UNDERSTANDING ANGLER PREFERENCES FOR HARVEST REGULATIONS BY LEVEL OF SPECIES PREFERENCE

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Abstract

A stated preference choice approach was used to understand anglers' preferences for harvest regulations by different levels of (first, second, and third choice) species preference. Seven attributes were investigated: bag limit, minimum size, maximum size, retention of big fish, average fish size, catch probability, and travel cost. Ten versions of a questionnaire with eight choice sets each were used. Questionnaires were mailed to 1,377 red drum anglers; 313 reported a first choice preference for a red drum fishing, 358 a second choice, and 120 a third. A conditional logit model was used to estimate four preference models. Anglers with a first preference for red drum wanted to catch larger fish, while those with a third preference wanted larger numbers. Anglers with a higher preference for red drum fishing were more likely to support current harvest regulations. All anglers regardless of preference level for red drum chose conservation of resources over exploitation.

1.0 Introduction

To develop and improve existing or new harvest regulations, fishery managers should have a basic knowledge of the extent to which anglers support current and proposed management options (Ditton 1996; Quinn 1996; Wilde & Ditton 1994). Prior to the era of public participation and open meeting laws in the 1970s, the nature and types of harvest regulations used were often left to managerial discretion. With mandates for greater public involvement, managers began to seek input from anglers as to whether they supported or opposed harvest restrictions as proposed. Not surprisingly, the area of angler preferences for various management alternatives has received less research attention than other human dimensions research areas.

Traditional research approaches for evaluating management preferences have focused on asking whether respondents support or oppose particular harvest restrictions (i.e., a proposed minimum size of 14 inches, a bag limit of four fish, etc) or on observing their actual fishing harvest behaviors at a site. Whereas the former approach was labeled as "opinion measurement" (Smith 1983), the latter has been referred to as a "revealed preference" approach (Louviere 1988). Unfortunately, these approaches do not yield insight into the relative importance of each of the harvest restrictions to anglers and the tradeoffs they are willing or not willing to make when viewing regulatory options jointly. For example, when anglers indicate support for a decreased bag limit, they also may support an increase in the minimum size limit or other additional means to reduce fishing mortality based on an opinion measurement approach. In addition, the revealed preference approach is limited for analyzing future regulation changes in that observable data on current anglers' harvest behavior does not provide sufficient variation for understanding angler preferences. Stated Preference choice models (SPCM) use hypothetical scenarios to derive individuals' preferences. SPCM have been used primarily in market research and evaluation to provide a means for simulating participant choices and analyzing preference data. Use of SPCM enables an understanding of the relationship of multiple factors as they contribute to preferences or choice behavior (Louviere 1988; Louviere & Timmermans 1990). These types of models have been used previously in natural resources management to better understand "consumer" preferences for various multi-attribute products and services including destination choices (Haider & Ewing 1990), park development and infrastructure needs (Hearne & Salinas 2002; Schroeder & Louviere 1999), and regulatory actions in natural resources settings (Adamowicz et al. 1998).

Various forms of stated preference models have been used previously to understand angler preferences for various proposals, "product" offerings (Driver 1985), and management alternatives. Roehl et al. (1993) used a stated preference approach (in a metric conjoint model) to understand angler preferences for four attributes (trip price, fishing quality, service quality, and catch) of the charter boat fishing experience. Also, they evaluated 16 fishing product profiles based on variations of the four attributes. Price was found to make the largest

contribution to preference followed by catching favorite fish species, fishing quality, and service quality. Aas et al. (2000) used a stated preference choice model to study how anglers would respond to various product profiles (three harvest regulation variables and two expectation variables) and to explore angler group differences in this regard. To avoid the problems associated with ranking data in a metric conjoint design, the discrete choice model made use of choice sets where respondents chose the most preferred set of alternatives. They found major choice differences between various angler groups based on gear use. Gillis and Ditton (2002) used metric conjoint analysis to investigate how anglers combined their preferences for various management measures under consideration and the relative influence of each management measure. Preference estimates were calculated for each level of a management measure and the 64 possible management measure combinations were ranked.

Harvest regulations are typically used as a means of allocating a limited fishery resource. In Texas, however, there is currently an abundance of red drum (Sciaenops ocellatus) fish stocks as a result of conservation measures that have increased escapement to offshore waters. Managers may be reaching a point where they can consider an increase in recreational harvest. To increase harvest in a fair and effective manner, managers want to know which various harvest regulations (set at current and proposed levels) are preferred by anglers and the trade-offs they are willing to make in the trip-decision process.

To avoid a typical assumption that the population of red drum anglers is a homogeneous group of individuals that all held the same views when it comes to management options under consideration, a means of segmentation is necessary to investigate group differences. Previously, Graefe (1981) developed and tested a classification of anglers targeting a particular species group to determine if there were unique angler sub-groups based on dedication, namely, those who fished exclusively for certain species, those who indicated those species as their first choice, etc. Whereas he found some noteworthy group differences consistent with the recreation specialization framework (Bryan 1977; Ditton et al. 1992; Scott & Shafer 2001), he did not find much evidence of unique angler sub-groups by dedication to a particular species group. Building on this work and extending it further into the area of preferences for management options, we sought to understand the differences in stated preferences for various policy options among those with stated first, second, and third choice preferences for red drum as a target species.

Our goal was to help the Texas Parks and Wildlife Department (TPWD) identify a user-friendly set of harvest regulations for red drum while also meeting their overall management objectives of maximizing angler satisfaction and long-term fishery conservation. The frequently conflicting relationship between those two objectives should be enhanced with a more holistic understanding of anglers' preferences. Accordingly, study objectives were to investigate the choices anglers make between hypothetical fishing trips as defined with varied harvest regulations, fishing expectations, and trip costs, to provide a ranking and analysis on the various management regulations being considered, and to understand choices according to their level of dedication to red drum as their preferred target species.

2.0 Methods

2.1 Survey Instrumentation

Stated preference choice modeling provides a means for investigating anglers' preferences for management products and for simulating the subsequent outcomes of changes in anglers' preferences. A two-step process was used to identify and reach the target sample of anglers with a preference for red drum fishing in coastal waters in Texas. The initial survey with a stratified random sample of 10,000 resident license holders to fish in Texas waters was conducted in 2002 (Anderson & Ditton 2003). We included a question that would allow us to identify a sample (N = 1,377) of anglers with a first, second, and third choice preference for red drum fishing for follow-up purposes. In 2003, a mail questionnaire was sent to ask about their red drum fishing trip preferences using a stated preference choice experimental design.

Seven attributes and subsequent attribute levels were selected based on a series of discussions with TPWD fishery managers. There were four types of management restrictions: (1) bag limit, (2) minimum size limit, (3) maximum size limit, and (4) retention of fish over the maximum size limit and three expectation attributes: (5) average fish size, (6) catch probability, and (7) trip cost per day. Non-regulatory attributes were included to have a realistic simulation of future fishing trips facing management changes (Aas et al. 2000; Gillis & Ditton 2002; Hicks 2002). A definition of each attribute is

Table 1.—Proposed Attributes and Levels

	Attribute	Description	Level
Restrictions	Bag limit	The number of red drum that an angler can retain per day	1. 3* 2. 4 3. 5
	Minimum size limit	The minimum size of red drum that an angler can legally retain	1. 18″ 2. 19″ 3. 20″
	Maximum size limit	The maximum size of red drum that an angler can legally retain	1. 28″ 2. 29″ 3. 30″
	Retain big fish	Each fishing year, an angler can retain one fish over the current maximum length (28”using a tag provided by TPWD)	1. two fish over the maximum size per year 2. five fish over the maximum size per year 3. seven fish over the maximum size per year
Expectations	Average fish size	Anglers' expectations regarding size of red drum caught	1. Smaller 2. Same as usual 3. Larger
	Catch Probability	The expected number of red drum that an angler catches on a typical fishing day	1. about the same 2. one more fish caught 3. two more fish caught
	Travel cost / day	Travel cost that an angler spends for a fishing trip per day (including gas and other trip expenses)	1. 25% less than your current total cost per day 2. Your current total cost per day 3. 25% more than your current total cost per day

* The underlined levels reflect current TPWD regulations.

presented in Table 1. The three levels of variation in each attribute were determined to reduce the burden on respondents (Bennett & Adamowicz 2001). Each management attribute included the status quo (current level) of the management regulation as the base level. Minor changes were made after a pretest with a local fishing club.

Fractional factorial designs were employed to generate an economical number of choice sets. In addition, a blocking design was added to segment the choice sets into blocks to reduce respondent burden (Bennett & Adamowicz 2001). Finally, a fractional factorial design with consideration of two-way interaction effects generated 80 choice sets, which were divided among 10 different versions (blocks) of the mail questionnaire with eight choice sets each. Figure 1 provides an example of one choice profile.

2.2 Models

The procedural development of stated preference models were based on random utility theory. Random utility theory assumes that individuals make choices that lead to the highest utility even though utilities are treated as random variables because of uncertainty factors (Ben-Akiva and Lerman 1985; Manski 1977). Based on obtained preferences derived from choice sets, utility is estimated using the indirect utility function, which is comprised of a deterministic component and a random error component (Louviere 2000). Since it is rationally assumed that individuals seek to maximize their utility, anglers are expected to prefer one fishing trip over another when the utility of the first is greater than the second. Assuming the error terms are independently and identically distributed and Gumbel-distributed, the probability can result in the conditional logit model (McFadden 1974; Ben-Akiva & Lerman 1985).

ATTRIBUTE	Trip A	Trip B	
BAG LIMIT	5	4	
MINIMUM SIZE	20″	19″	
MAXIMUM SIZE	30″	30″	
RETAIN BIG FISH	Two fish over maximum size per year	Two fish over maximum size per year	
AVERAGE FISH SIZE	Same as usual	Same as usual	
CATCH PROBABILITY	One more fish caught	About the same	
TRIP COST/ DAY	Your current trip cost/day	25% less than your current trip cost / day	
Which trip do you prefer? (circle only one)	TRIP A	TRIP B	I would not take either trip

Figure 1.—An Example of a Choice Set Sent to Respondents

3.0 Results

Of the 1,377 questionnaires mailed, we received 791 replies for an effective response rate of 59.8% using a slightly modified Dillman Total Design Survey Method (Dillman 1978). When we compared respondents and non-respondents across sociodemographics and general fishing behavior, respondents were generally older, had higher incomes, were more skilled and attributed more importance to fishing compared to other recreational activities, than nonrespondents. About 791 questionnaires were returned usable for an effective response rate of 60%; 313 with a stated first preference for a red drum fishing, 358 with a second preference, and 120 with a third preference.

We used a conditional logit model to estimate four different preference models including a pooled model for all anglers. Conditional logit model estimations are presented first in Table 2. As expected, all effects of the primary attributes were statistically significant ($p<0.05$). When C1 serve as alternative specific constants, the negative value for C1 (the "no trip" option) indicates that this option was less preferred to fishing trips conducted under the current fishing rules and regulations. As expected, an increase in bag limit and maximum size will lead to considerable increases in fishing trip participation in the pooled model. Likewise, there was a strong preference for increasing catch probability and anglers preferred a lower minimum size. However, contrary to expectations, anglers favored the current two fish over 28" maximum size per year regulation over the other options presented. That only 11% of anglers reported they had used red drum tags (provided free of charge) in the previous 12 months may demonstrate their indifference to the tag system intended by TPWD to distribute the catch of large fish as equitably as possible among the angler population. Two interaction effects were added to estimate specified models based on prior information regarding important relationships between variables. A likelihood ratio test indicated that the model with interaction effects was superior to that with main effects only.

In contrast with all primary attributes of angler preference which were statistically significant in the all-angler model and in the first-preference model, MAXIMUM and a two-way effect of CATCH and BAG LIMIT in the second-preference model and MAXIMUM, RETAIN, AVERAGE SIZE and a two-way effect of MAXIMUM and BAG LIMIT in the third-preference model were not statistically significant (Table 2). In general, anglers with a first preference for red drum generally preferred to catch larger fish, while those with a third preference preferred catching larger numbers.

An advantage of the stated preference choice method is that it provides a ranking of feasible management options (Blamey, Gordon, & Chapman, 1999). There are changes in utility as a result of a modification of regulations as well as expectations. Hence, the benefit gain or loss is measured by predicted probabilities to participate in a fishing trip given a specific level of attributes in each option. The predicted probabilities were computed as above and overall willingness- to-pay (WTP) values using $\frac{1}{\beta_{\text{trip cost}}}(V_C - V_N)$ as suggested by Hanemann (1984).

Table 2.—Results of Conditional Logit Model

	All Anglers		Preference Level					
			1st Preference		2nd Preference		3rd Preference	
Variable	Estimated Coefficient	Z-value	Estimated Coefficient	Z-value	Estimated Coefficient	Z-value	Estimated Coefficient	Z-value
C1	-0.7680	-4.64*	-0.6038	-2.29*	-0.9476	-3.80*	-0.8565	-2.00*
BAGLIMIT	0.4408	6.59*	0.4760	4.49*	0.3727	3.70*	0.5854	3.39*
MINIMUM	-0.1334	-5.20*	-0.0921	-2.24*	0.1429	-3.71*	-0.2233	-3.44*
MAXIMUM	0.1710	2.72*	0.2156	2.16*	0.1543	1.63	0.0982	0.60
RETAIN	-0.0922	-9.73*	-0.0682	-4.55*	-0.1341	-9.33*	-0.0331	-1.37
AVERAGE2	0.3497	6.87*	0.5271	6.40*	0.3109	4.06*	0.0755	0.60
AVERAGE3	0.6257	11.39*	0.8140	9.19*	0.6268	7.59*	0.2322	1.68#
CATCH	0.2870	4.65*	0.3589	3.68*	0.1911	2.06*	0.4217	2.61*
TRIPCOST	-0.0254	-23.44*	-0.0237	-13.74*	0.0272	-16.77*	-0.02423	-8.57*
MAX*BAG	-0.0976	-3.40*	-0.0975	-2.14*	-0.1004	-2.32*	-0.0932	-1.25
CATCH*BAG	-0.0611	-2.14*	-0.0806	-1.78#	-0.0227	-0.53	-0.1483	-2.00*

* indicates the statistical significance at 0.05 level.
# indicates the statistical significance at 0.1 level.

Here, V_C indicates the utility acquired from the current condition of a fishing trip and V_N is the utility from the new scenario with altered levels of attributes.

A set of seven different red drum management scenarios with the changes in expectation variables for a red drum fishing trip are shown with predicted probabilities and overall WTP values in Table 3. The levels of expectation attributes were varied such that average fish size would remain the same while catch probability would increase with stricter rules and regulations. Likewise, with a relaxation of harvest restrictions comes an increase in average fish size but with less catch probability as a result of their increased harvest. This scenario consideration is useful in that anglers' fishing trips will likely be affected by their expectations. Their expectations can reflect their choices of fishing trips based on the expectations of catching fish in light of the condition of the fishery resource (fish stocks). The scenario analysis indicated that anglers with a higher preference for red drum fishing were more likely to prefer current harvest regulations and less willing to relax the rules and regulations.

4.0 Discussion

Managers can expect anglers with a different levels of species preference to react differently to management options under consideration. Overall, anglers (except for those with a third preference level for red drum) chose conservation of fishery resources over exploitation. These results can help managers take angler diversity into account in future management efforts and not disenfranchise certain angler segments by focusing on measures of central tendency. As management options are considered and policies are formulated, decision makers cannot please everyone. Management options that promote resource conservation and sustainability are likely to be more supported by anglers with a higher level of species preference accompanied with expressions of high economic value for the status quo option than by anglers with a lower level of species preference. Thus, the various scenario analyses can serve as a baseline to help managers optimize the selection of the best combination of regulation attributes for more efficient management.

Several points are noted in terms of management implementation and implications. First, willingness to pay is a useful reference value for benefit measurement in policy decision-making because the monetized value eases the decision process for efficient resource allocation and distribution. Thus, different willingness-to-pay values by species preferences can be useful for purposes of cost-benefit analysis. Second, different management priorities may indicate different policy changes. For

Table 3.—The Predicted Probabilities and WTP of Proposed Scenarios with Changes in Fishing Trip Expectations

							Pooled		1st pref.		2nd pref.		3rd pref.	
	BAG	MIN	MAX	RETAIN	AVE.	CATCH	Prob.	WTP	Prob.	WTP	Prob.	WTP	Prob.	WTP
Scenario1	3	20	28	2	Same as usual	two more fish	0.143(4)		0.136(5)		0.160(3)		0.080(7)	
Scenario2	3	19	28	2	Same as usual	two more fish	0.164(2)	123.2	0.149(3)	121.5	0.184(1)	124.4	0.100(5)	127.8
Scenario3	4	20	29	5	Same as usual	one more fish	0.112(7)	105.7	0.115(7)	108.9	0.111(6)	98.1	0.094(6)	124.8
Scenario4	4	19	29	5	Larger	one more fish	0.169(1)	124.6	0.168(1)	127.6	0.175(2)	121.7	0.148(2)	146.8
Scenario5	4	19	29	7	Larger	one more fish	0.141(5)	116.1	0.147(4)	120.8	0.134(4)	107.9	0.139(3)	143.6
Scenario6	4	19	30	7	Larger	About the same	0.116(6)	107.4	0.123(6)	112.1	0.106(7)	95.6	0.135(4)	142.3
Scenario7	5	18	30	7	Larger	About the same	0.154(3)	120.4	0.162(2)	125.7	0.131(5)	106.7	0.304(1)	181.4

Note. Trip cost was restricted to be the same at the anglers' current trip cost for the comparison purpose.
The levels of Interaction effects were also changed depending on those of main effects.
WTP values were computed using average fishing trip expenditures of $117.

example, if the agency's goal is to attain long-term conservation goals and focus on resource protection, this is more likely secured by sustaining the current status quo management options. This is generally supported by the high probability (and willingness-to-pay values) of anglers' trip decisions with the current status quo options for angler groups with a first and second preference. On the other hand, this kind of management policy may deter additional participation by anglers with a third species preference. If the management goal is to attract additional participation of anglers who place the least importance on catching red drum previously, then a relaxation of management options is needed.

Overall, an understanding of disparate group preferences and trade-offs is an essential part of an efficient fishery management process that avoids over exploitation of fishery resources and maximizes angler satisfaction with their fishing trips. While the importance of maintaining or increasing angler satisfaction and preventing declines in angler numbers is important from a service delivery standpoint, balanced policy changes by the management agency are more likely.

5.0 Citations

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