Bering Sea and Aleutian Islands arrowtooth flounder model developments

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In this document I discuss changes to the Bering Sea Aleutian Islands (BSAI) arrowtooth flounder (ATF) model for the upcoming 2016 assessment. Two main changes were implemented; examining data weighting using the methods of Francis (2011) and updating the age-length transition matrix.

In 2015 the model was adjusted to accommodate any number of surveys, and therefore could be used for either Gulf of Alaska or BSAI data. The BSAI model was the basis for the new "combined" model; thus results using BSAI data changed very little from 2014.

In the model there is a small constant added to the proportions for the multinomial likelihoods that provide some robustness. The values varied from 0.01 to 0.00001 in the old code without a clear rationale. Consequently, all were set to a value of 0.0001 (and will be evaluated for sensitivity in the future). Comparisons with the 2014 model and the new "combined" model, biomass and female spawning biomass, instantaneous natural mortality estimates, and selectivity show that results are virtually identical (Figures 1-3).

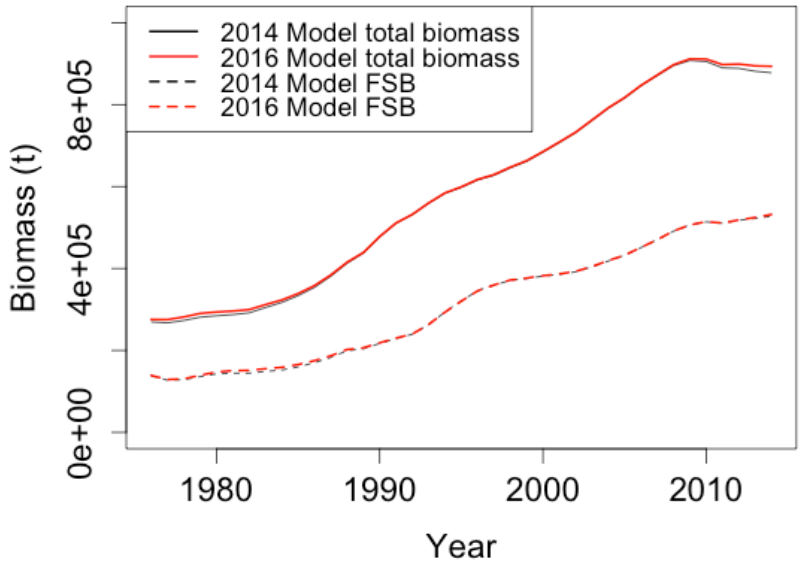


Fig. 1. This is the total and female spawning biomass (FSB) for the 2014 model and the 2016 model ("combined" model).

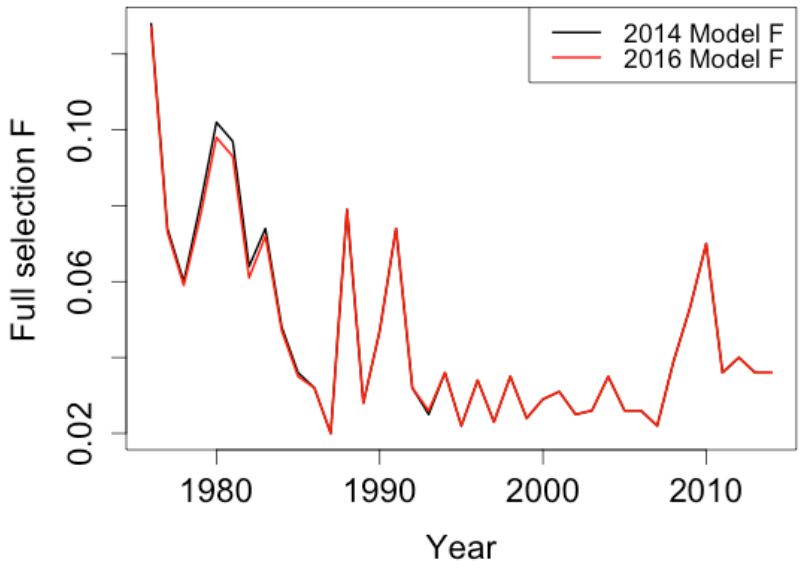


Fig. 2. Full selection F (Fishing mortality rate on age 8 females, which are subject to the highest level of selectivity).

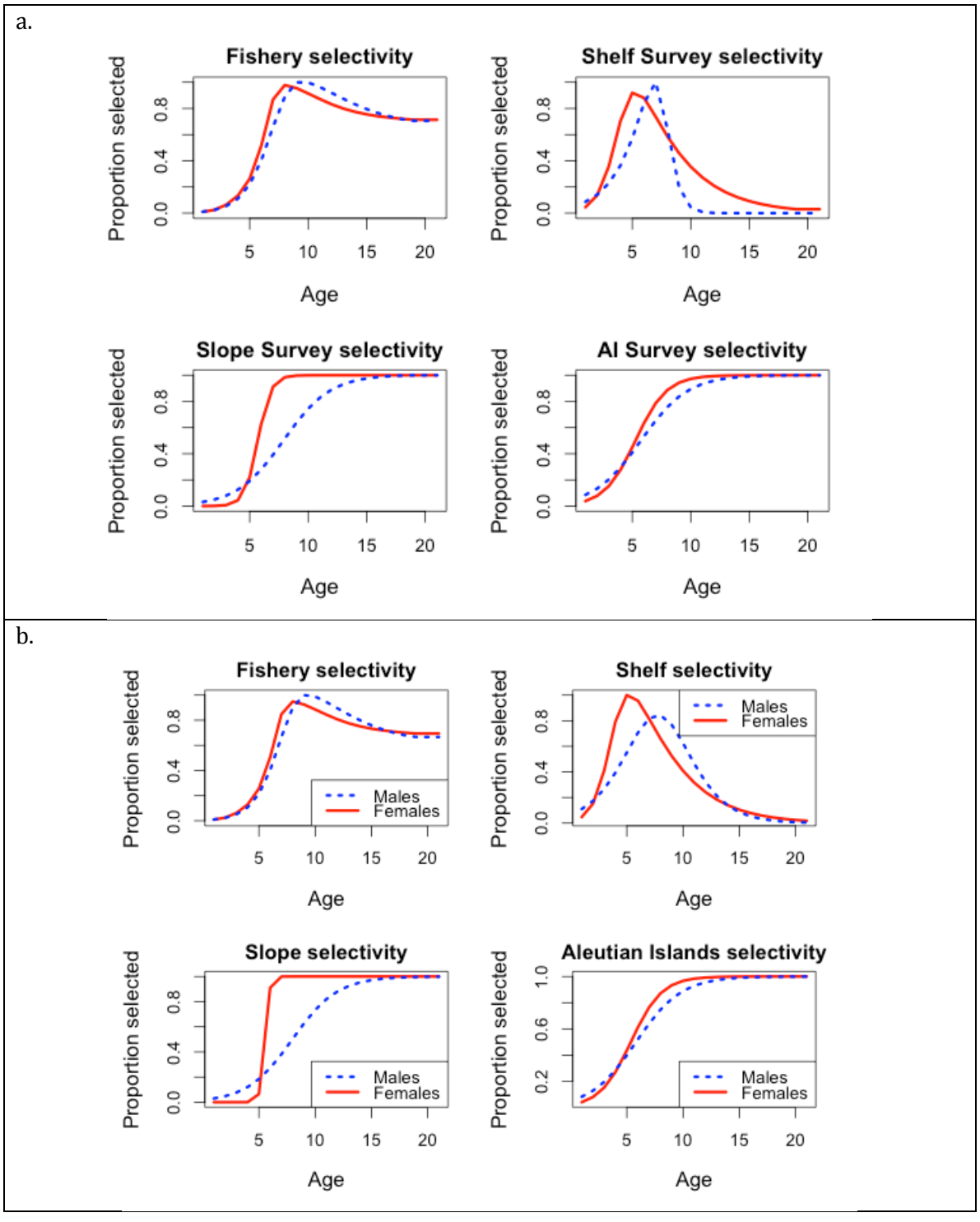


Fig. 3. Panel a. represents the selectivity for the 2016 combined model, panel a. is for the 2014 model.

The likelihood consisted of the following components:

1. Selectivity (for fishery). The likelihood penalizes differences in selectivity in sequential ages as part of the non-parametric smoothness specification. Survey selectivities are logistic and thus do not require smoothing.
2. Recruitment likelihood (lognormal with variance specified).
3. Size composition likelihood for the fishery, and three surveys (multinomial).
4. Age composition likelihood for shelf and AI survey (multinomial).
5. Survey biomass likelihood (lognormal with variances based on sampling error).
6. Catch likelihood (lognormal assuming a value for CV).

I decided to change the weighting value on the catch likehood to an estimate of the uncertainty in the catch reported. In the GOA pollock assessment, catch is assumed to be associated with 5% uncertainty. Some of the ATF catch is discarded so there is probably higher uncertainty in the ATF catch, so I have started with 6% error on catch. This had little effect on model output.

Likelihoods are assumed to have variances specified correctly weighted equally. Francis (2011) suggests weighting in two phases; the first phase involves using information about the way in which the data were collected. The second phase occurs after the model has been run and is intended to make model output more consistent with the data. The fit of the model output to the data is measured using standardized deviation of the normalized residuals, SDNR (Francis 2011). The SDNR were all close to 1. Adjusting the weights of the likelihood components did not improve the fit. Weights to all likelihoods were adjusted one at a time, but again did not improve the fit, so they were not changed.

The second change was a new age length conversion matrix. The previous matrix was based on only three years of age data from the shelf research survey. Since that time, one new year of age data from the Bering Sea shelf and one year from the Aleutian Islands has been aged. Data was also available from other surveys in the BSAI; 1,280 males and 2,593 females so I used all available data to estimate the revised matrix (Fig. 8). Results with the updated values showed that biomass estimates were slightly lower than that from the earlier version (Figs. 4-6). Model fits to all three surveys were reasonable (Fig. 7).

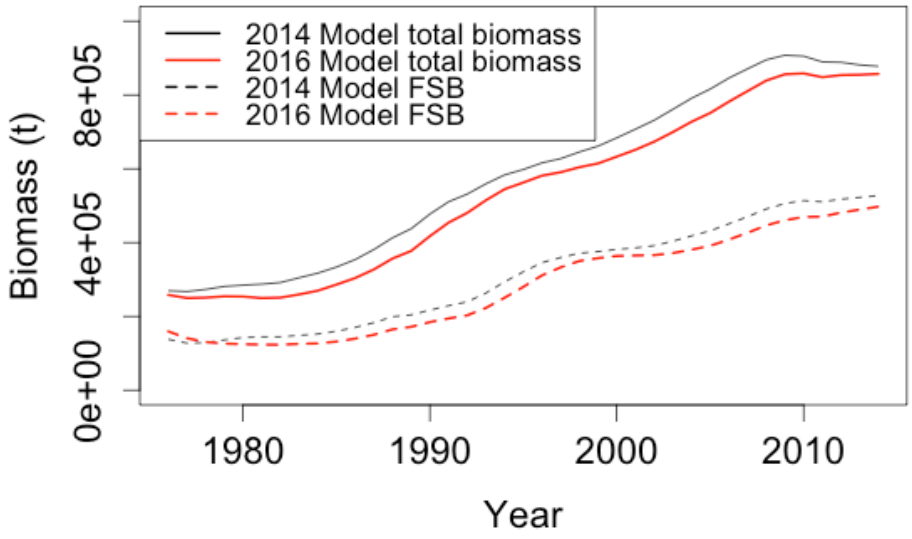


Fig. 4. Total and female spawning biomass for the 2014 model and the current model with a new transition matrix.

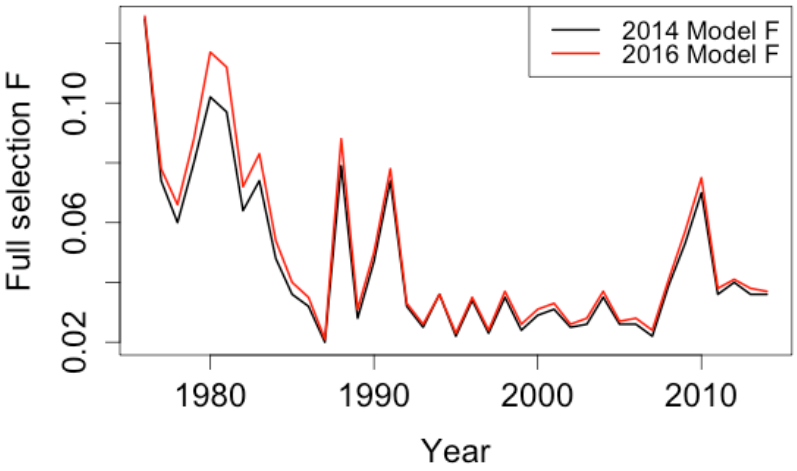


Fig. 5. Change in fishing mortality between the 2014 model and the 2016 model with updated age-length transition matrix.

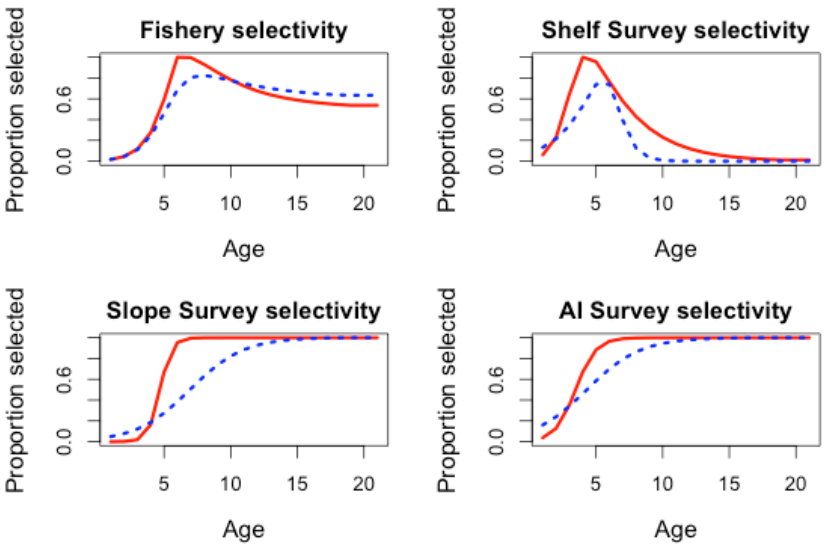


Fig. 6. Fishery and survey selectivities with the 2016 model with updated transition matrix.

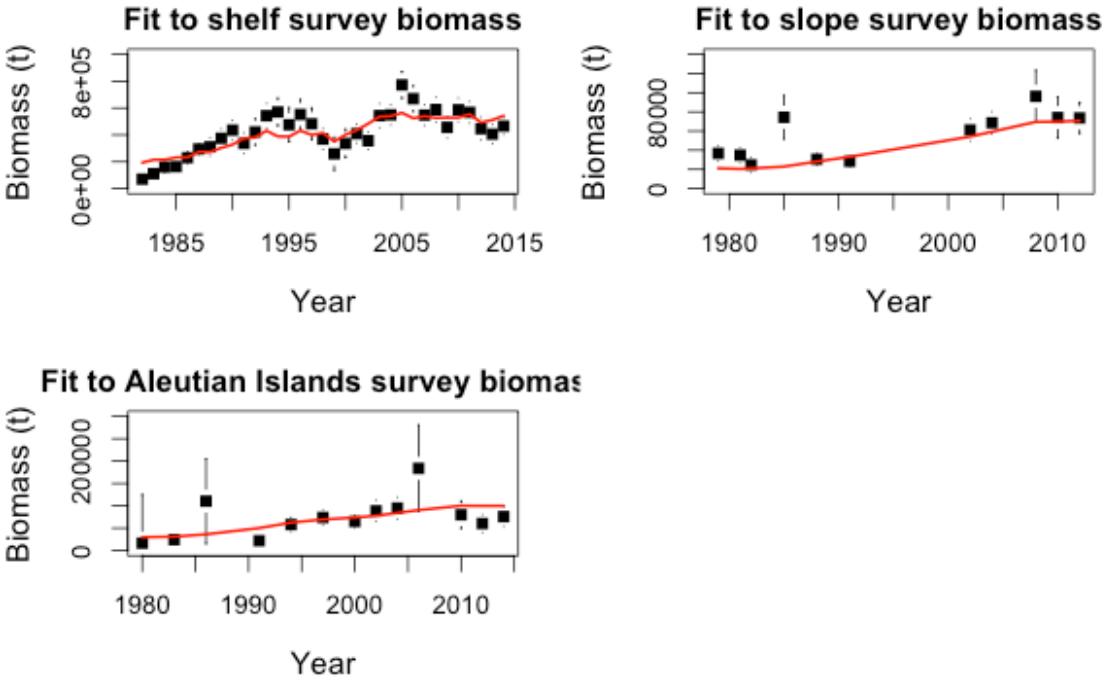


Fig. 7. Fit to the shelf, slope, and Aleutian Island data.

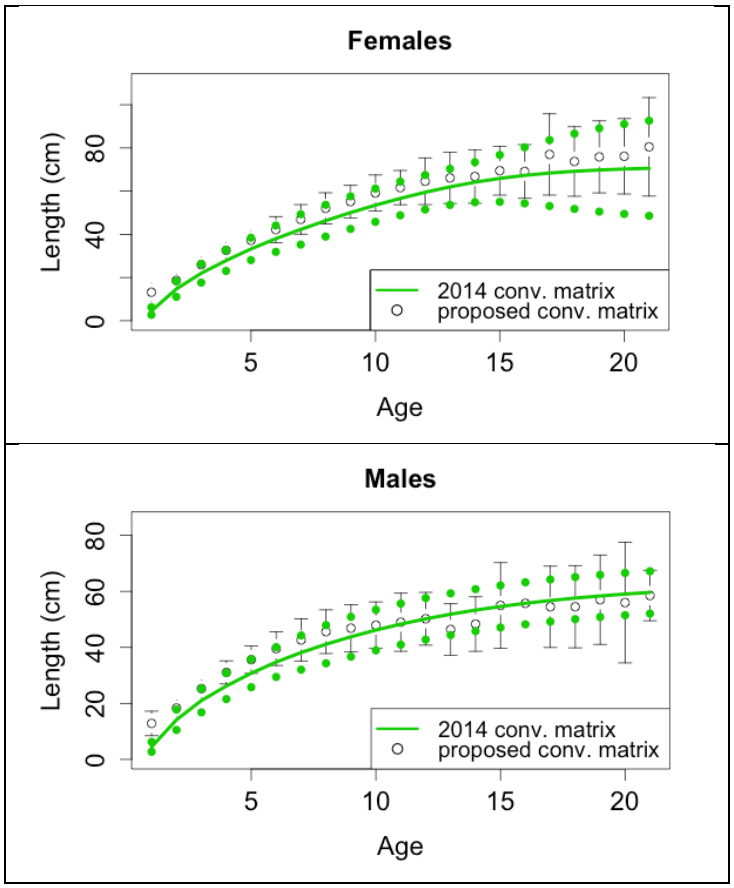


Fig. 8. This is the mean and 95% upper and lower confidence intervals for the new and old length conversion matrix.