Review of Caribbean Stock Assessments:
Queen snapper, silk snapper, and redtail parrotfish

SEDAR 26 Review Panel
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1   EXECUTIVE SUMMARY

This report presents results of an independent peer review of three U.S. Caribbean reef fish stock assessments (queen snapper, silk snapper, and redtail parrotfish), conducted for the Center for Independent Experts (CIE). The primary active of the review was active participation in the October 17- 20, 2011 SEDAR 26 Review Workshop in San Juan, Puerto Rico. Major focus for the review was: understanding issues and limitations of the data and other information available for the assessments; ensuring best possible use was made of available data and that analytical methods were appropriate; and that conclusions about stock status were consistent with the data and analyses presented.

The SEDAR 26 review process was thorough, effective, and resulted in a comprehensive review of all information and analytical approaches that might inform assessment of stock status. The Review Panel members agreed all substantive issues and the SEDAR 26 Summary Report represents consensus opinion, although there was no requirement for the Panel to reach consensus.

The information and data base available to assess the U.S. Caribbean queen snapper, silk snapper, and redtail parrotfish resources is extremely limited, which precludes the use of standard fisheries stock assessment models. Quantitative analyses to inform stock status were limited to two approaches; commercial fishery catch per unit effort (CPUE) standardization, and analyses of commercial fishery length frequency data. Conclusions that could be reached from these analyses were very limited. The indices generated from CPUE standardizations were not considered proportional to abundance because of changes in fishers' behaviour and technological advances that could not be accounted for in the standardizations. Large uncertainty in life history parameters limited interpretation of exploitation trends from the length frequency analyses.

Stock status Summary Statements, prepared during the Review Workshop, reflect the best possible use of the available information and conclude that there is no evidence to suggest that overfishing is occurring on the U.S. Caribbean queen snapper, silk snapper, or retail parrotfish resources. These conclusions provide the strongest statements possible about stock status given the data limitations. For all species but the Puerto Rico queen snapper the conclusions are based on qualitative interpretation of the data (length frequency and catch trends), basic life history, and fundamental principles of fisheries population dynamics. The science reviewed during SEDAR 26 represents the best scientific information available for U.S. Caribbean queen snapper, silk snapper and retail parrotfish.

Consideration should be given to the best approach for future SEDAR reviews of U.S. Caribbean reef fish. The three species assessed during SEDAR 26 are among the most data/information rich, so it is likely that assessment results for other reef fish might be less conclusive than those reported here. Development of criteria that specify minimal data requirements for pursuing an assessment may be useful. Development of procedures and guidelines for implementation of the SEINE method (or other length-based models), would enhance future assessments. Management strategy evaluation would be a useful approach for developing guidelines.

2   BACKGROUND

This document reports on an independent peer review of three U.S. Caribbean stock assessments (queen snapper, silk snapper, and redtail parrotfish) conducted for the Center for Independent Experts (CIE). The primary review activity was active participation in the October 17- 20, 2011 SEDAR 26 Review Workshop in San Juan, Puerto Rico.

The CIE *Statement of Work* (Appendix 2) defines the scope of this review. In addition to participation in the SEDAR 26 Review Workshop, the *Statement of Work* requests a pre-review of assessment documents and other pertinent background materials prior to the review meeting and preparation of this report summarizing review findings relative to the terms of reference for the review.

The SEDAR 26 assessment process was comprised of three phases; a Data Workshop, a Stock Assessment Workshop, and the Review Workshop discussed here. Through this process, benchmark stock assessments were prepared for queen snapper, silk snapper, and redtail rockfish for each of the three U.S. Caribbean island platforms, Puerto Rico, St. Croix, and St. Thomas/St. John.

3   DESCRIPTION OF REVIEW ACTIVITIES

The activities undertaken for this review include; 1) assimilation and pre-review of assessment documents and other pertinent background materials prior to the Review Workshop, 2) participation in the SEDAR 26 Review Workshop and contribution to a Summary Report, and 3) preparation of this report for the CIE.

The materials pre-reviewed prior to the SEDAR 26 Review Workshop included: Assessment Process Reports for U.S. Caribbean queen snapper, silk snapper and redtail parrotfish; the SEDAR 26 Data Workshop Report and background documents reviewed at the Data Workshop; and other relevant background documents (Appendix 1).

The primary focus for SEDAR 26 Review Panel members (Appendix 3) during the October 17 - 20, 2011 meeting included:
- Understanding issues and limitations of the data and other information available for the assessments.
- Ensuring best possible use was made of available data, and that analytical and qualitative methods employed to assess the stocks were appropriate.
- Ensuring that the Terms of Reference (ToR, Annex 2 of Appendix 2) for the Review Workshop were appropriately addressed.
- Agreeing conclusions with respect to the Review Workshop ToR.

A review Summary Report, summarizing the Panel's views and conclusions relative to the meeting ToR, was prepared by Panel members during and after the meeting. This report, prepared for the CIE, reflects my own views, which are consistent with the Panel's conclusions on all substantive issues.

4   SUMMARY OF FINDINGS

4.1   OVERVIEW

The information and data base available to assess the U.S. Caribbean queen snapper, silk snapper, and redtail parrotfish resources is extremely limited, which precludes the use of standard fisheries stock assessment models. The Data Workshop appropriately concluded that quantitative analyses to inform stock status were limited to two approaches: commercial fishery catch per unit effort (CPUE) standardization, and analyses of commercial fishery length frequency data.

Conclusions that could be reached from the quantitative analyses were very limited. The indices generated from CPUE standardizations were not considered proportional to abundance because of changes in fishers' behaviour and technological advances that could not be accounted for in the standardizations. Large uncertainty in life history parameters limited interpretation of exploitation trends from length frequency analyses. As such, conclusions about stock status were largely based on fundamental principles of fisheries stock dynamics and qualitative interpretation of the available data.

Many of the data limitations and analytical issues related to assessing these stocks are generic across the species and platforms reviewed during the SEDAR 26. As such, I provide general comments related to the Review Workshop ToR below. This is followed by specific comments for each of the reviewed species and island platforms.

4.2   TERMS OF REFERENCE

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

The SEDAR 26 Data Workshop conducted a thorough and comprehensive review of all available data and information that might be useful for the assessments of U.S. Caribbean queen snapper, silk snapper and redtail parrotfish. This included evaluation of: life history information; fisheries statistics; fisheries independent surveys; and commercial fishery CPUE data and standardization methods. The SEDAR 26 Assessment Workshop adhered to the data recommendations from the Data Workshop.

Best possible use was made of the limited data available for assessing these resources. Analyses conducted for the stock assessments focussed on the commercial fishery length frequency data, which is the most reliable and consistent of the data sets. A number of commercial fishery CPUE standardizations were conducted, but as discussed below, the CPUE indices were not likely to reflect abundance trends.

Life History Parameters:

A thorough literature review of life history parameters was conducted during the SEDAR 26 Data Workshop to inform the stock assessments, in particular the length frequency analyses that rely on growth parameter estimates (von Bertalanffy K and L_{inf}). Published values of the growth parameters tended to be highly variable, in particular for queen snapper and redtail parrotfish, which resulted in large uncertainty in the total mortality estimates (Z) from the length frequency analyses.

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Queen snapper and silk snapper estimates of length at maturity data (L_{mat}) are available from a recent histological study conducted in the U.S. Caribbean, so these values are, correctly, assumed to be reliable.

The large uncertainty in growth parameters and lack of local growth studies severely limited interpretation of results from the length frequency analyses, which was the only potential analytical approach that could inform conclusions about trends in exploitation rates.

Landings and Effort Data:

Different programs have been used to collect landings data for Puerto Rico (PR) and the U.S. Virgin Islands (US VI) and data limitations and issues associated with each differ, though both are subject to some degree of non-reporting. Expansion factors are used to account for unreported catch in PR, but methods to calculate expansion factors for US VI have not been agreed (though non-reporting is believed to be minor). For PR, species-specific landings are generally reported, though parrotfish are reported generically. For the US VI, landings are only reported by species group.

No discard information is available for queen and silk snapper, though discards are believed to be minor. Redtail parrotfish discards observed in PR were minor, but only a small number of trips were sampled.

The landings information is highly uncertain and presentation of a single time series is misleading. Measures of uncertainty associated with the point estimates would be helpful to interpret trends and impacts of management measures. Development of as long time series as possible would provide a better historical context for current fisheries. For example, the Assessment Process Reports present PR landings beginning in 1983 (when electronic data became available), but landings pre-1983 were significantly higher than post-1983 (SEDAR26-RD01).

Landings data were not explicitly used in the stock assessments, however they can be useful to interpret trends in other data sources. For example, an increasing trend in landings in conjunction with a decrease in mean size of the catch is often a signal of overfishing.

Recreational Catch:

Recreational catch and discard estimates (from the Marine Recreational Information Program, MRIP) are available for PR since 2000. Although uncertainty in the estimates are large (estimated CVs), they provide useful information on the relative magnitude of the commercial versus recreational fisheries. For the period 2000 – 2009, recreational catches were 69%, 30% and 57% of the reported commercial landings of silk snapper, queen snapper and parrotfish, respectively. Relative to calculated landings these values will be lower, but they do indicate that recreational catch cannot be ignored when considering total removals.

Effort data from the recreational fishery is only reported as number of trips by general fishing mode, so precludes catch rate analyses for this fishery. Also, there are no consistent time series of length frequency data for length-based analyses.

Recreational catch data are not available for the US VI.

Trip Interview Program Data (TIP, LFs):

Time series of length frequency (LF) data are available from the Trip Interview Program (TIP) for both PR and the US VI. Trained port samplers have collected species-specific LF data from commercial fishing vessels since 1983. Although there is some concern that sampling of vessels and sampling of the catch has not always been random, this data set represents the best potential source of information to inform stock status and exploitation trends. These data were, appropriately, used extensively in length-based analyses.

Fishery Independent data:

Although considerable fishery-independent survey data exist for the U.S. Caribbean, the majority of studies are spatially and/or temporally limited, precluding any value for stock assessment. The SEDAR 26 Data Workshop thoroughly investigated these studies for potential data that could inform the stock assessments.

A series of deep-water cruises, conducted by NMFS between 1979 and 1985 and again in 2009, had potential value for the assessment. Bottom longline gear was used both in the earlier time series and again in 2009, however there was only partial overlap in the locations fished. During the earlier time series queen snapper and silk snapper were relatively abundant, but in 2009 no queen snapper and only 2 silk snapper were caught. In addition to little overlap in the locations fished by bottom longline, it seems likely that the depth distribution also differed between the earlier surveys and the 2009 survey. This is extremely unfortunate. If the 2009 survey had followed a design similar to the earlier surveys, it could have produced fishery-independent estimates of changes in abundance (for a number of deep-water species) between 1979-1985 and 2009.

TOR 2: Evaluate the adequacy, appropriateness, and application of methods used to assess the stock taking into consideration the data-poor nature of the fisheries.

The two analytical approaches used to assess the stocks, CPUE analysis and LF analysis, were appropriate given the limited data available for these fisheries. The CPUE analyses were not used to interpret stock status because it was unlikely that CPUE index trends reflected stock abundance trends, and appropriately the analysts focussed on the LF analyses.

The SEINE model (Survival Estimation in Non-Equilibrium Situations, Gedamke and Hoenig, 2006), a non-equilibrium extension of the Berverton-Holt equilibrium method to estimate total mortality (Z) from length frequency data, was used to estimate time-varying Z. An innovative extension of the SEINE method was developed to deal with the high uncertainty in growth parameters, however ultimately this uncertainty limited the conclusions that could be drawn from the analyses.

CPUE Analysis

A number of preliminary CPUE standardizations were conducted for the SEDAR26 Data Workshop, investigating a range of approaches for conducting the standardizations. These included: a multi-species CPUE approach, application of the Stephens and MacCall trip selection approach, and standard delta-lognormal analysis of selected trips. The Data Workshop recommended use of the delta-lognormal in conjunction with trip selection criteria for each species/platform, where trip selection criteria were based on expert knowledge of fishing centre/gear categories that were likely to target the species of interest. This decision is appropriate

given the multi-species approach is new and requires further validation, and results from the Stephens/MacCall trip selection approach were similar to those using the "expert knowledge" approach.

Considerable effort went into grooming the data for the CPUE analyses to ensure records reflecting multiple fishing trips, multiple gears, or other potentially erroneous information were removed. However, lack of ancillary data related to trip effort (i.e., that document technology changes, species targeted, depth fished) restricted the ability of the CPUE standardizations to account for technological advances and changes in targeting or other aspects of fishers' behaviour that change species-specific vulnerability.

For all CPUE analyses conducted (i.e., species/gear/platform combinations), the Assessment Workshop concluded that the standardized indices could not be considered proportional to abundance. Appropriately, the CPUE analyses were not used in interpreting stock status.

SEINE Analyses

The SEINE model, an analytical method that relies only on a time series of LF data and growth parameters, is appropriate for the data-limited U.S. Caribbean reef fisheries. The relative simplicity in data requirements is, however, countered by a suite of assumptions implicit to the method. Of these, the assumption that fishery selectivity is asymptotic and that the length of full vulnerability (L_c) can be readily determined was the most limiting for the current applications.

The growth parameter estimates for queen snapper, silk snapper and redtail parrotfish (von Bertalanffy K and L_{inf}) were highly uncertain, as were the plausible ranges for L_c as determined by visual inspection of length frequency plots. This resulted in a broad range of sensitivity analyses across the axes of uncertainty, and high uncertainty in the resultant Z estimates.

The SEINE analyses can potentially inform estimates of fishing mortality (F) in cases where natural mortality is reasonably well known, or there are changes (trends) in total mortality. For the analyses reported here, estimation of F is not appropriate because of high uncertainty in both natural mortality and total mortality estimates.

Determining whether the LF data supported a change in Z was based on an AICc (bias-corrected AIC) criterion. A decrease of 5 or more in AICc for the more complex model (ie. with an additional change in Z), was taken as "strong" support for the change in Z and evidence that indeed Z had changed. This criterion perhaps favours models that indicate no change in Z too strongly: a decrease in AICc of 5 means the more complex model is ~12 times more likely than the simpler (no change) model (Burnham et al. 2011).

For SEINE analyses where a change in Z was supported, an innovative extension to the analysis was developed using a Z ratio estimator. The Z ratios were estimated relatively precisely even though absolute estimates of Z were highly uncertain. This allowed some inferences about changes and trends in Z.

The analysts made the most of the limited data available, conducting a comprehensive set of analyses to extract as much information as possible from the length frequency data.

TOR3: Recommend appropriate estimates, when available, of stock abundance, biomass, and exploitation. When data-limitations preclude estimates, provide summary of conclusions that can be drawn from data-poor methodologies that were used in assessment.

Direct estimates of stock abundance, biomass and exploitation rates are not available for these data limited assessments.

Some limited inferences about trends in exploitation rates, based on the length frequency SEINE analysis, are discussed in the species summaries below (Sections 5.3, 5.4, and 5.5).

TOR4: Evaluate the methods used to estimate population benchmarks and management parameters (e.g., MSY, Fmsy, Bmsy, MSST, MFMT, or their proxies); recommend appropriate management benchmarks, provide estimated values for management benchmarks, and provide declaration of stock status.

No direct estimates of management parameters or population benchmarks could be derived given data limitations, the data-poor methodologies employed, and uncertainty in basic life-history parameters (e.g. von Bertalanffy growth parameters).

For Puerto Rico queen snapper, results from the SEINE analysis were used indirectly to make inferences about stock status relative to overfishing (F_{msy}). The approach used was innovative and appropriate, and is described in Section 4.3 below.

For the other stocks considered in SEDAR 26, inferences of stock status relative to overfishing were made based on qualitative interpretation of the data and fundamental principles of fisheries stock assessment. These are described and discussed in the species-specific summaries below (Sections 5.3, 5.4, and 5.5).

TOR 5: Evaluate the adequacy, appropriateness, and application of methods used to project future population status taking into consideration the data limitations and proposed alternatives; recommend appropriate estimates of future stock condition (e.g., exploitation, abundance, biomass).

Data limitations preclude application of population models that would allow projection of stocks into the future.

TOR 6: Evaluate the adequacy, appropriateness, and application of methods used to characterize uncertainty in estimated parameters. Provide, if available, measures of uncertainty for estimated parameters. Comment on the degree to which methods used to evaluate uncertainty reflect and capture significant sources of uncertainty. Ensure that the implications of uncertainty in technical conclusions are clearly stated.

The primary quantitative method used for the stock assessments was length frequency analysis using the SEINE model to estimate Z and changes in Z. These analyses require reliable estimates of growth parameters and a reasonable estimate of the length at which fish are fully vulnerable to the gear. Additionally, there are assumptions implicit to the method that may be violated. These include: growth follows a von Bertalanffy curve and is constant over time; recruitment is

continuous and time invariant; total mortality is constant with length for lengths greater than the length of full vulnerability; and no individual variability in growth.

For the species considered in SEDAR26 there is large uncertainty in the von Bertalanffy growth parameters and considerable uncertainty in the length at full vulnerability. To address these uncertainties an extensive set of sensitivity analyses was conducted across the plausible ranges of K, L_{inf}, and L_c, which resulted in high uncertainty in Z estimates. The so-called *base case* should not be taken as the most likely, rather it is the central point of the sensitivity test values. For example, the *base* value for the queen snapper K parameter was the mid-point of two values taken from the literature for queen snapper. The extreme values tested in the sensitivity analyses are each more likely than the mid-point estimate, as they reflect the results from a particular study (the studies appear to have used different ageing criteria).

The sensitivity analyses are useful to present the potential range in Z, however they should not be interpreted as representing a probability distribution for Z. Developing a probability distribution for Z would entail weighting each of the Z estimates by the likelihood of the Z (or Zs) given the data, and the probability of the associated growth parameters and L_c (which are unknown).

The sensitivity analysis approach taken to characterize uncertainty in the Z estimates is appropriate, given that uncertainty in the growth and L_c parameters is likely the most significant component of uncertainty in Z. A more comprehensive assessment of uncertainty would consider uncertainty relative to the implicit assumptions of the SEINE model (e.g., constant recruitment, time-invariant von Bertalanffy growth), perhaps using a simulation approach, but for these assessments this would not have enhanced the results. The key components of uncertainty in SEINE Z estimates were appropriately investigated, and Z ratio estimates found to be relatively insensitive to these.

Standard analytical approaches were used to estimate confidence limits for the standardized commercial CPUE indices. Of course, these confidence limits provide no information about the relationship between CPUE and stock abundance. The CPUE indices were not used to infer stock abundance trends so uncertainty in the indices does not affect stock status interpretations.

TOR 7: Ensure the stock assessment results are clearly and accurately presented in the Stock Assessment Report and that reported results are consistent with Review Panel recommendations.

The stock assessment results are clearly and accurately presented in the Stock Assessment Report. Clear and succinct summary statements about the status of each stock were not obvious or easy to find in these reports so the Review Panel requested that stock status summaries be prepared and these have been appended as Addenda to the Assessment Process Reports.

The Summary Statements reflect the best possible use of the available information and conclude that there is no evidence to suggest that overfishing is occurring on the U.S. Caribbean queen snapper, silk snapper, or retail parrotfish resources. These conclusions provide the strongest statements possible about stock status given the data limitations. For all but Puerto Rico queen snapper the conclusions are based on qualitative interpretation of the data (length frequency and catch trends), basic life history, and fundamental principles of fisheries population dynamics.

TOR 8: Evaluate the SEDAR Process as applied to the reviewed assessment and identify any Terms of Reference which were inadequately addressed by the Data or Assessment Workshops.

The SEDAR 26 review process was thorough, effective, and resulted in a comprehensive review of all information that could inform the stock assessments. Separation of the data compilation and evaluation (Data Workshop) from the analytical components of the assessments (Assessment Workshop) ensured that each of these aspects of the assessment received appropriate attention and that the appropriate experts participated in each of the workshops.

The ToR for the Data and Assessment Workshops were addressed to the extent possible given the data limitations of the assessment.

TOR 9: Consider the research recommendations provided by the Data and Assessment workshops and make any additional recommendation or prioritizations warranted. Clearly denote research and monitoring needs that could improve the reliability of future assessments. Recommend an appropriate interval for the next assessment, and whether a benchmark or update assessment is warranted.

The U.S. Caribbean fisheries are very data-poor, a situation that will continue in the near future. Fisheries stock assessments require time series of data, and these require time to accumulate. For the near future, length-based analyses are likely to be the primary analytical tool available for stock assessments. As shown for the stocks reviewed for SEDAR 26, uncertainty in growth parameters severely limited conclusions that could be made from the length frequency analyses. Studies to estimate species-specific growth parameters for key U.S. Caribbean fisheries resources should be of highest priority. These studies should be designed to ensure the oldest possible individuals of each species are sampled, as these are critical to estimating reliable growth parameters.

Existing commercial length frequency data, from the TIP program, is adequate for length-based analyses of some species/platforms/fisheries combinations, but is not adequate for many of them. The TIP program should be expanded to ensure adequate sampling of all species for which assessments will be required in the future. Also, the design of the TIP program requires investigation. There was some indication during the review that sampling is not always random and there is a possibility of species mis-identification (for redtail parrotfish).

Improved collection of basic fisheries data (catch, landings and effort) is required. Ideally, this data would include more precise geo-referenced information including depth fished, and better effort metrics. Species-specific data are required for the US VI, if the management goal is species-specific management. Co-ordination and support from fishers is essential to ensure increased reporting requirements result in improved data quality.

The recreational catch, as estimated from the MRIP program, appears to be a significant component of the total Puerto Rico catch for the three SEDAR 26 species. Expansion of this program to the US VI is likely warranted. Design of the program should be reviewed to ascertain if sampling is adequate to provide acceptably precise estimates for key species.

Development of procedures and guidelines for conducting length-based analyses (i.e. using the SEINE model), would improve future stock assessments. Thorough simulation testing would be useful to investigate aspects such as: performance of the ratio estimator given uncertainty or error in growth parameters; appropriate AICc criteria for model selection (possibly non-symmetric for

increase/decrease in Z); use of proxies for M, F_{msy} or other management metrics; appropriate Lc for multi-gear fisheries with different vulnerabilities; and effect of non-compliance with implicit assumptions of the method.

The existing U.S. Caribbean fisheries independent projects are unlikely to be useful for stock assessment because of their limited spatial and temporal coverage. An exception to this is the NMFS deep-reef surveys conducted from 1979 – 1985, which provide a valuable snapshot of the deep-reef resources at that time. A well designed survey that replicates aspects of the earlier surveys could provide useful information about changes in abundance for some key deep-reef fisheries resources. Unfortunately the design of the 2009 Oregon II deep-reef survey differed substantially from the earlier surveys, which appears to limit the potential for using this information in stock assessments. Further analysis of the 2009 Oregon II survey data is warranted to ascertain if there is any potential value for assessment of some species.

Recommending an appropriate interval for the next assessments of the three SEDAR 26 species is difficult because that decision should be dependent on the acquisition of new information/data that would potentially allow more definitive statements about stock status. Minimally, this should include reliable estimates of growth parameters for any stock that will be re-assessed. The SEDAR process is human resource intensive, and best use of these limited resources needs to be considered. Even update assessments are time-intensive.

Within the SEDAR process it may be useful to work on developing decision rules that would determine when an assessment update is required. For example, when a benchmark assessment is conducted a component of that assessment could be to decide if there are any analytical or data-based measures that are likely to inform future changes in abundance or fishing pressure. Two examples are: 1) the abundance index from a particular CPUE standardization, or 2) the mean fish size above a prescribed Lc for a particular fishery. The agreed measure could be calculated annually or when updated data are available, following the agreed protocol for its measurement. If the measured value is outside a pre-agreed range (i.e. indicating a significant change in abundance or exploitation), a full assessment would be required. The advantage of such an approach is that it ensures a level of monitoring for the stock without requiring a time consuming assessment. This type of approach could (and should) be investigated using management strategy evaluation.

TOR 10: Prepare a Peer Review Summary Report summarizing the Panel's evaluation of the stock assessment and addressing each Term of Reference.

Members of the Peer Review Panel prepared, reviewed, and approved all sections of the Summary Report which is now being compiled by the Panel Chair.

4.3   QUEEN SNAPPER SUMMARY

The PR queen snapper fishery, a relatively deep-reef fishery, is a recent development with the first reported landings occurring in 1987. This is a targeted fishery, and landings have been relatively stable over the last decade. For the US VI, species-specific landings are not available with snapper reported as a generic group, so the history of that fishery is unknown.

SEINE analyses were conducted for the PR hook and line fishery and St. Croix hook and line fishery. Sample sizes were not adequate for length-based analyses of St. Thomas/St. John queen snapper fisheries.

High uncertainty in the von Bertalanffy K parameter and in the length that queen snapper are fully selected (L_c) required sensitivity analyses over a broad parameter space and resulted in high uncertainty in Z estimates. An innovative extension to the SEINE analysis was developed, using a Z ratio estimator, which resulted in reasonably precise estimates of current Z relative to Z in the early years of the Puerto Rico fishery.

For the Puerto Rico SEINE analysis, the AIC criterion provided support for an increase in Z beginning in 1996. Many of the Z estimates were quite high with Z ranging from ~0.3 to ~ 2.5 over the sensitivity range investigated. The ratio of Z in the later period relative to that in the earlier period was less variable, ranging from 0.55 to 0.85, and indicating an increase in fishing pressure over the history of the fishery.

For the St. Croix SEINE analysis, the AIC criterion did not provide the requisite "strong" support for a change in Z over the period of the analysis. Again, Z estimates were high, ranging from 0.5 to ~3.5 over the sensitivity range investigated, with Z estimates strongly correlated with the von Bertalanffy growth parameter.

For Puerto Rico queen snapper the SEINE analysis was used indirectly to make inferences about stock status relative to overfishing. This queen snapper stock was unexploited (or very lightly exploited) at the start of the time series so total mortality at that time should be very close to the natural mortality rate. Across the sensitivity scenarios considered, the SEINE analyses indicated a proportional increase in Z from the early to the later period of the fishery ranging from 0.55 to 0.85. Adopting a common assumption used in fisheries population dynamics, that F_{msy} is twice the natural mortality rate, allows the conclusion that the current fishing mortality rate is below F_{msy}. The assumptions in this approach for determining status relative to overfishing should be relatively robust to the uncertainties in the assessment, assuming the fishery was only lightly exploited at the beginning of the time series.

The St. Croix queen snapper length frequency data show no major changes over the time series, with an ongoing presence of larger individuals. The SEINE analysis did not provide strong support for a change in Z, though estimates were somewhat higher for St. Croix than for Puerto Rico, suggesting potentially higher exploitation rates. The conclusion that this stock is not undergoing overfishing was based on: stability in the length frequency data; most of the catch taken is above the size at maturity; and anecdotal information that commercial fishing pressure is low (three fishers actively fish deep water snappers). This conclusion is consistent with the analyses and data presented in the assessment.

For St. Thomas/St. John queen snapper the limited number of length samples in recent years and the lack of species-specific landings data preclude any conclusions regarding changes in mortality or stock status.

4.4   SILK SNAPPER SUMMARY

Silk snapper landings in Puerto Rico have declined since the mid 1990s and currently are less than one third of earlier levels. This may be attributed to a reported shift in targeting from silk snapper to queen snapper. Species-specific landings data are not available for the US VI.

For silk snapper, interpretation of length frequency data is complicated by a size-depth relationship, whereby larger individuals are found deeper. This could lead to erroneous conclusions about exploitation trends from length-based analyses if there are changes in the depth distribution fished.

A shift in the size structure of silk snapper landed in the PR hook and line fishery, potentially associated with planned implementation of a minimum legal size, suggests a change in targeting or retention for this fishery and precludes a SEINE analysis. The sequentially increasing proportion of larger fish in the length frequency data may be indicative of a decrease in Z, or may simply reflect a change in fishers' behaviour. There is some indication of a shift in the depth distribution of the hook and line fishery, but sample sizes are too small for a definitive conclusion.

A SEINE analysis of St. Croix silk snapper did not provide "strong" support for a change in Z. The analysis did suggest an increase in Z (a 5 to 35% increase based on the Z ratio approach), but small sample sizes preclude any firm conclusion. Also, there is some indication of a decrease in the depth distribution fished, albeit sample sizes are small.

The assessment draws conclusions on the status of Puerto Rico silk snapper relative to overfishing on the basis of the data-poor methodologies used in the assessment, fundamental principles of fisheries stock dynamics, and qualitative interpretation of the data. The assessment concludes that there is no evidence to suggest that overfishing is occurring on Puerto Rico silk snapper. The basis for that conclusion is: the size structure has remained relatively stable with recent increases of larger fish indicating exploitation rates have been sustainable and possibly are decreasing; and the majority of commercially-caught fish are above the size at maturity. This conclusion is consistent with the analyses and data presented in the assessment.

For St. Croix and St. Thomas/St. John the limited number of length frequency samples and lack of species-specific landings data preclude any conclusion about changes in mortality or stock status.

4.5   REDTAIL PARROTFISH SUMMARY

Among the species considered in this review, the information base for redtail parrotfish is the poorest. Species-specific landings data are not available for any of the platforms and growth parameters are available from only one study (with an unlikely estimate for K), so parameters from related parrotfish species were used.

Redtail parrotfish SEINE analyses were conducted for Puerto Rico (pot and trap fishery and net fishery), St. Thomas/St. John (pot and trap fishery), and St. Croix (pot and trap fishery, net fishery, and diver-based fishery). Of these, only the St. Croix pot and trap fishery analysis provided "strong" support for a change in Z, indicating a 30% to 60% decline in total morality occurring around 1996.

High uncertainty in Z estimates, as a result of uncertainty in redtail parrotfish growth parameters and the length at full vulnerability, and unknown natural mortality preclude direct estimates of fishing mortality.

The assessment draws conclusions about the status of redtail parrotfish relative to overfishing on the basis of the data-poor methodologies used in the assessment, fundamental principles of fisheries stock dynamics, and qualitative interpretation of the data. The assessment concludes that there is no evidence to suggest that overfishing is occurring on redtail parrotfish in the U.S. Caribbean. The basis for that conclusion is: the size structure of fully vulnerable fish has remained stable over time (or, possibly has increased in St. Croix), indicating exploitation rates have been sustainable; the majority of commercially-caught fish are above the size at maturity; and high growth rates, low age at maturity, and short population doubling time suggest this species would be resilient to fishing pressure.

The conclusion reached in the assessment, that there is no evidence to suggest that overfishing is occurring on redtail parrotfish in the U.S. Caribbean, is consistent with the data and analyses presented.

5   CONCLUSIONS AND RECOMMENDATIONS

The SEDAR 26 review process for queen snapper, silk snapper, and redtail parrotfish was thorough and effective, and resulted in a comprehensive review of all information and analytical approaches that might inform assessment of stock status. The Review Panel members agreed all substantive issues and the SEDAR 26 Summary Report represents consensus opinion. Stock status Summary Statements, prepared during the Review Workshop, reflect the best possible use of the available information and conclude that for queen snapper, silk snapper, and retail parrotfish, there is no evidence to suggest that overfishing is occurring in the U.S. Caribbean.

The information and data base available to assess the U.S. Caribbean queen snapper, silk snapper, and redtail parrotfish resources is extremely limited which precludes the use of standard fisheries stock assessment models. Results from the two quantitative methods employed to assess the stocks were generally not useful to inform stock status: indices generated from CPUE standardizations were not considered proportional to abundance because of changes in fishers' behaviour and technological advances that could not be accounted for in the standardizations; and, large uncertainty in life history parameters limited interpretation of exploitation trends from length frequency analyses. As such, the conclusion that overfishing is not occurring on these resources, is largely based on fundamental principles of fisheries stock dynamics and qualitative interpretation of the available data.

Consideration should be given to the best approach for future SEDAR reviews of U.S. Caribbean reef fish. The three species assessed during SEDAR 26 are among the most data/information rich, so it is likely that assessment results for other reef fish might be less conclusive than those reported here. Development of criteria that specify minimal data requirements for pursuing an assessment may be useful. Development of procedures and guidelines for implementation of the SEINE method (or other length-based models), would enhance future assessments. Management strategy evaluation would be a useful approach for developing guidelines.

APPENDIX 1. BIBLIOGRAPHY

I. Stock Assessment Process Reports

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    October, 2011. 74p.

Anon. U.S. Caribbean queen snapper. SEDAR 26 Section III: Assessment Process Report.
    October, 2011. 67p.

Anon. U.S. Caribbean redtail parrotfish. SEDAR 26 Section III: Assessment Process Report.
    October, 2011. 120p.

II. Documents prepared for the Data Workshop

Bryan, M.D., M. del Mar Lopez, and B. Tokotch. A review of the life history characteristics of
    silk snapper, queen snapper, and redtail parrotfish. SEDAR26-DW-01.

Cummings, N.J. and V. Matter. Summarized information on recreational catches of silk and
    queen snapper and parrotfish in Puerto Rico since 2000. SEDAR26-DW-02.

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    SEDAR26-DW-03.

Campbell, M., T. Gedamke, and W. Ingram. Preliminary Evaluation of available length-
    frequency information in the US Caribbean Trip Interview Program (TIP) data. SEDAR26-
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Cummings, N.J. Updated catch per unit abundance indices for silk and queen snapper from the
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Ingram, G.W. Delta-lognormal and multinomial approaches to index development for parrotfish,
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    and the U.S. Virgin Islands. SEDAR26-DW-10.

III. Additional SEDAR26 reference documents

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Gedamke, T. and C. Porch. Estimating mutton snapper mortality rates from mean lengths and catch rates in non-equilibrium conditions (SEDAR 14-RW01). SEDAR26-RD03

Gedamke, T. Estimation of mutton snapper total mortality rate from length observations. (SEDAR 14-AW05). SEDAR26-RD04.

Toller, W. A preliminary investigation into the accuracy of commercial catch reports using information from the St. Croix net fishery. SEDAR26-RD05

IV. Additional References in this report

Burnham, K.P., D.R. Anderson, and K.P. Huyvaert. 2011. AIC model selection and multimodel inference in behavioural ecology: some background, observations, and comparisons. Behav. Ecol Sociobiol. 65: 23-35.

Gedamke, T, and J. M. Hoenig. 2006. Estimating mortality from mean length data in nonequilibrium situations, with application to the assessment of goosefish. Trans. Am. Fish. Soc. 135:476-487.

Attachment A: Statement of Work for Vivian Haist

External Independent Peer Review by the Center for Independent Experts

SEDAR 26 Caribbean Queen Snapper, Silk Snapper, and Redtail Parrotfish Review

Scope of Work and CIE Process: The National Marine Fisheries Service's (NMFS) Office of Science and Technology coordinates and manages a contract providing external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of NMFS scientific projects. The Statement of Work (SoW) described herein was established by the NMFS Project Contact and Contracting Officer's Technical Representative (COTR), and reviewed by CIE for compliance with their policy for providing independent expertise that can provide impartial and independent peer review without conflicts of interest. CIE reviewers are selected by the CIE Steering Committee and CIE Coordination Team to conduct the independent peer review of NMFS science in compliance the predetermined Terms of Reference (ToRs) of the peer review. Each CIE reviewer is contracted to deliver an independent peer review report to be approved by the CIE Steering Committee and the report is to be formatted with content requirements as specified in **Annex 1**. This SoW describes the work tasks and deliverables of the CIE reviewer for conducting an independent peer review of the following NMFS project. Further information on the CIE process can be obtained from www.ciereviews.org.

Project Description: SEDAR 26 will be a compilation of data, a benchmark assessment of the stock, and an assessment review conducted for Caribbean Queen Snapper, Silk Snapper, and Redtail Parrotfish. The review workshop provides an independent peer review of SEDAR stock assessments. The term review is applied broadly, as the review panel may request additional analyses, error corrections and sensitivity runs of the assessment models provided by the assessment workshop panel. The review panel is ultimately responsible for ensuring that the best possible assessment is provided through the SEDAR process. The stocks assessed through SEDAR 26 are within the jurisdiction of the Caribbean Fisheries Management Council and the territorial waters of Puerto Rico and the U.S. Virgin Islands. The Terms of Reference (ToRs) of the peer review are attached in **Annex 2**. The tentative agenda of the panel review meeting is attached in **Annex 3**.

Requirements for CIE Reviewers: Three CIE reviewers shall conduct an impartial and independent peer review in accordance with the SoW and ToRs herein. CIE reviewers shall have working knowledge and recent experience in the application stock assessment, statistics, fisheries science, and marine biology sufficient to complete the primary task of reviewing the technical details of the methods used for the assessment. Expertise with data poor assessment methods would be preferable. Each CIE reviewer's duties shall not exceed a maximum of 14 days to complete all work tasks of the peer review described herein.

Location of Peer Review: Each CIE reviewer shall conduct an independent peer review during the panel review meeting scheduled in San Juan, Puerto Rico during October 17-21, 2011.

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

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

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

Pre-review Background Documents: Two weeks before the peer review, the NMFS Project Contact will send (by electronic mail or make available at an FTP site) to the CIE reviewers the necessary background information and reports for the peer review. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE Lead Coordinator on where to send documents. CIE reviewers are responsible only for the pre-review documents that are delivered to the reviewer in accordance to the SoW scheduled deadlines specified herein. The CIE reviewers shall read all documents in preparation for the peer review.

Panel Review Meeting: Each CIE reviewer shall conduct the independent peer review in accordance with the SoW and ToRs, and shall not serve in any other role unless specified herein. **Modifications to the SoW and ToRs can not be made during the peer review, and any SoW or ToRs modifications prior to the peer review shall be approved by the COTR and CIE Lead Coordinator.** Each CIE reviewer shall actively participate in a professional and respectful manner as a member of the meeting review panel, and their peer review tasks shall be focused on the ToRs as specified herein. The NMFS Project Contact is responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). The NMFS Project Contact is responsible for ensuring that the Chair understands the contractual role of the CIE reviewers as specified herein. The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements, including the meeting facility arrangements.

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

Other Tasks – Contribution to Summary Report: Each CIE reviewer may assist the Chair of the panel review meeting with contributions to the Summary Report, based on the terms of reference

of the review. Each CIE reviewer is not required to reach a consensus, and should provide a brief summary of the reviewer's views on the summary of findings and conclusions reached by the review panel in accordance with the ToRs.

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

1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review.
2) Participate in the panel review meeting in San Juan, Puerto Rico during October 17-21, 2011.
3) In San Juan, Puerto Rico during October 17-21, 2011 as specified herein, conduct an independent peer review in accordance with the ToRs (**Annex 2**).
4) No later than November 4, 2011, each CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts," and sent to Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and David Sampson, CIE Regional Coordinator, via email to david.sampson@oregonstate.edu. Each CIE report shall be written using the format and content requirements specified in Annex 1, and address each ToR in **Annex 2**.

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

September 12, 2011	CIE sends reviewer contact information to the COTR, who then sends this to the NMFS Project Contact
October 3, 2011	NMFS Project Contact sends the CIE Reviewers the pre-review documents
October 17-21, 2011	Each reviewer participates and conducts an independent peer review during the panel review meeting
November 4, 2011	CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
November 18, 2011	CIE submits CIE independent peer review reports to the COTR
November 24, 2012	The COTR distributes the final CIE reports to the NMFS Project Contact and regional Center Director

Modifications to the Statement of Work: Requests to modify this SoW must be approved by the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the COTR within 10 working days after receipt of all required information of the decision on substitutions. The COTR can approve changes to the milestone dates, list of pre-review documents, and ToRs within the SoW as long as the role and ability of the CIE reviewers to complete the deliverable in accordance with the SoW is not adversely impacted. The SoW and ToRs shall not be changed once the peer review has begun.

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

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

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

Support Personnel:

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

1. The CIE independent report shall be prefaced with an Executive Summary providing a concise summary of the findings and recommendations, and specify whether the science reviewed is the best scientific information available.

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

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

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

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

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

   e. The CIE independent report shall be a stand-alone document for others to understand the weaknesses and strengths of the science reviewed, regardless of whether or not they read the summary report. The CIE independent report shall be an independent peer review of each ToRs, and shall not simply repeat the contents of the summary report.

3. The reviewer report shall include the following appendices:

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

Annex 2: Terms of Reference for the Peer Review

SEDAR 26 Caribbean Queen Snapper, Silk Snapper, and Redtail Parrotfish Review

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

2. Evaluate the adequacy, appropriateness, and application of methods used to assess the stock taking into consideration the data-poor nature of the fisheries.

3. Recommend appropriate estimates, when available, of stock abundance, biomass, and exploitation. When data-limitations preclude estimates, provide summary of conclusions that can be drawn from data-poor methodologies that were used in assessment.

4. Evaluate the methods used to estimate population benchmarks and management parameters (*e.g., MSY, Fmsy, Bmsy, MSST, MFMT, or their proxies*); recommend appropriate management benchmarks, provide estimated values for management benchmarks, and provide declarations of stock status.

5. Evaluate the adequacy, appropriateness, and application of the methods used to project future population status taking into consideration the data limitations and proposed alternatives; recommend appropriate estimates of future stock condition (e.g., exploitation, abundance, biomass).

6. Evaluate the adequacy, appropriateness, and application of methods used to characterize uncertainty in estimated parameters. Provide, if available, measures of uncertainty for estimated parameters. Comment on the degree to which methods used to evaluate uncertainty reflect and capture the significant sources of uncertainty. Ensure that the implications of uncertainty in technical conclusions are clearly stated.

7. Ensure that stock assessment results are clearly and accurately presented in the Stock Assessment Report and that reported results are consistent with Review Panel recommendations.[*]

8. Evaluate the SEDAR Process as applied to the reviewed assessment and identify any Terms of Reference which were inadequately addressed by the Data or Assessment Workshops.

9. Consider the research recommendations provided by the Data and Assessment workshops and make any additional recommendations or prioritizations warranted. Clearly denote research and monitoring needs that could improve the reliability of future assessments. Recommend an appropriate interval for the next assessment, and whether a benchmark or update assessment is warranted.

10. Prepare a Peer Review Summary Report summarizing the Panel's evaluation of the stock assessment and addressing each Term of Reference.

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

Annex 3: Agenda

SEDAR 26 Caribbean Queen Snapper, Silk Snapper, and Redtail Parrotfish Review

San Juan, Puerto Rico

October 17-21, 2011

**Monday**
1:00 p.m.	**Convene**	
1:00 – 1:30	**Introductions and Opening Remarks**	
	Coordinator	
	- Agenda Review, TOR, Task Assignments	
1:30 – 3:30	**Assessment Presentation**	**TBD**
3:30 – 4:00	**Break**	
4:00 – 6:00	**Continue Presentation/Discussion**	**Chair**

**Tuesday**
8:30 a.m. – 11:30 a.m.	**Assessment Presentation**	**Chair**
11:30 a.m. – 1:30 p.m.	**Lunch Break**	
1:30 p.m. – 3:30 p.m.	**Panel Discussion**	**TBD**
	- _Assessment Data & Methods_	
	- Identify additional analyses, sensitivities, corrections	
3:30 p.m. – 4:00 p.m.	**Break**	
4:00 p.m. – 6:00 p.m.	**Panel Discussion**	**Chair**
	- Continue deliberations	
	- Review additional analyses	

**Tuesday Goals****:** Initial presentations completed, sensitivities and modifications identified.

**Wednesday**
8:30 a.m. – 11:30 a.m.	**Panel Discussion**	**Chair**
	- Review additional analyses, sensitivities	
	- Consensus recommendations and comments	
11:30 a.m. – 1:30 p.m.	**Lunch Break**	
1:30 p.m. – 3:30 p.m.	**Panel Discussion**	**TBD**
3:30 p.m. – 4:00 p.m.	**Break**	
4:00 p.m. – 6:00 p.m.	**Panel Discussion**	**Chair**

**Wednesday Goals:** Final sensitivities identified, Preferred models selected, Projection approaches approved, Summary report drafts begun

**Thursday**
8:30 a.m. – 11:30 a.m.	**Panel Discussion**	**Chair**
	- Final sensitivities reviewed.	
	- Projections reviewed.	
11:30 a.m. – 1:30 p.m.	**Lunch Break**	
1:30 p.m. – 3:30 p.m.	**Panel Discussion or Work Session**	**Chair**
3:30 p.m. - 4:00 p.m.	**Break**	
4:00 p.m. - 6:00 p.m.	**Panel Work Session**	**Chair**
	- Review Consensus Reports	

**Thursday Goals:** Complete assessment work and discussions. Final results available. Draft Summary Report reviewed.

**Friday**
8:30 a.m. – 12:00 p.m.	**Panel Work Session**	**Chair**
12:00 p.m.	**ADJOURN**	

APPENDIX 3. SEDAR 26 REVIEW PANEL MEMBERSHIP

Review Panel:

Walter Keithly	LSU, Panel Chair
Reni Garcia	Scientific and Statistical Committee (SSC) Representative
Vivian Haist	Center for Independent Experts (CIE)
Cathy Dichmont	Center for Independent Experts (CIE)
Panayiota Apostolaki	Center for Independent Experts (CIE)