

Insights from a Survey of the Recreational Fishery in Bermuda

Secretos de una Encuesta de la Pesca Recreativa en las Bermudas

Aperçus d'une Enquête sur la Pêche Récréative dans les Bermudes

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ABSTRACT

Recreational fishing has always been a popular pastime in Bermuda, yet information on this aspect of the fishery has been sparse and largely anecdotal until recently. More data on recreational fishing practices and estimates of recreational landings are needed to facilitate better management of recreational fishing activity and to help fulfill international reporting obligations. In 2011, a survey of recreational fishing activity in Bermuda was conducted by interviewing fishers on the shoreline and mailing a survey to boat owners. The primary goal was to further investigate the extent of various forms of recreational fishing in Bermuda and to acquire estimates of the types and numbers of fishes being caught. The survey also aimed to find out whether the fishing public was familiar with, and generally supportive of, the new fishing regulations brought in at the end of 2010. Opinions on licensing and reporting options were also sought. Important differences highlighted by the survey are that shoreline fishers were more active than boat owners, although boat owners caught more than twice as many fish per capita, and the fish they caught were much larger. However, virtually all those surveyed viewed their fishing as a relaxing leisure activity conducted with friends and family. Awareness of key fisheries regulations was good across both survey categories and those surveyed were generally supportive of the measures in place. In contrast, there was little support for licensing recreational fishing activities.

KEY WORDS: Recreational fishing, survey, Bermuda, recreational catch, fishers' attitudes

INTRODUCTION

Recreational fishing has always been a popular pastime in Bermuda, for its social value as well as its role in supplementing the household diet. However, with the exception of a single study on recreational landings of pelagic species (Hellin 1999), information about the recreational fishery in Bermuda has been sparse and largely anecdotal until recently. The only real data on recreational fishing on the reef platform come from a portion of a survey conducted in 2008 as part of an economic valuation of Bermuda's coral reefs (Sarkis et al. 2010). As has been commonly found elsewhere, data from this survey suggest that a large proportion of recreational fishers fish primarily for leisure and social reasons, rather than for food (Fedler and Ditton 1986, Henry and Lyle 2003). It is perhaps because of this that many people conclude that recreational fishers do not have a significant impact on marine resources.

However, studies show that, while the majority of people fishing for recreation do relatively little fishing and occasionally take home a few fish, a small minority fish frequently and can be responsible for catching a considerable amount (Henry and Lyle 2003, Taylor et al. 2012). The contribution of recreational fishing to overall fishing-related mortality is increasingly being recognized, and for some species in some places, recreational fish catches have been found to equal or exceed those of commercial catches (Henry and Lyle 2003, Coleman et al. 2004, Cooke and Cowx 2004). Excluding subsistence fishers who are dependent on their fishing activity for survival, it has been estimated that approximately 10% of the global population fishes recreationally (Cooke and Cowx 2004, Gerrero 2009), and this increases to approximately 20% in countries with significant coastlines and to approximately 30% in some coastal locations outside of urban centres (PRDNER 2001, Henry and Lyle 2003, NOAA 2006, DFO 2007). Data collected during the 2008 economic valuation survey of Bermuda's coral reefs suggest that as many as 16,000 people in Bermuda fish on a recreational basis, and that total annual recreational fishery landings are close to two-thirds of the annual commercial fishery landings (Sarkis et al. 2011). This implies that the collective impact of recreational fishing on Bermuda's marine resources is quite high.

There is a clear need for information on recreational fishing practices and estimates of recreational landings in order to facilitate better management of recreational fishing activity in Bermuda. Data on the recreational landings of pelagic species are also required to fulfill reporting obligations to the International Commission for the Conservation of Atlantic Tunas (ICCAT).

The primary goal of this survey was to further investigate the levels of various forms of recreational fishing in Bermuda and to acquire estimates of the types and numbers of fishes being caught. The survey also aimed to find out whether the fishing public was familiar with, and generally supportive of, the new fishing regulations that came into force at the end of 2010. Following up on discussions held during the review of the 2000 Green Paper on Marine Resources and the Fishing Industry in Bermuda, and subsequent policies in the 2005 White Paper developed from that, attitudes regarding the licensing of recreational fishing and reporting on recreational fishing activities were also investigated. It was anticipated that the results would inform future management and outreach efforts.

METHODS

The 2011 survey of recreational fishing activity in Bermuda consisted of 33 multi-part questions covering the amount, platform (shoreline or boat type), and location of the respondents' fishing activity during the past year; gear types used; fish species targeted and landed; awareness of, and degree of support for, key fisheries regulations; motivations for fishing; willingness to record and submit information on fishing activity; attitudes towards the licensing of recreational fishing; attitudes regarding the possibility of establishing a recreational fishing advisory body; and demographics. A map was provided for respondents to elaborate on the spatial distribution of their fishing effort if they wished, in order to gather data for future spatial management initiatives.

Although questions concerning the economic aspects of recreational fishing were included in initial drafts, during testing it became clear that they made the survey unfeasibly long and, since the economics of the recreational reef fishery were addressed by Sarkis et al. (2010), this topic was eliminated for pragmatic reasons. The question about fishing platforms asked whether respondents had fished on chartered fishing vessels, but respondents were instructed not to include fish caught on charters in their landings record since Bermuda manages charter vessels as part of the commercial fishery and these fish would already have been reported through the commercial statistics programme. Similarly, the question about gear types included use of recreational lobster nooses but, as this sector of the recreational fishery operates under a licensing system that includes reporting requirements, recreational lobster landings were not further addressed in this survey. All opinion questions were based on a scale of 1 (not at all important or firmly against) to 5 (very important or very supportive).

The survey was conducted in two parts — A shoreline survey and a mailing to owners of private vessels.

Shoreline surveys were conducted by the three staff members of the Marine Resources Section as well as one of the Park Rangers from the Parks Department, who volunteered to conduct surveys on an opportunistic basis during his rounds. Potential survey areas were suggested by the Fisheries Wardens based on their knowledge of fishing activity around Bermuda's shoreline, and were visited by surveyors on multiple occasions between August and October of 2011. In order to avoid the potential for bias in the results, the preamble of the shoreline survey included a filtering question to ensure that active commercial fishers and their immediate family were not inadvertently included. However, individuals who had previously been engaged in the commercial fishery but were no longer actively participating were included in the survey.

The mail survey was based on a list of all registered boat owners from the past two years (2009 – 2010 and 2010 – 2011), provided by the Department of Marine and Ports Services. This list was filtered to restrict the survey to

private owners of motorized vessels that were 14' (4.25 m) long or larger. This list included some vessels that belonged to registered commercial fishermen or their immediate family members, so these individuals were also filtered out in order to avoid bias. Where multiple vessels were registered to the same person at the same address, only one survey was mailed to that address. A total of 2,876 surveys were mailed or e-mailed out in October 2011.

RESULTS

Shoreline Survey

A total of 86 surveys were conducted of people actively fishing from the shoreline at various locations around the islands from August through October of 2011. Potential survey sites identified by the Fisheries Wardens were supplemented by the personal observations of surveyors. Surveys were conducted in the east end at Town Cut, St. George's waterfront, Kindley Field Park, Longbird Bridge, Watch Hill Park, Paynter's Hill (Harrington Sound), the rocks by Bailey's Bay Cricket Club, Crawl Hill railway trail and Shelley Bay railway trail, in central parishes at Devonshire Bay, Flatts public dock and wooden dock, Penhurst Park, Ducking Stool Park, Admiralty Park, Spanish Point Park, Albuoy's Point, and Darrell's Wharf, and in the west end at Fort Scaur, Somerset Bridge, Evans Bay, Watford Bridge and associated docks, Sandys public wharf, Grey's Bridge, and the Dockyard arm. The Ocean Avenue shoreline in the central parishes was also visited on several occasions, as this had been identified as an area where people frequently fished, but there was no fishing activity observed during visits.

People fishing from the shoreline fished an average of 21 days per year. Over one third (36%) said they had fished 5 or fewer times, 14% had fished 6 – 10 times, 19% had fished 11 – 20 times per year, 25% had fished 21 – 50 times per year, and 6% said they fished more than 50 times in the past year (Figure 1). Many individuals had only fished once during the past year, but the greatest number of days fished by a single individual during the year was 300. Between them, the 86 respondents spent a total of 1,824 days fishing over the course of the year.

Almost all interviewees (97%) reported fishing primarily from public shorelines, although 8% also fished from private shorelines and 15% reported fishing on boats belonging to other people. Only 2% said they also fished from boats they owned themselves. Most shoreline fishers fished exclusively at the site where they were interviewed, with only a few reporting that they fished at a variety of locations. Most interviewees were fishing with hook and line, and 78% had used a handline in the past year while 70% had used a rod and reel, with over 50% reporting using both gear types. Castnets were used in the last year by 17% of those interviewed. Other gear types were rarely used by those surveyed on the shoreline as their use is

restricted in nearshore areas and generally requires a boat, but 5% had used a spear in the past year and 3% had used a lobster noose.

Approximately one third of shoreline fishers (36%) said they targeted particular species and grey snappers, *Lutjanus griseus*, were most frequently targeted, followed by Lane snappers, *L. synagris*, Almaco jack, *Seriola rivoliana*, yellowtail snappers, *L. chrysurus*, little tunny, *Thunnus alletteratus*, and hogfish, *Lachnolaimus maximus*. Round scad, *Decapterus punctatus*, and little tunny were most frequently landed, followed by grey snappers, Lane snappers, hogfish and jacks, unspecified fishes from the family Carangidae. Although hogfish only ranked 6th in terms of targeting preference and 5th in terms of total landings, several individuals reported specializing in this species, giving it the third highest capture rate (an average of 20 individuals per fisher per year for those targeting this species). In all, 85 people surveyed reported landing at least 3,249 fish during the past year weighing an estimated 3,000 lbs (~1,350 kg) based on numbers reported multiplied by typical weights for each species, an average of 38 fish per person. The smallest reported individual catch was one fish over the course of the past year and the greatest was 525 fish, although when schooling species such as round scad and little tunny were excluded the greatest individual catch was 256 fish per annum. In addition, 12% of respondents said that they also regularly caught grunts, bream and other small demersal species such as squirrelfish but always or almost always released them.

Relaxation and spending time with friends and family were cited as the two most important motivating factors for going fishing, and were important or very important to 98% and 64% of shorefishing respondents respectively. Fishing for food was an important motivating factor for 54% of those fishing from the shore and tradition was considered an important factor by 39% of shoreline fishers, while the sport aspect of fishing was important to only 18% of those interviewed. These results are summarised in Figure 2. For shoreline fishers, catching large fish was generally more important than catching many fish, with 60% saying that catching large fish was important or very important, but the number of fish caught was still important or very important to 18% of interviewees.

Most shoreline fishers were aware of minimum size limits and bag limits restricting the number of certain species that may be retained per day, with 72% and 65% of interviewees respectively being familiar with these key regulations. Further, interviewees generally supported such measures, even if they were unaware of them, with 94% and 82% respectively, saying they were supportive or very supportive. Shoreline fishers were less familiar with the areas that are closed to fishing, with 57% of interviewees being aware of areas permanently closed to fish and 64% being aware of the seasonally closed areas. These numbers are not surprising as the closed areas are offshore and do not affect shoreline fishing, but the longstanding nature of

the seasonal closures means that many Bermudians are familiar with them regardless. Again, interviewees were generally supportive of area closures in principle even if they were not aware of their existence, with 70% and 93% expressing support for permanent and seasonal closures respectively. These answers are summarized in Figure 3.

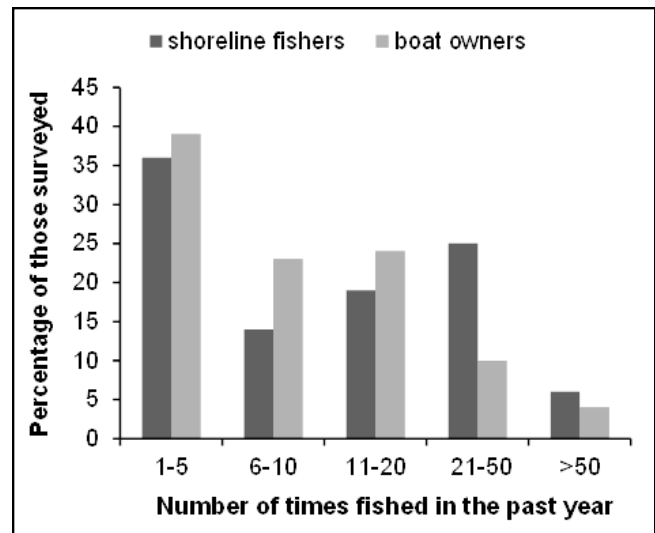


Figure 1. Fishing frequency of shoreline fishers and boat fishers, presented as a percentage of those surveyed.

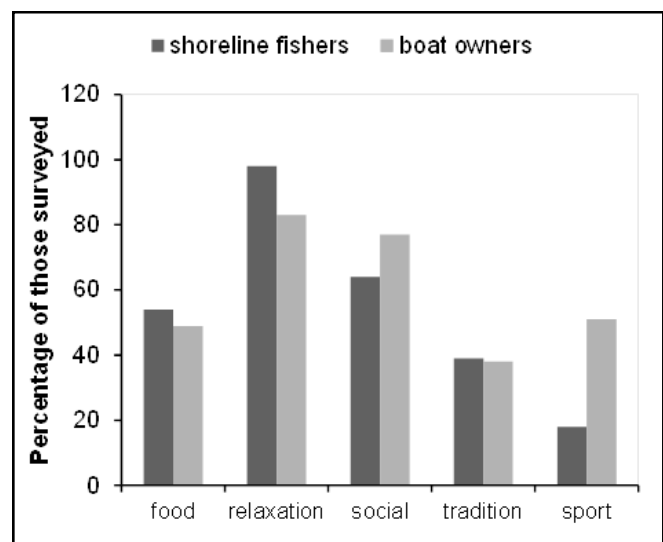


Figure 2. Comparison of motivations for fishing amongst shoreline fishers and boat fishers, presented as a percentage of those surveyed.

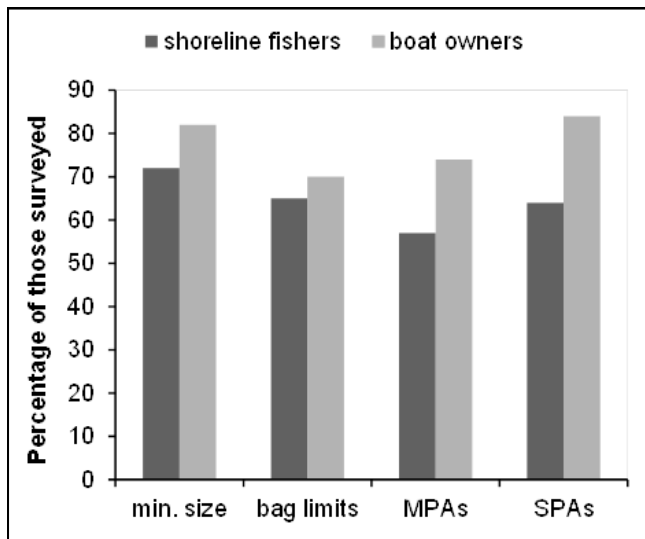


Figure 3. Awareness of key fisheries regulations amongst shoreline fishers and boat fishers, presented as a percentage of those surveyed. (min. size = minimum size limits for retention; bag limits = limit of the number of individuals of certain species that may be retained per day; MPAs = Marine Protected Areas permanently closed to fishing; SPAs = Seasonally Protected Areas, closed to fishing during the spawning season to protect aggregating fishes).

Only 21% of 84 shoreline fishers were supportive or very supportive of the idea of recreational fishing licences, while approximately 48% did not support licensing, 15.5% were ambivalent, and 15.5% were uncertain. Many of those who were unsupportive said that they did not fish very often and that they felt licensing was not worthwhile. However, 30% of those who were not supportive said that they would view licensing more favorably if concessions were given to youth and seniors, or if the cost was low and different tiers of license were available. Although 38% of interviewees said they were unwilling to spend time recording information on their fishing practices and catch, the remaining 62% expressed a willingness to do so and to report the information back to the Department.

Interviewees came from a range of backgrounds, but 62% identified as Bermudian. Another 21% of interviewees were from India or Asian countries, 9% were from Western Europe (including the United Kingdom and Portugal / the Azores), 3% were North American and 2% came from Caribbean islands. Most of those surveyed were adult males fishing alone or in a group (78%), 12% were fishing as a family, 6% were women fishing alone and 5% were fishing as a couple. Of the 84 respondents who answered the question on employment, 17% worked in construction, 15% described themselves as working in technical trades, 13% said they worked in some area of the hospitality industry, and 6% described themselves as working in management. In addition to several Government employees, nine other employment categories were

represented by small numbers of people, along with two people who said they were unemployed. Five percent of those surveyed were students, and 6% of respondents said they were retired. It might be expected that these groups without the constraints of a job would fish more frequently, and indeed, the four students surveyed had fished an average of 56 days in the past year, but the retirees only fished an average of 13 days in the past year, well below the overall average. None of those surveyed while fishing from the shore were current members of a fishing club, although two interviewees had been members previously.

Mail Survey

The mail survey generated 529 responses, and 112 surveys were returned as undeliverable. This equates to a return rate of 19% for the 2,766 surveys presumably received. A return rate of 5% is considered adequate for proceeding with analysis.

Of the respondents to the mail survey, 186, or 35%, said that they had fished within the past year. The mean number of fishing days per year for these respondents was 14, although 39% said they had fished 5 or fewer times in the past year, 23% had fished 6 – 10 times, 24% had fished 11 – 20 times per year, 10% had fished 21 – 50 times per year, and 4% said they fished more than 50 times in the past year (Figure 1). Again, many individuals had only fished once during the past year, but the greatest number of days fished by a single individual during the year was 200. Respondents spent a total of 2,653 days fishing between them during the past year.

Not all surveys were complete, and three responses were not utilized during further analysis because there was no further data or the data supplied were blatantly false. The information in the remaining surveys was utilized on a question by question basis, with reporting on each result noting the number of respondents who had completed that question.

Of 180 respondents, 167 people (93%) had spent 1,835 days fishing from their own boat during the past year, while 59 people had spent time fishing boats belonging to others and 38 people had been on a charter boat during the past year. In addition, 46 respondents (26%) had spent 392 days fishing from public or private shorelines or docks. Data were also acquired on the spatial distribution of these activities for further analysis.

Of 180 respondents, 98 had used a handline for fishing during the past year (54%), 153 had used a rod and reel (85%), 97 had used a trolling rod (54%), 34 had used a spear (19%), 42 had used a lobster noose (23%) and 24 had used a cast net during the past year (13%). Many respondents reported having used other gear types in the past, and this was particularly true of handlines, as most people start out with this gear type, but was also true of spearfishing and lobster diving, as these physically demanding gears are often abandoned by older fishers.

The survey asked respondents to identify and rank the fish species that they targeted most frequently, and 162 people responded to this question. Of those, 135, or 83%, said that they targeted particular species when they fished, while the remainder said that they did not target any particular species. Lane snappers, *L. synagris*, were the most commonly targeted species, followed by wahoo, *Acanthocybium solandri*, yellowfin tuna, *Thunnus albacares*, and then Almaco jack, *S. rivoliana*. Amberjack, *S. dumerili*, grey snapper, *L. griseus*, yellowtail snapper, *L. chrysurus*, triggerfish / turbot, unspecified fishes from the family Balistidae, coney, *Cephalopholis fulva*, hind, *Epinephelus guttatus*, and hogfish, *L. maximus*, were also popular target species.

Further asked to estimate the number of fish of each species that they had caught during the past year, 67 respondents reported that they had caught 3,311 lane snappers, 49 respondents caught 1,357 triggerfish, and 31 respondents caught 1,211 coneys. Other frequently landed species were yellowtail snapper (773), Almaco jack (747), and creolefish / barber, *Paranthias furcifer* (692). More respondents reported catching wahoo and yellowfin tuna, but with 61 people catching 420 wahoo and 52 people catching 484 yellowfin tuna, catch rates were not as high. More than 11,000 fish weighing an estimated 31,000lbs (~14,000 kg)(based on numbers reported multiplied by typical weights for each species) were reported landed during the past year. The 129 fishers who answered this part of the question caught an average of 88 fish per person, even though four of these respondents reported catching nothing or releasing all fish they had caught. The greatest catch was 1,081 fish, and the landings of this individual and others with notably large catches were driven by schooling species such as yellowtail snapper, Lane snapper, triggerfish / turbot and creolefish / barber.

Relaxation and spending time with friends and family were the two most important motivating factors for going fishing, with 83% and 77% of respondents respectively citing these as important or very important factors. The sport aspect of fishing was important or very important to 51% of respondents, and fishing for food was a motivating factor for 49% of respondents. Tradition was a factor in 38% of cases. This question was completed by 174 respondents and the data are summarized in Figure 2. Catching large fish was important or very important to 96 respondents (55%), while catching many fish was important or very important for only 37 (21%) of the 180 respondents who answered this question.

The questions regarding familiarity with the fishing regulations were answered by 180 respondents, with answers summarised in Figure 3. Most respondents (147 or 82%) said they were aware of minimum size limits for certain species, but 167 respondents (95%), including some who were not aware of the regulation, said that they were supportive or very supportive of the principle. Most respondents (126 or 70%) were also aware of bag limits

restricting the number of certain species that may be retained per day, but 130 respondents (73%) were supportive or very supportive of the principle. Most respondents (133 or 74%) were aware of areas permanently closed to fishing, while 152 (84%) were aware of seasonally closed areas. Support for these measures was recorded by 143 and 167 respondents (81% and 95%), respectively.

However, only 27% of respondents were supportive or very supportive of licensing recreational fishers, while 54% of respondents did not support recreational fishing licences. The remainder of the 174 respondents who answered this question were ambivalent (25 or 14%) or undecided (8 or 5%). Again, many who were unsupportive noted that they did not fish very often and that they felt licensing was not worthwhile, while others commented that they felt it would be pointless as they believed it could not be enforced. However, 40% of those who were not supportive said that they would view licensing more favorably if concessions were given to youth and seniors, or if the cost was low and different tiers of license were available. Although 44 of 176 respondents (25%) said that they were not prepared to record their catch, the remaining 75% indicated being willing to spend time recording details of their catch for submission to the Department, even in the absence of a licensing system.

Of the 175 respondents who answered the question on background, 131 (75%) identified as Bermudian, with the remainder primarily British or West European (including the Azores) (23 or 13%) or North American (18 or 10%). Of those who responded, 95% were male, 4% were female and 1% answered as a couple. Of the 174 respondents who answered the question on employment, 28% described themselves as working in management, 14% said they worked in the insurance industry, 8% worked in construction and 6% in finance or banking. Twenty-eight respondents (16%) said they were retired but, although it might be expected that retirees would fish more frequently, this group fished an average of 11 days in the past year, below the overall average. Fourteen respondents were current members of a fishing club, although 10 more responded that they had been members in the past.

DISCUSSION

Important Insights and Key Comparisons Between Surveys

Shoreline fishers interviewed fished more actively than boat owners who responded to the mail survey, fishing 50% more often on average (21 times versus 14). This difference was driven primarily by the much greater proportion of shoreline fishers who reported fishing 21 – 50 times per year, as well as the slightly higher proportion of shoreline fishers who fish extremely frequently (more than 50 times per year) (Figure 1). These differences are likely a result of the relative time, effort and expense involved in fishing from a boat versus the shore.

In contrast, on a per capita basis, respondents to the mail survey reported landing more than double the number of fish that shoreline fishers had landed over the past year (88 versus 38), from a greater variety of species. Those fishing from boats were also more than twice as likely to target their fishing towards a particular species, and the targeted species were generally larger and more valuable than those caught by shoreline fishers. As a result it is estimated that, on a per capita basis, shoreline fishers took home an average of 35 lbs (~ 16 kg) of fish over the course of the past year, while those fishing from boats took home an average of 242 lbs (~ 109 kg) (based on numbers reported multiplied by typical weights for each species).

The survey has revealed the extent of recreational fishing pressure on hogfish, *L. maximus*, driven by the large catches of a relatively small number of individuals. This species is currently regulated via a minimum size for retention of 18" (45 cm), but the only catch restriction in effect for the species is the two fish per species per day limit for spearfishers. Further examination of the management of this species appears to be warranted.

While relaxation was overwhelmingly cited as the most important motivation for fishing across all those surveyed, with social reasons a close second, fishing for food was important to a slightly greater percentage of shoreline fishers while the sport aspect of fishing was important to a far greater percentage of those fishing from boats (Figure 2). Tradition was an important motivator for nearly 40% of all fishers, while a few also mentioned solitude, teaching children, and experiencing the environment as additional reasons that they fish.

Awareness of key fisheries regulations was good across both survey categories and those surveyed were generally supportive of the measures in place (Figure 3). However, shoreline fishers were less likely to be aware of measures such as closed areas that did not directly affect them and were less aware of all regulations on average. When this information is cross-referenced against the demographic data, it seems likely that this is a result of the greater proportion of non-Bermudians and short-term guest workers fishing from the shore, and indicates a need for greater outreach to this group. Several of those surveyed said that they had read the fisheries regulations signs in place in various shoreline locations, and had learned from them.

Shoreline fishers represented a more diverse cross-section of the community than boat owners responding to the mail survey, despite still being primarily Bermudians. As might be expected, the two groups are drawn from slightly different economic profiles, with a significantly greater proportion of boat owners responding that they were employed in higher paying sectors (48% as compared to 9%). A notable proportion of boat owners surveyed (26%) said that they also spent considerable time (nine days on average) fishing from shore, as compared to those fishing from the shoreline, who rarely fished from boats.

Boat owners, on average, appeared to take their fishing more seriously, targeting particular species, using a wider range of gear types, and placing greater importance on the sport aspect of their fishing activity. They were also more likely to be a member of a fishing club. This is referred to as 'specialization' in studies of recreational fishing behaviour (Loomis and Holland 1997).

Despite the differences in the backgrounds and fishing practices of shoreline and boat fishers, attitudes towards the licensing of recreational fishing were remarkably consistent, with similar percentages of each group expressing support and opposition. However, boat owners were slightly more supportive of licensing overall and, when compared to shoreline fishers, a greater proportion of boat owners said that they would view licensing more favorably if certain concessions were given. This appears to be partly a result of the greater percentage of retirees in the boat owner mail survey, since that was one concession category suggested, but the percentage of those indicating increased support was similar for all types of concession. The percentage of those surveyed who said they would be willing to submit details of their fishing activities to the Department, irrespective of licensing requirements, was also slightly higher amongst boat owners.

The overall pattern of greater awareness of regulations, support for regulatory measures (even licensing), and willingness to report on fishing activity amongst boat owners as compared to shoreline fishers is likely influenced by their demographic profiles, but is also consistent with the observed higher degree of fishing specialization amongst boat owners, as specialization is generally associated with a tendency to support greater regulation of recreational activities (Loomis and Holland 1997).

However, the very low representation of fishing club members amongst those surveyed has demonstrated that, while useful for discussing the pelagic recreational fishery, meetings organized through the fishing clubs are not an effective way of communicating with the vast majority of recreational fishers. In their survey responses, 65% of shore fishers and 46% of boat owners supported the idea of a recreational fishing liaison group, and 50% and 35% respectively said a membership organization would be appropriate, but only 15 – 25% would pay a membership fee or get actively involved themselves. A few of those surveyed said that they would prefer occasional town hall or focus group meetings rather than a formalized liaison group. This aspect of the survey was discussed with recreational fishers in a series of town hall meetings in which the overall results of the survey were presented, and some further ideas were generated and several of those present volunteered to work further with the Department of Environmental Protection on this issue.

Limitations

The main limitation of this study is the low number of shoreline surveys conducted. As the study by the Depart-

ment of Conservation Services estimated that 16,000 people in Bermuda fish and that 70% of them fish from shore, 560 surveys of shoreline fishers would ideally have been conducted in order to ensure a representative sample. However recreational fishing activity generally takes place outside of working hours and this study was limited by time and manpower that had to be coordinated with weather conditions suitable for fishing. Nonetheless, the breakdown of effort is similar to that found in other, more comprehensive surveys, so we believe we are justified in analyzing the data as representative.

Another limitation was the lack of access to private shorelines. Homeowners or domestic staff with access to private docks may well fish more frequently than typical shoreline fishers, but this study was not able to fully evaluate this sector. However, 8% of shoreline fishers and 14% of boat owners reported spending an average of 8 days fishing from private shorelines.

The returns from the mail survey indicate that 35% of boat owners fish, but it is possible that a disproportionate number of non-respondents do not fish but failed to understand the importance of contributing this information to the survey. However, this figure is in line with other estimates of the prevalence of recreational fishing and is actually lower than rates of fishing reported by boat owners in some other surveys, which are more typically 40 – 55% (PRDENR 2001, Henry and Lyle 2003). As opportunities for interacting with the natural environment are limited on the small, highly developed island of Bermuda, boating activity frequently fulfills this role and goes some way to explaining the apparently high proportion of boat owners that do not fish.

Scaling up the Data to the Wider Population

With the caveat that extrapolations of survey results must be interpreted carefully, the household survey conducted in 2008 estimated that approximately 16,000 people in Bermuda fish recreationally (Sarkis et al. 2010), and this information can be combined with the numbers from this survey to scale up the impact of recreational fishers across the whole Bermuda population. Based on householder responses in Sarkis et al. (2010), approximately 30% of those who fish recreationally in Bermuda could be considered boat fishers, similar to figures from Puerto Rico (PRDNER 2001). This suggests that there are 11,200 shoreline fishers and 4,800 boat fishers in Bermuda.

Using the per capita figures of 38 fish weighing 35 lbs being landed by each shoreline fisher, 11,200 fishers could be landing up to 425,600 fish weighing 392,000lbs (~177,200 kg) in a typical year. If the respondents to the mail survey were representative of all boat owners, these data could be extrapolated to suggest that up to 1,000 boat owners utilize their vessels for fishing or at least fish in some form. If each boat owner usually takes several friends along on a fishing trip, that could result in 4,800 people fishing from boats during the course of a year. Using the

per capita figures calculated as representing the catch of the vessel rather than an individual, boating fishers could be landing approximately 88,000 individual fishes weighing 242,000 lbs (~109,300 kg) in a typical year. These numbers would put typical annual landings from the entire recreational fishing sector at approximately 513,600 fish weighing 634,000lbs (~286,500 kg).

These results provide an interesting comparison to patterns found in the United States by Figueira and Coleman (2010), where 65% of recreational landings were attributed to individuals fishing from small private or rented boats and only 13% of landings were attributed to shore fishers. Differences are likely related to the greater availability of fishing opportunities for small, readily-affordable, recreational boats in the United States and the numerous shoreline fishing opportunities available on Bermuda's predominantly rocky shoreline. A commonality is the recognition that the impact of various recreational fishing sectors is driven by the numbers of participants rather than individual extraction rates (Cox et al. 2002, Figueira and Coleman 2010).

In 2010, the most recent year for which statistics are complete, the small commercial fishery in Bermuda, which comprises approximately 75 full-time fishing vessels and just over 100 part-time vessels, caught fish weighing a total of 771,000 lbs (~348,500 kg). The commercial catch is generally measured by weight rather than numbers, but this would involve well over 200,000 fish (not including baitfish). The estimates of recreational fishing landings extrapolated from the results of these surveys suggest that recreational landings are equivalent to 82% of commercial landings by weight. Even if these extrapolations overestimate the landings from the recreational fishery in Bermuda, it is clear that a low to moderate rate of extraction by a large number of participants means that this sector has a significant impact on the resource.

CONCLUSIONS

While not definitive, this survey provides a good start for evaluating the impacts of recreational fishing on Bermuda's fishery resources. In addition to the estimates of recreational fishery landings, which will need to be refined through additional discussion with fishers and further data collection, this survey has provided valuable insight into the recreational fishing population, their fishing habits, their motivations, and their attitudes towards fisheries management measures. Some regulatory needs and outreach gaps were also identified.

There were some important differences between shoreline fishers and boat owners that responded to the mail survey. Shoreline fishers were more active than boat owners, although boat owners caught more than twice as many fish per capita, and the fish they caught were much larger. Shoreline fishers also represented a more diverse cross-section of the community than boat owners, despite still being primarily Bermudians. However virtually all

those surveyed viewed their fishing as a relaxing leisure activity conducted with friends and family. Awareness of key fisheries regulations was good across both survey categories and those surveyed were generally supportive of the measures in place.

One of the goals of this survey was to gauge attitudes towards recording information on fishing practices and catches that could assist with the management of local fish stocks, and to find out whether a licensing system to facilitate that would be accepted. The original discussions regarding licensing took place over 10 years ago now, and circumstances in Bermuda have changed considerably in that time. This survey has shown that there is little public support for the licensing of recreational fishing activities in Bermuda, although some concessions might make licensing more acceptable, but that a greater proportion of people would be willing to at least record details of their fishing activity on a voluntary basis to assist with management of local fish stocks. Indeed, more than 80 recreational fishing logbooks were distributed following requests from fishers during this survey. Further discussion is now required to determine the approach that will work best to generate the information that managers need without unduly impacting on this important form of recreation that so many people enjoy.

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