CRFM Fishery Report – 2012

Volume 1

Report of Eighth Annual Scientific Meeting – Kingstown, St. Vincent and the Grenadines, 20 - 30 June 2012

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Foreword

The Eighth Annual Scientific Meeting took place during 20 – 30 June 2012 in Kingstown, St. Vincent and the Grenadines. During this Meeting, the five CRFM Resource Working Groups met. The CLWG completed a bio-economic assessment of the Jamaica queen conch fishery. The LPWG conducted several activities including: the evaluation of the status and availability of blackfin tuna data in the Eastern Caribbean; a preliminary assessment of the blackfin tuna fishery; and a review of the ERAEF methodology. Updates on the progress of the recreational fishery studies being conducted under the CLME project were also provided and the FAD deployment and research activities being coordinated by the MAGDELESA project were reviewed. The RSWG continued analysis of the Montserrat reef fishery data and conducted a preliminary analysis of the Jamaica reef fishery. The SCPWG reviewed the MCA study of the flyingfish fishery in the Eastern Caribbean as well as the activities of the first meeting of the joint CRFM/WECAFC Working Group on Flyingfish in the Eastern Caribbean. The main output of this joint working group was an updated the sub-regional fisheries management plan for the flyingfish fishery in the Eastern Caribbean and a resolution to be presented to the CRFM Ministerial Sub-Committee on flyingfish. The SGWG updated the Atlantic seabob assessments for Guyana and Suriname respectively.

The DMTWG completed training in methods focused on graphical techniques for data quality control and on graphical approaches to data analysis. A plenary session was held to review the 2011–2012 inter-sessional activities, discuss training needs and develop the workplan for the 2012 – 2013 period.

During the plenary session of the Eighth Annual Scientific Meeting, updates were provided on relevant collaborative activities / projects / programmes which included: the WECAFC joint-technical working groups; a website being developed by the University of Southern Mississippi to collect data on the *Sargassum* sp. event; lionfish studies being conducted by UWI/CERMES; the MAGDELESA project being coordinated by IFREMER; and the status of the Lionfish Action Plans at the national level.

The Report of the Eighth Annual Scientific Meeting is published in two Volumes: Volume 1 contains the report of the plenary sessions and the full reports of the CRFM Resource Working Groups for 2012. Eight national reports were submitted for consideration by the Meeting in 2012, 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 Mr. Derrick Theopille, Mr. Jullan Defoe, Mr. Fujii Motoki and Mr. Tetsuya Miyahara. These contributions are gratefully acknowledged.

Contents

List of Acronyms and Abbreviations

CARIFIS	-	Caribbean Fisheries Information System
CERMES	-	Centre for Resource Management and Environmental Studies
CIDA	-	Canadian International Development Agency
CLME	-	Caribbean large Marine Ecosystem
CLWG	-	Conch and Lobster Resource Working Group
CPUE	-	Catch Per Unit of Effort
CRFM	-	Caribbean Regional Fisheries Mechanism
DMTWG	-	Data, Methods and Training Working Group
EAF	-	Ecosystem Approach to Fisheries
EBM	-	Ecosystem Based Management
ERAEF	-	Ecological Risk Assessment for the Effects of Fishing
EU	-	European Union
FAD	-	Fish Aggregating Device
FAO	-	Food and Agriculture Organization of the United Nations
FMP	-	Fisheries Management Plan
FORCE	-	Future of Reefs in a Changing Environment
GCFI	-	Gulf and Caribbean Fisheries Institute
ICCAT	-	International Commission for the Conservation of Atlantic Tunas
IFREMER	-	Institut Français de Recherche pour l'Exploitation de la Mer
ICRI	-	International Coral Reef Initiative
JICA	-	Japanese International Cooperation Agency
LPWG	-	Large Pelagic Fish Resource Working Group
LRS	-	License and Registration System
MEY	-	Maximum Economic Yield
MSC	-	Marine Stewardess Council
MSY	-	Maximum Sustainable Yield
NGO	-	Non-Governmental Organization
NMFS-SEFSC	-	National Marine Fisheries Service – South East Fisheries Science Center
NOAA	-	National Oceanic and Atmospheric Administration
OSPESCA	-	Organization of Fishing and Aquaculture in Central America (Organización del Sector Pesquero y Acuícola de Centroamerica)
PSA	-	Productivity and Susceptibility Analysis
REEF	-	Reef Environmental Education Foundation
RSWG	-	Reef and Slope Fish Resource Working Group
SCPWG	-	Small Coastal Pelagic Fish Resource Working Group
SGWG	-	Shrimp and Groundfish Resource Working Group
SVG	-	St. Vincent and the Grenadines
TAC	-	Total Allowable Catch
TCI	-	Turks and Caicos Islands
TIP	-	Trip Interview Programme
UK	-	United Kingdom
USA	-	United States of America
UWI	-	University of the West Indies
WECAFC	-	Western Central Atlantic Fishery Commission

1. Opening of meeting

A short ceremony was conducted to formally open the plenary session. Mrs. Jennifer Cruickshank-Howard, Senior Fisheries Officer of the St. Vincent and the Grenadines Fisheries Division chaired the opening ceremony. The ceremony commenced with an offer of prayer by Mr. Reshevski Jack, Fisheries Officer of the St. Vincent and the Grenadines Fisheries Division, followed by the national anthem.

Chief Fisheries Officer of St. Vincent and the Grenadines, Mr. Raymond Ryan, was unable to attend and deliver his address. In his absence, Mrs. Cruickshank-Howard officially welcomed participants to the eighth annual CRFM Scientific Meeting. She noted that the CRFM Scientific meetings had started in 2004, and over 50 fisheries and many species had been assessed and analyzed and the results had assisted with the improvement of management approaches. She highlighted one such achievement in 2009, when an analysis of the beach seine fishery for jacks and robins in St. Vincent and the Grenadines was carried out in response to the foreign fishing vessels purchasing these species for bait and depleting supplies to the local market. That study was reviewed and endorsed, and the recommendations made were presented to the St. Vincent and the Grenadines government. It was noted that all small Caribbean island states were facing challenges regarding the protection of their marine resources and while Ecological Based Management (EBM) approaches were advocated widely at the global level, small island states faced many challenges conforming to these approaches. She therefore highlighted that the various reports from the scientists, consultants and fisheries division staff who worked diligently over the last two weeks within their respective working groups were important in addressing these issues. She extended hope for a fruitful meeting.

Dr. Susan Singh-Renton, the Deputy Executive Director of the CRFM Secretariat welcomed participants on behalf of the CRFM Secretariat to the Eighth Annual Scientific Meeting. She noted that the scientific meeting had come a long way since its first session in 2004. She acknowledged the accomplishments from such meetings and the completion of over 50 fisheries analyses as Mrs. Cruickshank-Howard previously mentioned. Through these Scientific Meetings, the broadening of analyses to include ecological and economic components had been achieved, and international recognition and networking had been improved. She informed the meeting that as a result of the annual scientific meetings, fisheries management reports and newsletters targeting a wider audience were now being regularly produced. Dr. Singh-Renton highlighted that the years of work had begun to bear actual fruit, as evidenced for example by the receipt of the Marine Stewardship Council (MSC) "ECO" certification of sustainability for the Suriname Atlantic seabob shrimp fishery in November 2011. This was an example of the results of the labour and support of the CRFM Scientific meetings. It was noted that the meetings were continuously evolving to keep pace with the emerging international paradigms for holistic, ecosystem-based approaches. On this point, the impact of other activities on marine ecosystems and living marine resources, and hence the necessity to manage the large marine ecosystems, was highlighted. In this regard, the Caribbean Large Marine Ecosystem project (CLME), funded by the Global Environmental Facility was mentioned, which, involved twenty-three countries and included two of the world's ecosystems (Caribbean and the Brazil shelf). This project, which was still in progress, was taking into account ecosystem approaches and the CRFM was responsible for completing two case studies under the CLME: one for the flyingfish fishery and the other for the large pelagic fishery. Dr. Singh-Renton explained that in addition to the working groups of the CRFM Scientific Meeting, the Western Central Atlantic Fishery Commission recently established joint working groups, three of which involved the CRFM. These groups were responsible for working on major resources within the Caribbean including: Spiny Lobster, Recreational Fisheries and Flyingfish. It was noted that the first flyingfish working group meeting was convened the previous week, during which a regional management plan was updated for consideration by those countries that harvested flyingfish. This plan was expected to be reviewed by stakeholders through national consultations, after which time the CRFM/WECAFC Working Group on

Flyingfish in the Eastern Caribbean would refine the plan based on feedback from the consultations. The plan could be endorsed by the CRFM Ministerial Council as early as April 2013. If this were achieved, it would represent the first shared fishery to be actively managed in the Eastern Caribbean. In closing, Dr. Singh-Renton highlighted that the journey to attain meaningful fisheries management of the shared marine resources for our human and social well being through the CRFM Scientific Meetings had just begun. She made reference to the various Caribbean states' national anthems and how these anthems reminded us of the resources that were held dear to us and also of our responsibility to protect them. This could only be achieved through attaining a strong fisheries knowledge and information base to inform management decisions.

The Honorable Minister for the Ministry of Agriculture, Rural Transformation, Forestry and Fisheries in St Vincent and the Grenadines, Mr. Saboto Caesar, extended a gracious welcome to participants. He affirmed that within a national developmental framework, as professionals and scientists it was our duty to ensure that the livelihoods of the people we served was secure. Reflecting on the global economic crisis and its impacts on the people of St. Vincent and the Grenadines, Mr. Caesar reminded the meeting that the fisheries sector contributed 2% of the countries' Gross Domestic Product, and there was a great opportunity for this to increase through investment in the sector. He noted that the employment opportunities the sector provided were significant and in a time when unemployment and under employment was a concern within the region, it was more important than ever. Following meetings such as the present one, we would be better equipped to offer strategies for growth within the sector to our fishermen. He acknowledged that the work over the last few days played an important role in the evolution of fisheries in the region. He highlighted that St. Vincent and the Grenadines had made significant strides in fisheries development including the deployment of 2 Fish Aggregating Devices (FAD) in its waters, which increased fish landings while also reducing fuel consumption and search time, and in so doing, was serving to increase the efficiency of fishing trips. Overall, production and productivity, through understanding of the quality of fish brought to consumers, was improving in the region. Moreover, as an emerging tourist destination, the consumption of fish and fish products was expected to increase both locally and through the possibility of exportation. The working groups were urged to continue to seek improvements in data collection and analytical skills, as it was important and necessary for the region to proceed with management measures and to ensure sustainable management of our marine resources.

In conclusion to the meeting's opening, a Vote of Thanks was delivered by Ms. Maren Headley to the Government of St. Vincent and the Grenadines, to the meeting speakers, to the rapporteurs, to the participating fisheries officers and consultants, to those participants of related organizations and institutions who provided inputs to working group deliberations, to the caterer and to the CRFM Secretariat staff.

2. Adoption of meeting agenda and meeting arrangements

Mr. Christopher Parker of the Fisheries Division, Ministry of Agriculture and Fisheries, Barbados, served as the official Chairperson of the plenary session.
The Chairperson invited the meeting to review and adopt the agenda.

No amendments to the agenda were made and the St. Lucia representative, Ms. Yvonne Edwin, moved to adopt the agenda. The Belize representative, Mr. Mauro Gongora seconded the motion.

The adopted meeting agenda is given in ***Appendix 1***.

3. Introduction of participants

The CRFM Secretariat advised that 12 CRFM Member States were participating in this year's scientific meeting sessions. Listed in alphabetic order, these 12 Member States were: Barbados, Belize, Dominica, Grenada, Guyana, Jamaica, Montserrat, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, and Turks and Caicos Islands.

The following institutions and organizations were also attending in observer capacity. Some of these observers were participating in both working group and plenary meeting sessions: National Marine Fisheries Service – South East Fisheries Science Center (NMFS SEFSC), IFREMER (Martinique) and University of the West Indies (UWI-CERMES, Cave Hill Campus).

In addition, three fish stock assessment consultants, one CIDA intern, and several CRFM Secretariat staff participated in several working group sessions and also the plenary session and provided specific technical contributions.

A list of participants is provided in ***Appendix 2***.

4. Presentation of national (country) reports

The Meeting was informed that eight national reports had been received to date from the following countries: Belize, Dominica, Guyana, Jamaica, St. Lucia, St. Vincent and the Grenadines, Suriname and Turks and Caicos Islands.

5. Reports of the CRFM Fishery Resource Working Groups

5.1 Conch and Lobster Resource Working Group (CLWG)

The 2012 Chairperson for the CLWG was Mr. Mauro Gongora of the Department of Marine Resources in Belize. Mr. Gongora presented the 2012 report of the CLWG. The detailed report of the CLWG is given in ***Appendix 3***.

Plenary discussion of CLWG

Professor Oxenford thanked the CLWG for its work. It was queried how the various "r" values were accounted for in the assessment given that recent studies indicated that the size at sexual maturity was higher than previously believed and currently only 50% of queen conch with a shell lip thickness of 15-20mm was considered mature. It was clarified that reported "r" values were used and the bio-economic assessment framework was prepared for including this as an uncertainty.

Professor Oxenford queried how were the fishing mortality values determined in the assessment given the closure of the Jamaica queen conch fishery for one year and the fact that the TAC would not have been filled. It was pointed out that for the purpose of this assessment it would have been difficult to remove the year from the analysis. The Meeting was informed that this issue would be discussed with the Permanent Secretary and the Ministry on return to Jamaica.

The Belize representative, Mr. Mauro Gongora indicated that shell lip thickness greater than 4mm would be appropriate in terms of harvesting conch in Belize. However, he noted that shell lip thickness depended

on the harvesting strategy, since the types of fishing done in various countries were different. For example, it was pointed out that in Jamaica, conch were harvested in deep waters which meant that these conch would obviously be large adults whereas in Belize fishing was done in shallow waters which meant that these conch were primarily sub-adults. In terms of the concern for the sustainability of the stocks it was believed that monitoring the amount taken from the population on a yearly basis was more important than restricting the size taken and it was pointed out that this management strategy appeared to be working based on the high recruitment rates being observed. He informed the meeting that the conch fishery was closed for three months, July, August and September and that before the closure of the season, the conch density increased incredibly fast and could not be due to migration from the deep water. It was therefore suggested that it was possible that the conch buried in the sand and based on certain cues and mechanisms during its life cycle the conch re-appeared at 1-1 ½ inch in size. It was suggested that a second burial also occurred where the animal was not seen until it re-emerged and entered the fishery.

Dr. Paul Medley, a consultant, queried whether the suggested 8% exploitation rate as determined by the conch abundance surveys and as a precautionary approach was too high given the low MSY observed in Jamaica. Professor Seijo, a consultant, pointed out that for the parameters which they had, the value was a good reference. It was also pointed out that major shifts in fisheries which were not industrial to reduce the level of fishing mortality (F) drastically, could cause socio-economic issues and therefore for Jamaica's parameter set, it was a reasonable F-value.

The Belize representative, Mr. Gongora added that there was no disagreement with the F value of the spawning stock being targeted, however it should be noted that this could not be applied to the exploitation of sub-adult animals as was the case in Belize.

The St. Lucia representative, Ms. Yvonne Edwin queried why the TAC was reduced from 3000 MT to 400 MT, and sought clarification on whether all data were being captured to ensure that the TAC was not being surpassed. The Jamaica representative, Mr. Ricardo Morris indicated that the system was robust enough, and since the fishery was export oriented there was no incentive to overfish and there was also a penalty for fishing above the quota.

The Surinamese representative, Mr. Mario Yspol queried why the MEY was higher than the MSY and it was indicated that it was referring to the biomass at these points, which was always higher at MEY.

5.2 Large Pelagic Fish Resource Working Group (LPWG)

The 2012 Chairperson for the LPWG was Mr. Derrick Theophile, the Dominica representative and the rapporteur was Ms. Yvonne Edwin, the St. Lucia representative. Mr. Theophile presented the 2012 report of the LPWG. The detailed report of the LPWG is given in ***Appendix 4***.

Plenary discussion of LPWG

Dr. Medley enquired if there was a way to identify when historical CPUE included FAD fishing. The St. Lucia representative, Ms. Edwin responded that to an extent it was possible, but the data collectors located at sites were only required to say if it was a FAD trip or not and that only some recorded this. She suggested that there should be a simple field added to the datasheets where the collector could indicate whether the fisher was actually fishing on the FAD, or if they were just in the FAD area. She indicated to the group that this was discussed during the MAGDELESA presentation. Mr. Medley sought further clarification on if the trips could be determined as FAD fishing retrospectively. Mr. Todd Gedamke offered two remarks; (i) that using species composition to identify if the fishing trip was indeed a FAD

trip would be possible if you had access to fine-scale species composition data and (ii) that a social aspect using interviews could be used to identify historical FAD trips if you have fisher identification on most of the trips. Ms. Edwin added that the largest challenge was getting people to collect comprehensive data. It was also noted that it was hard to determine the scale of FAD fishing (i.e. if the FAD is moved due to sinking, current, etc.) and although the boat fished in the FAD area, that may not necessarily mean the fisher was using the FAD.

Dr. Singh-Renton noted that it was worth the effort to do a separate study and identify the vessels which fished at FADs and the time periods when these vessels were operating. It was pointed out that the FAD fishery had a longer history in Dominica and in this case, the fishers would be able to provide this information. The Meeting was reminded that in some years there were reductions in landings of some species and an increase in the landings of others. It was further noted that there was a similar pattern of catches along the Eastern Caribbean chain on a yearly basis and as more data analyses were completed, ecosystem–scale trends may become apparent.

Ms. Edwin also informed the Meeting that fishers had deployed FADs in St. Lucia during the JICA project on the Formulation of a Master Plan for the Sustainable Utilization of Fisheries Resources in the Caribbean.

5.3 Reef and Slope Fish Resource Working Group (RSWG)

The 2012 Chairperson for the RSWG Mr. Alwyn Ponteen, the Montserrat representative presented the 2012 report of the RSWG. The detailed report of the RSWG is given in ***Appendix 5***.

Plenary discussion of RSWG

Professor Oxenford complimented the RSWG on their presentation and indicated her fascination with the improvement of datasets. She went on to query whether after the effort of cleaning the data, were they returned to the database or would they remain on a personal computer. The representative from Montserrat indicated that at present, the cleaned database would be treated as a separate exercise. He also noted that it was important to now consider the way forward. He indicated that that the lessons learnt regarding cleaning data were well noted.

The Barbados representative, Mr. Parker indicated that in their database, the reporting format for data was different from the input format. He also pointed out that cleaned datasets were kept as separate files as to renter these data would be considered as double work. He also indicated that CARIFIS would be used to continue taking in the new data. The UWI representative, Professor Oxenford indicated that this was the main point and suggested that in looking for a way forward, a mechanism for archiving cleaned datasets was necessary.

The NMFS-SEFSC representative, Nancie Cummins informed the Meeting that the issue of cleaning databases was discussed within the RSWG and it was agreed that a mechanism for editing and correcting the data was necessary as analyses were only as quality driven as the data you have. The NMFS - SEFSC representative, Todd Gedamke indicated that this was also discussed in the LPWG and supported the need for a master database.

Dr. Singh-Renton supported the need for editing of the original database as data may be required for other types of analyses and once errors were identified in national databases, they should be corrected. It was further pointed out that accurate representation of the fisheries in contexts other than fisheries assessments may be necessary. This emphasized also that maintenance of a quality database should to be addressed at the national level. Dr. Singh-Renton also reminded the Meeting that, as previously discussed, if datasets

were cleaned, the CRFM Secretariat could store them. It was suggested that as an interim recommendation, the datasets prepared by the various Working Groups should be held at the Secretariat, to facilitate access in subsequent years for additional work. It was also recommended that a sub-regional database should be considered for shared resources. The Montserrat representative, Mr. Ponteen recognized the significance of accurate data and suggested that CRFM should be the driving force behind improving the national data systems and he also recommended that this issue should be taken to the Ministerial Council and the Heads of Governments.

Dr. Singh-Renton indicated that specific recommendations should be noted within the Working Group reports. She also requested the assistance of consultants in creating presentations which the fisheries officers could share on return to their respective countries.

Professor Hoenig queried whether CARIFIS as a fox pro programme could be put into Microsoft Access, as this was the cheapest platform option and the database issue needed to be addressed. The opinion of the meeting was sought on this issue. The Barbados representative, Mr. Parker noted that the issue was entering the data and pointed out that data had been stored in different software by various countries and this needed standardization. He also suggested that the cleaned database be kept in Microsoft Access. The representative from NMFS - SEFSC, Mr. Todd Gedamke, noted that the Microsoft Access platform would be ideal as data could easily be compiled for analyses. He also noted that the front end of the new software could be designed to match the existing database and this would not be a difficult exercise for someone to programme.

Dr. Singh-Renton indicated that based on the report of the CARIFIS survey completed by CRFM, some countries would like to retain it as a database. She pointed out that the Caribbean Fisheries Forum had reviewed the findings of the report. The Meeting was also informed that the CRFM Secretariat was currently collaborating with a local / regional IT expert to determine how to move forward regarding CARIFIS.

The Barbados representative, Mr. Parker indicated that there was agreement on the need for incorporating cleaned data into national databases. The St. Lucia representative, Ms. Edwin also added that it was important to record historical events which could have possibly impacted on fishing industries e.g. the occurrence of hurricanes.

The Belize representative, Mr. Gongora, commented on the high catches of parrotfish being reported by Jamaica and pointed out that he understood that this was a livelihoods issue and many people depended on these species. He queried whether the fisheries department had considered the ecological impacts of removing large quantities of grazers from the reef especially considering their roles in the control of algae cover. The Jamaica representative, Ms. Anna Ebanks indicated that there was a preliminary study planned and discussions with UWI and other environmental agencies regarding parrotfish and possible management strategies were underway. The Belize representative noted that it would be important to determine the effects of banning these fisheries. He also went on to inform the Meeting that in Belize, particularly in the marine reserves, fishing for these species had been banned. He indicated that in Central and Northern Belize the sizes of parrot fish were now returning to those as seen in the previous years and recommended that Jamaica looked into this issue. The Jamaica representative, Mr. Morris also added that in the case of Jamaica the issue with reef grazers in general was recognised, however the nature of the fishery and use of traps provided some difficulty. The Meeting was informed that as a management measure, night diving was banned as it accounted for the majority of parrot fish caught as they slept at night and were easy targets. This measure was considered to be the first management step until the other studies came on board.

The Montserrat representative, Mr. Ponteen indicated that the situation regarding reef fisheries and the use of fish pots was the same in Montserrat as in Jamaica and this also needed to be addressed at the higher levels of government as banning the use of these gears would involve the provision of alternative livelihoods for the fishers.

5.4 Shrimp and Groundfish Working Group (SGWG)

The 2012 Chairperson for the SGWG was one of the Suriname representatives Mr. Zojindra Arjune. He presented the 2012 report of the SGWG. The detailed report of the SGWG is given in ***Appendix 6***.

Plenary discussion of SGWG

Dr. Singh-Renton enquired whether seasonality was considered as a factor regarding size composition as this was not seen in the presentation. The consultant, Dr. Paul Medley, indicated that seasonality was considered in previous assessments and would be revisited next year.

Dr. Singh-Renton pointed out that in the size chart there were horizontal rows with only one data point and she enquired about the significance of this. Dr. Medley indicated that the data were plotted as a proportion and therefore with small datasets it could be either one or two points. Dr. Medley indicated that the graphs would be improved next year and this was to be clarified in the report.

The representative from Suriname, Mr. Mario Yspol indicated that it was possible that the artisanal seabob fishery which began in May and lasted until September / October coincided with the breeding period for seabob and therefore these data should also be included in the assessment.

Dr. Singh-Renton noted that if the artisanal catch was destined for local consumption, this may not be an issue. Mr. Yspol indicated that there were three areas where these artisanal fisheries operated and buyers travelled to these sites. Given the long distance from the fishing areas to the markets, middlemen were used. The meeting was informed that a survey was going to be conducted to cover the multi-production stages as well as fishing effort of the artisanal seabob fishery. It was also pointed out that fishing depended on the cycle of the moon, and even though the activities were not carried out consistently, total catch still needed to be accounted for.

Professor Seijo pointed out that many shrimp fisheries were small scale and usually harvested juveniles in the lagoons, whereas the industrial fleets were harvesting the adults. He enquired whether the group had considered doing an age structure analysis of the fishery where the effects of how these two fleet types affected the stock could be investigated. Dr. Medley indicated that this was attempted; however the data were not adequate. It was also pointed out that it would be costly to collect these types of data and this would have to be tied into a direct management benefit. It was highlighted that the artisanal fishers were not very involved in the management of seabob. Dr. Medley also explained that if the stock was lightly exploited then these analyses were not necessary, however the closer the fishery was operating to MSY then these types of analyses may be considered.

5.5 Small Coastal Pelagic Working Group (SCPWG)

The 2012 Chairperson for the SCPWG was Ms. Maren Headley of the CRFM Secretariat. Ms. Headley presented the 2012 report of the SCPWG. The detailed report of the SCPWG is given in ***Appendix 7***. No questions or recommendations were raised following the presentation by the SCPWG and the Chair proceeded to the next agenda item

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

The 2012 Chairperson for the DMTWG was Mrs. June Masters of the CRFM Secretariat. Mrs. Masters presented the 2012 report of the DMTWG. The detailed report of the DMTWG is given in ***Appendix 8***.

No questions or recommendations were raised following the presentation by the DMTWG and the Chair proceeded to the next agenda item.

7. Collaboration with other organizations and activities.

7.1 WECAFC- joint technical working groups

Dr. Singh-Renton provided the Meeting with an update of the joint WECAFC Working Groups which were recently established during the 14th WECAFC session held during February 2012.

A number of working groups were established by WECAFC. Five of these working groups included CRFM as a partner organization. These were:

1. OSPESCA / WECAFC / CRFM / CFMC Working Group on Spiny Lobster
2. WECAFC / OSPESCA / CRFM / CFMC Working Group on Recreational Fisheries
3. CFMC / OSPESCA / WECAFC / CRFM Working Group on Queen Conch
4. CRFM / WECAFC Working Group on Flyingfish in the Eastern Caribbean
5. CFMC / WECAFC / OSPESCA/CRFM Working Group on Spawning Aggregations

The other remaining working groups were:

6. IFREMER/WECAFC Working Group on Development of Sustainable Moored Fish Aggregating Device (FAD) Fishing in the Lesser Antilles
7. WECAFC Working Group on the management of deep-sea fisheries

The TORs for the working groups were shared with the Meeting participants for their review.

Dr. Singh-Renton informed the Meeting that the first meeting of the joint queen conch working group was to take place in Panama during October 2012 and some of the outputs of the CRFM CLWG would be of relevance during that Meeting. It was suggested that participants should perhaps discuss how they could be involved in the spiny lobster and queen conch joint working groups. The participants were also reminded that the joint Working Groups would facilitate the management of these resources and scientific work.

The UWI representative, Professor Oxenford queried the two year time-frame allocated to these groups and also the process for selecting members. Dr. Singh-Renton indicated that the time-frame was linked to the inter-sessional period between WECAFC Commission meetings. Changes in the time period could be determined at the next WECAFC session in 2014. Regarding membership, Dr. Singh-Renton also pointed out that an email was circulated in the case of the lobster working group, which requested countries and organizations to identify a member who would be participating in that group.

7.2 Report of the First Meeting of the CRFM-WECAFC Working Group on Eastern Caribbean Flyingfish

The meeting noted that the First Meeting of the CRFM-WECAFC Working Group on Eastern Caribbean Flyingfish had been convened during 18-19 June 2012, and that this meeting had developed an updated

fisheries management plan for consideration by the countries. The report of the working group would be finalized in the near future, and the management plan and proposed management measures were expected to be reviewed at the national level via consultation with the relevant stakeholders. These consultations were expected to conclude in December 2012, after which time, the plan would be further refined by the joint working group, and then submitted formally to the CRFM for adoption at the Ministerial level.
There were no questions concerning this subject. However, there were some general concerns about collaborative work, involving other agencies and organizations. In particular, the Belize representative, Mr. Gongora expressed concern that many times the region was faced with the situation where management measures were imposed but no technical and financial assistance was provided to undertake the type of work required. The importance of discussing these initiatives with all the parties was highlighted. He outlined as an example, the discussions on Belize conch fishery which took place at the Queen Conch Experts Workshop held in Miami during the period May 22-24, 2012. He pointed out that at the meeting Belize was given the mandate to do an analysis on its deepwater conch stock, even though Belize did not fish the deep water stocks, and no technical or financial assistance was offered to fulfill this mandate. He also encouraged Member States to defend their national interest when participating in international fora. Dr. Singh-Renton expressed her appreciation for the issues raised by Mr. Gongora and noted that the joint technical working groups provided the opportunity for collaboration on the management of valuable fisheries resources and represented a first step in addressing the many challenges faced. She noted that Mr. Gongora's concerns also highlighted why participation in international fora was essential. She also pointed out that the tasks of these joint WECAFC working groups should be understood and consideration should be given regarding the contributions of the CRFM scientific meetings. The need to be proactive in both the preparation and participation in these joint working groups was also reiterated by Dr. Singh-Renton.

7.3 University of Southern Mississippi – establishment of website and collaboration in data collection

Dr. Singh-Renton indicated that the *Sargassum* presentation, prepared by Mr. Jim Franks from the University of Mississippi and which was delivered during the 10th Caribbean Fisheries Forum, would be circulated to participants.

Professor Oxenford gave a brief PowerPoint presentation on *Sargassum* and recent observations in the Eastern Caribbean.

The Montserrat representative, Mr. Ponteen indicated that *Sargassum* moss was an issue in Montserrat as well and informed the meeting that fishers had been seeing this phenomenon since the 1950s, therefore historical records for these events should be investigated. He also made reference to a comment made about flyingfish being present in the mid-Atlantic and suggested that work needed to be done related to the meteorological and ocean conditions. The Meeting was also informed that in January, February and March, a large number of species which were not usually seen were present in abundance including balahoo, jacks and gar. The importance of recording these events was noted as well as their usefulness in planning for future events.

The Barbados representative, Mr. Parker indicated that historical research had been done and the occurrence of *Sargassum* off Barbados had been recorded in the past as well as accounts of abundant flyingfish which would bounce off the sails and land on the decks of ships. The importance of considering historical records was also noted.

The consultant, Professor Seijo queried if any significant difference in the outflows of the Amazon River in relation to this increasing abundance of *Sargassum* was observed. The UWI representative indicated that in June there was a flooding event in Venezuela; however no larger plume was detected.

Professor Oxenford also informed the Meeting that *Sargassum* was considered as a treasure in North America. She indicated that there was a TAC of 5000 MT and a fisheries management plan since it was harvested for the feed supplement industry and also for biofuel. It was also required that observers were present on board to ensure that the organisms associated with the *Sargassum* mats were also not harvested.

7.4 University of the West Indies

On behalf of the University of the West Indies (UWI), CERMES, Professor Oxenford informed the meeting that the current research was focused on lionfish and its impacts on the pot fish fishery and the fishing communities in Barbados and CERMES was involved in the collection of baseline lionfish data. She reported that UWI was also involved in a major European Union project (FORCE), which was focused on improving coral reef management in the Caribbean. CERMES was also conducting many small student projects on fishery related issues. Dr. Singh-Renton further reminded the Meeting of the CRFM / UWI research agenda.

7.5 IFREMER

Mr. Lionel Reynal informed the meeting that IFREMER was presently involved in the MAGDELESA FAD project. With regards to technical collaboration he noted that IFREMER was interested in collaborating with CRFM Secretariat on the analysis of the blackfin tuna fishery. He also acknowledged the WECAFC working groups and noted that IFREMER was limited with regards to personnel, in particular personnel to collect data.

8. Lionfish Action Plans

A summary of updates on lionfish activities being conducted at the national level is provided below by country in alphabetical order.

<u>Belize</u>

Mr. Gongora pointed out that the invasion was now widespread in Belize especially in the fisheries reserves. The fact that fishers were not allowed to enter these zones to conduct extractive activities and the lionfish were left to eat all the fish in the conservation zones was highlighted. In addition, the Fisheries Department was now given the responsibility for supervising the culling of the lionfish in the reserves using spear guns. It was considered to be unfair to allow fishers to enter the reserves and only target lionfish, and queried how this could be justified. It was pointed out that this was an example where the environmental agenda was placed before the fisheries agenda.

Mr. Ponteen indicated that he was pleased to hear this concern and referred to parrotfish situation and the fact that lionfish were being caught in 3000ft of water. He also queried what other gears would be useful in capturing lionfish.

Mr. Parker indicated that there would always be the need for conservation zones which were covered by the national legislations. He noted that there should be a disincentive to stop fishers from taking species which they were not supposed too and this was why it was important to have a well developed market as the capture of the lionfish would then be viable for the fishers. He also agreed that the presence of lionfish would undermine the value of these zones in terms of fish stocks and therefore eradication programmes should be structured to take this into account.

Mr. Gongora raised the point again that it was important to defend the national fisheries agenda, however in the Caribbean this did not always occur. He also noted that the Caribbean Common Fisheries Policy was setting the scene to move forward, however he was concerned that poorer fishing communities would not benefit from the policy as they lacked representation as a group.

Barbados

Mr. Parker indicated that immediate collection of genetic lionfish samples throughout the region of the lionfish was necessary as it would be best to record the invasion event as early as possible. It was pointed out that in Barbados the spread was being noted, and there was a Heritage Department within the Ministry of Environment which was also documenting the event. The Meeting was informed that there were two aspects of the Barbados response that had been popular and successful. These were a facebook page and a 24 hour hotline.

Professor Oxenford also pointed out that there was also a Caribbean lionfish listserv group which shared information and the NGO, REEF special lionfish web site. The Meeting was informed that lionfish book was being prepared for publication and the dissection guide was available. The existence of a dropbox which contained all these references was mentioned.

Dominica

Mr. Theophile indicated that last year Mr. Lad Atkins of REEF provided training to fisheries staff and dive shop operators in locating and capturing lionfish. He also noted that fishers were currently capturing lionfish. A "Google docs" file was also set up by the Fisheries Division to report sightings and captures of lionfish by diveshop operators and fishers. A dive master was also preparing a document on the lionfish event in Dominica and it was expected to be finalized shortly. Various consultations and stakeholder awareness programmes had also been conducted in the communities.

Dr. Singh-Renton queried whether the work being done by REEF was related to the work by ICRI Ad Hoc Committee on Lionfish. She also reminded the meeting of these initiatives including the Best Practices Manual in collaboration with GCFI and the upcoming study on ciguatera in lionfish. Professor Oxenford indicated that it was the same group of individuals. Regarding ciguatera, if the island was considered to be high risk, then the same would apply for lionfish as the other fish species.

St. Kitts and Nevis

The representative from St. Kitts and Nevis, Mr. Samuel Heyliger informed the meeting that there were currently no formal plans for the management of lionfish. A session was held for fishers to share cleaning, processing and cooking techniques for lionfish and radio programmes also discussed the event. He also explained to the Meeting that there was a salt water aquarium at the Fisheries Division where the public could observe demonstrations of the lionfish being fed. In terms of ciguatera, it was pointed out that all species of fish had been found to have ciguatera and it was most likely that lionfish may be less toxic than the snappers and hinds. Mr. Parker said he liked the idea of feeding the fish as a visual demonstration and queried whether there was a monitoring programme in place and if samples were being collected. Mr. Heyliger indicated that data were being collected and lionfish were also recently sent to St. Lucia to assist with the development of a recipe book. It was also pointed out that initially the occurrences of lionfish were being charted; however it had now become widespread and occurred everywhere.

St. Lucia

Ms. Edwin indicated that a draft response and action plan existed and she confirmed that lionfish sightings had occurred and public sensitization through schools was being done. Two schools within each district were being targeted and data collectors were being trained to collect information on lionfish. A form was also developed to be filled out by dive shop operators. It was further noted that if lionfish were captured in the marine reserves there were specific actions. The Meeting was informed that there was also an aquarium with lionfish at the Fisheries Department.

St. Vincent and the Grenadines

The St. Vincent and the Grenadines' representative, Mrs. Cheryl Jardine-Jackson informed the meeting that a task force group had been set up and an action plan was being reviewed. It was pointed out that during the recently concluded Fisherman's day competition, a lionfish competition was also held. It was noted that lionfish were abundant in the Grenadines with numerous sightings in Union Island. She also explained that the lionfish action plan was presented to the Minister and public consultations were to follow.

Turks and Caicos Islands

The Turks and Caicos Islands' representative, Ms. Jasmine Parker, indicated that just like the other islands, a huge educational campaign was completed. This included articles, newspapers and training of scientists, staff of the fisheries department, and dive shops in the capture and handling of lionfish. A yearly lionfish hunt which involved the diveshops was also held with prizes donated by sponsors. The Meeting was also informed that restaurants were paying up to $US 10/lb and there was one restaurant serving lionfish pizza, while high end restaurants were preparing gourmet lionfish dishes. It was also noted that the Department of Environment and Coastal Resources issued permits to catch lionfish in the reserves.

The Barbados representative, Mr. Parker suggested that the compilation of national lionfish activities and action plans be a task for the DMTWG so that commonalities and best practices could be determined and a harmonized response prepared. Once this existed and there was a cohesive group, it would be advantageous to determine which organizations would be best to work with. It was also reiterated that it was key to capture the beginning phase of this invasion and act promptly.

9. Any other business

There was no other business or discussions raised.

10. Review and adoption of meeting report

Mr. Parker enquired as to the timeline for the submission of the final report. In response, Dr. Singh-Renton proposed that the final reports for the working groups be submitted by 31 July 2012 to CRFM and that the various Powerpoint presentations be submitted by Monday, 2 July 2012.

It was agreed that the report of the plenary sessions would be adopted via email.

11. Adjournment

Mr. Parker thanked the meeting participants for their contributions, and noted that it was a successful meeting which involved hard work. He also noted that he was a trained scientist and from that perspective he was pleased to come and engage in these exercises. He also acknowledged the CRFM Secretariat for the good planning, and the caterer for the snacks. He thanked the government of St. Vincent and the Grenadines for hosting the Meeting and ensuring that some of the carnival events were seen. He also thanked the consultants for their wisdom and efforts.

Dr. Susan Singh-Renton thanked the chair and on behalf of the CRFM Secretariat thanked the participants for their efforts as it was a long time to be away from their home and families. She noted that good progress had been made and there was now the need to maintain the pace. She thanked the consultants for their work and patience, Professor Hazel Oxenford for her presentation and technical contributions and Mr. Parker for his patience, the entertaining moments and for keeping the meeting jogging along. She proposed that the tentative dates for next year's meeting be 3-14 June, 2013. These dates would likely be finalized by December 2012. She also noted that if the CRFM/WECAFC Working Group on Flyingfish in the Eastern Caribbean meeting was to take place, then the Scientific Meeting would start on 5 June 2013. It was expected that plenary would be a 1½ day session.

The meeting was adjourned at 11:00 am on 30 June 2012.

Appendix 1: Agenda

I. Meeting of the DMTWG: 20 - 21 June 2012

II. Individual Resource Working Group Sessions: 22 - 28 June 2012

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

III. Formal plenary sessions: 29 - 30 June 2012

1. Opening of the meeting.
2. Adoption of meeting agenda and meeting arrangements.
3. Introduction of participants.
4. Presentation of national (country) reports.
5. 2012 reports of the CRFM Fishery Resource Working Groups (listed in alphabetical order):
   - 5.1 Conch and Lobster Resource Working Group (CLWG);
   - 5.2 Large Pelagic Fish Resource Working Group (LPWG);
   - 5.3 Reef and Slope Fish Resource Working Group (RSWG);
   - 5.4 Shrimp and Groundfish Working Group (SGWG);
   - 5.5 Small Coastal Pelagic Working Group (SCPWG).
6. Report of 2012 Meeting of the Working Group on Data Methods and Training (DMTWG).
7. Collaboration with partner organizations and agencies.
8. Any other business.
9. Review and adoption of meeting report.
10. Adjournment.

Draft Annotated Agenda

I. Meeting of the DMTWG: 20 - 21 June 2012

- *Training in the use of Excel and its application to fishery analyses will be conducted during this meeting.*

II. Individual Resource Working Group Sessions: 22 - 28 June 2012

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

III. Formal plenary sessions: 29 - 30 June 2012

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 29 June 2012.*

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. Introduction of participants.
   - *Each participant will be invited to introduce him/herself, and to state his/her interest in 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 2012 Meeting.*

5. 2012 reports of the CRFM Fishery Resource Working Groups (listed in alphabetical order):
   5.1 Conch and Lobster Resource Working Group (CLWG);
   5.2 Large Pelagic Fish Resource Working Group (LPWG);
   5.3 Reef and Slope Fish Resource Working Group (RSWG);
   5.4 Shrimp and Groundfish Working Group (SGWG).
   5.5 Small Coastal Pelagic Working Group (SCPWG)
   - *Each Working Group Chairperson will present an overall report of the Working Group's 2012 meeting, including overall findings, recommendations and conclusions.*
   - *Each species rapporteur will also present his/her fishery assessment report for 2012.*
   - *Following each presentation, the Meeting will be invited to review, discuss, and endorse each report's findings and recommendations.*

6. Report of 2012 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. Collaboration with partner organizations and agencies.
   - *The chairperson will afford review and consideration of recommendations in respect of related research and assessment work being carried out by partner organizations and agencies.*

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

9. 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.*

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

Resource Working Group Meeting Agenda

1. Review of inter-sessional activities, including management developments since last meeting.
2. General review of fisheries trends throughout the region, including recent developments.
3. Review of selected fishery to be assessed - i.e. review available new data and information, including review of national reports, fisheries trends, and management developments.
4. Review of management objectives and possible management strategies – i.e. review of fisheries management plans, stated management objectives and agreed, practical management strategies in order to agree on the approaches to 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 2012.
7. Any other business
8. Adjournment.

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

1. Opening of meeting.
2. Adoption of agenda and meeting arrangements.
3. Training in Excel.
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 Conch and Lobster Resource Working Group (CLWG)

Chairperson:	Mauro Gongora, Belize
Rapporteur:	Jasmine Parker, Turks and Caicos Islands
Other Members:	Ricardo Morris (Jamaica), Samuel Heyliger (St. Kitts and Nevis), Kris Isaacs (St. Vincent and the Grenadines), Maren Headley (CRFM Secretariat)
Consultant:	Professor Juan Carlos Seijo (Fisheries Consultant)

A. OVERVIEW

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

This year the CLWG was rather a small group comprised of representatives of Turks and Caicos Islands, Jamaica, Belize and St. Kitts and Nevis. A representative of St. Vincent and the Grenadines also attended the meeting. The participatory nature of the meeting provided an excellent opportunity for participants to share information about the conch and lobster situations in their countries. The group discussions held with the consultant greatly benefitted the group.

During the inter-sessional period several on-going and new activities were undertaken by member countries in relation to lobster and conch fisheries research and management efforts. The chairman guided the discussions and requested participants to provide an overview of the activities carried out in their countries.

The working group chairman introduced the objectives of the meeting and presented Dr. Juan Carlos Seijo, Consultant who then made a presentation on bio-economic analysis to introduce the main parameters employed in the bio-economic analysis work that would be carried out.

The working group agreed that Jamaica's conch data set would be explored as part of the bio-economic analysis exercise that would be carried out this year.

A summary of the main inter-sessional activities carried out by country is presented below.

<u>Turks and Caicos Islands</u>

- ✓ Catch and effort data for Spiny lobster and conch and scale fish was collected at landings sites and processing facilities.
- ✓ Biological data for spiny lobster was collected.
- ✓ Fishing effort data was collected.
- ✓ No underwater conch visual census was carried out but there are plans to conduct this activity once the country budget has been approved by June 2012.
- ✓ The Governor of TCI has established the lobster fishing season for eight months from August 1 to March 31.

- ✓ The Fisheries policies and legislation is under review and various recommendations are being considered for lobster and conch fisheries at the moment. The review process is expected to be completed shortly.

Jamaica

- ✓ A revision of the Fisheries Act and Regulations is being carried out but it is incomplete at the moment.

- ✓ Lobster research on pueruli larvae and juvenile recruitment was carried out and will continue this year.

- ✓ Research was carried out in lobster habitat enhancement structures.

- ✓ A lobster stock assessment needs to be carried out

- ✓ The exploration of diversification into other new fish species is ongoing. One species with high potential is the sea cucumber, which has attracted the attention of some persons interested in exporting this product.

- ✓ Jamaica made a short presentation on its preliminary conch bio-economic analysis. The model used was developed by Dr. Seijo to conduct an analysis of the Turks and Caicos Islands data during the 2010 Annual Scientific Meeting.

Belize

- ✓ Catch and effort data for spiny lobster, conch and scale fish were collected at fishermen cooperatives and processing facilities.

- ✓ Biological data for spiny lobster and conch were collected at fishing sites and fishermen cooperatives.

- ✓ No underwater conch visual census was carried out in the inter-sessional period but the next national conch survey is scheduled to be carried out during the period August 15 to September 15, 2012.

- ✓ The Total Allowable Catch (TAC) estimate will be ready before the opening of the conch fishing season, which starts on October 1, 2012.

- ✓ Belize implemented a Managed Access Program at two pilot sites (Glovers Reef and Port Honduras Marine Reserves). The objective of the program is to improve fisheries management, data collection and reporting, fisheries enforcement, and improve stock conditions. The program allows fishermen to be part of the decision making process.

- ✓ Belize participated at the Queen Conch Experts Workshop that was organized by the Caribbean Fishery Management Council. The workshop was held in Miami during the period May 22-26, 2012. The workshop report was distributed to the participants of this CRFM Scientific Meeting so that participants would be aware of the workshop findings, conclusions and recommendations. Belize pointed out some major areas of concern in the report to the participants that needed special attention by CRFM member countries; especially in light of the fact that a resolution will

be drafted and presented at a follow-up meeting in October 2012. It is anticipated that a request will then be made to table the resolution at the next CITES COP meeting in 2013.

- ✓ A technical revision of the Belize fisheries act and regulations was carried out with the help of an international consultant and an experienced local attorney. The new act named "Living Aquatic Resources Bill 2012" is currently being reviewed by the government and is expected to be passed shortly. The new act incorporates a number of provisions not considered in the old act including high seas fishery management, international conservation and management measures, fisheries fund and fisheries council among others.

St. Kitts and Nevis

- ✓ The conch fishery does not have a closed season and is for local consumption only.
- ✓ Conch minimum size limit was put in place to avoid overexploitation.
- ✓ There is no lobster fishery and catches are mostly incidental in the conch fishery.
- ✓ Conch (approximately 150 fishers) fishing is concentrated in the South East Peninsula, which is considered a conch and lobster breeding ground but it is not protected.
- ✓ The conch fishing area encompassing (20) square miles is planned to be protected.
- ✓ The channel between St Kitts and Nevis is to be declared a special management area for protection of fishery nursery grounds and will be used for tourism purposes as well.

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

The conch fisheries of member countries are generally considered in good conditions given the various management measures currently being implemented in each country. In the case of Jamaica, the conch fishery has seen a substantial reduction in fishing effort and the fishing mortality rate has declined from 0.22 in 1994 to 0.04 in 2011.

Belize's conch fishery is stable and is characterized as a shallow water artisanal small-scale fishery that primarily targets legal-sized pre-adult individuals in the fishing grounds. The annual high recruitment into the fishery as demonstrated in the national conch surveys in the last 10 years indicates high levels of sustainability. It is believed that the untouched deep water adult spawning stocks could be supplying seed stock to the shallow fishing grounds but this need to be corroborated. Fishing effort (number of fishermen) shows an increasing pattern and is responsible for the increase in conch meat production volume. The control of fishing effort in the conch fishery is being done through the implementation of a managed access program that has produced very good results as fishermen participate in the decision-making process and are complying with data reporting, there is increased patrols and compliance with regulations, reduced illegal fishing and greater cooperation with the authorities.

3. Fishery data preparation, analysis, and report preparation

The members of the CLWG agreed to the following work plan for the meeting.

Jamaica

A bio-economic analysis of the conch fishery was carried out as an exercise and training for the working group. Data provided by the Jamaica Fisheries Division would be validated and incorporated in the bio-economic models originally developed for the Turks and Caicos Islands by Dr. Juan Carlos Seijo.

Other

No other activities were planned.

4. Inter-sessional workplan and Recommendations

Inter-sessional workplan

The working group agreed that countries will carry out the following activities during the inter-sessional period.

Turks and Caicos Islands

- ✓ Update the conch fishery bio-economic analysis to incorporate the data for 2011.
- ✓ Continue CPUE data collection and monitoring of conch and lobster landings.

Belize

- ✓ Update the fishery-dependent lobster stock assessment to the period 2010-2011.
- ✓ Conduct a national conch survey (August 15 to September 15, 2012).
- ✓ Continue CPUE data collection and monitoring of conch and lobster landings.
- ✓ Continue lobster biological collection.

Jamaica

- ✓ Refine the results of the conch bio-economic assessment done at this scientific meeting.
- ✓ Conduct a fishery-dependent lobster stock assessment.
- ✓ Continue CPUE data collection and monitoring of conch and lobster landings.

St. Kitts and Nevis

- ✓ Continue CPUE data collection and monitoring of conch and lobster landings.

Issues and Recommendations

1. Countries should encourage the ACP-FISH II Project to expedite the execution of the two conch projects that are extremely important for conch producing/exporting countries of the Caribbean region. One of these projects is the training workshop on conch underwater visual surveys.
2. Countries' representation at regional and international conch and lobster fora is important to defend the national and regional interest, especially as it relates to management strategies promoted by international organizations that could potentially threaten the livelihoods of fishermen and their families.
3. The proposed 8% conch harvest rule and the conch density of 100 adults per hectare as presented in the Miami Queen Conch Experts Workshop report need to be carefully considered because there would be social and economic implications at the national and regional levels. There is a

need to conduct conch surveys/stock assessments in some countries before a decision can be made.

4. The financing of conch surveys through export taxes suggests that monies would be collected from the industry and placed under the control of the Fisheries Divisions of member countries. The Finance regulations do not allow for that and all monies are paid into a consolidated revenue fund and cannot be used for any fishery/marine research activity unless approved in the national budgets.
5. The prohibition on the use of compressed air for commercial fishing to protect conch and lobster stocks in deeper waters, 2- 3 month closed season, license vessels and limited entry will have some serious implications in some countries such as Jamaica and St. Kitts. The social and economic implications for such an intervention are unimaginable and should not be considered at this time.
6. Limited entry into the conch and lobster fisheries such as in the case of Jamaica was considered a better option than banning the use of compressed air.
7. The introduction of VMS for monitoring conch and lobster fishing will have serious financial implications for both the fishers and the Fisheries Divisions.
8. The tabling of a resolution on the findings, conclusions and recommendations of the Miami Queen Conch Expert Workshop (QCEW) report at the next CITES-COP meeting in 2013 will more than likely become a part of the conditions for countries involved in the international trade in conch.
9. Countries do not have the resources to complete a deep water assessment. However, a shallow water assessment and genetic research should be done to compare populations.

5. Review and adoption of Working Group report, including species/ fisheries reports for 2012.

The Working Group Report was reviewed and adopted by the members of the CLWG.

6. Adjournment.

The meeting of the SGWG adjourned at 6.30 pm on 28 June 2012

B. FISHERY REPORTS

1. The Queen Conch (*Strombus gigas*) Fishery of Jamaica

1.1 Management Objectives

The management of Queen Conch in Jamaica is guided by the Conch Fishery Management Plan as well as the National Fisheries Policy and thus aims to optimize the sustainable economic and social benefits from the fishery while maintaining the stock's biological integrity. This aim is pursued through the development and implementation of a sound management regime inclusive of; among other things, an annual Total Allowable Catch (TAC) system, regular biological assessments, a limited entry policy, a close season (July 1 to October 31), control and monitoring of fishery-related activities, and appropriate legislative arrangements.

1.2 Status of Stock

Results of the recent 2011 Jamaica Queen Conch abundance survey, which is the latest scientific assessment of the stock, were not available at the time of writing this report.

Jamaica's Queen Conch stock has benefited greatly from the implementation of a National Total Allowable Catch (NTAC) system implemented since 1994 and the 8% MSY rule used to determine the quantity of conch harvested annually. These as well as other management measures have moved the stock from being subject to open access conditions, as was the case when the fishery started in the 1980's, to where it is now a relatively well-managed fishery. This is illustrated in the fact that Jamaica has managed to maintain healthy stock densities throughout the Pedro Bank where our primary conch stock and industrial fishery are located (see Table 1).

Table 1. Estimates of density for each depth strata and total Queen Conch biomass on the Pedro Bank for each survey year. Modified from Smikle (2010).

Survey Year	Depth Strata (Metres)	Density Estimate (Conch/ha)	Biomass Estimate (Metric Ton)
1994	**0-10**	**73**	**13,325.48**
	10-20	**152**	
	20-30	**203**	
1997	**0-10**	**175**	**12,203.27**
	10-20	**88**	
	20-30	**203**	
2002	**0-10**	**175**	**15,305.85**
	10-20	**138**	
	20-30	**244**	
2007	**0-10**	**378**	**5,205.07**
	10-20	**49**	
	20-30	**50**	

Jamaica has also been successful in negotiating and implementing a 1995 agreement to reduce the NTAC to close to 1000 MT by the year 2000 (Aiken *et al*., 2006) which has also contributed to a reduction of effort and the relatively good status of the stock. These successes are continually being threatened by externalities, the most important of which is poaching by foreign vessels, which is thought to be significant when compared to the level of Jamaica's production.

1.3 Management Advice

The Queen Conch fishery of Jamaica is at a point where decision tables that consider alternative management decisions, possible states of nature, and the calculated performance of biologic and economic variables can now be completed. This approach will allow for consideration of the fishery uncertainties, and calculation of the corresponding risks of alternative management decisions.

1.4 Statistics and Research Recommendations

- Research questions that were considered as relevant for advancing knowledge on the species and for responsible management of the fishery include: Are queen conch postlarvae settling with different patterns in search for adequate water habitat, temperature, salinity and/or food?
- What are the possible current effects of climate change on queen conch stocks?
- Is fishery recruitment of young adults the result of immigration from deeper waters or from postlarval berried individuals?
- What is the calculated effect of alternative stock rebuilding strategies aiming at bioeconomic target reference points?
- What is the risk of the biologic indicator (Bt/BMSY) falling below the corresponding LRP with alternative stock recovery strategies?

1.5 Stock Assessment Summary

The bio-economic analysis of the *Strombus gigas* (Queen Conch) fishery completed during this meeting can provide managers with the tools to consider alternative management decisions, possible states of nature, and the calculated performance of biologic and economic variables.

1.6 Special Comments

None.

1.7 Policy Summary

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

- To conserve and manage the marine capture fisheries resources of Jamaica;
- To produce the optimal sustainable yield of each major resource, which means reversal of overfishing in overexploited fisheries and increased fishing effort in under-exploited fisheries;
- To produce a vibrant and healthy capture fisheries sector; and in the process to recover resource rents to finance the fishery management process;
- To enhance suitable areas of habitat;
- To achieve sustainable development and utilization of fisheries resources in deep waters and distant shoals with due consideration to international obligations, and
- To achieve sustainable development and utilization of fisheries resources in inland waters.

1.8 Scientific Assessments

Very little scientific work was done prior to 1994 when the first abundance survey was done. In fact, the first assessment of Jamaica's Queen Conch stock had to be based on literature reviews, interviews and workshops conducted jointly by the CARICOM Fisheries Resources Assessment & Management Programme (CFRAMP) and Fisheries Division in 1992 (Aiken *et al.,* 2006).

The 1994 Jamaica Queen Conch abundance survey represented the first in a series to assess the abundance, density and biomass with a view to recommending an appropriate TAC for the fishery. Other surveys were conducted in 1997, 2002, 2007 and the most recent in 2011. Details of the 1994 and 1997 surveys have been reported in Appeldoorn (1995) and Tewfik and Appeldoorn (1998) respectively, while Smikle and Appledoorn (2003) reported on the 2002 survey. Results of the 2007 survey were reported in an unpublished report (Smikle, 2008). The assessment report for 2011 was not finalized at the time of writing this report.

1.8.1 Description of the Fishery

The Queen Conch (*Strombus gigas*) fishery is Jamaica's most important fishery contributing millions in foreign exchange revenue each year and providing employment for many Jamaicans (CMFC/CFRAMP 1999). The fishery is an export-oriented industrial fishery with annual exports averaging over 500 metric tonnes over the last decade (Smikle, 2010). Fishing is concentrated on Jamaica's largest offshore back, the Pedro Bank, where the product is caught by divers using breathing assisting apparatus (mainly Hookha) operated from small dories or canoes associated with mother vessels ranging from 25 to 30 m in length.

1.8.2 Overall Assessment Objectives

The main objective of this analysis was to examine alternative TAC management strategies.

1.8.3 Data Used

Data used in the analysis were obtained primarily from the Fisheries Division's database and available literature (both published and unpublished) on conch fishery in Jamaica and within the region. These were complemented with interviews with fisheries managers and other persons involved in the exploitation of the resource in Jamaica. Input parameters were estimated as follows:

Table 2. Description of parameters used to conduct the current bioeconomic analysis

Parameter	Description of Estimate	Unit of measurement	References
Intrinsic rate of growth (r)	Rate of intrinsic population growth was obtained as described in the reference	1/year	CFMC/CFRAMP 1999
Carrying capacity (K)	Obtained by assuming the virgin stock density is equal to the 1994 survey densities for strata 0-10 m and 20-30 m (276.97 conch/ha). This density was then used to estimate the virgin stock biomass and 2.76 conversion factor for biomass	MT	Adopted from Appledoorn 1995
Catchability coefficient (q)	This is the proportion of the biomass which is taken by 1 unit of effort.	1/boat/year	This study with Fisheries Division data (2012) and CFMC/CFRAMP, 1999
Unit cost of effort (cu)	This is the cost of one unit of effort. Calculated assuming that	USD/boat/year	This study with Fisheries Division

	each vessel 25 to 30 m vessel incur costs per trip (5 days) equal to US$30,000 and therefore would incur costs of US$6,000/day. These values were then multiplied by the average number of fishing days per season		data (2012)
Price of species (p)	An estimate of the ex-vessel price was obtained by assuming	USD/MT	Fisher interviews (2012)
Average number of fishing days	Obtained using 2009 fishing season data as a baseline	days/year/boat	Fisheries Division data (2009)

Of note also are the assumptions that each vessel spends approximately 5 days/trip using 20 divers to fish the product with each diver fishing at a catch rate of 30 kg/hour for 7 hours each day. These figures were obtained by examining the Fisheries Division data.

1.8.4 Stock Assessment Method

1.8.4.1 Bioeconomic assessment of queen conch (Strombus gigas) of Jamaica under uncertainty

The group discussed the importance of considering alternative intrinsic growth rate parameters (*r*) to reflect different rates of population growth response to spawning stock stock biomass with alternative TAC´s management strategies. For a long lived species like queen conch (*Strombus gigas*), two *r´*s were considered as possible states of nature (θi) which would have different effects of alternative TAC´s under consideration for the fishery. These r´s are the following:

θ1: r = 0.18 (this study) and θ1 = 0.24 (CFMC / CFRM, 1999)

Concerning alternative fishery management decisions, three were considered:

d1: TAC at Fmsy, r=0.18
d2: TAC at Fmsy, r=0.24
d3: TAC at F0.08
A biomass dynamic bio-economic model was developed for the fishery. The parameter set used to conduct the bioeconomic analysis is the following:

Table 3. Bioeconomic parameter of the queen conch fishery of Jamaica.

Parmeter	Symbol	Value	Unit of measurement	Reference
Intrinsic rate of growth	r	0.18	1/year	CFMC/CFRM (1999)
Carrying capacity	K	27,708	MT	Appledorn, (1995)
Catchability coefficient	q	0.008	1/boat/year	CFMC/CFRM (1999)
Unit cost of effort	cu	150,000	USD/boat/year	This study, FD data (2012)
Price of species	p	2400	USD/ton	Fisher interviews (2012)

1.8.4.2 Results and discussion

With this set of biologic and economic parameters, bioeconomic reference points were calculated analytically and numerically for the queen conch fishery of Jamaica with the following results:

Table 4. Bioeconomic reference point for the queen conch fishery calculated with the parameter set reported in Table 3.

Name	Equation	θ_1: r=0.18	θ_2: r=0.24	Unit of measurement
Biomass at bioeconomic equilibrium	$B_{be}=cu/pq$	7,813	7,813	Ton
Effort at bioeconomic equilibrium	$f_{be} = 2\ f_{mey}$	16	22	Mother vessels
Catch at bioeconomic equilibrium	$Y_{be}= qf_{be}K(1-qf_{be}/r)$	1,010	1,346	Ton
Effort at MSY	$f_{msy} = r/2q$	11	15	Mother vessels
Catch at MSY	$Y_{msy} = Kr/4$	1,247	1,662	Ton
Effort at maximum economic yield	$f_{mey} = r/2q(1- cu/pqK)$	8	11	Mother vessels
Catch at MEY	$Y_{mey} = qf_{mey}K(1-qf_{mey}/r)$	1,148	1,530	Ton
Biomass at MEY	$B_{mey}=(1-qf_{mre}/r)K$	17,760	17,760	Ton
Biomass at MSY	$B_{msy}=(1-qf_{mrs}/r)K$	13,854	13,854	Ton

With the TAC´s established for the period 1994 - 2011, and corresponding catches reported for the fishery, annual F values were calculated for this period (Figure 1). From this figure we can observe that in 1994 the fishery had a considerably high F = 0.22, operating with a TAC = 3000 ton and a biomass calculated from survey of 13,600 ton. TAC´s decreased over from 3000 ton to 400 t in 2011. This last TAC represents an F = 0.04.

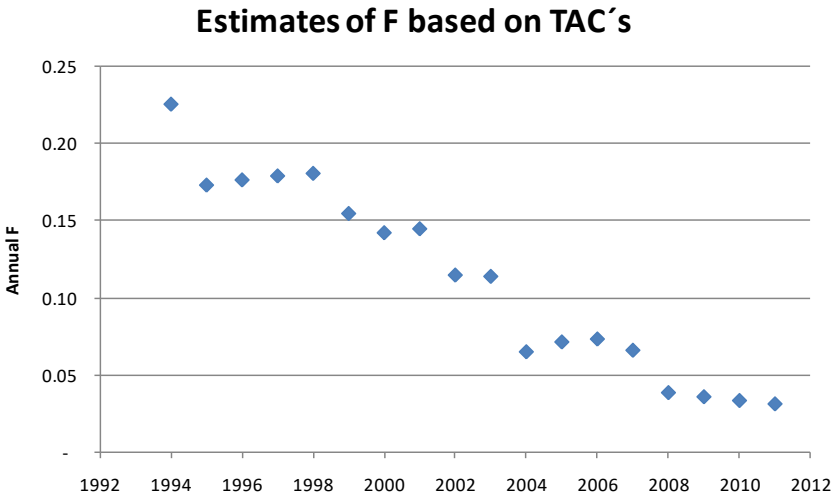


Figure 1. Estimates of F based on TAC´s in the queen conch fishery of Jamaica for the period 1994-2011.

It should be pointed out that two approaches are suggested to be used to deal with the uncertainties associated uncertainties presented in fisheries management (Anderson and Seijo, 2010). To answer the question of how to deal with new uncertainties inherent to data collection and stock assessment of queen conch (*Strombus gigas*) in the absence of probabilities of occurrence of possible states of nature, the decision tables approach was selected.

Decision tables procedure:

(i) The queen conch fishery manager should select <u>one</u> fishery management strategy ***d*** from a ***D*** set of management options.
(ii) When selecting a strategy ***d*** the decision-maker should be aware of the possible consequences.
(iii) The queen conch fishery manager should select <u>one</u> fishery management strategy ***d*** from a ***D*** set of management options.
(iv) When selecting a strategy ***d*** the decision-maker should be aware of the possible consequences.

Approach

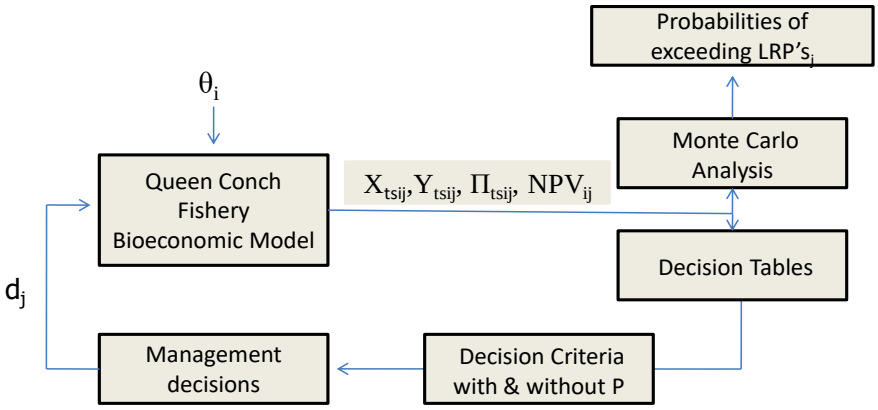


Figure 2. Bioeconomic approach for analysis of the queen conch fishery of Jamaica.

Calculated consequences will be a function of:

(i) Cause-effect relationships represented in the recruitment model built to explore management questions
(ii) Bio-ecologic and economic parameter set used, and
(iii) Possible states of nature concerning appropriateness of alternative population growth parameter used.

A decision table has the components presented in Table 5.

Table 5. Structure and components of a decision table.

Possible management strategies	Alternative states of nature				Criterion value
	θ_1	θ_2	…	θ_j	
	P_{θ_1}	$P_{\theta 2}$	…	$P_{\theta j}$	
d_1	$R_{1,1}$	$R_{1,2}$		$R_{1,j}$	C_1
d_2	$R_{2,1}$	$R_{2,2}$		$R_{2,j}$	
⋮	⋮	⋮		⋮	⋮
d_i	$R_{i,1}$	$R_{i,2}$		$R_{i,j}$	C_i

Criteria **without** probabilities of occurrence of θ_i

In the absence of probabilities of occurrence of alternative states of nature, there are three precautionary criteria which could be considered for responsible fisheries of fisheries management: the Maximin, the Minimax, and the Bayesian criteria.

Maximin

If the queen conch fishery manager is cautious and highly risk averse, he will tend select the decision that involves the maximum performance value of the spawning biomass indicator of the minimum estimated for the different states of nature associated, in this case, to population growth processes. The proper criterion for this level of risk aversion is the Maximin.

Table 6a. Decision table with the Maximin criteria considering long-run fishable biomass as the performance variable.

	Alternative States of Nature		Miaximin Criteria
Alternative Decisions	θ_1 (r=0.18)	θ_2 (r=0.24)	Min
d_1: TAC at F_{msy}, r=0.18	12361	16175	12361
d2: TAC at F_{msy}, r=0.24	9518	13890	9518
d3: TAC at $F_{0.08}$	15354	18475	15354

Performance indicator: Biomass (ton).

Maximin Criteria: Select the maximum of the minimum performance vector

For fishable biomass as the performance variable, the Maximin criteria selects fishery management decision d_3 which corresponds to a TAC determined over time based on a F = 0.08.

Table 6b. Decision table with the Maximin criteria considering long-run fishery yield as the performance variable.

	Alternative States of Nature		Maximin
Alternative Decisions	θ_1 (r=0.18)	θ_2 (r=0.24)	Min
d_1: TAC at F_{msy}, r=0.18	1246	1618	1246
d2: TAC at F_{msy}, r=0.24	1142	1667	1142
d3: TAC at $F_{0.08}$	1228	1478	1228

Performance indicator: Yield (ton of conch meet).

Maximin Criteria: Select the decision that yields the maximum of the minimum performance vector

For sustainable fishery yield, the Maximin criteria selects fishery management decision d_1 which corresponds to a TAC determined over time based on a Fmsy using an r=0.18.

Minimax

For the Minimax approach, we built the loss of opportunity matrix through specifying the loss function L (θi, dj). The Minimax criteria estimate the maximum loss of opportunities for each fishery management strategy and select the one that yields the minimum of the possible maximum losses.

With this criterion the fishery manager will proceed as if nature selects, out of the possible states of nature, the "least favorable" intrinsic growth parameter of population biomass.

Table 7. Loss of opportunity matrix built for the Minimax criteria considering long-run fishery fishable biomass as the performance variable.

	Loss of Opportunity Matrix Alternative States of Nature		Minimax Criteria
Alternative Decisions	θ_1 (r=0.18)	θ_2 (r=0.24)	Max Loss of Opportunities
d_1: TAC at F_{msy}, r=0.18	2993	2300	2993
d2: TAC at F_{msy}, r=0.24	5837	4585	5837
d3: TAC at $F_{0.08}$	0	0	0

Performance indicator: Biomass (ton).

Minimax Criteria: Select the decision that generates the minimum of the maximum losses vector

For fishable biomass as the performance variable, the Minimax criteria selects fishery management decision d_3 which corresponds to a TAC determined over time based on an F = 0.08.

Table 8. Loss of opportunity matrix built for the Minimax criteria considering long-run fishery yield as the performance variable.

	Loss of Opportunity Matrix Alternative States of Nature		Minimax Criteria
Alternative Decisions	θ_1 (r=0.18)	θ_2 (r=0.24)	Max Loss of Opportunity
d_1: TAC at F_{msy}, r=0.18	0	49	49
d2: TAC at F_{msy}, r=0.24	104	0	104
d3: TAC at $F_{0.08}$	18	189	189

Performance indicator: Yield (ton of conch meet).

Minimax Criteria: Select the decision that generates the minimum of the maximum losses vector

For sustainable fishery yield, the Minimax criteria also selects fishery management decision d_1 which corresponds to a TAC determined over time based on an Fmsy using an r=0.18.

As knowledge and information becomes available, with prior (or posterior) probabilities, a decision table considering model / parameters associated to regime shifts uncertainties can be built to aid the fisheries

management process. At this stage, there are no calculated probabilities of occurrence for the alternative states of nature, therefore we considered an equal probability of occurrence p=0.5.

Results are presented in Table 9. With these probabilities an expected loss of opportunities can be calculated for each alternative decision under consideration. The Bayesian criterion indicates to select the decision that may result in the minimum expected value of loss of opportunities.

Table 9. Loss of opportunity matrix with probabilities built for the Bayesian criteria considering long-run fishery yield as the performance variable.

Loss of Opportunity Matrix

	Alternative States of Nature		
Alternative Decisions	θ_1 (r=0.18) 0.5	θ_2 (r=0.24) 0.5	EV Loss of Opportunity
d_1: TAC at F_{msy}, r=0.18	0	49	24
d2: TAC at F_{msy}, r=0.24	104	0	52
d3: TAC at $F_{0.08}$	18	189	103

Performace indicator: Yield (ton of conch meet).

Bayesian Criteria: Select the decision that yields the minimum expected value of loss of opportunities

As a result the Bayesian criterion for long-run yield also selects decision d_1.

1.9 References

Aiken, K., G. A. Kong, S.G. Smikle, R. Appeldoorn, and G. Warner. (2006). *Managing Jamaica's queen conch resources*. Ocean and Coastal Management 49 (5-6):332-341.

Anderson, L.G.; J.C. Seijo. 2010. Bioeconomics of Fisheries Management. Wiley-Blackwell, New Jersey. 305 p.

Appeldoorn, R.S. (1995). *Stock abundance and potential yield of the queen conch of Pedro Bank*. Univ. Puerto Rico / Fisheries Division, Jamaica. 30pp.

CFMC / CFRAMP (1999). *Report on the Queen Conch Stock Assessment and Management Workshop*. Belize City, Belize, 15-22 March 1999. page 42.

Mahon R, Kong A & Aiken K. (1992). *A preliminary assessment of the conch fishery on the shelf and banks off the south coast of Jamaica*. CARICOM Fishery Research Document 1992; No. 8

Seijo, J.C.; J.F. Caddy. (2000). Uncertainty in bio-economic reference points and indicators of marine fisheries. Mar. Freshwater Res., 51:477-483.

Seijo, J.C.; O. Defeo & S. Salas. 1998. Fisheries bioeconomics: theory, modelling and management. FAO Fish. Tech. Pap. 368:108p.

Smikle, S.G. (2008). *Conch Abundance Survey 2007 Report*. [Unpublished]

Smikle, S.G. (2010). *2010 Pedro Bank Queen Conch Fishery, Assessment & TAC Recommendation*. 11pp.

Smikle, S.G. and Appledoorn, R.S. (2003). 2002 Estimates of Abundance and Potential Yield for the Pedro Bank Queen Conch Population. 4-8 pp.

Tewfik, A. and Appeldoorn, R.S. (1998). 1997 *Queen Conch (Strombus gigas) Abundance Survey and Potential Yield Estimates for Pedro Bank, Jamaica*. Fisheries Division, Jamaica. 39 pp.

Appendix 4: Report of the Large Pelagic Fish Resource Working Group (LPWG)

Mr. Derrick Theophile – Dominica (Chairman)
Ms. Yvonne Edwin – St. Lucia
Mr. Francis Calliste – Grenada
Ms. Cheryl Jardine-Jackson – St. Vincent and the Grenadines
Mr. Reshevski Jack – St. Vincent and the Grenadines
Mr. Christopher Parker – Barbados
Mr. Mario Yspol - Suriname
Mons. Lionel Reynal – IFREMER (Martinique)
Ms. Heloise Mathieu – IFREMER (Martinique)
Prof. John Hoenig – Consultant (Virginia Institute of Marine Science)
Ms. Nancie Cummings – NMFS, SEFSC (Miami, FL, USA)
Dr. Todd Gedamke – NMFS, SEFSC (Miami, FL, USA)
Dr. Susan Singh-Renton – CRFM Secretariat

A. OVERVIEW

The working group was assigned the following tasks:
1. Evaluate the status and availability of the blackfin tuna data among the countries represented
2. Attempt an assessment of the blackfin tuna fishery in the Eastern Caribbean
3. Review the two reports on recreational fishing submitted by the CLME consultants
4. Review of the ERAEF analysis for Large Pelagics and update information where necessary
5. Review the MAGDELESA project (FADs)

Blackfin tuna data analyses

Data were available for four countries: Grenada, Dominica, St. Lucia and St. Vincent. The working group focused on cleaning and compiling the data and conducting a preliminary analysis to address Items 1 and 2 above.

Review of Recreational Studies done for CLME project

The highly migratory large pelagic fish resources are an important contributor to employment, income and food security in the Caribbean LME and adjacent Guianas-Brazil region. These resources are exploited by countries from within the region, as well as by foreign nations for commercial and recreational purposes. The recreational fishery forms a significant component of the harvest subsector of the large pelagic fishing industry in the region. Recreational fishing can be conducted by individuals from private or charter vessels and includes sport and leisure fishing activities. Many countries in the Caribbean are known for their sport fishing activities and attract visitors for that purpose, while charter-boat fishing is a major component of the marine-based tourism activities in other countries. The main target species of the recreational fisheries in the Caribbean are: billfishes, yellowfin tuna, wahoo, king mackerel, and dolphinfish. Notwithstanding this level of importance, recreational fishing activities have received minimal fishery management attention in most Caribbean countries and data on this fishery are lacking.

In view of this, the Working Group noted that CRFM is overseeing four studies that are ongoing to document the nature and importance of recreational fishing activities in the Caribbean region: Northern Caribbean, Southern Caribbean, Western Caribbean and Eastern Caribbean. These studies are intended to

contribute to the CLME project, specifically towards improving the technical information base with regard to recreational fishing activities. Completed draft reports of the studies examining the eastern and southern Caribbean areas were available for review by the Working Group during the meeting. These two reports were discussed in general, and it was agreed that suggested specific text revisions and recommendations for improvement would be emailed to the CRFM Secretariat by the end of the meeting to facilitate finalization of the reports by the relevant consultants. It was also agreed that the CRFM Secretariat would email to the working Group members the remaining two reports (northern and western Caribbean) when these are completed in the near future.

Review of the work progress on ERAEF

The LPWG reviewed the ERAEF analysis that was introduced during the 2011 Scientific Meeting. The ERAEF had been expanded from considering only dolphinfish as the target, to considering all large pelagics landed in the region to follow the Ecosystem-Based Approach. Included in the updated report was the development of a Productivity and Susceptibility Analysis (PSA). This takes into account biological and ecological data from various sources to determine the productivity of the various species to recover from being depleted (their resilience), coupled with fishery information to determine the susceptibility of each species to the fishery. The LPWG agreed to work towards review and validation of the methods and various outputs produced during the meeting.

A description of ERAEF methodology and outputs from the ERAEF applied to the hook and line fishery of the Eastern Caribbean was presented to the LPWG. The group participated in the review and validation of the various outputs of the Analysis. Productivity and Susceptibility cut-offs and thresholds for determining the relative risk scores of each species were discussed and alternative attributes and methods were explored. Methods for determining selectivity of the fishing gear for multiple species was investigated in particular to determine the most appropriate method to assess this in data poor situations. General comments and recommendations were made regarding the ERAEF methodology and data improvements to be incorporated into the final technical report.

Review of progress of MAGDELESA Project

MAGDELESA Project was presented by IFREMER representatives. This project aims to develop together with the scientific teams and fisheries managers in the Lesser Antilles and Haiti an integrated and participatory approach to the sustainable and responsible development of the blooming anchored FAD fishery. MAGDELESA results from activities undertaken in the framework of the Lesser Antilles working group of the FAO / WECAFC, which aims at supporting conservation, management and sustainable development of the biodiversity and natural spaces, of the coastal areas and natural resources marine. The goals of the project are:

- The redeployment of the overfishing of the coastal resources (primarily fauna of the coral reefs) towards the pelagic high-sea species (tunas and tuna-like species) that still provide a reasonable possibility for catches, by the use of FAD (Fish Aggregation Device).
- To develop sustainable fishing practices for shared pelagic resources.

So far, FADS have been deployed in Dominica, Grenada, St. Kitts and Nevis and St. Vincent and the Grenadines.

General Recommendations

The overarching recommendations were in regards to improving data quantity, quality and availability for assessment purposes. Specific recommendations are included in the subsequent sections.

Any other business

No further issues were raised for discussion.

Adjournment

The meeting was adjourned at 7:30 p.m. on Thursday, 28 June 2012.

B. FISHERIES REPORTS

1. The Blackfin Tuna (*Thunnus atlanticus*) Fishery of the Eastern Caribbean

1.1 Management Objectives

No management objectives were available specifically to the blackfin tuna fishery.

1.2 Status of Stock

Data were evaluated from St. Lucia, Grenada, Dominica, and St. Vincent and the Grenadines and on a qualitative basis there is no evidence that overfishing is occurring on the blackfin tuna stocks. It should be noted that caution is still warranted even though an increasing trend in landings was generally observed. This could be due to a number of factors including: an increase in abundance, more comprehensive data collection, or changes in fishing behavior and techniques. Overall it is believed that data collection protocols have improved and Fish Aggregating Devices (FADs) were implemented during this time period so the increasing trend could be a reflection of these changes rather than a reflection of increased abundance.

1.3 Management Advice

Given the concerns regarding changes in data collection protocols and the use of FADs in keeping with the principles of the precautionary approach, it is recommended that catch levels not be increased above the current levels.

1.4 Statistics and Research Recommendations

As mentioned in 1.2 and 1.3 above one of the biggest concerns in the interpretation of the existing data are changes in the amount of actual landings that are being included in the databases and the fact that fishers have increasingly been fishing on FADs. To that end, two primary research recommendations are being put forward:

1) For each trip / record a data field be included which indicates whether the trip was conducted at / near a FAD, and
2) Each data collection program to conduct surveys or analysis which will indicate the proportion of total catch which is being reported in the database.
3) Length frequency data collected to assist in the definition of any migration patterns that may exist.
4) Participate in the proposed genetic studies of IFREMER to help define stock structure.

1.4.1 Data Quality

Some cleaning of the datasets was necessary. This was conducted during the workshop. Dates for records continue to be problematic, which is not uncommon. The Dominica dataset, in particular required substantial formatting and cleaning data across various database formats across 18 years.

One limitation was that the datasets among the countries were not standardized and the fact that a common database is not used. It was highly recommended that across region variable names be standardized to facilitate scripting within analytical programs e.g. R statistical package.

1.4.2 Research

Research should be done on the impact of FADs on the fishery for each country. Sampling and monitoring programmes appropriate to each country should be designed to collect relevant information on this topic. Studies need to be conducted to better understand migration patterns and stock structure in the region. The working group noticed relatively obvious patterns in peak landings on a monthly scale across islands. Further investigation of these patterns might provide insights as to migratory patterns within the region. In this context, it is recommended that countries collect length frequency data for their catches. It is noted that IFREMER will be conducting a genetic population study of the blackfin tuna.

1.5 Stock Assessment Summary

Plots of annual nominal landings for all four islands indicated a general increasing trend. In the case of St. Lucia, a standardized plot of landings was constructed. Since none of the plots exhibited decreasing trends, there was no evidence of stock depletion at current harvest levels. However, our interpretation considered changes in behavior (eg. use of FADs) and improved data reporting were the most probable causes for the increased landings observed over time. As such, in keeping with the principles of precautionary approach, it is recommended that no significant increase in fishing effort be allowed until more information becomes available on the status of the stock.

1.6 Special Comments

None.

1.7 Policy Summary

No management regulations specifically for blackfin tuna have been found for any of the harvesting nations and there are no ICCAT regulations currently in place for this species.

1.8 Scientific Assessments

1.8.1 Description of the Fishery

In the WECAFC region, the highest quantities of blackfin tuna are landed by Venezuelan fishing fleets. Blackfin tuna accounted for the highest proportion of tunas caught by the pelagic longline fishery in northeast Brazil (56.2%) with an average catch per unit effort (CPUE) of 0.32 individuals per 100 hooks (Hazin *et al*. 2001 in MMA 2006). The species is often taken along with skipjack tunas (*Katsuwonus pelamis*) with which it often forms mixed schools.

The southeastern coast of Cuba is known to be one of the richest fishing grounds for the species. Based on available statistics for the Eastern Caribbean region, the largest recorded quantities of the species are landed in the French Islands of Martinique and Guadeloupe, with Grenada landing the largest quantity among the CRFM member countries.

Blackfin tuna are taken by a number of gears. In Brazil, blackfin tuna are largely taken as by-catch in the longline fisheries that primarily target the highly migratory large pelagic species. However, in one area viz. Rio Grande do Norte state they are taken in the artisanal handline fishery, which is economically important to the region (Freire *et al*., 2005). In Cuba, blackfin tuna are mainly taken by live bait and jackpole gear. In Venezuela, in addition to baitboat fishing, blackfin tuna are taken on long lines and in purse seines (Cabello *et al*., 2003). In the Eastern Caribbean the species is mainly taken by trolling over coastal shelf areas. The animals are also found around sea mounts, drifting objects and moored-FADs;

facilitating their capture by simple trolling gear in these deeper waters as well (Taquet *et al*., 2000). In fact, Laurans *et al*., (2000) report that the blackfin tuna landed at Martinique are mainly taken by trolling around FADs or over seamounts. Blackfin tuna are also an important species in the sports fisheries of the Bahamas and Florida where they are taken on typical rod and reel gear.

1.8.2 Data Used

The table shows the data available for countries represented at this year's LPWG meeting.

Country	**Blackfin Tuna Data Available**	**Database used by the country**	**Other Data Available**	**Status of the data/ Requirements for getting the data analysis ready.**
St. Vincent	1994-2004	TIP	Length frequency for 1996-2004	All the date fields needs to be amended for 2000-2004
	2005-2009	EXCEL		Some missing data The date field needs to be reformatted. Data entries up to April 2012
	2011-2012	CARIFIS		
Dominica	1989-1993	Spreadsheet application	Length frequency for 1995-1998	Some variables and fields need to be reformatted and corrected. Missing data for some fields needs to be included
	1994-2006	TIP		
	2007-2008	EXCEL		
	2009-2012	ACCESS		
St. Lucia	1995-2011	TIP	Biological data for 1996-1998	The stored data in TIP requires some clean up.
Grenada	1978-2011	No database in use		Basic MS Excel entries for summary purposes
Barbados				No Blackfin Tuna available
Suriname				No Blackfin Tuna available

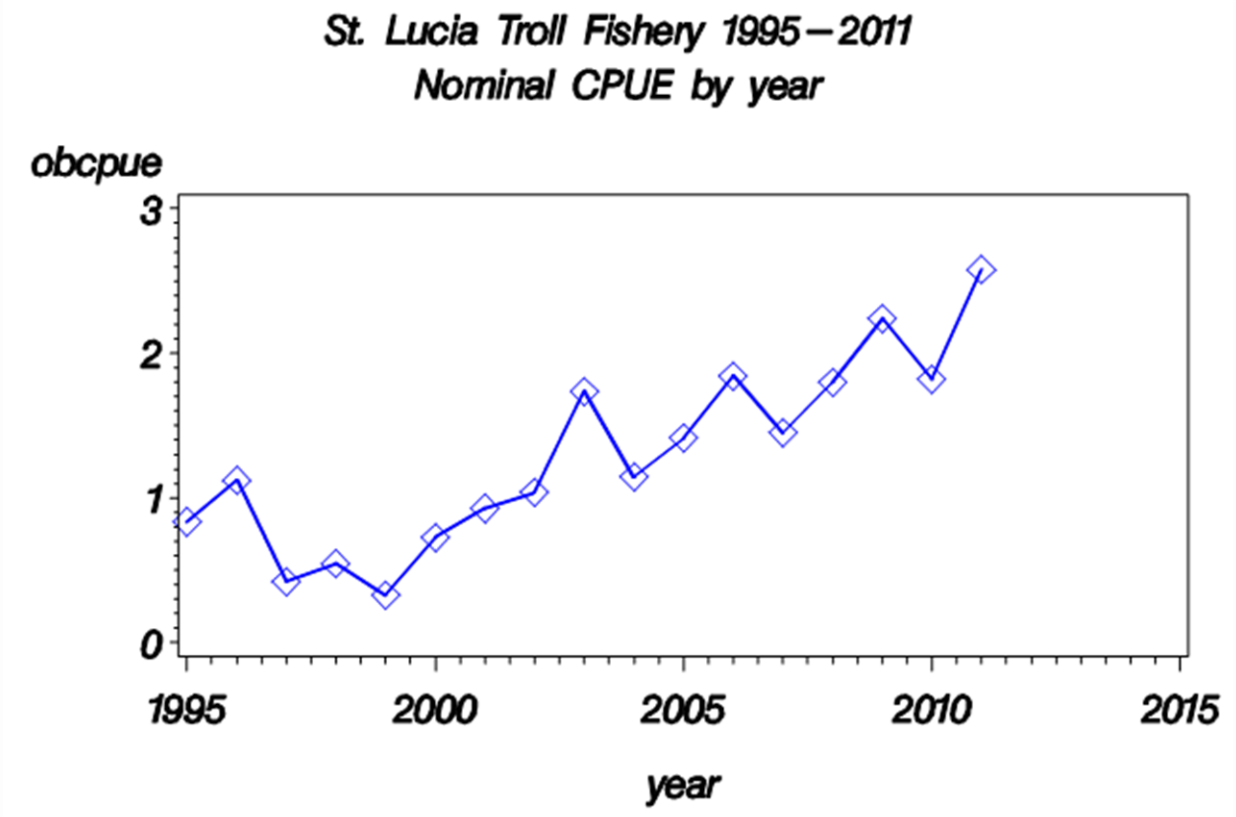
1.8.3 Assessment 1: Stock Assessment Method

1.8.3.1 Objective

To explore the development of a standardize CPUE abundance index for the Blackfin tuna fishery. This was done only with Saint Lucia data given that the other countries datasets did not contain all the required components for this assessment.

1.8.3.2 Method / Models / Data

The individual detailed ocean pelagic trip observations for St. Lucia were available from 1995-2011 and was used to explore the development of a standardize CPUE abundance index for the Blackfin tuna fishery. The data had been extracted sequentially by year and it was first necessary to combine the observations into a single file of all the observations for the time period. A few additional quality control edits of the data were necessary before further processing. The plot below illustrates the nominal CPUE by year for 1995 - 2011.



Analytical Approach

The approach used in developing the Standardize CPUE abundance was to first extract the summarized catch for the unique ocean pelagics (obscpue), then to extract the positive blackfin tuna trip (obspos). Further examination was conducted of the dataset to observe the number of trip observations for the total fishery, number of trip observations by year and gear. This was necessary in order to determine the data sufficiency and to identify possible auxillary variables and factors that could be used in modeling the trip specific catch per unit of effort.

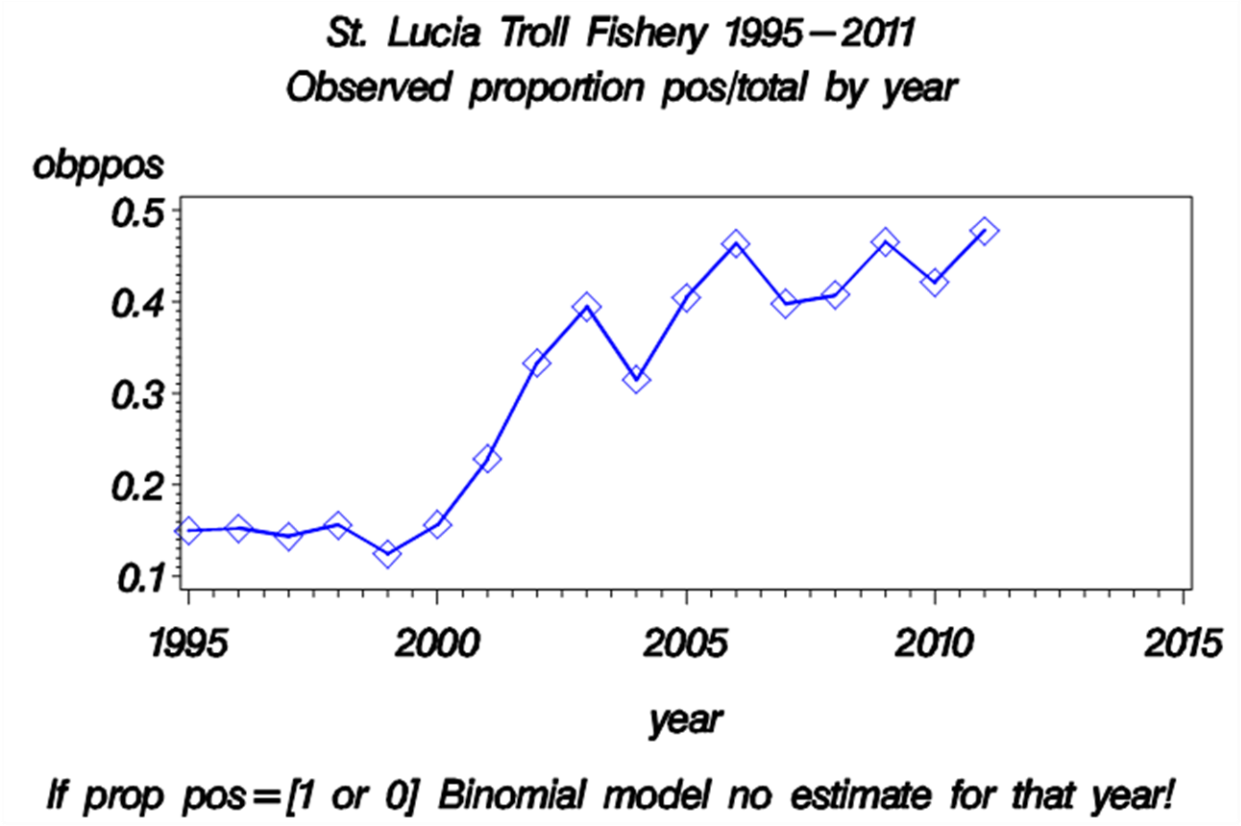
Factors available and used in modeling the catch per unit of effort (CPUE): **year, month, gear**. Although, vessel id was present for some of the data records this variable was not consistently present across the entire data set.

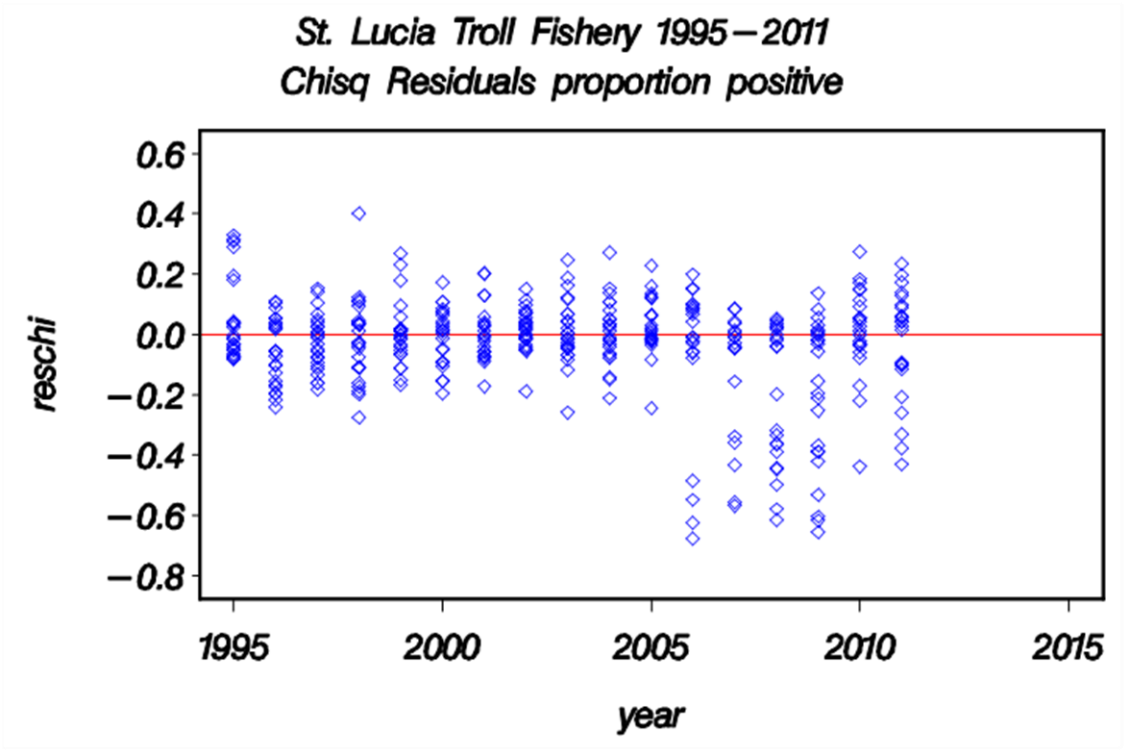
Table 1: Factors available and used on modeling the CPUE.

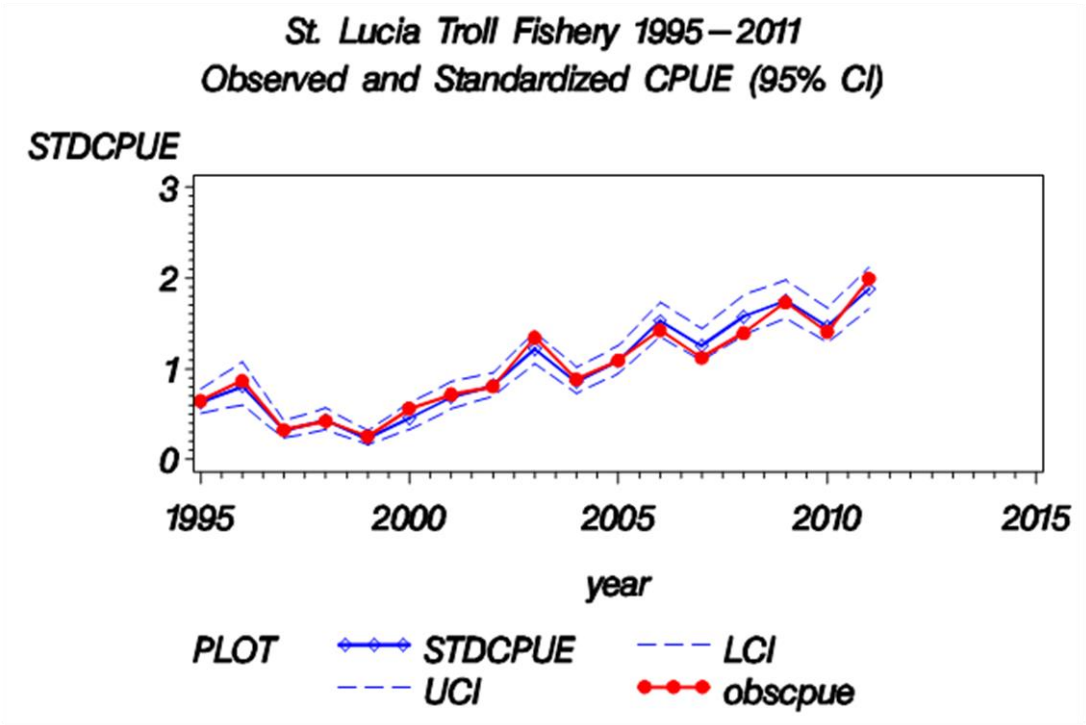
Class Level Information		
Class	*Levels*	*Values*
year	17	1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011
month	12	1 2 3 4 5 6 7 8 9 10 11 12
GEARSTAT	2	HLIN TROL

Abundance Model Explored

The method used for the Generalized Linear Modeling Approach was to incorporate all fishing trips from the handline and troll fisheries in a two stage model. Firstly, a regression was fitted to the positive catch observations using a lognormal fit. Then a binomial model was fitted to the proportion of positives observations and then the two resulting models were combined. Factors included in both models were year (1995 - 2011), month (1 - 12) and gear (troll, handline).




St. Lucia Troll Fishery 1995–2011
Chisq Residuals proportion positive
reschi
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8
1995
2000
2005
2010
2015
year


St. Lucia Troll Fishery 1995–2011
Observed and Standardized CPUE (95% CI)
STDCPUE
3
2
1
0
1995
2000
2005
2010
2015
year
PLOT
STDCPUE
LCI
UCI
obscpue

1.8.3.3 Results & Discussion

The modeled results indicated that there were changes in the distribution of the residual errors for the model 2 fit (fit of the binomial model to the proportion of positive observations), beginning in 2006. Discussions in the group as to possible changes in the fishery in 2006 did not identify any systematic problems with the data. It is recommended that the national scientists from St. Lucia investigate this issue during the 2012 inter-sessional work period.

The group also prepared a supplementary report which is attached at Annex 1 and provides an overview of the blackfin tuna fishery in Dominica, Grenada, St. Lucia and St. Vincent and the Grenadines.

1.9 References

Cabello, A., Marcano, J., Narváez M., Silva, O., Gómez, A, Figuera, B., Vallenilla, O., Salazar, H. (2003). Management of tuna resources in Venezuela. Zootecnia Trop., 21(3):261-274.

Laurans, M., Taquet, M., Reynal, L., Lagin, A. (2000). Comparaison des captures des grands poissons pélagiques en Martinique avec ou sans dispositifs de concentration de poissons (DCP). In: Le Gall, J.Y., Cayré, P., Taquet, M. (Eds.), Pêche thonière et dispositifs de concentration de poissons, Caraïbe-Martinique, 15–19 oct. 1999. Ifremer, Actes Colloq., pp. 421–434.

MMA. (2006). Programa REVIZEE: Avaliacao do potencial sustentavel de recursos vivos na Zona Economica Exclusiva: relatorio executivo. *Ministerio do Meio Ambiente. MMA. Secretaria de Qualidade Ambiental. Brasilia:* 208 p.

Freire, K.M.F., R. Lessa and J.E. Lins-Oliveira (2005). Fishery and biology of blackfin tuna *Thunnus atlanticus* off northeastern Brazil. Gulf and Caribbean Research 17:15-24.

Taquet, M, Reynal, L., Laurans, M., Lagina, A. (2000). Blackfin tuna (*Thunnus atlanticus*) fishing around FADs in Martinique (French West Indies). Aquat. Living Resour. 13. 259−262.

Annex 1: Large Pelagic Group Working Report

Introduction

1. Blackfin tuna (*Thunnus atlanticus*)

1.1 Biology

1.1.1 Growth

The maximum reported length for Blackfin tuna is 110 cm fork length (FL) (Collette 2010) with the IGFA all-tackle gamefish weight record for this species being 22.4 kg for a specimen caught off the coast of Florida. However, most are taken at an average size of approximately 50 cm (FL) and a weight of about 3.2 kg. Maturity is reached at around two years of age or around 40-50 cm (FL). Blackfin tuna are considered to be fast growing short-lived species that may live past 5 years of age. Growth rates have been reported at 1-1.5 cm per month.

1.1.2 Diet

Blackfin tuna are known to consume a varied diet including surface and deep-sea fishes, squids, amphipods, shrimp, crabs and Stomatopods and Decapod larvae. Dolphinfish, blue marlin and skipjack tuna are known predators of blackfin tuna. Spawning is believed to occur offshore in oceanic waters.

1.1.3 Reproduction

Vieira *et al*. (2005) reported that the coastal waters off Northeast Brazil probably serve as a breeding ground for blackfin tuna. The animals are found in highest abundances in that area during the second half of the year when spawning occurs with peak activity around December. This contrasts with the reported spawning periods for blackfin tuna off Florida (April to November), notably with a peak in May (Collette and Nauen, 1983). The spawning period in the Gulf of Mexico is given as between June to September (Collete and Nauen, 1983). Vieira *et al*. (2005) also note that the animals are total spawners i.e. reproducing once per spawning period. Battaglia (1993) suggests that spawning in the Caribbean occurs between April and September. The presence of numerous mature males and females around FADs off Martinique during May and June led Taquet *et al*. (2000) to postulate that there was a blackfin tuna breeding ground within the Lesser Antilles. The spawning period implied falls within the period defined for off Florida (Collette and Nauen, 1983) and for the Caribbean (Battaglia, 1993).

These studies therefore collectively suggest that distinct spawning grounds occur throughout the animals' geographic range. However, this information does not address if the animals are faithful to specific spawning grounds, which would be a more solid basis for stock differentiation at the genetic level. While it seems unlikely that the animals would move from one extreme of their range to the other to spawn, it is quite possible that they may move through portions of their ranges and move to the nearest spawning ground when the time arises.

1.2 Distribution, migration and Stock Structure

1.2.1 Distribution

Blackfin tuna is a highly migratory, warm-water species known to migrate into more temperate waters during the summer months. It is believed that the species is confined to coastal waters warmer than 20ºC (Collette and Nauen, 1983). Blackfin tuna is considered to be one of the most commonly occurring tuna

species in the western central Atlantic. Blackfin tuna is an epipelagic species, often found over reefs, bays and offshore. Blackfin tuna are believed to occur only in the western Atlantic Ocean from Massachusetts (USA) (Mather and Shuck, 1952) south to Rio de Janeiro (Brazil) (Mather and Day, 1954), including the Caribbean (Bullis and Mather, 1956, Boobe and Tee-Van, 1936) and the Gulf of Mexico. However, one report indicates the presence of the species off the Canary Islands (Laboratorio Oceanografico de Canarias, 1974).

1.2.2 Migration

Very little solid information is available on site faithfulness of blackfin tuna. Doray *et al*. (2004) report the presence of all age groups around FADs off Martinique, albeit at different water depths. The authors further report the presence of 4 month-old juveniles in the area which coincide well with recruit cohorts produced from March to October spawning events. As such the data support a Caribbean recruit source. Singh-Renton and Renton (2007) reports the recapture, two years later, of 2 blackfin tuna tagged off the same area off St. Vincent. Although by no means a good sample size, the capture of these two fish close to their points of release two years afterwards may be an indication that blackfin tuna exhibit some level of site faithfulness.

1.2.3 Stock Structure

The stock structure of blackfin tuna is not fully understood but various lines of evidence including that presented earlier such as the variation in spawning periods across the region suggest that there may be a number of separate stocks across the geographic range of the species. For example, there is evidence of genetic differentiation between the Gulf of Mexico and Northwest USA Atlantic stocks (Saxton 2009). Given the dominant meso-scale current patterns in the region, it seems unlikely that there is any south to north transport of viable black fin tuna larvae from the Caribbean region into the south Atlantic. In such a scenario the 5ºN latitude line similar to that proposed by ICCAT for Atlantic sailfish may be considered as a suitable hypothetical northern limit for any presumptive southern stock or aggregate of stocks.

On the other hand, larvae produced off northern Brazil could become entrained in the North Brazil Current (NBC) and then be either transported along the South American coastline and the southernmost Caribbean islands via the Guiana current or deflected away from the Caribbean islands via the North Equatorial Counter Current. Larvae released at locations along the northern coast of South America could therefore be transported to these southernmost Caribbean islands. However larval flow to the more central and Northern islands in the Caribbean chain is likely to be stymied by the dominant east to west flows in the region from the North Equatorial current and its associated water mass.

It is possible that the larval pool in the Caribbean could at least be augmented with larvae transported from locations along the northern coast of South America primarily via ephemeral North Brazil Current (NBC) rings as they traverse the region (Fig. 1). It is noteworthy that NBC rings form in the latter half of the year (June to January) thus coinciding with the suspected peak spawning period of blackfin tuna off Brazil. While this maximizes the likelihood of larvae being present in this water mass, the true test of these larvae reaching the Caribbean from such distant locations in a viable state hinges on their larval life span and the conditions in the water mass being supportive of larval survival and development.

Without any contradictory information on the subject, for management purposes it is reasonable to presume the existence of a largely self-sustaining Caribbean stock of blackfin tuna. Some additional anecdotal support for this hypothesized south/north stocks division within the Caribbean is the fact that blackfin tuna is not known to be common in either Trinidad or Barbados where the possible influences of the Guiana current is stronger than in the more northern Caribbean islands where the species is more abundant, effectively describing a gap between the areas of higher abundances of the species and possible

stock or groups of stocks located along the South American coast and in the central and northern Eastern Caribbean islands. However it is also unclear if any such Caribbean stock is effectively separate from the Northwest Atlantic stock identified by Saxton (2009).

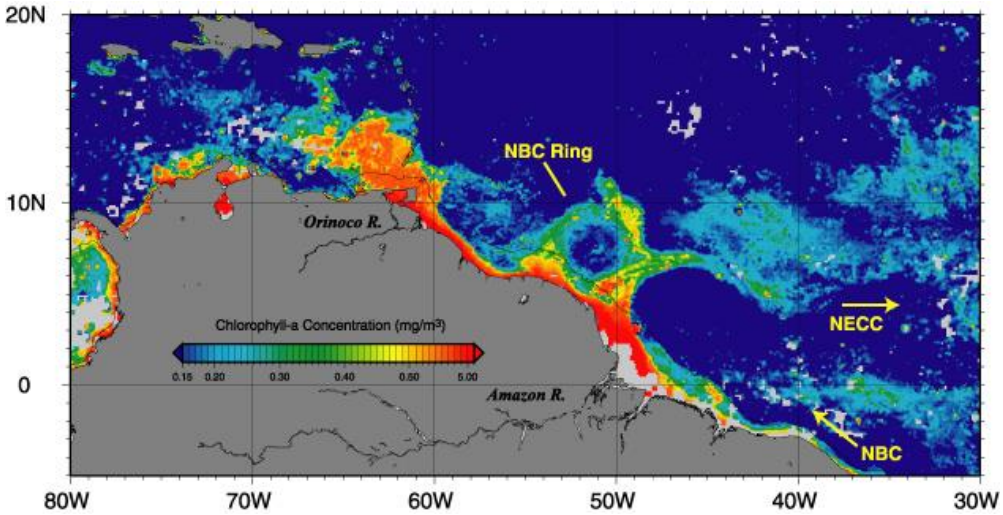


Figure 1: Ephemeral North Brazil Current (NBC) rings.

1.3 The fishery

In the WECAFC region, the highest quantities of blackfin tuna are landed by Venezuelan fishing fleets. Blackfin tuna accounted for the highest proportion of tunas caught by the pelagic longline fishery in northeast Brazil (56.2%) with an average catch per unit effort (CPUE) of 0.32 individuals per 100 hooks (Hazin *et al*. 2001 in MMA 2006). The species is often taken along with skipjack tunas (*Katsuwonus pelamis*) with which it often forms mixed schools.

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Blackfin tuna are taken by a number of gears. In Brazil, blackfin tuna are largely taken as by-catch in the longline fisheries that primarily target the highly migratory large pelagic species. However, in one area *viz.* Rio Grande do Norte state they are taken in the artisanal handline fishery, which is economically important to the region (Freire *et al*., 2005). In Cuba, blackfin tuna are mainly taken by live bait and jackpole gear. In Venezuela, in addition to baitboat fishing, blackfin tuna are taken on long lines and in purse seines (Cabello *et al*., 2003). In the Eastern Caribbean the species is mainly taken by trolling over coastal shelf areas. The animals are also found around sea mounts, drifting objects and moored-FADs; facilitating their capture by simple trolling gear in these deeper waters as well (Taquet *et al*., 2000). In fact, Laurans *et al*., (2000) report that the blackfin tuna landed at Martinique are mainly taken by trolling around FADs or over seamounts. Blackfin tuna are also an important species in the sports fisheries of the Bahamas and Florida where they are taken on typical rod and reel gear.

1.3.1 Existing management

No management regulations specifically for blackfin tuna have been found for any of the harvesting

nations and no ICCAT regulations are currently in place for this species. However, Reynal *et al*. (2011) report that a limit of 3 fish per trip per person on board is in place for recreational fishing operations in Guadeloupe and regulatory measures are in place for fishing on FADs in Martinique and Guadeloupe. Limits on total power and gross tonnage of vessels are also in place for the Commercial fleets of Guadeloupe and Martinique.

1.3.2 Summary of previous stock assessment work

The working group is unaware of any comprehensive stock assessment of this species. However, based on the lack of any consistent decline in recorded catches of this species through time, the IUCN lists blackfin tuna as a species of "Least Concern" but recommends close monitoring. However, IUCN also notes that a number of major fishing nations for this species have ceased reporting landings. Some assessment of catch data for the Venezuelan fishery was conducted during the 7th annual CRFM Scientific meeting. The results of standardized relative indices of abundance of blackfin tuna from the baitboat fishery showed an uneven sustained declining trend beginning in 1997 with a minor recovery at the end of the time series.

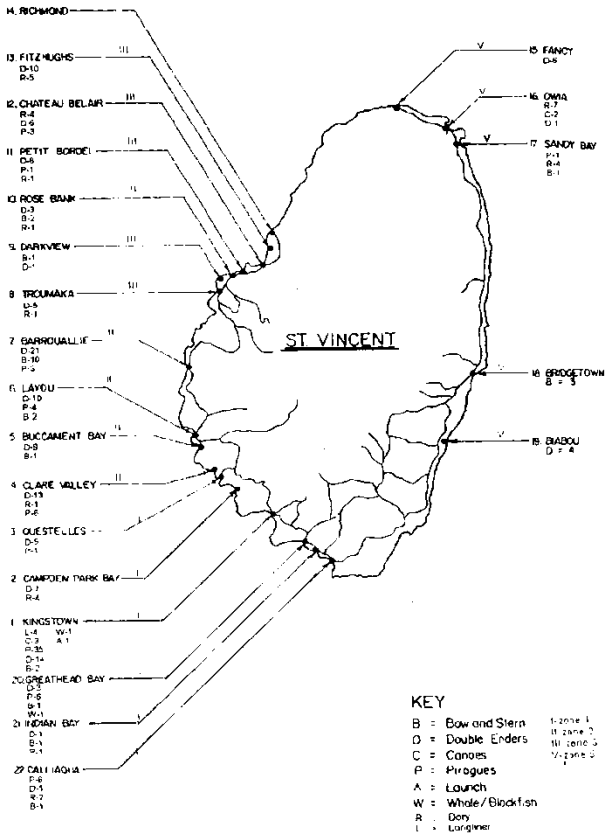
Saint Vincent

Summary of Data

Prior to 1992, landings information (census) was collected only from the Kingstown Fish Market. In 1992 a sampling programme for estimating catch and fishing effort was designed by the Fisheries Division in collaboration with the OECS Fisheries Unit and later by CFRAMP to expand fisheries data collection across the island, including biological data. Under the revised data collection programme a "status" (primary, secondary or tertiary) was defined for each site determined by the number of vessels, level of infrastructure.

The general objective of the data collection programme was to provide data and scientific analyses necessary to assist resource managers to make resource management decisions. The data collected under the programme include: catch, effort, individual fish length and weight. At the start of the programme, six data collectors were recruited and given the responsibility for data collection in a given zone. Note that this number declined overtime and at present there are only three data collectors, with one zone lacking data collectors for the last two years. There are thirty six (36) landing sites, divided into seven zones (Fig 2.). There are two (2) primary sites (Kingstown and Barrouallie); fourteen (14) secondary and twenty (20) tertiary sites. Data are collected from all landing sites using a cluster-stratified random sampling methodology. For each zone, landing sites are stratified according to status, and selected at random from each stratum for sampling on a particular data structure and the number of fisheries occurring at the respective site.

Figure 2: Landing sites and zones



Accessory information is also being collected through the Licensing and Registration System (LRS). This provides information on the fleet, and relevant socio-economic information on the fishers. The data collectors are trained to not only to take accurate and unbiased data from fishermen but also to participate in other fisheries extension duties, such as offering advice on engine maintenance, gear technology, processing.

Data Improvements

The dataset from TIP 1994 to 2004 was cleaned due to inconsistencies, wrong information etc. Cleaning efforts include:

- Change year on records which show 1980 to 1984 to the correct date of 2000 to 2004. The reason for this error is that TIP did not allow for years beyond year 2000. Thus 1980 was used for the year 2000 and so forth.
- For the number of crew, there was an error where the area fished was entered into this field instead of the number of crew. This was corrected for 1999 to 2001.
- The gear code was entered into the landing site field in error for 1994 to 2004. This was also corrected for 1999 to 2001.
- Calculated missing soak time information for the year 1999 to 2001.

- Corrected date values for 2006 data.

Sampling Strategy

As previously mentioned, the catch and effort data follows a stratified sampling methodology. In this approach the sampling frame (which is all the identified fish landing sites within the country) is first partitioned into groups or strata, and the sampling is then performed separately within each stratum. This method combines the conceptual simplicity of simple random sampling with potentially significant gains in reliability.

The technique of simple random sampling is used to select the days of the month each landing site is sampled. Sampling is not carried out on Saturdays, Sundays and major holidays, nevertheless, every day is considered as a potential fishing day. This simplifies data analysis and does not seem to be a great source of error since fishermen fish whenever they can regardless of what day it is. An estimate of the amount of fish landed in the country is obtained by summing the totals of all the estimates for the individual landing sites. The sampling programme is presently under review.

Raising Factor

An estimate of the total amount of fish landed in St. Vincent and the Grenadines is obtained by summing the totals of all the estimates for the individual landing zones as well as the census information collected at the New Kingstown Fish Market.

Estimates = Zone1 + Zone2 + Zone3 + ...Zone7

Total landings = Census + Estimates

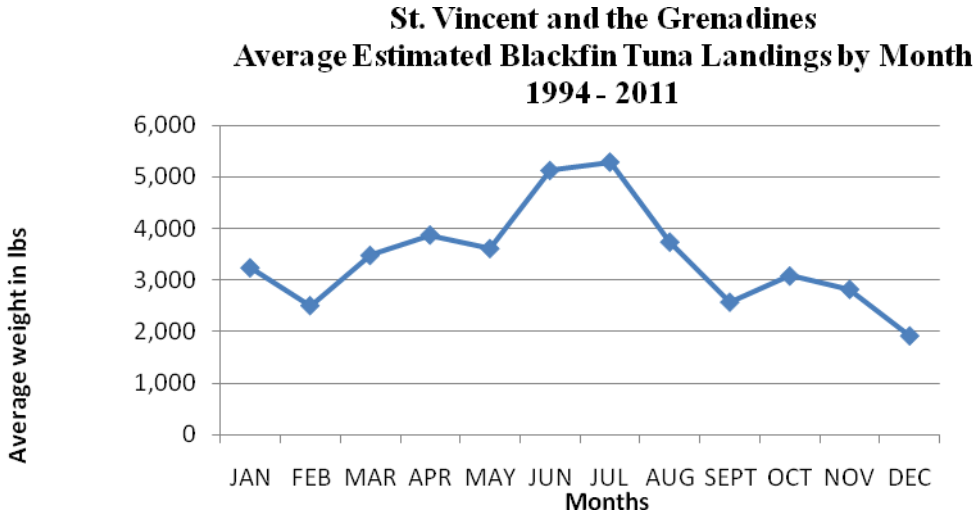
To calculate an estimate of the amount of fish landed at a particular landing site the sample weight and the raising factor (rf) must be taken into consideration.

Raising factor (rf) = (# of days in month / # of days sampled)

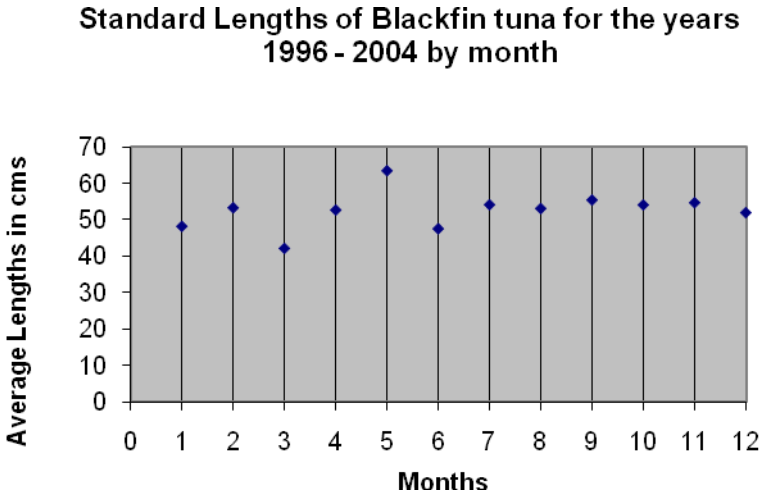
Estimate for any site = sampled weight x rf

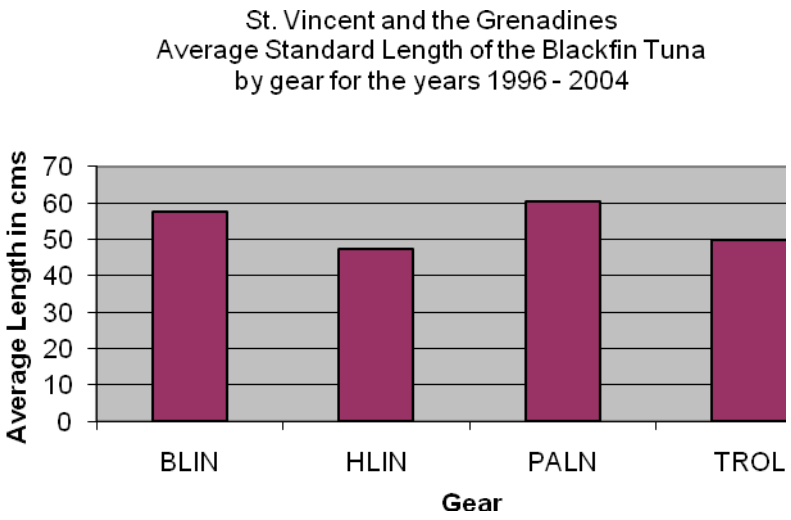
Plots

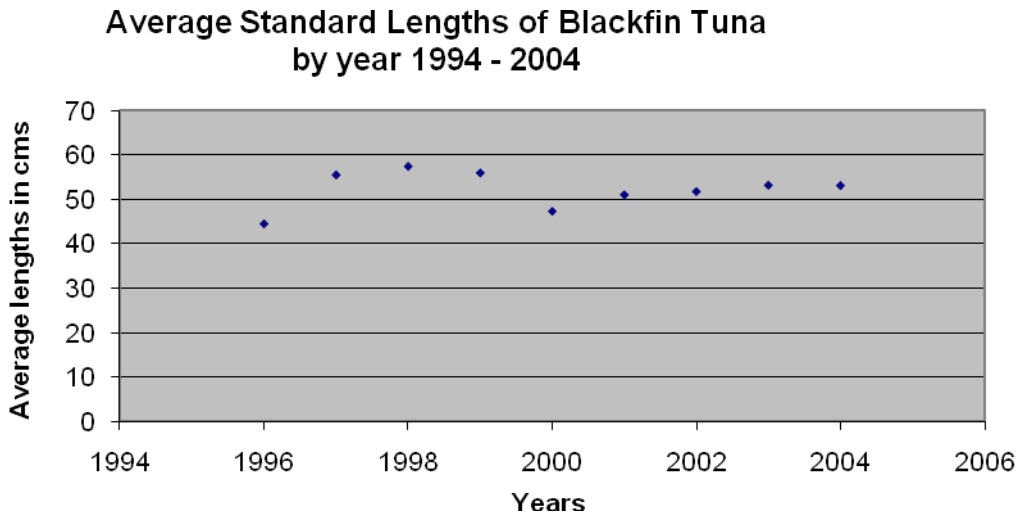
Average estimated Blackfin tuna for the years 1994 to 2011 by month.

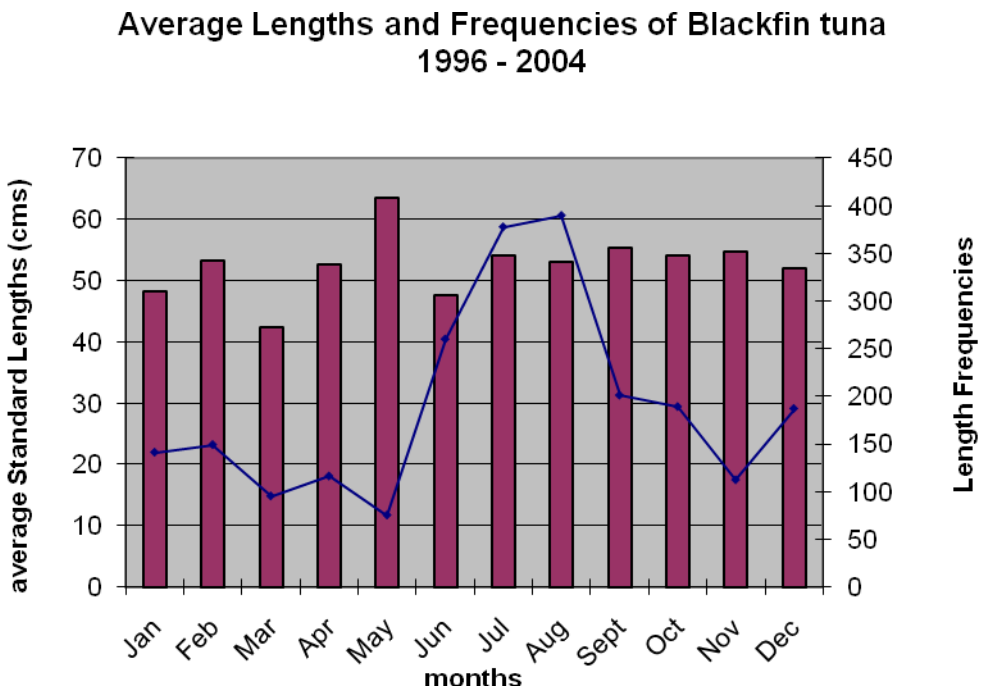


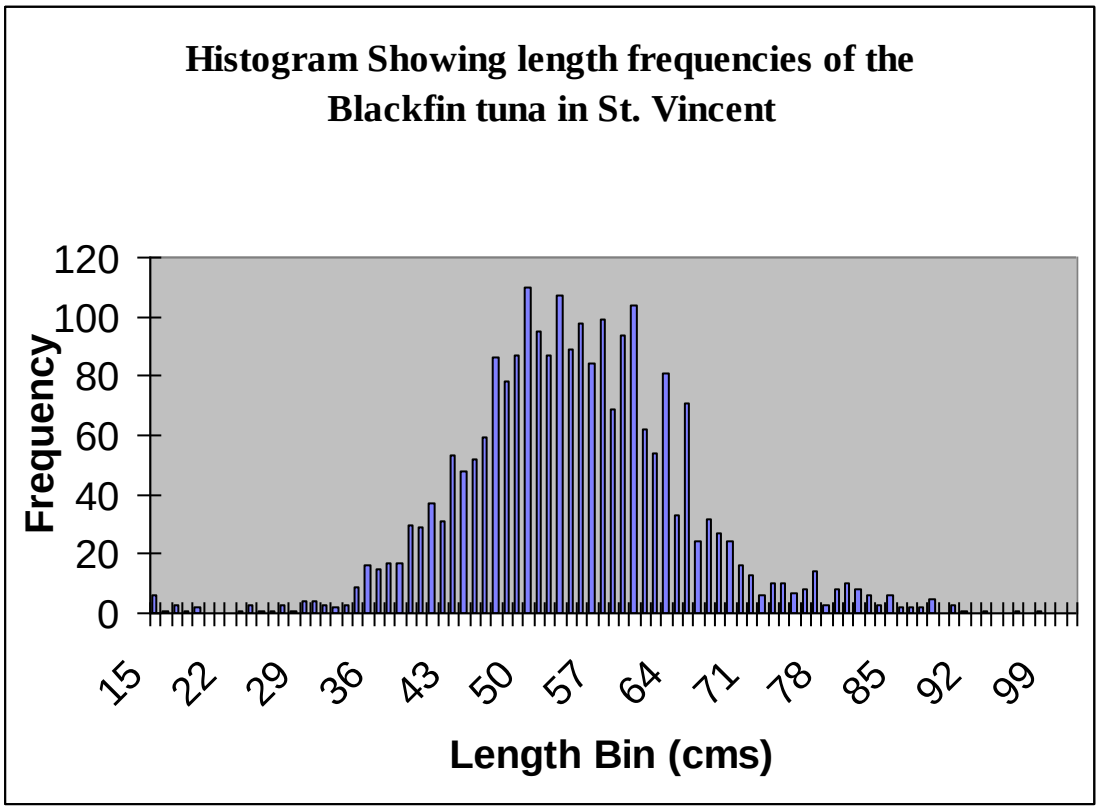
Expanded Plots




St. Vincent and the Grenadines
Average Standard Length of the Blackfin Tuna
by gear for the years 1996 - 2004
Average Length in cms
70
60
50
40
30
20
10
0
BLIN
HLIN
PALN
TROL
Gear


Average Standard Lengths of Blackfin Tuna
by year 1994 - 2004
Average lengths in cms
70
60
50
40
30
20
10
0
1994
1996
1998
2000
2002
2004
2006
Years


Average Lengths and Frequencies of Blackfin tuna
1996 - 2004
average Standard Lengths (cms)
Length Frequencies
70
60
50
40
30
20
10
0
450
400
350
300
250
200
150
100
50
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
months


Histogram Showing length frequencies of the
Blackfin tuna in St. Vincent
Frequency
120
100
80
60
40
20
0
15
22
29
36
43
50
57
64
71
78
85
92
99
Length Bin (cms)

Grenada

Summary of Data

The Fisheries Division of Grenada operates and manages seven landing sites where data is collected and recorded on a daily basis and submitted to the Fisheries Division monthly for processing. There is one additional site, managed by two private fish exporters, who provide landings data to the Fisheries Division. The data collected includes: total landings by species by fishing boat, fishing effort such as time spent fishing and area fished.

Length frequency and biological data were collected in the past. However, unfortunately due to logistical reasons the collection of this valuable data has been discontinued. In addition approximately 95% of all blackfin tuna are caught by trolling mainly on the east coast of Grenada. The blackfin fishery comprises approximately 120 fishermen and 60 open pirogues, size 18 ft. – 20 ft. powered by 40 – 60 HP outboard engines. Each boat carries two persons per trip and spends approximately four hours at sea; one hour to arrive at the fishing ground, two hours engaged in fishing activities and one hour to return. On average approximately 35- 40 fishing boats target blackfin tuna on a daily basis.

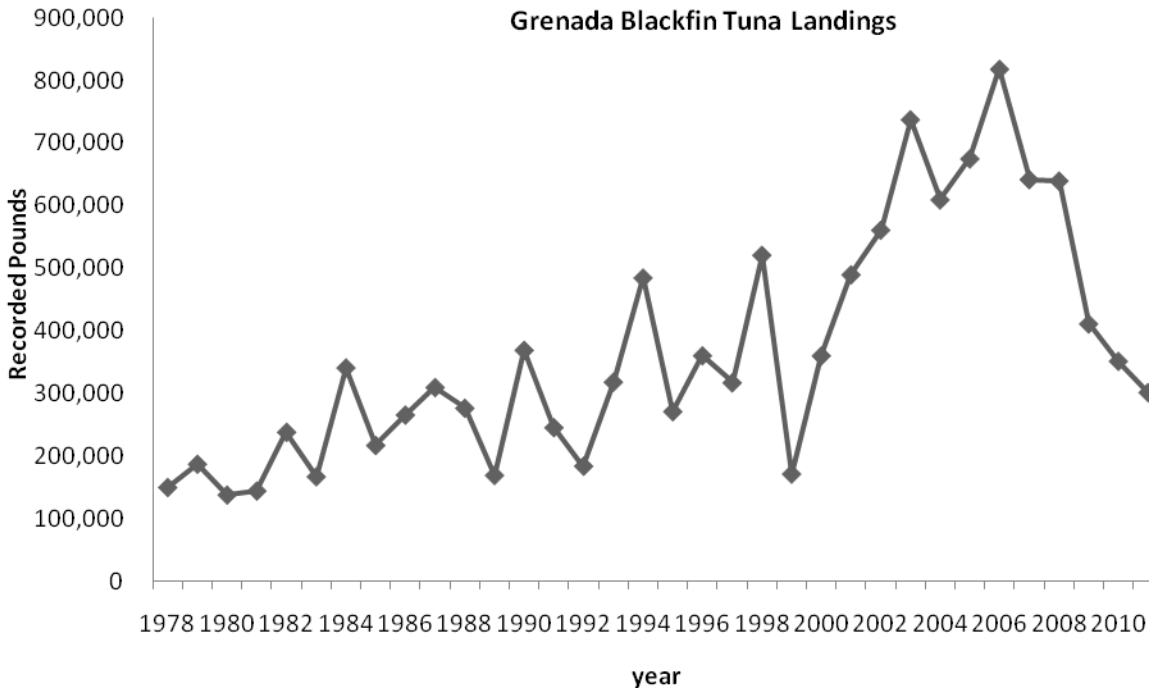
After the data is returned to the office, it is entered by one data clerk into an MS Excel spreadsheet and a summary of the landing activity is produced.

Data Improvement

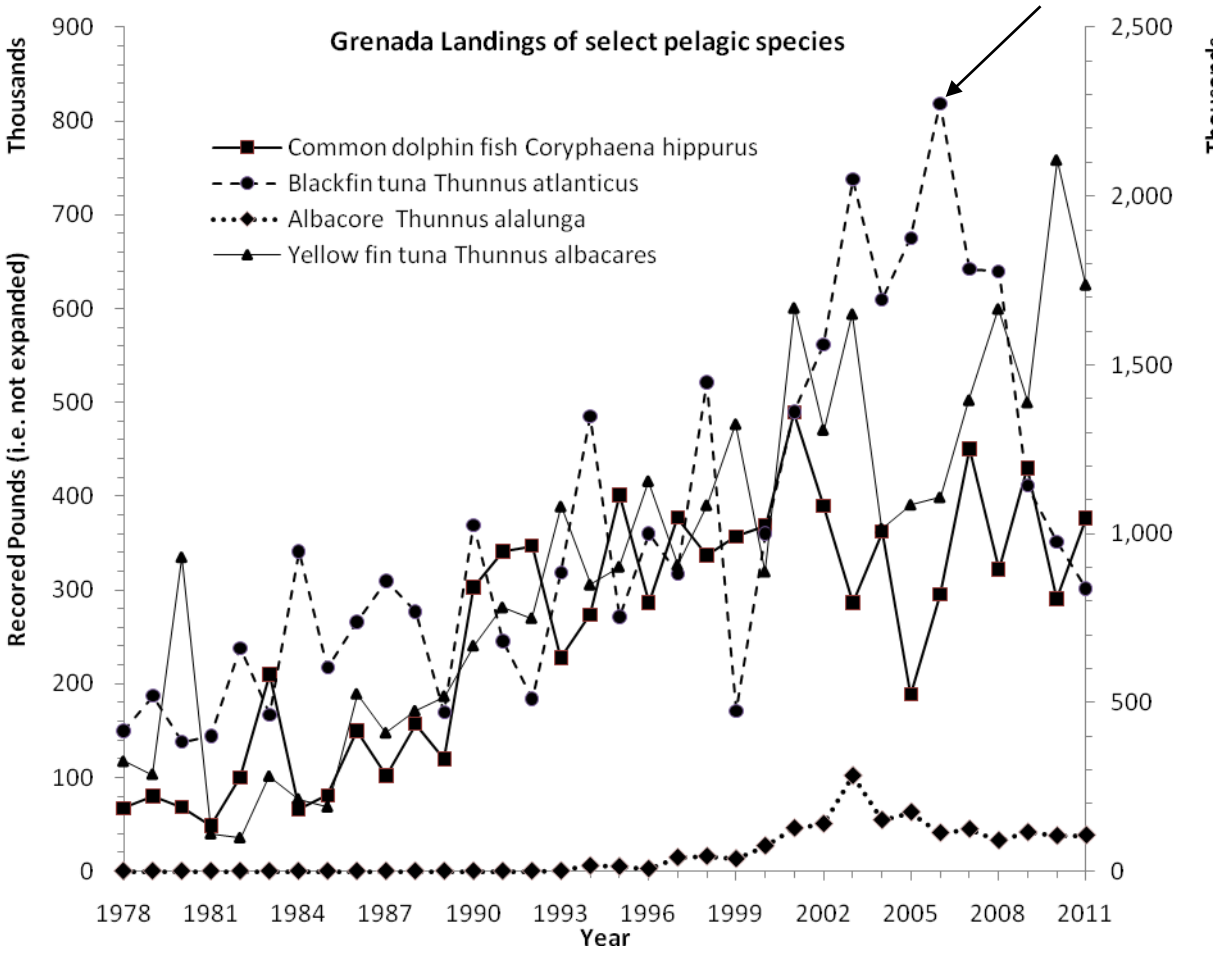
Grenada's vessel database needs to be cleaned. Specifically, the data indicates that 700 fishing boats are currently engaged in fishing activities. Based on my local knowledge, not all of these vessels are actively fishing. This deficiency existed within the data system, as a result of no policy being in place and limited knowledge by data staff on the process of eliminating inactive fishing boats from the database and lack of coordination between extension officers and data collectors. Moreover, inadequate staffing of the Fisheries Division remains a problem as it relates to data collectors, data managers and recruiting or replacing staff.

Raw Plots

Graph represents blackfin tuna landings for Grenada.



The spike in fish landings between the years of 2005 – 2006 may represent a good year for fishing. The sudden drop in between 2008–2009 may be as a result of normal fluctuations or inconsistent data collections. We may conclude that the continuous drop in fish landings there after maybe as a result of the failure to record catches at the main landing site for blackfin tuna (east coast of Grenada: Grenville) Attempts have been made to improve data collection by means of imposing conditions attached to government subsidies and thus encourage fishermen to cooperate.



Landings of a select group of pelagic species from Grenada's pelagic fisheries.

Landings represent recorded catch and are not expanded to account for total landings from the island / country. Increasing trend may represent greater effort in sampling rather than abundance. Note the arrow in the upper right indicating that around 2005 blackfin landings peaked while landings of yellowfin and dolphin were low. The same fishers may have shifted effort during this time period.

Blackfin tuna is not a choice fish in Grenada but an important food fishery. It is marketed for local consumption and targeted by fishermen mainly on the east coast of Grenada.

Sampling Strategy

Data is collected daily from all boats landed at the eight commercial landing sites. No data is collected at two additional sites where conch and lobster primarily are landed.

Raising Factor

The following species are lifted by a factor of 1.4:

- Yellowfin tuna
- Sailfish
- Dolphinfish
- King mackerel

- Wahoo
- Marlins

It is uncertain how the 1.4 was arrived at. However, the raising factor is contested for ocean pelagics as close to 100% of the landings are collected. Other species are raised by a factor of 1.75.

The raising factor of 10% which is employed to a specific fishery is done by the Chief Fisheries Officer based on information from extension officers, biologist, market supervisors and fishing trends.

As it relates to the blackfin tuna fishery, data from 2010 - 2011 can be considered as misleading bearing in mind that a new culture has been developed among fishermen who often by-pass the fish market thus resulting in their catches not being weighed and recorded. This may have contributed towards the data being bumped up.

Other

The statistics department raised concerns about the decrease in blackfin landings for the east coast. This is due to fishers evading the fish market (where data is collected). To address this problem conditions have been attached to concessions and fuel rebates, making it mandatory for fishers to weigh their catches as a condition to receive government subsidies.

Dominica

Summary of Data Collected for the Fishery

The data collected covers basic catch and effort parameters. The variables are:

- Date of record
- Number of boats sampled at date
- Number of boats fishing but not sampled at date
- Landing site: the place where the record was collected or the fish was landed
- Vessel ID: referencing the registration number for the fishing boat which landed the fish
- Vessel type: referencing the type of fishing vessel (canoe, keel, FRP / pirogue)
- Species caught: the local (English) name or code identifying the "fish" species caught and recorded
- Weight: weight of the species caught. Values are in pounds in all cases for Dominica
- Fishery: This denotes the fishery for which the fish is associated. Typical fishery labels are CP for Coastal Pelagics, OP for Ocean Pelagics and RF for Reef Fisheries.
- Data collector: the name of the person who recorded the information at the landing site. This information is not always collected within the databases; however, the data collectors seldom change.
- Landing type: this is the state of the fish when it is weighed, whether "round in pounds / RP", "gutted / GT" or "Beheaded/HD". This can affect the final weight calculated for the fish.
- Crew size: This shows the number of persons on the boat for any particular fishing trip.
- Hours Fished: This says how long the fishing trip was. Values are in hours.
- Gear / method: This is the label for the gear used to catch the fish. The gear is not described in any further detail within the regular data collection system.
- Motorized. This variable indicates whether or not the boat in question was motorized, or used an engine of some type for the fishing trip. Propulsion is not described in any further detail with this system.
- Area fished: This is a record of the place where the fish was caught. In most cases these are local areas where fishing is done, in other cases this is just an indication that the fish was caught off a Fish Aggregating Device (FAD). Not all of the information can be geo-referenced or the area referenced can be very wide or ambiguous, such as the common reference to "channel" as a fishing location.
- Soak time: This refers to how long the fishing gear is kept soaking. Values are in hours.

Not all of these variables are available throughout the entire time period of data.

History of Data Available

Catch and effort data ranges from 1989 to present (2012). During this period, it appears that MS Excel was used from 1989 to 1994. The Trip Interview Program (TIP) was used from 1994 to 2007. There were problems with the TIP program for part of 2007, at which point a MS Excel spreadsheet was used for data entry. This spreadsheet conformed to the fields found in TIP. A MS Access database was introduced in 2009 and has been used ever since. Data is extracted from this database into MS Excel for analyses.

Data Improvements

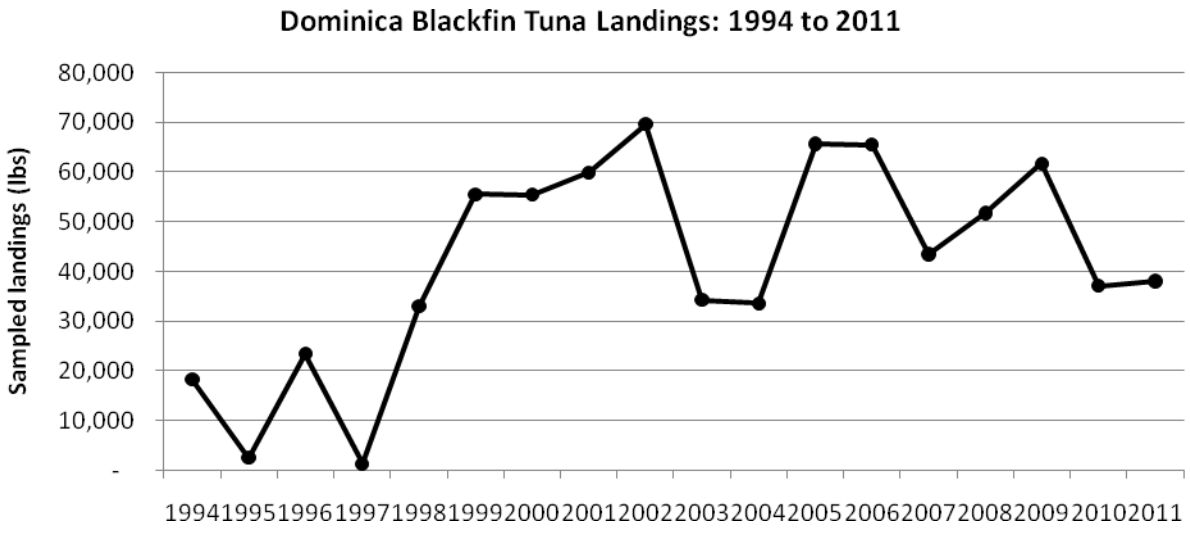
The existing data requires considerable cleaning before any analysis can be performed. This included:

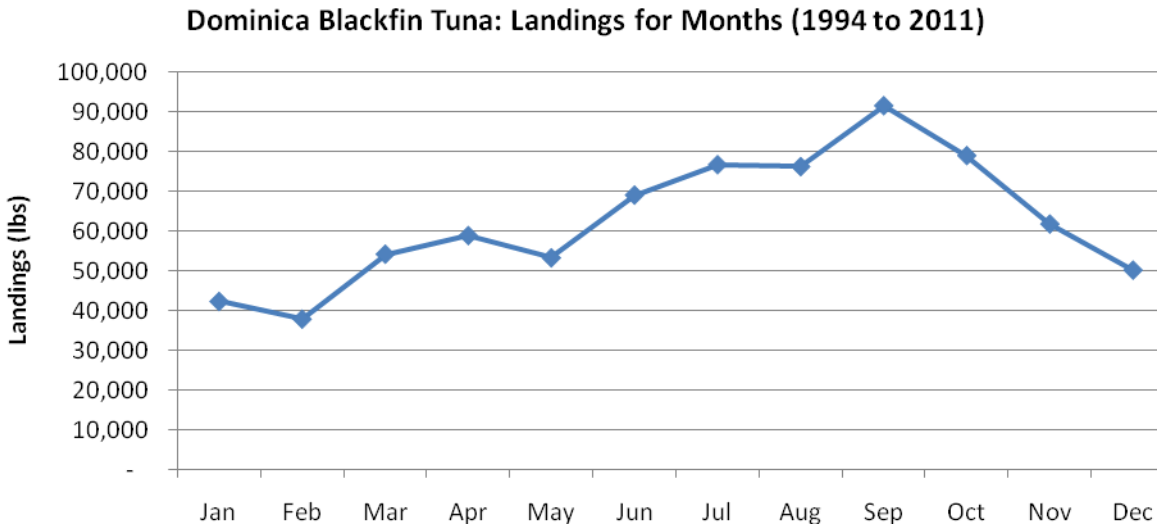
- Relabeling earlier datasets to match names and labels currently being used; standardizing the names and labels across all datasets

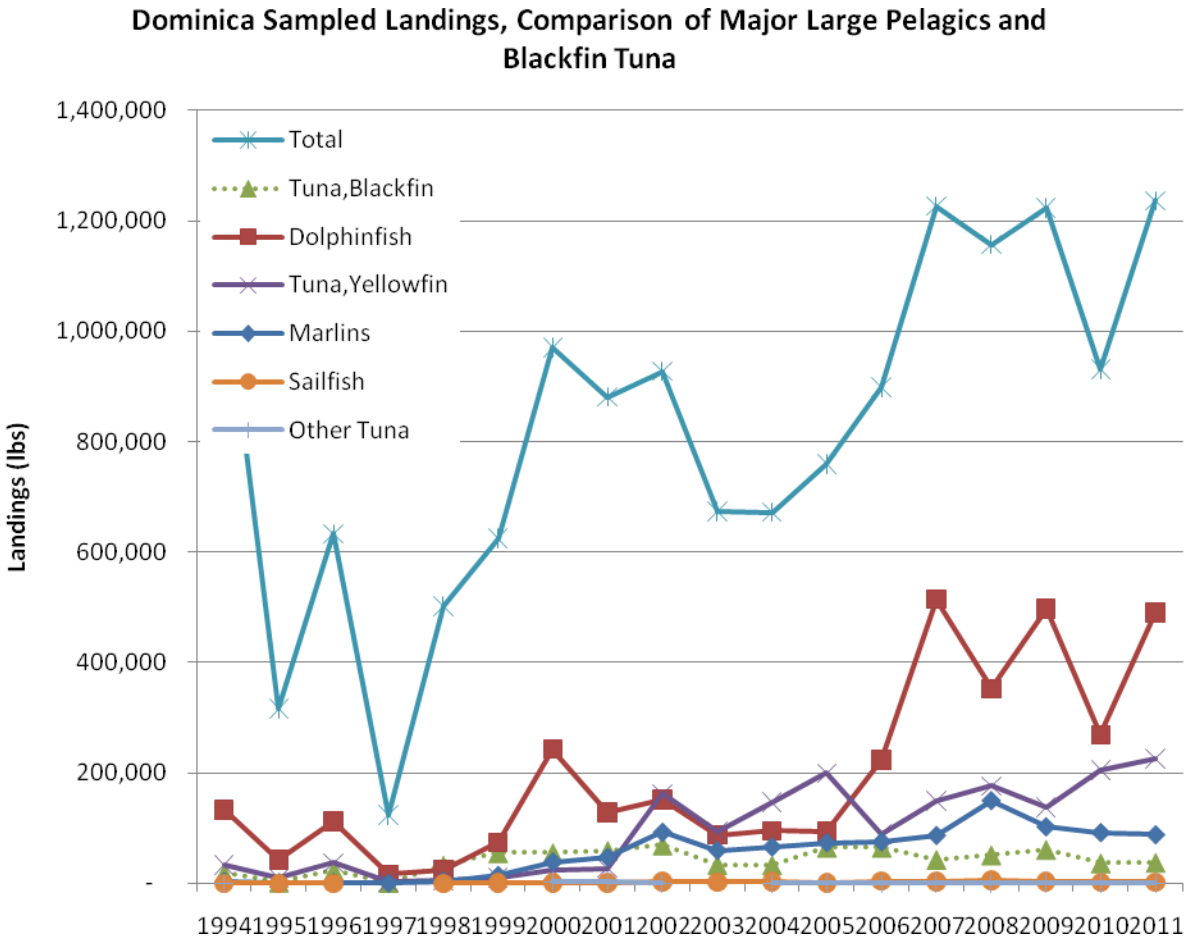
- Standardizing data fields across all years and datasets
- Relocating or adding all datasets to one master spreadsheet or database
- Correcting obvious errors in data entry. Such as records where the fish and gear do not match, spelling errors, unexplained and unhelpful outliers (that may be an incorrect entry), among others.

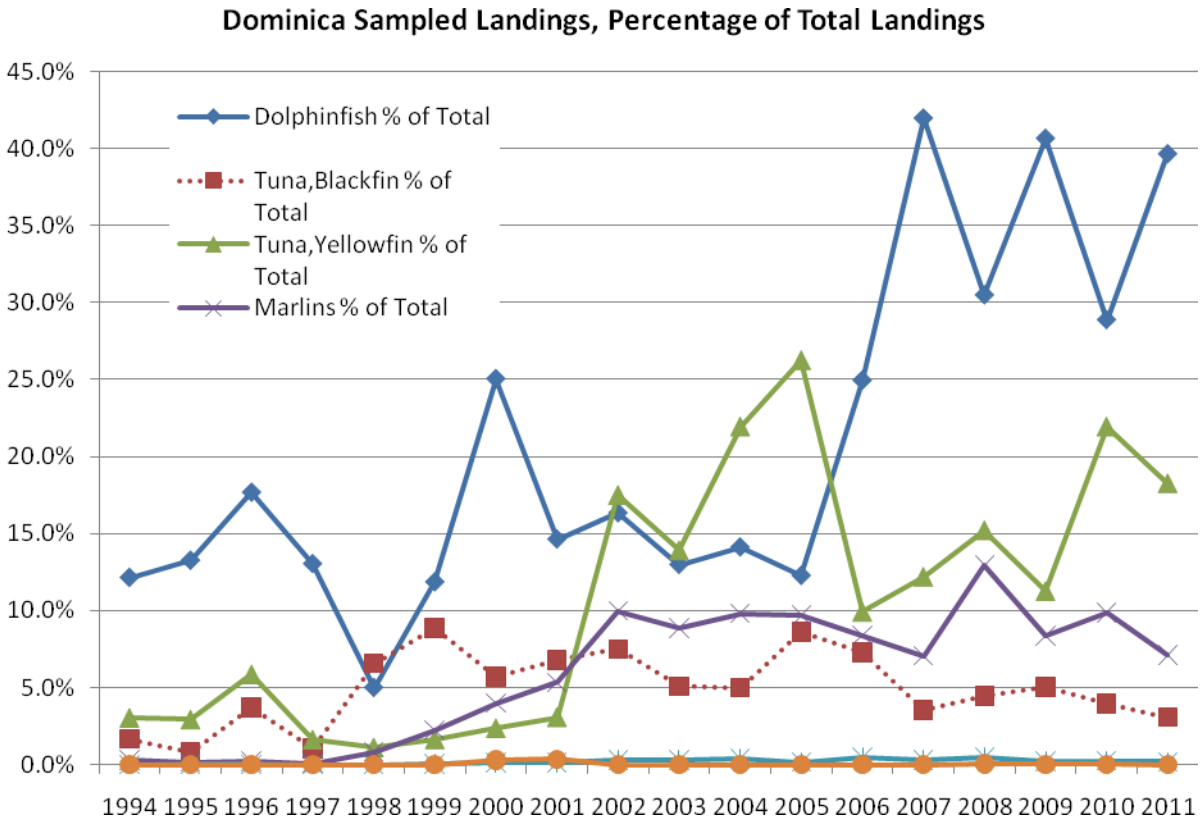
Beyond the actual data, the collection program needs some improvements. Suggested improvements include:

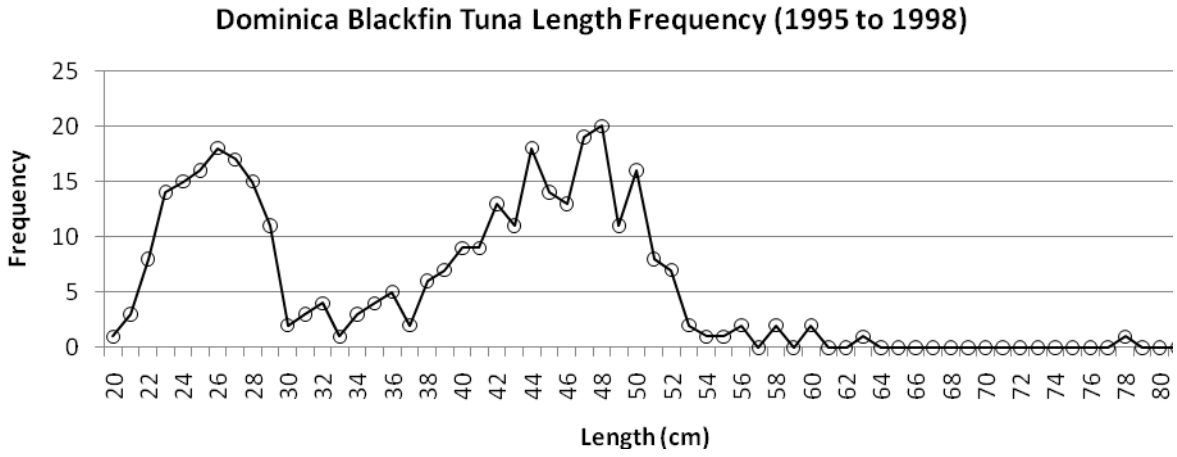
- Improved monitoring of data collector activity at landing sites
- Improvement of collection form to capture more details for certain fisheries. More detail is required on gear, such as mesh size or hooks used or number of sets might need to be added. Details on FADs, including location is also important. Certain projects already allow for capturing these types of information, however, we would like to continue capturing this information beyond the life of these projects.






Dominica Sampled Landings, Comparison of Major Large Pelagics and Blackfin Tuna
Landings (lbs)
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
-
Total
Tuna,Blackfin
Dolphinfish
Tuna,Yellowfin
Marlins
Sailfish
Other Tuna
1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011


Dominica Sampled Landings, Percentage of Total Landings
45.0%
40.0%
35.0%
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
Dolphinfish % of Total
Tuna,Blackfin % of Total
Tuna,Yellowfin % of Total
Marlins % of Total
1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011


Dominica Blackfin Tuna Length Frequency (1995 to 1998)
Frequency
25
20
15
10
5
0
20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80
Length (cm)

Sampling Strategy

There is only one regular sampling program, the fish catch and effort sampling program. Data is collected at 13 landing sites around the island by 9 data collectors (part-time employees attached to the Fisheries Division). Random sampling is performed at all sites except for Marigot (after the completion of the new fisheries facility in 2004) which captures all data for all boats landed. Generally, more than 50% of the day's catch is sampled randomly by the data collector. Collection is done for at least 4 days weekly.

A data book is issued to data collectors monthly for the purpose of collecting the data. The data collected include: date of catch, landing site name, number of boats sampled and total number of boats fished at

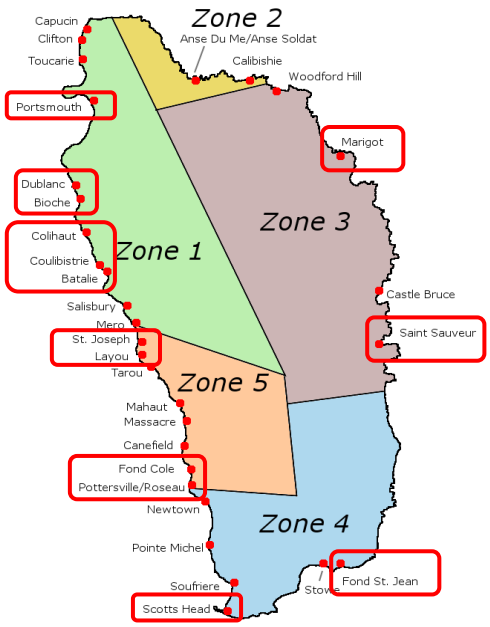


Figure 1- Map of Dominica, divided by Fisheries Liaison Officer (FLO) Zones, showing landing sites, with data collection

that date, boat registration number or other identification (usually owner or captain name), name of species caught, weight of species caught, gear used, fishing location (name of location), time spent at sea and number of crew members.

Data collectors are supervised by Fisheries Officers on field visits. This has resulted in the removal of poor data collectors and overall improvement in data quality. The Fisheries Division endeavors to maintain and improve the quality of information collected by hosting data collectors meetings, bringing every collector to the main office to discuss matters pertaining to the job, including data collection issues and results of data analyses.

Raising Factor

Estimated or "raised" landings are calculated for the island by taking into consideration the following factors:

- The sampling coverage for the landing site or sample rate for each landing site (total boats landed per date of record versus the total boats sampled by the data collector)
- The total sampled landings (weight in pounds)
- The sampling coverage for the island (the number of sites where data is collected, versus the number of sites where data is NOT collected).

After the total sampled landings are calculated, the sample rate for each landing site (where data is collected) is used to determine how much of the total fishing activity was captured during our sampling effort (described in the sampling strategy). The sampled totals are then raised to accommodate the sampling ratio. This gives the total estimated landings for all the sampled sites. Un-sampled sites or sites where there was no data collector presence are equated to sampled sites, giving some idea as to their potential effort and catch. This means that sites with similar fleet and fishing activity are equated in an effort to get an idea of what the potential catch might be. These “other” sites are added to the previous total, giving the total estimated landings for the island. Estimates are calculated annually.

Saint Lucia

Summary of Data

The data extracted from the Saint Lucia database for this analysis included:

- sequence number (unique identifier)
- date (trip date)
- vessel ID (vessel registration number)
- gear type (the gear used to catch the species most widely used gear for ocean pelagic fishing trips are trolling lines (TROL), handlines (HLIN), bottom longlines (BLIN) and harpoon (HARP)
- gear quantity (number of each gear type used)
- soak time (calculated as the difference between the departure and return times of the vessel, minus 2 hours for travel and preparation.
- Species (species caught)
- Weight (weight of each species caught)
- measurement type (method used to measure the species, (GP) gutted, (RP) round whole)

Data records for each year for the period 1995 – 2011 were exported from TIP to MS Excel into separate worksheets and the same variables were maintained for all selected years. Required for this meeting was a query output that listed all possibly ocean pelagic trips that landed fish or returned with no catch.

All sampled data collected by the Department is stored as dBase (.dbf) files and can be made available in an MS Excel format through specific queries.

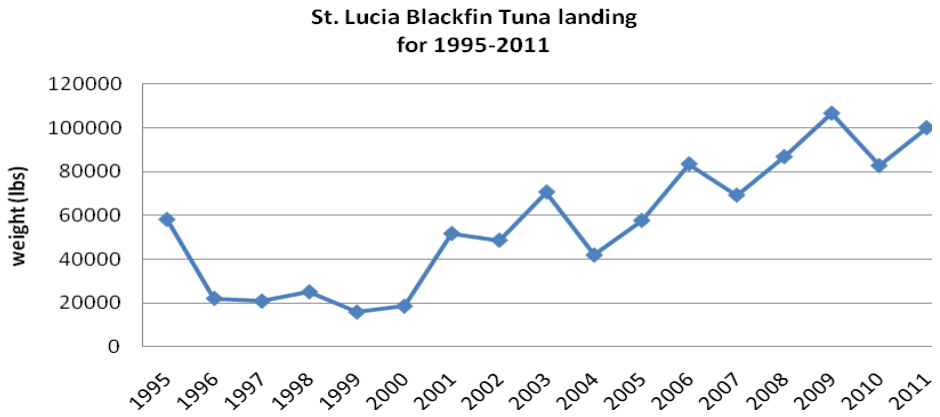
Data Improvements

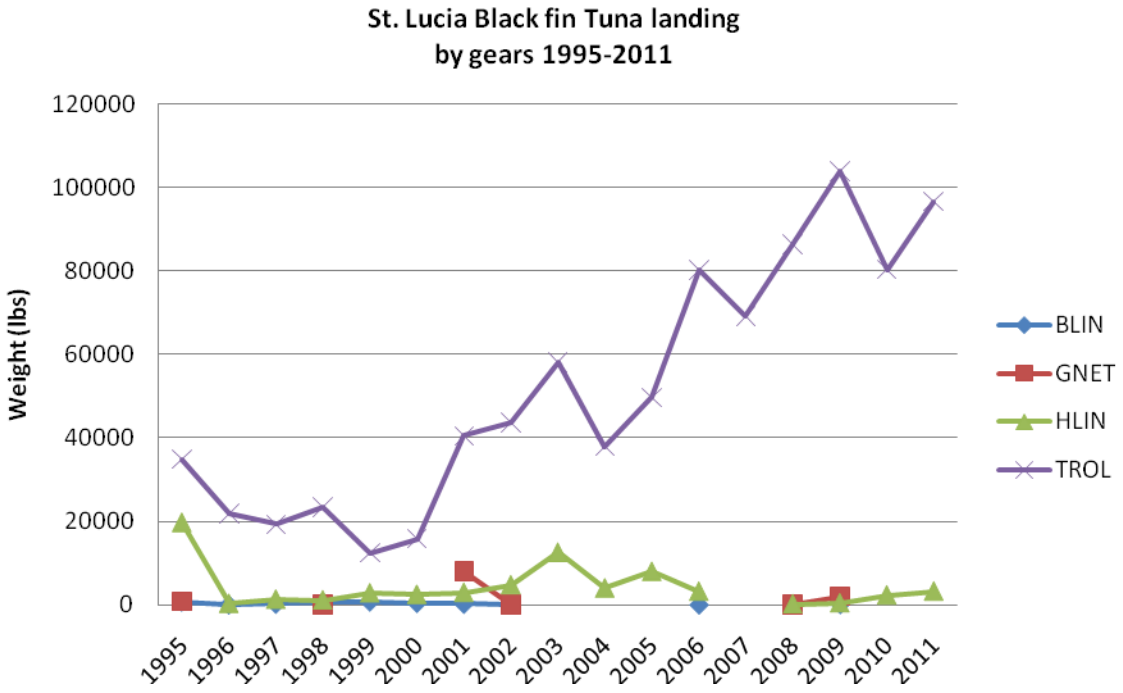
Prior to analyses a data verification process was conducted to ensure that the variables were the same and the gears and species corresponded for each year. After clean up and verification of the dataset, the individual years were merged into one.

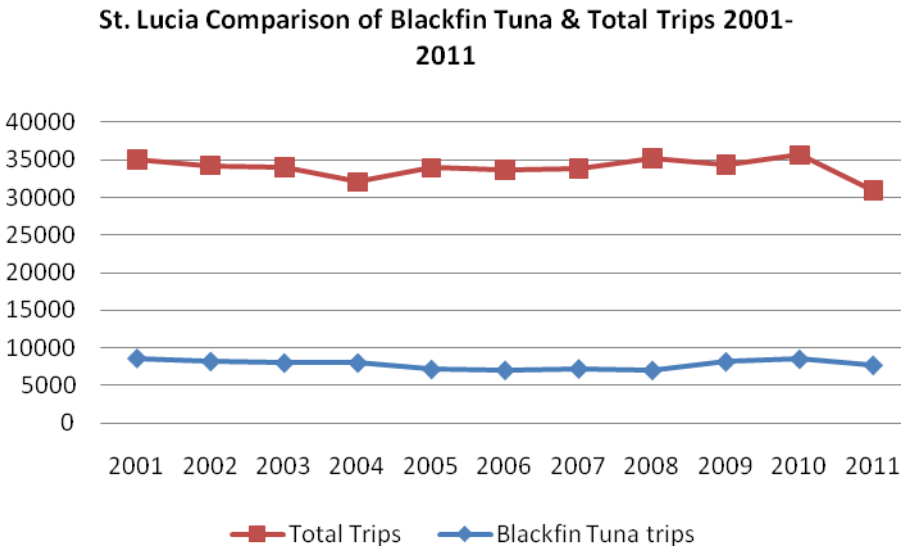
Recommendation

1. The corrections made to this dataset should be made to the data kept in storage.

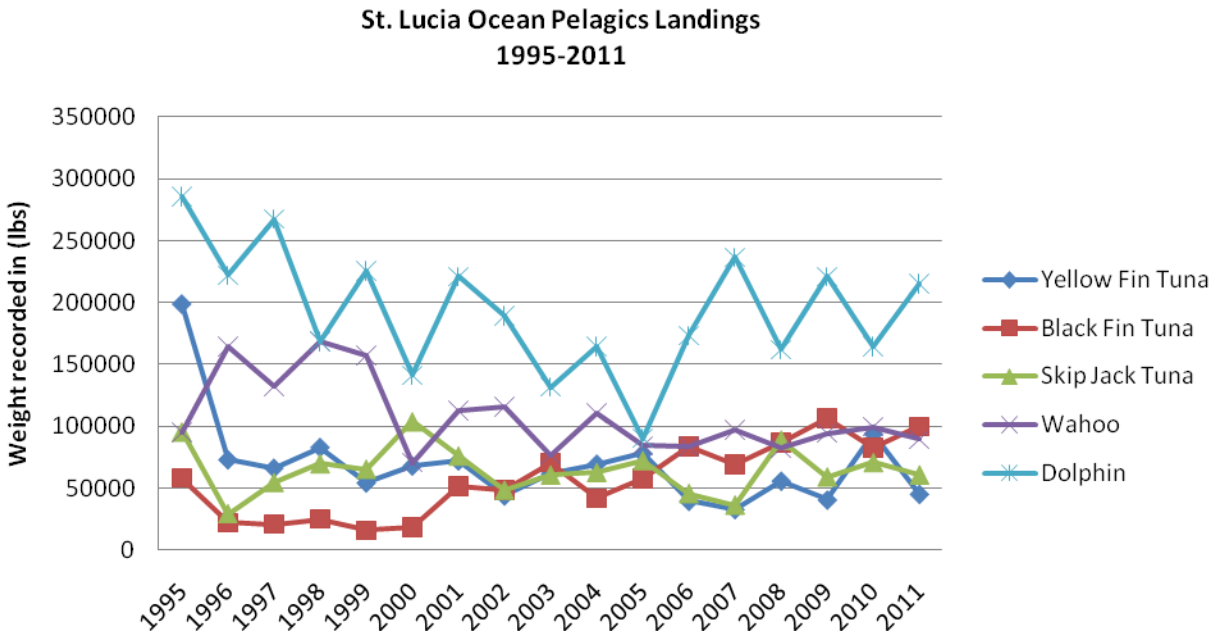
Raw Plots




St. Lucia Black fin Tuna landing by gears 1995-2011
Weight (lbs)
120000
100000
80000
60000
40000
20000
0
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
BLIN
GNET
HLIN
TROL


St. Lucia Comparison of Blackfin Tuna & Total Trips 2001-2011
40000
35000
30000
25000
20000
15000
10000
5000
0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Total Trips
Blackfin Tuna trips

Extended Plots



Sampling Strategy

The Department of Fisheries uses a stratified random sampling strategy where nine of the twenty-two landing sites are sampled for fifteen randomly selected days monthly for every other returning vessel.

Raising Factor

To arrive at the estimated landings a raising factor is calculated for each month and site for all sampled sites. For each non-sampled site a percentage of the estimate for a similar sampled site is used.

Calculation of the raising factor:

*Raising Factor = (Fish Days * Total vessel / Days Sampled) / Boats sampled*

Other

Member countries of the Large Pelagic Working Group (LPWG) felt that Saint Lucia's dataset had maintained a good standard throughout the years and other countries should emulate these data standards.

References

Battaglia A. (1993). Les grands poissons pélagiques à la Martinique et en région Caraïbe. Biologie et pêche. Ifremer, Rapp. DRV N◦ 93/027.

Boobe, W and Tee-Van, J. (1936). Systematic notes on Bermudian and West Indian tunas of the genera Parathunnus and Neothunnus. Zoologica. (New York) 21. 177-194.

Bullis, W.J., and Mather, J.R. (1956). Status of the knowledge on the biology and resources of the blackfin tuna, Thunnus atlanticus (Pisces, Scombridae). Col. Vol. Sci. Pap. ICCAT, 7. SCRS/1977/036. 0131-0141.

Cabello, A., Marcano, J., Narváez M., Silva, O., Gómez, A, Figuera, B., Vallenilla, O., Salazar, H. (2003). Management of tuna resources in Venezuela. Zootecnia Trop., 21(3):261-274.

Collette, B.B. 2010. Reproduction and Development in Epipelagic Fishes. In: Cole, K.S. (ed.), *Reproduction and Sexuality in Marine Fishes: Patterns and Processes*, University of California Press, Berkeley, CA.

Collette, B.B., and Nauen, C.E. (1983). FAO species catalogue. Vol. 2. Scombrids of the world. An annotated and illustrated catalogue of tunas, mackerels, bonitos and related species known to date. FAO Fish. Synop. 125, Vol. 2.

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

Laboratorio Oceanográfico de Canarias, (1974). Pesquerías de túnidos en Las Islas Canarias. ICCAT Col. Vol. Sci. Pap., 2: 314-319.

Laurans, M., Taquet, M., Reynal, L., Lagin, A. (2000). Comparaison des captures des grands poissons pélagiques en Martinique avec ou sans dispositifs de concentration de poissons (DCP). In: Le Gall, J.Y., Cayré, P., Taquet, M. (Eds.), Pêche thonière et dispositifs de concentration de poissons, Caraïbe-Martinique, 15–19 oct. 1999. Ifremer, Actes Colloq., pp. 421–434.

Freire, K.; Lessa, R.; Lins-Oliveira, J.E. (2005). Fishery and biology of blackfin tuna *Thunnus atlanticus* off Northeastern Brazil. Gulf and Caribbean Research 17:15-24.

Mather, F.J III., and Day, C. G. (1954). Observations of Pelagic Fishes of the Tropical Atlantic. Copeia, Vol. 1954, No. 3 (Jul. 29, 1954), pp. 179-188

Mather, F.J III., and Shuck, H.A. (1952). Additional notes on the distribution of the blackfin tuna (Parathunnus atlanticus). Copeia 1952. 267.

Reynal, L., Monthieux, A., Chantrel, J., Lagin, A., Rivoalen, J.J., et Norbert, M.H. (2006). Premiers éléments sur la biologie et la pêche du marlin bleu (*Makaira nigricans)* autour des DCP ancrés en Martinique. ICCAT Col. Vol. Sci. Papers, 59: 303-314

Saxton, B.L. (2009). Historical demography and genetic population structure of the blackfin tuna (*Thunnus atlanticus*) from the Northwest Atlantic Ocean and the Gulf of Mexico. Master of Science Thesis. Texas A&M University. 91 p.

Singh-Renton, S. and Renton, J. (2007). CFRAMP's Large Pelagic Tagging Program. Gulf and Caribbean Research, Vol. 19 (2), p 99-102.

Taquet, M, Reynal, L., Laurans, M., Lagina, A. (2000). Blackfin tuna (*Thunnus atlanticus*) fishing around FADs in Martinique (French West Indies). Aquat. Living Resour. 13. 259−262.

Vieira, K.R., Lins Oliveira, J.E., Barbalho, M.C., Junior, J.G. (2005). Reproductive characteristics of blackfin tuna (Thunnus altanticus - Lesson, 1831) in northeast Brazil. Col. Vol. Sci. Pap. ICCAT, 58(5): 1629-1634.

Appendix 5: Report of the Reef and Slope Fish Resource Working Group (RSWG)

Chairman: Alwyn Ponteen (Montserrat)
Co- Chair: Anna-Cherice Ebanks (Jamaica)
Consultant: John Hoenig (Virginia Institute of Marine Science)
Nancie Cummings (NOAA Fisheries, SEFSC- Miami, FL USA)

A. OVERVIEW

Inter-sessional tasks identified by the RSWG at the Fifth Annual Scientific Meeting included computerizing of the trip specific landings 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 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 acknowledged the considerable work that was done by Montserrat to prepare the data.

Since that time, Montserrat has devoted considerable effort to computerizing its landings data in the CARFIS format. At the Eighth Annual meeting, data were available from Montserrat covering the years 1995 – 2011 (17 years) plus the first quarter of 2012. Jamaica also has data in the CARFIS format and five years of data, covering 2005 – 2009, were available at the meeting.

The Working Group focused on quality control of the data, exploratory data analysis, and examination of trends over time, particularly of catch rates over time. Specifically, the WG addressed 5 technical analyses: 1) summarize the salient features of the Montserrat database, 2) analyze Montserrat data on red hind from the pot fishery, 3) analyze Montserrat data on needlefishes from the beach seine fishery, 4) summarize salient features of the Jamaica database, 5) analyze Jamaica data on doctorfish from the South Coast, North Coast and Offshore Banks.

B. FISHERIES REPORTS

1.0 Montserrat Reef Fishery

The available data were collected by national scientists who sampled landings and compiled data on a trip level basis. Landings data included: date, landing site, landed weight by species, gear type and effort information. The number of trips sampled from 1995 through the first quarter of 2012 was 11,072, and 222 species or species groups were recorded. The data have been archived in the CARFIS database format.

The three main types of fishing gear used in Montserrat are pots, beach seines and lines (hand, bottom, and drift) (Figure 1). In terms of the number of trips landing a species, red hind is the most abundant species and occurs mainly in the pot fishery; needlefishes are the most important in the beach seine fishery (Annex 1). Consequently, we focus primarily on these two fisheries. The number of trips landing a species can be a misleading indication of a species' importance. Needlefishes are landed in approximately half as many trips as red hind, yet the landed weight of needlefishes (166,852 kg) is four times the landed weight of red hind (41,067 kg) and the mean weight landed per positive trip is almost 8 times higher for needlefishes than red hind (Annex 2).

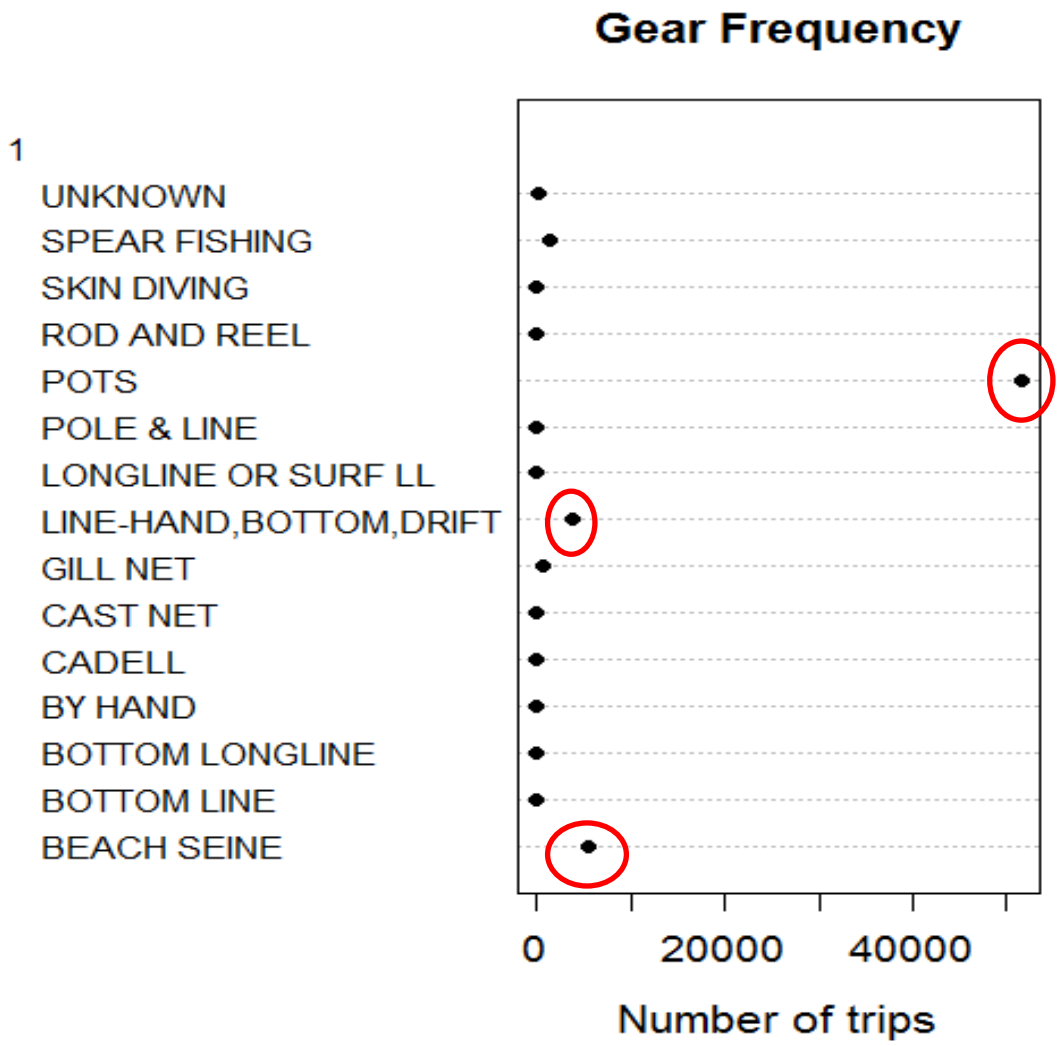


Figure 1: Frequency of gear use in the Montserrat landings database, 1995-present.

Pot fishing effort, measured as number of trips, declined to a third of its peak level from 1995 to 2000, then rose until 2005 before declining to the lowest value in 2009 (Figure 2). Effort rose in 2010 and 2011.

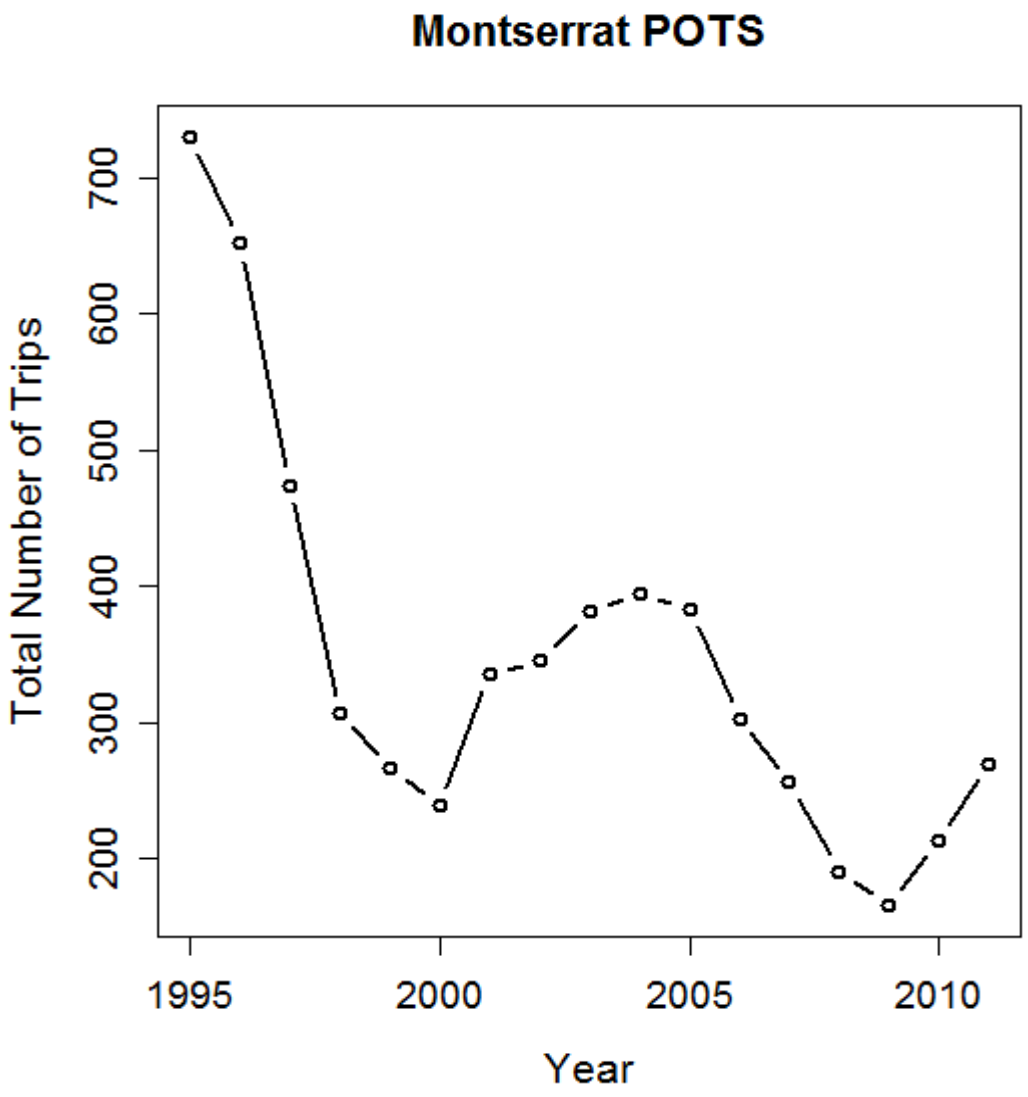


Figure 2: Pot fishing effort in Montserrat, 19995 – 2011.

Beach seine fishing effort measured as number of trips also shows a strong downward trend from 1995 to 2011 and is currently at its lowest recorded level (Figure 3).

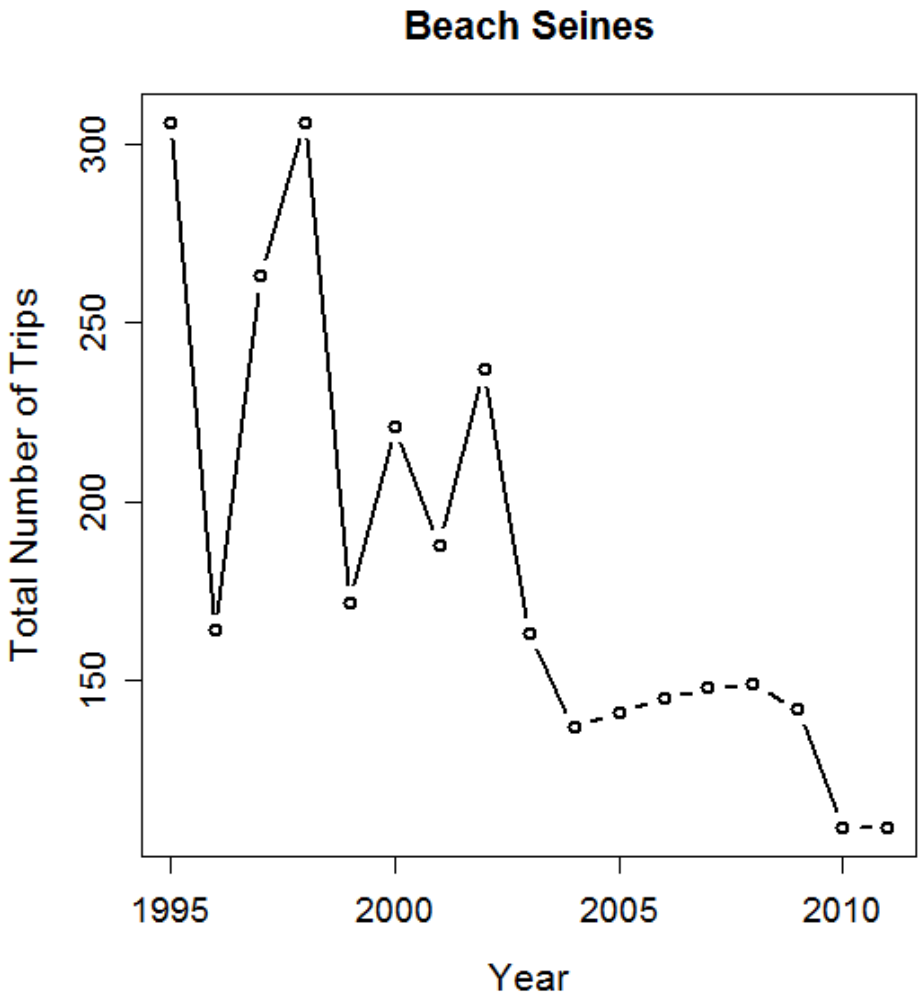


Figure 3: Beach seine fishing effort in Montserrat, 19995 – 2011.

1.1 Management Objectives

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

1. To strengthen the Fisheries Division's Management capabilities by incorporating the sub-sector concerns in the wider frame work of Coastal Zone Management and Development Planning.
2. To have more diverse species of locally fresh fish available on the market all year around.
3. Build greater awareness amongst Staff and Stakeholders of their role in ensuring that the marine resources remain sustainable.
4. Promote and regulate the sustainable use of the living and non-living marine resources
5. To increase the role of the Fisheries industry in the building of the National Economy.
6. To use the marine resources wisely so as to improve income and employment opportunities, alleviate poverty and contribute to food and nutrition security in Montserrat.
7. To ensure that the exploitation of fisheries resources and the carrying on of any related activities

are conducted in a manner consistent with the principles of ecologically sustainable development (which include the exercise of the precautionary principle), in particular the need to have regard to the impact of fishing activities on non-targeted species and the long term sustainability of the marine environment.

8. To protect the marine environment and its resources by reducing pollution and protecting the maritime area against adverse effects of human activities through enforcement, so as to safeguard human health and to conserve the marine ecosystem.
9. To design and implement training and extension program in order to improve the status and career orientation of all stakeholders in the fisheries sector and to increase public awareness of fisheries potential.
10. To improve fish landing facilities, marketing, storage, distribution and quality enhancement.

1.2 Status of Stocks

The status of the Red hind and needlefish stocks are currently unknown. However, total pot fishery effort has declined since 1995 and the catch rate of red hind has increased overall since 1995 (but declined after 2005). Similarly, the total effort (trips) in the beach seine fishery has declined since 1995 and needlefish nominal catch rates (in trips catching needlefishes) increased from 1995 to 2005 but then declined somewhat. Needlefish catch rates (all trips, including trips with zero catches) have been stable since 1999.The results suggest the stocks are not in peril but it cannot be determined at this point where the stocks are in relation to optimum exploitation.

1.3 Management Advice

Until a detailed stock assessment is conducted there are no recommended changes to the fishery. The data (time series from 1995 to 2011) are sufficient to begin more complicated and robust statistical analyses (production models, CPUE standardizations); however, the analyses would benefit greatly from having data prior to 1995 made available.

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 2012/2013 inter-sessional period, should improve the data quality significantly and the management advice generated from analyses of these data.

- Obtain catch and effort data prior to 1995
- Explore obtaining data from other bays
- Continue quality control (QC) edits for data on a routine basis (as data are collected, as data are keypunched)
- Develop summary QC computer routines to identify data outliers

The following recommendations remain from the RSWG at the Sixth Annual Scientific Meeting:

- The current landings data collection form should be modified to account for discards, spatial area of catch, quantity and type of gear used;
- Develop protocols to improve the timeliness of landings data availability from fishers who may not be accessible during normal working hours;

- The 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 collection. These data needs are required in order to describe catch at size and to evaluate seasonal changes in maturity of the RSF species.

- Implement routine surveys of the landings for biological information collections of size and age data for primary species landed (e.g., top 10)
- Interim sampling priorities can be set using the 2010 Case Study results (total catch by species, total effort by fishery)
- Develop habitat maps and incorporate into analyses

The following recommendations remain from the RSWG at the Sixth Annual Scientific Meeting:

- Routine biological data collections (length / weight, maturity, ageing), should be implemented. Species to be studied should be identified during the 2010/2011 inter-sessional period and should be based on examinations of the landings data. Attention should be given to prioritization of species at both the national and the regional level;
- Information on spawning timing and areas needs to be documented as soon as possible. It is recommended to conduct a survey of the local fishers as a starting point to obtain this information as well as investigate fishing on spawning aggregations;
- Conduct a literature search at the national and regional level to document information on growth, mortality, spawning, maturation, fecundity.

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;
- Consider incorporation of other data types (habitat, environmental) into future analyses.

1.5 Data Analysis Summary

The data are believed to represent a reasonably complete tally of fishing landings and catch. Consequently, in addition to providing catch rates as an index of abundance, there is the potential to use absolute catch and effort to construct more elaborate models, especially production models. The analyses therefore focused on describing landings in weight, effort and catch rate for the two most abundant single species, red hind and needlefish. Effort in the pot fishery declined steadily over the period 1995 to 2011 and, correspondingly, catch rates rose (and leveled off in the most recent years). Beach seine effort has declined steadily over the period 1995 - 2011 and catch rates of needlefish have increased as measured by catch per trip catching needlefish.

2.0 Montserrat Reef Fishery – Red Hind

The catch in kg per trip for those trips catching red hind ("positive trips") is shown in Figure 4; total catch by year is shown in Figure 5. From Figures 2, 4 and 5 it can be seen that the catch rate has risen over the time series. Total catch has been variable, reflecting mostly the trend in effort over time.

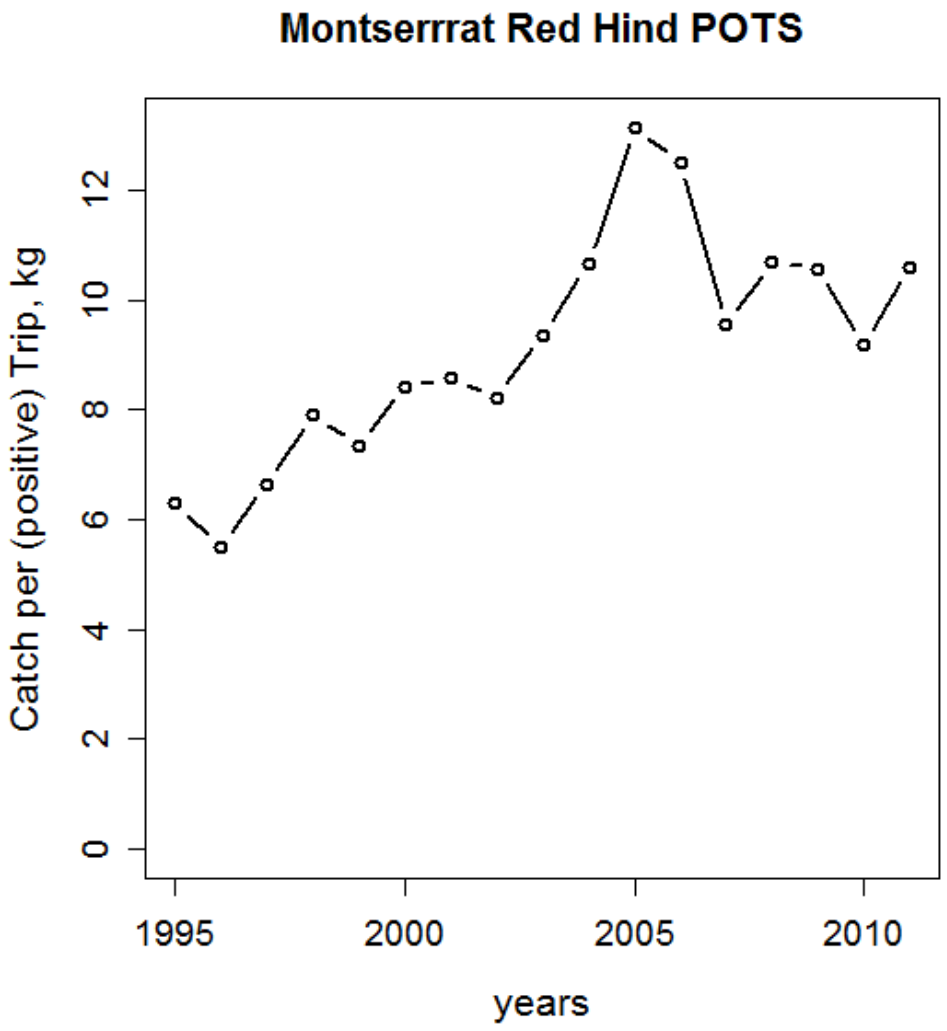


Figure 4: Catch of red hind in kg per trip for just those trips in which red hind were caught.

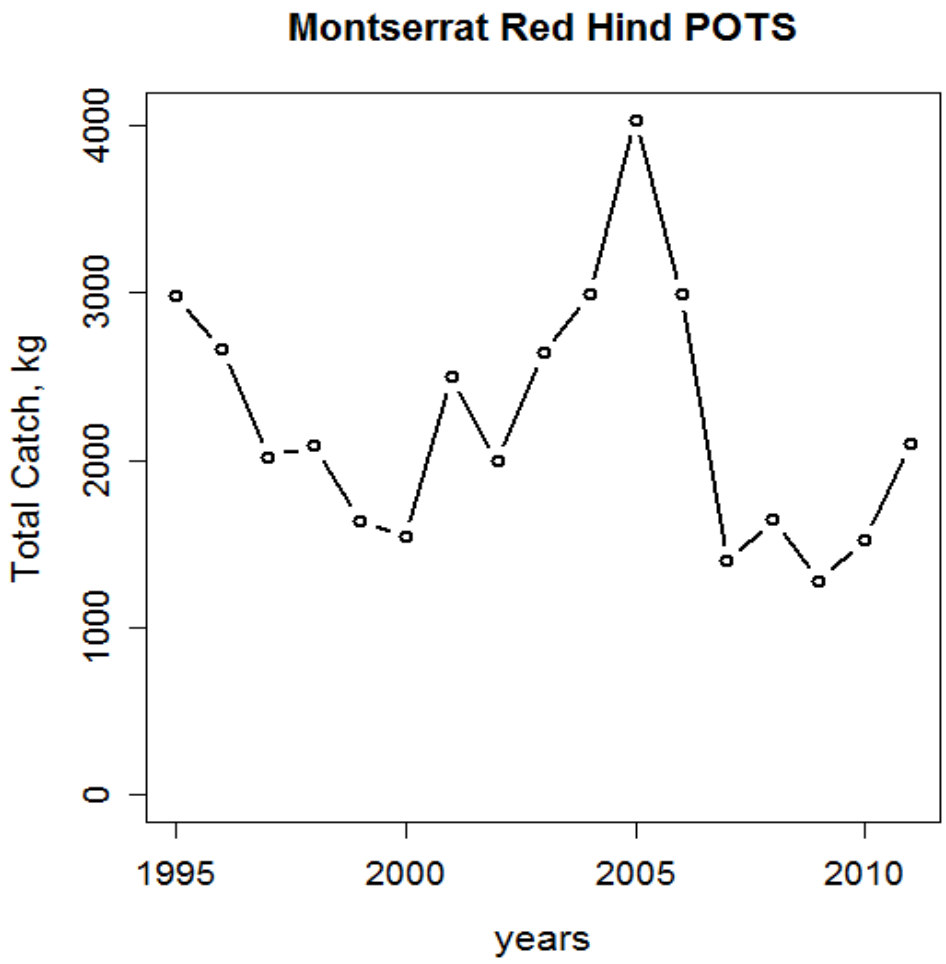


Figure 5: Total sampled landings of red hind by year.

Interpretation of catch per trip in a multispecies fishery can be complicated by changes over time in directed or targeting fishing by some fishers for particular species. For this reason, the Working Group chose to look at the magnitude of catch of red hind for those trips in which red hind were caught (positive trips). However, it is important to check whether the percentage of positive trips changes over time. We find that the percentage of positive trips has fluctuated randomly without trend over time (Figure 6). Thus, the trends in catch rate of red hind are very similar regardless of whether catch rate is calculated over all trips or over positive trips (Figure 7).

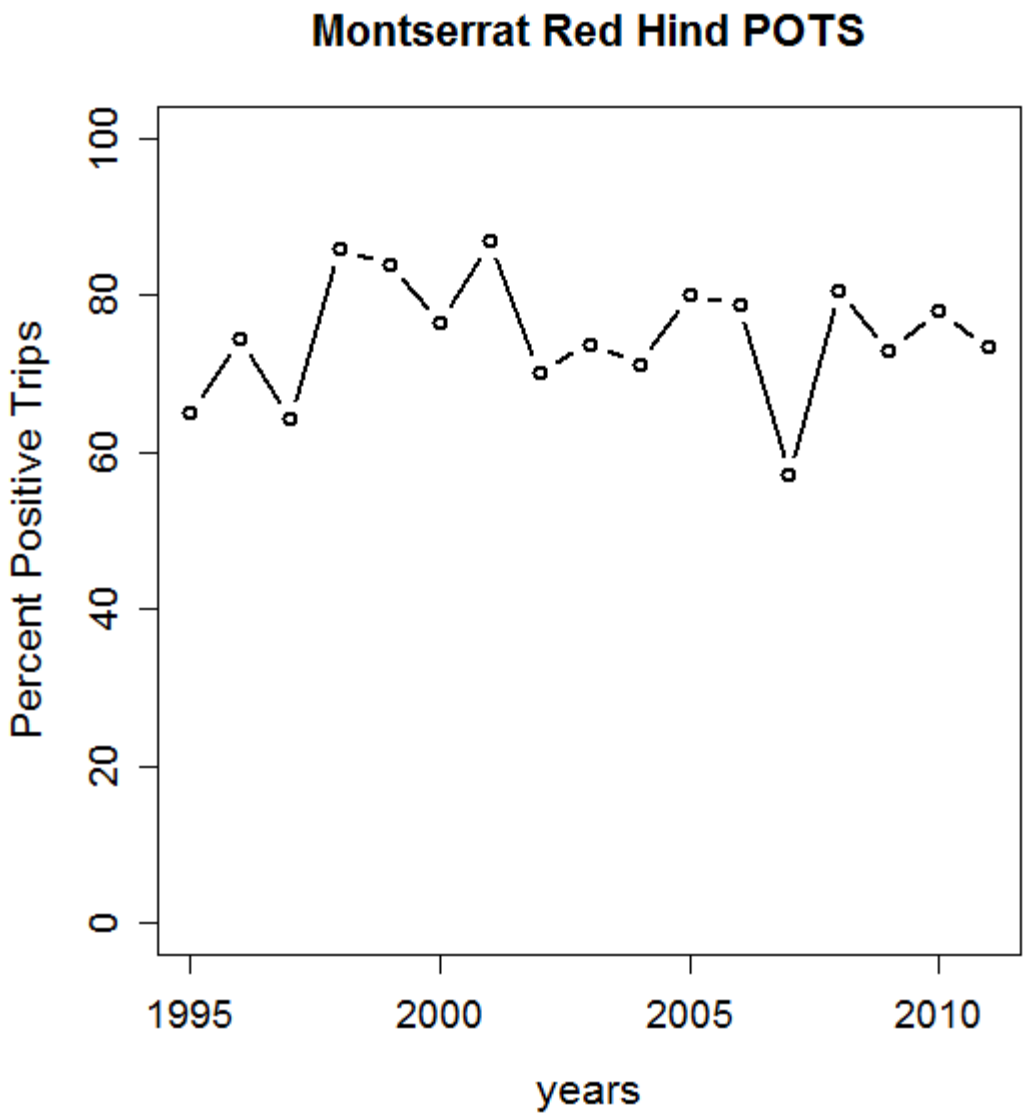


Figure 6: Percentage of trips catching red hind with pots in Montserrat.

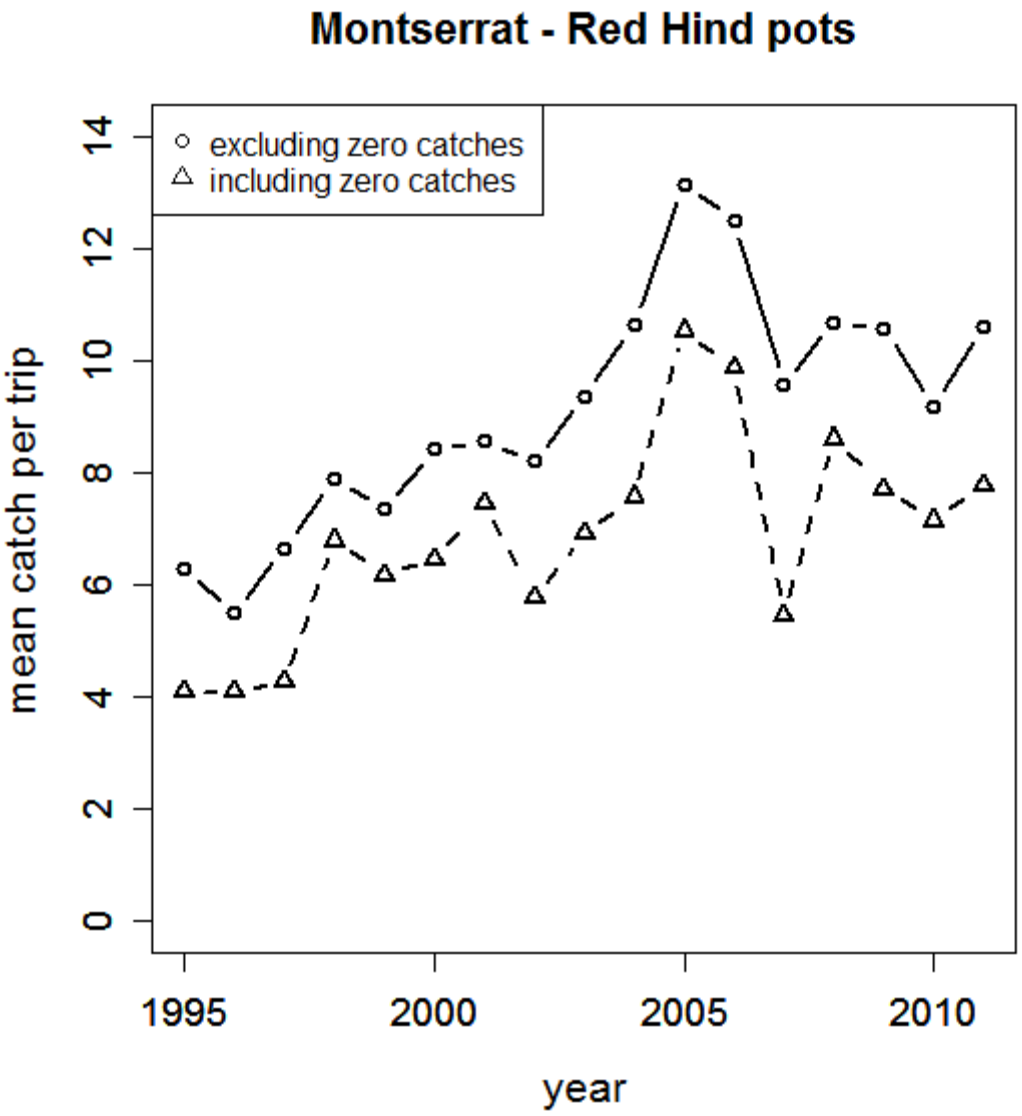


Figure 7: Comparison of two methods for calculating catch rate of red hind in the Montserrat pot fishery.

2.1 Management Objectives

There are no special management objectives for red hind or for the pot fishery. The general objectives are described in Section 1.1.

2.2 Status of Stock

Although no quantitative statements about stock status can be made at this time, the declining trend in effort in the pot fishery coupled with the increasing catch rate of red hind over time and the stable percentage of pot fishing trips reporting landings of red hind suggest that the stock is not in any danger.

2.3 Management Advice

This is one stock for which management could benefit greatly from additional analysis of the existing data. The lengthy time series (1995 - 2011, with more years available if the data are computerized) provides the opportunity in the future to conduct more complicated and robust statistical analyses of resource condition, e.g., via production model, CPUE standardizations, and other population models. This would enable managers to make changes to meet target (optimal) exploitation rates.

2.4 Statistics and Research Recommendations

Statistics and research recommendations for red hind and for the pot fishery are as described in section 1.4.

3. Montserrat Reef Fishery - Needlefish

The catch rate in kg per trip for those trips catching needlefish ("positive trips") is shown in Figure 8; total catch by year is shown in Figure 9. It can be seen that effort has trended downward strongly from 1995 to 2011 (Figure 3); catch rate has trended upward and leveled off in recent years (Figure 8). Total catch (Figure 9) has trended downward reflecting the dominant effect of declining effort over the lesser effect of increasing catch rate.

The percentage of beach seine trips catching needlefish is highly variable over the time series, ranging from about 20% to 80% (Figure 10). The differences between catch rates calculated with and without trips with catches of zero needlefish are sufficiently different (Figure 11) to warrant examination of both types of catch rate in the future.

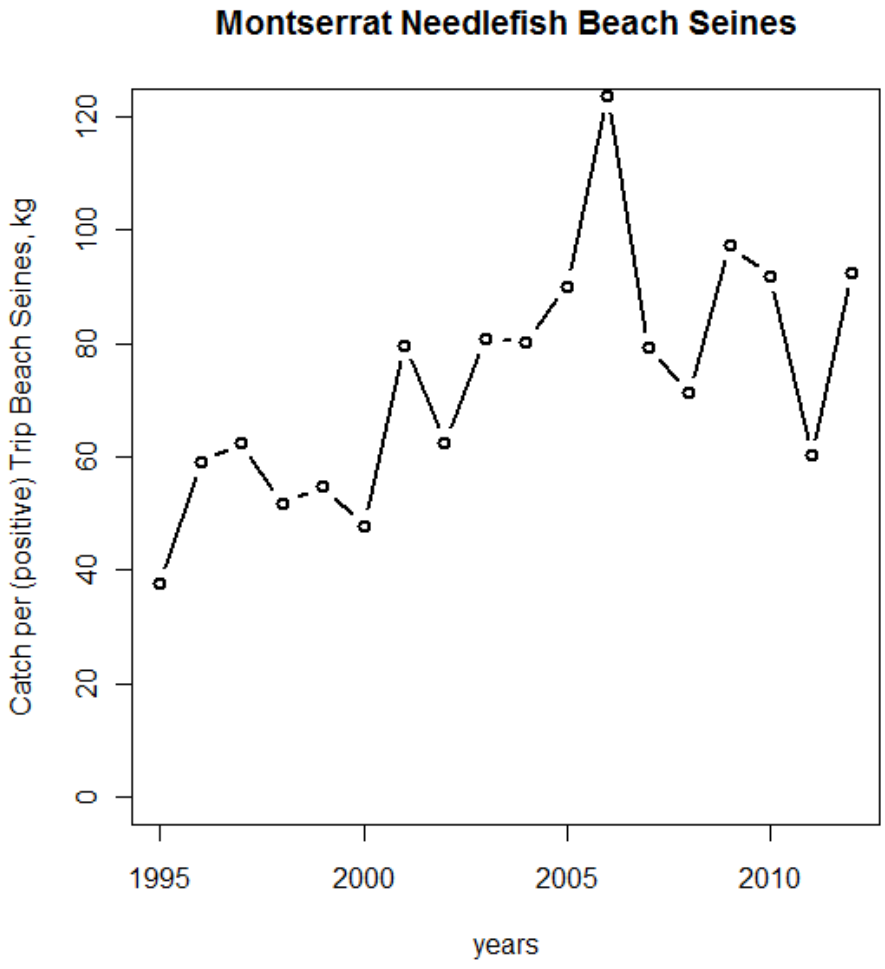


Figure 8: Catch rate of needlefish in beach seines (kg/trip) calculated for those trips landing needlefish.

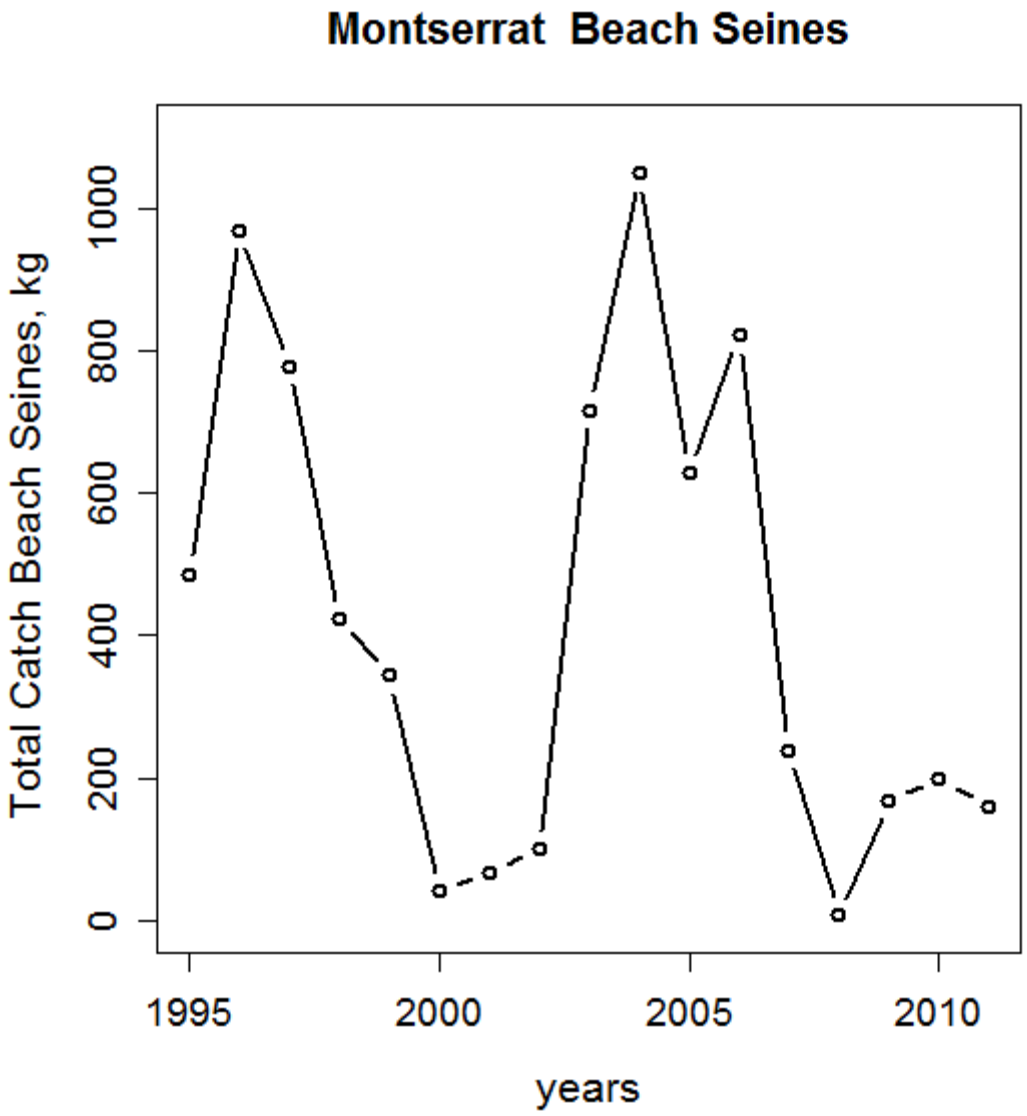


Figure 9: Total catch (kg) of needlefish in beach seines.

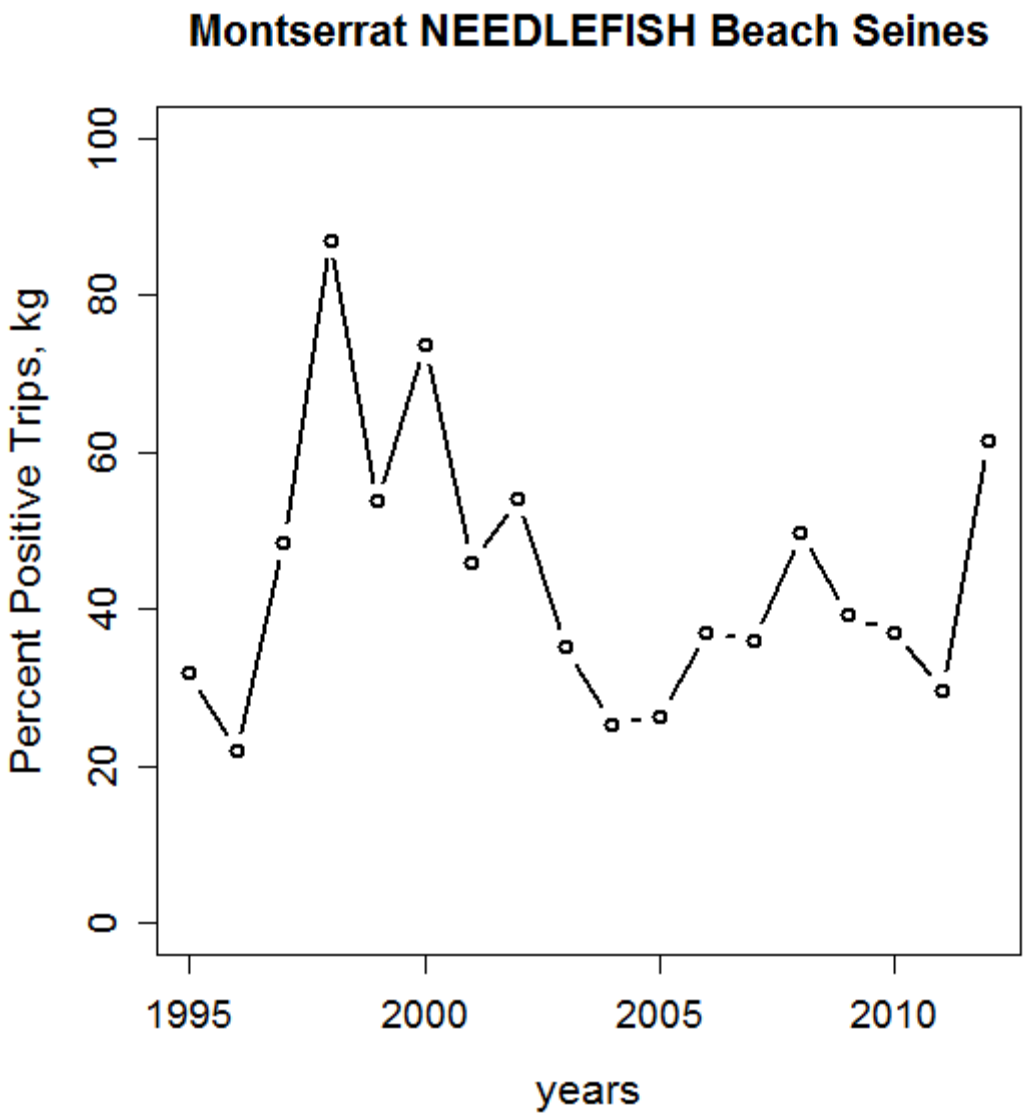


Figure 10: Percentage of beach seine trips catching needlefish.

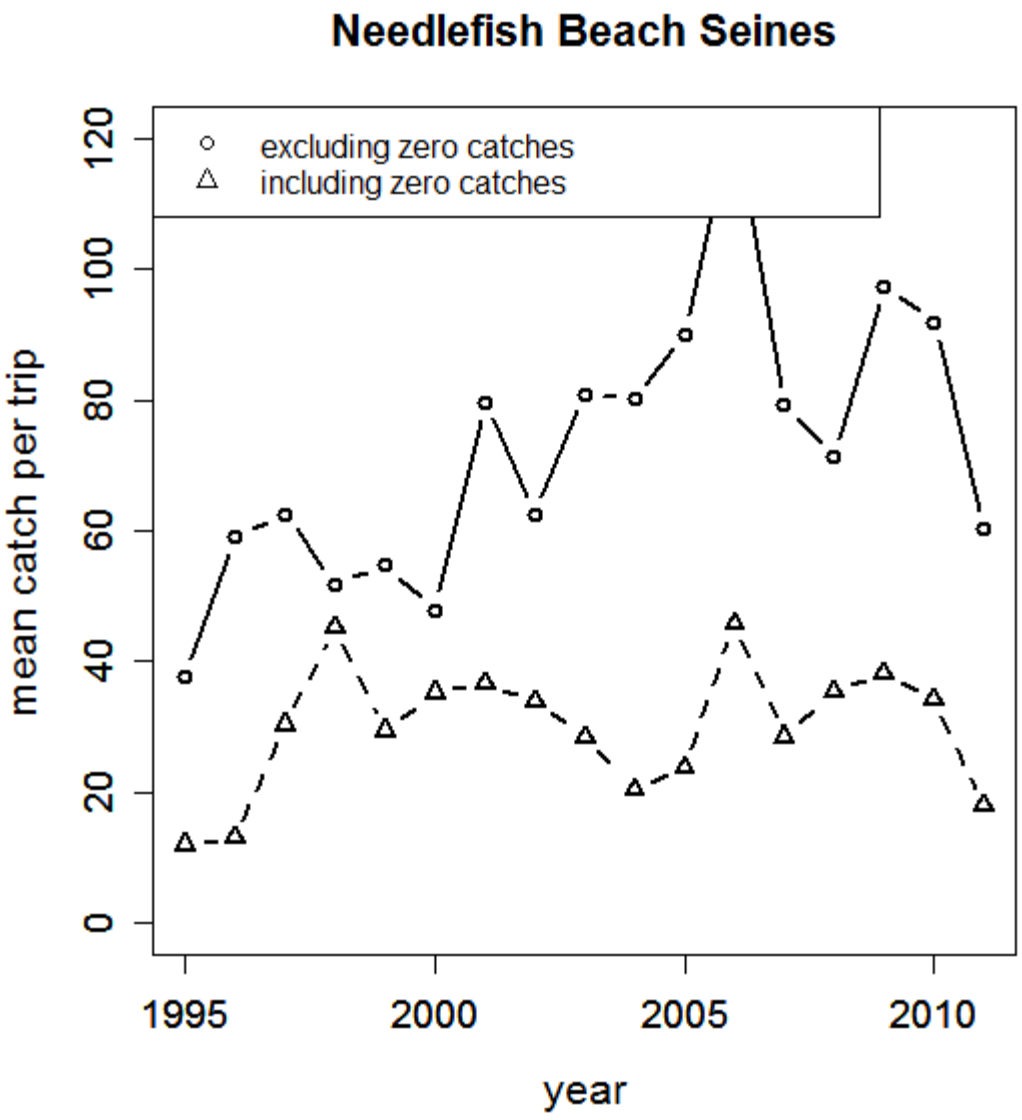


Figure 11: Comparison of two methods for calculating catch rate of needlefish in the Montserrat beach seine fishery.

3.1 Management Objectives

There are no special management objectives for needlefish or for the beach seine fishery. The general objectives are described in Section 1.1.

3.2 Status of Stock

Although no quantitative statements about stock status can be made at this time, the declining trend in effort in the beach seine fishery coupled with the increasing or stable catch rate of needlefish over time suggest that the stock is not in any danger.

3.3 Management Advice

This is one stock for which management could benefit greatly from additional analysis of the existing data. The lengthy time series (1995-2011, with more years available if the data are computerized) provides the opportunity in the future to conduct more complicated and robust statistical analyses of resource condition, e.g., via production model, CPUE standardizations, and other population models. This would enable managers to make changes to meet target (optimal) exploitation rates.

3.4 Statistics and Research Recommendations

Statistics and research recommendations for needlefish and for the beach seine fishery are as described in section 1.4.

4. Jamaica Reef Fishery

Five years of data (2005 – 2009) were available to the Working Group although there are more years of data in the CARIFIS database. Data were available on 11,000 trips and there were on average three species reported per trip. A summary of the species and species groups landed with the number of trips is given in Annex 3. Annex 4 gives the total weight of the observed landings by species or species group. Unfortunately, the Working Group did not have information on the proportion of the total landings that were represented in the observed trips. Hence, total effort and total catches are not known; therefore the data are used primarily to obtain catch rates.

As with the Montserrat data, the available data were collected by national scientists who sampled landings and compiled data on a trip level basis. Landings data include: date, landing site, landed weight by species, gear type and effort information. The data have been archived in the CARIFIS database format.

Most of the observed landings were from the South Coast (15,119 trips) and North Coast (111,026 trips), with 4,365 trips coming from the offshore bank. Location was not available for 2386 trips.

Doctorfish was landed in more trips than any other species (Annex 3). In terms of landed weight, doctorfish ranked eighth (Annex 4) behind conch, lobster, parrotfishes (aggregated species), Atlantic threadfin herring, stoplight parrotfish, grunts (aggregated species) and snappers (aggregated species). Furthermore, doctorfish is landed in each region, with the number of trips with landings of doctorfish being 15,119; 11,926 and 4,365 for the South Coast, North Coast and Offshore Bank, respectively. (There were 2386 trips landing doctorfish for which there is no recorded location.) Because doctorfish is so widely encountered, the Working Group decided to examine the data for this species for each of three regions.

4.1 Management Objectives

The Jamaica Draft National Fisheries Policy (2008) provides a framework for the formulation of management strategies designed to address the important issues, challenges and opportunities facing the industry including; globalization, trade expansion, economic efficiency, industry structure and governance, and food safety and quality. The main goals of the National Fisheries Policy are:

1. Improve contribution to economic growth and reduction of poverty;
2. Improve contribution to sustainable livelihood of Jamaicans through employment in fisheries and responsible fisheries management;
3. Improve fisheries contribution to National Food Security;

Its immediate objectives are:

4. Ensure sustainable development of the fisheries sector;
5. Promote efficiency of the fishing and aquaculture industry;
6. Promote economic and social development of fisheries sector;
7. Improve systems and procedures for the management of the fishing and aquaculture industry;
8. Promote partnerships with stakeholders in the management and development of capture fisheries and aquaculture, and ensure transparency and accountability in the governance of fisheries resources.

4.2 Status of Stocks

No statements can be made about the status of the stocks because the Working Group only had access to five years of data and these did not include the most recent years. Also, the Working Group did not have information on the fraction of the fishery that was sampled and thus could not raise observed landings and efforts to the totals. The analysis was therefore exploratory in nature.

4.3 Management Advice

Complete time series of sampled statistics (catch, effort) should be made available at next Annual Scientific Meeting for analyses to continue work conducted in 2012.

4.4 Statistics and Research Recommendations

4.4.1 Data Quality

- Aggregated species identifications limit the ability for single species assessments;
- Information is needed on sampling fractions (raising factors) so that total landings and total effort can be calculated;
- There are numerous missing locations in the database which should be investigated;
- When calculating catch rates, consideration of trips with zero catches may be influential;
- The entire times series of data (over all years) should be analyzed;
- Consideration should be made of the CARIFIS Data Server for Database Archival for facilitating data extraction and continuity in data retrieval across the Island.

4.4.2 Biological data collections

There is a fundamental need for biological data, especially size and age composition data.

4.5 Data Analysis Summary

The three main types of fishing gear used on the South Coast of Jamaica are China nets, pots (Z-traps) and handlines (Figure 12). The number of trips on the South Coast catching a given species is shown by gear type in Table 1. Unfortunately, the top seven categories are mixtures of species.

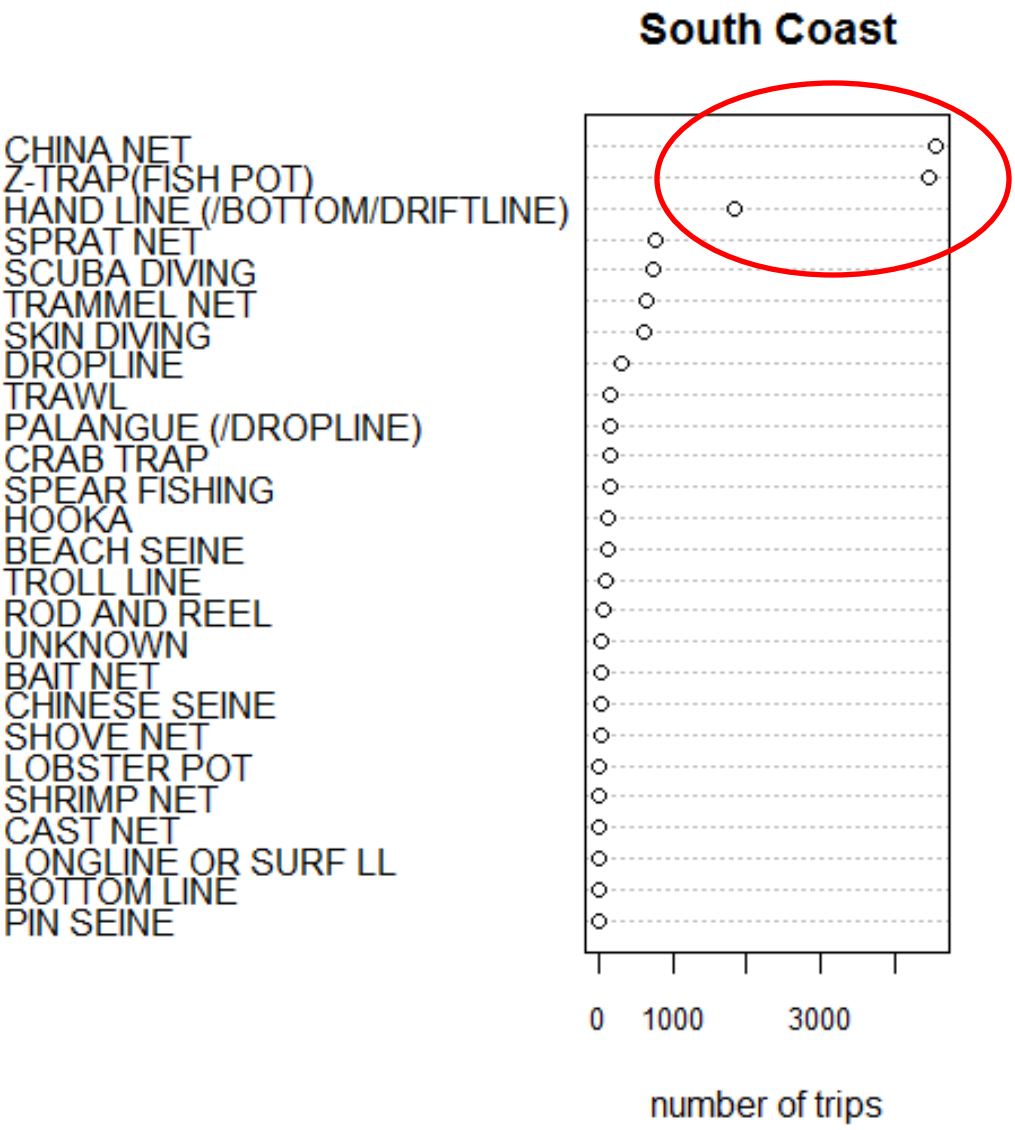


Figure 12: Use of various fishing gears on the South Coast of Jamaica, 2005-2009.

Table 1. Number of trips for each Species / Group in the three most common fishing gear categories, South Coast (2005-2009 combined).

Species/Group	Z-TRAP	CHINA NET	HAND LINE	TOTAL
UNKNOWN	408	357	75	840
SNAPPERS	208	386	104	698
GRUNTS	258	283	96	637
MOJARRAS	16	456	0	472
PARROTFISHES	317	103	16	436
JACKS	111	208	95	414
SQUIRRELFISHES	278	59	58	395
DOCTORFISH	**363**	**23**	**7**	**393**
SNAPPER, YELLOWTAIL	155	12	220	387
PENAEUS SCHMITTI	0	385	0	385
BARRACUDA, GREAT	43	100	96	239
LOBSTER, CARIB. SPINY	192	33	6	231
DRUMMER, GROUND	5	194	4	203
SNOOK, COMMON	4	190	5	199
SEA BREAM	26	164	8	198
MACKEREL, ATLANTIC	3	119	59	181
SNAPPER, RED	78	23	46	147
TUNA, BLACKFIN	14	17	115	146

The two main types of fishing gear used on the North Coast of Jamaica are pots (Z-traps) and handlines (Figure 13). The number of trips on the North Coast catching a given species is shown by gear type in Table 2. Much of the catch is not fully identified and, even when it is, interpretation of the data may be problematic. For example, redband parrotfish is commonly tallied but it is not clear what the total catch for this species may be because some of the fish tabulated as “parrotfishes” may be redband parrotfish.

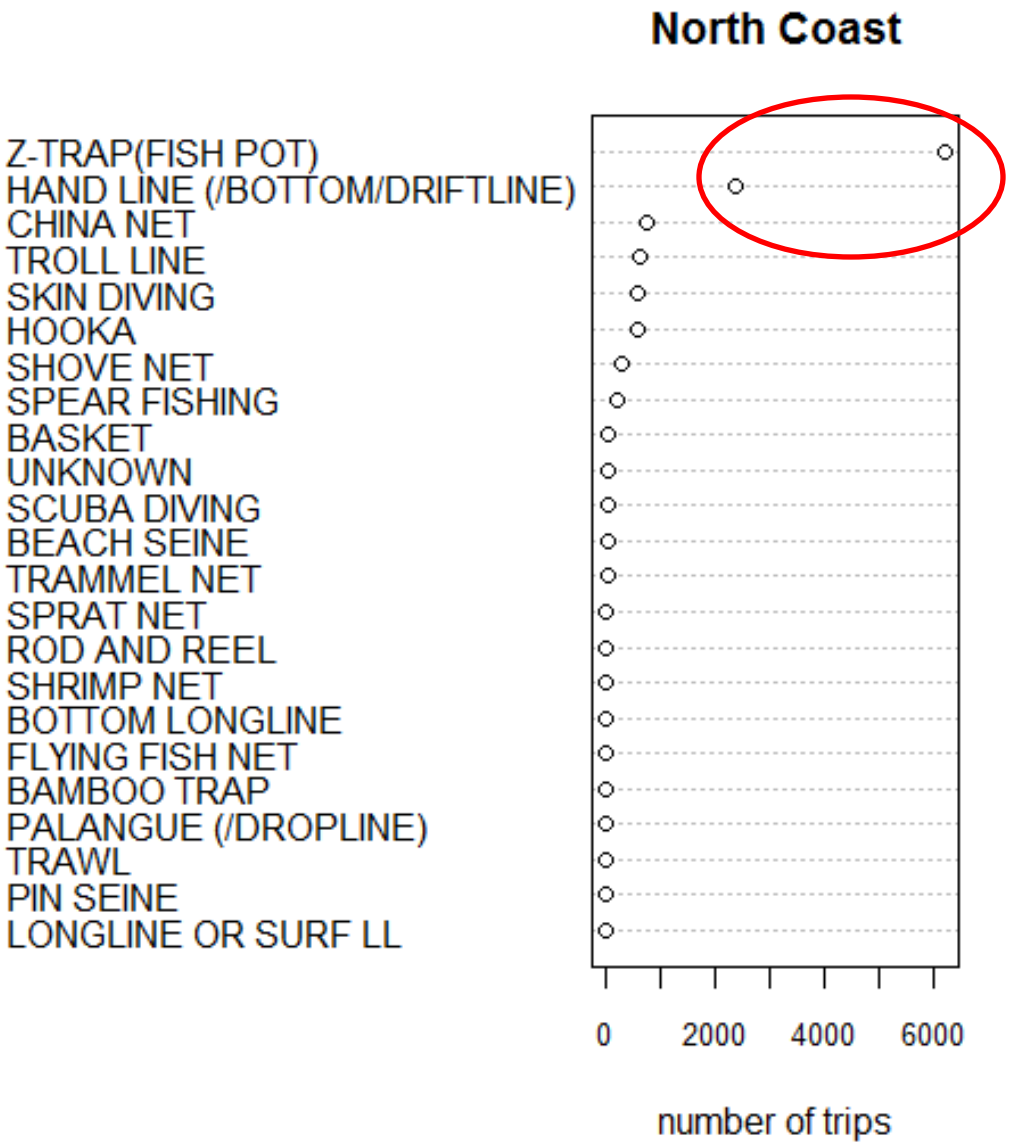


Figure 13: Use of various fishing gears on the North Coast of Jamaica, 2005-2009.

Table 2. Number of trips for each Species/Group in the three most common fishing gear categories, North Coast (2005-2009 combined).

Species/Group	Z-TRAP	CHINA NET	HAND LINE	TOTAL
DOCTORFISH	**884**	**41**	**16**	**941**
SQUIRRELFISHES	616	22	80	718
PARROTFISHES	569	40	36	645
PARROTFISH, REDBAND	360	20	17	397
MULLETS	9	42	296	347
JACKS	200	69	61	330
CRAYFISH	0	10	301	311
SNAPPER, YELLOWTAIL	244	8	41	293
GRUNTS	201	35	51	287
CONEY	211	7	68	286
SNAPPERS	178	32	66	276
PARROTFISH, STOPL.	230	25	8	263
MUDFISH	0	8	254	262
UNKNOWN	207	30	19	256
SNAPPER, DOG	190	12	14	216
LOBSTER, CARIB. SPINY	206	6	1	213
BARRACUDA, GREAT	66	11	114	191

The two main types of fishing gear used on the Offshore Bank of Jamaica are pots (Z-traps) and hookas (Figure 14). The number of trips on the Offshore Bank catching a given species is shown by gear type in Table 3. As with the other areas, there are problems with the catch not being fully identified.

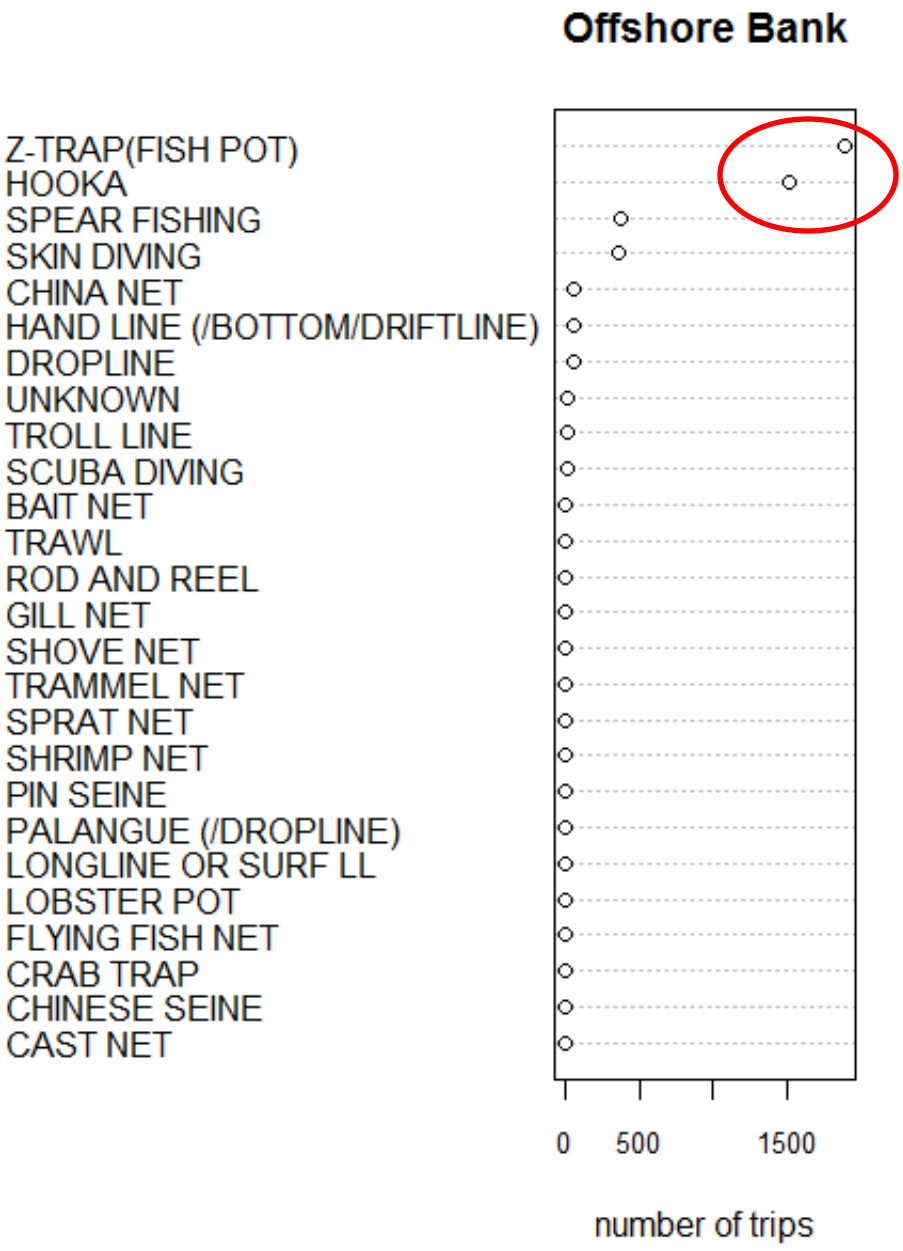


Figure 14: Use of various fishing gears on the Offshore Bank of Jamaica, 2005-2009.

Table3. Number of trips for each Species/Group in the three most common fishing gear categories, Offshore Bank (2005-2009 combined).

Species / group	Z-TRAP	HOOKA	SPEAR	TOTAL
CONCH, QUEEN	0	791	0	791
PARROTFISHES	169	103	66	338
DOCTORFISH	**205**	**48**	**48**	**301**
GRUNTS	182	74	33	289
UNKNOWN	166	53	36	255
SQUIRRELFISHES	137	33	16	186
LOBSTER, CARIB. SPINY	84	99	0	183
PARROTFISH, STOPLIGHT	78	95	5	178
GOATFISHES	106	5	10	121
TRIGGERFISH, QUEEN	72	30	7	109
LOBSTERS, SPINY	39	1	62	102
JACKS	74	21	5	100
SURGEON, OCEAN	76	6	3	85
SNAPPERS	50	16	8	74
PARROTFISH, REDBAND	46	16	11	73
BARRACUDA, GREAT	27	15	4	46
TRIGGERFISHES	33	8	4	45
BLUE TANG	30	5	7	42

5. Jamaican Reef Fishery - The Z-trap fishery for Doctorfish

5.1 Management Objectives

There are no special management objectives for doctorfish or for the Z-trap fishery sector. Overall management objectives are stated in section 4.1.

5.2 Status of Stocks

See section 4.2.

5.3 Management Advice

See section 4.3

5.4 Statistics and Research Recommendations

These are as given in section 4.4.

5.5 Data Analysis Summary

South Coast

The number of trips sampled each year was around 200 except in the most recent year (2009) when half that many trips were sampled (Figure 15). The percentage of trips landing doctorfish was around 40% in all five years (Figure 16). The trends in catch rate over time were very similar for positive trips for doctorfish and for all trips, except in the last year (2009) when the two indices diverged (Figure 17). Thus, it can make a difference whether or not trips with catches of zero doctorfish are included in the catch rate calculation. Overall, the observed landings of doctorfish declined steadily over the five year period (Figure 18). Because sampling fractions (the proportion of the total number of trips that were observed by port samplers) are unknown to the Working Group, it is not possible at this time to make a strong interpretation of the catch and the effort data; the conclusions about catch rate may be robust, however.

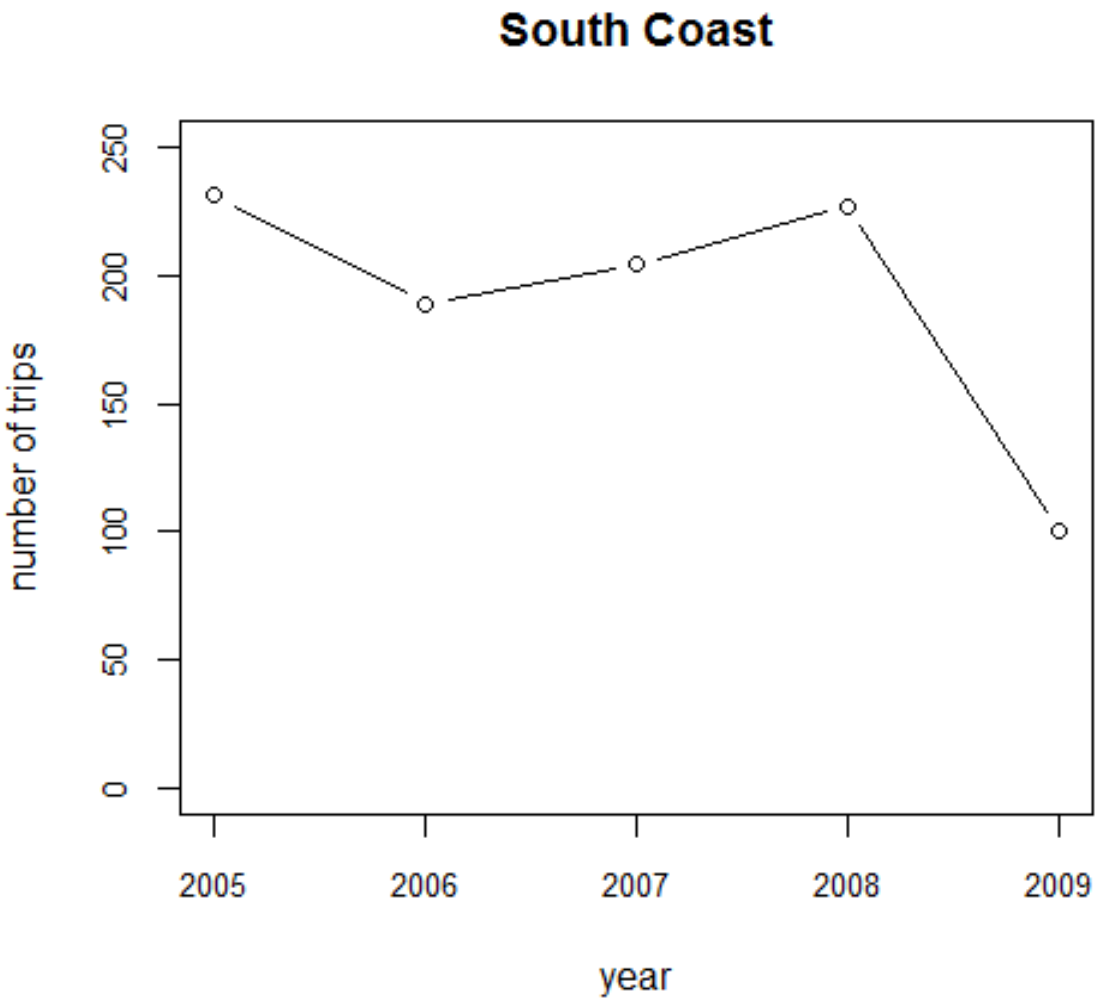


Figure 15: Number of trips sampled along the South Coast of Jamaica from 2005 through 2009.

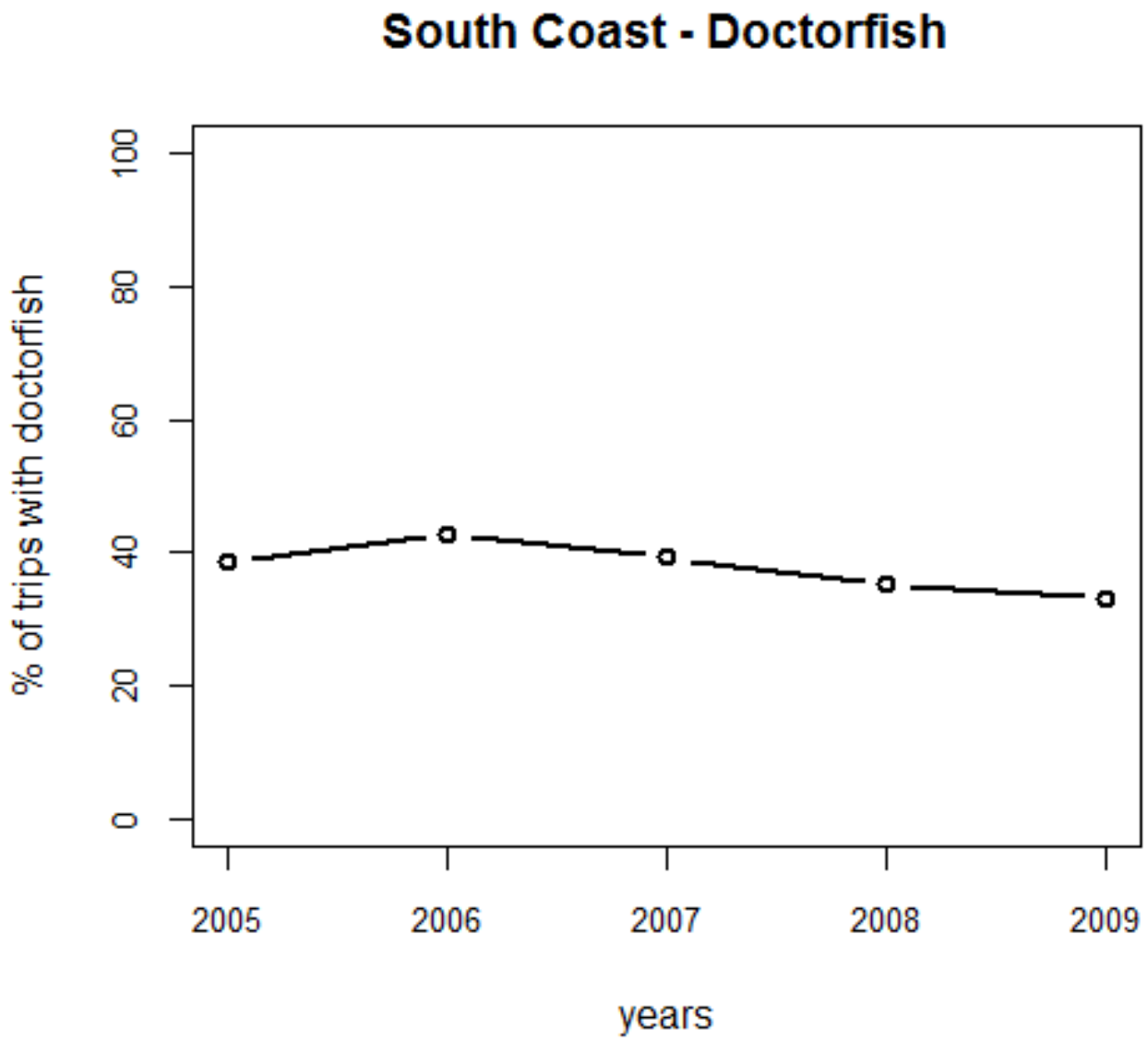


Figure 16: Percentage of positive trips for doctorfish, i.e., trips landing doctorfish, on the South Coast of Jamaica from 2005 to 2009.

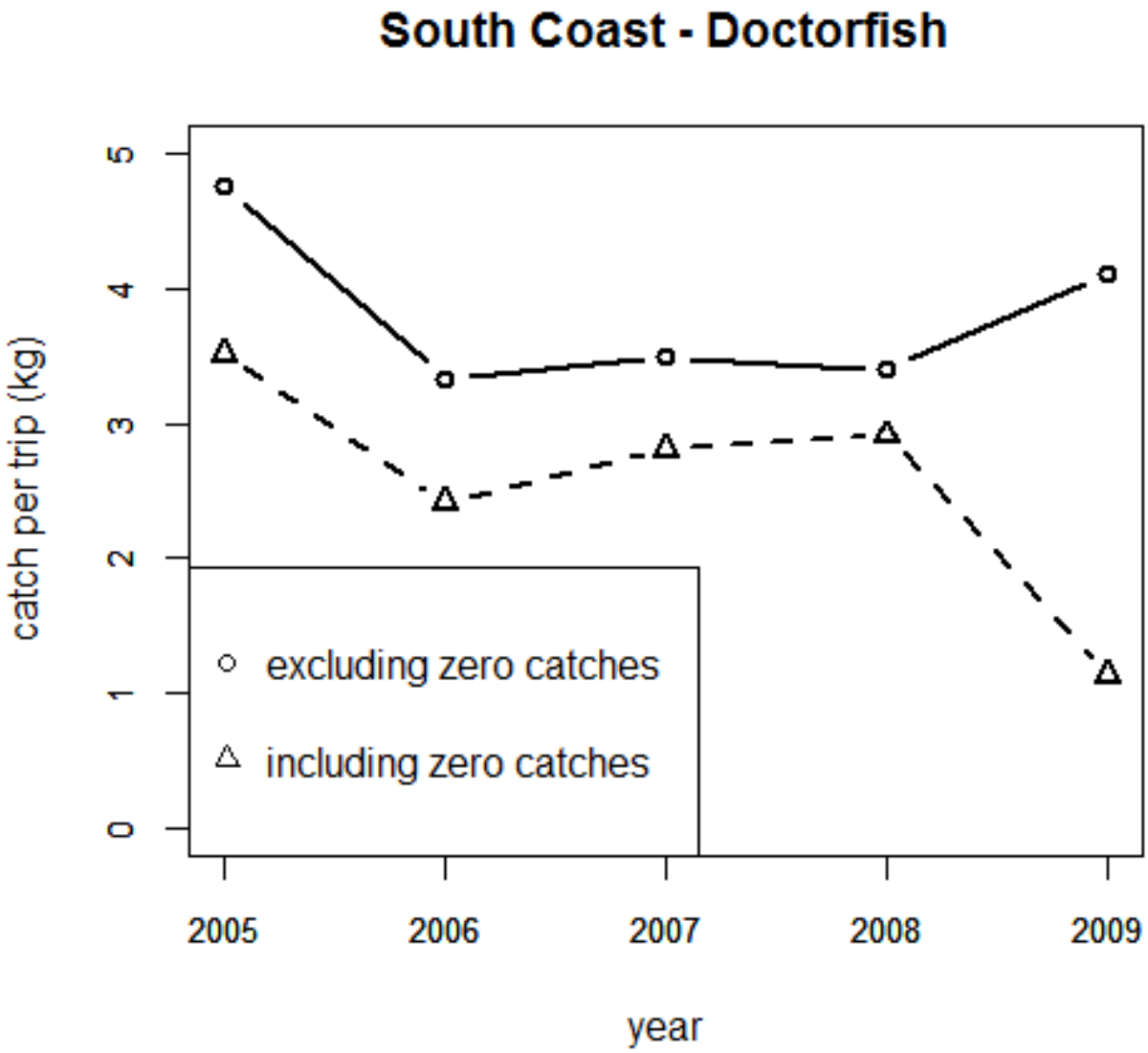


Figure 17: Comparison of two methods for calculating catch rate of doctorfish in the Jamaica Z-trap fishery on the South Coast.

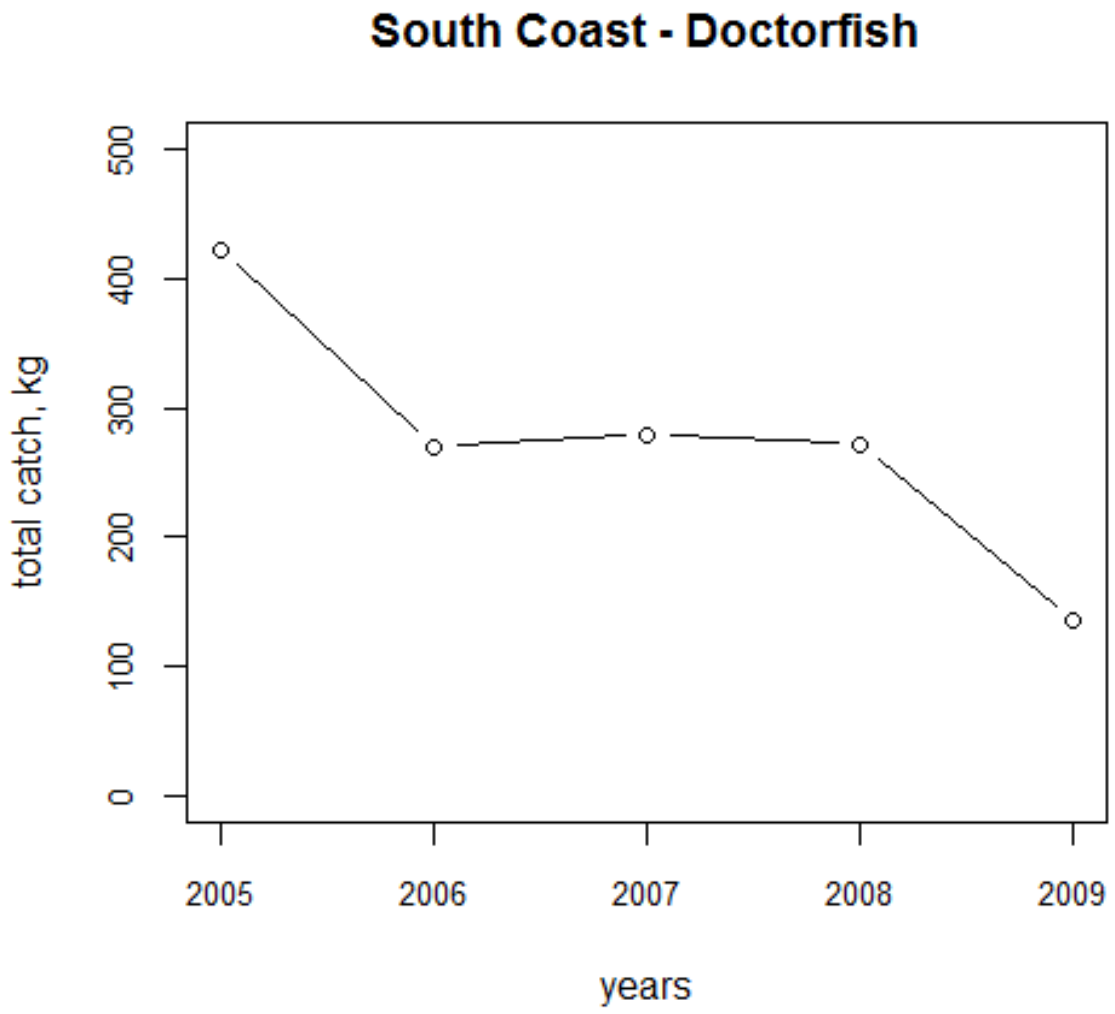


Figure 18: Total observed catch of doctorfish in the landings sampled on the South Coast of Jamaica from fishers using Z-traps.

North Coast

The number of trips sampled each year declined steadily over the time period 2005-2009 (Figure 19). The percentage of trips landing doctorfish declined slightly over the five years (Figure 20). The catch rate declined over time regardless of whether zero catches were included or excluded from the calculation (Figure 21). The observed landings of doctorfish declined sharply over the five year period (Figure 22). Because sampling fractions (the proportion of the total number of trips that were observed by port samplers) are unknown to the Working Group, it is not possible at this time to make a strong interpretation of the catch and the effort data; the conclusions about catch rate may be robust, however, and suggest catch rates should be examined for more years and for more species to see if there is evidence of sustained decline.

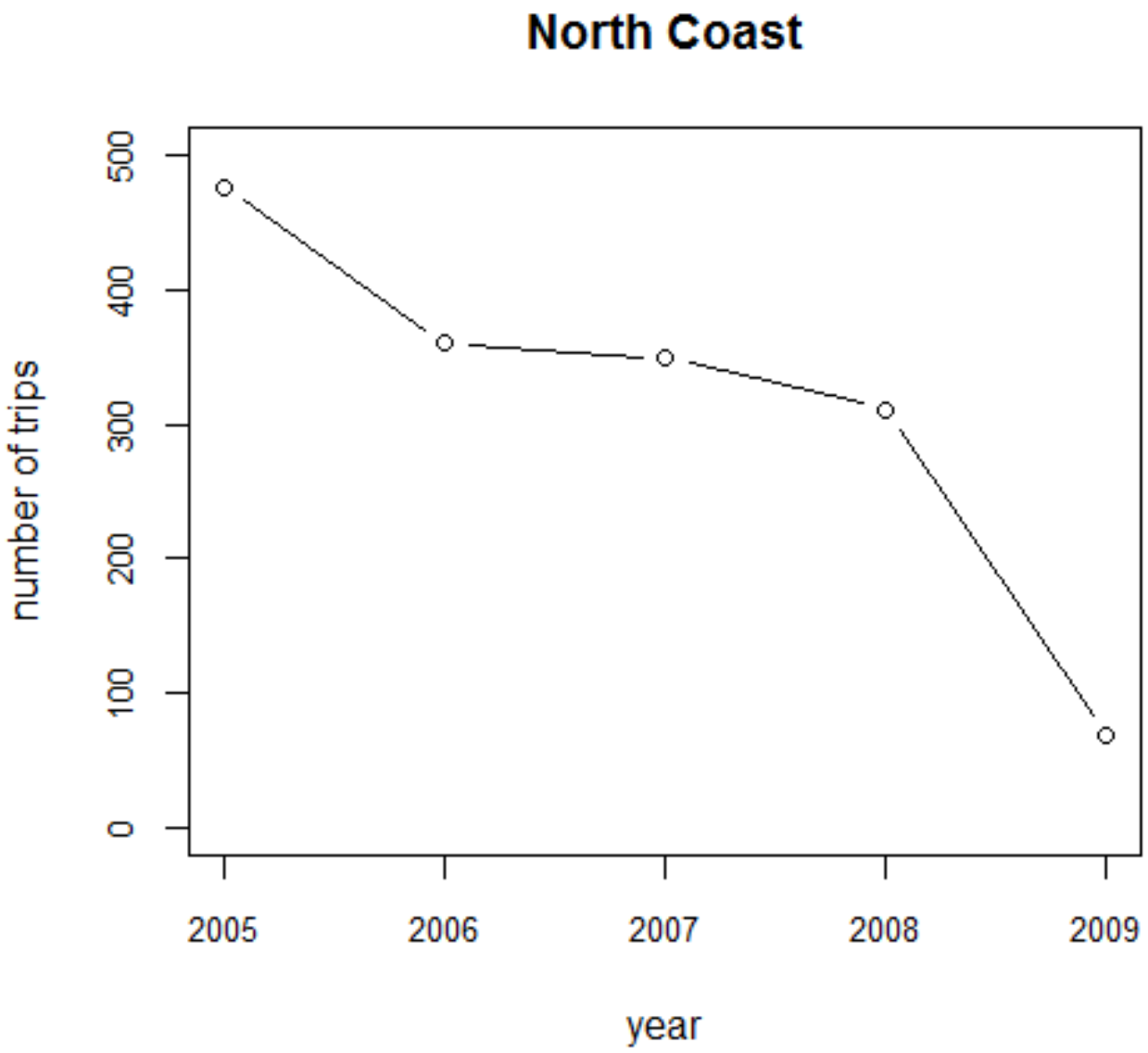


Figure 19: Number of trips sampled along the North Coast of Jamaica from 2005 through 2009.

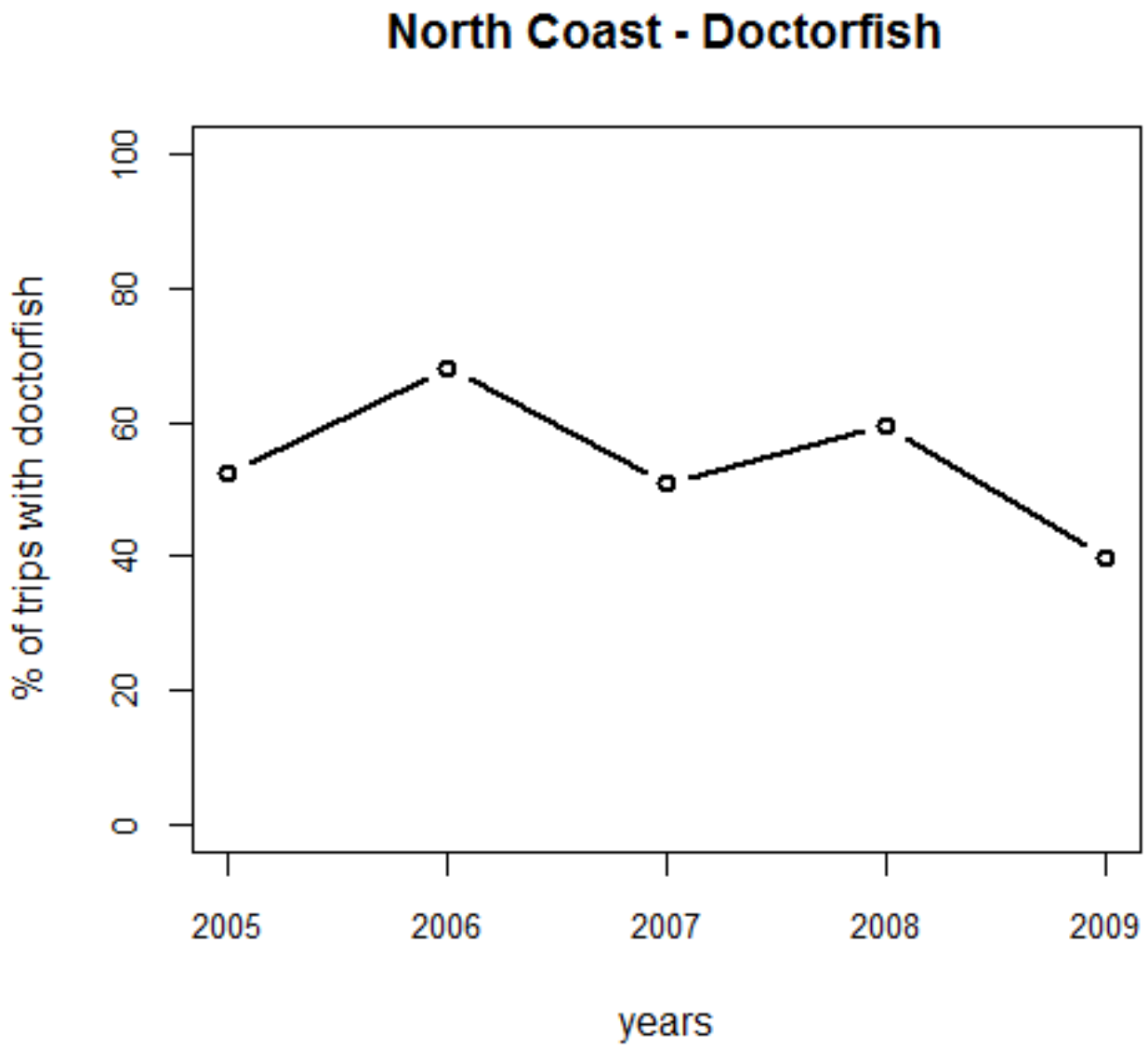


Figure 20. Percentage of positive trips for doctorfish, i.e., trips landing doctorfish, on the North Coast of Jamaica from 2005 to 2009.

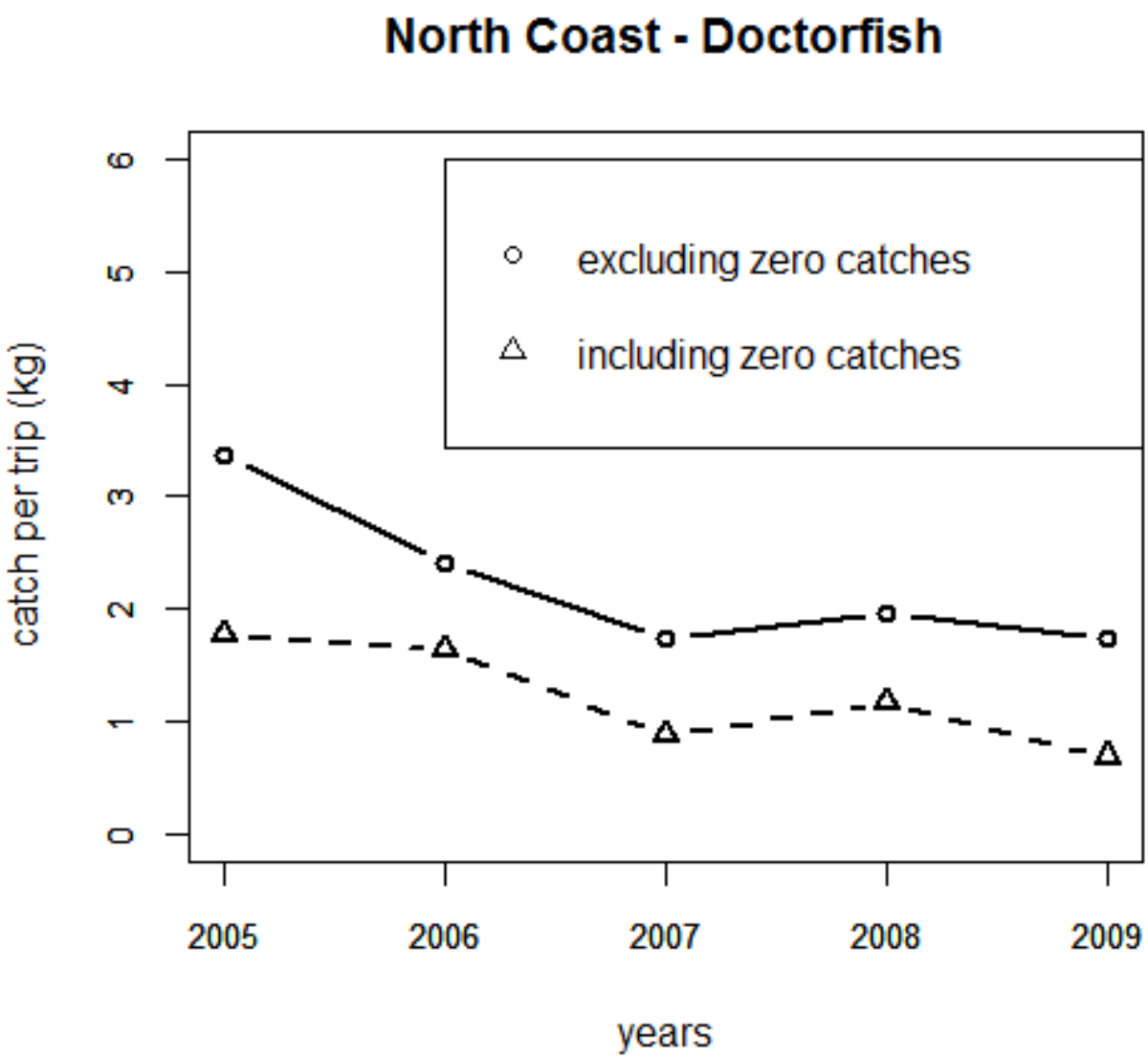


Figure 21: Comparison of two methods for calculating catch rate of doctorfish in the Jamaica Z-trap fishery on the North Coast.

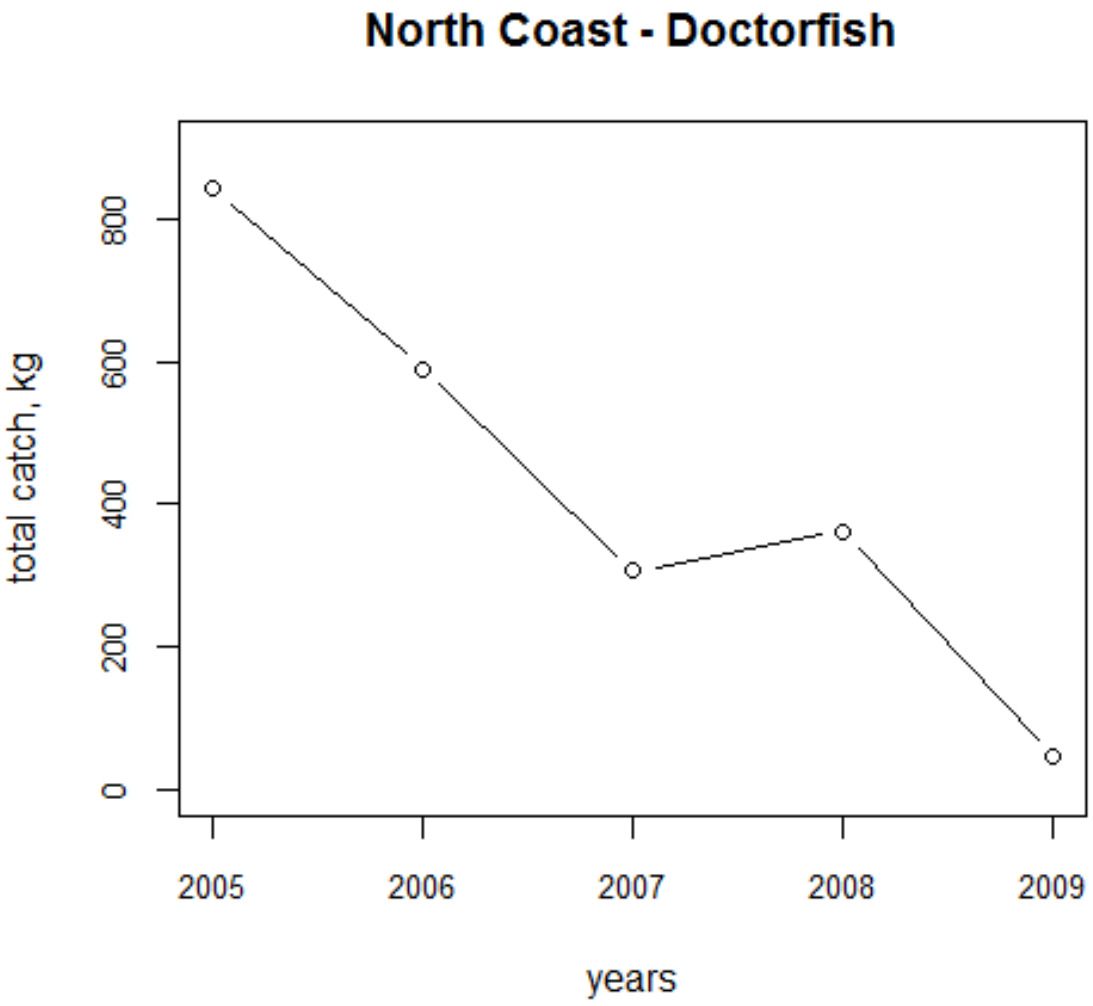


Figure 2: Total observed catch of doctorfish in the landings sampled on the North Coast of Jamaica from fishers using Z-traps.

Offshore Bank

The number of trips sampled each year fluctuated without trend over the five years (Figure 23). The percentage of trips landing doctorfish increased steadily from 40% to 80% (Figure 24). The trends in catch rate over time differed for positive trips for doctorfish and for all trips (Figure 25). In the former case, the catch rates were lower in 2007, 2008 and 2009 than they were in 2005 and 2006; in the latter case the catch rates did not show a clear trend over time. Thus, it can make a difference whether or not trips with catches of zero doctorfish are included in the catch rate calculation. Overall, the observed landings of doctorfish varied without trend over the five year period (Figure 26). Because sampling fractions (the proportion of the total number of trips that were observed by port samplers) are unknown to the Working Group, it is not possible at this time to make a strong interpretation of the catch and the effort data; the conclusions about catch rate depend on the method of calculation.

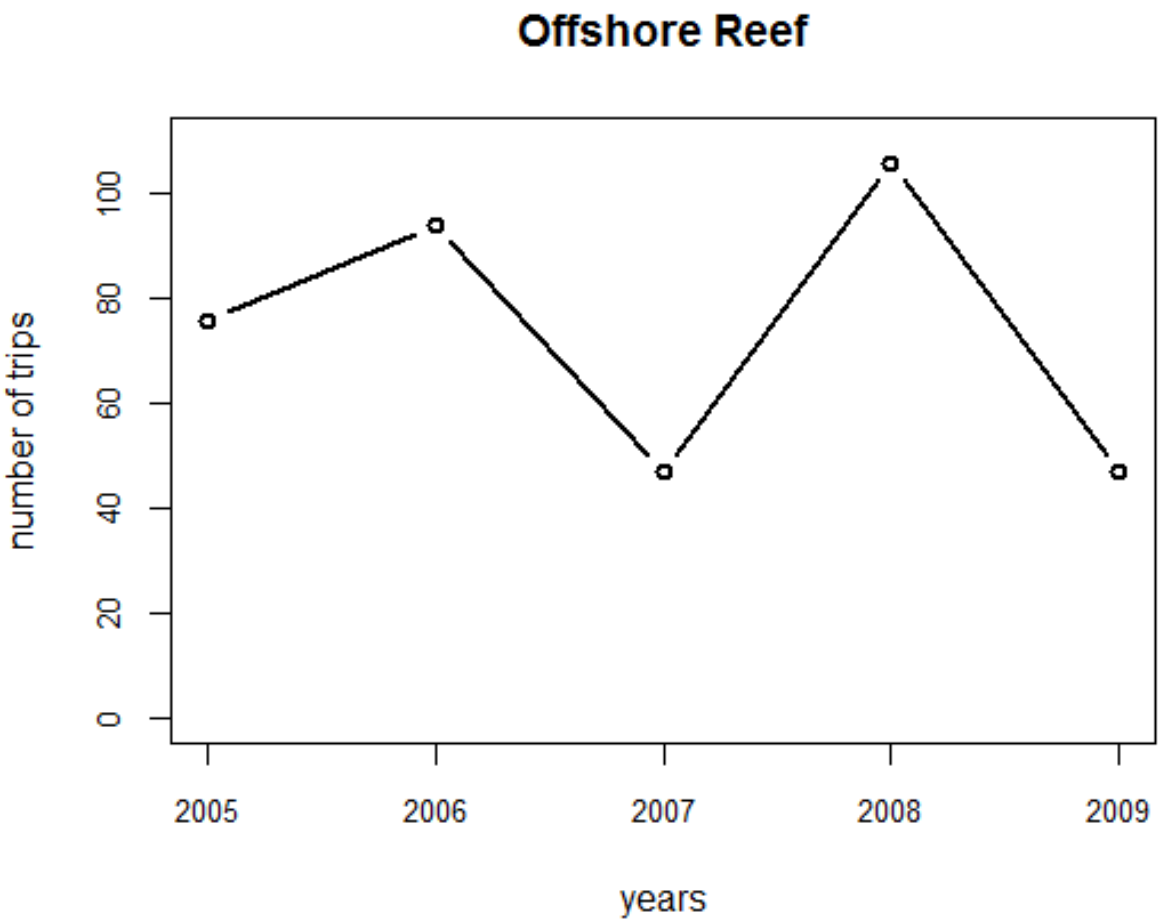


Figure 23: Number of trips sampled from the Offshore Bank of Jamaica from 2005 through 2009.

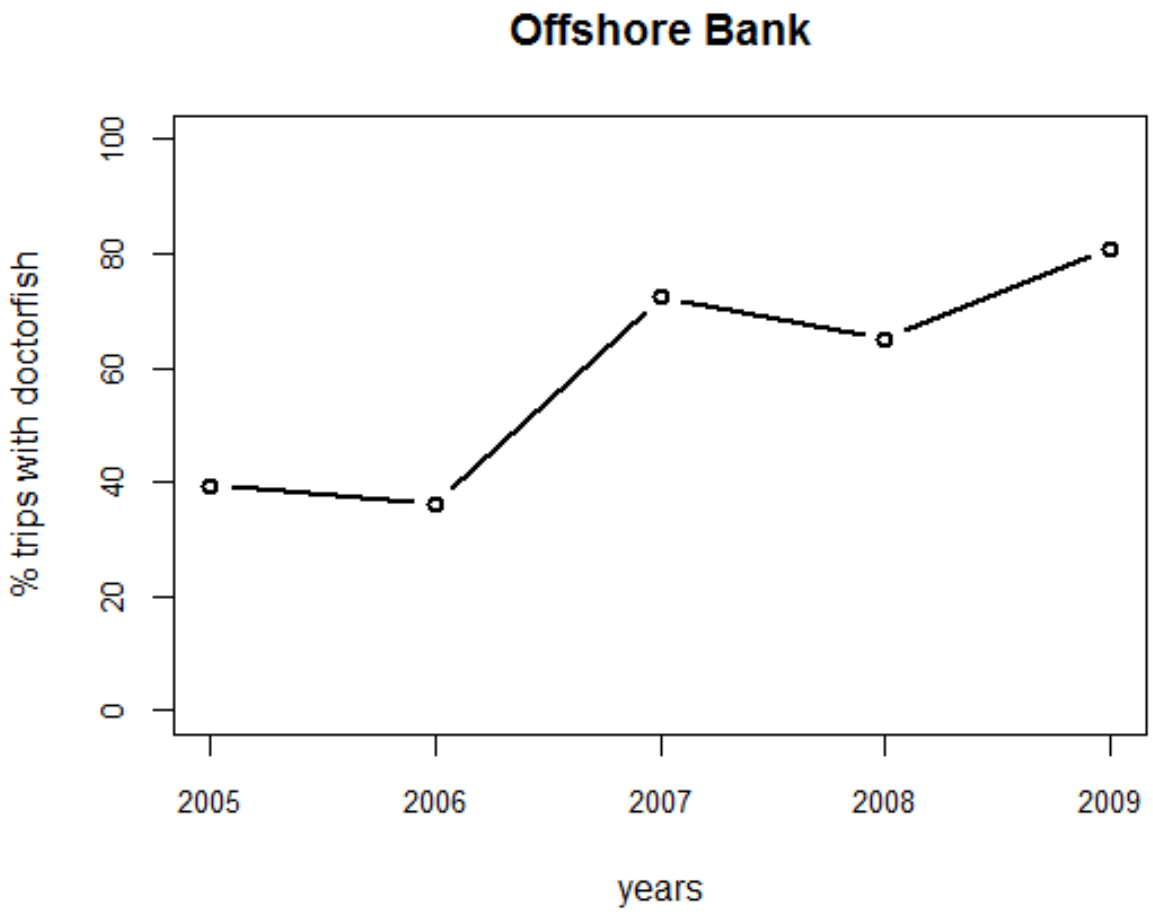


Figure 24: Percentage of positive trips for doctorfish, i.e., trips landing doctorfish, on the Offshore Bank of Jamaica from 2005 to 2009.

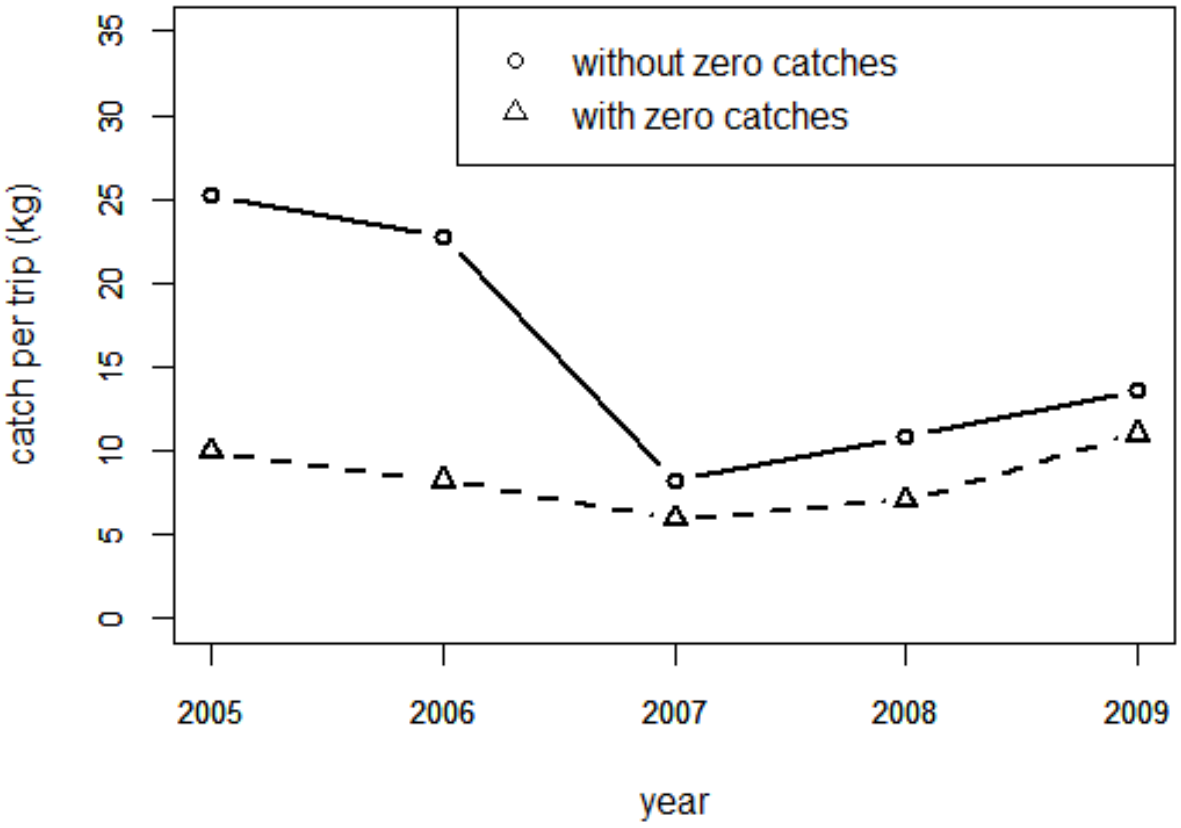


Figure 25: Comparison of two methods for calculating catch rate of doctorfish in the Jamaica Z-trap fishery on the Offshore Bank.

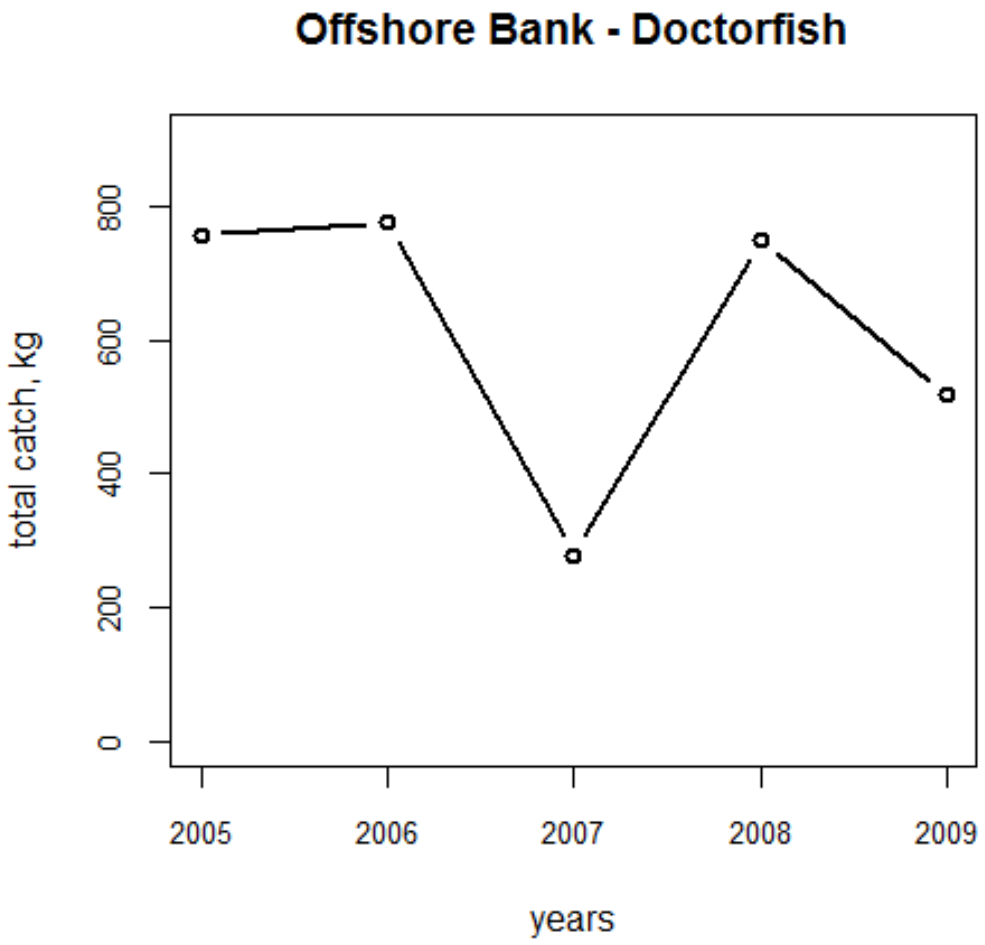


Figure 26: Total observed catch of doctorfish in the landings sampled from the Offshore Bank of Jamaica from fishers using Z-traps.

Discussion

General Issues and Recommendations

- The Working Group recommends CRFM national scientists consider parallel analyses of more CARIFIS databases to promote efficiency, provide mutual support, and benefit from common lessons.

- Attention should be given to improving access to data and to data quality control

    - All fisheries data should be electronically backed up nationally on the countries' servers and a copy backed up on the CRFM server.
    - Fisheries data quality control programs should be developed both at a national and regional level
    - A review of the national fisheries data collection systems should be conducted
    - Training will improve data quality and promote better use of a database
    - It is vital to extend the length of the time series of data by computerizing historic records

- Review and update CARIFIS data base to include other species (lion fish) and section in the data base. Also, the current landings data collection form should be modified to account for discards, spatial area of catch, quantity and type of gear used.

- In both Jamaica and Montserrat, there is a need to improve the level of identification of the catch to the species level wherever possible.

- In both Jamaica and Montserrat, habitat mapping for the coastal zones of Jamaica and Montserrat would be helpful.

- The Working Group believes it is important to establish routine biological sampling surveys for all fisheries to gather information on size composition and possibly on age composition

- There is a great need and a great opportunity to study lionfish

Fish production, including that of lionfish, depends on the species' intrinsic maximum growth rate and the carrying capacity of the environment. We can measure the maximum growth rate directly when the population size is low; we can measure carrying capacity by noting how growth slows as the population grows. Thus, it is important to institute monitoring programs now to capitalize on the opportunity to measure the critical vital rates. This will afford scientists and managers opportunities to devise and evaluate possible control strategies. In terms of directing fishing effort towards an invasive species as a means of controlling the impact of the species on the ecosystem, there are several factors that govern the efficacy of this approach. First, the species should have commercial value so that there is an incentive for fishers to target the species. However, as the stock declines, fishers lose incentive to target the species. Therefore, a second factor is that there should be non-density-dependent fishing mortality. This can occur if the species is taken as bycatch in other fisheries, e.g., lionfish are caught in lobster traps. Thus, lobster fishers will maintain fishing pressure on lionfish even if lionfish abundance declines. Another mechanism generating non-density-dependent fishing mortality can be exploitation by recreational fishers and divers who can be directed to kill all lionfish encountered. A third factor controlling the success of lionfish reduction efforts is the size at which the fish are caught. Very small lionfish may not have commercial value so some mechanism for promoting the killing/harvest of small lionfish may have to be devised.

The Working Group recommends a thorough review of lionfish plans in the intersession and coordination of efforts to enhance plans.

<u>Biological data collection</u>

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

1. Catch length frequency sampling should be implemented during the 2012 / 2013 period and continued as an ongoing data collection priority;
2. Routine biological data collections (length / weight, maturity, ageing), should be implemented. Species to be studied should be identified during the 2012 / 2013 inter-sessional period and should be based on examinations of the landings data. Attention should be given to prioritization of species at both the national and the regional level;
3. 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;
4. Conduct a literature search at the national and regional level to document information on growth, mortality, spawning, maturation, fecundity.
5. Obtain all research reports conducted in the marine environment of Montserrat prior to and during ongoing volcanic activity.

Annex 1. Number of sampled trips by species for the Montserrat fishery, 1995-2012 (first quarter) combined. Results are given for the three most abundant gear types and for all gear types shown in Figure 1 combined.

SPECIES	Beach Seines	Lines	Pots	All 3 Gears
HIND, RED	110	284	4399	4793
BLUE TANG	107	30	4301	4438
BUTTERFISH	126	119	4144	4389
SQUIRRELFISH, LONGJAW	92	129	3960	4181
TRIGGERFISH, QUEEN	86	78	3946	4110
DOCTORFISH	112	37	3713	3862
COWFISH, HONEYCOMB	59	22	3098	3179
NEEDLEFISHES	2425	14	286	2725
ROCK BEAUTY	21	7	1938	1966
GOATFISHES	55	14	1875	1944
GRUNT, FRENCH	37	11	1883	1931
UNKNOWN	291	547	526	1364
PARROTFISH, STOPLIGHT	38	13	1202	1253
SNAPPER, SILK	27	550	616	1193
GRUNT, CAESAR	11	17	1097	1125
SNAPPER, RED	34	493	556	1083
PARROTFISH, BLUE	19	7	964	990
SURGEON, OCEAN	20	1	905	926
FILEFISH, SCRAWLED	17	1	729	747
BALLYHOO	680	5	51	736
LOBSTER, CARIB. SPINY	19	2	635	656
HIND, ROCK	17	20	603	640
GRUNTS	21	7	600	628

Annex 2. Number of trips, landed weight, and mean weight per positive trip for the major species in the Montserrat fishery, 1995 – 2012 (first quarter), for all gear types combined.

Species	Number trips	Landed_weight (kg)	Mean weight per positive trip(kg)
HIND, RED	**4873**	**41067**	**8**
BLUE TANG	4528	21308	5
CONEY	4241	12824	3
LONGJAW SQUIRRELFISH	4233	21999	5
TRIGGERFISH,QUEEN	4184	27580	7
DOCTORFISH	3939	19481	5
COWFISH, HONEYCOMB	3222	18919	6
NEEDLEFISHES	**2690**	**166852**	**62**
ROCK BEAUTY	1982	3359	2
GOATFISHES	1966	4653	2
GRUNT, FRENCH	1959	5231	3
UNKNOWN	1441	0	0
PARROTFISH, STOPLIGHT	1359	4596	3
SNAPPER, SILK	1204	9607	8
GRUNT, CAESAR	1178	2995	3
SNAPPER, RED	1098	9883	9
PARROTFISH, BLUE	1044	2946	3
SURGEON, OCEAN	945	3339	4
FILEFISH, SCRAWLED	762	2627	3
BALLYHOO	737	24813	34
HIND, ROCK	711	2720	4
LOBSTER, CARIB. SPINY	693	2840	4
GRUNTS	637	1496	2

Annex 3. Summary of the number of trips in Jamaica landing each species or species group, 2005 – 2009. Just the 13 most commonly encountered species are listed.

UNKNOWN	2390
DOCTORFISH	1986
PARROTFISHES	1829
SQUIRRELFISHES	1654
GRUNTS	1569
SNAPPERS	1451
LOBSTER, CARIB. SPINY	1249
JACKS	1101
CONCH, QUEEN	897
SNAPPER, YELLOWTAIL	831
BARRACUDA, GREAT	740
PARROTFISH, REDBAND	722
PARROTFISH, STOPLIGHT	684

Annex 4. Total weight of observed landings in kg by major species/species groups. Data are from 2005 - 2009 combined.

CONCH, QUEEN	545,426
LOBSTER, CARIB. SPINY	45,103
PARROTFISHES	44,082
HERRING, ATL THREAD	24,444
PARROTFISH, STOPLIGHT	23,926
GRUNTS	13,444
SNAPPERS	11,444
DOCTORFISH	10,089
ANCHOVIES	9,996
SNAPPER, YELLOWTAIL	8,691
HOGFISH	7,445
JACKS	6,723
CRAB, BLUE	6,272
SQUIRRELFISHES	6,111
PARROTFISH, REDBAND	5,647
BARRACUDA, GREAT	5,239
TUNA, BLACKFIN	5,115
MOJARRAS	4,850

Appendix 6: Report of the Shrimp and Groundfish Resource Working Group (SGWG)

Chairperson: Zojindra Arjune, Suriname
Rapporteurs: Rabani Gajnabi, Guyana (Shrimp)
Zojindra Arjune, Suriname (shrimp)
Consultant: Paul Medley (Fisheries Consultant, UK)

A. OVERVIEW

1. Report of Work Progress since the last Meeting

At the 8th CRFM Scientific Meeting in 2012, Guyana and Suriname each conducted a separate assessment for the seabob (*Xiphopenaeus kroyeri*) using data from their respective national fleets. Trinidad and Tobago did not participate in the SGWG in 2012. The following summarizes the progress of work by the two countries since their last meeting, respectively from 2009 for Guyana and 2011 for Suriname. The SGWG did not meet at the 2010 Sixth Annual Meeting.

Guyana

Although Guyana was not represented at the 2011 meeting, data was obtained from the two processing plants in Guyana, Noble House and BEV. The data from Noble house was collected through a program which was initiated by the company in 2007 and which includes the collection of biological data, including size composition, maturity, as well as landings and fishing effort. BEV provided similar data going back to 2005. Both companies and the Fisheries Department participate in the data collection program.

The Department of Fisheries in Guyana also obtained new rainfall and river outflow data for the period 1980 to 2010, which were obtained from the Hydro-meteorological Department of the Ministry of Agriculture, Guyana.

Suriname

The Fisheries Department in Suriname obtained landings by size category and effort data from the two seabob processing companies, namely Heiploeg Suriname (previously Guiana Seafoods), and Namoona. Landings data (peeled weight in pounds) by size category for 1997 to 2011 were obtained from Heiploeg Suriname with days at sea for 2001 to 2011, and landings data (live weight in kilogrammes) by size category for 1999 to 2011 were obtained from Namoona with days at sea for 2003 to 2011. Recent biological data collected by Heiploeg Suriname has also been made available to the Fisheries Department. The catch and effort data series has been extended as far back as 1989 for the seabob fishery.

Given the downward trend in deep sea shrimp trawling and concerns raised about future depletion of important stocks including the seabob, the government continues to sharpen its policy towards sustainable fisheries as described in the fisheries policy document ("White Paper for the Subsector Fisheries, 2012-2016"). Previous stock assessment and the development and implementation of a harvest control rule (HCR) for the seabob industry fit well into this policy.

In 2008, the Suriname seabob industry, particularly the Heiploeg Group, initiated the MSC certification process (www.msc.org), which was supported by the government (Ministry of Agriculture, Animal Husbandry and Fisheries) by the establishment of a special seabob working group which is a management

advisory group comprising the Government of Suriname, the two seabob processing companies, the NGO World Wildlife Fund (WWF) and other relevant stakeholders. The HCR is being reviewed monthly to monitor the status of the fishery using data provided by the seabob processing companies. The MSC certification was successfully obtained in November 2011.

Concerning the estimation of the artisanal catch, a survey was planned in 2011 for different species relevant to this subsector. Execution of this larger survey has been delayed and therefore it was decided to conduct a separate survey for the artisanal seabob fishery. This should be completed in 2012, based on information from the seabob buyers or by sampling the artisanal landings.

If it can be verified that the artisanal landings are insignificant then no further monitoring of this component of the fishery will be required in the long term. If estimates suggest these catches are significant, a time series of estimated catches needs to be developed for inclusion in the assessment.

2. Report on Relevant Activities/Plans of Other International Fisheries Organizations.

CLME / FAO

The project 'Sustainable Management of the Shared Living Marine Resources of the Caribbean Large Marine Ecosystem (CLME) and Adjacent Regions' is a regional project financed by the Global Environmental Fund (GEF). Part of this project is a 'Case Study for the Shared Stocks of the Shrimp and Groundfish Fishery of the Guianas-Brazil Shelf'. The implementation lies with the Food and Agriculture Organization of the United Nations, FAO, the Fisheries and Aquaculture Division. Regional organisations participating in the project include the Caribbean Natural Resource Institute (CANARI), the 'Centre for Resource Management and Environmental Studies, (CERMES) and the Caribbean Regional Fisheries Mechanism, (CRFM)'. The main purpose is to acquire the unknown data for a Transboundary Diagnostic Analyses (TDA), which should serve as a base for a Strategic Action Plan (SAP). The Ecosystem Approach to Fisheries (EAF) will be applied in the management of the shrimp and bottom trawl fishery.

Furthermore it is necessary to improve management practices at the national and regional levels to optimise the benefits from the fisheries resources. There are indications of overfishing of shrimp and groundfish resources and the influence of human activities on coastal areas. However, little is known of the effects of climate change. Countries taking part in the "Case Study on the Shared Stocks of the Shrimp and Groundfish Fishery of the Guianas – Brazil Shelf", include Trinidad and Tobago, Venezuela, Guyana, Suriname, French-Guyana and Brazil.

ACP Fish II

In accordance with the Regional Action Plan of the ACP Fish 2 program the project "Support to formulate fisheries management plans for Guyana, Suriname and Trinidad and Tobago" was approved and launched in May of this year. The next Program Monitoring Workshop is planned for October in Suriname.

3. Tasks to be Addressed at 2012 Meeting.

Guyana and Suriname

- Evaluate the available data particularly for Guyana for stock assessment.
- Updated assessments of Atlantic seabob (*Xiphopenaeus kroyeri*) are to be conducted for Guyana and Suriname separately as well as jointly.
- Brief introduction to stock assessment modelling.

- Effect of river outflow / rainfall on productivity is to be examined.
- Examine available size composition data for stock assessment purposes.

4. Relevant Policy / Management Objectives, Fishery Characteristics / Trends and Available Data for Fishery Analyses / Assessments Identified at (3).

Guyana

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

Since 2011, the Guyana Fisheries Department has negotiated a capacity reduction of 20% of vessels that are targeting seabob. The Department of Fisheries, Ministry of Health Veterinary Public Health Unit, trawler operators and seafood processors are meeting regularly to discuss IUU fishing and MSC certification. There are new measures in place to reduce opportunities to fish illegally due to the implementation of a catch documentation scheme for exports to the EU.

Suriname

The Government of Suriname intends to continue monitoring and improving the sustainability of the seabob fishery, specifically the HCR and the effectiveness thereof. Other management measures include the institutionalisation of the seabob working group to improve collection and transfer of the required data, collaboration among stakeholders and annual review and, if necessary adjustment of the management plan.

Research on the effect of the seabob trawl fishery on the ecosystem including other stocks and species in particular the longnose stingray (*Dasyatis guttata*) and the smooth butterfly ray (*Gymnura micrura*), is also of importance within the management plan.

Available Data for Assessments

Guyana

- Data received from two of the four seabob processing companies were considered complete. The other two companies failed to provide good quality data and hence the data submitted were used only for estimating total catch.
- Catch and effort for 2001 to 2011.
- Total catch for 1998 to 2011.
- Total catch for 1985 to 1997 from FAO FIGIS database.
- Biological data as described under Item (1)
- Rainfall data 1980 - 2010

Suriname

- Landings by month and size category for 1997 to 2011 available.
- Catch and effort for 1997 to 2011
- Total catch for 1997 to 2011

- Total catch for 1989 to 1997 from FAO FIGIS database.
- Biological data as described under Item (1)

5. Fisheries Statistical and Assessment Analyses Conducted

Guyana and Suriname

The following analyses were conducted for the countries separately:

- A catch and effort biomass dynamics model was fitted using Bayesian framework.
- Various other exploratory analyses were done including cross-correlations for rainfall.
- Examine size biological data collected 2008-09 and 2012

6. Other Tasks Conducted.

This agenda item was not applicable.

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

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

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

- Basic training / refresher course in data manipulation and management to include such items as: look up functions; data query tools; pivot tables; basic introduction to SQL or Microsoft Query. This training should be targeted at officers in the region involved in stock assessment work and who attend the CRFM Scientific Meetings. Such training would facilitate improved data preparation and analysis during the inter-sessional period.
- Book and/or training manual for the instruction on the use of R.
- Ageing of priority species of groundfish assessed and/or identified for assessment at previous scientific meetings would be useful for obtaining growth curves. As such, funding should be allocated to the Regional Age and Growth Lab to facilitate the ageing of these species. Funding may also be required to assist member countries in obtaining the necessary fish samples.

9. Inter-sessional Work Plan and Recommendations

General

- Although the communication has somewhat improved between last year's representatives Lara Fereira from Trinidad and Tobago, Ranjiet Soekhradj from Suriname and the consultant Paul Medley, we still recommend greater interaction among SGWG members during the inter-sessional period to facilitate the work of the group. This can be done with little cost via electronic mail, Skype, net meeting site or video conferencing.
- The Stock Assessment Parameters Profile for five species of Western Atlantic Tropical Shrimp, first developed by the Government of Trinidad and Tobago under an FAO/UNDP Project TRI/91/001 and subsequently updated, will be circulated among the members of the SGWG for update with new information obtained from assessments conducted at this workshop as well as any other relevant information.

- Further training in the assessment methodology can also be conducted for the SGWG and other working groups to give member countries the chance to improve the basic understanding of stock assessment among more fisheries staff. This will improve the preparation of data and participation at the scientific meeting.

Guyana & Suriname

- Training in data collection and analytical methods specifically for seabob management should be undertaken by members of the working group and other government staff to take on full roles and responsibilities for the management of this species. The process applied to seabob could be developed and adapted to other species as appropriate.
- The Guyana catch and effort data series should be extended as far back as possible prior to 2005. Catch and effort data for Suriname has been verified to the extent possible. Estimates for the artisanal catch need to be completed.
- The artisanal survey has been set up for providing an accurate estimate of the artisanal seabob catch in Suriname and an estimate of 800 t was provided to this meeting as the upper limit of this catch. It is recommended that the final estimate is submitted to the SGWG for inclusion in the stock assessment to test its significance in terms the determination of stock status and scientific advice.
- Given the vulnerability of the elasmabranchs taken as bycatch in the seabob fishery (Longnose stingray, *Dasyatis guttata* and the smooth butterfly ray, *Gymnura micrura*), it is recommended that data are gathered on these species adequate for a risk assessment. This would include, but not be limited to, total catch (estimated) and the catch and effort over at least one year, size and sex composition, and data from the tagging program.
- Attempts should be made to improve co-operation and communication between the fisheries departments of Guyana and Suriname, since they have the same types of fisheries. This would be especially profitable for joint and comparative analyses of the seabob and other stocks, and joint review and update of the assessments conducted for Suriname and Guyana at the scientific meetings, including sensitivity analyses and projections. In order to conduct the sensitivity analyses, the key parameters that introduce the most uncertainty into the assessments must be identified. Size composition data can be used to estimate growth and mortality, and this information can be used to improve the assessment.
- A system should be developed for the Fisheries Department to obtain the data from the seabob processing companies in Guyana. A system must be developed for Guyana fisheries department to have access to data from the processing facilities. The establishment of a seabob management working group, as in Suriname, may be useful in this respect.
- There should be programmes for biological sampling in both countries under responsibility of the government.
- A standardized computer entry data sheet should be developed as well as a database for the catch and effort and size composition and other relevant data including by-catch for both countries. Countries also require databases to manage the increased amounts of these data they will receive from the processors and other sources.
- A comparative study between the Suriname and Guyana seabob fishery and management regimes to allow the fishery management to adapt and to improve.
- Determine other species of importance for stock assessment in both countries to be assessed at the next SGWG. This would depend upon adequate data preparation. It was suggested that the grey snapper and trout for Suriname, other penaeid shrimp for Guyana are candidates for assessment in 2013.
- For Guyana, prepare data for a re-evaluation of a potential closed season 1 – 2 months. This was conducted in 2007, but more and better data has become available since then.

10. General Recommendations

- The shrimp and groundfish resources are shared by the countries on the Brazil-Guianas Continental Shelf. As some of these countries are not members of the CRFM (Venezuela, French Guiana, Brazil), it is recommended that the CRFM network with the FAO / WECAFC ad hoc Working Group on Shrimp and Groundfish Resources of the Brazil-Guianas Continental Shelf.
- Countries should ensure that their representatives are provided with laptops powerful enough to run the assessment models at the scientific meetings.

11. Review and Adoption of Working Group Report.

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

12. Adjournment.

The meeting of the SGWG adjourned at 7.30 pm on 28 June 2012.

B. FISHERIES REPORTS

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

Zojindra Arjune, (Rapporteur, Suriname)
Paul Medley (Consultant, UK)

1.1 Management Objectives

A responsible and sustainable fishery from an ecological standpoint which has minimal effect on:

1. the stock (*Xiphopenaeus kroyeri*);
2. the ecosystem; and
3. the breeding grounds of other species within the ecosystem.

A responsible and sustainable fishery from an economical standpoint which:

1. is economically viable,
2. sustains and improves the economical position of the fishermen through coordinated and self-regulation, and
3 is cost reductive

1.2 Status of Stock

The assessment indicates that the stock is not overfished ($B/B_{MSY} > 1.0$) and overfishing is not occurring ($F/F_{MSY} < 1.0$; Figure 1; Table 1). This conclusion depends, among other things, upon a reasonably accurate time series of total catch. Results for this update assessment remain broadly the same as those from the last stock assessment in 2011 and appears robust to likely levels of artisanal landings which have not been included in the catch data.

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

Parameter	Lower 5%	Median	Upper 95%
R	0.48	0.74	1.07
B_∞ (t)	39578	58462	91233
B 2010 (t)	0.66	0.72	0.78
MSY (t)	9753	10561	11928
Current Yield		7101	
Replacement Yield	7972	8492	8698
B/BMSY	1.33	1.45	1.56
F/FMSY	0.45	0.54	0.62

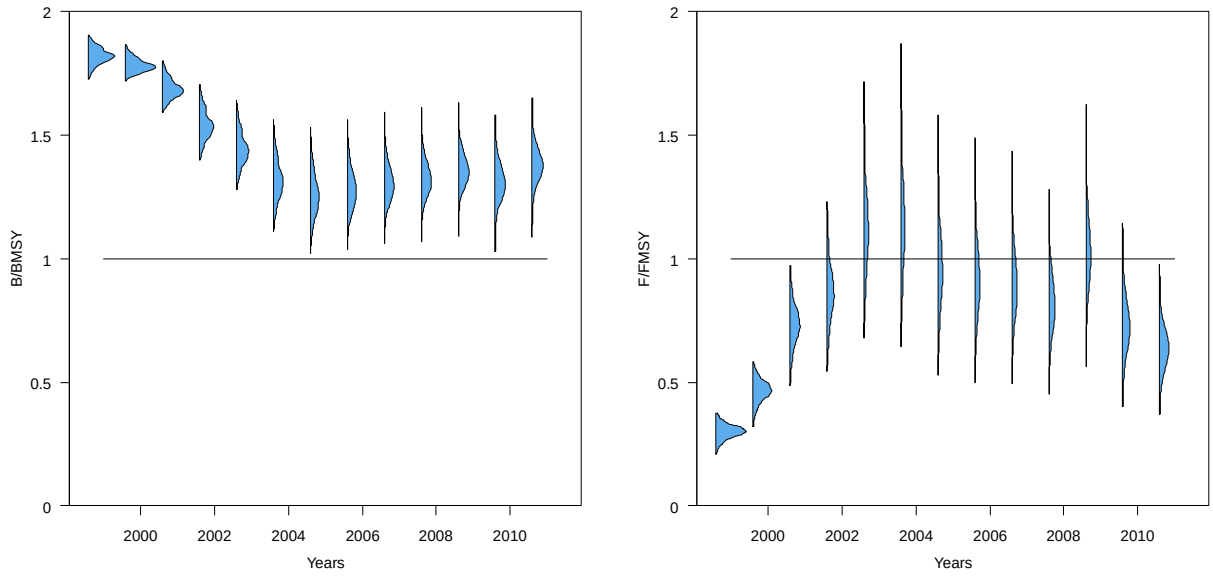


Figure 1: Probability estimates of the biomass and fishing mortality relative to the MSY value based on the Monte Carlo integration of the model posterior. The range of values is shown from 5000 random draws from the posterior probability using a Monte Carlo integration. More peaked distributions indicate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

1.3 Management Advice

The management advice remains unchanged from 2011.

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

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

CPUE is used as a proxy for the biomass, with reference points based upon the 2009 stock assessment. Results from the current assessment suggest that these reference points are precautionary (Table 2). The CPUE expected at MSY is 1.38 t day^{-1}, whereas current CPUE is 1.93 t day^{-1}.

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

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

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

	2009	2012
Limit	0.89	0.83
Trigger	1.48	1.38
Target	1.65	1.66

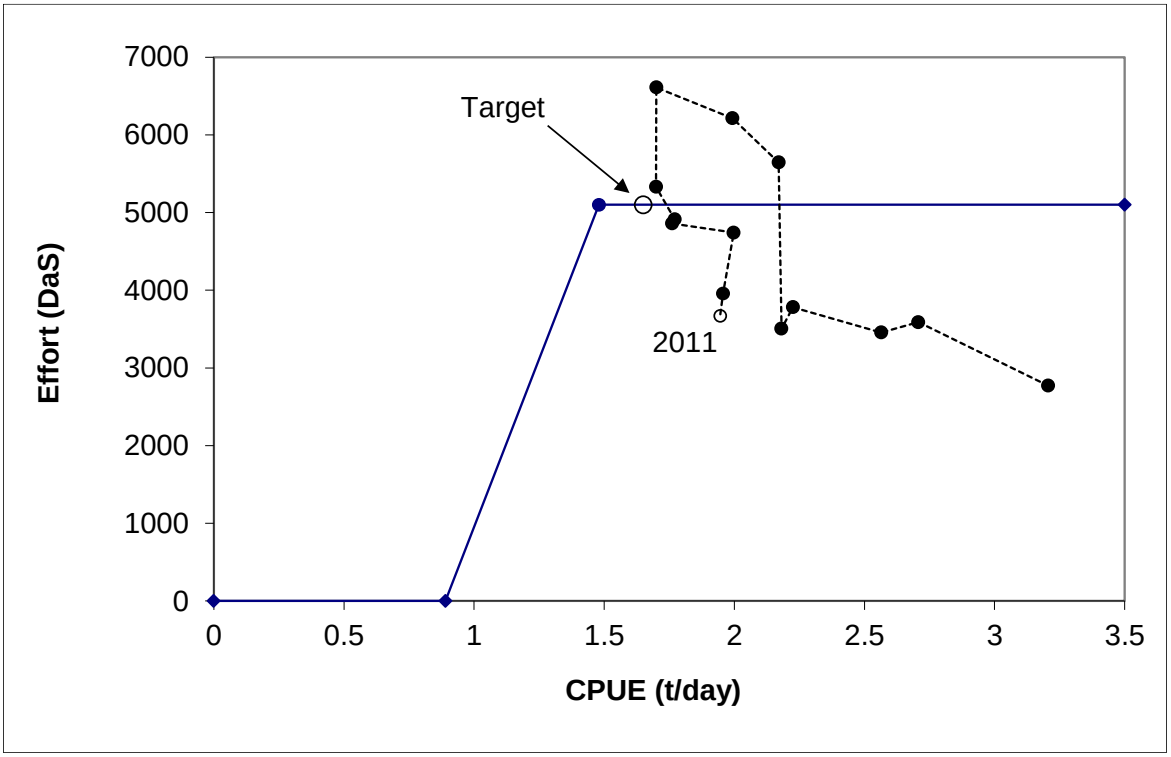


Figure 2: Harvest control rule (HCR) being applied to the fishery with historical time series of HCR CPUE calculated as a moving average and effort for the corrected data. The target CPUE is shown along with the estimated HCR CPUE in 2011 (from the 2012 assessment). This can be interpreted as the point estimates of fishing mortality are below the target level and biomass above the target level.

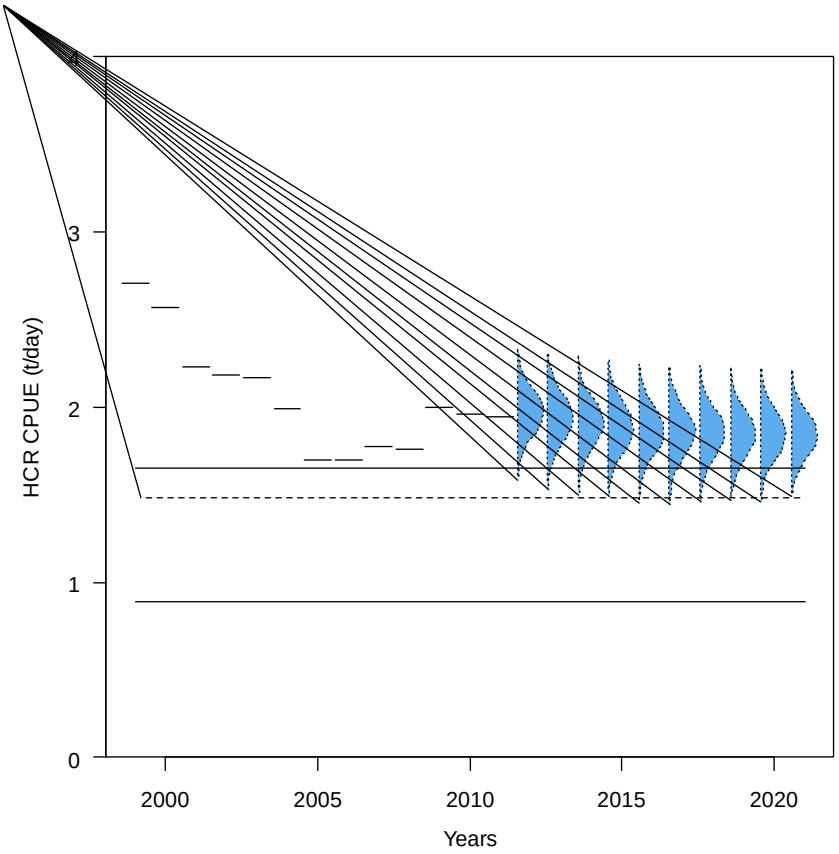


Figure 3: Observed historical CPUE (horizontal line) and projected probability distribution under the harvest control rule. The model predicts that it is highly likely that the CPUE will remain above the target level.

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

1.4 Statistics and Research Recommendations

1.4.1 Data Quality

Annual catch and effort data were available for the period 1998-2011 (Figure 4). Although there remains some doubt over data collected before 1999, no information is available to correct it. Errors so far back in time are unlikely to have a significant impact on the stock assessment unless they are very large.

The local artisanal catches for the dried seabob market had not been estimated in time for this meeting. Nevertheless, information was sufficient to indicate the likely level of this catch, which was expected to be less than 800 t total landed weight (Yspol, pers. comm.). It was believed that this was sufficient to allow a sensitivity analysis to see what impact if any this level of catch might have on the stock assessment. However, this remains a sensitivity analysis until precise estimates come available.

1.4.2 Research

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

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

Research is continuing on growth and mortality of seabob through the collection of detailed size frequencies. A considerable data set is already available, but analysis is incomplete. The data were reviewed and some analysis completed at the 2009 meeting. The research should give estimates of growth rates, maximum size and mortality rates for independent comparison with the results obtained from the catch and effort data. It is recommended that high priority be given to the analysis of these data.

1.5 Stock Assessment Summary

Bayesian statistics and the Monte Carlo (Sample importance resample algorithm) methods were used to estimate probability distributions for Maximum Sustainable Yield (MSY)[1], Replaceable Yield[2], current biomass relative to biomass at MSY, and current fishing mortality relative to fishing mortality at MSY. The assessment used the logistic biomass dynamics model fitted to the total catch 1989-2011 and catch and effort 1998-2011.

This stock assessment updates the 2010 assessment. Catch per unit effort (CPUE)[3] was used as an index of the abundance of stock. The measure of effort used was the number of days at sea, which would include steaming time. This was the only measure of effort available, but was thought to be strongly related to the amount of fishing carried out. The CPUE index has appeared to decline each year to 2005, but has also shown a recent increasing trend (Figure 4). The results indicate a reasonable fit of the model (Figure 5), but it should be noted that although the model largely explained the trends in the CPUE, these trends formed only a small part of the variation in CPUE. The number of data points (13) was limited and with only very shallow trends, the four parameters could only be weakly estimated.

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

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

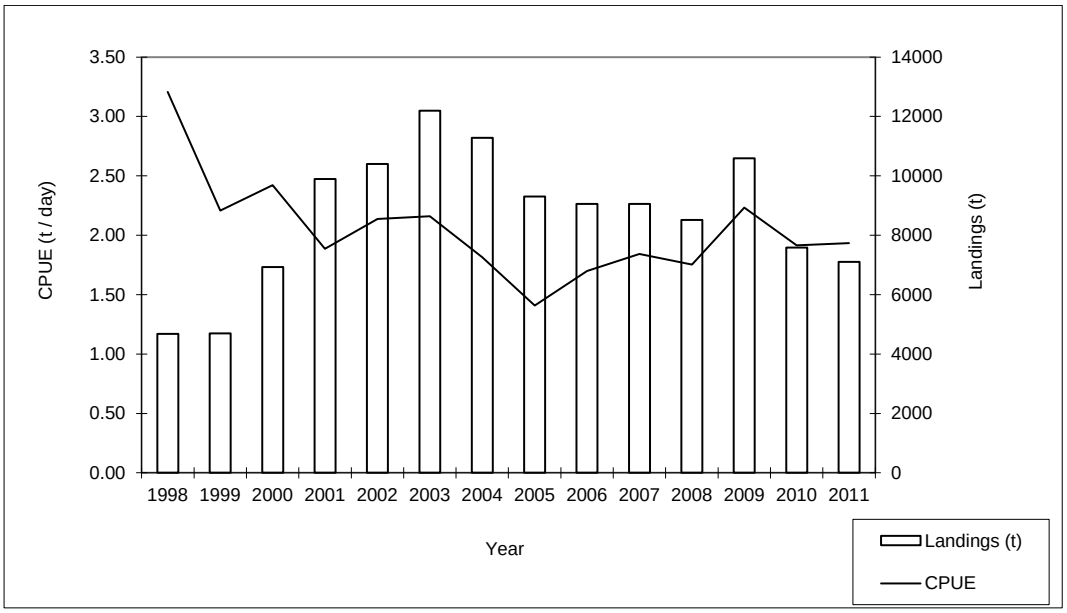


Figure 4: The CPUE abundance index shows a continuous decline since 1998 to 2006, suggesting that the stock abundance has declined over this period. However, there is some indication of more recent increase in catch rate following reduced catches after 2005, which are sustaining the CPUE close to 2 t / day.

1.6 Special Comments

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

The Suriname seabob fishery has successfully achieved Marine Stewardship Council certification (www.msc.org).

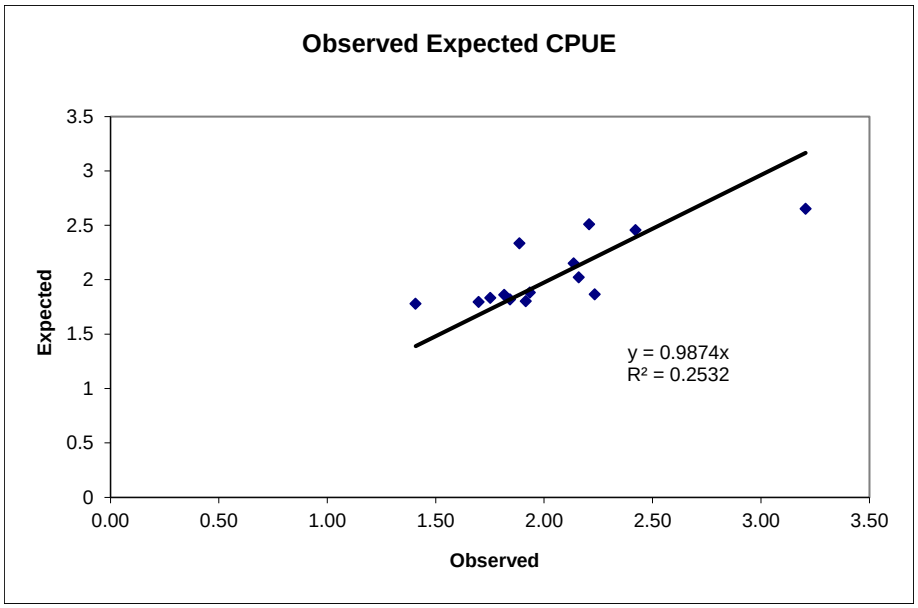


Figure 5: Observed and expected CPUE from the model fit. The residuals show no obvious pattern around the regression line going through the origin.

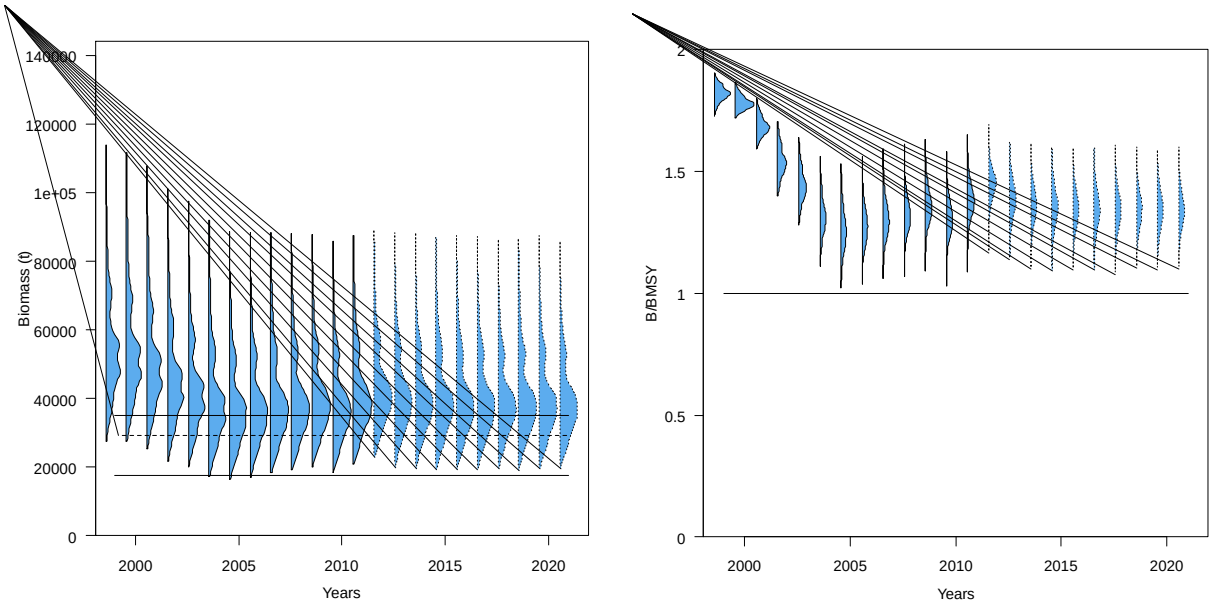


Figure 6: Absolute and relative biomass probability distributions for estimates (solid) and projections (dotted) from the fitted stock assessment model. The relevant reference points are also shown as horizontal lines with target (120% median MSY), trigger (dotted; median MSY) and limit (60% median MSY)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

1.7 Policy Summary

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

- Provides employment at the primary and secondary levels. The fishery also creates more alternative job opportunities and reasonable incomes. Diversity of the sector is also important.
- Creates a balance of payment through export of fish and shrimp products
- Contributes to the GDP of the country
- Contributes to the national budget through fees and income tax.

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

1.8 Scientific Assessments

1.8.1 Description of the Fishery

The seabob industrial trawl fishery started in 1996 with one company, which owned 10 boats. In 1997, this company increased the number of vessels to 15, and a second company joined the fishery, with 3 vessels. At present, the seabob fleet comprises 22 vessels owned by two companies, namely Heiploeg Suriname N.V and Namoona N.V. with 12 vessels and 10 vessels, respectively. The vessels licensed to fish for seabob are 18-36m in length. Seabob is exploited in the EEZ at depths of 11-24 m. The catch is processed and exported by two processing plants.

There is also an artisanal fishery for seabob with about 500 vessels; this fishery uses Chinese seines, drying the seabob for local consumption. Catches prior to 1996 are attributed to this fishery.

1.8.2 Overall Assessment Objectives

The main objective of this assessment was to update the status of the stock and reference points using the new corrected data and test the harvest control rule currently being used for Suriname seabob fisheries.

1.8.3 Data Used

Name	Description
Total seabob landings	Reported monthly seabob landings based on processor reports 1989 - 2011
Catch and effort data	Reported seabob landings and days at sea per trip based on processor reports 1998 - 2011

The data were reviewed and checked at the scientific meeting in 2009 and updated data used in the 2011 stock assessment. This assessment uses the same data as reported in the 2011 scientific meeting (CRFM, 2011), but the 2011 data have been added to the assessment.

1.8.4 Assessment 1: Update Stock Assessment for 2012

1.8.4.1 Objective

Update the stock assessment using the most recent catch and effort data (above) and test the robustness of the current harvest control rule to the new assessment.

1.8.4.2 Method / Models / Data

The method applied is the same as that reported for 2011. The method and model are described in CRFM (2009) in Section 5.4 pp123 - 129.

The method fits a standard biomass dynamics model to total catch, catch and effort data, using CPUE as an abundance index. The model is fitted in a Bayesian framework to allow greater flexibility and a better evaluation of the assessment uncertainty. Specifically, the assessments include "priors" to help determine likely parameter values as well as use information in the data. The priors presume that the stock was only lightly exploited at the start of the time series, and that there is a loose correspondence in productivity per unit area between this fishery and others reporting biomass estimates based on scientific surveys. The prior for the intrinsic rate of increase was based on estimates obtained for other stock assessments for penaeid shrimps. The likelihood is based on the normal probability density function.

1.8.4.3 Results

The fitting method worked reasonably well, and the model was able to apply the importance sampling method where the importance range was relatively low (a maximum log weight of less than 1.0 and minimum greater than -8.6 corresponding to the number of random draws). This excludes very high or low importance weights. Improvements in the fit will be sought in future assessments, specifically by applying full rejection sampling. The results are a reliable representation of the posterior, but all uncertainties with respect to model and data still apply.

The marginal probabilities of various performance indicators were obtained from the posterior. These are true probabilities and can be interpreted as such. The main performance indicators were biomass relative to biomass at MSY, the replacement yield, the maximum sustainable yield and current fishing mortality relative to fishing mortality at MSY. The main results of the stock assessment are presented in Stock Status (Section 1.2) and Management Advice (Section 1.3). Most importantly the results suggest that it is likely that the stock is not overfished, and overfishing has not occurred in 2011. This is the same result as for 2010.

Table 4 Comparison of the median estimates between the 2009 and 2011 assessments. Note that stock status relative to MSY (B/BMSY and F/FMSY) refer to different years (2008 and 2010), although with little change in the fishery, they should be comparable.

Parameter	2011	2012
r	0.68	0.74
B_∞	60822	58462
B_{now}	0.68	0.72
MSY (t)	10465	10561
B/BMSY	1.37	1.45
F/FMSY	0.57	0.54

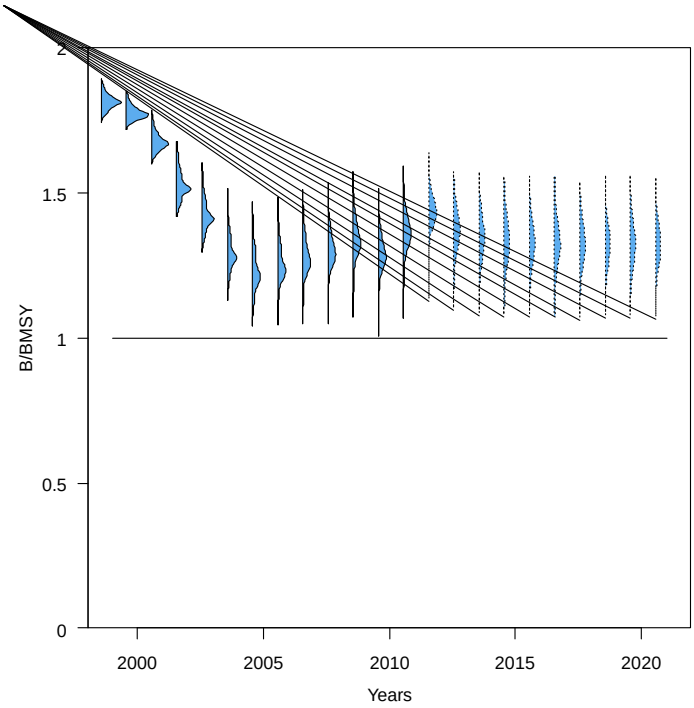


Figure 7: Past status of the fishery and projected status under the current harvest control rule.

1.8.4.4 Discussion

It is unlikely that further revision of the data are possible and therefore annual stock assessments considering the low exploitation level do not appear necessary because the assessment is not likely to change within the next 2 years. Importantly, the current harvest control rule appears precautionary and should not lead to overfishing (Figure 7).

It appears that the current harvest control rule should continue to protect the stock as long as catchability does not change (see CRFM, 2011, Section 1.8.5 on developing and testing the Harvest Control Rule). However, it is not clear whether the fishing industry would be able to apply the current fishing effort constraint of 5100 days-at-sea due to the limited number of vessel licences. In this sense the HCR has not been tested, but there is no evidence that it would not achieve its objectives. It is therefore recommended that no changes are required in the harvest control rule at this time. It is also unlikely that any change will occur to allow scientific advice on the appropriateness of the HCR in 2013 unless more information becomes available. The HCR can be evaluated on other criteria (economic and social), however.

1.8.5 Assessment 2: Sensitivity for the Inclusion of Artisanal Catches

1.8.5.1 Objective

Based on the updated stock assessment (Section 1.8.4), include levels of artisanal catch in the total catch time series, assuming an additional 800 t caught per year.

1.8.4.2 Method / Models / Data

The assessment was the same as that described in Section 1.8.4. However, all year's total catch data included a further 800 t catch (raw weight) which was added in. This was a crude approximation for the impact of the artisanal fishery on the assessment. The artisanal fishery was assumed to have consistently

landed this (or less) seabob throughout the available time series (since 1989), which no large trends or changes during this time.

1.8.4.3 Results

The general result shows effectively no change in status and implies that the harvest control rule should be robust to this uncertainty (Figure 8). This result is not unexpected given the way the artisanal harvest was added to the model. The harvest has no impact on the CPUE abundance index, so the model attempts to explain the observations by estimating increased biomass. In this context, the industrial landings have proportionally less impact on the stock.

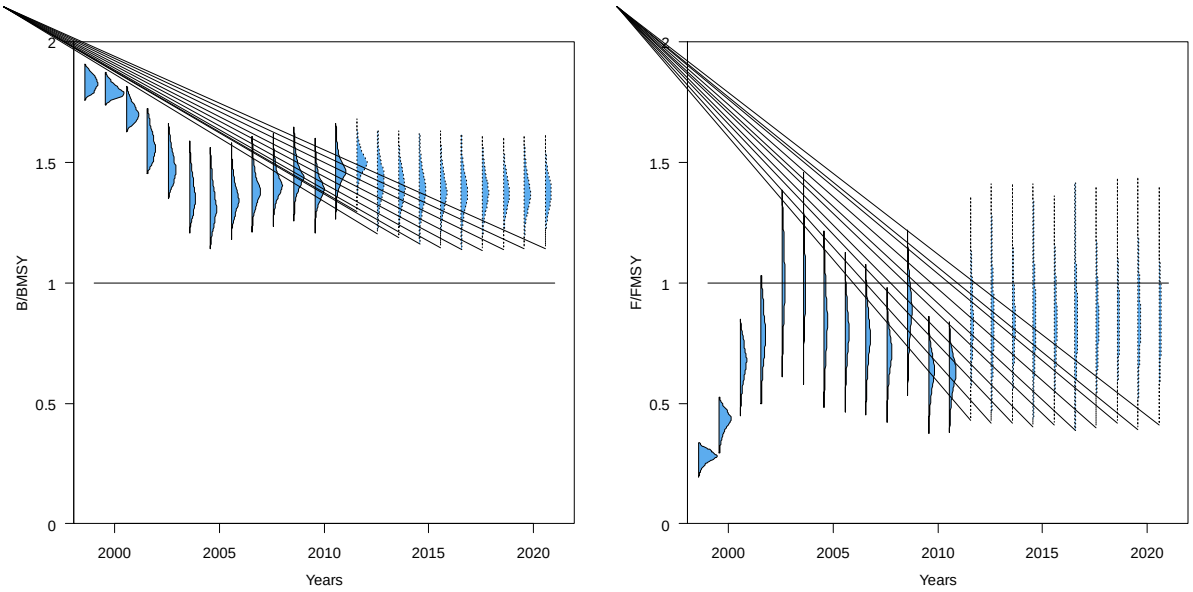


Figure 8: Past status of the fishery and projected status under the current harvest control rule.

1.8.4.4 Discussion

This was a preliminary assessment including artisanal catch. Improved catch estimates may be available next year. However, this sensitivity suggests that catches of this magnitude are unlikely to have much impact on the results of the stock assessment. Nevertheless, it would be valuable to include artisanal catch based on the magnitude and perhaps with some random variation, to account for the uncertainty this lack of data may incur. Some idea of trends and variation in artisanal catch, as well as the absolute size of this catch, will be useful for future stock assessments.

2. GUYANA SEABOB (*Xiphopenaeus kroyeri*) FISHERY

Rabani Gajnabi, Fisheries Officer, Guyana
Paul Medley, Fisheries Consultant, UK

2.1 Management Objectives

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

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

2.2 Status of Stock

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

The preliminary stock assessment suggests that the stock is well above the MSY level ($B/B_{MSY} > 1.0$) and the 2011 catch (19,433t) was well below the MSY level ($F/F_{MSY} < 1.0$; Table 1; Figure 1). However, reservations were expressed by the group due to the quality of some of the data used and the short time series of CPUE data available. In addition, catch rates are significantly lower in Guyana (1.2 t / day) compared to Suriname (1.9 t / day) and average tail weight slightly lower.

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

Parameter	Lower 5%	Median	Upper 95%
r	0.37	0.61	0.96
B_∞ (t)	121513	179701	263243
B 2012	0.67	0.77	0.86
MSY (t)	20347	26501	39863
Current Yield		19343	
Replacement Yield (t)	17784	19070	19170
B/B_{MSY}	1.33	1.53	1.72
F/F_{MSY}	0.32	0.51	0.73

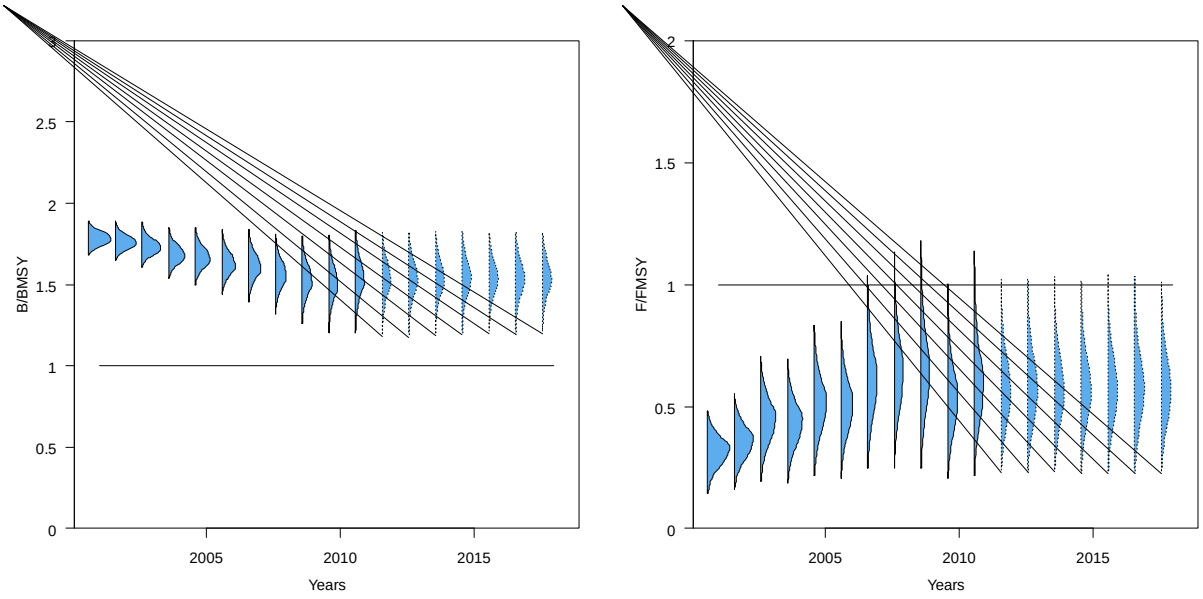


Figure 1: Probability estimates based on the Monte Carlo integration of the posterior biomass dynamics model fitted to the catch and effort data

2.3 Management Advice

The management advice remains the same as that given in 2009. Priority should be given to the development of reference points and harvest control rule based upon the available data and precautionary principle.

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

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

The reference points (biomass, yield and fishing mortality at MSY) have been estimated from the annual catch and effort time series. However, given the very short time series of catch and effort data, the estimates cannot be made with high accuracy and remain uncertain. In addition, the total catch data requires further validation to ensure that it is correct. Therefore the reference points are an interim and need to be verified through further research. The results also need to be confirmed through analysis of the size composition data. It is further recommended that references points are developed as part of a harvest control rule.

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

A harvest control rule should have the following properties:

- It should maintain a harvest rate which should keep at or around the target level in the long term.

- It should reduce the harvest rate as the stock approaches the limit level.
- Fishing should be minimized if the stock falls below the limit.

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

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

To protect recruits to the fishery and allow them to grow, a closed season may be most valuable set in September/October. However, alternative closure times may still be warranted if special protection is required for the spawning stock (May or June).

2.4 Statistics and Research Recommendations

2.4.1 Data Quality

Annual total catch data were available for the period 1985-2011 and monthly catch and effort data available for 2001-2011 (Figure 2). There remains considerable uncertainty over the data accuracy. There have been very significant increases in catch during the time series but mainly during the period when catch per unit effort was unavailable. The catch per unit effort shows a small decrease possibly corresponding to an increase in total just before the series starts. However, catch-per-unit-effort data does not cover the important period 1990-2000 when there was a significant increase in catch, which will severely limit the quality of the stock assessment.

Size frequency data were also available, but there was insufficient time at the meeting to carry out a thorough examination of these data. Some preliminary analysis was undertaken of the size frequency data covering December 2007 to June 2009, and then started again in December 2012. The data consist of random samples taken from the landed catch before processing in the Noble House processing facility. These data have been collected by the processors for the purposes of stock assessment.

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

2.4.2 Research

1. The biological sampling data from landings was reinstated in 2011, which is highly commended by the SGWG. The group believes that these data will prove to be particularly important in understanding the Guyana seabob stock dynamics and therefore biological data collection should continue and be extended among all main processing facilities.
2. The observer program should be reinstated in order to monitor catch onboard vessels to get catch rate information, length-frequency data, and geographic information.
3. Economic data such as price per pound for the various market categories should be documented over the course of a year.

2.5 Stock Assessment Summary

Bayesian Statistics and the Monte Carlo (Sample importance resample algorithm) methods were used to estimate maximum sustainable yield (MSY)[4], replacement yield[5], current biomass relative to biomass at MSY, and current fishing mortality relative to fishing mortality at MSY. The assessment used the logistic surplus-yield model fitted to the total catch 1985-2011 and catch and effort 2001 - 2011.

Catch per unit effort (CPUE)[6] was used as an index of stock abundance. The measure of effort used was the number of days at sea, which would include steaming time. The CPUE data were constructed from two series: processor data reported to government 2005-2011 and other data obtained directly from a processor for the period 2001-08. The CPUE index appears to be declining each year (Figure 2) indicating a small decline in stock size since the start of the series.

The results indicate some problems with the fit of the model (Figure 3), and therefore this model is likely to predict CPUE changes poorly. The number of CPUE data points was limited and with only a decreasing trend, so that the priors may have influence on the results. The rate of increase is negatively correlated with the estimate of abundance, so a higher rate of increase would imply lower biomass.

The maximum sustainable yield suggested most likely values would be between 20000-40000 t $year^{-1}$ (Table 1). However, the assessment entirely depends upon the accuracy of the available data and is likely to be heavily influenced by the high catches in 2004 and 2005. If these are overestimates, the state of the stock may well be re-evaluated downwards.

The assessment indicates that the stock is not overfished ($B/B_{MSY} > 1.0$) and overfishing is not occurring ($F/F_{MSY} < 1.0$). The working group can not endorse this conclusion without verification of the data, improvement in the stock assessment and/or evidence from other sources.

Assuming that the stock status is correctly estimated, the current level of fishing can be sustained. However, the current catch per unit effort is significantly lower than Suriname (Figure 4). A better understanding of the relative fisheries and seabob populations in Suriname and Guyana would produce significant improvements in management advice.

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

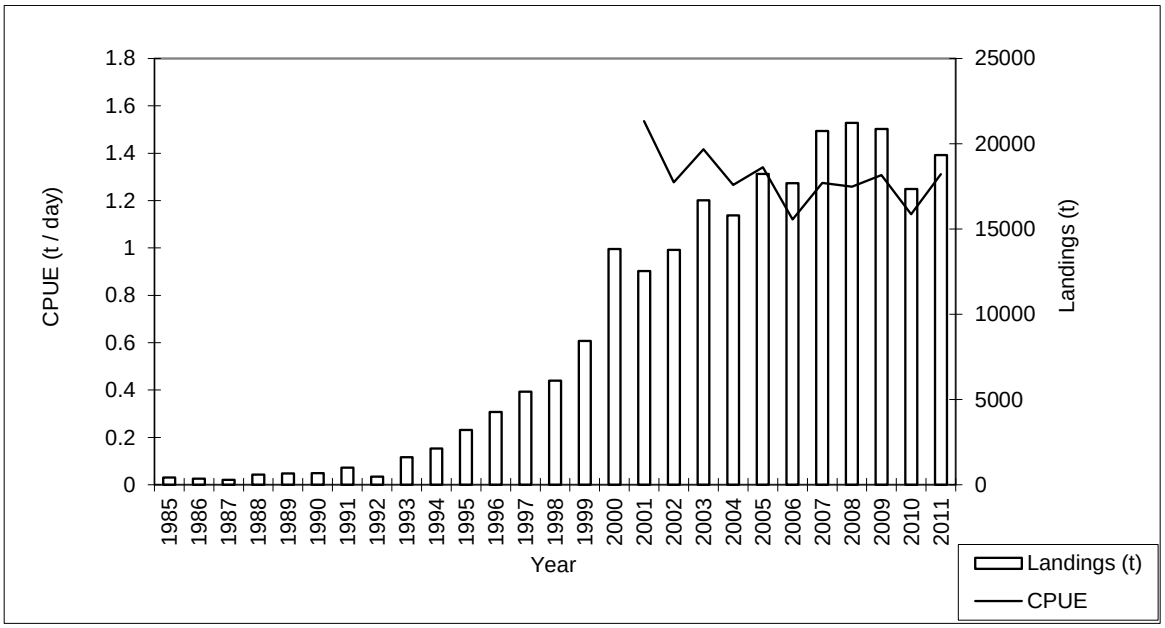


Figure 2: The CPUE abundance index and landings of seabob 1985-2011.

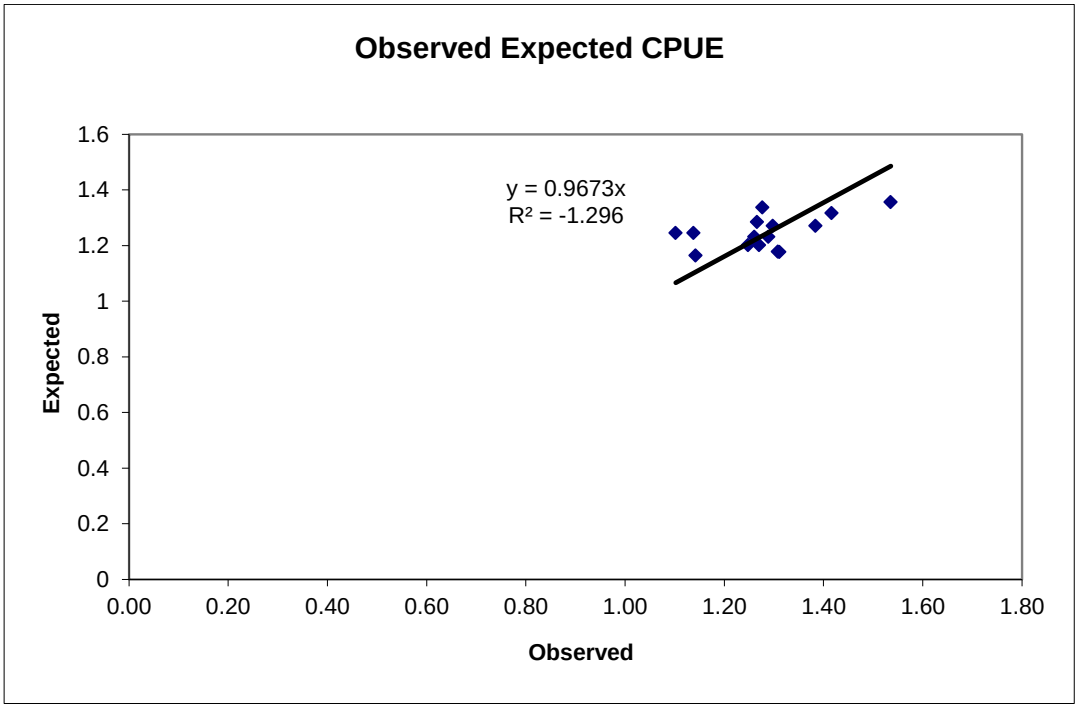


Figure 3: Observed and expected CPUE from the model fit. The residuals show some bias around the regression line going through the origin, with expected values being relatively high compared to the observed CPUE at lower values.

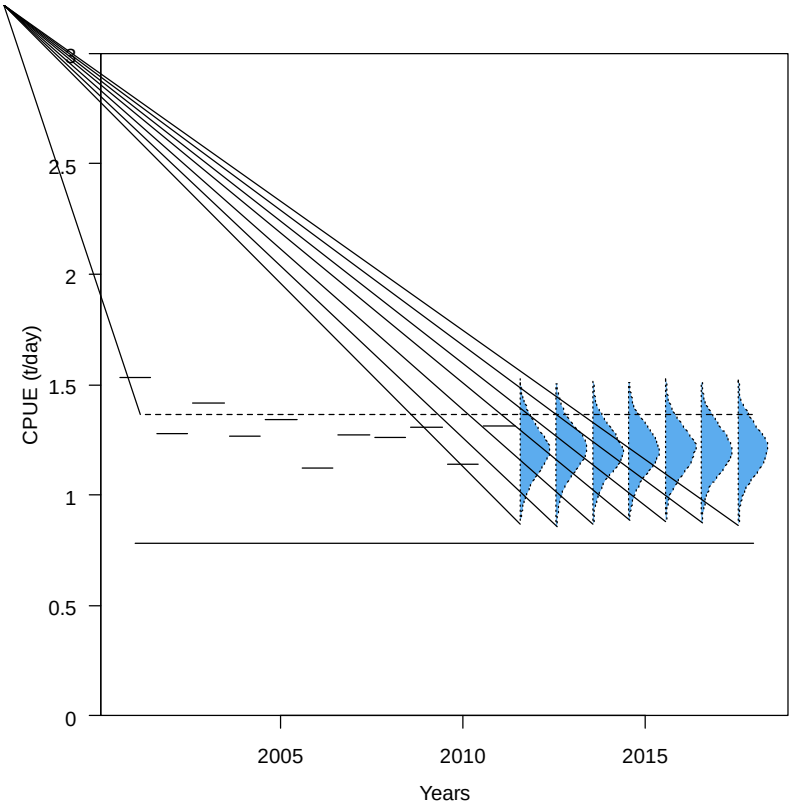


Figure 4: Observed mean CPUE (horizontal lines) and projected CPUE (probability) assuming total fishing effort is maintained as the mean observed 2008-2011. The lower solid line represents the median estimate of the CPUE expected at MSY for this fishery. The upper dotted line represents the median estimate of the CPUE expected at MSY for the Suriname fishery.

1.6 Special Comments

The working group would like to encourage on-going data collection initiatives of the biological data and continued improvements in the co-operation with the fishing industry.

It is likely with improvements in the catch and effort data and other information that the state of the stock will be revised downward. This is based on the view of the working group that the biomass estimate in this model may well be too high. Therefore, this stock assessment should not be used for decisions on the further development of the fishery or expansion in exploitation until the result can be verified.

1.7 Policy Summary

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

1.8 Scientific Assessments

1.8.1 Background or Description of the Fishery

Guyana Seabob Fishery

The Offshore Industrial fishery consists of one hundred and twenty five (125) trawlers, eight (8) large fish / shrimp processing plants and numerous wharves and dry docking facilities. Thirty one trawlers are licensed to catch penaeid shrimp while ninety-four (94) are licensed to catch seabob. Ice and freezing facilities servicing this fishery are owned and operated by participants within and outside the fishery sub-sector.

Thirty-one trawlers are exploiting mainly penaeid shrimp *(P. brasiliensis, P. notialis, P. schmitti, and P. subtilis)* with finfish and small amounts of squid (*Loligo spp.*) and lobster (*Panulirus spp.*) as by-catch. While ninety-four (94) mainly exploit seabob (*Xiphopenaeus kroyeri*) and various fin-fish species (*Macrodon ancylodon, Micropogonias furnieri, Nebris microps, Arius spp.,Cynoscion spp.*), with small quantities of penaeid shrimp as by-catch. The Turtle Excluder Devices (TED's) are mandatory for the entire shrimp trawl fleet. One company is using BRD on the trawl nets.

The penaeid shrimp vessels would spend an average of 30 days at sea per trip and do approximately 10 - 12 trips per year. The seabob trawlers spend 5 - 9 days at sea per trip, but an average trip lasts 7 days. A typical seabob vessel makes 2 - 3 trips per month, and an average of 30 trips per year (see also Fisheries Management Data System Terminal Workshop, Guyana Report, St Lucia, 1999).

1.8.2 Overall Assessment Objectives

The main objective of this assessment was to update the status of the stock, define reference points and a harvest control rule for the Guyana seabob fisheries.

1.8.3 Data Used

Name	**Description**
Total seabob landings	Reported monthly seabob landings based on processor reports 1985-2011
Catch and effort data	Reported seabob landings and days at sea per trip from Government and based on processor reports 2005-2011
Catch and effort data	Reported seabob landings and days at sea per trip extracted from the daily Guiana Seafoods N.V. processor reports 2001-2008.
Morphometric Data	In December 2007, 500 animals were sampled and measured, stratified over sex and size.
Size Composition Sampling Data	From December 2007 to June 2012, ongoing random sampling of the landed size composition from Guiana Seafoods in Suriname and Noble House Seafoods in Guyana.

1.8.4 Assessment 1: Update Stock Assessment for 2012

1.8.4.1 Objective

Update the stock assessment using the most recent catch and effort data (above) and test the robustness of the current harvest control rule to the new assessment.

1.8.4.2 Method / Models / Data

The method applied is the same as that reported for 2009 and for Suriname in this report. The method and model are described in CRFM (2009) in Section 5.4 pp123 - 129.

The method fits a standard biomass dynamics model to total catch, and to catch and effort data, using CPUE as an abundance index. The method also uses priors which are the same as those used for the Suriname stock assessment.

Two catch and effort data series were available. Government data exist for the years 2005-2011, although total landings extend back to 1985. This is a disappointingly short time series of catch and effort data, and the short time series makes it impossible to fit any reliable model. The series was extended further back using catch and effort data specific to a single processor with data covering 2001-2008. These two series were combined as independent series, except the average processor CPUE was scaled to the same average as the Government index where they overlapped.

1.8.4.3 Results and Discussion

The most important results are described in sections 1.1 – 1.5.

The available data appears reasonably consistent and there were no outliers or obvious errors in any of the data. The annual total catch data appears to extend back to the beginning, or near beginning, of the fishery, which is very useful in estimating stock status. The CPUE data unfortunately, only covers the more recent period during which catches have been stable (Figure 2). Therefore the expected CPUE and biomass when the stock would be only lightly exploited is not well estimated, which makes the reference points based on MSY unreliable.

If the catch and effort time series cannot be extended back to 1990, the only other option to improve the assessment would be to make use of the biological sampling and landings data sorted by grade. This suggests the next assessment for this fishery should be an age or size based assessment, with explicit modeling of growth, mortality and recruitment. This is more complex than simple biomass dynamics modeling, and may be difficult without additional data on growth, but should if successful lead to more precise estimates of sustainable yield and improved management advice.

1.8.5 Assessment 2: Seabob Size Composition Analysis (Suriname and Guyana)

1.8.5.1 Objective

The objective was to continue the development of a size-based stock assessment which will model within season dynamics and complement the catch and effort model. This represents a further development of work initiated in 2009 (CRFM, 2009).

1.8.5.2 Method / Models / Data

The available data were reviewed and preliminary analyses were limited to generalized linear model fit to size, country and maturity data.

Size composition data are collected by regularly (up to 8 times during the day) taking a 200g sample of the landed seabob catch from baskets as they are being delivered for peeling and grading. All animals in the sample were measured for sex, maturity for females, and tail weight. The tail weight was taken as this was the most robust and easiest size measure to take. Most tails were intact. On the rare occasion where a tail was not in tact (e.g. a segment was missing), the individual was replaced by another individual shrimp of the same size selected from the baskets. This individual was selected as the same size by eye, which on testing was found to be accurate enough. Digital scales effectively accurate to $1/10^{th}$ gram were available to measure tail weight. In addition, the total number and total weight of "white shrimp" were measured as a separate group in each sample. This species did occur in the catch, albeit only as a small proportion of the samples taken.

For each sample, the date, the processing facility, the vessel from which the sample was taken, and the person doing the sampling were recorded. The data were entered onto a spreadsheet designed for the purpose. Data from these spreadsheets were compiled into a single table for this analysis as the original database was unavailable. The biological samples taken together should be representative of the whole landed catch size, sex and maturity composition.

1.8.5.3 Results and Discussion

Although Guyana shrimp tend to be smaller, there is very little difference in median size between Suriname and Guyana (Figure 5). However, there is a much greater variation in size in the catches of the two countries, with Guyana seabob having a much greater variability. This is likely to be due, at least in part, to differences in selectivity. However, the larger maximum size observed in Guyana would also suggest different growth pattern and different productivity between the two areas.

There is no overall trend in size, although there is considerable variation between years (Figure 6). The differing variance within years may be explained by different sample sizes. Seasonality is evident with largest sizes of seabob being encountered in April and May (Figure 7), which is most likely the main spawning time. Again changes in variation among months may be due in part of sample sizes as well as growth and mortality patterns.

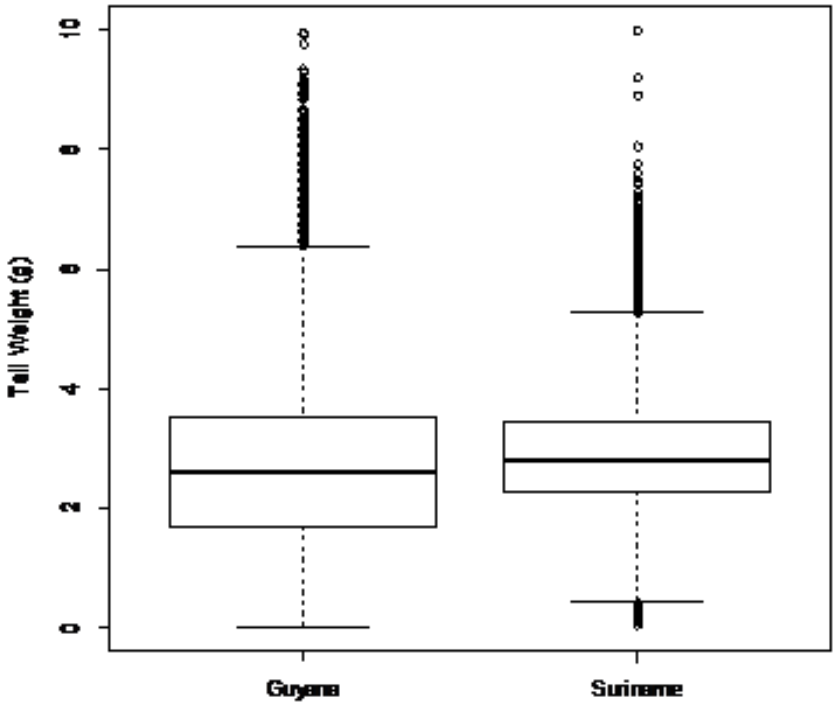


Figure 5 "Box and whisker" plots showing the median and inter-quartile range of tail weight for Guyana and Suriname for all samples collected 2010-2012. The whiskers extend up to 1.5 the quartile width, with outliers being shown beyond this.

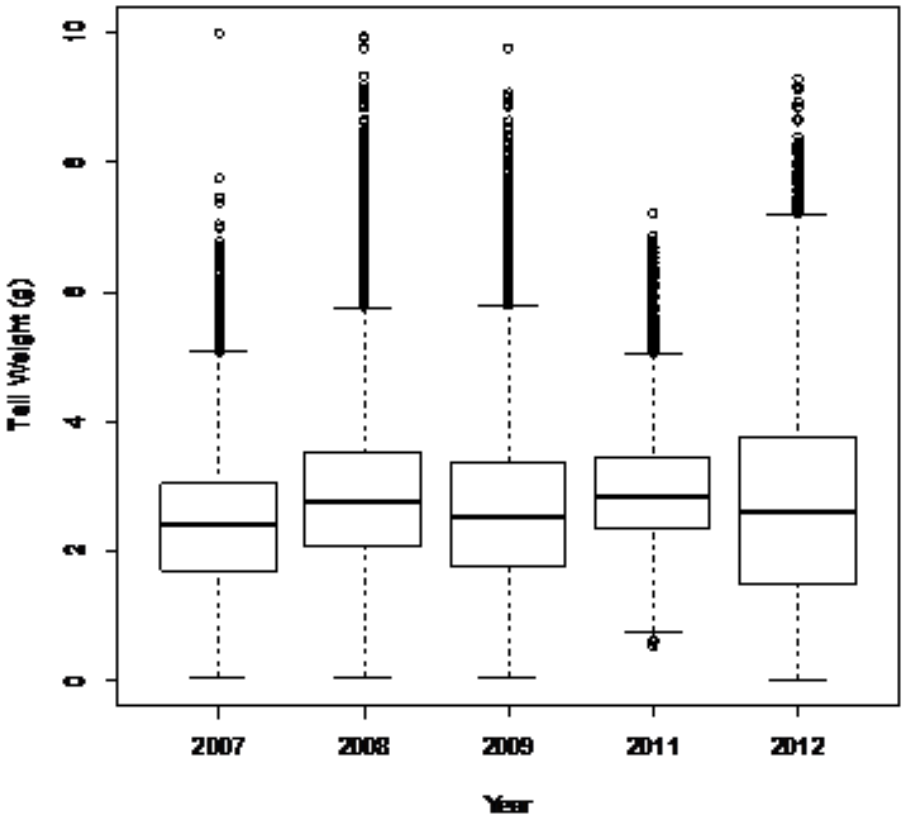


Figure 6: Median and quartile range of tail weight by year. Data were not collected in 2010 and not in all months in 2007, 2009 and 2011-2012.

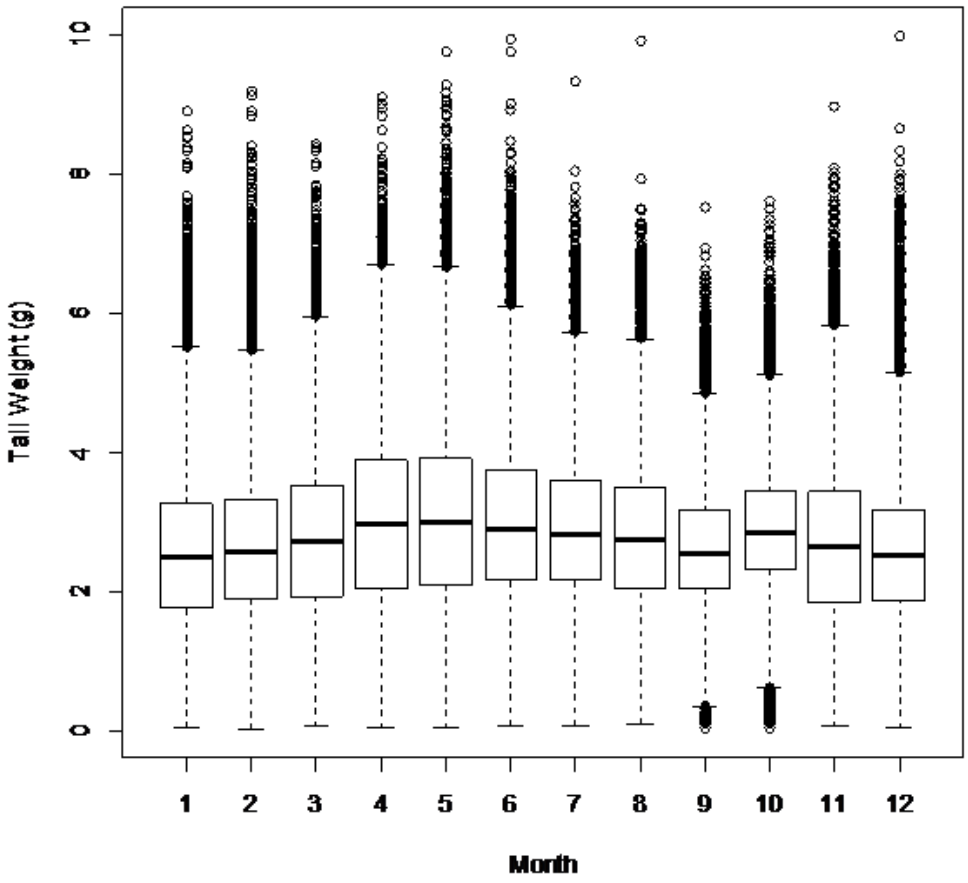


Figure 7: Median and quartile range of tail weight by month.

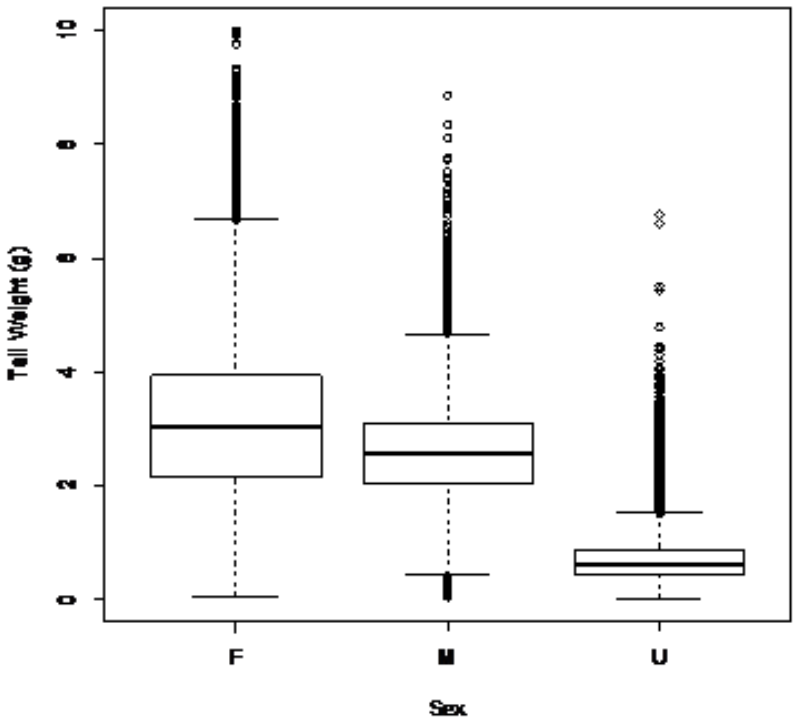


Figure 8: Median and quartile range of females (left), males (middle) and "unknown" (right).

Females are clearly larger than males on average (Figure 8), suggesting that they grow to a larger size. Where the sex cannot be determined, the seabob tend to be small and therefore immature so that the sex dimorphism is not apparent. In general, there are fewer males in the catches, but whether this is due to a sex ratio different from 1:1, or whether it is an artifact of higher selectivity for larger seabob is not clear.

The maturity of female seabob can be determined by the presence of a "green vein" running through the thorax and abdomen. This green vein is not only more likely to be seen in larger specimens (Figure 9), but there is a significant difference between Guyana and Suriname in that Guyana seabob tend to mature at a smaller size (Figure 9). This was determined with a generalized linear model fitted to binary data (maturity is true or false). The model fit was exploratory, and other factors will need to be included (e.g. month) before the model can be finalized.

Differences such as between the size at maturity illustrate a clear difference between Suriname and Guyana populations. That these are separate adult populations is to be expected. Given their body shape, adult seabob are very unlikely to swim significant distances along the coast. However, this does not mean that recruitment is more widely spread, and that populations do not support each other through larval distribution. Too little is known about their ecology and life history to be sure of population structure and appropriate management units, but smaller units than the national coast may improve yields from these stocks.

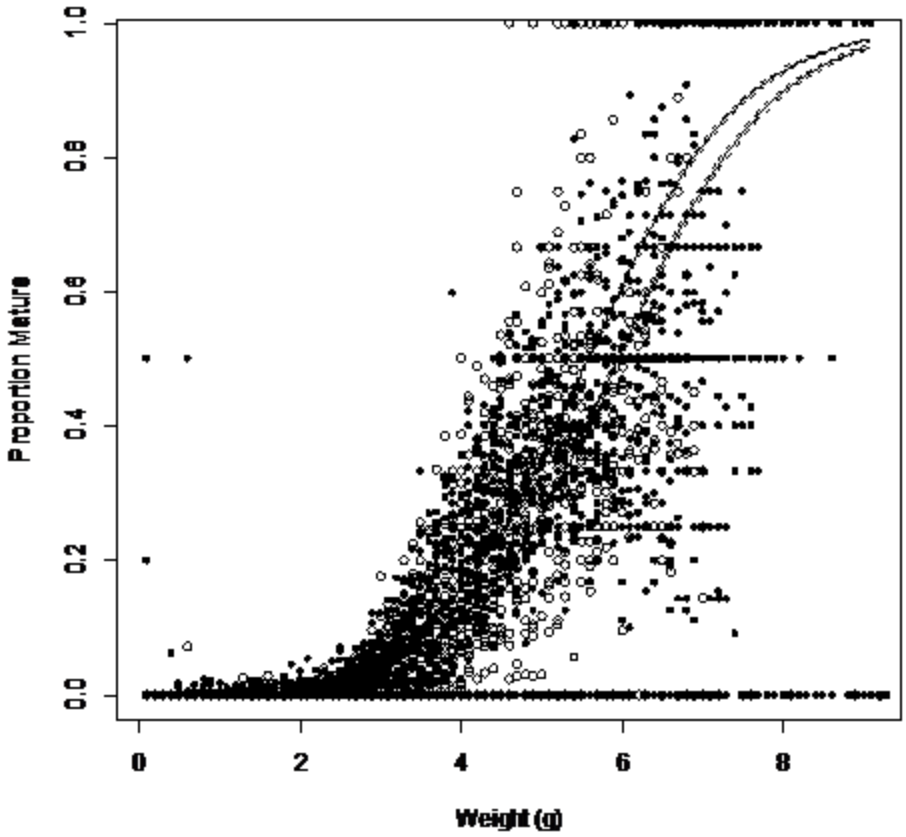


Figure 9: Plot of the GLM logistic fit to the proportion of females mature for Suriname (white dots) and Guyana (solid dots). The points forming horizontal lines represent categories containing small samples (e.g. 1 or 2 shrimp), so the proportions cannot vary continuously between 0 and 1. The logistic fit (solid lines) of Guyana (left) and Suriname (right) with dotted lines showing 95% confidence intervals are also shown.

1.8.5 Assessment 3: Rainfall Patterns and Seabob Productivity

1.8.5.1 Objective

The objective was to consider whether rainfall data might be used as an index of seabob productivity after some appropriate delay.

1.8.5.2 Method / Models / Data

Linear correlations can be calculated between time series at different lags. This was done for monthly Guyana CPUE and monthly rainfall (Figure 10). Previous work looked at cross correlations between monthly Guyana CPUE and river outflow. A positive correlation was discovered around 9 - 11 months which suggested there may be some relationship with recruitment success. Unfortunately river outflow data is not available for Suriname and is difficult to obtain from the relevant Guyana authority. Rainfall data is more widely available and covers a longer time series, and therefore patterns related to productivity with these data would be more valuable.

1.8.5.3 Results and Discussion

Relationships between rainfall and seabob CPUE were weak and mostly negative, with the exception of a positive pattern around 8-11 month lag (Figure 10). The implication is that rainfall may be a more noisy index of productivity for seabob than river outflow and any relationship may be very weak. Nevertheless, further research, particularly where population processes, such as growth and recruitment, are modelled separately is probably worthwhile. An index predicting future recruitment and growth would be particularly useful for management purposes.

Any causal relationship is likely to be indirect through water outflow raising nutrient levels and therefore increasing food for larvae and adult seabob, which may produce a broader effect than that measured on a scale of months. However, weak correlations are likely to occur due to common seasonality effects, so any relationship does not automatically imply that changes in fresh water flows cause changes in seabob production.

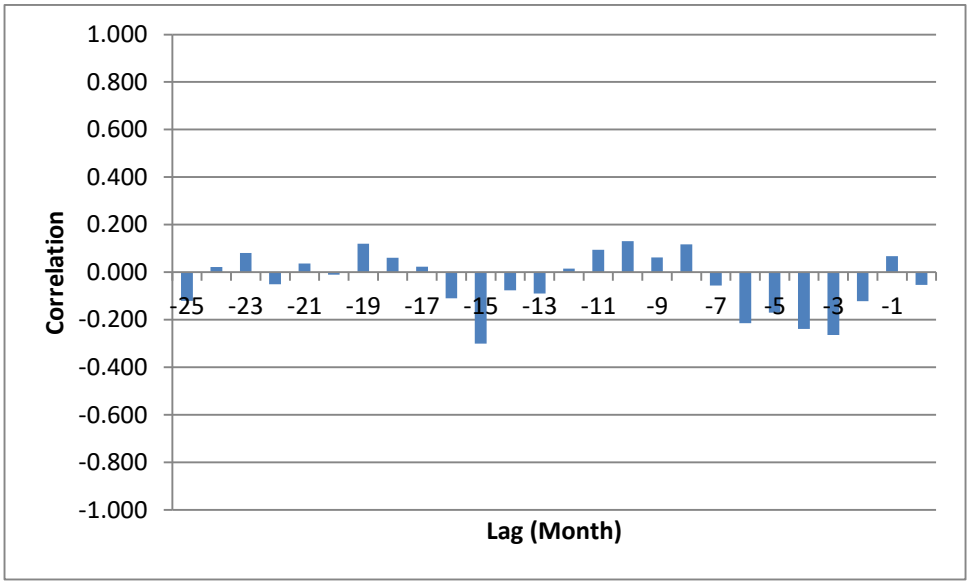


Figure 10: Cross correlations between monthly rainfall and seabob CPUE for Guyana 2001-2008.

References

CFRAMP (2001). Fisheries Management Data System Terminal Workshop Proceedings, "*The way forward – a review and planning session*", 25-28 November, Castries, St. Lucia. CARICOM Fishery Research Document No. 25: p 491.

CRFM (2009) CRFM Fishery Report - 2009. Volume 1. Report of Fifth Annual Scientific Meeting – Kingstown, St. Vincent and the Grenadines, 09 - 18 June 2009. 167 p.

Appendix 7: Report of the Small Coastal Pelagic Fish Resource Working Group (SCPWG)

Chairperson: Maren Headley, CRFM Secretariat
Rapporteur: Maren Headley, CRFM Secretariat
Other Members: Dr. Susan Singh-Renton (CRFM Secretariat), Francis Calliste (Grenada), Derrick Theophile, (Dominica), Yvonne Edwin (St. Lucia), Christopher Parker (Barbados), Paul Medley (Fisheries Consultant)

A. OVERVIEW

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

A brief review on the Multiple Criteria Analysis (MCA) Study of the flyingfish fishery in the Eastern Caribbean was provided. The study was focused on obtaining the perspectives of stakeholders on the importance of various management objectives. Regional governance of the flyingfish fishery in the Eastern Caribbean requires agreement upon management objectives as well as how important these objectives are in relation to each other. A pre-established hierarchy of objectives can guide governance of the fishery and significantly assist decision-making processes. This hierarchy is critical to manage the complexity of a multi-species regional fishery, because it is rarely possible to optimize multiple and competing objectives. Field work was conducted with fishers, fish processors, and fisheries division staff in Barbados, St. Lucia and Tobago to determine their perception of the relative importance of a range of management objectives drawn from fisheries management plans and reports relating to the Eastern Caribbean Flyingfish fishery. Respondents from landing sites conducted a modified pairwise comparison technique which involved sorting cards with a description of each management objective. In this technique, respondents were asked to arrange the cards according to their importance.

An enquiry was made on the type of Pair-Wise comparison utilized in the study and it was pointed out that various methods existed. Clarification was sought on the development of the operational objectives and it was indicated that a draft was prepared and shared with the shareholders who then added to them. The meeting was reminded that the study was intended to provide a decision analysis tool for managers.

A query on the length of time it took to complete the stakeholder surveys in each country was made and it was pointed out that this took one week each. Some of the limitations of the study included inadequate identification of all fishers and funding to complete more stakeholder surveys.

There was some discussion on the usefulness of the study results and the importance of keeping the interview data up to date and linking them to the current situation to ensure a direct influence at the management level was highlighted. It was pointed out that the relative weights of the objectives showed the importance attributed by the stakeholders. The importance of choosing meaningful indicators to which stakeholders can relate to was also raised.

The Meeting was reminded that the final management decisions were made at the political level and if congruence amongst stakeholders was achieved, then this would be fine, however if there was disparity, it could create problems. The importance of providing feedback to stakeholders to ensure that they were well informed was pointed out. The meeting was also informed that cluster analyses had been done to determine if particular groups had identified specific issues.

The group was informed that once the indicators and reference points were agreed on, the MCA could be tested. It was agreed that the spreadsheet would be circulated by email inter-sessionally and explored during the next Scientific Meeting

A verbal update was provided on the formation of the various joint technical working groups during the 14th WECAFC session in Panama, 2012. The group noted that the first meeting of the joint CRFM / WECAFC Working Group on Flyingfish in the Eastern Caribbean occurred during 18 – 19 June 2012.

The main tasks completed during the Meeting were:

- An update of the sub-regional fisheries management plan for the flyingfish fishery in the Eastern Caribbean
- A discussion on the national consultation process for review of the sub-regional fisheries management plan for the flyingfish fishery in the Eastern Caribbean
- Drafting of a resolution on the Sub-regional Fisheries Management Plan for the flyingfish fishery in the Eastern Caribbean to be presented to the Ministerial Sub-committee on flyingfish
- Discussion of an inter-sessional workplan

The second meeting of the joint working group will be held next year before the Ninth Annual Scientific Meeting.

5. Inter-sessional workplan and Recommendations.

Inter-sessional workplan

The Group noted that the joint CRFM / WECAFC Working Group on Flyingfish in the Eastern Caribbean meeting was convened and recognized the need for countries to provide support for the implementation of the inter-sessional plan.

Recommendations

It was recommended that the MCA should be completed to allow full exploration of the tool and its usefulness.

6. Review and adoption of Working Group report for 2012.

The group adopted the meeting report.

7. Adjournment.

The meeting was adjourned at 6:00 pm.

Appendix 8: Report of the Data, Methods and Training Working Group (DMTWG)

1. Opening of the Meeting

The Statistics and Information Analyst, CRFM (June Masters) served as Chairperson of the DMTWG. The Chairperson opened the meeting at 9: 20 am, and welcomed the participants to the 2012 / 2013 meeting of the DMTWG. The participants were invited to introduce themselves. In attendance were representatives from twelve (12) Member States and two (2) observers: Nancie Cummings, U. S. NOAA, NMFS and Professor Hazel Oxenford, CERMES, UWI Cave Hill Campus. Also present was Professor John Hoenig, (Consultant) who would provide training for the group.

Dr. Singh-Renton, Deputy Executive Director of the CRFM also welcomed the participants and expressed her delight at the hosting of another Scientific Meeting.

Professor Hoenig the training consultant was also asked to introduce himself to the group and provide a brief overview of the training that would be undertaken by the group for 2012/2013.

2. Review and adoption of Meeting Agenda

The draft agenda was presented to the meeting for review and adoption. With regards to Item 3: Training in use of Excel for data manipulation and analyses, it was pointed out that the training to be provided was changed to: Training in use of "R" for data manipulation and analyses. The Agenda that was adopted can be seen at Appendix 1.

The St. Lucia representative, Miss Yvonne Edwin, was appointed to rapporteur the meeting. Working hours and timing of refreshment breaks were established.

3. Training Sessions

3.1 Training in the use of R statistical and graphical programming language

Professor John Hoenig provided instruction on the use of the free statistical and graphical programming language R and on the use of the free editor RStudio. He covered downloading and installing R, downloading packages of functions, data input, data manipulation, error message, finding information about R, and graphics.

3.2 Training in Methods

Training in methods focused on graphical techniques for data quality control and on graphical approaches to data analysis. Techniques for both goals include strip charts, dot charts, jittering, box and whisker plots, rug displays, histograms, and scatterplots. Additional techniques for data analysis include star plots, scatterplot smoothers (e.g., lowess), kernel density estimators, use of translucent plotting symbols, and parallel coordinates plots. Some important principles of graphing were discussed such as scaling, banking, dealing with overprinting and crowding, avoiding mental calculations, and orientation of graphs.

4. Plenary session

A plenary session to review the 2011 – 2012 inter-sessional activities, discuss training needs and develop the workplan for the 2012 – 2013 period was held on 21 June 2012.

4.1 Review of the 2011 – 2012 inter-sessional activities

Ms. Maren Headley and Ms. June Masters provided the Meeting with an update of the inter-sessional activities undertaken by the CRFM Secretariat. Updates were as follows:

a) CRFM yahoo e-group, CRFM toolbox and CRFM notebook

Ms. Headley reported that during the 2010 – 2011 inter-sessional period, a yahoo e-group, a CRFM toolbox and a CRFM notebook were established for the use of the DMTWG, but to date these facilities were seldom used by the members of the working group. Ms. Headley asked the group members to provide feedback on the usefulness of the e-group, the toolbox and the notebook, and to indicate the challenges faced in using these facilities or reasons for the limited use of the facilities.

Discussion

By way of feedback the Dominican representative indicated that the use of yahoo e-groups for communication was becoming outdated as the tool of choice for communicating and networking for many people is now Facebook. The Dominican representative therefore suggested that the yahoo e-group be switched to Facebook to keep in pace with the changing IT landscape. The Dominican representative was supported by SVG on this issue. The Barbados representative expressed the opinion that even though the facilities were not being used frequently at present, they were of value and should continue to be available to the group members. The Belize representative indicated that there was a need for the facilities offered, he however felt that personnel should be assigned to regularly (at least once per month) circulate updates, newsletters etc. on the e-group. Suriname also supported this suggestion.

The current representatives from Guyana, Jamaica, Grenada, Turks and Caicos Islands and one of the representatives from Suriname, were new to the group and were not aware of the facilities. The new members of the group raised queries as to the difference between the toolbox and the notebook and the uses of these facilities. Given these queries the St. Lucian representative suggested that a short visual presentation on the use of the toolbox and notebook was necessary. She also suggested that more material should be placed in the toolbox and notebook.

A query was also raised concerning the necessity for a password to access the toolbox and notebook. Ms. Headley indicated that the Turks and Caicos Island (who had contributed the notebook material) was uncomfortable with free access to the country's data. Professor Hoenig also indicated that he had requested that a password be placed on the facilities to protect intellectual property. Professor Hoenig indicated further that if the group wanted the password removed he was willing to withdraw his request to have a password placed on the facility.

The group asked Ms. Headley to re-send the information (including the password) and instructions to the group (including the new members). The group agreed to make a concerted effort to use the facilities during the upcoming inter-sessional period.

b) 2011 CARIFIS survey

Ms. Masters provided an update on the 2011 CARIFIS survey. She reported that the second meeting of the CRFM DMTWG recommended that: the CRFM Secretariat should find out if Member States wished to continue with the use and development of CARIFIS. During the 2011/2012 inter-sessional period the CRFM Secretariat developed (in-house) and circulated to all Member States the CRFM stage of implementation of CARIFIS and options for the way forward Questionnaire. Sixteen (16) Member States returned completed questionnaires. Trinidad and Tobago returned one questionnaire for Trinidad and one

for Tobago, thus there were 17 responses. Antigua and Barbuda did not return a completed questionnaire but indicated that CARIFIS was not used by that Fisheries Division. The report of the survey was presented at the Tenth Meeting of the Caribbean Fisheries Forum, held in The Bahamas, 26 – 28 March, 2012. The PowerPoint presentation delivered to the Forum, as well as the complete text of the report "Overview of the Status of Performance of CARIFIS in CRFM Member States, and Options for the Way Forward" were shared with the working group.

Ms. Masters informed the group that the Forum recommended that technical advice be provided to Member States in addition to a cost analysis of fixing and upgrading CARIFIS versus alternative options.

Discussion

The group reviewed the report "Overview of the Status of Performance of CARIFIS in CRFM Member States, and Options for the Way Forward" and discussed the recommendations that came out of the CARIFIS survey, and the recommendation given by the Forum. The Suriname representative thought that the recommendations should have said something about extraction and debugging of the database. The representative from Montserrat suggested that if the decision was to move ahead with CARIFIS then the group should get some training in CARIFIS use. The representative from Barbados felt that the report should have stated the complete responses of Member States instead of summarised responses.

Queries about simultaneous use of CARIFIS were raised by the Suriname representative and it was clarified that in the case of Montserrat two computers were used to enter data simultaneously. The St. Lucia representative reminded the group that the TIP and LRS software were merged and upgraded to CARIFIS. She queried if it was known if these two software packages had been upgraded over the years. Nancie Cummings of the US, NOAA, NMFS, informed the group that with regard to TIP, it had been upgraded using Oracle and would be revamped in 2013. She further stated that the Trip Interview Programme (TIP) Bio-statistical Data Collection software has been online for a number of years and data collectors are able to remotely enter data which goes to a central server at NMFS. In addition, recently they have developed online data entry system for the US Caribbean commercial landings data (CCL).

The Montserrat representative raised concern as to whether or not the report had been sent to the group members. Ms. Masters explained that the report was sent to the group members. However a number of group members indicated that they had not seen the report and bearing in mind the new members of the group, Ms. Masters indicated that she would re-circulate the document. The representative from Montserrat indicated that while he recognized that information passed along the formal channels, he also felt that items of immediate concern to the group should be copied to the group members. However the Suriname representative reminded the group that the formal channels of communication should be adhered to. Professor Hoenig suggested that the mailing list used by the DMTWG should be a cumulative list of all persons who had at some time participated in the group. He explained that though he (or others) might be missing from certain meetings of the group he (and others) would like to be kept informed of the activities of the group.

4.2 Suggested Training for the 2012 - 2013 period

1. The Jamaican representative requested more days for training.
2. The Suriname representative indicated that though he had previous knowledge of data cleaning techniques, at the recently concluded UNU-FTP/ Gov Iceland / CRFM stock assessment workshop he was introduced to more advanced techniques, and would therefore like to request that the group be provided with training in data cleaning techniques.

3. The Montserrat representative suggested that, if it was agreed that CRFM would move forward with the upgrading of CARIFIS; then Member States would need training in CARIFIS use. As such the training session of the DMTWG 2013/2014 could be used for that purpose.
4. Professor Hoenig offered to develop a lesson in data cleaning techniques using excel and distribute it to the members of the group. It would be placed in the CRFM toolbox.
5. The representative from Dominica suggested training in technical writing which would include interpreting data.
6. The representative from St. Lucia suggested that the group should consider a one week training course to deliver training in data management, data analysis and data cleaning.
7. The group also agreed that the two week stock assessment course that was provided through the UNU-FTP/ Gov Iceland / CRFM partnership should be repeated.

4.3 2012 – 2013 inter-sessional Workplan

(a) The Secretariat will review the mailing list for the DMTWG, with a view to making the list a cumulative list.
(b) The Secretariat will circulate to all group members the password and access information for the CRFM toolbox and CRFM notebook.
(c) The Secretariat will at least once per month post information on the yahoo e-group. Information could include group updates, newsletters, articles of interest, etc. Country representatives from Dominica, Turks and Caicos Islands, Jamaica, Montserrat, St. Lucia and Belize will assist the Secretariat by submitting articles, etc.
(d) The CRFM Secretariat will re-circulate to the group the report *"Overview of the Status of Performance of CARIFIS in CRFM Member States, and Options for the Way Forward".*
(e) The Secretariat will update the group on progress made with the recommendation from the Forum that technical advice be provided to Member States in addition to a cost analysis of fixing and upgrading CARIFIS versus alternative options.
(f) Professor Hoenig will develop a lesson in data cleaning techniques to be placed in the CRFM toolbox.
(g) Professor Hoenig, (the DMTWG Consultant) and Nancie Cummings (U. S. National Marine Fisheries Service) will continue to assist group members to improve and develop their skills in using "R", and will be available to answer all "R" queries from the group over the inter-sessional period.
(h) Meeting participants agreed to make every effort to utilize the e-group, the CRFM toolbox, and the CRFM notebook, as well as to schedule time to practice using "R" during the upcoming inter-sessional period.
(i) In an effort to pass on the training received during the DMTWG training session, the meeting participants agreed to facilitate at least one training session (based on the training provided in the DMTWG training session or the fishery assessment undertaken at the Scientific Meeting), in their respective Fisheries Departments.

5. Any other Business

The representative from Belize indicated that Belize would be undertaking a conch survey during August - October 2012. An invitation was extended to all group members to come to Belize to participate in and learn from the survey. The Belize Fisheries Department could not fund group members for this activity, but it was further suggested that group members seek funding for the activity.

The Montserrat representative indicated that in his opinion data collection and management seemed to be low priority issues for CRFM fisheries managers. He suggested that the DMTWG should demonstrate to

the region's fisheries managers the importance of data collection and management, through a presentation at the next CRFM Forum meeting.

6. Adjournment

The plenary session adjourned at 5:15 on 21 June 2012.