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CRFM Fishery Report - 2011

# Volume 2

## Report of Seventh Annual CRFM Scientific Meeting - St.Vincent and the Grenadines, 16-24 June, 2011



CRFM Secretariat
Belize
2011

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## Fishery Management Advisory Summaries

### Report of Seventh Annual Scientific Meeting –
### Kingstown, St. Vincent and the Grenadines, 16 – 24 June 2011

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# Foreword

The Seventh Annual Scientific Meeting took place during 16 - 24 June 2011 in Kingstown, St. Vincent and the Grenadines. During this Meeting, CRFM Resource Working Groups examined data from the following fisheries: the flyingfish fishery of the Eastern Caribbean, the seabob fishery of Suriname, and the shrimp trawl fishery of Trinidad and Tobago and Venezuela. The SGWG also reviewed catch and effort data from the white shrimp fishery in Kingston Harbour, Jamaica. The LPWG conducted several activities: exploration of catch and effort data from the blackfin tuna fishery in St. Lucia, Vincent & the Grenadines and Trinidad & Tobago; review of a report on the fishing fleets targeting dolphinfish, flyingfishes and blackfin tuna in Martinique and Guadeloupe; review of a report on blackfin tuna catch, catch rates, and size structure from Venezuelan fisheries; and completed the first part of an ERAEF analysis of the Eastern Caribbean dolphinfish fishery. This year's CLWG meeting completed a peer review of a Caribbean spiny lobster stock assessment that was conducted intersessionally in The Bahamas during 2010. The RSWG did not meet in 2011.

A training seminar on bioeconomics of the ecosystem approach to fisheries was held during the meeting of the DMTWG. An update on the progress made by the JICA FAD and Statistics pilot studies, with special emphasis on the data collection, storage, and management aspects was also provided. A plenary session was held to review and discuss issues and recommendations pertaining to data, methods and training, as well as to review the inter-sessional activities of the DMTWG.

During the plenary session of the Seventh Annual Scientific Meeting, updates were provided on relevant collaborative activities / projects / programmes which included: the CIDA pelagic internship hosted by CRFM; the CLME project; the Regional Governance Framework Project; the CRFM/JICA Formulation of a Master Plan on Sustainable Use of Fisheries Resources for Coastal Community Development in the Eastern Caribbean Project; and the ACP Fish II Programme.

The Report of the Seventh Annual Scientific Meeting is published in two Volumes: Volume 1 contains the report of the plenary sessions and the full reports of the CRFM Resource Working Groups for 2011. Eight national reports were submitted for consideration by the Seventh Annual Scientific 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.

The covers for this volume were designed and prepared by Mr. Shaun Young, while the photographs were provided by Ms. Maren Headley, Ms. Elaine Ferrier, Mr. Motoki Fujii and Ms. Brooke Campbell. These contributions are gratefully acknowledged.

# Contents

# List of Acronyms and Abbreviations

| | | |
|---|---|---|
| **ACP** | - | African, Caribbean and Pacific states |
| **CARICOM** | - | Caribbean Community |
| **CERMES** | - | Centre for Resource Management and Environmental Studies |
| **CIDA** | - | Canadian International Development Agency |
| **CLME** | - | Caribbean large Marine Ecosystem |
| **CLWG** | - | Conch and Lobster Resource Working Group |
| **CPUE** | - | Catch Per Unit of Effort |
| **CRFM** | - | Caribbean Regional Fisheries Mechanism |
| **DMR** | - | Department of Marine Resources |
| **DMTWG** | - | Data, Methods and Training Working Group |
| **EAF** | - | Ecosystem Approach to Fisheries |
| **EBFM** | - | Ecosystem Based Fisheries Management |
| **ERAEF** | - | Ecological Risk Assessment for the Effects of Fishing |
| **ETP** | - | Endangered, Threatened and Protected (species) |
| **EU** | - | European Union |
| **FAD** | - | Fish Aggregating Device |
| **FAO** | - | Food and Agriculture Organization of the United Nations |
| **FMP** | - | Fisheries Management Plan |
| **GDP** | - | Gross Domestic Product |
| **GEF** | - | Global Environmental Fund |
| **GLM** | - | General Linear Models |
| **HCR** | - | Harvest Control Rule |
| **ICCAT** | - | International Commission for the Conservation of Atlantic Tunas |
| **IFREMER** | - | Institut Français de Recherche pour l'Exploitation de la Mer |
| **IQ** | - | Individual Quotas |
| **JICA** | - | Japanese International Cooperation Agency |
| **LAPE** | - | Lesser Antilles Pelagic Ecosystem |
| **LPWG** | - | Large Pelagic Fish Resource Working Group |
| **MPA** | - | Marine Protected Areas |
| **MSC P&C** | - | Marine Stewardess Council Principles and Criteria |
| **MSY** | - | Maximum Sustainable Yield |
| **NGO** | - | Non-Governmental Organization |
| **NMFS-SEFSC** | - | National Marine Fisheries Service – South East Fisheries Science Center |
| **NOAA** | - | National Oceanic and Atmospheric Administration |
| **NPV** | - | Net Present Value |
| **OSPESCA** | - | Organization of Fishing and Aquaculture in Central America (Organización del Sector Pesquero y Acuícola de Centroamerica) |
| **RSWG** | - | Reef and Slope Fish Resource Working Group |
| **SCPWG** | - | Small Coastal Pelagic Fish Resource Working Group |
| **SGWG** | - | Shrimp and Groundfish Resource Working Group |
| **SICA** | - | Scale Intensity and Consequence Analysis |
| **SSB** | - | Spawning Stock Biomass |
| **TAC** | - | Total Allowable Catch |
| **TRP** | - | Target Reference Point |
| **UNDP** | - | United Nations Development Programme |
| **WECAFC** | - | Western Central Atlantic Fishery Commission |
| **WWF** | - | World Wildlife Fund |

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

Consultant: Dr. Paul Medley
Chairman: Lester Gittens (The Bahamas)

## A. INTRODUCTION

The Conch and Lobster Working Group meeting was attended by representatives of Anguilla, The Bahamas, Belize, Jamaica, Montserrat, St Kitts, St Vincent & the Grenadines, OSPESCA, as well as Dr Paul Medley (consultant).

This year's meeting was specially convened to facilitate the peer review of a Caribbean spiny lobster stock assessment that was conducted inter-sessionally in The Bahamas during 2010 (see Annex 1). The assessment was conducted as part of a lobster fishery improvement project aimed at bringing the fishery up to Marine Stewardship Council (MSC) certification standards.

Time was also allotted to discussing lobster and conch related issues that other countries wished to raise. Issues that were raised included:-

1. A CLWG meeting should be convened at the next Scientific Meeting so that countries can discuss progress made and further strategize as a region.
2. It was also felt that a wider regional meeting possibly involving the WECAFC is overdue.
3. Nicaragua has implemented a quota system that may be of interest to other countries. A presentation of how Nicaragua's system works should be considered for the next meeting.
4. The regional review of the lobster fishery conducted by the CRFM should be presented at next year's meeting.

## B. FISHERIES REPORTS

### 1.0 <u>The spiny lobster (*Panulirus argus*) fishery of the Bahamas</u>

### 1.1 Management Objectives

The management objective for the spiny lobster fishery is to ensure that spiny lobsters are harvested for maximum economic benefit and in a sustainable manner. This is unofficial as a fishery management plan is still being developed.

### 1.2 Status of Stocks

Based on the inter-sessional stock assessment, the lobster fishery is believed to be in a good state. The stock assessment is believed to be the best to date and is based on exhaustive analysis of the best data available.

### 1.3 Management Advice

Given the great economic importance of the lobster fishery and the role it plays in recruitment in the region, every effort should be made to further improve the assessment.

## 1.4 Statistics and Research Recommendations

### 1.4.1 Data Quality

The data analyzed was not ideal hence the longtime difficulty of assessing the fishery. Although this is the best assessment to date, it is still recognized that there is a less than ideal amount of uncertainty. This cannot be changed for the historic data but new data collection efforts can address this. An improvement in data quality is fully expected and it is expected that the implementation of a Catch Certificate programme will facilitate this. This program was initiated at the beginning of the 2010-2011 season in an effort to comply with European Union demands.

### 1.4.2 Research Needs

It is recommended that research be conducted on the impact of casitas on the lobster fishery. It is unknown whether casitas enhance the fishery by increasing total production, whether their aggregating effects simply hasten overfishing or whether each circumstance prevails in certain situations. Research in this area is expected to begin during mid 2012.

Fishery independent data is also needed to enhance the stock assessment.

## 1.5 Stock Assessment Summary

Stock assessment results indicate that the biomass of spawning lobsters is well above levels of concern. Figure 1 shows the estimates relative to internationally recognized reference points. The suggested target reference point was 40% spawning stock biomass (SSB), 30% SSB as a trigger for management intervention and 20% SSB as the point at which all fishing should cease.

Diver catch per unit effort was used as a proxy for SSB and was suggested as for use in a harvest control rule. It is suggested that management intervention should take place when catch per unit effort goes below 30lbs (13.61 kg) per man/day for divers or if 7 million lbs (3.18 million kg) of tails is exported. The suggested management action would involve limiting exports as this is the main driving force behind the fishery.

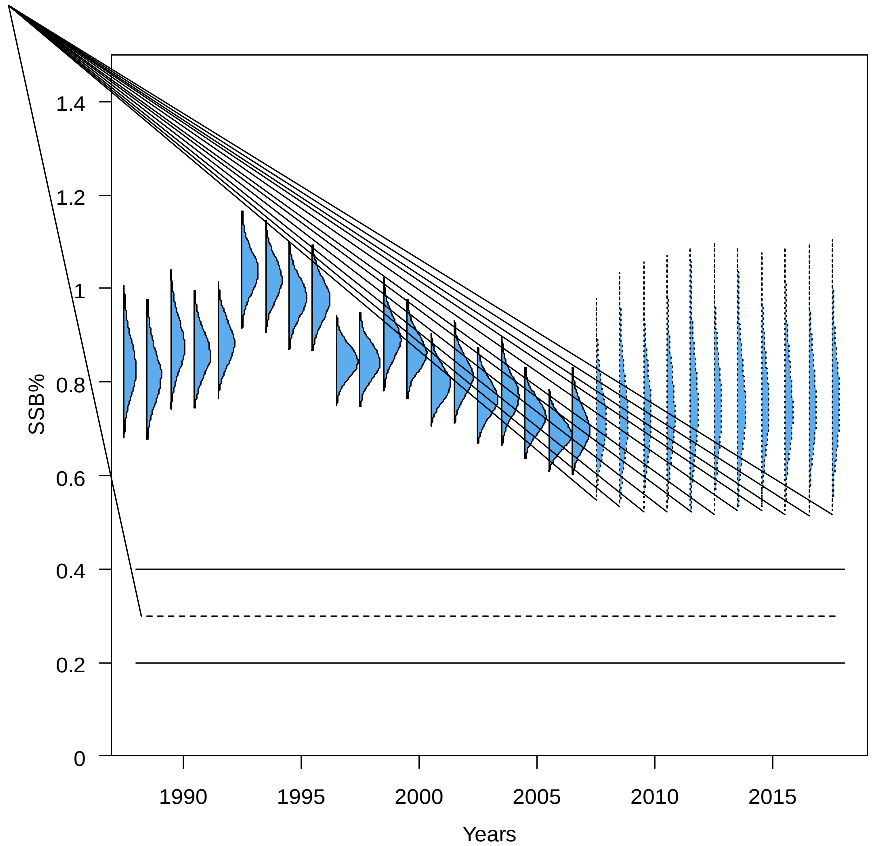


**Figure 1: Spawning Stock Biomass Per Year**

## 1.6 Special Comments

A number of suggestions were received that would either improve the accuracy of the stock assessment or enhance management of the fishery in other ways. These include:-

1. Make efforts to estimate local consumption as this fluctuates and can be significant if other countries are used as an example.
2. Explore directly limiting effort to control the fishery should intervention be needed. Belize has implemented such a system which can be sued as an example.
3. When local consumption is further investigated, it is suggested that at 5% and below the local consumption would be insignificant.
4. The views of fishers should be incorporated into assessment efforts if they can be sufficiently quantified.
5. Attempt to look at recruitment trends in Cuba and Florida to further estimate recruitment in The Bahamas.
6. Conduct simulations of what the status of the stocks would be if the assessment was done on bank by bank basis.
7. Obtain better data going forward. This includes fishery dependent and fishery independent data.

**Annex 1: 2010 Bahamas Spiny Lobster Stock Assessment**

Prepared by: Dr. Paul Medley
Sunny View, Main Street, Alne, UK, YO61 1RT
paulahmedley@yahoo.co.uk

## 1. Preparation of this Document

This document has been prepared for the Bahamas Fisheries Improvement Plan. It documents work done and results particularly addressing Principle 1 under the Marine Stewardship Council Principles and Criteria (MSC P&C).

The assessment and advice presented here has not yet undergone peer review. Various outputs from the assessment, including management advice should be reviewed and changed as considered appropriate by an independent scientific working group. As such, this report's conclusions (Sections 3-11) will be subject to evaluation and change before gaining any official status in the harvest strategy.

## 2. Recommendations for the Fisheries Improvement Plan

The main objective of this study was to support the Fisheries Improvement Plan (primarily task 4.3), which aims to help the fishery meet the MSC standard. On completion of the work, the tasks identified in the plan relevant to Principle 1 were reviewed and remaining tasks identified which need to be completed (Table 1).

Two major gaps have been identified which need to be addressed:

1. It is recommended that a Bahamas Spiny Lobster Working Group is established which consists of representatives of all major stakeholders (i.e. relevant Government staff, processors, fishers, scientists) who will advise government of actions which need to be taken to implement and be consistent with agreed policy. Such a working group could form the focus for many of the requirements under the MSC standard, including all performance indicators under MSC P&C 1.2 and 3.2, as well as addressing 3.1.2, and all management strategies under Principle 2. Bearing in mind that managing fisheries is an on-going process, the Working Group would exist to address any issues in future as they arise. The first objective of the Working Group would be to take the fishery forward as quickly as possible to certification.
2. The main remaining hurdle for meeting MSC P&C for Principle 1 is the data collection system (FIP tasks 1.1 – 1.3). A minimum requirement will be reliable data collection and management reporting information rapidly and accurately enough that the harvest control rule can be applied, as well as providing the longer term needs of an improved stock assessment. It is not clear that the DMR or the processors can do this without technical support. It is important to note that the primary data collection would be implemented with the processors, not the DMR, although the DMR would need to verify and manage their part of the system.

**Table 1: Evaluation of tasks relevant to the FIP and MSC certification**

| No. | Task | Comments |
|---|---|---|
| 1.1 | Development of revised data collection form | The current fisheries information system is not good enough to support the harvest strategy. Even where data are now being collected in a more rigorous fashion, they need to be made available through an information system. This will be critical for all four Principle 1 management performance indicators (P1.2.1 - 4). Currently, the processors and DMR do not have the capacity |
| 1.2 | Initiate data collection at processors | |
| 1.3 | Update and maintenance of Fisheries Information System | |

| | | |
|---|---|---|
| | | to carry out these tasks. |
| 2. | Education and Outreach (all tasks) | The proposed Bahamas Spiny Lobster Working Group should have a role in carrying out all tasks under these headings. |
| 3. | Enforcement (all tasks) | |
| 4.1 | Demonstrate effectiveness of MPAs | This has been marked as high priority for the stock status determination and assessment, but this information is not necessary for either. It is difficult to see what can be done to address this in the short term, and it should not be necessary to address before the full MSC assessment. The current role of MPAs in the harvest strategy is to reduce general risk factors for the fishery only, and this can be argued effectively without the completion research. |
| 4.2 | Develop in-house capacity to conduct stock assessments | This is an on-going requirement and need not be completed before full MSC assessment. |
| 4.3 | Develop stock assessment, harvest control rules and reference points | This report addresses these issues. A stock status determination has been made; reference points and harvest control rule have been proposed. The next stage of the process will be to carry out the scientific and management review. It is planned to have the CRFM Conch and Lobster Working Group conduct the scientific review of the stock assessment, HCR and management advice. The management review should be undertaken by the Bahamas Spiny Lobster Working Group (see above). |
| 4.4 | Growth, minimum size at capture and maturity | There is information in the scientific literature to support the minimum size. In addition, a maturity study can be conducted rapidly to provide an estimate of the onset of maturity between November 2010 and April 2011. This is likely to support the current minimum size. Growth estimates would be valuable, but are unlikely to be conducted before full assessment, unless full assessment was significantly delayed. Even without new data, an argument can be constructed to support the current minimum size. |
| 4.12 | Develop a research plan to investigate the prevalence of lobster virus PaV1 | This task has been identified incorrectly as a high priority for determining the status of the stock. It is not necessary for determining stock status, but it is a long term task providing useful information for the harvest strategy and possibly stock assessment modeling, as well as market quality of the product. |

## 3. State of Stock

The latest stock assessment using all the available catch and effort data indicates that overall the Bahamas spiny lobster stock are not overfished and overfishing is not occurring. This can be interpreted as there being no evidence in these data of overfishing. However, precise determination of stock status is not possible due to limited relevant information in the available data.

Previous stock assessments based on other data have indicated very high exploitation rates. These over-estimates of the exploitation rates were thought to be due, at least in part, to limitations on models and data in capturing the main characteristics of the population dynamics and the fishery. This limitation is also thought to apply to the latest assessment, although the problem is less severe.

## 4. Management Advice

Although the assessment indicates the Bahamas stocks are in a good state, the uncertainties associated with this assessment, and an inability at this stage to provide advice for specific populations within the Bahamas archipelago, suggest that the stocks should be treated as fully exploited until more and better information becomes available. Therefore, management controls should be applied which will directly limit exploitation to the current level and prevent any further expansion. Central to this advice is to establish a harvest control rule.

## 5. Reference Points

Internationally recognized precautionary reference points should be adopted to protect the stock. It is not possible to reliably estimate reference points based on maximum sustainable yield, so generic points appropriate for the stock should be used. The biomass relative to the unexploited biomass can be estimated and therefore this should be used as the basis for reference points.

A limit reference point is proposed which is set at 20% of the unexploited spawning stock biomass (SSB). If the SSB falls below this point the stock should be considered severely overfished and catches should be minimized, which could include a ban on exports.

A target reference point is proposed which is set at 40% of the unexploited spawning stock biomass. An important objective of the harvest strategy should be to maintain the stock so that it fluctuates around the target or remains above it.

## 6. Harvest Strategy

The harvest strategy currently has two main components:

1. To ensure that the optimum size composition is maintained in the catches; and the selectivity pattern provides as much protection to spawners as possible. This is currently being achieved through a minimum size and closed season.
2. To ensure the exploitation rate is maintained at a level commensurate with the productivity of the stock and appropriate action is taken to reduce exploitation when the risk to the spawning stock has increased to an unacceptable level. It is planned to achieve this through the implementation of the harvest control rule.

However, the current harvest strategy is not fully developed, but requires a well defined process implementing a feedback-control system. A system which evaluates its own performance is the only way to ensure sustainability.

It is recommended that a Bahamas Spiny Lobster Working Group be established to evaluate and advise on the management of the Bahamas lobster fisheries. Terms of reference for this working group are being distributed for consultation. Establishing such a group would meet a number of requirements for MSC certification under all three Principles. One of the important tasks of the group would be to implement and evaluate the harvest strategy, and in particular be responsible for timely and accurate application of the harvest control rule.

## 7. Harvest Control Rule

A harvest control rule (HCR) has been proposed which will contribute to the harvest strategy by ensuring the exploitation rate is reduced when the apparent stock size falls below the trigger point (Box 1). The decisions that result from the HCR are taken based on an index which is calculated from data collected at the beginning of the lobster season. There are a number of indices which could be calculated, and it is recommended that at least two are estimated each year to help with the evaluation and auditing of the rule. Indices include:

- The index which is currently suggested for the HCR is the average catch (tail weight) per man day taken by divers during August. Historical information already exists to propose appropriate reference points for this index, although the true behaviour of this index might only become apparent under the new data collection system which has only recently been implemented.
- An index obtained from fishers who are preparing for the season in July. Fishers would collect standardized information on abundance from condominiums and diving activity which could be sent into the Department of Marine Resources and combined into an abundance index. While this has the advantage of involving the fishing community in implementing the rule, there is no current information that might be used to evaluate this approach and the data may be difficult to validate.
- A fishery independent index obtained by DMR staff and others during the closed season by inspecting condominiums and traps. There is no current information that might be used to evaluate this approach and obtaining a valid sample representing the large fishery area involved may be difficult and expensive to achieve.
- Mean size as calculated from the commercial size composition reported as part of the export procedure. The mean size would cover the whole year and is not suitable for the harvest control rule, but provides a useful comparison for other indices.

The details of the data collection system for the index and the necessary auditing that will be required to ensure it is correct have not yet been developed.

**Box 1.** Proposed Harvest Control Rule for Bahamas Spiny Lobster. The terms in bold-italics need to be reviewed by a scientific working group to test whether they are consistent with each other and precautionary and based on the best scientific advice currently available. Note that a valid sample for calculating the index has yet to be determined and the maximum export of 7 million pounds needs to be verified.

The Total Allowable Export shall be set at:

- ***7 million pounds*** lobster tails when the index catch rate is at or above the trigger index.
- a linearly declining value when the current index is below the trigger index according to the calculation:
    - TAE = (Current Index – Limit Index) * ***700000*** lbs tails
    - ***zero (the fishery is closed)*** if the current index is at or below the limit index.
    - The trigger index shall be set at ***30*** lbs per man day.
    - The current index for each year shall be calculated as the average between the previous year's index and index of the current year. The index is calculated from the catch divided by the number of man days required to obtain that catch for a valid sample taken from the August diving activity.
    - The target index shall be set at ***40*** lbs per man day and the limit index shall be set at ***20*** lbs per man day.
- The year to year change in the TAE shall not vary by no more than ***15%***.

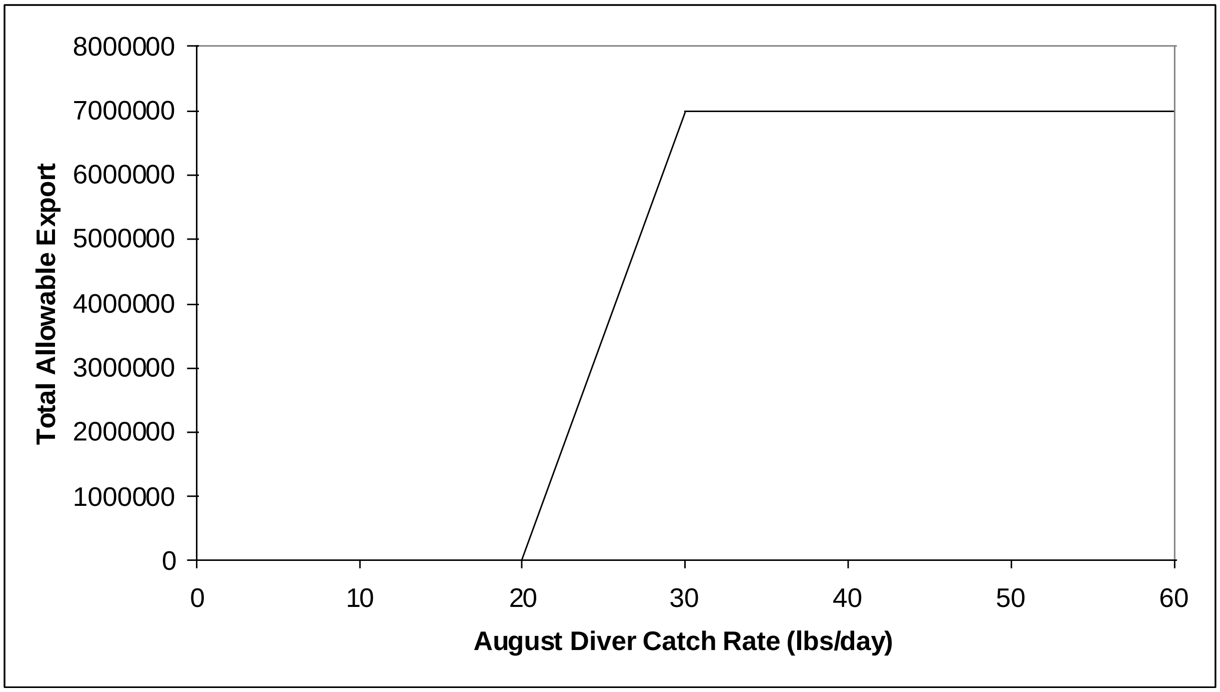


**Figure 1: The proposed harvest control rule linking the index observation to the maximum allowed export in each year. This is the graphical representation of the rule in Box 1.**

The maximum level of catch currently proposed will not reduce the size of the fishery, but will prevent further expansion. If recruitment continues to decline it will decrease the landings and protect the fishery. However, it still needs to be demonstrated that under this rule catches can be reduced fast enough to protect the stock.

## 8. Recommendations

**Improve estimates of catch and catch-effort time series.** The primary problem for the stock assessment is the relatively poor data available. Total annual exports are recorded reasonably accurately, but when these catches are actually taken within the year has to be estimated. In addition, there are catches which are not exported and which should be estimated and included when possible. These locally consumed catches will need to be estimated as a time series to have any impact on the stock assessment.

The catch and effort data are based upon trip interviews. Some of these data are clearly erroneous either in collection or recording in the database. Fishing effort in particular has not been recorded accurately. Quality control of these data has been poor and, in particular, quality of effort data for some of the mother-ship operations needs to be improved. If the harvest control rule depends on catch and effort data, it is a very high priority that these data be improved. Improvements should be seen with the EU Catch Certificate system.

**Implement a stock assessment review process.** This stock assessment must undergo peer review. This would be most easily and cost-effectively done using the CRFM Conch and Lobster Working Group which should meet in June of each year. The review should carry the following tasks:

- Oversee the overall quality of the assessment, including checking for simple errors, such as coding errors and incorrect data through examining residuals and outliers etc.

- Consider whether the model assumptions and structure are reasonable. If the model structure can be significantly improved, implement the improvement as part of the assessment.
- Identify an appropriate base case and sensitivity analyses. Request and review all output necessary to verify the model fit, diagnose problems and be able to give management advice.
- Identify the main axis of uncertainty and bracket the interval which will cover the true fishery state with a high degree of certainty.
- Provide full management advice, taking account of the uncertainty, based on the best scientific assessment available. The management advice may require evaluation of management tools such as harvest control rules, indicating whether they are precautionary and robust to uncertainties identified as part of the assessment process.

**Include Size Composition Data into the Assessment**. Assuming that the current catch and effort data are considered acceptable, including size composition should allow the assessment to model the population components. However, the limitations on the size data (i.e. sizes based on weight and inconsistent sizes used in commercial size categories) would make such a model far from easy to complete.

**Assessments for the Separate Bank Populations**. The stock assessment cannot separate the different lobster populations in the Bahamas because the catch data cannot be attributed to any particular location. Strictly speaking, adult stocks should be managed separately, and as data improves, separate assessments for each area should be undertaken.

## II. REPORT OF THE SMALL COSTAL PELAGIC FISH RESOURCE WORKING GROUP (SCPWG)

| | |
|---|---|
| Consultant: | Professor Juan Carlos Seijo |
| Chairperson: | Maren Headley |
| Group Members: | Dr. Susan Singh-Renton (CRFM Secretariat); Ms. Ruth Redman (Trinidad and Tobago); Mr. Mauro Gongora (Belize); Ms. Elizabeth Mohammed (Trinidad and Tobago); Mr. Ricardo Morris (Jamaica); Professor Hazel Oxenford (CERMES); Mrs. Anginette Murray (Jamaica); Mr. Sam Heyliger (St. Kitts and Nevis); Mr. Alwyn Ponteen (Montserrat); Ms. Elaine Ferrier (CIDA) |

### A. OVERVIEW

### 1. Review and Adoption of Meeting Agenda

The group reviewed and adopted the proposed agenda.

### 2. Review of Meeting's Objectives

It was agreed that the main objectives of this year's meeting would be to:

(i) To explore the bioeconomic dynamic impacts of managing the multi-fleet and multispecies flyingfish fishery.

(ii) To undertake risk analysis of alternative fishery management decisions.

### 3. Review of Working Group's Commitment to the CLME Project

An overview of the Flyingfish Pilot component of the CLME project was provided. The Caribbean Large Marine Ecosystem (CLME) project is a four year Global Environment Fund (GEF) project to promote the sustainable management of the shared living marine resources of the region through an integrated or ecosystem-management approach (CRFM 2010; UNDP 2010). The overall coordination for this flyingfish pilot will be provided by the CRFM Secretariat.

The following priority actions for the sustainability of the Eastern Caribbean flyingfish fishery have been identified under the CLME Flyingfish Pilot project:

(i) Improvement of data availability and information including catch / effort information, in the Eastern Caribbean taking into account long lining and mixed landings;

(ii) Bioeconomic studies of the fishery to establish the bioeconomic criteria and set reliable management measures for the fourwinged flyingfish;

(iii) Assessment of species interaction between flyingfish and large pelagic fishes to provide for these in management using EBM principles; and

(iv) Assessment of economic risk and social impacts to refine the management for the fourwinged flyingfish.

## 4. Review of available new data and information on fishery interest, including review of national reports, fisheries trends, pertinent technical studies completed to date and management developments.

A brief overview of the flyingfish fisheries in the region was provided including trends in landings and the value of the fisheries in the Eastern Caribbean.

An update on the status of the flyingfish fishery in Tobago was provided by the national representative. It was reported that only one company was currently processing flyingfish and fishers were not targeting flyingfish as much as in previous years given the lack of a market. The meeting was also informed that many of the individuals who received training in deboning flyingfish, which adds considerable value to the product have left the processing sector and sought alternative employment.

An inter-sessional study completed by the CIDA intern Ms. Elaine Ferrier, was presented to the group. The study was focused on obtaining the perspectives of stakeholders on the importance of various management objectives. A summary of the findings is provided below.

Regional governance of the flyingfish fishery in the Eastern Caribbean requires agreement upon management objectives as well as how important these objectives are in relation to each other. A pre-established hierarchy of objectives can guide governance of the fishery and significantly assist decision-making processes. This hierarchy is critical to manage the complexity of a multi-species regional fishery, because it is rarely possible to optimize multiple and competing objectives (Pope 1997 as cited in Mardle *et al.*, 2004).

Field work was conducted with fishers, fish processors, and fisheries division staff in Barbados and Tobago to determine their perception of the relative importance of a range of management objectives drawn from FMPs and reports relating to the Eastern Caribbean Flyingfish fishery. Thirty seven respondents from eight landing sites conducted a modified pairwise comparison technique developed by Simos (1990, as described in Ondrus and Pigneur 2006) which involved sorting cards with a description of each management objective. In this technique, respondents were asked to arrange the cards according to their importance from 1 to *n*. This ordinal data was then converted into pairwise comparison tables. That is, if a respondent sorted objective A as more important than objective B, objective A was recorded as being more important in the pairwise comparison. Note that this assumes that by positioning a card in a certain level, the respondent believed this card to be more important than all those below it, less important than all those above it, and of equal importance to those in the same level.

The management objectives drawn from FMPs and grey literature reports and their relative weights as determined in the study are as follows (Figure 1):

16.2% Sustaining the stock size

- Ensuring that there are Flyingfish available for future generations
- Preventing overfishing to maintain a healthy stock

10% Accurate information

- Ensuring that an effective data collection system is in place to provide accurate information and knowledge about the state of the fishery

10.1% High profits

- Optimal economic benefits for all involved in the fishery

10.3% Effective management

- Ensuring that there is an effective system for management and enforcement to management as needed
- Effective management is adaptive, responsive to changing information about the fishery, and involves stakeholders in decision-making

7.4% Affordable food source

- Ensuring that Flyingfish remains an affordable and available source of food for the future

7.6% Balanced ecosystem (balanced trophic levels)

- When something is removed from the ecosystem, we know that it has an effect on other species and ecosystem processes.

10% Successful processing and export market

- Developing the post-harvest production and export of Flyingfish

7% Resilience to environmental change

- Ability to withstand the effects of climate change, extreme weather events and other environmental changes

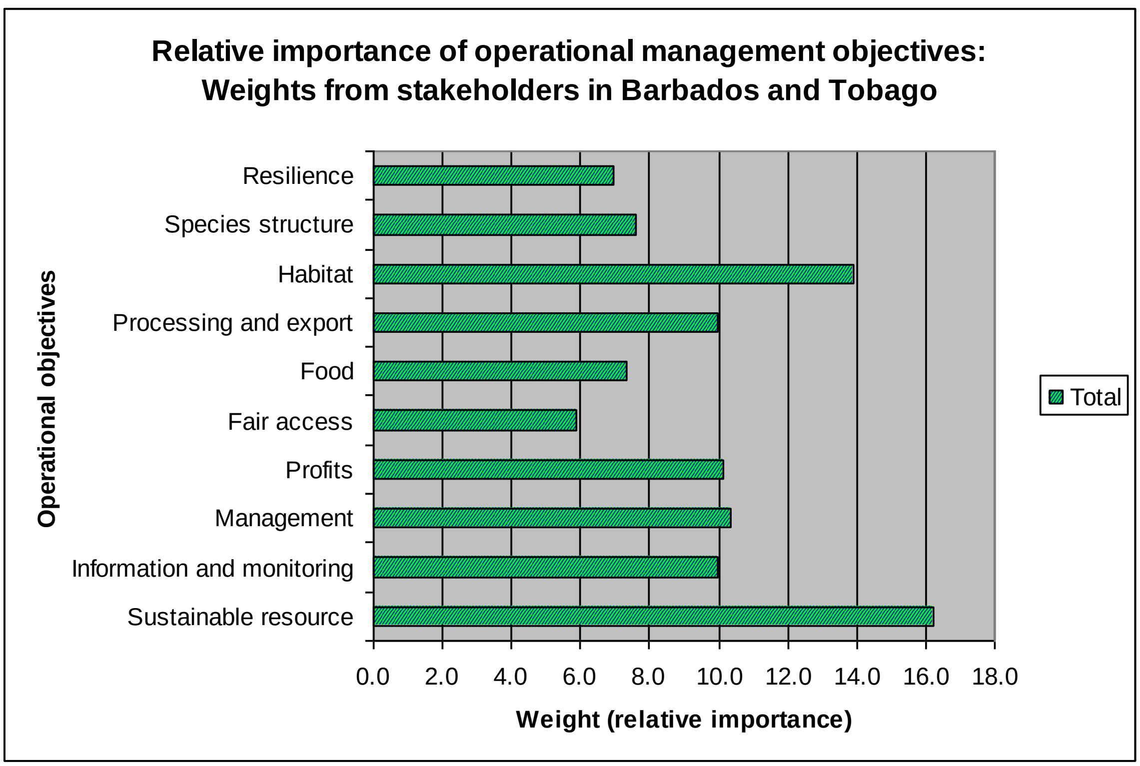


**Figure 1: Relative importance of operational management objectives: weights from stakeholders in Barbados and Tobago.**

## B. FISHERIES REPORTS

## 1.0 Eastern Caribbean Flyingfish Fishery

### 1.1 Management Summary

#### 1.1.1 Policy and Objectives

**Regional Flyingfish Policy**

Regional policy relating to flyingfish in the Eastern Caribbean is currently under development. In 1999, an ad hoc Working Group was assembled by the FAO to compile existing data and develop regional policy and management strategies. The following policy statement was developed in 2008 at the third meeting of this group:

"The objective of fisheries management and development shall be to ensure responsible and sustained fisheries, such that the fisheries resources in the waters of the eastern Caribbean are optimally utilized for the long-term benefit of all people in the eastern Caribbean region."

More specifically, the working group articulated the following operational objectives for the flyingfish fishery (FAO 2010; paraphrased and headings added):

Management

- Collaborative management
- Fair access to the fishery
- Distribution of benefits to all people in the region
- Active fisherfolk organizations with effective links to other organizations and governments

Harvest sector

- Well trained fishers
- Investment in the fishery
- Commitment to responsible fishing practices
- Access to reasonably priced fishing equip and supplies, stable market

Post-harvest sector

- High quality fish and fish products
- Prevention of wastage
- Greater distribution of profits
- Value-added (processed) products
- Better distribution of fish products to all sectors of the local public

#### 1.1.2 Fisheries Management

**Flyingfish Management**

There are currently no management rules or controls for the Flyingfish fishery in the Eastern Caribbean. In lieu of formal reference points for the Flyingfish fishery, a stock assessment conducted in 2008 identified an annual harvest trigger point of 5,000 tonnes, indicating that:
"Sustained catches at, or above, this level are likely to bring about an unacceptable risk of overfishing. Either catches must be maintained below this level, or further research, data collection and stock

assessment work is required to enable a new higher limit to be set while still ensuring that the limit is safe” (Medley *et al.* 2008).

**Table 1: The feasibility of various future management actions for Flyingfish and the limitations (FAO, 2010)**

| **Type of Control** | **Control** | **Constraints** |
|---|---|---|
| Output controls | Total allowable catches (TACs) or individual quotas (IQs) | Allocation of allowable catch among countries would be contentious and difficult. Setting a TAC for the duration of the season may result in overcapitalization of the stock at the beginning of the season. Setting quotas for periods within the season or allocating IQs may be a way around this problem. However a TAC or IQ approach requires a standard of monitoring that is beyond the capacity of most or all countries, and would be even more challenging at the regional level. An advantage to this approach is that it can be modified each year if managers are able to use catch data to predict future abundance. |
| | Size limits | Not relevant for several reasons: Flyingfish do not continue to grow once they mature; the fishing technique targets spawning fish, which are mature; and the gill net is a standardized size which targets mature fish and is therefore size-selective. Would require an impractical amount of monitoring to enforce size of catches. |
| Input controls | Limited licensing | Licensing would be challenging due to the complication of determining a standard unit of effort for the many different types of boats. In addition, allocation of licenses among stakeholders within the region would be contentious and difficult. Despite these challenges this approach is “probably the most appropriate tool at this time”. |
| | Closures | Closures may be appropriate, yet because there are two distinct spawning periods, the timing of the closure would be dependent on whether these two spawning periods indicate the presence of two Flyingfish stocks. If there are two stocks, then two closures during both spawning periods would be necessary to protect both stocks. Alternate possibilities include having several closed periods throughout the season or alternating the timing of the closure from year to year. Implementation of closures would be challenging to the uncertainties about stock dynamics. In addition, while not mentioned in the report, a further complication is the linkage to large pelagic fisheries through the extensive use of Flyingfish as a bait fish. |
| | Bag limits (limiting individual or boat to catching a certain amount of fish per trip) | Not practical for Flyingfish because it would require surveying catches from each boat for each trip, and this is far beyond the current monitoring capacity of fisheries departments. Catches are extremely variable because Flyingfish spawn in large but unevenly distributed schools. As a result catch rate per day varies enormously from day to day depending on whether a school was encountered. |
| | Gear limits | Regulating mesh size of gillnets is irrelevant because Flyingfish grow very little after they mature. Regulating FADs may be appropriate because they are often covered in eggs from fish spawning around them. Wasting these eggs by bringing FADs to shore could have negative implications for recruitment. |
| | Monetary | Monetary incentives or disincentives are crude and unlikely to be acceptable. |

## 1.2 Status of Stocks

### 1.2.1 Flyingfish (*Hirundichthys affinis*)

Estimates of annual total flyingfish landings for the eastern Caribbean are available in FAO (2010). The landings, estimated for Barbados, Trinidad and Tobago, St Lucia, Grenada, St Vincent and the Grenadines, Dominica and Martinique vary considerably from year to year. These estimated landings ranged from 1,025 to 2,523 tonnes per year between 1950 and 1979 and appeared to increase thereafter, ranging from 2,121 to 4,725 tonnes per year between 1980 and 2007 (Figure 2). The estimated average annual landing between 2002 and 2007 was 2,512 tonnes. These data are, however, to be treated cautiously as they are likely underestimates of the true catches in the region. Grenada has developed a significant bait fishery for the species, the catches of which are not well documented. In addition, landings from Martinique and other countries in the Eastern Caribbean likely to be harvesting the species are not available. There are also gaps in available data which required interpolation to estimate landings for years without data. Generally several countries lack a clear methodology for estimating total catches from recorded data. Consequently, there is tremendous uncertainty in the level of historical catches of flyingfish for the Eastern Caribbean. Estimates of fishing effort are also uncertain.

Three stock assessments of the flyingfish fishery within the Eastern Caribbean have been conducted (Mahon 1989; Oxenford *et al*., 2007; Medley *et al*., 2008) and extensive research undertaken on the fishery by the Eastern Caribbean Flyingfish Project (Oxenford *et al*., 2007). In addition, a preliminary trophic model constructed for the Lesser Antilles Pelagic Ecosystem (LAPE) project examined impacts of predator-prey and technological interactions in the fishery (Mohammed *et al*., 2008a) and a preliminary bioeconomic model for the eastern Caribbean flyingfish fishery was developed (Headley, 2009).

The most recent stock assessment (Medley *et al*., 2008) considered a wider spatial range of landings data than the previous assessments (Barbados, Trinidad and Tobago, St Lucia, Grenada, St Vincent and the Grenadines, Dominica and Martinique) for 1955 to 2007 and catch and effort data from Barbados, Trinidad and Tobago and Saint Lucia from 1994 to 2007. A Beverton and Holt Stock Recruitment model was used with the possible oceanographic effects on the population accounted for by inclusion of process error in the analyses and uncertainties in biological parameters accounted for using a Bayesian approach. ***The stock assessment suggested that the stock of flyingfish in the eastern Caribbean is not overfished and that overfishing is not occurring.***

The assessment, however, could not be used to determine whether or not "local depletion" may be occurring as the data are not available in the level of detail required to do so. Catch rates have remained fairly stable even with increased overall catches. Given the potential stock area, and estimates of a relatively large stock size from tagging and survey data, it is unlikely that the catches have ever exceeded the maximum sustainable yield from the stock. Consequently, there is no evidence that the stock has ever been overfished.

The model estimated, for 2007, MSY at between 3,312 and 36,291 tonnes; B/Bmsy at between 1.97 and 4.17; and F/Fmsy at between 0.03 and 0.5 (0.05 and 0.95 confidence intervals respectively). The model projections show that keeping the fishing effort and capacity or catch at about 2,500 tonnes (the maximum recorded catch to date has been 4,700 tonnes) should be safe with overfishing very unlikely even with stock fluctuations due to environmental influences. Given the uncertainty in the MSY value, attempts to fix the fishing mortality in relation to MSY or set catches at or above 5,000 tonnes led to prediction of significant risks in overfishing. Consequently, it was suggested that a trigger point should be established at 5,000 tonnes, such that when catches consistently exceed this figure management should take action to safeguard the stock from overfishing.

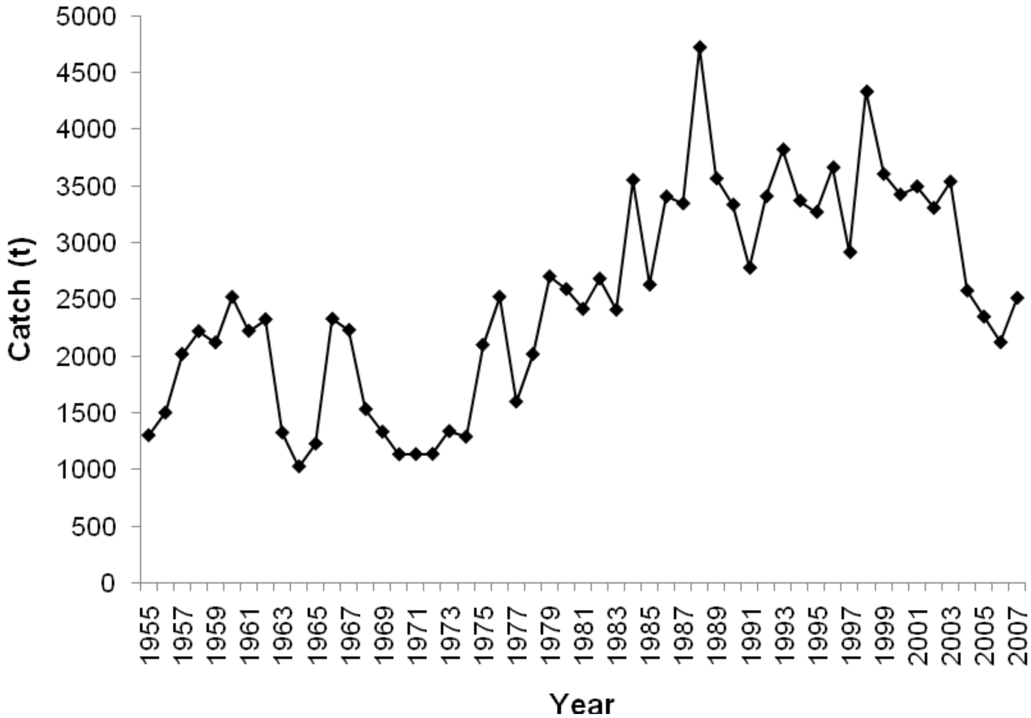


**Figure 1: The estimated total catches of flyingfish from the Eastern Caribbean stock (1955-2007).**

### 1.2.2 LAPE-flyingfish / dolphinfish interactions

A trophic model using Ecopath with Ecosim software was developed for the Lesser Antilles Pelagic Ecosystem (LAPE - an estimated area of 610,000 km$^2$ including the Exclusive Economic Zones of all the islands from Antigua and Barbuda and St. Kitts/Nevis in the north to Trinidad in the south, excluding the Gulf of Paria) representing an average year between 2001 and 2005 (Mohammed *et al*., 2008a) under the FAO Lesser Antilles Pelagic Ecosystem Project. Due to severe data limitations the model drew on inputs from other models constructed for the LAPE region, central Atlantic region, Florida shelf ecosystem, central Pacific Ocean and the British Virgin Islands reef ecosystem as well as new information (diet composition and biomass estimates of some species, primary production, fisheries catches) generated by the Project or in the published literature.

The data inputs included average catches between 2001 and 2005 disaggregated by eight defined fleet types (Mohammed *et al*., 2008b), estimates of total mortality or the ratio of production to biomass, consumption rates and biomass (Mohammed et al., 2008a) as well as estimates of diet composition (Heileman *et al*., 2008). Thirty-one functional groups were defined with flyingfish and dolphinfish representing explicit groups. The model was balanced by solving simultaneous linear equations describing production, consumption, fishery removals, other mortality, net migration and biomass accumulation for all groups in the system to satisfy the two Ecopath master equations after Christensen *et al.* (2000) and adjusting input parameters where necessary based on consultation with regional experts.

The balanced model, which represents one of several possible representations of the biomass flows in the ecosystem, gave an estimated biomass of 126,880 tonnes for flyingfish and 16,958 tonnes for dolphinfish, assuming homogeneous distribution throughout the LAPE area. The estimated base fishing mortality of flyingfish was 0.013 year$^{-1}$; predation mortality was 3.787 year$^{-1}$ and other mortality 0.2 year$^{-1}$. Flyingfish experienced greatest predation mortality from dolphinfish (1.15 $year^{-1}$), large mesopelagics (1.11 $year^{-1}$), large squids (0.74 $year^{-1}$) and coastal predators (0.52 $year^{-1}$). For dolphinfish, the estimated base fishing mortality was 0.13 $year^{-1}$, predation mortality was 4.394 $year^{-1}$ and other mortality was 0.196 $year^{-1}$. Dolphinfish experienced greatest predation mortality due to cannibalism (4.32 $year^{-1}$) compared to predation by bigeye tuna (0.023 $year^{-1}$ and yellowfin tuna (0.016 $year^{-1}$). A preliminary simulation using Ecosim examined the impacts of increased fishing mortality on flyingfish from the baseline to F = 1.0 $year^{-1}$ at year 5, and sustained at this level for an additional 15 years showed that dolphinfish, as a key predator of flyingfish, is negatively impacted. However, when dolphinfish is subject to a similar pattern in fishing mortality the increases in flyingfish biomass were modest. A combined increase in fishing mortality of the two groups was detrimental to dolphinfish. ***The inequality in responses to increased fishing on flyingfish and dolphinfish suggests that prey availability is a stronger control in the dolphinfish – flyingfish dynamics, than predator control.***

The authors caution about the limitations of the model, including its non-validation and advised that the model be considered a framework for critical analysis which can be used to assess the compatibility of new and existing information for the region, to develop hypotheses about the biological and technical interactions within the LAPE and to identify research needs for understanding these interactions and their relevance to management.

Fanning and Oxenford (2011) extracted outputs of the trophic model (Mohammed *et al*., 2008a) to describe the trophic, technical and economic linkages between dolphinfish and flyingfish, and among the longline, beach seine and traditional flyingfish fisheries and to highlight the management concerns that are of relevance to implementing an ecosystem approach to fisheries. In concluding, the authors noted that single species assessments of both species, each of which is annual, based on their respective life history characteristics have suggested that each stock can withstand relatively high levels of fishing effort with little risk of stock collapse but that when the trophic linkages are quantified it becomes apparent that the dolphinfish population is highly sensitive to flyingfish biomass, and the respective fishery is less likely to be sustainable with a marked decrease in flyingfish biomass. The authors recommended that the quality and quantity of catch and economic data be improved and that basic biological research, in particular diet studies, be conducted to improve the model quality as a basis for its use in assessing ecosystem level changes over time.

## 1.3 Management Advice

Given that stock fluctuations and climate change effects can negatively affect the abundance of flyingfish, the following management considerations are suggested:

1. Strengthening, through education, fishing community resilience and adaptability to fluctuating stocks and changes in resource accessibility,
2. Fostering vessel malleability and versatility to facilitate shifting of target species as required by stock fluctuations and climate changes effects on species distribution and availability and over space and time,
3. Fishing licensing, for this fishery should be for multiple species rather than for single species. This would allow fishermen to react intelligently to relative stock abundance/availability and associated profits over time.

## 1.4 Statistics and research recommendations

### 1.4.1 Recommendations for the Caribbean Regional Fisheries Mechanism Secretariat

Future bioeconomic research for this important fishery of the CLME, should perhaps consider the following questions:

1. Are long-term stock fluctuations associated to changes in abundance of predators (i.e. dolphinfish, and other large pelagic species) and competitors targeted by other fleets? If so, is there a dynamic bioeconomic optimum level of effort and fishing capacity of the eco-technological interdependent fleets?
2. Are the cycle and/or amplitude of long-term fluctuating stocks changing with climate change? If so, what should the adequate vessel capacity be?

In order to address the questions listed above, biomass estimates for the important commercial pelagic species harvested in the multi-species flyingfish fishery will be necessary to incorporate in the analysis their dynamics and corresponding ecological interdependencies.

### 1.4.2 Individual Countries

Countries should consider conducting a cost survey of their multi-species pelagic fleets, which would allow the economic data to be updated.

## 1.5 Stock Assessment Summary

This assessment explored the bioeconomic dynamic impacts of managing the multi-fleet and multispecies flyingfish fishery, and undertook risk analysis of alternative fishery management decisions. Some of the management questions considered in the analysis of this stock fluctuating fishery involved the following questions:

1. Can this stock fluctuating fishery be managed sustainably with an open access strategy?
2. Which is the bioeconomic optimum fishing mortality and corresponding vector of catch quotas for managing a stock fluctuating fishery?
3. Which are the risks of falling below limit reference points associate to alternative fishery management strategies?

For the identified management questions, and corresponding performance variables:

1. A dynamic model was built with and without fluctuating carrying capacity.
2. Bioeconomic parameters were calculated from data provided by participants' countries and relevant published previous fishery assessments.
3. Without fluctuating carrying capacity, as suggested by Klyashtorin (2001), the flyingfish pelagic fishery model did not represent the dynamics of observed catch.
4. Optimal control theory was applied to estimate the cycle and amplitude parameters that best fitted the trajectory of observed catch data, and the optimum fishing mortality (Fopt) to be multiplied over time by the fluctuating biomass to obtain a dynamic TAC.
5. Proceed to explore alternative management strategies to address the management questions and their effect on $B_t$, $Y_t$ and NPV.
6. A Monte Carlo analysis was undertaken to estimate the probability of exceeding biologic ($B(OA)_t/K_t$) and economic LRP's (NPV(OA)/NPV(TACopt) with alternative management strategies. A risk analysis to estimate tables without mathematical probabilities were built using alternative criteria involving different degrees of risk aversion.

The main results of this preliminary dynamic bioeconomic analysis are the following:

1. The biomass dynamics for this stock fluctuating fishery using a dynamic carrying capacity with an expanded version of Schaefer-Gordon model with multispecies and multi-fleet built in reflects adequately the trajectory of catches for the period 1950-2007.
2. Under open access, harvest rates in the neighborhood of 5000/year ton could result in temporary collapse of this pelagic fishery. This could be prevented with catch quotas, tending to the

TACopt, are established and effort is controlled to reduce exploitation rates by 30% to allow the resource to recover its natural fluctuations over time.

3. The multi-species nature of this fishery involves additions to the flows of revenues to the fishery over time coming from the harvest of valuable large pelagic species like dolphinfish, tunas, wahoo, among others. Therefore, under open access, fishermen will not react by reducing their effort when encountering lower biomass levels of flyingfish because the other species harvested will tend to cover the variable costs of the fishing trip. Also, it was pointed in the discussions of the working group that price of flyingfish has is very seasonally sensitive to supply (harvest rates over time), tending to reach substantial increases in price with low catch rates. This effect not explored in the quantitative analysis will tend to accentuate the need for managing the fishery with the input and output control measures mentioned above.
4. Monte Carlo analysis indicates that with the current exploitation rates there is no risk of exceeding a 0.3 ratio of Bt/Kt.
5. It was estimated in the Monte Carlo analysis that the net present value of the flow of profits was in the neighborhood of 63% of the profits that could be obtained if operating the fishery at Fop.

## 1.6 Special Comments

None.

## 1.7 Policy Summary

Regional policy relating to flyingfish in the Eastern Caribbean is currently under development. In 1999, an Ad Hoc Working Group was assembled by the FAO to compile existing data and develop regional policy and management strategies. The following policy statement was developed in 2008 at the third meeting of this group:

"The objective of fisheries management and development shall be to ensure responsible and sustained fisheries, such that the fisheries resources in the waters of the eastern Caribbean are optimally utilized for the long-term benefit of all people in the eastern Caribbean region."

## 1.8 Conclusion and Recommendations

The main conclusions of this preliminary bioeconomic analysis of the four-wing flyingfish fishery are the following:

(i) Because of exogenous fluctuations of carrying capacity, there are no possibilities for reaching equilibrium (including bioeconomic equilibrium) in the fourwing flyingfish fishery of the Eastern Caribbean.

(ii) Non-equilibrium conditions and stochasticity precludes the derivation of analytical solutions for the differential equations describing resource and fishers dynamics.

(iii) Calculation of values of state variables for resource biomass and fleet specific effort dynamics should be undertaken using numerical integration methods (e.g. Euler numerical integration)

(iv) Effort, catch and profits will tend to fluctuate in response to oscillations of resource abundance through time, but not linearly because additional contributions of harvest of other pelagic species contribute to pay for the variable costs of daily fishing effort.

(v) For stock fluctuating fisheries, target and limit reference points should not be scalars or discrete values of biologic and economic indicators. To be meaningful, they should become time varying hypothesis vectors of TRP's and LRP's with the corresponding vector of TAC´s.

(vi) The optimum fishing mortality for the stock fluctuating fishery was $F_{opt} = 0.11$.

(vii) Under current open access regime long-run risks are high for both, biologic and economic indicators.

(viii) Model dynamic results of the Monte Carlo analysis indicate that license limiting to current levels of effort drive above mentioned risks to low levels and increase to more than 70% the probabilities of achieving bioeconomic target reference points for this fishery of the Eastern Caribbean region.

Future bioeconomic research for this important fishery of the CLME, should perhaps consider the following questions:

1. Are long-term stock fluctuations associated to changes in abundance of predators (i.e. dolphinfish, and other large pelagic species) and competitors targeted by other fleets? If so, is there a dynamic bioeconomic optimum level of effort and fishing capacity of the eco-technological interdependent fleets?
2. Is the cycle and/or amplitude of long-term fluctuating stocks changing with climate change? If so, what should the adequate vessel capacity be?

Finally, long-term stock fluctuating fisheries and possible climate change effects upon them, could suggest the following management considerations:

1. Strengthening, through education, fishing community resilience and adaptability to fluctuating stocks and changes in resource accessibility;
2. Fostering vessel malleability and versatility to facilitate shifting of target species as required by stock fluctuations and climate changes effects on species distribution and availability and over space and time;
3. Fishing licensing, for this fishery should be for multiple species rather than for single species. This would allow fishermen to react intelligently to relative stock abundance/availability and associated profits over time.

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UNDP 2010. PIMS 2193 - Sustainable Management of the Shared Living Marine Resources of the Caribbean Large Marine Ecosystem (CLME) and Adjacent Regions

## III. REPORT OF THE SHRIMP AND GROUNDFISH RESORUCE WORKING GROUP (SGWG)

Chairperson: Lara Ferreira, Trinidad and Tobago
Rapporteurs: Ranjitsing Soekhradj, Suriname (Shrimp)
Lara Ferreira, Trinidad and Tobago (Shrimp)
Anginette Murray, Jamaica (Shrimp)
Ricardo Morris, Jamaica (Shrimp)
Consultant: Paul Medley (Fisheries Consultant, UK)

### A. OVERVIEW

#### 1. Review of inter-sessional activities since last meeting, including management developments during this period

At the 5th CRFM Scientific Meeting in 2009 the following analyses were conducted for the Atlantic seabob (*Xiphopenaeus kroyeri*) fishery in Guyana and Suriname separately as no evidence was found that the stocks were shared: 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; several morphometric relationships were determined; and various other exploratory analyses were done including cross-correlations for river outflow. In the case of Trinidad and Tobago, preliminary analyses of ParFish interview data for the shrimp trawl fishery were conducted.

The Inter-sessional Work Plan documented in the Report of the Shrimp and Groundfish Resource Working Group at the 2009 Fifth Annual CRFM Scientific Meeting (the SGWG did not meet at the 2010 Sixth Annual Meeting) was reviewed and achievements noted as follows.

***General***

More interaction among SGWG members during the inter-sessional period was recommended via electronic mail, Skype, net meeting sites or video conferencing. There was some interaction via electronic mail among the members with respect to advancement in the ParFish assessment for Trinidad, and the development and implementation of the Harvest Control Rule (HCR) for the Suriname seabob fishery. There was a suggestion that if funding is sourced for the conduct of activities during the inter-sessional period then this would promote more communication among the members of the Group.

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, is still to 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 and Suriname***

The Fisheries Department in Suriname obtained landings by size category and effort data from the two seabob processing companies, namely Heiploeg Suriname (previously Guiana Seafoods which was bought over by Heiploeg), and Namoona. Landings data (peeled weight in pounds) by size category for 1997 to 2010 were obtained from Heiploeg Suriname with days at sea for 2001 to 2010, and landings data (live weight in kilogrammes) by size category for 1999 to 2010 were obtained from Namoona with days at sea for 2003 to 2010.

Although no bilateral meeting between Suriname and Guyana was held as recommended, some sensitivity analyses were conducted for the Suriname seabob assessment and the HCR was developed and implemented. This rule has been reviewed by the Suriname Seabob Working Group which is a management advisory group comprising the Government of Suriname, the two seabob processing companies, and the NGO World Wildlife Fund (WWF). The HCR is being reviewed monthly to monitor the status of the fishery. The relevant data are being obtained from the seabob processing companies in Suriname to facilitate the monthly monitoring of the HCR.

***Trinidad and Tobago***

The Parfish interview data for the shrimp trawl fishery of Trinidad and Tobago were analysed to determine the "priors" for the parameters (r, Binf, Bnow, q0) to update the Bayesian biomass dynamics model for Trinidad and Tobago and Venezuela. In order to complete this analysis the methodology was implemented in MS Excel and R. The "prior" probability of the parameters was determined based on the proximity to the fishers' estimated values. A method to use the preference interview data to estimate utility for different HCRs was developed. Seven of the 43 ParFish interviews completed were considered invalid and therefore not used in the analysis. The 1988 to 2004 time series of shrimp landings and effort data for Trinidad and Tobago were updated to 2009. A similar data set was obtained from Venezuela to update the series. Effort data however are still not available for Venezuela's artisanal shrimping fleet.

## 2. General review of fisheries trends throughout the region, including recent developments

It was noted that industrial trawling in Venezuelan waters was banned by law as of 2008 which provided for a one-year transition period until 2009. It was also noted that trawling was also banned in Belize waters.

Details on the management developments in the seabob fishery in Suriname in its attempts to obtain MSC Certification were discussed and are provided as Appendix 1.

## 3. Fishery data preparation, analysis, and report preparation

The members of the SGWG agreed to the following work plan for the meeting

**<u>Suriname</u>**

(a) Update the 2009 assessment of Atlantic seabob (*Xiphopenaeus kroyeri*) with revised and updated annual catch and effort
(b) Publish the harvest control rule (HCR) and review its performance.
(c) Address any issues raised by management specifically artisanal catch

**<u>Trinidad and Tobago</u>**

(a) Complete ParFish assessment for the shrimp trawl fishery of Trinidad and Tobago
(b) Incorporate ParFish data into a Bayesian biomass dynamics model for Trinidad and Tobago and Venezuela
(c) Develop a HCR using ParFish data
(d) Review assessment and HCR and make recommendations to Trinidad and Tobago Government.

**Other**

(a) Review catch and effort data on the marine white shrimp (*Penaeus schmitti)* fishery in the Kingston Harbour, Jamaica
(b) Consider the use of hydrometric data as a recruitment/growth index using Guyana data.

**Suriname**

The 2009 seabob assessment was updated with the corrected landings and effort time series from the two processing companies. The current assessment used the live weight as in the previous assessments from which the harvest control rule was developed.

The current HCR for Suriname was tested against the new assessment to ensure it continues to achieve its objectives. The HCR was found to be robust to the changes in the assessment that have occurred.

The assessment and HCR were reviewed for robustness against uncertainties. Further recommendations were made to the Suriname Seabob Working Group on monitoring and procedures to ensure continued sustainability.

Catch data are not available for the artisanal fishery but the catch is estimated to be some 500 tonnes per year. Recommendations were made on designing a data collection programme to estimate this catch.

**Trinidad and Tobago**

Nominal CPUE indices (not standardized as this had little effect in previous assessments) were used in the logistic model. Indices were still provided separately for the main fleet types which captures the main differences among indices. Unfortunately, original raw data for the CPUE index was unavailable, but averaged data derived from the same source were used, which followed the same trends. This was combined with total annual catch obtained from Venezuela and Trinidad to update the 2006 assessment. Recent information suggests catches have substantially declined and the stock has recovered to some extent.

The stock assessment also used the Parfish interview data to carry out a decision analysis. The interviews provide a prior probability based on fisher opinions and fisher preferences among different catch and effort projections.

The fishers' preference scores with respect to various levels of effort and resulting catch were used to estimate the more preferred Harvest Control Rules. The aim would be to select those which are expected to produce the most preferred outcomes for presentation to fishers.

The base effort was taken as the median effort of the entire Trinidad and Tobago / Venezuela shrimp fleet 1991 to 2004 (30,750 days at sea in Type II equivalent effort) when the shrimp stock was at its lowest. Various lengths of closed season were considered, where the closed season reduced this effort proportionally. Note that current effort is thought to be much lower than this, but is not due to direct management intervention. In this context, a closed season would be put in place to protect the fishery against expansion back to unsustainable levels. Other controls besides a closed season were also considered, but it is not thought possible to implement other management measures at this time.

Choice of month for the closed season could be chosen based on fisher preference (Parfish interviews), or observed shrimp size in particular months or some combination of the two. It was recommended that a two month closed season be implemented and the fishers should be consulted on when the closure should take place and how these would be administered.

***Other***

**Jamaica**

Catch and effort data from 1996, 2000 – 2010 for the marine white shrimp (*Penaeus schmitti)* in the Kingston Harbour area were examined with the objective of determining the current stock status. It was determined that based on the limited data set it would not be possible to conduct a reliable stock assessment. As a result, it was decided to conduct a review of the fishery highlighting various management issues and some of their implications. Recommendations were then put forward to address these issues.

Time did not permit the consideration of hydrometric data as a recruitment /growth index using Guyana data.

## 4. Inter-sessional workplan and Recommendations

**Inter-sessional workplan**

**General**

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 and previous workshops as well as any other relevant information.

**Suriname**

The artisanal catch of seabob is to be estimated as part of the requirement for MSC certification. This can be done based on information from the seabob buyers or by sampling the artisanal landings. If it can be verified that the artisanal landings are less than 5% of the total seabob catch then no further monitoring of this component of the fishery will be required in the longterm. If estimates suggest these catches are significant, a time series of estimated catches needs to be developed for inclusion in the assessment.
The catch and effort data series is to be extended as far back as possible prior to 1998 for the seabob fishery.

**Trinidad and Tobago**

The results of the ParFish analysis and biomass dynamics assessment for the shrimp fishery of Trinidad and Tobago and Venezuela are to be presented to the fishing communities.

A closed season for the shrimp trawl fishery of Trinidad and Tobago is to be implemented in collaboration with the fishing industry stakeholders.

Computerization of the Trinidad historical catch and effort data from the 1950s to the 1990s is to be continued.

**Jamaica**

The national sampling plan for the white shrimp fishery that would facilitate regular stock assessments is to be implemented.

An independent monitoring of white shrimp catch rates in various areas within the Kingston Harbour (and possibly other areas) to determine the status of the stock and explore alternative fishing areas is to be conducted.

A programme to obtain a socio-economic baseline which will complement the biological data for the fishery is to be implemented. This baseline must include, but not be limited to; the number of active fishers and vessels per year, earning per fisher/boat, basic household information, the degree of importance of the fishery (economic and nutritional), operating costs of fishing

Relevant areas of the above recommendations are to be included in a management plan for the fishery and the associated legislative regulations put in place.

**Recommendations**

**General**

An official membership list for the CFRM SGWG should be established to facilitate and promote interaction among the member countries on issues related to these fisheries.

Funding could be sourced for the conduct of assessment- or management-related activities during the inter-sessional period. The World Wildlife Fund (WWF) is one of the organizations identified as offering funding in the area of fishery improvement plans with a view to raising the standard of fisheries management to facilitate Marine Stewardship Council (MSC) Certification.

The use of hydrometric data as a recruitment/growth index should be considered as such factors as water levels and water flows may cause fluctuation in stock size and hence help to explain variation in CPUE and if so should be taken into consideration in the HCR. Data are available from Guyana for such exploratory analyses.

**Suriname**

The **measured** weights should be obtained from the seabob processing companies and not the weights to which conversion factors have already been applied for e.g. Namoona measures peeled weight in pounds (so this is the measurement that should be obtained) but applies the factor 2.3 to convert to live weight and then divides by 2.2046 to convert to kilogrammes.

Peeled weight (instead of live weight) in kilogrammes should be used in the assessment in future. The morphometric and size frequency data should be examined at the next meeting as they provide some information on size and age structure, which are not addressed by the current assessment. 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.

Issues related to bycatch should be considered. Such issues are included in the research plan developed for this fishery by the Suriname seabob management working group. This research plan forms part of the management plan.

**Trinidad and Tobago**

Review historical records and consult with Trinidad industrial trawl fleet operators in an attempt to verify or refine shrimp catch estimates prior to the year 2000 when sampling of this fleet was very low or non-existent.

Implement a trip reporting system for the semi-industrial and industrial trawl fleets of Trinidad and Tobago.

Implement an Observer Programme for the semi-industrial and industrial trawl fleets to verify the trip reporting system.

Structure data collection to allow individual shrimp species to be monitored.

Obtain more detailed information, including on species life history, to account for other factors affecting productivity, such as pollution, which was suggested as a contributing factor by stakeholders.
The shrimp stock distribution in Trinidad and Tobago waters should be investigated. Salinity, water temperature, depth, chlorophyll distribution, shrimp species composition, and any other data which would assist in determining the stock distribution should be collated.

Re-evaluate stock structure as the current assumed structure, effectively a single stock shared between Venezuela and Trinidad, may not be accurate enough to protect fleets from depleting the resources they have access to.

Recommendations to improve the logistic model for the Trinidad and Tobago/Venezuela shrimp fishery:

- Consider changing catchability due to any shifts from targeting shrimp to targeting bycatch.
- Include the CPUE standardization as part of the stock assessment rather that performing this outside the assessment and pulling in the results.
- Estimate the shrimp CPUE for the historical years

**Jamaica**

An assessment incorporating the socio-economic baseline data of the white shrimp fishery should be conducted at the ninth CRFM scientific meeting (in the next two years).

**1. Review and adoption of Working Group report, including species / fisheries reports for 2011.**

The Working Group Report will be finalized, reviewed and adopted by the members of the SGWG via electronic mail during the inter-sessional period.

**Adjournment.**

The meeting of the SGWG adjourned at 5.40 pm on 23 June 2011.

## B. FISHERIES REPORTS

## 1.0 The Seabob (*Xiphopenaeus kroyeri*) Fishery of Suriname

Rapporteur: Ranjitsing Soekhradj (Suriname)
Consultant: Paul Medley (Consultant, UK)

### 1.1 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 important contributor to the domestic protein supply.
- Frozen seabob, produced by the seabob processors, is exported, and dried shrimp might have export potential (not demonstrated yet). Generation of foreign currency must therefore be taken into account in management.

### 1.2 Status of Stock

The assessment indicates that the stock is not overfished ($B/B_{MSY} > 1.0$) and overfishing is not occurring ($F/F_{MSY} < 1.0$; Figure 1; Table 1). This conclusion depends, among other things, upon a reasonably accurate time series of total catch. The total catch has now been verified back to 1999 and further improvements are not likely to change the current determination. Results remain broadly the same as those from the last stock assessment in 2009.

**Table 1 Stock assessment results with 90% confidence intervals.**

| Parameter | Lower 5% | Median | Upper 95% |
|---|---|---|---|
| **R** | 0.39 | 0.68 | 1.04 |
| **$B_\infty$ (t)** | 40437 | 60822 | 109838 |
| | | | |
| **B 2010 (t)** | 0.60 | 0.68 | 0.76 |
| **MSY (t)** | 9293 | 10465 | 12068 |
| | | | |
| **Current Yield** | | 7584 | |
| **Replacement Yield** | 8640 | 9056 | 9164 |
| **B/BMSY** | 1.19 | 1.37 | 1.51 |
| **F/FMSY** | 0.45 | 0.57 | 0.71 |

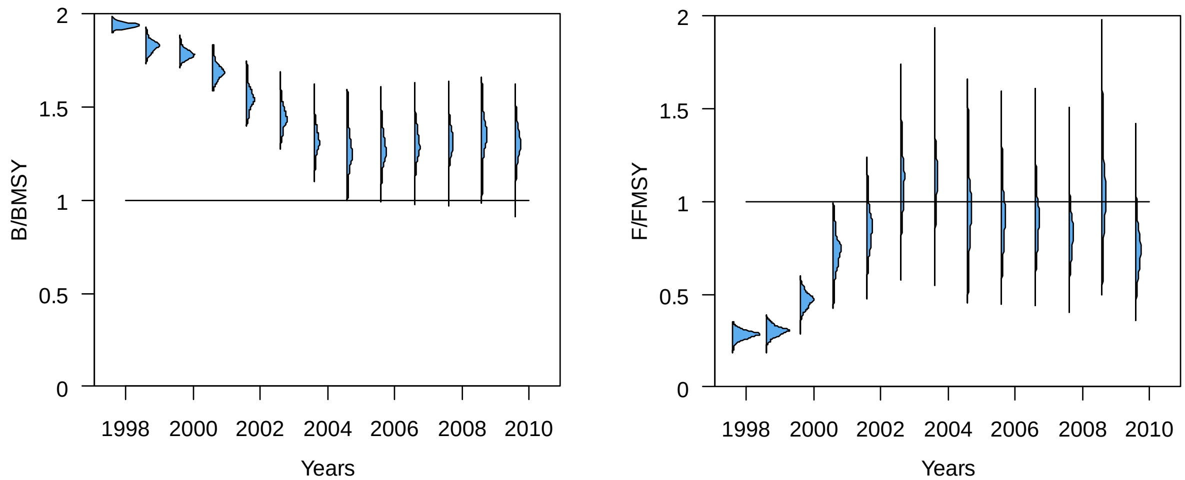


**Figure 1. Probability estimates of the biomass and fishing mortality relative to the MSY value based on the Monte Carlo integration of the model posterior. The range of values is shown from 5000 random draws from the posterior probability using a Monte Carlo integration. More peaked distributions indicate greater certainty in estimates, whereas flatter distributions indicate greater uncertainty.**

## 1.3 Management Advice

It is recommended to continue applying the current harvest control rule for several years to allow it to be evaluated. On evaluation, further scientific recommendations might be made.

New reference points and a harvest control rule have been adopted based on the maximum sustainable yield point (MSY), with the biomass limit reference point at 60% and target reference point at 120% of the MSY estimate respectively.

CPUE is used as a proxy for the biomass, with reference points based upon the previous 2009 stock assessment. Results from the current assessment suggest that these reference points are more precautionary than originally intended (Table 2). The CPUE expected at MSY is 1.38 t $day^{-1}$, whereas current CPUE is 1.76 t $day^{-1}$.

The harvest control rule uses the proxies CPUE and days-at-sea for biomass and fishing mortality, taking into account the uncertainty with which the values of interest have been estimated (Figure 2).

The most important finding with respect to the harvest control rule is to ensure the CPUE index remains valid. The greatest risk to the index is change to the fleet, including alterations to gears, vessels or operations. It is important that any and all changes are monitored and managed carefully. It should be ensured that catch and effort data can be separated by vessel, that gear and operations are recorded by vessel and if changes are to occur that these are not undertaken simultaneously across the fleet.

**Table 2 Comparison between CPUE (t / day at sea) reference points for 2009 and 2011 (the most recent assessment). The trigger reference point is the expected CPUE at MSY. The 2009 values are used in the current harvest control rule, which the most recent stock assessment suggests are precautionary. The 2011 are more accurate estimates of the appropriate values, so reference point values higher than these are more precautionary.**

| | 2009 | 2011 |
|---|---|---|
| Limit | 0.89 | 0.83 |
| Trigger | 1.48 | 1.38 |
| Target | 1.65 | 1.66 |

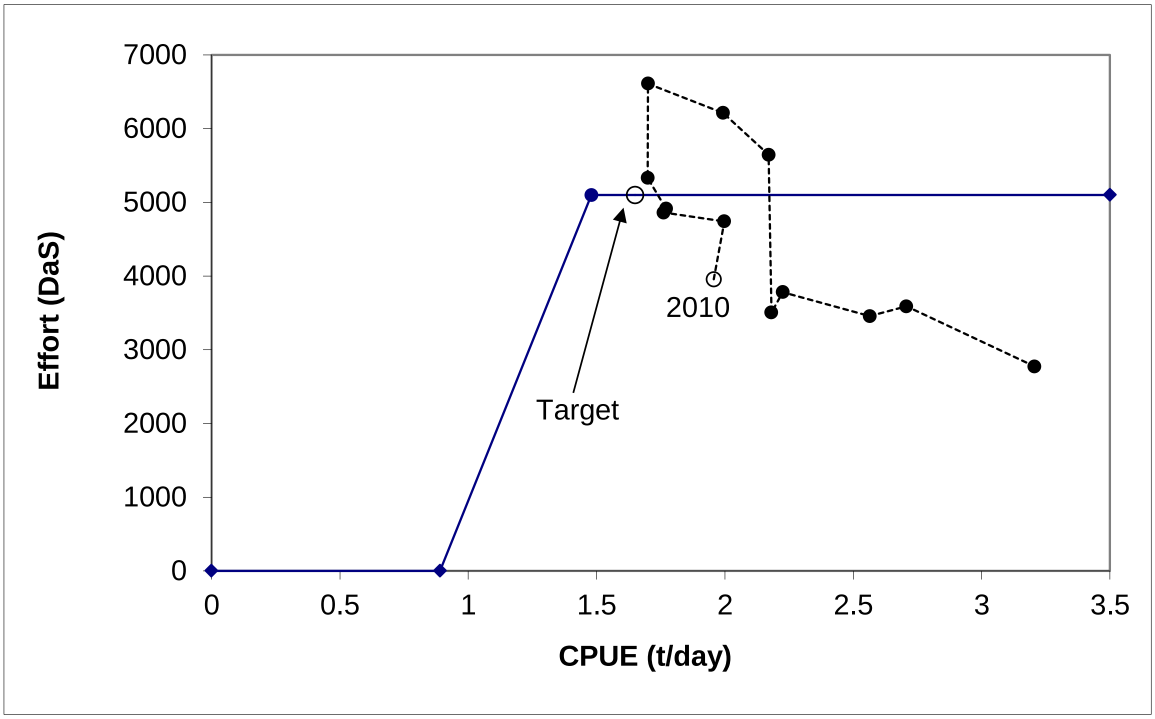


**Figure 2 Harvest control rule (HCR) being applied to the fishery with historical time series of HCR CPUE calculated as a moving average and effort for the corrected data. The target CPUE is shown along with the estimated HCR CPUE in 2010 (from the 2011 assessment). This can be interpreted as the point estimates of fishing mortality are below the target level and biomass above the target level.**

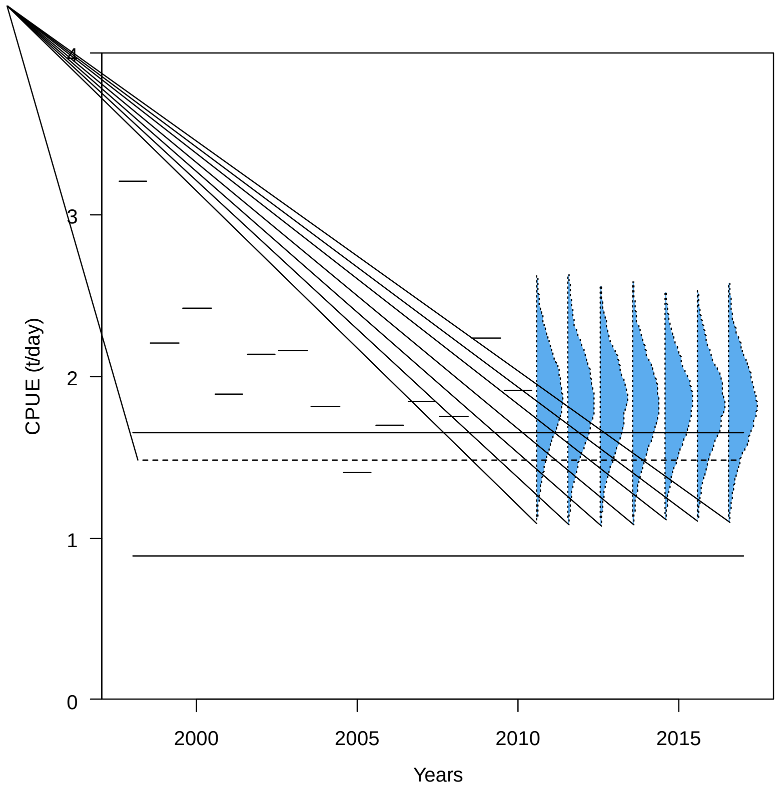


**Figure 3 Observed historical CPUE (horizontal line) and projected probability distribution under the harvest control rule. The model predicts that it is highly likely that the CPUE will remain above the target level.**

The harvest control rule has not been in operation long enough to allow any evaluation. However, based on the historical behavior of the fishery, it remains the best estimate for limiting the fishery to sustainable exploitation levels and therefore should be implemented while undergoing monitoring for at least three years. The CPUE projected under the harvest control rule should on average fluctuate above the target CPUE (Figure 3).

## 1.4 Statistics and Research Recommendations

### 1.4.1 Data Quality

Annual catch and effort data were available for the period 1998 - 2010 and monthly data available for 2002 - 2010 (Figure 4). Previously errors had been found in the catch and effort data. These errors have, to a large extent, been eliminated and the catch effort data have been validated back to 2001 and the total catch data validated back to 1999.

The morphometric and size frequency data were not examined at this meeting due to insufficient time. These data should be examined at the next meeting as they provide some information on size and age structure, which are not addressed by the current assessment.

Additional catch data were used which were obtained from the FAO FIGIS database. These data are not likely to be very accurate, but were of sufficient accuracy to allow catches to be estimated back to the start of the fishery. The level of precision of these data was sufficient for this analysis. Further validation of the historical data is still required and should be completed during the inter-sessional period.

As well as validating export catch estimates, the local artisanal catches for the dried seabob market need to be estimated. If estimates suggest these catches are significant, a time series of estimated catches needs to be developed for inclusion in the assessment. It is important to note that unless there have been significant changes in these catches over time, they would not lead to a change in stock status, but they will affect the estimate of absolute biomass.

### 1.4.2 Research

A research plan has been developed for this fishery by the Suriname seabob management working group, and this research plan forms part of the management plan. This includes new issues related to bycatch which has not been previously considered by this working group.

The primary aim for the stock assessment is to complete validation of the total catch, including estimates of the artisanal catch.

Research is continuing 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 2009 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. It is recommended that high priority be given to the analysis of these data.

## 1.5 Stock Assessment Summary

Bayesian statistics and the Monte Carlo (Sample importance resample algorithm) methods were used to estimate probability distributions for Maximum Sustainable Yield (MSY)[1], Replaceable Yield[2], current biomass relative to biomass at MSY, and current fishing mortality relative to fishing mortality at MSY. The assessment used the logistic biomass dynamics model fitted to the total catch 1989-2010 and catch and effort 1998-2010.

Catch per unit effort (CPUE)[3] 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. This was the only measure of effort available, but was thought to be strongly related to the amount of fishing carried out. The CPUE index has appeared to decline each year to 2005, but has also shown a recent increasing trend (Figure 4). The results indicate a reasonable fit of the model (Figure 5), but it should be noted that although the model largely explained the trends in the CPUE, these trends formed only a small part of the variation in CPUE. The number of data points (13) was limited and with only very shallow trends, the four parameters could only be weakly estimated.

The maximum sustainable yield was estimated to be between 9 000 and 12 000 t year$^{-1}$ (Table 1). However, in absolute terms, biomass, and therefore yield is poorly estimated (Figure 6). Hence, the harvest control rule based on CPUE and effort rather than catch will be much more reliable.

[1] **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.
[2] **Replacement Yield** is the yield/catch taken from a stock which keeps the stock at the current size.
[3] **CPUE** is the quantity caught (in number or in weight) with one standard unit of fishing effort.

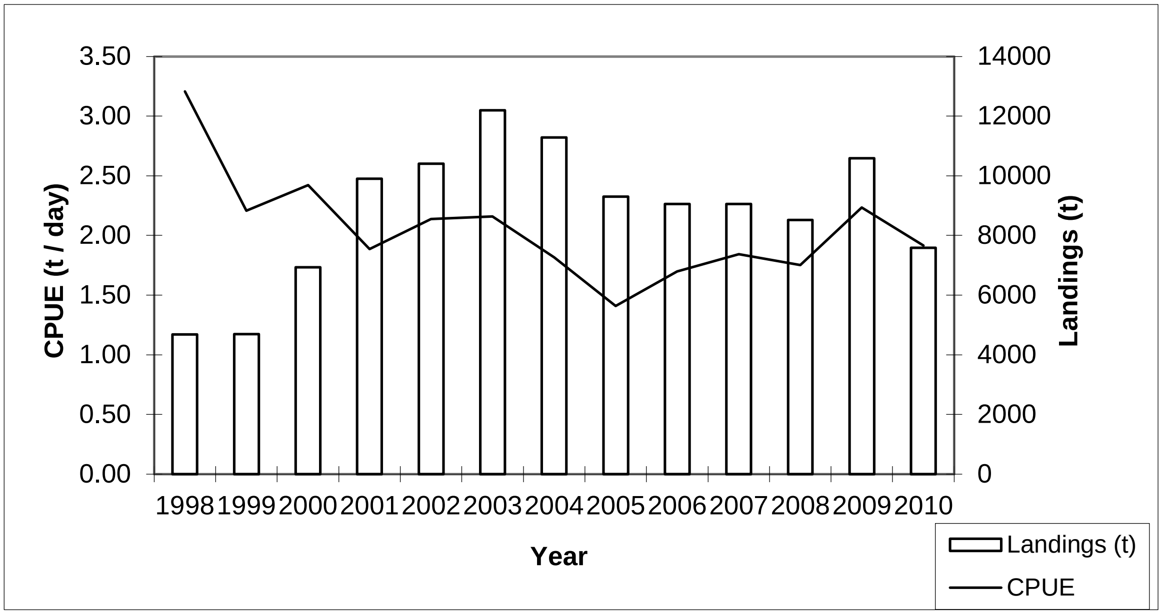


**Figure 4: The CPUE abundance index shows a continuous decline since 1998 to 2006, suggesting that the stock abundance has declined over this period. However, there is some indication of more recent increase in catch rate following reduced catches after 2005.**

## 1.6 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 Suriname seabob fishery is currently undergoing Marine Stewardship Council certification (www.msc.org).

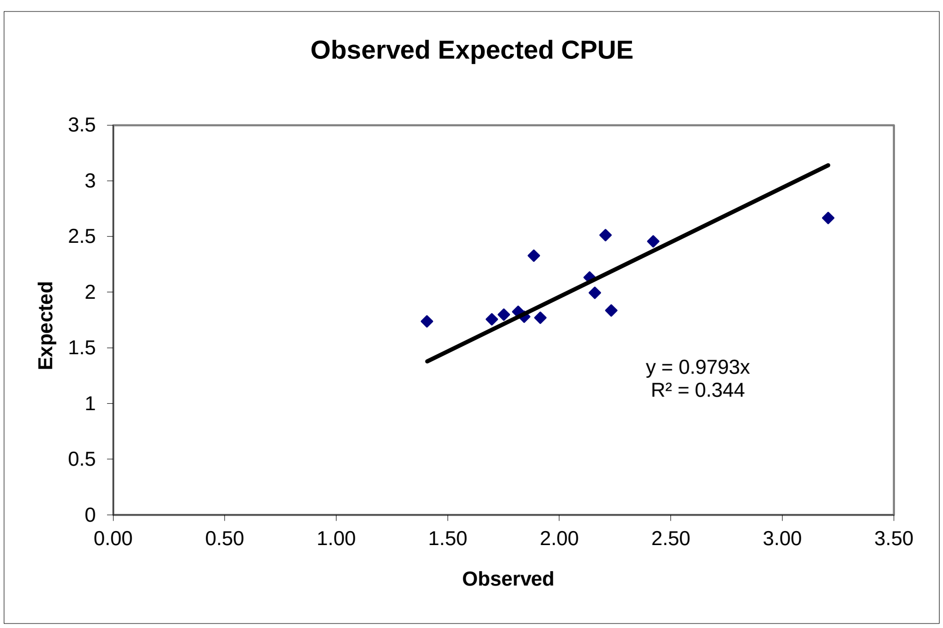


**Figure 5 Observed and expected CPUE from the model fit. The residuals show no obvious pattern around the regression line going through the origin.**

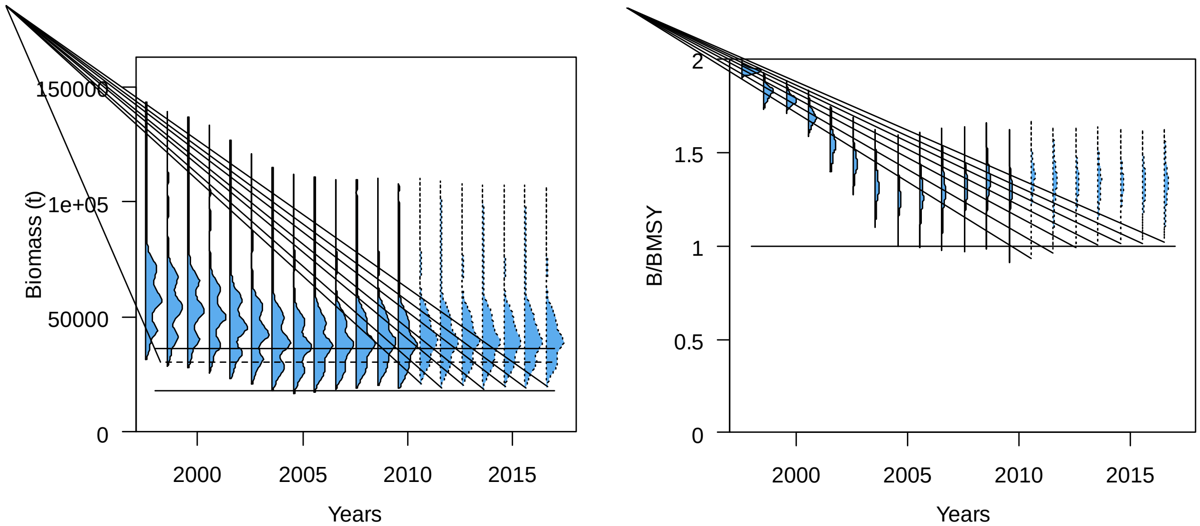


**Figure 6 Absolute and relative biomass probability distributions for estimates (solid) and projections (dotted) from the fitted stock assessment model. The relevant reference points are also shown as horizontal lines with target (120% median MSY), trigger (dotted; median MSY) and limit (60% median MSY) for biomass, and MSY level for the relative biomass. Although biomass is uncertain, the relative biomass is very likely to remain above the MSY reference point.**

## 1.7 Policy Summary

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

- Provides employment at the primary and secondary levels. The fishery also creates more alternative job opportunities and reasonable incomes. 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 and to provide further development opportunities.

## 2.0 The Shrimp Fisheries Shared by Trinidad and Tobago and Venezuela

Rapporteur: Lara Ferreira (Trinidad and Tobago)
Consultant: Paul Medley (UK Consultant)

### 2.1 Management Objectives

The management objective for the shrimp trawl fishery of the Government of the Republic of Trinidad and Tobago is "full utilization of the resource consistent with adequate conservation, and minimal conflict between the artisanal and non-artisanal components of the fishery" (Fisheries Division and FAO, 1992). Within the context of this assessment, the primary objective is interpreted as maintaining the stock size above that required for maximum sustainable yield (MSY).

### 2.2 Status of Stocks

The overall stock biomass is likely to be stable or increasing. However, local depletion could still be taking place.

The general results indicate the state of the stock is likely to be above maximum sustainable yield (MSY) and the current fishing mortality is well below MSY (Table A and Figure A). The maximum sustainable yield is in the region of 1800 t and catches higher than this will not be sustainable. This is significantly higher than previous estimates (around 1300 t). This is a marked change of status compared to the previous assessment. However, it should be noted that there are severe and increasing limitations on the available data.

It should also be noted that although lower catches in Venezuela (due to the ban on industrial trawling effective 2009) are likely to have benefited the stock overall, it is suspected that parts of the stock in Trinidad will remain depleted. Specifically, although CPUE in Trinidad waters shows a slight upward trend, this is not as significant as that which might be expected given the decrease in catches.

### 2.3 Management Advice

A harvest control rule should be implemented for Trinidad in order to control the amount of fish caught. At the very least, a fixed seasonal closure of 1-2 months each year, which is considered a relatively crude measure, should be implemented to reduce fishing effort. Projections of biomass and fishing mortality relative to MSY under three fishing effort scenarios, namely zero (representing the current situation), one, and two month season closures are provided in Figure B. The stock is likely to decline below MSY without management action (first scenario) while closures of one and two months greatly improve the likely status of the stock in the medium term, although the resulting levels of effort will likely still cause overfishing in the longer term as fishing mortality is too high.

**Table A: Results from the stock assessment model fit. The parameter estimates are given at the top of the table, and the more general results at the bottom. Replacement Yield is the catch which is expected to cause no change in the population. The main result is that the stock state is likely to be above the maximum sustainable yield point ($B_{2010}$ status > 0.5; B/BMSY > 1.0).**

| Parameter | Percentiles | | |
|---|---|---|---|
| | **0.05** | **Median** | **0.95** |
| **r** | 0.25 | 0.39 | 0.54 |
| **$B_\infty$ (t)** | 12974 | 17703 | 27755 |
| | | | |
| **$B_{2010}$ status** | 0.47 | 0.57 | 0.65 |
| **MSY (t)** | 1672 | 1775 | 1872 |
| | | | |
| **Current Yield** | | 832 | |
| **Replacement Yield** | 1610 | 1731 | 1839 |
| **B/BMSY** | 0.93 | 1.12 | 1.29 |
| **F/FMSY** | 0.38 | 0.44 | 0.54 |

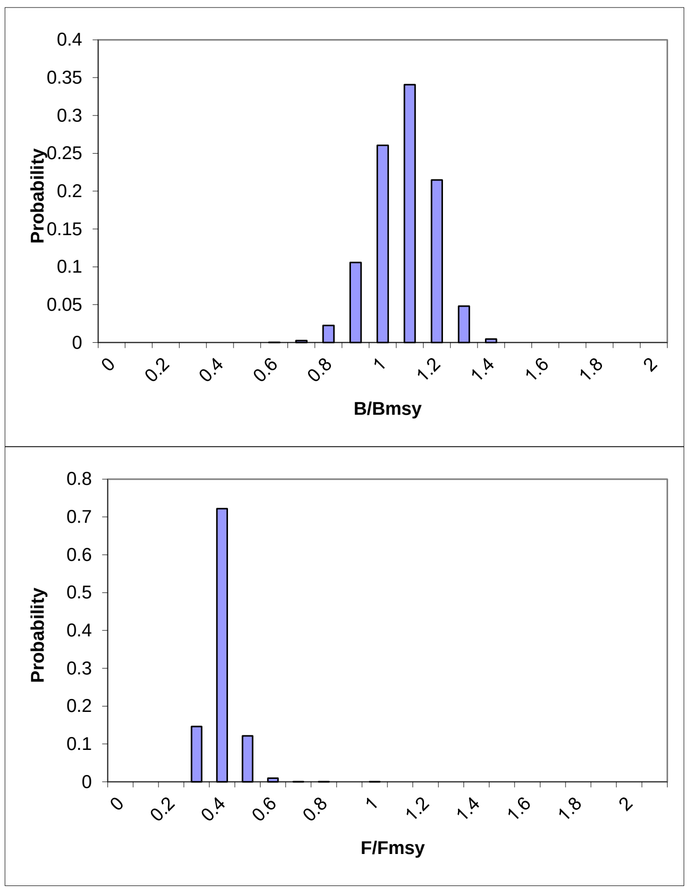


**Figure A: Biomass (top) and fishing mortality (bottom) relative to the MSY level.**
**The low fishing mortality and high biomass are directly as a result of low recent catches.**

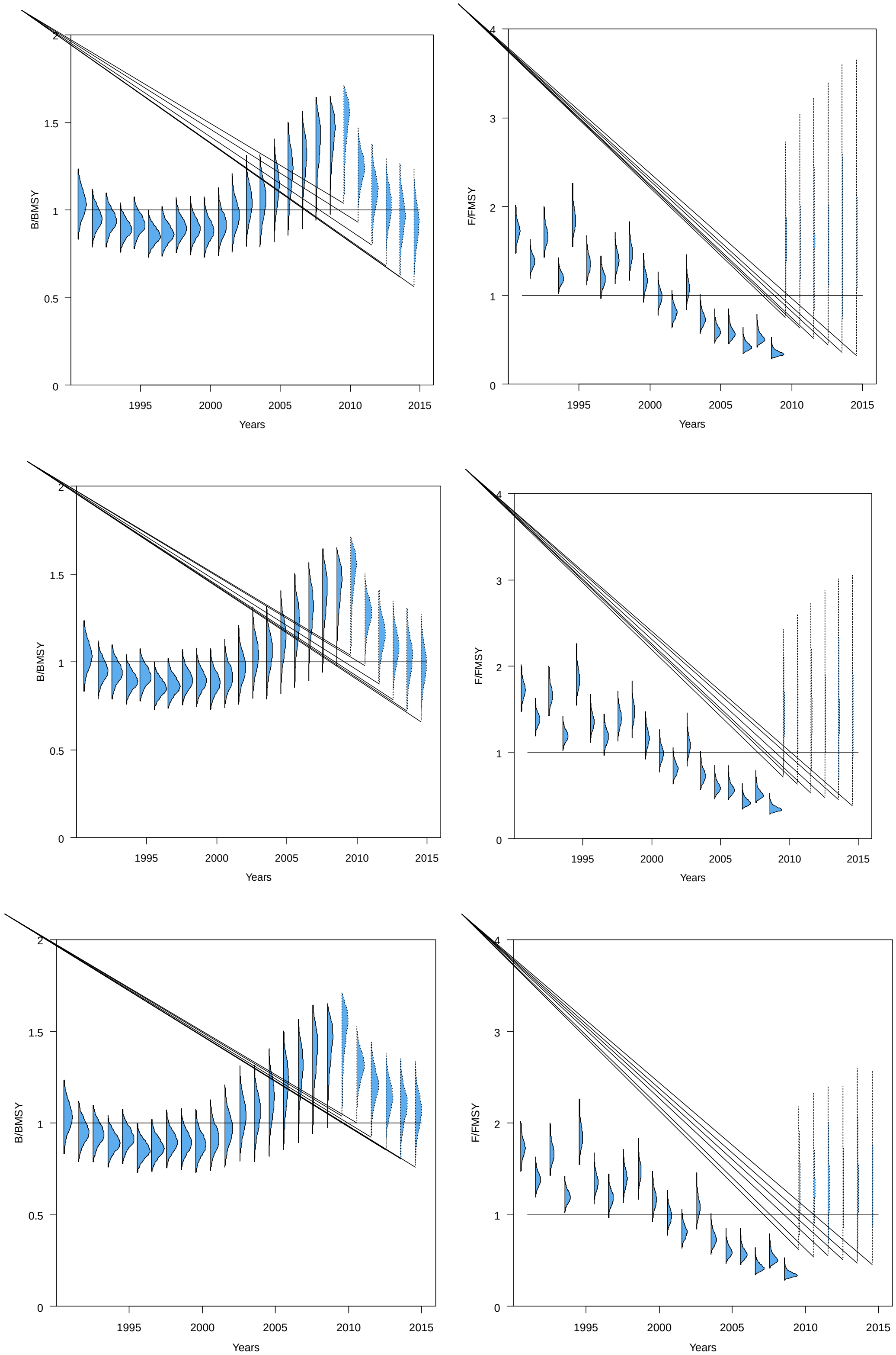


**Figure B Projections of biomass and fishing mortality relative to MSY under 0 (top), 1 (middle) and 2 (bottom) month season closures. The shaded area graphs represent probability density, so low flat graphs indicate very high uncertainty, and narrow pointed graphs relative certainty. A dotted outline to graphs indicate they are projections, whereas solid lines are estimates from the stock assessment.**

A more sophisticated and complex feedback-control rule, for example, a control on effort in response to changes in shrimp biomass (or a biomass indicator such as CPUE) (Figure C) such that exploitation is reduced as the stock declines, is recommended if the monitoring system can support it. This kind of harvest control rule is more conservative resulting in higher CPUE and biomass (Figure D), but possibly lower catches at least in the medium term.

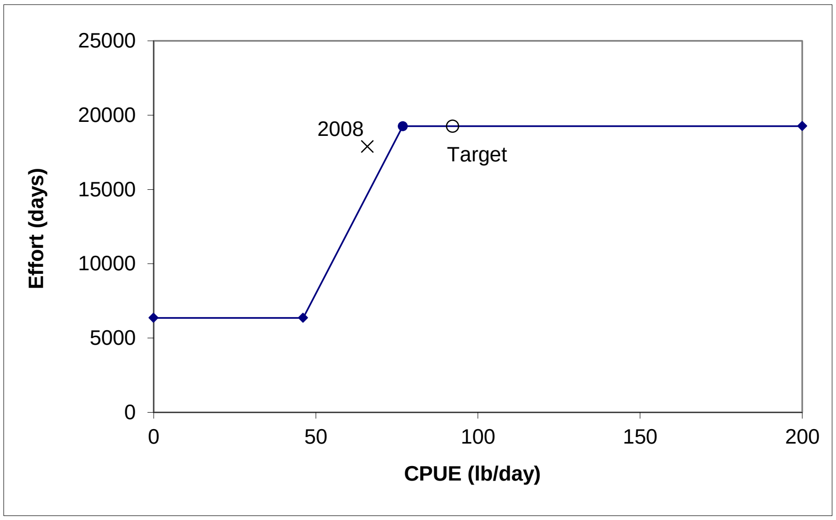


**Figure C Possible harvest control rule based on CPUE as an indicator of biomass, and effort in days at sea. If the CPUE drops below a trigger level, effort is reduced according to the line but within a constraint to some minimum level (here 30% of the MSY). The target CPUE and effort based on MSY but with some precaution built in (open circle) and the situation in 2008 (cross) are also shown.**

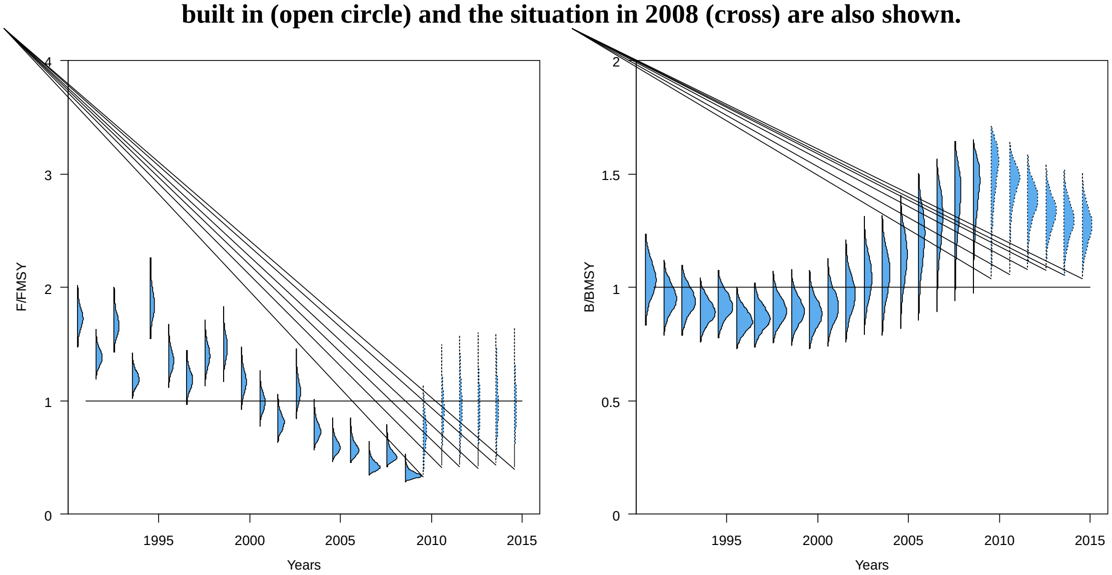


**Figure D Results from applying the harvest control rule (Figure C). The stock should be reduced but would most likely remain above the MSY level. This in turn would maintain higher catch rates for the fleet as well as higher catches.**

### 2.4 Statistics and Research Recommendations

#### 2.4.1 Data Quality

1. Implement a Trip Reporting System for the semi-industrial and industrial trawl fleets of Trinidad and Tobago in order to obtain more comprehensive catch and effort records for these fleets.
2. Implement an Observer Programme for the semi-industrial and industrial trawl fleets of Trinidad and Tobago to verify the trip reporting system.
3. Review historical records and consult with Trinidad industrial trawl fleet operators in an attempt to verify or refine shrimp catch estimates prior to the year 2000 when sampling of this fleet was very low or non-existent. Since this fleet takes a large proportion of the total catch, poor estimates will add considerably to the uncertainty of the assessment.
4. Continue and complete computerization of the Trinidad historical catch and effort data from the 1950s to the 1990s. The 1975 base year was important in estimating the unexploited state and hence MSY and the current state of the stock.
5. Structure data collection to allow individual shrimp species to be monitored.
6. Obtain more detailed information, including on species life history, to account for other factors affecting productivity, such as pollution, which was suggested as a contributing factor by stakeholders.

#### 2.4.2 Research

1. Investigate the shrimp stock distribution in Trinidad and Tobago waters. Salinity, water temperature, depth, chlorophyll distribution, shrimp species composition, and any other data which would assist in determining the stock distribution are to be collated.
2. Re-evaluate stock structure as the current assumed structure, effectively a single stock shared between Venezuela and Trinidad, may not be accurate enough to protect fleets from depleting the resources they have access to.
3. Improve the logistic model for the Trinidad and Tobago/Venezuela shrimp fishery as follows:
   - Consider changing catchability due to any shifts from targeting shrimp to targeting bycatch.
   - Include the CPUE standardization as part of the stock assessment rather than performing this outside the assessment and pulling in the results.
   - Estimate the shrimp CPUE for the historical years

### 2.5 Stock Assessment Summary

The current assessment is an update to that conducted under the FAO/WECAFC ad hoc Working Group on Shrimp and Groundfish Fisheries of the Guianas-Brazil Continental Shelf in 2005 by Medley *et al*. (2006) and updated at the CRFM Scientific Meeting in 2006 by Ferreira and Medley (2006).

A biomass dynamics (logistic or Schaefer surplus production) model was fitted to the available total catch data (1988 to 2009) and the CPUE indices using Bayesian Monte Carlo integration techniques. The CPUE indices were not standardized as this had little effect in previous assessments. Nominal indices were preferred as being simpler to determine and more robust. CPUE indices were still provided separately for the main fleet types which captures the main differences among indices. The model provides advice on a limit reference point, the maximum sustainable yield (MSY). The model requires three population parameters: $B_0$ = state at the start of the time series, $r$ = the rate of population growth, $B_\infty$ = unexploited stock size, and as many catchability parameters as there are gear types (index series). These were estimated based on the ParFish interviews and converted into prior probability density. The MSY fishery reference point also requires some information on abundance index values when the stock is unexploited. This was achieved by linking CPUE available from all fleets in 1975 to an estimate of stock status at that time, when the stock was thought to be lightly fished.

Utility (relative costs and benefits) for various outcomes which might occur in response to management interventions was estimated from fishers' relative preferences among outcomes, that is, various scenarios of levels of catch (lbs of shrimp) and effort (days at sea) (which could also represent different amounts of income and work) in a month as departures from their current situation. The ParFish interview data thus allowed a review of possible harvest control rules (decision rules which control the amount of fish caught) to identify a set which could be put forward for further discussion. Projections of biomass and fishing mortality relative to MSY were made under zero, one and two month season closures. The default effort level chosen to test the rule was the estimated median observed effort in the time series 1991-2004 (30 750 Type II-equivalent days-at-sea). Therefore, this effort was used in the projection, with the total effort being reduced by $1/12^{th}$ for each month of closure. A harvest control rule based on CPUE as an indicator of biomass, and effort in days at sea was also examined. If the CPUE drops below a trigger level, effort is reduced according to a line (Figure C) but within a constraint to some minimum level (here 30% of the MSY).

## 2.6 Special Comments

The shrimp stocks of Trinidad and Tobago have, up until now, been assumed to be shared with neighbouring Venezuela. It is however being recommended here, based on the results of the assessment, that attempts be made to re-evaluate the stock structure. It is desirable that scientists from both countries be involved in this exercise. Further, depending on the results of this study, it may be useful for assessment of these stocks to be done jointly with Venezuela with management recommendations being applicable to the fisheries of both countries. If this is the case, then Venezuela should be urged to participate in the CRFM Scientific Meetings or, if this is not possible, to submit the relevant data for analysis as was the case with this assessment.

## 2.7 Policy Summary

The Fisheries Division is in the process of conducting a review and update of the 2007 Draft Policy (Fisheries Division 2007). The overriding policy objectives are to develop and maintain a cost-effective fisheries management structure, to modernize the legislative and regulatory framework and establish mechanisms for surveillance and enforcement; to ensure the sustainability of the fisheries resources; to promote transparent decision-making and training of stakeholders; to reduce post-harvest loss and promote quality assurance in fish and fishery products offered for local consumption and export; to prioritize the provision of facilities for the fishing industry that meet local and international food safety standards through a system of designated fish landing sites and ensure a safe working environment while considering the socio-economic implications of management measures for fisherfolk; to ensure the integration of fisheries in coastal zone development and provide a mechanism to reduce conflict and facilitate the amelioration of negative impacts due to competing economic activities in the coastal zone; and to protect fishing habitats and address environmental impacts on fisheries.

The Open Access nature of the fisheries is recognized as a critical issue and the policy is to move towards regulated entry, fisheries research and policies for promoting the Ecosystem Approach to Fisheries (EAF) and establishment of Marine Protected Areas (MPAs). For the artisanal fisheries, Government's policy will ensure that any displacement in this fishery as a result of any policy measure should be done in a fair and equitable manner and that those affected continue to earn a decent livelihood; mesh sizes used in gillnets will be increased to reduce the detrimental impact of this net on the inshore fisheries and biodiversity; reduction in bycatch and discards in the demersal shrimp fisheries and the negative impact of trawl gear on the ecosystem will be pursued by the introduction of environmentally friendly gear and enforcement of appropriate management measures.

The Policy promotes collaboration with regional and international organizations for management of transboundary stocks and the establishment of the necessary enforcement mechanisms.

## 2.8 References


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## 3.0 Marine Shrimp Fishery in Kingston Harbour, Jamaica

Rapporteurs: Ricardo Morris (Jamaica)
Anginette Murray (Jamaica)
Consultant: Paul Medley (UK Consultant)

### 3.1 Introduction

Jamaica's marine shrimp fishery is primarily artisanal and concentrated mainly in the Kingston Harbour and a few other small near-shore areas especially on the south shelf of the island in areas influenced by high-nutrient run-off. The main species targeted is the Marine White Shrimp *Penaeus schmitti*; however *P. notialis* and *P. brasiliensis* are often captured and recorded in the fishery (Jones and Medley 2000). Shrimp caught are sold locally to householders and a few restaurants at prices often higher than that of finfish (~US$3.6/lb).

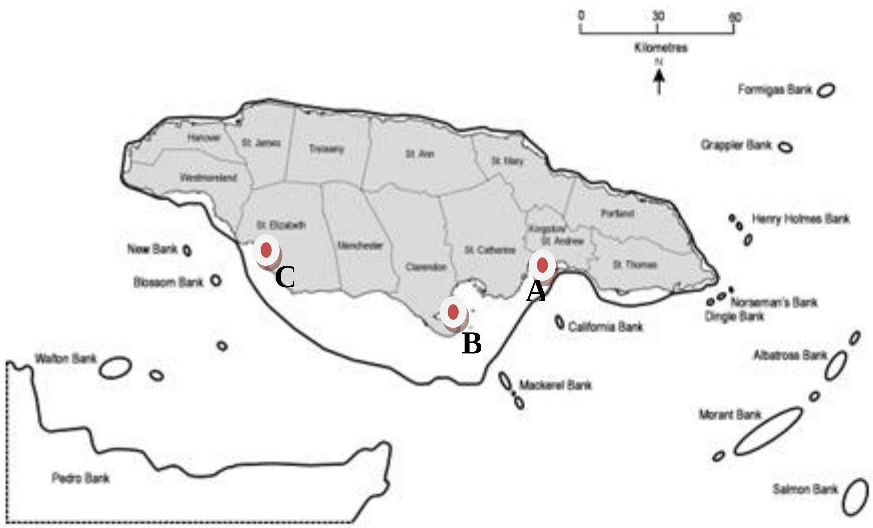


**Figure 2. Main shrimp fishing areas of Jamaica; including, (A) Kingston Harbour (B) Portland Bight area and (C) the Black River estuary. (adapted from Gustavson (2002)).**

Within the Kingston Harbour, and indeed other areas, the white shrimp fishery is subsistent in nature and often forms an income supplement for fishers. There are two main fleets targeting shrimp in the; (i) wooden canoes using mono-filament nylon gillnets measuring 1.4–1.9cm mesh size and (ii) fibreglass (FRP) boats using hand operated trawls of 1.9 cm mesh size and powered by 40 HP engines (Galbraith and Ehrhardt, 2000). These gears are usually operated at depths ranging from 10 – 15m. White shrimp are also captured by fishers using seine nets though not specifically targeted.

### 3.2 Previous Assessments

Since the start of Jamaica's data collection programme there have been at least three (3) attempts at assessing the fishery in the Kingston Harbour. The first of which was completed by Galbraith and Ehrhardt (2000) who looked to analyse data from 1996 to 1999, then in 2000 an assessment was done by Jones and Medley (2000) to develop an appropriate monitoring and management plan. Both reports though providing useful baselines and management recommendations were limited due to relatively poor data and thus were not reliable assessments of the status of the fishery. A third study was done in 2003 to assess the level of compensation to shrimp fishers displaced by engineering works done to develop the harbour. This technical report also could not come up with a reliable model for either production or economic earnings due to a poor data set.

## 3.3 Management

### 3.3.1 Management Objective

The management objective for the Jamaican white shrimp fishery is to promote and ensure stock sustainability, efficient utilization of the stock and sustainable livelihoods.

### 3.3.2 Data Quality/Monitoring

Jamaica has been collecting catch and effort data by gear for the Kingston Harbour area and other landing sites around the island since 1996. The shrimp sampling plan, which is still in place, requires also the collection of monthly biological sampling. Due to various resource constraints, the type and quality of data collected has been seriously compromised partially resulting in a lack of meaningful assessments being done on the fishery, and by extension, the type of management intervention that can be implemented.

### 3.3.3 Environmental and Anthropogenic issues affecting the fishery

There are a number of environmental and man-made factors that are presumed to have serious effects on the white shrimp stock, particularly in the inner bay (Hunts Bay) and outer areas of the Kingston Harbour area. This has serious implications for management since many factors external to the fishery are believed to affect the size and availability of the stock, however this will need to be confirmed by the appropriate research. The Kingston Harbour is a sink for both natural and artificial drainage systems including at least two relatively large rivers and several gullies and conduits which release significant amounts of land-based nutrients in the area. The harbour also facilitates a relatively high volume of marine vessel traffic and their associated activities; such as the release of bilge and wastes which may be impacting the stock and may need to be assessed. The fishery is also impacted by occasional engineering work to develop and maintain the harbour. As recent as 2002 a large dredging exercise in the harbour caused significant negative impacts on the livelihoods of shrimp fishers in the area.

## 3.4 Review Summary

The objective of the current assessment was to examine the current catch data set (1996, 2000-2010) and decipher trends given the data’s limitations.

### 3.4.1 Catch trends

Figure 2 below shows the total reported monthly catch of white shrimp landed per year at Hunts Bay (Kingston Harbour) 1996, 2000-2010. There are many instances of incomplete data for each year. Monthly landings are relatively low, fluctuating generally just below 10kg/month with very little variation.

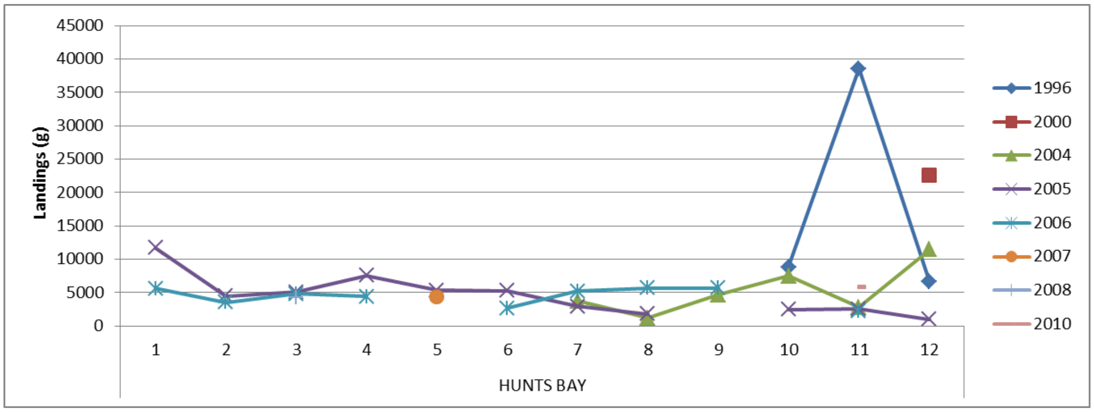


***Figure 2. Total reported monthly landings of white shrimp caught per year at the Hunts Bay fishing beach (Kingston Harbour) 1996, 2000-2010.***

Figure 3 below compares the reported annual landings of white shrimp at Hunts Bay by gear type. Here the main trend seen is that trawling gear (TRWL) generally lands a larger quantity of shrimp versus other gears, notably gill/china net (CHNE).

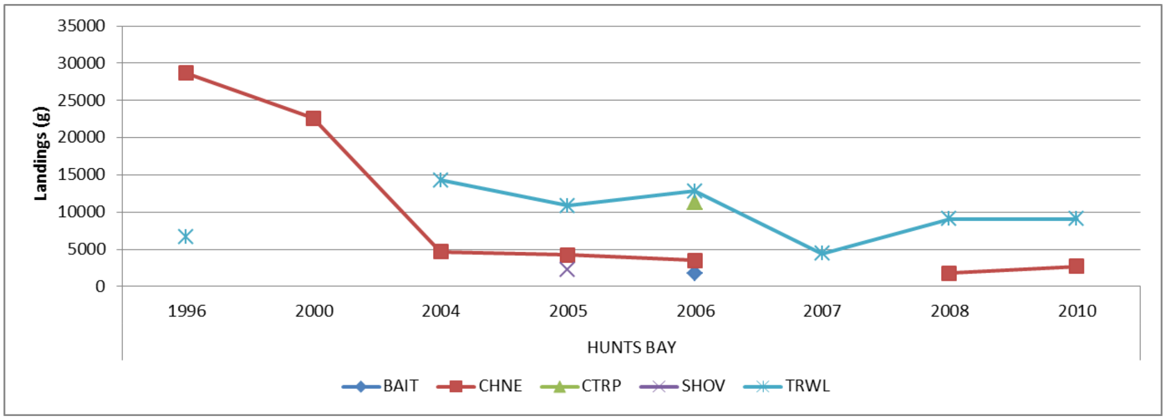


***Figure 3. Annual landings of white shrimp caught using various gear types (BAIT – bait net, CHNE – gill/china net, CTRP – crab trap, SHOV – shove net and TRWL – trawl) at the Hunts Bay fishing beach (Kingston Harbour).***

### 3.5 Recommendations

The following recommendations are put forward as a guide to developing the fishery as a whole and meeting the management objectives of the fishery.

- Resources must be found to develop the Jamaica's white shrimp data and carry out the activities of the sampling plan. This should be geared toward developing the data set for regular stock assessments.
- Conduct an independent monitoring of white shrimp catch rates in various areas within the Kingston Harbour (and possibly other areas) to determine the status of the stock and explore alternative fishing areas.
- A programme must be put in place to obtain a socio-economic baseline which will complement the biological data for the fishery. This baseline must include, but not be limited to; the number of active fishers and vessels per year, earning per fisher/boat, basic household information, the degree of importance of the fishery (economic and nutrition), operating costs of fishing

- Include relevant areas of the above recommendations in a management plan for the fishery and also legislative regulations.

## 3.6 References


Galbraith, A. and N.M. Ehrhardt, 2000. *Preliminary assessment of the Jamaican penaeid shrimp fisheries of Kingston Harbour*. *FAO Fish. Rep.* 628: 149-153.

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Jones, I. and P.A. Medley 2000. *Jamaica shrimp fishery assessment*. Paper presented at the Fourth Workshop on the Assessment and Management of the Shrimp and Groundfish Fisheries on the Brazil-Guianas Shelf. 2-13 October 2000, Cumaná, Venezuela.

## IV. REPORT OF THE LARGE PELAGIC FISH RESOURCE WORKING GROUP (LPWG)

Chairman: Ms. Louanna Martin – Trinidad and Tobago
Ms. Yvonne Edwin – St. Lucia
Ms. Kafi Gumbs – Anguilla
Mr. Crafton Isaac – Grenada
Ms. Cheryl Jardine-Jackson – St. Vincent and the Grenadines
Dr. Freddy Arocha – Instituto Oceanográfico de Venezuela-Universidad de Oriente (Venezuela)
Mons. Lionel Reynal – IFREMER (Martinique)
Ms. Nancie Cummings – NMFS, SEFSC (Miami, FL, USA)
Dr. Todd Gedamke – NMFS, SEFSC (Miami, FL, USA)
Sr. Manuel Perez – OSPESCA (El Salvador)
Ms. Lara Puetz – Intern-CIDA/Dalhousie University (Canada)
Dr. Susan Singh-Renton – CRFM Secretariat

### A. OVERVIEW

***Review of inter-sessional activities since last meeting, including management developments during this period.***

Attempts were made to obtain blackfin tuna data from Cuba, Dominican Republic and Columbia as recommended by the LPWG at its 2010 meeting. Catch data were submitted by the Dominican Republic, however, they expressed a lack of confidence in the data. Data were not received from any of the other countries.

***Review of blackfin tuna fisheries, data and information and trends***

Catch, catch rates, stock structure and information on the biology of blackfin tuna were reviewed at the 2010 LPWG meeting. The findings are documented in the 2010 report of the WG.

***Review of commitments to the CLME project***

The group agreed to prepare for the CLME project, information packages on dolphinfish and blackfin tuna which will include information on the fisheries in Venezuela and the French West Indies.
In order to address the data improvement component of the CLME project commitments the CRFM Secretariat is implementing an ERAEF on dolphinfish. The group agreed to work towards completing the assessment to the SICA/Stage 1 level at the meeting. The ERAEF is expected to highlight data requirements based on identified operational objectives not only for stock assessment but also to meet the demands of EAF.

**Recommendations**

The members of the group expressed their frustration at not being able to access, at the meeting, all of the data and information presented at the 2010 meeting. As a result the group recommended that a data repository be established for all data and information, including presentations and papers, submitted to the working group for its work. Given the issues of confidentiality involved, a server allowing for the application of restrictions would be required in addition to a part time server manager. In this regard it is recommended that the CRFM position of Program Manager Statistics and Information be filled and that a data policy be adopted by the CRFM. The working group opened a 'Dropbox' to allow for the sharing of data and information among members of the group in the short term. It was recommended that read-only documents be shared in the Dropbox.

***Review of management objectives and management strategies – i.e. review of fisheries***

Group members present indicated that the same general objectives applied for all of their fisheries and that the operational objectives identified in the ERAEF were applicable to the management of the fisheries. It was agreed that the sub-components of the dolphinfish fisheries most at risk from fishing were population size and behaviour/movement of the population. These sub-components were also found to be applicable with respect to other pelagics fisheries. It was agreed that in relation to addressing the maintenance of population size, the most appropriate management action/operational objective would be to maintain biomass above a specified level. With respect to addressing behaviour/movement of the population, the management action/operational objective identified was to ensure that the behaviour and movement pattern of the population do not change outside acceptable bounds.

Consideration was also given to the types of management measures that would be most suitable for pelagic fisheries in the region given their complex nature in terms of the simultaneous targeting and capture of multiple species, the simultaneous use of multiple gears, and the limited availability of resources for monitoring and enforcement.

**Recommendations**

Given the general characteristics of the fisheries it was felt that catch limits would be very difficult to monitor and enforce; their use therefore was not likely to be successful. It was agreed that effort limits and size limits would be more appropriate.

***Review of selected fishery to be assessed – i.e. review available updated data and information, including review of national reports, fisheries***

An ERAEF scoping analysis was completed for the dolphinfish fishery. This involved the development of a profile of the fishery, establishment of the units of analysis or lists of species, habitat and communities involved in the fisheries. With respect to the species lists, target, target bait, by-product/by-catch and threatened, endangered and protected (TEP) species were identified.

For the assessment of the blackfin tuna fishery, catch and effort data were submitted by St Lucia, St Vincent and the Grenadines, Trinidad and Tobago, Jamaica, the French West Indies and Venezuela. The French West Indies also submitted species composition and length frequency statistics. Venezuela submitted CPUE and size statistics.

The St Lucia data were individual trip records for the period 1995 – 2009. The data included weights of all species caught and measures of effort (soak time, gear quantity and crew size) by gear type. The data submitted by St Vincent and the Grenadines were 2455 individual records for trips in which blackfin tuna were caught over the period 1984 – 1994. Species weight and value, and crew size and soak time among other measures of effort, were included by gear type. The data submitted by Trinidad and Tobago were 7385 records of individual trips in which flyingfish, dolphinfish and blackfin tuna were caught in Tobago for the period 2005 – 2010. The data included species weight and price, and number of crew by fishing method. The data submitted for the French West Indies included catch series for Martinique and Guadeloupe for dolphinfish and blackfin tuna for the period 1985 – 2009 and estimates of CPUE by gear for the years 2009 and 2010. The data submitted for Venezuela included blackfin tuna catch series and standardised CPUE for the period 1988 – 2009 and size data by fleet from 1993 to 2010.

A description of the blackfin tuna fisheries of Venezuela was presented, which highlighted fishing areas of the different fleets, preliminary catch and effort analyses by fleet, diagnostic analyses on the data, and blackfin tuna size structure analyses for the bait boat and purse seine fleets.

Information was presented on the impacts of FADs in pelagic fisheries in the French West Indies. The structure of pelagic species populations around the FADs was highlighted and research being implemented and planned based on the use of FADs was introduced to the working group. Information was also presented on the identification of small tunas as developed in the French West Indies. JICA's collaborative work with the CRFM in the region on FADs fisheries in Dominica and St Lucia was mentioned in addition to French West Indies's/IFREMER's plans to work with Dominica on FADs fisheries.

**Recommendations**

- Regional studies on reproduction and genetics with respect to blackfin tuna and the identification of small tunas (especially blackfin tuna and yellowfin tuna) should be considered by the working group.
- Grenada should computerize catch and effort and other fisheries related data.

***Fishery data preparation, analysis and assessment planning and implementation, and report preparation***

With respect to the ERAEF of dolphinfish, the group engaged in determining the most appropriate management objectives for the fishery. These included core objectives (what is trying to be achieved) and operational objectives (how to measure achievement). Additionally, the hazards of fishing and external activities within the fishery, leading to the potential harm of the components assessed in the ERAEF analysis, were discussed and reviewed. Finally, the Level 1 Scale Intensity and Consequence Analysis (SICA) was commenced and SICA tables for two out of the five ERAEF components were discussed and completed.

Based on consideration of the data submitted it was decided that an assessment of blackfin tuna could not be attempted at this meeting. It was agreed that a case study on catch standardization using the St Lucia data would be attempted with the aim of addressing the issues of improvement of data collection and reporting and assessment planning. Diagnostic analyses were performed on the data and CPUE standardization attempted using a GLM approach.

Specific recommendations were made for the attention of the St. Lucia scientists; however, more general recommendations for the attention of all countries submitting data for regional assessment were identified.

**Recommendations**

- General data collection protocol should be proposed and agreed upon by participating countries
- Recommendations for St Lucia:
  - Default values should not be used
  - Missing values should be retained

***Review and adoption of Working Group report, including species/fisheries reports for 2011***

The working group report will be adopted by correspondence.

***Inter-sessional workplan***

- ERAEF
    - Review of SICA report
    - Discussion on appropriate productivity and susceptibility most applicable to the regional pelagic fisheries
- Research on blackfin tuna biology
    - Consider proposals identified by IFREMER and Venezuela on genetics, reproduction and identification of little tunas (MAGDELESA project)
- Paper for ICCAT on blackfin tuna case study
- Data improvement – Grenada data computerization
- Request for US dolphinfish statistics and analyses that were produced by David Die in 2010
- Preparation of information packages for CLME

***Any other business***

No further issues were raised for discussion.

***Adjournment***

The meeting was adjourned at 4:30 p.m. on Wednesday 22 June 2011.

## B. FISHERIES REPORTS

### 1.0 Ecological Risk Assessment for the Effects of Fishing (ERAEF) for the Dolphinfish Fishery in the Eastern Caribbean

*Lara Puetz*

### 1.1 Overview of ERAEF Experimental Approach

An Ecological Risk Assessment for the Effects of Fishing (ERAEF) framework was developed for the Australian government as a scientific tool to support ecosystem based fisheries management (EBFM). The hierarchical approach is useful for data-deficient fisheries, such as the dolphinfish fishery in the eastern Caribbean, as it facilitates a progression from qualitative (needed in data poor situations) to quantitative analyses with each subsequent level of analysis. It is precautionary because in the absence of data, high risk is associated with fishing activities. ERAEF's overall objective is to determine existing areas of vulnerability for ecosystem components within the fishery and its associated causes, in order to improve the sustainable use of the resource. Several international groups have developed modified versions of ERAEF to assess the potential risk of a fishery in data poor scenarios, such as the ICCAT Ecosystems Working Group, NOAA's National Marine Fisheries Service and the Marine Stewardship Council. In a similar fashion, the Caribbean Regional Fisheries Mechanism (CRFM) could benefit from the use of an EBFM tool such as ERAEF for data poor fisheries, such as the dolphinfish fishery, to promote collaboration in management strategies where such resources are shared.

### 1.2 Significance for the Caribbean Large Marine Ecosystem Project

One of the main goals of the Caribbean Large Marine Ecosystem (CLME) project is to work towards the sustainable management of shared marine resources within the region. These goals can be obtained through improved regional databases, addressing major issues, causes and actions for the living marine resources and the implementation of management reforms. ERAEF can be used as a tool to assist in the CLME project objectives for the large pelagic dolphinfish fishery exploited by many nations within the western central Atlantic region.

### 1.3 Objectives and Outputs

The **Scoping** section of the ERAEF framework was discussed and completed in the LPWG during the 2011 CRFM Scientific Meeting. At this stage of the assessment, a profile of the dolphinfish fishery, previously compiled into one comprehensive report, and the units of analysis list for all species, habitats and communities within the fishery were presented to the LPWG for review. The most appropriated management objectives for the dolphinfish fishery were determined by the group which included core objectives (what is trying to be achieved) and operational objectives (how to measure achievement). Finally, the hazards of fishing and external activities within the fishery, leading to the potential harm of the components assessed in the ERAEF analysis, were discussed and reviewed. Completed outputs from the Scoping section will provide a detailed profile of the dolphinfish fishery, including its biological, ecological and environmental components and will inform progressive levels in the ERAEF analysis.

The **Level 1** Scale Intensity and Consequence Analysis (SICA) was commenced and SICA tables for two out of the five ERAEF components were discussed and completed. Goals of the SICA analysis were to determine the most vulnerable element for each component and apply a worst case approach when choosing the most vulnerable sub-component and unit of analysis (species, habitat, communities) associated with each fishing activity. Operational objectives were selected to indicate potential management responses to high risk activities within the fishery. Low consequence activities for target and byproduct/bycatch species were screened out by the working group to determine which hazards associated with the dolphinfish fishery have significant impacts on the two components. The process will help the CRFM direct the development of management solutions with current available data and where to focus future research and resources for the regionally shared stock.

## 2.0 Data issues highlighted in the assessment of blackfin tuna

*Todd Gedamke*

### 2.1 Overview of Available Data

The data submitted by St. Vincent and the Grenadines, St. Lucia, and Trinidad/Tobago were evaluated. For all nations, only records which recorded blackfin tuna were initially submitted. Unfortunately, the filtering of data to only include trips that had positive records for blackfin does not provide the information necessary to evaluate changes in catch rates or inferences on changes in population size. To illustrate this point, consider a fishery where exploitation has significantly reduced population size. Fishers and vessels targeting blackfin, for example, may have been 100% successful 10 years ago and now only 10% of the trips are able to catch their target. By evaluating only the successful (ie. positive trips) the underlying decline in catchability of the species - an indication of declining population size - may be masked by a few fishers that know how or where to exploit the reduced number of individuals in the population. Therefore, to develop an index all available information on catch and effort, regardless of species landed must be available.

The St. Lucia representative was able to provide complete data sets for trips recorded as pelagic trips in order to facilitate a case study on how the methodology should work. It should be stressed here that the results of this exercise should not be treated as a true reflection of the stock. A number of questions about the raw data and how they were collected did not allow a reliable index to be generated. For example, the measure of effort (gear quantity and/or soak time) was filled with a default value of 3 when it was not collected. As a result, it is impossible for the analyst to determine when a true '3' was present and when a default '3' was filled to this data field. Specific to this point the group recommended that default values not be used by data managers and that missing values should be retained. As part of the discussion, the importance of metadata for future CRFM meetings was stressed. In order to ease interpretation in the CRFM forum metadata should comprise at least a few primary components including the definitions of variables included in the data (e.g. units and species codes), explanation of any manipulations from raw form (e.g. use of default values), and any other caveats.

### 2.2 Overall Recommendations

1. A minimum data collection protocol, including a requirement for the recording of metadata, should be proposed and agreed upon by participating nations. This should comprise data that can reasonably be expected to be collected. Each nation can then add specifics based on the individual characteristics of their fisheries. A list should be developed that starts with the coarsest categories to finest, e.g.:
    1) Catch – Goals: Total catch and catch per trip
    2) Effort –Goals: Total Effort

    The FAO references, http://www.fao.org/docrep/005/X8923E/X8923E00.htm and http://www.fao.org/docrep/W5449E/w5449e00.htm provide information on minimum data collection needs, e.g. see Table 1. below.

2. Factors to be included in a Catch per Unit Effort (CPUE) standardization process:

Given the lack of available factors to include in a CPUE standardization procedure that were available, the group discussed aspects of fishing which may affect catch rates including:

1) Spatial information
2) Fishing area – The group discussed developing a statistical area grid, 1° latitude x 1°longitude, that would cover the entire region. Finer scale information should be attempted to be obtained in each nation.
3) Depth – This information is more critical for reef fisheries, but should be collected for all fisheries.
4) Distance from shore/port/nearest land – This has not proved very meaningful in the US Caribbean, but if clearly defined may serve useful in the pelagic fisheries in particular.
5) Use of fish aggregating device (FADs) – 'Yes/No', 'ID#' for established FADs and codes and descriptors for fishers using/deploying their own FADs
6) Time of fishing – Information to determine the start and end of fishing
7) Lunar cycle – This does not need to be recorded on data sheets as it is easily incorporated into analysis using date of fishing.
8) Bait Type – Condition (e.g. live, dead, lure); species used for live bait
9) Gear Characteristics – Hook type (J, circle), mesh size etc. See FAO catalogue (http://www.fao.org/DOCREP/005/X8923E/X8923E03.htm#ch3.1.1) for details.

***Table 1. List of effort measures, in order of priority according to the ability of measure to provide a relationship between fishing effort and fishing mortality).***
***(From http://www.fao.org/DOCREP/005/X8923E/X8923E03.htm#ch3.1.1)***

| **FIRST** | **PRIORITY** | |
|---|---|---|
| **Fishing Gear** | **Effort Measure** | **Definition** |
| Surrounding nets (purse seines) | Number of sets<br>and | Number of times the gear has been set or shot, and whether or not successfully. This measure is appropriate when school is related to stock abundance or sets are made in a random manner. |
| | Searching time | This represents time on the grounds, less time spent shooting net and retrieving the catch etc. This measure is complicated by the use of aircraft spotting as well as by the dissemination of information from vessel to vessel. Ideally, it should include the area searched as well. The measure is appropriate when a set is only made when a school has been located. |
| Fishing with FAD (Fish Attracting Device frequently used with purse seine) | Number of hours or days since last fishing activity | Number of hours or days (duration) in which FAD (Fishing Attracting Device) is left in the water since it was fished last time. |
| Beach seines | Number of sets | Number of times the gear has been set or shot, and the number of sets in which a catch was made. |
| Castnet | Number of casts | Number of times the gear has been cast, and whether or not a catch was made. |
| Boat seines | Number of hours | Number of hours during which the seine was on the |

| | | |
|---|---|---|
| (Danish seine, etc.) | fished | bottom fishing. |
| Trawls | Number of hours fished | Number of hours during which the trawl was in the water (midwater trawl), or on the bottom (bottom trawl), and fishing. |
| Boat dredges | Number of hours fished | Number of hours during which the dredge was on the bottom and fishing. |
| Gillnets (set or drift) | Number of effort units | Length of nets expressed in 100-metre units multiplied by the number of sets made (=accumulated total length in metres of nets used in a given time period divided by 100). |
| Gillnets (fixed) | Number of effort units | Length of net expressed in 100-metre units and the number of times the net was cleared. |
| Lift net | Number of hours fished | Number of hours during which the net was in the water, whether or not a catch was made. |
| Traps (uncovered pound nets) | Number of effort units | Number of days fished and the number of units hauled. |
| Covered pots and fyke nets | Number of effort units | Number of lifts and the number of units (=total number of units fished in a given time period) and estimated soak time. |
| Longlines (set or drift) | Numbers of hooks | Number of hooks set and hauled in a given time period. |
| Pole-and-line | Number of days fished | The number of days fishing (24-hour periods, reckoned from midnight to midnight) including days searching. Similar to purse seine, in that schools are searched for and then fished. |
| Rod-and-reel (recreational) | Number of line-hours | Number of hours during which the lines were in the water times number of lines used. |
| Troll | Number of line-days | Total number of line days in the given time period. |
| Jigs, (hand and mechanical) | Number of line-days | Total number of line days in the given time period. |
| Other small scale net gears | Number of operations | Number of fishing operations, whether or not a catch was made. These include push net, scoop net, drive-in net etc. |
| Other small scale stationary gears | Number of hours fished | Number of hours during which the gears were in the water for fishing, whether or not a catch was made. Those gears include guiding barriers, bag net, stow net, portable net, etc. |
| Harpoons/spears | Number of days fished | The number of days fishing (24-hour periods, reckoned from midnight to midnight) including days during which searching took place without fishing. If more than one spear-fisher operates from a vessel, the |

| | | |
|---|---|---|
| | | numbers of fishers (spears) need to be recorded as well. |
| **SECOND** | **PRIORITY** | |
| **Fishing Gear** | **Effort Measure** | **Definition** |
| Boat seines (Danish seine, etc.) | Number of sets made | Number of times the gear has been set or shot, whether or not a catch was made. |
| Trawls | Number of sets made | Number of times the gear has been set or shot (either in mid-water or to the bottom), whether or not a catch was made |
| Lift net | Number of hours fished | Number of times the net was set or shot in the water, whether or not a catch was made |
| | | |
| All gears | Number of days fished | The number of days (24-hour period, reckoned from midnight to midnight) on which any fishing took place. For those fisheries in which searching is a substantial part of the fishing operation, days in which searching but no fishing took place should be included in "days fished". |
| **THIRD** | **PRIORITY** | |
| **Fishing Gear** | **Effort Measure** | **Definition** |
| All gears | Number of days on ground | The number of days (24-hour periods, reckoned from midnight to midnight) in which the vessel was on the fishing ground, and includes in addition to the days fishing and searching also all the other days while the vessel was on the fishing ground. |
| **FOURTH** | **PRIORITY** | |
| **Fishing Gear** | **Effort Measure** | **Definition** |
| All gears | Number of days absent from port | The number of days absent from port on any one trip should include the day the fishing craft sailed but not the day of landing. Where it is known that fishing took place on each day of the trip the number of "days absent from port" should include not only the day of departure, but also the day of arrival back in port. Where on any trip a fishing craft visits more than one "fishing area" (as defined for statistical purposes) an appropriate fraction of the total number of days absent from port should be allocated to each "fishing area" in proportion to the number of days spent in each. The total number of trip days should be the sum of the number of days allocated to all of the different "fishing areas" visited. |
| **FIFTH** | **PRIORITY** | |
| **Fishing Gear** | **Effort Measure** | **Definition** |
| All gears | Number of trips made | Any voyage during which fishing took place in only one "fishing area" is to be counted as one trip. When in a single trip a craft visits more than one "fishing area" an |

| | | |
|---|---|---|
| | | appropriate fraction of the trips should be apportioned to each "fishing area" in proportion to the number of days spent fishing in each. The total number of trips for the statistical area as a whole should be the same as the sum of trips to each "fishing area". |

## 3.0 Martinique and Guadeloupe fishing fleets targeting Dolphinfish, Flyingfishes and Blackfin tuna

*Lionel Reynal[1], Sébastien Demaneche[2] and Olivier Guyader[2] (June 2011)*
[(1)]Ifremer, Station de Martinique Lionel.Reynal@ifremer.fr
[(2)]Ifremer, Centre de Brest Sebastien.Demaneche@ifremer.fr Olivier.Guyader@ifremer.fr

### 3.1 Fishery and Fleet description

During the year 2008 and 2009 in Martinique, 1084 and 1098 boats were registered as commercial fishing boats and in Guadeloupe 878 and 903 respectively. Within the same years, 85% and 82 % (916 & 896) of the vessel fleet were active in Martinique and in Guadeloupe 90% and 86 % (794 & 778) were active. Most of the boats are between 5 to 9 m total length. The 7 to 9 m boats are more frequent in Martinique (figure 1). During the last decade, the number of 7 to 9m boats increased in Guadeloupe while the number of 5 to 7 m boats decreased (figure. 2). The average length of the boats is similar between the two French Antilles, but the engine average power is higher in Guadeloupe (139 kW *vs* 80). The total power of the fleets had increased steadily from 56,788 to 87,420 kW in Martinique between 1993 and 2009 and at the same time, from 84,240 to 125,874 kW in Guadeloupe. The average age of the boats are 16 years in Martinique and 11 years in Guadeloupe.

Dolphinfish, flyingfish and blackfin tuna are mainly targeted using the following:

- High sea hand lines and trolling lines for large pelagic fishes,
- Trolling lines and drifting vertical lines around FADs for large pelagic fishes,
- High sea drifting nets for flyingfish (Martinique only),
- Nets for flyingfish during High sea lines for large pelagic fishes (Martinique only).

Flyingfish are not targeted by the commercial fishing boats of Guadeloupe. This is practiced mainly by high sea fleets. Related to the typology made by IFREMER, 10 different fleets are distinguished (table 1) totalling 464 boats in Guadeloupe and 435 in Martinique (2008).

The boats of these high sea fleets share their activities between high sea and the insular shelves. An example of the seasonality of the different activities is given for Martinique in 2008 (figure 3). The seasonal activity of the high sea hand and trolling lines which are targeting mostly dolphinfish between December to June, impacts others activities which are higher from July to November. The total number of trips per year on the insular shelves is higher than at high sea (figure 4). The drifting nets for flyingfish are used on the west coast of Martinique inside the 24 NM limit. FADs are mainly exploited inside the 24 NM while high sea hand and trolling lines are fishing outside the 24 NM (figures 5 & 6).

Fishing around Moored Fish Aggregating Devices (FADs) took place in Martinique and Guadeloupe during the 90's and seems to have changed the activity and the seasonality of the high sea fishing. The data from enquiries made in 1979 and 1989 show a high proportion of boats practising high sea lines during the first half of the year and a sharp decline in the second half of the year. In 2006, this seasonality is less definite. The high sea boats share their activities between high sea lines and FADs. Fishing is practised all year long; as a result some of the high sea boats stay offshore between June to December (figure 7).

### 3.2 Statistics and Sampling

A Fisheries Information System (FIS) conceived by IFREMER has been implementing in Guadeloupe and Martinique since the beginning of 2010 after a pilot project was ran in 2008 in Guadeloupe and May 2008 to December 2009 in Martinique. The FIS is a permanent, operational and multidisciplinary national network (figure 8) for the observation of marine resources and their associated uses.

The methods used are the following:

- *Phone investigation*: stratified sampling plan based on a simple stratified random sampling of the vessel each week to reconstitute trip and inactivity on 7 days. Stratification (25 stratums) made out of length, gradient and zone of fishing of the vessel. In Martinique, 75 interviews are made per week and 60 in Guadeloupe.
- *Sampling at landing points*: sampling strategy of harbours with at least 10 vessels between Monday to Friday.

The pilot studies give first preliminary figures on the extrapolated landings of these islands but this data has to be validated. The scattering of the landing points around Guadeloupe and Martinique (more than 100 in each island) makes the monitoring of the fishing activities difficult. The use of two methods to estimate the number of trips gave results up to 2 times less than those obtained in Martinique by a previous study 20 years ago (Gobert, 1989). A field survey has been launched in Martinique in order to improve this issue.

The annual estimates of the landings are presented in table 2 for Martinique (2009 & 2010) and table 3 for Guadeloupe (2008) with their confidence intervals. The CPUE are given in the same tables. For Martinique some of small blackfin tunas (2 kg or less) are in a category called "non identified *Thunnini"*. In this unidentified *Thunnini* the proportion of blackfin tuna is unknown. The weights of the fish are recorded as round whole for the flyingfish and *Thunnini* and gutted for the dolphinfish and blackfin tuna.
Estimates of catch rates per trip obtained during stratified random surveys in 2008-2009 in Guadeloupe and Martinique were used to reconstruct the total annual catch by assuming that these catch rates represent average catch rates for the fishery through the entire historic period. Annual catch was calculated as the product of the catch rate and the number of boats per year. Annual catch estimates for 2008, the period for which there is more reliable data, range from 393 to 561 t (metric tons) per year, which represents an estimate of 474 t (metric tons) for dolphinfish in Guadeloupe and 12 to 17 t for blackfin tuna (estimate 14 t).

In Martinique, for 2009 estimates range from 23 to 64 t (estimate 40 t) for dolphinfish and from 9 to 29 t (estimate 18 t) for blackfin tuna.

The final estimates of historical harvest for both islands therefore start from a small catch rate around FADs of 3 tons of dolphinfish and 1 ton of blackfin tuna in 1985. made in Martinique to 377 t of dolphinfish and 20 t of blackfin tuna for both islands in 1997, to the present estimate of between 416 to 625 t of dolphinfish and 21 to 46 for blackfin tuna in 2008 (tables 4 & 5).

For other gears, the estimate of historical catches cannot be determine because of the lack of information on the evolution of the number of boats and the change in the fishery as there was significant increases of engine power and the achievement of FADs fishing.

In 1987, the estimates of annual landings in Martinique done by Gobert (1989) were up to 370.4 t for flyingfish and 247.8 t for dolphinfish. The high sea lines number of trips was estimate at 24,477 and the catch per trip for dolphinfish at 10.12 kg. Several assumptions could explain the high difference of CPUE value between 1987 and 2009 which includes increasing engine power which allows the boats to search in wider area and differences in abundances however no assertion can be given. As a consequence, it seems hazardous to try to build historical data series for high sea lines.

The monthly catches per trip show peaks of CPUE in March-April for dolphinfish and flyingfish and between June and September for blackfin tuna. The curve of the unidentified *Thunnini* CPUE has several peaks which suggest a mixture of species with different seasonality (tables 6 & 7).

Limited data is available on length frequencies in Martinique (table 6) for dolphinfish in 1986 & 1987 (figure 8) and for blackfin tuna in 1986 & 1987 (figure 9) and 2008 & 2009 (figure 10). The blackfin tuna length frequencies indicate two predominant modal classes, one less than 30 cm fork length and the other between 45 and 60 cm. According to Doray *et al.* (2004), young blackfin tuna probably leave the vicinity of Martinique to undergo a trophic migration at 7 to 8 month-old, and thereafter comes to breed in the Lesser Antilles area. The lengths of Dolphin fish are between 24 and 128 cm (figure 11).

### 3.3. Research

Research projects on FADs sustainable development were conduct in Martinique by IFREMER. A Lesser Antilles project named MAGDELESA was proposed to start in October 2011. An ongoing project is conducting a diagnostic in Martinique and Guadeloupe of the contamination of the fishing faun by chemical products and especially by the chlordecone: a pesticide used in banana plantations. Other organisms are working mostly on coral with the objective to protect this ecosystem and the associated resources. The implementation of the FIS will bring the necessary information needed to conduct research on biodiversity of the marine faun of the French West Indies.

### 3.4. Legislation and Management Regulations

There are no special legislation and management regulations for commercial fishing of dolphinfish, blackfin tuna and flyingfish. In Guadeloupe, recreational fishing is limited to 3 fish per trip and person on board. Regulation measures on FADs have been taken in Martinique and Guadeloupe. Limit of total power and gross tonnage is separately imposed for the Commercial fleets of Guadeloupe and Martinique.

### 3.5 Literature cited

Doray M., B. Stéquert and M. Taquet, 2004. Age and growth of blackfin tuna (*Thunnus atlanticus*) caught under moored fish aggregating devices around Martinique Island. Aquat. Living Resour. 17, 13-18.

Gobert B., 1989. Effort de pêche et production des pêcheries artisanales martiniquaises. Document scientifique n° 22, 95 p.

## Figures and Tables

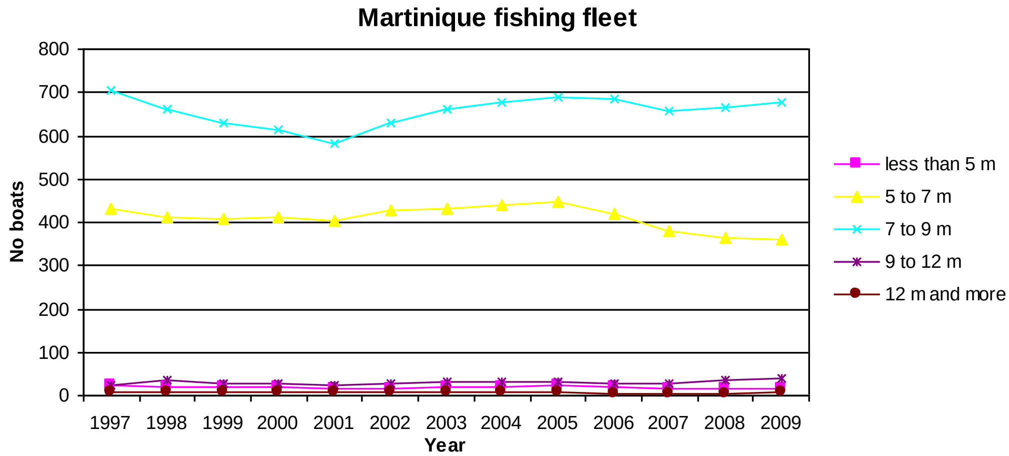



**Figure 1. Length frequencies of the fishing fleet of Martinique (1997 to 2009)**

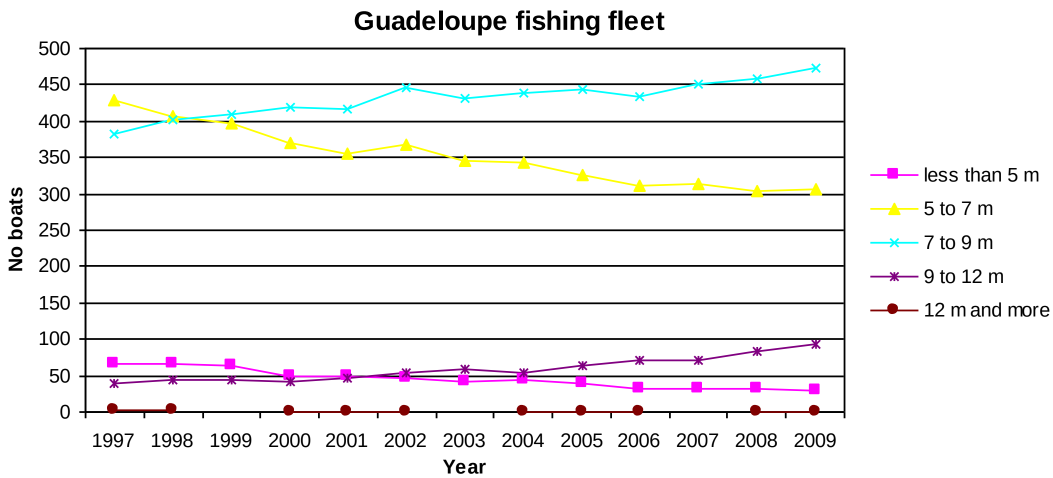



**Figure 2. Length frequencies of the fishing fleet of Guadeloupe (1997 to 2009)**

| Fleets / Number of boats (2008) | Guadeloupe | Martinique |
|---|---|---|
| FADs | 63 | 85 |
| FADs - Traps | 73 | 87 |
| FADs - Nets | 25 | 39 |
| FADs - others lines | 37 | 16 |
| FADs - Polyvalent fixed gears | 104 | 61 |
| High sea hand and Trolling lines | 12 | 17 |
| High sea hand and Trolling lines - Traps | 41 | 77 |
| High sea hand and Trolling lines - Nets | 24 | 12 |
| High sea hand and Trolling lines - others lines | 13 | 3 |
| High sea hand and Trolling lines -Polyvalent fixed gears | 72 | 38 |
| **Total** | **464** | **435** |

**Table 1. High sea fishing fleets of Guadeloupe and Martinique (2008)**

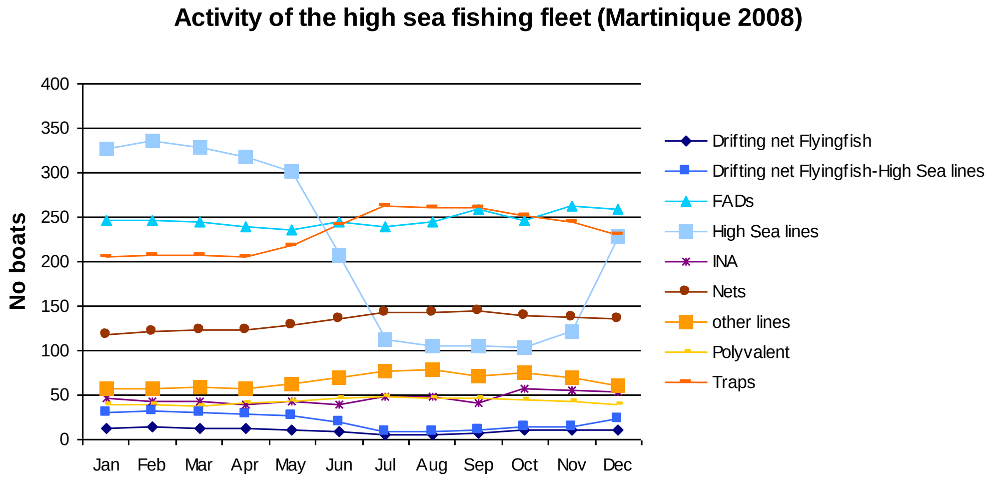



**Figure 3. Seasonality of the high fishing fleet of Martinique – number of boats per month and metier (2008)**

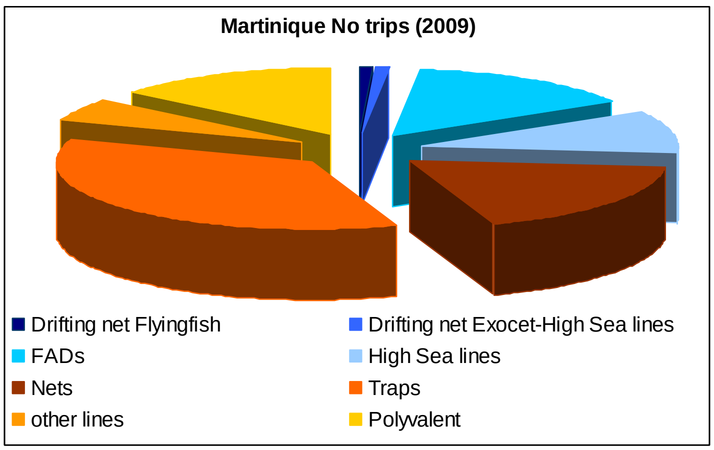



**Figure 4. Number of trips per metier of the high sea fishing fleet of Martinique (2009)**

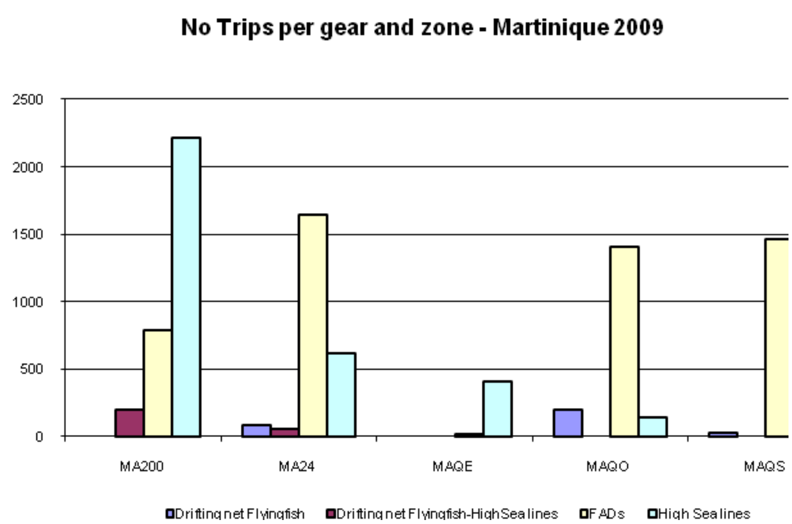



**Figure 5. Number of trips per zone of the high sea fishing fleet of Martinique**

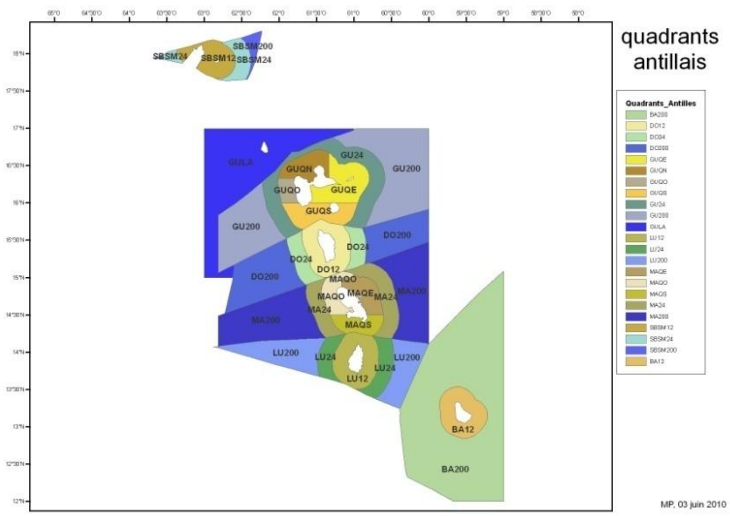



**Figure 6. Map of the zone used by the FIS of Ifremer**

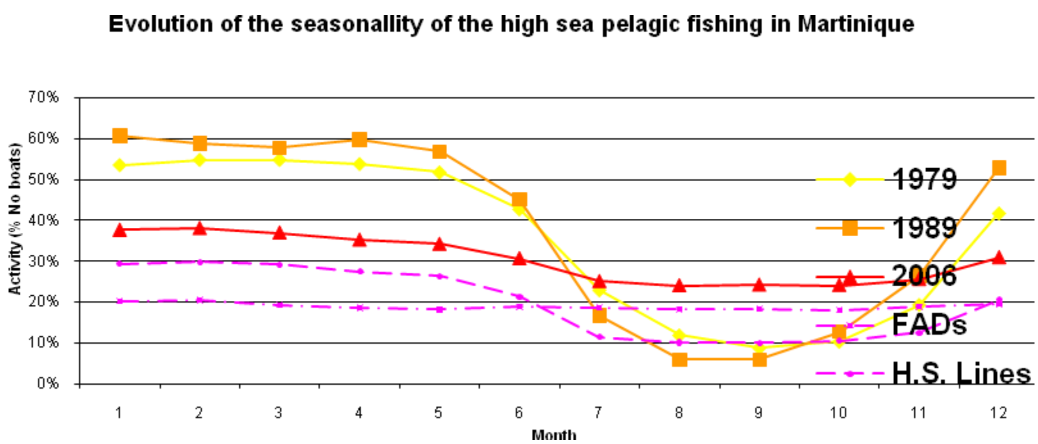



**Figure 7. Evolution of the seasonality of the high sea pelagic fishing in Martinique**

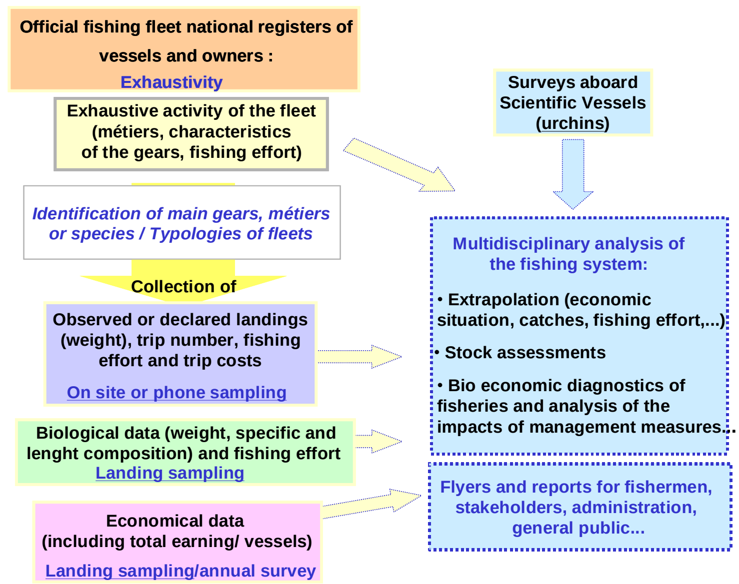



**Figure 8. Organisation of the FIS of Ifremer**

| Metier | No trips Martinique | Martinique 2009 - Landings (kg) Flyingfish | Dolphinfish | Blackfin tuna | Small thunnini (<+2 kg) | Martinique 2009 - CPUE (kg) Flyingfishe | Dolphinfishe | Blackfin tuna | Small thunnini (<+2 kg) |
|---|---|---|---|---|---|---|---|---|---|
| Drifting net Flyingfish | 2 571 | 34 199 | | | 170 | 13.30 | | | 0.07 |
| FADs | 6 088 | 612 | 40 406 | 17 571 | 49 773 | 0.10 | 6.64 | 2.89 | 8.18 |
| High Sea lines (+Drifting nets) | 6 388 | 4 434 | 192 806 | 9 442 | 13 459 | 0.69 | 30.18 | 1.48 | 2.11 |
| other lines | 595 | | 472 | 242 | | | 0.79 | 0.41 | |
| **Total estimate** | | **39 577** | **234 689** | **28 913** | **69 823** | | | | |
| *Low* | | *14 407* | *144 417* | *13 939* | *34 251* | | | | |
| *High* | | *81 445* | *351 159* | *50 801* | *126 930* | | | | |

(a)

| Metier | No trips Martinique | Martinique 2010 - Landings (kg) Flyingfish | Dolphinfish | Blackfin tuna | Small thunnini (<+2 kg) | Martinique 2010 - CPUE (kg) Flyingfish | Dolphinfish | Blackfin tuna | Small thunnini (<+2 kg) |
|---|---|---|---|---|---|---|---|---|---|
| Drifting net Flyingfish | 1 816 | 67 607 | | | | 37.23 | | | |
| FADs | 6 120 | 308 | 12 334 | 9 066 | 46 253 | 0.05 | 2.02 | 1.48 | 7.56 |
| High Sea lines (+Drifting nets) | 4 709 | 3 786 | 124 268 | 5 794 | 19 525 | 0.80 | 26.39 | 1.23 | 4.15 |
| other lines | 304 | | | 881 | 551 | | | 2.90 | 1.81 |
| **Total estimate** | | **84 674** | **153 136** | **17 215** | **66 140** | | | | |
| *Low* | | *44 248* | *104 207* | *7 892* | *49 504* | | | | |
| *High* | | *138 177* | *217 540* | *29 842* | *85 475* | | | | |

(b)

**Table 2. Number of trips, catches and CPUE per gear used to target the fishes for Martinique 2009 (a) and 2010 (b) – Data to be validated.**

| Metier | No trips Guadeloupe | Guadeloupe 2008 - Landings (kg) Flyingfish | Dolphinfish | Blackfin tuna | Guadeloupe 2008 - CPUE (kg) Flyingfish | Dolphinfish | Blackfin tuna |
|---|---|---|---|---|---|---|---|
| Decked boat | 559 | | 119 752 | | | 214.23 | |
| FADs | 14 110 | 88 | 474 231 | 14 030 | 0.01 | 33.61 | 0.99 |
| High Sea lines (+Drifting nets) | 8 055 | 248 | 553 711 | 1 177 | 0.03 | 68.74 | 0.15 |
| **Total estimate** | | **336** | **1 147 694** | **15 207** | | | |
| *Low* | | *1 209* | *945 883* | *12 567* | | | |
| *High* | | *2 408* | *1 397 258* | *18 016* | | | |

**Table 3. Number of trips, catches and CPUE per gear used to target the fishes for Guadeloupe 2008 – Data to be validated**

| Year | Low Dolphinfish Landings | High Dolphinfish Landings | Dolphinfish Landings estimates | Low Blackfin tuna Landings | High Blackfin tuna Landings | Blackfin tuna Landings estimates |
|---|---|---|---|---|---|---|
| 1985 | 1 | 4 | 3 | 1 | 2 | 1 |
| 1986 | 1 | 4 | 3 | 1 | 2 | 1 |
| 1987 | 5 | 13 | 8 | 2 | 6 | 4 |
| 1988 | 5 | 13 | 8 | 2 | 6 | 4 |
| 1989 | 5 | 13 | 8 | 2 | 6 | 4 |
| 1990 | 5 | 15 | 9 | 2 | 7 | 4 |
| 1991 | 6 | 17 | 10 | 2 | 8 | 5 |
| 1992 | 6 | 17 | 10 | 2 | 8 | 5 |
| 1993 | 7 | 18 | 12 | 3 | 8 | 5 |
| 1994 | 7 | 20 | 13 | 3 | 9 | 5 |
| 1995 | 7 | 20 | 13 | 3 | 9 | 5 |
| 1996 | 9 | 24 | 15 | 3 | 11 | 7 |
| 1997 | 12 | 33 | 21 | 5 | 15 | 9 |
| 1998 | 15 | 41 | 26 | 6 | 19 | 11 |
| 1999 | 16 | 46 | 29 | 7 | 21 | 13 |
| 2000 | 18 | 50 | 31 | 7 | 23 | 14 |
| 2001 | 20 | 55 | 35 | 8 | 25 | 15 |
| 2002 | 21 | 59 | 37 | 8 | 27 | 16 |
| 2003 | 21 | 59 | 37 | 8 | 27 | 16 |
| 2004 | 22 | 61 | 39 | 9 | 28 | 17 |
| 2005 | 24 | 67 | 42 | 9 | 31 | 18 |
| 2006 | 24 | 67 | 42 | 9 | 31 | 18 |
| 2007 | 23 | 66 | 41 | 9 | 30 | 18 |
| 2008 | 23 | 64 | 40 | 9 | 29 | 18 |
| 2009 | **23** | **64** | **40** | **9** | **29** | **18** |

**Table 4. Estimates of historical catch (t) of FADs fishing for Dolphinfish and Blackfin tuna in Martinique**

| year | Low Dolphinfish Landings | High Dolphinfish Landings | Dolphinfish Landings estimates | Low Blackfin tuna Landings | High Blackfin tuna Landings | Blackfin tuna Landings estimates |
|---|---|---|---|---|---|---|
| 1985 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 20 | 28 | 24 | 1 | 1 | 1 |
| 1990 | 49 | 70 | 59 | 1 | 2 | 2 |
| 1991 | 59 | 84 | 71 | 2 | 2 | 2 |
| 1992 | 89 | 126 | 107 | 3 | 4 | 3 |
| 1993 | 187 | 267 | 226 | 6 | 8 | 7 |
| 1994 | 197 | 281 | 238 | 6 | 8 | 7 |
| 1995 | 207 | 295 | 249 | 6 | 9 | 7 |
| 1996 | 275 | 393 | 333 | 8 | 12 | 10 |
| 1997 | 295 | 421 | 356 | 9 | 12 | 11 |
| 1998 | 305 | 436 | 368 | 9 | 13 | 11 |
| 1999 | 334 | 478 | 404 | 10 | 14 | 12 |
| 2000 | 354 | 506 | 428 | 10 | 15 | 13 |
| 2001 | 374 | 534 | 451 | 11 | 16 | 13 |
| 2002 | 374 | 534 | 451 | 11 | 16 | 13 |
| 2003 | 374 | 534 | 451 | 11 | 16 | 13 |
| 2004 | 374 | 534 | 451 | 11 | 16 | 13 |
| 2005 | 374 | 534 | 451 | 11 | 16 | 13 |
| 2006 | 374 | 534 | 451 | 11 | 16 | 13 |
| 2007 | 364 | 519 | 439 | 11 | 15 | 13 |
| 2008 | **393** | **561** | **474** | **12** | **17** | **14** |

**Table 5. Estimates of historical catch (t) of FADs fishing for Dolphinfish and Blackfin tuna in Guadeloupe**

| Year | Spieces | Gear | Jan | Feb | Mar | Apr | May | Jun | Jul | Agu | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2009 | Dolphinfish | FADs | 5.82 | 18.50 | 6.85 | 16.21 | | | 5.40 | 3.14 | 1.71 | 1.17 | 0.51 | 2.46 |
| 2009 | Dolphinfish | High Sea lines (+Drifting nets) | 9.53 | 23.20 | 56.20 | 38.07 | 35.23 | 19.94 | 7.63 | | 0.60 | | 7.86 | 17.50 |
| 2009 | Blackfin tuna | FADs | 0.88 | | 1.71 | 1.67 | 0.77 | 3.00 | 9.50 | 4.29 | 6.97 | 0.81 | 1.26 | |
| 2009 | Blackfin tuna | High Sea lines (+Drifting nets) | 3.82 | 0.00 | 0.93 | 0.65 | 1.92 | 1.55 | 6.73 | 13.40 | 2.30 | | 6.43 | |
| 2009 | Thunnini | FADs | 1.35 | 3.64 | 4.52 | 3.43 | 4.00 | 4.00 | 0.60 | 19.71 | 7.83 | 2.47 | 6.89 | 12.83 |
| 2009 | Thunnini | High Sea lines (+Drifting nets) | 3.82 | | 0.29 | 2.95 | | 0.09 | 2.97 | 10.20 | 8.00 | 13.67 | 1.79 | 4.00 |
| 2009 | Flyingfish | Drifting net Flyingfish | 13.33 | 1.00 | 35.69 | | 25.70 | 1.38 | | 15.00 | | | | |
| 2009 | Flyingfish | High Sea lines (+Drifting nets) | | | | 0.18 | 4.46 | 3.41 | | | | | | 7.50 |
| | | | | | | | | | | | | | | |
| 2010 | Dolphinfish | FADs | 0.42 | 4.58 | | 2.22 | 3.63 | 3.86 | 1.68 | | 1.50 | 0.22 | 1.32 | 2.67 |
| 2010 | Dolphinfish | High Sea lines (+Drifting nets) | 29.12 | 15.62 | 16.60 | 56.25 | 30.31 | 3.17 | 16.50 | | | | | 4.57 |
| 2010 | Blackfin tuna | FADs | | 3.58 | | 1.11 | 1.95 | 0.74 | 0.89 | 2.44 | 1.07 | 1.93 | | 0.24 |
| 2010 | Blackfin tuna | High Sea lines (+Drifting nets) | 5.38 | | 2.09 | | 0.37 | | | | | | | |
| 2010 | Thunnini | FADs | 8.05 | 3.26 | 9.23 | 9.67 | 11.08 | 3.75 | 6.31 | 7.00 | 5.05 | 12.42 | 11.36 | 4.89 |
| 2010 | Thunnini | High Sea lines (+Drifting nets) | 4.49 | 9.45 | 2.13 | 0.42 | 0.89 | 5.56 | 0.83 | 3.00 | | 35.00 | | 4.86 |
| 2010 | Flyingfish | Drifting net Flyingfish | 63.50 | 16.89 | 83.70 | 8.67 | 23.00 | 6.25 | 0.10 | | | 56.96 | 4.50 | 63.53 |
| 2010 | Flyingfish | High Sea lines (+Drifting nets) | 0.51 | 0.01 | 1.59 | 3.33 | 2.69 | | | | | | | |

**Table 6. Estimates of average catch per trip (kg) for Dolphinfish, Blackfin tuna, and flyingfish per main gear – Martinique 2009 & 2010**

| Year | Gear | Jan | Feb | Mar | Apr | May | Jun | Jul | Agu | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2009 | DCP | 661 | 423 | 568 | 505 | 207 | 29 | 331 | 483 | 599 | 803 | 804 | 672 |
| 2009 | Drifting net Flyingfish | 281 | | 951 | 269 | 209 | 138 | 117 | 58 | 240 | | | 308 |
| 2009 | High Sea lines (+Drifting nets) | 786 | 1338 | 1277 | 1400 | 433 | 304 | 367 | 110 | 92 | 155 | 85 | 42 |
| | | | | | | | | | | | | | |
| 2010 | DCP | 268 | 321 | 200 | 385 | 320 | 785 | 691 | 682 | 510 | 756 | 554 | 649 |
| 2010 | Drifting net Flyingfish | 164 | 207 | 140 | 210 | 80 | 139 | 31 | 36 | 36 | 181 | 338 | 252 |
| 2010 | High Sea lines (+Drifting nets) | 521 | 754 | 1138 | 438 | 1136 | 314 | 92 | 18 | 0 | 30 | 15 | 252 |

**Table 7. Estimates of the number of trips per month for the main gears witch target Dolphinfish, Blackfin tuna and flyingfish – Martinique 2009 & 2010**

| Type of Length | FL (cm) | | | | | TL (cm) | | |
|---|---|---|---|---|---|---|---|---|
| Year | 2008 | | | 2009 | | 1986 | 1987 | |
| Gear | FADs | H.S. Lines | Other lines | FADs | H.S. Lines | H.S. Lines | H.S. Lines | Deep trolling Lines |
| Dolphinfish | 53 | 60 | 0 | 0 | 0 | 286 | 597 | 9 |
| Blackfin tuna | 190 | 19 | 11 | 46 | 11 | 186 | 287 | 216 |

**Table 8. Number of length frequencies data available in Martinique for Dolphinfish and Blackfin tuna**

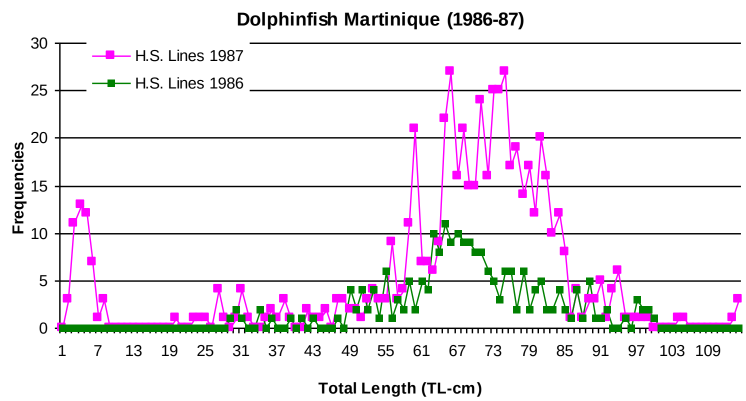



**Figure 8. Total length (TL – cm) frequencies of Dolphinfish in 1986 and 1987 in Martinique**

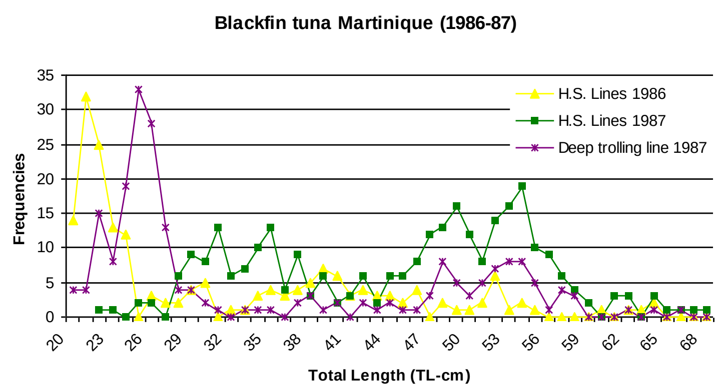



**Figure 9. Total length (TL – cm) frequencies of Blackfin tuna in Martinique (1986-87)**

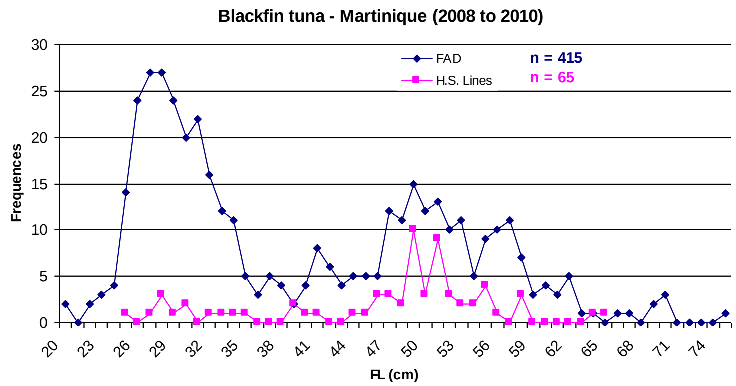



**Figure 10. Fork length (FL – cm) frequencies of Blackfin tuna in Martinique (2008-10)**

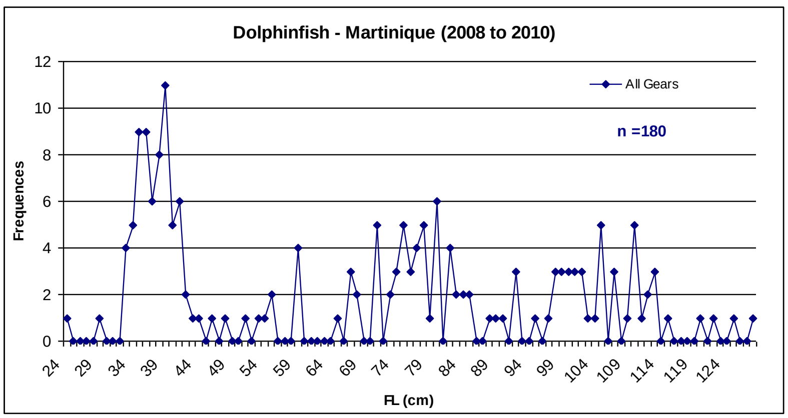



**Figure 11. Fork length (FL – cm) frequencies of Dolphinfish in Martinique (2008-2010)**

## 4.0 Blackfin tuna catch, catch rates, and size structure from Venezuelan fisheries

Freddy Arocha, Alexander Bárrios, Jésus Marcano, and Xiomara Gutiérrez

Blackfin tuna is commonly caught by industrial and artisanal Venezuelan fleets throughout the Caribbean Sea and adjacent waters. The Venezuelan purse seine fleet that operates in the Caribbean Sea consists of 10 vessels, mostly with a capacity of 600 t; while the baitboat fleet consists of about 8 vessels with a capacity that ranges between 50 and 250 t. This fleet operates most of the time in conjunction with the purse seine fleet. The artisanal fleets that fish for blackfin tuna are the offshore small scale fleet that uses pelagic longline gear, and the coastal artisanal drift-gillnet fishery.

As per recommendation in the CRFM Blackfin tuna report, the total historical catch information available for blackfin tuna was revised. Upon the revision it was concluded by the Venezuelan tuna working group that the most reliable data on blackfin tuna catches were those available from TASK II information in the ICCAT database, as it corresponded to accurate port sampling and monitoring of >80% of the logbook data controlled by trained officials. Additional catch information from the artisanal fleets was included to account for the total catch of blackfin tuna from Venezuela. The highest catches were observed between 1998 and 2002, when in 2001 reached its peak of over 1700 t (Figure 1), since then the catch has remained at around 300 t, with the exception of 2004 and 2007 when catches increased to about 700 t. Although, the main blackfin tuna catch come from the Venezuelan industrial surface fleets, in the last year of the series the artisanal drift-gillnet fleet account for a substantial increase with respect to previous years.

Blackfin tuna caught by the Venezuelan fishery showed a strong seasonal positive signal towards the end of the year in two of the fleets (purse seine and offshore small scale longline). While the artisanal coastal drift-gillnet showed a seasonal increase towards the beginning of the year (Figure 2), possibly indicating an offshore–inshore movement between the end and the beginning of the year.

Standardization of catch rates were attempted for the industrial surface fleets using general linear model (GLM) techniques. The relative indices of abundance for blackfin tuna were estimated by Generalized Linear Modeling approach assuming a lognormal model distribution. However, only relative indices of abundance of the baitboat fleet were adequately standardized as indicated by the diagnostic plots (Figure 3). However, the model utilized was not appropriate for standardizing the relative indices of abundance from the purse seine fleet; no attempts were made to explore other options during the meeting but will be carried out in the near future. The standardized relative indices of abundance of blackfin tuna from the baitboat fishery show an uneven sustained declining trend beginning in 1997 (Figure 4 a), showing a minor recovery at the end of the time series. The nominal blackfin tuna catch rates from the purse seine fleet appear to be around or below 250 t/effective fishing days (EFF) during most of the time period, with three noticeable peaks in 1990, 1992-93, and 2001-02, of 1400 t/EFF, ~1000 t/EFF, and ~900 t/EFF, respectively (Figure 4 b). The reason for the decreased trend is unknown and requires further in depth analysis to be undertaken in the future.

Annual and seasonal size structure was analyzed for both surface fisheries. The average annual size structure from the purse seine fleet did not vary throughout the time series, in contrast to the size structure from the baitboat fleet where average sizes were larger in some years (Figure 5 a). Similarly, the seasonal size structure from the baitboat fleet showed a trend in which the average of large fish increased from April to July (Figure 5b), in contrast to the seasonal average size structure from the purse seine fleet where no trends were observed.

The temporal and spatial distribution of the combined size structure of blackfin tuna from both industrial surface fleets were presented by separating adult and mature fish (> 50 cm FL) from those that were not

(Figure 6). The sampled catch appears to be dominated by adult mature fish throughout the season over all the fishing area, with the exception of the second quarter where adult mature fish seem to be more common. However, during the first quarter, non-mature fish (<50 cm FL) appear to be important in catches in the eastern section of the fishing area, and it appears the within this area an important proportion of the fish in the sampled catch are non-mature fish.

The information from blackfin tuna catches from the offshore small scale longline fleet and the coastal artisanal drift-gillnet fishery is very limited. Despite the recent increase in catch from one of these fleets, the information if any is mostly limited to catch statistics. One of the main reasons is that blackfin tuna from these fleets is mostly reported as 'albacora' and often is misidentified in official statistics as *Thunnus alalunga*, *T. albacares* or placed under the category of 'other tunas' or 'small tunas'. However, the Instituto Oceanografico of the Universidad de Oriente in Cumaná has started an enhanced monitoring program of the offshore small scale longline fleet that will contribute to increase our knowledge of blackfin tuna captured by this fleet.

## Figures

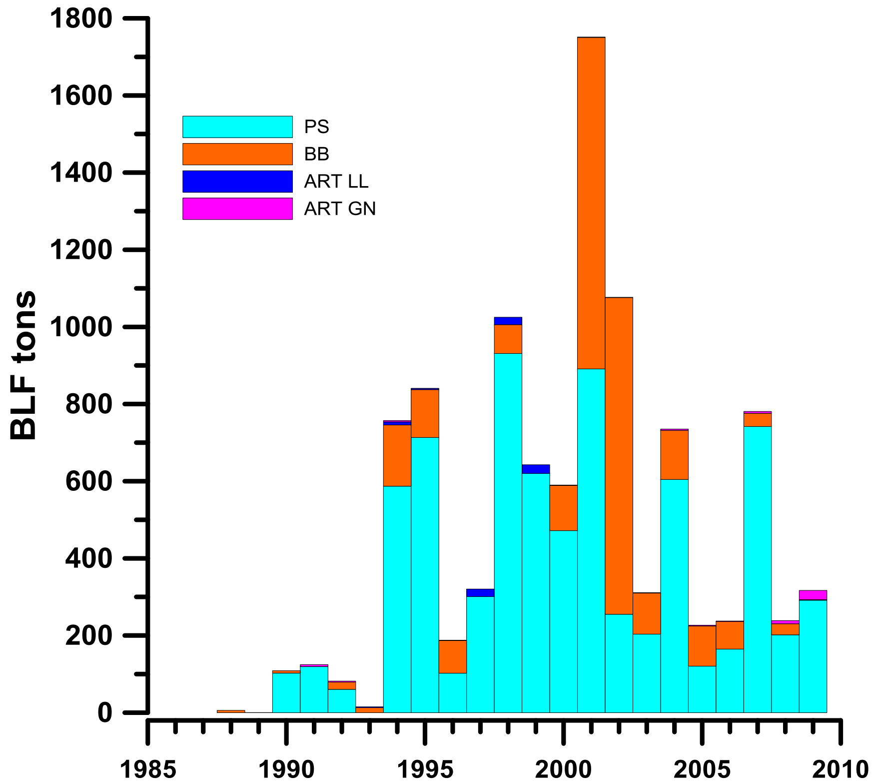
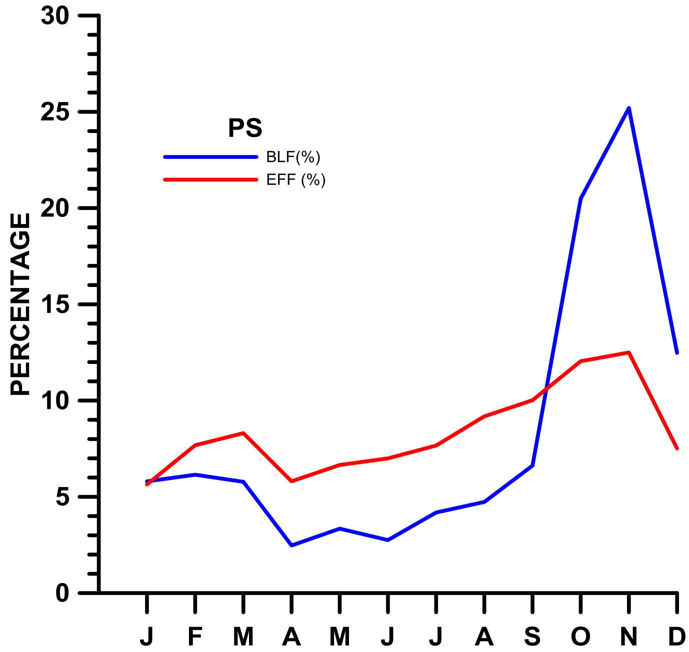
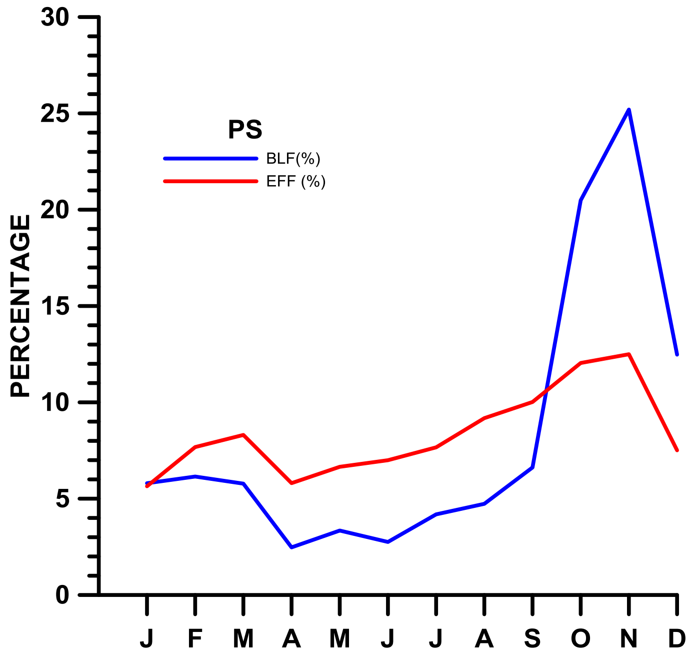
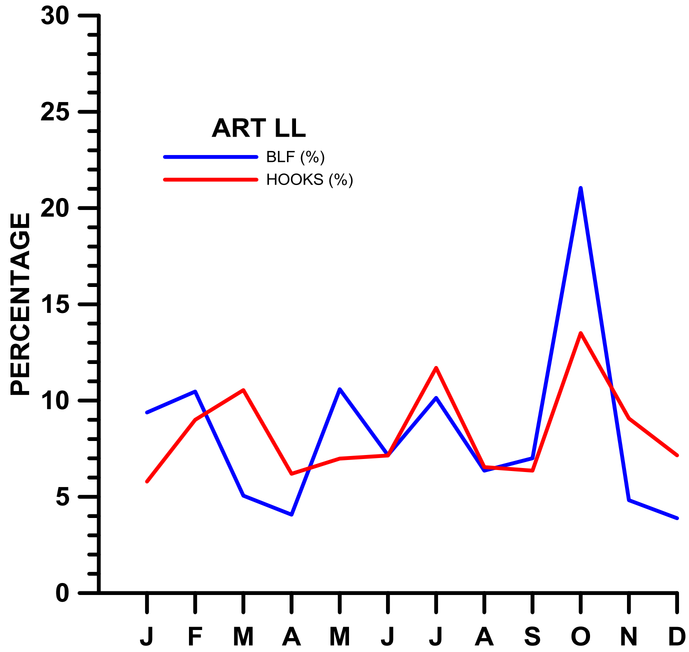



**Figure 1. Blackfin tuna (BLF) total catches by gear from Venezuela between 1988 and 2009.**


30
25
20
15
10
5
0
PERCENTAGE
PS
BLF(%)
EFF (%)
J F M A M J J A S O N D


30
25
20
15
10
5
0
PERCENTAGE
PS
BLF(%)
EFF (%)
J F M A M J J A S O N D



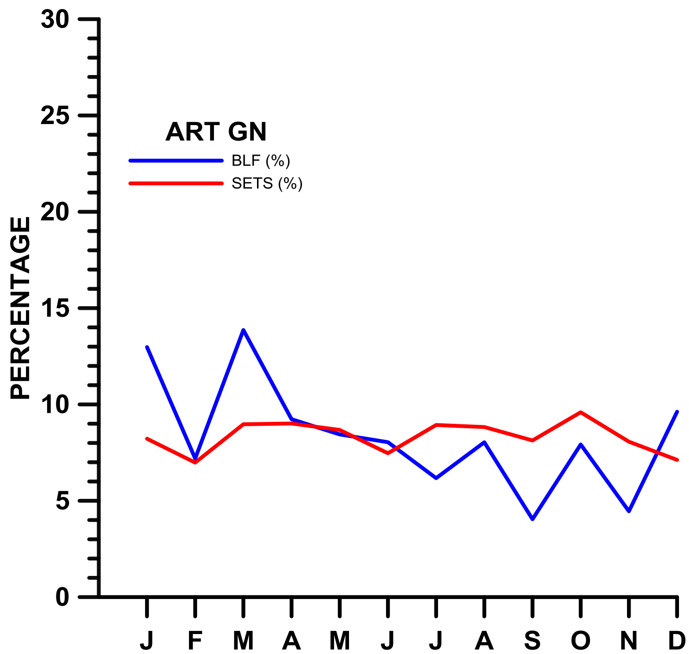
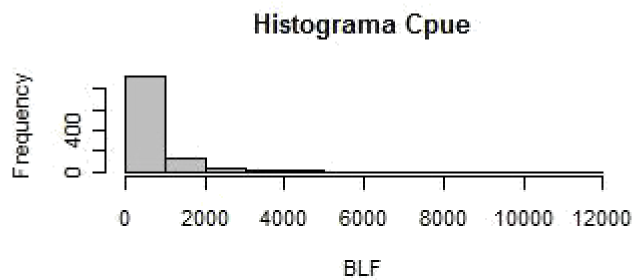
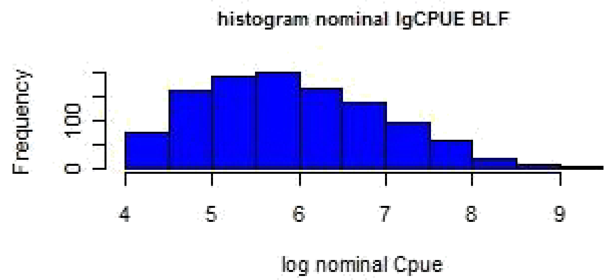
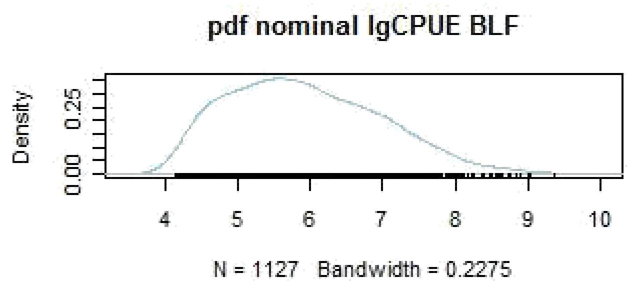
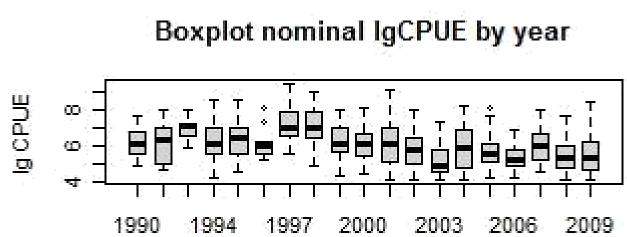




**Figure 2. Cumulative monthly blackfin tuna catches and effort from the Venezuelan purse seine (PS), baitboat (BB), artisanal longline (ART LL), and artisanal drift-gillnet fleets (ART GN).**


Histograma Cpue
Frequency
0
400
0
2000
4000
6000
8000
10000
12000
BLF


histogram nominal lgCPUE BLF
Frequency
0
100
4
5
6
7
8
9
log nominal Cpue


pdf nominal lgCPUE BLF
Density
0.00
0.25
4
5
6
7
8
9
10
N = 1127 Bandwidth = 0.2275


Boxplot nominal lgCPUE by year
lg CPUE
4
6
8
1990
1994
1997
2000
2003
2006
2009

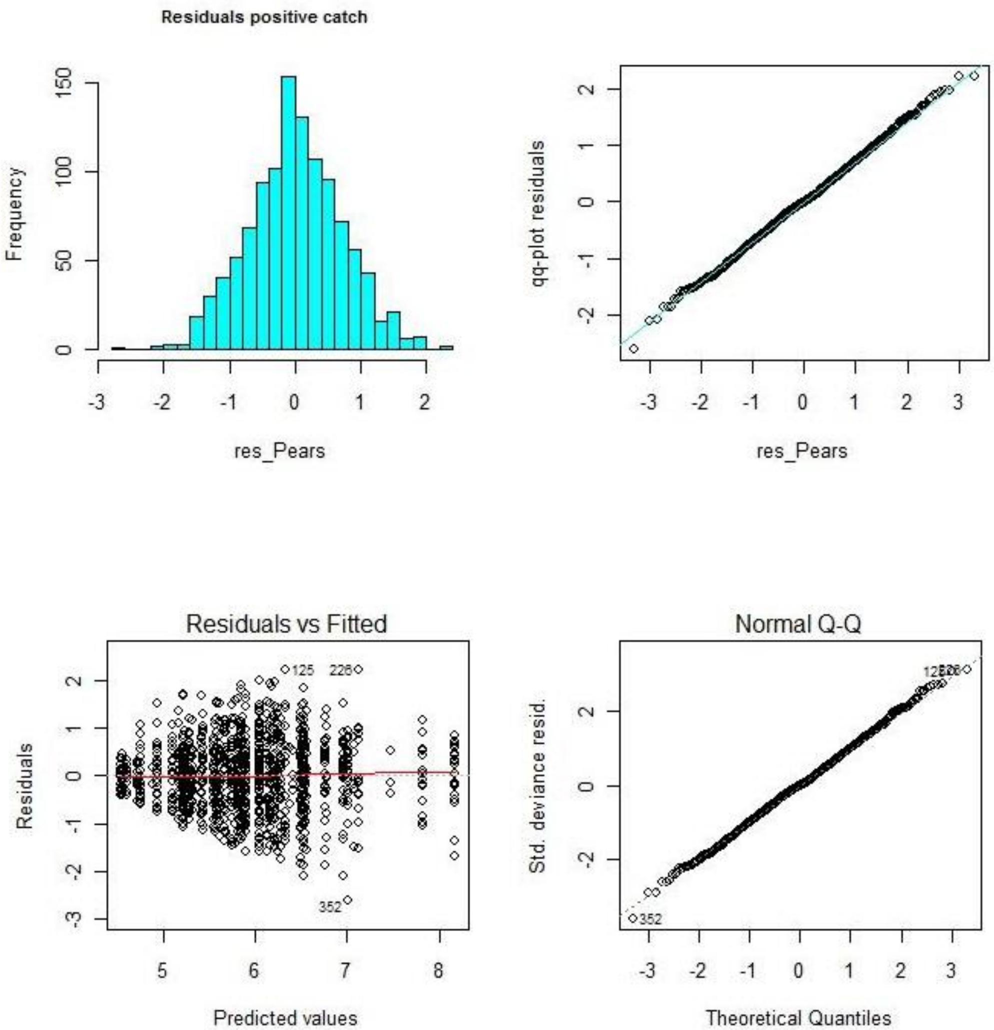



**Figure 3. Exploratory plots for lgCPUE of blackfin tuna (right panel) and diagnostic plots of residuals from the GLM of lgCPUE (left panel).**

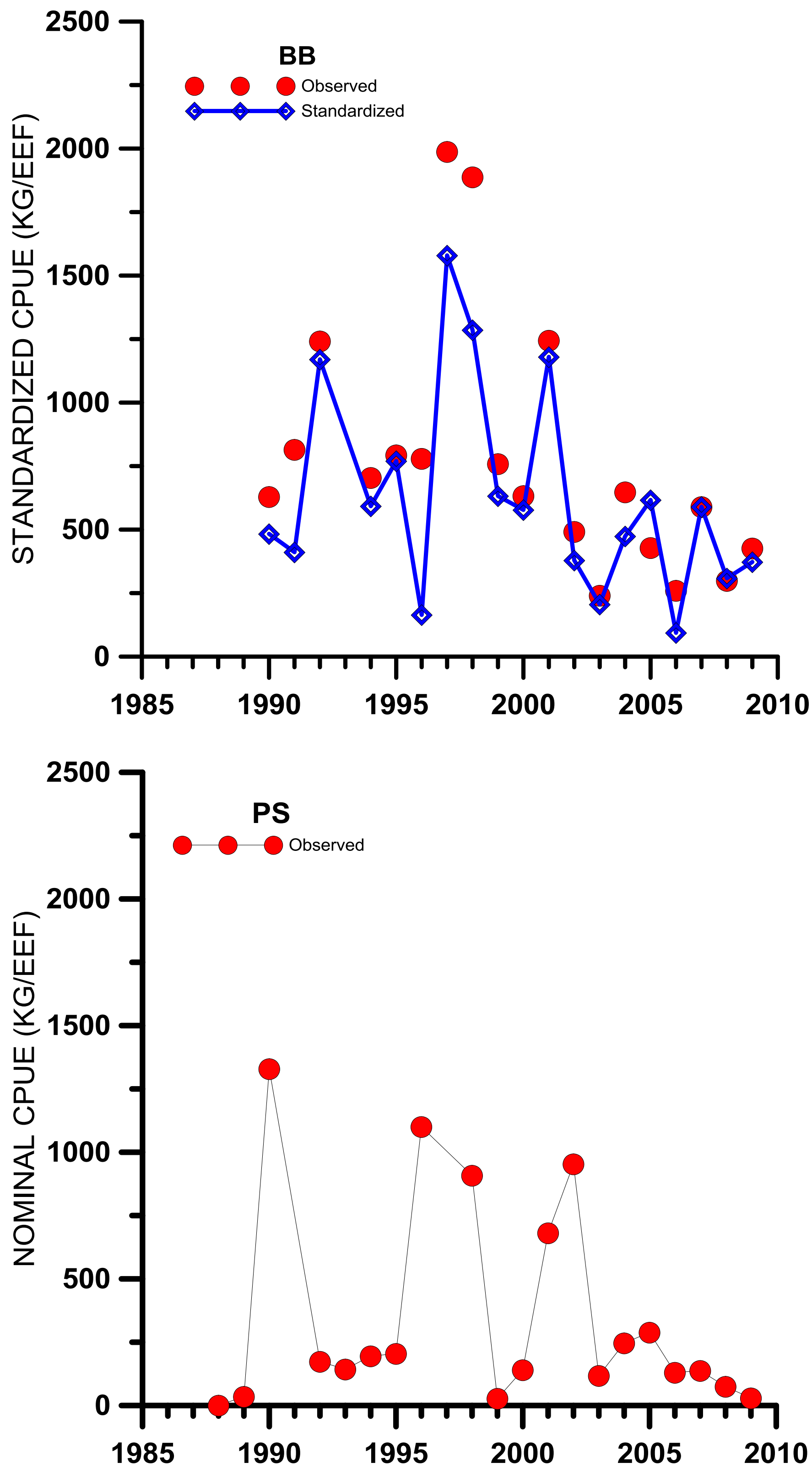
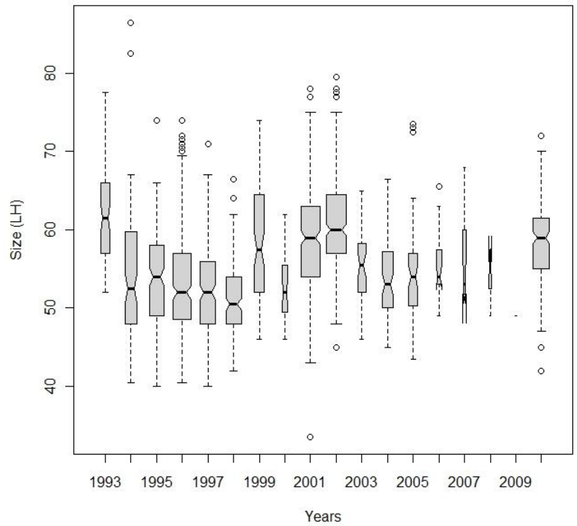
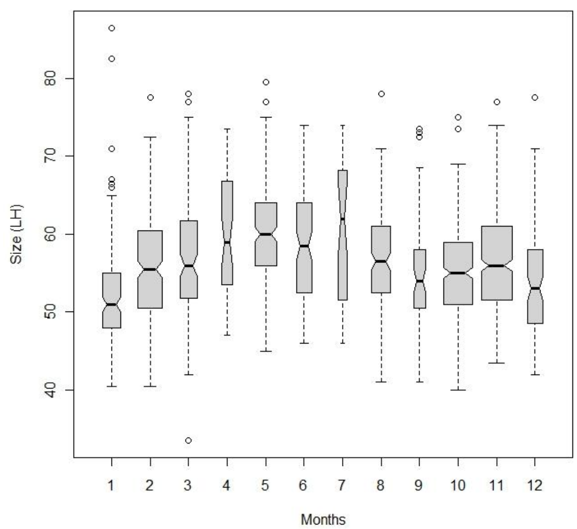



**Figure 4. Standardized indices of relative abundance of blackfin tuna from the baitboat (BB) fleet, and nominal catch rates of blackfin tuna from the purse seine (PS) fleet.**

**BB**

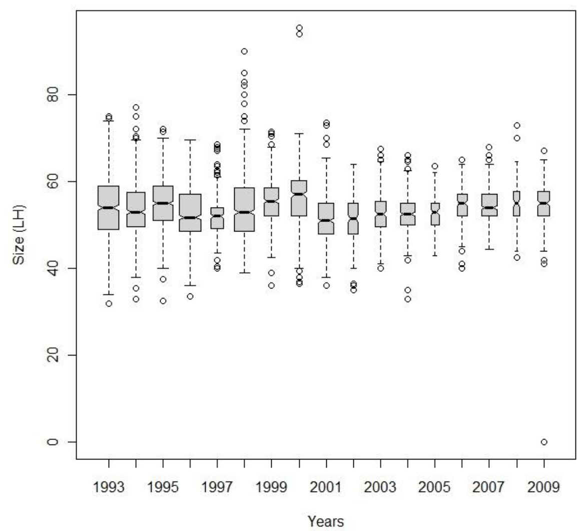


Size (LH)
40
50
60
70
80
1993
1995
1997
1999
2001
2003
2005
2007
2009
Years

Size (LH)
40
50
60
70
80
1
2
3
4
5
6
7
8
9
10
11
12
Months

**PS**



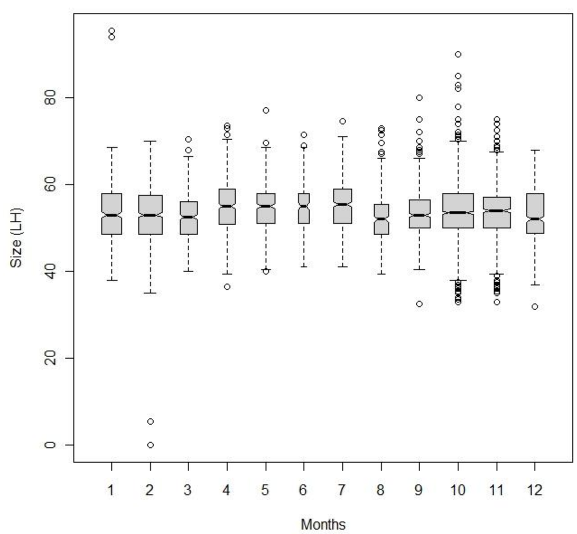
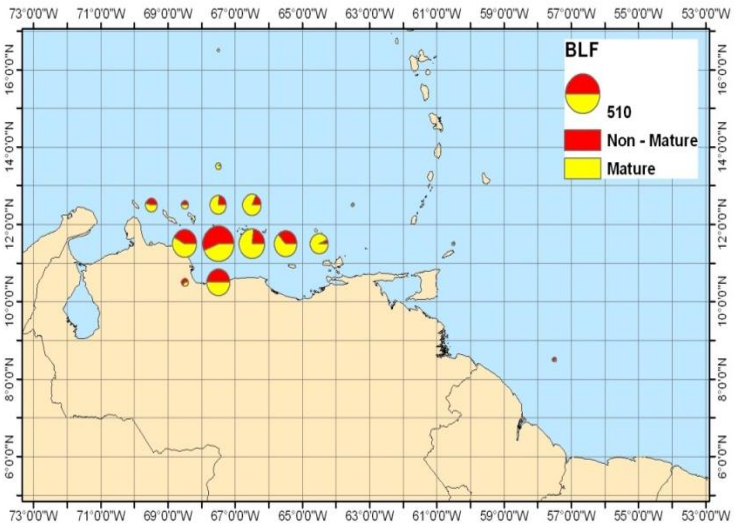
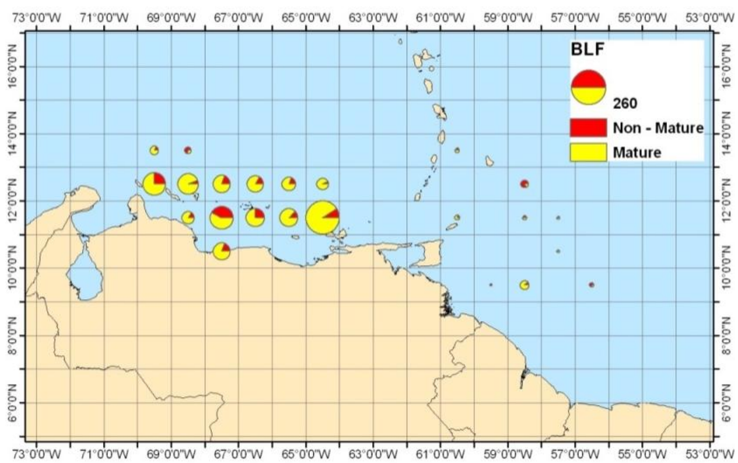




**Figure 5. Annual and cumulative monthly size structure of sampled catch of blackfin tuna from the Venezuelan industrial surface fleets, baitboat (BB) and purse seine (PS).**

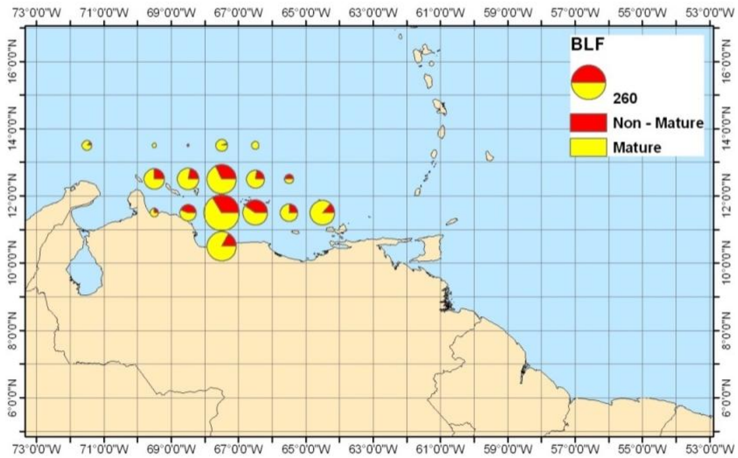
**Q1**




**Q2**



**Q3**




**Q4**

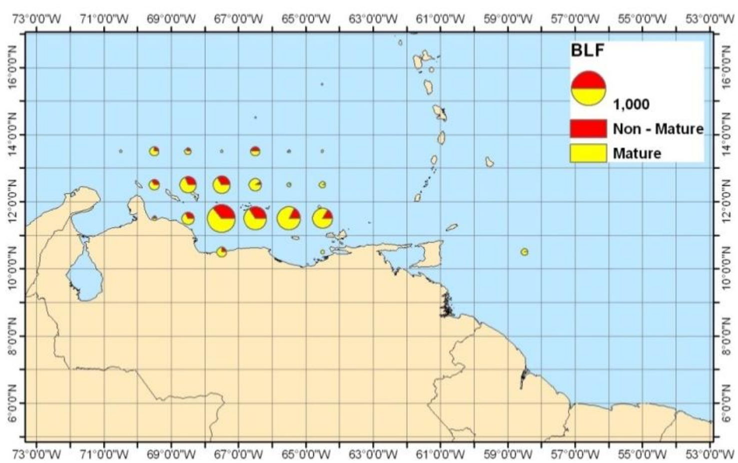



**Figure 6. Temporal and spatial distribution of non-mature (<50 cm FL) and mature (>50 cm FL) blackfin tuna sampled catch from the combined Venezuelan industrial surface fleets.**