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ABSTRACT

This site is located in the western part of Jamaica and is the third largest fishing community, but before this 2001-2002 study, little was known about this site. Approximately 700 fishers using 120 relatively large (16 m) open boats operate from this relatively well developed site. These boats are all constructed on the beach and are the largest in the island. We investigated selected reef fish species from trap catches, gear distribution, fishing grounds, socio-economic information on fishers as well as attitudes towards potential management measures.

The overfished condition of the reef fish resources targeted by these fishers who operated mainly on Pedro Bank, 100 km to the south, was evident from the high proportion (61%) of "trash" (lower grade) fish in trap landings. Ranked dominant families were Scaridae (parrotfish), 41%, Mullidae (goatfishes (18%), and the Holocentridae (squirrelfishes), 9%. Fish traps with 3.18 cm maximum aperture mesh wire were the predominant gear utilized by 49% of all fishers, with hook and line gear at 37%. Comparisons of estimates of the von Bertalanffy growth parameters for the eleven most abundant reef fish species from seven families, indicated the reef fish populations they represented, were not significantly different from many other Caribbean reef fish populations with high mortality rates. There is a curious interference by dolphins (Mammalia, Delphinidae) with fish traps that will form the basis of another project.

Of the 69 fishers interviewed, 87% were full-time, and 52% were over 40 years old. Most had been fishing from more than 10 years. Most fishers perceived that there was need for management measures such as shorter fishing seasons, introduction of fishery reserves, increasing the minimum size for lobsters, and co-management of the reef fisheries.

KEY WORDS: Fishing gear, reef fish, management, Jamaica

Pesca Artisanal en Jamaica: Un Estudio de un Sitio de Aterrizaje de Peces Grandes

Whitehouse se encuentra situado en el occidente de la Jamaica y es el tercer mas grande comunidad de los pescadores. Pero antes de ese estudio desde 2001-2002, se no ha entendi mucho de este lugar. Aproximadamente 700 pescadores, se utilizando 120 canoas mas grande edasen (18m), pescando desde este lugar mas desarrollado. Esos barcos son contruido sobre la playa y se los mas

grandes en toda la isla. Hemos investigados los peces arrecifes particulares desde las nasas para peces, el distribucion de artes de pesca, las zonas de pesca, la informacion socio-economico sobre los pescadores, y tambien, opiniones sobre regulaciones del manejo para la pesqueria para el futuro.

El estado de sobrepesca de los peces del arrecife que estaba la objeto de los pescadores, se operan en el Banco Pedro, 100 km al sur de la isla, estaba probado por la proporcion mas grande encontrado en la categoria de menor valor (se llama en ingles "trash") (61%) desde los desembarcaciones de las nasas antillanas.. Las otras familias con las abundancias mas grandes, son, en el orden, Scaridae (loros), (41%), Mullidae (barbas) 18%, y Holocentridae (ojos grandes) 9%. Nasas antillanas con la apertura maxima de 3.18 cm estaba el arte de pesca mas comun utilizado por 81% los pescadores, y los anuelos y lineas, 42%. Los parametros de von Bertalanffy se han calculado para 11 especies del arrecifes, se han demostrado que esos especies no son muy diferente del los otros especies similares de los otros lugares en el Caribe, con ratos grandes de la mortalidad. Se lo ha observado un fenomeno muy interesante que los delfines (Mamalia) jugando con nasas en este region.

Un total de 87% de todos los pescadores estaban pescadores permanentes, y 52% tienen mas que 40 anos de la edad. La majoridad estaban pescando para mas que 10 anos. La majoridad de los pescadores piensan que es necesario los regulaciones de manejo como por ejemplo, vedas, refugios, subiendo a talla minimo para la langosta, y el co-manejo de la pesca del arrecife.

PALABRAS CLAVES: Jamaica, artes de pesca, peces arrecifes, manejo

INTRODUCTION

Jamaica lies to the centre of the southwest Caribbean Sea and is third largest of the Greater Antilles with a total land area of 10,940 km², a population of approximately 2.5 million, and a coastline of 885 km. It has many small inlets and bays along this coastline (NRCD 1987). Lying in the path of the northeasterly trade winds, wind speeds exceeding 15 m/sec and associated choppy seas are common, with a calmer period between October and February (Munro 1983, Aiken 1993). Currents in the vicinity of the island are westerly and vary from 0.5 – 1.0 knots per hour. For most of the year tidal effects are slight to nil, although over Pedro Bank they can reverse at ebb tide. The majority of the sea floor on the shelf is seagrass and soft corals over sand and limestone bedrock, with coralline growth usually concentrated at the edges (Aiken 1993, Halcrow 1998). There are muddy areas near the estuaries of several large permanent rivers emptying at the south coast. Much of the south shelf is flat and shallow with a mean depth of approximately 20 m and a maximum width near the middle of it, of approximately 25 km. The north shelf, in contrast, is a narrow 1.6 km band. The larger reefs are found on the eastern portion of the south shelf and are of the fringing and sill types. There is deep water separating the island from all the oceanic banks. The edges of the shelf have a vertical or near-vertical profile into deep water (> 300 m) on all sides. The island and the nine proximal oceanic banks have a total area of 4,170 km². An Exclusive Economic Zone established in 1996 has increased

Jamaica's total marine area to 274,000 km². Fishing activities from Whitehouse, take place within the national EEZ. This assumption was tested.

Figure 1 shows the location of Whitehouse fishing beach, near the eastern edge of the parish of Westmoreland parish, approximately 180 km from the island's capital of Kingston. It is recorded by the Fisheries Division of the Ministry of Agriculture as having approximately 700 fishers and some 150 boats. There is a large river, the Black River, which empties just to the east of Whitehouse, which provides a large volume of fresh water input into the coastal waters up current of Whitehouse. Whether there is significant siltation effect on corals in nearshore waters near that location is unknown at the present time, but during the two years of study, no significant siltation was observed or reported to us from that river. The shelf near Whitehouse is relatively flat and shallow with a mean depth of approximately 20 m. study. There are actually two (twin) adjoining landing, Whitehouse beach proper which is larger and with a large mooring pier and gear storage, and the slightly smaller, Gillings Gully beach to the west. The active fishers cooperative for the twin beaches, takes its name from this latter site. It is estimated to be the third largest fishing site in Jamaica. The site has a modern pier, freezers, and market area courtesy of Japanese government constructed in 1999. It was thought to be a base for approximately 700 fishers with 150 fishing vessels. It was always thought to be an important landing site, yet little data had been collected there previous to this study.



Figure 1. Map of Jamaica showing location of Whitehouse study

The Fishing Industry

The fishing industry is primarily artisanal and small-scale, but is surprisingly diverse and complex (Halcrow 1998). There are at least 15,000 to 20,000 active fishers and at least 3,500 registered fishing vessels operating from 184 landing sites spread relatively evenly around the entire island. The typical vessel is an open canoe (95% of all vessels) that range in size from 4 m wooden dugouts to > 18 m larger fiberglass canoes that fish Pedro Bank 150 km offshore to the south. All larger canoes use large (> 40 hp) outboard engines. There is also a small number of decked, offshore vessels in the 12 m to 20 m size range that are fitted with inboard gasoline or diesel engines that fish adjacent oceanic banks. There is a small fishing port in Kingston that was constructed in 1980 with concrete berths and other facilities for larger decked vessels. It is presently in a somewhat poor condition.

The main landings are of coral reef fishes (Munro 1983, Aiken and Haughton 1987, Koslow et al. 1988, Aiken 1993, Aiken and Kong 2000). Though 445 species of marine bony and cartilaginous fish species have been described by Caldwell (1966), only 96 species of fish and two lobster species have been described from the Port Royal reefs near Kingston by Munro. The main fishing areas are on the island shelf and on the nine small oceanic banks. Pedro bank is a larger oceanic bank that is 5,500 km² in area and is to the southwest of Kingston. It is accessible to all larger south coast canoes, and many undertake the perilous, but profitable journey. On the eastern fringe of Pedro bank are three small sandy cays on which fishers reside, fishing and shipping their sorted catches mainly to Kingston, at regular intervals for most of the year. The main fishing gears are fish traps (pots) and beach seine, tangle and gill nets, followed by hand lines, spear fishing and some use of illegal explosives. Since 1980, there has been a steady increase in the number of fishers employing nets of various kinds in an attempt to avoid widespread pot stealing. By 1996, net fishing gears were 40% of all gears employed, equaling the use of pots (Fisheries Division 1997). Large Z-shaped Antillean fish traps (which take crabs and lobsters also) were used by 55% of all fishers and these exploited Pedro Bank resources. A total of 42% of all fishers exploited south coastal shelf resources using traps primarily. These same fishers also traveled to other very small offshore banks that were nearby. Handlines (hook-and-line) were used by 42% of all fishers. Many fishers employ more than one type of gear (Espeut and Grant 1990). North coast fishers are mainly part-time while those on the south coast are mainly full-time. Marketing is by a large diffuse higgler system. This organizational pattern was tested for Whitehouse.

Fish production statistics from the Fisheries Division for 1996 and 1999 suggest that marine catches island wide of all fishable products totaled in those years, 14,400 t and 8,300 t annually, respectively. Old Harbour bay, the country's largest fishing beach produces roughly 33 % of annual production. It was assumed that Whitehouse was the third largest contributor to this total annual fish catch. This assumption was tested.

Fish pot or trap fishing is conducted in two major locations; 1) the island shelf and 2) the offshore banks and their cays. The great majority of fish landings are from reef fisheries, mostly from the southern island shelf. The

primary gear is the Jamaican version of the Antillean fish trap, which consists of a hardwood frame over which hexagonal meshwire is stretched in a Z-shape with two horse-necked entrance funnels. These traps are set near, but never on, the fringing reefs at depths between 20 to 40 m on average. They are usually deployed singly, with simple baits for up to six days. Newer pop-up floats are gaining popularity due to increasing fish pot piracy. Traps are retrieved from the seafloor, by hand by a crew of about three persons, operating from an open boat. This fishery produces scalefish, spiny lobsters, crabs, and some octopus. Small quantities of shark and rays are caught in the net fisheries where catches are dominated by scalefish. Nearly 60% of all fishers operate on the south coast.

Offshore, the major activities center on Pedro Bank, which has three sandy cays supporting a maximum of about 150 persons. These fishers use traps, scuba and lines to harvest reef fish, queen conch and spiny lobsters from all over the bank. One thousand fishers and 200 boats are registered with the Fisheries Division as having permits for fishing Pedro Bank and on the much smaller Morant Bank to the southeast of the island. Queen conch is taken by cay-based divers from industrial vessels. The resident cay fishers sell their fish and lobster harvest to larger carrier boats, laden with ice, that take the fish to Kingston. Many larger partly-decked canoes with special insulated ice-holds also travel from south coast beaches to the cays to transport catches back to the island. Fishing patterns at Whitehouse were examined.

The two study hypotheses were tested by collecting a variety of fisheries, biological and sociological data at the study site over a 24 month period. Included in the objectives were the following:

- i) Determination of numbers of fishers at WH (Whitehouse),
- ii) Determination of number of vessels operating from WH,
- iii) Determination of seasonality of fishing at WH,
- iv) Description of fishable species composition by gear type landed at WH,
- v) Estimation of how many WH fishers fishing on Pedro bank,
- vi) Pedro Bank contribution in catches landed at Whitehouse,
- vii) Estimation of costs of Pedro bank fishing,
- viii) Determination of fishing effort by WH fishers on Pedro bank,
- ix) Determination of seasonality of fishing on Pedro bank,
- x) Estimation of value of catches landed annually, monthly,
- xi) Comparison of project data with data from study site collected and held by Fisheries Division,
- xii) Socio-economic characterization of fishers operating at WH,
- xiii) Estimation of earnings by fishers,
- xiv) Disposal of incomes of fishers,
- xv) Problem analysis of fisheries activities,
- xvi) Review of regulations affecting fisheries management, and
- xvii) Formulation of management plan for fisheries resources landed.

Hypothesis

The following was a general hypothesis, based on the authors own personal observations based on prior knowledge of the study area for 25 years.

H-1

- I) Whitehouse fishing beach is significantly different from other large south coast fishing beaches (fish landing sites)
- II) Whitehouse fishing beach is not significantly different from other large south coast fishing beaches

H-2

- I) Pedro Bank plays an important role in fishing at Whitehouse
- II) Pedro Bank plays no significant role in fishing at Whitehouse.

METHODS

Using mainly random sampling of fishers on the site, we;

- i) Applied questionnaire sampling to a significant percentage (10%) of fishers in order to obtain the following,
- ii) Personal information on fishers (age, years fishing experience, etc.),
- iii) Collected; fishing gear data which will produce as completely as possible, an understanding of the operation of the fishing activities there, especially on a) fish pot fishery, b) net fishing, c) hook and line fishing, d) spear fishing, e) other methods or combinations of methods,
- iv) Data on fishing vessels (numbers, characteristics, places visited to fish, operational costs for vessels, etc.),
- v) Biological data on the fishable resources harvested,
- vi) Data on seasonality (patterns of fishing activity),
- vii) Socio-economic data on operational costs relating to fisheries, such as outboard engine fuel cost, fish pot–building supplies, net costs, ice supply and costs, miscellaneous gear costs, fish prices, etc.),
- viii) Data on marketing (identification of buyers, eventual site of disposal of fish products, ultimate buyers, mark-up prices),
- ix) Data on distributional aspects (transportation costs, types of motorized transport, problems relating to above),
- x) Data on attitude of fishers towards fisheries management by means of suggesting various options for the future,
- xi) Other miscellaneous socio-biological data such as membership in fishers' cooperatives, dependents on fishing, and
- xii) Socio-cultural data (e.g. attitudes to fishing generally, aspirations of fishers' family members, family structure, disposal of incomes).

Data were collected on questionnaires and biological data recording sheets in the field, and those data transposed to commercially available spreadsheet programs and stored in computers at the Department of Life Sciences, UWI, Mona campus. Data were analyzed using fisheries software, especially FiSAT

from FAO/ICLARM, spreadsheet statistical packages, and special statistical software (such as Statistica) that were available to the project. FISAT incorporated several sub-routines for analyses of length-frequency data (e.g. ELEFAN) in order to obtain growth rates and fitting of growth curves, estimates of natural, fishing and total mortality rates. The fieldwork section of the project ran for two calendar years, beginning in January, 2001, and ended at the close of 2002 (24 months). There was a link with the Department of Economics at the UWI, Mona through Dr. Michael Witter, who gave relevant advice.

RESULTS

Whitehouse is located near a part of the larger south shelf, as can be seen in Figure 1, where the shelf narrows. If the findings of the USSR/Jamaica fisheries research programme can be accepted as accurate, then the coastal shelf just off the beach at that location, comprises as we travel from shore outwards to deeper waters as follows; a) clayed silt, b) silty sand, c) old coral reef, followed by d) coral formations (USSR Ministry of Fisheries 1980). Fishers there mainly use traps and do some hook and line fishing at and near the edge of the shelf, seeming to exploit the fishes associated with the coral reefs there. There is a steep drop-off into deep (> 300 m) water at the edge.

Pedro bank has a different benthic habitat sequence. There, the center of the bank is dominated by sand, but as the edge is approached, there are scattered coral heads which increase in density until relatively dense coral growth at the edge is reached (Munro 1983). There is a steep, near-vertical drop-off into very deep oceanic water at the edge of Pedro Bank which is known to have major reef fish resources. The role of Pedro Bank resources in Whitehouse landings was investigated, and we found that Whitehouse fishers harvested fish and lobster from the entire northern edge of Pedro Bank. They tended to prefer, however, the central and eastern parts of the northern edge. Fishers used Z-traps, but about 50% used traps and hand lines in the typical two to three day trips to that area. Another 20% did trolling seasonally as they traveled to and from the Bank to do trap and line fishing. Sixty percent of all Whitehouse fishers depended on Pedro Bank for its resources. The catches from that area were always of greater mean size and weight, was more diverse in fish species and earned more per trip than did catches from the south shelf. We found that there were at least 700 fishers using 120 fishing canoes at Whitehouse in the 2001 – 2002 period of the study. The Antillean Z-trap is the principal gear that impacts reef fish diversity. Contributions of various groups of species were investigated at Whitehouse. The study suggests that the aforementioned hypotheses were correct. Whitehouse beach is significantly larger than Belmont to the west and Scott's Cove to the east. It has many more fishers (17 times and 23 times) and vessels (10 times and 6 times), respectively, than those aforementioned beaches.

Overfished Status of Fishery

The continued overfished status of the shelf fishery resources landed at WH beach was evident from the high proportion of 'trash' fish in the catches. This market category comprised 61% of the total landing over the study period.

Dominant Fish Families and Species

The dominant reef fish family comprising the landings during this study was the Scaridae (parrotfishes) making up 41%, the Mullidae or goatfishes 18% and the squirrelfishes or wenchman family 9%. Figure 2 shows the composition by family of the nine most common reef fish landings.

The dominant reef fish family was the Scaridae or parrot fishes. This group comprised 41% of all reef fish landing observed. The Mullidae or goatfishes, *Pseudupeneus maculatus*, red-spotted goatfish and *Mulloidichthes martinicus*, yellow goatfish or queen mullet, in that order of abundance, comprised 18% of the catch. These two are higher-valued species. But, two low-valued species, Holocentridae (squirrelfishes) and Acanthuridae (doctor fishes) together made up 17% of fish landings. So, three families of lesser value made up 58% of fish catches. Three commercially valuable groups, Mullidae, Serranidae (groupers) and Lutjanidae (snappers) together constituted 31%.

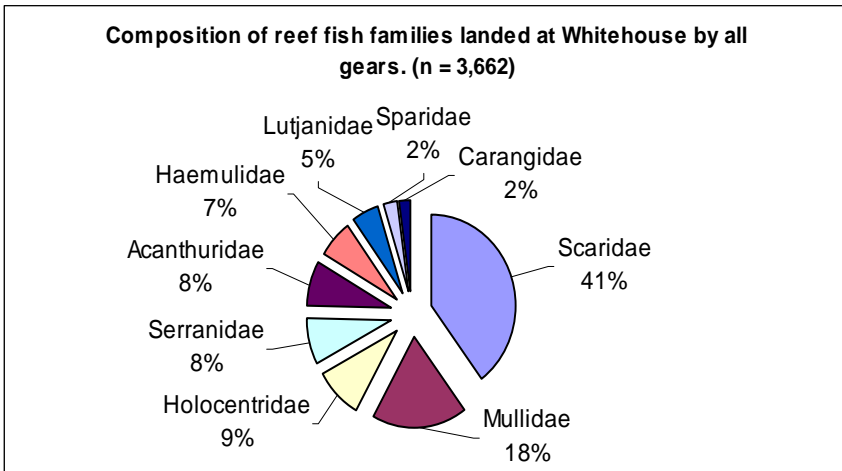
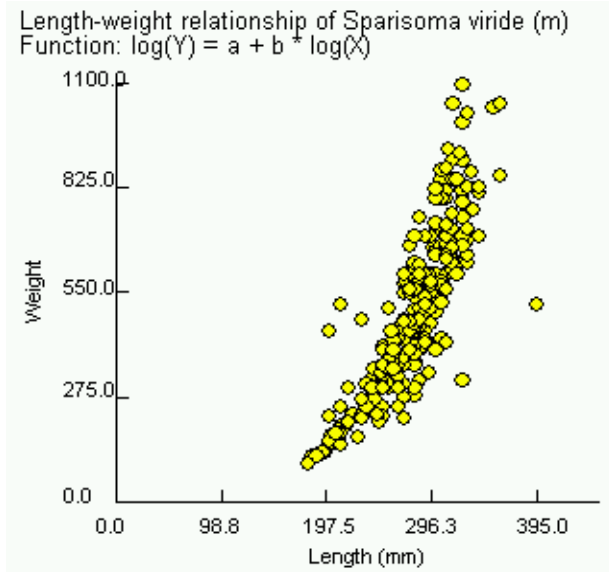


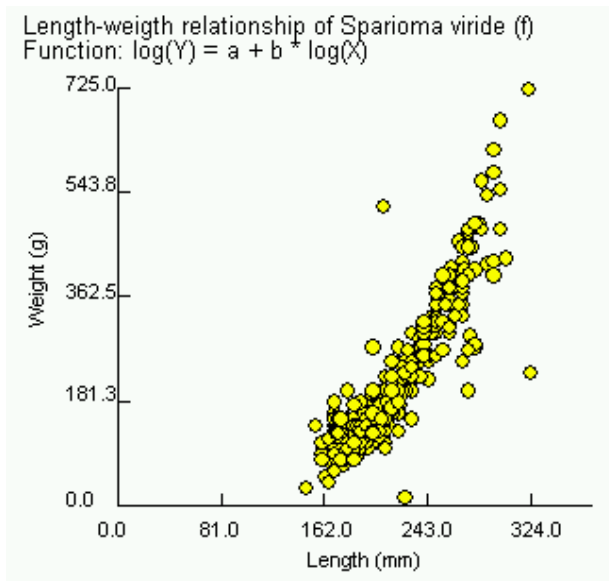
Figure 2. Reef fish family composition of landings at Whitehouse beach, Westmoreland 2001 - 2002

Biology and Population Dynamics of Reef Fish

A total of eleven reef fish species out of at least 30 species observed were investigated. This number chosen was based on higher abundance and regular appearance in fish trap landings at the site during the study period to allow larger sample sizes. A number of biological relationships such as length-weight relationships, and important biological parameters such as growth rates, and growth performance index (\dot{O}) were investigated. One main example chosen as representative of the reef fish species was the stoplight parrotfish, *Sparisoma viride*, which was very common in fish landings. Figure 3 shows the length-weight relationships estimated for males and females of this species from fish trap catches from both the shelf and Pedro Bank fishing areas.



Length-weight relationship of *S. viride* (m) Wt (g) = $0.0092FL (mm)^{3.008}$, $r^2 = 0.7619$. n = 236



Length-weight relationship of *S. viride* (f) Wt (g) = $0.0075FL (mm)^{3.065}$, $r^2 = 0.7711$. n = 427

Figure 3. Length-weight relationships for *Sparisoma viride*, stoplight parrotfish, from fish trap catches from shelf and offshore area, landed at Whitehouse.

The length-weight relationship showed that the stoplight male parrotfishes were significantly heavier at any length compared with females. This supported by the length frequency distribution figure for both sexes where there were more larger males than females and that males attained a significantly larger maximum size than females (Figure 4). Length-weight relationships were obtained for all 11 species of fishes investigated, but only one representative example is shown in this paper for the sake of brevity.

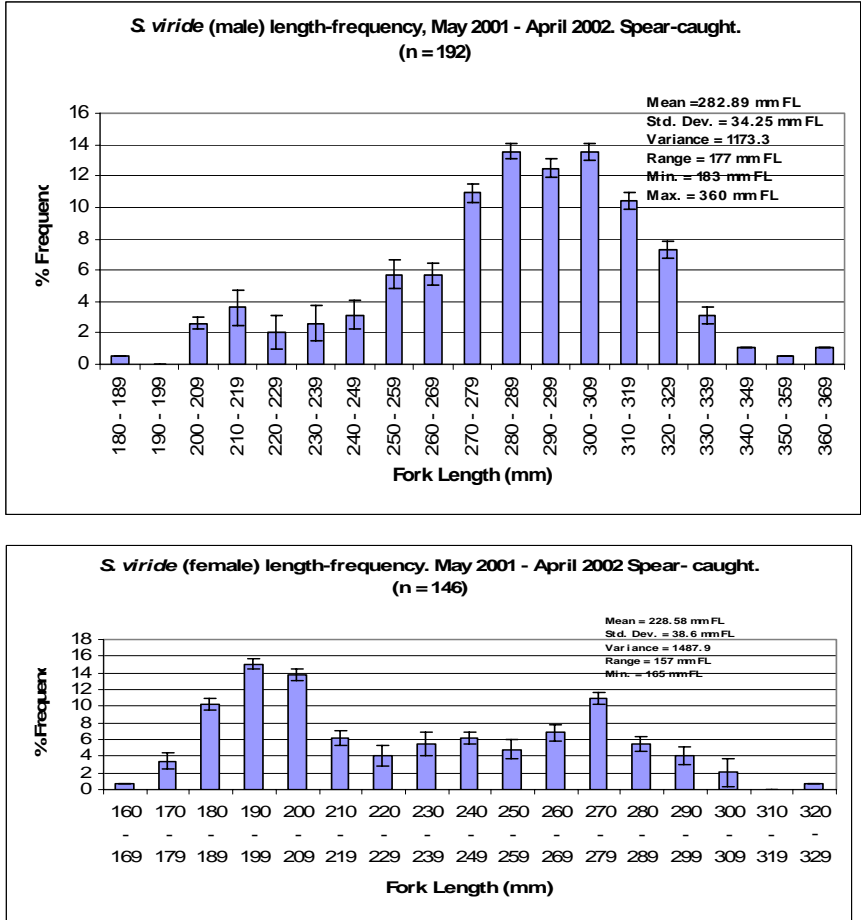
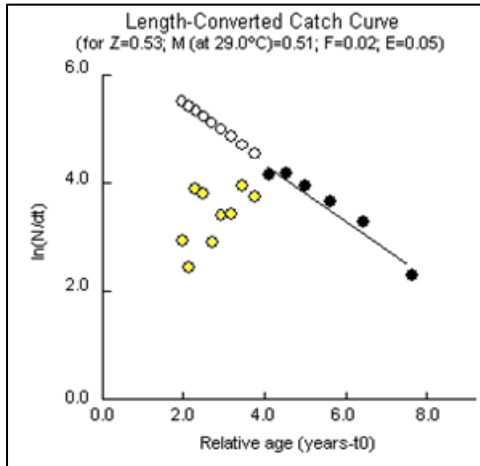
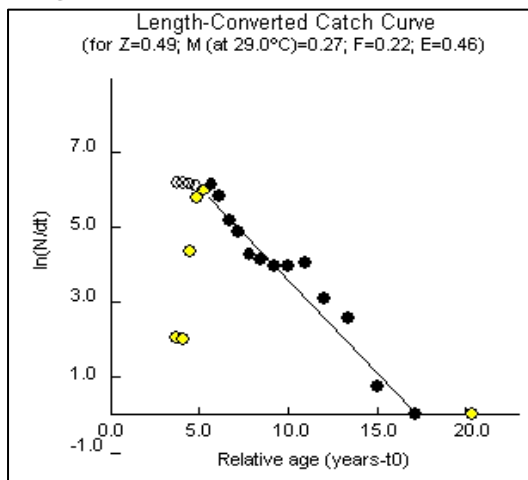


Figure 4. Length-frequency distribution for *S. viride* males and females from trap catches landed at Whitehouse beach.

Figure 4 showed that males obtained by spear fishermen attained a maximum size of just over 360 mm TL while females reached only 320 mm TL. Most males were larger than females with a majority of males in the range 270 – 330 mm TL. Two modes which may represent two year classes are apparent, particularly in the female size distribution. Total mortality estimates for *S. viride* are shown in Figure 5.



Length-converted catch curve for *S. viride* (m)



Length-converted catch curve for *S. viride* (f).

Figure 5. Total mortality (Z) estimates for *Sparisoma viride* males ($Z = 0.53$) and females (0.49) from trap catches landed at Whitehouse.

Annual total mortality rate (Z) estimates shown in Figure 5 suggest that male *S. viride* had just slightly higher total mortality rates than females. The stoplight parrot fish is presented as a representative example of the types of results that were obtained for all 11 reef fish species.

Von Bertalanffy growth formula parameters estimated by FiSAT software and based on length-frequency data for eleven reef fish species are summarized in Table 1. The table compares estimates from earlier research on these species including such research as that by Munro and his co-workers (1983).

Table 1. Summary of Von Bertalanffy population parameters for 11 reef fish species landed at Whitehouse, showing present results and those from previous studies.

SPECIES	PREVIOUS STUDIES					PRESENT STUDY				
	L _∞ (mm)	K	Ø'	M	Z	L _∞ (mm)	K	Ø'	M	Z
<i>S. viride</i> (stoplight parrot)	395.00	0.963	2.91	—	—	341.25	0.275	2.46	0.562	0.393
<i>S. aurofrenatum</i> (redband parrotfish)	260.00	0.200	2.13	—	—	246.75	0.730	2.65	1.190	1.269
<i>S. taeniopterus</i>	350.00	-	-	-	-	278.25	0.580	2.65	0.990	1.519
<i>S. chrysopterus</i>	409.00	0.782	3.14	-	-	320.25	0.360	2.57	0.697	0.542
<i>P. maculatus</i>	213.58	0.525	3.88	1.890	1.890	267.75	0.610	2.64	1.034	1.707
<i>M. martinicus</i> (yellow goatfish)	301.60	0.400	2.55	1.700	1.700	362.25	0.130	2.23	0.345	0.587
<i>H. ascensionis</i>	279.45	0.867	2.92	2.873	1.700	246.75	0.520	2.50	0.955	1.421
<i>H. aurolineatum</i>	258.75	0.583	2.27	2.755	-	246.75	0.520	2.42	0.953	1.421
<i>E. fulvus</i>	424.50	0.528	2.50	1.635	1.580	320.25	0.230	2.37	0.519	0.480
<i>E. cruentatus</i>	360.00	0.290	2.52	0.490	-	320.25	0.150	2.19	0.393	0.367
<i>A. chirurgus</i>	355.50	0.279	2.62	1.580	-	278.25	0.390	2.48	0.765	1.359

Table 1 showed that with few exceptions, the maximum lengths found in the present study were slightly smaller than those from earlier studies. The sole exception was *M. martinicus*, yellow goatfish, where the maximum size found was 362 mm FL, which was 61 mm greater than the earlier maximum size found. A comparison of annual growth rates (K) most were the same or slightly less than previous estimates. Stoplight parrot fish showed a much slower growth rate (K = 0.275) compared with earlier studies (0.963), while in contrast, redband parrot fish showed a much greater growth rate (0.730) than earlier studies (0.200). Most of the species in this study showed low natural mortality rates relative to earlier work.

An important part of the present study was an investigation of the attitudes of fishers to potential fishery management measures. The interviews conducted represented approximately 10% of all known fishers. Most (87%) of all fishers had no other occupation, while 12% were part-time. The greatest proportion of fishers were between 40 – 50 years old and 11-20 years fishing experience was the most common group (see Figure 6).

With regard to gear use, the majority of all fishers used fish traps (55% of those using Pedro Bank and 44% of south shelf fishers). The other ranked gear types, were hook-and-line, nets and spears (Figure 7).

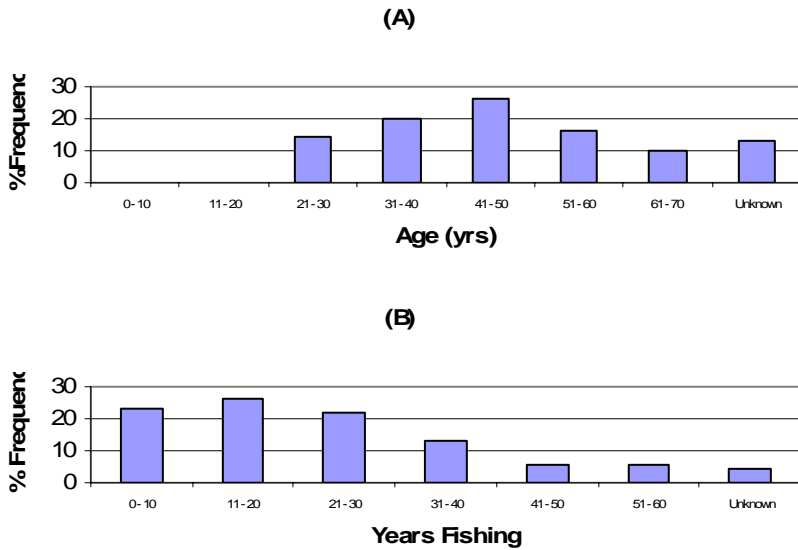


Figure 6. Age structure of Whitehouse fishers (A) and number of years spent fishing (B).

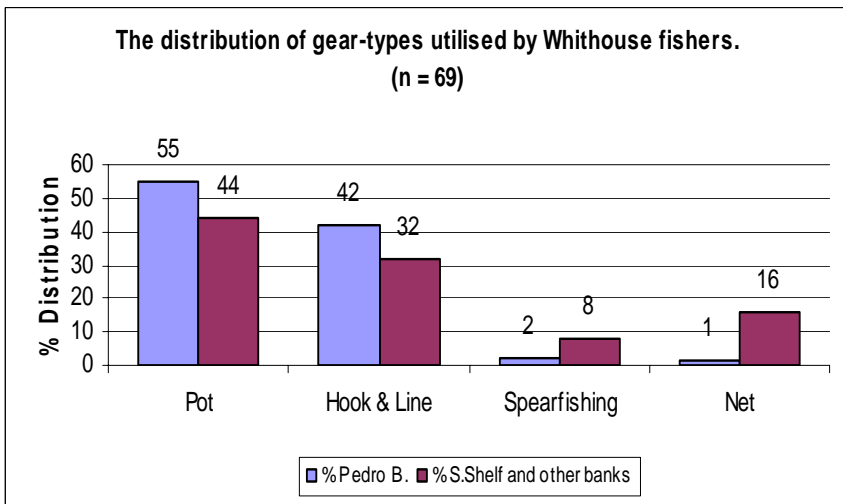


Figure 7. Gear types used on Pedro Bank and the south shelf by Whitehouse fishers.

A number of questions were asked regarding opinions on possible future management measures such as increases in trap meshes, fishing seasons, quotas, introduction of fishery reserves, co-management, increased lobster minimum size, and the use of dynamite. Most fishers disagreed with larger mesh introduction claiming it would result in serious losses of the Mullidae or goatfishes which have a cylindrical body cross section. They also disagreed with a reduced fishing season, quotas for fish, but agreed with introduction of fishery reserves (Figure 8).

Most fishers agreed with an increase in lobster minimum size and with the introduction of co-management, but disagreed with dynamite use and suggested sometimes drastic punishment for fishers using dynamite (Figure 9).

Whitehouse beach has the largest canoes in the entire island with a average length of 15m compared to 10m on most other beaches. Also, nearly all these large boats are constructed by hand on the beach by highly skilled artisans. The number of fishing vessels (open canoes) counted and examined totaled 120. This number is 30 less than that recorded in 1998 (Halcrow 1998). The size range was from 4 m to 16 m and this indicates this beach had the largest canoes in the island (Figure 10).

DISCUSSION

The main fisheries resources are coral reef fishes, spiny lobsters, conch, small coastal pelagic finfish and large offshore pelagic finfish. The reef fish species of major importance come from many families, which include Lutjanidae (snappers), Serranidae (groupers), Carangidae (jacks), Mullidae (goatfishes), Scaridae (parrotfishes), Haemulidae (grunts), Balistidae (triggerfishes), Acanthuridae (doctor fishes), Holocentridae (squirrelfishes), and Holacanthidae (angelfishes). Species composition of landings at Whitehouse was investigated and we found that the dominant reef fish families comprising the fish landings during this study was the Scaridae (parrotfishes) making up 41%, the Mullidae or goatfishes 18% and the squirrelfishes or wenchman family 9%. Thus, two lower-priced fish families, the parrot fishes and the squirrel fishes, together comprised 50% of all fish landings. This is higher than expected and is further confirmation of the relatively high levels of overfishing at the fishing grounds exploited by western Jamaican fishers.

In the 1970s it was reported that there were only 10 species on the south shelf that individually contributed more than 4% by weight to the catch and together these species comprised approximately 42% of the total catch. Spiny lobsters comprised 8% by weight (Munro 1983). In 1996, reef fishes constituted 80% of all landings (Fisheries Division 1997). Recent information on species diversity in reef fish catches (Koslow, et al. 1988, Koslow et al. 1994, Clemetson 1994) can be compared with earlier findings from roughly similar areas made by Munro (1983), Hartsuijker (1982), and Nicholson and Hartsuijker (1983). The Fisheries Division has more data gathered between 1995 and 1998 for various landing sites around the island. Comparisons suggest that since the late 1970s there have been changes in species diversity with loss of the predatory species and replacement by less valuable ones. This is clearly the case in western Jamaican waters.

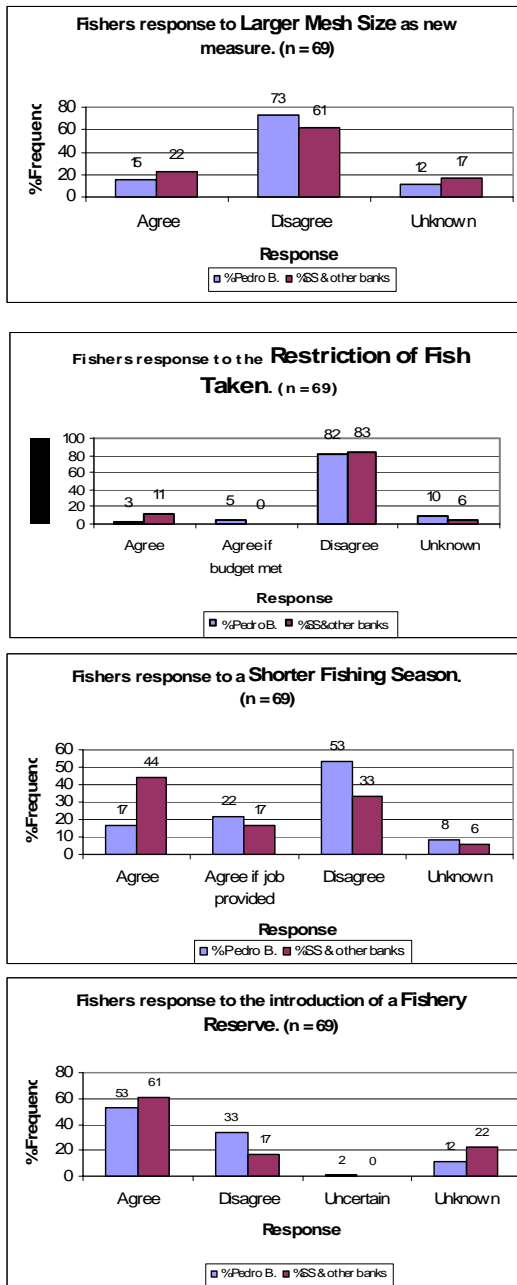


Figure 8. Fishers responses to potential management measures.

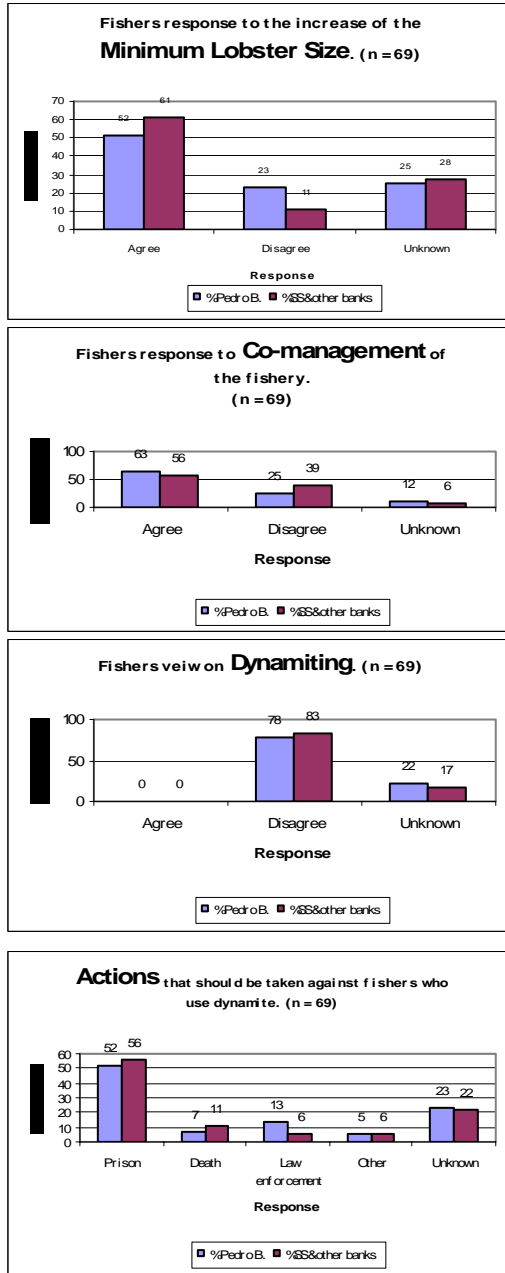


Figure 9. Fishers opinions on minimum lobster size increase, co-management, dynamite use and actions to be taken on dynamiters.

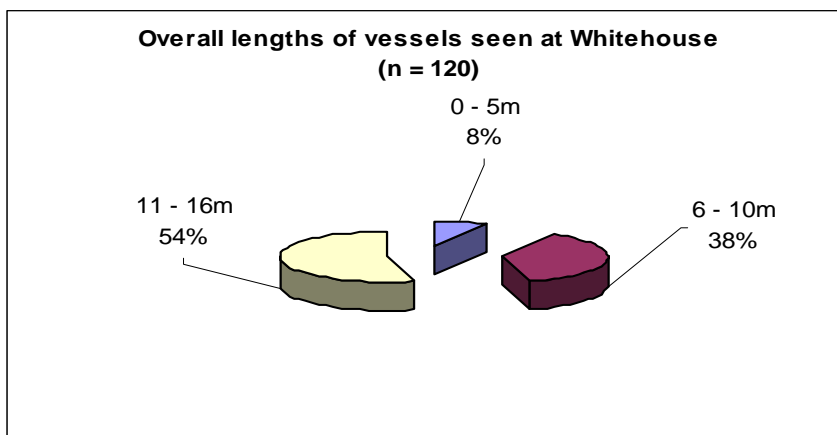


Figure 10. Length (m) overall of canoes at Whitehouse

That the length-weight relationships of males and females of the stoplight parrotfish, *Sparisoma viride* showed that the former were heavier and achieved larger sizes (Figures 3 and 4) was not unexpected. This is because this species (and others in the family Scaridae) show protogynous hermaphroditism where all fish begin as females, and as dominant males are removed by fishing or natural mortality, some of the larger females change sex and become functional males to replace them. Females and to some extent, males, display two modes in their length-frequency distributions (see Figure 4). These two modes probably represent year-classes. The two modes at 190 and 270 mm TL, in the length-frequency distribution of spear-caught *S. viride* females were clearer suggestions of two year-classes. Further, as this species spawns once annually (Munro 1983), then we can derive an annual growth rate of approximately 80 mm TL per year for females. Though these were caught by spears, we assume that the conclusions apply generally to this species both on the island shelf and offshore.

The mainly smaller asymptotic sizes found (Table 1) in the present study may be due to the heavily overfished status of the reef fish resources. In fact, combined with other characteristics such as lower than expected predatory (higher trophic level) fish families which have a higher commercial value, and the higher proportion of lower trophic level families (e.g. parrot fishes and squirrel fishes), we suggest these are the very indicators of the overfished status of the reef fish trap fishery mentioned by other workers (Munro 1983, Nicholson and Hartsuijker 1983, Aiken and Haughton 1987, Koslow et al. 1988). Growth rates (K) values were generally lower than in previous studies as were the natural mortality rates (M). These differences could be due to the relatively short (24 months) duration of the present study relative to the earlier studies.

Generally, fishers' interviews showed that the major fishing ground was Pedro Bank and other much smaller adjacent oceanic banks with a minority of

fishers exploiting the south shelf. This was not entirely unexpected, as the shelf resources are known to be more overexploited than offshore banks. Fishers did not support larger meshes, reduced fishing seasons, quotas for fish catches, or use of dynamite, but agreed with fishery reserves, increase of minimum lobster size, co-management, and with severe punishment for dynamiters. The wooden canoes at Whitehouse were remarkable for their large sizes and were at least 3 m larger than the average elsewhere. Also noteworthy was the fact that these large wooden boats were all constructed on the beach by highly skilled artisans. We must note that in contrast to other fishing communities only a minority of the canoes were made of fiberglass. Two to three day (48 - 72 hours) long trips to Pedro Bank were common, and this feature is another one unique to this site, as most other trap canoes operating from the south coast mainland executed round trips of only approximately 8 - 12 hours. Fishers were in middle age (40 - 50 years old) on average with around 10 years of experience. This is in keeping with the findings of the few similar studies done (e.g. Espeut and Grant 1990).

We cannot definitively account for the reduction by 30 of the number of canoes operating from this beach since an estimate was done in 1998 (Halcrow 1998). Perhaps it was due to natural attrition, but this rate would be unusually high. We suggest that it could be a combination of that factor and fishers electing to drop out of the trap fishery since 1998 due to reduced earnings due to overfishing, as most fishers said their incomes had fallen over that period. Another possible factor is the gradual loss of boat-building artisans over time.

Finally, we recorded many reported instances of physical interference with fish traps owned by Whitehouse fishers by dolphins (mammals) both on the south shelf and on Pedro Bank. Traps are apparently overturned, stood on end or toppled into deeper waters, or in some cases had their mesh damaged in apparent efforts to remove the catch trapped inside. This is previously unreported in Jamaica. This unusual phenomenon will be the focus of a subsequent study by the University of the West Indies, Mona campus.

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LITERATURE CITED

- Aiken, K.A. 1993. Jamaica: Marine fishery resources of the Antilles: Lesser Antilles, Puerto Rico and Hispaniola. *FAO Fisheries Technical Papers* 326:1160-1180.

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- Aiken, K.A. and M.O. Haughton. 1987. Status of the Jamaica reef fishery and suggestions for its management. *Proceedings of the Gulf and Caribbean Fisheries Institute* **38**:469-484.
- Aiken, K.A. and G.A. Kong. 2000. The marine fisheries of Jamaica. *Naga ICLARM Quarterly* **23**(1):29-35.
- Clemetson, A.O. [1994]. An investigation of the Jamaican south shelf coral reef fisheries using catch and effort data. University of the West Indies, Mona, Jamaica. MS Thesis, Unpubl. 136pp.
- Espeut, P. and S. Grant. 1990. An economic and social analysis of small-scale fisheries in Jamaica. Institute of Social and Economic Research. University of the West Indies, Mona, Jamaica. 80 pp.
- Fisheries Division. [1997]. Fish production survey for 1996. Ministry of Agriculture, Kingston, Jamaica. Unpubl. MS. 35 pp.
- Halcrow, W. 1998. Sir William Halcrow & Partners. South coast sustainable development study: Phase 1, Government of Jamaica. Tech. Rep. 2. Marine Resources, Kingston, Jamaica.
- Hartsuijker, L. 1982. Report: summary of findings (restricted). FAO/TCP/Jamaica 8902. 56 pp.
- Koslow, J. A., F. Hanley, and R. Wicklund. 1988. Effects of fishing on reef fish communities at Pedro Bank and Port Royal cays, Jamaica. *Marine Ecology Progress Series* **43**:201-212.
- Koslow, J.A., K.A. Aiken, S.A. Auil, and A.O. Clemetson. 1994. Catch and effort analysis for the reef fisheries of Jamaica and Belize. *Fisheries Bulletin (US)* **92**:737-747.
- Munro, J.L. 1983. *Caribbean Coral Reef Fishery Resources*. ICLARM Studies Review No. 7. 276 pp.
- Natural Resources Conservation Department. 1987. Jamaica: country environmental profile, with R.M. Field Associates. Kingston, Jamaica. 362 pp.
- Nicholson, W. and L. Hartsuijker. 1983. The state of the fisheries resources of Pedro Bank and the south Jamaica shelf. *FAO Fisheries Reports* **278** (Suppl.):215-254
- USSR Ministry of Fisheries/Government of Jamaica. 1980. Report on the main results of the USSR/Jamaica Fishery Research Programme in 1979-1980, AtlantNiro, Kaliningrad, Soviet Union. 80 pp.

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