Further Explorations of A Stock Production Model Incorporating Covariates (ASPIC) for Yellowtail Snapper (*Ocyurus chrysurus*) in the US Caribbean

Joshua Sladek Nowlis
NOAA Fisheries
Southeast Fisheries Science Center
75 Virginia Beach Drive
Miami, FL 33149

At the SEDAR 8 Assessment Workshop, two versions of A Stock Production Model Incorporating Covariates (ASPIC) (Prager 1994) were developed for the US Caribbean yellowtail snapper stock (SEDAR8-AW-Report). One of these ASPIC models was based on landings and catch rate information from the line and trap fisheries off Puerto Rico while the other was based on crudely estimated landings and effort in the line fishery off St. Thomas, US Virgin Islands. Workshop participants noted that, since these islands lay on the same geological platform, they should be modeled together. This report discusses an effort to do so.

METHODS

Yellowtail snapper catch rates were determined for two Puerto Rican fishing sectors, line and trap, from 1983-2003. The line fishery was characterized by increasing landings over the time period and catch per unit effort that generally increased with the exception of a large spike in 1984 (Fig. 1). The trap fishery was characterized by declining landings in the early years of the series, which gradually increased in later years (Fig. 2). Catch per unit effort was relatively flat but showed the same 1984 spike as the line fishing series (Figs. 1, 2). The 1984 Puerto Rico catch rate data were excluded based on problems they caused in the model (SEDAR8-AW-Report), which came up in this version of the model as well.

At the Assessment Workshop, members of the St. Thomas Fishermen's Association provided a history of line fishing effort (SEDAR8-AW-Report). These data were combined with loosely extrapolated catches to estimate catch rates from 1983-2003 (Fig. 3). Both data series, catches and catch per unit effort, dropped in the first few years and then rose more or less steadily through 2003.

Combined, annual catches from these three fishing sectors ranged from just under 75,000 to just over 366,000 pounds over the time period 1983-2003. They averaged just under 200,000 pounds. This distribution of annual catches was the basis for initial estimates of MSY. Note that 2003 catch data was only partially available prior to the Assessment Workshop. Therefore, fishing mortality rates from 2002 and biomass levels from the start of 2003 were the basis of any status determinations.

A base model was configured using a logistic stock-recruitment relationship, equal weighting of indices, and initial parameter estimates as follows: initial biomass relative to unfished abundance = 0.5 (i.e., MSY level), MSY of 300,000 (between the mean and maximum annual catches observed) with a range of 100,000 to 500,000, carrying capacity equal to ten times MSY levels, or 3,000,000 with a range of 1,000,000 to 5,000,000, and catchability coefficients for the line and trap fleets of 0.01 and 0.003, respectively.

RESULTS

The base model converged on a solution with abundance that started at less than half of MSY levels, dropped slightly initially, increased through the mid 1990s, stayed relatively constant through 2000, and recently dropped, ending a bit above its starting level (Fig. 4). Fishing mortality rates dropped initially from about twice MSY levels to about MSY levels. The model estimated that in recent years fishing mortality rates have surged to more than twice MSY levels (Fig. 4).

However, these results were highly sensitive to the initial parameter values used in the estimation procedure. If initial abundance values were manipulated down to 10% of carrying capacity (20% of MSY levels) or up to 90% of carrying capacity (180% of MSY levels), the model converged on a result suggesting a fishery in slightly better shape than the base model but still overfished and experiencing overfishing (Fig. 5). If initial values of MSY were specified higher (366,000, equal to the maximum observed annual catch) or lower (200,000, equal to the mean annual catch) and carrying capacity initial values were varied to remain ten times MSY, the model estimated that the current fishery is in better shape still. The high MSY version still indicated an overfished fishery experiencing overfishing but the low MSY version suggested the fishery might be healthy (Fig. 5). Note that the values that were manipulated here were simply the starting points for the model’s estimation procedure and therefore should not influence the results in a stable model. Since the model itself is well-tested and known to be stable, the problem lies in conflicting signals from the data, as confirmed by the presence of a negative correlation among catch rate trends.

In short, the available data for the US Caribbean northern platform, including Puerto Rico, St. Thomas, and St. John, were ultimately inadequate to allow for definitive conclusions about the status of this stock using an ASPIC surplus production model. No further sensitivity analyses were performed because it was apparent the problem lie in the conflicting catch rate trends. These were separated into Puerto Rico and St. Thomas/St. John versions in analyses performed at the Assessment Workshop (SEDAR8-AW-Report).

REFERENCES

Prager, MH. 1994. A suite of extensions to a nonequilibrium surplus-production model. Fish. Bull. 92: 374-389.

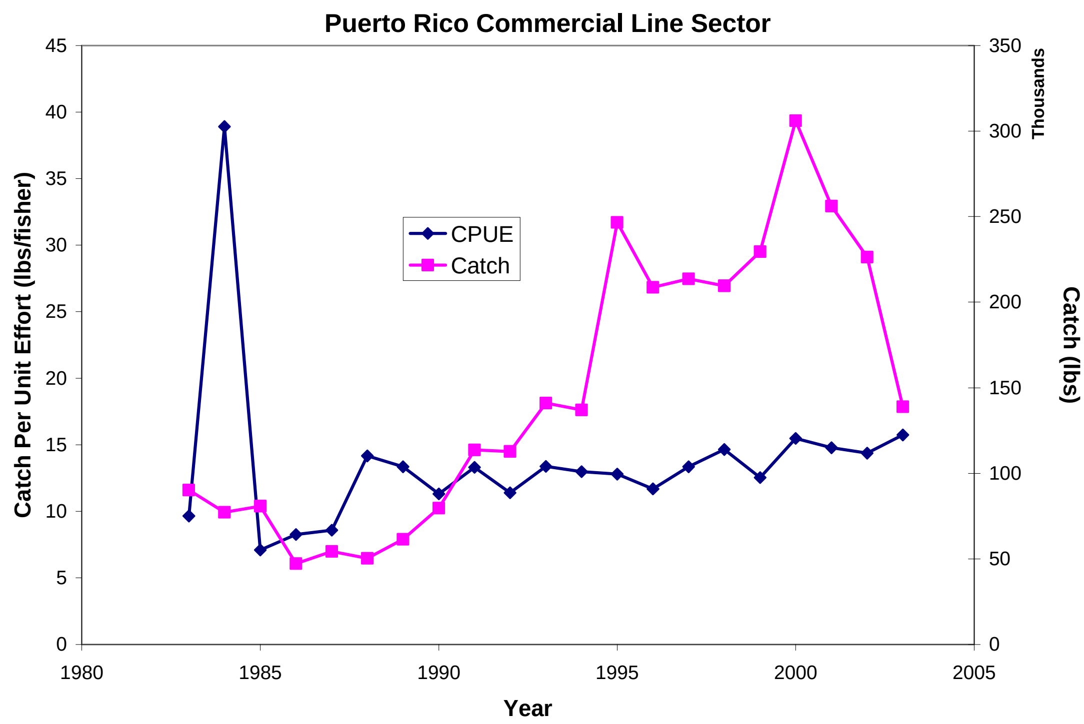

Fig. 1—Catch and Catch Per Unit Effort for the Puerto Rico Line Fleet.

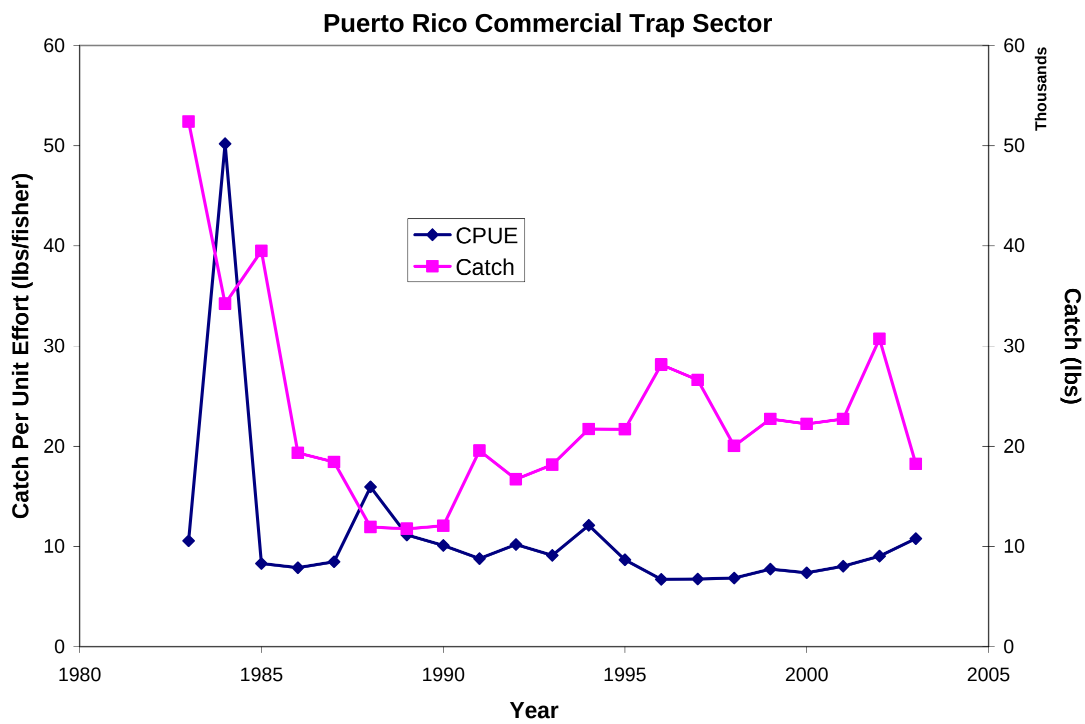

Fig. 2—Catch and Catch Per Unit Effort for the Puerto Rico Trap Fleet.

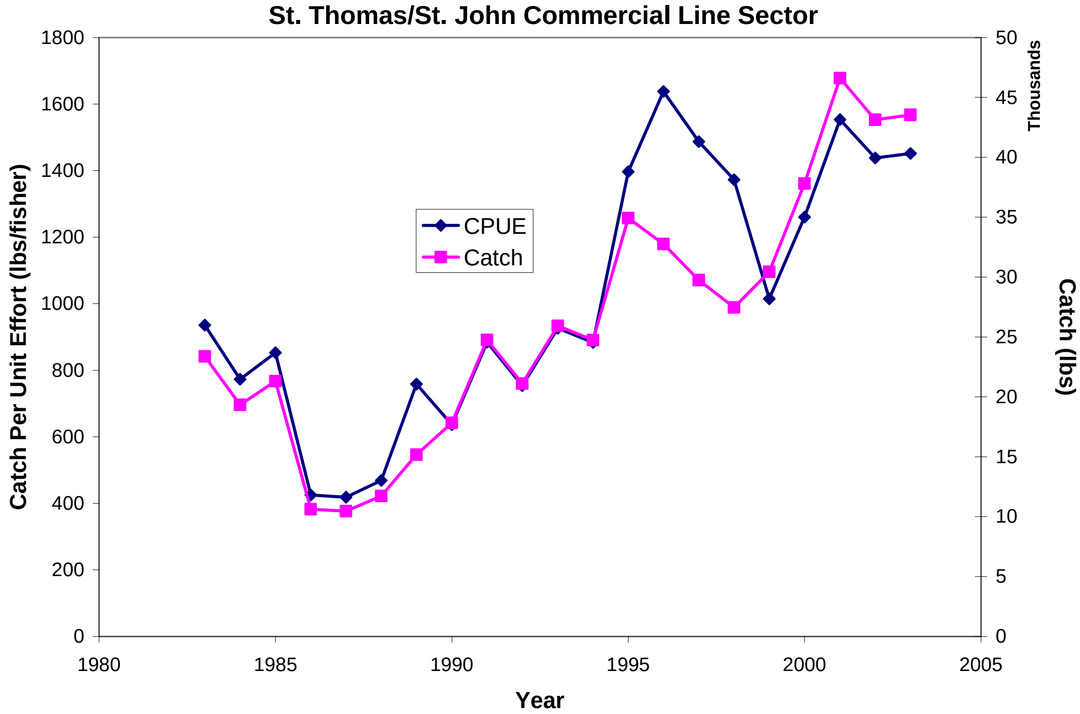

Fig. 3—Catch and Catch Per Unit Effort for the St. Thomas/St. John Line Fleet.

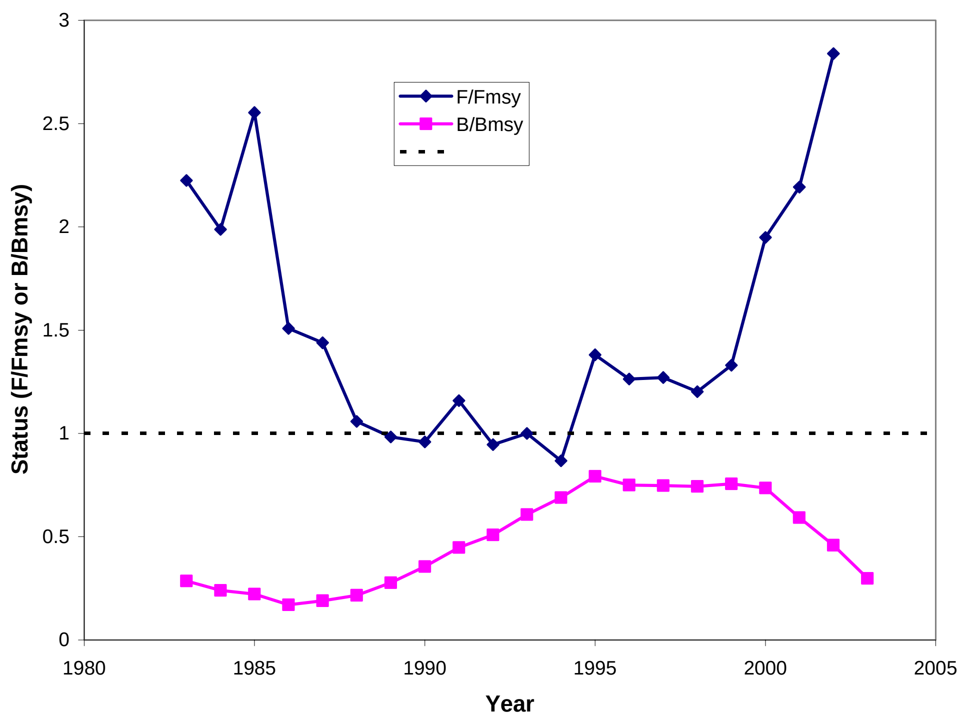

Fig. 4—Abundance and fishing mortality rate trajectories for US Caribbean Northern Platform Yellowtail Snapper.

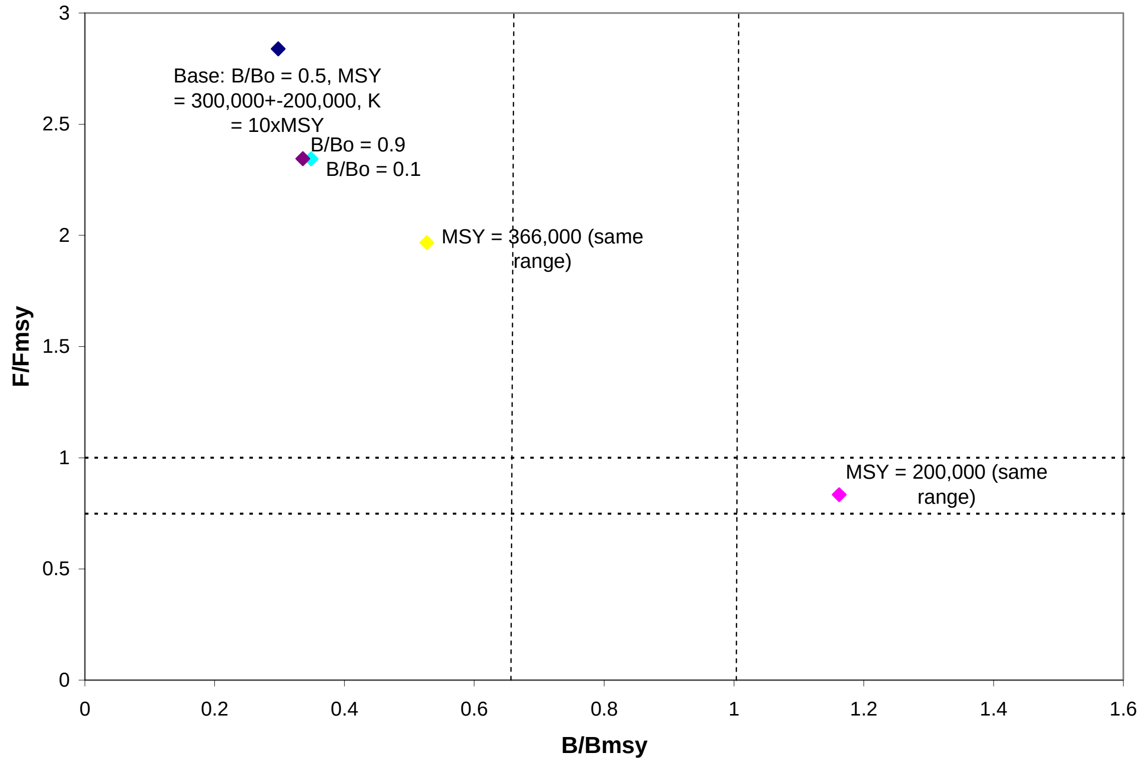

Fig. 5— Current Estimates of Abundance and Fishing Mortality Rates for US Caribbean Northern Platform Yellowtail Snapper. Abundance (B/Bmsy) estimates from 2003 and fishing mortality rate (F/Fmsy) estimates from 2002, both scaled relative to MSY levels. Colored regions on the phase plot indicate: management action is needed (red), no management action is needed (green), or, approaching conditions where management action may be needed (orange).