15. Assessment of the Thornyhead stock complex in the Gulf of Alaska

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November 2017

Executive Summary

Rockfish have historically been assessed on a biennial stock assessment schedule to coincide with the availability of new trawl survey data (odd years). In 2017, the Alaska Fisheries Science Center participated in a stock assessment prioritization process. It was recommended that the Gulf of Alaska (GOA) thornyhead complex remain on a biennial stock assessment schedule with a full stock assessment produced in even years and no stock assessment produced in odd years. However, we performed a partial stock assessment for this year because the allowable biological catch (ABC) has been exceeded in the past in the western GOA, and because the biomass estimates provided by the GOA trawl surveys have at times displayed extreme variability between surveys. Because we have chosen to perform a partial stock assessment, we followed the recommendation of the Science and Statistical Committee (SSC) and the GOA Groundfish Plan Team that "partial assessments for Tiers 4-5 should be an expanded version of the current off-year executive summaries, *including catch/biomass ratios for all species in addition to re-running the random effects model"* (SSC minutes – February 2017).

Here we present the new off-year enhanced executive summary. This summary is similar in style and content as in past years (Echave et al. 2016, http://www.afsc.noaa.gov/REFM/Docs/2016/GOAthorny.pdf), but will now incorporate new survey biomass from the most recent bottom trawl survey to update exploitable biomass estimates and recommended ABC and OFL values for the following two years. Please refer to the last full stock assessment report presented in 2015 for further information regarding the assessment calculations (Echave et al. 2015, http://www.afsc.noaa.gov/REFM/Docs/2015/GOAthorny.pdf). A full stock assessment document will be presented in next year's SAFE report.

This stock is classified as a Tier 5 stock. We use a random effects (RE) model applied to the GOA trawl survey biomass estimates from 1984-2017 to estimate exploitable biomass and determine the recommended ABC for the thornyhead rockfish stock complex. As in recent assessments the RE model was fit to the time series of survey biomass values and estimates of uncertainty by region and depth strata (to account for incomplete survey data), and then summed to obtain Gulfwide biomass.

Summary of Changes in Assessment Inputs

Changes in the input data:

1. Total catch weight for GOA thornyheads is updated with partial 2017 data through 17 October 2017.
2. Survey biomass information for GOA thornyheads as used in the random effects model is updated to include 2017 GOA bottom trawl survey data.

Changes in assessment methodology:
There were no changes in assessment methodology this year.

Summary of Results

Applying the F_{ABC} (0.0225) to the estimate of current exploitable biomass (using the random effects model) of 90,570 t (+/- 95% CI of 71,072 and 115,417) for thornyhead rockfish results in a recommended

Gulfwide ABC of 2,038 t for the 2018 fishery. This ABC is 3.9% higher than the 2017 ABC of 1,961 t. The OFL is 2,717 t. Reference values for thornyhead rockfish are summarized in the following table, with the recommended ABC and OFL values in bold. The stock was not being subjected to overfishing last year.

Quantity	As estimated or *specified last* year for:		As estimated or *recommended this* year for:	
	2017	2018	2018	2019
M (natural mortality rate)	0.03	0.03	0.03	0.03
Tier	5	5	5	5
Biomass (t)	87,155	87,155	90,570	90,570
F_{OFL}	F=M=0.03	F=M=0.03	F=M=0.03	F=M=0.03
$maxF_{ABC}$	0.75M=0.0225	0.75M=0.0225	0.75M=0.0225	0.75M=0.0225
F_{ABC}	0.0225	0.0225	0.0225	0.0225
OFL (t)	2,615	2,615	**2,717**	2,717
maxABC (t)	1,961	1,961	2,038	2,038
ABC (t)	1,961	1,961	**2,038**	2,038
Status	As determined *last* year for:		As determined *this* year for:	
	2015	2016	2016	2017
Overfishing	No	n/a	No	n/a

Fishery Trends

Updated catch data (t) for thornyhead rockfish in the Gulf of Alaska as of October 17, 2017 (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	Eastern	Gulfwide Total	Gulfwide ABC	Gulfwide TAC
2016	207	689	222	1,119	1,961	1,961
2017	133	533	237	903	1,961	1,961

Gulfwide catch of thornyhead rockfish for 2017 (as of Oct 17) is 19% lower than the 2016 catch, with decreases of 36% and 23% occurring in the Western and Central GOA, respectively, and a slight increase in the Eastern GOA. Historically, the majority of thornyhead have been caught as bycatch in the rockfish and sablefish fisheries, with lesser amounts in the flatfish and halibut fisheries: 2017 catch is down in the rockfish fishery (6%) and the sablefish fishery (21%) from 2016. While the pollock fishery has historically caught <1 t of thornyhead annually, 72 t of thornyhead rockfish were caught in the pollock fishery in 2016. Catches of shortraker rockfish, a species of similar depth and habitat range, had abnormally high catch in the pollock fishery in 2016 as well. The total allowable catch (TAC) for the GOA thornyhead complex has not been fully taken since 1995, and are generally between 30-70% of annual quotas.

Survey Trends

The 2017 trawl survey biomass estimate decreased by 10% from the 2015 estimate but is well above the long-term mean (Figure 15-1). In contrast, the 2017 longline survey abundance estimate (relative population number or RPN) increased by 30% from the 2016 estimate and remains above the long-term mean. Trawl survey estimates by area (Figure 15-2) were down in the CGOA (24% in Chirikof and 26%

Kodiak), and down in the Yakutat area of the EGOA as well. Estimates were up slightly in the Shumagin (WGOA) and Southeast (EGOA) areas.

Area Allocation of Harvests

For apportionment of ABC/OFL, the random effects model was fit to area-specific biomass and subsequent proportions of biomass by area were calculated. The following table shows the recommended apportionment, estimated biomass, and ABC value by regulatory area for 2018/2019. Please refer to the last full stock assessment report for information regarding the apportionment rationale for the thornyhead rockfish stock complex.

	Regulatory area			
	Western	Central	Eastern	Total
Area Apportionment	16.9%	45.2%	37.9%	
Estimated Area Biomass (t)[1]	15,277	40,930	34,363	90,570
Area ABC (t)	344	921	773	2,038
OFL (t)				2,717

Summaries for Plan Team

Species	Year	Biomass[1]	OFL	ABC	TAC	Catch[2]
Thornyhead rockfish	2016	87,155	2,615	1,961	1,961	1,119
	2017	87,155	2,615	1,961	1,961	903
	2018	90,570	2,717	2,038	2,038	
	2019					

Stock/ Assemblage	Area	2017				2018		2019	
		OFL	ABC	TAC	Catch[2]	OFL	ABC	OFL	ABC
Thornyhead rockfish	W		291	291	133		344		344
	C		988	988	533		921		921
	E		682	682	237		773		773
	Total	2,615	1,961	1,961	903	2,717	2,038	2,717	2,038

[1]Total biomass estimates from the random effects model

[2]Current as of October 17, 2017. Source: NMFS Alaska Regional Office Catch Accounting System via the Alaska Fisheries Information Network (AKFIN) database (http://www.akfin.org).

Responses to SSC and Plan Team Comments on Assessments in General

Since this is an off-cycle year and only an executive summary is presented, we do not address most comments. For comments relevant to or that require a full assessment, we will present responses in next year's full assessment.

"Secondly, a few assessments incorporate multiple indices that could also be used for apportionment. The Team recommends an evaluation on how best to tailor the RE model to accommodate multiple indices." (Plan Team, November 2015)

This will be examined in the next full assessment. Additionally, the use of a geostatistical model is still being investigated for both biomass estimates and apportionment, of which the outcome may affect the use of the RE model.

"Finally, an area apportionment approach using the RE model which specifies a common "process error" has been developed and should be considered. This may help in some situations where observation errors are particularly high and/or vary between regions." (Plan Team, November 2015)
A common process error parameter is estimated within the RE model for shortspine thornyheads across depth strata and regions.

"The Team recommends that a workgoup or subset of authors investigate applying the geostatistical approach to selected stocks." (Plan Team, November 2015)
A working group is currently investigating the geostatistical approach and the results of this evaluation will be applied to the thornyhead complex as appropriate.

"The SSC requests that stock assessment authors bookmark their assessment documents and commends those that have already adopted this practice." (SSC, October 2016)
Assessment documents for the thornyhead complex have been bookmarked.

"*…The SSC also recommends explicit consideration and documentation of ecosystem and stock assessment status for each stock, perhaps following the framework suggested below, during the December Council meeting to aid in identifying areas of concern."* (SSC October 2017)
A newly proposed framework for considering ecosystem and socioeconomic factors has been submitted as an appendix in some assessments this year. This is an attempt to document these factors with respect to stock status and also provide indicators for continued monitoring to identify areas of concern. These reports are currently submitted as an appendix and in future years it is anticipated that they would be available for all stocks as the framework is adaptable for data-limited to data-rich stocks. We plan to evaluate and potentially incorporate this new ecosystem/socioeconomic report as an appendix when it becomes available for the thornyhead stock complex.

Responses to SSC and Plan Team Comments Specific to this Assessment

"The PT noted the high discard rates for thornyheads over the last four years and requested the author investigate these. The PT also recommended that the author examine the tagging data. The SSC concurs with these suggestions." (SSC, December 2015)
Discard rates for thornyheads will be examined in the next full assessment. A review of the thornyhead rockfish tagging data was included as an appendix to the 2017 Executive Summary and published in Echave (2017)

*"High rates of discards appear to have occurred in some recent years (e.g., 41% in 2013). The Team requests the authors investigate the reasons for these high discard rates (*GOA Plan Team, November 2015)*."*
This will be examined in the next full assessment.

"The SSC supports the author's plan to explore the feasibility of incorporating longline survey abundance indices for use in estimating biological reference points and possibly area apportionments. If the longline survey is added to the assessment, the SSC and the PT notes that methods will need to be developed to estimate area apportionments for assessments that utilize more than one survey." (SSC, December 2015)
This work is ongoing and the results of these investigations will be presented in 2018.

Literature Cited

Echave, K. B., Hulson, P. J. F., S.K. Shotwell. 2015. Assessment of Thornyhead stock complex in the Gulf of Alaska. In Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska, p. 1303-1350. North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage AK 99501. Available online: http://www.afsc.noaa.gov/REFM/Docs/2015/GOAthorny.pdf

Echave, K. B., Hulson, P. J. F., S.K. Shotwell. 2016. Assessment of Thornyhead stock complex in the Gulf of Alaska. In Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska, p. 609-618. North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage AK 99501. Available online: http://www.afsc.noaa.gov/REFM/Docs/2016/GOAthorny.pdf

Echave, K. B. 2017. First results of the tagging of shortspine thornyhead, *Sebastolobus alascanus*, in Alaska. Fish. Res. 195:46-51.

Figures

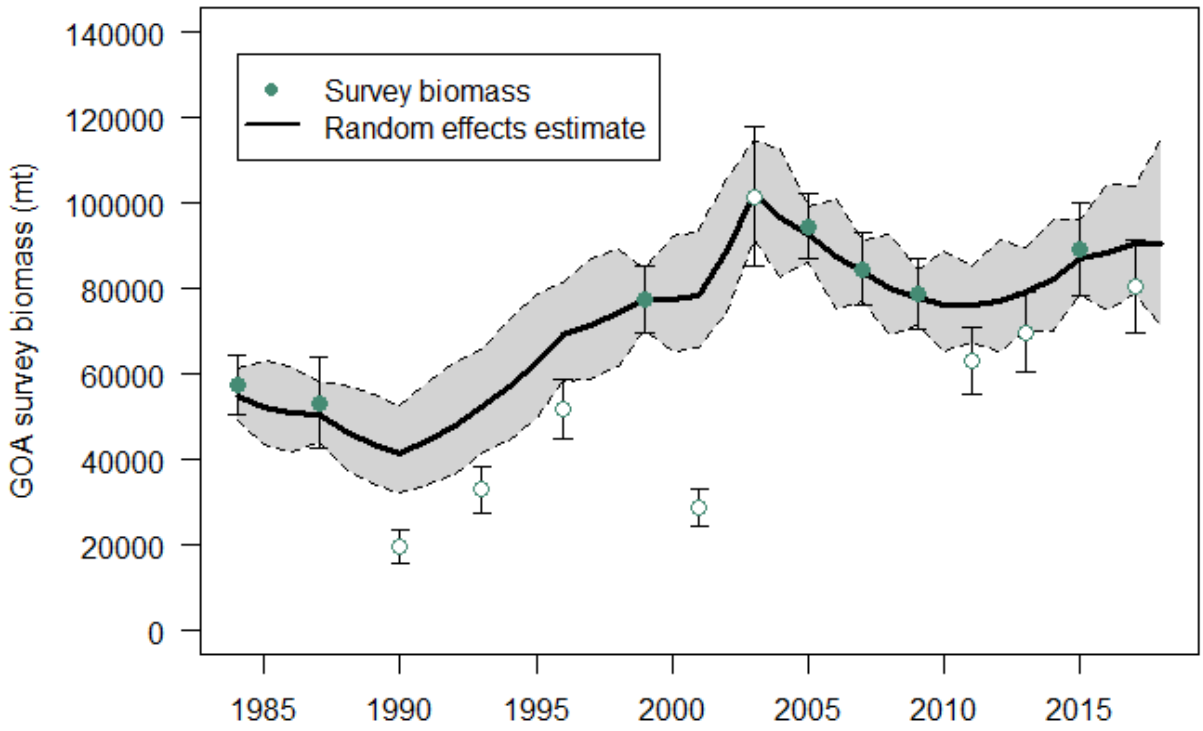

Figure 15-1.--Biomass estimates (t) of thornyhead rockfish from NMFS bottom trawl surveys (filled circle) and from a random effects model (solid black line with grey region denoting 95% confidence interval) that utilizes trawl survey biomass estimates from all years (1984-2017, with 95% sampling error confidence intervals shown with error bars). Open circle points in the figure denote years with missing regional/depth strata data.

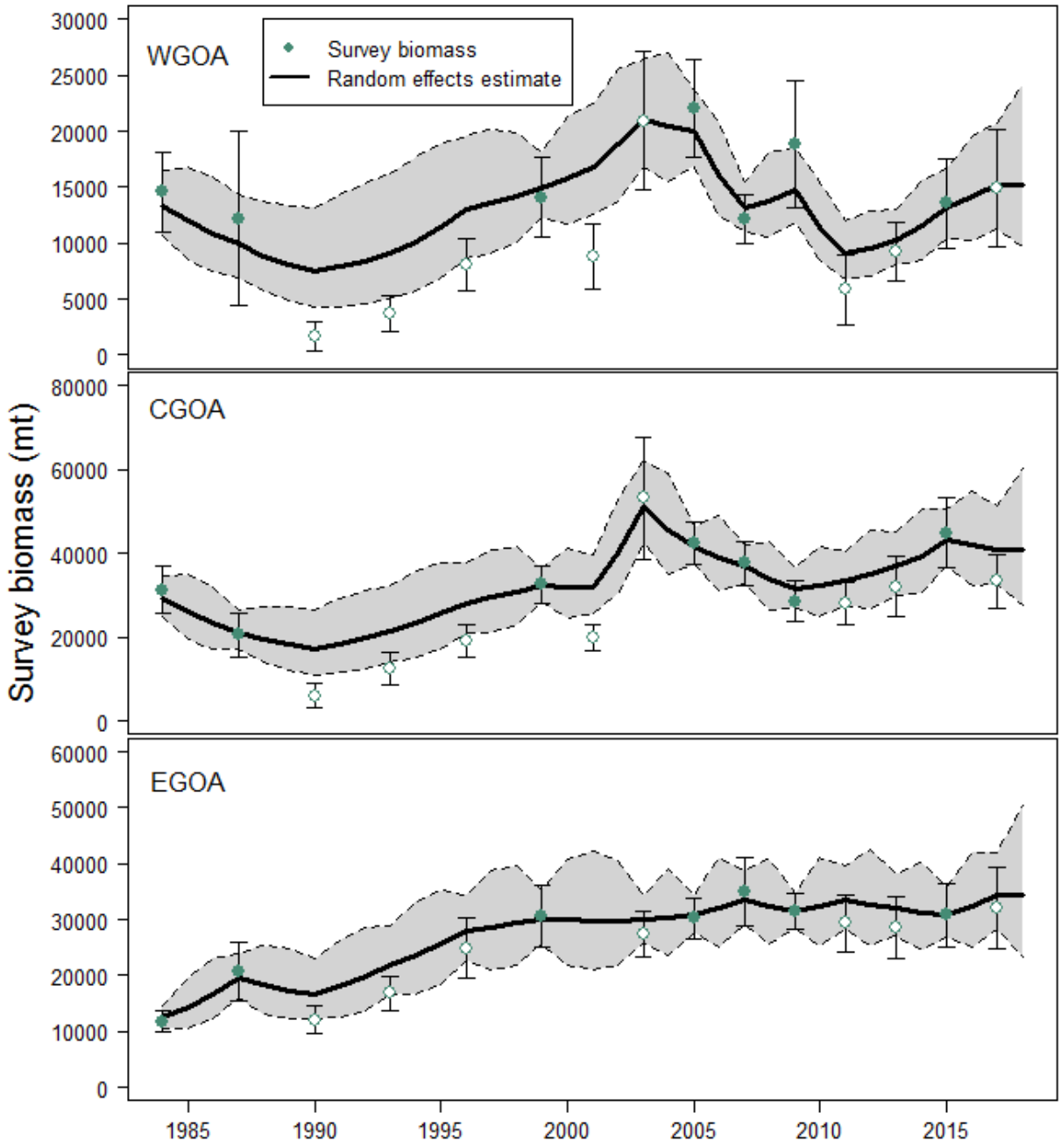

Figure 15-2.-- Biomass estimates (t) of thornyhead rockfish by area from NMFS bottom trawl surveys (filled circle) and from a random effects model (solid black line with grey region denoting 95% confidence interval) that utilizes trawl survey biomass estimates from all years (1984 – 2017, with 95% sampling error confidence intervals shown with error bars). Open circle points in the figure denote years with missing regional/depth strata data. Top panel is the Western Gulf of Alaska (WGOA) Area, middle panel is the Central Gulf of Alaska (CGOA) Area, and bottom panel is the Eastern Gulf of Alaska (EGOA) Area. Please note the different scales between panels on the y-axis.

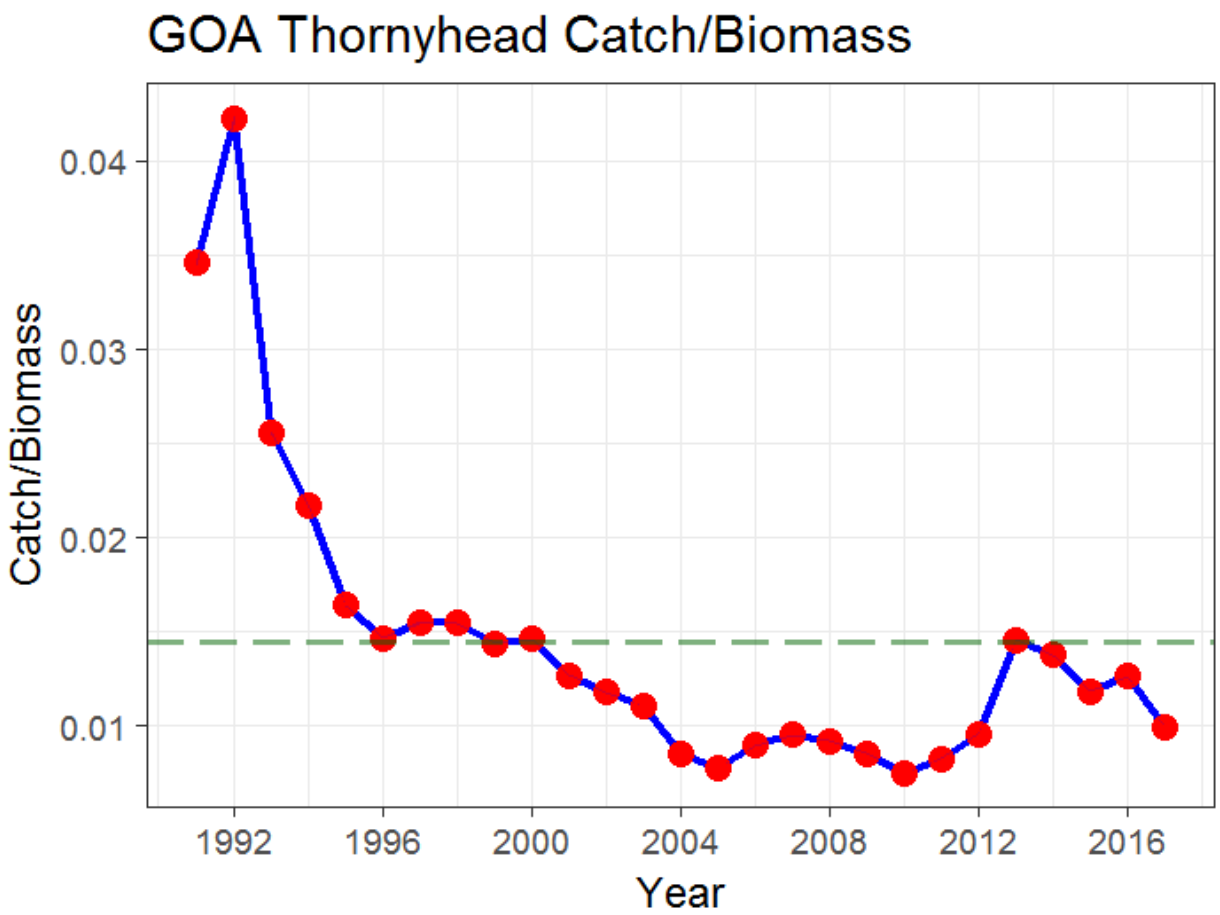

Figure 15-3.-- Observed catch over total biomass (point estimates in red circles) for Gulf of Alaska thornyhead rockfish complex from 1991-2017. Green dotted line is long-term average for the time series. Catch in 2017 through Oct 17, 2017.