SAFMC Staff Review of Comments Submitted by Dr. Frank Hester Regarding the Red Snapper Assessment

Upon review of the comments on the red snapper assessment submitted by Dr. Hester, there may be a need to further evaluate the selectivity assumption, its impact on the disparity between historical mean catch weight estimates and observations, and any potential impacts on recent SSB estimates. The underlying question is with selectivity, and whether a dome or flat top pattern is more appropriate for the recreational fishery. Potential evidence that the flat top assumption may bias some results is provided through Dr. Hester's comparison of the model produced mean catch weight (from total estimated catch in numbers and in weight) and the mean catch weight from the FWS reports in 1965 and 1970.

1. Dr. Hester criticizes the DW for information not provided. The observations are correct, but criticisms are somewhat unfounded as the DW report fully acknowledges these and several other data concerns.

- The DW provided the life history information that was available. Fecundity is seldom available for SG stocks, and this criticism would only be warranted if he cited some information that was overlooked. He does not.
- Very few species have available 'observations based estimates of natural mortality'. In fact, I cannot think of a single wild stock where such information is available.
- The DW provided one approach to estimating pre 1981 recreational catches – a linear interpolation that has little justification and is soundly disputed by the observations that area available in the FWS reports.
- No issues requiring additional analyses are raised in this section.

2. Comparison of VPA and forward projecting catch-age

- That VPA is more 'familiar' than catch-age is the opinion of the author. My opinion is that SEDAR participants are much more familiar with the model framework used for red snapper as it has been in use since the first SEDAR.
- It is true that both models suffer from poor data. Extensive comparisons of the various model classes in use today prove that all models suffer from poor and missing data, and that some models are better than others at dealing with particular data holes. SEDAR assessments seldom use VPA because VPA models require a complete catch-age input and apply an assumption that the catch is measured without error. Most stocks managed by the SAFMC have only a short time series of age observations adequate for constructing catch at age, and it is widely accepted that key catch sectors have considerable error in their catch estimates. In fact, determining the level of uncertainty in historic catch records is usually a topic of extensive discussion. The model used for red snapper is state of the art and has been extensively reviewed by independent peer review panels.
- Both models suffer from terminal year uncertainty and provide more accurate estimates farther back in time. This is a simple fact of all age structured assessments that essentially rely on tracking a cohort as it progress through its life.
- No issues requiring additional analyses are raised in this section.

3. It is stated that use of the FWS reports causes a major problem

- I disagree with this statement. As Dr Hester states in quotations from the AW report, initial model runs without the FWS observations suggested that pre-1981 catches were significantly higher than those estimated by the simple linear interpolation provided by the DW group. The fact is that age and length composition information suggest that the population was already reduced by the time sampling began, and observations of catch post-1981 were inadequate to drive the population down to accommodate the age composition observed when actual age composition observations became available. The model was looking for a way to remove fish, and since recreational catches are specified to have greater uncertainty than commercial catches, in terms of minimizing error the appropriate way for the model to do this was to increase early recreational catches. When reviewed further at the AW, the panel recognized that the FWS reports corroborated the path the model was determined to take, and therefore including those observations and developing an alternative historical catch series improved overall model performance, in terms of fit and residual patterns.
- The FWS observations are legitimate observations and deserved further consideration at the AW. They are based on survey results and recall, and their precision may be difficult to ascertain, but they are believed to provide better information than the linear interpolation put forth by the DW. Historical catch records are important to inferring long-term productivity, and this debate underscores the need to refine methods for estimating pre-1981 recreational landings and other historical removals

4. Conversion of catch in weight to catch in numbers. This section indicates that perhaps Dr. Hester believes that the problem with the assessment is more in how the FWS observations are incorporated than in the fact that they were incorporated at all.

- I am not familiar enough with the internal workings of the model to know all the steps it takes to go from an overall annual weight to the annual estimates of abundance and then catches at age, but I am fairly certain it involves more than just the selectivity curve. We could request further clarification, but I don't think this is critical to the potentially relevant point that emerges later.
- It is stated "The fact that these are averages implies that half the landings are less than 3 pounds" . This is not always true. It is true, however, that the preferred statistic to describe the center value of a distribution is the median, and if the median were 3 pounds then half of the observations would be less than 3 pounds. However, the same cannot be said of the average. Consider a simple example with 3 observations: 25, 50, and 225. The average is 100 and the value of the median observation is 50, so in this example one-third of the values are less than the median and two-thirds have values less than the average. All of this is really beside, and unfortunately detracts from, the fundamental observation that is identified later— that there is a discrepancy between the mean weight from the FWS reports, which provide the bulk of the landings in the early years, and the mean weight from the overall, model-estimated catch at age.
- I don't see adequate information provided to support the statement that the catch at age should heavily favor fish less than three years old. I'm also confused by the switch from an argument based on pounds to an argument based on age. If the population was indeed lightly exploited in the earliest years, and retained reasonable numbers of older fish, it

5. Selectivity Issues

- The model does incorporate a flat selectivity curve for the recreational fisheries. I am not clear whether this was a specification or whether the shape of the selectivity curve was something the model was free to determine. It is not apparent in the assessment report whether an alternative selectivity was forced in a sensitivity analysis and I can't recall that being explored at the AW.
- Concerns over the use of the flat selectivity curve were raised by Roy Crabtree some time ago. The Gulf red snapper assessment used a dome curve, and while this alone is not ample reason to apply a dome shaped selectivity pattern to Atlantic red snapper, it does provide some justification to consider a sensitivity incorporating a similar pattern.
- Some anecdotal reports suggest that species like red snapper which inhabit bottom substrates and can grow to very large size may have domed selectivity patterns by size because the largest fish are more difficult to land. There is some confounding though when selectivity is considered by age, especially for a stock such as this where the life history observations reveal that length is not informative of age. In other words, while the biggest fish may be harder to land, the biggest fish are not always and necessarily the oldest fish. Again, though, since this perception exists the domed selectivity pattern should be explored if it has not already.
- The selectivity issue may somewhat alter the model estimates of overall annual catch mean weight.

6. Conclusions

- Concerns are raised with the early catch records and the selectivity. To me, the issues go hand in hand as the selectivity assumption will influence the estimated catch age distribution and hence the back calculated average weight of the catch.
- Given Dr. Hester's submission and prior concerns raised regarding selectivity, I would like to know more about how the selectivity curve was modeled. I would also like to see a sensitivity analysis fixing a dome shaped selectivity curve in the recreational fisheries, at least in the early years when there are substantial numbers of older fish in the estimated population.
- I believe the issue of selectivity should be explored. I will be surprised if specifying a dome shaped selectivity curve will substantially change stock status estimates, but the issue requires attention so that the process can move ahead.
- It is within reason to hypothesize that a domed shaped selectivity would increase the estimated abundance of older fish, impact SSB, and ultimately influence the Stock-Recruit relationship and steepness.
- It is also within reason to hypothesize that switching to a dome shaped selectivity pattern will increase the overall F. The model needs to account for a certain number of dead fish, and if you specify that a certain segment of the population is 'off limits' or receives a smaller portion of the overall F, the model will likely be forced to increase the overall removal rate. Considering beyond the scientific ramifications, given this outcome, actions applied to the portion of the population that is exploited might need to be more severe.

- Hypothesizing even further along these lines, increased abundance of older fish would increase SSB and potentially decrease the extent to which the stock is overfished, but keep in mind that all estimates suggest the stock is severely overfished and current SSB is on the order of 3% of the desired level.

7. Discussion Items
   - Dr. Hester's concluding discussion largely reflects the opinions stated by the Review Panel, namely that while the stock appears to be at a point of equilibrium, the relation of this point of equilibrium to desirable conditions and long term maximization of yields is uncertain.
   - While current F may be sustainable over a short time, there is considerable evidence to suggest that yield is well below MSY. Also, evidence suggests the fishery is highly susceptible to fluctuations in correlation with year class strength which is risky and a classic sign of excessive exploitation.
   - There is well noted uncertainty in the biological reference for exploitation, but it should be acknowledged that estimates of current F are well above any of the proposed values for MFMT.
   - I am skeptical that new data sources will be found at this point, largely because none have surfaced over the last year as controversies regarding this assessment arose and because Dr. Hester, who clearly devoted considerable time and effort to reviewing the assessment, fails to point out any even potential sources of information to shed light on the uncertainties in the assessment.
   - I am skeptical that increased sampling of the current population in the short term will resolve the problems with estimating long-term productivity. Improving estimates of productivity can only be achieved through reducing exploitation so the age structure can expand and ensuring adequate monitoring as the population recovers.
   - Increased sampling may shed some light on the current age composition, and should at least provide greater confidence in the age composition estimates. Such endeavors should not be short lived however, as the assessment considerably suffers from a lack of both age and length sampling. Commercial age samples range from 7 to 332 annually, and only 1820 are available over nearly 20 years. That is less than 100 per year on average, which is pretty poor for a fish with a life span over 50 years.
   - I agree the Council needs to take action, and all the available evidence indicates that fishing mortality must be reduced substantially.
   - I strongly and completely disagree with the characterization that all assessment scientists presuppose a stock is depleted. This is one of several unfortunate opinion statements that detract from the potentially legitimate concerns raised regarding the selectivity pattern, and the questions raised regarding the differences in observed and estimated overall mean weight.