AN ASSESSMENT OF ECONOMIC IMPACT & VISITOR SATISFACTION: A CASE STUDY FROM CANTON LAKE, OKLAHOMA

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Abstract: Lake resources provide a variety of socioeconomic benefits ranging from market based goods (e.g., water supply and irrigation) to non-market based ecosystem services (e.g., recreation, wildlife habitat). However, ecosystem services are difficult to quantify and their benefits have been largely overlooked during natural resource decision making. In Oklahoma, debates over water allocation for alternative uses followed water releases from Canton Lake during the 2010-2013 drought. While water rights at Canton Lake rest with Oklahoma City, the lake remains a popular recreation destination in the region suggesting significant social and economic values for its recreational use. In an effort to provide managers and policy makers with a more holistic picture of the human dimensions at Canton Lake, survey data – collected from Canton Lake visitors during 2018 and 2019 – were used to evaluate visitor satisfaction as well as the economic impacts of visitor spending. Ordinal logistic regression, based in random utility theory, was utilized to evaluate which factors contributed to visitor satisfaction whereas input-output models – developed in IMpact Analysis for PLANning (IMPLAN) software – were used to estimate the effects of visitor spending on the three-county region and state. The results suggest that some, but not all, expressive and instrumental attributes were good predictors of overall satisfaction. Lake accessibility and fishing quality, which are particularly vulnerable to low water levels, may contribute to a decline in lake visitation. Economic data further suggests that resident and nonresident visitors contribute significantly to the regional economy, particularly in the retail and accommodation & food services sectors. However, nonresidents account for over half of all visitor spending meaning that reduced visitation could lead to a substantial loss in economic activity for the three-county region and, to a lesser extent, state. Altogether these results indicate that future withdrawals from Canton Lake under current policy are likely to have significant negative social and economic effects.

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INTRODUCTION

Despite legislation to bring it in line with other uses (USACE 1985), recreational use of water has received lower priority among decision-makers historically (NRLS Commission 1999). This lack of appreciation has led to slower accumulation of data and quantification concerning recreational and other non-market based ecosystem services (NRLS Commission 1999). Thus, water management decisions are often influenced by market based goods and services such as drinking water and hydroelectricity (Colby 1989; Loomis 2000), and non-market benefits such as recreational access often get overlooked.

In the famous case of Mono Lake v. City of Los Angeles, water from a hypersaline lake in California was diverted to the City of Los Angeles for over 40 years until a 1983 California Supreme Court ruling ordered the re-balancing of water allocation to satisfy Public Trust values alongside the city's water rights (Loomis 1987). By the time reallocation was ordered, Mono Lake had dropped nearly 50 feet and doubled in salinity (Brewer and Libecap 2009) threatening critical nesting and migratory bird habitat provided by the unique ecology of the lake (Loomis 1987). Similarly, across the Southeast, the Tennessee Valley Authority historically allocated water for maximum hydroelectric power production on its reservoirs reducing late season access and subsequent recreational benefits (Cordell and Bergstrom 1993). More recent debates over water allocation in Oklahoma have illustrated the need for a more comprehensive accounting of the economic and human dimensions at Canton Lake — a rural lake in the northwest part of the state.

Stakeholder conflicts, exacerbated during excessive heat and prolonged drought, reached new levels in Oklahoma when severe drought gripped the Southwest from 2010-2013 and reduced Oklahoma's already limited water resources. To alleviate low water levels at Lake Hefner, a municipal water supply source for the large metropolitan area of Oklahoma City, nearly 10 billion gallons of water were diverted from Canton Lake in early 2013 (Anon 2013). Ensuing low Canton Lake water levels, and persistent drought conditions, led to poor lake conditions, extensive mud flats, and closed boat ramps (Allen 2015), all of which have been shown to be significant deterrents to lake visitation in Oklahoma (Daniels and Melstrom 2017; Melstrom et al. 2015).

As one of the few large water bodies in the region, Canton Lake has been a popular recreation destination in northwestern Oklahoma for campers, boaters, and anglers from both within and beyond the state. As Hutt et al. (2013) suggest in their study of two Mississippi recreation fisheries though, negative economic impacts arise when decreased angling effort, and in turn recreation visitation, leads to reduced trip-related spending near affected lakes. Expenditures by anglers are of particular importance because the majority have been found to be trip-related and local, whereas hunters or wildlife-viewers make more non-local equipment purchases near home before a trip (Munn et al. 2010). As Oklahoma's premier walleye – *Sander vitreus* – fishery (Stahl and Harper 2008), and host to the oldest fishing tournament in the state, the Canton Lake region could face significant economic impacts if lake conditions reduce fish populations and/or lake access. Emerging research on the human dimensions of natural resources has become an increasingly valuable resource in evaluating these impacts (Hunt, Sutton, and Arlinghaus 2013).

Human dimensions research also encompasses the study of psycho-social aspects of fisheries management such as understanding anglers' motivations, perceptions, expectations, and attitudes. For example, Shelby and Vaske (2007) noted that visitor perceptions of crowding and limited access can detract from overall satisfaction of recreation experiences. With this

information , managers can provide more overall points of access or, alternatively, restrict current site access to certain visitors in order to enhance visitor satisfaction (Fedler and Ditton 1994). Knowing how visitors perceive current and future management objectives can also provide decision makers an opportunity to manipulate objectives or, at the very least, open an avenue for a productive dialogue among stakeholders. Without detailed knowledge on both economic impacts and social importance of Canton Lake, local and state agencies such as the Oklahoma Department of Wildlife Conservation (ODWC) cannot make informed decisions regarding fair and justifiable allocation of water among competing uses.

This study will have a two-fold contribution to inform management at Canton Lake. First, economic impact and social analyses of Canton Lake will provide stakeholders with a more holistic picture of the costs and benefits associated with current water allocation policy. Additionally, information on the economic impact of Canton Lake will be compiled for the first time, contributing to the body of lake recreation economic impact literature. Second, evaluating the factors related to overall visitor satisfaction will provide lake managers valuable information regarding desirable management strategies to improve visitors' satisfaction.

Therefore, the following thesis provides an evaluation of the management and policy implications arising from social and economic analyses at Canton Lake. The thesis is organized as follows: chapter II examines the expressive and instrumental factors contributing to visitor satisfaction, chapter III assesses economic impacts of visitors given current and projected visitation estimates, and lastly chapter IV provides a summary of the overall findings.

CHAPTER II

EVALUATING THE ROLE OF INSTRUMENTAL AND EXPRESSIVE ATTRIBUTES IN DETERMINING VISITOR SATISFACTION AT A RURAL RESERVOIR IN OKLAHOMA

ABSTRACT

Natural resource managers rely on user feedback to provide satisfying recreation experiences through tailored regulations and management objectives. In the case of Canton Lake in northwest Oklahoma, recent water diversions to Oklahoma City – substantially lowering lake levels and disrupting area visitation in 2013 and 2014 – have caused concern among natural resource managers about where to focus limited resources to sustain recreation satisfaction in the face of future water allocation. The objective of this study was to examine whether and to what extent site-specific factors, within instrumental and expressive dimensions, contribute to visitor satisfaction. An ordinal logistic regression model, based on the random economic theory, was combined with data collected from a survey of visitors in 2018-19 recreation season. Results suggest that visitors were 'mostly satisfied' with their visit and some, but not all, expressive and instrumental attributes were good predictors of overall satisfaction at Canton Lake. Visitors who had higher levels of attachment to the lake, experienced better fishing, and were satisfied with facilities were more likely to be satisfied than other visitors. Conversely, visitors who experienced more problems were less likely to be satisfied with their visit. Trip characteristics were also predictive of satisfaction, although to a lesser extent. Therefore, managers may see the largest return on their limited resources by focusing on three key areas: 1) determining and improving manageable factors of the fishing experience; 2) increasing facility satisfaction through increased accessibility to all visitors; and 3) addressing perceived problems around the lake such as litter and alcohol use/abuse. With a baseline in place, further studies may help determine to what extent drought and water withdrawals affect visitor satisfaction.

Keywords: Canton Lake, satisfaction, ordinal logistic regression, survey, Oklahoma, human dimensions, drought, water conflict

1. INTRODUCTION

Canton Lake, which is one of the few major lakes in Western Oklahoma, has been a popular recreation destination for campers, boaters, anglers, and hunters from Oklahoma and beyond. However, the Lake faces a complex water issue due to frequent droughts, and is further complicated by the competing demand for municipal water in Oklahoma City, which holds the rights to water stored at Canton. As a result, water withdrawals for municipal use are likely to impact the recreation potential and visitor experience at Canton Lake.

Visitor satisfaction is an important aspect of managing natural resources on public lands such as Canton. Over the past fifty years, managers have realized that recreation management is as much about the human component as it is the biophysical properties of the resource (Hunt and Grado 2010; Hunt et al. 2013). By analyzing visitor experiences, managers position themselves to maintain or increase satisfaction and, subsequently, participation through tailored regulations and management objectives (Driver and Knopf 1977; Kuehn, Luzadis, and Brincka 2013; Tonge, Moore, and Taplin 2012). Behind this idea stands the Theory of Reasoned Action (Fishbein and Ajzen 1975) which posits that attitudes influence behavioral intentions which are direct predictors of behavior. In other words, a visitor's satisfaction with the recreation experience directly influences their recreational intentions which can predict future participation in that experience (Manfredo 2008).

Overall satisfaction has long been used as a proxy to evaluate the quality of recreation experiences (Manning 1999) with its maximization as resource managers' ultimate goal (Lime and Stankey 1971). While this is important for managers to gauge how they are performing in a broad sense, a single measure of satisfaction falls short of providing relevant information to resource managers on how and where to focus limited resources. This has led researchers to spend considerable effort on determining how to accurately measure and identify the individual components, or 'multiple satisfactions' (Hendee 1974), of an experience that contribute most significantly to overall satisfaction (Williams 1989).

Resource managers in Oklahoma such as the Oklahoma Department of Wildlife Conservation (ODWC) are especially interested in identifying the components of visitor satisfaction following extensive drought throughout Oklahoma and subsequent water withdrawals from Canton Lake during the first half of the 2010s. Impacts of the water withdrawals included lasting low water levels which reduced lake access, due to extensive mud flats and closed boat ramps (Allen 2015), and, in turn, reduced visitation. Besides providing more, or deeper, access points which would allow recreation in shallower waters, information regarding visitor satisfaction may provide managers insight on how to further mitigate the loss of visitors when water levels are below normal. Visitor perceptions also provide managers indirect feedback about whether current management objectives are focused on aspects of the experience deemed important to the visitors themselves (Manning 1999). Ultimately, visitor satisfaction inquiry allows for a reflexive system of adaptive management which may help reduce future impacts of drought and water withdrawals.

1.1 Recreation Satisfaction and Visitor Perceptions

Recreation satisfaction research can be credited with origins in marketing and consumer research wherein recreation visitors are considered customers of a product or service (LaPage 1968; Williams 1989). Two primary research frameworks, namely the expectancy-performance approach and the instrumental-expressive attribute approach, have been widely used in previous scholarly efforts. The expectation-performance approach postulates that satisfaction results when performance measures meet or exceed preconceived expectations about the product, otherwise disconfirmation and dissatisfaction occur (Bultena and Klessig 1969; Oliver 1980; Williams 1989). Using the expectation-performance approach, Parasuraman et al. (1985, 1988) simplified service quality into five key dimensions: tangibles, reliability, responsiveness, assurance, and empathy. Consequently, they determined these five dimensions could be reliably captured through a battery of 22 measurable attributes, and their "gap" scores, in a model named

SERVQUAL (Parasuraman et al. 1988). While this framework provides a strong theoretical foundation for satisfaction research, efficacy of the SERVQUAL model has come under criticism from those utilizing performance-only measures.

Several studies comparing expectation-performance and performance-only measures have found significant results in favor of a performance-only methodology (Burns, Graefe, and Absher 2003; Cronin and Taylor 1992). Babakus and Boller (1992), in an attempt to replicate SERVQUAL findings, found that expectations were uncorrelated to ratings of overall quality and, in addition to Carman (1990), suggested that an expectation-performance difference score elicited from a single question would perform better. Not only have single measures been found to perform adequately, but creating difference scores post-hoc requires the collection of double the data – sometimes after different time intervals, i.e. pre- and post-experience – potentially inflating both survey costs and the cognitive burden on respondents (Jain and Gupta 2004). Even as an independently measured variable, Noe & Uysal (1997) found no evidence that expectations could explain much variance in recreation users' overall satisfaction across three study sites. They did, however, provide empirical evidence for a two-dimensional recreation satisfaction model using performance-only measures of attributes (Noe and Uysal 1997).

Although the role of instrumental and expressive indicators has been routinely investigated in the past, Noe and Uysal (1997) brought an interesting line of research inquiry by incorporating both instrumental and expressive dimensions of the recreation experience within a single satisfaction framework. According to the authors, instrumental attributes refer to the aspects of an experience under direct control of management agencies such as facilities, personnel, safety, and visitor information. Expressive attributes, on the other hand, capture the emotional aspects of an experience such as motivation or perception of the crowding (Noe and Uysal 1997). Importantly, Noe and Uysal (1997) found that the role of both instrumental and expressive indicators in overall satisfaction are a site-specific phenomenon, which differ with the nature of the recreational venue.

Building on previous work by Noe and Uysal (1997), my study contributes to the existing literature from three unique ways. First, my study at Canton Lake in northwest Oklahoma provides a platform to empirically test the predictive ability of expressive and instrumental factors on overall visitor satisfaction in a new geographic context. Second, I have expanded the traditional niche of the expressive-instrumental model by incorporating the role, if any, of socio-demographic attributes.

With my research, I aim to answer the relevant research questions: a) Who visits Canton Lake?; b) Which instrumental and expressive attributes impact overall visitor satisfaction?; and c) What influence, if any, does a visitor's demographics and participation in activities have on their overall satisfaction? In addition to learning the general characteristics of their clientele, lake managers would benefit from an examination of such relationships.

2. METHODS

Canton Lake is a 7,910 surface acre, wind-swept, and relatively shallow reservoir located along the North Canadian River in Blaine and Dewey counties of northwestern Oklahoma as illustrated in Figure 2.1 (Stahl and Harper 2008). Canton Wildlife Management Area (WMA), managed by the Oklahoma Department of Wildlife Conservation (ODWC), encompasses another 14,877 acres adjacent to the lake creating over 22,500 continuous acres of recreational opportunities (ODWC 2017). The U.S. Army Corps of Engineers (USACE) operates the dam as well as "more than 240 campsites" across four campgrounds, most of which have electric and water hookups (USACE 2018). As one of only a few lakes of its size in northwest Oklahoma, it is a popular destination for recreationists interested in a wide variety of recreational activities which include camping, boating, swimming and fishing.

Information about the study population was unknown prior to data collection, so I developed a mixed mode survey design consisting of an on-site survey supplemented by a mail-in questionnaire from May 2018 to May 2019. This design helped reduce the disruption to visitor

trips, by simplifying on-site interviews, and provided the chance to ask more questions than is generally acceptable in person (Dillman 2000; Herrick and McDonald 1992; Vaske 2008). The on-site survey administration mimicked protocols followed in traditional access-point creel surveys (Malvestuto 1996; Pollock, Jones, and Brown 1994). Although questions asked on site were simplistic compared to a traditional creel survey, this technique allowed us to identify and personally contact study participants which past research indicated may positively affect response rates for the supplemental questionnaire (Dillman 2000; Ditton and Hunt 2001). Access points were stratified according to estimated visitation levels (high, medium, and low) while surveys were clustered in 5-6 hour blocks based on the time of day (AM or PM) and then stratified by day of week (weekend/holiday and weekday).

During access-point surveys, clerks attempted to contact all exiting vehicles and used a survey log to collect vehicle information such as party size, type of watercraft, and the action taken by the vehicle. Visitor address information was obtained on individual address cards, for confidentiality, before administering a ten-page questionnaire contained within a prepaid return envelope. The Tailored Design Method (2000) was used to develop and coordinate follow-up mailings which included a postcard and second survey questionnaire to increase response rates. The mail-in questionnaire had four overarching survey sections: a) Recreation Experience; b) Recreation Satisfaction & Fishing Quality; c) Management Issues & Challenges; and d) Demographics. Each section was organized following guidelines proposed by Vaske (2008) to increase comprehension and decrease the cognitive burden on respondents.

I tested for nonresponse bias through comparison of early and late respondents which has been found to be an acceptable and commonly used alternative to resampling (Armstrong and Overton 1977; Groves 2006; Lindner, Murphy, and Briers 2001; Wellman et al. 1980). Late respondents were defined as respondents who responded after the third, and final, contact attempt. This included those whose original survey was received more than 10 days after the final contact mailing date as well as all respondents who completed the replacement survey sent with the final

contact. Differences between early and late respondents across variables of interest, including demographics and perceptions, were then assessed using a series of chi-square and independent t-tests.

2.1 Theoretical Framework

This study uses consumer choice theory, and, in extension, random utility theory as its foundation (McFadden 1986). Choice theory, in our case, would assume that visitors, by choosing to recreate at Canton Lake, are maximizing their preferences in the face of other alternatives (McFadden 1986). Furthermore, individual utility, U, is attained from this choice – greater than the utility of the alternatives – and can be modeled utilizing random utility theory where U_{ni} represents the utility of alternative, i, for an individual, n (McFadden 1974). U_{ni} can further be modeled as a function of both a vector, X_{ni}, of respondent preferences and sociodemographic characteristics as well as a random component, ε_{ni} (Boxall and Adamowicz 2002). Using this framework, I was able to model visitor satisfaction using ordered logistic regression.

The objective of this study was to evaluate the factors which contribute most to the overall satisfaction of visitors at Canton Lake. Because satisfaction can be viewed as a categorical representation of an unobservable continuous random variable (Lu 1999), I used ordered logistic regression to examine these factors. Ordered logit models also provide an alternative method of multivariate comparison for ordinal data that would otherwise work well with multiple regression techniques (Winship and Mare 1984). The model can be mathematically represented by the following equation:

$$Y_i = \beta X_i + \epsilon_i \quad \textbf{(1)}$$

where Y_i is the unobserved continuous dependent variable – overall satisfaction, β is a parameter to be estimated, X_i is the vector of observed independent variables, and ϵ_i is random uncorrelated error (Winship and Mare 1984). The X_i vector consisted of multiple independent variables,

categorized as instrumental attributes, expressive attributes, trip characteristics, and demographics (Table 2.1).

2.2 Overall Satisfaction

Overall satisfaction was originally measured on a single seven point Likert- scale (1- Completely dissatisfied, 7- Completely satisfied), similar to Herrick and McDonald (1992). Likert scales are built to confer order rather than distance between categories (Winship and Mare 1984), so I used this to assume a new, three category structure of overall satisfaction post-hoc. The resulting scale assigned a value of 1 to visitors who chose original categories 1 through 5, "Completely dissatisfied" up to "Somewhat satisfied," whereas visitors who responded "Mostly satisfied" and "Completely satisfied" were simply recoded 2 & 3, respectively.

2.3 Expressive and Instrumental Attributes

The quality of fishing, one of the most pursued activities at Canton Lake due to the walleye (*Sander vitreus*) fishery, was measured on a 7-point Likert scale similar to Noe and Uysal (1-poor to 7-excellent; 1997). The composite variables (facility satisfaction, crowding, management problems, and sense of place) were constructed from the average score of individual components (Table 2.2), after assessing Cronbach's alpha and polychoric principle component analysis (PCA) for scale reliability (Gliem and Gliem 2003; Herrick and McDonald 1992). Average, rather than summation, scores were used to combine individual component scores so as to reduce loss of data due to "did not use" response or item non-response (Fletcher and Fletcher 2003). Additionally, facility satisfaction items were measured on a dichotomous scale, "not satisfied" and "satisfied," whereas the other three sets of individual components were measured on five-point Likert scales. Respondents having answered at least 50% of a component's individual questions were used to calculate composite variables.

2.4 Socio-Demographic Attributes

Trip characteristics and demographics were each represented by five unique variables. Demographic variables consisted of age, sex, education, income, and a binary variable to indicate one's membership in conservation/outdoors groups including Ducks Unlimited, National Rifle Association, and Canton Lake Association. Four trip characteristic variables were directly measured on the survey instrument (number of activities participated in, trip length, one-way distance traveled, and a binary for day vs. overnight users) whereas consumptive habit – whether or not a respondent harvests a resource – was derived from the types of activities in which respondents participated. Visitors were separated into three categories based on their participation in various activities with those who indicated fishing and/or hunting exclusively as their recreational activities at Canton Lake classified as 'consumptive' users. Visitors exclusively selecting from the remaining activities including camping and wildlife viewing were classified as 'non-consumptive' users, and 'mixed consumptive' users were defined as those who participated in both types of activities.

3. RESULTS

Seven hundred eighty-six questionnaires were distributed to lake visitors while 319 were returned for a 44% effective response rate after accounting for undeliverable addresses. Checks for unit nonresponse bias found that there were no significant differences between early and late respondents on all key variables. Item nonresponse, however, led to a significant reduction in regression sample size (n = 176) and required analysis to determine representativeness of the entire sample. It is worth noting that most item nonresponse (69%) was the result of visitors who either did not fish, and could not report fishing quality, or "did not use" enough facilities to calculate crowding or facility satisfaction scores. Regardless, a binary variable representing respondent inclusion in the regression analysis was used to group complete and incomplete respondents for comparisons.

Initial comparative tests, i.e. Student's t, Wilcoxon rank-sum, and proportion tests, comparing model variables between the two groups, defined above, identified three demographic variables and two trip characteristics that significantly differed: age ($t = 3.61$; $p < 0.001$), sex ($z = 2.27$; $p = 0.02$), membership in conservation groups ($z = -2.71$; $p < 0.01$), the number of activities participated in ($t = -4.51$; $p < 0.001$), and consumptive habit ($z = -5.53$; $p < 0.001$). The model sample may slightly over-represent both younger and male visitors as well as those who claim membership in a natural resource group (Table 2.3). However, after using linear regression on nearly the entire sample ($n = 294$) to measure the amount of variance in overall satisfaction explained by these variables, which was less than 2%, I was able to conclude that item nonresponse was a function of 'missing at random' and the model can be generalized to the visitor population (Little 1986; Little and Rubin 1989). The difference in consumption between the groups is the result of no 'non-consumptive' visitors being included in the ordinal regression model since they do not fish and cannot provide a rating on fishing quality.

Respondents ranged in age from 19 to 86 years old with an average age of 53. Sixty-two percent of respondents were male and 95% of respondents identified as Caucasian or white. In general, respondents were well educated with over 50% having an associate's/technical degree or higher and less than 30% having a high school degree or lower; the remaining 20% had some college education but no degree. Responses about previous year (2017 or 2018) estimated household income indicated that 16% of respondents made less than $35,000, 39% made between $35,000 and $75,000, and 45% made over $75,000. Less than half of respondents (40%) specified membership in any outdoor or conservation groups.

More than 70% of respondents reported that they had been visiting Canton Lake for 20 years or longer whereas 5% indicated that they were first time visitors. The majority of respondents (91%) were Oklahoma residents with 40% of those residing within the three-county, or 30-mile, region surrounding Canton Lake. Non-Oklahoma residents made up 9% of respondents, were mostly (80%) residents of either Kansas or Texas, and address data collected

from the entire on-site sample (n = 786) for follow-up mailings confirms that respondents were spatially representative of the overall sample. No demographics were significant predictors of overall satisfaction and were removed from the regression model after confirming a simpler model performed equally well through a Likelihood-ratio test ($\chi^2 = 0.15$; $p = 0.997$).

Visitors traveled anywhere from 1 to 500 miles to visit the lake, and 69% indicated that they typically stayed overnight whereas 31% only visited for the day. Trip length was removed from analyses because over 20% of respondents who responded "Yes" to staying overnight stated that their trips lasted less than 12 hours while 14% of day users reported trip lengths of 12 hours or more. While theoretically possible, it is highly unlikely, so I chose to assume that overnight responses were more accurate and, using their correlation to trip length ($r = 0.4625$, $p < 0.001$), could be interpreted similarly.

Nearly 70% of respondents participate in four or more activities at Canton Lake with camping and swimming, 73% and 68%, as the most common. The primary reasons respondents visited Canton Lake, however, were camping (39%) and fishing (36%) although respondents often selected multiple reasons. For example, 58% of respondents indicated camping as their primary activity but also listed one or more other primary reasons for being at the lake. On the other hand, when fishing was a primary reason for visiting only 36% of respondents provided a separate reason for being at the lake, most of which were there for camping. Data on consumptive habits reveal that 80% of respondents engage in both consumptive and non-consumptive activities whereas consumptive-only and non-consumptive only users make up 6% and 14%, respectively.

3.1 Ordinal Logistic Regression

Cronbach's alpha scores for the scales underlying the instrumental and expressive attributes, shown in Table 2.2, ranged from adequate to good (0.69 to 0.90) confirming the internal consistently. Additionally, polychoric principle components analysis (PCA) revealed that 60-73% of the variance in the scales was explained in the first component. Forward stepwise

ordinal regression, using program STATA, was used to evaluate the expressive and instrumental attributes contributing to overall satisfaction. Results using the original composite scales for facility satisfaction and distance traveled were difficult to interpret, so they were manipulated (i.e. multiplied or divided) for use in the regression model to provide results at meaningful scales. Facility satisfaction was transformed from a 1-point to a 6-point scale to represent a whole number of facilities with which a visitor was satisfied whereas distance traveled was reduced so that one unit would represent 25 miles. Table 2.4 provides β coefficients, presented as odds ratios, for the model variables.

The model provided evidence that the instrumental and expressive attributes, with the exception of crowding, were good predictors of overall satisfaction. Both expressive attributes, sense of place and fish quality, as well as facility satisfaction were positively related (OR = 2.65, 1.77 and 1.33) with visitor satisfaction. Alternatively, increased perception of problems reduced the odds (OR = 0.40) that an individual reported higher satisfaction.

The results also indicate that trip characteristics were significant predictors of overall visitor satisfaction. Sum of activities, distance, and consumption all had odds ratios below one (0.83, 0.87, and 0.07) indicating that visitors who participate in more activities, travel a farther distance (in 25-mile increments), or participate in consumptive-only activities are less likely than their respective counterparts to report higher satisfaction. In contrast to the other trip characteristics, overnight visitors, compared to their day use counterparts, were not likely to report significantly higher level of satisfaction (OR = 1.86; p = 0.103).

Since independent variables are measured on a different scale, it limited my ability to directly compare odds ratios between variables to gauge each variable's relative contribution to the model. Therefore, following (Fletcher and Fletcher 2003; Graefe and Burns 2013) I used multiple linear regression model to understand relative importance of each independent variable in overall visitor satisfaction. Table 2.4 presents the results of multiple linear regression, which includes model contribution – the proportion of variance explained in terms of 'R^2 change' – for

each variable. The results indicate that sense of place, fish quality, and problems contribute most to the model with each explaining 9-10% of model variance in contrast to all other variables, which explained between 2-3% each.

4. DISCUSSION

This study attempted to characterize the previously unknown visitor population at Canton Lake and explore the validity of a modified recreational satisfaction model in a new context. My results provide evidence that the satisfaction of Canton Lake visitors is largely driven by the "dual" dimensions first described by Noe and Uysal (1997). Unlike Noe and Uysal (1997), who limited their analysis to two broad variables, namely the expressive and instrumental dimensions, I assessed and found multiple significant predictors of satisfaction within each dimension.

The positive and significant role of fishing quality in visitor satisfaction is perhaps the easiest to explain as angler trip satisfaction is directly tied to their fishing success, whether that be size of catch (McCormick and Porter 2014) or number caught (Beardmore et al. 2015). This means visitor satisfaction could be viewed as an extension of angler trip satisfaction to some extent. It should be noted that while only 36% of visitors had a primary purpose of fishing during their visit, most respondents (78%) indicated that they were, indeed, anglers. The results of my study would then indicate that one's perception of fishing quality transcends the entire experience, even if they partook in other activities, and still influences their overall satisfaction.

My model indicates that one's sense of place is a significant predictor for visitor satisfaction, which is consistent with previous research on tourist satisfaction (Hwang, Lee, and Chen 2005; Prayag and Ryan 2012; Ramkissoon, Smith, and Weiler 2013). Interestingly, I found lack of support for perceived crowding as a predictor of satisfaction in my model although past research indicates that crowding, either perceived or actual, may negatively impact the recreation experience (Vaske and Shelby 2008). Like satisfaction though, perceived crowding is a complex concept found to be influenced by demographics (Fleishman, Feitelson, and Salomon 2004;

Rasoolimanesh et al. 2016; Zehrer and Raich 2016), expectations (Shelby et al. 1983; Tseng et al. 2009), and activity type (Vaske and Shelby 2008).

Regardless of activity type, most lake visitors are engaged in some form of active recreation in which they are contributing to the experience. Noe and Uysal's (1997) proposition that active recreation visitors, i.e. campers, fishers, and swimmers, place higher importance on expressive rather than instrumental attributes when evaluating their overall satisfaction might therefore explain facility satisfaction's lack of contribution to the final model. This lack of variance explained only 2% in the linear model and indicates that facilities are most likely a means to an end for the recreation users, and their real satisfaction is derived from the emotional stimulation they receive from pursuing recreation. Historical site and tourist visitors are proposed to differ in this respect as they rely more on the external variables, e.g. staff and facility cleanliness, to have an enjoyable experience (Uysal 2003). Alternatively, in a study on the five manageable components of a park, the facilities component contributed next to nothing to overall satisfaction as compared to the other components including park maintenance (Fletcher and Fletcher 2003). Corroborating their findings, it appears that problems – based on manageable maintenance and visitor impacts – contribute more to the model (9%) than the facilities component (2%). The results also indicate that a one unit increase in perceived problems at the lake significantly reduces the odds (0.40) that a visitor will report a higher level of satisfaction. Studies on the influence of perceived visitor impacts, e.g. erosion and trampled vegetation, on satisfaction have reported similar findings across both park (Chin et al. 2000) and trail (Lynn and Brown 2003) settings.

In addition to support for the dual dimensions of satisfaction, there is also support for trip characteristic variables as predictors of visitor satisfaction. Little, if any, research up to this point has evaluated the number of activities participated in or distance traveled within a recreation satisfaction model though. However, it could be argued that distance serves as a proxy for site familiarity, i.e. those living closer are more familiar with the lake, which Greiner et al. (2016)

found to increase anglers' odds of being satisfied with a fishing trip. The effect of consumption on satisfaction, on the other hand, has been better studied and my results agree with the recent 30-year meta-analysis by Vaske and Roemer (2013) which found that, in general, consumptive users report lower satisfaction than non-consumptive users. Nonetheless, consumptive-only users represent only six percent of respondents at Canton Lake and the literature indicates that little can be done to improve their satisfaction short of having a successful trip, i.e. harvesting quality wildlife, (Manning 1999; Vaske et al. 1982; Vaske, Fedler, and Graefe 1986).

5. CONCLUSION

Trip characteristics, expressive attributes, and instrumental attributes all appear to be important in determining visitor satisfaction at Canton Lake. As indicated by prior research though, these factors tend to be site specific (Noe and Uysal 1997) and are subject to the recreation opportunities available. In my case, the quality of the local fishery plays the largest role in contributing to a visitor's assessment of satisfaction which may, to some extent, indicate the popularity of Canton Lake as a fishing destination within and beyond Oklahoma. Moreover, satisfied anglers who feel a connection with the lake and do not encounter problems during their visit will have strong odds of being satisfied with their experience.

One caveat of this study is worth noting. Despite following the Tailored Design Method (Dillman 2000) and limiting the mail-in survey to ten pages, I suspect the cognitive burden was still high resulting in a response rate below 50% and that any supplementary survey sections or questions may have reduced response rates even further. While my analysis did not reveal systemic differences between early and late respondents, I cannot rule out the possible impact of non-response bias in my study results. Therefore, study results require a cautious interpretation.

5.1 Management Implications

Study results have important management implications. Based on this information managers may receive the most benefit from maintaining relatively high/normal water levels, if possible, and reducing the presence of litter around the lake. Additionally, fishing piers/jetties may require particular attention in the form of increased ease of access for both individuals with limited mobility as well as families with young children; respondents indicated these needs through the open-ended comment section. This may indirectly increase visitors' perceived fishing quality too, by facilitating familial experiences where young and old can participate equally. Crowding, however, may be a result of the lake's popularity with visitors and harder to manage. Moderate levels of crowding do not appear to directly impact one's satisfaction, although it may do so indirectly by leading to increased perceptions of problems such as litter and alcohol use. Rather than adding extra facilities to reduce crowding at this point, it may be more important to focus on increasing personnel resources to address the problems potentially exacerbated by crowding. Ultimately, resource managers can use the results of this study to tailor management and monitoring efforts to the specific needs of Canton Lake visitors.

Table 2.1. Summary of variables used in ordinal logistic regression model.

Variable	Description
Perceptions	
Overall Satisfaction	Measure of overall satisfaction collapsed into three categories for analysis (1 = Not Satisfied; 2 = Mostly Satisfied; 3 = Completely Satisfied)
Sense of Place	Overall Sense of Place measured on five-point Likert scale (1 = Strongly Disagree; 5 = Strongly Agree)
Problems	Overall Perception of Problems measured on five-point Likert type scale (1 = No Problem; 5 = Serious Problem)
Crowding	Overall Perception of Crowding measured on five-point Likert type scale (1 = Not Crowded; 5 = Very Crowded)
Facility Satisfaction	Binary measure of satisfaction with Canton Lake facilities (0 = Not Satisfied; 1 = Satisfied)
Fishing Quality	Integer value revealing the quality of fishing at Canton Lake (1 = Poor; 7 = Excellent)
Trip Characteristics	
Sum of Activities	Number of activities respondent participates in at Canton Lake
Trip Length	Time, in hours, typically spent recreating at Canton Lake
Distance	Total one-way distance, in miles, traveled to visit Canton Lake
Overnight	Binary measure of whether a visitor typically stays overnight (0 = No; 1 = Yes)
Consumption Level	Ordered categorical measure of consumption habits (1 = Non-consumptive; 2 = Mixed-consumptive; 3 = Consumptive)
Demographics	
Age	Respondent's age in years
Female	Binary measure of gender (0 = Male; 1 = Female)
Education	Ordered categorical variable measuring highest level of education attained
Employed	Dummy variable for respondent employment status (0 = Not Employed; 1 = Employed)
Income	Ordered categorical variable revealing level of prior year household income
Conservation Groups	Dummy variable for respondent membership in outdoors groups (0 = No; 1 = Yes)

[a] Original satisfaction Likert scale: 1 = Completely dissatisfied; 2 = Mostly dissatisfied; 3 = Somewhat dissatisfied; 4 = Neutral; 5 = Somewhat satisfied; 6 = Mostly satisfied; 7 = Completely satisfied. (1-5 recoded to 'Not Satisfied')
[b] Composite variable; sum of individual factor variables divided by number of variables in the given factor (see Table 2.2).

Table 2.2. Item-test correlations and Cronbach's alpha for four composite attitudes (adapted from Herrick and McDonald 1992).

Composite Attitudes	Mean	Standard Deviation	Item-test Correlation	Cronbach's alpha
Facility Satisfaction				**0.69**
Campgrounds	0.96	0.20	0.53	
Swimming Area	0.85	0.35	0.61	
Boat Ramps	0.86	0.35	0.71	
Fishing Piers or Jetties	0.83	0.38	0.61	
Picnic Areas	0.93	0.26	0.74	
Parking Lots	0.92	0.28	0.73	
Sense of Place				**0.90**
I feel happiest when I am at Canton Lake	3.93	0.86	0.85	
I really miss Canton Lake when I am away from it too long	3.60	0.97	0.81	
Canton Lake is the best place for doing things I enjoy most	3.65	0.99	0.86	
For the activities I do at Canton Lake, there are no better places	3.37	1.05	0.77	
I feel I can be myself when I am at Canton Lake	4.04	0.93	0.77	
Canton Lake reflects the type of person I am	3.78	0.94	0.85	
Crowding				**0.88**
Campgrounds	3.24	1.21	0.78	
Swimming Area	3.27	1.24	0.76	
Boat Ramps	3.26	1.14	0.83	
Fishing Piers	2.64	1.19	0.76	
Picnic Areas	2.54	1.16	0.82	
Parking Lots	3.09	1.28	0.84	
Problems				**0.87**
Erosion of Banks	1.80	1.09	0.67	
Objects in Water that Make Boating Difficult	1.87	1.16	0.71	
Water Pollution	1.80	1.01	0.79	
Trampled Vegetation or Bare Ground	1.81	1.04	0.72	
Noise from Watercraft	1.76	0.98	0.68	
Alcohol Use/Abuse	1.99	1.19	0.68	
Water Levels (Too Low)	2.35	1.52	0.54	
Water Levels (Too High)	1.57	0.96	0.58	
Crime	1.59	0.87	0.75	
Litter	2.28	1.35	0.73	

Table 2.3. Summary statistics of overall and model samples.

	SAMPLE				
Variables	**Overall**			**Model**	
	Mean	**SD**	***n***	**Mean**	***n***
Overall Satisfaction	**2.12**	0.76	309	**2.11**	176
Expressive Attributes					
Sense of Place	**3.73**	0.78	312	**3.76**	176
Crowding	**3.00**	1.01	272	**3.05**	176
Fish Quality	**4.52**	1.39	249	**4.61**	176
Instrumental Attributes					
Facility Satisfaction	**0.89**	0.21	287	**0.87**	176
Problems	**1.89**	0.77	287	**1.94**	176
Trip Characteristics					
Sum of Activities	**4.64**	2.09	314	**5.07**	176
Distance	**70**	74.02	307	**68**	176
Overnight	**0.69**	0.46	312	**0.71**	176
Consumption	**1.92**	0.43	318	**2.03**	176
Demographics					
Age	**52**	15.48	311	**50**	176
Female	**0.38**	0.49	312	**0.33**	176
Education	**3.64**	1.37	310	**3.70**	176
Income	**4.21**	1.50	285	**4.26**	176
Conservation Groups	**0.40**	0.49	319	**0.47**	176

Table 2.4. Results of final ordinal logistic and linear regression models (n = 176).

	Ordered Logit Model [a]		*Linear Model* [b]		
Predictor Variables	**Odds Ratio**	***p***	**Coef.**	***p***	***R^2 Change***
Expressive					
Sense of Place	2.65	<0.001	0.26	<0.001	0.09
Fish Quality	1.77	<0.001	0.15	<0.001	0.10
Instrumental					
Problems	0.40	<0.001	-0.25	<0.001	0.09
Facility Satisfaction	1.33	0.03	0.07	0.06	0.02
Trip Characteristics					
Sum of Activities	0.83	<0.05	-0.05	0.07	0.02
Distance	0.87	0.02	-0.04	0.04	0.03
Overnight	1.86	0.10	0.18	0.10	0.02
Consumption	0.07	0.04	-0.53	0.04	0.02

[a] LR Chi^2 = 97.16; p < 0.001; Pseudo R^2 = 0.259
[b] F = 14.94; p < 0.001; Adjusted R^2 = 0.389

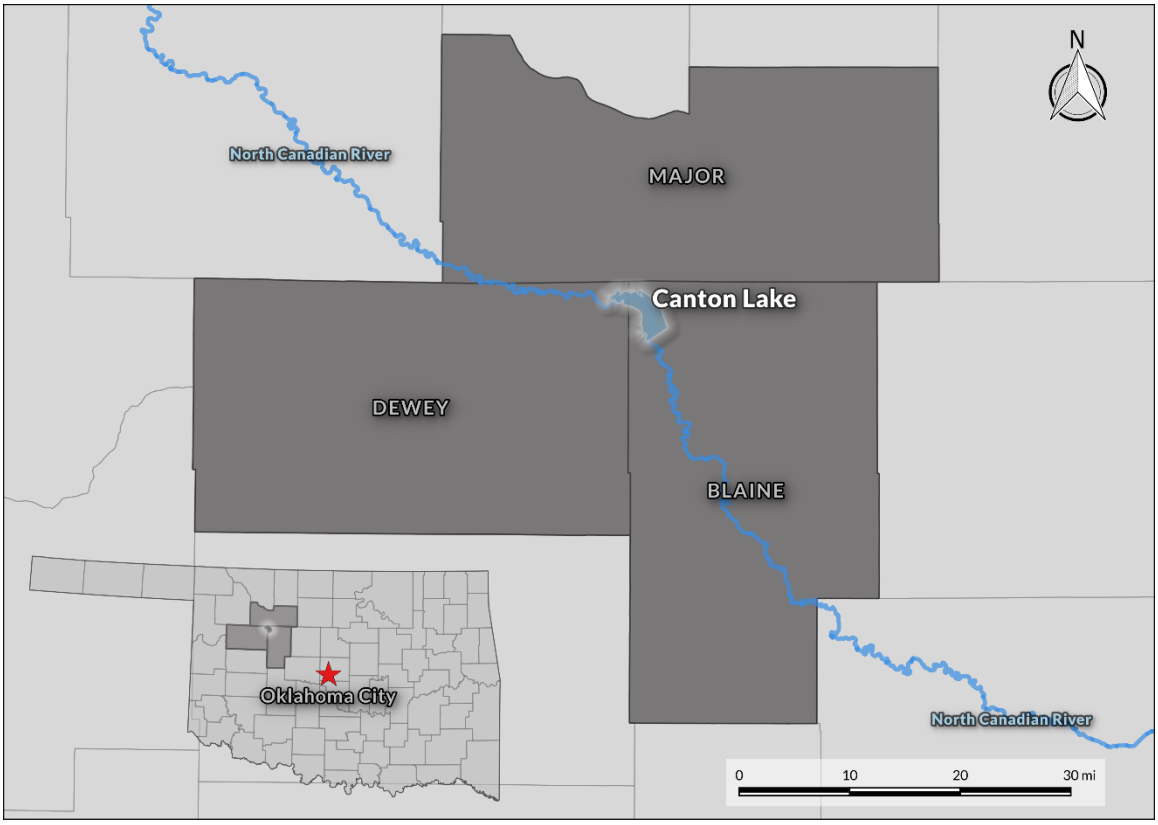

Figure 2.1. Map detailing the position of Canton Lake along the North Canadian River in northwest Oklahoma.

CHAPTER III

FUTURE WATER ALLOCATION AND THE REGIONAL ECONOMIC IMPACTS OF VISITORS AT CANTON LAKE, OKLAHOMA

ABSTRACT

Lake resources provide a wide variety of benefits ranging from economic goods (e.g., water supply and irrigation) to ecosystem services (e.g., recreation, wildlife habitat). Unfortunately, because of their non-market nature, benefits associated with ecosystem services are rarely incorporated in policy decisions regarding resource allocation and distribution. In Oklahoma, debates over water allocation for alternative uses followed water releases from Canton Lake during the 2010-2013 drought. While water rights at Canton Lake rest with Oklahoma City, the lake remains a popular recreation destination in the region suggesting significant economic value for its recreational use. By employing an input-output model for data collected from surveys of lake visitors from 2018-2019, this study characterizes the economic contribution and impacts of visitor spending on the three-county region surrounding Canton Lake. I estimated that both the resident and nonresident visitors took 115,770 trips during the year with spending of $4.19 million contributing to 50 jobs, $1.22 million in labor income, and $1.78 million in value added. Nonresidents, however, accounted for the majority of expenditures and were estimated to have total economic impacts of $2.23 million in support of 30 jobs in the region. I also evaluated the potential change in nonresident visitation, and subsequent economic impacts, should lake levels be reduced similar to 2013 levels in the future. The most conservative estimate suggests that the region could face a loss of at least $0.99 million in total impacts and 13 jobs. Lastly, this study illustrates the importance of lake recreation to a rural economy and how important this information is for making truly informed policy decisions.

Keywords: Canton Lake, economic impact, water policy, economic contribution, recreation, IMPLAN, natural resource economics, water conflict, Oklahoma

1. INTRODUCTION

Because of its near infinite uses to humans, water has become an intensely marketed commodity. While its provisioning ecosystem services are easily quantifiable, water provides several other rarely quantified non-marketable goods and services leading to inefficient allocation policies (Birol, Karousakis, and Koundouri 2006; Wilson and Carpenter 1999). In addition, changing water values over the past 50 years have stressed historic allocation policies as larger urban populations with more leisure-focused lifestyles have increased demand for the often competing objectives between municipal water supply— a market based good, and recreation— a non-market based service (Colby 1989; Miller 1985). Although conflicts over resource allocation may be inevitable, a more complete accounting of ecosystem services ensures that policy and management decisions are based on all stakeholder values (Loomis 2000). Recent debate over water allocation in Oklahoma, stemming from drought conditions across the Southwest from 2010-2013, illustrated this need for further resource accounting at Canton Lake – a rural lake in the northwest part of the state.

As one of the few large water bodies in western Oklahoma, Canton Lake has been a popular recreation destination for campers, boaters, and anglers from both within and beyond the state. However, to alleviate low water levels at Lake Hefner – a municipal water supply source for the large metropolitan area of Oklahoma City – nearly 10 billion gallons (30,000 ac-ft) of water were diverted from Canton Lake in early 2013 (Anon 2013). Subsequent low Canton Lake water levels contributed to poor lake conditions, extensive mud flats and the closure of boat ramps (Allen 2015), all of which have been shown to be significant deterrents to lake visitation in Oklahoma (Daniels and Melstrom 2017; Melstrom et al. 2015).

Canton Lake has long been considered a premier fishing destination in Oklahoma with healthy populations of walleye – *Sander vitreus*, white bass – *Morone chrysops,* hybrid striped bass – *Morone saxatilis,* catfish – *Siluriformes spp*, and crappie – *Pomoxis spp*. According to the latest five-year Fisheries Management Plan for Canton Reservoir, the walleye and hybrid striped

bass fisheries have been especially strong and are used for stocking other lakes throughout the state (Stahl and Harper 2008). To celebrate the success of the walleye fishery, the community of Canton has hosted the "largest and oldest" fishing tournament - the Walleye Rodeo - in May for the past 52 years (Walleye Rodeo 2017). The four-day event draws hundreds of anglers, from within and beyond the state of Oklahoma, who contribute significantly to the local economy (Walleye Rodeo 2017).

Decreased lake visitation, and in turn angling effort, reduce trip-related spending near affected lakes and can have significant negative economic impacts (Hutt et al. 2013). Expenditures by anglers are of particular importance because the majority have been found to be trip-related and local, whereas hunters or wildlife-viewers make more non-local equipment purchases near home before a trip (Munn et al. 2010). As Oklahoma's premier walleye fishery (Stahl and Harper 2008), and host to the oldest fishing tournament in the state, the Canton Lake region is likely to face significant economic impacts if lake conditions reduce fish populations and/or recreation access.

1.1 Literature Review

National and regional scale studies have illustrated the broad impacts recreation can have on such economies. The U.S. Army Corps of Engineers (USACE), the largest operator of federal water projects in the United States, estimated total yearly expenditures of visitors within 30 miles of its 405 projects to be $8.5 billion dollars resulting in nearly 97,000 jobs (USACE 2016). In the case of the entire Southeast U.S. region, Munn et al. (2010) found that the economy benefited from $33 billion of direct, $11 billion of indirect, and $9.6 billion of induced impacts from wildlife-related recreation. However, smaller areas, especially those rich with natural resources, may benefit from recreation visitors as thoroughly (Keith, Fawson, and Chang 1996). Previous economic impact analyses illustrate the potential net economic benefits that recreational activities and stocking programs can have on local and state economies. For instance, recreational spending

across five state parks in Georgia had total economic impacts to their local economies ranging from $0.72 to $33.14 million, in 1990 dollars, depending on lake size/amenities (Bergstrom et al. 1990). In Mississippi, angler expenditures at Sardis and Grenada Reservoirs had state economic impacts of US$5.83 and $2.15 million in support of 75 and 51 jobs, respectively (Hutt et al. 2013). Stocking and management efforts of a largemouth bass – *Micropterus salmoides* – fishery at Lake Fork, Texas resulted in estimated economic impacts of $32.0 million and $17.7 million for the region and state, respectively (Hunt and Ditton 1996). Two independent striped bass – *Morone saxatilis* – fisheries ranged from $1.2 million (Lothrop et al. 2014) to $44 million (Schorr et al. 1995) in estimated total local economic impacts resulting from non-local anglers. While these studies provide some insights on economic impacts coming from mid-scale recreational facilities, extrapolation of results from these studies to Canton Lake, as previous research suggests (Knetsch 1964; Loomis et al. 1995; Wall 1998), may drastically under or overestimate economic calculations. For one, economic regions differ spatio-temporally across the landscape based on their size and industry composition. Additionally, the quality and quantity of site alternatives can have a drastic effect on visitation patterns at otherwise similar lakes (Knetsch 1964; Loomis et al. 1995).

In Oklahoma, some efforts have been made to understand the economic value of lakes to local economies. Specifically, a recent state-wide survey by Melstrom et al. (2015) estimated Oklahoma anglers spend an average of $50 per fishing trip and 31 days fishing throughout the year. The authors suggested that even small lakes with low annual visitation could promote substantial angler expenditures and, in turn, have significant economic impacts (Melstrom et al. 2015). While the study does provide insights on the economic value of Oklahoma fisheries, it relied on the broader sample of Oklahoma resident fishing license holders and did not focus on a particular lake. Thus, little is known about the specific economic impacts of recreation at Canton Lake. Regional economic variability combined with refinements of IMPLAN software provide a basis for conducting an economic assessment of Canton Lake.

The overall goal of this study was to estimate the economic impact of recreational visitors on the three-county region surrounding Canton Lake. To this end, study objectives were fourfold: 1) determine trip expenditures and visitation estimates for resident and nonresident visitors; 2) quantify the economic contribution of recreation visitors to the region; 3) quantify the economic impact of nonresident visitors; and 4) evaluate the potential economic impacts of future water policy.

2. METHODS

2.1 Study Area

Canton Lake's large size and location in rural northwest Oklahoma makes it a popular destination for multiple recreation groups including campers, boaters, and beach-goers. Therefore, strong recreation visitation not only supports maintenance efforts by the U.S. Army Corps of Engineers (USACE), who operate the dam and the "more than 240 campsites" across four developed campgrounds (USACE 2018), but also local businesses especially dependent on the summer season. To best represent this regional economy for analysis, I determined that the three counties immediately surrounding the lake would constitute the local impact region. Although somewhat conservative to Bergstrom et al. (1990) who used *all* adjacent counties to the county in which the parks of interest were located, I wanted to account for Canton Lake's unique position at the intersection of three counties as highlighted in Figure 3.1. It should be noted that local visitors who live within the three-county region will be referred to as 'residents' whereas all other non-local visitors will be considered 'nonresidents.'

2.2 Mixed Mode Survey

Creel and mail-in type surveys have been frequently used to collect angler and recreational user information (Ditton and Hunt 2001). The on-site nature of a creel survey allows for the collection of accurate visitation numbers and fishing trip characteristics from a targeted

clientele (Ditton and Hunt 2001) whereas a mail-in survey better captures cognitively challenging human dimensions data such as perceptions and trip expenditures (Chen, Hunt, and Ditton 2003; Dillman 2000). A traditional creel survey, however, would have missed a significant portion of the target study population, yet retaining the opportunity for personal contact was important for its potential to increase response rates compared to mail-only surveys (Dillman 2000; Ditton and Hunt 2001). Therefore, survey clerks conducted two-minute standardized creel surveys supplemented with longer take home surveys.

On-site survey protocols began with an attempt to contact every exiting vehicle, and, whether or not it stopped, it was recorded by the clerk for visitation estimates post-hoc. If stopped, visitors were informed about the study following a structured script, told their rights and responsibilities as survey participants, and were then requested to participate in the brief on-site study. Visitor unit number, vehicle party size, and type of watercraft were recorded by the clerk in a survey log that included other important information such as survey date and general weather conditions. The creel survey concluded with a request for visitors to take part in the longer mail-in survey and provide his/her address information. Cooperative visitors were provided a uniquely identified survey packet and an address card to be collected and stored, along with survey logs, at Oklahoma State University (OSU). Following survey methods proposed by Dillman (2000), mail-in surveys distributed on site were enclosed within a prepaid, pre-addressed envelope. In addition, each survey contained a participant information sheet describing the voluntary, anonymous, and confidential nature of research participation which, along with all other survey materials, was approved through the OSU Institutional Review Board.

After on-site contact, address cards were entered into an electronic database to facilitate follow-up mailings, i.e. mail merge files, and track the receipt of completed surveys. Two follow-up mailings were conducted in an effort to increase the overall response rate: 1) a reminder postcard sent within two weeks of initial contact; and 2) a second survey packet, containing a prepaid, pre-addressed envelope, sent two weeks later if the original survey had not yet been

returned. Undeliverable addresses were monitored and accounted for in the final effective response rate.

2.3 Visitation Estimates

In some cases, economic impact analyses rely on previously gathered visitation and spending data without a survey component (Bergstrom et al. 1990; Douglas and Harpman 1995; Piper 1997). While this is an accepted practice and useful for limited-budget projects, visitation data is a critical component of accurate economic analyses and recent events at Canton Lake prompted efforts to gather firsthand visitation data during 2018 and 2019. New USACE data collection methods in 2014, 77 fewer campgrounds available from 2011-2015 due to tornado damage, and ongoing construction traffic all played a role in potentially skewed visitation estimates up until 2018 (USACE personnel, personal communication, November 21, 2018). Lacking prior knowledge on the study population, a multistage sampling scheme (cluster-stratification) was implemented in order to efficiently allocate limited survey resources (Vaske 2008).

The entire Canton Lake recreation area was first evaluated, through aerial imagery and in-person visits, to determine the number of unique access points to ensure maximum sampling coverage, and the resulting twenty-four survey sites were classified into three usage level strata based on ODWC-supported visitation estimates – high, medium and low distributed 60% - 30% - 10%, respectively. To further guide sampling effort and post-hoc visitation estimates, sites were again stratified, but with respect to temporal visitation estimates – weekday (40%) or weekend (60%) – resulting in six total strata, e.g., high use sites on weekends, low use sites on weekdays. Proportions of sampling effort for these strata were derived from the combination of both usage level and temporal stratifications (Vaske 2008).

Upon determining the proportional sampling effort, survey time blocks, i.e. clusters, were selected to capture the majority of daily visitor traffic while also ensuring safety of personnel.

Canton Lake does not close to the public on a nightly basis, beyond quiet hours in campgrounds and restricted access to the WMA during hunting seasons, so initial surveys were based on two eight-hour clusters starting at 0600 and 1400 hours. However, early concerns over technician safety and limited manpower, along with observations of limited visitor traffic during low visibility hours, led to an adjustment of cluster configurations. Weekday clusters were reduced by two hours, starting at 0800 hours and ending by 2000 hours, whereas weekend visitors were determined to be best captured by three, five-hour clusters starting at 0700 hours.

Given survey administration constraints, such as a lack of on-site housing leading to lengthy travel times, researchers surveyed 109 clusters from May 2018 to May 2019. The number of clusters selected for each strata was determined by the proportional sampling effort outlined above. In addition, due to the large number of access points at Canton Lake, clusters were further divided equally among the individual sites within each strata. Therefore, final survey clusters were chosen at random using a numbered list of the entire year's potential spatial-temporal clusters and randomly assigned one of the strata's access points.

This sampling scheme allowed for accurate aggregation of yearly visitation following similar methods of traditional creel surveys assessing angler effort (Pollock et al. 1994). Recreation trips per strata were estimated given the formula:

$$Recreation\ Trips\ Per\ Strata = \hat{e}_i = \sum_{i=1}^{n} v_i * d_i * b_i * s_i \quad \textbf{(1)}$$

where for each strata, i, v_i is the average number of vehicles exiting per time block, d_i is the number of days in the season, b_i is the number of time blocks per day, and s_i is the average number of recreation sites open to recreation across the entire season. Recreation trips per strata were then summed to provide an overall estimate, $\sum_i^n \hat{e}_i = \hat{E}_i$, of the yearly trips made to Canton Lake. However, before use in the input-output model, trips will need to be divided across the four visitor segments to obtain 'activity levels' as used in IMPLAN (IMPLAN 2018). Therefore, I assumed that overnight visitors make up 8% of total trips during a typical year based on visitation

data provided by USACE personnel (personal communication, November 9, 2018), and used response rates for the individual visitor segments to determine the split of resident and nonresident trips made within day and overnight groups.

2.4 Economic Impact Analysis

Economic impacts are estimated through input-output analysis, a legacy of Leontief and his work to determine the interacting effects of industries within an economy (Miller and Blair 1985). Total economic impact consists of both primary impacts, or the direct impacts of dollars spent at a business – and secondary impacts (Hutt et al. 2013). Secondary impacts include indirect impacts, the benefits those dollars have on that business' supporting industries which supply it with goods and services, and induced impacts, the subsequent expenditures made by employees of direct and indirect industries within the local economy (Miller and Blair 1985). Figure 3.2 is an illustration of how inputs flow through a region as it pertains to Canton Lake.

It is important to note that economic impact analysis typically involves only those expenditures brought into the region of interest from nonresidents since resident expenditures are thought to be a recycling of money within the economy (Loomis and Walsh 1997). Some authors have argued, however, that it may be appropriate to include local expenditures as a part of economic impacts, if a loss of local recreation opportunities leads residents to spend their recreation dollars outside the region (Hutt et al. 2013; Leeworthy et al. 2001). On the other hand, Kemper, Popp, and Miller (2008) report the sales, income and employment generated by all visitors as a measure of economic 'contribution' which provides an idea of the overall magnitude of economic activity generated by the resource. I opted to provide a measure of the contribution, as defined by Kemper et al. (2008), of all visitors to the region in addition to the economic impacts of nonresidents.

The input-output model used for this study, the Impact Analysis for Planning (IMPLAN) interface, was developed for use by the U.S. Forest Service in the 1970s to estimate the economic

impact of resource outputs at local levels (IMPLAN 2018). This resulted in a computer-based program consisting of an input-output database divided into 536 economic sectors (IMPLAN 2018) and county-level economic data important for small-scale regional analysis (Upneja et al. 2001). Since its inception, IMPLAN has been widely used by federal and state agencies to evaluate the effects of recreation visitation on local and regional economies (Bergstrom et al. 1990; Cordell and Bergstrom 1993; English et al. 1995). Of importance, since input-output models are based on the concept of multipliers, IMPLAN can account for the ripple effects coming from the dollars spent directly within a sector on the regional economy (Miller and Blair 1985). Multipliers summarize the overall economic impact to a region while also indicating the relative strength of indirect and induced impacts. Broken down, multipliers can be classified as Type I or Type II depending on the information sought. Type I multipliers are calculated from the sum of direct plus indirect impacts divided by direct impacts whereas Type II, also referred to as social accounting matrix (SAM), multipliers incorporate induced impacts as well in the equation resulting in total impacts divided by the direct impacts. A multiplier of one indicates no further impacts within the economy of the direct expenditure of a dollar. Thus, impacts for the respective secondary effects are positive to the extent a multiplier is above one (Munn et al. 2010) and tend to grow larger as the economy of scale increases.

Data for the input-output model was derived from the mail-in survey where respondents were asked to provide their average daily expenditures made specifically for Canton Lake recreation in categories such as lodging, food, and transportation. These categories were then split into specific expenditure categories reflective of the individual sectors used by IMPLAN. Daily expenditures, however, do not necessarily occur at the same frequency throughout or across trips, so respondents were also asked to estimate the number of days per year they made expenditures in each category. Subsequent yearly expenditures were divided by the respondent's average yearly trips to provide a more accurate representation of their per trip expenditures in each category (dollars/trip/category). Separate expenditure profiles were constructed for different

visitor segments based on residency status in the impact region and whether they stayed overnight. This was done because day and overnight visitors tend to have significantly different spending patterns, and residency provides the basis for the traditional concept of economic impacts; nonresident visitors bring "new" dollars to the region whereas resident visitors are redistributing dollars already within the region (Chen et al. 2003; Crompton, Lee, and Shuster 2001). IMPLAN's bridge table was used to identify appropriate model sectors for the survey expenditure categories, and the corresponding expenditures were added to the model for each visitor segment along with that segment's corresponding trip total. However, assuming 100% of nonresident visitor expenditures were made locally would likely overestimate the model. In the case of nonresident gasoline expenditures, where visitors may fill up their vehicle or watercraft near home as part of their trip, the local purchase percentage (LPP) was set to 50% meaning that the model only applies half of gas expenditures to final direct demand. Moreover, some expenditures such as those made for retail or gasoline do not accrue to the region in their entirety because a portion of each sale goes to cover the production and import costs final suppliers pay to companies located outside the regional economy. IMPLAN estimates sector-specific margins – reflecting the percentage of expenditures that remain in the region given production and import 'leakages' – based on the structure of the regional economy (IMPLAN 2018). After accounting for LPP and margins, IMPLAN was used to model the secondary effects of both resident and nonresident visitors on the regional Canton Lake economy represented by Blaine, Dewey, and Major counties.

IMPLAN was also used to model the ripple effects of Canton Lake visitor spending on the entirety of Oklahoma. As Seung (2014) points out, rarely are all economic impacts contained within one region due to industry linkages among regions yet these 'external' impacts can have broader policy implications than those resulting from a single-region analysis alone. In the case of Canton Lake, it is likely that some of the leakages mentioned above will be captured within the state of Oklahoma because Oklahoma has a more robust economy which can provide inputs to the

smaller, three-county study region. IMPLAN supports this through multiregional input-output (MRIO) analysis where interregional trade flows are utilized to track the secondary impacts in linked regions, i.e. state of Oklahoma, resulting from direct demand within the study region (IMPLAN 2018).

The input-output models were constructed utilizing the most recent IMPLAN software and 2016 county-level industry data. Put simply, input-output analysis explains outputs of sectors within an economy based on their interactions with all other sectors (Leontief 1936) resulting in an inter-industry transactions table from which a model of linear equations can be constructed (Miller and Blair 1985). The summation of linear equations can be represented within matrix notation as:

$$x = Zi + f \quad \textbf{(2)}$$

where $\boldsymbol{x}$ is the total output, $\boldsymbol{Zi}$ are intermediate inputs, and $\boldsymbol{f}$ is final demand (Miller and Blair 1985). IMPLAN allocates expenditures by appropriate sectors based on the inputs needed to provide the purchased goods (Bergstrom et al. 1990). Along with direct expenditures, the model estimates indirect and induced impacts of expenditures on the regional economy. The resulting Type I & II multipliers, derived from the equations below, are useful in comparing the results to other areas and determining how changes across different industries would influence the economy (Grado et al. 2011).

$$Type\ I = \left(\frac{Direct\ Effect + Indirect\ Effect}{Direct\ Effect}\right) \quad \textbf{(3)}$$

$$Type\ II\ (SAM) = \left(\frac{Direct\ Effect + Indirect\ Effect + Induced\ Effect}{Direct\ Effect}\right) \quad \textbf{(4)}$$

2.5 Estimates on Economic Loss Due to Water Drawdown

In addition to ascertaining economic impacts from visitation at normal lake levels, I wanted to evaluate the potential change in visitation, and subsequent economic impacts, should

lake levels be reduced similar to 2013 levels in the future. Respondents were provided a quick overview of the 2013 situation at Canton Lake before being asked to report how they would alter their behavior given a hypothetical prompt. Specifically, respondents were asked

"If the water levels at Canton Lake decreased by similar amounts due to future water releases, indicate how your trips to Canton Lake would change:"

Respondents were provided three options: 'My number of trips wouldn't change'; 'I would make fewer trips there'; and 'I would stop visiting Canton.' These responses were then split in a similar manner as visitor segments above to account for different proportions between day and overnight users, but were not reduced by residency because those proportions did not significantly differ. This information was used to conduct a sensitivity analysis of the economic impacts resulting from the corresponding loss of visitation (to the 2018/2019 visitation estimate) that would occur at various levels of reported trip changes. Rather than simply providing the overall economic impacts of visitors to Canton Lake, this provides a much more accurate idea of the potential economic impacts of 2013 water levels.

3. RESULTS

Survey clerks recruited 786 recreation visitors for the mail-in survey and, of those, 319 returned completed questionnaires. Fifty-four visitors were either repeat contacts or had undeliverable addresses, and could not be followed up with, resulting in an effective response rate of 44%. Among respondent visitors, 45% were residents, and 55% were nonresident Oklahomans whereas 9% of visitors were from out-of-state. Residents and nonresidents were similar across most sociodemographic characteristics with the average respondent being male (59% & 64%) middle-aged (55 and 52), Caucasian, and having a median household income of $50,000-75,000 (Table 3.1). Nonresidents had a median education level of an associate/technical degree whereas residents had a median education of some college.

I estimated that a total of 115,770 trips were made to Canton Lake from May 1, 2018 to April 30, 2019. Trip estimates per visitor segment are shown in Table 3.2 along with their respective expenditure profiles used in the input-output model. Resident day trips accounted for over half of all trips (61,020) and resulted in average trip expenditures of $23.62/trip. Nonresident day trips made up the majority (45,488) of remaining trips at an average trip expense of $32.04/trip. Overnight visitors, assumed to be 8% of total trips, were mostly nonresidents (82%) who also had the highest trip expenditures of any visitor segment at $196.24/trip — nearly double the trip expenditures of resident overnight visitors who spent an average of $109.56/trip. Despite taking fewer trips to Canton Lake, nonresidents made higher per trip expenditures as part of their recreation and accounted for 61% of all visitor spending.

Table 3.3 presents the results of the IMPLAN model, aggregated by 2-digit NAICS sectors in 2019 dollars, for resident and nonresident visitor spending on the three-county region of Dewey, Blaine, and Major Counties. Resident expenditures may not be considered as a loss to the region should demand change, but, together with nonresident expenditures, it does give an idea of the overall 'contribution' (Kemper et al. 2008) of visitors to the region. In all, Canton Lake visitor spending of $4.19 million – taking into account the local purchases percentage of gas expenditures –contributed to 50 full and part-time jobs, $1.22 million in labor income, and $1.78 million in value added. As a portion of the entire regional economy this amounts to 0.36% of jobs, 0.24% of labor income, and 0.21% of value added. Accommodation & food service and retail trade sectors saw the largest effect of visitor spending with job contributions of 4.67% and 1.66%, respectively. It should be noted that only $2.84 million in visitor spending stayed within the region, for a capture rate of 67.8%, due to 'leakages' from the purchase of products imported to the region.

Nonresidents spent a total of $2.56 million on recreation trips to Canton Lake resulting in total economic impacts of $2.23 million. Immediate leakages from margined purchases reduced the amount of direct spending effects within the region to $1.61 million – a capture rate of 62.9%

– which had secondary effects of $0.62 million (Table 3.4). Nonresident expenditures support 30 jobs and had a Type II (SAM) multiplier of 1.39. Type II multipliers represent the total economic impacts divided by direct impacts, which means that for every dollar spent by nonresident visitors to Canton Lake it generated $1.39 in economic activity throughout the economy. Furthermore, the multi-regional input-output model estimates that nonresident spending in the three-county region has continued secondary effects of $0.28 million in support of 1.7 jobs throughout the state of Oklahoma.

Visitors indicated that, in the event of future water levels similar to those which occurred in 2013, 89-90% would change the amount of trips they take to Canton Lake. Fifty percent of overnight visitors and 37% of day visitors reported that they would stop visiting Canton Lake entirely. The IMPLAN model reflecting the reduction of trips due to those who would stop visiting estimated that total economic impacts would equal $1.24 million in support of 16.8 jobs – a loss of $0.99 million total impacts and 13.2 jobs from the region (Table 3.4). Day visitors were most likely (53%) to report that they would make 'fewer trips' whereas 39% of overnight visitors indicated the same. The corresponding sensitivity analysis – ranging from 20-80% – revealed that trip reductions by those visitors who would make fewer trips, combined with those who would stop visiting, could result in an additional loss to the regional economy between $0.13 and $0.81 million in total economic impacts. If 'fewer trips' is assessed as half of normal trips for these visitors, total economic impacts amount to $0.74 million and support 9.9 jobs in the region.

4. DISCUSSION

This study attempted to obtain an accurate representation of economic activity generated by visitors to Canton Lake. These estimates illustrated the total effects of all visitor spending (contribution) as well as nonresident spending (impacts) on the region. Moreover, several models were created to provide a range of the potential impacts that may result from the threat of drought and water withdrawals.

Overall, visitor spending has a substantial effect on the regional economy. According to my IMPLAN model, the three-county region surrounding Canton Lake has total employment of 13,791 across all sectors meaning that 0.36% of jobs are supported by Canton Lake recreation. More important to the local economy are the nearly 2 and 5% of retail and accommodation & food service sector jobs, respectively, supported in the three-county region. Kemper et al. (2008), in a similar economic study of recreation visitors at the USACE-managed Beaver Lake in northwest Arkansas, reported that the 600 supported jobs only accounted for about 0.26% of all regional jobs. While no two economic regions will be the exact same, the study at Beaver Lake provides an idea of the importance of Canton Lake to the surrounding region, which is rural and sparsely populated. Rural, and less robust, economies may not depend on recreation visitation to function, but certain sectors – retail and accommodation & food services – will certainly benefit. Due to Canton Lake's proximity, it is also likely that a large portion of the impacts associated with these two sectors accumulate to the town of Canton in addition to several businesses around the lake. Interpreted this way, visitor spending becomes even more impactful for jobs and labor income for these sectors in the specific Canton area. As opposed to resident visitors who 'recycle' their money through the regional economy, nonresidents introduce their dollars to the region and create economic impacts.

Nonresidents made considerably more expenditures per trip than residents yet made only slightly fewer day trips and more overnight trips than resident visitors. This means that nonresidents make up over half of spending at the lake and have significant economic impacts on the region. The resulting output Type II, or social accounting matrix, multiplier was 1.39 which falls towards the low end of previous regional economic impact studies of lakes and state parks which have ranged from 1.28 (Chen et al. 2003) to 1.97 (Bergstrom et al. 1990). However, it is important to keep in mind that multipliers are influenced by the size and composition of the regional economy. Ultimately, nonresident visitors report strong ties to lake with the average visitor having visited the lake for nearly 25 years and being 'mostly satisfied' with their 2018/19

visits. Thus, nonresident visitation and subsequent economic impacts are not likely to fluctuate widely unless severe weather events produce a water situation such as occurred in the early 2010s.

I modeled the potential change in economic impacts of future water withdrawals to the regional economy using a conservative approach, similar to Hutt et al. (2013). Rather than model activity at varying reservoir water levels though, I assessed changes to visitation using a sensitivity analysis of respondent answers to a hypothetical question about how their trips would change should Canton Lake water levels be reduced to 2013 levels. This was deemed appropriate because, although hypothetical, the situation upon which it was based was real, having occurred only several years prior in 2013, and familiar to all but 10% of respondents – these respondents were removed from further analysis. Even the most conservative estimate of visitation change indicates a substantial loss of economic activity to the regional economy which will likely be felt most acutely by businesses and employees near Canton Lake. Although actual data for visitation during 2013/14 would have provided the most accurate estimates of reduced visitation, this conservative approach provides a general idea of the impacts upon which management and policy decisions can be made.

Study results have important policy implications. First, tourism and recreation-based economies, such as Canton, are generally susceptible to quality of amenity resources (English, Marcouiller, and Cordell 2000; Joshi, Poudyal, and Larson 2017; Lal, Alavalapati, and Mercer 2011). Although effects of the 2013 water drawdown did not stretch over a longer timeframe, its legacy may alter long-run visitor interest given the elastic nature of recreation demand (Daniels and Melstrom 2017). Second, the relatively small gap between value-added and job related SAM multiplier (1.20 vs 1.39) indicates that Canton Lake largely supports full time employment opportunities. As such, economic losses from water drawdowns are likely to have a severe impact on the overall health of the local economy. Conversely, losses to the regional economy can be reduced through the establishment of incrementally higher water level minimums than those that

occurred during 2013. As a shallow lake to begin with, the addition of a few feet of water to 2013 lake levels may provide significantly broader access to lake visitors and retain long-time visitors; future research in this area would be particularly useful to determine that minimum threshold. Third, results based on MRIO analysis suggest that economic impacts from the use of Canton Lake ripple beyond the region and make a statewide contribution in terms of economic outputs, value-added and employment opportunities. Finally, my estimates on economic impacts are conservative, as I did not report economic impacts coming from resident visitors, which add about an additional $1.72 million in economic output and 20 full-and-part time jobs.

5. CONCLUSION

This study combines economic models of input-output analysis of visitor expenditures to characterize the economic impact of recreational use at Canton Lake. Rather than simply providing an overview of the current economic activity generated by visitors, economic data was also paired with elicited visitor behavior to project the potential regional economic losses the region may experience in future events of drought or municipal withdrawals. Negative impacts of current water management in regards to drought were significant, ranging from $0.99 million to $1.80 million, and this did not include resident visitors who would spend their recreation money outside of the three-county region. Clearly, the regional Canton Lake economy stands to benefit from changes in water policy in times of drought through jobs and labor income. However, future research on its nonuse value to Oklahoma residents – especially those in Oklahoma City – will be important in establishing Canton Lake's complete value to society.

Table 3.1. Sociodemographic characteristics of resident and nonresident visitors to Canton Lake

Residency	Average Age	Gender (%Male)	Race (% Caucasian)	Median Household Income ($)	Median Education Level
Resident	55	59	96	50,000 - 75,000	Some College
Non-Resident	52	64	95	50,000 - 75,000	AS or Technical Degree

Table 3.2. Trip expenditure profiles constructed from survey responses of residents and nonresidents.

	Residents		Nonresidents	
Expenditure Categories	Day ($/trip)	Overnight ($/trip)	Day ($/trip)	Overnight ($/trip)
Lodging				
Hotel or Motel	0.00	0.00	0.00	1.11
Cabin or Bed & Breakfast	0.36	0.00	0.00	0.20
Public Campground Fees	0.17	14.36	1.31	31.65
Rental (Home, Cottage, Camper)	0.54	0.75	0.70	2.40
Food & Beverages				
Restaurants	6.07	7.05	2.32	19.43
Convenience Store	1.55	10.50	4.28	15.65
Grocery Store	3.91	28.85	4.93	25.90
Transportation				
Gas & Oil	6.77	10.28	6.10	49.92
Vehicle or Trailer Repair	0.08	0.04	0.09	0.43
Other Transportation (Motorcycle, ATV)	0.00	0.00	0.22	0.19
Boat & Watercraft				
Boat Rental	0.01	0.00	0.00	0.03
Boat Repair or Service	0.16	2.11	0.00	0.17
Parking or Launch Fees	0.70	0.57	0.15	0.51
Gas & Oil	1.09	16.81	0.75	9.85
Other Supplies, Entertainment				
Park Use Fees	0.52	2.26	2.12	5.54
Camping Supplies	0.31	4.45	1.15	12.40
Fishing Supplies	0.97	10.00	5.45	8.94
Hunting Supplies	0.03	0.31	0.27	0.41
Fishing or Hunting Licenses	0.29	0.47	2.03	3.31
Souvenirs & Gifts	0.01	0.49	0.03	1.37
Entertainment	0.06	0.25	0.03	6.69
Other	0.00	0.01	0.11	0.15
Total Expenditures Per Trip ($/trip)	23.62	109.56	32.04	196.24
Trips Per Year	61,020	1,672	45,488	7,589
Total Expenditures ($ million)	1.44	0.18	1.46	1.49

Table 3.3. Total economic contribution of resident *and* nonresident visitors to the Canton Lake region (in 2019 dollars).

2-Digit NAICS Sector	Final Direct Demand	Labor Income	Value Added	Jobs
11 Ag, Forestry, Fish & Hunting	187,299	122,272	95,351	1.1
21 Mining	43,904	43,501	140,744	2.0
22 Utilities	0	1,301	2,206	0.0
23 Construction	0	19,130	22,496	0.3
31-33 Manufacturing	523,834	12,522	92,982	0.1
42 Wholesale	172,333	63,116	142,541	1.1
44-45 Retail Trade	734,182	211,629	362,408	19.1
48-49 Transportation & Warehousing	12,341	60,554	40,387	0.8
51 Information	0	13,278	21,251	0.2
52 Finance & Insurance	0	18,985	28,320	0.5
53 Real Estate & Rental	65,877	15,475	98,005	1.5
54 Professional-scientific & Tech Svcs	0	13,549	16,916	0.4
55 Management of Companies	0	4,376	6,226	0.1
56 Administrative & Waste Services	54	13,249	17,231	0.6
61 Educational Services	0	1,152	1,160	0.0
62 Health & Social Services	0	20,927	23,657	0.6
71 Arts-Entertainment & Recreation	52,686	19,618	30,134	1.0
72 Accommodation & Food Services	1,001,471	525,091	576,059	19.6
81 Other Services	27,573	30,171	41,406	0.9
92 Government & non-NAICS	19,792	10,045	22,726	0.2
All Sectors	2,841,347	1,219,940	1,782,205	50.0
Total Visitor Spending	4,188,583	-	-	-
Capture Rate (%)	67.8	-	-	-

Table 3.4. Economic impacts of nonresident visitor spending on the Canton Lake region and an analysis of reduced trip demand by nonresident visitors if water levels became similar to those occurring in 2013 (in 2019 dollars).

			Sensitivity Analysis - 'I would make *fewer* trips there'		
Economic Impacts	All Nonresident Visitors	'Would stop visiting Canton'	20%	50%	80%
Jobs	30.0	16.8	14.0	10.9	5.8
Direct Effects	1,606,005	893,881	748,355	530,090	311,809
Secondary Effects					
Indirect	383,887	214,999	179,935	127,345	74,751
Induced	241,034	133,290	111,630	79,144	46,655
Total Impact	2,230,926	1,242,170	1,039,920	736,579	433,215
Potential Regional Loss					
Jobs	-	(13.2)	(16.0)	(19.1)	(24.2)
Total Impact	-	(988,756)	(1,119,006)	(1,494,347)	(1,797,711)

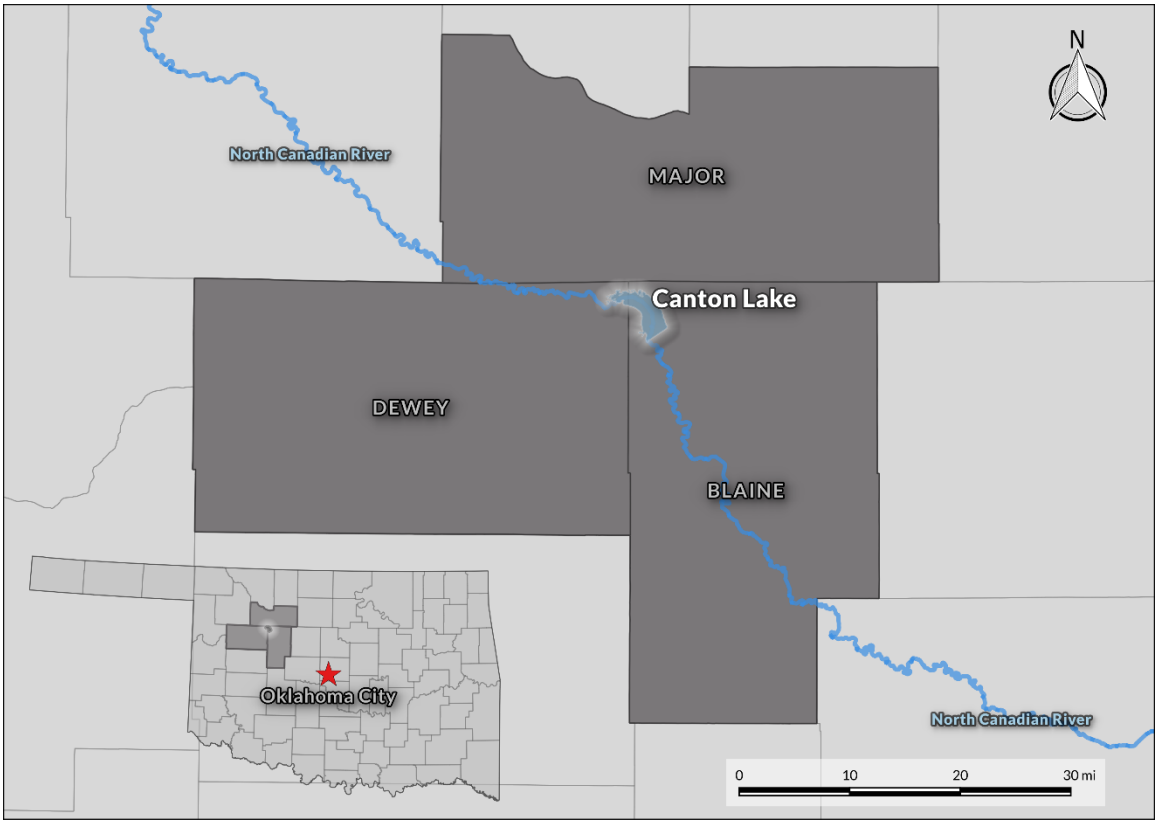

Figure 3.1. Map illustrating the three-county Canton Lake study region of Dewey, Major, and Blaine Counties in northwestern Oklahoma.

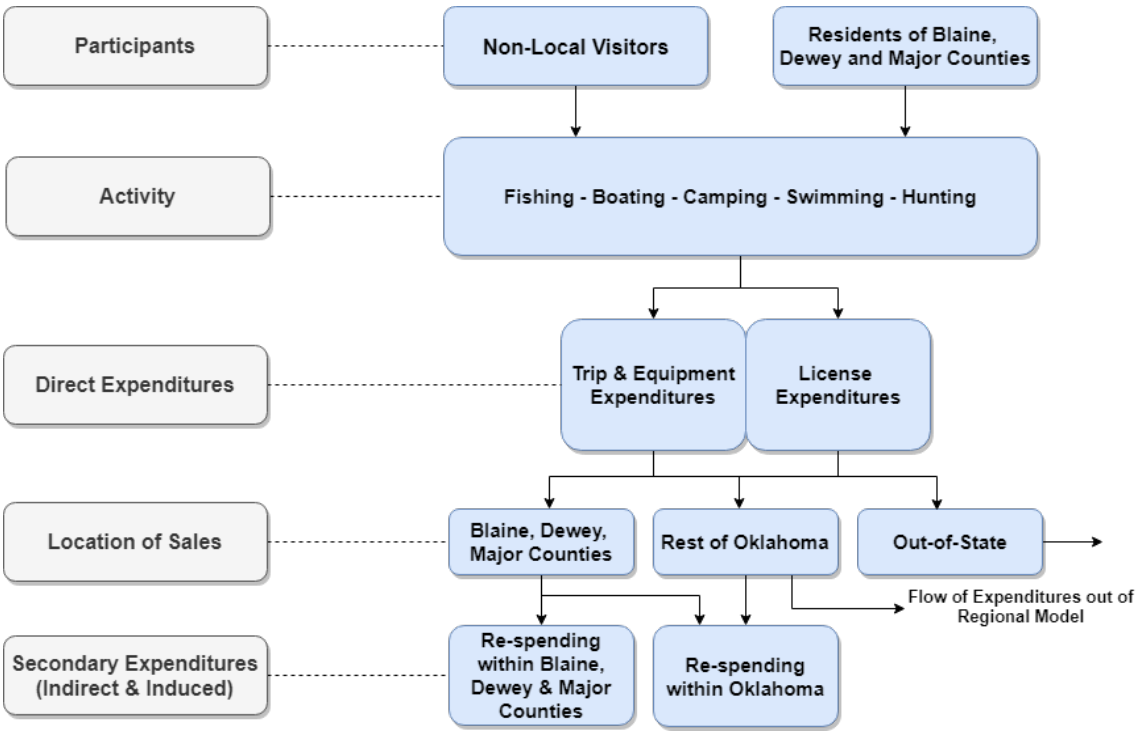

Figure 3.2. Graphical representation of the regional & state input-output models for Canton Lake (adapted from Pickton and Sikorowski 2004).

CHAPTER IV

CONCLUSION

The results presented herein illustrate the significance of Canton Lake to visitors as well as the entire region, and suggest that the persistence of current water policies would have negative social and economic effects. Future low water levels are likely to limit visitor access and contribute to poor fishing conditions which would decrease visitor satisfaction. Similarly, most visitors will alter the number of trips they take to Canton Lake leading to significant economic losses to the region. However, tailored management objectives and water policy may help reduce these effects.

Chapter II revealed that the satisfaction of Canton Lake visitors is largely a function of their fishing experience, sense of place, and perception of management problems. The importance of the fishing experience in determining one's satisfaction contributes to the idea that Canton Lake is a popular fishery within and beyond the state of Oklahoma. As such, ensuring that visitor anglers have continued access to the fishery in times of low water levels will have positive effects on visitor satisfaction and, in turn, visitation. Furthermore, managers can help offset negative effects of low water levels on satisfaction by focusing limited resources on monitoring litter as well as alcohol use. Although tailored management will help offset the effects of low water levels, changes in water policy will bring about broader benefits throughout the region and state.

Results from chapter III indicate that resident and nonresident visitors significantly contribute to the three-county regional economy surrounding Canton Lake, especially in the retail and food & accommodation sectors. The additional multiregional input-output analysis

demonstrates that economic impacts extend beyond the regional economy and provide economic benefits throughout Oklahoma. Consequently, the most conservative predictions of visitation changes due to low water levels estimate that economic losses would be significant. However, given that visitors are attached to Canton Lake, it may only take a slight increase in water level minimums during drawdowns to provide sufficient recreation opportunities.

Taken together, the results from chapter II and III provide an important first step towards accounting for all stakeholder values in future water management and policy decisions regarding Canton Lake. Managers now have a baseline to which they can measure their performance in meeting visitors' needs. Additionally, future research on the effect of drought and water withdrawals on visitor satisfaction could provide greater insight into reducing stakeholder conflicts. Lastly, future research on Canton Lake's nonuse value to all Oklahoma residents is an important next step in establishing the total value of Canton Lake to society.

REFERENCES

REFERENCES FOR CHAPTER I

Allen, Silas. 2015. “Northwest Oklahoma Reservoir Canton Lake Begins to Rebound.” *NewsOK*.

Anon. 2013. “Water from Canton Lake Flowing Toward Oklahoma City.” *News9*. Retrieved September 15, 2018 (http://www.news9.com/story/20813473/water-from-canton-lake-flowing-toward-oklahoma-city).

Brewer, Jedidiah and Gary D. Libecap. 2009. “Property Rights and the Public Trust Doctrine in Environmental Protection and Natural Resource Conservation.” *Australian Journal of Agricultural and Resource Economics* 53(1):1–17.

Colby, Bonnie G. 1989. “Estimating the Value of Water in Alternative Uses.” *Natural Resourses Journal* 29(2):511–27.

Cordell, H. Ken and John C. Bergstrom. 1993. “Comparison of Recreation Use Values Among Alternative Reservoir Water Level Management Scenarios.” *Water Resources Research* 29(2):247–58.

Daniels, Brannon and Richard T. Melstrom. 2017. “Examining Recreation Demand for Lakeshore Parks in Oklahoma: What Is Causing the Downward Trend in Attendance?” *Journal of Park & Recreation Administration* 35(2):25–36.

Fedler, Anthony J. and Robert B. Ditton. 1994. “Understanding Angler Motivations in Fisheries Management.” *Fisheries* 19(4):6–13.

Hunt, Len M., Stephen G. Sutton, and Robert Arlinghaus. 2013. "Illustrating the Critical Role of Human Dimensions Research for Understanding and Managing Recreational Fisheries within a Social-Ecological System Framework." *Fisheries Management and Ecology* 20:111–24.

Hutt, Clifford P., Kevin M. Hunt, Susan F. Steffen, Stephen C. Grado, and Leandro E. Miranda. 2013. "Economic Values and Regional Economic Impacts of Recreational Fisheries in Mississippi Reservoirs." *North American Journal of Fisheries Management* 33(1):44–55.

Loomis, John B. 1987. "Balancing Public Trust Resources of Mono Lake and Los Angeles' Water Right: An Economic Approach." *Water Resources Research* 23(8):1449–56.

Loomis, John B. 2000. "Environmental Valuation Techniques in Water Resource Decision Making." *Journal of Water Resources Planning and Management* 126(6):339–44.

Melstrom, Richard T., Deshamithra Jayasekera, Corey Jager, and Tracy A. Boyer. 2015. "The Economic Value of Sportfishing Trips to Oklahoma Lakes." *Oklahoma Cooperative Extension Service Fact Sheet AGEC-1054.* 8.

Munn, Ian A., Anwar Hussain, Stan Spurlock, and James E. Henderson. 2010. "Economic Impact of Fishing, Hunting, and Wildlife-Associated Recreation Expenditures on the Southeast U.S. Regional Economy: An Input-Output Analysis." *Human Dimensions of Wildlife* 15(6):433–49.

NRLS Commission. 1999. "Reservoirs of Opportunity: Report of the National Recreation Lakes Study Commission. Executive Summary." 13.

Shelby, Lori B. and Jerry J. Vaske. 2007. "Perceived Crowding among Hunters and Anglers: A Meta-Analysis." *Human Dimensions of Wildlife* 12(4):241–61.

Stahl, John and Ty Harper. 2008. *Canton Reservoir: 5-Year Fisheries Mangement Plan*. Northwest Region.

USACE. 1985. "Regulation No. 1165-2-400." 1–25.

REFERENCES FOR CHAPTER II

Allen, Silas. 2015. “Northwest Oklahoma Reservoir Canton Lake Begins to Rebound.” *NewsOK*.

Armstrong, J. Scott and Terry S. Overton. 1977. “Estimating Nonresponse Bias in Mail Surveys.” *Journal of Marketing Research* XIV(August):396–402.

Babakus, Emin and Gregory W. Boller. 1992. “An Empirical Assessment of the SERVQUAL Scale.” *Journal of Business Research* 24(3):253–68.

Beardmore, Ben, Len M. Hunt, Wolfgang Haider, Malte Dorow, and Robert Arlinghaus. 2015. “Effectively Managing Angler Satisfaction in Recreational Fisheries Requires Understanding the Fish Species and the Anglers.” *Canadian Journal of Fisheries and Aquatic Sciences* 72(4):500–513.

Boxall, Peter C. and Wiktor L. Adamowicz. 2002. “Understanding Heterogeneous Preferences in Random Utility Models: A Latent Class Approach.” *Environmental and Resource Economics* 23(4):421–46.

Bultena, Gordon L. and Lowell L. Klessig. 1969. “Satisfaction in Camping : A Conceptualization and Guide to Social Research.” *Journal of Leisure Research* 1(4):348–54.

Burns, Robert C., Alan R. Graefe, and James D. Absher. 2003. “Alternate Measurement Approaches to Recreational Customer Satisfaction: Satisfaction-Only Versus Gap Scores.” *Leisure Sciences* 25(4):363–80.

Carman, James M. 1990. “Consumer Perceptions of Service Quality: An Assessment of the SERVQUAL Dimension.” *Journal of Retailing* 66(1):33–55.

Chin, Cynthia L. M., Susan A. Moore, Tabatha J. Wallington, and Ross K. Dowling. 2000. “Ecotourism in Bako National Park, Borneo: Visitors’ Perspectives on Environmental Impacts and Their Management.” *Journal of Sustainable Tourism* 8(1):20–35.

Cronin, J. Joseph and Steven A. Taylor. 1992. “Measuring Service Quality: A Reexamination and Extension.” *Journal of Marketing* 56(3):55–68.

Dillman, Don A. 2000. *Internet and Mail Surveys: The Tailored Design Method*. New York: Wiley.

Ditton, Robert B. and Kevin M. Hunt. 2001. "Combining Creel Intercept and Mail Survey Methods to Understand the Human Dimensions of Local Freshwater Fisheries." *Fisheries Management and Ecology* 8(4–5):295–301.

Driver, B. L. and Richard C. Knopf. 1977. "Personality, Outdoor Recreation, and Expected Consequences." *Environment and Behavior* 9(2):169–93.

Fishbein, Martin and Icek Ajzen. 1975. *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research*. Reading, MA: Addison-Wesley.

Fleishman, Larisa, Eran Feitelson, and Ilan Salomon. 2004. "The Role of Cultural and Demographic Diversity in Crowding Perception: Evidence from Nature Reserves in Israel." *Tourism Analysis* 9(1–2):23–40.

Fletcher, Donna and Harold Fletcher. 2003. "Manageable Predictors of Park Visitor Satisfaction: Maintenance and Personnel." *Journal of Park and Recreation Administration* 21(1):21–37.

Gliem, Joseph A. and Rosemary R. Gliem. 2003. "Calculating, Interpreting, and Reporting Cronbach's Alpha Reliability Coefficient for Likert-Type Scales." Pp. 82–88 in *2003 Midwest Research to Practice Conference in Adult, Continuing, and Community Education*.

Graefe, Alan R. and Robert C. Burns. 2013. "Testing a Mediation Model of Customer Service and Satisfaction in Outdoor Recreation." *Journal of Outdoor Recreation and Tourism* 3–4:36–46.

Greiner, Michael J., David O. Lucchesi, Steven R. Chipps, and Larry M. Gigliotti. 2016. "Community Fisheries in Eastern South Dakota: Angler Demographics, Use, and Factors Influencing Satisfaction." *Human Dimensions of Wildlife* 21(3):254–63.

Groves, Robert M. 2006. "Nonresponse Rates and Nonresponse Bias in Household Surveys." *Public Opinion Quarterly* 70(5):646–75.

Hendee, John C. 1974. “A Multiple-Satisfaction Approach to Game Management.” *Wildlife Society Bulletin* 2(3):104–13.

Herrick, Theresa A. and Cary D. McDonald. 1992. “Factors Affecting Overall Satisfaction with a River Recreation Experience.” *Environmental Management* 16(2):243–47.

Hunt, Kevin M. and Stephen C. Grado. 2010. “Use of Social and Economic Information in Fisheries Assessments.” Pp. 425–447 in *Inland Fisheries Management in North America*. Bethesda, Maryland.

Hunt, Len M., Stephen G. Sutton, and Robert Arlinghaus. 2013. “Illustrating the Critical Role of Human Dimensions Research for Understanding and Managing Recreational Fisheries within a Social-Ecological System Framework.” *Fisheries Management and Ecology* 20:111–24.

Hwang, Shiuh Nan, Chuan Lee, and Huei Ju Chen. 2005. “The Relationship among Tourists’ Involvement, Place Attachment and Interpretation Satisfaction in Taiwan’s National Parks.” *Tourism Management* 26(2):143–56.

Jain, Sanjay K. and Garima Gupta. 2004. “Measuring Service Quality: SERVQUAL vs. SERVPERF Scales.” *Vikalpa* 29(2):25–37.

Kuehn, Diane, Valerie Luzadis, and Matthew Brincka. 2013. “An Analysis of the Factors Influencing Fishing Participation by Resident Anglers.” *Human Dimensions of Wildlife* 18(5):322–39.

LaPage, Wilbur F. 1968. *The Role of Customer Satisfaction in Managing Campgrounds*. PA.

Lime, David W. and George H. Stankey. 1971. “Carrying Capacity: Maintaining Outdoor Recreation Quality.” Pp. 174–84 in *The Forestry Recreation Symposium*. Northeast Forest Experiment Station: U.S. Forest Service, USDA.

Lindner, James R., Tim H. Murphy, and Gary E. Briers. 2001. “Handling Nonresponse in Social Science Research.” *Journal of Agricultural Education* 42(4):43–53.

Little, Roderick J. A. 1986. “Survey Nonresponse Adjustments for Estimates of Means.” *International Statistical Review* 54(2):139–57.

Little, Roderick J. A. and Donald B. Rubin. 1989. “Analysis of Social Science Data with Missing Values.” *Sociological Methods and Research* 18(2 & 3):292–326.

Lu, Max. 1999. “Determinants of Residential Satisfaction: Ordered Logit vs. Regression Models.” *Growth and Change* 30(2):264–87.

Lynn, Natasha A. and Robert D. Brown. 2003. “Effects of Recreational Use Impacts on Hiking Experiences in Natural Areas.” *Landscape and Urban Planning* 64(1–2):77–87.

Malvestuto, Stephen P. 1996. “Sampling the Recreational Creel.” in *Fisheries techniques*. Bethesda, Maryland: American Fisheries Society.

Manfredo, Michael J. 2008. *Who Cares About Wildlife? Social Science Concepts for Exploring Human-Wildlife Relationships and Conservation Issues*. New York, NY: Springer.

Manning, Robert E. 1999. *Studies in Outdoor Recreation*. 2nd ed. Corvallis, OR: Oregon State University Press.

McCormick, Joshua L. and Timothy K. Porter. 2014. “Effect of Fishing Success on Angler Satisfaction on a Central Oregon Rainbow Trout Fishery: Implications for Establishing Management Objectives.” *North American Journal of Fisheries Management* 34(5):938–44.

McFadden, Daniel. 1974. “The Measurement of Urban Travel Demand.” *Journal of Public Economics* 3(4):303–28.

McFadden, Daniel. 1986. “The Choice Theory Approach.” *Marketing Science* 5(4):275–97.

Noe, Francis P. and Muzaffer Uysal. 1997. “Evaluation of Outdoor Recreational Settings A Problem of Measuring User Satisfaction.” *Journal of Retailing and Consumer Services* 4(4):223–30.

ODWC. 2017. “Canton.” *Wildlife Management Areas*. Retrieved June 8, 2018 (https://www.wildlifedepartment.com/wildlife-management-areas/canton).

Oliver, Richard L. 1980. “A Cognitive Model of the Antecedents and Consequences of Satisfaction Decisions.” *Journal of Marketing Research* 17(4):460–69.

Parasuraman, A., Valarie A. Zeithaml, and Leonard L. Berry. 1985. “A Conceptual Model of Service Quality and Its Implications for Future Research.” *Journal of Marketing* 49(4):41–50.

Parasuraman, A., Valarie A. Zeithaml, and Leonard L. Berry. 1988. “SERVQUAL : A Multiple-Item Scale for Measuring Consumer Perceptions of Service Quality.” *Journal of Retailing* 64(1).

Pollock, Kenneth H., Cynthia M. Jones, and Tommy L. Brown. 1994. *Angler Survey Methods and Their Applications in Fisheries Management*. Special Pu. Bethesda, Maryland: American Fisheries Society.

Prayag, Girish and Chris Ryan. 2012. “Antecedents of Tourists’ Loyalty to Mauritius: The Role and Influence of Destination Image, Place Attachment, Personal Involvement, and Satisfaction.” *Journal of Travel Research* 51(3):342–56.

Ramkissoon, Haywantee, Liam David Graham Smith, and Betty Weiler. 2013. “Testing the Dimensionality of Place Attachment and Its Relationships with Place Satisfaction and Pro-Environmental Behaviours: A Structural Equation Modelling Approach.” *Tourism Management* 36:552–66.

Rasoolimanesh, S. Mostafa, Mastura Jaafar, Azizan Marzuki, and Diana Mohamad. 2016. “How Visitor and Environmental Characteristics Influence Perceived Crowding.” *Asia Pacific Journal of Tourism Research* 21(9):952–67.

Shelby, Bo, Thomas A. Heberlein, Jerry J. Vaske, and Geraldine Alfano. 1983. “Expectations, Preferences, and Feeling Crowded in Recreation Activities.” *Leisure Sciences* 6(1):1–14.

Stahl, John and Ty Harper. 2008. *Canton Reservoir: 5-Year Fisheries Mangement Plan*. Northwest Region.

Tonge, Joanna, Susan A. Moore, and Ross Taplin. 2012. “Annals of Leisure Research Visitor Satisfaction Analysis as a Tool for Park Managers: A Review and Case Study.”

Tseng, Yung-Ping, Gerard T. Kyle, C. Scott Shafer, Alan R. Graefe, Timothy A. Bradle, and Michael A. Schuett. 2009. “Exploring the Crowding–Satisfaction Relationship in Recreational Boating.” *Environmental Management* 43:496–507.

USACE. 2018. “Welcome to Canton Lake.” *Tulsa District*. Retrieved June 8, 2018 (https://www.swt.usace.army.mil/Locations/Tulsa-District-Lakes/Oklahoma/Canton-Lake/).

Uysal, Muzaffer. 2003. “Satisfaction Components in Outdoor Recreation and Tourism Settings.” *E-Review of Tourism Research* 1(3):35–38.

Vaske, Jerry J. 2008. *Survey Research and Analysis*. State College, PA: Venture Publishing.

Vaske, Jerry J., Maureen P. Donnelly, Thomas A. Heberlein, and Bo Shelby. 1982. “Differences in Reported Satisfaction Ratings by Consumptive and Nonconsumptive Recreationists.” *Journal of Leisure Research* 14(3):195–206.

Vaske, Jerry J., Anthony J. Fedler, and Alan R. Graefe. 1986. “Multiple Determinants of Satisfaction from a Specific Waterfowl Hunting Trip.” *Leisure Sciences* 8(2):149–66.

Vaske, Jerry J. and Jennifer M. Roemer. 2013. “Differences in Overall Satisfaction by Consumptive and Nonconsumptive Recreationists: A Comparative Analysis of Three Decades of Research.” *Human Dimensions of Wildlife* 18(3):159–80.

Vaske, Jerry J. and Lori B. Shelby. 2008. “Crowding as a Descriptive Indicator and an Evaluative Standard: Results from 30 Years of Research.” *Leisure Sciences* 30(2):111–26.

Wellman, J. Douglas, E. G. Hawk, Joseph W. Roggenbuck, and Gregory J. Buhyoff. 1980. “Mailed Questionnaire Surveys and the Reluctant Respondent: An Empirical Examination of Differences Between Early and Late Respondents.” *Journal of Leisure Research* 12(2):164–73.

Williams, Daniel. 1989. “Great Expectations and the Limits to Satisfaction: A Review of Recreation and Consumer Satisfaction Research.” Pp. 422–38 in *Outdoor recreation benchmark 1988: Proceedings of the National Outdoor Recreation Forum*. Asheville, NC.

Winship, Christopher and Robert D. Mare. 1984. “Regression Models with Ordinal Variables.” *American Sociological Review* 49(4):512–25.

Zehrer, Anita and Frieda Raich. 2016. “The Impact of Perceived Crowding on Customer Satisfaction.” *Journal of Hospitality and Tourism Management* 29:88–98.

REFERENCES FOR CHAPTER III

Allen, Silas. 2015. “Northwest Oklahoma Reservoir Canton Lake Begins to Rebound.” *NewsOK*.

Anon. 2013. “Water from Canton Lake Flowing Toward Oklahoma City.” *News9*. Retrieved September 15, 2018 (http://www.news9.com/story/20813473/water-from-canton-lake-flowing-toward-oklahoma-city).

Bergstrom, John C., H. Ken Cordell, Gregory A. Ashley, and Alan E. Watson. 1990. “Economic Impacts of Recreational Spending on Rural Areas: A Case Study.” *Economic Development Quarterly* 4(1):29–39.

Birol, Ekin, Katia Karousakis, and Phoebe Koundouri. 2006. “Using Economic Valuation Techniques to Inform Water Resources Management: A Survey and Critical Appraisal of Available Techniques and an Application.” *Science of the Total Environment* 365:105–22.

Chen, Rachel J., Kevin M. Hunt, and Robert B. Ditton. 2003. “Estimating the Economic Impacts of a Trophy Largemouth Bass Fishery: Issues and Applications.” *North American Journal of Fisheries Management* 23(3):835–44.

Colby, Bonnie G. 1989. “Estimating the Value of Water in Alternative Uses.” *Natural Resources Journal* 29(2):511–27.

Cordell, H. Ken and John C. Bergstrom. 1993. “Comparison of Recreation Use Values Among Alternative Reservoir Water Level Management Scenarios.” *Water Resources Research* 29(2):247–58.

Crompton, John L., Seokho Lee, and Thomas J. Shuster. 2001. “A Guide for Undertaking Economic Impact Studies: The Springfest Example.” *Journal of Travel Research* 40(1):79–87.

Daniels, Brannon and Richard T. Melstrom. 2017. “Examining Recreation Demand for Lakeshore Parks in Oklahoma: What Is Causing the Downward Trend in Attendance?” *Journal of Park & Recreation Administration* 35(2):25–36.

Dillman, Don A. 2000. *Internet and Mail Surveys: The Tailored Design Method*. New York: Wiley.

Ditton, Robert B. and Kevin M. Hunt. 2001. “Combining Creel Intercept and Mail Survey Methods to Understand the Human Dimensions of Local Freshwater Fisheries.” *Fisheries Management and Ecology* 8(4–5):295–301.

Douglas, Aaron J. and David A. Harpman. 1995. “Estimating Recreation Employment Effects with IMPLAN for the Glen Canyon Dam Region.” *Journal of Environmental Management* 44(3):233–47.

English, Donald B. K., David W. Marcouiller, and H. Ken Cordell. 2000. “Tourism Dependence in Rural America: Estimates and Effects.” *Society & Natural Resources* 13(3):185–202.

English, Donald BK, JM Bowker, John C. Bergstrom, and H. Ken Cordell. 1995. *Estimating the Economic Impacts of Recreation Response to Resource Management Alternatives (General Technical Report SE-91)*. Asheville, NC.

Grado, Stephen C., Kevin M. Hunt, Clifford P. Hutt, Xiana T. Santos, and Richard M. Kaminski. 2011. “Economic Impacts of Waterfowl Hunting in Mississippi Derived From a State-Based Mail Survey.” *Human Dimensions of Wildlife* 16(2):100–113.

Hunt, Kevin M. and Robert B. Ditton. 1996. *A Social and Economic Study of the Lake Fork Reservoir Recreational Fishery*. College Station, TX.

Hutt, Clifford P., Kevin M. Hunt, Susan F. Steffen, Stephen C. Grado, and Leandro E. Miranda. 2013. "Economic Values and Regional Economic Impacts of Recreational Fisheries in Mississippi Reservoirs." *North American Journal of Fisheries Management* 33(1):44–55.

IMPLAN. 2018. "IMPLAN." Retrieved September 20, 2018 (implan.com).

Joshi, Omkar, Neelam C. Poudyal, and Lincoln R. Larson. 2017. "The Influence of Sociopolitical, Natural, and Cultural Factors on International Tourism Growth: A Cross-Country Panel Analysis." *Environment, Development and Sustainability* 19(3):825–38.

Keith, John, Christopher Fawson, and Tsangyao Chang. 1996. "Recreation as an Economic Development Strategy: Some Evidence from Utah." *Journal of Leisure Research* 28(2):96–107.

Kemper, Nathan P., Jennie S. Popp, and Wayne P. Miller. 2008. "Regional Growth and Beaver Lake: A Study of Recreation Visitors." *Tourism Economics* 14(2): 409-26.

Knetsch, Jack L. 1964. "Economics of Including Recreation as a Purpose of Eastern Water Projects." *Journal of Farm Economics* 46(5):1148–57.

Lal, Pankaj, Janaki R. R. Alavalapati, and Evan D. Mercer. 2011. "Socio-Economic Impacts of Climate Change on Rural United States." *Mitig Adapt Strateg Glob Change* 16:819–44.

Leeworthy, Vernon R., Peter C. Wiley, Donald B. K. English, and Warren Kriesel. 2001. "Correcting Response Bias in Tourist Spending Surveys." *Annals of Tourism Research* 28(1):83–97.

Leontief, Wassily. 1936. "Quantitative Input and Output Relations in the Economic Systems of the United States." *The Review of Economics and Statistics* 18(3):105–25.

Loomis, John B. and Richard G. Walsh. 1997. *Recreation Economic Decisions: Comparing Benefits and Costs*. 2nd ed. Venture Pub.

Loomis, John B. 2000. “Environmental Valuation Techniques in Water Resource Decision Making.” *Journal of Water Resources Planning and Management* 126(6):339–44.

Loomis, John B., Brian Roach, Frank Ward, and Richard Ready. 1995. “Testing Transferability of Recreation Demand Models Across Regions: A Study of Corps of Engineer Reservoirs.” *Water Resources Research* 31(3):721–30.

Lothrop, Ryan L., Terry R. Hanson, Steven M. Sammons, Diane Hite, and Michael J. Maceina. 2014. “Economic Impact of a Recreational Striped Bass Fishery.” *North American Journal of Fisheries Management* 34(2):301–10.

Melstrom, Richard T., Deshamithra Jayasekera, Corey Jager, and Tracy A. Boyer. 2015. “The Economic Value of Sportfishing Trips to Oklahoma Lakes.” *Oklahoma Cooperative Extension Service Fact Sheet AGEC-1054.* 1–8.

Miller, Ronald E. and Peter D. Blair. 1985. *Input-Output Analysis: Foundations and Extensions*. Englewood Cliffs, NJ: Prentice Hall.

Miller, William H. 1985. “Water Resource Planning for Maximum Benefit.” *American Water Works Association* 77(9):44–47.

Munn, Ian A., Anwar Hussain, Stan Spurlock, and James E. Henderson. 2010. “Economic Impact of Fishing, Hunting, and Wildlife-Associated Recreation Expenditures on the Southeast U.S. Regional Economy: An Input-Output Analysis.” *Human Dimensions of Wildlife* 15(6):433–49.

Pickton, Todd and Linda Sikorowski. 2004. *The Economic Impacts of Hunting, Fishing, and Wildlife Watching in Colorado*. Denver, CO: BBC Research & Consulting. 21.

Piper, Steven. 1997. “Regional Impacts and Benefits of Water-Based Activities: An Application in the Black Hills Region of South Dakota and Wyoming.” *Impact Assessment* 15(4):335–59.

Pollock, Kenneth H., Cynthia M. Jones, and Tommy L. Brown. 1994. *Angler Survey Methods and Their Applications in Fisheries Management*. Special Pu. Bethesda, Maryland: American Fisheries Society.

Schorr, Mark S., Jaysingh Sah, Dean F. Schreiner, Micheal R. Meador, and Loren G. Hill. 1995. "Regional Economic Impact of the Lake Texoma (Oklahoma-Texas) Striped Bass Fishery." *Fisheries* 20(5):14–18.

Seung, Chang K. 2014. "Estimating Effects of Exogenous Output Changes: An Application of Multi-Regional Social Accounting Matrix (MRSAM) Method to Natural Resource Management." *Regional Science Policy & Practice* 6(2):177–93.

Stahl, John and Ty Harper. 2008. *Canton Reservoir: 5-Year Fisheries Mangement Plan*. Northwest Region.

Upneja, Arun, Elwood L. Shafer, WonSeok Seo, and Jihwan Yoon. 2001. "Economic Benefits of Sport Fishing and Angler Wildlife Watching in Pennsylvania." *Journal of Travel Research* 40(1):68–78.

USACE. 2016. "National Level Report." *Value to the Nation: Fast Facts*. Retrieved September 26, 2018 (http://www.corpsresults.us/recreation/fastfacts/nationalreport.cfm).

USACE. 2018. "Welcome to Canton Lake." *Tulsa District*. Retrieved June 8, 2018 (https://www.swt.usace.army.mil/Locations/Tulsa-District-Lakes/Oklahoma/Canton-Lake/).

Vaske, Jerry J. 2008. *Survey Research and Analysis*. State College, PA: Venture Publishing.

Wall, Geoffrey. 1998. "Implications of Global Climate Change for Tourism and Recreation in Wetland Areas." *Climatic Change* 40:371–89.

Walleye Rodeo. 2017. "Welcome!" *Canton Lake Walleye Rodeo*. Retrieved June 8, 2018 (http://www.walleyerodeo.com).

Wilson, Matthew A. and Stephen R. Carpenter. 1999. "Economic Valuation of Freshwater Ecosystem Services in the United States: 1971-1997." *Ecological Applications* 9:772–83.

APPENDICES

APPENDIX A: IRB Approval Sheet

Oklahoma State University Institutional Review Board

Date:	05/01/2018
Application Number:	AG-18-25
Proposal Title:	Economic Value and Regional Impacts of Canton Lake Fishery: Current Impacts and Future Implications of Alternative Water Uses
Principal Investigator:	Adam Frakes
Co-Investigator(s):	
Faculty Adviser:	Omkar Joshi
Project Coordinator:	
Research Assistant(s):	
Processed as:	Exempt

Status Recommended by Reviewer(s): Approved

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

The final versions of any recruitment, consent and assent documents bearing the IRB approval stamp are available for download from IRBManager. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be approved by the IRB. Protocol modifications requiring approval may include changes to the title, PI, adviser, other research personnel, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms.
2. Submit a request for continuation if the study extends beyond the approval period. This continuation must receive IRB review and approval before the research can continue.
3. Report any unanticipated and/or adverse events to the IRB Office promptly.
4. Notify the IRB office when your research project is complete or when you are no longer affiliated with Oklahoma State University.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact the IRB Office at 223 Scott Hall (phone: 405-744-3377, irb@okstate.edu).

Sincerely,

Hugh Crethar, Chair Institutional Review Board

APPENDIX B: Participant Information Sheet

DEPARTMENT OF
Natural Resource
Ecology & Management

Canton Lake Visitor Survey

Participant Information

Title: Canton Lake Visitor Survey

Investigator (s): Adam Frakes, Omkar Joshi, Oklahoma State University

Purpose: The purpose of this study is to understand the extent and type of recreational use of Canton Lake Reservoir, and estimate the total economic impact generated by the visitors' expenditures. Your responses will provide valuable information for the government agencies and other stakeholders to maximize Canton Lake's benefit in the region. You must be 18 years or older to participate.

What to expect: As you exit the reservoir, you will be asked about your arrival time, group size, and type of watercraft. If you agree to participate in a longer survey, the survey clerk will give you a survey. You will be requested to complete the survey at your convenient time, and return it in the self-addressed, stamped envelope. Please note that there is no 'right' or 'wrong' answer, and you may skip any questions you do not wish to answer. It should take you about 15-20 minutes to complete.

Risks: There are no anticipated risks or discomforts in participating in this research beyond those experienced in everyday life.

Benefits: There are no direct benefits to you. However, this survey will allow visitors to provide their perceptions of current conditions of the reservoir and associated recreation resources.

Compensation: There is no financial compensation.

Your Rights and Confidentiality: Your participation in this research is voluntary. There is no penalty for refusal to participate, and you are free to withdraw your consent and participation in this project at any time.

Confidentiality: Your identity will not be associated with your responses, and your responses are strictly confidential. Any written results will discuss group findings. The data will be stored at Oklahoma State University in a locked file cabinet and in password protected files. Data will be destroyed three years after the study has been completed.

Contacts: You may contact the researchers at the following addresses or phone number, should you want to discuss your participation in the study and/or request information about the results of the study: Adam Frakes, Graduate Research Assistant, 008C Ag Hall, Dept. of Natural Resource Ecology and Management, Oklahoma State University, Stillwater, OK 74078, +1-405-744-5614 or afrakes@okstate.edu. If you have questions about your rights as a research volunteer, you may contact the IRB Office at 223 Scott Hall, Stillwater, OK 74078, +1-405-744-3377 or irb@okstate.edu

If you choose to participate: Returning your completed survey to the data collector indicates your willingness to participate in this research study.

1

APPENDIX C: Canton Lake Visitor Survey 2018-2019

Canton Lake Visitor Survey 2018 - 2019

Oklahoma State University

Department of Natural Resource Ecology & Management

DEPARTMENT OF
Natural Resource
Ecology & Management

OKLAHOMA
DEPARTMENT OF WILDLIFE CONSERVATION

The information you provide will not be associated with your name, and will only be presented, if at all, in aggregate with the rest of the survey respondents.

Canton Lake Visitor Survey

This survey is being conducted by Oklahoma State University with funding support from Oklahoma Department of Wildlife Conservation (ODWC) to obtain information about your recreational activities including fishing at Canton Lake. Please complete as many questions as possible even if you use Canton Lake for other recreational activities such as boating, wildlife viewing, hunting, bird watching, swimming, camping, etc.

SECTION A: RECREATION EXPERIENCE AT CANTON LAKE

1. **In which of the following recreational activities do you or members of your household participate at Canton Lake?** *(Check **ALL** that apply)*

☐ Boat Fishing	☐ Swimming	☐ Picnic / Family Gathering
☐ Shore Fishing	☐ Camping	☐ Canoeing / Kayaking
☐ Hunting	☐ Hiking / Walking	☐ Other (specify):
☐ Pleasure Boating	☐ Wildlife Viewing	_____

1.1 On the day you were contacted for this survey, what was your primary recreational activity at Canton Lake? *(please write below)*

_____

2. **How many years have you been visiting Canton Lake for recreation?** _____Years

3. **Typically, about how far do you travel from your residence to visit Canton Lake?**

One-way Distance of _____ Miles **AND/OR** One-way Commute Time: _____ Hours _____Minutes

3.1 In a typical trip, about how many hours do you spend at Canton? _____Hours

4. **In an average year, about how many trips do you take to Canton Lake for recreation?**

Month	Trips	Month	Trips	Month	Trips
January		May		September	
February		June		October	
March		July		November	
April		August		December	

5. **Do you typically stay <u>overnight</u> while recreating at Canton Lake?**

☐ Yes ☐ No *(Skip to **Q7**)*

5.1 Where do you typically stay?

☐ Campground (Camper, Tent) ☐ Hotels or Motels
☐ Friend or Relative's Property ☐ Rental (Cabin, Bed & Breakfast)
☐ Other (specify): _____

6. **On your last <u>overnight</u> trip to Canton Lake, how many total nights were you away from home?**

   _____ # Nights

7. **Do you have another public recreation area similar to Canton Lake within a similar distance from your home?**

   ☐ Yes → **Please indicate which recreation area or lake:** _____

   ☐ No

8. **In your typical trip to Canton, how many people (including yourself) travel with you in the same vehicle?**

   _____ Persons

9. **On your typical trip, do you:**

   ☐ Pay only your personal expenses?

   ☐ Share expenses with others in your party?

   ☐ Pay for yourself and others? → How many (including yourself)? _____ **Total # Paid For**

10. During a typical trip to Canton Lake for recreation, how much do you spend on average per day? And, about how many days of the year do you make expenditures in each of the below categories as part of your Canton Lake recreation?

	Dollars Per Day	Number of Days
Lodging:		
Hotel or Motel	$	
Bed & Breakfast or Cabin	$	
Public or Private Campground for RV, Tent, Camper	$	
Rental (Home, Cottage, Camper)	$	
Food & Beverages:		
Meals at Restaurants (including tips)	$	
Convenience/Special Food Stores	$	
Grocery Store or Supermarket	$	
Transportation to and from Canton Lake:		
Gasoline & Oil	$	
Repair/Service for Automobile, Truck, SUV, Trailer	$	
Other Transportation (Bicycle, Motorcycle, ATV)	$	
Other Transportation Costs (Specify):	$	
Boat (Motorized & Non-motorized Watercraft):		
Boat Rental Fees	$	
Boat Repairs & Service	$	
Entry, Parking, or Launch Fees	$	
Gasoline & Oil	$	
Other Expenses:		
Park Use Fees	$	
Camping Supplies	$	
Fishing Supplies	$	
Hunting Supplies	$	
Guide/Outfitter or Tour Fees	$	
Fishing/Hunting Fees or Licenses	$	
Other Equipment Rentals	$	
Souvenirs & Gifts	$	
Entertainment	$	
Other (please specify): _____	$	

B. RECREATION SATISFACTION & FISHING QUALITY

1. **Overall, how satisfied or dissatisfied were you with your most recent visit to Canton Lake?**
   (Check ONE response)

☐ Completely dissatisfied ☐ Mostly dissatisfied ☐ Somewhat dissatisfied ☐ Neither satisfied or dissatisfied ☐ Somewhat satisfied ☐ Mostly satisfied ☐ Completely satisfied

2. **How satisfied are you with the quality of the following facilities at Canton Lake?**
   *(Check **ONE** response for each item)*

	Don't Use	Not Satisfied	Satisfied
Campgrounds	☐	☐	☐
Swimming Area	☐	☐	☐
Boat Ramps	☐	☐	☐
Fishing Piers / Jetties	☐	☐	☐
Picnic Areas	☐	☐	☐
Parking Lots	☐	☐	☐

3. **Rate your level of agreement or disagreement with each of the following statements.**
   *(Check **ONE** response for each item)*

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
I feel happiest when I am at Canton Lake.	☐	☐	☐	☐	☐
I really miss Canton Lake when I am away from it for too long.	☐	☐	☐	☐	☐
Canton Lake is the best place for doing things I enjoy most.	☐	☐	☐	☐	☐
For the activities I do at Canton Lake, there are no better places.	☐	☐	☐	☐	☐
I feel I can be myself when I am at Canton Lake	☐	☐	☐	☐	☐
Canton Lake reflects the type of person I am.	☐	☐	☐	☐	☐

If you do not fish at Canton Lake, please skip to Section C on page 6

SECTION B (Cont.)

4. **In which season do you mostly fish at Canton Lake?** *(Check **ALL** that apply)*

☐ Summer ☐ Fall ☐ Winter ☐ Spring

5. **What time of the week do you mostly fish at Canton Lake?** *(Check **ALL** that apply)*

☐ Weekends (Friday evening – Sunday night) ☐ Weekdays (Monday morning – Friday afternoon)

6. **What time of day do you mostly fish at Canton Lake?** (*Check **ALL** that apply)*

☐ Early Morning (4am – 8am) ☐ Morning (8am – 12pm) ☐ Afternoon (12pm – 5pm) ☐ Evening (5pm – 10pm) ☐ Night (10pm – 4 am)

7. **While fishing at Canton, which are your target species?** *(Check **ALL** that apply)*

☐ Walleye ☐ Catfish
☐ Crappie ☐ Large Mouth Bass
☐ Hybrid Striped Bass ☐ No Preference
☐ Other (specify): _____

8. **How many fish did you catch and/or keep on the trip when you were surveyed (or the most recent trip)?**

Caught: _____ # Kept: _____

9. **On a scale of 1 to 7 (with 1 being POOR and 7 being EXCELLENT), how would you rate the current quality of fishing at Canton Lake?**

Poor ←						→ Excellent
1	2	3	4	5	6	7

10. **Have you ever participated in the Canton Walleye Rodeo?**

☐ Yes ☐ No *(Skip to **SECTION C**)*

11. **How did water levels influence your decision to participate in this event?**

No Influence ←						→ Heavily Influenced
1	2	3	4	5	6	7

C. MANAGEMENT ISSUES & CHALLENGES

1. **Please rate your perception of the level of CROWDING at each of the following areas you use at Canton Lake.** (*Check **ONE** response for each item)*

	Don't Use	Not Crowded 1	2	3	4	Very Crowded 5
Campground	☐	☐	☐	☐	☐	☐
Swimming Area	☐	☐	☐	☐	☐	☐
Boat Ramps	☐	☐	☐	☐	☐	☐
Fishing Piers / Jetties	☐	☐	☐	☐	☐	☐
Picnic Areas	☐	☐	☐	☐	☐	☐
Parking Lots	☐	☐	☐	☐	☐	☐

2. **In general, to what extent is each of the following a PROBLEM at Canton Lake, if at all?** *(Check **ONE** response for each item)*

	Not a Problem 1	2	3	4	Serious Problem 5
Erosion of Banks	☐	☐	☐	☐	☐
Objects in Water that Make Boating Difficult	☐	☐	☐	☐	☐
Water Pollution	☐	☐	☐	☐	☐
Trampled Vegetation or Bare Ground	☐	☐	☐	☐	☐
Noise from Watercraft	☐	☐	☐	☐	☐
Alcohol Use/Abuse	☐	☐	☐	☐	☐
Water Levels (too low)	☐	☐	☐	☐	☐
Water Levels (too high)	☐	☐	☐	☐	☐
Crime	☐	☐	☐	☐	☐
Litter	☐	☐	☐	☐	☐

Water Rights at Canton Lake:

Canton Lake was constructed during the 1940s to serve as flood control as well as irrigation and municipal water supply storage. The reservoir itself has been managed by the US Army Corps of Engineers since its inception while the Oklahoma Department of Wildlife Conservation has managed the fishery (i.e. fish stocking, population monitoring). Oklahoma City (OKC) currently owns the water rights to the reservoir and may release the water at any time to meet their water needs.

3. **Before reading this study, were you aware of the water rights situation at Canton Lake?**

   ☐ Yes ☐ No

4. **How concerned are you with the potential of future water releases impacting your recreation experience at Canton?**

   ☐ Not at all Concerned ☐ Slightly Concerned ☐ Moderately Concerned ☐ Very Concerned ☐ Extremely Concerned

5. **Which of the following concerns you MOST about water releases?** *(Check ALL that apply)*

   ☐ Decline of Walleye stock
   ☐ Algae bloom
   ☐ Limited boat access
   ☐ Reduced wildlife viewing opportunities
   ☐ Other (specify): _____
   ☐ Poor fish catch rate
   ☐ Decreased bank fishing access
   ☐ Excessive plant growth around the edge
   ☐ Less or no swimming areas

Back in 2013, while Canton Lake was half full, water levels were reduced by another 30,000 acre-feet due to the use of water in Oklahoma City for the purpose of drinking. As a result of the low lake level, only one boat ramp remained accessible throughout the 2013 recreation season.

6. **How familiar are you with the lake conditions during that or other times of similar conditions?**

   ☐ Not at all familiar ☐ Somewhat familiar ☐ Very familiar

7. **If the water levels at Canton Lake decreased by similar amounts due to future water releases, indicate how your trips to Canton Lake would change:**

   ☐ My number of trips wouldn't change ☐ I would make fewer trips there ☐ I would stop visiting Canton

SECTION C (Cont.)

Please assume that Canton Lake could be managed in one of the five scenarios described below. Lake management scenarios are different in terms of how much water may be allocated between Canton Lake and Oklahoma City (OKC). After reviewing each scenario, answer questions 8-10.

SCENARIO 1 • Water level is managed SOLELY FOR RECREATION (i.e. at full level) • No water is released from the reservoir
SCENARIO 2 • Water level is managed MAINLY FOR RECREATION • Up to 20% of water may be released to meet water needs of OKC • Water may not be released again until lake level has reached full pool
SCENARIO 3 • Water levels are managed to sustain recreation at Canton and meet OKC's water needs • Up to 30% of water may be released to meet water needs of OKC • Canton Lake must be allowed to recover to 90% between releases
SCENARIO 4 • Water levels are managed MAINLY FOR OKC WATER SUPPLY • Multiple water releases (up to 30% per release) can be performed every year • Water level may not be released below 50% full capacity
SCENARIO 5 • Water levels are managed SOLELY FOR OKC WATER SUPPLY • Multiple lake releases can be performed every year • No minimum lake level or recovery period is set

8. How acceptable or unacceptable are each of the management scenarios above?

Scenario	Completely unacceptable	Somewhat unacceptable	Neutral	Somewhat acceptable	Completely acceptable	No Opinion
1	☐	☐	☐	☐	☐	☐
2	☐	☐	☐	☐	☐	☐
3	☐	☐	☐	☐	☐	☐
4	☐	☐	☐	☐	☐	☐
5	☐	☐	☐	☐	☐	☐

9. Which of the above management scenarios would you **PREFER to see implemented** at Canton Lake?

Scenario Number				
1	2	3	4	5

10. Assume that it would require additional funding to manage Canton Lake according to your preferred scenario, and lake managers need to collect that, in part, from lake users in terms of an entry fee per vehicle. What is the maximum amount you would consider paying per vehicle to access Canton Lake for recreation?

I would pay $_____ **dollars per trip.**

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D. DEMOGRAPHICS

Questions in this section will help us in making sure our respondents are representative of the population of Canton Lake visitors. All responses are confidential and are used for statistical purposes only.

1. **What is your age?** _____ Years

2. **Are you … ?** ☐ Male ☐ Female

3. **What is your ZIP Code?** _____ Zip Code

4. **Which of the following categories best describes your race/ethnicity?** *(Check **ALL** that apply)*

   ☐ Caucasian ☐ Asian or Pacific Islander
   ☐ African American ☐ American Indian
   ☐ Hispanic/Latino/Spanish ☐ Other: _____

5. **Including yourself, how many people live in your household?**

   _____ Total #
   _____ Children (<18years)
   _____ # of Anglers

6. **What is the last level of school you completed?**

   ☐ Less than High School ☐ Some College ☐ Bachelor's
   ☐ High School or GED ☐ Associates or Technical School ☐ Post-graduate

7. **What is your current employment status?** *(Check **ALL** that apply)*

   ☐ Full-Time Job ☐ Student ☐ Retired
   ☐ Part-Time Job ☐ Unemployed ☐ Military

8. **What was your total gross household income in 2017 before taxes?**

   ☐ Less than $20,000 ☐ $35,000 - 49,999 ☐ $75,000 – 99,999
   ☐ $20,000 - 34,999 ☐ $50,000 – 74,999 ☐ $100,000 or More

9. **Are you a member of any of the following associations/groups?** *(Check **ALL** that apply)*

   ☐ Ducks Unlimited ☐ Trout Unlimited
   ☐ Pheasants/Quail Forever ☐ Canton Lake Association
   ☐ National Wild Turkey Federation ☐ Conservation Coalition of Oklahoma
   ☐ National Rifle Association (NRA) ☐ Other: _____

Thank you for taking time to answer these questions! If you have any other comments about your recreation experience at Canton Lake, please use the space below.

Using the pre-paid, self-addressed envelope provided, please return this questionnaire to:

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008C Agricultural Hall
Oklahoma State University
Stillwater, OK 74078

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VITA

Adam Frakes

Candidate for the Degree of

Master of Science

Thesis: AN ASSESSMENT OF ECONOMIC IMPACT & VISITOR SATISFACTION: A CASE STUDY FROM CANTON LAKE, OKLAHOMA

Major Field: Natural Resource Ecology and Management

Biographical:

Education:

Completed the requirements for the Master of Science in Natural Resource Ecology and Management at Oklahoma State University, Stillwater, Oklahoma in December, 2019.

Completed the requirements for the Bachelor of Science in Animal Ecology at Iowa State University, Ames, Iowa in 2013.

Experience:

Undergraduate Research Assistant at Iowa State University, 2013; Independent Researcher at University of Notre Dame: Environmental Research Center, 2013; Biological Technician at Iowa State University, 2014 & 2017; Graduate Research Assistant at Oklahoma State University, 2018-2019

Professional Memberships:

International Association for Society and Natural Resources