Theme 1: Scientific/technical approach to fishery stock assessment model

Summary

The Alaska Fisheries Science Center (AFSC) uses standard and customized versions of models that are found in the NOAA Fisheries toolbox. The majority of the data-rich target species (Tiers 1-3) are based on the AMAK (Assessment Model for Alaska) framework (e.g., Courtney et al. 2007, Ianelli et al. 2013). The others use the recent versions of the Stock Synthesis package (Methot and Wetzel 2013). Both are so-called integrated statistical catch-at-age models (Maunder and Punt 2013), that incorporate fishery dependent and fishery independent data such as abundance indices and length and age composition in one statistical framework. These models are able to produce estimates of female spawning biomass and annual catch limits and estimate the uncertainty around those quantities.

For more data-limited situations (Tiers 4-6), mainly non-target stocks, a variety of methods exist to set annual catch limits. Annual catch limits for stocks where “reliable” survey biomass and natural mortality exist are usually estimated as the product of natural mortality and an average of recent survey biomass estimates and a 25% buffer. For the most data-limited situations, annual catch limits are based on the time series of historical catch (Tier 6), or included in the Fishery Management Plan as an ecosystem component, where catch is monitored but not constrained by annual catch limits. A workgroup has recently conducted simulations to assess the most appropriate method for survey averaging and has generally recommended the use of Kalman filter/random effects-type models (Plan Team survey averaging working group report 2012).

Both the AMAK and SS type models are capable of considering environmental or ecosystem effects. One example in use at AFSC is the estimation of temperature-dependent catchability (see 2013 BSA yellowfin sole assessment) that relates the amount of yellowfin biomass available to the trawl survey to bottom temperature in that year. Another example that illustrates the capability is using environmental data (e.g., the position of the North Pacific Polar Front) inside the stock assessment to help explain variability in sablefish recruitment (Shotwell et al. 2013).

The assessment modeling at AFSC is constantly evolving. Since assessments are conducted and reviewed annually, many challenges are noted and incrementally solved through developments in existing methods and consideration of new methods. Multiple AFSC scientists are on national and international assessment working groups which helps foster collaboration and infusion of alternative methods at the AFSC. The use of Stock Synthesis at AFSC keeps the Center up to date to what many are using nationally and internationally. However, the use of custom models allows assessment authors to easily make incremental changes or adopt innovative approaches in stock-specific cases. The assessment group at AFSC meets internally each year to present new methods and current stock assessment issues. Many assessment scientists also are affiliate faculty at universities and serve on graduate committees for projects that often provide detailed testing of stock assessment models (e.g., Hulson et al. 2013).