Measurement of catch-related attitudes and their influence on angler preferences

By

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The primary purpose of my dissertation was to assess two competing models of catch-related attitudes (CRA) of recreational anglers for: 1) valid psychometric measurement, 2) consistency of CRA under different angling contexts, and 3) effect of CRA on angler preferences. Data came from a statewide survey of 6,924 licensed Texas anglers, and a follow-up survey of 1,078 freshwater catfish anglers identified by the statewide survey. I used confirmatory factor analysis to determine that a 4-construct model of CRA provided better fit to the data than a 3-construct model, and was configural and metric invariant across gender, ethnic, and angling context groups indicating cross-group comparisons would be unbiased. However, low factor loadings on several items, and low variance extracted estimates, indicate that current CRA scales require refinement. Additionally, structural equation models found that angler responses to the CRA scale were moderately consistent when measured in generic and species-specific contexts (50-60% shared variance), and the relationship between the two was not consistently moderated by measures of angling avidity. Next, I assessed influence of CRA on angler fishing trip preferences using a stated choice analysis. Results showed

that angler choice of hypothetical fishing trips was influenced primarily by travel costs and catch-related trip attributes, and that CRA were significant mediators of angler preferences for associated trip attributes. Finally, I used a latent class state choice model to analyze separate trip choice models for five sub-groups of catfish anglers divided based on their CRA scores. Individual models showed considerable variation in preference for catch-related attributes paralleling strength of each groups' attitudes towards a given CRA construct. Overall, results indicated that CRA scales are valid predictors of angler preferences and behavioral intentions. Human dimensions researchers studying angler populations will find the CRA scale to be a useful tool to incorporate into predictive models of angler behavior and preferences. Furthermore, fisheries managers should find the CRA scales useful to assess management preferences of an increasingly heterogeneous angler clientele, and aide them in designing management plans that efficiently meet angler needs and catch-related expectations.

DEDICATION

I dedicate my dissertation to my loving wife Alyssa. More than anything your steadfast love and support are what made this possible. Thank you for taking this journey with me, and supporting me every step of the way.

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CHAPTER I

INTRODUCTION

Fisheries management is a process that requires consideration of fish populations, their habitat, and social and economic concerns of the people that use fisheries resources (Nielsen, 1999). Traditionally, fisheries managers in the United States believed these needs could best be met by maximizing harvest and activity days (Hendee, 1974; Nielsen, 1999), but researchers have shown that anglers pursue fishing opportunities and derive their satisfaction from them for a multitude of reasons (Knopf, Driver, & Bassett, 1973; Hendee, 1974; Driver & Cooksey, 1977; Fedler & Ditton, 1994; Arlinghaus, 2006). These reasons for fishing may either be specific to the fishing experience (i.e., activity-specific), such as the experience of catching fish, or can be experienced in a multitude of outdoor activities (i.e., activity-general), such as spending time outdoors and relaxing.

Researchers interested in studying recreational anglers have shown particular interest in angler attitudes toward the catch-related aspects of fishing, or what has been termed the consumptive orientation of anglers (Graefe, 1980; Aas & Vitterso, 2000; Sutton, 2003; Anderson, Ditton, & Hunt, 2007). Consumptive orientation regarding to recreational anglers has been defined as an individual's "disposition to catch fish, attitudes toward keeping or releasing fish caught, and the importance of the number and size of fish caught" (Anderson et al., 2007, p. 181). While catching fish is an obvious component of the recreational fishing experience, it received little attention from early researchers in the United States who were primarily interested in determining why people chose between different recreational activities and found such activity-specific motivations to be of little use to compare across diverse activities (Knopf et al., 1973; Driver, 1977; Driver & Cooksey, 1977). However, researchers interested in understanding why anglers would choose different fishing experiences felt that an understanding of catch-related attitudes (CRA) was vital (Graefe, 1980; Sutton, 2003).

Studying attitudes has long been of interest to social scientists because of the influence attitudes have on individual preferences and behavior (Ajzen, 1991; Ajzen & Driver, 1991; Morey, Thacher, & Breffle, 2006; Aldrich, Grimsrud, Thacher, & Kotchen, 2007). Sutton (2003) found that an angler's intentions to practice catch-and-release were influenced significantly by their attitudes toward keeping fish and catching trophy fish. Other researchers have found that intentions to participate in outdoor recreational activities, including hunting, were most strongly predicted by their attitudes toward those activities (Ajzen 1991; Hrubes, Ajzen, & Daigle, 2001). Attitudes also have been shown to be helpful in explaining preference heterogeneity within populations (Boxall & Adamowicz, 2002; Morey et al., 2006; Aldrich et al., 2007). Boxall and Adamowicz (2002) divided wilderness recreationists using a latent class model based on their recreational motivations, and found significant differences between groups in their preferences regarding campsite development and encounters with other recreationalists. A study on Lake Michigan's Green Bay divided anglers based on their attitudes toward fish consumption advisories, species pursued, catch rates, and fees and found significant differences between groups regarding their willingness-to-pay (WTP) for polychlorinated biphenyl (PCB) removal (Morey et al. 2006). Finally, individuals with strong proenvironmental attitudes have been shown to have a greater preference to restore sturgeon *Acipenseridae* and other threatened species (Aldrich et al., 2007).

Attitudes have been defined as "a person's evaluation of any psychological object" (Ajzen & Fishbein, 1980). In turn, a psychological object can be defined as a person's mental perception of an object, action, or event. Despite their importance, measurement of attitudes has been made difficult by their latent nature (i.e., they are not directly observable). The successful measurement and interpretation of attitudes has thus depended on precise identification of the attitude object, or latent construct, of interest. To date efforts to quantify CRA of anglers have been complicated by differences in opinion as to exactly what and how many latent constructs were involved (Graefe, 1980; Aas & Vitterso, 2000; Anderson et al., 2007). While the first researcher to develop measurements of CRA suggested there may be five or more constructs involved (Graefe, 1980), subsequent researchers have proposed both a model consisting of only three constructs nested within a broader consumptiveness construct (Aas and Vitterso, 2000), and a model consisting of four distinct constructs (Anderson et al., 2007).

Another issue of potential concern regarding CRA was whether to frame them within a generic or species-specific context. In a study that framed CRA in a generic context, Sutton (2003) found that angler CRA were most consistent with their intentions to practice catch-and-release when the fish species in question was their preferred species, suggesting that angler attitudes may vary across fish species. This was important to note because the vast majority of published studies have only measured generic CRA toward fishing, essentially assuming that angler attitudes do not vary based on species pursued. If this assumption was erroneous, then use of generically measured CRA could result in misleading conclusions about attitudes and preferences of anglers toward catching specific fish species. For example, managers could over estimate the probability of anglers practicing catch-and-release on a particular fishery and thus underestimate number of fish likely to be harvested. This could lead to regulations that are too liberal resulting in over exploitation of a fishery.

Given the issues stated above, the purpose of my dissertation was to assess competing models of CRA under generic and species-specific contexts to: 1) determine which model provides the most consistent fit to the data and validate it for construct validity and metric invariance, 2) assess consistency of angler CRA between generic and species-specific contexts and determine what variables could potentially moderate the relationship between the two, and 3) assess effect of CRA on angler preferences for fishing site attributes using a stated choice analysis.

Objectives and Hypotheses

My dissertation sought to contrast two proposed CRA models, evaluate consistency of CRA between generic and species-specific contexts, and examine ability of CRA to explain heterogeneity in angler preferences regarding fishing trips. Study results were intended to provide a better understanding of the nature of CRA within different contexts, and assist fisheries managers in developing management regimes that better provide for the unique needs of their respective clientele. Each objective listed below is addressed in a separate dissertation chapter. Specific study objectives and their associated hypotheses were:

<u>Objective 1</u>: Assess if structure of angler CRA toward fishing in general differs from the structure of CRA toward fishing for a specific species of fish using confirmatory factor analysis and tests of measurement invariance.

H_1: The 4-construct model of CRA provides a better fit to the data than the 3-construct model when using a generic scale.

H_2: The final model of CRA is invariant across generic and species-specific contexts.

H_3: The final model of CRA is invariant across angler gender.

H_4: The final model of CRA is invariant across angler ethnic background.

<u>Objective 2</u>: Assess if level of importance an angler places on fishing for a particular species moderated the level of disparity between CRA toward that particular species and toward fishing in general.

H_5: Anglers indicating that catfish are their most preferred species to pursue will exhibit greater consistency between generic and species-specific CRA than anglers that prefer other species.

H_6: As personal importance of catfishing increases, consistency between generic and species-specific CRA will increase.

H_7: As frequency of catfishing increases, consistency between generic and species specific CRA will increase.

<u>Objective 3</u>: Assess effect of CRA on angler preferences for fishing site attributes using a stated choice analysis.

H_8: As angler attitudes toward catching numbers of fish increase in strength they will receive greater utility from increases in catch.

H_9: As angler attitudes toward catching large fish increase in strength they will receive greater utility from increases in fish size.

H_{10}: As angler attitudes toward harvesting fish increase in strength they will receive greater utility from increases in harvest.

Organization of Dissertation

This dissertation is organized into three standalone articles designed to answer each of the three objectives, bookended by an introductory and synthesis chapter. Chapter I provides an introduction to the need for improved measurement of CRA, and states the dissertation objectives. Chapter II is titled "Evaluation of Two Competing Models of Angler Catch-Related Attitudes." It is an evaluation of two competing measurement models of CRA, and will be submitted to the *Human Dimensions of Wildlife Journal* for publication consideration. Chapter III is titled "Moderating Effects on Catch-Related Attitude Consistency between Generic and Species-Specific Contexts." It investigates consistency of CRA under different angling contexts related to species pursued, and determines if various angler characteristics moderate this relationship. It will be submitted to the *Human Dimensions of Wildlife Journal* for publication consideration. Chapter IV is titled "Effect of Angler Catch-Related Attitudes on Fishing Trip Preferences." It uses a latent class stated choice analysis to determine how CRA influence angler trip preferences, and will be submitted to the *North American Journal of Fisheries Management* for publication consideration. Finally, Chapter V is a synthesis chapter presented to tie the three articles together in a summary fashion. All chapters are formatted according to the Publication Manual of the American Psychological Society (5^{th} edition) (APA, 2001).

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CHAPTER II

EVALUATION OF TWO COMPETING MODELS OF ANGLER CATCH-RELATED ATTITUDES

Introduction

Researchers interested in studying recreational anglers have shown particular interest in angler attitudes toward catch-related aspects of fishing, or what has been termed the consumptive orientation of anglers (Graefe, 1980; Aas & Vitterso, 2000; Sutton, 2003; Anderson, Ditton, & Hunt, 2007). Consumptive orientation regarding recreational anglers has been defined as an individual's "disposition to catch fish, attitudes toward keeping or releasing fish caught, and the importance of the number and size of fish caught" (Anderson et al., 2007, p. 181). While catching fish is an obvious component of the recreational fishing experience, it received little attention from early researchers who were primarily interested in determining why people chose different recreational activities and found such activity-specific motivations to be outside their area of interest (Knopf, Driver, & Bassett, 1973; Driver, 1977; Driver & Cooksey, 1977). However, researchers interested in understanding why anglers would choose different fishing experiences felt an understanding of catch-related attitudes (CRA) would be vital (Graefe, 1980; Sutton, 2003).

To quantify CRA, researchers first needed to develop a measurement scale. Most researchers interested in attitude measurements have adopted use of reflective measurement scales (Bollen & Lennox, 1991). Reflective measurement scales involve designing a set of carefully worded, unidimensional statements meant to reflect latent attitudes the researcher intends to study. Study participant level of agreement with these statements serves as an indicator of their attitude toward the object in question. Several statements are designed to measure each latent attitude to ensure the researcher has a reliable measurement scale, and either an average or summated score of related items is used as a measurement of an individual's attitude toward the latent construct. Nevertheless, the individual's score on an attitudinal measurement scale and their true score on the theoretical construct are not technically the same thing (Wu, Li, & Zumbo, 2007). The former is merely an indicator variable of the latter. Proper validation of a measurement scale requires rigorous testing of the measurement scale, or model, using confirmatory factor analysis to test if the model meets construct validity assumptions and metric invariance across relevant groups (Garver & Mentzer, 1999; Steenkamp & Baumgartner, 1998; Wu et al., 2007; Casper, Bocarro, Kanters, & Floyd, 2011). While several researchers have attempted to develop and validate multi-construct scales to measure angler CRA, these studies have been inconsistent in number of constructs presented in the final model, and none have attempted to test for metric invariance across groups (Graefe, 1980; Aas & Vitterso, 2000; Anderson, Ditton, & Hunt, 2007). Using data from two Texas angler surveys, I assessed the specification and structure of two models of CRA (i.e., 3-construct, 4-construct), and then evaluated the best fitting model for factorial validity, reliability, and metric invariance by gender, ethnicity, and context of fish taxa pursued.

Background

Catch-related Attitudes Theory and Models

The first effort to quantify CRA was conducted by Graefe (1980) as part of a study of Texas anglers. Graefe (1980) initially developed 16 items designed to measure attitudes toward the catch-related aspects of fishing or, as he termed it, the consumptive orientation of anglers (Table 2.1). An exploratory factor analysis (EFA) reduced these items into six factors including: 1) “Number of fish caught” which included items designed to measure anglers’ attitudes toward catching numbers of fish, 2) “Disposition of the catch” which dealt with anglers’ attitude toward harvesting and cleaning fish, 3) a general orientation to “Catching something” which dealt with whether an angler felt catching fish was necessary to make a fishing trip worthwhile, and 3-constructs related to the type of fish caught which dealt primarily with attitudes toward catching big or trophy fish and were termed 4) “Big fish,” 5) “Trophy fish,” and 6) “Challenging fish.” While EFA is a useful tool in the early stages of developing attitudinal scales, it is not considered a rigorous enough test for final development of a measurement model (Bollen & Lennox, 1991). This is because EFA does not require *a priori* specification of what constructs an item will load on, but allows items to load on all factors. A more rigorous test of attitudinal measurement models is confirmatory factor analysis (CFA) (Bollen & Lennox, 1991). Following Graefe’s work, two studies used CFA to develop a measurement model of CRA with some conflicting results (Aas & Vitterso, 2000; Anderson et al., 2007).

Aas and Vitterso (2000) used Graefe’s original scale in a study of Scandinavian anglers in an attempt to validate a catch-related attitude scale using CFA. Because their study used a sample of Scandinavian anglers, it was necessary for them to translate scale items which resulted in some changes of wording due to language and cultural differences. Aas and Vitterso (2000) developed a model with three independent sub-dimensions (i.e., catch, large fish, release) nested together within a general consumptiveness factor. Their primary change from Graefe's (1980) original work was to combine the "catching something" and "catching numbers" constructs. On the surface this seemed reasonable as one would expect responses on the two scales to be correlated. However, when Anderson and colleagues (2007) attempted to validate their own model using a sample of Texas anglers, they specified a model with four distinct constructs (catching something, catching numbers of fish, catching big fish, and keeping fish; Table 2.2). While the CFA found a strong correlation between the "catching something" and "catching numbers" constructs, it was concluded that the separate constructs explained more variation in the data then they shared, and as such should be considered distinct (Anderson et al., 2007). Because Aas and Vitterso's (2000) study changed wording due to language and cultural differences, Anderson and colleagues (2007) concluded that the combination of changes in item wording due to the translation, and potential cultural differences between Scandinavian and American anglers were the reason Aas and Vitterso (2000) only identified three latent constructs within their model. However, if cultural differences between anglers of different nationalities can influence attitude structure it begs the question, "Can cultural differences between different groups of American anglers also lead to different catch-related attitude structures?"

Researchers have long held that recreational anglers in United States do not represent a homogeneous group, but are composed of heterogeneous sub-groups of anglers with different interests and potentially different cultural backgrounds (Bryan, 1976; Ditton, Loomis, & Choi, 1992; Toth & Brown, 1997; Hunt & Ditton, 2002; Hunt, Floyd, & Ditton, 2007; Hutt and Bettoli, 2007). Additionally, researchers have found differences in CRA and motivations between anglers of different racial backgrounds (Toth and Brown, 1997; Hunt et al., 2007). Toth and Brown (1997) concluded that harvesting fish for subsistence was a primary motivation for Black anglers in the Mississippi Delta region while White anglers were more interested in sport fishing. Furthermore, Toth and Brown (1997) identified five motivational factors for White males related to family leisure, sport, sociability, economic-barter, and social networks; but only identified three factors for Black males involving holistic leisure, economic-social networks, and subsistence. Hunt, Floyd, and Ditton (2007) found that Black anglers in Texas scored significantly higher than White anglers on catch-related attitude scales related to catching numbers of fish, large fish, and harvesting fish, suggesting that the catch-related aspects of fishing were of greater importance to Black anglers. These and other authors have theorized that racial differences in recreational attitudes and motivations in the United States have their origin in historical patterns of social relations that have led people of different cultural backgrounds to develop different orientations toward the natural resources (Washburne, 1978; West, 1989; Toth & Brown, 1997; Hunt et al., 2007).

Other researchers have found evidence of behavioral and attitudinal differences among different angling groups completely unrelated to race and ethnicity (Bryan, 1976; Ditton, Loomis, & Choi, 1992; Hutt and Bettoli, 2007). Bryan (1977) developed the concept of recreational specialization to explain the process by which trout anglers in the western United States went from being novices new to the sport to being specialized participants with distinct preferences regarding the fishing experience. Ditton and colleagues (1992) re-conceptualized the theory of recreational specialization from a social world perspective, which stated that anglers aggregated into distinct social worlds with similar preferences and interests. Specialization theory holds that as anglers progress within the activity, in this case fishing, it would eventually become an increasingly centralized aspect of their lives, and conservation of the resource would become a greater priority to the individual (Bryan 1977; Ditton et al., 1992). This increased emphasis on conservation would in turn be manifested as an increased practice of catch-and-release with diminished importance placed on harvested fish (Ditton et al., 1992). However, researchers examining trout anglers in the southern United States (Hutt & Bettoli, 2007) and eel anglers in Germany (Dorow, Beardmore, Haider, & Arlinghaus, 2009) have found that increased levels of specialization among anglers did not always translate into a de-emphasis in harvesting fish. All this suggested that CRA toward fishing may be culturally influenced even between anglers in the same country, and may vary depending on which fish species anglers are targeting.

At least one researcher has found evidence that an individual's CRA can vary across fish species. Sutton (2003) measured CRA on a generic scale and found that although anglers with negative attitudes toward keeping fish were more likely to release fish they caught; their intention to do so was moderated by whether or not the fish in question was their preferred species. In other words, the correlation between their stated intention to release a fish and their stated attitudes toward keeping fish were strongest when the fish in question was their preferred species (Sutton, 2003). When the fish in question was not their preferred species, their attitudes and behavioral intentions were less likely to be aligned. This suggested that angler CRA as measured with a generic scale may not be reflective of their CRA toward all species at all times. Throughout all of the scale variations developed to measure angler CRA, one constant has been that the scales were designed to measure angler CRA in general without consideration of species pursued or context. Given the evidence that CRA may vary across cultural and species contexts, researchers should take steps to validate the base scale, and test the measurement invariance of the scale across different contexts to ensure that cross-group comparisons are valid.

Construct Validity and Invariance

All previous attempts to validate a measurement model of CRA have solely evaluated the proposed models on whether they meet assumptions of construct validity. These assumptions are: 1) convergent validity (i.e., items all measure the construct they were designed to measure); 2) divergent validity (i.e., items do not measure other constructs); 3) unidimensionality (i.e., only one construct underlies the set of items in the scale); and 4) reliability (i.e., measurement items are internally consistent and vary together statistically) (Garver & Mentzer, 1999). These efforts to validate the model are indeed important as a reflective scale must exhibit construct validity as a measurement instrument, but they do not go far enough to ensure that the measurement model is valid for use across different populations by testing for measurement invariance.

Measurement scales are considered invariant when they exhibit similar psychometric properties under different conditions (i.e., across groups, different contexts, or different times) (Casper et al., 2011). It is necessary to validate measurement scales for invariance to determine that differences in scores across groups, or under different contexts, are reflective of true differences on the construct and not measurement biases due to differences in factor structure or loadings (Steenkamp & Baumgartner, 1998; Vandenberg & Lance, 2000; Casper et al., 2011). Typically, measurement scales are tested for invariance using multi-group analyses that compare scales across times, gender, ethnic, and cultural groups (Wu et al., 2007; Casper et al., 2011). Tests of measurement invariance typically involve comparisons of several model characteristics across groups with the most commonly tested psychometric properties being: 1) configural invariance (i.e., items load on the same factors), 2) metric invariance (i.e., items have statistically similar factor loadings), 3) scalar invariance (i.e., items have similar intercepts), and 4) residual invariance (i.e., items have similar error terms) (Vandenburg & Lance, 2000).

There has been much debate on what level of invariance is needed to ensure that measurement bias does not exist between groups that could influence cross-group comparison tests (Vandenburg & Lance, 2000; Wu et al., 2007). It is generally accepted that configural and metric invariance must exist between two groups for group comparisons to be valid (Vandenburg & Lance, 2000). However, some researchers have argued that models must also exhibit scalar invariance for comparisons to be valid (Wu et al., 2007; Casper et al., 2011). If a measurement scale is scalar invariant across groups it means that the scale has statistically similar intercepts, or measurement origins, across groups, and a lack of scalar invariance may indicate a systematic bias in measurement between groups (Wu et al., 2007). However, Vandenburg and Lance (2000) argued that a lack of scalar invariance may not suggest a bias in measurement so much as a difference in mean scores across groups on the constructs of interest. As such, if a difference in mean scores is expected across groups then a lack of scalar invariance does not invalidate cross group comparisons (Vandenburg & Lance, 2000).

Objectives

While significant research has examined CRA, researchers have used measurement models with inconsistent factor structures, and assessments of measurement validity have been limited primarily to White, Anglo males who dominant angler groups in United States and Europe (Aas & Vitterso, 2000; USDI & USDC, 2006; Anderson et al., 2007). As such, there is a need for a more direct comparison of the proposed factor structures of CRA, and an assessment of measurement validity across different socio-demographic subgroups. Therefore, I used a sample of Texas anglers to accomplish the following four objectives: 1) to assess if a 3- or 4-construct model of CRA provides the best fit for the CRA data, 2) to determine if the final model of CRA is invariant between genders, 3) to determine if the final model of CRA is invariant across ethnic subgroups, and 4) to determine if the final model of CRA is invariant across generic versus species-specific contexts.

Methods

Study Population

This study was conducted using data collected from a statewide survey of Texas anglers (n = 6,924) conducted from May to June 2009, and a follow-up survey of freshwater catfish anglers identified by the statewide survey (n = 1,078) conducted from April to May 2010. The sampling frame for the initial statewide angler survey consisted of individuals that had purchased a resident fishing license in Texas between 1 September

2007 and 31 August 2008. A triennial survey of 6,924 licensed Texas anglers conducted by Texas Parks and Wildlife Department (TPWD) was used to identify a sample of anglers that had either fished for catfish the previous year, or indicated that catfish were one of their three most preferred freshwater species to pursue. This identified a sample of 1,078 potential catfish anglers to receive a follow-up mail survey designed to collect data on angling behavior, CRA, and trip preferences pertaining specifically to fishing for freshwater catfish. Initial confirmatory factor analyses and model comparisons were conducted exclusively on White, Anglo males as these were the dominant individuals in the samples, and to avoid bias introduced by respondents of different ethnic or gender backgrounds (Toth & Brown, 1997; Anderson et al., 2007; Hunt et al., 2007). Once a final model was chosen, the model was tested for construct validity and measurement invariance across select socio-demographic and angling context groups.

Survey Implementation

Survey implementation for both the statewide and follow-up mail surveys followed Dillman's Tailored Design Method (2007) to increase response rate. Specifically, on Day 1 of the study, individuals were sent a personalized pre-study letter from the Chief of Management and Research for Inland Fisheries Division of the TPWD explaining the study's purpose and how they were selected. On Day 8, all individuals were sent a questionnaire, pre-paid business reply envelope, and a personalized cover letter (i.e., a complete packet) from the Principal Investigator at Mississippi State University (MSU) providing instructions for completing and returning the questionnaire. On Day 18, all individuals were sent a follow-up reminder/thank you note. To increase response rate, individuals that did not initially respond to the first questionnaire mailing were sent a second complete packet on Day 28 and a third complete packet on Day 42 if necessary. All procedures were approved by the MSU Institutional Review Board (IRB) for the Protection of Human Subjects (IRB Docket 10-102).

Mail questionnaires for both surveys included the CRA attitude scale validated by Anderson and colleagues (2007) (Table 2.2). The scale consisted of 16 items designed to measure four constructs associated with consumptive orientation (i.e., catching something, catching numbers of fish, catching large/trophy fish, keeping fish). Respondents were instructed to indicate whether they agreed or disagreed with each item on a 5-point Likert type scale (response format: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree). Four items were reverse coded for analysis purposes because they were written to solicit a response inverse to that of other items within their construct. In the statewide survey questionnaire, respondents were instructed to reply to the scale items based on their attitudes toward the catch-related aspects of fishing in general (i.e., "Please indicate the extent to which you agree or disagree with the following statements" with all statements referring to fish and fishing in a generic context). In the follow-up questionnaire of catfish anglers, respondents were instructed to complete the scale based on their attitudes toward fishing for, and catching, catfish (i.e., "Please indicate the extent to which you agree or disagree with the following statements about fishing for and catching catfish"). Wording of individual items in each questionnaire was not modified from Anderson and colleagues (2007).

Data Analysis

Prior to analysis I inspected the data, and deleted participants that failed to answer any of the items on any given construct. For individuals that responded to some, but not all items on a construct, I used a Markov chain Monte Carlo algorithm in SAS Version 9.1 (SAS Institute, Inc., 2008) to input missing values (Schafer, 1997). CFA was conducted in statistical analysis package LISREL (Kelloway, 1998) to evaluate two models of CRA proposed by previous researchers (Aas and Vitterso, 2000; Anderson et al, 2007). The first model, proposed by Aas and Vitterso (2000), consisted of 3-constructs measuring angler attitudes toward catching fish, catching big fish, and harvesting fish (Figure 2.1). The second model was proposed by Anderson and colleagues (2007) and consisted of four constructs measuring angler attitudes toward catching something, catching numbers of fish, catching big/trophy fish, and harvesting fish (Figure 2.2). Both the 3- and 4-construct models were evaluated using generic catch-related attitudinal data collected from the statewide mail survey to determine which model provided a better fit to the data. Once a final model was chosen, it was evaluated again with the species-specific data collected in the follow-up mail survey of catfish anglers. Because the data used were ordinal in nature, and thus by definition was not continuous and multivariate normal, CFA was conducted using a standardized model and asymptotic covariance matrix (Joreskog, 2002).

Overall model fit was evaluated using the Satorra-Bentler (1988) χ^2 (S-B χ^2), χ^2/df ratio, standardized root mean square residual (SRMR), Goodness of Fit Index (GFI), Comparative Fit Index (CFI), and root mean square error of approximation (RMSEA) (Kelloway, 1998). Acceptable models should have non-significant χ^2 statistics, χ^2/df ratio less than 2, a SRMR less than 0.1, GFI and CFI greater than 0.95, and a RMSEA less than 0.05 (Kelloway, 1998; Garver & Mentzer, 1999). The last four fit statistics were used because it has been shown that χ^2 statistics are highly sensitive to large sample sizes, and if used on their own would lead to the rejection of well-fitting models when sample sizes are much greater than N = 200 (Garver & Mentzer, 1999). A χ^2 difference test was used to determine which of the competing models provided the best fit to the data (Kelloway, 1998). This was done by taking the difference of the χ^2 statistics and degrees of freedom for the final versions of the 3- and 4-construct models, and comparing the difference between their χ^2 statistics to the values in a χ^2 table for the associated degrees of freedom. If the χ^2 difference test is significant, then the model with the lesser χ^2 statistic is deemed to be a better fit for the data. Next, multi-group analysis was used to test the scales for configural, metric, scalar, and residual invariance cross generic and species-specific contexts, gender, and ethnic status (e.g., Anglo and non-Anglo) (Steenkamp & Baumgartner, 1998; Vandenberg & Lance, 2000; Casper et al., 2011). Configural invariance means that measurement items load on the same constructs across models, whereas metric, scalar, and residual invariance means that item factor loadings, intercepts, and measurement residuals (errors) are statistically equal across models, respectively (Steenkamp & Baumgartner, 1998; Vandenberg & Lance, 2000). Configural invariance was judged by whether the multi-group model had acceptable fit statistics. Metric, scalar, and residual invariance was judged based on χ^2 difference and CFI difference tests between each invariance model compared to the configural invariance model. For the model to be declared invariant at each level, the χ^2 difference test should be insignificant and the CFI difference should be 0.01 or less.

Results

Response Rates

The statewide survey of Texas anglers generated 1,888 responses which provided a response rate of 30% after adjustment for non-eligible surveys (i.e., 526 non-deliverable surveys and 8 refusals). Of these, only 1,019 were White, Anglo males that provided usable data on the generic CRA scale, and were used for initial model testing and development. The follow-up survey generated 587 responses for a response rate of 57% after adjustment for non-eligible surveys (i.e., 38 non-deliverable surveys and 15 refusals or deceased). Ninety-seven individuals indicated that they had neither fished for nor caught a catfish in the previous two years giving an effective sample size of 490 individuals. This was further reduced to 318 individuals after excluding individuals that were not White, Anglo males, or failed to provide usable data on the species-specific catch-related attitude scales.

A check for potential non-response bias using logistic regression and demographic data provided in the Texas license file was conducted using methods outlined by Fisher (1996). Analysis indicated that age, gender, and coastal county status were all significant predictors of non-response to the original statewide survey, but only age significantly predicted non-response probability to the follow-up survey of catfish anglers. Respondents had a greater average age than non-respondents for both surveys, whereas females and inland county residents had a greater likelihood of responding to the original statewide survey.

Baseline Models

Evaluation of the two competing catch-related attitude models was conducted using data from the Texas statewide angler survey with the initial comparisons only using data from Anglo males to be consistent with the analysis conducted by Anderson and colleagues (2007). Initial CFA results of the 3- and 4-construct models of CRA indicated poor fit of the model to the data with multiple large modification indices (MI >10), suggesting issues with both convergent and discriminant reliability (Table 2.3). A series of modifications were made to both models by removing problematic items to improve the fit of each model. The most problematic of the original 16 items was item V10 (The bigger the fish I catch, the better the fishing trip), which had lambda modification indices of greater than 10 across all constructs for both models, indicating that item V10 could not distinguish between the four constructs. This is likely because it shares similar wording to several other items. Given the problems with this item, it was dropped from both models which were re-analyzed with the other 15 items. Removal of item V10 resulted in significant improvement to model fit, and a large decrease in the number of large MIs. In the next iteration of the analysis item V15 (I want to keep all the fish I catch) was removed because of its weak loading on the Keeping Fish construct ($\lambda = .59$) compared to the other items, and numerous large MI's indicating that it wanted to load on the other constructs and its error term wanted to correlate with other items. In the next iteration of the analysis, item V2 (When I go fishing, I'm just as happy if I don't catch any fish) was removed from both models because it exhibited several large lambda and theta-delta MI's. Finally, item V7 (A full stringer is the best indicator of a good fishing trip) was removed from both models because of large lambda and theta-delta MI's.

Following modifications, the 3- and 4-construct models still had significant χ^2 statistics indicating a lack of fit to the data (Table 2.3). However, the other fit statistics listed in Table 2.3 indicated that the models did provide a good fit to the data. It is well documented that the χ^2 test is very sensitive to large sample sizes, and with a sample of 1,019 individuals it would be very difficult to obtain a non-significant χ^2 test for this analysis (Kelloway, 1998). Of the two models, the 4-construct model exhibited the better fit statistics, and with a significant χ^2 difference ($\Delta \chi^2 = 100.3$; $df = 3$; $p < .001$), it was concluded that the 4-construct model provided the best fit to the data. Furthermore, the final 4-construct model had the least SRMA (.046) and RMSEA (.044) and the greatest GFI (.96), all of which were in the ranges for indicating acceptable fit (Garver & Mentzer, 1999) compared to the final 3-construct model. Following acceptance of the 4-construct model, the model also was evaluated using the species-specific data from the follow-up survey, and was still found to have acceptable fit (Table 2.3).

Construct Validity and Invariance Tests

Having identified the model that provided the best fit to the data, it was then necessary to evaluate the construct validity of the final measurement model. All observed variables had significant standardized loadings at the $p < .05$ level using the generic and species-specific data (Table 2.4). Seven and six of the 12 items had low factor loadings ($\lambda > .7$, the recommended minimum to indicate convergent validity) (Garver & Mentzer, 1999), using the generic and species-specific data, respectively. Of the items with low loadings, five from the generic model and three from the species-specific model were in the marginal range ($.6 \geq \lambda \geq .7$). The same pattern was seen in the indicator reliability estimates of both models. Three of the four constructs (Catching

Something, Catching Numbers, Keeping Fish) also exhibited acceptable composite reliability (VE > .7) under both models (Table 2.4) (Garver & Mentzer, 1999). Finally, tests for measurement invariance using multi-group CFA indicated that the 4-construct model had acceptable configural and metric invariance across generic and species-specific contexts, gender, and ethnic status (Table 2.5), indicating that the construct scales had the same factor loading structure and statistically similar factor loadings across these different contexts and groups. Based on criteria set forth by Vandenberg and Lance (2000), these results indicated that meaningful comparisons can be made between generic and species-specific CRA scales as well as between the CRA of males and females and Anglos and non-Anglos.

Discussion

This study's purpose was to compare the fit of two previously proposed models of CRA and test the best fitting model for factorial validity and invariance across different demographic sub-groups and angling contexts. Based on fit indices in CFA, it can be concluded that the 4-construct model proposed by Anderson and colleagues (2007) provided a better fit to the available data then the 3-construct model proposed by Aas and Vitterso (2000). Upon reaching this conclusion, I then used the 4-construct model to assess model fit and measurement invariance across gender, ethnic, and angling species-context groups. I found the 4-construct model to provide good to moderately acceptable fit across groups, and to possess configural and metric invariance. These results indicated that the 4-construct model would provide valid measurement of CRA across a wide variety of user groups and angling contexts. While non-response bias is always a concern in survey research when calculating population estimates, it should not be an issue in this study as I conducted separate analyses for each demographic group rather than combining them in a population wide analysis (Fisher 1996).

Close examination of Aas and Vitterso's (2000) paper indicates that they also could have easily adopted a 4-construct model. Anderson and colleagues (2007) based their model on Graefe's (1980) early work which separated items using exploratory factor analysis and a traditional eigenvalue cut off of 1.0. However, Aas and Vitterso (2000) used a greater cut off value based on recommendations set forth by Lauteschlager (1989), and rejected presence of a fourth construct despite conducting an initial exploratory factor analysis that generated four constructs with eigenvalues greater than 1.0 (the leastest was 1.09). Had they used the more traditional cut off of eigenvalues ≥ 1.0 then they would likely have also adopted a 4-construct model (Aas & Vitterso, 2000).

In the process of assessing model fit, I started out with the original 16 items used by Anderson and colleagues (2007), and made a series of modifications to the 3- and 4-construct models to improve model fit and construct validity. Anderson and colleagues (2007) also made modifications to their model, and it is interesting that they settled on the same 12 items for the final model as this study. This may be due, in part, to both studies using a sample of White, Anglo male anglers from Texas for initial model assessment. Anderson and colleagues (2007) limited their sample to White, Anglo males to "avoid bias introduced by individuals from different ethnic backgrounds and gender (Toth & Brown, 1997)." Anderson and colleagues (2007) also recommended that future studies conducted with different angler populations would be advised to include at minimum the full complement of 16 items in their surveys until such time as the 12 item model can be validated under different angler populations. Results of my analyses have indicated that the 12 item model should be adequate for assessing CRA across a variety of diverse user groups. However, additional research will be needed to evaluate model fit and invariance among specific minority angler groups as sample size limitations forced me to combine all non-Anglo individuals into one group versus evaluating the model separately for each non-Anglo ethnic group in the sample. Such studies may consider collecting data on the full 16 item scale so that they might independently determine the final model that best fits their data.

While my study results indicated that the 4-construct model of CRA provided good fit to the data, good fit does not always equal valid measurement (Fornell, 1983). Each of the four constructs presented in my final measurement model present some issues with construct validity as each construct possessed items with low ($\lambda < .60$) to marginal ($.60 \leq \lambda \leq .70$) standardized loadings, and less than preferred indicator reliability (SMC $\geq$ .50) (Fornell, 1983; Garver & Mentzer, 1999). Low standardized loadings are a common problem with measurement models designed to measure attitudinal constructs, and have been a consistent problem for previous CRA studies (Aas & Vitterso, 2000; Anderson et al., 2007; Kyle, Norman, Jodice, Graefe, & Marsinko, 2007). Low standardized loadings are considered problematic in measurement theory because they may indicate that the construct as measured does not fully meet the assumption of unidimensionality (Hulland, Chow, & Lam, 1996; Garver & Mentzer, 1999). Failure to achieve unidimensionality can result when measurement items refer to, or hint at, multiple constructs. A good example of this among the original 16 catch-related attitude items is the BIGBETTER item (“I would rather catch 1 or 2 big fish than 10 smaller fish”) which is meant to measure the Catching Large/Trophy Fish construct, but could also be interpreted as a reverse coded item for the Catching Numbers construct. Other items that could suffer from this issue are the LIMIT and EAT items. While the LIMIT item is meant to measure the Catching Numbers construct, its use of the term 'limit' suggests harvesting fish which could associate it with the Keeping Fish construct. Conversely, the EAT item is meant to measure the Harvesting Fish construct, but it could be argued that eating fish and harvesting them are two slightly different constructs.

Another item that suffered from a weak standardized loading was the NOFISH item in the Catching Something construct. A possible explanation of the weak loading for the NOFISH item is that it was reverse coded. Reverse coded items are written as negative measures of the construct with the idea that individual answers to these items should be the opposite of their answers to positively worded items (Weems & Onwuegbuzie, 2001). Responses to these items are then reverse coded before data analysis (i.e., a response of 1 on a 5-point scale is changed to a 5). Reverse coded items are often included in measurement scales to identify and prevent response set bias which is the "tendency on the part of individuals to respond to attitude statements for reasons other then the content of the statement" (Maranell, 1974, p. 247). The problem with reverse coded items is that there use tends to reduce the reliability of measurement scales (Weems & Onwuegbuzie, 2001). In a study using positively and negatively worded measurement items, Weems and Onwuegbuzie (2001) found that confidence intervals of mean scores on negatively worded items did not overlap the confidence intervals of mean scores on positively worded items after reverse coding. Thus, they concluded that the negatively worded items might be measuring a different underlying construct, and their inclusion in a scale threatened to violate the assumption of unidimensional constructs.

Researchers should consider whether this or response set bias is more problematic when designing attitudinal measurement scales.

Finally, the Catching Large Fish construct has potential issues with convergent validity. While items related to catching big fish, trophy fish, and challenging fish may appear similar on the surface, it is obvious from this analysis that these concepts are not as similar as one might think. It is possible that the combination of these items may create a construct that is more formative in nature than reflective (Bollen & Lennox, 1991). Graefe's (1980) initial exploratory factor analysis of catch-related attitude items even suggested that these items might represent separate constructs. As such, future researchers should consider separating the construct into two constructs representing Catching Big Fish and Catching Challenging Fish for evaluation purposes. Efforts to split the Catching Large Fish construct, and improve measurement of the other constructs will require development of new and modified measurement items, and I have included suggestions for these in Table 2.6. It is also my recommendation that researchers attempting to develop an improved measurement scale should also keep the 16 items used in this study so that they can be compared to any new items.

In addition to assessing model fit and construct validity, I also assessed measurement invariance of the 4-construct model across demographic and contextual groups. Assessment of measurement invariance is essential to determining if an attitudinal scale provides equivalent measurement of a construct across different groups, especially when those groups were under-represented or absent from samples used in the original development of the scale (Vandenburg & Lance, 2000; Wu et al., 2007; Casper et al., 2011). Tests of measurement invariance are most commonly assessed across groups that differ on socio-demographic, national, and temporal variables. Failure to assess measurement invariance prior to making group comparisons can result in biased statistical results. I found evidence of configural and metric invariance across gender, ethnic, and angling context groups on the CRA scale, but failed to find evidence of invariance at increasingly constrained levels. The literature on assessing measurement invariance has been divided on what levels of invariance are needed to ensure unbiased group comparisons (Vandenburg & Lance, 2000; Wu et al., 2007). Vandenberg and Lance (2007) indicate that configural and metric invariance should be adequate to ensure unbiased comparisons across groups when one expects to see differences in group means. However, Wu and colleagues (2007) suggest that scalar, and possibly residual, invariance also is needed to ensure unbiased comparisons. While my study results meet the former requirement, they do not meet the latter. As such, future efforts to improve CRA measurement and assess differences between populations on the constructs also should assess measurement invariance.

In summary, I showed that the 4-construct model of CRA proposed by Anderson and colleagues (2007) provided a better fit to the data than the 3-construct model proposed by Aas and Vitterso (2000). I also demonstrated that the CRA scale was invariant between gender and ethnic groups, and between traditional generic-species context and a species-specific context, indicating that the model has similar psychometric measurement properties and is unbiased between the two contexts. As such, it is valid to make comparisons between an angler's generic CRA, and their attitudes toward catching a specific species in future research.

Table 2.1 Items originally developed by Graefe (1980) to measure catch-related attitudes toward recreational fishing.

Number of fish caught dimension	
A full stringer is the best indicator of a good fishing trip	
The more fish I catch, the happier I am	
A successful fishing trip is one in which many fish are caught	
Disposition of catch dimension	
I'm just as happy if I don't keep the fish I catch	
Keeping the fish I catch is more enjoyable than releasing them	
Cleaning fish is worth it to be able to eat the fish I catch	
Bringing fish home to the table is an important outcome of fishing	
General orientation to catching something dimension	
When I go fishing, I'm not satisfied unless I catch something	
If I thought I wouldn’t catch any fish, I wouldn’t go fishing	
A fishing trip can be successful even if no fish are caught	
When I go fishing, I'm just as happy if I don't catch a fish	
If I was sure I wouldn’t catch fish, I wouldn’t go fishing	
Statements related to type of fish caught	
The bigger the fish I catch, the better the fishing trip	
Catching a trophy fish is the biggest reward to me	
I’m happiest with a fishing trip if I catch a challenging game fish	
It doesn’t matter to me what type of fish I catch	

Table 2.2 Measurement scale validated by Anderson and colleagues (2007) to measure catch-related attitudes toward recreational fishing by four hypothesized constructs of consumptive orientation[a].

Factor 1 - Attitudes toward catching something (CATSOM)
V1 – A fishing trip can be successful even if no fish are caught (NOFISH)[b]
V2 – When I go fishing, I'm just as happy if I don't catch a fish (HAPPY)[b]
V3 – If I thought I wouldn't catch any fish, I wouldn't go fishing (NOCATCH)
V4 – When I go fishing, I'm not satisfied unless I catch something (SOMETHING)

Factor 2 - Attitudes toward catching numbers of fish (CATNUM)
V5 – The more fish I catch, the happier I am (MOREFISH)
V6 – A successful fishing trip is one in which many fish are caught (MANYFISH)
V7 – A full stringer is the best indicator of a good fishing trip (FULLSTRING)
V8 – I'm happiest with a fishing trip if I at least catch the daily bag limit of fish (LIMIT)

Factor 3 - Attitudes toward catching large/trophy gamefish (CATLAR)
V9 – I would rather catch one or two big fish than ten smaller fish (BIGFISH)
V10 – The bigger the fish I catch, the better the fishing trip (BIGBETTER)
V11 – I'm happiest with a fishing trip if I catch a challenging game fish (CHALLENGE)
V12 – I like to fish where I know I have a chance to catch a "trophy" fish (TROPHY)

Factor 4 - Attitude toward keeping fish (KEEPFISH)
V13 – I usually eat the fish I catch (EAT)
V14 – I'm just as happy if I don't keep the fish I catch (DONTKEEP)[b]
V15 – I want to keep all the fish I catch (WANTKEEP)
V16 – I'm just as happy if I release the fish I catch (RELEASE)[b]

The CATSOM and CATNUM constructs are combined in Aas and Vitterso's (2000) 3-construct model.

[a] Respondents were asked to indicate whether they agreed or disagreed with each item on a 5-point Likert-type scale with 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; and 5 = strongly agree.

[b] Item reverse coded for analysis purposes.

Table 2.3 Goodness of fit statistics from confirmatory factor analyses comparing the 3- and 4-construct measurement models of catch-related attitudes toward recreational fishing.

Model No.	No. Items	d.f.	S-B χ^2	χ^2 /(d.f.)	SRMR	GFI	CFI	RMSEA
3-construct Generic Models (N = 1,019)								
Model 1	16	101	874.04	8.65	.083	.84	.82	.087
Model 2	15	87	722.78	8.31	.075	.86	.83	.085
Model 3	14	74	469.38	6.34	.070	.89	.87	.072
Model 4	13	62	328.99	5.31	.058	.92	.90	.065
Model 5	12	51	244.22	4.79	.056	.93	.91	.061
4-construct Generic Models (N = 1,019)								
Model 1	16	98	599.80	6.12	.073	.88	.87	.071
Model 2	15	84	467.89	5.57	.065	.90	.89	.067
Model 3	14	71	296.38	4.17	.053	.93	.92	.056
Model 4	13	59	186.06	3.15	.048	.95	.94	.046
Model 5	12	48	143.90	3.00	.046	.96	.94	.044
4-construct Base Models for Invariance Tests [a]								
Catfishing	12	48	63.68	1.33	.064	.94	.94	.032
Male	12	48	209.87	4.37	.048	.95	.93	.051
Female	12	48	77.60	1.62	.060	.92	.92	.048
Anglo	12	48	168.36	3.51	.043	.96	.95	.045
Non-Anglo	12	48	98.08	2.04	.068	.91	.90	.062

Data for all analyses came from a statewide survey of Texas anglers (May to June 2009) except for the catfishing model for which data came from a follow-up survey of catfish anglers (April to June 2010).

[a] Sample sizes (N) for sub-group tests of model fit: Catfishing = 318; Male = 1,279; Female = 273; Anglo = 1,242; Non-Anglo = 275

NOTE: d.f. = degrees of freedom, S-B χ^2 = Satorra-Bentler Chi-square, SRMR = standardized root mean residual, GFI = goodness-of-fit index, CFI = comparative fit index, RMSEA = root mean squared error of approximation.

Table 2.4 Factor loadings, reliability, and variance extracted of 12 indicator items within a measurement model intended to measure four constructs of catch-related attitudes toward recreational fishing as determined by confirmatory factor analysis for both generic (Gen) and species-specific (Spp) models.

Factors and indicators[a]	Standardized loadings[b]		Indicator reliability[c]		Average variance extracted[e]	
	Gen	Spp	Gen	Spp	Gen	Spp
Catching something			.75[d]	.77[d]	.50	.53
NOFISH	.59	.58	.35	.34		
NOCATCH	.68	.64	.46	.41		
SOMETHING	.84	.92	.70	.84		
Catching numbers			.74[d]	.77[d]	.48	.53
MOREFISH	.66	.71	.43	.51		
MANYFISH	.77	.85	.59	.72		
LIMIT	.66	.61	.43	.37		
Catching large fish			.67[d]	.68[d]	.41	.42
BIGFISH	.51	.52	.26	.27		
CHALLENGE	.62	.72	.38	.51		
TROPHY	.76	.69	.58	.48		
Keeping fish			.82[d]	.81[d]	.61	.59
EAT	.60	.53	.36	.28		
DONTKEEP	.82	.84	.68	.70		
RELEASE	.88	.89	.78	.80		

Data for the generic model was collected by a statewide survey of Texas anglers (May to June 2009). Data for the species-specific model was collected by a follow-up survey of catfish anglers (April to June 2010).

[a] Indicator statements found in Table 2.1.

[b] All loadings were significant at $p < 0.05$.

[c] Indicator reliability, or squared multiple correlation, is an estimate of the percentage of variance in the data accounted for by the underlying factor on which the variable loads.

[d] Composite reliability (VE) is a measure of the internal consistency of the variables within a factor.

[e] Variance extracted estimates measure the amount of data variance explained by the underlying factor compared to variance due to measurement error.

Table 2.5 Invariance tests for the 4-construct model of catch-related attitudes between gender, ethnic, and species context groups.

Model	Invariance level	χ^2	*p*	RMSEA	CFI	$\Delta \chi^2$	Δ d.f.	Δ CFI
Male vs.	Configural	34.24	1.000	.000	1.00			
Female	Metric	56.27	1.000	.000	1.00	22.03	12	.00
	Scalar	748.69	< .001	.080	.90	**714.45**	24	**-.10**
	Residual	768.03	< .001	.077	.89	**733.79**	36	**-.11**
Anglo vs.	Configural	32.27	1.000	.000	1.00			
Non-anglo	Metric	40.63	1.000	.000	1.00	8.36	12	.00
	Scalar	474.02	< .001	.060	.88	**441.75**	**24**	**-.12**
	Residual	484.77	< .001	.057	.88	**452.50**	**36**	**-.12**
Species	Configural	283.43	< .001	.052	.96			
context	Metric	307.43	< .001	.050	.96	24.00	12	.00
	Scalar	619.64	< .001	.077	.90	**336.21**	24	**-.06**
	Residual	622.89	< .001	.073	.90	**339.46**	36	**-.06**

Data were collected by a statewide survey of Texas anglers (May to June 2009), and a follow-up survey of catfish anglers (April to June 2010).
* Indicates p < .01; bold indicates change in fit indices below cut off criteria.
NOTE: d.f. = degrees of freedom, χ^2 = Chi-square, CFI = comparative fit index, RMSEA = root mean squared error of approximation.

Table 2.6 Proposed measurement items for inclusion in future assessments of the catch-related attitudes model in addition to the 16 items validated by Anderson and colleagues (2007).

Catching Something Construct
A fishing trip is only successful if fish are caught
I must catch fish for the fishing trip to be enjoyable/successful [a]
Catching Numbers Construct
I am happiest with a fishing trip if I catch a lot of fish [b]
I am not satisfied if I don't catch several fish per hour
Catching Large Fish
Catching a big fish makes for an exciting fishing trip
I prefer to fish for large fish
Catching a large fish is the most exciting part of a fishing trip
Catching Challenging/Trophy Fish
I prefer to catch fish that test my angling skills
The more challenging it is to land a fish, the more rewarding the catch
Keeping/Harvesting Fish
I want to keep most of the fish I catch
I want to keep enough fish to make a meal
I would not go fishing if I could not keep any

[a] From Kyle, Norman, Jodice, Graefe, & Marsinko (2007)
[b] From Steffen and Hunt (2011)

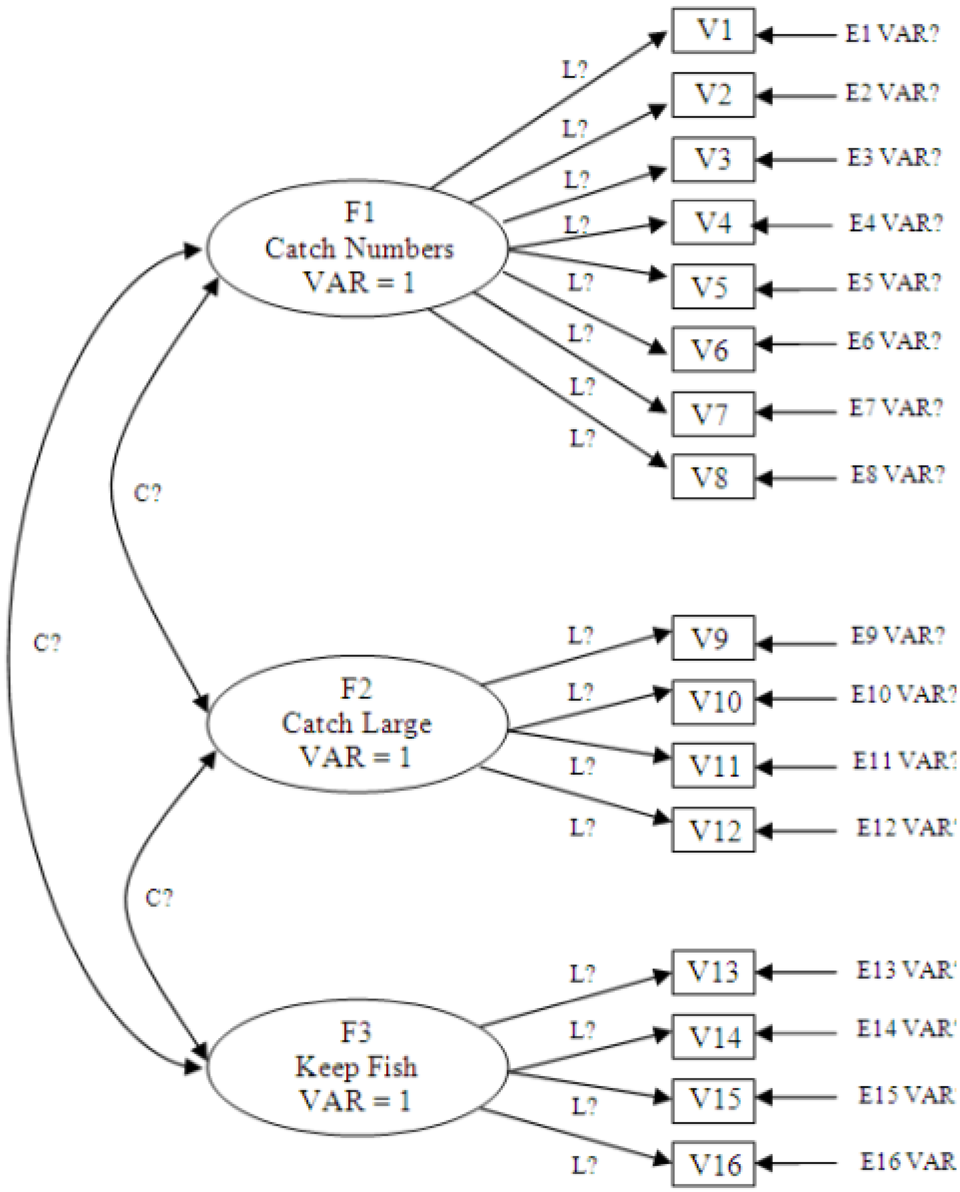

Figure 2.1 Aas and Vitterso's (2000) conceptual path diagram of their proposed 3-construct model of angler catch-related attitudes.

Detailed explanations of individual indicator items (V) and latent constructs or factors (F) can be found in Table 2.2. Confirmatory factor analysis was used to estimate factor loadings (L), residual error terms (E) and their associated variance (VAR), and covariances between latent constructs (C).

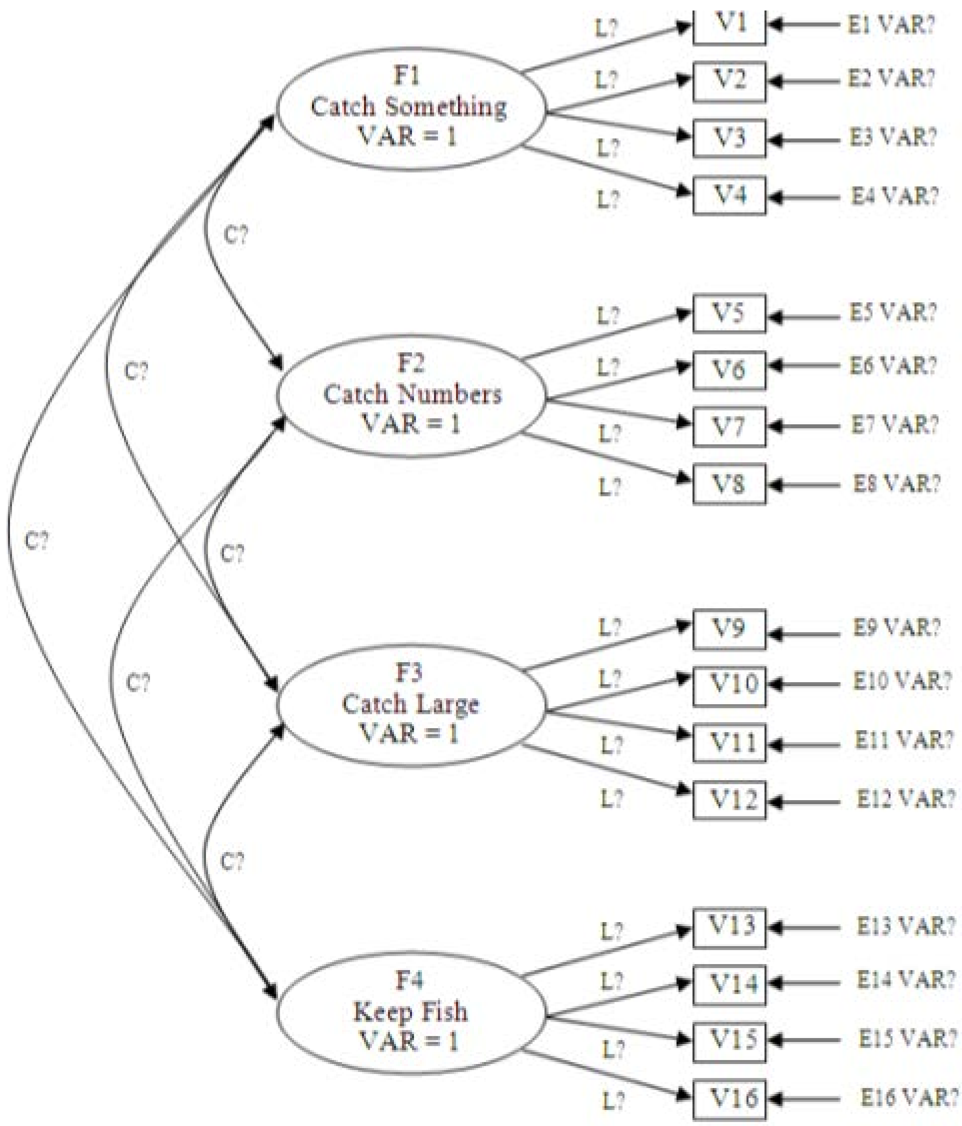

Figure 2.2 Anderson and colleagues' (2007) conceptual path diagram of their proposed 4-construct model of angler catch-related attitudes.

Detailed explanations of individual indicator items (V) and latent constructs or factors (F) can be found in Table 2.2. Confirmatory factor analysis was used to estimate factor loadings (L), residual error terms (E) and their associated variance (VAR), and covariances between latent constructs (C).

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CHAPTER III

MODERATING EFFECTS ON CATCH-RELATED ATTITUDE CONSISTENCY BETWEEN GENERIC AND SPECIES-SPECIFIC CONTEXTS

Introduction

The study of attitudes has been of great interest to social psychologists and natural resource managers alike because of the inherent influence attitudes have on people's behavior (Fishbein & Ajzen, 1975; Fazio, 1986; Ajzen & Driver, 1991; Sutton & Ditton, 2001; Sutton, 2003). The study of attitudes has been of particular interest to natural resources managers whose conservation efforts would be aided by a better understanding of why people participate in certain types of behavior, and how undesirable behavior can be altered by educational programs designed to change their attitudes toward the behavior (Heberlein, 1973; Gramann & Vander Stoep, 1986; Manfredo, Yuan, & McGuire, 1992). The justification for studying catch-related attitudes (CRA) has been that understanding them will aide fisheries managers in determining management goals for fisheries resources by identifying whether anglers were most interested in harvesting fish, high catch rates, and/or trophy fishing opportunities (Graefe, 1980; Aas & Vitterso, 2000; Anderson et al., 2007).

Early researchers often failed to find a strong link between environmental attitudes and behavior (Heberlein, 1973). However, later researchers concluded that this failure was generally due to lack of specificity in the measurement of attitudes related to the behavior of interest, and a failure to consider other factors that could influence behavior such as individual perceptions of social norms and constraints (Fishbein & Ajzen, 1975; Ajzen & Driver, 1991). Other researchers also have illustrated that the importance an individual places on a given activity, and that the mental accessibility of their attitudes toward an activity, also can influence the strength of the relationship between a person's attitudes and their behavior (Fazio, 1986; Manfredo et al., 1992; Bright & Manfredo, 1995). Importance of attitude specificity and context has been particularly illustrated in several studies of angler behavior that have examined the influence of angler attitudes toward the practice of catch-and-release fishing (Sutton & Ditton, 2001; Sutton, 2003; Wallmo & Gentner, 2008).

In a study of freshwater anglers in Texas, Sutton (2003) found that angler attitudes toward keeping fish and catching large/trophy fish significantly affected angler intentions to practice catch-and-release in hypothetical scenarios. However, ability of angler CRA to predict their behavioral intentions was moderated by whether the fish species specified in the hypothetical scenario was their most preferred species to catch. In other words, the correlation between their stated intention to release a fish and their stated attitudes toward keeping fish was strongest when the fish in question was their preferred species (Sutton, 2003). In a similar study of saltwater anglers fishing in the northeast Atlantic, Wallmo and Gentner (2008) found a significant relationship between angler attitudes toward releasing fish and their stated intentions to practice catch-and-release. However, they also found that intention to practice catch-and-release was influenced by the fish species presented in a given hypothetical scenario. Finally, a study of European anglers found that an angler's primary motives for fishing varied across fish species pursued with some species being pursued primarily for catch-related motives (e.g., harvesting), whereas others were primarily pursued for non-catch related motives (e.g., enjoying solitude), further suggesting that anglers may have different mind sets toward pursuing different species (Beardmore, Haider, Hunt, & Arlinghaus, 2011).

A potential reason for why the relationship between CRA and behavioral intentions to practice catch-and-release was moderated by species in these studies is that they both measured CRA on generic scales that assume an angler's attitudes toward catch do not vary across species (Sutton, 2003; Wallmo & Gentner, 2008). As these studies suggest, angler CRA as measured with a generic scale may not be reflective of their CRA toward all species at all times. This could be particularly problematic for those attempting to use CRA data to inform fisheries management plans, as management is traditionally done at the species and resource level (Nielson, 1999; Hunt, 2001).

It is possible that CRA measurement at a generic level does not offer an adequate level of specificity. Researchers studying effect of attitudes on behavior have long indicated that very specific measurement of the attitude object and concurring behavior is essential to the successful prediction of behavioral intentions, and thus behavior (Fishbein & Ajzen, 1975; Ajzen, 1991). In a study in which they validated a generic scale of CRA, Anderson and colleagues (2007) stated that they expected angler attitudes toward catch to vary depending on the context of a given fishing trip. Examples they gave included fishing with family versus friends, or when fishing on a lake known for producing trophy fish (Anderson et al., 2007). Given the potential influence of trip context on CRA, researchers conducting studies on specific resources, or looking to explain specific behaviors, may be best served to define the context anglers should consider when responding to a measurement scale on CRA. However, defining a specific context in which the angler should consider their answers is not always practical, especially when conducting a state-wide survey of anglers that often pursue multiple species in a variety of angling contexts.

This raises the question, if CRA can vary dependent on the context of a fishing trip, what context are anglers envisioning when answering items measured on a generic scale? One attitudinal theory that may help answer this question is Fazio's (1986) Process Model of Attitudes (PMA). The PMA holds that attitudes best predict behavior when they are highly accessible and thus easily activated within the individual's mind when they are confronted with a related attitude-object. The PMA states that an individual's attitudes tend to be more accessible when they were formed through direct experience with the attitude object, and when the individual has the opportunity to repeatedly express their attitudes toward the object (Fazio, 1986). Fazio (1986) postulated that when an individual was highly experienced with a given attitude object their behavior was guided by their own attitudes, but when they were less experienced with an attitude-object they would be less trusting of their own attitudes and rely more heavily on their knowledge of social norms to guide their behavior. Sutton (2003) found that angler CRA were most consistent with their intentions to practice catch-and-release when the fish species in question was their preferred species. That CRA measured on a generic scale, as opposed to a species specific scale, would best reflect angler behavioral intentions toward their most preferred species would appear to be consistent with Fazio's PMA.

Numerous researchers have shown that avid anglers tend to concentrate their angling effort toward a handful of species with one or two species receiving most of their angling effort (Bryan, 1977; Ditton et al., 1992; Hutt & Bettoli, 2007). The result of this concentrated effort is that anglers have greater opportunities to express their CRA toward their preferred species through their behavior and, in turn, may be more likely to draw on these experiences when asked to express their CRA on a generic scale. Similarly, studies have found that the more important an attitude-object was to an individual, the more likely their attitudes toward that object affected their behavior (Smith, 1994; Bright & Manfredo, 1995). Bright and Manfredo (1995) found that the correlation between individual attitudes toward natural resource issues and their level of support for related management strategies was related positively to level of importance the individual placed on the issue. Therefore, I would expect the more an angler prefers a given species, the more importance they will likely place on that species and their attitudes toward that specific species will be of greater salience to them. Anglers may have different attitudes regarding consumption of less preferred species, but these attitudes will likely receive less consideration when the angler is asked to indicate their attitudes on a generic scale.

The objective of this study was to assess consistency of angler responses to a CRA scales presented in generic and species-specific contexts, and whether the level of consistency between the two was moderated by three variables that measure the angler's avidity for the species, or group of species, in question. Howell (2010, p.557) defined a moderating relationship as a situation "in which the relationship between the independent and dependent variable changes as a function of the level of a third variable (the moderator)." The three variables I examined as potential moderators of the consistency of CRA were the: 1) anglers' most preferred species, 2) level of importance anglers placed on fishing for species in question compared to other species, and 3) frequency with which anglers pursued the species in question.

Methods

Survey Implementation

I conducted this study using data collected from a statewide survey of Texas anglers (*n* = 6,924), and a follow-up survey of freshwater catfish anglers identified by the statewide survey (*n* = 1,078). The sampling frame for the initial statewide angler survey consisted of individuals that had purchased a resident fishing license in Texas between 1 September 2007 and 31 August 2008. A tri-annual survey of 6,924 licensed Texas anglers conducted by Texas Parks and Wildlife Department (TPWD) was used to identify a sample of anglers that had either fished for catfish the previous year, or indicated that catfish were one of their three most preferred freshwater species to pursue. This identified a sample of 1,078 potential catfish anglers to receive a follow-up mail survey designed to collect data on angling behavior, CRA, and trip preferences pertaining specifically to fishing for freshwater catfish.

Survey implementation used Dillman's Tailored Design Method (2007) to increase response rate. Specifically, on Day 1 of the study, individuals were sent a personalized pre-study letter from the Chief of Management and Research for Inland Fisheries Division of the TPWD explaining the study's purpose and how they were selected. On Day 8, all individuals were sent a questionnaire, pre-paid business reply envelope, and a personalized cover letter (i.e., a complete packet) from the Principal Investigator at Mississippi State University (MSU) providing instructions for completing and returning the questionnaire. On Day 18, all individuals were sent a follow-up reminder/thank you note. To increase the response rate, individuals that did not initially respond to the first questionnaire mailing were sent a second complete packet on Day 28 and a third complete packet on Day 42 if necessary. All procedures were approved by the MSU Institutional Review Board (IRB) for the Protection of Human Subjects (IRB Docket 10-102).

Measures

Catch-related Attitudes

Respondents were asked to respond to 16 items (Anderson et al., 2007) pertaining to their CRA in a generic context in the statewide survey, and regarding specifically to catching catfish in the follow-up survey. The 16 item scale was designed to measure four constructs associated with consumptive orientation (i.e., catching something, catching numbers of fish, catching large/trophy fish, keeping fish). Respondents were instructed to indicate whether they agreed or disagreed with each item on a 5-point Likert type scale (response format: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree). Four items were reverse coded for analysis purposes because they were written to solicit a response inverse to that of other items within their construct to avoid response set bias (Maranell, 1974). The wording of individual items in each questionnaire was not modified. Data were then used to validate a 4-construct, 12-item scale of CRA which was used for all subsequent analysis in this dissertation (Table 3.1).

Species Preference

Respondents to the statewide survey were asked to indicate the three species of freshwater fish they most preferred to catch. I divided anglers into groups based on the species they most preferred to pursue. Only anglers that ranked catfish *Ictaluridae*, black bass *Micropterus spp.*, or crappie *Poxomis spp.* as their most preferred fish to pursue were included in the species preference analysis as inadequate sample size existed for anglers that preferred other species. These were the same three species groups used by Sutton (2003) in his study of effects of CRA on catch-and-release behavior, and are the three most commonly pursued freshwater sportfish species groups in Texas (USDI & USDC, 2006).

Catfishing Importance

Respondents to the follow-up mail survey were asked to rate importance of catfishing compared to their other fishing activities (1 = most important, 2 = 2nd most important, 3 = 3rd most important, 4 = none of the above). I then divided anglers into groups based on the level of importance they placed on catfishing compared to other fishing activities. Importance was measured on an ordinal scale, and respondents were divided into groups accordingly. Respondents indicating that fishing for catfish was not among their three most important fishing activities were excluded from moderation analyses as the sample size for this group was too small for analysis purposes.

Fishing Frequency for Catfish

Respondents to the follow-up mail survey of catfish anglers were asked how frequently they had fished for catfish on several types of water bodies over the previous

12 months. These estimates of catfishing frequency were then summed to estimate total annual catfishing frequency. Frequency of fishing for catfish was measured as a continuous variable, and thus respondents were divided into three groups based on whether their frequency of catfishing was less than or equal to the 33rd percentile (10 trips), 66th percentile (25 trips), or above.

Data Analysis

Multi-group structural equations models (MGSEMs) in LISREL (Kelloway, 1998) were used to assess measurement model invariance across groups (Vandenburg & Lance, 2000; Wu, Li, & Zumbo, 2007). First, I divided respondents into three groups for each of the proposed moderation variables for multi-group analysis purposes. Second, I then evaluated each model for configural and metric invariance across groups for the three moderation variables to determine that the models were invariant, and that valid comparisons could be made across group models (Vandenburg & Lance, 2000; Wu, Li, & Zumbo, 2007). Next, MGSEMs were used to determine if the relationship between generic and species-specific catch-related attitude constructs were significantly moderated by level of species preference, importance of catfishing, and catfish fishing frequency (Baron & Kenny, 1986; Sauer & Dick, 1993; Kim, Kaye, & Wright, 2001). MGSEM is preferred to more traditional moderation analysis when using latent variables because it controls for measurement error in the latent constructs (Sauer & Dick, 1993). For each CRA construct, structural models with generic CRA predicting species-specific CRA were tested first without the moderator variables to establish a baseline level of effect, and then across groups for all three moderator variables using MGSEMs (Figure 3.1). In MGSEMs using discrete moderator variables separate models are estimated simultaneously for each group of respondents. Two runs of the MGSEM are made with the gamma (γ) parameters allowed to be estimated freely across groups in the first run, and the gamma parameters constrained to be equal in the second run (Sauer & Dick, 1993). Each run of the structural model generates a set of overall fit statistics including the χ^2 test. If a χ^2 difference test between the two runs of the model is significant, then the grouping variable can be declared a significant moderator of the relationship (gamma, γ; Figure 3.1) tested within the MGSEM (Sauer & Dick, 1993; Sylvia-Bobiak & Caldwell, 2006). Following an initial significant finding of moderation additional gamma paths were freed, and χ^2 difference tests were used to compare the constrained model to models with one gamma path unconstrained to ascertain significantly different groups. Additionally, paired t-tests and effect sizes were used to compare mean summated scores between generic and species-specific contexts for each group across the four CRA constructs.

Results

The statewide survey of Texas anglers generated 1,888 responses which provided a response rate of 30% after adjustment for non-eligible surveys (i.e., 526 non-deliverable surveys and 8 refusals). Of the respondents to the statewide survey, 1,078 indicated that they had caught a catfish in the previous year, or had ranked them among their top three preferred fish to pursue. The follow-up survey generated 587 responses for a response rate of 57% after adjustment for non-eligible surveys (i.e., 38 non-deliverable surveys and 15 refusals or deceased). Ninety-seven individuals who indicated that they had neither fished for nor caught a catfish in the previous two years were excluded from further data analysis, along with 33 individuals that did not provide completed surveys, giving an effective sample size of 457 individuals for analysis purposes.

A check for potential non-response bias using logistic regression and demographic data provided in the Texas license file was conducted using methods outlined by Fisher (1996). Analysis indicated that age, gender, and coastal county status were all significant predictors of non-response to the original statewide survey, but only age significantly predicted non-response probability to the follow-up survey of catfish anglers. Respondents had a greater average age than non-respondents for both surveys whereas females and inland county residents had a greater likelihood of responding to the original statewide survey.

CRA scale items exhibited moderate to strong correlations with one another when measured within and between generic versus species-specific contexts (Table 3.2). Items also had similar means and standard deviations between generic and species-specific contexts (Table 3.2). Thus, it was expected that base structural models all showed a strong, significant relationship (γ = .71 to .77; $p < .05$) between generic and species-specific CRA and high variance extracted estimates (γ R^2 = .59 to .60) (Table 3.3). Despite these strong results, only the Catching Something model exhibited fit statistics (S-B χ^2 = 12.32, d.f. = 8, p = .138; CFI = .98; RMSEA = .034) that uniformly indicated that the model provided a good fit to the data (Table 3.3). Garver and Mentzer (1999) indicated that acceptable models should have non-significant χ^2 statistics, CFI greater than .95, and a RMSEA less than .05; however, other experts have suggested that a CFI greater than 0.90, and a RMSEA less than 0.1 are also acceptable (Steiger, 1990). Furthermore, χ^2statistics are very sensitive to sample size, thus most researchers rely on the other fit statistics to assess model fit (Kelloway, 1998; Garver and Mentzer; 1999). Considering these points, the three other models examined were found to provide moderate fits to the data as some of their fit statistics indicated a good fit whereas others did not (Catching Numbers: S-B $\chi^2 = 37.95$, d.f. = 8, $p < .001$, CFI = .93, RMSEA = .091; Catching Large Fish: S-B $\chi^2 = 43.26$, d.f. = 8, $p < .001$, CFI = .89, RMSEA = .098; Keeping Fish: S-B $\chi^2 = 68.79$, d.f. = 8, $p < .001$, CFI = .90, RMSEA = .129) (Table 3.3).

Next, I determined if angler preferred species, the importance of catfishing, or catfishing frequency moderated consistency of CRA between generic and species-specific context using MGSEMs. All group models were determined to be configurally invariant (i.e., exhibited the same number of latent constructs) based on the CFI statistic (CFI > 0.9), and all models, excluding one (CATLAR – Species Preferred), were determined to be metric invariant (i.e., statistically similar factor loadings) based on the χ^2difference ($\Delta \chi^2$ statistic insignificant) and the CFI difference (Δ CFI ≤ 0.01) tests (Table 3.5). Because the CATLAR model did not pass the metric invariance test across the preferred species groups ($\Delta \chi^2 = 44.70$, Δ d.f. = 12, $p < .001$), a valid moderation analysis could not be run across preferred species groups for the CATLAR construct.

Having established measurement invariance on 11 of the 12 proposed models, I ran tests for moderation using MGSEM (Table 3.6). Of the 11 MGSEMs I ran, only the CATNUM construct modeled across preferred species groups and provided a significant $\Delta \chi^2$ statistic ($\Delta \chi^2 = 11.37$, Δ d.f. = 2, $p < .01$), indicating species preference is a potential moderator of the consistency between generic and species-specific CRA related to catching numbers of fish (Table 3.6). Further comparison of the constrained model with modified constrained models with one gamma path freed indicated that the crappie ($\Delta \chi^2$

= 10.44, Δ d.f. = 1, $p < .01$) and bass ($\Delta \chi^2 = 5.03$, Δ d.f. = 1, $p < .05$) models had significantly different gamma paths than the catfish model.

Finally, I ran paired t-tests to compare CRA summated scores between generic and species-specific contexts for each group (Table 3.8). Twelve group comparisons indicated that mean CRA summated scores were significantly greater when measured in a species-specific context as compared to a generic context, and all but two of these were for comparisons made on the CATLAR and KEEPFISH scales (Table 3.8). Effect sizes for significant mean differences ranged from .13 to .23 (Table 3.8). However, Cohen (1988) classifies effect sizes of .20 as being small because they indicate an 85% overlap in the distributions of the two samples.

Discussion

In this study, I wanted to determine if the CRA measurement in a generic-species context provided an adequate level of specificity to accurately reflect angler attitudes toward catching a specific group of fish species, catfish in the case of this study, and whether the relationship between the two was moderated by species preference, importance of catfishing, and catfishing frequency. My data analysis indicated that CRA measurements on a generic scale strongly predicted responses on a species-specific scale, and explained most of the variance (approximately 60%) in responses on the species-specific scales. However, despite the high level of correlation between the two scales, 60% hardly represents a perfect level of prediction. As such, researchers and fisheries managers interested in understanding angler attitudes toward specific groups of fish species should consider measuring CRA on species-specific scales when survey space and funds allow, or ask respondents to fill out the scale based on their attitudes toward catching their most preferred species.

Surveys aimed toward anglers using specific fisheries resources, such as the follow-up survey of catfish anglers used in this study, can provide managers with extremely helpful information when a proper sample frame of anglers can be identified (Hunt & Ditton, 1996; Hunt, 2001). Such resource specific surveys are generally aimed toward either anglers pursuing a specific species of fish, or related group of fish species, or anglers using a specific body of water where most anglers are often targeting the same type of fish (Chen, Hunt, & Ditton, 2003; Hutt and Bettoli, 2007). In these cases, it is relatively easy to include a species-specific CRA scale in the survey questionnaire. The more specific catch-related attitude data is to the fishery in question, the more relevant it should be to angler behavior toward the resource (Anderson et al., 2007). While effect size differences between generic and species-specific construct summated scores were small, these differences could still be big enough to weaken the predictive ability of behavioral models like Ajzen's (1991) theory of planned behavior. However, researchers conducting statewide surveys to compare CRA of different angler groups should find generic scales adequate to the task so long as they are only used to infer angler attitudes toward catching their most preferred species of fish.

Analysis of potential moderators of the relationship between generic and species-specific CRA failed to find evidence of moderation with one exception. I found evidence of moderation of consistency of generic and species-specific attitudes toward catching numbers of fish by species preference. However, failure of species preference to moderate consistency of attitudes toward harvesting fish between generic and species-specific contexts was unexpected. Sutton (2003) found that attitudes toward harvesting fish best predicted intentions to practice catch-and-release when the species in question was the anglers most preferred species. It is possible that my analysis failed to come to a similar conclusion because almost all of the anglers in this study had indicated catfish were among their top three preferred species. It is possible that this restricted my sample to anglers with too high a preference for catfish to find the expected inconsistency between the two contexts. This also could explain why other analyses did not find evidence of moderation.

A similar conclusion also could be drawn for the lack of a moderation effect for the variable fishing frequency. The PMA (Fazio, 1986) stipulates that repeated expression of an attitude increases the strength of the relationship between attitudes and behavior. I used fishing frequency as a measure of attitude expression because an angler is given the opportunity to express their attitudes toward catch each time they go fishing. In a study testing effect of repeated expression on attitude consistency regarding support for controlled burn policies in Yellowstone National Park, respondents were grouped based on amount of time they had spent discussing the major forest fire of 1988 (Mafredo, Yuan, & McGuire, 2001). These groups ranged from individuals who had never discussed that fire to those who had discussed it for hours. All individuals recruited for this study had fished for, or caught, catfish in the previous year. It is possible absence of individuals that had not fished for catfish in the sample might explain why fishing frequency had no moderating effect on the consistency of CRA across generic and species-specific contexts. Indeed, Sutton's (2003) finding that species preference moderated effect of CRA on intentions to practice catch-and-release may have been due to anglers being presented hypothetical scenarios involving fish species that they rarely if ever pursued, or were only likely to catch incidentally.

While non-response bias is always a concern in survey research, it was not an issue in this study despite high non-response to the original statewide survey. This is because my objective was not to make generalizations about the angler population in Texas, but to examine effect of select variables on attitude consistency across species-related contexts (Fisher, 1996). Given adequate sample size and matching data for individuals in my study, my theoretical inferences about the moderating affects of species preference, importance, and angling frequency on catch-related attitude consistency are still valid.

Overall, my study results would appear to indicate that angler attitudes toward catch are fairly consistent across species contexts, unlike recent research into angler motivations which has found considerable variation in angler motives for pursuing various species (Beardmore et al., 2011). However, additional research is needed to confirm these findings. The findings are not generalizable to all angling situations as I only measured species-specific CRA toward one group of fish (catfish), and only included anglers that had fished for catfish in the previous year in Texas. Future studies will need to measure CRA within other species contexts to verify the study results. A comparison of species-specific CRA toward black bass would be particularly interesting as black bass anglers are generally known for being less harvest oriented than catfish anglers (Wilde & Ditton 1994; Wilde & Ditton 1999). Furthermore, as suggested by Anderson and colleagues (2007), additional research is needed to investigate consistency of CRA between contexts unrelated to species pursued such as fishing with friends versus family. The CRA study has the potential to improve our understanding of how anglers use fisheries resources. A better understanding of how these attitudes can be influenced by situational contexts can only help researchers to better predict and understand angling behavior and provide for the needs of an increasingly diverse angling clientele.

Table 3.1 Twelve-item measurement model validated by Anderson and colleagues (2007) to measure catch-related attitudes toward recreational fishing by four hypothesized constructs of consumptive orientation[a].

Factor 1 - Attitudes toward catching something (CATSOM)
NOFISH – A fishing trip can be successful even if no fish are caught[b]
NOCATCH – If I thought I wouldn't catch any fish, I wouldn't go fishing
SOMETHING – When I go fishing, I'm not satisfied unless I catch something
Factor 2 - Attitudes toward catching numbers of fish (CATNUM)
MOREFISH – The more fish I catch, the happier I am
MANYFISH – A successful fishing trip is one in which many fish are caught
LIMIT – I'm happiest with a fishing trip if I at least catch the daily bag limit of fish
Factor 3 - Attitudes toward catching large / trophy gamefish (CATLAR)
BIGFISH – I would rather catch one or two big fish than ten smaller fish
CHALLENGE – I'm happiest with a fishing trip if I catch a challenging game fish
TROPHY – I like to fish where I know I have a chance to catch a "trophy" fish
Factor 4 - Attitude toward keeping fish (KEEPFISH)
EAT – I usually eat the fish I catch
DONTKEEP – I'm just as happy if I don't keep the fish I catch[b]
RELEASE – I'm just as happy if I release the fish I catch[b]

[a] Respondents were asked to indicate whether they agreed or disagreed with each item on a 5-point Likert-type scale with 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; and 5 = strongly agree.
[b] Item reverse coded for analysis purposes.

Table 3.2 Correlation among scale items for four constructs of catch-related attitudes measured on generic (G) and species-specific (S) scales[a].

Variables	1	2	3	4	5	6	Mean	SD
Catching something								
NOFISH (G)	1.000						2.04	0.96
NOCATCH (G)	.319	1.000					2.55	1.30
SOMETHING (G)	.430	.473	1.000				2.83	1.11
NOFISH (S)	.347	.293	.324	1.000			2.15	1.07
NOCATCH (S)	.291	.357	.329	.372	1.000		2.64	1.23
SOMETHING (S)	.374	.320	.432	.456	.498	1.000	2.68	1.12
Catching numbers								
MOREFISH (G)	1.000						3.64	0.96
MANYFISH (G)	.469	1.000					3.12	1.07
LIMIT (G)	.395	.357	1.000				2.89	1.05
MOREFISH (S)	.412	.313	.195	1.000			3.85	1.06
MANYFISH (S)	.372	.419	.271	.532	1.000		3.27	1.11
LIMIT (S)	.238	.264	.358	.303	.453	1.000	2.82	1.11
Catching large fish								
BIGFISH (G)	1.000						3.03	1.02
CHALLENGE (G)	.295	1.000					3.35	1.08
TROPHY (G)	.356	.475	1.000				2.90	1.17
BIGFISH (S)	.392	.180	.208	1.000			2.99	1.04
CHALLENGE (S)	.259	.346	.248	.300	1.000		3.55	0.98
TROPHY (S)	.291	.331	.462	.330	.445	1.000	3.14	1.03
Keeping fish								
EAT (G)	1.000						3.75	1.29
DONTKEEP (G)	.401	1.000					2.41	1.14
RELEASE (G)	.424	.722	1.000				2.34	1.10
EAT (S)	.552	.312	.355	1.000			3.92	1.16
DONTKEEP (S)	.297	.520	.489	.400	1.000		2.49	1.07
RELEASE (S)	.344	.567	.568	.428	.699	1.000	2.47	1.07

Data were collected by a statewide survey of Texas anglers (May to June 2009), and a follow-up survey of catfish anglers (April to June 2010).

[a] Statements can be found in Table 3.1.

Table 3.3 Standardized loadings (λ), SMC's, and direct effects (generic CRA → species-specific CRA) from structural equation models examining the relationship between catch-related attitude scales measured in a generic versus species-specific context.

	Generic scale (X)		Species-specific scale (Y)		Direct effect	
Variables	λ	R^2	λ	R^2	γ	R^2
Catching something					.77*	.60
NOFISH	.64	.41	.67	.44		
NOCATCH	.65*	.43	.68*	.46		
SOMETHING	.77*	.59	.80*	.63		
S-B χ^2 = 12.32, d.f. = 8, p = .138, CFI = .98, RMSEA = .034						
Catching numbers					.71*	.50
MOREFISH	.75	.56	.71	.50		
MANYFISH	.71*	.51	.87*	.75		
LIMIT	.57*	.32	.58*	.34		
S-B χ^2 = 37.95, d.f. = 8, p < .001, CFI = .93, RMSEA = .091						
Catching large fish					.77*	.60
BIGFISH	.54	.29	.49	.24		
CHALLENGE	.65*	.43	.62*	.34		
TROPHY	.76*	.58	.80*	.63		
S-B χ^2 = 43.26, d.f. = 8, p < .001, CFI = .89, RMSEA = .098						
Keeping fish					.77*	.60
EAT	.56	.31	.56	.32		
DONTKEEP	.87*	.77	.83*	.68		
RELEASE	.89*	.79	.91*	.83		
S-B χ^2 = 68.79, d.f. = 8, p < .001, CFI = .90, RMSEA = .129						

Data were collected by a statewide survey of Texas anglers (May to June 2009), and a follow-up survey of catfish anglers (April to June 2010).

* Significant at the p = .05 level. The first item in each construct was used as a reference variable for analysis purposes, and as such was not tested for significance.

NOTE: d.f. = degrees of freedom, S-B χ^2 = Satorra-Bentler Chi-square, CFI = comparative fit index, RMSEA = root mean squared error of approximation.

Table 3.4 Distribution of respondents divided into groups for moderation analysis across the variables species most preferred, importance of catfishing, and catfishing frequency.

Variables	Moderation Groups 1	2	3
Species most preferred [a]	135	93	180
Catfishing importance [b]	119	168	163
Catfishing frequency [c]	132	139	152

Data were collected by a statewide survey of Texas anglers (May to June 2009), and a follow-up survey of catfish anglers (April to June 2010).

[a] Species most preferred: Group 1 = catfish; Group 2 = crappie; Group 3 = bass

[b] Catfishing importance: Group 1 = most important fishing activity; Group 2 = second most important; Group 3 = third most important

[c] Catfishing frequency: Group 1 = 25 or more catfishing trips in previous 12 months; 2 = 11-24 catfishing trips in previous 12 months; 3 = 10 or fewer catfishing trips in previous 12 months

Table 3.5 Invariance tests for catch-related attitude scales across moderation variable groups used in multi-group moderation analyses in LISREL.

Models	Invariance level	χ^2	p	d.f.	RMSEA	CFI	$\Delta \chi^2$	Δ d.f.	Δ CFI
				Species Preferred					
CATSOM	Configural[a]	53.46	.010	32	.072	.97			
	Metric[b]	67.27	.014	44	.064	.96	13.81	12	-.01
CATNUM	Configural	56.53	.005	32	.077	.95			
	Metric	74.09	.003	44	.073	.94	17.56	12	-.01
CATLAR	Configural	57.10	.004	32	.078	.95			
	Metric	101.8	< .001	44	.101	.89	**44.70**	12	**-.06**
KEEPFISH	Configural	89.17	< .001	32	.117	.93			
	Metric	104.7	< .001	44	.103	.93	15.53	12	.00
				Importance of Catfishing					
CATSOM	Configural	39.83	.160	32	.041	.99			
	Metric	44.71	.440	44	.010	1.00	4.88	12	.01
CATNUM	Configural	54.65	.007	32	.069	.97			
	Metric	71.88	.005	44	.065	.96	17.23	12	-.01
CATLAR	Configural	66.14	< .001	32	.085	.92			
	Metric	76.41	.002	44	.070	.92	10.27	12	.00
KEEPFISH	Configural	90.00	< .001	32	.110	.94			
	Metric	98.95	< .001	44	.092	.94	8.95	12	.00
				Days Catfishing					
CATSOM	Configural	48.18	.033	32	.060	.98			
	Metric	61.10	.045	44	.053	.97	12.92	12	-.01
CATNUM	Configural	48.45	.031	32	.061	.97			
	Metric	54.04	.140	44	.040	.98	5.59	12	.01
CATLAR	Configural	63.18	< .001	32	.083	.92			
	Metric	77.38	.001	44	.074	.91	14.20	12	-.01
KEEPFISH	Configural	84.58	< .001	32	.110	.96			
	Metric	90.94	< .001	44	.087	.96	6.36	12	.00

Data were collected by a statewide survey of Texas anglers (May to June 2009), and a follow-up survey of catfish anglers (April to June 2010).

[a] The criteria for configural invariance are non-significant χ^2 and CFI $\geq$ 0.90.

[b] The criteria for metric invariance are non-significant $\Delta \chi^2$ and Δ CFI $\leq$ 0.01.

NOTE: χ^2 = Chi-square, CFI = comparative fit index, RMSEA = root mean squared error of approximation.

Table 3.6 Tests of moderation effects of angler preferred species, importance of catfishing, and days catfishing to consistency of catch-related attitudes in generic and species-specific contexts.

Models	Gamma (γ)	χ^2	*p*	d.f.	RMSEA	CFI	$\Delta\,\chi^2$	Δ d.f.	Δ CFI
				Species Preferred					
CATSOM	Free	40.34	.020	24	.072	.97			
	Constrained	44.60	.013	26	.074	.97	4.26	2	.00
CATNUM	Free	39.27	.026	24	.070	.97			
	Constrained	50.64	.003	26	.085	.95	11.37*	2	-.02
	Crappie	40.20	.028	25	.068	.97	10.44**	1	-.02
	Bass	45.61	.007	25	.080	.96	5.03*	1	-.01
KEEPFISH	Free	77.49	< .001	24	.130	.93			
	Constrained	78.52	< .001	26	.120	.94	1.03	2	.01
				Importance of Catfishing					
CATSOM	Free	30.22	.180	24	.042	.99			
	Constrained	31.08	.230	26	.036	.99	0.86	2	.00
CATNUM	Free	47.76	.003	24	.082	.97			
	Constrained	49.08	.004	26	.077	.97	1.32	2	.00
CATLAR	Free	59.80	< .001	24	.100	.92			
	Constrained	65.45	< .001	26	.100	.91	5.65	2	-.01
KEEPFISH	Free	87.21	< .001	24	.130	.93			
	Constrained	87.65	< .001	26	.130	.93	0.44	2	.00
				Days Catfishing					
CATSOM	Free	32.79	.110	24	.051	.99			
	Constrained	36.14	.089	26	.053	.99	3.35	2	.00
CATNUM	Free	43.79	.008	24	.077	.97			
	Constrained	45.83	.010	26	.074	.97	2.04	2	.00
CATLAR	Free	55.02	< .001	24	.096	.92			
	Constrained	56.45	< .001	26	.092	.92	1.43	2	.00
KEEPFISH	Free	82.27	< .001	24	.130	.95			
	Constrained	83.10	< .001	26	.130	.95	0.83	2	.00

Following an initial significant finding of moderation, $\Delta\,\chi^2$ tests were used to compare the constrained model to models with one gamma path unconstrained to ascertain groups that differed significantly. Data were collected by a statewide survey of Texas anglers (May to June 2009), and a follow-up survey of catfish anglers (April to June 2010).
* Significant at the $p = .05$ level; ** Significant at the $p = .01$ level

Table 3.7 Standardized parameter estimates and R^2 for multi-group structural equation models examining moderation effect of species preference on the relationship between generic and species-specific catch-related attitudes on the CATNUM construct.

	Generic scale (X)		Species-specific scale (Y)		Direct effect	
Preference groups	λ	R^2	λ	R^2	γ	R^2
Catfish						
MOREFISH	.77	.59	.73	.53	.70**	.49
MANYFISH	.79**	.62	.79**	.62		
LIMIT	.74**	.55	.70**	.49		
Crappie						
MOREFISH	.65	.43	.94	.88	.90**	.82
MANYFISH	.47**	.22	.81**	.66		
LIMIT	.41**	.17	.56**	.32		
Bass						
MOREFISH	.82	.68	.65	.42	.66**	.44
MANYFISH	.73**	.54	.94**	.89		
LIMIT	.65**	.43	.58**	.33		

Data were collected by a statewide survey of Texas anglers (May to June 2009), and a follow-up survey of catfish anglers (April to June 2010).
* Significant at the $p = .05$ level
** Significant at the $p < .001$ level

Table 3.8 Mean summated scores on generic (G) and species-specific (S) catch-related attitude scales, and effect size* (ES) measures across groups compared in moderation analyses (for preferred species, importance of catfishing, and catfishing frequency).

	Catch-related attitude scales											
Moderation	CATSOM			CATNUM			CATLAR			KEEPFISH		
Groups	G	S	E	G	S	E	G	S	E	G	S	E
Preferred Species												
Catfish	7.31	7.32	0.00	9.77	10.16	0.16	9.08	9.55	**0.21**	9.50	9.48	0.01
Crappie	7.76	7.58	0.07	9.69	10.08	0.16	8.77	9.27	**0.22**	9.11	9.51	0.16
Bass	7.38	7.48	0.04	9.58	9.68	0.04	9.78	9.96	0.07	7.41	8.07	**0.23**
Catfishing Importance												
Most	7.56	7.38	0.07	9.74	10.20	0.18	9.06	9.57	**0.21**	9.36	9.73	0.14
Second	7.43	7.45	0.01	9.75	9.91	0.07	9.31	9.52	0.08	8.52	8.92	**0.13**
Third	7.38	7.53	0.06	9.88	9.85	0.01	9.69	10.00	0.12	7.64	8.11	**0.18**
Frequency Catfishing (days)												
26 +	7.05	7.17	0.04	9.67	10.02	**0.15**	9.30	9.77	**0.18**	8.64	9.11	**0.16**
11 – 25	7.44	7.26	0.07	9.65	10.09	**0.17**	9.41	9.87	**0.19**	8.40	8.73	0.12
10 or less	7.78	7.81	0.01	9.79	9.75	0.02	9.32	9.45	0.05	8.41	8.84	**0.15**

Effect sizes in bold indicate that generic and species-specific catch-related attitude summated scores differed significantly at the $p = .05$ level according to paired t-tests. Data were collected by a statewide survey of Texas anglers (May to June 2009), and a follow-up survey of catfish anglers (April to June 2010).
* Effect Size = |(G – S) / Standard Deviation of G|

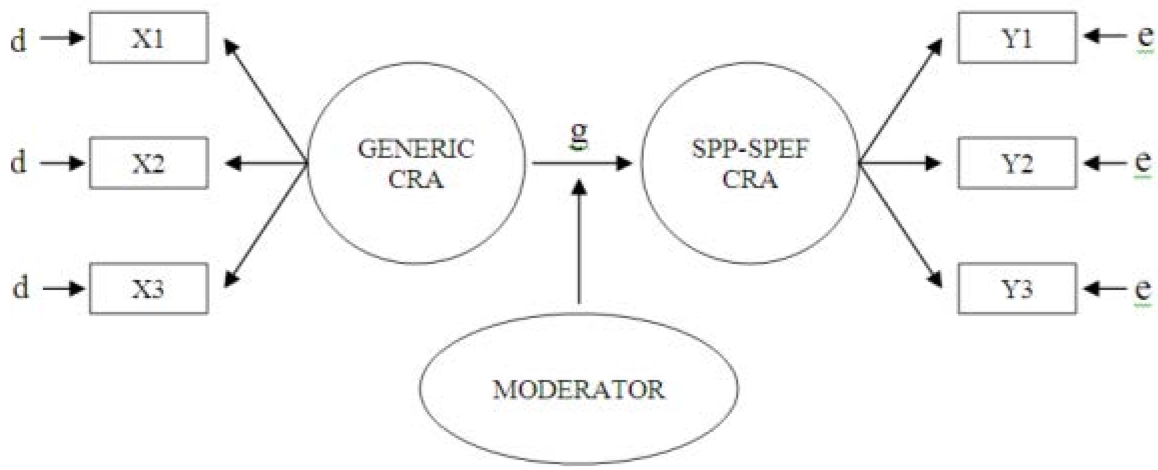

Figure 3.1 Path diagram of a multi-group structural equations model used to test the moderation effects of species preference, catfishing importance, and catfishing frequency on the relationship between generic and species-specific (SPP-SPEF) catch-related attitudes

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CHAPTER IV

EFFECT OF ANGLER CATCH-RELATED ATTITUDES ON FISHING TRIP PREFERENCES

Introduction

Increasing population age and growing minority populations in the United States combined with resulting shifts in angler preferences, diversified public demands, and stagnating budgets are likely to present fisheries management agencies with unique challenges over the coming decades (Murdoch, Backman, Ditton, Hoque, & Ellis, 1992; Floyd & Lee, 2002). Aging angler populations threaten to reduce license sales as more of the angling population reaches an age at which they are exempt from license purchases (Murdoch et al., 1992; Floyd & Lee, 2002). Additionally, increasing minority populations are also likely to lead to decreased per capita fishing participation as minorities traditionally have lower participation rates in this activity (Floyd & Lee, 2002). These challenges will necessitate that agencies take steps to allocate scarce agency resources in as efficient a manner as possible, which will require agencies to have a better grasp of angler preferences related to fisheries management and fishing opportunities.

Early research into angler preferences was often over-simplified; characterized by single item questions that asked respondents to rate the importance of individual characteristics of the angling experience, and only reported the data as a population mean or distribution to represent the average angler or simplistic groups of anglers (Fedler & Ditton, 1986; Wilde & Ditton, 1999). Later studies of angler preferences began to segment anglers based on theoretical constructs such as specialization that divide anglers into groups based on their level of commitment and involvement in angling, but they still measured preferences using single-item questions that didn't require anglers to make trade-offs between competing management goals (e.g., providing more fish versus bigger fish) (Chipman & Helfrich, 1988; Ditton, Loomis, & Choi, 1992; Fisher, 1997; Hutt & Bettoli, 2007). Recently however, fisheries researchers have adopted a new method to examine individual preferences related to recreational fisheries called stated choice modeling (SCM) (Aas, Haider, & Hunt, 2000; Gillis & Ditton, 2002; Oh, Ditton, Gentner, & Riechers, 2005; Dorow, Beardmore, Haider, & Arlinghaus, 2009a; Carlin, Schroeder, & Fulton, 2012). Unlike previous methods of examining angler preferences, SCM requires anglers to make choices between hypothetical trip or management scenarios giving this method the added benefit of requiring anglers to make trade-offs between alternatives, thus giving researchers and managers better insights into what is truly important to anglers in a fishing experience.

The goal of this study is to use a SCM approach to develop a better understanding of angler trip preferences toward catch-related aspects of the fishing experience, and site characteristics unrelated to catch. While many studies of angler motivations have found that motives unrelated to catch are generally ranked higher than catch-related motives (Driver & Cooksey, 1977; Fedler & Ditton, 1994; Fisher, 1997), other studies have found that catch-related aspects of fishing trips are better predictors of fishing satisfaction (Arlinghaus, 2006; Hutt & Neal, 2010). It is therefore reasonable to assume that incorporating catch-related attitude (CRA) data into the SCM would help explain additional variation in individual choice and preference heterogeneity. Recent studies have found similar approaches to be very effective to examine preference heterogeneity among anglers (Morey, Thacher, & Breffle, 2006; Oh & Ditton, 2006; Dorow, Beardmore, Haider, & Arlinghaus, 2009b). Thus, I used a segmentation approach (i.e., cluster analysis) to divide anglers into groups based upon their CRA. Using this methodology, I hope to demonstrate the influence of CRA on angler preferences, and illustrate a method for improving allocation of agency resources for management efforts.

Background

Stated Choice Models

SCM finds its theoretical background in Lancaster consumer theory and random utility theory (Oh et al., 2005). Lancaster's (1966) consumer theory holds that individuals derive utility, or benefits, from the combination of attributes that make up a given commodity. Random utility theory (Manski, 1977) posits that individuals are rational actors that seek to maximize utility through their choices of commodities and actions. SCM combines these theories by asking individuals to make choices between hypothetical commodities, or scenarios, which vary over several attributes. Through these choices SCM derives individual preferences and utility (Louviere & Timmermans, 1991). In studies designed to derive angler preferences, the hypothetical scenario in question is often a fishing trip (Gillis & Ditton, 2002; Oh et al., 2005). Each scenario used to fit the model consists of multiple attributes which make up primary characteristics of the fishing trip, and are varied along several levels from one scenario to the next. Fishing trip scenarios are presented in pairs and individuals are then asked to examine each of the paired scenarios and indicate which of the two fishing trips they would be most likely to take, if either. To come to this conclusion the individual must consider all attributes within these scenarios simultaneously, determine what trade-offs they are willing to make, and make a choice that best suits their needs and preferences and provides them with the greatest utility. With individual choice serving as the dependent variable, and scenario attributes serving as independent variables, the researcher is able to determine how much each attribute influences trip choice, and estimate the part-worth utilities derived from individual attribute levels (Louviere & Timmermans, 1991; Gillis and Ditton, 2002). Finally, coefficients generated by the model can be used to estimate the probability of an angler choosing a given hypothetical scenario (Blamey, Gordon, and Chapman, 1990).

Several studies have used SCM to examine effect of fishing regulations (e.g., length limits, creel limits, equipment restrictions), angler expectations (i.e., size and number of fish caught), and travel costs (i.e., distance traveled) on trip choice and preferences. Aas, Haider, and Hunt (2000) used an SCM to examine effect of three regulations, and expectations of average fish size and number of fish caught on trip choice by brown trout *Salmo trutta* anglers in Norway. They found that an angler's probability of choosing a given trip decreased as regulations became stricter, and increased as angler expectations of size and number of fish caught increased. Gillis and Ditton (2002) used an SCM to examine preferences of Atlantic billfish *Istiophoridae* anglers, and found strong support for the establishment of no kill tournaments and hook restrictions. Oh and colleagues (2005) used an SCM to study effect of four regulations, average fish size, catch probability, and trip cost on fishing trip choices and the willingness-to-pay (WTP) of Texas red drum *Sciaenops ocellatus* anglers. Dorow and colleagues (2009a) used an SCM model to study management preferences of European eel *Anguilla anguilla* anglers in Germany, and found that while they supported moderate increases in minimum size and bag limits, they were opposed to large changes in these limits that would result in significant harvest reductions. Carlin and colleagues (2012) used an SCM to examine marginal effects of fishing regulations and catch expectations on walleye *Sander vitreus* angler site choice preferences. These studies all concluded that the SCM approach offered substantial benefits to fisheries managers by illustrating the degree to which different management alternatives affected angler preferences.

Several researchers have argued that a failing of SCM the previously mentioned studies is their use of conditional or multinomial logit models which assume homogeneity of preferences across the surveyed population (Train, 1998; Provencher, Baerenklau, & Bishop, 2002; Morey et al., 2006). In reality, preferences are rarely homogeneous whether the population in question is composed of anglers or any other group. If the researcher's goal was merely to determine the management scenario preferred by the greatest proportion of the population, and estimate average willingness-to-pay (WTP), then the assumption of homogeneity of preferences was not that detrimental. However, if one seeks to develop an understanding of how preferences differ between groups of individuals then this assumption is problematic.

Researchers have proposed several methods of addressing preference heterogeneity in SCM studies. They have examined this by interacting scenario attributes with relevant descriptive variables within the model (Dellaert & Lindberg, 2003; Carlin et al., 2012). These descriptive variables could be either socio-demographic, behavioral, or attitudinal in nature, and would indicate how preferences for given attributes may differ across the range of the descriptive variable. Other researchers have adopted the use of random-parameter logit models, which allow estimates of preference (i.e., the model coefficients) to vary randomly across individuals as opposed to being fixed (Train, 1998; Provencher et al., 2002). These models recognize that individual tastes will vary, but do little to explain exactly why they vary. A final method proposed by other researchers has been to use a latent class or cluster approach to divide individuals into groups based on similar characteristics or attitudes and running separate SCM models for each group (Boxall & Adamowicz, 2002; Morey et al., 2006; Oh & Ditton, 2006).

Boxall and Adamowicz (2002) used a latent class analysis (LCA) to assign wilderness park users into four groups based on their motivations for participating in outdoor recreation. LCA is similar to cluster analysis, but instead of assigning individuals to specific groups it estimates the probability of an individual belonging to each group and the individual is assigned to the group for which they have the greatest probability of membership (Boxall & Adamowicz, 2002). Boxall and Adamowicz (2002) found distinct differences between groups in terms of their preferences for different types of campsites, level of site development, and number of encounters with other groups. Morey and colleagues (2006) used LCA to divide anglers using Lake Michigan's Green Bay into four groups based on their attitudes toward different fish species, consumption advisors, and boating fees. They found that anglers with greater concerns about fish consumption advisories exhibited a greater WTP for fishing locations uncontaminated by polychlorinated biphenyls (PCB). Conversely, anglers that were primarily concerned about catch rates, and boating fees had the least WTP for PCB-free fishing sites. Finally, Oh and Ditton (2006) used cluster analysis to divide red drum anglers into three groups based on their level of recreational specialization. Results of the SCM models fitted to each group indicated that more specialized anglers preferred stricter regulations to protect the resource whereas less specialized anglers preferred to relax current regulations and catch more fish. Each study concluded that running separate SCMs on different sub-groups provided them greater insight into the heterogeneity of preferences within their study populations, and more importantly, into the causes of that heterogeneity.

Catch-related Attitudes

Consumptive orientation regarding recreational anglers has been defined as an individual's "disposition to catch fish, attitudes toward keeping or releasing fish caught, and the importance of the number and size of fish caught" (Anderson, Ditton, & Hunt 2007, p. 181). An angler's attitudes toward these catch-related aspects of fishing will greatly influence their opinions regarding management goals, regulations, and their choice of fishing trips. Researchers have developed and refined an attitudinal scale designed to measure consumptive orientations of anglers (Graefe 1980; Sutton 2003; Anderson et al. 2007). Designed to measure four distinct attitudinal constructs (i.e., catching something, catching numbers of fish, catching big fish, keeping fish) regarding an angler's consumptive orientation, the scale has individuals rate their level of agreement with 16 statements, four for each construct, designed to measure their orientation toward each of the four constructs. Summated scores for each construct can then be used to categorize individuals as being low, medium, or high on the scale (Anderson et al. 2007). These attitude scores and socio-economic data also can be included in SCM to serve as measures of individual characteristics that may influence fishing trip choice.

Methods

Questionnaire Design and Implementation

I developed an implemented an 11-page self-administered mail questionnaire to collect the necessary study data. The first 5 pages collected data on general angling behavior and CRA. The next 4 pages were composed of the questions needed for the SCM and their associated instructions. The questions used to collect the data needed to estimate the SCM consisted of 6 paired hypothetical choice scenarios that were varied over 6 attributes of the fishing trip related to catch, harvest, size of catfish caught, type of water fished, level of site development, and distance traveled to the fishing site. Respondents were asked to examine each pair of trip scenarios and indicate which of the two catfishing trips they would most prefer to take or if they would choose to take neither. Finally, the last page consisted of several socio-demographic questions.

The sample for the mail survey consisted of 1,078 individuals that had responded to the 2009 Survey of Texas Anglers conducted by Texas Parks and Wildlife Department (TPWD) and indicated that they had either fished for catfish in the previous year or listed "catfish," or a particular catfish species, as one their three most preferred species to catch while freshwater fishing in Texas. Survey implementation used Dillman's Tailored Design Method (2007) to increase response rate. Specifically, on Day 1 of the study, individuals were sent a personalized letter from the Chief of Management and Research for Inland Fisheries Division of TPWD explaining the study's purpose and how they were selected. On Day 8, all individuals were sent a questionnaire, pre-paid business reply envelope, and a personalized cover letter (i.e., a complete packet) from the Principal Investigator at Mississippi State University (MSU) providing instructions for completing and returning the questionnaire. On Day 18, all individuals were sent a follow-up reminder/thank you note. To increase response rate, individuals that did not initially respond to the first questionnaire mailing were sent a second complete packet on Day 28 and a third complete packet on Day 42 if necessary. All procedures were approved by the MSU Institutional Review Board (IRB) for the Protection of Human Subjects (IRB Docket 10-102).

Stated Choice Model

The follow-up questionnaire included a series of choice sets designed to collect data for estimation of a SCM (Figure 4.1). Attributes and levels used in the choice sets were selected based on discussions with fisheries biologists and researchers from the TPWD (Table 4.1). Attributes related to number of catfish caught during the fishing trip, number harvested, average size of catfish caught, type of water on which the trip took place, level of site development at the fishing site, and distance traveled to the site. Number of levels per attribute was limited to three to reduce number of choice sets that would have to be generated to fit the models so as to reduce respondent burden and minimize costs (Oh et al., 2005). I chose attributes and levels that I felt were within the control of fisheries managers and likely to influence angler utility as the study goal was to identify scenarios managers could provide to maximize angler utility. While distance traveled may appear to be out of the site manager's control, knowledge of how it influences customer utility may be helpful in determining the optimal location of catfishing sites in relation to potential angler populations.

A fractional factorial design was used to develop a tractable number of choice sets for fitting the SCM (Louviere, 1988). While use of a full factorial design would ensure perfect orthogonality of the choice set design by providing every possible combination of attribute levels, it would also generate far too many choice sets to be feasibly executed in a study (Louviere, 1988). A fractional factorial design will generate a reasonable number of choice sets while still maximizing orthogonality in a way that will allow the researcher to fit the necessary models (Bennett & Adamowicz, 2001). However, even when using a fractional factorial design number of choice sets is usually too high to present them all to a single individual without placing an undue burden on them. This necessitates the need for blocking choice sets into uncorrelated groups, or blocks, thus reducing number of choice sets presented to any one individual while allowing for the collection of needed data (Bennett & Adamowicz, 2001). The SAS macros *%mktex* and *%mktblock* were used to generate a fractional factorial design of 54 choice sets divided into 9 blocks of 6 paired trip comparisons (Kuhfeld, 2005). Separate questionnaire versions were then designed for each block of paired trip comparisons, and 120 individuals were assigned to receive each version.

Catch-related Attitude Scale

Participants were asked in the follow-up survey to respond to 16 items (Anderson et al., 2007) pertaining to their CRA in regard specifically to catching catfish. The scale consisted of 16 items designed to measure four constructs associated with consumptive orientation (i.e., catching something, catching numbers of fish, catching large/trophy fish, keeping fish). Respondents were instructed to indicate whether they agreed or disagreed with each item on a 5-point Likert type scale (response format: 1 = strongly disagree, 2 =

disagree, 3 = neutral, 4 = agree, 5 = strongly agree). Four items were reverse coded for analysis purposes because they were written to solicit a response inverse to that of other items within their construct to avoid response set bias (Maranell, 1974). The wording of individual items in each questionnaire was not modified. Data were then used to validate a 4-construct, 12-item scale of CRA which was used for all subsequent analysis in this study (Table 4.2).

Data Analysis

To determine if population estimates needed to be adjusted for non-response bias, logistic regression was used to determine if age, gender, or residence location had a significant effect on individual response probabilities (Fisher, 1996). These variables are included in the TPWD electronic database of licensed anglers and are the only variables known for respondents and non-respondents to the 2009 Texas Statewide Angler Survey and the follow-up 2010 Survey of Texas Freshwater Catfish Anglers. For the logistic regression analysis, response status (1 = respondent, 0 = non-respondent) served as the dependent variable and gender (1 = female, 0 = male), age (years), and whether they lived in a coastal or inland county served as dependent variables. Separate analyses were conducted for the statewide and follow-up surveys, and were used to calculate separate response probabilities for each survey. These probabilities were then inverted to serve as sampling weights for each survey, and summed for each individual in the final sample (Fisher, 1996). Respondent sampling weights were then used to adjust all frequencies, sample means, proportions, and univariate statistical analyses to correct for non-response bias. However, response weights were not used to adjust responses to the SCM due to its experimental nature.

Stated choice models were fitted in SAS using the TRANSREG and PHREG procedures (Kuhfeld, 2005). The TRANSREG procedure was used to code attribute data using effects coding (Bech & Gyrd-Hansen, 2005). In effects coding the attribute level that was expected to be least preferred was assigned a code of -1, the level hypothesized to be the most preferred level was given a code of 1, and the status quo scenario was given a code of 0 (Table 4.1). A travel cost value was calculated for each level of the distance traveled attribute, and used as a continuous variable in the SCM so that implicit values, or WTP, could be calculated for each attribute level. The three levels of distance traveled presented in the choice scenarios were recoded to 10, 50, and 150 miles, respectively. Travel cost was calculated for each distance level as the roundtrip time and driving costs for each distance level (Table 4.1). I used data provided by the American Automobile Association (AAA) for the per-mile operating cost (AAA, 2010). According to AAA, the composite average per-mile operating cost for a vehicle driving 15,000 miles per year was $0.565 per mile. This estimate included fuel, maintenance, tire, insurance, license, depreciation, and finance costs associated with vehicle operation. Furthermore, I added opportunity cost of time spent traveling, which represents time that could have been devoted to other activities or work, to the mileage operating cost per distance level. Opportunity cost of travel is calculated based on an individual's hourly wage, and the recreation literature has generally agreed that 1/3 of the hourly wage rate is an acceptable lower bound for lost opportunity cost with the full wage representing the upper bound (Parson, 2003; Knocke & Lupi, 2007). I chose to use the lower bound to provide a conservative estimate of WTP because the SCM used required a constant value per distance level for all individuals within a given analysis. Thus, I used the median household income of anglers in each analysis to determine the 1/3 wage rate for each analysis, and an assumption of an average speed of 40 mile per hour (Parsons, 2003; Knoche & Lupi, 2007).

Following final coding of attribute levels, the choice model was fitted using the PHREG procedure which fits a multinomial logit model (SAS, 2008). In a multinomial logit model the dependent variable, in this case choice, is binary coded depending on whether the given scenario was chosen or not, and independent variables were the coded scenario attributes. Coefficients were calculated for categorical attribute levels coded as either -1 or 1, and for trip cost. Calculated coefficients represented the part-worth utilities of individual attribute levels (Louviere, 1988; Blamey et al., 1999; Gillis & Ditton, 2002; Oh & Ditton, 2005).

I fitted a series of SCMs in SAS to evaluate effects of CRA on preference heterogeneity. First, three models were fitted to the overall sample. Model 1 consisted only of the trip scenario attributes. Model 2 consisted of trip scenario attributes and individual demographic variables interacted with the alternative specific constant (ASC). The ASC was the coefficient representing the choice of one of the hypothetical catfishing trips (both coded 1) over the 'stay at home' or 'neither' option (coded 0). These interaction variables indicated whether an individual's demographic characteristics make them more or less likely to have selected a given fishing trip. Model 3 consisted of trip scenario attributes, significant interactions between demographic variables and the ASC, and interactions between CRA scale scores and relevant attributes within the SCM. In Model 3, the individual's score on the CATNUM construct was interacted with the catch attribute, their score on the CATLAR construct was interacted with the size attribute, and their score of the KEEPFISH construct was interacted with the harvest attribute. These interactions were calculated to determine how CRA mediated angler preferences for trip attributes.

Next, I used a latent class approach to further address CRA effects on preference heterogeneity. Catfish anglers were divided into groups based on their CRA construct scores with hierarchical cluster analysis using Ward's method, and squared Euclidean distance in SPSS (Hair, Black, Babin, & Anderson, 2009). The final number of clusters was determined by comparing degree of change in the clustering coefficient by number of clusters per iteration of the analysis. The clustering coefficient was a measure of the between cluster variation given the number of clusters in the selected solution. The point at which the decrease in the clustering coefficient begins to taper off was considered a good stopping rule for determining number of clusters (Aldenderfer & Blashfield, 1984). Separate SCMs were then fitted for each of the catfish angler clusters to identify differences in trip preferences between clusters using Model 1.

Results

Response Rate and Non-response Analysis

I received returned questionnaires from 587 individuals for a raw response rate of 54%. When adjusted for 38 non-deliverable and 15 non-eligible responses (i.e., refusals, deceased, or indicated they did not fish) the final adjusted response rate was 57%. Ninety-seven of the 587 individuals who provided useable responses indicated that they had neither fished for, nor caught, a catfish in the previous two years, and an additional 23 failed to provide key data. These individuals were removed from analysis giving an effective sample size of 467 individuals for most of the variables used in the data analyses. Non-response analysis indicated that age, gender, and coastal county status were all significant predictors of non-response to the original statewide survey, but only age significantly predicted non-response probability to the follow-up survey of catfish anglers (Table 4.3). Respondents had a greater average age than non-respondents for both surveys, whereas females and inland county residents had a greater likelihood of responding to the original statewide survey (Table 4.3).

Stated Choice Models

Respondents chose one two hypothetical fishing trips over the neither option in 86% of the choice scenarios for which data were collected. This is reflected in the positive sign for the ASC coefficient in all three models (Table 4.4). Models 2 and 3 added interaction terms between the ASC and five demographic variables to determine if these variables had a significant effect on choice between a fishing trip option and the neither option. In Model 2 it was determined that age and income ($p < .001$) had a strong significant effect on whether a respondent choose a fishing trip over the neither option in opposing directions (AGE: $\beta = -0.029$; $p < .001$: INCOME: $\beta = 0.203$; $p < .001$) (Table 4.4). Model 2 also indicated that non-white respondents ($\beta = - 0.494$; $p < .05$) had significantly lesser likelihood of choosing a fishing trip, but this interaction became insignificant in Model 3 ($\beta = - 0.239$; $p > .05$) (Table 4.4). Model 2 found that gender did not significantly affect choice so it was removed from Model 3 (Table 4.4).

Among trip related attributes, travel cost was the strongest determinate of choice for all three models (Table 4.4). In Models 1 and 2 the catch-related coefficients were all significant at the $p < .001$ level with signs in the expected directions indicating that decreases in catch, harvest, and size of catfish caught had a significantly negative effect on angler utility, whereas increases in catch-related attributes had the opposite effect (Table 4.4). Size of catfish caught was the second best predictor of respondent choice behind distance travelled (Table 4.4). A plurality (43%) of respondents reported that most catfish they caught were in the 10 to 15 inch size range with 39% reporting a typical size range of 16 to 20 inches. After reduced size, the no harvest level had the next greatest negative impact on trip choice (Table 4.4). While the reduced harvest level had a greater effect on choice than the reduced catch level, the opposite was true for the increased catch and harvest levels (Table 4.4). Average number of catfish caught or harvested on a typical trip was reported to be 9 and 6 catfish per day, respectively (Table 4.5).

In Model 3, catch-related attitude scores were interacted with associated catch-related attribute levels. Interactions between KEEPFISH scores and the two harvest attribute levels were both significant in the expected direction indicating that harvest oriented individuals were less likely to choose a reduced harvest scenario and more likely to choose an increased harvest scenario (Table 4.4). Interaction between CATNUM scores and increased catch level was significant and positive as was the interaction between CATLAR scores and increased size level, suggesting individuals with greater scores on these constructs were more likely to choose scenarios involving increased catch or size of catfish, respectively (Table 4.4). However, interactions between CATNUM/ CATLAR scores and reduced catch/size levels were not significant; indicating that no matter what individuals scored on these CRA constructs no one was more likely to accept a scenario involving a reduction in the size or number of catfish caught (Table 4.4). It should also be noted that after including the interaction effects for the CATNUM and

CATLAR construct scores in Model 3, coefficients for the catch and size attributes became insignificant. A similar pattern was found for the harvest attribute levels; however, significance of the harvest attribute levels on choice only became less significant as opposed to insignificant.

The final two attributes included in the SCM were type of water body and level of site development. These attributes had the least impact on respondent choice. The status quo scenario for these attributes involved a trip on a river or stream with basic access site develop (i.e., a boat launch and minimal amenities; Table 4.1). No significant difference in angler utility was found between trips on rivers or streams and those taken on large reservoirs, indicating anglers were indifferent toward fishing on one or the other (Table 4.4). However, there was a significant negative relationship between trip choice and fishing on a small reservoir (Table 4.4). These relationships were maintained across all three models. The SCM also indicated that there was no significant difference in angler utility between fishing a site with a basic level of development and a well-developed site (Table 4.4). These relationships also were maintained across all three models.

Latent Group Analysis

I identified five clusters of anglers based on four constructs of CRA using hierarchical cluster analysis with Ward's method in SPSS (Figure 4.2). Cluster 1 (n = 146; 32%) was labeled *Casual Anglers* because they exhibited relatively low summated-scores on all four CRA constructs (Table 4.5). Compared to the overall sample, trip choice by cluster 1 was similarly affected by changes in catfish size, and reductions in harvest; however, their choice of trip scenarios was much less affected by changes in catch, and they were indifferent toward increases in harvest, type of water body, or level of site development (Table 4.6). Cluster 2 (n = 121; 26%) was labeled *Number Anglers* because their CRA summated-scores were greatest on the CATNUM construct (Table 4.5). Effect of attribute levels on *Number Anglers* trip choice was similar to that of the overall sample except that *Number Anglers* were indifferent about reductions in harvest, type of water body, and level of site development. Cluster 3 (n = 81; 18%) was labeled *Harvest Anglers* because they had a significantly greater summated-score on the KEEPFISH construct than any of the other clusters (Table 4.5). Cluster 3 also had the least summated-score on the CATLAR construct. Aside from travel cost, *Harvest Angler* trip choice was most strongly influenced by changes in harvest levels with the negative effect of reducing harvest to zero (β = -0.682; $p < .001$; WTP = -107.50 USD) being twice as great as effect of doubling the harvest (β = 0.331; $p < .01$; WTP = 52.16 USD) (Table 4.6). The only other attribute level to have a significant effect on trip choice by harvest anglers was reducing catfish size (β = -0.276; $p < .05$; WTP = -43.57 USD) (Table 4.6). However, *Harvest Anglers* were indifferent toward increases in catfish size. Cluster 4 (n = 77; 17%) was labeled *Numbers & Size Anglers* because they had high average summated-scores on the CATNUM and CATLAR constructs, and also had the greatest score on the CATSOM construct (Table 4.5). Trip choice by *Number & Size Anglers* was most affected by changes in catch (HALF: β = -0.552; $p < .001$; WTP = -79.83 USD; TRIPLE: β = 0.551; $p < .001$; WTP = 84.28 USD), and increases in harvest compared to the other clusters (β = 0.395; $p < .01$; WTP = 60.39 USD) (Table 4.6). Cluster 4 was also the only cluster whose choice of trips was affected negatively by small reservoirs (β = -0.310; $p < .01$; WTP = -47.38 USD) and undeveloped sites (β = -0.337; $p < .01$; WTP = -51.49 USD) (Table 4.6). The final cluster, cluster 5, was labeled *Size*

Anglers because they had the greatest summated-score on the CATLAR construct, and by far the least summated-score on the KEEPFISH construct (Table 4.5). *Size Angler* trip choice was by far most affected by changes in catfish size compared to the other clusters (SMALLER: $\beta = -0.934$; $p < .001$; WTP = -123.23 USD; LARGER: $\beta = 1.071$; $p < .001$; WTP = 141.35 USD) (Table 4.6). Unlike the other clusters, *Size Anglers* were completely indifferent toward harvest with neither a decrease ($\beta = -0.037$; $p > .05$; WTP = -4.86 USD) nor increase ($\beta = -0.006$; $p > .05$; WTP = -0.78 USD) in harvest having any influence on their choice of fishing trips (Table 4.6).

Finally, I used results of the SCMs for each cluster to calculate their choice probabilities and WTP for five hypothetical management scenarios (Table 4.7). These scenarios ranged from a large reservoir or river catfish population with poor fishing quality (scenario 1), to an intensely managed small reservoir with high quality catfishing (scenario 5) that would be typical of a private fee-fishing enterprise or an intensely managed urban fishery. All five angler clusters had negative WTP for scenario 1, and had their greatest choice probability and WTP for scenario 5 (Table 4.7). However, the pattern of choice probabilities and WTP across groups varied considerably for the other choice scenarios (Table 4.7). While scenario 2 (increased catch and harvest) provided the second greatest choice probability and WTP for four of the five clusters, scenarios 3 and 4 provided negative WTP for some groups and positive WTP for others. Scenario 3 (larger catfish but no harvest) provided the most disparate results across groups, with the *Harvest Anglers* (WTP = -111.50 USD) and *Numbers & Size Anglers* (WTP = -53.70 USD) clusters giving it their least WTP, whereas the *Size Anglers* cluster gave it their second greatest WTP (141.66 USD) (Table 4.7).

Discussion

This study used an SCM combined with a latent group analysis approach to estimate utility, or benefit, anglers received from various fishing trip attributes. The method's strength is that it requires respondents to examine the trip scenarios presented to them, consider them in their totality, and determine what trade-offs they are willing to make when selecting a fishing trip given a limited budget (Louviere & Timmermans, 1991; Oh et al., 2005; Morey et al., 2006; Dorow et al., 2009a). For this reason, studies that use SCMs to evaluate angler preferences are generally considered superior to traditional studies that use single-item measures to assess angler preferences for a variety of site or catch-related attributes (Fedler & Ditton, 1986; Hunt & Ditton, 1997). However, SCMs are limited by number of attributes that can effectively be included within a choice set due to limitation in human cognitive abilities, and space constraints within survey questionnaires (Louviere & Timmermans, 1991). In this study, attributes used within the SCM were limited to trip characteristics that were considered managerially relevant, and within control of a fisheries management agency to influence. Chosen attributes fell within two groups: 1) catch-related attributes of a fishing trip (i.e., relative number catfish caught, harvested, size of catfish), and 2) site specific characteristics (i.e., type of water body, level of site development and access, distance traveled).

Travel cost was the strongest determinate of choice for all three SCM models and the five latent class models, as would be predicted by economic theory (Lancaster, 1966). Next to the cost of a trip, the catch-related aspects of a fishing trip were foremost on catfish anglers' minds when determining their choice of fishing locations. This finding was consistent with previous studies that found angler satisfaction influenced more by the catch-related aspects of a trip than with non-catch aspects (Arlinghaus, 2006; Hutt & Neal, 2010). While importance of harvesting fish appeared to vary across angler clusters, all were concerned with number and size of catfish caught. Even those angler groups that scored low on the CATNUM and CATLAR attitude constructs were not willing to sacrifice reductions in number and size of catfish they typically caught for other trip attributes. It is possible that some catfish angler groups (i.e., *Harvest Anglers*) were concerned that catching fewer and smaller catfish would mean catching fewer catfish that were worth harvesting. However, more consistent with their attitudes, the SCM and latent group analyses did suggest that anglers with weaker attitudes toward catching numbers of catfish and larger catfish received less utility from increases in number and size of catfish caught compared to other anglers.

While increases in size and numbers of catfish caught have the potential to offer the greatest increases in utility to anglers, SCM results indicated that few changes in composition of a catfish angler’s catch had a greater negative impact on utility than a reduction in number of catfish harvested. Only a reduction in the typical size of catfish caught had a greater negative impact on utility in the base models and in all but one of the latent group models. This may, in part, be due to anglers believing smaller than normal catfish would be too small to be worth harvesting (Wallmo & Gentner, 2008). Managers looking to improve size and number of catfish caught will have to find ways of accomplishing these tasks without making significant cuts in number of catfish most anglers keep. This may be a difficult task on high-use urban resources. However, managers also should keep in mind that average number of catfish typically harvested by catfish anglers in this study was little more than one-fourth of the statewide bag limit.

SCM results also indicated that catfish anglers placed much less importance on type of water fished and level of site development compared to travel cost and catch-related attributes of a fishing trip. Results indicated that there was no significant difference in angler utility between fishing a site with a basic level of development and a well-developed site. However, there was a significant negative relationship between trip choice and scenarios specifying an undeveloped site with no boat launch. This suggested that the average catfish angler does not receive significantly greater utility from angling sites that provide more than a boat launch and basic amenities. This also suggested that fisheries managers looking to promote a quality catfish fishery have a significant amount of leeway in choosing the setting of the fishery. While catfish anglers indicated a preference for large reservoirs and rivers over small reservoirs, they also indicated that the distance they needed to travel and the quality of the fishing were of far greater importance to their selection of a fishing trip. This point is of particular importance to fisheries managers and fee-fishing operators as providing the most preferred catfish angling scenarios examined would require intense fishery management with application of stocking catchable-sized catfish, pond fertilization, and potentially even fish feeding devices. While such measures may be economically practical on small, contained water bodies, they would be far too costly for use on the open, large water systems for which catfish anglers reported a minor preference.

In addition to using the SCM and latent group analyses to identify catfish angler preferences for fishing trip attributes, this study also allowed for evaluation of the relationship between CRAs and angler preferences toward catch-related aspects of the fishing experience. In Model 3, I used interaction terms within the model to determine if CRA mediated angler preferences toward catch-related attribute levels. After including interaction effects for the CATNUM and CATLAR construct scores in Model 3, coefficients for the catch and size attributes became insignificant. This suggested that respondent's CRA toward the number and size of fish caught were significant predictors of their preferences for these attributes, and fully mediated the relationship between trip attributes and choice (Baron & Kenny, 1986; Anderson & Fulton, 2008). A similar pattern was found for the harvest attribute levels; however, significance of the harvest attribute levels on choice only became less significant as opposed to insignificant. This suggests that angler attitudes toward harvest partially mediated their harvest preferences indicating that other factors in addition to their attitudes toward harvest were influencing their choice of trip scenarios (Baron & Kenny, 1986). These results indicated that the CRA scales, as currently formulated, have predictive validity in that they are shown to be good predictors of associated angler preferences.

That the relationship between the KEEPFISH construct, and catfish angler preferences toward harvest did not suggest full mediation can be interpreted two ways. One, it could suggest that the KEEPFISH construct as currently formulated needs improvement. Currently, including items that measure angler attitudes toward releasing fish and their attitudes toward eating fish could suggest that the current scale is not uni-dimensional, thus violating one of the assumptions of scale measurement (Garver & Mentzer, 1999). An alternative explanation could also be that angler attitudes toward harvest are not the only factor influencing their preferences toward harvest. In his theory of planned behavior, Ajzen (1991) indicated that behavior is influenced by subjective norms (i.e., perceived normative beliefs of ones reference groups) as well as personal attitudes. Traditionally, catfishing has been greatly associated with harvesting fish for food, and it is possible that some anglers that score low on the KEEPFISH scale may still have people back home that expect them to bring back some fish for dinner or desire to at least keep a few while releasing most of their catch (Toth & Brown, 1997). It is important to consider that the reduced harvest option used in this study specified that no fish would be harvested. Had the reduced harvest level not been so strict, the strength of the mediation effect between the KEEPFISH construct and angler preferences may have been stronger.

Finally, I used a form of latent group analysis (i.e., cluster analysis) to divide catfish anglers into five groups based on their CRAs so that I could run separate SCMs for each group. Researchers have adopted this method to circumvent the homogenous preferences assumption of multi-logit models so that they can better explain preference heterogeneity within a population (Boxall & Adamowicz, 2002; Oh et al., 2005; Morey et al., 2006; Aldrich, Grimsrud, Thacher, & Kotchen, 2007). I found that CRAs were useful criteria for accounting for preference heterogeneity because of their direct relationship to the catch-related aspects of fishing trips. While the nature of the five groups identified by the cluster analysis was not unexpected, quantifying the relative size of each cluster and the different levels of utility they each receive from different fishing trip attributes will enable fisheries managers to devise management plans that are better suited to meet the varied needs of each angler sub-group. Fisheries managers that are developing regional management plans with limited agency resources would do well to adopt the approach used in this study to evaluate angler preferences and identify management goals that would best meet the needs of their clientele.

Table 4.1 Attribute levels used in the stated choice experiment conducted in the follow-up survey of catfish anglers (April to June 2010).

Attributes	Level 1	Level 2	Level 3
Catch	Half as many caught as usual (-1)	Same as usual (0)	Three times as many caught as usual (1)
Harvest	None harvested (-1)	Same as usual (0)	Twice as many fish harvested as usual (1)
Size	Smaller than usual, many sub-legal (-1)	Same as usual (0)	Larger than usual, some of trophy size (1)
Type of water body	Large reservoir (over 100 acres) (-1)	River or stream (0)	Small pond or reservoir (under 100 acres) (1)
Level of site development	Undeveloped site (Rustic shoreline access with no boat ramps, restrooms, or picnic tables) (-1)	Basic site development (Gravel shoreline trails with a boat launch, portable restroom facilities, and picnic tables) (0)	Well developed site (Well maintained trails, some paved, with fishing piers, marinas, permanent restroom facilities, and sheltered picnic areas) (1)
Distance traveled and associated costs[a]	Located within 10 miles of home ($16.91) [b] ($15.31) [c]	Located 11 - 100 miles of home ($84.55) [b] ($76.53) [c]	Located over 100 miles from home ($253.65) [b] ($229.58) [c]

Level 2 represents a "status quo" scenario which is needed as a reference point for variations. Effects coding used in stated choice analysis is presented in parenthesis for the catch through site development attributes. Travel cost values (2011 USD) used in the SCM analysis are presented for the distance traveled attribute.

[a] Travel costs were calculated based on round trip mileage costs derived by AAA (2010), and one-third of the median hourly wage rate.

[b] Travel cost values used in the overall models, and the cluster 1-4 models. Based on a median income of $70,000.

[c] Travel cost values used in the cluster 5 model. Based on a median income of $50,000 (2011 USD).

Table 4.2 Twelve-item measurement model validated by Anderson and colleagues (2007) to measure CRA toward recreational fishing by four hypothesized constructs of consumptive orientation[a].

Factor 1 - Attitudes toward catching something (CATSOM)
- NOFISH – A fishing trip can be successful even if no fish are caught[b]
- NOCATCH – If I thought I wouldn't catch any fish, I wouldn't go fishing
- SOMETHING – When I go fishing, I'm not satisfied unless I catch something

Factor 2 - Attitudes toward catching numbers of fish (CATNUM)
- MOREFISH – The more fish I catch, the happier I am
- MANYFISH – A successful fishing trip is one in which many fish are caught
- LIMIT – I'm happiest with a fishing trip if I at least catch the daily bag limit of fish

Factor 3 - Attitudes toward catching large / trophy gamefish (CATLAR)
- BIGFISH – I would rather catch one or two big fish than ten smaller fish
- CHALLENGE – I'm happiest with a fishing trip if I catch a challenging game fish
- TROPHY – I like to fish where I know I have a chance to catch a "trophy" fish

Factor 4 - Attitude toward keeping fish (KEEPFISH)
- EAT – I usually eat the fish I catch
- DONTKEEP – I'm just as happy if I don't keep the fish I catch[b]
- RELEASE – I'm just as happy if I release the fish I catch[b]

[a] Respondents were asked to indicate whether they agreed or disagreed with each item on a 5-point Likert-type scale with 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; and 5 = strongly agree.
[b] Item reverse coded for analysis purposes.

Table 4.3 Results of non-response bias analysis for statewide (May to June 2009) and follow-up surveys of catfish anglers (April to June 2010).

Parameter	d.f.	Coefficient	SE	Mean		Wald χ^2	p-value
				Resp	NR		
				Statewide Survey			
Intercept	1	2.640	0.135			383.33	< .001
Age	1	-0.043	0.003	48.8	42.5	299.16	< .001
Coastal	1	0.133	0.067	0.24	0.27	3.98	.046
Female	1	0.235	0.075	0.18	0.14	9.80	.002
				Catfish Angler Survey			
Intercept	1	1.623	0.305			28.25	< .001
Age	1	-0.040	0.006	50.5	44.8	53.74	< .001
Coastal	1	0.103	0.170	0.17	0.18	0.37	.545
Female	1	0.064	0.170	0.18	0.16	0.14	.708

Means presented for respondents and non-respondents on the coastal and female variables represent the proportions of those individuals in each group.

Table 4.4 Part-worth utility estimates and standard errors (SE) from three multinomial logit models fit to the stated choice data.

Variable	Model 1	Model 2	Model 3
ASC (Trip A or B)	1.848 (0.068) ***	2.863 (0.372) ***	2.894 (0.344) ***
Travel cost	-0.006 (0.001) ***	-0.006 (0.001) ***	-0.007 (0.001) ***
Catch half	-0.259 (0.053) ***	-0.276 (0.058) ***	0.023 (0.186)
Catch triple	0.282 (0.042) ***	0.297 (0.046) ***	-0.099 (0.177)
Harvest none	-0.415 (0.044) ***	-0.438 (0.048) ***	0.422 (0.161) **
Harvest twice	0.209 (0.052) ***	0.208 (0.057) ***	-0.346 (0.159) *
Size smaller	-0.504 (0.047) ***	-0.525 (0.051) ***	-0.247 (0.204)
Size larger	0.442 (0.043) ***	0.443 (0.047) ***	-0.287 (0.193)
Large reservoir	0.038 (0.043)	0.077 (0.048)	0.100 (0.048) *
Small reservoir	-0.118 (0.043) **	-0.129 (0.046) **	-0.126 (0.047) **
Undeveloped site	-0.123 (0.043) **	-0.138 (0.047) **	-0.154 (0.047) **
Well developed site	0.056 (0.044)	0.045 (0.048)	0.046 (0.048)
age*asc		-0.029 (0.006) ***	-0.031 (0.006) ***
income*asc		0.203 (0.041) ***	0.172 (0.041) ***
race*asc		-0.494 (0.224) *	-0.239 (0.209)
gender*asc		-0.256 (0.185)	
CATNUM*Catch half			-0.033 (0.018)
CATNUM*Catch triple			0.041 (0.017) *
KEEPFISH* Harvest none			-0.097 (0.018) ***
KEEPFISH* Harvest twice			0.061 (0.016) ***
CATLAR* Size smaller			-0.030 (0.021)
CATLAR* Size larger			0.077 (0.020) ***
-2 logL (initial)	6,095.10	5,214.01	5253.56
-2 logL (final)	4,843.16 (n = 8,324)	4,025.80 (n = 7,122)	4,014.28 (n = 7,176)

Model 1 consists of the attribute levels only; Model 2 includes the attribute levels and socio-economic variables; and Model 3 consists of the attribute levels, significant socio-economic variables, and interactions between catch-related attitude construct scores and related attribute levels. Data were collected by a follow-up survey of catfish anglers (April to June 2010).

Notes: * indicates statistical significance at the p = .05 level, ** indicates significance at the p = .01 level, and *** indicates significance at the $p < .001$ level. Socio-economic variables were coded as follows: age = age in years; income = household income in units of US$20,000; race = 1 if non-White, 0 if White; gender = 1 if female, 0 male. The alternative-specific constant (ASC) is coded 1 for trips A and B in the choice set, and 0 for the neither option. CATNUM, KEEPFISH, and CATLAR are summated scores on three scales measuring CRA. Sample size for each model is based on the number of trip scenarios (3 per choice set) included in each model. Sample sizes decline across models due to missing data for interaction variables from some respondents.

Table 4.5 Catfish angler latent groups as determined by cluster analysis of respondents' summated scores on the four catch-related attitude scales listed in Table 4.2.

	Angler Clusters						
	Casual	Number	Harvest	Numbers & Size	Size	Overall	*p*
N	146	121	81	77	37	462	
Average catch-related attitude construct scores							
CATSOM	5.4[a]	7.5[b]	9.0[c]	10.8[d]	5.2[a]	7.5	<.001
CATNUM	7.8[a]	10.8[b]	10.1[b]	12.3[c]	10.7[b]	9.9	<.001
CATLAR	8.5[a]	9.9[b]	8.1[a]	12.0[c]	12.2[c]	9.7	<.001
KEEPFISH	7.6[a]	8.7[b]	12.1[c]	9.7[b]	5.7[d]	8.9	<.001
In a typical trip:							
# catfish caught	9.3 (0.8)	8.0 (0.7)	10.7 (1.2)	9.5 (1.1)	8.6 (1.4)	9.1 (0.4)	.148
# catfish harvest	5.5 (0.5) [ab]	5.4 (0.5) [ab]	8.1 (1.0) [b]	6.4 (0.8) [ab]	4.2 (0.7) [a]	5.9 (0.3)	.009
Typical length range of catfish caught:							<.001
< 10 in.	6.9	2.8	5.2	4.2	0.0	4.5	
10-15 in.	46.2	42.6	37.8	48.0	28.2	42.5	
16-20 in.	36.9	35.5	46.6	38.0	49.7	39.3	
21-25 in.	7.5	15.5	6.5	6.6	22.1	10.8	
>25 in.	2.6	3.6	3.9	3.2	0.0	2.9	
Median income (2011 USD)	70,000	70,000	70,000	70,000	50,000	70,000	<.001

Mean summated scores, typical number and size of catfish caught, and median income are reported for each cluster. Statistically significant differences between cluster means were determined by ANOVA and Tukey's multiple comparisons tests at the $\alpha = .05$ level. Clusters with different superscripts differed significantly from each other at the $p = .05$ level. Data were collected by a follow-up survey of catfish anglers (April to June 2010).

Table 4.6 Part-worth utility (PWU) estimates and willingness-to-pay (WTP) results of multinomial logit models fit to the stated choice data for each cluster of Texas freshwater catfish anglers and overall.

	Angler Clusters											
	Overall (n = 462)		Casual (n = 146)		Numbers (n = 121)		Harvest (n = 81)		Numbers & Size (n = 77)		Size (n = 37)	
Variable	PWU	WTP	PWU	WTP	PWU	WTP	PWU	WTP	PWU	WTP	PWU	WTP
ASC (Trip A/B)	1.848***		1.774***		2.111***		1.610***		2.115***		2.134***	
Travel cost	-0.006***		-0.006***		-0.007***		-0.006***		-0.007***		-0.008***	
Catch half	-0.259***	-41.64	-0.214*	-35.21	-0.313**	-47.54	-0.192	-30.35	-0.522***	-79.83	-0.424*	-55.96
Catch triple	0.282***	45.19	0.182*	29.91	0.313***	47.52	0.199	31.34	0.551***	84.28	0.596***	78.60
Harvest none	-0.415***	-66.61	-0.367***	-60.53	-0.364***	-55.34	-0.682***	-107.50	-0.554***	-84.77	-0.037	-4.86
Harvest twice	0.209***	33.47	0.124	20.44	0.154	23.45	0.331**	52.16	0.395**	60.39	-0.006	-0.78
Size smaller	-0.504***	-80.87	-0.545***	-89.77	-0.478***	-72.69	-0.276*	-43.57	-0.661***	-101.06	-0.934***	-123.23
Size larger	0.442***	70.92	0.403***	66.34	0.570***	86.67	0.119	18.72	0.513***	78.45	1.071***	141.35
Large reservoir	0.038	6.06	0.039	6.43	0.061	9.28	0.153	24.12	0.112	17.15	0.108	14.20
Small reservoir	-0.118**	-19.01	-0.139	-22.95	-0.011	-1.72	-0.144	-22.72	-0.310**	-47.38	0.039	5.17
Undeveloped	-0.123**	-19.69	-0.083	-13.66	-0.148	-22.50	-0.095	-14.95	-0.337**	-51.49	-0.056	-7.43
Well developed	0.056	9.02	-0.099	-16.33	0.116	17.69	0.029	4.52	0.223	34.11	0.189	25.00
-2 logL (initial)	6,095.10		1,832.49		1,491.92		1,028.30		947.00		470.21	
-2 logL (final)	4,843.16		1,479.77		1,131.96		846.91		670.37		314.26	
No. scenarios (n)	8,324		2,501		2,037		1,407		1,293		642	

Each model included only the SCM attribute level variables making the models comparable to Model 1 in Table 4.4. Data were collected by a follow-up survey of catfish anglers (April to June 2010).
Notes: * indicates statistical significance at the $p = 0.05$ level, ** indicates significance at the $p = 0.01$ level, and *** indicates significance at the $p < 0.001$ level. The alternative-specific constant (ASC) is coded 1 for trips A and B in the choice set, and 0 for the neither option.

Table 4.7 Predicted choice probabilities and willingness-to-pay (WTP) in 2011 USD for proposed catfishing trips as determined by the part-worth utilities estimated by the stated choice analyses.

	Trip Attributes [a]					Catfish Angler Clusters									
						Casual		Numbers		Harvest		Numbers & Size		Size	
Scenario	Catch	Harvest	Size	Water Type[b]	Site Dev[c]	Prob	WTP	Prob	WTP	Prob	WTP	Prob	WTP	Prob	WTP
1	Triple	Same	Smaller	LR / R	Basic	0.119	-59.86	0.113	-25.17	0.167	-12.23	0.118	-16.78	0.056	-44.63
2	Triple	Twice	Same	LR / R	Undev	0.215	36.69	0.183	48.47	0.278	68.55	0.242	93.18	0.134	70.39
3	Same	None	Larger	SR	Basic	0.155	-17.14	0.162	29.61	0.089	-111.50	0.093	-53.70	0.230	141.66
4	Half	Same	Larger	LR / R	Basic	0.207	31.13	0.172	39.13	0.167	-11.63	0.131	-1.38	0.150	85.39
5	Triple	Twice	Larger	SR	Basic	0.304	93.74	0.371	155.92	0.299	79.50	0.416	175.74	0.430	224.34

Data were collected by a follow-up survey of catfish anglers (April to June 2010).

[a] Detailed descriptions of trip attributes can be found in Table 4.1.

[b] Large reservoirs and rivers (LR/R) were combined for scenarios because no statistical difference was found in their effect of trip choice as opposed to small reservoirs (SR) which had a reduced likelihood of being chosen.

[c] Site development was caped at the basic level for included scenarios because well developed sites did not affect likelihood of trip choice.

Attribute	Trip A	Trip B	
CATCH	Same as usual	Half as many caught as usual	
HARVEST	Twice as many harvested as usual	None harvested	
SIZE	Smaller than usual, many sub-legal	Smaller than usual, many sub-legal	
TYPE OF WATER	Small pond or reservoir (under 100 acres)	Large reservoir (over 100 acres)	
LEVEL OF SITE DEVELOPMENT	Undeveloped site	Basic site development	
DISTANCE	Located 11-100 miles from home	Located over 100 miles from home	
Which trip do you *MOST* prefer? **(Circle only one)**	**TRIP A**	**TRIP B**	**NEITHER**

Figure 4.1 An example of the choice sets presented in a 2010 survey of Texas catfish anglers used to collect data to fit a stated choice model.

Each choice set presented two hypothetical fishing trip scenarios and a neither option to the survey respondent. Choice set scenarios were varied over six trip attributes (for attribute levels see Table 4.1). Respondents were asked to indicate which hypothetical fishing trip they would prefer to take, or if they were interested in neither trip.

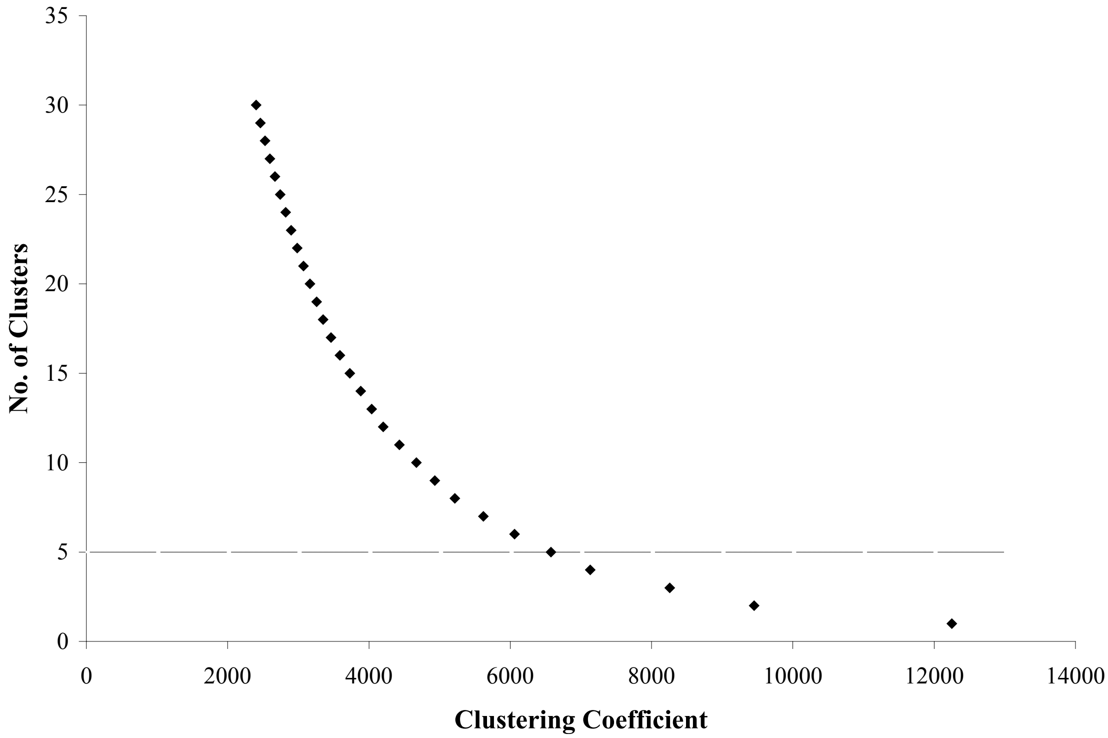

Figure 4.2 Hierarchical cluster analysis coefficient by number of clusters per iteration of the cluster analysis conducted with respondent catch-related attitude construct scores.

Data were collected by a follow-up survey of catfish anglers (April to June 2010).

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CHAPTER V

SYNTHESIS OF CATCH-RELATED ATTITUDE MEASUREMENTS AND THEIR INFLUENCE ON ANGLER PREFERENCES

Synthesis

The purpose of my dissertation was to examine catch-related attitude (CRA) measurements and how they could be used to better understand angler preferences. First, in Chapter II I compared two proposed measurement models of CRA that had previously been developed by Aas and Vitterso (2000) and Anderson and colleagues (2007), and evaluated the model that best fit the data for measurement invariance across gender, ethnic, and angling context groups. Second, in Chapter III I tested the CRA measurement model for consistency across generic- and species-specific angling contexts, and evaluated several variables associated with angler avidity toward a given species that might moderate this relationship. Finally, in Chapter IV I used a latent class stated choice analysis to examine influence of CRA on angler preferences regarding fishing trip attributes. In this chapter I provide a summary and synthesis of the respective findings of these three studies, and make recommendations for future research into angler CRA.

Validation of Catch-related Attitudes Scale

The results of Chapter II showed that the 4-construct model of CRA proposed by Anderson and colleagues (2007) provided a better fit to the data than the 3-construct model proposed by Aas and Vitterso (2000). After removing four problematic items from both models, the 4-construct model of CRA demonstrated consistently better fit statistics than the 3-construct model. Additionally, a chi-square difference test indicated that the 4-construct model provided significantly better fit to the data than the 3-construct model. Thus, my results indicated that structure of the CRA scale was best represented by a 4-construct model measuring attitudes towards 'Catching Something,' 'Catching Numbers of Fish,' 'Catching Large Fish,' and "Keeping Fish.' However, my results also suggested that measurement of the four constructs needs further refinement, as approximately half of the items included in the final model exhibited less than ideal factor loadings ($\lambda < 0.7$) (Garver & Mentzer, 1999).

Additionally, I was able to establish an acceptable level of measurement invariance for the 4-construct model across gender (male vs. female), ethnic (Anglo vs. non-Anglo), and species context (generic vs. species-specific) groups. These results validate use of the 4-construct CRA model across a variety of angler groups and contexts, which is of particular importance given the changing demographics of the United States population and efforts by fisheries agencies to better understand needs of under-represented angler groups in hopes of recruiting them to the sport (Murdock et al., 1996; Hunt et al., 2007). Furthermore, establishment of measurement invariance across angling contexts related to species pursued allowed for a valid assessment of CRA consistency across generic and species-specific contexts in Chapter III. More generally, the results illustrate the importance of validating psychometric measurement models to ensure unbiased cross group comparisons.

Catch-related Attitude Consistency and Moderation

In Chapter III, I examined consistency of CRA scores between scales presented in a generic versus a species-specific (i.e., freshwater catfish) context, and tested three measures of angling avidity (i.e., species preference, catfishing importance, catfishing frequency) as potential moderators of the relationship. I found that generic CRA to be a strong predictor of species-specific CRA, indicating that CRA are fairly consistent across contexts. However, strength of the relationship between the two contexts was low enough to indicate that researchers hoping to better understand effect of CRA on angler behavior and preferences using statistical models should consider collecting context specific CRA data whenever possible. My analysis did not find consistent evidence of moderation of the relationship between generic and species-specific CRA by common measurements of angling avidity. The one exception to this was that I did find evidence that angler preferred species did moderate consistency of CRA attitudes on the Catching Numbers construct. These analyses may have been complicated the follow-up survey of catfish anglers which only included individuals that had fished for catfish in the previous year, or had ranked catfish among their three most preferred fish to pursue, suggesting that low avidity catfish anglers were likely under-represented in this study.

Catch-related Attitudes and Trip Preferences

In Chapter IV, I used a series of stated choice models to examine influence of angler CRA on fishing trip preferences. Results showed that angler choice of hypothetical fishing trips was primarily influenced by travel costs and catch-related trip attributes, and minimally influenced by type and size of water body and level of site development. Furthermore, I found evidence of CRA mediating angler preferences by interacting angler CRA scores with corresponding attribute levels in the overall SCM. Results indicated that angler CRA fully mediated their preferences regarding number and size of catfish caught on a trip, and partially mediated their harvest preferences. These results demonstrated the importance of CRA for understanding preference heterogeneity among anglers, and their potential for helping to guide fisheries management decisions regarding resource allocation and selection of catch regulations that can aide in developing desired fisheries resources (e.g., establishment of slot limits to encourage development of a trophy fishery).

Next, I used a latent class SCM to separate catfish anglers into sub-groups based on their species-specific CRA construct scores before analyzing influence on catch and non-catch related trip attributes on angler choice of hypothetical fishing trips. Respondents were divided into five angler sub-groups, or latent classes, using a cluster analysis of their scores on the four CRA scales. Angler sub-groups ranged from casual anglers that scored low on all four constructs to highly specialized trophy catfish anglers. Much like the overall stated choice models, each of the latent class models I examined indicated the catch-related attributes (i.e., catch, harvest, size) had a greater influence on angler trip choice than any non-catch related attribute except trip cost (i.e., distance traveled). However, the individual CRA latent class models showed considerable variation in which catch-related attributes had the strongest influence on trip choice with the importance of each catch-related attribute closely paralleling strength of each group's attitudes towards a given CRA construct.

Future Research Needs

My dissertation sought to develop a firmer understanding of the CRA scale by evaluating consistency of its psychometric properties across multiple socio-economic sub-groups and angling contexts, and assessing influence of CRA on fishing trip preferences. My analyses indicated that a 4-construct model offered the best fit to the data, and valid measurement across multiple contexts related to angler demographics and species context. Furthermore, results from SCM indicated that the CRA scales represent valid predictors of angler preferences and behavioral intentions. As such, the CRA scales have the potential to help human dimensions researchers and fisheries managers better assess and understand needs of an increasingly heterogeneous angling population, and facilitate more efficient management of fisheries resources.

Future studies of CRA should focus on four areas : 1) improvement of the measurement model, 2) assessment of measurement invariance across additional socio-economic groups, 3) consistency of CRA across additional angling contexts, 3) influence of CRA and other variables on angler trip preferences, and 4) effect of CRA on other aspects of the fishing experience including fisheries management and regulatory preferences.

While my analysis indicated that the 4-construct model of CRA provided an adequate fit to the data, additional work is needed to improve measurement of the scale as seven items within the scale were found to have less than optimal standardized loadings ($\lambda \geq .70$). Standardized loadings of at least .70 are recommended for measurement models because that is the point at which at least 50% of the variance in the item can be contributed to the construct (Garver & Mentzer, 1999). Future studies should include the full 16 items used within this study in addition to the new items proposed in Chapter II to identify an improved set of measurement scales. In addition to assessing new measurement items, researchers should attempt to split the 'Catching Large Fish' construct into two constructs measuring 'Catching Large Fish' and 'Catching Challenging Fish.' The current 'Catching Large Fish' construct as presented showed signs of violating the assumption of unidimensionality in that most items had low factor loadings, and high error variances (Bollen & Lennox, 1991). Use of unidimensional factors is important in attitudinal research as they are necessary to ensure the construct in question measures only one attitude. Failure to meet this assumption can seriously complicate efforts to interpret results of analysis examining influence of attitudes on behavior and preferences.

Additional efforts also will be needed to assess invariance of CRA scales. First, if future researchers modify the current scales with new items, the invariance tests presented in this dissertation will not be valid for the new measurement scales and the invariance tests will need to be redone. Second, additional tests are needed to determine the scales level of invariance across non-Anglo angler sub-groups. This dissertation did not possess adequate sample sizes to conduct separate invariance tests between African-, Hispanic-, Asian-, and Native American anglers. Given the under-representation of these groups among licensed anglers, it will be necessary to use stratified random samples to collect adequate sample sizes for analysis purposes (USDI, 2007). Third, additional invariance tests will be needed if researchers wish to use the current scales to compare CRA across anglers from other countries. Human dimensions studies of anglers are becoming increasingly common in other predominantly Anglo countries in Europe and

Australia (Aas & Vitterso, 2000; Arlinghaus, 2006; Sutton, 2007). Cultural differences across countries, especially non-English speaking nations that will require translation of scale items into another language, can bias the psychometric measurement properties of an attitude scale (Wu et al., 2007). Fourth, the scale should be evaluated for invariance if future studies attempt to compare American anglers from different regions. While regional cultural differences are less likely to be an issue within the United States, it is best to be thorough to ensure unbiased cross-group comparisons. Finally, additional invariance tests are needed to ensure unbiased measurement across different angling contexts. In this dissertation I examined measurement invariance of the CRA scales between generic and species-specific contexts. Future studies examining differences in CRA between anglers that fish primary with family, friends, or alone should also consider testing for invariance.

By demonstrating invariance of the CRA scale between generic and species-specific context, I was able to conduct a valid evaluation of the consistency of CRA between the two contexts. I used context of fishing for catfish for the species-specific context in my analysis of attitude consistency and potential of angler avidity to moderate that relationship. This research was motivated by Sutton's (2003) study of the effect of CRA on catch-and-release behavior, which found evidence that the relationship between the two was moderated by whether the fish species in question was the anglers' preferred species. I found evidence of moderate inconsistency between the two contexts, but found little evidence that the relationship was moderated by variables of angler avidity. Future researchers could improve upon the current study by: 1) including CRA data on fishing for additional species of game fish and 2) including CRA data from anglers with less avidity for the species in question. The sampling frame for the catfish angler survey in this study was limited by individuals that had either fished for catfish in the previous year, or listed catfish as being among their three most preferred species to pursue. Additionally, the sample was likely limited to even more avid anglers due to non-response. Future studies including less avid anglers should have more success at identifying potential moderators to consistency of CRA across contexts.

Future research should further examine the relationship between CRA and angler preferences. I found evidence in the SCMs that angler attitudes towards 'Catching Numbers of Fish' and 'Catching Large Fish' fully mediated the relationship between trip choice and number and size of catfish anglers could expect to catch. However, attitudes towards 'Keeping Fish' only partially mediated the relationship between trip choice and number of fish harvested. This suggested that angler preferences regarding harvest of catfish depended on more than their own attitudes towards harvest. Ajzen's (1991) theory of planned behavior may suggest other possible factors influencing this relationship. Ajzen (1991) argues that behavior intentions are a function of individual attitudes, social norms, and perceived controls. Toth and Brown (1997) found that harvesting fish for social gatherings was a motivation of many anglers in the Mississippi Delta. Catfish are traditionally seen as a food fish (Wilde & Ditton, 1999), and angler preferences regarding harvest may be partially mediated by social norms in addition to personal CRA. Future research should seek to examine this possibility for catfish anglers and anglers pursuing other species. Future research also needs to confirm if the relationship between CRA and catch-related preferences found in this study hold for anglers that pursue other species, especially more traditional sportfish such as black bass and trout (Wilde & Ditton, 1994;

Hutt & Bettoli, 2007). Future research should examine the relationship of CRA and angler preferences for fishing regulations, which were not included in the stated choice experiment used in my dissertation, to determine if effect of CRA on catch preferences is translated into support for the fisheries management efforts needed to obtain preferred outcomes.

Finally, additional research is needed to assess influence of CRA on angler behavior. Sutton (2003) assessed the link between angler CRA and their expression of behavioral intentions to practice catch-and-release. He found that CRA towards harvesting fish and catching large fish helped to predict angler intentions to practice catch-and-release (Sutton, 2003). Additional research is needed to link CRA to actual behavior. Ajzen's (1991) theory of planned behavior states that behavior is influenced by behavioral intentions, which are in turn influenced by personal attitudes, perceptions of social norms, and perceived controls. To date, research that has examined the link between CRA and behavior has mostly been limited to using hypothetical scenarios to test the influence of CRA on behavioral intentions to practice behaviors such as catch-and-release, or the likelihood of anglers to choose hypothetical fishing trips. One exception was a study by Sutton and Ditton (2001) that showed that tuna angler attitudes toward keeping fish were a significant predictor of their practice of actual catch-and-release behavior. Future studies on the effect of CRA on angler behavior and trip preferences also should seek to examine CRA effects on actual behavior and revealed preferences wherever possible.

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APPENDIX A

COVARIANCE MATRICES USED IN CONFIRMATORY FACTOR ANALYSES AND STRUCTURAL EQUATIONS MODELS

Table A.1 Polychoric correlation matrix of responses by male, Anglo anglers to 16 attitudinal items* designed to measure generic catch-related attitudes, and used to assess model fit between proposed 3- and 4-construct models with confirmatory factor analysis.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
NOFISH	1.00															
HAPPY	0.58	1.00														
NOCATCH	0.41	0.43	1.00													
SOMETHING	0.48	0.51	0.57	1.00												
MOREFISH	0.28	0.35	0.31	0.43	1.00											
MANYFISH	0.43	0.38	0.38	0.5	0.52	1.00										
FULLSTRING	0.37	0.31	0.36	0.49	0.47	0.62	1.00									
LIMIT	0.24	0.28	0.3	0.45	0.44	0.49	0.58	1.00								
BIGFISH	0.04	0.00	0.05	0.09	0.11	0.16	0.09	0.13	1.00							
BIGBETTER	0.25	0.27	0.25	0.37	0.42	0.51	0.52	0.44	0.42	1.00						
CHALLENGE	0.06	0.12	0.11	0.22	0.16	0.18	0.15	0.25	0.34	0.44	1.00					
TROPHY	0.13	0.20	0.22	0.34	0.26	0.30	0.25	0.32	0.38	0.50	0.46	1.00				
EAT	0.05	0.10	0.19	0.14	0.02	0.13	0.26	0.19	-0.10	-0.08	-0.07	-0.11	1.00			
DONTKEEP	0.28	0.34	0.24	0.18	0.10	0.20	0.27	0.16	-0.14	0.03	-0.10	-0.02	0.50	1.00		
WANTKEEP	0.19	0.14	0.25	0.28	0.17	0.30	0.44	0.34	-0.05	0.13	-0.01	0.03	0.54	0.44	1.00	
RELEASE	0.28	0.32	0.27	0.21	0.10	0.16	0.27	0.13	-0.14	0.02	-0.16	-0.08	0.52	0.72	0.45	1.00

Data were collected by a statewide survey of Texas anglers (May to June 2009).
* Item statements can be found in Table 2.2.

Table A.2 Polychoric correlation matrix of responses by male, Anglo anglers to 12 attitudinal items* designed to measure catfishing-specific catch-related attitudes.

	1	2	3	4	5	6	7	8	9	10	11	12
NOFISH	1.00											
NOCATCH	0.42	1.00										
SOMETHING	0.54	0.58	1.00									
MOREFISH	0.07	0.28	0.25	1.00								
MANYFISH	0.16	0.27	0.39	0.63	1.00							
LIMIT	0.20	0.35	0.46	0.39	0.50	1.00						
BIGFISH	0.03	0.08	0.15	0.24	0.20	0.06	1.00					
CHALLENGE	-0.04	0.08	0.13	0.30	0.25	0.15	0.37	1.00				
TROPHY	-0.01	0.15	0.20	0.31	0.31	0.20	0.39	0.48	1.00			
EAT	-0.05	0.04	0.18	0.08	0.25	0.21	-0.07	-0.04	-0.01	1.00		
DONTKEEP	0.27	0.29	0.42	0.16	0.24	0.30	-0.06	-0.21	-0.08	0.46	1.00	
RELEASE	0.31	0.31	0.43	0.15	0.27	0.29	-0.04	-0.24	-0.10	0.48	0.74	1.00

Data was used to assess model fit and measurement invariance of a 4-construct model with confirmatory factor analysis. Data were collected by a follow-up survey of Texas catfish anglers (April to June 2010).
* Item statements can be found in Table 2.2.

Table A.3 Asymptotic covariance matrix of responses by male anglers to 12 attitudinal items* designed to measure generic catch-related attitudes.

	1	2	3	4	5	6	7	8	9	10	11	12
NOFISH	1.492											
NOCATCH	1.042	2.421										
SOMETHING	0.789	1.188	1.233									
MOREFISH	0.626	0.987	0.863	1.197								
MANYFISH	0.746	1.078	0.918	0.923	1.218							
LIMIT	0.679	0.996	0.852	0.841	0.874	1.103						
BIGFISH	0.635	0.941	0.804	0.852	0.842	0.799	1.210					
CHALLENGE	0.640	1.002	0.877	0.958	0.901	0.867	0.960	1.376				
TROPHY	0.712	1.079	0.924	0.900	0.922	0.880	0.955	1.020	1.427			
EAT	0.856	1.401	1.160	1.255	1.192	1.146	1.151	1.292	1.179	2.913		
DONTKEEP	0.871	1.069	0.811	0.728	0.804	0.763	0.708	0.742	0.788	1.214	1.611	
RELEASE	0.844	1.019	0.766	0.664	0.736	0.707	0.654	0.664	0.715	1.125	1.187	1.538

Data was used to assess model fit and measurement invariance of a 4-construct model with confirmatory factor analysis. Data were collected by a statewide survey of Texas anglers (May to June 2009).
* Item statements can be found in Table 2.2.

Table A.4 Asymptotic covariance matrix of responses by female anglers to 12 attitudinal items* designed to measure generic catch-related attitudes.

	1	2	3	4	5	6	7	8	9	10	11	12
NOFISH	1.353											
NOCATCH	1.125	2.965										
SOMETHING	0.921	1.505	1.703									
MOREFISH	0.616	0.961	0.933	1.165								
MANYFISH	0.774	1.173	1.093	0.933	1.333							
LIMIT	0.737	1.088	0.999	0.810	0.902	1.320						
BIGFISH	0.668	1.008	0.941	0.825	0.909	0.860	1.241					
CHALLENGE	0.740	1.143	1.080	0.970	0.978	0.999	0.986	1.634				
TROPHY	0.716	1.077	0.900	0.677	0.767	0.803	0.755	0.944	1.196			
EAT	1.162	1.899	1.777	1.721	1.777	1.652	1.631	1.818	1.237	6.073		
DONTKEEP	0.924	1.317	1.107	0.839	1.018	1.018	0.914	0.972	0.839	2.023	2.208	
RELEASE	0.912	1.316	1.078	0.782	0.935	0.981	0.850	0.909	0.817	1.928	1.691	2.071

Data was used to assess model fit and measurement invariance of a 4-construct model with confirmatory factor analysis. Data were collected by a statewide survey of Texas anglers (May to June 2009).
* Item statements can be found in Table 2.2.

Table A.5 Asymptotic covariance matrix of responses by Anglo anglers to 12 attitudinal items* designed to measure generic catch-related attitudes.

	1	2	3	4	5	6	7	8	9	10	11	12
NOFISH	1.401											
NOCATCH	0.672	2.445										
SOMETHING	0.533	1.017	1.279									
MOREFISH	0.313	0.692	0.718	1.132								
MANYFISH	0.452	0.813	0.808	0.790	1.176							
LIMIT	0.389	0.728	0.735	0.671	0.736	1.089						
BIGFISH	0.283	0.596	0.614	0.641	0.647	0.592	1.087					
CHALLENGE	0.300	0.685	0.724	0.793	0.724	0.688	0.757	1.355				
TROPHY	0.360	0.759	0.741	0.678	0.710	0.694	0.728	0.850	1.392			
EAT	0.398	1.008	0.960	1.076	1.005	0.918	0.865	1.062	0.832	3.394		
DONTKEEP	0.517	0.724	0.585	0.481	0.579	0.551	0.415	0.459	0.468	1.022	1.789	
RELEASE	0.503	0.670	0.514	0.383	0.467	0.459	0.328	0.339	0.357	0.871	1.184	1.654

Data was used to assess model fit and measurement invariance of a 4-construct model with confirmatory factor analysis. Data were collected by a statewide survey of Texas anglers (May to June 2009).
* Item statements can be found in Table 2.2.

Table A.6 Asymptotic covariance matrix of responses by non-Anglo anglers to 12 attitudinal items* designed to measure generic catch-related attitudes.

	1	2	3	4	5	6	7	8	9	10	11	12
NOFISH	1.698											
NOCATCH	0.813	3.186										
SOMETHING	0.670	1.114	1.491									
MOREFISH	0.380	0.755	0.811	1.540								
MANYFISH	0.570	0.901	0.879	0.961	1.527							
LIMIT	0.382	0.760	0.744	0.879	0.850	1.348						
BIGFISH	0.355	0.717	0.756	1.019	0.905	0.892	1.651					
CHALLENGE	0.365	0.821	0.863	1.150	0.970	1.044	1.213	1.941				
TROPHY	0.420	0.884	0.895	0.879	0.907	0.838	0.998	1.118	1.773			
EAT	0.379	0.909	0.887	1.229	1.015	1.095	1.192	1.335	0.977	2.997		
DONTKEEP	0.571	0.664	0.557	0.437	0.533	0.449	0.432	0.472	0.488	0.735	1.482	
RELEASE	0.497	0.631	0.508	0.412	0.480	0.403	0.382	0.396	0.406	0.723	0.980	1.499

Data was used to assess model fit and measurement invariance of a 4-construct model with confirmatory factor analysis. Data were collected by a statewide survey of Texas anglers (May to June 2009).
* Item statements can be found in Table 2.2.

Table A.7 Correlation among scale items for the Catching Something catch-related attitudes construct measured on generic (G) and species-specific (S) scales[a] across three species preference groups.

Preference groups	1	2	3	4	5	6
Catfish anglers						
NOFISH (G)	1.00					
NOCATCH (G)	0.30	1.00				
SOMETHING (G)	0.46	0.52	1.00			
NOFISH (S)	0.27	0.27	0.36	1.00		
NOCATCH (S)	0.25	0.31	0.32	0.37	1.00	
SOMETHING (S)	0.26	0.03	0.34	0.33	0.50	1.00
Crappie anglers						
NOFISH (G)	1.00					
NOCATCH (G)	0.46	1.00				
SOMETHING (G)	0.56	0.57	1.00			
NOFISH (S)	0.53	0.29	0.52	1.00		
NOCATCH (S)	0.33	0.38	0.13	0.28	1.00	
SOMETHING (S)	0.46	0.50	0.53	0.43	0.27	1.00
Bass anglers						
NOFISH (G)	1.00					
NOCATCH (G)	0.50	1.00				
SOMETHING (G)	0.53	0.57	1.00			
NOFISH (S)	0.41	0.46	0.36	1.00		
NOCATCH (S)	0.39	0.46	0.42	0.40	1.00	
SOMETHING (S)	0.35	0.49	0.44	0.59	0.65	1.00

Data were used to assess model invariance across groups, and test for moderation of attitude consistency across generic and species-specific contexts. Data were collected by a statewide survey of Texas anglers (May to June 2009), and a follow-up survey of catfish anglers (April to June 2010).

[a] Statements can be found in Table 3.1.

Table A.8 Correlation among scale items for the Catching Numbers catch-related attitudes construct measured on generic (G) and species-specific (S) scales[a] across three species preference groups.

Preference groups	1	2	3	4	5	6
Catfish anglers						
MOREFISH (G)	1.00					
MANYFISH (G)	0.60	1.00				
LIMIT (G)	0.50	0.57	1.00			
MOREFISH (S)	0.45	0.39	0.29	1.00		
MANYFISH (S)	0.41	0.45	0.38	0.59	1.00	
LIMIT (S)	0.34	0.37	0.43	0.49	0.59	1.00
Crappie anglers						
MOREFISH (G)	1.00					
MANYFISH (G)	0.75	1.00				
LIMIT (G)	0.44	0.45	1.00			
MOREFISH (S)	0.47	0.44	0.40	1.00		
MANYFISH (S)	0.42	0.39	0.34	0.40	1.00	
LIMIT (S)	0.19	0.21	0.48	0.36	0.10	1.00
Bass anglers						
MOREFISH (G)	1.00					
MANYFISH (G)	0.54	1.00				
LIMIT (G)	0.19	0.48	1.00			
MOREFISH (S)	0.43	0.41	0.23	1.00		
MANYFISH (S)	0.26	0.52	0.30	0.51	1.00	
LIMIT (S)	0.10	0.26	0.31	0.45	0.43	1.00

Data were used to assess model invariance across groups, and test for moderation of attitude consistency across generic and species-specific contexts. Data were collected by a statewide survey of Texas anglers (May to June 2009), and a follow-up survey of catfish anglers (April to June 2010).

[a] Statements can be found in Table 3.1.

Table A.9 Correlation among scale items for the Catching Large Fish catch-related attitudes construct measured on generic (G) and species-specific (S) scales[a] across three species preference groups.

Preference groups	1	2	3	4	5	6
Catfish anglers						
BIGFISH (G)	1.00					
CHALLENGE (G)	0.41	1.00				
TROPHY (G)	0.38	0.47	1.00			
BIGFISH (S)	0.49	0.28	0.35	1.00		
CHALLENGE (S)	0.23	0.41	0.36	0.19	1.00	
TROPHY (S)	0.19	0.29	0.44	0.31	0.39	1.00
Crappie anglers						
BIGFISH (G)	1.00					
CHALLENGE (G)	0.40	1.00				
TROPHY (G)	0.40	0.40	1.00			
BIGFISH (S)	0.44	0.46	0.05	1.00		
CHALLENGE (S)	0.17	0.44	0.07	0.27	1.00	
TROPHY (S)	0.22	0.33	0.28	0.32	0.40	1.00
Bass anglers						
BIGFISH (G)	1.00					
CHALLENGE (G)	0.17	1.00				
TROPHY (G)	0.36	0.43	1.00			
BIGFISH (S)	0.31	0.20	0.39	1.00		
CHALLENGE (S)	0.13	0.35	0.49	0.36	1.00	
TROPHY (S)	0.20	0.19	0.63	0.47	0.64	1.00

Data were used to assess model invariance across groups, and test for moderation of attitude consistency across generic and species-specific contexts. Data were collected by a statewide survey of Texas anglers (May to June 2009), and a follow-up survey of catfish anglers (April to June 2010).

[a] Statements can be found in Table 3.1.

Table A.10 Correlation among scale items for the Keeping Fish catch-related attitudes construct measured on generic (G) and species-specific (S) scales[a] across three species preference groups.

Preference groups	1	2	3	4	5	6
Catfish anglers						
EAT (G)	1.00					
DONTKEEP (G)	0.37	1.00				
RELEASE (G)	0.50	0.74	1.00			
EAT (S)	0.63	0.25	0.39	1.00		
DONTKEEP (S)	0.28	0.46	0.54	0.32	1.00	
RELEASE (S)	0.34	0.41	0.60	0.37	0.79	1.00
Crappie anglers						
EAT (G)	1.00					
DONTKEEP (G)	0.32	1.00				
RELEASE (G)	0.28	0.89	1.00			
EAT (S)	0.70	0.35	0.28	1.00		
DONTKEEP (S)	0.30	0.65	0.66	0.48	1.00	
RELEASE (S)	0.23	0.52	0.53	0.34	0.65	1.00
Bass anglers						
EAT (G)	1.00					
DONTKEEP (G)	0.56	1.00				
RELEASE (G)	0.57	0.73	1.00			
EAT (S)	0.61	0.34	0.43	1.00		
DONTKEEP (S)	0.41	0.56	0.59	0.49	1.00	
RELEASE (S)	0.50	0.61	0.66	0.54	0.78	1.00

Data were used to assess model invariance across groups, and test for moderation of attitude consistency across generic and species-specific contexts. Data were collected by a statewide survey of Texas anglers (May to June 2009), and a follow-up survey of catfish anglers (April to June 2010).
[a] Statements can be found in Table 3.1.

Table A.11 Correlation among scale items for the Catching Something catch-related attitudes construct measured on generic (G) and species-specific (S) scales[a] across three catfishing importance groups.

Importance groups	1	2	3	4	5	6
Most important						
NOFISH (G)	1.00					
NOCATCH (G)	0.40	1.00				
SOMETHING (G)	0.40	0.55	1.00			
NOFISH (S)	0.41	0.19	0.20	1.00		
NOCATCH (S)	0.28	0.29	0.21	0.45	1.00	
SOMETHING (S)	0.35	0.30	0.42	0.49	0.60	1.00
2nd most important						
NOFISH (G)	1.00					
NOCATCH (G)	0.40	1.00				
SOMETHING (G)	0.52	0.57	1.00			
NOFISH (S)	0.47	0.36	0.49	1.00		
NOCATCH (S)	0.32	0.50	0.48	0.48	1.00	
SOMETHING (S)	0.46	0.33	0.53	0.55	047	1.00
3rd most important						
NOFISH (G)	1.00					
NOCATCH (G)	0.38	1.00				
SOMETHING (G)	0.49	0.47	1.00			
NOFISH (S)	0.35	0.39	0.34	1.00		
NOCATCH (S)	0.43	0.32	0.31	0.42	1.00	
SOMETHING (S)	0.44	0.41	0.47	0.51	0.59	1.00

Data were used to assess model invariance across groups, and test for moderation of attitude consistency across generic and species-specific contexts. Data were collected by a statewide survey of Texas anglers (May to June 2009), and a follow-up survey of catfish anglers (April to June 2010).

[a] Statements can be found in Table 3.1.

Table A.12 Correlation among scale items for the Catching Numbers catch-related attitudes construct measured on generic (G) and species-specific (S) scales[a] across three catfishing importance groups.

Importance groups	1	2	3	4	5	6
Most important						
MOREFISH (G)	1.00					
MANYFISH (G)	0.52	1.00				
LIMIT (G)	0.55	0.58	1.00			
MOREFISH (S)	0.44	0.35	0.26	1.00		
MANYFISH (S)	0.37	0.46	0.41	0.67	1.00	
LIMIT (S)	0.34	0.36	0.42	0.39	0.47	1.00
2nd most important						
MOREFISH (G)	1.00					
MANYFISH (G)	0.54	1.00				
LIMIT (G)	0.35	0.44	1.00			
MOREFISH (S)	0.36	0.34	0.16	1.00		
MANYFISH (S)	0.41	0.49	0.24	0.55	1.00	
LIMIT (S)	0.14	0.25	0.36	0.32	0.60	1.00
3rd most important						
MOREFISH (G)	1.00					
MANYFISH (G)	0.52	1.00				
LIMIT (G)	0.47	0.24	1.00			
MOREFISH (S)	0.56	0.39	0.27	1.00		
MANYFISH (S)	0.48	0.45	0.31	0.64	1.00	
LIMIT (S)	0.32	0.28	0.44	0.36	0.48	1.00

Data were used to assess model invariance across groups, and test for moderation of attitude consistency across generic and species-specific contexts. Data were collected by a statewide survey of Texas anglers (May to June 2009), and a follow-up survey of catfish anglers (April to June 2010).

[a] Statements can be found in Table 3.1.

Table A.13 Correlation among scale items for the Catching Large Fish catch-related attitudes construct measured on generic (G) and species-specific (S) scales[a] across three catfishing importance groups.

Importance groups	1	2	3	4	5	6
Most important						
BIGFISH (G)	1.00					
CHALLENGE (G)	0.26	1.00				
TROPHY (G)	0.49	0.40	1.00			
BIGFISH (S)	0.47	0.23	0.30	1.00		
CHALLENGE (S)	0.33	0.48	0.35	0.42	1.00	
TROPHY (S)	0.36	0.40	0.51	0.33	0.50	1.00
2nd most important						
BIGFISH (G)	1.00					
CHALLENGE (G)	0.33	1.00				
TROPHY (G)	0.36	0.62	1.00			
BIGFISH (S)	0.42	0.01	0.17	1.00		
CHALLENGE (S)	0.31	0.23	0.24	0.27	1.00	
TROPHY (S)	0.40	0.28	0.51	0.34	0.48	1.00
3rd most important						
BIGFISH (G)	1.00					
CHALLENGE (G)	0.36	1.00				
TROPHY (G)	0.40	0.48	1.00			
BIGFISH (S)	0.38	0.30	0.25	1.00		
CHALLENGE (S)	0.20	0.45	0.24	0.33	1.00	
TROPHY (S)	0.16	0.41	0.51	0.43	0.46	1.00

Data were used to assess model invariance across groups, and test for moderation of attitude consistency across generic and species-specific contexts. Data were collected by a statewide survey of Texas anglers (May to June 2009), and a follow-up survey of catfish anglers (April to June 2010).

[a] Statements can be found in Table 3.1.

Table A.14 Correlation among scale items for the Keeping Fish catch-related attitudes construct measured on generic (G) and species-specific (S) scales[a] across three catfishing importance groups.

Importance groups	1	2	3	4	5	6
Most important						
EAT (G)	1.00					
DONTKEEP (G)	0.40	1.00				
RELEASE (G)	0.42	0.82	1.00			
EAT (S)	0.66	0.31	0.39	1.00		
DONTKEEP (S)	0.19	0.51	0.43	0.25	1.00	
RELEASE (S)	0.32	0.62	0.65	0.41	0.77	1.00
2nd most impotant						
EAT (G)	1.00					
DONTKEEP (G)	0.44	1.00				
RELEASE (G)	0.53	0.77	1.00			
EAT (S)	0.53	0.39	0.48	1.00		
DONTKEEP (S)	0.37	0.60	0.56	0.47	1.00	
RELEASE (S)	0.42	0.59	0.58	0.58	0.82	1.00
3rd most important						
EAT (G)	1.00					
DONTKEEP (G)	0.49	1.00				
RELEASE (G)	0.46	0.75	1.00			
EAT (S)	0.67	0.35	0.31	1.00		
DONTKEEP (S)	0.36	0.52	0.57	0.55	1.00	
RELEASE (S)	0.35	0.59	0.59	0.44	0.70	1.00

Data were used to assess model invariance across groups, and test for moderation of attitude consistency across generic and species-specific contexts. Data were collected by a statewide survey of Texas anglers (May to June 2009), and a follow-up survey of catfish anglers (April to June 2010).

[a] Statements can be found in Table 3.1.

Table A.15 Correlation among scale items for the Catching Something catch-related attitudes construct measured on generic (G) and species-specific (S) scales[a] across three catfishing frequency groups.

Frequency groups	1	2	3	4	5	6
25+ days						
NOFISH (G)	1.00					
NOCATCH (G)	0.34	1.00				
SOMETHING (G)	0.47	0.56	1.00			
NOFISH (S)	0.31	0.30	0.22	1.00		
NOCATCH (S)	0.20	0.33	0.19	0.35	1.00	
SOMETHING (S)	0.35	0.38	0.34	0.63	0.48	1.00
10-24 days						
NOFISH (G)	1.00					
NOCATCH (G)	0.38	1.00				
SOMETHING (G)	0.51	0.50	1.00			
NOFISH (S)	0.47	0.31	0.37	1.00		
NOCATCH (S)	0.33	0.42	0.48	0.44	1.00	
SOMETHING (S)	0.45	0.31	0.52	0.53	0.55	1.00
Less than 10 days						
NOFISH (G)	1.00					
NOCATCH (G)	0.35	1.00				
SOMETHING (G)	0.45	0.48	1.00			
NOFISH (S)	0.41	0.31	0.48	1.00		
NOCATCH (S)	0.49	0.41	0.40	0.53	1.00	
SOMETHING (S)	0.46	0.31	0.50	0.41	0.57	1.00

Data were used to assess model invariance across groups, and test for moderation of attitude consistency across generic and species-specific contexts. Data were collected by a statewide survey of Texas anglers (May to June 2009), and a follow-up survey of catfish anglers (April to June 2010).

[a] Statements can be found in Table 3.1.

Table A.16 Correlation among scale items for the Catching Numbers catch-related attitudes construct measured on generic (G) and species-specific (S) scales[a] across three catfishing frequency groups.

Frequency groups	1	2	3	4	5	6
25+ days						
MOREFISH (G)	1.00					
MANYFISH (G)	0.61	1.00				
LIMIT (G)	0.42	0.56	1.00			
MOREFISH (S)	0.40	0.33	0.31	1.00		
MANYFISH (S)	0.34	0.50	0.38	0.50	1.00	
LIMIT (S)	0.18	0.32	0.40	0.43	0.46	1.00
10-24 days						
MOREFISH (G)	1.00					
MANYFISH (G)	0.65	1.00				
LIMIT (G)	0.43	0.55	1.00			
MOREFISH (S)	0.46	0.49	0.36	1.00		
MANYFISH (S)	0.43	0.52	0.33	0.53	1.00	
LIMIT (S)	0.36	0.37	0.41	0.55	0.55	1.00
Less than 10 days						
MOREFISH (G)	1.00					
MANYFISH (G)	0.59	1.00				
LIMIT (G)	0.17	0.39	1.00			
MOREFISH (S)	0.51	0.37	0.07	1.00		
MANYFISH (S)	0.35	0.41	0.19	0.54	1.00	
LIMIT (S)	0.15	0.16	0.35	0.33	0.24	1.00

Data were used to assess model invariance across groups, and test for moderation of attitude consistency across generic and species-specific contexts. Data were collected by a statewide survey of Texas anglers (May to June 2009), and a follow-up survey of catfish anglers (April to June 2010).
[a] Statements can be found in Table 3.1.

Table A.17 Correlation among scale items for the Catching Large Fish catch-related attitudes construct measured on generic (G) and species-specific (S) scales[a] across three catfishing frequency groups.

Frequency groups	1	2	3	4	5	6
25+ days						
BIGFISH (G)	1.00					
CHALLENGE (G)	0.37	1.00				
TROPHY (G)	0.42	0.27	1.00			
BIGFISH (S)	0.50	0.25	0.29	1.00		
CHALLENGE (S)	0.22	0.37	0.38	0.38	1.00	
TROPHY (S)	0.38	0.19	0.61	0.48	0.53	1.00
10-24 days						
BIGFISH (G)	1.00					
CHALLENGE (G)	0.27	1.00				
TROPHY (G)	0.31	0.63	1.00			
BIGFISH (S)	0.43	0.29	0.38	1.00		
CHALLENGE (S)	0.10	0.31	0.40	0.19	1.00	
TROPHY (S)	0.17	0.25	0.50	0.29	0.56	1.00
Less than 10 days						
BIGFISH (G)	1.00					
CHALLENGE (G)	0.31	1.00				
TROPHY (G)	0.38	0.55	1.00			
BIGFISH (S)	0.30	0.27	0.30	1.00		
CHALLENGE (S)	0.21	0.48	0.31	0.41	1.00	
TROPHY (S)	0.17	0.34	0.44	0.45	0.46	1.00

Data were used to assess model invariance across groups, and test for moderation of attitude consistency across generic and species-specific contexts. Data were collected by a statewide survey of Texas anglers (May to June 2009), and a follow-up survey of catfish anglers (April to June 2010).

[a] Statements can be found in Table 3.1.

Table A.18 Correlation among scale items for the Keeping Fish catch-related attitudes construct measured on generic (G) and species-specific (S) scales[a] across three catfishing frequency groups.

Frequency groups	1	2	3	4	5	6
25+ days						
EAT (G)	1.00					
DONTKEEP (G)	0.44	1.00				
RELEASE (G)	0.56	0.78	1.00			
EAT (S)	0.67	0.29	0.38	1.00		
DONTKEEP (S)	0.39	0.54	0.65	0.44	1.00	
RELEASE (S)	0.49	0.54	0.62	0.52	0.81	1.00
10-24 days						
EAT (G)	1.00					
DONTKEEP (G)	0.39	1.00				
RELEASE (G)	0.52	0.77	1.00			
EAT (S)	0.70	0.40	0.51	1.00		
DONTKEEP (S)	0.31	0.51	0.53	0.45	1.00	
RELEASE (S)	0.48	0.50	0.59	0.54	0.81	1.00
Less than 10 days						
EAT (G)	1.00					
DONTKEEP (G)	0.52	1.00				
RELEASE (G)	0.41	0.71	1.00			
EAT (S)	0.59	0.31	0.27	1.00		
DONTKEEP (S)	0.44	0.61	0.62	0.49	1.00	
RELEASE (S)	0.42	0.65	0.68	0.47	0.77	1.00

Data were used to assess model invariance across groups, and test for moderation of attitude consistency across generic and species-specific contexts. Data were collected by a statewide survey of Texas anglers (May to June 2009), and a follow-up survey of catfish anglers (April to June 2010).

[a] Statements can be found in Table 3.1.