M. zonurus (darkfin)	<1%	<1%	1%	0%

** *Hemitripterus* spp. is likely all *H. bolini.*

§ Miscellaneous sculpins comprises unidentified sculpins as well as a number of minor sculpin species.

Table 3. Total catch estimates for Gulf of Alaska sculpins. Source: NMFS AKRO Blend/Catch Accounting System, as of November 21, 2014.

Year	Catch (t)
2006	582
2007	965
2008	1,932
2009	1,408
2010	916
2011	1,010
2012	1,002
2013	1,724
2014	1,470

Table 4. Species-specific catch estimates (t) and species-specific ABCs (t) for 2012, 2013, and 2014. The 2012 and 2013 estimates are based on random effect model output. *The 2014 estimate of biomass is based on the 2013 estimates. Other sculpin consists of all sculpin species other than the four specified here.

	Year	plain sculpin	yellow Irish lord	great sculpin	bigmouth sculpin	Other sculpin
	2012					
Estimated Biomass		2,950	18,324	7,157	3,618	946
ABC by species		655	3,051	1,192	602	158
catch		1	588	93	163	157
	2013					
Estimated Biomass		2,970	18,853	7,134	3,657	920
ABC by species		659	3,139	1,188	609	153
catch		6	779	129	205	605
	2014					
Estimated Biomass*		2,970	18,853	7,134	3,657	920
ABC by species		659	3,139	1,188	609	153
catch		1	810	90	167	402

Figures

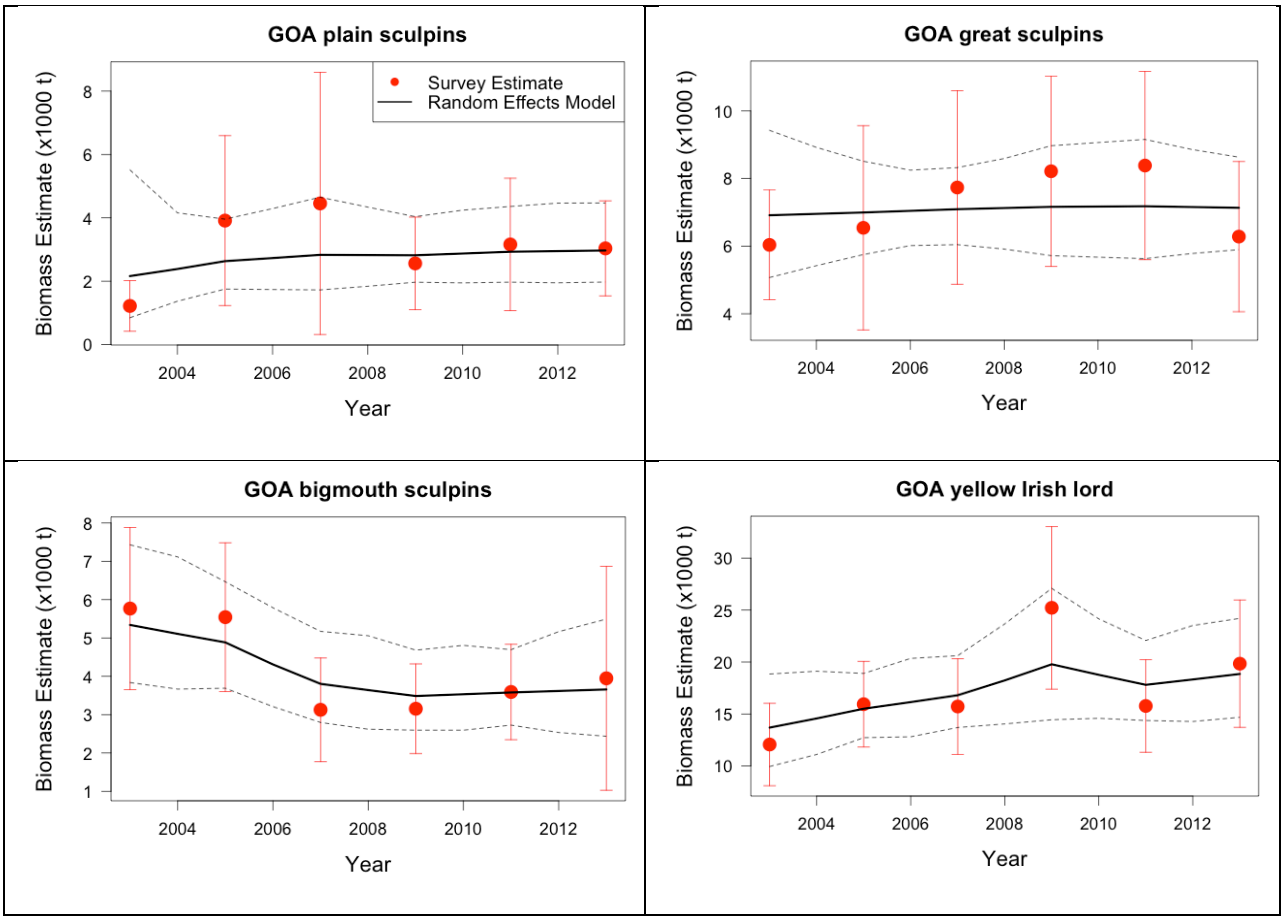

Figure 1. Random effects model estimates for the four most common GOA sculpin species, plain, great, and bigmouth sculpins, and yellow Irish lord. The figure legend in the top left panel applies to all panels; survey estimates of biomass and 95% confidence intervals are red and random effects estimates and 95% confidence intervals are black.

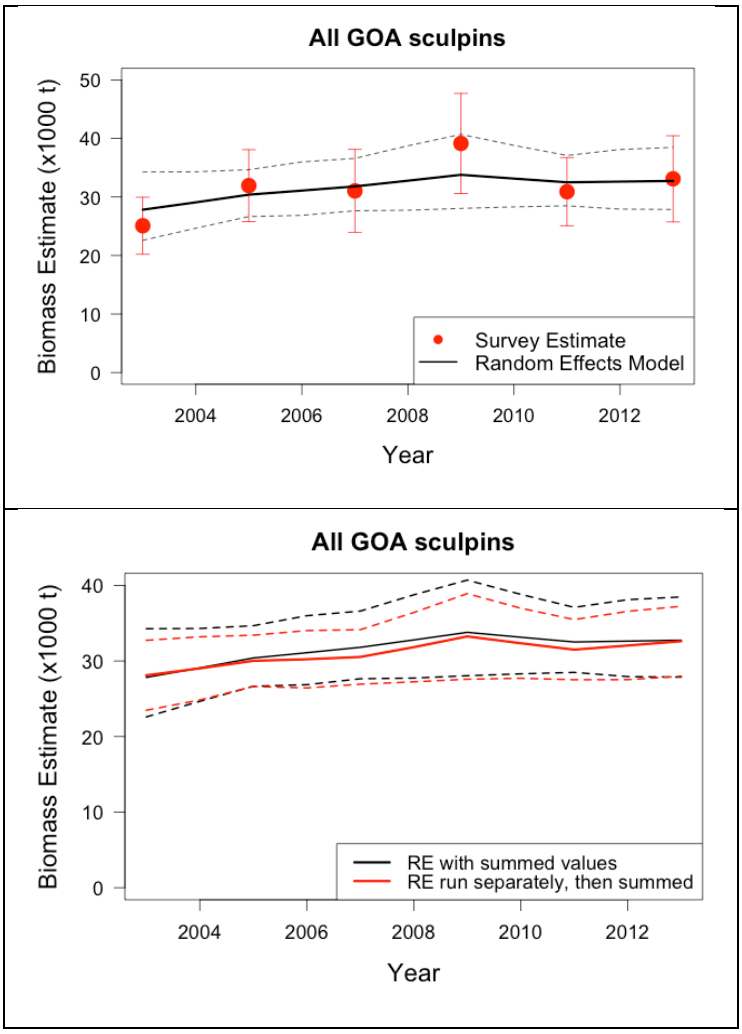

Figure 2. Survey and random effects model estimates for the four most common GOA sculpin species; bigmouth, plain, great, and yellow Irish lord. In the upper panel, the random effects model incorporated summed estimates of biomass and associated variance (black) and summed survey estimates and associated 95% confidence intervals are shown in red. In the lower panel, the black lines represent the random effects model estimate with summed biomass values (and 95% confidence intervals), while the red lines represent the summed results of four random effect models, each with data from one species, and 95% confidence intervals.