A Human Dimensions Perspective on the Billfish Fishery in Puerto Rico

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ABSTRACT

There is little social and economic information specific to billfish angling. To learn about billfish anglers in Puerto Rico, a Spanish version of a mail questionnaire was sent to a sample of Commonwealth residents who participated in one or more billfish tournaments held there in 1991-1992. Results showed billfish anglers were more likely male, better educated, had higher household incomes, and fished twice as frequently as saltwater anglers in general. Forty percent of the anglers accounted for a disproportionate share of total fishing days (72%). Overall, billfish anglers demonstrated a high level of appreciation for both catch and non-catch elements of the sport fishing experience. There was higher within-group agreement on the importance of other fishing behaviors than just catching and retaining big fish. Likewise, there was diversity of opinion on the importance of catching "something," retention of all fish caught, and measuring trip success by number of fish caught. Whereas most anglers strongly opposed handlining for billfish, less than a majority supported each of the remaining nine management options presented. Results were generally consistent with what would have been expected from recreation specialization theory. This group of billfish anglers would appear to be located toward the high specialization end of the total continuum of saltwater anglers. While more homogeneous than a sample of saltwater anglers, some within-group heterogeneity exists, perhaps attributable to cultural differences.

INTRODUCTION

In their proposed social and economic research agenda in support of billfish conservation, Fedler and Ditton (1990) observed there was little social and economic information specific to billfish angling. Most of what is available can best be described as "surrogate biology" (after Brown 1987) with emphasis on the percentage of anglers targeting and catching billfish and catch per unit of effort (CPUE). Also, there is insufficient sample size upon which to base conclusions regarding the billfish fishery. To leverage additional support on behalf of billfish management and conservation, Fedler and Ditton (1990) challenged non-governmental sport fishing organizations to achieve a better understanding of their constituency and the social and economic benefits associated with the billfish fishery:

> Constituency groups need to explore ways to be more effective if they are to coax government to exercise fully its responsibilities for management of common property fisheries resources. Instead of relying on ethical and biological arguments, those who represent billfish anglers in political decision-making need to recognize the imperative of using well-grounded constituent and economic arguments. Biological points made by anglers can be (and often are) dismissed by management agencies as naive, anecdotal, uninformed, and not based on data. Legislators often do not understand biological arguments, as well.

The Billfish Foundation of Fort Lauderdale, Florida responded by funding a series of social and economic studies of the billfish fishery. The first study focused on a sample of billfish tournament anglers in Western U.S. Atlantic waters (with coverage extending from New York to Texas including the U.S. Virgin Islands and Puerto Rico) (Ditton and Fisher 1990; Fisher and Ditton 1992). This paper presents results from a second study of anglers who participated in billfish tournaments in Puerto Rico (including residents of Puerto Rico, elsewhere in the U.S. and abroad); a third study of tournament and charter boat billfish anglers in the Cabo San Lucas - Mazatlan area of Mexico is scheduled to begin in 1994. The purpose of these efforts has been to understand the social and economic importance of billfish angling, better understand the diversity of the angler population, and provide support for fishery management decision-making.

The concept of recreation specialization (Bryan 1977; Ditton *et al.* 1992) is useful for understanding billfish anglers, their social world, and where they fit into the overall social world of sport fishing. First, a social world is defined as "an internally recognizable constellation of actors, organizations, events, and practices which have coalesced into a perceived sphere of interest and involvement for participants" (Unruh 1979). Second, specialization is defined as "a process by which recreation social worlds and subworlds segment and intersect into new recreation subworlds, and the subsequent ordered arrangement of these subworlds and their members along a continuum" (Ditton *et al.* 1992). At one end of the continuum is the least specialized subworld of anglers who are naive and hold a simplistic view of their activity. At the other end of the continuum are the most specialized subworlds of anglers who have made fishing a central life interest. As level of specialization increases across the overall sport fishing social world, we would expect to see increases in the cost of individual participation; more years of previous experience; greater frequency of participation; more attention to equipment and use of technology; greater acceptance and support for rules, norms, and procedures; greater involvement with various types of media; and greater appreciation for both catch and non-catch related elements of the sport fishing experience (Ditton *et al.* 1992).

Applying the concept of recreation specialization to the social world of billfish angling, we would expect to find billfish anglers skewed toward the high specialization end of the overall continuum of anglers with regard to the variables mentioned previously. We would expect billfish anglers to be more experienced (years of fishing participation), to fish more frequently, and to show higher levels of appreciation for both catch and non-catch elements of the sport fishing experience.

Further, we would expect far more homogeneity than among the general population of anglers. As a "rare event" fishery, we would expect to find a subworld of anglers who have focused their activity on a particular species (or complex of species) with well-developed fishing skills and capabilities. Consequently, we would expect much more similarity among billfish anglers in fishing motivations and attitudes than among the general angler population. Also, because of the greater homogeneity hypothesized in this group, we would expect a more even distribution of days of fishing participation than found in the general angler population. Previous research (Ditton 1980; O'Leary and Pate 1979; Romsa and Girling 1976) showed that 20% of the anglers accounted for between 66% and 73% of the total angler effort (activity occasions). These studies, however, focused on the overall angler population or on angler groups targeting widely available species.

In light of the limited understanding of billfish anglers and their fishing activity, this paper has three objectives: 1) To profile billfish anglers who reside in Puerto Rico according to their social and economic characteristics, participation characteristics, fishing motivations, and attitudes; 2) To verify what would be expected about this group from recreation specialization theory; and 3) To discuss the theoretical and methodological implications of study results.

METHODS

As is often the case in human dimensions research, there was no available sampling frame for billfish anglers. Therefore, it was necessary to merge the lists of participants in 14 billfish tournaments held in Puerto Rico between August, 1991 and October 1992. We included anglers who participated in one or more billfish tournaments during this time period. By definition, the sampling frame did not include all individuals taking non-tournament trips using charter and private boats. Whereas tournament anglers were asked about their billfish fishing outside of tournaments, private boat owners targeting billfish but not participating in tournaments were not covered by the survey. From the outset we recognized we were dealing with a subset of billfish anglers; however, this proxy angler group was identifiable and provided a cost effective means of obtaining information from billfish anglers.

With juveniles (< 15 years of age) removed, the sampling frame included 1,475 resident anglers and 154 non-resident anglers. The survey was sent to a random sample of 885 resident anglers with an expectation of a response rate of about 60%. This would yield a sample size of 531 which is considered sufficient to represent a large population (Krejcie and Morgan 1970). Because overall study objectives focused on the economic impact of the fishery, all non-resident billfish anglers in the sample were contacted.

A ten-page mail questionnaire was developed to collect information from anglers. Most items were pre-tested and used previously by Ditton and Fisher (1990). First, we sought information on anglers' personal characteristics (age, sex, education, and income), and sport fishing participation characteristics (years of previous fishing experience, annual fishing frequency). Second, anglers were asked to rate the importance of 16 motive statements as reasons for fishing using a Likert-type scale. Eleven motive statements dealt with the generic benefits sought in most outdoor recreation activities (activity-general). The statements were single-item measures of the following Driver (1977) domains: physical rest, escape physical pressures, escape daily routine, relationships with native, escape role over loads, family togetherness, social contacts, exploration, achievement-competence testing, and equipment. In addition, six motive statements dealt with experience elements associated only with sport fishing (activity-specific): to obtain fish for eating, for the experience of the catch, to obtain a "trophy" fish, to be close to the sea, for the challenge or sport, and to obtain a tournament trophy/prize. Driver and Cooksey (1978) documented the reliability and validity of the non-catch scales. Third, anglers were asked a series of questions about their orientation toward catching fish. Anglers were asked to indicate the extent to which they agreed with each attitudinal statement on a Likert-type scale developed by Graefe (1980) to understand four sub-dimensions of consumption: number of fish caught, type of fish caught, disposition of catch, and general orientation towards catching "something." Finally, using a Likert-type scale, anglers were asked whether or not they supported each of 10 management options for managing the recreational billfish fishery.

Mailings began on April 5, 1993 following a slightly modified version of the Dillman (1978) mail survey methodology. Residents of Puerto Rico and other Spanish-speaking countries were sent a Spanish translation of the questionnaire; others received an English version. Two weeks after the initial mailing, all survey participants were sent a reminder postcard. Two weeks later, a second mailing was sent 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 mailing (in English) was sent in a final effort to improve the survey response rate.

A total of 346 usable questionnaires were returned by Puerto Rican residents; 86 by non-residents. After non-deliverables were excluded, an overall

response rate of 49% was achieved. This response rate was lower than the 60% achieved in a previous study of billfish anglers in the U.S. Atlantic which included residents of Puerto Rico (Ditton and Fisher 1990)

It was impossible for us to conduct a telephone check of non-respondents to ascertain the extent of non-response bias because many anglers listed business or post office boxes or had unlisted numbers. Therefore, we used weighing procedures (Little and Rubin 1987) to reduce the effect of non-response bias with regard to population estimates of angler harvest and expenditures. Unweighted sample data were used in this paper because of its emphasis on hypothesis testing. Throughout the paper, unweighted sample data for resident billfish anglers are compared with unweighted sample data from other studies in an effort to put billfish anglers in perspective. For background on the statewide survey of saltwater anglers in Texas used most often for comparison purposes, see Hunt *et al.* (In Press).

RESULTS

Personal Characteristics

Billfish anglers who reside in Puerto Rico differed from those of the saltwater anglers sample in terms of personal characteristics. There were few (3%) females among the group of resident billfish anglers (Table 1) while about 17% of the sample of saltwater anglers were female. Billfish anglers are slightly older on average than saltwater anglers in general with 52% and 45%, respectively, in age categories of 40 years. About 34% of the billfish anglers had household incomes of $100,000 while only 6% of the saltwater angler sample had similar income levels. Finally, about 68% of billfish anglers had 4 years of college education compared to 27% for the population of anglers 16 years of age in Texas (U.S. Fish and Wildlife Service 1993).

As additional perspective, we should point out that resident billfish anglers in Puerto Rico were significantly different from the other two groups of non-resident billfish anglers (that participated in tournaments in Puerto Rico) in age and income category with no significant difference in years of education. Resident billfish anglers were younger and had lower incomes.

Participation Characteristics

Billfish anglers would appear to have a strong commitment to fishing in terms of years of previous experience and annual frequency (Table 2). Both billfish anglers and saltwater anglers in general show similar mean scores for years of saltwater fishing experience, probably reflecting the current age distribution of the U.S. population (Murdock *et al.* 1992). The mean years of billfish fishing experience (13.1) among resident billfish anglers suggests they began billfish fishing after several years of saltwater experience. Billfish anglers reported fishing almost twice as frequently as the general population of saltwater

Table 1. Characteristics of resident billfish anglers.

Personal Characteristics:		
Sex (n=344)		
	Female	2.9%
	Male	97.1%
Education(n=342)		
	less than high school graduate	4.1%
	high school graduate	7.5%
	1-3 years of college	20.8%
	4 years of college	38.3%
	post graduate school	29.4%
Income (n=331)		
	< $20,000	10.9%
	$20,000 - 39,999	19.6%
	$40,000 - 59,999	11.0%
	$60,000 - 79,999	12.3%
	$80,000 - 99,999	12.2%
	> $100,000	34.0%
Age		
	mean	39.7 years
Participation Characteristics:		
Saltwater fishingexperience(n=341)		
mean		18.9 years
Billfish fishing experience (n=330)		
mean		13.1 years
Annual saltwater fishing (n=339)		
mean		38.3 days

anglers. Lower standard deviations for mean years of saltwater fishing and saltwater fishing frequency among billfish anglers indicates greater homogeneity than among the saltwater angler sample. There were no significant differences between resident billfish anglers and the other two groups of non-resident billfish anglers (that participated in tournament in Puerto Rico) in annual saltwater fishing frequency and years of fishing experience (in saltwater and for billfish).

When we view the distribution of fishing days across quintiles of resident billfish anglers, we find that 40% of the anglers accounted for 72% of the fishing days. The remaining 60% of the billfish anglers accounted for the remaining 28% of the days. The distribution of fishing days across the saltwater angler sample was skewed even more disproportionately; 40% of the saltwater anglers accounted for 82% of the fishing days. Results for saltwater anglers

Table 2. Percent distribution of annual sport fishing days (1) by participation frequency categories.

Sample	Category (2)					
	1	2	3	4	5	Total
Billfish anglers (Puerto Rico residents)	4	9	15	24	48	100
Texas saltwater anglers	3	5	10	21	61	100

(1) Participation was in days where one day is recorded when an angler participates for any part of a day.
(2) Each category represents 20% of the angler sample. Categorization reflects angler continuum in that anglers with lowest fishing frequencies are in category 1 and anglers with highest fishing frequencies are in category 5.

were similar to distribution results presented previously for a sample of striped bass anglers and two samples of anglers in general (Ditton 1980).

Fishing Motivations

Which experience outcomes in sport fishing motivate this sample of anglers? Most billfish anglers rated 13 of 17 sport fishing motivations as very or extremely important. Also, most rated the remaining two motivations ("to obtain fish for eating" and "to win a tournament trophy/prize money") as not at all or slightly important. Two of the three angler motivations with the highest ranked mean scores were activity-specific ("for the experience of the catch and for the challenge or sport") (Table 3). Means for four motivations ("to be close to the sea," "for the challenge or sport," "for relaxation," and "for the experience of the catch") had standard deviations .95; there was a higher rate of agreement within the billfish angler sample regarding these elements of the fishing experience. There was less agreement among billfish anglers on the importance of four other fishing motivations: "for family recreation," "to test my equipment," "to obtain a "trophy" fish" and "to get away from the demands of others." Overall, billfish anglers were appreciative of both activity-general and activity-specific elements of sport fishing.

Table 3. Sample means and standard deviations for important scores for reasons why people fish (motives) in saltwater for selected angler groups.

	Puerto Rico Billfish Anglers		Texas Saltwater Anglers	
Motive	Mean[a]	Standard Deviation	Mean	Standard Deviation
To be outdoors	3.52	1.11	4.09	1.26
Family recreation	3.33	1.24	3.54	1.55
New/Difference things	3.48	1.15	3.10	1.66
Relaxation	4.24	0.92	4.26	1.23
Close to sea/water	3.88	0.74	3.49	1.67
Fish for eating	2.38	1.17	2.98	1.77
Get away from demands	2.68	1.41	3.65	1.80
Experience of catch	4.23	0.95	3.80	1.54
Test equipment	2.83	1.25	2.14	1.57
Be with friends	3.38	1.04	3.37	1.58
Unpolluted natural	3.87	1.09	3.98	1.55
Win tournament	1.98	1.19	1.62	1.42
Develop skills	3.64	1.14	2.76	1.78
Get away/routine	3.95	0.98	4.05	1.39
"Trophy" fish	3.21	1.35	2.11	1.81
Challenge/sport	4.15	0.91	3.50	1.72
Adventure/excitement	3.89	1.01	3.73	1.52
	n=335		n=2,259	

[a]1=not at all important; 2=slightly important; 3=moderately important; 4=very important; 5=extremely important.

The statewide sample of licensed saltwater anglers provides contrasting results. Most rated only 10 of the 17 sport fishing motivations as very or extremely important. Four motivations ("to experience new and different things," "to be with friends," "to develop my skills," and "to obtain a trophy fish") were less important to the sample of saltwater anglers than to billfish anglers. One motivation ("to get away from the demands of other people") was more important to the general sample of anglers than to billfish anglers. Angler motivations with the highest ranked mean scores were all activity-general ("for relaxation," "to be outdoors," and "to get away from the regular routine"). Also, based on standard deviations, there was much less agreement among the general saltwater angler sample regarding the importance of all 17 motives than among billfish anglers.

Orientation Towards Catch

Most billfish anglers agreed with the following statements about saltwater fishing: "The more fish I catch, the happier I am," "A fishing trip can be successful even if no fish are caught," "I usually eat the fish I catch," "I would rather catch one or two big fish than ten smaller fish," "When I go fishing I'm just as happy if I don't catch a fish," "The bigger the fish I catch, the better the fishing trip," "I'm just as happy if I don't keep the fish I catch," "I like to fish where there are several kinds of fish to catch," "I'm just as happy releasing the fish I catch," and "I like to fish where I know I have a chance of catching a trophy fish." Lower standard deviation scores revealed a high level of agreement among anglers on the importance of fishing behaviors besides just catching and retaining big fish (Table 4). Likewise, standard deviation scores were highest indicating a diversity of opinion for items pertaining to the importance of catching "something," retention of all fish caught, and measuring trip success by number of fish caught.

Among the sample of saltwater anglers, most anglers only agreed with four statements about saltwater fishing: "The more fish I catch, the happier I am," "A fishing trip can be successful even if no fish are caught," "I usually eat the fish I catch" and "I like to fish where there are several kinds of fish to catch." Most billfish anglers agreed with these four, also. As indicated by the standard deviation scores (higher on every statement than for the sample of billfish anglers), there was a diversity of opinions on the importance of catching lots of fish, catching big fish, catching something, and retaining fish among others.

Management Preferences

Overall, there was little support expressed among resident billfish anglers for nine of ten management options presented (Table 5). Most anglers (85.3%) strongly opposed the practices of handlining and harpooning billfish. Slightly less than 50% of the anglers opposed a provision for catch and release-only billfish fishing. Otherwise, there was a wide diversity of opinion within the billfish angler sample. Four proposed restrictions on fishing gear prompted high levels (29%) of neutral response.

These results contrasted sharply with responses from the other two groups of billfish anglers participating in tournament fishing in Puerto Rico (those from elsewhere in the U.S. and abroad). In both of these groups, most anglers supported increased minimum sizes for blue marlin, no double hooks on lures, mandatory "no kill" tournaments, and catch and release-only billfish fishing (zero bag limit). Likewise, both groups opposed handlining and harpooning of billfish.

Table 4. Sample means and standard deviations for extent of agreement with statements about saltwater sport fishing for selected angler groups.

	Group			
	Puerto Rico Billfish Anglers		Texas Saltwater Anglers	
Statement	Mean[a]	Standard Deviation	Mean[a]	Standard Deviation
The more fish I catch, the happier I am...	3.80	1.10	3.49	1.55
A fishing t rip can be successful even if no fish are caught...	4.20	0.90	3.78	1.47
I usually eat the fish I catch...	3.50	1.00	4.09	1.49
A successful fishing trip is one in which many fish are caught...	3.20	1.20	3.09	1.56
I would rather catch one or two big fish than ten smaller...	3.80	1.10	3.37	1.60
When I go fishing, I'm just as happy if I don't catch a fish...	3.54	1.15	2.93	1.63
It doesn't matter to me what type of fish I catch...	3.06	1.21	2.93	1.63
The bigger the fish I catch, the better the fishing trip...	3.70	1.14	3.23	1.55
I'm just as happy if I don't keep the fish I catch...	4.11	1.00	3.20	1.68
I like to fish where there are several kinds of fish to catch...	4.25	0.80	4.10	1.00
I want to keep all the fish I catch	2.30	1.20	2.39	1.57
I'm happiest with a fishing trip if catch challenging game fish...	4.53	0.70	——	——
I'm just as happy releasing the fish I catch...	3.99	1.02	3.25	1.63
If I thought I wouldn't catch any fish I wouldn't go fishing...	2.39	1.37	——	——
I like to fish where I have a chance of catching a trophy fish	3.81	1.09	3.01	1.71
When I go fishing, I'm not satisfied unless I catch at least something	2.87	1.14	——	——
	n=347		n=2,304	

[a]1=strongly disagree; 2=disagree; 3=neutral; 4=agree; 5=strongly agree.

Table 5. Percent of resident billfish anglers by support of an opposition to options formanaging the recreational billfish fishery; sample means and standard deviations.

Statement	Percent Occurrence[a]						
	1	2	3	4	5	Mean	SD
Increase in minimum sizes for blue marlin	14.1	19.5	27.0	22.2	17.1	3.09	1.29
No double hooks on lures...	15.7	23.1	29.1	18.1	13.9	2.91	1.26
No stainless steel hooks	13.2	21.3	29.6	16.5	19.5	3.08	1.30
Allow handling and harpooning...	62.8	22.5	9.0	3.3	2.4	1.60	0.95
Mandatory "no kill" tournaments...	10.3	17.2	28.1	20.5	23.9	3.31	1.29
No "living baiting"...	17.9	18.5	38.5	12.8	12.2	2.83	1.22
Artificial baits only...	13.5	19.8	37.2	17.4	12.0	2.95	1.18
Seasonal closures for billfish anglers...	21.8	21.1	19.9	21.8	15.4	2.88	1.38
Area closures for billfish anglers...	33.3	34.8	15.0	10.2	6.6	2.22	1.20
Catch and release only (zero bag limit)	24.9	24.0	25.5	14.3	11.2	2.63	1.30
							n=333

[a]1=strongly oppose; 2=oppose; 3=neutral; 4=support; 5=strongly support.

DISCUSSION

Results for resident billfish anglers were generally consistent with what would be expected from specialization theory. This group of billfish anglers would appear to be located toward the high specialization end of the total continuum of saltwater anglers. From previous experience, they would appear to have gained a greater appreciation of more of the individual benefits involved in sport fishing, including both catch and non-catch related elements. There were some relatively homogeneous attitudes within this billfish angling social world. Although certainly more homogeneous than the general angler population, some heterogeneity exists. For example, we observed within-group differences regarding the appropriateness of various billfish conservation measures, *i.e.*, gear types, catch and release fishing, and mandatory "no kill" tournaments. Also, non-resident billfish anglers that visited Puerto Rico to participate in fishing tournaments were in much more agreement regarding the need for conservation measures. Cultural differences among resident and non-resident angler groups likely provide some explanation of differences in value orientation. Among resident billfish anglers, cultural differences are revealed by those who oppose catch and release only and mandatory "no kill" tournaments and those who participate only in catch and release tournaments to the exclusion of others or those who stress the challenge aspects of billfish angling by using light tackle in conjunction with catch and release techniques.

Just how did this group of individuals evolve into this social world? As the data indicate, most were involved in saltwater fishing for several years before they fished for billfish. But not all saltwater anglers progress along the sport fishing continuum; for, as Unruh (1979) suggests, the process may not be linear or inevitable. Through social interaction and learning, some entered and exited various subworlds within the saltwater sport fishing social world as their understandings of sport fishing changed. Eventually, they reached the more specific social world of billfish angling or perhaps focused on even more specific billfish fishing subgroup interests. Within the billfish social world, there are some anglers who participate extensively and for whom billfish fishing is a central life interest; there are others who participate less frequently, hold divergent views, but for whom billfish fishing is preferred over other kinds of fishing experiences. There are inconsistencies. As Fisher (1993) reminds us, however, "specialization is a multi-dimensional concept, and there is probably no reliable univariate measure of specialization." Of the six variables he used in his cluster analysis of anglers, none increased strictly with increasing level of specialization.

It was necessary to make comparisons between billfish angler results and those from other groups in order to put the former group in perspective. The 1990 Texas statewide survey of licensed anglers was relied upon heavily for this purpose because it provided an overview of the entire social world of saltwater

fishing, included comparable questions and, thus, included the best available specific data. We recognize that a comparison with the population of saltwater anglers in Puerto Rico would have been preferable, but no such study has been completed. No such study is foreseeable since anglers in Puerto Rico are not required to have a fishing license to fish saltwater (Chaparro 1987) and thus they cannot be sampled efficiently.

In keeping with the "rare event" nature of their fishing success, billfish anglers are a distinctive group of anglers in terms of personal and experience characteristics and motivation and attitude patterns. As a group, they are probably not unique as other angler social worlds also have well-developed fishing skills and capabilities in pursuit of multi-dimensional fishing experiences. What is important to recognize here is that these angler social worlds have been masked by "the average angler" approach taken by many previous angler studies. Furthermore, despite the human dimensions imperative of the Magnuson Fisheries Management and Conservation Act, our knowledge of most other species-specific groups remains inadequate.

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LITERATURE CITED

Brown, T.L. 1987. Typology of human dimensions information needed for Great Lakes sport fishing management. *Trans. Amer. Fish. Soc.* **116**:320-324.

Bryan, H. 1977. Leisure value systems and recreational specialization: the case of trout fishermen. *J. Leisure Res.* **9**:174-187.

Chaparro, R.S. 1987. *The licensing of marine recreational fisherman in the Commonwealth of Puerto Rico.* Master's Professional Paper. Texas A&M University, College Station.

Dillman, D.A. 1978. *Mail and telephone surveys: The total design method.* John Wiley and Sons, N.Y., 325 pp.

Ditton, R.B. 1980. Recreation striped bass fishing: a social and economic perspective. Pages 63-75 *in* Clepper, H., ed *Marine Recreational Fisheries 5.* Sport Fishing Institute, Washington, DC.

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 pp.

Ditton, R.B., D.K. Loomis and S. Choi. 1992. Recreation specialization: re-conceptualization from a social world perspective. *J. Leisure Res.* **24**:33-51.

Driver, B.L. 1977. Item pool for scales designed to quantity the psychological outcomes desired and expected from recreation participation. Unpublished report. USDA Forest Service, Rocky Mountain For. and Range Exp. Sta., Ft. Collins.

Driver, B.L. and R.W. Cooksey. 1978. Psychological outcomes that are desired and expected from recreational fishing and their relevance to sport fisheries management. Unpublished report. USDA Forest Service, Rocky Mountain For. and Range Exp. Sta., Ft. Collins.

Fedler, A.J. and R.B. Ditton. 1990. A social and economic research agenda in support of billfish conservation. Pages 263-268 *in* Stroud, R.H., ed, *Planning the future of billfishes: Research and Management in the 90's and beyond. Part 2.* Contributed papers. Proc. Second Int. Billfish Symp. Kailua-Kona, HI, pp 263-268. Natl. Coalition Mar. Conserv. Inc., Savannah, GA.

Fisher, M.R. 1993. The relationship between non-response bias and angler specialization. Doctoral dissertation. Texas A&M University, College Station.

Fisher, M.R. and R.D. Ditton. In Press. Characteristics of U.S. tournament anglers. *Marine Fisheries Review* **12**: 28-33.

Graefe, A.R. 1977. Development of an attitude scale to measure fishermen's desire to catch fish. Unpublished paper available from author at School of Hotel, Restaurant and Recreation Management, Pennsylvania State University, University Park.

Graefe, A.R. 1980. The relationship between level of participation and selected aspects of specialization in recreational fishing. Unpublished Ph.D Dissertation, Dept. of Recreation and Parks, Texas A&M University. 155p.

Hunt, K.H., R.B. Ditton, R. Riechers, S. Gutreuter, M. Osborn and G.C. Matlock. In Press. Demographics, participation, attitudes, expenditures, and management preferences of Texas anglers. *Management Data Series Report.* Wildlife and Fisheries Division, Texas Parks and Wildlife Department, Austin. 25 pp.

Krejcie, R.V. and D.W. Morgan. 1970. *Determining sample size for research activities.* Educational and Psychological Measurement **30**:607-610.

Little, R. and D. Rubin. 1987. *Statistical analysis with missing data.* John Wiley and Sons, New York. 278 pp.

Murdock, S.H., K. Backman, R.B. Ditton, M.N. Hogue and D. Ellis. 1992. Demographic change in the 1990's and the twenty-first century: Implications for fisheries management. *Fisheries* (Bethesda) **17** (2):6-13.

O'Leary, J.T. and G. Pate. 1979. Waterbased activity involvement for recreation consumers at state, federal, local, or private facilities. *Water Res. Bull.* **15**:182-188.

Romsa, G.H. and S. Girling. 1976. The identification of outdoor recreation market segments on the basis of frequency of participation. *J. Leisure Res.* **8**:247-255.

Unruh, D.R. 1979. Characteristics and types of participation in social worlds. *Symbolic Interaction* **2**:115-130.

U.S. Fish and Wildlife Service. 1993. National survey of fishing, hunting and wildlife—associated recreation—Texas. U.S. Government Printing Office, Washington, DC. 41 pp.