

# The Economic Importance Of Recreational Billfish Angling In Puerto Rico

DON J. CLARK<sup>1</sup>, ROBERT B. DITTON<sup>1</sup> and RUPERTO S. CHAPARRO<sup>2</sup>

<sup>1</sup>Texas A&M University  
Department of Wildlife and Fisheries Sciences  
College Station, TX 77843-2258

<sup>2</sup>University of Puerto Rico  
Department of Marine Science  
Mayaguez, PR 00708

## ABSTRACT

The current federal Fishery Management Plan (FMP) for Atlantic Billfishes prohibits the sale of four billfish species, which serves to reserve the fishery for recreational use only. This was done to maintain the highest availability of billfishes to recreational anglers. Yet, little is known about the social and economic aspects of the recreational fishery. A mail survey was conducted of a sample of 885 resident and 154 non-resident tournament billfish anglers in Puerto Rico. The random sample was drawn from a list of entries in the fourteen billfish tournaments held in Puerto Rico.

Anglers were asked about their tournament and non-tournament billfish fishing both in and out of Puerto Rico. Expenditures for non-durable goods and services were significantly different between resident and non-resident anglers. Billfish trip-related expenditures in Puerto Rico averaged over \$700/person/trip for residents and nearly \$4,000/person/trip for non-residents.

Annual consumer's surplus averaged \$11,135. The total economic value of billfish fishing in Puerto Rico (expenditures + consumer's surplus) was estimated at \$44 million.

The economic impact of non-resident billfish anglers to the Puerto Rican economy was estimated at \$4.75 million and was responsible for over 200 jobs. The economic value of billfish fishing to the Puerto Rican economy suggests a need for continued protection, increased law enforcement, and educational programs which encourage catch and release fishing. Implications for billfish management in the Gulf and Caribbean region are discussed.

## INTRODUCTION

For the U.S. Gulf of Mexico and Caribbean, the term billfish refers to any of five species of pelagic, highly migratory fish: the sailfish, *Istiophorus platypterus*; the white marlin, *Tetrapturus albidus*; the blue marlin, *Makaira nigricans*; the longbill spearfish, *Tetrapturus pfluegeri*; and the swordfish, *Xiphias gladius*. These fish have been pursued by recreational anglers in the Atlantic since around 1900. In the early part of this century, an active sport fishery began to develop along the Atlantic coast of the U.S. and in the Caribbean. Participation in recreational billfish fishing continues to grow. In the U.S. Atlantic and Caribbean, over 7,000 anglers made over 100,000 billfish

fishing trips in 1990 (Ditton and Fisher, 1990). Competitive billfish tournaments have grown to number over 800 in the U.S. and Caribbean.

In 1988, a Fishery Management Plan for Atlantic Billfishes (FMP) was adopted for U.S. Exclusive Economic Zone (EEZ) waters (SAFMC, 1988). The FMP sought to prevent the development of a domestic commercial market for Atlantic billfish, other than swordfish, by including a "no sale" provision. The result of the FMP was to reserve the entire fishery for recreational anglers because of the tradition of use by recreational anglers, their practice of releasing a large percentage of their catch, and the economic value of the recreational fishery. The intent was to "minimize harvest, thereby maximizing population density while still allowing traditional, competitive fishing tournaments" for billfish (SAFMC, 1988). The resulting higher densities of billfish were hoped to increase the likelihood of recreational anglers catching a billfish. An increase in the likelihood of fishing success was proposed to have a positive impact on the social and economic values of the fishery.

Catching a billfish is considered a "rare event", that is, the time spent fishing for billfish is large when compared to the actual number of fish caught. In the U.S. Atlantic, billfish success rates (trips catching billfish/total trips targeting billfish) vary by region from 28% of trips for the U.S. Gulf of Mexico to 46% for the Mid-Atlantic (Ditton and Fisher, 1990). Because it is a rare event and the chance of encountering billfish anglers is small, estimates of the extent of billfish fishing are difficult to determine. Creel and angler intercept surveys encounter few billfish anglers; therefore, estimates of billfish fishing pressure and harvest are often based on insufficient sample sizes (Fedler and Ditton, 1990). This casts doubts on the validity of many extrapolations of billfish-specific angler statistics from surveys of the general population of anglers.

In attempting to overcome the validity problems, several studies have sought to identify the population of billfish anglers, their expenditures, and the total economic impact of billfish fishing. Survey results in 1977 showed recreational billfish anglers in the U.S. Atlantic spent nearly 291,000 boat days, at an average cost of \$350 per boat day, resulting in \$1,300 spent for every billfish landed (SAFMC, 1988). In 1978, billfish fishing provided 66,000 people with more than 1 million days of recreation and resulted in an economic value of approximately \$100 million (Rockland, 1989). In 1983, in the Mid-Atlantic region alone, 21,276 boat days were dedicated to marlin or tuna fishing, resulting in over \$40 million in economic impact for billfish fishing or \$7,400 per billfish landed (SAFMC, 1988). In the U.S. Atlantic and Caribbean, billfish anglers expenditures averaged \$1,601 per trip (or \$618 per day) and \$2,147 per tournament billfish trip. The result was an average expenditure of \$5,576 for every billfish caught during a tournament or \$29,730 per billfish landed (Fisher and Ditton, 1992). Comparisons between studies are limited because the value

of the U.S. dollar has not been standardized, and catch and release rates among anglers differ by region.

An angler's actual expenditures are only a partial measure of the true value of the fishery and therefore not a useful measure of its economic worth (Huppert, 1983). A fishing trip has much greater value than the costs associated with getting to, using, and returning from the resource. Testing one's skill, experiencing adventure, relaxing, camaraderie with friends and family, etc., are some of the components of a fishing trip that also provide value. One way of estimating these values is to determine how much anglers are willing to pay in excess of their actual expenditures. The excess amount is termed consumer's surplus. The angler's gross willingness to pay represents their actual expenditures for billfish plus the value of the benefits or satisfaction received from the experience (Rockland, 1985). Fisher and Ditton (1992) found the per trip consumer's surplus for U.S. Atlantic billfish anglers was approximately \$262; the resulting net economic benefit for these anglers was over \$2,000,000.

To determine the economic impact of billfish-related expenditures, it is first necessary to separate the purchases made by resident anglers from those of non-residents. It is assumed that money spent by local residents to participate in fishing does not have an economic impact on the area since it likely would have been spent even if the individual had not gone billfish fishing. Expenditures by non-residents, however, are considered new monies which increase the area's economic base and produce economic impacts (Milon and Thunberg, 1993). The purchasing of goods and services by non-resident anglers transfers money to local merchants, who in turn spend the money for goods and services necessary to maintain their businesses. This re-spending is an indirect benefit included as part of the economic impact resulting from billfish angling. This money may again be spent locally, or used to purchase goods and services originating outside of the local economy.

The spending and re-spending continues until all of the money brought in by non-residents has left the local economy. As money is spent outside of the region, it is lost to the economy. This loss is termed leakage. The length of time new money remains in the economy, or how many times it is re-spent locally, is indicated by the economic multiplier (Devaney III *et al.*, 1976). Larger multipliers indicate that money remains in the local economy for a longer period of time, resulting in greater re-spending and thus greater economic impact (Davidson and Schaffer, 1980). Smaller economic multipliers indicate a high level of leakage and the total impact of the new money is minimized. For Puerto Rico, the best economic multipliers we could find pertained to the economics of tourism (Junta de Planificacion de Puerto Rico, 1992). However, research is currently underway towards expanding the IMPLAN input/output program to Puerto Rico which will provide regional multipliers for use in future studies (W. Maki, pers. comm).

In light of the limited economic information available, this study estimated the economic value and impact of the billfish fishery to Puerto Rico.

### METHODS

Because there is no special license for billfish anglers, no list is available of the total population for sampling purposes. As an alternative means of accessing these anglers, we identified participants in fourteen Puerto Rican billfish tournaments during the period from August, 1991 through October, 1992.

An inventory of fourteen billfish tournament held in Puerto Rico during 1992 was obtained from Association de Pesca Deportiva de Puerto Rico (Table 1). Legible records from tournament entry forms were used to identify the population. After removing individuals identified as juveniles, we were able to identify a total of 1,629 anglers. Of these, 1,475 listed addresses in Puerto Rico and were considered residents. Another 82 anglers listed addresses in the mainland United States or U.S. Virgin Islands. The remaining 72 anglers listed addresses in various foreign countries.

A random sample of 885 anglers from Puerto Rico and all non-resident anglers were selected to receive a mail questionnaire regarding their tournament and non-tournament billfish fishing activities in Puerto Rico. Anglers were asked a series of economic questions. First, they were asked to report their personal expenditures for each of eleven expense items on their most recent billfish fishing trip in Puerto Rico. Second, a close-ended contingent valuation (CVM) question was used to determine the anglers willingness to pay. The question asked: "If the price of goods and services were to increase so a billfish fishing trip cost \$[Bid Value] more than usual, would you pay the higher price rather than stop fishing for billfish?". Each angler was presented with a random bid offer from a preselected range of ten values (\$75-\$750 in increments of \$75). Bid values were chosen based on previously reported expenditures of Atlantic Billfish anglers (Fisher and Ditton, 1992). Anglers were prompted that usual costs referred to their total expenditures described previously and were told to assume their income remained the same. Consumer's surplus was evaluated using logistic regression (Agresti, 1990), by determining the probability of a "yes" response to the bid offered. The threshold level ( $P[\text{yes}] = P[\text{no}] = 0.5$ ) indicates the angler's net willingness to pay.

A slightly modified version of the Dillman (1978) mail survey methodology was used to enhance response rates. Residents of Puerto Rico and other Spanish-speaking countries were sent a Spanish translation of the survey on April 5, 1993. All others received an identical survey in English. Two weeks after the first mail-out, all survey participants were sent a reminder postcard thanking them for their participation. This was followed two weeks later by a second mailing to non-respondents. Four weeks later, a third mailing was sent to those who had not yet responded. After an additional four weeks, a fourth

Table 1. Puerto Rican billfish tournaments surveyed.

TOURNAMENT	DATES HELD
Club Nautico de San Juan	
38th International	August, 1991
Club Nautico de al Parguera	May, 1992
Association de Pesca Deportiva de Dorado	June, 1992
Club Nautico Vega Baja Vela	July, 1992
Club de Pesca Deportiva de Ponce	July, 1992
Club Nautico de Arecibo	August, 1992
Cangrejos Yacht Club	August, 1992
Club Nautico de Rincon	September, 1992
Puerto Rico Light Tackle Anglers	September, 1992
Club Deportiva de Oeste	October, 1992
Club Nautico de Boqueron	October, 1992
Club Nautico de Mayaguez	October, 1992
Club Nautico Vega Baja Vela	November, 1992
Club Nautico de Arecibo	November, 1992

mailing of the English versions of the survey went to the remaining non-respondents. This was done to improve response rates, since a previous survey of billfish anglers (which included residents of Puerto Rico) achieved a response rate of over 60% (Ditton and Fisher, 1990). The fourth mailing attempted to duplicate this effort by sending English versions of the questionnaire and cover letter in stamped (not metered) Billfish Foundation envelopes.

After removing non-deliverables, an overall response rate of 49% was achieved. This was lower than expected, and differed considerably by state or country of residence (Table 2). Because response rates were lower than anticipated and a telephone check of nonrespondents was not feasible (many anglers listed business or post office box addresses), we assumed survey results were subject to nonresponse bias and implemented weighting procedures to reduce the effect of nonresponse. Anglers within a tournament are likely homogeneous with respect to the population, so tournament means ( $\bar{x}_j$ ) should be relatively unaffected by nonresponse bias. As the population proportion of billfish tournament anglers was known for each tournament ( $N_j/N$ ) and respondent means within each tournament were assumed unbiased, population estimates ( $\bar{x}$ ) were calculated using poststratified means (Little and Rubin, 1987), where:

$$\bar{x} = N^{-1} \sum_j N_j \bar{x}_j$$

Table 2. Total number and percent response of billfish anglers.

State or Country	Number Mailed	Number Non-Deliverable	Number Returned	Percent Response
Puerto Rico	885	135	347	46.3
NON-RESIDENTS				
Arkansas	1	1	0	--
Bahamas	3	0	2	66.7
Bermuda	2	0	2	100.0
California	8	0	8	100.0
Colombia	3	0	1	33.3
Colorado	1	1	0	--
Connecticut	2	1	1	100.0
Costa Rica	3	0	3	100.0
Dominican Rep.	3	5	5	826.7
Florida	39	3	26	72.2
Georgia	3	1	1	50.0
Gran Canaria	2	0	1	50.0
Guatemala	4	0	3	75.0
Hawaii	1	0	0	0.0
Holland	1	0	0	0.0
Illinois	3	0	1	33.3
Indiana	1	0	1	100.0
Ivory Coast	2	0	2	100.0
Massachusetts	2	0	1	50.0
Mexico	7	0	4	57.1
New Hampshire	1	0	1	100.0
New York	1	0	1	100.0
Netherland Antilles	3	0	3	100.0
North Carolina	1	1	0	--
Ontario, Canada	1	0	1	100.0
Pennsylvania	3	0	3	100.0
Republic of Panama	1	0	0	0.0
South Africa	3	3	0	--
South Carolina	3	0	3	100.0
Spain	2	0	2	100.0
Texas	2	0	2	100.0
U.S. Virgin Islands	12	2	8	80.0
Virginia	1	0	1	100.0
Total	1044	153	437	49.0

**Proceedings of the 46th Gulf and Caribbean Fisheries Institute**

**Table 3.** Trip related expenditures for resident and non-resident billfish anglers.

Expenditure category	Resident		Non-Resident	
	Percent who purchased each item	Average expense to individuals who purchased each item <sup>a</sup>	Percent who purchased each item	Average expense to individuals who purchased each item <sup>a</sup>
Automobile	73.0	\$22.52 + 0.50	39.7	\$156.22 + 8.06
Other Trans.	5.2	276.34 + 9.93	69.8	544.79 + 60.59
Boat Rental	2.9	890.33 + 31.80	24.4	1,332.50 + -b
Boat operation	75.8	319.67 + 12.72	20.2	740.30 + 35.91
Boat launch fees	6.6	141.99 + 23.74	8.3	414.03 + 28.40
Entrance fees	36.7	223.09 + 4.44	58.8	1,083.57 + 81.63
Lodging	13.3	299.83 + 8.73	65.0	789.16 + 42.22
Food,drinks,ice	83.7	96.98 + 2.08	69.2	360.25 + 21.20
Bait, tackle	73.5	71.30 + 1.83	39.7	381.62 + 46.64
Captain/charter	22.1	305.71 + 22.31	19.9	833.59 + 40.75
Other Expenses	7.6	15.89 + 0.90	11.4	207.35 + 44.21
<b>Total</b>	<b>98.8</b>	<b>710.87 + 19.67</b>	<b>100.0</b>	<b>3,945.26 + 143.24</b>

<sup>a</sup> Values are means + standard error. Average category expenses are not additive because of different numbers of individuals purchased items in each category.

<sup>b</sup> Due to weighting procedures, standard error calculations were not possible

**Table 4.** Logistic regression model of willingness to pay for an increase in billfish trip expenses.

Variable description	Parameter estimate and standard error	Chi-square value	Prob.> chi-square
Intercept	1.2808 (0.6369)	4.04	0.0443
Bid Value	-0.0012 (0.0005)	6.60	0.0102
Total \$/trip	0.0003 (0.0001)	11.23	0.0008
Years in school	-0.0999 (0.0353)	8.01	0.0047
Income	0.1640 (0.0258)	40.47	0.0001
Age	-0.0164 (0.0086)	3.65	0.0561
N	434		
Consumer's surplus	\$545 <sup>a</sup>		

<sup>a</sup> Calculated by \$955.01/trip, 40.33/age, 15.94/years in school, income/\$70,000-79,999

## RESULTS

From tournament entries, we estimate there were 1,475 adult Puerto Rican residents who fished in one or more billfish tournaments identified by the Association de Pesca Deportiva de Puerto Rico. An additional 154 non-residents traveled to Puerto Rico from the U.S. mainland and other countries to participate in these tournaments. Table 2 lists the distribution of anglers by state or country of residence and their respective response rates.

### **Expenditures**

On their most recent trip for billfish in Puerto Rico, anglers reported an average total expenditure of \$955. There were substantial differences between residents and non-residents. Resident anglers' average trip expenditure was \$711, while non-residents spent \$3,945 on their most recent trip specifically targeting billfish. Residents reported they spent about two days fishing on the trip described, while non-residents spent an average of slightly less than four days fishing on the trip. When expenditures were divided by the number of days spent fishing, resident anglers averaged \$374/day while non-residents spent \$1,052/day.

Trip expenditures for resident and non-resident anglers are shown in Table 3. The proportion of individuals who reported purchases in each item category varied considerably between resident and non-resident anglers. The average amount spent in each category was higher for non-resident anglers.

### **Consumer's Surplus**

Due to the small number of non-resident anglers, and the fact that the CVM bids were accepted by over 84% of non-residents, we were unable to fit a significant model to calculate their consumer's surplus. Therefore, resident and non-resident anglers were grouped together in calculating consumer's surplus. The consumer's surplus for billfish trips was estimated to be \$545/trip (Table 4). When multiplied by the average number of billfish trips in Puerto Rico/year (20.44) we derive an annual consumer's surplus of \$11,135. The total population of 1,629 anglers received an annual economic benefit of \$18,138,926 above what they paid to go billfish fishing. Given the high rate of bid acceptance by non-resident anglers, we can assume their consumer's surplus was higher than the \$545 calculated for the overall sample. Therefore, \$18 million should be considered a conservative measure of economic benefit.

In calculating the economic value and impact of billfish fishing, we assumed trip-related expenditures were made in Puerto Rico. Combine consumer's surplus with total resident and nonresident expenditures of \$21,320,579 and \$4,459,270, respectively, and the economic value of the billfish fishery in Puerto Rico is estimated to be \$43,918,775.

### **Economic Impact**

Due to the economic dependance of Puerto Rico on the United States, there is rapid leakage of money from Puerto Rico back to the United States. This



dependence is due, in part, to widespread public entitlements from the U.S. mainland. Additionally, employed Puerto Rican residents work primarily for U.S. companies on imported raw materials with imported machines to produce products for export. The people then use their incomes to buy products which are primarily imported from the U.S. (Weisskoff, 1985). As a result, the economic multiplier estimated for the tourism industry in Puerto Rico is just 1.07 (Junta de Planificacion de Puerto Rico, 1992). In other words, every dollar of expenditures in Puerto Rico by non-resident tourists, in this case anglers, results in just \$1.07 in economic impact before the money leaves Puerto Rico. When an angler spends money on goods and services in Puerto Rico, the receiver of this money almost immediately purchases an imported good or service with it. Even so, the \$4,459,270 in expenditures by non-resident anglers on billfish trips in Puerto Rico has an economic impact of \$4,771,419 on the economy of Puerto Rico.

Using estimates from the tourism sector, each \$1 million in non-resident (new money) expenditures translates to 42 jobs in Puerto Rico (*Junta de Planificacion de Puerto Rico*, 1992). From this, we estimate that overall billfish tournament activity in Puerto Rico results in over 200 jobs for Puerto Rican citizens. Due to the temporary and seasonal nature of fishing, especially tournament fishing, some of the job benefits associated with billfish fishing do not result in full-time employment.

#### **Billfish Fishing Trips Outside of Puerto Rico**

Some resident billfish anglers (29%) pursued billfish outside of Puerto Rico during the twelve months preceding the survey. Of the 1,475 resident anglers, we estimate 423 fished for billfish outside of Puerto Rico during the previous twelve months. They averaged 6.7 days of billfish fishing outside Puerto Rico, with the most frequent destinations (in order of frequency) being: Costa Rica, the U.S. Virgin Islands, and Panama. Fourteen other destinations were listed by at least one angler. This amounts to 2,847 angler days of billfish fishing spent by Puerto Rican residents in other areas. Assuming their expenditures for billfish fishing in other countries are similar or greater to those spent on billfish at home, at least \$1 million was spent by resident anglers in pursuit of billfish outside of Puerto Rico.

Most non-residents (93%) fished for billfish in areas other than Puerto Rico. They averaged 17.3 days of billfish fishing outside Puerto Rico, with the most frequently listed destinations (in order of frequency) being: Mexico, Costa Rica, U.S. mainland, and the U.S. Virgin Islands. Non-resident anglers also listed an additional seventeen less frequently visited destinations. Again, assuming expenditures in other locations are similar to those in Puerto Rico, these anglers represent another 2,472 angler days, and therefore \$2.6 million, spent on billfish fishing outside Puerto Rico.

The total \$3.5 million spent by resident and non-resident billfish anglers fishing in the U.S. Atlantic and Caribbean region (but outside of Puerto Rico) can be viewed as money that was potentially available (or lost) to the Puerto Rican economy. If anglers received all the benefits from billfish fishing they desired from the opportunities available to them in Puerto Rico, some of this \$3.5 million, and the associated employment opportunities, might have impacted the Puerto Rican economy.

The results of this study provide the basis for promulgation of a sportfishing-related economic development strategy for Puerto Rico. Four factors influence the amount of impact sport fishing will have on an area: the number of anglers, where anglers come from, how many others they bring with them, and the length of their stay (Ditton and Loomis, 1987). While, more anglers will result in greater total expenditures, the number of anglers who are non-residents of the area determine the amount of new economic activity to the area. Increased marketing of the billfish fishing opportunities in Puerto Rico could draw more anglers from outside the commonwealth. The third factor affecting the impact of fishing is the number of additional people accompanying the angler (non-participants). Although this study made no effort to investigate the expenditures of non-participants, they have economic consequences. Finally, the longer participants stay in the area, the greater their expenditures. In this study, we found non-resident anglers fished more days (four vs. two days) on trips that lasted longer (six vs. three days) than resident anglers. Increasing the frequency of billfish tournaments and promoting tourist opportunities that encourage longer, repeat visits could increase the economic impact of billfish anglers in Puerto Rico.

### CONCLUSION

In 1986 there were 204,215 pounds of marlin landed from the U.S. Atlantic and sold at an ex-vessel price of \$134,716. In 1985 Puerto Rican anglers landed just over 11,000 pounds of billfish that were sold at an ex-vessel price of \$16,294 (SAFMC, 1988). The 1985 wholesale price for marlin in the U.S. was about \$1.50 per pound. While the ex-vessel price of billfish does not adequately reflect the total value of fish caught by commercial fishermen (Edwards, 1991), the results of this study suggests the value of a billfish to the recreational fishery is likely many times its value to the commercial market. This would appear to provide support for why the fishery was reserved for recreational anglers in U.S. waters.

The results of this study describe the economic benefit of continuing allocation of the billfish resource to the recreational fishery. By comparing the values of billfish caught today by recreational and those previously caught by commercial fishermen, it does not appear as if any increase in cumulative economic value would be generated by allocating a portion of the catch to the

commercial industry (Edwards, 1991). Increased enforcement of existing regulations, educational programs which encourage catch and release among anglers, and live release of billfish bycatch by commercial fishermen might further increase billfish populations and thus the economic benefits currently enjoyed. Uncertainty about the status of fish stocks and the tremendous economic value of the recreational billfish fishery would seem to indicate the need for, and further, provide incentive for billfish management.

With appropriate management, billfish can provide substantial economic benefits to the Gulf and Caribbean region. Many countries in the Gulf and Caribbean region have substantial populations of billfish, and many have established recreational fisheries for them (*e.g.*, De Sylva, 1974; Prince, *et al.*, 1990). Using Puerto Rico as an example, it can be estimated that any of these countries could (and likely do) see tremendous economic returns from increased billfish populations. The high economic value of the billfish fishery is coupled with the fact that it is primarily a catch and release fishery. Billfish anglers release between 36% (Figley, 1984) and 89% (Fisher and Ditton, 1992) of their catch. The same fish that was responsible for generating thousands of dollars in expenditures can be pursued, caught, and released by numerous anglers during its lifetime. The key to maintaining this economic yield is successful management.

If anglers feel they have a reasonably good probability of catching fish, they will continue to fish (and make expenditures). However, for highly migratory species, like billfish, it is difficult for one country to have much impact on maintaining populations. Even an area the size of the U.S. Exclusive Economic Zone (EEZ) will have only a small portion of the population of some billfish species at any given time. The result is a substantial portion, if not most, of the population could be subject to commercial harvest despite the U.S. ban on the sale of billfish. Billfish available to all recreational anglers in the region are subject to overfishing by commercial fleets, external to the U.S. EEZ; this can only be resolved through international management. If domestic and foreign commercial anglers are allowed to deplete billfish through directed harvest or bycatch to a level where recreational anglers no longer feel they have a reasonable probability of catching a billfish, the economic benefits documented in this study can be jeopardized. However, to realize and/or maintain these benefits, all countries within the region, if not the entire migratory range of billfish, must initiate cooperative international billfish management efforts.

#### **ACKNOWLEDGMENTS**

This study was sponsored by the Billfish Foundation in cooperation with the Sport Fishing Association of Puerto Rico, the Club Nautico de San Juan International Billfish Tournament, and the University of Puerto Rico Sea Grant College Program. This project could not have been completed without the

assistance of several individuals in Puerto Rico: Laura Cotte, Michael Pauley, Henry Rexach, Jr., Mickey Tirado, Luis Valldejuli, Ralph "Agie" Vicente, and Bill Wood. We also wish to thank Dr. Mark Fisher for his assistance with data analysis and Robin Reichers for his review of this manuscript. We are appreciative of the administrative support provided by John Spence and all of his staff members at The Billfish Foundation. Finally, we thank all of the billfish anglers who responded to our mail questionnaire.

#### LITERATURE CITED

- Agresti, A., 1990. *Categorical Data Analysis*. John Wiley And Sons, N.y. 558 Pp.
- Davidson, L.S. and W.A. Schaffer. 1980. A Discussion Of Methods Employed In Analyzing The Impact Of Short-term Entertainment Events. *J. Travel Res.* Winter, 1980: 12-16.
- De Sylva, D.p. 1974. A Review Of The World Sport Fishery For Billfishes (Isiophoridae and Xiphiidae) in Shomura, R.S. And F. Williams, (eds.). *Proc. Inter. Billfish Symp. Kailua-kona, Hi. Part 2. Review And Contributed Papers*. NOAA Tech. Report NMFS SSRF-675.
- Devaney III, J.W., G. Ashe, and B. Parkhurst. 1976. *Parable Beach: A Primer In Coastal Zone Economics*. Mit Press. Cambridge, MA. 99 p.
- Dillman, D.a. 1978. Mail And Telephone Surveys: *The Total Design Method*. John Wiley And Sons N.Y., 325 p.
- Ditton, R.B. And M.R. Fisher. 1990. *Characteristics, behavior, attitudes, expenditures, harvest and management preferences of billfish tournament anglers*. Report for the Billfish Foundation, Miami, FL. 43 p.
- Ditton, R.B. and D.K. Loomis. 1987. *1985 Hall of Fame Fishing Tournament: An analysis of participants' characteristics, attitudes and expenditures*. Texas A&M University Sea Grant College Program. TAMU-SG-88-201. 58 pp.
- Edwards, S.F. 1991. A critique of three "economics" arguments commonly used to influence fishery allocations. *N. American J. Fish. Manage.* 11 (2):121-130.
- Fedler, A.J. and R.B. Ditton. 1990. A social and economic research agenda in support of billfish conservation. pp 263-268 in Stroud, R.H., (ed.). *Planning the future of billfishes: Research and Management in the 90s and beyond. Part 2. Contributed papers. Proc. Second Int. Billfish Symp. Kailua-Kona, HI.*. Natl. Coalition Mar. Conserv. Inc., Savannah, GA.
- Figley, W. 1984. *Survey of recreational tuna and marlin fishing in the mid-Atlantic, 1983*. Report to Billfish Inter-Council Steering Committee, Tampa, FL. 8 pp.
- Fisher, M.R. and R.B. Ditton. 1992. Characteristics of billfish anglers in the U.S. Atlantic ocean. *Marine Fisheries Review*. 54(1):1-6.
- Huppert, D.D. 1983. NMFS guidelines on economic valuation of marine recreational fishing. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-SWFC-32, 35 pp.
- Junta de Planificacion de Puerto Rico. 1992. *Informe economico al gobernador. Estado Libre Asociado de Puerto Rico. Oficina del Gobernador*. 19 p

- Little, R.J.A. and D.B. Rubin. 1987. *Statistical analysis with missing data*. John Wiley and Sons, N.Y. 278 pp.
- Milon, J.W. and E. Thunberg. 1993. *A regional analysis of current and future Florida resident participation in marine recreational fishing*. Sea Grant Report No. 112. Florida Sea Grant College Program. Gainesville, FL. 78 pp.
- Prince, E.D., A.R. Bertolino, and A.M. Lopez. 1990. A comparison of fishing success and average weights of blue marlin and white marlin landed by the recreational fishery in the western Atlantic Ocean, Gulf of Mexico, and Caribbean Sea, 1972-1986. pp 159- 178. In Stroud, R.H., (ed.). *Planning the future of billfishes: Research and Management in the 90s and beyond. Part 1. Fishery and stock synopses, data needs and management. Proc. Second Int. Billfish Symp. Kailua-Kona, HI*. Natl. Coalition Mar. Conserv. Inc., Savannah, GA.
- Rockland, D.B. 1985. The economic benefits of a fishery resource: A practical guide. SFI Economics Program. Tech. Report I. Sport Fishing Institute. Washington, D.C. 10 pp.
- Rockland, D.B. 1989. Socio-economic information needs. pp 255-262. In Stroud, R.H., (ed.). *Planning the future of billfishes: Research and Management in the 90s and beyond. Part 1. Fishery and stock synopses, data needs and management. Proc. Second Int. Billfish Symp. Kailua-Kona, HI*. Natl. Coalition Mar. Conserv. Inc., Savannah, GA.
- SAFMC (South Atlantic Fishery Management Council). 1988. Fishery management plan, final environmental impact statement, regulatory impact review, and initial regulatory flexibility analysis for the Atlantic billfishes. Southpark Circle, Charleston, S.C. 29414-6446. 72pp.
- Weisskoff, R. 1985. *Factories and food stamps: The Puerto Rico model of development*. John Hopkins University Press. Baltimore MD. 190 pp.