

The Spear Fishery of Barbados

La Pesca Submarina de Barbados

La Pêche au Harpon de la Barbade

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ABSTRACT

The spear fishery of Barbados is poorly documented and its contribution to the island's fishing industry is relatively unknown due to the multitude of landing sites and informal sales of a diverse catch which has made monitoring very difficult. This study attempts to fill some of the many gaps in the documented knowledge of the spear fishery, particularly its importance in contributing to livelihoods, the distribution of fishing effort and the total annual landings of the reef fishery. Information was gathered through an initial scoping exercise followed by formal interviews with fishers, participant observation on fishing trips and measurements of a sub-sample of catches between June and September 2013. The spear fishery of Barbados comprises an estimated 110 active fishers, half of whom consider themselves to be commercial and the rest recreational. They fish on shallow nearshore reefs all around the island which they access from boats and by swimming from shore, by free diving and with the use of SCUBA gear. The concentration of landing/operating sites is on the leeward west and southwest coasts, although the most heavily used reef areas are on the northwest and southeast coasts. The average stated mean catch of commercial spear fishers is twice that of recreational fishers, although their multispecies catch is very similar in species composition. Catches of both fisher groups are dominated by the parrotfish family. Both fisher groups fish year-round with some increase in trip frequency by commercial fishers during the summer months. A crude estimate of total annual landings by the spear fishery based on interview data is 152 mt, which is considerably more than the official records show for the entire reef fishery. The results of this study will contribute to on going efforts to understand the importance of the reef fishery and improve the sustainable management of the island's reef resources.

KEY WORDS: Spear fishery, reef fishery, parrotfishes, Barbados

INTRODUCTION

Coral reefs in the Caribbean are of extreme importance for their rich biodiversity, contribution to human livelihoods and key ecosystem services such as coastal protection, but they are being severely impacted across the region by anthropogenic activities (Burke et al. 2011). The wide range of anthropogenic impacts include local-level overfishing and pollution (primarily sediments and nutrients) (Schutte et al. 2010), a regional-level invasion by the non-native lionfish (Albins and Hixon 2011), and global warming that is now exacerbating the decline of reef health through increasing sea surface temperatures, increasing frequency of significant storms, sea level rise and ocean acidification (Hoegh-Guldberg et al. 2007). This highlights the urgent need for more effective forms of management and conservation aimed at retaining or restoring coral reef resilience. This will require an ecosystem-based management (EBM) approach, and a key element will be the management of the multi-gear, multi-species coral reef fisheries, to ensure that reef fish populations remain or are restored to a level where they can serve important ecological functions in the reef community, such as effective grazing (Mumby and Steneck 2008).

Barbados, the most easterly of the Caribbean islands located in the Lesser Antilles, is no exception. Like elsewhere in the Caribbean, the coral reefs of Barbados are facing similar local, regional and global level threats (Eakin et al. 2010). This is a matter of substantial concern, given that the island's economy is highly dependent on healthy reefs (NCSO 2004). Of particular significance among the local level threats in Barbados is the reef fishery, which, although considered a minor fishery, is known to be over-exploited (Fisheries Division 2004, Mahon et al. 2007, McConney 2011). Furthermore, the reef fishery receives little attention and remains open access, poorly monitored and essentially unmanaged (Fisheries Division 2004, McConney 2011).

The reef fishery targets the multi-species reef fish community and is exploited using various fishing methods and gears including fish traps and handlines (McConney 2011), seine nets (Maraj et al. 2011) and spearguns. The trap fishery has received the most attention, with several relatively recent studies examining the impacts of gear management measures (Robichaud et al. 1999, Selliah et al. 2001, Baldwin et al. 2004) and economic value and performance (Mahon et al. 2007, Schuhmann et al. 2011). The considerable contribution of the seine fishery to reef fish landings was only recently revealed in a study by Maraj et al. (2011). The spear fishery remains undocumented with no data on its extent, importance or contribution to the island's reef fish landings. Without such information on the reef fishery, improvements to the current level of management are unlikely. Having a more prudent and efficient management system would benefit all reef stakeholders.

This study aims to address this lack of information on the spear fishery of Barbados by attempting to fill some of the major knowledge gaps. In so doing, this project is intended to contribute to ongoing research and efforts by the Fisheries Division to develop fishery-specific management plans for the island.

METHODOLOGY

Interview Survey

Information about the spear fishery was collected primarily by formal interviews and informal conversation with spear fishers and key informants in 2012 - 2013. This was supplemented through observation whilst accompanying fishers on spearfishing trips or casually interacting with spear fishers at landing and operating sites and in their communities over a period of three months (June-September 2013). Spear fishers were located initially with the help of key informants and a scoping survey of all landing areas around the entire island. Thereafter fishers were located with the help of other fishers using a 'snowball' approach. Based on the results of the scoping, interviews were spatially stratified by location to ensure a representative subsample of spear fishers was interviewed.

Two interviews, one rapid and one longer, were developed and administered following 'SocMon Caribbean' (Bunce and Pomeroy 2003). Rapid interviews took approximately five minutes, whilst long interviews took around 10 minutes to complete. The use of participatory and visualisation approaches were employed in the interview process by making use of maps on which fishers drew their main fishing areas.

Biological Data

Quantitative biological data on catch weight and species composition, as well as individual fish size were collected opportunistically from a subsample of the spear fishers during trips or when they were interviewed at their landing sites. Where necessary, catches or known weight subsamples of the catch were purchased to allow this biological data collection. Length measurements to the nearest cm (fork length for finfish; carapace length for crustaceans) were taken using a fish measuring board; weight was recorded using fish vendors' pan scales (to the nearest ounce) or a hanging scale (to the nearest 10 g). When time did not permit, fish were placed onto a gridded plastic sheet and photographed to record species composition and estimate sizes at a later time, and catch weight was estimated using a traditional fish bucket which holds approximately 40 lb of reef fish species when full.

Data Handling and Analysis

Data were stored, sorted and analysed using pivot tables and standard descriptive statistics in Microsoft Excel 2010. ArcGIS including ArcMap 10.0, ArcCatalog and ArcToolbox extensions were used for mapping operating/landing sites and overlapping individuals' fishing grounds.

RESULTS

A total of 110 active spear fishers were identified throughout the island of Barbados. Of these, 74 (67%) were interviewed and used as a representative sample to describe the spear fishery. Just over half of the fishers (51%) considered themselves to be commercial spear

fishers, whilst 49% classified themselves as recreational fishers.

Spear Fisher Demographics

Of the spear fishers interviewed, all were male, although there were two recreational female spear fishers identified. Spear fishers ranged in age from 16 - 67 years old with the largest number of individuals in the 46 - 55 age group. There was also a significant number of fishers ($n = 17$) under the age of 25, most of whom were school boys.

Landing and Operating Sites

The majority of interviewed spear fishers land/operate from sites located on the sheltered leeward west (54%) and on the semi-sheltered south (35%) coasts of the island, whereas 10% operate from the exposed, windward east coast (Figure 1). The distribution of landing/operating sites is slightly different between commercial and recreational fishers, with the latter being concentrated in the Bridgetown area whilst commercial spear fishers mainly operate from the fishing communities of Six Men's, Pile Bay and Oistins (Figure 1). The majority of spear fishers (79%) do not live in the vicinity of their spear fishing sites.

Motivation for Spear Fishing

The main motivation for spear fishing varies as expected between commercial and recreational spear fishers. The majority of recreational spear fishers (70%) indicated that they fish mainly for fun, although some (21%) were motivated by selling all or part of their catch and a few fished primarily for food (9%). All commercial spear fishers are motivated primarily by money and sell 75-100% of their catch.

Income Dependency

Spear fishing is important to the income of many of the individuals interviewed. The majority (63%) of commercial spear fishers stated that they rely on this activity for more than 50% of their total income (Figure 2). Most also have at least one additional job, with other income being generated from a variety of alternative jobs within both the private and public sectors, and 32% of commercial spear fishers also work in the seasonal offshore pelagic fishery. Of the recreational spear fishers, one-quarter are full-time students with the rest, excluding one, being employed outside the fishing industry.

Fishing Practices

Spear fishers access their fishing grounds by boat or by swimming from shore and either free-dive or use SCUBA gear. Most (78%) commercial spear fishers always use a boat, whereas only 28% of recreational fishers do so, with 25% sometimes using a boat and 45% always swimming from shore. The typical boats used are small open "moses" or pirogues with outboard engines, and the

larger ice-boats with inboard diesel engines, used primarily in the offshore pelagic fishery. Slightly more commercial spear fishers (55%) free dive than use SCUBA, whilst the majority (72%) of recreational fishers free dive, although a few (11%) always use SCUBA and the rest (17%) may use SCUBA on some trips.

Fishing grounds

Spear fishing grounds are located on the shallow coral reef areas all around the island, with considerable overlap among fishers in their stated fishing ranges. However, some areas are used by more fishers than others, with the area north of Six Men's on the west coast and off Sam Lords on the southeast coast having the highest density of spear fishers (Figure 1).

Fishing Effort

As expected, commercial spear fishers spent longer per trip (average stated mean trip length = 4.3 hr) and conducted more trips per week (average stated mean number of trips = 4 trips) than recreational fishers (3.2 hr, 2 trips). Annually,

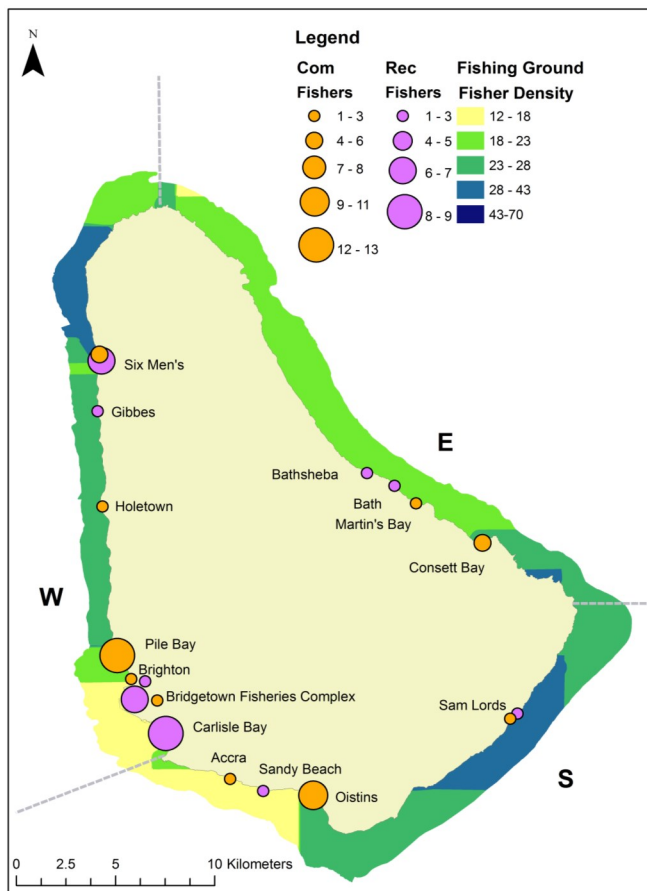


Figure 1. Map of Barbados showing the main landing/operating sites of commercial and recreational spear fishers ($n = 69$ respondents) and density of fishers on fishing grounds around the island based on interviews ($n = 70$ respondents).

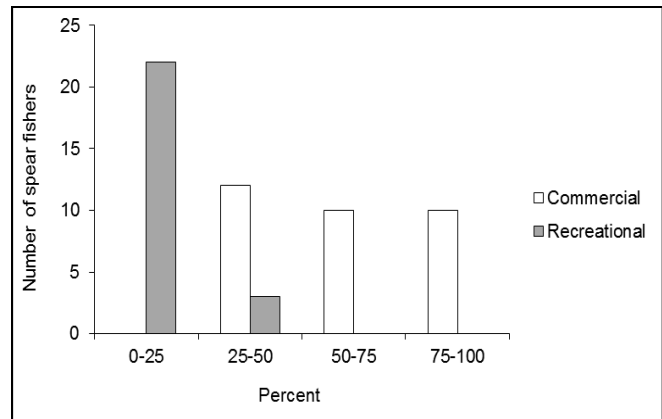


Figure 2. The stated percent contribution of spear fishing to livelihood income, shown separately for commercial and recreational spear fishers ($n = 57$ respondents).

commercial fishers made 141 trips on average, while recreational fishers made approximately half of this (70 trips per year). The spear fishery is active year-round, but some commercial spear fishers (particularly those who are involved in the offshore pelagic fishery) have a strong seasonal pattern, concentrating their spear fishing effort during the summer months, the off-season for the pelagic fishery (Figure 3).

Catch

The spear fishing catch is multi-species, comprising many nearshore benthic reef species (finfishes, lobsters, crabs, octopus, conch) and a few larger reef associated pelagic species (barracudas, mackerels, jacks, sharks). There was no apparent difference in the species composition of commercial versus recreational spear fishers' catches. The stated top three species caught by spear fishers were parrotfishes stated by 75% of fishers, barracuda (52% of fishers) and lobsters (41% of fishers). The average stated mean catch per individual per trip was 14.2 kg for commercial fishers and 6.9 kg for recreational divers. From a limited sub-sampling of catches from 15% of fishers, the observed catch rates were similar to those stated, although the species composition of catches varied. However, parrotfishes still ranked as the most important species, making up 39% of the observed catches (Figure 4). Mean individual parrotfish size in the catches was 672 (SD ± 416) g and 22.8 (SD ± 5.5) cm fork length.

The total spear fishing yield from the coral reefs of Barbados was estimated using the stated mean number of fishing trips each month (trimmed to a maximum of 22 where fishers claimed to be fishing more than five days a week on average) and the stated mean catch per trip for every fisher. The total was then extrapolated to the estimated total number of spear fishers (110) on the island. This gave a crude estimate of total annual landings by the entire spear fishery of 152 mt of reef species.

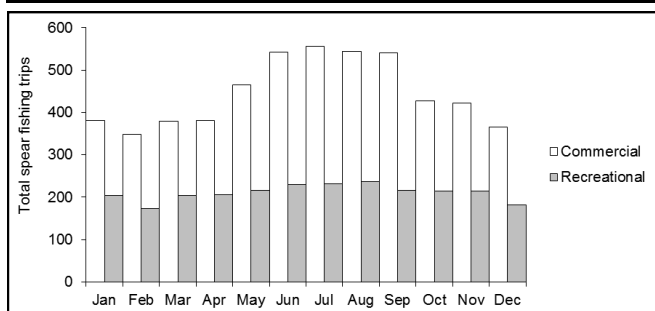


Figure 3. Monthly total number of spear fishing trips made by interviewed fishers based on their stated mean number of trips per week each month. Data are shown separately for commercial and recreational spear fishers ($n = 74$ respondents).

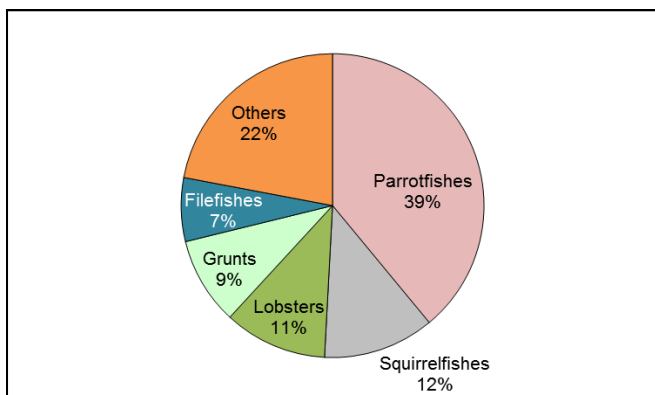


Figure 4. Observed family composition of spear fishing catches based on number caught.

DISCUSSION

The island-wide spear fishery of Barbados is dominated by males in their 40s and 50s and comprises an almost equal number of commercial and recreational fishers. It is a year-round fishery with some seasonality in fishing effort, caused by some commercial spear fishers concentrating their effort in the pelagic fishery off-season (summer months). Spear fishing grounds, located on the shallow reef areas, are shared among fishers; the most heavily used being on the NW and SE coasts, interestingly in areas less heavily used by the tourism industry, which may reduce likelihood of conflict between the two industries. The spear fishery catch of Barbados is multi-species, although the parrotfish family appears to be the most commonly targeted. This should be a matter of concern to reef managers in Barbados given the acknowledged overfished status of the island's reefs (Fisheries Division 2004, McConney 2011), the ecological importance of parrotfishes to coral reefs (Mumby and Steneck 2008), the importance of healthy reefs to the Barbados economy (NCS 2004) and the recently adopted recommendation to urgently restore parrotfish populations on Caribbean reefs (ICRI 2013).

Of particular note is the crude estimate of annual yield from this fishery (152 mt), which is significantly higher than the official landings records for the entire reef fishery (approx. 60 mt, Staskiewicz et al. 2008), and the contribution of the recreational catch to this total (approx. 28.5 mt annually). While there is some possibility that fishers overstate their catch, these findings still corroborate those of Staskiewicz et al. (2008) and Maraj et al. (2011), that the official records are grossly under-estimating the yield and hence value and impact of fishing on Barbados' reefs, and perhaps explains the apparent absence of concern for managing these 'minor' fisheries.

The management challenges in the Barbados spear fishery are typical of many small-scale artisanal fisheries, with limited resources, decentralized and unpredictable landing sites, limited supporting legislation and enforcement capacity, and an already over-fished resource. The cost of doing nothing however, in a country dependent on healthy reefs, is daunting and highlights the urgency of addressing the management of Barbados' reefs, including the reef fisheries and those whose livelihoods depend upon them. The fact that the majority of interviewed fishers themselves recognize that the reef species are in low abundance compared with earlier times and that the reef is deemed by them to be generally unhealthy, should at least help in garnering their support to initiate an ecosystem based approach to managing the island's reef resources. Furthermore, this study has filled important information gaps that will help to inform the management process.

From this preliminary study, the small-scale, male dominated, year-round open access, unmanaged and unmonitored spear fishery of Barbados is typical of the other reef fisheries in the island, contributing to the food and livelihood security of fishers with one or more alternative jobs (e.g. Maraj et al. 2011, McConney 2011, Schuhmann et al. 2011). These attributes are also typical of tropical small-scale fisheries in general (Berkes et al. 2001). Although small-scale, the contribution to food security, total income and recreational opportunity are particularly important during the summer months in Barbados, coinciding with the off-season for the island's main pelagic fishery, and the long school summer holidays when students target the fishery.

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