

The Establishment, Maintenance, and Use of Statistical Monitoring Programmes for Artisanal Fisheries: The Case of Bermuda

BRIAN FRICK, NORBERT SIMMONS, AND JACK WARD

*Bermuda Division of Fisheries
Department of Agriculture and Fisheries
P.O. Box CR52
Crawl, Bermuda
CRBX*

ABSTRACT

En las naciones más desarrolladas se han venido estableciendo, con éxito, métodos de seguimiento estadístico a las pesquerías más importantes. Estos han sido a través de sistemas compulsorios de cuadernos de bitácoras para viajes de pesca, el requerir records sobre plantas procesadoras y/o sitios de desembarco, etc. Las pesquerías de la mayor parte de las pequeñas islas operan desde muchos pequeños sitios de desembarco, lo cual disminuye la posibilidad de obtener records adecuados de facilidades de desembarco y procesamiento de peces. En estos casos los pescadores deben ser la fuente para suplir la información sobre capturas y esfuerzo.

Este trabajo examina la experiencia en Bermuda, con un programa de estadística de seguimiento a las pesquerías, basado en requerimientos mandatorios de someter información sobre las capturas y esfuerzo diario de cada barco con licencia de pesca. Los métodos utilizados para coleccionar los datos, analizar éstos y el uso de la información coleccionada son examinados aquí. El tema sobre la confidencialidad de las estadísticas aparente y real es discutido, así como aquel del efecto en la conducta de reportar datos en relación a varios esfuerzos de administración pesquera basados en el análisis de los datos coleccionados.

Las debilidades y ventajas de los últimos doce años de esfuerzo siguiendo éstas pesquerías, se evalúa con la idea de ayudar a otros en el establecimiento de mejores programas de estadística pesquera.

INTRODUCTION

The Bermuda shelf from shore to the 100 fathom contour and including two offshore banks is approximately 380 square miles in area (Figure 1). This relatively small shelf area supports a fishing industry of approximately 200 registered fishing vessels producing some 500 metric tonnes of finfish annually. Despite the small scale of the fishery, the catch is landed at more than 20 sites around the island. As there is no central marketing centre for landings in Bermuda, sampling the commercial catch for monitoring purposes is frustrating at best. Further, the taxation structure of the Island is such that documentation by fishermen with respect to sales or earnings is generally not required by law, and thus tends to be minimal. The net result is an industry largely without any documentation useful for management purposes.

Given these difficulties, it was obvious that records of fishing effort and success would have to be collected from the fishermen themselves in order to assess the state of the fishery. (Fortunately Bermuda is blessed with a very high

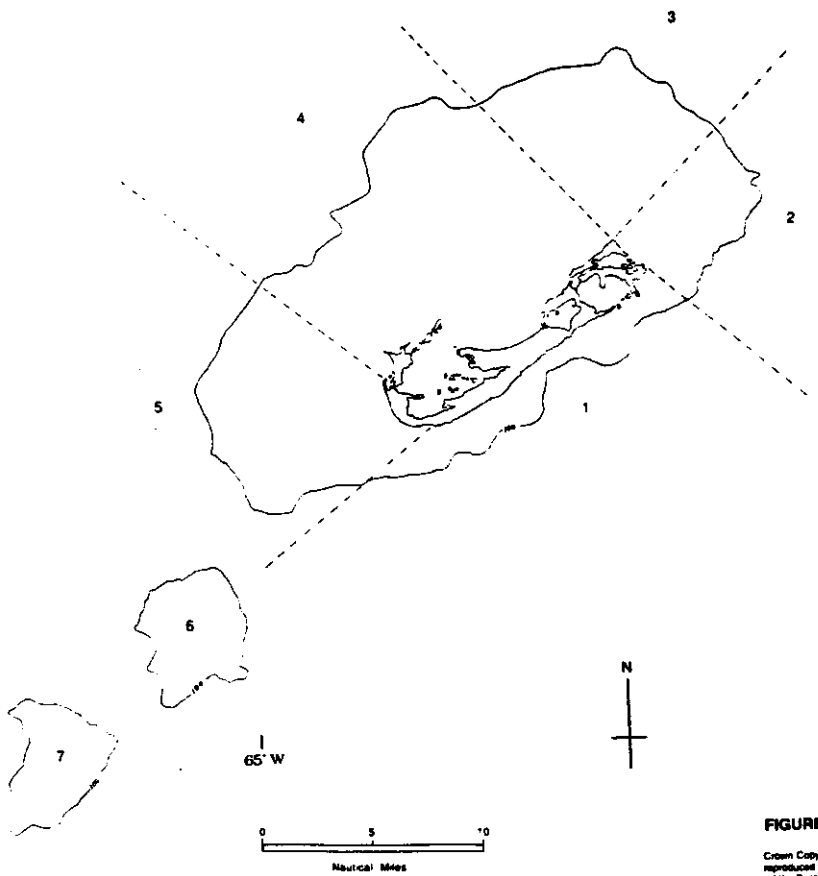


FIGURE 1
Crown Copyright
reproduced from Admiralty chart 300 with the permission
of the Controller of Her Majesty's Stationery Office

Figure 1. Bermuda.

literacy rate, a factor of prime importance in programmes which rely on self reported data.) This paper describes the evolution of the Bermuda fisheries statistics programme with reference to our methods of acquiring data on industry activities and processing the same to produce meaningful information which would be of use to fishery managers. Particular attention is given to the problems arising from the use of the information from our programme for the management of the local industry. No attempt is made to review the literature relevant to the establishment of monitoring programmes, however the reader is advised that a wealth of such information exists. Rather than providing advice on how to set up a monitoring programme, this case study is aimed at pinpointing some of the many pitfalls which we encountered along the way, with the hope that others many benefit from our experience.

HISTORICAL PERSPECTIVE

Prior to the establishment of Bermuda's self-reporting programme, the only information relevant to the performance of the local fishery was obtained through seasonal surveys of selected fishermen. An anecdotal estimate of the catch based on these interviews and the number of fishermen registered was thereby obtained (Burnett-Herkes, pers. comm.). Later, towards the end of the 1960's, Government began systematically collecting statistics on catch and effort from members of the fishing industry. Submissions at this time were made on a purely voluntary basis, but were encouraged by the fact that the privilege of importing duty free fishing gear was made contingent upon the reporting of one's catch for at least three months prior to importation. Information was collected by means of two forms supplied by Government, and attempted to assess both catch and effort data and general operating costs. However, due to the nature of the reporting incentive, participation tended to be somewhat sporadic, peaking at times of major gear purchases.

Passage of the Fisheries Act, 1972 and its attendant Regulations, made it mandatory for licenced fishermen to keep daily logs of catch and effort, and to submit these records on a weekly basis. At this time pre-printed Fishing Return Forms (Figure 2) were produced and distributed to the industry in an effort to ensure standardization and to make reporting easier for the fishermen concerned. The information collected for each licenced vessel attempted to measure the following:

1. Effort expended: time spent at sea; number of net sets made; number of pots hauled; number of fishermen employed on each trip; time spent distributing catch and channels through which catch was distributed; and other time spent in the industry (repairs, gear fabrication, etc.).
2. Catch obtained: with details as to the weight and number of each species caught, together with the type of gear used (nets, pots, handlines, or rod and reel).
3. Area and depth fished: with Bermuda's waters being divided into 7 reporting areas (As outlined in Figure 1), and depth being divided (initially) into 4 categories.

To make it easier for fishermen to fulfill this obligation, the forms were supplied in a postage-free, self-addressed format. Self-carboned duplicates were included in each "book" of forms to provide fishermen with their own personal record of their activities. As can be seen from the instructions provided with the

FISHERIES DIVISION
Department of Agriculture & Fisheries

FORM 3

FISHERIES STATISTICS

Code No. (Licence No.)

Area Fished

Depth Fished

No. of Fishermen

Day Month Year

Reg. Fishermen No.

Fish pots landed

Net sets made

Handmade / Vertical drop line sets made

Sw/face long line sets made

Snapper reel sets made

TOTAL

No. of boats per set

Distribution of Catch: Retail Wholesale Restaurant Hotel Own Use

(please tick appropriate box)

CATCH	Weight	No.	Gear Used	Catch	Weight	No.	Gear Used
ROCKFISH, GROUPERS				TUNA, MACKERAL, etc.			
001 Rockfish (Black)				451 Yellowfin (Alfson)			
002 Rockfish Monkey Hog				451 Blackfin			
003 Rockfish Gag or Tiger				452 Almacora			
004 Rockfish Red, or Princess				453 Mackerel			
005 Hamlet (Nassau grouper)				454 Dolphin			
006 Red Hind				455 Oceanic Bonito			
007 Coney				456 Barracuda			
008 Barber				457 Wahoo			
009 Misty Grouper (John Paw)				458 Blue Marlin			
010 Wreck Fish				459 White Marlin			
011 Graysby				460 Sward Fish			
012 Other				461 Other			
JACKS				SHARKS			
120 Amberjack				570 Tiger Shark			
121 Bonito (Almacorjack)				571 Dusky Shark			
122 Usualty				572 Blue Shark			
123 Blue Runner				573 Mako Shark			
124 Rainbow Runner				574 Gummy Shark			
125 Goggle Eye				575 Other Shark			
126 Rubins				SHELLFISH			
127 Steel Head				680 Lobster			
128 Other				681 Guinea (Lob A)			
SNAPPERS				682 Licust			
230 Gray Snapper				683 Mouson (Hrs)			
231 Silk Snapper				684 Octopus			
232 Yellowtail				685 Crab			
233 Red Snapper				686 Prawn			
234 Wanchman Snapper				BAIT			
235 Queen Snapper				790 Fry			
236 Other				791 Crinoid			
MISCELLANEOUS				792 Herring			
340 Porge				793 Pitkards			
341 Chuk				794 Flying Fish			
342 Hogfish				795 Sallyhen (Hut Hut)			
343 Parrot Fish				796 Other			
345 Turbot							
346 Bream Pin Fish							
347 Moray							
348 Muller							
349 Doctor Fish							
350 Squared Fish							
351 Other							

TIME SPENT

Man Hours

a. Processing Catch b. Distribution of Catch c. Making Mending nets d. Making Pots

Hours at Sea

e. Rigging Lines f. Boat Repairs g. Engine Repairs h. Other (time)

Total Pts. 344 Credits

Figure 2. Statistics Return Form completed by fishermen.

forms in Figure 3, some low-level "coding" of the data was conducted by the fishermen themselves.

Unfortunately, the compulsory programme was not an overwhelming success at first. This was perhaps due to two factors: first, a perception by the industry of over-regulation, in that too many rules were introduced at one time with the new Fisheries Act. Second, a major split in the ranks of the leading fishermen's association occurred at this time over the new Regulations and virtually destroyed the rapport that had existed between Government and the industry. To counter this, considerable extension efforts have been made by Government in an attempt to encourage the industry to comply with the requirements of our compulsory programme.

During the first two years of this programme the collected information was compiled by hand, focusing primarily on summaries of landings by species, together with some estimates of expended effort. It was not until 1975 that funds became available for electronic data processing, which commenced in 1976, with an external data processing company beginning work on the 1975 returns. Several summary reports of catch and effort were produced to provide: total catch by species; a comparison of total catch with effort expended (man hours, pots hauled, etc.); distribution of catch through various marketing channels; catch for each vessel (by species groups); catch by reporting area; and catch by species for each of the 28 combinations of area and depth.

These reports were produced on a monthly, quarterly, and annual basis, continuing to be produced up to and including calendar 1981, when funding for external data processing was suspended in anticipation of a move to in-house facilities.

The pre-printed forms used for data collection underwent a series of minor modifications during this period. In addition to an expansion of the species list, the number of depth categories was increased to 12 and the number of gear types to eight. This last change allowed for measures of effort to be made for three additional gear types which were gaining prominence in the industry: longlines, vertical drop lines, and snapper reels.

In-house processing finally got under way in early 1983 using the Division's own microcomputer, running custom made software provided by the Bermuda Government's Data Processing Unit (D.P.U.). This software consisted of a standard commercially available data base package called DataFlex, manufactured by Data Access Corporation, which was adapted to our needs. This approach was by far the most cost-effective for Fisheries, when compared to the option of designing and writing our own program from the beginning. Several good quality data base packages of varying sophistication and power are available on the market today and it makes little sense to "reinvent the wheel." Data base programs of this nature essentially provide a framework whereby the user can define:

1. What data he wishes to store (organized into "fields").
2. A method of entering the data in an easy fashion without any specialized knowledge being required by the operator (usually by means of a fixed input screen which defines "windows" to be filled).
3. A method of retrieving the data in a logical, summarized form (by organizing the data according to key fields and generating reports).

The new system produced eight reports of interest, modeled after our earlier first generation of reports but with an increased emphasis on effort expended by

DEPARTMENT OF AGRICULTURE & FISHERIES

FISHERIES DIVISION — FORM 3

DIRECTIONS

The owner of every licensed fishing vessel, or if the fishing vessel is operated by a person other than the owner then that person, shall keep a **daily log** of catch and effort statistics relating to the operation of that fishing vessel in the waters adjacent to Bermuda and shall make a **weekly return** thereof. The owner or as the case may be the operator of a licensed fishing vessel who fails to make the returns as required, shall be guilty of an offence against the Fisheries Regulations. This may also prejudice the opportunity of the licence holder to relicence and/or obtain special permits. The log shall be kept on Form 3 supplied by the Department. The forms are available at the outlets listed on the inside of this cover

CODE No. The fishing vessel identification number.

AREA FISHED These areas are numbered 1 through 7 as illustrated on the inside of this cover, choose the correct area and enter the appropriate number.

TOTAL POTS, LINES, NETS HAULED Total number of fish pots hauled in any one trip (include a second hauling as another pot hauled). Total number of anchored vertical drop line, snapper reel, and surface long line sets made. Enter number of sets and hooks per set in boxes provided.

APPROX. DEPTH This is the approximate depth fished in fathoms. Enter the appropriate code number as illustrated below.

<u>Depth Fished</u>	<u>Code No.</u>
0 — 12	1
13 — 20	2
21 — 30	3
31 — 50	4
51 — 100	5
101 — 150	6
151 — 200	7
201 — 250	8
251 — 300	9
301 — 350	10
351 — 400	11
401 — 500	12
501 — 600	13
601 — 700	14
701 & deeper	15

DISTRIBUTION OF CATCH Distribution of fish to the various sales outlets, e.g. restaurants, retail (public), etc. using codes provided 1, 2, 3, 4 or 5.

CATCH Names of fish caught.
Weight: Total weight in lbs. of each type of fish caught.
Number: Total number of each type of fish caught.
Gear Used: Use appropriate code No. illustrated below for type of gear used.

<u>Gear Used</u>	<u>Code No.</u>
Bait Net	1
Seine (Hauling) Net	2
Handline	3
Fish Pot	4
Rod and Reel	5
Snapper reel	6
Vertical drop lines	7
Surface long lines	8
Crab/Prawn pot	9

TIME SPENT **Hours at sea:** Total time at sea, from leaving moorings until returning to moorings.
Man Hours. How was your time spent other than at sea? Please fill in the appropriate amount of time spent in hours.

Figure 3. Instructions accompanying Statistics Return Forms.

individual fishing units. At present two reports have proved to be the most useful to us, providing the majority of our current management information. These detail total landings by species and both individual and total effort expended by the industry.

We hope that the net result of these changes will be a system for analyzing reported catch and effort statistics that can meet the information needs of the Division and outside organizations for several years into the future.

SOME CAVEATS

The data analysis carried out by any system can only be as accurate as the information collected. This is totally dependent on the cooperation of the individual fishermen within the industry and their full support can only be assured if they can see some benefit accruing to themselves from the programme. For this to be possible, they must feel that they can fully trust the fishery managers, and have the confidence that the latter's activities are being undertaken for the good of all in the industry. Credibility is essential.

In addition, the confidentiality of collected information must be maintained, and must be seen to be so by the industry. Accurate information cannot be expected from fishermen if they fear that the information may be made available to, for example, competitors, divorce courts or, more importantly, to other Government agencies who may use their reported data for taxation purposes. For this reason we have pledged at the outset that any information gleaned from the programme would never be given to any agency or persons outside of the Division, except in a general, industry-wide format. To date the Division has faithfully kept this promise, although at times certain individuals in the industry have been mistrustful and have, as a result, stated that they have limited the information they have reported to us (most notably measures of effort).

Hindsight now gives us insight into considerations overlooked when our programme was first established. These points may be of value to others considering initiating their own monitoring programme based on self-reported data by their local industry. Some of these points are concerned more with the pure "mechanics" of our programme, that is, the operational difficulties which we have encountered. Others are of a broader, more policy-oriented nature, being concerned with problems which we have encountered in utilizing our acquired information to select and effect changes in the management of our fishery.

Data Collection

In requesting that fishermen report the weight of their catch, we failed to clearly specify which weight to report, (that is, whole weight, gilled and gutted, etc.). This problem, once recognized, cannot be rectified without adverse effects. Once a system has been running for several years, changing the measure a fisherman reports destroys comparability, the most valued product of such programmes. We feel that it is of utmost importance to carefully scrutinize the directions for reporting to ensure that the fishermen understand what is expected of them prior to the start of any programme.

Our reporting forms at one point included a category for "Fillet." We have found that fishermen will often report their filleted catch in this category rather than by individual species. As local fish is commonly sold in the fillet form much information may have been lost in this fashion.

If previously unknown or unexploited stocks become targets for a developing fishery they should be incorporated into the reporting programme as quickly as possible. The inclusion of blank species and gear categories in the reporting form might be used to facilitate this. In Bermuda, the most productive period of our short-lived vertical line fishery for snappers was essentially missed due to the time lag between initiation of the fishery and inclusion of the new species, gear, and depth categories on the reporting forms.

One further point: we strongly advise that once a Species (or Gear or Depth range) has been assigned a code on the reporting form, this code should not be changed whenever the form is updated or expanded. To do so runs the risk of diminishing compatibility between data collected by the two versions of forms within the data base software.

Data Usage

The Bermuda Government supports a policy of partial subsidy of the commercial fishery in the form of duty free entry of essential fishing gear and boats, together with a subsidy for fuel costs for full time fishermen. Eligibility for these benefits is determined by involvement and success in the industry as reported through statistical submissions. As import duty on marine items is extremely high in Bermuda, this provides an incentive for the falsification of reported data. The use of fisheries statistics for such a purpose is extremely tempting, however when fishermen learn of these uses (an inevitable eventuality) the reliability of the collected information is undermined. This effect may be tempered to some degree by the perception among fishermen that their earnings may be reported to the Tax Commissioner. Thus the potential benefits of overstating one's participation and catch may be offset by the fear of being taxed on this same base. However, we do feel that, if at all possible, such uses should be avoided.

Changes in management may, in certain instances, produce changes in the reporting of catches by fishermen. If declining catches prompt restrictions on fishing effort, fishermen may report increased catch rates in an attempt to stimulate the easing of restrictions. The date at which critical changes in management occurred should be kept in mind when looking for trends in catch rates over time. If at all possible, other collection techniques should be used to supplement or verify catch records from the very beginning, thereby enhancing the validity of observed trends.

CONCLUSION

The documented decline of grouper landings from 205.5 metric tonnes in 1975 to 80.7 metric tonnes in 1985 has prompted increased limitations on fishing effort. A system of limited entry has been instituted with the use of fish traps being restricted to full time fishermen. Full time fishermen are legally defined inter alia as "any fisherman who spends a minimum of 100 days at sea in a licensed fishing vessel. . ." (Government of Bermuda, Fisheries Act, 1972 as amended 1985). Unfortunately, self reported statistics are the only available source of information concerning time spent at sea (Figure 4). This development has, we feel, dramatically increased the incentive for falsification of statistical returns, as fishermen may overstate effort in order to maintain their trap allotments.

ANNOUNCEMENT FROM:

*The United Bda.
Fisherman's Assoc.*

To all fishermen if you value
your permit, get your
statistics up to date & your
hundred days. This is the
last quarter.

Signed Danny Parias

FROM: The Royal Gazette, Hamilton, Bermuda
October 3, 1986

FIGURE 4

Figure 4.

This example further illustrates the two-edged nature of management based on fisheries statistics: without the documentation of the decline in grouper landings the introduction of effort limitations would probably have been impossible; however, the industry's reaction to this management measure may well serve to place our statistics programme in jeopardy. If information obtained from a self-reporting statistics programme is to be used as a cornerstone in management schemes of this nature, we strongly suggest that efficient enforcement methods to discourage biased reporting, coupled with an alternate collection programme to verify reported data, will be critical ingredients to success.

NOTE: DataFlex is a trademark of Data Access Corporation, Miami, Florida, U.S.A.