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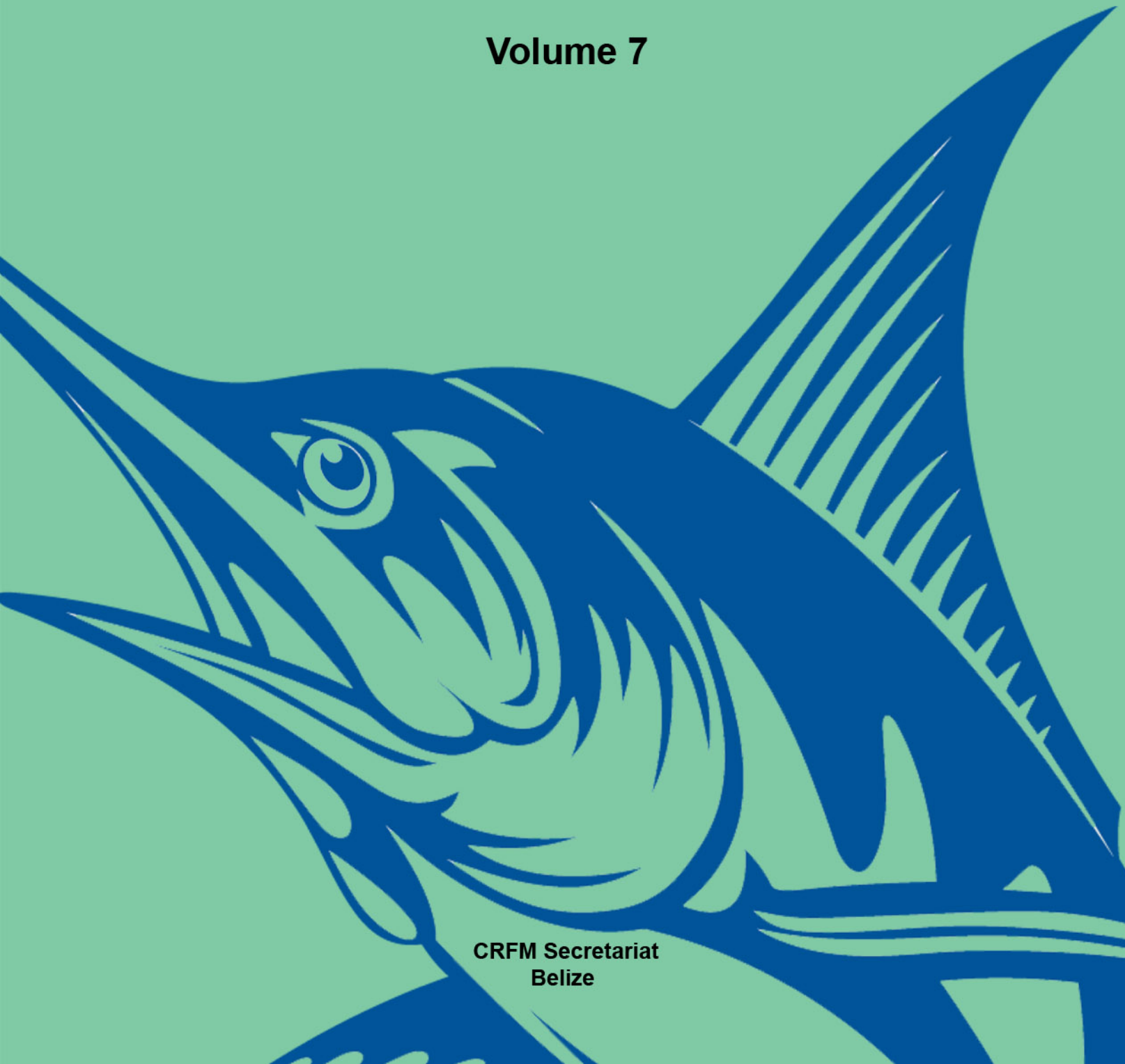

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RECREATIONAL FISHERY COMPONENT OF THE CARIBBEAN LARGE MARINE ECOSYSTEM, LARGE PELAGIC FISHERIES CASE STUDY: SOUTHERN CARIBBEAN AREA (VENEZUELA WITH NOTES FROM COLOMBIA)

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Abstract

Fishing in the southern Caribbean Sea has been performed since men occupied these territories thousands of years ago. The high productivity of coastal waters, associated to seasonal upwellings, has allowed high densities of several marine resources, particularly filter feeders like sardines, which in turn attracted the presence of large predatory fish to the area. In spite of the long history of the activity, rules to regulate it are of relative recent origin (the first regulation in 1944 and then 2008 in Venezuela and 1991 in Colombia). Billfish recreational fishing events in Venezuela have been recorded since 1940 and tournaments since 1956. Sport fishing for billfish is practiced as a regular activity off the coasts of Venezuela, mainly from 6 of the 42 recorded marinas in the country. They hold about 1400 recreational vessels (most are 7 - 14 m long) but only around 10% participate in sport fishing. There should be about 240 persons directly working on board, and an estimated 1000 persons indirectly involved, providing services and maintenance of this fleet. In the central coast, sport fishing of billfish is practiced regularly both in and off tournaments, while in the western and eastern coasts this activity concentrates during tournaments. During the 70's and 80's, Venezuela was considered as the World Capital of White Marlin. In 1975, thirty vessels released 980 billfish in a three day tournament, but currently average release is about 20 billfish per day of tournament. The country has served as a venue for numerous national and international tournaments. The number of tournaments targeting billfish has varied around 6 nationwide in 1988 - 2011, with a maximum of 12 tournaments celebrated in 1995, but only 4 events have taken place since 2010. The sport catch of billfish is released during tournaments and during all sport fishing activities that occur within 50 nm around La Guaira harbor. The retained catch cannot be sold. The gear involves canes and lines in the range of 20 to 50lbs, the former for the capture of white marlin and sailfish, using the 50 lbs line for fishing blue marlin. The bait can be artificial or natural, being ballyhoo (*Hemirhamphus* sp.) or mullet (*Mugil curema*) the two common fish species used. Five billfish species are found in the southern Caribbean Sea. The three most common ones in the catch of recreational vessels (inshore areas), are: blue marlin, *Makaira nigricans*, Atlantic white marlin, *Tetrapturus albidus* and Atlantic sailfish, *Istiophorus albicans*. Two more species occur in low frequency but not in sport fishing, the longbill spearfish, *T. pfluegeri* and the round scale spearfish, *T. georgei*. The first three are present throughout the year, but blue marlin is most abundant during the first half of the year, white marlin during the second half, and sailfish in February, June and September – November. Information on the biology of the species, size structure and vertical distribution is provided in the text. Since 1988, an ICCAT financed project on sport fishing of billfishes has recorded the results of most sport fishing events and evaluated the tendencies of the historic abundance (CPUE) of the different species. Billfish are incidentally captured by industrial tuna long liners and directly targeted by artisan fishers off the central coast and in northern

Margarita Island. There is seldom overlap in the areas of operation of sport fishers and the industrial fleet, but complete overlap between sport and artisan fishers in the central coast which is a source of an unresolved conflict. Few research activities have been performed in Colombia on sport fishing. There has been a recent complaint against the granting of permits to foreign industrial tuna long liners because billfish bycatch cannot be avoided and this will further reduce the low densities of these resources. Along with the economic importance of sport fishing to local economies, the data provided from these activities in the Southern Caribbean Sea area have proven to be of enormous importance for the assessment of the billfish resources in the general Atlantic Ocean.

1. INTRODUCTION

Fishing activities in the Caribbean Sea in general, and particularly along the Venezuelan coasts, are as old as the inhabitants of this land themselves. Indigenous people, mainly of the Arawak nation, who were later displaced by members from the Caribbean group from the Orinoco valley by the end of the XV century, lived upon gathering, hunting and fishing. Their ability to navigate in the rough Caribbean Sea waters was remarkable, being able to travel for commerce in small canoes with oars or sails, between the northern coast of South America, the islands in the Caribbean Sea and even the Central American coasts. Their navigation skills are still kept by the fishers, like those from Margarita Island, who have been able to fish all over the Caribbean Sea and the coasts of northeastern South America, sharing their fishing knowledge with some of the local residents in several regions and countries (Alió, 2005).

In spite of the long fishing history of the region, the setting of norms to regulate this economic activity was decided in relatively recent years. The first Law of Fishing in Venezuela dates back to 1944, and only covered artisanal fisheries since no industrial or aquaculture activities were performed at that time. But its general and non-regulatory frame was such that it was possible to achieve substantial developments through the creation of sublegal norms. This allowed the fishing sector to expand landings from a few thousand tons to more than 600 thousand tons by 2004 (Molinet *et al.,* 2008). This was achieved through the creation of the industrial trawl fleet targeting shrimp and other sea bottom resources, the purchase of an industrial tuna fleet and the development of aquaculture facilities for marine and fresh water resources. The newer version of the Law of Fisheries and Aquaculture (hereafter referred to as LFA) was approved in 2001, not through discussions in the National Assembly but by a Presidential Decree. It was almost immediately modified several times by users' request until the 2008 version now in force, but which still has received severe criticism by fishers, aquaculturists and academics (Molinet, *op. cit.*).

Recreational fishing activities in Venezuela involve marine and continental resources. These activities are popular among youngsters and the elderly, being performed for quite a long time. However, the organization of sport fishing tournaments is of relatively recent origin. Tournaments have involved trout, cichlids and other freshwater species in rivers and lakes, while billfish, barracuda, wahoo, dolphinfish, tunas, and even swordfish have been targeted in marine coastal zones. Regulations of sport fishing were established by sublegal norms until 2001, when they were incorporated, along with other norms for regular fishing activities, into the LFA. Billfish recreational fishing events in the country have been recorded since 1940; and tournaments since 1956. Further details are provided below on the development of marine sport fishing in Venezuela and the care taken to record catches and effort from them. However, it should be underlined that the importance of these records goes far beyond the scope of sport fishing since they have been critically useful for the current management of billfish in general in the Atlantic Ocean.

During World War II, the threat of submarines to all surface vessels was widespread and this restricted the development of commercial fisheries, particularly offshore ones. In the late forties, after this War ended, fishing vessels of several countries, mainly from Asia and Europe, rapidly expanded their area of fishing offshore and eventually all oceans were subjected to fishing pressure (Myers and Worm, 2003, 2005; Myers *et al.,* 2007). Some resources, particular those predatory fish with longer life spans like billfish, sharks and tunas, were fished more intensively and many of their populations decreased, some to unsustainable levels nowadays, like white marlin and some shark species. At present, recovery efforts of these fish populations need management reference points that show their status prior to the severe decline recorded from the 70's to 90's (Pauly, 1995; Mora *et al*. 2009). A piece of the puzzle is provided, at least for billfish in the Atlantic Ocean, by the records of sport fishing in the Central Venezuelan coast that show levels of abundance during the 1960s. The other source of reference points for such populations is found in the data from the Japanese fleet (Alió and Die, 2002).

This report covers the development of marine sport fishing in Venezuela, its control, and the economic and social impact of this activity.

2. RECREATIONAL FISHERY CONTEXT

In the Venezuelan economy, agriculture represented 4% of the GNP in 2007 (World Bank, 2012), a typical low value for an oil producing country. Fisheries and aquaculture activities accounted for 10% of the agricultural sector. In the year 2004, landings reached the historical maximum of 640,400 t, but decreased to 219,150 t in 2011, following the crash of the sardine, *Sardinella aurita*, fishery in 2005 and a severe decrease of the turkey wing ark clam, *Arca zebra* (Mollusca; Bivalvia; Arcidae) fishery in recent years. Recreational fisheries are not allowed to sell the catch, but these landings are consumed by fishers, crews or donated to consumers. Landings from recreational fishery events are incorporated into the national statistics (but not the strikes or the fish captured and released) and reported to FAO since 1960. The results of billfish tournaments are also reported to the International Commission for the Conservation of Atlantic Tunas since 1987. Recreational fishing is usually associated with those marinas where most vessels are stored.

In spite of the small amount of fish landed by the recreational fishing sector, its contribution to the economy of certain communities in the vicinity of the marinas may be very important. The services demanded by sport fishers for themselves and for their vessels and fishing operations, the travel, hotel and food expenses, the fishing permits, can represent an outstanding amount of funding for local economies. Hence, in many coastal communities it is understood that a living billfish is far more valuable than a dead one. For example, Ruben Jaen (pers. comm.) mentions that the contribution of sport fishing to the GNP of the USA is close to one hundred ten thousand million dollars, including the construction and sale of yachts, and services associated with this economic activity. In Venezuela, the contribution of recreational fishing to the general country economy is probably small; however, joined together with the other supporting activities of the recreational fleet (like service providers, e.g. fuel and lubricants, bait, equipment, vessels repair, etc.) may represent a major portion of the economic activities in some coastal communities, particularly those located close to national parks.

The tendency in the regional Caribbean Sea area seems to follow the protection of billfish in order to promote sport fishing activities in the different island and mainland countries. Venezuela seems to have moved away from this strategy, since regular fishing activities upon billfish are on the rise in Margarita Island and the central coast of the country, while marine recreational fishing activities and tournaments are progressively decreasing. But attempts to reverse such situations have to be implemented, and they have to come more from the communities of fishers themselves (both sport and commercial fishers) than from other sources, since they will be the main persons to benefit from a change in the policy towards billfish conservation and use.

3. BACKGROUND AND EVOLUTION OF THE FISHERY

To record the evolution of sport fishing in Venezuela, a contact was made with one of the most important sport fishers in the country, Dr. Ruben Jaen Centeno, who is Trustee Emeritus of the International Game Fish Association and who kindly offered his notes. He recalled that the first trials to capture billfish in the country date back to 1940 and were made by the Phelps family. Later, in September 1942, Carlos Heny from his yacht "Chubasco" captured a white marlin with hand line in a location north of La Guaira harbor. In August 1947, Freddie Behrens, on board of the vessel "Sol y Mar", captured the first blue marlin with rod and reel, under sport fishing regulations, landing it in Caraballeda Yachting Club, near La Guaira, where it was verified that it weighed 80kg. Starting in 1950, the members of the Arrecifes Yacht

Club, under the direction of Johnny Phelps, performed regular fishing for billfish and in September 1956 organized the first billfish national tournament of this club. In August 1957, the national government organized the First International Tournament of Billfish Fishing which was attended by foreign visitors. Within the three days of the event, the 22 participating vessels with 66 fishers landed a total of 288 billfish. In September 1958 the second International tournament took place with the participation of 24 vessels that landed 188 billfish, mostly white marlins.

In September 1959, the sport fishers started a new strategy, very advanced for their time, which consisted of releasing all the 287 marlins and sailfish captured in the tournament, for the purpose of conservation of the species. This practice is currently applied in most national and international tournaments worldwide.

After the closure of Arrecifes Yacht Club (due to the construction of a power plant by Electricidad de Caracas, C.A. in the site) the Playa Grande Yachting Club was founded in Catia La Mar, Vargas State. This Club organized the First International Blue Marlin Tournament, a 4-day event in May 1960, with the participation of 20 vessels and 60 fishers, who captured 22 blue marlins (the largest weighing 165 kg) and recorded 59 strikes. The tradition of this tournament, which is always celebrated during the first semester of the year, has been maintained until present time (an outstanding accomplishment of 51 years), with great difficulties during the last four events.

For the following twenty years, Venezuela was considered as the World Capital of White Marlin. To support this fact it is worth mentioning that in 1975, thirty vessels released 980 of them within three days. Among the fishers, three of them using 20lb lines, released 59 white marlins in a single day, just 9 miles north of La Guaira. During the 1960s to 1980s, Venezuela became one of the best places in the world for the fishing of white and blue marlins and sailfish, serving as a venue of numerous national and international tournaments. Another three events also worth mentioning, were the 1995 International Light Tackle Association event, celebrated 9 - 12 October, with the participation of 41 vessels and 123 fishers in which a total of 719 billfish were captured and released (670 white marlins, 15 blue marlins and 34 sail fish); and the 5th (May 1999) and 6th (Sept. 2000) International La Guaira Billfish Shootouts, celebrated with 40 and 33 vessels, in which 256 and 399 billfish were captured and released, respectively. However, the average capture rate has been around 39 billfish in a two-day tournament.

Sport fishing statistics of catch and effort were carefully taken at this Club since 1961, which served to record migratory movements of the billfish and trends in the abundance of the billfish in the Caribbean Sea. These data have been reflected and analyzed in several publications (Jaen, 1964; Jaen, 1992; Machado and Jaen, 1982; García de Los Salmones *et al.*, 1989; Gaertner *et al.*, 1989; Gaertner *et al*, 1991; Alió *et al.*, 1994; Gaertner and Alió, 1994; Gaertner and Alió, 1998; Alió *et al.*, 2002).

On 4 December 1976, Dr. Jaén obtained the World record of blue marlin fishing (using 50 lb line test) with an individual of 384 kg (802 lb) and later, on 30th December 1994, he set the record for the Caribbean Sea with a blue marlin of 480kg (1056 lb), captured while using a line of 80 lb test.

In 1990, during the expansion of the industrial long line fleet, several sport fishers requested the Fisheries Administration to implement a no-fishing zone around La Guaira, in an effort to protect the billfish populations in the area. These populations were being fished by both the industrial long line tuna fleet and the artisanal gillnet fleet from Playa Verde, a town near La Guaira. That year, President Jaime Lusinchi issued a decree setting a protected zone of 2,500 square miles, or 50 miles around La Guaira harbor. This type of initiative was followed by some countries (like the USA), although it has had limited success locally. The no-fishing restriction was applied only to the industrial tuna fleet. On their part, the sport fishers had to release all captured billfish and the artisanal fleet was frozen at a level of 35 vessels and their special fishing permits were considered non-transferable, in the expectation that the entire fleet would progressively disappear within the life span of the vessels, something that did not happen.

Billfish in Venezuela are mainly landed by three fleets; the artisanal fleet of Playa Verde which started operating around 1990 and landed 191 t in 2011; the artisanal fleet off Juan Griego, that operates with long line and live bait during the second half of the year, and started targeting billfish and dolphinfish in 1988, landing 585 t in 2011; and the industrial fleet of tuna long liners which has operated since the 1940s and landed 71 t in 2011 (INSOPESCA, 2012). The information on capture of tuna and tuna like species, billfish and sharks from these fleets has been reported to ICCAT since the 1970s.

Due to the interdiction to land billfish caught around La Guaira by sport fishers since 1990, there was a further negative consequence of this measure associated with the inability to maintain the data base on regular sport fishing activities upon billfish in the central coast of Venezuela. Since then, the effort made by sport fishers was demonstrable by the exits from harbors, but their catch could not be certified and so harbor masters had to rely upon the verbal report of what was captured and released during the trips. Eventually sport fishers in the main marina, Playa Grande Yachting Club, refused altogether to report any capture and the data base could not be supported any longer. This data base was initiated in 1961 and continued uninterrupted until 1989, being one of the few data bases in the world containing information on fish abundance (CPUE) before the 1970s, when industrial fisheries reached their maximum development worldwide and spread over all the world's oceans (Myers and Worm, 2003). Hence, this data base is used to serve as a reference point for ICCAT to evaluate the current status of billfish resources, before they were severely depleted. Considering approaches to compensate the lack of information from regular sport fishing activities after 1990, Browder and Prince (1988) suggested the use of tournament and dock catch and effort data to obtain indices of annual relative abundance for billfish. In this regard, Alió and Marcano (2001) validated the technique to contrast the trends of billfish abundance recorded from the sport fishing activity off Playa Grande Yachting Club and from sport fishing tournaments in the central Venezuelan coast, during the period 1984 - 1999.

Sport fishing for billfish is practiced as a regular activity off the coasts of Venezuela. There are 42 recorded marinas in the country, 16 in the western region, 14 in the central region and 12 more in eastern Venezuela (Table 1). In spite of the large number of marinas, sport fishing tournaments targeting billfish are currently organized by 6 of them: one marina in the western region (Club Naútico Cardón), and another in the eastern region (Puerto La Cruz) plan regular fishing tournaments at least once a year; the remaining 4 marinas (Puerto Viejo, Playa Grande Yachting Club, Marina Caraballeda and Club Puerto Azul) arrange several tournaments during the year in the central region around La Guaira (Figure 1). Although not regularly organized, there have been some tournaments planned by local marinas in four locations off the central - western coast of Venezuela (Puerto Cabello, Turiamo, Ocumare and Morrocoy National Park), but the last recorded events in these places dated back to 1998. Some marinas (for example, Punta Brava in Puerto Cabello) also organize sport fishing tournaments targeting other species like king mackerel, wahoo or dolphinfish. In the latter type of events, the fishing is done at distances from 0 to 4 miles offshore, in contrast to those events targeting billfish in which the fishing is done at distances from 3 to 20 miles offshore (Gaertner *et al.*, 1989). However, the records from the events close to shore for the period 1991 - 1997 indicate that billfish can represent 22% of the catch in numbers.

Until at least five years ago there were several companies near La Guaira offering charter trips for visitors to practice sport fishing in Placer of La Guaira. Two of those facilities operated from Puerto Viejo Hotel and Marina and from Marina Caraballeda. Local harbor masters in those marinas indicated that such activities ceased after 2005 as a consequence of the worsening of national security and local economic uncertainties.

The fact that most tournaments take place in the central zone is probably related to the abundance of billfish throughout the year in this area. Billfish tend to concentrate in a place known as Placer of La Guaira, which is an old submerged platform located 19 km offshore of the Caracas International Airport, being 19 km long and 10 km wide (Machado and Jaen, 1988). Its deepest limits have been located at

depths of 300 - 400 m, with a shallowest depth at 94 m called Bank of Macuto (Gines, 1972; Alió and Die, 2002).

Sport fishers are organized in Clubs that could be related to certain marinas. These Clubs are recognized by the Venezuelan Government through the National Sports Institute (Instituto Nacional de Deportes), an institute associated to the Ministry of Sports. Tournaments are planned by the national clubs but also by foreign persons or companies that maintain itinerant tournaments throughout the Caribbean Sea. For example, Jean Vernon has organized several editions of the Presidential Caribbean Cup in La Guaira, as well as Rick Alvarez with the Venezuela International Super Slam and the International La Guaira Billfish Shootout, the latter on its 15th edition. The tournaments organized outside of the marinas and associated with Clubs, are controlled either from other marinas or from hotels.

Since 1988, a project on sport fishing of billfishes was initiated by researchers of Fondo Nacional de Investigaciones Agropecuarias (currently Instituto Nacional de Investigaciones Agrícolas) of the Ministry of Agriculture and Lands, and Instituto Oceanográfico de Venezuela of Universidad de Oriente, with the purpose to record the results of most sport fishing tournaments in Venezuela and evaluate the tendencies of the historic abundance (CPUE) of the different species. It was initially financed by ORSTOM (currently Institut de recherche pour le développement-IRD), France, and since 1990 until the present time by ICCAT (International Commission for the Conservation of Atlantic Tunas) as part of the Enhanced Research Project on Billfish. The records indicate that the number of events targeting billfish has varied around 6 nationwide in the period 1988 - 2011, with a maximum of 12 tournaments celebrated in 1995 (Figure 2). The amount of events has reduced to 4 since 2010.

Table 1. Location of marinas in Venezuela and identification of those that organize sport fishing tournaments. Source: INEA (2011).

Name of Marina	Location*	Region of Venezuela	Organizes billfish tournaments
Marina Dorada	Maracaibo, Lke. Mrcbo.	Western	No
Club Bahía	Judibana, Gulf. Ven.	Western	No
Club Naútico Cardón	Pta. Cardón, Gulf. Ven	Western	Yes
El Rey	Tucacas	Western	No
Proconce Dos	Tucacas	Western	No
El Ancla	Tucacas	Western	No
Tucacas	Tucacas	Western	No
Caribbean Suits, Marina Club	Tucacas	Western	No
Puerto Varadero	Tucacas	Western	No
Coral Reef Morrocoy	Tucacas	Western	No
Alejandrito	Tucacas	Western	No
La Cuevita	Tucacas	Western	No
Paraiso	Tucacas	Western	No
Indunave	Tucacas	Western	No
Los Manglares	Tucacas	Western	No
Morrocoy	Tucacas	Western	No
Punta Brava	Puerto Cabello	Central	No
Puerto Viejo Hotel & Marina	La Guaira	Central	Yes
Playa Grande Yachting Club	La Guaira	Central	Yes
Caraballeda	La Guaira	Central	Yes
Playa Azul	La Guaira	Central	No
Puerto Azul	La Guaira	Central	Yes
Aguasal Club & Marina	Higuerote	Central	No
Club Bahía de Los Piratas	Higuerote	Central	No
Carrasco	Higuerote	Central	No
Higuerote	Higuerote	Central	No
Carenero Yacht Club	Higuerote	Central	No
Astillero Higuerote	Higuerote	Central	No
Cavafa	Higuerote	Central	No
Americo Vespucio	Puerto La Cruz	Eastern	No
Puerto Viejo Yacht Club	Puerto La Cruz	Eastern	No
Imbuca	Puerto La Cruz	Eastern	No
Puerto La Cruz	Puerto La Cruz	Eastern	Yes
Bahía Redonda	Puerto La Cruz	Eastern	No
Pamatacualito	Puerto La Cruz	Eastern	No
Cumanagoto	Cumaná	Eastern	No
Venetur	Porlamar, Margarita Is.	Eastern	No
Servimar	Porlamar, Margarita Is.	Eastern	No
Punta de Piedras	Pta. Piedras, Margar. Is.	Eastern	No
Concordia	Porlamar, Margarita	Eastern	No

* See position of the locations in Figure 1.

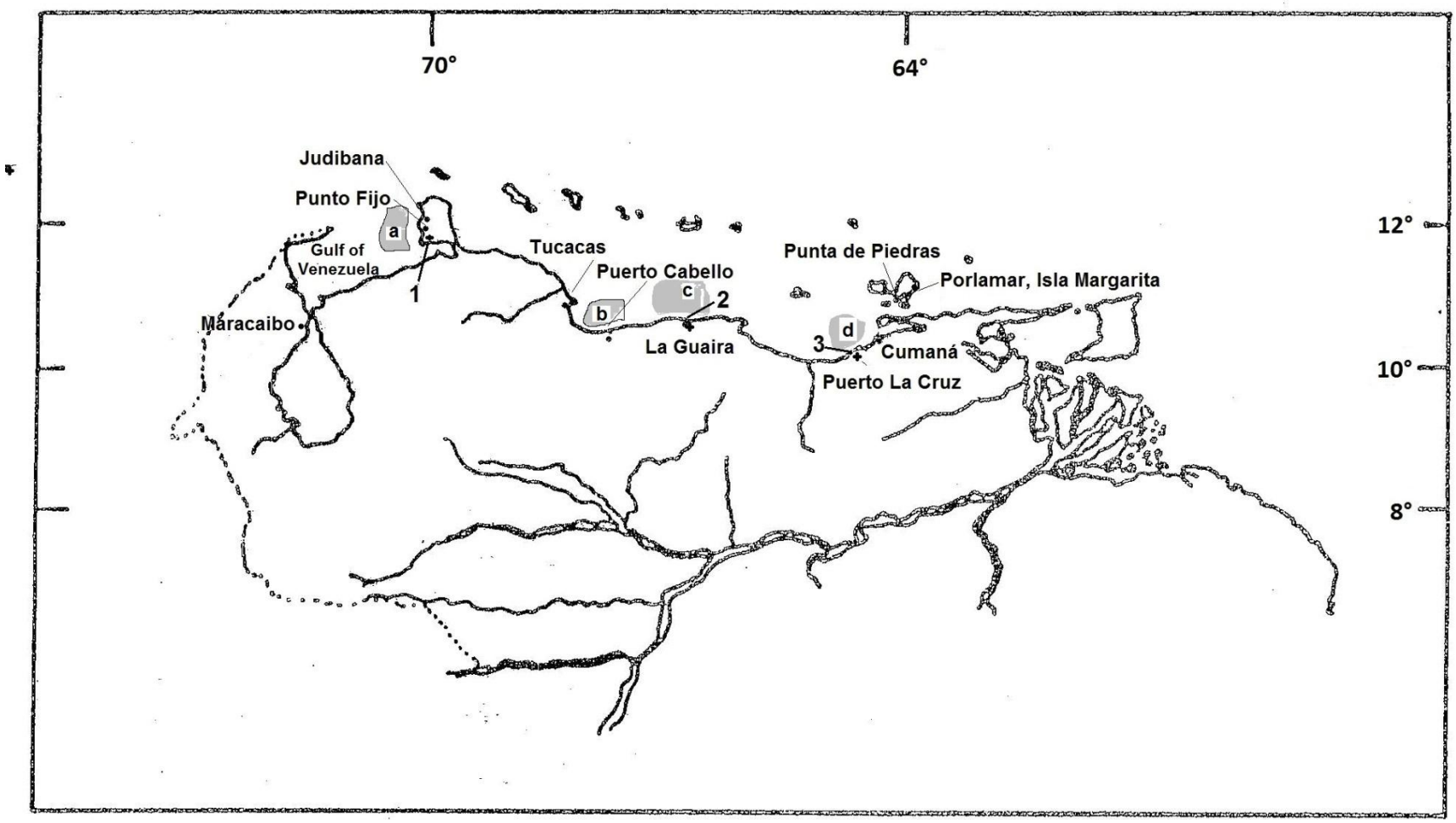

Figure 1. Location of cities with marinas and areas of sport fishing operation. Numbers identify those marinas from where billfish sport fishing tournaments are organized: 1. Club Naútico Cardón; 2, Playa Grande Yachting Club, Club Caraballeda, Club Puerto Azul; 3, Puerto La Cruz. The fishing areas are shown as shaded areas in each geographic region; a, Gulf of Venezuela; b, western-central; c, Placer of La Guaira; d, eastern.

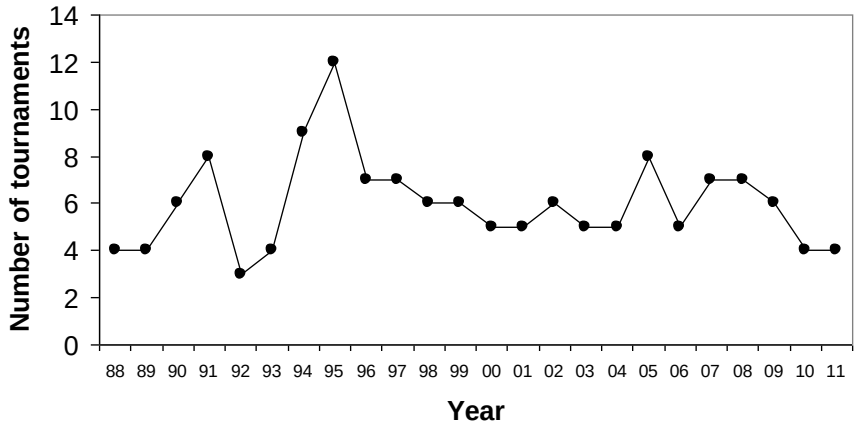

Figure 2. Number of recorded marine sport fishing tournaments targeting billfish in Venezuela. Source: José Alió. Instituto Nacional de Investigaciones Agrícolas.

4. SOCIO-ECONOMIC CONSIDERATIONS

4.1 Fate of the catch

(i) Catch and release

Except for the area contained within 50 miles offshore around La Guaira, where all billfish (live or dead) are to be released, the entire catch from regular sport fishing activities in Venezuela can be kept on board, but not sold. To address this concern, Article 15, section 6 of the LFA (Venezuela, 2008), indicates that the catch from recreational fishing activities is not intended for commercialization, which involves all species captured since no discrimination is made in the regulation.

(ii) Retention for consumption by family and friends

The retained catch is either consumed by the fishers or the crew.

(iii) Sale of catch

As was mentioned in item (i) of this section, the sale of the entire catch from recreational activities is not allowed in Venezuela.

4.2 Fleet size and characteristics

Gaertner *et al.* (1989) mentioned that the size of vessels in the marina of the Playa Grande Yachting Club, where most tournaments are scheduled in the country, vary in the range 7 - 40 m (23 - 131 ft), with a high proportion of vessels in the range 12 - 20 m (39 – 66 ft) (Figure 3). These authors also report that about half of the 80 vessels that participated in billfish sport fishing tournaments nationwide in the late 1980s, operated from this marina. In marinas outside of La Guaira, where vessel owners are more involved in recreational trips than fishing tournaments, the vessels are usually in the length range 5 - 14 m (15 - 46 ft). In this respect, the Harbor Master of Club Naútico Cardón, H. Colmenares, described that there are 53 sport vessels parked in this marina with lengths between 5 and 14 m (15 - 46 ft), being most vessels around 10 m long (32 ft). All vessels with lengths beyond 8 m (24 ft) have diesel inboard engines.

According to R. Jaen (pers. com.), most vessels involved in sport fishing tournaments are in the length range 9 - 16 m (28 - 48 ft).

25ft (7.5 m)

17ft (5.1 m)

33ft (9.95 m)

23ft (7.06m)

57ft (17.26 m)

Figure 3. Sample of vessels that participate in sport fishing activities in Venezuela and estimated lengths. Source: Harbor Master, Playa Grande Yachting Club.

The size of the fleet associated with marine sport fishing was assessed using estimates by the harbor masters in the six marinas where these activities are regularly initiated (Table 2). These estimates were contrasted with the number of vessels participating in sport fishing tournaments nationwide.

Table 2. Estimated number of vessels involved in recreational and sport fishing activities in Venezuela. Source: Harbor masters.

Name of Marina	Location	No. parked vessels	No. vessels participating in sport fishing
Club Naútico Cardón	Pta. Cardón, Gulf. Venezuela	53	30
Municipal Punta Brava	Puerto Cabello	100	10
Puerto Viejo Hotel & Marina	Catia La Mar	100	1
Playa Grande Yachting Club	Catia La Mar	240	40
Caraballeda	Macuto	200	20
Puerto Azul	Naiguatá	114	10
Various marinas	Puerto La Cruz	600	30
Total		1407	141

The estimated size of the fleet participating in marine sport fishing activities targeting billfish in Venezuela is about 140 vessels, a number rather low in comparison with the large amount of vessels currently parked in the same marinas. Their owners evidently have the economic funding to support the vessels, but according to R. Jaen (pers. com.), most of them lack the forbearance required to spend the large amount of leisure time fishing requires.

4.3 Fishing seasons

There are five species of billfish reported in Southern Caribbean Sea waters. The three most common ones in the catch of recreational vessels (inshore areas), are: blue marlin, *Makaira nigricans* (Lacepède 1802), Atlantic white marlin, *Tetrapturus albidus* (Poey 1860) and Atlantic sailfish, *Istiophorus albicans* (Latreille 1804). There are two more species that occur in low frequency in inshore waters but are captured more often offshore by tuna long line vessels or by artisanal fishers with long line in the eastern part of the country (Marcano *et al.*, 1994): the longbill spearfish, *T. pfluegeri* (Robins and de Sylva 1963) and the round scale spearfish, *T. georgei* (Lowe 1841).

During their migratory movements within the Western Central Atlantic ocean, these fish spend time in the highly productive Venezuelan waters, where some species feed only (*M. nigricans* and *T. albidus*), or both feed and reproduce (*I. albicans*, *T. pfluegeri* and *T. georgei*) (García de Los Salmones *et al*. 1989; Gaertner *et al*., 1989; Barrios, 2007).

The period when they can be found in the local coastal zones was evaluated by Gaertner *et al.* (1989) with data from campaigns made by sport fishers from the Playa Grande Yachting Club off tournaments in the period 1961 - 1987 (Figure 4). The three main billfish species are present in Venezuelan waters throughout the year, but white marlin is most abundant during the second half of the year, particularly during July – October. Blue marlin shows a reverse distribution in time, since it is more common during the first half, mainly during January - May. The presence of sailfish is more widely spread in the year, with periods of higher abundance in February, June and September - November.

Considering those periods of higher abundance of billfish species in the country, tournaments targeting blue marlin are organized around May in the central Venezuelan coast, whereas those tournaments targeting white marlin take place between October and November. The events organized in the Gulf of Venezuela between 1988 and 2011 have occurred in November and only captured sailfish. However, there are records of tournaments from locations in the nearby Netherland Antilles (Bonaire and Curacao) during March with captures of blue marlin and sailfish. The presence of blue marlin there may be related to the deeper waters around these islands in comparison with the much shallower environment of the Gulf of Venezuela. In eastern Venezuela, where deep waters are found in front of Puerto la Cruz, sport tournaments have been organized in October and November and only sailfish and blue marlins are reported in the catches. The latter information was obtained from three tournaments made in Puerto La Cruz during 1994. The presence of blue marlins so late in the year is unusual in the Venezuelan coasts. The population of billfish in the eastern region of the country seems to be dominated by the sailfish (61% of the landings) and white marlin (39%), while the blue marlin and longbill spearfish represent only 0.3% of the billfish landings, as recorded from the long line fishery off Juan Griego that operates in the northern Margarita Island and other islands and archipelagos nearby (Marcano *et al*., 1994).

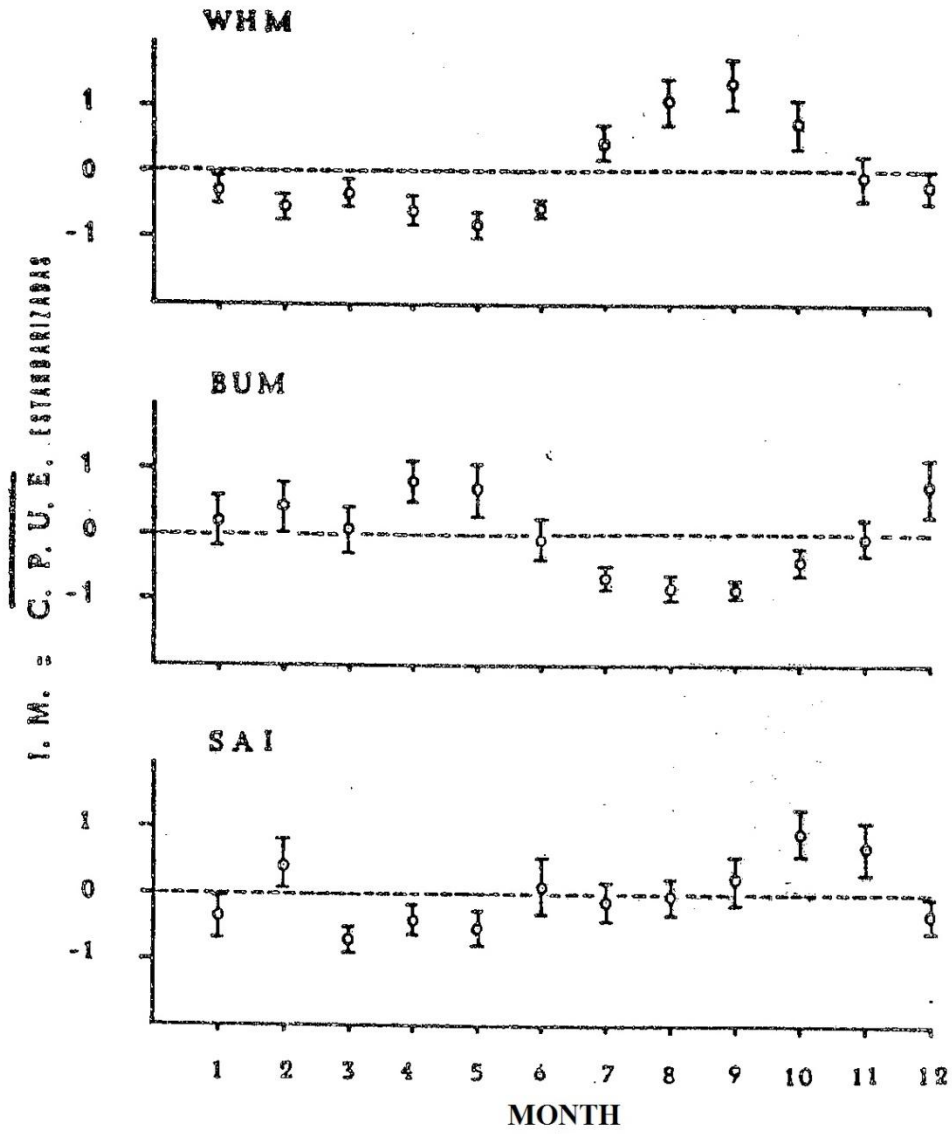

Figure 4. Standardized average monthly capture per unit of effort (CPUE) for the main billfish species landed at Playa Grande Yachting Club, Central Venezuela, during 1961-1987. After Gaertner et al. (1989)

4.4 Gear

Recreational fishers use canes and lines in the range of 20 to 50 lbs, the former for the capture of white marlin and sailfish, using the 50 lbs line for fishing blue marlin. The bait can be artificial or natural, being ballyhoo (*Hemirhamphus* sp.) or mullet (*Mugil curema*) the two common fish species used for this purpose. Nylon leaders with different strengths are also used with the hooks, 80 lbs. for white marlin or sailfish and 300 lbs. for blue marlin (R. Jaen, pers. comm.). In these cases the hook is attached at the pectoral fins level of the fish used as bait. Metal leaders and a hook attached to the tail of the bait are used in sport fishing events targeting other species like wahoo, Spanish mackerel, small scombrids, barracuda,

tunas, dolphinfish, etc. although an appreciable number of billfish can also be captured in these events (Gaertner *et al.*, 1989).

During the history of marine sport fishing in Venezuela, there was an important change in the gear used by fishers which occurred between 1968 and 1970. Prior to those years the fishers used thick fishing lines which somehow hindered the marlins from hooking, and since then thinner lines have been used. This change may have increased the hooking rate by a factor of two (Alió and Die, 2002).

4.5 Spatial distribution of effort by recreational fishers

Marine sport fishing activities in Venezuela take place in areas relatively shallow and close to shore, even in regions where deep bottom can be regularly found, like in the central coast of the country (Figure 1). Most recreational fishing tournaments or personal fishing activities (not associated to tournaments) targeting billfish take place along the central coast of the country, in the vicinity of Placer de La Guaira, located 19 km offshore from La Guaira. In this area, the fishers exploit a coastal zone of 40 km between Catia La Mar and Naiguatá. Towards the west side of the central coast, the fishing activities take place along a coast line of 30 km between the city of Puerto Cabello and Cata. In the Gulf of Venezuela, in the western side of the country, marine sport fishing occurs in the eastern side of this gulf along a coast line of 20 km between Punta Cardón and Amuay, at a distance not beyond 30 km from the coast line. Finally, the fishing in the eastern side of the country exploits an area about 10 km from shore in the vicinity of Puerto La Cruz, since the region has deep water areas relatively close to shore.

4.6 Direct employment / employment opportunities provided by fishery

In spite of the large number of marinas and the estimated several thousand recreational vessels operating in the country, the number of vessels associated with sport fishing is rather small. Alió and Gaertner (1989) estimated 80 as the number of vessels practicing sport fishing and being involved in tournaments, or used as charter boats for sport fishing within the central coast of the country. With an estimated fleet size of 140 sport vessels nationwide (Table 2) and a crew comprising a captain and one sailor in each of them, there should be about 240 persons directly working on board, and an estimated 1000 persons indirectly involved, providing services and maintenance of this fleet. The type of labor performed among the latter involves diesel and gasoline engine suppliers and repair shops, fuel and lubricant providers, dry dock workers, hardware shop personnel, harbor maintenance, construction and maintenance of wharfs and infrastructure of marinas, food and beverage providers, Harbor Master office personnel, naval rescue personnel (Fire Dept.), Merchant Naval Control personnel, bait providers (fishers and sellers), among others.

According to the harbor masters in Playa Grande Yachting Club and Marina Puerto Viejo, the disappearance of the charter boats for sport fishing activities in the vicinity of La Guaira around 2004, decreased even more the job opportunities pertaining to sport fishing in the country.

4.7 Revenues and costs of recreational fishing

The costs involved in owning and operating a recreational vessel are associated with fixed initial costs (like purchasing the vessel and its operational devices) and variable costs for maintenance. As an example, the Harbor Master of Playa Grande Yachting Club mentioned that the costs of owning a vessel of average size in Venezuela, 8 m (26 ft), can be around US$100,000 while the monthly costs for maintenance would be around US$ 2,500 (Table 3).

When the recreational vessels could be rented as charter boats there could be revenue for owning one, but this activity has ceased in the central coast of Venezuela. Thus the main benefit derived from owning a recreational vessel is the opportunity to enjoy nature and the fishing activities.

Table 3. Itemized list of costs associated to buying and operating a recreational vessel of 26 ft (8 m) long in Venezuela.

Itemized costs	Initial cost (US$)	Monthly costs (US$)
Acquisition of vessel, engine (diesel 100 HP) and electronic equipment (radios SSB and VHF, GPS-Ecosounder, radar)	100,000.	
Mechanical, hull and equipment maintenance		50.
Dock parking costs and services		40.
Fuel and lubricants		170.
Crew (captain and sailor)		1,100.
Food and beverages		200.
Fishing gear and bait		120.
Marine charts	100.	
Property taxes and fishing permits for vessel and crew		8.
Insurance		800.
Total	100,100.	2,488.

5. ECONOMIC VALUATION OF THE RECREATIONAL FISHERY

An economic valuation of the recreational fishery in Venezuela has not been done yet and it is a gap in our understanding of the contribution and performance of this fishery.

6. ECOLOGICAL AND TECHNOLOGICAL INTERDEPENDENCIES WITH COMMERCIAL FISHERIES

Billfish are captured in Venezuela as incidental bycatch in tuna long line vessels (Marcano *et al.* 2004; Marcano *et al.* 2002, 2008, 2011; INSOPESCA 2011). The areas of operation of these vessels comprise the section of the Caribbean Sea and the Western Central Atlantic Ocean to the north and northeast of the South American coast line (Figure 5). Billfish are also captured by fisheries targeting them like the marine sport fisheries (Gaertner *et al*., 1998) and the artisanal fisheries off Playa Verde in the Central Venezuelan coast (Alió *et al.* 1994) and Juan Griego in the northern Margarita Island (Marcano *et al.*, 1994).

As was mentioned before, sport fishers are required to release all captured animals in the vicinity of La Guaira, but it seems that most sport fishers in other coastal zones are releasing them as well. Hence, landings of billfish from sport fishers in Venezuela are very small, and consists perhaps of those animals considered exceptional or trophies which are allowed to be landed by the current legislation.

The artisanal fishers at Playa Verde use gillnets 200 to 1500 m long, 7 - 14 m in height, made with polyamide mesh 15 - 25 cm (5 - 10 in) stretched (Alió *et al*., 1994). Fishers change the characteristics of the gear between November and February, when a smaller mesh size (10 - 15 cm or 4 - 6 in) is used to target small scombrid fishes which are abundant during this time of the year. Early in the 1980s these fishers targeted sharks and other pelagic fish while operating with long lines around Las Aves

archipelago, between Bonaire and Los Roques archipelago. In the late 1980s they moved operations to the proximity of La Guaira, attracted by improved prices of billfish in the local market, and changed the gear to gillnet. The area of operation of these artisanal fishers overlaps with the area used by sport fishers in Placer of La Guaira (Figure 1, shaded area c). It can be observed that this area of operation is inshore, usually within the first 20 miles from the coast line, and there is little, if any, overlap with the areas of operation of industrial tuna long liners (compare Figures 1 and 5).

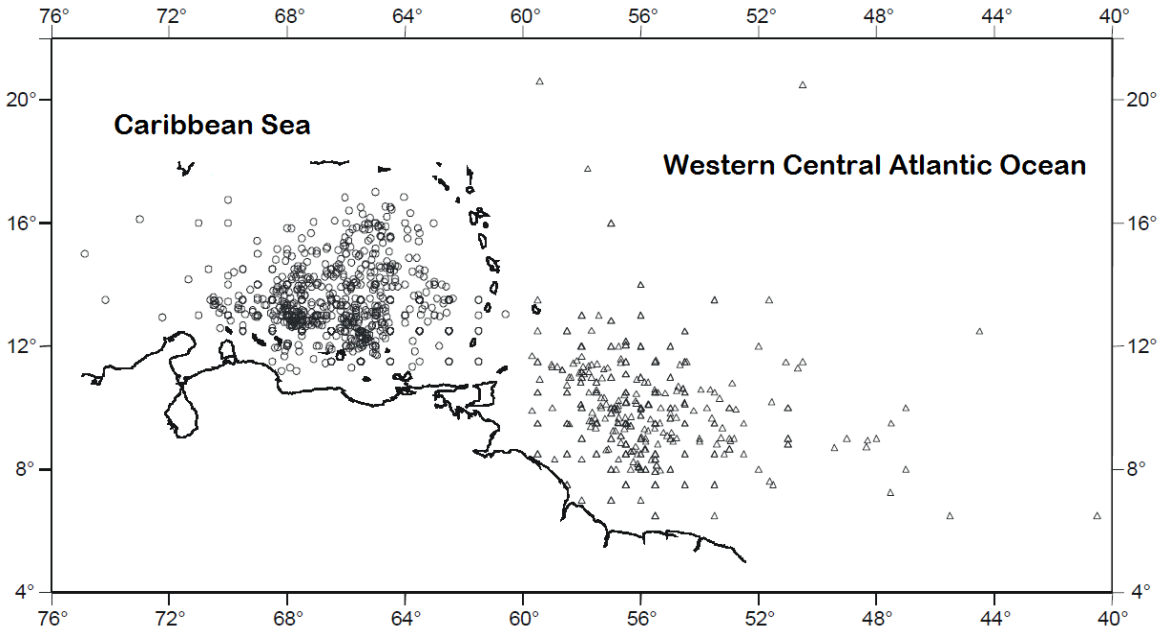

Figure 5. Fishing areas of the Venezuelan long line vessels that operated in the Caribbean Sea (o) and in the Western Central Atlantic Ocean (Δ) from 1986 to 2000. Each dot is a place where the long line was set on a day. After Marcano et al. (2004).

The artisanal fishers at Juan Griego use long lines with live bait between September and February, a period when white marlin and sailfish occur more abundantly in the southern Caribbean Sea (Marcano *et al,* 1994). These fishers target carites (scombrids) with line and hook during the rest of the year. Other species landed by these fishers are the blue marlin, swordfish, longbill spearfish (*T. pfluejeri*), among others, although they represent only 1% of the landings. This fishery maintains the highest catch per unit of effort levels among the artisanal and industrial pelagic fisheries in the country. The area of operation of this fleet has increased progressively in the last decade (A. Lárez, INIA, pers. comm.), since they originally operated in northern Margarita Island and around the island of La Blanquilla and Los Testigos archipelago, to the current operating zone from Bonaire, Netherland Antilles, to eastern Trinidad island. There is no overlap with the areas used by sport fishers from Puerto La Cruz in eastern Venezuela (Figure 1, shaded area d), but there is an increasing overlap with the area used by industrial tuna long liners.

Alió *et al.* (1994) compared the size structure of captures among the local fishers in the central Venezuelan coast before the prohibition for industrial tuna vessels to operate near La Guaira was enacted. These authors did not find significant differences among the sailfish landed by sport, artisanal or industrial long line fishers, which had an average size of 166 cm (± 7 SD) lower jaw-fork length (LJFL). The mean size of white marlin differed significantly among the three fisheries, with the largest animals being those landed by sport fishers (163 ± 9 cm) and the smallest those landed by long liners (160 ± 22 cm). The size range of blue marlin landed by sport and artisanal fishers was similar (204 ± 25 cm LJFL) and larger than those animals landed by tuna long liners (178 ± 26 cm). The differences in size range of

the billfish among the three fisheries suggest that resources stratify according to age and depth, younger animals occurring in deeper water. It also seems that both artisanal and sport fishers are exploiting the same segment of the billfish population. This fact is also supported by the reported extraordinary high number of tags recovered by artisanal fishers soon after the billfish has been tagged by sport fishers in La Guaira region (E. Prince, NOAA - NMFS, pers. comm.). In this respect, Marcano *et al*. (2002) reported a recuperation of 496 tags from January 1999 to August 2001 (an average of 186 tags recovered per year) from a sampled population derived from the commercial catch of about 18,480 individuals (13,480 sailfish, 3,200 blue marlin and 1,800 white marlin). The number of recovered tags decreased to 45 between January 2009 and August 2010 (an average of 23 tags recuperated per year) from a sampled population of 8,718 individuals (6,038 sailfish, 1,719 blue marlin and 961 white marlin). The reduction in the rate of recuperated tags could be reflecting that the tagging effort by sport fishers and probably the sport fishing activity in general as well, have severely decreased in recent years (-76%), whereas the commercial capture rate of billfish by artisanal fishers only decreased by about half that percentage (-37%).

7. CONFLICTS AND COOPERATION OF MULTIPLE USERS OF THE ECOSYSTEM

As was mentioned before, due to the particular geomorphologic feature of the ocean floor, the central coast of Venezuela promotes a concentration of large pelagic fish, like tunas, sharks, billfish, among other species. This condition has attracted the attention of multiple fishers to the area, sometimes with severely contrasting purposes on the use of the fishery resources. For many decades until the late 1980s, billfish had low commercial value in Venezuela, and during this time they were incidentally captured by industrial tuna long liners operating since the 1940s, and were only directly targeted by sport fishers and artisanal fishers in eastern Venezuela.

For sport fishers, billfish resources are the utmost precious game item and were not always landed. In some international tournaments the release of live fish was compulsory, even before the special mandatory release measure around La Guaira was implemented by the Venezuelan Government in 1990. The tendency to release all captured billfish has become a common rule among sport fishers not only in Venezuela in general, but also in many countries within the Caribbean Sea.

Important economic changes that took place in the country during the early 1980s (among them, the devaluation of national currency after several decades of stability in relation to the US dollar) promoted the increase in price of several commodities. One of the affected items was fish and billfish in particular. The new market conditions for billfish induced the reorientation of the species targeted by artisanal fishers in the central coast of the country. They were formerly exploiting sharks with long line and replaced the gear by gillnets targeting billfish and other large pelagic fish. The new market condition also supported the artisanal and seasonal fishery of billfish in eastern Venezuela. Billfish that were traditionally processed and sold dried and salted, as was commonly done with other low value species or animals, when conditions of freshness were not amenable for the fresh fish market, were now consumed fresh or frozen in greater proportion.

The appearance of a new artisanal fishery directly targeting billfish in the central coast of the country, which landed the greatest amount of billfish among all national fisheries that captured these species, was fought by sport fishers since its early development. Considering that billfish should not be landed, particularly around the hotspot of Placer of La Guaira, the sport fishers proposed in 1990 the special regulation in the area that was supposed to restrict the capture of billfish by any fishery around La Guaira, However, the Government only restricted the industrial and sport fisheries, leaving in operation the artisanal one since then. Sport fishers argue that the CPUE of billfish shows a sustained decreasing trend since the 1980s and blame the local artisanal fishers for the decline. Notwithstanding the important

extraction of billfish resources by industrial and artisanal fishers in the country, the billfish in the general Atlantic ocean have shown a significant and sustained decrease since the 1970s and the phenomenon has been evaluated in several ICCAT workshops specially dedicated to the three main billfish species (ICCAT, 2001). As a result of such workshops, it became evident that incidental capture of billfish by major long line fleets in the Atlantic Ocean was the main factor affecting the decrease of the populations of these species. Their current biomasses were below those amounts considered necessary to re-populate the ocean to levels of sustainable yield.

In consequence, there have been several measures recommended by ICCAT to contracting and non-contracting parties, entities or fishing entities associated to this multilateral organization, to promote the recuperation of the billfish resources in the Atlantic Ocean. Among those measures there are: the improvement of current and historical statistics of effort and landings of billfish; the promotion of voluntary release by all fishers of live blue marlin and white marlin; countries with artisanal marlin fisheries shall submit to ICCAT documentation of the character and extent of such fisheries and shall implement domestic measures to cap artisanal marlin catches at 2006 levels; the annual amount of blue marlin that can be harvested and retained for landing by pelagic longline and purse seine vessels must be no more than 50% of the 1996 or 1999 landing levels, whichever is greater; and for white marlin must be no more than 33% of those limits (ICCAT, 2006). These recommendations were later ratified (ICCAT, 2010) and extended to 2012 (ICCAT, 2011). A further measure in the latter recommendation incorporates a total allowable catch (TAC) for blue marlin of 2000 t during 2012, which affects all billfish fisheries in the ICCAT jurisdiction.

On its part, the United States of America, in an effort to help preserve the billfish resources but also to promote the more profitable touristic fishing activities, restricted the landing of billfish by any fishery in its national waters. This policy contrasts with the measure adopted by the Venezuelan Government in 1991, which has allowed the operation of the two current artisanal fisheries that target billfish in the central and eastern coasts of the country.

8. CURRENT MANAGEMENT REGIME OF THE RECREATIONAL FISHERY

8.1 Prevailing management questions

The tendency among recreational fishers in Venezuela is not to land the captured billfish, not only during tournaments but also during other recreational fishing activities carried out at the individual fisher level. There is only a legal requirement for recreational fishers not to land billfish in the vicinity of La Guaira. However, it seems that fishers in other fishing grounds of the country also comply with this rule, which perhaps reflects a general movement among big game fishers to preserve the resources their sport is based on. In this way, removal of individuals from the population is minimized, although some of the returned individuals may not survive after the fishing fight, which can last on average for about 30 minutes for a blue marlin, 20 minutes for a white marlin and 10 minutes for a sailfish (Gaertner and Alió, 1994). In this regard, ICCAT (2006) also made the recommendation that research should be performed on the fate of these catch-and-released individuals.

This attitude contrasts with the fact that Venezuela allows artisanal fisheries directly targeting billfish, with landings that surpass by far those of the industrial tuna fleets (865 t vs. 202 t in 2011, respectively; INSOPESCA 2012). Maintaining the billfishes for their meat should be evaluated in the light of the benefits those resources could provide to the coastal communities, if the resources were to be left unfished in the ocean and used instead for promoting tourism in the local areas.

8.2 Fishery governance

Fishing and aquaculture activities are regulated by the Decree No. 5.930 with Range and Strength of Law of Fisheries and Aquaculture, from 11 March 2008 (Venezuela, 2008), hereafter referred as LFA. The main authority for policy setting on fisheries, aquaculture, products processing and ancillary activities is the Ministry of Agriculture and Land, and the implementing agency is the Socialist Institute of Fisheries and Aquaculture (INSOPESCA).

Sport fishing is defined in Article 15-6 of LFA as the fishing activity with the purpose of tourism, recreation or competition. The catches obtained from this fishery are not intended for commercialization, even though they could generate other benefits as services offered by the organizer of the activity. There are two fundamental types of sport fishing, according to the strategy used: the fishing using attractants of organisms by means of lures, bait or other devices, and the fishing by prosecution of organisms with harpoon in their specific habitat.

Although Article 25 specifies that certain fishery resources and the area within the coastal line and 6 miles offshore, are reserved for artisanal fishing operations, the sport and recreational fishing activities are exempted from these restrictions.

The performance of any type of fishing in Venezuela requires the corresponding authorization from the Socialist Institute of Fisheries and Aquaculture – INSOPESCA (Article 40). Sport and recreational fishing require a permit which will have a duration of up to one (1) year and is renewable (Article 41b). Such a permit is intended for the capture of certain species in the areas allowed, as long as there is no interference with other fisheries according to the current regulations and norms of fisheries ordination established in the LFA.

The cost of the sport fishing permit for nationals is US$ 20.93 (due to the high inflation in Venezuela during the last 10 years, tributes are expressed in the laws as “tributary units” that are adjusted yearly; 1 tributary unit, hereafter referred to as TU, is equivalent to Bs. 90.00 as of February 2012) (Article 44-9); the cost of such permit for non-resident persons is US$41.86 (equivalent to 2 TU) (Article 44-10). The fishing permit for the owner of a national vessel involved in not-for-profit activities is US$52.33 (equivalent to 2.5 TU) (Article 44-28) and US$313.95 (equivalent to 15 TU) for foreign vessels (Article 44-29). When the sport fishing activities are for profit, the cost of the fishing permits are US$313.95 for national vessels and US$837.21 (equivalent to 40 TU) for foreign ones (Article 44 -30 and 44-31, respectively).

Any person holding a fishing permit is required to make a mandatory report of the volume and composition of the catch at the end of every month or at the end of the trip, as well as any other information requested by INSOPESCA (Article 68). The lack of such report can be sanctioned with fines that range from US$4,186 to US$6,279 (equivalent to 200 – 300 TU) (Article 84). The supply of false information can be subjected to fines in the range of US$14,651 to US$20,930 (equivalent to 700 – 1000 TU) (Article 86). The legislation also contemplates sanctions for performing fishing activities without a permit (Article 87) but sport fishing is not included in the list.

8.2.1 Verification of fishing permits during tournaments

Previous to the tournament, the organizers should contact INSOPESCA to report the event and request the presence of a Fishery Inspector in the location chosen for the participating vessels to depart. The latter is to verify the possession of the fishing permits of all participating vessels and persons, and also to issue permits to those in need. For this, the interested party should deposit in a bank the cost of the permit and hand in the voucher to the Inspector.

8.2.2. Prohibition of industrial tuna fishing and restriction to land billfish by recreational fishers around La Guaira

In 1990, the Fisheries Administration received a request from sport fishers in the central Venezuela region to prohibit the operation of tuna fleets in the vicinity of Placer de La Guaira, in an effort to reduce billfish mortality within the central Venezuelan coast where most marine sport fishing activity takes place. There was no consultation with the industrial fishers nor with the fishery researchers on the proposed measure and the measure was issued as a Presidential Decree setting a protected zone of 2,500 square miles, or 50 miles around La Guaira harbor (Venezuela - MAC, 1990). The regulation restricted the fishing activities of industrial tuna vessels within the specified zone, impacting three fleet types: purse seiners, bait boats and long liners. A year later (Venezuela - MAC, 1991), a new regulation was issued which allowed the operation of the artisanal fishery with gillnets off Playa Verde, and fixed at 35 the number of non-transferable fishing permits, each for a single owner. The measure also required that all billfish captured by sport fishers be released.

9. ASSESSMENT OF THE NATURE AND IMPORTANCE OF RECREATIONAL FISHERIES IN THE SOUTHERN CARIBBEAN AREA

Recreational fisheries in the southern Caribbean Area involve regular fishing activities performed outside of and during tournaments. It seems that in certain locations, fishers mainly practice one or the other. In this sense, Gaertner and Alió (1994) found that fishers off Playa Grande Yachting Club are mainly involved in sport fishing outside of tournaments while the opposite was observed among fishers in eastern and western Venezuela. Tournaments are organized and intended to accommodate for different fishers' experiences. Some events attract the participation of family members with little fishing experience and target more coastal species like Spanish mackerel, wahoo, dolphinfish. Other events, targeting billfish, tunas or even swordfish, are oriented towards more experienced fishers and some have international scope.

As its name indicates, recreational fishing is an activity that is mainly sport or leisure oriented. Its economic importance reaches far beyond the value of the catch, which is usually released free or consumed by the fishers. The fact that countries like the USA restrict the landing of billfish in an effort to maintain the abundance of these resources and attract sport fishers reflects the great economic importance of recreational fishing activities for some coastal areas. The economy associated with recreational fishing relies on the selling of equipment (fishing gear, vessels, equipment, etc.) and many other ancillary activities (maintenance service, lodging and food, transportation, tourism, sales, etc.) that are needed to support the fishing.

Along with its economic importance, the data provided from sport fishing activities in the southern Caribbean Area have proven to be of enormous importance for the assessment of the billfish resources when billfishes were landed. In spite of its fortuitous origin, linked to a personal decision of a dedicated harbor master, the late Mr. José Acosta from Playa Grande Yachting Club in the central Venezuelan coast, the meticulously recorded daily fishing effort and landings, outside of as well as during tournaments from 1961 to 1990, represents a precious milestone in the fisheries record of the world. This record represents a contribution from the southern Caribbean Area to help describe the changes in abundance of the billfish resources prior to and after the period of very heavy exploitation that occurred in the 1980s and 1990s. Currently, the records from sport fishing tournaments in the southern Caribbean Sea keep providing a picture of the abundance of billfish resources in the general Atlantic Ocean, and for this the standardized trends of CPUE are compared along time with other fisheries that land these species. One of the strengths of the data from sport fisheries is the greater reliability of the information, particularly that coming out of tournaments, since there are judges on board that do not fish but play a

role as observers. The judges record the information on catch by confirming the species captured, the time of hooking and duration of fight, and the release of the fish within every participating vessel.

Another issue worth mentioning is that many times, sport fishing involves several family members, particularly in special tournaments that promote the family involvement and until 2003 was organized yearly. Recently this type of event is gaining momentum again at marinas near La Guaira, as was reported by the harbor master at Playa Grande Yachting Club. Fishing is an activity that promotes the contact between the human being and nature in a way that regular duties within a city do not usually allow. In this way, the conservation of natural resources has a special meaning for those who participate in fishing activities in general, and sport activities in particular, and affect a growing proportion of the population in countries with marine, river, or lake coasts.

10. CONCLUSIONS

There is an old tradition of recreational fisheries in Venezuela, being an activity practiced by persons of very different ages in marine coastal zones, rivers and lakes. Recreational fishing targeting billfish is much more limited in the number of participating persons but also has a tradition dating back to the 1940s. There are 42 marinas in the country but sport fishing activities targeting billfish are found in only 5 of them. It is estimated that around 140 vessels participate in sport fishing activities targeting billfish in the country, and this provides about 240 direct and 1000 indirect job opportunities.

Particular geomorphological coastal conditions in the central coast of Venezuela create a place called Placer of La Guaira on top of an old, submerged, platform located 19 km offshore of the Caracas International Airport, 19 km long and 10 km wide. It serves as an area of concentration of billfish, allowing one of the best fishing locations in the Caribbean Sea. Hence, there is potential for developing a flourishing sport fishing activity associated with billfish that could provide economic benefit to the inhabitants of coastal communities located around the extant marinas.

The Venezuelan Fisheries Authorities have adopted contradictory measures to protect the billfish populations in the country. On the one hand, there have been restrictions imposed on the operation of industrial tuna vessels in a special zone of 50 miles around La Guaira, a measure that also affects sport fishers since they are not allowed to land the captured animals in this zone. Other measures recommended by ICCAT have been promoted regarding the industrial tuna long line fleet operations, like the release of all billfish that are caught alive, and the establishing of size limits to the billfish carcasses than can be landed. On the other hand, the government permitted the development and operation of artisanal fisheries in the vicinity of Placer of La Guaira and in the northern Margarita Island, which annually land an unrestricted number of billfish. This has been a source of permanent conflict between sport and artisanal fishers in the central coast of the country, since a capture of billfish close to 300 t annually is said to severely reduce the CPUE of billfish during sport activities in the area. The contribution of the fisheries directly targeting billfish to the fish production of the country needs to be revised in the light of the economic benefits these resources would bring to the coastal communities if left unfished and available for sport fishing activities.

The database on fishing effort and billfish catch outside of tournaments that was maintained during 1961-90 for recreational fishing activities off Playa Grande Yachting Club represents a valuable milestone for establishing reference points of the abundance of billfish populations before they were severely depleted in the 1970s and 1980s. Addition of information to this data base ceased after the prohibition to land the captured billfish by sport fishers was imposed in 1990. The sport fishers were unwilling to report their catches and releases to the harbor masters of the marinas, as before, and the Fishery Authorities did not make an effort to promote changes in that attitude.

11. RECOMMENDATIONS FOR RECREATIONAL FISHERIES MANAGEMENT AND FUTURE RESEARCH EFFORTS IN THE STUDY AREA

(a) The recuperation of the data base on daily information of effort and catch and releases from marinas where sport fishing is practiced targeting billfish, particularly from Playa Grande Yachting Club, is a highly desirable task to be assumed by the national fisheries authorities and also by the fishers themselves and Fishing Sport Clubs. It is necessary to promote among fishers the value of the historic data from Venezuelan sport fisheries for the studies of conservation of highly migratory fishery resources in the general Atlantic Ocean.

(b) There should be a better record of the fishing permits granted to sport fishers and vessels, as well as the recording of results of fishing during and outside of tournaments. The request for all fishers to report their catch and effort on a monthly basis should be enforced, both because it is the law and also as it represents a contribution of users in providing information needed for the proper management of the resources they are using.

(c) The Fisheries Authorities and the Ministry of Tourism should assume the promotion of sport fisheries in the several marinas of the country, particularly the type of fishing that releases the captured animals. The organization of fishing tournaments nationwide is a proper way to stimulate the participation of fishers. This will be a means to promote jobs and a better general welfare in the areas where the marinas are located. In this regard, a valuation of the recreational fisheries should be done in order to assess their economic contribution to the country in general and to the local coastal communities in particular.

(d) The continuation of fisheries targeting billfishes for their meat should be evaluated in the light of the benefits those resources could provide to the coastal communities, if the resources were to be left unfished in the ocean and used instead for promoting tourism in the local areas.

(e) The Fisheries Authorities should ensure the participation of national researchers in the workshops where the evaluation of highly migratory resources, like tunas and tuna-like fish species, billfish and sharks, are organized by the International Commission for the Conservation of Atlantic Tunas, to be certain that information from the country on effort and catches is properly conveyed and evaluated. Likewise, the participation of fishery administrators in the decision meetings of ICCAT should be approached as an issue of national interest, in order to ensure the proper management of the highly migratory fishery resources, the fulfillment of ICCAT recommendations by national fishers, and that the assignment of quotas and other restrictions are done in the national interest and that of the fishery resources.

12. CASE OF TUNA LONG LINE FISHERIES IN COLOMBIA AND IMPACT ON SPORT FISHERIES

The main piece of legislation regulating the fisheries and aquaculture activities in Colombia is the Law No. 13 from 1990, implemented by Decree No. 2.256 from 1991, which establishes the General Statute of Fishing (FAO, 2010). The central authority for policy setting, administration and management of fisheries is the Ministry of Agriculture and Rural Development, and in particular the National Authority of Aquaculture and Fisheries (AUNAP). The latter was created by Presidential Decree No. 4182 from 03 November 2011 and initiated operations in January 2012. Until December 2011, the responsibility of fisheries and aquaculture was a mandate of the Colombian Institute of Rural Development - *INCODER*. The latter was established by Decree No.1.300 from 2003 as part of the reorganization process of the public administration. Within it, the Directorate of Fisheries and Aquaculture replaced the abolished

National Institute of Fisheries and Aquaculture - *INPA* (Decree No.1.293 from 2003). This Directorate was responsible for the planning and the general administration of the sector, which involved the granting of licenses, permits, concessions of fishing and aquaculture, as well as the maintenance of the General Registry of Fisheries and Aquaculture.

There is no structured collection of data on sport fishing in Colombia. However, INCODER and the organization MARVIVA (an NGO) have issued a booklet promoting good sport fishing practices, with emphasis on the Colombian Pacific Ocean.

Espinal *et al.* (2005) reported that tunas represent about 33% of the total fishery production of Colombia and 59% of the marine fishery landings. The capture is mainly performed by industrial purse seine vessels. The artisanal fleet only lands 1% of the total tuna discharge and is composed of juvenile tunas captured with hooks. Most of the tuna captures (74%) are made in the eastern Pacific Ocean and the remaining 26% in the Caribbean Sea and Atlantic Ocean. There have been reports of illegal fishing by foreign industrial tuna long liners, which also capture billfish as bycatch in the Pacific coast of Colombia, but most probably the same type of incidents also occur in the Caribbean coast (AUNAP, 2012).

A recent complaint was brought up by sport fishers in Cartagena, who oppose the granting of fishing permits by INCODER to 12 tuna long line vessels from Japan and Korea which have operated since 2009 in the Colombian Caribbean Sea. The sport fishers argued that billfish bycatch cannot be avoided and is decreasing the biomass of the species their sport activities are based on. In this regard, two at-sea observer sampling programs were organized to verify the capture rate of billfish in the bycatch. In spite of the verification that billfish are regularly captured, restrictive actions regarding the issue of fishing permits to the long liners have not been taken yet by Colombian Fisheries Authorities.

In the study of Marcano *et al.* (2004) evaluating the bycatch of Venezuelan tuna long liners which operated in the Caribbean Sea and Western Central Atlantic Ocean (WCAO) during 1986-2000, part of the sampling was conducted in the vicinity of Colombian waters. Captures in the Caribbean Sea were composed of tunas (73.2%), mainly *Thunnus albacares*, and the remaining bycatch comprised blue and white marlins, sailfish, wahoo, swordfish, dolphinfish and sharks of the genera *Isurus*, *Carcharhinus* and *Sphyrna*. The CPUE of white marlin in the Caribbean Sea varied between 0.2 and 2.6 kg/100 hooks – day; that of blue marlin 0.2 and 3.4 kg/100 hooks – day, and sailfish 0.1 and 2 kg/100 hooks – day. There were no significant differences in the CPUE between the Caribbean Sea and WCAO. A declining trend in the CPUE was observed in the three billfish species over time, in spite of occasional periods of higher abundance of short duration. This condition of the billfish resources in the general Caribbean Sea should lead the AUNAP Directorate to be especially cautious in granting permits to vessels involved in fisheries whose bycatch comprise billfish.

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RECREATIONAL FISHERIES OF THE EASTERN CARIBBEAN

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Abstract

Large pelagic fish resources contribute significantly to employment, income and food security in the Caribbean Large Marine Ecosystem and adjacent Guianas-Brazil region. These resources also support recreational fisheries. Many countries in the Caribbean are known for their sport fishing which is a major component of marine-based tourism activities and which targets mainly billfishes, yellowfin tuna, wahoo, king mackerel and the common dolphinfish. Notwithstanding their level of importance, however, recreational fisheries have received limited management attention in most Caribbean countries due to the absence of relevant governance mechanisms and the paucity of data and information to facilitate effective management. Using information from a variety of sources, published and unpublished, as well as interviews with state agencies, regional organizations and academic institutions, game fishing associations and recreational charterboat fishing operators this paper aims to develop the information base to facilitate improved understanding of large pelagic fisheries, with a focus on the nature and importance of recreational fishing activities in selected countries of the Eastern Caribbean. The paper provides a description of the key elements of recreational fisheries with emphasis on the biological, ecological, economic and sociological aspects relevant to fisheries management. Preliminary estimates of catches, landings, number and species of fish tagged and released, fishing effort, revenue and cost of fishing among other key factors are derived for selected components of the fisheries. Current legislation and management measures implemented in the region are reviewed and ecological and technological interdependencies with commercial fisheries are discussed. Based on the findings recommendations for future research and management of recreational fisheries, consistent with the ecosystem approach to fisheries management are proposed.

1. INTRODUCTION

1.1 Context

This study is a component of the transboundary diagnostic analysis of the large pelagic fishery case study, implemented by the Caribbean Regional Fisheries Mechanism under the *Sustainable Management of the Shared Marine Resources of the Caribbean Large Marine Ecosystem (CLME) and Adjacent Regions Project* (Caribbean Large Marine Ecosystem Project – CLME Project) funded by the Global Environment Facility (UNDP and IOC, 2008). Large pelagic fish resources contribute significantly to employment, income and food security in the Caribbean LME and adjacent Guianas - Brazil region. In addition, these resources support recreational fisheries. Many countries in the Caribbean are known for their sport fishing which is a major component of marine-based tourism activities and which targets mainly billfishes, yellowfin tuna, wahoo, king mackerel and the common dolphinfish. Although these species fall under the management purview of the International Commission for the Conservation of Atlantic Tunas (ICCAT), the Commission has focused mainly on large tunas and billfishes and has not yet begun to actively manage small tunas, mackerels and the Common Dolphinfish, which are of particular importance to the region. Notwithstanding this level of importance, recreational fishing activities have received minimal management attention in most Caribbean countries due to the absence of relevant governance mechanisms, and the information base for effective governance and management is quite limited. Consequently, this desk study is intended to develop the information base to facilitate an improved understanding of large pelagic fisheries, with a focus on the nature and importance of recreational fishing activities in selected countries of the Eastern Caribbean (Figure 1), and to make recommendations for promoting the ecosystem approach to fisheries management (after Garcia *et al*, 2003) and governance in the respective fisheries (CRFM, 2010a).

Figure 1: Map of the entire Caribbean with Eastern Caribbean region indicated in rectangle (Source: http://geology.com/world/caribbean-satellite-image.shtml)

1.2 Definition

The Food and Agriculture Organization (FAO) of the United Nations defines recreational fishing as *"any fishing for which the primary motive is leisure rather than profit, the provision of food or the conduct of scientific research and which may not involve the sale, barter, or trade of part or all of the catch".* Arlinghaus *et al.* (2010) indicate that recreational fishing usually does not contribute substantially (e.g. >50%) to meeting the basic nutritional and physiological needs of the individual. To distinguish recreational fishing from commercial fishing the European Inland Fisheries Advisory Commission proposes that "*Recreational fishing is fishing of aquatic animals that do not constitute the individual's primary resource to meet nutritional needs and are not generally sold or otherwise traded on export, domestic or black markets".* Further, to distinguish recreational fishing from subsistence fishing FAO (2011) notes that generally "*recreational fishers have the financial capacity to substitute the fishing products by other products to meet nutritional needs and to secure protein intake and survival".* Several other definitions of recreational fishing are provided by the ICCAT Working Group on Sport and Recreational Fisheries (ICCAT, 2010). In the Eastern Caribbean, Antia *et al*., (2000) defined recreational fishing *as fishing not for commercial purposes but for relaxation, pleasure, amusement and subsistence*. However, Mike and Cowx (1996) and Antia *et al*. (2000), acknowledge the sale of catches by recreational fishers in the region to offset the costs of the fishing trip as well as vessel and engine maintenance costs. Throughout this paper the term "recreational fishing" takes the meaning as ascribed by Antia *et al*. (2000) as well as Mike and Cowx (1996), and includes fishing for sport.

1.3 Scope

This study focuses on countries in the Eastern Caribbean, from Antigua and Barbuda in the north to Trinidad and Tobago in the south. Although initially intended to focus on one or two countries, due to the general lack of data and information on recreational fisheries in the region, the study instead documents any existing data and information available at this time across all relevant countries. Consequently, recreational fisheries in Antigua and Barbuda, Barbados, Grenada, Saint Lucia and Trinidad and Tobago are featured in this report.

Recreational fishing in the Eastern Caribbean is quite diverse in respect of the species targeted. Such species include reef and other coastal fishes caught with spears and line- fishing off rocks, coastal pelagics caught with pelagic lines and large, highly migratory pelagics caught mainly with rod and reels in deep sea waters. In keeping with the focus of the case study, this assessment considers highly migratory pelagic species (such as large tunas and billfishes) and pelagic species of regional distribution (such as dolphinfish, wahoo, mackerels, small tunas). Persons involved in recreational fishing include: (1) individuals who are amateurs and go fishing with family and friends on weekends mainly for pleasure and subsistence; (2) experienced fishers who fish with family and friends but also participate in sport fishing tournaments professionally at the national, regional or international level and (3) experienced fishers who have established charter boat fishing companies servicing the fishing needs of tourists or wealthy nationals. This study focuses mainly on sport/recreational fishing tournaments and charter boat fishing, although some information is also provided for amateur fishing in Trinidad and Tobago. It addresses only a subset of the recreational fishery subsector as described by FAO (2011)[1].

[1] FAO (2011) describes the recreational fishery subsector as "*the entire network of stakeholders involved in or fully or partly dependent on recreational fisheries including amongst others fisheries ministries and agencies, managers, non-governmental organizations (e.g., umbrella angling associations and clubs), anglers, non-angling recreational fishers, tackle shops and tackle manufacturers, bait suppliers, charter-boating industry, recreational boat builders and chandlery suppliers, marina operators and specialized angling and fishing media, recreational fishing tourism and other related business and organizations as well as all other enterprises supporting recreational fisheries*

1.4 Approach to acquisition of data and information

Data and information were acquired through the following approaches:

(1) review of published literature;
(2) internet searches;
(3) requests for information from:
    (a) Fisheries Departments in Antigua and Barbuda, Barbados, Grenada, Saint Lucia and Trinidad and Tobago;
    (b) Game Fishing Associations or tournament organizers in Antigua and Barbuda, Barbados, Grenada, Saint Lucia and Trinidad and Tobago;
    (c) Charter fishing boat operator in Grenada;
    (d) Tourism Departments in Saint Lucia, Barbados and Trinidad and Tobago;
    (e) The International Transport Division, Barbados;
    (f) The Organization of Eastern Caribbean States, Natural Resources Management Unit
    (g) The University of the West Indies, Centre for Resource Management and Environmental Studies, Barbados;
    (h) The Billfish Foundation, Fort Lauderdale, Florida.
(4) Interviews with four charter fishing boat operators in Trinidad and Tobago;

Questionnaires were developed to acquire information specifically from Game Fishing Associations and charter fishing boat operators. Based on the responses received the study focused on fishing tournaments in Barbados, Grenada and Trinidad and Tobago. In respect of charterboat fishing, information was made available for Grenada and Trinidad and Tobago. A literature review and internet searches yielded general information on recreational fisheries in the five countries that are the focus of this study.

2. RECREATIONAL FISHERY CONTEXT

Recreational fishing is considered ecosystem-based recreation because the activity depends on marine fish populations and can benefit significantly from maintaining such populations. Globally marine recreational fisheries, targeting a variety of species, are estimated to comprise a minimum of some 58 million marine anglers who generate about US$40 billion and support over 954,000 jobs (Cisneros-Montemajor and Sumaila, 2010). The estimated landings from recreational fishing are about one million metric tonnes per year, approximately 1.7% of world commercial catches (less catches of small pelagics). It is estimated that 0.23% of the population in the Caribbean region participates in recreational fishing with an estimated expenditure per capita of US$540 (based on a 2003 base year). However, there remains a lack of reliable statistics worldwide, including the Eastern Caribbean region which compromises the reliability of available statistics.

Mahon and McConney (2004) attest that recreational fishing can be a significant component of the harvest sector, with significant impacts on pelagic resources, in particular, large, long-lived species such as billfish. They note that some places of the Caribbean are known for their sport fishing which serves to attract visitors and that charterboat fishing is a component of the overall marine-based tourism offering. The authors recognized that although important, this sector remains an undocumented contributor to tourism economies and due to the species exploited is an important link between shared resource management and tourism.

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including aquaculture operations that produce stocking material or commercial fishing enterprises that sell angling tickets on their waters."

The fishing sector, in general, is not a major contributor to the Gross Domestic Product in Eastern Caribbean countries. The contribution of fisheries to the Gross Domestic Product in Antigua and Barbuda, Barbados, Grenada, Saint Lucia and Trinidad and Tobago is 1.48% (2003), 0.9% (1990), 1.83% (1994), 15 (year not provided) and 0.07% (2006, 2007 and 2008) respectively (CRFM website: http: www.caricom-fisheries.com). These figures do not include income derived from recreational fisheries as this information is not documented. It should also be noted that in general the value of recreational fisheries extends beyond that of being part of the industry when one considers the personal values by way of sport (including the challenge, the contest, *etc*.), camaraderie, exercise, recreation, solace, mental relaxation, appreciation of nature, understanding the environment and supreme quality food (Kearney, 1999).

2.1 Species targeted by recreational pelagic fisheries and status of stocks

The species[2] of large pelagic fish targeted by recreational fishers in the Eastern Caribbean include Common Dolphinfish, Wahoo, King Mackerel, Serra Spanish Mackerel, Yellowfin Tuna, Sailfish, Blue Marlin, White Marlin and Blackfin Tuna. Several species are also caught incidentally. These species include barracudas, Crevalle Jack, Bigeye Tuna, Cobia, Rainbow Runner, Bull Shark and Shortfin Mako. Although Albacore and Skipjack Tuna are not mentioned in catches of the recreational fishery, it is likely that these species are also caught but are perhaps not well identified among similar tuna species, or not caught in large amounts. In addition, one recreational fisher in Tobago identified Silky Shark as present in the by-catch, though not in large quantities. It is uncertain whether other shark species e.g., Blue Shark, threshers and hammerhead sharks are present in the by-catch of recreational fisheries. The majority of these species are under the management purview of the International Commission for the Conservation of Atlantic Tunas.

Based on assessment studies the status of many regional stocks such as the Common Dolphinfish, Wahoo, King Mackerel, Serra Spanish Mackerel and Crevalle Jack remain inconclusive due to uncertainties in stock delineation, poor data quality, absence of time series of catch and effort and biological data and uncertainties in life history parameters, in particular the age and growth parameters (Parker, 2010; CRFM, 2007; Martin and Die, 2008; Martin and Knowlis, 2005 and Mohammed *et al*., 2008a). The Atlantic stock of Yellowfin Tuna and North Atlantic stock of Albacore are considered overfished while the Western Atlantic Skipjack Tuna stock is possibly not overfished and the status of the Atlantic Bigeye Tuna stock is highly uncertain (ICCAT Report 2010 - 2011 (II)). One of the spawning areas of Yellowfin Tuna is located in the southeastern Caribbean Sea (ICCAT, 2012a) and due to the use of Fish Attraction Devices (FADs) in the area there is concern about the negative impacts, particularly on young age classes which show a strong association with FADs, and on the biology and ecology of the species in general due to changes in feeding and migratory behaviours. The North Atlantic Swordfish stock is fully exploited while the status of the Atlantic Blue Marlin stock and Western Atlantic Sailfish stocks are uncertain and the Atlantic White Marline stock is showing sign of rebuilding (ICCAT Report 2010 - 2011 (II)). The status of the North Atlantic Shortfin Mako stock remains inconclusive although there is high probability that the stock is below the biomass required to support Maximum Sustainable Yield (MSY,) while the status of the North Atlantic Blue Shark stock is highly uncertain, the biomass believed to be above, and the fishing effort below that required to achieve MSY ((ICCAT Report 2010 - 2011 (II)). The status of Silky and Thresher shark stocks remain unknown.

A trophic model was developed under a regional project entitled *Scientific Basis for Ecosystem-Based Management in the Lesser Antilles including Interactions with Marine Mammals and Other Top*

[2] Scientific names of all species listed in this report are provided in *Appendix 1*

Predators (LAPE Project)[3], and used along with information from abundance surveys, diet composition studies and estimates of catches and fishing effort, to quantify abundance, fishing and natural mortality and trophic linkages among species or species groups in the pelagic ecosystem and to examine possible policy options for management of the respective fisheries. Although the recreational fishing fleet was not included in the model, impacts of increasing fishing mortality by commercial fleets on pelagic species were examined (Mohammed *et al*., 2008). These impacts are however, relevant to all instances of increasing fishing mortality whether from commercial or recreational fisheries. Results suggested that prey availability is a stronger factor in the dolphinfish-flyingfish dynamics (dolphinfish being a key predator of flyingfish) than predator control. Increasing fishing mortality on dolphinfish had either very little or a positive effect on flyingfish biomass due to predation release while comparable increases in fishing mortality on flyingfish had considerable negative impacts on dolphinfish biomass. Depensation effects were evident, due to the trophic linkage between Yellowfin and Skipjack tuna. Specific increases in fishing mortality caused a decline in Yellowfin tuna biomass while the biomass of Skipjack tuna increased as a result of a release in predation from Yellowfin tuna, its key predator. Reducing fishing mortality to its original baseline level caused the biomass of Skipjack tuna to increase while that of Yellowfin tuna took a longer time to recover due to predation by Skipjack tuna on juveniles of Yellowfin tuna. It was concluded that Skipjack tuna, controls the recovery of its own key predator. When fishing mortality was increased on Skipjack Tuna only, the biomass of Yellowfin Tuna increased despite the importance of Skipjack Tuna in its diet, mainly due to the resulting decrease in predation on its juveniles.

2.2 Landings of large pelagic species

Landings of pelagic marine fish (category in FAO FishStatJ Database) reported by countries in the Eastern Caribbean comprise some 39 species and species groups of which 25 represent large pelagic species. These statistics pertain mainly to commercial operations although some recreational fishery statistics may also be included, as is the case with Trinidad and Tobago. Estimated annual landings for the general pelagic marine fish category between 1989 and 2009 varied between 13,802 tonnes (1994) and 23,484 tonnes (2004). Estimated landings of the 25 large pelagic species and species groups varied between 61 and 86% of total landings of all pelagic species over the 20-year period, with the main species being Yellowfin tuna (included in large tunas category); Serra Spanish Mackerel, Mackerels (unspecified) and King Mackerel (included in the mackerels category) and Common Dolphinfish (Figure 2). Generally, annual landings varied between 10,752 tonnes (1999) and 18,100 tonnes (2004). However, the increase in landings over the period has been marginal.

[3] This project was implemented by the Food and Agriculture Organization and the respective countries and funded by the Government of Japan.

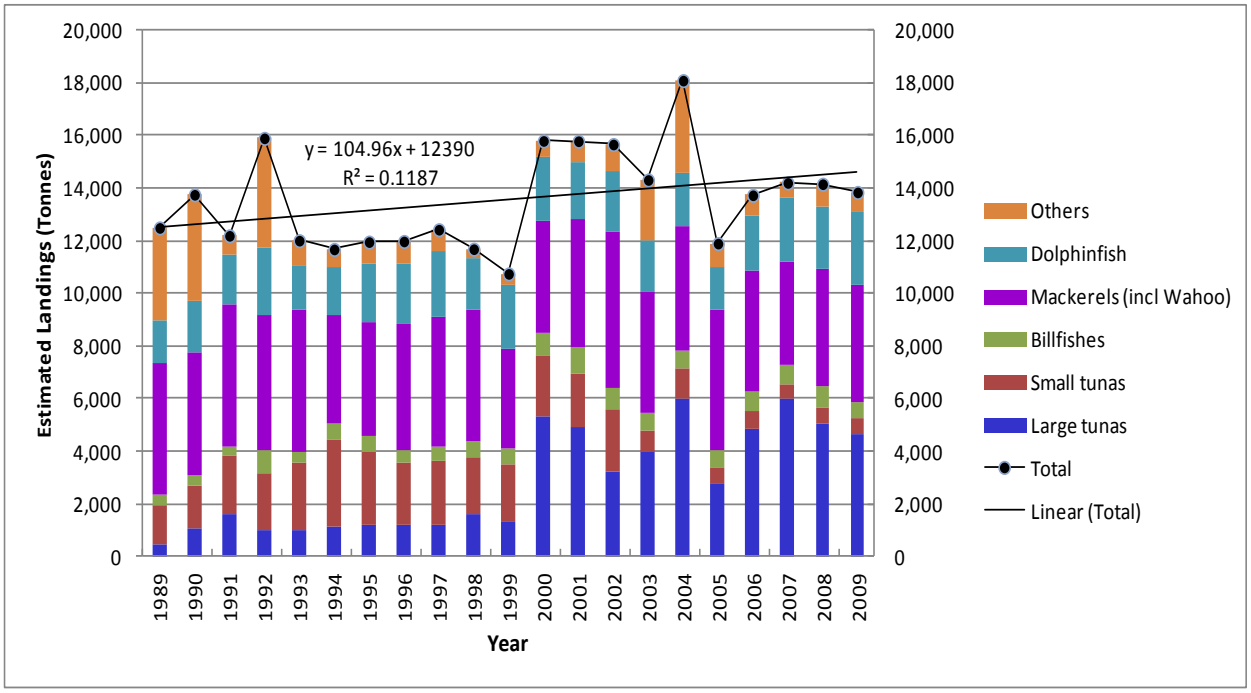

Figure 2: Estimated landings of large major pelagic species in the Eastern Caribbean over the period 1989 to 2009 – Source FAO FishStatJ

2.2 Trophic linkages of large pelagic species

In the context of an Ecosystem Approach to Fisheries the trophic linkages among large pelagic species and between large pelagic species and other species (some being inshore pelagic species as well as the pelagic larval state of some reef species) are critical to management decision-making, since several natural prey species are also targeted by fisheries (either as a source of food or bait) or may also feature as a component of the by-catch. Trophic linkages are also among the bio-ecological factors to be considered for a robust bio-economic assessment of recreational fisheries (CRFM, 2010b). The trophic linkages of the large pelagic species targeted by recreational fisheries were examined by Heileman *et al.* (2008), for the Lesser Antilles region based on an analysis of results of 131 studies (8% from the Lesser Antilles Pelagic Ecosystem) conducted as part of the LAPE Project. Marine living species were aggregated into functional groups based on similarities in distribution and diet (Mohammed *et al*., 2008).

Among the large migratory pelagics small squids comprise a significant component of the diet of Swordfish (45%), other billfishes such as Blue, White and Black Marlin, Sailfish and Longbill Spearfish (14.5%), Yellowfin Tuna (17.6%), mackerels such as Serra Spanish Mackerel, King Mackerel and Cero Mackerel (13.6 %), Wahoo (17.3%), the dolphinfish (8.35%), Albacore (9.08%) and Blackfin Tuna (13.8%). Large mesopelagic fish (Snake Mackerel, Longnose Lanternfish, Oilfish and Atlantic Pomfret) also feature significantly in the diets of Swordfish (14.2%), other billfishes (15.8%), Yellowfin Tuna (14%), Wahoo (20.5%), Albacore (48.3%), Bigeye Tuna (40.5%) and Blackfin Tuna (4.5%) while small mesopelagic fish (lanternfishes) are of importance in the diet of Albacore (8.87%) and Bigeye Tuna (11.1%). Small offshore pelagics (comprising juveniles of several pelagic species as well as juveniles of reef species in their pelagic state) appear of little importance in the diet of several large pelagic species but are of importance in the diet of mackerels (9.96%).

At least six prey species or groups were also of importance to commercial fisheries. Coastal predators (barracudas, large jacks and other related species) are targeted by artisanal commercial fisheries and also feature in the diet of Swordfish (12.6%), other billfishes (6.96%), Yellowfin Tuna (9%), mackerels (32%), dolphinfish (24.4%) and Blackfin Tuna (32.1%). Flyingfish is also a target species in artisanal and non-artisanal (iceboat) fisheries which, although of apparent little importance in the diet of Swordfish, Yellowfin tuna, Skipjack tuna, mackerels and Wahoo, features as an important prey of seabirds (7.45% of the diet), other billfishes (5.42%), dolphinfish (21.6%), Bigeye Tuna (25.6%) and Blackfin Tuna (8.38%). It is interesting to note that dolphinfish, a major species caught in pelagic commercial and recreational fisheries, exhibits a high level of cannibalism which accounts for 22.9% of the diet and that Skipjack Tuna, also a target species in commercial fisheries, comprises 13.1% of the diet of other billfishes and 9.76% of the diet of Yellowfin Tuna. Although small coastal pelagics (scads, herrings, sardines, and other similar species) which are caught mainly in commercial beach seine (for human consumption) and bait fisheries feature in the diet of most large pelagic species, the contribution amounts to less than 4% of the diet in each case. Other offshore predators (Atlantic Bonito, bullet tunas, Little Tunny and triggerfish) which are also targeted by commercial fisheries feature in the diet of mackerels and Bigeye Tuna but account for less than 4% in each case.

Pelagic sharks (thresher sharks, mako sharks, Blue Shark, Porbeagle, hammerhead sharks, Silky Sharks, Tiger Sharks, Blacktip Sharks, Oceanic Whitetip, Sandbar and Spinner Sharks) are common predators of most large pelagic species while other billfishes, mackerels, Wahoo and Common Dolphinfish exhibit cannibalism on their young. Swordfish, Bigeye Tuna and Skipjack Tuna are major predators of other billfishes and along with this group are also predators of Yellowfin Tuna, mackerels, Wahoo, dolphinfish and Albacore. Yellowfin tuna are major predators of mackerels, Wahoo, dolphinfish and Albacore, and along with Swordfish, other billfishes and Skipjack Tuna also consume Bigeye and Blackfin tunas. Mackerels have a wide range of predators which apart from those already listed include Wahoo, dolphinfish, Baleen Whales, coastal predators and small squid. Mackerels and dolphinfish are also predators of Wahoo.

3. BACKGROUND AND EVOLUTION OF THE FISHERY

Little is officially documented on the background and evolution of recreational fisheries in the Eastern Caribbean. Popular historical accounts of fisheries in the region such as those published in the Development and Welfare Bulletin of the early 1940s and accounts of the UNDP / FAO Caribbean Fishery Development Project in the late 1960s to early 1970s make little, if any mention, of recreational fisheries. The most recent documented regional development is establishment of the Southern Caribbean Billfish Circuit (SCBC) on January 18th, 2008. This "Circuit" was conceived by a group of enthusiastic fishers during the Spice Island Billfish Tournament in Grenada, aboard the Saint Lucian vessel, Grey Ghost. The SCBC comprises six major fishing associations from Barbados, Grenada, Martinique, St. Lucia, Tobago and Trinidad and Tobago (SCBC website, accessed 16 July 2012). It seeks to harmonize the plans, rules and regulations pertaining to fishing tournaments targeting billfish in the Southern Caribbean. The main objectives of the SCBC are to: encourage the development of fishing as a sport; assist in conservation of marine resources; co-operate with other organizations with similar objectives; promote legislation for conservation of piscatorial and other maritime affairs; promote all such causes that are incidental or conducive to the above objectives; and to promote camaraderie and competition among various 'Circuit' members.

In Barbados, fishing 'for fun' is noted as a pastime for those commercial fishers who would have improved their financial and social status (Peirce, 2009), though many Barbadians spend their off-days from work fishing to provide food for their families or to assist in the payment of bills. Although the industry has a long history, sport fishing was formally established in 1961 when a group of local

enthusiasts formed the Barbados Game Fishing Club and focused on organizing all game fishing tournaments, first nationally, and internationally since 1990. The associated marina is based at Port St Charles. The Club was eventually renamed the Barbados Game Fishing Association (BGFA) and is affiliated with the International Game Fishing Association and the National Sports Council. The main objectives of the BGFA are to: promote and encourage the art of rod and reel fishing; organize and supervise game fishing tournaments throughout the year; accumulate data and keep records on fish and fishing and promote and encourage conservation of fish and marine life (http://barbadosgamefishing.com/). As at 2009, the BGFA consisted of 235 members (Peirce, 2009).

In Grenada, although recreational fishing is recognized as having a long history, the organization of recreational (sport) fishing tournaments and application of rules consistent with those of the International Game Fishing Association began in 1964. This venture was pioneered by Mr James Needham, an American who migrated to Grenada and who owned the popular Flambouyant Hotel, assisted by Mr Martin Mathias, a US national and Mr Louis Rostant, Managing Director and Founder of TATIL Insurance Ltd. [4] In the late 1960s Grenada held the men's and women's world record for yellowfin tuna caught on rod and reel, the pictorial evidence being housed at the Grenada National Museum. Although in the 1960s and 1970s all billfish caught were killed, due to the conservation drive pioneered by Mr Sid Johnson, an avid sport fisher and conservationist from Trinidad, almost all billfish caught at tournaments are now released alive with points awarded for blue marlin (under 226.8kg) and white marlin or sailfish (under 27.22 kg).

In Saint Lucia recreational fishing began around the 1950s (De Beauville-Scott, 1994). Since then the fishery has developed both for recreational and business purposes. In 1994 at least five families depended on the fishery as a source of income. The Saint Lucia Game Fishing Association was established in 1972 (then known as a fishing club) with 12 members, its membership having increased to 66 persons by 1994. The Association organizes all fishing tournaments in Saint Lucia, both formal and informal. Informal tournaments are timed to coincide with national holidays such as Independence Day, Whit Monday and National Day occurring in February, May and December while the major tournament is held at the beginning of October. These tournaments target regional pelagic species such as dolphinfish, tuna, kingfish, wahoo, barracuda and small sharks.

The earliest available account of recreational or sport fishing in Trinidad and Tobago is provided by Vincent (1910). The author provided detailed accounts of the available species and described their seasonality and popular fishing areas. Although recreational fishing has continued since, the next known written account of the activity in Trinidad is from Mike (1993) who conducted an analysis of the fishery off the northwestern peninsula, followed by Shoy (2010) who attempted to repeat the 1993 study. Recreational charter boat fishing operations began some twenty-five years ago, mainly in Tobago as a consequence of hotels requesting such services for their guests[5]. The operations started with the use of pirogues but have progressed to more highly powered boats commonly referred to as "sport fishers". The industry experienced a boom about seventeen years ago due to demands from expatriates and persons working in the petroleum industry seeking extra-curricular activities. Currently, the industry is supported by tourists, expatriates, and wealthy locals.

3.1 Catches and Landings

Data on catches or landings (in cases where fish are released) were obtained from the Game Fishing Associations, organizers of game fishing tournaments, the Fisheries Departments or charterboat fishing companies of the respective countries where available.

[4] Richard McIntyre, Organizer of the Spice Island Billfish Tournament (pers. com.)
[5] Gary Story, Southern Caribbean Charters Ltd. (pers. com.)

Antigua and Barbuda

Time series data on recreational catches were not available. Fishing tournaments are organized by the Antigua and Barbuda Sport Fishing Club. These tournaments include the one-day Francis Nunez Jr. Fishing Tournament which commenced in 2010 and is convened at Nelson's Dockyard, English Harbour, the one-day Best in the West Tournament which is convened at Fullers Dock in Jolly Harbour and the Annual Antigua and Barbuda Sport Fishing Tournament which commenced in 1967 and is convened at Nelson's Dockyard, English Harbour (Antigua and Barbuda Sport Fishing Club, 2012). An internet search in July 2012 identified three charterboat fishing companies in Antigua and Barbuda. Due to time limitations acquisition of catch or landings data from these companies was not pursued.

Barbados

Information on catches of the recreational fleet in Barbados is sparse. There is no official recording system for catches of the recreational fishery however; the Barbados Game Fishing Association keeps records of all fish landed during tournaments, the data in earlier years being aggregated across all billfish species. Detailed information for 2008, as well as data on the number of billfish caught between 2005 and 2012 (note that most billfish are released) were provided, however, time series data on landings of other species were not available at the time of this study. A review of ICCAT Task I Database identified 0.541t of blue marlin, 1.622t of Sailfish and 3.245t of White Marlin landed by the sport fishery using handlines and rod and reel in 2010. Oxenford (1994) provided statistics on billfish catches in Barbados between 1987 and 1992, based on data from both commercial catches and game fishing tournaments, but did not disaggregate the estimated total landings by the respective fleets. Mohammed *et al*., (2003) reconstructed catches using data from the Barbados Game Fishing Association, for fishing tournaments held between 1992 and 2001, which were available at the Barbados Fisheries Division (Table 1). Records prior to 2000 give details on individual fish weights by species, with a total weight for those fish below the size limit by species, while records since 2000 document only the weights of those fish meeting the minimum weight criteria for the competition along with information on the total number of fish caught by each boat. The major species caught are Common Dolphinfish and Wahoo. Common Dolphinfish accounted for between 32% and 67% of the reconstructed annual total catch while Wahoo accounted for between 20% and 53%. The three species of billfishes combined accounted for between 7% and 36% of the reconstructed annual catch over the ten year period. Excluding data for 2000 and 2001, due to the limitations explained above, there appeared a considerable decline in catches between 1996 (11.6 tons) and 1999 (2.4 tons).

Table 1: Catches from recreational fishing tournaments ((a)1992 to 2001 and (b) 2005 to 2012

(a) Catches for 1992 to 2001 in tonnes - Source: Mohammed *et al*., 2003a

Year	Common Dolphin-fish	Wahoo	Sailfish	White Marlin	Blue Marlin	Yellowfin Tuna	King Mackerel	Other pelagics	Total
1992	6.21	3.62	0.32	0.08	0.40	0.12	-	0.04	10.79
1993	2.82	4.26	0.18	0.10	0.59	0.01	-	0.03	7.99
1994	3.42	1.99	0.15	0.03	0.47	0.19	-	0.05	6.30
1995	4.11	3.58	0.07	0.08	0.75	0.18	-	0.13	8.89
1996	5.33	4.88	0.05	0.04	1.06	0.08	0.02	0.11	11.58
1997	3.84	1.15	0.29	-	0.35	0.08	-	0.01	5.72
1998	1.79	0.70	0.11	0.02	0.32	0.06	-	0.01	3.02
1999	1.18	0.96	0.07	-	0.10	0.05	-	0.02	2.37
2000	0.54	0.44	0.05	0.02	0.43	0.04	-	0.13	1.66
2001	0.81	0.48	0.05	0.07	0.70	0.17	-	-	2.3

(b) Catches for 2005 to 2012 in number of fish - Source: James Peirce, Secretary, Barbados Game Fishing Association – Note that most billfish are released

Year	Blue	White	Sailfish	Spearfish					Total

Table 1: Catches from recreational fishing tournaments ((a)1992 to 2001 and (b) 2005 to 2012									
(a) Catches for 1992 to 2001 in tonnes - Source: Mohammed *et al*., 2003a									
Year	**Common Dolphin-fish**	**Wahoo**	**Sailfish**	**White Marlin**	**Blue Marlin**	**Yellowfin Tuna**	**King Mackerel**	**Other pelagics**	**Total**
	Marlin	**Marlin**							
2005	8	3	7	0					18
2006	22	0	0	0					22
2007	36	6	4	3					49
2008	36	2	3	4					45
2009	27	0	1	1					29
2010	24	7	0	2					33
2011	12	7	11	1					31
2012	8	1	9	0					18

Catches at the nine offshore fishing tournaments convened in 2008 were estimated at 3,182 kg, comprising 669 kg of Blue Marlin (3 fish), 16.3 kg of Sailfish (1 fish), 1,259 kg of Wahoo (185 fish) and 1,238 kg of Common Dolphinfish (182 fish), (Peirce, 2009). During this tournament 30 billfish were caught and released (27 Blue Marlin, one Sailfish and two Spearfish) and several Wahoo and Common Dolphinfish were caught. This international tournament is a qualifying event for the Offshore World Championship usually convened by the International Game Fishing Association.

Peirce (2009) asserts that catches from recreational fishing in Barbados impact negligibly on fish population numbers. He noted that during the offshore fishing season (January to April), fishing vessels fish once per weekend, resulting in a total of 16 trips throughout the season; with an average catch of 20 fish weighing about 123 kg, though on a good day up to 50 fish may be caught per boat and on a bad day no fish may be caught.

In 2009 there were eight charter boats involved in recreational fishing in Barbados (Peirce, 2009), and an internet search in July 2012 identified five charter boat fishing companies involved in this activity on a commercial basis. Due to time limitations acquisition of catch or landings data from these companies was not pursued.

Grenada

The Spice Island Billfish Tournament is the highlight of the sportfishing subsector in Grenada. This tournament was first convened in 1964, and annually subsequently except for the revolution years. It attracts boats from neighbouring islands and anglers from around the world (http://www.sibtgrenada.com/index.htm). Sponsored mainly by Budget Marine, this tournament is convened at the Grenada Yacht Club in St Georges, over a three-day period usually in January of each year. Like the international tournament convened in Barbados, this tournament is also a qualifying event for the Offshore World Championship. The tournament organizers, comprising twelve members, routinely collect data on the weight of each fish caught and landed by species, the overall number of anglers and number of boats participating and the number of fishes tagged and released by species. However, these data have only recently been computerized (since 2010) and only fish that are brought to the scale are weighed. Data between 2004 and 2010 are available in hard copy only while data prior to 2004 were destroyed during Hurricane Ivan.

A search of the ICCAT Task I Database did not identify any catches from the sport (recreational) fishery in Grenada, possibly due to the fact that the Fisheries Department has not yet extended its data collection programme to include recreational fisheries. Estimates of total annual landings from 1992 to 1998

(Mohammed and Rennie, 2003) and from 2004 to 2012 (based on data provided by organizers of the Spice Island Billfish Tournament) are provided in Table 2. Estimated landings have increased from 1226 kg in 2004 to 2059 kg by 2012. Generally, the landed catch is comprised mainly of Yellowfin Tuna, Common Dolphinfish, Wahoo and Blue Marlin. However, data in earlier years suggest that Sailfish and White Marlin were more prominent in the landings and Yellowfin Tuna less important compared to the more recent period. The decline in landings of sailfish and white marlin between 2004 and 2012 is likely due to increasing efforts to tag and release such fish.

An internet search in July 2012 identified three charterboat fishing companies, each operating one vessel. Landings data from 2003 to 2011 were available for one vessel (Table 3). Estimated annual landed catches varied between 582 kg (2004) to 1,663 kg (2007). Average annual total catch was 927 kg, comprising mainly of Yellowfin Tuna (39%), Common Dolphinfish (34%) and Wahoo (26%). Given that the other two active sport fishing boats operate at 75% and 40% the level of the vessel examined in detail in this report and assuming that landings are similarly proportioned the estimated combined landings in 2011 is only 810 kg for the three vessels.

Table 2: Estimated weight (kg) of fish landed annually at the Spice Island Billfish Tournament (1992 to 1998 and 2004 to 2012)

Year	Yellowfin Tuna	Common Dolphinfish	Wahoo	Blue Marlin	White Marlin	Sailfish	Total
1992	0	***n.a.***	***n.a.***	50	360	2800	3210*
1993	60	***n.a.***	***n.a.***	230	190	1840	2320*
1994	130	***n.a.***	***n.a.***	400	20	870	1420*
1995	60	***n.a.***	***n.a.***	230	50	1200	1540*
1996	0	***n.a.***	***n.a.***	50	80	1530	1660*
1997	0	***n.a.***	***n.a.***	320	50	1170	1540*
1998	0	***n.a.***	***n.a.***	590	20	820	1430*
……	……	……	……	……	……	……	……
2004	486	***177***	***261***	157	27	117	1225
2005	761	25	217	0	0	0	1003
2006	74	***354***	***87***	659	0	0	1174
2007	325	***139***	***58***	480	0	3	1005
2008	***715***	***25***	***15***	190	0	0	945
2009	130	192	94	201	0	0	617
2010	811	359	***174***	378	0	0	1722
2011	1007	471	445	0	0	0	1923
2012	993	779	286	0	0	0	2058

Estimates from 1992 to 1998 were taken from Mohammed and Rennie (2003) and from 2004 to 2012 were based on data provided by organizers of the Spice Island Billfish Tournament;

n.a. – not available; * - underestimates due to absence of Common Dolphinfish and Wahoo in the records as well as non-representation of fish retained but not brought to the scale.

Estimates between 2004 and 2005 are derived as the product of number of fish (provided) and average fish weight, assuming that the average weight of individuals of each species brought to the scale is the same for those which were retained but not brought to the scale; Estimates in bold text and italicized were derived similarly but assuming the same average fish weight for the species in 2005; Estimates in shaded cells were derived as the average of landings in the years immediately preceding and following the respective year for the respective species.

Table 3: Estimated annual weight (kg) of fish landed by one fishing charterboat in Grenada (2003 to 2011)

Year	Yellowfin Tuna	Common Dolphinfish	Wahoo	Blue Marlin	White Marlin	Sailfish	Total
2003	610.0	***157.8***	***121.5***	0.0	0.0	0.0	889.3
2004	218.8	144.1	218.8	0.0	0.0	0.0	581.6
2005	237.3	130.3	316.0	0.0	0.0	0.0	683.6
2006	195.0	349.8	260.9	0.0	0.0	0.0	805.7
2007	427.3	886.3	229.1	120.0	0.0	0.0	1662.7
2008	539.1	278.9	75.0	0.0	0.0	0.0	893.0
2009	357.3	445.0	364.1	0.0	0.0	0.0	1166.3
2010	371.8	385.8	201.6	0.0	0.0	0.0	959.1
2011	231.4	286.4	186.8	0.0	0.0	0.0	704.5

Estimates are derived as the product of number of fish (provided) and average fish weight, assuming that the average weight of fish landed is the same for non-landed fish of the same species; Estimates in bold text and italicized were derived similarly but assuming the same average fish weight for the species in 2005; Estimates in shaded cells were derived as the average of landings in the years immediately preceding and following the respective year for the respective species

Saint Lucia

A formal, international billfish tournament is convened annually in October since 1972. This four-day tournament is organized by the St Lucia Game Fishing Association which comprised 15 members as at January 2012. De Beauville-Scott (1994) noted that, as at 1994 there was no system for accurate data collection on the fishery. She indicated that Blue Marlin was the most common species caught, with Sailfish being less abundant and White Marlin the least at the international tournament. The species composition of the catches from the annual billfish tournaments between 1991 and 1994 was 41.5% Blue Marlin; 17.9% Common Dolphinfish; 15.1% Sailfish; 11.3% barracuda; 7.5% tuna; 5.7% King Mackerel and Wahoo and 0.9% mackerel (De Beauville-Scott, 1994).

Reconstructed annual catches from tournaments between 1991 and 2000 are provided in Table 4 (Mohammed and Joseph, 2003). Blue marlin accounted for the majority of the catch (84.3%), while sailfish, tunas and barracudas accounted for 4.6%, 3.0% and 3.9% respectively. Wahoo, Common Dolphinfish, spearfish and mackerels accounted for only 2.1%, 1.9%, 0.2% and 0.3% of the total catch respectively. In respect of more recent catch data from the annual billfish tournaments the Saint Lucia Game Fishing Association has indicated that data have been recorded since 2005 but the data were not made available for this study.

Table 4: Reconstructed annual catches (kg) from fishing tournaments in Saint Lucia (1991 to 2000) Source: Mohammed and Joseph, 2003 (figures converted from tonnes to kg)

Species	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Blue Marlin	1,060	480	480	1,170	1,660	2,160	1,440	720	800	540
Sailfish	70	30	30	80	70	60	60	70	50	50
Wahoo	10	10	10	20	20	20	20	60	60	30
Common Dolphinfish	50	20	20	50	30	10	10	10	30	10
Spearfish	-	-	-	-	-	-	-	20	-	-
Tunas	60	30	30	60	60	50	50	40	-	-
Barracuda	160	70	70	180	-	-	-	-	-	-
Mackerel	10	10	10	10	-	-	-	-	-	-
TOTAL	1,430	640	640	1,570	1,840	2,250	1,600	920	940	630

Estimates of annual landings of Northern Bluefin Tuna, believed by a regional expert[6] to be mis-identified Blackfin Tuna, caught with handlines and rod and reel, from 1987 to 1995 were 1,000; 3,000; 2,000; 14,000; 14,000; 14,000; 2,000; 43,000 and 9,000 kg respectively according to the ICCAT Task I Database. This database also provides estimates of annual landings for Blue Marlin caught with the same gear from 1997 to 1998 (3,500 and 1,000 kg respectively) and 2000 to 2001 (10,300 and 4,600 kg respectively).

In addition to the main billfish tournament there is also the Michael Hackshaw Memorial tournament organized by Captain Mike's[7] as well as fishing expeditions, the timing and frequency of which are informed by the level of tourist visits. These expeditions are conducted by charter boats. An internet search in July 2012 identified six charter boat fishing companies. Due to time limitations acquisition of catch or landings data from these companies was not pursued.

Trinidad and Tobago

Catches of the recreational fishery are not well documented except for landed catches at sport fishing tournaments. In respect of fishing outside of the tournament, Mike (1993) examined aspects of the recreational fishery operating from the northwestern peninsula of Trinidad. He provided statistics on the catch per trip and overall catch per year (range and average) for each fishing method based on the respective fishers' estimates. Average catch per trip with the use of a-la-vive[8] gear was 70.42 kg, but this ranged between 10.9 and 454 kg. He noted that 42.8% of the catches were less than 23 kg. Correspondingly, the average catch per trip with the use of troll gear was 36.2 kg, but this ranged between 4.7 and 139 kg, with 45% of the fishers catching less than 23 kg. Based on the fishers' estimates of their total catch per year Mike (1993) estimated the overall catch of the recreational fishery in 1993 as 1,231 tonnes, of which 491 and 331 tonnes were from a-la-vive and trolling respectively.

Although Mike (1993) did not disaggregate the total catch into the respective species he provided the details of catches by species from twelve fishers who used a-la-vive. If the catches of these fishers are representative of the recreational fishers in general then the species composition of the 1993 catch from a-la-vive is estimated as 51.2% King Mackerel; 44.6% Serra Spanish Mackerel; 2.8% Crevalle Jack; 0.98% Guachanche Barracuda and 0.41% tuna. Similarly, catch details were provided for 23 fishers who used troll gear and the estimated species composition of the catch is 39.3% King Mackerel; 21.7% Wahoo; 19.9% Serra Spanish Mackerel; 6.7% billfish; 5.8% Crevalle Jack; 5.4% tuna; 0.8% Guachanche Barracuda and 0.3% Common Dolphinfish. Using the estimates of species composition and total catches for the respective gears (822 tonnes from trolling and a-la-vive) the total catch in 1993 of the respective species from the recreational fishery off the northwest peninsula, is estimated as: 381 tonnes King Mackerel; 72 tonnes Wahoo; 285 tonnes Serra Spanish Mackerel; 22 tonnes billfish; 33 tonnes Crevalle Jack; 20 tonnes tuna; 8 tonnes Guachanche Barracuda and one tonne Common Dolphinfish.

Shoy (2010) attempted to repeat the 1993 study. She provided statistics on the average catch per trip but without details on the gear type and number of trips per year it is difficult to estimate the overall catch. The average catch per trip for the respective species was as follows: 22.7 kg of Serra Spanish Mackerel; 8.6 kg of Guachanche Barracuda; 23.9 kg of Atlantic Bonito; 38 kg of King Mackerel; 40.5 kg of tuna; 23.9 kg of Crevalle Jack; 64.5 kg of Wahoo; 41.1 kg of Common Dolphinfish and 27 kg of jack (unspecified). Shoy (2010) noted that 43% of the fishers interviewed did not respond to the related question, however, many expressed concern that they caught less than what was caught 10 to 15 years ago

[6] Susan Singh-Renton, CRFM Secretariat Deputy Executive Director (pers. com.)
[7] Annie Hamu, Saint Lucia Game Fishing Association (pers. com.)
[8] Pelagic line set with live bait

and that the size of fish caught was now smaller with a considerable increase in fishing effort to catch the species and sizes desired.

Fishing tournaments are organized mainly by the Trinidad and Tobago Game Fishing Association (TTGFA). This Association was established in October 1986, its founders being avid sport fishers and marine environmentalists. The TTGFA's main objectives are to encourage the development of fishing as a sport, to assist in the conservation of marine resources and to cooperate with other organizations with similar objectives, to assist in the dissemination of related information and to promote legislation in conservation and maritime affairs (http://ttgfa.com). Currently the Association comprises 210 members, who operate from 65 vessels (30 pirogues, 20 cabin cruisers and 15 sport fishing boats). The Association collects data on fish brought to the scale at fishing tournaments but data have only been computerized for 2005[9].

3.1.1 Landings from fishing tournaments

At least seven tournaments are convened annually. These tournaments include the International Billfish Fishing Tournament, Kingfish tournament, Wahoo tournament, Junior Anglers' tournament, Funfish Tournament and Tarpon tournament which are organized by the Trinidad and Tobago Game Fishing Association and the Charlotteville Tournament (International Game Fishing Tournament) organized by a group of recreational fishing enthusiasts in Tobago. Details of these tournaments are as follows:

1. The International Billfish Fishing Tournament commenced in 1981 (data available at the Fisheries Division) and is convened annually between March and April, over three days, at Pigeon Point, Tobago. The tournament attracts both local and foreign recreational fishers and vessels.
2. The Kingfish (King Mackerel) tournament commenced in 1993 (data available at the Fisheries Division for informal sessions in 1991 and 1992), and is convened annually between June and July, over two days, at the Trinidad and Tobago Yacht Club, Glencoe. This tournament is local in nature, i.e. it does not attract foreign participation.
3. The Wahoo tournament commenced in 1993 (data available at the Fisheries Division from 1999) and is held between February and March each year, over two days, at the Trinidad and Tobago Yacht Club, West Moorings. Like the Kingfish tournament this tournament is limited to local participation.
4. The Junior Anglers tournament commenced in 1990 (data available at the Fisheries Division from 2008; 2009 data not available) and targets all species of fish. The tournament is held annually between June and July, over one day, at the Trinidad and Tobago Yacht Club, West Moorings. This tournament in particular serves to get the young anglers involved so as to build their fishing skills.
5. The Funfish tournament began in 1990 (data available at the Fisheries Division for 1991 to 1998) and like the Junior Anglers Tournament targets all species of fish. The tournament is convened annually in November over one day, at the Trinidad and Tobago Yacht Club, West Moorings. The tournament is limited to local participation.
6. The Tarpon tournament commenced in 2006. The Fisheries Division has no data on this tournament, however, all tarpon caught are released (i.e. no fish is landed). The tournament is convened annually in August over three days, at the Sweet Water Marina, Chaguaramas. Since Tarpon is a coastal species it is not of significance to this study, however, many recreational fishers in northwest Trinidad see development of the recreational fishery for tarpon as a tremendous opportunity for the sector given the worldwide demand for this type of recreational experience which is claimed to be unique to Trinidad.

[9] Marilyn Sheppard, Vice President, TTGFA (pers. com.)

7. The Charlotteville Tournament (Tobago International Game Fishing Tournament) commenced in 1986 (data available at the Fisheries Division for informal session in 1985) and is convened annually between March and April, over three days, at the Man-o-War Bay in Charlotteville, Tobago. It comprises two competitions held in parallel for international and local categories respectively. This tournament attracts local and foreign recreational fishers and vessels.

The catch or landing statistics from tournaments convened in Trinidad and Tobago were provided by the Fisheries Division which records data on: species landed; area fished; number of anglers; number of lines; boat name; species length and species weight. These data however, have not been collected from inception of the respective tournaments, nor for all years when tournaments were convened. For tournaments between 1981 and 2002 data were available on landings of certain species only (Common Dolphinfish, King Mackerel, Wahoo and Blackfin Tuna). In addition, the data do not include the species and weight of fish which anglers may keep on board their vessels. Consequently the data are considered underestimates of catches from fishing tournaments for the respective years.

Table 5 indicates the Fisheries Division's data coverage of the six fishing tournaments (note that tournaments commenced at different times) convened between 1981 and 2011. In cases where only fish length was measured the parameters in the relationship between fish length and weight (sub-section 3.2) were used to estimate the corresponding weight. The International Billfish Tournament convened in Tobago has realized the greatest landings (24,730 kg) over the period, understandably so as it is the longest running tournament, followed by the Wahoo tournament (15, 405 kg), the Funfish Tournament (7,004 kg), the Charlotteville tournament (6,666 kg), the Kingfish tournament (6,232 kg) and the Junior Angler's Tournament (1,241 kg). In respect of the species composition of the respective landings over the thirty-one year period, Common Dolphinfish and Wahoo combined accounted for 79%, Common Dolphinfish accounted for 33.4% and Wahoo for 45.6%, while King Mackerel accounted for only 11.2% and all tunas combined (tuna species not identified in some cases) accounted for only 3.2%.

Table 5: Cumulative landings (kg) at six fishing tournaments convened in Trinidad and Tobago (1981 to 2011)

Tournament Name	CT	FT	JAT	KT	TIBT	WT	Total
Atlantic Sailfish	92				179		**271**
Blue Marlin	618				1,770	156	**2,544**
Yellowfin Tuna	966				129	41	**1,136**
Bigeye Tuna				6		14	**19**
Blackfin Tuna	66	109		7	107	25	**313**
Atlantic Bonito			288	20		16	**324**
Tunas (unid)						127	**127**
Common Dolphinfish	2,321	383	3	274	16,778	688	**20,447**
Wahoo	2,041	6,067		328	5,733	13,769	**27,938**
King Mackerel		445	590	5,321	26	480	**6,863**
Serra Spanish Mackerel			143	3			**146**
Shortfin Mako	39						**39**
Crevalle Jack			114	246		70	**430**
Others	524		103	28	7	19	**681**
Total	**6,666**	**7,004**	**1,241**	**6,232**	**24,730**	**15,405**	**61,278**

CT: Charlotteville Fishing Tournament; FT: Funfish Tournament; JAT: Junior Anglers' Tournament; KT: Kingfish Tournament; TIBT: Tobago International Billfish Tournament; WT: Wahoo Tournament

Figure 3 (top) indicates the landings at all fishing tournaments between 1981 and 2011 disaggregated by species. Blackfin Tuna, Bigeye Tuna, Atlantic Bonito, Yellowfin Tuna and all unidentified tunas were grouped into one overall "Tunas" category. Likewise Serra Spanish Mackerel, King Mackerel and Wahoo were all grouped under the "Mackerels" category. The category "Others" includes barracudas, Cobia, Bull Shark, grouper, Jewfish, Rainbow Runner, snappers, Southern Red Snapper, Yellowedge Grouper, Leatherjack, Crevalle Jack and Mako Shark. As indicated previously, mackerels (King Mackerel, Wahoo and Serra Spanish Mackerel) and Common Dolphinfish make up the major component of the landings in most years. Trends in annual landings at fishing tournaments (Figure 3 - bottom) confirm the importance of mackerels and Common Dolphinfish to the recreational fishery in Trinidad and Tobago. As is generally observed for pelagic species landings varied from year to year, ranging between 23 kg in 1995 to 4,389 kg in 2002, the annual average landings being 1,127 kg over the period examined. Annual landings of Common Dolphinfish varied between 53 kg in 1985 and 2,212kg in 1990, the annual average being 660kg. Landings of other species groups were below 800kg in any given year.

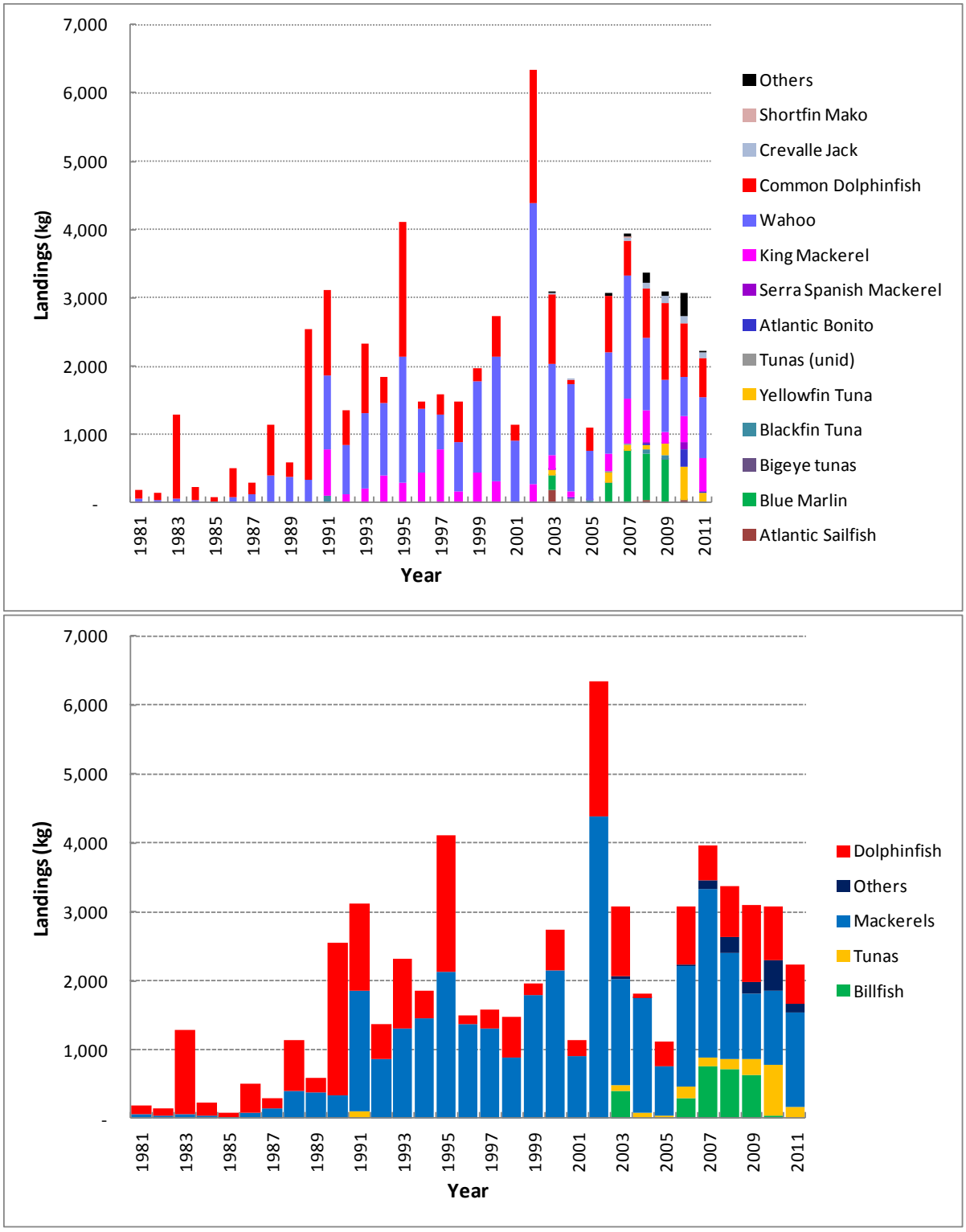

Figure 3: Landings (kg) at fishing tournaments convened in Trinidad and Tobago (1981 to 2011) – (top) landings by species; (bottom) landings by species groups – Sourse: Fisheries Division, Ministry of Food Production, Land and Marine Affairs

3.1.2 Landings from Charter boat Fishing Operations

Charter boat fishing operators in Tobago service mainly the tourism industry while the clientele of those in Trinidad is mainly corporate in nature. Landings from charter boat fishing operators were based on interviews of four vessel owners/operators. These operators do not keep records of their catches so the data were based on their recollection of activities the previous year. In Tobago two charter boat fishing operators target offshore pelagics (the other charter boats targets coastal and reef species), both of whom were interviewed and in Trinidad two operators (using vessels of the sport fisher type) were interviewed, one owned two vessels but responded in respect of one. Total landings from the four vessels are estimated at 13,616 kg per year, with Wahoo and dolphinfish being most prevalent (Table 6). However, if one considers that there are three other charter boat fishing vessels (sport fisherman type) operating full-time in Trinidad, and using an average landings per year per vessel of 3,404 kg, derived from the two interviews and assuming similar levels of fishing activity, then the estimated overall average annual landings from the seven charter boat fishing operators targeting large pelagic species in Trinidad and Tobago are 23,828 kg.

Table 6: Estimated landings (kgs) of fish from four charter boat fishing operators in Trinidad and Tobago.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Barracuda	45	45	45	45	45	45	45	45	45	45	45	45	545
Dolphinfish	534	534	561	343	343	130	84	50	50	50	216	261	3,157
King Mackerel	98	98	98	120	120	250	250	250	250	120	98	98	1,850
Wahoo	932	1,000	841	795	727	68	-	-	-	68	705	886	6,023
Tunas	273	273	291	291	191	55	55	-	34	170	193	216	2,041
Total	1,882	1,950	1,836	1,595	1,427	548	434	345	380	455	1,257	1,507	13,616

Tunas include Blackfin Tuna, Yellowfin Tuna as well as some unidentified tuna species.

In addition to the species listed in Table 6 several other species are caught incidentally. These species include “hatchet marlin” (identity uncertain), Spearfish, Mako Shark and Silky Shark in Tobago and Crevalle Jack, Blacktip Shark and Atlantic Bonito in Trinidad.

Most Sailfish and Blue Marlin are released when caught. In Tobago one operator indicated that about 227 kg of billfish may be caught each month between January and April and 114 kg each month between November and December. The other operator noted that about 6 Blue Marlin are caught between October and December, 10 fish between January and February and 20 fish between March and May; on average about 16 to 79 billfish in general may be caught and released per year; with each Blue Marlin weighing between 80 and 91 kg. With respect to Sailfish, one operator in Tobago indicated that about 20 Sailfish are caught between October and May. One operator in Trinidad indicated that about 4 Sailfish may be caught per month between November and April while the other noted that the species is caught in December, January and February where about one fish is caught per month, averaging between 18 and 32 kg.

In Trinidad the two operators interviewed also target the Tarpon fishery and follow a strict catch and release philosophy. One operator estimated that 2 to 6 fish are caught per trip between October and November, each weighing between 46 and 91 kg and 5 to 15 fish are caught per trip between May and September, each ranging between 6 and 114 kg. The other operator estimated that 3 fish are caught per month from January to May and September to December and 12 to 15 fish are caught over 4 to 5 hrs of fishing per day, for about 12 days per month between June and August with small fish ranging between 11 and 14 kg and large fish between 46 and 91kg.

One operator in Trinidad caught Crevalle Jack incidentally. These fish are caught between May and September using live bait. About 40 to 100 fish may be caught per trip, each weighing between 4 and 9 kg. Catches are about half this amount during the months of October to December and March to April.

3.2 Sizes of fish caught

The Fisheries Division, Trinidad, also records the length of each fish by species brought to the scale, or caught but not brought to scale. The size ranges, as well as parameters in the relationship between fork length and weight, of the major fish species caught at the six tournaments in Trinidad and Tobago are given in Table 7. The parameters are used to estimate the corresponding fish weights in instances when the weight of fish was not recorded (as may be the case if the fish is not brought to scale, due to size restrictions associated with tournament rules) but the fish length is still measured by the Division.

Table 7: Parameters in the relationship between length and weight of seven fish species caught at fishing tournaments in Trinidad and Tobago (FL – fork length; weight in kg)

Species Common Name	Scientific Name	Sex	Length Type (cm)	Length Range (cm FL)	Equation: $W = aL^b$	R^2	N
King Mackerel	*Scomberomorus cavalla*	Mixed	FL	32 – 144	$W = 8.953 \times 10^{-6} L^{2.952}$	0.946	636
Serra Spanish Mackerel	*Scomberomorus brasiliensis*	Mixed	FL	35 – 75	$W = 4.14 \times 10^{-5} L^{2.561}$	0.764	102
Common Dolphinfish	*Coryphaena hippurus*	Mixed	FL	45 – 162	$W = 1.641 \times 10^{-4} L^{2.362}$	0.593	546
		Females	FL	61 – 136	$W = 5.728 \times 10^{-5} L^{2.573}$	0.814	230
		Males	FL	80 -162	$W = 1.524 \times 10^{-5} L^{2.878}$	0.85	131
Wahoo	*Acanthocybium solandri*	Mixed	FL	69 – 180	$W = 6.823 \times 10^{-6} L^{2.989}$	0.788	712
Crevalle Jack	*Caranx hippos*	Mixed	FL	31 – 83	$W = 2.286 \times 10^{-5} L^{2.93}$	0.924	96
Yellowfin Tuna	*Thunnus albacores*	Mixed	FL	42 – 122	$W = 2.506 \times 10^{-5} L^{2.916}$	0.985	74

4. SOCIO–ECONOMIC CONSIDERATIONS

4.1 Fate of the catch

Catches from recreational fishing may be retained by anglers, donated to charity, sold to cover fishing trip costs or as an added source of income, tagged and released or released. There appears to be no enforced restrictions in respect of the sale of fish caught recreationally in the region. There is a growing trend towards the release of billfish as the respective game fishing associations become more conservation-oriented. The Fisheries Departments of Trinidad and Tobago and Grenada have had the benefit of working closely with the Billfish Foundation in promoting sustainable fishing practices (tag and release or catch and release programmes). The game fishing associations work closely with the Billfish Foundation and the International Game Fishing Association to ensure that catch or tag and release programmes are implemented for billfish. In fact, tournament rules dictate that digital cameras be used to film the capture and release of billfish at tournaments and the footage is presented to tournament judges as a means of verification of the species caught, estimated weight and release.

Barbados

Catches from recreational fisheries are utilized in several ways, however, statistics are not available as to the respective quantities that are retained for personal consumption, donated to charity, sold or released. In Barbados tournament anglers often sell their catch to subsidize their fishing costs, in particular the cost of fuel (Antia *et al*., 2002) as well as vessel maintenance costs (Peirce, 2009). Such persons consider sales as assisting in meeting the public consumer demand for fish and decreasing the quantity of fish imported. However, the sale can also serve as a source of added income to the fisher / boat owner. Catches at fishing tournaments may be sold to vendors, donated to charity or retained by the anglers. Popular organizations to which fish is donated include the Needy Children's Club established by Dame Olga Lopes-Seale and Farrs Children's Home. At the 2009 international fishing tournament 30 billfish were caught and released, 27 were Blue Marlin, one Sailfish and 2 Spearfish.

Grenada

Catches from the Spice Island Billfish Tournaments were either retained by the anglers (about 35% of the overall catch) or tagged and released, or sold at the fish market (about 65% of the overall catch) to a vendor at a current average price of about US$ 0.83 per kg. The vendor in turn sells the fish for profit. In some years however, a portion or sometimes all of the fish is donated to charity. Grenada participates extensively in the tagging programme implemented by the Billfish Foundation (see *Subsection 4.2 Tag and Release*).

Saint Lucia

In the early 1990s, consistent with international conservation initiatives, the practice of catch and release at sport fishing tournaments began even though there are no formal release programs in place, for billfish in particular, tag and release is practiced (De Beauville-Scott, 1994). Consistent with conservation initiatives by 1994 catch and release was practiced for selected species and sizes (Blue Marlin under 68kg; White Marlin under 15.88 kg; Sailfish under 15.88 kg and Swordfish under 22.68 kg). At the 1994 international billfish tournament 100 billfish were caught of which 49 were boated (presumed landed), 4 were released without tags and 47 were tagged and released (De Beauville-Scott, 1994). In addition, sharks and barracudas were also released once they were under 68 kg.

Trinidad and Tobago

The Trinidad and Tobago Game Fishing Association sells all catches from the marlin tournaments to fish processors in Tobago at a nominal fee, the processors in turn sell the fish for profit (TTGFA website). The Association also purchases bait from these processors. At all other 2-day weekend tournaments the entire catch of the first day is donated to a number of charity-based organizations. The Trinidad and Tobago Game Fishing Association is affiliated with the International Game Fishing Association and pioneered the tag-and-release format of all the Billfishes (Blue Marlin, White Marlin and Sailfish) in the Eastern and Southern Caribbean tournaments, to the extent that this release format is now a standard in all tournaments. Consequently, all billfish as well as tarpon tournaments are strictly catch and release in Trinidad and Tobago (TTGFA website). A billfish may be landed if the angler is of the opinion that it may fetch a prize or break a record. However, minimum weight requirements are enforced for all species and strict penalties in respect of deduction of winning points are enforced. In respect of the Charlotteville Tournament, catch and release of billfish are also practiced. Generally, although billfish were tagged and released in the early years of the tournament, due to related accidents involving inexperienced anglers catch and release is promoted instead.

Four charter boat fishing operators indicated that the fish caught may be given to clients, donated to charity, sold in order to offset trip costs or to contribute to income. One operator gave about 13.61kg (30 lbs) of catch to clients, sold the remaining catch and split the monies three ways (one share for the boat, the other for the operator and the other for the crew). In this way, the crew also benefits from the added income and there is added incentive to work. Another operator utilised the catch in his seafood business. All operators indicated that they released the majority of billfish caught and in the case of tarpon, the same applies.

In a recent survey, 64 % of the 86 respondents of the recreational fishery in the northwestern peninsula of Trinidad indicated that they do not sell their catch while the other 36% sold a portion of their catch (Shoy, 2010). The catch may be sold at the mooring site, markets to local vendors or from the homes of fishers (Mike, 1993). Of those who sold their catch 42% did so to supplement their income, 16% each to offset the cost of fuel and of the fishing trip and 26% to avoid wastage. The majority of the fish is sold to the Almoorings Fishing Cooperative, government fish markets in Carenage and Cocorite as well as business establishments such as restaurants and hotels in the Chaguaramas area. Small amounts are sold at places of residence.

4.2 Tag and release

The Billfish Foundation has collaborated with several Game Fishing Associations and tournament organizers in the Eastern Caribbean region to promote tag and release as a conservation measure and as a means of acquiring data to inform management decisions for several species of billfishes. Consequently, through voluntary assistance from members of these organizations and participants at such tournaments some 2,625 fish have been tagged and released, or recaptured, between 27 June 1991 and 5 January 2012 in the region bounded by latitude 9 to 19 degrees North and longitude 59 to 64 degrees West (Table 8). The majority of fish tagged and released or recaptured were in the waters under the national jurisdiction of Grenada, Martinique and Trinidad and Tobago, between 1999 and 2004. The Game Fishing Associations, Game Fishing tournaments or tournament organizers associated with the tag and release exercises were: Mutual Mount Gay Tournament in Barbados, Barbados Game Fishing Association and respective fishing tournaments, Antigua Billfish Tournament, Antigua and Barbuda Sport Fishing Association, Bahamas Billfish Championship, Billfish Extreme Release League, Carib International Game Fishing Tournament in Tobago, Trinidad and Tobago Game Fishing Association, Double Dutch Game Fishing Tournament, Spice Island Billfish Tournament (Grenada), Guadeloupe Marlin Club, Martinique Billfish Tournament, Martinique Billfish Association, Mr Nicholas Hackshaw (Saint Lucia), St Bart's Open Tournament, Saint Lucia Billfish Tournament, Saint Lucia Game Fishing Association and Tobago International Game Fishing Tournament and the respective organizing Committee.

The majority of fishes tagged and released or recaptured were Blue Marlin (1,469), Sailfish (825) and White Marlin (236), with considerably fewer numbers of Spearfish (68), Swordfish (19), Yellowfin Tuna (7) and Striped Marlin (1) – (Table 9). Most Blue and White Marlin were tagged and released or recaptured off Martinique, while Grenada was more popular for Sailfish. Over the period examined seventy-five (75) fish were recaptured, comprising mainly Blue Marlin (64), with significantly fewer numbers of Sailfish (8), White Marlin (2) and Striped Marlin (1). Most of the recaptures were in the waters under the jurisdiction of Martinique, Grenada and Guadeloupe.

In respect of the charterboat fishing subsector, one such operator from Grenada provided information on the number of fish tagged and released between 2003 and 2011 (Table 10). Sailfish comprise the majority of billfishes tagged and released, though the total number of fish tagged and released has declined over the last four years.

Table 8. Annual number of fish tagged and released or recaptured in the waters under the jurisdictions of countries in the region bounded between 9 to 19 degrees North and 59 to 64 degrees West (June 1991 to January 2012)- (Data Source: The Billfish Foundation – Country Codes: AN: Anguilla; AB: Antigua and Barbuda; BA: Barbados; BO: Bonaire; DO: Dominica; GR: Grenada; GA: Guadeloupe; GY: Guyana; IB: Isla La Blanquilla; MA: Martinique; STB: St Bart; SBE: St Barthelemy; SL: Saint Lucia; SV: St Vincent & the Grenadines; TT: Trinidad and Tobago; NI: Not indicated)

Year	AN	AB	BA	BO	DO	GR	GA	GY	IB	MA	NI	STB	SBE	SL	SV	TT	Grand Total
1991		1	1														2
1992		2				1	1										4
1993		1				1	5			11						1	19
1994					15	8	64			41	1		3	23		7	162
1995		3	1			9	44			65	1		1	18		22	164
1996	2	15	3		3	7	13			70			2	14		17	146
1997		3	3		2	19	20			43			1	30		14	135
1998	8	2	4			23	14			36			1	16		28	132
1999		3	9	1		89	10			63	4			35		62	276
2000		4	3		5	139	5	1		39	1			28	2	49	276
2001		1	14		1	115	4			62				9	1	55	262
2002			7			59	1			53		2	1	1		39	163
2003		8	22			99				110				8		13	260
2004		31	5		2	73				17	1	2		5		81	217
2005		5				19				33				5		11	73
2006		11	3		2	25	1			13				1	4	9	69
2007		14			1	70	1		1	1	2			1	3	2	95
2008						52				2						1	55
2009			1			29	1			1				1			33
2010						21				4				10			35
2011		1				19	1			5				8			34
2012						13											13
Grand Total	10	105	76	1	31	890	185	1	1	669	9	4	9	213	10	411	2625

Table 9. Number of fish by species which were tagged and released or recaptured in the waters under the jurisdictions of countries in the region bounded between 9 to 19 degrees North and 59 to 64 degrees West (June 1991 to January 2012)- (Data Source: The Billfish Foundation – Numbers in brackets are reflective of recaptures i.e. 56(5) means that of the 56 fish released, 5 were captured and tagged previously - recaptures)

Country	Blue Marlin	Yellowfin Tuna	Sailfish	Spearfish	Striped Marlin	Swordfish	White Marlin	Total
Anguilla	9	0	0	0	0	0	1	10
Antigua & Barbuda	72	0	10	2	0	0	21	105
Barbados	56 (5)	0	0	5	0	0	15	76(5)
Bonaire	1(1)	0	0	0	0	0	0	1(1)
Dominica	19(9)	0	1	0	0	7	4	31(9)
Grenada	213(9)	1	592(6)	4	0	0	80 (1)	890 (16)
Guadeloupe	167(12)	6	3	4	0	5	0	185(12)
Guyana	1(1)	0	0	0	0	0	0	1(1)
Isla La Blanquilla	1	0	0	0	0	0	0	1

Table 9. Number of fish by species which were tagged and released or recaptured in the waters under the jurisdictions of countries in the region bounded between 9 to 19 degrees North and 59 to 64 degrees West (June 1991 to January 2012)- (Data Source: The Billfish Foundation – Numbers in brackets are reflective of recaptures i.e. 56(5) means that of the 56 fish released, 5 were captured and tagged previously - recaptures)

Country	Blue Marlin	Yellowfin Tuna	Sailfish	Spearfish	Striped Marlin	Swordfish	White Marlin	Total
Martinique	481(23)	0	57	38	1(1)	7	85	669(25)
Not indicated	8 (3)	0	0	0	0	0	1(1)	9(4)
St Bart	4	0	0	0	0	0	0	4
St Barthelemy	7	0	0	0	0	0	2	9
Saint Lucia	151	0	34	12	0	0	16	213
St Vincent and Grenadines	6	0	2	1	0	0	1	10
Trinidad and Tobago	273 (1)	0	126 (1)	2	0	0	10	411(2)
Total	1469 (64)	7	825 (8)	68	1(1)	19	236(2)	2625(75)

Table 10: Number of Billfish tagged and / or released by one charterboat fishing operator in Grenada (2003 - 2012)

Year	Blue Marlin	White Marlin	Sailfish	Total
2003	19	6	28	53
2004	9	4	26	39
2005	7	3	6	16
2006	2	3	18	23
2007	9	7	32	48
2008	14	6	21	41
2009	8	5	18	31
2010	11	6	14	31
2011	9	1	11	21

4.3 Fleet size and characteristics and number of fishers

Since traditionally the Fisheries Departments of the region have focused attention on management of commercial fisheries, data on fleet size and number of fishers in the recreational fisheries are sparse, though some information exists on fleet characteristics and fishing gear. An internet search in July 2012 identified charter boat fishing companies in the respective countries, the details are provided in the respective subsections below. It is to be noted however, that not all charter boat companies maintain websites and that some companies that go out of business do not retract information posted online. Consequently, caution should be exercised in interpreting the information.

Antigua and Barbuda

The number of recreational fishing vessels in Antigua and Barbuda is not documented. In the early 2000s about 25 to 30 vessels from Barbados, Guadeloupe, Martinique, Montserrat, Saint Barthelemy, Saint Lucia, Saint Maarten, Saint Thomas and Tortola visited the islands for the fishing tournament (Mahon and McConney, 2004). The authors also documented a maximum of 10 charter vessels between 5 and 11m and 30 private local vessels.

Three charter boat fishing companies were identified through an internet search in July 2012 – Overdraft Deep Sea Fishing Charters, Obsession Sport Fishing Charters and Nightwing Charters. These companies

own five vessels of the sport fisher type, between 9.45 and 13.7m, with diesel engines of the Detroit, Yanmar or Caterpillar types ranging between 175 and 360 Hp. The vessels are all licensed for charters, fully insured with public liability insurance and meet coast guard safety regulations.

Information on the current number of recreational fishing vessels and the number of recreational fishers was not available.

Barbados

Oxenford (1990) noted the existence of a small recreational fishery for pelagic species comprising at the time of less than 20 boats, both private and charter vessels. In the early 2000s up to 7 boats visited for the international tournaments, but in some years none visited, while 8 charter fishing boats operated full time from the Careenage (Mahon and McConney, 2004). The Barbados Fisheries Division does not currently register recreational fishing boats, however, the Division is focusing on drafting legislation under the current Fisheries Act to facilitate registration and licensing of these vessels as well as collection of relevant fisheries data from the owners and operators.[10] The International Transport Division of the Ministry of International Business and International Transport is the agency with responsibility for registration of recreational fishing vessels. However, due to the high fees associated with this process some owners of recreational fishing vessels have opted to register their vessels with the Fisheries Department. These data were however not available due to difficulties in disaggregating such vessels from commercial fishing vessels in the records. Charter vessels are registered by the International Transport Division, however, due to the high cost of duty some owners choose not to have their vessels registered. More than 400 pleasure crafts, comprising catamarans, yachts and cabin cruisers, are registered in Barbados.[11] However, there is no record keeping on the activities of these vessels and consequently those engaged in fishing cannot be identified at this time.

The only available information on recreational fishing vessels specifically, is documented in Peirce (2009). Two classes of vessels may be used for offshore fishing: (1) 6 to 9 m vessels, powered by two outboard engines which are also used for inshore fishing and (2) sport fisher type vessels, between 9 and 15 m in length, powered by two diesel engines and equipped with safety, navigational and fishing equipment. The fleet which participated in the 2008 offshore fishing tournaments (a total of nine days) comprised 35 vessels and 225 anglers (Peirce, 2009) but it is likely that participation was not limited to local vessels. In 2009 the International fishing tournament, held over five days at Port St Charles, was patronized by 31 fishing boats and 210 anglers from Antigua and Barbuda, Grenada, Guadeloupe, England, Italy, Martinique, Jamaica, Scotland, St Vincent, Saint Lucia, Trinidad and Tobago and the United States of America.

Peirce (2009) identified eight vessels engaged in charter fishing in 2009. Five charterboat fishing companies were identified through an internet search in July 2012 - IOU Charters, High Seas Fishing Charters, Challenge Charters and Tours, Predator Sport Fishing and Cannon Charters. These companies own six boats, which range between 7 and 12m, with twin turbo diesel engines ranging between 225 Hp and 450 Hp of the Cummins, Perkins or Sabre brand.

Information on the number of recreational fishers was not available.

Grenada

Some recreational fishing vessels in Grenada are registered with the Port Authority, however, high duties act as a deterrent to registering. The Grenada Fisheries Department has not yet registered recreational fishing vessels, and consequently, the number of local, recreational fishing vessels is not known. It is

[10] Stephen Willoughby, Chief Fisheries Officer, Barbados Fisheries Division (pers. com.)
[11] Walter Best, Shipping Superintendent, International Transport Division, Barbados (pers. com.)

estimated that currently there are about 60 vessels involved in the recreational fishery, most targeting the large pelagic fishery[12]. Based on data provided by organizers of the Spice Island Fishing Tournaments convened between 2007 and 2012 the number of local vessels participating annually ranged between six and eleven and the number of foreign vessels participating annually ranged between 28 and 42 (Figure 4 - top graph). Generally the total number of vessels participating annually in the tournament ranged between 19 (2005 and 2006 respectively) and 52 (2011) and the number of anglers ranged between 83 (2005) and 256 (2012). The number of anglers participating in the tournament has increased substantially from less than 100 in 2006 to over 250 by 2012, while the number of boats has more than doubled over the same period (Figure 4 – bottom graph). Vessels participating in the tournament are of two types – the larger, carrying inboard engines and ranging between 8.5 and 26 m, represented by vessels from Trinidad, Saint Lucia, Barbados, Cayman Islands, Martinique, Guadeloupe and Antigua, and the smaller, carrying outboard engines and ranging between 6.7 and 10.7 m, represented by vessels from Trinidad and Tobago and the United Kingdom. The majority of vessels participating in this tournament are of foreign origin.

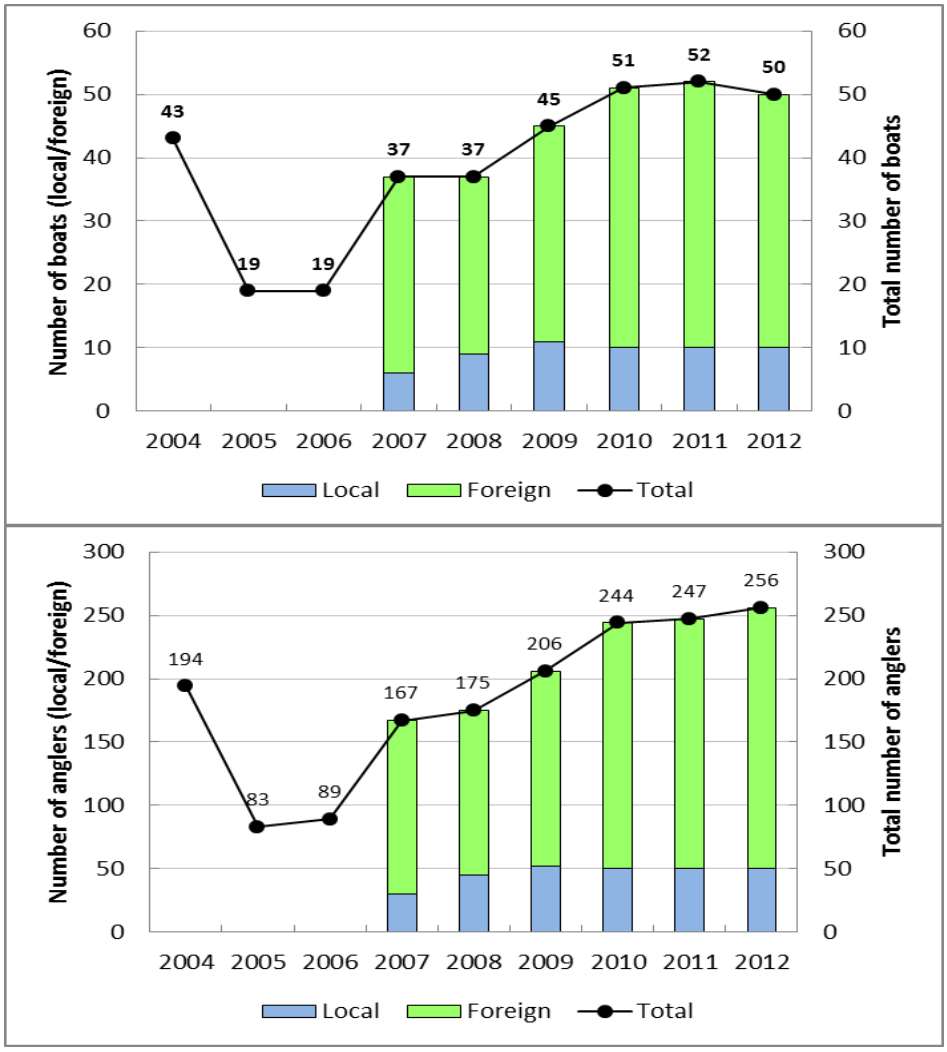

Figure 4: Number of boats (top) and anglers (bottom) participating in the Spice Island Billfish Tournament (2004 to 2012) – Source: Tournament

[12] Justin Rennie, Chief Fisheries Officer, Grenada Fisheries Department (pers. com.)

In the early 2000s, 4 charter boats were very active while other boats were chartered for part time fishing for personal use (Mahon and McConney, 2004). At the time about 15 private local vessels were involved in recreational fishing in Grenada and about 1 or 2 in Carriacou. Three charterboat fishing companies were identified through an internet search in July 2012 - True Blue Sport Fishing, Surf n Turf and First Impressions Limited. These companies own three vessels, which range between 9.45 and 11.6m, with diesel engines ranging between 330 Hp and 440 Hp of the Cummins and Yanmar brands. Between 2005 and 2011, the number of fishing days per year for one of these vessels ranged from 117 in 2005 to 200 in 2003, the average being 165 days per year (Figure 5). Generally, there has been a decline in the number of fishing days since 2007 (198 days) with the 2011 effort being 146 days.

Information on the number of recreational fishers outside the tournament scenario was not available.

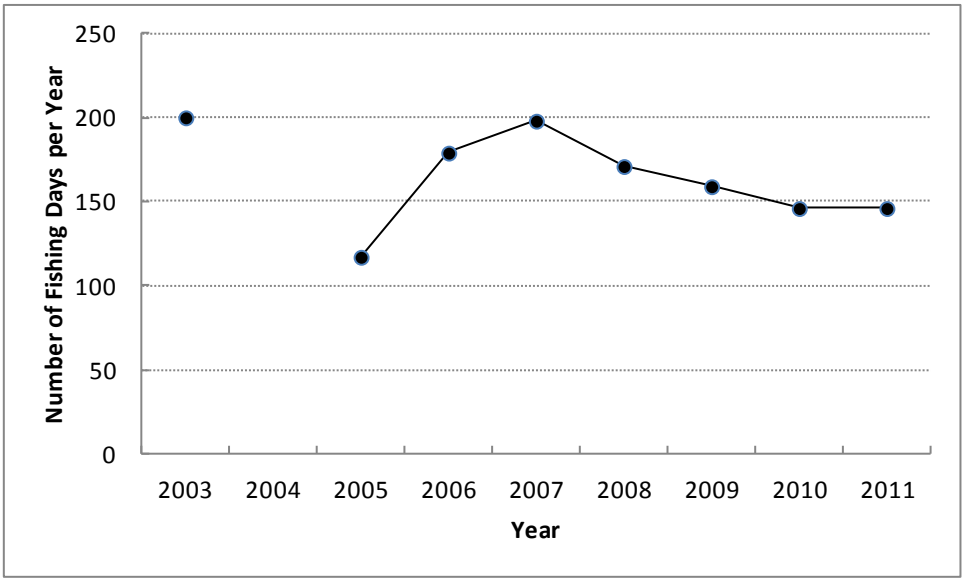

Figure 5: Number of fishing days per year for one charter fishing boat operator in Grenada (2003-2011)

Saint Lucia

In 1994 there were 19 sport fishing vessels ranging between 5.2 and 14 m. Of these vessels, 11 were involved in commercial sport fishing (presumed to be charter boat fishing) and others were involved in formal and informal fishing tournaments (De Beauville-Scott, 1994). Recreational fishing vessels in Saint Lucia are registered with the Fisheries Department. Currently twenty-four vessels are registered but there is evidence that more are involved in recreational fishing but are not registered[13]. Registered vessels range between 4.6 and 19.8 m, are constructed of fiberglass and carry engines ranging between 30 and 3200Hp.

Although only local boats participated in the international billfish tournament initially, increased publicity in the 1980s resulted in participation by foreign vessels from neighbouring countries (e.g. Martinique, Grenada, Barbados and St Vincent). In 1990 vessels from five islands were registered to participate, with a combined 113 anglers (De Beauville-Scott, 1994). The tournament sought international reach in 1991 with 25 boats participating from 7 countries. In 1992, 15 boats and 83 anglers from 7 countries participated and 23 boats from 10 countries, with 110 anglers combined, participated in 1993. By 1994, 34 boats from 14 countries were registered (166 anglers) to participate. In respect of more recent

[13] Saint Lucia Fisheries Department, Unpublished data

tournaments the Saint Lucia Game Fishing Association has indicated that data are collected on the number of vessels participating but such data was not made available for this study.

Eight charterboat fishing companies were identified through an internet search in July 2012 - BB Kingfisher Charters, Mystic Man Tours and Charters, Saint Lucia Fishing Charters, Trivial Pursuit Charters, Reel Irie, Hackshaw's Boat Charters Sportfishing, Captain Mike's and Serenity Vacation Tours. These companies own 16 fishing vessels which range between 7.9 and 18.6m and carry diesel engines ranging between 550 and 2,800 Hp.

Trinidad and Tobago

In Trinidad and Tobago, under the Shipping Act (1987; last amended in 2007) and Motor Launches Act (1926, last amended in 1985) the recognized authority for the registration and licensing of marine crafts is the Maritime Services Division, Ministry of Transport. However, due to resource limitations at that Division the Fisheries Division has informally kept a register of fishing vessels for record keeping and decision- making for fisheries management purposes. While the Division has focused on registration of commercial fishing vessels, several recreational fishing vessels, under the guise of commercial fishing due mainly to the similarities in the fishing methods utilized, have opted to register with the fishing vessels. Their motivation for so doing is the fact that owners of registered fishing vessels are eligible for a variety of fishing incentives under the Fishing Industry (Assistance Act) (1955, last amended in 1958), the Value Added Tax Act (1989, last amended in 2007) and the Agricultural Incentive Programme implemented by the Ministry of Food Production, Land and Marine Affairs. The proposed new fisheries legislation makes provisions for the recording of fishing vessels, including recreational fishing vessels and the proposed Pleasure Craft Act under the Maritime Services Division makes provisions for registration of related crafts, including recreational fishing vessels.

Mike (1993) estimated that there were 307 recreational fishing vessels operating from the northwest peninsula of Trinidad and provided a description of the fleet operating from this area. However, these vessels targeted both pelagic and demersal species. The fleet at the time consisted mainly of fiberglass pirogues (55.5%) and powerboats (35.5%), with cabin cruisers (7%) and wooden pirogues (2%) being less common. Fibreglass pirogues were between 6.4 and 10.7 m, the majority being 9.5 to 10.7 m; and power boats ranged between 5.2 and 10.7 m, the majority being 6.4 to 7.6 m. Cabin cruisers which were generally larger than other boats, reaching 9.5 to 11.6 m and the one wooden pirogue sampled was in the 9.5 to 10.7 m range. Sturm *et al*. (1998), citing Fabres and Kuruvilla (1992), provided an estimate of 413 vessels. Shoy (2010) estimated that the fleet operating from the same area had increased to 430 vessels by 2011 and although the same types of vessels were still present in the fleet as in the early 1990s, there appeared an increase in the number of cabin cruisers which represented 22.8% of the sample. Fibreglass pirogues were still predominantly used (45.6%), though seeming to have decreased in popularity, as well as powerboats (27.8%) and wooden pirogues to a lesser extent (3.8%). It was also evident that the average size of vessels used in the recreational fishery had increased between 1993 and 2010. Cabin cruisers now ranged between 7.9 and 16.8m, fiberglass pirogues between 6.4 and 12.2 m and powerboats between 6.4 and 21.3 m (the majority being between 9.4 and 10.7 m). In respect of electronic equipment, Shoy (2010) recorded increasing use of global positioning systems since 1993 and noted that almost all recreational fishing vessels were fitted with basic navigational (GPS and fish finders) and communication (VHS radio, cell phones) equipment.

In Trinidad, during non-tournament periods in the early 2000s, about three vessels from the USA and Venezuela visited and up to 15 such vessels visited in previous tournaments although Trinidad and Tobago was at the time not being promoted as a recreational fishing destination (Mahon and McConney, 2004). Organizers of fishing tournaments usually record the respective vessel names and associated flag country. However, this information is not normally made available to the Fisheries Division.

Consequently, it is possible only to report on the number of vessels participating in the respective tournaments that land fish at the weighing station and are recorded by the Fisheries Division (Table 11).

Table 11: Number of boats reporting to weighing stations at fishing tournaments convened in Trinidad and Tobago (2003 to 2011) – Source Fisheries Division

Tournament	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
Charlotteville Tournament				105	63	86	141	68	73	536
Junior Anglers Tournament						164		278	184	626
Kingfish Tournament	49			23	138	81	39	56	43	429
Tobago International Billfish Tournament	126		45	37	49	60	24	65	23	429
Wahoo Tournament	60	87		102	117	38	54	39	62	559
Total	235	87	45	267	367	429	258	506	385	2579

Nine charterboat fishing companies were identified through an internet search in July 2012 (four in Trinidad and five in Tobago) - Island Yacht Charterers, Ringleader Charters, Red Beard Charters, South Caribbean Charters Ltd, Dillon's Fishing Charter, Dream Catcher Marine Charters, Fishjammer Charters, Grand Slam and Hard Play Fishing Charters. Together these companies own nine vessels which range between 11.3 and 14.3m, with engines ranging between 550 and 1470 Hp. Further investigation revealed that three such vessels of the sport fisher type were engaged in recreational fishing for offshore, highly migratory pelagics in Tobago[14] and about five such vessels in Trinidad[15]. However, it is likely that pirogues may also be chartered for recreational fishing, but the number of such vessels is not known. Some of these pirogues may also be involved in commercial fishing.

It is estimated that there were 2,393 recreational fishers in the northwestern peninsula during the early 1990s (Mike, 1993) and 1,789 in 2010 (Shoy, 2010). It is interesting to note that both studies show an opposite trend in the corresponding number of vessels, which increased from 307 in 1998 to 430 by 2010.

4.4 Fishing seasons

The pelagic fishing season in the Eastern Caribbean is dictated by the species targeted and their availability or abundance in the region. Fishing tournaments that target specific species or species groups are therefore convened to coincide with the peak periods of availability.

Barbados

The main fishing season for offshore pelagics is between mid-November and May, the Barbados International Fishing Tournament being convened around March/April annually (Peirce, 2009). Charter vessels operate mainly from December to April, the tourist season (Oxenford, 1990). During this time all the main species such as Wahoo, Common Dolphinfish, White and Blue Marlin, Sailfish, Yellowfin and

[14] Santos Dillon, Dillon's Fishing Charter (pers. com.)
[15] Gary Story, South Caribbean Charters Ltd. (pers. com.)

Blackfin Tuna are available.[16] Although marlins pass the island in September/October the best months are February, March and April. Tunas are usually caught during the "winter months" (December to April). Generally regional species such as Dolphinfish and Wahoo along with several tropical shark species are caught year round. Private vessels operate on weekends, between January and April (the peak fishing season) and target the large oceanic pelagic fishes (Oxenford, 1990).

Grenada

Based on information from one charter fishing boat owner, peak catches are realized from November to April with lowest catches between August and October.

Saint Lucia

Recreational fishing occurs year round (De Beauville-Scott, 1994), and is possible due to the differences in seasonality of the various species targeted.

Trinidad

Vincent (1910) provided the earliest account of seasonality in the recreational fishery which he linked to popular fishing areas (Table 12). Subsequently, both Mike (1993) and Shoy (2010) noted that the major fishing methods employed to catch pelagic species (trolling and a-la-vive) were practiced throughout the year. King Mackerel, Serra Spanish Mackerel, Crevalle Jack and barracudas are caught mainly between March and September while Wahoo are caught mainly between December and February (Mike, 1993). Shoy (2010) listed the most popular period for capture of King Mackerel, Crevalle Jack, Atlantic Bonito and Serra Spanish Mackerel using a-la-vive as: July to September, July to October, January to December and July to September respectively. Similarly, the most popular period for capture of Wahoo, Common Dolphinfish and sharks using troll lines were: November to March, July to August and January to December respectively. Tournaments targeting billfish are held between March and May, those targeting King Mackerel are held between June and July; those targeting Wahoo are held between February and March, while those targeting tarpon are held in August. Charter boats operate year round with the changing seasonality of the respective offshore pelagic species.

Table 12: Seasonality and area of capture of species caught in the recreational fishery in Trinidad (Source: Vincent, 1910)

Species	Area	Peak periods of abundance											
		J	F	M	A	M	J	J	A	S	O	N	D
Crevalle jack, King Mackerel, Tarpon, Atlantic Bonito	Pointe Baleine				■	■	■	■					
King Mackerel	Cap La Pena, Northeast Venezuela							■	■	■			
King Mackerel, Crevalle jack	NE of Monos Boca towards Macqueripe Bay						■	■	■				
Crevalle jack	Bocas				■	■	■	■	■	■	■		

[16] IOU Charters - http://www.worldwidefishing.com/barbados/b2635/index.html?page_type=salt&state_page=barbados&company=IOU+Charters

Table 12: Seasonality and area of capture of species caught in the recreational fishery in Trinidad (Source: Vincent, 1910)

Species	Area	Peak periods of abundance											
		J	F	M	A	M	J	J	A	S	O	N	D
King Mackerel	N & NE coast from Macqueripe to Matura												
Tarpon	Bocas and North Coast												
Barracuda	Nearshore off Bocas and N and E coasts												

4.5 Gears

It was not possible to conduct a detailed analysis of the gear specifications however; recreational fishers who target large pelagic species utilize mainly rod and reel and troll lines. The most popular reels are Penn International, Alutecnos and Shimano reels. In Trinidad and Tobago, fishing with live-bait (a-la-vive) is common among pirogues in the recreational fishery. Such bait comprises mainly engraulids and clupeids. Other species of bait include halfbeaks (ballyhoo) and Hirundichthyids (flyingfish). Artificial lures are also used. Vessels may also be outfitted with outriggers and downriggers, fighting chairs as well as belts and harnesses and equipment for hauling the fish on board (e.g. garfs). It is common for vessels to be outfitted with Global Positioning Systems (GPS), fish finders, VHF radios and modern safety equipment.

4.6 Spatial distribution of effort by recreational fishers

Barbados

Due to the country's narrow continental shelf, water over 122 m depth exists within 1.2 km off the coast and the 457m contour is only 4.83km offshore. Consequently, fishing occurs fairly close inshore. Charter boat fishing occurs mainly off the south and west coasts due to deep structure close inshore[17]. The West Coast is always protected from the prevailing easterly trade winds and is ideal for persons who are inexperienced at sea.

Grenada

Vessels participating in the Spice Island Billfish Tournament fish off the west coast of Grenada up to 56 km (35 miles) offshore while the charter fishing boat for which information was obtained fished in the same area but ventured a maximum distance of 48 km (30 miles).

Saint Lucia

Generally recreational fishing occurs within the Exclusive Economic Zone of Saint Lucia with a greater focus in the area north of the island[18]. Participants in the international billfish tournament fish between 8 and 80 km (5 and 50 miles) offshore.[19]

[17] IOU Charters - http://www.worldwidefishing.com/barbados/b2635/index.html?page_type=salt&state_page=barbados&company=IOU+Charters

[18] Saint Lucia Fisheries Department – email communication

[19] Annie Hamu, Saint Lucia Game Fishing Association (pers. com.)

Trinidad

During the early 1900s sport fishing was conducted mainly off the northwest coast of Trinidad, due in part to the unavailability of visitor accommodation at other areas along the north coast, suggesting an early linkage with tourism (Vincent, 1910). Currently, recreational fishing in Trinidad and Tobago generally occurs in the Gulf of Paria, off the north coast of Trinidad, the northeastern peninsular of Tobago and in the area between Trinidad and Tobago, in the Galleon's Passage, locally called "The Shallows" (Figure 6). Mike (1993) reported that recreational fishing occurred in the Gulf of Paria and from St Peter's Bay in Carenage, along the southern coast of the northwestern peninsula, including the offshore islands (the Bocas, Saut D'eau, Chacachacare), to the northern coast of the northwestern peninsula, and extending along the north coast to as far as Toco and Tobago. Most fishing takes place within 3.2 to 8 km (2 miles) off the coast, a-la-vive often practiced up to 8 km (5 miles) offshore while trolling is conducted mainly between 3 and 16 km (2 and 10 miles) offshore, though there are instances when this activity may extend beyond 32 to 48 km (20 to 30 miles), (Mike, 1993; Shoy, 2010). The most popular recreational fishing areas along the north coast of Trinidad are from Macqueripe to Pointe a Diable, Saut D'eau to Balata, Maracas to La Filette, Gaspar Grande, Chupara Point, Las Cuevas and Gran Bocas (Mike, 1993; Shoy, 2010).

Participants in fishing tournaments convened in Trinidad fish mainly off the north coast of Trinidad except for those in the Junior Anglers' Tournament who fish in calmer waters in the Gulf of Paria. Participants in tournaments convened in Tobago fish mainly off north eastern Tobago and to a lesser extent off south western Tobago (off Pigeon Point, Mt Irvine and "the Shallows").[20] Tournament participants often cite the "local" names of several fishing areas, the exact geographic location of those areas around Trinidad are currently being mapped by the Fisheries Division. The charter boat fishing operators in Tobago fish around the island, off Plymouth, Big Hill and Sisters, and venture as far as 32 to 64 km (20 to 40 miles) offshore as well as off the north (Saut D'eau) and east (Emerald shoals) coasts of Trinidad. In addition, one vessel fishes off the Shallows and up to 16 km (10 miles) into the Caribbean Sea. Charter boat fishing operators in Trinidad fish about 0.4 km (¼ mile) off the islands in the northwestern area and off the north coast during July to October and between 0.4 and 32 km (¼ to 20 miles) off the north coast during the remainder of the year.

[20] International Billfish Tournament and Charlotteville Tournaments – mainly 16 to 19 km (10 to 12 miles) NW Tobago; King Mackerel Tournament – 1.6 to 8 km (1 to 5 miles) off Trinidad's north coast; Wahoo Tournament – 12 to 16 km (8 to 10 miles) off Trinidad's north coast; Junior Anglers' Tournament – off Trinidad's north coast, the Bocas and Gulf of Paria; Funfish Tournament – off Trinidad's north coast; Tarpon Tournament – off the Bocas

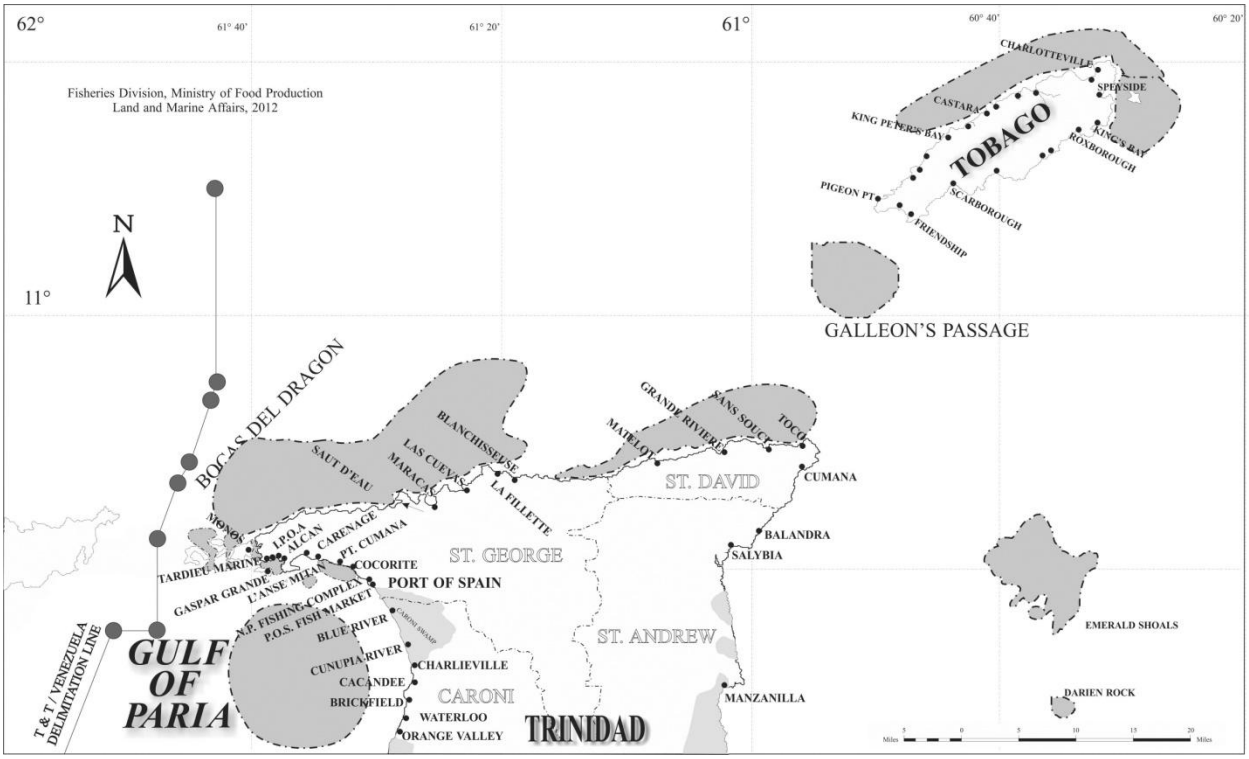

Figure 6. Map showing some popular recreational fishing areas off Trinidad and Tobago (shaded). Source: Fisheries Division, Ministry of Food Production, Land and Marine Affairs, Trinidad and Tobago

4.7 Direct employment/employment opportunities provided by fishery

Data on employment in the recreational fishery are not available. This is due mainly to the fragmented nature of the sub-sector and the fact that recreational fishers are not organized in a manner that would facilitate easy access to information on the sub-sector. Where there are established game fishing associations not all recreational fishers are members and there is need to maintain and improve the record keeping of such associations. In respect of the various components of the sub-sector the greatest opportunity for direct employment appears to be in the charter boat fishing component if the required tourism base can be attained and maintained. Other opportunities for employment, though temporary, exist in the provision of support services for convening fishing tournaments. Indirect employment is currently provided through tackle and bait shops, boat builders, repair craftsmen, boat accessory suppliers, and boat yard staff (Valdez, 2011), as well as jobs in tourism associated with visiting recreational fishers.

4.8 Revenues and costs of recreational fishing

The cost of recreational fishing activity is dependent on a number of factors, namely, the area of fishing, the sea conditions, type of fishing method (whether active or passive) and duration of fishing, with the cost of fuel being a key determinant (Gillet *et al*., 2007). The cost of fishing and revenues (where possible to estimate) are presented below.

<u>Barbados</u>

Peirce (2009) estimated that an offshore fishing trip costs about US$490.82 (BB$1,000), with about US$25 (BB$50) per person per trip for food, drinks, lures and bait and upwards of US$245 (BB$50) for the cost of fuel, vessel maintenance and fishing gear. The corresponding value of the landed catch was

about US$37 (BB$75) per vessel per trip or US$6 (BB$11.68) per person. The capital cost of a 6 to 9m vessel powered by outboard engines is between US$12,271 (BB$25,000) and US$39,266 (BB$80,000) and the cost of a sport fisher type vessel, between 9 and 15m, is between US$49,082 (BB$100,000) and US$245,410 (BB$500,000). Annual maintenance costs are about 20% the cost of the vessel. The price of fishing gear varies depending on the intended use (Peirce, 2009). In order to conform to rules of the International Game Fishing Association, gear of a specific characteristic must be used e.g., laser-sharpened hooks (US$10 or BB$20 each); lever drag reels (US$491 or BB$1,000 each); high quality nylon (US$49 or BB$100 per spool) and tournament quality rods (US$491 or BB$1,000 each). Consequently, Peirce (2009) estimated that appreciable marlin equipment can cost about US$1,227 (BB$2,500) and given that about 5 such set-ups are carried along with lures (US$74 or BB$150 each), gaffs, downriggers, teaser reels, gear costs could escalate to over US$7,362 (BB$15,000).

Revenues are not well documented. However, Peirce (2009) notes that recreational fishers often sell their catch to offset trip and vessel maintenance costs. He attributes the survival of the sport fishing industry to the fact that several recreational fishers were former, or part-time, commercial fishers, *since the Barbados economy does not produce a class of persons that can afford to pursue this sport solely based on other income*.

Grenada

Data were made available for one of three charter fishing boats currently operating in Grenada. This vessel is a 9.5m sport fisher valued at US$88,336 (EC$240,000), built in 1988 and carrying Twin Cummins Turbo diesel engines of 330Hp combined, valued at US$36,807 (EC$100,000). The vessel is fitted with global positioning system, VHF radio, fish finder, autopilot feature and a regular cellular phone for other communication. Safety equipment includes life jacket and rings, first aid kit and flares, while fishing equipment includes outriggers and downriggers, a fighting chair, fighting belts and harness, Shimano and Penn international rods and reels as well as gaffs, tags and stick.

The owner of the vessel offers three fishing packages of 4, 6 and 8 hour duration and on average in recent years conducted about twenty-four 8- and 6-hour trips respectively and seventy 4-hour trips per year. Data were provided for a 4-hour trip and the unit cost per hour was used to derive estimates for the various components of operational costs in respect of the six- and eight- hour packages. Costs were provided either per trip or per year. Costs provided per trip were adjusted to represent overall costs per year.

Costs included fuel, food and drinks, fishing gear/tackle, bait, ice, vessel insurance, vessel maintenance (minor and major works – major works being dry-docking, painting of hull, engine overhaul), dockage fees, licence fees, crew wage, commissions for packages booked through hotels, car operations to transport guests and captain to and from the vessel, home office expenses (telephone, internet, printer, electricity for office and bait storage, advertising (website development and maintenance, flyers, other miscellaneous advertising costs). Total cost, US$44,182 (EC$119,291) was derived per year based on interview of the boat owner (Table 13). Fuel accounted for 26% of overall cost, followed by crew wage (25%) and dockage fees for berthing and utilities (7%), (Figure 8). The prices of the three fishing packages offered are US$663 (EC$1,800) for an 8-hr trip, US$580 (EC$1,575) for a 6-hr trip and US$442 (EC$1,200) for a 4-hr trip, with annual revenue estimated at US$61,111 (EC$165,000). A simple deduction of costs from revenue shows a profit of US$16,929 (EC$45,708) per year. However such earnings are subject to 15% Value Added Tax, which takes the profit down to US$14,300 (EC$38,852) per year. The analysis does not factor in the capital costs associated with the vessel and engines. The other two vessels are not required to pay VAT and are estimated to operate at 75% and 40% of the level of the vessel examined. Consequently the combined cost of fishing per year is US$94,992 (EC$ 256,477.61), the estimated combined revenue per year is US$131,389 (EC$354,750) and the combined profit per year

is US$33,858 (EC$91,416.18) for the three vessels, which are considered to be operating below their maximum potential.

Table 13: Estimated Annual Cost of Operation of a Charter Fishing Boat in Grenada

COSTS – ITEM	Cost (EC$) per Year	Cost (US$) Per Year	Details
Fuel	30,800.00	11,407.41	Based on an estimate of the average cost of fuel per trip and given that on average 24 8-hr and24 6-hr and 70 4-hr trips are conducted annually
Food and Drinks	4,620.00	1,711.11	Based on an estimate of the average cost of food per trip and given that on average 24 8-hr and24 6-hr and 70 4-hr trips are conducted annually
Fishing gear and tackle	3,259.91	1,207.37	Based on an estimate of EC$20 per trip for loss of hooks and other minor equipment. Every 3 years a rod and reel costing about US$1,000 total are replaced; one third of this cost is attributed to the annual cost. Currency conversion - US$1 = EC$2.70
Bait	1,180.00	437.04	Based on an estimate of EC$10 per trip
Ice	708.00	262.22	Based on an estimate of EC$6 per trip
Crew wage	29,600.00	10,962.96	There are two crew members including the captain/boat owner. It was assumed that both persons received the same wage. Each crew member receives in addition to the wage per trip an additional EC$400 per month
Insurance (boat and car)	7,444.00	2,757.04	Based on the estimate given of EC$58 per trip for vessel and EC$600 for a car (see transportation below)
Boat maintenance	8,500.00	3,148.15	Cost of painting hull (antifouling paint)
Berthing & utilities	12,000.00	4,444.44	
Licence	500.00	185.19	
Commission	5,400.00	2,000.00	Commission of 10% the cost of the charter package (exclusive of 15% VAT) is paid to hotels through which the fishing trips are booked. About 30% the total charter trips are booked in this manner
Transportation	5,700.00	2,111.11	Estimate provided for vehicle that transports clients and captain to and from the boat
Office expenses	6,700.00	2,481.48	telephone, internet, printer, electricity (for office and bait storage)
Advertising	1,700.00	629.63	(website, flyers, other miscellaneous advertising costs
Miscellaneous	1,180.00	437.04	
TOTAL	19,291.91	4,182.19	

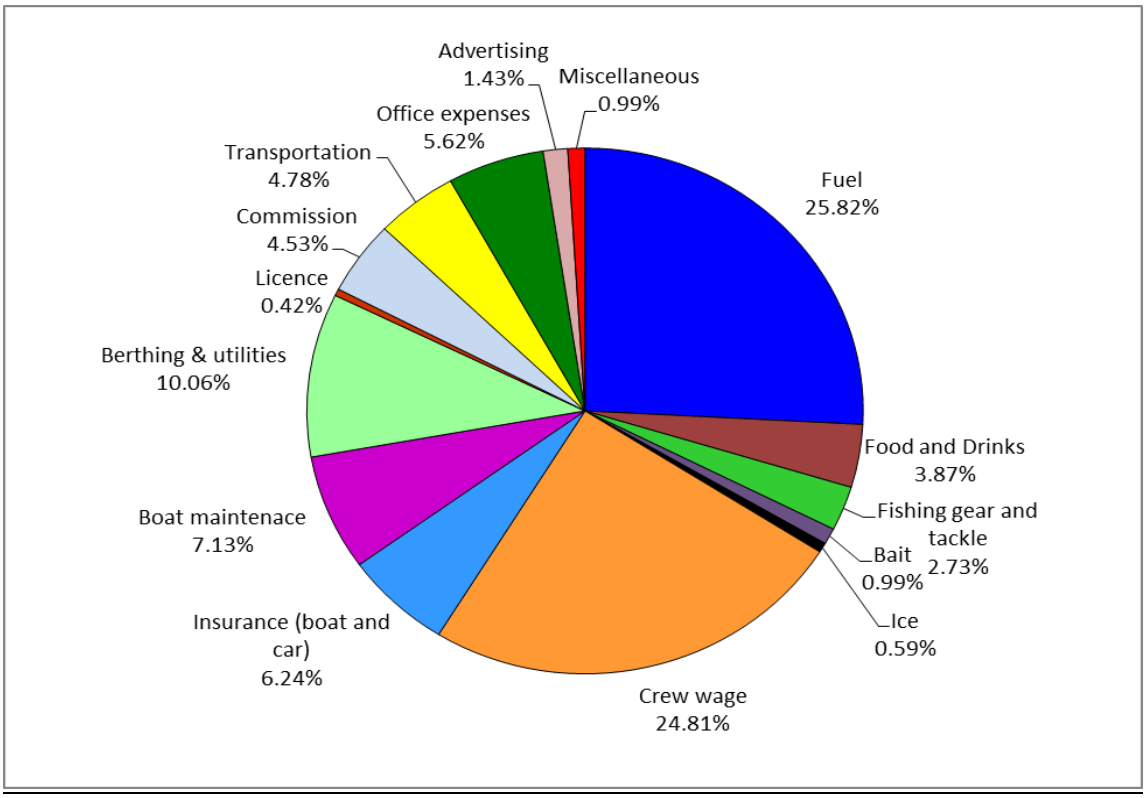

Figure 8: Percentage contribution of various items to overall annual cost of fishing of a charter boat operating in Grenada

Saint Lucia

The estimated average annual operating expenses for a charter fishing boat was about US$84,300 in 1994, disaggregated as US$3,300 dockage and utility costs; US$60,000 fuel cost and US$21,000 maintenance cost (De Beauville-Scott, 1994). This estimate was calculated using an average of 14 days fishing per month with daily fishing trips being offered at a cost of between US$600 and US$800 (De Beauville-Scott, 1994). *Assuming an average US$700 per day, with 14 days fishing per month throughout the year, estimated earning per boat is US$117,600, representing a profit of US$ 33,300 per year.*

Trinidad and Tobago

Two charter boat fishing operators were interviewed from Tobago and two from Trinidad. The vessels operating in Tobago were (1) a 12.2m sport fisher, built in 1987 and currently valued at US$145,000, with two diesel engines purchased in 1987, of 1470Hp combined and currently valued at US$30,000 and (2) a 9.5m Bertram built in 1983, with Twin Engines (Perkins) of 550 Hp combined and vessel and engines valued at US$100,000. The vessels operating in Trinidad were (1) a 11.3m sport fisher built in 1978 with Twin diesel engines of 550 Hp combined, the vessel and engines estimated at US$100,000 and (2) a 11.6m Phoenix sport fisher built in 1984, with two Detroit diesel engines of 850 Hp combined, vessel and engines estimated at US$140,000. All vessels are fitted with global positioning systems, VHF radios, fish finders and mobile phones, with three having an autopilot feature. All vessels carry life jackets, first aid kits and flares, while two carry life rafts and one a dinghy (uncertified), one vessel carries life rings and one vessel carries a fire extinguisher and is fitted with a halon system and emergency position-indicating radio beacon. All vessels are fitted with outriggers and downriggers, fighting chair, fighting belts and harness, two carry Penn and Shimano international rods and reels, one carries Penn

international rods and the other carries custom rods and reels. All vessels carry gaffs, lures, wires, hooks and other minor gear.

Since the charter boat fishing operations in Trinidad and Tobago differ due to the target clientele, operations in Tobago target tourists and operations in Trinidad target mainly corporate entities, expatriates and wealthy individuals, with tourists to a lesser extent, the revenues and costs are represented separately for operations in both islands. In Trinidad one vessel owner offers two fishing packages, of 8-hr and 4.5-hr duration and in the previous year conducted about seventy trips for each package. The other vessel owners offers three fishing packages, of 8-hr, 6-hr and 3.5-hr duration and conducted about fifteen 8-hr trips, twenty 6-hr trips and sixty-five 3.5-hr trips the previous year. In Tobago, one vessel owner offers two fishing packages of 8-hr and 4-hr duration and on average in recent years conducted about thirty-five 8-hr and forty 4-hr trips per year. Data were provided for an 8-hour trip and the unit cost per hour was used to derive estimates for the respective components of fishing cost for the 4-hour trip. The other vessel owner in Tobago offers two fishing packages of 8.5-hr and 4.5hr duration and in recent years conducted, on average, twenty 8.5-hr and twenty-five 4.5-hr trips per year. Data were provided for both trip types. Costs were provided for all the items as outlined previously, either per trip or per year, but costs per trip were adjusted to represent overall costs per year.

The estimated average annual cost of operation of a charter fishing boat in Trinidad and Tobago is provided in Table 14 and the relative percentage by item is provided in Figure 9 (top and bottom graphs respectively). The average annual cost of operation was US$59,632 (TT$388,405) and US$31,660 (TT$206,215) for a charter fishing boat in Trinidad and Tobago respectively. The difference in fishing costs between the two islands is due mainly to the number of fishing trips, with twice as many fishing trips conducted by the two charter fishing boats in Trinidad, compared to the two such boats in Tobago, and the higher boat maintenance costs quoted by the owners of the vessels in Trinidad. Since the cost of fuel in Trinidad and Tobago is subsidized by the Government, this component does not feature significantly in the average annual cost of operation, estimated at 11% and 8% for vessels in Trinidad and Tobago respectively. As noted previously, fuel is the highest contributor to overall operation cost for the charter fishing boat investigated in Grenada. In Trinidad and Tobago the cost of vessel maintenance (36% and 24% respectively) and crew wages (19% and 18% respectively) are the main contributors to overall cost of operation. It is to be noted that charter boat fishing vessels are not currently subject to any licence fees in Trinidad and Tobago. The average prices of the three fishing packages offered are US$800 to US$900 for an 8 to 8.5-hr trip, US$650 for a 6-Hr trip and US$440 to US$495 for a 3.5 to 4.5 –hr trip. Average annual gross revenue is estimated at US$69,279 (TT$451,238) and US$38,049 (TT$247,826) for a charter fishing boat owner in Trinidad and Tobago respectively. A simple deduction of costs from revenue shows an average annual profit of US$9,647 (TT$62,832) and US$6,389 (TT$41,612) for a charter fishing boat operator in Trinidad and Tobago respectively. The analysis does not factor in the capital costs associated with the vessel and engines. Also, the costs and earning for vessels from Trinidad include charter fishing for tarpon, a coastal pelagic species. It is interesting to note however, that all charter fishing boat operators have alternative sources of income i.e. they do not depend solely on profits from charter boat fishing. Consequently the vessels are not operating at their full potential. The downturn in the global economy and consequent declines in the number of tourists visiting Tobago along with failure of the authorities to develop the tourism industry in Tobago are seen as two of the critical factors affecting development of the industry. One of the charter boat fishing operators involved in the sector for more than 20 years provided estimates of the various aspects of his fishing costs and earnings ten years ago. Based on similar methodology employed above his estimated annual cost was US$68,228 (TT$444,393), estimated annual earnings was US$123,323 (TT$803,250) and estimated annual profit was US$55,095 (TT$358,857). At that time he made 250 charter fishing trips per year compared to the 75 trips he currently makes per year.

Table 14: Estimated Average Annual Cost of Operation of a Charter Fishing Boat in Trinidad and Tobago				
COSTS – ITEM	**Trinidad**		**Tobago**	
	Cost (TT$)	**Cost (US$)**	**Cost (TT$)**	**Cost (US$)**
Fuel	43,781.25	6,721.74	18,000.00	2,763.54
Food and Drinks	32,093.75	4,927.35	10,125.00	1,554.49
Fishing gear and tackle	2,625.00	403.02	18,000.00	2,763.54
Bait	3,625.00	556.55	5,000.00	767.65
Ice	3,268.75	501.85	1,250.00	191.91
Crew wage	71,583.00	10,990.19	39,500.00	6,064.44
Insurance (boat)	28,500.00	4,375.61	20,000.00	3,070.60
Boat maintenance	140,000.00	21,494.20	51,800.00	7,952.85
Berthing and utility	25,800.00	3,961.07	12,000.00	1,842.36
Commission	3,023.00	464.18	18,489.71	2,838.73
Transportation	-	-	5,000.00	767.65
Office expenses	12,850.00	1,972.86	2,500.00	383.83
Advertising	13,150.00	2,018.92	10,500.00	1,612.07
Miscellaneous	4,800.00	736.94	3,050.00	468.27
TOTAL	388,405.00	59,631.85	206,214.71	31,660.14
Cost for Trinidad is the average of two vessels with engines of 850 Hp and 550 Hp which conducted 240 fishing trips per year combined; cost for Tobago is the average of two vessels with engines of 550 Hp and 1470 Hp which conducted 120 fishing trips per year combined.				

Mike and Cowx (1996) noted that the cost of fishing in 1993 varied with the distance travelled and fishing method utilized. They estimated a mean cost per trip (excluding the cost of fishing gear) of US$55.45 (TT$355) for live-bait fishing (range between US$10.78 and US$160.93 [TT$69 TT$1,030]) and US$69.20 (TT$443) for trolling (range between US$72.95 or TT$467 and US$179.63 or TT$1,150). The highest percentage of total trip cost was attributed to fuel (74% and 61% for live bait fishing and trolling respectively). Seventeen years since the 1993 study, Shoy (2010) ascertained that more than half the fishers (53% of her survey respondents) in the northwestern peninsula of Trinidad paid between US$47.02 (TT$301) and US$78.10 (TT$500) per fishing trip (includes the cost of ice, bait and fuel), while 22.4% paid between US$78.10 (TT$501) and US$156.20 (TT$1000) and 19% paid in excess of US$156.20 (TT$1,000). The average cost of a fishing trip was in the vicinity of US$89.82 or TT$575 (assuming US$156.20 or TT$1,000 is the maximum cost). Shoy (2010) however did not investigate the differences in cost associated with different fishing methods.

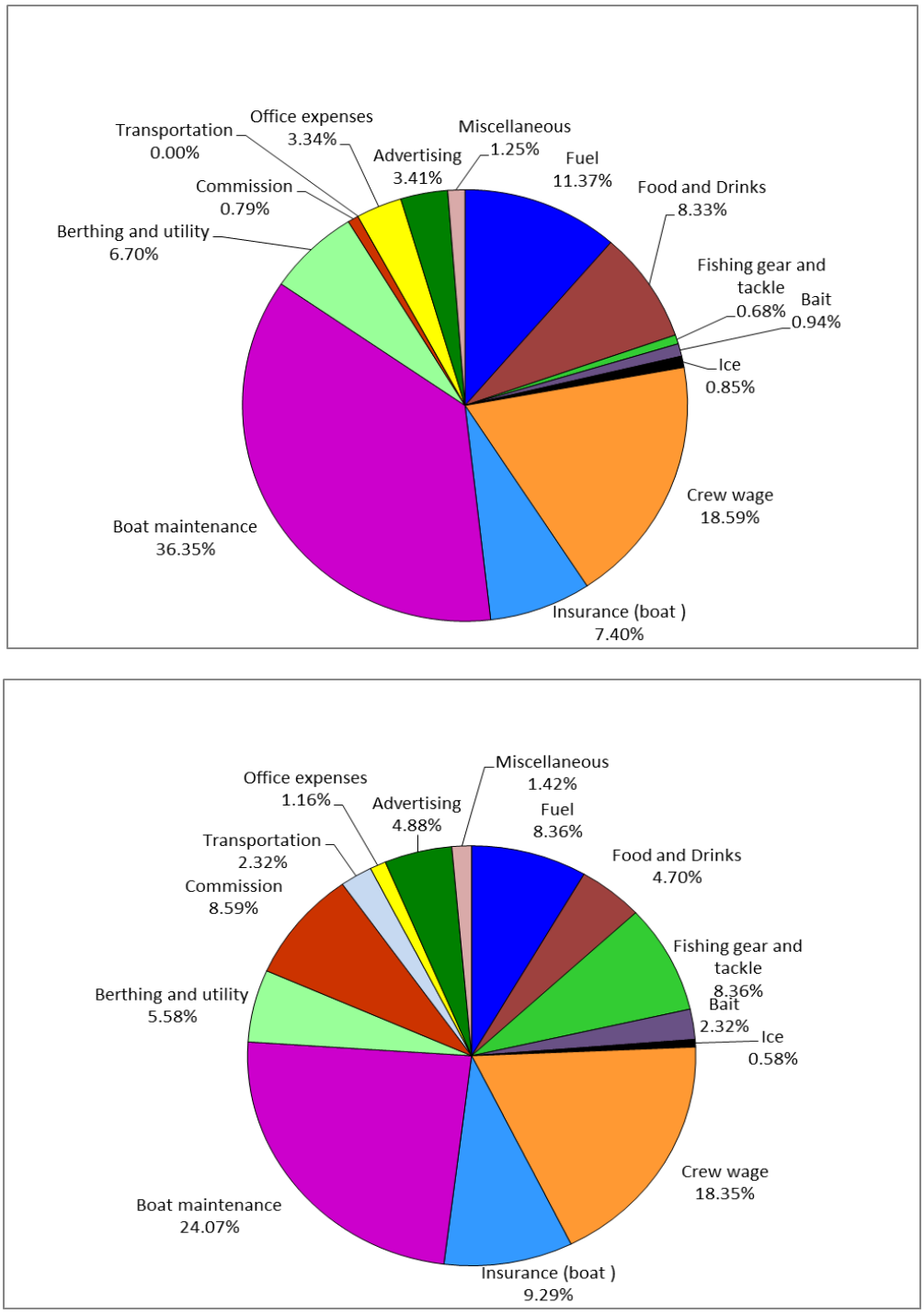

Figure 9: Percentage contribution of various items to annual average cost of fishing of a charter boat operating in Trinidad (top figure) and Tobago (bottom figure)

5. ECONOMIC VALUATION OF RECREATIONAL FISHERY

Economic valuation, as economic impact analysis, entails a detailed study of the direct impacts (initial sales or outputs of businesses), indirect impacts (due to provision of goods and services by other businesses) and induced impacts (resulting from use of income earned by employees of the respective

businesses), (Stoll *et al*., 2002). Mahon and McConney (2004) expressed concern that there are few comprehensive valuations of the recreational fishery for CARICOM countries and that the situation severely impacts on development planning for pelagic fisheries. They provided a crude estimate of US$6.6 million total annual revenue for all charter boats in CARICOM countries from an estimate of 85 such boats and assuming such vessels made three trips per week with revenue of US$500 / trip. They estimated that the recreational fishery accounted for about 9% of the value of commercial fisheries, excluding earnings from the sale of fish caught, earnings from tournaments and the value of private vessels.

Berkes *et al.* (2001) noted the absence of data for valuation of the contribution of recreational fisheries, particularly of charter fishing boats, to the overall fishery sector in Antigua and Barbuda. The authors derived a preliminary estimate for 20 cruisers available for charter fishing trips at a cost of US$400 per trip. Assuming that each vessel operates three days per week over 40 weeks for the year, they estimated the gross revenue from the subsector as being US$960,000. In the early 2000s about US$37,040 (EC$100,000) was required to convene a tournament, with entry fees being US$70 per person, while marinas waived dock fees and prizes were provided by the private sector (Mahon and McConney, 2004). A recent internet search indicated that charter boat fishing companies in Antigua and Barbuda usually offer three fishing packages of 4-hr, 6-hr and 8-hr duration, which cost between US$450 and US$650, US$650 and US$800, and US$790 to US$1500 respectively. From a similar search, one of the charterboat fishing companies in Barbados offers similar packages, with prices of US$450, US$550 and US$750 for 4-hr, 6-hr and 8-hr fishing trips respectively.

In the early 2000s the Spice Island Billfish tournament was estimated to generate about US$148,160 (EC$400,000) per year with prizes amounting to US$24,817 (US$11,112; US$7,408 and US$3,704 for blue marlin, white marlin and sailfish respectively) and about US$8,334 generated from registration fees for 150 anglers (Mahon and McConney, 2004). A comprehensive economic impact assessment of the Spice Island Billfish Tournament is soon to be conducted (McIntyre, pers.com)[21]. Data provided for recent years, by a member of the tournament organizing committee[22], indicate that customs and immigration fees are paid by foreign boats, a tournament fee of US$303.68 is charged for each participating vessel; replacement of tackle may cost about US$300 or more, with estimates of fuel cost per day ranging between US$92 and US$184. The cost of food estimated at US$36 per day and bait at US$7.36 per day. In addition, the cost of souvenir t-shirts promoting the tournament could amount to US$250 - US$400 per boat. Three fishing packages are offered by charterboat fishing companies. These packages are of 4-hr, 6-hr and 8-hr duration and cost between US$440 and US$475, US$575 and US$600, and US$660 and US$700 respectively.

Little is documented on the economic evaluation of recreational fisheries in Saint Lucia. However, from 1991 to 1994 prizes at the international billfish tournaments were US$11,945; US$23,900; US$34,445 and US$41,500 respectively (De Beauville-Scott, 1994). In respect of charter boat fishing operations associated with the annual billfish tournament, the cost of board and lodge of clients was US$600 per person, with the tournament participation fee being US$350 and the cost of ground transportation being US$240 for four persons over a 3-day tournament (De Beauville-Scott, 1994). Mainly two fishing packages are offered by charterboat fishing operators, a half-day or 4-hr fishing trip that ranges between US$475 and US$1600 and an 8-hr fishing trip that ranges between US$825 and US$3000.

The Trinidad and Tobago Game Fishing Association (TTGFA) conservatively estimates that the marlin tournament, through direct and indirect expenses earns about US$467,290 (TT$3 million) for Tobago

[21] Richard McIntyre, Chairman of the Spice Island Billfish Tournament Organizing Committee, Grenada (pers. com.)
[22] Gary Clifford, Member of the Spice Island Billfish Tournament Organizing Committee, Grenada (pers. com.)

(TTGFA website). The earnings are spread across a wide cross section of business enterprises, including airline fees, hotel fees, cost of meals at restaurants or from vendors at village shops, cost of souvenirs and cost of other recreational activity (diving, bird watching, sightseeing, hiking etc.). The cost of participation in tournaments is US$170 for members of the Association and US$200 for non-members.[23] The cost of participation in the Tobago International Game Fishing Tournament is US$200 per angler, with a minimum of four anglers per team. Although there are no estimates of the economic value of this tournament some insight was provided by one of the tournament organizers[24] who indicated that due to its timing not many families patronize nor do participants usually stay in Tobago much beyond the four-day duration of the tournament since it is convened during the school term when families are less likely to take vacation. However, in addition to the businesses mentioned previously, local charter boat operators are hired by foreign teams that are without a vessel but wish to participate in the tournament. Local businesses also earn income through the rental of chairs, tents, tables and through catering for the anglers and tournament staff during the period. One popular local supplier of fishing equipment has been allowed to advertise and sell his merchandise. Prizes are donated by the Tobago House of Assembly, the Ministry of Sport, Tourism Development Company, Carib Brewery, Budget Marine, Digicel and others. The Trinidad and Tobago Coast Guard and Immigration Division also provide their services at no cost. To promote tourism the tournament organizers ensure some prizes can only be claimed on a return trip to Tobago.

Burke *et al*., (2008) conducted economic valuations of coral reefs in Saint Lucia for which local (non-commercial) fishing was valued at between US$155,000 and US$790,000. Non-commercial fishing included fishing for consumption, some trade in the informal economy, and fishing for pleasure. Although not relevant to the focus of this study (pelagic recreational fisheries), the high uncertainty of the estimate due to the small number of valid survey respondents addresses the general issue of reliability of available data on fisheries in the region. In respect of the recreational fishers operating off the northwestern peninsula of Trinidad, in excess of US$1 million (TT$6.4 million) is estimated to be spent each year (Mike and Cowx, 1996).

6. ECOLOGICAL AND TECHNOLOGICAL INTERDEPENDENCIES WITH COMMERCIAL FISHERIES

Ecological and technological interdependencies between recreational and commercial fisheries are not well documented for the Eastern Caribbean region. However, based on the nature of the respective activities and a review of the general literature on recreational fishing, elements of such dependencies in the region can be inferred.

6.1 Exploitation of natural prey of large pelagic species for use as bait and food

A direct interdependency exists between recreational and commercial fisheries since both fisheries utilize the same species as bait to catch large, migratory, pelagic species. In northwest Trinidad popular species of bait include Atlantic Bonito, grunt, sardines, herring, Ballyhoo and flyingfish (Shoy, 2010). In other countries of the Eastern Caribbean flyingfish, Ballyhoo, scads and sprats are also used as bait (Grant, 2008). In addition, many of these species are caught in commercial fisheries as a source of food, particularly for local communities. Consequently there are competing uses between recreational and commercial fisheries for the same species. Since these species are also natural prey of large pelagic species, and their abundance is known to be highly influenced by environmental conditions, then increasing fishing effort on these species could negatively impact fisheries for large pelagic species.

[23] Marilyn Sheppard, Vice-President TTGFA, (pers. com.)
[24] Daniella Rodriguez, Organizer of the Charlotteville Fishing Tournament, (pers. com.)

6.2 Exploitation of top predators and associated trophic effects

Current national policies in the region support expansion of commercial fisheries for large pelagic species which typically are at high trophic levels. Some species such as billfish and Yellowfin Tuna are caught in both commercial (artisanal and non-artisanal) and recreational fisheries, however, only recreational fisheries practice catch and release of billfish. A global analysis on predatory fish communities has shown that in 2003 the global predatory fish biomass was only 10% of pre-industrial levels (Myers and Worm, 2003), but similar analysis of pelagic species that are restricted in distribution e.g., dolphinfish, mackerels and small tunas in the Eastern Caribbean region have not been undertaken. While there is the growing practice of catch and release in recreational fisheries, particularly in respect of billfish species, there is also evidence that recreational fishers tend to retain certain species of high commercial value e.g. dolphinfish (Antia *et al*., 2002). Consequently, there is also competition between commercial and recreational fisheries for the same market. Stock assessments of species that are regionally distributed (e.g. dolphinfish, wahoo, king mackerel, Serra Spanish mackerel) have proved inconclusive and the respective limits of stock distribution are unknown. Continued expansion of pelagic fisheries (commercial and recreational), without improvements in data collection to increase the reliability of results from stock assessments and management recommendations, could lead to overexploitation with consequent trophic and ecological impacts on other species (McPhee *et al*., 2002) which are predators, competitors or prey of the respective species.

6.3 Impacts on species caught incidentally

Commercial fisheries (e.g. trawl and gillnets) capture marine turtles incidentally in Trinidad and Tobago. Consequently regulations stipulate the use of Turtle Excluder Devices in trawl nets of the semi-industrial and industrial fleets. Line fishing using live bait is also being promoted instead of gillnet fishing particularly in the northeastern peninsula of Trinidad and modifications to the design and use of gillnets are promoted in an effort to reduce the incidental capture of marine turtles (Eckhert and Eckhert, 2005). Some recreational fishers also utilize lines (trolling and a-la-vive or live-bait fishing) and therefore it is assumed that the capture of marine turtles is not an issue in recreational pelagic fisheries.

Some pelagic species of sharks (e.g. shortfin mako) are caught incidentally in recreational fisheries as well as commercial fisheries using longlines. Sharks are known to occupy a high position in the trophic web as top predators. Due to their life history (producing a few live young at a time and late maturation) most Atlantic pelagic sharks exhibit limited biological productivity and therefore can be overfished at very low fishing mortality (ICCAT, 2012a). As a result, the combined impacts of both commercial and recreational fishing mortality on sharks is cause for concern, particularly since catches, landings and fishing effort are not well documented in the region.

6.4 Post-release mortality

Despite efforts to reduce fishing mortality through release of fish caught, method of capture (e.g., the types of hook used) and manner of handling (length of tackle period, damage during hook removal, period of retention out of water) can result in physical trauma, psychological stress and ultimately resulting post-release mortality and increased risk of predation (Skomal, 2007; FAO, 2011). However, such mortality has not been quantified in the Eastern Caribbean region.

6.5 Technological improvements

Both recreational fishing vessels, particularly those of the sport fisher type, as well as commercial longliners, utilize global positioning systems (GPS) as well as fish finders. These devices considerably increase the efficiency of fishing. Aggregations of fish which constitute popular fishing grounds, the

location of which would have been secretly guarded in the past, are now easy to locate and consequently the likelihood of overfishing is greater. It should be noted that recreational fishers employ similar fishing methods to commercial fishers, troll lines and a-la-vive fishing mainly.

7. CONFLICTS AND COOPERATION OF MULTIPLE USERS OF THE ECOSYSTEM

Generally, concerns were expressed among anglers in respect of the impacts of commercial fishing and, in particular, longlining by foreign vessels, on the stocks of fish they target. They were of the opinion that foreign longliners contribute to overfishing of the resources and block the movement of fish into fishing areas targeted by recreational fishers in the region. De Silva (2011) identified unsustainable fishing practices such as illegal driftnetting and shark finning by foreign fleets and significant quantities of billfish in the by-catch of both foreign and regional fleets (Grenada, Barbados and fishing around FADs in Martinique) as the major concerns of recreational fishers in the Caribbean. The efficient catching and possible decline of flyingfish resources, which is a source of food for many pelagic species including billfish, is also thought to be a threat to the pelagic fisheries resources. De Silva (2011) advocates for the institution of catch quotas for billfish caught commercially (catch limits already apply to ICCAT Contracting Parties), the promotion of catch and release and delivery of related training and awareness programmes among recreational fishers and institution of programmes to "take billfish off the menu". He supports development of the "catch and release" charter fishery as a greater source of revenue (through foreign exchange) than the sale of billfish by the commercial fishery.

Barbados

Recreational and commercial fishers cooperate to assist each other during distress at-sea and in sharing of information regarding currents, tides, fishing area locations and in providing each other with bait (Antia *et al*., 2002; Peirce, 2009). The major sources of conflict between the two subsectors are: (1) inadvertent destruction of commercial fishing gear, which is either unmarked or poorly marked, by recreational fishing boats; (2) competition for fish aggregated around marine debris; and (3) market competition for the sale of fish (Antia *et al*., 2002). Through the sharing of knowledge specific fishing techniques and equipment such as depth sounders, GPS plotters, downriggers, rods and fishing lures have been adopted by commercial fishers (Peirce, 2009). The allocation of space at the recently expanded marina at Port St. Charles is a source of conflict between local and foreign recreational fishers, with potential to impact negatively on local fishers who depend on the sale of their catches to upkeep their vessels (Peirce, 2009).

Grenada

Recreational fishers are of the view that commercial fishers do not recognize their right to fish in the same waters and continue to undermine their conservation efforts by capturing and landing billfish which they have previously caught and released. Consequently, recreational fishers hold commercial fishers accountable for the overexploited status of billfish and the negative impacts on their industry by way of reduced opportunity to experience the challenge of catching such fish. In the past there has been conflict between the two groups for use of sea space[25]. This conflict arose because recreational fishing vessels fished in the same areas as commercial fishers, causing entanglement and destruction of commercial fishing gear. Also, recreational fishers were thought to benefit from the aggregation of pelagic fish around devices set by commercial fishers to attract the fish. This situation has been resolved by the zoning of fishing areas for commercial and recreational purposes.

[25] Justin Rennie, Chief Fisheries Officer, Grenada Fisheries Department (pers. com.)

Saint Lucia

In the mid-1990s members of the Saint Lucia Game Fishing Association claimed that commercial longlining of neighbouring islands and local experimental longlining were causing a rapid decline in the billfish population, however such claims were not substantiated by data and information. Currently, the main sources of conflict between recreational and commercial fishers pertain to the use of Fish Aggregating Devices (FADs), in particular competition for space and access to aggregated fish. Commercial fishers contend that it is more difficult to catch fish already caught and released by recreational fishers[26]. As well, commercial fishers are of the view that the noise emanating from large engines used by recreational fishers is disruptive to fishing. They experience congestion around FADs due to the larger recreational vessels which make it difficult for them to maneuver after a fish has been hooked. They also feel that recreational fishers are responsible for the cutting of their fishing lines.

Trinidad and Tobago

In Trinidad and Tobago the main sources of conflict are in respect of the operations of foreign longliners targeting similar species, impacts of seismic surveys conducted by the oil and gas sector on fish populations and unsustainable fishing practices of commercial fishers. Other issues related to multiple use of the ecosystem include pollution, banditry and piracy (Shoy, 2010).

Valdez (2011) noted that participants of the fishing tournaments hosted by the TTGFA have experienced a marked decline in their catch rates from year to year and attributed this decline to the activities of foreign longliners, which utilize Trinidad and Tobago either as a transhipment port or to export their catch, but provide very little opportunity for employment locally. These sentiments were also expressed by charterboat operators and the TTGFA. The Association has expressed concerns over the lack of monitoring of fish transhipment activities of a foreign company based at Sea Lots, Port of Spain and the unsustainable fishing practices believed to be undertaken by the foreign vessels associated with the company. There is also concern that the foreign longliners, which operate between 200 and 400 miles off the coast and target tuna and swordfish, also catch several other species as by-catch that are of specific importance to Trinidad and Tobago.

Valdez (2011) also expressed concern regarding the impacts of seismic surveys on survival, abundance and catch rate of fish. He noted the significant drop in catch rates experienced during, and long after, the conduct of seismic surveys, corroborated by a number of international studies, and believed to also impact migratory species. The TTGFA attributed the conduct of seismic surveys, three to four months prior to the 2011 international billfish tournament off Tobago, as the reason for the decline in billfish catch (15 fish caught and released), compared to the 51 billfish caught and released during the 2012 tournament when there was no seismic activity.

Recreational charter boat fishers in Trinidad have also expressed concern about the unsustainable fishing practices being conducted by commercial fishers (transparent gillnets and trawling) and the continued operation of some charter fishing boats without appropriate insurance coverage for clients. Disregard for existing laws in respect of mesh size restrictions have contributed to the current overfished situation for many species of commercial importance. In addition, transparent gillnets contribute to the destruction of turtles and marine mammals such as dolphins. When these nets are lost they continue to fish (ghost fishing). Trawlers also cause damage to important fish breeding grounds in the Gulf of Paria, posing a threat to future efforts to further develop the Tarpon fishery. Some were of the opinion that trawling should be banned and that surveillance by the Trinidad and Tobago Coast Guard should be strengthened to enforce the fisheries laws.

[26] Saint Lucia Fisheries Department – email communication

8. CURRENT MANAGEMENT REGIME OF THE RECREATIONAL FISHERY

Generally in the Eastern Caribbean region, recreational fisheries are unmanaged and there is, except for billfish species, a lack of readily available information for decision-making.

8.1 Prevailing management questions

Essentially the prevailing management questions pertaining to marine recreational fisheries seek to ascertain basic information required to make informed decisions. More specifically, the relative impacts of commercial and recreational fishing, in respect of the quantities and species of fish caught as well as the size and state of maturity of such fish, are critically important in deciding the management measures that are most feasible to implement and which will have the greatest impact on recovery of those stocks that are overexploited.

Basic questions in relation to the number of recreational fishers and fishing vessels remain unanswered. The difficulties in quantifying these parameters are linked to challenges in identifying recreational fishers. In several countries recreational fishers use similar gear as commercial fishers (e.g., use of troll lines, live-bait fishing in Trinidad (Mike, 2003), sell their catch to cover fishing trip costs or earn extra income (Mike, 1993; Antia *et al*., 2002; Gillet *et al*., 2007) and are unwilling to acknowledge their fishing status if this action precludes them from accessing incentives intended for commercial fishers (as is the case in Trinidad and Tobago and documented in Grant, 2008). It is also difficult to ascertain from the records of various government agencies (Fisheries Departments, Maritime Services Divisions, Ministry of Tourism) the actual number of recreational fishing vessels as these vessels are not well monitored and regulations regarding registration not effectively enforced.

In addition, other information critical for management, such as the fate of the catch, the level of employment associated with the industry and the socio-economic value of the industry is also not readily available. There is evidence that tag and/or release is practiced but the respective record-keeping at the national level is poor. A related management question pertains to the level of post-release mortality of tagged fish, particularly for those species of regional importance (Wahoo, Common Dolphinfish, King Mackerel, Serra Spanish Mackerel and Yellowfin Tuna), for which no data are currently available.

Another critical fisheries management question relates to whether or not recreational fishers should be allowed to sell their catch as many claim to do so to offset the cost of fishing. The answer is contingent on the status of the respective resource, the current levels of commercial catches, whether or not there is a "surplus" to which recreational fishers can have access and possible market competition with commercial fisheries. A possible solution is discussed in sub-section 11.1 on Fisheries Management.

8.2 Fishery governance

Four regional initiatives are likely to impact directly on recreational fisheries in the region: (1) the Draft Agreement Establishing the Caribbean Community Common Fisheries Policy; (2) the Saint Lucia (Castries) Declaration on Illegal, Unreported and Unregulated (IUU) Fishing of July 2010; (3) the Caribbean Regional Fisheries Mechanism's Working Group on ICCAT and (3) the recent establishment of the joint Western Central Atlantic Fishery Commission / Organization of Fishing and Aquaculture in Central America / Caribbean Regional Fisheries Mechanism / Caribbean Fishery Management Council Working Group on Recreational Fisheries (WECAFC / OSPESCA / CRFM / CFMC Working Group on Recreational Fisheries).

Member States of the Caribbean Regional Fisheries Mechanism, comprising several countries of the Eastern Caribbean, recognize the importance of collaboration for conservation, management, sustainable

utilization, and development of fisheries resources and related ecosystems and for implementation of internationally accepted best practices in this regard. Consequently, these countries have committed to articulating an agreement for establishment of a Common Fisheries Policy. Currently this draft agreement is under review by the legal arm of the Secretariat of the Caribbean Community. Once endorsed at the national level this Agreement is to be implemented through a series of protocols to be negotiated among the parties. Though the agreement does not specifically identify management measures for recreational fisheries it addresses, in general, issues related to the management and conservation of all stocks that are shared among Parties to the Agreement.

The Saint Lucia (Castries) Declaration on IUU Fishing sets forth the commitment of member States of the Caribbean Regional Fisheries Mechanism to work together, along with regional and international partners to identify, prevent, deter and eliminate IUU fishing in the Caribbean, to strengthen efforts to effectively implement relevant international instruments to protect, conserve, manage and use the fisheries and other living marine resources and their ecosystems in a sustainable manner. Signatories to the Declaration recognize the primary responsibilities of Flag, Port and Coastal States to establish and implement a comprehensive and integrated approach to addressing IUU fishing, along with market related measures and measures to ensure that nationals do not support or engage in IUU fishing in order to address the economic, social and environmental impacts of IUU fishing.

The CRFM Working Group on ICCAT, endorsed by the Caribbean Fisheries Forum in March 2012, is intended to strengthen the region's positioning in respect of securing the desired benefits of the respective countries, to achieve a more coordinated approach towards participation in ICCAT's conservation and management activities and to strengthen the present CARICOM/CRFM working relationship with ICCAT. The Working Group is expected to monitor development at ICCAT and to consider and formulate regional strategies and responses to address critical issues of common concern. It is also charged with the responsibility to establish and implement a communication, education and reporting strategy to facilitate multi-level support for proactive participation in ICCAT and to undertake any ICCAT-related tasks directed by the Forum.

The WECAFC / OSPESCA / CRFM / CFMC Working Group on Recreational Fisheries, established at the Fourteenth Session of the Western Central Atlantic Fishery Commission, held in Panama between 6 and 9 February 2012, is charged with the responsibility to begin implementation of the FAO Technical Guidelines for Responsible Fisheries: Recreational Fisheries. Specifically the Working Group is expected to develop an assessment methodology for the socio-economic valuation of recreational fisheries in the Wider Caribbean Region and to test such methodology in the Eastern Caribbean/Lesser Antilles States; to prepare a recreational fisheries data collection scheme for testing in the WECAFC region and to prepare a draft Billfish management and conservation plan for the wider Caribbean Region for endorsement by WECAFC, OSPESCA, CRFM, CFMC and ICCAT.

Internationally, a working group on recreational fisheries was established by the Standing Committee on Research Statistics as agreed at the 2006 meeting of the International Commission for the Conservation of Atlantic Tunas (ICCAT). In the Eastern Caribbean Barbados, St Vincent and the Grenadines and Trinidad and Tobago are Contracting Parties to the International Convention for the Conservation of Atlantic Tunas and therefore have an obligation to comply with the respective management recommendations. The working group, which met for the first time in 2009, is charged with the responsibility to: (1) examine the biological and economic impact of recreational and sport fishing activities on ICCAT managed stocks and assess the level of harvest; (2) identify approaches for managing the recreational and sport fishing activities in ICCAT fisheries; and (3) report the results of deliberations to the Commission and make recommendations for next steps to manage the recreational and sport fishing activities in the Convention area (ICCAT, 2012b). In keeping with its mandate the working group has recommended that Contracting and Co-operating Parties (CPCs) document the elements of their recreational fisheries and collect data to

enable accurate estimation of total removals and post release mortality. The ICCAT has in turn identified minimum standard practices for data collection which include data on: (1) catch by species; (2) length / weight of landed fish; (3) discards by species; (4) length / weight of discarded fish; (5) disposition of discards; (6) location and time of fishing trip; and (7) estimation of release mortality by species. The working group, in light of differences among CPCs as to what constitutes sport and recreational fisheries, has undertaken to articulate a common definition for future use. Due to general concerns regarding the lack of data and information on sport and recreational fisheries the working group requires all CPCs to submit a description of their respective fisheries and has committed to investigation of methods for monitoring and evaluating recreational fisheries in 2012 (ICCAT, 2012b), consistent with ICCAT Resolution 99-7 which aims to improve recreational fisheries statistics. In addition, the working group intends to articulate measures regarding management, control and monitoring of sport and recreational fisheries.

In respect of the country-specific legislation for the Eastern Caribbean, current legislation for all countries, except Trinidad and Tobago provides specifically for regional cooperation in fisheries management. The elements of the current fisheries legislation relevant to recreational fisheries are presented below.

Antigua and Barbuda

The Fisheries Act No. 22 of 2006 includes the recreational fishery in its overall definitions of "fishery", "fishing vessel" and more specifically "foreign sports fishing vessel". The Act promotes a precautionary approach to fisheries management and makes provisions for the development, implementation and review of fisheries management and development plans, establishment of a Fisheries Advisory Committee (though such a Committee has not yet been established), regional cooperation in fisheries management, registration and licensing, among other management measures. Recreational fishing vessels are required to be registered and the Chief Fisheries Officer is required to keep a register of local fishing vessels. Both local and foreign sport fishing vessels are required to be licensed. Foreign sport fishing licences are not contingent on an agreement between the Government of Antigua and Barbuda and the respective State or association as with licences for other foreign vessels. In fact such licences are waived for sport fishing tournaments. Further, greater leniency is applied to the penalty for foreign sport fishing vessels fishing in the waters of Antigua and Barbuda without a valid licence or in violation of a condition of an existing licence compared to other foreign fishing vessels, the penalty being US$111,111 (EC$300,000) compared to US$1,111,111 (EC$3 million). The Act also makes provisions for the Minister to make regulations in respect of organizing and regulating sports fishing in the waters of Antigua and Barbuda. Recreational fishing vessels are not entitled to fisheries subsidies.

Barbados

Barbados has not yet developed a policy for the utilization of its exclusive economic zone but has promoted a policy of delimitation of maritime boundaries of CARICOM member states and utilization of the resources therein as common resources in respect of fisheries, with management at the regional level (Barbados Fisheries Division, 2004).

The Fisheries Act of 1993 (Chapter 391, amended in 2000) makes provisions for fisheries management and development schemes, establishment of a Fisheries Advisory Committee, regional cooperation in fisheries, registration and licensing, among other management measures. The Act includes recreational fishery in its overall definition of "fishery". It specifically defines commercial fishing as *fishing for the purpose of selling all or any of the fish caught*, implying that once fish is sold the activity cannot be considered as recreational and this is emphasized in the definition of sport fishing (*fishing for the purpose of recreation, personal consumption or competition)*. The current Fisheries Advisory Committee includes

representation from four members of the fishing industry and one from fishing associations; however, the recreational fishery sub-sector is not currently represented. The Act provides for the licensing of commercial fishers and registration and inspection of commercial fishing vessels only. In the case of foreign fishing vessels, the Chief Fisheries Officer, unless authorized under regulations made to give effect to a licensing programme, may not refuse to issue or renew a sport fishing licence *if he is satisfied that the vessel will be engaged only in a specific activity in the waters of Barbados*. However, anyone fishing in contravention of any condition of a sport fishing licence is subject to a fine not exceeding US$25,000 (BB$50,000), or to imprisonment for twelve months, or both. The Chief Fisheries Officer is required to keep a register of local, commercial fishing vessels which have a valid certificate of registration i.e. a register of recreational fishing vessels by the Chief Fisheries Officer is not mandatory. The Act also requires that organizers of sport fishing tournaments provide statistical information on catches taken during the course of the tournaments and for the licensing of sport fishing clubs. Current regulations prohibit the landing of Yellowfin and Bigeye tuna that are less than 3.2 kg live weight and the use of pelagic drift nets that are greater than 2.5 km in length.

Most sport fishers are of the opinion that fisheries managers do not appreciate marine recreational fishing (Antia *et al*., 2000). The Fisheries Management Plan (Barbados Fisheries Division, 2004) recognizes the importance of the large pelagic fishery to recreation and tourism through game fishing tournaments and charter boat operations. The Plan suggests other possible management measures such as catch quotas, minimum size-at-capture and gear restrictions, restrictions on the number of fishing vessels and special requirements for export. The Plan recognizes the shared and straddling nature of pelagic resources and consequently the need to manage such resources at the very least at the regional level (Eastern Caribbean) cognizant of the management units utilized by the ICCAT[27].

Recreational fishers understand that due to increasing exploitation of the resources there is need to implement management measures which may entail increasing the number of rules and regulations at fishing tournaments. Consequently, more rules have been implemented at fishing tournaments, consistent with requirements of the International Game Fishing Association and including minimum retention weights (Antia *et al*., 2002). Regarding other possible management measures such as bag limits, catch and release and prohibition of sale of fish, the level of acceptance of these measures by anglers depends on their reasons for fishing and the target species. Consequently, those who fish for the challenge and target marlins support catch and release while those who target dolphinfish do not. Those who fish primarily for the consumption of fish and target dolphinfish do not support a bag limit or prohibition of sale. Antia *et al.* (2002) concluded that consumption and sale of fish are important elements to be considered in the management of marine recreational fisheries in Barbados. The authors suggested that the trade-off between an unregulated local longline fishery and regulating billfish harvests to enhance the recreational fishery (which in turn would focus on catch and release) be considered in the fisheries management plan.

Grenada

The existing Grenada Fisheries Policy seeks to promote sustainable development of the pelagic fishery, to promote development of the catch and release sport fishery and to establish linkages with international regulatory bodies, such as the International Commission for the Conservation of Atlantic Tunas, in order to access vital information to properly manage pelagic fisheries (Isaac, 2011). This policy is currently being revised; the new policy[28] will recognize the current important and potential contribution of

[27] Barbados has been a Contracting Party to the International Convention for the Conservation of Atlantic Tunas since 13th December 2000.

[28] Currently the Grenada Fisheries Department, with funding and technical assistance from the regional ACP Fish II Programme, *Strengthening Fisheries Management in ACP Countries*, is developing a new fisheries policy which will give consideration to issues in respect of recreational fisheries.

recreational fisheries to economic and social development and the need for effective management and data gathering and analysis.[29] The Grenada Fisheries Act No. 15 of 1986 makes provisions for inclusion of recreational fisheries in its definitions of "fishery" and for sport fishing in its definition of "fishing vessel". In general the Act makes provisions for management and development plans, establishment of a Fisheries Advisory Committee, regional cooperation in fisheries management, licensing and registration fishers, licensing of local fishing vessels (both commercial and recreational) and foreign fishing. Although the Port Authority is responsible for the registration of all ships in Grenada, the Fisheries Division maintains its own registration records for fishing vessels and implements a vessel inspection scheme to ascertain a vessel's fitness for the purpose of fishing. Over the last three years the relevant provisions have been implemented for all vessel types, except recreational vessels. The Grenada Fisheries Department intends, in the near future, to implement a comprehensive programme to register and license all vessels involved in the recreational fishery[12]. Participation of foreign vessels in the Spice Island Billfish Tournament has been facilitated through issuance of licences, the cost of which has been waived in recent years as a means of encouraging participation in light of the perceived overall national economic benefits that accrue from such events.

According to the Grenada Statutory Rules and Orders No. 9 of 1987 the Fisheries Advisory Committee includes representation by three persons from among professional fishermen. There is also representation of the yachting association and dive fishers on the Fisheries Advisory Committee, which may represent the concerns of some recreational fishers but generally there is no specific representation of recreational fishers, particularly those targeting offshore, large, migratory pelagics. Contravention of any condition of a sport fishing licence is subject to a penalty of US$3,681 (EC$10,000). Regulations for local fishing licences provide for the submission of logbook data. The Act empowers the Minister (with responsibility for fisheries) to make regulations in respect of the organization and regulation of sport fishing in the fishery waters. Current regulations (Grenada Statutory Rules and Orders No. 9 of 1987), however, do not address recreational or sport fishing specifically. Incentives are not provided for recreational fishing vessels and there are no restrictions on the sale of catch in the recreational fishery. The Statutory Rules and Orders offer some protection against damage to local fishing operations, including non-commercial operations, by foreign fishing vessels licensed to operate in the fishery waters. Regulations also prohibit the capture, sale and purchase of turtles and turtle eggs.

Saint Lucia

The Saint Lucia Fisheries Management Plan of 2006 seeks to promote the sustainable development of commercial and sport fisheries for large pelagic species and to cooperate with other Caribbean States to manage the respective resources (Saint Lucia Department of Fisheries, 2011). The Saint Lucia Fisheries Act No. 10 of 1984 makes provisions for inclusion of recreational fisheries in its definitions of "fishery" and for sport fishing in its definition of "fishing vessel". The Act makes provisions for management and development plans, regional cooperation in fisheries management, licensing and registration fishers, licensing of local fishing vessels (both commercial and recreational) and foreign fishing. Although the Act also makes provisions for establishment of a Fisheries Advisory Committee, these provisions have not yet been implemented. The Act is similar in its treatment of recreational or sport fishing as the Grenada Fisheries Act. In addition, the Saint Lucia Fisheries Regulations of 1994 (Saint Lucia Statutory Instruments 1994, No. 9, Part V) define "sportfishing" as *fishing by any vessel within the fishery waters for sporting purposes or for purposes other than commercial*. The Regulations require that the convener of a fishing tournament obtains the approval of the Minister with responsibility for fisheries, that vessels engaged in the sport fishery be licensed and outline the conditions attached to a licence as well as provide specific rules for sport fishing. Licences for participation of foreign fishing vessels in recreational fishing tournaments cost US$73.60 (EC$200) per trip or US$368 (EC$1000) annually for vessels that are not

[29] Justin Rennie, Chief Fisheries Officer, Grenada Fisheries Department (pers. com.)

authorized to use more than six reels and US$2,576.47 (EC$7000) per year for vessels that are authorized to use more than six reels[30]. Such licence fees are however, normally waived. Although a condition of the Minister's approval for convening of fishing tournaments is that tournament organizers submit catch and effort data to the Fisheries Department, such a requirement is not enforced. General sport fishing rules for pelagic species require that sport fishing be conducted using traditional methods of angling with a hook or lure attached to a line held in the hand or attached to a pole, rod or reel; limit the number of rods or reels to eight, except where authorized; limit the number of migratory pelagic fish that could be caught (no more than 18 King Mackerel, Common Dolphinfish or Wahoo); advise that fish not intended to be used be released; and prohibit the carrying on board of turtles. Recreational fishers are currently afforded incentives from the Ministry of Tourism.

Trinidad and Tobago

The current Fisheries Act of 1916 and the associated Regulations do not specifically address the issue of recreational fishing, nor do they make provisions for fishery management plans, establishment of a Fisheries Advisory Committee or licensing and registration. The Act is also limited in its jurisdiction to the rivers and Territorial Sea of Trinidad and Tobago. It makes provisions for the Minister to make regulations prescribing the dimensions of fishing nets or appliances for fishing and their use, restricting the size of fish in the catch, prohibiting the sale of certain species, declaring prohibited areas and restricting fishing areas and times. Regulations specify the dimensions of specific nets, some used to catch King Mackerel, Serra Spanish Mackerel and Crevalle Jack, which are targeted in recreational fisheries but with different gear (pelagic lines). A size limit of 30.48 cm (twelve inches) is imposed on catches of Kingfish and Serra Spanish Mackerel, among other species and sardines can be sold only to bona fide fishermen for use as bait. Foreign fishing in the waters under the jurisdiction of Trinidad and Tobago is currently regulated under the Archipelagic Waters and Exclusive Economic Zone (EEZ) Act (1986). This act provides for the conservation and management of living resources within the Exclusive Economic Zone, the determination of total allowable catch and foreign access to the fisheries resources in the Territorial Sea, Archipelagic waters or EEZ, as well as licensing of foreign fishing vessels. The Act also makes provisions for a Certificate of Exemption from the requirement for a foreign fishing licence and empowers the President to make regulations in respect of the protection and preservation of the marine environment, licensing of persons as foreign fishers, setting of catch quotas, regulating the sizes of fish that may be caught, imposing seasonal and fishing area closures among other management measures. Currently however, there is no specific management regime for the recreational fishery.

Some recreational fishing vessels are currently entered in the records of the Fisheries Division while some vessels are licensed under the Motor Launches Act, enforced by the Maritime Services Division of the Ministry of Transport. The current policy excludes the provision of concessions and subsidies on recreational fishing vessels as such measures, when initially implemented, were intended to facilitate development of the commercial fishery as a source of livelihood and national food security. In addition, the organizers of fishing tournaments upon request are granted a waiver (in lieu of a Certificate of Exemption) from the license requirement for foreign fishing vessels under the Archipelagic Waters and Exclusive Economic Zone Act. The waiver usually lists the species to be caught, is contingent on the organizers providing data on the number of participating vessels, individual weight of all fish weighed by species, a list of species caught but not weighed and the respective weight estimates and a list of species tagged with estimated sizes. However, this requirement for data submission is not enforced. The waiver also instructs that foreign fishing vessels report to the Trinidad and Tobago Customs on entry into and departure from the waters of Trinidad and Tobago. Recreational fishers are not currently engaged in fisheries management discussions however, the group was represented on the National Monitoring Committee on Foreign Fishing and Related Matters which existed from 1991 to 2008. This Committee

[30] Saint Lucia Fisheries Department

was charged with the responsibility to, *inter alia*, monitor the operations of foreign fishing vessels in Trinidad and Tobago waters, including compliance with conditions of access, monitor the characteristics of foreign fishing vessels that use Trinidad and Tobago for transhipment or landing to ensure compliance with international law and agreements, and to inform the Minister on industry activities that may adversely affect the conservation and management of living resources.

The proposed new fisheries legislation, which is intended to replace the Fisheries Act of 1916 makes provisions for consultation with stakeholders in the development of fisheries management plans and for representation by recreational fishers on the proposed Trinidad and Tobago Fisheries Advisory Board. The proposed new fisheries legislation also addresses recreational fishing explicitly. It defines recreational fishing as *fishing for recreation, competition or personal consumption, and not primarily for commercial purposes* and considers "sport fishing" and pleasure fishing" to have the same meaning as recreational fishing. The proposed new fisheries legislation makes provisions for the development, review and implementation of fisheries management plans, the establishment of a Trinidad and Tobago Fisheries Advisory Board (TTFAB), registration of fishers and recording of fishing vessels (commercial and recreational) as well as licensing of both local and foreign fishing vessels. Recreational fishing will be regulated through a licensing system while a participant in a recreational fishing tournament on board a foreign fishing vessel may apply for exemption from the requirement to be licensed. The proposed legislation also makes provisions for fishing without a fishing vessel and mandates the provision of data and information and stakeholder participation in the management process.

In respect of management issues faced by the recreational fishery sub-sector Shoy (2010) examined the factors negatively affecting recreational fishing in the northwestern peninsula of Trinidad and the majority of respondents indicated unsustainable fishing (41% of the 86 respondents), while 12.5% indicated the high cost of fuel, 10.7% indicated the lack of fishing regulations, 8.9% each indicated pollution and the availability, supply and cost of bait, 7.1 % expressed concern in respect of bandits and pirates, 7.4% indicated crew availability, 5.4% indicated overfishing, and 1.8% each indicated the cost of fishing equipment and lack of precaution taken by recreational fishers.

9. ASSESSMENT OF THE NATURE AND IMPORTANCE OF RECREATIONAL FISHERIES IN THE EASTERN CARIBBEAN AREA

Recreational fisheries in the Eastern Caribbean provide a source of leisure and relaxation for many persons who fish on weekends with their family and friends. Such fisheries also provide a challenge and hobby for sport fishing enthusiasts, both local and foreign, who participate in fishing tournaments. They also offer an alternative vacation experience to tourists visiting the region and provide an additional food source for recreational fishers and their families and friends as well as persons who benefit from a number of charitable organizations. In addition, through the establishment and strengthening of linkages among related groups (sport, recreational or game fishing associations or groups), the sharing of information, participation in extra-regional fishing tournaments and linkages with conservation and research institutions (such as The Billfish Foundation) there is increasing awareness of conservation issues and modern fisheries management and conservation practices among sport fishing enthusiasts in the region. Such enthusiasts are experienced fishers who fish for large, highly-migratory pelagics in offshore waters, many of whom are strong advocates for conservation of billfishes in the region.

From an economic perspective, recreational fisheries serve as a source of income to charterboat fishing operators and to fishers seeking to offset the costs of their fishing trips and vessel and engine maintenance. Charterboat fishing operators support ecotourism, in conjunction with catch and release programmes, as a greater contributor to income than the sale of fish for food. Local airline agencies, hotels, restaurants and other business enterprises (both of commercial and cottage types) benefit

financially from the influx of visitors associated with sport fishing tournaments while local suppliers of fishing vessels, engines, gear and other equipment and support services provided through maintenance of fishing vessels and engines also contribute to the economy.

Recreational fishers have contributed to conservation efforts and scientific research through participation in tagging programmes implemented by The Billfish Foundation. While some countries have sought to report on catches of large pelagic species to contribute to regional and international assessment, management and conservation initiatives, the lack of comprehensive data collection programmes for recreational fisheries is a continuing challenge that is evident in the sparse information base for management decision-making.

10. CONCLUSIONS

10.1 Main Findings

The main findings of this study are as follows:

(1) Recreational fisheries in the Eastern Caribbean are not well documented. Basic information on the number of persons and vessels engaged in this activity, the level of fishing effort and quantity of catches as well as the socio-economic impacts of this subsector necessary for management decision-making is not available in most countries. Although a few studies have been conducted on recreational fisheries in the region (Mike, 1993; De Beauville-Scott, 1994; Mike and Cowx, 1996; Antia *et al*., 2002; Peirce, 2009 and Shoy, 2010), they are limited in scope, focusing only on specific subsectors, rather than a comprehensive analysis of such fisheries.

(2) Landings of large pelagics in the Eastern Caribbean are dominated by dolphinfish, mackerels (including wahoo) and large tunas. In the recreational fisheries, landings (by weight) are dominated by dolphinfish, wahoo and yellowfin tuna. Catches of the recreational fishery are utilized for personal consumption, donated to charitable causes, sold to offset the cost of the fishing trip or to make a profit, released or tagged and released (billfishes).

(3) The exploitation of ecologically sensitive or overexploited species (e.g., marine mammals, turtles, seabirds, Silky Shark, Shortfin Mako and billfishes), either as a target or incidentally, is a feature of recreational fisheries which has not yet been quantified.

(4) Evidence of excessive fishing in recreational fisheries in Trinidad, due to the claims by some fishers that they sell their catch to avoid wastage, suggests the need for regulation of the fishery.

(5) Assessments of the status of large pelagic species of significant importance to recreational fisheries in the region (e.g., Common Dolphinfish, Wahoo, King Mackerel and Serra Spanish Mackerel produced results that are inconclusive. Major constraints to assessments are unavailability of data, poor data quality and uncertainties regarding stock structure.

(6) The main fishing season for large, highly migratory pelagic occurs from mid-November to May. These species are caught with troll lines or rod and reel from vessels of two major types, pirogues and sport fishers. The sport fishers are larger vessels with highly-powered engines, which are often chartered, and are fitted with modern navigation (GPS), communication and safety equipment.

(7) There is some level of organization of recreational fishers as evident in the existing Game Fishing Associations (Trinidad and Tobago Game Fishing Association, Barbados Game Fishing Association, Antigua and Barbuda Sport Fishing Association) and organizing committees for specific tournaments (Tobago International Game Fishing Tournament, Spice Island Billfish Tournament) which holds some promise for engagement of the sector in the management process. However, it appears that not all recreational fishers are members of such associations. Further,

there appears to be no similar organization of charter boat fishing operators, although such persons may themselves be members of Game Fishing Associations.

(8) Recreational fishers are not, but would like to be, actively engaged in fisheries management discussions with the respective fisheries administrations. In most instances the legal provisions for establishment of Fisheries Advisories Committees are not enacted and where they are, recreational fishers are not represented on the Committees.

(9) Commercial fishing is perceived to exert the greater impact on the resources and the socio-economic well-being of impoverished communities. Consequently, access to fisheries incentives is limited to the commercial subsector.

(10) Currently national game fishing organizations and organizers of fishing tournaments promote catch and release of over-exploited species (billfishes in particular), institute minimum landing weights for selected species and penalize anglers for non-compliance through a point-reduction system, while offering reward points for catch and release. Strong linkages among related organizations in Saint Lucia, Barbados, Grenada, Trinidad and Tobago and Martinique and collaboration with the Billfish Foundation as well as membership in the International Game Fishing Association (representatives from Barbados, Saint Lucia and Trinidad and Tobago) promote and strengthen awareness of international conservation efforts. Game fishing associations and tournament organizers seek to follow IGFA angling rules, but due to inadequate monitoring it is difficult to assess the extent to which IGFA rules are followed.

(11) Charterboat fishing operators in the Eastern Caribbean face a number of challenges: a declining client base due to reduction in tourism resulting from the global economic downturn; lack of appropriate marina facilities; high capital costs as well as duty and value-added taxes on fishing and related equipment; inaccessibility to government concessions; reduced emphasis on tourism development; high operational costs; lack of resources for global promotion and little opportunity for participation in the fisheries management process.

(12) Charterboat fishing operations have been severely impacted by the global economic downturn due to drastic declines in the number of tourists visiting the region. The only exception is in Trinidad where the clientele includes business travelers to the island as well as expatriates and members of the diplomatic corps. Despite the decline in business such charter boat fishing operators are able to continue operating because they are in receipt of other sources of income. In Grenada fuel and crew wages are the major components of annual fishing cost (26% and 25% respectively) while in Trinidad and Tobago vessel maintenance and crew wages are the major associated costs (25-36% and 18-19% respectively). Due to the Government's subsidization of fuel for local use in Trinidad and Tobago, the cost of fuel is not as significant as other countries in the Eastern Caribbean.

(13) The main ecological and technological dependencies with commercial fisheries relate to exploitation of natural prey of large pelagic species both for bait and as a food source, exploitation of top predators and resulting trophic and biodiversity impacts, negative impacts on ecologically sensitive and overexploited species which may be targeted or caught incidentally (by-catch) and mortality following release of fish.

(14) The major sources of conflict with other users of the ecosystem pertain to unsustainable fishing practices of local commercial vessels e.g., trawlers and gillnetters (Trinidad), the destruction of commercial fishing gear by recreational vessels, competition for sea space for the purpose of fishing and coastal space for mooring, as well as competition for fish around Fish Attraction Devices, competition for markets in cases where fish caught by recreational fishers is sold. There is also conflict with foreign commercial longliners which fish unsustainably (e.g. illegal drift netting, shark finning) and which are thought to block the movement of migratory pelagic fish from being accessed in areas traditionally fished by local fishers. The main area of cooperation between recreational and commercial fishers pertains to assistance at sea during times of distress and sharing of information on fishing technology.

(15) Except for Saint Lucia, none of the countries of the Eastern Caribbean have implemented regulations pertaining to recreational fishing specifically, apart from the waiving of licences to facilitate the participation of foreign vessels in local fishing tournaments. However, existing legislation makes provisions for implementation of a range of management measures e.g., size limits, closed seasons and areas, bag limits, among others through licensing and registration systems.

10.2 Study Limitations

The results of this study were impacted both in terms of the level of detail and the geographic and fleet coverage by a number of factors, including:

(1) The timing of the information-gathering component of this study coincided with the period when most Game Fishing Associations in the region were organizing their annual tournaments and consequently the Associations were unable to devote much time to providing the required information;
(2) Lack of awareness among stakeholders in respect of this study may have been a contributing factor to the low feedback received. While a description of the assessment and its objectives were provided in initial communication with relevant individuals and agencies, feedback may have been strengthened through promotion of the project by relevant national and regional authorities which have committed to participation in the CLME Project;
(3) In general, members of the industry are apprehensive about providing data and information for fear of taxation;
(4) The general culture in the Caribbean region which has not yet accepted electronic mail as a valid and expedient method of communication;
(5) The resources allocated to this assessment, which was undertaken over a 10-day Consultancy, did not allow for overseas travel to facilitate meeting directly with stakeholders in the recreational fishery. This situation, along with the limitation at (3) severely impacted the ability to acquire the necessary information. The importance of the personal interview process as an effective means of collecting data from charterboat operators, allowing for open-ended questions, a deeper understanding of the industry and acquiring sensitive business and economic information is documented in Stoll *et al* (2002). Although this approach was used in Trinidad and Tobago the same could not be implemented in other countries in the Eastern Caribbean due mainly to resource limitations.

11. RECOMMENDATIONS FOR RECREATIONAL FISHERIES MANAGEMENT AND FUTURE RESEARCH EFFORTS IN THE STUDY AREA

11.1 Fisheries Management

Since the species targeted by recreational fisheries (pelagic as well as reef and other inshore species) are also targeted by commercial fisheries, and the relative impacts of both components of the fishing sector on the respective stocks are not known, complementary management measures must be implemented in both fisheries to achieve long term sustainability of the respective resources. The respective management issues for pelagic fisheries (commercial and recreational) have been highlighted by Grant (2008). In respective of management efforts in the Eastern Caribbean however, it should be noted that traditionally commercial fisheries have played a critical role in achieving food security, in poverty alleviation and as a social safety net in rural communities where the opportunities for employment are limited. Consequently, the majority of fisheries administrations, faced with limited human and financial resources, have sought to make their management interventions in the most cost effective manner, through focusing on commercial instead of recreational fisheries.

The FAO Code of Conduct for Responsible Fisheries has clearly articulated a policy that favours the interest of subsistence and commercial fishers, over additional uses of fish stocks, particularly in developing countries. The Code seeks to protect the rights of fishers and fish workers, particularly those involved in subsistence, small-scale and artisanal fisheries as a means to securing their livelihood and promotes preferential access, where appropriate, to traditional fishing grounds and resources in waters under national jurisdiction. However, recognizing the ethical issues related to human welfare, freedom and justice the Code encourages managers to "*carefully value the basic interests of subsistence fisheries*" (assuming that this measure also applies to commercial fisheries), "*with more prosperous resident and non-resident recreational fisheries, and maintain access to resources and work for equal distribution of economic benefits associated with local recreational fisheries"*. Consequently, the need to integrate all aspects of fisheries into the policy framework and governance mechanisms and to promote stakeholder participation in the management process is apparent. In addition, management is to be supported by appropriate legislation and effective monitoring, control, surveillance and enforcement. It is to be noted that members of the Organization of Eastern Caribbean States have harmonized their fisheries legislation and sought to implement a joint fisheries surveillance and enforcement programme. In light of the current over or fully-exploited status, as well as unknown status, of some large pelagic fish stocks which are harvested by recreational fisheries in the Eastern Caribbean the following management measures are recommended (in no particular order of priority) and can be implemented through the licensing arrangements provided for in the current legislation or proposed legislation of the respective countries. The required data collection programmes and future research to support implementation of the management measures suggested are discussed in *Subsection 11.3 Future Data Collection and Research*.

11.1.1 Designation of size limits

Designation of size limits is recommended to reduce fishing mortality, particularly for fish which have not yet attained sexual maturity but not for fish populations which exhibit high densities and slow growth due to the tendency to lead to overpopulation and intra-specific competition (Lewin *et al*., 2006). Minimum size limits of 251cm and 168cm lower jaw fork length for Blue Marlin and White Marlin respectively, caught in recreational fisheries are recommended (ICCAT, 2000). Current legislation in the five Eastern Caribbean countries examined makes provisions for the use of size limits as a management measure (*Appendix 2*).

11.1.2 Designation of closed fishing seasons and fishing areas

Designation of closed fishing seasons and fishing areas are recommended to protect spawning fish and juveniles during periods of high susceptibility to mortality in critical fish habitats (spawning and nursery areas). Both measures can lead to rapidly developing and persistent effects such as average increases in densities, biomass, individual size and species diversity and can reduce negative ecological impacts such as habitat destruction by fishery-related activities (Lewin *et al*., 2006). However, their effectiveness varies depending on the species, functional guild, movement, home range as well as type, size and variety of habitats. Marine protected areas tend to favour short-lived and fast growing species with comparable home ranges, though resulting positive impacts may be compromised if the exchange rate between the reserve and open areas is high (Lewin *et al*., 2006). Consequently, complementary policies aimed at long term conservation of ecosystems and fish communities in non-reserve areas must also be implemented. Current legislation in the five Eastern Caribbean countries examined supports use of closed seasons, prohibited areas and marine reserves as management measures (*Appendix 2*). However, due to the extended distribution range of many highly-migratory pelagic species compared to the EEZs of the respective countries and the need for closed areas to be of sufficient size to achieve the desired effect on spawning stock and juvenile fish, implementation of closed areas in the region is likely to be impractical for such species.

11.1.3 Regulation of Fish Attraction / Aggregating Devices (FADs)

The use of FADs should be regulated to facilitate sustainable fishing practices. Unregulated use of FADs can lead to overexploitation of the respective fish stocks due to high fishing pressure on aggregated fish. Although more prevalent in the commercial fishery, some recreational fishers also utilize such devices e.g., fishers operating off the north coast of Trinidad[31]. There is international concern regarding the strong association of young age classes of Yellowfin Tuna with FADs and consequent increases in vulnerability to surface fishing gears, as well as possible negative impacts on the biology and ecology of the species due to changes in feeding and migratory behaviours (ICCAT, 2012a). Appropriate management measures are likely to be identified in current research by IFREMER in Martinique and the MAGDELESA Project in the Lesser Antilles, both cited in Reynal *et al*., (2012), as well as the pilot project on the FAD fishery for large pelagic in Dominica and Saint Lucia (JICA and IC NET Limited, 2012). Current legislation in all the Eastern Caribbean countries examined, except for Trinidad and Tobago, provides for regulation of the use of FADs through licensing and control as well as designation of rights to the aggregated fish (*Appendix 2*). Proposed new legislation in Trinidad and Tobago makes provisions for regulating the placement and use of such devices as a condition of a local fishing vessel license, sets out penalties for unauthorized interference, destruction, disturbance or removal of fish from such devices.

11.1.4 Implementation of bag limits

Implementation of bag limits in recreational fisheries is recommended to address the issue of market competition with commercial fisheries. In the absence of other management measures, however, bag limits have been found to be insufficient to limit total harvest because they restrict catch of individuals but not the number of anglers or the total catch and may lead to discarding of smaller fish in favour of larger ones (Lewin *et al*., 2006). Consequently, a suite of management measures is required to effectively address the problem and the support of stakeholders is critical in this regard. Regionally, tournament anglers in Barbados do not support bag limits for marketable species since certain species (e.g. Common Dolphinfish) are highly favoured for consumption and sale (Antia *et al*., 2002). The Draft Fisheries Management Policy for Trinidad and Tobago discourages competition of the recreational fisheries subsector with the commercial subsector due to the more sophisticated gear and equipment available to recreational fisheries (Trinidad Fisheries Division, 2011). In this regard, the Draft Policy supports appropriate measures, including imposition of catch limits in the recreational fishery. Current legislation in the countries examined do not make specific provisions for bag limits, but in existing provisions the licensing of fishing vessels, informed by fisheries management plans, can achieve the same purpose.

11.1.5 Use of technological solutions to reduce catches of non-target, ecologically-sensitive and over-exploited species

Technological measures should be implemented, either solely or in combination with other management measures, to reduce catches of ecologically sensitive and overexploited species. Such measures should be informed by research (see *Subsection 11.3 Future Data Collection and Research*). Possible technological solutions include changes in hook type and size (a change from "J" hooks to circle hooks has proven to significantly reduce mortality of billfishes), as well as identification of alternative types of bait type which can improve the selectivity of species in the catch as well as deter or promote avoidance of unwanted species (Cramer, 2004; Horodysky and Graves, 2005; Hall and Mainprizz, 2005). Regionally, in addition to licensing schemes, aspects of the fisheries legislation of the countries examined make provisions for regulation of fishing gear, fishing areas and times as well as the catching and utilization of fish caught incidentally (Appendix 2). The proposed new fisheries legislation for Trinidad and Tobago also makes

[31] Jonathan Delarosa, Island Yacht Charterers (pers. com.)

specific reference to consideration of discards, associated and dependent species in the setting of management objectives.

11.1.6 Conservation – catch or tag and release

Catch and release programmes should be promoted throughout the recreational fishery sub-sector (outside of the tournament scenario) for species that are over-exploited or of uncertain stock status (e.g., pelagic sharks), and tag and release efforts of the Billfish Foundation and ICCAT Enhanced Billfish Research Programme should be supported. Tag and release programmes seek to acquire vital biological information (e.g. migration patterns, age and growth rates, diving depths and sex ratios) which can contribute significantly to stock assessment, policy formulation, assessment of socio-economic importance of the fishery and effective management of the resources (http://billfish.org/sections/102-tag-release/posts). The Draft Fisheries Management Policy for Trinidad and Tobago (Trinidad Fisheries Division, 2011) promotes implementation of tag and release programmes for recreational fisheries. Effective implementation of such programmes will require (1) training of recreational fishers in best practices to reduce post-release mortality (FAO, 2011), species identification and methods of biological data collection; (2) exploration of best measures to reduce post release mortality of species of specific importance to the region (e.g., gear modifications, methods of fish handling, hook removal and disentanglement) and (3) identification of funding to purchase tags and other related equipment and to promote the programme.

11.1.7 Participation of stakeholders in the management process

Mechanisms to facilitate participation of stakeholders in the management process at several levels of governance (national, regional and international) should be developed and implemented.

At the national level, establishment of recreational fisher groups (comprising tournament and non-tournament anglers and charter boat fishing operators) should be facilitated and supported as a means of encouraging participation of this sub-sector in the fisheries management process. Currently the majority of recreational fishers are not members of such groups e.g., of the estimated 1,789 recreational fishers in the northwest of Trinidad (Shoy, 2010), only 210 are members of the Trinidad and Tobago Game Fishing Association. Consequently, recreational fishers should be encouraged to seek membership in existing formal organizations or establish new organizations to represent their respective interests in management discussions. Fisheries administrations, the Caribbean Regional Fisheries Mechanism, the Caribbean Network of Fisherfolk Organizations (CNFO) and existing national game fishing associations can play an important role in this regard.

Establishment of national fisheries advisory entities, as provided for in the respective fisheries legislation, should be expedited and representation of recreational fishers on such entities secured. The membership of existing fishery advisory bodies should be reconstituted to include representation by the recreational fishery subsector. Management discussions should involve all relevant subsectors (subsistence, commercial and recreational) to build awareness of the range of management issues, the challenges and opportunities facing each subsector and to promote meaningful discourse on management objectives and appropriate measures to be implemented across all subsectors of the pelagic fishery.

National inter-sectoral committees should be established to facilitate implementation of an Ecosystem Approach to Fisheries management. Such committees should be so constituted to ensure participation of a broad range of stakeholders for comprehensive identification of issues and development and integration of systems for effective management. Such committees may best operate under frameworks for an integrated approach to coastal zone management.

Recreational fishers and their respective groups should be required to support management decision-making by providing data and information on their fishing activities. This recommendation is currently supported by existing fisheries legislation in some countries (*Appendix 2*). Despite current efforts of game fishing associations to collect catch, release and effort data at fishing tournaments it is not apparent in most cases that the data are organized or electronically stored to facilitate easy retrieval and analysis. Such associations also experience a loss in "institutional memory" with changes in membership of tournament organizing committees, particularly when data from previous tournaments are not shared with new members. Consequently, there is need to strengthen these associations/organizations to improve the quality and types of data and information collected and to establish electronic databases to facilitate time series data analysis and reporting. Such support should include training programmes on species identification and methods of data collection and analysis as well as database development and maintenance.

At the regional and international levels stakeholder participation in the management process should be encouraged through the provision of resources to facilitate participation of national fisheries scientists in regional and international meetings to assess the status of large pelagic fish stocks and to contribute to improving the spatio-temporal coverage and quality of the respective datasets and reliability of management advice (e.g. the Annual Scientific Meetings of the Caribbean Regional Fisheries Mechanism and the meeting of the Standing Committee on Research and Statistics of the International Commission for the Conservation of Atlantic Tunas). In addition, resources should be provided for participation of fisheries administrators in the related management meetings to secure the respective interest of their countries and to facilitate development and implementation of national fisheries management plans which are consistent with regional and international initiatives for management and conservation of fisheries and biodiversity.

11.1.8 Adoption of international best practices for recreational fisheries

It is recommended that international best practices, as articulated in the FAO Technical Guidelines for Responsible Fisheries: Recreational Fisheries (FAO, 2011) be reviewed and modified to suit the Eastern Caribbean situation and programmes be developed and promoted among recreational fishers, and implemented in the context of the Code of Practice for Recreational Fisheries. The Code of Practice for Recreational Fisheries addresses, *inter alia*, issues of environmental stewardship and ethics, policy and institutional frameworks, compliance and enforcement, recreational fishing practices, fish welfare, stakeholder interactions, management, research and awareness, education and training.

11.1.9 Economic development - ecotourism

To fully realize the economic potential of the charter fishing boat component of the recreational fishing sub-sector ecotourism should be promoted as a viable option for increased foreign exchange while at the same time conserving the resources upon which the sub-sector depends through implementation of management measures discussed previously. It is recognized that one of the many reasons why countries have embraced marine recreational activities is their high economic benefits and that if such activities are undertaken in a manner which reduces their potential negative environmental impacts they can continually provide value from the same ecosystems or individual organisms through time (Cisneros-Montemajor and Sumaila, 2010). *Consequently, respective tourism policies must be aligned accordingly.* In Trinidad and Tobago the National Tourism Policy promotes the development of marketing strategies in collaboration with the Tobago House of Assembly and other key stakeholders which target selected niche markets and serve to enhance and promote regional sporting events among them, sport or recreational fishing, to maximize socio-economic benefits from the growing sports tourism market (Ministry of Tourism of Trinidad and Tobago, 2010).

Institutional linkages should be developed, and where these already exist they should be strengthened, to comprehensively address the challenges faced by charterboat fishing operators which serve as an impediment to development of the subsector, and in particular, development of ecotourism. Several Government agencies are of relevance in this regard, including those with responsibility for trade and finance (to minimize capital costs), infrastructure (provision of marinas); environment (to address issues of pollution, including waste disposal); maritime services (to address issues of health and safety); fisheries management; food production (to mitigate against any shortfalls in commercial fish production due to development of the recreational fishing sub-sector); tourism and the hotel industry (to facilitate promotion of sport fishing packages both locally and internationally).

While promotion of ecotourism is recommended however, the respective governments must be mindful of the tremendous impacts of tourism as an external driver to the recreational fishing sub-sector and put in place measures to minimize the economic impacts that may result from future global economic downturn given the experience in the region thus far.

11.1.10 Climate Change Impacts and Identification of Alternative Target Species

In light of impending impacts of climate change on the biology, distribution and availability of pelagic species in the region it is recommended that alternative species be explored for recreational fisheries. In Trinidad and Tobago the Tarpon is seen as a viable alternative. The impact of climate change is a cross-cutting issue with long term implications under the CLME Project. Predicted impacts include expansion of oxygen minimum zones, changes in primary productivity and ocean circulation patterns, sea level rise and extreme weather events with consequent changes in fish body size, reproduction, habitats, population growth, species abundance and distribution, community structure, biodiversity, trophic interactions, fisheries catches, economics of fishing and fisheries management approaches (Sumaila *et al*., 2011). Specifically in the tropics, fish catch potential is predicted to decrease with the situation compounded by acidification and reduced dissolved oxygen.

11.1.11 Integrated Coastal Zone Management

It is recommended that an integrated approach to planning and management of activities that impact on the coastal zone be adopted for the protection and development of coastal ecosystems and resources. Since such an approach necessitates that sectoral and public interests be taken into account it is recommended that recreational fishers be recognized among the relevant stakeholders. A number of issues related to use of the coastal zone pertain directly to the activities of recreational fishers. These issues include pollution (loss or discard of fishing gear that cause injury or mortality to other aquatic animals (see Cooke and Cowx, 2004), improper garbage and sewage disposal, spillage of vessel engine oil), biodiversity loss (through harvesting of ecologically sensitive and overexploited species and introduction of alien invasive species in ballast water) and competition for space related to use of the coastal zone.

Programmes for monitoring of hull condition and ballast water at marinas and systems for proper disposal of derelict vessels should be implemented to reduce the likelihood that these vessels may serve as vectors or reservoirs for introduced species. In Trinidad and Tobago the Water Pollution Rules, under the Environmental Management Act are pertinent. Alien invasive species are commonly introduced through hull fouling and the ballast water of marine crafts. Pleasure crafts, particularly those traversing international and regional waters, can serve as potential sources of macroalgal invasions in coastal areas (Mineur *et al*., 2008). Several large sport fishing vessels in the Eastern Caribbean participate in recreational fishing tournaments in other countries throughout the region as well as internationally and are likely to be moored at various marinas where such species may exist. Also, marinas in the Caribbean also accommodate a variety of pleasure crafts which are of foreign origin.

Countries which have not yet ratified international conventions to address issues of marine pollution should do so, and those that have, should develop the appropriate legislative framework and systems to meet the resulting national obligations. Addressing the issue of pollution however, requires a multi-sectoral approach as it is not one that is specific to the recreational fishing sub-sector, but pertains in general to the proper management of the coastal zone and the associated industries e.g., marinas and boat / ship yards, oil and gas companies. In Trinidad, the sediment of the coastal waters in Chaguaramas, a popular boating area, has been found to be contaminated with copper, lead, zinc, mercury and Butyl-tin (TBT), a compound associated with boat building and ship repair activities (ECLAC, 2002). Oil spills from vessels using two-stroke engines and improper waste disposal (including sewage) are also evident in the area. It should be noted that several countries of the Eastern Caribbean are already obligated to address the issue of pollution from ships through their ratification of the 1993 International Convention for the Prevention of Pollution from Ship (MARPOL) and associated Annexes as well as the 2001 International Convention on the Control of Harmful Anti-fouling Systems on Ships and the 2004 International Convention for the Control and Management of Ships' Ballast Water and Sediments (*Appendix 3*). These countries however, lack the legislative framework and systems to do so. It should be noted that the responsibility for implementation of these Conventions rests with the national authorities concerned with maritime services, which must by necessity collaborate with all relevant stakeholders, including the respective Fisheries Departments and fishers (recreational and commercial) to effectively meet their international obligations.

11.2 Future Data Collection, Analysis, and Research

Establishment of data collection programmes, or strengthening of existing programmes[32]*, to quantify current key elements of the recreational fishery subsector, to monitor developments over time and to inform the broader research agenda, as well as directed research in critical areas, is recommended to address the data and information requirements to inform management decision-making in the context of the Ecosystem Approach to Fisheries and mindful of the three transboundary issues identified under the CLME Project (overfishing, pollution and habitat modification or destruction)*. Such data collection programmes should be harmonized among countries fishing the same stocks. It should be noted that data collection on recreational fisheries should focus on the three components - fishing tournaments, charterboat fishing operations and recreational fishing by individuals "amateurs" or non-tournament fishing and that complementary programmes for commercial fisheries which target the same species and stocks as recreational fisheries are required for a comprehensive information base.

Specific programmes are recommended for the collection of data on:

(a) Catch - date of fishing, fishing areas (geographic coordinates) as well as landed weights, weight of by-catch (landed or discarded) by species;
(b) Fishing effort – details of gear type (type and strength of lines, types of hooks) and quantity; time spent fishing; number of vessels and number of fishers; and
(c) Releases - number, species and estimated weight of each fish caught and released, or caught, tagged and released along with the respective geographic locations.

[32] The case for strengthened data collection systems is supported by ICCAT Resolution 99-07 – Resolution by ICCAT on Improving Recreational Fishery Statistics which calls for each Contracting Party, Cooperating non-Contracting Party, Entity or Fishing Entity from 2000 to (1) provide specific data to the Standing Committee on Research and Statistics so as to allow the Commission to determine separately the magnitude of recreational fisheries of each species of Atlantic tuna and tuna-like fish; and (2) include a discussion in their annual reports to ICCAT of the techniques used to manage these fisheries. Within the eastern Caribbean Trinidad and Tobago, Barbados and St Vincent and the Grenadines are Contracting Parties to the International Convention for the Conservation of Atlantic Tunas.

Specific research programmes, which should be directed by policy, are recommended on:

(a) Species biology – sizes of fish caught; state of maturity, size at maturity, spawning seasons, spawning areas, age and growth; distribution, migration and home ranges of species of regional importance (e.g., Common Dolphinfish, Wahoo and King Mackerel);
(b) Socio-economic characterization of the recreational fishery subsector – demographics of members of the fishing sector including information on their full-time employment; cost of fishing, income from sale of fish, income from charter boat fishing, cost of hosting fishing tournaments, economic returns from tournaments and valuation of fishing tournaments;
(c) Assessment of the status of stocks targeted by recreational fisheries, including current population sizes and density;
(d) Economic evaluation of the recreational fishing subsector – this analysis should include the social, environmental and cultural value of recreational fisheries, the economic evaluation of fishing tournaments and charterboat fishing and should investigate the extent to which the sale of fish covers fishing costs or supplements the income of persons who have categorized themselves as recreational fishers. Techniques for conducting such analyses are detailed in Steinback (1999) and Pitcher and Hollingworth (2002);
(e) Assessment of the physiological impacts of tag and release or catch and release, in particular post-release mortality of dolphinfish and wahoo, which are of regional importance. FAO (2011) identifies factors that affect fish welfare and a previous study has indicated that post release mortality following tag and release of billfish is relatively low (10 to 15%) with shark attack rather than exhaustion being the main source of such mortality (Pepperell, 2000 cited by Genter Consulting Group, 2007). Approaches used to characterize physical trauma and psychological stress resulting from capture of sharks, tunas and marlin and consequences for post-release survivorship are described in Skomal (2007). However, similar studies for species of regional importance have not yet been conducted; and
(f) Identification of viable alternative target species for recreational fisheries in light of the likely declines in abundance and redistribution of the resources (large tunas and billfish) envisaged with climate change in future.

11.2.1 Suggestions for implementation of data collection programmes

Fishing tournament organizers should be mandated to provide the required information on target and incidental catches (landed and discarded), fishing effort and tag or catch and release. A logbook system may be implemented to acquire this information from charter boat fishing operators. Acquisition of information from non-tournament recreational fishers may require that a sampling system be implemented by fisheries administrations. Recreational fishers should be involved in the data collection exercises and be afforded the appropriate training. A critical requirement however, should be that all recreational fishers attain membership in Game Fishing Associations / Organizations so that such persons can be easily identified for survey and other management-related purposes.

11.2.2 Linkages between data collection and research programmes and proposed management measures

While in general the data collection and research programmes recommended will inform management decision-making, specific programmes will provide valuable information to direct the management measures suggested in Section 17.1. Research on sizes at maturity and at capture, details of gear used in recreational fisheries for capture of key species of importance in the region, along with information on growth rates, population size and density will inform the use of size limit as a management measure. In addition, research on spawning areas and times, distribution, migration and home ranges will provide information for implementation of closed fishing seasons, protected areas and closed areas. It is to be noted that Yellowfin Tuna spawn in the southeastern Caribbean, among other areas, (ICCAT, 2012a) but

the precise areas and times are not known. In respect of reduction in catches of ecologically sensitive and overexploited species, analysis of catch data to quantify the extent to which such species are targeted or caught incidentally and retained or discarded as well as the areas and times of such captures could assist in identifying the most appropriate management measure to be implemented. Likewise, analysis of catch data to identify the species composition of recreational catches and social and economic profiles along with results of stock assessments can be used to inform the use of bag limits as a management measure.

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14. APPENDICES

Appendix 1: List of Species

Common Name	Scientific Name	Common Name	Scientific Name
Albacore	*Thunnus alalunga*	Longnose lanternfish	*Alepisaurus ferox*
Atlantic bonito	*Sarda sarda*	Northern bluefin tuna	*Thunnus thynnus*
Atlantic pomfret	*Brama brama*	Oceanic Whitetip shark	*Carcharhinus longimanus*
Ballyhoo	*Hemiramphus brasiliensis; Hyporhamphus unifasciatus*	Oilfish	*Ruvettus pretiosus*
Barracuda	*Sphyraena* spp.	Porbeagle	*Lamna nasus*
Bigeye tuna	*Thunnus obesus*	Rainbow runner	*Elagatis bipinnulata*
Blackfin tuna	*Thunnus atlanticus*	Sailfish	*Istiophorus platypterus*
Blacktip shark	*Carcharhinus limbatus*	Sandbar shark	*Carcharhinus plumbeus*
Blue marlin	*Makaira nigricans*	Sardine	*Sardinella* spp.
Blue shark	*Prionace glauca*	Scad	*Decapterus* spp.
Bull shark	*Carcharhinus leucas*	Serra Spanish mackerel	*Scomberomorus brasiliensis*
Cobia	*Rachycentron canadum*	Shortfin mako	*Isurus oxyrinchus*
Common Dolphinfish	*Coryphaena hippurus*	Silky shark	*Carcharhinus falciformis*
Crevalle jack	*Caranx hippos*	Skipjack tuna	*Katsuwonus pelamis*
Flyingfish	*Hirundicthys affinis; Parexocoetus brachypterus*	Snake mackerel	*Gempylus serpens*
Great Barracuda	*Sphyraena barracuda*	Snappers	Lutjanidae
Grouper	*Mycteroperca spp.*	Southern red snapper	*Lutjanus purpureus*
Grunt	Haemulidae	Spinner shark	*Carcharhinus brevipinna*
Guachanche Barracuda	*Sphyraena guachanche*	Spratt	*Opisthonema oglinum*
Hammerhead shark	*Sphyrna* spp.	Swordfish	*Xiphias gladius*
Hatchet marlin		Tarpon	*Megalops atlanticus*
Herring	Clupeidae	Thresher shark	*Alopias* spp.
Jack	Carangidae	Tiger shark	*Galeocerdo cuvier*
Jewfish	*Epinephelus itajara*	Wahoo	*Acanthocybium solandri*
King mackerel	*Scomberomorus cavalla*	White marlin	*Tetrapturus albidus*
Leatherjack (Zapate)	*Oligoplites salien; Oligoplites saurus*	Yellowedge grouper	*Hyporthodus flavolimbatus*
Longbill spearfish	*Tetrapturus pfluegeri*	Yellowfin tuna	*Thunnus albacares*
Longfin mako	*Isurus paucus*		

Appendix 2: Fisheries legislation in selected Eastern Caribbean countries that support the recommended fisheries management and other measures

Proposed management and related measures	Antigua and Barbuda	Barbados	Grenada	Saint Lucia	Trinidad and Tobago
Size limits	Section 76(2)(b	Section 46(b)	Section 40(2)(b)	Section 39(2)(b)	Section 4(b)
Closed fishing seasons and areas	Sections 53 and 76(2)(b)	Section 46(a)	Sections 23 and 40(2)(b)	Sections 22 and 39(2)(b)	Section 4(c) and Marine Areas Preservation and Enhancement Act No. 1 of 1970
Regulation of Fish Attraction/Aggregating Devices	Section 76(2)(m)	Section 46(o)	Section 40(2)(o)	Section 39(2)(o)	None- but provisions in proposed new legislation
Bag limits	None; but can be a condition of fishing licence under Section 13	None; but can be a condition of fishing licence under Section 14	None; but can be a condition of fishing licence under Section 13	None; but can be a condition of fishing licence under Section 13	None- but provisions in proposed new legislation
Reduction in catches of non-target, ecologically-sensitive and over-exploited species	Section 76 (2)(b) and (d)	Section 46 (a) and (f	Section 40 (2)(b) and (d)	Section 39 (2)(b) and (d)	Section 4
Catch or tag and release	none	none	none	none	none
Implementation of data collection systems	Section 76(2)(v) Recording and timely reporting of fishery data and vessel data and information	Section 4(2)(d) fishery schemes for management and development of fisheries …indicating the main requirements for statistical information on the fishery and the means to obtain such information	none	none	None - but provisions in proposed new legislation
1. Antigua and Barbuda : Fisheries Act, No 22 of 2006					
2. Barbados: L.R.O. 1995, CAP.391; Fisheries Amendment Act 2000-8					
3. Grenada: Fisheries Act No. 15 of 1986					
4. St Lucia: Fisheries Act No. 10 of 1984					
5. Trinidad and Tobago: Fisheries Act No. 39 of 1916					

Appendix 3: International Conventions to Address Issues of Marine Pollution and Status of Ratification (R) by Countries of the Eastern Caribbean

Convention	AB	BA	DO	GR	SK	SL	SV	TT
International Convention for the Prevention of Marine Pollution from Ships (MARPOL) - 1993	R	R	R	R	R	R	R	R
MARPOL – Annex I – Regulations for the Prevention of Pollution by Oil (02 October 1983)	R	R	R		R	R	R	R
MARPOL – Annex II – Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk (02 October 1983)	R	R	R		R	R	R	R
MARPOL – Annex II – Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk (02 October 1983)	R	R	R		R	R	R	R
MARPOL – Annex III – Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form (01 July 1992)	R	R	R		R	R	R	R
MARPOL – Annex IV – Prevention of Pollution by Sewage from Ships (27 September 2003)	R	R			R	R	R	R
MARPOL – Annex V – Prevention of Pollution by Garbage from Ships (31 December 1988)	R	R	R		R	R	R	R
MARPOL – Annex VI – Prevention of Air Pollution from Ships (19 May 2005)	R	R			R		R	
International Convention on the Control of Harmful Antifouling Systems on Ships (2001) – Parties are required to prohibit and/or restrict the use of harmful anti-fouling systems on ships flying their flag, as well as ships not entitled to fly their flag but which operate under their authority and all ships that enter a port, shipyard or offshore terminal of a Party. This Convention seeks to eliminate the use of anti-fouling paints known to cause harm to marine organisms and humans.	R	R			R			R
International Convention for the Control and Management of Ships' Ballast Water and Sediments (2004) – This Convention seeks to prevent the spread of harmful aquatic organisms (e.g. alien invasive species) from one region to another by establishing standards and procedures for the management and control of ships' ballast water and sediments. Parties are required to ensure that their ships in international traffic comply with specified standards for the management of ballast water and sediments based on a ship-specific ballast water management plan.	R	R			R			R
AB: Antigua and Barbuda; BA: Barbados; DO: Dominica; GR: Grenada; SK: St Kitts and Nevis; SL: Saint Lucia; SV: St Vincent and the Grenadines; TT: Trinidad and Tobago								

CARIBBEAN PELAGIC RECREATIONAL FISHING, ECONOMIC GROWTH, POVERTY ALLEVIATION, AND FOOD SECURITY

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Abstract

This report (the "Report") aims to better characterize and quantify the economic importance of recreational fishing for highly migratory pelagic species (HMS) in the Northern Caribbean. Data was gathered for the Report through surveys distributed in Puerto Rico and the U.S. Virgin Islands (USVI) in the Fall and Summer of 2012. The Report supplements the broader Caribbean Large Marine Ecosystem and Adjacent Regions (CLME) Project (the "CLME Project") being conducted by the Caribbean Regional Fisheries Mechanism (CRFM) and offers insight to fisheries managers tackling significant challenges in the development of effective regional management strategies. Despite regulatory challenges, recreational HMS fisheries provide essential employment opportunities, vital food security, and significant prospects for economic development in the Caribbean and justify further socioeconomic study. While commercial fishing industries have a long history of participation in the regulatory process, recreational stakeholders have only recently began to garner the attention of Caribbean governments. The base of knowledge expanded by this survey will ultimately improve the standing of recreational fishing and associated tourism industries as an economic priority for the region. By improving the status of HMS, the oceanic ecosystems in which they live, and the fishing opportunities which they provide communities, positive economic returns may be generated for Caribbean nations and businesses.

1. INTRODUCTION

In light of waning fish stocks and the mutual ambition for economic development, many fisheries managers find themselves overlooking a precipice of political choice. The foreign distant-water commercial fishing industry offers the potential for rapid economic development for ambitious island territories. However, while marketing commercial fishing rights brings the promise of economic growth, it also involves necessary long-term economic and ecological consequences. The risk of such consequences warrants balanced consideration of alternatives. This Report explores one such alternative that might provide more sustainable economic development in the Northern Caribbean: a shift in domestic strategy to promote and protect the recreational fishing industry.

Advancement of the recreational fishery in the Northern Caribbean requires effective management across the greater Caribbean region. The recreational fishery depends upon pelagic fish that frequently roam through the marine boundaries delineated by nations. Indeed, the Exclusive Economic Zones (EEZs) of the dozens of Caribbean coastal territories cast a mosaic of sovereign marine jurisdictions over much of the Caribbean Sea that rarely corresponds with ecological boundaries (Chakalall *et al*., 1998). The CRFM was formed to help bridge the gaps between these sovereigns.

The CRFM was officially inaugurated on 27 March 2003, in Belize City, Belize, where it is headquartered, following the signing of the Agreement Establishing the CRFM on 4 February 2002 (FAO Regional Fisheries Bodies Summary Descriptions, 2012). It is an inter-governmental organization charged with the mission to "promote and facilitate the responsible utilization of the region's fisheries and other aquatic resources for the economic and social benefits of the current and future population of the region" (FAO Regional Fisheries Bodies Summary Descriptions, 2012). The CLME Project is a four-year Global Environment Fund (GEF) intervention worth a total of US $56,310,947[33] ($7,008,116 from GEF and $47,804,111 in co-financing. Project partners include 23 GEF countries, two associate countries and 11 organizations (CLME, 2012).

The overall objective of the CLME Project is to achieve sustainable management of the shared living marine resources (LMR) of the CLME through an integrated management approach that will meet the World Symposium on Sustainable Development (WSSD) target for sustainable fisheries (CLME, 2012). The specific project objectives include: to identify, analyze and agree upon major issues, root causes and actions required to achieve sustainable management of shared LMR in the CLME; to improve the shared knowledge base for sustainable use and management of trans-boundary LMR; to implement legal, policy and institutional (SAP) reforms to achieve sustainable trans-boundary LMR management; and to develop an institutional and procedural approach to LME level monitoring, evaluation and reporting (CLME, 2012). Ultimately, the CLME Project should improve food security and enhance livelihoods in coastal communities that rely on fisheries and tourism.

CRFM has reached out to several non-profit organizations to help execute the recreational component of the CLME Project - one of which, The Billfish Foundation (TBF), prepared this Report. TBF was founded in 1986 as a science-based non-profit organization (TBF, 2012). It helps to ensure the conservation of billfish while protecting the economies of the many nations that depend upon them (TBF, 2012). While most know TBF for its successful tagging program, it has for years been a leader in advancing billfish socioeconomic studies. Socioeconomic studies like those it conducted in Mexico and Central and South America have provided empirical foundations upon which stronger and smarter policies have been constructed, (*See, e.g.*, Ditton & Grimes, 1995; Ditton & Grimes, 1996; Southwick 2008). The recent growth of TBF's Caribbean Campaign demonstrates a continued commitment to the advancement of sustainable fisheries policy based on science and statistical data.

[33] All currency figures denoted by "$" in this Report are in U.S. dollars.

This Report contributes to the CLME Project by characterizing the nature and quantifying the economic importance of recreational HMS fishing in Puerto Rico and the USVI—or the "Northern Caribbean." Data was collected from billfish anglers on species targeted, fates of fish caught, gear selection, direct expenditures, and other socioeconomic characteristics. Multiple pelagic species were inquired about, though the bulk of analysis pertains to billfish. "Billfish" include sailfish, swordfish, spearfish, and marlin—all of which are discussed here. Although it is now illegal for U.S. vessels to harvest billfish (excluding swordfish) commercially,[34] billfish have been pursued for sport in the Caribbean at a growing rate since the turn of the 20th century (Clark, Ditton & Chaparro, 1997). The steady increase in recreational fishing demands political attention and suggests a need to strengthen management measures (Cisneros-Montemayor & Sumailaa, 2010). A critical initial step in determining which measures are most appropriate is to assess the socioeconomic metrics of the activity (Cisneros-Montemayor & Sumailaa, 2010). Accordingly, this Report assesses the socioeconomic metrics for the recreational fisheries associated with tournaments of the Northern Caribbean.

To be clear, the findings of this Report are not scientific; they are meant to shed initial insights into the issues and lay the groundwork for additional, formal investigations in the near future. Ultimately, the hope is that this Report improves the standing of recreational fishing and associated tourism trades as an economic priority for the region. Administrative commitment to such "eco-tourism" (Holland *et al*., 2004) should in turn advance conservation efforts for HMS and their oceanic ecosystems, while simultaneously generating positive economic returns for Caribbean nations, businesses, and citizens.

2. METHODOLOGY

While some studies of commercial fisheries in the Caribbean have been conducted, studies of the recreational component of the fishery remain rare. To supplement the deficiency in scholarship, TBF conducted this study on billfish anglers in the Northern Caribbean. The study comprised an extensive literature review and reconciliation of various studies, thorough survey design and implementation, and integration of years of Geographical Information Systems (GIS) data on recreational fishing effort. Surveys were collected for four months from June through September 2012. This Report was subsequently prepared from September 2012 to December 2012.

The survey design process involved multiple considerations and multiple drafts. TBF began by reviewing previous fisheries studies. Numerous governmental organizations, including the National Oceanic Atmospheric Administration (NOAA), have conducted fisheries surveys for decades. However, most of these previous studies pertain to commercial fishing efforts and few focused on Caribbean recreational fisheries. A few scientists and economists began to conduct recreational fishing surveys in the early 1990's for TBF. Robert Ditton's socioeconomic research on recreational fishing in Puerto Rico formed the foundation of our survey design (Ditton & Clark, 1994). However, we expanded upon Ditton's original survey methodology and adapted it to modern survey distribution methods.

While Ditton relied upon telephone and direct mail techniques to distribute surveys, this study relies heavily upon Internet-based survey distribution. The Survey Gizmo Company provided the technical support for the survey questioning structure and facilitated survey distribution. Survey Gizmo's web-based survey questioning allows for adaptive questioning, which proved an exceptional way to balance expediency and toughness in questioning structure.

This balance was perhaps the most critical aspect of the methodology here. While achieving depth in data collection is the ultimate goal of any study, overwhelming a survey participant with a complicated or

[34] The laws concerning billfish harvest are detailed in the Management section below.

lengthy survey can result in participant abandonment. An adaptive questioning framework can simplify and shorten a survey as the participant progresses through the survey. For example, if a survey participant indicates that he "caught billfish in the last 12 months," a follow-up question may be "were those billfish released or retained?" Alternatively, if that participant indicates that he did not catch billfish last year, the survey can shift the flow of questioning. While the online methodology provided an efficient means for survey administration it also resulting in some questions being skipped. These skipped questions result in some discrepancies in the Species Targeted and Caught section.

While online questioning facilitated a broad range of survey participants, traditional paper surveys were not abandoned. TBF promotional efforts generated many hardcopy surveys that were subsequently entered manually by TBF. In the USVI, hardcopy surveys were distributed and collected on site from the 2012 July Open Billfish Tournament and the USVI Open. In Puerto Rico, hardcopy surveys were collected from the Club Nautico de Arecibo, the Club Nautico de Vega Baja, and the 59th International Billfish Tournament at Club Náutico de San Juan.

Significantly, participants for this study were not recruited exclusively at tournaments. For example, over 50% of Puerto Rico participants completed the survey "in their capacity" as a fishing/yacht club member (as opposed to tournament participants). By contrast, only approximately 35% of all participants completed the survey "in their capacity" as tournament participants. Participants were also recruited at marinas, tackle shops, sportfishing business centers, and other areas of the recreational fishery. Moreover, the participant pool was not limited to vessel owners or captains; at least one fifth of participants in each territory did not have a boat-owner in their household, but we anglers.

Because TBF had more difficulty attracting participants from the USVI than Puerto Rico, marinas and fishing clubs were targeted more heavily in the USVI than in Puerto Rico. TBF left numerous hardcopies and flyers of the online-survey at marina offices, on the transoms of charter boats, and with individuals at boat ramps and docks. The marinas targeted in St. Thomas included: American Yacht Harbor, Crown Bay Marina, Yacht Haven Grande, The Waterfront, Fish Hawk Marine, Pirateís Cove, and Sapphire Beach Marine. The marinas targeted in St. Croix included: Green Cay Marina and St. Croix Maine. Hardcopies and flyers were also distributed to the Virgin Islands Big Game Club in St. Thomas and the Golden Hook Fishing Club in St. Croix.

Moreover, information on the online survey was distributed through the electronic mailing lists of a number of organizations, including the Virgin Islands Big Game Club, the Golden Hook Fishing Club, the 59th International Billfish Tournament at Club Náutico de San Juan, the Club Nautico de Vega Baja, the Club Nautico de Arecibo, the International Light Tackle Tournament Association (ILTTA), and the International Game Fish Tournament Observers (IGFTO).

Finally, all past and present TBF members from the USVI and Puerto Rico were contacted and provided a link to the online survey.

A total of 55 surveys were collected for the USVI study area. Twenty-four surveys (43%) were administered in person and 31 surveys (57%) were administered over the Internet. Twenty hardcopy surveys were collected at the 2012 USVI the July Open Tournament and four were collected at the USVI Boy Scouts Tournament.

A total of 120 surveys were received for the Puerto Rico study area. Forty-eight surveys (40%) were administered in person and 72 surveys (60%) were administered over the Internet. Thirty-one hardcopy surveys were collected at the 2012 Club Nautico de Arecibo Tournament, 10 hardcopy surveys were collected at the 2012 Vega Baja Tournament, and seven hardcopy surveys were collected at the 59th International Billfish Tournament at Club Náutico de San Juan.

Although the survey inquired about billfish, tuna, and sharks, it was distributed primarily to billfish tournament anglers. It follows that the survey was designed to collect more information about billfish than other pelagics, and the sample sizes for questions pertaining to billfish are generally much larger than those concerning other pelagics.

3. BACKGROUND AND EVOLUTION OF THE FISHERY

3.1 The Global Recreational Fishery

Fish and fisheries products are among the most traded commodities in the world. Trade volumes for fisheries products reached new heights in 2011 and will likely continue to rise as developing countries grow their fisheries capacity to help contribute to meeting the world's demand for fish. In addition to direct trade revenues, fisheries provide significant, often overlooked, economic and employment opportunities. Recreational fishing, occurring currently in 118 maritime countries and 76% of the EEZs around the world, offers opportunities through more sustainable means than commercial fisheries (Cisneros-Montemayor & Sumailaa, 2010; Mora *et al*., 2009). Although highly variable as an industry, recreational fishing may be described generally as non-commercial fishing activity other than that needed to meet essential nutritional needs (Arlinghaus & Cooke, 2008). The FAO defines recreational fishing "as fishing of aquatic animals (mainly fish) that do not constitute the participant's primary resource to meet basic nutritional needs and are not generally sold or otherwise traded on export, domestic or black markets." "In contrast, commercial and subsistence fisheries are primarily directed towards sustaining the livelihood of the fisherman and his or her family, with fishing contributing substantially to meeting nutritional needs of the participant" (FAO Tech. Guidelines, 2012). The FAO has acknowledged that the demarcation between recreational fisheries and subsistence or artisanal fisheries is ambiguous. This is particularly the case in the Caribbean, but not so in the continental U.S. waters. Unlike subsistence fishers, however, recreational anglers have the financial capacity to substitute the fishing products by other products to meet nutritional needs and secure protein (FAO Tech. Guidelines, 2012).

While many developed nations have fostered recreational fishing industries in their respective countries, such industries have expanded in developing nations as well. One study cited by the FAO estimated the worldwide annual recreational catch at 47 billion fish, equating to approximately 12 percent of the total world catch (FAO World Report, 2012; Kurien & Williams, 2009). Other studies cited by the FAO estimate the total number of recreational fishers in North America, Europe, and Oceania to be 140 million with a potential maximum of 700 recreational anglers worldwide (FAO World Report, 2012; Cisneros-Montemayor & Sumaila, 2010; Cooke & Cowx, 2004). Across countries with reliable statistics, average global participation in recreational fishing has been estimated at 10.6 ± 6.1 percent (SD) (Arlinghaus & Cooke, 2009). Cumulatively these participants expend billions of dollars on recreational fishing annually, supporting millions of jobs (Cisneros-Montemayor & Sumailaa, 2010).

As participation in the recreational fishery continues to grow, regulators should be prepared to capitalize on potential economic growth and prevent externalities. To do so, regulators must understand the users of the fishery. Participation rates for recreational fishing vary with geography and seasonality, while related expenditures depend on the socioeconomics characteristics of the anglers. For example, the recreational fisheries of many nations are used more by foreigners than locals (Cisneros-Montemayor & Sumailaa, 2010). In such nations, regulators should generally anticipate heavy fishing activity with associated expenditures on food and lodging during tourist season(s). Alternatively, the recreational fisheries of less-visited nations may be more likely to be used consistently year round. Regardless of the fishery's users, however, heightened marine recreational participation poses significant economic, social, and environmental implications that must be accounted for in fishery management plans.

3.2 The Recreational Fishery of the Caribbean

The Caribbean Sea, oceanographically highly variable and spatially diverse, offers an array of fisheries and other marine resources becoming increasingly important to the regional economy (Chakalall *et al*., 1998). In addition to sparking economic growth, fisheries provide critical sources of subsistence and employment. In its most recent report published on "The State of World Fisheries and Agriculture" published in 2012, the FAO found average annual per capita fish consumption in Latin American and the Caribbean was 9.9 kg in 2009 (FAO World Report, 2012). Although this number is relatively small, demand for fish elsewhere drives incentives to export fisheries products and sell fishing rights to distant water fishing fleets (FAO World Report, 2012). Accordingly, an estimated 1,974,000 people are employed in the fishing industry in Latin America and the Caribbean (FAO World Report, 2012).

As Caribbean territories continue to shift from agricultural and extractive industries, the ecotourism trade has become a greater source of sustainable development in the region (Holland, 1997). Likewise, as appreciation for the ecological and social aspects of recreational fishing has increased, government recognition of the immense economic and cultural importance of recreational fishing has grown (Mora *et al*., 2009; Ihde *et al*., 2011). Economists have correlated the importance of recreational fishing to the tourist industry in the Caribbean in particular, noting the region's potential to "maintain the appeal of the Caribbean to U.S. travellers who account for nearly 65% of all overnight visitors to the region" (Schmeid, 1987). Although commercial fishing has historically been relied on to promote economic development, recreational fishing stands as a convincing alternative. Despite the relative dearth of data, this Report aims to develop a better understanding of the economic opportunities recreational fishing offers stakeholders in the Northern Caribbean.

The "Northern Caribbean" consists of Puerto Rico and the USVI. Puerto Rico is an unincorporated U.S. territory that comprises an archipelago located in the Greater Antilles just east of the Dominican Republic at 18° 15' N, 66° 30' W (CIA World Factbook Puerto Rico, 2012). The archipelago consists of a main island, known as Puerto Rico, and several smaller islands, the largest of which are Vieques, Culebra and Mona (FAO Caribbean Study 2011, 286). Including its continental shelf, the main island's area is 4,073 km^2; the coastline extends 1,094 km (Salas *et al*., 2011). Puerto Rico was ceded to the U.S. 1898, but the territory did not become an official commonwealth until 1952 (CIA World Factbook Puerto Rico, 2012). The territory's population currently stands at just under four million people (CIA World Factbook Puerto Rico, 2012).

The fisheries of Puerto Rico may generally be classified as artisanal and small-scale in nature (Salas *et al*., 2011). Commercial fisheries are largely demersal and based in the coastal zone (University of Puerto Rico Sea Grant, 2012); reef, bait, and a variety of ornamental and deep-water species are all harvested here for profit (Salas *et al*., 2011). Conversely, Puerto Rico's smaller pelagic commercial industry is generally known for tuna, dorado, wahoo, marlin, sailfish, and swordfish (Salas *et al*., 2011). A multitude of gears are employed by commercial fishermen, including horizontal and vertical longlines, gill and trammel nets, and traps for reef fish and shellfish (University of Puerto Rico Sea Grant, 2012).

Very little data is available on Puerto Rico's recreational fisheries. The National Marine Fisheries Service (NMFS) only started implementing its Marine Recreational Fisheries Sampling Survey Program[35] in Puerto Rico in 2000 (Salas *et al*., 2011) and does not include Puerto Rico (or the USVI) in its Large Pelagic Species Survey (LPS)—which would be highly pertinent to this study. Popular reef fish caught via hand-line from shore include snappers, groupers, grunts, and jacks (Salas *et al*., 2011; University of

[35] The survey provides an estimate of the total fish landed, the variance and size composition of the total, and other auxiliary information on the estimated number of fish harvested and released.

Puerto Rico Sea Grant). Common pelagic fish harvested by boat trolling include marlin, wahoo, tuna and dorado (Salas *et al*., 2011; University of Puerto Rico Sea Grant). This Report analyzes the stock of such pelagic species in light of numerous socioeconomic considerations.

The USVI is an unincorporated territory of the U.S. located in the Lesser Antilles east of Puerto Rico at 18° 20' N, 64° 50' W (CIA World Factbook USVI, 2012). In addition to the three main islands of St. Croix, St. John, and St. Thomas, the territory features a number of smaller surrounding islands. Cumulatively, the islands' land area is 346 km^2, while the coastline measures 188 km (CIA World Factbook USVI, 2012). USVI residents were granted U.S. citizenship in 1927 after Denmark sold the territory to the U.S. in 1917 (CIA World Factbook USVI, 2012). The territory's population currently stands at 109,574 (CIA World Factbook USVI, 2012).

Like Puerto Rico, the USVI has fisheries that can be categorized as commercial, recreational, and subsistence. Trap fishers seeking reef fish and lobster dominate the commercial fishing industry in St. Thomas and St. John. However, significant portions of commercial fishers in St. Croix target pelagic fish and deep-water snappers (Kojis & Quinn, 2006). The market for fish in the USVI has increased notably with the area's population and technology (Kojis & Quinn, 2006).

As in Puerto Rico, information on recreational fishing in the USVI is very limited. Most data is collected from fishing tournaments or special projects (Garcia-Moliner *et al*., 2002). Tourists, which make up the bulk of recreational anglers in the USVI, are known to charter boats to fish for tarpon and snook in inshore waters, although snapper and grouper also remain popular (Garcia-Moliner *et al*., 2002). At open sea, marlin, sailfish, tuna, wahoo, and dorado are all pursued for sport (USVI DPNR Deep Water Game Fish, 2012).

4. SURVEY PARTICIPANTS' DEMOGRAPHICS

4.1 Resident and Sector Status

Most socioeconomic studies of fisheries establish a profile of fisheries users because the better they are understood, the better fisheries managers can achieve their goals. TBF identified several previous studies that established profiles for recreational fishermen along the U.S. Atlantic Coast (Ditton & Fisher, 1990), the Mexico Pacific Coast (Southwick, 2008; Ditton *et al*., 1996), Costa Rica (Jimenez, 2010; Ditton & Grimes, 1995) and Puerto Rico (Ditton & Clark, 1994).[36] One common theme from these previous studies was the significant homogeneity among billfish anglers—despite great diversity among recreational anglers as a whole (Ditton *et al*., 1999). Ditton & Loomis (1992) organized the various angler profiles along a continuum of fishing specialization. Lower specialization anglers tend to harvest more fish and appreciate the food value of what they catch - which are activity-specific elements (Ditton & Loomis, 1992). They also tend to value "rare" events like catching a billfish less (Ditton & Loomis, 1992). Conversely, billfish anglers tend to be skewed toward the highest end of specialization of the continuum of anglers (Ditton *et al*., 1999). They tend to be older, fish more frequently, and have a higher appreciation of non-catch or the non activity-specific elements of recreational fishing (Ditton *et al*., 1999). Additionally, high specialization anglers have a higher level of mediated interaction and, critically, a lower level of resource dependency than low specialization anglers (Ditton & Loomis, 1992). Finally, high specialization anglers tend to attach less importance to activity-specific elements and more to the non activity-specific elements of the fishing experience than non-specialized anglers (Ditton *et al*., 1999). See Figure #1 in the Appendix for resident status of survey participants.

[36] The studies authored by Southwick and Jimenez were actually prepared on behalf of TBF.

One hundred and twenty Puerto Rico survey participants (100%) indicated that they were residents of Puerto Rico and zero Puerto Rico survey participants (0%) indicated that they were visitors of Puerto Rico. 49 USVI survey participants (89.1%) indicated that they were recreational anglers, one USVI survey participant (1.8%) indicated that he was a commercial fisherman, and five USVI survey participants (9.1%) indicated that they were both recreational and commercial fishermen. See Figure #2 in the Appendix for Sectors Puerto Rican Participants fish in and Figure #3 for Sectors USVI Participants fish in.

Thirty-five USVI survey participants (64%) indicated that they were residents of the USVI and 20 USVI survey participants (36%) indicated that they were visitors of the USVI. 113 Puerto Rico survey participants (94.2%) indicated that they were recreational anglers, two Puerto Rico participants (1.7%) indicated that they were commercial fishermen, and five Puerto Rico participants (4.2%) indicated that they were both recreational and commercial fishermen.

4.2 Saltwater and Pelagic Fishing Experience

Fishing experience provides a critical metric in building an angler's profile. The age and experience of an angler are necessarily linked. Older anglers also tend to have more disposable income to use for fishing tournaments, which can be quite expensive. As detailed further below, the majority of participants here are avid fishing tournament-goers. It follows that the sample frame here is more likely to contain older, wealthier anglers than poorer, novice anglers. The high levels of experience that participants reported (and to a lesser extent, the high levels of income, which are discussed throughout the Report) supports this inference: 58% of Puerto Rico participants and 71% of USVI participants had at least twenty years of fishing experience. This trend does not appear to have changed much over the years. In a similar study conducted by Fisher and Ditton (1992), 58% of participating recreational anglers along the U.S. Atlantic indicated they had at least 21 years of fishing experience, while 52% of anglers had at least 11 years of experience targeting pelagics. See Figure #4 in the Appendix for Participant Years of Experience in Saltwater. The specific results for participant fishing experience here are as follows:

Of the 51 USVI participants who provided a response to the fishing experience questions: zero participants (0%) indicated that they had no experience fishing in saltwater, four participants (7.84%) indicated that they had one to five years experience fishing in saltwater, two participants (3.92%) indicated that they had five to 10 years experience fishing in saltwater, eight participants (15.68%) indicated that they had 10 to 20 years experience fishing in saltwater, 16 participants (31.37%) indicated that they had 20 to 20 years experience fishing in saltwater, and 21 participants (41.18%) indicated that they had over thirty years experience fishing in saltwater.

Of the 114 Puerto Rico participants who provided a response to the fishing experience questions: zero participants (0%) indicated that they had no experience fishing in saltwater, seven participants (6.14%) indicated that they had one to five years experience fishing in saltwater, 14 participants (1.28%) indicated that they had five to 10 years experience fishing in saltwater, 26 participants (22.81%) indicated that they had 10 to 20 years experience fishing in saltwater, 23 participants (20.18%) indicated that they had 20 to 30 years experience fishing in saltwater, and 44 participants (38.60%) indicated that they had over 30 years experience fishing in saltwater.

Of the 51 USVI participants who provided a response to the fishing experience questions: two participants (3.92%) indicated that they had no experience targeting pelagic species, four participants (7.84%) indicated that they had one to five years experience targeting pelagic species, five participants (9.80%) indicated that they had five to 10 years experience targeting pelagic species, 14 participants (27.45%) indicated that they had 10 to 20 years experience targeting pelagic species, 14 participants

(27.45%) indicated that they had 20 to 30 years experience targeting pelagic species, and 12 participants (23.53%) indicated that they had over 30 years experience targeting pelagic species.

Of the 114 Puerto Rico participants who provided a response to the fishing experience questions: three participants (2.63%) indicated that they had no experience targeting pelagic species, 14 participants (12.28%) indicated that they had one to five years experience targeting pelagic species, 21 participants (18.42%) indicated that they had five to 10 years experience targeting pelagic species, 23 participants (20.18%) indicated that they had 10 to 20 years experience targeting pelagic species, 23 participants (20.18%) indicated that they had 20 to 30 years experience targeting pelagic species, and 30 participants (26.32%) indicated that they had over 30 years experience targeting pelagic species. See Figure #5 in the Appendix for Participant Targeting Pelagic Species.

4.3 Days Spent Targeting Pelagic Fish over the Last 12 Months

Although annual recreational fishing effort may be measured by the number of fish caught or released, the number of days spent targeting fish offers a better metric. This is especially true when the fishery users value the non-catch aspects of fishing. The annual metric of days fished fluctuates from year to year and can offer insight into changing user values.

Of the 114 Puerto Rico participants who provided a response to this inquiry, nine participants (7.9%) indicated that they did not target pelagic species at all over the past year, 18 participants (15.8%) indicated that they targeted pelagic species one to five days, 25 participants (21.9%) indicated that they targeted pelagic species five to 10 days, 22 participants (19.3%) indicated that they targeted pelagic species 10 to 20 days, 20 participants (17.5%) indicated that they targeted pelagic species 20 to 30 days, and 20 participants (17.5%) indicated that they targeted pelagic species over 30 days.

Of the 51 USVI participants who provided a response to this inquiry, four participants (7.8%) indicated that they did not target pelagic species at all over the past year, three participants (5.9%) indicated that they targeted pelagic species one to five days, eight participants (15.7%) indicated that they targeted pelagic species five to 10 days, 10 participants (19.6%) indicated that they targeted pelagic species 10 to 20 days, 12 participants (23.5%) indicated that they targeted pelagic species 20 to 30 days, and 14 participants (27.5%) indicated that they targeted pelagic species over 30 days. See Figure #6 in the Appendix for Days Spent Targeting Pelagic Fish.

In order to determine how the last 12 months compared with previous years, survey participants were asked if they fished more this year, less this year, or about the same.

Of the 52 USVI participants who provided a response to this inquiry, five participants (9.6%) indicated that they fished more than usual this year, 28 participants (53.8%) indicated that they fished about the same amount of days this year, and 19 participants (36.5%) indicated that they fished less than usual this year.

Of the 114 Puerto Rico participants who provided a response to this inquiry, eight participants (7%) indicated that they fished more than usual this year, 43 participants (37.7%) indicated that they fished about the same amount of days this year, and 63 participants (55.3%) indicated that they fished less than usual this year. While no question in the survey asked why the participant might have fished less this year than last year, an informal inquiry with many of them indicated that rising fuel costs were a great concern. See Figure #7 in the Appendix for How This Compares with Previous Years.

5. SURVEY PARTICIPANTS' MOTIVATION

People fish recreationally for many reasons: understanding the various elements that form the individual and aggregate motivations for recreational fishing results in more efficient fisheries management. At a categorical level, a fisherman's motivations indicate whether he tends to release, tag, eat, donated or sell his catch. More broadly, this metric indicates whether a recreational fisher's intrinsic values, such as "nature appreciation, challenge, adventure and excitement, and the experience of the catch" prevail over extrinsic values such as sustenance (Holland, 1997). Moreover, the motivation of recreational anglers offers insight into their propensity for conservation. Interestingly, Holland (2004) argues that intrinsic values of recreational anglers have actually created more value in released pelagic fish than in harvested pelagic fish.

Participants here were asked to rank nine separate "motivations" for fishing in accordance with their own priorities. One hundred and nine Puerto Rico participants and 52 USVI participants responded. In the USVI, participants' primary motivations for fishing were "to obtain fish for eating" and "to catch and release fish for sport." This result is not very surprising, as numerous studies on recreational fisheries in Puerto Rico and the USVI have concluded that the principal motivation for recreational fishing in the region is to provide food (Griffith *et al*., 2007; Impact, 2007). For example, out of seventeen categories, "to obtain fish for eating" received the highest score in a 1994 survey of Puerto Rico billfish anglers conducted by Ditton *et al.* (1994). Interestingly, Ditton and Clark (1994) found that recreational anglers from the U.S. Atlantic mainland attached the most importance to "relaxation," "experiencing the catch," and "the challenge." Ditton's work supports the inference that recreational anglers in the Northern Caribbean value the fish they catch as a food source more than domestic U.S. anglers.

Despite the high motivation USVI participants had "to obtain fish for eating," the "fate of the catch" results from the survey (see Part B.1. of the Fishing Behavior section below) indicate that a small proportion of billfish anglers actually eat the *billfish* they catch. Thus, it appears that USVI billfish anglers target other species for food at least somewhat regularly. The survey results indicate that yellowfin tuna is one of these species. It should also be noted that "to catch and release fish for sport," "to spend time with friends or family," and "to be on the water or outdoors" all finished within a percentage point of "to obtain fish for eating." This shows great diversity in the incentives USVI anglers have to fish recreationally. Meanwhile, in Puerto Rico, "to catch and release fish for sport" received by far the highest score, and "to obtain fish for eating" only received the fifth highest score. It is hard to discern the source of this discrepancy, especially given that the same ratio of surveys was collected at tournaments in each territory (35.7%). Moreover, the USVI participant pool actually included visiting participants from the U.S. mainland (who according to Ditton & Clark's (1994) findings are less likely to be incentivized to fish for food) whereas the Puerto Rico participant pool did not. Despite this anomaly, Puerto Rico's scores for the other categories were relatively close to the USVI's, suggesting relative homogeneity in the motivations for anglers in both territories. See Table #1 in the Appendix for Survey Participant Motivation. The detailed rankings for fishing motivation are as follows:

In the USVI, "to obtain fish for eating" received a total score of 310 (15%), "to catch and release fish for sport" received a total score of 308 (14.91%), "to spend time with family or friends" received a total score of 305 (14.76%), "to be on the water or outdoors" received a total score of 291 (14.09%), "for relaxation" received a total score of 238 (11.52%), "to compete in a fishing tournament" received a total score of 219 (10.60%), "for travel and adventure" received a total score of 183 (8.86%), "to catch a record size trophy fish" received a total score of 135 (6.53%), and "to earn a living as a fishing guide" received a total score of 77 (3.73%).

In Puerto Rico, "to obtain fish for eating" received a total score of 313 (9.84%), "to catch and release fish for sport" received a total score of 759 (23.87%), "to spend time with family or friends" received a total

score of 519 (16.32%), "to be on the water or outdoors" received a total score of 322 (10.13%), "for relaxation" received a total score of 387 (12.17%), "to compete in a fishing tournament" received a total score of 396 (12.45%), "for travel and adventure" received a total score of 192 (6.04%), "to catch a record size trophy fish" received a total score of 191 (6.01%), and "to earn a living as a fishing guide" received a total score of 101 (3.18%). See Figure #8 in the Appendix for Survey Participant Motivation Chart.

The survey results suggest that segments of the recreational fishing industry are distinguishable by motivation. Fisheries managers throughout the Caribbean and greater U.S. should consider these diverse motivations when considering HMS output controls. Bag limits and slot limits might not always be the best-tailored regulations for recreational anglers that do not place great value on catching a record size trophy fish.

6. FISHING BEHAVIOR & SUCCESS

6.1 Statistical Data

6.1.1 Species Targeted and Caught

Targeting of Billfish Species in the Northern Caribbean

Atlantic Blue Marlin (*Makaira nigricans)*

United States Virgin Islands

Of the 48 USVI participants that targeted billfish, 46 participants (95.8%) indicated that they targeted blue marlin. Reporting on catch success over the last 12 months: 12 USVI participants indicated that although they targeted blue marlin, they caught none, 17 participants indicated they caught one to five blue marlin, three participants indicated they caught five to 10 blue marlin, five participants indicated they caught 10 to 25 blue marlin, two participants indicated they caught 25 to 50 blue marlin, and 4 participants indicated they caught over 50 blue marlin. See Figure #9 and #10 in the Appendix for Billfish Targeting Charts.

Puerto Rico

Of the 107 Puerto Rico participants that targeted billfish, 105 participants (98.1%) indicated that they targeted blue marlin. Reporting on catch success over the last 12 months: 22 participants indicated that although they targeted blue marlin, they caught none, 59 participants indicated they caught one to five blue marlin, 14 participants indicated they caught five to 10 blue marlin, 14 participants indicated they caught 10 to 25 blue marlin, three participants indicated they caught 25 to 50 blue marlin, and two participants indicated they caught over 50 blue marlin.

White Marlin (*Tetrapturus albidus*)

United States Virgin Islands

Of the 48 USVI participants that targeted billfish, 36 participants (75%) indicated that they targeted white marlin. Reporting on catch success in the last 12 months: 16 USVI participants indicated that although they targeted white marlin, they caught none, 11 participants indicated they caught one to five white marlin, two participants indicated they caught five to 10 white marlin, two participants indicated they

caught 10 to 25 white marlin, and one participant indicated he caught 25 to 50 white marlin, and two participants indicated they caught over 50 white marlin.

Puerto Rico

Of the 107 Puerto Rico participants that targeted billfish, 82 participants (76.6%) indicated that they targeted white marlin. Reporting on catch success over the last 12 months: 31 Puerto Rico participants indicated that although they targeted white marlin, they caught none, 34 participants indicated they caught one to five white marlin, four participants indicated they caught five to 10 white marlin, five participants indicated they caught 10 to 25 white marlin, and one participant indicated he caught 25 to 50 white marlin, and one participant indicated he or she caught over 50 white marlin.

Atlantic Sailfish (I*stiophorus albicans*)

United States Virgin Islands

Of the 48 USVI participants that target billfish, 31 participants (64.5%) indicated that they targeted sailfish. Reporting on catch success over the last 12 months: 8 USVI participants indicated that although they targeted sailfish, they caught none, seven participants indicated they caught one to five sailfish, two participants indicated that they caught five to ten sailfish, five participants indicated they caught 10 to 25 sailfish, three participants indicated they caught 25 to 50 sailfish, and four participants indicated they caught over 50 sailfish. See Table #2 in the Appendix for Billfish Targeting Table.

Puerto Rico

Of the 107 Puerto Rico participants that targeted billfish, 75 participants (70.1%) indicated that they targeted sailfish. Reporting on catch success over the last 12 months: 28 Puerto Rico participants indicated although they targeted sailfish, they caught none, 31 participants indicated they caught one to five sailfish, six participants indicated they caught five to ten sailfish, two participants indicated they caught 10 to 25 sailfish, and two participants indicated they caught 25 to 50 sailfish.

Swordfish (*Xiphias gladius*)

United States Virgin Islands

Of the 48 USVI participants that targeted billfish, 19 participants (39.6%) indicated that they targeted swordfish. Reporting on catch success over the last 12 months: 10 USVI participants indicated that although they targeted swordfish, they caught none, and eight participants indicated they caught one to five swordfish.

Puerto Rico

Of the 107 Puerto Rico participants that targeted billfish, 35 participants (32.7%) indicated that they targeted swordfish. Reporting on catch success over the last 12 months: 23 Puerto Rico participants indicated that although they targeted swordfish, they caught none; eight participants indicated they caught one to five swordfish, and one participant indicated he caught five to 10 swordfish.

Spearfish *(Tetrapturus pfluegeri*)

United States Virgin Islands

Of the 48 USVI participants that targeted billfish, six participants (12.5%) indicated that they targeted spearfish. Reporting on catch success over the last 12 months: three USVI participants indicated although they targeted spearfish, they caught none, and two participants indicated they caught one to five spearfish.

Puerto Rico

Of the 107 Puerto Rico participants that targeted billfish, 22 participants (20.6%) indicated that they targeted spearfish. Reporting on catch success over the last 12 months: 21 Puerto Rico participants indicated that although they targeted spearfish, they caught none, and one participant indicated he caught one to five spearfish.

Targeting of Tuna Species in the Northern Caribbean

Atlantic Bluefin Tuna (*Thunnus thynnus*)

United States Virgin Islands

Of the 50 USVI participants that targeted tuna, 11 participants (22%) indicated that they targeted bluefin tuna. Reporting on catch success over the last 12 months: four USVI participants indicated that although they targeted bluefin tuna, they caught none, and seven participants indicated they caught one to five bluefin tuna.

Puerto Rico

Of the 92 Puerto Rico participants that targeted tuna, 28 participants (30.4%) indicated that they targeted bluefin tuna. Reporting on catch success over the last 12 months: 16 Puerto Rico participants indicated that although they targeted bluefin tuna, they caught none; eight participants indicated they caught one to five bluefin tuna, and three participants indicated they caught five to 10 bluefin tuna. See Figures #11 and #12 for Tuna Targeting Charts.

Yellowfin Tuna (*Thunnus albacares)*

United States Virgin Islands

Of the 50 USVI participants that targeted tuna, 49 participants (98%) indicated that they targeted yellowfin tuna. Reporting on catch success over the last 12 months: 11 Puerto Rico participants indicated that although they targeted yellowfin tuna, they caught none, 18 participants indicated they caught one to five yellowfin tuna, six participants indicated they caught 5 to 10 yellowfin tuna, six participants indicated they caught 10 to 25 yellowfin tuna, one participant indicated he caught 25 to 50 yellowfin tuna, and one participant indicated he caught over 50 yellowfin tuna.

Puerto Rico

Of the 92 Puerto Rico participants that targeted tuna, 78 participants (84.8%) indicated that they targeted yellowfin tuna. Reporting on catch success over the last 12 months: 32 Puerto Rico participants indicated that although they targeted yellowfin tuna, they caught none, 33 participants indicated they caught one to

five yellowfin tuna, four participants indicated they caught five to 10 yellowfin tuna, and two participants indicated they caught 10 to 25 yellowfin tuna.

Albacore Tuna (*Thunnus alalunga)*

United States Virgin Islands

Of the 50 USVI participants that targeted tuna, two participants (14%) indicated that they targeted albacore tuna. Reporting on catch success over the last 12 months: one USVI participant indicated that although he targeted albacore tuna, he caught none, and one participant indicated he caught one to five albacore tuna. See Table #3 for Tuna Targeting Table.

Puerto Rico

Of the 92 Puerto Rico participants that targeted tuna, 32 participants (34.8%) indicated that they targeted albacore tuna. Reporting on catch success over the last 12 months: 10 Puerto Rico participants indicated that although they targeted albacore tuna, they caught none, nine participants indicated they caught one to five albacore tuna, five participants indicated they caught five to 10 albacore tuna, three participants indicated they caught 10 to 25 albacore tuna, and two participants indicated they caught over 50 albacore tuna.

Bigeye Tuna (*Thunnus obesus*)

United States Virgin Islands

Of the 50 USVI participants that targeted tuna, seven participants (14%) indicated that they targeted bigeye tuna. Reporting on catch success over the last 12 months: two participants in the USVI indicated that although they targeted bigeye tuna, they caught none, two participants indicated they caught one to five bigeye tuna, one participant indicated he caught five to 10 bigeye tuna, one participant indicated he caught 10 to 25 bigeye tuna, and one participant indicated he caught 25 to 50 bigeye tuna.

Puerto Rico

Of the 92 Puerto Rico participants that targeted tuna, 12 participants (13%) indicated that they targeted bigeye tuna. Reporting on catch success over the last 12 months: two Puerto Rico participants indicated that although they targeted bigeye tuna, they caught none, five participants indicated they caught one to five bigeye tuna, and three participants indicated they caught five to 10 bigeye tuna.

Other Tuna Species

United States Virgin Islands

Of the 50 USVI participants that indicated they target tuna, eight participants (16%) indicated that they targeted some other species of tuna. Reporting on catch success over the last 12 months: three USVI participants indicated that although they targeted other tuna species, they caught none, one participant indicated he caught one to five other tuna species, one participant indicated he or she caught 5 to 10 other tuna species, one participant indicated he caught 10 to 25 other tuna species, and two participants indicated they caught over 50 other tuna species.

Puerto Rico

Of the 92 Puerto Rico participants that targeted tuna, five participants (5.4%) indicated that they targeted some other species of tuna. Reporting on catch success over the last 12 months: four Puerto Rico participants indicated that although they targeted other tuna species, they caught none, and one participant indicated he caught one to five other tuna species.

Targeting of Shark Species in the Northern Caribbean

Shortfin Mako (*Isurus oxyrinchus)*

United States Virgin Islands

Of the 13 USVI participants that targeted sharks, four participants (30.8%) indicated that they targeted shortfin mako. Reporting on catch success over the last 12 months: four USVI participants indicated that although they targeted shortfin mako, they caught none, and three participants indicated they caught one to five shortfin mako. See Figure #13 and #14 for Shark Targeting Charts.

Puerto Rico

Of the 32 Puerto Rico participants that targeted sharks, 17 participants (53.1%) indicated that they targeted shortfin mako. Reporting on catch success over the last 12 months: 13 Puerto Rico participants indicated that although they targeted shortfin mako, they caught none; three participants indicated they caught one to five shortfin mako.

Blue Shark (*Prionace glauca*)

United States Virgin Islands

Of the 13 USVI participants that targeted sharks, two participants (15.4%) indicated that they targeted blue sharks. Reporting on catch success over the last 12 months: one USVI participant indicated he caught five to 10 blue sharks, and two participants indicated they caught over 50 blue sharks. See Table #3 for Shark Targeting.

Puerto Rico

Of the 32 Puerto Rico participants that targeted sharks, two participants (6.3%) indicated that they targeted blue sharks. Reporting on catch success over the last 12 months: three Puerto Rico participants indicated that although they targeted blue sharks, they caught none.

Other Shark Species

United States Virgin Islands

Of the 13 USVI participants that targeted sharks, 12 participants (92.3%) indicated that they targeted some other species of shark. Reporting on catch success over the last 12 months: seven USVI participants indicated that although they targeted other shark species, they caught none, and three participants indicated they caught one to five other shark species.

Puerto Rico

Of the 32 Puerto Rico participants that targeted sharks, 15 participants (46.9%) indicated that they targeted some other species of shark. Reporting on catch success over the last 12 months: nine Puerto Rico participants indicated that although they targeted other shark species, they caught none, one participant indicated he caught one to five other shark species, one participant indicated he caught five to 10 other shark species, and three participants indicated they caught 10 to 25 other shark species.

6.1.2 Fate of Species Caught

Fate of Billfish Species Caught in the Northern Caribbean in the Last 12 Months

To ascertain the fate of fish caught and to determine the catch and release practices of recreational anglers in the Northern Caribbean, survey participants were asked to indicate whether they released, tagged,[37] retained to eat, donated, or sold the fish that they caught. The question type allowed the participant to "check all that apply" to allow for the possibility that the fate of the fish as determined by a participant's behavior was not always uniform. Moreover, on the Internet-based survey, the fate of the fish questioning was given on a species-by-species basis depending upon whether that participant indicated that they target the species.

Atlantic Blue Marlin (*Makaira nigricans)*

United States Virgin Islands

Of the participants that indicated that they targeted blue marlin in the USVI, 100% of those participants indicated that they released blue marlin, 15.15% of those participants indicated that they tagged blue marlin, and 3.03% of those participants indicated that they retained blue marlin to eat. See Figure #15 for Fate of Billfish Caught in USVI.

Puerto Rico

Of the participants that indicated that they targeted blue marlin in Puerto Rico, 89.16% of those participants indicated that they released blue marlin, 43.37% of those participants indicated that they tagged blue marlin, 2.41% of those participants indicated that they retained blue marlin to eat, and 2.41% of those participants indicated that they donated blue marlin. We are not certain where fish were donated, or whether donation was contingent on whether the fish were dead when captured, as the survey did not ask this. However, only a very small number of participants indicated they donated fish. See Figure #16 for Fate of Billfish Caught in Puerto Rico.

White Marlin (*Tetrapturus albidus*)

United States Virgin Islands

Of the participants that indicated that they targeted white marlin in the USVI, 100% of those participants indicated that they released white marlin. See above.

[37] Tagging, or marking and then releasing, a captured fish, allows scientists to gain a wide variety of information about that species. More advanced tagging allows the movement of fish to be tracked in real time via satellite, while more rudimentary tagging permits comparison of different locations where fish have been captured. In addition to providing useful data on the population, size, and mortality of different fish species, tagging provides essential information about the migratory patterns of HMS.

Puerto Rico

Of the participants that indicated that they targeted white marlin in Puerto Rico, 92.59% of those participants indicated that they released white marlin, 33.33% of those participants indicated that they tagged white marlin, and 1.85% of those participants indicated that they donated white marlin.

Atlantic Sailfish (I*stiophorus albicans*)

United States Virgin Islands

Of the participants that indicated that they targeted sailfish in the USVI, 100% of those participants indicated that they released sailfish.

Puerto Rico

Of the participants that indicated that they targeted sailfish in Puerto Rico, 95.74% of those participants indicated that they released sailfish, 33.33% of those participants indicated that they tagged sailfish, and 2.13% of those participants indicated that they donated sailfish.

Swordfish *(Xiphias gladius*)

United States Virgin Islands

Of the participants that indicated that they targeted swordfish in the USVI, 36.36% of those participants indicated that they released swordfish, 72.73% of those participants indicated that they retained swordfish to eat, and 18.18% of those participants indicated that they donated swordfish.

Puerto Rico

Of the participants that indicated that they targeted swordfish in Puerto Rico, 38.46% of those participants indicated that they released swordfish, 69.23% of those participants indicated that they retained swordfish to eat, 7.69% of those participants indicated that they donated swordfish, and 7.69% of those participants indicated that they sold swordfish. Swordfish, unlike other billfish, are a commercially targeted species.

Spearfish *(Tetrapturus pfluegeri*)

United States Virgin Islands

Of the participants that indicated that they targeted spearfish in the USVI, 100% of those participants indicated that they released spearfish.

Puerto Rico

Of the participants that indicated that they targeted spearfish in Puerto Rico, 100% of those participants indicated that they released spearfish, 33.33% indicated that they tagged spearfish.

Fate of Tuna Species Caught in the Northern Caribbean in the Last 12 Months

Atlantic Bluefin Tuna (*Thunnus thynnus*)

United States Virgin Islands

Of the participants that indicated that they targeted bluefin tuna in the USVI, 25% of those participants indicated that they released bluefin tuna, 87.50% of those participants indicated that they retained bluefin tuna to eat, and 12.50% of those participants indicated that they sold bluefin tuna. See Figure #17 for Fate of Tuna Caught in the USVI.

Puerto Rico

Of the participants that indicated that they targeted bluefin tuna in Puerto Rico, 21.43% of those participants indicated that they released bluefin tuna, and 78.57% of those participants indicated that they retained bluefin tuna to eat. See Figure #18 for Fate of Tuna Caught in the Puerto Rico.

Yellowfin Tuna (*Thunnus albacares)*

United States Virgin Islands

Of the participants that indicated that they targeted yellowfin tuna in the USVI, 15.79% of those participants indicated that they released yellowfin tuna, 94.74% of those participants indicated that they retained yellowfin tuna to eat, and 7.89% of those participants indicated that they sold yellowfin tuna.

Puerto Rico

Of the participants that indicated that they targeted yellowfin tuna in Puerto Rico, 16.36% of those participants indicated that they released yellowfin tuna, 3.64% of those participants indicated that they tagged yellowfin tuna, 81.82% of those participants indicated that they retained yellowfin tuna to eat, 1.82% of those participants indicated that they donated yellowfin tuna, and 1.82% of those participants indicated that they sold yellowfin tuna.

Albacore Tuna (*Thunnus alalunga)*

United States Virgin Islands

Of the participants that indicated that they targeted albacore tuna in the USVI, 100% of those participants indicated that they retained albacore tuna to eat.

Puerto Rico

Of the participants that indicated that they targeted albacore tuna in Puerto Rico, 27.27% of those participants indicated that they released albacore tuna, 68.18% of those participants indicated that they retained albacore tuna to eat, 4.55% of those participants indicated that they donated albacore tuna, and 4.55% of those participants indicated that they sold albacore tuna.

Bigeye Tuna (*Thunnus obesus*)

United States Virgin Islands

Of the participants that indicated that they targeted bigeye tuna in the USVI, 100% of those participants indicated that they retained bigeye tuna to eat.

Puerto Rico

Of the participants that indicated that they targeted bigeye tuna in Puerto Rico, 40% of those participants indicated that they released bigeye tuna, 60% of those participants indicated that they retained bigeye tuna to eat.

Other Tuna Species

United States Virgin Islands

Of the participants that indicated that they targeted other tuna species in the USVI, 100% of those participants indicated that they retained other tuna species to eat, and 40% of those participants indicated that they sold other tuna species.

Puerto Rico

Of the participants that indicated that they targeted other tuna species in the Puerto Rico, 100% of those participants indicated that they retained other tuna species to eat.

Fate of Shark Species Caught in the Northern Caribbean in the Last 12 Months

Shortfin Mako (*Isurus oxyrinchus)*

United States Virgin Islands

Of the participants that indicated that they targeted shortfin mako in the USVI, 50% of those participants indicated that they released shortfin mako, and 50% of those participants indicated that they retained shortfin mako to eat. See Figure #19 for Fate of Sharks Caught in the USVI.

Puerto Rico

Of the participants that indicated that they targeted shortfin mako in Puerto Rico, 100% of those participants indicated that they released shortfin mako. See Figure #20 for Fate of Sharks Caught in Puerto Rico.

Blue Shark (*Prionace glauca*)

United States Virgin Islands

Of the participants that indicated that they targeted blue sharks in the USVI, 100% of those participants indicated that they released blue sharks.

Puerto Rico

Of the participants that indicated that they targeted blue sharks in Puerto Rico, no data was collected as to fate of fish caught.

Other Shark Species

United States Virgin Islands

Of the participants that indicated that they targeted other shark species in the USVI, 50% of those participants indicated that they released other shark species, 33.33% of those participants indicated that they retained other shark species to eat, 1% of those participants indicated that they donated other shark species, and 16.67% of those participants indicated that they donated other shark species.

Puerto Rico

Of the participants that indicated that they targeted other shark species in Puerto Rico, 100% of those participants indicated that they released other shark species.

6.2 Analysis of Results

6.2.1 Analysis of Statistical Data

Blue and white marlin, sailfish, and yellowfin tuna were the most popular pelagic species included in the survey. Of the 107 Puerto Rico participants that targeted billfish, all but two of them (98%) targeted blue marlin, and just over three-fourths of them (76%) targeted white marlin.[38] Regarding other billfish, 70% of Puerto Rico participants' targeted sailfish, while only 33% targeted swordfish and 21% targeted spearfish. The results for the USVI were fairly similar: All but two participants (96%) targeted blue marlin, 75% white marlin, 65% sailfish, 40% swordfish, and 13% spearfish.

Tuna was more popular than billfish among USVI participants; two more participants (50) targeted tuna than billfish (48). Conversely, in Puerto Rico, more participants targeted billfish (107) than tuna (92). Notably, all but one of the 50 USVI participants (98%) targeted yellowfin tuna. The percentage was lower in Puerto Rico, where 78 of the 92 participants (85%) targeted yellowfin. In contrast to the popular yellowfin, bluefin, albacore, and bigeye tuna were all targeted by fewer than 40% of total participants. Further, while yellowfin was targeted more in the USVI, significantly more Puerto Rico participants targeted albacore tuna (37% versus 2%). Only 13 total participants indicated they targeted another species of tuna; blackfin and skipjack were the only other tuna species these participants identified.

Sharks likewise do not appear to be a particularly popular recreational target in the Northern Caribbean. Only 32 Puerto Rico participants and 13 USVI participants targeted them, or 26% of total participants. Shortfin mako was targeted much more often by these participants than blue shark (47% vs. 9%). Notably, however, all but one of the USVI participants indicated that they targeted other sharks such as the thresher shark and tiger shark.

Blue marlins were caught by participants more than any other fish included in the survey: 79% of Puerto Rico participants and 73% USVI participants caught at least one within the last year. While the numbers

[38] For convenience, unless otherwise indicated explicitly, all percentages cited in this section are taken from the number of respective participants in each region that indicated they targeted billfish, tuna, or sharks—not the total number of participants.

for sailfish closely mirror the numbers for blue marlin (71% for Puerto Rico and 74% for the USVI), the catch rate for white marlin (62% for Puerto Rico and 55% for the USVI) was notably lower in the region. Likewise, the low number of total participants that targeted spearfish (28) and swordfish (54) *could* be an indicator for these species: only 17 participants managed to catch a swordfish and three a spearfish. The majority of participants who caught billfish only caught between one and five and very few caught over ten.

The first major difference between Puerto Rico and USVI participants in this analysis lies in the number of participants that caught tuna over the past year. Seventy-eight percent of USVI participants caught yellowfin tuna versus 59% of Puerto Rico participants. Also, while five Puerto Rico participants caught albacore, only one USVI participant caught one. Finally, five USVI participants caught "other" tuna species over the past while only one Puerto Rico participant did. These discrepancies could be related to species targeted in each area: 23% more USVI participants targeted yellowfin than Puerto Rico participants, 35% more Puerto Rico participants targeted albacore than USVI participants, and 10% more USVI participants targeted "other" species than Puerto Rico participants. The differences in species targeted and caught may in turn be partially explained by the difference in participant demographics, e.g., over a third of USVI participants were visitors and all Puerto Rico participants were citizens.

The greater total number of sharks caught by USVI participants than Puerto Rico participants - nine versus eight - despite the USVI' significantly smaller sample size - also suggests a material difference between the demographics of the two participant pools. However, it is difficult to draw any concrete conclusions regarding the discrepancy in species caught without more research.

Promisingly, the majority of participants released all billfish they caught. The notable exception was swordfish, which the results indicate were eaten by every participant in each territory that caught one.[39] Only one participant in either territory reported selling a billfish (a swordfish), and only several more indicated they donated one. Though a healthy portion of Puerto Rico participants indicated that they tagged certain billfish, major tagging opportunities remain - particularly in the USVI. Encouragingly, 46% of Puerto Rico participants that caught blue marlin tagged (at least) one, while 40% tagged white marlin and 32% tagged sailfish. Only 17% of USVI participants that caught blue marlin tagged one, however, and zero USVI participants tagged any white marlin or sailfish. No swordfish were tagged in either territory, though a spearfish was tagged in Puerto Rico.

Tuna is clearly a favored entrée in the Northern Caribbean. The results show that almost every participant in either territory that landed tuna ate that species (see the possibility for error described in footnote 7). To put the findings in perspective, the tuna eaten by the smallest number of participants – bigeye - was eaten by 11 of the 13 total participants that caught one. As discussed above in the Motivations section, many recreational anglers in the Northern Caribbean - including more affluent ones that target billfish - are greatly motivated by the prospect of eating their catch. Given tuna's universal popularity as food then, it is not surprising that so many anglers ate the tuna they caught. A small minority of participants released some tuna: 23% of Puerto Rico participants who caught yellowfin released at least one, 32% released albacore, 38% released bluefin, and 50% released bigeye (somewhat of an outlier given that only eight participants caught bigeye tuna). In the USVI, only 19% of participants who caught yellowfin released one, while 66% released bluefin (another outlier given that only three USVI participants reported catching bluefin); no other tuna were reported as released. Only two participants in either territory reported tagging tuna—both Puerto Rico participants that tagged yellowfin.

[39] There is likely error here due to minor inconsistencies between the results for the separate questions on fish caught and fate of the catch. E.g., 35 USVI participants said they released blue marlin despite only 31 USVI participants indicating they actually caught any in the previous question.

Encouragingly, 13 of the 15 total participants that caught sharks released at least one of them (untagged). No Puerto Rico participants reported landing sharks, while only a few USVI participants reported eating and / or donating them.

6.2.2 Discussion on Catch and Release

The catch-and-release ethos has spread greatly in the Caribbean over the past two decades, thanks in large part to supportive management practices like mandatory no-kill tournaments, minimum harvest sizes, and restrictions on stainless steel-hooks with longline gear (Holland, Ditton, & Graefe 2004). Tagging programs also contributed as anglers learned they could assist by collecting data for science and conservation needs. The ecological goals that can be achieved from catch and release are obvious, but regulators should also recognize that catch and release is not a deterrent to economic prosperity. Appreciation for the tangible and intangible benefits of catch and release (e.g., greater chance of catching a fish, long-term stock replenishment) is growing among locals and tourists alike. Indeed, "regions such as the Caribbean that are interested in both ecotourism and economic development may develop tourism trade strategies to attract anglers who minimize their impacts by utilizing catch and release techniques where appropriate" (Graefe & Ditton, 1997).

The survey results reflect the popularity of catch and release in the Northern Caribbean. Although the actual percentage of participants that released all billfish cannot be generated from the results here, we can estimate that the number is *at least* 89%;[40] excluding swordfish, the number jumps to 97%. In Puerto Rico, the estimate comes out to 90%, 96% excluding swordfish; in the USVI, this estimate comes out to 87%, 99% excluding swordfish. Notably, a similar study conducted by Alan Graefe and Robert Ditton (1997) with data collected at Puerto Rico billfish tournaments in 1992 (see Ditton & Clark, 1994) found that only *41%* of participants released all billfish they caught - representing an approximate 50% increase in anglers that released all billfish caught. It should be noted that Graefe & Ditton used a larger sample size of 399 participants, all of which were surveyed at a billfish tournament (Graefe & Ditton, 1997). Nevertheless, approximately 80% of the Puerto Rico participants here also competed in pelagic tournaments over the past twelve months (see the Tournament Participation section), several of which were used for Graefe & Ditton's study (e.g., the International Billfish Tournament at Club Nautico de San Juan and the Club Nautico de Arecibo Tournament) (Graefe & Ditton, 1997). Moreover, approximately 85% of the participants in Graefe & Ditton's sample were Puerto Rico residents (Ditton & Clark, 1994), and every Puerto Rico participant in this study was a Puerto Rico resident. These similarities suggest that the participant demographics in the two surveys are relatively compatible. Indeed, there is a reasonable chance that a participant here took the survey used for Graefe & Ditton's study.

It is interesting to note that catch and release appeared to have gained substantially more acceptance in the U.S. mainland than in Puerto Rico before the turn of the century. In a parallel study using data collected from U.S. Atlantic billfish tournaments in 1991 (see Fisher & Ditton, 1992), Graefe & Ditton found that 70% of participants there released all billfish (Graefe & Ditton, 1997). Also notable, in Graefe & Ditton's Puerto Rico study, 25% of Puerto Rico residents were in favor of a catch and release only (or zero bag limit) management plan, while 59% of non-residents (many of which were U.S. mainlanders) favored such a plan (Ditton & Clark, 1994). The marked improvement in catch and release for Puerto Rico reflected here indicate anglers' willingness to collect data through tagging. It also suggests the aggressive regulatory efforts by NOAA and the Puerto Rico Government are paying dividends. Specifically, the

[40] This estimate was calculated by first subtracting the number of participants that indicated they ate, donated, or sold billfish (28) from the total number of participants that caught billfish (256) to estimate the number of participants that did not land billfish (228). Then this estimate of participants that did not land billfish (228) was divided by the total number of participants that caught billfish (256). This formula was then repeated without swordfish factored into any of the figures.

minimum-size, reporting, and permitting requirements of the 1988 Fishery Management Plan (FMP) for Atlantic Billfish (the "1988 FMP") appear to have become firmly entrenched in the community. For example, the lack of any illegal sales reported by participants here - who had the choice to remain anonymous - demonstrates compliance with the FMP's 'no-sale' provision for billfish (other than swordfish), which effectively bans any sort of domestic commercial market (NMFS Safe Report, 2011). In contrast, a number of recreational anglers interviewed between November 2003 and July 2006 for a NOAA study conducted on Puerto Rico's fisheries revealed fishing income earned by recreational anglers (Griffith *et al*., 2007). Moreover, an NMFS report published in 1998 found that many anglers were openly selling marlin in Arecibo - from where many surveys for this Report were taken (NMFS Social Report 17, 1998). Of course, the catch and release ethos is still subject to criticism. One key concern documented in the NOAA Puerto Rico study concerns economic waste (Griffith *et al*., 2007). After being hooked and fighting an angler for hours, many billfish are critically injured[41] and die shortly after being released, or become "shark bait" (Griffith *et al*., 2007). At the same time, traditional tag recapture data and satellite tag tracking also indicate the fish can survive after being caught, tagged, and released.

Very little statistical data on recreational fisheries in the USVI is available. A 1998 telephone survey conducted by the USVI Division of Fish and Wildlife generated useful information on the demographics of local recreational anglers, but very little on their specific behavior or tendencies (i.e., species targeted, caught, released) (Mateo, 2004). Socioeconomic data on the region's two most popular pelagic species, wahoo and Dorado, was published by the DFW in the early 2000's (Toller, O'Sullivan & Gomez, 2005); unfortunately, these fish were not included in this survey for comparison. One previous DFW study is pertinent, however. At varying points between 1973 and 1990, DFW monitored and recorded the catch and release rates for blue marlin at four local tournaments (Friedlander & Contillo, 1990) The release rates are as follows: 93% (55% tagged) at the Biras Creek Tournament from 1987-1990, 87% (61% tagged) at the U.S.V.I. Open from 1973-1990, 96% (83% tagged) at the AYH Tournament from 1988-1990, and 55% (52% tagged) at the July Open from 1983-1990 (Friedlander & Contillo, 1990). The low 55% release rate for the July Open, which appears to be an outlier, might be partially explained by the residency of the tournament participants: Unlike the extremely popular U.S.V.I Open, which attracted participants from the U.S. mainland, the July Open was attended primarily by locals and Puerto Ricans during the 1980's (Friedlander & Contillo, 1990). Recall the divergent billfish release rates for Puerto Rico (41%) and the U.S. mainland (70%) from Graefe & Ditton's study, and it seems increasingly apparent that billfish conservation practices have improved drastically in the Northern Caribbean over the past several decades.

Though educational outreach on how to properly release a fish, demographic changes and economic development surely contributed to this improvement in billfish conservation, regulators and tournament organizers also played a vital role. Consider that, unlike the July Open, the time periods covered for the more favorable Biras Creek and AYH Tournament studies coincide with the advancement of more stringent federal and local regulation, e.g., the 1988 FMP and the proposed Virgin Islands Marine Reserve System[42] (Impact, 2007). A reasonable inference can be made that heightened regulative attention contributed to the higher release-rates these tournaments had than the July Open, which the DFW started monitoring four to five years prior. Although the 17-year window covering the USVI Open's impressive 96% release rate starts ten years before the July Open in 1973, that tournament is somewhat of an outlier compared to other tournaments. The USVI Open has been widely hailed for its revolutionary conservation practices, specifically, pioneering a "modified release" point (awarding points for releasing fish) and

[41] Encouragingly, anglers interviewed by NOAA did report dragging fish along the water in an attempt to resuscitate them.

[42] The Marine Reserve System itself was not actually approved by the local government, but four Marine Reserves were ultimately designated by the Commissioner of Planning and Natural Resources; three were enacted in St. Thomas in 1992, and one was enacted in St. Croix in 1996.

minimum size limit (USVI Open, 2012). Factor in the large number of participants from the U.S. mainland polled at the tournament, and the USVI Open's impressive release rate is likely not indicative of the USVI's greater stance on catch and release during the 1970's and early 1980's. Of course, the operators and participants of the USVI Open - many of whom provided useful data for this Report - all deserve substantial credit for the improvement in billfish release rates reflected here. Indeed, recreational fisheries in the USVI demonstrate how regulatory and community stakeholders can jointly promote billfish conservation.

7. GEAR SELECTION

Post release mortality of pelagic fish is strongly dependent on gear selection (Graves & Horodysky 2009; Prince 2002; Cooke 2006). With the exception of a single outlier, participants from both regions unanimously selected "rod and reel" as the gear they used the most. The responses for bait used were predictably more diverse: In the USVI, 43 participants (84.3%) indicated that they used artificial bait, 45 participants (84.3%) indicated that they used dead bait, 25 participants (49%) indicated that they used live bait, and 14 participants (27.5%) indicated that they fly fished. In Puerto Rico, 97 participants (90.7%) indicated they that used artificial bait, 77 participants (72%) indicated that they used dead bait, 24 participants (22.4%) indicated that they used live bait, and five participants (22.4%) indicated that they fly fished. Finally, 69% of Puerto Rico participants and 73% of USVI participants indicated they used circle hooks with some regularity. In contrast, 53% of Puerto Rico participants and 63% of USVI participants indicated that they still used J-hooks some of the time.

The near unanimous selection of "rod and reel" as primary gear used was a bit surprising, but may be indicative of the sample of recreational fisherman surveyed. As noted earlier, recreational anglers in Puerto Rico and the USVI target multiple species with multiple gears (Salas *et al*., 2011). The NOAA Puerto Rico study showed that 68% of recreational anglers used two different gear types, 40% used three, 21% used four, and 11% used five (Griffith *et al*., 2007). "Hooks and lines" (similar to rod and reel) was only listed by 25% of all participants (including commercial fishermen) as the primary gear used (Griffith *et al*., 2007). The FAO study likewise found that lines only accounted for 40% of total landings in Puerto Rico between 2001 and 2003 (Salas *et al*., 2011). A separate NOAA study conducted on USVI fisheries in 2004 and 2005 highlighted the popularity of nets and traps and found that it is not uncommon for anglers to employ multiple gears on a single trip (e.g., trolling on the way to set up a trap) (Impact, 2007). Contrary to the results here, the numbers from the FAO and NOAA Puerto Rico studies above suggest that a material percentage of recreational anglers in the Northern Caribbean use a primary gear other than rod and reel. Unlike most recreational anglers, however, almost every participant here targeted HMS, which is generally only fished with lines. Contrarily, other popular species in the region are targeted with other gear (Clark *et al*., 2012); the NOAA Puerto Rico study found that, for the commercial and recreational fisheries combined, the three most targeted species by trap were lobster, conch, and silk snapper, and the three most targeted species by net were snappers, snook, and lobster. Taking all of these factors into account, an inference can be made that recreational anglers in Puerto Rico and the USVI that target HMS do not target shellfish or coastal finfish—or species fished by trap and net—as much as they target HMS. If they did, one would presume that more than one of the 175 participants that revealed their primary fishing gear would have identified trap or net. This inference buttresses the distinction between billfish anglers, or high specialization anglers, and lower specialization anglers in the Northern Caribbean. The dichotomy between high and low specialization anglers is explored above in the Demographics section of this Report.

Despite the fact that a majority of participants still use J-hooks, the fact that a larger majority of them also use circle hooks is nevertheless encouraging. Non-offset circle hooks are distinguished from J-hooks by the hook's point, which is perpendicular to the shank of the hook. They promote HMS conservation by

reducing post-release mortality and by-catch (Straughn, 2012). Moreover, studies have shown that billfish catch rates may actually be higher with circle hooks than J-hooks (Straughn, 2012; Hoey, 1996; Rudershausen *et al*.; 2011 Prince, 2002). Although circle hooks have been used in commercial fisheries for decades, regular use in the recreational sector did not begin until tournaments started promoting them in the 1990's (Cooke, 2006). Recognizing the efficacy of circle hooks, NMFS passed a regulation in January 2008 requiring anglers participating in billfish tournaments and using natural baits (dead or alive) to use non-offset circle hooks when deploying natural bait (commercial vessels using pelagic longline gear in Atlantic HMS fisheries have been required to use circle hooks since August 2004) (Straughn, 2012).

NMFS does not have an accurate estimate of circle hook usage (NMFS Final Env. Assessment, 2007). Moreover, past studies are limited by the fact that circle hooks are a relatively recent innovation and tournament anglers were only required to start using them in 2008. Given that 81% of total participants competed in pelagic fishing tournaments over the past year and at least 77% of total participants used natural bait, it can be inferred that the majority of participants have been legally required to use circle hooks over the past year. Even though U.S. regulations require use of non-offset circle hooks in billfish tournaments when using natural bait, there was no direct correlation with tournament participation and circle hook-use. In fact, there is a slightly negative relationship: 66% of Puerto Rico tournament participants (minus 3% of total Puerto Rico circle hook usage) and 70% of USVI tournament participants (minus 3% of total USVI circle hook usage) used circle hooks. Phrased differently, 34% of Puerto Rico tournament participants and 30% of USVI tournament participants did not indicate circle-hooks usage. Because the survey results do not indicate when certain bait-types were used, or whether participants that did not "primarily" use circle hooks nevertheless used them when required to, an accurate estimate of non-compliance with the 2008 circle hook regulation cannot be made. However, the results suggest that opportunities to educate anglers on regulatory compliance and the benefits of circle hooks remain.

8. FLEET SIZE AND CHARACTERISTICS

Understanding the size and characteristics of the fleet that uses the fishery helps regulators identify areas and stakeholders on which to focus management efforts. Moreover, vessel purchases offer staggering influx of capital to a local economy. Even if vessels are purchased outside of that local economy, the annual maintenance costs of parts and mechanic services provide additional economic considerations. Unfortunately, budgetary and personnel limitations - or, as is the case here, (relatively) small sample sizes - make acquiring comprehensive fleet data extremely difficult. Thus, the survey results on this subject are somewhat limited. Nevertheless, some interesting statistics on vessel size, ownership, and location were generated:

In Puerto Rico, 79 participants (86.6%) indicated that they or someone in their household owned one or more sportfishing boats; 12 participants (13.2%) did not. Of the 12 participants who did not own fishing boats, two participants (16.7%) indicated that they intended to purchase a boat in the next 12 months. Of those who owned boats, 56 participants (71.8%) indicated that they stored their boat at a marina, four participants (5.1%) indicated that they stored their boat at a drydock, zero participants (0%) indicated that they stored their boat at anchor, 14 participants (17.9%) indicated that they stored their boat at a private residence, and four participants (5.1%) indicated that they stored their boat at a trailer. The survey did not specify whether boats stored at private residences were stored in water.

Forty percent of the Puerto Rico participants that owned boats indicated that their vessel was between 20 to 30 feet long. This was the most popular length by a wide margin. In contrast, 9.2% of participants had boats under 20 feet, 23.7% had boats between 30 to 40 feet, 14.5% between 40 and 50 feet, and 11.8%

over 50 feet. 54.5% of Puerto Rico participants that owned a sportfishing boat had a boat with an inbound propulsion system, 42.9% had an outboard propulsion system, and 2.6% had both.

Responses to fleet size at marinas where Puerto Rico participants docked their boats were as follows: 56% (not part of a fleet), 4% (under 10 boats), 0% (10-20 boats), 2.7% (20-30 boats), 5.3% (30 to 40 boats), 2.7% (40-50 boats), and 29% (over 50 boats).

In the USVI, 30 participants (68.2%) indicated that they or someone in their household owned one or more sportfishing boats; 14 participants (31.8%) did not. Of the 14 participants who did not own fishing boats, two participants (14.3%) indicated that they intended to purchase a boat in the next 12 months. Twenty participants (66.7%) indicated that they stored their boat at a marina, four participants (13.3%) indicated that they stored their boat at a drydock, four participants (13.3%) indicated that they stored their boat at anchor, one participant (3.3%) indicated that he stored his boat at a private residence, and one participant (3.3%) indicated that he stored his boat at a trailer.

Thirty-one percent of the USVI participants that owned a boat had vessels between 30 to 40 feet and 20 to 30 feet respectively (62% total). Twenty percent had a boat between 40 to 50 feet, 13.8% over 50 feet, and 3.4% under 20 feet. Fifty-three percent of the sportfishing boats belonging to USVI participants had an inboard propulsion system, 40% had an outboard propulsion system, and 6.7% had both.

Finally, responses to fleet size at marinas where USVI participants docked their boats were as follows: 26.7% (not part of a fleet), 16.7% (under 10 boats), 3.3% (10-20 boats), 6.7% (20-30 boats), 6.7% (30-40 boats), 6.7% (40-50 boats), and 26.7% (over 50 boats). It is interesting to note that a majority of Puerto Rico participants did not dock their vessels with a fleet, while only a quarter of USVI participants did not dock their vessels with a fleet. Contrarily, 18% more Puerto Rico participants owned boats than USVI participants.

The fact that a large majority of participants that docked their boats at marine facilities did so at facilities holding over 50 other boats does show very high capacity relative to the small geographic and population size of the territories. To further gauge the capacity for docking larger vessels targeting pelagics in the region, TBF reached out to ten random marinas in the USVI; the average number of slips among the marinas was 75 and the lowest maximum size reported was 50 feet. The capacity of the marinas accords nicely with the results here, as only 12% of participants had boats over 50 feet and most of them kept their boats at larger facilities. Though marinas were reluctant to share the number of boats that actually docked at their facilities, one prominent USVI marina with approximately 120 slips said that while there were ten vessels that targeted billfish docked there in October 2012, 30 visiting vessels that targeted billfish were present during peak season over the summer. This surplus of available slips at such a well-known facility buttresses the inference that billfish anglers enjoy a multitude of viable options at which to dock their vessels in the Northern Caribbean. It follows that the infrastructure is in place for the USVI to grow its recreational fishery and thereby boost its local economy.

No Puerto Rico participants explicitly indicated they kept their boats outside Puerto Rico, and only four participants stated that their boats were registered in another country. To compare with a larger sample size, the NOAA Puerto Rico study found that 90% of recreational anglers docked their boats locally (Griffith *et al*., 2007). In the USVI, eight participants had boats registered elsewhere and six participants docked their boats outside the USVI. The higher number of boats being registered and docked outside the local region by USVI participants is attributable to the visitors that took the USVI survey. The positive, local economic impact of the great number of fishing boats being purchased and maintained locally is significant.

As suggested by the spatial maps below, many larger sportfishing boats in Puerto Rico concentrate in the San Juan region. In the USVI, sportfishing boats and charter operations tend to be more spread out; this is primarily attributable to the geographic layout of the islands and the lack of a major metropolitan area rivalling San Juan. Despite Puerto Rico's substantially larger population, both territories actually run a similar number of charter operations. As discussed in the Management section below, there were only four more active HMS Charter permits for Puerto Rico (27) than the USVI (23) in 2011 (although a significantly higher number of general HMS angler permits were active for Puerto Rico). A 2002 study conducted for the GCFI actually found that there were 27 charter operations in the USVI compared to 19 for Puerto Rico (Mateo, 2004). The significantly greater proportion of charter operations in the USVI demonstrates just how dependent the USVI economy is dependent on tourism trade. Indeed, 80% of the USVI's GDP derives from the tourism trade (CIA World Factbook USVI, 2012).

The size of the vessels owned by participants demonstrates a positive correlation with income. Just as USVI participants had slightly higher income than Puerto Rico participants, they also owned slightly larger boats. Again, the visiting USVI participants are accountable for this discrepancy - seven of the 13 visiting USVI participants that agreed to share their income earned at least $200,000 per year and only one of the 14 USVI resident participants earned that much. By contrast, nearly a quarter of Puerto Rico participants (all residents) that agreed to disclose their income earned over $200,000 per year. Although both territories have high poverty rates,[43] Puerto Rico has a larger and wealthier upper-class than the USVI and thus is not as dependent on tourism to sustain its recreational pelagic industry.

9. SEASONALITY OF FISHING EFFORT

The seasonal data produced by the survey correlates with the seasonal billfish tournaments in Puerto Rico and the USVI. Both territories host famous tournaments during the summer months - e.g., the USVI Open (August) and the July Open (July) in the USVI, and the Club Nautico de Vega Baja (July) and the International Billfish Tournament at Club Nautico de San Juan (September) in Puerto Rico. The tournament period coincides with the spawning and consequent increased abundance period for blue marlin - the most targeted species at tournaments in Puerto Rico - between May and September (Rodriguez-Ferrer 5, 2004). It follows that blue marlin were targeted by participants in both territories between May and September more than any other months. This rate peaked in August for Puerto Rico, during which 80% of Puerto Rico participants that targeted blue marlin targeted blue marlin;[44] the rate peaked in July for the USVI, during which 67% of USVI participants target blue marlin. Although white marlin is likewise targeted heavily in the summer, the effort directed towards the species appears to be more dispersed. Over a full calendar year, the range of participants targeting white marlin was 19 in Puerto Rico and 8 in the USVI, while the range for blue marlin was 74 in Puerto Rico and 18 in the USVI. The striking variance in range between the two territories - even taking the different sample sizes into account - deserves attention. One might presume from its higher ranges that Puerto Rico participants included more visitors that only fished at summer tournaments. However, quite the opposite is true: Every Puerto Rico participant was a resident of Puerto Rico, while 36% of USVI participants were visitors. Moreover, approximately 35% of surveys from each territory were collected at tournaments, and approximately 80% of each territory's participants competed in tournaments over the past year. Thus, Puerto Rico's extremely high blue marlin range cannot necessarily be attributed to exclusive fishing in summer tournaments. Instead, the results suggest that marlin are targeted at a more steady annual rate in

[43] Puerto Rico's GDP per capita and poverty rate stands at approximately $16,300 and 46% respectively; recent estimates for the USVI are $14,500 and 29%. (CIA World Factbook Puerto Rico & USVI, 2012)

[44] For convenience, unless otherwise indicated explicitly, all percentages of participants that targeted a particular species during a particular month cited in this Seasonality section are calculated from the number of respective participants in each territory that indicated they targeted that particular species at all.

the USVI than in Puerto Rico, though more research is needed to affirm this observation. See Figure #21 and #22 for Seasonality of Fishing Effort for Billfish in the USVI and Puerto Rico.

While marlins are clearly popular amongst anglers in the summer, other billfish seem to be more popular in the colder months. In Puerto Rico, sailfish and spearfish were targeted most heavily between October and December (the highest rate belonged to sailfish in November at 66%). There was very little variance in the amount of participants that targeted swordfish in Puerto Rico throughout the year. In the USVI, sailfish, spearfish, *and* swordfish were targeted most heavily between January and March (the highest rate belonged to sailfish in January at 38%), which correlates with the Northern Caribbean's peak tourist season (U.S. News Travel, 2012). It follows that, once again, the visiting (tourist) USVI participants could be responsible for the seasonal discrepancy between the two regions. Likewise, this winter tourist presence might help explain the USVI's significantly lower range for marlin.

Tuna are generally fished year-round in the Northern Caribbean. The range for yellowfin tuna - by far the most targeted tuna species among participants - was 18 in Puerto Rico and 7 in the USVI (relatively close to the white marlin range). Yellowfin was targeted most during the summer in Puerto Rico (peaked at 38% in August) and most during the winter in the USVI (peaked at 53% in January). It follows that the territorial rates for yellowfin (and other tuna species) correlate with the trends noted above regarding proportionally higher marlin fishing in Puerto Rico during the summer and proportionally higher sailfish, swordfish, and spearfish fishing in the USVI during the winter. Accordingly, the seasonal targeting rates for tuna support the somewhat tenuous inference that pelagic fishing seasons are more pronounced in Puerto Rico than the USVI, and the more tenable inference that visiting participants skewed the results for the USVI's winter months. Each of these inferences in turn demonstrates the effect billfish tournaments and tourism may have on a territory's fishery - and consequently its economy. See Figure #23 and #24 for Seasonality of Fishing Effort for Tuna in the USVI and Puerto Rico.

Sharks were generally targeted during the summer, the highest rate in each territory being in August. That month, 47% of Puerto Rico participants targeted shortfin mako and 33% of USVI participants targeted "other" shark species. The small sample size of participants targeting sharks (32 in Puerto Rico and 13 in the USVI) makes meaningful analysis of seasonal data difficult, though it is curious that twice as many Puerto Rico participants (8) targeted "other" shark species in January than in any other month. See Figure #25 and #26 for Seasonality of Fishing Effort for Sharks in the USVI and Puerto Rico.

10. TOURNAMENT PARTICIPATION IN THE NORTHERN CARIBBEAN

Although Anderson and Ditton (2003) approximated that a relatively small percentage of recreational anglers participate in fishing tournaments, the local economic impact they can have is significant. For instance, Ditton and Clark (1994) estimated that in 1994, billfish tournaments created 170 jobs in Puerto Rico. Billfish tournament also stand as a vanguard for conservation practices such as catch and release and circle hook usage (Oh *et al*., 2007).

As the demographics of the participants here reflect, participation in recreational fishing tournaments is often limited to older, more experienced anglers. Ditton and Stoll (2003) found that tournament participants along the U.S. Atlantic are typically highly educated (college graduates and above) white males in their forties (46-50 years) with high household incomes (US$70,000 - $179,000).

NMFS requires all HMS Tournaments to submit Tournament Report Cards. These cards indicate the number of HMS released and retained. The 2011 NOAA Report Card data (from tournaments that submitted their data to NOAA), which is quite encouraging, is disclosed below. Tournament participation and expenditure data from the survey here follow the Report Card data.

The 2011 Torneo de Pesca Interclub de Caribe de San Juan reported 24 blue marlin released and one white marlin released. The 2011 International Billfish Tournament at Club Nautico de San Juan reported that 84 blue marlin were released. The 2011 International Light Tackle Blue Marlin Tournament de San Juan reported 116 blue marlins released. The 2011 Ladies National Blue Marlin Tournament de San Juan reported four blue marlins released. The 2011 Club Nautico de Arecibo Tournament reported four sailfish released and two sailfish retained. The 2011 Torneo Familiar de Pesca de Pez Vela reported one blue marlin released, four white marlins released, and 13 sailfish released. In total, Puerto Rico HMS Tournaments Report Cards revealed 252 of 254 total fish released; an amazing 99.21% release rate for its 2011 tournaments.

The 2011 Goldenhook Dolphin Tournament in St. Croix reported one sailfish released. The 2011 Goldenhook Challenge Tournament in St. Croix reported one blue marlin released. The 2011 USVI July Open Tournament in St. Thomas reported 19 blue marlins released and one white marlin released. The 2011 USVI Open Atlantic Blue Marlin Tournament in St. Thomas reported 107 blue marlins released. The USVI July Open Tournament in St. Thomas reported 21 blue marlins released and one white marlin released. These results combine for a staggering 100% release rate for 2011 USVI tournaments.

Forty-four participants in the USVI (83%) indicated that they participated in a pelagic fishing tournament in the past 12 months; nine participants (17%) indicated that they did not. Ten participants (28.6%) indicated that they participated in the Golden Hook Fishing Club Tournament, 15 participants (42.9%) indicated that they participated in the 49th Annual July Open Tournament, nine participants (25.7%) indicated that they participated in the USVI Open - Atlantic Blue Marlin Tournament, six participants (17.1%) indicated that they participated in the Virgin Islands Billfish Tournament for Haiti, eight participants (22.9%) indicated that they participated in the Golden Hook Challenge Tournament, nine participants (25.7%) indicated that they participated in the Golden Hook Fish Club Dolphin Tournament, zero participants (0.0%) indicated that they participated in the USVI Memorial Day Tournament, eight participants (22.9%) indicated that they participated in the Golden Hook Fishing Club – Guy/Gal Tournament, nine participants (25.7%) indicated that they participated in the Golden Hook Fishing Club – Wahoo Finale Tournament, and nine participants (25.7%) indicated that they participated in an "Other Tournament."

Of the 30 participants in the USVI who listed their tournament expenditures over the past 12 months, seven participants (23.3%) indicated that they spent $500, two participants (6.7%) indicated that they spent between $500 and $1,000, five participants (16.7%) indicated that they spent between $1000 and $2,500, five participants (16.7%) indicated that they spent between $2,500 and $5,000, and 11 participants (36.7%) indicated that they spent over $5,000.

Eighty-nine participants (79.5%) in Puerto Rico indicated that they participated in a pelagic fishing tournament over the past 12 months; 23 participants (20.5%) indicated that they did not. Forty-four participants (60.3%) indicated that they participated in the Torneo de Pesca Aguja Azul, 19 participants (26.0%) indicated that they participated in the Club Náutico de Vega Baja Tournament, 30 participants (41.1%) indicated that they participated in the 58th International Billfish Tournament at Club Nautico de San Juan, 12 participants (16.4%) indicated that they participated in the Club Náutico de Boqueron, 24 participants (32.9%) indicated that they participated in the International Light Tackle Blue Marlin Tournament, eight participants (11.0%) indicated that they participated in the Torneo de Damas de la Asociacion de Pesca de Puerto Rico, two participants (2.7%) indicated that they participated in the 3er Circuito Vela-Peto, six participants (8.2%) indicated that they participated in the 8vo Torneo de Pez Vela, 11 participants (15.1%) indicated that they participated in the 33 Clásico Pez Vela, four participants (5.5%) indicated that they participated in the Cuadragesemo Primer Clásico Aguja Azul, 11 participants (15.1%) indicated that they participated in the Torneo de Pesca Interclub del Caribe 2012, 10 participants (13.7%) indicated that they participated in the 29 Torneo Aguja Azul, 13 participants (17.8%) indicated

that they participated in the 44 Clásico Aguja Azul, and six participants (8.2%) indicated that they participated in an "Other" Tournament.

Of the 68 participants in Puerto Rico who listed their tournament expenditures over the past 12 months, eight participants (11.8%) indicated that they spent under $500, 15 participants (22.1%) indicated that they spent between $500 and $1,000, 16 participants (23.5%) indicated that they spent between $1000 and $2,500, 12 participants (17.6%) indicated that they spent between $2,500 and $5,000, and 17 participants (25%) indicated that they spent over $5,000.

11. SPATIAL DISTRIBUTION OF RECREATIONAL FISHING

11.1 Spatial Distribution of Recreational Fishing Effort

The spatial distribution of recreational fishing effort is critical to a number of fisheries management factors. Variability in the magnitude of fishing effort may suggest a need for variability in enforcement actions. Moreover, having information on the spatial distribution of recreational fishing may help identify fisheries conflicts with other users, including commercial anglers.

For the USVI analysis, a 0.5 degree x 0.5 degree grid was created between -65.00° W and -65.00°W and 17.25°N and 19.25°N. For the Puerto Rico analysis, a 0.5 degree x 0.5 degree grid was created between -64.00° W and -65.50°W and 17.00°N and 19.00°N. The grid system was colored according to the percentage of participants who indicated that they fished recreationally within a quadrant in the last 12 months. Each participant was asked to select the three quadrants in which they fish the most; the grids are colored from green (least) to red (most) according to the amount of effort put into that quadrant.

Most anglers in Puerto Rico are local in that they live in the communities where they fish (FAO 294, 2012), and all the Puerto Rico participants were Puerto Rico residents. It is no surprise then that the spatial map for Puerto Rico reflects where most of the Puerto Rico participants live. Indeed, many Puerto Rico surveys were collected at Arecibo and Vega Baja, which are both located in the top-fished quadrants along the north coast. Although the population of the San Juan region makes it seem like the natural candidate to be the top-fished overall area in Puerto Rico, the NOAA Puerto Rico study actually found that relatively little fishing activity takes place on the northern coast compared to the west and southwest coasts (Griffith 5, 2007). In particular, Cabo Rojo, Lajas, and Rincon are viewed as perhaps the territory's most significant fishing centers (Griffith, 2007). Matos-Caraballo and Agar (2008) also identified the highest density of commercial anglers along the west coast of Puerto Rico; interestingly, most commercial fishermen there indicated that the range of their effort was limited due to increases in fuel costs (Matos-Caraballo & Agar, 2008). Keeping the distinction between Puerto Rico's commercial and recreational fisheries in mind, the results here do reflect the large number of billfish tournaments and yacht clubs along the north coast, where a majority of surveys were collected. The area's large surrounding population and proximity to the famous billfish hotspot "Billfish Pass" (a.k.a. "Blue Marlin Alley") a natural trench located about a mile and a half north of San Juan, make the north coast the natural epicenter for pelagic recreational fishing activity. See Map #1 for Spatial Distribution of Puerto Rican Angler Effort Maps.

The spatial data for the USVI also came out as expected, with the top two fished areas lying around St. Croix. Pelagic fishing is much more popular around St. Croix then the northern islands of St. Thomas and St. John, where trap fishing dominates (Kojis & Quinn, 2006; Clark *et al*., 2012). The spatial map also reflects the popularity of the "North Drop," a renowned billfish fishing area between the USVI and British Virgin Islands, and the "South Drop," another popular HMS zone between St. Thomas/St. John and St. Croix. See Map #2 for Spatial Distribution of USVI Angler Effort Maps.

11.2 Spatial Distribution of Recreational fishing Catch

TBF's Tag and Release database provided the basis for both the GIS analysis and spatial distribution of recreational fishing catch in the Northern Caribbean. During the first part of the GIS analysis, the spatial distribution of billfish anglers from the USVI and Puerto Rico that have released, tagged, or recaptured billfish species was evaluated. Within the TBF database, records were isolated for billfish tagged, released, or recaptured by anglers from the USVI and Puerto Rico. It is important to note that some release records contained multiple releases; the total number of billfish accounted for within these records was 7,599 billfish. Of the total TBF billfish records in the study area, 153 were tagged or released in the last 12 months. The vector data for each billfish interaction was plotted in ArcGIS; any points that fell on land because of incorrect geo-location data were removed from the spatial analysis.

For the USVI analysis, a 0.5 degree x 0.5 degree grid was created between -65.00° W and -65.00°W and 17.25°N and 19.25°N. For the Puerto Rico analysis, a 0.5 degree x 0.5 degree grid was created between -64.00° W and -65.50°W and 17.00°N and 19.00°N. A spatial join between the grid and the vector data was performed to provide the grid system with the sum of all the catch information associated with each vector points falling within a particular quadrant. The grid system was colored according to the sum of the number of billfish released within a quadrant; the grids were colored from green to red as the number of billfish increased. This analysis allowed for the observation of the areas with the highest areas of catch for anglers targeting billfish around the USVI and Puerto Rico. See Maps #3 and #5 for Spatial Distribution of Billfish Catch Maps for Puerto Rico and the USVI.

GIS analysis also demonstrates the highly migratory nature of billfish. Specifically, it shows the wide distribution of migration patterns for tagged/recaptured billfish in the waters surrounding the USVI and Puerto Rico. For this aspect of the study, the parameters of the grid defined above were used to isolate billfish that were either tagged or recaptured within the given location to give insight into their migratory patterns. Blue marlin and swordfish were the species with the greatest distance between their location patterns, with blue marlin travelling across the Atlantic and swordfish being recaptured off of the coast of Canada. White marlin and sailfish were also recaptured throughout the Caribbean, the Gulf of Mexico, and along the U.S. Atlantic Coast. See Map #4 and #6 for Billfish Tag and Release Maps for Puerto Rico and USVI.

Conventional tagging, while providing insight into billfish migrations, only allows for start and end points to be determined. With that in mind, little is known about the whereabouts of tagged billfish before their recapture. Nevertheless, the spatial analysis of tagged and recaptured billfish provides a powerful reminder of just how far HMS can travel. It follows that the spatial analysis here illustrates the importance of collaborative conservation between Caribbean territories. See Map #7 for Billfish Recapture Map for Puerto Rico and the USVI.

12. REVENUES AND COSTS OF RECREATIONAL FISHING

12.1 Statistical Data

Notable sources of revenues from recreational fishing include the sale and care of a vessel, tournament revenues, and various trip revenues. Captain, crew, and charter fees provide a direct impact on the local economy while creating opportunities for local employment. Boat operation costs, including maintenance, spare parts, and fuel, are also significant. For those recreational anglers who do not own a boat of their own, boat rental revenues can nevertheless be substantial. The fishing gear, live bait, artificial lures, and other tackle that is uniquely associated with recreational fishing also provide extensive local revenues - particularly during billfish tournament season. Further, recreational anglers purchase a variety of

consumable goods from restaurants and local stores in their capacities as both anglers and tourists. Additionally, many recreational anglers stay in local hotels and take local flights around a region. Likewise, recreational anglers may contribute revenues through renting and fuelling cars. Finally, customs and entrance fees as well as any fishing licensure fees offer important financial support for regulatory programs of local governments. All of these expenditures were included in the survey here, with the results as follows:

In the USVI, on participants' last fishing trip targeting pelagic species, the average spent on captain, crew and charter fees was $908.33 (with a standard deviation of $643.75); the average spent on boat operations was $1,237.31 (with a standard deviation of $2,245.63); the average spent on boat rental fees was $3,400 (with a standard deviation of $1,608.31); the average spent on food, drinks and ice was $284.48 (with a standard deviation of $394.97); the average spent on lodging was $703.75 (with a standard deviation of 360.69); the average spent on airfare was $758.64 (with a standard deviation of 734.02); the average spent on live bait, artificial lures, and other tackle was $148.33 (with a standard deviation of $157.57); the average spent on customs and entrance fees was $140.00 (with a standard deviation of $182.10); the average spent on automobile transportation was $109.18 (with a standard deviation of $99.53); the average spent on boat launch/hoist fees was $0.00; and the average spent on anything else was $311.67 (with a standard deviation of $200.03). See Figure #27 for Average Trip Expenditures for the USVI.

Two outliers were removed from the USVI statistical analyses above because the expenditures were roughly ten times the averages provided by other recreational anglers.

In Puerto Rico, on participants' last fishing trip targeting pelagic species, the average spent on captain, crew and charter fees was $891.67 (with a standard deviation of $3,005.73); the average spent on boat operations was $1,318.67 (with a standard deviation of $5,861.88); the average spent on boat rental fees was $2,666.67 (with a standard deviation of $1,608.31); the average spent on food, drinks and ice was $246.77 (with a standard deviation of $8,787.40); the average spent on lodging was $1,150.00 (with a standard deviation of $2,941.25); the average spent on airfare was $795.00 (with a standard deviation of $751.44); the average spent on live bait, artificial lures, and other tackle was $244.70 (with a standard deviation of $2,032.88); the average spent on customs and entrance fees was $256.36 (with a standard deviation of $533.41); the average spent on automobile transportation was $603.44 (with a standard deviation of $443.78); the average spent on boat launch/hoist fees was $0.00; and the average spent on anything else was $529.69 (with a standard deviation of $17,388.28). See Figure #28 for Average Trip Expenditures for Puerto Rico.

The high standard deviations of this data reveal great variability in revenues from local sportfishing expenditures.

Perhaps the single greatest source of revenue from recreational anglers is vessel purchases. The survey results for vessel ownership and associated costs for maintenance and crew are as follows:

Of the 28 boat owners in the USVI who listed the how much they spent on their vessel, four participants (13.8%) indicated that they spent less than $25,000 on their boat; five participants (17.2%) indicated that they spent between $25,000 and $50,000 on their boat; two participants (6.9% indicated that they spent between $50,000 and $100,000 on their boat; nine participants (31%) indicated that they spent between $100,000 and $250,000 on their boat; two participants (6.9%) indicated that they spent between $250,000 and $500,000 on their boat; two participants (6.9%) indicated that they spent between $500,000 and $1 million on their boat; and three participants (10.3%) indicated that they spent over $2 million on their boat.

Of the 27 boat owners in the USVI who listed how much they spent annually on boat maintenance, one participant (3.7%) indicated that he spent under $500, zero participants (0.0%) indicated that they spent between $500 and $1,000, seven participants (25.9%) indicated that they spent between $1,000 and $2,500, six participants (22.2%) indicated that they spent between $2,500 and $5,000, and 13 participants (48.1%) indicated that they spent over $5,000. See Figure #29 for Vessel Expenditures for the USVI.

Of the 77 boat owners in Puerto Rico who listed how much they spent on their vessel (and its motor), 18 participants (23.4%) indicated that they spent less than $25,000, 14 participants (18.2%) indicated that they spent between $25,000 and $50,000, 11 participants (14.3% indicated that they spent between $50,000 and $100,000, 15 participants (19.5%) indicated that they spent between $100,000 and $250,000, four participants (5.2%) indicated that they spent between $250,000 and $500,000, seven participants (9.1%) indicated that they spent between $500,000 and $1 million, and one participant (1.3%) indicated that he spent over $2 million.

Of the 74 boat owners in Puerto Rico who listed how much they spent annually on boat maintenance, nine participants (12.2%) indicated that they spent under $500, nine participants (12.2%) indicated that they spent between $500 and $1,000, nine participants (12.2%) indicated that they spent between $1,000 and $2,500, 13 participants (17.6%) indicated that they spent between $2,500 and $5,000, and 24 participants (45.9%) indicated that they spent over $5,000. See Figure #30 for Vessel Expenditures for Puerto Rico.

In the USVI, 11 participants indicated that they hired crewmembers to work on their boat. An average of 2.45 people was employed by these 11 participants. Eighteen percent of these participants employed one person, 36% employed two persons, 36% employed three persons, 0% employed four persons, and 9% employed five or more persons.

Twenty-four participants in the USVI revealed the crewmember salaries they paid over the past 12 months. Total annual expenses among these participants were $535,000. Salary expenditures ranged from $1,000 to $130,000, with an average of $89,166.67.

In Puerto Rico, 32 participants indicated that they hired crewmembers to work on their boat. An average of 1.94 people was employed by these 32 participants. Forty-seven percent of these participants employed one person, 37% employed two persons, 6% employed three persons, 13% employed four persons, and 3% employed five or more persons.

Twenty-four participants in Puerto Rico revealed the crewmember salaries they paid over the past 12 months.[45] Total annual expenses among these participants were $539,300. Salary expenditures ranged from $300 to $100,000, with an average of $22,470.83.

Finally, of those who own vessels in the USVI, 11 participants (36.7%) indicated that they purchased their vessel in the USVI and 19 participants (63.3%) indicated that they purchased their vessel outside of the USVI. Of those who own vessels in Puerto Rico, 61 participants (80.3%) indicated that they purchased their vessel in Puerto Rico and 15 participants (19.7%) indicated that they purchased their vessel outside of Puerto Rico.

12.2 Analysis of Results

The Puerto Rico participants here—all residents—averaged $8,702 in expenditures[46] on their last trip targeting pelagic species. Though the survey did not ask participants to disclose any specific amount of

[45] A single participant-outlier indicating he paid $5 in crew salaries was removed from this statistic.

billfish trips or days they spent targeting billfish, it did have them estimate a range of days spent targeting pelagic species over the past year. These ranges are covered in the Demographics section above, but are repeated here for clarity: 7.9% of the 114 responding Puerto Rico participants did not target pelagic species at all, 15.8% of such participants targeted pelagic species between 1 - 5 days, 21.9% of such participants targeted pelagic species between 5-10 days, 19.3% of such participants targeted pelagic species between 10 - 20 days, 17.5% of such participants targeted pelagic species between 20 - 30 days, and 17.5% of such participants targeted pelagic species over 30 days. From these ranges, the average number of days Puerto Rico participants spent targeting pelagic species over the past year can be estimated at approximately fifteen. Again, however, because the survey results do not offer how many billfish trips participants actually took this past year, a verifiable estimate of the number of days participants averaged per trip - and consequently their average expenses per day - cannot be made. Likewise, an accurate comparison between the results here and NOAA's most recent estimate of average daily billfish expenditures in the Atlantic and Caribbean - which came out to $686 per angler - cannot be made (NMFS SAFE Report, 2011). The 1994 study Ditton & Clark conducted on Puerto Rico billfish tournament anglers, however, offers a mirror "average expense per trip" figure for comparison that is quite telling.

Ditton & Clark found that resident anglers averaged 21 billfish fishing trips in Puerto Rico and 36 days fishing in saltwater over the past year (Ditton & Clark, 1994). Non-resident anglers averaged seven billfish fishing trips in Puerto Rico and 33 days fishing in saltwater (Ditton & Clark, 1994). Average expenditures per billfish fishing trip (excluding tournament fees) were estimated to be $711 for residents and $3,945 for non-residents (Ditton & Clark, 1994). Per day, average expenditures were $374 for residents and $1,052 for non-residents. Because all the Puerto Rico participants here were residents, the pertinent number from Ditton & Clark's study is the estimated $711 per trip resident anglers spent targeting billfish. This figure is about $8,000 lower than the $8,702 estimate generated for this Report twenty years later.[47]

A few things are clear from comparing the results here with Ditton & Clark's, despite the incongruence of the two studies. One, even accounting for inflation, the significant $8,000 increase in average billfish trip expenses between 1992 (when the data was collected) and 2012 shows that billfish fishing is much more expensive than it used to be. Much of this rise in cost may be attributed to the market for rental boats (by far the leading expenditure in both studies), which has trended upward with growing demand. Likewise, the cost of driving and/or flying to and from the marina has gone up. Though it is sensible to correlate much of this rise in demand with growth in tourist trade, the high expenditures reported by resident participants here indicate that the spending power of the territory's upper-class should not be discounted. Indeed, though Puerto Rico's poverty rate remains exceptionally high (46%) (CIA World Factbook Puerto Rico, 2012), the territory's high-tech and pharmaceutical manufacturing industries continue to attract highly educated professionals with supple discretionary income. (Griffith 4, 2007) These industries took

[46] Notably, this figure excludes tournament entrance/calcutta fees and vessel purchases. It includes captain, crew and charter fees; boat operation costs; boat rental fees; food, drinks and ice; lodging costs; airfare; live bait, artificial lures and other tackle; customs and entrance fees; automobile transportation; boat launch and hoist fees.

[47] It bears mentioning that Ditton & Clark's (and NOAA's) estimates for average trip costs were based off a participant's last *billfish* fishing trip, whereas the estimate here was based off a participant's last *pelagic* fishing trip. Like all of Ditton & Clark's participants, however, the vast majority of participants here were avid billfish tournament anglers that completed surveys during or immediately after such tournaments. Thus, there is some error in comparing the two studies. Because targeting billfish is more expensive than targeting other pelagics, it might be appropriate to adjust Ditton & Clark's estimate downward—thus further exasperating the difference between the two figures. However, because most participants here were avid billfish tournament anglers surveyed at tournaments, it is reasonable to assume that much of what they spent on their last pelagic fishing trip was directed towards billfish.

off with the conjunction of the North American Free Trade Agreement (NAFTA)[48] and the tech-boom - events that contemporaneously displaced many low-skill workers in the area (Griffith 4, 2007). The local sportfishing industry would be wise to capitalize on the increasing amount of discretionary income entering the market.

The other theory that can be formulated by comparing the results here with Ditton & Clark's is that recreational pelagic fishing effort actually appears to have decreased in Puerto Rico. While Ditton & Clark's participants averaged 38 days per year fishing in saltwater, only 17.5% of Puerto Rico participants here indicated they targeted pelagic species over 30 days during the past year. Of course, postulating that billfish anglers are fishing less is counterintuitive. After all, in its most recent Technical Guidelines for Recreational Fisheries, FAO proclaimed that recreational fisheries in Latin America are still experiencing rapid growth (FAO Tech. Guidelines 4, 2012). Further, the NOAA Puerto Rico study projected that the number of recreational anglers in Puerto Rico has doubled since the 1980's (Griffith, 2007). To be clear, the results here do not support an inference that the actual number of billfish *anglers* in Puerto Rico has decreased—just their overall effort. This decline might be attributed to the rise in cost for billfish anglers. While cost and regulation for non-billfish recreational anglers has also increased, most non-billfish recreational anglers are not necessarily subject to the heavy permitting requirements and capital demands that billfish anglers are (larger boats, expensive gear, etc.).

Of course, a more unfortunate possibility is that billfish anglers may have become deterred by lower available stock. To be clear, this is a tentative hypothesis that demands more research; however, the widespread recognition of billfish overfishing by large commercial pelagic longline and purse seine gears fishing throughout the fishes' migration, at least gives it some plausibility.

Potentially compounding the deterrent effect of lower available stock is The Law of Diminishing Marginal Returns. The Law of Diminishing Marginal Returns holds that with each additional billfish trip an angler takes, the marginal benefits the angler receives further decreases; meanwhile, the marginal cost to billfish anglers continues to increase. In theory, anglers will continue to fish until their marginal benefits equals their marginal cost, or where "equilibrium" is reached. Much of the recreational fishing experience is driven by "hope" of catching fish; thus, lower available marlin stock, however, may be further lowering the marginal benefit to anglers of repeated trips. Consequently, the equilibrium quantity of fishing trips for anglers also decreases. Phrased differently, the decreased odds of catching a marlin may be mitigating catch-related benefits (e.g., "thrill of the catch," "catching a trophy fish") that previously superseded the marginal cost of a subsequent billfish trip; the less committed billfish anglers may respond by targeting billfish less. It follows that management and conservation results in great abundance of fish in the water will increase angler likelihood to fish and to expend in a region (Southwick, 2008).

It should be noted that the cost of tournament entrance fees has also increased. The participants in Ditton's study spent an average of $222 per tournament on entrance fees (excluding calcutta fees), and an average of $1,113 per year on tournament entrance fees (Ditton & Clark, 1994). The largest tournament in the USVI today, the USVI Open Atlantic Blue Marlin Tournament, charged a $2,500 per boat fee in 2006 (max four anglers per boat) (USVI Open, 2012). The largest billfish tournament in Puerto Rico, the International Billfish Tournament at Club Nautico de San Juan, currently charges visiting anglers $1,850 or teams $5,550 (max three anglers per boat) (San Juan International Billfish Tournament, 2012). For each of these tournaments, the entrance fee per angler comes out to a minimum of $600. This number actually falls on the lower end of the spectrum of the national average estimated range for tournament entrance fees of $500 - $1,000 (NMFS SAFE Report, 2011). Like the International Billfish Tournament at

[48] NAFTA, passed in 1994, permitted Mexico to start competing with Puerto Rico's labor-intensive manufacturing industries and thus hurt these industries significantly.

Club Nautico de San Juan, however, entrance fees for some U.S. mainland tournaments (e.g., Mississippi Gulf Coast Billfish Classic, Orange Beach Billfish Classic) exceed $5,000 per boat (Mississippi Gulf Coast, 2013; Orange Beach, 2013).

The survey here did not ask participants to disclose how much money they spent on tournament entrance fees; it did, however, ask participants to disclose the total amount (including fees and other expenditures) they spent on tournaments over the past 12 months. This data is available in the Tournament Participation section above, but repeated here for clarity: Of the USVI participants that competed in tournaments, only seven (24%) spent under $500; 6.9% spent between $500 and $1,000; 17.2% spent between $1,000 and $2,500; 13.8% spent between $2,500 and $5,000; and 37.9% spent over $5,000. In Puerto Rico, 11.8% of participants that competed in billfish tournaments spent under $500 on such tournaments; 22.1% spent between $500 and $1,000; 23.5% spent between $1,000 and $2,500; 17.6% spent between $2,500 and $5,000; and 25% spent over $5,000. These numbers show that over half of the total participants that competed in billfish tournaments spent at least $2,500 on such tournaments this past year. While high, this number is still approximately $5,500 lower than the $8,072 participants averaged on pelagic expenditures on their last pelagic fishing trip. This substantial monetary difference indicates that Northern Caribbean billfish anglers target pelagic species outside of tournaments quite often; and this supposition in turn agrees with the conjecture made earlier based on the motivational and behavioral results that billfish anglers target pelagic species other than billfish for food at least somewhat regularly.

13. DIRECT EMPLOYMENT AND EMPLOYMENT OPPORTUNITIES PROVIDED BY RECREATIONAL FISHING

Direct employment and employment opportunities provided by recreational fishing can be ascertained by surveying various local businesses that cater to sportfishermen, or by using censual information provided by the government. It may also be estimated at a broader level by following the flow of expenditures from sportfishermen. Once in the local market, recreational fishing expenditures have the potential to multiply and create a larger impact on a local economy. Employment opportunities not directly associated with the recreational fishing industry may also be created.

Berkes *et al*. (2001) estimated that marine capture fisheries employ between 21 and 50 million people worldwide. Cisneros-Montemajor & Sumaila (2010) estimate that 58 million recreational anglers generate a minimum total of $40 billion and support over 954,000 jobs. Similarly, Garcia & de Leiva-Moreno (2003) estimate that recreational fishing expenditures account for 0.1% of GDP ($47 billion) and provides one million jobs around the world. In contrast, Garcia & Levia-Moreno estimate that commercial fisheries employ between 21 and 50 million people worldwide (Garcia and de Leiva-Moreno, 2003).

Studies in Mexico and the U.S. prognosticated that, for every $23,000 and $45,000 expended on recreational fishing, a full-time job is generated there (Steinback *et al*., 2004; Gentner & Steinback, 2008; Southwick *et al*., 2008). In Puerto Rico, Ditton, Clark & Chaparro (1995) estimated the economic impact of non-resident billfish anglers on the local economy to be $4.75 million and responsible for over 200 jobs. In an earlier study with Clark, Ditton (1994) estimated recreational fishing expenditures for billfish fishing trips in Puerto Rico at $26 million with annual consumer surplus estimates totaling $18 million, resulting in a total economic impact of nearly $44 million. In a later study with Stoll, Ditton (2003) quantified a mean direct expenditure of $980 per billfish fishing trip in Puerto Rico. Ditton & Stoll (2003) applied a conservative impact multiplier of 1.5 to get a total impact of $1,471 per trip and a less conservative multiplier of 2.5 to get a total impact of $2,452 per trip. Once extrapolated to the whole of Puerto Rico, Ditton & Stoll (2003) found that aggregate impacts of recreational fishing ranged between $48.6 million and $81.01 million depending upon the multiplier used; ten years later, that impact might have grown.

14. ECOLOGICAL AND TECHNOLOGICAL INTERDEPENDENCIES WITH COMMERCIAL FISHERIES

The FAO estimates that approximately 155 finfish (83% of total landings) and 10 shellfish (17% of total landings) are targeted commercially in Puerto Rico (FAO Study 287, 2012). Like the recreational fishery, commercial fishing in the region peaks in the summer and drops off in the Fall (Griffith *et al*., 2007). Thanks in large part to the illegality of commercial billfish harvest (excluding swordfish), however, few HMS are targeted in the Northern Caribbean. Indeed, pelagic species only accounted for roughly 7% of the total commercial harvest in Puerto Rico between 1983 and 2002 (Salas *et al*., 2012). Nevertheless, tuna, dorado, wahoo, marlin, sailfish and swordfish are still targeted to some extent in the region's commercial fishery (Salas *et al*., 2012).

Similar statistics regarding the commercial fishery in the USVI were not included in the FAO Study or NMFS SAFE Report. A census conducted by Barbara Kojis and Norman Quinn of the USVI Division of Fish and Wildlife revealed that there were approximately 380 commercial permit holders in the USVI in 2006 (Kojis & Quinn, 2006). While snappers, groupers, and many different species of reef fish hold commercial importance in the USVI, lobster and conch are also very popular: Shellfish accounted for approximately 25% of commercial landings in 2004 (Impact, 2007). Thanks in large part to the popularity of shellfish; an estimated 6,500 active traps are currently being used in the USVI for commercial harvest (Clark *et al*., 2012).

Traps are the prime example, but commercial fishers use many other specialized gears that recreational anglers do not (Impact, 2007). The NOAA Puerto Rico study found that while 64% of commercial fishers use at least three types of gear, only 39.7% of recreational anglers use at least three types of gear (still a relatively high number) (Griffith *et al*., 2007). While lines were the most popular gear in both fisheries, the FAO estimates that traps account for 22% of the commercial harvest, divers 18%, and nets 18% (Salas *et al*., 2012). In the USVI, multiple gears are also common in both fisheries. While traps dominate the commercial fishery, handlines are the most popular gear used recreationally (Kojis & Quinn, 2006). As an interesting side note, many recreational anglers purchase bait from commercial fishers (Griffith *et al*., 2007).

In 2011, there were only 88 tuna commercial permit holders and no shark or swordfish permit holders in Puerto Rico (no commercial permits are issued for other billfish) (NMFS SAFE Report, 2011). The majority of these permit holders were based off the west coast near Aguadilla and Rincon (NMFS SAFE Report, 2011). This is not surprising, as approximately half of Puerto Rico's commercial catch comes from the west coast (Wilson, 2010). Contrast the west coast with the north coast - the most heavily fished area by participants here by far - which only accounts for 10% of the commercial harvest (Wilson, 2010). Most recreational billfish anglers in Puerto Rico are based off the north coast around San Juan, where most of the private charters, boats, and sportfishing tournaments are located (Wilson, 2010). Thus, billfish anglers in Puerto Rico are not as affected by the commercial fishery as other recreational and artisanal fishers are - especially considering that they generally are not competing with the commercial sector for catch.

Commercial fishing in the USVI is more evenly dispersed around territorial waters though the large proportion of traps used there (Kojis & Quinn, 2006) focuses much of the commercial effort in territorial waters close to shore (Clark *et al*., 2012). Thus, billfish anglers in the USVI appear to be able to navigate away from commercial presence with relative ease. Still, as the stock of inshore reef fish has decreased, the commercial fishery has pushed seaward (Kojis & Quinn, 2006). This transfer of targeting effort from reef fish to HMS will likely contribute to the overfishing of billfish and a diminishment in the associated ecotourism trade. Marine Conservation Districts, discussed further in the Current Management section below, also cause commercial fishers to relocate and infringe on traditional recreational fishing grounds.

Participants here still expressed some concern over the commercial fishery. "Commercial fishing is intensifying" received a 3.64 average ranking in Puerto Rico and a 3.45 average ranking in the USVI, the third ranked problem in each territory. Nevertheless, as the U.S. commercial fishery has become more tightly regulated, the attitude of recreational billfish anglers towards the commercial fishery appears to have improved. Angler awareness of the presence of large distant-water commercial fishing vessels fishing throughout the Caribbean waters, some re-flagged by Caribbean nations, substantiates angler concern that commercial fishing pressure is increasing. Indeed, unlike the results here, commercial fishing was identified as *the most* critical concern of recreational billfish anglers that participated in Ditton & Clark's 1994 study by a notable margin.

A few other interesting statistics: Only 9% of fishermen on the 670 active commercial fishing vessels that Matas-Caraballo & Agar (2010) counted in Puerto Rico in 2009 felt that commercial fishing was to blame for fisheries decline. Thus, internal conflict among the local commercial fishery appears to be relatively minimal. Moreover, as recently as 2006, over 60% of anglers surveyed from the commercial and recreational fisheries respectively indicated they were "satisfied," "extremely satisfied, or "satisfied enough" with fishing in Puerto Rico (Griffith *et al*., 2007). While there are certainly opportunities to raise this percentage, the optimistic purview of the majority in 2006 demonstrated that neither sector was overly distraught with the state of the region's fisheries. As greater commercial fishing pressure continues to increase throughout the Caribbean by the large distant-water boats, however, this optimistic view may change as fishing encounter rates likely will fall further.

16. CONFLICTS AND COOPERATION OF MULTIPLE USERS OF THE ECOSYSTEM

The classic symptoms of overfishing - and the conflicts that come with it - are present in the Northern Caribbean: a reduction in total landings, decline in catch per unit effort, and shifts to catch of smaller fish (Matas-Caraballo & Agar, 2010). While commercial fishers contributed significantly to fisheries stock depletion, some have argued that recreational fisheries have as well (Coleman *et al*. 2004; Cooke & Cowx, 2004, 2006; Lewin *et al*., 2006). Such conflicts are not restricted to those between the recreational and commercial fisheries; however, many conflicts exist between local and foreign fleets as well. It is also important to note at the outset that when apex oceanic predators like a billfish, tuna, or shark are harvested, the significance of the impact on the ecosystem is more severe than if a prey species was harvested (Paine, 1966; Stevens *et al.*, 2000, Myers *et al*., 2007).

As recreational fishing activity has increased in the United States, recreational landings have dropped significantly in the last decade (Christensen *et al*., 2007). NOAA's Atlantic Billfish Landings Update reported that a total of 279 non-tournament recreational billfish were landed in U.S. Atlantic Waters in 2011, including 43 blue marlin, 56 white marlin, 7 spearfish, and 173 sailfish. Through June 2012, 138 landed billfish had been reported: 30 blue marlin, 2 white marlin, and 109 sailfish. These numbers reflect a notable decrease from previous years (NMFS 2012). While decreased landings reflect a number of negative stock externalities suffered by all users of the resource (not to mention the resource itself) they also can reflect a greater embrace of the catch and release ethic by HMS anglers. In particular, depletion of fish stocks has negative implications for both food security and economic development, including the fishing tourism trade. Moreover, the less stable fish stocks, the greater the potential for a reduction in regional social and economic welfare. The Nineteenth Session of the FAO Committee on Fisheries, held in March 1991, recognized these threats and recommended that fisheries management shift to embrace conservation and environmental, as well as social and economic, considerations (FAO Tech. Guidelines, 2012).

Lower harvest rates envelope many of the conflicts that may arise among users of the fishery. First, incidental commercial catch of non-target species (bycatch) using non-selective gear is detrimental to

recreational anglers (Crowder & Murawski, 1998). Although billfish (excluding swordfish) are no longer targeted commercially in the U.S., most commercial gear does not discriminate among large pelagic species, resulting in the pointless loss of many billfish. Of course, recreational anglers also contribute bycatch that hurts local commercial fishing stocks.

Additionally, fishing vessels - advertently or inadvertently - often venture outside accepted marine boundaries into foreign territories and exploit resources there. This outside use compromises the ability of local stakeholders to exploit and profit from the fishery. Again, neither the commercial nor recreational fisheries are immune from this problem. Alternatively, drastic increases in fishing effort in previously unexploited areas may create a host of biological and social externalities - not to mention great administrative burden. Other, broader issues that plague fisheries include increases in pollution, abusive fishing techniques, and illegal, unreported and unregulated fishing practices (FAO Responsible Fisheries, 2012). Unfortunately, many of these conflicts continue to increase in magnitude today.

To better assess the conflicts facing recreational anglers in the Northern Caribbean, TBF asked participants to score six conflicts between one (least severe) and five (most severe). See Figure #31 for Perceived Fisheries Conflicts Chart. The results follow:

In the USVI, "fisheries law are not being enforced" ranked first (with an average rank of 3.85), "ecosystems and habitat are being destroyed" ranked second (with an average rank of 3.70), "commercial fishing is intensifying" ranked third (with an average rank of 3.45), "fisheries laws are written too weak" ranked fourth (with an average rank of 3.35), "pollution is worsening" ranked fifth (with an average rank of 3.00), and "the number of recreational anglers is growing" ranked last (with an average rank of 1.73).

In Puerto Rico, "fisheries law are not being enforced" ranked first (with an average rank of 3.88), "ecosystems and habitat are being destroyed" ranked second (with an average rank of 3.88), "pollution is worsening" ranked third (with an average rank of 3.85), "commercial fishing is intensifying" ranked fourth (with an average rank of 3.64), "fisheries laws are written too weak" ranked fifth (with an average rank of 3.25), and "the number of recreational anglers is growing" ranked last (with an average rank of 2.23).

Reported participant conflicts are further expanded upon in the Current Management section below.

17. CURRENT MANAGEMENT REGIME OF THE RECREATIONAL FISHERY

A major consequence of the increased societal demand for fishery conservation is that fisheries governance, including the management of recreational fishing, must employ integrated policies across multiple sectors. These polices typically manifest as controls on the level of input or output put into the fishery. Common input controls include seasonal closures and gear restrictions, while typical output controls include traditional fisheries quotas, catch size and bag limits (FAO Tech. Guidelines, 2012). In implementing such controls, Cisneros-Montemayor and Sumailaa (2010) argue three particularly important indicators for regulators to consider: the amount of stakeholder participation, associated employment opportunities, and level of direct expenditure.

The steady increase in public participation in marine recreational activities, including recreational fishing, suggests the need to strengthen effective management measures (Cisneros-Montemayor & Sumailaa, 2010). A critical initial step in strengthening these management measures is to assess regulations already in place, as well as the perceptions of anglers on such regulations.

As U.S. territories, Puerto Rico and the USVI fall under the jurisdiction of the U.S. Federal Government. Consequently, they are subject to federal law. Under the Submerged Lands Act, each territory may claim the natural resources within three nautical miles of its shore. (43 U.S.C. § 1301 (2012)) Therefore, Puerto Rico and USVI law governs fishery management within this zone, or "state waters." However, both Puerto Rico and the USVSI have adopted the federal regulations and permit requirements for billfish, swordfish, tuna, and sharks. (Interview with DNER, 2012; 12 U.S.V.I. § 9A (2012)) Thus, any recreational anglers in Puerto Rico or the USVI that targets or catches these pelagic species must comply with the HMS FMP.[49]

The USVI Department of Natural Resources (DPNR) (and through it the DFW) and Puerto Rico Department of Natural and Environmental Resources (DNER) have primary management responsibilities over fisheries in territorial waters. Additionally, members of the DPNR, DNER, and other local agencies, sit on the Caribbean Fisheries Management Council (CFMC), one of the eight federal fishery management councils established by the Magnuson-Stevenson Act. The CFMC assists NOAA in amending and enforcing the Consolidated Atlantic HMS FMP (the "HMS FMP"), which consolidated the 1988 FMP and the 1999 FMP for Atlantic tuna, billfish, swordfish, and sharks in 2006. In 2012, an Amendment to the HMS FMP - Amendment Four: U.S. Caribbean Management Measures - was enacted to better manage the traditional small-scale commercial fleet in Puerto Rico and the USVI (HMS FMP, 2012). New management measures taken in Amendment Four include creation of a new Caribbean Commercial Small Boat permit, specific authorized species and retention limits, modification of reporting requirements, authorization of specific gears, small-scale fishing vessel size restrictions, and consideration of mandatory workshop training (HMS FMP, 2012).

The HMS FMP places a number of restrictions on the Atlantic's recreational fishery. Among other stipulations, the HMS FMP requires that recreational vessels obtain an "HMS Angling" permit to harvest sharks, tuna, swordfish, and billfish. Charters and headboats must also obtain a separate "HMS Charter" permit. Moreover, a separate permit is required to fish tuna commercially (HMS FMP, 2006). Finally, billfish tournaments are *supposed* to apply to NOAA for a permit as well (NMFS Recreational Compliance Guide, 2012). In October 2011, a total of 27 HMS Charter permits and 1,375 HMS Angling permits were active in Puerto Rico; 23 HMS Charter permits and 84 HMS Angling permits were active in the USVI (NMFS SAFE Report, 2012). In 2010, only 13 blue marlin and three white marlin tournaments in Puerto Rico registered with NOAA; only six blue marlin tournaments and six white marlin tournaments registered in the USVI (NMFS SAFE Report, 2012). That same year, 13 sailfish tournaments in Puerto Rico and six sailfish tournaments in the USVI registered (NMFS SAFE Report, 2012).

As discussed above, the 1988 FMP prohibited the sale of domestic Atlantic billfish excluding swordfish. Until recently, however, imports of Pacific billfish were still allowed, hindering the effectiveness of the 1988 FMP's no-sale clause because some selling marlin claimed they were all imported from the Pacific and were not Atlantic fish that were prohibited. To close this loophole, President Barack Obama signed "The Billfish Conservation Act" into law on October 8, 2012. This piece of legislation closes option to

[49] Separate "state" recreational fishing permits are only required in the USVI for harvesting shrimp at Altona Lagoon and Great Pond, St. Croix, or baitfish at St. James Reserve or Cas Cay Mangrove Lagoon Marine Reserve; no "state" permits are required for fishing HMS. (USVI DFW Info Booklet, 2009) In Puerto Rico, no separate recreational fishing permits are currently required. However, a regulation that is yet to be implemented would require state recreational fishing permits for harvesting spiny lobster, queen conch, blue land crab, freshwater shrimp, airajo goby, and yes, billfish. (Interview with DNER, 2012) In an interview with TBF, DNER indicated that this regulation could be implemented in 2013, but no definite timetable had been set. (Interview with DNER, 2012)

sell Pacific billfish and essentially will ban, once implemented, the sale of any billfish (again, excluding swordfish) in the continental U.S.[50] and U.S. Atlantic territories (Billfish Conservation Act, 2012).

The HMS FMP also imposes certain retention limits and reporting requirements. The recreational daily swordfish retention limit is one per person, four per private vessel, six per charter, and 15 per headboat (HMS FMP, 2006). The minimum-size limit for swordfish is 47-inches (lower jaw fork length) and spearfish retention is prohibited (HMS FMP, 2006). Although there is no mandatory retention limit for other billfish, there is a 99-inch size limit for blue marlin, a 66 inch size limit for white marlin, and a 63 inch size limit for sailfish (HMS FMP, 2006).

To comply with international recommendations agreed upon at the International Commission for the Conservation of Atlantic Tunas (ICCAT) and achieve more consistent reporting of billfish, the U.S. agreed to limit anglers' annual landings of Atlantic Blue and White Marlin to 250 combined (Fed. Reg. 2003; HMS FMP, 2006). As part of this initiative, NOAA aggressively encourages release of all billfish and requires all non-tournament billfish landings to be reported via phone or internet within 24 hours (HMS FMP, 2006). Unfortunately, compliance with these reporting provisions in the Northern Caribbean is thought to be quite low (MRIP HMS Work Group, 2009). Indeed, in one 2008 study piloted by the DNER, 400 HMS Angling vessel permit holders - approximately 40% of permit holders in Puerto Rico during that time - disclosed 27 billfish landings over the past year. During that same timeframe, however, only seven landings were reported to NOAA (MRIP HMS Work Group, 2012). A separate NOAA study on the impact of the HMS FMP on local communities concluded that 30,000 recreational anglers in Puerto Rico did not report their landings (Wilson, 1998). This situation obviously begs of more educational outreach and enforcement.

Tuna landings are also highly regulated in U.S. waters. All tuna in the Atlantic - including the Gulf of Mexico and Caribbean Sea - are managed under the dual authority of the Magnuson Act and ICCAT. For bluefin tuna - The bluefin tuna fishery in particular is subject to a series of output and technical restrictions. Notably, the Gulf of Mexico is a designated spawning ground for bluefin tuna and thus directed fishing of bluefin tuna in this region is prohibited (incidental trophy fish are permitted) (HMS FMP, 2006). In the rest of the Atlantic, NOAA has enforced a daily commercial retention limit (for "General" permit holders) of two bluefin tuna measuring 73 inches or greater through at least March 2013 (HMS FMP, 2006). For Atlantic recreational vessels (HMS "Angling" or "Charter" permit holders) outside the Gulf of Mexico, only one bluefin tuna between 23 inches and 73 inches may be retained per day per vessel per trip (HMS FMP, 2006). Further, such recreational vessels may only retain one bluefin tuna greater than 73 inches (a "trophy fish") per year (HMS FMP, 2006). Finally, all bluefin tuna landings must be reported (HMS FMP, 2006). In most years the quota for the angler category for bluefin tuna is taken before the fish migrate into the Gulf of Mexico thus resulting in a zero retention limit for anglers in that region. Other recreational fishing tuna restrictions include a retention limit of three yellowfin tuna per day/trip and a minimum size-limit of 27 inches for yellowfin and bigeye tuna (HMS FMP, 2006).

For sharks, the government includes various species within management complexes (groups). The recreational fishery is regulated with bag limits, size limits, vessel limits with no commercial retention allowed (HMS FMP, 2010). No sharks recreationally caught may be sold (HMS FMP, 2010).

Although Puerto Rico and the USVI are not currently included in the NMFS's Large Pelagic Species Survey, NMFS is currently implementing a pilot project in Puerto Rico to achieve more accurate estimates of HMS landings. The first phase of the program was implemented through 2011; in this phase, members of the University of Puerto Rico Sea Grant Program contacted all HMS permit holders with

[50] Traditional billfish fisheries in Hawaii and the Pacific Insular Area are excepted from the Billfish Conservation Act.

vessels registered in Puerto Rico. Answers were kept strictly confidential (Federal Register, 2011). The second phase of the program has been implemented since February 2011; in this phase, anglers are asked to affix a traditional tag to all blue marlin, white marlin, sailfish, and swordfish (Federal Register, 2011). To receive the tag, anglers must complete a catch card for each fish landed (Federal Register, 2011). As of March 2012, tags and cards were available at 16 different marinas, clubs, and tackle shops along the coast (Salz, 2012). Notably, the catch card program is voluntary; if an angler that lands a billfish does not complete a catch card, the angler must report the landing through telephone or Internet in accordance with federal law (University of Puerto Rico Sea Grant, 2012).

The collaborative effort between NMFS and local stakeholders is commendable, but participation has been limited. To boost collection efforts, government officials have launched an educational outreach campaign (Federal Register, 2011). Officials have utilized local and social media outlets to raise awareness of the catch card program and its value. Tournament organizers and sportfishing associations have also promoted the program. Unfortunately, angler response to the outreach efforts has been unexceptional thus far: As of March 2012, only four blue marlins had been reported via catch card (Salz, 2012). NMFS identified the non-mandatory nature of the catch card program, reporting station hours, and tag size as possible explanations for the low results (Salz, 2012). As mentioned above, however, low reporting is not restricted to the catch card program: Landings are not being reported via phone or web. Of course, regulatory mechanisms on output such as catch cards are notoriously difficult to enforce. This is especially true for isolated islands with limited resources such as Puerto Rico. Nevertheless, at this advanced stage of the pilot program, regulators might consider reallocating resources from outreach programs towards more intensive monitoring or enforcement of billfish anglers' regulations.

Recreational anglers in the Northern Caribbean have historically expensed frustration with regulation - though not to the same extent as commercial fishers. The NOAA Puerto Rico study revealed a number of recurring complaints among the recreational fishing community: regulations do not account for local anglers' knowledge of fish; regulations were designed for other parts of the Atlantic coast outside the Caribbean region; regulations exclude mangroves and other coastal habitats; MPAs present navigational issues; seasonal closures place anglers at risk by encouraging heavy fishing prior to closure; size limits lead to waste; regulation enforcement is uneven; licensing process is expensive and unfair; and anglers are not given enough credit for their own conservation efforts (Griffith *et al.*, 2007). It should be noted that the NOAA Puerto Rico study was conducted very soon after the "Fishery Regulation Act for the Conservation and Management of the Territorial Fishery Resources of Puerto Rico" was enacted in 2004 (Griffith *et al*., 2007). Thus, locals were presumably still getting accustomed to the new marine reserves, closed seasons, and size requirements imposed by the Act.

Studies in the USVI have uncovered similar dissatisfaction with regulations. In preparing the USVI Fisheries Conservation and Management Plan, the DFW discovered that many anglers felt overwhelmed by the large number of territorial and federal agencies regulating fisheries in the region (USVI DFW Conservation Plan, 2005). There was a common sentiment that the government had failed to take the action necessary to resolve user-conflicts with the British Virgin Islands and other foreign entities (USVI DFW Conservation Plan, 2005). Similarly, interviewees for the NOAA USVI study expressed pointed concern with the Marine Conservation Districts (MCDs) situated around the islands[51] (Impact, 2007). In

[51] Two MCDs lies just outside of state waters south of St. Thomas. One, the "Hind Bank MCD," prohibits all fishing within the 16-square mile zone December through February but permits pelagic fishing other months. The second, the "Grammanik Bank MCD," is adjacent to the "Hind Bank MCD; all fishing is prohibited there from February to April while pelagic fishing is permitted the rest of the year. A third MCD, the "Mutton Snapper MCD" lies just within state waters south of St. Croix. Fishing here is banned from March through June, while pelagics may be harvested the rest of the year. Also relevant, the DNER identified five Marine Reserves (no-take zones) in Puerto Rico: Mona Island Nature Reserve (the largest), Monito Island Nature Reserve, Desecheo Island Marine Reserve,

particular, they complained that closing off certain fishing areas only leads to overcrowding - and consequently overfishing - in nearby areas (Impact, 2007). Congestion promotes conflicts between anglers that are exasperated by the small size of the islands and the cultural differences between them. Although commercial trappers are most affected by these closures and conflicts, recreational pelagic anglers still bear the externalities of displacement, which grows worse as species become more overfished.

The results of the survey here portray similar frustration with regulations: The top-ranked "problem" participants in both territories identified with the recreational fishery was "fisheries laws are not being enforced." This category received an average ranking of 3.88 in Puerto Rico and 3.85 in the USVI. "Fisheries laws are written too weak" was the fifth-ranked problem in Puerto Rico with a 3.25 ranking and the fourth-ranked problem in the USVI with a 3.35 average ranking. These results correspond somewhat with the recent FAO study conducted in Puerto Rico, which concluded that, while there is a "robust set of management regulations in place," major enforcement opportunities remain (Salas *et al*., 2012). It follows that regulation enforcement is perceived to be a greater problem in the Northern Caribbean than the regulations themselves.

The lack of enforcement cited by participants here and elsewhere touches on a larger internal problem facing regulators. One can assume that the lack of enforcement contributes to under-reporting of landings. Billfish anglers in the Northern Caribbean simply have very little incentive to cooperate with regulators. This problem is compounded by the fact that many billfish anglers are tourists. Enforcement and education efforts do not have the same deterrent effect on tourists because tourists are generally not exposed to such efforts. Moreover, tourists are not as likely to be familiar with local fishing regulations. In conducting research for this Report, TBF was alarmed to discover that Puerto Rico's local fishing regulations are not available in any English medium.[52] For a region frequented by tourists from the U.S. mainland that like to fish, this is simply unacceptable.

The relationship between under-reporting and enforcement works in the opposite direction as well. Under reporting of landings - and the minimal data available on local recreational fisheries as a whole - makes it difficult for regulators to determine where and how they should focus enforcement efforts; arguably, it gives regulators an "out" so to speak. As if this lack of information does not present enough of a challenge, regulators also must account for the highly migratory nature of billfish and other pelagics. These cross boundary movements complicate efforts to monitor local stock levels and necessitates regional and user cooperation.

Even regional entities like the CFMC do not have the resources or jurisdiction required to efficiently track HMS stock. The map of recaptured billfish in the Appendix below discussed in the Spatial Analysis section above demonstrates how far billfish travel outside Caribbean waters: Blue Marlins tagged in the Northern Caribbean were recaptured as far east as Africa, and swordfish tagged in the Northern Caribbean were recaptured in the middle of the North Atlantic. A previous study conducted by TBF Science & Policy Specialist Andrew Cox buttresses these findings: Sailfish tagged in Isla Mujeres, Mexico were subsequently tracked to Venezuela, Cuba, the Bahamas, and Florida. (Cox, 2011) Though global cooperation is required to offset these highly migratory challenges, local anglers can still play a pivotal role in overcoming them by tagging and reporting their catch. As the analysis in this Report demonstrates,

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Canal Luis Pena Natural Reserve in Culebra, and Tres Palmas Marine Reserve in Rincon. The area of Condado Lagoon is also a no-take zone. (Interview with DNER)

[52] Despite the lack of English regulations, representatives of the DNER—in particular, Helena Antoun, Craig Lilyestrom, and Alda Rosario—were extremely helpful in clarifying pertinent regulations and assisting TBF with this Report.

major tagging and reporting opportunities in the Northern Caribbean remain and should be considered as not only a data collection tool, but also one to advance the release ethic.

18. ASSESSMENT OF THE NATURE AND IMPORTANCE OF THE RECREATIONAL FISHERIES IN THE NORTHERN CARIBBEAN

This study, building upon the few that preceded it, has demonstrated the wide scope of economic impacts that recreational fishing has on the Northern Caribbean. Specifically, it has shown how recreational fishing generates revenue streams into numerous local businesses (e.g., marinas, tackle shops, hotels, etc.) and creates employment opportunities within these businesses. The FAO estimates that over 1,974,000 people in the Caribbean and Latin America are employed within the fishing industry (FAO World Report, 2012), and investment in the recreational fishing industry offers tremendous potential to grow this number in *sustainable* fashion. By no means, have the benefits of recreational fisheries gone unnoticed in the Caribbean; Nicaragua and Costa Rico have imposed significant regulatory restraints on commercial fisheries and allocated billfish fisheries exclusively to recreational anglers (FAO Tech. Guidelines, 2012). Federal U.S. prohibitions on the commercial Atlantic billfish harvest (HMS FMP, 2006) have taken Puerto Rico and the USVI in the same direction. To fully realize the benefits of the recreational fishery, however, fishery and tourist trade regulators must take more proactive, forward-thinking steps to promote it and maximize its benefits for the region.

The non-market values recreational anglers derive from the fishery give them an inherent interest in developing effective stock-management strategies that ensure continued fishing opportunities (Arlinghaus, 2006). It comes as no surprise then, that the FAO has documented substantial evidence on how recreational anglers help solve conservation problems (FAO Tech. Guidelines, 2012; Arlinghaus, 2006). Some recreational anglers have enhanced biodiversity through the stocking of native fish and habitat management (FAO Tech. Guidelines, 2012). Others have sought the imposition of regulatory restrictions on their own fishing practices. For example, many anglers have lobbied for harvest limitations and/or catch-and-release requirements for certain species. While some recreational anglers take an active role in fisheries management, others take a more indirect role by financing such actions like purchasing recreational fishing licenses as an example (FAO Tech. Guidelines, 2012). It follows that accounting for the interests of the recreational fishing industry and encouraging the participation of recreational anglers in the regulatory process should lead to increased management success (Sullivan, 2003). This is particularly true in the Northern Caribbean, where recreational fishing represents a lifestyle that provides a strong part of the cultural and participant identity of the people living there (Stoffle *et al*., 2011). As Stoffle *et al*. (2011) explain, "there is no doubt that the commercial and recreational fisheries of St. Thomas have always been and still remain important to the local residents, be they the first inhabitants of the island, the Taino people of the past, or the modern day eclectic mix that is the St. Thomas population." Going further and including recreational fishing interests and tourist trade interests in the management process might maximize potential benefits for leaving some fish in the water. This would enhance the recreational fishing and tourist trade industry and change the focus from solely extractive activities.

19. CONCLUSION

The results of the survey reflect positive development in the Northern Caribbean's recreational pelagic fishery. In particular, the near unanimous release rates participants reported for billfish (excluding swordfish) are encouraging. Stakeholders should also be pleased that over half the participants indicated they use circle hooks, a documented conservation tool to increase post-release mortality. In addition to demonstrating growing billfish conservation, the survey results reinforce the economic impact of

recreational fishing. The thousands of dollars in fishing expenditures reported by participants are especially meaningful in small, poorer territories like Puerto Rico and the U.S.V.I. Indeed, considering how dependent each territory's economy is on tourism, fisheries managers would be wise to promote the region's multitude of tournaments and charter operations to ecotourists. If regulators and tournament-organizers continue to advance conservation-minded fishing practices, recreational fishing can provide a sustainable alternative to large commercial fishing operations, especially for large distant water fishing fleets, as a means economic development in the Northern Caribbean.

In order to effectively advance the recreational fishing industry, however, regulators need to acquire more information. In the tourist-dependent Northern Caribbean, the distribution and socioeconomic intricacies of visiting billfish anglers in particular merits further study. At the same time - as this study demonstrates - the effort exerted by resident recreational fisherman should not be ignored. Much of the lack of information on recreational anglers can be attributed to incognizance or misconception regarding the users of the fishery (Valdes-Pizzini, 1989). Ditton and Stoll (2003) cite several specific factors that impede management of billfish anglers: 1) billfish anglers are a small constituency compared to other angler groups or anglers in general, 2) billfish anglers may be disproportionately large at particular locations or concentrated, but overall fewer, 3) integrated fisheries management remains a novel concept, 4) data collection from billfish anglers remains more challenging because wide dispersal and identification is difficult. Overcoming these and other related obstacles is paramount to the success of future fisheries management in the Northern Caribbean. Once the socioeconomic characteristics of billfish anglers are better understood, regulators will be able to balance conflicting uses of the fishery much more efficiently. Although the essential goal of any fisheries management plan should be to achieve "the point at which capitalism and conservation join together to fight for the same cause: wildlife preservation and profit" (Ashton, 1989), several more specific recommendations pertaining to the Northern Caribbean are identified below.

20. RECOMMENDATIONS FOR RECREATIONAL FISHERIES MANAGMENT AND FUTURE RESEARCH EFFORTS IN THE STUDY AREA

In writing this Report, several recommendations have been deduced for regulators at the federal and local level to consider. These recommendations are somewhat broad and by no means exclusive. It should also be reiterated that no scientific findings are made in this Report, which is only intended to offer preliminary insights for more thorough investigations in the future. To a certain extent, however, these recommendations all present realistic opportunities to improve the fishery, the status of the stocks and the economic returns to the area. Strategic follow through on these suggestions could solve multiple problems facing the fishery.

- NMFS should consider incorporating Puerto Rico into its mandatory Catch Card Census Program, which currently only includes Maryland and North Carolina. The infrastructure from the pilot program in Puerto Rico is already in place. A non-voluntary system would surely incentivize great angler participation in the program, which, according to the pilot study in Puerto Rico, is sorely needed. The mandatory Catch Card Census Program also generates more diverse landings data, as spearfish and bluefin tuna are included on top of the billfish already included in pilot program (blue marlin, white marlin, sailfish, and swordfish). The USVI should also be a candidate for its own pilot catch card program. However, given the USVI's proximity to Puerto Rico, and the USVI's small geographic size and abundance of infrastructure in place, it may be feasible to include the USVI in the mandatory program with Puerto Rico. If executed properly, incorporation of Puerto Rico and the USVI into the mandatory Catch Card Census Program would improve the accuracy of landings estimates and help regulators manage the fishery more efficiently.

- NMFS should consider including Puerto Rico and the USVI in its LPS survey. (The LPS Survey currently is taken from Maine to Virginia.) The LPS would give regulators a much greater sample size from which to deduce catch and effort estimates for HMS in the region.
- Regulators should consider piloting a project on yellowfin tuna in the Northern Caribbean. As demonstrated by the results here, the number of sportfishers that target yellowfin outside billfish tournaments is very high. Moreover, the survey results show that - unlike most billfish - captured yellowfin tuna are usually landed and eaten. More research is needed to gauge the health of the yellowfin tuna stock, the local demand for the species and potential fishing tourist attraction to augment that for billfish. In light of growing international interests at ICCAT for yellowfin management and conservation, requiring the reporting of landings data would begin a catch history that may serve the area well when hard limitation caps are likely approved in the not too distant future.
- Regulators could incentivize anglers who fish for pelagic species to assist in regulatory enforcement. As discussed above, participants identified "lack of enforcement" as the biggest problem with the state of the fishery. It follows that many recreational anglers would likely be willing to help regulators stop illegal fishing practices and pollution. Regulators might consider organizing "fishery patrol" groups (similar to "neighborhood watch") or perhaps offering rewards for reporting violations.
- Regulators should incentivize recreational billfish anglers to tag their catch. The results of the survey show that major tagging opportunities exist in the recreational fishery - particularly in the USVI. It follows that training should be provided on the proper method of tagging, releasing and resuscitating fish. More importantly, regulators must educate anglers on the purpose and benefits of tagging fish: By tagging their catch, anglers are combating overfishing, rebuilding-stocks, and promoting the ecotourism fishing trade, all of which generate more jobs, trade and food security. Similar to reporting violations, regulators could offer anglers rewards for tagging fish or reporting recaptures. This would create the need for regulators to provide tags for angler use. Local regulators should consider various measures to deter retaliation for participation in the regulatory process. As discussed throughout the Report, greater stakeholder involvement is the key to improving the Northern Caribbean's recreational fishery and promoting sustainable economic development in the region. Indeed, Sullivan (2003) proved that the participation of recreational anglers in the development of fisheries regulations led to increased management success. It follows that NOAA's findings that many recreational anglers are reluctant to assist regulators and submit input out of fear of retaliation is particularly disconcerting.
- New educational-outreach programs that include recreational fishing interests, eco-fishing tourist trade interests, and local commercial fishing interests, could instill a greater sense of ownership and stewardship for the migratory species in the Caribbean to benefit the locals. These ends could also be reached in the Caribbean through a harmonious management, conservation, and eco-fishing trade development plan; a positive alternative to large distant-water-fishing fleets that take fish from locals and leave little in return.

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22. APPENDICES

APPENDIX A: FIGURES

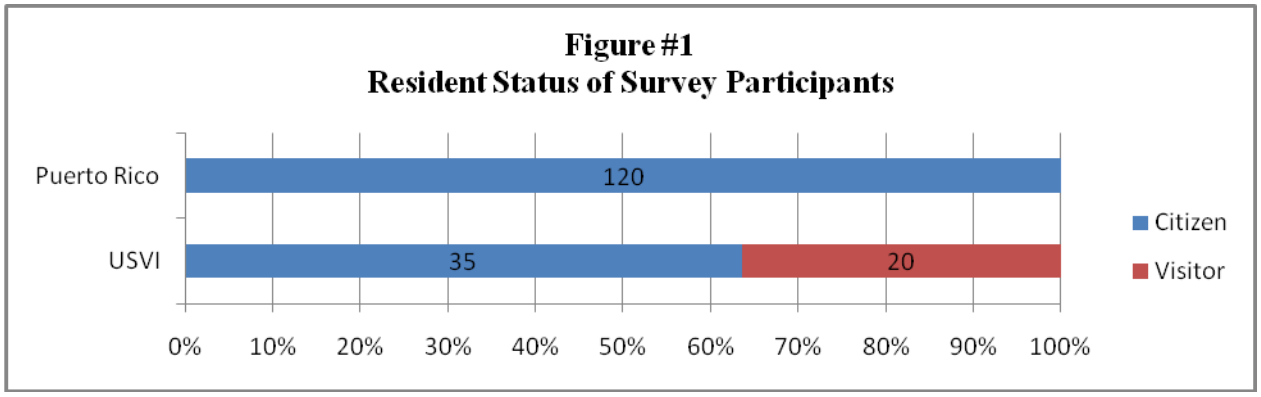


Figure #2
Sectors USVI Participants Fish In

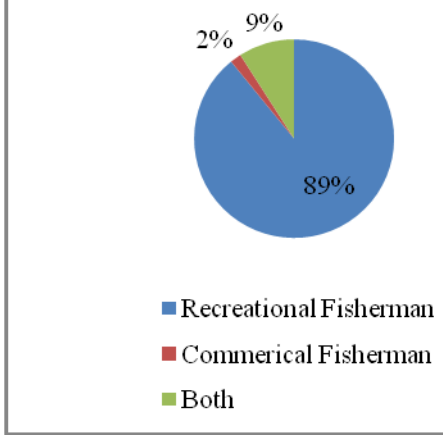


Figure #3
Sectors Puerto Rico Participants Fish In

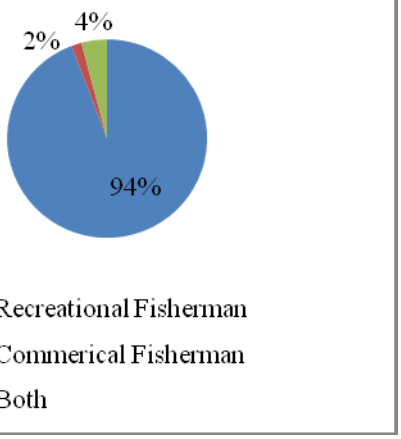


Figure #4
Participant Years of Experience Fishing in Saltwater

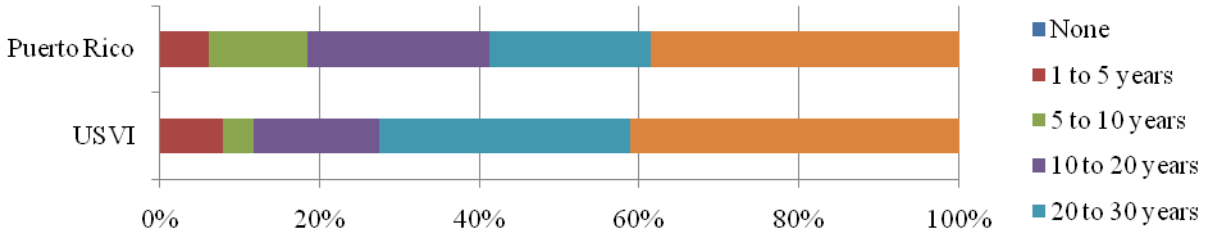
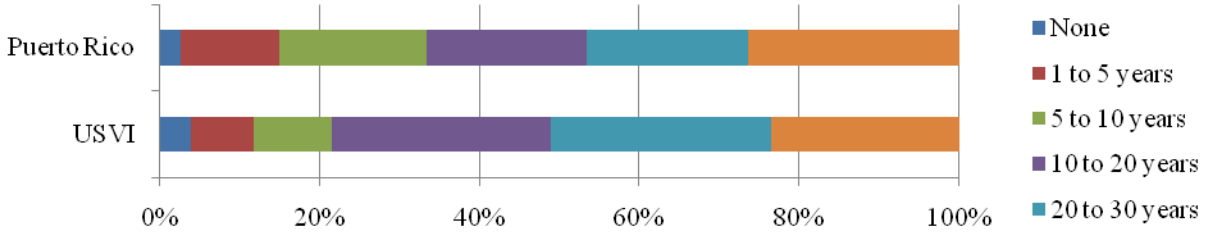


Figure #5
Participant Years Experience Targeting Pelagic Species



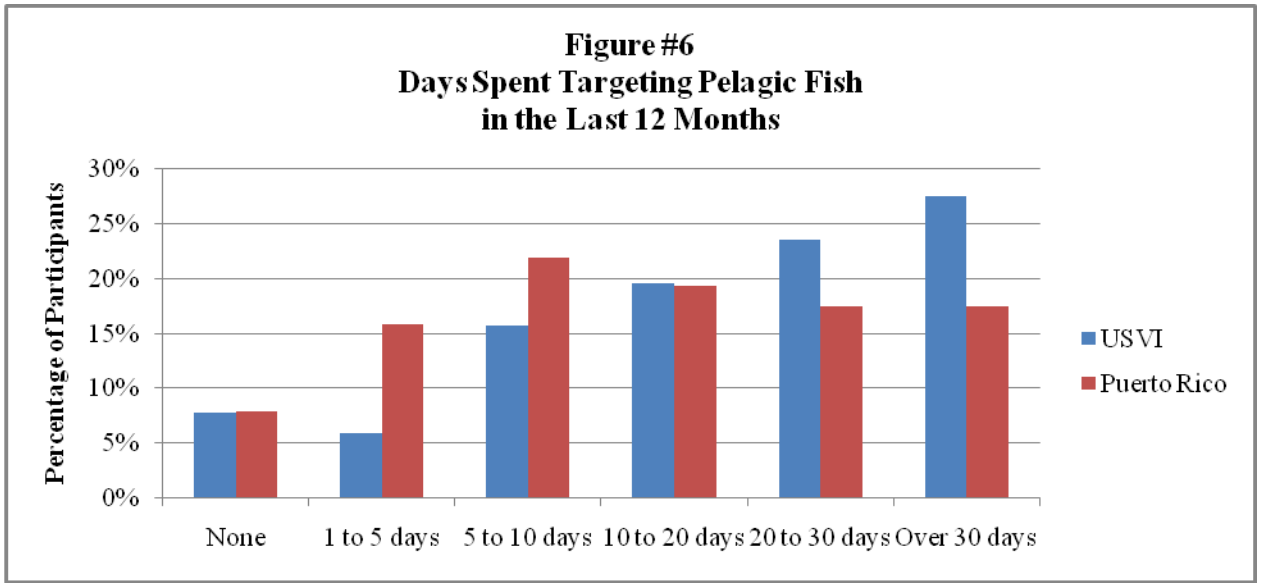


Figure #6
Days Spent Targeting Pelagic Fish
in the Last 12 Months
Percentage of Participants
30%
25%
20%
15%
10%
5%
0%
None
1 to 5 days
5 to 10 days
10 to 20 days
20 to 30 days
Over 30 days
USVI
Puerto Rico

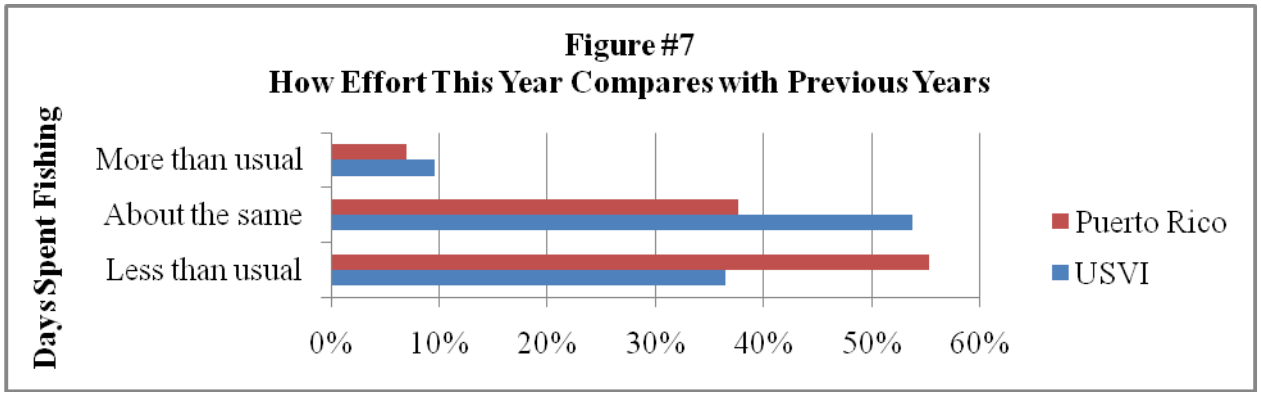


Figure #7
How Effort This Year Compares with Previous Years
Days Spent Fishing
More than usual
About the same
Less than usual
0%
10%
20%
30%
40%
50%
60%
Puerto Rico
USVI

Figure #8
Recreational Sportfishing Motivations

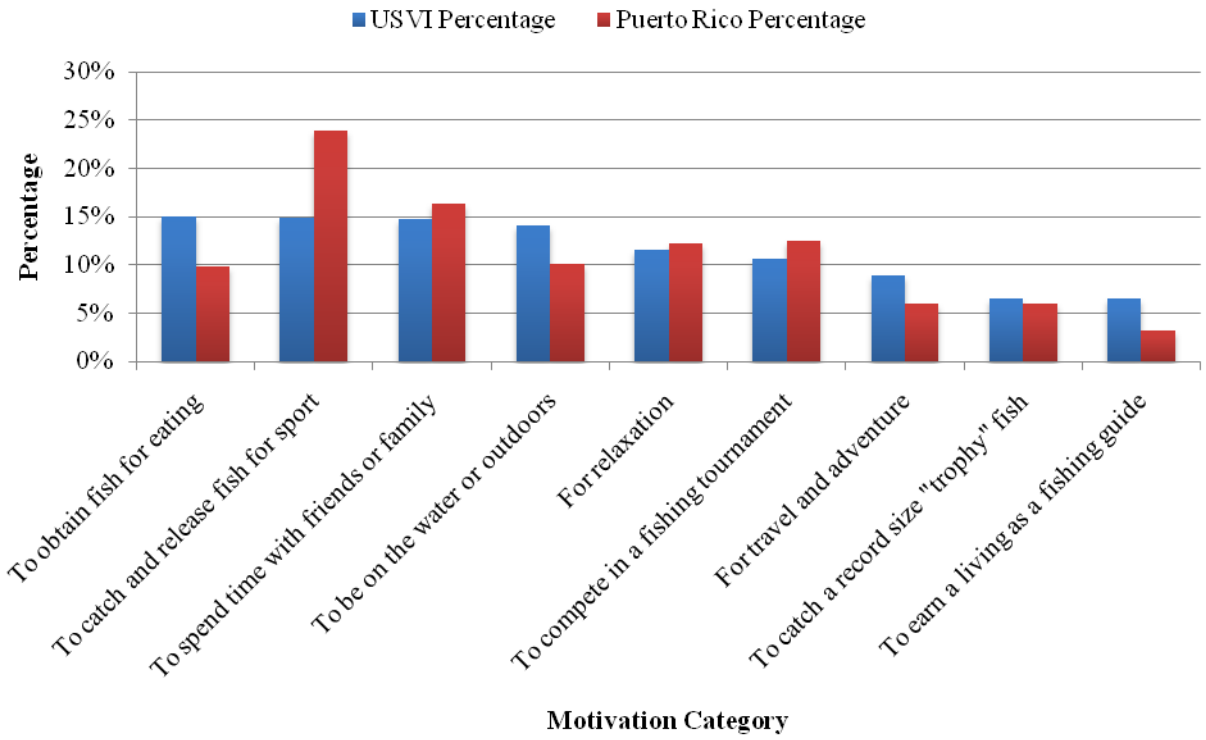


Figure #9
Number of Survey Participants Targeting Billfish Species

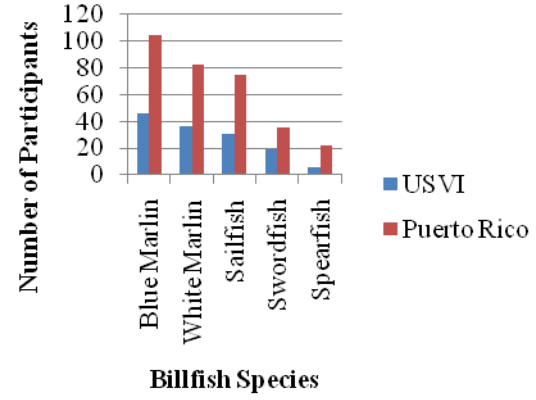


Figure #10
Percentage of Survey Participants Targeting Billfish Species

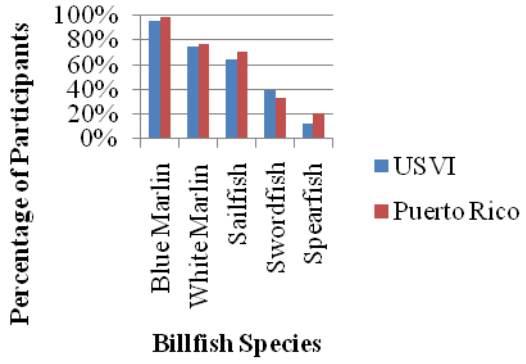


Figure #11
Number of Survey Participants Targeting Tuna Species

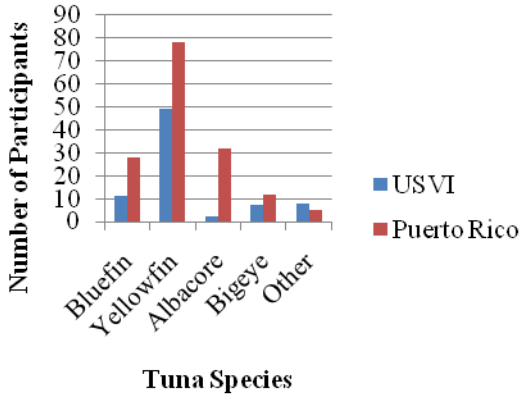


Figure #12
Percentage of Survey Participants Targeting Tuna Species

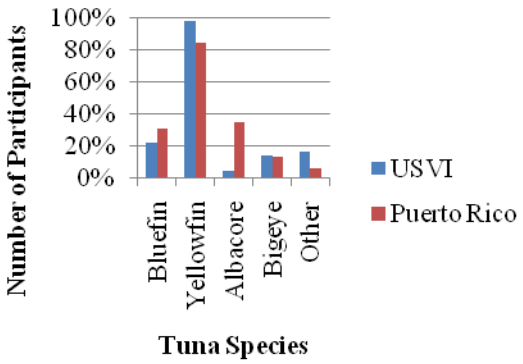


Figure #13
Number of Survey Participants Targeting Shark Species

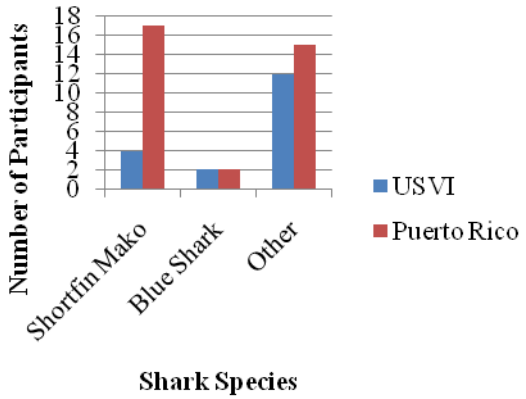


Figure #14
Percentage of Survey Participants Targeting Shark Species

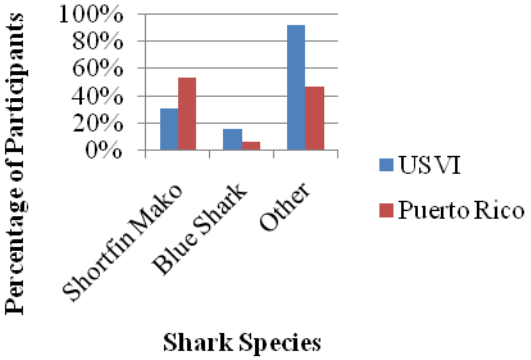
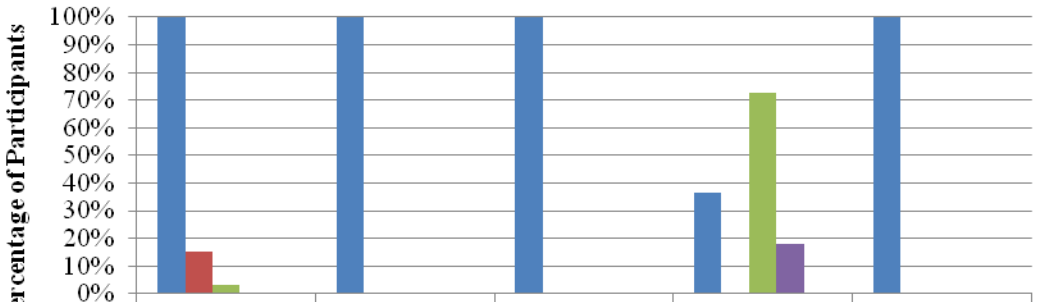


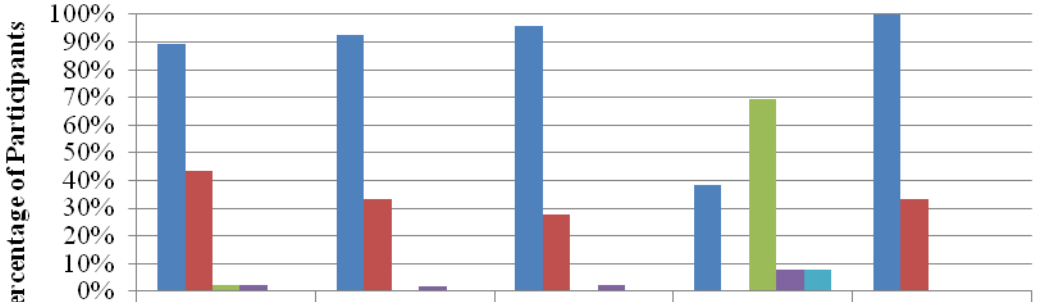
Figure #15
United States Virgin Islands
Fate of Billfish Caught



	Blue Marlin	White Marlin	Sailfish	Swordfish	Spearfish
Released	100.00%	100.00%	100.00%	36.36%	100.00%
Tagged	15.15%	0.00%	0.00%	0.00%	0.00%
Eaten	3.03%	0.00%	0.00%	72.73%	0.00%
Donated	0.00%	0.00%	0.00%	18.18%	0.00%
Sold	0.00%	0.00%	0.00%	0.00%	0.00%

Billfish Species

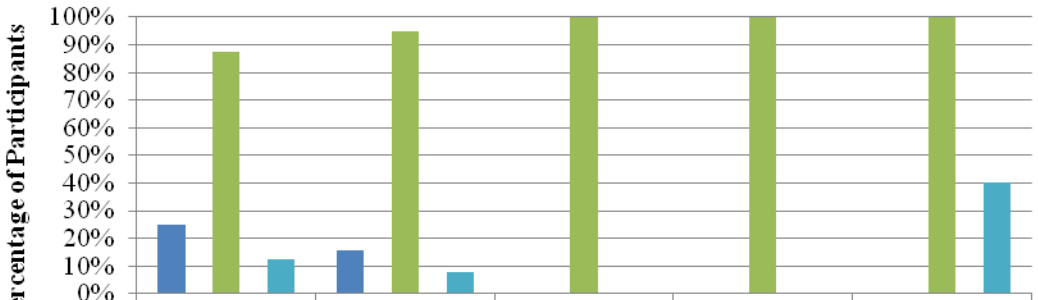
Figure #16
Puerto Rico
Fate of Billfish Caught



	Blue Marlin	White Marlin	Sailfish	Swordfish	Spearfish
Released	89.16%	92.59%	95.74%	38.46%	100.00%
Tagged	43.37%	33.33%	27.66%	0.00%	33.33%
Eaten	2.41%	0.00%	0.00%	69.23%	0.00%
Donated	2.41%	1.85%	2.13%	7.69%	0.00%
Sold	0.00%	0.00%	0.00%	7.69%	0.00%

Billfish Species

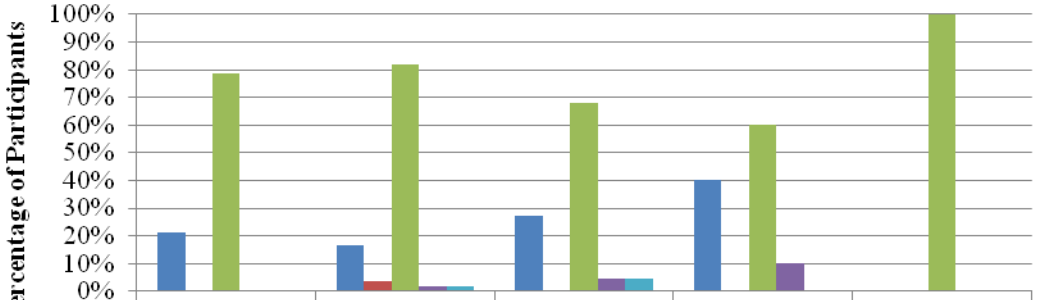
Figure #17
United States Virgin Islands
Fate of Tuna Caught



	Bluefin	Yellowfin	Albacore	Bigeye	Other
Released	25.00%	15.79%	0.00%	0.00%	0.00%
Tagged	0.00%	0.00%	0.00%	0.00%	0.00%
Eaten	87.50%	94.74%	100.00%	100.00%	100.00%
Donated	0.00%	0.00%	0.00%	0.00%	0.00%
Sold	12.50%	7.89%	0.00%	0.00%	40.00%

Tuna Species

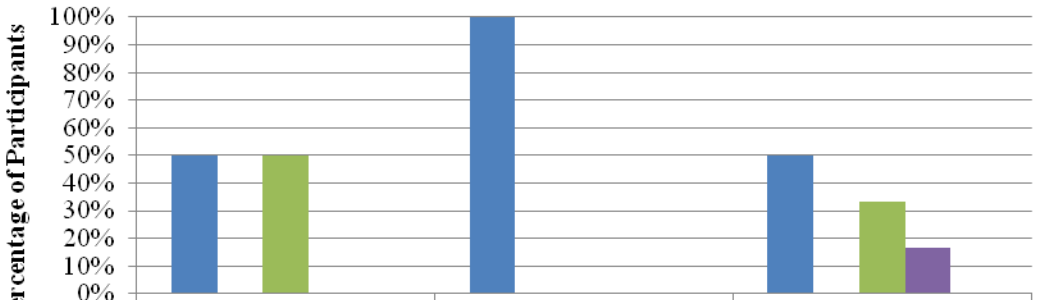
Figure #18
Puerto Rico
Fate of Tuna Caught



	Bluefin	Yellowfin	Albacore	Bigeye	Other
Released	21.43%	16.36%	27.27%	40.00%	0.00%
Tagged	0.00%	3.64%	0.00%	0.00%	0.00%
Eaten	78.57%	81.82%	68.18%	60.00%	100.00%
Donated	0.00%	1.82%	4.55%	10.00%	0.00%
Sold	0.00%	1.82%	4.55%	0.00%	0.00%

Tuna Species

Figure #19
United States Virgin Islands
Fate of Sharks Caught



	Shortfin Mako	Blue Shark	Other
Released	50.00%	100.00%	50.00%
Tagged	0.00%	0.00%	0.00%
Eaten	50.00%	0.00%	33.33%
Donated	0.00%	0.00%	16.67%
Sold	0.00%	0.00%	0.00%

Shark Species

Figure #20
Puerto Rico
Fate of Sharks Caught

	Shortfin Mako	Blue Shark	Other
Released	100.00%	0.00%	100.00%
Tagged	0.00%	0.00%	0.00%
Eaten	0.00%	0.00%	0.00%
Donated	0.00%	0.00%	0.00%
Sold	0.00%	0.00%	0.00%

Shark Species

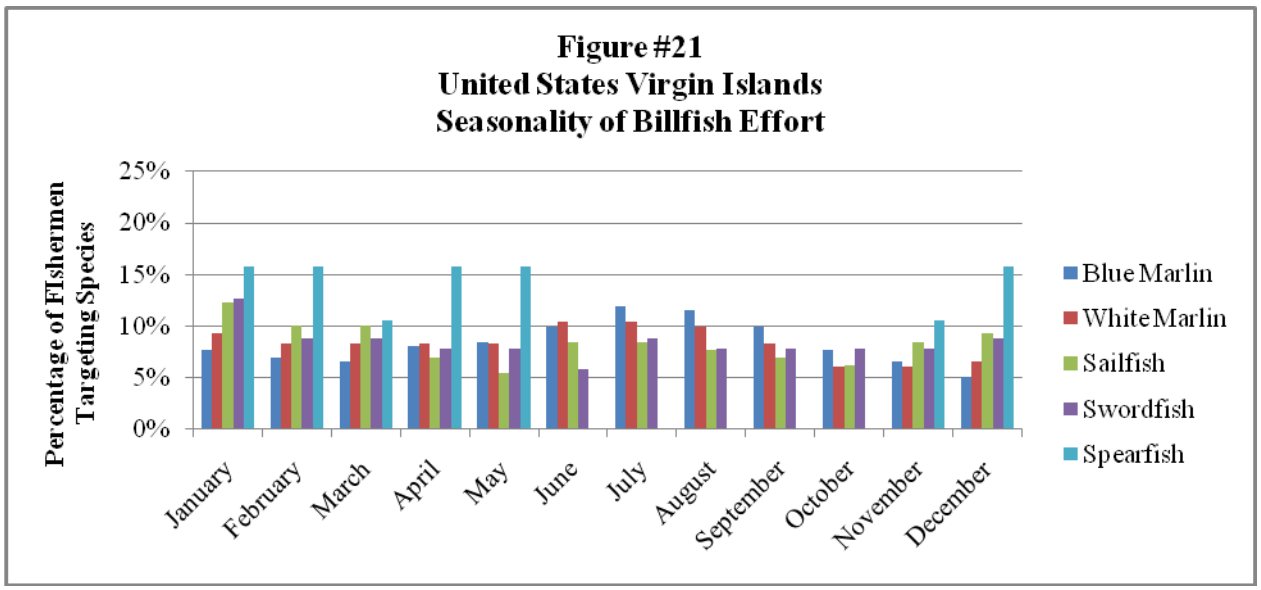


Figure #21
United States Virgin Islands
Seasonality of Billfish Effort
Percentage of Fishermen Targeting Species
25%
20%
15%
10%
5%
0%
January
February
March
April
May
June
July
August
September
October
November
December
Blue Marlin
White Marlin
Sailfish
Swordfish
Spearfish

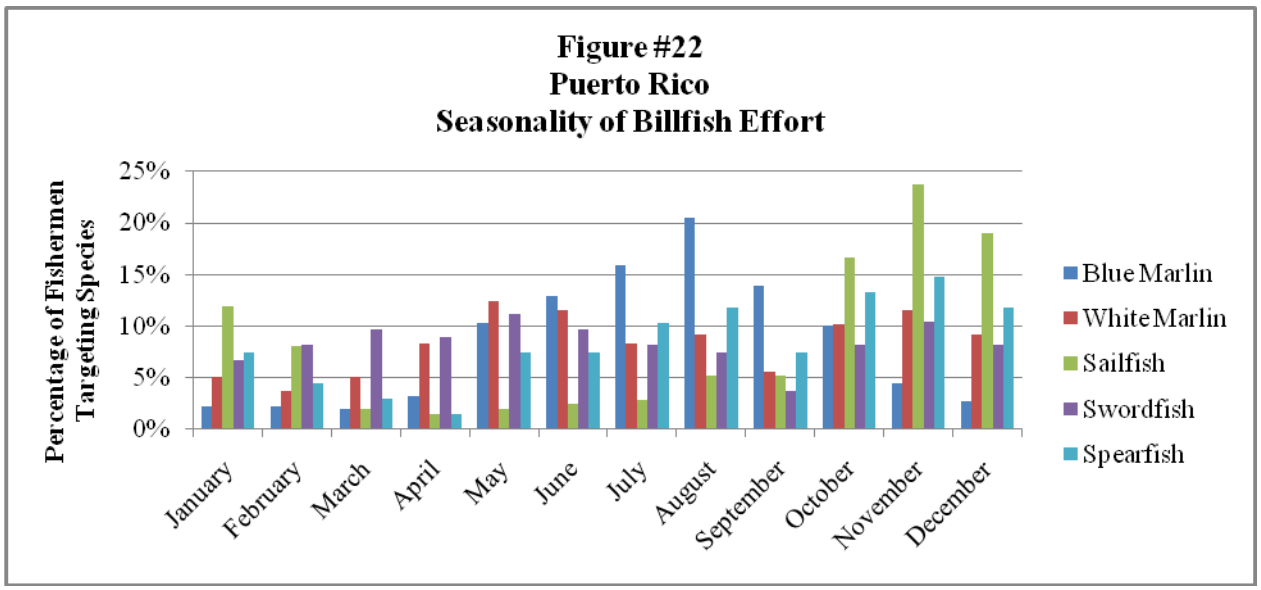


Figure #22
Puerto Rico
Seasonality of Billfish Effort
Percentage of Fishermen Targeting Species
25%
20%
15%
10%
5%
0%
January
February
March
April
May
June
July
August
September
October
November
December
Blue Marlin
White Marlin
Sailfish
Swordfish
Spearfish

Figure #23
United States Virgin Islands
Seasonality of Tuna Effort

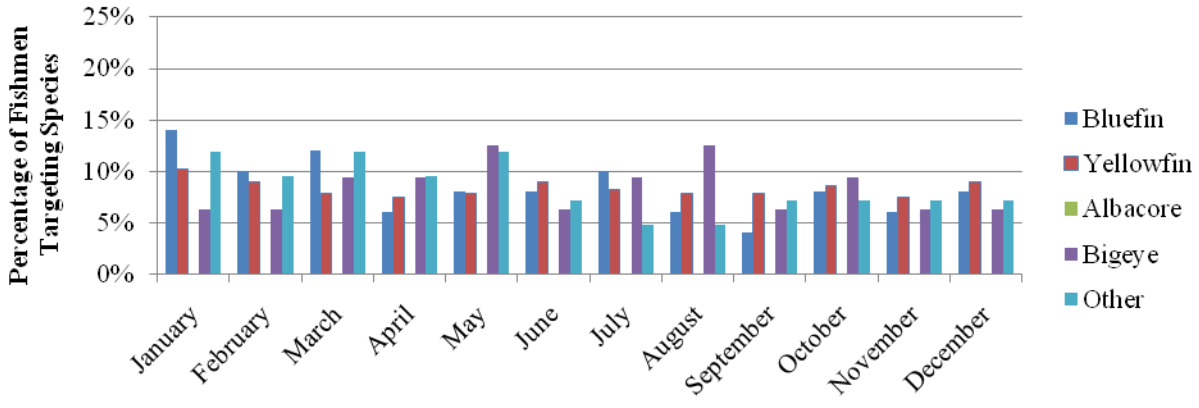


Figure #24
Puerto Rico
Seasonality of Tuna Effort

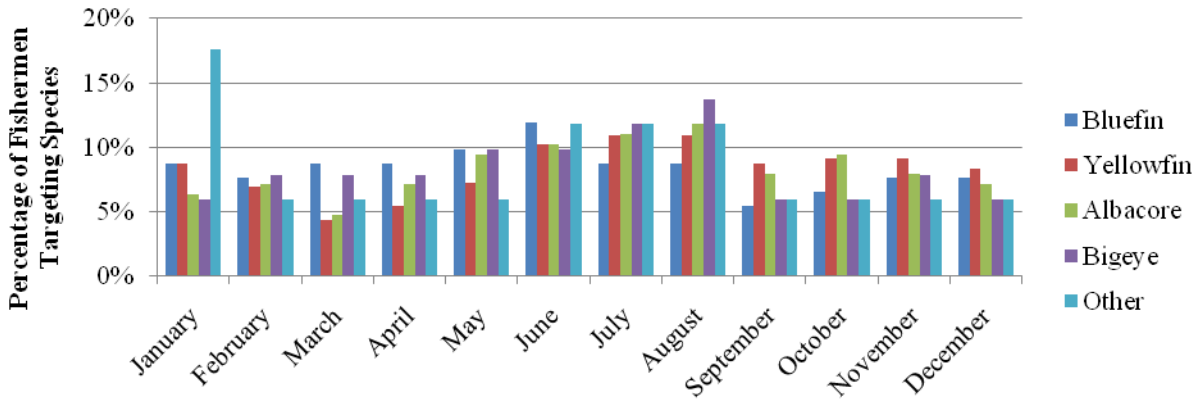


Figure #25
United States Virgin Islands
Seasonality of Shark Effort

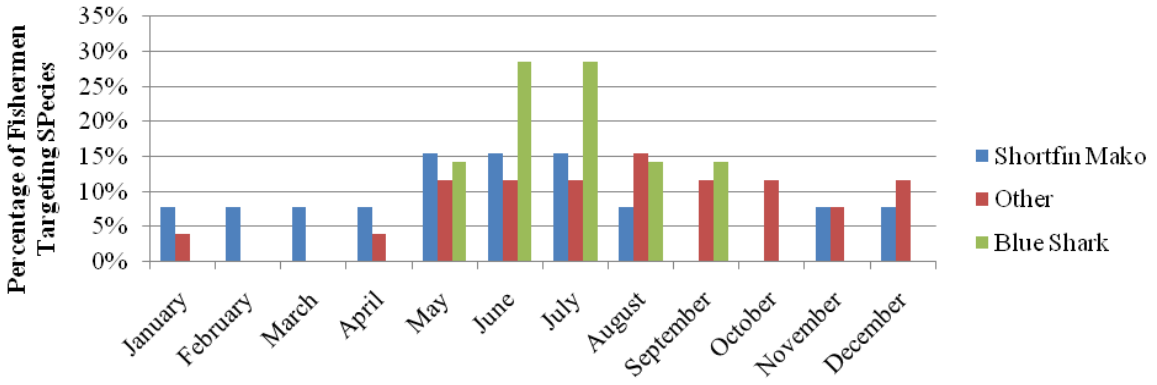


Figure #26
Puerto Rico
Seasonality of Shark Effort

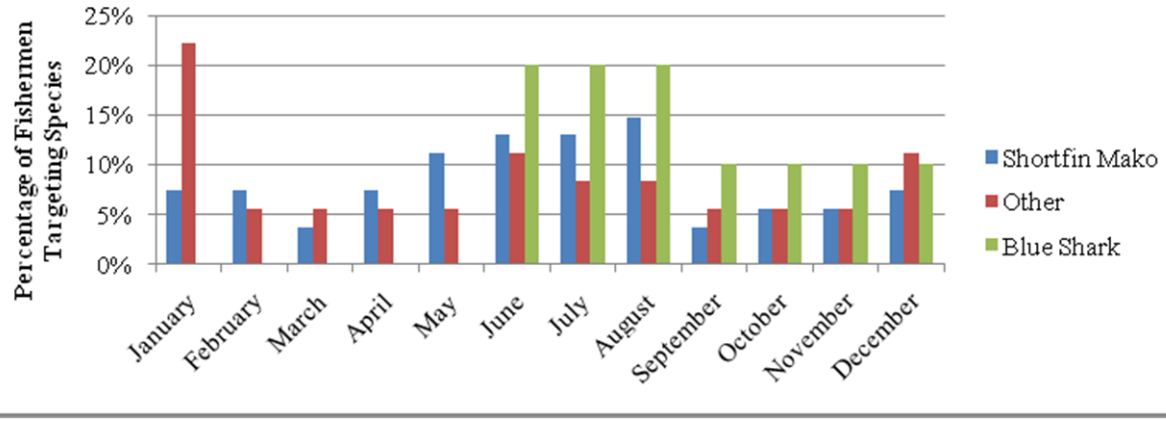
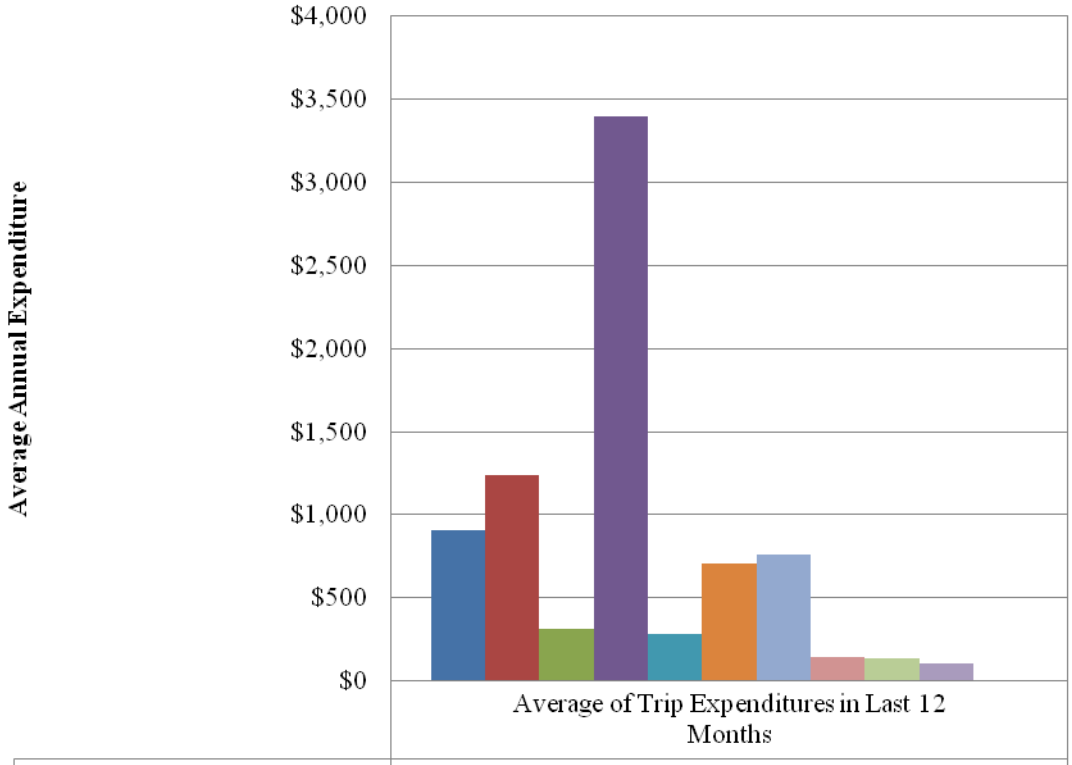
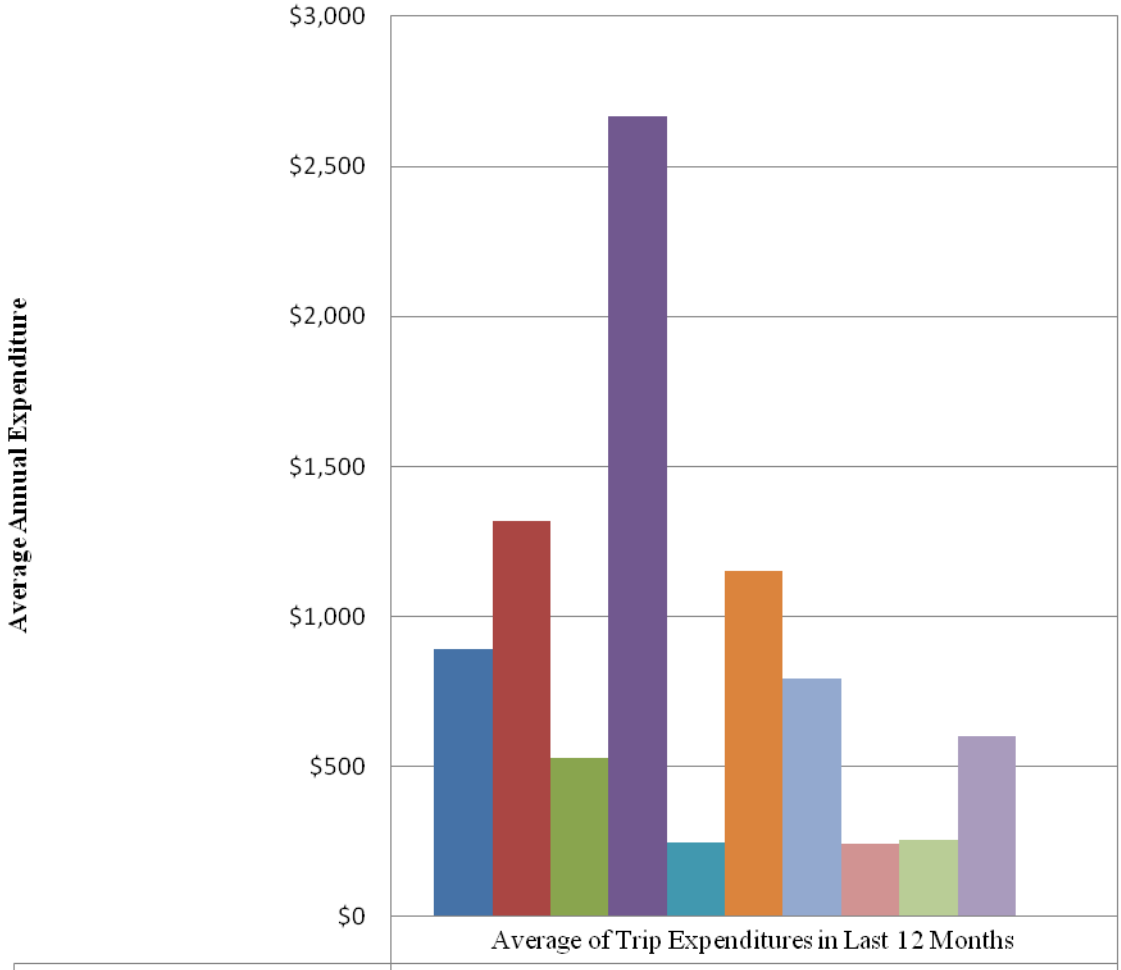


Figure #27
United States Virgin Islands
Average Trip Expenditures
On Last Pelagic Fishing Trip



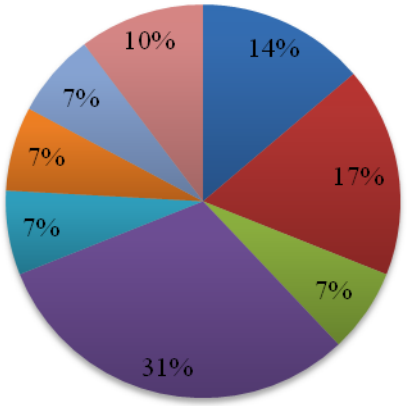
Captain, Crew and Charter Fees	$908.33
Boat Operation Costs	$1,237.31
Anything Else	$311.67
Boat Rental Fees	$3,400.00
Food, Drinks, Ice	$284.48
Lodging Costs	$703.75
Airfare	$758.64
Live Bait, Artificial Lures, and Other Tackle	$148.33
Customs and Entrance Fees	$140.00
Automobile transportation	$109.18
Boat Launch/Hoist Fees	$0.00

Figure #28
Puerto Rico
Average Trip Expenditures
On Last Pelagic Fishing Trip



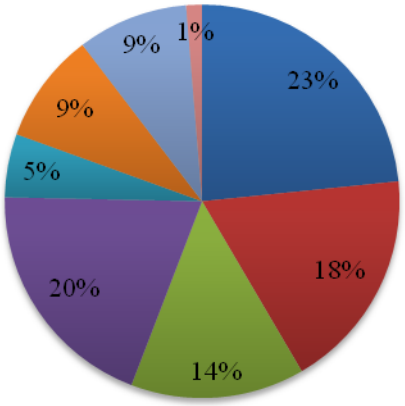
	Average of Trip Expenditures in Last 12 Months
Captain, Crew and Charter Fees	$891.67
Boat Operation Costs	$1,318.67
Anything Else	$529.69
Boat Rental Fees	$2,666.67
Food, Drinks, Ice	$246.77
Lodging Costs	$1,150.00
Airfare	$795.00
Live Bait, Artificial Lures, and Other Tackle	$244.70
Customs and Entrance Fees	$256.36
Automobile transportation	$603.44
Boat Launch/Hoist Fees	$0.00

Figure #29
United States Virgin Islands
Vessel Purchase Expenditures



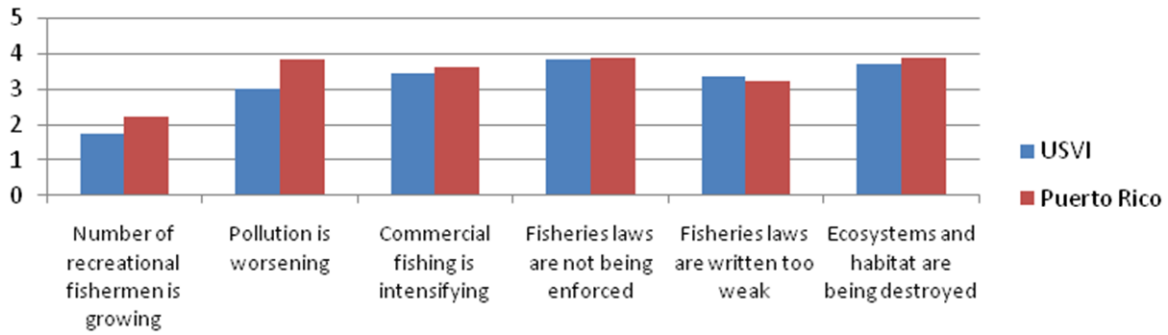
- Less the $25,000
- Between $25,000 and $50,000
- Between $50,000 and $100,000
- Between 100,000 and $250,000
- Between $250,000 and $500,000
- Between $500,000 and $1 million
- Between $1 million and $2 million
- Over $2 million

Figure #30
Puerto Rico
Vessel Purchase Expenditures



- Less the $25,000
- Between $25,000 and $50,000
- Between $50,000 and $100,000
- Between 100,000 and $250,000
- Between $250,000 and $500,000
- Between $500,000 and $1 million
- Between $1 million and $2 million
- Over $2 million

Figure #31
Percieved Fisheries Conflicts



APPENDIX B: TABLES

Table #1

	USVI Total Score	USVI Percentage	Puerto Rico Total Score	Puerto Rico Percentage
To obtain fish for eating	310	15.00%	313	9.84%
To catch and release fish for sport	308	14.91%	759	23.87%
To spend time with friends or family	305	14.76%	519	16.32%
To be on the water or outdoors	291	14.09%	322	10.13%
For relaxation	238	11.52%	387	12.17%
To compete in a fishing tournament	219	10.60%	396	12.45%
For travel and adventure	183	8.86%	192	6.04%
To catch a record size "trophy" fish	135	6.53%	191	6.01%
To earn a living as a fishing guide	77	6.53%	101	3.18%
Total	2066	102.81%	3180	100%

Table #2

Billfish Species	USVI Number of Participants	USVI Percentage	Puerto Rico Number of Participants	Puerto Rico Percentage
Blue Marlin	46	95.80%	105	98.10%
White Marlin	36	75%	82	76.60%
Sailfish	31	64.60%	75	70.10%
Swordfish	19	39.60%	35	32.70%
Spearfish	6	12.50%	22	20.60%
Total	48		107	

Table #3

Tuna Species	USVI Number of Participants	USVI Percentage	Puerto Rico Number of Participants	Puerto Rico Percentage
Bluefin	11	22%	28	30.40%
Yellowfin	49	98%	78	84.80%
Albacore	2	4%	32	34.80%
Bigeye	7	14%	12	13%
Other Tuna	8	16%	5	5.40%

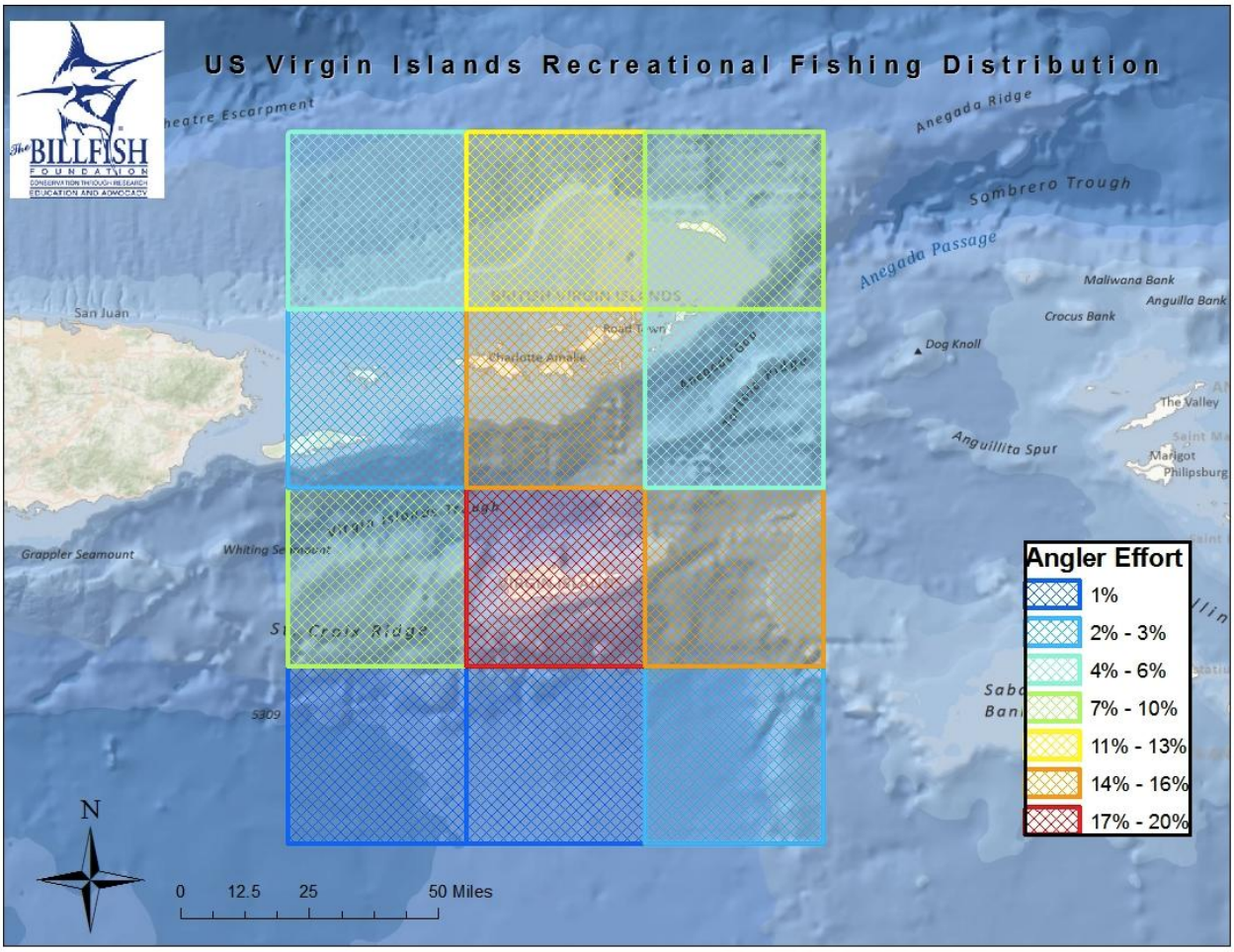
Total	50		92	

Table #4

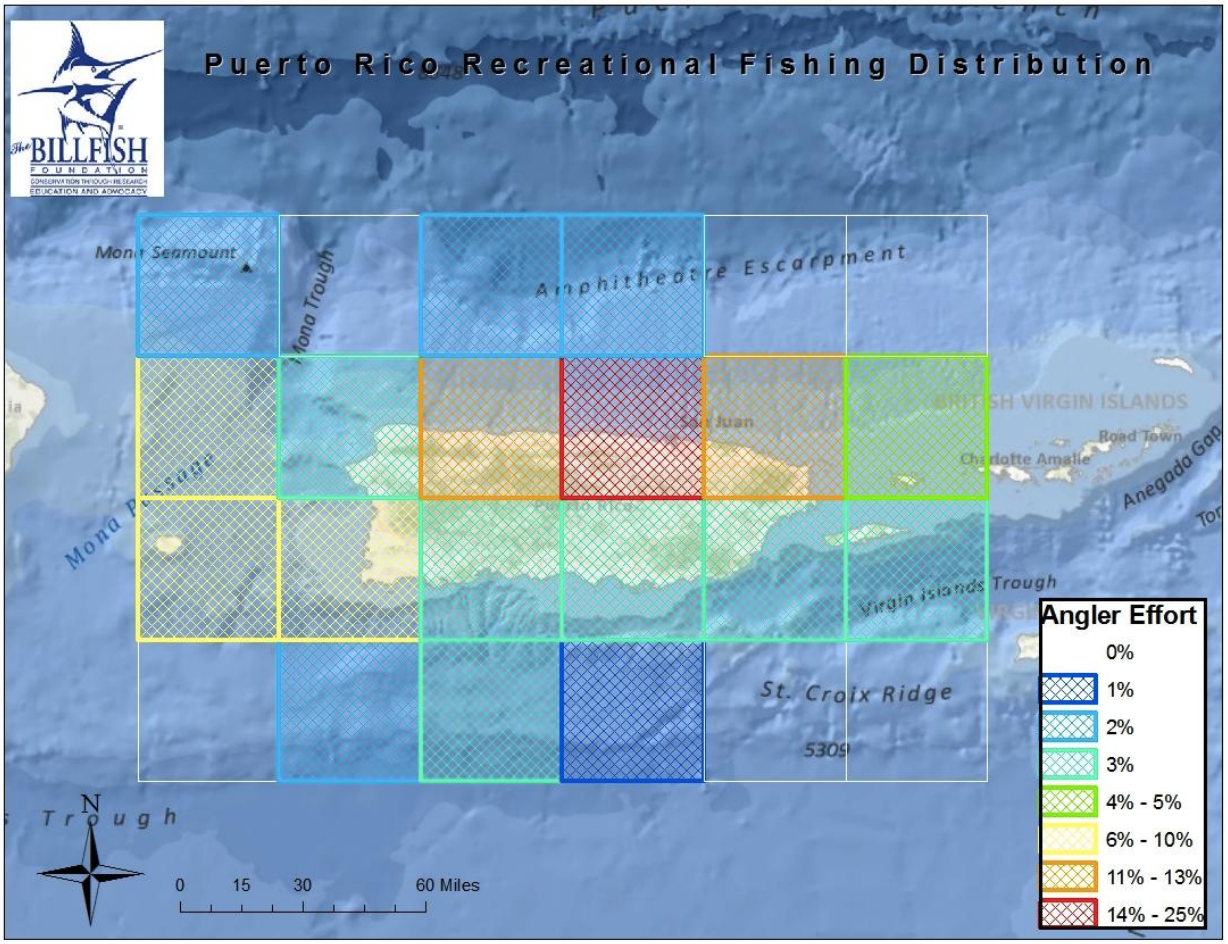
Shark Species	USVI Number of Participants	USVI Percentage	Puerto Rico Number of Participants	Puerto Rico Percentage
Shortfin Mako	4	30.80%	17	53.10%
Blue Shark	2	15.40%	2	6.30%
Other Sharks	12	92.30%	15	46.90%
Total	13		32	

APPENDIX C: MAPS

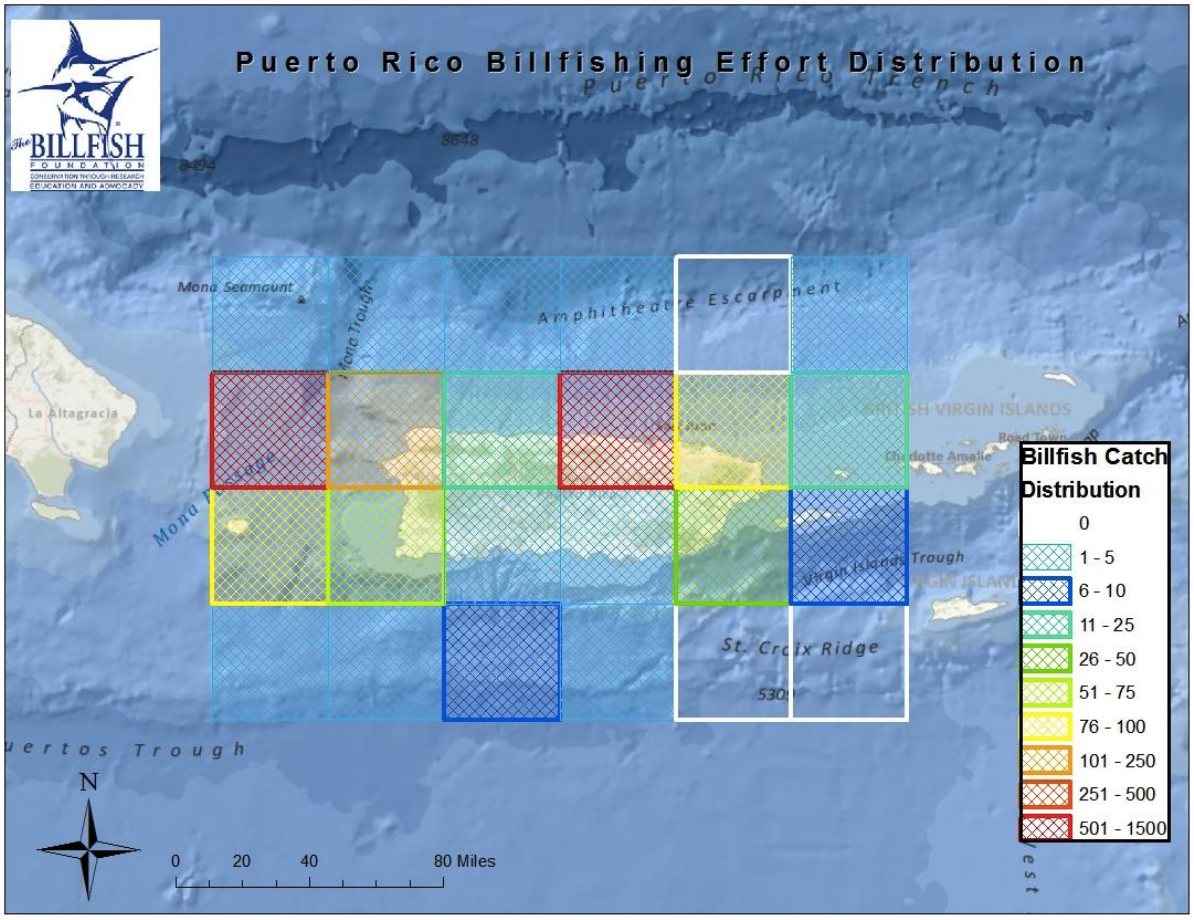
Map #1



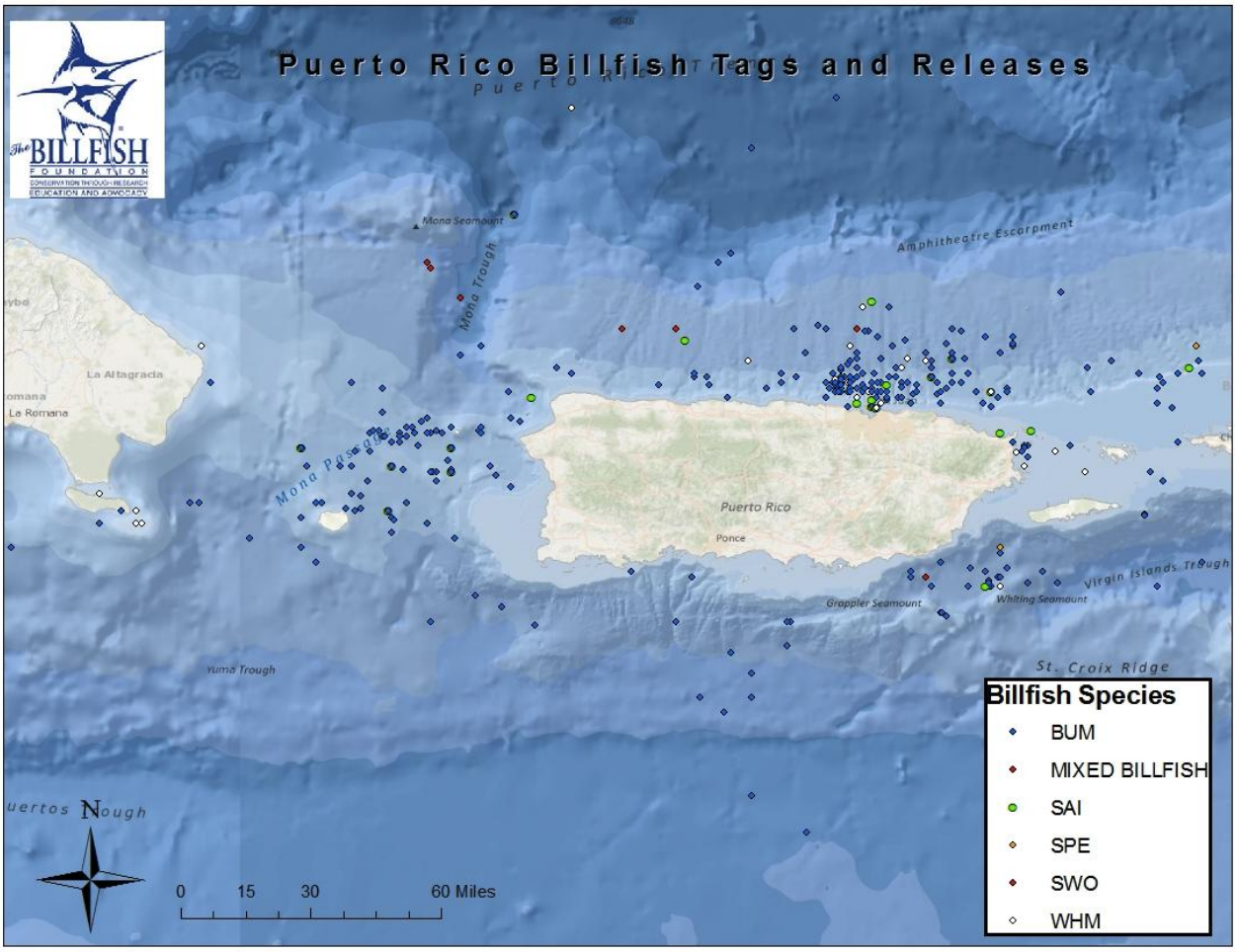
Map #2


Puerto Rico Recreational Fishing Distribution
Mona Seamount
Mona Trough
Amphitheatre Escarpment
San Juan
BRITISH VIRGIN ISLANDS
Road Town
Charlotte Amalie
Anegada Gap
Mona Passage
Virgin Islands Trough
St. Croix Ridge
5305
Trough
N
0 15 30 60 Miles
Angler Effort
0%
1%
2%
3%
4% - 5%
6% - 10%
11% - 13%
14% - 25%

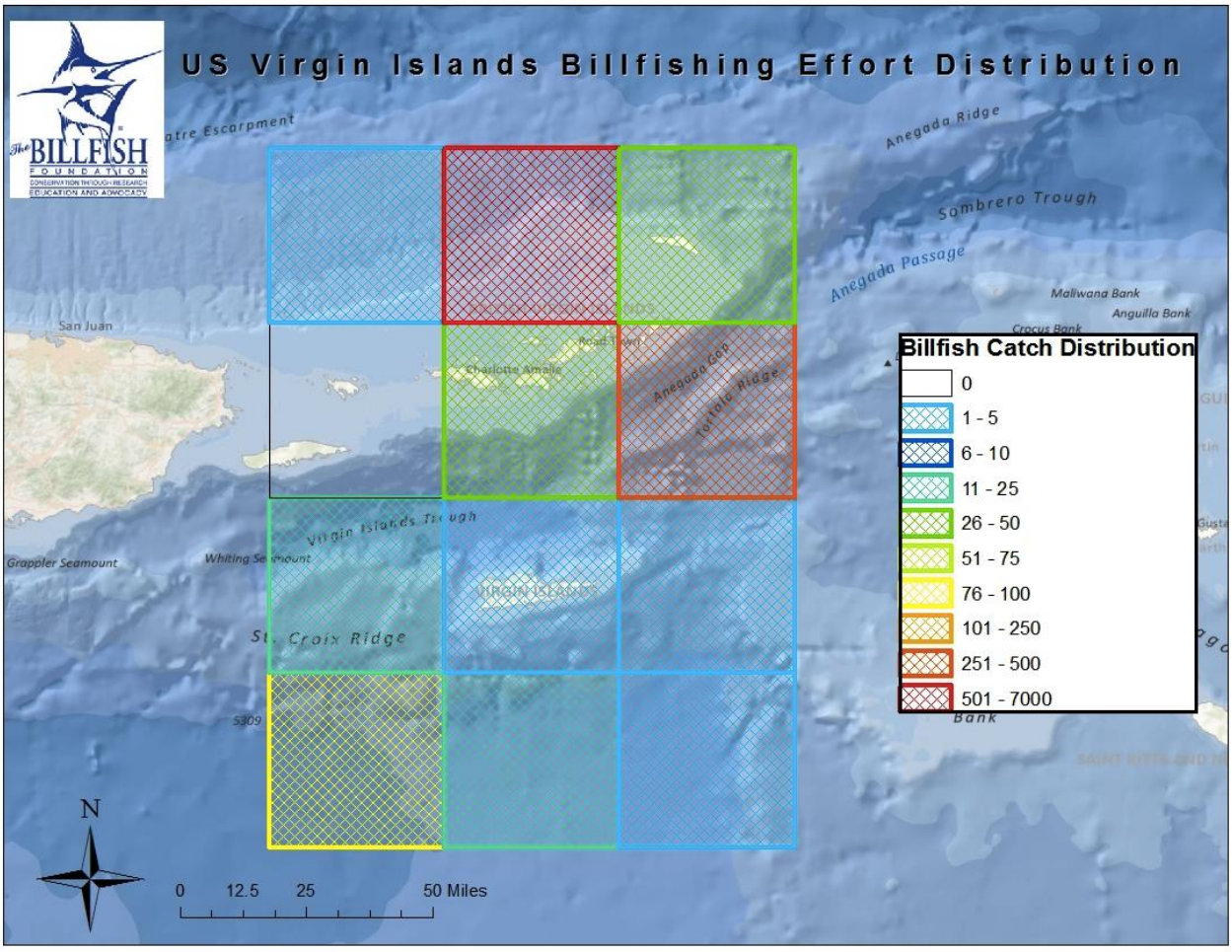
Map #3


Puerto Rico Billfishing Effort Distribution
Puerto Rico Trench
8648
Mona Seamount
Mona Canyon
Anegada Trough
Amphitheatre Escarpment
La Altagracia
Charlotte Amalie
Virgin Islands Trough
St. Croix Ridge
5305
Billfish Catch Distribution
0
1 - 5
6 - 10
11 - 25
26 - 50
51 - 75
76 - 100
101 - 250
251 - 500
501 - 1500
N
0
20
40
80 Miles

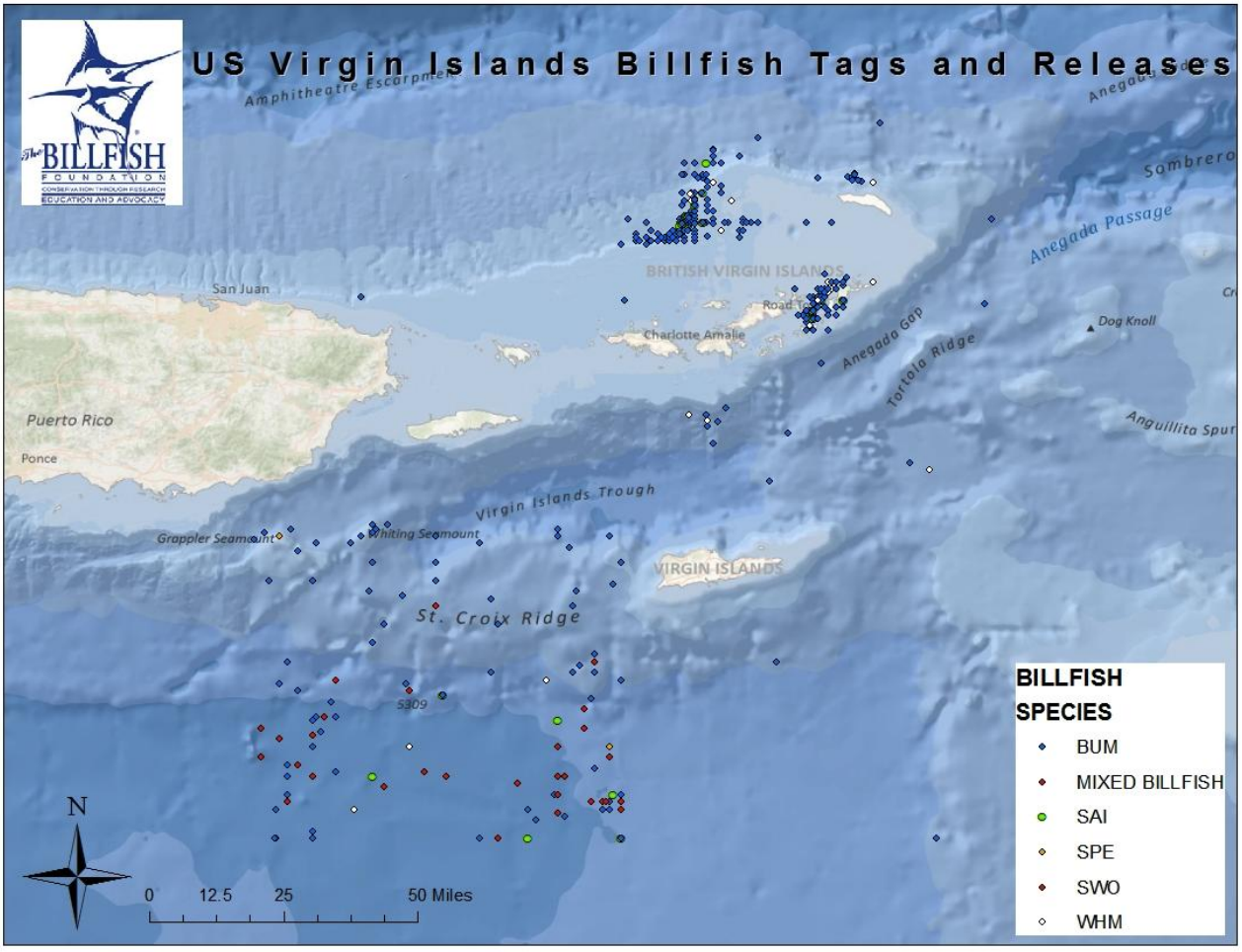
Map #4


Puerto Rico Billfish Tags and Releases
The BILLFISH FOUNDATION
Mona Seamount
Mona Trough
Amphitheatre Escarpment
La Altagracia
La Romana
Mona Passage
Puerto Rico
Ponce
Virgin Islands Trough
Grappler Seamount
Whiting Seamount
Yuma Trough
St. Croix Ridge
N
0 15 30 60 Miles
Billfish Species
BUM
MIXED BILLFISH
SAI
SPE
SWO
WHM

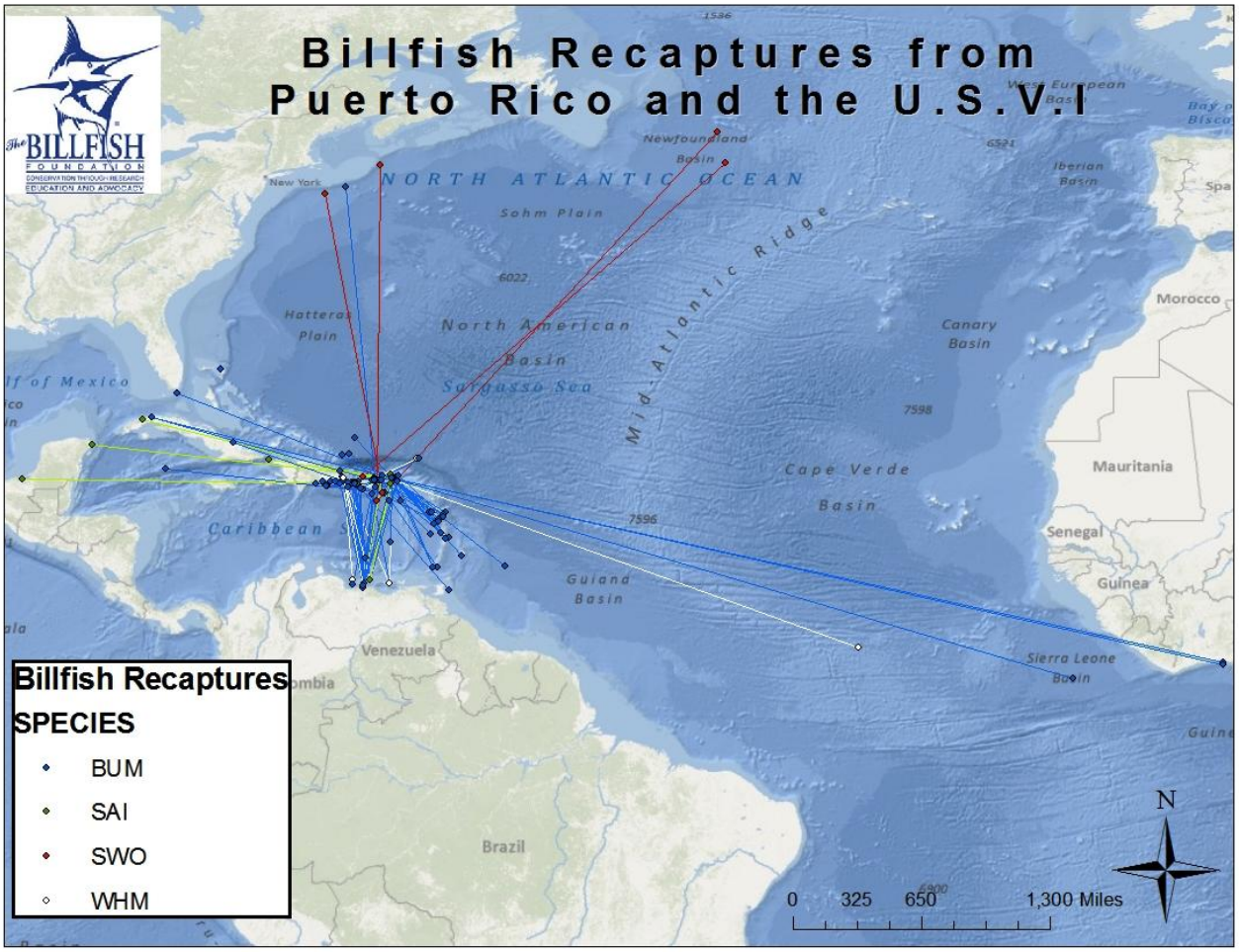
Map #5


US Virgin Islands Billfishing Effort Distribution
The BILLFISH FOUNDATION
CONSERVATION THROUGH RESEARCH EDUCATION AND ADVOCACY
Anegada Ridge
Sombrero Trough
Anegada Passage
Maliwana Bank
Anguilla Bank
Crocus Bank
San Juan
Charlotte Amalie
Anegada Gap
Tortola Ridge
Virgin Islands Trough
Grappler Seamount
Whiting Seamount
St. Croix Ridge
5309
Billfish Catch Distribution
0
1 - 5
6 - 10
11 - 25
26 - 50
51 - 75
76 - 100
101 - 250
251 - 500
501 - 7000
N
0 12.5 25 50 Miles

Map #6


US Virgin Islands Billfish Tags and Releases
The BILLFISH FOUNDATION
CONSERVATION THROUGH RESEARCH EDUCATION AND ADVOCACY
Amphitheatre Escarpment
Sombrero
Anegada Passage
BRITISH VIRGIN ISLANDS
San Juan
Road Town
Charlotte Amalie
Anegada Gap
Tortola Ridge
Dog Knoll
Puerto Rico
Ponce
Anguillita Spur
Virgin Islands Trough
Grappler Seamount
Whiting Seamount
VIRGIN ISLANDS
St. Croix Ridge
5309
N
0 12.5 25 50 Miles
BILLFISH SPECIES
BUM
MIXED BILLFISH
SAI
SPE
SWO
WHM

Map #7


Billfish Recaptures from Puerto Rico and the U.S.V.I
The BILLFISH FOUNDATION
CONSERVATION THROUGH RESEARCH EDUCATION AND ADVOCACY
NORTH ATLANTIC OCEAN
New York
Newfoundland Basin
Sohm Plain
Hatteras Plain
North American Basin
Sargasso Sea
Mid-Atlantic Ridge
Iberian Basin
Morocco
Canary Basin
Cape Verde Basin
Mauritania
Senegal
Guinea
Sierra Leone Basin
Guiand Basin
Caribbean S
Venezuela
Brazil
Billfish Recaptures
SPECIES
BUM
SAI
SWO
WHM
N
0 325 650 1,300 Miles

This volume contains the following papers: