CARICOM FISHERY RESEARCH DOCUMENT NO. 21

Establishment of Data Acquisition and Monitoring Systems for the BELIZE SHRIMP FISHERY

Species Caught and Landed
For the Belize Shrimp Fishery

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TABLE OF CONTENTS

APPENDICES

1. 0 BACKGROUND & INTRODUCTION

The Belize Shrimp Capture Fishery can be divided into the Industrial Trawl Fishery and the Coastal Artisanal Fishery.

The Industrial Trawl Fishery is regulated by a closed season established by the Government of Belize on the advise of the Belize Fisheries Department which usually runs from March 15 to July 14, each year.

The fleet size for this fishery ranges from 4 - 6. Trawlers, mostly of the Gulf of Mexico type, run 30 day trips during the open season making an average of 2 hauls per night. The main fishing grounds are the Inner Channel (also known as the Main Channel) and Victoria Channel. (See Appendix D-1 for map showing fishing grounds for the shrimp capture fishery)

The target species is what is locally known as the pink shrimp; however, commercially important species of by-catch may be retained if large enough to be marketed. While by-catch like the sea horse may be sold on board the vessel (while docked in the Belize City harbour) to restaurant owners, virtually all the products retained from the catches are landed at either Northern or National Fishermen Cooperatives in Belize City.

The Artisanal Fishery, unlike the Industrial Trawl Fishery, is not regulated by a closed season. Fishermen respond to the availability of their target species, locally known as the white shrimp and so may fish for them as few as a couple weeks per year. Anecdotal information from fishermen indicate that the vessel population is variable as the primary fishery for most artisanal fishermen, who tend to fish for shrimp when in "season", is indeed the finfish fishery.

The fishing grounds for the Coastal Artisanal Fishery are located 1 to 2 miles off the coast of Belize starting from the mouth of Haulover Creek in the Belize District to the mouth of the Sarstoon River in the Toledo District (Appendix D-2).

Equipped with cast nets or drag nets, these fishermen set off on 1 to 2 day trips in small canoes or launches. It is noteworthy that while the trawlers "net" shrimp only during the night, artisanal fishermen only fish for shrimp during daylight hours, making as many as 10 hauls per trip.

Information on the catch and landings in the Coastal Artisanal Fishery remains minimal and there is still no document that reasonably describes the nature of that fishery. On the other hand, it has

been considerably easier to obtain information on the Industrial Trawl Fishery.[1]

For example, RDA International conducted a study in 1991 with the aim of assessing the ecological and economic impacts of shrimp trawling in Belize. Two of the findings were that -:

i. The shrimp to by-catch ratio was 1:7.3

ii. Juvenile shad (Gerridae) and snappers (Lutjanidae) were the most common in the catch.

At that time, all the by-catch was thrown overboard and eaten by fishes, birds and benthic carnivores. The by-catch was reportedly discarded because it was mainly made up of small fishes.

One of the recommendations coming out of the study by RDA International was that a long term comprehensive programme of research and monitoring be implemented. It was with this in mind that the Shrimp and Groundfish CFRAMP Sub-project activities were implemented in Belize in 1996 (Phillips et. al, 1996) to gather data for stock assessment of shrimp and by-catch. The project covers both the Industrial Trawl Fishery and the Coastal Artisanal Fishery.

A number of different activities were incorporated into the project, including the identification of species being harvested in the shrimp capture fishery and the collection of catch and effort data. The species identification exercises should allow us to determine the composition of the catch and landings of each component of the fishery - the Industrial Trawl component and the Coastal Artisanal component.

In this document, we will look at the species caught and landed for both the industrial and artisanal components of the Belize shrimp capture fishery in an effort to provide some preliminary information for a more long term assessment of the fishery.

[1] Refer to the document *Establishment of Data Acquisition and Monitoring Systems for the Belize Shrimp Fishery: A Description of the Belize Shrimp Capture Fishery* for a more detailed description of the fishing fleet, gear types, fishing grounds, landings sites and landing procedures.

2. 0 ASSESSMENT OF SPECIES CAUGHT AND LANDED IN THE BELIZE SHRIMP FISHERY

2.1 *Species Caught and Landed in the Industrial Trawl Fishery.*

2. 1.1. METHODOLOGY

2.1.1.1 Assessment of the Catch

The Fisheries Department, in collaboration with CFRAMP, undertook an exercise to identify, to the species level where possible, the catch and landings from industrial shrimp trawlers operating in Belize. This exercise began in February 1996 and ended in October 1996. It was only conducted during the official shrimping season which runs from July 15 to March 14 each year. During this period, fisheries personnel undertook three trips (in February, September & October) to sea, on board commercial trawlers to sample the catch.

Trawler trips usually last 30 days, and each trip the data collectors took lasted for an overnight, during which time samples were taken from both hauls pulled in that night.

On each trip personnel attempted to follow the procedure set out below:

- Estimate the weight of the total catch.
- Take a sample of the catch by, first, removing the large fishes, turtles and other large marine organisms (recording species and weights), and second, removing 25 - 50 lbs of the remaining catch, using a container.
- Sort out the sample:
  - Identify the shrimp by species and record the weight for each species.
  - Identify the commercially important fishes and other invertebrates and record the weight for each species.
  - Identify the remainder of the catch as far as possible and record the weights of the groups identified.
- Collect specimens for reference collection and further identification if necessary.
- Take photographs of fishing operations, catch and specimens for reference collection and species identification.

- Take note of any substratum that may have been hauled up by the nets.
- Note the total weight of the shrimp determined by the trawler crew.
- Record all the data on the prescribed forms (Appendix A).
- Additional information that may be important to understanding the Shrimp Trawl Fishery or the species affected by its exploitation should be noted in your field notebook.

Deviations from the methodology set out are as follows -:

- A by-eye estimate of the catch was made by the trawler crew to get an idea of the total weight of the catch.
- There were occasions on which Data Collectors did not take samples of the catch, but instead got by-eye estimates of selected species in the catch (mostly those that are familiar them.)
- Samples of the catch taken by the Data Collectors were not of the total catch but of the remainder of the catch after the trawler crew removed the shrimp.
- Commercially important species of finfish and invertebrates were sometimes not identified as far down as the species level.
- The Data Collectors did not get the opportunity to sort and identify the shrimp so as to assess that portion of the catch. Also, a sample of shrimp was not taken on all three occasions for identification.
- A few shrimp were identified on board the trawler, some were taken to the laboratory at the Fisheries Department in Belize City, and a specimen was sent to T. Phillips, RAU Leader for the Shrimp and Groundfish Sub-project for verification of identification.
- Otherwise, few identifications were done on board the trawlers, hence samples of by-catch had to be taken to the Fisheries Department lab to be identified.

2.1.1.2 Calculations for the Determination of Total Weights of Species in the Catch

The calculations to derive the total weights of the species in the catch (when samples were taken) were basically extrapolations from sampled data using the estimate of the total weight of the catch.

For example, If we determine that -:

a. The estimated total weight of the catch = 1,000 lbs.
b. The measured total weight of the shrimp = 100 lbs
c. The Sample weight of *Lutjanus synagris* = 10 lbs
d. The total weight of the sample (excluding shrimp) = 50 lbs

Then we can estimate the total weight for the species *L. Synagris* -:

Total weight of species in catch = [Proportion of sample comprised by species] X
[Total weight of the catch, excluding weight of shrimp]

= (10/50) x (1,000 - 100) = 900/5
= 180 lbs.

Therefore, the estimated total weight of *L. Synagris* in the catch is 180 lbs.

There are 2 things that should be noted -:

1. This method of estimation assumes the samples taken were representative of the catch.

2. The calculations are done in this manner because **the samples taken did *not* include the shrimp.** [When weights for large organisms not represented in the sample were recorded, the same procedure was applied. This means that the weights for these species must be subtracted from the total weight of the catch before total weights of *sampled* species are estimated.]

2.1.1.3 Determination of Landings

Once landed at the cooperative, the products were weighed and the information recorded by both the trawler captain and a senior plant employee. This information was later collected by Data Collectors from the Belize Fisheries Department.

Except for seahorses sold to restaurant owners who board the vessels while they are off-loading in the Belize City harbour, all products are landed at the cooperatives. We have no information on that portion of the landings that does not get to the cooperatives.

2. 1. 2 RESULTS

2.1.2.1 Landings of Shrimp and Commercially Important By-catch

After each 30-day trip, the trawlers dock in the Belize City harbour where the shrimp and by-catch are off-loaded and transported in small skiffs to the cooperative which runs the operations for that vessel. Sometimes, the by-catch retained is not off-loaded until the next trip back into town. For example, it can be noted in table 1. below that close to 5,000 pounds of by-catch was landed off Northern 1 on October 24, 1996 while none was landed for the previous trip. The Plant Manager at the Cooperative indicated that indeed some by-catch had accumulated over the previous two months. Additionally, by-catch retained for long periods may be discarded to make room for fresher products.

Table 1. summarizes the landings for a period of approximately 4 months for Northern Fishermen's Cooperative.

Table 1. LANDINGS OF SHRIMP AND BY-CATCH FROM COMMERCIAL TRAWLERS (15 JULY 1996 TO 24 OCTOBER 1996)

Duration (of trawler trip)	Vessel	Landings	
15 Jul - 15 Aug' 96	NORTHERN 1	Shrimp By-catch	6403 531
15 Jul - 16 Aug '96	NORTHERN 11	Shrimp By-catch	6093 446
16 Aug - 19 Sept '96	NORTHERN 1	Shrimp By-catch	4497 *not landed**
16 Aug - Sept '96	NORTHERN 11	Shrimp By-catch	3762 *not landed**
19 Sept - 24 Oct '96	NORTHERN 1	Shrimp By-catch	5845 4682
19 Sept - 24 Oct '96	NORTHERN 11	Shrimp By-catch	5557 *not landed**

The high level of discards becomes apparent from Table 1. indicating that since the 1996 shrimp season has re-opened, more shrimp has been landed than by-catch, while we know for a fact that shrimp catch in trawl nets is very low. It is noteworthy though that some commercially important species of by-catch is landed at the cooperative. *L. synagris*, though a commercially important species, is not usually landed because it is generally too small to attract buyers.

Table 2. BREAKDOWN OF BY-CATCH LANDED OFF NORTHERN 1
(24 OCTOBER 1996)

Name		Weight in lbs.
Sarda sarda	(Bonito)	234
Caranx hippos	(Crevalle Jack)	3,167
Carangidae	(Jacks)	750
mixed		531
TOTAL		**4,682**

We had attempted to obtain similar information for all trawler trips; however, due to logistical constraints within the Fisheries Department, we were unsuccessful in doing so.

2. 1. 2. 2 Catch Composition (Based on On-Board Samples)

The following tables - tables 3 to 5 - give a breakdown of the catch for each trip taken by Data Collectors per haul. However, in table 1, the data for both hauls are combined. Table 1 is different from the others in that it presents estimates of sampled weights for selected species and families, along with the actual total weight of shrimp in the catch. ***No estimate was made of the total weight of the catch.***

Other types of information given include date and time of trip, fishing area, as well as fishing grounds (see Appendix D-1 for actual location of fishing areas and fishing grounds).

Table 3. Breakdown of Sampled Catch for Trip #1 . Haul # 1 & #2 combined

Date: February, 1996 **Time:** 5:45 p.m. & 12:00 a.m. **Area:** 5 **Fishing Grounds:** Main Channel

Species	Sampled Weight (lbs)	Total Weight (lbs)	% of species in catch
Paneus notialis	-	120.0	-
Lutjanus synagris	40	-	-
Caranx hippos	50	-	-
Scomberomorous regalis	70	-	-
Sciaenidae	30	-	-
Clupeidae (Shad)	40	-	-
TOTAL	230	-	-

Note: Besides the 120 pounds of *P. notialis* caught in the trawl nets, the Data Collectors also noted a single specimen of *Paneus brasiliensis* in the shrimp retained by the crew.

Table 4.a. Breakdown of Catch for Trip # 2 . Haul #1

Date: September 4, 1996 **Time:** 5:45 p.m. **Area:** 5 **Fishing Grounds:** Main Channel

Species	Total Weight (lbs)	% of species in the catch
Paneus notialis	78	7.1
Lutjanus analis	5	0.5
L. synagris	175	15.9
Sciaenidae	300	27.3
Ariidae	150	13.6
Rajiformes	300	27.3
Mixed[2]	92	8.3
TOTAL	1100	100.0

Note: Sample weights were bumped up using the technique described in Section 2.1.1.2. The actual weights for these species (rounded up to the nearest unit) were 1 lbs, 13 lbs and 24 pounds respectively and the total sample weight was approximately 50 pounds. The remainder of the sample includes species that were not identified by the Data Collectors.

[2]The category mixed refers to a variety of unspecified organisms including some of the species listed in Appendix B.

Table 4.b. Breakdown of Catch for Trip # 2 . Haul #2

Date: September 4, 1996 **Time:** 12:00 a.m. **Area:** 5 **Fishing Grounds:** Main Channel

Species	Total Weight (lbs)	% of species in the catch
Paneus notialis	125	6.5
Lutjanus synagris	500	26.1
Caranx hippos	30	1.6
Caranx bartholomaei	70	3.6
Panularis argus	125	6.5
Rachycentron canadum	70	3.6
Carangidae	70	3.6
Fasciolaridae	60	3.1
Sciaenidae	600	31.3
Sharks	70	3.6
Mixed	202	10.5
TOTAL	1920	100.0

Note: Weights for species identified in the 50 lb sample taken from this haul are: *Sciaenidae* - 20 lbs, *R. canadum* - 3 lbs, *L. synagris* - 14 lbs, Carangidae - 3 lbs, Sharks - 3 lbs. (These figures are rounded up to the nearest unit)

Table 5.a. Breakdown of Catch for Trip # 3 . Haul #1

Date: October 2, 1996 **Time:** 5:45 p.m. **Area:** 5 **Fishing Grounds:** Victoria Channel

Species	Total Weight (lbs)	% of species in the catch
Paneus notialis	93	13.3
Lutjanus griseus	5	0.5
L. synagris	40	5.7
Panularis argus	20	2.9
Rajiformes	70	10.0
Mixed	471	67.6
TOTAL	700	100.0

Note: In this instance, the total sample weight was 25 pounds. Sample weight for *L. synagris* was 2 lbs, *L. griseus* - 1 pound and *P. argus* - 1 lb. A variety of unidentified organisms made up the rest of the sample. (These figures presented are rounded up to the nearest unit.)

Table 5.b. Breakdown of Catch for Trip # 3 . Haul #2

Date: October 2, 1996 **Time:** 12:00 am **Area:** 5 **Fishing Grounds:** Victoria Channel

Species	Total Weight (lbs)	% of species in the catch
Paneus notialis	104	10.4
Lutjanus synagris	150	15.0
Panularis argus	100	10.0
Rajiformes	20	2.0
Mixed	626	62.6
TOTAL	1000	100.0

Note: Only two species were identified in the sample from this haul. *L. synagris* - 4 lbs and *P. argus* - 3 lbs. The rest of organisms making up the 25 pound sample were not identified.

2. 1. 3 Discussion & Recommendations

Though the data do not provide an *accurate* reflection of the catch composition and the relative abundance of the species in the catch of industrial trawlers, they do give a general idea of the make-up of the catch in the two channels specified - The Main & Victoria Channels. As mentioned previously, Appendix B lists 71 of the species identified over the duration of the study. This indicates that a lot of vital information - systematic, ecological, biological, economic and social - can be obtained by a careful and realistic assessment of the Belize Shrimp Capture Fishery.

While, as expected, the percentage composition of the targeted shrimp was low (ranging from 6.5% to 14 %) there is also some indication, both from the data gathered and from the observations of Data Collectors, that the percentage composition of juveniles of commercially important species, like the Lane Snapper, is considerably high. In fact, tables 3 to 5 show that the percent composition of *L. synagris* was higher than that of the shrimp in all except one of the hauls. Its abundance in terms of weight was four times that of *P. notialis* in table 4.b. This implies that there may be a trade-off associated with shrimp trawling, i.e.: shrimp trawling activities may impact negatively on the artisanal finfish fishery for which species like *L. synagris* are important.

It is notable that while virtually all by-catch was once discarded (RDA, 1991), some of the by-catch is now landed at the fishing cooperatives (Tables 1 & 2). Even though levels of discards are still high, it is clear that some attempt is being made to better utilize the trawler by-catch.

It is interesting to note that for trips 2 and 3, the percent composition of *L. synagris* is greater in the second haul than in the first, and furthermore, it is generally greater in the Victoria Channel than in the Main Channel.

The data also indicate that the total weight of the catch is usually higher for the second haul. Additionally, for the pink shrimp, the Sciaenidae, and the Rajiformes, weights are also higher in the second hauls. It would indeed be interesting to see if this trend remains consistent, and if so, to determine why.

Considerations

- More attention was focussed on making quantitative assessments of the catch rather than determining first what species make up the catch or the sample taken. This meant that weights were often presented by families or even order of organisms. Data Collectors complained that they had to do this because of the constraints they faced on board the trawlers. They felt it impractical to do much species identification on board.

- The Data Collectors pointed out that a 25 - 50 lb sample may not be representative of the catch as it was observed to be quite diverse. They explained that many sample baskets could have been taken each with almost unique combinations of species.

- Very little species specific assessments were done for the rest of the catch due to the inexperience of Data Collectors with identifying new species on board and with approximating weights of catches. Additionally, time and manpower constraints further made it difficult for a more thorough assessment to be carried out.

- The methodology outlined above was not documented until August, 1996 before the second trip was taken. However, this procedure was based on the actual procedures followed on the February trip. A revision was subsequently made to the procedure in October as a minimum sample weight required was decided and a technique was outlined for making sure large organisms were covered in the assessment.

- A good assessment of a trawler's catch requires that at least the most abundant organisms, and not only commercially important species, are identified to the species level. For example, it is not accurate to say that Sciaenidae makes up a larger portion of the catch if *L. Synagris* has a total weight 200 lbs and Sciaenidae, having an estimated total weight of 300, may be comprised of 175 lbs of 1 species and only 125 lbs of another.

- Assessments were carried out only in terms of weights, and no estimate of the number of individuals in the catch was made. This would better allow for the assessment of potential ecological impacts.

For these reasons, there were problems with reporting on the make-up of the catch.

1. The methodology set out for the collection of data was not keenly followed.

2. All the relevant information was not obtained on all three occasions. For example, the species composition form was *never* properly filled out.

3. The assessment was poor overall because of the unfamiliarity of the Data Collectors with the species caught and inexperience with the process of field identification.

Recommendations

In light of the problems that were encountered in species identification and consequently the collection of the data for the study, recommendations are that-:

I. Exclusive species identification training sessions are conducted before any more quantitative assessments are carried out.

II. Procedures for sampling of data be streamlined before any more quantitative assessments are made. (This would most likely be achieved under the Observer Program to be implemented in the 1997/1998 financial year.)

III. Data Collectors be trained on species identification in the field as well as using the sampling technique(s) chosen.

IV. Estimates of number of individuals be included in the assessment of the catch.

V. Priority species be identified for these assessments.

VI. Codes be used to tag species that are difficult to identify in the field so as to keep on board assessments as species specific as possible. These would, of course, be identified in the Belize Fisheries Department Lab at a later date.

2. 2 SPECIES CAUGHT AND LANDED IN THE COASTAL ARTISANAL SHRIMP FISHERY

2. 2. 1 METHODOLOGY

We have attempted to source artisanal fishermen from whom to collect data on species caught and landed in Belize City, Dangriga and Punta Gorda.

We have chosen these sites to begin with because-:

a. It was reported that fishermen from these areas fish for shrimp

b. They are cities / towns with Chinese restaurants who place a demand on shrimp and so are likely to have fishermen actively fishing for shrimp

c. They are readily accessible by public transport

Unfortunately, we have only been able to collect data from one fisherman. Some fishermen who we contacted have claimed that they have not fished for shrimp this season; some say they usually fish for shrimp only once a year. Nonetheless, we have obtained some anecdotal information on the make-up of the catch for artisanal shrimp fishery through informal interviews with 8 Belize City fishermen.

Since fishermen respond to the availability of shrimp and because fishing trips cannot be forecasted well in advance, it is difficult to arrange with fishermen to gather data on-board vessels. Additionally, since products are often not landed at any one site, it is equally difficult to collect landings information.

Products are sometimes landed at the Punta Gorda market, but since our current data collection system no longer includes that market site, we have had to ask Mr. Arzu, a staff member stationed in Punta Gorda, to collect information on landings for us.

Reportedly, the finfish by-catch is landed in the Sarstoon area, south of Punta Gorda. Attempts to collect data from fishermen there have been unsuccessful, except for the one instance mentioned earlier. Additionally, no species identification was done.

We have attempted to purchase samples from fishermen for species identification, but due to an unfortunate transhipment problem, the shrimp were damaged and could not be identified.

2. 2. 2 RESULTS

2.2.2.1 Background Information (for interview obtained)

Vessel Name	ID No.	Crew #	Place of Departure	Place of landing	Date of trip	Gear Used	Hours Fished
Carmencita	Tol 45	2	Temash River	Sarstoon area	23 October 1996	Drag net 1/2 " mesh	7

2.2.2.2 Catch Data

Shrimp: 20 lbs
By-catch: no recording

2.2.2.3 Make - up of the catch

According to Belize City fishermen, examples of organisms in the catch include the white shrimp, *Paneaues schmitti*, (locally known as the river shrimp) several species of snappers, drummers, sharks, and catfishes.

2. 2. 3 DISCUSSION

Important information on the Coastal Artisanal Shrimp Fishery remains lacking. Most urgent is the need to identify the species caught in the fishery, but before we can get reliable identifications, field workers need to be trained in the process of identifying species.

There is also the need to document the catch composition for this fishery. We could arrange with fishermen to go out to sea with them or to purchase the entire catch obtained at sea. Once the National Frame Survey is completed in 1997, we should be better able to tract fishermen and collect the desired data.

2. 2. 4 SUMMARY & RECOMMENDATIONS

It must be noted that:

1. Species identification trips for this fishery will be more difficult to arrange than for the Industrial Trawl Fishery since fishermen do not have use a standard landing site nor are they able to forecast in advance when shrimp will be available to them.

2. It is difficult to determine when to find fishermen at sea or where to find them after a day's fishing.

3. Since the fisheries officer in Punta Gorda is not a trained Data Collector, he could not identify the shrimp landed. Because the sample bought for 'in lab' identification was damaged, the species could not have been determined.

4. Information on species caught and landed is still minimal.

Due to the problems we have encountered, it is recommended that -:

i. the current data collection system be expanded to include those sites where shrimp are landed by artisanal fishermen;

ii. the National Frame Survey could be used in mapping out a strategy for collecting the desired data;

iii. Data Collectors are trained in species identification and techniques for sampling a catch;

iv. a Data Collector is hired for the Shrimp and Groundfish Sub-project as the collection of data from the Coastal Artisanal Shrimp Fishery will be demanding and will require a trained person dedicated to the collection of data for this particular fishery.

It is also hoped that that Data Collector could gather catch and effort data on other fisheries from those sites as well.

3.0 REFERENCES

RDA International, Inc., 1991. Ecological and Economic Impacts of Shrimp Trawling in Belize.

Phillips, T. and G. Richards, 1996; Country Proposal-Belize, Data Acquisition and Monitoring Systems - Shrimp Fishery.