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ABSTRACT

While constraints on anglers' harvest behavior have become increasingly necessary, there is little understanding of angler diversity in preferences for particular management restrictions. This study's objectives were to understand anglers' opinions and preferences for management harvest restrictions using a stated preference choice approach (SPCA), to view the diversity of anglers' opinions and management preferences using the recreation specialization concept, and to suggest feasible management options for fisheries managers. Using a fractional factorial design with seven regulation and expectation attributes required 10 different versions of the mail questionnaire with 8 choice sets each. With an effective response rate of 60%, the final data set included the total responses of 522 red drum anglers with 261, 206, and 55 casual, intermediate, and advanced anglers, respectively. We used conditional logit models to estimate four different preference models including a pooled model for all anglers. As expected, we found that increases in bag limit and maximum size as well as catch probability will lead to considerable increases in the choice of one fishing trip over another. Likewise, anglers preferred a lower minimum size and favored the current two fish over 28" maximum size per year regulation over other options presented. Each specified model of a heterogeneous specialization segment, however, showed different patterns of significant variables. While most variables were statistically significant with the same expected signs, distinctions were noticed. For example, minimum size limit, maximum size limit, average fish size, and expected catch probability were not significant for advanced anglers. Overall, advanced anglers were less interested in relaxing current red drum regulations, while casual anglers showed a strong preference for catching more red drum by relaxing regulations. Results are discussed to help fishery managers take angler diversity into account in future decision-making. Analysis of various scenarios will help optimize the selection of the best combination of regulation attributes.

KEY WORDS: Red drum, *Sciaenops ocellatus*, anglers

Diferencias de Especialización en las Preferencias de los Pescadores por las Normas de Regulación de las Capturas de ‘Red Drum’ (*Sciaenops ocellatus*)

Mientras que las restricciones en las actividades pesqueras se han hecho cada vez más necesarias, se sabe poco sobre la diversidad de preferencias de los pescadores por regulaciones particulares. Los objetivos del estudio fueron comprender las opiniones y preferencias de los pescadores por restricciones de captura, utilizando una aproximación establecida de selección preferente (‘stated preference choice approach’, SPCA); examinar la diversidad de opiniones y preferencias de manejo de los pescadores utilizando el concepto de especialización recreativa; y sugerir opciones de manejo viables a los gestores de pesquerías. El uso de un diseño factorial fraccional con siete atributos de regulación y de expectativa requirió 10 versiones diferentes del cuestionario enviado por correo, con 8 conjuntos de alternativas cada uno. Con una tasa de respuesta efectiva del 60%, el conjunto final de datos incluyó el total de respuestas de 522 pescadores de ‘red drum’, con 261, 206 y 55 pescadores ocasionales, intermedios y avanzados respectivamente. Utilizamos modelos logit condicionales para estimar cuatro modelos diferentes de preferencias, incluyendo un modelo conjunto para todos los pescadores. Como era de esperar, encontramos que el incremento en el número máximo y la talla máxima, así como la probabilidad de captura, conllevarían un incremento considerable en la participación en actividades de pesca. Del mismo modo, los pescadores prefirieron un tamaño mínimo más bajo y favorecieron la normativa actual de dos peces al año con tamaño máximo de 28”, por encima de otras opciones presentadas. En cambio, cada uno de los modelos especificados para cada segmento de especialización mostró un conjunto diferente de variables significativas. Mientras que la mayoría de las variables fue estadísticamente significativa con el signo esperado, se pueden hacer distinciones. Por ejemplo, el límite en el tamaño mínimo, en el tamaño máximo, en el tamaño medio del pez, y la probabilidad esperada de captura no fueron significativas para los pescadores avanzados. En conjunto los pescadores avanzados se mostraron menos interesados en relajar la normativa actual sobre el ‘red drum’, mientras que los pescadores ocasionales mostraron una fuerte preferencia por la captura de un mayor número de ‘red drum’ mediante una normativa menos estricta. La discusión de los resultados se hace con el fin de ayudar a los gestores de pesquerías a tener en cuenta la diversidad de pescadores de cara a futuras decisiones de manejo. El análisis de varios escenarios ayudará a optimizar la selección de la mejor combinación de atributos de regulación.

PALABRAS CLAVES: Red drum, *Sciaenops ocellatus*, pescadores

INTRODUCTION

The fact that recreational fishing typically involves a direct consumption of fishery resources requires management agencies to enforce various management measures. As constraints on recreationists' behavior and resource uses become a common goal of management strategies, fisheries managers have increasingly shown an interest in understanding angler preferences for various management alternatives. Thus, fisheries managers should have a scientific knowledge of understanding, evaluating and predicting anglers' support for current and proposed management regulations to the most practicable extent (Wilde and Ditton 1994, Aas et al. 2000).

A typical research design such as public opinion measurement (Smith 1983) requires individuals to reveal their preference for each item of rule making and concern, one at a time. In contrast, a stated preference choice approach (SPCA) is advantageous in that anglers' preferences are exposed by making use of a set of hypothetical choice scenarios in combination with the most important attributes and consequent levels (Boxall et al. 1996, Louviere et al. 2000). Based on the rational assumption that anglers make their decisions on multiple attributes of fishing products viewed simultaneously (Schroeder and Louviere 1999), a SPCA is useful for understanding anglers' holistic preferences allowing for trade-offs among regulation attributes together with inserted expectation attributes.

Previous studies have shown that recreationists are not a homogeneous group and that sub-groups vary in terms of behavior, experience, skill and the importance of an activity (e.g., Bryan 1977, Ditton et al. 1992). As an effective market segmentation tool, recreation specialization has been used widely with robust theoretical and empirical support since its initiation by Bryan (1977). The main advantage for managers using specialization is that it can enhance an understanding of group differences (i.e., diversity) on a variety of issues that enable them to improve services already provided (Driver 1985, Fedler and Ditton 1994). Using the recreation specialization framework (e.g., Bryan 1977, Ditton et al. 1992, Scott and Shafer 2001), it would be expected that various preferences for management interventions are preferred to a lesser or greater extent among participant sub-groups along a continuum.

There has been no managerially useful research on anglers' preferences for various rules and regulations using the recreation specialization framework. Therefore, the objectives of this paper were to:

- i) Understand anglers' opinions and preferences for management harvest restrictions using stated preference choice modeling;
- ii) Identify anglers' opinions and preferences by group segments using the recreation specialization framework; and,
- iii) Suggest feasible options for management regulations that maximize angler satisfaction and conserve the limited fishery resources in a sustainable way.

RECREATION SPECIALIZATION

As an alternative market segmentation approach, recreation specialization as proposed by Bryan (1977) has been gaining in popularity for understanding the diverse aspects of anglers' attitudes and behavior. According to the recreation specialization framework, as anglers become more involved in fishing, there is a focus shift from fish consumption to preservation and increased emphasis on the activity's generic nature and resource setting (Bryan 1977, Katz 1981, Ditton et al. 1992, Fisher 1997). Accordingly, high specialization anglers show greater appreciation of and support for resource management practices that reduce the adverse user impacts on natural resources. Overall, the understanding and support of management restrictions are also closely connected to their concerns for resource conservation.

Despite numerous studies, which have attempted to discover empirical support for management measures and conservation concerns separately, there has been less interest in an integrated understanding of the issues. Using the concept of recreation specialization, heterogeneous segments are expected to show different patterns of within-group preferences for management alternatives as an expression of their increasing commitment to their fishing activity. Given the need for constantly changing management harvest restrictions, it can be reasoned that anglers consider their preferences for restriction changes along with their concern for long-term sustainability of fisheries stocks (Gillis and Ditton 2002, Oh et al. In press). The study focus was to integrate the recreation specialization concept into an understanding of heterogeneous preferences for fishing management interventions.

METHODS

Instrumentation

Two mail surveys were conducted to identify and reach the target sample of red drum anglers in Texas. The initial survey questionnaire collected data on anglers' saltwater fishing participation, motivations, attitudes, and management preferences including eight variables that represent recreation specialization (e.g., total number of days in fishing for the behavioral dimension, self-evaluated fishing skill for the skill and knowledge dimension, and replacement cost for fishing equipment owned by angler for the commitment dimension). A follow-up mail questionnaire was sent to ask specifically about their red drum fishing trip preferences using a stated preference choice experimental design. To include the important attributes and levels for each attribute, discussions with fishery managers as well as the previous angler preference studies were used (e.g., Aas et al. 2000, Gillis and Ditton 2002, Hicks 2002). Finally, four types of restrictions (i.e., bag limit, minimum size limit, maximum size limit, and retention of big fish) were included as policy attributes. Furthermore, three expectation attributes were included in the study (i.e., average fish size sought, catch probability, and travel cost per day) so that anglers could predict simulated

outcomes based on management changes affecting their future fishing trips (Aas et al. 2000, Gillis and Ditton 2002, Hicks 2002). Three levels including the current level for each attribute were selected to reduce burden as well as to secure sufficient variations in the policy options considered. A more detailed description of each attribute is presented in Table 1.

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. <u>3</u> 2. 4 3. 5
	Minimum size limit	The minimum size of red drum that an angler can legally retain	1. 18" 2. 19" 3. <u>20"</u>
	Maximum size limit	The maximum size of red drum that an angler can legally retain	1. <u>28"</u> 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. <u>two fish over the maximum size per year</u> 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 state agency fishing regulations.

The use of fractional factorial designs with blocking generated 80 choice sets that were divided into 10 blocks of 8 paired trip comparisons. Figure 1 provides an example of one choice profile. To simulate the realistic decision making process for fishing trip participation, each choice set included the ability to not take either trip (Bennett and Adamowicz 2001).

ATTRIBUTE	Trip A	Trip B	
BAG LIMIT	5	4	
MINIMUM SIZE	20"	19"	
MAXIMUM SIZE	30"	30"	
RETAIN BIG FISH	<i>Two fish over maximum size per year</i>	<i>Two fish over maximum size per year</i>	
AVERAGE FISH SIZE	<i>Same as usual</i>	<i>Same as usual</i>	
CATCH PROBABILITY	<i>One more fish caught</i>	<i>About the same</i>	
TRIP COST / DAY	<i>Your current trip cost / day</i>	<i>25% less than your current trip cost / day</i>	
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

Models

When it is reasonably assumed that individuals make choices to maximize utility (Manski 1977), random utility theory indicates that utility is estimated through an indirect utility function comprised of a deterministic component and a random error component (Louviere 1988, Louviere et al. 2000). Based on the assumption that the error terms are independently and identically distributed and Gumbel-distributed, this specification can result in the conditional logit model (McFadden 1974, Ben-Akiva and Lerman 1985).

Although there are several methods to take into account heterogeneous preferences of angler clientele, we used a segmentation approach that uncovers underlying latent classes or segments (i.e., cluster analysis approach). Because these segments, to which anglers belong, have different preference structures affected by attitudinal and behavioral information that correspond to their level of recreation specialization (Swait 1994), this method was seen as more advantageous than others.

RESULTS

Of the 1,377 questionnaires mailed, 791 replies were received for a raw response rate of 57.4% using a modified Dillman Total Design Survey Method (Dillman 1978). When non-deliverables were deleted, the effective response rate was 59.8%. Compared to non-respondents, respondents were older, had higher household incomes, were more skilled and attributed more importance to fishing compared to other recreational activities. No significant differences were detected between respondents and non-respondents for other questions (e.g., total cost of fishing trip and level of fishing satisfaction). Caution is required in generalizing the study results to the population of anglers seeking

red drum as these variables could be related to fishing avidity, which may influence responses to other questions.

Confirmatory factor analysis (CFA) was used to test the theoretical foundation of recreation specialization using the three dimensional model suggested by Scott and Shafer (2001). The CFA was implemented with eight variables to identify specialization levels: total days fished in the last 12 months (TDAYFISH) and total days fished in saltwater in the last 12 months (TDAYSW) for *the behavioral dimension*; self-perceived skill level in general fishing (ABILITY), self-perceived skill in saltwater fishing (ABILESW), and subjective constraint level of fishing skill (CSKILL) for *the skill and knowledge dimension*, and importance of fishing compared to other activities (COMPARE), member of a fishing club or organization (CLUB), and expenditure amount of fishing equipment (EQUIP) for *the commitment dimension*. The overall results for the CFA were satisfactory (e.g., Cronbach's alpha of 0.68, the Comparative Fit Index = 0.96, the Non-Normed Fit Index = 0.94 and the Standardized Root Mean Squared Residual = 0.03). Detailed results were not included here; for more details, contact the first author.

K-means cluster analysis based on three dimensions generated three groups, which we labeled as causal, intermediate and advanced anglers. A descriptive summary of the three clusters is provided in Table 2. Mean values of the three angler groups demonstrated the heterogeneity of the groups. Despite some slight inconsistency, intermediate and advanced anglers were more likely to spend more fishing days, rate their fishing ability higher and

Table 2. Mean value of variables by cluster level of recreation specialization

Variable	Level of Specialization		
	Casual (cluster 1)	Intermediate (Cluster 2)	Advanced (Cluster 3)
	n = 261	n = 206	n = 55
TDAYFISH	23	33	104
TDAYSW	11	20	74
ABILESW	1.48	2.33	2.25
ABILITY	3.24	4.43	4.07
CSKILL	3.75	4.58	4.36
COMPARE	2.70	3.25	3.58
EQUIP	6.12	13.50	21.59
CLUB	0.10	0.34	0.53

The Results of the Stated Preference Choice Models

The conditional logit model was used to estimate four different preference models (including a pooled model for all anglers). Two interaction effects were added to improve the explained variance for the all-angler, casual-angler, and intermediate-angler models. However, the secondary effects were not included in the advanced-angler model because of no significant difference with the main effects only model. All effects of the primary attributes were

statistically significant ($p < 0.05$) in the model. ASC was set to be an alternative specific constant and the negative value for ASC indicated that “no fishing trip” was less preferred to fishing trips conducted under the current management measures. Besides the attribute of RETAIN, which represents “to retain more fish larger than the maximum size limit”, all other attributes had the expected signs. While an increase in bag limit and maximum size limit was likely to lead to considerable increases in fishing trip participation, a decrease in minimum size limit was preferred. Likewise, a strong preference was revealed for increasing catch probability and average fish size. However, contrary to expectations, the negative coefficients of RETAIN attribute indicated that anglers were likely to prefer the current “two fish over the 28” maximum size per year regulation” over the other options presented. Two interaction effects, which showed the modification effect of those two attributes on fishing trip participation, were likely to alleviate the strong positive effects of each attribute.

Each specified model of heterogeneous specialization segments, however, showed different patterns of explanatory powers and significant variables as expected. Although most variables were statistically significant with the same expected signs, some important distinctions were noticed. The following variables were not significant: MAXIMUM and the interaction effect between CATCH and BAGLIMIT for casual anglers, ASC and MINIMUM for intermediate anglers, and MINIMUM, MAXIMUM, AVERAGE3, and CATCH for advanced anglers. Overall, advanced anglers were less interested in relaxing current harvest restrictions, while casual anglers showed a strong preference for catching a greater number of red drum by relaxing current harvest restrictions (Table 3).

DISCUSSION

Study results provided support for the proposition suggested by Bryan (1977) and stated by Ditton et al. (1992) that acceptance and support for the rules and procedures associated with fishing would depend on anglers' specialization level. High specialization anglers have more to lose from resource degradation and disturbance and hence have a more holistic view of natural resources and the need for management. As a result, they should show greater appreciation of and support for resource management practices such as harvest regulations than low specialization recreationists (Bryan 1977, Katz 1981, Ditton et al. 1992, Fisher 1997, Sutton and Ditton 2001). Thus, more specialized anglers were more likely to prefer current harvest regulations and be less willing to relax the rules and regulations to assure that the resources and the experiences they provide remain available. In contrast, less specialized anglers were likely more interested in catching more fish by relaxing harvest regulations.

Table 3. Results of Conditional Logit Model

Variable	Specialization Level							
	All Anglers		Casual Angler		Intermediate Angler		Advanced Angler	
	Estimated Coefficient	Z-value	Estimated Coefficient	Z-value	Estimated Coefficient	Z-value	Estimated Coefficient	Z-value
ASC	-0.7077	-3.45**	-1.2757	-4.35**	-0.1747	-0.53	-1.009	-2.47**
BAGLIMIT	0.4779	5.77**	0.3891	3.30**	0.5909	4.47**	0.2724	2.84**
MINIMUM	-0.1077	-3.40**	-0.1811	-4.03**	-0.0115	-0.23	-0.1134	-1.15
MAXIMUM	0.1591	2.10**	0.0879	0.79	0.2359	1.92*	-0.0079	-0.09
RETAIN	-0.0939	-8.05**	-0.0783	-4.69**	-0.0887	-4.79**	-0.2153	-5.96**
AVERAGE2	0.3668	5.90**	0.3396	3.88**	0.3690	3.64**	0.4413	2.33**
AVERAGE3	0.6444	9.49**	0.5844	6.06**	0.7749	7.12**	0.3467	1.62
CATCH	0.4408	5.76**	0.4582	4.19**	0.4663	3.87**	0.1475	1.56
TRIPCOST	-0.0256	-19.15**	-0.0262	-13.86**	-0.0247	-11.61**	-0.0264	-6.11**
MAX*BAG	-0.0936	-2.64**	-0.0658	-1.30	-0.1296	-2.30**	N/A	
CATCH*BAG	-0.1277	-3.60**	-0.1025	-2.03**	-0.1774	-3.16**	N/A	

* indicates the statistical significance at 10% level

** indicates the statistical significance at 5% level.

Managers can expect angler groups with different levels of preferences to react differently to management options. Despite the ease of implementation and enforcement of uniform management restrictions, "a diverse management regime may increase public support for fisheries management and conservation, bringing a concomitant increase in regulatory compliance" (Fisher 1997, p. 8). Accordingly, management options that promote resource conservation and sustainability are likely to be more supported by high specialization anglers (accompanied with an expression of high economic value for the status quo option) than by low specialization anglers (Oh et al. Accepted). These results can help fishery managers take angler diversity into account and not disenfranchise certain angler segments by focusing on measures of central tendency.

There are some other points worth noting. First, we used three rather than the four segmented groups described previously by Bryan (1977). Although there is no way to know the true number of specialization groups, a more systematic approach for determining the number of groups will improve our understanding of angler diversity. Second, because of the hypothetical nature of the SPCA, there have been concerns about the external validity of predictions (Hanley et al. 1998, Blamey and Bennett 2001). However, joint use of a revealed preference model and stated preference choice will improve predictive validity (Adamowicz et al. 1997, Louviere et al. 2000). Finally, this study was applied in the unique situation of an abundance of red drum fish stocks in Texas. In contrast with a scarcity situation, abundant stocks will be expected to have different influences on angler opinions and preferences for regulation changes considering future conservation.

In conclusion, an understanding of disparate group preferences and tradeoffs is essential to implementing harvest restrictions and other management rules. While managers' goals of maintaining or increasing angler satisfaction and preventing declines in angler numbers are all important from a service delivery standpoint, a balanced management approach is essential.

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