ISSN:1995-1434

CRFM Fishery Report - 2009

Volume 2

Report of Fifth Annual Scientific Meeting - Kingstown, St.Vincent and the Grenadines, 9-18 June 2009

CRFM Secretariat
Belize
2009

CRFM Fishery Report – 2009

Volume 2

Fishery Management Advisory Summaries

Report of Fifth Annual Scientific Meeting – Kingstown, St. Vincent and the Grenadines, 09-18 June 2009

CRFM Secretariat
Belize
2009

CRFM FISHERY REPORT – 2009. Volume 2 - Fishery Management Advisory Summaries. Report of Fifth Annual Scientific Meeting – Kingstown, St. Vincent and the Grenadines, 09-18 June 2009

Correct Citation:
CRFM 2009. Report of Fifth Annual Scientific Meeting – Kingstown, St. Vincent and the Grenadines, 09-18 June 2009 – Fishery Management Advisory Summaries. *CRFM Fishery Report* - 2009. Volume 2. 60p.

ISSN: 1995-1434
ISBN: 978-976-8165-34-3

Published by the Caribbean Regional Fisheries Mechanism Secretariat,
Belize City, Belize

Foreword

The Fifth Annual Scientific Meeting took place during 09-18 June, 2009. During this Meeting, CRFM Resource Working Groups examined data from the following fisheries: the spiny lobster (*Panulirus argus*) fishery of Jamaica; the queen conch (*Strombus gigas*) fishery of St. Lucia; the red hind (*Epinephelus guttatus*) and queen triggerfish (*Balistes vetula*) fisheries of Montserrat; the beach seine fishery of St. Vincent and the Grenadines; the shrimp trawl fishery of Trinidad and Tobago; and the Atlantic Seabob (*Xiphopenaeus kroyeri*) fisheries of Guyana and Suriname. The report of the assessment of Eastern Caribbean fourwing flyingfish (*Hirundichthys affinis*), completed by WECAFC in 2008, was also reviewed and acknowledged.

Additionally, the characteristics of the finfish and conch fisheries of the Turks and Caicos Islands and Nevis (of St. Kitts and Nevis) respectively were examined to make specific recommendations for improving sampling of these fisheries in the future. The LPWG did not undertake any assessments in 2009, but completed several tasks, of which the main ones were: preparation of 3 technical reports for consideration by ICCAT's Standing Committee on Research and Statistics, and development of a monitoring and management plan for the finfish fisheries of the Turks and Caicos Islands.

An informal meeting of the Working Group on Data, Methods and Training was held, during which current issues pertaining to each of the three areas (data, methods, training) were discussed, and key inter-sessional tasks were identified, as well as the need for basic training in R (statistical software) to be pursued at the next meeting of the Working Group. At the request of the Executive Committee of the Caribbean Fisheries Forum, the proposal to establish a CRFM Scientific Committee was also reviewed and finalized by the Meeting.

The Report of the 2009 CRFM Annual Scientific Meeting is published in two Volumes: Volume 1 contains the proceedings of the plenary sessions and the full reports of the CRFM Resource Working Groups for 2009. Six national reports were submitted for consideration by the 2009 Meeting, and these are published as Supplement 1 to Volume 1. Volume 2 contains part A (Overview), and the fishery management advisory summaries of individual fishery reports comprising part B of each Working Group report, where relevant. Volume 1 is intended to serve as the primary reference for fishery assessment scientists, while Volume 2 is intended to serve as the main reference for managers and stakeholders.

Contents

List of Acronyms and Abbreviations

ACP	-	African, Caribbean and Pacific states
ANOVA	-	Analysis of Variance
CARICOM	-	Caribbean Community
CARIFIS	-	Caribbean Fisheries Information System
CERMES	-	Centre for Resource Management and Environmental Studies
CFF	-	Caribbean Fisheries Forum
CFRAMP	-	CARICOM Fisheries Resource Assessment and Management Programme
CLWG	-	Conch and Lobster Resource Working Group
CPUE	-	Catch Per Unit of Effort
CRFM	-	Caribbean Regional Fisheries Mechanism
CSC	-	CRFM Scientific Committee
DANIDA	-	Danish International Development Agency
DMTWG	-	Data and Methods Working Group
FAD	-	Fish Aggregating Device
FAO	-	Food and Agriculture Organization of the United Nations
GDP	-	Gross Domestic Product
GLM	-	General Linear Model
ICCAT	-	International Commission for the Conservation of Atlantic Tunas
IMA	-	Institute of Marine Affairs
INSOPESCA	-	Instituto Socialista de la Pesca y Acuicultura
IUU	-	Illegal, Unreported and Unregulated fishing
LAPE	-	Lesser Antilles Pelagic Ecosystem Project
LPWG	-	Large Pelagic Fish Resource Working Group
MCMC	-	Monte Carlo Markov Chain Methods
MPA	-	Marine Protected Areas
MS	-	Microsoft
MSC	-	Marine Stewardship Council
MSY	-	Maximum Sustainable Yield
MT	-	Metric Tonne
NMFS-SEFSC	-	National Marine Fisheries Service – South East Fisheries Science Center
NOAA		National Oceanic and Atmospheric Administration
RSF	-	Reef and Slope Fish
RSWG	-	Reef and Slope Fish Resource Working Group
SCPWG	-	Small Coastal Pelagic Fish Resource Working Group
SEDAR	-	Southeast Data, Assessment and Review Process
SGWG	-	Shrimp and Groundfish Resource Working Group
STATIN	-	Statistical Institute of Jamaica
TCI	-	Turks and Caicos Islands
TIP	-	Trip Interview Programme
UNDP	-	United Nations Development Programme
UNU-FTP	-	United Nations University – Fisheries Training Programme
USA	-	United States of America
USVI	-	United States Virgin Islands
UWI	-	University of the West Indies
WECAFC	-	Western Central Atlantic Fishery Commission
YPR	-	Yield Per Recruit

I. REPORT OF THE CONCH AND LOBSTER RESOURCE WORKING GROUP (CLWG)

Chairperson: Anginette Murray
Kimberlee Cooke and Anginette Murray (Jamaica); Shawn Isles (Nevis); Allena Joseph (St. Lucia)
John Hoenig (Consultant); Paul Medley (Consultant); June Masters (CRFM Secretariat)

A. OVERVIEW

Three countries (Jamaica, Saint Lucia and Nevis) attended the meeting. There were no representatives from the other countries that indicated in the 2008-09 work plan that they would participate.

During the inter-sessional period discussions were held with the members of the CLWG to determine the work plan for this year's scientific meeting with the view of conducting regional assessments. The following summarizes the discussions held before and during the meeting.

Regional Assessments

Two approaches were proposed:

1. One approach was to seek to answer a truly region wide question involving the analysis of combined data or
2. More individualized approach geared towards separate analyses answering the same question for each country.

Proposed problems with regional assessment included:

- Previous attempts to do regional assessments such as at the WECAFC level, resulted in more summary type analyses such as summaries of the total landings of the various so called stocks
- Many of the countries that make up the CRFM are believed to be in different lobster stocks. Consequently, in depth scientific analysis of the combined data would therefore not be very meaningful. In addition, data from the non-CRFM countries would be integral as part of such in depth analysis.

The Working Group noted that conch and lobster are not highly migratory species and the different countries appear to have distinct stocks (although recruitment in some areas may be dependent on dynamics in other ("source") areas). Consequently, integrated models of conch or lobster populations over large geographical scales do not appear appropriate.

The Working Group further notes that a wider view of assessment to include approaches used in other countries is helpful. Currently, three approaches seem to be evolving: 1) using abundance surveys as a means for judging stock status and choosing management measures, 2) using a series of catch and effort data to fit biomass-dynamic (surplus production) models, and 3) combining abundance surveys and catch rate data so that a) catch rates can be converted into estimates of abundance, and b) abundance estimates can be incorporated in biomass-dynamic models. For each approach, information from other countries can be useful. Examples are given below.

There are advantages in sharing experiences with, and information on, the design and analysis of abundance surveys using scuba diving. This can make the design and implementation of new surveys easier and improvements in design or methods can be shared. It may also be possible to share personnel for surveys.

It is difficult to establish a reliable biomass-dynamic model when the time series of observations is short, particularly when fishing effort has not varied much over the course of the time series. One way around this is to incorporate prior information into the model. To do this, experiences in other countries are used to formulate likely values for parameters which are then incorporated into the model as prior distributions. Thus, comparative studies of conch and lobster population dynamics in different areas would be useful.

Comparative data from different countries have other important uses. For example, one might ask what levels of biomass density appear sustainable and what levels have led to stock crashes based on the collective experiences of all countries. Similarly, the question of what levels of exploitation are reasonable can be approached through comparative studies of dynamics across countries.

Therefore, the Working Group proposes that a regional approach to assessment should focus on comparative studies of population dynamics and on development of generally applicable methodology.

Work Attempted

Given the constraints that existed, the CLWG was not able to conduct regional assessments as envisaged. Instead the focus once again was on individual assessments and making plans for the upcoming year. Analyses completed at the current meeting included the establishment of the tail length that corresponds to the legal minimum carapace length incorporated in the legislation for Caribbean spiny lobster for Jamaica. Nevis reviewed existing landings data while designing a sampling plan. Jamaica updated the surplus production model for lobster and Saint Lucia updated the production model for conch.

Recommendations made by the CLWG are as follows:

Research Recommendations

1. Jamaica: Conch
    a. Compile and verify all data on catch, effort, and catch rate, with particular reference to units and conversion factors.
    b. Estimate catchability coefficient from several years of survey and landings data.
    c. Estimate exploitation rate from the survey data and landings
    d. Estimate survival rate from the 2007 survey data and landings
    e. Create a simple model of conch population dynamics based on total catch and two survey estimates (requires access to 2007 survey data)
    f. Explore use of biomass dynamic models. In particular, inquire as to why the original biomass dynamic model was not developed further.

2. Jamaica: Lobster.
    a. Consider ways to improve the catch and effort data. These data still present a problem with missing data and suspected significant errors in recording and collection.
    b. Obtain missing catch and CPUE data for the periods 1982-3, 1990, completing the time series used in the most recent assessment and check the CPUE data for errors.
    c. Obtain exports by size category from the processors for as long a time series as possible. Historical data will be important in assessing the stock.
    d. Obtain size compositions from tail measurements within the size categories.

3. St. Kitts and Nevis: Conch.
    a. Compile all available fisheries data for conch. Perform quality control checks, and integrate the data from Nevis and St. Kitts. In particular, for the landings data there appear to be problems with year and with units.

    b. Consider the impact of a suite of possible management actions to reduce fishing mortality, with respect to
        - Enforceability
        - Effectiveness
        - Impact on the industry

    c. Monitor the resource through annual abundance surveys based on scuba diving to count conch along transects. These surveys will document distribution and abundance of conch by size class and can be used to track changes in the population over time. Abundance surveys also offer the possibility of estimating
        - Exploitation rate
        - Annual survival rate
        - Recruitment to the fishery (and thus a forecast for the next year)

    d. Monitor catch and effort for at least a portion of the fishery as a means of monitoring relative abundance.

    e. Determine the value of the catchability coefficient, so that commercial catch rates can be converted into estimates of stock abundance. This requires surveys be conducted to estimate abundance.

4. Saint Lucia: Conch.
    a. Conduct a visual survey to fine tune the conch assessment study previously done.
    b. Map habitat for both fished and non fished areas.
    c. The collection of catch and effort data on the conch fishery should be continued and should include depth estimates.

<u>Other recommendations</u>

1. Further training on basic analytic and data handling skills is needed, in particular the use of pivot tables in Excel and the R statistical language. The suggested timing of this training in basic skills is during the first day of the meeting so that there is a greater chance that the skills learnt will be retained as they will be used immediately. In addition, the person receiving the training would be the one attending the meeting

2. Efforts to obtain all data useful in fisheries analysis should resume. This includes sources outside of the agencies that the various representatives work such as visiting researchers, weather departments and universities.

3. Assistance in obtaining funding for small scale research and data collection for individual countries is needed. Recognizing that countries are ultimately responsible for the resources allocated towards managing their fisheries, there is still the occasional necessity of obtaining funding from external sources. Possible avenues of assistance include training in the writing of funding requests and drafting of such requests by the CRFM.

4. There needs to be greater emphasis placed on transfer of knowledge between country representatives and their compatriots in order to facilitate the continued and efficient work of the

working groups when there are changes in country representatives from meeting to meeting. This includes where persons leave their department altogether and where circumstances dictate that a different person attend the meeting from year to year.

5. A long-term goal is to maximize the amount of analysis done between meetings and to utilize the meeting for fine tuning, review and planning. This depends heavily on the time that can be spent on such activities between meetings and the abilities of the individuals involved.

6. Greater attention needs to be placed on the inter-sessional work of the working group in order for countries to gain maximum benefit from the meeting.

7. The work of organizations that provide eco-labels, such as the Marine Stewardship Council, should be considered by the working groups as there is a possibility that such labels will be needed for continued access to particular markets. Adherence to MSC standards also promotes improved stock assessments and management. The course of action for incorporating the requirements prescribed by such organizations should first be addressed by the Caribbean Fisheries Forum.

8. A consultant, familiar with incorporating socio-economic data into resource assessments, should be invited to the next meeting to provide technical support during the work sessions.

Proposed workplan for Sixth CRFM Scientific Meeting

Due to the limited countries represented at this year's meeting the Working Group proposes to do some work in the inter-session, as follows.

- Correspond with member states to develop workplan
- Prepare for training in R at the next Scientific Meeting by having participants download R and Tinn-R prior to the meeting. Consultant will prepare detailed instructions and assist scientific officers in the member states.
- Examine the socio-economic data from Saint Lucia
- Develop specific plans for a transect survey of conch abundance in St. Kitts and Nevis and in Saint Lucia.

Based on the data that are expected to be available and subject to the approval of the Caribbean Fisheries Forum, the proposed resource assessments for the Sixth CRFM Scientific Meeting are noted below.

- Analyze conch survey data from St. Kitts and Nevis if survey has been completed
- Analyze conch survey data from Saint Lucia if survey has been completed
- Analyze Jamaica conch survey data from 2007, as well as biological data, if prepared and available.

Other topics may be identified during the inter-session.

B. FISHERY MANAGEMENT ADVISORY SUMMARIES

1.0 Spiny Lobster (*Panulirus argus*) fishery of Jamaica

1.1 Management Objectives

The management objective for the spiny lobster fishery of Jamaica is "Biological sustainable use of the fishery resources in order to ensure present and future economic earnings from the fishery"

1.2 Status of Stock

An update of the previous year's assessment was carried out on the industrial lobster fishery of the Pedro Bank. The results, due to limitations of the available data, were still not conclusive, but provided some indications of the status of the fishery. The model suggested the stock is not overfished and current catches are not resulting in overfishing.

With the inclusion of an additional three years data there is still no evidence that the stock is overfished. Both the previous and updated assessment revealed that the recommended MSY from the Pedro Bank was at a median of 200mt. Data from the industrial fishery revealed that since 2004 the catch has been decreasing from 450 mt to 111.5 mt as seen in 2007. With lower catches, the model now predicts that the stock is not being overfished ($F < F_{MSY}$) and is not overfished ($B > B_{MSY}$).

It should be noted that the production model does not fit the data well. This is because the catch rate series does not appear to be informative. Consequently, the model outputs are highly dependent on what is being assumed for the priors. Nonetheless, the model is the only one currently available and provides some guidance on appropriate levels of harvest.

1.3 Management Advice

Current management measures include a Close Season for the months of April to June for all lobster fishers; there is also the recent implementation of a current legislation that prohibits persons from having lobsters during the Close Season. Enforcement includes end-of-season declarations of lobster by the processors and inspections of fish processing plants, hotels, beaches, and restaurants. Also, the industrial fishery operates under a limited access system that controls the number of industrial vessels.

As a cautionary approach Jamaica may consider implementing a total allowable catch of 200t for this fishery, enforced through an export quota. The maximum sustainable yield is likely to be in the range of 78 – 1098 t, with 200 t being the median.

The Government should also consider establishing minimum tail weight and length regulation, so that these size regulations can still be enforced after processing. A minimum tail size, consistent with the minimum legal carapace length, was determined at this meeting.

1.4 Statistics and Research Recommendations

<u>Data Quality</u>

The annual total catches that were used in the assessment included data from the industrial fishery from Pedro Bank. Total catches of lobsters from the industrial fleet were estimated to be equal to total exports. For the purposes of this assessment it is assumed that the industrial fleet catch is a constant proportion of the total catch. This assumption needs to be further verified. Export data were available from 1979 – 2007 with three years missing (1982, 1983, 1990). CPUE was obtained for lobster pot fishing operations on Pedro Bank for 10 years (CARIFIS database). The major challenges posed by the data were the gaps in the data series, and uncertainty in the CPUE index as a good index of abundance.

The following activities will need to be undertaken to improve the assessment:

- Consider ways to improve the catch and effort data. These data still present a problem with missing data and suspected significant errors in recording and collection.
- Obtain missing catch and CPUE data for the periods 1982-3, 1990, completing the time series used in the most recent assessment and check the CPUE data for errors.
- Obtain exports by size category from the processors for as long a time series as possible. Historical data will be important in assessing the stock.
- Obtain size compositions from tail measurements within the size categories. This can only be done for current and future landings.

Research

During the 1980s about 60 percent of total lobster landings came from the Pedro Bank but that declined to 20 percent in 1996-1997. The contribution of lobsters landed in Jamaica that come from the island shelf and the banks have not been recently quantified (Kelly, 2002).

According to Munro (1983) the lobster populations in Jamaica have changed considerably. Kelly (2002) noted that fishing effort had increased significantly in the preceding recent years and that the level of fishing mortality at that time appeared to be greater than the optimum recommended for the fishery in 2002. FAO (1993) declared that from a biological perspective, fishing mortality should be reduced to minimize the risk of over-exploitation.

More intense specific monitoring should be carried out on a single lobster fishery to determine the detail necessary for a full assessment, as well as the seasonal patterns in landings, estimates of current fishing mortality etc. The work could be conducted as a single one or two year project, although it would need to be conducted as a continuous activity during this period by dedicated staff to avoid any breaks in the time series.

It was recommended in the plenary session that patterns in recruitment and in landings be compared across wide geographical areas to look for regional patterns. This would be a major research undertaking and would require a commitment from member states.

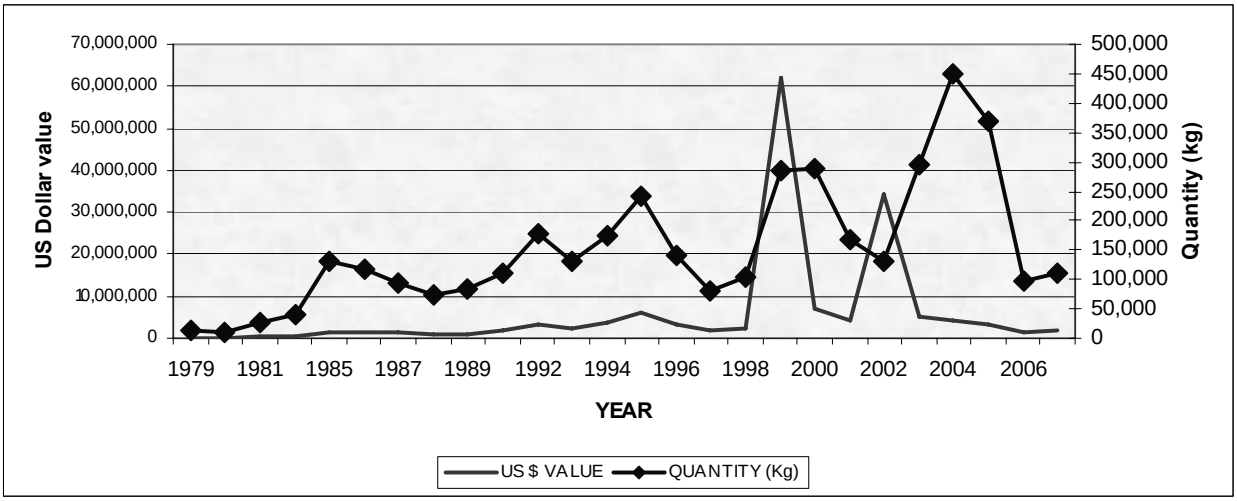

Fig. 1: Export quantities and US$ value of the spiny lobster for Jamaica period 1979 – 2007 (Data Source: Statistical Institute of Jamaica)

1.5 Stock Assessment Summary

The most important data to be used in the assessment of the Pedro Bank spiny lobster fishery were the total exports since 1979 (Fig. 1). These have increased since 1979 when the stock was likely to have been only lightly fished.

Attempts were made to assess the status of the lobster stock using a surplus production model fitted in a Bayesian framework. The Bayesian statistical analysis offers a method in which uncertainty can be explicitly incorporated in inference, and decision making, and external information can be used formally to improve the fit through providing priors. Priors were derived from previous Turks and Caicos Islands and The Bahamas assessments.

However, results from this assessment were highly uncertain (Table 1), with confidence intervals being wide for the indicators and reference points of interest. The general indications were that the stock was not likely to be overfished (median B/B_{MSY} = 1.25), and overfishing is not occurring (median F/F_{MSY} = 0.49, and most recent catch (111 tonnes) < replacement catch (179 tonnes)).

It should be noted that the production model does not fit the data well. This is because the catch rate series does not appear to be informative. Consequently, the model outputs are highly dependent on what is being assumed for the priors. Nonetheless, the model is the only one currently available and provides some guidance on appropriate levels of harvest.

Table 1: Comparison of new and previous parameter estimates and reference point estimates from the Jamaica assessment. The confidence bounds are generally wide illustrating the uncertainty in the assessment. The main information contribution for the assessment was the priors (based on information from the Bahamas and Turks and Caicos Islands) and the total catches. The CPUE index was relatively uninformative.

	2008 Assessments			2009 Assessments		
90% Confidence Intervals (percentiles)	**5%**	**Median (50%)**	**95%**	**5%**	**Median (50%)**	**95%**
R	0.06	0.21	0.71	0.05	0.20	0.65
B_∞ (t)	2280	4415	10734	2293	4271	9515
$B_{current}$ / B_∞	0.34	0.66	0.92	0.37	0.62	0.90
MSY (t)	78	207	1098	75	195	878
Observed Yield (kg)	450, 807 (2004)			111,500 (2007)		
Replacement Yield (t)	73	187	352	71.00	179.00	335.00
B/BMSY	0.69	1.31	1.84	0.74	1.25	1.80
F/FMSY	0.25	1.63	6.64	0.08	0.49	1.80

Minimum tail length

Fig. 2 shows the plot of carapace length versus tail length for male and female lobsters combined. A linear regression described the relationship by:

carapace length = -1.63 + 0.58 * tail length, with $R^2 = 0.78$.

Thus, it is estimated that lobsters with a tail length of 134.2 mm have on average a carapace length of 76.2 mm. Also computed were 95% prediction intervals, such that 95% of future observations should fall in the interval. The prediction intervals show that a lobster with a tail length greater than or equal to 153 mm has at least a 95% chance of being legal sized.

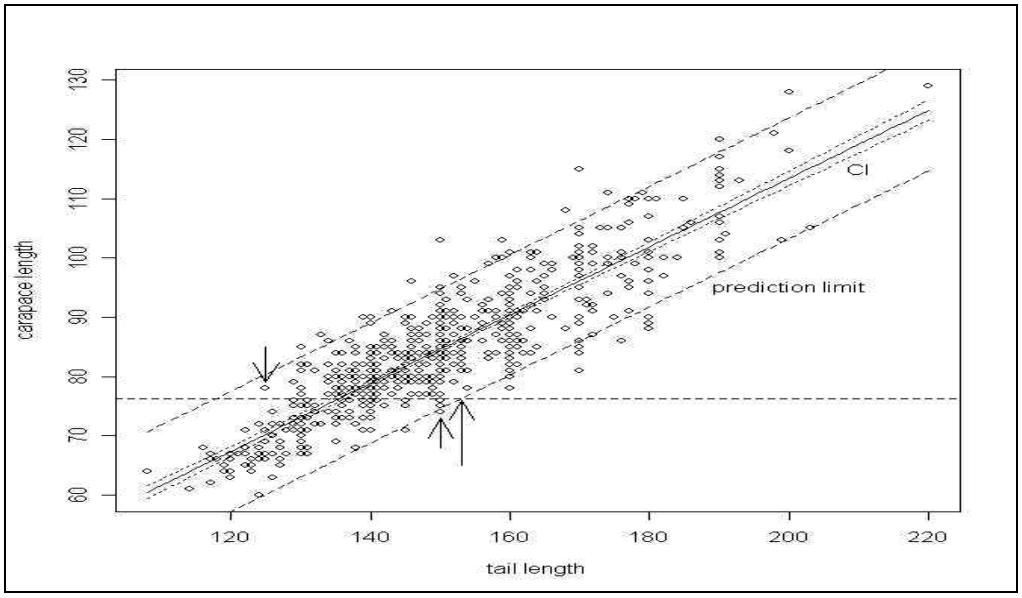

Fig. 2: Plot of carapace length versus tail length for male and female lobsters combined

A conversion factor of 0.565 was established in order to convert tail length to carapace length (mm). This factor will become useful for inspectors in determining whether the tails measured do in fact correspond to the minimum legal tail-length.

1.6 Special Comments

A significant problem with surplus production models in assessing spiny lobster is it is assumed that the population is self-recruiting, whereas it is generally thought that lobster recruitment is spread widely across islands. This will add considerably to the uncertainty of this assessment. With better data, alternative approaches to assessment would need to be considered.

1.7 Policy Summary

The goal to be achieved for management of the marine fisheries of Jamaica is the sustainable use of fisheries resources for the maximum benefit of the people of Jamaica. In the draft management plan for the lobster fishery, the stated management objective is to restore/rehabilitate the fishery through protection of lobsters, and protection and enhancement of their habitat.

The management tools of gear restrictions, effort reduction, and enforced closed season and co-management arrangements, should be examined for use in this fishery. There is already legislation in place to prevent the taking of berried lobster, the prohibition of the possession and landing of lobsters during the closed season of lobsters. However, monitoring data suggest that these regulations are not being strictly respected.

References

FAO. (1993). Marine fishery resources of the Antilles. *FAO Fisheries Technical Paper* No. **326**. Rome

Kelly. R. (2002). Report on the spiny lobster fishery in Jamaica *In* Report of the Second Workshop on the Management of Caribbean Spiny Lobster Fisheries in the WECAFC Area Havana, Cuba, 30 September - 4 October 2002. *FAO Fisheries Report/FAO Informe de Pesca*. No. **715**. Rome, Roma, FAO. 2003. 273p.accessed on June 12, 2008 at http://www.fao.org/DOCREP/006/Y4931B/y4931b0e.htm#fn22

Munro, J.L. (1983). Caribbean coral reef fishery resources. *ICLARM Studies and Reviews* 7, Manila, Philippines.

2.0 Conch Fishery of Jamaica

2.1 Research Recommendations for the Jamaica conch Fishery

There are two approaches to assessing the status of conch on Pedro Bank. The first is to look at catch rates in the commercial fishery along with associated fishery data such as the spatial distribution of fishing effort. The second is to monitor biomass through periodic surveys (generally every 3 years). These two approaches are not incompatible and the results from the two methods should be integrated to obtain improved assessment of the resource. The calculations proposed here were not attempted at the meeting because of uncertainties about the data. The following recommendations were developed by the Working Group.

1) Compile and verify all data on catch, effort, and catch rate, with particular reference to units and conversion factors.

2.2 Commercial catch and effort statistics

Monitoring catch rates provides a method for tracking changes in the population over time. However, this provides qualitative indications on what changes in quota might be appropriate.

2) Estimate catchability coefficient from several years of data.

The catch rate index of abundance can be converted into an estimate of absolute population abundance if information is available on the catchability coefficient. The catchability coefficient, q, is the constant of proportionality that relates catch rate, c/e, to average biomass, $\overline{B}$. Thus,

$$c / e = q\overline{B}.$$

The absolute biomass can be estimated from transect surveys. The average biomass over the course of the year can be estimated as the average of the estimates obtained from the survey at the start of the year and the end of the year (or start of the next year). (If the biomass does not change much from the start of the year to the end then a single survey might suffice).

Estimates of q should be made for several years in order to obtain a precise result.

3) Explore use of biomass dynamic models.

Given a sufficient number of years of data on catch and effort in the conch fishery, it should be possible to develop a biomass dynamic (or surplus production) model. Furthermore, estimates of absolute abundance or catchability coefficient from transect surveys can be incorporated in the model and used to "anchor" the fitted trajectory of biomass over time to observed values.

A surplus production model was developed prior to the initiation of the transect surveys but was abandoned. It was not clear to the Working Group why this was so and it is recommended that the surplus production model be revisited to see what it might contribute to towards the development of a surplus production model in the future.

Commercial catch data can also be used in conjunction with a survey estimate of abundance to compute an estimate of the exploitation rate (see below).

2.3 Diver transect surveys of abundance

Additional analyses of the survey data should be considered. In particular, in addition to the estimation of catchability coefficient described above, it is worth trying to estimate exploitation rate and annual survival rate from the survey data from 2007.

4) Estimate exploitation rate. The exploitation rate, u, is the fraction of the population present at the start of the year that is harvested during the year. It can be estimated from the landings and survey data as follows:

$$u = \frac{landings}{\hat{N}_{adults} + \hat{N}_{large\ juveniles}}$$

where $\hat{N}_{adults}$ is the survey estimate of adult conch at the start of the year and similarly $\hat{N}_{large\ juveniles}$ is the estimate for large juveniles. We include the large juveniles in the denominator because these animals become adults during the year and contribute to the landings.

5) Survival rate. The annual survival rate, S, is the fraction of the population present at the start of the year that is alive at the end of the year. If there are surveys at the start of year 1 and 2 that produce estimates of the number of adults and large juveniles, then survival rate can be estimated by

$$S = \frac{N_{adult,2}}{N_{adult,1} + N_{large\ juvenile,1}}.$$

Here, the subscripts refer to the component of the population (adult vs. large juvenile) and the survey (1 or 2). The number of adults at time 2 represents the surviving number of adults from time 1 plus the surviving number of large juveniles from time 1 (which have now become adults at time 2). Hence, it is necessary to include the large juveniles in the denominator.

2.4 Integrated model of fishery and survey data.

6.) Create a simple model of conch population dynamics based on total catch and two survey estimates. In addition to using fishery and survey data to estimate the catchability coefficient in the fishery and the exploitation rate, it is possible to put together a simple model of the population dynamics of conch and use it to either estimate unreported catch (if this is large) or to check on the reliability of the available data (if unreported catch is small). The model looks like a simplified version of the Collie-Sissenwine model (Collie and Sissenwine 1983).

The basic idea is to predict the abundance of adult conch in a second survey from the abundance of adults and large juveniles in the previous survey (i.e., one year earlier) and the known catch. The model can be written as;

Predicted adults at time 2 = number of adults and large juveniles at time 1 – catch – natural mortality.

An assumption has to be made about the value of natural mortality. Several trial values should be tried. If illegal fishing is minimal then the predicted abundance of adults should match the observed abundance if the surveys and catch data are reliable. This can provide an important check on the reliability of the available data. If, on the other hand, there is substantial unreported catch, then the

difference between predicted and observed number of adults at time 2 can provide an estimate of the unreported catch.

If annual surveys are available for several years then a multi-year model can be constructed which can be used to smooth the estimates of abundance to reduce measurement error, as in the Collie-Sissenwine method.

3.0 The Nevis Conch Fishery

Trends in landings are not currently available. Examination of various reports with landings data revealed problems with incorrect units and confusion about years. Consequently, there is a need to examine the historical landings data. Anecdotal information suggests conch may have been depleted from inshore areas and fishers are now fishing in deeper water.

3.1 Management Objectives

Currently, the fishing regulations pertaining to conch are as follows:

(1) In this Regulation, "immature conch" means:

(i) a conch, the shell of which is smaller that 18 cm in length; or
(ii) a conch, the shell of which does not have a flared lip; or
(iii) a conch with a total meat weight of less than 225 grams (0.5 lbs) after removal of the digestive gland.

(2) No person shall take, sell or purchase or have in his possession any "immature conch".

(3) The Minister may by notice published in the *Gazette* declare any period or area or both as closed for conch fishing.

(4) No person shall fish for conch during the period of a closed season for conch.

(5) This Regulation relates to the Queen Conch (*Strombus gigas)*.

3.2 Status of the Stocks

The status of the stock is uncertain because no assessment has been made.

3.3 Management Advice

No advice can be provided at this time. There is a need to compile information on landings and other statistics pertaining to the fishery, regulations in effect, and on potential regulations and their probable impacts. Data must be integrated with data from St. Kitts because fishers from the two islands fish the same grounds.

3.4 Statistics and Research Recommendations

Data Quality

There is a need for the landings data from Nevis and St. Kitts to be compiled, checked and combined. Other sources of data should be sought, if possible.

Research recommendations

- Inventory and compile all available data for Nevis and St. Kitts; put them in a comparable format and perform quality control checks. In particular, landings need to be examined because the available reports are contradictory with respect to years and units of measurement.

- Effort should be made to collect information on total fishing effort during the year. One way to do this would be to get plant operators to provide information on the number of tanks of air supplied to fishers.

- Determine the depths at which most of the fishing is taking place and try to determine the distribution of fishing effort over the banks. This will help in designing an abundance survey and will also be useful for determining if there is localized depletion of the resource causing shifts in fishing locations over time.

- When landings data have been checked, they should be examined for trends over time.

- Consider a suite of possible management actions to reduce fishing mortality, with respect to
    - Enforceability
    - Effectiveness
    - Impact on the industry

- Monitor the resource through annual abundance surveys based on scuba diving to count conch along transects. These surveys will document distribution and abundance of conch by size class and can be used to track changes in the population over time. Abundance surveys also offer the possibility of estimating
    - Exploitation rate, or the fraction of the population present at the start of a year that is harvested during the year
    - Annual survival rate, or the fraction of the population present at the start of a year that survives to the end of the year.
    - Recruitment to the fishery (and thus a forecast for the next year)

  Transect surveys of conch resources are used in Florida (USA) and Jamaica and have been used in the Turks and Caicos Islands.

- Monitor catch and effort for at least a portion of the fishery. Catch rate (catch/effort) provides a way to monitor relative abundance of the stock. It is not redundant with survey abundance estimates because each source of information provides highly variable (i.e., uncertain) estimates. Thus, it is important to determine the reliability of information on abundance by comparing two or more independent sources of information.

- Determine the value of the catchability coefficient, q, which is the constant of proportionality relating catch rate (cpue) to absolute abundance. That is,

  $$cpue/q = abundance.$$

  Catchability, q, can be estimated by dividing cpue in the fishery by the abundance estimated from the transect survey. The precision of the estimated q can be enhanced by using several years of survey and cpue data to do the computation. An estimate of the catchability coefficient is important because it can be used to convert an estimate of cpue in the fishery into an estimate of stock abundance.

4.0 Queen Conch Fishery in Saint Lucia

4.1 Management Objectives

The management objectives for the conch fishery in Saint Lucia are to:

- Rebuild queen conch stocks, particularly in the near shore;
- Ensure sustainable use of the queen conch resource.

4.2 Status of the Stock

The abundance of the stock continues to decline. The 2008 landings were beyond the thirty (30) tonnes recommended by the Fourth Annual CRFM Scientific Meeting. The assessment again indicates that the stock is likely to be over finished. The status of the stock appears to have worsened slightly compared to the assessment conducted in 2007.

4.3 Management Advice

In order to ensure the sustainability of the queen conch fishery and to rebuild the density of the stock over time, the following are recommended:

-Fully enforce existing regulations, which make it illegal to harvest immature conch and which allow for a closed season, by:

- Developing and implementing a National Plan of Action for IUU[1] Fishing.
- Improving on monitoring, control and surveillance capabilities of the enforcement agencies (Department of Fisheries, Saint Lucia Royal Police Force, Coast guard etc.)

- Establish and enforce the total allowable catch (harvest quota) which, initially, should not be beyond 30 tonnes per year. The reduction of the catch should speed recovery and reduce the risk of further over fishing.

- Limit entry into the fishery to traditional fishers, in order to control the fishing effort.

4.4 Statistics and Research Recommendations

Data Quality

- The catch and effort data appear generally very reliable.

- The data were not sufficient to conduct the assessment alone; therefore, in addition to catch and effort data from Saint Lucia, information from Jamaica and the Turks and Caicos Islands was used to estimate key values used in the assessment for Saint Lucia. However, results from Saint Lucia's Conch Resource Study Assessment transect survey were incorporated into the production model for the first time.

- There is a need for an island-wide transect data survey data on the abundance and habitat of conch in Saint Lucia to improve estimates of stock status.

Research

As suggested by the Third Annual CRFM Scientific Meeting, the inclusion of the following data may improve the reliability of the assessment:

- Abundance /Density survey
- Habitat mapping (both fished and non fished areas)

[1] IUU- illegal, unreported and unregulated fishing

• With funding from the European Union Special Framework of Assistance (2003), a conch assessment project has been completed and included data on the density of conch in fished areas and the socioeconomic importance of the conch fishery in Saint Lucia.

• The collection of catch and effort data on the conch fishery should be continued and should include depth estimates.

• In the medium term, all conch habitats in Saint Lucia should be mapped.

• In the long term, it is recommended that data on the density and abundance of conch in Saint Lucia be surveyed regularly to estimate better the existing biomass and the rate of increase of the conch stock in Saint Lucia.

• With the current location of the conch stock in Saint Lucia, it would be difficult to conduct density surveys and habitat mapping in areas which are not currently fished because the depth becomes a limiting factor.

4.5 Stock Assessment Summary

• Catch per unit effort (CPUE)[2] was used as an index of stock abundance. The measure of effort was the *number of tanks used*. This measure was chosen based on the analysis done at the Fourth Annual CRFM Scientific meeting (CRFM 2008).

• The CPUE index appears to be declining each year (Fig. 1). The CPUE for 2007 was estimated at 11.13; this is an indication that for every one unit of effort (SCUBA tank) the fishers are catching approximately 11 pounds (5 kg) of conch. For 2008, the CPUE index was 10.77.

• The assessment of the conch stock in Saint Lucia was updated using the Schaefer surplus-yield model to include catch and effort data collected in 2008. The surplus production model was a Bayesian model and provided estimates of Maximum Sustainable Yield (MSY[3]).

• The results indicate that the current biomass of the stock is below the biomass of the stock at MSY (Fig. 2) and the current catch of 37.8 tons is likely to result in over fishing.

[2] CPUE is the quantity of fish caught (in number or in weight) with on standard unit of fishing effort.

[3] Maximum Sustainable Yield or MSY is, theoretically, the largest yield/catch that can be taken from a species' stock over an indefinite period. Any yield above MSY is thought to be unsustainable.

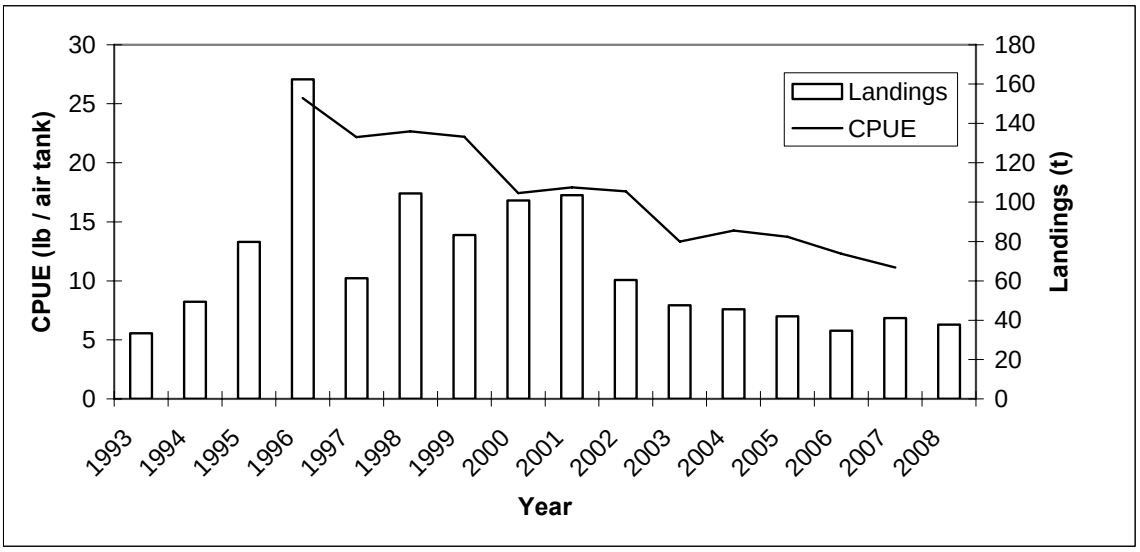

Fig. 1: The CPUE abundance index shows a continuous decline since 1996, suggesting that the stock abundance has declined over this period. The catch time series 1993-2001 has some uncertainty as to the recorded data (see Section 1.4.1).

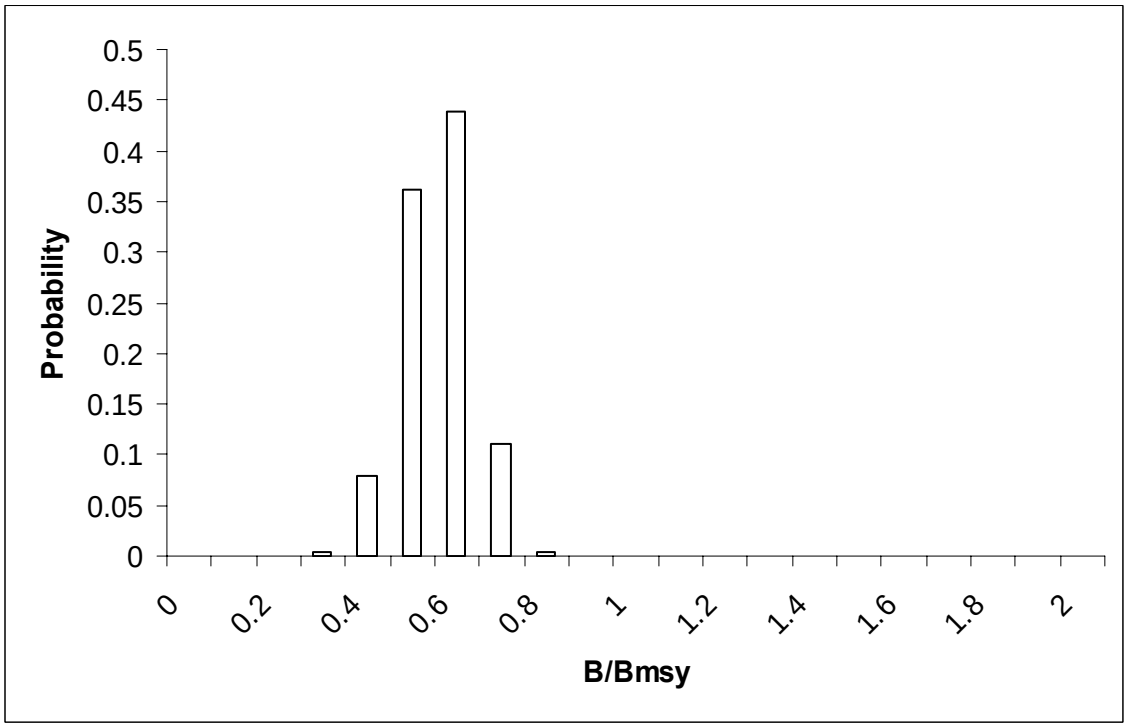

Fig. 2: There is a high probability that the current biomass of the stock is below the MSY target of 1 (B/BMSY < 1).

4.6 Special Comments

- The Bayesian priors[4] may be estimated to be too high because values used in their calculation are believed to be higher than what really exist. That is, there is concern that comparing bank areas without taking account of the local habitat leads to greater uncertainty in the assessment.

- Last year it was recommended that improved prior information, based on actual conch habitat areas in St. Lucia, compared with use of data from TCI and Jamaica might increase the accuracy of the assessment. Accordingly, this year a model was fitted in which the prior distribution for virgin biomass was based on observed densities in Saint Lucia taken from the Conch Resource Assessment. The overall results did not differ much from last year's results.

- There is a need for management to apply measures such that the CPUE for this fishery increases. This, as a by-product, would also lead to better parameter estimates.

4.7 Policy Summary

The policy of the Government of Saint Lucia is the commitment to the conservation and sustainable use of its fisheries resources for the long-term benefit of the people of Saint Lucia.

The overall goals for fisheries management are:

- Maintain or restore populations of marine species at levels that can produce the optimal sustainable yield as qualified by relevant environmental and economic factors, taking into consideration relationships among various species.

- Preserve rare and fragile ecosystems, as well as habitats and other ecologically sensitive areas, especially coral reef ecosystems, estuaries, mangroves, seagrass beds, and other spawning and nursery areas.

- Protect and restore endangered marine and freshwater species.

- Prevent the use of destructive fishing gear and methods.

- Take into account traditional knowledge and interests of local communities, small scale artisanal fisheries and indigenous people in development and management.

- Develop and increase the potential of living marine resources to meet human nutritional needs, as well as social, cultural, economic and development goals in a manner which would ensure sustainable use of the resources.

- Ensure effective monitoring and enforcement with respect to fishing and other aquatic resource uses.

- Promote relevant scientific research with respect to fisheries resources.

- Ensure that the fishing industry is integrated into the policy and decision-making process concerning fisheries and coastal zone management.

- Promote a collaborative approach to freshwater and marine management.
- Co-operate with other nations in the management of shared and highly migratory fish stocks.

[4] A prior is a probability distribution for a variable with an uncertain quantity. The value assigned is based on probability.

References

CRFM. (2008). Report of the Fourth Annual Scientific Meeting- St. Vincent and the Grenadines. *CRFM Fishery Report*- 2008, Volume 1.

Nichols, K., and Jennings-Clarke, S. (1994). An overview of the Conch Industry in St. Lucia, West Indies. In:R.S. Appledorn & B. Rodriquez (Ed.) *Conch Biology, Fisheries and Mariculture* Fundacion Cientifica Los Roquez, Caracas, Ven.

Walker, L. (unpubl). Conch Fishery of Saint Lucia: analysis of questionnaires administered to boat owners. Unpublished report.

II. LARGE PELAGIC FISH RESOURCE WORKING GROUP (LPWG)

Chairman: Leslie E. Straker
Derrick Theophille (Dominica); Paul Phillip (Grenada); Leslie Straker (St. Vincent and the Grenadines) Garth Ottley and Louanna Martin (Trinidad and Tobago); Kathy Lockhart (Turks and Caicos Islands); David Die (Consultant/ ICCAT)

A. OVERVIEW

At the Fourth Annual CRFM Scientific Meeting held in 2008 Mr. Christopher Parker, Barbados, was selected as Chairman of the Large Pelagics Working Group (LPWG) for the Fifth Annual Scientific Meeting. However, Mr. Parker was unable to attend this meeting. As a result a new chairperson was nominated, Mr. Leslie Straker. Dr. David Die was the consultant assigned to work with the LPWG. The group approved the following set of tasks on which it would focus its attention during the working group session:

1. Review of inter-sessional activities
    a. Review of the ICCAT Data Training Workshop held in Guyana, plus its recommendations to be considered by the LPWG:
        i. Preparation of an ICCAT SCRS paper providing feedback on the data queries raised by ICCAT during the Feb 09 Guyana workshop - countries concerned would have to provide their explanations and perhaps data as well to justify the explanations.
        ii. Preparation of an ICCAT SCRS paper by Trinidad and Tobago (T&T) to document and justify revision of the T&T billfish catch-series held in the ICCAT database.
        iii. Finalization of port sampling proposal
    b. Review of the ICCAT SCRS 2008 report, including relevant recommendations to be considered by the LPWG.
    c. Review and possible finalization of proposal being prepared by the Turks and Caicos Islands to improve monitoring and management of its finfish fishery.
2. Review and conduct assessments of selected species
3. Discuss training of workshop participants in fisheries statistical analyses

Review of Inter-sessional Activities

Review of outcomes of ICCAT Data Training Workshop
ICCAT, with the support of CRFM, organized a data training workshop in Georgetown, Guyana, February 16-20, 2009. During the workshop participants agreed to revise, after the workshop, some specific issues pertaining the national data provided to ICCAT. The LPWG reviewed the progress made on these issues. The following sections summarize such progress.

Review of billfish catches of Trinidad &Tobago

Prior to 2001, reports of longline billfish landings provided by Trinidad and Tobago (T&T) to the ICCAT Secretariat contained "billfish unclassified". Since 2001 these landings are reported by species. An ICCAT SCRS paper was prepared to review the longline landings for T&T, including the disaggregation of the "billfish unclassified" reports. As a result T&T billfish landings are now reported by species from 1983 onwards.

SCRS paper summarizing responses to data query issues

Several country specific data query issues were raised pertaining to Task 1 at the Guyana workshop. Participants from the relevant countries at the CRFM workshop provided answers to these questions and prepared a draft ICCAT SCRS paper.

During the plenary session of the present meeting, it was suggested that a short introduction and rational section be included in this proposed paper. It was also suggested that in the case of Grenada, a short description of the longline fishery should be included. This will ensure that there are no further misinterpretations by ICCAT with respect to the size of the operations in this country. A query was raised with respect to the verification of the St. Vincent and the Grenadines NEI data from 1990-1999. It was suggested that some information should still be available at ICCAT at least in hardcopy. However, the ICCAT representative indicated that this might not be so and that instead, St. Vincent and the Grenadines should approach the vessel companies and possibly the port in Trinidad and Tobago to look into the possibility of reconstructing some of this data from records that might be available on file. St. Vincent and the Grenadines re-iterated its commitment to resolving this issue and indicated that if portions of the NEI catch were to be officially allocated to St. Vincent and the Grenadines this must be done with some proven justification.

Development of a proposal for port sampling and at sea-observer data collection

The LPWG completed the development of a proposal for ICCAT funding that will support the establishment of port sampling at the transhipment ports of Trinidad where vessels from Belize, St. Vincent & Grenadines and Trinidad & Tobago land tuna and tuna-like species. Additionally, the proposal aims at collecting data in Tobago and Barbados, from port sampling in the former and at-sea observer on the later. Data collected will be landings by species and size data on all ICCAT species. The proposal requests two years of funding from ICCAT and is part of an initiative of CRFM and ICCAT to help contracting parties to fulfil their obligations for data collection.

During the plenary session of the present meeting, it was indicated that it might be useful to obtain some additional information from the vessels in this proposed sampling program. Some efforts could be focused on collecting some ex-vessel prices and other socio-economic data which could be more beneficial to the countries. However, it was indicated that although this could be useful data, at the moment, it was not a priority for ICCAT. While it is understood that the general focus of the proposed project will be on collecting information on catch, effort and landings, some of these socio-economic type data could also be collected. This could be decided upon by the Parties involved.

There were also some discussions about making the use of logbooks by these target longliners in the proposed program, mandatory. It was indicated that for some of these vessels, in particular, the St. Vincent and the Grenadines registered high-seas vessels, this was already mandatory. However, it is the companies who send the information to the fisheries authority from these logbooks. No fisheries official ever inspects these logbooks. With the proposed sampling program this could be one of the duties of the samplers at the ports – to verify what is reported to the officials from the logbooks.

The question was raised as to whether Grenada, a non-contracting party to ICCAT, could be included in this proposal to at least benefit from the training element. However, it was indicated that because Grenada was a non-contracting party it was uncertain as to how ICCAT will treat this request. The ICCAT representatives indicated that from time to time, ICCAT organizes training workshops by regional blocks on various technical topics from which all countries could benefit. The 2008 Guyana training workshop was given as an example of such a training workshop.

Review of 2008 ICCAT SCRS report

The ICCAT SCRS considered in its meeting of 2008 the proposal by CRFM to hold an ICCAT-CRFM join assessments of Spanish mackerel and blackfin tuna. ICCAT SCRS identified two impediments with respect to moving forward with this proposal: financial resources to support the meeting and the lack of an established agreement between CRFM and ICCAT. There is a need for such agreement to clearly define the output of such a meeting. The LPWG agreed to attempt in the late part of 2009 some form of web-based collaboration between CRFM and selected ICCAT scientists to initiate the activities required to support such a joint assessment.

Turks and Caicos Island Concept Note for Finfish Fishery

Turks and Caicos Islands (TCI) expressed the desire to have the LPWG to comment on a document aimed at guiding the research and monitoring efforts of TCI regarding the finfish fishery of the archipelago. The document proposes a definition of the "universe" represented by the Fin-fish fishery in TCI during 2009. TCI requested the LPWG to examine this document to determine if some of the ideas presented in the document should be applicable to recreational fishery monitoring in other CRFM countries.

The Concept Note was divided into two documents. One is a Concept Note inclusive of policy, goals and objectives. It would be a briefing to show managers that intention of the research priorities for the fin-fish fishery. A second document would be a research strategy to develop a research-monitoring program of the Fin-fish fishery.

Essential data to be collected include a list of all landing sites (number and locations), gear types used, and number of fishers involved in the fishery. Additionally a list of priority species (perhaps the top 10-20) needs to be developed. These species should be those of high importance in the fishery because of their quantity and/or value but also may include some of high importance because of their critical conservation status. TCI may consider the process being used in Puerto Rico to develop a similar list for the fisheries of the island[5]. Information on the timing and seasonality of activities as well as historical information on its evolution, even if it includes anecdotal references, needs to be collated as well. Finally the paper proposes to make costs estimates of the monitoring requirements.

All information should be summarized in a briefing document that can help the planning of the overall strategy for data collection. Because TCI proposes to aim at no more than 20% maximum error in sampling it is imperative that the TCI prioritize the value of different data sets. Once the sampling strategy is determined, then forms can be easily created and implemented. Guidance on survey design can be obtained from FAO publications on the matter provided to the LPWG by the consultant.

It was discussed that the collection of information from the sport/recreational fishery may prove rather problematic. It was suggested to collect information by a visiting card supplied when purchasing a fishing license. Alternatively, fishers purchasing a license could be asked to provide an email address so that TCI could send them a message directing them to a website where they could

[5] Todd Kellison, NOAA SEFSC personal communication

enter information on their recreational catch. Regardless of the method used for data collection it was agreed that some form of incentive would have to be provided to encourage recreational fishers to report landing information.

Assessments

In 2008 the LPWG agreed to conduct an assessment of dolphinfish during the 2009 CRFM scientific meeting. Unfortunately no new information on dolphinfish was brought to the 2009 meeting by participants. Therefore it was agreed that this species would not be reassessed this year but in 2010.

The LPWG reviewed whether any new information on other pelagic species (eg. wahoo, king mackerel…) was available to be analyzed, but none was forthcoming hence it was agreed that this year the group would not conduct any new or update past assessments.

Training in fisheries statistical analyses

The LPWG considered that beyond the need for supporting training for single species assessment there is also a need to train CRFM scientists in techniques related to the assessment of the entire ecosystem. The LPWG examined the accomplishments of the FAO-LAPE project and its possible application to the future work to be done by the LPWG as it moves towards providing assessments that follow the principles of ecosystem-based fishery management. Specifically, the LPWG proposes to use the results of the LAPE Project as a source of data and models that can support training session on ecosystem categorizing tools. This training would allow the LPWG to embark in future evaluations of the health of the entire pelagic ecosystem and not restrict itself to individual stocks. With the view of kick starting this process the LPWG constructed a time series of the average trophic level of fish harvest from 1979-2008 by the St. Vincent and the Grenadines fleet.

The plenary session of the present meeting, supported the type of analyses that were reported in appendix 5, and the initiative of the LPWG to start thinking about analyses at the ecosystem level and with a broader focus than the current single-species assessments. Except for the LPWG none of the other group indicated that they give any great consideration to this idea in their deliberations. The plenary session also agreed that other CRFM scientific working groups should consider some of the available ecosystem tools in their analyses as the next necessary step in getting a better understanding of many of the Region's fisheries.

General Recommendations

Three major recommendations are made by the LPWG: continuing the exploration of ecosystem indicators, conducting a dolphinfish assessment in 2010 and postponing the blackfin tuna and Spanish mackerel assessment until at least 2011. More details on these recommendations are provided below.

- The LPWG recommends to use the results of the LAPE project to start developing ecosystem indicators for the pelagic ecosystem. This would be a very useful way to learn more about the fishery ecosystem as opposed to continuing to focus our attention on single species analyses. This may be done in several ways:
    - Communicating results of single species CRFM assessments to LAPE scientists so that the models developed by LAPE can continuously be updated.
    - Spend the time looking at the assumptions made by the LAPE project, making corrections where required and transmitting these to LAPE scientists.
    - Take some ownership of the modelling effort by LAPE and re-run their regional ECOPATH model by making and effort of changing some of the parameters to answer different questions that they did not consider during the LAPE project and that are of interest to the LPWG.

- Conduct a dolphinfish assessment in 2010 making sure that this time it includes some of the other key regional fishery fleets that were not considered in the prior assessment (i.e. Trinidad and Tobago, France and Venezuela).
    - During the intersession, LPWG members should help convince these other countries to supply the data or facilitate their participation at the CRFM Scientific Meeting. The opportunity might be there for one of the members of the LPWG to attend the GCFI or the ICCAT-SCRS to develop appropriate network to get information on the dolphinfish from Venezuela and other relevant countries attending GCFI.
    - The group should to set up an inter-sessional meeting through video conferencing prior to a dolphinfish assessment and invite France, Venezuela, etc, to discuss what other available data these countries might have. This should probably be done early in the last quarter of 2009.
- Postpone the Spanish mackerel and blackfin tuna assessments until at least 2011 when we can better assess the success of the video-conferencing efforts to involve other countries.

B. FISHERY MANAGEMENT ADVISORY SUMMARIES

No large pelagic fish assessments were conducted in 2009. However, specific research papers and project proposals were prepared, which are reproduced in Volume 1 of this report.

III. REEF AND SLOPE FISH RESOURCE WORKING GROUP (RSWG)

Chairman: John A. Jeffers (Montserrat)
John A. Jeffers (Montserrat); Nancie Cummings (NMFS, SEFSC- Miami, FL USA)

A. OVERVIEW

The chairman of the Reef and Slope Working Group (RSWG) for the Fifth Annual Scientific Meeting of the CRFM was the only member present. Inter-sessional tasks identified by the RSWG at the Fourth Annual Scientific Meeting included: developing an analysis data set for mutton snapper from Belize, for parrotfishes from St. Kitts and Nevis, species to be determined from St. Lucia, and developing data sets for red hind and queen triggerfish from Montserrat. The RSWG group commenced the work with data from only one country, Montserrat, as no other data sets were made available for the meeting. At the opening of the Fifth Annual Meeting, the Chairperson stressed the importance of the various working groups to consider regional agencies and countries involved in similar work.

B. FISHERY MANAGEMENT ADVISORY SUMMARIES

1.0 The Red Hind (*Epinephelus guttatus*) and Queen Triggerfish (*Balistes vetula*) fisheries of Montserrat

1.1 Management Objectives

Red hind and Queen triggerfish are considered as important components of the demersal reef and slope fisheries in Montserrat. The demand for these species has increased over the past five years as compared with other demersal caught species. The Montserrat Fisheries Division has noted the following management objectives for the reef and slope fishery:

- Manage the fisheries stocks to maintain sustainability at the national and at a regional level;
- Implement management measures as needed to ensure viability of the resources through effort controls, size limits, closed seasons, MPA's;
- Maximize fishers revenue while assuring acceptable levels of stock sizes;
- Minimize impacts on habitat and fishery resources to optimize future stock health.

1.2 Status of Stock

The status of the Red hind and Queen triggerfish stocks are currently unknown.

1.3 Management Advice

Until a detailed stock assessment is conducted there are no recommended changes to the fishery. However there may be a need to implement corrective measures in the future in order to achieve sustainability.

Sustainability of the RSF resources can only be achieved if the recommendations from the scientific meeting are implemented successfully within the desired time frame in order for a full evaluation of the resources to be conducted.

1.4 Statistics and Research Recommendations

Data Quality

Several tasks were identified, which if completed during the 2009/2010 inter-sessional period, should improve the data quality significantly and the management advice generated from analyses of these data.

- The current landings data collection form should be modified to account for discards, spatial area of catch, quantity and type of gear used;
- Develop protocols to improve the timeliness of landings data availability from fishers who may not be accessible during normal working hours;
- The historical landings data needs to be computerized including developing quality control and assurance protocols to ensure an accurate time series of data;
- Generate preliminary summaries of the computerized data to use in evaluating the sufficiency of data for future stock assessment evaluations for the multispecies RSF;
- Funding is needed to support these tasks and to provide for the purchase of a computer dedicated to the data collection program and for the data entry and quality control/assurance;
- The fishable area for the RSF has been reduced in recent years due to volcanic activity; there is a need to quantify the current amount of RSF fishable area and to document any potential ongoing threats (e.g., mud flows, sedimentation) to the marine environment.

Biological data collection

Several critical needs were identified pertaining to biological data collections. These data needs are required in order to describe catch at size and to evaluate seasonal changes in maturity of the RSF species.

- Catch length frequency sampling should be implemented during the 2009/2010 period and continued as an ongoing data collection priority;
- Routine biological data collections (length/weight, maturity, ageing), should be implemented. Species to be studied should be identified during the 2009/2010 inter-sessional period and should be based on examinations of the landings data. Attention should be given to prioritization of species at both the national and the regional level;
- Information on spawning timing and areas needs to be documented as soon as possible. It is recommended to conduct a survey of the local fishers as a starting point to obtain this information as well as investigate fishing on spawning aggregations;
- Conduct a literature search at the national and regional level to document information on growth, mortality, spawning, maturation, fecundity.

Other data collection

- Conduct a literature search to document and compile a list of all research in volcanic activity and the impacts it has on the marine/fishery environment;

1.5 Data Analysis Summary

While there was no assessment there were several issues discussed. There is a critical need to have the data fully computerized so that a full analysis can be conducted in 2010 of the RSF. The quantity of discards and reason for discarding must be documented in order to provide accurate information on total catch.

The preliminary analyses of the summary CPUE data (Lbs per trip vs Trips) showed a positive relationship between catch and effort supporting further analyses of the complete time series when the data become available. In addition, the results of the ANOVA supports further examination of the raw data to identify additional auxiliary data to use in describing the variability in CPUE (e.g, # of crew, vessel fishing power, area (ground) fished). The time series of data analyzed at this meeting, 2004-2008, is insufficient to allow long term changes in the Red Hind and Queen Triggerfish fisheries to be quantified.

Exact information on fishing location is not available however it is known that since the onset of volcanic activity that fishers have moved to new fishing locations.

1.6 Special Notes

Preliminary examinations of summary CPUE data for Red Hind and Queen Triggerfish from the Montserrat pot fisheries were conducted at this meeting. Future analyses of these RSF fisheries can be strengthened if the data improvement recommendations are implemented in a timely manner.

Every year a significant number of traps are lost or destroyed with a high percentage of these traps continuing to fish for extended periods. This emphasizes the need to quantify the long term impacts on fishery resources from these ghost fishing traps as relates to number of lost traps and quantity of catch.

The ongoing volcanic activity associated with continuous mudflows has had a negative influence on fishery production areas, as well as nursery habitats. The impacts from other natural events such as hurricanes and surging seas also impact fishery production and nursery habitats.

Given the fluid nature of the marine environment there is a need to document various events that influencing negatively on the marine environment and more so the fisheries and habitats associated with the fisheries, on an ongoing basis.

1.7 Policy Summary

The policy of the Montserrat government as it relates to the RSF is to ensure the fishery resources are sustainable. As part of this objective, it is planned that in 2010, training of some RSF fishers will be done to educate them into pelagic fisheries operations, in an attempt to reduce RSF effort.

IV. SHRIMP AND GROUNDFISH RESOURCE WORKING GROUP (SGWG)

Chairperson: Lara Ferreira, Trinidad and Tobago
Colletta Derrell (Guyana); Ranjitsing Soekhradj (Suriname); Lara Ferreira (Trinidad and Tobago); Paul Medley (Consultant)

A. OVERVIEW

Report of Work Progress since 2008 Meeting
At the 4th CRFM Scientific Meeting in 2008, two stock assessments for shrimp and one stock assessment for groundfish were completed. Guyana and Suriname each conducted a separate assessment for the seabob (*Xiphopenaeus kroyeri*) using data from their respective national fleets. Trinidad and Tobago conducted an assessment for the whitemouth croaker (*Micropogonias furnieri*) exploited by local fleets. The following summarizes the progress of work on shrimp and groundfish for these three countries since the 2008 meeting.

Guyana & Suriname
A biological data collection programme was initiated in December 2007 at two processing plants in Guyana (Noble House) and Suriname (Guiana Seafoods) by the owner of the plants, a Belgian company by the name of Morubel NV. This programme (which includes the collection of morphometric data, size composition, maturity, and landings and effort data) continued throughout the inter-sessional period with the participation of staff of the Fisheries Department in the case of Guyana. In the case of Suriname, a meeting was held between the Government and the processing companies, and the Government agreed that it would participate in the data collection programmes. The biological data collected by the processing companies were submitted to the Fisheries Departments in the two countries. The landings and effort data were computerized by the Fisheries Departments. Some analysis of the morphometric data was conducted to determine length and weight conversions.

The Department of Fisheries in Guyana obtained landing data by size category and month from the three other seabob processing companies in Guyana. Rainfall data for the period 1996 to 2008, and Essequibo River outflow data for the period 1998 to 2007 were also obtained from the Hydrometeorological Department of the Ministry of Agriculture, Guyana. The Fisheries Department in Suriname obtained landing data by size category and month for 2008 from the second seabob processing company in Suriname, namely Namoona.

Trinidad & Tobago
Trinidad and Tobago had previously agreed to test the ParFish (Participatory Fisheries Stock Assessment) methodology which was identified for consideration under the Methods Working Group as being particularly appropriate for data-poor fisheries. The Government of Trinidad and Tobago contracted Dr. Paul Medley for a two-week period in April/May 2008 to brief Fisheries Division staff on the methodology and to conduct training in carrying out the ParFish interviews. The shrimp trawl fishery was used for the case study. A total of 43 interviews were conducted with fisherfolk in the artisanal, semi-industrial and industrial shrimp trawl fisheries over the period April to October 2008.

Report on Relevant Activities/Plans of Other International Fisheries Organizations.
In 2008, plans were being made by the FAO to host a meeting of the WECAFC (Western Central Atlantic Fishery Commission) ad hoc Working Group on the Shrimp and Groundfish Resources of

the Brazil-Guianas Shelf on the constraints to fisheries management in the subregion and their resolution. In preparation for the Workshop, the FAO had a matrix/spreadsheet prepared which summarized for each member country the status of the various shrimp and groundfish fisheries and the recommendations (national and regional) made for the management of these fisheries based on the reports of the assessment and related workshops of the Ad hoc Working Group held over the period 1986 to 2005. The matrix was disseminated to member countries of the WECAFC Group for completion regarding the status of implementation of recommendations, constraints and potential solutions. Countries were also requested to prepare a national report for which a table of contents was provided. No responses were received from countries as at the end of 2008.

The Chair of the CRFM Shrimp and Groundfish Working Group (SGWG), who was involved in the preparation of the matrix, provided an electronic copy of the matrix to the members of the SGWG present at the 2009 meeting as they were not familiar with the matrix and had not previously seen it. It was agreed that they would take it to their superiors in their respective countries in an attempt to follow-up on the activity. The Chair of the SGWG will continue to liaise with the members of the SGWG with regard to the completion of the matrix.

Tasks to be Addressed at 2009 Meeting.

Guyana & Suriname

- Assessments of Atlantic seabob (*Xiphopenaeus kroyeri*) are to be conducted for Guyana and Suriname separately as well as jointly.
- Effect of river outflow on productivity is to be examined.
- Morphometric relationships are to be determined for the seabob resources for Guyana and Suriname separately, and then compared to determine whether they are significantly different.
- Size compositions are to be analysed to determine growth parameter estimates.
- The management unit with regard to the seabob stock is to be identified.
- Recommendations with respect to harvest control rules and reference points are to be produced.
- The most appropriate time for a closed season in each of the two countries is to be determined.

Trinidad and Tobago

- Data obtained from the ParFish interviews conducted for the shrimp trawl fishery are to be analysed.
- ParFish data are to be incorporated into a Bayesian biomass dynamics model for Trinidad and Tobago and Venezuela. This model will be a modification of the biomass dynamics model developed for Trinidad and Tobago-Venezuela at the 2006 CRFM Scientific Meeting (Ferreira and Medley, 2006), and the 2005 bilateral Trinidad and Tobago-Venezuela meeting held under the auspices of the FAO/WECAFC Ad Hoc Working Group on the Shrimp and Groundfish Resources of the Guianas-Brazil Continental Shelf (Medley *et al*, 2006).

Relevant Policy/Management Objectives, Fishery Characteristics/Trends and Available Data for Fishery Analyses/Assessments Identified above.

Guyana

A closed season from September to October which was recommended by the trawler association has been in place since 2003. However, analyses conducted in 2007 based on the best available information suggested that a closed season in May would be effective in protecting the pulse of recruitment rather than the current closed season. Further investigations on growth rates and patterns of recruitment are required to verify and refine this advice.

Suriname

The Government of Suriname in collaboration with the two seabob processing plants intends to seek MSC (Marine Stewardship Council) Certification which is a requirement to export the seabob internationally. MSC certification requires that fisheries stocks are identified and assessed.

Available Data for Assessments

Guyana

- Data received from only one of the four seabob processing companies were considered complete. The other three companies failed to provide good quality data and hence the data submitted were used only for estimating total catch.
- Catch and CPUE for 2000 to 2008.
- Total catch for 1998 to 2008.
- Total catch for 1985 to 1997 from FAO FIGIS database.
- Biological data as described in an earlier section of this report.

Suriname

- Landings by month and size category for 1998 to 2008 available. (Data for 1998 to 2006 to be verified.)
- Catch and CPUE for 1998 to 2008.
- Total catch for 1998 to 2008.
- Total catch for 1989 to 1997 from FAO FIGIS database.
- Biological data as described in an earlier section of this report.

Fisheries Statistical and Assessment Analyses Conducted.

Guyana and Suriname

The following analyses were conducted for the countries separately:

- A catch and effort biomass dynamics model was fitted using Bayesian framework.
- Analysis of size composition data was conducted to determine the optimum closed season.
- Morphometric relationships were determined using the following measurements/data: total weight; tail weight; peeled tail weight; carapace length; tail length; sex.
- Various other exploratory analyses were done including cross-correlations for river outflow.
- Although explored using morphometrics, CPUE indices and size compositions, no evidence was found indicating that the stocks between Suriname and Guyana were shared, therefore separate assessments were undertaken.

Trinidad and Tobago

- Preliminary analyses of ParFish interview data were conducted.

A number of tasks identified in Agenda Item (3) were not completed due to lack of time. These tasks should be continued during the inter-sessional period and at the next scientific meeting.

Other Tasks Conducted.

This agenda item was not applicable.

Review and Adoption of Fishery Analysis Reports and Other Technical Documents.

Reports of the assessments of the seabob (*Xiphopenaeus kroyeri*) fisheries of Guyana and Suriname were adopted by the SGWG and are provided in part B of this report.

Issues and Recommendations Re: Data, Methods, Training for DMTWG.

- Basic training/refresher course in data manipulation and management to include such items as: look up functions; data query tools; pivot tables; basic introduction to SQL or Microsoft Query. This training should be targeted at officers in the region involved in stock assessment work and who attend the CRFM Scientific Meetings. Such training would facilitate improved data preparation and analysis during the inter-sessional period.

- Ageing of priority species of groundfish assessed and/or identified for assessment at previous scientific meetings would be useful for obtaining growth curves. As such, funding should be allocated to the Regional Age and Growth Lab to facilitate the ageing of these species. Funding may also be required to assist member countries in obtaining the necessary fish samples.

- Analysis of the ParFish interviews conducted for the shrimp trawl fishery of Trinidad and Tobago, and the incorporation of the data into an updated and modified biomass dynamics model for Trinidad and Tobago and Venezuela using a Bayesian framework should be completed during the inter-sessional period. This activity will require the technical assistance of Dr. Paul Medley, for which funding will be requested from the CRFM. The results of the ParFish interviews and assessment should be presented to the fishing communities.

Inter-sessional Work Plan

General

- More interaction is required among SGWG members during the inter-sessional period. This can be done via electronic mail, Skype, netmeeting site or video conferencing.

- The Stock Assessment Parameters Profile for five species of Western Atlantic Tropical Shrimp, first developed by the Government of Trinidad and Tobago under an FAO/UNDP Project TRI/91/001 and subsequently updated, will be circulated among the members of the SGWG for update with new information obtained from assessments conducted at this workshop as well as any other relevant information.

Guyana & Suriname

- Catch and effort data for Suriname is to be verified. Catch and effort data series is to be extended as far back as possible prior to 2002 in the case of Guyana, and 1998 in the case of Suriname.

- Attempts should be made to hold a bilateral meeting to review and update the assessments conducted for Suriname and Guyana at the 2009 meeting, including sensitivity analyses and projections. In order to conduct the sensitivity analyses, the key parameters that introduce the most uncertainty into the assessments must be identified. Size composition data can be used to estimate growth and mortality, and this information can be used to improve the assessment. Training in the assessment methodology should also be conducted for the members of the SGWG. The fishing industry should also be invited to the meeting to review and comment on the data and assessments. Funding for this bilateral meeting would need to be explored with the CRFM and the seabob processing companies.

- A system should be developed to obtain more accurate data from the seabob processing companies in Guyana and Suriname. A standardized computer entry data sheet should be developed as well as a database for the catch and effort and size composition data. Technical assistance will be required for this activity. Options as to how this can be achieved will be explored.

Trinidad and Tobago

- Parfish trials were conducted inter-sessionally, and the details are documented in the report of the Data, Methods and Training Working Group (see Volume 1 of this report).

General Recommendations

- The shrimp and groundfish resources are shared by the countries on the Brazil-Guianas Continental Shelf. As some of these countries are not members of the CRFM (Venezuela, French Guiana, Brazil), it is recommended that the CRFM network with the FAO/WECAFC ad

hoc Working Group on Shrimp and Groundfish Resources of the Brazil-Guianas Continental Shelf.

- Member countries should ensure that their representatives are provided with laptops powerful enough to run the assessment models at the scientific meetings.

Review and Adoption of Working Group Report.
The Working Group Report was reviewed and adopted by the members of the SGWG.

Adjournment.
The meeting of the SGWG adjourned at 7.30 pm on June 16, 2009

References

Ferreira, L. and P. Medley. (2006). The shrimp fisheries shared by Trinidad & Tobago and Venezuela. In: *Report of Second Annual Scientific Meeting – Port of Spain, Trinidad and Tobago, 13-22 March 2006. CRFM Fishery Report* – 2006, Volume **1**. pp. 93-111.

Medley, P., J. Alió, L. Ferreira and L. Marcano. (2006). Assessment of shrimp stocks shared by Trinidad and Tobago and Venezuela. FAO/Western Central Atlantic Fishery Commission. Report of Workshop on the Assessment of Shrimp and Groundfish Fisheries on the Brazil-Guianas Shelf. Port of Spain, Trinidad and Tobago, 11-22 April, 2005. Rome: FAO. (DRAFT).

B. FISHERY MANAGEMENT ADVISORY SUMMARIES

1.0 Guyana Seabob (*Xiphopenaeus kroyeri*) Fishery

1.1 Management Objectives

The Draft Fisheries Management Plan of Guyana states that the objectives for seabob management are:

1. To maintain the seabob stock at all times above 50% of its mean unexploited level.
2. To maintain all non-target species, associated and dependent species above 50% of their mean biomass levels in the absence of fishing activities.
3. To stabilize the net incomes of the operators in the fishery at a level above the national minimum desired income.
4. To include as many of the existing participants in the fishery as is possible given the biological, ecological, and economic objectives.

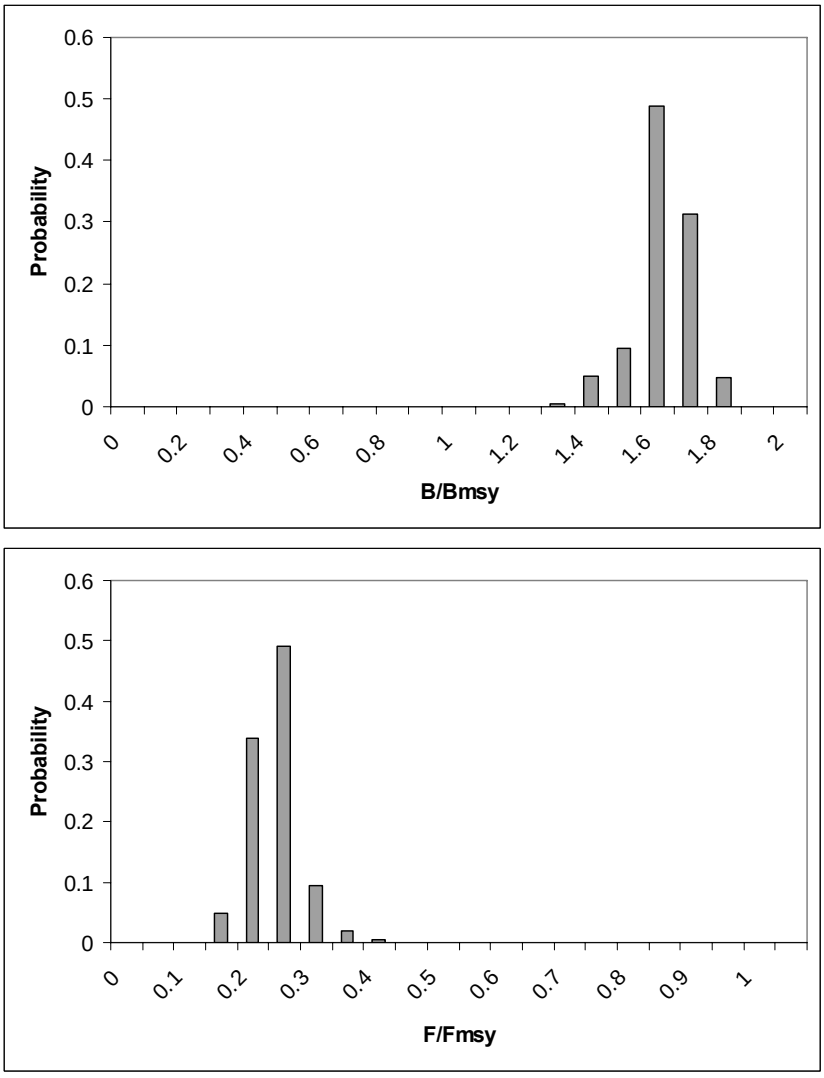

Fig. 1: Probability estimates based on the Monte Carlo integration of the posterior biomass dynamics model fitted to the catch and effort data.

1.2 Status of Stock

There is no evidence from the catch and effort data that the stock is overfished and or that overfishing is occurring. The CPUE time series shows a shallow decline but still remains high relative to the start of the series. Furthermore, despite much higher catches reported for 2004 and 2005, the CPUE showed little reaction with a slight dip followed by recovery.

The stock assessment indicates that the stock is well above the MSY level ($B/B_{MSY} > 1.0$) and the 2008 catch (10100t) was well below the MSY level ($F/F_{MSY} < 1.0$; Fig. 1).

1.3 Management Advice

It is recommended to adopt reference points and a harvest control rule within the fisheries management plan to ensure that the fishing is sustainable. The reference points and harvest control rule have been proposed based on the maximum sustainable yield point (MSY).

> Limit reference point: Biomass at 60% of the MSY estimate
> Target reference point: Biomass 120% of the MSY estimate (consistent with the management objectives).

The reference points (biomass, yield and fishing mortality at MSY) have been estimated from the annual catch and effort time series. However, given the very short time series of data, the estimates cannot be made with high accuracy and remain uncertain. Therefore the reference points are considered preliminary and need to be verified through further research. The results also need to be confirmed through analysis of the size composition data.

To maintain the stock at the target level, a trigger reference point is required. For Guyana, under the current management objectives, the trigger point would be at MSY. The trigger point identifies when management action is required to reduce the exploitation rate and rebuild the stock. The trigger point will also need to take into account the uncertainty associated with the monitoring variables chosen as part of the harvest control rule.

Controls to maintain the stock around the target level need to be defined, as do the controls applied to reduce fishing mortality as the limit reference point is approached. These could include a closed season, export catch limits and fishing effort control.

A harvest control rule should have the following properties:

- It should maintain a harvest rate which should keep at or around the target level in the long term.
- It should reduce the harvest rate as the stock approaches the limit level.
- Fishing should be minimized if the stock falls below the limit.

In addition, the following property may also be considered useful:

-
- The harvest control rule should limit year-to-year fluctuations in the control measures to levels acceptable to the fishing industry wherever possible. This will help industry to plan for and maintain a suitable level of catching and processing capacity commensurate with the productivity of the resource.

To protect recruits to the fishery and allow them to grow, a closed season would be most valuable if set in September/October. The smallest seabob are landed in September (Fig. 2), so the largest increase in yield-per-recruit would be obtained from closure at this time. However, alternative closure times (May or June) may still be warranted if special protection is required for the spawning stock. This is a departure from previous advice due to a significant improvement in the available

data on size composition. Previously, average size estimates depended upon commercial size categories which appear to have been inaccurate. Direct scientific sampling of size composition was available at this meeting.

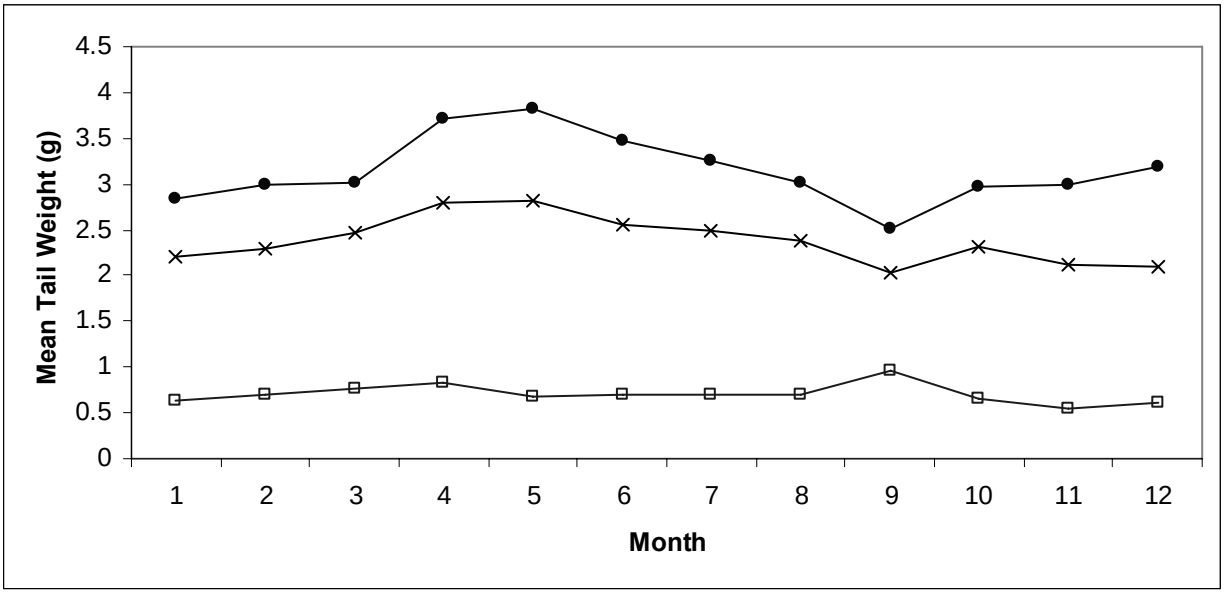

Fig. 2: Mean tail weight (g) for females (●), males (×) and juveniles (□) in Guyana by month. There is clear seasonality with maximum size reached in April/May and declining to a minimum in September when most immature seabob are encountered.

1.4 Statistics and Research Recommendations

Data Quality

Annual total catch data were available for the period 1998-2008 and monthly catch and effort data available for 2000-2008 (Fig. 3). There remains considerable uncertainty over the data accuracy. There have been very significant increases in catch during the time series without a corresponding significant drop in catch per unit effort. One reason for this is that there could be errors in data provided by the processors. This needs urgent attention as the stock assessment depends on these historical data.

Morphometric and size frequency data were also available, but there was insufficient time at the meeting to carry out a thorough examination of these data. The morphometric data were collected in December 2007 to estimate various length and weight relationships useful for conversion purposes. The size frequency data cover December 2007 to June 2008 so far, and consist of random samples taken from the landed catch before processing in the Noble House processing facility. These data have been collected by the processors for the purposes of stock assessment and have been used to consider alternative season closures.

Additional catch data were obtained from the FAO FIGIS database. These data are not likely to be very accurate, but were sufficient to allow catches to be estimated back to the start of the fishery. The level of precision of these data was adequate for this analysis, but need to be improved for future assessments to increase accuracy of the management advice.

Research

The observer program should be reinstated in order to monitor catch onboard vessels to get catch rate information, length-frequency data, and geographic information.

Economic data such as price per pound for the various market categories should be documented over the course of a year.

1.5 Stock Assessment Summary

Bayesian Statistics and the Monte Carlo (Sample importance resample algorithm) methods were used to estimate maximum sustainable yield (MSY)[6], replacement yield[7], current biomass relative to biomass at MSY, and current fishing mortality relative to fishing mortality at MSY. The assessment used the logistic surplus-yield model fitted to the total catch 1985-2008 and catch and effort 2000-2008.

Catch per unit effort (CPUE)[8] was used as an index of stock abundance. The measure of effort used was the number of days at sea, which would include steaming time. The CPUE index appears to be declining each year (Figure 3) indicating a small decline in stock size since the start of the series.

The results indicate a reasonable fit of the model (Fig. 4), but it should be noted that although the model explained the negative trend in the CPUE, this trend only formed a small part of the variation in CPUE. The number of CPUE data points (8) was limited and with only a decreasing trend, so that the priors may have influence on the results. The rate of increase is negatively correlated with the estimate of abundance, so a higher rate of increase would imply lower biomass.

The maximum sustainable yield suggested most likely values would be between 22,000-34,000 t $year^{-1}$ (Table 1; Fig. 5). The assessment depends upon the accuracy of the available data and is heavily influenced by the high catches in 2004 and 2005. If these are overestimates, the state of the stock may well be re-evaluated downwards. A sensitivity analysis replaced 2004 and 2005 total catches with the lower 2003 catch, and repeated the assessment. In this analysis, the assessment also indicated that the stock was not overfished, albeit the overall biomass was lower.

The assessment indicates that the stock is not overfished ($B/B_{MSY} > 1.0$) and overfishing is not occurring ($F/F_{MSY} < 1.0$). The working group does not endorse this conclusion without verification of the data.

River outflow and rainfall data were examined with the intention of using these environmental data as an indicator of productivity. This index was not incorporated at this time, but will form the subject of ongoing research to improve the stock assessment.

[6] **Maximum Sustainable Yield** or **MSY** is, theoretically, the largest yield/catch that can be taken from a species' stock over an indefinite period. Any yield greater than MSY is thought to be unsustainable.
[7] **Replacement Yield** is the yield/catch taken from a stock which keeps the stock at the current size.
[8] **CPUE** is the quantity of fish caught (in number or in weight) with one standard unit of fishing effort.

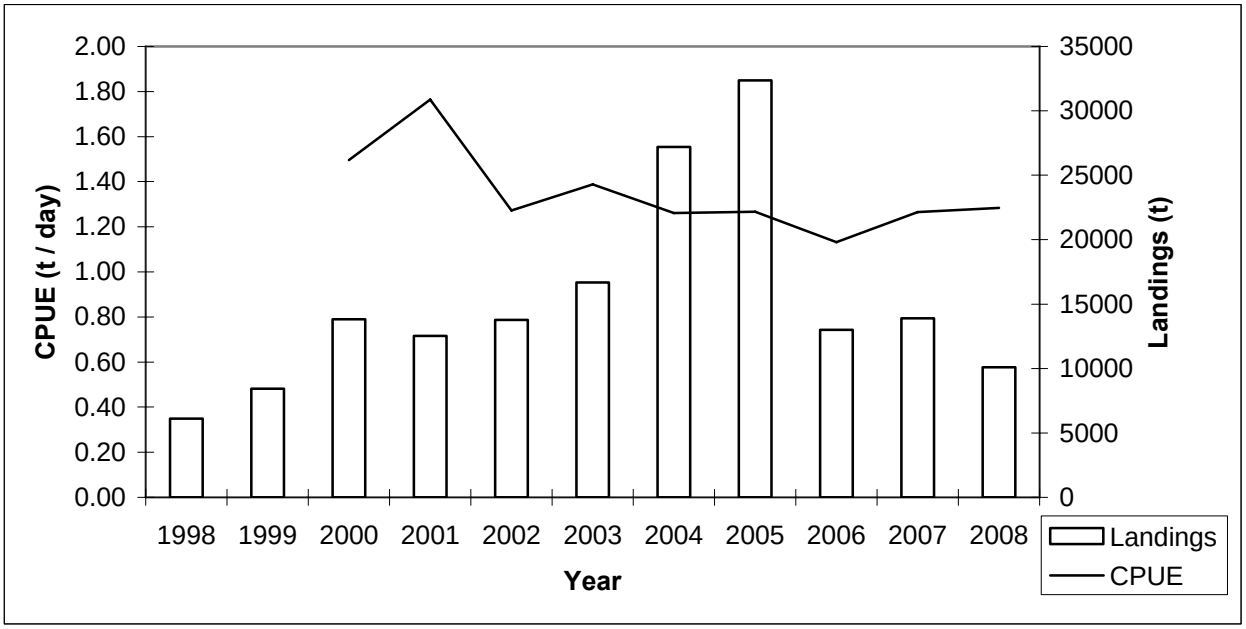

Fig. 3: The CPUE abundance index and landings of Guyana seabob 1998-2008. The CPUE shows an overall negative trend. Total effort data are unavailable for this fishery.

Table 1: Summary of results from fitting the logistic biomass dynamics model to the available catch and effort data 1985-2008. While the rate of increase (r) seems reasonable for a fast growing species, the biomass is much higher than the prior would suggest (based on a survey by Pezzuto *et al*. (2008) of a bay with an exploited seabob stock in Brazil). With a large biomass and relatively low catch, the state of the stock is estimated as likely to be above MSY and increasing.

Parameter	Lower Percentile 0.05	Median 0.5	Upper Percentile 0.95
r	0.57	0.68	0.93
B_∞	142387	149564	157540
B_{now}	0.75	0.82	0.91
MSY (t)	21424	25483	34676
	0.57	0.68	0.93
Current Yield (t)		10100	
Replacement Yield (t)	11784	14959	16076
B/BMSY	1.50	1.64	1.81
F/FMSY	0.19	0.27	0.34

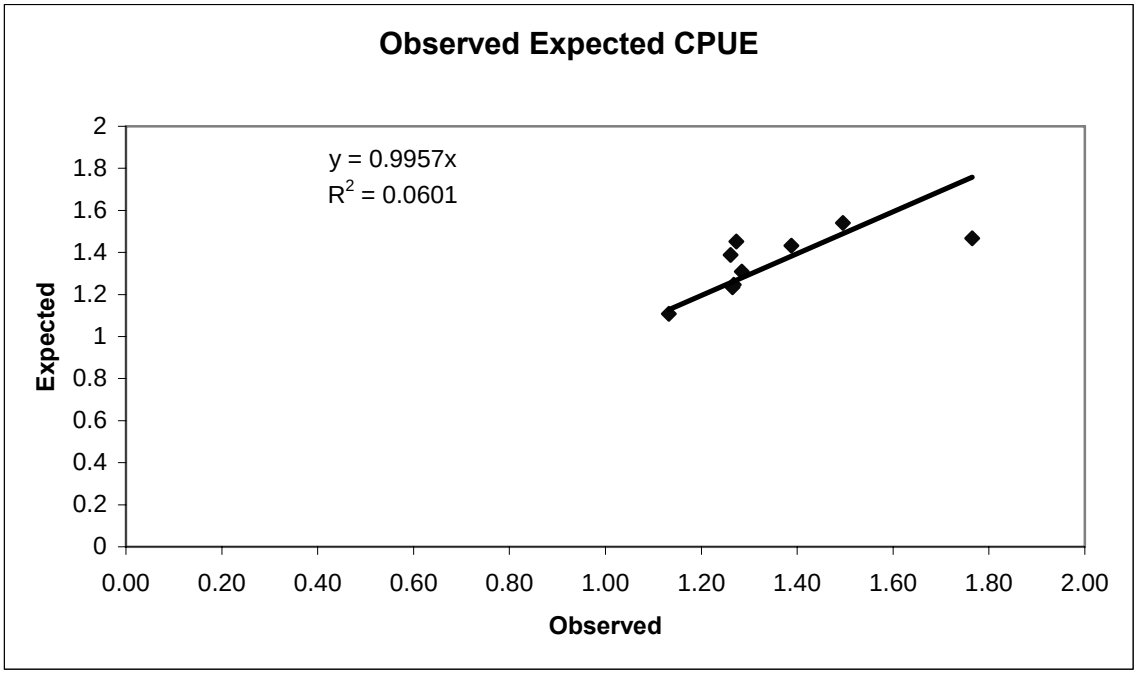

Fig. 4: Observed and expected CPUE from the model fit. The residuals show no obvious pattern around the regression line going through the origin, but the observed CPUE in 2001 was much higher than the expected from the model leading to the apparent outlier below the regression line.

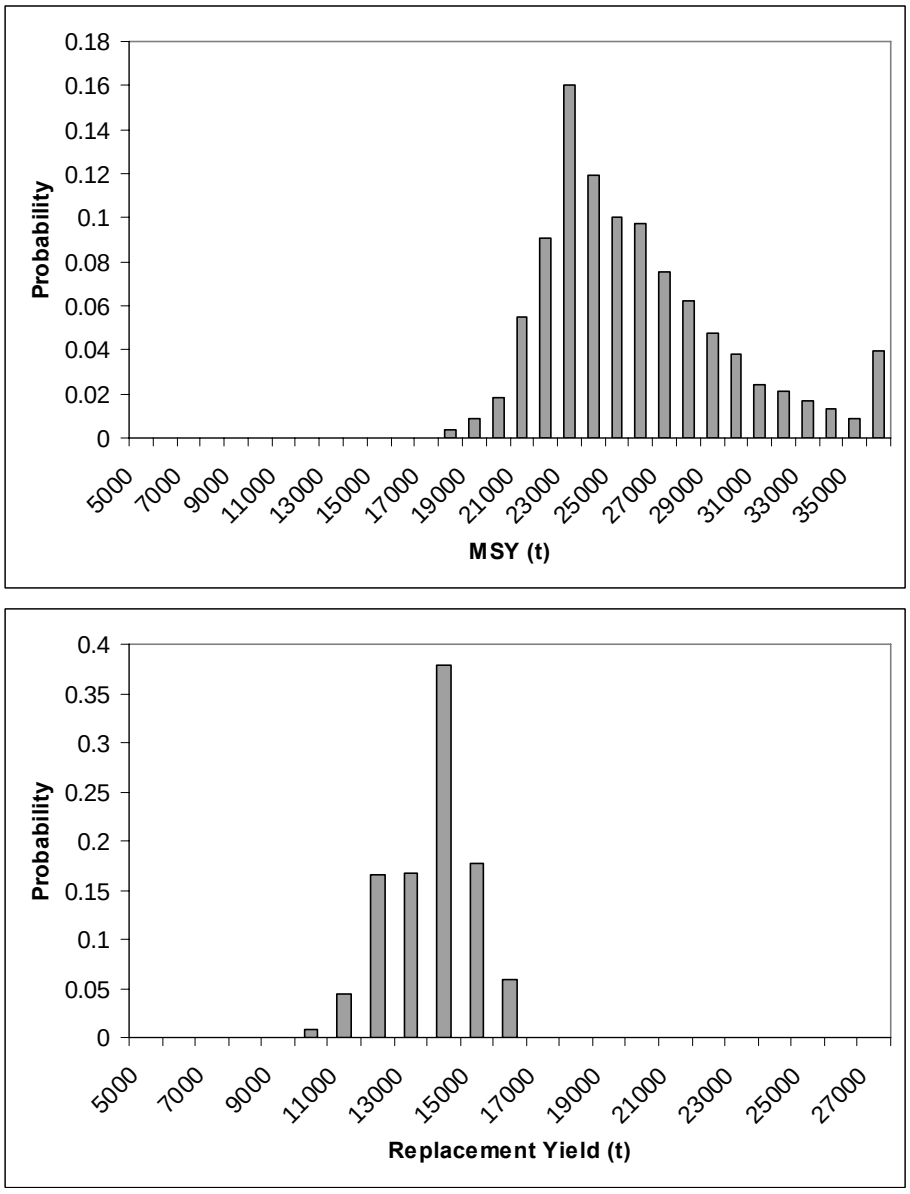

Fig. 5: Maximum sustainable yield and current replacement yield probability estimates for the Guyana seabob fishery.

As well as a standard stock assessment, the available size composition data were used to examine the effect a closed season of one month may have on yield. A simple function based on yield-per-recruit was used to estimate the change in yield for the size composition being selected in each month (Fig. 6). The most appropriate month for a closure will have the highest YPR score. In this case, the most appropriate month is clearly September when the smallest shrimp have been recorded in the sampling in that month.

Although the YPR scores for all months are negative, indicating that a closed season is not useful to increase yield-per-recruit, this conclusion is unreliable. To be valid the absolute YPR scores require parameters such as fishing mortality which were unavailable, so "reasonable" values were used rather than estimated values. The interpretation of the best month for closure, remains valid since this is not sensitive to the parameters, but depends primarily upon the size of shrimp being landed in each month.

It should be noted that this only considers yield-per-recruit (calculating gains in biomass against losses from mortality), not other considerations such as effort reduction to decrease fishing mortality.

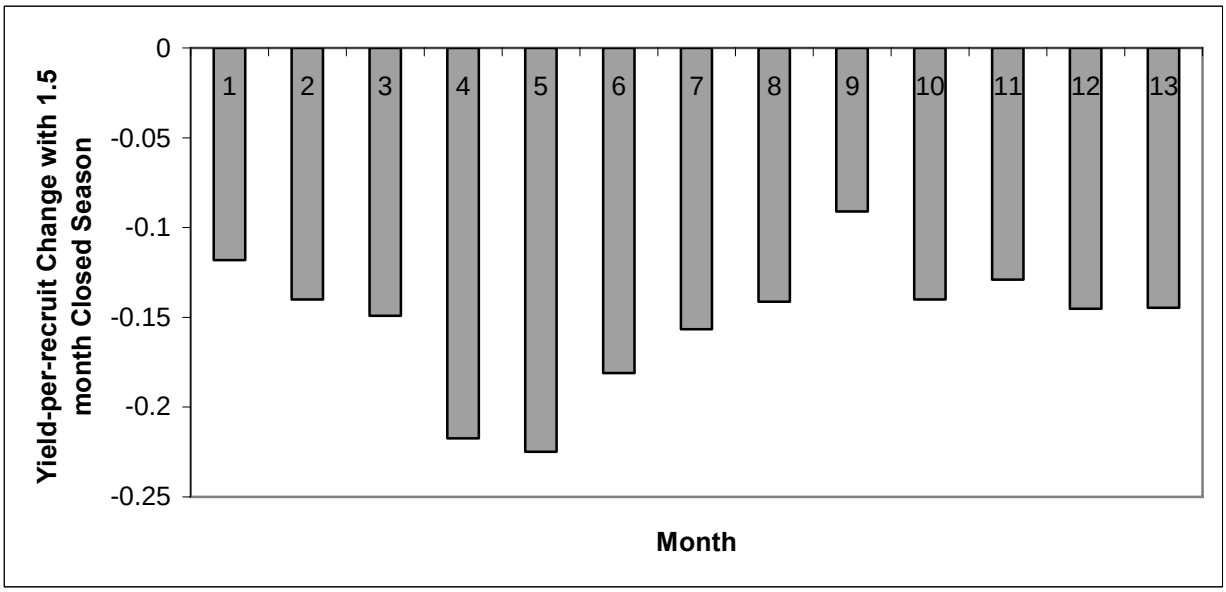

Fig. 6: Relative advantages to starting a closed season in the different months of the year based on the change in yield-per-recruit.

1.6 Special Comments

As a direct result of the better data provided to this meeting on the size composition of the landings, the closed season advice has changed from previous assessments. The new data are much more accurate and therefore the advice is more reliable. The working group would like to encourage further data collection initiatives of this type and continued improvements in the co-operation with the fishing industry.

It is likely that with improvements in the catch and effort data the state of the stock will be revised downward. This is based on the view of the working group that the biomass estimate in this model is currently too high.

The biomass estimate is an accumulation over the entire year accounting for population processes, such as growth and recruitment, within the year. Therefore, this does not represent an estimate of standing stock biomass.

In the light of these two points, this biomass estimate should not be used for decisions on the further development of the fishery or expansion in exploitation.

1.7 Policy Summary

The policy is to manage, regulate and promote the sustainable utilization of Guyana's fishery resources for the benefit and safety of all stakeholders in the sector and the nation as a whole.

2.0 Suriname Seabob (*Xiphopenaeus kroyeri*) Fishery

2.1 Management Objectives

- This fishery sustains a large number of families, and is also one of the few profitable occupations in some rural areas. Preservation of this source of income, and of the living standards of the population involved, are important objectives.
- The way fishermen themselves are managing their activities, adjusting effort in accordance with expected (net) benefits, can be seen as a way of optimising economic yield.
- Fresh and dried shrimp are traditional commodities for the local market, and also an indispensable contributor to the domestic protein supply.
- Frozen seabob flesh, produced by the seabob factory, is exported and dried shrimp might have export potential (not demonstrated yet). Generation of foreign currency must therefore be taken into account in management.

2.2 Status of Stock

The assessment indicates that the stock is not overfished ($B/B_{MSY} > 1.0$) and overfishing is not occurring ($F/F_{MSY} < 1.0$; Fig. 1). This conclusion depends, among other things, upon a reasonably accurate time series of total catch which needs to be verified.

Best estimates				
Current Yield	**MSY (t)**	**Replacement Yield**	**B/BMSY**	**F/FMSY**
8224	8881	7981	1.28	0.77

2.3 Management Advice

It is recommended to adopt reference points and a harvest control rule within the fisheries management plan to ensure that the fishing is sustainable. New provisional reference points and a harvest control rule have been proposed based on the maximum sustainable yield point (MSY).

Limit reference point: Biomass at 60% of the MSY estimate
Target reference point: Biomass 120% of the MSY estimate

The reference points (biomass, yield and fishing mortality at MSY) have been estimated from the annual catch and effort time series. CPUE can therefore be used as a proxy for the biomass.

The CPUE expected at MSY is 1.46 t day^{-1}, whereas current CPUE is 1.87 t day^{-1}. The limit reference point will be 60% of the MSY at 0.88 t day^{-1}, so the main objective of the harvest control rule would be to maintain the catch rate above this level. However, CPUE will never be an exact measure of biomass and some error needs to be accounted for.

To maintain the stock at target levels, a trigger reference point has to be proposed, which will need to take into account the uncertainty associated with the monitoring variables chosen as part of the harvest control rule. The harvest control rule also uses proxies, CPUE and days-at-sea for biomass and fishing mortality respectively, and takes into account the uncertainty with which they are estimated.

Controls to maintain the stock around the target level need to be defined, as do the controls applied to reduce fishing mortality as the limit reference point is approached. These could include a closed season, export catch limits and fishing effort control.

A harvest control rule should have the following properties:

- It should maintain a harvest rate which should keep at or around the target level in the long term.
- It should reduce the harvest rate as the stock approaches the limit level.
- Fishing should be minimized if the stock falls below the limit.

In addition, the following properties may also be considered useful:

- The harvest control rule should limit year-to-year fluctuations in the control measures to levels acceptable to the fishing industry wherever possible. This will help industry to plan for and maintain a suitable level of catching and processing capacity commensurate with the productivity of the resource.

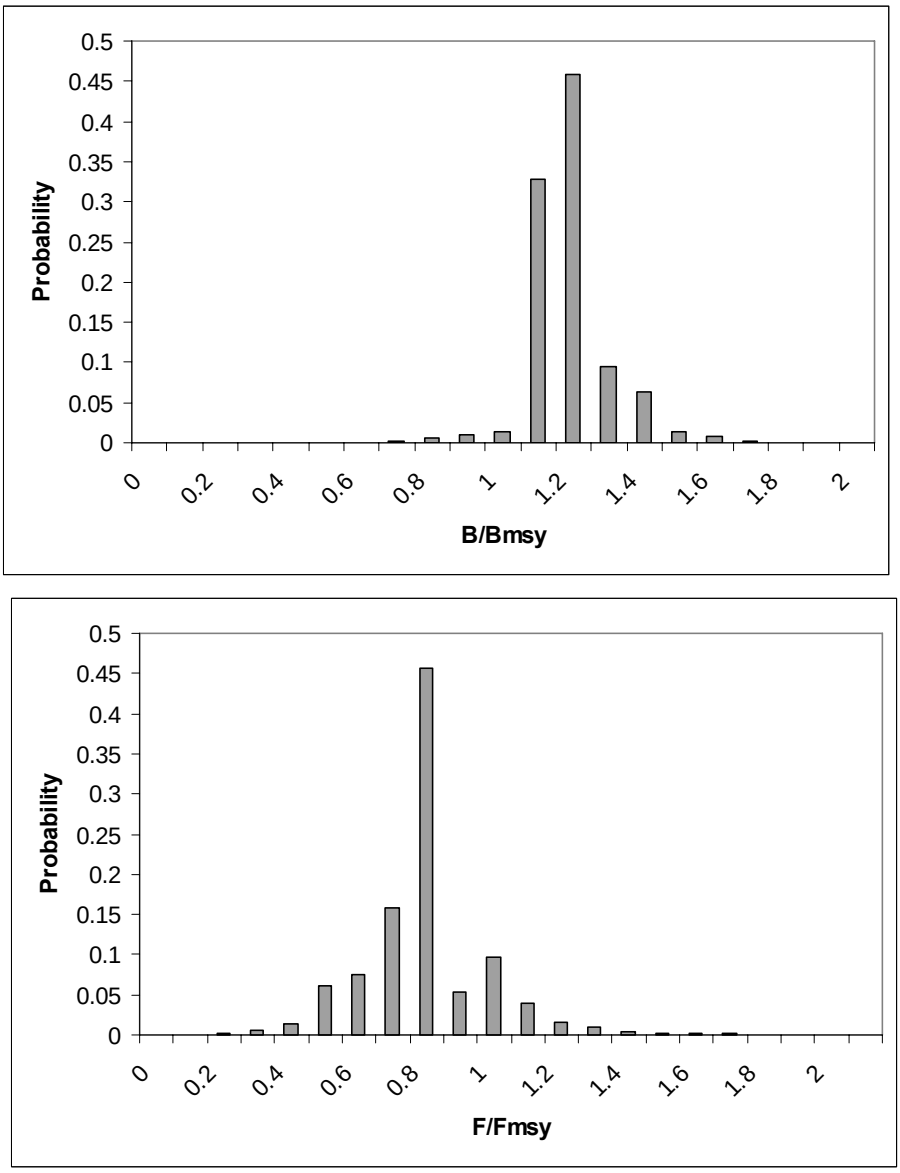

Fig. 1: Probability estimates based on the Monte Carlo integration of the posterior biomass dynamics model fitted to the catch and effort data.

2.4 Statistics and Research Recommendations

Data Quality

Annual catch and effort data were available for the period 1998-2008 and monthly data available for 2002-2008 (Fig. 2). There was uncertainty over the data accuracy. Mistakes made in assembling data became apparent when data from the same original source, which therefore should be the same, were found to be different. Differences are not large enough to invalidate the stock assessment, but nevertheless data need to be validated as quickly as possible.

Morphometric and size frequency data were also available, but there was insufficient time at the meeting to carry out a thorough examination of these data. The morphometric data were collected in December 2007 to estimate various length and weight relationships useful for conversion purposes. The size frequency data cover December 2007 to June 2008 so far, and are random samples taken from landed catch before processing in Guiana Seafoods (Suriname) and Noble House (Guyana) processing plants. These data have been collected by the processors for the purposes of stock assessment. They have been used to consider alternative season closures.

Additional catch data were obtained from the FAO FIGIS database. The level of precision of these data was considered to be sufficient to estimate catches back to the start of the fishery. The data should however be improved for future assessments to increase the accuracy of the management advice.

Research

Research is currently being undertaken on growth and mortality of seabob through the collection of detailed size frequencies. A considerable data set is already available, but analysis is incomplete. The data were reviewed and some analysis completed at the current meeting. The research should give estimates of growth rates, maximum size and mortality rates for independent comparison with the results obtained from the catch and effort data.

A further task to be completed in the intersessional period will be to develop a research plan for seabob and the seabob fishery.

2.5 Stock Assessment Summary

Bayesian Statistics and the Monte Carlo (Sample importance resample algorithm) methods were used to estimate Maximum Sustainable Yield (MSY)[9], Replaceable Yield[10], current biomass relative to biomass at MSY, and current fishing mortality relative to fishing mortality at MSY. The assessment used the logistic surplus-yield model fitted to the total catch 1989-2008 and catch and effort 1998-2008.

Catch per unit effort (CPUE)[11] was used as an index of the abundance of stock. The measure of effort used was the number of days at sea, which would include steaming time. The CPUE index appears to be declining each year (Fig. 2) indicating a small decline in stock size since the start of the series.

The results indicate a reasonable fit of the model (Fig.3), but it should be noted that although the model explained the negative trend in the CPUE, this trend only formed a small part of the variation in CPUE. The number of data points (10) was limited and with only a decreasing trend, effectively

[9] **Maximum Sustainable Yield** or **MSY** is, theoretically, the largest yield/catch that can be taken from a species' stock over an indefinite period. Any yield greater than MSY is thought to be unsustainable.

[10] **Replacement Yield** is the yield/catch taken from a stock which keeps the stock at the current size.

[11] **CPUE** is the quantity of fish caught (in number or in weight) with one standard unit of fishing effort.

three out of four parameters could be estimated with the data, so that the informative priors will have influenced the results.

The rate of increase (*r*) is negatively correlated with the estimate of abundance, so a higher *r* would suggest lower biomass. Given the life history of this species (a small crustacean with high growth and mortality rates), the current r is probably underestimated and the biomass overestimated. However, correcting this would require improved prior information than currently available.

The maximum sustainable yield suggested most likely values would be between 8000-9000 t year^{-1} (Table 2; Fig. 4). However, the assessment also indicated that MSY could be lower than this and therefore ongoing monitoring is required.

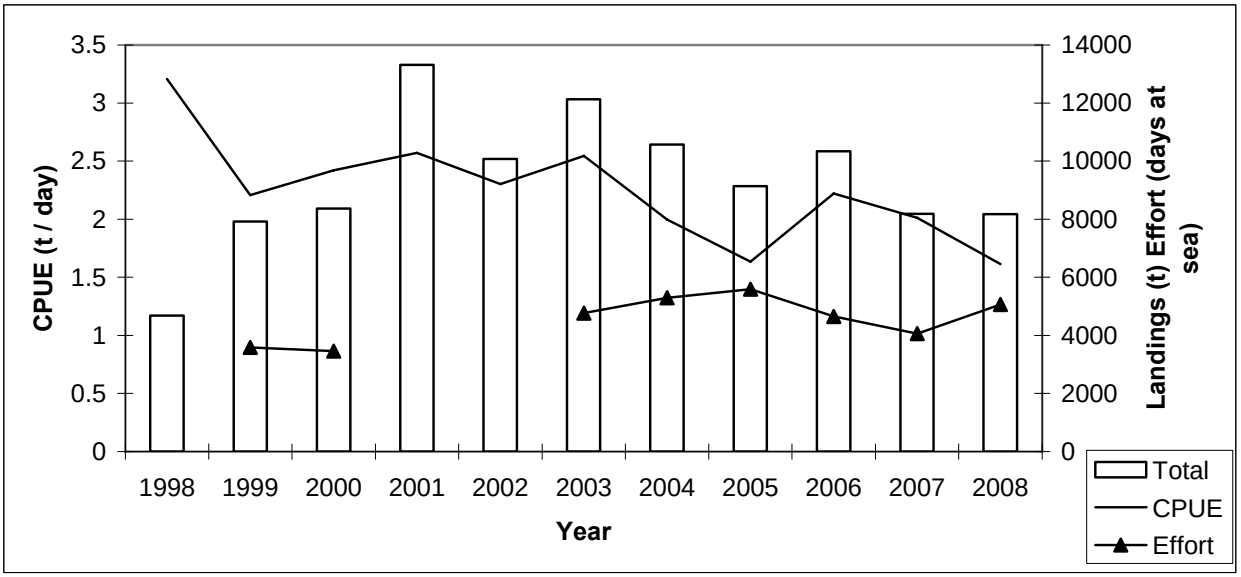

Fig. 2: The total catch and effort and CPUE time series available for Suriname seabob. The CPUE abundance index shows a continuous decline since 1998, suggesting that the stock abundance has declined over this period. The catch time series 1998-2008 has some uncertainty as to the recorded data (see Section 1.4.1). Where total effort was unavailable, the total catch is more uncertain.

Table 2: Summary of results from fitting the logistic biomass dynamics model to the available catch and effort data 1989-2008.

Parameter	Lower Percentile 0.05	Median 0.5	Upper Percentile 0.95
r	0.17	0.40	0.49
B_∞	78 625	84 303	145 093
B_{now}	0.56	0.61	0.72
MSY (t)	6 120	8 403	10 524
Current Yield (t)		8 224	
Replacement Yield (t)	5 888	8 039	8 612
B/BMSY	1.12	1.22	1.43
F/FMSY	0.57	0.82	1.17

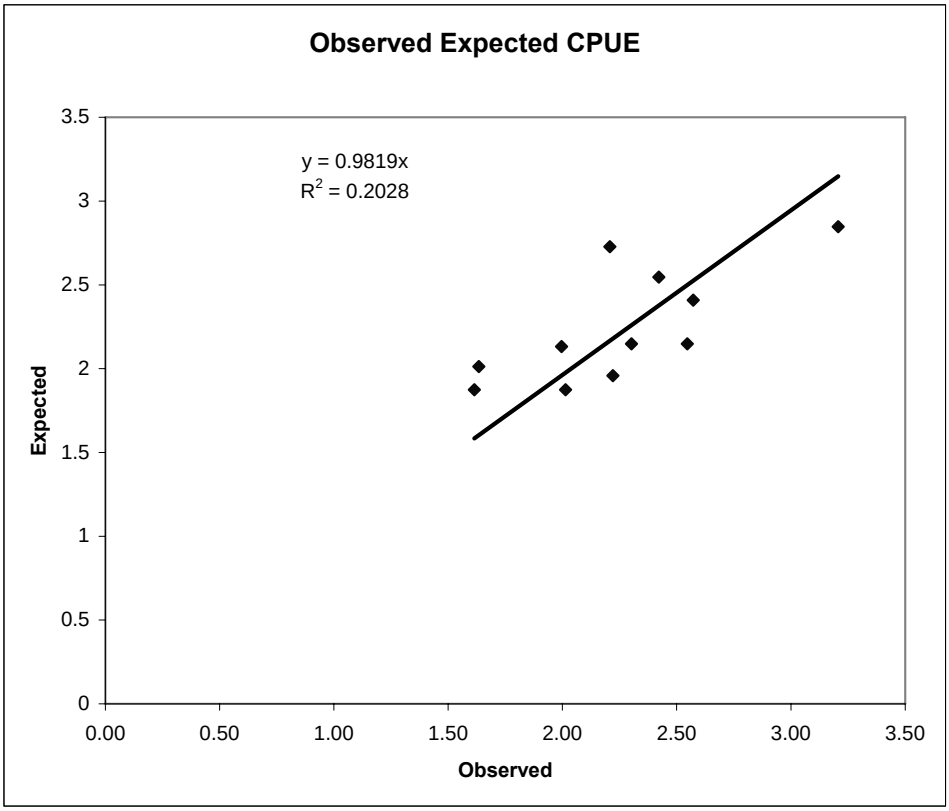

Fig. 3: Observed and expected CPUE from the model fit. The residuals show no obvious pattern around the regression line going through the origin.

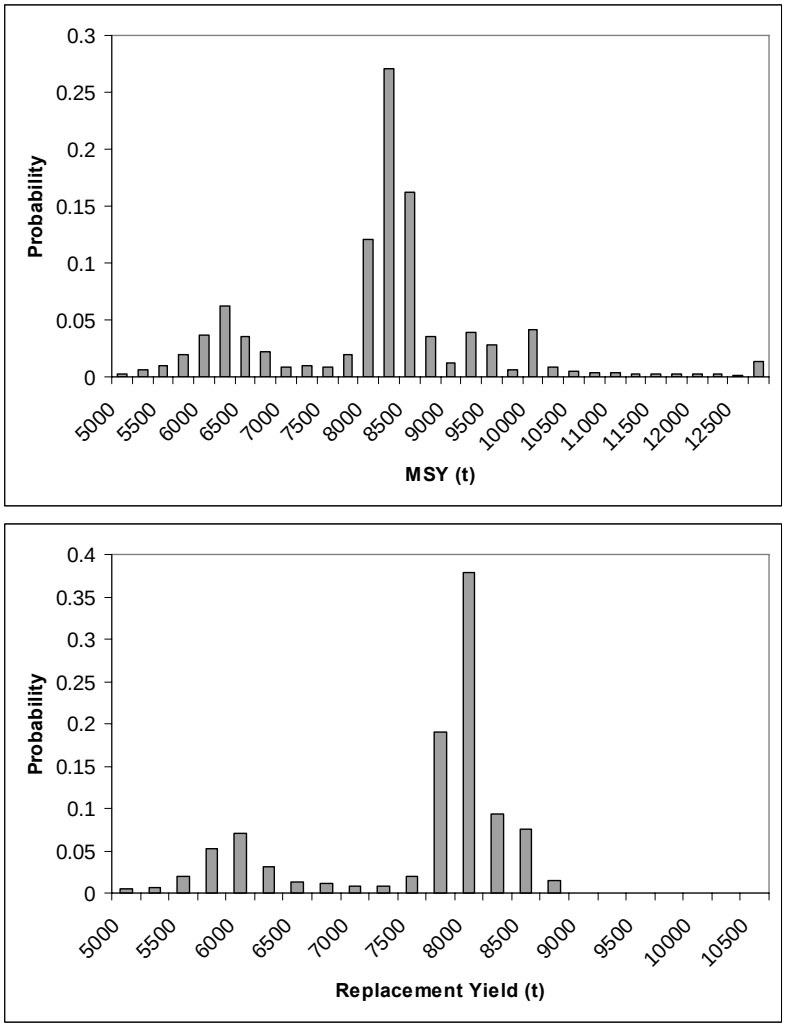

Fig. 4: Maximum sustainable yield and current replacement yield probability estimates for the Suriname seabob fishery.

As well as a standard stock assessment, the available size composition data were used to examine the effect a closed season of one month may have on yield. A simple function based on yield-per-recruit was used to estimate the change in yield for the size composition being selected in each month (Fig. 5). The most appropriate month for a closure will have the highest YPR score.

In this case, the most appropriate months are likely to be one of those from December to February. The scores for all months are negative, indicating that a closed season is not useful to increase yield-per-recruit, although it may be useful for other purposes. However, to be valid the absolute YPR scores require parameters such as fishing mortality which were unavailable, so "reasonable" values were used rather than estimated values. The interpretation of the best month for closure, should a closed season be implemented remains valid since this is not sensitive to the parameters, but depends primarily upon the size of shrimp being landed in each month.

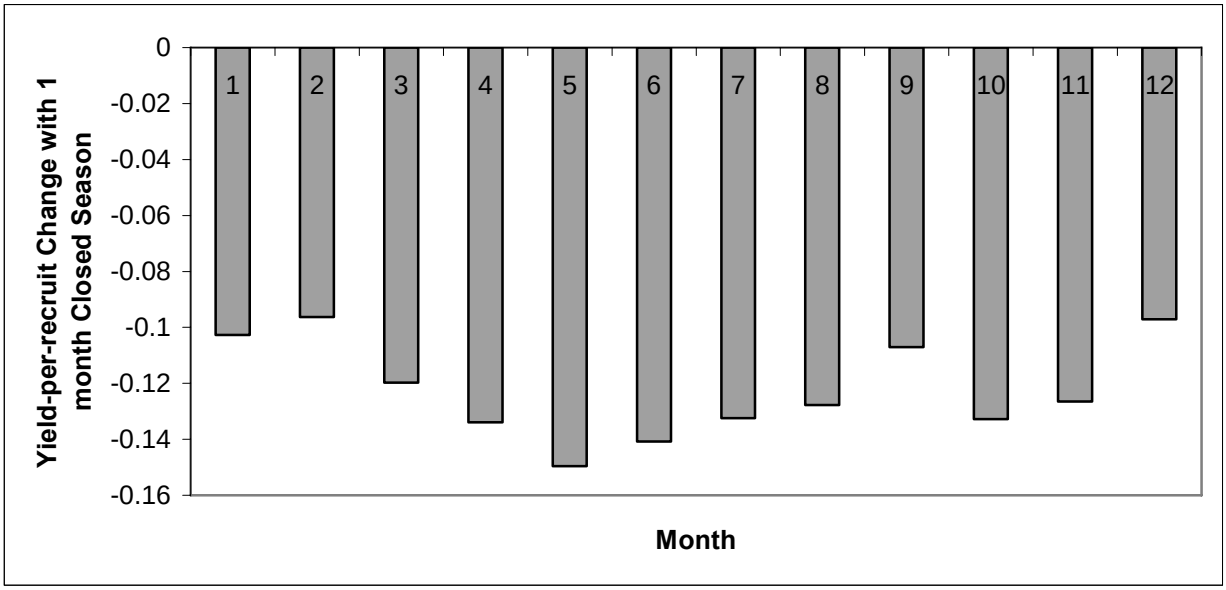

Fig. 5: Relative advantage to starting a closed season in the different months of the year based on the change in yield-per-recruit.

2.6 Special Comments

In 2008 it was recommended that Suriname and Guyana have similar programs for collecting biological data. This has been successfully achieved through a standard data collection protocol implemented in the processing facilities of Guiana Seafoods (Suriname) and Noble House Seafoods (Guyana).

The biomass estimate is an accumulation over the entire year accounting for population processes, such as growth and recruitment, within the year. Therefore, this does not represent an estimate of standing stock biomass and should not be used for decisions on the further development of the fishery or expansion in exploitation.

2.7 Policy Summary

The role of the fisheries sector could be expressed as follows:

- Provides jobs (primary and secondary level): creates more qualitative job opportunities and reasonable incomes. The diversity of the sector is also important.
- Creates a balance of payment through export of fish and shrimp products
- Contributes to the GDP of the country
- Contributes to the national budget through fees and income tax.

The main policy is to manage the fish and shrimp resources in a sustainable manner to generate revenues on a long term basis.

V. SMALL COASTAL PELAGIC FISH RESOURCE WORKING GROUP (SCPWG)

Chairperson: Maren Headley
Derrick Theophile (Dominica); Paul Phillips (Grenada); John Jeffers (Montserrat); Shawn Isles (St. Kitts and Nevis); Kris Isaacs and Leslie Straker (St. Vincent and the Grenadines); Garth Ottley and Lara Ferreira (Trinidad and Tobago); Kathy Lockhart (Turks and Caicos Islands); Susan Singh-Renton and Maren Headley (CRFM Secretariat); Nancie Cummings and Todd Gedamke (US National Marine Service, Southeast Fisheries Science Center); Paul Medley (Consultant)

A. OVERVIEW

Review of Inter-sessional activities

At the Fourth Scientific Meeting in 2008, the SCPWG developed an action plan in view of a one year ban imposed in St. Vincent and the Grenadines, in April 2008, on the sale of small coastal pelagic fish as live bait to foreign-owned longline fishing vessels. Inter-sessional work was conducted in St. Vincent and the Grenadines to determine the trends in the small coastal pelagic fishing operations and the potential demands for these fish from both the food and bait markets. Recommendations were made, taking into account market needs and fishery production levels. The detailed report of this study is included as part of this report and is provided in section B.

Another task identified by the Working Group during the 2008 Scientific Meeting was for each country to complete: lists of the fishers, fishing units (including vessels and vessel owners), landing sites, fishing areas, gears and gear owners, species harvested, and market routes. These lists were required to establish a sampling frame for routine monitoring activities. The meeting was informed that a frame survey for the beach seine fishery was in progress in St. Vincent and the Grenadines, and that these data would be analysed more fully during the next inter-sessional period. Additionally, the representative from Grenada indicated that during the inter-sessional period a census of all beach seines was conducted. In Grenada, the data collected included: the numbers, location and fishing area, information of the mesh sizes, fishing times, influence of the moon and possible distribution of catch (Anon. in prep).

Report on Relevant Activities and Plans of other International Fisheries Organizations and Non CRFM Countries

Eastern Caribbean Flyingfish Assessment

The WECAFC *Ad Hoc* Flyingfish Working Group of the Eastern Caribbean, established in 1997, has held three meetings during 1999-2008 (FAO, 1999; 2001; FAO, in prep). In 2008, the Working Group carried out an assessment of the Eastern Caribbean flyingfish stock (FAO, in prep.). The consultant, responsible for leading the 2008 flyingfish stock assessment conducted by WECAFC, was present at the SCPWG meeting, and was asked to present an overview of the work completed for consideration by the Working Group.

Based on the overview provided, the stock assessment suggested that the stock was not currently overfished and also that overfishing was not occurring. Catch rates have remained stable overall in the time series as catches have increased. The potential yield appeared to be greater than the total catches taken during the fishery's history, since the stock area and stock size were estimated to be relatively large. In consequence, unless a significant increase in catches occurred, no immediate management action was required for stock conservation. The maximum recorded catch so far has

been 4700t. In order to avoid overfishing, the establishment of a 5000t catch trigger was suggested by the WECAFC Working Group. The assessment indicated that any fisheries development exceeding 5000t would have unpredictable consequences. In reviewing the assessment results, several of the research recommendations made by the WECAFC Working group were also highlighted.

Following the presentation of the overview, a query was raised regarding the incorporation of environmental data into the assessments. It was noted that attempts were made to do so using environmental data for one country.

In response to another query regarding how countries could move forward with regards to determining whether local depletion was occurring, it was indicated that this would need to be addressed at the national level. However, it was noted that the limitation to this would be the lack of data at the national and regional levels.

Although the SCPWG did not have enough time to conduct a detailed review of the flyingfish assessment completed by the WECAFC Working Group, the SCPWG acknowledged support for the work completed to date and for the initial evaluation undertaken of the findings and recommendations.

Efforts to Improve Sampling in US Caribbean Territories

The following is a summary of the presentations made by Todd Gedamke and Nancie Cummings.

Assessment Needs and Survey Design

Two talks were given which addressed the challenges that are faced in conducting assessments in the relatively data-limited small scale fisheries of the Caribbean. Todd Gedamke and Nancie Cummings began the discussion by reviewing the goals of fisheries stock assessments and, in particular, how the basic concepts surrounding maximum sustainable yield (MSY) form the central point of this process. To highlight that these challenges are faced throughout the Caribbean, an overview of assessment efforts in the US Caribbean was used as a case study and a brief summary of that discussion follows. In recent years, the National Marine Fisheries Service (NMFS) through the Southeast Data, Assessment and Review Process (SEDAR) has attempted to conduct stock assessments in Puerto Rico, and the United States Virgin Islands (USVI) of St. Thomas/St. John, and St. Croix. A team of stock assessment scientists working with data collected over the last 35 years have found that data-limitations preclude valid comprehensive stock assessments for all but a few species. In response to these findings NMFS has organized a data collection working group to review the commercial data collection program and recommend modifications so that future assessments can be conducted.

A brief overview of the data collection working group process was presented. While some specific details of the differences in the fisheries for each island group (i.e. Puerto Rico versus the USVI) were summarized the challenges which should be common to all CRFM participants were highlighted. For example, as in most Caribbean fisheries where a large number of small boats fish from numerous locations, the ability to quantify the landings for the entire island is particularly challenging. In the US Caribbean fishermen are required to report their landings monthly, however, uncertainty due to mis- and non-reporting has resulted in high uncertainty in landings estimates and hampered stock assessments. Another common problem which is faced in the USVI and many Caribbean nations has been a lack of species specific data records. While recording species groups such as ‘groupers’ or ‘snappers’ makes data collection easier, extreme differences in life-history parameters within one of these groups results in different vulnerabilities to fishing pressure. While landings of the species group may remain constant, an individual species could be become depleted, or even go extinct, without any ability to detect this in the data.

The second talk focused on how to design a survey and monitoring program to collect the data necessary to conduct stock assessments. While fishery-independent methods (e.g. scientific surveys conducted with an underlying statistical design) provide the most robust source of information, the high costs associated with this approach generally preclude their use in the small scale Caribbean fisheries. As such, the focus of the discussion was on fishery-dependent information and how to sample the commercial landings. The first step in this approach is to determine the 'universe' or the entire sampling frame. In other words, a clear description of the fishery including the number of boats, types of gear being used, species composition of the catch, number of landing sites, and what happens to the fish once they are landed is the first step in designing an effective sampling program. Once these factors are determined, a program can be designed so that sub-samples of the entire landings encompassing all fishing locations results in a representative picture of the overall fishery. The sampling design should account for both spatial and temporal differences in the fishery and will have to account for practical considerations such as the amount of personnel available to conduct the work. The pro's and con's of conducting intensive surveys on an infrequent basis (i.e. comprehensive snapshots) versus longer term monitoring programs were also discussed.

The Working Group appreciated the information shared and agreed that it would be useful for the US scientists to guide a discussion on the development of sampling programmes for selected fisheries in St. Vincent and the Grenadines and TCI. This task was undertaken and is reported under Item 3.0.

Tasks to be addressed during the Meeting

Taking into account the beach seine surveys which were conducted inter-sessionally by Grenada and St. Vincent and the Grenadines in order to develop universe lists (frame surveys) based on recommendations made by the SCPWG at the last Scientific Meeting, and the fact that TCI is in the process of establishing a sampling programme for its fin fish fisheries, the Working Group agreed to review the process of designing statistically based sampling programmes for these types of fisheries, which is currently being utilized for the US Caribbean territories.

This review was led by a staff member of the NMFS SEFSC, Dr. Todd Gedamke, and following were key points raised.

- a quantitative fish stock assessment is an attempt to reflect the 'true' picture of stock status. However, as it is not possible to count every fish in the sea, the best alternatives of obtaining a representative subsample would be via fishery dependent sampling, as well as fishery independent sampling whenever feasible.
- A comprehensive and representative sampling programme would facilitate assessments which are representative of stock situations.

Fisheries dependent sampling

- A frame survey must be conducted to identify all fishing units and landing sites involved, both by fishery and by gear. The use of key informants and local knowledge are essential support for a successful frame survey, but there must be some evaluation of the validity of the information so obtained.
- In order to achieve a representative subsample, samples need to be suitably spread across the relevant spatial and temporal strata. If available, data on historical landings, numbers of vessels and/or persons/fishers, could be used to apportion the sampling effort across each of the key spatial and temporal strata. Time/effort required of the samplers would also need to be considered.
- Two approaches are recommended for achieving adequate and representative statistical coverage:

i) Intensive short term/ "snap-shot" sampling which involved describing the universe, obtaining the variance, and determining sample sizes/strata, and collecting socioeconomic data.
ii) Monitoring over the long-term.

- The Group was informed that the Intensive short term sampling could be conducted periodically depending on the fishery's complexity whereas monitoring over the long-term should be an ongoing process.
- The Group was also reminded that a sampling frame could be designed based on a Intensive short term sampling alone, whereas monitoring over the long term without conducting Intensive short term sampling would result in a sampling frame which was not representative.

Fisheries independent sampling

- The importance of fishery independent surveys that also take into account spatial and temporal strata (grids/transects stratified by depth or habitat) was discussed. It was indicated that this type of sampling provided data which were more representative than data based on catches and landings and could be used directly by assessment models. The use of incentives for involving commercial fishers in fisheries independent surveys was also highlighted, e.g. reservation of portion of catch quota for involvement in such surveys.

Issues and Recommendations Pertaining to Data, Methods, and/or Training for DMTWG

Following the exercise led by Dr. Gedamke, the Group agreed that the issue of data collection and sampling methodology was very fundamental to all fisheries and that it should be addressed under the DMTWG. One option would be for countries to begin the process of developing universe lists for all key fisheries, and conducting Intensive short term sampling that could then be reviewed during the second meeting of the DMTWG for informing sampling programme improvements.

In order for countries to conduct, the tasks which should be undertaken during the inter-sessional period include:

- Development of data collection/interview forms
- Completion of universe lists
- Compilation of habitat maps, and fishing area maps

Inter-sessional Work Plan

Based on the reviews and discussions held by the Working Group this year, it is recommended that.

1) The universe lists for the small coastal pelagic fisheries should be completed and should include: a list of all fishers, fishing areas, the number of boats, gear types, species composition of the catch, number of landing sites, and distribution of the fish after landing to the various sectors e.g. fish vendors, trading vessels, processing plants restaurants, and the public. These data would facilitate the establishment of a sampling frame.
2) In the long-term, fishing activity data should be gathered using weekly or fortnightly on-site interviews. During on-site interviews, data collectors should take the opportunity to collect samples for biological analysis.
3) Given the important contribution of these fisheries to overall landings and food security in several countries, countries should ensure that appropriate human and financial resources are made available to implement the proposed sampling programmes. It should be noted that key informants and fishers in the respective communities could be utilized to assist with sampling of the fisheries.
4) Countries should engage fishers in consultations prior to commencing the proposed sampling programmes, to inform them of the intentions of the national fisheries authority.

This should be conducted as a goodwill gesture and to nurture co-operation from fishers during data collection activities.

5) Inter-sessionally the Group should also review the analysis of ecosystem impacts caused by fluctuations in the abundance of small coastal pelagic resources, and consider options for advancing this analysis in the future. This would serve as a good starting point for consideration by the Working Group of the application of ecosystem models for fishery assessment purposes.

Adjournment

The Meeting was adjourned at 5:25 pm on June 16, 2009.

References

Anon. (in prep) Grenada, Small Coastal Pelagic Beach Seine Survey.

CRFM. (2008). Report of Fourth Annual Scientific Meeting – Kingstown, St. Vincent and the Grenadines, 10-20 June 2008. *CRFM Fishery Report – 200*8, Volume 1. 222 pp.

FAO, (1999). Report of the First meeting if the WECAFC Ad Hoc Flyingfish Working Group of the Eastern Caribbean. *FAO Fisheries Report* No. **613**. Rome. 45 pp.

FAO, (2001). Report on the Second Meeting of the WECAFC Ad Hoc Flyingfish Working Group of the Eastern Caribbean. *FAO Fisheries Report* No. **670.** Rome. 155 pp.

FAO (in prep) WECAFC Flyingfish Working Group Meeting Flyingfish Stock Assessment.

B. FISHERY MANAGEMENT ADVISORY SUMMARIES

1.0 Analysis of supply and demand for small coastal pelagic fish species, mackerel scad (*Decapterus macarellus*) and bigeye scad (*Selar crumenopthalmus*), in St. Vincent and the Grenadines

1.1 Study Objectives

The study was part of a larger activity that had three aims.
(i) For the purpose of developing a field sampling programme, data were gathered on the nature and extent of seine fishing operations throughout the state of St. Vincent and the Grenadines.
(ii) Data were also gathered to identify, and to improve understanding of, the key components comprising the beach seine industry.
(iii) In St. Vincent and the Grenadines, the government imposed a 1-year ban on the sale of live bait to foreign-owned longline vessels in April 2008. To facilitate an informed review of the government's need to continue the ban, trends in small coastal pelagic beach seine fishing operations were examined, and production/supply was compared with market demands.
The present report provides the results of the analysis undertaken in respect of aim (iii).

1.2 Methods

Interviews with local consumers

Interviews were conducted with 150 local consumers to determine consumption patterns of these fish by local households (Appendix 1). Consumers were interviewed during visits to 6 major points of sale on St. Vincent: Kingstown, Campden Park; Clare Valley and Questelles; Layou; Barrouallie; Chateau Belair.

Interviews with captains/owners of foreign-flagged longline fishing vessels

At the time the ban was imposed in April 2008, the Fisheries Division estimated that 8-9 foreign-owned longline vessels were purchasing live bait from local seine fishers. Of this total, 5 fishing vessel operators were interviewed (3 vessel owners, 1 captain and 1 company director) to determine the nature and extent of their demands for live bait. The questionnaire developed for these interviews is shown in Appendix 2.

Interviews with beach seine fishers

A total of 32 seine fishing units were identified to be active throughout the state of St. Vincent and the Grenadines. Of this total, 21 seine unit leaders were interviewed about their fishing operations and their opinions about market demands. The questionnaire used for these interviews is shown in Appendix 3.

Analysis of historical landings data

Landings data gathered during routine fishery monitoring for the period 1979-2008 were examined. It was noted that:
(i) for the period 1979-1992, available landings data reflected activity at the Kingstown fish market only;
(ii) from 1993, though the data collection programme began to capture landings taken throughout the country, there were an initial problem of double-counting, and:
(iii) dramatic annual fluctuations in landings were observed during the past 3 years.
In view of this, we decided to use landings for the most recent 10-year period, 1999-2008 to examine both annual and monthly trends in production.

1.3 Results and Discussion

Food demand

Over 80% of the consumers interviewed identified robin as their preferred species of small pelagic food fish. Of the 309 species preference identifications by consumers, 39% were for robin, while 28% of the identifications were jack. Consumers confirmed that price and availability were the most important factors influencing their purchase of small pelagic fish. Based on purchase data provided by the 150 households interviewed, we estimated an average consumption of 4.8 lbs per person per month. From this, we estimated a total maximum potential consumption demand of 214,493 lbs per month for the population of Kingstown and the west coast of St. Vincent which had the most regular access to supplies of small pelagic species. This figure assumes that the sample is representative of the small fish consumption patterns of households not interviewed in the areas concerned

Bait demand

At the time of the study, 4 vessels were flagged with Trinidad and Tobago and one was flagged with the USA. These vessels were 15-22 m in total length. Fishing trips ranged from 14 to 21 days, with each vessel able to set its longline gear to fish 600-900 hooks at a time. All interviewees indicated that the most preferred bait species was the jack, because this species kept in good condition longer than any other small fish species caught in St. Vincent and the Grenadines. Notwithstanding, availability of bait and time of year were the most crucial factors influencing bait purchases. Both jack and robin were purchased in live condition directly from fishers at a price of US$1-1.20 per lb.

All interviewees indicated that they would like to purchase bait from April to December, while 3 vessels indicated that they would like to purchase bait every month of the year.

To estimate live bait demand, the actual fishing days per trip were assumed to be 12-19 days, with 600-900 hooks deployed once per day. Based on the recommended size of small fish, 5 fish typically weigh 1 lb. These data gave an estimated bait demand of 1440-3420 lbs of bait for each fishing trip. *It should be noted that this maximum figure of 3420 lbs per vessel per trip agrees with a maximum estimate of 4000 lbs per vessel per trip, provided by 1 fisher who regularly sold bait fish to the vessels before the ban*. Assuming each vessel conducts 1-1½ trips per month, the estimated potential monthly demand for bait per vessel was estimated to range between 1,440 lbs and 5,130 lbs per month. For the 5 vessels interviewed, this would give a combined total monthly demand for live bait of 7200-25,650 lbs.

Analysis of supply level (fish landings) and comparison with demand

Production/supply trends - The main species comprising the landings have been mackerel scad (*Decapterus macarellus*, local name ‘robin’), and bigeye scad (*Selar crumenopthalmus*, local name **‘**jack”). During the period 1999-2008, the landings of robin and jack showed relative stability until 2006-2008 during which time dramatic yearly fluctuations were observed. While it is possible that the observed fluctuations may reflect a real change in stock conditions, as well as the instability of these conditions, whether caused by the ongoing impacts of climate change impacts, natural shifts in stock abundance, or movement patterns from year to year, it is also possible that during 2006-2008, that some of the live catch that was being sold directly to the foreign longliners at sea was not being fully captured by the land-based sampling programme (fig. 1).

While robin was generally most abundant in the early part of the year and landings of jack typically peaked around the middle of the year, the observed seasonal peaks were not tightly fixed from year to year. The variability is apparent when the mean monthly landings and 95% confidence interval range were estimated for the preferred bait, jack (fig. 2), and for the two main small pelagic species, jack and robin, combined (fig. 3).

Comparison with food and live bait demand levels - For the 5 vessels interviewed, the combined monthly demand for live bait was estimated to range from 7200 lbs to 25,650 lbs per month. In figures 2 and 3, these estimated levels are shown for reference. It should be noted that larger vessels that fish more than 900 hooks per day would have an even higher demand. Figs. 4 and 5 show the mean landings of jack, and of jack and robin combined, left after both the minimum and maximum bait demand amounts are subtracted from each monthly mean landing value. The monthly food demands for jack, and for jack and robin combined, of the Kingstown and west coast populations, were calculated by using preference data and apportionment of the total estimated food demand. These amounts are also shown in figs. 4 and 5. In each instance, the remaining supply was insufficient to satisfy the total food demand.

Economic considerations

Consumers usually paid EC$2-4/lb for jack and robin, depending on size of fish and availability. The longline operators indicated that they paid EC$2.68-3.22 per pound of live bait. The differences in gross profit made by fishers were calculated for 4 different pricing scenarios, using the upper and lower price limits for each market group (Table 1). The higher price per pound paid by the bait market in 3 of the 4 pricing scenarios resulted in notably better profits for fishers, ranging from EC$0.68 to as much as EC$1.22 on every pound obtained from the bait market.

Opinions on improving market services and management

Fishers - The fishers ranked the travelling vendors (48%) and the local consumers (47%) as their most important buyers. Of 18 opinions submitted with regard to the ban and supplying both the bait and food markets, 5 opinions noted the need to regulate the size of bait sold. While 5 opinions indicated that only the local food market should be retained, 3 opinions felt that there was enough resource to supply both the food and bait markets. One opinion reflected the possibility for increasing fishing effort to address increasing market demands.

Consumers – Of 64 opinions expressed, 29 suggested an increase in fishing effort in order to increase the supply of fish, while 29 recognized the need for improved management and enforcement, including the need for using more environmentally-friendly fishing methods and resolving sectoral conflicts.

Longline operators – Of the 13 opinions expressed, 3 recommended that the longline vessels be allocated bait quotas, 3 recognized that a minimum bait size limit should be effectively enforced, and 3 noted the importance of regulating sales. Two opinions recommended that the size of longline vessels purchasing bait should be restricted, as larger vessels would have a higher demand for bait and would be more inclined to purchase all bait sizes. Another 2 opinions noted the need for active enforcement of the management rules.

1.4 Conclusions

1. Of the 6 small coastal pelagic species fished in St. Vincent and the Grenadines, only robin and jack were landed in substantial commercial quantities. Landings of these species usually varied with month, and this monthly pattern varied from year to year.
2. The jack was the most preferred bait species by the longliners, as it keeps in good condition for a longer period compared to other potential bait species.
3. Robin was the species most preferred by the average consumer.
4. For the given vessel size range (15-22 m), with hook setting capacity of 600-900 hooks per day, a trip length of 14-21 days and averaging 1-1½ trips per month, the estimated maximum potential monthly demand for bait was 5,130 lbs per vessel or 25,650 lbs of bait for a total of 5 vessels of the size and fishing capacity examined.

5. For the population of Kingstown and the west coast of St. Vincent, the estimated total small fish food market demand was 214,493 lbs per month. A few consumers from other parts of the country indicated a similar demand per person per month of 4.8 lbs of jack and robin.
6. The combined monthly landings of jacks and robins exceeded the monthly consumption demand noted at (5) only once since 1999.
7. The overseas bait market is more lucrative for fishers when local food market price for these small fish remains below EC$3.00 per lb.
8. Economic benefits from live bait market was enjoyed by only 4 fishers

1.5 Recommendations

Research and Resource assessment

The status of the jack and robin stocks are unknown.
(i) Given recent observed dramatic annual fluctuations with an overall downward trend in landings since 2003, urgently review and improve fishery monitoring system to facilitate assessment of the resource, including improved understanding of the biology and ecology of the fishes concerned.
(ii) Consideration should be given to the collection of additional social and economic data and information to facilitate a more comprehensive evaluation of the socio-economic aspects necessary for informing management decisions pertaining to this fishery.

Food market

This is a large market with demand exceeding production/supply.
(i) Improve distribution of jack and robin by road and market services to increase local food security (health benefits), and to guarantee quicker and greater sales for the fishers (economic benefits).

Live bait market

If live bait market is to be retained:
(i) Establish a limit on the number of vessels purchasing live bait;
(ii) Consider sale of the jack only as live bait, given consumers' preference for robin
(iii) Consider options for ensuring equitability of the economic benefits derived.

Management Control

(i) Establish minimum size limits for both the jack and robin, to guarantee continued resource productivity
(ii) Invest in improved Monitoring Control Surveillance to ensure management controls are effective.

Table 1. Prices of jack and robin paid by the live bait and food markets, and the gross profit difference (live bait price-food market price) per pound and per 1000 pounds.

Bait market	Food market	Difference per lb and per 1000 lbs
2.68	2.00	$0.68 per lb, $680 per 1000 lbs
2.68	3.00	-$0.32 per lb, -$320 per 1000 lbs
3.22	2.00	$1.22 per lb, $1220 per 1000 lbs
3.22	3.00	$0.22 per lb, $220 per 1000 lbs

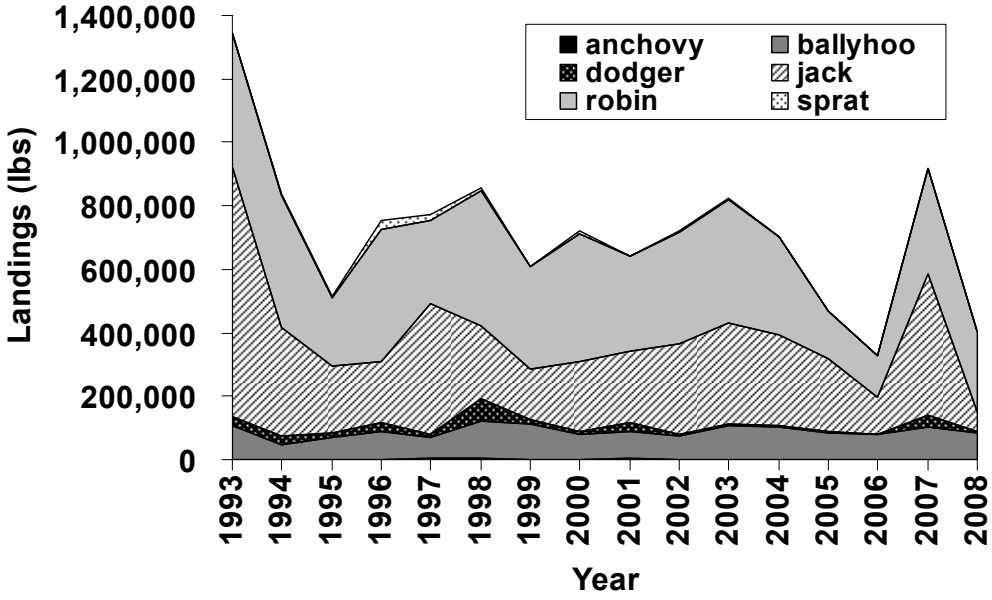

Fig. 1: Annual total landings (lbs) of 6 small coastal pelagic fish species during the period 1993-2008.

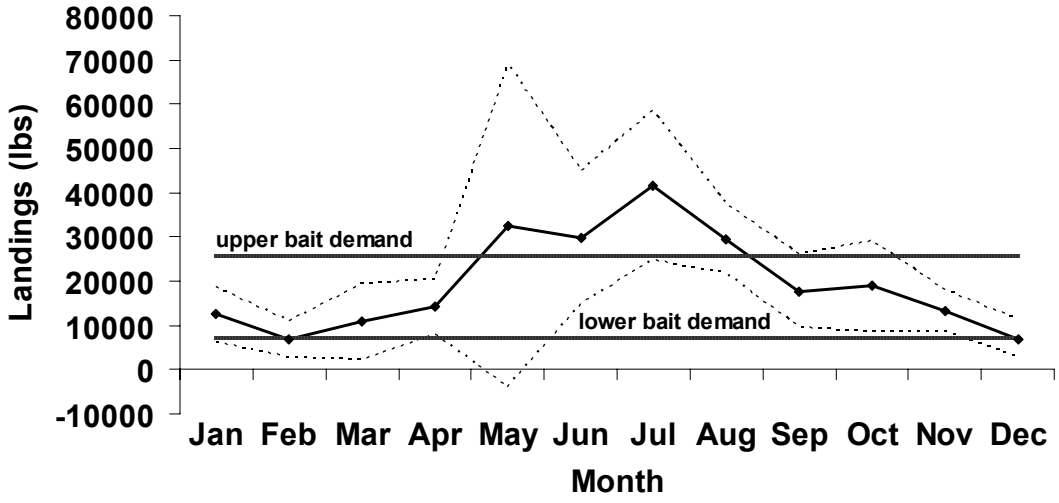

Fig. 2: Monthly average landings of jack for period 1999-2008, showing 95% confidence interval. The lower and upper limits of the estimated monthly live bait demand range for 5 longline vessels [7,200 - 25,650 lb/mth] are shown for reference.

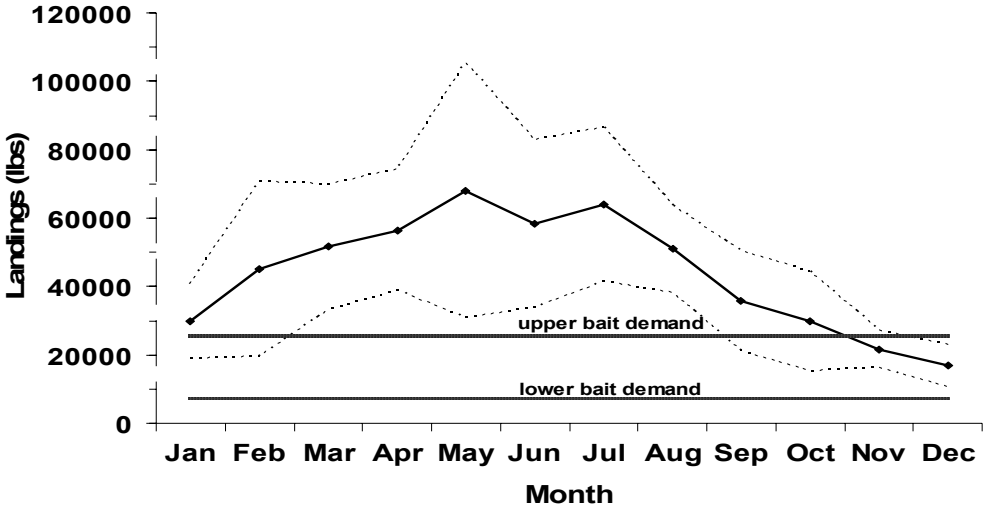

Fig. 3: Average monthly landings of jack and robin (combined) for 1999-2008, with 95% confidence interval. The lower and upper limits of the estimated monthly demand range for 5 longline vessels [7,200 - 25,650 lb/mth] are shown for reference.

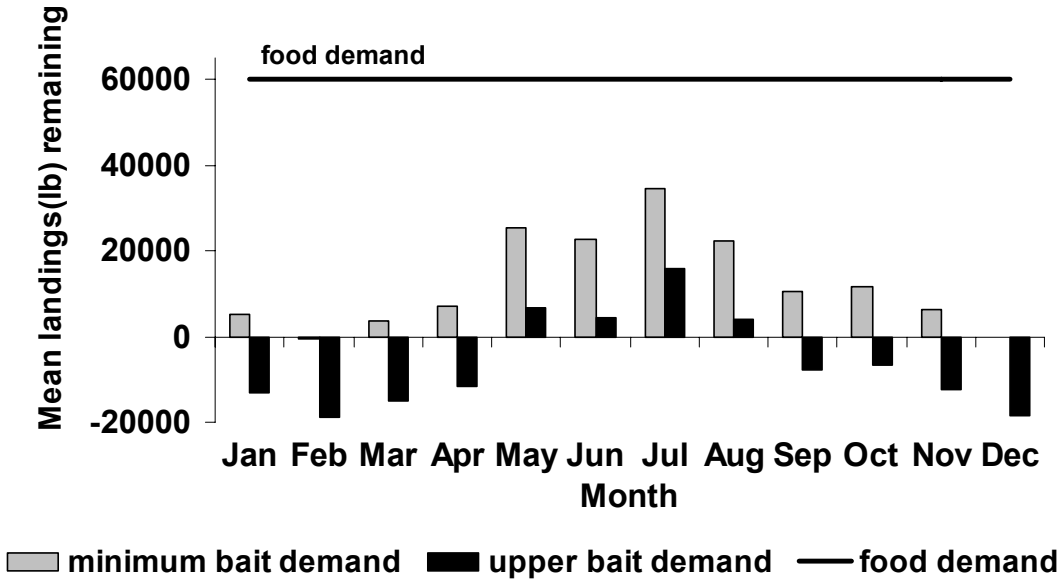

Fig. 4: Minimum and maximum live bait demands subtracted from the mean monthly production of jack, with food demand amount for jack (60,058 lbs) shown for reference.

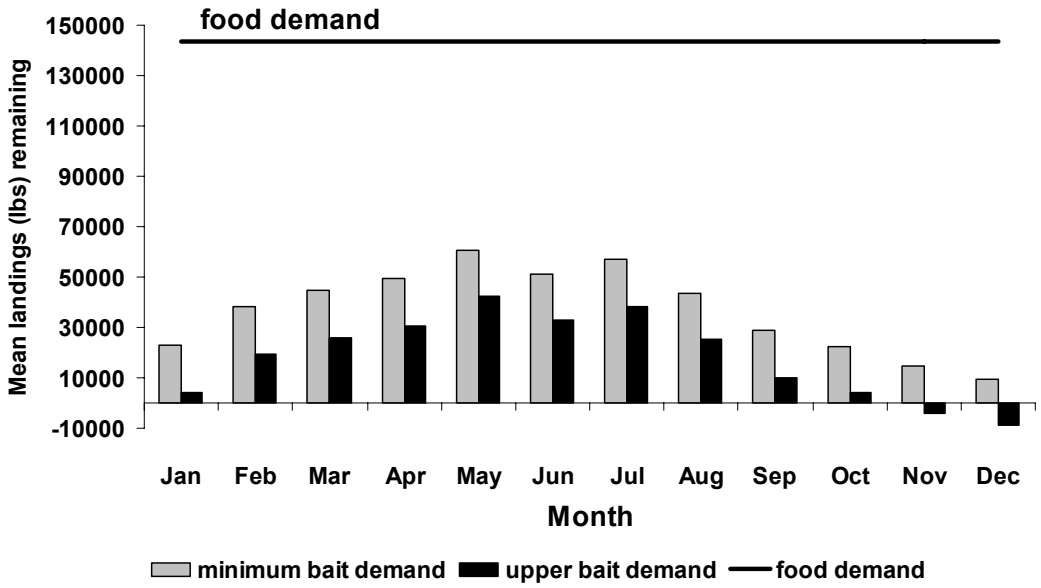

Fig. 5: Minimum and maximum live bait demand amounts subtracted from mean landings (jack and robin combined) for each month, with food demand line for jacks and robin combined (143,710 lbs), shown for reference.


parfish