CIE Independent Report
Stock Assessment Workshop
Atlantic Red Drum
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North Charleston, South Carolina

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Executive Summary

The Assessment Workshop (AW) report was not completed by the time this CIE report was required, and analyses were still being conducted by the lead analyst. Rapporteur notes were not available either. I cannot report in detail on Summary of Findings for each ToR, and Conclusions and Recommendations in accordance with the ToRs. However:

- There was consensus on the baseline assessment model (i.e. statistical catch at age, SCCA) and configuration for the northern region red drum stock.
- There was consensus on the baseline assessment model for the southern region red drum stock (i.e. SCCA), although a precise configuration for this model was not be determined.

Little progress was made at the AW on draft text for the Assessment Workshop Report or the Summary Report. Most of this will occur outside plenary, and, in my experience, such reports do not get the same level of review as those developed in plenary. However, I recognize that there was too much analysis required at SEDAR 18 AW to allow for drafts to be completed. Part of the problem was the length of time since the last full assessment of the northern and southern red drum stocks. I provide a few recommendations that may speed up future assessments.

To assist the AW I provided analyses and working papers:

1. **S18-AW02**. Nonparametric growth model for Atlantic red drum, and changes to natural mortality (M) estimates.
2. **S18-AW06**. Graphical analyses of the catch age composition for red rum.
3. **S18-AW07**. Semi-separable untuned VPA for red drum.
4. **S18-AW11**. Tagging estimates of abundance at age for the northern region red drum stock.

Background

SEDAR 18 involves a compilation of data at a **data workshop (DW)**, a benchmark assessment of the stock at an **assessment workshop (AW)**, and an assessment review for Atlantic red drum. The goal of SEDAR assessment workshops is to conduct quantitative population analysis to determine stock status, evaluate management benchmarks, and project future stock conditions. The lead assessment agency and SEDAR partner for SEDAR 18 is the Atlantic States Marine Fisheries Commission.

Red drum is an important recreational fishery resource and contributes to commercial fisheries within its range on the Atlantic coast of the US. The most recent assessments of red drum in Atlantic waters are those done in 2000 for the Atlantic stock and in 2005 for both Florida coasts. 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 SEDAR 18 Assessment Panel was composed of one CIE-appointed panelist, five panelists appointed by the Atlantic States Marine Fisheries Commission from Atlantic coastal states, and one panelist appointed by the SEFSC director. The workshop was chaired by the SEDAR coordinator. Commission staff, Commission members, and Commission advisory panel members attended as observers.

The **Terms of Reference** (**ToRs**) for the AW are described later in this report. The AW was tasked with preparing an Assessment Workshop Report which summarized the primary assessment findings, and a first draft of the Summary Report.

The specific goals of the AW were to:

- Review post-DW data changes and analyses suggested by the DW.
- Summarize data used in each assessment model, and justify deviations from DW recommendations.
- Develop population assessment models compatible with relevant data.
- Recommend a model configuration deemed useful for advice relative to static SPR levels.
- Document input data, assumptions, equations, and model code in a working paper.
- Include a continuity case run to determine the effect, if there is a model change.
- Provide estimates of stock population parameters.
- Characterize scientific uncertainty in the assessment and estimated values.
- Provide measures of model performance, reliability, and ‘goodness of fit’.

- Provide recruitment evaluations and estimates of SPR and escapement.
- Evaluate the impacts of management actions on the stock.
- Discuss workshop research recommendations.
- Prepare a spreadsheet containing model parameter estimates and relevant population information with data findings.
- Complete the AW Report and Summary Report draft, and
- Develop a post AW task list.

Role of reviewer

The CIE appointed expert was tasked with participating on the Assessment Panel, rather than the Review Panel. This included participating in discussions of technical details of the methods used for the SEDAR assessment, and assisting in decisions related to model configuration. The appointee was tasked with impartially and independently contributing fresh information to improve the assessment being undertaken, and determining if the best available science was utilized for fisheries management decisions.

During the AW, the appointee and six other assessment panel members discussed technical details of the methods used in the SEDAR assessment, and assisted in decisions related to model configuration. The CIE expert was tasked with impartially critiquing the assessment being undertaken to advise the analytic team on ways to improve the model and to interpret and present its results. The CIE expert assisted in the determination that the best available information and science were utilized in the assessment and, to the extent determined by the lead analyst, contributed to the written assessment workshop report (see below).

The CIE expert was asked to read all documents in preparation for the assessment workshop. This included 18 documents prepared by the DW, and 68 other background documents. During the review meeting, I participated in panel discussions on assessment methods, data, validity, results, recommendations, and conclusions, according to the ToRs.

To assist the AW, I provided analyses and working papers (WP's). The WP's were provided so that relevant sections could be included in the AW report. The WP's I provided were:

1. **S18-AW02**. Nonparametric growth model for Atlantic red drum, and changes to natural mortality (M) estimates.
2. **S18-AW06**. Graphical analyses of the catch age composition for red rum.
3. **S18-AW07**. Semi-separable untuned VPA for red drum.
4. **S18-AW11**. Tagging estimates of abundance at age for the northern region red drum stock.

The Abstract or Summaries are provided in **Appendix 3**.

Summary of AW findings

- There was consensus (see Tor2) on the baseline assessment model (i.e. statistical catch at age, **SCCA**) and configuration for the northern region red drum stock.
- There was consensus (see Tor2) on the baseline assessment model for the southern region red drum stock (i.e. SCCA), although a precise configuration for this model was not be determined. Issues to be resolved involved treatment of age-composition information for recreational release mortalities and the weighting of data components.

The AW report was not completed by the time this CIE report was required, and analyses were still being conducted by the lead analyst. Rapporteur notes were not available either. This reflects the large amount of work that was required to assess the two red drum stocks (northern and southern) since the last full assessment was conducted nine years ago (2000). Substantial progress was made at the AW, and I anticipate that useful conclusions and recommendations will be forthcoming in the next several weeks regarding all AW ToR's; however, currently I cannot report on Summary of Findings for each AW ToR, and Conclusions and Recommendations in accordance with the ToR's for this report.

Based on my own notes, in this section I describe the assessment activities completed during the assessment workshop, and give my independent views on each ToR.

In the next section (Summary of conclusions and recommendations), I provide recommendations to improve the assessment and the assessment process.

ToR 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 chair asked for changes in assessment inputs indices to be described.

There were no changes to tuning indices since the DW. I felt that the DW report provided a reasonable description of the tuning indices, including their strengths and weaknesses. However, there was some confusion among AW participants about the tuning indices. Some states had provided alternative analyses (i.e. arithmetic or geometric mean), and it was not clear which ones were being used in the statistical catch at age (SCCA) stock assessment model. The lead assessment scientist asked that participants check the indices to make sure the right ones were used, but confirmations were not reported to the meeting. There was also some uncertainty about how to interpret the measures of uncertainty provided for the tuning indices.

Final catch and catch age data were also adjusted since the DW, and this continued after the AW. I did not get the sense that the adjustments were substantial, but the adjustments did not get much peer-review.

A substantial fraction of the catch for both red drum stocks involved mortality inferred from catch and release fisheries. There is little quantitative information on the mortality rates for releases or their age compositions. These issues were considered in some detail at the AW, and I feel this took too much of the meeting's time and detracted from establishing base models and report writing. The issue of mortality rates for releases should have been resolved at the DW.

Sampling information for the various red drum fisheries was poor in some cases. This required some subjective decisions to be made regarding how to infer age compositions. As a result, the catch-at-age seemed rather noisy.

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.

Population assessment models were developed for the northern and southern red drum stocks. The AW concluded that SCCA would be used as the basic assessment model for both stocks. Models would cover 1982-2007 and ages 1-7+.

<u>Basic SCCA configuration for the southern stock.</u>

The SCCA will be based on eight indices of abundance:

Source:	FL	GA	SC	FL	SC	FL	MRFSS	SC
Ages:	1	1	1	2	2	3	1-3	7+

Total catch and age-compositions are used for seven "fleets": Three fleets for each state's (FL,GA,SC) recreational harvest. Three fleets for each state's recreational release mortalities. One fleet for FL commercial harvest. Commercial landings from GA and SC are added to their recreational harvest.

Age selectivities are estimated for time periods corresponding to important changes in management regulations:

1. FL commercial harvest: 1982-1986.

2. FL recreational harvest: 1) 1982-1985, 2) 1986-2007.
3. GA recreational+commercial harvest: 1) 1982-1985, 2) 1986-1991, 3) 1992-2001, 4) 2002-2007.
4. SC recreational+commercial harvest: 1) 1982-1989, 2) 1990-1993, 3) 1994-2000, 4) 2001-2007.
5. *FL, GA, and SC recreational release mortalities still to be resolved*.

Selectivities for ages 4 and 5+ are assumed to be 10% and 5% of selectivity at age 3. Selectivity is estimated for ages 1-3 in each of time period.

Data components will be weighted by standard errors where available, and additional external weighting would be by default (i.e. 1) except for recreational release "fleets". *Data weighting is still to be resolved*.

Basic SCCA configuration for the northern stock.

The SCCA will be based on four indices of abundance:

Source:	NC GN	NC GN	NC JA	MRFSS
Ages:	1	2	1	1-3

And tagging estimates of fishing mortality at ages 1-3. *The specifics (i.e. fit function, weighting) of including tagging-F's were not resolved during the meeting*.

Total catch and age-compositions are used for four "fleets": 1) Commercial (beach seine, gill net), 2) commercial (other), 3) recreational harvest, and 4) recreational release mortalities.

Age selectivities for each fleet are estimated for three time periods corresponding to important changes in management regulations: 1) 1982-1991, 2) 1992-1998, 3) 1999-2007. Selectivity for recreational release mortalities are inferred from tagging estimates.

Selectivities for ages 4 and 5+ are assumed to be 10% and 5% of selectivity at age 3. Selectivity is estimated for ages 1-3 in each of time period.

Data components will be weighted by standard errors and additional external weighting would be by default (i.e. 1).

Workshop activities

Initial models were not fully compatible with the data because they required age compositions for the catch and release mortality component, and reliable information was not available for all years and regions. At the AW, these problems were resolved by using tagging estimates of the age-selectivity of the

catch and release fishery for the northern stock where the age compositions were not available. Only the total mortality estimates for releases (i.e. all ages) were used in the SCCA. For the southern stock, age compositions were available for some states and these were used in the SCCA. Tagging estimates of selectivity for the northern stock were incorporated into the southern stock SCCA where appropriate. The details of this are somewhat complicated, but I felt by the end of the AW meeting that substantial progress was made in resolving the catch and release mortality issue.

Tagging information was also used to provide absolute estimates of stock size for ages 1-3 for the northern region, to be used when estimating the SCCA. This provided important information to scale the population abundance estimates from SCCA. Otherwise, a much greater range in stock size estimates occurred. The tagging estimates of abundance (see S18 AW11) were derived from harvested catch at age and tagging estimates of the fishing mortality for the harvested catch (Fharvest). After the meeting, some problems were discovered with the tagging estimates of abundance. Until these problems are resolved, it was decided that the best approach was to include tagging estimates of Fharvest directly into fitting the SCCA. In addition, the tagging estimates of Frelease could be used the same way. Using external estimates of F will also provide useful information to scale the population model. It was felt that using the tagging estimates of F directly was statistically more appropriate in the SCCA context where there is non-ignorable measurement error in the catch.

A draft document describing the SCCA was provided during the workshop. This seemed reasonably complete, although I did not have the opportunity at the workshop to go through it in detail, and some specifics will have to be updated for the RW. This included how tagging selectivities and fishing mortalities were incorporated into the model. Computer code was provided, although I did not look at this in much detail.

A working paper was provided after the AW with the output from the SCCA's for both stocks. More output would help. Suggestions are provided in the next section.

The chosen assessment model differed from that used previously (Vaughan and Carmichael 2000), which is expected because of the long time period between assessments. Vaughan and Carmichael (2000) applied three separate models: a Separable Virtual Population Analysis (SVPA), a Spreadsheet Virtual Population Analysis (SprdVPA), and a virtual population analysis using F-ADAPT. The AW agreed that a SCCA was the most appropriate model to use in the current assessment. Only the SprdVPA could be reproduced for the continuity run. Also, treatments of assessment input data (i.e. age composition of catches, M's) changed, and the tuning indices used in Vaughan and Carmichael (2000) could not be located.

The AW decided to apply the continuity model to the original catch at age data and natural mortality values, and the data derived for the SEDAR 18 AW. However, the indices were updated for both runs of the model. This analysis measured the impact of some of the changes in the assessment inputs on the 2000 assessment.

It was not possible to do a true continuity run of applying the previous and proposed assessment models to data for the current assessment period. I am not sure why this was, but I recall there were several issues that had to be resolved. Because of the length of time since the last assessment, and because the model in Vaughan and Carmichael (2000) was not being considered for the current assessment, it did not seem useful to devote much of the AW's time to conducting a true continuity model run.

ToR 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.

Estimates of stock-recruitment relationships were not provided because good estimates of spawning stock size were not available.

The SCCA produced age-specific estimates of fishing mortality (both harvest and catch and release), abundance, and selectivity. The F's were decomposed by broad gear/fleet types: beach seine/gill net and others for the northern region stock; state and commercial for southern region stock; recreational harvested, and recreational released.

Measures of precision were not provided.

ToR 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'.

The assessment incorporated standard errors for input values.

Measures of precision for estimated quantities were not provided to the AW. Some preliminary runs gave indefinite Hessians (not provided) and "linearized" standard errors could not be produced.

Measures of model performance (i.e. parameter gradients, etc) were not provided.

Goodness of fit was evaluated using time series plots of observed and predicted values.

Untuned VPA's were provided to partially evaluate uncertainty in the modelling approach.

Uncertainty from model assumptions and configuration, and model reliability, will be assessed using some sensitivity analyses. These will be conducted after the AW.

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

Stock-recruitment and spawner-per-recruit evaluations were not provided because of the difficulty in estimating spawning stock size.

Yield-per-recruit estimates were not included in the preliminary models presented at AW, and I do not think there are plans to do so.

ToR 6: Provide estimates of spawning potential ratio and escapement 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%).

Such estimates were not provided to the AW, although I am confident that this information will be provided to the RW for the baseline assessment models.

ToR 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.

No results were presented for this ToR.

ToR 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 was adequately addressed at the AW. Every participant was given an opportunity to provide recommendations for future research and data collection. Recommendations were recorded and I expect that they will appear in the workshop report.

ToR 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.

The assessment lead provided spreadsheets for some preliminary model runs considered at the meeting and shortly after. This included basic output from the SCCA, and some graphs. They were not clearly documented, and did not include any results for spawning potential ratio and escapement.

The DW spreadsheet was available, and it was updated as required. It contained most of the data summaries provided to the AW, although it did not include some raw data that were included as graphics in the DW report.

ToR 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.

The Assessment Workshop Report and a first draft of the Summary Report were not completed at the AW. A list of tasks to be completed following the workshop was developed.

Summary of conclusions and recommendations

ToR 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 DW should produce a comparison graph of tuning indices, and if possible provide measures of uncertainty on these graphs. This could involve several panels on a single page, each with age-specific indices (± 2 standard error). The idea is a one-page summary of the tuning indices.

Of course it is desirable to have as complete information on commercial landings as possible; however, I realize that these data are probably acquired on an almost continual basis, and updates will always produce some differences. It seems desirable to decide on a cut-off date before the AW to compile landings statistics to be considered as “official” for the assessment. Making minor changes to landings during or after the AW may create unnecessary workload and detract from other important assessment initiatives.

It would be desirable to develop a more automatic (and perhaps statistically efficient) way to infer age compositions of commercial catches when sampling is

too sparse. Subjectively assigning ‘neighboring’ samples is prone to error, and rarely gets good peer review. An objective way of delineating a ‘neighbor’ would be useful. This also has the benefit of being repeatable. If the computer program used to create the catch at age is saved, and a standardized database of sampling information exists, then catch at age can be replicated at any time by simply re-running the program. For example, I have used a kernel density estimation procedure to estimate the length composition of a fishery for any time, location, and gear. All historic length samples are used, with kernel weights assigned according to the ‘distance’ between the prediction point and the samples. The kernel weights, and most importantly how they decline with distance (i.e. the size of the neighborhood), could be decided using some objective criteria, such as cross-validation on independent data. This may also provide a way to quantify the uncertainty in catch age compositions.

For the important catch and release fishery component there was almost no sampling information, and the above procedure could not be used. Essentially, the neighborhoods would be empty. Additional data are required. Utilizing tagging information, like with the northern red drum stock, seems like a good approach. There are several ways to do this which I will not describe.

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.

Most of the tuning indices for the southern stock are state-specific, and cover only a portion of the stock range. If there are spatio-temporal variations in abundance in the stock then these indices will legitimately give different trends. I don’t see how the SCCA index could sort this out. For some reason the preliminary model runs fitted the South Carolina index at age 2 very well, but not the MRFSS index. This latter index covers the largest portion of the stock and is as long as the South Carolina index; however, the MRFSS is age-aggregated. All things being equal, I would be more comfortable if the MRFSS index was fit best. I can rationalize mis-fit with the state indices as local variability. Some rationale for the MRFSS mis-fit should be provided.

In a preliminary run, the fit to the South Carolina YOY index was very poor, and the average predicted was greater than the averaged observed. These averages should be approximately equal, and identically equal on a log scale.

It seemed that the southern region SCCA was not converged in the sense that the overall scale of stock size estimates was not well determined by the tuning indices. A similar pattern occurred (so I understand) for the northern stock, but the tagging estimates of F provide substantial information to fix the scale, and also to provide trend information. Clearly there is a need to analyze tagging datasets for the southern stock with the specific objective of providing as much information as possible to improve the stock assessment.

A true continuity run will be valuable if the next assessment of the stock is conducted within a shorter time frame (i.e. 5 years).

As part of the output from the SCCA's for both stocks, provide

1. Total fit to each index/catch/age composition (i.e. more detail to Table 3 in S18-AW08).
2. Residual plots. Plotting observed vs. predicted for indices is good and should be retained, but this does not give you direct information about the individual point contributions to the total fit. Standardized residuals, (log(obis)-log(prod))/std.dev, that directly contribute to the objective function are useful. Likewise for catch and age compositions.
3. Provide estimated selectivities in addition to estimated age-compositions.
4. Provide plots of numbers-at-age, and F-at-age.

It would be useful for the assessment team to create a graphics 'can' for the SCCA, so that the assessment lead spends as little time as possible producing plots during a meeting. R is a good package for this. It can also create html tables of output to be included directly into a report. There is a lot of R code freely available to do useful graphics (e.g. SPAY plots, see S18-AW06).

ToR 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.

Like most stock assessment models, reliable measures of precision were not provided. The SCCA did not estimate variances for its various inputs. These were derived from the CV's of tuning indices or age-composition data, and I am not sure what was done for the catch data. However, these CV's are only part of the error (the measurement error) and do not account for any process error. This was not quantified.

Precision should be defined more precisely. Otherwise, one has to accept a possibly wide variety of measures of precision that are not all compatible (e.g. Survey design-based, model-based, subjective Bayesian).

In a highly parameterized model like the SCCA, it is well known that variances (e.g. process error) are difficult to estimate reliably.

Considerable research would need to occur to establish that measures of precision are reliable (i.e. they are what the claim to be). There is much that can be written about this. Briefly, the best models I have seen for quantifying uncertain are state-space models in which high dimensional parameters (basically those with year subscripts) are treated as random effects. The information about parameters with year subscripts does not grow as data are accumulated, and asymptotic inference procedures such as Hessian based standard errors may not be reliable. Small sample size procedures seem necessary. If the high dimension parameters are treated as random then they can be predicted using empirical Bayes. Marginal likelihood approaches also can provide more accurate results for random effect models. ADMB seems to handle random effects very nicely. This is currently an area that requires much more development for stock assessment models in general.

ToR 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'.

A statistical state-space model in which high dimensional parameters are treated as random effects (see Tor3) may be a good approach to characterize uncertainty in model estimates. At the least, this approach could provide a realistic alternative model to the SCCA.

For the results of both assessments to be considered robust and reliable, I think the assessment models should be applied to simulated data from a realistic range of operating models producing noisy data. However, this standard is rarely applied in stock assessments I am familiar with, and it is unfair to say that best practice requires such simulations.

Sensitivity analyses will be used to characterize uncertainty by the AW. This is a subjective way to characterize uncertainty, and prone to mis-interpretation. It is subjective because it involves choosing perturbations to model inputs or assumptions. It is prone to mis-interpretation because of the temptation to interpret the range of model outputs as an interval for what happened in the population. A sensitivity analyses does not provide an interval with desirable statistical properties for important assessment quantities. Sensitivity analyses usually focus on the impact of model mis-specification, which is a component of uncertainty.

Sensitivity analyses are important when “building” a stock assessment model. Ideally, a good stock assessment model produces intervals for parameters, and that those intervals contain the parameter estimates obtained from most sensitivity analyses. A more objective approach to sensitivity analyses would be useful. Cadigan and Farrell (2002, 2004) outlined an objective approach that is fairly simple to use, even for models that are time consuming to optimize. The approach is particularly easy to use if the assessment software gives derivatives automatically. Sensitivity should be routinely assessed with respect to perturbations to catch, M, likelihood weights, and selectivity assumptions. This should save the AW and RW much time in doing re-runs

Cadigan, N. G. and Farrell, P. J. 2002. Generalized local influence with applications to fish stock cohort analysis. Appl. Statist. 51: 1-15.

Cadigan, N. G. and Farrell, P. J. 2004. Local Influence Diagnostics for the Retrospective Problem in Sequential Population Analysis . ICES Journal of Marine Science. 62: 256-265.

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

I have no recommendations for this ToR.

ToR 6: Provide estimates of spawning potential ratio and escapement 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%).

I have no recommendations for this ToR.

ToR 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.

I have no recommendations for this ToR.

ToR 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.

I have embedded research recommendations in my comments for ToR's 1-4.

ToR 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.

A goal should be to automate this process, so that every SCCA model run generates this spreadsheet. I would also add the configuration file. This is a good way to archive runs, so that they can be reproduced years from now. In assessments I have conducted I also archived my stock assessment model code, so that I can rerun models from 10 years ago with almost the same ease as 10 years ago.

ToR 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.

Little progress was made at the AW on drafts of the Assessment Workshop Report or the Summary Report. Most of this will occur outside plenary, and in my experience such reports do not get the same level of review as those developed in plenary. However, I recognize that there was too much analysis required at SEDAR 18 AW to allow for this ToR to be completed.

Critique of the SEDAR assessment process

The timeframe since the last full assessment was too long for the two red drum stocks to be assessed within the normal SEDAR process timeframe of a one week meeting. This process is rigorous in terms of the expectations of the DW, AW, and RW, and the documentation and format expected. However, the objectives of the AW were not met during the AW meeting plenary. Much work continued after the meeting, and the peer review of these analyses will likely be deficient in some areas.

If the next assessment is within 5 years then I would anticipate more progress could be made in plenary at the AW, particularly with drafts of the Assessment Workshop Report and the Summary Report. However, it is important to schedule sufficient time at the AW to complete or make substantial progress on the entire set of ToR's. This did not occur in SEDAR18 AW.

Stock-recruit relationships for these stocks are not used. Estimates of mature stock size were not attempted at the AW, and it seems likely to me that any such estimates would be highly uncertain given the life-cycle of red drum and the

nature of the fishery. Mature fish essentially escape into a refuge (they are not fished much) and it will always be difficult to estimate the size of this portion of the stock. The references to stock-recruit relationships in the ToR's should be removed.

Rapporteur notes should be compiled and made available at the meeting. Ideally notes are compiled each night and made available to participants the next day for review. This should be a daily business item of the meeting.

Appendix 1: Bibliography of materials provided for appointee's involvement

1) SEDAR (Southeast Data, Assessment, and Review) Stock Assessment Program.
2) Tasks, Responsibilities, and Supplemental Instructions for SEDAR Assessment Workshop Participants.
3) SEDAR Workshop Panelist Guidelines.
4) FTP Site for SEDAR 18 Data & Document Compilation.
5) SEDAR 18 Atlantic Red Drum Workshops Document List, and 86 reference documents.
6) SEDAR 18 Assessment Workshop Daily Schedule and Tasks.
7) SEDAR 18 - Atlantic Red Drum Stock Assessment Modified Project Schedule.
8) SEDAR 18 Participants List. Atlantic Red Drum Assessment Workshop. June 1-5, 2009. Charleston, SC.
9) SEDAR 18. Atlantic Red DrumWorkshop Terms of Reference.
10) Summary: SEDAR 18 Pre-Assessment Workshop Conference Call

Appendix 2: A copy of the CIE Statement of Work

Attachment A: Statement of Work for Dr. Noel Cadigan

External Independent Resource Assessment Panel Membership by the Center for Independent Experts

SEDAR 18 Stock Assessment Workshop
Atlantic Red Drum
June 1-5, 2009
North Charleston, South Carolina

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 and to participate in resource assessments involving NMFS. The Statement of Work (SoW) described herein was established by the NMFS Contracting Officer's Technical Representative (COTR) and CIE based on the resource assessment requirements submitted by NMFS Project Contact. CIE appointees are selected by the CIE Coordination Team and Steering Committee to conduct the peer review of NMFS science and to participate in resources assessments with project specific Terms of Reference (ToRs). The CIE appointee shall produce a CIE independent report of the appointee's involvement with specific format and content requirements (**Annex 1**). This SoW describes the CIE appointee's work tasks and deliverables related to the following NMFS resource assessment project.

Project Description: South East Data, Assessment, and Review (SEDAR) is a process for fisheries stock assessment development and review conducted by the South Atlantic, Gulf of Mexico, and Caribbean Fishery Management Councils; NOAA Fisheries Southeast Fisheries Science Center (SEFSC) and Southeast Regional Office (SERO); and the Atlantic and Gulf States Marine Fisheries Commissions. SEDAR is organized around three workshops: data, assessment, and review. Input data are compiled during the data workshop, population models are developed during the assessment workshop, and an independent peer review of the data, assessment models, and results is provided by the review workshop. SEDAR documents include working papers prepared for each workshop, supporting reference documents, and a SEDAR stock assessment report. The SEDAR stock assessment report consists of a data report produced by the data workshop, a stock assessment report produced by the assessment workshop, and a peer review panel report prepared by the review workshop.

SEDAR is a public process conducted by the Fishery Management Councils and Commission in the Southeast US. All workshops, including the assessment workshop, are open to the public and noticed in the Federal Register. All documents prepared for SEDAR are freely distributed to the public upon request and posted to the publicly accessible SEDAR website. Verbal public comment during SEDAR workshops is taken on an 'as needed' basis; the workshop chair is allowed discretion to recognize the public and solicit comment as appropriate during panel deliberations. Written comments are accepted in accordance with existing Council or Commission operating procedures. The names of all participants, including those on the assessment panel, are revealed.

SEDAR 18 will be a compilation of data, a benchmark assessment of the stock, and an assessment review for Atlantic red drum. The CIE appointed expert will participate on the Assessment Panel, rather than the Review Panel. Request for three CIE appointments to the SEDAR 18 Review Panel have been made separately. SEDAR assessments typically involve an assessment panel composed of assessment analysts named by the lead SEDAR partner, fishery scientists, and fishery managers. The lead assessment agency and SEDAR partner for SEDAR 18 is the Atlantic States Marine Fisheries Commission. Red drum is an

important recreational fishery resource and contributes to commercial fisheries within its range on the Atlantic coast of the US. The most recent assessments of red drum in Atlantic waters are those done in 2000 for the Atlantic stock and in 2005 for both Florida coasts. 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 SEDAR 18 Assessment Panel will be composed of one CIE-appointed panelist, five panelists appointed by the Atlantic States Marine Fisheries Commission from Atlantic coastal states, and one panelist appointed by the SEFSC director. The workshop will be chaired by the SEDAR coordinator. Commission staff, Commission members, and Commission advisory panel members are scheduled to attend as observers. Members of the public may attend SEDAR assessment workshops.

The Terms of Reference (ToRs) of the assessment are attached in **Annex 2**. The tentative agenda of the assessment workshop is attached in **Annex 3,** and the Assessment Workshop Report outline appears as **Annex 4**.

Requirements for CIE Appointee: The CIE appointed expert shall participate as a panel member in the SEDAR fishery resource assessment of Atlantic red drum in accordance with the SoW and ToRs herein. The appointee will participate in discussions of technical details of the methods used for the SEDAR assessment, and assist in decisions related to model configuration during the workshop. It is anticipated the independent analyst will impartially and independently contribute fresh information to improve the assessment being undertaken and to determine if the best available science is utilized for fisheries management decisions.

The CIE assessment panel appointee should have expertise, background, and experience in stock assessment, statistics, fisheries science, and marine biology sufficient to complete the primary task of participation in discussions of technical details of the methods used for this SEDAR assessment, and to assist in decisions related to model configuration during the workshop, in accordance with the SoW and ToRs herein.

The CIE appointee's duties shall not exceed a maximum of 14 work days to complete all work tasks of the assessment described herein. They will comprise several days prior to the SEDAR assessment workshop for document review, five days at the workshop, and several days following the workshop to contribute to the assessment workshop report as a panelist and to ensure final assessment comments and document edits are provided to the lead analyst.

Location of Assessment Workshop: The CIE appointee shall participate during the assessment workshop scheduled in North Charleston, South Carolina during June 1-5, 2009.

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

Prior to the Assessment Workshop: Upon completion of the CIE appointee selection by the CIE Steering committee, the CIE shall provide the CIE appointee information (name, affiliation, and contact details) to the COTR, who forwards this information to the NMFS Project Contact no later than the date specified in the Schedule of Milestones and Deliverables. The CIE is responsible for providing the SoW and ToRs to the CIE appointee. The NMFS Project Contact is responsible for providing the CIE appointee with the background documents, reports, and information concerning other pertinent workshop arrangements. Any changes to the SoW or ToRs must be made through the COTR prior to the commencement of the assessment workshop.

Foreign National Security Clearance: The assessment workshop will not be held at a government facility, so foreign national security clearance is not necessary.

Pre- Assessment Workshop Background Documents: Two weeks before the assessment workshop, the NMFS Project Contact will send by electronic mail or make available at an FTP site to the CIE appointee all necessary background information and reports for the assessment workshop. 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 appointee shall read all documents in preparation for the assessment workshop.

The SEDAR 18 Documents List is displayed as Annex 5. Working papers and reference documents are available at the SEDAR website (http://www.sefsc.noaa.gov/sedar/). The report of the data workshop is in preparation. This list of pre-assessment documents may be updated up to two weeks before the assessment workshop. Any delays in submission of pre-assessment documents will result in delays with the CIE appointee's participation, including a SoW modification to the schedule of milestones and deliverables. Furthermore, the CIE appointee is responsible only for the pre-assessment documents that are delivered to the appointee in accordance to the SoW scheduled deadlines specified herein.

Assessment Workshop: The CIE appointee shall participate in the fishery resource assessment in accordance with the SoW and ToRs. **Modifications to the SoW and ToRs can not be made during the assessment workshop, and any SoW or ToRs modifications prior to the assessment workshop shall be approved by the COTR and CIE Lead Coordinator.** The CIE appointee shall actively participate in a professional and respectful manner as a member of the assessment workshop panel, and the appointee's 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 the assessment workshop or teleconference arrangements). The CIE Lead Coordinator can contact the Project Contact to confirm any assessment workshop arrangements, including the meeting facility arrangements.

It is anticipated significant progress will have been realized by the analytic team in model development prior to the assessment workshop, and the model to-date will have been provided to the CIE appointee. During the assessment workshop the appointee will serve with six other assessment panel members in discussing technical details of the methods used in the SEDAR assessment, and assist in decisions related to model configuration. Other panel members comprise the analytic team of five ASMFC appointed analysts and one NMFS analyst as consultant. The CIE independent analyst will impartially critique the assessment being undertaken to advise the analytic team on ways to improve the model and to interpret and present its results. The CIE expert will assist in the determination that the best available information and science are utilized in the assessment and, to the extent determined by the lead analyst, will contribute to the written assessment workshop report.

The Project Contact is the SEDAR Coordinator assigned to SEDAR 18 for Atlantic red drum and serves as workshop chairman, and not as an assessment panel member. A state senior scientist appointed by the Atlantic States Marine Fisheries Commission serves as lead analyst. Guidelines for the conduct of a SEDAR assessment workshop appear as Annex 6.

Contract Deliverables - Independent CIE Reports: The CIE appointed expert shall complete an independent report in accordance with the SoW and with the required format and content described in Annex 1. The independent report shall address each ToR as described in Annex 2.

Other Tasks – Contribution to the Assessment Workshop Report: The CIE appointed expert will assist the Chair of the assessment workshop and the lead analyst with contributions to the Assessment Workshop Report. The CIE appointee is not required to reach a consensus with other assessment panel members, and should instead provide a statement of the appointee's critique of the resource assessment model and recommendations on its improvement.

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

1) Conduct necessary pre-assessment workshop preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the assessment workshop;
2) Participate during the assessment workshop at the location and on the dates called for in the SoW; impartially critique the assessment and model to-date; independently relate opinions, advice, and recommendations to the assessment panel; and contribute to the assessment workshop report as directed by the chairman and lead analyst.
3) No later than June 19, 2009, the CIE appointee shall submit an independent report addressed to the "Center for Independent Experts," and sent to Mr. Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and CIE Regional Coordinator, via email David Sampson david-sampson@oregonstate.edu. The CIE report shall be written using the format and content requirements specified in Annex 1, and address each ToR in Annex 2;
4) The CIE appointee shall address changes as required by the CIE 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.

April 27, 2009	CIE sends appointed expert's contact information to the COTR, who then sends this to the NMFS Project Contact.
May 15, 2009	NMFS Project Contact sends the CIE expert the pre- assessment workshop documents.
June 1-5, 2009	The CIE appointed expert participates in the resource assessment workshop.
June 19, 2009	CIE appointee submits draft CIE independent report to the CIE Lead Coordinator and CIE Regional Coordinator.
July 2, 2009	CIE submits CIE independent report to the COTR.
July 10, 2009	The COTR distributes the final CIE report to the NMFS Project 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-assessment workshop documents, and Terms of Reference (ToR) of the SoW as long as the role and ability of the CIE appointed expert 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 assessment workshop has begun.

Acceptance of Deliverables: Upon review and acceptance of the CIE independent report by the CIE Lead Coordinator, Regional Coordinator, and Steering Committee, the report shall be sent to the COTR for final approval as a contract deliverable based on compliance with the SoW. As specified in the Schedule of Milestones and Deliverables, the CIE shall send via e-mail the contract deliverable (the CIE independent report) 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) the CIE report shall have the format and content in accordance with

Annex 1, (2) the CIE report shall address each ToR as specified in Annex 2, (3) the CIE report 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 report in *.PDF format to the COTR. The COTR will distribute the approved CIE report to the NMFS Project Contact and regional Center Director.

Key Personnel:

William Michaels, Contracting Officer's Technical Representative (COTR)
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Annex 1: Format and Contents of CIE Independent 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 appointed expert's report shall consist of a Background, Description of the Individual Appointee's Role in the Assessment Activities, Summary of Findings for each ToR, and Conclusions and Recommendations in accordance with the ToRs.

   a. Appointee should describe in Appointee's own words the assessment activities completed during the assessment workshop, including providing a detailed summary of findings, conclusions, and recommendations.

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

   c. Appointee should elaborate on any points raised in the assessment workshop report that the appointee feels might require further clarification.

   d. Appointee shall provide a critique of the SEDAR assessment 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 summary report. The CIE independent report shall be an independent appraisal of each ToR and shall not simply repeat the contents of the assessment workshop report.

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

   Appendix 1: Bibliography of materials provided for appointee's involvement
   Appendix 2: A copy of the CIE Statement of Work
   Appendix 3: Panel Membership or other pertinent information from the assessment workshop report.

Annex 2: Terms of Reference for the Assessment Workshop

SEDAR 18
Atlantic Red Drum

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.

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.

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.

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'.

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

6. Provide estimates of spawning potential ratio and escapement 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%).

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.

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.

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.

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.

These Terms of Reference may be modified prior to the Assessment Workshop. If so, final terms of reference will be provided to the panelists with the workshop briefing materials.

Annex 3: Tentative Agenda

SEDAR 18 Assessment Workshop Daily Schedule and Tasks

Workshop Location and Duration

Hilton Garden Inn, 5265 International Boulevard, North Charleston, SC 29418
Monday June 1 beginning at 1:00pm until Friday June 5, adjournment at 1:00pm

General Daily Schedule

Mornings (Tuesday-Friday) Session I - 8:00- 9:30 Session II - 10:00-11:30

Afternoons (Monday-Thursday) Session I - 1:00- 3:00 Session II - 3:30-5:30

This schedule is provides the general sequence of events. Session times will be followed to the extent possible. Timing of plenary sessions, work sessions, and topical discussions will be driven by progress.

Workshop Goals

In response to the Assessment Workshop Terms of Reference the panel will:

- review post-DW data changes and analyses suggested by the DW,
- summarize data used in each assessment model, and justify deviations from DW recs,
- develop population assessment models compatible with data,
- recommend configuration deemed useful for advice relative to static SPR levels,
- document input data, assumptions, equations, and model code in a working paper,
- include a continuity case run to determine the effect, if there is a model change,
- provide estimates of stock population parameters,
- characterize scientific uncertainty in the assessment and estimated values,
- provide measures of model performance, reliability, and 'goodness of fit',
- provide recruitment evaluations and estimates of SPR and escapement,
- evaluate the impacts of management actions on the stock,
- discuss workshop research recommendations,
- prepare a spreadsheet containing model parameter estimates and relevant population information with data findings,
- complete the AW Report and Summary Report draft, and
- develop a post AW task list.

Working Levels

The following tasks will be completed by the panel during plenary sessions:

- hold topical discussions,
- identify tasks to be accomplished and confirm individual and small group assignments,
- receive reports on individual and small group efforts and discuss progress and issues, and
- adopt findings and recommendations as workshop products.

During work sessions individuals and small groups will:

- perform agreed to tasks;
- develop, compile, and qualify data to be fit to the proposed models; and
- draft Assessment Workshop report components and replies to Terms of Reference (ToR).

Daily Overview

Monday	Topical Discussions:	Introductions
June 1		Review and resolve data issues.
		Analysts present initial models.
	Milestones:	Final data decisions
		Identify individual roles and tasks.
	Homework:	Review materials and Data Section text.
Tuesday	Topical Discussions:	Approve continuity runs and base configuration
June 2		Identify sensitivity runs.
	Milestones:	Base configuration is concluded.
		Sensitivity/Uncertainty run lists are developed.
	Homework:	Finish base and continuity runs.
		Prepare sensitivity runs.
Wednesday	Topical Discussions:	Evaluate sensitivities
June 3		Compare models and select preferred run
		Projection and benchmark methods
	Milestones:	The preferred model is determined.
		Consensus is reached on stock status.
	Homework:	Final preferred runs.
Thursday	Topical Discussions:	Compare and contrast models;
June 4		SFA parameters and status determination
	Milestones:	Consensus text is drafted
	Homework:	Make final runs. Draft report components text
Friday	Topical Discussions:	Review results and conclusions in draft reports
June 5		Discuss DW research recs and offer new ones.
	Milestones:	AW report is drafted and reviewed.
		All data and report component files are on server.
		Adjournment
	Homework:	Drive safely.
		Comply with post-AW SEDAR Project Schedule

Annex 4: Assessment Workshop Report

The extent of the written contribution to the Assessment Workshop Report by the CIE appointed expert will be determined by the Assessment Workshop Chairman and the lead assessment analyst, but will be limited to matters of the appointee's: (1) participation at the assessment workshop; (2) critique of the assessment and model to-date; and (3) independent opinions, advice, and recommendations toward improvement of the assessment and model.

The Assessment workshop Report is Section III of the final Stock Assessment Report. Its outline follows.

III. Assessment Workshop Report [Assessment Workshop Panel]

1. Workshop Proceedings

1.1 Introduction **[SEDAR]**

1.1.1 Workshop Time and Place

1.1.2 Terms of Reference

1.1.3 List of Participants

1.1.4 List of Assessment Workshop Working Papers

1.2 Panel Recommendations and Comments (Offer consensus comments and recommendations. Address each Assessment Workshop Term of Reference.) **[AW Panel]**

1.2.1 Review of Working Papers

1.2.2 Review of Terms of Reference

(Terms of Reference are detailed in Annex 2.)

2. Data Review and Update **[Lead Analyst and Data Compiler]**

2.1 Tabulated Input Data as Used in Assessment Modeling

2.2 Deviations from the Data Workshop

2.3 Resolution of Issues Raised by the Data Workshop

2.4 Additional Data Analyses - if any

3. Stock Assessment Models and Results (This may be finalized after the Assessment Workshop.) **[Analyst for each model]**

3.1 Model One - typically the 'continuity case'. (Repeat this item for each model.)

3.1.1 Methods

3.1.1.1 Overview

3.1.1.2 Data Sources (State sources and tabulate all data used in the model even if duplicated from Data Workshop report.)

3.1.1.3 Model Configuration and Equations (Describe the configuration, explicitly state assumptions, and list equations. If a standard accepted model, such as NFT, ICCAT, ICES, or FAO, this equations requirement may be accommodated by citation of program documentation.)

3.1.1.4 Parameters Estimated (List all model estimated parameters.)

3.1.1.5 Uncertainty and Measures of Precision (Describe the methods used to evaluate sources of error including process, observation, and any other error.)

3.1.1.6 Benchmark and Reference Points Methods

3.1.2 Results

3.1.2.1 Measures of Overall Model Fit

3.1.2.2 Parameter Estimates and Associated Measures of Uncertainty (Provide a table of all model parameters and their values. Include SE, CV, or other appropriate measures of variation.)

3.1.2.3 Stock Abundance and Recruitment

3.1.2.4 Stock Biomass (Include total and spawning stock biomass.)

3.1.2.5 Fishery Selectivity

3.1.2.6 Fishing Mortality

3.1.2.7 Stock-Recruitment Parameters

3.1.2.8 Evaluation of Uncertainty (This is broader than paragraph 3.1.2.2. Include evaluation of assumptions, model configurations, etc. This may include retrospective analyses and sensitivities.)

3.1.2.9 Benchmarks / Reference Points (Provide the management parameters.)

3.1.3 Discussion

3.1.4 Tables (For recommended content refer to SEDAR Guidelines Section 8.3.)

3.1.5 Figures (For recommended content refer to SEDAR Guidelines Section 8.3.)

3.1.6 References

3.2 Model Two (or more as needed)

4. Submitted Comment - any submitted, written comment or opinion statements **[Assessment Workshop participants or observers]**

Annex 5

SEDAR 18
Atlantic Red Drum
Workshops Document List (3-5-09)

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 in South Carolina	SC DNR undated
SEDAR18-DW18	South Carolina randomly stratified trammel net survey	Arnott 2009
Documents Prepared for the Assessment Workshop		
SEDAR18-AW01	None submitted	
Documents Prepared for the Review Workshop		
SEDAR18-RW01	SEDAR 18 Atlantic Red Drum Document for Peer Review	To be prepared following Assessment Workshop
Workshop Reports		

	SEDAR 18 Data Workshop Report	To be prepared following Data Workshop
	SEDAR 18 Assessment Workshop Report	To be prepared following Assessment Workshop
	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 habitats by the use of passive acoustics	Luczkovich & Pullinger 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	Bacheler, Paramore,

	an estuarine fish	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	Gold, Turner 2002

	of Mexico, as inferred from variation in nuclear-coded microsatellites	
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, USFWS Circular 153	J. R. Clark
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

Annex 6

SEDAR Assessment Workshop Guidelines
(from SEDAR Guidelines, version 17, October 2007)

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

SEDAR Overview

SouthEast Data, Assessment, and Review (**SEDAR**) is a cooperative Fishery Management Council process initiated in 2002 to improve the quality and reliability of fishery stock assessments in the South Atlantic, Gulf of Mexico, and US Caribbean. SEDAR is managed by the Caribbean, Gulf of Mexico, and South Atlantic Regional Fishery Management Councils in coordination with NOAA Fisheries and the Atlantic and Gulf States Marine Fisheries Commissions. Oversight is provided by a Steering Committee composed of representatives of these partner agencies.

SEDAR is organized around three workshops. First is the Data Workshop, during which fisheries, monitoring, and life history data are reviewed and compiled. Second is the Assessment workshop, during which assessment models are developed and population parameters are estimated using the information provided from the Data Workshop. Third and final is the Review Workshop, during which independent experts review the input data, assessment methods, and assessment products. The charge to each SEDAR Workshop is specified in Terms of Reference that are approved by the appropriate Council. The completed assessment, including the reports of all 3 workshops and all supporting documentation, is then forwarded to the Council SSC for certification as 'appropriate for management' and development of specific management recommendations.

Assessment workshop participants include the workshop panel, appointed observers, and other observers. Workshop panels are composed of include NOAA Fisheries stock assessment scientists, Commission/State/university/independent assessment scientists, Council advisory panel (commercial, recreational, and/or NGO) representatives, and Council technical committee representatives, such as members of the Scientific & Statistical Committee. Council or senior agency representatives may participate as official observers, but cannot serve as panel members. Members of the public who attend are noted as observers. The SEDAR coordinator will typically serve as the workshop Chair. As with all SEDAR workshops, stock assessment workshop panelists are to be appointed from each Councils' SEDAR Advisory Panel.

SEDAR workshops are open, transparent, public processes administered according to the rules and regulations governing Federal Fishery Management Council operations and other applicable Federal laws. All workshops are recorded. The names and affiliations of workshop panel participants and workshop observers will be disclosed. SEDAR workshop reports and submitted working papers are public documents that become part of the official SEDAR Administrative Record and will be posted on the SEDAR website. The public is given opportunities to comment during SEDAR Workshops and may submit written comments to the associated Councils, Commissions or other agencies in accordance with Council guidelines.

Assessment Workshop Goal

The goal of SEDAR assessment workshops is to conduct quantitative population analysis to determine stock status, evaluate management benchmarks, and project future stock conditions.

Pre-Workshop Preparation

Panelists should review the findings of the data workshop, including any submitted working papers and reference documents. Those with analytical capabilities may wish to conduct their own model runs.

Working Papers

Initial analyses, data summaries, and program documentation should be submitted in advance as SEDAR Working Papers. Deadlines for submission will be provided on the schedule for each project. Working papers and all other documentation will be distributed electronically via email and the SEDAR website (http://www.sefsc.noaa.gov/sedar/). Papers should be submitted as word documents or .pdf files. Authors may follow any format of their choosing, but are encouraged to review instruction in the SEDAR workshop guidelines pertaining to content and formatting. Working papers are numbered sequentially by SEDAR

cycle and workshop. Please contact the SEDAR Coordinator to obtain document numbers. Working papers shall not contain confidential information.

SEDAR Agendas

Establishing strict agendas for SEDAR workshops is not usually practical, as no one can foresee all the issues that will develop or predict the amount of discussion that will be generated for any particular item. Therefore, workshop agendas provide a general listing of meeting times and are constructed around daily milestones and tasks. Evening working sessions are likely. Only the starting and ending time of the workshop are certain, to enable appropriate travel planning; all other events during the workshop may change as necessary to meet the tasks outlined in the Terms of Reference.

Consensus

SEDAR workshops strive to achieve group consensus on many potentially complex and controversial issues, and it is recognized that consensus may not always equate to unanimous consent for each issue. For SEDAR purposes, consensus is taken to mean that all workshop panelists consent to the range and treatment of recommendations included in the report.

Nature of Discussions

Those criticizing the work and recommendations of others are expected to do so constructively and to offer reasonable solutions to go along with any criticisms. Recommendations for sensitivity and exploratory analyses along with ranges for critical parameters should all be considered when evaluating uncertain information.

Materials Distribution

SEDAR workshops are 'paperless' to the extent possible. Materials such as datasets and working papers that are received within submission deadlines will be distributed by SEDAR staff via email and website posting, and hard copies or cds will be mailed upon request. Paper copies of the agenda and Terms of Reference will be provided at the workshop. Working papers that are distributed in advance by SEDAR staff and made available on the website will not be provided in print copy at the workshop, but will be available by cd and posted to the workshop network. Those who submit working papers after the submission deadline are responsible for providing both print and electronic copies for distribution at the workshop. **Please contact the SEDAR Coordinator for the appropriate number of copies.**

Confidentiality

SEDAR is a Council process and therefore it is an open and public process. All working papers are available to distribution to the general public, all data summaries are available to distribution to the general public, but not all workshop participants have clearance to view confidential data. Therefore, no confidential data should be included in any SEDAR documentation. This includes working papers, reference documents, workshop presentations, and SEDAR assessment reports. Under no circumstances should confidential data be stored on publicly accessible locations of SEDAR workshop networks. **Authors and data submitters are responsible for ensuring that submitted papers and datasets do not contain confidential data.**

Administrative Record and Public Comment

SEDAR is a public Council process. All submitted documents and official correspondence become part of the official administrative record. All SEDAR workshops are announced in the Federal Register. All workshop discussion sessions are recorded. All working papers and final documents will be publicly posted on the SEDAR website. The names and affiliations of all workshop participants and observers will be listed in the workshop reports. The general public is welcome to view all workshop proceedings and will be given the opportunity to comment during plenary sessions as necessary. Written public comments will be accepted in accordance with each Council's Standard Operating Procedures.

Meeting Attendance and Sign-in Forms

Sign in forms will be posted in the meeting space during each day of the workshop. All appointed participants are expected to sign in each day that they attend. Failure to sign-in could result in denial of reimbursement requests. SEDAR workshops seldom 'end early' and it is never known when a critical issue may be discussed; therefore, participants are strongly encouraged to stay for the entire workshop.

Network and IT

A wireless network is available at each SEDAR workshop to provide internet and file server access. IT staff will be available during each workshop to aid each participant in securing network access.

What to Bring

Workshop participants should come prepared to conduct analyses and prepare report text. Ideally they should bring a laptop computer with word processing and networking capabilities. Participants should bring

electronic copies of any documents they want considered during the workshop. Participants should bring copies of any relevant research documents which are not already provided in the project document list.

Assessment Workshop Roles and Responsibilities

Workshop Chair: (SEDAR Coordinator) Responsible for conducting the workshop, scheduling workshop sessions, and ensuring the Terms of Reference are addressed.

Workshop Rapporteur: (Council Appointee, 1 per stock) Responsible for taking notes during plenary sessions to ensure that discussion items are reflected in the workshop report, assists chair in ensuring Terms of Reference and Council requirements are addressed. May be asked by appointing Council to assist in presenting workshop findings to the SSC and other Council bodies.

Stock Leader (Council Appointee, 1 per stock) Prepares and edits the proceedings section of the assessment workshop report. Responsible for compiling segments drafted by workshop participants and completing and submitting report in accordance with project deadlines. Represents the assessment panel at the Review Workshop and subsequent Council meetings. Rapporteur and Editor roles may be filled by one individual at Council's discretion.

Lead Analyst: (SEFSC/Assessment Agency, 1 per stock) Leader of the assessment team, responsible for preparing population models and making presentations to the assessment panel. Also responsible for presenting the assessment to the Review Panel and the SSC and Council.

Analytical Team: Core group of assessment analysts responsible for conducting model runs, presenting results, and conducting further analyses during the Review Workshop.

Data Presenters: Responsible for presenting overviews of data sources, including the results of any post-DW analyses and compilations. May be filled by the same individuals as other workshop roles, or may be filled by data workshop workgroup leaders.

SEDAR Workshop Panelist Code of Conduct

- SEDAR workshop panel 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 workshop decisions are based on consensus. Panels are expected to reach conclusions that all participants can accept, which may include agreeing to acknowledge multiple possibilities.
- 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.

Appendix 3: Panel Membership or other pertinent information from the assessment workshop report.

WP AW02

Nonparametric growth model for Atlantic red drum, and changes to natural mortality (M) estimates.

Noel Cadigan
CIE expert
Fisheries and Oceans Canada

Abstract

There is evidence of misfit in the von Bertalanffy growth model for the northern region Atlantic red drum stock provided by the SEDAR 18 Data Workshop (DW). We used a nonparametric smooth monotone growth model which fit both the southern and northern region data very well. This growth model resulted in somewhat higher estimates of natural mortality (M) for younger ages based on the scaled Lorenzen method. The largest difference was for one-year old fish from the northern region, where the DW Lorenzen M estimate based on the von Bertalanffy model predicted length was 0.16 and the M estimate based on the nonparametric model was 0.20.

WP AW06

Graphical analyses of the catch age composition for red drum.

Noel Cadigan
Fisheries and Oceans Canada
CIE expert

Summary

It is first important to note that the catch at age data used in this working paper includes the inferred deaths from the recreational B2 (catch and release) fishery component. Preliminary estimates of the age composition of this catch component were considered too unreliable to use in the assessments for both the northern and southern region red drum stocks. This component represents approximately 20% of the total catch for both stocks, with considerable annual variability. A figure for this has been prepared for the AW report. Hence, age composition information presented in this working paper will not be exactly the same as that used in the stock assessment model, but should be broadly indicative.

The size and age structure of total catch is important information in most stock assessments. A simple graphical display is shown in Figure 1 for the northern red drum stock. The top panel shows the total annual catch, the middle panel shows the annual age composition, and the bottom panel shows the relative size of catch compared to the same ages in other years. The areas of the bubbles are proportional to size. Computational details are given in the Appendix. Figure 1 demonstrates that the total catch for the northern red drum stock has considerable inter-annual variability. It is composed of primarily ages 1-3. Age 1 fish were caught more frequently prior to 1992. The distribution of catch at older ages has considerable inter-annual variability, perhaps due to their infrequent occurrence and sampling error.

Standardized proportions at year (SPAY; see Appendix) can show cohort patterns more clearly. These are shown in the top panel of Figure 2. They give the trends in the middle panel of Figure 1. Strong cohorts are not evident in the catches. Exceptions are the 1990 cohort which was relatively strong at ages 1-5 and 7. The 1996 and, to a lesser extent, the 1997 cohorts can be tracked for several ages. Standardized proportions at year (SPYA) shown in the bottom panel of Figure 2 give the trends relative to the average for the proportions in the bottom panel of Figure 1. They show more clearly when catches are above or below average. For example, they show that catches in 2007 at ages 1, 6, and 9 were average in the time series, whereas catches at other ages were all above average.

SPAY plots are provided by the FLEDA component of the FLR (Fisheries Library in R) package for the R statistical software. FLEDA provides exploratory analysis of stock assessment data.

Catches for the southern region red drum stock (top panel Figure 3) were highest in 1984-5 and 1987. Catches since 2000 have been slightly higher than in the 1990's. Overall, catches for this stock show less inter-annual variability compared to the northern region stock (Figure 1). Ages 1-4 dominate the catches (middle panel, Figure 3). The SPAY and SPYA plots show three periods of fairly consistent age compositions:

1. 1982-1990. Catches at age one are more prevalent.
2. 1991-1999/2000. Catches at ages 6-9 are more prevalent.
3. 2000/2001-2007. Catches at ages 2-5 are more prevalent.

This suggests potential changes in fishery selectivity.

WP AW07

Semi-separable untuned VPA for red drum.

Noel Cadigan
Fisheries and Oceans Canada

CIE expert

Summary

Untuned backwards VPA's were applied to catch at age data for the northern and southern regions red drum stocks to provide comparisons with estimates of historic stock size from statistical catch at age (SCCA) assessment models. The final year (2007) abundance of age two fish was determined by specifying their fishing mortality (F), and 2007 abundances at other ages were selected with a combination of constraints on selectivity in 2007 and approximate separability of F during 2003-2007. The constraints on selectivity were similar to those used in the SCCA assessment model, and were consistent with tagging information. Age compositions for the release mortality component of the recreational fishery (i.e. B2 catches) were inferred from the harvested age compositions (i.e. A+B1 catches) and the selectivity of the B2 fishery component relative to the A+B1 component, as inferred from a tagging model.

The results show that average F for ages 1-3 in the **northern region** was about 1.5 during 1982-1990 but declined during 1991-1994 and was relatively stable during 1995-2002 with a mean of 0.9. Total abundance during 1982-1997 fluctuated between 200 000 and 400 000, but increased to 660 000 in 1998 and then declined to 160 000 in 2003, the second lowest value during 1982-2003. Untuned VPA results after 2003 are more speculative because the VPA is not yet converged.

Results for the **southern region** demonstrated that the VPA was not converged in the base setup. This is because of the low levels of F during 1990-2000, and the truncated age-structure of the catches. Cohorts are never "fished-out", and the size of the plus group that survives the larger juvenile fishery is quite uncertain. The basic trend in the VPA is for stock abundance to increase during 1982-1987, and then decline after 1991.

Untuned VPA's using alternative F-constraints were similar to the base setting for the NR, but quite different for the SR, which again demonstrates the lack of convergence in the SR VPA. The alternative VPA for the SR stock, which utilized specific selectivity information obtained from tagging studies for the NR stock, seemed more reliable in that some degree of convergence was achieved. However, the scale and trends in the base and alternative VPA for the SR stock were quite different, suggesting that the assessment of this stock will be more uncertain than the NR stock.

WP AW11

Tagging estimates of abundance at age for the northern region red drum stock.

Noel Cadigan
CIE Expert
Fisheries and Oceans Canada

Lee Paramore
North Carolina Division of Marine Fisheries

Abstract

Trends in estimates of abundance derived from tagging estimates of fishing mortality rates (F) and independent estimates of catch-at-age were consistent with the general understanding of stock trends for northern red drum. However, we found that catch-curve estimates of F from tagging abundance-at-age estimates suggested lower F's overall than the tagging-F's themselves, although the trends in F's were similar. Until these discrepancies are resolved, it seems more prudent to use the tagging-F's to assist in estimating a SCCA. Tagging-F's and their standard errors can be treated as direct inputs and fitted to SCCA model estimates of F. Fitting to *log(F)* may be reasonable but requires some investigation. Tagging-F's should only be compared with the appropriate F component in the SCCA.