# 6. Assessment of the arrowtooth flounder stock in the Eastern Bering Sea and Aleutian Islands

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## Introduction

Arrowtooth flounder (ATF) have historically been assessed on an annual basis in the Bering Sea/Aleutian Islands region to coincide with the annual Bering Sea shelf multispecies groundfish trawl survey conducted each summer. In 2012, Bering Sea/Aleutian Islands (BSAI) arrowtooth flounder were moved to a biennial assessment schedule to coincide with the frequency of trawl surveys in the Aleutian Islands (AI) and the eastern Bering Sea (EBS) slope. These surveys occur in even years, and for these years a full assessment of Arrowtooth flounder in the BSAI area will be conducted. Arrowtooth flounder are managed as a Tier 3 stock using a statistical age-structured model as the primary assessment tool. Details of the model can be found at http://www.afsc.noaa.gov/REFM/Docs/2011/BSAIatf.pdf.

## Updated ABC, OFL, Catch and Projection

Because this is an "off-year" for the BSAI ATF, new survey information is not incorporated into the assessment model for this update. Instead, a projection model is run with updated catch information. This projection model run incorporates the most recent catch and provides estimates of 2014 and 2015 ABC and OFL without re-estimating the stock assessment model parameters and biological reference points. The projection model is based on the previous year's model results. The 2012 model was rerun retrospectively to incorporate a new maturity ogive (Stark 2011), which was approved by the Plan Team in September, 2013.

New catch information for this update includes the final estimate of 2012 catch and a revised estimate of 2013 catch. The 2012 catch was 22,714 t, 53% higher than the reported catch as of October 15, 2012 was 14,832. The 2013 catch through October 20, 2013 was 19,681 t. The estimated 2013 complete catch of 21,124 t was obtained by summing the total catch through October 27, 2013 (19,722 t) and the average catch from Nov-Dec from 2010 – 2012 (1,402 t). The 2014 catch was set to the average annual catch from 2010-2012 (19,675 t). A summary of the updated projection model results is shown below.

| | Last year | | This year | |
|---|---|---|---|---|
| **Quantity/Status** | 2013 | 2014 | 2014 | 2015 |
| *M* (natural mortality) | 0.35, 0.2 | 0.35, 0.2 | 0.13 | 0.13 |
| Specified/recommended Tier | 3a | 3a | 3a | 3a |
| Projected biomass (ages 1+) | 1,021,060 | 1,014,250 | 1,023,440 | 995,494 |
| **Female spawning biomass (t)** | | | | |
| Projected (point estimate) | 638,377 | 638,377 | 626,319 | 632,319 |
| Lower 95% confidence interval | | | 574,000 | 576,000 |
| Upper 95% confidence interval | | | 679,000 | 689,000 |
| $B_{100\%}$ | 616,191 | 616,191 | 577,538 | 577,538 |
| $B_{40\%}$ | 246,476 | 246,476 | 231,015 | 231,015 |
| $B_{35\%}$ | 215,667 | 215,667 | 202,138 | 202,138 |
| $F_{OFL}$ | 0.21 | 0.21 | 0.186 | 0.186 |
| $maxF_{ABC}$ (maximum allowable = F40%) | 0.17 | 0.17 | 0.156 | 0.156 |
| Specified/recommended $F_{ABC}$ | 0.17 | 0.17 | 0.156 | 0.156 |
| Specified/recommended OFL (t) | 186,000 | 186,000 | 125,642 | 125,025 |
| Specified/recommended ABC (t) | 152,000 | 152,000 | 106,599 | 106,089 |
| **Status** | As determined last year for: | | As determined this year for: | |
| | 2011 | 2012 | 2012 | 2013 |
| Is the stock being subjected to overfishing? | No | No | No | n/a |
| Is the stock currently overfished? | No | No | No | No |
| Is the stock approaching a condition of being overfished? | No | No | No | No |

Because the maturity ogive was changed in the 2013 assessment, the reference points calculated for 2012 are not appropriate for 2013. However, under both sets of reference points, female spawning biomass is well above $B_{40\%}$, and in no danger of overfishing.

***SSC and Plan Team Comments on Assessments in General.***

There are no general comments that refer to BSAI arrowtooth flounder.

***SSC and Plan Team comments Specific to this Assessment.***

December 2012 SSC minutes:

No significant changes were made to assessment methodology, but several input data sets were updated or revised. The most significant change in input data appears to be replacement of Zimmerman's (1997) female size at maturity data with more recent information from Stark (2008). Because size at 50% maturity is larger in the latter study (46 cm) than the earlier study (42.2 cm), estimates of female spawning biomass are significantly lower in this year's assessment compared to last year's assessment. The Plan Team had concerns about switching from one maturity schedule to the other and also had concerns about the statistical method used to estimate maturity parameters in this year's assessment.

The Plan Team did not accept this year's assessment model because of the aforementioned issues with the maturity schedule. Thus, the Team recommended rolling over last year's projected ABC and OFL for 2013 for use in this year's specifications for 2013 and 2014. Because of the concerns about the

use of maturity data in this year's assessment, the SSC agrees with the Plan Team's advice to roll over last year's ABC and OFL specifications.

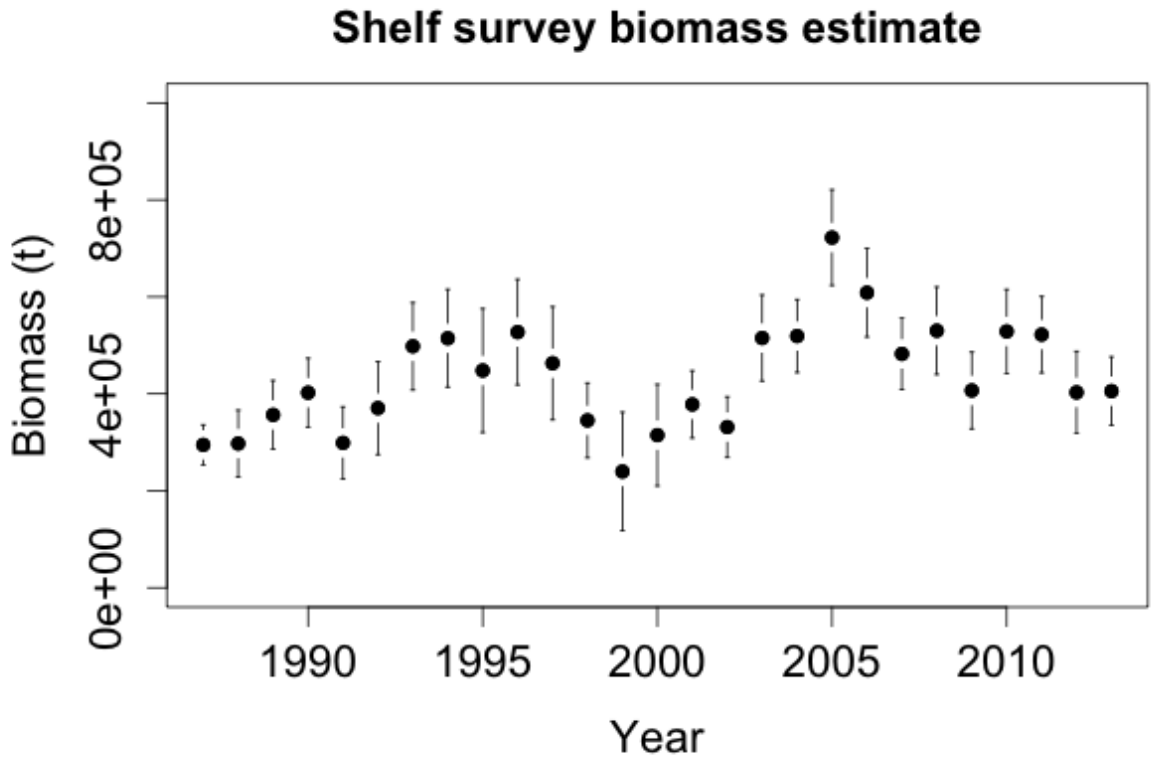
In next year's assessment, the SSC requests more detailed information to be presented about the sampling for arrowtooth flounder maturity by Zimmerman (1997) and Stark (2008). In particular, the samples used to estimate both maturity curves should be considered with respect to location of sampling and possible environmental and density-dependent effects to the extent possible. For instance, changes in size at maturity might be expected under different thermal histories of the cohorts sampled and under large shifts in arrowtooth flounder density over time. This additional detail may be helpful to decisions about how to best combine results to estimate maturity for the stock assessment.

*Author's response:*

In the September 2013 Plan Team meeting, the author presented information on the maturity studies. In 2011 a study was published which estimated maturity-at-age of arrowtooth flounder in the Bering Sea (Stark 2011). The assessment author recommended that the Stark (2011) maturity-at-age parameters replace Zimmerman (1997) parameters in the BSAI ATF stock assessment because maturity-at-age is less variable than maturity-at-length and the sample was taken in the Bering Sea. The plan team accepted the use of the Stark (2011) maturity parameters. The 2012 assessment was updated with the Stark (2011) maturity parameters prior to the new projection model runs for 2013.

**2013 Survey results**

The 2013 Bering Sea survey biomass estimate for arrowtooth flounder was 405,509 t, which is similar to the 2012 estimate of 402,887 t. The 2012 estimate of $B_{40\%}$ was 281,088 t; arrowtooth flounder biomass is above this reference point. The exploitation level remains at less than 5% for 2013.



**Summary table for the Plan Team**

| Year | Biomass (t)[1] | OFL | ABC | TAC | Catch[2] |
|---|---|---|---|---|---|
| 2012 | 1,127,050 | 181,000 | 150,000 | 25,000 | 22,714 |
| 2013 | 1,048,350 | 186,000 | 152,000 | 25,000 | 19,722[1] |
| 2014 | 1,036,960 | 125,642 | 105,968 | | |
| 2015 | 1,024,080 | 125,025 | 106,089 | | |

[1] Total biomass from age-structured projection model.

[2] Catch as of October 27, 2013.