7. Assessment of the arrowtooth flounder stock in the Gulf of Alaska

Ingrid Spies and Wayne Palsson
Alaska Fisheries Science Center
National Marine Fisheries Service

Executive Summary

The Gulf of Alaska (GOA) arrowtooth flounder (ATF, *Atheresthes stomias*) stock is managed in Tier 3a and is assessed on a biennial basis to coincide with the GOA groundfish trawl survey. These surveys occur in odd years, and for these years a full assessment of arrowtooth flounder in the GOA area is conducted. On even years, parameter values from the previous year's assessment model (Spies et al. 2017; http://www.afsc.noaa.gov/REFM/Stocks/assessments.htm) and total catch information for the current and previous year are used to make projections and to recommend ABC and OFL for the following two years.

A single species projection model was used to predict the status of the GOA ATF stock for 2019 and 2020 and to calculate ABC for those years. The projection model incorporated parameter values from the 2017 assessment model (Spies et al. 2017) as well as catch information from 2017 and 2018 (partial through October 8, 2017).

Summary of Changes in Assessment Inputs

Changes in the input data:

1. The stock assessment model was not run for this update. New input data for the projection model consisted of the total catch for 2017 (26,865 t) and the current catch for 2018 (13,376 t as of October 8, 2018).
2. Running the projection model to predict 2019 and 2020 ABCs requires estimates for the total catches in 2018 and 2019. The final catch for 2018 was estimated by adding the average catch between October 9 and December 31 from the previous five years (2013-2017) to the 2018 catch through October 8, 2018 for a total of 13,649 t. The 2019 catch was estimated as the average catch over the past five years (2014-2018, utilizing the full year's catch estimate for 2018), for an estimate of 23,347 t.

Changes in the assessment methodology:
There were no changes to the assessment methodology.

Summary of Results

Based on the projection model results, recommended ABCs for 2019 and 2020 are 145,841 t and 140,865 t, respectively, and the OFLs are 174,598 t and 168,634 t. The new ABC and OFL recommendations for 2019 are similar to the 2017 ABCs and OFL developed using the 2017 full assessment model. The stock is not overfished, and is not approaching a condition of being overfished. Reference values are presented in the following table.

Quantity	As estimated or *specified last* year for: 2018	2019	*As estimated or *recommended this* year for: 2019	2020
M (natural mortality rate)**	0.35, 0.2	0.35, 0.2	0.35, 0.2	0.35, 0.2
Tier	3a	3a	3a	3a
Projected total (age 1+) biomass (t)	1,421,306	1,384,292	1,391,460	1,367,620
Projected Female spawning	873,789	835,009	869,399	810,159
$B_{100\%}$	924,644	924,644	924,644	924,644
$B_{40\%}$	369,858	369,858	369,858	369,858
$B_{35\%}$	323,625	323,625	323,625	323,625
F_{OFL}	0.238	0.238	0.238	0.238
$maxF_{ABC}$	0.196	0.196	0.196	0.196
F_{ABC}	0.196	0.196	0.196	0.196
OFL (t)	180,697	173,872	174,598	168,634
maxABC (t)	150,945	145,234	145,841	140,865
ABC (t)	150,945	145,234	145,841	140,865
Status	As determined *last* year for: 2016	2017	As determined *this* year for: 2017	2018
Overfishing	no	n/a	no	n/a
Overfished	n/a	no	n/a	no
Approaching overfished	n/a	no	n/a	no

*Projections are based on estimated catches of 13,649 t for 2018 and 23,347 t for 2019.
**Natural mortality rate is 0.35 for males, 0.2 for males.

Area Apportionment

The following table shows recommended area apportionments for 2019 and 2020, based on the proportion of survey biomass projected for each area using the survey averaging random effects model developed by the survey averaging working group. The recommended area apportionment percentages are found in the introduction to the 2017 SAFE document (www.afsc.noaa.gov/REFM/Docs/2015/GOAintro.pdf).

	Western	Central	West Yakutat	East Yakutat/SE	Total
2017 Area Apportionment	24.68%	48.68%	10.91%	15.73%	100%
2019 ABC (t)	35,994	70,995	15,911	22,941	145,841
2020 ABC (t)	34,765	68,573	15,368	22,158	140,865

Summary

Year	Age 1+ Biomass (t)[1]	Female spawning biomass (t)[1]	OFL	ABC	TAC	Catch[2]
2017	2,103,090	1,174,400	219,327	186,093	103,300	26,865
2018	2,079,029	1,154,310	180,697	150,945	76,300	13,376[2]
2019	1,391,460[1]	869,399[1]	174,598[1]	145,841[1]		
2020	1,367,620[1]	810,159[1]	168,634[1]	140,865[1]		

[1]Results from age-structured projection model.
[2] Catch as of October 8, 2018.
Currently, "off year" assessments are required to present a catch to biomass ratio, which is calculated as the catch divided by the total age 1+ biomass from the assessment model and 2018 total biomass from the projection model (Spies et al. 2017). The catch to biomass ratio for 1993-2018 has ranged from 0.007 in 2004 to 0.022 in 2014 (Table 7.1, Figure 7.1). The catch to biomass ratio has been steadily increasing since 1993 (Figure 7.1). The catch to biomass ratio in 2018 was 0.010, and was 0.018 in 2017. Predicted catch to biomass ratio for 2019 is 0.017.

Responses to SSC and Plan Team Comments on Assessments in General

Comments from the SSC October 2017 – June 2018

1. Provide thorough documentation of model evaluation and the logical basis for changes in model complexity in all cases.

Authors' response

This will be incorporated into the next full GOA ATF assessment in 2019.

2. Standardize the measure of fish condition.

Authors' response

Fish condition was not reported in this assessment but will be considered in future assessments.

3. Include projected distributions of fishing mortality that are conditional on future catches being fixed at the point estimates from the harvest control rule, where those distributions incorporate parameter uncertainty in addition to uncertainty in future recruitment.

Authors' response

Current projections are based on the standard projection model used in previous years.

4. Over the course of the summer, determine whether any factor or set of factors described in last year's ESR implies that the biomass of your stock will decline by at least 20% this year. Determine whether the current and future condition of your stock and the current and future condition of its ecosystem are "OK" or "not OK." •

Authors' response

Noted and a determination will be included in the full assessment in 2019.

Responses to SSC and Plan Team Comments Specific to this Assessment

November 2017 Plan Team
The Team recommends documenting the survey design and spatial distribution of tows in the 1961 and 1975 surveys in order to evaluate comparability with recent surveys.
The Team also recommends evaluating the cooperative US-Japan longline surveys, and this may provide information on stock trends from 1979 – 1992.

Authors' response

This will be considered in the 2019 full assessment.

December 2017 SSC

The SSC supports the Plan Team's recommendation that the assessment authors continue to reevaluate the use of these early survey data. The Plan Team recommended documenting the survey design and spatial distribution in 1961 and 1975 to evaluate the comparability of these early surveys to recent surveys. The Team also recommended evaluating the cooperative US-Japan longline surveys, as they may provide information on stock trends over the period from 1979 – 1992. In addition, the SSC recommends that the authors look into the availability of ADF&G bottom trawl surveys in the central and western Gulf of Alaska to see if any of them span the years in question.

The SSC endorses the Plan Team's and authors' recommended ABC and OFL for arrowtooth flounder for 2018 and 2019 using Tier 3a calculations, as well as the recommended area apportionments of ABC.

Authors' response

This will be considered in the 2019 full assessment.

Literature cited

Spies, I., Ianelli, J., Kingham, A., Narita, R. and Palsson,W. 2017. Assessment of the arrowtooth flounder stock in the Gulf of Alaska. North Pacific Fishery Management Council, P. O. Box 103136, Anchorage, AK 99510.

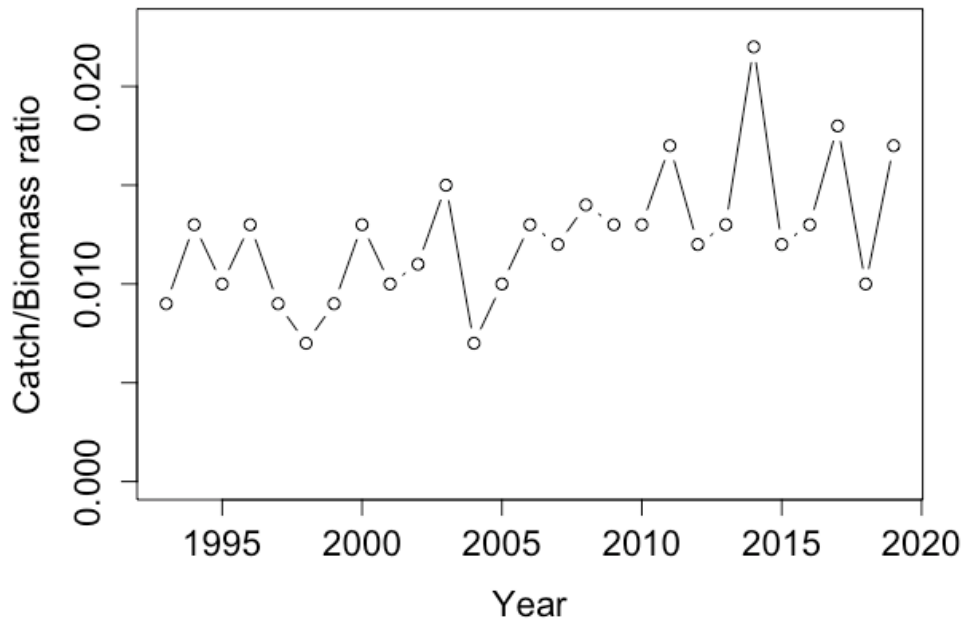

Figure 7.1 Catch to biomass ratio for Gulf of Alaska arrowtooth flounder from 1993-2019. Values for 2019 are based on projected estimates.

Table 7.1 Biomass estimates from the 2017 full assessment model, except for 2018, which was generated by the single species projection model. *Catch data is from the NMFS AKRO BLEND/Catch Accounting System, except for 2018 which is an estimate based on the catch as of October 8, 2018 extrapolated to Dec. 31, 2018 based on average catches from 2013-2017. **The 2019 estimate of biomass is based on the projection model output, and the 2019 catch estimate is based on the average catch from 2014-2018, including the full year estimate of catch for 2018.

Year	Biomass	Catch	Catch/Biomass Ratio
1993	1,773,450	15,559	0.009
1994	1,782,690	23,560	0.013
1995	1,776,230	18,428	0.010
1996	1,770,270	22,583	0.013
1997	1,769,730	16,319	0.009
1998	1,793,380	12,975	0.007
1999	1,835,310	16,207	0.009
2000	1,906,500	24,252	0.013
2001	1,957,130	19,964	0.010
2002	2,004,400	21,231	0.011
2003	2,035,310	29,994	0.015
2004	2,048,680	15,304	0.007
2005	2,069,910	19,770	0.010
2006	2,076,580	27,653	0.013
2007	2,054,040	25,494	0.012
2008	2,020,760	29,293	0.014
2009	1,962,540	24,937	0.013
2010	1,895,200	24,268	0.013
2011	1,826,620	30,903	0.017
2012	1,756,300	20,565	0.012
2013	1,701,770	21,612	0.013
2014	1,647,660	36,294	0.022
2015	1,571,460	19,054	0.012
2016	1,520,290	19,828	0.013
2017	1,463,110	26,865	0.018
2018	1,421,306	13,649*	0.010
2019**	1,391,460	23,347	0.017