

Characteristics of Billfish Anglers in the U.S. Atlantic Ocean

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Introduction

A mail survey of U.S. billfish tournament anglers in the western Atlantic Ocean (from Maine to Texas, including Puerto Rico and the U.S. Virgin Islands) was completed to provide a social and economic profile of this group of anglers and to examine their fishing activity, attitudes, trip expenditures, consumer's surplus, catch, and management preferences. The research

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ABSTRACT—A mail survey of 1,984 U.S. billfish tournament anglers was completed to examine their fishing activity, attitudes, trip expenditures, consumer's surplus, catch levels, and management preferences. A sample of 1,984 anglers was drawn from billfish tournaments in the western Atlantic Ocean (from Maine to Texas, including Puerto Rico and the U.S. Virgin Islands) during 1989. A response rate of 61% was obtained (excluding nondeliverables). Anglers averaged 13 billfish trips per year, catching a billfish 40% of the time while 89% of billfish caught were released with <1 billfish per year per angler retained. Catch and retention rates varied by region. Expenditures averaged \$1,600 per trip, but varied by region. The annual consumer's surplus was \$262 per angler, but increased to \$448 per angler if billfish populations were to increase. An estimated 7,915 tournament anglers in the U.S. western Atlantic spent \$179,425,000 in pursuit of billfish in 1989. Anglers opposed management options that would diminish their ability to catch a billfish, but supported options limiting the number of billfish landed.

was initiated in response to social and economic research needs identified in the Atlantic Fishery Management Plan (FMP) for Billfish¹. Also, better social and economic information was expected to expand constituency support for billfish conservation. Although the number of billfish anglers may be small, their economic effect may be disproportionately high due to greater expenditures per angler per day with a significant impact on local and regional economies. Without adequate conservation measures for billfish, these benefits could be reduced or lost.

Before August 1988, there was no approved FMP for Atlantic billfishes, although the five Atlantic Fishery Management Councils implemented a Preliminary Management Plan² in March 1978 and proposed several draft FMP's from 1976 to 1988. These early plans espoused the idea that billfish were best reserved for recreational purposes because of their historical and traditional use by anglers, the anglers' custom of releasing a large percentage of their catch, and the economic value of the recreational fishery.

By setting minimum length requirements and prohibiting the sale of billfishes, the FMP (50 C.F.R. 644) seeks to conserve 4 species: Sailfish, *Istiophorus platypterus* (57 inches lower jaw fork length); blue marlin, *Makaira nigricans* (86 inches lower

jaw fork length); white marlin, *Tetrapturus albidus* (62 inches lower jaw fork length); and longbill spearfish, *Tetrapturus pfluegeri* (no minimum length). Also, there is a prohibition on the possession of these species by longline and driftnet vessels in the Federal fisheries jurisdiction (EEZ). The five councils that approved the FMP sought to prevent a domestic market for billfish with a "no sale" provision. They recognized a directed commercial fishery could result in a substantial harvest if there was an incentive to catch billfish¹. Also, the prohibition of the sale of incidentally caught billfish set a precedent because it reserved billfish for the recreational fishery.

The billfish FMP¹ was heavily predicated on social and economic considerations³. Typically, the optimum yield of a fishery (OY) is defined as ". . . that amount of fish which will provide the greatest overall benefit to the Nation, with particular reference to food production and recreational opportunities; and which is prescribed as such on the basis of the maximum sustainable yield from such fishery, as modified by any relevant economic, social, or ecological factor" (16 U.S.C. 1802). Because of limited biological data, MSY for billfish could not be determined. Optimum yield, however, does not have to be expressed numerically when MSY is unreliable or inestimable (50 C.F.R. 602.11). Therefore, the councils defined OY as "the greatest number of billfish that can be caught by the recreational fishery in the EEZ"¹.

¹Fishery management plan, final environmental impact statement, regulatory impact review, and initial regulatory flexibility analysis for Atlantic billfishes. 1988. S. Atl. Fish. Manage. Council, Southpark Bldg., Suite 306, 1 Southpark Circle, Charleston, SC 29407

²Preliminary management plan for Atlantic billfishes and sharks. 1978. S. Atl. Fish. Manage. Council, Southpark Bldg., Suite 306, 1 Southpark Circle, Charleston, SC 29407.

³Source document for the fishery management plan for the Atlantic billfishes. 1988. S. Atl. Fish. Manage. Council, Southpark Bldg., Suite 306, 1 Southpark Circle, Charleston, SC 29407.

The rationale of the FMP was to optimize the social and economic benefits to the nation by reserving the resource for the traditional recreational fishery.

Little quantitative data was included in the FMP regarding social and economic benefits of the recreational billfish fishery for several reasons. First, since billfish anglers account for a small part of the total population of saltwater anglers, state and Federal fishery surveys did not intercept many billfish anglers (Fedler and Ditton, 1988). Consequently, total billfish participants, trips, expenditures, and harvest were difficult to estimate accurately. Second, because irregularly implemented surveys have been used to gather information on this "rare event" fishery, results were either not applicable over the entire range of the fishery (Figley, 1984; Freeman, 1985; Brown and Ofiera, 1987) or were outdated (Hamm and Slater, 1979).

The economic value of the recreational billfish fishery was not adequately discussed in the FMP. Expenditures, which are the usual measure of the value of a recreational fishing trip and are essential to understand local economic impacts, are not a valid measure of the trip's true economic worth. Expenditures do not represent an addition to the welfare of the nation because they would probably be spent for something else if not for billfish (Huppert, 1983). Furthermore, a fishing trip has much greater value than the costs associated with getting to, using, and returning from the resource. Testing one's skills, experiencing adventure, relaxing, camaraderie with friends and family are some of the other components of a fishing trip which are also of value to an angler. Estimating the value of these benefits (consumer's surplus) can be ascertained using contingent valuation methods (CVM) which measure willingness to pay in excess of trip expenditures (Huppert, 1983). Consumer's surplus is an important concept because it represents an increase in the welfare of the nation as a result of the opportunity to fish for billfish.

In light of the limited social and economic information contained in the Billfish FMP, this paper has three objec-

tives: 1) To profile the population of billfish tournament anglers according to their social and economic characteristics and to examine their fishing activity, attitudes, trip expenditures, consumer's surplus, catch levels, and management preferences; 2) to estimate the anglers' total catch, trip expenditures, and consumer's surplus in the study area; and 3) to discuss the implications of angler attitudes regarding present and future billfish management measures.

Methods

A survey of billfish anglers is difficult because the population of billfish anglers is not readily identifiable. No special license exists that can provide a list of billfish anglers. Therefore, we sampled from a list of U.S. anglers who had participated in billfish tournaments during 1989. This proxy group was identifiable and provided a cost-effective means of obtaining information from billfish anglers.

We completed an inventory of 359 billfish tournaments held during 1989 in the study area (Maine to Texas, including Puerto Rico and U.S. Virgin Islands). Tournaments were located in every coastal Atlantic or Gulf state except Connecticut, Mississippi, and New Hampshire. Tournaments in the Bahamas with a U.S. mailing address or telephone number were included with the assumption most entrants were U.S. citizens.

A sampling goal of 2,000 billfish anglers was based solely on cost considerations since population size and variance were unknown. A sample size of 380 was considered sufficient to represent a large population (Krejcie and Morgan, 1970), but a larger sample was required to test for group differences.

Twenty-seven tournaments could provide a total sample of 2,000 if each tournament provided names and addresses of 75 billfish anglers. Tournaments were sorted in chronological order and a random sample of 27 was selected. Tournament directors were contacted in August 1989 to explain the purpose of the survey and to solicit their cooperation. Those who refused to participate were replaced with another randomly selected tournament.

A total of 1,984 billfish anglers was selected. Officials from selected tournaments were asked to provide a list of participants. A systematic sample of 75 was selected from tournaments with >75 participants while all were selected from smaller tournaments (≤ 75 participants). Only those anglers listing a U.S. address were considered for sampling.

A 10-page questionnaire was developed to collect information from anglers. First, anglers were asked about their fishing experience: Number of years fishing, number of years fishing for billfish, number of days in the previous 12 months by setting, and an evaluation of their fishing ability compared with other anglers. Second, they were asked to identify their top three target species and to indicate whether any one species commanded most of their effort. Third, anglers were asked to evaluate several management options and if implementation would cause them to stop fishing for billfish. Anglers were also asked if they were familiar with the new minimum size limits and if their fishing was affected. Fourth, we asked anglers a series of questions to identify characteristics of a typical trip and their most recent billfish tournament (effort, species targeted, and catch/retention rates). Fifth, anglers were asked to report how much they spent for each of 11 expense items on their most recent billfishing trip.

We used two closed-ended contingent valuation (CVM) questions to ascertain the amount anglers were willing to pay for a billfish stamp at current billfish population levels, and at a 25% increase in the billfish population. Each angler was presented noniteratively with a random offer from a preselected range of eight bid values from \$25 to \$200. Consumer's surplus was evaluated using logistic regression. Logistic regression is appropriate when the dependent variable is a binary indicator variable (e.g., "yes" or "no"), and can be used to determine the threshold level of an angler's willingness-to-pay (Agresti, 1990).

Using data provided by the angler sample, we estimated the total number of tournament billfish anglers in the study area. From this, we estimated to-

tal annual expenditures, consumer's surplus, and billfish catch and landings by extrapolation of sample results.

A total of 1,171 individuals responded to the mail survey for an overall response rate of 61.4% (when nondeliverables were excluded). Mailings were initiated on 27 October 1989 following the procedures of Dillman (1978). Since some tournaments in the sample had not taken place or provided their list of participants, questionnaires were mailed on 27 October to a partial sample of 966 billfish anglers to minimize their recall time. A reminder postcard was mailed on 3 November, with second and third mailings on 20 November and 9 January, respectively. Surveys were mailed to the remaining 1,018 anglers on 19 February 1990, following the same procedures and time sequence.

A telephone survey of nonrespondents was completed to identify characteristics of nonrespondents for comparison with respondents. This was done to test the assumption that the two groups were alike for making projections of harvest and expenditures (Bethlehem and Kersten, 1985). Questions were used regarding years of saltwater fishing experience, species preference, years of billfishing experience, and annual frequency of participation. Telephone calling resulted in 77 completed surveys from a sample of 190 nonrespondents. Using the Mann-Whitney U or chi-square test, as appropriate, we found no significant differences between respondents and nonrespondents at the 0.05 level of significance. Therefore, our use of respondents' expenditure and harvest level data for nonrespondents in making projections was validated.

Results

Angler Characteristics

Thirty-six states (including Puerto Rico, the U.S. Virgin Islands, and the District of Columbia) were represented in the sample of billfish tournament anglers. Over 93% resided in coastal states or jurisdictions. Most (58%) anglers reported fishing 21 years (\bar{X} =26 years). When compared with age dis-

tribution data, a lifetime commitment to saltwater fishing is suggested. Most (52%) reported fishing for billfish \geq 11 years (\bar{X} =14 years). When compared with the mean for saltwater fishing, it can be argued most began fishing for billfish after several years of saltwater experience. Most (70%) reported they did not fish in freshwater or from the shore in saltwater during the previous 12 months. In contrast, 83% reported they fished at least 14 days in saltwater from a boat (\bar{X} =39 days). In total, the sample of anglers spent an average of 44 days fishing in the previous 12 months. About 37% rated themselves as "more skilled" than other anglers. Almost 93% rated themselves as "equally or more skilled" with the remainder "less skilled."

Species Preferences

Species from the billfish family (Istiophoridae) were most preferred (first choice) by 71% of the respondents. Blue marlin was the most preferred single species (39%). Also, istiophorids were most preferred as a second and third choice by 46% and 28% of the respondents, respectively. White marlin was the second-most preferred single species (17%) followed by sailfish (15%). Over 90% of the respondents listed pelagic species only, and 62% reported they devoted most of their effort to one species. Of this group, istiophorids were targeted by

73% with blue marlin the most sought single species (29%).

Angler Opinions on Fisheries Management Options

Most billfish anglers were opposed to reducing the minimum sizes for billfish in the FMP, no minimum sizes for tournament-caught fish, no minimum sizes for fish to be mounted by a taxidermist, banning double hooks, allowing handlining or harpooning for recreational purposes, banning "live baiting," a one billfish per boat per day bag limit, and area closures for the fishery (Table 1). Most supported larger minimum sizes for billfish, larger minimum sizes for tournament-caught fish, mandatory "no kill" tournaments, a one billfish per angler per day bag limit, a zero bag limit, and a billfish stamp. Anglers were evenly divided over banning stainless steel hooks and seasonal closures for the fishery.

Several alternate billfish regulations were so unfavorable to some anglers they reported they would stop fishing if they were implemented. Area closures would cause the greatest exit from the fishery (12% of respondents), followed by seasonal closures (11%), a billfish stamp (10%), zero bag limit (10%), one billfish per boat per day bag limit (10%), and allowing harpooning and handlining for recreational purposes (8%). The strength of opposition to these regulations (except har-

Table 1.—Distribution of billfish anglers by the extent they support/oppose management options for billfish; ranked by mean score.

| Management option | Percent by category ¹ | | | | | Mean | n |
|---|----------------------------------|-------|-------|-------|-------|------|-------|
| | 1 | 2 | 3 | 4 | 5 | | |
| Increased minimum sizes for tournaments | 7.8% | 12.1% | 18.8% | 29.2% | 32.1% | 3.66 | 1,060 |
| Increased minimum sizes | 6.2 | 13.6 | 20.1 | 29.8 | 30.2 | 3.64 | 1,072 |
| Zero bag limit | 11.0 | 14.7 | 16.3 | 24.1 | 33.8 | 3.56 | 1,077 |
| Mandatory "no kill" tournaments | 9.3 | 17.0 | 19.7 | 21.3 | 32.8 | 3.51 | 1,077 |
| 1 billfish/angler/day | 15.9 | 15.0 | 14.1 | 27.4 | 27.6 | 3.36 | 1,065 |
| Billfish stamp | 14.4 | 11.0 | 25.8 | 28.7 | 20.1 | 3.29 | 1,080 |
| No stainless steel hooks | 15.5 | 18.7 | 27.7 | 18.8 | 19.4 | 3.08 | 1,074 |
| Seasonal closures | 21.0 | 20.5 | 21.5 | 21.3 | 15.7 | 2.90 | 1,066 |
| Area closures | 21.7 | 21.0 | 24.3 | 19.8 | 13.2 | 2.82 | 1,058 |
| 1 billfish/boat/day | 23.1 | 26.8 | 18.8 | 14.0 | 17.3 | 2.76 | 1,058 |
| No "live baiting" | 19.7 | 28.4 | 29.2 | 11.4 | 11.2 | 2.66 | 1,069 |
| No double hooks | 24.0 | 29.7 | 29.9 | 8.2 | 8.2 | 2.47 | 1,073 |
| No min. sizes for taxidermy mounts | 44.7 | 23.8 | 15.0 | 9.5 | 7.0 | 2.10 | 1,049 |
| No min. sizes for nontournament fish | 48.3 | 29.6 | 14.0 | 5.1 | 3.1 | 1.85 | 1,042 |
| Decreased minimum sizes | 47.9 | 28.4 | 17.9 | 2.5 | 3.3 | 1.85 | 1,050 |
| Handling/harpooning for recreation | 62.4 | 23.4 | 8.4 | 2.0 | 3.8 | 1.61 | 1,049 |

¹1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly agree

pooning and handlining) is not reflected in Table 1. Anglers who reported they would stop fishing were evenly distributed in the study area; opposition was not concentrated in any one region.

Most anglers (81%) reported the minimum size limits implemented in 1989 had no effect on their billfishing activity. Of the 9% reporting they were unfamiliar with the size limits, 46% were from states north of Virginia and 37% from Florida. Finally, most (77%) respondents reported a limit of one billfish per boat per day would have no effect on their fishing behavior, while 23% reported there would be a negative effect if implemented.

Typical Billfish Fishing Trips

Anglers reported an average of 13 billfish trips per year. With each trip lasting about 2.7 days, this resulted in an average of 35 days per year. Each day averaged 8.0 hours of fishing. Effort required to catch a billfish was 6.3 days. Almost 300 respondents (26%) reported they did not catch a billfish in the previous 12 months. These anglers probably did not invest enough time to be successful, as 22% of the respondents made <3 trips in the previous 12 months. On average, each angler landed <1 (0.7) billfish per year, or 1 billfish every 1.4 years. This should be viewed with caution, however, as 71% reported they did not keep any billfish in the past 12 months. Thus, 29% of the billfish angler population accounted for 100% of the fishing mortality.

Trip characteristics (trips per year, trips to catch a billfish, and billfish re-

tained) varied by region (Table 2). The average number of billfish trips per year varied from 8.7 for Gulf of Mexico anglers to 17.3 for Caribbean anglers. Accordingly, the average number of successful trips (trips with billfish caught) varied from 2.4 for Gulf anglers and 7.0 for Caribbean anglers. The success rate was lowest for Gulf anglers (28%) and highest for Mid-Atlantic anglers (46%). The retention rate varied from a mean of 0.35 billfish per angler per year in the Mid-Atlantic to 2.87 in the Caribbean.

Most Recent Billfish Tournament

Anglers reported fishing an average of 2.7 days during their last tournament with an average of 8.3 hours of fishing per day. Blue marlin was the most commonly targeted billfish species (74%), followed by white marlin (49%) and sailfish (43%). While 73% of the respondents did not catch a blue marlin during the most recent tournament, the other 27% (307 anglers) caught a total of 607. Of these, 490 blue marlin were released (81%) with the remainder (117) landed. Similarly, 79% and 82% of the respondents did not catch a white marlin or sailfish, respectively. Nevertheless, 522 white marlin and 687 sailfish were caught. Almost all white marlin and sailfish were released, with only 48 (9%) and 29 (4%), respectively, landed. Two of five spearfish caught were released. In all, 1,129 anglers caught 1,821 billfish but landed only 11% during their most recent tournaments. Of the 1,625 billfish reported as released, 69% were tagged.

Results from Table 2 and Table 3 showed Mid-Atlantic anglers were most successful and released the most billfish. Gulf of Mexico anglers made the fewest trips per year and were the least successful. Caribbean anglers made the most trips per year and landed the most billfish. It would be unwise to provide an estimate for New England based on the results of only 17 respondents, but trip characteristics were comparable to the other Atlantic regions.

Catch and retention rates varied by region (Table 3). Mid-Atlantic anglers caught the most billfish per angler and had the highest release rate per angler. Gulf of Mexico anglers caught the fewest billfish per angler, and Caribbean anglers had the lowest release rate per angler.

Expenditures of Billfish Anglers

On their most recent fishing trip for billfish, respondents reported an average expenditure of \$1,601 (excluding tournament fees) (Table 4). The trip averaged 2.59 days in length, with an average expenditure of \$618 per day. Boat operation costs (fuel, fresh water, etc.) on billfish trips were highest, and food, drinks, and ice costs were incurred most frequently. The average amount spent annually on billfish tournament fees was \$1,856, or \$546 per tournament. Since the average number of days spent per tournament (2.66 days) was comparable to the mean number of days on their most recent trip (2.59), total expenditures per angler per tournament was estimated at \$1,601 + \$546 = \$2,147.

Table 2.—Regional billfishing trip characteristics in the western U.S. Atlantic Ocean.

| Region ¹ | n ² | Trips per year per angler | Successful trips per year per angler ³ | Success rate (%) | Billfish landed per year per angler |
|---------------------|------------------|---------------------------|---|------------------|-------------------------------------|
| Caribbean | 100 ⁴ | 17.3 | 6.98 | 40 | 2.87 |
| Gulf | 326 | 8.7 | 2.44 | 28 | 0.44 |
| Mid-Atlantic | 318 | 13.0 | 5.98 | 46 | 0.35 |
| South Atlantic | 343 | 16.5 | 6.72 | 41 | 0.66 |
| Total ⁵ | 1,129 | 13.1 | 5.21 | 40 | 0.68 |

¹Only 17 respondents were from New England and are not reported.

²Only respondents from coastal states (including Pennsylvania) were distributed by regions.

³Trips with billfish caught.

⁴95 respondents were from Puerto Rico.

⁵Includes New England and noncoastal respondents.

Table 3.—Catch and retention rate from most recent tournament by region.

| Region | n | Total billfish caught | Total billfish landed | Percent release | Catch per angler | Billfish landed per angler |
|--------------------|-------|-----------------------|-----------------------|-----------------|------------------|----------------------------|
| Caribbean | 100 | 184 | 48 | 74 | 1.84 | 0.48 |
| Gulf | 326 | 270 | 50 | 81 | 0.83 | 0.15 |
| Mid-Atlantic | 318 | 687 | 34 | 95 | 2.16 | 0.11 |
| South Atlantic | 343 | 583 | 51 | 91 | 1.70 | 0.15 |
| Total ¹ | 1,129 | 1,821 | 196 | 89 | 1.61 | 0.17 |

¹Includes New England and noncoastal respondents.

Billfishing expenditures (total expenditure per trip, days fishing per trip, and cost per day) varied by region (Table 5). The Caribbean region had the least expensive trips, on a per day and per trip basis. Although the most expensive trips were in the South Atlantic, it was more expensive per day in the Gulf of Mexico. New England mean expenditures were comparable to the other Atlantic regions.

Tables 6 and 7 report the results of the logistic regression model of the willingness-to-pay responses and consumer's surplus estimates. Angler characteristics that were expected to affect willingness-to-pay included 1) annual number of billfish trips, 2) years of fishing experience for billfish, 3) expenditures per billfish trip, and 4) annual household income. Years of fishing experience for billfish was statistically insignificant ($P>0.6$) and was not in-

Table 4.—Mean expenditures from most recent billfish trip in the U.S. western Atlantic Ocean.

| Expenditure item | Mean spent per angler | Percent of anglers who bought each item | Mean expense to anglers who bought each item |
|-----------------------------------|-----------------------|---|--|
| Food, drinks, ice | \$152.61 | 80.2 | \$190.29 |
| Boat operation | \$462.56 | 72.8 | \$635.38 |
| Bait and tackle | \$95.65 | 67.1 | \$142.55 |
| Automobile transportation | \$38.29 | 58.7 | \$65.23 |
| Lodging | \$163.88 | 32.9 | \$498.12 |
| Other transportation ¹ | \$170.64 | 25.2 | \$677.14 |
| Captain/charter fees | \$203.75 | 23.8 | \$856.09 |
| Other ² | \$90.28 | 14.1 | \$640.28 |
| Boat rental | \$144.23 | 10.5 | \$1,373.62 |
| Entrance fees | \$50.57 | 10.1 | \$500.69 |
| Boat launch hoist fees | \$28.16 | 8.9 | \$316.14 |
| Total (n=1129) | \$1,600.62 | | |

¹Includes modes of transportation other than automobiles.

²Includes slip rental, repairs, satellite data, and other miscellaneous items.

Table 5.—Mean expenditure per billfishing trip, days fishing per trip, and expenditures per day, by region.

| Region | n | Expenditure per trip | Days fishing per trip | Expenditure per day |
|--------------------|-------|----------------------|-----------------------|---------------------|
| Caribbean | 100 | \$824 | 2.13 | \$387 |
| Gulf | 326 | \$1,232 | 2.18 | \$565 |
| Mid-Atlantic | 318 | \$1,454 | 2.72 | \$535 |
| South Atlantic | 343 | \$1,905 | 4.33 | \$440 |
| Total ¹ | 1,129 | \$1,601 | 2.59 | \$618 |

¹Includes New England and noncoastal respondents.

cluded in the final model. The standardized estimates indicate the probability of a "yes" response decreases as the stamp price increases, and increases as income, trip expenditures, and the number of trips/year increases. The number of billfish trips/year appears to have the greatest influence on willingness-to-pay. We also asked anglers the highest price they would pay for a stamp (open-ended) rather than stop fishing for billfish at the current population levels. The average price was \$247, indicating good agreement

Table 6.—Logistic regression model of willingness-to-pay for a billfish stamp at current billfish population levels, and consumer's surplus.

| Variable description | Parameter estimate and standard error | Wald chi-square value | Prob.> chi-square | Standardized est. |
|---------------------------------|---|-----------------------|-------------------|-------------------|
| Intercept ¹ | 0.4006 (0.2576) | 2.42 | 0.1200 | |
| Stamp price | -0.00664 (0.00138) | 23.23 | 0.0001 | -0.208 |
| Billfish trips/year | 0.0305 (0.0069) | 19.39 | 0.0001 | 0.307 |
| Total \$/trip | 0.000137 (0.000052) | 6.94 | 0.0084 | 0.187 |
| Annual household income | 9.76x10 ⁻⁶ (2.01x10 ⁻⁶) | 23.59 | 0.0001 | 0.207 |
| n | 1,002 | | | |
| Model chi-square | 104.3 (P<0.0001) | | | |
| % concordance | 70.6 | | | |
| Consumer's surplus ² | \$262.38 | | | |

¹Nonsignificant and not included in the consumer's surplus calculation.

²Calculated using a mean of 13 billfish trips/year, \$1,601/trip, and a median household income of \$115,000.

Table 7.—Logistic regression model of willingness-to-pay for a billfish stamp at 25% higher billfish population levels, and consumer's surplus.

| Variable description | Parameter estimate and standard error | Wald chi-square value | Prob.> chi-square | Standardized est. |
|-------------------------|---|-----------------------|-------------------|-------------------|
| Intercept | 0.6347 (0.2934) | 4.68 | 0.0305 | |
| Stamp price | -0.00603 (0.00158) | 14.58 | 0.0001 | -0.189 |
| Billfish trips/year | 0.0436 (0.0097) | 20.39 | 0.0001 | 0.426 |
| Total \$/trip | 0.000143 (0.000065) | 4.83 | 0.0280 | 0.195 |
| Annual household income | 1.10x10 ⁻⁵ (2.30x10 ⁻⁶) | 22.09 | 0.0001 | 0.229 |
| n | 988 | | | |
| Model chi-square | 92.7 (P<0.0001) | | | |
| % concordance | 72.0 | | | |
| Consumer's surplus | \$447.73 | | | |

with the logistic model. There were no significant regional differences in mean willingness-to-pay for a billfish stamp.

Annual Trip and Harvest Estimates

From the results of our tournament inventory (number of tournaments and number of anglers per tournament) and the mail survey (number of tournaments per angler), we estimated 7,915 U.S. tournament billfish anglers in the western Atlantic Ocean in 1989. This group makes a total of 102,895 ± 6,512 (90% confidence interval) billfish fishing trips per year (both tournament and nontournament), or 266,498 days per year. On 40% of these trips a billfish was caught. These anglers caught 42,301 billfish, released 89% of their catch, and landed 5,541 ± 715 (90% confidence interval) billfish. The total catch was composed of 38% sailfish, 33% blue marlin, 29% white marlin, and <1% spearfish. Of the billfish landed, 59% were blue marlin, 24% were white marlin, 15% were sailfish and the remainder spearfish. Tournaments accounted for only 25% of the annual billfish landings for this group of anglers. Whereas we were unable to make estimates for the population of nontournament billfish anglers, we would expect catch rates to be higher for tournament billfish anglers.

Annual Expenditure Estimates in the Study Area

Billfish tournament anglers spent an estimated \$179,425,000 in pursuit of billfish (tournament and nontournament trips). This equals \$4,242 per billfish caught or \$32,381 per billfish landed. Included in the total were billfish tournament expenses of \$58,964,000, of which \$14,690,000 were tournament fees. This amounts to \$5,576 for every tournament-caught billfish and \$42,565 for every tournament-landed billfish.

Annual Consumer's Surplus in the Study Area

At current billfish population levels, the annual net economic benefits for this group of anglers was \$2,073,730

for the opportunity to fish for billfish. If the numbers of billfish were to increase by 25%, annual net economic benefits would be \$3,545,920. Thus, by subtraction, the net benefits gained from a 25% increase in the billfish population would be \$1,472,190 for this group of anglers.

Discussion

Billfish tournament anglers are a unique segment of saltwater anglers. Their fishing frequency of 44 days per year far exceeds the 11 days reported by saltwater anglers nationwide (USFWS, 1988). Greater fishing frequency and years of previous experience probably account for why almost 40% of billfish anglers rated themselves "more skilled" than other anglers, contrasted with 13% of the statewide population of Texas saltwater anglers (Ditton et al., 1990). The cost of a billfish fishing trip (\$1,601) is about 7 times higher than the cost of a king mackerel trip in the Gulf of Mexico (\$226) (Stoll et al., 1989). Similarly, per-day billfishing costs (\$618) are about 13 times higher than general daily saltwater fishing expenses in 1985 (\$47) (USFWS, 1988).

Regulations that would diminish billfish anglers' ability to catch (not land) a billfish would likely meet strong opposition. Therefore, if further regulation of the recreational fishery becomes necessary, decisionmakers might consider a management regime that would achieve the desired objective but not deter or inhibit anglers from catching billfish (e.g., seasonal or area closures). Since most billfish are released, stricter size requirements, daily limits, or annual bag limits would have little or no impact on anglers who release billfish. Further regulations may not be necessary if fishery conservation groups generate greater support for catch and release programs among Caribbean anglers. Support for catch and release has long

been established in the fishery and is expanding (Prince et al., 1990).

Results support the decision to reserve billfish for the recreational fishery. Billfish anglers have a low success rate and an even lower retention rate; their effect on billfish populations is slight, while the economic value of a billfish trip is great. The annual consumer's surplus of a billfish angler (\$262) is almost 10 times higher than king mackerel anglers in the Gulf of Mexico in 1987 (\$27) (Stoll et al., 1989). Further, decommercialization of the billfish fishery should increase billfish populations and increase social and economic benefits to the nation (\$448 per angler annually with a 25% increase in billfish). Also, current regulations do not deny commercial fishermen their directed fishery (tuna or swordfish). If domestic and foreign longliners are allowed to deplete billfish on a bycatch basis to where anglers no longer feel they have an opportunity to catch them, current economic benefits could be lost. Also, there would be impacts of lost revenues on providers and local communities.

Current U.S. management efforts are a step in the right direction toward billfish conservation. Whereas billfish available to U.S. recreational anglers can be affected by overfishing by foreign fleets (external to our EEZ), this can only be resolved through international efforts, i.e., the International Convention for the Conservation of Atlantic Tunas (ICCAT).

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