Report on the SEDAR 18 Assessment Review for Atlantic Red Drum, August 2009

N. G. Hall

Unit 2
2 Wexford Street
Subiaco
Western Australia 6008
Australia
Phone: +61 8 9401 6891
Email: nghall@iinet.net.au

September 2009

Contents

1. Executive Summary

The SEDAR 18 Review Workshop examined the 2009 stock assessments developed for both the northern and southern stocks of Atlantic Red Drum and, after exploring areas of concern, accepted a base model for each stock. The accepted base models, which were developed using the ADMB software package, differed slightly from those which had been proposed initially by the Assessment Workshop (AW) in that they freely estimated the selectivities of age 4 and 5+ fish relative to that of age 3 fish rather than setting the values of these to 10 and 5%, respectively. Model estimates and predictions of biomass were imprecise, primarily because of the paucity of data relating to the abundance and age composition of older fish, i.e., those that have left the estuaries. The assessment for the northern stock was highly dependent on the input data derived from analyses of the data collected in the tagging program in North Carolina, but results from such a tagging study were not available to anchor the model fitted to the data for the southern stock.

The Review Workshop concluded that a reliable assessment of whether the stocks were overfished was not possible as a result of great uncertainty associated with the abundance of older fish. The Review Workshop concluded, however, that the 3-year average of static Spawning Potential Ratio was an appropriate measure to be used as an overfishing indicator. In the case of the northern stock, estimates of this variable were highly dependent on the information that had been input to the assessment model from the results of the analysis of tagging data. Assessment model results for this stock indicated that the 3-year average static Spawning Potential Ratio estimate of 0.45 (approximate 95% confidence interval of 0.41 to 0.50 based on conditional likelihood profile, point estimates ranging from 0.43 to 0.48 for the sensitivity runs explored, and no discernable retrospective pattern) exceeded the threshold and target reference points of 30 and 40%, respectively. A less clear result was obtained for the southern stock, however. For this, the point estimate of the 3-year average static Spawning Potential Ratio for the base model was 0.49, with approximate 95% confidence intervals from the conditional likelihood profile ranging from 0.31 to 0.82. Point estimates of this variable from different sensitivity runs ranged from 0.001 to 0.64, where the value of 0.001 resulted from a sensitivity run in which the selectivities from ages 1 to 5 for all fishing fleets in all selectivity-blocking periods were estimated. The implausibly low value appeared to result from the estimation of much higher selectivities for older fish than was the case for the other runs. Without this apparently anomalous value, the point estimates from the other sensitivity runs ranged from 0.37 to 0.64. The patterns of the trends in the estimates of the 3-year average static Spawning Potential Ratio in the retrospective analysis using the base model for the southern stock were similar, but the absolute magnitude varied markedly among the runs that employed data to different final years. The levels of the estimates appeared to lie consistently above the 30% reference level, however, suggesting that the southern stock is not currently experiencing overfishing to the extent that the threshold overfishing reference point has been breached.

A priority for research for the northern stock is to integrate the analysis of the tagging data for North Carolina into the Statistical Catch at Age assessment model, thereby assuring consistency of the assumptions used in the analyses and allowing the assessment to fully consider the implications of uncertainty in the tagging analysis. Research priorities for the southern region include the development of a well-designed tagging program, the review of the adequacy and representativeness of the various

survey indices, and investigation of the convergence issues and apparent tensions among the different datasets within the assessment model for this region.

The Data and Assessment Workshops are to be commended for the quality of the stock assessment and documentation that they submitted to the SEDAR Review Workshop, and the Assessment Team for its very competent and professional responses to the Workshop's many requests.

2. Background

2.1. Overview

A meeting to review the 2009 stock assessment for Atlantic Red Drum was held in Atlanta from 24-28 August, 2009. The SEDAR 18 Panel comprised, as Chairman, Dr Robert O'Boyle, and, as panel members, Dr Matthew Cieri, ASMFC ME DNR, and Drs Kevin Stokes, Jamie Gibson, and Norman Hall, who had been appointed by the Center for Independent Experts (CIE) (Appendix 3). The final agenda for the Review Workshop is presented in Appendix 4.

Three weeks prior to the SEDAR 18 meeting, the stock assessment document and other background documentation had been made available to Panel members. A list of these documents is presented in Appendix 1.

The Statement of Work provided to Dr Norm Hall by the CIE is attached as Appendix 2. This requires that, in addition to satisfying SEDAR's requirements for SEDAR 18 Panel members under its "Workshop Terms of Reference", an independent peer review of the assessment and review process is prepared. This report documents the findings of that independent review and is prepared in accordance with the CIE Statement of Work.

2.2. Terms of Reference

The terms of reference for the SEDAR 18 Panel are set out in SEDAR's document, "SEDAR 18. Atlantic Red Drum. Workshop Terms of Reference", while the terms of reference for this independent peer review are presented in Annex 2 of Appendix 2.

2.3. Panel membership

Details of the Panel that undertook the review of the Atlantic Red Drum stock assessment are presented in Appendix 3. In particular, the SEDAR 18 Panel members comprised:

- Dr Robert O'Boyle, Consultant, Panel Chair
- Dr Matthew Cieri, ASMFC ME DNR
- Dr Kevin Stokes, Center for Independent Experts (CIE)
- Dr Jamie Gibson, Center for Independent Experts (CIE)
- Dr Norman Hall, Center for Independent Experts (CIE)

2.4. Date and place

The SEDAR 18 Panel met to review the stock assessments for Atlantic Red Drum on August 24-28, 2009, at Doubletree Buckhead Hotel, Atlanta, Georgia.

2.5. Disclaimer

The information in this report has been provided by way of review only. The author makes no representation, express or implied, as to the accuracy of the information and accepts no liability whatsoever for either its use or any reliance placed on it.

2.6. Acknowledgments

Thanks are expressed to the personnel at SEDAR for making the review such an interesting and positive experience, and particularly to Drs Mike Murphy, Lee Paramore and Joe Grist, who responded so positively and rapidly to the many requests that were made of them. Dr Dale Theiling is to be especially thanked for ensuring that all necessary documentation was available well before the meeting and for providing guidance regarding the SEDAR process when this was necessary. The smooth running of the workshop was assisted greatly by the rapporteurs and support staff, and particularly Patrick Gilles who ensured connection of our notebook computers to the file server, allowing reviewers to focus on the stock assessment and models.

3. Description of Reviewer's role in review activities

As required under the CIE's statement of work, I familiarised myself with the assessment documentation and actively participated in the telephone conference calls among panellists prior to the meeting and in the discussions during the review meeting. Note also that, in the notes that follow and in subsequent sections of this report, the results reported are those that were presented to the Review Workshop. Following the Workshop, the Assessment Team was requested to prepare an Addendum to its original report in which the results using the new base models are reported. It is thus possible that there will be some minor inconsistencies between the results reported here, and those that are reported in the Addendum.

Review activities

Prior to the Review Workshop, the Review Panel considered and discussed the documents relating to the Atlantic Red Drum assessment that had been provided, such that issues of concern could be identified and communicated to the assessment team. Two issues of particular concern were a coding error identified by Dr Gibson, that incorrectly implemented the adjustment of the predictions of the survey indices to allow for the periods between the start of the year and the times at which the surveys were conducted, and a mismatch between the data input and values reported in the DW and AW reports that I had identified. On investigating the latter issue, the Assessment Team found that the data for the juvenile abundance index for the

northern region had been entered incorrectly, while two other tables had been updated subsequent to presenting the data in the reports. A further problem relating to model structure that had been identified by Dr Gibson was an over-paramerisation issue that related to the inclusion of a superfluous parameter in both the initial abundance-at-age and recruitment deviation parameter vectors. The Assessment Team addressed these important issues, presenting the results of the revised assessment runs at the start of the Review Workshop.

Details of the data used in the assessment, the biology of the species and the stock assessment model were presented by the Assessment Team in the early sessions of the Review Workshop (RW). The Panel discussed the information that had been presented, accepting the separation into northern and southern stocks as proposed by the assessment team, the use of the smoothed monotone growth curve and use of the Lorenzen model to describe the change in natural mortality with age.

Advice provided at the RW that the lengths at which 50% of females were mature was similar in the northern and southern regions and that the age at which 50% of females were mature was the same in both regions appeared inconsistent with the very different growth curves in the two regions. A more detailed examination of the available data appears warranted.

The Workshop considered the data on the mortality of released fish and agreed that this was an area that deserved further research, addressing questions such as the factors influencing mortality and whether this mortality differed between the northern and southern regions.

Inadequacies of length and age samples that resulted in the need to borrow age-length key data from other fishing gears or areas or to collapse the length composition data over length bins raised concern that the age characterization of some of the catches or releases was uncertain. The use of age-length keys derived from pooled data for the early years had the potential of smoothing the data and losing information on year-class strength.

An abrupt introduction of commercial discards in the northern region from 1999 was due to the decision by the Assessment Workshop not to extrapolate the discard data from 2004-06 to the years prior to 1999 as the regulations in these earlier years differed from those that applied after 1999. The Review Workshop considered that extrapolation might be more appropriate than ignoring the mortality associated with these discards, suggesting also that additional error could be considered to allow for the extrapolation to these earlier years.

The influence of the tagging data on the assessment for the northern region was discussed at considerable length. The Panel was concerned that the assumptions used in the analysis of the tagging data differed from those used in the assessment models and concluded that it would be preferable to develop an integrated model that included both the analysis of the tagging data and the assessment.

The Review Workshop was particularly concerned that the estimates of the initial abundance of the plus group was inconsistent with estimates of the abundances of the younger age classes and might result from a selectivity for older fish that was too small. Dr Gibson observed that this was a greater problem in the northern than southern region, and suggested that there would be value in re-running the assessment model excluding data for the earlier years and exploring the use of alternative values of the constants relating the selectivities of age 4 and 5+ fish to the selectivity of the age 3 fish. The Workshop discussed whether it might be more appropriate to drop the data for the period 1982-88 and run the assessment model using data from 1989. The

possibility of increasing selectivity of older age classes was raised. Low numbers of fish in intermediate age classes suggested a "hole" in the age composition.

The Workshop suggested that there would be value in extending the assessment model to produce estimates of length composition and to fit the model directly to length-composition data rather than converting the length compositions to age compositions when the age-length key was inadequate. It was noted by Dr Murphy, however, that there was little information in the length composition data for older age classes, as the length of a five year old fish was similar to that of a 20 year old fish.

The criteria used for model selection were discussed by the Workshop. It was suggested that weights were possibly more appropriately used to explore the impact of including or excluding the influence of different data sets on the value of the objective function. The effect of the weights was to adjust the variance of the data sets, and the Workshop advised that this might be accomplished in a more objective way by allowing the additional variance associated with process error to be estimated by the model.

The Workshop discussed the overfishing indicator and concluded that the use of a 3-year moving average of static Spawning Potential Ratio (sSPR) would be more appropriate than use of the annual estimate as the inter-annual variability in the latter would produce highly inconsistent conclusions regarding the overfishing status of the stock. It was decided that, to allow for an understanding of the influence of model uncertainty on the estimates of sSPR, the values of this indicator should be listed in the table comparing the results of the various sensitivity runs.

An exploration of model sensitivity to alternative values of the selection constants relating the selectivity of 4 and 5+ fish to that of age 3 fish was considered essential. Similarly, the Workshop concluded that runs to compare the effect of including or excluding the tagging data for the northern region should be undertaken. The Workshop decided that the data prior to 1989 should be excluded from the assessment. Participants also discussed the input of geometric or arithmetic means for the survey results, and advised that use of the former would result in double smoothing and that it was more correct to input the arithmetic means.

The Review Panel expressed concern that the penalty imposed on the selectivities to "regularize" these had the effect of smoothing the estimates. A very high factor would result in a common value of selectivity. The Assessment Team advised that the intent of the penalty was to avoid "spikes" in selectivity and that, without this penalty, the model failed to converge to an area in parameter space within which the Hessian was positive definite. The exclusion of the penalty was explored by the Workshop and it was confirmed that it was essential for model convergence. The Workshop concluded that the term would need to be retained, but that the model's sensitivity to exclusion of the term suggested that the information available within the input data was insufficient to provide a robust description of the fishery, and that convergence of the model was facilitated by the information provided by the assumption that such a penalty should be included. That is, the "glue" that holds the model together appears to be driven by an assumption rather than by the available data.

The Workshop discussed whether a reliable indicator of the overfished status of the stock could be determined. After considering the cryptic and implausibly large biomass of the plus group of fish, the panel concluded that a reliable measure of the biomass or the spawning biomass could not be determined. As a consequence, it is also not possible to produce reliable estimates of the parameters of the stock-

recruitment relationship or to determine reliable reference points against which the biomass estimate might be compared. Use of alternative overfishing indicators was considered, but use of proxies to sSPR such as escapement and fishing mortality-based indicators required estimation of reference points that produced sSPR values equivalent to the target and threshold levels for this last indicator. It was thus considered more appropriate to continue to use the existing sSPR reference points and the sSPR indicator than one of the alternative indicators. This decision was reinforced by recognition of the fact that fishing mortality reference points would vary as fishing effort shifted among the various fishing gears and "fleets".

The Review Workshop requested that the model should be run to explore the effect of a range of constants representing the relative selectivities of the age 4 and 5+ fish relative to that of age 3 fish. The runs were to exclude data prior to 1989, to use arithmetic means of survey indices rather than geometric means and to retain the use of the penalty on the selectivities that "regularized" these parameter estimates.

Dr Gibson presented the results of an MCMC analysis that he had run using the model, which demonstrated the value of this tool to explore the uncertainty of the parameters and estimates of sSPR.

The results of the runs requested by the Review Panel were considered. Results were re-arranged into tables that allowed the results from the alternative runs to be compared more readily (Tables 1 and 2). Note that, in the tables below, I have entered the values of the three-year average of sSPR rather than the annual sSPR which was examined by the Review Panel.

Table 1. Results of fitting the assessment model for the northern region with different values of the constants relating age-4 and age-5 selectivities to age-3 selectivities.

Selectivity factor		Negative log-likelihood	3-year average sSPR
Age-4	Age-5+		
0.05	0.025	1666	0.46
0.2	0.1	2505	0.65
0.2	0.2	2014	0.47
0.2	0.4	2045	0.44
1	1	4179	0.44
0.061 (est)	0.001 (est)	1656	0.45

Table 2. Results of fitting the assessment model for the southern region with different values of the constants relating age-4 and age-5 selectivities to age-3 selectivities.

Selectivity factor		Negative log-likelihood	3-year average sSPR
Age-4	Age-5+		
0.05	0.025	1106	0.62
0.2	0.1	1105	0.11
0.2	0.2	1117	0.02
0.2	0.4	1118	0.006
1	1	1075	0.001
0.314 (est.)	0.008 (est.)	1065	0.49

The values of the objective function for the northern region were far more sensitive to the values of the age-4 and 5+ selectivities than those in the southern region. In contrast, the values of sSPR for the southern region were far more sensitive than those for the northern region. The latter result appears likely to be due to the influence of the tagging data on the estimates of fishing mortality in the northern region.

The Review Panel decided that, because of the sensitivity of model results to these selectivity parameters, it was better to estimate rather than to specify the values of the age-4 and age-5+ selectivities relative to that of the age-3 fish, and selected the models that estimated these values as the base models for the assessment. It was noted, however, that, for the northern region, proportions at age were typically overestimated for younger and older age classes and underestimated for ages-4 and 5 (Fig. 1). Similar patterns were evident in the proportion-at-age data for the southern region (Fig. 2).

The plots of the conditional likelihood profiles of the 3-year average sSPR revealed that the estimate for this indicator for the northern stock of Atlantic Red Drum, i.e. 0.45, was far more precise than that for the southern stock, i.e. 0.49 (Figs 3 and 4). In both cases, the value of the 3-year average sSPR that maximized the likelihood exceeded 40%. The estimated 95% confidence limits for the 3-year average sSPR for the northern and southern stocks were 0.41 to 0.50 and 0.31 to 0.82, respectively.

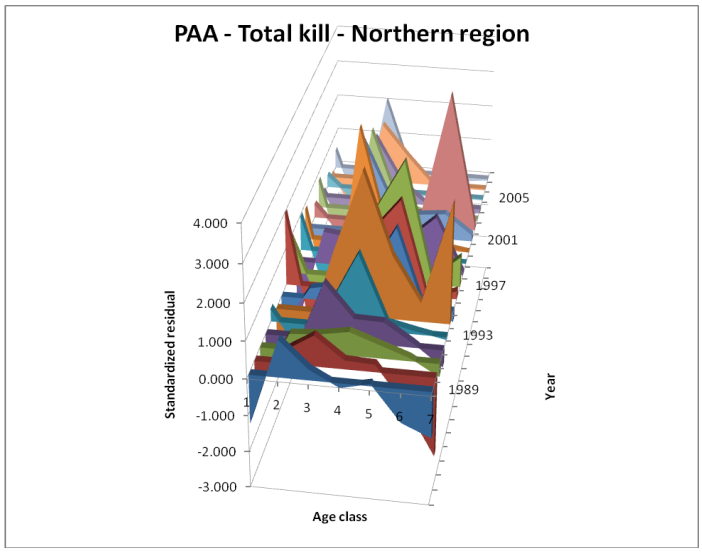

Figure 1. Standardized residuals for the proportions at age in the total kill for the northern region.

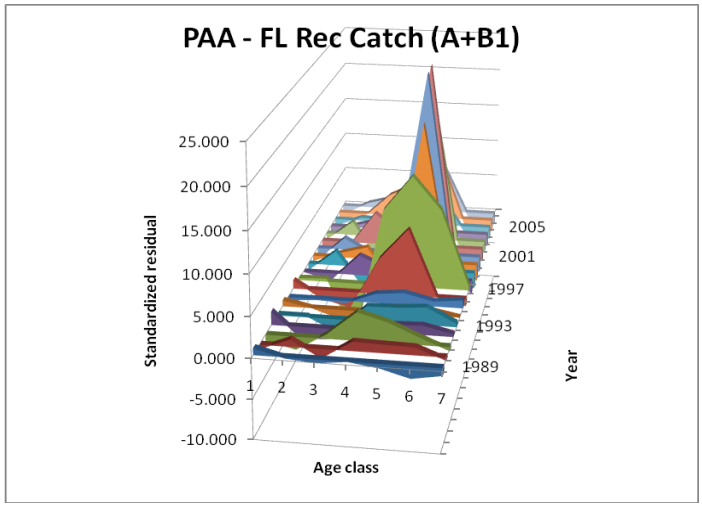

Figure 2. Standardized residuals for the proportions at age in the Florida recreational (A + B1) catch

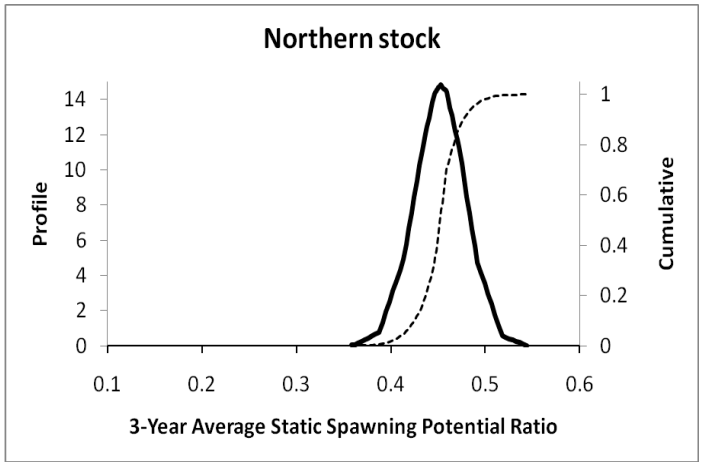

Figure 3. Likelihood profile for 3-year average static Spawning Potential Ratio for northern stock of Atlantic Red Drum.

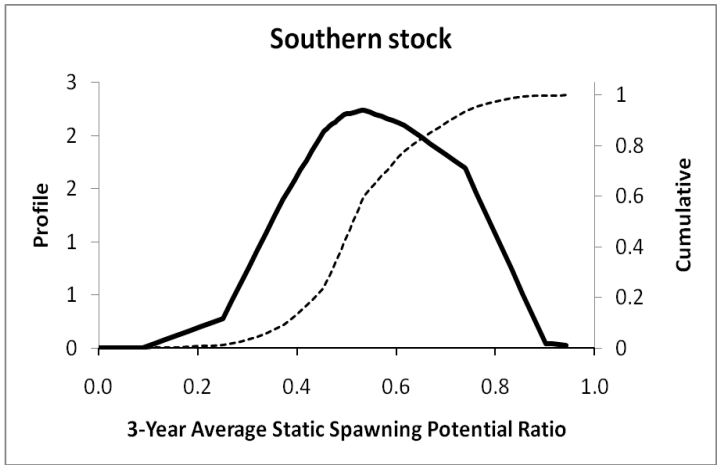

Figure 4. Likelihood profile for 3-year average static Spawning Potential Ratio for southern stock of Atlantic Red Drum.

The Workshop requested that, using the new base models, further model runs should be undertaken to explore the sensitivity of model outputs to the higher and lower estimates of age-dependent natural mortality, to a mortality of released fish of

16 rather than 8%, and, for the northern region, the inclusion and exclusion of the tagging data.

The Workshop discussed whether the assessment should be rejected, partially accepted, or accepted. There was consensus among Review Panel Members that the estimate of total or spawning biomass of each stock was uncertain due to the lack of information relating to the older fish. The Workshop accepted that the model appeared to be producing plausible estimates of the abundances and fishing mortalities of the younger fish within each region. The question that the Workshop had to consider was whether overfishing benchmarks could be established based on the estimates derived for the younger fish.

A request was made to the Assessment Team for a sensitivity run that employed only ages 1 to 4, thus removing the "cryptic" biomass, to assess whether the estimates of fishing mortality of the younger fish were influenced by that cryptic biomass. Dr Murphy attempted to modify the model in response to this request, but subsequently advised that the modification would require a new set of model assumptions and could not be accomplished during the Review Workshop.

The Workshop reviewed the results of the sensitivity runs, comparing these with those of the base model. For the northern region, removal of the tagging data resulted in an unrealistic increase in sSPR. Increase in release mortality produced an increase in sSPR, as was expected. For the other sensitivity runs, the impact on sSPR was marginal. For the southern region, estimation of selectivities for ages 1 to 5 for all fleets and selectivity-blocks led to an unrealistically low sSPR. It was suggested that this might be the result of the model estimating a higher selectivity on older fish.

Dr Gibson displayed the results of MCMC runs for the northern and southern regions. These suggested that the model was producing more precise estimates of the younger than the older ages, implying that the data were not as informative for the latter ages (Figs 5 and 6). Similar ranges were estimated for the three-year average sSPR to those that had been found with likelihood profiles (Figs 7 and 8).

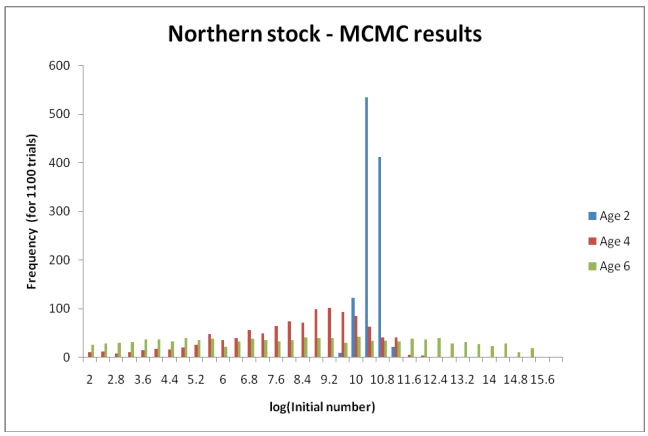

Figure 5. Frequency distribution of the logarithms of the initial numbers of Red Drum of ages 2, 4, and 6 in the northern region for 1100 iterations of the MCMC.

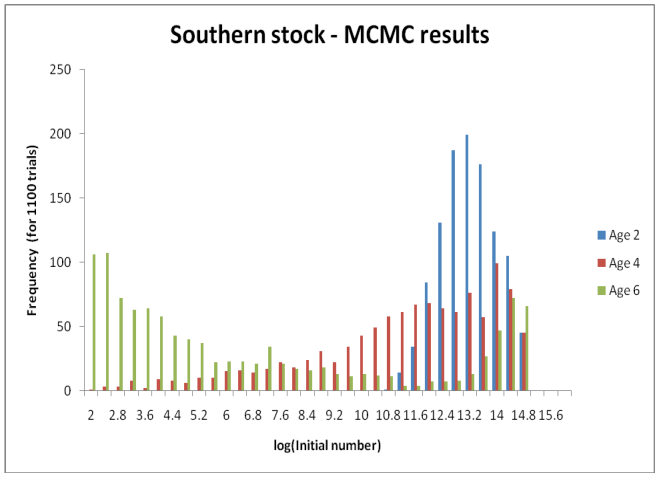

Figure 6. Frequency distribution of the logarithms of the initial numbers of Red Drum of ages 2, 4, and 6 in the southern region for 1100 iterations of the MCMC.

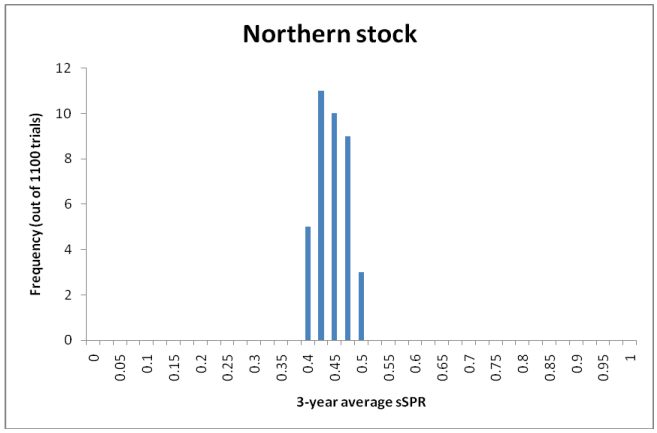

Figure 7. Frequency distribution of the 3-year average of sSPR for Red Drum in the northern region for 1100 iterations of the MCMC.

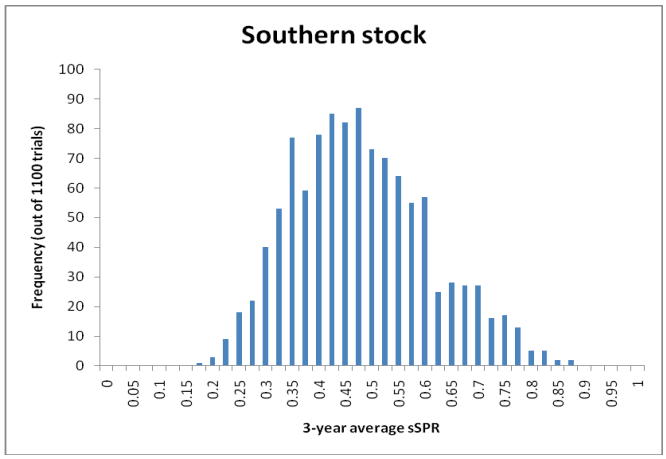

Figure 8. Frequency distribution of the 3-year average of sSPR for Red Drum in the southern region for 1100 iterations of the MCMC.

Convergence problems were encountered in one of the runs for the retrospective analyses for both the northern and regions.

The results of the retrospective analysis for the northern region revealed no discernable pattern (Fig. 9). The Workshop concluded that this was the result of the influence of the tagging data and noted that, as these had been analysed externally, dropping years within the assessment had no effect on the tagging results input to the assessment. If the tagging analysis had been fully integrated within the assessment

model, successive years of tagging data would have been dropped from the tagging analysis resulting in a proper retrospective analysis.

For the southern region, marked differences in the estimates of the average sSPR resulted when successive years were dropped from the assessment (Fig. 10). Although the levels differed, the trends were similar. A hypothesis was proposed that the differences might be due to dropping data points from the short time series for the survey index from Georgia, and then dropping the series completely when the number of data points became too small. Subsequent investigation by the Assessment Team, who reran the retrospective analysis without this index, discounted this theory.

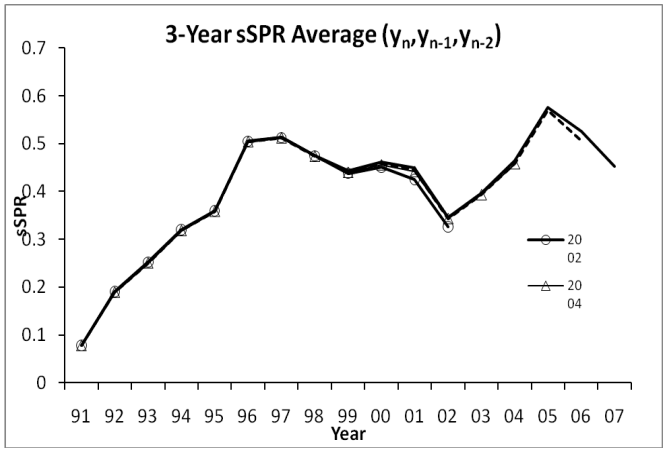

Figure 9. Time series of 3-year average sSPR from retrospective analysis for northern stock. The run for 2005 did not converge.

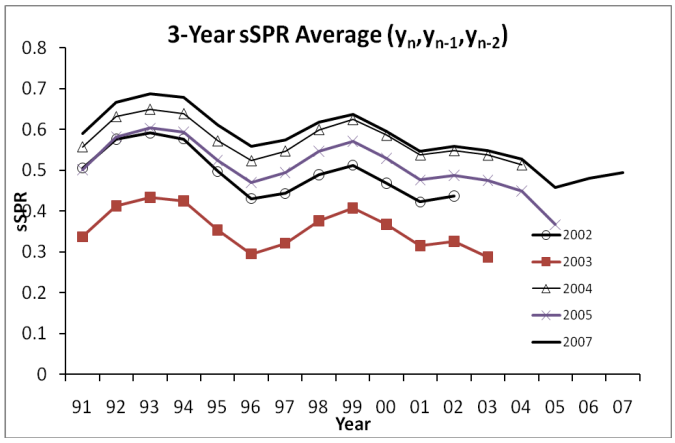

Figure 10. Time series of 3-year average sSPR from retrospective analysis for southern stock. The run for 2006 did not converge.

The Workshop concluded that the tagging data anchor the results produced by the assessment for the northern region, but noted that there were inconsistencies between the assumptions used for the tagging and assessment analyses (Table 3). The residuals of the proportions at age for both the northern and southern regions show a definite pattern suggesting a structural deficiency in the model or tension among data sets. The data appear to be informative about the abundances of ages 1 to 3, and about the exploitation of these age classes. The data for the northern region appear to be informative about the 3-year average sSPR, with the estimates from most of the sensitivity runs being close. The value for this stock is greater than 30%. The data in the southern region are less informative about the 3-year average sSPR, with

sensitivity and retrospective runs producing a range of values (Table 3 and Fig. 10). While uncertain, the results suggest that it is unlikely that overfishing is occurring. For both the northern and southern regions, it appeared that the results of the base models could be used to provide an indication of stock status, although the results from the northern region are more precise that those for the southern region.

Table 3. Results from sensitivity runs

	North		South	
Sensitivity	Total (weighted) objective function	3-year average sSPR for 2005-2007	Total (weighted) objective function	3-year average sSPR for 2005-2007
Base	1288	0.45	1065	0.49
Low M	1300	0.45	1065	0.37
High M	1278	0.46	1065	0.64
RelM 0.16	2061	0.48	1065	0.53
Sel 1-5	1231	0.43	1085	0.001
w/o Tagging	685	0.90		

Finally, the Review Panel discussed the various ToRs and, for each ToR, developed an outline of the text to be produced for the RW Report.

The contribution of Dr Jamie Gibson to the success of the review should be acknowledged. While participating fully in all discussions, Dr Gibson simultaneously probed the assessment models and their uncertainty by undertaking numerous exploratory runs, the results of which assisted the Review Workshop greatly in their evaluations of the two stock assessments.

4. Summary of findings

In this section of the document, I have attempted to present my own assessment of each of the Terms of Reference for the SEDAR 18 Review. Note that I have not attempted to paraphrase those sections of the Review Workshop report which I was responsible for drafting and which I have included in my CIE report.

ToR 1. Evaluate the adequacy, appropriateness, and application of data used in the assessment.

The SEDAR 18 Data Workshop (DW) collated the data available for Atlantic Red Drum and evaluated their reliability and adequacy for use in subsequent stock assessment. Reference documents used by the DW were made available to supplement the information included in the DW Report. The Excel Workbook compiled by the DW provided a valuable summary of the data that the DW had recommended for use in the assessment. The final selection of the data to be used in

the assessment was made by the AW, however, and differed slightly from that proposed for use by the DW. The data selected for use by the AW was reported in the files of input data used in the assessments of the Red Drum in the different regions. It would have been useful, however, if the Excel Workbook produced by the DW had been updated by the AW to provide a record of the data that was ultimately used, in a form that could be readily compared with that recommended by the DW.

Stock structure

The decision to consider Atlantic Red Drum as two independent stocks for stock assessment and management appears appropriate given the differences in growth and longevity noted in biological studies. The discussion on stock structure in the DW Report needs to be broadened, however, to include information on mixing ascertained from tagging and other studies, e.g. otolith microchemistry or parasite studies, if these are available. While genetic studies suggest that there is some level of mixing, the extent to which there is movement of adults between the northern and southern regions or among spawning aggregations associated with different estuaries within a region is unknown. It appeared from the advice presented at the Review Workshop (RW) that some tagged Red Drum exhibit site fidelity, which would support the decision to consider Red Drum in the northern and southern regions as separate stocks. Otolith microchemistry might provide further insight into the extent to which there is interchange of individuals between the regions.

Section 2.3 of the SEDAR 18 Data Workshop Report advises that the distribution of red drum on the Atlantic coast ranged from Massachusetts to Florida, yet the current distribution, as reflected by landings of commercial and recreational fishers, is reported as ranging from southern Florida to Chesapeake Bay. It was unclear from the DW Report whether or not there had been a contraction from the original range, as this had not been factored into the assessment for the northern stock.

Biological parameters

Movement of Red Drum from the estuarine to the marine environment and length-dependent selectivity of the fish that are caught are likely to bias the estimates of growth parameters and parameters of the relationship between the proportions of fish that are mature and the lengths of those fish. The DW Report does not discuss the potential for such bias in parameter estimates, nor the implications of this for subsequent stock assessment.

Birth date

There are inconsistencies in the meanings attributed to the terms “birth date” and “age”, as used in different sections of the Data and Assessment Workshop Reports. Thus the documents report the use of a biological birth date of September 1, “regardless of differences between hatch dates among regions”, and a birth date within the assessment models of January 1. Similarly, the fish that are considered to be of model “age” 1 are in fact the age 0 fish that recruited as young of the year on September 1 of the previous calendar year. It would be more apt to refer to the “ages” used in the model as age classes, where age class 1 contains fish of ages 4 to 15 months. The potential exists that, in passing information from the biological and

research studies to the assessment model, error has been introduced through failure to consider the different meanings attributed to the terms “birth date” and “age”.

Growth

The decision by the Assessment Workshop (AW) to use the nonparametric smooth monotone growth model developed by Dr Cadigan (reported in S18-AW02) was accepted. It is noted, however, that the description of this curve includes neither the parameter estimates and functional form to calculate lengths at age nor a table of such lengths at age. Instead, the routine that fits the model is presented, but the data to which the model was fitted are not presented. Future stock assessment is likely to be hindered by the failure to report the data used in the analysis, how and when these data were collected, and the predicted values of length at age. Comment needs to be made regarding whether the growth curves of the males and females of Red Drum within each region differ. The fact that there are considerable differences between the growth curves for the northern and southern stocks of Red Drum appears likely to be the result of the geographic distribution of the data used in the analyses. It is unlikely that there is a sudden switch from one growth curve to the other at the boundary separating the two regions. A cline is more likely. Some consideration of the basis for the difference should be presented, i.e. does it reflect different productivity, different genetic characteristics, latitudinal or temperature related differences?

Maturity

A common schedule of proportion of females that are mature at each age is input to the models for the northern and southern stocks. Advice provided by the Assessment Team at the RW suggested that the lengths at which 50% of females were mature were similar within both regions. Given the difference exhibited by length at age in the two regions, such similarity would imply a difference in the proportions mature at age. There would be value in considering in greater detail the data relating to the maturity-length relationships and discussing how these relationships relate to the different growth curves.

Mortality, M.

The decision to use length-dependent mortality rather than constant mortality is reasonable as this assumption appears more consistent with our understanding of the processes that shape the ecosystem. The decision to use the form of model proposed by Lorenzen (1996) within the assessment is arbitrary, however, and, while recognizing that other models were discussed by the DW, exploration within the assessment of other functional forms might also be useful. The decision to scale the Lorenzen curve such that survival from age 1 to the maximum age is equal to 1.5% and thus matches the Hoenig-based estimate of M appears sound. The range of values of percentage survival used in scaling the Lorenzen-based age-dependent estimates of M appear adequate to explore the uncertainty associated with estimates of this parameter.

A minor issue that was identified is the fact that, according to the description on page 17 of the DW Report, the weight at age at July 1 is calculated from the mean length at this age using the region-specific weight-length relationship. It should be noted that, because of the nonlinear relationship between weight and length and the

distribution of lengths at age, the mean weight of a fish at this age is not equal to the weight of a fish of the mean length at this age.

Discard mortality

The mortality that is suffered by fish that are caught and released is uncertain, and depends on the method of capture. The value of 8% used in the assessment for the recreational live release fishery and of 16% used as an upper "limit" when assessing sensitivity of model output to this parameter appeared consistent with the available data. With the apparent increase in the numbers of fish that are caught and released by recreational fishers, further research to determine this parameter more precisely could be useful.

Removals

The data relating to the masses of fish landed by commercial fishers appear sound and, if used in this form, would justify the precision assumed by the AW. The conversion from mass to numbers of fish landed introduces errors due to the need to pool length data or extrapolate from length data for other fishing gears. The resulting precision of the numbers of fish removed by the commercial fishers may be somewhat less than that assumed by the AW. It may have been preferable for the assessment models to have estimated the masses of fish landed rather than the numbers landed, as this calculation would have avoided the uncertainties associated with inadequate sampling, but would have used information on age-dependent selection by each fishing fleet, the expected distribution of length at age, and the relationship between weight and length.

The basis for the discards by commercial fishers is unclear. That is, were the fish discarded because of regulations relating to the size or number of fish that could be retained, or were they discarded due to market acceptance and economic considerations? Presumably the basis for discard changed across years. An understanding of the time series of factors affecting discards would assist in assessing whether extrapolation of rates of discard to other years was likely to be warranted.

There is considerable uncertainty in the data for the earlier years of the assessment, i.e. the early 1980s. The DW Report states, on page 46, that sampling for North Carolina and Virginia "was particularly poor to 1989". Thus conversion of catches from biomass to numbers is likely to be imprecise and proportions at age even more imprecise because of the need to use a pooled age-length key for 1981-88. The DW accepted that extrapolation of commercial discard data for North Carolina for 2004-06 to other years between 1999 and 2007 was reasonable because consistent regulations relating to use of commercial gill nets and commercial size and trap limits had applied during this period. The DW expressed reservations regarding extrapolation of commercial discard data to earlier years. Age data for commercial catches from Florida were pooled across years and gears for 1981-88, and no biological samples were taken from commercial catches in South Carolina and Georgia. However, with such uncertainty in catch, discards, and proportions at age, it would be preferable to exclude the data from 1982-88 from the assessment for both regions, as was recommended by the RW for the base models proposed at the Review Workshop.

Removals (MRFSS Types A and B1) by recreational fishers appear adequately although imprecisely estimated by the MRFSS surveys. Similarly numbers of fish

caught by recreational fishers and released alive (MRFSS Type B2) appear adequately but imprecisely estimated.

Proportions at age (PAA)

The uncertainty associated with the conversion of length composition samples from commercial catches to age compositions and pooling over different gear types, with age-length keys (ALKs) that are not necessarily drawn from the length composition to which they are applied, has possibly not been taken fully into account in the assessment models. The proportions at age are assumed to be an accurate rather than imprecise representation of the age composition of the sample, where the latter is assumed to represent a multinomial sample from the true age composition with an effective sample size set to the square root of the sample size of the age-length key used for the year, or two if no age-length key was available for the year. Thus, the assumption is that the imprecision of the PAA data is taken into account by setting the value of the effective sample size to an appropriate level. The question is whether the effective sample size is correctly specified to accommodate the uncertainty in the data and approaches used to overcome the inadequacy of the length and age samples. This requires further investigation.

Data on the length composition of landed Type A catches were obtained from MRFSS, while the length compositions of released Type B2 catches were derived from recreational logbook data. The length compositions of Type B1 landings were determined from the combination of the length compositions of the Type A and B2 landings, but the method by which this was done is not described in the background document (S18-DW09). The age-length key used to convert the length composition of the Type A and B1 landings to an age composition was derived from age and length samples from commercial, scientific and recreational catches. A single age-length key was used for 1981-2003 while separate ALKs were used for each year from 2004 to 2007. The age-length keys used for the live release catches were derived from the age-length samples obtained in scientific surveys. Application of an age-length key derived from one statistical population to a length-composition sample from another statistical population introduces error. There would possibly be value in extending the SCA model to predict the length composition of catches and modify the objective function to fit the model to length rather than age composition data.

Survey indices

Drs O'Boyle and Cieri advised that use of the geometric rather than arithmetic mean in a model that assumed a log-normal distribution of annual survey indices had the effect of smoothing the data twice. The correct approach was to input the annual indices of abundance as arithmetic means.

The assumption is made that the survey indices in the southern regions are representative of the abundance of the entire southern stock. Yet, from the descriptions of the life history of the Red Drum, it is possible that each of these surveys is representative only of the fish within the surveyed area and that the abundance within the surveyed area relative to that in the southern region varies among years. That is, rather than the survey index exhibiting only variation of the magnitude estimated from the statistical analysis of the survey data, there is an additional "process" error representing the annual variation in abundance of the fish

within the surveyed area relative to that of the population that needs to be considered and explicitly included in the likelihood calculations of the assessment model.

Tagging data

Details of the analysis of the tagging data are provided in S18-RD34. The analysis applied age-length keys derived for each six-month period apparently using 17 years of pooled ageing data. Fish of ages 4 and older were pooled. Age-dependent values of M were assumed to be 0.30 for age 1, 0.22 for age 2, 0.16 for age 3, and 0.10 for age 4+. An annual tag-retention rate of 0.74 was assumed, based on data from another study. Data from fish recaptured within seven days of ageing were excluded from the analysis. The shortness of this mixing period, the mismatch between the mortalities used in this study and those employed in the assessment model, and the apparent use of pooled ageing data from 17 years of sampling, is likely to introduce inconsistency and lead to tensions among various components of the objective function calculated by the assessment model. It is recommended that the analysis of the tagging data be incorporated within the assessment model, such that consistent assumptions are used and the uncertainty associated with the tagging analysis can be taken fully into account.

ToR 2. Evaluate the adequacy, appropriateness, and application of methods used to assess the stock.

A statistical catch at age (SCA) model provides a representation of the life history processes that are typically observed for a fish stock. Thus, each year a number of fish recruit to the stock as young of the year (YOY). These fish are exposed to natural and fishing mortality, and those that survive to the end of the year become one year older. Older age classes, i.e. those for which the mean length and proportion mature are approximately constant, are frequently combined to form a plus group. Natural mortality is usually assumed to be constant, but an age-dependent natural mortality can readily be accommodated. Fishing mortality can arise from one or more fishing fleets (or gear types) and is typically assumed to be age or size-dependent and separable into the product of a fishing mortality that is experienced by fully-selected fish and an age- or size-dependent selectivity factor. The selectivity at age and fully-selected fishing mortalities vary among different fishing fleets and among time periods. The models are used to calculate estimated values of catches, fishing effort, relative catch per unit of effort (cpue) of different age classes observed by different fishing fleets, and proportions at age of the catches experienced by the different fishing fleets. These predicted values are compared with the observed data to produce estimates of the negative log-likelihood of the different components and combined to produce an overall negative log-likelihood.

The models developed for the two Red Drum stocks are of the above form, which appears appropriate given the biological characteristics of the stock. By representing the levels of annual recruitment as parameters, rather than employing a stock-recruitment relationship, greater complexity has been introduced but any concerns that the spawning biomass in one region might contribute to recruitment in the other region or that the level of contrast in stock size and information present within the data might be inadequate to allow estimation of the parameters of the stock-recruitment relationship are avoided. Because, according to the advice provided at the RW, the growth curves of females and males are the same, and the data suggest

that the ratio of females to males is 1:1, there is no reason to complicate the model by introducing sex structure.

The number of age classes included in the model, i.e. the age that is considered to represent a plus group is chosen arbitrarily, but the decision should be based on the information content of the input data. It is possible that, in this respect, the model proposed for each Red Drum stock is overly complex. In this context, it is noted that the AW assumed the selectivity of fish of model age classes 5 and greater to be the same, tagging data of ages 4 and above were pooled, and the proportions at age of these older age classes are poorly represented in samples. The initial numbers at age are estimated as parameters of the model.

The decision to use values of 10 and 5% to represent the selectivities of fishes of ages 4 and 5 (or older), respectively, relative to those of age 3 fish imposes a constraint on the model structure. Although the values of these constants were based on results from analysis of tagging, there appears little evidence to demonstrate that these values are correct. A more appropriate model structure would be to treat the values as parameters to be estimated from the available data, as was considered by the AW in one of their sensitivity runs. The fact that the model for the southern region was highly sensitive to the decision to freely estimate the parameters demonstrates that the decision to constrain the relative selectivities of these ages to constant values demands that the values used are accurate. Without such assurance, it is better to estimate the values. Following an exploration of the sensitivity of the model to the values of these constants, the Review Workshop (RW) concluded that the base models for the assessment should estimate these parameters rather than setting them to constant values determined externally to the SCA assessment models.

A further aspect of model structure is the decision as to which of the various data sets available for the fishery are to be included. The AW has included all data sets that appear to be representative of the removals, proportions at age, abundance and fishing mortality of the stock, i.e. excluding those data sets that the DW had assessed as being inadequate. It is useful to recognise, however, that, as additional data sets are included, there is increased potential for tension to exist between the values of the parameters that provide the best fit for the different data sets. The values of the parameters estimated when fitting the model will, in such cases, reflect a balance or trade off between the competing influences of different and often somewhat inconsistent data sets. Such a trade-off appears present in the model proposed by the AW for the northern region, as demonstrated by the sensitivity of parameter estimates to the inclusion/exclusion of the tagging data that the AW reported. The inconsistency of the assumptions used when analysing the tagging data and those used in the SCA model may be another factor leading to this sensitivity.

As recommended by the RW, it would be preferable to exclude data from 1982-88 from the assessment due to the uncertainty associated with the data for these earlier years.

A further indication of possible inconsistency in the information contained within the different data sets is provided by the patterns evident in the residuals of the proportions at age. Such inconsistency may arise when data are not truly representative of the variables that they purport to measure, or when the structure of the observation model is incorrectly specified. Further investigation of the tensions among the data sets by exploring the likelihood profiles for the different components over the ranges of values of the various key parameters may identify which of the data sets are inconsistent and indicate whether a modification to model structure is required.

There would be value in explicitly including an additional variance term in the calculation of the negative log-likelihoods of the survey indices that are not fully representative of the stock within each region to account for possible "process" error, i.e. variation in the proportion of the stock within the region that lies within the region covered by the survey. The objective function calculated in the AD Model Builder implementation of the model includes a "brake" penalty in early phases of fitting that was intended to keep the solution from converging towards smaller values of fishing mortality, but which appears to do exactly the opposite as it adds a larger penalty to the objective function when the average fishing mortality is large. This term is described neither in the AW report nor the description of the model provided by the AW. A further term included in the objective function to "regularize" the selectivities is also not described in either the AW report or the model description. Investigation in the RW demonstrated that this term had considerable influence on whether the model converged, and could therefore not be removed. Such model behaviour is disturbing.

An issue that became evident when exploring the structure of the model and the influence of the different data sets was the lack of information within the available data on the initial abundance of the older age classes. The catches, proportions at age, tagging data, and the majority of the indices provide information only on the younger age classes. There is very limited information on the abundance of the older age classes, yet, with maximum ages of 62 years in the north and 38 years in the south, a considerable number of fish would be expected to be present in coastal waters. As Dr Cieri observed, the longevity of these fish is such that fish that are present in the initial population will continue to be represented through the period that is modelled. The abundance of these fish, however, is determined by the estimates of the initial numbers of fish in each age class, i.e. by parameter estimates. There is insufficient information in the input data to estimate the abundance of the older fish reliably. As these fish represent the mature individuals, it follows that spawning biomass is also poorly estimated. In turn, this affects ability to derive parameter estimates for the stock-recruitment relationship, to estimate the expected recruitment for the unexploited stock, and to estimate the spawning stock at MSY.

ToR 3. Recommend appropriate estimates of stock abundance, biomass, and exploitation.

As described above, the assessment models were unable to produce reliable estimates of stock abundance, biomass or the level of exploitation of the stock as a whole. Estimates of numbers of fish recruiting to each stock and of the fishing mortalities of the younger age classes appear more reliable, however, particularly in the northern region where tagging data provide considerable information on exploitation of these younger age classes. Using the estimates of these fishing mortalities, it would be possible to estimate the age-dependent exploitation rates of fish to age-4. For older fish, the estimates of age-dependent exploitation rates would become increasingly unreliable, however. The Workshop considered that, rather than calculating escapement or exploitation rates, it was preferable to calculate the value of static Spawning Potential Ratio (sSPR), as appropriate target and limit benchmark levels exist for this variable for other fish stocks and appear applicable for use with the Atlantic Red Drum stocks.

For the southern region, although trends in relative levels of fishing mortality and sSPR appear consistent, retrospective analysis demonstrates that the absolute

values of these parameters are sensitive to the input data employed when fitting the model. For the southern region, there would be considerable value in analysing existing tagging data and incorporating this information into the assessment model and in establishing a long-term tagging program to provide information on age-dependent fishing mortality. For both regions, the collection of data that would provide information on the abundance of the fish within coastal marine waters relative to that within the estuaries would assist greatly in improving the reliability of the estimate of the initial numbers at age of older fish present within each stock.

ToR 4. Evaluate the methods used to estimate population benchmarks and management parameters (e.g., static spawning potential ratio); provide estimated values for management benchmarks, and declarations of stock status. Evaluate the population metric used by managers to determine the stock status and, if appropriate, recommend alternative measures.

The inability of the model to produce reliable estimates of biomass and spawning biomass and thereby to determine a stock-recruitment relationship that would facilitate estimation of unexploited spawning biomass precludes use of such indicators as measures of whether or not the stocks are overfished. Thus, consideration of benchmark levels of these indicators is currently of little value.

Use of the assessment models to produce indicators that reflect whether or not overfishing was occurring appeared more promising. In particular, because target and threshold benchmark parameters exist for static Spawning Potential Ratio for other fish stocks, and these appear relevant for use with the stocks of Atlantic Red Drum, use of this variable as an overfishing indicator is favoured. Examination of the estimates of sSPR produced by the assessment models revealed, however, that there was considerable inter-annual variation in the value of this indicator. The RW decided that such variability would impede use of sSPR as an indicator. Accordingly, a three-point moving average of the annual estimates of sSPR was selected for use as an indicator of the overfishing status of the stocks.

Although retrospective analysis of the model for the southern region demonstrated that reliable absolute measures of the three-point moving average of sSPR could not be determined, the trends in this variable were consistent and generally the results obtained for the 2007 level of this variable (calculated using the 2005-07 estimates of sSPR) lay above the 30% threshold reference point (Fig. 10). With the tagging data from North Carolina heavily influencing the assessment, far more reliable estimates of the average sSPR were obtained for the northern region. Again the value of this indicator lay above the 30% limit reference point.

The RW discussed the use of escapement and of fishing mortality as alternative overfishing indicators. In both cases, the variables are essentially proxies for the sSPR indicator, and, if these were selected to be used, would require calculation of the benchmark values that correspond to the reference levels that have already been selected for sSPR, i.e. a management target of 40% and an overfishing threshold of 30%. A complication of use of fishing mortality is that it is the aggregated effect of the fishing mortality of the different fleets that determines the escapement and the value of sSPR. Reference points would be required for the fishing mortality for each fleet, and these would depend on the distribution of fishing effort among the various fleets.

ToR 5. Evaluate the adequacy, appropriateness, and application of methods used to characterize uncertainty in estimated parameters. Provide measures of uncertainty for estimated parameters. Ensure that the implications of uncertainty in technical conclusions are clearly stated.

Adequacy, appropriateness, and application of methods used to characterize uncertainty in estimated parameters.

The SCA models that were developed to integrate the information present within the different sets of catch, proportion at age, survey, and tagging data available for the northern and southern stocks of Atlantic Red Drum are complex, requiring estimation of a large number of parameters,. As complexity grows and additional datasets are incorporated into such models, the potential for contradictory signals from the different datasets increases. Such signals can lead to tensions among different model components when fitting, residual patterns that indicate structural inadequacy of the model, and difficulty in interpreting model results.

The decision by the AW to implement the SCA models for the northern and southern stocks within ADMB facilitated exploration of the uncertainty of estimates of parameters and derived variables using the well-tested features of this software. Thus, use of ADMB facilitated calculation by the AW of estimates of the asymptotic standard errors of parameters and exploration of conditional profile likelihoods for selected indicator variables.

A variety of approaches had been applied by the AW to characterize the uncertainty of the estimated parameters and derived variables output by the model that was brought forward for review. These included use of the post-convergence facility of ADMB to calculate estimates of the asymptotic standard errors of the parameters and conditional profile likelihoods of sSPR and escapement. Time series of parameter estimates ± 2SEs and observed data were plotted to display the extent to which the estimates matched the corresponding observations. The AW also reported the estimates of the non-weighted total standardized residual sum of squares that resulted when the objective function was calculated as a weighted sum of the negative log-likelihoods (NLLs) of the different components, i.e. catches, PAAs, survey indices, and, in the case of the northern region, tagging data sets, to which the model was fitted. Through these weights, the AW had explored 36 and 27 alternative hypotheses relating to the precision of the different sets of input data used for the northern and southern stocks, respectively. The AW had selected the weights to be employed for the base model for each stock as those that had produced the smallest standardized residual sum of squares for that stock. A retrospective analysis had been undertaken for the selected base model for each region.

Subsequently, during the RW, the Assessment Team produced plots of time series with observed and predicted data ± 2 asymptotic SEs, and tables of the residuals and of the NLLs for the different components that resulted when the sensitivities of the model outputs to various forms of structural uncertainty were explored. The RW drew the attention of the Assessment Team to an option within ADMB that enables calculation of estimates of the asymptotic standard deviations of derived variables.

Use of ADMB's post-convergence MCMC utility to produce estimates of the true marginal distributions of the posterior probability distributions of both parameters and derived variables was discussed at the RW. An exploration of the output produced from the base models by the Assessment Team using this tool supported the

characterization of uncertainty obtained using the approaches that had been adopted by the AW, and assisted the RW in interpreting the sources of uncertainty and model fit for each stock.

In future stock assessments, the parameter correlation matrix should be explored. Highly-correlated parameters indicate that the parameter estimates to which the model has converged are likely not to be unique, and that the model may be over-parameterised.

The RW accepted the approaches that had been employed by the AW as adequate, but advised that it might be more appropriate to explore possible tension among components contributing to the NLL by using the weights to include or exclude different components when fitting.

The RW advised that it would be preferable to estimate process error variance rather than imposing this through the use of subjectively determined weights.

The RW agreed with the AW's conclusion that model structure was a major source of the uncertainty of estimates of stock status indicators, and that these estimates were likely to be sensitive to the values of the constants used as the selectivities of age 4 and 5+ fish relative to that of age 3 fish and to the levels of natural mortality and of mortality after release. The AW had explored the sensitivity of values of sSPR and escapement through age 5 to model (structural) uncertainty for each stock by comparing the estimates produced by different sensitivity runs with those obtained using the base models. It had also employed these sensitivity runs to explore the sensitivity of model output to considerably greater mortality of released fish, less or greater natural mortality, and to the estimation of selectivities for ages 1 to 5 rather than to only age 3 with that for ages 4 and 5 (and older) set to 0.10 and 0.05, respectively.

The uncertainty associated with the values of the selectivities of age 4 and 5+ fish relative to that of age 3 fish was identified by the RW as being of high importance for determining the model structure to be used as the base model for each stock. Sensitivity runs using combinations of a range of values for each selectivity, and for a sensitivity run that estimated these values, demonstrated to the RW that model output was highly sensitive to these values, and that the best-fitting model for each region was that which had treated the variables as parameters to be estimated rather than constants to be specified and input to the model. Accordingly, the RW selected to use the model that estimated the selectivities of age 4 and 5+ fish as the new base model for each stock.

The sensitivity of the new base models to lower and higher values of natural mortality and to a higher level of mortality of released fish (i.e., 16 rather than 8%) was explored using sensitivity runs. The RW also requested a sensitivity run for the northern stock that excluded tagging data to determine the extent to which the available catch, PAA and survey data contributed information on stock status and hence allowed the value of the tagging program to be assessed. It was recognized, however, that there was insufficient time during the RW to consider the implications of uncertainty in the input data derived from analysis of tagging data conducted externally to the SCA model. Tables comparing the results of the selectivity runs, plots, and tables of residuals were examined.

The RW endorsed the AW's finding that estimates of population abundance were highly sensitive to the inclusion or exclusion of the externally-determined tag-based input data.

From the results of the sensitivity and other exploratory model runs, the RW identified that the information content of the tagging data had a dominant influence on

the values of parameters that were estimated when the model for the northern stock was fitted. The importance of the tagging data to the assessment of the northern stock highlighted a future need to integrate the tagging analysis within the SCA model (see Research Recommendations). Such integration would ensure that assumptions used when analysing the tagging data would be consistent with those of the assessment model and that the uncertainties associated with the tagging data would be carried forward fully into the estimates of the SCA.

Tables of residuals revealed patterns that indicated that PAAs were poorly estimated by the base model for both stocks of Atlantic Red Drum.

A retrospective analysis conducted by the Assessment Team using the base model demonstrated that the time series of predicted values of the three-year average sSPR for the northern stock were almost identical for runs employing data till 2002, 2004, 2006, and 2007, noting that a model run for 2005 failed to converge, i.e. failed to produce a positive-definite Hessian matrix. The RW recognized, however, that this analysis was not a true retrospective run as the tagging data, which had been analysed independently to produce the results that were input to the model, were not affected by dropping years of data in the various runs of the analysis. The influence of these tagging data was sufficient to ensure that similar trajectories of the three-year average sSPR were predicted for each of the runs considered in the retrospective analysis.

A retrospective analysis employing the base model for the southern stock produced a very clear and disturbing retrospective pattern. The time series of estimates of the three-year average of sSPR had very similar trends but varied markedly in magnitude, with the values for 2003 being considerably lower than those for other years (see Addendum to Assessment Workshop Report). Again, one of the runs for the retrospective analysis failed to converge. The RW explored whether the pattern produced by the retrospective analysis could be a consequence of the short Georgia survey index being progressively reduced and ultimately dropped from the analysis when truncation of this short time series to a terminal year of 2003 left insufficient data for the index to be retained. Repeating the retrospective analysis without this index failed to alter the residual pattern. The RW also explored whether reduction of the number of parameters providing the information used by the model to initialize the vector of numbers at age in 1989 from seven to three could resolve the retrospective pattern. Again, however, the pattern of predicted values produced by the residual analysis continued to display characteristics similar to the retrospective pattern produced for the base model.

The retrospective pattern of the base model for the southern stock demonstrates that, although trends in relative values appear to be unaffected, estimates of the three-year average sSPR are highly sensitive to the input data.

Failure of the models for both the northern and southern stocks to converge for all runs undertaken in the respective retrospective analyses indicates that the base models are not robust and may exhibit convergence problems.

Measures of uncertainty for estimated parameters

After examining the appropriateness of alternative indicators of stock status and the ability of the models to produce reliable estimates of these variables, the RW concluded that it was appropriate to consider only a stock status indicator relating to overfishing. Thus, the three-year average of the sSPR for 2007 was the only indicator considered by the RW when assessing stock status.

Likelihood profiles and cumulative probability plots of the three-year average sSPR for 2007 were produced using the base models for each of the two stocks (see Addendum to Assessment Workshop Report).

Implications of uncertainty in technical conclusions

The uncertainty of the technical conclusions was considered by the RW when responding to each of the ToRs.

ToR 6. Ensure that stock assessment results are clearly and accurately presented in the Stock Assessment Report and Summary Report and that reported results are consistent with Review Panel recommendations.

The Review Workshop Report and Stock Assessment Report are still in preparation. Further work was being undertaken by the Assessment Team following the Review Workshop to prepare an addendum to the stock assessment that incorporated the modifications recommended in the RW and reported the revised results of the assessment. As required in the CIE SoW (Appendix 2), I am continuing to participate in the preparation and review of the Review Workshop Report and, to the extent possible, ensure that the stock assessment results are clearly and accurately presented and that reported results are consistent with Review Panel recommendations.

ToR 7. Evaluate the SEDAR Process. Identify any Terms of Reference which were inadequately addressed by the Data or Assessment Workshops; identify any additional information or assistance which will improve Review Workshops; suggest improvements or identify aspects requiring clarification.

SEDAR Process

The Review Workshop ran smoothly. Several factors contributed to this. Firstly, the presence throughout the Workshop of experienced Information Technology support personnel facilitated connection of notebook computers to an on-site file server and sharing of files, presentations and data. Secondly, the provision of personnel to serve as rapporteurs assisted the Review Panel by allowing them to concentrate more on the presentations and discussions. Thirdly, the pre-meeting teleconference calls were of considerable value allowing identification of issues by the Review Panel, such that requests for information could be submitted to the assessment team and considered before the meeting commenced.

There would be value in including an item in the ToRs for the Assessment Workshop to collate the data sets that are input to the assessment model into tables within a specific section of the assessment report, and also including them in an accompanying Excel workbook. It was somewhat of a paper chase to determine precisely which tables of data were carried over from the Data Workshop and were input to the models. Explicit inclusion of all input data within a single section of the Assessment Report would facilitate checking that the input data identified in the Report corresponded exactly with the data files input to the model.

There would be value in including an item in the ToRs for the Assessment Workshop to verify that the model described in the AR is correctly implemented, i.e. that there is a one-to-one correspondence between the mathematical description and the computer code. Consideration should be given to requiring implementation in two

different software platforms, as this facilitates the detection of implementation errors and is a practice that many stock assessment experts employ.

The greatest problem for the Reviewers remains that the need to take notes detracts from the ability to concentrate on the review. Despite the Rapporteur's support, each Panelist is charged with the responsibility for reporting on specific items within the ToRs, and some note-taking is unavoidable. There is no link, however, between the notes taken and the information projected onto the screen. There is also difficulty when detailed tables or graphs are presented to distinguish some features on the screen without moving closer to the screen. There would be considerable value in employing a web-conferencing tool (e.g. WebEx, Dimdim, Yugma) to share the presenter's desktop with the Review Panel's notebook computers, and to record both the movements of the mouse and the discussions of the presenter and Panelists within the context of the computer output on the screen that is being discussed. While not eliminating the need for note taking, such software would facilitate the capture of specific questions posed by the panel, and the responses of the Assessment Team or other Panelists. The record of the presentation and discussions would be invaluable to the Panelists when preparing their final reports. Note that I do not propose that the Review Workshop be undertaken online, as there is considerable value in being able to interact with other panellists outside the formal workshop hours, and thereby to gain a greater appreciation of issues and potential solutions.

The Terms of Reference for the SEDAR 18 Atlantic Red Drum Data Workshop (as approved by the South Atlantic State-Federal Fisheries Management Board, October 23, 2008) were:

1. *Characterize stock structure and develop a unit stock definition. Provide a map of species and stock distribution(s).*

   Although the distribution of Red Drum was described, no map of the species or of the distribution of the stocks was presented in the DW Report. The DW did provide a characterization of stock structure and did develop unit stock definitions appropriate for stock assessment.

2. *Tabulate available life history information (e.g., age, growth, natural mortality, reproductive characteristics, discard mortality rates); provide appropriate models to describe natural mortality, growth, maturation, and fecundity by age, sex, or length as applicable; and provide appropriate relations between length and weight and between various length measures. Evaluate the adequacy of available life-history information for input into stock assessments and recommend life history information for use in population modeling.*

   The available life history data were discussed and their adequacy for use in stock assessment was evaluated. Data recommended for use in population modelling were tabulated in an Excel workbook for use by the AW.

3. *Evaluate all available tag/recapture data for use in estimating mortality rates, both natural and fishing, within appropriate strata (e.g., age, size classes, areas); estimate tag/recapture-based selectivity vectors for fishery units, by length or age.*

A description of the analysis of the North Carolina tagging data was presented in S18-RD34. The DW reported that these tagging data were not discussed. They advised, however, that the data were being re-analysed to provide estimates of selectivity, survival and exploitation, but that the adequacy of the results for use in the assessment models would need to be determined by the AW. While this analysis was not described in detail in the AW report, the results of the analysis were accepted for use and reported.

The AW report advised that the report on the study of mortality using SC tagged Red Drum (S18-DW12) provided no obvious information on trends in abundance but suggested that further analysis of the South Carolina tagging data "could possibly produce trends in exploitation or survival that could be useful".

4. *Consider relevant fishery dependent and independent data sources to develop measures of population abundance. Document all programs used to develop indices; address program objectives, methods, coverage, sampling intensity, and other relevant characteristics. Provide maps of survey coverage. Develop relative abundance indices by appropriate strata (e.g., age, size, area, and fishery); provide measures of precision. Evaluate the degree to which available indices represent fishery and population conditions. Evaluate stock enhancement effects on indices.*

The DW considered the data sets that could possibly be used to provide measures of adult abundance and reported on these under the specified headings. Relative abundance indices were developed and the effect of stock enhancement was considered. The adequacy of the indices for use in stock assessment was assessed. While maps of survey coverage were provided in the DW Report, these did not compare the area of survey coverage with the distribution of the stock and it was difficult to assess the extent to which the surveys represented the stock. Diagrams that displayed the extent to which the age composition surveyed by the survey represented the age composition of the fish within the survey area, and that displayed the time period over which data were collected would also have provided useful summaries of the representativeness of the survey.

5. *Characterize catch for each fishery unit (e.g., commercial hook and line, recreational, commercial gill net), including both landings and discard removals, in pounds and number. Discuss the adequacy of available data for accurately characterizing harvest and discard by species and fishery unit. For estimated catch provide measures of precision. Provide all available data on the length and age distributions of the catch, both harvest and discard. Provide figures of the amount of fishery effort and harvest. Also, provide a timeline of all fishery regulations relevant to the above fishery units, such as size limits, caps, and gear restrictions.*

The DW appears to have satisfied this ToR. A timeline of fishery regulations was produced and reported in the data workbook.

6. *Provide recommendations for future research in areas such as sampling, fishery monitoring, and stock assessment. Evaluate sampling intensity by sector (fleet), area, and season.*

   Recommendations for future research were provided for areas such as sampling and fishery monitoring, and for the collection of data that would be of value for stock assessment. Sampling intensity of surveys and biological sampling of catches was discussed.

7. *Develop a spreadsheet of potential assessment model input data that incorporates the decisions and recommendations of the Data Workshop. Review and approve the contents of the input spreadsheet within 6 weeks prior to the Assessment Workshop.*

   A Data Workbook, which provided tables of data and values of parameters considered by the DW to be adequate, informative and thus had potential to be used for stock assessment, was produced in Excel by the DW and provided to the AW

8. *Prepare complete documentation of workshop actions and decisions (Section II. of the SEDAR assessment report); prepare a list of tasks to be completed following the workshop, including deadlines and personnel assignments.*

   The DW appears to have satisfied this ToR.

The Terms of Reference for the SEDAR 18 Atlantic Red Drum Assessment Workshop (as approved by the South Atlantic State-Federal Fisheries Management Board, October 23, 2008) were:

1. *Review any changes in data following the data workshop, any completed analyses suggested by the data workshop. Summarize data as used in each assessment model. Provide justification for any deviations from Data Workshop recommendations.*

   The AW satisfied this ToR.

2. *Develop population assessment models that are compatible with available data and recommend which model and configuration is deemed most reliable or useful for providing advice relative to current management metric (static SPR levels). Document all input data, assumptions, and equations. Document model code in an AW working paper. If chosen assessment model differs from that used previously (Vaughan and Carmichael 2000) include a continuity case run of that model to determine, as best as possible, the effect of changing assessment models.*

   The AW addressed this ToR. As a consequence of the changes in the methods used to calculate indices and catch at age since the 2000 assessment was undertaken, it was not possible to produce input data for the earlier model extending over the same years as covered by the new SCA model. To provide

an indication of the possible influence of the new model structure compared with the old, at the request of the RW, the new SCA model was run using data from the same years as used in the earlier assessment.

3. *Provide estimates of stock population parameters (fishing mortality, abundance, biomass, selectivity, stock-recruitment relationship, discard removals, etc.) by age and other relevant categorizations (i.e., fleet or sector); include representative measures of precision for parameter estimates.*

This ToR was satisfied. The stock-recruitment relationship was presented as a plot of the estimated values of recruitment versus the estimated values of spawning biomass for the previous year.

4. *Characterize scientific uncertainty in the assessment and estimated values, considering components such as input data sources, data assumptions, modeling approach, and model configuration. Provide appropriate measures of model performance, reliability, and 'goodness of fit'.*

This ToR was satisfied.

5. *Provide yield-per-recruit, spawner-per-recruit, and stock-recruitment evaluations, including figures and tables of complete parameters.*

Results of the yield-per-recruit and spawner-per-recruit analyses were reported by the AW. Analysis of the stock-recruitment relationship was not pursued beyond producing the simple plot because of the concerns held by the AW that the estimate of spawning biomass was unreliable due to the lack of information relating to the abundance of fish outside the estuaries.

6. *Provide estimates of spawning potential ratio consistent with the goal of Amendment 2 to the Interstate FMP for Red Drum (i.e., to achieve and maintain optimum yield for the Atlantic coast red drum fishery as the amount of harvest that can be taken while maintaining the Static Spawning Potential Ratio at or above 40%).*

This ToR was satisfied.

7. *Evaluate the impacts of past and current management actions on the stock, with emphasis on determining progress toward stated management goals and identifying possible unintended fishery or population effects.*

This ToR was satisfied.

8. *Consider the data workshop research recommendations. Provide additional recommendations for future research and data collection (field and assessment); be as specific as possible in describing sampling design and sampling intensity.*

This ToR was satisfied.

9. *Prepare an accessible, documented, labeled, and formatted spreadsheet containing all model parameter estimates and all relevant population information resulting from model estimates and any projection and simulation exercises. Include all data included in assessment report tables, all data that support assessment workshop figures, and those tables required for the summary report.*

   This ToR was satisfied.

10. *Complete the Assessment Workshop Report (Section III of the SEDAR Stock Assessment Report), prepare a first draft of the Summary Report, and develop a list of tasks to be completed following the workshop.*

    This ToR was satisfied.

ToR 8. Review the research recommendations provided by the Data and Assessment workshops and make any additional recommendations warranted. Clearly indicate the research and monitoring needs that may appreciably improve the reliability of future assessments. Recommend an appropriate interval for the next assessment.

Research recommendations from the Data Workshop:

Life History Research Recommendations

1. The ASMFC-approved multi-state sampling program of adult Atlantic red drum from Florida to Virginia represents a unique opportunity to obtain critical comprehensive data. Specifically relevant to the genetic population structure evaluation is the concurrent aging of the fish which will allow for the determination if any detected genetic structure is the result of differential age composition of the reproductive stock, particularly in light of the proposed temporal genetic heterogeneity (Chapman et al. 2002) and suspected age structure differences from the GoM. The combined age-specific life history and genetic knowledge will allow for greater interpretive capabilities of the genetic data as well as provide the needed life history information necessary for an accurate estimate of effective population sizes for Atlantic red drum.

   This research recommendation is poorly written. It appears to be a proposal to use data from an ASMFC sampling program of adult Red Drum from Florida to Virginia (1) to investigate whether any detected genetic structure in the population is the result of differential age composition of the spawning stock, and (2) to produce a more accurate estimate of sample size. The proposed study will not appreciably improve the reliability of future assessments.

2. Updated maturity schedules and fecundity information for adult Atlantic red drum from Florida to Virginia is lacking. Just as there are suspected age structure differences between the Atlantic and GoM stocks, maturity schedules and fecundity estimates are also suspected to be different in the Atlantic stock.

Again, this statement fails to clearly identify the research that is recommended. Reading between the lines, it appears that the DW is recommending a study to determine the maturity schedule and fecundity of Red Drum over its range from Florida to Virginia and to assess whether these differ significantly among fish from different locations. While there is a need to collate currently available data and resolve some confusion relating to the maturity schedules that are currently used in the assessment models, the proposed study will not appreciably improve the reliability of future assessments as the maturity schedule is not a major axis of uncertainty, i.e. the proposed research is considered of lower priority than other studies. Fecundity is currently not used within the assessment models, which produce estimates of female spawning biomass. The onset of maturity potentially influences the movement of fish from the estuary, and, in combination with the selectivity at age (or length) of the different fisheries, may lead to biased estimates of the maturity schedule if not taken into consideration when designing the study.

3. Further study is needed to determine discard mortality estimates for the Atlantic coast, both for recreational and commercial gears. Additionally, discard estimates should examine the impact of slot-size limit management and explore regulatory discard impacts due to high-grading.

   The proposed research is of value to future assessments. Live release morality should be related to the various factors likely to influence this variable, e.g., salinity, depth, hook type, month, etc.

4. Dedicated northern and southern region larval and juvenile recruitment indices, as well as a Virginia adult recruitment index are recommended to provide more informative trends for future assessment processes.

   The proposed larval study will not appreciably improve the reliability of future assessments. The development of further indices should be considered within the framework of the surveys that are currently undertaken, and should be assessed to determine whether they are likely to provide information that would be more representative of the abundance of fish within different locations and habitats. An additional index may provide little additional information to assist the stock assessment unless it focuses on determining the abundance of fish in marine coastal waters relative to the abundance within the estuaries.

5. Continued cooperation between state ageing labs, such as the October 2008 red drum ageing workshop, to provide consistent age verification between labs. Additionally, otolith microchemistry should be approached to look at state differences between regions for stock differentiation.

   Regular exchange of otoliths (and scales) among laboratories to ensure consistency of the ages that are assigned to fish read by the different laboratories is considered an essential element of age-reading protocol and should already be practised by the various laboratories. Such exchange should be on-going and is endorsed. While otolith microchemistry may provide

valuable information on stock structure and the link between the fish within an estuary and the fish in the coastal waters in different locations along the coast, the proposed study will not appreciably improve the reliability of future assessments in the short term. The data that are available for stock assessment are not of sufficient resolution to support separation into additional unit stocks and thus, although valuable, the information provided by study of the otolith microchemistry is unlikely to add substantially to the accuracy or precision of the existing models.

6. Identification of juvenile and adult habitat requirements and loss rates would provide more informative information for future management planning

   The proposed study will not appreciably improve the reliability of future assessments. Information on the use of different habitats by Red Drum and on the impact to Red Drum of habitat loss are not considered within the current model structure.

Commercial Workgroup Research Recommendations

7. Continued and expanded observer coverage for the NC and VA gill net fisheries (5-10% coverage).

   There is an ongoing need for information on the quantity and age composition of discards from commercial gill net fisheries. The data obtained from the proposed observer coverage will be of value to future assessments.

8. Expand observer coverage to include other gears of concern (i.e. haul seine, pound net, trawls).

   There is an ongoing need for information on the quantity and age composition of discards from commercial fisheries that use fishing gears other than gill nets. The data obtained from the proposed observer coverage will be of value to future assessments.

9. Expand biostatistical sampling (ages and lengths) to better cover all statistical strata (gears/states - principally NC and VA) – more ages proportional to lengths, preferably otoliths.

   Biostatistical sampling to characterize the proportions at age of the catches by the different fishing gears and sectors, or the fish that are caught then discarded or released alive, is essential. The design of the sampling programs used to collect these data should be reviewed in a holistic context to ensure that they produce sufficient representative length and age composition data to generate statistically-reliable estimates of the necessary quality, and thus produce reliable estimates of proportions at age for the various fisheries. Improvement of the sampling programs will be of value to future assessments.

Recreational Workgroup Research Recommendations

10. Review of Historical Data: - Have experts in survey design and implementation review historical data.

    Historical survey design can only be documented, and methods used to analyse the resulting data refined to ensure that the results are as reliable as possible given the design used. It is probably of greater importance to review the survey design currently used for each of the recreational fisheries within each state, to determine whether, in a holistic sense, a more appropriate survey design could be implemented (while still retaining consistency of data within current time series). As written, the value of the proposed research to future assessment appears limited.

11. Marine Recreational Information Program (MRIP):- The recreational statistics workgroup supports ongoing efforts to improve recreational and for-hire data collection through the Marine Recreational Information Program (MRIP).

    The value of this research to future assessment is determined by the extent that MRIP is likely to improve the accuracy and precision of the recreational data beyond that accuracy and precision of existing methods of data collection. Without additional information on this, the value of this research proposal cannot be assessed.

12. Volunteer Logbook: - We support inclusion of volunteer logbook data for length.

    The data on length of live released fish produced by the volunteer logbook program should prove valuable to future assessment provided that methods of analysis recognise the fact that these data are fishery-dependent, and that data collection is not in accord with a well-designed statistical program.

Indices Workgroup Research Recommendations

13. Adult sampling with the goal of small population estimates or density estimates through tag-recapture methods to evaluate trends in abundance over time. Secondarily, this would help with delineate the stock distribution and mixing rates.

    Well-designed tagging programs have the potential to provide valuable data on fishing mortality for use in future stock assessment. It is essential that such programs are considered in a holistic sense. Thus, the proposed tagging study needs to be considered in the overall context of the value of its results for assessment and its likely effectiveness assessed through a preliminary simulation study. The research proposal needs further consideration and development, however, before it is possible to assess the value of the specific proposed research for future assessment.

14. Suggests a workshop on adaptive sampling techniques as applied to wildlife populations as well as other techniques that can be applied to aggregated species.

The use of adaptive sampling techniques needs to be considered within the context of the statistical design of a holistic sampling and survey program that will provide reliable indices of abundance of the different age classes within each stock and reliable characterization of the age composition of removals from those stocks. Without placing the research proposal in such context, by itself it is unlikely to improve future stock assessment.

15. Encourage that states continue on with current surveys, and with current methodologies. If sampling methodologies change, the workgroup suggests some consistency exist between the original and new methodologies.

    Agreed, but there is a need to review the statistical design of data collection programs to ensure that representative data are collected to provide reliable indices of abundance of the different age classes within each stock and reliable characterization of the age composition of removals from those stocks. It is important that, if the design of data collection programs changes, there is sufficient overlap between old and new methods to allow calibration of the data collected with the new design relative to that collected with the old. Continued collection of data by the states is of value to future assessment.

16. Age structure established for surveys internally rather through external age-length keys.

    The application of age-length keys derived from sampling one statistical population to length data collected from another statistical population introduces error. Thus, the proposal to develop age-length keys using age and length samples collected from the same source as the length data to which the age-length key is to be applied is endorsed. This is considered best practice, and should improve the accuracy of the proportions at age used in future stock assessments.

Research recommendations from the Assessment Workshop:

17. Determine batch fecundity estimates of red drum.

    Batch fecundity is currently not used in the assessment. Thus the proposed study will not appreciably improve the reliability of future assessments

18. Conduct experiments using logbooks etc. to develop estimates of the B2 catch in both the North and South regions.

    It is unclear what experiments could be conducted. However, as discussed earlier, the data on length of live released fish produced by the volunteer logbook program should prove valuable to future assessment provided that analysis of these data recognises the fact that these data are fishery-dependent, and that data collection is not in accord with a well-designed statistical program.

19. Further identify the selectivity of age classes of the B2 catch in both regions.

Selectivity of the B2 catch in both regions should be estimated by the assessment model using observed data on proportions at age and proportions at length of the released fish or tagging data. Identification of selectivity external to the model is not endorsed, as the estimates are likely to be obtained using assumptions that are inconsistent with those of the model, and the uncertainty of the external estimates will not be carried forward to the estimates of the uncertainty of the indicators of stock status. Thus, while research to obtain reliable and representative data on the length and age composition of live releases is endorsed, the research proposal above is unlikely to be of value to future assessment if its intention is to estimate selectivity externally to the assessment model.

20. Determine if existing and historic recreational tagging programs can be used to evaluate better B2 selectivities.

    Refer to the response to the previous research recommendation.

Research recommendations from the Review Workshop:

21. A review of the current set of surveys within each region should be undertaken to assess the extent to which these provide indices that, as a group, are representative of the abundances of the various age classes of the stock within the region, and to assess whether current activities should be expanded, enhanced or modified to provide more accurate or more precise indices. The value of such extension or modification should be assessed through simulation. Continuity of existing time series should be maintained to overlap with any new indices such that new indices can be calibrated with old indices. The current suite of indices appears to have developed incrementally without considering the overall strategic needs for assessment of the Red Drum stocks, and appears to provide limited coverage of the fish that have left the estuaries and moved to coastal marine waters.

22. Within the context of the above review, consideration should be given to developing a survey within each region that will provide an index of abundance of the adult Red Drum within coastal marine waters and the age composition of that stock. The latter is of considerable importance in confirming that the mortality assumptions of the assessment model are sound, noting that, at the RW, attention was drawn to an apparent paucity of fish within intermediate age classes that suggested that older fish might become more vulnerable to capture. Testable hypotheses to explain such patterns in age composition data need to be developed.

23. The currently available tagging data, particularly data from the southern region, should be subjected to appropriate analysis to obtain estimates of fishing mortality and abundance. Following such analysis, the statistical design of the tagging programs within each region should be reviewed to assess whether the programs should be expanded or modified to provide accurate and improved estimates of fishing mortality at age for the various age classes, and to assess the proportion of Red Drum of each age class that move

from the estuary. The influence of tagging data was clearly evident when the assessment for the northern stock was examined by the RW.

24. The assessment models should be enhanced to analyse the tagging data within the model, rather than doing this externally, and thereby ensuring consistency of assumptions used in the tagging and assessment models and carrying the influence of the uncertainty associated with tagging forward to the estimates of the uncertainty of the indicators of stock status that are determined by the SCA model.

25. An alternative assessment should be developed for the northern region that is based solely on the results obtained from the analysis of tagging data, using the estimates of fishing mortality to calculate static Spawning Potential Ratio. This should be done within the integrated model (by setting weights of other components of the overall negative log-likelihood to zero) such that the predictions of the various survey indices and of proportions at age can be compared with observed values. Such an assessment may provide a more cost-effective approach to management than that provided by the full assessment model, and provides another way of exploring the influence that the tagging data have on the assessment that results from use of the SCA model.

26. The contribution of the survey indices to the negative log-likelihood calculated by the assessment model should be modified to allow for both the variance associated with sampling, i.e., related to the CVs calculated for the surveys, and an additional variance component due to "fluctuations in ... the fraction of the population present in the sites being surveyed" (Punt et al., 2002). An example is presented by Oliveira et al. (2007), who cite Butterworth et al. (1993). Essentially, the inclusion of this additional variance provides an iterative re-weighting of the survey indices and avoids the need for including an arbitrary, subjective, external weighting, such as that currently employed in the assessment model. A similar approach may need to be adopted for other components of the objective function if the observations are derived from samples that are not fully representative.

27. The effective sample size that is currently employed when calculating the negative log-likelihood of the proportion-at-age data, i.e., the square root of the number of fish in the age-length key for the year or 2 if no age-length key was available for the year, should be compared with the value that is currently calculated in the ADMB implementation of the model using the method described by McAllister and Ianelli (1997, Appendix 2, Equation 2.5). Such a comparison might indicate whether the effective sample size currently used is appropriate.

28. The assessment model should be enhanced to allow prediction of length composition and calculation of the negative log-likelihood associated with the extent to which this predicted length composition deviates from the observed length composition. Use of length composition rather than age composition when fitting the assessment should be explored for those cases where insufficient age and length samples have been collected to derive a reliable age-length key.

29. The influence of the cryptic adult biomass on estimates of static Spawning Potential Ratio should be investigated by imposing a penalty on the size of this biomass and assessing the extent to which the quality of the fit has been degraded or the estimate of sSPR has been modified by imposition of the penalty.

30. Possible inconsistencies among the various data sets that contribute to the objective function of the assessment model should be explored by plotting the likelihood profiles for each component across the ranges of feasible values for the parameters that represent the major axes of uncertainty. By examining the resulting plots, it is possible to identify the values of the parameters that minimize the negative log-likelihood of the different components, and thereby identify those parameters that most influence the values of the parameter estimates. Identification of inconsistencies among the data sets provides a focus for re-assessing the extent to which the inconsistent data sets are representative of the variables that they are intended to measure.

31. Convergence of the assessment models for the base, sensitivity and retrospective runs should be confirmed by "jittering" the initial parameter values and re-fitting the model a number of times, e.g. 100, then comparing the resulting parameter estimates (e.g., Methot (2007)). Exploration of the consequences of "jittering" may also reveal whether the model converges to a region of parameter space in which the Hessian is positive definite, noting that, in several of the retrospective runs, the Hessian was found to be non-positive definite.

32. Exploration of uncertainty for future stock assessments should include the presentation of results from MCMC, particularly when exploring the likelihood profiles for indicator variables such as static Spawning Potential Ratio.

Appropriate interval for next assessment

An appropriate interval for the next assessment would be five years. This would allow sufficient time to collect further data, to integrate the tagging analysis within the stock assessment model, to analyse the available tagging data for the southern region, and to explore inconsistencies among data sets, problems with convergence, model structure(as evident in patterns of residuals), and retrospective analysis. A longer interval between assessments would not encourage the collection of additional tagging data, improvement of the model, and continued review of the data and assessment to ensure that the reliability of the management indicators continues to be improved.

ToR 9. Prepare a Peer Review Consensus Summary summarizing the Panel's evaluation of the stock assessment and addressing each Term of Reference. Develop a list of tasks to be completed following the workshop. Complete and submit the Consensus Report within 3 weeks of workshop conclusion.

As noted earlier, the Review Workshop Report and Stock Assessment Report are still in preparation. Further work was being undertaken by the Assessment Team

following the Review Workshop to prepare an addendum to the stock assessment that incorporated the modifications recommended in the RW and reported the revised results of the assessment. As required in the CIE SoW (Appendix 2), I am continuing to participate in the preparation and review of the Review Workshop Report such that this may be finalized.

5. Conclusions and recommendations

The Review Workshop considered the available data on stock structure and accepted that, for the purposes of assessment, it was appropriate to divide the Atlantic stock into a northern and southern stock, and that the boundary that had been adopted was appropriate. It was noted, however, that a finer stock structure may exist, to which scientists and managers need to be alert, as the potential exists for sub-stocks with lower productivity to be adversely affected if the distribution of effort is such that effort is heavily focused on them.

The Review Workshop accepted that a statistical catch at age (SCA) model was an appropriate model for the assessment and that, after correcting several minor errors prior to and during the review, such a model had been correctly implemented in AD Model Builder. One slight concern that remained unresolved was the inclusion of a small penalty term to "regularize" the selectivities. The Review Workshop accepted that removal of this term resulted in convergence problems, and thus accepted that, at this time, the term should be retained within the model.

After exploring areas of concern, the Review Workshop accepted base models for the northern and southern stocks of Atlantic Red Drum that differed slightly from those which had been proposed initially by the Assessment Workshop (AW). The accepted base models estimated the selectivities of age 4 and 5+ fish relative to that of age 3 fish rather than setting the values of these to 10 and 5%, respectively. Model estimates and predictions were imprecise, primarily as a result of the paucity of input data relating to the abundance and age composition of older fish, i.e., those that have left the estuaries. The assessment for the northern stock was highly dependent on the input data derived from analyses of the data collected in the tagging program in North Carolina, but results from such a tagging study were not available to anchor the model fitted to the data for the southern stock. The Assessment Team was urged to explore whether the tagging data that exist for the southern stock could be used in the assessment, as the information within these data might assist to resolve some of the imprecision and problems that became evident in the retrospective analysis.

The Review Workshop concluded that a reliable assessment of whether the stocks were overfished was not possible as a result of great uncertainty associated with the abundance of older fish. It concluded, however, that the 3-year average of static Spawning Potential Ratio was an appropriate measure to be used as an overfishing indicator. In the case of the northern stock, estimates of this variable were highly dependent on the information that had been input to the assessment model from the results of the analysis of tagging data. Assessment model results for this stock indicated that the 3-year average static Spawning Potential Ratio estimate of 0.45 (approximate 95% confidence interval of 0.41 to 0.50 based on conditional likelihood profile, point estimates ranging from 0.43 to 0.48 for the sensitivity runs explored, and no discernable retrospective pattern) exceeded the threshold and target reference points of 30 and 40%, respectively. A less clear result was obtained for the southern stock, however. For this, the point estimate of the 3-year average static

Spawning Potential Ratio for the base model was 0.49, with approximate 95% confidence intervals from the conditional likelihood profile ranging from 0.31 to 0.82. Point estimates of this variable from different sensitivity runs ranged from 0.001 to 0.64, where the value of 0.001 resulted from a sensitivity run in which the selectivities from ages 1 to 5 for all fishing fleets in all selectivity-blocking periods were estimated. The implausibly low value appeared to result from the estimation of much higher selectivities for older fish than was the case for the other runs. There is, however, little information available in the input data for the southern region that would allow precise estimation of the selectivities of these older fish. Without this apparently anomalous value of the 3-year average sSPR, the point estimates from the other sensitivity runs ranged from 0.37 to 0.64. The patterns of the trends in the estimates of the 3-year average static Spawning Potential Ratio in the retrospective analysis using the base model for the southern stock were similar, but the absolute magnitude varied markedly among the runs that employed data to different final years. The levels of the estimates appeared to lie consistently above the 30% reference level, however, suggesting that the southern stock is not currently experiencing overfishing to the extent that the threshold overfishing reference point has been breached.

A priority for research for the northern stock is to integrate the analysis of the tagging data for North Carolina into the Statistical Catch at Age assessment model, thereby assuring consistency of the assumptions used in the analyses and allowing the assessment to fully consider the implications of uncertainty in the tagging analysis. Research priorities for the southern region include the development of a well-designed tagging program, the review of the adequacy and representativeness of the various survey indices, and investigation of the convergence issues and apparent tensions among the different datasets within the assessment model for this region.

6. References

Butterworth, D. S., De Oliveira, J. A. A., & Cochrane, K. L., 1993. Current initiatives in refining the management procedure for the South African anchovy resource. In: Kruse, G., Eggers, D. M., Marasco, R. J., Pautzke, C., & Quinn II, T. J. (Eds), Proceedings of the International Symposium on Management Strategies for Exploited Fish Populations. Alaska Sea Grant College Program Report No. 93-02, University of Alaska Fairbanks, pp. 439–473.

De Oliveira, J. A. A., Boyer, H. J., & Kirchner, C. H. 2007. Developing age-structured stock assessment models as a basis for management procedure evaluations for Namibian sardine. Fisheries Research, 85: 148-158.

McAllister, M. K., & Ianelli, J. N. 1997. Bayesian stock assessment using catch-at-age data and the sampling-importance resampling algorithm. Can. J. Fish. Aquat. Sci., **5**: 284–300.

Methot R. 2007 User manual for the Integrated analysis program stock synthesis 2 (SS2). Model version 2.00c.

Punt, A. E., Walker, T. I., & Prince, J. D. 2002. Assessing the management-related benefits of fixed station, fishery-independent surveys in Australia's southern shark fishery. Fisheries Research, 55: 281–295.

Appendix 1: Bibliography of all material provided

SEDAR 18
Atlantic Red Drum
Workshops Document List

Document #	Title	Authors
Documents Prepared for the Data Workshop		
SEDAR18-DW01	Red drum assessment history	Vaughan 2008
SEDAR18-DW02	Overview of Red Drum Tagging Data and Recapture Results by state from Virginia to Florida	S-18 DW Tagging Workgroup 2009
SEDAR18-DW03	Atlantic States Red Drum Management Overview	Meserve 2009
SEDAR18-DW04	Georgia's Marine Sportfish Carcass Recovery Project	Georgia DNR
SEDAR18-DW05	Georgia's Metadata for Fishery Independent RD Data 2002-07	Georgia DNR
SEDAR18-DW06	NC Biological Data-Surveys Descriptions and Background Info	Paramore 2009
SEDAR18-DW07	Life-History Based Estimates of Natural Mortality for U.S. South Atlantic Red Drum	Vaughan 2008
SEDAR18-DW08	Reported commercial landings of red drum in Florida and estimated annual length and age composition	Murphy 2009
SEDAR18-DW09	Recreational harvest estimates and estimated catch-at-age for the recreational fishery in Florida during 1982-2007	Murphy 2009
SEDAR18-DW10	Indices of relative abundance for young-of-the-year and subadult red drum in Florida	Murphy 2009
SEDAR18-DW11	SC Red drum electro-fishing survey	SC DNR undated
SEDAR18-DW12	SC Red Drum Tagging Data	S. Arnott 2009
SEDAR18-DW13	SC Tournament and Fish Wrack Recycle Program 2002-2007	McDonough undated
SEDAR18-DW14	Assessment of Adult Red Drum in South Carolina	SC DNR undated
SEDAR18-DW15	South Carolina Fishery Independent Survey Description and Protocol	SC DNR undated
SEDAR18-DW16	An Estimate of RD Removals from NC Estuarine Gill Net Fishery Occurring from both Rec Users of Gill Nets and from Regulatory and Unmarketable Discards.	Paramore 2009
SEDAR18-DW17	Estimating the size and age composition of the B–2 fish (caught and released alive) in the recreational fishery for red drum and spotted seatrout in South Carolina	McDonough, Wenner 2009

SEDAR18-DW18	South Carolina randomly stratified trammel net survey	Arnott 2009
Documents Prepared for the Assessment Workshop		
SEDAR18-AW01	Estimating the age composition of the MRFSS estimated landings for red drum along the Atlantic coast.	Murphy 2009
SEDAR18-AW02	Nonparametric growth model for the northern region Atlantic red drum stock, and changes to natural mortality (M) estimates.	Cadigan 2009
SEDAR18-AW03	Preliminary estimation of red drum fishing mortality rates in the southern and northern regions using the SVPA/FADAPT method employed in the last assessment and comparison of findings between short (1986-1998) and long (1982-2007) time frame runs.	Murphy 2009
SEDAR18-AW04	Estimation of the length and age composition of red drum caught and released alive by anglers fishing along the mid and South Atlantic coast of the U.S. during 1982-2007.	Murphy 2009
SEDAR18-AW05text SEDAR18-AW05table	References and selected abstracts on red drum hook mortality	Denson, Arnott 2009
SEDAR18-AW06	Graphical analyses of the catch age composition for red drum	Cadigan 2009
SEDAR18-AW07	Semi-separable untuned VPA for red drum.	Cadigan 2009
SEDAR18-AW08	Description of the input and findings from potential base model runs for the northern and southern red drum stocks from the U.S. Atlantic coast.	Murphy 2009
SEDAR18-AW09	Description of the age-structured model used to estimate population dynamics parameters for the southern and northern region red drum stocks along the Atlantic coast of the U.S.	Murphy 2009
SEDAR18-AW10	Percentage, by age class, of red drum tagged by the SC marine game fish tagging program	McDonough, Arnott 2009
SEDAR18-AW11	Tagging estimates of abundance at age for the northern region red drum stock	Cadigan, Paramore 2009
SEDAR18-AW12	Continuity Run of the Spreadsheet Virtual Population Analysis	Grist, Lee 2009
Documents Prepared for the Review Workshop		
SEDAR18-RW01	Application of the statistical catch-at-age models for red drum to the data for the time period used in the previous assessment, 1986-1998.	Murphy 2009
Workshop Reports		
SEDAR18-DW Report	SEDAR 18 Data Workshop Report	SEDAR 18 DW Panel 2009

SEDAR18-AW Report	SEDAR 18 Assessment Workshop Report	SEDAR 18 AW Panel 2009
SEDAR18-RW Report	SEDAR 18 Review Workshop Report	To be prepared following Review Workshop
Final Assessment Reports		
SEDAR18-SAR01	Assessment of the red drum stock in the US Atlantic	To be prepared following Review Workshop
Reference Documents		
SEDAR18-RD01	Tag-reporting levels for RD caught by anglers in SC and Georgia estuaries	Denson et al 2002
SEDAR18-RD02	Association of large juvenile RD with an estuarine creek on the Atlantic coast of Florida	Adams & Tremain 2000
SEDAR18-RD03	Use of passive acoustics to determine RD spawning in Georgia waters	Barbieri *et al* TAFS 2008
SEDAR18-RD04	Spatial and temporal patterns in modeled particle transport to estuarine habitat with comparisons to larval fish settlement patterns	Brown *et al* 2005
SEDAR18-RD05	Incidental catch and discard of RD, in a large mesh Paralichthyidae gillnet fishery: experimental evaluation of a fisher's experience at limiting bycatch	Buckel *et al* 2006
SEDAR18-RD06	Site fidelity and movement patterns of wild subadult RD, within a salt marsh-dominated estuarine landscape	Dresser & Kneib 2007
SEDAR18-RD07	Behavior and recruitment success in fish larvae: variation with growth rate and the batch effect	Fuiman et al 2005
SEDAR18-RD08	Estimating stock composition of anadromous fishes from mark–recovery data: possible application to American shad	Hoenic , Latour & Olney TAFS 2008
SEDAR18-RD09	Distribution of RD spawning sites Identified by a towed hydrophone array	Holt TAFS 2008
SEDAR18-RD10	Year-class component, growth, and movement of juvenile RD stocked seasonally in a SC estuary	Jenkins *et al* 2004
SEDAR18-RD11	Experimental investigation of spatial and temporal variation in estuarine growth of age-0 juvenile RD	Lanier & Scharf 2007
SEDAR18-RD12	Estimates of fishing and natural mortality for subadult RD in SC Waters	Latour *et al* 2001
SEDAR18-RD13	Properties of the residuals from two tag-recovery models	Latour *et al* 2002
SEDAR18-RD14	Habitat triage for exploited fishes: Can we identify essential ''Essential Fish Habitat?''	Levin & Stunz 2005
SEDAR18-RD15	Identifying Sciaenid critical spawning	Luczkovich & Pullinger

	habitats by the use of passive acoustics	TAFS 2008
SEDAR18-RD16	Large scale patterns in fish trophodynamics of estuarine and shelf habitats of the SE US	Marancik & Hare 2007
SEDAR18-RD17	Ecophys.Fish: A simulation model of fish growth in time-varying environmental regimes	Neill et al 2004
SEDAR18-RD18	Population structure of RD as determined by otolith chemistry	Patterson et al 2004
SEDAR18-RD19	A new growth model for RD that accommodates seasonal and ontogenic changes in growth rates	Porch et al 2002
SEDAR18-RD20	Estimating abundance from gillnet samples with application to RD in Texas bays	Porch et al 2002b
SEDAR18-RD21	Icthyoplankton community structure in a shallow subtropical estuary of the Florida Atlantic coast	Reyier & Shenker 2007
SEDAR18-RD22	Role of an estuarine fisheries reserve in the production and export of ichthyoplankton	Reyier et al 2008
SEDAR18-RD23	Trophic plasticity and foraging performance in RD	Ruehl & DeWitt 2007
SEDAR18-RD24	Estuarine recruitment, growth, and first-year survival of juvenile RD in NC	Stewart & Scharf TAFS 2008
SEDAR 18-RD25	Habitat-related predation on juvenile wild-caught and hatchery-reared RD	Stunz & Minello 2001
SEDAR 18-RD26	Selection of estuarine nursery habitats by wild-caught and hatchery-reared juvenile red drum in laboratory mesocosms	Stunz et al 2001
SEDAR 18-RD27	Growth of newly settled red drum Sciaenops ocellatus in different estuarine habitat types	Stunz et al 2002
SEDAR 18-RD28	Multidirectional movements of sportfish species between an estuarine no-take zone and surrounding waters of the Indian River Lagoon, Florida	Tremain et al 2004
SEDAR 18-RD29	Marine stock enhancement in Florida: A multi-disciplinary, stakeholder-supported, accountability-based approach	Tringali et al 2008
SEDAR 18-RD30	Estimating improvement in spawning potential ratios for South Atlantic RD through bag and size limit regulations	Vaughan & Carmichael 2002
SEDAR 18-RD31	Catch-and-release mortality in subadult and adult red drum captured with popular fishing hook types	Vecchio & Wenner NAJFM 2008
SEDAR 18-RD32	Using estuarine landscape structure to model distribution patterns in nekton communities and in juveniles of fishery species	Whaley et al 2007

SEDAR 18-RD33	Reproductive biology of red drum, Sciaenops ocellatus, from the neritic waters of the northern Gulf of Mexico	Wilson and Neiland 1994
SEDAR 18-RD34	An age-dependent tag return model for estimating mortality and selectivity of an estuarine-dependent fish with high rates of catch and release	Bacheler et al 2008
SEDAR 18-RD35	Genetic effective size in populations of hatchery-raised red drum released for stock enhancement	Gold *et al* 2008
SEDAR 18-RD36	Contributions to the biology of red drum, *Sciaenops ocellatus*, in South Carolina	Wenner 2000
SEDAR 18-RD37	Recruitment of juvenile red drum in North Carolina: spatiotemporal patterns of year-class strength and validation of a seine survey	Bacheler, Paramore, Buckel, and Scharf 2008
SEDAR 18-RD38	Hooking Mortality of spotted seatrout (*Cynoscion nebulosus*), weakfish (*Cynoscion regalis*), red drum (*Sciaenops ocellatus*), and southern flounder (*Paralichthys lethostigma*) in North Carolina	Gearhart 2002
SEDAR 18-RD39	Evaluation of the estuarine hook and line recreational fishery in Neuse River, North Carolina	Brown 2007
SEDAR 18-RD40	Large circle hooks and short leaders with fixed weights reduce incidence of deep hooking in angled adult red drum	Beckwith and Brown 2005
SEDAR 18-RD41	Abiotic and biotic factors influence the habitat use of an estuarine fish	Bacheler, Paramore, Buckel, and Hightower 2008
SEDAR 18-RD42	Stock Status of the northern red drum stock	Takade and Paramore 2005
SEDAR 18-RD43	Short-term hooking mortality and movement of adult red drum (*Sciaenops ocellatus*) in the Neuse River, North Carolina.	Aguilar 2003
SEDAR 18-RD44	Identification of critical spawning habitat and male courtship vocalization characteristics of red drum, *Sciaenops ocellatus*, in the lower Neuse River estuary of North Carolina	Beckwith 2006
SEDAR 18-RD45	Movement and selectivity of red drum and survival of adult red drum: an analysis of 20 years of tagging data	Burdick, Hightower, Buckel, Paramore, and Pollock 2007
SEDAR 18-RD46	Age, growth, mortality, and reproductive biology of red drums in North Carolina waters	Ross, Stephens, and Vaughan 1995
SEDAR 18-RD47	North Carolina red drum fishery management plan, amendment 1	Red drum fishery management plan advisory committee and NC DMF 2008

SEDAR 18-RD48	Status of the red drum stock of the Atlantic coast- stock assessment report for 1989	Vaughan and Helser 1990
SEDAR 18-RD49	Status of the red drum stock of the Atlantic coast- stock assessment report for 1991	Vaughan 1992
SEDAR 18-RD50	Status of the red drum stock of the Atlantic coast- stock assessment report for 1992	Vaughan 1993
SEDAR 18-RD51	Status of the red drum stock of the Atlantic coast- stock assessment report for 1995	Vaughan 1996
SEDAR 18-RD52	Assessment for Atlantic red drum for 1999-northern and southern regions	Vaughan and Carmichael 2000
SEDAR 18-RD53	Bag and size limit analysis for red drum in northern and southern regions of the U. S. Atlantic	Vaughan and Carmichael 2001
SEDAR 18-RD54	Seasonal variation in age-specific movement patterns of red drum Sciaenops ocellatus inferred from conventional tagging and telemetry	Bacheler, Paramore, Burdick, Buckel, Hightower in review
SEDAR 18-RD55	A combined telemetry – tag return approach to estimate fishing and natural mortality rates of an estuarine fish	Bacheler, Buckel, Hightower, Paramore and Pollock in review
SEDAR 18-RD56	Investigation into the Feasibility of Stocking Artificially Propagated Red Drum in Georgia	Pafford, Nicholson, and Woodward 1990
SEDAR 18-RD57	A Biological and Fisheries Profile of Red Drum, Sciaenops ocellatus	Mercer 1984
SEDAR 18-RD58	Ultrasonic Biotelemetry Study of Young-Adult Red Drum in Georgia, July 1993 – September 1995	Nicholson, Jordan, and Purser 1996
SEDAR 18-RD59	Habitat Use and Movement of Subadult Red Drum, Sciaenops ocellatus, within a Salt Marsh-Estuarine System	Dresser 1996
SEDAR 18-RD60	Mortality, Movement, and Growth of Red Drum in Georgia	Pafford, Woodward, and Nicholson 1990
SEDAR 18-RD61	Spatial Homogeneity & Temporal Heterogeneity of Red Drum Microsatellites-Effective Pop Size & Management Implications	Chapman, Ball, Mash 2002
SEDAR 18-RD62	A modified stepping-stone model of population structure in Red Drum from Northern GOM	Gold, Burridge, Turner 2001
SEDAR 18-RD63	Population structure of red drum in the Northern Gulf of Mexico, as inferred from variation in nuclear-coded microsatellites	Gold, Turner 2002
SEDAR 18-RD64	An analysis of genetic population structure of red drum based on mtDNA control region sequences	Seyoum, Tringali, Bert, McElroy, Stokes 2000
SEDAR18-RD65	The 1960 Salt-Water Angling Survey,	J. R. Clark

	USFWS Circular 153	
SEDAR18-RD66	The 1965 Salt-Water Angling Survey, USFWS Resource Publication 67	D. G. Deuel and J. R. Clark. 1968
SEDAR18-RD67	1970 Salt-Water Angling Survey, NMFS Current Fisheries Statistics Number 6200	D. G. Deuel. 1973
SEDAR18-RD68	Overview of an experimental stock enhancement program for red drum in South Carolina	Smith, Jenkins, Denson 1997

Appendix 2: Copy of CIE Statement of Work

External Independent Peer Review by the Center for Independent Experts

SEDAR 18 - Atlantic Red Drum

Scope of Work and CIE Process: The National Marine Fisheries Service's (NMFS) Office of Science and Technology coordinates and manages a contract to provide external expertise through the Center for Independent Experts (CIE) to conduct impartial and independent peer reviews of NMFS scientific projects. This Statement of Work (SoW) described herein was established by the NMFS Contracting Officer's Technical Representative (COTR) and CIE based on the peer review requirements submitted by NMFS Project Contact. CIE reviewers are selected by the CIE Coordination Team and Steering Committee to conduct the peer review of NMFS science with project specific Terms of Reference (ToRs). Each CIE reviewer shall produce a CIE independent peer review report with specific format and content requirements (**Annex 1**). This SoW describes the work tasks and deliverables of the CIE reviewers for conducting an independent peer review of the following NMFS project.

Project Description: SEDAR 18 will be a compilation of data, a benchmark assessment of stock, and an assessment review for Atlantic red drum conducted under the SEDAR (Southeast Data, Assessment and Review) process. SEDAR peer reviews typically involve a panel composed of one NOAA/NMFS chair, one reviewer selected by each resource management agency (1 for SEDAR 18), and three CIE reviewers. The lead assessment agency will be the Atlantic States Marine Fisheries Commission (ASMFC). The Southeast Regional Office, NMFS will be involved. Assessment of the Atlantic stock of red drum is an approved item of the SEDAR Steering Committee assessment schedule. Red drum is an important recreational fishery resource and contributes to commercial fisheries on the Atlantic coast. The most recent assessments of red drum are: Atlantic in 2000 and Florida both coasts in 2005. Considerable additional life history and fishery data have been collected since these assessments. Significant changes in stock status have been documented due to management efforts and population abundance. The purpose of the review is to ensure the assessment is based on sound scientific methods and provides information that is robust and adequate for determining stock status. The review is conducted by a panel of experts during a week-long workshop that is open to the public. Assessment team representatives will present their findings to the review panel which will then address a series of Terms of Reference. Reviewers will critique the assessment and document their findings in a written report that they prepare during the workshop and complete within two weeks of its conclusion. The Terms of Reference (ToRs) of the peer review are attached in **Annex 2**. The tentative agenda of the panel review meeting is attached in **Annex 3**.

Requirements for CIE Reviewers: Three CIE reviewers shall conduct an impartial and independent peer review in accordance with the SoW and ToRs herein. Each CIE reviewer's duties shall not exceed a maximum of 14 days to complete all work tasks of the peer review described herein. CIE reviewers shall have the expertise, background, and experience to complete an independent peer review in accordance with the SoW and ToRs herein. CIE reviewer shall have expertise and working experience in stock assessment, statistics, fisheries science, and marine biology.

Location of Peer Review: Each CIE reviewer shall conduct an independent peer review during the SEDAR 18 panel review meeting scheduled in Atlanta, Georgia during August 24-28, 2009.

Statement of Tasks: Each CIE reviewers shall complete the following tasks in accordance with the SoW and Schedule of Milestones and Deliverables herein.

Prior to the Peer Review: Upon completion of the CIE reviewer selection by the CIE Steering committee, the CIE shall provide the CIE reviewer information (name, affiliation, and contact details) to the COTR, who forwards this information to the NMFS Project Contact no later the date specified in the Schedule of Milestones and Deliverables. The CIE is responsible for providing the SoW and ToRs to the CIE reviewers. The NMFS Project Contact is responsible for providing the CIE reviewers with the background documents, reports, foreign national security clearance, and information concerning other pertinent meeting arrangements. The NMFS Project Contact is also responsible for providing the Chair a copy of the SoW in advance of the panel review meeting. Any changes to the SoW or ToRs must be made through the COTR prior to the commencement of the peer review.

Foreign National Security Clearance: When CIE reviewers participate during a panel review meeting at a government facility, the NMFS Project Contact is responsible for obtaining the Foreign National Security Clearance approval for CIE reviewers who are non-US citizens. For this reason, the CIE reviewers shall provide requested information (e.g., name, contact information, birth date, passport number, travel dates, and country of origin) to the NMFS Project Clearance for the purpose of their security clearance, and this information shall be submitted at least 30 days before the peer review in accordance with the NOAA Deemed Export Technology Control Program NAO 207-12 regulations (available at the Deemed Exports NAO website: http://deemedexports.noaa.gov/sponsor.html).

Pre-review Background Documents: Two weeks before the peer review, the NMFS Project Contact will send by electronic mail or make available at an FTP site the CIE reviewers all necessary background information and reports for the peer review. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE on where to send documents. The CIE reviewers shall read all documents in preparation for the peer review.

Review workshop panelists receive the Assessment Report, including sections prepared by the data and assessment workshops; supplemental analytical materials including all working papers and reference documents from prior workshops; and general information regarding the Review Workshop, including the agenda, report outlines, terms of reference, and participant list. This list of pre-review documents may be updated up to two weeks before the peer review. Any delays in submission of pre-review documents for the CIE peer review will result in delays with the CIE peer review process, including a SoW modification to the schedule of milestones and deliverables. Furthermore, the CIE reviewers are responsible only for the pre-review documents that are delivered to the reviewer in accordance to the SoW scheduled deadlines specified herein.

Panel Review Meeting: Each CIE reviewers shall conduct the independent peer review in accordance with the SoW and ToRs. **Modifications to the SoW and ToRs can not be made during the peer review, and any SoW or ToRs modifications prior to the peer review shall be approved by the**

COTR and CIE Lead Coordinator. Each CIE reviewer shall actively participate in a professional and respectful manner as a member of the meeting review panel, and their peer review tasks shall be focused on the ToRs as specified in the contract SoW. The NMFS Project Contact is responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements, including the meeting facility arrangements.

Instructions to reviewers and the chair are provided in Annex 5. Reviewers are expected to review documents prior to the workshop, participate in panel discussions critiquing and evaluating the assessment, and contribute to preparation of the Review Panel Report documenting the panel's findings for each Term of Reference. The review workshop will be run by a chair who may also serve in a limited review capacity and will prepare an executive summary for the workshop panel report.

The Review Panel Chair is responsible for compiling, editing, and submitting the Review Panel Report to the SEDAR Coordinator by a deadline specified in the assessment schedule. At the start of the workshop the Chair will assign each panelist specific duties, such as drafting specific Review Panel Report sections. The Chair may select one panelist to serve as assessment leader for each stock assessment under review. The assessment leader is responsible for preparing initial drafts of the Review Panel Report for the assigned assessment. Such duties may be further subdivided if workshop manpower allows. The ASMFC will provide a rapporteur to take notes on the discussions so that panelists can more fully participate in discussions and assist the analytical team in documenting panel recommendations.

Contract Deliverables - Independent CIE Peer Review Reports: Each CIE reviewer shall complete an independent peer review report in accordance with the SoW. Each CIE reviewer shall complete the independent peer review according to required format and content as described in Annex 1. Each CIE reviewer shall complete the independent peer review addressing each ToR as described in Annex 2.

Other Tasks – Contribution to Review Panel Report: Each CIE reviewer will assist the Chair of the review panel with contributions to the Review Panel Report. CIE reviewers are not required to reach a consensus, and should instead provide a brief summary of their views on the summary of findings and conclusions reached by the review panel in accordance with the ToRs, and ensure final review comments and document edits are provided to the Chair.

Specific Tasks for CIE Reviewers: The following chronological list of tasks shall be completed by each CIE reviewer in a timely manner as specified in the **Schedule of Milestones and Deliverables**.

1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review;
2) Participate during the panel review meeting at the LOCATION and DATES as called for in the SoW, and conduct an independent peer review in accordance with the ToRs (Annex 2);
3) No later than 11 September 2009, each CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts," and sent to Mr. Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and to Dr. David Sampson, CIE Regional Coordinator, via email to david.sampson@oregonstate.edu. Each CIE report shall be written using the format and content requirements specified in Annex 1, and address each ToR in Annex 2;
4) CIE reviewers shall address changes as required by the CIE review in accordance with the schedule of milestones and deliverables.

Schedule of Milestones and Deliverables: CIE shall complete the tasks and deliverables described in this SoW in accordance with the following schedule.

22 July 2009	CIE sends reviewer contact information to the COTR, who then sends this to the NMFS Project Contact
10 August 2009	NMFS Project Contact sends the CIE Reviewers the pre-review documents
24-28 August 2009	Each reviewer participates and conducts an independent peer review during the panel review meeting in Atlanta, Georgia
11 September 2009	CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
25 September 2009	CIE submits CIE independent peer review reports to the COTR
01 October 2009	The COTR distributes the final CIE reports to the NMFS Project Contact, the Lead Assessment Agency Contact, and regional Center Director

Modifications to the Statement of Work: Requests to modify this SoW must be made through the Contracting Officer's Technical Representative (COTR) who submits the modification for approval to the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the CIE within 10 working days after receipt of all required information of the decision on substitutions. The COTR can approve changes to the milestone dates, list of pre-review documents, and Terms of Reference (ToR) of the SoW as long as the role and ability of the CIE reviewers to complete the SoW deliverable in accordance with the ToRs and deliverable schedule are not adversely impacted. The SoW and ToRs cannot be changed once the peer review has begun.

Acceptance of Deliverables: Upon review and acceptance of the CIE independent peer review reports by the CIE Lead Coordinator, Regional Coordinator, and Steering Committee, these reports shall be sent to the COTR for final approval as contract deliverables based on compliance with the SoW. As specified in the Schedule of Milestones and Deliverables, the CIE shall send via e-mail the contract deliverables (the CIE independent peer review reports) to the COTR (William Michaels, via William.Michaels@noaa.gov).

Applicable Performance Standards: The contract is successfully completed when the COTR provides final approval of the contract deliverables. The acceptance of the contract deliverables shall be based on three performance standards: (1) each CIE report shall have the format and content in accordance with Annex 1, (2) each CIE report shall address each ToR as specified in Annex 2, (3) the CIE reports shall be delivered in a timely manner as specified in the schedule of milestones and deliverables.

Distribution of Approved Deliverables: Upon notification of acceptance by the COTR, the CIE Lead Coordinator shall send via e-mail the final CIE reports in *.PDF format to the COTR. The COTR will distribute the approved CIE reports to the NMFS Project Contact, the Lead Assessment Agency Contact, and regional Center Director.

Key Personnel:

William Michaels, Contracting Officer's Technical Representative (COTR)

NMFS Office of Science and Technology
1315 East West Hwy, SSMC3, F/ST4, Silver Spring, MD 20910
William.Michaels@noaa.gov Phone: 301-713-2363 ext 136

Manoj Shivlani, CIE Lead Coordinator
Northern Taiga Ventures, Inc.
10600 SW 131st Court, Miami, FL 33186
shivlanim@bellsouth.net Phone: 305-383-4229

Dale Theiling, SEDAR Coordinator (NMFS Project Contact)
South Atlantic Fishery Management Council, 4055 Faber Drive, Suite 201,
North Charleston, SC 29405
Dale.Theiling@SAFMC.net, Phone: 843-571-4366

Bonnie Ponwith, SEFSC Science Director
NMFS, SEFSC, 75 Virginia Beach Drive, Miami, FL 33149
Bonnie.Ponwith@noaa.gov Phone: 305-361-4264

Patrick Campfield, Science Director (Lead Assessment Agency Contact)
Atlantic States Marine Fisheries Commission
1444 "Eye" St. NW
Washington DC 20005
pcampfield@asmfc.org Phone: (202) 289-6400

Annex 1: Format and Contents of CIE Independent Peer Review Report

1. The CIE independent report shall be prefaced with an Executive Summary providing a concise summary of the findings and recommendations.

2. The main body of the reviewer report shall consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Summary of Findings for each ToR, and Conclusions and Recommendations in accordance with the ToRs.

   a. Reviewers should describe in their own words the review activities completed during the panel review meeting, including providing a detailed summary of findings, conclusions, and recommendations.

   b. Reviewers should discuss their independent views on each ToR even if these were consistent with those of other panelists, and especially where there were divergent views.

   c. Reviewers should elaborate on any points raised in the Review Panel Report that they feel might require further clarification.

   d. Reviewers shall provide a critique of the NMFS review process, including suggestions for improvements of both process and products.

   e. The CIE independent report shall be a stand-alone document for others to understand the proceedings and findings of the meeting, regardless of whether or not they read the Review Panel Report. The CIE independent report shall be an independent peer review of each ToRs, and shall not simply repeat the contents of the Review Panel Report.

3. The reviewer report shall include as separate appendices as follows:

   Appendix 1: Bibliography of materials provided for review
   Appendix 2: A copy of the CIE Statement of Work
   Appendix 3: Panel Membership or other pertinent information from the panel review meeting.

Annex 2: Terms of Reference for the Peer Review

SEDAR 18 - Atlantic Red Drum

Approved by the South Atlantic State-Federal Fisheries Management Board

October 23, 2008

Review Workshop

1. Evaluate the adequacy, appropriateness, and application of data used in the assessment*.
2. Evaluate the adequacy, appropriateness, and application of methods used to assess the stock*.
3. Recommend appropriate estimates of stock abundance, biomass, and exploitation*.
4. Evaluate the methods used to estimate population benchmarks and management parameters (e.g., static spawning potential ratio); provide estimated values for management benchmarks, and declarations of stock status*. Evaluate the population metric used by managers to determine the stock status and, if appropriate, recommend alternative measures.
5. Evaluate the adequacy, appropriateness, and application of methods used to characterize uncertainty in estimated parameters. Provide measures of uncertainty for estimated parameters*. Ensure that the implications of uncertainty in technical conclusions are clearly stated.
6. Ensure that stock assessment results are clearly and accurately presented in the Stock Assessment Report and Summary Report and that reported results are consistent with Review Panel recommendations**.
7. Evaluate the SEDAR Process. Identify any Terms of Reference which were inadequately addressed by the Data or Assessment Workshops; identify any additional information or assistance which will improve Review Workshops; suggest improvements or identify aspects requiring clarification.
8. Review the research recommendations provided by the Data and Assessment workshops and make any additional recommendations warranted. Clearly indicate the research and monitoring needs that may appreciably improve the reliability of future assessments. Recommend an appropriate interval for the next assessment.
9. Prepare a Peer Review Consensus Summary summarizing the Panel's evaluation of the stock assessment and addressing each Term of Reference. Develop a list of tasks to be completed following the workshop. Complete and submit the Consensus Report within 3 weeks of workshop conclusion.

* The review panel may request additional sensitivity analyses, evaluation of alternative assumptions, and correction of errors identified in the assessments provided by the assessment workshop panel; the review panel may not request a new assessment. Additional details regarding the latitude given the review panel to deviate from assessments provided by the assessment workshop panel are provided in the *SEDAR Guidelines* and the *SEDAR Review Panel Overview and Instructions*.

** The panel shall ensure that corrected estimates are provided by addenda to the assessment report in the event corrections are made in the assessment, alternative model configurations are recommended, or additional analyses are prepared as a result of review panel findings regarding the TORs above.

Annex 3: Tentative Agenda

SEDAR 18 REVIEW WORKSHOP
Atlantic Red Drum

Doubletree Buckhead Atlanta
3342 Peachtree Road, NE, Atlanta, Georgia

TBN by NMFS, Chair
Mr. Dale Theiling, SEDAR Coordinator

Monday, August 24, 2009

1:00pm – 5:30pm	**Afternoon Session**	
	Convene	
	Introductions and Opening Remarks	SEDAR Coordinator and Chair
	Agenda Review, TOR Review	Chair
	Task Assignments	Chair
	Assessment Presentation	Lead analyst
	Assessment Discussion	Review Panel and Lead analyst

Tuesday, August 25, 2009

8:00am - 11:30am	**Morning Session**	
	Assessment Discussion	Review Panel
12:00noon	**Lunch**	
2:00pm – 5:30pm	**Afternoon Session**	
	Topical Discussions	Review Panel

Wednesday, August 26, 2009

8:00am - 11:30am	**Morning Session**	
	Topical Discussions	Review Panel
12:00noon	**Lunch**	
2:00pm – 5:30pm	**Afternoon Session**	
	Topical Discussions	Review Panel

Thursday, August 27, 2009

8:00am - 11:30am	**Morning Session**	
	Topical Discussions	Review Panel
12:00noon	**Lunch**	
2:00pm – 5:30pm	**Afternoon Session**	
	Review Workshop Report	Review Panel

Friday, August 28, 2009

8:00am - 11:30am Morning Session

	Final Review of Panel Documents	Chair
12:00noon	Adjournment	Chair

Discussion Topics

Evaluation of data and their preparation and presentation
Choice and utilization of assessment models and methods
Continuity run from previous assessment(s)
Alternative assessment approaches
Identification of additional analyses, sensitivities, and corrections
Review of additional analyses and sensitivities
Initial workshop recommendations and comments
Data and Assessment Workshop Research Recommendations
Identify Review Panel research recommendations
Improvement of the SEDAR process
Assure all Terms of Reference are addressed
Develop draft Review Panel Report sections
Review draft Review Panel Report sections
Finalize workshop recommendations
Finalize Review Panel Report
Post Review Workshop tasks and products due Chair and CIE

The timing of particular events is tentative, and the Chair may modify this schedule during the workshop as needed to complete stated tasks. However, to accommodate travel planning the workshop will start as scheduled and will conclude no later than the stated time.

SEDAR is a public process, and the public is welcome to attend SEDAR workshops. Although no formal public comment period is scheduled, the workshop Chair will allow opportunity during the meeting for the public in attendance to comment on discussion items.

Annex 4: Review Panel Report

Executive Summary

I. Terms of Reference

List each Term of Reference, and include a summary of the Panel discussion regarding the particular item. Include a clear statement indicating whether or not the criteria in the Term of Reference are satisfied.

II. Analyses and Evaluations

Summary results and findings of review panel analytical requests.

Note: The Review Panel Report becomes Chapter 2 of the Review Workshop Report.

Annex 5: SEDAR Review Workshop Panelist and Chair Instructions

Tasks, Responsibilities, and Supplemental Instructions
for
SEDAR Review Workshop Participants

SEDAR Review Workshop Overview

SEDAR Review Workshops provide independent peer review of stock assessments prepared through SEDAR data and assessment workshops. The goal of the review is to ensure that the assessment and results presented are scientifically sound and that managers are provided adequate advice regarding stock status, management benchmarks, and the general nature of appropriate future management actions. The Review Panel has limited authority to request additional analyses, corrections of existing analyses and sensitivity runs.

An analytical and presentation team, composed of a subset of the Assessment Workshop panel and representing the primary analysts for each assessment, will be present at the workshop to present assessment findings, provide an overview of assessment data, provide additional results or model information, and prepare any additional analyses requested by the Review Panel. Although many individuals contribute to a SEDAR assessment, the Review Panel is ultimately responsible for ensuring that the best possible assessment is provided through the SEDAR process.

The review panel shall not provide specific management advice. Such advice will be provided by existing Council Committees, such as the Science and Statistical Committee and Advisory Panels, following completion of the assessment.

SEDAR review workshop panels are typically composed of a Chair, 3 reviewers appointed by the CIE (Center for Independent Experts), and 1 reviewer appointed by each Council having jurisdiction over the stocks under review. All reviewers are independent, meaning that they should not have contributed to the assessment under review and should not have a role in any management actions that may stem from the assessment. Each Council may appoint several official observers, typically including representatives of the Council, its SSC, and appropriate Advisory Panels.

All SEDAR workshops, including the Review Workshop, are open, transparent, public processes administered according to the rules and regulations governing Federal Fishery Management Council operations. All SEDAR workshops are recorded and transcripts of workshop discussions may be prepared upon request through the SEDAR Steering Committee. The names and affiliations of reviewers will be disclosed in the review workshop documents. The Review Workshop Report will be publicly distributed along with the other SEDAR Workshop working papers and workshop reports. The public may submit written comments in accordance with Council guidelines once the report is disseminated to the relevant Council.

Review workshop panelists receive the Assessment Report, including sections prepared by the data and assessment workshops; supplemental analytical materials including all working papers and reference documents from prior workshops; and general information regarding the Review Workshop, including the agenda, report outlines, terms of reference, and participant list. Review panelists are expected to read and review the provided materials to become familiar with the assessment.

The charge to each SEDAR Review Workshop is specified in Terms of Reference. During the review the Review Workshop panel will prepare a Review Panel Report for each stock assessed addressing each of the Terms of Reference. The summary should represent the views of the group as

a whole, but shall also include any dissenting views of individual panelists if appropriate. Outlines and example documents will be provided by SEDAR staff.

Review Workshop Panel General Instructions

The Review Panel Chair is responsible for compiling, editing, and submitting the Review Panel Report to the SEDAR Coordinator by a deadline specified in the assessment schedule. At the start of the workshop the Chair will assign each panelist specific duties, such as drafting specific report sections. The Chair may select one panelist to serve as assessment leader for each stock assessment under review. The assessment leader is responsible for preparing initial drafts of text addressing Terms of Reference for the assigned assessment. Such duties may be further subdivided if workshop manpower allows. The SEFSC will provide a rapporteur to take notes on the discussions so that panelists can more fully participate in discussions and assist the analytical team in documenting panel recommendations.

The Review Panel's primary responsibility is to ensure that assessment results are based on sound science, appropriate methods, and appropriate data. During the course of review, the panel is allowed limited flexibility to deviate from the assessment provided by the Assessment Workshop. This flexibility may include modifying the assessment configuration and assumptions, requesting a reasonable number of sensitivity runs, requesting additional details and results of the existing assessments, or requesting correction of any errors identified. However, the allowance for flexibility is limited, and the review panel is not authorized to conduct an alternative assessment or to request an alternative assessment from the technical staff present. The SEDAR Steering Committee recognizes that determining when modifications constitute an 'alternative' assessment is a subjective decision, and has therefore determined that the Review Panel is responsible for applying its collective judgment in determining whether proposed changes and corrections to the presented assessment are sufficient to constitute an alternative assessment. The Review Panel Chair will coordinate with the SEDAR Coordinator and technical staff present to determine which requests can be accomplished and prioritize desired analyses.

Any changes in assessment results stemming from modifications or corrections solicited by the review panel will be documented in an addendum to the assessment report. If updated estimates are not available for review by the conclusion of the workshop, the review panel shall agree to a process for reviewing the final results. Any additional or supplemental analyses requested by the Review Panel and completed by the Analytical team shall, at the discretion of the chair and panel, be either documented through a supplemental report or included in the Review Panel Report.

If the Review Panel finds an assessment deficient to the extent that technical staff present cannot correct the deficiencies during the course of the workshop, or the Panel deems that desired modifications would result in an alternative assessment, then the Review Panel shall provide in writing the required remedial measures suggest an appropriate approach for correcting the assessment and subsequently reviewing the corrected assessment.

Review Workshop Panel Participant Information

Serving as a review workshop panelists is a considerable time commitment that requires more than simply the daily sessions of the review workshop. Panelists will need to set aside time in the weeks prior to the workshop to review data and assessment documents. During the workshop, time beyond that of the scheduled daily sessions may be required to complete workshop tasks and reports. Time is required following the workshop to review and finalize panel reports.

Review panelists are expected to author workshop reports and may conduct supplementary analyses or data summaries. Panelists should come prepared with a laptop computer for these tasks.

The SEDAR Steering Committee and SEDAR Coordinator establish deadlines for document submission. SEDAR staff distributes working documents and support materials (agenda, participant instructions) to workshop participants, typically two weeks prior to the workshop.

SEDAR Workshop Panelist Code of Conduct

- SEDAR workshop panels decisions shall be based on science. Discussions and deliberations shall not consider possible future management actions, agency financial concerns, or social and economic consequences.
- SEDAR Review Workshop Panels are encouraged to reach a group consensus that all participants can accept, which may include agreeing to acknowledge and present multiple possibilities. If this is not feasible, then each reviewer may state their individual opinion with regard to the Terms of Reference and are responsible for providing appropriate text that captures their opinion for the Review Panel Report.
- Personal attacks will not be tolerated. Advancement in science is based on disagreement and healthy, spirited discourse is encouraged. However, professionalism must be upheld and those who descend into personal attacks will be asked to leave.
- SEDAR workshop panelists are expected to support their discussions with appropriate text and analytical contributions. Each panelist is individually responsible for ensuring that their points and recommendations are addressed in workshop reports; they should not rely on others to address their concerns.
- Panelists are expected to provide constructive suggestions and alternative solutions; criticisms should be followed with recommendations and solutions.

Review Workshop Networking and IT

A wireless network is available at each SEDAR workshop to provide internet and file server access. All reports and documents pertaining to the review will be available on the server. IT staff will be available during the review workshop to aid each participant in securing network access.

Review Workshop Chair, Reviewer, and Support Staff Responsibilities

Review Workshop Chair:

1. Approximately 3 weeks prior to the Assessment Review Panel workshop the Chair shall be provided with same document package provided to the Technical Reviewers and appointed observers, including stock assessment reports and associated documents. The Chair shall read and review all documents to gain an in-depth understanding of the stock assessment under consideration and the data and information considered in the assessment.
2. Approximately 1 week prior to the workshop the Chair may be asked to participate in a conference call with the SEDAR Coordinator and representatives of the stock assessment teams to review the final agenda, plan for presentations, and meeting format.
3. During the Assessment Review Workshop the Chair shall control and guide the meeting, including the coordination of presentations, discussions, and task assignments.
4. During the Assessment Review Workshop the Chair may participate in technical discussions and serve as a technical reviewer.
5. During the Assessment Review Workshop the Chair shall work with the SEDAR Coordinator and the analytical and presentation team to manage the workload of panel requests and recommendations. At the conclusion of each session the Chair shall provide prioritized task lists to the analytical team and SEDAR Coordinator.
6. The Chair shall facilitate preparation and writing of the Review Panel Report. Review panel

members, agency staff, and others present at the meeting will assist the Chair as needed. The Chair shall be responsible for the editorial content of Panel reports, and the Chair shall be responsible for ensuring that reports are produced and distributed to appropriate contacts on schedule (see "Final Reports" below).

7. The SEDAR coordinator shall assist the Assessment Review Panel Chair prior to, during, and after the meeting to ensure that documents are distributed in a timely fashion.

8. Expected Time Obligation: It is estimated that the Chair's duties shall occupy up to 14 days: several days prior to the Review Panel meeting for document review, five days for the workshop, and several days following the meeting to ensure that the final documents are completed.

Review Workshop Technical Reviewer:

1. Approximately three weeks prior to the meeting, the reviewers shall be provided with the stock assessment reports, associated supporting documents, and review workshop instructions including the Terms of Reference. Reviewers shall read these documents to gain an in-depth understanding of the stock assessment, the resources and information considered in the assessment, and their responsibilities as reviewers.

2. During the Review Panel meeting, reviewers shall participate in panel discussions on assessment methods, data, validity, results, recommendations, and conclusions as guided by the Terms of Reference. The reviewers shall develop a Review Panel Report for each assessment reviewed. Reviewers may be asked to serve as an assessment leader during the review to facilitate preparing first drafts of review reports.

3. Following the Review Panel meeting, reviewers shall work with the chair to complete and review the Review Panel Reports. Reports shall be completed, reviewed by all panelists, and comments submitted to the Chair within two weeks of the conclusion of the workshop.

4. Additional obligation of CIE-appointed reviewers: Following the Review Panel meeting, each reviewer appointed by the CIE shall prepare an individual CIE Reviewer Report and submit it in accordance with specifications provided in the Statement of Work.

Review Workshop Support Staff:

SEDAR Coordinator: Arrange workshop and handle meeting logistics; distribute workshop materials and notices; support chair and reviewers during review workshop; coordinate with chair and analytical team to prioritize panel task requests; address procedural issues that arise; distribute final workshop products in accordance with SEDAR protocols.

Analytical and Presentation Team: Present data overview and assessment results, address panel questions and comments as required; complete panel requests for additional analyses or model corrections in accordance with SEDAR guidelines; document any analyses conducted during the workshop.

Rapporteur: Take notes on panel discussion of assigned species for use by technical reviewers in preparing initial report drafts, assist SEDAR Coordinator, Chair, and Analytical team in addressing panel requests and completing workshop documents as necessary.

IT Support: Set-up and manage the SEDAR network to provide internet and file server capabilities during the workshop, work with hotel or vendor contacts to provide internet and email access, ensure all participants are able to access the network, and address any IT-related issues that arise during the workshop

SEDAR Administrative Assistant: Provide general support to workshop participants, coordinate with hotel banquet and events staff to facilitate proper room arrangements and daily catering orders, record workshop sessions, manage submitted documents and written statements for administrative record.

SEDAR Review Workshop Panel Report Outline

Executive Summary

I. Terms of Reference

List each Term of Reference, and include a summary of the Panel discussion regarding the particular item. Include a clear statement indicating whether or not the criteria in the Term of Reference are satisfied.

II. Analyses and Evaluations

Summary results and findings of review panel analytical requests.

Appendix 3: Panel membership

SEDAR 18 Participants List
Atlantic Red Drum
Peer Review Workshop
August 24-28, 2009
Atlanta, GA

Appointee	Function	Affiliation
Independent Review Panel		
Dr Robert O'Boyle	Chair and Reviewer	Consultant
Dr. Matthew Cieri	Independent Reviewer	ASMFC ME DNR
Dr. Kevin Stokes	Independent Reviewer	CIE
Dr. Norm Hall	Independent Reviewer	CIE
Dr. Jamie Gibson	Independent Reviewer	CIE
Rapporteur		
Dr. Mike Denson	Rapporteur	ASMFC RD SAS
Presenters and Analytical Team		
Dr. Mike Murphy	Lead Analyst	ASMFC RD SAS
Lee Paramore	Stock Leader	ASMFC-TC
Dr. Joe Grist	Presenter and Asst-Rapporteur	ASMFC RD SAS
Appointed Observers		
Robert Boyles	Commissioner	ASMFC
Spud Woodward	Commissioner	ASMFC
Nichola Meserve	Red Drum FMP Coordinator	ASMFC
Bill Windley	ASMFC AP Chair	Recreational, Maryland
Coordination		
Dale Theiling	Coordinator	SEDAR
Rachael Lindsay	Administrative Support	SEDAR
Patrick Gilles	IT Support	SEFSC-Miami

Acronyms

ACCSP	Atlantic Coastal Cooperative Statistics Program
ASMFC TC	Atlantic States Marine Fisheries Commission Technical Committee
CIE	Center for Independent Experts
FL FWCC	Florida Fish and Wildlife Conservation Commission
FMP	Fishery Management Plan
GA DNR	Georgia Department of Natural Resources
IT	Information Technology
ME DNR	Maine Department of Natural Resources
MRFSS	Marine Recreational Fisheries Statistics System
MRIP	Marine Recreational Information Program
NC DMF	North Carolina Division of Marine Fisheries
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
RD SAS	Red Drum Stock Assessment Subcommittee
SEFSC	Southeast Fisheries Science Center, National Marine Fisheries Service
SC DNR	South Carolina Department of Natural Resources
SEDAR	Southeast Data, Assessment, and Review

TIP	Trip Interview Program, National Marine Fisheries Service
VMRC	Virginia Marine Resources Commission

Appendix 4 Agenda

SEDAR 18 REVIEW WORKSHOP
Atlantic Red Drum
Doubletree Buckhead Hotel, Atlanta, Georgia
24 – 28 August 2009
AGENDA

- **Monday, 24 August 2009**
  - 13:00 – 17:30 Afternoon Session
    - Introduction, opening remarks, review of terms of reference & agenda
    - Northern & Southern assessment presentations & discussion
    - Data Inputs
  - 17:30 – 19:00 Supper
  - 19:00 – 21:00 Evening Session
    - Data Inputs (cont'd)
- **Tuesday, 25 August 2009**
  - 08:00 – 12:00 Morning Session
    - Assessment models
  - 12:00 – 14:00 Lunch
  - 14:00 – 17:30 Afternoon Session
    - Assessment models (cont'd)
    - Biological Reference Points
  - 17:30 – 19:00 Supper
  - 19:00 – 21:00 Evening Session
    - Biological Reference Points (cont'd)
    - Model rerun specifications (if required)
- **Wednesday, 26 August 2009**
  - 08:00 – 12:00 Morning Session
    - Drafting & Reruns
  - 12:00 – 14:00 Lunch
  - 14:00 – 17:30 Afternoon Session
    - Consideration of drafts & reruns
- **Thursday, 27 August 2009**
  - 08:00 – 12:00 Morning Session
    - Stock Status (Northern & Southern Stocks)
  - 12:00 – 14:00 Lunch
  - 14:00 – 17:30 Afternoon Session
    - Findings for each terms of reference
- **Friday, 28 August 2009**

- 08:00 – 12:00 Morning Session
  - Discussion on SEDAR Process
  - Research Recommendations
  - Report assignments

Appendix 5 Acronyms

ABC	Acceptable Biological Catch
ADMB	AD Model Builder
ALK	Age-length key
ASMFC	Atlantic States Marine Fisheries Commission
Bmsy	The spawning biomass at MSY
CIE	Center for Independent Experts
FMP	Fishery Management Plan
Fmsy	The long-term fishing mortality associated with sustaining the spawning biomass at Bmsy
Frebuild	Maximum fishing mortality under which the stock would rebuild within the required time
ME DNR	Maine Department of Natural Resources
MFMT	Maximum Fishing Mortality Threshold
MRFSS	Marine Recreational Fisheries Statistics Survey
MRFSS Type A	Observed recreational landings
MRFSS Type B1	Unobserved recreational landings
MRFSS Type B2	Fish that were caught by recreational fishers and released alive
MSST	Minimum Stock Size Threshold
MSY	Maximum Sustainable Yield
OY	Optimum yield
PAA	Proportion at age
SCA	Statistical Catch at Age
SFA	Sustainable Fisheries Act
ToR	Term of Reference