15. Assessment of the Thornyhead stock complex 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 (GOA) thornyheads in off-cycle (even) years, we present an executive summary to recommend harvest levels for the next 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 with updated assessment results will be presented in next year's SAFE report.

We use a random effects model applied to the GOA trawl survey biomass estimates from 1984-2015 to estimate exploitable biomass and determine the recommended ABC for the thornyhead rockfish stock complex. This stock is classified as a Tier 5 stock. For an off-cycle year, there is no new survey information for thornyhead rockfish; therefore, the 2015 estimates (Echave et al. 2015, http://www.afsc.noaa.gov/REFM/Docs/2015/GOAshortraker.pdf) are rolled over for the next year.

Summary of Changes in Assessment Inputs

Changes in the input data: There were no changes made to the assessment inputs since this was an off-cycle year.

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

Summary of Results

For the 2017 fishery, we recommend the maximum allowable ABC of 1,961 t for thornyhead rockfish. 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:	
	2016	2017	2017	2018
M (natural mortality rate)	0.03	0.03	0.03	0.03
Tier	5	5	5	5
Biomass (t)	87,155	87,155	87,155	87,155
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	**2,615**	2,615
maxABC (t)	1,961	1,961	1,961	1,961
ABC (t)	1,961	1,961	**1,961**	1,961
Status	As determined *last* year for:		As determined *this* year for:	
	2014	2015	2015	2016
Overfishing	No	n/a	No	n/a

Updated catch data (t) for thornyhead rockfish in the Gulf of Alaska as of October 3, 2016 (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
2015	233	587	214	1,033	1,841	1,841
2016	165	613	206	984	1,961	1,961

Area Apportionment

The following table shows the recommended apportionment for 2017. The apportionment percentages are the same as in the 2015 assessment (for the 2016 fishery). Please refer to the last full stock assessment report for information regarding the apportionment rationale for the thornyhead rockfish stock complex.

	Western	Central	Eastern	Total
Area Apportionment	15%	50%	35%	100%
Area ABC (t)	**291**	**988**	**682**	**1,961**
OFL (t)				**2,615**

Summaries for Plan Team

Species	Year	Biomass[1]	OFL	ABC	TAC	Catch[2]
Thornyhead rockfish	2015	81,816	2,454	1,841	1,841	1,033
	2016	87,155	2,615	1,961	1,961	984
	2017	87,155	2,615	1,961	1,961	
	2018		*2,615*	*1,961*		

Stock/ Assemblage	Area	2016 OFL	2016 ABC	2016 TAC	2016 Catch[2]	2017 OFL	2017 ABC	2018 OFL	2018 ABC
Thornyhead rockfish	W		291	291	165		291		291
	C		988	988	613		988		988
	E		682	682	206		682		682
	Total	2,615	1,961	1,961	984	2,615	1,961	2,615	1,961

[1]Total biomass from trawl survey estimates and includes expansion to 701-1000 m.

[2]Current as of October 3, 2016. 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.

"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)
This will be examined in the next full assessment.

"The SSC requests that stock assessment authors bookmark their assessment documents and commends those that have already adopted this practice." (SSC, October 2016)
This will be examined in the next full assessment.

Responses to SSC and Plan Team Comments Specific to this Assessment

"Additionally, the Team requests a summary of the thornyhead rockfish tagging data be presented at the September 2016 Plan Team meeting so that it may be considered for the next full assessment." (GOA Plan Team, November 2015)
A review of the thornyhead rockfish tagging data is included as an appendix to this Executive Summary

"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)
A review of the thornyhead rockfish tagging data is included as an appendix to this Executive Summary. Discard rates for thornyheads will be examined in the next full assessment.

*"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 will be examined in the next full assessment.

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

Appendix 15.A Evaluation of the Tagging History of Gulf of Alaska Shortspine Thornyhead

Introduction

Shortspine thornyhead (*Sebastolobus alascanus*; SST) are a long lived, deep dwelling species that inhabit the northeastern Pacific Ocean from Baja Mexico to the Gulf of Alaska (GOA), westward to the Aleutian Islands (AI), eastern Bering Sea (BS), and into the Seas of Okhotsk and Japan (Echave et al. 2015). Adult SST are generally found along the continental slope at depths of 150 – 450 m. Thornyheads (*Sebastolobus* species) are groundfish belonging to the family Scorpanenidae, which contains the rockfishes. While thornyheads are considered rockfish, they are distinguished from the "true" rockfish in the genus *Sebaste*s primarily by reproductive biology. Thornyheads are also differentiated from *Sebastes* in that they lack a swim bladder, making them ideal tagging specimens.

The National Marine Fisheries Service (NMFS) Auke Bay Laboratory (ABL) has released 13,897 tagged SST in Alaska waters since 1992, and over 220 of those fish have been recovered. Data from the releases and recoveries are maintained in the ABL Groundfish Tag Database. Since 1997, tagging in offshore waters has occurred aboard chartered commercial vessels during the NMFS annual Domestic Longline Survey. Approximately 5% of the longline survey catch of SST are tagged and released each year, which generally equals about 500 – 1,000 fish per year. Offshore tagging has included conventional anchor tags and internally implanted electronic archival tags. Analysis of tag data is the primary method used to examine SST movement patterns and can assist with questions regarding stock structure and growth. The purpose of this document is to present a brief summary of release and recovery data of SSTs.

Tag Releases

Since 1997, approximately 5% of the catch of SST on the NMFS annual Domestic Longline Survey have been tagged and released each year, which generally equals about 500 – 1,000 fish per year (Table 1). Shortspine thornyhead were first tagged in 1992, but not consistently until 1997. In that time, 13,694 SST have been tagged with traditional anchor tags, and beginning in 2003 and continuing in 2004 and 2006, 203 electronic archival tags were surgically implanted inside SST. These are tags that collect temperature and depth data at a predefined sampling rate.

Tag Recoveries

Since 1997, 228 tagged SST have been recovered, of which two have been archival tags (Table 1). The majority of recovered tags have been caught on longline gear (160 tags), with just 38 on trawl gear and one in a trap. This is likely a result of the nature of these different fisheries. Many fish caught on longline gear are visually inspected at the roller and/or processed on the vessel, and a tag on a fish would be more easily detected. In addition, tag reporting rates for SST may be lower than other fish (e.g. sablefish; Heifetz and Maloney 2001; Echave et al. 2013) for many reasons, one being that tags are harder to see next to the orange coloring of these fish. Tag recovery rates and tag loss have never been estimated for SST, and would be useful to estimate in the future. The majority of tag recoveries have been in the Central (75 tags) and Eastern (83 tags) GOA (Table 2). The shortest duration a tag was at liberty was for 2 days, and the longest was for 15.5 years. The fish at liberty for 15.5 years grew 10 mm in that time and traveled 4.3 nautical miles (nm). The fish at liberty for 2 days traveled 7.8 nm. The average time at liberty for all recovered SST tags was just under 4 years.

Movement Patterns

Tag recoveries are given a position accuracy score of 1 – 5: 1 means the exact recovery location is known and 5 means there is no recovery location information. All movement discussions below involve only those recoveries with a position accuracy code of 1. Distance (great circle distance distance) traveled by recovered tagged SST range from <1 nm to 990 nm. The following are the percentage of recoveries per noted distance traveled: < 2 nm (19%), >=2 – 5 nm (36%), >5-10 nm (18%), >10 – 50 nm (12%), >50 – 100 nm (4%), and > 100 nm (11%). The average distance traveled was 46 nm (Table 3). It is important to note that movement of less than 5 nm could be influenced by the relationship of where the fish are actually being released versus where they were initially caught on the longline survey. The release location in the tag database for all tag releases on the longline survey are the start coordinates for the haul, but each haul is approximately 4 nm in length. Fish that are tagged on the longline survey aren't released at their exact catch location, but generally further along the set of gear. How fast the fish is tagged and released on the survey could affect the accuracy of the total movement inferred from the recovery information.

While the majority of tagged SST showed little to no movement (73% of tagged recoveries traveled less than 10 nm), it is important to point out that there have been some large movements, some of which have crossed management and international boundaries. Figure 1 shows the release and recovery locations of all tagged recoveries that displayed total movement >50 nm. Of particular interest are the number of recoveries in BC (Figure 2), and the concentrated area of these recoveries. Whether this is a result of where fishery effort occurs, or is an area of congregation of SSTs is not known. The majority of recovered SST remained within their management area of release (Table 4). Shortspine thornyhead released in the Eastern GOA displayed the most movement (Figure 2). Of the 102 recoveries that were released in the Eastern GOA, 76% remained within the Eastern GOA, 18% were recovered in British Columbia, Canada (BC), 5% were recovered in the Central GOA, and 1% were recovered on the West Coast (WC). These numbers include all recoveries from Eastern GOA tag releases, regardless of their position accuracy score.

Growth

Nearly half (48%) of the 153 fish with reliable size information showed no change in growth (39 fish) or negative growth (35 fish). These zero growth fish ranged in time at liberty between 33 and 5,072 days, reiterating the already known fact that SST exhibit extremely slow growth. The phenomena of "shrinkage" has even been seen in tagged fish recovered by NMFS research vessels and observers where accurate length measurement are expected. Ten of the 89 recovered tagged SST on NMFS research vessels or by observers showed a decrease in size.

Summary

As budgets allow, tagging of SST will continue into the future on the annual longline survey. Potential research questions such as estimating tag loss and recovery rates would be useful. In addition, data has yet to be retrieved off of the two recovered electronic tags, which may provide insight into the vertical movements of this species.

Literature Cited

Echave, K. B., D. H. Hanselman, and N. E. Maloney. 2013. Report to industry on the Alaska sablefish tag program, 1972 - 2012. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-254, 47 p.

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.

Heifetz, J., and N. E. Maloney. 2001. Estimation of tag-reporting rates for sablefish in the northeastern Pacific Ocean. Alaska Fish. Res. Bull. 8:1-11.

Tables

Table 1. Total number of tagged shortspine thornyhead released and recovered by year. Total number recovered does not equal reported total due to missing recovery date data.

Year	Number Released	Number Recovered
1992	100	-
1997	495	-
1998	525	3
1999	618	5
2000	501	7
2001	637	9
2002	586	10
2003	588	8
2004	473	10
2005	556	12
2006	643	11
2007	681	11
2008	607	12
2009	783	16
2010	947	23
2011	912	14
2012	748	11
2013	1,123	19
2014	738	28
2015	870	15
2016	766	3

Table 2. Total number of tagged shortspine thornyhead released and recovered by area. Eastern Bering Sea (BS), Aleutian Islands (AI), Western Gulf of Alaska (WGOA), Central Gulf of Alaska (CGOA), Eastern Gulf of Alaska (EGOA), British Columbia (BC), and West Coast (WC). Total recovered will not add up to the actual total number of tags recovered, due to no recovery location data on 14 tags.

Area	Total Released	Total Recovered
BS	664	16
AI	695	3
WGOA	1,747	16
CGOA	4,536	75
EGOA	6,247	83
BC	8	20
WC	-	1

Table 3. Minimum (min), maximum (max), and average (avg) distance traveled (great circle distance; nautical miles) by sex. Sex 1 = male, sex 2 = female, and sex 3 = unknown. Only fish with position accuracy code of 1 are included in this analysis.

Sex	Min Distance	Max Distance	Avg Distance
1	0.7	594	49
2	0.3	503	44
3	0.6	990	43

Table 4. The percentage of fish recovered in each area (top column headings) from each release area (left hand row headers). Only fish with position accuracy code of 1 are included in this analysis.

	Recovery Area						
Release Area	AI	EBS	WGOA	CGOA	EGOA	BC	WC
AI	75%	25%					
EBS		100%					
WGOA			94%	6%			
CGOA			1%	90%	6%	3%	
EGOA				5%	76%	18%	1%

Figures

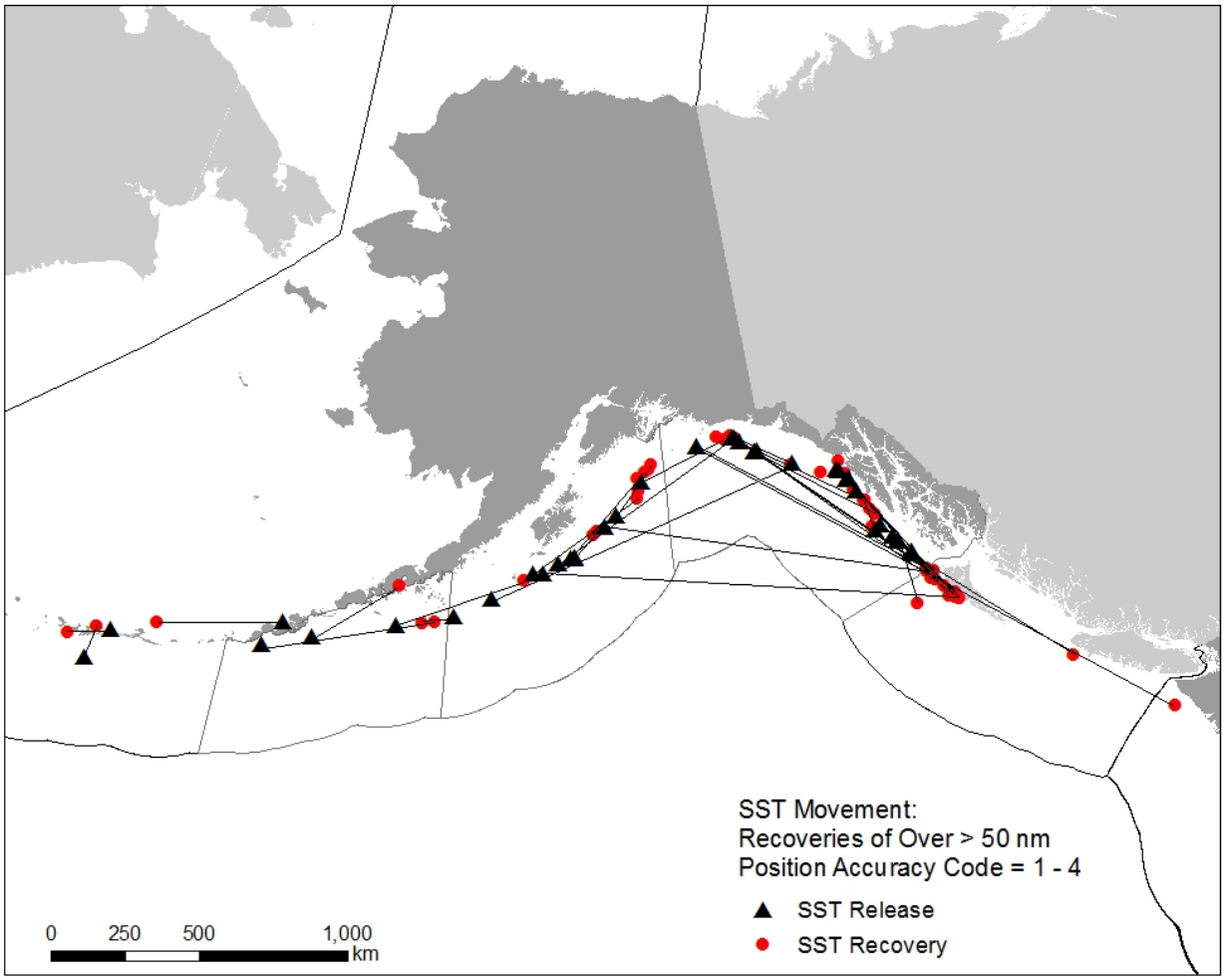

Figure 1. Figure displaying movement of tagged shortspine thornyhead that traveled over 50 nautical miles (nm) between their release (black triangle) and recovery (red dot) locations. Line represents great circle distance between the release and recovery locations, and is not representative of the path traveled between the two points. Data with position accuracy code of 1 – 4 are displayed.

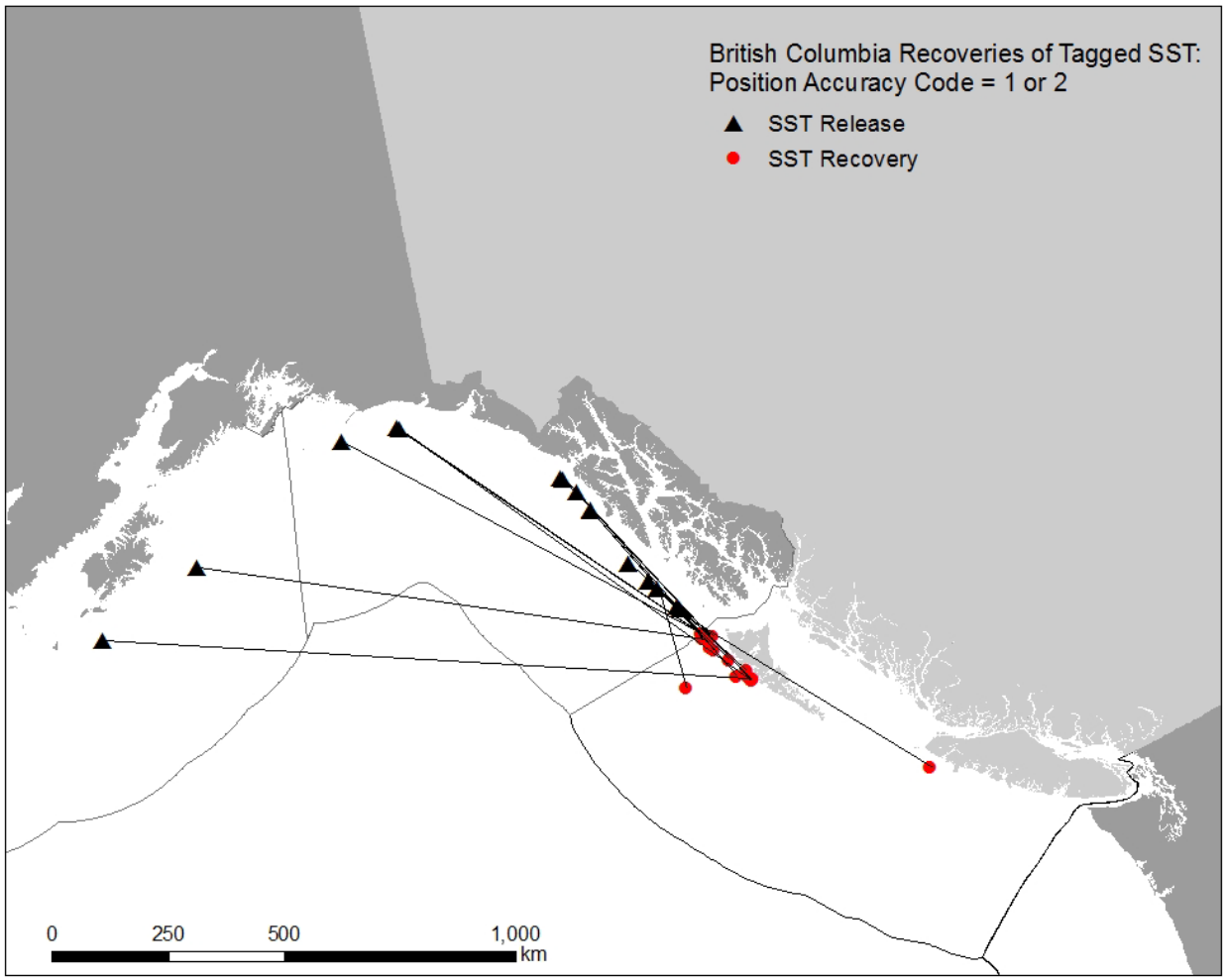

Figure 2. Figure displaying movement of tagged shortspine thornyhead that were recovered in British Columbia (BC). The line represents great circle distance between the release (black triangle) and recovery (red dot) locations, and is not representative of the path traveled between the two points. Data with position accuracy code of 1 or 2 are presented.