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Caribbean Queen Snapper, Silk Snapper, and Redtail Parrotfish Review 2011

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Executive Summary

The SEDAR 26 review workshop for the Caribbean queen and silk snapper, and redtail parrotfish took place in San Juan, Puerto Rico from 17 to 20 October 2011. In attendance were review panel members Drs Dichmont, Apostolaki, Garcia and Haist, with chair Dr Keithly, assessment and data review authors, and several interested observers. The review was the final in a series of prior workshops, being Data Review and Assessment Review workshops. Documents were provided from both these meetings, as well as supporting documents (see Appendix 1), that were well aligned with the Terms of References. Access to these documents was made available through an FTP site. These reports covered management of the fishery, biology of the species, available data, their analyses, and basic conclusions. These documents were extensive and generally well presented. The review was undertaken in a very positive light with good interactions between the panel and the team. This meant that issues were well addressed by the end of the meeting. Furthermore, the team were asked to undertake additional work, which they did very co-operatively. This added to the Review output and, hopefully, clarifies final outputs and findings.

Several data sets are available for Puerto Rico (PR) and the US Virgin Islands (USVI) (the latter divided into St, Thomas/St. John and St. Croix areas), with the most important being:

a. Trip interview program (TIP) (mainly commercial) data for both Puerto Rico and US Virgin Islands;
b. Puerto Rico commercial sales/trip ticket data;
c. US Virgin Islands commercial landings reports; and
d. MRFSS observations of recreational catch and effort since 2000 in Puerto Rico.

There are large gaps and uncertainties in the data given that the full range of illegal, unregulated and unreported fishing occurs (to varying degrees) in the areas. The result is that commercial landings and effort data are available, but unreliable, in its raw form. The USVI data are also not disaggregated by species.

Analyses concentrated on creating more reliable datasets (e.g. through expansion factors for PR landings data), standardising commercial catch rate data and analysing length frequency data. Catch rate standardisation applied the delta lognormal generalised linear modelling approach – a well-established method for zero inflated data, as seem to be the case here. Presence or absence of catch used a binomial distribution and the positive catch used a lognormal distribution. Length frequency analyses concentrated mainly on four aspects:

a. determine maximum length at capture;
b. determining whether spawning aggregations were targeted;

Calculating total mortality (Z) (and if possible fishing mortality – F – or a proxy)

c. using Beverton and Holt equilibrium analyses; and
d. a modified version of the Gedemke and Hoenig (2006) method, called SEINE (Survival Estimation in Non Equilibrium Situations).

All these analyses were undertaken with a very high standard and correctly applied. The SEINE method is an appropriate method to apply to this data set and is the most important method used. Although there are further modifications that would be beneficial (see Recommendations and future work), the output provided is generally appropriate.

Great thought has gone into data mining and their reliability, as well as on methods to improve their usefulness for analysis. The review team was asked to provide a summary of the data and biological information, whether these were used, and any pertinent issues (Section VI: Addenda and Post-Review Updates). This is an important output of the review as it draws together information that is contained in several documents and was not as accessible in the different reports.

Uncertainty could be better described by not providing a single landings series, but rather in the form of, for example, median and confidence intervals for all regions. All sources of uncertainty should be included in this series. However, in the analyses, uncertainty is well described using extensive sensitivity tests.

Although recreational catch data are available for Puerto Rico since 2000, these data were not used. This is despite the fact that the recreational catch for some of the species are high enough that they should not be ignored. This is an important data set and further work on these data is recommended (see Recommendations and future work).

Conclusions from the catch rate standardisation were that the catch rate index was not proportional to biomass. This issue is particularly highlighted for queen snapper where the start of the catch rate series is likely to represent a lightly fished stock, yet catch rates have increased while landings have also increased. Although there is further research suggested (see Recommendations and future work), it is likely that, at present, the finding that standardised catch rates are not an index of abundance is robust.

The size-based analysis was comprehensive and demonstrates that this is the most important data source and should be maintained and extended. A large feature of these data, in general, is that most of the animals from the three species are mature when they are captured. Although several techniques could have been undertaken to produce the size at selectivity and to test whether selectivity has changed over time, given the structure of the size frequency distributions, it is appropriate that simple visual analysis of the data was used. On the other hand, combining the data by month over the period to inspect whether the fisheries target spawning aggregations is not appropriate. This is because most animals in the size frequency distribution were mature and so any signal is unlikely to clearly appear.

The equilibrium Beverton and Holt analysis is a well-know technique of calculating equilibrium total mortality, Z. These were generally calculated before 1991 and after 2000 for each gear and species, so as to determine how much Z has changed over time. This analysis was undertaken with a wide range of sensitivity tests over the length of first capture, using high, middle and low values of von Bertalanffy growth parameters, L_inf and Kappa. However, analyses concentrated on the non-equilibrium SEINE method, which is a highly appropriate method for these data sets. The application of and modifications to the method, together with large sensitivity tests, are appropriate. The degree to which uncertainty was addressed in these analyses was extensive and a good model.

The SEINE method uses a similar philosophy to that of the Beverton and Holt approach but does not assume equilibrium. Given that these fisheries have been fished and that patterns have changed over time, especially on queen snapper, a non-equilibrium method is much more appropriate. Applying this method to obtain relative mortality (rather than absolute) – as recommended by the Assessment team – is supported. The large uncertainty in growth translates into larger uncertainty in absolute values.

Although some of the size based analysis produced Fmsy proxies, there is large uncertainty in these values. This result demonstrates that a key research priority is that basic biology

parameters specific to this region for these species are needed. Meta-analysis shows that growth parameters can vary substantially even compared to relevant tropical regions.

The assessment team was asked during the workshop to provide statements on analyses and conclusions for each species (see Section VI: Addenda and Post-Review Updates). This is because the documentation was incomplete in this regard. Clear summaries are more important for data poor fisheries because one has to draw from several information sources and proxies to derive an overall conclusion. The statements produced (and provided in Section VI: Addenda and Post-Review Updates during the Workshop) are appropriate and comprehensive. They are an essential output of the Workshop.

Background

Three species of fish - queen snapper, silk snapper, and redtail parrotfish - caught both commercially and recreationally by US Caribbean fisheries have been the subject of extensive review and analyses. Several workshops have been undertaken to collate and investigate different forms of data and undertake analyses of the data. These three species have been selected because, amongst other aspects, they are of the more data "rich" species in the region. In 2011, there have been three SEDAR workshops on these species – SEDAR 26 Data Workshop, SEDAR 26 Assessment Workshop and SEDAR 26 Review Workshop. The aim of these three workshops is to provide key information about stock status and management parameters, and an international review of the research. Panel members for the Review were Drs Dichmont, Apostolaki, Garcia and Haist, with chair Dr Keithly. This document is the independent CIE review report of one of the panel members. Independent CIE reports will also be provided by Drs Apostolaki and Haist. An overall panel report was also provided by the panel members and should be treated as an important addition to this review report.

Description of Review Activities

The SEDAR 26 review workshop for the Caribbean queen and silk snapper, and redtail parrotfish took place in San Juan, Puerto Rico from 17 to 20 October 2011. This is the culmination of a Data and Assessment Review workshop that had happened prior to the Review workshop. Before the Review workshop, documents from each of the Workshops plus supplementary material were made available on the SEDAR 26 FTP site (see Appendix 1). Presentations during the workshop were also provided, as were documents regarding additional requests.

The objective of the Review Workshop was to "ensure that the assessment and results presented are scientifically sound and that managers are provided adequate advice regarding stock status, management benchmarks, and the general nature of appropriate future management actions".

The Terms of Reference were:

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 meeting was chaired by Walter Keithly (Louisiana State University) on behalf of the CIE review team, but the panel review was the view of the CIE panel members.

Changes to the documentation

The Assessment team was asked to provide additional information during the workshop summarising the:

a. biological parameters of the three species;
b. the data available, which were used or not (with reasons);
c. statements by species summarising the conclusions that can be drawn from both the data and assessment reviews.

These are provided as Addenda to the Workshop reports (Section VI: Addenda and Workshop Updates for each species).

Summary comments

A typical aspect of data poor species – as opposed to a data rich stock assessment output – is that one usually has to draw together conclusions from various sources in a narrative. The Addenda (Section VI: Addenda and Post-Review Updates) to the workshop now provide an excellent addition and the conclusions therein are supported.

Furthermore, the SEDAR 26 panel report highlights extensive findings in an overall summary by species (Section VI: Addenda and Post-Review Updates) and this CIE report should be seen in the context of the Section VI Panel report.

As in the panel summary, this reviewer agrees with the panel overview that:

- "The panel agrees that there has been a very thorough process of mining the data, investigating all sources of data and their related uncertainty. Similarly, a meta-analysis was undertaken of all relevant sources in the literature to inform sensitivity tests, rather than use single values.
- There is very large uncertainty in almost all the data and input parameters, which correctly therefore requires applications of data poor methods.
- The Assessment team extensively applied methods appropriate for data poor fisheries and also undertook a very good extension and application of the SEINE (Survival Estimation in Non Equilibrium Situations) (Gedamke and Hoenig, 2006) method.
- The panel supports that the most valuable information at this stage is the size frequency information and that continued investment in this data set is essential.
- Uncertainty in the analyses is well presented. However, uncertainty was not well presented in the landings data especially through endeavouring to provide only a single expanded landings data set in Puerto Rico. The need for expansion factors in USVI is much reduced given that returns were mandatory. For all landings series, a more appropriate method would be to present median estimates of landings with confidence intervals for all regions. All sources of uncertainty should be included in this analysis. Further modifications with regard to the SEINE analysis could be undertaken (see detailed comments below).
- The CPUE standardisation methods were appropriately applied given the low information base of key factors such as gear information (e.g. GPS), depth fished, and species targeted. The panel agrees with the conclusions that the standardised catch rate indices do not reflect abundance trends. Much more extensive investigation of the feasibility of including additional factors or variables either as offsets or ratios of catch to relevant species total catch should be undertaken in the future. However, it is acknowledged that the data themselves have such serious gaps that it is unlikely that the conclusions will change.
- The panel suggests that the SEINE method has not been tested enough in a simulation study to assess its strength with regard to developing overfishing proxies. The simulation studies should be tested on a simulated population with known parameters, recruitment and size frequency. Despite this view, the method shows the greatest promise in these data poor situations."

The reviewer further emphasises that Section VI provides the best summary of all documents provided.

It is recommended that future reports should include this information or at least in a similar format. This means that Reviewers do not need to summarise this themselves from several sources and also infer the findings of the Assessment team. Such clear summary statements from the Assessment Team clarify their findings and excellently place it in its data poor context.

Recommendation 1. Future SEDAR Assessment Review documents should include clear Summary statements of narrative that lead the team to a certain conclusion and contextualises its data poor context.

To avoid continual replication, this report will concentrate rather on major issues or any additional comments not included in either of the Addenda or the Panel Report and will directly address the Terms of Reference by species (and within those, by region, if applicable). Terms of Reference 8, 9 and 10 are not reviewed by species, as this is not appropriate.

Queen snapper

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

The Assessment team provided an additional document as part of the review process that summarises: a) the data; b) the strengths and weaknesses of the data; c) which data are used with reasons for all three species reviewed (Section VI: Addenda and Post-Review Updates). The SEDAR 26 Data Workshop undertook a thorough review of all the available data as well as their associated issues. These data included a meta-analysis of life history information (see Section VI: Addenda and Post-Review Updates), fisheries dependent information such as recreational and commercial data, fisheries independent data such as surveys and information for the standardisation of catch rates, e.g., landing depth, location. The SEDAR 26 Assessment Workshop adhered to the recommendations from the Data Workshop, as is appropriate.

From these two SEDAR 26 workshops, it is clear that the data are not of the type and quality that would allow for data rich assessment methods. This fishery is information poor as, even though a time series of catch rate data is available, these are correctly shown to not be an index of a biomass – a key assumption in a stock assessment model. The use of data poor methods to queen snapper is therefore appropriate.

Estimates of von Bertalanffy growth parameters for queen snapper are not available for the region. Reported estimates for L_inf and K were 1020 mm TL and 1030 mm TL, and 0.29 and 0.61 per year, respectively. Although the L_inf values are fairly consistent with each other, the K values are very divergent. Estimates of natural mortality were 0.33 and 0.76 per year – the latter value was rejected by the Data workshop since it could not be verified. Given the uncertainty, the assessment team appropriately covered a range of uncertainties on these parameters through sensitivity tests.

Recommendation 2. The highest cause of uncertainty in subsequent analyses are the lack of robust population dynamic parameters especially growth. This is a high priority and should be obtained for the region given that studies from similar regions show such different growth values.

The queen snapper differs from the other two species being reviewed, in that it occurs in deeper waters of the shelf edge, and in Puerto Rico (PR) has only recently been targeted which resulted in an expansion of the fishery over the past decade. The PR landings data are heavily influenced by the fact that reporting was not mandatory until 2002. Landings data in PR are therefore expanded to adjust for this miss-reporting using, initially, the ratio of active to licenced fishers, and, after 2002, the ratio of observed landings to the reported landings. Presently, reported landings are still low in PR and effort should be made to increase the reporting rates. Rather than provide a single landing series, it is much more appropriate, given the uncertainties in the data, to provide a series of landings data with upper and lower bounds or confidence intervals. All sources of uncertainty can therefore be included, and the reporting of this landings series would highlight the degree of uncertainty in the data. The same would apply to the USVI regions.

Recommendation 3. Emphasis should be placed on increasing the present reasonably low PR commercial landings reporting rates.

Recommendation 4. Rather than provide a single landing series by region, it is much more appropriate, given the uncertainties in the data, to provide a series of landings data with upper and lower bounds or confidence

intervals. All sources of uncertainty can therefore be included, and the reporting of this landings series would highlight the degree of uncertainty in the data. This is applicable to all species reviewed.

Landings data by species in the USVI are not available. This means that species specific landings data are not available. There seems no objective method of separating the landings to individual species.

Recommendation 5. An investigation into the appropriateness of providing species specific data of all major species for USVI is appropriate given the value of these fisheries.

However, in USVI commercial landings reporting has been mandatory well before the electronic logbook data series starts. Under-reporting is not accounted for as there is disagreement as to an appropriate method to calculate expansion factors. This discussion should be revisited, especially if one tries to provide a range of landings values (upper and lower bounds, or confidence intervals).

The unadjusted queen snapper PR recreational catch is about an average of 33,000 pounds per year. These estimates are available since 2000. These values show that the recreational catch is a moderate source of mortality (relative to the commercial fishery) and should be given more consideration in future analyses. Although recreational catch information is not available for USVI, anecdotal information suggests this is small.

Recommendation 6. More emphasis should be placed on the PR queen snapper recreational catch and this source of mortality should be included into total mortality and total landings calculations wherever possible.

Information provided during the Assessment Review workshop summarising the fishery independent survey data for the U.S. Caribbean shows it to be extensive but coverage of the species of interest is low. An earlier series of cruises directed at deepwater species were conducted annually between 1979 and 1985. A much less extensive repeat survey was undertaken in 2009. Bottom longline gear was used in both sets of surveys. The earlier series resulted in queen snapper being the second most common species caught whereas none were caught in 2009. This difference seems most likely to be due to different survey designs in terms of spatial and temporal overlap. Given the cost of independent surveys and the importance of species such as queen snapper, if future surveys were to take place, consideration should be made to match the earlier surveys in terms of location and design. This would allow for direct comparisons with low fishing pressure years. Given the data poor nature of this fishery, this information would be extremely valuable.

Recommendation 7. If future surveys were to take place, consideration should be made to match the earlier surveys in terms of location and temporal design. This would allow for direct comparisons with low fishing pressure years. Given the data poor nature of this fishery, this information would be extremely valuable.

The most valuable data for this fishery are length frequency information. In PR, both recreational and commercial length frequency data are available. However, the Data Workshop found the recreational length frequency data to be insufficient for length frequency analysis. However, it would still be worth comparing the data with that from the commercial fishery. Trip Interview Program (TIP) data for all 3 regions are available. These are collected

by trained port samplers that measure commercially landed fish. The extent of these data is described in Section VI: Addenda and Post-Review Updates. For the queen snapper commercial fishery, the only extensive data set in PR and St. Croix (STX) is from the hook and line fishery – the important gear type for this species. In St. Thomas/St. John length frequency data from the major gear types were not sufficient for analysis. A characteristic of this data set is that the majority of animals caught are mature. The appropriate data sets were subsequently used for analysis and were also well checked for obvious breaches of assumptions such as changes to selectivity over time.

Overall, extensive consideration of the different sources of data was made. Furthermore, the Data and Assessment Workshops cleaned these data appropriately and assessed them for their strengths and weaknesses. **Therefore, the best possible use of these data sets was made.**

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.

Three major classes of analyses were made:

a. catch rate standardisation;
b. equilibrium Beverton and Holt total mortality calculations; and
c. SEINE non-equilibrium total (and relative) mortality changes.

The catch standardisation used a delta lognormal statistical method where presence or absence of queen snapper catch was estimated using a binomial distribution and a lognormal distribution was used for positive catches. With the absence of detailed key information such as gear and navigation changes – likely to be very important in this deepwater fishery – the index of abundance from the standardisation would also include confounding changes in catchability. Support for this is clear when the standardised index of abundance is increasing over time despite the fact that a) the early part of the time series reflect very little prior fishing, and b) landings are increasing over this period.

Multispecies standardisation was undertaken but was not recommended by the SEDAR 26 Assessment Workshop for use until further work has been undertaken. If an appropriate species mix is standardised together, especially in a hierarchical approach, then this approach is more likely to provide better results.

> **Recommendation 8.** Multi-species standardisation for an appropriate mix of species, especially undertaken using hierarchical approaches, could provide the potential breakthrough to make these data usable.

High uncertainty in the von Bertalanffy growth parameters and in the length at which queen snapper are fully selected (e.g. 366 to 546 mm for PR) resulted in the length analyses being undertaken over wide sensitivity tests. For PR, analyses were undertaken on the hook and line fishery only. When one visually investigates this size frequency data set, there are early indications of possible age modes, which should be investigated further at a later stage. A very important characteristic of this data set is the degree of mature animals in the catch, as well as a long tail of very large animals throughout the time series – an influential correct observation used in the summary statements regarding queen snappers in PR. Investigations into changes of selectivity, targeting and depth over time (year or season) were also undertaken. All these were appropriate, except that it is highly unlikely the data would show any sign of targeting changes towards spawning aggregations given the amount of mature animals normally in the data.

The key approach for queen snapper for PR and STX using the SEINE method was appropriate given the limitations in the data. Given the large uncertainty in the input parameters, extensive sensitivity tests were undertaken. This resulted in high uncertainty in the Z estimates. A novel extension of the SEINE method in PR of reflecting a Z ratio (current Z relative to early year Z) resulted in more precise estimates. This ratio removes some of the inherent correlation between total mortality and growth rates (through natural mortality). This comprehensive investigation and development of novel techniques greatly enhanced this information limited analysis.

The PR SEINE analysis, using AIC criterion, supported an increase in Z beginning in 1996. However, many of the Z estimates were very high – from about 0.3 to 2.5 – over the sensitivity tests. As stated above, given that there is less confounding between growth parameters and Z, the ratio Z estimator was less variable, ranging from 0.55 to 0.85 also showing that fishing mortality may have increased over the fishery. However, during the review, it was noted that 3 years of data would be very influential in the PR analyses. These are 1992, 1993 and 1995 that represent very little side data. When the SEINE analyses were undertaken without these points, the previous conclusions were not as strong. Given the preliminary nature of these analyses, further investigation of this issue is required. Despite these issues, the use of the SEINE method and its extensions are endorsed.

> **Recommendation 9.** Further investigation of the queen snapper PR SEINE analyses should be undertaken considering the degree of influence of the three key data points (1992, 1993 and 1995).

Using the SEINE method on STX data, the AIC criterion did not provide support for a change in Z over the period. As for PR, the estimated Z's were high over the sensitivity test, further highlighting that the lack of more certain growth parameters are a major uncertainty and a priority for further data collection.

TOR 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.

No direct estimates of stock abundance and exploitation are available that are robust for stock assessment purposes. Conclusions therefore have to be drawn from a series of analyses and data sets.

During the workshop, the assessment team were asked to provide a summary of conclusions that can be drawn from the different data and methodologies. This was not adequately provided in the Assessment Workshop report. **The summary statements provided (Section VI: Addenda and Post-Review Updates) are an excellent summary of the data and methods used and are supported here.** It is recommended that these be read in full (rather than picking out certain aspects), given that it is a combination of data and analyses that influence the conclusions.

TOR 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.

No direct estimates of management parameters such as Fmsy could be estimated from the data, given the lack of robust growth parameters and the limitations to the data. Data poor methods are used to move towards these parameters, of which the SEINE method and its

modifications have the most promise. Some inference of stock status relative to overfishing was obtained from the SEINE analysis in PR. These analyses showed an increase in Z over the time series of the data. There are large acknowledged uncertainties in these analyses, but the approach itself has merit.

The assessment team was asked during the Review workshop to provide summary statements of queen snapper stock status and inferred management parameters. **The summary that there is "no evidence to suggest that overfishing is occurring on queen snapper in the US Caribbean" is supported and consistent with the conclusions that can be drawn from the data and the various analyses.**

TOR 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).

No projections were possible given the data. This conclusion is supported.

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 the significant sources of uncertainty. Ensure that the implications of uncertainty in technical conclusions are clearly stated.

A very positive characteristic of the analyses and research undertaken both for and during the Data and Assessment Workshops are extensive consideration of the uncertainties in the data, input parameters, robustness of assumptions etc. An exception is that, although uncertainty was extensively considered, the landings data are presented as a single series. Given the uncertainties it would be better to provide these with upper and lower bounds or confidence intervals. The catch rate standardisation also undertook sensitivity tests by deleting lower percentiles of the data.

The key SEINE analysis was undertaken over large ranges of growth and length at first capture parameter values, which is appropriate.

Despite these uncertainties, the conclusions presented in the summary statements (Section VI: Addenda and Post-Review Updates) are likely to be robust.

TOR 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.

The results were reasonably clearly presented in terms of the Terms of Reference. However, it was lacking in consistency between species and regions. Furthermore – and more importantly - it did not include an adequate summary of information (together with which was used or not, and why) or a series of statements from which one could draw a conclusion. This was corrected during the Review Workshop, which was appreciated. **This is an essential aspect of the documents and should be considered as a major document of the SEDAR 26 process. The conclusions drawn in the summary statement make the strongest possible statements that can be drawn given the data limitations and uncertainty.**

Silk snapper

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

The Assessment team provided an Addendum as part of the review process that summarises the data, the strengths and weaknesses of the data, which are (or not) used with reasons for all three species reviewed (Section VI: Addenda and Post-Review Updates). **This is a valuable summary of the information and the decisions described therein are supported.** As for the other species, the SEDAR 26 Data Workshop undertook a thorough review of all the available data (as well as their associated issues) on silk snapper. These data included meta-analysis of life history information (see Section VI: Addenda and Post-Review Updates), fisheries dependent information such as recreational and commercial data, fisheries independent data such as surveys, and information for the standardisation of catch rates e.g. landing depth, location. The SEDAR 26 Assessment Workshop adhered to the recommendations from the Data Workshop, as is appropriate.

Literature reviews and meta-analysis of population dynamic information, especially growth and mortality parameters, were undertaken. This was extensive and showed that using parameters from similar regions may not be appropriate (as stated) and this lack of local information is a large source of uncertainty.

Commercial landings data are available in electronic form from 1983 to 2009 for silk snappers by species in PR, whereas in USVI landings data are only available from 1998 by species group. PR landings data are expanded as per queen snapper and were developed in SEDAR 14 using the ratio of active to licenced fishers (1970-2002) and the ratio of landed pounds observed versus the landed pounds reports thereafter. As per queen snapper, only a single landings series is provided, which does not represent the true uncertainty in this series and it is therefore recommended (as above) to provide a landing series that includes all form of uncertainty and mortality. As per queen snapper, it is recommended that obtaining species specific data should be investigated for USVI.

Recreational data are available for silk snappers in PR (but not in USVI). Estimated silk snapper recreational landings are about, on average, 96,000 pounds per year. This is a significant source of mortality and further emphasis should be placed on this fishery.

> **Recommendation 10.** Given the size of the recreational catch in PR and other regions, more emphasis should be placed on this fishery and collecting appropriate levels of data for use in analyses such as the SEINE method i.e. size frequency data.

There was little information on the level of discards in both the commercial and recreational catches for any of the species including silk snapper. Closed seasons and the expected introduction of a minimum legal size limit during certain years may have caused some discarding.

> **Recommendation 11.** The issue of discarding as a source of mortality should be further investigated.

Information provided during the Assessment Review workshop summarising the fishery independent survey data for the U.S. Caribbean shows it to be extensive but coverage of the species of interest is low. Some of the data are also not available and may be useful for silk snapper.

Recommendation 12. Further investigation into the use of the independent survey data for silk snapper should be investigated given the higher likelihood of survey overlap with this species compared with queen snapper – a more deepwater fishery.

An earlier series of cruises directed at deep water species were conducted annually between 1979 and 1985. A much less extensive repeat survey was undertaken in 2009. Bottom longline gear was used in both sets of surveys. Given the small extent of the latter survey, there was little value in comparing the two data series. This is a lost opportunity and, as for queen snapper, it is recommended that future surveys be designed to link to the earlier surveys for assessment purposes.

Commercial length frequency data from the TIP are available for the silk snapper hook and line (PR and STX) and the pots/traps fisheries (PR) at a level useful for size frequency analysis. Sample sizes were too small for the other fisheries and regions. Recreational length frequency data are only available for PR but this is insufficient for length frequency analysis.

Recommendation 13. Given the importance of the size frequency analysis, this data set should be expanded to include more regions and the recreational fishery – the latter especially for silk snappers.

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.

As per queen snapper, the analysis can be divided into three sections – a) catch rate standardisation, b) equilibrium Beverton and Holt Z calculation and c) the SEINE non equilibrium (as implied in the name) Z estimator.

The catch standardisation used a delta lognormal statistical method where presence or absence of silk snapper catch was estimated using a binomial distribution and a lognormal distribution was used for positive catches using the handline and fish pots data in PR. No catch rate series of values was available for any of the other regions and gear types. **This decision is supported.**

The Assessment Workshop did not recommend the use of the standardised catch rates for use in stock assessment, as this series was not an index of abundance. Reasons provided were that there were changes in targeting (including to queen snapper) over the time period and, in the case of fish pots, the small proportion of landings by this gear. **This view is appropriate.** As for queen snapper, the multispecies standardisation has merit and should be further investigated (see above recommendations). However, the single species approach for silk snapper could be further advanced if the ratio of the catch to other key (relevant) species is included in the analyses. This has been shown to be a valuable inclusion in other ground fisheries.

Recommendation 14. The single species approach for silk snapper could be further advanced if the ratio of the catch to other key (relevant) species is included in the analyses. This has been shown to be a valuable inclusion in other ground fisheries.

There is also high uncertainty in the von Bertalanffy growth parameters for silk snapper. Linf ranged from 600 mm to 1170 mm, with the length type often not reported. Although this might not reduce the uncertainty, it may be possible to approach the authors of the papers/reports to clarify the length type. Sensitivity tests for the length frequency analyses

were therefore taken over a range of K, Linf and length at first capture values. The data on silk snapper used for length analyses were from the hook and line (PR, STX) and pots/trap data (PR fisheries). There were not sufficient length data for the remaining gear and region combinations

A very important characteristic of this data set is the degree of mature animals as well as a long tail of very large animals throughout the time series – an influential correct observation used in the summary statements regarding silk snappers in PR. Investigations of changes of selectivity, targeting and depth over time (year or season) were undertaken. All these were appropriate except that it is highly unlikely the data would show any sign of targeting changes towards spawning aggregations given the amount of mature animals normally in the data. The length frequency data seems to have changed little from 1983 to 2002. The change thereafter to larger animals on average may have been due to the minimum size regulation. This increasing proportion, as stated in the summary of Section VI: Addenda and Post-Review Updates, suggests that exploitation may have declined, which was also supported "by an observed decline in recreational fishing effort and the reported shift in targeting from silk snapper to queen snapper in the commercial line fishery" (Section VI: Addenda and Post-Review Updates).

Spatio-temporal analyses are hampered by biases in the data due to, for example, the sampling design. Given the importance of these size data, developing a practical collection design and then maintaining that design protocol is important for future work.

Recommendation 15. Given the importance of the size data for all three species, developing a practical collection design and then maintaining that design protocol is important for future work.

As for queen snapper, the key approach for silk snapper for PR and STX using the SEINE method was appropriate given the limitations in the data. Given the large uncertainty in the input parameters, extensive sensitivity tests were undertaken. This resulted in high uncertainty in the absolute Z estimates. As per the panel report, further investment in the SEINE is required.

Recommendation 16. Although several simulation studies have been undertaken using the SEINE analyses, these did not include testing through analysing a population of known parameter values, recruitment and size frequency, with different sources of uncertainty and biases. This would highlight the strength and weaknesses of the method. Given its value for data poor fisheries that rely on size frequency data, this investment would be useful.

Recommendation 17. Furthermore, the SEINE method should be extended to apply a Bayesian hierarchical model that draws information from species with more information (Punt et al., 2011, although this method is not Bayesian). This method would integrate across all the different forms of uncertainty and also allow more data rich species' information to be drawn from for the data poor species. Punt *et al*. (2011) demonstrate different common assumptions that can be drawn from this method.

TOR 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.

No direct estimates of stock abundance and exploitation are available that are robust for stock assessment purposes. Conclusions therefore have to be drawn from a series of analyses and data sets.

During the workshop, the assessment team was asked to provide a summary of conclusions that can be drawn from the different data and methodologies. This was not adequately provided in the Assessment Workshop report. **The summary statements provided (Section VI: Addenda and Post-Review Updates) are an excellent summary of the data and methods used and are supported here.**

TOR 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.

No direct estimates of management parameters such as Fmsy could be estimated from the data, given the lack of robust growth parameters and the limitations to the data. Data poor methods are used to move towards estimating these parameters of which the SEINE method and its modifications have the most promise. There are large acknowledged uncertainties in these analyses, but the approach itself has merit.

The assessment team was asked during the Review workshop to provide summary statements of queen snapper stock status and inferred management parameters. **The summary that "silk snapper in Puerto Rico is not currently subject to overfishing" whereas the "limited number of length samples in recent years and lack of species-specific landings data does not allow for conclusions to be made regarding changes in mortality, the current mortality rate, or stock status for silk snapper in St. Croix and St. Thomas/St. John" is supported and consistent with the conclusions that can be drawn from the data and the various analyses.** This statement for PR is due to the presence of larger animals in the length frequency samples over time, the observed decline in recreational fishing effort and the reported shift in commercial targeting towards queen snapper away from silk snapper.

TOR 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).

No projections were undertaken given the data poor nature of the silk snapper fisheries.

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 the significant sources of uncertainty. Ensure that the implications of uncertainty in technical conclusions are clearly stated.

As for queen snapper, a very positive characteristic of the analyses and research undertaken both for and during the Data and Assessment Workshops are extensive consideration of the uncertainties in the data, input parameters, robustness of assumptions etc. An exception is

that, although uncertainty was extensively considered, the landings data are presented as a single series. Given the uncertainties it would be better to provide these with upper and lower bounds or confidence intervals.

The catch rate standardisation for PR used different subsets of the data. The key SEINE analysis was undertaken over large ranges of growth and length at first capture parameter values, which is appropriate. The implications of these uncertainties were well explained in the report.

As per queen snapper, the combinations of sensitivity tests in the SEINE analysis may have been too extensive. When the likelihood surface of a few species was investigated during the Review Workshop, this showed that a large area of the likelihood is relatively flat and not well sampled, whereas other regions are sampled that are clearly well away from the "best" results. It is recommended that the likelihood surface be used to better define the sampling regions for the sensitivity tests.

Recommendation 18. It is recommended that the likelihood surface be used to better define the sampling regions for the sensitivity tests of the SEINE analyses.

Despite these uncertainties, the conclusions presented in the summary statements (Section VI: Addenda and Post-Review Updates) are likely to be robust.

TOR 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.

The results were reasonably clearly presented in terms of the Terms of Reference. The Assessment Report was lacking in consistency between species and regions. Furthermore - and more importantly - it did not include an adequate summary of information (together with which was used or not, and why) or a series of statements from which one could draw a conclusion. This was particularly lacking in the silk snapper and parrotfish reports. This was corrected during the Review Workshop, which was appreciated. **This is an essential aspect of the documents and should be considered as a major document to the SEDAR 26 process. The conclusions drawn in the summary statement make the strongest possible statements that can be drawn given the data limitations and uncertainty.**

Redtail parrotfish

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

The difference between redtail parrotfish and the silk and snapper species is that the data are not species specific in any region including PR. This seriously curtailed the type of analyses that could be undertaken for this species. Analyses therefore concentrated on parrotfishes as a group. Unlike for queen and silk snapper, the commercial landings data were used in the Summary Statement (Section VI: Addenda and Post-Review Updates) for qualitative interpretation of parrotfish overfishing status. Recreational landings and discard information was available for redtail parrotfish in PR, but not for USVI.

As for the two snapper species reviewed, information provided during the Assessment Review workshop summarising the fishery independent survey data for the U.S. Caribbean was provided. However, these showed that the surveys applicable to yellowtail parrotfish are

limited in spatial and temporal extent, and limited sample size. Many of the datasets were unavailable for the Assessment Workshop. This conclusion is supported.

Both commercial and recreational length frequency data are available for redtail parrotfish, however the recreational data were not sufficient for analysis. Commercial TIP data used in subsequent analyses were only available for the nets (PR, USVI regions), pots/traps (PR, STX) and diver (STX) fisheries. The sample sizes for other region/gear combinations were too small.

There was some discussion during the Review Workshop whether some of these redtail parrotfish may have been miss-identified and were really yellowtail parrotfish – the latter has several morphs as it ages, some of which look similar to redtail parrotfish. This issue was not resolved and can only be investigated in future data collections.

Recommendation 19. It is recommended that the identification of redtail parrotfish in the TIP and recreational data are correct.

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.

Analyses of retail parrotfish were restricted due to lack of species-specific data. As for the queen and silk snapper species, the analyses were in roughly three components: a) catch rate standardisation; b) Beverton and Holt equilibrium Z estimation: and c) SEINE non-equilibrium Z estimation. The latter method was again emphasised given that the equilibrium assumption was not appropriate.

Unlike the two snapper species, catch rate standardisation was by gear type. For snappers gear type was included as a factor in the standardisation. It is recommended that the standardisation also be undertaken with gear type, combined as a factor, included even though this may require reformulation of the equations to account for different units. This type of standardisation is more appropriate given one is attempting to obtain an overall index of abundance in the region. There is nothing that indicates that these gear types are fishing different distinct stocks.

Recommendation 20. It is recommended that the standardisation also be undertaken with gear type combined as a factor even though this may require reformulation of the equations to account for different units. This type of standardisation is more appropriate given one is attempting to obtain an overall index of abundance in the region. There is nothing that indicates that these gear types are fishing different distinct stocks.

The extensive sensitivity tests for the redtail parrotfish SEINE analysis for this species showed very large sensitivity to input parameters, especially the ratio of length at first capture with Linf in some regions. For parrotfish, a large number of the simulations did not converge, which further shows that several parameter combinations are chosen in the sensitivity tests that are inappropriate or sample far from the maximum of the likelihood.

TOR 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.

No direct estimates of stock abundance and exploitation are available that are robust for stock assessment purposes. Conclusions therefore have to be drawn from a series of analyses and data sets.

During the workshop, the assessment team were asked to provide a summary of conclusions that can be drawn from the different data and methodologies. This was not adequately provided in the Assessment Workshop report. **The summary statements provided (Section VI: Addenda and Post-Review Updates) are an excellent summary of the data and methods used and are supported here.**

TOR 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.

No direct estimates of management parameters such as Fmsy could be estimated from the data, given the lack of robust growth parameters and the limitations to the data. Data poor methods are used to move towards estimating these parameters of which the SEINE method and its modifications have the most promise. There are large acknowledged uncertainties in these analyses, but the approach itself has merit.

The assessment team was asked during the Review workshop to provide summary statements of queen snapper stock status and inferred management parameters. **The summary that "given the available information for all three islands there is no evidence to suggest that overfishing is occurring on redtail parrotfish in the US Caribbean" is supported and consistent with the conclusions that can be drawn from the data and the various analyses.**

TOR 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).

No projections were undertaken given the data poor nature of the silk snapper fisheries.

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 the significant sources of uncertainty. Ensure that the implications of uncertainty in technical conclusions are clearly stated.

As for queen and silk snapper, a very positive characteristic of the analyses and research undertaken both for and during the Data and Assessment Workshops are extensive consideration of the uncertainties in the data, input parameters, robustness of assumptions etc. An exception is that, although uncertainty was extensively considered, the landings data are presented as a single series. However, given these data are for parrotfish as a group, it is less clear how one would fully define uncertainty in this context.

The catch rate standardisation for PR used different subsets of the data. The key SEINE analysis was undertaken over large ranges of growth and length at first capture parameter values, which is appropriate. The implications of these uncertainties were well explained in the report.

As per queen and silk snapper, the combinations of sensitivity tests in the SEINE analysis may have been too extensive as shown by the non-convergence of certain parameter combinations.

Despite these uncertainties, the conclusions presented in the summary statements (Section VI: Addenda and Post-Review Updates) are likely to be robust.

TOR 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.

The Assessment results were reasonably clearly presented in terms of the Terms of Reference. The Assessment Report was lacking in consistency between species and regions. Furthermore, and more importantly, it did not include an adequate summary of information (together with which was used or not, and why) or a series of statements from which one could draw a conclusion. This was particularly lacking in the parrotfish reports. This was corrected during the Review Workshop, which was appreciated. **This is an essential aspect of the documents and should be considered as a major document to the SEDAR 26 process. The conclusions drawn in the summary statement make the strongest possible statements that can be drawn given the data limitations and uncertainty.**

Terms of References 8 to 10

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.

Fundamental questions that were posed during the workshop were: a) why these three species were chosen; and b) why a single species approach was undertaken. The assessment team provided an analysis table that showed a review of the data and this was obviously influential to the choice of which species to first review. However, it is well worth returning to these questions, given the data poor nature of the fishery. The following statement written in the panel report is supported:

"The panel recommends that the annual process of attempting to develop data poor assessments for all the major target species should be reviewed. In the panel's opinion, it would be more appropriate to investigate a more strategic approach to progress management of these fisheries without necessarily applying these techniques to all the species. This is especially the case, as the three species reviewed here were some of the best species in terms of data within the region. Therefore subsequent species (except lobster and trochus) are more likely to be even more uncertain. Possible methods would be to use a mixture of risk assessment techniques and clustering species together in a logical manner, for example through being exposed to similar fishing mortality pressure trends. Another approach would be to select key species based on importance to the different fisheries and the ecosystem that is likely to be the first to reflect when there are management issues."

As the panel report states, there are several strategic approaches that can be investigated. The first is to choose specific species based on their representativeness or characteristics such as a) commercial importance, b) recreational importance, c) importance in the ecosystem (top predator, major food source), d) level of risk to extinction, e) species that will highlight overfishing issues before any other etc. This still takes a single species approach but picks key species on which data collection and assessment research is focused. A second option, is to undertake a single species approach but to assess these as a mixture in a single assessment (see Punt *et al*. 2011) assuming common underlying parameters, e.g., similar relative fishing mortality trends over time, similar recruitment deviations etc. This means one can draw from the data rich(er) species to the more data poor species. A third approach is to cluster species into logical groups and assess these together. Although assessment approaches tend to prefer single species approaches, there is a growing list of data poor methods that work with groups of species.

TOR 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.

The section below (Recommendations and future work) addresses research priorities of this reviewer. These are drawn from the SEDAR 26 review process itself, as well as research recommendations for future research provided in the SEDAR Data and Assessment Workshops reports, as well as key documents provided for the review (including SEDAR Procedures Workshop 3 (2009)). However, these research recommendations were not prioritised and placed into a global list - something attempted in the section below. Despite the fact that the review was by species, most of the recommendations below are of a general nature that are common to all these species.

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

The panel report was provided to the chair for editing.

Conclusions

The following conclusions can be drawn from the review:

a. The literature review and meta-analyses to obtain population dynamic parameters were extensive and appropriate, but showed that specific US Caribbean information is needed.
b. The available data was mined as much as possible for information, and the strengths and weaknesses of the data are well understood. Where possible corrective action was taken.
c. The use of data poor methods is appropriate given the information poor nature of the fisheries.
d. The analyses were correctly undertaken with extensive investigation of uncertainty through sensitivity analyses.
e. It is an appropriate conclusion that the catch standardisation did not produce indices of abundances for the species.
f. Emphasis on the size frequency data is appropriate.
g. The SEINE method and modification thereof are a novel approach to analyse size frequency data so as to estimate total mortality, and in some cases, F ratio estimations.
h. A key output of the Review were summary statements by species as Addenda to SEDAR 26 Review Workshop, which provide the most concise statements of data used, their strengths and weaknesses and whether overfishing is likely to occur. These Addenda are a key output of the Report and supported.

Future work beyond recommendations

See ToR 8.

Recommendations and future work

Panel recommendations

It is appropriate to add the panel recommendations as these overlap extensively with those in this report. These are (with recommendation numbers from this review where specific *additional* comments are made are inserted):

Major priorities

1. "There is large degree of uncertainty in the assessment due to the data poor nature of this fishery. In the short to medium terms, the key data set is likely to remain size frequency distributions. The ability to utilize length-frequency data is contingent upon having reliable estimates of life history parameters (von Bertalanffy parameters in particular), therefore the highest priority for future research are:

    a. Studies on basic life history (e.g. age-growth relationships and estimating natural mortality) are essential in the US Caribbean and will greatly enhance the utility of the existing length-frequency data. This information should provide the greatest benefit to providing management advice in the short term. This should be placed as a top priority for key species. [Recommendation 2]

    b. At present, the TIP size frequency data provides the only source of information on stock status and benchmarks and it is therefore essential that this program be at least continued. However, expansion (for example, to USVI) and improvement of the TIP program will be recommended for continued collection of species-specific size information. [Recommendation 13, Recommendation 15]

    c. Focus should be on developing more complete and accurate data sets into the future, particularly on trip based catch and effort and recording of more geographical data on catch location.

    d. The recreational catch and effort is an important data set and should be continued. Expanding this system to the USVI may also be useful. Furthermore, this source of mortality should be included in the analyses. [Recommendation 6, Recommendation 10]

    e. Emphasis should be placed on extension, as compliance and unreporting is likely to increase when more data are required of fishers. Given the present low rate of reporting in PR, this would be of great concern. [Recommendation 3]

    f. Validation of fisher reported catch, landings and trip effort should be undertaken. [Recommendation 3]

    g. The collection of landings statistics in the USVI should be species-specific because analysis of the current species-groupings is not informative for stock assessments, unless future assessments and management action focus on logical clusters of species. [Recommendation 5]

    h. Characterization of multi- species trips to allow identification of trips that split fishing effort across different gears and species groups. This work should be coordinated with fisher groups to enhance buy-in by the industry.

    i. It is important to encourage fishermen to submit all the monthly catch reports, to submit reports for months when they do not fish, and to complete all the fields in the reports, since critical information such as effort, gear, and location fished are often missing or incomplete.

2. All sources of mortality should be considered in the analyses especially for the recreational fishery catch in Puerto Rico for silk and queen snapper. [Recommendation 4, Recommendation 6, Recommendation 10, Recommendation 11]

3. Given the importance of the SEINE method and that extensions of this method are likely to be used into the near future, the following additional modification are required:

    a. When the full likelihood surface for the SEINE analyses were shown in session, it was clear that unnecessary combinations are sampled and that the surface is reasonably flat near the optimal

likelihood, which means more sampling needs to be undertaken within this range. [Recommendation 18]

b. The SEINE method should be extended to apply a Bayesian hierarchical model that draws on species with more information (Punt *et al*., 2011, although this method is not Bayesian). This method would integrate across all the different forms of uncertainty and also allow more data rich species' information to be drawn from for the data poor species. [Recommendation 17]

c. The SEINE method should be extended to include the estimate of M for those species where this information is available. This directly acknowledged the correlation between growth, maximum length and natural mortality.

d. The SEINE method should be tested in a simulation study using a simulated population with known parameters, recruitment, and size frequency and including variability in key parameters. Furthermore, these results should then be converted to a guideline on how to apply this information in a data poor situation. [Recommendation 16]

e. Some preliminary analyses were undertaken during the Review that should be further investigated. [Recommendation 9]

Medium priority

1. For all landings series, a more appropriate method would be to present median estimates of landings with confidence intervals for all regions. All sources of uncertainty should be included in this analysis. [Recommendation 4]
2. The CPUE standardisation methods needs much more extensive investigation, including:

    a. The feasibility of including additional factors or variables either as offsets or ratios of catch to relevant species total catch should be undertaken in the future. An overall redtailed parrotfish index from the catch rate standardisation should be developed in the future. [Recommendation 14,

    b. Developing an overall redtailed parrotfish index from the catch rate standardisation in the future [Recommendation 20]

3. Given the uncertainty in the data, any future FIS should be designed in such a way as to be aligned with the earlier surveys. This would be extremely useful for comparison. [Recommendation 7, Recommendation 12]

Lower priority

1. There is some question whether changing the commercial catch expansion method during the series produces biases. Therefore, the effect of the two different methods over the time series to develop the expansion factors should be tested.
2. There is a need to develop sampling efforts to better identify and quantify discards in the commercial fisheries." [Recommendation 11]

Additional recommendations:

- Recommendation 1 – High priority,
- Recommendation 8 – Medium priority
- Recommendation 9 - High, and
- Recommendation 19 - Medium,

List of recommendations from this report

In order to link the recommendations with the text, these are provided as a numbered list drawn from the above report.

References

Gedamke, T. and J.M. Hoenig. 2006. Estimating mortality from mean length data in nonequilibrium situations, with application to the assessment of goosefish. Transactions of the American Fisheries Society, 135: 476-487.

Punt, A. E., Smith, D. C., and Smith, A. D. M. 2011. Among-stock comparisons for improving stock assessments of data-poor stocks: the "Robin Hood" approach. ICES Journal of Marine Science, 68: 972–981.

Appendix 1 Bibliography of materials provided for review

SEDAR 26

Caribbean Silk Snapper, Queen Snapper, and Redtail Parrotfish

Workshop Document List

Document #	Title	Authors	Working Group
Documents Prepared for the Data Workshop			
SEDAR26-DW-01	A review of the life history characteristics of silk snapper, queen snapper, and redtail parrotfish	Bryan, M.D., M. del Mar Lopez, and B. Tokotch	Life History
SEDAR26-DW-02	Summarized information on recreational catches of silk and queen snapper and parrotfish in Puerto Rico since 2000	Cummings, N.J. and V. Matter	PR Catch Statistics
SEDAR26-DW-03	Updated landings information for the commercial fisheries in Puerto Rico with emphasis on silk and queen snapper and parrotfish fisheries	Cummings, N.J. and Daniel Matos-Caraballo	PR Catch Statistics
SEDAR26-DW-04	Preliminary Evaluation of available length-frequency information in the US Caribbean Trip Interview Program (TIP) data	Matthew Campbell, Todd Gedamke, Walter Ingram	
SEDAR26-DW-05	Updated catch per unit abundance indices for silk and queen snapper from the commercial fisheries in Puerto Rico	Cummings, N.J.	Indices
SEDAR26-DW-06	Not Received		
SEDAR26-DW-07	Delta-lognormal and multinomial approaches to index development for parrotfish, silk snapper, and queen snapper from Puerto Rican Trip Tickets	G. Walter Ingram, Jr.	Indices
SEDAR26-DW-08	Reported commercial landings of parrotfish, snappers, groupers, and unclassified finfish in the United States Virgin Islands, 1974-2008	McCarthy, K.J.	USVI Catch Statistics

SEDAR26-DW-09	Standardized catch rates of parrotfish from commercial fish traps, SCUBA, and gillnets in the US Virgin Islands, 1998-2008	McCarthy, K.J.	Indices
SEDAR26-DW-10	Summary of Fishery Independent Data from Puerto Rico and the U.S. Virgin Islands	Adam G. Pollack and G. Walter Ingram, Jr.	Indices
Documents Prepared for the Review Workshop			
SEDAR26-RW-01			
SEDAR26-RW-02			
Final Stock Assessment Reports			
SEDAR26-SAR1	Silk snapper		
SEDAR26-SAR2	Queen snapper		

Appendix 2 Copy of the CIE Statement of Work

Attachment A: Statement of Work for Dr. Catherine Dichmont (CSIRO)

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:

William Michaels, Program Manager, COTR

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Key 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 Panel Membership

Chair	Walter Keithly
Members	Cathy Dichmont
	Panayiota Apostolaki
	Reni Garcia
	Vivian Haist