A Socio-economic Review of Recreational Billfish Fisheries

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ABSTRACT

Most states and some nations conduct surveys of resident anglers in support of their public trust responsibilities for marine recreational fisheries management. Their goal is to know as much about these users of fishery resources as they do fishery resources themselves. With highly migratory species such as billfish, this is virtually impossible because anglers as well as fish know no boundaries. As a result, best available means must be found to sample the universe of billfish anglers. At the 1988 International Billfish Symposium, Fedler and Ditton (1990) reported there was little social and economic information specific to billfishing and that problems surrounded currently available data and their use. They called for a research program funded mostly by non-governmental organizations to better understand the size and distribution of the billfish angler constituency and its economics vis-à-vis the commercial fishery. This paper will summarize and critique the extent of social and economic research on billfish angling completed over the past ten years as a result of these efforts and discuss implications for fisheries development in the Gulf and Caribbean. It will also conclude with recommendations and a new research agenda to guide future efforts.

KEY WORDS: Billfish Fisheries, recreational fisheries, human dimensions

INTRODUCTION

Over the past ten years, there has been considerable research on billfish anglers, their characteristics, management preferences, expenditures, and economic impacts. As a result, Caribbean nations seeking to develop recreational fisheries for billfish should have a much better understanding of the billfish angling market today. This paper provides a synthesis of recent human dimensions understandings and update of a paper entitled "A Social and economic Research Agenda in Support of Billfish Conservation" (Fedler and Ditton 1990). Also, this paper builds on other papers presented previously at GCFI meetings (Ditton 1978, Ditton 1982, Schmied 1982, Schmied 1985) which outlined the

process of recreational fisheries development, available information on angler markets, and information needs in support of sustainable fisheries development. While recreational fisheries service providers doing business in the Caribbean probably have a good understanding of their markets, it is also important that fisheries and tourism agencies have this knowledge because of their essential roles in the tourism system (Gunn 1992).

In 1988, several social science researchers were invited to the International Billfish Research Symposium in Hawaii to provide a socio-economic overview of recreational billfish fisheries. Among the papers presented, Rockland (1989) carefully differentiated economic valuation from economic impact concerns in order to guide future data collection and decision making efforts relative to these two concerns. Orbach (1990) provided a policy overview and analysis to enhance understanding of regional differences in billfish management and the FMP for Atlantic Billfishes which was about to be approved by the U.S. Secretary of Commerce at the time. Fedler and Ditton (1990) reviewed previous social and economic research on the recreational billfish fishery, detailed what little was available, and alternatively concentrated their efforts on developing a human dimensions research agenda for billfish fisheries.

Most angler-related research available in 1988 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 were usually insufficient sample sizes upon which to base conclusions regarding the recreational billfish fishery. The lack of social and economic information on recreational billfish fisheries was attributed to four factors (Fedler and Ditton 1990). First, billfish anglers are a small constituency compared to other angler groups or the overall number of recreational anglers. The number of billfish anglers may be disproportionately large at particular fishing destinations but overall they constitute a small angler segment. The billfish fishery is a "rare event fishery" for sampling purposes in the United States: not only are fewer fish caught compared to other species but fewer anglers seek them as well. Second, the usual motivation for social and economic research, namely, highly publicized resource allocation battles, has been missing previously. Third, integrated fisheries management is still a new concept and thus social and economic concerns and research support still trail traditional biological and ecological concerns. And finally, data collection from billfish anglers is likely to be difficult because anglers are widely dispersed and not easily identifiable for survey research purposes. Thus, efforts to collect data from the population of billfish anglers suffer from the lack of an identifiable universe and sampling frame, because there is no specific license required for billfish angling (nor is one likely soon!). As a result nearly all previous efforts have focused on identifiable subsets of billfish anglers, i.e., billfish tournament anglers, billfish

using charterboats, members of billfish conservation organizations, *Marlin Magazine* readers, etc. Questions remain regarding the generalizability of results from these sub-population groups to the population level but they are nevertheless useful to promote understanding at the sub-population level.

DEMOGRAPHIC CHARACTERISTICS

One analysis of the overall population of billfish anglers provides useful perspective for all of the previous studies of billfish anglers at the sub-population level. Based on secondary analysis of the 1991 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (U.S. Fish and Wildlife Service 1993) data set, the American Sportfishing Association (1995) projects that 230,000 anglers in the United States spent 2,136,899 days fishing for various billfish species in 1991. Nationally, this works out to 3.6% of all saltwater anglers over age 16 and an average of 6.6 days of fishing per billfish angler. The ten states with the highest number of billfish anglers are as follows:

1) Florida (159,575)
2) California (31,162)
3) North Carolina (30,071)
4) Hawaii (26,588)
5) Texas (23,714)
6) New Jersey (17,687)
7) New York (12,671)
8) South Carolina),
9) Maryland (9,959
10) Delaware (8,666).

A demographic profile of the national population of billfish anglers residing in the U.S. is as follows: Most live in small cities and towns (45%) followed by big cities and urban areas (28%); most (72%) are male; most (64%) are married; most (64%) are between 25 and 44 years of age; most (54%) have household incomes between US$30,000 and US$74,999*[1], with only 13% at $75,000 or more; and 50% have a high school education or less (American Sportfishing Association 1995).

Four billfish angler studies completed since 1989 (Ditton and Fisher 1990, Ditton and Clark 1994, Ditton and Grimes 1995, Ditton, Grimes and Finkelstein 1996) have focused on sub-population groups of billfish anglers and provide a very different demographic profile. Tournament and charter boat billfish anglers, for example, are typically white males in their forties (46- 50 years of age), highly educated (college graduates and above, and with high annual household incomes ($70,000 - $179,000). Differences from billfish angling population level data may best be explained by their participation in tournaments, use of charter boats, and extensive participation in billfish rather than as an artifact of targeting billfish species. When these sub-groups of billfish anglers are compared to the general population of licensed anglers in general, the former are even more distinctive. The community of licensed anglers in Texas, for example,

* All currency given in U.S. dollars.

is dominated by 30 - 49 year old white males with about 20% female anglers (Ditton and Hunt 1996). About 45% of licensed anglers in Texas have annual household incomes below $40,000(median income category = $40,000 - $49,0000, most (89%) were white/ Anglo (Ditton and Hunt 1996), and only 27% of anglers 16 years of age and above had four or more years of college (U.S. Fish and Wildlife Service 1997).

COMMITMENT TO FISHING

In terms of years of previous fishing experience and annual fishing frequency, billfish anglers studied previously by Ditton and his associates have exhibited a high level of commitment to their fishing activity. The mean number of years fishing in saltwater (19 to 26 years of experience for tournament billfish anglers in the U.S. Atlantic) exceeds the mean number of years fishing for billfish (10 to 16 years); this suggests most began billfish fishing after 5 to 12 years of saltwater fishing experience. Furthermore, billfish anglers studied in the U.S. Atlantic, Puerto Rico, and Costa Rica fished 39-43 days which is more than twice as frequently as the statewide population of licensed saltwater anglers in Texas (17 days)(Ditton and Hunt 1996).

When asked how their fishing ability compared to other anglers in general, over 33% of the anglers who participated in billfish tournaments in the U.S. Atlantic, those who participated in tournaments in Puerto Rico (residents only), and those who used charter boats in Costa Rica indicated they were more skilled. Only 19 % of the billfish charterboat anglers in the southern Baja felt they were more skilled than other anglers. Results for billfish anglers contrast with those for saltwater anglers in Texas, for example, where only 11% felt they were more skilled than other anglers (Ditton and Hunt 1996).

NEW APPROACHES TO FISHERIES DEVELOPMENT

The term "fisheries development" is usually associated with commercial fisheries; however, it can apply as well to rational decisions by public sector decision makers to promote particular recreational fisheries. Private sector providers such as travel agencies are already promoting billfish fisheries in the Caribbean region because of angler de mand for quality fishing opportunities close to major market areas in the U.S. Some Caribbean tourism offices work in consultation with their fishery agency counterparts to promote billfish angling in their respective nations and work with private providers to ensure their fishing destinations remain competitive. Some Caribbean nations are not interested in promoting recreational fishing as a means of economic development at all. Others do not have all of the ingredients to compete successfully with the major

billfish destinations in the region, or cannot get all of the constituent parts of the tourism system to work together to become a major billfish fishing destination.

Several arguments can be made on behalf of development of recreational billfish fisheries in the Caribbean. First, billfish anglers spend a great deal of money to go fishing, more than other anglers and much more than tourists in general. Anglers reported spending an average of $3,446 on their most recent trip to Costa Rica (Ditton and Grimes 1995). This amount is generally consistent with what non-residents spent to go fishing for billfish in Puerto Rico (Ditton and Clark 1994). Major local expenditures incurred by over two-thirds of the anglers included charter and guide fees, lodging, food and drink expenditures and "other". Most expenditures in the "other" category were for fishing equipment, tackle, fuel, souvenirs, and recreation/entertainment. The average trip to Costa Rica lasted about 7 days with just over 4 days of fishing. Excluding airfare, anglers spent $2,623 per person for the trip or $351 per day.

When billfish anglers make expenditures, there are indirect economic impacts as well. Purchases of charter boat services and restaurant meals, for example, transfer money to local service providers who in turn must make purchases to produce the goods and services demanded by anglers. And those suppliers to providers make purchases to meet their needs. Indirect impacts associated with billfish angling also include the additional purchases of goods and services resulting from wages paid directly or indirectly by affected businesses. These impacts have additional indirect economic impacts themselves (Rockland 1985). Local economic impacts continue as money is re-spent until it "leaks out" of the local economy; likewise island nations are impacted in a positive economic fashion until monies leave their economy. Economic multipliers like 2.5 used in the southern Baja area of Mexico mean that money remains in the local economy longer resulting in greater re-spending and economic impact; smaller multipliers like the one used previously (1.07) in an economic impact study of the billfish fishery in Puerto Rico (Ditton and Clark 1994) indicate rapid leakage out of the economy due to a dependence on imported goods.

Nevertheless, nonresident billfish tournament anglers spent $3,945 on their last fishing trip to Puerto Rico which included just less than four days of billfish angling; this works out to $1,052/ day. Overall, total fishing trip expenditures by this group of non-resident billfish (excluding tournament entry fees) totaled $4,459,270. When their airfares ($427,492) were deleted from their total expenditures, it was estimated they spent about $4,031,778 in Puerto Rico; using the low multiplier (1.07) described above, these expenditures had an economic impact of $4,314,002 on the Commonwealth's economy and were responsible for about 170 jobs (Ditton and Clark 1994). In Costa Rica, billfish

anglers taking charter trips offshore spent $5,492,006 (excluding airfare) for fishing-related expenditures. In lieu of a recognized economic multiplier for the tourism sector in Costa Rica, a conservative one of 2.0 was used to calculate the extent of indirect economic impact associated with billfish angler expenditures. This means that for every dollar spent in Costa Rica by non-resident anglers, there was $2 in economic impact before the money leaves the country. The $5,492,006 in fishing-related expenditures had a total economic impact of $10,984,012 on the Costa Rican economy. When non-fishing related expenditures were included (these expenditures, it can be argued, wouldn't have occurred without the primary focus on billfish fishing), a total direct expenditure of $8,880,986 had a total economic impact of $17,791,972 on the Costa Rica economy (Ditton and Grimes 1995). In the southern Baja, when total angling and non-angling trip expenses are taken together (excluding airfare to Mexico), billfish anglers taking charter boat and panga trips offshore spent US$44,411,914 in a one year period. Using a moderate economic multiplier (2.5) for the tourism sector in Baja California Sur, fishing-related expenditures had a total impact of $53,994,967 on the state's economy; when total expenditures ($44, 411,914) are considered, billfish anglers had a total economic impact of $99,926,807 on the state's economy (Ditton et al. 1996).

A second argument for development of recreational billfish fisheries in the Caribbean is the movement toward "catch and release" as a social norm within the billfish angler community. This means that stock abundance is more likely to be sustained concurrently with quality fishing and angler expenditures in support of local and national economies. Even with billfish tournaments, which have traditionally emphasized extrinsic rewards, i.e., money and prizes for the largest billfish landed, much is changing. There is a trend toward billfish tournaments which encourage "catch and release" in support of billfish conservation. As an indicator of this, billfish tournament anglers in the U.S. Atlantic (including the U.S. Caribbean) indicated a self-reported billfish release rate of 89%(Ditton and Fisher 1990). In this fishery, each angler kept one billfish per year on average. Actually, 29% of this group of tournament anglers accounted for 100% of the billfish brought to the dock. Among tournament anglers in Puerto Rico, release rates were lower but still 72% and 87% for resident and non-resident billfish anglers, respectively. Graefe et al. 1996 investigated the predictors of the decision to release all billfish caught annually by tournament anglers in the U.S. Atlantic (Ditton and Fisher 1992) and Puerto Rico (Ditton and Clark 1994). They reported that the best predictors of releasing all fish caught were the number of trips targeting billfish and the number of tournaments entered (the more trips and tournaments, the more likely one was to keep at least one billfish), geography (anglers in Puerto Rico tournaments were more likely to keep billfish), and income (the greater the income, the less likely

to keep billfish). Whereas level of formal education was not a significant predictor, members of fishing conservation organizations were significantly more likely to release all billfish caught.

Generally, there is consistency between anglers' self-reports of high billfish release rates and their management preferences. Most anglers in the U.S. Atlantic supported increased minimum sizes, increased minimum sizes for tournaments, mandatory "no-kill" tournaments, one billfish/ angler/ day, and a zero bag limit; most opposed decreasing minimum sizes, not having minimum sizes for tournaments, not having minimum sizes for fish that will be mounted, and recreational handlining and harpooning of billfish (Ditton and Fisher 1990). Most non-resident tournament billfish anglers in Puerto Rico supported increasing the minimum sizes for blue marlin, mandatory "no-kill" tournaments, catch and release only (zero bag limit), no stainless steel hooks, and they were opposed to recreational handlining and harpooning of billfish (Ditton and Clark 1994). Most resident tournament billfish anglers in Puerto Rico did not support these same management options with the exception of being opposed to recreational handlining and harpooning. There were numerous other differences between these two angler groups in demographic characteristics, fishing motivations, and orientation towards catch. Graefe et al. 1994 attributed these differences to cultural differences between groups. They suggested that management agencies need to be aware of cultural differences within the recreational fishing community if their efforts are to be effective and understood by the angling community.

Beyond angler management preferences and their practice of "catch and release", the maintenance of stock abundance and related angler expenditure levels depend on externalities from other activities like commercial longlining and other exploitative recreational fisheries in the region. Most (81%) charter boat billfish anglers in Costa Rica reported they were likely to go billfish angling elsewhere if "continued longlining in Costa Rica reduced billfish populations so ... chances of a successful trip were decreased by 25%" (Ditton and Grimes 1995); on the other hand, most (56%) charter boat billfish anglers in the southern Baja indicated they would not go somewhere else if their fishing success declined. Most would return to Mexico and some would target other species (Ditton et al. 1996). Perhaps they have fewer alternative billfish angling opportunities at the same level of cost. This question was not asked of non-resident anglers in Puerto Rico.

And finally, development of recreational billfish fisheries need not lead to overfishing as has been the case in commercial fisheries, or result in the problems typically associated with recreational fisheries development in various locales. As suggested by Holland et al. (1998), development of billfish fisheries, if done correctly, can be viewed from an ecotourism perspective, a

connotation usually reserved for birding and other non-consumptive wildlife-associated forms of outdoor recreation. The authors construct a template of ecotourism criteria from previous literature and evaluate billfish fisheries according to these established criteria. They conclude that billfish angling can be a form of ecotourism if it meets the criteria of:

i) a unique natural resource
ii) a unique clientele
iii) an activity of environmental resource responsibility
iv) with economic support for resource conservation
v) that provides an economic advantage for appreciative use, and
vi) with direct economic assistance to the local economy.

The authors argue that it is not the type of activity per se that qualifies it as ecotourism but the specific nature of the human behaviors involved, the distribution of economic benefits, and the associated social and economic impacts. Accordingly, it can be argued that birding and other supposedly non-consumptive recreational activities do not always qualify as ecotourism. Holland et al. (1998) make the case that billfish angling in the U.S. Atlantic and in Puerto Rico qualifies in many ways as ecotourism; an even stronger case was made for the recreational billfish fishery in Costa Rica.

While there may be many other locales or situations where billfish angling would not meet the various criteria for ecotourism, there is increasing peer pressure within this angler community to minimize its negative impacts and to enhance its positive impacts. The Presidential Challenge of Central America tournament series is an example of efforts to do exactly this. It was originally conceived as a means of encouraging billfish fisheries development from Mexico through Panama through increased governmental awareness of sustainable recreational fisheries and their benefits. The tournament series is catch-and-release only, employs locals only, depends on locally-produced goods and services, uses profits to support conservation through grants to local fisheries conservation organizations, and seeks to enhance economic development but without negative social and economic impacts (Vernon 1998). They recently co-sponsored the First Central American Conference for the Conservation of Sport Fishing in Panama City. Their goal was to make directors of tourism and fisheries agencies in Central American nations more aware of their more sensitive approach to recreational fisheries development.

MANAGEMENT IMPLICATIONS

As a part of their stewardship responsibilities, fisheries management agencies must make allocation decisions on a regular basis. For one, they must decide how they will use their available funding to carry out their management responsibilities. They must decide whether they will have both commercial and

recreational fisheries (not to mention small-scale subsistence fisheries) and with what management emphases. Many agencies are guided by tradition in these determinations; others are charged specifically with making decisions that are in the "public interest". The South Atlantic Fishery Management Council (1988) in the U.S., for example, developed the Fishery Management Plan for Atlantic Billfishes and reserved the billfish resource for its traditional use, which in the continental U.S. is almost entirely a recreational fishery. They did so because they believed they were optimizing "the social and economic benefits to the nation" (South Atlantic Fishery Management Council 1988); the U.S. Secretary of Commerce agreed with this thinking and approved the plan. This was a political decision based on "best available social and economic scientific data" which at the time was mainly billfish angler expenditure data and their economic impacts on the local community and region. No effort was made to calculate changes in economic benefits (net economic value) due to this allocation decision as per established economic valuation procedures (Huppert 1983). Ditton and Fisher (1990) completed the first economic valuation study of the U.S. Atlantic billfish fishery but only after the plan had been approved.

While economic impact understandings are derived from the expenditures made by billfish anglers (the cost of going fishing), economic value addresses how much resource users (in this case, billfish anglers) value the opportunity to use billfish resources. The extent to which anglers value their billfish fishing opportunity is partially expressed by their fishing expenditures, but this partial measure of total value excludes an additional value they would pay in a market situation before foregoing the opportunity to fish for billfish (This is commonly referred to as consumer's surplus or net economic value). Measures of willingness to pay in excess of trip expenditures can be used to estimate the value of these additional benefits to the individual (Huppert 1983, Edwards 1990; Waddington et al. 1994). The contingent valuation method (CVM) was used to estimate the net economic value (consumers' surplus) of billfish fishing in the U.S. Atlantic (Fisher and Ditton 1992), Puerto Rico (Ditton and Clark 1994), Costa Rica (Ditton and Grimes 1995), and in the southern Baja, Mexico (Ditton et al 1996). In each case, the net economic value of the billfish fishing experience was the difference between the total benefits received (total economic value) by anglers and the expenditures they incurred to go fishing and utilize the billfish resource.

Study results provide an estimate of the total economic value of billfish angling. In the U.S. Atlantic, for example, Fisher and Ditton (1992) reported that billfish tournament anglers were willing to pay an additional $262 (net economic benefits) annually above and beyond their total trip expenditures for the opportunity to catch billfish. Total aggregated annual net economic benefits ($2,073,730) added to aggregated annul billfish angler expenditures

($179,425,000) yielded a social value or an aggregated total economic value of $181,498,730 for billfish fishing in the U.S. Atlantic. In Puerto Rico, where catch per unit of effort was much higher than elsewhere in the U.S. Atlantic, the net economic benefits per trip were estimated at $549 (Ditton and Clark 1994).

When total aggregated annual net economic benefits ($18,138,926) were combined with total aggregated annual resident and non-resident angling expenditures of $21,320,926 and $4,459,270, respectively, the social value of billfish angling in Puerto Rico was estimated at $43,918,775. Similarly, the social values of the Costa Rica charter boat billfish fishery and the southern Baja, Mexico charter boat billfish fishery were estimated at $28,314,720 and $69,719,152, respectively.

Just what do these numbers mean? A comparative example might clarify their usefulness and meaning. When one purchases fish in the marketplace (dockside) there is a price that is paid by the consumer. This price includes the cost of inputs used to harvest the fish and a profit margin for the producer over and above costs. In purely competitive markets, the profit margin for the marginal producer would be a normal rate of return for this type of activity while in less competitive markets there is some return in excess of a normal rate due to an inability of others to enter the market to compete with existing producers. There may also be a return to nonmarginal producers in excess of the normal return, possibly due to scarcity of unique factors of production such as the best fishing locations. This latter return is often called scarcity rent or producer's surplus. Thus, the price of fish includes the cost of inputs and a normal rate of return for the marginal producer ("the last guy on the block" who goes fishing with less favorable resources and skills but yet is able to sell a desired product to the consumer). But some producers earn an additional return (inframarginal) due to the uniqueness of the inputs and skills they possess; this is referred to as the producers' surplus. Fish prices, in a well functioning market, capture economic opportunity costs for the marginal producer and, for nonmarginal producers (all those other than the "last guy in"), it captures a producers surplus as well. In a situation where markets do not exist, such as billfishing experiences, individuals pay a price by purchasing services from others (e.g., charter operators, tour agencies, hotels, restaurants, etc.) who cover their own expenses and earn a normal return and possibly a producer's surplus as well. Thus, it is possible to compare angler expenditures for billfish fishing with dockside fish prices.

But what about consumer's surplus? In the case of dockside fish sales, the consumer receives a residual value above the price paid which is termed consumer's surplus. Likewise, so too does the billfish angler. What happens when the fishery resource or, more specifically, the billfish resource is reduced in quantity (or, comparably, quality). In this case, dockside or other consumers of billfish as a food source would lose the consumer's surplus unless an alternative

source of supply can be found at the same price. When a product (of a resource) is non-unique, it will be available from other suppliers and possibly at the same price. If billfish can be purchased elsewhere for the same price, there is no loss of consumer's surplus. If purchased at a higher price, a portion of the consumer's surplus will be lost. Those supplying the resource and/or its products will be different and who receives the producer's surplus will thus be altered. But, provided these producer's surpluses are of the same or comparable magnitude, the changes may be largely self-canceling from a national or international perspective.

If billfish as a food source are viewed as closely substitutable with other types of fish, then the availability of these substitutes at comparable prices will mean there is minimal loss of consumer surplus. That is, even though the billfish resource is reduced, these consumers are still able to get what they want; a food source at the same cost.

If the billfish resource is unique and not available elsewhere, its loss will result in alteration of both consumer and producer surpluses. We argue that billfish meals as a food source are much less unique (have more substitutes) than billfish angling experiences (having fewer substitutes). Both billfish meals and billfish angling experiences require billfish in their production but the value of billfish in the latter is argued to be higher. Lessened billfish qualities or quantities clearly impact the valuation of angling experiences. Such changes imply a higher cost to anglers of producing a comparable billfishing experience to that received in the past, meaning that their consumer's surplus (residual above cost) is reduced, a direct welfare loss to consumers (billfish anglers). If resources are paid their opportunity costs in the marketplace, the producers of the inputs anglers use to produce their experiences will receive a normal rate of return for the inputs they sell (travel, etc.) but fewer billfishing trips consumed by anglers will imply lessened purchases and, thereby, lessened aggregate producer's surplus as well.

Thus, the net value of recreational billfish fishing is the summation of consumer and producer surplus associated with the activity, just as it is for commercial fish sales. However, more importantly, since the billfish fishery constitutes a unique recreational resource, reductions in billfish populations are largely irreplaceable for anglers. Thus, reductions (or increases) in billfish populations result in both producer and consumer surplus changes unlike those experienced in some other market good contexts. The loss to society from declining billfish population levels is the change in producer and consumer surplus (net valuation) while the expenditure to engage in billfish angling provides a measure of the direct economic impact upon regional economies and the ultimate indirect impacts linked to those expenditures as measured by

economic multipliers. (For a somewhat comparable discussion, see Stoll, Loomis, and Bergstrom 1987.)

Economic valuation results are useful in various ways. First, they provide a baseline for future comparisons. As more anglers are attracted to these fishing destinations and if fishing quality and conditions remain the same or improve, billfish angling will have even higher social values than reported here. This implies an important role for understanding the current baseline from which policy changes and their impacts must be compared. Second, with changes in fish abundance or management policies, it will be possible to measure and understand resultant changes in economic value with follow-up billfish angler studies. Growth in billfish populations will likely not lower commercial billfish prices nearly as much as it will increase the quality of billfish angling experiences. Furthermore, the expectation is that future growth in the demand for billfish angling will be greater than the demand for billfish as a food resource. Third, given the shift toward catch and release billfish fisheries, much of the social value of billfish angling reported here does not result in harvest and thus with careful attention to release mortality, an allocation of billfish to the recreational sector results in much higher values than might be the case in the commercial sector. Unfortunately, since comparable net economic benefits (producers' and consumers' surplus) associated with directed commercial fisheries are not known, efforts to optimize fisheries management decision making will continue to be difficult. There seems little reason to expect producers' surpluses from commercial fishing activities or from the suppliers of inputs selling services to recreationists to be vastly different. However, it is quite likely that the consumers' surpluses associated with consumption of billfish angling, a unique experience, are larger than the consumers' surplus associated with consumption of commercial billfish catch, which is one of a variety of other seafood and non-seafood nutritional sources. That is, there are fewer substitutes for billfish angling experience than there are for billfish as a nutritional source.

FUTURE RESEARCH NEEDS

There are still additional research needs. First, there is the matter of resource substitution. If billfish anglers are constrained by various factors where they currently fish, the question is where are they likely to go fishing and whether they will receive the same level of satisfaction enjoyed previously at the original fishing location. Billfish angler substitution behavior was investigated previously in Costa Rica using a scenario which described a change in fishing outcomes (reduced billfish populations which reduced their chances of a successful fishing trip by 25%) and inquired how their travel plans would change as a result(Ditton and Grimes 1995). Most anglers responded they would travel to an alternate location to fish for billfish. The alternate locations (top five in

order of preference) were: Panama, Venezuela, Mexico/ Pacific, Guatemala, and Mexico/ Caribbean. We need to better understand what areas will be the most likely substitutes for major billfish angling destinations in the Caribbean and the most important predictors for those making decisions about substitute destinations. For management purposes, it will be important to understand the extent of additional stresses, which will be placed upon these alternative destinations in the future.

Second, billfish angler preferences for various management measures need to be better understood among the trade-offs made in terms of the various management attributes under consideration. Previously, common practice was to ask anglers to rate a series of single management options in terms of their support or opposition; options were separate from each other and usually did not approximate the complexity of final choices made by decision makers. While it is good that managers want to know more about angler preferences, this traditional approach produces results, which are artificial, at best in that trade-offs are not considered among items. In the future, much more attention needs to go to stated preference and stated choice analyses because these techniques allow respondents to "evaluate technologically new or otherwise radically different... management concepts" (Louviere and Timmermans 1990). Conjoint measurement, for example, is used to identify the most desirable combination of features for management measures from an angler perspective. This technique is currently being used by Gillis (1998) to estimate preference functions and describe how billfish anglers (in this case, members of The Billfish Foundation) combine their preferences for various choice options to form an overall opinion of (or preference for) particular management options under consideration for the revised U.S. Atlantic Billfish management Plan.

Third, economic valuation research efforts need to go beyond willingness-to-pay for the current billfish angling experience to examine the willingness-to-pay or net economic benefits under various management conditions. This methodology was recently used to understand differential willingness-to-pay under three different catch scenarios in the Cape Hatteras Bluefin Tuna fishery including total catch and release (Ditton et al. 1998). Results showed that net economic benefits associated with the most restrictive management regime (total catch and release) were as expected less than the least restrictive management regime (one billfish retained/ person) but differences were not that great. The study concluded that, given a goal of increasing total economic benefits without any additional quota, a greater number of catch and release anglers needed to be attracted to the fishery.

There are educational and extension needs as well. In particular, more meetings, which bring together billfish researchers from all relevant disciplines, are an important investment in professional training and involvement and in so

doing, they help to rationalize the process of billfish management. A Third International Billfish Symposium needs to be held as soon as possible to promote communication among researchers and with policy makers, update what is known about billfish fisheries by region of the world since 1988, and revise the international research agenda. Complementarily, the Billfish Research Symposium held at the 1994 and 1998 meetings of the Gulf and Caribbean Fisheries Institute need to be held annually to encourage close working relationships and greater understanding at the regional level. And finally, a basic but important need - fisheries professionals in Caribbean nations should be encouraged to write and publish detailed descriptions of their marine recreational billfish fisheries. Some notable examples include the southeastern United States (Schmied and Burgess (1987), the Caribbean (Campos 1985), and Central America (Barrantes and Poma 1985). Emphasis should be given to species targeted, catch per unit effort measures, number of licenses sold, charter fleet size and distribution, number and distribution of fishing tournaments held, and other characteristics of their marine recreational fishery. This information could serve as the basis for informed discussions among neighbor nations in the Caribbean regarding tourism development strategies and billfish fisheries management needs.

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