

Consensus Summary Report

Caribbean yellowtail snapper (*Ocyurus chrysurus*)

Caribbean spiny lobster (*Panulirus argus*)

South Atlantic – Gulf of Mexico spiny lobster (*Panulirus argus*)

Prepared by the SEDAR 8 Review Panel for:

Caribbean Fishery Management Council

Gulf of Mexico Fishery Management Council

South Atlantic Fishery Management Council

Edited by Andrew I. L. Payne for

SEDAR 8, 16-20 May 2005

San Juan, Puerto Rico

Executive summary

The SEDAR 8 Review Workshop met in San Juan, Puerto Rico, from 16 to 20 May 2005. The Panel itself comprised the Chair and a reviewer appointed by the CIE, four US technical experts, the SEDAR facilitator, and two stakeholder representatives. All documentation, including background documentation provided to earlier Data and Assessment Workshops, was provided to the Panel in good time for prior review, and was comprehensive for the job in hand.

The meeting considered three stocks, Caribbean yellowtail snapper, Caribbean spiny lobster, and South Atlantic – Gulf of Mexico spiny lobster. Able presenters had been assigned by the Assessment Workshops and went to great trouble to explain the background behind and the output from the assessments. For only one of these stocks, South Atlantic – Gulf of Mexico spiny lobster, were extensive additional runs requested during the meeting. Discussions for all three stocks focused on the assessments and what they meant in terms of the Review Workshop's Terms of Reference, the documentation of relevant comments about them, derivation of suggestions for future research and monitoring, and canvassing of stakeholder opinion. Finally, some time was spent evaluating the SEDAR assessment process in full, as requested.

For Caribbean yellowtail snapper, the data were deemed insufficient to provide a signal to underpin management advice, though the assessment methodology itself was sound. The importance of well-designed, systematic, long-term targeted research programs needed to construct adequate time-series of catch and abundance indices was stressed. Currently, it seems that data quality control independent of the data collection process has not been effectively realized, and validation of historical and future collections is urgently needed. Partnerships with fishermen are clearly one way to achieve this, and the need to look at the stock as part of a species assemblage or community was noted. Of the many research suggestions made, highest priority was assigned to the carrying out of fishery-independent surveys, the collection of more catch data, including specifically the recreational fishery, and the collection of age and length data from commercial and recreational catches and from fishery-independent surveys.

For Caribbean spiny lobster, the data were also deemed currently insufficient to provide the required management advice, though again the methodology applied was sound. The Panel noted that the data series could seemingly be split into two components, before and after about 1992, and focused much discussion on why this might be and how best to model it in future. Additional factors and modifications to the modelling approach were proposed for consideration in an attempt to understand better the dynamics of the population, and high priority was suggested be assigned to the creation of a standardized recruitment index. Other priority research and monitoring included incorporating historical data into existing data sets, and utilizing refined models (better to identify viable hypotheses). Partnerships with fishermen were again proposed to facilitate the data collection process.

In respect of South Atlantic – Gulf of Mexico spiny lobster, the data and assessments were accepted, as was the base-case ICA model of stock dynamics. Several further runs were requested and provided, but overall the base-case results were considered the best and not likely to be unreliable. Some time was spent discussing relative stock status with respect to overfished levels and the importance of this stock in terms of the whole population in the Western Atlantic. The various stocks likely primed each other with larvae and recruits. There was also strong support to re-establish an observer program for the commercial trap fishery. Other research priorities should include a broadening of the fishery-independent indices of abundance, the provision of improved growth information, perhaps through tagging, and

modelling of various scenarios covering a range of hypotheses concerning recruitment and changes in gear selectivity, as well as suitable performance indicators.

Comments on the SEDAR assessment process stressed: the need for better communication with and dissemination of information to stakeholders; the need for an advanced plan for assessments and a comprehensive glossary of terms; the continuity of personnel throughout each workshop process, in terms of stakeholders perhaps finding new ways of ensuring their participation; incorporation of fishermen's knowledge into the assessment process better; the need to maximize the time for preparing data series; the importance of independence in the review process, though not solely through CIE-contracted reviewers; and the importance of providing for the Review Panel an executive summary for substantive documents, a succinct table of model parameters, and if appropriate a table of management options.

1. Introduction

1.1 Time and Place

The SEDAR 8 Review Workshop met in San Juan, Puerto Rico, from 16 to 20 May 2005.

1.2 Terms of Reference for the Review Workshop

1. Evaluate whether data used in the analyses are treated appropriately and are adequate for assessing the stocks; state whether or not the input data are scientifically sound.
2. Evaluate the adequacy, appropriateness, and application of the methods used to assess the populations; state whether or not the methods are scientifically sound.
3. Recommend appropriate or best-estimated values of population parameters such as abundance, biomass, and exploitation.
4. Evaluate the adequacy, appropriateness, and application of the methods used to estimate stock status criteria (population benchmarks such as MSY , F_{msy} , B_{msy} , $MSST$, $MFMT$). State whether or not the methods are scientifically sound.
5. Recommend appropriate values for stock status criteria.
6. Evaluate the adequacy, appropriateness, and application of the methods used to project future population status and, if appropriate, evaluate stock rebuilding; state whether or not the methods are scientifically sound.
7. Recommend probable values for future population condition and status.
8. Ensure that all desired and necessary assessment results (*as listed in the SEDAR Stock Assessment Report Outline*) are clearly and accurately presented in the Stock Assessment Report and that such results are consistent with the Review Panel's consensus regarding adequacy, appropriateness, and application of the data and methods.
9. Evaluate the Data and Assessment Workshops with regard to fulfilling their respective Terms of Reference and state whether or not the Terms of Reference for previous workshops are adequately addressed in the Data Workshop and Stock Assessment Report sections;
10. Develop recommendations for future research for improving data collection and stock assessment.
11. Prepare a Consensus Report summarizing the peer review Panel's evaluation of the reviewed stock assessments and addressing these Terms of Reference. (Drafted during the Review Workshop with a final report due two weeks after the workshop ends.)

1.3 List of Participants

<u>Participants</u>	<u>Affiliation</u>
<i>Review Panel:</i>	
Andrew Payne	CIE, Chair
Paul Medley	CIE, Reviewer
Richard Appeldoorn	University of Puerto Rico
James Berkson	NOAA Fisheries/RTR Unit
Edward Schuster	St Croix Fisheries Advisory Cttee
Simon Stafford	GMFMC Advisory Panel
Ian Stewart	NOAA Fisheries/NWFSC
Doug Vaughan	NOAA Fisheries/SEFSC
<i>Presenters:</i>	
Liz Brooks	NOAA Fisheries/SEFSC
Nancie Cummings	NOAA Fisheries/SEFSC
David Die	University of Miami, RSMAS
John Hunt	Florida FWC
Robert Muller	Florida FWC
Mike Murphy	Florida FWC
Josh Sladek Nowlis	NOAA Fisheries/SEFSC
Francisco Pagan	University of Puerto Rico
Jerry Scott	NOAA Fisheries/SEFSC
Monica Valle	University of Miami, RSMAS
<i>Observers:</i>	
Mark Drew	Nature Conservancy, St Croix
Michon Fabio	CFMC Advisory Panel
Tony Iarocci	SAFMC
Joe Kimmel	NOAA Fisheries SERO
Barbara Kojis	US Virgin Islands DFW
Jimmy Magner	St Thomas Fishermen's Assn
Eugenio Pinero	CFMC
Julian Magras	St Thomas Fishermen's Assn
John Merriner	NOAA Fisheries SEFSC
Miguel Rolon	CFMC
Roger Uwate	US Virgin Islands DFW
Roy Williams	GMFMC
<i>Staff support:</i>	
John Carmichael	SEDAR
Cynthia Morant	SAFMC
Lloyd Darby	SEFSC
Graciela Garcia-Moliner	CFMC

1.4 Review Workshop working papers

An impressive quantity of documentation was provided before the meeting by the facilitator. Much of this pertained to material provided to either the Data Workshop or Assessment Workshop for each of the three review species. However, specific material for the review workshop itself was also provided, and this is listed below.

NUMBER	TITLE	Author
Working Papers		
SEDAR8-RW1	Further explorations of a stock production model incorporating covariates (ASPIC) for yellowtail snapper (<i>Ocyurus chrysurus</i>) in the US Caribbean	J. Sladek Nowlis
SEDAR8-RW2	Length frequency analysis of Caribbean spiny lobster (<i>Panulirus argus</i>) sampled by the Puerto Rico commercial Trip Interview Program (1980-2003)	S.D. Chormanski, D. Die, S. Saul
SEDAR8-RW3	Maturity of spiny lobsters in the US Caribbean	D. Die
Supplementary Documents		
SEDAR8-RD24	Preliminary estimations of growth, mortality and yield per recruit for the spiny lobster <i>Panulirus argus</i> in St. Croix, USVI. <i>Proc. Gulf Carib. Fish. Inst.</i> 53: 59-75	I. Mateo, W.J. Tobias
SEDAR8-RD25	Population dynamics for spiny lobster <i>Panulirus argus</i> in Puerto Rico: Progress report. <i>Proc. Gulf Carib. Fish. Inst.</i> 55: 506-520	I. Mateo
Assessment Reports		
SEDAR8-SAR1	Stock assessment report for Caribbean yellowtail snapper	J. Sladek Nowlis
SEDAR8-SAR2	Stock assessment report for Caribbean spiny lobster	J. Sladek Nowlis
SEDAR8-SAR3	Stock assessment report for South Atlantic – Gulf of Mexico spiny lobster	R. Muller, J. Hunt

2. Terms of Reference

2.1 Background

Generally, the Review Workshop is the third meeting in the SEDAR process, and this situation pertained to all three stocks reviewed during SEDAR 8. The Panel was pleased to be able to record that the terms of reference set for Data Workshops and Assessment Workshops for the three stocks were fully met, but there was some concern expressed that pressure may have been brought to bear on participants at some of those workshops to progress management further than was possible from the available data. Quite simply, data time-series, and in some cases recent basic biological data, were likely unable to support the development of meaningful assessments for the stocks just yet.

Notwithstanding, the Panel was impressed by the quantity and quality of the work that had gone into the various assessments. The presentations were well structured and clear, and the information provided through the presentations, and in response to questions, gave an excellent basis for the Panel's subsequent deliberations and conclusions.

2.2 Review of the Panel's deliberations

The deliberations on each species are presented in the form of responses to the terms of reference questions specifically, followed by relevant comments on the discussions, suggestions for future research, and stakeholder opinion, the last two not specifically in order of priority.

A. *Caribbean yellowtail snapper*

Terms of reference

1. Evaluate whether data used in the analyses are treated appropriately and are adequate for assessing the stocks; state whether or not the input data are scientifically sound.

The data were treated appropriately, but were not adequate yet for assessing the stocks.

2. Evaluate the adequacy, appropriateness, and application of the methods used to assess the populations; state whether or not the methods are scientifically sound.

The two methods were appropriate for exploring the potential for an assessment, but ultimately merely showed the inadequacy of the data. Nonetheless, the methods are scientifically sound, if given appropriate data.

3. Recommend appropriate or best-estimated values of population parameters such as abundance, biomass, and exploitation.

An acceptable assessment had not been developed, so appropriate population parameters were not produced.

4. Evaluate the adequacy, appropriateness, and application of the methods used to estimate stock status criteria (population benchmarks such as MSY, F_{msy} , B_{msy} , MSST, MFMT). State whether or not the methods are scientifically sound.

An acceptable assessment had not been developed, so estimates of stock status criteria were not produced.

5. Recommend appropriate values for stock status criteria.

An acceptable assessment had not been developed, so appropriate stock status criteria were not produced. Although a number of key reference points were provided (B_{msy}/B_0 , SPR_{msy} , F_{msy} – given selectivity vector) and seem to be robust across the various models, they do not provide information on current stock status.

6. Evaluate the adequacy, appropriateness, and application of the methods used to project future population status and, if appropriate, evaluate stock rebuilding; state whether or not the methods are scientifically sound.

No population projections were possible.

7. Recommend probable values for future population condition and status.

No population projections were made or possible, so probable values for future population condition and status were not produced.

8. Ensure that all desired and necessary assessment results (*as listed in the SEDAR Stock Assessment Report Outline*) are clearly and accurately presented in the Stock Assessment Report and that such results are consistent with the Review Panel's consensus regarding adequacy, appropriateness, and application of the data and methods.

All desired and necessary assessment results are clearly and accurately presented in the Stock Assessment Report for the species, but they are currently uninformative on stock status. These results are consistent with the Review Panel's consensus regarding adequacy, appropriateness, and application of the data and methods.

9. Evaluate the Data and Assessment Workshops with regard to fulfilling their respective Terms of Reference and state whether or not the Terms of Reference for previous workshops are adequately addressed in the Data Workshop and Stock Assessment Report sections.

The Data Workshop fulfilled its Terms of Reference. The Assessment Workshop fulfilled its Terms of Reference to the extent possible, given the limitations of the data.

10. Develop recommendations for future research for improving data collection and stock assessment.

See below the comments section.

Comments

The Review Panel offers the following comments regarding research needs and the data and assessment of yellowtail snapper.

1. Well-designed, systematic research programs are essential to providing the data necessary for effective management. Much of the research reviewed lacked the necessary sample sizes and regular (ongoing) data collection needed to construct an adequate time-series of catch and abundance indices.

2. The yellowtail snapper fishery is unique among Caribbean fisheries with regard to fishing methods and timing, and the needed research designs. It is an important fishery in the U.S. Caribbean. The design of data collection must take into account the unique aspects of the fishery, and therefore sampling effort will need to be either added or redirected to target yellowtail snapper more effectively.

3. A commitment to long-term research and data collection is essential for effective management. Short-term research and data collection are not the solution to the data

problems identified in this assessment. Long-term research and monitoring are necessary in the Caribbean, as in any other managed fishery. Based on the studies and data available, it is clear that the resources necessary to collect essential data are not currently available to support scientifically based management of yellowtail snapper in the region.

4. Throughout the region, data quality control independent of the data collection process has not been effectively realized. Validation of historical and future collections is needed for the data to be used appropriately for any type of assessment. Documentation of changes in data collection and management methods must be maintained and provided to those charged with conducting the assessments and reviews.

5. The Panel recognizes the significant effort that has been put into data collection in the region and emphasizes that, although the resulting data are insufficient for an assessment at this time, they will be useful for assessment in future when combined with additional data identified elsewhere in this report. Past efforts are not wasted, but rather their data will play an important role, providing the temporal contrast needed by assessment models. The recommendations below are offered as improvements to the current data collection, not as replacements.

6. The Panel strongly endorses the need to develop partnerships with local fishermen to conduct research and to collect needed data. Partnerships with the fishing community and other stakeholders are a cost-effective way to collect components of the data necessary for the assessment process. Currently, it is clear that there is a high level of interest in the fishing community to cooperate with management agencies in collecting data, and this partnership should be encouraged and strengthened. This would also facilitate ongoing cooperation and participation by fishermen in the management process, benefiting all involved.

7. Monitoring and assessment of yellowtail snapper should be undertaken with due consideration given to the species' importance in the overall species assemblage and community. Future ecosystem management will likely dictate such a course of action.

Recommendations for future data collection and research

Fishery-independent data

- A new independent sampling regime to target yellowtail snapper more effectively should be created, because current methods do not allow temporal or spatial coverage.
- Visual surveys can provide useful fishery-independent data. The methods would, however, vary, based on the depth of the insular shelf.
- The output of other existing studies (NOAA and non-NOAA) should be examined to see if alternative fishery-independent sampling already exists.

Life history data

- Fecundity data should be collected
- Maturity data should be collected
- Growth information should be collected
- The parameter natural mortality needs investigation on the basis of better data

Catch data

- Recreational catches need to be sampled and quantified better
- Information on trip species targeting is needed
- Information on the location of catches is sometimes not good, and should be improved
- Identification of species in the snapper complex in the US Virgin Islands is crucial to future assessments
- Historical data from the US Virgin Islands need to be collected from fishermen, if they exist
- Port samplers need to modify their schedules to target yellowtail snapper landings, and to sample sizes of the species need to increase
- TIP sampling in the US Virgin Islands needs to be revitalized

Age and length frequency data

- These are needed from all commercial catches
- These are urgently required from recreational catches
- Fishery-independent surveys can provide these crucial data

Genetic / otolith microchemistry studies

- Stock structure is important in assessments, and genetics and otolith microchemistry offer hope to unravel it in future

Spatially explicit studies

- Identification of spawning areas and the source of recruits is important
- Construction of habitat maps will help identify stratification for research designs
- Combination of habitat maps with fish counts and habitat models will aid in providing population estimates
- Development of a GIS map of yellowtail snapper landings throughout the species' geographical range could help in the production of a distribution map of catches

Mark-recapture studies

- This could help identify movements and migrations
- Fishing mortality estimates could be derived
- Population estimates would be enhanced with such studies
- Such studies could help solve the perplexing question of stock structure

Of the above, the Panel places the highest priority on the following, understanding the need to maximize the likelihood of generating an acceptable assessment of the stock in the near future:

- The carrying out of fishery-independent surveys
- Collection of more catch data, including specifically the recreational fishery
- The collection of age and length data from commercial and recreational catches and from fishery-independent surveys

Stakeholder opinion

- The need for robust education of fishermen and other stakeholders is acknowledged. Such education should be of a two-way nature and would potentially lead to an enhancement of their trust in the assessment and management process, especially if they were to become involved in research program design.
- The fact that most of the product in the yellowtail snapper fishery is sold retail and that there are no fish houses (at least in the US Virgin Islands) makes any meaningful future stock assessment in the region extremely dependent on cooperation with the local fishermen.
- A paucity of recent socio-economic information continues to hinder the development of integrated biological, economic, and social assessments.
- Partnerships with organizations such as NGOs, which are often staffed by highly qualified people and are perhaps also less constrained by political influence, can mobilize extra resources in meeting some of the research objectives.
- Biological and habitat/ecosystem research information is as important in the assessment process as catch data.
- Over the past 35+ years of fishing, yellowtail snapper abundance has remained stable.
- Detailed data (information) on yellowtail snapper catch are lacking for US Virgin Islands commercial landings. The lack of this type of data has introduced uncertainty into the determination of stock status. Therefore, collection of detailed catch information there is suggested as a top research priority.

B. Caribbean spiny lobster

Terms of reference

1. Evaluate whether data used in the analyses are treated appropriately and are adequate for assessing the stocks; state whether or not the input data are scientifically sound.

The data were treated appropriately, but they were not sufficiently informative to assess stock status. An alternative explanation is that the data may be inconsistent with the assumptions of the models being applied.

2. Evaluate the adequacy, appropriateness, and application of the methods used to assess the populations; state whether or not the methods are scientifically sound.

The methods were appropriate to explore the potential for an assessment, but ultimately were limited by the uninformative nature of the data. The Panel expressed some concern about the method used to standardize the stock abundance indices. The GLM and delta-lognormal approach is appropriate, but determining terms in the model based purely on statistical criteria can lead to bias in the index. Future assessment workshops need to reconsider how the various effects might influence an abundance index, and choose to test GLM terms accordingly.

3. Recommend appropriate or best-estimated values of population parameters such as abundance, biomass, and exploitation.

It had not been possible to produce an acceptable assessment so appropriate population parameters were not recommended.

4. Evaluate the adequacy, appropriateness, and application of the methods used to estimate stock status criteria (population benchmarks such as MSY, F_{msy} , B_{msy} , MSST, MFMT). State whether or not the methods are scientifically sound.

An acceptable assessment had not been developed, so estimates of stock status criteria were not produced.

5. Recommend appropriate values for stock status criteria.

An acceptable assessment had not been developed, so appropriate stock status criteria were not produced. Analysis of % catch under minimum size coupled with other YPR studies showed the current minimum size to be appropriate to maximize YPR, and trends in relative abundance indices and length distributions indicate some stability over the past 20 years, but these results do not provide information on stock status. YPR analyses suggest that the Caribbean spiny lobster fishery is not experiencing growth-overfishing (i.e. the ratios of current to MSY-level exploitation rates were consistently <1). Although it would be tempting to draw a specific conclusion on stock status from this information, there are a number of reasons to avoid doing so. The recruitment-based models indicated a wider range of uncertainty regarding overfishing, and the YPR analyses were limited by assumptions about key parameters (e.g. natural mortality, stock-recruitment shape) and a limited time frame. Consequently, the Review Panel concluded that Caribbean spiny lobster stock status remained unknown.

6. Evaluate the adequacy, appropriateness, and application of the methods used to project future population status and, if appropriate, evaluate stock rebuilding; state whether or not the methods are scientifically sound.

No population projections were possible.

7. Recommend probable values for future population condition and status.

No population projections were possible, so probable values for future population condition and status were not produced.

8. Ensure that all desired and necessary assessment results (*as listed in the SEDAR Stock Assessment Report Outline*) are clearly and accurately presented in the Stock Assessment Report and that such results are consistent with the Review Panel's consensus regarding adequacy, appropriateness, and application of the data and methods.

All desired and necessary assessment results are clearly and accurately presented in the Stock Assessment Report, but they remain uninformative on stock status. The results are consistent with the Review Panel's consensus regarding adequacy, appropriateness, and application of the data and methods.

9. Evaluate the Data and Assessment Workshops with regard to fulfilling their respective Terms of Reference and state whether or not the Terms of Reference for previous workshops are adequately addressed in the Data Workshop and Stock Assessment Report sections.

The Data Workshop fulfilled its Terms of Reference. The Assessment Workshop fulfilled its Terms of Reference to the extent possible, given the limitations of the data.

10. Develop recommendations for future research for improving data collection and stock assessment.

See below the comments section.

Comments

1. With the available data, an interesting story becomes evident. The data series can seemingly be split into two components, before and after about 1992. In the first part of the time-series, the abundance indices decline. The models were able to recreate the decline in nominal CPUE on Puerto Rico / St Thomas / St John. This is a common pattern found in exploited fish populations, biomass steadily decreasing, and fishing mortality steadily increasing. The second part of the time-series shows the abundance index remaining steady while the catch increases, a trend inconsistent with our expectation of a fishery in a closed system. As catch increases above the level that was causing a population decline in the first portion of the time-series, we would expect the abundance index either to continue to decline or for the decline potentially to accelerate. Instead, the abundance index levels off as the catch increases. Because of this situation, standard production model approaches do not fit the entire time-series, because they do not have the ability to recreate the observed behavior.

The Panel therefore suggests that additional factors be considered in an attempt to understand better the dynamics of the population. One possibility is that recruitment may have increased during the second half of the time-series, allowing for increased catch without reducing population size. Another possibility is that fishermen may have moved into new areas, accessing a previously unexploited portion of the population, so allowing for increased catches. Other possible hypotheses involve changes in the gear used, or in post-settlement survival, and/or changes in post-larval settlement rates.

It should be possible to modify the modelling approach to produce a model that would support the observed data. One way to do this would be to allow the recruitment parameter r to increase over the second part of the time-series. This would require refining a model unique to the system, perhaps moving beyond the standard modelling software currently used. Once a model can recreate the behavior observed in the data, it should be possible better to identify hypotheses for the cause of the behavior.

Clearly, understanding the dynamics of recruitment in this fishery is crucial. There is therefore a great need to create a standardized annual recruitment index to support any assessment of this stock.

2. The Panel strongly endorses the development of partnerships with local fishermen, to conduct research and to collect the data needed for assessments. Partnership with the fishing community is a cost-effective way to collect components of the needed data. Currently, there is a high level of interest in the fishing community to cooperate with management agencies in collecting data, so the partnership should be encouraged and strengthened. This would also facilitate ongoing cooperation and participation by fishermen in the management process, benefiting all involved.

Recommendations for future data collection and research

Improve and complete historical data on relative abundance indices and catch

- For the commercial fishery
 - Recover pre-1983 data for Puerto Rico
 - Create/recover pre-1975 data for the US Virgin Islands by working with the fishermen's associations
 - Use the newly available US Virgin Islands data for the period 1987–1992
 - Use structured interviews with fishermen to assess gear changes
- For the recreational fishery
 - Estimate historical and current levels

Fishery-independent monitoring

- The Panel identified an apparent inconsistency between the assessment model assumptions of recruitment as a direct function of spawning stock. This appeared to be important enough to warrant two recommendations: 1) to build additional flexibility into the models to allow time-varying recruitment (or at least recruitment dynamics); and 2) to seek to establish a fishery-independent index of recruitment, which is deemed to be crucial. Based on presentations made during the review, there appears to be a tested method for conducting such a survey, and these types of data are currently being used in the SA-GOM lobster assessment. The method consists of placing a series of post-larval collectors in appropriate areas and consistent sampling their catch. This approach appears to be conducive to cooperative research, utilizing fishermen's knowledge of the area as well as their frequent visits to sampling areas. The Panel strongly endorses the need for such a survey to provide a data series for use in the Caribbean spiny lobster assessment, preferably with a sampling design covering both platforms, given the uncertainty about the spatial coupling of recruitment dynamics
- It is necessary to develop and implement sampling program(s) specific to both pre-recruit and adult Caribbean spiny lobsters
- It is crucial to increase sampling effort in the US Caribbean.
- There will be benefit in further diversifying the regions sampled to include equal coverage of areas frequently fished
- Visual surveys for size structure, abundance, and YPR could provide useful time-series of data

Revise the trip interview program (TIP) database exhaustively

- Completing the historical data set would be valuable
- Revitalizing TIP sampling in the US Virgin Islands would have many benefits, not just for the Caribbean spiny lobster stock
- Effort should be directed at key species, generating trip-target information, and obtaining needed detail

Length distribution of the catch

- For the commercial fishery
 - Complete incorporation of non-digitized data for the US Virgin Islands (TIP)
 - Recover historical length data for Puerto Rico and the US Virgin Islands from other studies prior to the TIP

- For the recreational fishery
Determine length distributions

Conduct studies to understand the ecology of early juveniles (25 mm carapace length)

- Habitat use needs to be understood better
- More needs to be known about settlement habitat
- Information on movements and migrations needs to be sought
- Clarity of the mortality rates needs to be sought

Spatially explicit studies

- Identify spawning areas and sources of recruits
- Build/acquire habitat maps to identify stratification for research designs
- Combine habitat maps with density counts and habitat models to provide population estimates
- Develop a GIS map of spiny lobster landings throughout the geographic range of the stock, producing catch distributions

Mark-recapture techniques

- Such studies could hone knowledge of abundance
- The techniques could provide additional information on movements and migrations
- Habitat preferences would be better understood

Stock structure

- Stock structure is important in assessments, and genetics offers hope to improve knowledge

Future assessments

- These should explore further use of length structure and density from closed areas as reference points
- Assessments need to be repeated when significant quantities of previously unavailable historical data have become available
- Alternative stock assumptions need to be considered during assessment
That of a wider Caribbean stock
That of the stock of the US Caribbean and neighboring islands
- The use of nominal CPUE should be considered in future assessments
- The modelling approach needs to be modified to produce a model that would support the observed data. Within the model, the recruitment parameter r should be allowed to increase over the second part of the time-series, perhaps moving beyond the standard modelling software currently used.

Of the above, the Panel places the highest priority on the following, understanding the need to maximize the likelihood of generating an acceptable assessment of the stock in the near future:

- Develop/strengthen fishery-independent data collection
- Incorporate historical data into existing data sets
- Utilize refined models (better to identify viable hypotheses)

Stakeholder opinion

- Priority should be given to research that supports efforts to collect new catch data and increase port sampling. Research efforts should foster involvement of and collaboration with fishers.
- The fact that most of the product in the Caribbean spiny lobster fishery is sold retail and that there are no fish houses (at least in the US Virgin Islands) makes any meaningful future stock assessment extremely dependent on cooperation with the local fishermen.
- There is need at least to explore approaches to identify and incorporate socio-economic and other data types into the model. Some such data may indirectly be reflected but still influence CPUE, and may be available for 20 years or more. Examples are (i) employment; (ii) fuel costs; (iii) coastal development, e.g. on St Croix the number of homes per hectare is a significant predictor of water quality, and water quality may impact habitat and species populations; (iv) km of roads; (v) average *per capita* income.

C. Spiny lobster in the Southeast United States

Introduction

A comprehensive overview of the data and models used for the SE lobster assessment was provided. The assessment models explored included ASPIC, a modified DeLury model, catch-curves, untuned VPA, and an integrated catch-at-age (ICA, developed by Ken Paterson) model. The results presented focused primarily on the DeLury and ICA models, with ICA the preferred base-case assessment model.

Panel requests for further analyses during the meeting

1. Additional sensitivity runs using the ICA model, intended to explore the effect of the base-case selectivity assumptions on the results:
 - Try an alternate year (>1993) to transition from estimated to constant selectivity
 - Try constant selectivity in the early period, then estimated selectivity thereafter, if possible.

The values estimated with three alternative selectivity assumptions were very close to the base-case model result. However, the CVs of recent fishing mortality did increase when the shortest period of constant recruitment was assumed. The second part of the request was not feasible using the current model framework. The Panel was nevertheless satisfied that the base-case results were not likely to be unreliable as a consequence of the selectivity assumptions used.

2. Try a run estimating natural mortality (M) using the DeLury model.

On attempting this, M was not considered to be reliably estimated, but the value used in the base-case model did appear to be consistent with the data.

3. Explore alternative methods for projecting future recruitments with uncertainty, possibly including

- Extrapolation of the recent estimated trend
- Re-sampling from residuals about the mean
- Re-sampling from Monte-Carlo results

A projection including variability in model parameters was completed. The qualitative results were similar for projections based on $F_{current}$ and $F_{20\%}$ although projected harvest levels were somewhat lower than the deterministic values. The Panel was satisfied that the approach adequately reflected uncertainty in future projections.

4. Subsequent to the first three requests, an additional request was made to produce a decision or scenario table based on the model runs already completed and evaluated by the Panel.

Three alternate recruitment scenarios were presented: similar to the last 12 years, similar to the last 4 years, and based on a stock-recruit curve. Respectively, these roughly corresponded to two levels of constant (high and low) recruitment, and to stock-sensitive recruitment. Three alternate management targets were simulated through F values of $F_{5\%}$, $F_{20\%}$ and $F_{30\%}$. However, after reviewing a series of results from this analysis, the Panel concluded that no further material needed to be included in this report or for them to formulate their decisions.

Terms of reference

1. Evaluate whether data used in the analyses are treated appropriately and are adequate for assessing the stocks; state whether or not the input data are scientifically sound.

The data used in this assessment were treated appropriately and are considered fully adequate to assess the stock.

2. Evaluate the adequacy, appropriateness, and application of the methods used to assess the populations; state whether or not the methods are scientifically sound.

The methods used in this assessment were adequate, appropriate, and scientifically sound.

3. Recommend appropriate or best-estimated values of population parameters such as abundance, biomass, and exploitation.

The base-case assessment model provided the best estimates for these values.

4. Evaluate the adequacy, appropriateness, and application of the methods used to estimate stock status criteria (population benchmarks such as MSY , F_{msy} , B_{msy} , $MSST$, $MFMT$). State whether or not the methods are scientifically sound.

Because of the lack of direct linkage between spawning stock and subsequent recruitment, there is no comparable proxy benchmark for SSB. For this reason, SSB/SSB_{msy} , MSY , and related criteria could not be estimated. A proxy benchmark for F was available from the SAFMC Fishery Management Plan for Spiny Lobster (Amendment 6) based on static SPR ($F_{oy} = 30\%$ SPR , and $F_{msy\ proxy} = 20\%$ SPR). The method used in this assessment for estimating stock status criteria for F was adequate, appropriate, and scientifically sound.

5. Recommend appropriate values for stock status criteria.

There was considerable discussion as to whether the $F_{20\%}$ threshold makes biological sense, given that values are likely to be close to this level under historical rates of fishing mortality. It was noted that, if all portions of this Caribbean stock had high fishing mortality rates, this might not be biologically reasonable over longer time-scales. The long-term average is currently estimated to be $SPR = 19\%$, presumed to be sustainable though slightly below the limit. The Panel concluded that there was no basis for recommending alternative benchmarks. Based on the assessment model results presented, overfishing does not appear to be occurring at the moment. Indeed, there is no evidence that growth-overfishing would occur even at very high rates of fishing mortality, given current estimated selectivity patterns. However, the stock status relative to overfished levels cannot be evaluated.

6. Evaluate the adequacy, appropriateness, and application of the methods used to project future population status and, if appropriate, evaluate stock rebuilding; state whether or not the methods are scientifically sound.

The methods used in this assessment were adequate, appropriate, and scientifically sound. The Panel preferred the revised projections including uncertainty in estimated model parameters.

7. Recommend probable values for future population condition and status.

There was no indication that future population conditions and status would be below the current levels reported from the base-case assessment model.

8. Ensure that all desired and necessary assessment results (*as listed in the SEDAR Stock Assessment Report Outline*) are clearly and accurately presented in the Stock Assessment Report and that such results are consistent with the Review Panel's consensus regarding adequacy, appropriateness, and application of the data and methods.

The necessary results fulfilling the SEDAR stock assessment report outline were presented. Additional analyses were performed in response to requests made by the Panel, the summary results of which are included in this report.

9. Evaluate the Data and Assessment Workshops with regard to fulfilling their respective Terms of Reference and state whether or not the Terms of Reference for previous workshops are adequately addressed in the Data Workshop and Stock Assessment Report sections.

The Data and Assessment Workshops appeared to have met their respective terms of reference fully.

10. Develop recommendations for future research for improving data collection and stock assessment.

See below the comments section.

Comments

The Review Panel offers the following comments regarding research needs:

1. Discussion of the ability to estimate the relative stock status with respect to overfished levels focused on the connectivity of the entire Caribbean spiny lobster population and the relative importance of the SA-GOM area in the total. It was noted that catches from the area make up <10% of the catch in the western Atlantic, and that present understanding of oceanographic patterns indicates that it is quite likely that the area receives larvae from other areas. This statement is based on the duration of the larval period and the speed and direction of prevailing currents. Critical information required to evaluate fully whether the stock is overfished include: identifying the source of the larvae settling in the SA-GOM area as well as determining the proportion of larval production from the area that is retained locally. A broad assessment of the Caribbean population would be desirable, but is impractical at this time.
2. There was support from both stakeholders and scientists at the Panel to re-establish an observer program for the commercial trap fishery. This program could supply useful data to be used directly in the present assessment model including: an index of pre-recruit numbers, adults, and other information that cannot be gained through other methods. Efficient coordination and communication between participants (both industry and scientists) must be a priority in planning this program. The Panel recognized that the program will be most valuable as the duration of the time-series increases, and planning should reflect this.

Recommendations for future data collection and research

Data from the commercial fishery

- Re-establish a commercial fishery observer program (described above).

Fishery-independent indices of abundance

- Standardize existing data sets that may be used for juvenile and legal-sized indices of abundance
- Design new monitoring programs to collect systematic, consistent, and statistically rigorous data.

Improved growth information

- Tagging projects should be initiated to obtain growth-rate data from larger (CL >100 mm) lobsters
- Activity may need to be focused in areas of reduced exploitation (such as the Tortugas) to allow capture of these larger individuals in appreciable numbers
- Reconcile growth information from Lipofuscin and tagging data

Modelling

- Conduct Monte Carlo simulations to test $F_{20\%}$ and $F_{30\%}$ threshold and target reference points against various performance criteria. The stock assessment workshop for the stock should develop various scenarios covering a range of hypotheses concerning recruitment and changes in gear selectivity, as well as suitable performance indicators, including catch and measures of SSB. Risks in the performance indicators associated with applying the threshold and target should be generated in future assessments.

Stakeholder opinion

- Fishing pressure has decreased in the Keys because (i) there are less traps as a result of the Trap Certificate Program, (ii) recent efforts to curtail a rapidly expanding illegal dive fishery, (iii) the loss of dock space and subsequent selling out as gentrification continues at an increasing rate, (iv) the loss of suitable crew as a direct consequence of the increasing cost of living in the Keys.
- Fishermen are very willing to sit down with scientists to devise long-term observer/sampling programs that enmesh with operational activity and satisfy crucial needs for data.

2.3 Recommendations for future SEDAR assessments

In terms of the terms of reference provided to the Review Workshop, opportunity was given to all participants (as well as to the Review Panel) to comment upon the whole SEDAR assessment process. What follows is a non-prioritized list of the main points made.

- There is a strong need for enhanced communication, specifically to stakeholders, about what SEDAR is trying to achieve in terms of management.
- To date, there has not been full acceptance from all, and this is put down at least partially to the lack of education and training of certain key parties about the process. Their cooperation is essential if SEDAR is to succeed in its objectives.
- An advanced plan of what species is to be handled when is essential for all those who need and wish to be involved in the process.
- There is need for a (web-based) Glossary of Terms used.
- Continuity of personnel in the workshops is crucial to ensuring both acceptance and enhanced understanding.
- Dissemination of the information created and the results in terms of management action are not always perceived by stakeholders to have been achieved, so it was felt that Councils should make greater effort in this regard, at all levels of the process.
- Several participants, both technical and representing fishermen, felt that greater effort should be made to maximize the time for preparation of data series, assessments, and review material. The Panel shied away from suggesting a deadline for receipt of material prior to each workshop, realizing that the very nature of some data would always make collection to the last possible moment necessary, but stressed that late receipt could easily lead to delayed or less informative assessments of stock status.
- As mentioned several times elsewhere in this report, strong cases were made for incorporating fishermen's knowledge better into the assessment and management process.
- The Review Panel requires the presence of scientists who have not been involved in the Data and/or Assessment Workshops. This may not be a preferred requirement for the participating stakeholders. Stakeholders would clearly benefit and be better able to participate fully in the review process if they had been present throughout all meetings. The Councils could maximize meeting this recommendation by considering paying stipends to participating stakeholders to compensate them for lost earnings.

- There was strong feeling that the anticipated changed representation on the Review Panel may not be most appropriate for the SEDAR area. While understanding and wholeheartedly endorsing the need for independent peer review, a strong case could be made for Panel representation to include stakeholders, biologists knowledgeable about the species, and stock assessment scientists who were not involved in the immediate assessment. It was felt unlikely that such people would be able to participate in the discussions at the current enthusiastic level unless they were formally accepted as members of the Panel.
- Allied to the above and notwithstanding what was ultimately decided on the make-up of the Panel, there was unanimity that the independence of the Review Panel chair (currently appointed by the CIE) was paramount and matched well the objective of independence.
- Given the volume of documentation associated with such reviews and the shortage of time often available to assimilate it, the Review Panel and other participants stressed the need for a clear executive summary to be provided for all substantive documents being addressed. Further, there was a call for a succinct table of model parameters (estimated and observed) to be provided for each assessment along with, if appropriate, a table of management options (e.g. a decision table) and the risks associated with them.