BILLFISH CATCH AND EFFORT DATA FROM BARBADOS, GRENADA, ST.LUCIA AND ST.VINCENT AND THE GRENADINES

by

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SUMMARY

Catch and effort data, from the pelagic fisheries of Barbados, Grenada, St. Lucia and St. Vincent and the Grenadines, were examined to determine the importance of billfish to these fisheries. In Barbados, St. Lucia and St. Vincent and the Grenadines, billfish usually comprised less than 3% of the catch. However, at 2 of the 3 main landing sites in Grenada, as much as 32% and 17.5% of the catch consisted of Atlantic sailfish and marlin. Data from both Barbados and Grenada indicated an overall increase in billfish CPUE with time, probably due to increasing fishing power of the vessels. The CPUE for these fishes also showed a seasonal pattern, with peaks generally occurring in November-December and April-May.

RESUME

Les données de capture et d'effort des pêcheries pélagiques des Barbades, de Grenade, de Ste. Lucie et de St. Vincent et des Grenadines ont été examinées pour déterminer l'importance des istiophoridés pour ces pêcheries. Aux Barbades, à Ste. Lucie et à St. Vincent et aux Grenadines, les istiophoridés constituaient normalement moins de 3 % de la prise. Néanmoins, dans deux des trois principaux points de débarquement de Grenade, jusqu'à 32 % et 17,5 % des prises se composaient de voilier de l'Atlantique et de makaires. Les données des Barbades et de Grenade indiquent un accroissement global de la CPUE des istiophoridés avec le temps, ce qui est probablement dû à la puissance de pêche accrue des unités. La CPUE de ces poissons montrait également un mode saisonnier, avec des pics se produisant en général en novembre-décembre et en avril-mai.

RESUMEN

Se examinaron los datos de captura y esfuerzo de las pesquerías pelágicas de Barbados, Grenada, St.Lucia y St.Vincent & Grenadines, para determinar la importancia de los marlines para estas pesquerías. En Barbados, St.Lucia y St.Vincent & Grenadines, los marlines constituyen normalmente menos del 3% de la captura. No obstante, en 2 de los 3 principales puntos de desembarque de Grenada, hasta el 32 y el 17.5% de la captura estaba compuesta por pez vela atlántico y marlín. Tanto los datos de Barbados como de Grenada indicaban un incremento global, con el tiempo, de la CPUE del marlín, que probablemente se debe a un aumento de la potencia pesquera de los barcos. La CPUE de estos peces mostraba así mismo un esquema estacional, y máximos generalmente en noviembre-diciembre y abril-mayo.

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1. INTRODUCTION

This document describes trends in billfish landings, and where possible, catch per unit effort (CPUE) at key landing sites in Barbados, Grenada, St. Lucia and St. Vincent and the Grenadines, which are the eastern Caribbean islands where the fisheries for offshore pelagics are most important, and where there are sufficient data to warrant analysis (fig. 1). This paper is based on a wider analysis of pelagic fisheries in these islands (Mahon *et al.* 1990).

The fisheries of these islands have been described in several publications, and only brief descriptions will be given here to orient the reader. Papers in Mahon and Rosenberg (1988) provide the most current information on fleet size and composition in these and other islands of the eastern Caribbean and describe the data collection systems which have resulted in the data used in the following analyses.

2. DATA SOURCES AND ANALYSIS

In Barbados, pelagic fishes are caught from two types of boat: day-boats, which fish in the vicinity of Barbados on one-day trips, and ice-boats which fish as far away as Tobago on trips of a week or more. In this study the catch and effort data from day-boats are used. Although most ice-boat catch is landed in Bridgetown and taken to processors, some is landed at Oistins. It was therefore necessary to subtract these landings and trips from the monthly totals (Collins and Mahon, 1989).

In Grenada, fish landings by species groups and fishing effort in number of trips are recorded at several sites (Finlay *et al.* 1988, Phillip and Isaac 1991, 1992). The most important sites are at Melville Street in St. Georges, Gouyave on the west coast, and Grenville on the east coast (fig. 1). In St. Lucia, large offshore pelagics are caught by trolling, almost exclusively from canoes. The major fishing areas for pelagics are on the east, and southeast coasts (Murray *et al.*, 1988). In St. Vincent, Kingstown is the major fishing center for large pelagics, which are caught by trolling (Morris *et al.*, 1988). Catch and effort data are available only from the Kingstown market.

Plots of monthly fishing effort and total landings of pelagics show that the season for large offshore pelagics is similar in most of the islands in this study (figs 2, 4 and 5). The peak season is always between January and June. Catches and effort are lowest between August and November. To facilitate comparison among islands, the end of August/beginning of September was taken as the transition point between pelagic fishing seasons. The pelagic season in most eastern Caribbean islands is determined largely by the availability of dolphinfish which is one of the major targeted species, and the availability of many of the less abundant species does not fit the overall pelagic season.

The average catch per unit effort (or where CPUE was unavailable, the average catch) over part or all of each fishing season was calculated for each landing area, as an index of abundance in the area fished by the boats of that landing area. There are differences in the way the CPUE indices were calculated for each island. In Barbados, weighted average catch/trip (day boats, weighted by effort) from September to the following August was used as the index of abundance per season.

In Grenada, there is a constraint on the use of fishing effort to calculate average monthly CPUE throughout the year: trips targeting pelagics are not distinguished from other types of trips. At all three sites, there is a seasonal shift of fishing effort from pelagic to other fisheries in the off-season for pelagics. Consequently, the effort data can only be used to estimate catch per unit effort during the peak period of the season. This allows comparison of CPUE among years in peak season, but does not allow the use of CPUE to establish seasonal patterns of abundance, or to compare seasonal shifts among years. Therefore, in Grenada, the average catch per trip (weighted by effort) from January to June each year was used as an index of abundance. Note also that in Grenada boat type and fishing methods differ among landing areas to the extent that absolute catch/unit effort is not comparable.

Seasonal patterns were investigated by plotting monthly average, maximum and minimum percent of annual landings or cumulative annual CPUE for each time series. These annual values are based on fishing seasons rather than on calendar years. There were not enough data on billfishes from St. Lucia and St. Vincent for analysis of catch rates.

3. CATCH COMPOSITION OF PELAGIC FISHERIES

In Barbados, fish landings, and effort in number of trips, are recorded at primary and secondary landing sites (Bell *et al.*, 1988). The longest time-series are for the two major landing areas: Oistins, in the south (since 1961), and Speightstown (since 1958) in the northwest (fig. 1). Billfish, which appear to contribute relatively little to the total landings (table 1), are not recorded separately by species. However, Oxenford (1990) reports that the catch of billfish between December and April in one year consisted of about equal numbers of sailfish, white marlin and blue marlin, with spearfish being landed occasionally. The composition by weight in that period was 21%, 16%, 54% and 9% respectively. Further work by Oxenford (1992) shows that catch composition varies with gear type, and has therefore probably changed in recent years with the introduction of longlining. This study uses the data on catch and effort from Oistins and Speightstown.

In Grenada, the composition of the catch appears to differ considerably among the three sites (table 2). At Grenville, the pelagic catch is taken entirely by trolling, and less than 1.0% of the catch consists of billfish species. In contrast, at the west and southwest landing sites, where most pelagics are caught by artisanal longline gear, the Atlantic sailfish is one of the most important species caught, comprising 28.2% and 13.9% of the catch at the Gouyave and Melville Street landing sites respectively. At these two sites also, a smaller percentage of the catch, 3.6-3.9%, consists of marlin.

In St. Lucia, the species composition of the catch at the three major sites is remarkably similar (able 3). Billfish represent only 0.1-1.2% of the catch. In St. Vincent, during the period 1979-1989, only 0.1% of the catch consisted of billfish species which were recorded together (table 4). In 1990-1991, however, the percentage of the catch comprising billfish species increased slightly to 1.11%. During this period, billfish species were recoded separately.

4. FISHING EFFORT, LANDINGS AND CPUE

4.1 Barbados

In Barbados the seasonal pattern of effort is similar at both landing sites, being minimal in August and September, and peaking in April/May (fig. 2). From the mid-sixties to about 1986, fishing effort in trips stayed at about the same level in Speightstown, then declined steadily (Mahon *et al.*, 1990). Effort has shifted away from this fishing center to nearby landing areas, Six Men's Bay and Half Moon Fort (P. McConney, Fisheries Officer, Barbados Fisheries Division, *pers comm.*). At Oistins, effort appears constant from the early sixties through to 1974 after which it showed an increasing trend to a peak in 1984, then decreased steadily with the lowest recent values in the 1988-89 season (*op. cit.*). At Oistins, the recent decrease in day-boat effort can be attributed to the growth in the ice-boat fleet. The reduction in day-boat effort is likely due to two effects. The first is that many of the largest day boats have been converted to ice-boats, thus reducing the total number of day-boats operating out of Oistins. The second effect is that ice-boats have been landing large volumes of fish at processors and to a lesser extent at Oistins, and reducing the incentive for day-boat fishing.

The seasonal patterns of total pelagic landings and CPUE are generally similar to that of effort (compare fig. 2c, e with 2a, and fig. 2d, f with 2b), with the main peak observed during April to May and the lowest figures recorded for August and September. In contrast, the seasonal pattern for billfish CPUE appears to be trimodal at Speightstown and bimodal at Oistins (fig. 2g, h), with the highest values observed in November and December. This is probably due to the fact that billfish species are not specifically targeted and they are only taken as incidental catches. Although the highest billfish catches appear to be taken just prior to and immediately after the main pelagic season and may be the result of a shift in effort to catch other available species, a smaller peak in billfish catches appears to occur during March-May, within the main pelagic season (fig. 2g, h).

The highest mean peak occurs in November-December and may be influenced also by the movement of billfishes migrating from temperate waters off the east coast of North America during the cooler winter months (Bayley and Prince, in press). Smaller peaks observed, including the March-May peak within the main fishing season, imply that return migrations to northern latitudes during the summer months occur gradually, but also that fish remaining in Caribbean waters move around locally to a sufficient extent to alter local seasonal abundance.

The time series of monthly CPUE and the average annual CPUE for all pelagics (fig. 3) show a steadily increasing trend with time. This trend is apparent to a lesser extent for billfish (fig. 3a, b, d). This observed increase in CPUE is likely to be a reflection of increased fishing power of launches over this time period (Oxenford and Hunte, 1987).

4.2 Grenada

The seasonal patterns and the monthly time-series of fishing effort at Gouyave and Melville Street are shown in figs. 4a, 5a, 6a and 7a. Since the effort is not only for pelagic fishing, and there is a significant amount of non-pelagic fishing in the off-season, the pelagic season is best defined by the landings (figs. 4b and 5b).

At Gouyave, the mean seasonal pattern of effort is bimodal, with the major peak from December to February (fig. 4a). The peaks in fishing effort and pelagic landings correspond closely, indicating that the effort is primarily for pelagics. At Melville St., fishing effort is highest between July and December, whereas pelagic landings are highest in January-March. This indicates that there is a considerable amount of non-pelagic fishing effort during the course of the year at Melville St..

The mean seasonal patterns show that at both sites, pelagic landings are highest from December to March, with a second peak occurring in May-June. Sailfish landings follow a similar seasonal pattern, and this is to be expected since sailfish comprise a notable portion of the pelagic catch at both Gouyave and Melville Street (figs. 4c and 5c). In fact, the seasonal pattern for sailfish (fig. 4c) suggests that the seasonal pattern of effort at Gouyave is driven primarily by the availability of sailfish. The monthly pattern of catches of sailfish (fig. 6c) show that there is considerable variability around the average annual seasonal pattern, particularly in terms of the relative strength of the two peaks.

The seasonal pattern for catches of marlins, which are taken in small amounts, is similar to that of sailfish. The average pattern indicates slight bimodality with peaks in January and March at Gouyave, and in January and April at Melville Street (figs. 4d and 5d). However, the occurrence of marked peaks in landings for marlins is clearly evident in the time series of monthly data (figs 6d and 7d).

The average seasonal CPUE for total pelagics, sailfish and marlin show similar general increases with time (fig. 8) at the Melville Street site, with the exception of a notable decrease in 1986 and 1987 for total pelagics and sailfish. In contrast, at Gouyave, CPUE increases with time from 1982 to 1987 for total pelagics and marlin, and from 1982 to 1988 for sailfish, and then decreases for the remaining time series, up to 1989 (see fig. 8). It should be noted that these average values are for the months of January to June only and are weighted by fishing effort. Since both landing sites are located on the same side of the island, the fishing areas are likely to be physically close to each other. Hence, the opposite patterns obtained for the two sites is an unexpected result. It is possible that these fish are aggregating in a very small area near Grenada, and that in some years this area is accessible to Melville Street, whereas in others it is accessible to Gouyave. However, further information and additional data are needed to reach a more accurate conclusion.

5. DISCUSSION AND CONCLUSIONS

In Barbados, all billfish species are recorded together, whereas in Grenada, the Atlantic sailfish and marlin are recorded separately. Billfish make a relatively minor contribution to total catch in all the islands except in Grenada where a notable portion of the catch consists of sailfish and marlin.

The seasonal patterns for CPUE of billfish in Barbados and Grenada appear to be either bi- or trimodal, in contrast to that observed for the total pelagic catch. In interpreting this result, it is important to remain aware that the seasonal patterns for minor species may be affected by the seasons for the preferred species. In Barbados, the peaks approximately bracket the main pelagic season and may be due to a redirection of fishing effort during the season. However, the main peak occurs during November-

December, when the distribution of these fish are believed to be restricted to warmer Caribbean waters during the winter months.

In Grenada, the sailfish season is sharply peaked and varies relatively little in timing; sailfish is one of the dominant species of the catch, and as may be expected, its seasonal CPUE pattern closely resembles that obtained for all pelagic species combined. The highest billfish catches are taken during December-February. This is slightly later than the Barbados peak, and may be explained by the fact that Grenada lies further south along the migration path. Total pelagic and billfish CPUEs showed general steady increases with time, and this is probably due to increased fishing power such as increased boat size, engine size and improved equipment; in particular the introduction of longlines.

Some inference on migratory patterns should be possible from the observed seasonality in Grenada, particularly for sailfish. Seasonality of fisheries and tagging data indicate that in summer sailfish are found in the Gulf of Mexico and off the east coast of North America as far north as Cape Hatteras, whereas in winter they are found in the Straits of Florida, in the US Virgin Islands, in the southeastern Caribbean, and off the north coast of South America (Mather *et al.* 1974, Bayley and Prince in press). However, it is not clear from the fishery data whether they are distributed throughout this area, or if there are migrations to specific places. The bimodality could be interpreted as resulting from a return migration with the peaks reflecting the passage of fish in each direction. If this is the case, the period of peak abundance further south and west should lie between the peaks. The only data available in that area do not support this interpretation (Hazin *et al.* in press). They are for longliners fishing off Brazil and show a seasonal pattern which is sharply unimodal with the peak occurring primarily in December.

The multimodal distribution of CPUE for blue marlin in Grenada could be interpreted in a similar way, as resulting from the passage of the fish on various legs of a migration. In the case of this species there is no other readily available information on seasonality with which to compare the data from Grenada. For both sailfish and blue marlin, the modes in the seasonal pattern of the fishery could, alternatively, be related to local environmental variability. For example, the outflow of the Orinoco river has a strong influence in the area of Grenada (Muller-Karger 1990), and reaches its minimum in March (on average).

It is clear that in order to resolve issues of seasonality for billfishes in the eastern Caribbean, more accurate data on catch and effort will be required -- specifically, the recording of billfish catches by species in Barbados, and the separate recording of effort for pelagic fishing in Grenada. Although it may be desirable to have more detailed information on the extent to which particular species are targeted on trips, this is probably beyond the scope of the data collection systems. Therefore, the approach of interviewing fishermen for their opinions on seasonality should be explored.

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Table 1. The percentage composition of the catch of offshore pelagic fishes in Barbados in 10 year periods (see text for species composition of groups)

Species/Group	Speightstown			Oistins		
	1960s	1970s	1980s	1960s	1970s	1980s
Flyingfish	81.5	80.0	83.5	5.4	40.3	53.8
Dolphinfish	10.3	13.3	13.0	29.3	48.3	34.4
Kingfish	1.0	1.1	1.0	6.8	6.4	6.6
Shark	2.2	1.8	0.8	3.1	1.0	1.1
Tuna	3.6	1.3	0.5	3.2	2.2	1.8
Billfishes	1.4	2.5	1.2	2.2	1.8	2.2

Table 2. The percentage composition of the catch of offshore pelagic fishes in Grenada – 1981-1989 (the first six months of 1981 are missing for Gouyave).

Species/Grou	Gouyave	Melville St.	Grenville
Flyingfish	6.8	21.4	0.1
Dolphinfish	8.0	7.2	17.9
Kingfish	2.5	2.3	17.2
Yellowfin tuna	47.3	41.6	1.5
Small tunas	-	-	55.0
Skipjack tuna	<0.1	0.6	4.3
Atlantic sailfish	28.2	13.9	0.9
Blue marlin	3.9	3.6	<0.1
Sharks	2.5	4.6	0.1
Rainbow runner	-	-	<0.1
Scomberomorus spp.	-	0.3	-
Barracuda	0.6	2.1	2.8

Table 3. The percentage composition of the catch by weight of offshore pelagic fishes in St. Lucia, 1984-1989 (see text for species composition of groups)

Species group	Dennery	Micoud	Vieux Fort
Dolphin	34.2	37.8	36.0
Kingfish	21.8	21.8	20.0
Yellowfin tuna	20.6	17.3	20.8
Skipjack tuna	20.6	14.8	17.9
Blackfin tuna	0.2	3.1	2.0
Billfish	0.2	0.1	1.2
Flyingfish	2.3	4.2	2.0

Table 4. The percentage composition of the catch by weight of offshore pelagic fishes in St. Vincent, 1979-1989 (see text for species composition of groups)

Species Group	Kingstown Market 79-89	Kingstown Market 90-91
Albacore	-	0.1
Amberfish	-	<0.1
Bigeye tuna	-	0.1
Dolphinfish	38.2	39.8
'Small tuna'	27.3	19.1
Blackfin tuna	23.0	11.3
Wahoo	5.9	14.1
Cavalli	2.9	2.9
Rainbow runner	1.1	1.7
Sailfish	-	0.6
Sharks	0.8	1.5
Swordfish	-	0.8
Yellowfin tuna	0.5	10.1
Barracuda	0.2	0.3
Billfishes	0.1	-
Blue Marlin	-	0.2
White Marlin	-	0.4

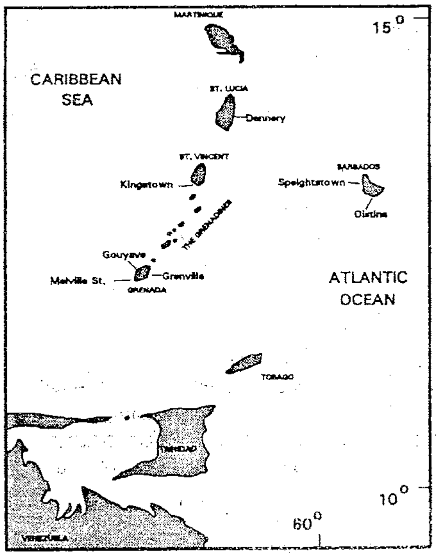

Fig. 1. The location of islands and landing sites.

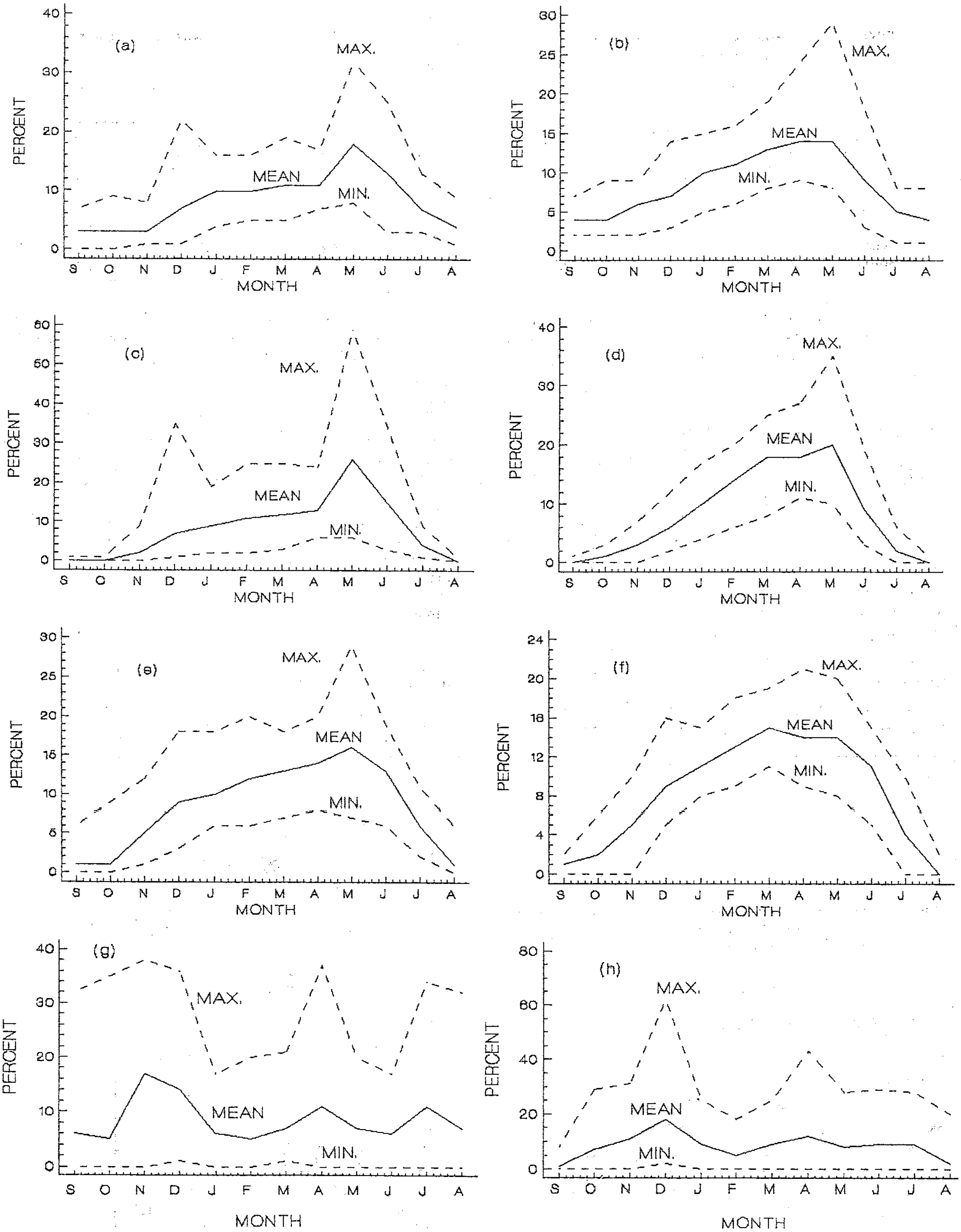

Fig. 2. Seasonal pattern of fishing effort (a) at Speightstown and (b) at Oistins, total pelagic landings (c) at Speightstown and (d) at Oistins, total catch/trip of pelagics (e) at Speightstown and (f) at Oistins, and billfish catch/trip (g) at Speightstown and (h) at Oistins, in Barbados.

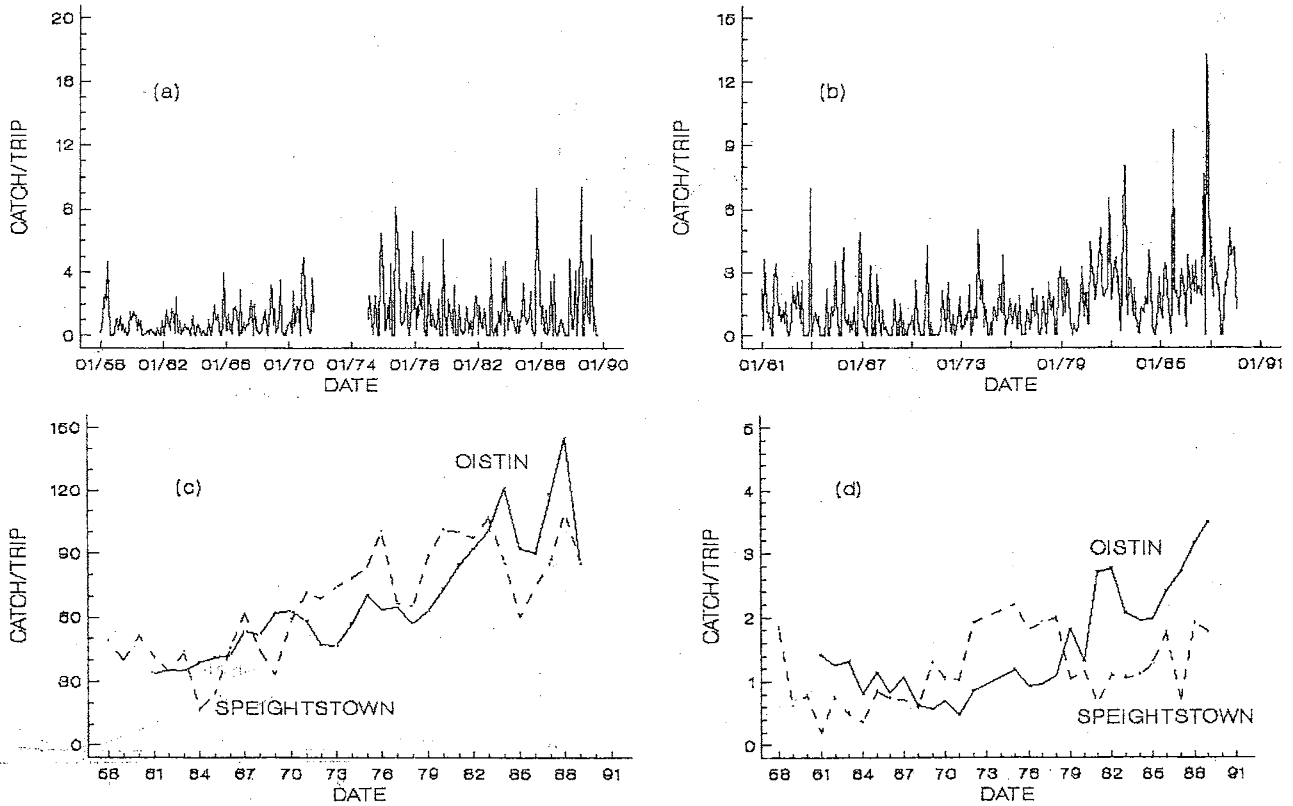

Fig. 3. Time series of billfish catch/trip (kg) (a) at Speightstown and (b) at Oistins, and average annual catch/trip (kg) of (c) pelagic fishes and (d) billfishes at each of these two landing sites in Barbados.

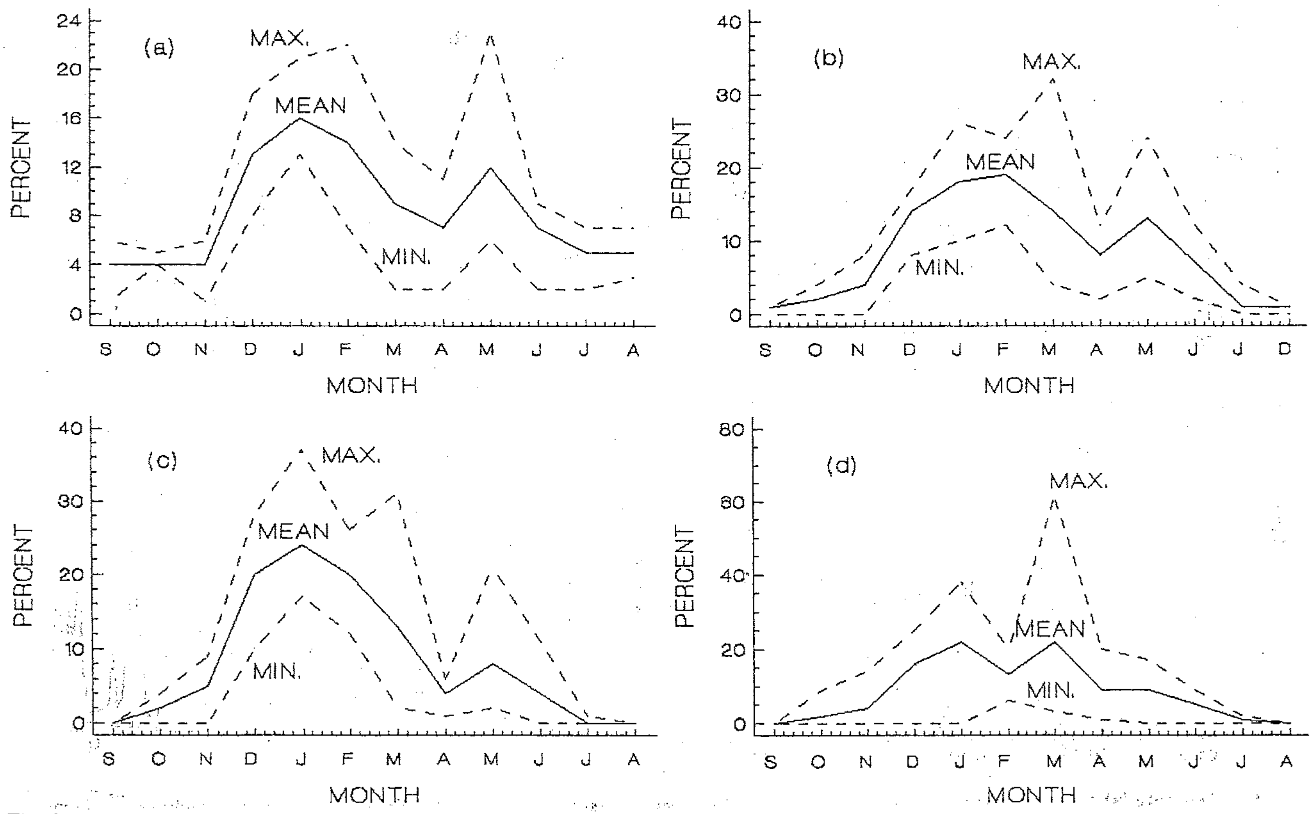

Fig. 4. Seasonal pattern of (a) fishing effort, (b) total pelagic landings, (c) sailfish landings and (d) marlin landings, at Gouyave in Grenada.

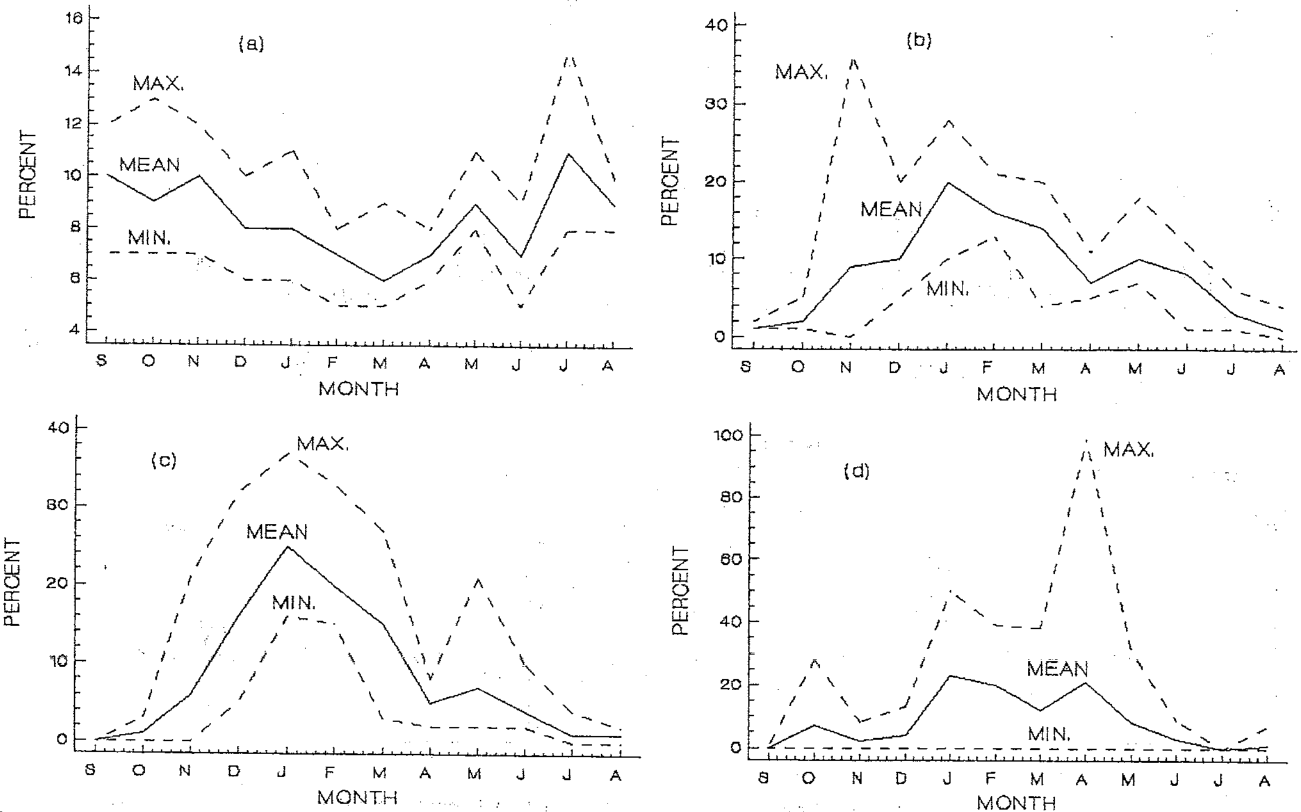

Fig. 5. Seasonal pattern of (a) fishing effort, (b) total pelagic landings, (c) sailfish landings and (d) marlin landings, at Melville Street in Grenada.

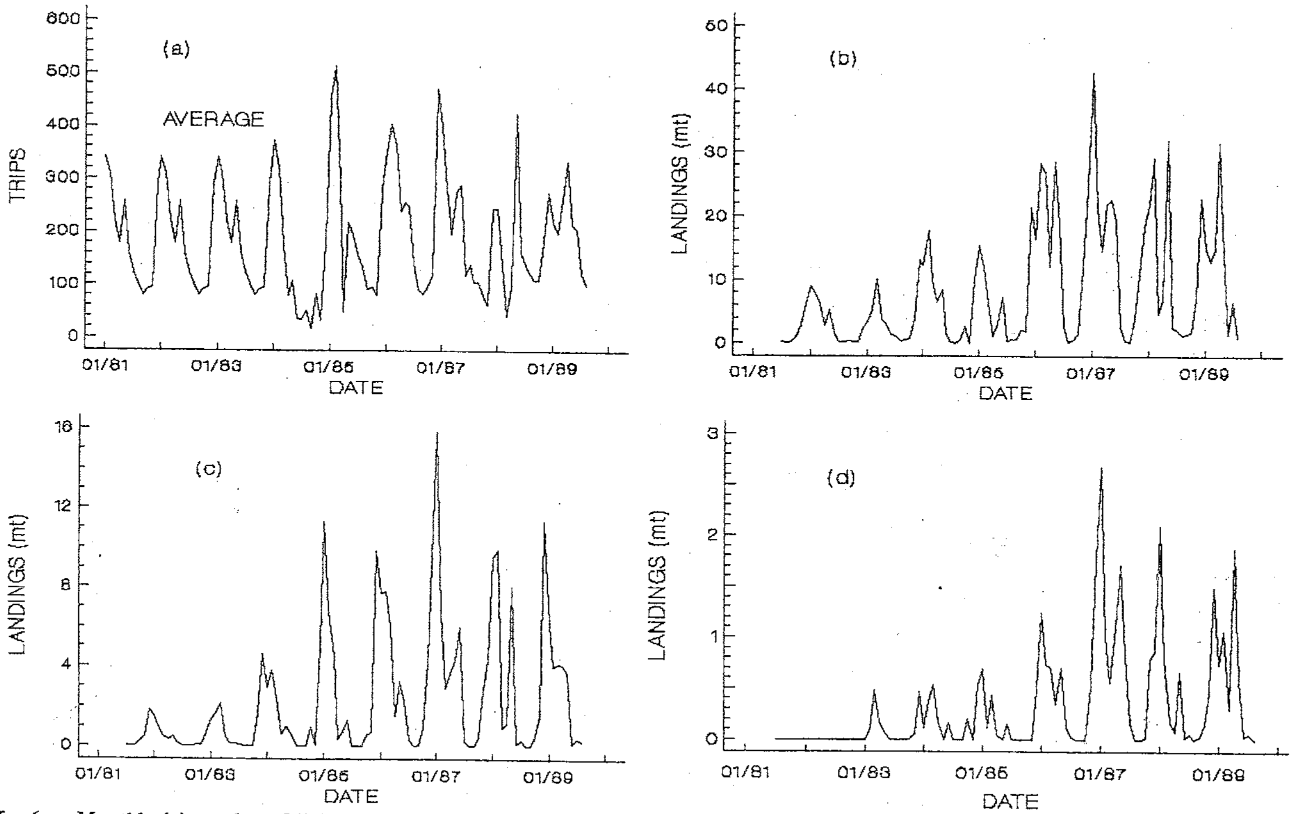

Fig. 6. Monthly (a) number of fishing trips, (b) landings of total pelagic fishes, (c) sailfish landings and (d) marlin landings, at Gouyave in Grenada.

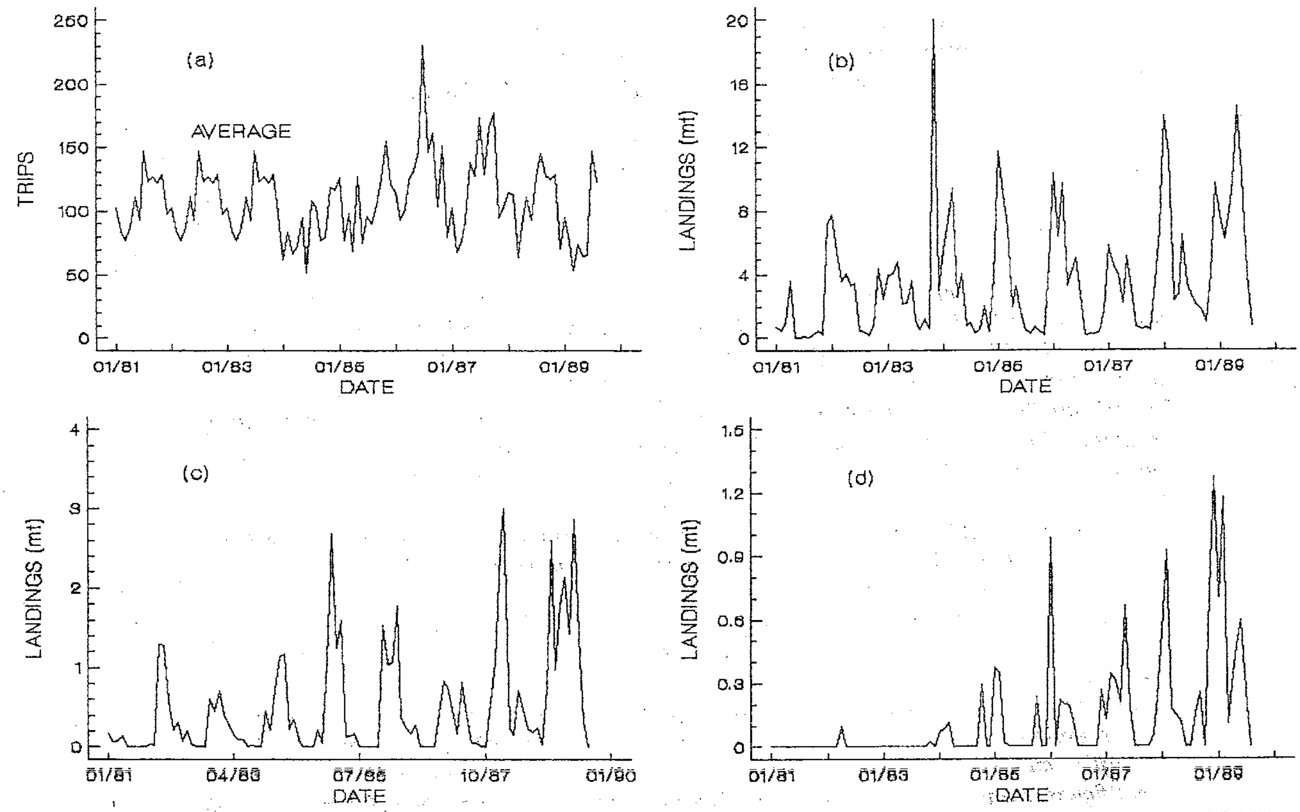

Fig. 7. Monthly (a) number of fishing trips, (b) landings of total pelagic fishes, (c) sailfish landings and (d) marlin landings, at Melville Street, Grenada.

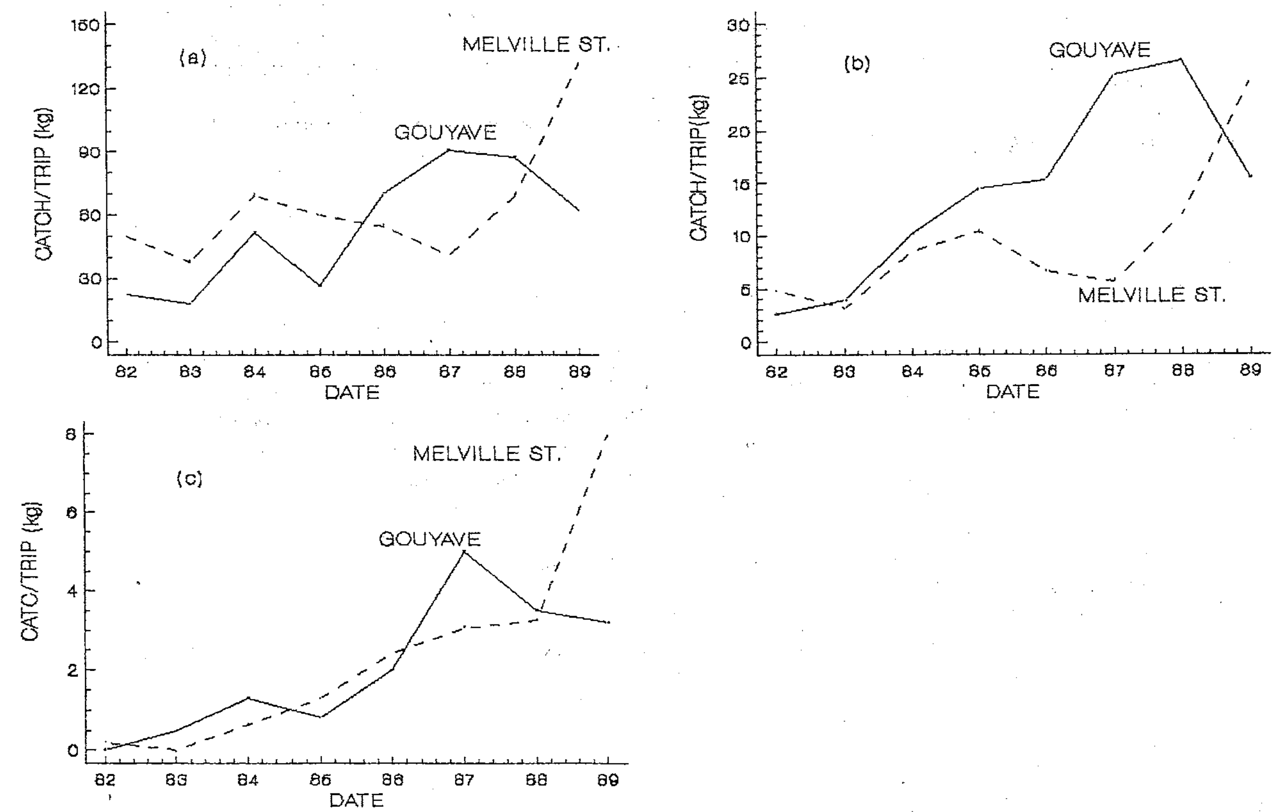

Fig. 8. Annual (January - June) average (a) total pelagic catch/trip (kg), (b) sailfish catch/trip (kg) and (c) marlin catch/trip (kg), in Grenada.