CRFM Secretariat

GLOVER'S REEF MARINE RESERVE DATA COLLECTION PLAN (PART 2)

Skiff and sailboat, Belize City

Sandra Grant
Consultant
June 2004

Funded by the Wildlife Conservation Society

CRFM Secretariat
Belize City, Belize
September 27, 2004

Glover's Reef Data Collection Plan

TABLE OF CONTENTS

Executive Summary

1. This report documents a marine fisheries catch and effort data collection plan for Glover's Reef, Belize, based on the investigation of an independent consultant, Sandra Grant, June 2004.

2. The report follows from the Glover's Reef Marine Reserve fisheries boat census 2004 report (Part 1), by using information from the census (e.g., fishing patterns, gear use, landing patterns, number of boats and fishermen by fishing beaches) to develop a catch and effort data collection program for the atoll, which will allow fisheries managers (Fisheries Department and WCS) the opportunity to understand fishing trends in the General Use Zone.

3. Presently, a number of research activities are being conducted in the Conservation Zone, however, very little research in the General Use Zone. Thus, by conducting this assessment, comparisons could be made between the two areas, and it is hoped that the results will demonstrate to fisheries managers, fishermen, and stakeholders, the benefits of marine reserves on fish production.

4. The report:
    - Summarizes the main fisheries and current management measures for lobster, conch, and finfish on Glover's Reef; the ongoing national data collection system implemented by the Fisheries Department; and the data collection process, briefly discussing each aspect, from generating research questions to analysis and monitoring.
    - Presents a data collection design for gathering catch, effort, and biological data for lobster, conch and finfish, from the atoll. The sampling approach divides the fishing fleet into two groups (1) Skiffs boats, operated by Dangriga and Hopkins fishers and (2) Sailboats, operated mainly by Sarteneja fishers. By sampling these two groups, estimates of total catch, and total

effort, may be obtained.

- Discusses data management, data and information sharing, and managing all types of research data conducted on the atoll.
- Outlines resources needed to implement the data collection program. Such resources include: hiring two data collectors, one stationed at Middle Caye and the other in Hopkins Village; purchasing equipment to do the work; training personnel; and monitoring data collection activities.

5. Unfortunately, the sampling program could not be linked to the national data collection program, because the national system needed re-structuring. However, the report could be used as a template to design other data collection systems.

1.1 Background (WCS)

Glover's Reef, the third largest marine reserve in Belize, was declared a marine reserve (1993), and a World Heritage Site in 1996. The Fisheries Department (Ecosystem Management Unit, Marine Reserves) manages the atoll and the Wildlife Conservation Society (WCS) provides support where it can. The WCS seeks to ensure the long-term conservation of this site by identifying threats to the atoll, building and strengthening alliances with stakeholders to support long-term conservation, and implementing strategic conservation interventions. The overall management goals of the atoll are:

1. To provide protection to the physical and biological resources of Glover's Reef, in order to maintain and sustain these resources for the benefit of current and future generations.
2. To maintain natural areas for education and research.
3. To preserve the value of the area for fisheries and to provide recreational and tourism services (Gibson, 2003).

One objective of goal no. 3 is important to this sampling program:

> *"… to provide protected habitats for commercially important species in order to enhance recruitment and replenishment, thus achieving sustainable yields, and to demonstrate these benefits to fishermen…" (Glover's Reef Management Plan, Gibson 2003:34)*

To meet this specific goal and objective, the WCS embarked on a number of research and monitoring programs to improve management and to assess the effectiveness of the reserve (Gibson, 2003). In the Conservation Zone, a number of fishery-independent research are being conducted (Acosta, 1998; Acosta, 2001; Acosta and Robertson, 2001; Gibson, 2003; see also Table 8). However, in the General Use Zone, very little research has been done. Thus the WCS wants to conduct fishery-dependent research (i.e. the amount of fish harvested, size, and species composition of fish products harvested) in the General Use Zone, to determine if there are any positive benefits (e.g.,, spillover effects) of the Conservation Zone on fish production. Although some fisheries data is available at the Fisheries Department and Fishermen Cooperatives (Mango Creek receiving station Stann Creek, National and Northern Fishermen Cooperatives Belize City), a comprehensive and systematic data collection program is needed, which would capture all fish harvested from the atoll.

1.2 The process

The WCS, with assistance from the Caribbean Regional Fisheries Mechanism (CRFM) Secretariat, employed a consultant, Sandra Grant, to develop a fisheries data collection program for Glover's Reef. The data will be used to determine trends in landings and fishing pressure at Glover's Reef Atoll, and provide baseline Catch per Unit Effort (CPUE) data in order to determine the effect of the marine reserve's 'no take' zone on fisheries production. Sampling occurred in Belize City, Glover's Reef Middle Caye, Sarteneja, Hopkins, Dangriga, with occasional trips to other sites to the Fishermen Cooperatives. It was estimated that it would take 36 days, between April and May, to implement a data collection system for Glover's Reef.

Ms. Grant (Consultant) was guided and assisted by Beverly Wade (Fisheries Department (FD) – Fisheries Administrator), James Azueta (FD - Ecosystem Management Unit), Isaias Majil (FD - Protected Area Management), Mauro Gongora and Ramon Carcamo (FD - Capture Fisheries Unit), Jerriann Frost and Isani Vincente (FD - Licensing and Registration), Janet Gibson (WCS - Associate Conservation Scientist), Danny Wesby (WCS), Milton Haughton (CRFM), Vincent Gillett [Belize Fishermen Cooperative Association (BFCA)]; Athen Marin (Research Assistant); Mr. Marin (Northern Fishermen Cooperative); and fishers from Hopkins, Dangriga, and Sarteneja. The activities undertaken during the consultancy are outlined in Appendix A.

1.3 Objectives

As defined by the terms of reference, the objective of this consultancy is to collect landings and effort data for lobster, conch, and main commercial finfish species for the General Use Zone of the Glover's Reef Marine Reserve. The consultant proposed to:

- Develop the frame survey and system for the collection of catch and effort data at Glover's Reef.
- Design a data collection plan for ongoing collection of fisheries catch, effort, biological, economic and social data (based on information obtained from the frame survey).
- Design a system for managing the data that is generated from the data collection system.
- Train fisheries data collectors, managers, and fishermen in essential components of the project.

The consultant was also asked to produce the following outputs: report on the frame survey; design a fisheries data collection plan for Glover's Reef; develop data collection forms; provide advice on computer software; prepare training material; train appropriate personnel; implement the data collection system; and report on data collected (during trial period). Reports and deliverables should be delivered to the CRFM Secretariat, the WCS, and the Fisheries Department.

1.4 Problems and difficulties encountered

Difficulties were encountered with locating Glover's Reef fishermen because they were from four fishing communities in Belize. In many instances, the research assistant and myself, visited communities, but fishermen were at sea. In those cases, we tried to wait for fishermen to return from sea, but, in some instances, we missed them altogether. During my visit to Glover's Reef, we were unable to observe fishing activities because on the day we went out, we did not observe any fishing vessels.

2. GLOVER'S REEF FISHERIES

This section gives an introductory review of the main fisheries and current management measures on the atoll. The information comes mainly from the Glover's Reef Marine Reserve Management Plan (Gibson, 1993).

2.1 Lobster

The lobster fishery employs about 108 fishermen and about 22 active vessels, ranging from 20 – 33 ft, utilizing 40-60 hp outboard engines and sail (Frame survey report). The only gear allowed when harvesting lobster is free dive, using hook sticks. Lobster is caught along the inner and outer reef habitat of the atoll as well as inshore the lagoon of the barrier reef. The fishery is regulated by an annual closed season from February 15 to June 14, minimum size restrictions by weight (144 g) or carapace length (8 cm), and a ban on berried and molting individuals. SCUBA is prohibited when diving for lobster for commercial use. Gear restrictions within the marine reserve General Use Zone also include a ban on the use of lobster traps.

Data on lobster catches from Northern and National Fishermen Co-operatives for the period 2000 and 2001 represents 8% and 10% respectively, of national annual total catch

(Gibson 2003). Research on lobster within the conservation zone showed that the populations increased and then stabilized causing a spillover effect into the general use zone (Acosta 1998).

2.2 Conch

The same vessels that are used for lobster are also used for conch. Fishermen dive free-lung, inshore the lagoon of the barrier reef and fore reef, to collect conch by hand. The fishery is regulated by a closed season, from July 1 to September 30, and by minimum size restrictions on shell length (18 cm) and market cleaned weight (85 g). The total production for conch for the period from 2000 to 2001 represented about 4-5% of the national annual total catch (Gibson 2003). Again Acosta (1998) research showed that the populations in the conservation zone increased, causing a spillover effect into the general use zone.

2.3 Finfish

In the Finfish fishery, species targeted are snappers (yellowtail, deepwater silk, mutton), and groupers; by fishermen using handline, spearguns, and caste net (bait). Finfish are targeted by fishers from Dangriga and Hopkins, however, for Sarteneja fishermen, it is incidental catch. Generally, there are no specific regulations on finfish, except for the closure of spawning aggregation sites for Nassau Grouper (NE Channel), and Mutton Snapper (between North East Caye and Long Caye). However, there are restrictions against the use of fish traps, nets or long line in the reserve (Fisheries Regulations, 1996).

3. OVERVIEW OF THE NATIONAL DATA COLLECTION SYSTEM

In Belize, there are five main components to collecting catch and effort data (Hoggarth 1998):

1. Census of lobster and conch landed direct to the fishing Cooperatives.
2. Sampling of catch and effort data of finfish landed at market sites, and lobster and conch landed at the Cooperatives.
3. Logbook recording of lobster, conch, and fish supplied directly to hotels in tourist areas.
4. Household data collection of fish catches to determine home consumption.
5. Logbook recording of catches and efforts on board industrial shrimp trawlers.

Presently, of the above five, the FD only collects data on the first component, from Northern and National Fishermen Cooperative processing plants. Data is compiled on a monthly basis from sales receipts (Appendix B), entered on compiled fisheries data form Cooperative sheet (Appendix C) and entered in an Excel spreadsheet (years 2000 to present). From the sales receipts, data on monthly catch and effort data are compiled by vessels landed that month, catch by species, effort (days fished), date (month and year), fishing areas 1-6 (Fig. 1), and gear type. In many instances, data is incomplete for areas, months, or Cooperatives. No catch and effort data (Appendix D) was collected for finfish at fish markets in Belize City, Vernon Street, Dangriga, Corozal, San Pedro, and Caye Caulker.

Biological data collection (for lobster, conch, finfish, and industrial shrimp) was established to determine the current status of the stocks and the optimal levels of exploitation, reproductive sizes and seasonality of exploited species, and indication of distribution and extent of juvenile and adult habitats (Hoggarth 1998). The lobster Biological Data Collection (BDC) program collected samples from all six fishing areas. Catches at sea were recorded on board fishing vessels and include data on carapace length, sex, and breeding state. Landings at Northern and National Fishermen Cooperatives, recorded tail length, 2nd segment width, sex and breeding state is sampled (Appendix E). Sampling targets recommended for lobster were 100/month/fishing ground from both processing plants. Maturity data was also required for 50 lobsters per month per fishing area. Presently, length frequency sampling only, was mainly from areas 1, 4, and 5.

Sampling of conch included both abundance surveys (1996, 2003), and at-sea recordings of annual length frequencies. Recommended sampling strategies for conch, were to sample shell lengths and lip thickness (when whole animals are landed), or to sample meat weights (when meat only are landed), supported by length-weight relationship sampled at sea (Hoggarth 1998). Sampling targets were 200-300 per fishing ground measured at sea (Appendix F).

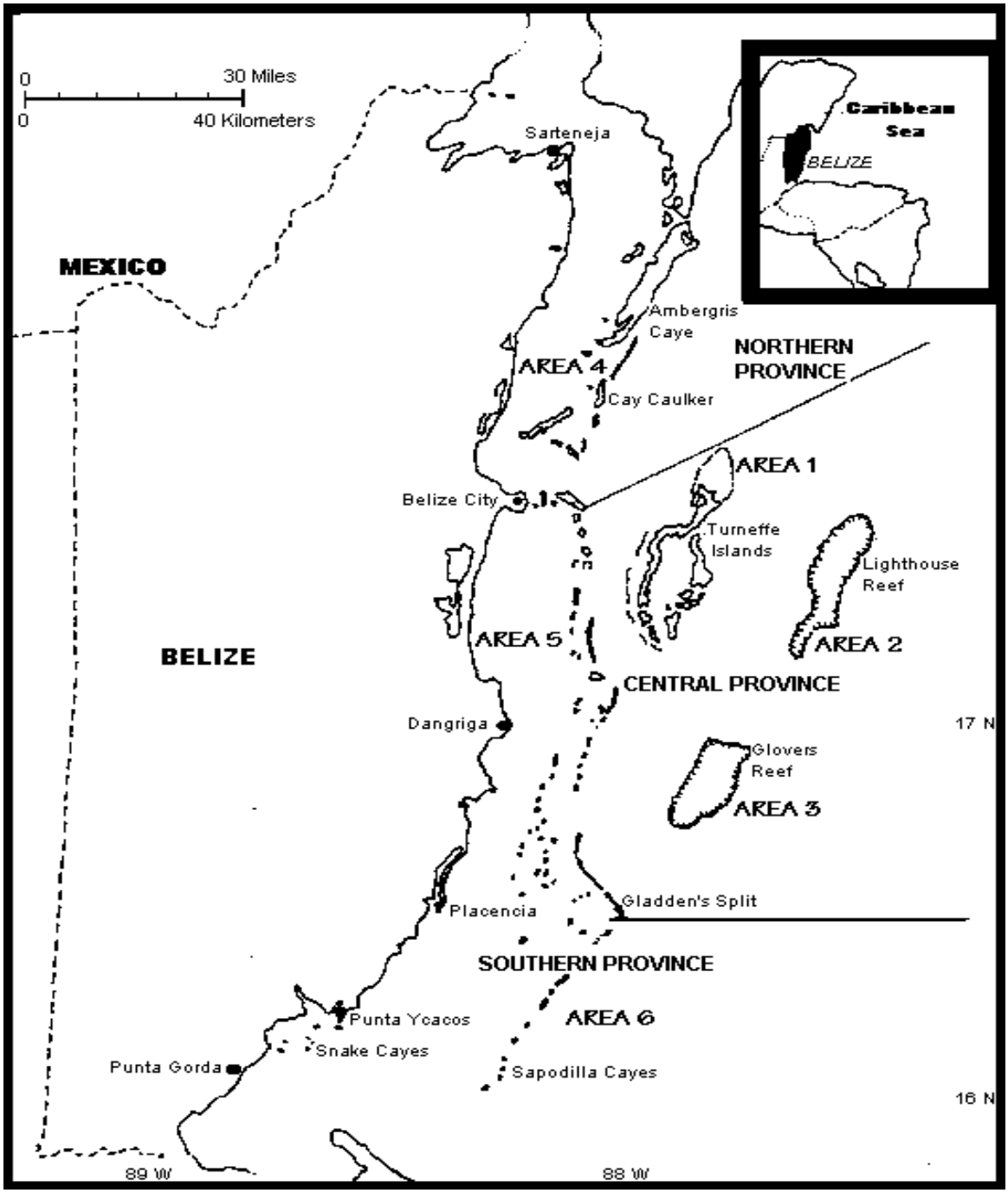


Fig. 1: Map of Belize showing fishing areas 1 to 6 (Source: Fisheries Department)

For finfish, large fillets were marketed through the Cooperatives, or taken directly to hotels and restaurants, while small whole species were landed at markets for local consumption. The sampling plan was based on representative length frequency data, maturity, and aging data. Sampling targets included 16 fish species, recording 150-200 lengths per month, maturity and otoliths data (Appendix G). Presently, no biological data is being collected on finfish.

For Glover's Reef, the Fisheries Department had catch and effort data from 2000 to present, for Northern, National, and Mango Creek Cooperatives; however, they did not collect catch and effort data from Dangriga fish market or Hopkins Village. Very little biological data existed for Glover's Reef.

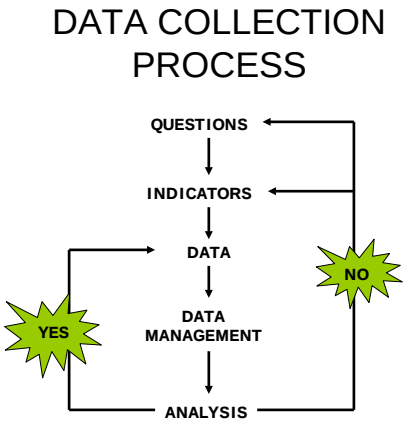
Overall, the FD's national data collection program needed urgent re-structuring, as it only captured catch and effort data from Northern and National Fishermen Cooperatives in Belize City (no data was collected from fish landing sites such as Punta Gorda, Hopkins Village, Dangriga, Vernon Street fish market, Corozol); and biological data from two of six fishing areas. Thus it is not possible at this time to link the present sampling program with that of the FD. However, in developing this ongoing data collection process for the collection of fisheries catch, effort, biological, economic, and social data plan, the consultant was conscious of possible links in the future.

4. DATA COLLECTION PROCESS

4.1 Review of the data collection process

There are five main processes needed to develop a data collection system:

- QUESTIONS – formulate your questions.
- INDICATORS - determine performance indicators or reference points to be used to answer questions.
- DATA - collect data based on indicator requirements.
- DATA MANAGEMENT – create a procedure for data entry and management.



- ANALYSIS - analyse data.

If the initial questions are not answered once the data has been collected and analysed, it is necessary to either change the indicators used or alter the questions. If the data analysis answers the initial questions, then data collection continues.

In this case, the questions asked were:

1. ***Is the fishery on Glover's Reef healthy?***
2. ***Are there any positive benefits for fisheries production resulting from the marine reserve's conservation zone?***

4.2 Performance indicators and reference points

Performance indicators are any quantifiable value that indicates how a fishery is performing. To interpret an indicator, reference points are used (Medley 2001). The main advantage of performance indicators and reference points is that they are easy to interpret; therefore, they are an important aid in decision-making (Medley, 2001). Table 1 (below) outlines some common types of indicators used in fisheries. Empirical indicators do not have a strong dependence on models; however, non-empirical indicators are directly related to analytical models and require scientific research programs.

Table 1: Some examples of the types of indicators and reference points used in fisheries (Source Medley, 2001:14)

Performance indicators/ Reference points		**Minimum data variables required**
Empirical	Total annual landings **CPUE** Vessel Profits Average Fish Size	Landings **Catch and effort** Catch, prices, and costs Catch composition; Age-at-first-maturity
Non-Empirical	Yield-per-recruit **Biomass and Maximum Sustainable Yield (MSY)** Net Present Value	A long time series of catch composition and effort **A long time series of catch and effort** A long time series of costs, prices, catch and effort

Catch per Unit Effort (CPUE) and Maximum Sustainable Yield (MSY) were chosen as performance indicators and reference points for this study. These methods of assessing stocks require data on the fishery (catch, effort) and biological data (species and size

frequency). A simple stock assessment utilizes landings and effort expended by fishermen to obtain CPUE, which is used as a relative measure of stock abundance. Thus changes in CPUE will reflect changes in relative fish abundance. Surplus production models require a long series of CPUE data gathered over several years. The model assumes that biomass (weight) of fish in the sea is proportional to the CPUE, so it provides an estimate of yield for varying levels of fishing effort. "MSY is the largest average catch that can be taken continuously from a stock under average environmental conditions" (CFRAMP, 1995). Environmental data, such as water temperature, depth and salinity also help to predict abundance, yield and distribution.

4.3 Data requirement

4.3.1 Catch measurement

Total landings for lobster, conch, and finfish by fishing area are usually obtained from the Cooperatives (Table 2) where fishermen take their products and obtain payment (lobster and conch, first and second payment) for their catch. In recent years, fishermen began selling products to hotels, restaurants, and fish markets (e.g.,, Vernon Street); quantities are unknown.

Table 2: Total 1994 catches of queen conch and lobster, as reported by TIP (before raising) (source Hoggarth 1998: Table 7.7).

Species and Area	Total Catch (lb)	Total effort (days fished)	CPUE (lb/day fished)
Queen Conch			
Area 1	15,371	23,671	0.65
Area 2	8,210	82	100.12
Area 3 (Glover's)	**12,021**	**23,484**	**0.51**
Area 4	53,991	35,773	1.51
Area 5	37,502	24,079	1.56
Area 6	22,891	21,125	1.08
Spiny Lobster			
Area 1	31,270	24,859	1.26
Area 2	10,173	2,741	3.71
Area 3 (Glover's)	**7,859**	**24,112**	**0.33**
Area 4	69,229	41,724	1.66
Area 5	69,191	31,265	2.21
Area 6	26,255	29,154	0.90

Data included combined gear or full effort measurement. Effort data for areas 1, 3, 4 are often given as 0.

4.3.2 Effort measurement

Effort measurement, such as number of fishermen or days fished, may provide reasonable comparisons of fishing activities between years "only if the fishing practices and their spatial and temporal distribution are constant" (Hoggarth, 1998). The method of using "days fished" is an inadequate indicator of fishing effort, because the "catchability" of a day will depend on the skills, knowledge and experience of fishers over time. Thus for monitoring abundance of fish using CPUE indices, more detailed effort will be required. Different fishing efforts are required for different gears (Table 3).

Table 3: Recommended fishing effort measurements for gears used in Belize (Adapted from Hoggarth 1998: Table 7.9).

Gear **a**	**Quantity of gear/ Number of sets** **b**	**Units of Gear** **c**	**Gear Descriptor** **d**	**Hours Fished** **e**	**Effort unit**
Traps	Total number of traps fished	Number of individual traps hauled per set	Mesh size	Set to haul per set	**a * d**
Troll Lines	Number of lines	Number of hooks (total)	None	Hours fished	**b * d**
Handlines	Number of lines	Number of hooks (total)	None [hook size]	Hours fished	**b * d**
Set Nets (weirs)	Number of times unit of gear was set	Yards (to be defined by gear)	Mesh size	Set to haul	
Trawls	Number of sets	Number of nets	Net type	Set to haul	**b * d**
Divers	Number of dives	Number of divers		Hours fished	**a * d**
Caste net	Number of times	Yards (size)	Mesh size	Set to haul	**a * d**

4.3.3 Biological parameters

Models for stock assessment are usually length-based (e.g., Thompson & Bell). Data collection for estimating biological parameters requires that specimens are representative of the fish population, as the data obtained are used to estimate population parameters. Such data requires information on growth, mortality, sex, age or size at maturity, recruitment timing, and exploitation rate.

Information on reproduction and maturity is used to protect spawning stock, by ensuring that enough fish are allowed to reach reproductive size, and that they are protected while they are spawning. Data on sex and maturity provides information on size at maturity, used to protect immature fish and to calculate health of the fishery, and spawning seasons and behaviour, used to protect species vulnerable to overfishing (CFRAMP 1995).

5. GLOVER'S REEF DATA COLLECTION SAMPLING PLAN

This section of the report details the sampling program for lobster, conch, and finfish of the Glover's Reef Atoll. Sampling will focus on total catch, total effort, and some biological measurement of specific species. Data required for fisheries management and decision-making are relatively simple, but the data may be difficult to obtain. Thus a sampling plan which optimizes quality and quantity versus the cost of monitoring is needed.

5.1 Catch and effort sampling plan

The sampling program should be divided into two sections: (1) Skiffs from Hopkins and Dangriga; and, (2) Sailboats from Sarteneja. Information from the frame survey suggested these two fishing practices are different and should be treated as such.

5.1.1 Skiff sampling

Skiff boats, ranged from 20-26 ft, were powered by outboard engines, and carried crew of 2-4 fishers from Hopkins and Dangriga. The frame survey captured 14 vessels; 43% which carried an extra dory, fish mainly by handline gear, but sometimes switch to dive for lobster and conch depending on catch levels. They usually fish with four handlines in the water, three droplines (120-250 fathoms) and one set line (50-150 fathoms). Hooks are baited with sprat, shrimp, or whole fish for deepwater snapper, barracuda, kingfish, and rockfish. They would fish 2-4 days for 7-15 hours at a time. Hopkins fishermen sell their finfish catch in Hopkins (to restaurants, hotels, and consumers), but lobster and conch is transported by road to a Mango Creek receiving station (Northern Cooperative). Dangriga fishermen sell their product in the Dangriga fish market (Fig. 2). Catch and effort data collection, will focus on capturing information at the first point of fish landings, Dangriga fish market and Hopkins village (Fig.2 shaded area).

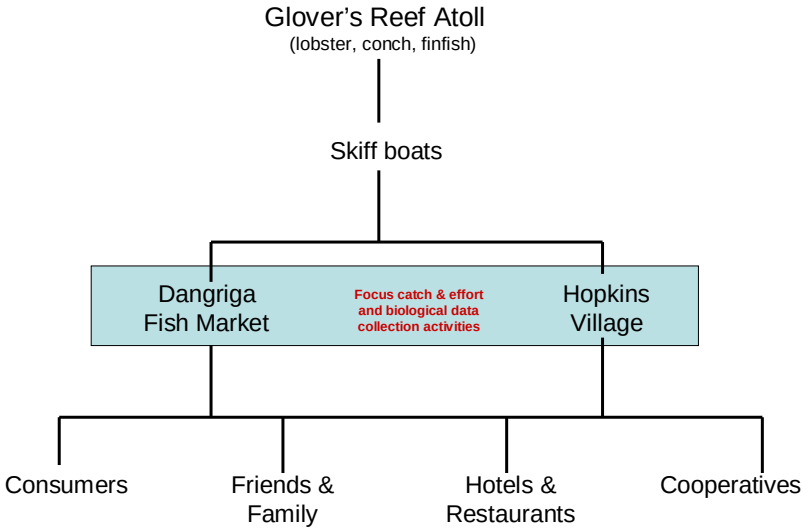


Fig. 2: Flow diagram showing the movement of fish products from the atoll to market/consumer (skiff boats)

Objective: To capture total catch (by species) and effort data by gear type and fishing community/market.

Issues:

- Data collection should be a census of all boats landed in Hopkins (12) and a sample of boats from Dangriga (2).
- If the data collector is unable to sample Dangriga, they would have to rely on informant information to determine when boats return from fishing, thus raise Hopkins data to determine landings from Dangriga fishermen i.e.,

Dangriga landings = [(Hopkins total monthly catch/number of trips) X total Dangriga boat trips per month]

Data collection:

- When fishers return from sea, determine whether the vessel fished Glover's Reef.
- Determine type of gear used and separate catch by gear type.
- Group fish by species (where possible) and weigh them before any fish are removed from the vessel:
    - Estimating total landings can be obtained from visual estimates of the weight or summing the weights of known volumes (See training manual).
- Complete **Fisheries Division catch and effort data sheet** (Appendix D):

- Record the vessel identification mark (this is the only way to trace catch and effort and biological data collected).
- Complete as many sections based on observations and background knowledge (crew size, fishing gear, time depart, time returned).
- Record the total weight of each species caught by fishing gear. If unable to obtain species-specific information, use total weight for major species groups landed.
- Determine the total fishing effort for each gear deployed (i.e., the units of gear used to obtain the catch).

- Document all vessels returning from Glover's Reef whether fish were caught or not.
- Send data sheets to WCS periodically.

Assumption:

- Dangriga and Hopkins boats have similar catch rates.

5.1.2 Sailboat sampling

Sailboats, ranged from 21-38 ft., were powered by sail and outboard/inboard engine, and carried crew of 7-12 fishermen and a cook, mainly from Sarteneja, and others from Belize City, Orange Walk, Corozal, Cayo. The frame survey captured eight active vessels, which had 7-14 dories, fished mainly free-dive gear for lobster and conch. When there is a demand for finfish, fishers would fish at night. They fished 8-10 days for 7-12 hours per day. Sailboat fishermen work independently, and each fisherman takes lobster and conch to their respective Cooperative. Some of this product is sold to hotels and restaurants. Rejects are taken home or sold outside the Cooperatives. Catch and effort data collection, will focus on capturing information at the Cooperatives where most fish products are landed (Fig. 3 shaded area). Missing information on fish products to hotels and restaurants, and family and friends will be supplied from the socio-economic study presently being undertaken by the WCS.

Fisher from sailboat landing conch at Cooperative, Belize City

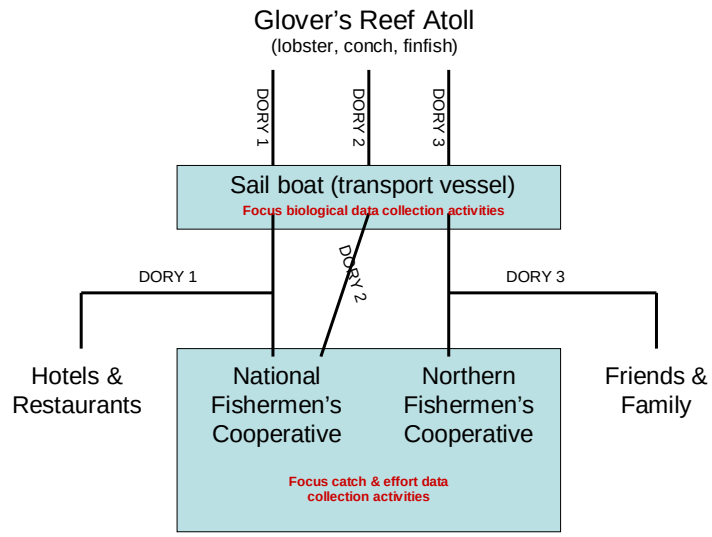


Fig. 3: Flow diagram showing the movement of fish products from the atoll to market/consumer (sail boats)

Objective: to capture total species catch and effort data by gear type and fishing beach.

Issues:

- Data from the Cooperatives (lobster, conch, finfish)
  - Most fishermen land their products at the Cooperatives; however, some sell their products in the markets, to hotels, or to restaurants. Once the percentage of fish landed at hotels and restaurants is known, landings at the Cooperative should be raised, i.e.,

    Total catch = Cooperative sales + Hotels sales + Restaurant sales + given to family and friends
- Species composition of filleted fish is not known.

Data collection:

- Data collection should focus on data from Cooperatives; National (Belize City) and Northern (Belize City and Mango Creek).
- Data collectors should go to the Cooperatives periodically and record information (Appendix C) for Area 3 from sales receipts, **or** obtain information from the Fisheries Department (where possible).

Assumption:

- All fish products landed are from area 3 (sometimes captain may fish two major fishing areas).

5.2 Biological sampling plan

The sampling design is based on the need to use biological information for:

1. Length-based stock assessment (Biomass & MSY).
2. Simple descriptive statistics of commercially important species (length frequency).
3. Monitor biological changes in population (temporal and spatial changes in size frequency).

The objective of biological data collection is to assess the status of fishery products on the atoll. Data collectors will collect length and weight data for lobster, conch, and finfish. Sexual maturity, and aging should be included where resources permit.

For each species in different sampling locations, the following is needed:

- Representative length samples [Fork Length (FL) or Total Length (TL)] with accompanying catch/effort/gear information.
- Weights from length-stratified sub-samples to determine weight relations.

Recommended sampling approach:

Table 4: Sample type by sampling intensity and design

Type of sample	Sampling intensity	Sampling design
Length frequency (full sampling `L')	150-200 fish/fishing ground/month	random within gear/fishing beach
Length frequency (less intense `l')	150-200 fish/fishing ground/two month	random within the major gear/landing
Maturity (`M')	10-15 per size class/ fishing ground	length stratified at major market area.
Age (`A')	25-50 fish/fishing ground	length stratified at major market area

The sampling design will attempt to capture this information by dividing sampling into two groups - skiff and sailboats by fishing gear and month. Proposed fish species for biological monitoring are lobster, conch, nassau grouper, yellowtail snapper, and mutton snapper. This list could be adjusted based on species availability and could include one

deepwater snapper species.

5.2.1 Skiff biological sampling

Objective: To assess the status of fishery products on the atoll.

Data collection (lobster, conch, & finfish):

- Ensure catch and effort data sheets are completed.
- Check whether the species was caught from more than one fishing area. If so, one should only sample species from Glover's Reef.
- Select species by gear type for biological sampling.
- Record total weight of species by gear type for sampling
- Measure each fish within the sample, according to Table 4. (See training manual for measurement of individual finfish, conch and lobster weight and measurements).
- Record information on appropriate data sheets; lobster (Appendix E), conch (Appendix F), finfish (Appendix G).
- Small quantities from different vessels should be sampled for best results.

NOTE: Sampling for catch and effort should be done whenever boats return from sea, and biological data should be collected at the same time until biological sampling targets are met.

Table 5: Overview of species for sampling and information type required for skiffs

Species	Scientific Name	Gear Type	Sampling targets	Comments
Spiny Lobster	*Panulirus argus*	Dive	Measure 100 tail length/month	Landed as tail and head meat
Queen Conch	*Strombus gigas*	Dive	Weight 100 conch meat/month	Landed without shell
Nassau Grouper	*Epinephelus mystacinus*	Handline	Measure 50 TL/month	Seasonal
Yellowtail Snapper	*Ocyurus chysurus*	Handline	Measure 50 FL/month	
Mutton Snapper	*Lutjanus analis*	Handline	Measure 50 FL/month	Seasonal
Deepwater Snapper		Handline	-to be determined-	

Note: Finfish biological sampling should depend on the outcome of finfish species composition assessment (see section 5.3.1).

Implementation strategy:

- It is recommended that the program should begin with catch and effort data

collection. After 3-5 months, or once the data collector(s) becomes familiar with the system, then biological sampling should be introduced.

- Once the data collector in Hopkins is familiar with the work, consideration could be given to sampling finfish in Dangriga.

Assumptions:

- Size frequency of finfish in Dangriga and Hopkins is similar.

5.2.2 Sailboat biological sampling

Objective: To assess the status of fishery products on the atoll.

Data collection:

- Sampling should be done at sea
- Ensure catch and effort data sheets are completed. [NOTE: At the point of sampling, fishers may not have completed fishing, please note on the data sheet]
- Check whether the species was caught from more than one fishing area. If so, only species from Glover's Reef should be sampled.
- Select species by gear type for biological sampling.
- Record total weight of species for sampling.
- Measure each fish within the sample according to Table 4.
- Record information on appropriate data sheets; lobster (Appendix E), conch (Appendix F), or finfish (Appendix G).

Table 6: Overview of species for sampling and information type required for sailboats

Species	Scientific Name	Gear Type	Sampling targets	Comments
Spiny Lobster	*Panulirus argus*	Dive	Measure 100 tail length/month	Landed as tail and head meat
Queen Conch	*Strombus gigas*	Dive	Weight 100 conch meat/month	Landed without shell
Finfish option?			-to be determined-	

Implementation strategy:

- Presently, the Fisheries Department conducts biological sampling for lobster and conch at sea. This activity should continue with data collector from WCS.

Assumption:

- All lobster and conch specimens landed are within legal size limit.

5.3 Fisheries-independent verifications

In designing this data collection program, a number of assumptions were made. The main assumptions were:

- The status of finfish resources on the atoll is healthy.
- The effort measure for dive and handline is the same between skiffs and sailboats.
- Catch rates between skiff's dory and sailboat's dory are the same.
- Catch rates for Hopkins and Dangriga are the same.
- Size frequency of finfish from Dangriga and Hopkins are similar.
- All lobster and conch specimens landed are within legal size limits.

Verification of these assumptions will require conducting a number of fisheries-independent studies. Of all the assumptions stated above, the most critical is understanding the present status of finfish resources on the atoll. Thus a special study will be carried out.

5.3.1 Finfish species composition on the atoll

Objective: To assess the status of finfish resources on the atoll.

Data collection:

- Sampling should be done at sea.
- Complete data sheet (Appendix H) by collecting boat name, type, gear type, total catch and effort at time of interview.
- Randomly scoop whole fish into buckets (minimum 10% of total catch).
- Sort fish in buckets by species group.
- Weigh fish by species group.
- For each group, remove each fish, then measure (TL/FL) and weigh.
- If possible, gut fish, remove gonad, identify sex and gonad stage (See training manual), then weigh.
- Record information.

Implementation strategy:

- This activity should be done monthly, for at least a year.
- After one year of data and analysis, the project should be re-evaluated to determine if it should be continued and to what extent.

5.4 Summary of data collection activities

Overall, the data collection program for Glover's Reef was aimed at developing a sampling plan which would allow fisheries managers (FD and the WCS) the opportunity to understand fishing trends in the General Use Zone and to demonstrate to fishers the positive benefits of marine reserves on fish production. Table 7 below gives a summary of the proposed catch and effort and biological data collection activities. Data should be recorded on appropriate data sheets, verified, and prepared for data entry and analysis.

Table 7: Summary of data collection activities for Glover's Reef

Fishery	Boat Type	Catch and effort	Biological (Length/Weight)
Lobster	Skiff	Data from fishing beach or Data from Mango Creek	Data from fishing beach/fish market
	Sail	Data from Cooperatives	Sample at sea
Conch	Skiff	Data from fishing beach or Data from Mango Creek	Data from fishing beach/fish market
	Sail	Data from Cooperatives	Sample at sea
Finfish	Skiff	Data from fishing beach	Data from fishing beach/fish market
	Sail	Data from Cooperatives + (? Missing data)	Sample at sea

6. DATA MANAGEMENT

Periodically, once per week or month, data sheets from the field should pass from data collectors to the person in charge of managing this activity. The data sheets should be checked, verified and entered in the appropriate databases. A number of database or data storage software options are available: for example, Excel, Access, SPSS, and Caribbean Fisheries Information System (CARIFIS/CRFM). The choice of database will depend on individual preference and competence.

CARFIS is a regional database still in its initial developmental stage, but could be a useful tool for data storage; it is able to store data on fishermen, vessels, processing plants, aquaculture plants, legal charges, and catch and effort data, in one program. It also has the ability to link to other databases. Because the number of fishers and boats in this area is so small, it may be best to use a simpler data storage system such as Excel or Access.

Data entered should be checked and verified on a regular basis to reduce error. Initially,

since the data is limited, maintaining the system should not require extensive hardware or software requirements.

The Wildlife Conservation Society would need to share data and information with the Fisheries Department, and visa versa, in an atmosphere of full disclosure. Thus, data collected in the field should be sent (hard copy or digital) to the FD and vice versa. Morphometric relationships (e.g., conch shell length to meat weight), quarterly and annual reports on Glover's Reef, and all other research/reports pertaining to the atoll should be easily accessible to the WCS.

A number of organizations are conducting research or monitoring programs (Table 8), either on the atoll or with fishers, and it is important also to manage data and information generated from these activities.

Table 8: Some research activities by organizations on Glover's Reef

Wildlife Conservation Society	**Fisheries Department**	**BFCA**
Long-term Atoll Monitoring program (LAMP) Meteorological, oceanographic parameters, productivity measurements of corals, sea grass & mangroves	Monitor five commercially exploited species of finfish using visual counts and measurements (hogfish, nassau grouper, black grouper, queen triggerfish, and mutton snapper)	Fisheries sustainability workshop sponsored by PACT
Effectiveness of the conservation zone in conserving lobster and conch populations.	Lobster and conch abundance and recruitment assessment -reserve staff collect data twice per year, beginning and end of season	Data collection in marine areas sponsored by OAK Foundation and UNDP
Seagrass monitoring program Belize 1 of 60 sites in the world	National fish survey and spawning aggregation	Proposal to get fishers involved in data collection to foster a better understanding of what is being done
Socio-economic study of the economic value of the atoll	SYNOPTIC project Twice per year (June and December) monitor fish, coral, seagrass and mangrove	
Nassau spawning aggregation monitoring	At sea biological sampling of lobster and conch	
Reef Recovery after 1998 Hurricane Mitch	National conch abundance survey (1996, 2004)	
Biological landscape	Assessment of queen conch population sponsored by PACT Distribution, abundance in marine reserves	
Glover's Reef seascape project	Improving management of lobster resources (project being finalized)	
Shark diversity study Types, species, numbers	National data collection activities Catch and effort , biological sampling	
Coral ecology and settlement monitoring		

7.1 Resources required

The following materials and equipments are necessary to implement the data collection activities (Table 9):

1. Measuring boards (1 m and 0.5 m)
2. Spring balances (for whole fish and gonads)
3. Plastic calipers (small – lobster; large - conch)
4. Clipboards
5. Buckets
6. Data sheets for catch and effort, and biological

Table 9: Prices of equipment required

Description	Catalog Number	Price	Quantity	Line Total (US$)
Vernier Caliper (Lobster)	70-2647	$6.95 Each	4	**$27.80**
Rule, Half-Meter (small finfish)	70-2619	$2.25 Each	2	**$4.50**
Meter stick with Plain Ends (large finfish)	70-2620	$3.25 Each	2	**$6.50**
Instrument Spring Scale, Capacity 30 lb or 15 kg	70-2032	$86.00 Each	2	**$172.00**
Pull-Spring Scales, Economy, 500 g x 10 g/5 N x 0.1 N (gonads)	70-2072	$4.15 Each	1	**$4.15**
Pull-Spring Scales, Economy, 100 g x 2 g (gonads)	70-2070	$4.15 Each	1	**$4.15**
Scales, Ohaus Compact Portable Electronic, Model CS-2000, Cap. 2,000 g x 1.0 g (**OPTIONAL** for gonads)	70-2216	$100.00 Each	1	**$100.00**
Large Caliper (Conch)			2	
Clipboard		$3.00 Each	4	**$12.00**
Bucket		$1.00 Each	4	**$4.00**

Source: Carolina Shopping Supplies www.carolina.com

In terms of human resource, the WCS would need one part-time data collector in Hopkins Village and another on Glover's Reef. The data collector in Hopkins should preferably live in the village, so that he/she would be available night or day to collect information from boats as they return from sea. The data collector would be given a set of equipment to do the job, and salary. The data collector on Glover's reef should have access to a small boat, and would require a budget for fuel (boat), salary, food, and accommodations.

7.2 Timeline

Timeline of activities required to implement a data collection program for Glover's Reef.

	2004						2005					
Activities/Month	**J**	**A**	**S**	**O**	**N**	**D**	**J**	**F**	**M**	**A**	**M**	**J**
Hire and train data collectors	X											
Initiate species composition activities	X	X										
Design sampling schedules, activities, and strategies		X	X									
Fishermen consultations			X									
Catch and effort data collection				X	X	X	X	X	X	X	X	X
Biological sampling (starting with conch)								X	X	X	X	X

8. REFERENCES

Acosta, C.A. 1998. Population Dynamics of Exploited Species and "Reserve Effects" in the Glover's Reef Marine Reserve, Belize. Annual Progress Report to the Wildlife Conservation Society, 2001. 21p.

Acosta, C.A. 2001. Glover's Reef Long-term Atoll Monitoring Program (LAMP). Glover's Reef Marine Research Station, Wildlife Conservation Society, Belize. 12p.

Acosta, C.A. and D.N. Robertson. 2001. Population Assessments of Exploited Species at Glover's Reef Marine Reserve. Annual Progress Report to the Wildlife Conservation Society, 2001. 21p.

CFRAMP, 1995. Principles of Fisheries Data Collection: Modules 1-5.

Gibson, J. 2003. Glover's Reef Marine Reserve and World Heritage Site Management Plan. The Coastal Zone Management Authority and Institute, Fisheries Department, and Wildlife Conservation Society. 106p.

Government of Belize. 1996. Fisheries (Glover's Reef Marine Reserve) Regulations. S.I. No. 70 of 1996 Arrangement of Regulations.

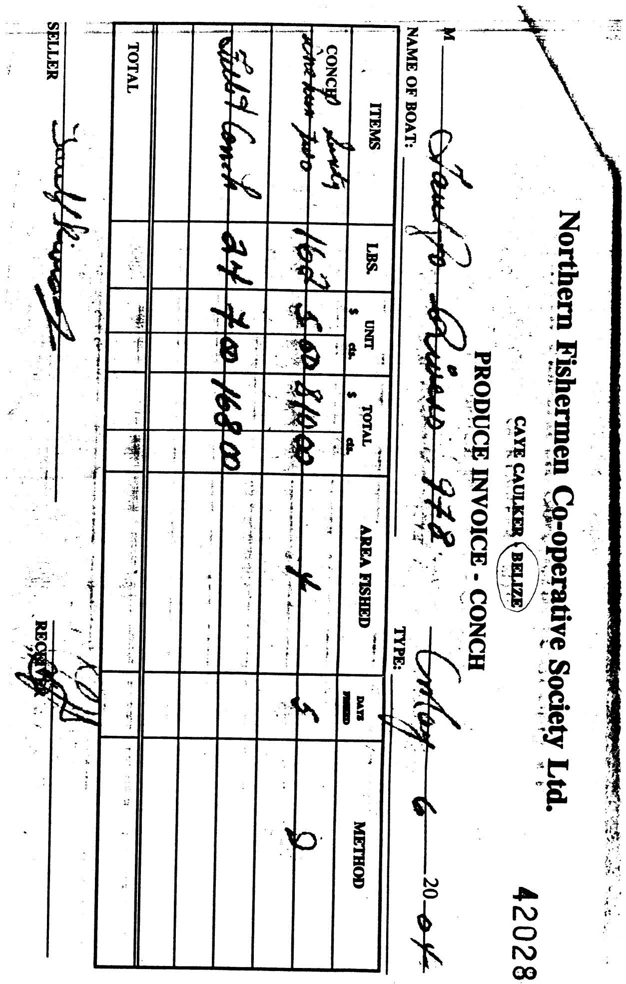
Hoggarth, D. 1998. A Review of the Catch, Effort, and Biological Data Collection System of the Marine Fisheries of Belize: Mission Report. Report to CARICOM Fisheries Resource Assessment and Management Program (CFRAMP).

Medley, P. 2001. Review of the Data Collection and Management Systems of the Marine Fisheries in the Bahamas. CARICOM Fisheries Unit, ICRAFD: Fisheries component.

APPENDIX A: ITINERY OF FIELD ACTIVITIES

Date	Comments
5-13/4/2004	Consultancy review – Fisheries Division (James Azueta – Ecosystem Management Unit), CRFM (Milton Haughton)
13/4/2004	Janet Gibson, Wildlife Conservation Society
15/4/2004	Fishermen consultation & data collection – Sarteneja
23-25/4/2004	Trip to Glover's Reef (meeting with WCS and FD staff on Middle Caye)
26/4/2004	Consultancy update – Wildlife Conservation Society
29/4/2004	Discuss consultancy with Beverly Wade, Chief Fisheries Officer
2/5/2004	Fishermen consultation – Hopkins
3/5/2004	Review Protected Area Management Unit activities – I. Majil (Coordinator)
6/5/2004	Review Capture Fisheries Unit activities – Mauro Gongora (Supervisor), Ramon Carcamo (Research Officer)
11/5/2004	Meeting with senior staff of the FD to discuss designing data collection plans (CFO, Ecosystem Management, Capture Fisheries Unit, & Protected Area Management)
14/5/2004	Consultancy update meeting (Janet Gibson & Milton Haughton)
20/5/2004	Presentation - Data collection plan for Glover's Reef; and training workshop
25/5/2004	Meeting with FD staff (12) to discuss improving the FD data management system
26/5/2004	Meeting with Mr. Marin, Northern Fishermen Cooperative

APPENDIX B: SALES RECEIPT (Northern Cooperative)


Northern Fishermen Co-operative Society Ltd.

CAYE CAULKER BELIZE

PRODUCE INVOICE - CONCH

42028

M ____ May 6 20 04

NAME OF BOAT: ____ 978 TYPE: ____

ITEMS	LBS.	UNIT $ cts.	TOTAL $ cts.	AREA FISHED	DATE FISHED	METHOD
CONCH [illegible]	168	5 00	840 00	4	5	9
Fillet Conch	24	7 00	168 00			
TOTAL						

SELLER ____ RECEIVER ____

APPENDIX C: COMPILED COOPERATIVE DATA SHEET

COMPILED FISHERIES DATA FROM COOPERATIVE

Month ________ 1992

Coop.	Area	Gear	Days fish	Lobster tails	Lobster meat	Conch	Fillet	Class A	Class B	Crabs
NATIONAL										

APPENDIX D

Catch and Effort Data Sheet

Landing Site: _____ Date: _____

Data Collectors_____ Weather_____

Landing Number						
Boat ID						
Crew NO.						
Date/Time-DEP.						
Date/Time-RET.						
Area Fished						
Gear						
Depth Fished						
Weather type						
Landing Type						
CATCH DATA BY SPECIES	Species	Weight	Species	Weight	Species	Weight

APPENDIX E:

CFRAMP BIOLOGICAL DATA COLLECTION - LOBSTER

LANDING SITE	DATE	DATA COLLECTOR	Entered	Checked
			Date	Date
			By	By

Boat Name			*Panulirus argus / Panulirus guttatus (circle one)*	Fishing Gear (circle one) FPOT LPOT GNET HOKA SCUB DIVE
Boat No.			Caribbean spiny lobster / Spotted spiny lobster	
Total Weight (circle one)		g kg lbs oz.	Area Fished (Fishing ground)	Weight type (circle one) Whole Headed
Sample Weight (circle one)		g kg lbs oz.	Sample Type (circle one) SU LU LS	

Lobster Length & Maturity Data *record for species caught in same gear only*

Sex & Maturity M F T D E S	Length - mm (circle one) TL CM SW	Sex & Maturity M F T D E S	Length - mm (circle one) TL CM SW

Key to Codes (Form [illegible])

1) Indicate recreational fishing boat by R

2) Weight: g = grams, kg = kilogrammes, lbs = pounds, oz = ounces

3) Sample Type: SU = measured at sea, LU = landed unsorted, LS = landed sorted

4) Fishing gear: FPOT = Fish pot, LPOT = Lobster Trap, GNet = Gill Net, Hokn = Hookn, SCUB = SCUBA, DIVE = Skindiving

5) Measurement: CM = Carapace length, TL = Total tail length, SW = 2nd segment width

6) Whole = whole lobster landed, Headed = tails landed

7) Sex & Maturity : M = Male, F = female, T = female with tar, D = female with orange eggs, E = female with brown eggs, S = female with [illegible]

APPENDIX F

BELIZE CONCH BIOLOGICAL DATA COLLECTION FORM
(Strombus gigas) -- sampling conch meat

Data Entry Only

Landing site:	Date:	Data Collector(s):

Entered:	Checked:
Date:	Date:
By:	By:

Boat No -		
Boat Name:		
Total Weight (Circle one)		g Kg. Oz. lbs
Sample weight (Circle one)		g Kg. Oz. lbs.

Area Fished (Fishing ground)	
Sample Type (Circle One)	

Fishing Gear	

For Reference Use only

*Weight Type	UN PF PS PE PR

Weight Type*: Market Clean / Fillet

Amount Weighed G kg lbs oz	No. Weight of Meat	No. Weight of Meat

Weight Type*: Market Clean / Fillet

Amount Weighed G kg lbs oz	No. Weight of Meat	No. Weight of Meat

Key to Codes:

1) Indicate recreational fishing boat by R

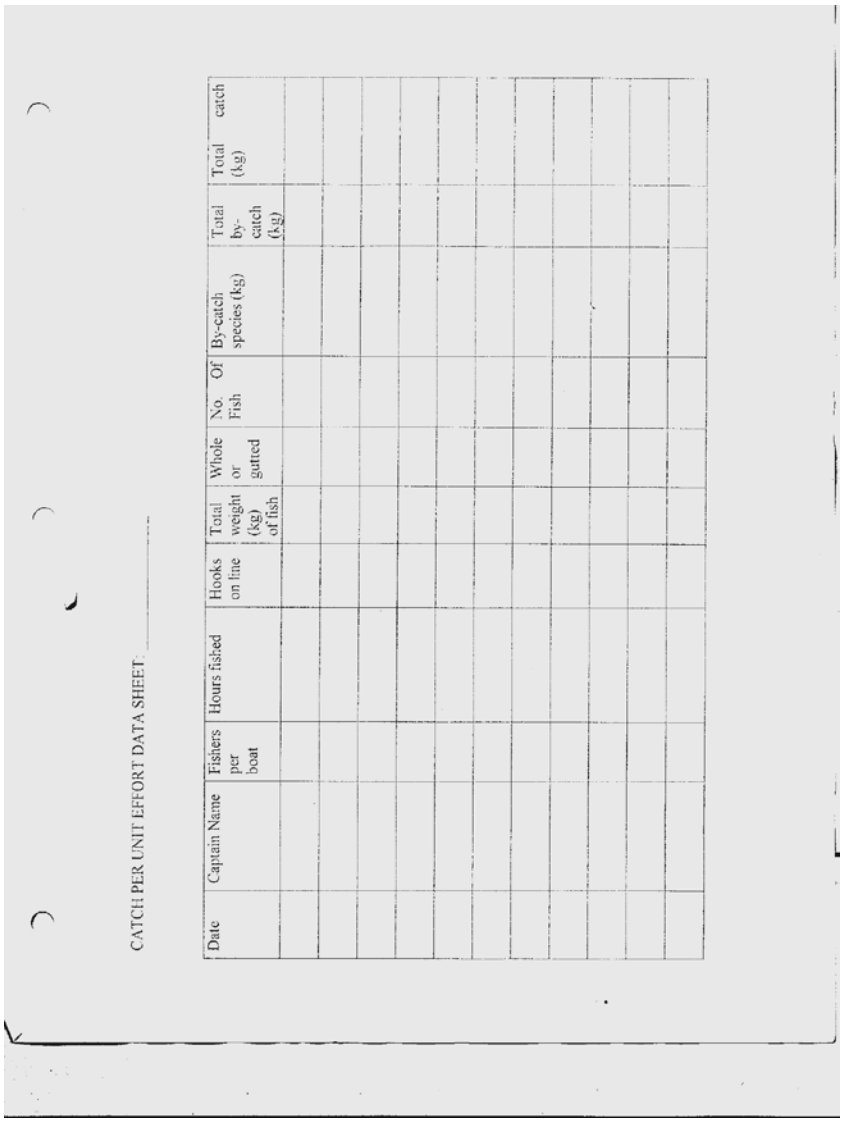
2) Weight:
g = grams;
kg = kilograms;
Lbs = pounds;
Oz = ounces

3) Sample Type:
SU = measured at sea;
LU = Landed unsorted;
LS= landed sorted

4) Fishing gear:
DIVE = skin diving.

5) Landed Status:
UN = Unprocessed,
PF = meat 50% processed,
PS = meat 65% processed,
PE = meat 85% processed,
PR = Meat 100% processed

APPENDIX G: FINFISH BIOLOGICAL DATA COLLECTION FORM



CATCH PER UNIT EFFORT DATA SHEET: _____

Date	Captain Name	Fishers per boat	Hours fished	Hooks on line	Total weight (kg) of fish	Whole or gutted	No. Of Fish	By-catch species (kg)	Total by-catch (kg)	Total (kg) catch

APPENDIX H: SPECIES COMPOSITION DATA SHEET

SPECIES COMPOSITION SURVEY: Data Sheet
(Wildlife Conservation Society)

Location:		
Date:	Time:	
Data Collector:		
Boat Name:		
Crew size (including captain):		
Hours spent fishing (thus far):	Gear type:	Number of gears:

CATCH DATA

Total weight by species (caught thus far):

Species	Weight	Numbers	Price/lb

BIOLOGICAL DATA

Species	Weight (g)	Length (cm)[1]	Sex	Gonad state[2] & weight

[1] Length should be measured to the fork of the tail.
[2] Record if gonads are: **I**mmature, **E**arly **D**evelopment, **L**ate **D**evelopment, **R**ipe and **R**unning, or **S**pent (see Table on Tissue Collection and Processing).