

Understanding Catch and Release Behavior Among Billfish Anglers

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ABSTRACT

Increasingly, catch and release is an emerging trend in billfish angling in Gulf and Caribbean waters. This paper examines the catch and release behavior of billfish anglers in an effort to understand the best predictors of release behavior. Data come from two studies of billfish tournament anglers, one involving participants in 27 billfish tournaments hosted along the Atlantic and Gulf of Mexico in the United States, and the other involving registrants in 14 Puerto Rican billfish tournaments. Sampled anglers in each study received a mail questionnaire which included questions on motivations, attitudes, opinions on management, fishing behavior patterns, and angler characteristics. Predictive models of catch-release behavior were developed using logistic regression and ordinary least squares regression analyses. Results showed that 62% of the billfish anglers reported returning all of the billfish they caught during the previous 12 months, with the remaining 38% keeping at least one billfish. The best predictors of releasing all billfish 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 the Puerto Rican tournaments were more likely to keep billfish), and income (the greater the income, the less likely to keep billfish). In predicting the number of billfish kept (which ranged from none to 25), income was the strongest predictor. It was noteworthy that level of formal education showed no relationship with keeping or releasing billfish. Club membership, on the other hand, contributed to releasing behavior as members of fishing conservation organizations were significantly more likely to release all of their billfish catch. Implications for fisheries management, tourism development, and educational efforts in the Gulf and Caribbean are highlighted.

KEY WORDS: Catch and release fishing, billfish

INTRODUCTION

Whereas not all billfish anglers practice catch and release techniques, there appears to be a growing trend among billfish anglers to do so. There are many purposes for releasing fish; they include doing one's share to prevent over fishing, enhancement of fishing opportunities for all anglers, reduction of waste,

and increased chances of catching larger billfish. Increasingly, tournaments have instituted minimum sizes and catch and release categories. Fisheries conservation groups like the International Game Fish Association (IGFA) have developed slogans such as "They're too valuable to catch just once!" to promote programs that encourage more widespread adoption of catch and release among billfish anglers. Several marine fisheries conservation organizations are seeking to replicate the success of catch and release fishing among bass anglers in fresh water. To promote increased release of fish caught will require marketing approaches whereby effective communications are targeted to anglers who are more likely to be receptive. Likewise, regions such as the Caribbean that are interested in both ecotourism and economic development may develop tourism strategies to attract anglers who minimize their impacts by utilizing catch and release techniques where appropriate (Holland *et al.* under review).

Overall, catch and release is a complex concept with multiple meanings to managers and anglers alike. First, it can be a requirement imposed on anglers by fishery management agencies or private sector access providers. In the latter case, for example, charter boat captains can enforce the requirement that all billfish caught are released. Also, catch and release can be a more socially-acceptable means of disposing of unwanted fish (fish too small, fish not targeted, don't want to eat the fish, etc.), a way to continue fishing after limits have been reached, or a meaningful fishing alternative where anglers voluntarily limit their take. These multiple meanings together with the changing context of fishing trips, i.e., social group fished with, species targeted, species caught, etc., make catch and release questions some of the most problematic to ask in an angler survey. Not surprisingly, from our experience, the most likely response from anglers to a direct question as to whether or not they practice catch and release is "it depends." All anglers probably practice catch and release at one time or another for one or more of the aforementioned reasons.

The problem with asking questions about catch and release may be reduced through a species-specific focus. This approach was used in the 1985 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation which focused questions on anglers targeting the two most popular freshwater species sought. Overall, 21% of all black bass anglers nationwide reported releasing all the fish they caught; about 36% indicated they voluntarily released some fish (USFWS, 1988). The reason cited most often for release by both groups of catch and release anglers was that the legal fish caught were too small. These results, however, don't provide much insight to the thinking of those anglers who release all of the bass they caught. Along with the definitional problems cited earlier, there are problems associated with classifying anglers as catch and release anglers. It would appear that the most reliable means would be classifying anglers according to whether they always practice catch and release for a

particular species or not.

Despite the definition and classification problems, there is little previous research on the characteristics of catch and release anglers. Grambsch and Fisher (1991) provide participation rates (percent who participate) in catch and release (all the time or sometimes) for various subgroups of black bass and trout anglers nationwide; currently, this provides the only available basis for hypothesizing likely predictors of release behavior among billfish anglers. For bass fishing, for example, rates of participation in catch and release were highest for anglers who were : 1) male, 2) 18- 24 years of age, 3) rural residents, 4) lived in the mid-Atlantic states, 5) with household incomes of \$30,000 - \$49,999, 6) had four or more years of college, 7) fished 30 days or more, and 8) who caught 26 fish or more in the previous year. Overall, significant positive correlations were identified for several variables (household income, education level, fishing frequency, and number of fish caught in a one year period). Although not specific to those who released all of their fish, this provides the most informed basis for hypothesized predictors of catch and release participation.

It is well established in the behavioral and human dimensions literature that specific behaviors, such as releasing billfish, are best predicted by a series of related attitudes and beliefs, and that the strength of the attitude-behavior relationship depends on the congruency in the level of specificity at which the concepts are measured (Fishbein and Ajzen, 1975). For example, Donnelly and Vaske (1995) found that approval of a proposed moose hunt in New Hampshire was more strongly related to specific beliefs about the moose population and proposed hunt than to demographic characteristics or more general beliefs about hunting or the State Fish and Game Department. Since national survey data did not include any attitudinal or belief variables, it was impossible for Grambsch and Fisher (1991) to investigate their relationships with catch and release previously.

The objective of this paper is to identify the best predictors of catch and release behavior among billfish anglers in the U.S. Atlantic Ocean. This examination includes identification of predictors of total catch and release participation (i.e. releasing all billfish caught) as well as predictors of the number of billfish kept among those who keep one or more billfish. It is hoped that results will provide support for ongoing billfish management efforts (South Atlantic Fishery Management Council, 1988) and all of the related applications mentioned earlier. It is important that program planners have a better means of targeting their educational efforts to promote more widespread adoption of the catch and release philosophy and technique among the billfish angler community. Besides serving as a benchmark study of the multivariate predictors of release behavior, this paper will hopefully produce a better understanding of catch and release in other fisheries of managerial interest as well.

METHODS

The data for this paper were drawn from billfish angler surveys conducted in the U.S. Atlantic region (Fisher and Ditton, 1992; Ditton and Clark, 1994). The sampling frame consisted of registrants in 27 billfish tournaments (or tournaments with billfish categories) held along the U.S. Atlantic coastline (Maine to Texas including Puerto Rico and the U.S. Virgin Islands) during 1991 and participants in 14 billfish tournaments held in Puerto Rico in 1992. The sampling focus on tournament billfish anglers was necessary because there are few anglers overall who target billfish and thus they do not show up appreciably in national or regional surveys (a rare event fishery!). Because there is no sampling frame available for billfish anglers, focusing on tournaments was also an efficient means of identifying billfish anglers. A random sample of anglers from each tournament list was sent a ten-page questionnaire about their billfish angling overall (not just the tournament where they were sampled), which had been pre-tested previously by the authors. The questionnaire included questions on anglers' reasons for fishing (motivations), fishing patterns, management opinions, and demographic characteristics.

Survey procedures followed a slightly modified Dillman (1978) survey methodology which featured two additional mailings plus a reminder card to non-respondents as necessary. Special efforts were made to personalize survey mailings to enhance response rates. The effective response rate for the U.S. Atlantic study was 61% (n = 1089), within the range of response rates achieved in a series of ten statewide angler surveys conducted in Texas between 1986 and 1994 (Hunt and Ditton, in press). The effective response rate achieved from the Puerto Rico sample of billfish anglers was 49% (n = 399).

To avoid having to assume non-respondents were similar to respondents, a non-respondent check was conducted for the North Atlantic survey. If non-respondents are different from respondents with respect to study variables, some angler segments will be over or under represented, and inferences made from respondents to the population will be subject to bias (Fisher, 1996). An abbreviated telephone survey of non-respondents was completed to identify characteristics of non-respondent billfish anglers for comparison purposes with respondents; no significant differences were detected (Ditton and Fisher, 1990). Since billfish anglers in Puerto Rico often listed business and post office boxes as addresses, it was not possible to complete a non-response check there.

Variables

The dependent variable of catch and release behavior was operationalized through a direct question that asked respondents how many billfish they had brought back to the dock during the past twelve months. Responses ranged from

0 to 25 fish, with 62% reporting none. Most of the analysis focused on discriminating between the 62% who kept no billfish and the other 38% who reported keeping one or more.

Independent variables were categorized into three groupings as follows. *Demographic characteristics* included age, income, education, gender, and geographic region (Mainland U.S. versus Puerto Rico). The second category of independent variables included a battery of *fishing behavior variables*, including years of experience in billfishing specifically and saltwater fishing generally, perceived fishing skill, level of participation as reflected in total days of fishing during the past year and number of tournaments entered during the past year, ancillary activities including membership in fishing conservation organizations and subscription to fishing-related magazines, and several questions dealing specifically with their billfish catch during the past year. Since one can only keep billfish that one has caught first, the latter questions represented the *opportunity* to keep billfish and included the reported number of trips where billfish were specifically targeted, the number of trips in which a billfish was brought to the boat, and the number of days it usually took the respondent to boat a billfish. The final category of independent variables, *fishing attitude variables*, included several fishing motivations, attitudes towards catching fish (consumptive propensity), willingness to pay for billfish conservation and management, and opinions about selected billfish management practices. These variables were believed to be conceptually relevant to the specific behavior of releasing billfish and were thus included in the analysis.

Data Analysis

To test the relationships between catch and release behavior and the full set of potential predictor variables, the odds of respondents' returning all billfish were examined. If n_1 is the number of individuals who return all of their billfish, and $n - n_1$ are people who kept one or more fish during the past year (where n is the sample size), then the estimated odds of returning all billfish are:

$$\text{ODDS} = n_1 / n - n_1 = p / 1 - p$$

where $N = n_1/n$ is the proportion of the sample who kept no billfish during the past year. The odds of returning all fish were calculated for various combinations of the independent variables. We estimated the odds of keeping no billfish and determined if they varied among respondents with different demographic characteristics, fishing behavior patterns, and fishing attitudes. Because odds are not normally distributed, log-linear models were used (Goodman, 1970, 1972, Bishop *et al.*, 1975).

The predictive power of the three classes of independent variables was examined using logistic regression. Separate equations were fitted for each set of predictor variables as well as for a model that included all independent variables simultaneously. Finally, ordinary least squares multiple regression was conducted with the same variables using their original continuous measurement scales. This analysis focused on determining predictors of the number of billfish kept during the past year versus the dichotomy of releasing all or keeping one or more billfish. Correlations among the predictor variables indicated that multicollinearity was not an issue.

While most of the variables were used directly in the analysis, some preliminary steps were needed to prepare the fishing motivations and attitudes variables. Since both of these concepts were measured through a series of numerous items, factor analyses were conducted to search for underlying dimensions of motivation and attitude. Resulting factors were further assessed through reliability analysis. This analysis yielded four motivation factors and three attitude factors, whose item composition is shown in Table 1. Further, for use in the logistic regression analysis, all independent variables were recoded into dichotomous variables. Scores as close to the median as possible were used to create the low and high categories for each variable.

RESULTS

Most respondents reported that they kept no billfish during the past year; 62% reported none while 38% kept at least one billfish (Table 2). The odds of keeping no billfish were 1.63 to 1 among respondents. As predicted by previous research, individuals reporting lower annual incomes were more likely to keep at least one billfish, as were younger anglers (under 45 years old) and those sampled in Puerto Rico. The odds for these variables differed from the odds of releasing billfish for the entire sample. Neither gender ($\chi^2 = 1.60$, $df = 1$, $P = 0.200$), nor years of formal education ($\chi^2 = 0.7$, 1 df , $P = 0.401$), however, influenced the odds of releasing all billfish caught.

Relative to fishing behavior variables, one's experience as reflected by number of years billfishing made little difference but their overall years of saltwater fishing was significant; those with more experience were much more likely to keep no billfish ($\chi^2 = 20.8$, $df = 1$, $p = .001$). Similarly, skill level made no significant difference but focusing one's effort on a particular species was associated with a greater likelihood of keeping at least one billfish ($\chi^2 = 29.8$, $df = 1$, $p = .001$). The number of tournaments participated in during the past year was significantly associated with catch and release behavior, as those who participated in 3 or fewer tournaments were much more likely to keep no billfish than those entering 4 or more tournaments ($\chi^2 = 78.1$, $df = 1$, $p = .001$). Likewise, greater overall fishing participation was associated with a greater

Table 1. Item composition and reliability analysis for fishing motive and attitude scales.*

	Item Mean	Standard Deviation	Item-Total Correlation	α if Item Delete
Motive 1 - Challenge Experience ($\alpha = .77$)				
For the experience of the catch	4.1	1.0	.50	.73
To develop my skills	3.5	1.2	.49	.75
For the challenge or sport	4.2	0.9	.67	.65
To experience adventure and excitement	4.1	1.0	.61	.68
Motive 2 - Nature Appreciation ($\alpha = .65$)				
To be outdoors	3.9	1.0	.47	.56
For family recreation	3.2	1.2	.32	.63
To experience new and different things	3.3	1.2	.38	.60
To be close to the sea	4.0	1.0	.41	.58
To experience unpolluted natural surroundings	3.9	1.1	.44	.57
Motive 3 - Trophy Seeking ($\alpha = .66$)				
To test my gear	2.5	1.2	.37	.69
To win a tournament	2.5	1.3	.49	.54

Table 1 (continued).

	Item Mean	Standard Deviation	Item-Total Correlation	α if Item Delete
To obtain a "trophy" fish	2.9	1.4	.57	.42
Motive 4 - Relaxation/Escape ($\alpha = .67$)				
For relaxation	4.2	1.0	.41	.62
To get away from the demands of other people	3.3	1.4	.45	.61
To get away from the regular routine	3.9	1.0	.56	.43
Attitude 1 - Catch Not Important ($\alpha = .65$)				
A fishing trip can be successful even if no fish are caught**	2.1	1.0	.48	N.A.
When I go fishing, I'm just as happy if I don't catch a fish**	3.1	1.2	.48	
Attitude 2 - Want Big Fish ($\alpha = .65$)				
I would rather catch one or two big fish than ten smaller fish	3.8	1.1	.49	N.A.
The bigger the fish I catch, the better the fishing trip	3.5	1.1	.49	

Table 1 (continued).

	Item Mean	Standard Deviation	Item-Total Correlation	α If Item Deleted
Attitude 3 - Want Many Fish ($\alpha = .67$)				
The more fish I catch, the happier I am	3.3	1.2	.50	N.A.
A successful fishing trip is one in which many fish are caught	3.0	1.1	.50	

* Motive items were scored on a 5-point scale where 1=not at all important and 5=extremely important. Fishing attitude items were measured on a 5-point scale where 1=strongly disagree and 5=strongly agree.

**These items were reverse coded for computation of the attitude index.

likelihood of keeping at least one billfish $\chi^2 = 22.3$, $df = 1$, $p = .001$). More specifically, the more trips made that were specifically targeting billfish ($\chi^2 = 92.1$, $df = 1$, $p = .001$) and the more trips where billfish were actually brought to the boat ($\chi^2 = 92.4$, $df = 1$, $p = .001$), the more likely it was that at least one billfish was kept. Likewise, the more days that were needed to boat a billfish, the more likely respondents were to keep at least one fish ($\chi^2 = 27.5$, $df = 1$, $p = .001$), suggesting that overall fishing effort was more important than fishing success in influencing the disposition of the catch. Finally, among the ancillary activities considered, being a member of a fishing club increased the odds of releasing all billfish substantially ($\chi^2 = 21.4$, $df = 1$, $p = .001$), while subscribing to fishing-related magazines seemed to make no difference ($\chi^2 = 0.4$, $df = 1$, $p = .531$).

Several attitudinal variables were also associated with releasing billfish. Among the fishing motives, the importance of "trophy seeking" was most strongly related to keeping billfish; those less interested in this motive were much more likely to release all of their billfish ($\chi^2 = 38.4$, 1 df , $P = .001$). Similarly, those to whom catching fish was less important overall (Attitude 1) were less likely to keep billfish ($\chi^2 = 10.0$, 1 df , $P = .002$) and those placing more importance on catching many fish (Attitude 3) were more likely to keep at least one billfish ($\chi^2 = 11.0$, 1 df , $P = .001$). Interestingly, the amount one was willing to pay to support billfish conservation and management showed no relationship to catch and release behavior ($\chi^2 = 0.5$, 1 df , $P = .498$), but one's opinions about management practices were strongly related to releasing billfish. Those who favored mandatory no kill tournaments ($\chi^2 = 54.6$, $df = 1$, $p = .001$) and catch and release fishing only or zero bag limit ($\chi^2 = 80.0$, $df = 1$, $p = .001$), not surprisingly, were much more likely to release all billfish caught.

Multivariate analysis of these relationships confirmed the relative importance of most of these significant predictor variables (Table 3). Among the demographic characteristics, only age and geographic location contributed significantly to the logistic regression model, and only geographic location remained in the complete model that included all of the variables. Among the fishing behavior variables, the strongest predictors were the number of tournaments participated in during the past year, focusing one's effort on a particular species, membership in a fishing conservation club or organization, and the three indicators representing billfish catch (number of trips targeting billfish, number of trips where billfish were caught, and days required to boat a billfish). All of these variables except for club membership remained significant in the complete model containing all variables. Relative to fishing attitudes, the trophy seeking (direct relationship) and relaxation/escape (inverse relationship) motives contributed significantly to the reduced model containing only the attitude variables, but dropped out of the complete model with the other

categories of variables included. Several of the fishing attitude (consumptive propensity) measures figured significantly in both the reduced and complete models. And the degree of support for mandatory no kill tournaments and catch and release restrictions contributed significantly to both the fishing attitude reduced model and the complete regression model, as would be expected on the basis of the attitude-behavior literature.

Each of the reduced models (demographic characteristics only, fishing behavior variables only, and fishing attitude variables only) showed similar explanatory power, correctly classifying 67 to 68% of the anglers into those who keep one or more billfish versus those who release all billfish. The explanatory power of the complete model containing all three sets of variables increased to 73% correctly classified.

Finally, multiple regression analysis focusing on these same sets of variables in their continuous form reconfirmed most of the same relationships. Among the demographic variables, geographic location and income were significant in both the reduced and complete regression models. The importance of geography is consistent with the logistic regression results, but the effect of income represents a notable difference between the two analyses. Apparently, income plays a greater role in the number of billfish kept than it does in the decision about whether or not to release all billfish.

Regarding fishing behavior variables, the strongest predictors of the number of billfish kept were the number of fishing trips targeting billfish and number of tournaments entered during the past year, both of which reflect greater opportunity to catch and keep billfish. Experience in billfishing and saltwater fishing generally seem to cancel each other out, as years billfishing leads to more billfish kept while years of overall saltwater fishing experience correlates negatively with the number of billfish kept. Several additional behavioral indicators (club membership, subscription to magazines, focusing effort on one species) that played minor, though statistically significant, roles in the behavior reduced model dropped out of the complete regression model with all sets of variables included.

The strongest attitudinal predictors of the number of billfish kept were the trophy seeking motive, the attitude that catch and the number of fish caught are important, and support for catch and release regulations. Only the consumptive attitude and support for regulations variables carried through to the complete regression model. The various reduced regression models explained between 8% and 12% of the variance in the number of billfish kept by billfish anglers. The fishing attitude and behavior models were slightly stronger ($R^2 = 11-12\%$) than the demographic characteristics model ($R^2 = .08$). The combined model with all three sets of variables accounted for 22% of the variance in the number of billfish kept and included at least two variables from each category.

Table 2. Estimated odds of releasing all billfish caught, by demographic characteristics, fishing behavior variables, and fishing attitude variables.

	Catch-Release Behavior						X ²	P
	Release Billfish Caught	All Caught	Keep Least Billfish	At One	Estimated Odds of Releasing All Billfish			
	n	%	n	%				
Entire Sample	922	62%	566	38%	1.63			
Demographic Characteristics								
Age						20.0	.001	
Under 45	403	56%	314	44%	1.28			
45 or Older	513	68%	247	32%	2.08			
Region						103.1	.001	
Mainland U.S.	759	70%	330	30%	2.30			
Puerto Rico	163	41%	236	59%	0.69			
Income						11.4	.001	

Table 2 (continued).

	n	%	n	%	χ^2	P
Under \$100,000	384	57%	287	49%	1.34	
\$100,000 and Above	490	66%	253	34%	1.94	
Education					0.7	.401
Less than 16 years	344	61%	224	39%	1.54	
16 Years or more	561	63%	333	37%	1.68	
Gender					1.6	.200
Male	892	62%	553	38%	1.61	
Female	26	72%	10	28%	2.60	
Fishing Behavior Variables						
Years Billfishing					2.3	.131
Less than 12 years	439	60%	288	40%	1.52	
12 years or more	477	64%	266	36%	1.79	
Years Saltwater Fishing					20.8	.001
Less than 23 years	409	56%	318	44%	1.29	
23 years or more	507	68%	241	32%	2.10	

Table 2 (continued).

	n	%	n	%	χ^2	P
Self-assessed Fishing Ability					0.4	.509
Less skilled or equal	597	63%	357	37%	1.67	
More skilled than others	320	61%	206	39%	1.55	
Focus Effort on One Species					29.8	.001
Yes	503	56%	390	44%	1.29	
No	410	70%	172	30%	2.38	
# of Tournaments Last Year					78.1	.001
3 or fewer	524	74%	189	26%	2.77	
4 or more	393	51%	375	49%	1.05	
Total Days Fishing Last Year					22.3	.001
30 or fewer	500	68%	235	32%	2.13	
More than 30	418	56%	327	44%	1.28	
Member of Fishing Club					21.4	.001
Yes	669	66%	342	34%	1.96	
No	247	54%	214	46%	1.15	
Subscribe to Fishing Magazines					0.4	.531
Yes	780	62%	474	38%	1.65	

Table 2 (continued).

	n	%	n	%	χ^2	P
No	135	60%	90	40%	1.50	
Days Needed to Boat a Billfish					27.5	.001
2 or fewer	395	67%	196	33%	2.02	
3 or more	362	52%	329	48%	1.10	
Trips with Billfish Brought to Boat					92.4	.001
2 or fewer	546	74%	190	26%	2.87	
3 or more	352	50%	357	50%	0.99	
Number of Trips Targeting Billfish					92.1	.001
7 or fewer	526	75%	179	25%	2.94	
8 or more	383	50%	379	50%	1.01	
Fishing Attitude Variables						
Motive 1 - Challenge Experience*					6.3	.012
4.0 or less	529	65%	288	35%	1.84	
4.25 or more	383	58%	273	42%	1.40	
Motive 2 - Nature Appreciation*					0.1	.782
3.75 or less	452	62%	279	38%	1.62	
3.80 or more	464	63%	278	38%	1.67	

Table 2 (continued).

	n	%	n	%	χ^2	P
Motive 3 - Trophy Seeking*					38.4	.001
2.5 or less	481	70%	203	30%		
2.67 or more	425	55%	354	45%		
Motive 4 - Relaxation/Escape*					10.1	.001
3.67 or less	427	58%	309	42%		
4.00 or more	485	66%	249	34%		
Attitude 1 - Catch Not Important**					10.0	.002
2.5 or less	485	58%	345	42%		
3.0 or more	429	67%	216	34%		
Attitude 2 - Want Big Fish**					4.1	.044
3.5 or less	443	65%	242	35%		
4.0 or more	470	60%	319	40%		
Attitude 3 - Want Many Fish**					11.0	.001
3.0 or less	505	66%	261	34%		
3.5 or more	406	58%	300	42%		
Willing to Pay for Billfish Mgmt.					0.5	.498
\$100 or less	439	63%	260	37%		

Table 2 (continued).

	n	%	n	%	χ^2	P
More than \$100	305	61%	196	39%	1.56	
Support No Kill Tournaments					54.6	.001
Oppose or Neutral	355	52%	329	48%	1.08	
Support/Strongly Support	529	71%	217	29%	2.44	
Support Catch & Release Only					80.0	.001
Oppose or Neutral	355	50%	349	50%	1.02	
Support/Strongly Support	530	73%	192	27%	2.76	

* Motive importance was measured on a 5-point scale where 1=not at all important and 5=extremely important.

** Fishing attitudes were measured on a 5-point scale where 1=strongly disagree and 5=strongly agree.

Table 3. Logistic regression analysis of the effect of demographic variables, fishing behavior variables, and fishing attitude variables on catch and release behavior among billfish anglers.

		Dependent Variable: Keep One or More Billfish Versus Release All							
		Reduced Model			Complete Model				
		B	Wald	R	Exp(B)	B	Wald	R	Exp(B)
Demographic Characteristics									
Age		-0.36	9.3*	-0.06	.70	-0.08	0.2	.00	.92
Region		1.08	72.1*	.19	2.97	.91	19.7*	.12	2.48
Income Level		-0.11	0.9	.00	.89	-0.24	1.8	.00	.79
Education Level		-0.11	0.8	.00	.90	-0.10	0.3	.00	.91
Gender		-0.59	2.1	-0.01	.55	-0.47	0.7	.00	.62
Constant		-0.9	4.6*						
Percent Correctly Classified		67%							

Table 3 (continued).

Fishing Behavior Variables

Years Billfishing	-.19	1.7	.00	.83	-.20	1.2	.00	.82
Years Saltwater Fishing	-.32	5.1*	-.04	.72	-.25	2.0	.00	.78
Self-assessed Fishing Ability	.05	0.1	.00	1.05	.27	2.3	.02	1.31
Focus Effort on One Species	-.60	19.4*	-.10	.55	-.61	12.7*	-.09	.54
Number of Tournaments Last Year	.69	24.8*	.12	2.00	.62	12.8*	.09	1.86
Total Days Fishing Last Year	.14	1.0	.00	1.15	.32	3.4	.03	1.38
Member of Fishing/Conservation Club	.71	22.6*	.11	2.02	.18	0.8	.00	1.19
Subscribe to Fishing Magazines	.12	0.4	.00	1.13	-.26	1.0	.00	.77
Number of Days Needed to Boat a Billfish	.45	11.7*	.08	1.57	.33	3.9*	.04	1.39
Number of Trips with Billfish Brought to Boat	.46	10.0*	.07	1.58	.51	8.3*	.07	1.66
Number of Trips Targetting Billfish Last Year	.49	11.1*	.08	1.63	.41	5.2*	.05	1.51
Constant	-1.66	19.8*						
Percent Correctly Classified	68%							

Table 3 (continued).

Fishing Attitude Variables

Motive 1-Challenge Experience	.24	2.8	.02	1.27	-0.00	0.0	.00	1.00
Motive 2-Nature Appreciation	.02	0.0	.00	1.02	.10	0.4	.00	1.11
Motive 3-Trophy Seeking	.53	13.4*	.09	1.70	.05	0.3	.00	1.05
Motive 4-Relaxation/Escape	-.52	14.3*	-.09	.60	-.30	3.2	-.03	.74
Attitude 1-Catch Not Important	.53	10.1*	.07	1.71	-.35	4.3*	-.04	.70
Attitude 2-Want Big Fish	.01	0.0	.00	1.01	.34	4.1*	.04	1.40
Attitude 3-Want Many Fish	.31	5.1*	.05	1.36	.16	0.9	.00	1.18
Willingness to Pay for Billfish Management	.31	5.3*	.05	1.36	.11	0.4	.00	1.11
Support Mandatory No Kill Tournaments	-.41	7.5*	-.06	.67	-.50	7.4*	-.07	.61
Support Catch and Release Only (zero bag limit)	-.81	29.7*	-.14	.44	-.67	13.1*	-.10	.51
Constant	-0.80							
Percent Correctly Classified	67%							
Constant: Overall Model					-0.6	0.6		
Percent Correctly Classified: Overall Model					73%			

* Significant at .05 level or below

Table 4. Multiple regression analysis of the effect of demographic variables, fishing behavior variables, and fishing attitude variables on the number of billfish kept during the past year.

	Dependent Variable: Number of Billfish Kept in Past Year		
	Reduced Models		Complete model
	B	Beta	Pearson r
Demographic Characteristics			
Age	.01	-.02	-.10*
Region	.74	.15*	.20*
Income Level	-.10	-.18*	-.22*
Education Level	.02	.03	-.00
Gender	-.54	-.04	-.02
Constant	1.42		
Coefficient of Determination (R ²)	.08		
Fishing Behavior Variables			
Years Billfishing	.02	.11*	.05
Years Saltwater Fishing	-.02	-.15*	-.10*
			.02
			-.01
			.09*
			-.09*

Table 4 (continued).

Self-assessed Fishing Ability	.15	.04	.07*	.13	.04
Focus Effort on One Species	-.31	-.07*	-.13*	-.22	-.06
Number of Tournaments Last Year	.09	.14*	.20*	.04	.06
Total Days Fishing Last Year	.00	.02	.12*	.00	-.01
Member of Fishing/Conservation Club	.35	.08*	.07*	.14	.04
Subscribe to Fishing Magazines	.51	.09*	.08*	-.04	-.01
Number of Trips Targeting Billfish	.02	.22*	.23*	.02	.17*
Trips with Billfish Brought to Boat	-.02	-.09*	.10*	.01	.04
Days Needed to Boat a Billfish	-.01	-.02	.01	-.01	-.05
Constant	-0.37				
Coefficient of Determination (R^2)	.11				
Fishing Attitude Variables					
Motive 1-Challenge Experience	.16	.06	.11*	.05	.02
Motive 2-Nature Appreciation	-.09	-.04	-.06*	-.13	-.05*
Motive 3-Trophy Seeking	.20	.11*	.18*	.07	.04
Motive 4-Relaxation/Escape	-.21	-.10*	-.09*	-.09	-.04
Attitude 1-Catch Not Important	-.27	-.13*	-.07*	-.12	-.06*
Attitude 2-Want Big Fish	.01	.01	.09*	.07	.04

Table 4 (continued).

Attitude 3-Want Many Fish	.21	.11*	.15*	.11	.06*
Willingness to Pay for Billfish Management	-.00	.00	-.02	-.00	-.05
Support Mandatory No Kill Tournaments	-.12	-.09*	-.21*	-.15	-.11*
Support Catch and Release Only (zero bag limit)	-.21	-.16*	-.25*	-.14	-.11*
Constant	2.00				
Coefficient of Determination (R ²)	.12				
Constant: Overall Model				1.81	
Coefficient of Determination (R ²): Overall Model					.22

* Significant at .05 level or below

DISCUSSION

Data reported here show that variables in each of three categories (demographics, fishing behavior variables, and fishing attitude variables) were related to catch and release fishing behavior. Contrary to some previous research, however (e.g. Donnelly and Vaske, 1995), the logistic regression models for each category showed similar levels of predictive power. The demographic characteristics resulted in nearly as accurate a level of correct classification as the models containing much more specific attitudinal and behavior variables, and the overall model with all three sets of variables included was markedly superior to any of the reduced models. The levels of percent correctly classified using logistical regression are relatively low, but do provide insights into the factors underlying catch and release behavior.

Similarly, the amount of variance accounted for by the multiple regression was relatively low in relation to the usual range of variance accounted for in recreation/human dimensions studies? We can only speculate on why the fairly extensive pool of predictor variables failed to account for a larger share of the variance in billfish releasing behavior. Future studies should attempt to include more attitudes and behaviors that are more conceptually and specifically related to catch and release behavior. For example, beliefs about the status of billfish populations and the impacts of fishing on the fish population may yield much stronger predictions of catch and release behavior than the more general management preference variables measured in the current data sets.

Results provide some useful priorities for those involved in marketing the catch and release angling philosophy to billfish anglers as well as identifying anglers who are likely to catch and release all billfish caught. Catch and release messages need to be directed to particular angler market segments which over represent older, wealthier anglers and those who belong to fishing clubs. Besides being strong predictors of release behavior, this focus on demographic descriptors is in keeping with the advice of Salwasser *et al.*, (1989) and Witter and Adams (1994) who recommend a marketing perspective among natural resource managers and others. Market segmentation involves the partitioning of potential clients into groups with similar characteristics that are likely to exhibit similar behaviors (Backman, 1994). Further, additional adoption and diffusion efforts need to be focused on Puerto Rico where the odds of releasing all billfish are much less than on the U.S. mainland. Because fishing club members are much more likely to release all billfish caught than those who don't belong to fishing clubs, additional efforts need to be made to recruit anglers to fishing clubs and organizations where they can be socialized to accept the catch and release fishing norm.

Several directions remain for future research on catch and release behavior. First, greater specificity of the particular billfish species caught and released

could provide strong predictors of the release behavior of all fish; anglers may be much more likely to release a sailfish than a blue marlin, for example. Second, the methodology demonstrated here can and should be used elsewhere with creel intercept designs that provide data on the number of a particular fish species that were caught and released, and also include the requisite demographic descriptors. Whereas there are trade-offs involved with expanding data collection in creel intercept surveys beyond catch and effort, additional behavioral and attitudinal data should be gathered for the best predictors reported in this paper. Finally, species-specific scenarios should be considered whereby anglers are told how many fish of various lengths they have caught and asked to identify which (if any) they would release. This would allow for further investigation of the various elements of catch and release and still provide the same type of dichotomous question used in the research. Instead of the potential for recall bias and telescoping associated with the 12 month recall period used here, responses would be hypothetical like willingness-to-pay questions.

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