# Understanding Angler Preferences and Tradeoffs for Harvest Regulations in the Texas Red Drum Fishery

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ABSTRACT

To restrict harvest, managers need knowledge of angler clientele and the extent to which they support current and proposed regulations. Traditional "revealed preference" research designs indicate whether anglers support or oppose individual restrictions. Unfortunately, this approach does not yield insight to the relative importance of each restriction to anglers and the tradeoffs they are willing to make. Alternately, choice models use hypothetical scenarios to derive individuals' preferences. We investigated 1) angler choices between trips with varied harvest regulations, fishing expectations, and trip costs, 2) angler preferences for each harvest regulation, and 3) within group differences in choice behavior. Attributes of managerial interest were bag limit, minimum size, maximum size, and retention of big fish. Expectation (non-regulatory) attributes included average fish size, catch probability, and travel cost. A factorial design of 7 attributes generated 2,187 choice profiles. Accordingly, we used 10 different versions of a mail questionnaire with 8 choice sets each. In 2003, we mailed questionnaires to 1,377 red drum anglers and asked about their fishing trip preferences using a discrete choice experimental design. We used conditional logit and nested logit to estimate the preference models. All primary attributes of angler preference were statistically significant. An increase in bag limit and maximum size of red drum will lead to considerable increases in fishing trip participation. Likewise, there was a strong preference for increasing catch probability. As expected anglers preferred a lower minimum size, while contrary to expectations, anglers favored the current two fish over 28" maximum size per year regulation over other options presented. We used scenario analysis to rank seven management scenarios in terms of their utility to anglers. Not surprisingly, anglers favored scenarios with more relaxed harvest regulations, but perhaps indicative of a conservation concern, the most preferred scenarios maintained the current retention rule for large fish.

KEY WORDS: Choice modeling, harvest regulations, recreational fisheries, red drum

# Interpretación de las Preferencias y Compromisos de los Pescadores Debido a Regulaciones en la Cosecha de la Pesquería del Red Drum, Texas

Con el fin de establecer restricciones en la cosecha, los administradores pesqueros necesitan conocer la clientela de pescadores y el grado en el cual estos apoyan las regulaciones actuales y las propuestas. Los diseños de investigación, en "revelación de preferencias" tradicionales, indican si los pescadores están a favor o en contra de restricciones especificas. Desafortunadamente, esta aproximación no proporciona una idea acerca de la importancia relativa de cada una de las restricciones para los pescadores y los compromisos que ellos están dispuestos a realizar. Alternativamente propusimos el uso de modelos que toman en cuenta escenarios hipotéticos en donde se consideran las preferencias específicas. Nosotros investigamos: 1) Las selecciones de los pescadores entre viajes con una variedad de regulaciones de cosechas, expectativas de pesca, y costos de viaje, 2) las preferencias de los pescadores por cada regulación de cosecha, y 3) diferencias en el comportamiento de selección dentro del grupo. Los atributos del manejo fueron: límite en el número de peces, tamaño mínimo, tamaño máximo, y retención de peces grandes. Las expectativas de los atributos (no regulados) incluyeron tamaño promedio del pez, probabilidad de captura, y costo de viaje. Un diseño factorial de 7 factores generó 2.187 perfiles de selección. De acuerdo a esto, utilizamos 10 versiones diferentes de cuestionarios enviados por correo con 8 grupos de preguntas en cada uno. En el 2003, enviamos los cuestionarios a 1.377 pescadores de Red Drum y preguntamos por sus preferencias de viajes de pesca, utilizando un diseño experimental discreto. Nosotros utilizamos "logit" condicionales y jerarquizados para estimar el modelo preferido. Todos los atributos principales de las preferencias de los pescadores fueron estadísticamente significativos. Un incremento en el número de peces y en el tamaño máximo del Red Drum conduciría a un incremento considerable en la participación de viajes de pesca. Así mismo habría una fuerte preferencia por incrementar la probabilidad de captura. Como esperábamos, los pescadores prefirieron un menor tamaño mínimo mientras que, contrariamente a lo que esperábamos, los pescadores favorecieron la regulación actual de dos peces por encima del tamaño máximo de 28" por año sobre las otras opciones presentadas. Nosotros utilizamos análisis de escenarios para clasificar los siete escenarios de manejo en término de su utilidad para los pescadores. No sorprendió el que los pescadores favorecieron los escenarios con regulaciones de cosecha mas flexibles, pero tal vez fue indicativo de un problema de conservación, los escenarios mas preferidos mantuvieron la regla de retención actual de peces grandes.

PALABRAS CLAVES: Las preferencias de los pescadores, red drum, Texas

## INTRODUCTION

To promulgate regulations, fishery managers should have a basic knowledge of the diversity of their angler clientele and the extent to which they support current and proposed management regulations (Wilde and Ditton 1994, Ditton 1996, Quinn 1996).

Traditional research designs for evaluating management preferences have focused on whether respondents supported or opposed particular harvest restrictions, i.e., a proposed minimum size of 14 inches, a bag limit of four fish, etc. This has been referred to as a "revealed preference" approach (Louviere 1988). Unfortunately, this approach does not yield insight to the relative importance of each of the harvest restrictions to anglers and the tradeoffs they are willing or not willing to make when viewing restrictions jointly. For example, when anglers indicate support for a decreased bag limit, they also may support the harvest of additional fish over the maximum size.

Discrete choice conjoint models (DCM), often referred to as stated preference or choice models, make use of hypothetical scenarios to derive individuals' preferences. DCM provides an alternate means for simulating participant choices and analyzing preference data. The technique assumes that complex decisions are based not on one factor or criterion but on several considered jointly; hence the term "conjoint". DCM enables an understanding of the relationship of multiple factors as they contribute to preferences or choice behavior (Louviere 1988, Louviere and Timmermans 1990). There have been several applications in fisheries management as managers seek advice on various proposals, develop various fishing "product" offerings (Driver 1985), and implement or revise harvest restrictions (Holland and Ditton 1992, Roehl et al. 1993, Aas et al. 2000, Gillis and Ditton 2002).

Harvest regulations are typically used as a means of allocating a limited fishery resource. In Texas, there is currently an abundance of red drum (*Sciaenops ocellatus*) fish stocks as a result of stocking efforts and conservation measures that have increased escapement to offshore waters and maybe reaching a point where recreational harvest could be increased. To increase harvest in a fair and effective manner, managers want to know the extent to which various harvest regulations (set at current and proposed levels) are preferred by anglers and the tradeoffs they are willing to make.

The purpose of this research was to understand the general relationships of tradeoffs in multi-attribute product profiles associated with various harvest regulations. The goal was to have user-friendly harvest regulations for red drum while also meeting their overall management objectives of maximizing angler satisfaction and long-term fishery conservation. Therefore, our study objectives were to investigate:

i) The choices anglers make between hypothetical fishing trips as defined with varied harvest regulations, fishing expectations, and trip costs;
ii) Angler preferences for each harvest regulation, and
iii) The provision and implementation of feasible management combinations of rules and regulations in choice behavior in the red drum fishery.

## METHODS

Discrete choice modeling (DCM) provides a holistic means for investigating anglers' preferences for management products and simulating the subsequent outcomes of changes in anglers' preferences. In the following sections, we provide insight and details for implementing a discrete choice model.

### Target Sample and Setting

The target sample for this study included anglers with a preference for fishing for red drum in coastal waters in Texas. A two-step process was necessary to identify this group. First, we conducted a survey of the 1,400,000 resident anglers licensed to fish in Texas waters for the 2001 fiscal year (September 1, 2000 – August 31, 2001)(Anderson and Ditton 2003). A stratified random sample of 10,000 resident license holders was obtained from TPWD. The mail survey was conducted between March 6, 2002 and April 3, 2002 by Anderson and Ditton (2003). The mail questionnaire collected data on anglers' freshwater and saltwater fishing participation, motivations, attitudes, management preferences, and fishing trip expenditures. One question enabled us to identify a sample (n = 1,377) of anglers with a first, second, and third choice preference for red drum for follow-up purposes. In the spring of 2003, we mailed a questionnaire to these anglers and asked them about their red drum fishing trip preferences using a discrete choice experimental design. Further, the previous survey provided data to conduct a respondent/non-respondent comparison to determine the applicability to the sampling population.

### Identification of Attributes and Levels

Attributes and levels of management interest in this study were identified and refined based on discussions with TPWD fishery managers. Four different types of restrictions were identified as attributes:

i) Bag limit,
ii) Minimum size limit,
iii) Maximum size limit, and
iv) Retention of big fish.

A definition of each attribute is provided in Table 1. Additionally, as noted in other recent studies of the stated behavior of anglers (Aas et al. 2000, Gillis and Ditton 2002, Hicks 2002), nonregulatory attributes were incorporated to have anglers predict outcomes based on changes of management in their future fishing trips.

Once attributes were identified, the boundaries of level variations had to be determined (Bennett and Adamowicz 2001). To reduce the burden on respondents and not to increase survey costs, we chose to have three levels for each attribute. Each of the management attributes included the current level management regulation as the base level. After attributes and levels were selected, a pretest (10 choice sets with two different versions of questions) was carried out with 20 members of a local fishing club that targets saltwater species. Based on analysis and comments provided, minor revisions of the levels were made.

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<br>2. 4<br>3. 5 |
| | Minimum size limit | The minimum size of red drum that an angler can legally retain | 1. 18"<br>2. 19"<br>3. 20" |
| | Maximum size limit | The maximum size of red drum that an angler can legally retain | 1. 28"<br>2. 29"<br>3. 30" |
| | Retain big fish | Each fishing year, an angle· 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<br>2. five fish over the maximum size per year<br>3. seven fish over the maximum size per year |
| Expectations | Average fish size | Anglers' expectations regarding size of red drum caught | 1. Smaller<br>2. Same as usual<br>3. Larger |
| | Catch Probability | The expected number of red drum that an angler catches on a typical fishing day | 1. about the same<br>2. one more fish caught<br>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<br>2. Your current total cost per day<br>3. 25% more than your current total cost per day |

The underlined levels reflect current TPWD regulations.

**Experimental Design**

A fractional factorial design was employed to generate an economical number of choice sets. The process of fractional factorial designs includes selection of an effective size of the combination of all profiles, while maintaining the orthogonality of the full factorial (Benett and Adamowicz 2001). An orthogonal design means that every attribute is uncorrelated with each other (Wonnocott and Wonnocott 1990). Because there are certain constraints to increasing the number of choice sets when using fractional factorial designs (i.e., increase burden to each individual), blocking is a good tool to deal with this situation. With a large number of choice sets, it is not feasible to have one respondent answer all of the choice sets. Thus, a blocking design can segment the choice sets into blocks to reduce the burden on a single respondent (Hanley et al. 1998, Bennett and Adamowicz 2001).

While a full factorial design of 7 attributes generated 2,187 choice profiles (= 3 × 3 × 3× 3 × 3 × 3 × 3), we were interested in secondary interaction effects as well as main effects. Regarding the importance of two-way interaction effects, etc., there is an increased likelihood for the influence of the secondary effects when there are more attributes included (i.e., typically representing 5 to 15 % of explained variance by the two-way interaction effects with 70 to 90 % by main effects for linear models) (Louviere et al. 2000). Thus, a fractional factorial design with consideration of two-way interaction effects led to the generation of 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. Also, to simulate real market behavior regarding non-choice of fishing trips (Benett and Adamowicz 2001), each choice set included the constant no trip decision.

| 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

**Models**

Given the consumer's choice model that individuals make choices that lead to the highest utility (Lancaster 1966, Manski 1977), we used discrete choice models to ask individuals to make a series of choices of hypothetical fishing trips with different levels of attributes. Based on obtained preferences, utility can be estimated using the indirect utility function, which is comprised of a deterministic component and a random error component (Louviere 1988, Louviere et al. 2000). A deterministic component can be estimated to represent the vector of coefficients of levels and attributes in order to obtain the part-worth utilities for attributes. Since it is rationally assumed that individuals maximize their utility, an angler will prefer an alternative of one fishing trip over another when the utility of the first is greater than the second. Assuming the error terms of the model are independently and identically distributed and Gumbel-distributed, the probability can result in the conditional logit model (McFadden 1974, Ben-Akiva and Lerman 1985). In addition, when one prominent property (the degree of independence from irrelevant alternatives property) is not satisfied for conditional logit model, an alternative model (a nested logit) is a good way to avoid this problem. The property of IIA states that 'for a specific individual the ratio of the choice probabilities of any two alternatives is entirely unaffected by the systematic utilities of any other alternatives' (Ben-Akiva and Lerman 1985:108).

**Survey Distribution**

We followed a slightly modified Dillman (1978) Total Design Survey Method with three mailings and a thank you/ reminder card after the first mailing. Because we anticipated our questions could raise problems for fishery managers in that anglers would think all of the attributes and levels used in the choice sets were "on the table', we took several precautions. We used university letterhead to make it clear that this was a university research project and de-emphasized the focus on regulations. We took the research out of the rule-making arena and emphasized the marketing aspects of better understanding angler choices.

## RESULTS

Of the 1,377 questionnaires mailed, we received 791 replies for a raw response rate of 57.4 %. When non-deliverables were deleted, our effective response rate was 59.8 %. When we compared respondents and non-respondents across socio-demographic (age, gender, and income) and fishing behavior variables (total cost of fishing trip, total fishing days in saltwater, total days of a typical fishing trip, compared fishing ability, the level of fishing satisfaction, and fishing importance), there were statistically significant group differences in four out of nine variables. Generally, respondents are older, have higher incomes, are more skilled and fish more frequently compared to nonrespondents.

Conditional logit model estimations are presented first in Table 2. As expected, all effects of the primary attributes were statistically significant at the 0.05 level of significance. C1 and C2 serve as alternative specific constants (ASC). The negative value for C2 for the "no trip" option, demonstrates that

that this option is less preferred to fishing trips conducted under the current fishing rules and regulations. All estimated coefficients of attributes had expected signs except for the RETAIN variable. An increase of the number of red drum caught and retained per day (BAGLIMIT) and the maximum size of red drum legally retained (MAXIMUM) lead to significant increases in fishing trip participation. Also, the positive sign of expected number of red drum caught on a fishing day (CATCH) and two AVERAGE variables reflect a strong preference for increasing catching probability and average fish size. The negative signs of MINIMUM and TRIPCOST suggest that the stricter restrictions in minimum size of red drum and the higher trip cost for a fishing trip were less preferred in fishing trip decision making. On the other hand, the "RETAIN" variable shows a negative coefficient, contrary to our expectation that anglers were likely to prefer a trophy tag to retain more big fish above the current bag limit.

Five interaction effects were added to estimate specified models based on concerns of fishery managers. Only two interaction effects (MAXIMUM and BAGLIMIT and CATCH and BAGLIMIT) were significant. The negative sign of the interaction effects decreased the size of the main effects as angler preference for levels of maximum fish size is not positively dependent on bag limit levels.

The test results of independence from irrelevant alternatives property (IIA) were rejected at the 0.05 level of significance for "No Trip" and "Trip A" and at the 0.10 significance level for "Trip B". Accordingly, to avoid the violation of IIA, a nested logit model was executed (Table 2). Whereas the magnitude of coefficients is slightly different, the significance and sign of coefficients of variables are not different from those with the conditional logit model.

An advantage of discrete choice modeling over other methods is that it provides a ranking of feasible options (Blamey et al. 1999). The utility changes as a result of a modification of rules and regulations as well as expectation attributes. Seven different red drum management scenarios for a red drum fishing trip are provided with predicted probabilities (Table 3). The predicted probabilities were computed using the conditional logit and nested logit equations. In each scenario, travel cost for a fishing trip per day is constrained to be the same at the current trip cost per day so scenarios can be compared without subjective changes of individual trip expenditures. Scenario1 is the base option with the status quo conditions for fishing regulations and expectations. Scenario7 was most preferred; Scenario4 was least preferred for many of the same reasons. Anglers favored Scenario7 with the predicted probability of 0.296. But as indicated by the negative coefficient, no change in the "RETAIN" attribute will increase the predicted probability of trip participation.

**Table 2.** Results of Conditional and Nested Logit Model

| Model | Conditional Logit | | | | | |
|---|---|---|---|---|---|---|
| **Attribute** | **Coefficient** | **St. error** | **Marginal Effect** | **Coefficient** | **St. error** | **Marginal effect** |
| C1 | 0.011* | 0.030 | 0.0092 | 0.0527* | 0.030 | 0.0095 |
| C2 | -0.6389** | 0.233 | -0.1152 | | | |
| C3 | | | | 0.6983** | 0.236 | 0.1258 |
| BAGLIMIT | 0.4819** | 0.104 | 0.0870 | 0.4933** | 0.106 | 0.0888 |
| MINIMUM | -0.1339** | 0.026 | -0.0241 | -0.1383** | 0.027 | -0.0249 |
| MAXIMUM | 0.1856** | 0.063 | 0.0334 | 0.1922** | 0.065 | 0.0346 |
| RETAIN | -0.0913** | 0.026 | -0.0165 | -0.0906** | 0.026 | -0.0163 |
| AVERAGE2 | 0.4894** | 0.133 | 0.0882 | 0.5041** | 0.136 | 0.0908 |
| AVERAGE3 | 0.6651** | 0.142 | 0.1199 | 0.6793** | 0.145 | 0.1224 |
| CATCH | 0.2840** | 0.062 | 0.0512 | 0.2866** | 0.063 | 0.0516 |
| TRIPCOST | -0.0257** | 0.001 | -0.0046 | -0.0261** | 0.001 | -0.0047 |
| Inclusive value | | | | | | |
| No Trip | | | | 1.0000 | 0.000 | |
| Trip | | | | 0.9334** | 0.093 | |
| Secondary effects | | | | | | |
| MAXIMUM*BAGLIMIT | -0.1023** | 0.029 | -0.0184 | -0.1050** | 0.029 | -0.0189 |
| CATCH*BAGLIMIT | -0.0573** | 0.029 | -0.0103 | -0.0562* | 0.029 | -0.0101 |
| BAGLIMIT*RETAIN | 0.0007 | 0.012 | 0.0001 | 0.0003 | 0.012 | 0.0001 |
| BAGLIMIT*AVERAGE2 | -0.0690 | 0.059 | -0.0124 | -0.0719 | 0.060 | -0.0130 |
| BAGLIMIT*AVERAGE3 | -0.0208 | 0.065 | -0.0037 | -0.0201 | 0.066 | -0.0036 |
| Model Statistics | | | | | | |
| number of choice sets | 6078 | | | 6078 | | |
| Log L | -5465.37 | | | -5465.12 | | |
| McFadden $\rho^2$ | 0.1815 | | | 0.1816 | | |

** indicates the statistical significance at 5% level.
* indicates the statistical significance at 10% level.
C1 is an alternative specific constant with a value of 1 for trip A.
C2 is an alternative specific constant with a value of 1 for 'no trip' option.
C3 is an alternative specific constant with a value of 1 for trip A and trip B.

Table 3. The Predicted Probabilities of Proposed Scenarios

| | | | | | | | Conditional Logit | Nested Logit | |
|---|---|---|---|---|---|---|---|---|---|
| | BAGLIMIT | MINIMUM | MAXIMUM | RETAIN | AVERAGE | CATCH | Probability | Probability | Ranking |
| Scenario1 | 3 | 20 | 28 | 2 | Same as usual | About same | 0.086 | 0.085 | 5 |
| Scenario2 | 3 | 19 | 28 | 2 | Smaller | one more fish | 0.136 | 0.134 | 4 |
| Scenario3 | 4 | 18 | 29 | 7 | Same as usual | one more fish | 0.081 | 0.084 | 6 |
| Scenario4 | 4 | 18 | 29 | 7 | Larger | About the same | 0.070 | 0.071 | 7 |
| Scenario5 | 4 | 19 | 29 | 5 | Same as usual | one more fish | 0.139 | 0.139 | 3 |
| Scenario6 | 5 | 19 | 30 | 5 | Larger | one more fish | 0.181 | 0.181 | 2 |
| Scenario7 | 5 | 18 | 30 | 2 | Larger | two more fish | 0.286 | 0.286 | 1 |

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.

## DISCUSSION

A variety of research tools have been used to understand angler preferences but they have not provided a means for understanding how anglers make trade-offs among regulatory attributes. The discrete choice conjoint method (DCM) appears to be a useful means of gaining such insight in support of fishery management decision making. In this paper, we showed that anglers are willing to relax certain aspects of management rules and regulations (e.g., bag limit, minimum size, and maximum size) but not retention of large fish. However, the indications of secondary effects and the retention attribute acted to moderate their strong harvest preferences. As suggested previously with billfish anglers (Gillis and Ditton 2002), this group of red drum anglers also indicated a preference for conservation over exploitation. While anglers showed increasing preferences for fishing trips with better fishing and service qualities (Roehl et al. 1993), they are also likely to be concerned with the long-term sustainability of fish stocks (Aas et al. 2000, Gillis and Ditton 2002). With restriction and expectation attributes examined simultaneously in this paper, anglers appear to be interested in harvest as well as sustainability.

Several cautions are worth noting in applying study results to fishery management. First, study results are based on the preferences of a particular group of angler respondents from a single survey. Application of discrete choice models to other angler samples elsewhere is essential. Second, as noted by Lindberg et al. (1999), there are various potential biases (for example, hypothetical, information, strategic, nonresponse bias among others) associated with any stated preference research design. These should be minimized with careful survey design and implementation. Third, analyses were performed under the basic assumption of average red drum anglers in a homogenous group. The high likelihood of heterogeneous segments within this group, each with particular socio-demographic characteristics, attitudes, and behaviors will likely mean different patterns of fishing preferences.

## LITERATURE CITED

Aas, O., W. Haider, and L. Hunt. 2000. Angler responses to harvest regulations in Engerdal, Norway: a conjoint based choice modeling approach. *North American Journal of Fisheries Management* **20**:940- 950.

Anderson, D.K. and R.B. Ditton. 2003. Demographics, participation, attitudes, and management preferences of Texas Anglers, 2001. Texas A&M University, Department of Wildlife and Fisheries Sciences, TAMU-WFSC-HD-624, College Station, Texas USA.

Ben-Akiva, M. and S.R. Lerman. 1985. *Discrete Choice Analysis: Theory and Application to Travel Demand.* MIT Press, Cambridge, Massachusetts USA.

Bennnett, J. and V. Adamowicz. 2001. Some fundamentals of environmental choice modeling. Pages 37-69 in: J. Bennett and R. Blamey, (eds.) *The Choice Modeling Approach to Environmental Valuation.* Edward Elgar, U.K.

Blamey, R.K., J. Gordon, and R. Chapman. 1999. Choice modeling: assessing the environmental values of water supply options. *The Australian Journal of Agricultural and Resource Economics* **43**:337-357.

Dillman, D.A. 1978. *Mail and Telephone Surveys: The Total Design Method.* Wiley & Sons, New York, New York USA.

Ditton, R.B. 1996. Understanding the diversity among Largemouth Bass anglers. *American Fisheries Society Symposium* **16**:135-144.

Driver, B.L. 1985. Specifying what is produced by management of wildlife by public agencies. *Leisure Sciences* **7**:281 - 294.

Gillis, K.S. and R.B. Ditton. 2002. A conjoint analysis of U.S. Atlantic billfish fishery management alternatives. *North American Journal of Fisheries Management* **22**:1218-1228.

Hanley, N., R. Wright, and V. Adamowicz. 1998. Using choice experiments to value the environment. *Environmental and Resource Economics* **11**:413-428.

Hicks, R.L. 2002. Stated preference methods for environmental management: recreational summer flounder angling in the Northeastern United States. National Marine Fisheries Services, NFFKS-18, Washington D.C. USA.

Holland, S.M. and R.B. Ditton. 1992. Fishing trip satisfaction: A typology of anglers. *North American Journal of Fisheries Management* **12**:28-33.

Lancaster, K. 1966. A new approach to consumer theory. *Journal of Political Economy* **74**:132-157.

Lindberg, K., B.G.C. Dellaert, and C.R. Rassing. 1999. Resident tradeoffs: A choice modeling approach. *Annals of Tourism Research* **26**:554–559.

Louviere, J.J. 1988. Analyzing individual decision-making: metric conjoint analysis. Sage university series on quantitative applications in the social sciences No. 67. Newbury Park, California USA.

Louviere, J.J., D. Hensher, and J. Swait. 2000. *Stated Choice methods: Analysis and Application.* Cambridge University Press, U.K.

Louviere, J.J. and H. Timmermans. 1990. Stated preference and choice models applied to recreation research: a review. *Leisure Sciences* **12**:9-32.

McFadden, D. 1974. Conditional logit analysis of qualitative choice behavior. Pages 105-142 in: P. Zarembka, (ed.). *Frontiers in Econometrics.* Academic Press, New York, New York USA.

Manski, C. 1977. The structure of random utility models. *Theory and Decisions* **8**:229-254.

Quinn, S.P. 1996. Trends in regulatory voluntary catch-and-release fishing. *North American Journal of Fisheries Management* **16**:152-162.

Roehl, W.S., R.B. Ditton, S.M. Holland, and P.R. Perdue. 1993. Developing new tourism products: sport fishing in the southeast United States. *Tourism Management* **14**:279-288.

Wilde, G.R. and R.B. Ditton. 1994. A management-oriented approach to understanding diversity among Largemouth Bass anglers. *North American Journal of Fisheries Management* **14**:34–40.

Wonnocott, T.H., and R.J. Wonnocott. 1990. *Introductory statistics.* John Wiley & Sons, New York, New York USA.