Weakfish Predation Models Summary

Additional analyses for the weakfish stock assessment include several new and updated approaches. Time series (1981-2007) of weakfish age aggregated (ages 1+) $F$ and stock biomass (mt) estimates were derived in the new assessment based on blended relative abundance indices from the MRFSS mid-Atlantic private boat fishery, the August NJ trawl survey, and the DE trawl survey.

1) New Analysis - Ricker stock recruitment (S-R) modeling that included the coast-wide blended recruitment index for the 1981 to 2007 year-classes against spawning stock size (mt) that consisted of the age aggregated (ages 1+) biomass (mt) estimates from the index-based analysis. This nonlinear model was run alone and in combination with a blended index of predation ($T_{pred}$) consisting of the time series of coast-wide striped bass and spiny dogfish abundance. When the Ricker model was run without predation effects, the statistical fit to the S-R data was strong (high coefficient of determination and low standard errors about the parameter estimates), but a significant serial correlation in the residuals was noted, indicating serious process error. When the Ricker model was fitted to S-R data in the presence of $T_{pred}$, the fit was strong, the precision of the parameter estimates was higher, and most importantly, the residual pattern became random over time, suggesting that enhanced predation of age 0 weakfish (emergence of a demographic bottleneck) by striped bass and spiny dogfish is an important process in the current weakfish stock-recruitment relationship.

2) New Analysis - Comprehensive screening of potential candidate predators (striped bass, spiny dogfish, bluefish and Summer flounder), environmental factors (mean summer (July-September) sea surface water temperature and deviations in the winter North Atlantic Oscillation index) and fishing-related effects (discards (mt) and discard-related $F$) against several response variables (weakfish surplus production, index of weakfish biomass and juvenile weakfish mortality) using a Pearson correlation matrix and stepwise multiple regression methods in SAS. Results revealed that only striped bass and spiny dogfish abundance was significantly ($P < 0.001$) linked to the recent (post 1998) rise in weakfish juvenile mortality and corresponding decline in weakfish biomass and surplus production.

3) Updated Steele-Henderson (S-H) model runs for Atlantic coast weakfish with and without predatory ($T_{pred}$) effects from 1981 to 2007. Another run with the S-H model includes the potential effects of declining menhaden abundance, as a secondary prey effect, on the recent rise in predatory mortality of striped bass on weakfish.

4) Updated (through 2007) equilibrium and non-equilibrium overfishing ($F_{msy}$, $B_{msy}$) estimates and their 95% confidence limits for weakfish based on results from the updated Steele-Henderson model. Results reveal that Atlantic coast weakfish is severely depleted by enhanced predatory mortality but is not overfished.