Developing Fishery Data Collection Systems for Eastern Caribbean Islands

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ABSTRACT

This paper describes a systematic approach to designing fishery data collection systems for Caribbean islands. The aim is for a minimum ongoing collection of catch and effort data for monitoring individual fisheries, and the performance of the fishery sector. Collection of additional information can be slotted into the system. Emphasis is placed on using mechanisms already in place, and on placing some onus for data collection on the fishing industry and users of fish products. Simplicity and flexibility are also priorities, so that the system can be refined by the Fishery Divisions with minimal dependence on external assistance. Path diagrams are first used to describe the disposition of fish and fish products from the fisherman to the consumer. Path segments are then intercepted using various tools: census, sampling, purchase slips, export licenses, etc. Tools often apply to more than one fishery type. The final stage is to devise an operational plan integrating all the required tools.

INTRODUCTION

The establishment of fishery data collection systems in islands of the eastern Caribbean has frequently been identified as a priority activity (*e.g.*, the OECS Fishery Desk Workshop, the Artisanal Fisheries and Aquaculture Network, the FAO Expert Consultation for Shared Fishery Resources of the Lesser Antilles Region, and at WECAFC meetings. The purpose of these systems would be at least to estimate catch and fishing effort in the major fisheries. Depending on the availability of personnel, the value of the fishery, and the objectives of management other types of data, such as prices, operating costs, length frequencies, may also be collected.

Monitoring catch and effort is fundamental to evaluating the performance of a fishery. This information allows the fishery manager to keep track of the growth of the fishing fleet and to evaluate changes in the status of the resource. Even if the common fishery models utilizing catch and effort data cannot be applied, simply monitoring trends in these variables can provide important information on the response of the fishery to management measures. Coupled with information on fish prices and operating costs, these data allow basic analysis of the economic performance of fishing vessels and of the industry as a whole.

The objective of this paper is to provide an overview of the process which was followed in designing fishery data collection systems in eastern Caribbean

Islands. Most texts on fishery data collection systems adopt a classical statistical sampling approach: stratification of landing sites and vessels, and random sampling within these strata. For several reasons we are advocating a more flexible approach to collection of fishery data (Caddy and Bazigos, 1986). A major reason is that in the manpower limited situations prevalent in the eastern Caribbean, it is necessary to take advantage of all possible sources of information, and to devise ways of spreading the onus of data collection through the industry. The interactions between the tourist and fishing industries in eastern Caribbean islands also present special problems and opportunities in data collection.

A SYSTEMATIC APPROACH

Our aim is to provide a systematic procedure for designing a data collection system. The stages are listed in Appendix 1, are described briefly below, and illustrated by an example of a simple fishery. Details of the various processes are covered elsewhere.

The objective of the system is to estimate the total catch and catch per unit effort for each major species or species group being fished in the Exclusive Economic Zone (EEZ) of an island. The process begins with a diagram which shows the disposition paths of each type of fish or fishery product from the fisherman through all participants in the industry, to the end user. Each complete path from fisherman to end user may consist of several segments. A complete system should intercept each path. This diagram aids in determining the path segment where the path should be intercepted. For total catch, a path or paths for a particular fishery can be intercepted at any point which is convenient. On the other hand, for catch per unit effort, it will usually be necessary to intercept the path as near as possible to the fisherman. Different data collection "tools" will be appropriate for different path segments. These tools and their application will be reviewed briefly.

Human resource limitations may mean that some paths or even fishery types cannot be included in the system. Alternatively, low priority paths may be covered with less rigorous methods than those paths known to account for significant amounts of catch.

Whatever practical decisions must be taken, designing the data collection system around a path diagram makes it easy to be explicit about which paths are covered in the system, and how. This provides the framework for regular review of the data collection system, for adapting to changes in the strengths of paths as new fisheries or facilities are developed, and for planned improvement of the system as resources become available.

FISH DISPOSITION PATHS

Two typical but not very complex disposition path diagrams are shown in

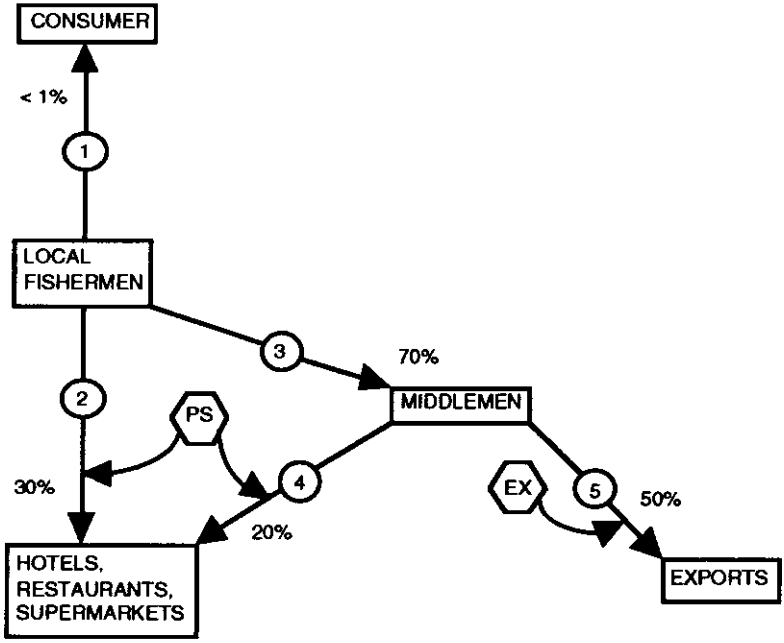

Figure 1a. Path diagram of the disposition of lobster and conch from St. Lessant. Percentages indicate the relative amounts moving along each path segment. Proposed data collection tools are shown in hexagons (PS = purchase slips, SP = sampling program, CE = total census, EX = export forms).

Figures 1a and 1b. Trap and line caught demersal fishes vary in quality from relatively large, choice or preferred species, chiefly snappers and groupers to less desirable, smaller reef species such as surgeonfishes, squirrelfishes, and grunts. Quality fish go to processors, exporters, and hotels/restaurants. The lower grade fish are typically sold to consumers directly on the beach or through a public market with a Superintendent who takes a tariff.

High priced species, such as conch and lobster are seldom affordable to the local householder. These typically go directly to hotels and restaurants, or via middlemen for export.

DATA COLLECTION TOOLS

There are several different ways of acquiring catch and effort data in eastern

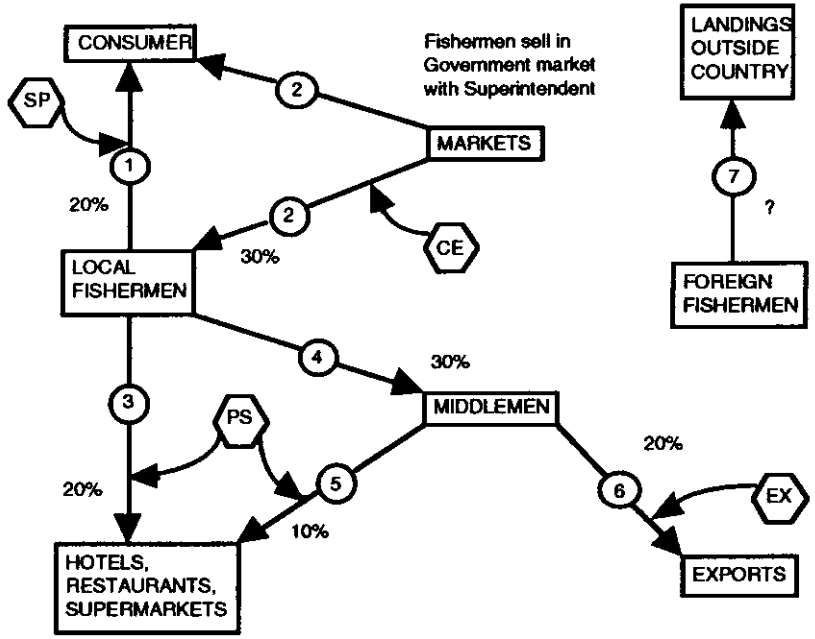

Figure 1b. Path diagram of the disposition of demersal fish from St. Lessant. Percentages indicate the relative amounts moving along each path segment. Proposed data collection tools are shown in hexagons (PS = purchase slips, SP = sampling program, CE = total census, EX = export forms).

Caribbean island situations.

Purchase Receipts

Well established businesses, such as hotels, restaurants, supermarkets or processing plants, which purchase fish from a fisherman or vendor, can be required to give a receipt, and to provide a copy to the Fishery Division. Receipts can be designed to include a variety of information such as location and fishing effort. Such receipts can cover a large portion of conch and lobster fisheries in certain islands, and shift the onus for data collection from the Fisheries Divisions, spreading it over numerous establishments. If purchase slip returns are incomplete, the missing information can be estimated from the returned slips as if a sampling approach had been used, but all appropriate

establishments should be included in the program.

Logbooks

Certain sizes and types of fishing vessels can be required to maintain log books in which catches and effort are recorded by day or trip. These books are then given to the Fishery Division for compilation. Log books eliminate the need for sampling that fleet component, although spot checking is necessary.

Export Licenses

Most countries require a license or permit to export fishery products. Licenses usually indicate amounts shipped but may not be explicit as to the species composition. This problem can be approached by designing more specific forms. Thus, minimal extra effort within an already functioning program may provide information which would require considerable resources if collected independently by the Fishery Division.

Total Census

At markets and landing areas where there are Superintendents, it is often possible to have them record the daily landings and effort. Often, this information is already recorded in the process of exacting the market toll. Again minor changes in the procedures may provide adequate catch and effort data from a large segment of the industry.

Sampling at Landing Places

In most islands, certain types of fish are typically landed at many small landing sites and sold directly to the public or vendors. Total census of total landings would require a substantial amount of manpower; basically one person per site. Under these circumstances, a sampling approach can be used to estimate landings. In the simplest situation, one type of boat and one type of fishery, this would involve estimating the average catch per boat trip (or other unit of effort), the average number of trips per boat per month, and the number of boats fishing from each landing area. Multiplying these three together at each landing area, then summing them, would provide an estimate of monthly catch. Catch per unit effort would have been obtained directly.

In practice most sampling programs will be more complicated as there will be different types of boats, and fishery, and one boat type may practice several fishery types. These sources of variability must be taken into account in designing the sampling program, generally by estimating the averages for each one separately. The more complex the fishery, the more sampling effort it will take to estimate each of the components. The amount of sampling effort required

will also depend on the degree of accuracy required.

FRAME SURVEY

Clearly, designing even a preliminary system, requires a substantial amount of background information on the fishery. The compilation of this information, which can be grouped in four categories (Table 1), is the frame survey. At first, the information may be crude, but as the sampling program is implemented and better information becomes available, the design of the system can be refined.

Table 1. Information to be acquired in the frame survey.

Resources
- Number of individuals for data collection
- Transportation
- Data processing capability

Landing points
- Map showing landing sites and access routes
- For each site or category of site tabulate
  - -vessels by category
  - -fish landings by species/group
  - -facilities (shed, storage, ice, boat haul, dock)
- Also indicate
  - -time of day when fish landed
  - -seasonality
  - -daily frequency of landings
  - -disposition of fish

Vessels
- Range of boat sizes and if these form discrete categories
- For each category indicate
  - -vessel type
  - -length and width
  - -power
  - -crew
  - -gear and equipment used
  - -range
  - -species targeted

Catch
- Overall, and for each boat type, estimate proportion of catch in each category:
  - -small pelagics (flyingfish, sardines, etc.)
  - -large pelagics (by species)
  - -reef fishes
  - -deep slope and bank
  - -conch
  - -lobster
  - -sea eggs
  - -seaweed

For example, the proportions of fish following different paths is useful in allocating sampling effort, but is seldom known. However, a Fishery Officer can usually provide a reasonable guess with which to start, and the allocation of effort can be revised after a season of data collection.

Resources

The available resources for data collection and management will determine the scope of the sampling program. A statistically designed sampling system eliminates the need to attempt a total census of catch, either for an entire island or even for an individual landing site. As available manpower is increased, the accuracy of estimates of catch and effort will improve. However, for small islands with relatively undeveloped fisheries, one or two collectors should be able to acquire sufficient information to provide reasonable estimates for the major components of the fishery.

Landing Sites

The importance of a sampling site can be related to a number of characteristics: amount of fish landed, number of boats landing, and available facilities for handling and marketing.

Fishing Vessels

Individual vessel characteristics will usually determine the units in which fishing effort is measured, as well as determining the importance of landing sites. Therefore, information required will include the size and power of vessels, the types of gear used, and the places where catch is landed.

Catch

In order to plan for sampling to estimate total catch by species or species group, it will be necessary to know the relative proportion of the major catch components and to have preliminary information of the catch composition by various vessels and at the various landing points. In certain instances the catch of various species will be estimated by apportioning the total catch within a species group (*e.g.*, pot fish) on the basis of subsampling for species composition of the catch.

DESIGNING THE SYSTEM

Deciding on Data Collection Tools

The disposition paths in Figures 1a and 1b have been used to prepare a path versus tool table (Table 2). There should be a separate sub-system for each fishery type, for example, demersals, lobster, or conch. The same tool, for example purchase receipts, may be used in several sub-systems which must then be linked by an operational plan. For each fishery it will be necessary to decide:

Table 2. Fishery characteristics of St. Lessant.

Landing area	Canoes	Keel boat	total	Sampling days Jan-June	July-Dec
Primary					
Newtown	50	30			
Secondary					
Old Road	20	10			
Marigot	10	40	85	56	29
East point	20	20			
Tertiary					
Sandy Bay	5				
Rocky Bay	5	5	15	10	5
Little Harbor		5			
	110	110	100	66	34

1. The degree of species breakdown to be collected, and if this breakdown will be required in all data collected, or estimated from sub-samples.
2. The units of effort which will be used.
3. Reporting zones, if any.

Lobster and Conch

In this case, lobster and conch have identical paths and can be dealt with in a single sub-system. Purchase receipts from hotels and restaurants would cover 50% of the catch, and export permits the rest. The small amount going to consumers can probably be ignored, but it could be estimated by adding a question to the purchase receipt.

Purchase receipts would cover the effort used to take 30% of the catch. This would probably provide an adequate estimate of catch per unit effort on a monthly and annual basis.

A possible format for a purchase receipt is shown in Figure 2. Here, days fished would be the unit of effort. Conch and lobster fishermen may keep several days catch in a crawl then sell to several places. Thus, the need for dates fished. Catch from all receipts for one fisherman or boat listing the same days would be summed and attributed to the effort of the dates fished. The answer "some" to the "amount sold" question would alert the data clerk to look out for other receipts.

Demersals

For this fishery, four methods would be required. Two of these, purchase receipts and export permits, would be in force for lobster and conch. They

PURCHASE FORM FOR FISHERY PRODUCTS

Date ..... Purchaser ..... Vendor .....
Species .....
Amount purchased (units) ..... Price paid .....
Zone fished ..... Dates fished .....
Amount sold [all] [some]

Figure 2. Purchase slip for fishery products purchased from fishermen or middlemen.

would account for 50% of the catch and provide effort information for 20% of the catch. The third method would be census in the market, as the attendant weighs the fish and charges a tariff. Again, the attendant could provide receipts for the tariff, and these receipts could include some extra information on effort, location, etc. Finally, to estimate the last 20% of the catch, it would be necessary to devise a program to sample landings at localities where fish are landed and sold directly to the consumer.

Operational Plan

A list of the many items to be considered in preparing an operational plan is in Appendix 1. This plan assumes one person dedicated full time to data collection and processing, that is, about 240 days/year. The data collection system consists of four tools. The time budget for these tools is shown below. This budget must take into consideration whether a computer is available for compilation of the data into regular reports: monthly or quarterly. In general, a system such as the one described here will only be feasible if data management is computerized.

Tool	Responsibility	Time allocation (days)	
		collect	compile
1) Purchase forms	Hotels/rest	12	24
2) Export licenses	Ministry of Trade	3	12
3) Census	Superintendent	3	36
4) Sampling	Fishery division	100	50
Total		118	122

Purchase Forms

Monthly pickup of forms from institutions, and entry of data into computer.

Export Licenses

Monthly pickup and data entry.

Census

Monthly pickup and data entry.

Sampling

Assume that the landing sites and boats are distributed as in Table 3. Since the censused market is at Newtown, it would not be included in the regular sampling program. Depending on the availability of manpower, and our confidence that all the fish actually passes through the market, sampling could be carried out there from time to time as a check. If fish are landed at roughly the same time of day at each place, it will be impossible for a data collector to visit more than one site per day. Assuming that there is enough manpower to sample on 100 days, and that there is no information on the relative amounts of fish landed at the markets, the sampling effort could be distributed between secondary and tertiary sites in proportion to the boats situated there (Table 3). If

Table 3. Table of disposition paths versus data collection tools.

Fishery	Path	Tools Sample	Census	Receipt	Log	Export	For.
Lobster/Conch	1			C/E			
	2			C/E			
	3	(4,5)					
	4			C			
	5				C		
Demersals	1	C/E					
	2		C/E	C/E			
	3						
	4	(5,6)					
	5			C			
	6				C		
	7						C/E

C = catch data collected, C/E = catch and effort data collected

we think that about 75% of the catch is landed in the period January to June, the effort could be apportioned accordingly, then divided up evenly among the months (Table 3).

The sampling schedule would be set up in advance, with the sites drawn at random. On each visit, the sampler records the following:

1. Boat.
2. Catch in each species category by each boat landing.
3. Any agreed upon indicators of effort beyond the trip (*e.g.*, crew, lines

fished, traps hauled, hours at sea).
4. Days since last fished (or some other indicator of frequency).
5. Boats not fishing.
6. Boats which did not return during the visit.
7. Any other data agreed on (prices, etc.).

The sampler also makes notes of fish disposition patterns.

Data Management and Outputs

The output of the data collection system would be monthly catch and catch per unit effort for some components of the fishery, for each species, or species group. This information could be summarized in a regular report. Assuming that a computer is available for data management, standard database or spreadsheet software, or a combination of the two could be programmed for data entry and checking, compilation, and report production.

APPLICATION TO EASTERN CARIBBEAN ISLANDS

The approach described above was applied in the following eastern Caribbean countries: Antigua and Barbuda, Anguilla, Barbados, British Virgin Islands, Dominica, Grenada, Montserrat, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, and Tobago. The systems designed for each of these countries are fully described in Mahon and Rosenberg (1988), and summarized below.

The sizes of the Fishery Divisions, the extent of current data collection, and the relative importance of the various fishery types vary considerably among the islands. In general, pelagics are more important in the southern islands, where shelves are narrow (except the Grenadines), and reef fish, lobster, and conch are more important in the northern islands with large shelves. The complexity of the fish distributional patterns also varies considerably among fishery types and islands (Figures 3a and 3b). The simplest pattern is for small species moving directly from fisherman to consumer. The most complex pattern is for high priced species going to a variety of purchasers: hotels, exporters, and processors.

In almost all islands where there are exports of fish and shellfish, permits are required. The resulting records provide one of the better sources of data in these islands. However, there are instances in which unpermitted exports are common, for example, from Anegada in the BVI.

In several islands, market caretakers/superintendents already census fish landings at major landing sites. This is done mainly in order to impose a tariff for using the market facilities. In these instances, the existing census was incorporated into the system designed. They are: fishery complexes in BVI, Nevis, Antigua, St. Lucia, and St. Vincent; and major landing places in Barbados, St. Lucia, and Grenada. The main new thrust in establishing fishery data collection in these islands will be setting up purchase slip systems for

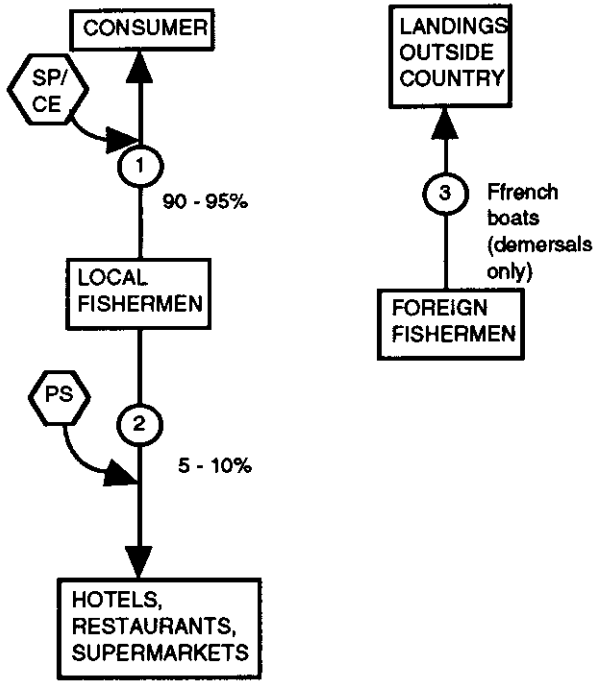

Figure 3a. Path diagram of the disposition of trap caught demersals and seine fish in Montserrat. Percentages indicate the relative amounts moving along each path segment. Proposed data collection tools are shown in haexagons (PS = purchase slips, SP sampling program, CE = total census) (from Jeffers *et al.*, 1988).

lobster and conch sales direct to restaurants, and sampling programs for small landing sites which are not censored by caretakers.

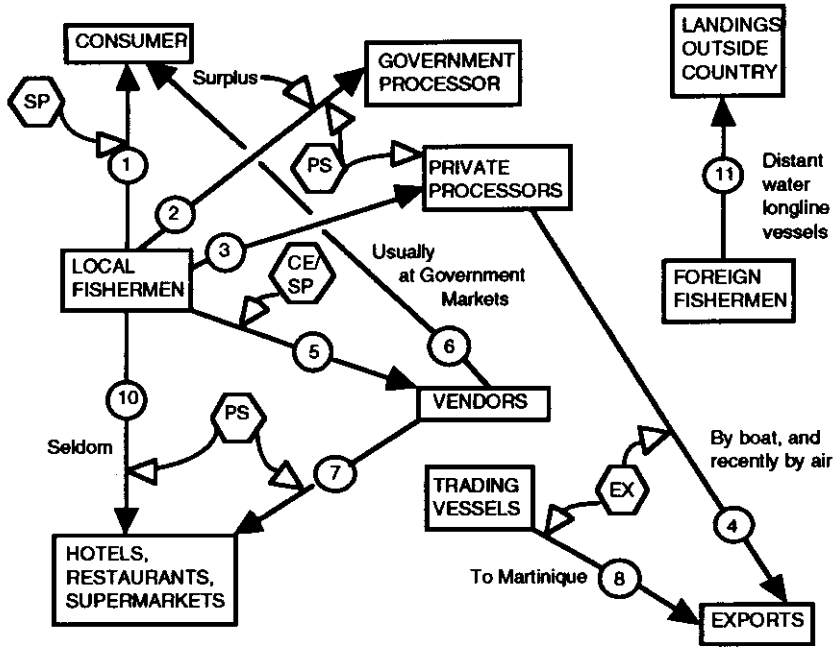

Figure 3b. Path diagram of the disposition of large pelagics and quality handline-caught demersals (snapper and grouper) from Grenada. These resources alternate seasonally. Percentage indicate the relative amounts moving along each path segment. Proposed data collection tools are shown in hexagons (PS = purchase slips, SP = sampling program, CE = total census, EX = export forms) (from Finlay *et al.*, 1988).

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APPENDIX

Appendix 1. Sequence of activities in designing a data collection system.

1. Identify fisheries, define disposition paths with rough proportions, and number segments (Figures 1 and 2).
2. Compile basic frame survey information on landing sites, vessels, etc.
3. Prepare table of collection tools versus disposition paths for island (Table 2).
4. Describe details of operation for each collection tool:
   a) General outline of how the tool will be applied.
   b) A list of the fisheries targeted by that tool.
   c) A list of information which must be acquired before the plan for that tool can be finalized.
   d) The agency or department which will be responsible for the application of the tool, and who they will have to coordinate with.
   e) The physical locations where the work will be carried out.
   f) A schedule for the deployment of manpower.
   g) Design of necessary forms.
   h) Actual field procedures for collecting and recording data.
   i) How the accuracy of the data and the proper application of procedures will be checked. The former may require occasional special studies. For example, a few days sampling at a censored site to compare the two estimates.
   j) Details on how data will be handled when it is brought back to the office: who will enter, or summarize it, and where it will be archived afterwards.
   k) Some sample calculations for each tool, and for combining data from tools.