CALIFORNIA SCORPIONFISH

STAR Panel Report

Southwest Fisheries Regional Office
Long Beach, California
May 9-13, 2005

STAR Panel members:

Martin Dorn (Chair), Alaska Fisheries Science Center and SSC representative
Jon Brodziak, Northeast Fisheries Science Center
Patrick Cordue, Center for Independent Experts
Christopher Legault (Rapporteur), Northeast Fisheries Science Center
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Deborah Aseline–Neilson, GMT representative
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STAT Team Members Present:

Mark Maunder, Quantitative Resource Assessment LLC
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Alec MacCall, Southwest Fisheries Science Center

Overview

The STAR Panel convened the week of May 9-13, 2005 at the Southwest Fisheries Regional Office at Long Beach to review a draft assessment by the STAT Team for scorpionfish. A draft report was provided to STAR Panel members in advance of the STAR workshop and an update was provided during the meeting. Dr. Mark Maunder of the STAT Team summarized the draft document including description of the fishery, biology of the species, and available data sources. He also reviewed relevant features, settings, assumptions and results from his initial base models. Following this review, the STAR Panel requested a number of additional detailed data summaries and analyses to evaluate data quality, appropriateness of model assumptions and interpretation of results.

The Panel had considerable discussions with the STAT team concerning the number of stocks to be assessed based on the biology of the species and data availability. The draft report presented results for eight stocks of scorpionfish based on observed differences in catch rates among the different areas. However, the paucity of data for most of the regions forced borrowing of estimates from the one area with the most data and resulted in similar estimated trends among the areas. Due to the high degree of similarity in biology, the lack of definitive stock structure information, and the similarity between results when the eight regions were summed relative to a single combined assessment, the STAT team and STAR Panel agreed that only a single stock, covering the US range of scorpionfish, would be assessed.

The STAT team provided a nonstandard but useful diagnostic of maximum exploitation rate when presenting results. The initial base run showed a high maximum exploitation rate and many of the STAR Panel requests focused on eliminating this problem. The maximum exploitation rate was calculated by summing the effects of fishing over all gears at the maximum age because all selectivity curves were asymptotic. The SS2 model contains a penalty for this value exceeding an input level, usually 0.90, but does not report the value by year. The Panel found this diagnostic useful as it considered the many sensitivity analyses conducted by the STAT team. This statistic may be useful in the future to other review panels and should be included as a standard feature in the model output. However, an even more useful output would be the fishing mortality rates at age.

The indices used for tuning the model also generated much discussion. The CPFV catch rate series had the last three points (2001-2003) removed due to changes in management that were expected to generate changes in recreational catch rate for scorpionfish. The utility of the sanitation survey indices was discussed and it was concluded that it could be used as an index of abundance once the four surveys were combined into a single index. Results were sensitive to the choice of including the sanitation index and so its inclusion was selected as the main source of uncertainty in the assessment.

The STAR Panel and STAT Team arrived at a new baseline model based on the requests and results described below having the primary components: a single stock; recruitment deviations are estimated 1966-2001; a single index from the four sanitation surveys; sex-specific growth rates; fixed CV for length at age; and two time-period selectivity curve for both the recreational and commercial fisheries. The Panel recommends an alternative model which does not include the sanitation index to demonstrate uncertainty in current stock status. The Panel concludes that this assessment is based on the best available data and provides the Council insight into scorpionfish stock status and captures the range of uncertainty. The Panel commends the Team for their professionalism, dedication, hard work and cooperation with Panel requests.

Analyses requested by the STAR Panel

1) Combine all subregions and run a single US stock of scorpionfish assessment. This was the initial base case. It had the problem of unrealistically high exploitation rates, with maximum greater than one.

2) Plot length frequencies and overlay expected lengths at age. Panel members expressed concerns that the length frequencies were not showing the usual progression of modes. These plots demonstrated that either individual "super-cohorts" or else a group of large cohorts were progressing through the length frequencies over time. The STAT team was able to demonstrate that changing the coefficient of variation on length at age in the models resulted in either of these possibilities being allowed, with the model selecting "super-cohorts" through large length at age CVs. Agreement was reached that smaller length at age CVs would be input to the model to prevent this biologically implausible result.

3) Examine distribution of catches in sanitation survey relative to outfall location. Panel members expressed concern that if high catch rates were only found near the outfall location, then the index could be indicating a measure of attraction instead of population abundance. Plots showed that high catch rates were found as often away from the outfall location as near it, thus alleviating this concern.

4) Combine the four individual sanitation surveys into a single index. Using the four surveys independently would artificially inflate their importance when fitting the model. The similar trends exhibited by the surveys as well as the larger geographic coverage generated by combining the indices supported this request as well. A single index was formed as the weighted average (using inverse variance) of the four series after each was standardized to have mean one during the period of overlap.

5) Use the same growth for both sexes to see if the high exploitation rates are due to differences in growth rate. Did not remove problem of exploitation rate greater than one.

6) Remove both small and large size outliers to see if length frequency fits improve. Did not improve fits.

7) Reduce maximum age in model to see if the high exploitation rates are an artifact of having too many ages. Did not remove problem of exploitation rate greater than one.

8) Estimate dome-shaped selectivity pattern for sanitation survey because smaller size composition observed. Model estimated an asymptotic selectivity pattern for this index. Further examination of the data demonstrated that the smaller average size of the sanitation index was due to selection of smaller fish than the recreational fishery, not a decrease in selectivity of older fish.

9) Estimate age-based selectivity for both sexes combined to determine if the high exploitation rate are due to sex specific growth. Did not remove problem of exploitation rate greater than one.

10) Fix length at age CV at values of 0.025, 0.050, 0.075, and 0.100 to examine impact of estimation of "super cohorts" and exploitation rates. These runs demonstrated that the model was sensitive to this parameter; as the CV increased the likelihood decreased and the maximum exploitation rate increased. The value of .050 was selected as the new base case formulation.

11) Fix steepness at 0.5 and 1.0 to see if results change considerably from base case with steepness of 0.7. Relatively minor changes were observed in the current depletion (0.79 and 0.86 vs. 0.84) and maximum exploitation rate (0.53 and 0.57 vs. 0.55).

12) Fix M at 0.2 and 0.3 to see if results change considerably from base case with M of 0.25. Relatively minor changes were observed in the current depletion (0.75 and 0.87 vs. 0.84) and maximum exploitation rate (0.59 and 0.50 vs. 0.55).

13) Do not include the sanitation survey due to concerns about its appropriateness as an index of abundance. This was the first sensitivity run that resulted in a current depletion rate well below all the others previously observed (0.18). Further consideration of this run by the STAT team and Panel determined that this result was an artifact of estimating recruitment in recent years where there was no longer a survey providing relative abundance information and fishery selectivities were estimated. Reducing the number of years with recruitment deviations estimated resulted in a current depletion that was lower than the base case but still seemed reasonable (0.58). This latter run was selected as the form of model uncertainty to carry forward in the decision table.

Final Base Model included:

<u>Data</u>
Full catch history separated by recreational and commercial components
Use both available indices: CPFV and sanitation (a combination of four separate series)
Use all of the available RecFIN length composition data
Use commercial length composition data for the trawl and hook-and-line sectors
Do not use the commercial length composition data for the gillnet sector

<u>Model</u>
Beverton and Holt stock recruitment relationship with steepness fixed at 0.7
Estimate recruitment deviations for years 1966-2001
Fix M at 0.25 for both sexes
Fix length at age coefficient of variation at 0.05 for both sexes
Begin the model in 1916 at equilibrium and assume no historical catch prior to 1916
Use sex specific growth curves
Use two time blocks for selectivities: recreational 1916-1999 and 2000-2003, commercial 1916-1998 and 1999-2003

14) Participate in assignment of probabilities to the base and alternative models. The STAR Panel and STAT Team members all submitted probabilities and these were averaged resulting in 0.74 probability to the base model and 0.26 probability to the alternative model.

15) Create a decision analysis using the two states of nature of the base case run and the run dropping the sanitation index and three levels of catch for 10 years: current (2004) catch; the 60:20 rule catch from the base case; and the catches associated with F50% from the base case. This table was produced and will be included in the executive summary of the stock assessment document.

Technical Merits and/or deficiencies in assessments

The STAT Team is commended for the extraordinary amount of effort put into this assessment and responsiveness to STAR Panel requests. The STAT Team's insight regarding the length at age variability proved pivotal in finding an acceptable model. Any perceived deficiencies in the assessment are likely the result of inadequate or poor data. The use of catch rates as a tuning index is always problematic. The sanitation survey was not designed as a scorpionfish survey is not conducted in prime scorpionfish habitat. Characterization of uncertainty through the use of a range of point estimates can be misleading.

Areas of disagreement regarding STAR Panel recommendations

None

Unresolved problems and major uncertainties

The model results are surprisingly insensitive to changes in both natural mortality and steepness, parameters that often cause large changes in model results. Instead, model results indicate that scorpionfish biomass declined before 1980 and has since increased due mainly to changes in recruitment. The sanitation index shows an increase in recent years, which causes recent recruitment estimates to be high. Dropping the sanitation index results in lower estimates of current recruitment and biomass. Forecasts of scorpionfish biomass should consider the possibility of both high and low future recruitment as the mechanisms causing the observed changes in recruitment estimates are not understood. Stock abundance over the medium term (5-10 years) is likely to be more strongly affected by the unknown influence of environment on recruitment than any other factor.

The assumed variation in length at age had a large impact on the estimated exploitation rate. When variation in length at age was assumed large, the model achieved the best fits to the unimodal length distributions of scorpionfish by attributing the entire length distribution to a "super-cohort" that was effectively removed each year by the fishery. When variation in length at age was lower, the length distribution contained multiple cohorts that persisted over time with lower estimated mortality rates. Because of this dependence on a poorly-known parameter, the exploitation rates that scorpionfish have experienced historically are highly uncertain.

Recommendations for future research

The sanitation surveys conducted to track the impact of sewage outfall provided a fishery independent index of abundance for scorpionfish. This data source should be more fully explored for other near-shore species of recreational or commercial interest. Methods should be developed to produce a more statistically rigorous index from the separate surveys.

An age, growth and maturity study for scorpionfish is needed. Although there has been previous research on scorpionfish age and growth, the available information is not appropriate for stock assessment modeling.

Location information for the historic groundfish data of all species is currently available, in hard copy form only, from the California Department of Fish and Game. Putting this information into electronic format would greatly improve the ability to assign catches of all species to specific stocks on a trip-by-trip basis.

The SS2 model should be modified to allow for projections of user-specified recruitment at user defined values. It would be most helpful if the default harvest policies were then recalculated automatically for these user-specified recruitments.