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MEMORANDUM TO: Roy E. Crabtree, Ph.D.
Regional Administrator, Southeast Regional Office

FROM: Bonnie Ponwith, Ph.D.
Science Director

SUBJECT: SEFSC Tilefish P* Projection Analysis for the South Atlantic Fishery Management Council

Enclosed is the Southeast Fisheries Science Center report describing the results of the stochastic population projections based on a P* (probability of overfishing) level of 35% for the U.S. South Atlantic tilefish population following the 2011 SEDAR 25 stock assessment.

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Tilefish P*=0.35 Projections

Prepared by the NOAA/NMFS Southeast Fisheries Science Center, Beaufort Laboratory
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Description of projections

At the last South Atlantic Fishery Management Council's, Scientific and Statistical Committee meeting (November 2011), a P* (probability of overfishing) level of 35% was established for tilefish based on the South Atlantic Fishery Management Council's ABC control rule. This report describes projections based on a P*=35% for the U.S. South Atlantic tilefish population following the 2011 SEDAR 25 stock assessment.

Projection Methods

The recursive algorithm described in Shertzer et al. (2010) as sequential PASCL was used to estimate acceptable biological catch (ABC) levels consistent with P*=35%. The stochastic output from the Monte Carlo/Bootstrap (MCB) analysis of the SEDAR 25 stock assessment was incorporated into the sequential PASCL algorithm in order to carry all uncertainty from the assessment into the projections. This complexity added to the sequential PASCL algorithm resulted in a tremendous increase in the computation time. As a result, the completion of 5,000 iterations for a five year projection analysis took approximately 65 hours to run. This analysis was run two times to determine if 5,000 iterations was sufficient for the results to be independent of the random number seed. The difference between these two runs was negligible, with approximately a 1% difference in values. Because of time constraints, the final results presented in this analysis are based on an average of these two runs.

The sequential PASCL algorithm can take into account the uncertainty associated with implementation (i.e. catching the target). Because no estimates for this type of uncertainty are available for tilefish, this analysis assumed the implementation uncertainty was zero (i.e. realized catch equals ABC exactly). It should be noted that in recent years the quota for tilefish has been exceeded by varying amounts. Should that trend continue into future years, such overages will not be accounted for in this analysis, particularly for years beyond 2012.

Stochastic projections were run to predict stock status in years after the assessment, 2011-2015. The basic structure of the projection model was the same as that of the assessment model, and parameter estimates were those from the assessment and MCB output. Fully selected F was apportioned between landings according to the selectivity curves averaged across fisheries, using geometric mean F from the last three years of the assessment period.

Point estimates of initial abundance at age in the projection (start of 2011), other than at age 1, were taken to be the 2010 estimates from each MCB run of the assessment, discounted by 2010 natural and fishing mortalities.

Fishing rates or catch levels that define the projections were assumed to start in 2012, which is the earliest year management could react to this assessment. Because the assessment period ended in 2010, the projections required an initialization period (2011). Fishing mortality in 2011 was assumed equal to the geometric mean F from the last three years of the assessment period.

To characterize uncertainty in future stock dynamics, stochasticity was included in replicate projections, each an extension of a single MCB assessment model fit. Thus, projections carried forward uncertainties in natural mortality, as well as in estimated quantities such as spawner-recruit parameters, selectivity curves, and in initial (start of 2011) abundance at age. Initial and subsequent recruitment values were generated with stochasticity using a Monte Carlo procedure, in which the estimated Beverton-Holt model of each MCB fit was used to compute mean annual recruitment values. Variability was added to the mean values by choosing multiplicative deviations at random from the recruitment deviations estimated for that chosen MCB run.

Because the base run model assumed no recruitment deviation (i.e. no stochasticity) for years 2004-2010 at age-1, the initial projection year (start of 2011) ages 2-7, which correspond to age-1 recruits in 2004-2010, included additional variability in recruitment following the same method for subsequent years at age-1.

The 2011 total landings were compiled from several sources as follows. Commercial landings were obtained from the accumulated landings system (399,664 lb whole wgt). Recreational landings were obtained from a website query of the MRFSS database, which resulted in an estimate of 9,824 fish harvested in Florida in 2011. Using an average weight estimate of 6.21 pounds whole weight (see August 14, 2009 Memorandum from the SEFSC to SERO), the MRFSS estimate of landings was computed as 61,007 (lb whole wgt). Headboat landings were assumed to be zero for this analysis. In the projection analysis, total landings of 460 (1000 lb whole wgt) were used for 2011.

Results

The results of the stochastic population projections with P* = 35% suggest the population can handle an increase in fishing mortality from the 2011 median estimate of 0.07 up to 0.09 (Table 1). This results in an increase in total landings to 668,000 (lb whole wgt) in 2012.

Table 1. Averaged results from two stochastic population projections for U.S. South Atlantic tilefish with a probability of overfishing (P*) equal to 35%. Spawning stock biomass (SSB) is in units of female gonad weight (mt) and acceptable biological catch (ABC) (1000 lb whole weight).

Year	pr($F>F_{MSY}$)	$F_{(10\%)}$	$F_{(50\%)}$	$F_{(90\%)}$	pr($SSB>SSB_{MSY}$)	$SSB_{(10\%)}$	$SSB_{(50\%)}$	$SSB_{(90\%)}$	ABC (1000 lb)
2011	0.23	0.03	0.07	0.16	0.94	28	50	106	460*
2012	0.35	0.04	0.09	0.24	0.95	28	53	118	668
2013	0.35	0.03	0.09	0.25	0.93	27	54	129	669
2014	0.35	0.03	0.09	0.25	0.91	26	55	137	666
2015	0.35	0.03	0.09	0.25	0.90	25	55	146	655

**ABC value for 2011 is based on estimated landings (see text).*

The population projections indicate the spawning biomass and landings will reach a peak and then start to decline, in large part due to the increase in *F* from 0.07 in 2011 to 0.09 in 2012 (Table 1). The Monte Carlo-bootstrap (MCB) results from the SEDAR 25 stock assessment also estimated some large year classes in the early 2000's and the passing of these year classes through the age structure explains part of the patterns indicated above.

General comments on projections

As usual, projections should be interpreted in light of the model assumptions and key aspects of the data. Some major considerations are the following:

- The P* used in this analysis is conditional on the assumptions made about management/implementation uncertainty. In this case there was no information on this type of uncertainty and therefore it was assumed to be zero (e.g. realized catch = ABC). If this assumption is violated, the projection results would be affected.
- Although projections included many major sources of uncertainty, they did not include structural (model) uncertainty. That is, projection results are conditional on one set of functional forms used to describe population dynamics, selectivity, recruitment, etc.
- Fisheries were assumed to continue fishing at their estimated current proportions of total effort, using the estimated current selectivity patterns. New management regulations that alter those proportions or selectivities would likely affect projection results.
- The projections assumed that the estimated spawner-recruit relationship applies in the future. If future recruitment is characterized by runs of large or small year classes, possibly due to environmental or ecological conditions, stock trajectories may be affected.

Literature Cited

Shertzer, K.W., M.H. Prager, and E.H. Williams. 2010. Probabilistic approaches to setting acceptable biological catch and annual catch targets for multiple years: reconciling methodology with national standard guidelines. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystems 2:451-458.

Figure 1. Averaged results from two stochastic projection analyses with P*=35%. Panel (A) solid circles indicate the value of P* for each year of the projection. Panel (B) and (C) indicate the 10th, 50th (solid line with filled circles), and 90th percentiles for fishing mortality and spawning stock biomass (mt). Panel (D) indicates the landings (1000 lb whole weight) values that correspond to P*=35% for each year of the projection.