Some considerations of area interactions

Jimmy Hull and Frank Hester

SEDAR25-RW11

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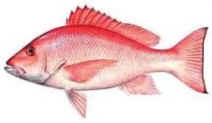

SEDAR 25: Some Considerations of Area Interactions

Prepared by

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Abstract. Reviewers for SEDAR 2 and Update recommended that: **"Sufficient details of the methods of data collection should be provided to allow the Review Panel to assess the extent to which catches from different spatial or temporal zones or from different fishing sectors have been representatively sampled, how the various samples are combined, and the sampling intensity that has been applied to the different sectors."** This paper explore the extent to which this recommendation was followed and offers some evidence based on the available disaggregated data for MARMAP and headboat data that area interaction are significant and require additional investigation.

Background. The black sea bass resource of the South Atlantic is believed to be a single genetic unit that ranges from Cape Hatteras on the north to Key West on the south. About 70% of the landings before 2003 came from the northern portion of the area. We lack the data to update the landings by states for the recent years however the imbalance between North and South is believed to continue.

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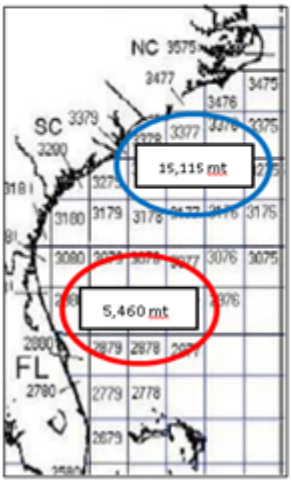
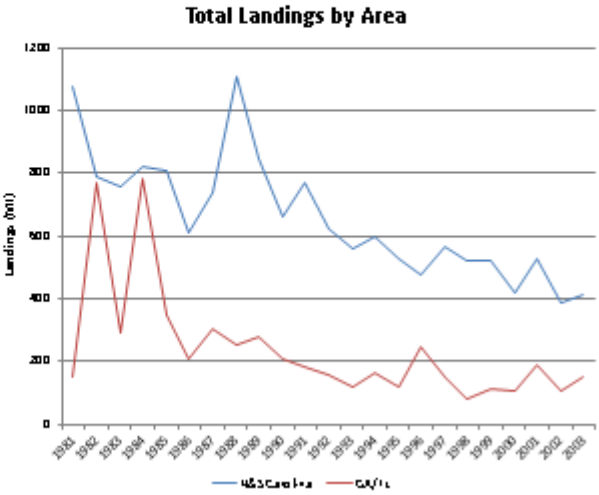
Distribution of Landings 1981-2003





Fish in this stock are known not to roam over large areas. In this they are quite different from coastal pelagic species. Their site specific habits and the considerable distances north and south of the distribution has raised questions about there being area differences that though not sufficient to

Hypothesize different genetic stocks, may support different management units due to area differences caused by environmental factors and/or exploitation by the fisheries. The review panel for SEDASR 2 stated**: "It is recommended that the assessment reports for future stock assessments include detailed descriptions of the methods of data collection, analysis, and the use of these data for stock assessment. Sufficient details of the methods of data collection should be provided to allow the Review Panel to assess the extent to which catches from different spatial or temporal zones or from different fishing sectors have been representatively sampled, how the various samples are combined, and the sampling intensity that has been applied to the different sectors.**

The Data Workshop for SEDAR recommended providing disaggregated catch and effort data for the Assessment Workshop. This would allow the investigation of YEAR*AREA interactions that exist in most of the abundance index analyses but were not pursued based on the assumption that the GLM analysis alone was adequate. Disaggregated data were not provided[i]; however, some data was available from

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MARMAP (a fishery independent survey) and the headboat recreational fishery data used to develop the headboat abundance index (SEDAR 25 DW-14) for us to evaluate some aspects of area interactions.

MARMAP Data. Date from the MARMAP chevron trap survey was avail to us in two parts, the survey data for 2009 and 2010 which included sample age information and a complete time series from 1990 to 2010 that did not provide sample age information prior to 2009[1]. A description of the MARMAP chevron trap program and methodology is provided in SEDAR 25 DW-3, and our analysis of the portion of the data available to us is given in SEDAR 25 AW-01.

SEDAR DW-3 indicated some obvious visual difference in nominal CPUE between latitudinal bands. The data were pooled and carried into a GLM model without further comment. No YEAR*AREA interactions were considered (SEDAR 25 DW Report, Appendix 5).

Our first interest was to evaluate pooling all the data into a single area on the hypothesis that there is a single management stock for the area from Virginia to south Florida. The alternate hypothesis is that there are two "stocks", one north of 32° and the other south off Georgia and Florida. The test was that the "stocks" in the two areas would exhibit compositional difference. These differences might be expressed by different age composition between the two areas in the same year that would not be expected if coastwise mixing were the norm. A simple t- test of age composition between areas rejected the homogenous single stock hypothesis[ii]. This suggest that pooling all the samples as was done in SEDAR 24 DW-3 might be reconsidered if a more detailed study using all the age composition data supports the separation.

We next examined how the index values compare for each hypothetical "stock". For this we used the entire time series and, lacking both age and length sample data, the SEDAR 25 DW-3 index values of catch per trap in numbers caught per hour soak[2]. The results are shown in Fig.2 at the end of this document and suggest a strong areal difference based on number caught.

Headboat Index.

The headboat index described in (SEDAR 25 DW-14) also did not consider YEAR*FACTOR interactions. It did provide a number of figures of residuals by factor, the one for region as a factor is reproduced below. It indicates that the mean catch rate for southern area of Georgia and Florida was significantly lower than in the other two regions. No discussion was offered. One wonders if this is a portion of the

[1] Age information is available in the MARMAP archives for the other years.

[2] MARMAP survey method was to set usually six traps in an area. Since these soaked for an generally less than 2 hours it seems likely that the traps were dispersed around the principal station and if the size of the area of dispersion is small (e.g. less than a few km.) these might be considered replicate samples.

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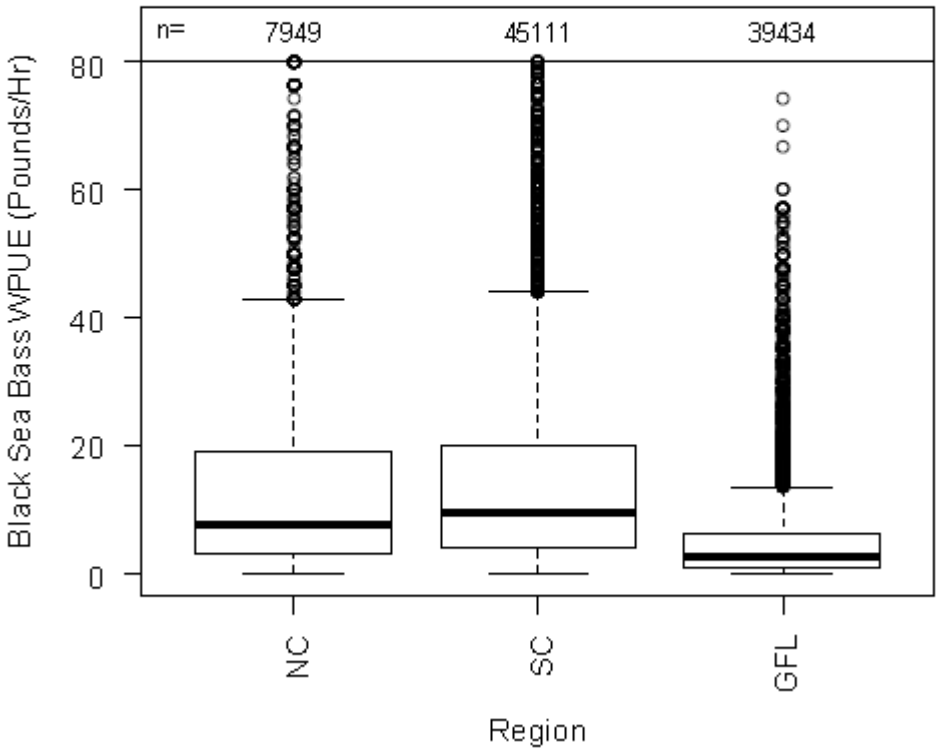
black sea bass range where abundance is lower for habitat, environmental and distributional reasons or if the difference reflects a decreased abundance owing to past fishing.

Figure 5. WPUE of black sea bass by region.



The Headboat index itself is standardized using a number of filters. It may be that in the process information has been lost that was present in the original data set. To look at that possibility we compare the nominal CPUE for the three areas with the composite standardized SEDAR 25 AW Index.

These are simple gross comparisons but they have some interesting features. First, here are the reported black sea bass headboat landings for the three areas. Three features stand out; the dominance of the South Carolina landings, the steep decline for both South Carolina and Florida when landings reports changed from boxes to actual observed and sampled weights and numbers, and the little fillip at the end when likely a large year class (or several) enter the fishery.

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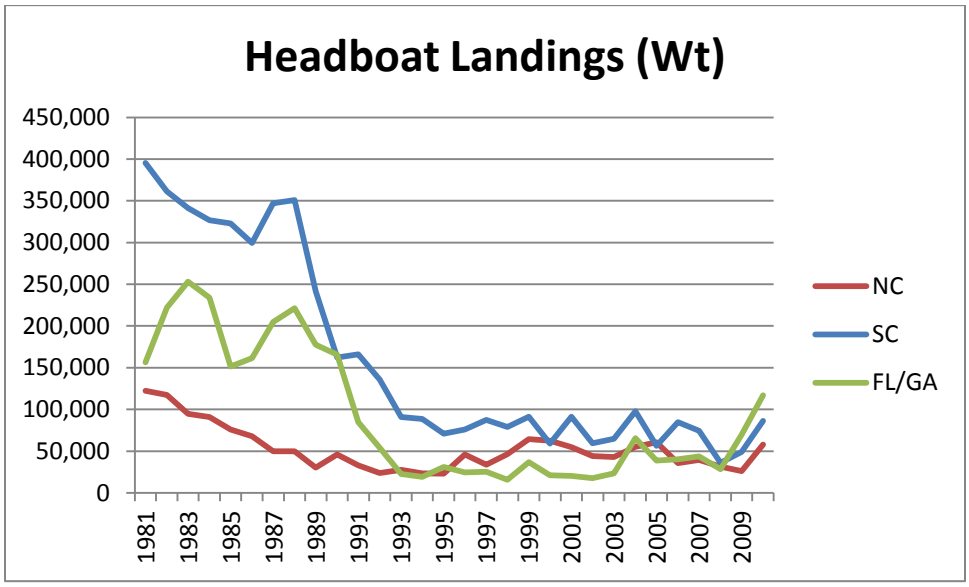
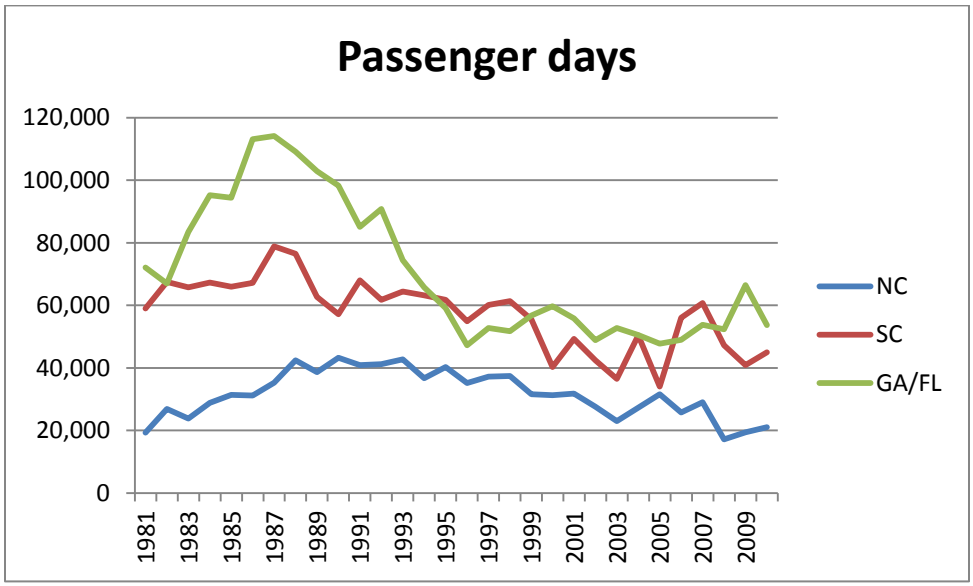


Next we look at the number of passenger days, again a gross compilation. The main features here is the pattern of the Florida headboat industry. One might speculate that the precipitous decline in black sea bass landings (above) and the decline in the Florida business (passenger days) are related.



Finally we looked at the nominal CPUE for the three areas. What is interesting is the unexplained increase in CPUE for Florida about the time that regulations and reporting were put in place.

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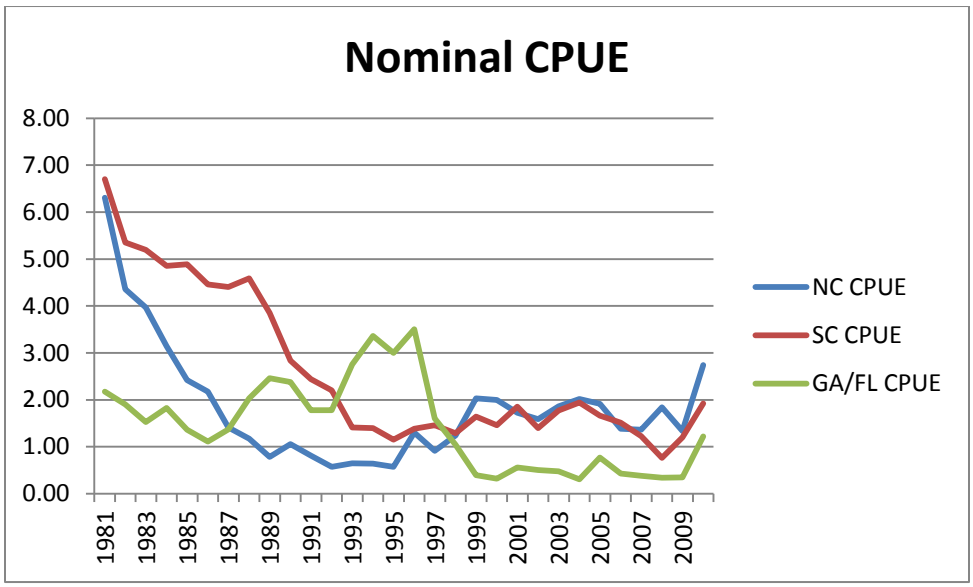
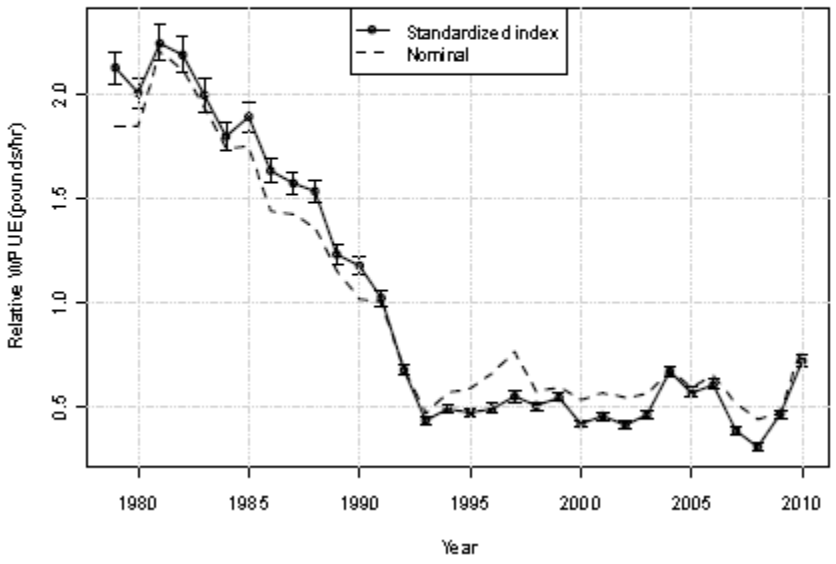


With the exception of Florida, there is a general broad agreement with the SEDAR Index below.

Figure 9. Relative Black sea bass WPUE scaled to the mean.



Source: SEDAR 25 DW-14

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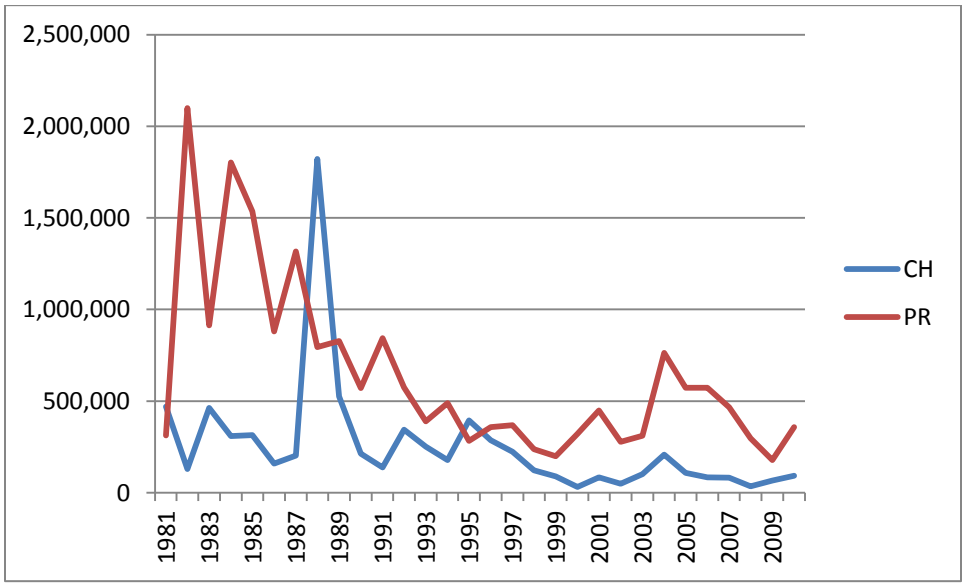
But if one looks beyond the headboat Index to the other fisheries the pattern is different.

Below are landings from the recreational MRFSS. The private boat (PR) in general follows the SEDAR index trend. The Charter boats (CH)) do not and include an anomalous spike in 1988. Unfortunately the MRFSS data were not provided disaggregated so neither the landings area of the spike nor its reliability were investigated. Also we did not determine whether the PR trend is general for all areas or area specific.



The commercial landings too were not provided disaggregated, but in their case the major declines in the early years suggested by the headboat Index seem absent (as is the case also for the commercial handline index not shown here but available in SEDAR 25 DW-18).

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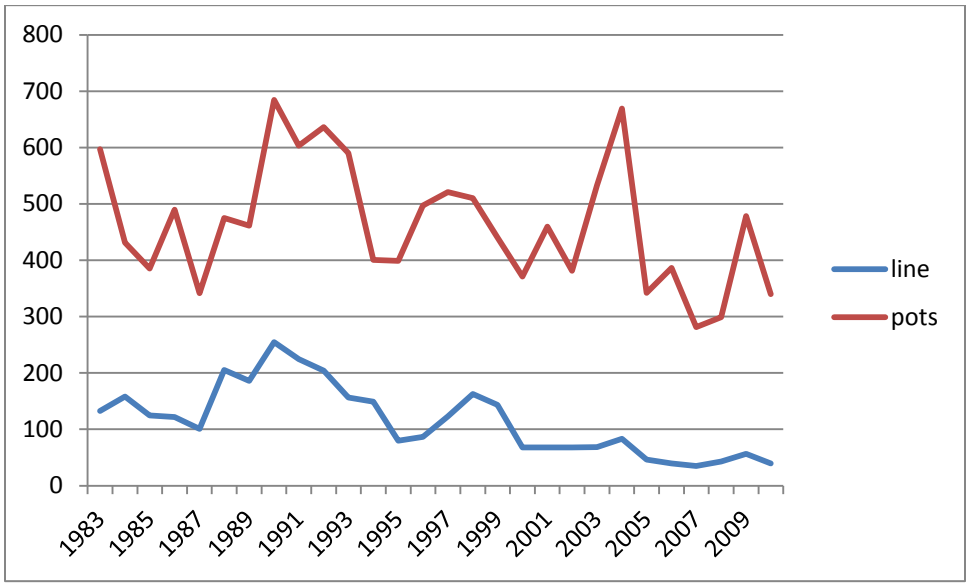

These several observations raise the question of how applicable the headboat index is to the general task of assessing a single homogeneous stock. The fact that the headboat and private boat patterns that are from the near shore areas and are similar showing the early decline whereas the Commercial landings, the handline index and charter boat landings which in general cover the more seaward areas and are reasonably invariant suggest that the effect of area and YEAR*FACTOR interaction may be more important than assumed when standardizing the indexes.

Discussion. These issues all bear on management. There is no question that it more expedient to assess the stock as a single management unit. The problem lies with determining where expediency lies in relation to sound science. All the analyses that have gone into SEDAR 25 appear to have been done without considering YEAR*FACTOR interactions. The may not be that important given the generally poor data quality available, but the whenever significant interactions occur in GLM modeling it is good practice to question them. It is also good practice when beginning an analysis to see if pooling that may be desirable to simplify the analysis is justified statistically.

The analysts are acting on the assumption that there was complete and rapid interchange through coastal migration when in reality the fishermen know that there is little coastwise movement for BSB. The assumption of a single management unit has never been tested and should be. The black sea bass fishery is changing, in large part in response to closures and restriction on other species. How the resource should be allocated will be discussed, and it would be helpful to understand better what effect concentrated removals from one area will have on other areas, and whether recruitment blankets the entire range or is spotty.

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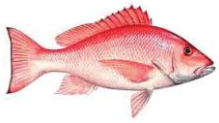

In general, data should be treated whenever possible by accepted and reproducible statistical methods. The Council receives advice from the Scientific Committee and SEDAR that is translated into quotas which are more precise than the supporting data and its analyses deserve. Some precision might be retained in the earlier stages if the data were questioned more thoroughly in the onset and statistical tests used to justify pooling, rounding and substitutions rather than relying on "eyeballing"5.

Conclusion. It was unfortunate that the recommendations by previous reviewers were not accepted for this assessment effectively postponing the question indefinitely. From the scant desegregated data we had there is at some support for further consideration of more than one stock unit when conducting the assessment. **The analysts are acting on the assumption that there is complete and rapid interchange through coastal migration when in reality the fishermen know that there is little coastwise movement for BSB. The assumption that TIME*FACTOR interactions are unimportant for South Atlantic black sea bass has never been tested but should be.**

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Figure 2. Patterns of MARMAP Indices with Headboat Index for comparison.

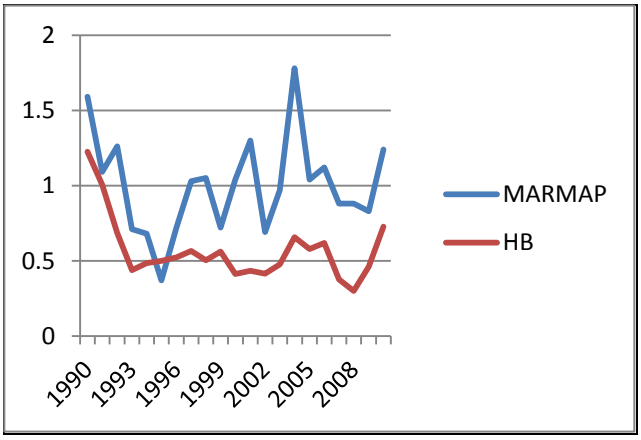

Figure 2a. Headboat and MARMAP indices (Note starting dates)

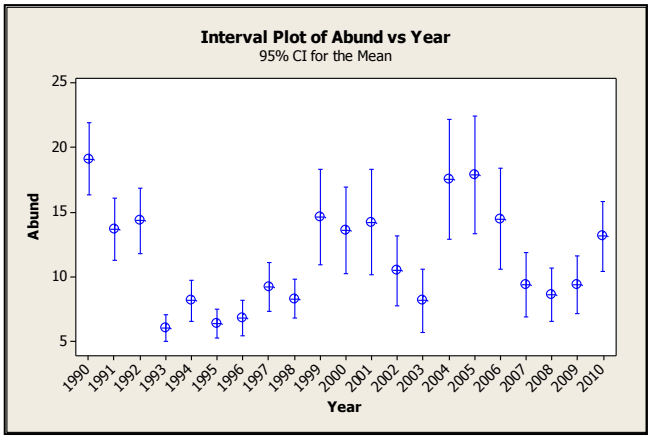

Figure 2b. MARMAP index all areas

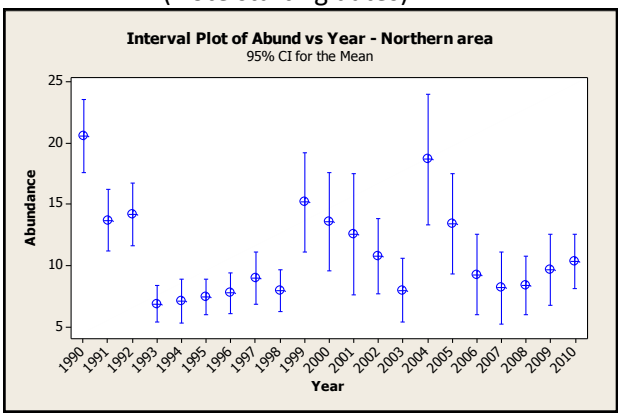

Figure 2c. MARMAP index northern area

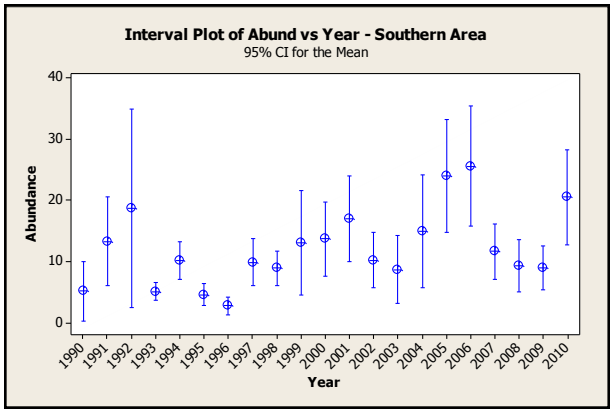

Figure 2d. MARMAP Index southern area

End Notes

[i] It is not clear when the decision not to provide the disaggregated data recommended by the DW was made. It appears to have been made after the DW workshop and the reasoning was the result from a whimsical analysis of sorts that purported to show there was no significant difference in the growth cure for fish taken north and south of the Georgia-South Carolina border. The discussion on page 22 of SDAR DW Report states:

> "A preliminary analysis of spatial and temporal variation in growth curves for black sea bass in the South Atlantic region was conducted using data from the MARMAP program. Exploratory analyses suggested similar growth curves across depth, latitude, and time periods. Though no

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formal statistical analysis was conducted, the slight apparent differences in growth with depth, latitude and time period occurred primarily for older ages (> age 6-8) where the model fit was not particularly good. This similarity in growth patterns within the South Atlantic region is consistent with the genetic data indicating no genetic differences from Cape Hatteras to Florida (section 2.3.1) and the similar mean size at age of black sea bass captured in Florida and in the Carolinas in both the commercial (Fig. 3a) (Sic) and recreational (Fig. 3b) fishery."

That of course addresses the wrong question. The suggested division into management units would be advanced if statistically supported age and length composition difference were found between areas in the same year indicating the fish do not mix rapidly enough to keep a uniform presence in all areas. (SEDAR 25 See AW-01). This is quite different from separation into genetic substocks. And the supporting Fig. 3a and 3b actually suggest persistent differences within a block of years that implies incomplete mixing between areas.

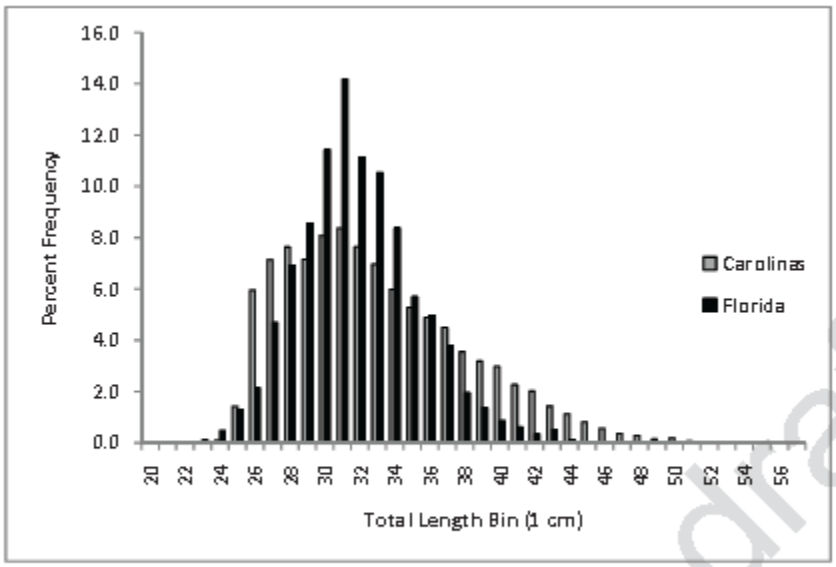

Figure 2. Total length frequency of black sea bass landed in the 2007 – 2010 commercial and recreational fisheries off North Carolina and South Carolina and off Florida.

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[ii] **Results for: 2010**

Two-Sample T-Test and CI: Calendar Age, Region

```
Two-sample T for Calendar Age
Region N Mean StDev SE Mean
North 957 3.20 1.19 0.039
South 692 3.01 1.04 0.039
Difference = mu (North) - mu (South)
Estimate for difference: 0.185131
95% CI for difference: (0.077003, 0.293259)
T-Test of difference = 0 (vs not =): T-Value = 3.36 P-Value = 0.001 DF = 1592
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Results for: 2009

Two-Sample T-Test and CI: Calendar Age, Region

```
Two-sample T for Calendar Age
Region N Mean StDev SE Mean
North 611 2.70 1.19 0.048
South 129 3.30 1.27 0.11
Difference = mu (North) - mu (South)
Estimate for difference: -0.598561
95% CI for difference: (-0.839294, -0.357828)
T-Test of difference = 0 (vs not =): T-Value = -4.91 P-Value = 0.000 DF = 178
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