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

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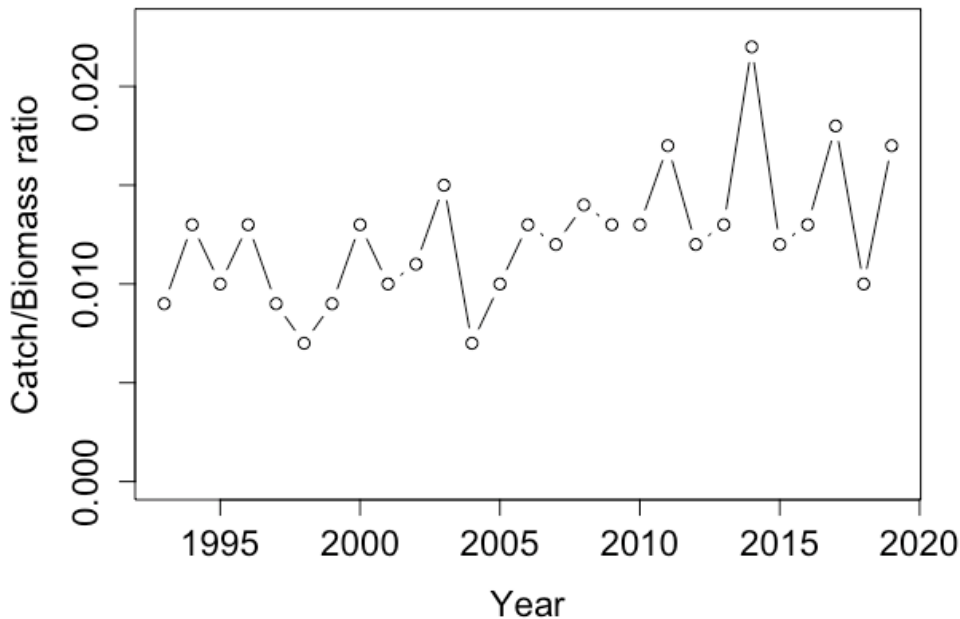
Figure 7.1 Catch to biomass ratio for Gulf of Alaska arrowtooth flounder from 1993-2019. Values for 2019 are based on projected estimates.

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 |