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CRFM Fishery Report - 2010

Volume 1

Report of Sixth Annual CRFM Scientific Meeting - St.Vincent and the Grenadines, 07-16 June, 2010

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Foreword

The Sixth Annual Scientific Meeting took place during 07-16 June 2010 in Kingstown, St. Vincent and the Grenadines. During this Meeting, CRFM Resource Working Groups examined data from the following fisheries: the reef fisheries of Montserrat, especially the red hind (*Epinephelus guttatus*) and queen triggerfish (*Balistes vetula*) fisheries; and the dolphinfish fishery of the Eastern Caribbean. The LPWG also reviewed blackfin tuna data available from the ICCAT database, and discussed country-specific details of landings information.

An inter-sessional plan for the bio-economic study of the Eastern Caribbean flyingfish fishery was developed by the SCPWG. The CLWG and the SGWG did not meet in 2010; however an inter-sessional study on the economics of the queen conch fishery in the Turks and Caicos Islands was completed during this Meeting. Inter-sessional studies completed for the Eastern Caribbean flyingfish fishery, and the spiny lobster fisheries of Belize and Jamaica under the United Nations University-Fisheries Training Programme in Iceland were also presented and discussed at the Meeting.

The first formal meeting of the Working Group on Data, Methods and Training (DMTWG) was convened, during which a 1½-day basic training course in the use of R (statistical software) was successfully conducted. A plenary session was also held to review and discuss issues and recommendations pertaining to data, methods and training, as well as identify inter-sessional activities for the DMTWG.

The Report of the Sixth Annual Scientific Meeting is published in two Volumes: Volume 1 contains the proceedings of the plenary sessions and the full reports of the CRFM Resource Working Groups for 2010. Six national reports were submitted for consideration by the Sixth 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, Mr. Derrick Theophille and Dr. Susan Singh-Renton. These contributions are gratefully acknowledged.

Contents

List of Acronyms and Abbreviations

ACP	-	African, Caribbean and Pacific states
CARICOM	-	Caribbean Community
CECAF	-	Commission for the Eastern Central Atlantic Fisheries
CFF	-	Caribbean Fisheries Forum
CFMC	-	Caribbean Fishery Management Council
CLME	-	Caribbean large Marine Ecosystem
CLWG	-	Conch and Lobster Resource Working Group
CNFO	-	Caribbean Network of National Fisherfolk Organizations
CPUE	-	Catch Per Unit of Effort
CRFM	-	Caribbean Regional Fisheries Mechanism
DECR	-	Department of Environment and Coastal Resources
DMTWG	-	Data and Methods Working Group
EBM	-	Ecosystem Based Management
EEZ	-	Exclusive Economic Zone
EU	-	European Union
FAD	-	Fish Aggregating Device
FAO	-	Food and Agriculture Organization of the United Nations
FMP	-	Fisheries Management Plan
GAM	-	General Additive Models
GLM	-	General Linear Models
ICCAT	-	International Commission for the Conservation of Atlantic Tunas
IFREMER	-	Institut Français de Recherche pour l'Exploitation de la Mer
IMA	-	Institute of Marine Affairs
LPWG	-	Large Pelagic Fish Resource Working Group
LRS	-	License and Registration System
MEY	-	Maximum Economic Yield
MSY	-	Maximum Sustainable Yield
NGO	-	Non Governmental Organization
NMFS-SEFSC	-	National Marine Fisheries Service – South East Fisheries Science Center
NW	-	North West
REEF	-	Reef Environmental and Education Foundation
RSWG	-	Reef and Slope Fish Resource Working Group
SAFMC	-	South Atlantic Fishery Management Council
SAP	-	Strategic Action Plan
SCPWG	-	Small Coastal Pelagic Fish Resource Working Group
TAC	-	Total Allowable Catch
TCI	-	Turks and Caicos Islands
TDA	-	Transboundary Diagnostic Analysis
TIP	-	Trip Interview Programme
TRP	-	Target Reference Point
UNU-FTP	-	United Nations University – Fisheries Training Programme
USA	-	United States of America
UWI	-	University of the West Indies
VPA	-	Virtual Population Analysis
WCA	-	Western Central Atlantic
WECAFC	-	Western Central Atlantic Fishery Commission

PART I – Report and Proceedings of the Plenary Sessions

1. Opening of the Meeting

Mr. Leslie Straker, a senior fisheries officer of the Fisheries Division of St. Vincent and the Grenadines chaired the opening ceremony, which commenced with a prayer offered by Mrs. June Masters of the CRFM Secretariat.

Following the opening prayer, Mr. Straker asked participants to observe a minute of silence in recognition of the recent passing of Mr. Bisessar Chakalall. Mr. Chakalall had been FAO's representative to the annual scientific meetings since 2008.

Mr. Straker then officially welcomed participants to the Meeting. The Honourable Minister of Agriculture, Forestry and Fisheries in the Ministry of Agriculture, Forestry and Fisheries, St. Vincent and the Grenadines, Mr. Montgomery Daniel, was unable to attend and to deliver the feature address, as scheduled.

Consequently, the CRFM Secretariat's Programme Manager for Research and Resource Assessment, Dr. Susan Singh-Renton, used the opportunity to provide a brief overview of the aims, and achievements of CRFM's annual scientific meetings thus far, as well as the ongoing challenges. Dr. Singh-Renton pointed out that since the commencement in 2004 of CRFM's annual scientific meetings, CRFM fisheries officers had examined data on over 30 fisheries, and developed recommendations for data improvement, additional research and very importantly, improved management of the fisheries concerned. Participants were informed that the annual gathering of scientists was working to broaden its focus, considering not only resource biology and sustainability concerns, but also addressing the social and economic aspects, which are equally as important in developing appropriate management advice. It was noted that steady progress in fisheries management was being made within the CRFM membership, and continued long-term commitment by all stakeholders was required. The arrangements under the CLME were also highlighted. In view of this, during 2010-1011 the scientific meeting would pay special attention to developing fishery status and management advice on dolphinfish, flyingfish, and blackfin tuna.

Additionally, the inputs by various parties in ensuring the meeting's success were gratefully acknowledged, including: the government of St Vincent and the Grenadines; the staff of the St. Vincent and the Grenadines Fisheries Division; representatives from the 11 CRFM Member States in attendance; the consultants; Brazil; Canada; NMFS-SEFSC (USA); IFREMER (Martinique); Orient University (Venezuela); the CNFO; UWI; CRFM Secretariat; and the caterer.

2. Adoption of meeting agenda and meeting arrangements

The chairman invited the meeting to review and adopt the meeting agenda.

Regarding Item 5, it was agreed that the SCPWG report would be presented first, followed by the RSWG report and finally the LPWG report. The chairperson of the SCPWG, Ms. Maren Headley, also advised the Meeting of her preference to have Item 7.3, the inter-sessional study titled 'Economic study of the Eastern Caribbean fourwing flyingfish', presented together with the report of the SCPWG. These modifications were accepted and incorporated into the agenda.

The adopted meeting agenda is given in Appendix 1.

3. Record of participation

The CRFM Secretariat advised that 11 CRFM Member States had participated in this year's scientific meeting sessions. Listed in alphabetic order, these 11 Member States were: Barbados, Belize, Dominica, Grenada, Guyana, Jamaica, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, The Bahamas, and The Turks and Caicos Islands. The representative from The Bahamas had participated in the DMTWG meeting only.

There was also full participation by several observers. Brazil and Canada were formally represented. The following institutions had also sent representatives, with most participating in both working group and plenary meeting sessions: National Marine Fisheries Service – South East Fisheries Science Center (NMFS SEFSC), IFREMER (Martinique), Universidad del Oriente (Venezuela); University of the West Indies (UWI - Cavehill campus).

A list of participants is provided in Appendix 2.

4. Presentation of national (country) reports

The CRFM Secretariat advised that the following countries had submitted national reports for consideration by the 2010 scientific meeting: Belize, Brazil, Jamaica, St. Kitts (of St. Kitts and Nevis), St. Lucia and the Turks and Caicos Islands. These reports are contained in supplement 1 to the report of the present meeting.

It was pointed out that the submission of national reports was decreasing each year. National representatives were urged to make every effort to prepare and submit their national reports on an annual basis. The national reports served to provide important information updates for consideration by the various working groups charged with undertaking fishery assessments and formulating management advice.

5. 2010 Reports of the CRFM Fishery Resource Working Groups

5.1 Small Coastal Pelagic Fish Resource Working Group (SCPWG)

Both the report of the SCPWG and the inter-sessional bioeconomic study of Eastern Caribbean fourwing flyingfish were presented under this agenda item. The detailed report of the SCPWG is provided in Appendix 3, and the corresponding consultant's report is provided in Appendix 8. A written summary of the inter-sessional study follows.

Summary of inter-sessional bioeconomic study of flyingfish in the Eastern Caribbean

Important commercial fisheries for: large oceanic, highly migratory species (e.g. yellowfin tuna, swordfish); more regional large pelagics (e.g. wahoo, dolphinfish); and small pelagics (e.g. flyingfish) all occur within the eastern Caribbean. Numerous fleet types are used; therefore these fisheries can be described as multi-species and multi-gear in nature since gillnets, trolled or stationary hook and line gears or both are used to fish both small and large pelagics during the same trip. Flyingfish and dolphinfish are two species which are usually targeted together. The goal of this project was to develop a bioeconomic model based on the predator-prey relationships among flyingfish, dolphinfish and other commercial fish species in the eastern Caribbean. The model was applied to the management question of whether direct harvest of flyingfish or indirect harvest through converted predator biomass is more profitable, given the low ex-vessel price of flyingfish. The results showed that the benefits obtained from direct harvest of flyingfish were \$1.7 million US. Harvest of the increased predator biomass associated with reduced flyingfish harvest resulted in benefits of $ 474 thousand US. The net benefits represented a loss of $1.3 million US (76%) of what was obtained by direct harvest of flyingfish. It was therefore clear that direct harvest of flyingfish is the better management strategy.

Plenary discussion of SCPWG report and inter-sessional bioeconomic study of eastern Caribbean fourwing flyingfish

The Chairman advised that the table of available data lacked an explanation of the abbreviation 'NA', and that information on management should be included. Regarding the same table, the representative from UWI, Professor Hazel Oxenford, pointed out that the information on available biological data by country in the index was not clear. Additionally, Professor Oxenford reminded the meeting that the 2008 FAO Ad Hoc Working Group on eastern Caribbean Flyingfish had already compiled much of the available data. Dr. Singh-Renton clarified that the purpose of the current table was simply to provide a summary update on the status of data. The representative from Barbados, Mr. Christopher Parker, indicated that the table contained errors with regard to the data from Barbados. Mr. Parker then offered to provide a corrected update for Barbados.

The LPWG consultant, Dr. David Die, thanked the SCPWG chairperson, Ms. Maren Headley, for what he considered to be an interesting presentation. Regarding the inter-sessional study, Dr. Die sought a clarification on the fleet relationships considered for estimating the profits. Ms. Headley confirmed that her inter-sessional study focused on two Barbadian fleets, and that there was an intention to advance the work in the future by including all fleets in the analysis. The SCPWG also intended to examine the relation between dolphinfish fishing activities and those aimed at flyingfish. Dr. Singh-Renton sought and obtained a clarification on the difference between the first and second activities listed in the inter-sessional workplan. Ms. Headley, supported by the SCPWG consultant, Professor Juan Carlos Seijo, noted that the first step was to develop the model for examining the predator-prey relationship of dolphinfish and flyingfish, and then the second step was to estimate the parameters required for the model.

5.2 Reef and Slope Fish Resource Working Group (RSWG)

The detailed report of the RSWG is provided in Appendix 4.

Plenary discussion of report

In examining and interpreting the fishery trends, Dr. Singh-Renton enquired whether the Working Group had considered any data on volcanic activity and its impact on the amount of available reef areas and hence also fishing activity. The consultant for the RSWG, Professor John Hoenig, indicated that spatial data appeared to be limited. Professor Hoenig emphasized that there was a need to quantify fishable habitat, and that the group's report had formulated recommendation to address this need.

Dr. Die noted that the dataset was limited and enquired about the availability of historical data. Professor Hoenig indicated that it was his understanding that data were available for additional years. Mrs. June Masters from the CRFM Secretariat was then able to confirm that Montserrat had data from 1993 onwards. Mrs. Masters indicated that due to limitations in staff and computer resources, Montserrat decided to focus on preparing the most recent 5 years of data for the present scientific meeting. The work of Montserrat was gratefully acknowledged, and Mrs. Masters urged the group to recommend assistance be given to Montserrat to complete data computerization. The RSWG report had already included a recommendation urging that the remaining available data be computerized.

Dr. Singh-Renton sought clarification about the sample size for the beginning of the 2008 year, as this was obviously an incomplete year with respect to data entry and may have been responsible for the observed low value. However, it was confirmed that the data for the month of January 2008 was considered complete enough to be included in the examination of monthly trends.

One of the representatives from St. Vincent and the Grenadines, Mrs. Cheryl Jardine-Jackson, enquired about the necessity of including vessel identification in the dataset submitted for analysis. Professor Hoenig pointed out that if the vessel could be identified through time, then monitoring performance of the same vessel through time would be very informative. One of the representatives from the NMFS-SEFSC, Ms. Nancie Cummings, supported the need to include vessel identifier data, as well as data that would identify the captain or skipper of a vessel, as the captain's skills were a crucial component of vessel catch performance.

Ms. Cummings, who had assisted with the analyses conducted by the RSWG, informed the meeting that all the analyses had been completed using the R software. This therefore afforded the working group members an opportunity to strengthen the R skills learnt during the DMTWG meeting. Moreover, all members of the working group had been involved in carrying out all the analyses possible on the type of data collected by Montserrat.

5.3 Large Pelagic Fish Resource Working Group (LPWG)

The detailed report of the LPWG is provided in Appendix 5, and the relevant consultant's report concerning the recreational study proposal is provided in Appendix 8.

Plenary discussion of report

The representative from the CNFO, Mr. Victory, noted that the 2009-2010 large pelagic fishing season in St. Vincent and the Grenadines had so far been recording lower catches than in previous years: he therefore enquired whether the working group had a possible explanation for this. The chairperson of the LPWG, Mr. Christopher Parker, pointed out that dolphinfish was an annual species, and that notable inter-annual fluctuations were to be expected. Mr. Parker pointed out that as long as there was not a steady decline in catches, the fishery should not be at risk. Dr. Die also made the point that the recent 'bumper catch' years might actually have been the abnormal years. Moreover, it was highlighted that variation in fishing range, environmental factors and recruitment could influence the catches of these fish between years.

Professor Seijo enquired whether there had been a change in the distribution of the species. Dr. Die responded that it was possible that in recent years, dolphinfish had been closer to the islands, as implied when the islands' data had been compared with data from the Venezuelan fishery.

Dr. Singh-Renton sought and obtained confirmation about the inclusion of the Venezuelan trend graphs to support the overall conclusions of the assessment. In addition, Dr. Singh-Renton noted that the list of recommendations was an ambitious one, and that it was important to identify the priorities, and the parties expected to carry out the required tasks. Dr. Die noted that some of the recommendations were blanket recommendations.

Regarding the issue of data availability and accuracy, Dr. Die pointed out that the table included in the report was meant to highlight the gaps in knowledge and was expected to be corrected, with the provision of better data. The table contained data on catch, length frequency and catch rates, and it was agreed that it would be amended before finalization of the report. There was a national level responsibility to provide accurate data in a timely fashion. Dr. Die also reminded the meeting that ICCAT Member States could be urged through ICCAT to provide better data. He therefore suggested that CRFM Member States approach ICCAT for its assistance in obtaining improved blackfin tuna data.

The meeting considered potential major areas of data gaps for blackfin tuna. It was agreed that non-CRFM countries such as Cuba, Dominica Republic and possibly Haiti should be considered.

6. Report of 2010 Meeting of the Working Group on Data, Methods and Training (DMTWG)

The detailed report of the DMTWG is provided in Appendix 6.

Plenary discussion of report

Dr. Die noted that while he agreed that additional training in R was desirable, he highlighted the importance of regular use of R so as to not forget the skills learned. He recommended that the group identify regular (daily) tasks that could be done in R, and perhaps countries were best placed to advise the working group about their regular tasks for which R could be used.

Professor Hoenig agreed that it was important to use R regularly, and confirmed that his course was designed for continued education. The work of the RSWG was used as an example of the analysis of data typically collected by CRFM States. It was noted that theses scripts were available as first steps in the training and use of R and additional scripts for additional analyses could be prepared on request. Mrs. Masters sought and obtained confirmation concerning Professor Hoenig's offer of voluntary assistance with R-trials in the inter-sessional period. Professor Hoenig confirmed that he would be able to handle short queries in the inter-sessional period.

On behalf of Dr. John Nielson, the representative from Canada who was absent for the plenary meeting discussions, the representative from Brazil, Dr. Carolina Minte-Vera, informed the Meeting that there was a commitment from Canada to support fish age and growth studies to be conducted by the IMA growth laboratory. Dr. Steve Campana had been tentatively selected to conduct the training.

The representative from The Turks and Caicos Islands (TCI) raised the issue of the methodology being used for conducting conch visual surveys. The use of the visual survey technique for conch fishery evaluation was popular, but Mrs. Lockhart noted the need to ensure that methodology was consistent across the region. Professor Hoenig then pointed out that the work of the CLWG could be advanced by a detailed review of the goals, design and analysis for conch surveys. The meeting agreed that discussions should be held inter-sessionally to verify whether this was a priority; if so, it should be considered by the DMTWG. Regarding the issue of different survey formats being utilized among countries, Professor Oxenford reminded the meeting about the conch assessment manual prepared by Drs. Ehrhardt and Valle-Esquivel, during the International Queen Conch Initiative. The manual had a comprehensive section on visual surveys and was available on the CFMC website. It was agreed that Member States should engage and work more closely to identify the pertinent issues for data collection studies, as well as to review and consider the methodology presented in the conch assessment manual.

7. Selected Inter-sessional Studies completed during 2009 – 2010

7.1 Economic Study of the Queen Conch Fishery of the TCI

A verbal and written account of an inter-sessional economic analysis of the queen conch fishery of the TCI was presented for consideration by the Meeting. The written account is provided in Appendix 7, and the corresponding consultant's report is provided in Appendix 8.

Plenary discussion of report

Dr. Die enquired whether there was a possible alternative hypothesis for the apparent decline in CPUE after hurricanes. Mrs. Lockhart indicated that the information provided by local fishers was strong to confirm the hurricane effect. Given the decrease in CPUE after the hurricanes, it was suggested that another visual survey be conducted to determine biomass and obtain spatial information on the distribution of conch. The point of including fishers in the survey process was also reinforced.

Professor Hoenig enquired about the setting of the 2008 and 2009 quotas, particularly whether the same model was used to predict future quotas after the hurricane. Mrs. Lockhart confirmed that this was the case. Dr. Hoenig then pointed out that the hurricanes most likely would have caused significant mortality, and therefore the production model should really take this into account. Otherwise, the current production model could be over-estimating biomass, thereby causing the fishery to operate at a level higher than F_{MSY}. Mrs. Lockhart indicated that a precautionary TAC level was being set to address this concern. Additionally, a visual survey was planned for the near future, and this would also help to shed light on the present situation. Nonetheless, Professor Hoenig advised that the situation should be monitored carefully on a monthly basis to determine if catch rates were decreasing, pending acquisition of a full year of data to begin analysis.

7.2 Spiny Lobster Fishery of Belize

A verbal account of an inter-sessional assessment of the spiny lobster fishery of Belize was provided for consideration by the Meeting, and a written summary of this account follows.

Summary

The Spiny lobster (*Panulirus argus*) is the most valuable fishery resource of Belize. The lobster fishery is artisanal and has been conducted under open access for the past 60 years. The majority of lobster is sold as tails to foreign markets and fishing cooperatives are responsible for their export.

The Spiny lobster of Belize was assessed using fishery-dependent lobster tails export data collected from two fishing cooperatives. The Virtual Population Analysis (VPA) or cohort analysis method was used to conduct the assessment in Microsoft Excel. The catches at age (1999 to 2009) values, obtained from the Slicing method, were used as the primary data set in the VPA. The results showed that lobsters catches consist of two age groups (ages 2 and 3), which represent about 98% of catches. The few age groups identified did not allow for an adequate age-based cohort analysis and therefore caution should be observed in the interpretation of results. Declines during the period 1999-2009 were observed for CPUE, stock size and recruitment levels. Also, fishing mortality appears to be high and the fishery could be experiencing some over- fishing. It was therefore thought that a management intervention to reduce fishing effort could benefit the fishery and an increase in the minimum size limit was recommended.

Plenary discussion of inter-sessional stock assessment of Belize spiny lobster fishery

The representative from Belize, Mr. Mauro Gongora, informed the Meeting that a catch share's programme would soon be implemented at Glovers Reef and there had already been a consultation process with the stakeholders, NGO's and the government. He further noted that management was seeking to move to a limited entry lobster fishery. Additionally, Mr. Gongora indicated that there were marine reserves, which represented no-take zones and provided refuge for lobsters, and also the use of SCUBA gear was not allowed.

Regarding the lack of a clear stock recruitment relationship, Professor Seijo suggested that this could be due to the long larval stage of the spiny lobster where recruits originate from the south, while Belize's larvae go to the north. That is to say, the data may not explain the whole picture as a result of some migration of a portion of the stock.

Dr. Hoenig enquired about the source of the terminal F value. Mr. Gongora indicated that given the sensitivity of the result to the terminal F value, different methods were explored, such as estimating the selection pattern, and using the mean F of the last 3 years, and also through use of length-converted catch curve analysis to provide an estimate of Z, which was then used to estimate F. However, Mr. Gongora indicated that there was a minimum tail weight regulation (4 ounces) and that the largest animals were also not caught because of gear restrictions; hence, the full range of carapace lengths were not captured. He advised though that there was a plan to target the larger animals by utilizing traps and deep water transects to collect biological data in the near future.

Professor Hoenig pointed out that if only a portion of the stock is harvested, then the length-converted catch curve method would not be useful. Professor Hoenig suggested that the validation of the model and the terminal F could be considered under the CLWG as a methodological question on how to design a study to account for uncertainty in the stock assessment. Mr. Gongora suggested that there was also a possibility to do so during the upcoming stock assessment programme under the UNU-FTP.

7.3 The Use of Production Models and length Frequency data in Stock Assessments in Jamaican Fisheries – Building on the Caribbean Spiny Lobster Observations

A verbal account of an inter-sessional assessment of the spiny lobster fishery of Jamaica was provided for consideration by the Meeting, and a written summary of this account follows.

Summary

As part of strengthening the capabilities of the Jamaica Fisheries Division to conduct independent stock assessment on possibly all fisheries for which there are available data, length-frequency methods and production models were applied to the spiny lobster fishery.

The four methods applied to the lobster data set included Data Exploration which examined length frequency distributions; fitting the data to surplus production model (Schaefer model) and length-based models (Jones' cohort analysis and the Thompson and Bell prediction model) thereby estimating fishery performance indicators MSY, $B_{(MSY)}$, $F_{(MSY)}$ and E_{MSY}. Given the uncertainties of model outcomes, the effects of alternative management options including those generated by the surplus production model were explored. Data exploration indicated some level of inconsistency with meeting sample targets however, a great portion of landings were below the minimum legal size of 76 mm. Schaefer model for performance indicators estimated MSY at 222 tons, $F_{(MSY)}$ at 0.4 and E_{MSY} at 3529 fishing days. However, forward projections showed that fishing at a fixed catch of 222 t proved to be unsustainable since the estimated biomass was already depleted (that is $B<B_{MSY}$) whereas fishing at the fixed effort of E_{MSY} showed stock recovery within 3 years.

In spite of the various limitations of the models used (such as assumptions about stock structure and uncertainties in landings and CPUE data), it was recommended that Jamaica pay close attention to both the current effort and catch levels imposed on the lobster stock as there appears to be potential dangers for the fishery if these levels of exploitation are continued.

Plenary discussion of inter-sessional stock assessment of Jamaica spiny lobster fishery

The representative from Dominica enquired whether the fishing areas were all off the Pedro bank and if data were being collected from this area. The representative from Jamaica, Mrs. Anginette Murray, indicated that data collection was focused on the shallow southern shelf area around Jamaica. Mrs. Murray pointed out that mainly the industrial fishers operate on the offshore banks and hence it was assumed that the export data were representative of the industrial catches. She indicated that there was a plan to capture the industrial catches directly in the future.

Professor Hoenig noted three requirements for successful application of a production model: a long time series of data, contrast in the data, and multiple cycles. Given that the available data was what one would have to work with, then it was important to explore options for improving the model, such as obtaining independent estimates of biomass from lobster surveys which could be used to compare the model results.

Dr. Die pointed out that a large part of the catch was under-sized. Hence, it was important to examine whether there had been a change in the average size of lobster over time, as growth overfishing could be occurring, as well as recruitment overfishing. Certainly, there is known non-compliance with respect to the size limits.

Mr. Gongora enquired about the measures being taken by the Fisheries Division to address the situation reflected in the recent assessment. Mrs. Murray indicated that the assessment had not yet been discussed in detail within the Fisheries Division, and so to date, no additional actions had been adopted. Mrs. Murray then provided a review of the current measures that included: a minimum carapace length, licences necessity for the industrial fishers and ten nature sanctuaries which were ‘no take’ zones. A quota system was also being considered and there was new legislation which prohibited the storage of lobster during the closed season. The latter had been recommended during a previous scientific meeting. Mrs. Murray further advised that Jamaica was in the process of conducting a lobster ‘casita’ project, in collaboration with Cuba. The casitas were being specifically located in nursery areas that were also protected, and hence offered an opportunity for stock replenish, especially, through growth.

Mr. Gongora acknowledged the effort of the analysis. In general, Mr. Gongora reminded the meeting that the inter-sessional assessments had been completed under the supervision of very experienced stock assessment experts from Iceland. He suggested that the assessments concerned be given serious consideration, and that the scientific meeting should make every effort to ensure that the management recommendations generated reach the decision-makers in a timely fashion.

Dr. Singh-Renton agreed with Mr. Gongora’s intervention, noting that there was responsibility at both the national and regional levels to inform managers and stakeholders of the status of fisheries and management action needs. Fisheries scientists working for national fisheries administrations and authorities had a duty to share the findings of their fishery and stock analyses and the arising management recommendations with managers and all other stakeholders at the national level. At the regional level, the CRFM structure and process already facilitated regular updates of scientific meeting results and recommendations to fisheries directors and from 2010, also to Ministers responsible for fisheries matters. Apart from the formal CRFM structure and process, Dr. Singh-Renton agreed to pursue an alternative option for informing the countries concerned about the assessments and recommendations arising from the work completed during the training attachments in Iceland.

8. Special Lecture – Analysis of Indo-pacific Lionfish: A Model for Range Extension

A verbal account of the proposed doctoral study on lionfish was provided for consideration by the Meeting. A written summary of this presentation follows.

Summary

The invasion of the Indo-Pacific lionfish, *Pterois volitans/miles* complex, in the Western Atlantic and Caribbean, could potentially have far reaching impacts throughout the region. The increased abundance of lionfish, speed of range expansion and voracious appetite of the lionfish has made their presence particularly interesting. *Pterois volitans/miles* have not been well studied in their native Pacific habitat, making their invasion difficult to study. Current research efforts have focused mainly on genetically characterizing their populations, determination of feeding and hunting behavior, identification of possible predators, and investigations of their impact on the ecosystem. Genetic analysis has shown that the haplotypes of individuals found in this region, match the most common haplotypes of individuals found in parts of the Indo-Pacific where the majority of *Pterois sp*. are collected for the aquarium trade. This analysis has helped to fortify the theory of aquaria releases as the most probably vector of invasion.

An important avenue of future research includes modeling of lionfish larval transport to determine patterns of propagation throughout their invaded region. This type of analysis would be used to test multiple hypotheses concerning the mechanisms of larval transport and discovery of the most probable sources and sinks of lionfish larvae. In addition, an analysis of the age structures in spatially distinct locations could help to identify the probable transport pathways, by showing which areas are sources or sinks. Learning more about the rapid spread of lionfish larvae could not only elucidate possible chokepoints in their populations, but may lead to more information about transport corridors available to native fish larvae. Additional studies concerning the effects that lionfish are having on the habitat and food web, as well as the effectiveness of eradication efforts should be undertaken to determine a management scheme that could control the present population and prevent further range expansion.

Plenary discussion of proposed lionfish study

Professor Hoenig enquired whether any thought had been given to the spread of lionfish as a result of adult migration. The presenter, Miss. Dominique Lazarre, a PhD candidate from the University of Miami, indicated that there was a general consensus of opinion that there was high site fidelity by adults and that widespread distribution was most likely due to multiple aquaria releases. Professor Hoenig then suggested that although lionfish appeared to have a limited home range, this could extend during breeding, and the use of satellite tags could be useful in tracking adult movement. Ms. Lazarre advised that the REEF initiative had conducted tagging during lionfish removal programmes, and the results supported the high site fidelity hypothesis. Mrs. Lockhart informed the meeting that lionfish was first recorded in the TCI in 2006, and further indicated that middle-sized fish also appeared to demonstrate site fidelity.

Dr. Singh-Renton enquired about the possible impact of hurricanes on the dislocation and hence spread of lionfish, but Ms. Lazarre indicated that the effects of hurricanes on the dispersal of lionfish were unclear.

Mr. Victory enquired about the impact of lionfish on reef fish populations. Ms. Lazarre indicated that during a lionfish study in 2008, which involved the removal of lionfish from 5/6 patch reefs, a 70-80% decline of native fish occurred in a five week period. She further noted that lionfish were very voracious and studies had quantified this. Dr. Die noted that the full impact of lionfish was not known, but it was clear that the impact has been significant. Moreover, lionfish did not have any natural predators.

Mr. Gongora noted that the abundance of lionfish was increasing in Belize, as evidenced by reports made by dive tour guides. He also indicated that there were reports that lionfish also ate small lobsters and not just fish. In Belize, the harvest of lionfish was being encouraged, and there was currently a programme for issuing a reward for each lionfish returned to the fisheries department. Mrs. Murray also confirmed that lionfish abundance was increasing in Jamaica, and the national authority was anxious to know how best to address the problem.

Dr. Die noted that there had been international efforts to address the problem, and that harvest of lionfish was being promoted. However, these efforts would not be sufficient to eradicate the lionfish. Dr. Die believed that it would be a good idea if the CRFM could seek to address the lionfish issue at the regional level in view of the fact that the problem had become region-wide.

A cautionary note was provided with regards to the possibility of ciguatera poisoning from this fish. However as the lionfish consumed mainly juvenile fish, the chances of ciguatera were considered low.

The representative of Grenada, Mr. Crafton Isaac, noted that educational materials had been distributed to the local dive charter companies, but little else had been done about lionfish. This was a result of the fact that the consumption of grunts on the reef by the lionfish was highlighted as a problem in Grenada, as the grunts were a major dive attraction. The chairman, Mr. Leslie Straker, informed the Meeting that, like Grenada, educational material on the lionfish had been circulated to the general public.

Professor Seijo enquired about the level of knowledge of the population dynamics of lionfish in its native areas. Ms. Lazzare indicated that, unfortunately, very few such studies had been completed to date, and hence there was limited understanding of lionfish population dynamics.

Mrs. Lockhart enquired about the arrangements to collect the lionfish otoliths. Ms. Lazarre confirmed that she would be responsible for travelling to the various countries, removing the otoliths, and taking them back to the USA. The national representatives agreed that they would give assistance, where possible, in facilitating this study.

9. Inter-sessional Work Plan

9.1 Data Collection, Compilation and Analysis for Proposed 2011 analyses of Dolphinfish and Flyingfish

The working groups presented their inter-sessional plans along with the reports under Item 5. The Meeting agreed the working groups should identify the persons or parties responsible for each proposed inter-sessional activity, and also that time deadlines should be established. The specific details should be reflected in the individual working group reports.

9.2 Fish Age and Growth Research

Dr. Singh-Renton reminded the Meeting of the intervention made earlier by Dr. Minte-Vera on behalf of Dr. John Nielson regarding financial support from Canada to support the age and growth studies in collaboration with the IMA growth laboratory. There was a good possibility that a training attachment would be approved in the near future for a fish age and growth scientist from the IMA laboratory to work with Dr. Steve Campana at his research laboratory in Canada. If so, this activity would take place during the inter-sessional period.

Additionally, Dr. Singh-Renton advised the Meeting that the Caribbean Fisheries Forum had approved the proposal for CRFM to provide some level of sponsorship on a yearly basis to the IMA fish age and growth laboratory to support research requested by the scientific meetings. Hence, national representatives were urged to re-examine and act on the relevant recommendations pertaining to fish age and growth research.

9.3 DMTWG contributions to CRFM Website

The Meeting agreed that a listserve would be established. A layman-friendly publication, aimed at engaging a broader audience on the outputs of Meeting, would be attempted inter-sessionally.

Additionally, it was agreed that the first example for the case-study notebook, would be provided by the TCI (Queen Conch Economic Study). Professor Hoenig confirmed that the R-scripts that he prepared and used in the training sessions could be the first contribution to the CRFM tool box. Dr. Die recommended that the CRFM tool box be linked to other tool boxes e.g. ICCAT or the NMFS-SEFSC, as these websites were well maintained and supported, and repetition should be avoided.

Mr. Gongora used the opportunity to inform the Meeting about two major upcoming activities in Belize: the lobster data collection programme which was expected to involve all of the marine reserves, and the national conch survey which was scheduled to commence in the first week of August 2010.

10. Any Other Business

Mrs. Murray enquired about the timing of the next meeting of the CLWG. In response, Dr. Singh-Renton noted that the CLWG was best placed to determine when it should meet next. Currently, CRFM did not have sufficient resources to facilitate consultant support for all working groups every year. Working groups were therefore advised to maintain regular communication between on-site meetings, so that all concerned could more effectively monitor their inter-sessional work progress, and be in a better position to plan and prepare for on-site meetings.

11. Review and Adoption of Meeting Report

It was agreed to adopt the report of the meeting by e-mail.

12. Adjournment

Dr. Minte-Vera thanked the CRFM for the invitation to the Meeting. She commended the Meeting for its achievements with regard to both capacity building and technical outputs, and noted that the scientific meeting was doing important work. Dr. Minte-Vera indicated that, on her return to Brazil, she would report on the region's work and progress, expressed her desire to continue the collaboration that has begun under the new Ministry of Fisheries.

The representative from Venezuela, Dr. Freddy Arocha, also expressed his thanks to the CRFM Secretariat for the invitation to participate in the Meeting, and indicated that sharing the data was a useful exercise. Dr. Arocha said that he also looked forward to future collaboration with the CRFM.

Both Dr. Die and Professor Hoenig thanked the CRFM for their invitations to participate, and indicated it was a successful meeting.

On behalf of the NMFS-SEFSC, Ms. Nancie Cummings thanked the Secretariat for the opportunity to be in attendance at the Meeting, and indicated her willingness to continue working with individual national representatives on scientific issues during the inter-sessional period.

The Meeting was adjourned on 16 June 2010 at 4:40 pm.

PART II – Appendices

Appendix 1: Meeting Agenda

I. Meeting of the DMTWG: 7-8 June 2010

II. Individual Resource Working Group Sessions: 9– 15 June 2010

Completion of selected fisheries analyses and assessments and Working Group reports.

III. Formal plenary sessions: 16 June 2010

1. Opening of the meeting.
2. Adoption of meeting agenda and meeting arrangements.
3. Record of participation.
4. Presentation of national (country) reports.
5. 2010 reports of the CRFM Fishery Resource Working Groups (listed in alphabetical order):
    - 5.1 Large Pelagic Fish Resource Working Group (LPWG);
    - 5.2 Reef and Slope Fish Resource Working Group (RSWG);
    - 5.3 Small Coastal Pelagic Fish Resource Working Group (SCPWG).
6. Report of 2010 Meeting of the Working Group on Data Methods and Training (DMTWG).
    - 7. Inter-sessional studies completed during 2009-10:
    - 7.1 Economic study of queen conch fishery of The Turks and Caicos Islands;
    - 7.2 Assessment of spiny lobster fishery of Belize.
    - 8. Inter-sessional workplan.
9. Any other business.
10. Review and adoption of meeting report.
11. Adjournment.

I. Meeting of the DMTWG: 7-8 June 2010
- Training in the statistical software R and its application to fishery analyses will be conducted during this meeting.

II. Individual Resource Working Group Sessions: 9– 15 June 2010
- Planning and completion of selected fisheries analyses and assessments and Working Group reports.

III. Formal plenary sessions: 16 June 2010

1. Opening of the meeting.
   - The plenary meeting sessions will be formally opened by a senior official of the government of St. Vincent and the Grenadines during a short ceremony commencing at 0900h on 16 June 2010.

2. Adoption of meeting agenda and meeting arrangements.
   - The Chairperson will review the agenda and request that it be adopted by the Meeting. The Chairperson will also confirm general meeting arrangements.

3. Record of participation.
   - The CRFM Secretariat will advise the meeting of the participation level for the 2010 Meeting. Participants, wishing to do so, will then be invited by the Chairperson to make brief opening statements. Such statements should be submitted in writing to the Secretariat and will be incorporated into the report of the Meeting.

4. Presentation of national (country) reports.
   - The Secretariat will be asked to list those national reports that have been submitted for consideration by the 2010 Meeting.

5. 2010 reports of the CRFM Fishery Resource Working Groups (listed in alphabetical order):
   5.1 Small Coastal Pelagic Fish Resource Working Group (SCPWG) and Economic study of Eastern
   Caribbean fourwing flyingfish;
   5.2 Reef and Slope Fish Resource Working Group (RSWG);
   5.3 Large Pelagic Fish Resource Working Group (LPWG).
   - Each Working Group Chairperson will present an overall report of the Working Group's 2010 meeting, including overall findings, recommendations and conclusions.
   - Where relevant, each species rapporteur will also present his/her fishery assessment report for 2010.
   - Following each presentation, the Meeting will be invited to review, discuss, and endorse each report's findings and recommendations.

6. Report of 2010 Meeting of the Working Group on Data Methods and Training (DMTWG).
- The Chairperson of this Working Group will present the report of this meeting for review and adoption.

7. Selected Inter-sessional studies completed during 2009-10:

7.1 Economic study of queen conch fishery of the TCI;

7.2 Spiny lobster fishery of Belize.

- *Verbal presentations will be made of selected inter-sessional studies, to facilitate review and discussion. Written summaries of presentations will be incorporated into the report of the Meeting.*

8. Inter-sessional workplan

8.1 Data collection, compilation and analysis for proposed 2011 analyses of dolphinfish and flyingfish;

8.2 Fish age and growth research;

8.3 DMTWG contributions to CRFM website.

- *The Meeting will review and agree on activities to be undertaken inter-sessionally, allocate tasks and set deadlines for completion of these tasks.*

9. Any other business
- *The Chairperson will address any items identified to be addressed under this agenda item.*

10. Review and adoption of meeting report.
- *The text of the report is reviewed and adopted. If time is limited, the report is to be adopted by email.*

11. Adjournment.
- *The Chairperson will make any necessary closing remarks, and move to adjourn the Meeting.*

LPWG/ SCPWG - Proposed Meeting Agenda

1. Review and adoption of Meeting agenda
2. Review of Working Group's commitments to the CLME project.
3. Review of available new data and information on fishery of interest, including review of national reports, fisheries trends, pertinent technical studies completed to date, and management developments.
4. Review of management objectives and practical management strategies to inform data analyses and assessments for the present meeting.
5. Fishery data preparation, analysis and assessment planning and implementation, and report preparation.
6. Develop inter-sessional work plan.
7. Review and adoption of working group report, and species/ fisheries reports for 2010.
8. Any other business
9. Adjournment.

RSWG - Proposed Meeting Agenda

1. Review and adoption of meeting agenda.
2. General review of fisheries trends throughout the region, including recent developments.
3. Review of available new data and information on fishery to be assessed, including review of national reports, fisheries trends, pertinent technical studies completed to date, and management developments.
4. Review of management objectives and possible management strategies to inform data analyses and assessments for the present meeting.
5. Fishery data preparation, analysis and assessment planning and implementation, and report preparation.
6. Review and adoption of working group report, including species/ fisheries reports for 2010.
7. Any other business
8. Adjournment.

Working Group on Data, Methods and Training (DMTWG) - Proposed Meeting Agenda

1. Opening of meeting.
2. Review and adoption of meeting agenda
3. Training in R.
4. Plenary session to review and discuss issues and recommendations pertaining to:
   4.1 Data;
   4.2 Methods;
   4.3 Training.
5. Any other business.
6. Adjournment.

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Appendix 3: Report of the Small Coastal Pelagic Fish Resource Working Group (SCPWG)

Consultant: Professor Juan Carlos Seijo
Chairperson: Maren Headley (CRFM Secretariat)
Susan Singh-Renton (CRFM Secretariat); Yvonne Edwin (St. Lucia); Chris Parker (Barbados); Harold Guiste (Dominica); Leslie Straker (St. Vincent and the Grenadines); Lionel Reynal (IFREMER)

1. Review and Adoption of Meeting Agenda

The Meeting was opened by Professor Seijo and the group adopted the agenda without any changes.

2. Review of the Working Group's Commitments to the CLME Project for Flying fish

The overall objective of the Caribbean Large Marine Ecosystem and Adjacent Regions (CLME) Project is the sustainable management of the shared living marine resources of the CLME and adjacent areas through an ecosystem-based management (EBM) approach. Under the Terms of Reference for TDA Gap Filling Activities and SAP for the Shared Stocks of the Eastern Caribbean Flyingfish Fishery, specific objectives and activities that will contribute to the TDA and for which CRFM has the overall responsibility are:

1. Improvement of availability of data and information including catch/effort information, in the Eastern Caribbean taking into account long lining and mixed landings;
2. Bioeconomic studies of the fishery to establish the bioeconomic criteria and set reliable management measures for the fourwinged flyingfish;
3. Assessment of species interaction between flyingfish and large pelagic fishes to provide for these in management using EBM principles; and
4. Assessment of economic risk and social impacts to refine the management for the fourwinged flyingfish.

3. Review of New Data and Information, National Reports, Fisheries Trends

Barbados**:** The participant from this country provided a description of how the fishing fleet evolved over time, not only in numbers but also in vessel characteristics and fishing power. The group was informed that data exist from 1949 when comprehensive sampling of the market catches first started, however these data are recorded as total landings and not by individual vessels; detailed trip record data became available from the introduction of TIP/LRS in 1994. The use of inappropriate raising factors in the years prior to 1994 was also highlighted as this resulted in overestimation of landings data.

St. Vincent and the Grenadines**:** The representative from this country pointed out that there was no targeted flyingfish fishery in St. Vincent and the Grenadines and that the annual landings are usually less than 500 kg. In terms of management policy for the resource, flyingfish is considered an underutilized species with the potential for use in the future, especially as a bait species for the longline fleet which consists of ten vessels.

***St. Lucia*:** St. Lucia indicated that computerized data are available for flyingfish from 1981-2009 and fishery operations are concentrated on the West Coast of the island where the fishers are primarily dependent on the small coastal pelagic fishery.

***Dominica*:** The representative from Dominica informed the group that there has been a shift from the flyingfish fishery to the large pelagic fishery within the last eight years due to the development of the FAD fishery. The annual flyingfish landings are less than 900 kg.

***Martinique*:** The representative from the French West Indies presented the group with flyingfish landings and catch and effort data for Guadeloupe (2008) and Martinique (2009). These data are summarised in Table 1.

Table 1: Landings and effort data for the flyingfish fisheries in Guadeloupe (2008) and Martinique (2009).

Metier	**No trips Martinique**	**Martinique 2009 Landings (kg)**	**Martinique 2009 CPUE (kg)**	**No trips Guadeloupe**	**Guadeloupe 2008 Landings (kg)**	**Guadeloupe 2008 CPUE (kg)**
Decked boat				559		
Drifting net Flyingfishes	316	43,439	138			
Drifting net Exocet-High Sea lines	251	11,581	46			
FADs	5,436	1,010	0.2	8,055	88	0.01
High Sea lines	3,658			14,110	248	0.02
other lines	1,864					
other gears	5,210	1173			1,404	
Total estimate		**57,203**			**1,740**	
Low		*19,594*			*1,209*	
High		*114,154*			*2,408*	

3.1 Review of Technical Studies and Management Developments

A study entitled, "Harvesting of Flyingfish in the Eastern Caribbean: A Bioeconomic Perspective" was presented to the group (Headley, 2009). Flyingfish and dolphinfish are two species which are usually targeted together by the same vessels, on the same trips, and utilizing different gear. The goal of this project was to develop a bioeconomic model based on the predator-prey relationships among flyingfish, dolphinfish and other commercial fish species in the eastern Caribbean. The model was applied to the management question of whether direct harvest of flyingfish or indirect harvest through converted predator biomass was more profitable, given the low ex-vessel price of flyingfish in comparison to the larger pelagics. The model estimated that benefits obtained from direct harvest of flyingfish were $1.7 million US whereas harvest of the increased predator biomass associated with reduced flyingfish harvest resulted in benefits of $ 474 thousand US. This represented a loss of $1.3 million in net benefits which corresponded to 76% of what was obtained by direct harvest of flyingfish. Therefore it was concluded that direct harvest of flyingfish was the better management strategy.

Comprehensive management methods were also discussed by the group and Professor Seijo delivered a presentation entitled "A Simple Decision Theory Framework to Manage Pelagic Fisheries of the CLME under Possible Effects of Climate Change." The focus of this presentation was a simple approach for dealing with uncertainties in fisheries. This approach involves the use of Monte Carlo methods and decision tables with alternative criteria reflecting different degrees of risk aversion and is summarised in Figure 1.

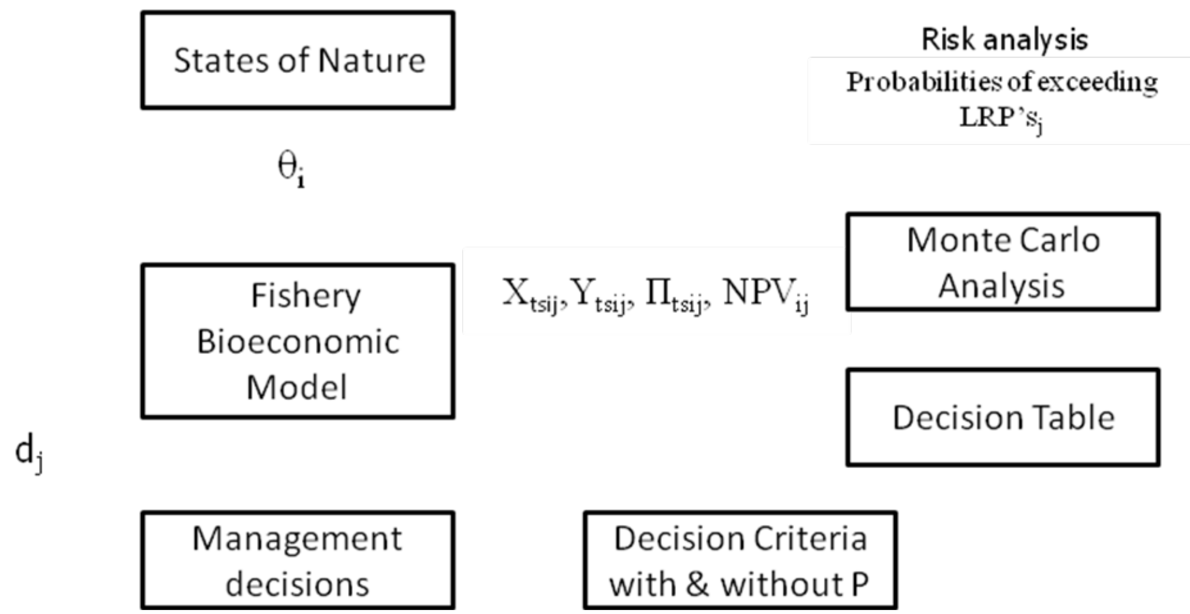

Figure 1: Approach to Developing Decision Tables (Source: Anderson and Seijo, 2010)

4. Review of Management Objectives and Practical Management Strategies

A review of the management objectives for the flyingfish fishery was not conducted; however the group agreed that management strategies must include all the key stakeholders and countries involved in the fishery. The management objectives for this fishery can be found in the Draft Sub-Regional Management Plan for Flyingfish in the Eastern Caribbean (FAO 2009).

5. Fishery Data Preparation, Analysis and Assessment Planning and Implementation

A data form was developed to record the time period for which assorted variables/parameters were available by country (Annex 1). The variables/parameters included raised catch totals, recorded catches, CPUE, length, weight, age, maturity, catchability and fleet sizes.

Flyingfish is a short-lived small pelagic species which is usually sensitive to environmental factors that tend to determine their abundance over space and time, and its fishery is therefore considered as a non-equilibrium one. The ecological interdependence between flyingfish and dolphinfish is also an important aspect for management of these two fisheries. On this note, the group agreed that an Ecosystem Approach to Fisheries was necessary and the steps are described below:

i. define fisheries management questions for the flyingfish fishery and the ecologically inter-dependent dolphinfish fishery in the context of multiple users of the CLME;
ii. identify possible ecological and technological interdependencies among these species within the ecosystem;
iii. select biological/ecological and economic/social performance variables;
iv. define corresponding ecosystem performance indicators for the fishery;

v. establish limit and target reference points for the indicators;
vi. identify alternative management strategies for the fishery within an ecosystem context;
vii. design a dynamic bio-economic model of the ecologically and technologically interdependent fishery;
viii. collect data to estimate model parameters;
ix. identify possible states of nature in uncertain and sensitive parameters;
x. build decision tables and apply decision criteria to deal with risk and uncertainty; and
xi. estimate probabilities of exceeding ecosystem limit reference points (risks) and of achieving desired target reference points.

These ideas are also reflected in the relevant section of the consultant's general report, included in this Volume as Appendix 8 (Seijo, 2010).

6. Inter-sessional Work Plan

The SCPWG agreed that the following tasks would be undertaken during the inter-sessional period:

1. Develop a dynamic bioeconomic analysis for flyingfish (*H. affinis*) and dolphinfish (*C. hippurus*) using existing parameter sets and updated annual catches and effort of countries harvesting these resources.

2. Given the ecological interdependency between dolphinfish and flyingfish, extend the bioeconimic model mentioned under (1.) to incorporate predator-prey relationships and determine the corresponding bioeconomic reference points.

3. Build decision tables for alternative management strategies of this fishery considering the uncertainty in possible states of nature and sensitive biological and economic parameters.

4. Undertake risk analysis of management strategies under consideration.

A summary of the necessary data and information which will be provided by the country representatives is set out below.

i. Heterogeneity of fleets in terms of fishing power and capacity – This will require countries to submit vessel, engine and gear specifications by their major fleets which target flyingfish and will include information on:
   - Fleet type
   - Vessel length (m)
   - Engine size (Hp)
   - Gillnets (average lengths and numbers)
   - Trolling/handline/longline (number of lines and number of hooks)
   - No. of fleets

ii. Compilation of economic data to determine the cost per unit of effort by fleet type – This will include cost information for the following:
   - Average ice cost/unit/trip/
   - Average food cost/unit/trip

iii. Catch and effort data as well as price data – Countries will have to submit catch ad effort (fishing days OR number of fishing trips) data by fleet type for the last five years. In order to calculate total revenue, these data will be necessary for flyingfish, dolphinfish as well as other species targeted during the same trips (e.g wahoo, tunas, sailfish and billfish).

iv. Use of existing population dynamics and ecological dependencies parameters estimated by recent studies for both flyingfish and dolphinfish (FAO, 2008; Mohammed *et al*., 2008; Headley, 2009).

7. Any Other Business

It was agreed that deadlines and contact persons needed to be identified by country.

8. Adjournment

The meeting was adjourned at 5:00 pm on June 15, 2010.

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Oxenford, H. A., R. Mahon and W. Hunte. (1995a) Distribution and relative abundance of flyingfish (Exocoetidae) in the eastern Caribbean. I. Adults. Mar. Ecol. Prog. Ser. 117:11-23.

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Annex 1. Summary of the time periods for which assorted variables/parameters are available for the flyingfish fishery by country.

Country Name	Raised Catch Total	Recorded Catch	CPUE (TRIP)	CPUE (Day)	CPUE (Other)						Catchability (specify unit)			Gear	Notes
						Length	Sex	Weight	Age	Maturity		Size	Type		
Trinidad & Tobago	1988-1997[2]	1974-1984[1] 1988-1997[2]	1979-1982 1988-2010	Likely same as CPUE (trip) as most pirogues make one trip per day; but to be verified by THA	Verify with THA – some data collected on time spent fishing; use of FADs; use of other gear for capture of associated species.	1991-1992; Nov 1996 to Jul 1998 (several gaps in data)	1991-1992; Nov 1996 to Jul 1998 (several gaps in data)	1991-1995; Nov 1996 to Jul 1998 (several gaps in data)	Otoliths from 20 fish examined in 1992	Feb '91 to Jan '92; Nov 1996 to Jul 1998 (several gaps in data)		1993[3]; 2002[4]	1993; 2002		Information in the following documents can be used to estimate catches in 1957: King-Webster, W. A. 1957. Fisheries Department report on the fisheries of Tobago. October 1957. Fisheries Department, Port of Spain, Trinidad, Trinidad and Tobago: 24 pp. King-Webster, W. A. And H. O. Rajkumar. 1958. A preliminary survey of the fisheries of the islands of Tobago. Caribbean Commission Central Secretariat: 19 pp.
Grenada	1978-2007[5]	NA	NA	NA	NA	1988 - 1995[7, 8, 9]	1988 - 1995[7,8,9]	1988 - 1995[7,8,9]	1988 - 1995[7,8,9]	1988 - 1995[7,8,9]		A	A	A	
St. Vincent	1978-2007[5]	NA	NA	NA	NA	1988 - 1995[7, 8, 9]	1988 - 1995[7,8,9]	1988 - 1995[7,8,9]	1988 - 1995[7,8,9]	1988 - 1995[7,8,9]		A	A	A	
St. Lucia	1981-2009[5]	1981-2009	1998-2007[5]	1	Gear	1988 - 1995[7, 8, 9]	1988 - 1995[7,8,9]	1988 - 1995[7,8,9]	1988 - 1995[7,8,9]	1988 - 1995[7,8,9]		A	FRP, Canoes	GNet	
Barbados	1950-1993	1994-2009	1998-2007[5]			1988 - 1995[7, 8, 9]	1988 - 1995[7,8,9]	1988 - 1995[7,8,9]	1988 - 1995[7,8,9]	1988 - 1995[7,8,9]	2000	1994 - 2009			
Martinique	1987, 2009	1987, 2009	1987,		1987,	2008 –	1988 -	2008-2009	1988 -	1988 -			Artisanal,	Troll,	

			2008-09		2008-09	2009[7,8,9]	1995[7,8,9]		1995[7,8,9]	1995[7,8,9]			FAD	Hline	
Guadeloupe	2008	2008	2008	2008		1988 - 1995[7, 8, 9]	1988 - 1995[7,8,9]	1988 - 1995[7,8,9]	1988 - 1995[7,8,9]	1988 - 1995[7,8,9]					
Dominica	1988 - 2007[5,6]	A	A	A	A	1988 - 1995[7, 8, 9]	1988 - 1995[7,8,9]	1988 - 1995[7,8,9]	1988 - 1995[7,8,9]	1988 - 1995[7,8,9]		A	A	A	

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Pandohee, E. (1994). Reports of the Drifting Fishery of Tobago. 1992/93 Fishing Seasons. Report of the Fisheries Division of the Ministry of Agriculture, Land and Marine Resources. St. Clair, Port of Spain, Trinidad, Trinidad and Tobago. 95p.

3. Based on national vessel census

4. FAO. (2002). Report of the Second Meeting of the WECAFC Ad Hoc Flyingfish Working Group of the Eastern Caribbean. Bridgetown, Barbados, 8-12 January 2001. FAO Fisheries Report. No. 670. Rome, 156 p.
5. FAO. (2009). Report of the third meeting of the WECAFC ad hoc flyingfish working group of the eastern Caribbean, Mt. Irvine, Tobago, 21-25 July, 2008. FAO Fisheries Report *in press*, 87pp.
6. Mohammed, E., M. Vasconcellos, S. Mackinson, P. Fanning, S. Heileman and F. Carocci. (2008). A trophic model of the Lesser Antilles pelagic ecosystem. Scientific basis for ecosystem-based management in the Lesser Antilles including interactions with marine mammals and other top predators. FAO/Government Cooperative Programme FI:GCP/RLA/140/JPN Technical Document 2, 168 pp.
7. Oxenford, H. A., R. Mahon, and W. Hunte (1993) eds. The Eastern Caribbean Flyingfish Project. OECS Fishery Report No. 9, 187 pp.
8. Oxenford, H. A., W. Hunte, R. Deane and S.E. Campana (1994) Otolith age validation and growth-rate variation in flyingfish (*Hirundichthys affinis*) from the Eastern Caribbean. Mar. Biol 118: 585-592
9. Oxenford, H. A., R. Mahon and W. Hunte. (1995a) Distribution and relative abundance of flyingfish (Exocoetidae) in the eastern Caribbean. I. Adults. Mar. Ecol. Prog. Ser. 117:11-23.
   Oxenford, H. A., R. Mahon and W. Hunte (1995b) Distribution and relative abundance of flyingfish (Exocoetidae) in the eastern Caribbean. III. Juveniles. Mar. Ecol. Prog. Ser. 117:39-47

Available	A
Not available	NA

Appendix 4: Reef and Slope Fish Resource Working Group (RSWG)

Chairman: Kishmo Clarke (St. Kitts)
Asst. Chair: Anginette Murray (Jamaica)
Consultant: John Hoenig (Virginia Institute of Marine Science)
Nancie Cummings (NMFS, SEFSC- Miami, FL USA)
Other group members:
Mauro Gongora (Belize)
Addevi Persaud (Guyana)
Dominique Lazarre (University of Miami – RSMAS)

A. INTRODUCTION

Inter-sessional tasks identified by the RSWG at the Fifth Annual Scientific Meeting included computerizing of the trip specific landing data for the Montserrat fisheries. These data would be used to develop an analysis set for the Sixth Annual Scientific Meeting. Although only some data were computerized, the RSWG group commenced working with these data. No other data sets were made available for the meeting from other countries until near the end of the meeting when data from Jamaica were obtained. Preliminary work began on the Jamaica data but no results became available to present here. At the opening of the Sixth Annual meeting, the Plenary Chairperson stressed the importance of the various working groups to encourage regional agencies and countries involved in similar work to make their data available in electronic form. The Working Group acknowledges the considerable work that was done by Montserrat to prepare the data.

B. TECHNICAL ANALYSES

1.0 The Red Hind (*Epinephelus guttatus*), Queen Triggerfish (*Balistes vetula)* and other species in the reef and slope fisheries of Montserrat

1.1 Management Objectives

Red hind and Queen Triggerfish are considered as important components of the demersal reef and slope fisheries in Montserrat. The demand for these species has increased over the past five years as compared with other demersal caught species. Five other species are commonly caught with red hind and triggerfish. Consequently, we consider seven species here, the additional species being Longjaw Squirrelfish (*Holocentrus marianus*), Honeycomb Cowfish (*Lactophrys poligonius*), Blue Tang (*Acanthurus coeruleus*), Coney (*Epinephelus fulvus*), and Doctorfish (*Acanthurus chirurgus*).

The Montserrat Fisheries Division has noted the following management objectives for the reef and slope fishery:

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

1.2 Status of Stocks

The statuses of the Red hind and Queen Trigger fish stocks, as well as the additional five species considered here, are currently unknown.

1.3 Management Advice

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

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

1.4 Statistics and Research Recommendations

1.4.1 Data Quality

Several tasks were identified which, if completed during the 2010/2011 intercessional period, should improve the data quality significantly and the management advice generated from analyses of these data.

- The data set was incomplete for 2008 and missing for 2009;
- The information on vessel id should be computerized for each landing record;
- Landings records prior to 2003 should be computerized to extend the time series available for analysis;
- Quality control and assurance protocols should be reviewed to ensure an accurate time series of data;
- The current landings data collection form should be modified to account for discards, spatial area of catch, quantity and type of gear used;
- Develop protocols to improve the timeliness of landings data availability from fishers who may not be accessible during normal working hours;
- Generate preliminary summaries of the computerized data intercessional to use in evaluating the sufficiency of data for future stock assessment evaluations for the multispecies RSF;
- Funding is needed to support these tasks and for the data entry and quality control/assurance;
- The fishable area for the RSF has been reduced in recent years due to volcanic activity; there is a need to quantify the current amount of RSF fishable area and to document any potential ongoing threats (e.g., mud flows, sedimentation) to the marine environment.

1.4.2 Biological data collections

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

- Catch length frequency sampling should be implemented during the 2010/2011 period and continued as an ongoing data collection priority;
- Routine biological data collections (length/weight, maturity, ageing), should be implemented. Species to be studied should be identified during the 2010/2011 intercessional period and should be based on examinations of the landings data. Attention should be given to prioritization of species at both the national and the regional level;

- Information on spawning timing and areas needs to be documented as soon as possible. It is recommended to conduct a survey of the local fishers as a starting point to obtain this information as well as investigate fishing on spawning aggregations;
- Conduct a literature search at the national and regional level to document information on growth, mortality, spawning, maturation, fecundity.

1.4.3 Other data collections

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

1.5 Data Analysis Summary

All but 20 of the landings records were from Carr's Bay. The 20 records from Little Bay were not analyzed. Almost all of the landings were from the reef fishery; the few observations from the coastal pelagic and ocean pelagic fishery were not analyzed. Almost all of the records are from the pot fishery. Catch rates were summarized only for catches from pots.

1.5.1 Red Hind

Seasonal Trends in Catch Rates:

- Red hind sampled landings were mainly from the Reef fishery and from pots (Table 1a)
- Red hind monthly catch rates showed a weak seasonal trend (Figure 1)
- There is the possibly a weak peak for April 2005, however all other four years in the time series do not show the peak
- For the most recent year, 2008, the catch rate is the lowest on record, sample sizes are very low for January and February (n=1 for February)
- Catch rates for 2008 began very low- this suggests a strong need to examine the remainder of the year's data (Tables 1b, 1c)

Annual trends in Catch Rates:

- As shown in Figure 2, the annual average catch rate increased for two years, then declined for two years, and the 2007 trend remains unchanged from 2003.

Table 1a. Number of Red Hind Observations by Fishery and Gear Type

		Gear Type							
Fishery		*BEACH SEINE*	*GILL NET*	*HAND LINE/ BOTTOM/DRIFTLINE*	*POLE & LINE*	*POTS*	*ROD & REEL*	*SPEAR FISHING*	*UNKNOWN*
	COASTAL PELAGIC	19	3	1	0	0	0	0	0
	OCEAN PELAGIC	0	0	1	0	0	0	0	0
	TFREEF	1	0	42	0	1265	0	16	2

Table 1b. Number of Red Hind Observations by Year and Month													
Year	**Month**												
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
	2003	28	23	21	19	25	18	20	27	22	36	16	26
	2004	25	24	22	17	22	19	21	24	31	30	23	23
	2005	21	29	32	24	20	30	25	33	33	21	24	15
	2006	14	22	19	26	25	20	17	12	25	20	21	17
	2007	10	7	10	10	9	11	15	13	14	15	18	6
	2008	11	1	0	0	0	0	0	0	0	0	0	0

Table 1c. Mean landed Weight (g) per trip of Red Hind Observations by Year and Month													
Year	**Month**												
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
	2003	7079	9072	8856	8284	9308	11038	13200	11407	8309	7900	10093	9613
	2004	9943	7541	12515	8965	7278	9764	8424	11850	14705	12761	8007	13194
	2005	9893	9541	10603	19996	11000	12640	16656	13429	11849	18166	13797	11219
	2006	8975	14123	10815	10520	11249	13018	10593	16443	16366	13721	13608	10059
	2007	11748	10368	11204	12020	9626	9402	10100	13782	8230	7832	5998	5821
	2008	5196	6804	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

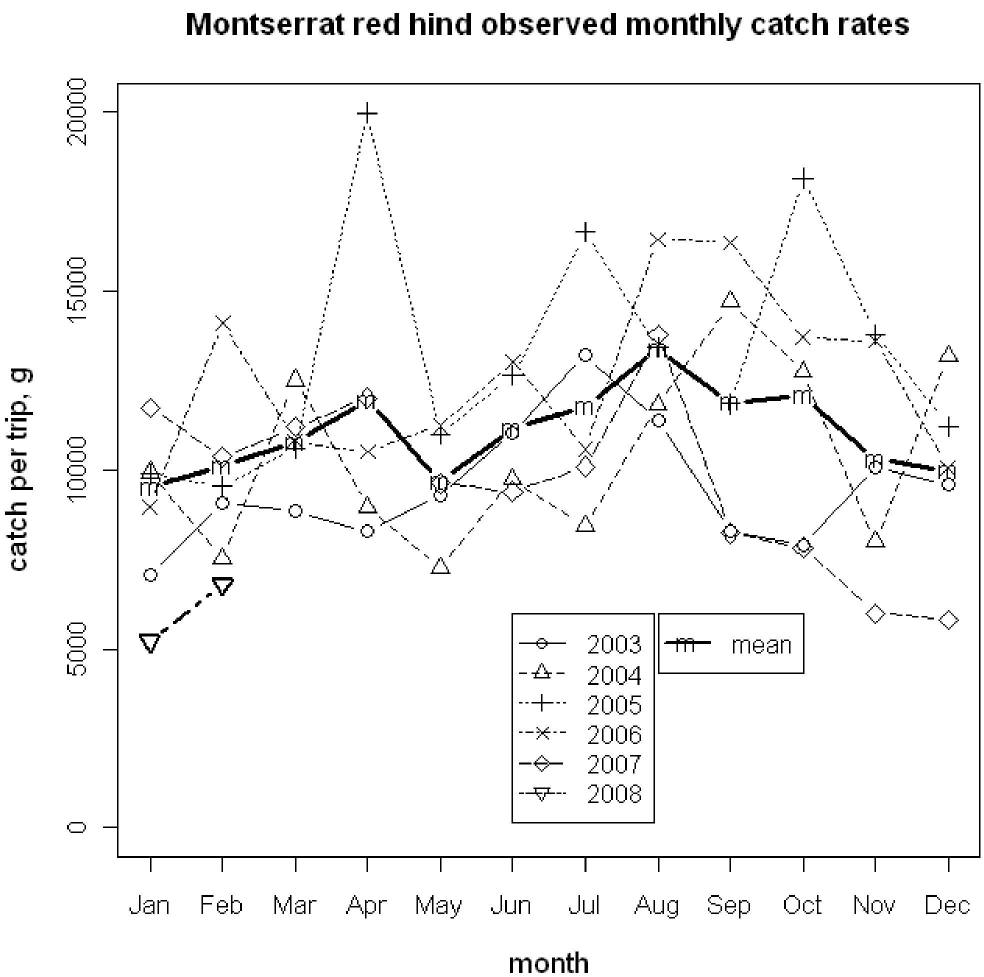

Figure 1. Monthly observed catch rates (grams per trip) by year (2003 - 2008) for Red Hind, Montserrat. The average across all years is shown with the heavyline and symbol=m. Data for 2008 are incomplete and should be interpreted with caution.

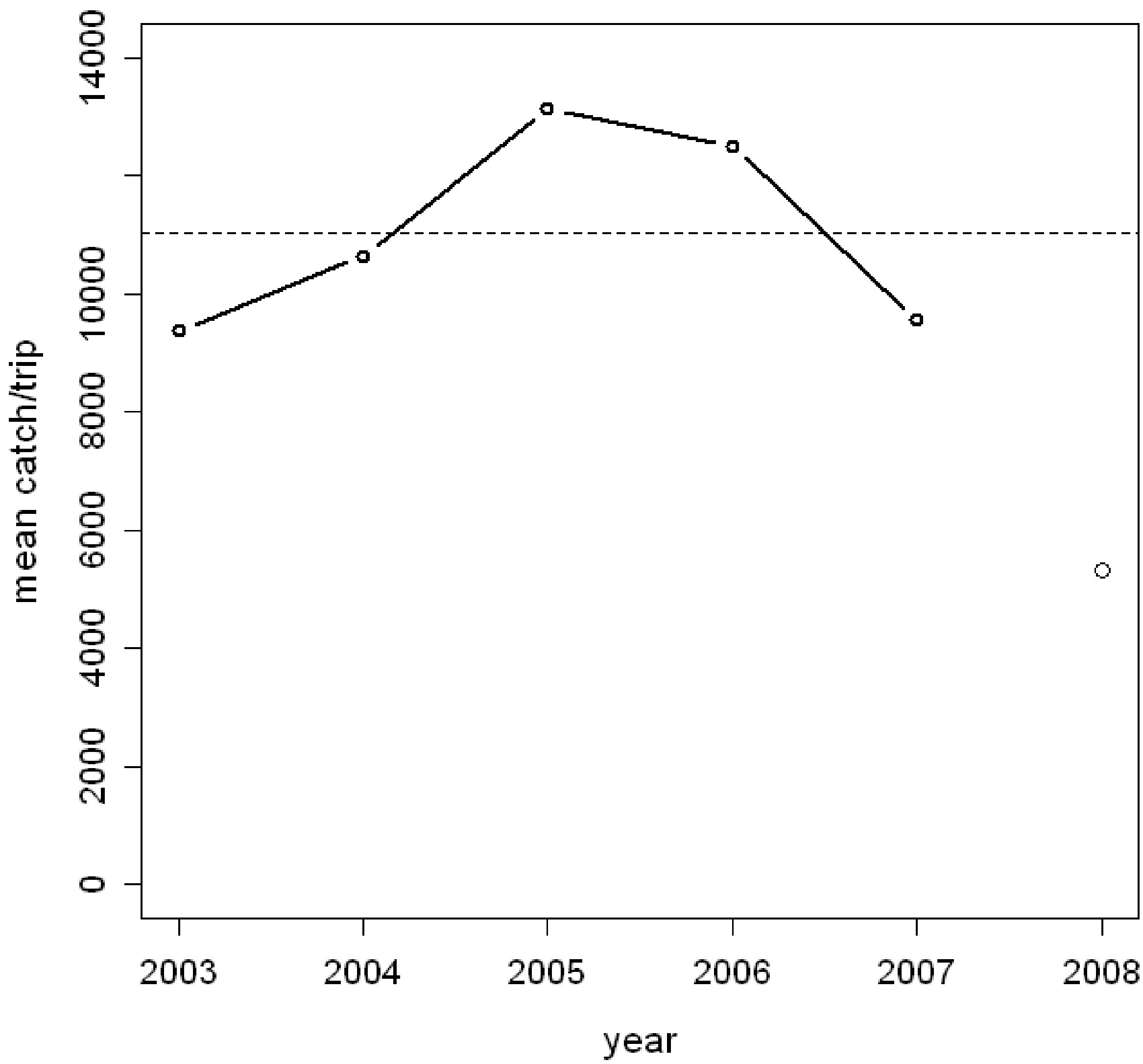

Figure 2. Average annual observed catch rates (grams per trip) for Red Hind, Montserrat. The point for 2008 is based on just two months of data.

1.5.2 Queen Triggerfish

Seasonal Trends in Catch Rates:

- Queen Triggerfish sampled landings were mainly from the Reef fishery and from pots (Table 2a);
- Analysis of monthly catch rates did not reveal any strong seasonal trend (Figure 3);
- The January 2008 catch rate was the lowest on record;
- Sample sizes for 2008 were very low. This in addition to the lowest catch rate on record strongly supports the need for full examination of the 2008 and later data (Tables. 2b, 2c).

Annual Trends in Catch Rates

- Annual Trends in Catch Rates in Queen Triggerfish catch rates did not vary greatly (Figure 4);
- The 2007 annual catch rate was unchanged.

Table 2a. Number of Queen Triggerfish Observations by Fishery and Gear Type

Fishery	Gear Type								
		BEACH SEINE	GILL NET	HAND LINE/ BOTTOM/DRIFTLINE	POLE & LINE	POTS	ROD & REEL	SPEAR FISHING	UNKNOWN
	COASTAL PELAGIC	0	0	0	0	0	0	0	0
	OCEAN PELAGIC	0	0	0	0	0	0	0	0
	TFREEF	1	0	20	0	1185	0	17	2

Table 2b. Number of Queen Triggerfish Observations by Year and Month

Year	Month												
		1	2	3	4	5	6	7	8	9	10	11	12
	2003	29	19	18	18	18	14	17	26	24	33	11	18
	2004	23	19	17	15	20	19	13	19	23	24	20	17
	2005	19	26	34	26	26	31	28	33	27	24	25	18
	2006	14	23	18	25	24	18	16	12	25	20	21	13
	2007	11	7	11	7	10	11	11	17	19	18	22	7
	2008	6	1	0	0	0	0	0	0	0	0	0	0

Table 2c. Mean landed Weight (g) per trip of Queen Triggerfish Observations by Year and Month

Year	Month												
		1	2	3	4	5	6	7	8	9	10	11	12
	2003	6225	6422	6325	6098	7031	6512	7071	8531	6936	6419	6680	11038
	2004	10393	6016	8218	4808	6124	6708	6385	6613	7889	7182	4151	8005
	2005	6637	6734	7765	13172	9229	7858	12587	10708	9811	14383	9108	10786
	2006	8521	10019	9450	10542	9828	10634	7598	13646	10397	9866	8338	8863
	2007	9649	9266	7216	11470	9253	6268	8495	7044	4918	8089	5381	6091
	2008	4385	2722	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

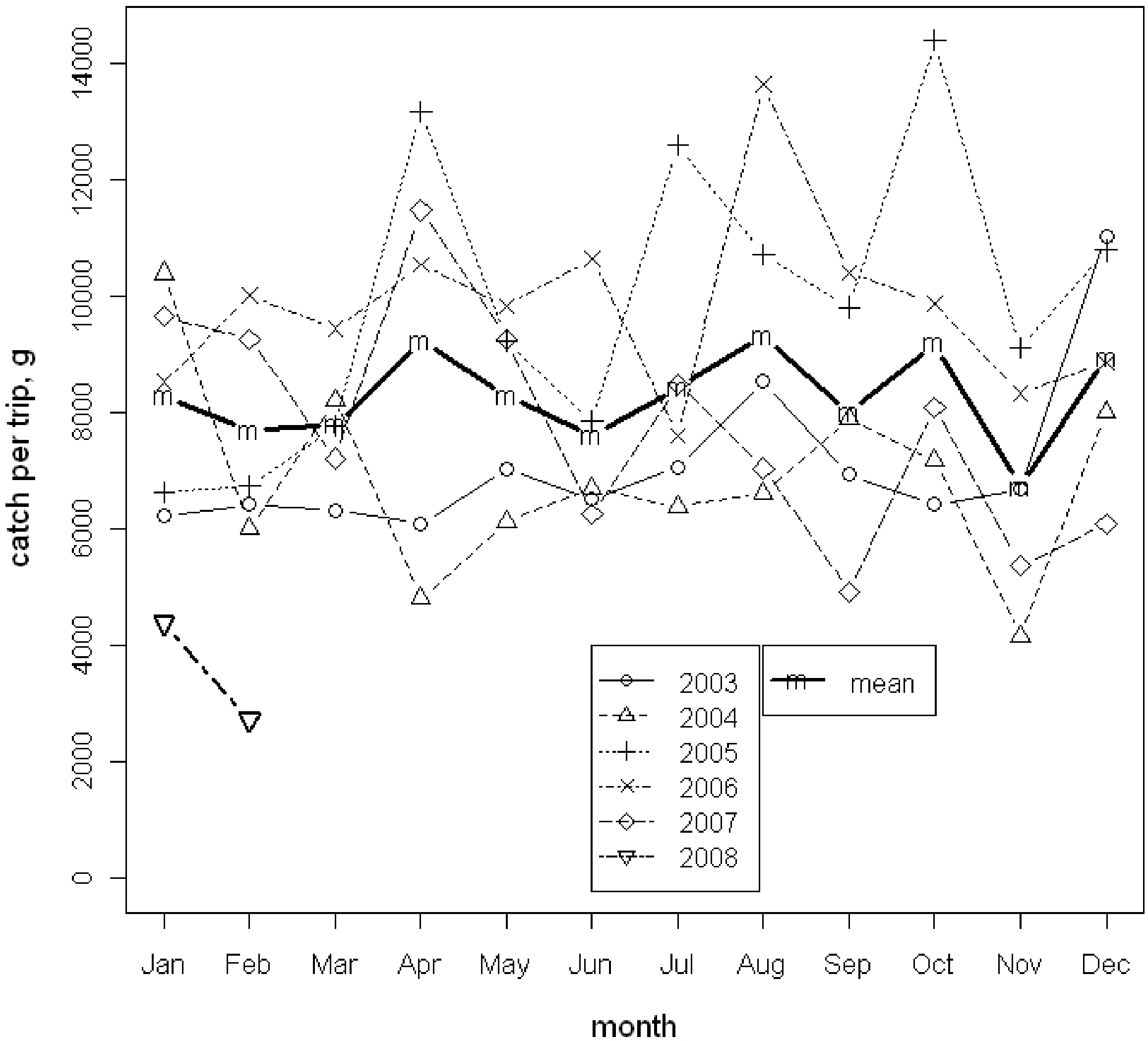

Figure 3. Monthly observed catch rates (grams per trip) by year (2003 - 2008) for Queen Triggerfish, Montserrat. The average across all years is shown with the heavyline and symbol=m. Data for 2008 are incomplete and should be interpreted with caution.

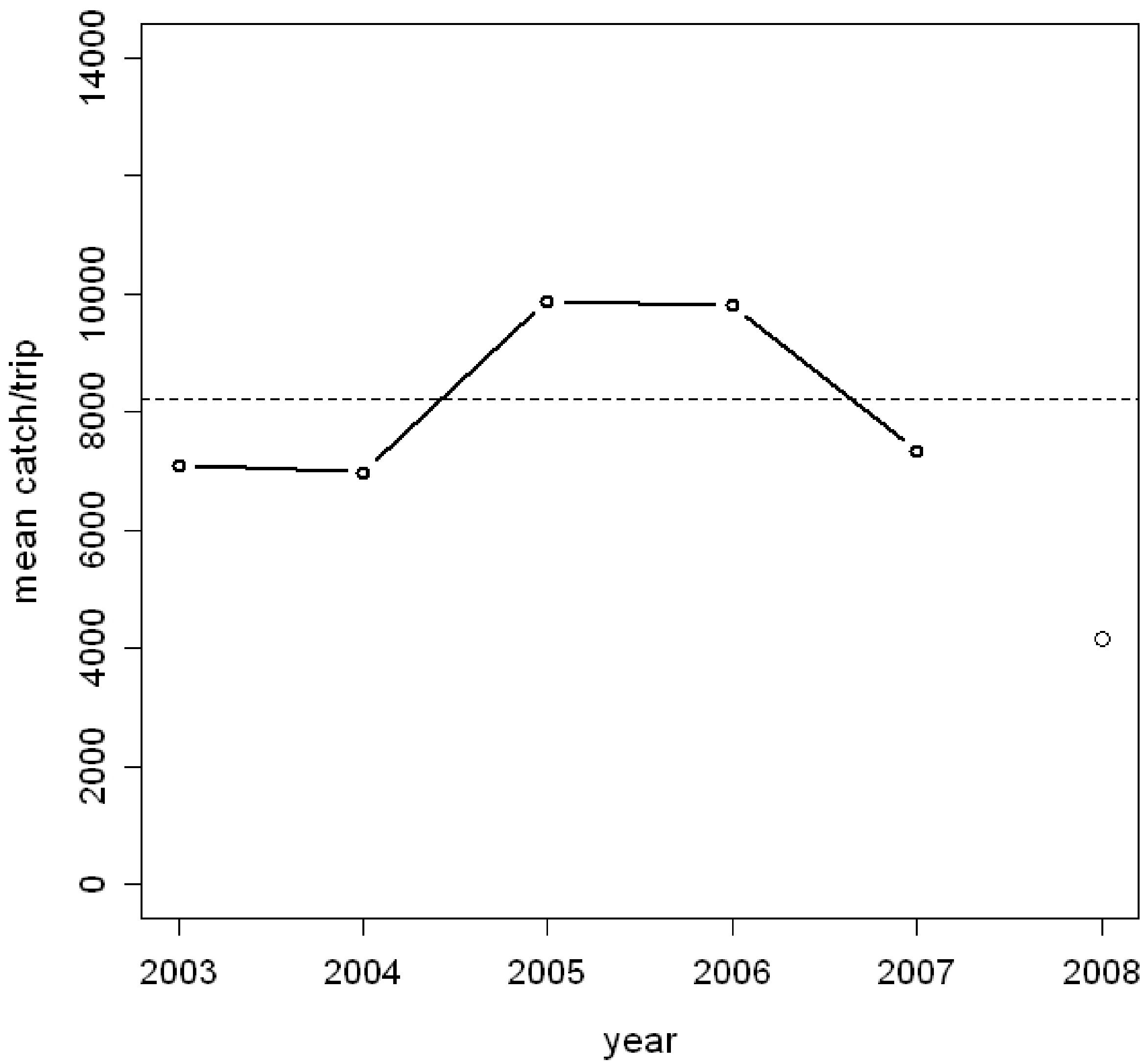

Figure 4. Average annual observed catch rates (grams per trip) for Queen Triggerfish, Montserrat. The point for 2008 is based on just two months of data.

<u>1.5.3 Longjaw Squirrelfish</u>

<u>*Seasonal Trend in Catch Rates*</u>

- Longjaw Squirrelfish sampled landings were mainly from the Reef fishery and from pots (Table 3a);
- Monthly catch rates did not show any seasonal trends (Figure 5);
- The January 2008 catch rate was tied for the lowest on record;
- As with Red Hind and Queen triggerfish sample sizes for 2008 were very low, again supporting the need to further examine the 2008 data and beyond (Tables 3b,3c).

Annual Trend in Catch Rates

The trend in annual catch rate of Longjaw Squirrelfish increased through 2006 and catch rate was close to average in 2007 (Figure 6).

Table 3a. Number of Longjaw Squirrelfish Observations by Fishery and Gear Type									
		Gear Type							
		BEACH SEINE	*GILL NET*	*HAND LINE/ BOTTOM/DRIFTLINE*	*POLE & LINE*	*POTS*	*ROD & REEL*	*SPEAR FISHING*	*UNKNOWN*
Fishery	*COASTAL PELAGIC*	15	2	0	0	0	0	0	0
	OCEAN PELAGIC	0	0	0	0	0	0	0	0
	TFREEF	1	0	19	0	1213	0	19	1

Table 3b. Number of Longjaw Squirrelfish Observations by Year and Month													
		Month											
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
Year	*2003*	31	26	22	14	25	17	21	24	23	33	18	25
	2004	27	31	23	16	24	20	19	21	29	27	21	19
	2005	20	26	35	23	21	28	27	30	30	22	26	18
	2006	17	22	16	26	25	21	15	11	24	21	19	17
	2007	9	3	0	0	0	0	9	16	24	17	21	6
	2008	8	0	0	0	0	0	0	0	0	0	0	0

Table 3c. Mean landed Weight (g) per trip of Longjaw Squirrelfish Observations by Year and Month													
		Month											
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
Year	*2003*	4682	4867	4103	3661	5207	5763	4298	3232	4575	4330	4410	4155
	2004	3427	3278	4023	3629	2240	4445	4966	5659	7868	5309	4450	6422
	2005	5080	5496	5301	7613	4255	4358	5208	4763	4264	5567	5775	6124
	2006	4136	7588	8307	5565	5298	4687	5655	6351	6199	4450	5037	3656
	2007	5242	2117	NA	NA	NA	NA	2974	4706	3421	4963	3521	3175
	2008	3402	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

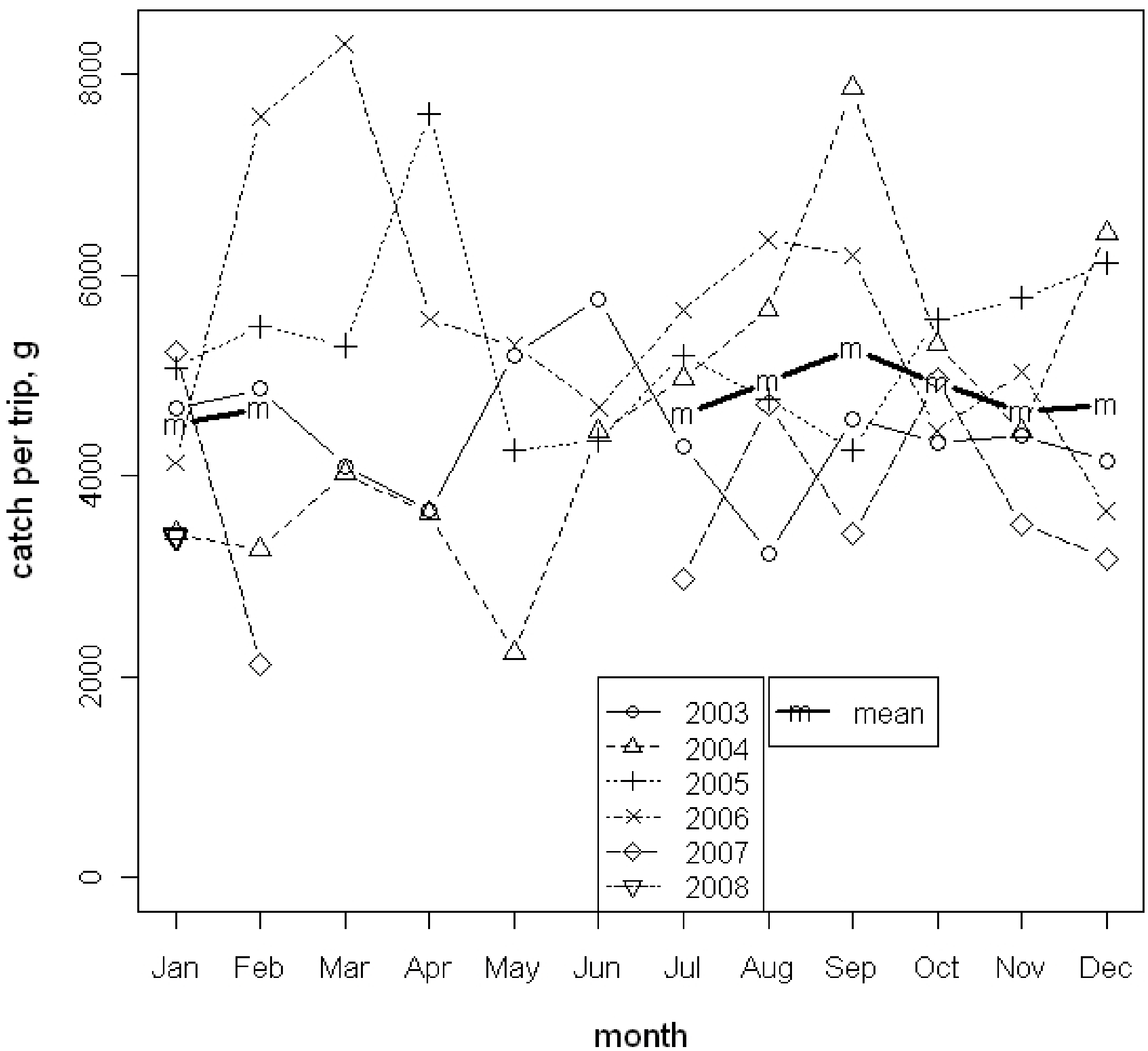

Figure 5. Monthly observed catch rates (grams per trip) by year (2003 - 2008) for Longjaw Squirrelfish, Montserrat. The average across all years is shown with the heavyline and symbol=m.
Data for 2008 are incomplete and should be interpreted with caution.

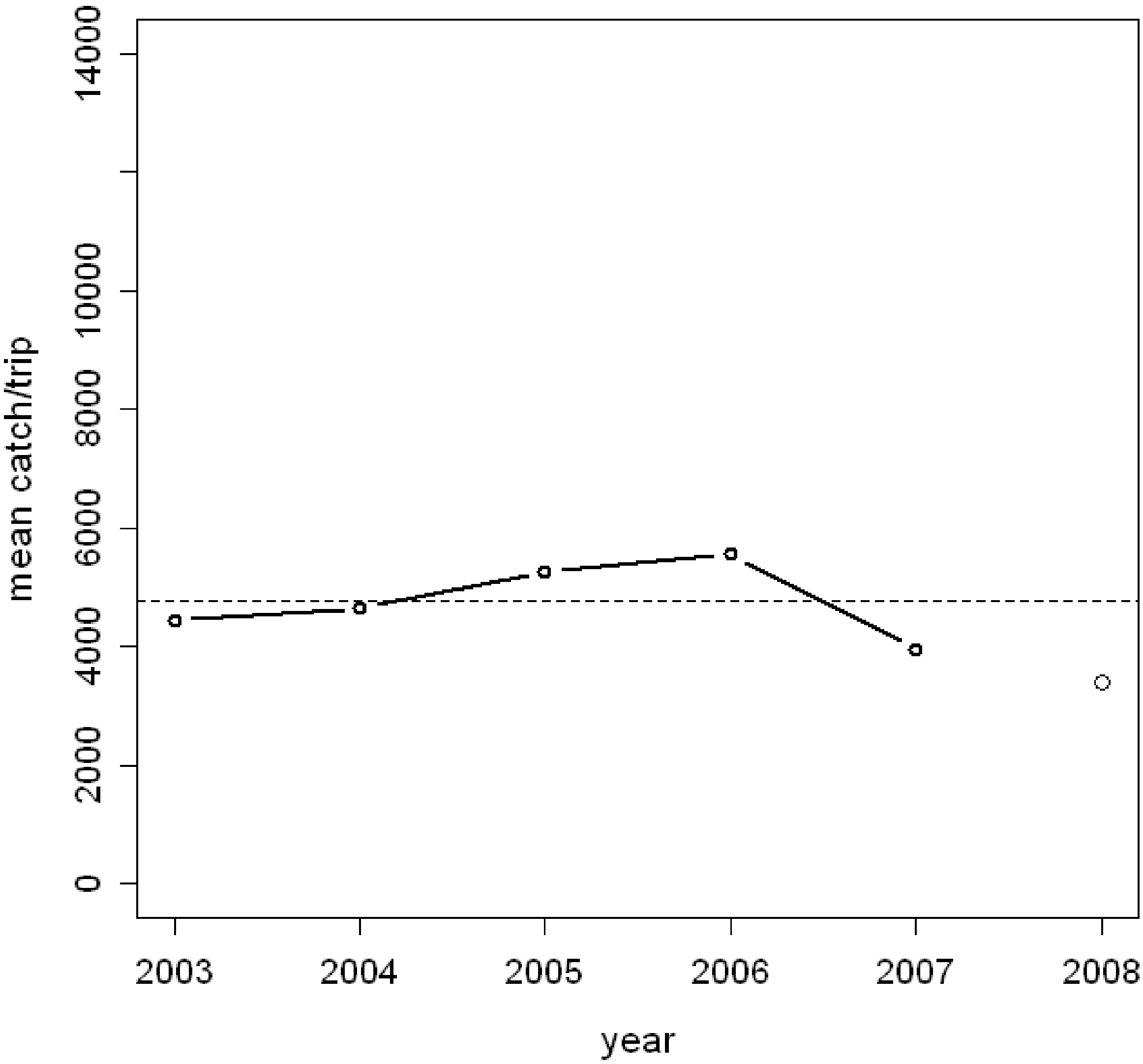

Figure 6. Average annual observed catch rates (grams per trip) for Longjaw Squirrelfish, Montserrat. The point for 2008 is based on just two months of data.

1.5.4 Honeycomb Cowfish

Seasonal Trend in Catch Rates

- Honeycomb Cowfish sampled landings were mainly from the Reef fishery and from pots (Table 4a).
- Monthly catch rates did not show seasonal trends in mean weight landed per trip of Honeycomb cowfish (Figure 7).
- The 2008 January monthly catch rate is above the long term mean, this represented 11 trips.
- February 2008 catch rate represented one data point (1 trip) (Tables 4b, 4c).

Annual trend in Catch Rates

- The trend in catch rates is up (Figure 8).
- Caution should be used in interpreting trends as sample sizes are low for the last two years of the data set (2007, 2008).

Table 4a. Number of Honeycomb Cowfish Observations by Fishery and Gear Type									
Fishery		**Gear Type**							
		BEACH SEINE	*GILL NET*	*HAND LINE/ BOTTOM/DRIFTLINE*	*POLE & LINE*	*POTS*	*ROD & REEL*	*SPEAR FISHING*	*UNKNOWN*
	COASTAL PELAGIC	0	0	0	0	0	0	0	0
	OCEAN PELAGIC	0	0	0	0	0	0	0	0
	TFREEF	0	0	6	0	988	0	12	1

Table 4b. Number of Honeycomb Cowfish Observations by Year and Month													
Year		**Month**											
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
	2003	16	10	10	13	20	13	14	23	21	25	15	18
	2004	22	22	23	14	15	17	17	16	16	23	19	18
	2005	16	23	27	20	23	24	27	25	22	19	20	12
	2006	12	20	19	18	13	16	13	11	9	15	15	14
	2007	8	3	4	8	12	8	6	11	20	17	14	4
	2008	11	1	0	0	0	0	0	0	0	0	0	0

Table 4c. Mean landed Weight (g) per trip of Honeycomb Cowfish Observations by Year and Month													
Year		**Month**											
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
	2003	4536	3810	5126	4683	5715	4536	6059	5325	5745	5697	5655	7409
	2004	7835	6309	6903	5670	6018	5630	6084	5301	5727	4911	4321	7963
	2005	6606	8658	7661	8845	8047	7881	10399	8455	9505	10218	9095	8959
	2006	8581	12315	12223	10055	8095	9129	10014	9361	10584	9767	10796	9590
	2007	11057	9828	10093	6691	8543	8675	14364	5938	4581	5176	9558	17577
	2008	9154	4536	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

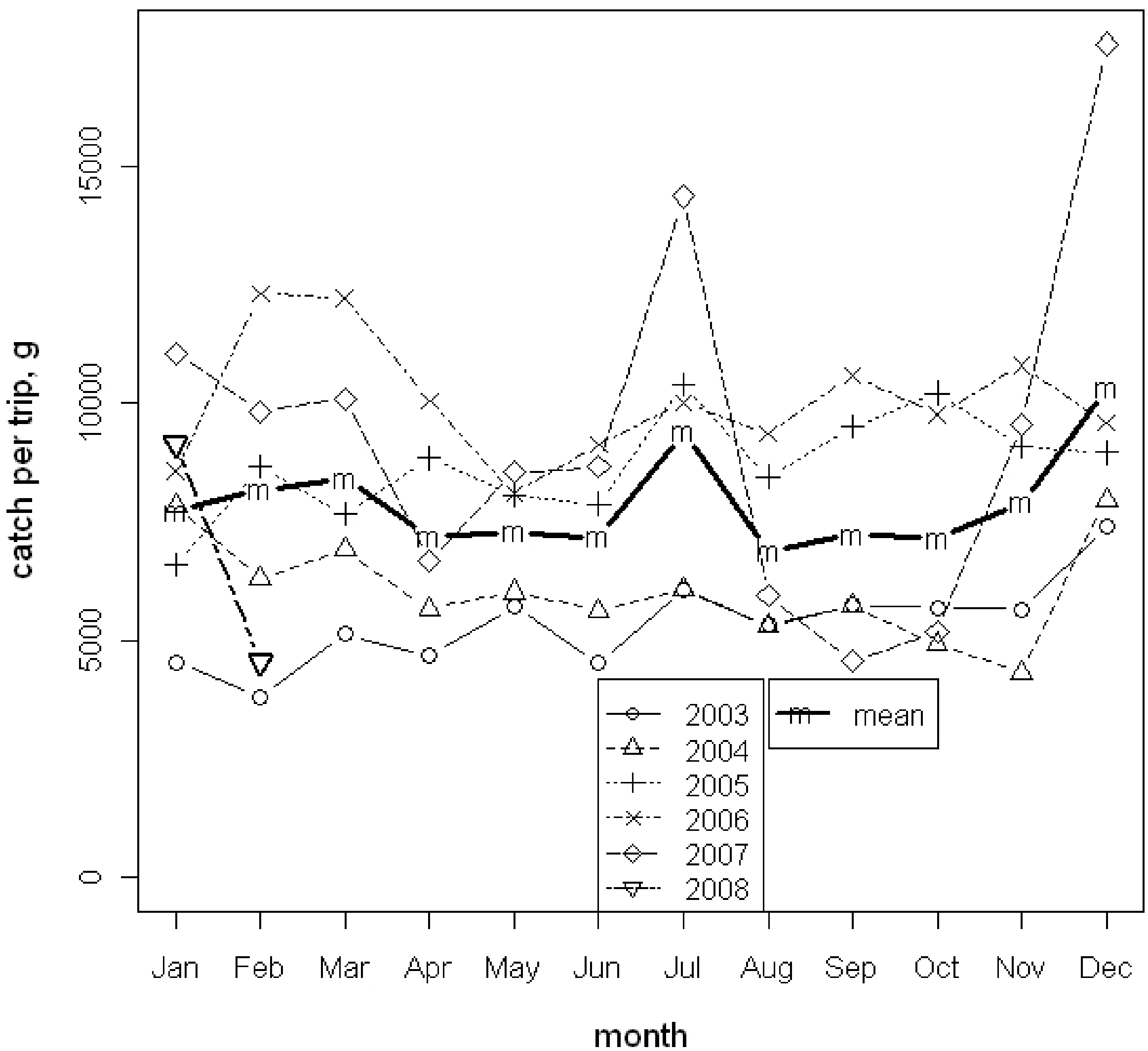

Figure 7. Monthly observed catch rates (grams per trip) by year (2003 - 2008) for Honeycomb Cowfish, Montserrat. The average across all years is shown with the heavyline and symbol=m. Data for 2008 are incomplete and should be interpreted with caution.

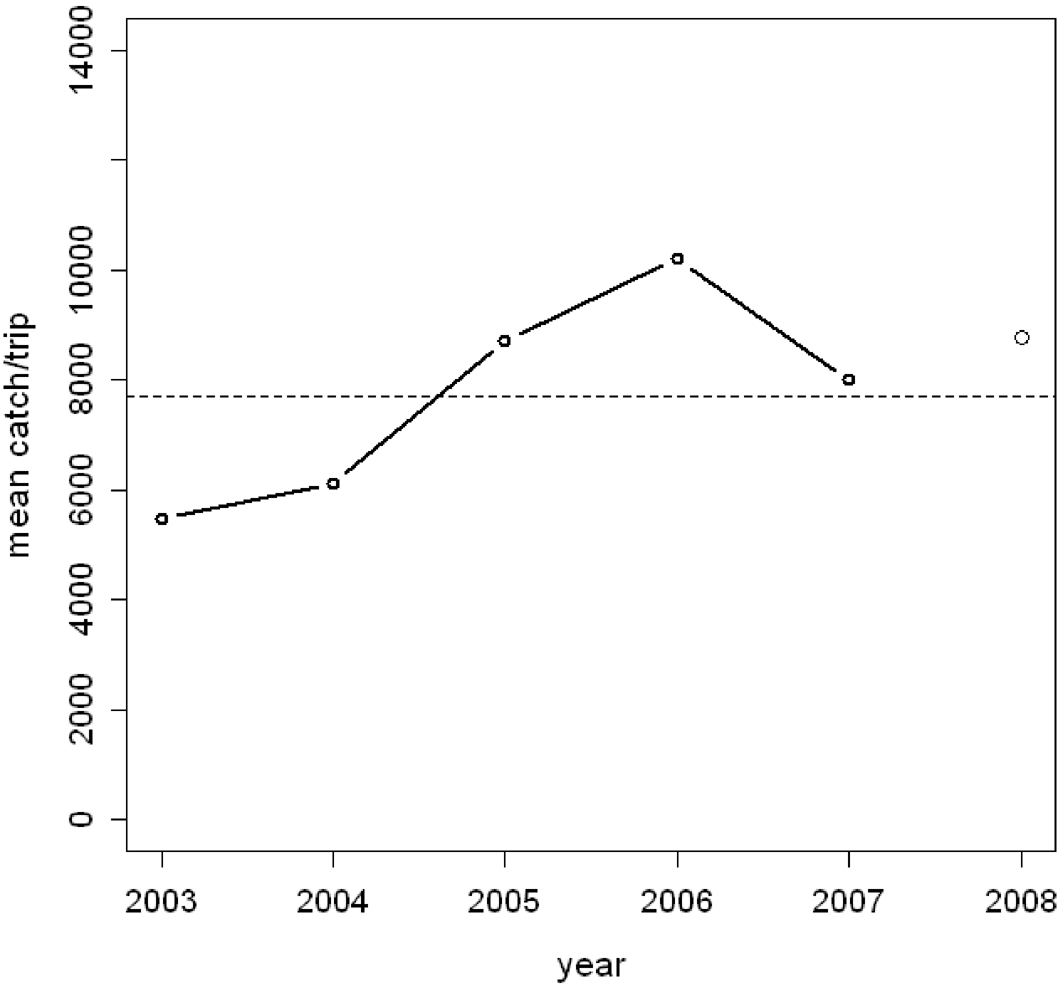

Figure 8. Average annual observed catch rates (grams per trip) for Honeycomb Cowfish, Montserrat. The point for 2008 is based on just two months of data.

<u>1.5.5 Blue tang</u>

<u>Seasonal Trend in Catch Rates</u>

- Blue Tang sampled landings were mainly from the Reef fishery and from pots (Table 5a).
- Blue Tang showed a weak seasonal trend in some years (Figure 9).
- As with the other species, samples sizes for 2008 are extremely low suggesting caution should be used when interpreting trends (Tables 5b, 5c).

<u>Annual trend</u>

- 2006-2007annual catch rates are above the long term average (Figure 10)
- The trend in catch rate is up.

Table 5a. Number of Blue Tang Observations by Fishery and Gear Type								
Fishery	**Gear Type**							
	BEACH SEINE	*GILL NET*	*HAND LINE/ BOTTOM/DRIFTLINE*	*POLE & LINE*	*POTS*	*ROD & REEL*	*SPEAR FISHING*	*UNKNOWN*
COASTAL PELAGIC	0	0	0	0	0	0	0	0
OCEAN PELAGIC	0	0	0	0	0	0	0	0
TFREEF	1	0	6	0	1201	0	28	1

Table 5b. Number of Blue Tang Observations by Year and Month												
Year	**Month**											
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
2003	19	19	16	8	24	13	8	13	14	17	9	18
2004	12	18	20	13	23	21	19	25	33	28	21	23
2005	15	30	37	27	25	27	29	33	33	25	29	21
2006	18	25	19	27	26	22	17	2	28	21	22	17
2007	11	8	11	11	12	13	17	18	24	20	26	9
2008	9	0	0	0	0	0	0	0	0	0	0	0

Table 5c. Mean landed Weight (g) per trip of Blue Tang Observations by Year and Month												
Year	**Month**											
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
2003	4035	3867	4621	4139	3440	3454	4423	4083	8230	3549	4082	3604
2004	3629	3755	4060	2791	2958	3607	3128	3683	6749	3791	3543	4832
2005	4718	6396	6841	9156	8219	7358	10308	9223	7876	10578	10871	10498
2006	9702	10669	10337	7946	10241	10062	9846	4309	10643	10541	8825	10406
2007	10928	6520	7670	8165	6539	6420	7604	10559	5632	7031	7572	6905
2008	3780	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

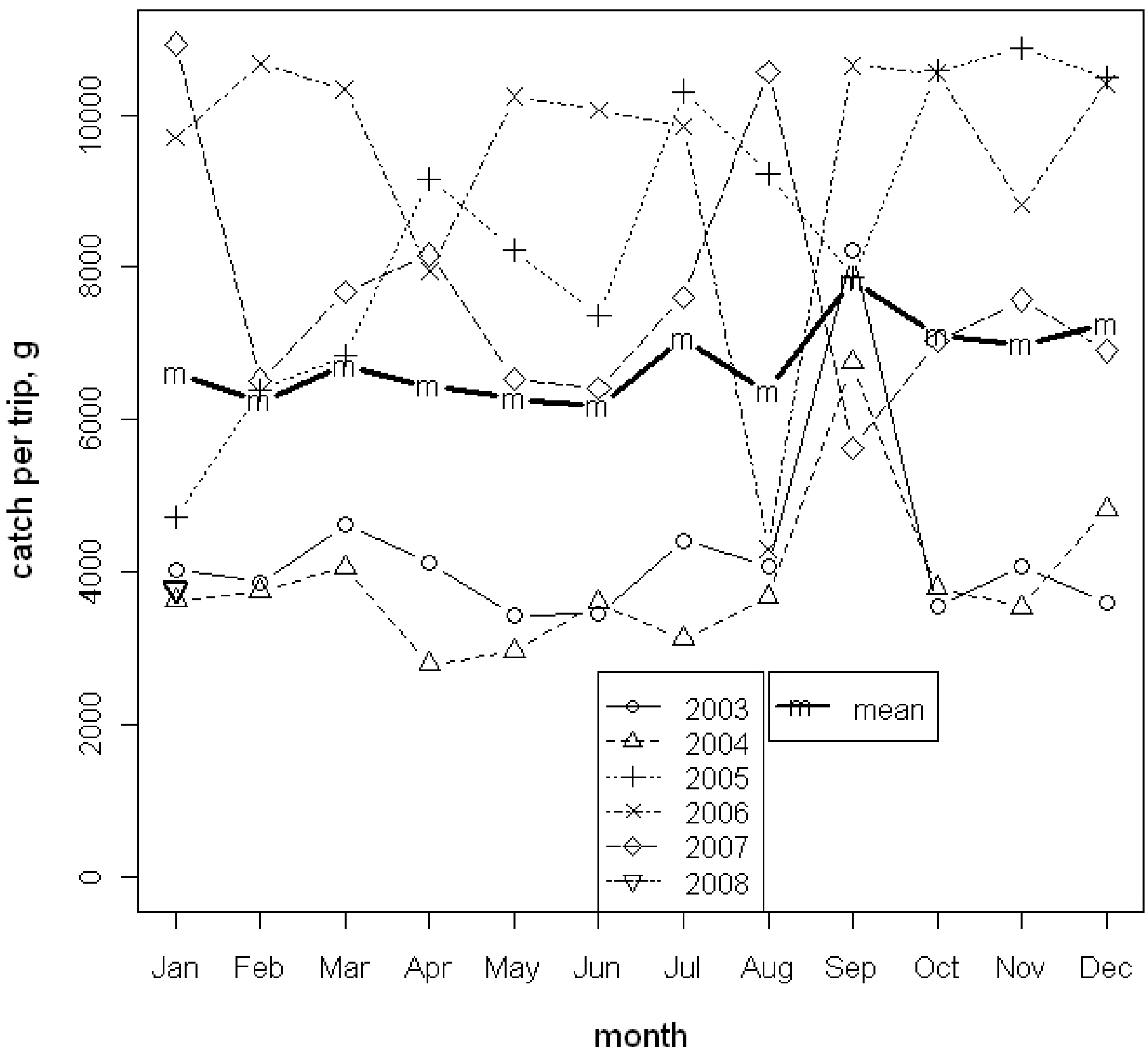

Figure 9. Monthly observed catch rates (grams per trip) by year (2003 – 2008) for Blue Tang, Montserrat. The average across all years is shown with the heavyline and symbol=m. Data for 2008 are incomplete and should be interpreted with caution.

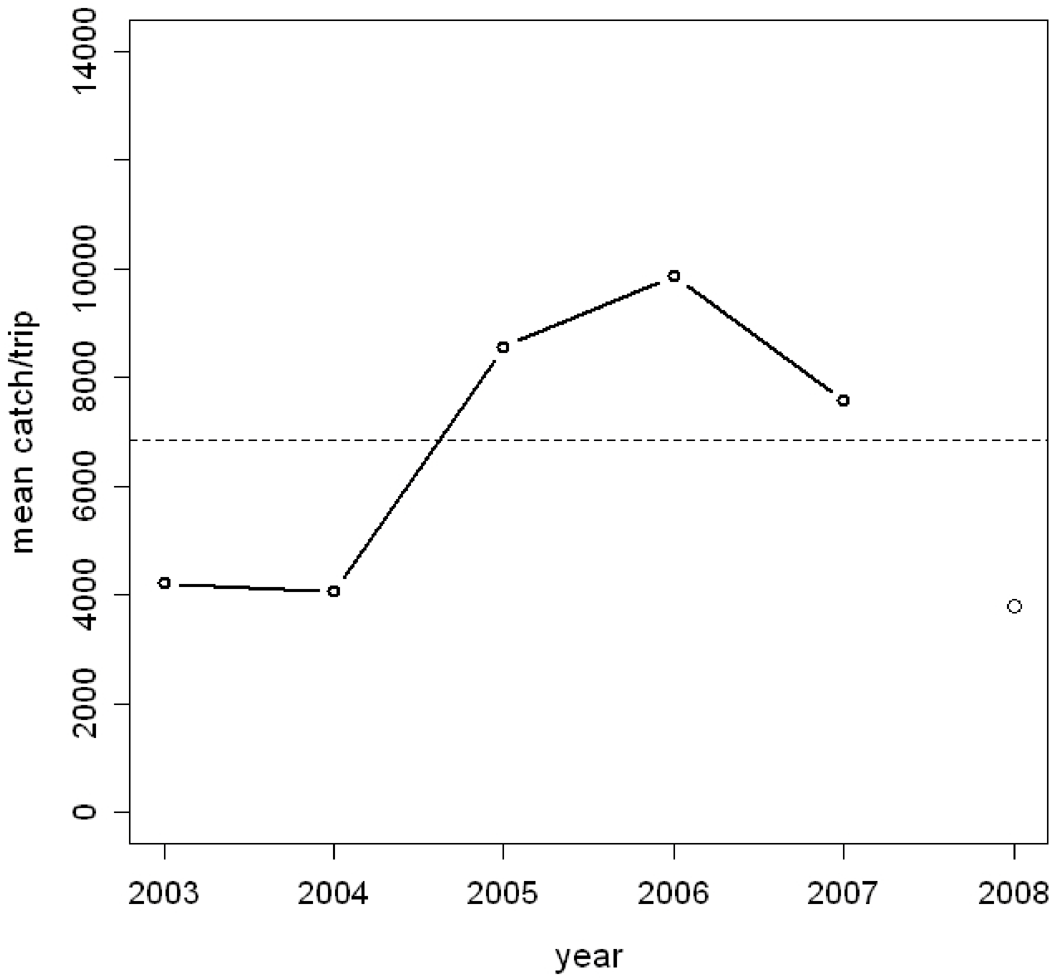

Figure 10. Average annual observed catch rates (grams per trip) for Blue Tang, Montserrat. The point for 2008 is based on just two months of data.

<u>1.5.6 Coney</u>

<u>*Seasonal Trends in Catch Rates*</u>

- Coney sampled landings were mainly from the Reef fishery and from pots (Table 6a).
- Coney monthly catch rates showed weak increasing seasonal trend (Figure 11).
- The monthly trend is increasing up to August.
- The 2008 values are the lowest value on record however sample sizes are extremely low for 2008 (Tables 6b, 6c).

<u>*Annual trend*</u>

The overall trend suggests a decline through 2007 (Figure 12). The 2007 catch rate is 32% lower than the 2003 value which was the highest in the time series.

Table 6a. Number of Coney Observations by Fishery and Gear Type									
	Gear Type								
Fishery		*BEACH SEINE*	*GILL NET*	*HAND LINE/ BOTTOM/DRIFTLINE*	*POLE & LINE*	*POTS*	*ROD & REEL*	*SPEAR FISHING*	*UNKNOWN*
	COASTAL PELAGIC	14	3	0	0	0	0	0	0
	OCEAN PELAGIC	0	0	0	0	0	0	0	0
	TFREEF	1	0	15	0	971	0	23	0

Table 6b. Number of Coney Observations by Year and Month													
	Month												
Year		*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
	2003	19	18	14	14	25	14	10	5	13	9	8	6
	2004	13	27	23	11	31	21	20	25	26	21	15	23
	2005	21	17	26	24	18	27	23	28	23	20	19	20
	2006	16	20	17	25	25	19	15	17	26	24	21	2
	2007	10	4	3	5	8	6	10	12	21	12	14	9
	2008	8	1	0	0	0	0	0	0	0	0	0	0

Table 6c. Mean landed Weight (g) per trip of Coney Observations by Year and Month													
	Month												
Year		*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
	2003	3251	4830	4362	3553	3865	3370	3175	2495	4990	3175	3629	1966
	2004	3489	2386	4103	2103	3074	3107	2631	2685	3577	2948	3175	3361
	2005	3357	2994	4615	5538	3656	5480	5051	2657	2248	2117	1958	2404
	2006	1956	1638	2401	2174	2206	1910	2268	6549	3875	3491	3024	2495
	2007	2873	2268	1512	2381	2495	1588	2382	3584	2081	2350	2344	2527
	2008	1512	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

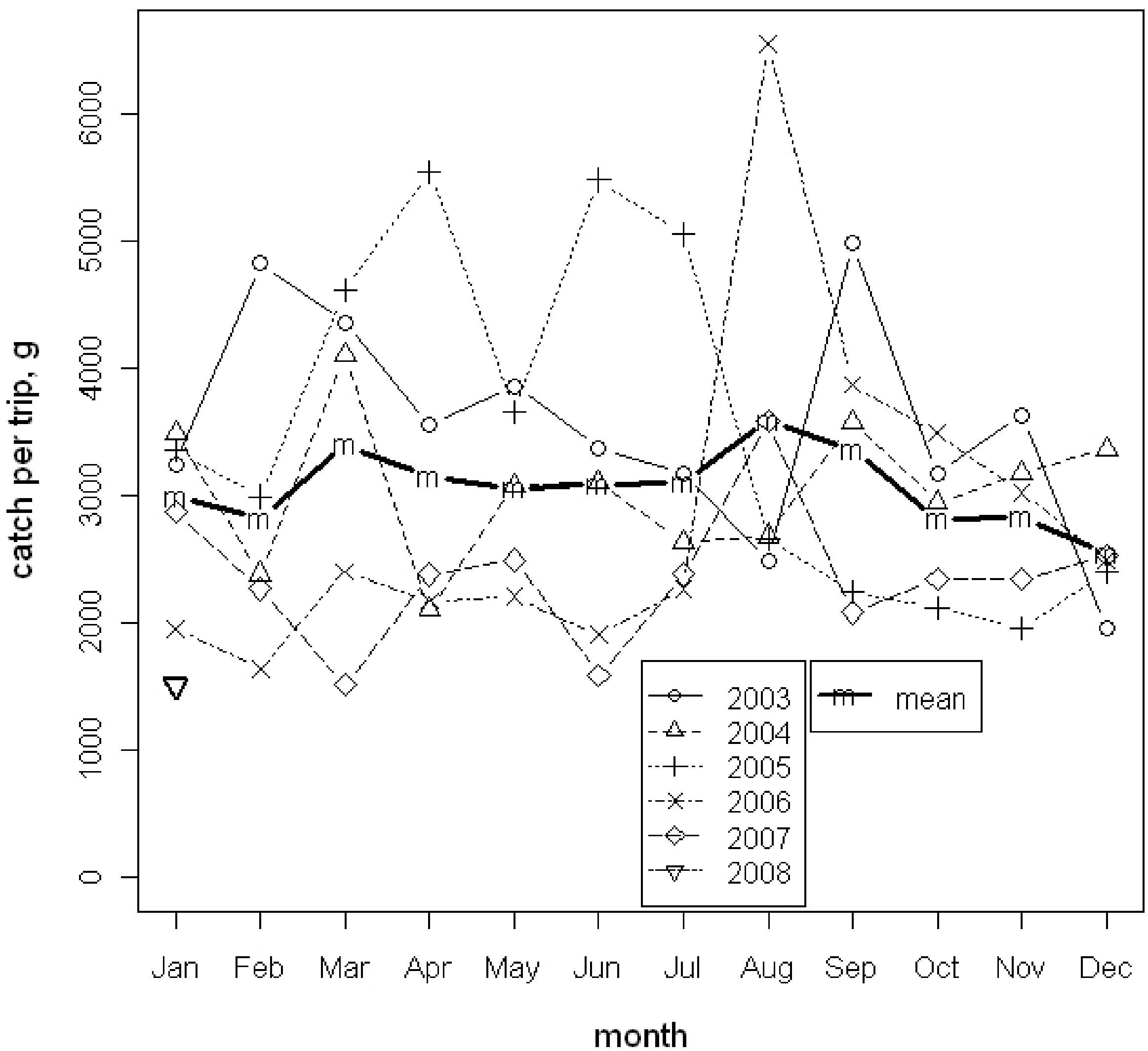

Figure 11. Monthly observed catch rates (grams per trip) by year (2003 – 2008) for Coney, Montserrat. The average across all years is shown with the heavyline and symbol=m. Data for 2008 are incomplete and should be interpreted with caution.

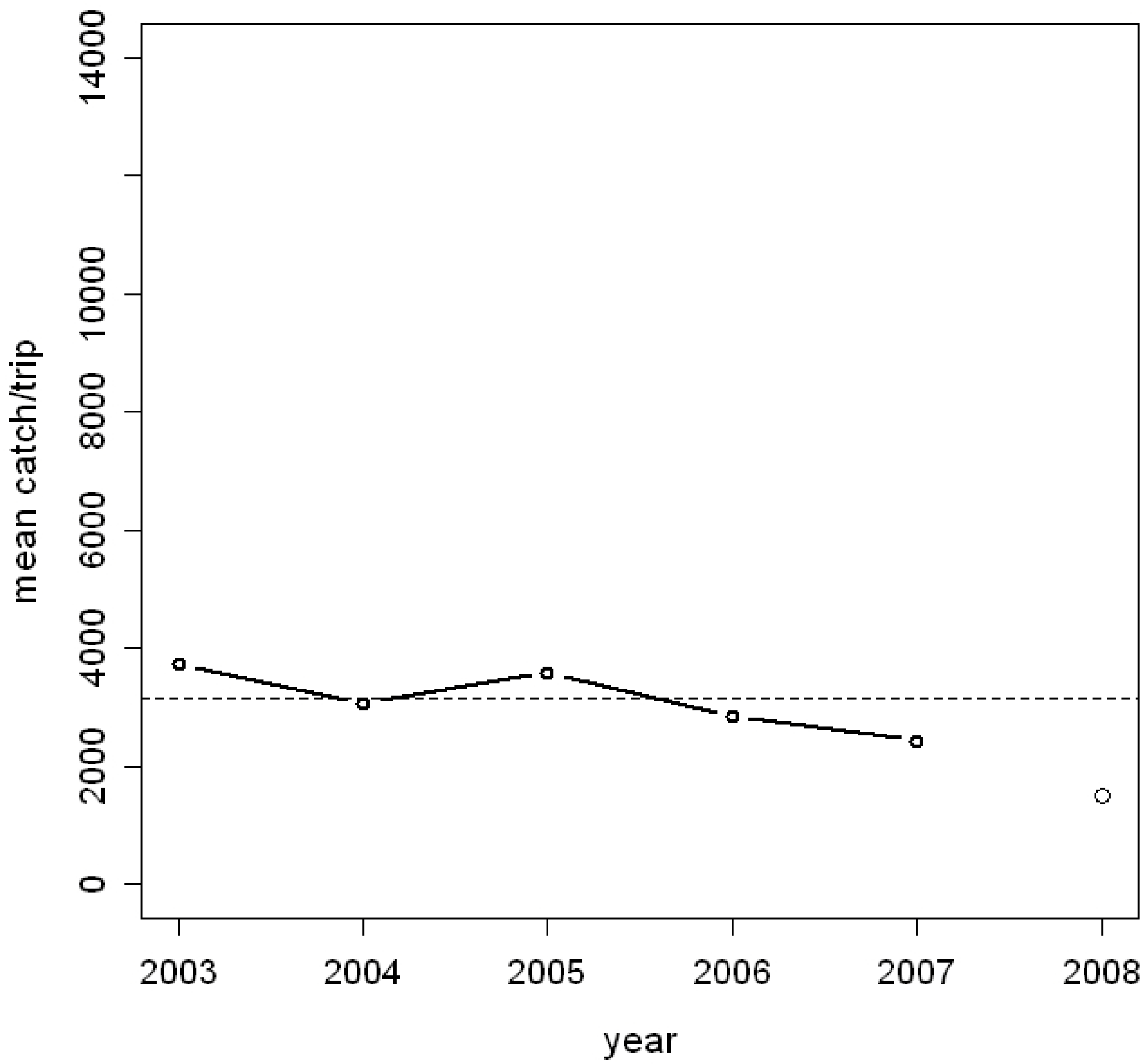

Figure 12. Average annual observed catch rates (grams per trip) for Coney, Montserrat. The point for 2008 is based on just two months of data.

1.5.7 Doctor fish

Seasonal Trends in Catch Rates

- Doctorfish sampled landings were mainly from the Reef fishery and from pots (Table 7a).
- The monthly catch rate data suggested a slight seasonal trend (Figure 13).
- January 2008 was the lowest catch rate on record; sample sizes are extremely low in 2008 suggesting caution should be exercised when interpreting trends (Table 7b, 7c).

Annual Trends in Catch Rates

Annual catch rates increased from 2003 through 2005 and declined thereafter (Figure 14).

Table 7a. Number of Doctorfish Observations by Fishery and Gear Type									
Fishery	**Gear Type**								
		BEACH SEINE	*GILL NET*	*HAND LINE/ BOTTOM/DRIFTLINE*	*POLE & LINE*	*POTS*	*ROD & REEL*	*SPEAR FISHING*	*UNKNOWN*
	COASTAL PELAGIC	26	5	0	0	0	0	0	0
	OCEAN PELAGIC	0	0	0	0	0	0	0	0
	TFREEF	1	0	7	0	1363	0	20	1

Table 7b. Number of Doctorfish Observations by Year and Month													
Year	**Month**												
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
	2003	31	25	27	16	27	18	14	21	25	38	18	26
	2004	27	26	22	17	24	19	22	27	32	29	27	24
	2005	19	19	39	27	25	27	29	33	33	25	29	21
	2006	17	25	19	27	26	22	17	16	27	22	22	17
	2007	11	8	11	11	12	13	15	18	25	23	26	10
	2008	10	3	0	0	0	0	0	0	0	0	0	0

Table 7c. Mean landed Weight (g) per trip of Doctorfish Observations by Year and Month													
Year	**Month**												
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
	2003	5180	4772	4687	4394	4654	5065	4504	5940	6713	5240	4914	4484
	2004	4855	5164	5134	3442	3893	5419	4536	5124	7598	4786	4250	5160
	2005	5610	6923	6304	8131	7040	5880	7868	7395	6777	8854	8978	9698
	2006	7978	7911	8260	6804	8566	8289	7204	6634	8988	9196	7299	8538
	2007	8247	4706	5319	7051	5821	5513	7530	8644	5407	5719	7729	7303
	2008	3493	4234	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

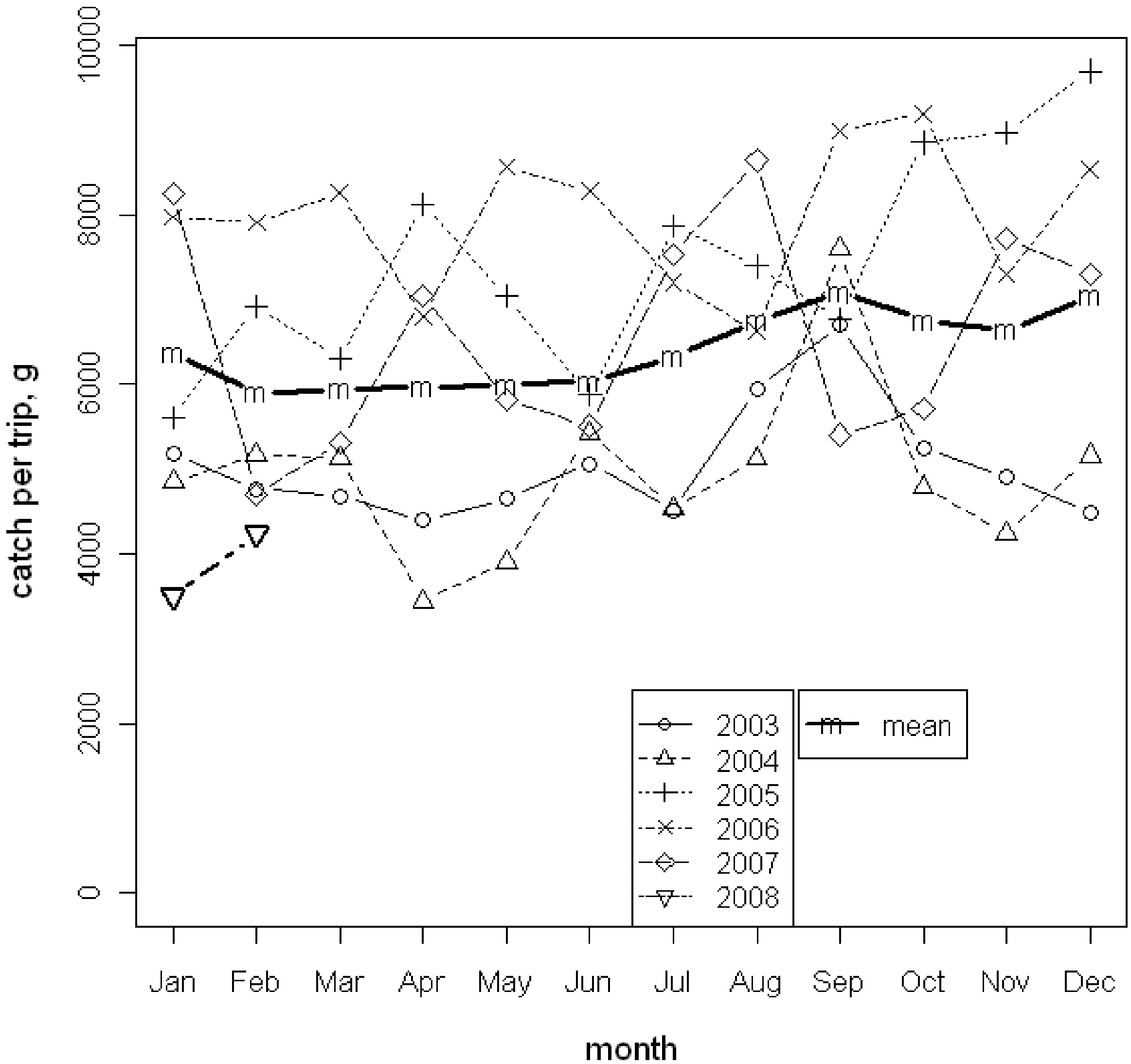

Figure 13. Monthly observed catch rates (grams per trip) by year (2003 - 2008) for Doctorfish, Montserrat. The average across all years is shown with the heavyline and symbol=m. Data for 2008 are incomplete and should be interpreted with caution.

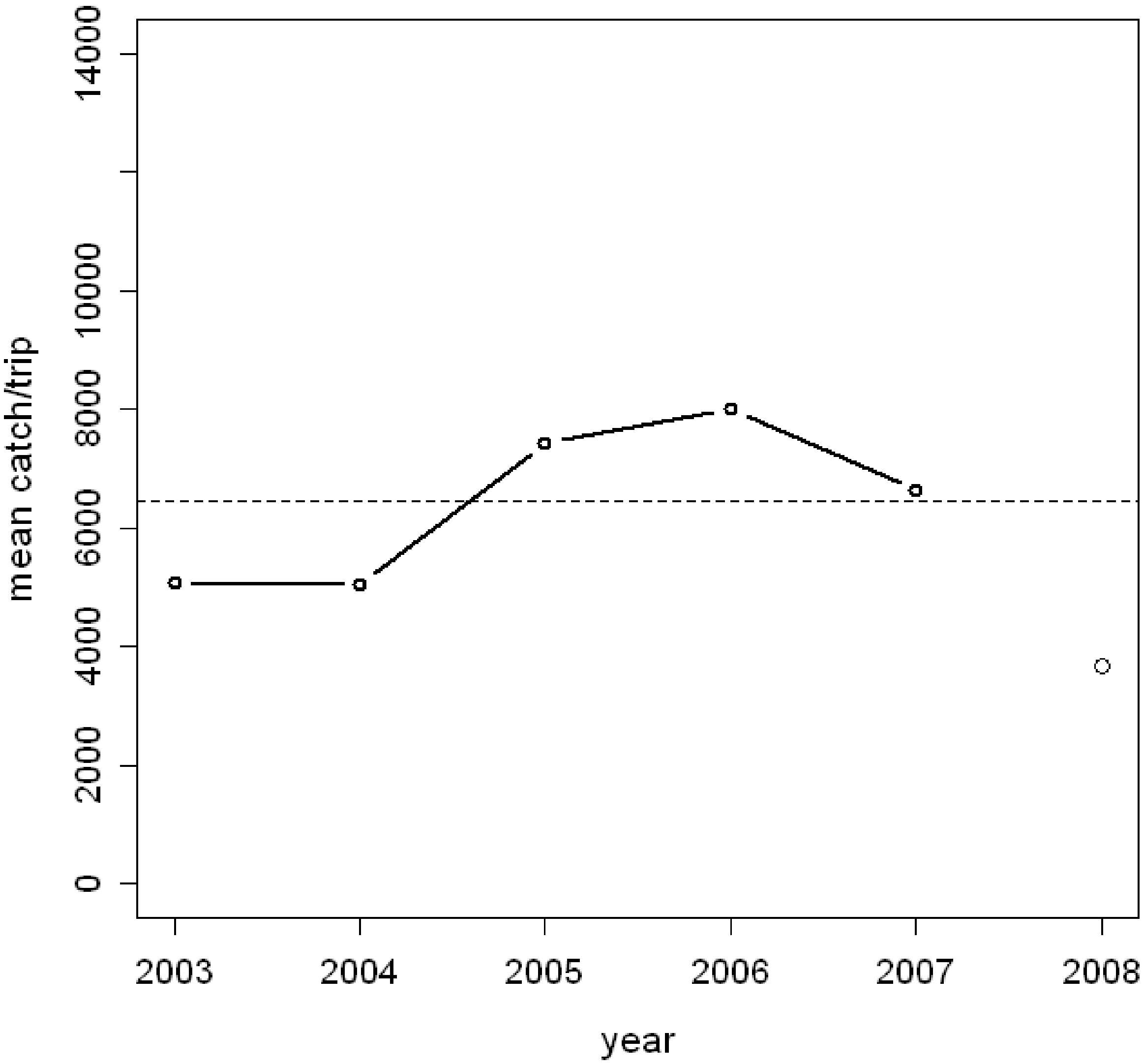

Figure14. Average annual observed catch rates (grams per trip) for Doctorfish, Montserrat. The point for 2008 is based on just two months of data.

1.6 Special Notes

None.

1.7 Policy Summary

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

1.8 Scientific Assessments

1.8.1 Background or Description of the Fishery

The reef and slope fishery (RSF) is a small artisanal fishery accounting for about 40 % to 60% of the national landings. Fishing has been carried out for generations using mainly trap and lines, although occasionally spear gun and gillnets are used. The harvest is composed of a variety of reef fish species up to sometimes 20 species or more. The dominant species include snappers, groupers, soldier fish, parrot fishes, etc. Typically, the local harvest only accounts for some 60% of the national demand for fish.

The fleet is often removed from the water once the threat of a storm is imminent due to the absence of a safe harbor.

The RSF fleet is made up of about 33 vessels, about 12-30 feet in length. The majority of vessels utilize a single engine, engine size ranges from 25-225 hp. There has been of recent a move towards fiberglass construction, with about 23 vessels being of fiberglass construction. About 10% of the vessels are equipped with electronic navigation and sonar gear. Two types of traps are in use: 1) the Z- trap and 2) the rectangular design with all traps using a mesh size of 1.5 inch or greater. Some traps are equipped with biodegradable escape panels. Traps are set individually and retrieved manually. Average soak time between trap hauls ranges from 3-5 days. The vessel operator is not usually involved in the setting and retrieval of the traps. Most vessels utilize a crew of two to set and retrieve the gear. Baiting has become a more common practice since about 2004 than previously observed for this fishery. Frequently used baits include: dried and smoked cattle skins, skins of the trigger fish, dried coconut, the entire rabbit intestine (aka agouti), and occasionally tins of sardines with a small hole punched allowing the oil and meat to filter out.

Two types of line fishing occur: 1) bottom long line and 2) hand line. With hand line fishing vessels, often the vessel operator is involved in the fishing operation. When retrieving the bottom long line, two crew are usually involved in the retrieval process. The number of bottom long line sets varies depending on the depth and the distance from shore.

The RSF fishery operates mainly in the Montserrat territorial sea (TTS) defined as 3 nautical miles nm or less from shore. However, it is known that some vessels fish beyond the TTS. Since 1996 maritime access controls have restricted the movement of vessels, fishing and non-fishing, within the Maritime Exclusion Zone because of pyroclastic flows on the eastern and western flanks of the Soufriere Hills Volcano. Nearly two-thirds of the island is considered to fall within the Exclusion Zone. According to a survey done by the Department of Earth Science University of Bristol up to 30km offshore has been affected by volcanic ash entering the marine environment by the movement of sediments.

In the recent years the RSF is experiencing several problems including: 1) attracting younger fishers due to more lucrative employment options, 2) migration of fishers off island, 3) destruction of fishing grounds due to on-going volcanic activities, and 4) difficulty in obtaining gear due to high costs and transportation constraints, 5) absence of Regulations to enforce certain provisions of the act, and 6) high demand of fresh fish and the absence of adequate storage facilities for fishers.

This fishery is more susceptible to ciguatera.

1.8.2 Overall assessment Objectives

The trip specific landings samples that were computerized during the 2010 inter-sessional period were used to begin preliminary evaluations of stock status of Red hind and Queen Triggerfish. In addition, the working group considered the data further to provide information on the complete fishery. Preliminary results are provided for five additional species (Longjaw Squirrelfish, Honeycomb Cowfish, Blue Tang, Coney and Doctorfish).

1.8.3 Data Used

The Montserrat Fisheries Division has collected summary information on landings since the early 1990's. Data collection occurs at the main landing site i.e., Carr's Bay / Little Bay, Mondays through Fridays during working hours i.e. 8 am – 4 pm. However, fishers are encouraged to provide the data should they arrive after normal working hours. Information on after-hours landings is usually obtained through three means: 1) telephone contacts or 2) fishers inform the fisheries division through office visit, or 3) interviews in the field by data collectors. About 95% of all RSF landings occur at the Carr's Bay/Little Bay site and about 98% of all catches are landed whole. In some cases actual Weights are recorded where-as in other cases estimates are used. Data received for the 2010 Sixth Annual Scientific Meeting included years 2003 through 2008 (2008 only contained information for January and February).

1.8.4 Analysis 1

Objectives

As previous stock evaluations of the Red Hind and Queen Trigger fish stocks for Montserrat have not been conducted, focus was directed towards identifying significant annual changes in catch rates for each species.

Method/Models/Data

The trip specific landings and effort data for the Montserrat pot fishery were reviewed and investigated using "R" computer software (www.cran.r-project.org). Initial examination of the data revealed that seven species dominated the majority of the trips. These data indicated that these seven species were landed in 1,000 or more sampled trips therefore subsequent analyses were conducted for these species: Red hind, Queen Triggerfish, Longjaw Squirrelfish, Honeycomb Cowfish, Blue Tang, Coney and Doctorfish. Annex 1 provides a complete listing for all 138 species that were sampled in the Montserrat fishery 2003 through 2008 of the number of trips sampled for each species.

After selection of the dominant species to consider, the data were categorized by primary gear and fishery in order to identify trips which targeted these species. The data showed that pot gear and the 'Reef' designated fishery dominated all species landings thus only landings by pot gear and the Reef fish fishery were included in further calculations. In addition, examination of trips by area showed that the landings were restricted mainly to a single site, Carr's Bay. Although a few trips were sampled from a secondary site (Little Bay, n=20) were excluded for these preliminary analyses as they did not contribute to a significant portion of the overall data set.

Several summaries of the data were considered. For each of the seven species (Red hind, Queen Triggerfish, Longjaw Squirrelfish, Honeycomb Cowfish, Blue Tang, Coney and Doctorfish) the individual trip specific catch rates were summarized to examine patterns in CPUE. CPUE was calculated as the mean landed Weight (grams) per trip. Catch rates were computed for these partitions of the data: a) by month and by year to evaluate changes in catch rate by season and b) to identify trends in annual CPUE over time. Tables and graphs of these products were prepared and studied as an aid in identifying patterns by species in the Montserrat reeffish pot fishery. As well, these initial basic examinations were carried out as a basis for developing more sophisticated future analysis models.

Red Hind pot fishery Summary Results

Red hind CPUE ranged from 5,329 grams per trip (2008) to 13,141 grams per trip (2005) over the six year period, 2003-2008 (Fig. 2). The trend in red hind pot catch rate suggests an increase from 2003 -2005 followed by a decline in the mean landed weight per trip of red hind from pots since 2006.

Visual inspection of the summary CPUE trends by year and month showed large variability between months both within year and across years.

Queen triggerfish pot fishery Summary Results

Queen triggerfish CPUE ranged from 3,898 grams per trip (2008) to 9,898 grams per trip (2005) over the six year period, 2003-2008 (Figure 4). The trend in Queen Triggerfish pot catch rate suggests an increase between 2003 and 2006 followed by a slight decline in mean landed weigh per trip of Queen Triggerfish since.

Visual inspection of the summary CPUE trends by year and month showed large variability between months both within year and across years.

Longjaw Squirrelfish

Longjaw Squirrelfish CPUE ranged from 3,402 grams per trip (2008) to 5,577 grams per trip (2006) over the six year period, 2003-2008 (Figure 6). The trend in pot catch rate suggests a slight increase in the mean landed weight per trip of Longjaw Squirrelfish from pots since 2003.

Visual inspection of the summary CPUE trends by year and month showed large variability between months both within year and across years.

Honeycomb cowfish

Honeycomb cowfish CPUE ranged from 5,358 grams per trip (2003) to 10,043 grams per trip (2006) over the six year period, 2003-2008 (Figure 8). The trend in pot catch rate suggests an overall increase in the mean landed weight of Longjaw Squirrelfish from pots from 2003 to 2007.

Visual inspection of the summary CPUE trends by year and month showed large variability between months both within year and across years.

Blue Tang

Blue Tang CPUE ranged from 3,780 grams per trip (2008) to 9,461 grams per trip (2006) over the six year period, 2003-2008 (Figure 10). The trend in Blue Tang catch rate suggests a moderate increase in Blue Tang catch rate through 20067 followed by a sharp decline in the mean landed weight per trip of Blue Tang CPUE from pots since 2006.

Visual inspection of the summary CPUE trends by year and month showed large variability between months both within year and across years.

Coney

Coney CPUE ranged from 1,760 grams per trip (2008) to 3,435 grams per trip (2003) over the six year period, 2003-2008 (Figure 12). The trend in Coney catch rate shows a slight decline in the mean landed weight per trip of Coney CPUE from pots overt the six year time series, 2003-2008.

Visual inspection of the summary CPUE trends by year and month showed large variability between months both within year and across years.

Doctorfish

Doctorfish CPUE ranged from 3,863 grams per trip (2003) to 7,972 grams per trip (2006) over the six year period, 2003-2008 (Figure 14). The trend in Doctorfish pot catch rate suggests an increasing trend through 2006 followed by a decline in the mean landed weight per trip of Doctorfish from pots since 2003.

Visual inspection of the summary CPUE trends by year and month showed large variability between months both within year and across years.

1.8.5 Discussion -Technical Analysis Recommendations

- The data for 2008 need to be reviewed and presented for further analysis
- Incorporate size information into analyses
- Evaluate impacts of fishing on size structure of catches
- The Working Group recommends that vessel information be included in the trip reports database. The reason is that fishers vary in the ability to catch fishes and in the species they target. If composition of the fishers is not taken into account, misleading trends in catch rates can occur. For example, suppose stock abundance declines over time. It is possible that fishers with low catch rates will drop out of the fishery because it is not worthwhile fishing. The result is that the average catch rate can increase over time because the average is calculated from remaining fishers in the fishery who tend to have higher catch rates (see hypothetical example, Figure 15). If vessel id information is included in the database, then percentage changes can be calculated for every pair of years from fishers who fished in both years. These proportional changes can be averaged to arrive at a conclusion about the average change in catch rate over time. In the case of the hypothetical example in Figure 15 we can see that 100% of the fishers who were active in years 1 and 2, 2 and 3, and 3 and 4 experienced declining catch rates. We can also compute an average change in catch rate for each pair of years.
- Explore use of ParFish to obtain information on stock status in near term
- Can compare ParFish results to results from more detailed analyses of CPUE, latter assumes all the previous identified data/analysis tasks will be completed in a timely fashion.
- Initiate Analyses of Size frequency data. Data collections should ensue during intercessional period
- Quantify Spawning Season and periodicity
- Document known spawning areas (from fisher survey)
- Document quantity of current fishable habitat
- Quantify discards and reason for discarding.

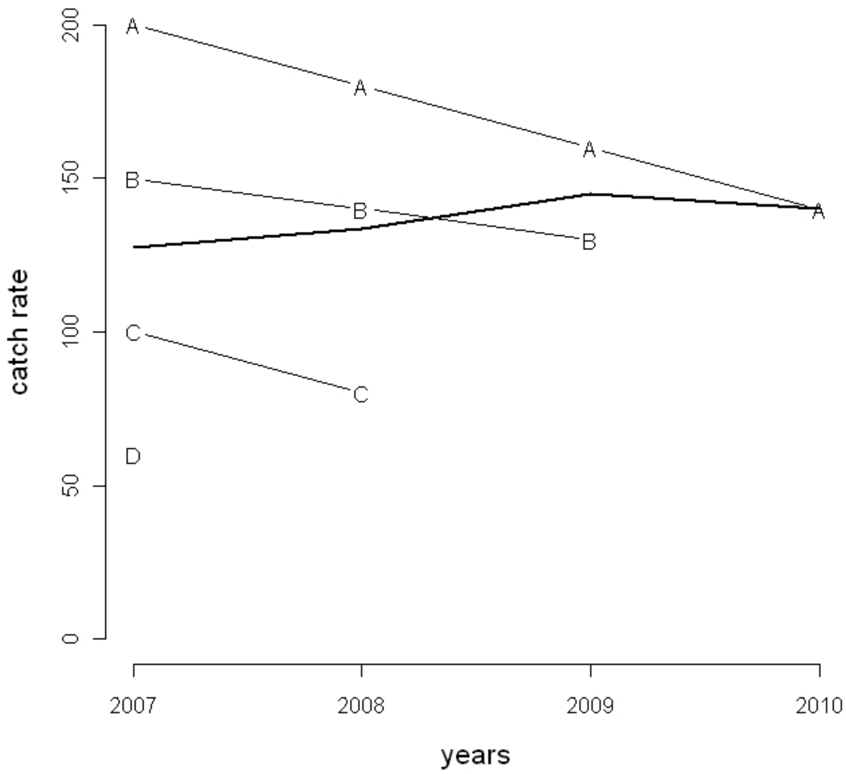

Figure 15. Catch rate history for individual fishers and the mean catch rate in the fishery over time. Four fishers are represented and each fisher who was active for at least two years showed a decline in catch rate over time. But, because the fishers with low catches drop out of the fishery, the average catch rate increases over time suggesting, falsely, fishing is getting better over time.

1.8.6 Management

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

2.0 Other objectives of the Reef And Slope Fish Resource Working Group

2.1 Statistics and Research Recommendations

2.1.1 Data Quality

- Data from St. Kitts and Nevis should be merged, edited, and entered into an electronic format
- Vessel id information should be added to trip reports databases for all countries
- Jamaica’s trip reports database should be updated to the present
- Data from Jamaica and St. Kitts and Nevis should be analyzed in the manner developed for Montserrat.

Annex 1. Number of sampled trips by species for the Montserrat fishery, 2003-2008 combined. Species which appeared in the recorded catches of more than 1,000 sampled trips are indicated in boldface type.

Species ID	Species	Number of Sampled Trips		Species ID	Species	Number of Sampled Trips
1	**DOCTORFISH**	**1423**		39	PARROTFISH,REDTAIL	46
2	**HIND,RED**	**1352**		40	BARRACUDAS	39
3	**LONGJAW SQUIRRELFISH**	**1270**		41	MACKERELS & TUNAS	39
4	**BLUE TANG**	**1249**		42	SNAPPER,MUTTON	38
5	**TRIGGERFISH,QUEEN**	**1242**		43	WAHOO	36
6	**CONEY**	**1029**		44	ANGELFISH,GRAY	35
7	**COWFISH,HONEYCOMB**	**1022**		45	SNAPPER,DOG	35
8	NEEDLEFISHES	663		46	BONEFISH	34
9	GRUNT,CAESAR	577		47	JACK,YELLOW	30
10	UNKNOWN	522		48	JACKS	29
11	GOATFISHES	505		49	JACK,BLACK	28
12	SNAPPER,RED	493		50	JACK,HORSE EYE	25
13	ROCK BEAUTY	478		51	MACKEREL,CERO	23
14	PARROTFISH,STOPLIGHT	428		52	TRIGGERFISH,OCEAN	22
15	GRUNT,FRENCH	344		53	TUNA,ALBACORE	21
16	SNAPPER,VERMILION	327		54	SNAPPER,MAHOGANY	18
17	PARROTFISH,BLUE	298		55	ANGELFISH,QUEEN	17
18	LOBSTER, CARIB. SPINY	225		56	WRASSE,CREOLE	17
19	FILEFISH,SCRAWLED	215		57	GROUPER,NASSAU	16
20	GRUNTS	178		58	SNAPPER,GLASSEYE	16
21	SNAPPER,SILK	178		59	DOLPHINS	13
22	BUTTERFISH	161		60	HERRINGS	13
23	ANGELFISH,FRENCH	154		61	SHARK,NURSE	13
24	MARGATE	133		62	SNAPPER,GRAY(GREY)	13
25	BALLYHOO	125		63	TRUNKFISH	13
26	JACK,BAR	121		64	ANGELFISHES	12
27	SCHOOLMASTER	115		65	BONITO,ATLANTIC	11
28	MARGATE,BLACK	110		66	KINGFISH,GULF	10
29	JACK,CREVALLE	97		67	PARROTFISH,REDBAND	10
30	SNAPPER,YELLOWTAIL	94		68	BUTTERFLYFISH,BANDED	9
31	PORGY,JOLTHEAD	91		69	LOBSTER,SPOTTED SPINY	9
32	SHARKS,UNCLASSIFIED	74		70	MORAY,GREEN	9
33	HONEYCOMB COWFISH	64		71	PARROTFISHES	9
34	SQUIRRELFISHES	60		72	SHARK,TIGER	8
35	HOGFISH,SPANISH	59		73	SOLDIERFISH,BLACKBAR	8
36	DURGON,BLACK	58		74	TURTLE,HAWKSBILL	8
37	CHUB,BERMUDA	55		75	SNAPPERS	7
38	HIND,ROCK	51		76	FILEFISH,WHITESPOTTED	6

Species ID	Species	Number of Sampled Trips		Species ID	Species	Number of Sampled Trips
82	PORKFISH	5		111	BUTTERFLYFISH,SPOTFIN	1
83	SHARK,SANDBAR	5		112	CONCH,QUEEN	1
84	GOATFISH,YELLOW	4		113	CONCH,W INDIAN CROWN	1
85	GROUPER,BLACK	4		114	EELS,CONGER	1
86	GRUNT,WHITE	4		115	FILEFISH,ORANGE	1
87	MACKEREL,SPANISH	4		116	FILEFISH, ORANGESPOT	1
88	MORAY,SPOTTED	4		117	GROUPER, RED	1
89	SAILORS CHOICE	4		118	GROUPER, TIGER	1
90	SCAD,BIGEYE	4		119	GROUPRERS, G:EPIN	1
91	SNAPPER,BLACKFIN	4		120	HOGFISH	1
92	TUNA,BLACKFIN	4		121	HOGFISH, SPOTFIN	1
93	BIGEYE	3		122	JACK, ALMACO	1
94	CRAB,SPECKLED SWIMMIN	3		123	MARLIN, WHITE	1
95	SHARK,OCEANIC WHITETI	3		124	MARLINS	1
96	SNAPPER,LANE	3		125	MORAY, STAUT	1
97	TUNA,SKIPJACK	3		126	OCTOPUS, CARIB. REEF	1
98	ANGELFISH,BLUE	2		127	PARROTFISH, RAINBOW	1
99	BARRACUDA,GREAT	2		128	PARROTFISH, STRIPPED	1
100	CREOLE FISH	2		129	PUDDINGWIFE	1
101	LOBSTERS,SPINY	2		130	SHARK, CARIBBEAN REEF	1
102	LOOKDOWN	2		131	SHARK, GREAT HAMMERHD	1
103	PARROTFISH,QUEEN	2		132	SHARK, LEMON	1
104	POMPANO,AFRICAN	2		133	SHARKSUCKER	1
105	PORGY,SAUCEREYE	2		134	SNAPPER, SOUTHERN RED	1
106	SPADEFISH,ATLANTIC	2		135	STINGRAYS	1
107	TUNA,YELLOWFIN	2		136	TRIGGERFISH, GRAY	1
108	TUNAS	2		137	TURTLE,ATL, GREEN SEA	1
109	BASS,PEACOCK	1		138	WRASSES	1
110	BIGEYES	1				

Appendix 5: Report of the Large Pelagic Fish Resource Working Group (LPWG)

Christopher Parker – Barbados (Chairman)
Dr. Freddy Arocha – invited scientist Venezuela
Mons. Lionel Reynal – French Caribbean territories
Dr. Carolina V. Minte-Vera – Brazil
Ms. Yvonne Edwin – St. Lucia
Mr. Harold Guiste – Dominica
Mr. Crafton Issac – Grenada
Mr. Leslie Straker – St. Vincent and the Grenadines
Ms. Cheryl Jardine-Jackson – St. Vincent and the Grenadines
Dr. David Die (USA) – Consultant
Dr. Juan Carlos Seijo (Mexico) – Consultant on recreational study

A. OVERVIEW

Introduction

During the first session of the working group, all members present were asked to identify all data and information that they were aware of regarding their national dolphinfish and blackfin tuna fisheries. Following these individual reviews, the type and time-range of each of the data-sets were summarized in a tabular form for ease of review. It was determined that this year's meeting would focus primarily on conducting as thorough an analysis of dolphinfish as possible and only a data review for black-fin tuna.

Dolphinfish

During the discussion that ensued regarding the initial presentations of national data sets and information, it was agreed that there was some convincing evidence that the dolphinfish fished in Eastern Caribbean waters may form part of a more widely dispersed stock or complex of stocks ranging along the northern coast of the South American continent, at least from Ceara State in Brazil to Venezuela. As previous assessments conducted by the CRFM LPWG were confined to the Eastern Caribbean only, it was agreed, to promote comparability in the results of the assessments through time, that the available eastern Caribbean dataset be again assessed separately at this meeting. In addition, data relevant to establishing the possible extended geographic range of the stock and its structure should be critically examined. The results of these assessments will be presented in a separate report.

Blackfin tuna

The group reviewed the available catch data for blackfin tuna in the ICCAT database and discussed some country-specific details of the landings information. Data for seventeen countries are available in the database; however no data are currently available for some Eastern Caribbean countries where catches might be expected, given the known range of the species. The groups listed the countries for which there are catch rates and/or length frequency data available. Finally the group reviewed recent studies on biology and stock structure. Although there is no comprehensive study of stock structure, a genetic study and a tagging study may indicate that there is some finer-scale population structuring within the region. Evidence in the literature also indicates that blackfin tuna may spawn in rather coastal areas.

CLME project

The group also reviewed its commitments to the CLME project. CRFM is an active participant in the Caribbean Large Marine Ecosystem Project (CLME) and a leader in the CLME activities related to large pelagic fish and flying fish. Large pelagic assessments within the CLME are to develop and promote Ecosystem Based Management (EBM).

The CLME identified a series of activities that are required to strengthen the TDA in reference to large pelagic fish to be done by the CRFM:

1. Enhancement of fisheries data collection
2. Undertake region-wide assessments of stock status for key species such as dolphinfish and blackfin tuna
3. Assess the economic importance and impact of recreational fisheries in the region by focusing on a few case study fisheries.

In order to accomplish these activities and others related to the strengthening of the Transboundary Diagnostic Analysis for large pelagic fish, the CLME has contracted the CRFM for a period of 2.5 years. As part of this contract the LPWG has conducted an assessment of dolphinfish at the present meeting and is preparing to conduct an assessment of blackfin tuna at the next scientific meeting of the CRFM. A proposal for the recreational study was developed by Professor Seijo, and is provided in his general report, included as Appendix 8 (Seijo, 2010).

Recommendations

At the end of the meeting the working group makes the following recommendations.

Dolphinfish

- Future assessments of dolphinfish should consider a stock that occupies the area from South and East of Puerto Rico to Northern Brazil
- A new assessment of dolphinfish is not recommended before 2012
- Although the assessment does not suggest a need to control harvest, there is a pressing need to improve the data available for this stock, so as to improve the accuracy of future assessments. This is specially the case for estimates of total harvest from those countries that have not provided them to the CRFM.

Blackfin tuna

- An assessment of blackfin tuna should be attempted at the 2011 meeting of the LPWG.
- Efforts should be made prior to an assessment, to recover missing data or correct inconsistent data for the Eastern Caribbean
- A review of catch histories should be sought from other countries that historically have reported large catches such as Dominican Republic and Cuba and from countries like Venezuela where harvest estimates differ between sources.

CLME project

- The CRFM should make sure that the subset of recreational fisheries selected for study are both representative of the range of fisheries of interest to the LPWG and have enough information available on them to be good candidates for the study.
- In designing further activities for the CLME contract the CRFM should give priority to those activities that will enhance data collection on large pelagic fish

B. FISHERY REPORTS

1. Dolphinfish (*Coryphaena hippurus*) fishery: Management Summary – Eastern Caribbean

Rapporteur: Christopher Parker

1.1 Policy and objectives

For most of the countries fishing dolphinfish in the eastern Caribbean, the management objectives for dolphinfish specifically, were not available to the authors at the time of writing. As a result, the CRFM Large Pelagic Fisheries Working Group requests guidelines from the Caribbean Fisheries Forum on the individual country management objectives for the dolphinfish to direct future stock assessments and further refine management recommendations for the species.

1.2 Status of stocks

Estimates of total harvest of dolphinfish by the countries of the eastern Caribbean have increased from about 700 t in the mid 1970s to about 1200 t in recent years, albeit with large fluctuations from year to year (Figure 1). Unfortunately these estimates suffer from the lack of accurate and consistent reports from some countries of the region, thus there remains significant uncertainty in the level of historical catches.

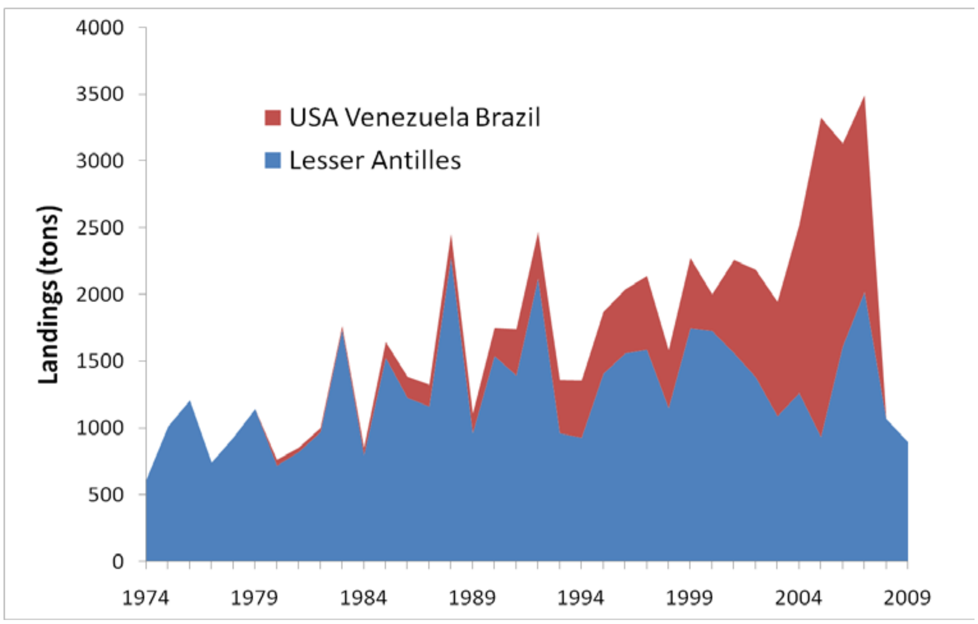

Figure 1: Estimates of total landings (tons) of dolphinfish by island nations of the Eastern Caribbean (Lesser Antilles) and by the fleets from USA, Venezuela and Brazil. Catches of 2008 and 2009 are preliminary.

Since 1994, relative abundance of dolphinfish in the eastern Caribbean, based on mean (standardized) catch per trip, have fluctuated between about 32.8 kg/trip and 74.7 kg/trip. Relative abundance was unusually high in 2009 and 2010 (Figure 2).

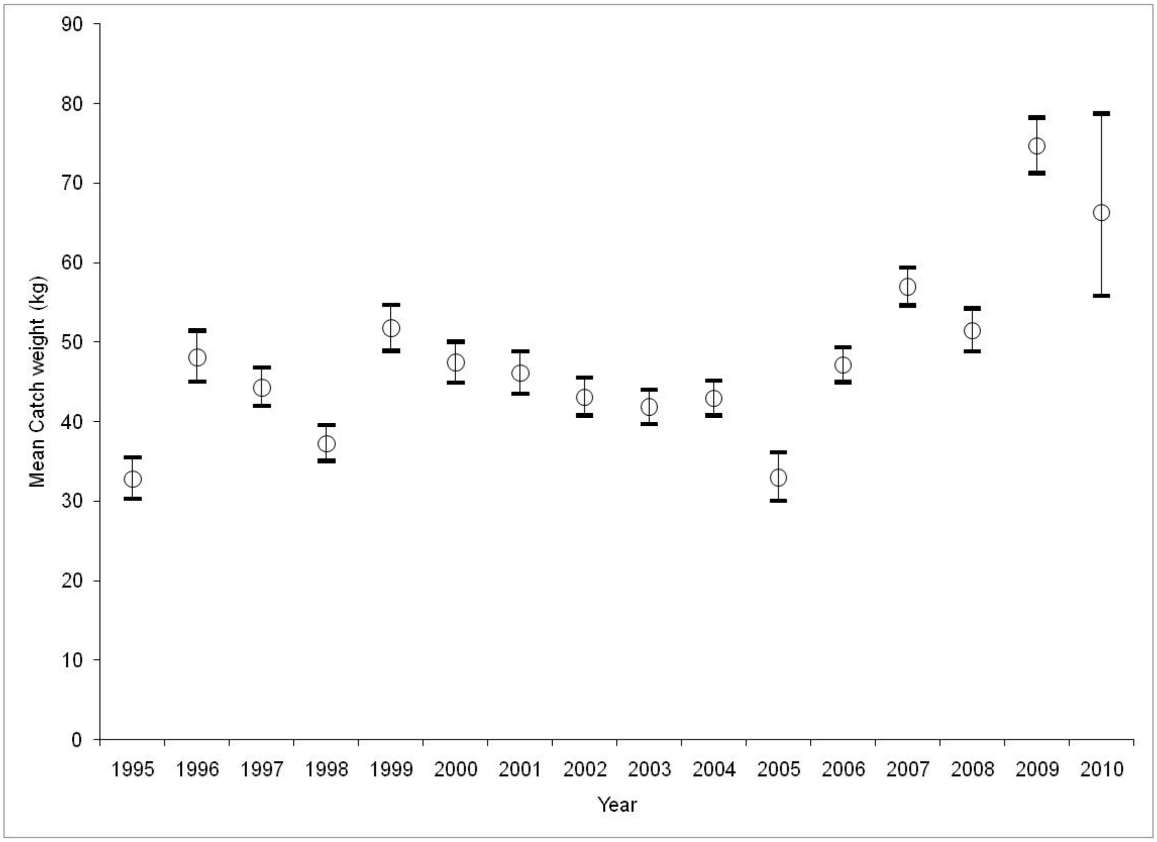

Figure 2: Standardised mean annual catch per trip (kg) for Eastern Caribbean for fishing years 1995-2010

New information on seasonal trends in catch rates estimated from General Additive Models (GAM) from fleets of non-island countries (Brazil, Venezuela and USA), suggest that dolphinfish migrate from Northern Brazil to the Eastern Caribbean, some also entering the southeastern Caribbean Sea. This confirms the hypothesis that the stock of fish caught in waters of the Eastern Caribbean is part of a much wider ranging dolphinfish stocks complex that extends as far as the northern coast of Brazil, the offshore equatorial area and the southeast of the Caribbean Sea (figure 3).

When the catches from non-island countries that fish this wider area of the Southern Caribbean stock are added to those from island countries the total harvest from the stock fluctuates around 1500 t in the 1990s but reaches levels in excess of 3000 t in recent years. Catches from some of the fleets operating in this wider area of the stock also suffer from incomplete reporting.

Relative abundance indices, based on standardized catch rates, for the fleets of non-island countries, available since the mid 1980s, also fluctuate between years without a significant trend.

The lack of a trend in relative abundance combined with an apparent increase in harvest does not allow for an accurate estimation of MSY or other reference points for the stock. Although it is not possible to estimate these reference points, the lack of a trend in relative abundance indices in the presence of an apparent increase in harvest suggest that the stock has not being overly affected by removals from fishing in the last 20 years or so. It is important to note that this does not mean that the stock has not declined, rather that declines are not detectable for the period for which there is available data. For other pelagic fish stocks in the region, such as billfish, the majority of the declines in stock size occurred in the 1960s and 1970s, before the period for which there is reliable data on dolphinfish for the Eastern Caribbean.

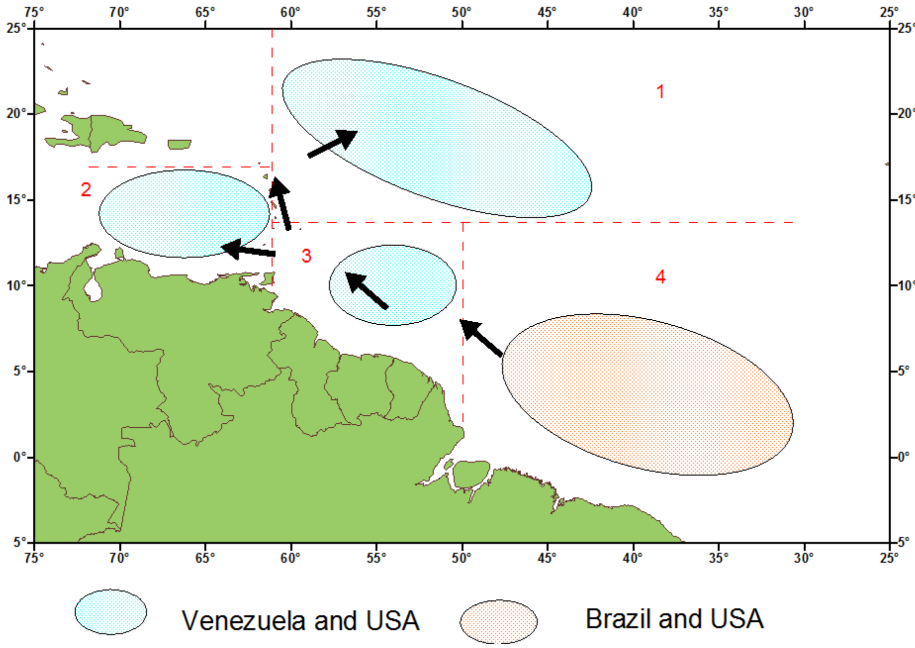

Figure 3: Depiction of the fishing areas where longline fleets of Venezuela, Brazil and USA report dolphinfish bycatch (ovals) and migration (arrows) inferred from GAM models of seasonal trends in catch rates.

1.3 Management advice

Based on the indices of abundance examined in the current study, there is no evidence to suggest that the stock is in a state of decline at current harvest levels. However, the assessments conducted at this workshop cannot be considered conclusive enough to predict the long-term sustainability of the fishery at current or increased levels of exploitation. Given this a precautionary approach should be adopted in managing this fishery and further developing of this fishery should not be promoted until the stock structure and dynamics are better understood.

Given the number of nations that are likely fishing the same dolphin stock and the possible extended geographic range of the stock or stocks complex, future stock assessments and management of this fishery must be based on continued collaborative arrangements between the CARICOM and major non-CARICOM fishing nations in the region including Venezuela, Brazil, France and the USA.

In order to improve future management countries should continue to give priority to the collection of accurate catch, effort and size data on dolphinfish and endeavor to recover and fill the gaps of historical catches from the earlier periods of the fishery.

1.4 Stock assessment summary

Total catch records for dolphinfish for territories in the WCA were obtained from various sources including directly from representatives of the national fisheries authorities and the FAO database examined and reviewed.

The Working Group initially examined nearly 220,000 trip catch records for three CRFM nations (Barbados, St. Lucia, St. Vincent) spanning the period 1994 to 2010. Trinidad and Grenada submitted summarized data for the period under consideration. However as these data were not disaggregated to the level of individual trips they could not be included in the CPUE-based abundance analyses that were undertaken at this meeting.

Changes in annual mean catch per unit effort (trip) were used as indices of abundance for the Eastern Caribbean dolphinfish fishery. A General Linear Models (GLM) was applied to standardize the data with respect to key factors identified (vessel type, season, island). The standardized annual CPUE estimates lack a significant trend, although they fluctuate between years. CPUE indices were unusually high for 2009 and 2010.

A review of the available data on stock structure was conducted including examination of tagging data from a project based in SE USA, seasonal catch per unit of effort trends from Brazilian, Venezuelan and USA fleets that harvest dolphinfish in the area and stock structure studies conducted in Brazil. Examination of all these data confirmed the migration of dolphinfish from the Equatorial area offshore from Brazil to the eastern Caribbean and the southeastern Caribbean Sea. A significant number of tagged fish were recaptured in the SE Caribbean, fish that were released in the SE coast of the USA. These recaptures question the hypothesis that the southern Caribbean stock is isolated from the stock in the northern Caribbean and the Eastern coast of the USA.

1.5 Statistics and research recommendations

Following are a number of recommendations to be addressed by the CRFM and individual countries for improvement of the quality of future assessments:

1.5.1 Recommendations for the Caribbean Regional Fisheries Mechanism

1. Continue collaboration with non-CRFM territories within the WCA region including the USA, Venezuela and France in future stock assessments.
2. Through the LPWG, further assess the implications of alternative stock structure hypotheses for dolphinfish in the WCA region.
3. Continue to monitor trends in regional catches and catch rates to identify any signs of changes in stock size and promote regional collaboration on appropriate management strategies to be implemented.
4. Encourage and assist countries to develop a regional database on historical catches and fishing effort, extending to a time period prior to the commencement of the CARICOM Fisheries Resource Assessment and Management Programme in the early 1990s. This exercise will involve intensive data mining from scientific, historical and administrative documents (published and grey literature) designed to expand the time series of available data, improve the contrast in the data set and contribute to improved parameter fitting in assessment models.

1.5.2 Individual countries

1. Countries must ensure that appropriate systems are in place to collect, record and report landings data for dolphinfish.

2. Provide accurate and complete data on total catches (or landings) of dolphinfish in the format and level of detail required by the CRFM for incorporation into stock assessments:
   a) Provide more detailed information on fishing effort associated with each catch record e.g. boat/ gear type and number of gear units as well as number of hours fishing or the number of hooks used. This information can facilitate improved estimates of catch per unit of effort and relative indices of abundance.
   b) Where necessary, revisions to sampling strategies should be considered to improve estimates of fishing effort, especially the identification of trips that target pelagic fish. This is required to properly estimate the number of trips that did not successfully catch dolphinfish because the relative frequency of these trips can also indicate changes in abundance.
   c) Conduct extensive review of historical data (data mining) aimed at providing information on historical catch rates and catches to improve the data base available for future assessments.
3. Submit fleet information to CRFM outlining on-going and historical developments to allow elucidation of the effects of changes in the fleet, fishing methods and technology on catch rates.

1.6 Special comments

None.

1.7 Policy Summary

The working group requires more information and guidance from the CRFM Forum on regional policies being considered for dolphinfish.

1.8 Scientific assessments

1.8.1 Background

1.8.1.1 Biology

Dolphinfish (*Coryphaena hippurus*) is a circum-tropical oceanic pelagic species. In the Atlantic the species is apparently restricted to waters warmer than 20^{o} C (Gibbs and Collette, 1959), ranging from as far north as Nova Scotia (Vladykov and McKenzie, 1935; Tibbo, 1962) to as far south as Rio de Janeiro, Brazil (Ribeiro, 1918; Scherbachev, 1973). However, the species only commonly occurs from North Carolina throughout the Gulf of Mexico and Caribbean to the northeastern coast of Brazil, where they are seasonally abundant (Oxenford, 1999).

Dolphinfish are fast growing and short lived (<2 years). Dolphinfish exhibit high fecundity reaching sexual maturity at an early age. In the western central Atlantic dolphinfish reach first maturity within the first year of life. Dolphinfish in the western central Atlantic area may have an extended spawning season peaking in May through June. The species is piscivorous, feeding mainly on scombrids, exocoetids, clupeids, cephalopods (Oxenford, 1999).

1.8.1.2 Distribution, migration and stock structure

Based on life history parameters and limited genetic data, Oxenford and Hunte, 1986, suggested the existence of at least two distinct aggregations of dolphinfish in the WCA region (northern and southern) with the ranges of the two putative stocks overlapping in the vicinity of Puerto Rico. Oxenford and Hunte (1986) furthermore, suggested that the range of the southern stock may encompass the entire the length of the northern coast of the South American mainland.

The two-stock hypothesis has been disputed by some workers e.g. Rivera and Appeldoorn (2000), Wingrove (2000). However, a subsequent genetic study that also included analysis of microsatellite variation at five polymorphic nuclear loci from dolphinfish samples suggested the existence of at least three genetically distinct populations in the region (an Eastern Caribbean, southern Florida (Daytona Beach south west to the Gulf of Mexico) and a Carolinean/Bermudean stock) (Chapman *et al*., unpublished).

1.8.1.3 The fishery

Dolphinfish is considered the most commercially important large pelagic fish in the Eastern Caribbean (Oxenford and Hunte, 1986). In the commercial fishery, the fish is captured with single hook lines and multi-hook longlines. In the recreational fisheries the fish is taken with rod and reel gear. The fish are known to aggregate around floating objects and are often captured around FADs. The fish is a major predator of flying fish and is a major associated catch species of the flying fish fishery of Barbados.

In the Caribbean dolphinfish may be taken by nearly any fishing vessel ranging from small open boats and fibreglass pirogues to the larger decked vessels including the longliners. However, the fish is only considered as a bycatch for the longline vessels, which mainly target the large tunas. Average trip lengths range from less than one day (8 to 12 hours) for the open boats and the decked Barbados dayboats to a number of days for the iceboats (between 4 days for Tobago and 7 days for Barbados) and longliners which may stay out at sea for more than 2 weeks. (See George *et al*., 2001 and Parker, 2001, for more details of the dolphinfish fishery).

1.8.1.4 Fisheries Management

Although listed as a highly migratory species in Annex I of the 1982 Convention on the Law of the Sea, the International Commission for the Conservation of Atlantic Tunas (ICCAT), which manages highly migratory species, does not specifically take responsibility for the management of Atlantic dolphinfish. As such there are no international systems for managing dolphinfish fisheries. The two regional FAO commissions, the Western Central Atlantic Fisheries Commission (WECAFC) and the Commission for the Eastern Central Atlantic Fisheries (CECAF), include dolphinfish as a species of interest. However, neither of these commissions deals with the actual management of fisheries as they were established by FAO as advisory bodies to FAO member countries and can set guidelines but not enforce regulations. An FAO sponsored study on management options for the large pelagic fisheries of the Eastern Caribbean (FAO, 2003) promoted the formation of a multinational management body for regional-based management of the dolphinfish fisheries. However, these regional management arrangements are yet to be finalized.

In the USA, the Dolphinfish fisheries conducted from the states of Maine to Florida are managed through the South Atlantic Fishery Management Council's (SAFMC) Dolphin Wahoo Fishery of the Atlantic Fishery Management Plan (FMP), in cooperation with the Mid-Atlantic and New England Councils. The SAFMC is precautionary in nature and geared towards maintaining current harvest levels. Regulations for the commercial fishery include: a total catch limit of 680 t, designations of essential fish habitat, minimum size limits, gear restrictions (only hook and line and spearfishing gear may be used with longline gear not to be used in areas where the use of that gear is prohibited for highly migratory species), and fishing permits are also required. Regulations for the recreational fishery include; a minimum size limit in some states, bag limits, and some permitting requirements.

There currently are no management regulations specifically for dolphinfish in any of the Eastern Caribbean countries. The need to manage this species at the regional level appears to be generally well accepted.

1.8.1.5 Eastern Caribbean stock assessment

1.8.1.5.1 Objective

The overall objective of these analyses was to ascertain the current status of the dolphinfish stock or stocks that exist in the Eastern Caribbean area and to advise on the future management of dolphinfish fisheries in the region. It should be noted that a major companion study at the 2010 CRFM Meeting, which will be reported subsequently, focused on defining the geographic range of the putative Southern Caribbean stock. However, the stock assessment reported here was limited to the Eastern Caribbean region to facilitate comparison with the results of earlier stock assessments that were also limited to this region. For the purposes of this assessment, standardized catch rates (CPUE) were examined to provide indices of abundance of the stock in recent years.

1.8.1.5.2 Method/models/data

The initial combined data set examined in this study comprised catch records for three CRFM nations (Barbados, St. Lucia, St. Vincent) spanning the period January 1994 to June 2010. All records were screened and records lacking crucial information such as the date of the landings catch weights etc removed along with obviously incorrect records. Whole weight in kilograms was used as the standard measure of catch weight. A conventional General Linear Model (GLM) approach was used to standardize the Eastern Caribbean catch rate (CPUE) data for elucidating inter-annual trends over the period studied (1995-2010) using natural log transformed catch weights.

It is well known that the fishing season for dolphinfish in the region begins in the latter half of one year and peaks significantly and ends in the early half of the following year. Given the short life span of the species (less than 2 years) it is presumed that the majority of the animals present in the area in any given fishing season are from the respective year's recruitment cohort. As such, it is more appropriate to define a standard time period that matches this recruitment-driven seasonality for the purposes of comparative time-series abundance assessments. The start and end dates of the typical fishing year were determined by examining the proportions of the annual catches taken in each month for all of the fishing fleets. Furthermore, to reduce the numbers of categories in the model it was decided to subdivide the fishing year into only two categories that included those months during which abundances were typically low (Low season) and those in which abundances were typically high (High season). The proportions of the annual catches taken in each month for all of the fishing fleets was also used to define these two seasons.

In terms of fishing power and techniques it was considered appropriate to group vessels along the lines of the Eastern Caribbean pirogue; Barbados moses, Barbados day boat, Barbados iceboat and Barbados longliner. In most cases, information such as the number of gears used, soak times and days fished were not provided by the reporting countries. Therefore, it was only possible to use catch per trip as a crude index of catch per unit effort. Differences in the catches per trip between such vessels thus include any differences due to the trip lengths usually taken by each vessel category (usually one day for pirogues, moses and dayboats, and multiple days for ice boats and long liners).

It should be noted that the records analysed here were only for successful fishing trips where dolphin landings were actually reported. Without taking into account unsuccessful fishing trips (i.e. fishing trips where dolphinfish were targeted but not taken), values of mean annual catch per trip will necessarily be overstated. For the purposes of tracking inter-annual trends in catch rate, overestimating the actual values is of course not that important provided that the numbers of unsuccessful trips were fairly constant and therefore the degree of overestimation was also constant over the years.

The existing catch reporting systems of most islands do not record true zero catch trips i.e. trips taken where unsuccessful attempts to capture large pelagics were made. Consequently this information was not available to the meeting. However, a crude index of zero catch trips in the context of dolphinfish, was calculated based on the percentage of total trip records in which any large pelagics (tunas, billfish, swordfish and wahoo) were taken for each fishing year period, (i.e. presumptive large pelagic fishing trips) that actually caught dolphinfish. The results were then simply plotted to illustrate any temporal trends. Only the Barbados dataset available to the meeting included catch records of other species and consequently this assessment was constrained to the four Barbados fleet types.

1.8.1.5.3 Results

<u>*Catch rates*</u>

Table 1 summarizes the total numbers of data records used in these analyses by state and fishing year. The monthly percentage contributions to total catches of dolphinfish by fleet type are presented in figure 1. Based on the seasonal abundance patterns in these graphs, it was decided to define a fishing year as July of the calendar year to June (inclusive) of the following calendar year. Additionally, the "High season" was determined to run between the months of February to May (inclusive), where monthly contributions were more than 10% of the respective total catch and the "Low season" was deemed to run from July of the calendar year to January of the subsequent calendar year.

The fishing year was designated the year in which the peak abundance occurred. For example the fishing year "1995" included the months of July to December 1994 and January to June 1995. Given that this treatment meant that only the months of January to June 1994 would represent the fishing year "1994"; these records were excluded from the analyses. As such the dataset analyzed started with the first complete fishing year of 1995. It should also be noted that only St. Vincent provided data for the latter half (January to July) 2010 for the fishing year 2010.

The statistics of the GLM analysis are presented in Table 2. All factors and interactions were found to have a significant effect on the GLM model and in addition to the fixed factors themselves (state, fishing year, season, vessel type) all first-level factor interactions (year*season, season*state, year*state and season*state) were included. However, none of the factor interactions (i.e.) improved the fit of the model by more than 5%. Therefore, only the fixed factors (i.e. year, season, stategear) were included in the final model. The statistics of the final full factorial model GLM used are presented in table 2.

A plot of the percentage of presumptive large pelagic trips by fishing year that included dolphinfish for each Barbadian fishing fleet type is presented in figure 3. The percentage of trips landing fluctuates appreciably for the moses and longliners, however there is no clear trend. In the case of both the dayboats and iceboats there is much less fluctuation with a fairly flat trend over the years.

1.8.1.5.4 Discussion

Based on the data available for the present study, mean catch rates (standardized catch per trip) of dolphinfish in the eastern Caribbean have fluctuated appreciably between about 32.8 kg/trip and 74.7 kg/trip over the period examined with comparatively very high values in 2009 and 2010.

However it should be noted that judging by the width of the error bars, the estimated mean for 2010 is quite uncertain. This uncertainty is most probably the result of the lack of landings records for both Barbados and St. Lucia for the months of January to June of 2010, which would be the peak season for the 2010 fishing year. It is also noteworthy that catches were above average for the last 4 years of the period examined (2007-2010).

Given the lack of any signs in a decline in catch rates over the study period (1995-2010), and the apparent increased catches in the last years, there is no evidence of decline in stock abundance over the current study period. Furthermore the lack of any declining temporal trend in the proportion of recorded large pelagic trips for any of the four fishing Barbados fishing fleets also supports stability in the stock over the study period. Based on these lines of evidence it may be concluded that the level of catches of dolphinfish over this time-frame have not severely impacted the sustainability of the stock and that current levels of harvest are probably sustainable. However, it must be cautioned that the period of this study only covers a relative short portion of the life of this fishery in the region and with limited information on historic stock abundances (i.e. prior to the study period) it is not possible the maximum biomass of this stock. Furthermore, the level catch trend over most of the study period coupled with an increase in the latter years makes it impossible to estimate MSY or other related reference points for management purposes or predict the long-term sustainability of the fishery at current or increased levels of exploitation.

It should be noted that the scale of the interannual fluctuations in the values of the proportions of successful dolphinfish trips especially in the case of the moses and longliners, and to a lesser extent the dayboats, is large enough to warrant consideration in future assessments such as through the use of a Delta-Lognormal model approach. Furthermore, few countries reported finer-scale effort information such as the length of the fishing trips, gear soak times and the numbers of gears used on each trip. Such information cannot be gleaned from general market data and must be obtained through more focused methods such as fisher interviews or trip logbooks. Authorities in the region should consider options for capturing this detailed information in the future. However, national surveys should be conducted to identify any historic changes at the gross level at least so that necessary adjustment factors may be included when assessing historic data series.

For the purpose of assessing a regionally shared stock, the dataset used for the present analyses was very limited both in terms of the number of fishing countries represented and the number of years for which records was provided. Given the importance of this species to most Eastern Caribbean countries it is important that greater efforts be made to collect and provide the data needed for stock analyses in the future.

1.8.1.5.5 Tables and Figures

Table 1: Number of trip records by country, fleet and fishing year.

Year	Dayboat	Iceboat	Longliner	Moses	Barbados Total	St. Lucia pirogue	St. Vincent pirogue	Total
1995	3506	1372	73	91	5042	2928	28	7998
1996	2746	1404	73	62	4285	2789	84	7158
1997	1364	1414	148	75	3001	2313	149	5463
1998	1307	1519	130	62	3018	1499	106	4623
1999	938	1460	176	63	2637	1841	196	4674
2000	752	1390	189	70	2401	1577	202	4180
2001	720	1402	150	142	2414	1954	62	4430
2002	862	1296	141	139	2438	1962	88	4488
2003	402	1387	144	121	2054	1500	170	3724
2004	523	1278	152	159	2112	1674	129	3915
2005	407	1077	138	106	1728	1276	16	3020
2006	460	1026	189	134	1809	1510	810	4129
2007	464	1140	168	220	1992	1991	1058	5041
2008	210	1130	167	82	1589	1379	627	3595
2009	277	1146	151	134	1708	1801	1041	4550
2010	13	150	31	8	202	373	728	1303
Total	14951	19591	2220	1668	38430	28367	5494	72291

Table 2: GLM model statistics.

Tests of Between-Subjects Effects
Dependent variable = Log weight

Source	Type III Sum of Squares	Degrees of freedom	Mean Square	F statistic	Sig.	Partial Eta Squared
Corrected Model	9.7E+03	1.2E+02	8.4E+01	4.6E+02	0.0E+00	4.3E-01
Intercept	3.1E+04	1.0E+00	3.1E+04	1.7E+05	0.0E+00	7.0E-01
State	7.0E+00	1.0E+00	7.0E+00	3.9E+01	4.3E-10	5.4E-04
Fishing year	1.6E+02	1.5E+01	1.0E+01	5.8E+01	4.8E-174	1.2E-02
Season (high/low)	4.3E+02	1.0E+00	4.3E+02	2.4E+03	0.0E+00	3.2E-02
Vessel type	1.3E+03	3.0E+00	4.4E+02	2.4E+03	0.0E+00	9.1E-02
State * Fishing year	8.5E+01	1.5E+01	5.7E+00	3.1E+01	8.1E-91	6.5E-03
State * Season	3.7E+00	1.0E+00	3.7E+00	2.1E+01	5.9E-06	2.8E-04
State * Vessel type	0.0E+00	0.0E+00	.	.	.	0.0E+00
Fishing year * Season	5.0E+01	1.5E+01	3.3E+00	1.8E+01	5.5E-50	3.8E-03
Fishing year * Vessel type	4.4E+01	4.5E+01	9.7E-01	5.4E+00	1.3E-28	3.3E-03
Season * Vessel type	1.1E+02	3.0E+00	3.6E+01	2.0E+02	2.5E-130	8.3E-03
Error	1.3E+04	7.2E+04	1.8E-01			
Total	2.4E+05	7.2E+04				
Corrected Total	2.3E+04	7.2E+04				

a. R Squared = .427 (Adjusted R Squared = .426)

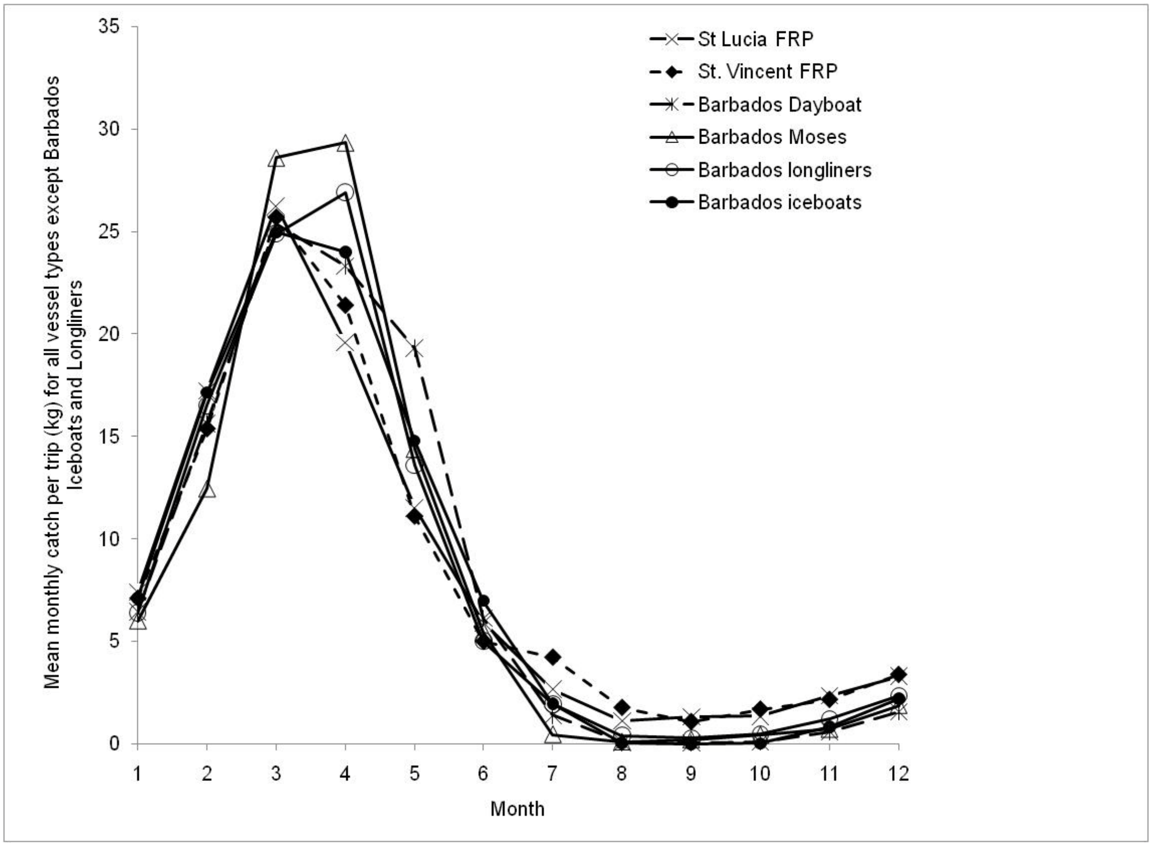

Figure 4: Seasonality of dolphin abundance in the region illustrated by mean monthly catches by Eastern Caribbean fishing fleets for the period 1994-2010

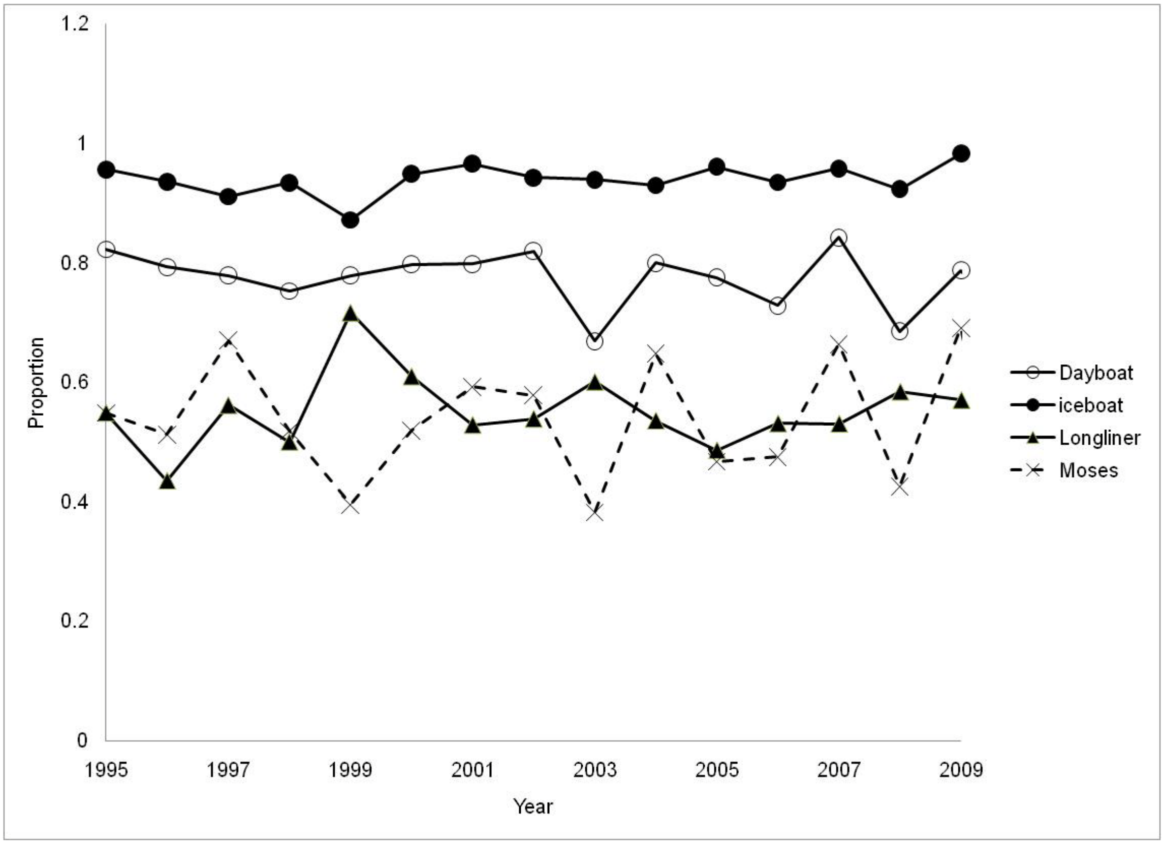

Figure 5: Proportion of all landings by Barbados fishing fleets of any large pelagic species (see text for details) that included dolphinfish (1994-2009)

5.9 References

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2. Evaluation of Blackfin tuna data

Prepared by: John Neilson and Carolina V. Minte-Vera

2.1 Available Catch Information

The Group examined available catch data from ICCAT (Figure 1). The total catches have increased steadily through 2002, reaching a peak of about 4500 t, with a rapid decline thereafter. However, EU-France did not report catches after 2002, and the reliability of the earlier records may be in doubt. Also, Cuba and the Dominican Republic reported significant catches in the 1980s, but have not reported since the late 1990s. In the case of Cuba, the absence of reported catches in recent years is puzzling, as Claro *et al*. (2001) state skipjack and blackfin tuna are the most important pelagic fish resources for that nation. The more recent annual total catches for all countries is less than 2000 t.

Table 1 summarizes available ICCAT catch data as shown in Figure 1, but further disaggregated by gear. While ICCAT Task 1 data are available, no Task 2 (catch and effort) or Task 2 (size) data are available for this species. The table gives a view of available data series, and their duration. Particularly complete data series are available for baitboat (Brazil and Venezuela), and unclassified gear series from Dominica, Grenada, and St. Vincent and the Grenadines.

The Group discussed some country-specific details of the landings information. Freire (2008) reported that no landings of blackfin tuna were recorded in the official data for Brazil before 1995. She concluded that the landings of this species (*albacorinha* in Portuguese) may have been recorded under another species (*albacora*) both in the Northeastern Brazil and in the rest of the country. The artisanal fishery for this species is mainly done in Baía Formosa (South of Rio Grande do Norte State) from September to January. Almost all landings recorded as *albacora* for Baía Formosa are, in fact, blackfin tuna. The artisanal catch of this species oscillated from 11.6 to 48.0t in Baía Formosa, from 1993 to 2001.

For Martinique and Guadeloupe catch series is available for 1989 to 2009. Part of this series was reconstructed based on the average annual catch per boat in 2008 and the number of boats operating year. This last information was obtained from interviews with skippers.

For the Venezuelan fisheries, blackfin tuna is commonly caught by the purse seine (PS) and baitboat (BB) fleets operating mostly in the Caribbean Sea. The Venezuelan purse seine fleet that operates in the area consists of 10 vessels, mostly with a capacity of 600 T. The baitboat fleet, consist of about 8 vessels which most of the time operate in conjunction with the purse seine fleet, with a capacity that ranges between 50 and 250 T.

The information presented in Figure 2 corresponds to the Venezuelan National Report submitted to ICCAT between 1988 and 2008. The combined landings (PS and BB) of blackfin tuna averaged 1678 T during the period 1988-2008. Peak landings occurred in 1994 and 1995 (~ 7400 and 8300 T).

The Group recommended that efforts be made to validate early catches from Cuba. For both the Dominican Republic and Cuba, the Group recommended confirming that no catches have been made in more recent years. Also, no data are currently available for some Eastern Caribbean countries where catches might be expected, given the known range of the species. Prior to the assessment, efforts could be made to recover these data, if possible. Finally, it was noted that the

Venezuelan landings differed between the ICCAT Task 1 data source, and the National Reports. Efforts to resolve the difference prior to the 2011 assessment are recommended.

2.2 Available Catch Rates

The following countries have information on blackfin tuna CPUE: Venezuela, St. Lucia, St. Vincent and the Grenadines, and the USA. The data series for St. Lucia extends from 1981 to 2009. The areas fished are within the St. Lucian Exclusive Economic Zone. The fleet consists of fiberglass-reinforced pirogues. The gear fished includes trolling and handline, and the fishing activity takes place between December and May.

Martinique and Guadeloupe have catch rate data for 2008 and 2009.

For Venezuela, catch rate series are available for both the baitboat (BB) and purse seine (PS) fleets (Figure 3). Effort was recorded as effective days of fishing (ef f days), nominal catch rates. The PS fleet presented the highest catch rates showing high levels in 1994, 1995 and 1997 of about 5000 kg/ef f days; while the BB fleet showed relatively high catch rates between 1994 and 2002, varying between 500-1100 kg/ef f days.

2.3 Stock structure

The only study on the genetic basis for stock structure identified by the Group was Saxton (2009). This author analyzed data of adult and larvae samples from the Gulf of Mexico and the NW Atlantic (Table 2). The mitochondrial DNA CR-I and six microsatellite loci revealed evidence of significant population differentiation between blackfin tuna from the two locations. This result may indicate that there is some finer-scale population structuring within the Region.

Further support for the local nature of blackfin tuna population structure is found in the tagging study of Singh-Renton and Renton (2007). Those authors described the results of a mark-recapture study of 787 blackfin tuna released in the EEZ of St. Vincent and the Grenadines. While only 11 recaptures were reported, 6 were at liberty for >100 d. In all cases, the distance between point of release and recapture was <100 km.

2.4 Length frequency data and biological parameters

From 1995 to 1998, St. Lucia collected information on length and sex composition of the catch. From 1986 to 1987, Martinique collected information of length for fish caught with H.S. lines and Deep trolling lines, and for 2008-2009 for fish caught on FADs and H.S. Lines. It was also noted that there are difficulties in correctly identifying the small blackfin tuna; therefore they are reported as small Thunnini, which may bias the length frequencies.

Headley (2005) presented information on blackfin tuna in the artisanal fishery in Tobago. The diet; sex ratio and size structure of the catch; length-weight and length-length relationships for males and females; gonadosomatic indices and state of maturity of males and females; and size at maturity were investigated during the period July 31 to September 17, 2004 for blackfin tuna landed at the Charlotteville fish market, Tobago. The blackfin tuna ranged in size from 32-91 cm FL and in weight from 0.7-13.1 kg. The mean size of the blackfin tuna was 71 cm FL, the mean weight 7.36 kg and the sex ratio of males to females was 2.03:1. The length at first maturity was 53 cm FL for males and females. Most females (85.6%) were either maturing or mature and most males (90.7%) were mature. The length-weight relationships for females and males were $W = 0.00007\ L^{2.6988}$ and $W = L\ 0.00006\ L^{2.7088}$ respectively. Headley *et al*. (2009) reported overall numerical abundance of prey items comprised fish (48%), crustaceans (46%) and cephalopods (6%). Prey species included small pelagics such as anchovies (ranked as most important prey overall), juveniles of larger pelagic such as jacks, juveniles of fish found in coral reef communities as adults, e.g. squirrelfishes, and some mesopelagic species. The importance of major diet categories differed significantly with predator size, with fishes becoming more important and crustaceans less important with increasing size.

Samples of the fish landings from 1996 to 2000 in Northeast Brazil (mainly Baía Formosa, thought to be a main spawning area in Brazil, 6°22'S and 35°00'W) allowed estimating the size structure and biological parameters (Freire 2008, Freire et al 2005). The landed fish ranged from 360 to 890 mm. Most landings were recorded from September to January, every year (Figure 4). The size with 0.5 probability of capture by hand line was 622 mm SL. The Von Bertalanffy growth parameters, estimated using the ELEFAN I software and length frequencies from 1996 to 1998, were: $L\infty$ = 910 mm, K= 0.62. The t_0 was assumed to be -0.22, after Doray *et al.* (2004). The relationship between eviscerated weight (WE g) and standard length (SL mm) was $WE=0.00001SL^{3.0284}$ (n=5209 fish). Viera et al (2005a) report the total weight (WT g) to total length (TL cm) relationship to be: $TW = 0.0255\ TL^{2.8438}$, for females, $TW = 0.0108\ TL^{3.0588}$, for males, and $TW = 0.0128\ TL^{3.0165}$, for sex combined; the total length to fork length FL to be: TL= 1,3381 +1,0449 FL, for females, TL= 1,3456 + 1,0449 FL, for males, and TL = 1,2496 + 1,0459 FL, for sexes combined. Spines from the studies by Freire are available for further investigation (Freire, pers. comm. to C. Minte-Vera.).

The reproductive activity in Baía Formosa (Brazil) was assessed for the months when there were enough samples (October to January 1996, Freire 2008), and it was detected for all those months. The size of first maturation (L50) was 492 mm SL for females and 513 mm for males. Viera *et al.* (2005b) sampled fish from September 2000 to January 2001 landed in Baía Formosa and observed reproductive activities in the whole period. The L50 was estimated to be 510 mm total length TL for females, while the L100 was 575 mm TL. The absolute fecundity ranged from 224,708 oocytes for a fish with 520 mm TL (1800g TW 18,58 mg of gonadal weight GW) to 4.874,389 oocytes for a fish with 722 mm TL (5800g TW and 260,06mg GW). Viera et al (2005b) concluded that coastal waters off Northeastern Brazil are a reproduction area for the blackfin tuna. Viera *et al*. (2005a) found that the sex ratio of landings favours males: 2.1 male to 1 female (946 specimens sampled).

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Table 1: ICCAT Task 1 blackfin tuna catches by flag and gear in the Western Atlantic, expressed in tons. Where the available data are available prior to 1990, the starting year of the series is reported

Flag	GearGrp	Year of Series Start, if <1990	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Brasil	BB	1982	16.0	56.0	35.0	20.0	31.0	153.0	265.0	93.0					151.0	1.2	118.0	90.0		232.7	17.9
	LL																	0.6	2.0	0.3	0.1
	LLFB						0.2		1.0	26.0											
	LLHB	1985	2.0		2.0	2.0	0.4		1.0	2.0											
	SPOR																	0.3	0.2		0.1
	SURF	1963	317.0	74.0	12.0		6.0		382.0	297.0	55.0	55.0	38.0								
	UNCL													148.5	1518.2				240.1		248.3
Cuba	BBI	1981	487.0	318.0	196.0	54.0	223.0	156.0	287.0	287.0											
Dominica	HAND																	18.1	9.2	24.0	
	LL																	0.1	0.0		
	LL-B																	0.0			
	TRAP																	0.1			
	TROL																19.8	38.0	28.8	19.7	12.3
	UNCL	1988	19.0	10.0	14.0	15.0	19.0	30.0				79.0	83.2	54.0	78.0	42.0			0.1	0.2	0.2
Dominican Republic	SURF	1968	520.0	536.0	110.0	133.0	239.0	892.0	892.0												
EU.España	PS				307.0	46.0															
EU.France	PSM	1974																			
	SURF	1970	865.0	1210.0	1170.0	1140.0	1330.0	1370.0	1040.0	1040.0	1040.0	1040.0	1040.0	1040.0	1040.0						
	UNCL	1950																			
Grenada	LL														254.6				371.3		
	TROL															334.7	267.6	306.3		291.4	290.3
	UNCL	1970	293.0	195.0	146.0	253.0	189.0	123.0	164.0	126.0	232.7	94.0	163.8	222.7							
Jamaica	UNCL																				
Mexico	LL					0.5								12.1		9.7	9.0	9.9	10.0	12.5	5.7
Netherlands Antilles	UNCL	1978	70.0	60.0	60.0	65.0	60.0	50.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0						
St. Vincent and Grenadines	UNCL	1988	38.0	11.0	7.0	53.0	19.0	20.0	18.0	22.0	17.2	15.0	23.0	24.0	24.0						
Sta. Lucia	HAND	1987	17.0	14.0	13.0	16.0	82.0	47.0			60.3		45.3	107.5							
	TROL															168.6	95.9	126.0	182.1	150.6	179.1
	UNCL								35.0	40.0	40.0	41.0			96.1						
Trinidad and Tobago	LLHB																	0.0		0.1	0.2
	RR															0.0	0.0	0.0		0.0	0.1
	SURF																				5.0
	UNCL															5.0	5.0	5.0	5.0	5.0	
U.S.A.	GILL	1989			0.2				0.0	0.3	4.0	2.0	1.4	4.0	0.9	1.6	0.6	0.5	0.2	0.1	0.4
	HAND	1981	10.0	1.4	1.2	29.0	0.1	7.0	9.0	8.0	8.0	20.0	12.1	21.5	23.5	32.2	23.5	19.7	14.7	14.6	17.0
	HARP														0.0						
	LL	1985	51.5	108.0	123.0	87.0	10.0	55.0	49.5	62.0	43.2	27.3	23.6	28.3	21.7	14.4	13.2	13.5	9.9	5.0	5.1
	MWT					0.0															
	PS																				
	PSG	1981																			
	RR	1985		0.0		389.0	482.0	518.0	388.0	469.0	647.0	568.0	288.5	419.6	287.0	365.4	637.8	191.1	806.3	402.0	631.2
	TRAP									0.1				0.3	0.2	0.2	0.1	0.1	0.0		0.2
	TRAW										0.1	0.0	0.1	0.3							
	TROL	1987	19.0	2.0	2.0	3.0	0.0	2.0		8.0	5.0										
	UNCL		0.5	0.5	0.2	0.2						0.0	0.0		0.3						
UK.Bermuda	RR	1977	13.0	8.0	6.0	5.0	7.0	4.0	5.0	4.0	6.0	6.0	5.0	4.0	5.0	9.0	4.0	5.0	8.1	7.3	6.3
UK.British Virgin Islands	LLHB																		3.0		
Venezuela	BB	1986	215.0	357.0	243.0	214.0			64.0	60.0	108.0		117.2	859.2	821.0	106.7	127.4	104.2	71.3	34.4	28.8
	LL					1.0			3.0	3.0		326.0							0.8	0.4	
	LLHB					2.2	8.2	2.9		19.7	19.4	22.5		38.0	65.5	9.1					
	PS		935.0	1241.0	1905.0	1007.0			691.0	415.0	907.0	844.0	471.9	891.2	323.2	203.6	604.5	120.6	164.9	741.9	201.8
	UNCL						13.0	621.0						113.5							

Table 2. Sample locations of blackfin tuna by region of capture North West Atlantic (NW Atl) and Gulf of Mexico (GoM) in a study of blackfin tuna stock structure using genetic markers (Saxton 2009)

Group	Sample	Year	n	Tissue Type	Location
NW Atl n=35	Charleston	1994	18	Adult	North Atlantic
	Islamorada	1994	16	Adult	26 N, 80 W
	Bermuda	1995	1	Adult	35 N, 65 W
GoM n=125	Freeport	2001	17	Adult	27 N, 94 W
		2002	1	Adult	27 N, 94 W
	Venice	2002	19	Adult	28 N, 94 W
		2003	18	Adult	28 N, 94 W
	GoML	2005	3	Larvae	27-28 N, 88-94 W
		2006	46	Larvae	27-28 N, 88-94 W
		2007	25	Larvae	27-28 N, 88-94 W

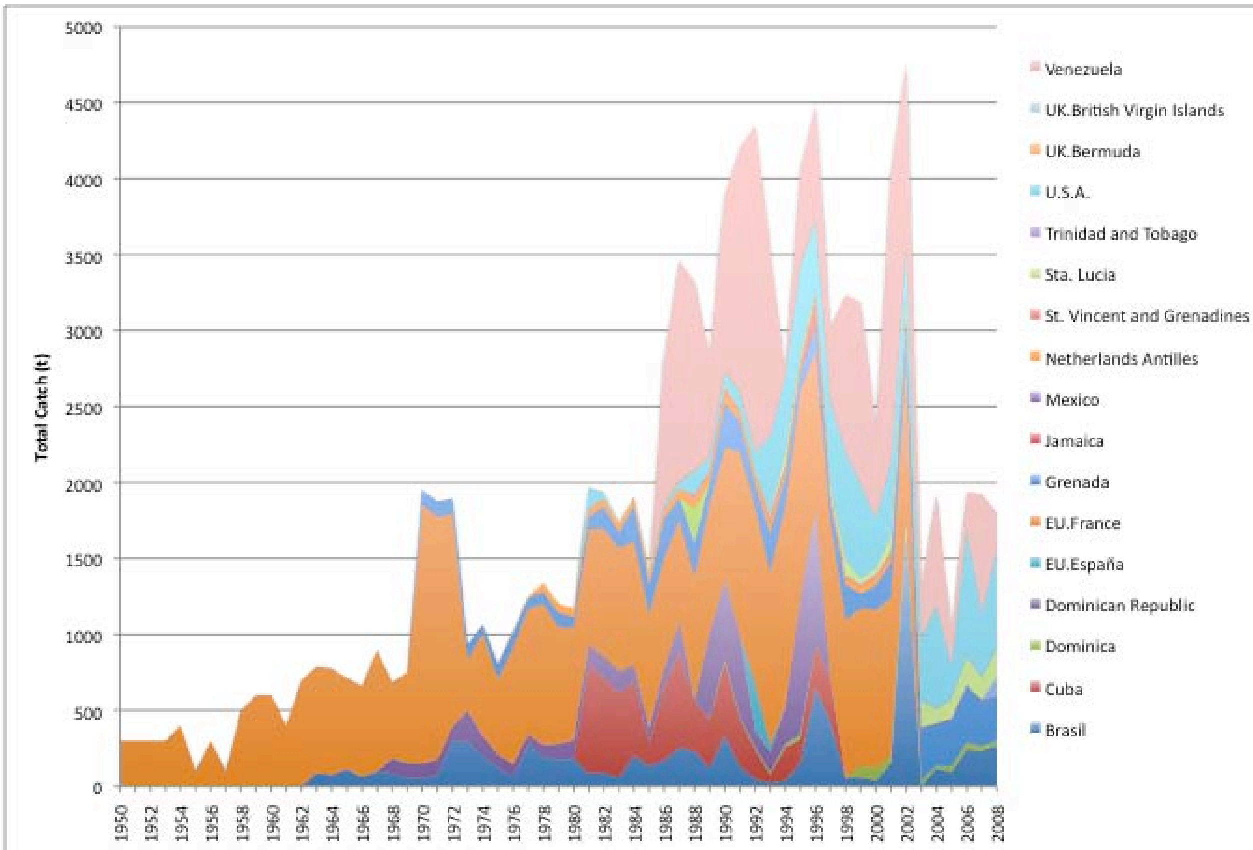


Figure 1: ICCAT Task 1 catch data (t), for blackfin tuna (Thunnus atlanticus) in the western Atlantic.

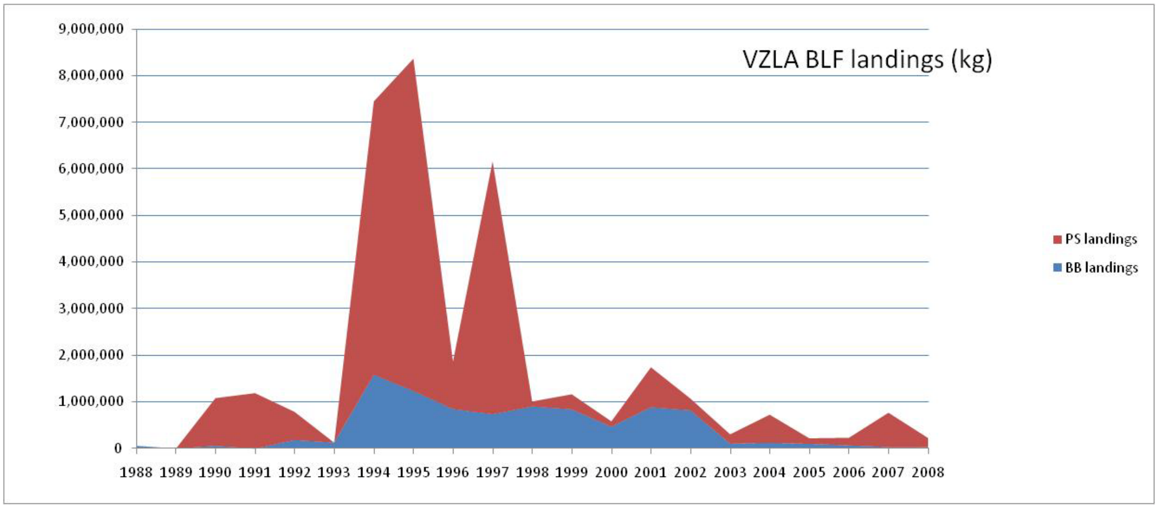
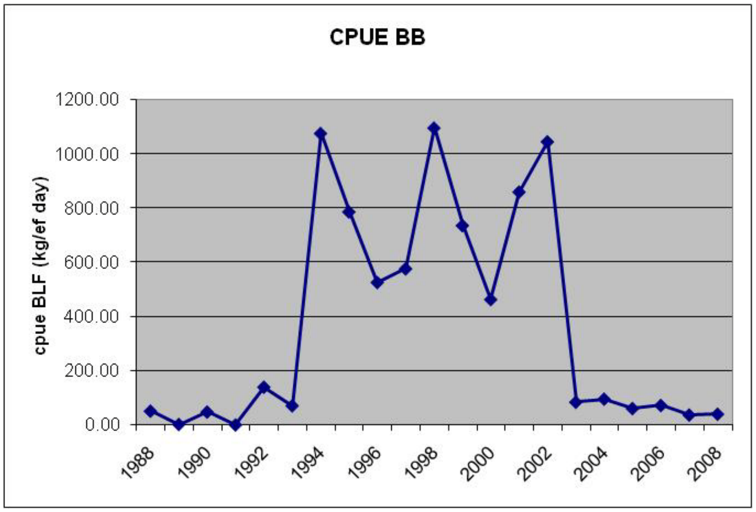


Figure 2: Venezuelan catch (kg) of blackfin tuna (Thunnus atlanticus) by the purse seine and baitboat fleets, 1988 to 2008, as reported in National Reports to ICCAT.



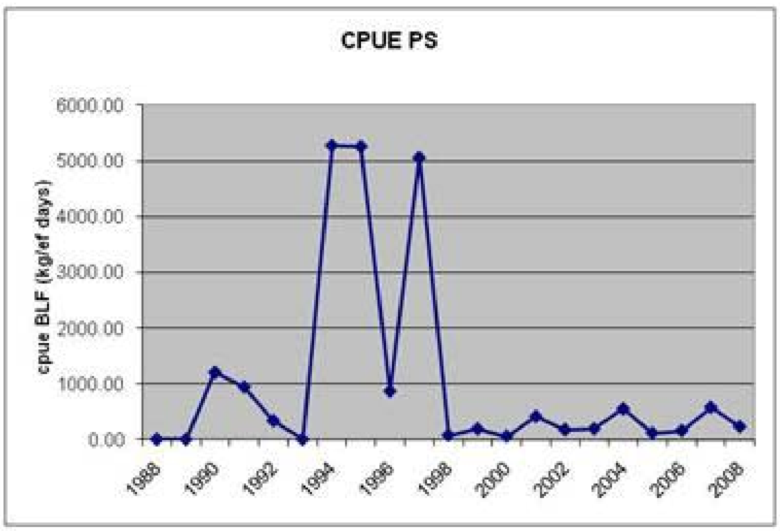


Figure 3: Venezuelan catch rates (kg/effort days) of blackfin tuna (Thunnus atlanticus) by the purse seine and baitboat fleets, 1988 to 2008.

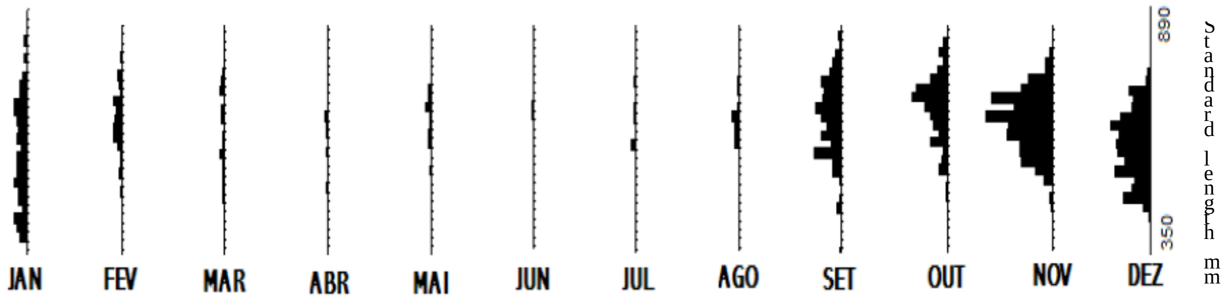


Figure 4: Standard length frequency (mm) for blackfin tuna Thunnus atlanticus sampled from 1998 to 2000 during the REVIZEE program in the Northeastern Brazil (3oS to 13o S, n=1082 fish). Data aggregated by month. Source: Freire (2008).

Appendix 6: Report of the First Meeting of the Working Group on Data, Methods and Training (DMTWG)

1. Opening of the Meeting

The Chairperson, Mr. Lester Gittens, opened the meeting, acknowledging that it was the first formal meeting of the Working Group, the establishment of which had been approved by the Seventh Meeting of the Caribbean Fisheries Forum in July 2009. In opening the plenary session, Mr. Gittens thanked June Masters for her efforts in chairing the informal meeting of the Working Group held in 2009. In addition, Mr. Gittens acknowledged the value of the R training session and the importance of participants putting into practice what they had learnt and ensuring their personal commitment to ensuring that their skills kept growing from year to year.

2. Review and Adoption of Meeting Agenda

The agenda for the meeting was adopted without any amendments. The adopted agenda is given in Annex 1. It was agreed that agenda item 3 would be conducted on the first day and on the morning and late afternoon of the second day of the meeting. It was agreed to address agenda items 4 and 5 during a plenary session on the afternoon of the second day.

3. Training in R

This agenda item was led by Professor John Hoenig. Each participant received a USB drive, loaded with the contents of the R training course that had been developed for the CRFM course by Professor Hoenig.

The primary purpose of the present R training was to allow participants to gain basic competence in using R and the companion package Tinn-R. In consequence, training sessions focused on several topics, including:

(i) basic computations,
(ii) data entry and manipulation, including sub-setting of data,
(iii) importing and exporting of data,
(iv) simple functions for data exploration,
(v) linear and non-linear regression,
(vi) data plotting.

Sample datasets were also used to facilitate the training in R, where necessary.

4. Plenary session to review and discuss issues and recommendations pertaining to: data, methods and training

The plenary session commenced at 3:25 p.m. on the afternoon of the second day of the meeting, and focused on selected key issues.

4.1 Data and Methods

4.1.1 Data submission and reporting deadlines - The Chairperson enquired about the fulfillment of the 2009 recommendation that countries submit cleaned datasets and national reports 6 weeks in advance of the meeting. The Secretariat indicated that this deadline was still not being met. The chairperson emphasized the importance of personal commitment on the part of national representatives in ensuring that their data and information submissions were made on time, and by so doing, maximizing the outputs and hence benefits to be derived from the proposed work of the scientific meetings.

4.1.2 Flow of information - The Chairperson then considered the importance of flow of information in ensuring an active management response to the advice generated by the annual scientific meetings, and recognized the role of fisheries officers in providing feedback when they returned to their respective countries. It was pointed out that so far, most of the management advice generated had not been dramatic, and that this may have been the reason for the apparent lack of reaction by the managers. The Working Group acknowledged that the national representatives at the annual scientific meetings and the CRFM Secretariat had distinct responsibilities at their respective levels for ensuring flow of information to fisheries stakeholders and managers.

A query was then raised about the status of the CRFM newsletter, which could potentially aim to provide monthly information updates. The Working Group was advised that the CRFM Newsletter had not been published for a while. The regularity of information flow at the scientific level was essential, as also the regularity of information flow to the fisheries stakeholders. It was pointed out that even though the reports of the scientific meetings were readily available online, and that scientific meeting report volumes 1 and 2 were produced as references to satisfy both the scientific and management readership, there was still a need to reproduce the information in a third format that would attract and engage a broader readership comprising both stakeholders and the general public. It was suggested that the required third format could be an annual scientific newsletter. There was some discussion regarding the value of an annual versus a monthly newsletter, and the content of such a newsletter. The Working Group also considered the necessity to have the scientific meeting outputs endorsed by the Caribbean Fisheries Forum (CFF) prior to their publication in any newsletter. Given the current time lapse between annual scientific meetings and the annual meetings of the CFF, The Working Group noted that there would be a 1-year delay in the release of scientific meeting outputs in the proposed third format.

In conclusion, the Working Group agreed that a listserve should be developed and used to address primarily the communication and information flow needs to serve the annual scientific meetings and its associated inter-sessional activities. In addition, the Working Group agreed that the scientific newsletter should commence as an annual product that should capture the outputs of the annual scientific meetings in a layman-friendly presentation format.

4.1.3 CRFM notebook/casebook - Concerning the recommendation to establish a CRFM notebook/casebook, the Chairperson sought the Working Group's ideas on implementation. The meeting agreed that the CRFM notebook/casebook should include any and all materials that would be considered useful. The need to develop and include standardized data forms in the notebook/casebook was discussed further, but there was no consensus on this matter.

However, it was agreed that the examples used for the notebook/casebook should include the relevant data forms applied to the situation under study, and should also provide clear guidance on data requirements. Such guidance could then form the basis for revising data forms at the national level. The Working Group recognized that contributions to the notebook/casebook would require those involved to communicate and collaborate with each other during the inter-sessional period.

A query was raised regarding the expected format for contributions, but the Working Group considered it premature to determine a format at this time. It was therefore agreed to wait to examine candidate contributions before finalizing the format, although it was envisaged that each contribution would include, at the minimum: data used, description of the analysis method, software used, and a comparison of approaches. The representative from the Turks and Caicos Islands volunteered to prepare the first contribution for the notebook/ casebook, to be submitted by the end of December 2010.

4.1.4 CRFM Toolbox – The Chairperson enquired whether the CRFM toolbox was still relevant and required. The Working Group generally agreed that the toolbox should be attempted. A concern was raised that the consultants should not be solely responsible for preparing the contributions to the CRFM toolbox. Professor Hoenig, who had conducted the training in R, volunteered R-scripts for inclusion in the toolbox, if the distribution of the scripts could be limited to participants in CRFM-related activities, and specifically, the scripts not be published on the internet.

The Chairperson then invited the Working Group to consider the mechanism for maintaining the toolbox. It was agreed that example data instead of real data would be used for illustrating the 'tools' included. There was also some discussion about whether the toolbox should be stored on the CRFM website, or retained by the Secretariat at its office. However, no final decision was reached on this matter.

4.1.5 Parfish – The Working group was reminded that a test of the Parfish method was being applied to the shrimp fishery of Trinidad and Tobago, and that the study was scheduled to have been completed during the 2009-10 inter-sessional period. However, given the absence of representation by Trinidad and Tobago, the presentation of the Parfish test update was deferred to the next meeting of the Working Group.

4.1.6 Fish age and growth research by IMA - The Chairperson requested an update on the progress of the proposal submitted by IMA for resumption of regional fish age and growth research. The Secretariat confirmed that at its meeting held in April 2010, the CFF gave approval for CRFM to pay an annual financial contribution to IMA for regional fish age and growth research. This annual financial contribution would be determined annually, in accordance with the approved CRFM annual work plan and budget commitments.

Recommendations

1) Recognizing the need to sustain communications during the inter-sessional periods, the Working Group proposed the establishment of a CRFM scientific listserve. The purpose of the listserve would be to facilitate communications and information exchange among those who participate in the annual scientific meetings.

2) Recognizing the need to attract and engage a broader readership that would include the general public, the Working Group proposed that a CRFM Scientific Newsletter should be established, sanctioned by the Caribbean Fisheries Forum and the Ministerial Council to operate with an agreed protocol. The Chairperson of the Annual scientific meeting, supported by the Secretariat, would be responsible for producing the newsletter. It was further recommended that a special bulletin could be released, as required and identified by the work of the proposed listserv.

3) The Working Group proposed to commence work on the notebook/casebook during the 2010-11 inter-sessional period, with the first contribution to be prepared for analysis of a fishery of the Turks and Caicos Islands.

4.2 Training

4.2.1 ECOPATH – The Chairperson asked the Secretariat to update the Working Group on training in ECOPATH. The Secretariat advised that its present understanding is that training in ECOPATH would be addressed in response to the relevant specific assessment needs identified by the Working Groups. To date, no specific need has been identified.

4.2.2 Training in data analysis – The Working Group acknowledged the achievements made during the present meeting in respect of the introduction to the R statistical software. There was considerable debate about the need to repeat the same course in 2011, versus an advanced course in R. Although national representatives to the scientific meeting changed from year to year, the Working Group considered and agreed that the same basic course should not be repeated exactly in 2011 because there would not likely be enough officers who would need to receive the basic course. This position was further supported by the fact that officers needed to ensure that they continued to develop their newly learned R-skills during the inter-sessional period, if the training was to be useful at all.

A query was raised regarding the continued use of Excel, and there was also an enquiry about the possibility of training in the use of pivot tables in Excel. The Working Group noted that Excel would continue to be useful for many purposes in the foreseeable future, and so skills in the use of Excel should be maintained and further developed, as needed. However, given that there is some turnover of participation in the scientific meeting from year to year, it was pointed out that there was an important trade-off regarding investment in training. Consequently, participants should consider pursuing training in Excel via online courses that were easily accessible, and the CRFM sponsored training should be reserved for the development of specialized skills.

The Working Group also considered the option of using an online conference system to hold the CRFM scientific training sessions. The Working Group was advised that the cost of such a system was approximately US$30,000. As this was a single cost, it could prove to be a very cost-effective option for delivery of training over the long-term.

The timing and length of any training sessions to be delivered were also discussed, with some Working Group members expressing a preference for training to be conducted separately from the scientific meetings. The Secretariat reminded the Working Group that the training session and the annual scientific meeting in 2010 had been dove-tailed in response to a specific request by the Working Group and the annual scientific meeting to do so. In addition, the extra cost of holding a separate on-site training session would need to be carefully considered, as it would likely require external funding support. If a separate meeting was desirable, The Working Group proposed that funding support be requested from the ACP Fish II project. The Secretariat also reminded the Working Group of the planned UNU-FTP stock assessment training course that would require 20 days of time by each participant. In view of this, any inter-sessional training should probably be scheduled for the 2011-12 time period.

Recommendations:
1) The Working Group recommended that the following options for continuing R-training be explored by the Secretariat to the extent possible: (i) use of online conferencing, (ii) a training session at the start of the 2011 scientific meeting, or (iii) a separate training session conducted inter-sessionally.
2) The basic course in R should not be repeated exactly in 2011, but additional/ advanced training in R should be pursued during the next scheduled training session.
3) It was agreed to hold the next DMTWG

5. Any other business

No additional business matters were tabled for the Meeting’s consideration.

6. Adjournment

Participants thanked the chairman for his efforts in ensuring a successful meeting. The plenary session adjourned at 6 p.m. Following a short additional training session in R, the Working Group adjourned its meeting at 6.45 p.m.

Appendix 7: Economic Study of Queen Conch Fishery of the TCI

TCI representative: Ms. Kathy Lockhart

Assigned Consultant: Professor Juan Carlos Seijo (Mexico)

1.1 Management Objectives/Questions

The overall management objective of the Turks and Caicos Islands is to promote sustainable development of the fisheries resources by adopting cautious conservation and management measures in conjunction with the 'Guidelines on the precautionary principle' (FAO *Technical guidelines for Responsible Fisheries.* No.2. Rome, FAO. 1996). More specifically, the management objectives of the Queen Conch fishery that are addressed in this document are:

1. Ensure that the catch in any one-year does not exceed the Maximum Sustainable Yield (MSY).
2. Restore and maintain populations of marine species to sustainable levels.
3. Ensure that the benefits from the exploitation of the fisheries resources are optimized by Belongers

The Turks and Caicos Island have been able to conduct an assessment on the Queen Conch fishery over the past decade with reasonable certainty. However, the Fisheries Management Plan (FMP) objectives, above, encompass more than biological information such as economics, social influences and environment. The purpose of this analysis was to answer the following management questions, which are directly related to the management objectives:

1. Is the current Queen Conch commercial landing quota set correctly?
2. What is the most efficient effort for the Queen Conch fishery?
3. What is the effort at MSY and at MEY for the Queen Conch fishery?

1.2 Status of the Fishery

The Turks and Caicos Islands (TCI) commercially fish primarily for both spiny lobster (*Panulirus argus*) and queen conch (*Strombus gigas*). Although intensively fished and possibly over-fished in certain areas (Ninnes, 1994), the Queen Conch populations of the Turks and Caicos Islands are generally considered to be stable. Assessments indicate that the catch rates were operating a constant level, which inferred that the stocks are operating at optimum levels. It is assumed that unexploited 'deep-water' stocks exist that contribute significantly to recruitment of the fished stocks in shallower waters (Ninnes and Medley, 1995). The overall fishing effort under the current national annual export quota of 600,000 lbs. (272,160 kg) is considered to be maintaining the stock size at suitable levels (Anon., 1999). However, in September of 2008 two major hurricanes, Hanna and Ike, struck the TCI directly, which is assumed to have affected the various fisheries both biologically and economically, mostly by affecting habitat for these species.

Queen conch commercial catches and effort are recorded at each of the five Class A processing facilities; where it is landed whole without a shell, although exported as "clean meat", which is 40% of the whole landed conch. Small retrofitted boats (fiberglass with 85-200 hp outboard engines) depart for fishing at approximately 7:00am and return at 5:00pm, carrying 1-2 divers and a boat driver that accounts for one boat-day.

There are still some areas of research that can be conducted a second time. A visual survey was conducted in 2001 with the expectation to conduct additional surveys every four (4) years to authenticate the assessment model. However, with financial constraints a second visual survey has yet to be conducted. Also, a local consumption survey was completed by the DECR in 2004/2005 and was incorporated into the assessment model. However, with an increasing population immigration that occurred from 2006-2008, an updated survey needs to be completed.

Finally, in order to address management questions and objective a collection of economic information was required. In 2010 a survey was conducted with the local fishers and processors to obtain economic and social information to the various fisheries. Now the TCI can assess not only the biological parameters, but also the economic parameters.

1.3 Management Advice

Management has a hard task of creating and maintaining a sustainable resource, while considering other management objectives such as employment, economic incentives and restraints and environmental influences. It is well recognized that fisheries managers must prioritize objectives and may even have to surrender some objectives for others to succeed.

Currently TCI has been able to attain some of the objectives and now must consider the cost and benefits to other achievable objectives. Based on the Fisheries Management Plan Objective: *to ensure that the benefits from the exploitation of the fishery are* ***optimized*** *by belongers;* both users and managers should consider applying effort restrictions at a rate of no more than the current effort of 113 licensed commercial vessels.

At this point it is essential for the TCI to obtain information to validate all the parameters of the stock assessment. The TCI should conduct a second visual survey of the Caicos Bank to both validate the model and provide spatial information for the species. This information may then be used in spatial distribution analysis that will in turn affect economic analysis as it determines the spatial distribution of fishing intensity and the corresponding costs from port of origin to alternative fishing grounds and patches.

The Queen Conch fishery of the TCI is at a point, where it can now conduct decision tables that consider alternative management decisions, possible states of nature, and the calculated performance of biologic and economic variables. This approach will allow considering the fishery uncertainties, and calculate the corresponding risks of alternative management decisions.

1.4 Statistics and Research Recommendations

The priority for future scientific activities is to improve and enhance current data collection, specifically:

- Conduct a visual survey to obtain spatial characteristics and validate the stock assessment.
- Work with Department of Economics and planning to obtain economic and social information with regards to the fisheries in the 2011 census.
- Conduct a Decision tables that consider alternative management decisions, possible states of nature, and the calculated performance of biologic and economic variables
- Conduct a local consumption survey to determine the local consumption rate.

1.5 Assessment Summary

The bio-economic assessment of the *Strombus gigas* (Queen Conch) fishery developed in the intersessional period and during this meeting can provide managers a more complete picture of the current status of the conch fishery with regards to catch, biomass and rent derived from the resource. Additional details are provided in the consultant’s general report, given in Appendix 8 of Volume 1 (Seijo, 2010).

It should be pointed out that two devastating major hurricanes impacted the TCI in 2008, attributing to the decrease in CPUE. In the past seven (7) years fishers have been working at a high level of effort for the fishery and fishers are now realizing the impacts of effort through decreasing profits (Figure 1).

With a current restriction on catch based on Maximum Sustainable Yield (MSY), biomass is essentially preserved, but fishers, under open access are progressively eliminating fishery profits.

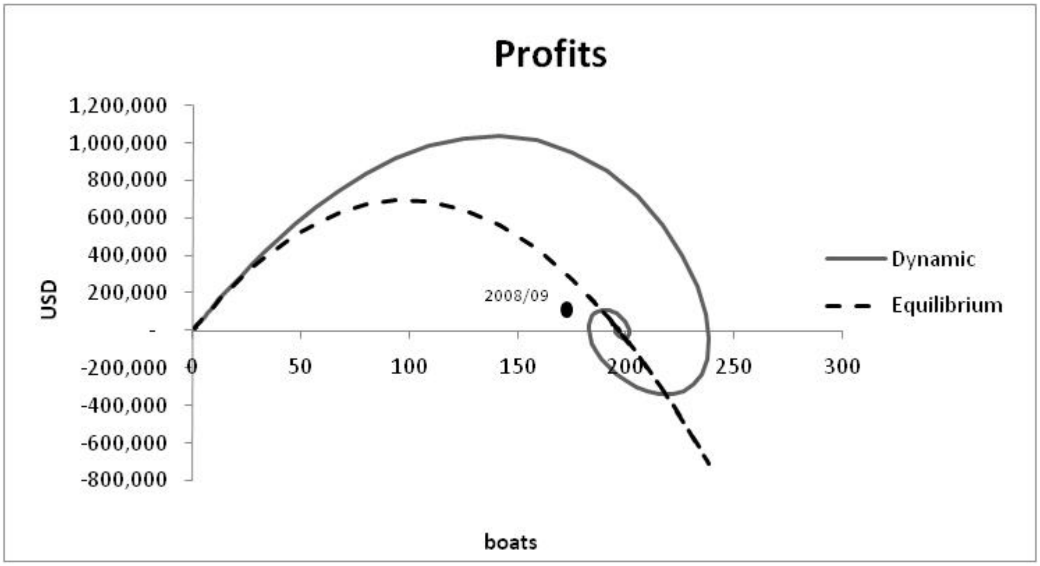


Figure 1. Sustainable and dynamic trajectories of profits. The dot represents the 2008/09 season.

1.6 Special Comments

None.

1.7 Policy Summary

The Fisheries Policy aims to ensure the sustainable use of the living marine resources and ecosystems through increased cooperation and collaboration with all the stakeholders for the improved welfare of the people of the TCI. The natural resources are national assets and the heritage of the TCI people, and should be managed and developed for the benefit of the present and future generations.

1.8 Scientific Assessments

1.8.1 Data Used

Name	Description
Catch and Effort Data	The catch landed by each boat is recorded and submitted via processing facility to the DECR. Effort of each boat is recorded via boat-days (boats go out for single days). The catch data extends back to 1887 with effort being collected since 1970's, but the information for the analysis is used from 1974 to present.
Commercial Boat License	License information was obtained from the DECR according to each year's licensing records dating from 2003-present.
Economic data	Questionnaires were conducted with commercial fishermen and Class A processors in 2010. Information gathered included economic (investment costs, variable costs) and social appeal.

Parameters	Parameters such as K (Carrying capacity), r (Intrinsic growth rate) and q (Catchability coefficient) are obtained from the 2009-2010 DECR assessment, with optional parameters from Medley (1998).

1.8.2 Method

A time series of total catch and reported effort were used to fit a modified Schaefer Surplus Model (1954) to provide the estimated population parameters as carrying capacity (K), intrinsic growth rate (r) and catchability coefficient (q). (Annex 1)

The economic data provided details for the costs and revenues analysis such as product price, investment costs fixed and variable costs of fishing. Unit cost of effort and price of the species were used to estimate profits and to model the dynamics of the fleet with the method of Smith (1969). Then the dynamic and sustainable versions of the Gordon-Schaefer model were applied to calculate the variations in fishery indicators over time and as a function of fishing effort, (Seijo *et al*., 1998). (Annex 1)

1.8.3 Results

Initially, the CPUE was graphed for 1974-2008, which showed some variation such as an increasing trend from 2003 on and a noticeable decrease in CPUE for 2008 (Figure 2) after the above mentioned hurricanes hit TCI.

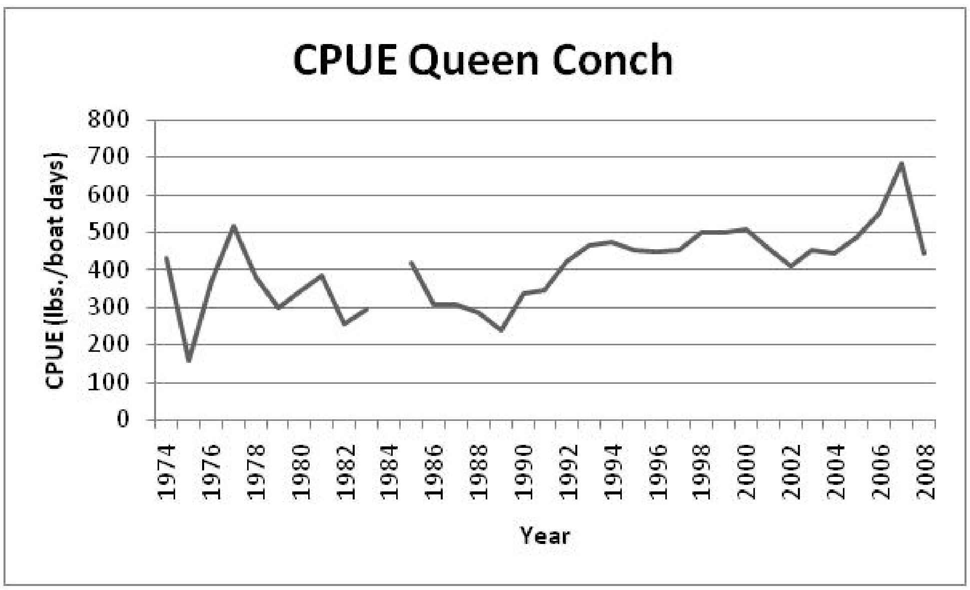


Figure 2. Catch per Unit Effort (CPUE) from 1974 through 2008

A breakdown of the CPUE by month for year 2003-2009, show a typical trend of high CPUE at the start of a season followed by a decline and increase at the end of the season. However, CPUE in general for the year declined from 2008/09 to 2009/10. The decline can be a reaction from the direct hit of two major hurricanes in September 2008 (Figure 3).

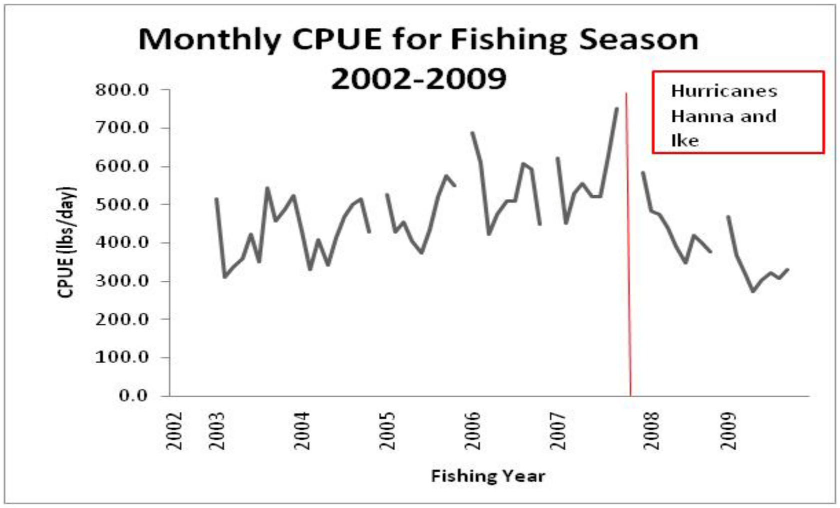


Figure 3. Monthly CPUE on a fishing yearly basis 2002-2009

Economic information for this analysis was obtained in 2010, including investment costs and fixed and variable cost estimations calculated during the meeting. (Tables 1-3)

Variable cost related to fishing effort ($/boat/day)	
Item	**USD**
Fuel	$134.96
Oil	$21.76
Grocery	$31.03
Boat & Engine Repair & Maintenance	$23.07
Catch Share for Fishers	40%

Table 1. Variable cost

Fixed cost ($/boat/year)	
Item	**USD**
Depreciation Vessel (5%/year)	$108
Depreciation Engine (14%/year)	$662
Licence by Boat	$70

Table 2. Fixed Costs

Other Economic Variable Summary	
X-vessel Price of Queen Conch ($/lb)	$1.20
Unit Cost of Effort ($/Year)	$10,186.24
Investment Cost of Boat and Engine ($)	$6,878.79

Table 3. Other Economic Variable Summary

Quasi-profits of the variable costs (profits obtained after paying for the variable costs) were generated for the fishery on a monthly basis for fishers. It can be noted that each year, fishers were obtaining a profit from the conch fishery until the current fishing year of 2009-2010. The months of December through February indicate that fishers have negative net revenues (Figures 4(a-f)).

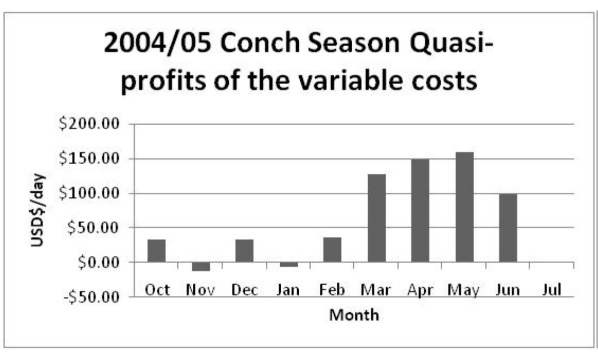


Figure 4a

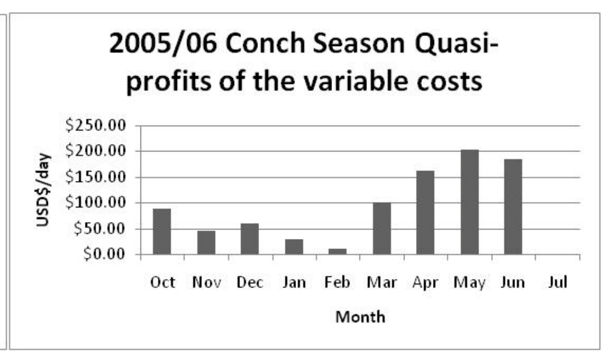


Figure 4b

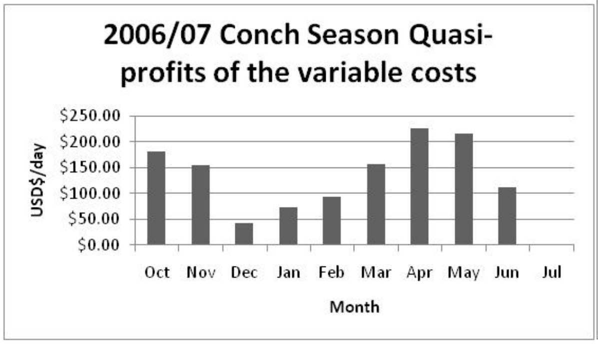


Figure 4c

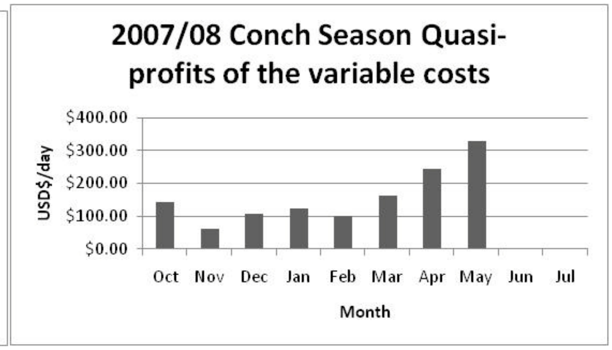


Figure 4d

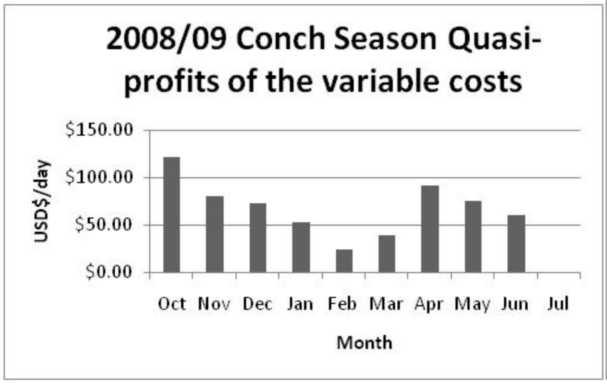


Figure 4e

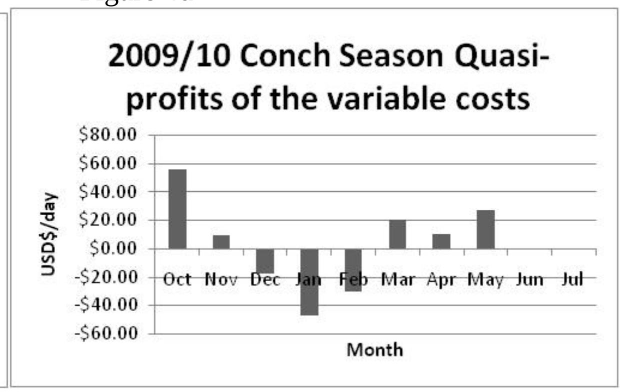


Figure 4f

Figure 4(a-f). Seasonal quasi-profits of the variable costs (cost of gas, oil, grocery, catch share and vessel/engine maintenance cost) for 2003-2009.

It can be observed that for data corresponding to the 2009-10 fishing season (up to May 31); profits have substantially decreased perhaps as a result of habitat and stock effects of the natural disasters that occurred in 2008.

Annual profits showed in Figure 5 indicate up until 2008, annual profits were increasing. Prior to the 2008/09 fishing season, two major hurricanes struck the TCI, which may have resulted in habitat and stock effects. These effects may have contributed to the decrease in annual profits in the 2008/09 and 2009/10 fishing season.

Variations in catch, revenues, cost, profits and biomass result from the application of a static (dot line), dynamic (grey solid line) and direct (black solid line) versions of the Gordon-Schaeffer model, as a function of fishing effort (Figure 6-9). It can be noted that the current quota system has placed a cap on the catch but effort (boats) have continued to increase. Currently, the fishing boats are operating near the Bio-economic equilibrium (B_e) as shown on Figure 6 as the black dot on.

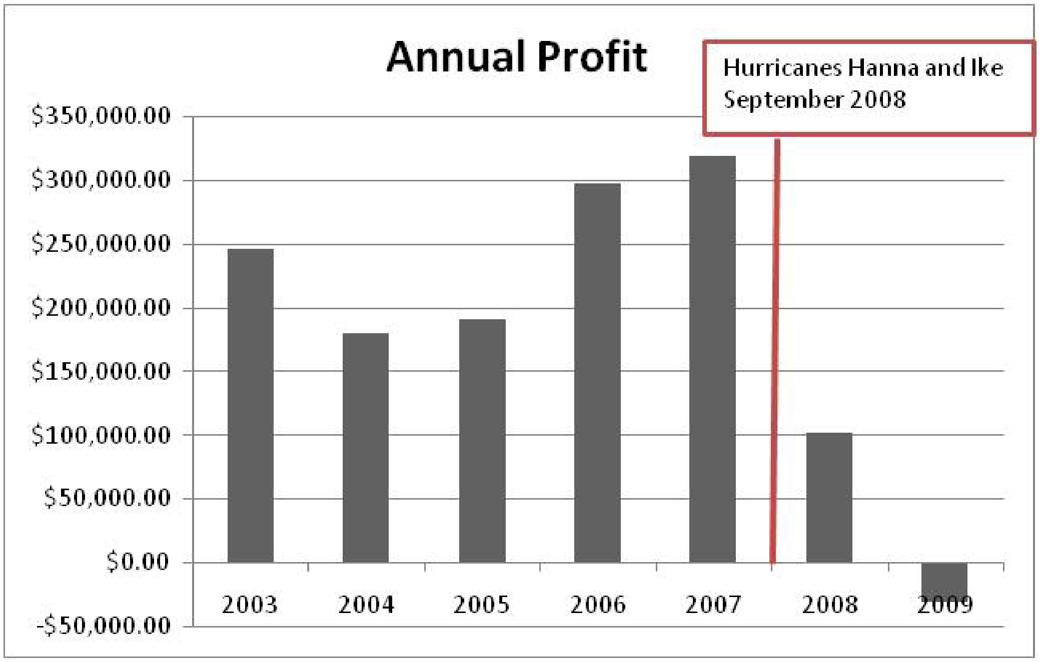


Figure 5. Annual Profit for the Queen Conch Fishery from 2003-present year. The red line indicates the time of occurrence of two major hurricanes in September 2008.

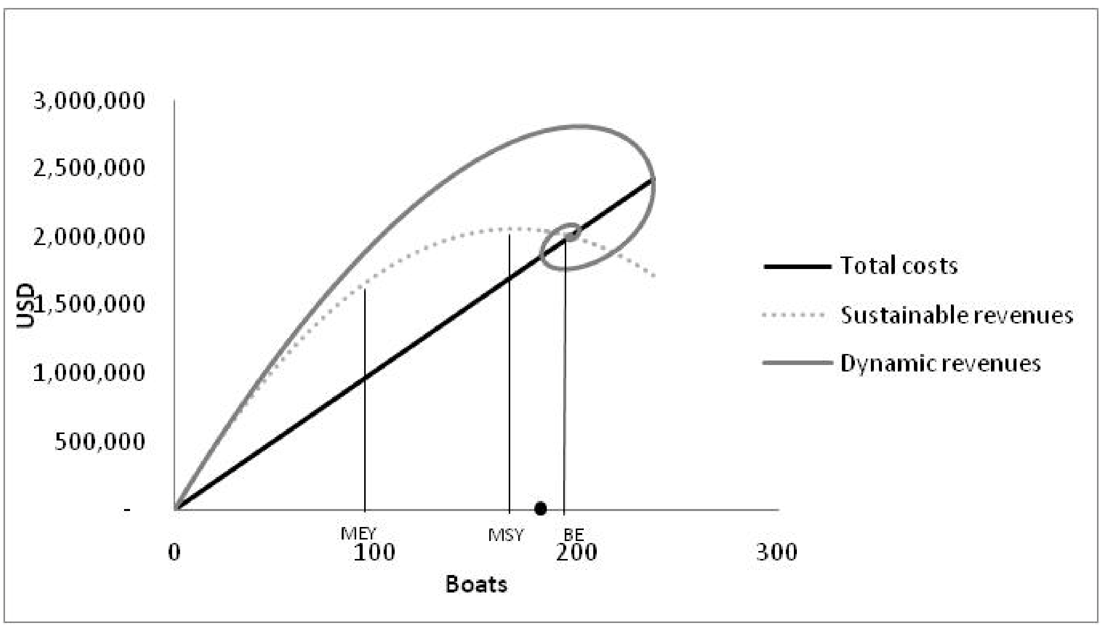


Figure 6. Sustainable and dynamic trajectories of revenues. The diagonal line corresponds to costs. The filled circle corresponds to the current situation in 2009-2010 fishing season.

The model compares the dynamic and equilibrium trajectories. Figure 7 represents the catch in both trajectories. The open circles represent documented catches from 2003-2008, which indicate that effort has been increasing and nearing the Bio-economical equilibrium.

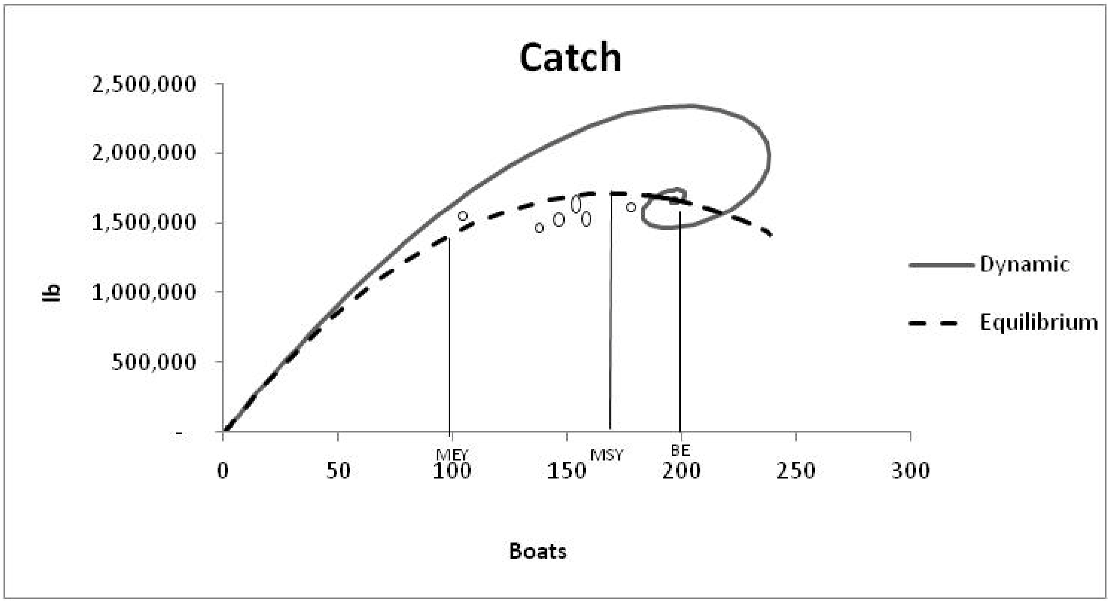


Figure 7. Equilibrium and dynamic trajectories of catch. Small dots represent catches vs. boats from 2003-present.

According to the information portrayed in Figure 8, the 2008/09 fishing season was nearing the bio-economic equilibrium at a value of 176 boats. The current 2009/10 fishing season has show a decrease in the number of boats to 113. This could suggest that the fishers have noticed a decline in the profits or that it has proven difficult to find product.

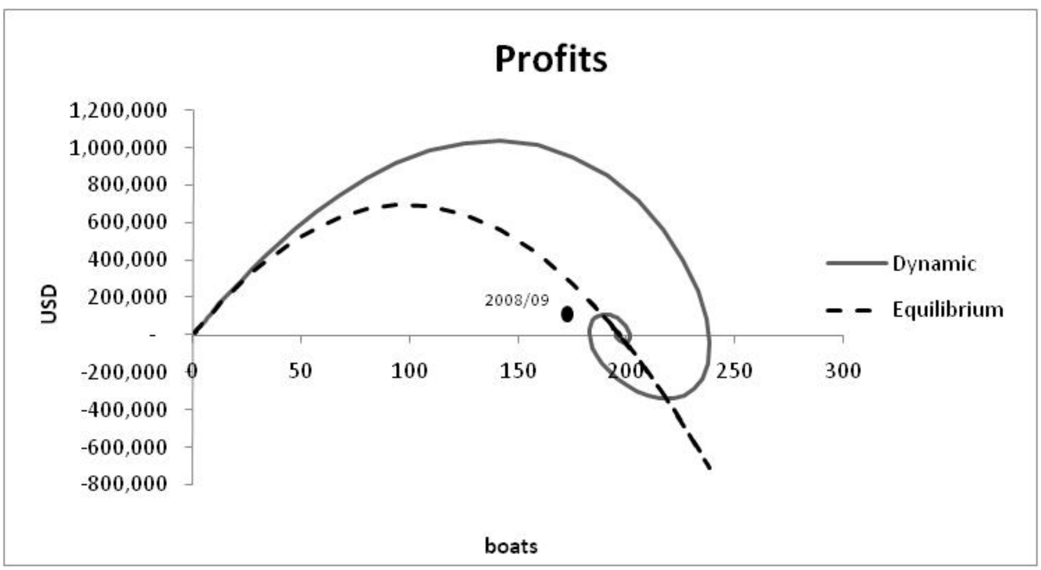


Figure 8. Equilibrium and dynamic trajectories of profits. The dot represents the 2008/09 season.

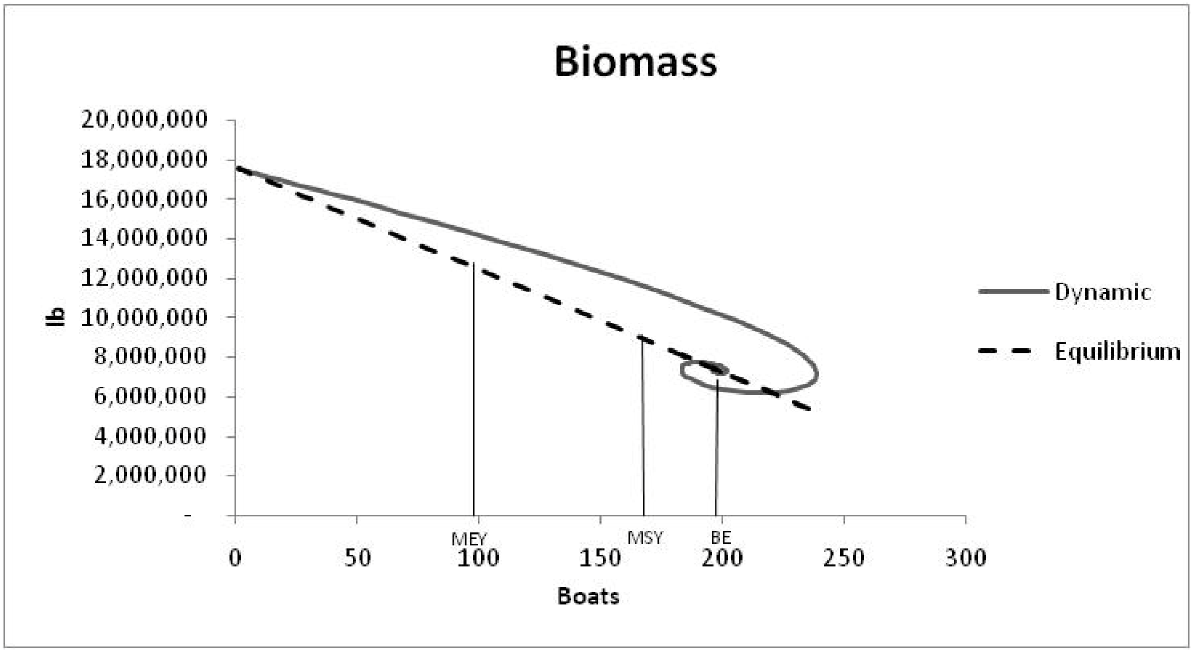


Figure 9. Equilibrium and dynamic trajectories of biomass

The model demonstrates an open access fishery, which is the current system of operation. At the present, the fishery appears to be at or below both the dynamic trajectory, but nearing the bio-economic equilibrium.

In Table 5, we have the calculated reference points for biomass, yield and profits considering the parameter set presented in Tables 1, 2, 3 and 4

Parmeter	Symbol	Value	Unit of measurement	Source
Intrinsic rate of growth	r	0.39	1/year	DECR (2009)
Carrying capacity	K	17,607,107	lb	DECR (2009)
Catchability coefficient	q	0.001152	1/boat/year	DECR (2009)
Unit cost of effort	cu	10,186	USD/boat/year	DECR Survey (2010)
Price of species	p	1.2	USD/lb	DECR (2010)
Fleet entry/exit parameter	ϕ	1.65E-05	boats/USD	
Average number of fishing days	f	24	days/year/boat	
daily catchability coefficient	q'	0.000048	1/boat/day	DECR (2009)

Table 4. Parameters obtained from the Department of Environment and Coastal Resources (DECR) conch stock assessment, DECR Fisher surveys.

Name	Equation	Value	Unit of measurement
Biomass in bioeconomic equilibrium	Bebe=cu/pq	7,368,345	lb
Effort in bioeconomic equilibrium	Eebe = 2Emre	197	boats
Catch in bioeconomic equilibrium	$C_{ebe} = qE_{ebe}K(1\text{-}qE_{ebe}/r)$	1,671,068	lb
Effort in MSY	Emsy = r/2q	169	boats
MSY	Cmsy = Kr/4	1,716,693	lb
Effort in MEY	Emey = r/2q(1- cu/pqK)	98	boats
Catch in MEY	Cmey= qEmreK(1-qEmre/r)	1,416,046	lb
Biomass in MEY	Bmey=(1-qEmre/r)K	12,487,726	lb
Biomass en MSY	Bmsy=(1-qEmrs/r)K	8,803,554	lb

Table 5. Reference Points for biomass (B_{be}, B_{MSY}, and B_{MEY}), catch (C_{be}, C_{MSY}, and C_{MEY}) and effort (E_{be}, E_{MSY}, and E_{MEY})

Projections of the Conch Fishery

Dynamic trajectories of catch, biomass and profits from the beginning of the fishery are exemplified (Figures 10-12) for the four management decisions applied in the Gordon-Schaefer model: (1) open access, (2) effort restriction at the MEY (3) catch quota at the MSY and (4) catch quota at MEY.

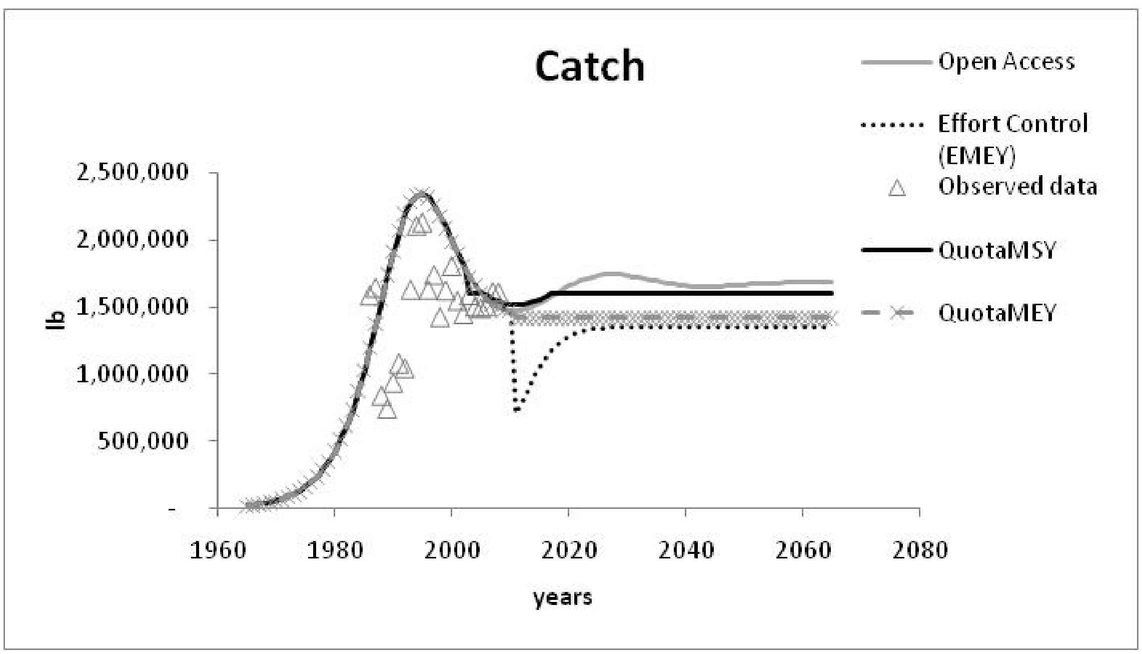


Figure 10. Catch effects based on four management decisions

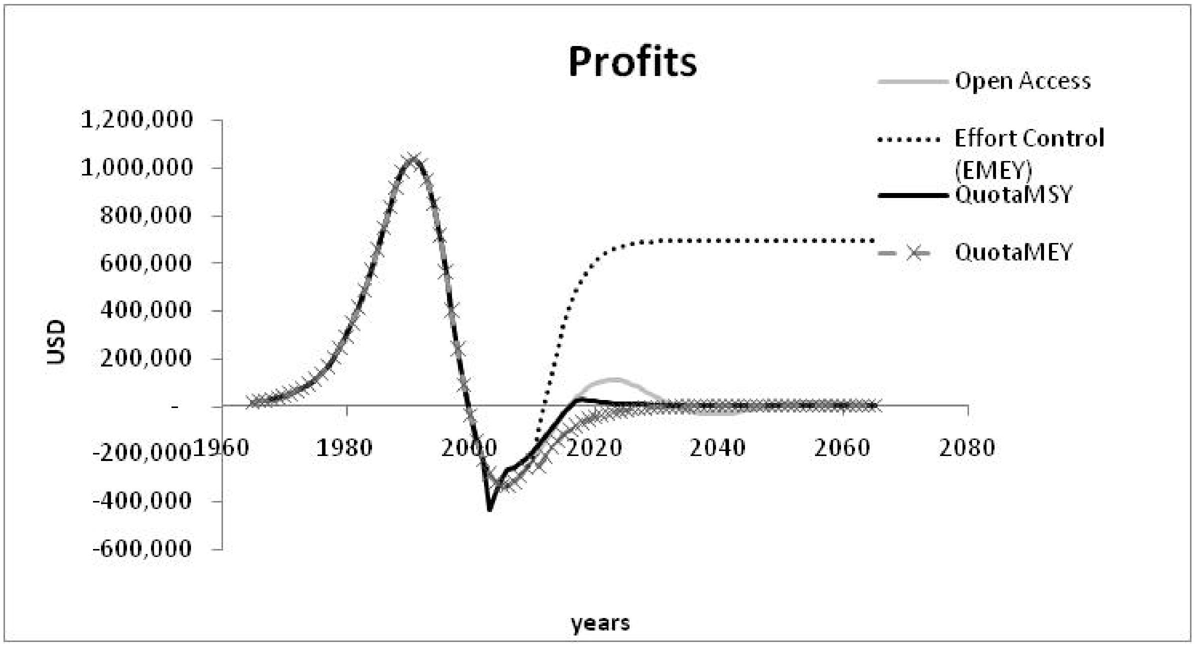


Figure 11. Profit effects based on four management decisions

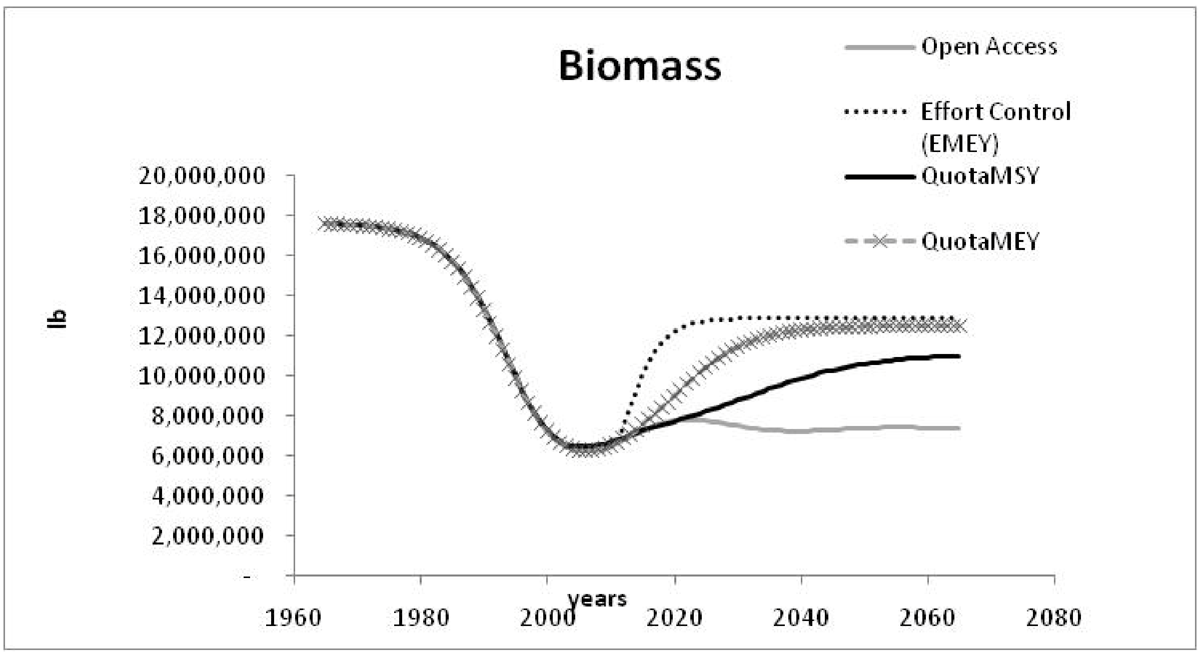


Figure 12. Biomass based on four management decisions.

Both the current Quota at MSY and effort restrictions are effective management measures to preserve biomass. If different management measures are taken catch is expected to be maintained because of the current catch quota (figure 10). However, in order to attain optimum economic yield for fishers, effort restriction is suggested (figure 11). Finally, for biomass to reach optimum, management must consider either setting an effort at MSY (effort control) or a catch quota at MEY.

1.8.4 Discussion

The above study has shown the seasonal fishery catch, effort, CPUE, and quasi-profits of the variable costs, as well as the estimation of bioeconomic reference points. Current bioeconomic status of the fishery is analyzed in reference to the calculated biologic and economic Target reference point (TRP) values (See table 5). In Figures 7 and 8 we can see that effort and profits are approaching bioeconomic equilibrium because the fishery is operating under open access conditions. At this point profits will tend to zero.

It appears as if the catch quota system is functioning for the conch fishery at the current time, but nearing bio-economic equilibrium. If however, the number of boats increase, profits would dissipate and there would be no incentive to remain in the fishery. It is apparent that fishers have discovered that there is little to no incentive to enter the fishery because of hindered profits and growth.

According the fisheries management objectives, fisheries managers and users may find a need to apply effort restrictions to ensure that the benefits from the exploitation of the fishery are **optimized** by belongers.

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Annex 1.

Equation	Description	Unit of Measurement
$CPUE_t = q\ B_t$	Catch per Unit Effort over Time	lb/effort
$B_{t+1}=B_t + dB/dt$	Biomass over time	lbs
$dB/dt = r*B_t\ (1-B_t / K) - C_t$	Growth of biomass	lbs/time
$E_{t+1} = E_t + Ø * \pi_t$ or $dE/dT = Ø*\pi_t$	Exit/Entry Equation	Effort (ex. # boats)
$C_t = qE_tB_t$	Dynamic Catch	lbs
$B_e\ = (1-qE/r)K$	Equilibrium Biomass	lbs
$Y = qEK(1-qE/r)K$	Sustainable Yield	lbs
$TR_t = pC_t$	Dynamic Total Revenue	USD
$TC_t = cuE_t$	Total costs	USD
$\Pi_t = TR_t – TC_t$	Dynamic profits	USD
$STR = pY$	Sustainable Revenue	USD
$S\pi = STR – TC_t$	Sustainable Profits	USD

Appendix 8: Report on activities conducted by Professor Seijo

This report includes the four main activities developed during the Scientific Meeting to achieve the terms of reference of the consultancy.

I. Proposed plan of study on the economic importance and impact of recreational fisheries in the region.

To pursue this objective of the TOR, a seminar was presented to address the following questions:

a. What is the value of a recreational fishery in the CLME? and
b. Which are the economic and social impacts of recreational fisheries in the CLME?

Before addressing the first question, the importance of considering bio-ecological factors of recreational fisheries for a robust economic assessment of these types of fisheries was acknowledged. Among these, the following were discussed: (i) Stock assessment of species of commercial and recreational use, (ii) time-space distribution of species of interest, (iii) main trophic relations of species targeted, (iv) feeding behavior, and (v) relevant environmental factors determining abundance and accessibility of recreationally targeted species.

The potential interdependencies with commercial fisheries in the CLME were also stressed by considering possible situations of *with and without* catch and release fishing procedures. For the latter it was recognized that eco-technological and bio-economic interdependencies are likely to exist as well as social conflicts with other ecosystem users, and congestion externalities in fishing grounds. Participants indicated that even with catch and release procedures there can be considerable probabilities of release mortalities depending on the depth from which the fish was caught and also depending on how responsible is the handling of the fish in the release process.

To calculate the economic value of a recreational fishery the basic principles of the travel-cost method were presented together with explicit consideration of the underlying assumptions. Recent extensions of the travel-cost method and other recreational fisheries assessment techniques to address biologic, economic and social factors of these types of fisheries were pointed out (See Pitcher and Hollingworth, 2002). The combination of the travel-cost method and contingent valuation techniques was also indicated as a possible approach to answer the first question. Two alternative forms of valuing recreational fisheries were discussed: the "whole experience" and the "on-site experience" (See Sinden and Worrel, 1979).

Approaches for answering the second management question, namely the economic impact of recreational fisheries would require the calculation of the direct, indirect and induced effects of the recreational fisheries sub-sector of the CLME region. Anglers purchase a variety of goods and services, (i.e. spending money on boats and fees, lodging, travel costs, food and beverages, etc.). Businesses providing these goods and services to anglers also must purchase goods and services and businesses providing these goods and services also must purchase goods and services and hire employees, which in turn generate more sales, income and employment.

Direct impacts include sales, income, and employment generated from initial purchase by anglers (e.g. party and charter access fees paid to owners of for-hire vessels). Indirect effects include sales, income and employment of businesses that supply the directly affected shops, for example for-hire owners must purchase bait from supply shops, and gasoline and oil from marine service stations. Induced effects represent the sales, income and employment resulting from expenditures by employees of the direct and indirect sectors.

The seminar discussed the use of input-output analysis as a possible approach to estimate the direct, indirect and induced impacts of recreational fisheries in the CLME region, and the corresponding sales, income and employment multipliers of this activity in Caribbean economy.

Participants of the Large Pelagic Fish Resource Working Group (LPWG) suggested that it was important to update the study by Mahon and McConney (2004) that described the recreational fisheries sector of the Caribbean region. It was also pointed out in the discussion that the effort to incorporate the economics of recreational fisheries should be parsimonious to avoid improvisation and learn from previous experiences in this region and elsewhere. It was agreed that a long-term strategy was needed to assess the biologic, economic and social impacts of recreational fisheries in the CLME region. Concerning survey designs for these types of studies, it was acknowledged in the discussion that careful use of instruments was very important. It should be pointed out that a detailed review of recreational fisheries surveys has been reported by the U.S. Ocean Studies Board (OSB, 2006).

Work plan for inter-sessional period

It was agreed, as a first step, to undertake the design of a long-run strategy for studying and managing recreational fisheries in the CLME region. To accomplish this, it seems fundamental to: (i) update the recreational fisheries sector statistics and characteristics reported by Mahon and McConney (2004); (ii) to document, study and analyze existing experience in the region involving research efforts to assess recreational fisheries in the Caribbean; and (iii) invite a recreational economics expert to accompany these efforts in the future. To achieve (i) and (ii) it is proposed to develop a case-studies book to document previous efforts and learning experiences in the study of recreational fisheries in the Caribbean region. The first chapter of this book, as an introduction, will set the stage for the selected case studies by presenting a historical overview and an update of the current statistics and general characteristics of the recreational sector in the CLME region. It will also briefly describe the book contents with specific reference to the case studies.

Book: Recreational fisheries in the CLME region: case studies
Purpose: to document, through a CRFM publication, relevant and diverse case studies of the recreational fisheries in the CLME region, considering the biological, economic and social dimensions of these fisheries.
Authors: a list of contributing authors can be identified to be contacted to prepare a set of five case studies with the following proposed content:
The suggested content of the case studies is the following:

1. Introduction
2. Recreational fishery context
   Background and evolution of the fishery
3. Socio-economic considerations
   Fate of the catch:
   - Catch and release,
   - Keeping for eating
   - Charity food donations
   - Selling catches.

   Fleet size and characteristics
   Fishing season
   Gears
   Spatial distribution of effort of recreational fishermen
   Direct employment
   Revenues and costs of recreational fishing
   Economic valuation of the recreational fishery

- Methods
- Findings

4. Ecological and technological interdependencies with commercial fisheries
5. Conflicts and cooperation of multiple users of the ecosystem
6. Current management regime of the recreational fishery
   Prevailing management questions
   Fishery governance
7. Conclusions
   Case study findings
8. Recommendations for recreational fisheries management and future research efforts in the study area.
9. References

II. The four wing Flying fish fishery

Concerning the four-wing flying fish fishery, two meetings were organized with members of SCPWG to discuss the current situation of their fisheries and to identity the main management questions each country is concerned with. Three studies were revised to assess the availability of critical parameters needed to undertake bio-economic analysis of the fishery. During the meetings it was acknowledged that the four-wing flying fish and the dolphinfish fishery should be analyzed together because they are, in general, caught by the same vessel, and they have significant predator–prey interdependence. After reviewing the literature published on the four-wing flying fish of the Caribbean region it was discussed that bioeconomic analysis of the fishery was possible to be undertaken with the available information but essential information concerning country fleets characteristics (types of fleets, number boats in each fleet, fishing days per month targeting these species) and their corresponding effort would have to be provided by working groups members. A seminar was presented analyzing the approaches to deal with growing uncertainties and risks, associated to management decisions. A bioeconomic ecosystem approach to fisheries management was presented to working group members. It involves the following steps: (i) define the flying fish and dolphinfish fisheries management questions in the context of multiple users of the marine ecosystem, (ii) identify possible ecological and technological interdependencies among these two species, habitats and fleets within the ecosystem, (iii) select biological/ecological and economic/social performance variables for the ecologically interdependent fishery, (iv) define corresponding ecosystem performance indicators for the ecological interdependent fishery flyingfish-dolphinfish, (v) establish limit and target reference points for the indicators, (vi) identify alternative management, co-management and/or community management strategies for the fishery within an ecosystem context, (vii) design a dynamic bio-economic model of the ecologically and technologically interdependent fishery, (viii) revise fishery relevant literature, and collect data to estimate model parameters, (ix) identify possible states of nature in uncertain and sensitive parameters, (x) build decision tables and apply decision criteria to deal with risk and uncertainty, (xi) estimate probabilities of exceeding ecosystem limit reference points (risks) and of achieving desired target reference points.

III. Bioeconomic analysis of Turks and Caicos queen conch (*Strombus gigas*) fishery

A review of the economic and biologic data collected inter-sessionally for this fishery by scientific staff of Turks and Caicos was undertaken. The collected data was considered adequate for building the parameter set needed for a bioeconomic analysis of the queen conch (*S. gigas*) fishery of Turks and Caicos Islands. For this analysis the following steps were followed:

(a) Review and arrange inter-annual available catch and effort data along the species fishing season,
(b) Calculation of seasonal (monthly) catch per unit of effort (CPUE, lb/fishing day)
(c) Calculation of variable costs per fishing day considering fuel and oil costs, food costs, fishers costs as a share of average daily catch and, the reported maintenance costs.

(d) For intra-annual economic analysis, the quasi-profits of the variable costs were calculated and reported for the 2003 – 2009 fishing seasons.

(e) For inter-annual bio-economic analysis fixed costs were calculated and added to the cost function to estimate fishery profits over time.

(f) With the estimated economic parameters, a dynamic Schaefer-Gordon Model was developed using the biologic parameters calculated in the recent stock assessment undertaken by Turks and Caicos scientists. The model represented satisfactorily observed data for the fishery.

(g) Alternative management strategies considering input and output controls were explored with the representative of Turks and Caicos.

IV. Seminar on decision theory applied to fisheries management in the Caribbean region

A seminar was presented with the main elements of decision theory which could be applied to deal with risk and uncertainty present in the Caribbean fisheries. Two approaches were considered: (i) decision tables with and without mathematical probabilities, (ii) Monte Carlo analysis to estimate the probability of exceeding fishery limit reference points, and/or achieving target reference points of CLME fisheries of interest.

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