Economic Value of Recreational Fishing on Walter F. George Reservoir (aka Lake Eufaula), Alabama and Georgia

by

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A thesis submitted to the Graduate Faculty of
Auburn University
in partial fulfillment of the
requirements for the Degree of
Fisheries, Master of Science

Auburn, Alabama
December 15, 2018

Keywords: recreational fishing, roving creel,
economic impact, travel cost model

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ABSTRACT

Recreational angling can be a major source of revenue for the local communities and States surrounding large reservoirs. This study estimated the angling effort and annual value of recreational angling at Walter F. George Reservoir (aka Lake Eufaula) reservoir, located between Alabama and Georgia. Creel, follow-up telephone surveys and aerial flights were used to calculate catch per unit effort and total effort fish species targeted by anglers (bass, crappie, sunfish, catfish, hybrid striped bass and 'anything'). Information on angler expenditures that occurred from January 1st to December 31st, 2017 were collected according to the where they occurred and in detail for reservoir contiguous counties in Alabama and Georgia, for non-contiguous AL-GA counties, and for other states. Expenditures were categorized according to general sales, fuel and lodging categories and local and state tax rates were used to calculated tax revenues from angler expenditures. In addition, travel cost models estimated angler demand, consumer surplus and total willingness-to-pay (WTP) for this reservoir. Total angling effort was estimated at 499,794 hours (SE, 49,235 h) or 74,234 annual trips. Alabama and Georgia residents contributed most of the angling effort (56% and 36%, respectively). Anglers targeting bass represented 52% of the total effort followed by 'anything' anglers (20%), crappie anglers (14%), sunfish anglers (8%), catfish anglers (5%), and hybrid striped bass anglers (1%). Direct expenditures were estimated to be $14.6 million and taxes collected on these expenditures were $1.2 million. Of the total expenditures spent within State borders, 86% was spent within Alabama ($12.6 million), 11% was spent within Georgia ($1.6 million) and the remaining 3%

was spent within other states ($0.4 million). However, of this total expenditure, Alabama residents spent $6.4 million of the total (44%), Georgia residents spent $5.0 million of the total (34%) and Other States' residents spent $3.2 million of the total (22%). Consumer surplus (CS) was estimated to be $435 per angler visit or $189 per angler day and the aggregated annual recreational angling CS was $14.0 million; and adding total expenditures ($14.6 million) to the annual consumer surplus provided an aggregate total WTP of $28.6 million. A count model using a negative binomial distribution was used to estimate demand for all anglers. Results showed that an increase in travel cost to the site and household income decreased the number of visits an angler would make to fish at Lake Eufaula, while an increase in age and tournament fishing increased visitation to the reservoir. In additional to all anglers, demand models were estimated for anglers targeting bass, crappie, sunfish, catfish hybrid striped bass, 'anything', local, nonlocal anglers and tournament bass anglers. In all models, travel cost was significant and had a negative coefficient, as theory would predict. The significance of gender and age variables varied by demand model and ethnicity was only significant in the sunfish demand model. Years of experience was a significant variable in the demand models for anglers targeting bass, catfish, 'anything' and for non-local anglers. In conclusion, results from this study provided fishery angler effort, targeted species angler information and economic impact of angling at Lake Eufaula on local cities, counties, Alabama, Georgia and other States. These results should be considered when fishery and city management plans are being developed for this reservoir.

Acknowledgments

I would like to thank my wife, Lydia Moore, for her constant support throughout my whole Auburn experience. Without her advice the whole process would have been much more difficult. I would also like to thank my original professors at Garrett College, Maryland for the guidance and passion that first got me interested in pursuing a career in biology and fisheries over fourteen years ago.

Many thanks to my major professor, Dr. Terry Hanson, for all the time he dedicated towards helping make much needed decisions, statistics, and edits for this project. Dr. Steve Sammons has always and continues to help me with advice and played a critical role in editing my thesis. Dr. Wayde Morse for jumping on board as my third committee member and the constant enthusiasm he has held for my project. I would like to also thank Dr. Michael Maceina for his commitment early on for conducting and helping me understand a large proportion of the statistical analysis for this project.

Thanks goes to the Alabama Department of Conservation and Natural Resources (ADCNR) and Georgia Department of Natural Resources (GADNR) for funding my 2017 project. I would also like to thank specific biologists such as Ken Weathers and Chris McKee (ADCNR) and John Kilpatrick (GADNR) for constant advice and speedy responses. Many thanks to Steven Gratz for advice throughout this project. Thank you to all of my drivers who participated in my surveys. Lastly, I would like to thank my pilot Dr. Jess Haggerty for his flexibility and commitment to my project throughout the whole year of field collection.

Table of Contents

List of Tables

List of Figures

List of Abbreviations

TCM	Travel cost method
WTP	Willingness-to-pay
CPE	Catch per effort; measure of catch rate
HPE	Harvest per effort; measure of harvest rate
RPE	Release per effort; measure of release rate
ADCNR	Alabama Department of Conservation and Natural Resources
GADNR	Georgia Department of Natural Resources

Definitions of Note

Bag Limit	Amount of fish and angler is legally allowed to harvest per species per day.
Consumer Surplus	Willingness-to-pay for a recreational visit above and beyond a person's actual expenditures and is the area below the recreational visit demand curve and above the equilibrium travel cost (price) of a trip visit.
Opportunity Cost	Measure in terms of value for the next best forgone alternative; in this study, also used in calculating a fraction of an angler's wage rate applied to the round-trip travel time to the recreation site and/or substitute sites.
Substitute Site	Similar site that could replace the study site and in this study was used as part of a substitute site opportunity cost in the travel cost method.
Trip	One angler fishing for a one-day period.
Visit	Fishing expedition for one angler and can be multiple days.
Travel Cost Method	Method to estimate travel costs (opportunity cost of travel plus actual expenditures) and visit frequency to establish angler visitation demand.
Willingness-to-pay	Maximum amount an angler is willing to pay for a fishing trip.

I. INTRODUCTION

Recreational fishing contributes to regional economies all over the United States (Weithman 1986; Hutt et al. 2013; Lothrop et al. 2014). In 2011, anglers spent over $456 million dollars in Alabama and $873 million dollars in Georgia (U.S. Department of the Interior, Fish and Wildlife Service and U.S. Department of Commerce, U.S. Census Bureau 2014). Many communities depend on money being spent near a local water body to support portions of their local community (Lothrop et al. 2014), and sport fisheries have proven to provide important local tourism programs (Martin 1987).

Fisheries management agencies must decide how, when, and where to allocate funding to most efficiently meet their mission of natural resource management. Reservoirs, rivers, lakes, and other bodies of water supply economic value to the local areas in which they are located. Without economic information, agency management decisions may not represent the most effective way of directing resources (Dalton et al. 1998). Conservation agencies are often asked to justify allocation of resources to specific programs or resources. Creel surveys provide managers an opportunity to allocate funding where anglers are most likely to benefit from the decisions (Long and Melstrom 2016). Economic data on specific resources assist these agencies to prioritize and justify programs to benefit these resources (Schorr et. al 1995). Failure to recognize the motivation and behavior of anglers results in poor management decisions or lost opportunities to maximize angler satisfaction (Felder and Ditton 1994).

Creel surveys have been traditionally used to collect data on angling effort, harvest, and socio-demographics, but more recent they have been used to calculate the economic impact of aquatic resources (Pollock et al. 1994; Ditton and Hunt 2001). These surveys can assist both fisheries management agencies and social scientists to collaborate and decide which goals should be targeted to maximize management decisions (Martin 1987; Ditton and Hunt 2001). In addition to state fish and game agencies, local governments and chambers of commerce can benefit from information on effort and spending of anglers. Economic data can guide local entities in building more infrastructures to better suit anglers and enhance economic benefits (Driscoll and Myers 2014).

I. 1. Angler Surveys

To obtain a full understanding of the overall fishery, creel surveys should be conducted during all seasons, weather conditions, and during low and high angler activity (Lockwood 2000). The best creel survey design will perform as many minimally intrusive surveys in the allocated time limit as possible (Mallison and Cichra 2004). Two main types of creel surveys are used to gain information about harvest, catch, effort, and overall economic impact contributed to the body of water being surveyed (Bernard et al. 1998). Access-point surveys are useful to retrieve effort, catch, and harvest rates of anglers (Pollock et al. 1994). This method is valuable in areas where access is limited, which ensures that the surveyor will have a good opportunity to have contact with most of the anglers entering and leaving the water body. Surveyors allocate a predetermined amount of time to interview anglers as they return back to the access-point after completing their fishing trip. The main benefit of this type of survey is that creel clerks obtain immediate information from completed fishing trips (Pollock et al. 1994; Lockwood 2000). Access-point surveys are usually cheaper to conduct compared to other methods because no boat is needed. Also, access-point surveys are usually preferred in areas where safety may be an issue. For instance, if a night survey is required for the creel survey, access-point surveys will be safer and more conducive to obtain interviews with anglers. This design is less effective when there are many access points to a water body.

The second common type of creel survey is a roving creel survey. Like the access-point survey, roving creel surveys are also on-site and are a good method to collect effort, catch, and harvest rates from anglers (Pollock et al. 1994). Anglers are constantly moving and can use various boat ramps in larger bodies of water; thus roving creel surveys are ideal under these conditions (Malvestuto et al. 1978; Pollock et al. 1994). A roving creel survey is also preferred in areas where there is a lot of waterfront property or shoreline access areas. This allows the surveyor to account for both bank anglers and anglers fishing from docks that otherwise would have been missed. In a roving creel survey, surveyors actively engage anglers via boat. This allows surveyors the opportunity to count the number of anglers along with the ability to collect instantaneous trip data (Hoenig et al. 1993). A disadvantage of using the roving creel survey method is that it generally only measures incomplete trips (Pollock et al. 1994). The surveyor will not be able to collect completed-trip data if the angler plans to continue to fish after the survey. Therefore, a combination of the roving creel survey with a follow-up interview will result in a better representation of the anglers trip (Alexiades et al. 2015).

A major benefit of roving creel surveys is the ability to obtain instantaneous data from the angler (Mallison and Cichra 2004). The instantaneous count method allows the survey clerk to count the number of anglers and boats in a given area with minimal bias (Hoenig et al. 1993) and this usually occurs at a specific point within each survey period. The count is typically conducted within 15-20 minutes to minimize chances of boats leaving the area while the count is being taken (Pollock et al. 1994; Bernard et al. 1998). Performing an instantaneous count at the beginning of the survey provides a more accurate estimate of the fishing effort, catch, and harvest rates taking place during that time (Malvestuto et al. 1978; Mallison and Circhra 2004).

The number of anglers may be counted using various methods including boats, stationary vantage points, and airplanes.

If an instantaneous count cannot be done during the survey period, a progressive count may be used. Unlike instantaneous counts, progressive counts are done throughout the entirety of the day as opposed to the beginning of the survey period. A progressive count is beneficial in areas where time will be too limited to do an initial count over the entire survey period (Pollock et al. 1994).

Aerial surveys are often used to obtain an instantaneous count. Although aerial counts cannot account for catch or harvest data, this method aids in determining effort and gaining an instantaneous count of boats over the reservoir (Lockwood 2000; Pollock et al. 1994). Aerial counts can be used to extrapolate sampling data collected from the roving creel survey to the entire number of anglers fishing the waterbody on that day.

Opportunity bias is the inability to count all the anglers leaving or arriving at a fishing area. Opportunity bias can however become reduced when choosing random sampling sites and periods throughout the survey (Bernard et al. 1998).

Another way to reduce bias during this type of survey is to use a stratified, random design to conduct the survey over various times of the day and areas. This stratification will reduce variability in estimates by accounting for various patterns of angling effort that takes place throughout the day (Malvestuto et al.1978; Pollock et al. 1994; Lockwood 2000). A target of at least 400 surveys during a year ensures an adequate sample size of the population of anglers (Ditton and Hunt 2001).

Phone interviews provide an inexpensive option in estimating how much anglers spent on fishing activities (Pollock et al. 1994; Schorr et. al 1995). By incorporating phone interviews, surveyors can collect complete effort, harvest, catch, and additional expenditure data that took place after the creel survey (Chen et al. 2003). Surveyors should contact the angler shortly after the trip to minimize recall bias (Pollock et al. 1994). Memory is imperfect so it is ideal to contact the angler within a week after the roving creel survey has been conducted.

I. 2. Economic Valuation

The travel cost method (TCM) is often used to estimate the economic value of a fishery. The TCM estimates travel costs of anglers including expenditures, length of trip, and opportunity costs (Parsons 2003). This method incorporates the distance traveled from the anglers' home to the reservoir where the creel study is being conducted (Weithman 1986). The TCM is unique because it can account for demand shifts due to the quality of the anglers experience on the reservoir (Weithman 1986). This method is effective in calculating complete benefits associated with trips planned just for the sole purpose of visiting an area such as a reservoir (Pollock et al. 1994). Economists and managers have used this method to determine the number of trips an angler would make if conditions either improved or decreased for the particular reservoir. Typically as the dollar amount of a fishing experience increases, the demand to make more or additional trips decreases (Lothrop et al. 2014), which is represented by a downward sloping linear relationship to create a demand curve (Figure 1)

Economic impact refers to value that would not be realized if a particular resource was not present, such as a fishery. Economic impacts can be broken down into two categories. Direct impacts are those in which money is spent on expenditures such as gas, food, lodging, etc. Indirect impacts refer to income that adds to the local communities or region which includes employment, taxes, and retail sales generated among businesses (Chen et al. 2003). Indirect impacts are usually the result of direct impact spending (Propst and Gavrilis 1987). When an angler enters into a region and spends money on products and services, it generates more money than what was initially spent (Propst and Gavrilis 1987; Ransom 2001). Industries that experience a net income demand even more goods, services, and additional jobs (Greene et al. 2006). Because state agencies are interested in the regional economic value of their fisheries, economists quite frequently use a multiplier when reporting gross sales to account for all the money added to the local economy (Weithman 1986). A multiplier becomes smaller the more an input is purchased outside of the region being surveyed (Chen et al. 2003). Some argue that economic impact on a local community does not necessarily include local anglers because people who live in the region are not adding money to the area; rather, the dollars are circulating (Martin 1987; Bradle et al. 2006). Other authors believe that there is a need to incorporate both local and non-local anglers due to the fact that a community could lose potential income if an angler decides to fish outside of a region due to poor fishing quality (Loomis 2006). It may be beneficial to separate local and non-local fisherman depending on what kind of economic data is being sought.

It is beneficial for economists and biologists to gauge the quality of anglers' experiences on any fishery of interest (Bradle et. al 2006). This information allows fishery managers to maximize the value of their resources by directing more effort towards projects that the anglers most prefer (Dalton et al. 1998). Determining whether or not higher catch rates or larger fish would influence the amount of times an angler would visit the reservoir in the future can help agencies choose proper management action to reach desired goals (Loomis 2006). In some instances, anglers have reported that they increase their number of trips substantially if fishing quality improved (Schramm et al. 2003). Another factor that may aid in an agency's evaluation on where to dedicate funds can be the angler's "willingness to pay" for certain management programs. Anglers may be willing to pay more than they currently do on fishing trips if their overall satisfaction increases. Thus, managing reservoirs to improve fishing quality in turn could boost local economies.

The economic value generated by a local fishery can be affected by various physical and environmental impacts, especially aquatic vegetation. In general, anglers prefer aquatic vegetation and consider it beneficial for catching their targeted species (Henderson 1996). A creel survey in two South Carolina reservoirs demonstrated that anglers felt that aquatic vegetation enhanced their fishing experience, which was predicted to increase economic value of these reservoirs through increased angling effort (Henderson et al. 2003). However, there have been cases when an excess of Hydrilla *verticillata* had negatively impacted angler effort. In 1977, Hydrilla coverage exceeded 80% of Orange Lake, Florida, resulting in a 90% loss in revenue generated by anglers (Colle et al. 1987). Typically non-angling home owners and other groups who use the body of water for waterskiing, swimming, and other recreational activities associated with the reservoir have negative feelings associated with increased aquatic vegetation (Henderson 1996, Slipke et al. 1998, Maceina et al. 2015). Decreasing water levels have also been known to negatively affect fish habitat and angler effort (Hanson et al. 2002; Bradle et al 2006; Hutt et al. 2013; Daugherty et al. 2015). Other factors that can decrease value of fisheries include increased land prices, crowding on boat ramps and waters, and recreational activities other than angling (Chen et al. 2003). Reservoir managers have been faced with the realization that managing their water resources for hydrological operations alone are no longer necessarily the most economically beneficial approach (Niemi and Raterman 2008).

As with any method, certain biases are associated with creel surveys. For harvest-oriented fisheries higher bag limits usually ensures that anglers will stay for a more extended period of time, thus allowing a greater chance of contact with creel clerks (Pollock et al. 1997). Some error can occur by not measuring or personally counting harvested fish, but generally these data are not worth the costs of potentially inconveniencing anglers and harming public relations (Mallison and Cichra 2004). Subjective response error is human error generated by an angler from either over or under estimating measurements such as the size of fish harvested, and should be considered when analyzing measurement error (Alexiades et al. 2015).

Among managers who wish to capitalize on money continuing to circulate around their local water body need to consider all types of anglers' desires for their fishing experience as individual preferences differ among anglers. More comprehensive economic data on the variety of anglers fishing area, resources allows community managers to dictate how and where to spend money to benefit the local economy (Driscoll and Myers 2014). A study of various Mississippi fishing sites showed that the angler's top reasons to fish was to be outdoors and to relax (Schramm et al. 2003). Fishing success does not always take priority over other desires. Another survey in Missouri showed that catching a trophy Muskellunge *Esox masquinongy* during tournaments only played a small role in overall angler satisfaction (Belusz and Witter 1986).

There have been countless numbers of creel surveys conducted on reservoirs throughout the country, but few have considered economic impacts of fishing. Because each reservoir has unique properties, including proximity to anglers, proximity to other bodies of water, resources, and uses, site-specific creel surveys will continue to be needed (Chen et al. 2003). To avoid consequences of improper management of reservoirs, managers must dedicate more time into understanding all the demands of their water users (Niemi and Raterman 2008). Creel surveys can aid in providing data that can show other stakeholders in reservoirs the economic importance of properly maintaining their local fishery. With continuing effort towards conducting creel surveys, economic gains should increase in local economies if agencies and economists understand the desires of fishermen.

I. 3. Study Objectives

The specific goals of the economic creel survey on Lake Eufaula were to:

1. Quantify recreational fishing effort, catch, and harvest rate for the main sport fish on Walter F. George Reservoir, Alabama-Georgia (hereafter, Lake Eufaula).
2. Quantify total expenditures and consumer surplus associated with these fisheries and partition trip expenditures into the respective regions where they occurred.
3. Determine amount of angler's trip expenditures that contribute to local taxes generated by the Lake Eufaula fishery.
4. Describe expectations and goals of anglers to better understand where to allocate resources in the future so managers can better meet demands of anglers and to increase revenue for this region.

II. METHODS

II.1. Study Site Description

Completed in 1963, Lake Eufaula is located between Columbus and Fort Gaines, Georgia extending approximately 137 km north of the Walter F. George lock and dam (Figure 2). The reservoir is located on the Chattahoochee River bordered by Alabama and Georgia and is operated by the United States Army Corps of Engineers to provide hydroelectric power and flood control but is also used heavily for recreation and angling. Covering approximately 18,285 ha the reservoir has 1,030 km of shoreline with mean and maximum depths of 6.2 m and 29.3 m, respectively (Environmental Protection Division 1993).

The creel survey covered the area between Walter F. George Dam to the Georgia State Road 39 Bridge, an area covering approximately 13,468 ha (Table 1, Figure 2). Section boundaries from downstream to upstream and their corresponding channel lengths were:

Section A - Walter F. George Dam to mile marker 84 (17.8 km)

Section B - Mile marker 84 to US highway 82 Bridge (19.1 km)

Section C - US highway 82 Bridge to Bustahatchee Creek (20.5 km)

Section D - Bustahatchee Creek to Georgia State Road 39 Bridge (22.1 km)

The Lake Eufaula fishery is managed jointly by the Georgia Department of Natural Resources (GADNR) and the Alabama Department of Conservation and Natural Resources (ADCNR). The reservoir supports many sport fisheries, such as Largemouth Bass *Micropterus salmoides*, crappie *Pomoxis* spp., sunfish *Lepomis* spp., Hybrid Striped Bass *Morone saxatilis* x *M. chrysops*, and catfish (family Ictaluridae). The reservoir is popular and has a national reputation for its Largemouth Bass fishery. In 2013 there were 51 bass tournaments reported to ADNCR that brought in 1,412 anglers to Lake Eufaula (Abernethy 2014). In 2017, there were 49 scheduled tournaments and more public tournaments were added throughout the year.

An instantaneous count, a roving creel survey, a follow-up telephone survey, and an aerial boat count were conducted to meet the objectives of this project. Data forms for these efforts are in Appendices I-IV, respectively. Cities and counties were separated for organization of expenditures, effort, and tax generation into the following designations. Counties and cities bordering Lake Eufaula were designated for Alabama (Alabama contiguous counties and cities) or Georgia (Georgia contiguous counties and cities). Non-bordering counties were also designated for Alabama (Alabama non-contiguous counties) or Georgia (Georgia non-contiguous counties). Lastly, all other states where anglers were from or spent money in were accounted for in the designation of other states not including Alabama or Georgia.

II.2. Roving Creel Survey

A roving creel survey took place from January 1 through December 31, 2017. The four sections mentioned above where further subdivided into anywhere from 3-5 subsections (Figures 2-6). Each sub-section varied in area due to the variation in shoreline length and width throughout the reservoir (Table 1). A stratified, non-uniform probability sampling design was used for this survey to select the sampling period, time of day, and section of reservoir to sample (Malvestuto et al. 1978; Pollock et al. 1994). Probabilities of sampling each section were weighted based on the amount of expected fishing pressure, determined after consultation with ADCNR and GADNR biologists. Section C had the highest weight of 35%, followed by section A and B (25% each), and section D (15%). There were at least twelve separate boat ramps that were used for convenient access to each section.

The roving creel survey was divided into four seasonal time periods: winter (December 1- January 31), spring (February 1- May 30), summer (June 1- September 31), and fall (October 1- November 30) to account for seasonal variation (Malvestuto et al. 1978). On days with aerial surveys, there was one time segment sampled. Sampling periods consisted of five consecutive days, and two periods were conducted each month. Each 5-day period consisted of two weekend days and three weekdays. Using a random-number generator, sampling time periods were chosen for three possible times of the day. During winter months each sampling period was divided into three 3.5-h segments: morning (6:30 AM to 10 AM), mid-day (10 AM to 1:30 PM), and evening (1:30 PM to 5 PM). For the remainder of the year each period was divided into three 4-hour segments: morning (6 AM to 10 AM), mid-day (10 AM to 2 PM), and evening (2

PM to 6 PM). Three aerial boat counts were conducted during each sampling period, one on a weekday and two on weekend days. Two out of the three potential time segments were sampled each day when there was no aerial survey. Thus, each 5-day sampling period was comprised of seven roving creel surveys and three aerial counts. This was conducted twice a month for a total of 14 roving creel surveys and 6 aerial counts per month or 168 roving creel surveys and 72 aerial counts for the year-long sampling portion of this project

Boat counts were conducted before interviews began to determine instantaneous effort by boating the full course of the selected sampling section, as described by Hoenig et al. (1993). This allowed a count of both boat and shoreline anglers and were recorded (Appendix I). After this process was completed the roving creel survey began (Appendix II). Fishing boats were approached at idle speed and continued with the trolling motor to prevent any disturbances to anglers. If possible, shore anglers were approached by docking the boat and approaching by land. This procedure was to ensure that the anglers' limited fishing section was not interrupted by the creel boat. In some cases where the surveyor felt they would disrupt the angler, the shore angler was counted in the instantaneous count but not approached for an interview. The survey clerk identified themselves and asked anglers if they would be willing to participate in an angling survey. Only one angler per boat was surveyed. The roving creel survey questions were designed to promote a continuous flow of conversation that lasted 5-10 minutes (Appendix II). Questions were related to their angling trip including duration of trip, how far the angler traveled, targeted species, total fish caught, effort angling, and estimated trip expenditures. After the on-site interview was completed anglers were asked if they would be willing to participate in a follow-up telephone interview; and if yes, contact info was collected. The creel survey process then continued until the end of the time period or all boaters in that subsection were interviewed.

II.3. Follow-up Telephone Survey

After the 5-day survey period was completed, anglers who agreed to a follow up telephone survey were called in the order they were interviewed. These anglers were contacted within the next week to prevent memory recall bias (Ditton and Hunt 2001). If anglers could not be reached after three attempts, they were taken off the phone list (Pollock et al. 1994). After making contact with the angler, more detailed information about their completed angling trip was obtained (Appendix III), including total hours fished, days spent at the reservoir, overall satisfaction, and plans to return. Other detailed questions were asked to obtain individual completed trip expenditures. These expenditures were divided into the larger towns and counties where their money was spent (Abbeville, Clio, Eufaula and Headland, Alabama; Ft. Gaines, Georgetown, Lumpkin and Omaha, Georgia) and other regions outside of the contiguous counties. At the end of the interview, anglers had an opportunity to pass along any additional comments regarding their fishing experience on the reservoir.

II.4. Aerial Boat Counts

Aerial boat counts were conducted three times each sample period for a total of six aerial boat counts per month (Appendix IV). In the case of inclement weather, boat counts were rescheduled during the sample period if possible. Aerial boat counts time segments were randomly picked for any given day and time period during each sampling period. During the survey year each sampling period start time was chosen as follows: morning (7:45 AM), mid-day (11:45 AM), and evening (3:45 PM). Aerial surveys typically took 1 hour to complete, and direction of initial flight path was chosen based on wind direction. The survey area consisted of the reservoir in between Walter F. George lock and dam to the Georgia State road 39 Bridge. Aerial boat counts were conducted over the entire study area of the reservoir, and the average altitude of the plane during surveys was approximately 457 m. Only boats that were not moving were counted for the survey. The counts were conducted by a lead counter who sat in the front of the plane alongside the pilot. A second observer was responsible for recording data and aiding in spotting boats on the reservoir.

II.5. Effort, Catch, and Harvest Rates

Effort, catch, and harvest rates were calculated for all species combined and for each target species category. Weekend and weekday effort for both daytime boat and shore anglers was estimated by accounting for the total number of weekend days and weekday days during the course of the year Malvestuto et al. (1978). Effort for boat anglers for a particular day (E) from aerial surveys for all target fish categories were calculated using the following equation:

$$E = (I * A * T) / \rho_1 \quad (1)$$

Where I is the instantaneous count of boats from aerial boat counts, A is the average number of anglers per boat, T is the length of the time block in hours, and ρ_1 is the probability of sampling an angler within each time block. Annual effort was estimated by multiplying the mean weekday effort for the year by the total number of weekdays in a year (260 days), and mean weekend effort by the total number of weekend days in a year (105). The summation of both weekday and weekend effort produced the total annual boat effort.

Shore angling effort (S) was calculated based on the instantaneous roving creel angler counts using the following equation described in Malvestuto et al. (1978):

$$S = (I * A * T)/(\rho_1 * \rho_2) \quad (2)$$

Where I is instantaneous count of shore anglers observed in the beginning of each survey, A is the average number of anglers per shore angling party, T is amount of hours in each time block;

ρ_1 is probability of sampling an angler within that time period; and ρ_2 is the probability of a shore angler fishing within the section. Annual effort was estimated by multiplying the mean weekday effort for the year by the total number of weekdays in a year (260 days), and mean weekend effort by the total number of weekend days in a year (105). The summation of both weekday and weekend effort produced the total annual shore effort.

Catch-per-effort (CPE) and harvest-per-effort (HPE) were estimated for each target species for both boat and shore line angling. Catch was defined as any fish that was caught. The fish after being caught could have been released or harvested from the reservoir. CPE was the total amount of fish caught per hour and, estimated by dividing the total catch observed during roving creel surveys ($\hat{C}_{\text{species}}$) by the total angler effort for each target species ($\hat{E}_{\text{species}}$).

$$CPE_{\text{Species}} = \hat{C}_{\text{species}} / \hat{E}_{\text{species}} \tag{3}$$

Harvest per effort (HPE) was the total amount of fish harvested per hour, estimated by substituting the total harvest per effort per species ($\hat{H}_{\text{species}}$) for the total catch observed per species ($\hat{C}_{\text{species}}$) from equation (3).

$$HPE_{\text{Species}} = \hat{H}_{\text{species}} / \hat{E}_{\text{species}} \tag{4}$$

Release per effort (RPE) was the total amount of fish released per hour, estimated by substituting the total release per effort per species ($\hat{R}_{\text{species}}$) for the total catch observed per species ($\hat{C}_{\text{species}}$) from equation (3).

$$RPE_{\text{Species}} = \hat{R}_{\text{species}} / \hat{E}_{\text{species}} \tag{5}$$

For this study, trip length was equal to the total hours of angling effort per angler on their fishing outing. Trip length was estimated for each target species by calculating the mean angler-estimated hours of effort for the specific trip of the interview. A "trip" was defined as one anglers fishing outing during a one day period. A "visit" was defined as one anglers fishing outing, which could include multiple trip days from their place of residence.

Annual night angling trips were estimated through total trip estimates, shore and boat, and data collected from the follow up telephone survey.

$$NT = (T/D) * F * R \tag{6}$$

Where *NT* was the total number of night trips made, *T* was the estimated annual trips among all anglers, *D* was the mean number of days anglers estimated they had fished at Lake Eufaula over the past 12 month period, *F* was the proportion of anglers who indicated they fished at night, *R* was the mean number of night fishing trips amongst anglers made in the past 12 months.

Percent effort by section ($\hat{E}_{\text{section}}$) was also calculated. The effort for each section for the summation of all weekdays was determined by:

$$\hat{E}_{\text{section,weekdays}} = \left(\frac{\Sigma\, Ib * Ab}{n} + \frac{\Sigma\, Ir * Ar}{n} \right)\ X\ 260 \tag{7}$$

Where *Ib* was the instantaneous count of boat anglers from aerial survey, *Ab* is the average number of people per angling boat party, *Ir* was the instantaneous count of shore anglers from roving creel survey, *Ar* was the average number of people per angling shore party, n is the number of times that section was sampled, and 260 was the number of weekdays in 2017. Similarly, the effort for each section for the summation of all weekend days for $\hat{E}_{\text{section}}$, was calculated equation (8) and substituting 105 weekend days instead of 260. The percent effort by section was then estimated by:

$$\hat{E}_{section} = \frac{\hat{E}_{section,weekdays} + \hat{E}_{section,weekend-days}}{\Sigma\ (\hat{E}_{section,weekdays} + \hat{E}_{section,weekend-days})}\ \text{X}\ 105 \tag{8}$$

This calculation was conducted for boat and shore anglers in each reservoir section of the study area.

II.6. Angler Socioeconomic Characteristics

Socioeconomic data was compared across all target species groups and local and non-local anglers depending on which characteristics were being estimated. The characteristics that were compared across target species groups included mean party size, mean expenditures, mean distance traveled, total number of annual visits to Lake Eufaula, sex, ethnicity, estimated number of night fishing trips, mean years of fishing experience, and mean alternative site distance. Mean age of anglers, mean household income, total years of fishing experience, and overall fishing quality was also compared across target species group. It was determined if the fishing trip was related to a tournament, whether pre-fishing or currently participating. If applicable, the amount of tournaments that the angler participated in over the past year was determined.

Angler residence was used to characterize them as local, non-local, border-states, and non-border states. Socioeconomic data that was compared across angler residence included mean expenditures, total number of estimated annual visits to Lake Eufaula, mean distance traveled, and mean alternative site distance. A One-Way Analysis of Variance (ANOVA) with a Tukey's Post-Hoc test was conducted to determine if there were significant differences between target groups party size and target groups expenditures per angler trip day. Results were considered significant if the P value was greater than 0.05.

II.7. Expenditures and Tax Revenue

Data from the phone survey were combined with those from the roving creel survey, instantaneous counts, and aerial surveys, to estimate completed expenditure and economic impacts using calculations described in Malvestuto et al. (1978). During the on-site roving creel survey, anglers were asked the direct monetary cost of their trip. The anglers who participated in a follow up interview were asked to categorize their trip expenditures. The categories included boat gas, lodging, groceries, restaurant meals, tournament fees, boat ramp fees, and costs associated with repair or maintenance. Those expenditures were also broken down to the cities in which they were purchased. Gas expenditures for automobiles were determined based on miles driven to and from the reservoir. The round-trip miles were multiplied by 53.5 cents per mile in accordance with standard mileage rate (Internal Revenue Service 2017).

Expenditures per day were determined for each expenditure category. The expenditure value was divided by the total number of days anglers fished during the 2017 year. Each area's expenditures were extrapolated by multiplying the proportion of expenditures spent in that region by total hours of angling effort on the lake to estimate the number of angling hours per respected region. The total number of angling hours was then divided by the number of average hours fished per angler on the reservoir to obtain the total amount of daily visits for each respected region. The total number of daily visits was multiplied by the average expenditures spent per day to estimate the total expenditures accruing in Alabama and Georgia contiguous counties, and cities therein and non-contiguous counties within each state, and other states.

Tax dollars resulting from categorized expenditures were calculated for Alabama and Georgia contiguous counties and cities therein, non-contiguous counties within each state, and other states. The resulting categorical estimated taxes were determined from the extrapolated expenditures from the follow-up telephone surveys. Municipalities within contiguous Alabama counties we focused on included Abbeville, Clio, Eufaula and Headland and within contiguous Georgia counties were Ft. Gaines, Georgetown, Lumpkin and Omaha. State taxes were applied to trip related expenditures in Alabama and Georgia contiguous counties and cities therein, non-contiguous counties, and other states. General tax rates were applied for goods such as groceries, restaurant meals, lodging, bait, and repair and maintenance associated with the anglers' trip. Sales tax for Alabama and Georgia non-contiguous counties were applied at a 4% tax rate. Additionally, all other states had a 4% sales tax rate applied. Gas taxes were applied to boat gas and vehicle gas. The state gas tax for Alabama was 18 cents per gallon while Georgia had a 26 cent per gallon gas tax applied. All other states had a 23 cent per gallon gas tax applied which was the national average for state gas tax (AAA 2018). The total amount of expenditures for each taxed municipality or state was divided by the average cost of fuel to obtain gallons of fuel used in angling visitation. This fuel gallon amount was then multiplied by the tax rate to determine the total fuel tax. Additional municipal gas taxes were 1 cent per gallon for Headland and Abbeville, Alabama, and 4 cents per gallon for Clio and Eufaula, Alabama. Extrapolated expenditures were then multiplied by the respected tax rate for each county and state. Lodging tax rates for the state and counties of Alabama and Georgia were obtained from the Alabama Department of Revenue (2018), Georgia Department of Revenue (2018), personal communications with city or county clerks, or sale-tax.com (2018), and were applied by either a percentage of cost and/or a flat rate per night.

II.8. Travel Cost Model

TCM was used with data gathered by on-site and follow-up interviews of recreational anglers to determine angler expenditures incurred to visit Lake Eufaula (Parsons 2003). Only visitors whose sole purpose was to participate in angling were accounted for in the TCM. A regression analysis of follow up survey data was used to describe the relationship between the total number of angling visits over the course of the year and independent variables including travel costs, total length of trip, round-trip travel time, fish species targeted, opportunity cost of time, opportunity cost of visiting an alternative substitute site, and other socio-demographic data (Parsons 2003).

Opportunity cost of time spent on the angler's trip is a common part of TCM (Parsons 2003). Opportunity cost (O_a) of time spent traveling from their home to Lake Eufaula and back to their home was estimated from data gathered during the follow-up survey using:

$$O_a = ((H_a/2{,}000) * 0.33) \text{ x } (D_a/55 \text{ mph}) \quad (9)$$

Where H_a was the annual household income for an angler divided by 2000 hours worked per year (assuming 40 hours per week multiplied by 50 weeks a year) to estimate an hourly wage rate for the given individual. The hourly wage rate was multiplied by 0.33 which represents the value of an anglers' per hour travel time. Only 0.33 was used because it is assumed that the cost of travel is does not amount to their hourly wage because the activity of driving is leading to leisure time (Ward and Beal 2000). D_a was the round-trip distance traveled to lake Eufaula that is divided by 55 mph (anglers average speed to destination) to estimate hours of travel (Prado 2006; Ojumu et al. 2009). To calculate opportunity cost of visiting a substitute site, D_a was replaced with D_{alt} , which is the round-trip distance to the alternative site.

Total expenditures for anglers are an important component to the TCM. Travel cost for an individual angler (T_c) was calculated by the following equation:

$$T_c = O_a + X_a \quad (10)$$

Where X_a was the summation of all anglers' expenditures including vehicle and boat gas, groceries, restaurant meals, lodging, bait, and repair/maintenance.

The quantity demanded (Q) for all angler trips on Lake Eufaula was estimated using the following equation:

$$Q = \beta_0 + \beta_1 T + \beta_2 S + \beta_3 H + \beta_4 V + \varepsilon_i \quad (11)$$

Where β_n are the coefficient estimates for the parameters, *T* is travel cost, *S* is the opportunity cost of travelling to a substitute site, *H* is the angler household income, *V* is a matrix of socio-demographic variables including age, gender, years of fishing experience, target species, ethnicity, that can effect angler visit demand, and ε_i is random model error (Ojumu et al. 2009).

Opportunity cost (S) of traveling to a substitute site is an important component of TCM. Anglers were asked if they could not fish at Eufaula to designate a preferred alternative site and to state the distance this site was from their residence. Anglers were then asked if they preferred to fish at Eufaula or their substitute site. When anglers did not have a substitute site to fish at, the most common named alternative site was used (Lake Seminole). The round-trip distance from an angler's house to Lake Seminole was then estimated.

Household income (H) was asked of each angler during the follow-up phone interview. If anglers did not respond to the question, an average was determined from other anglers traveling from the same region. If there was no income data for that particular region, the information was removed from the data set used in the TCM.

The quantity of angling trips was estimated using count model with a negative binomial distribution to account for overdispersion, truncation, and endogenous stratification (Parsons 2003; Martinez-Espineira and Amoako-Tuffour 2008) using the following equation:

$$\lambda = \exp(\beta_0 + \beta_1 T + \beta_2 S + \beta_3 H + \beta_4 V + \alpha) \quad (12)$$

Where β were the coefficient estimates, *T* was the aggregated travel cost, *S* was the opportunity cost of a substitute site *H* was the anglers household income, *V* was a matrix of socio-demographic variables, and α was a parameter that determines the degree of dispersion in the predictions (Parsons 2003; Martinez-Espineira and Amoako-Tuffour 2008). Overdispersion of the data on the number of visits commonly occurs in recreational count sampling. Due to the fact that fewer anglers make many visits opposed to many anglers making fewer visits, variance in this study's case is larger than the mean for the visit count data. This can results in underestimated standard errors resulting in inflated t-statistics if overdispersion is not corrected. Using the log-likelihood ratio test (Poisson and negative binomial models), dispersion was tested and found that the mean-equal-to-the variance supposition was soundly rejected ($P < 0.0001$). Thus, the overdispersion issue was accounted for and corrected using the negative binomial model distribution. The parameter (α) in this model accounts for missing heterogeneity and prevents overdisperion that accures when variance is larger than the mean for the data.

Endogenous stratification or avidity bias is described as the probability of interviewing an angler who makes multiple trips is higher than the probability of interviewing an angler who visits a destination once (Englin and Shonkwiler 1995). To correct for this, a non-uniform probability sampling strategy was applied to ensure an accurate estimate of average trips per angler by weighting each observation prior to the parameter estimation. Thompson (1991) determined that applying a non-uniform probability sampling strategy, similar to the one used for this study, was effective at correcting avidity bias related to expenditure estimates per trip. Less than 2% of the on-site interviews were repeat anglers; thus, endogenous stratification had a small impact on the TCM and CS estimates made from this study.

Travel cost, income, and substitute site opportunity cost were included in the total costs to estimate consumer surplus (Parsons 2003). Variables that were significant were used in the model at a P-value ≤ 0.05 and collinear variables were removed (Ward and Beal 2000).

II.9. Consumer Surplus

Consumer surplus (CS) was estimated by calculating the difference in price anglers paid for a fishing trip compared to their willingness to pay for the same trip (Parsons 2003). A regression analysis was conducted to show the relationship between the annual number of visits and independent variables such as travel costs for the trip to estimate willingness to pay. Consumer surplus per angler visit (CSv) was estimated using the following:

$$CSv = \frac{(\hat{\lambda}/-\hat{\beta}_1)}{\hat{\lambda}} = \frac{1}{-\hat{\beta}_1} \tag{13}$$

Where $\hat{\lambda}$ was the estimated number of angler trips and $\hat{\beta}_1$ was the estimated travel cost coefficient from the TCM (Equation 9; Parson 2003).

Consumer surplus for all anglers was calculated using travel cost model data. Consumer surplus was also calculated for Alabama and Georgia contiguous counties and included cities therein and also calculated for non-contiguous counties along with out of state regardless of their target species. CSv was converted into consumer surplus per day (CSd) by dividing the average CSv visit length by using the following:

$$CSd = \frac{(\hat{\lambda}/-\hat{\beta}_1)}{\hat{\lambda}} = \frac{1}{-\hat{\beta}_1} \ / \ AT \tag{14}$$

Where $\hat{\lambda}$ was the estimated number of angler trips $\hat{\beta}_1$ was the estimated travel cost coefficient from the TCM (Equation 9; Parson 2003), and *AT* was the average visit length of the angler. Aggregate consumer surplus was estimated by multiplying angler consumer surplus per day by the total number of annual trips taken on Lake Eufaula. Total willingness to pay (WTP) is the maximum trip price an angler is willing to pay above the individual's actual expenditures incurred on a particular trip, and was estimated by summing consumer surplus with travel cost.

III. RESULTS

III. 1. Descriptive Survey Statistics

Instantaneous boat counts were conducted on Lake Eufaula on 119 separate sampling days with 217 roving creels, resulting in 573 completed on-site interviews between January and December 2017. One sampling day was cancelled due to a severe rain event. During the instantaneous boat counts, 678 angling parties were observed totaling 1,219 individuals for an observed average of 3.1 boats per instantaneous count.

On-site interviews consisted of 545 (95%) boat angler parties and 28 (5%) shore angler parties. Of the 573 interviews, only 11 (<1%) were parties previously sampled during the study. The noon shift time period was sampled most frequently (310 interviews), followed by AM (133), and PM (130; Table 2). The majority of roving creel survey interviews occurred in the spring (308 interviews), followed by the summer (168), fall (77), and winter (20; Table 3). Bass anglers comprised the highest proportion of fishing parties during every season. Overall, most anglers were targeting bass (52%), followed by anything (20%), crappie (14%), sunfish (8%), catfish (5%), and hybrid striped bass (1%; Table 4). More anglers were interviewed during the spring compared to other seasons, except for catfish anglers that were interviewed most frequently during the summer (Table 4). Fifty-four percent of all anglers interviewed during the on-site creel survey were in section C of the reservoir (309 interviews), followed by section A (124), B (123), and section D (17; Table 5, Figure 2).

Of the 297 bass anglers interviewed, 54% said their trip was related to a tournament. Of these, 62% were currently in a tournament when interviewed while 38% were pre-fishing for a tournament. Tournament bass anglers occupied similar proportions when fishing on section C (57%), followed by B (22%), A (18%), and D (3%).

Most shore anglers interviewed during the on-site interview targeted anything (68%), followed by crappie (21%); while sunfish and catfish anglers comprised the remaining 11% (Table 6). Shore anglers were interviewed on section A (11 interviews) and C (11) most frequently, and section B (6); no shore line anglers were interviewed in section D.

A total of 59 aerial surveys were conducted during 2017 resulting in 3,890 angling boats. A total of 13 flights were cancelled due to inclement weather. Aerial counts estimated a mean boat density of 4.9 boats per 1,000 ha during the 12-month sampling period (Table 7). The highest boat density observed was on March 25, 2017 with an average of 21.31 boats per 1,000 hectares. A total of 380 pontoon boats was counted and based on the roving creel surveys finding that 70% of pontoon boats encountered were actively fishing, there were 266 fishing pontoon boats from the aerial survey. There was an average of 97 boats observed during weekend flights compared to an average of 38 boats observed during weekday flights (Table 7). The majority of angling boats observed occurred on the weekend (70%), compared to the weekday (30%; Table 8). Most angling boats were observed per time block was during the Noon shift (2,043 boats), followed by the AM shift (1,180), and PM (667; Table 8). Most angling boats were observed during spring (2,432) followed by the summer (756), fall (555) and winter (147; Table 9).

III. 2. Effort, Catch, and Harvest Rates

Total angling effort, including boat and shore angling, was estimated at 499,794 h (SE, 49,235 h) with an estimated 74,234 annual trips (Table 10). Estimated effort by Alabama anglers was an estimated 279,989 h (SE, 27,581 h) over 41,587 annual trips. Estimated total effort by Georgia anglers was an estimated 177,937 hours (SE, 17,528 h) over 26,429 annual trips. Boat anglers comprised most of the effort; however, estimated annual shore effort was 5,983 hours

(SE, 994 h) over 889 annual trips. In the follow-up telephone survey, 27% of anglers indicated that they had fished for their targeted species at Lake Eufaula during night in the previous 12 months. Mean number of yearly night trips including all anglers was estimated to be 18.96 angling nights.

Bass anglers fished an estimated 259,893 h (SE, 25,602 h) over 33,752 trips in 2017 (Table 10). Mean trip length was 7.7 h, mean CPE was 0.95 bass/h, and mean HPE was 0.04 fish/h resulting in an estimated 10,396 bass harvested per year. Bass angler RPE was highest amongst all other anglers at 0.91 fish/h. Tournament bass anglers fished an estimated 142,941 h (SE, 14,018) over 21,231 annual trips and their CPE was similar to the overall bass angler estimate 0.96 fish/h (Table 11).

Crappie anglers fished an estimated 69,971 h (SE, 6,893 h) over 12,958 trips in 2017 (Table 10). Mean trip length was 5.4 h, mean CPE was 2.01 fish/h, and mean RPE was 0.31 fish/h; mean HPE was 1.70 fish/h, resulting in an estimated 118,951 crappie harvested in 2017. Sunfish anglers fished an estimated 39,984 h (SE, 3,939 h) over 6,555 trips in 2017 (Table 10). Mean trip length was 6.1 h, mean CPE was 3.10 fish/h, and mean RPE was 1.02 fish/h; mean HPE was 2.07 fish/h resulting in an estimated 82,766 sunfish harvested in 2017.

Catfish anglers fished an estimated 24,990 h (SE, 2,462 h) over 3,471 trips in 2017 (Table 10). Mean trip length was 7.2 h, mean CPE was 1.15 fish/h, and mean RPE was 0.12 fish/h; mean HPE was 1.03 fish/h resulting in an estimated 25,739 catfish harvested per year in 2017. Hybrid striped bass anglers fished an estimated 4,998 h (SE, 492 h) over 1,111 trips in 2017 (Table 10). Mean trip length was 4.5 h, mean CPE was 4.31 fish/h, and mean RPE was 0.45 fish/h; mean HPE was 2.14 fish/h resulting in an estimated 21,541 hybrid striped bass harvested per year in 2017. Anything anglers fished an estimated 99,959 h (SE, 9,847) over

16,387 trips in 2017 (Table 10). Mean anything angler trip length was 6.1 h, mean CPE was 2.82 fish/h, and mean RPE was 0.2 fish/h; mean HPE was 1.28 fish/h with an estimated 281,884 fish harvested in 2017.

Boat anglers had similar CPE, HPE, and overall harvest numbers compared to combined boat and shore line anglers (Table 10). Due to the low sample size of shore anglers, effort, CPE, and HPE did not greatly contributed to the overall angling numbers. Shore anglers mainly targeted anything (68%), followed by crappie (21%), catfish (7%), and sunfish (4%). Out of the six shore anglers that were targeting crappie, none caught any fish up until the time of the interview.

III. 3 Angler Socioeconomic Characteristics

The average party size among all anglers was 1.92 people per party (Table 12). A one-way ANOVA (F=2.33, df=724, P=0.04237) with a Tukey *Posthoc* test found that mean party size across all target species was similar ($P < 0.05$) . Party size was anglers targeting hybrid striped bass (2.50), followed by catfish (2.31), anything (2.07), crappie (1.87), and bass (1.84) (Table 12).

A One-way ANOVA (F=1.84, df =340, P=0.1049) with a Tukey Post-hoc test found that expenditures per angler day for all angling parties were not statistically significantly different ($P < 0.05$). The mean trip expenditure per angler/day was $130. Average expenditures per angler/day collected in the follow-up telephone were for anglers targeting bass was $182, crappie ($74), sunfish ($68), catfish ($61), anything ($58), and hybrid striped bass ($26) (Table 12). Average expenditures per angler/day with tournament bass anglers was $435 (Table 11).

Average opportunity cost to travel roundtrip to Lake Eufaula was highest for anglers outside of the state of Alabama and Georgia ($172.47), followed by Georgia non-contiguous residents ($72.68), Alabama non-contiguous residence ($55.63), Alabama contiguous residents ($12.58), and Georgia contiguous residents ($0.98). Alabama and Georgia residents who live in contiguous counties of Lake Eufaula have combined had an average opportunity cost ($11.33) while all other non-local residents had a much larger cost ($75.77). Anglers targeting anything had the highest opportunity cost ($69.15), followed by crappie ($67.85), bass ($59.81), sunfish ($53.80), and catfish ($40.85).

Anglers who visited Lake Eufaula traveled from 35 separate counties in Alabama, 62 separate counties in Georgia, and 8 additional states (Tables 13-15). Of the 573 angling parties interviewed, 57% claimed residence in Alabama, followed by 34% in Georgia, and the remaining 9% were from states other than Alabama and Georgia (Table 13). Of the anglers who lived in Alabama, 47% lived in contiguous counties of Lake Eufaula (Table 14). Of the anglers who lived in Georgia, 9% lived in contiguous counties of Lake Eufaula (Table 15).

The average one-way trip from their residence to Lake Eufaula for all anglers was 150 km. Anglers targeting bass traveled the farthest (174 km), followed by those targeting crappie (140 km), catfish (130 km), anything (117 km), sunfish (109 km), and hybrid striped bass (72 km; Table 16). Tournament bass anglers on average traveled 208 km one way (Table 11). Of all the anglers interviewed during the on-site roving creel survey, the most targeted species was bass (52%), followed by anything (20%), crappie (14%), sunfish (8%), catfish (5%), and hybrid striped bass (1%).

All anglers fished an average of 36 days over the past 12 months. Anglers targeting crappie fished the most days in the past 12 months at lake Eufaula (mean, 42 days, N=81), followed by bass (mean, 37 days, N=296), anything (mean, 34 days, N=115), sunfish (mean, 32 days, N=44), catfish (mean, 32 days, N=31), and hybrid striped bass (mean, 12 days, N=5; Table

16). On average, anglers spent 2.3 days for every visit they took to fish on Lake Eufaula. On average anglers targeting catfish had the longest trip length (3.2 days), followed by crappie (2.7 days), anything (2.6 days), bass (2.2 days), and hybrid striped bass (1 day; Table 16). Tournament bass anglers spent an average 2.3 days for every trip they made to Lake Eufaula (Table 11)**.**

On average, interviewed anglers were 53 years old, with an average household income of $104,000 (SD 117,000),and most were male Caucasians. The average age ranged from bass anglers (48 years) to sunfish anglers (60 years). Anglers targeting crappie, catfish, hybrid striped bass, and anything had the same average age of 58 (Table 16). The mean household income was highest for anglers targeting bass ($118,000, SD 144,000), followed by catfish ($116,000, SD 65,000), anything ($82,000 SD 53,000), crappie ($76,000, SD 39,000), and sunfish ($71,000, SD 45,000). Tournament anglers on average had the highest household income ($130,000, SD 93,000; Table 11). Hybrid striped bass had too low a sample size to determine average household income. Ninety one percent of the anglers interviewed were Caucasian while the remaining 9% where other ethnicities. The average trip quality rating for all anglers was 2.7 out of 5, with 1 being equal to poor and 5 equating to excellent. Trip satisfaction ratings ranged from bass anglers (3.2 out of 5) to hybrid striped bass anglers (1 out of 5).

Forty-five percent of all anglers who were interviewed stayed at least one day overnight. Most of anglers who had overnight trips stayed at a campground (40%), followed by hotel/motel (24%), private property (22%), friends/family house (7%), and other/RV park (7%).

III. 4. Expenditures and Tax Revenue

From the follow up telephone survey, it was estimated that anglers targeting bass spent the most per trip day ($308), followed by sunfish ($115), catfish ($110), crappie ($108), anything ($101), and hybrid striped bass anglers ($49; Table 17). Anglers who stayed overnight spent an estimated $100 more per day than anglers who had a 1-day visit (Table 17). Anglers targeting bass, crappie, and anything spent more money per day if staying overnight compared to 1-day visit anglers. Anglers targeting sunfish, catfish, and hybrid striped bass all spent more money per day if having a 1-day visit compared to overnight, however, there were no anglers targeting hybrid striped bass who stayed overnight from the follow-up telephone interview. Most of expenditures were for fuel (32%), followed by repair and maintenance (22%), lodging (18%), groceries (11%), restaurant meals (7%), equipment/bait (4%), tournament fees (6%), and boat ramp fees (1%). Boat angling parties spent an average of $205 a day; whereas shore anglers spent an average of $95 (Table 18). Tournament angling parties spent $473 per trip day, which was the highest across all angler groups (Table 11).

Alabama resident anglers who participated in the follow-up telephone interview spent an average, of $259 per trip day, followed by Georgia residents ($196), and anglers visiting from states other than Alabama and Georgia ($147) (Table 19). Most expenditures by Alabama residents was spent on repair and maintenance (37%), followed by fuel (26%), lodging (12%), grocery (9%), restaurant meals (6%), tournament fees (5%), equipment/bait (4%), and boat launch fees (1%; Table 19).

Most expenditures by Georgia residents was spent on fuel (33%), followed by lodging (20%), repair and maintenance (14%), grocery (12%), tournament fees (8%), restaurant meals (7%), equipment/bait (4%), and boat launch fees (1%) (Table 19). The most expenditures by residents outside of Alabama and Georgia was spent on fuel (35%), followed by lodging (27%), grocery (15%), restaurant meals (8%), tournament fees (6%), repair and maintenance (5%), equipment/bait (5%), and boat ramp fees (1%; Table 19).

Total annual extrapolated angler expenditures for Lake Eufaula was estimated at $14.6 million (Table 20). Anglers targeting bass accounted for the highest amount of expenditures (71%), followed by anything (11%), crappie (9%), sunfish (5%), catfish (3%), and hybrid striped bass (1%; Table 20). Anglers who were Alabama residents spent 44% of the total expenditures regardless of where they made purchases, followed by Georgia residents (34%), and anglers from areas outside of Alabama and Georgia spent the remaining 22% (Table 21). Of the total expenditures, 86% was spent within the Alabama state border ($12.6 million); 11% were spent within the Georgia state border ($1.6 million), and the remaining 3% was spent in other states ($0.4 million).

Total tax revenue gained related to fishing on Lake Eufaula was $1.24 million (Table 22). Of the total tax revenue, Alabama received $1,067,140, Georgia received $126,039, and all other states received $33,420. General sales generated 38% of this revenue followed by fuel sales (37%), and lodging (25%). Total tax revenue totaled $422,563 for the contiguous Alabama counties to the reservoir and their included cities of Abbeville, Headland, Clio, and Eufaula (Table 22). Total tax revenue totaled $9,626 for the contiguous counties in Georgia and their included cities of Lumpkin, Omaha, Georgetown, and Fort Gains.

III. 5. Travel Cost Model and Consumer Surplus

Variables that were significant in explaining overall angler visitation to Lake Eufaula included travel cost, gender, household income, ethnicity, and tournament participation (Table 23). An increase in the probability of not being Caucasian and an increase in tournament participation increased visitation, while an increase in the remaining variables would result in a decrease in visitation. Notably, an increase in travel cost would decrease visitation as economic theory would suggest. Ethnicity was the most influential variable in explaining visitation with a parameter estimate of 0.9813. Consumer surplus among all anglers was $435 per angler visit. Total willingness to pay (WTP) was $352 per angler day which was calculated by summing the consumer surplus per day ($189) and travel cost per day ($163). Travel cost is the summation of both total cost and opportunity to cost travel to Lake Eufaula. Consumer surplus accounted for 54% of the total WTP. Travel cost per day and consumer surplus per day were derived by dividing mean travel cost or consumer surplus per angler visit by average length of stay per visit (2.3 days). Aggregate consumer surplus for all recreational angling at Lake Eufaula was estimated at $14.0 million; and adding total expenditures ($14.6 million) results in an estimated aggregate total WTP of $28.6 million.

Variables significant in explaining angler visitation to Lake Eufaula for bass anglers included travel cost, gender, age, years of fishing experience, and the opportunity cost to travel to a substitute site (Table 24). An increase in age, and the probability of being a female both increased visitation, while an increase in the remaining variables would result in a decrease in visitation. Gender was the most influential variable in explaining visitation with a parameter estimate of 0.8834. Consumer surplus among all anglers was $244 per angler visit. Total willingness to pay (WTP) was $306 per angler day which was calculated by summing the consumer surplus per day ($111) and travel cost per day ($195). Consumer surplus accounted for 36% of the total WTP. Travel cost per day and consumer surplus per day were derived by dividing visit cost by average length of stay (2.2 days).

Variables significant in explaining angler visitation to Lake Eufaula for crappie anglers included travel cost, household income, and tournament participation (Table 25). An increase in all of the variables would result with a decrease in visitation. Household income was the most influential variable in explaining visitation with a parameter estimate of -0.7719. Consumer surplus among all anglers was $50 per angler visit. Total willingness to pay (WTP) was $144 per angler day which was calculated by summing the consumer surplus per day ($19) and travel cost per day ($125). Consumer surplus accounted for 13% of the total WTP. Travel cost per day and consumer surplus per day were derived by dividing both by average length of stay (2.7 days.)

Variables that were significant in explaining angler visitation to Lake Eufaula for sunfish anglers included travel cost, household income, probability of not being Caucasian, and tournament participation (Table 26). An increase in all of the variables would result with a decrease in visitation. Ethnicity was the most influential variable in explaining visitation with a parameter estimate of -2.1611. Consumer surplus among all anglers was $21 per angler visit. Total willingness to pay (WTP) was $173 per angler day which was calculated by summing the consumer surplus per day ($16) and travel cost per day ($157). Consumer surplus accounted for 9% of the total WTP. Travel cost per day and consumer surplus per day were derived by dividing both by average length of stay (1.3 days.)

Variables that were significant in explaining angler visitation to Lake Eufaula for catfish anglers included travel cost and years of fishing experience (Table 27). An increase in years of fishing experience positively influenced visitation, while an increase in the travel cost would result in a decrease in visitation. Years of fishing experience was the most influential variable in explaining visitation with a parameter estimate of 0.0766. Consumer surplus among all anglers was $81 per angler visit. Total willingness to pay (WTP) was $71 per angler day which was calculated by summing the consumer surplus per day ($25) and travel cost per day ($46). Consumer surplus accounted for 35% of the total WTP. Travel cost per day and consumer surplus per day were derived by dividing visit cost by average length of stay (3.2 days.)

Variables that were significant in explaining angler visitation to Lake Eufaula for anything anglers included travel cost, age, tournament participation, years of fishing experience, and CPE (Table 28). An increase in years of fishing experience positively influenced visitation, while an increase in the remaining variables would result in a decrease in visitation. CPE was the most influential variable in explaining visitation with a parameter estimate of -0.1247. Consumer surplus among all anglers was $119 per angler visit. Total willingness to pay (WTP) was $190 per angler day which was calculated by summing the consumer surplus per day ($46) and travel cost per day ($144). Consumer surplus accounted for 24% of the total WTP. Travel cost per day and consumer surplus per day were derived by dividing both by average length of stay (2.6 days).

Variables that were significant in explaining angler visitation to Lake Eufaula for tournament bass anglers included travel cost and CPE (Table 29). An increase in both variables would result with a decrease in visitation. CPE was the most influential variable in explaining visitation with a parameter estimate of -0.1302. Consumer surplus among all anglers was $164 per angler visit. Total willingness to pay (WTP) was $208 per angler day which was calculated by summing the consumer surplus per day ($63) and travel cost per day ($145). Consumer surplus accounted for 30% of the total WTP. Travel cost per day and consumer surplus per day were derived by dividing visit cost by average length of stay (2.6 days.). Due to a small sample size, a TCM regression was not run for hybrid striped bass anglers. Due to a small sample size (N = 2), a TCM regression was not run for hybrid striped bass anglers.

Variables that were significant in explaining angler visitation to Lake Eufaula by local anglers included travel cost, tournament participation, and CPE (Table 30). As all had a negative signs for coefficients, an increase in all of the variables would result in a decrease in visitation. Travel cost was the most influential variable in explaining visitation with a parameter estimate of -0.0789. Consumer surplus among all anglers was $13 per angler visit. Total willingness to pay (WTP) was $32 per angler day which was calculated by summing the consumer surplus per day ($5) and travel cost per day ($27). Consumer surplus accounted for 16% of the total WTP. Travel cost per day and consumer surplus per day were derived by dividing both by average length of stay (2.8 days.)

Variables that were significant in explaining angler visitation to Lake Eufaula by non-local anglers included travel cost, probability of being a female**,** age, household income, and years of fishing experience (Table 31). An increase in years of fishing experience positively influenced visitation while an increase in the remaining variables would result in a decrease in visitation. Gender was the most influential variable in explaining visitation with a parameter estimate of -0.8932. Consumer surplus among all anglers was $135 per angler visit. Total willingness to pay (WTP) was $240 per angler day which was calculated by summing the consumer surplus per day ($54) and travel cost per day ($186). Consumer surplus accounted for 23% of the total WTP. Travel cost per day and consumer surplus per day were derived by dividing both by average length of stay (2.5 days.)

IV. DISCUSSION

IV. 1. Roving Creel Survey

An on-site roving creel survey was chosen over an access point creel survey due to the large size of Lake Eufaula and the amount of access points on the lake. There are a total of at least 27 boat ramps on Lake Eufaula so it would be difficult to survey at any singular ramp and be confident in the overall sample size. On-site creel surveys typically lasted 3-5 minutes and were conducted to gain preliminary fishing information from anglers. Throughout the course of the survey period, an average of 2.6 angling parties were interviewed during each on-site roving creel period. This average was higher than on Lewis Smith Lake, Alabama (1.9; Lothrop 2012), but lower than on Lake Guntersville, Alabama (4.8; McKee 2013), and Millers Ferry Reservoir, Alabama (3.9; Gratz 2017). Lake Guntersville, Alabama study site was the largest out of the four study sites where angling parties per hectare were compared (27,500 ha), followed by Lake Eufaula (13,500 ha), Lewis Smith, Alabama (8,600 thousand ha), and Millers Ferry Reservoir (7,000 ha). Some days in the slower angling months during winter and fall months, multiple creel surveys were performed in the 4-hour time period. This was to ensure that effort towards interviews was maximized while surveyors were on Lake Eufaula. By interviewing multiple sections on slower days, interviews per 4-hour time period increased to an adjusted 3.4 interviews per roving creel time period. Fewer anglers may have been contacted per time period due to the sectioning of the lake.

Survey effort assigned to weighted sections closely matched actual survey effort (Table 32). Section C was sampled most frequently (38%), followed by B (25%), A (24%), and D (12%; Table 32). Section D had the least amount of actual fishing pressure while sections A and B had about the same amount of fishing pressure, and section C had the highest amount of actual fishing pressure (Table 32). The utilization of section C was overestimated by 19%, while sections A, B, and D were underestimated by 3%, 4%, and 12% respectively (Table 32). The proportion of actual fishing pressure was not exact compared to the weighted sampling. This could be due to the location of Lake Point Marina in Section C, making this section a much more popular area. Section D was least popular due to the lack of access points where anglers could launch their boats.

Due to the width of large areas in Lake Eufaula, smaller amounts of shoreline km were surveyed per section, most notably in section A, B, and C (Figures 3-6). The longest width of Lake Eufaula is approximately 5.6 km, while on average section D is < 0.5 km. Anglers were encountered more frequently fishing in association with the shoreline, so if sections were divided more longitudinally, there may have been more encounters per roving creel survey.

The proportions of interviewed anglers by season during the on-site roving creel survey were nearly identical to those anglers who responded for the follow-up telephone survey (Tables 4 and 33). The highest amount of anglers were interviewed in the spring, followed by summer, fall, and winter. The proportions of interviewed anglers by reservoir section during the on-site roving creel survey were also nearly identical to those anglers who responded for the follow-up telephone survey (Tables 5 and 34). The highest amount of angler interviews were in section C, followed by A, B, and D. These similarities indicate that the follow-up telephone survey is representative of data collected during the on-site roving creel survey.

IV. 2. Follow-up Telephone Survey

To obtain completed visit information and specifics about expenditures, follow-up telephone surveys were attempted for each angler who agreed to the interview. The follow-up telephone interview lasted 10-15 minutes and covered a greater amount of trip details than that of the on-site survey. Only 3% of anglers who were interviewed during the on-site creel survey refused a follow-up telephone interview. Of the remaining anglers who agreed to a follow-up telephone survey, 67% participated within three calls. Calls were typically made during weekdays between 4-8 pm in the anglers' time zone. During the end of the on-site creel survey, anglers were informed that the surveyor would be calling from a telephone with an Auburn area code to limit ignored calls from unfamiliar numbers. Anglers seemed most responsive to calls from a local area code, so most calls were conducted using an Alabama landline telephone. If anglers could not be reached during the week, a third call was attempted during the weekends. This procedure of making phone calls may have resulted in a response rate that was higher than for Lewis Smith Lake, Alabama (52%; Lothrop. 2012) and Lake Guntersville, Alabama (56%; McKee 2013). A response rate of 81% was reported by Gratz (2017), however, this was an adjusted response rate based on removing wrong numbers from the calculation. Response rates for this survey were also higher than the mail-in response rates on Alabama water bodies sent by both Quintana (25%; 2015) and Snellings (26%; 2015), and for Oklahoma resident anglers (26%; Long and Melstrom 2014) who used web and phone surveys along with mail-in surveys. A mixture of contact attempts may increase the likelihood of response for follow-up telephone surveys.

Lake Eufaula has a noticeable presence of aquatic vegetation, most commonly Hydrilla. Hydrilla seems to be most abundant during the summer months, especially in the south end of the reservoir and in coves along the lake. Noticing this trend in previous years led to a follow-up question on whether or not the angler being interviewed would prefer less, the same amount, or more aquatic vegetation in Lake Eufaula. Amongst all anglers 34% preferred less, 39% preferred the same, and 27% preferred more aquatic vegetation. The results were similar to a mail-in survey for anglers in the state of Texas where 41-54% anglers were neutral on their feelings towards aquatic vegetation (Wilde et al. 1992). However, forty-nine percent of all anglers at Lake Seminole responded that they would prefer less aquatic vegetation (Slipke et al. 1998). Amongst bass anglers 22% preferred less aquatic vegetation, 40% preferred the same, and 28% preferred more. Slipke et al. (1998) also reported that on Lake Seminole, bass anglers preferred the same amount of aquatic vegetation regardless of whether they owned waterfront property. Out of anglers who claimed to have some sort of waterfront residence on Lake Eufaula, 59% preferred less hydrilla, 24% preferred the same, and 17% preferred more aquatic vegetation. The trend of lake front homeowners preferring less aquatic vegetation compared to non-home owners was similar at Lake Seminole (Slipke et al. 1998). Residence on lakes most likely prefer less vegetation due to aesthetic, economic, and recreational problems associated with an abundance of aquatic plants (Wilde et al. 1992).

Another subject that came up frequently in conversation with anglers was the stocking of hybrid striped bass. The presence of striped bass in a reservoir has resulted in complaints amongst anglers targeting other fish species based on preconceived notions that striped bass negatively affect other species (Churchill et al. 2002). Many anglers reported that they believe hybrid striped bass are either overconsuming bass or outcompeting with them. ADCNR and GADNR both stock hybrid striped bass annually in Lake Eufaula. Currently, both Alabama and Georgia stock 6 fingerling per acre resulting in an average of 271,000 fingerlings of hybrid striped bass per year. A question during the follow-up interview was whether or not the angler being interviewed would prefer less, the same amount, or more hybrid striped bass in Lake Eufaula. Amongst all anglers 16% preferred less, 50% preferred the same, and 34% preferred more hybrid striped bass in Lake Eufaula. Amongst bass anglers, 20% preferred less, 47%

preferred the same, and 33% preferred striped bass in Lake Eufaula. Although bass anglers seem to slightly prefer less hybrid striped bass compared to all anglers, Shepherd and Maceina (2009) reported that on Lewis Smith Lake, Alabama, the stocking of hybrid striped bass had minimal effect on black bass populations.

IV. 3. Aerial Boat Counts

Aerial boat counts proved to be an important procedure that complimented both the on-site and follow-up telephone interviews. Aerial boat counts helped extrapolate angling effort and expenditures that may have otherwise been underestimated by using the roving creel survey alone. If we relied solely on instantaneous counts and roving creel surveys without the aid of aerial boat counts, effort would have been underestimated by approximately 82%. Similar to the boat angling effort estimated in the Delaware River and Estuary (Volstad et al. 2006) and boat angling effort on Lake Guntersville, Alabama (McKee 2013), the aerial counts on Lake Eufaula resulted in a standard error of total angling effort below 20%. Each aerial survey took an average of one hour to complete. During this hour we were able to get an accurate estimate of fishing pressure on the entire reservoir during any given sample time period. The aircraft allowed surveyors to spot fishing boats that otherwise may have been missed during the roving creel survey. Aerial counts also allowed surveyors to skip certain shallow long coves during instantaneous counts which enabled them to focus more on higher fishing pressure areas. Smallwood et al. (2012) commented after their aerial surveys in Perth, Western Australia, that aerial surveys are a good tool to determine where to focus sampling effort for future surveys. The aerial counts also confirmed that the weighted samplings conducted for each section corresponded with the actual fishing pressure per section. Although we did not count boats per section on aerial flights, it was apparent after multiple flights that the angling boats were proportionally similar to the weights we previously assigned for each section.

Angling boats observed during the aerial survey were similar to angling boats interviewed on the roving creel survey based on season, strata, and sampling time block. The majority of boats observed during both flight and roving creel surveys was highest during spring, followed by summer, fall, and winter; was highest during weekend days compared to weekdays; and was highest during the noon shift, followed by the AM shift, and PM shift (Tables 3,4,8 and 9). Observing similar trends over the whole lake during aerial surveys is representative of what is actually occurring during on-site interviews. This assumption may be useful for future roving creel surveys. Smallwood et al. (2012) reported that out of three sampling techniques using remote cameras, roving creel surveys, and aerial boat counts, aerial boat counts was the cheapest method. They were able to collect a vast amount of effort data while minimizing the expenses of hiring a crew to complete more labor intensive survey methods.

IV. 4. Effort, Catch, and Harvest Rates

Lake Eufaula had a total fishing effort of 499,794 h which was less than half the amount of Lake Guntersville, Alabama (1,349,000 h; McKee 2013), but much higher than both Lewis Smith Lake, Alabama (233,756 h; Lothrop 2012), and Millers Ferry Reservoir, Alabama (97,257 h; Gratz 2017). Observed bass catch per effort (CPE) were 0.95 bass/h which is greater than on Lewis Smith Lake, Alabama (0.76 Bass/h; Lothrop 2012), Millers Ferry Reservoir, Alabama (0.75 bass/h; Gratz 2017) and on Lake Guntersville, Alabama (0.64 bass/h). Tournament anglers had a higher CPE on Lake Guntersville, Alabama with 0.77 bass/h (Snellings 2015) than the other reservoirs mentioned except for Lake Eufaula tournament anglers (0.96 bass/h). Lake Eufaula also had a higher CPE for catfish and anything (1.40 catfish/h, 2.08 anything/h) than both Lake Guntersville, Alabama (0.33 catfish/h, 1.57 anything/h; McKee 2013) and Millers

Ferry Reservoir, Alabama (1.11 catfish/h, 0.78 anything/h; Gratz 2017). During a creel survey on Lake Wilson, Alabama, a slightly higher CPE compared to Lake Eufaula was reported for catfish (1.5 catfish/h; Holley et al. 2009). Holley et al. (2009) reported that 50% of angling effort was directed towards catfish, which is a significantly larger proportion compared to Lake Eufaula in which anglers targeting catfish accounted for only 5% of total angling effort. Bass HPE on Lake Eufaula was 0.04 bass/h which was higher than Lake Guntersville, Alabama (0.02/h; McKee 2013), but lower than both Millers Ferry Reservoir, Alabama (0.10 bass/h; Gratz 2017) and Lewis Smith Lake, Alabama (0.20 bass/h; Lothrop 2012). Typically tournament anglers release bass back into the reservoir rather than participating in harvest. Tournament angling is popular at both Lake Eufaula and Lake Guntersville which would results in an overall lower harvest rate for bass.

The proportion of shore anglers to boat anglers was relatively low on Lake Eufaula (5%). On Lake Guntersville, Alabama 13% of all anglers where shore anglers (McKee 2013), while on Millers Ferry Reservoir, Alabama, 10% of all anglers interviewed were shore anglers (Gratz 2013). The two reservoirs may have more shoreline areas with easier access compared to Lake Eufaula resulting in more shore anglers.

The majority of fishing effort was observed in the spring time, followed by summer, fall, and winter. This has been a common trend between other surveys such as Lewis Smith Lake, Alabama, (Lothrop 2012), and on Millers Ferry, Alabama, (Gratz 2017). Lake Guntersville, Alabama, showed the same trend for highest fishing pressure in the springtime (McKee 2013), however, most of the effort afterwards showed a different pattern of second highest effort during the winter, followed by summer, and fall. Multiple anglers reported to creel clerks on both Lake Eufaula and Millers Ferry, Alabama (2017) that during the winter months they commonly choose to hunt rather than fish. It is possible that less people hunt around the Lake Guntersville area resulting in more angling effort during the winter time.

The majority of fishing effort on Lake Eufaula was observed during the weekend compared to weekdays. This has been a common trend between other surveys such as Lothrop (2012), McKee (2013), and Gratz (2017). The weekend is most popular for obvious reasons such as time off work, and highest percentage of fishing tournaments occurring during this time. In general, this trend should be similar to most lakes regardless of their location resulting in higher fishing pressure during weekends.

The highest density of anglers was observed during the noon period. This may be due to both recreational and tournament anglers fish on the water at the same time during this time period. The noon sampling period was also the most popular on Lake Guntersville, Alabama, (McKee 2013) and Millers Ferry, Alabama, (Gratz 2017).

More than half of the anglers interviewed were located in section C (Table 5). Again, the reason for this is due to the high popularity of Lake Point Marina and its large ramp facility, which is centrally located in section C. Shore anglers were interviewed in all sections except for section D. Section D is less populated and has fewer boat ramps and access points resulting in less shore angling opportunities.

IV. 5. Angler Socioeconomic Characteristics

The mean party size for all anglers was 1.92, which was higher than on both Lake Guntersville, Alabama (1.84; McKee 2013), and Millers Ferry Reservoir, Alabama (1.77; Gratz 2017). The mean party size for bass anglers was the smallest at 1.84 (Table 12) while spending the most time on the lake at 7.7 hours per day (Table 10). This may be related to tournament angling. Typically there are two anglers during a tournament and tournaments can last up to 10 hours per day.

Twenty seven percent of all anglers interviewed lived in contiguous counties of Lake Eufaula in Alabama while only three percent lived in contiguous counties of Lake Eufaula on the Georgia side (Tables 14 and 15). Local anglers were more prominent on both Millers Ferry Reservoir, Alabama (33%; Gratz 2017) and Lake Guntersville, Alabama (63%; McKee 2013). The combined two Alabama contiguous counties (Henry and Barbour) have a population that is 3.8 times higher than the combined three Georgia contiguous counties (Stewart, Quitman, and Clay; U.S. Census Bureau 2010). Fifty seven percent of anglers claimed residency in Alabama, followed by 34% in Georgia, and 9% for all other states.

The average one-way distance people travel to Lake Eufaula to fish was 150 kilometers which is higher than on Lewis Smith Lake, Alabama (77 kilometers; Lothrop 2012), Lake Guntersville, Alabama (106 kilometers; McKee 2013) and Millers Ferry Reservoir, Alabama (115 kilometers; Gratz 2017). Anglers may travel such a long distance compared to other reservoirs due to the lack of waterbodies around the Eufaula area, or because people generally prefer to fish Lake Eufaula over any other lake. During the follow-up interview, 73% of anglers said they prefer Lake Eufaula over any other water body located in Georgia or Alabama that they had fished in the past year. Anglers may travel further on average compared to Lake Guntersville, Alabama and Millers Ferry, Alabama because there are a higher percentage of local anglers around both of those water bodies.

Bass anglers were the youngest of all age groups and had the largest income which is similar to the findings of McKee (2013) and Gratz (2017). McKee (2013) and Gratz (2017) reported sunfish having the second highest income, followed by crappie, then catfish and anything anglers while on Lake Eufaula the second highest income was anglers targeting catfish, followed by anything, crappie, and sunfish anglers. Tournament anglers for Lake Eufaula had the highest income out of any target species groups. This is most likely because in general tournament anglers own their own boat, trailer, truck, and have more overnight trips in order to pre-fish tournaments compared to other anglers.

Although anglers were asked on the on-site roving creel survey if they were currently on a guided trip, there were no anglers who had a guide during that time. There were however three encounters with guides themselves who were fishing on solo trips. Two guides offered services to target any fish while one was strictly a bass angling guide.

IV. 6. Expenditures and Tax Revenue

Recreational anglers on Lake Eufaula spent an estimated $14.6 million which was less than Sam Rayburn Reservoir, Texas ($32.3 million; Driscoll et al. 2010), but more than on Lake Guntersville, Alabama ($13.4 million; McKee 2013), and Millers Ferry Reservoir, Alabama ($2.5 million; Gratz 2017). Sam Rayburn Reservoir, Texas most likely had the highest amount of expenditures compared to other reservoirs because it has the most hectares of fishable water. Although Lake Eufaula is smaller in size compared to Lake Guntersville, Alabama, anglers travel greater distances to fish at Lake Eufaula which leads to higher expenditures. Lewis Lake, Alabama and Millers Ferry, Alabama had lower expenditures most likely because the reservoir is a lot smaller compared to the others.

Previous studies have reported that anglers tend to underestimate their expenditures during the on-site survey compared to the follow-up telephone survey. On Lake Eufaula, expenditures were underestimated by 48%. In general, asking about expenditures during the on-site survey is not reliable. This pattern was similar to previous studies but was underestimated at a much higher percentage compared to on Lake Guntersville, Alabama (12%; McKee 2013), Millers Ferry Reservoir, Alabama (17%; Gratz 2017), and on Lewis Smith Lake, Alabama (28%; Lothrop 2012). During the follow-up telephone survey, anglers are required to break down their expenditures by category, which aids in determining exact cities where money was spent. This enabled detailed information so we could further figure out tax revenue by county and cities. We can assume economic data from the follow-up survey is more accurate than the on-site survey because estimates were from completed trip information rather than a guess as to what the angler thought they were going to spend. However, the longer period between angling trip and follow-up survey can affect memory of individual costs incurred.

Among all anglers, fuel was the largest expenditure compared to any other category, which supports findings from McKee (2013) and Gratz (2017). This held especially true for bass anglers compared to other angler target species groups. On average, bass anglers traveled the furthest to visit Lake Eufaula, especially tournament bass anglers. Along with spending more money for vehicle fuel, bass anglers typically travel farther distances on the water which results in a greater boat gas usage. This trend was witnessed on Lake Eufaula where anglers were interviewed up to 52 kilometers from where they put in. Similarly Gratz (2017) interviewed anglers up to 60 kilometers from where they originally launched their boat. Long and Melstrom (2016) also saw similar trends in their study surveying Oklahoma anglers, where bass anglers spent more money compared to any other targeted species group except for trout.

Repair and maintenance were the second largest expenditure on Lake Eufaula. Through personal communication with anglers, repair costs often accrued from hitting stumps in backwaters. This reservoir has large shallow areas in open water sections. With the fluctuation of water levels at Lake Eufaula, anglers claimed to have hit stumps that they had previously avoided when water levels were higher. Another expense that commonly came up in conversation was wear and tear on vehicles traveling to Eufaula and returning home. The chance of vehicles needing repair and maintenance increases with travel distance from Lake Eufaula.

Lodging was the third largest expenditure on Lake Eufaula. Anglers traveled long distances to fish Lake Eufaula and stayed an average of 2.3 days, resulting in anglers spending a significant portion of their expenditures on lodging. Having a higher proportion of expenditures going towards gas and lodging also help explain why angling parties who stay overnight spend approximately twice the amount of money per day compared to anglers who fish day trips only. Non-resident anglers' trip expenditures are typically higher because their trip length is longer compared to resident anglers (Hutt et al. 2013). People who are traveling farther distances spend more money on gas and lodging, while day trip anglers travel fewer miles and do not spend money on lodging. Further, anglers who stay overnight are more likely to eat at restaurants compared to day trip anglers who are more likely to pack a lunch and bring their own groceries.

There are several reasons why anglers spent approximately 8 times more in Alabama compared to Georgia (Table 22). Out of Alabama and Georgia anglers, 61% live in Alabama compared to 39% in Georgia. There are also more local anglers on the Alabama side of the reservoir compared to the Georgia side (Tables 14 and 15). In general, more anglers are local to Alabama, so they spend more money in the contiguous counties they are traveling from. There are also more than 5 times the amount of boat ramps in Alabama compared to Georgia. This would encourage more anglers to put their boats in on the Alabama side due to a wider range of access and this proximity to Alabama increases their opportunity to make purchases in Alabama. Out of all the boat ramps, Lake Point is used at the highest rate compared to any other ramp in either Alabama or Georgia. Lake Point boat ramp has multiple launch areas, more amenities, and a higher capacity compared to any other boat ramp on Lake Eufaula. Infrastructure such as those on Lake Point encourage large events that attract tournament bass anglers (Driscoll and Myers 2014). Forty-four percent of all anglers who used a boat ramp launched out of Lake Point Marina, increasing the odds of anglers making purchases on the Alabama side. Out of all anglers who claimed to stay at some sort of lodging, only 7% of those anglers stayed overnight in Georgia while 93% stayed overnight in Alabama. Lastly, there are more lodging, restaurants, gas stations, and grocery stores on the Alabama side than the Georgia side.

Combining both Georgia and Alabama contiguous counties results in 67% of all expenditures being spent locally. This was higher than on Millers Ferry Reservoir, Alabama (50%; Gratz 2017) but lower than on Lake Guntersville, Alabama (80%; McKee 2013) and Lewis Smith Lake, Alabama (84%; Lothrop 2012). The percentage of expenditures incurred locally at Millers Ferry Reservoir, Alabama was most likely smaller in comparison due to the lack of resources surrounding the majority of the surveyed water body (Gratz 2013). The percentage of expenditures incurred locally at Lake Guntersville, Alabama and Lewis Smith Lake, Alabama was most likely smaller in comparison to Lake Eufaula because the other lakes had a higher percentage of local anglers, ensuring that money spent related to fishing would stay in the local counties.

Tax revenue generated from both Alabama and Georgia cities in contiguous reservoir counties amounted to $432,190 and an additional $770,616 in state taxes. Out of the cities in contiguous counties of Lake Eufaula, Alabama received 98% of the tax revenue while Georgia received 2%. Out of the total state taxes, Alabama received 84% of the state tax revenue while Georgia received 16%. This is due to Alabama having eight times the expenditures spent in the state compared to Georgia. General taxes generated the largest amount of tax revenue with both Alabama and Georgia cities in contiguous counties amounting to $203,661 and an additional

$266,601 in state taxes. Ranging from a 4 to 6% general sales tax rate, all Alabama and Georgia cities in contiguous counties benefited from these taxes; excluding Lumpkin, GA where no general sales expenditures were reported during follow-up phone interviews. Fuel tax generated the second highest amount of tax revenue. Only cities in contiguous counties of Alabama received benefits of $43,542 since there is no county or city tax for fuel in Georgia. Alabama and Georgia did however receive $380,878 in state fuel tax revenue. The smallest category to receive tax revenue was lodging in which Omaha, GA received $281 and Eufaula, Alabama received $184,706. In addition, Alabama received $123,137 state tax from lodging. During the survey period, a state tax was not implemented in Georgia on lodging. Using a 4% tax rate on general sales and the national average of $0.23 per gallon, an estimated $33,420 of tax revenue went to states other than Alabama and Georgia where anglers spent money.

IV. 7. Travel Cost Model and Consumer Surplus

A key component in determining the value of a fishery is to estimate an angler's willingness to pay that exceeds their actual expenditures during a visit. This study examined 10 survey variables to help explain angler demand at Lake Eufaula. Binary variables included gender and ethnicity, while non-binary variables included travel cost, household income, tournament participation, years of fishing experience, CPE, and opportunity cost to travel to a substitute site.

All of the variables in the TCM were significant in explaining at least one of the models that were analyzed. An increase in travel cost resulted in a decrease in visitation among all models. This would be expected assuming that less visits would be taken by an angler as expenditures associating with fishing at Lake Eufaula increases. Ninety-seven percent of anglers interviewed were male which explains why an increase in the probability of being female resulted in a decrease in visitation for two of the models. However, one model was positively related to being female which may have to do with the small sample size of female anglers. An increase in age resulted in a decrease in visitation for two models and was positively related to visitation in one model. An increase in age resulted in a decrease of visitation amongst bass tournament anglers but was not statistically significant (Table 29). When asking bass anglers if their trip was related to a tournament, many replied by saying that they used to at a younger age. This would also explain why there is a positive relationship with visitation with increased bass angler age (Table 24). An increase in household income resulted in a decrease in visitation in four models. In general if household income increases, the number of trips taken to a particular area should increase (Pokkia et al. 2018). I expected bass anglers and tournament bass anglers to have a positive relationship with household income and visitation but this was not the case for this study. More than 91% of anglers interviewed were Caucasian which explains why an increase in the probability of being Caucasian was positively related to visitation in one model. However, one model was negatively related to being Caucasian which may have to do with the small sample size of non-Caucasian angler. An increase in the amount of tournaments an angler participated in during the last year resulted in a decrease in visitation in four models and was positively related to visitation in one model. An increase in years of fishing experience resulted in a decrease in visitation for two models and was positively related to a visitation in two models. An increase in CPE resulted in a decrease of visitation in two models. An increase in opportunity cost to travel to a substitute site resulted in decrease visitation for two models.

Estimated consumer surplus for anglers at Lake Eufaula was $435 per visit and $189 per day. These results were higher than most other studies that used a negative binomial model to estimate consumer surplus on other reservoirs. McKee (2013) estimated an average consumer surplus of $156 per angler day. Lothrop et al. (2014) estimated an average consumer surplus of $47 per angler day for striped bass anglers on Lewis Smith Lake, Alabama. Other studies who had lower consumer surplus values included on the Lower Illinois River, Oklahoma ($112; Prado 2006), on the Snake River, Idaho ($159; Nowell and Kerkvliet 2002), and in Yellowstone National Park ($172; Kirkvliet et al. 2000).

Studies reviewed for consumer surplus comparisons that were higher than Lake Eufaula included Snellings (2015) who calculated a higher consumer surplus per angler day for tournament anglers on Lake Guntersville, Alabama ($225). While comparing just bass angler consumer surplus, Bilgic and Florkowski (2007) estimated a higher average consumer surplus for southeastern United States ($161 per day) compared to Lake Eufaula bass anglers ($111).

Consumer surplus per day was highest at Lake Eufaula for bass anglers ($111), tournament bass anglers ($63), and non-local anglers ($54). These three types of angling groups also have the highest travel costs compared to any other angler target groups which helps explain this trend.

Aggregate consumer surplus for Lake Eufaula was estimated to be $14 million which was higher than on Lewis Smith Lake, Alabama ($0.6 million; Lothrop 2014), but lower than on Lake Guntersville, Alabama (31.8; Mckee 2013). Total willingness to pay per angler day was $352 which was higher than on Lake Guntersville, Alabama ($270; McKee 2013). Although estimates of Lake Eufaula willingness to pay was higher than McKee (2013), aggregate consumer surplus was a smaller amount. This is most likely because Lake Guntersville had a higher amount of estimated total angling trips compared to Lake Eufaula.

V. CONCLUSIONS AND MANAGEMENT IMPLICATIONS

Implementing an aerial boat count to compliment a roving creel survey for this study was an important method in estimating angler effort. McKee (2013) also noticed the importance for the combination of both methods most notably because it allowed him to focus on surveying in higher fishing pressure areas during the on-site roving creel. Gratz (2015) admits that not having access to aerial boat counts limited his time in accurately surveying the entirety of his study area. In future roving creel surveys, implementing an aerial boat count for the study would be beneficial in accurately estimating angling effort which in return would maximize their efficiency in calculating yearly expenditures.

Although shore anglers only accounted for 5% of the total angler interviews, managers should consider accommodating the needs of these anglers in the future. There are fishing dock areas around boat ramps alongside the Lake Eufaula boundary, but the proximity is very close to boats entering and exiting the water. Some complaints from shore anglers included the disruption that occurs from constant boat action. If parks where could add areas away from the main boat ramps, they should in return see an increase in shore angler presence at their facilities.

After conducting the survey, it is apparent that most expenditures are being spent on the Alabama side compared to the Georgia side of Lake Eufaula. The main reason of this is the lack of accommodations on the Georgia side. Road access to the lake is more spread out and has a lot fewer boat ramps in Georgia. Although it would be hard to replicate the space and amenities Lake Point Marina has, Georgia could add more boat ramp or shore line access areas which would increase revenue going to the surrounding counties of Lake Eufaula. Having road access to more boat ramps would also increase the opportunity to build more infrastructures such as gas stations, restaurants, bait and tackle shops, and hotels to accommodate anglers. Comments from anglers about hotels on the Alabama side may also need to be taken into consideration for businesses. Anglers have commented that there are only a handful of hotel and motels that fully accommodate boat anglers. The most popular hotels are ones in which there are adequate parking for boats and trailers that also include plug in options to charge batteries overnight. Multiple tournament bass anglers that were interviewed stated that they visited the lake for 7 days prior to their tournaments. By expanding parking lots on existing hotels, or building overnight facilities in the future, accommodating boat anglers would increase the chance of anglers staying at their particular business.

Increasing the amount of angler presence on Lake Eufaula should be a top priority for managers interested in accumulating more expenditures around the reservoir. There are two main demographics that were under represented in the angler population. Minority groups and females had fewer numbers of anglers compared to the average male Caucasian angler. There is a chance that these groups don't get the same exposure to angling. To increase visits from these groups, managers need to consider how to attract these could be anglers. A way to do this may be to have natural resource agencies promote free angling days several times a year. If this is advertised well and the agencies provide fishing equipment, we may see an increase in certain demographics that haven't had the exposure in their past.

Fish management agencies may decide to replicate this study on Lake Eufaula or other reservoirs in the future. If state agencies want to get as much out of the interview process with the smallest amount of time or money invested, they may want to consider focusing survey efforts towards times when angling was witnessed during its highest pressure. Many previous studies including the one on Lake Eufaula noticed the highest boat density during spring months.

On average 8.21 boats per 1,000 hectares were observed during the aerial boat count which was higher than during any other season (Table 7). The noon shift during the aerial boat count survey also had the highest density of angling boats compared to any other time shift. If managers are limited on resources, they may want to consider only conducting roving creel surveys with aerial boat counts during the noon time block during spring months. If managers can afford to survey for a longer period, they may want to consider excluding winter months. Winter month only accounted for approximately 3% of total interviews during the 2017 survey on Lake Eufaula. Reviewing past literature on angler effort would aid in managers to focus on popular angling times resulting in less resources during times when fishing pressure is not as high.

A few questions during the survey revolved around both the presence of aquatic vegetation in Lake Eufaula and the stocking of hybrid striped bass. After asking how anglers felt about these subjects, it is hard to determine how to manage for the future. On average, anglers currently prefer the management plans for controlling aquatic vegetation and the stocking rate of hybrid striped bass. Although there were small groups who had passionate opinions on both subjects, overall, anglers seemed content with the management practices concerning both controversial issues on Lake Eufaula.

Recreational fishing on Lake Eufaula has proven to be an important source of revenue to both the Alabama side, and hopefully even more to the Georgia side in the future. Investments into infrastructure and amenities to accommodate anglers will be an up-front cost, but after realizing how much fishing effort is associated with the lake, could prove to produce a lot more benefits long term.

VI. References

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VII. TABLES

Table 1. Area covering each section and respected subsection in hectares (Ha), Lake Eufaula, 2017.

Section	Sub 1	Sub 2	Sub 3	Sub 4	Sub 5	Total (Ha)
A	1,734	1,126	1,568	1,208	341	5,977
B	807	1,431	555	1,103	-	3,896
C	863	881	409	642	-	2,795
D	209	253	339	-	-	800
Total	3,613	3,691	2,871	2,953	341	13,468

Table 2. Anglers targeting specific species by sampling time block (morning [AM], noon [NN], and evening [PM]) contacted during the on-site roving creel survey, Lake Eufaula, 2017.

	AM		NN		PM		Total	
Angler Type	N	%	N	%	N	%	N	%
Bass	75	25	176	59	46	16	297	52
Crappie	19	23	38	47	24	30	81	14
Sunfish	13	29	21	48	10	23	44	8
Catfish	10	32	12	38	9	29	31	5
Striped Bass	1	20	2	40	2	40	5	1
Anything	15	13	61	53	39	34	115	20
Total	133	23	310	54	130	23	573	100

Table 3. Weekend and weekday strata anglers contacted by season during the on-site roving creel survey, Lake Eufaula, 2017.

	Winter		Spring		Summer		Fall		Total	
Strata	N	%	N	%	N	%	N	%	N	%
Weekend	7	35	166	54	89	53	33	43	295	51
Weekday	13	65	142	46	79	47	44	57	278	49
Total	20	100	308	100	168	100	77	100	573	100

Table 4. Boat and shore anglers targeting specific species by season contacted during the on-site roving creel survey, Lake Eufaula, 2017.

	Winter		Spring		Summer		Fall		Total	
Angler Type	N	%	N	%	N	%	N	%	N	%
Bass	14	70	151	49	83	49	49	63	297	52
Crappie	2	10	50	16	17	10	12	16	81	14
Sunfish	0	0	24	8	17	10	3	4	44	8
Catfish	0	0	13	4	15	10	3	4	31	5
Striped Bass	1	5	4	1	0	0	0	0	5	1
Anything	3	15	66	22	36	21	10	13	115	20
Total	20	100	308	100	168	100	77	100	573	100

Table 5. Boat and shore anglers targeting specific species by reservoir section contacted during the on-site roving creel survey, Lake Eufaula, 2017.

	A		B		C		D		Total	
Angler Type	N	%	N	%	N	%	N	%	N	%
Bass	61	49	61	50	166	54	9	53	297	52
Crappie	23	19	15	12	42	13	1	6	81	14
Sunfish	7	6	9	7	28	9	0	0	44	8
Catfish	11	9	8	7	12	4	0	0	31	5
Striped Bass	4	3	1	1	0	0	0	0	5	1
Anything	18	14	29	23	61	20	7	41	115	20
Total	124	100	123	100	309	100	17	100	573	100

Table 6. Shore anglers targeting specific species by reservoir section contacted during the on-site roving creel survey, Lake Eufaula, 2017.

	A		B		C		D		Total	
Angler Type	N	%	N	%	N	%	N	%	N	%
Bass	0	0	0	0	0	0	0	0	0	0
Crappie	4	36	0	0	2	18	0	0	6	21
Sunfish	1	9	0	0	0	0	0	0	1	4
Catfish	0	0	1	17	1	9	0	0	2	7
Striped Bass	0	0	0	0	0	0	0	0	0	0
Anything	6	55	5	83	8	73	0	0	19	68
Total	11	100	6	100	11	100	0	0	28	100

Table 7. Mean angling boat counts per 1,000 hectares during 59 aerial surveys for various times of year, sample shifts, and strata, Lake Eufaula, 2017.

Day/ Shift	Mean	Std. Dev.	Total Days	Boats per 1000 Hectares
Per Day	66	64	59	4.90
Per Winter Day	21	16	7	1.56
Per Spring Day	111	83	22	8.21
Per Summer Day	38	22	20	2.81
Per Fall Day	44	25	10	3.28
Per AM Shift	54	48	22	3.98
Per Noon Shift	108	86	19	7.98
Per PM Shift	37	21	18	2.75
Per Weekday Day	38	23	31	2.79
Per Weekend Day	97	80	28	7.23

Table 8. Weekend and weekday angler boats observed during aerial boat count survey by sampling time block (morning [AM], noon [NN], and evening [PM]), Lake Eufaula, 2017.

	AM		NN		PM		Total	
Strata	N	%	N	%	N	%	N	%
Weekend	658	56	1,897	93	171	26	2,726	70
Weekday	522	44	146	7	496	74	1,164	30
Total	1,180	100	2,043	100	667	100	3,890	100

Table 9. Weekend and weekday angler boats observed during aerial boat count survey by season, Lake Eufaula, 2017.

	Winter		Spring		Summer		Fall		Total	
Strata	N	%	N	%	N	%	N	%	N	%
Weekend	128	87	1,731	71	574	76	293	53	2,726	70
Weekday	19	13	701	29	182	24	262	47	1,164	30
Total	147	100	2,432	100	756	100	555	100	3,890	100

Table 10. Angling effort, catch rate, and harvest rate information during the day by species obtained by the on-site roving creel survey, Lake Eufaula, 2017.

Method	Angler Type	Angling Effort	Standard Error	Angling Effort %	Average Trip Length, hours	Trips	CPE	HPE	Harvested Fish, #
All	Bass (297)	259,893	25,602	52	7.7	33,752	0.95	0.04	10,396
	Crappie (81)	69,971	6,893	14	5.4	12,958	2.01	1.70	118,951
	Sunfish (44)	39,984	3,939	8	6.1	6,555	3.1	2.07	82,766
	Catfish (31)	24,990	2,462	5	7.2	3,471	1.15	1.03	25,739
	Striped Bass (5)	4,998	492	1	4.5	1,111	4.31	2.14	21,541
	Anything (115)	99,959	9,847	20	6.1	16,387	2.82	1.28	281,884
	Total (573)	499,794	49,235	100	-	74,234	-	-	-
	Average	-	-	-	6.9		-	-	-

Table 10. Continued.

Method	Angler Type	Angling Effort, Hours	Standard Error	Angling Effort %	Average Trip Length, hours	Trips	CPE	HPE	Harvested Fish, #
Boat	Bass (297)	266,658	26,050	54	7.5	39,606	0.95	0.04	10,666
	Crappie (75)	69,134	6,754	14	5.8	10,268	2.06	1.74	120,292
	Sunfish (43)	39,505	3,859	8	5.4	5,868	3.09	2.09	82,565
	Catfish (29)	24,691	2,412	5	6.1	3,667	1.16	1.04	25,678
	Striped Bass (5)	4,938	482	1	4.5	733	2.14	4.31	21,283
	Anything (96)	88,886	8,683	18	6.2	13,202	1.28	2.82	250,658
	Total (545)	493,811	48,241	100	-	73,344	-	-	511,141
	Average	-	-	-	5.9	-	-	-	-
Shore	Bass (0)	-	-	-	-	-	-	-	-
	Crappie (6)	1,256	209	21	3.8	187	0.00	0.00	0.00
	Sunfish (1)	239	40	4	4.0	36	3.43	1.71	409
	Catfish (2)	419	70	7	4.5	62	0.63	0.63	264
	Striped Bass (0)	-	-	-	-	-	-	-	-
	Anything (19)	4,068	676	68	4.1	605	0.53	0.24	2,156
	Total (28)	5,983	994	100	-	890	-	-	2,829
	Average	-	-	-	-		-	-	-

Table 11. Summary of angler variable means by targeted species group, collected during the on-site roving creel, follow-up telephone survey, and aerial boat count survey. Lake Eufaula, 2017.

Variable	Tournament Bass Angler	Bass Angler	All Angler
Angling Effort (hours)	142,941	259,893	499,794
CPE	0.96	0.95	-
Expenditures per Angler/Day ($)	435	182	130
Average Distance One Way (km)	208	174	150
Average Visit Length (days)	2.3	2.2	2.3
Household Income ($)	130,000	118,000	104,000
Expenditures per Angler/Visit ($)	473	308	209
Total Expenditures ($ millions)	4.2	10.4	14.6

Table 12. Mean party size, and expenditures by target species per angler trip obtained during the follow-up telephone survey, Lake Eufaula, 2017.

Target	N	Party Size	Party Size Std Dev	Expenditures ($)	Expenditures Std Dev
Bass	195	1.84	0.68	182	474
Crappie	39	1.87	0.80	74	71
Sunfish	25	2.00	0.41	68	57
Catfish	19	2.31	1.25	61	34
Striped Bass	2	2.50	2.12	26	14
Anything	66	2.07	0.86	58	46
All Anglers	346	1.92	0.77	130	362

Table 13. Number of recreational angling parties contacted during on-site roving creel survey by state of residence, Lake Eufaula, 2017.

State	Total	Bass	Crappie	Sunfish	Catfish	Anything	Striped bass
Alabama	329	151	52	33	17	74	2
Georgia	195	120	24	6	7	35	3
Florida	30	13	1	4	7	5	0
Indiana	1	0	1	0	0	0	0
Kentucky	4	3	1	0	0	0	0
Michigan	1	0	1	0	0	0	0
North Carolina	1	1	0	0	0	0	0
South Carolina	4	4	0	0	0	0	0
Tennessee	7	5	1	1	0	0	0
Wisconsin	1	0	0	0	0	1	0
Total	573	297	81	44	31	115	5

Table 14. Number of recreational angling parties contacted during on-site roving creel survey by county of Alabama residence in Lake Eufaula, 2017.

County	Total	Bass	Crappie	Sunfish	Catfish	Anything	Striped bass
Henry[1]	83	30	14	14	2	22	1
Barbour[1]	70	32	16	5	2	15	0
Dale	48	13	8	7	5	14	1
Russell	20	14	3	0	0	3	0
Lee	18	13	2	1	0	2	0
Pike	14	5	2	0	3	4	0
Coffee	12	5	2	2	2	1	0
Geneva	8	0	1	1	0	6	0
Houston	8	1	2	3	0	2	0
Jefferson	7	7	0	0	0	0	0
Escambia	4	1	0	0	1	2	0
Montgomery	3	1	1	0	0	1	0
Talladega	3	3	0	0	0	0	0
Tuscaloosa	3	3	0	0	0	0	0
Calhoun	3	3	0	0	0	0	0
Covington	2	1	1	0	0	0	0
Etowah	2	2	0	0	0	0	0
Jackson	2	1	0	0	1	0	0
Mobile	2	1	0	0	0	1	0
Walker	2	2	0	0	0	0	0
Baldwin	1	1	0	0	0	0	0
Bullock	1	0	0	0	0	1	0
Cherokee	1	1	0	0	0	0	0
Chilton	1	1	0	0	0	0	0
Clarke	1	1	0	0	0	0	0
Clay	1	1	0	0	0	0	0
Colbert	1	1	0	0	0	0	0
Crenshaw	1	0	0	0	1	0	0
Dallas	1	1	0	0	0	0	0
Limestone	1	1	0	0	0	0	0
Shelby	1	1	0	0	0	0	0
St. Clair	1	1	0	0	0	0	0
Marshall	1	1	0	0	0	0	0
Elmore	1	1	0	0	0	0	0
Tallapoosa	1	1	0	0	0	0	0
Total	329	151	52	33	17	74	2

[1] Contiguous county of Lake Eufaula

Table 15. Number of recreational angling parties contacted during on-site roving creel survey by county of Georgia residence in Lake Eufaula, 2017.

County	Total	Bass	Crappie	Sunfish	Catfish	Anything	Striped bass
Muscogee	23	22	0	0	0	1	0
Clay[1]	12	5	3	1	0	2	1
Dougherty	12	8	0	1	1	2	0
Lee	11	5	1	0	0	4	1
Coffee	10	1	6	0	1	2	0
Fulton	8	6	1	0	0	1	0
Houston	6	4	0	1	0	1	0
Cobb	5	5	0	0	0	0	0
Coweta	5	5	0	0	0	0	0
Randolph	5	0	1	0	0	4	0
Troup	5	4	1	0	0	0	0
Quitman[1]	4	0	1	0	1	2	0
Ben Hill	4	2	1	0	0	1	0
Early	4	2	1	0	0	1	0
Terrell	4	1	0	0	0	2	1
Bibb	3	2	0	1	0	0	0
Calhoun	3	3	0	0	0	0	0
Carroll	3	3	0	0	0	0	0
Decatur	3	3	0	0	0	0	0
Lowndes	3	1	0	0	1	1	0
Miller	3	1	0	1	0	1	0
Mitchell	3	1	0	0	2	0	0
Seminole	3	2	0	0	0	1	0
Stewart[1]	2	1	1	0	0	0	0
Bleckley	2	0	2	0	0	0	0
Colquitt	2	1	0	0	0	1	0
Dodge	2	2	0	0	0	0	0
Forsyth	2	2	0	0	0	0	0
Harris	2	1	0	0	0	1	0
Henry	2	2	0	0	0	0	0
Irwin	2	2	0	0	0	0	0
Jeff Davis	2	1	0	1	0	0	0
McDuffie	2	2	0	0	0	0	0
Paulding	2	2	0	0	0	0	0
Tift	2	0	1	0	0	1	0
Ware	2	0	1	0	0	1	0

Table 15. Continued.

County	Total	Bass	Crappie	Sunfish	Catfish	Anything	Striped bass
Clarke	2	2	0	0	0	0	0
Richmond	2	2	0	0	0	0	0
Baldwin	1	1	0	0	0	0	0
Chatham	1	1	0	0	0	0	0
Dade	1	0	1	0	0	0	0
Evans	1	0	0	0	0	1	0
Fayette	1	1	0	0	0	0	0
Gilmer	1	1	0	0	0	0	0
Glynn	1	0	0	0	0	1	0
Greene	1	1	0	0	0	0	0
Gwinnett	1	1	0	0	0	0	0
Hall	1	1	0	0	0	0	0
Haralson	1	1	0	0	0	0	0
Heard	1	0	0	0	0	1	0
Lanier	1	0	0	0	1	0	0
Liberty	1	1	0	0	0	0	0
Pierce	1	0	1	0	0	0	0
Pike	1	1	0	0	0	0	0
Pulaski	1	0	1	0	0	0	0
Taylor	1	0	0	0	0	1	0
Toombs	1	1	0	0	0	0	0
Upson	1	1	0	0	0	0	0
Walker	1	1	0	0	0	0	0
Walton	1	1	0	0	0	0	0
Wilcox	1	0	0	0	0	1	0
Total	195	120	24	6	7	35	3

[1] Contiguous county of Lake Eufaula

Table 16. Summary of angler variable means (SD in parenthesis) by species targeted, collected during the on-site roving creel and follow-up telephone surveys Lake Eufaula, Alabama and Georgia January 2017 through December 2017. Including distance – one-way distance from trip origination site to reservoir access site, Trip Length - number of days in trip at time of interview, Days Fished – number of days fished at Lake Eufaula in 12 months prior to interview, Tournament Related – whether their current trip was related to a tournament (0=no, 1=yes), Tournaments – number of tournaments fished at Lake Eufaula in 12 months prior to interview, Club Member – whether they were a member of a fishing club (0=no,1=yes), Quality – quality of fishing (1 = poor, 5 = excellent), Alt. Site Distance - one-way distance from residence to alternative site access, Age –age of angler in years, Years Fished – number of years angler has been fishing, Household Income – annual household income ($), Hydrilla – preference of aquatic plants in Lake Eufaula (0=prefer less, 1=prefer same amount, 2=prefer more), and Stripers – preference of hybrid striped bass stocking in Lake Eufaula (0=prefer less, 1=prefer same amount, 2=prefer more), Lake Eufaula, 2017.

Table on following page

Table 16. Continued.

Variable	Bass	Crappie	Sunfish	Catfish	Striped Bass	Anything	All
Distance (km.)	171 (161)	140 (233)	109 (72)	130 (76)	72 (45)	117 (177)	150 (171)
Trip Length (days)	2.2 (3.7)	2.7 (5.5)	1.8 (1.3)	3.2 (2.7)	1.0 (0.0)	2.6 (5.2)	2.3 (4.2)
Days Fished	37 (49)	42 (57)	32 (46)	32 (42)	12 (11)	34 (52)	36 (50)
Tournament Related	0.54 (0.50)	0.02 (0.16)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.28 (0.45)
Tournament (#)	3.5 (7.5)	0.3 (2.8)	0.0 (0.0)	1.0 (5.4)	0.2 (0.4)	0.4 (2.4)	2.0 (6.0)
Club Member	0.35 (0.48)	0.01 (0.11)	0.0 (0.0)	0.03 (0.18)	0.0 (0.0)	0.02 (0.16)	0.19 (0.39)
Quality	2.6 (1.3)	2.6 (1.3)	3.1 (1.4)	3.1 (1.3)	2.5 (2.1)	2.6 (1.2)	2.7 (1.3)
Alt. Site Distance (km.)	114 (106)	124 (117)	117 (148)	79 (56)	0.0 (0.0)	95 (79)	111 (105)
Age	48 (14)	58 (13)	60 (15)	58 (16)	58 (5)	58 (15)	53 (15)
Years Fished	33 (14)	44 (15)	42 (21)	46 (14)	28 (4)	47 (15)	38 (16)
Household Income ($)	118,000 (144,000)	76,000 (39,000)	71,000 (45,000)	116,000 (65,000)	---	82,000 (53,000)	104,000 (117,000)
Hydrilla	1.2 (0.7)	0.59 (0.71)	0.60 (0.65)	0.26 (0.45)	0.5 (0.7)	0.77 (0.72)	0.9 (0.8)
Stripers	1.1 (0.7)	1.2 (0.7)	1.0 (0.6)	1.6 (0.5)	2 (0)	1.2 (0.6)	1.2 (0.7)

Table 17. Summary of angling party expenditures ($) by trip type and species per trip day, SD in parenthesis, obtained during the follow-up telephone survey, Lake Eufaula, 2017.

Trip Type	Category	Bass	Crappie	Sunfish	Catfish	Striped Bass	Anything	All
Day/Overnight Combined		(N=195)	(N=39)	(N=25)	(N=19)	(N=2)	(N=66)	(N=346)
	Fuel	90 (58)	47 (58)	60 (41)	36 (30)	37 (22)	36 (35)	66 (54)
	Lodging	50 (51)	27 (51)	6 (18)	28 (34)	-	22 (37)	37 (47)
	Grocery	26 (36)	16 (29)	16 (13)	27 (20)	13 (4)	22 (18)	23 (30)
	Restaurant	19 (34)	12 (23)	9 (21)	5 (14)	-	9 (15)	14 (28)
	Equipment/ Bait	12 (37)	3 (7)	11 (15)	3 (6)	-	8 (15)	9 (29)
	Tournament Fee	24 (55)	1 (24)	-	0 (1)	-	-	13 (44)
	Launch Fee	2 (3)	1 (4)	1 (3)	1 (6)	-	0 (2)	2 (3)
	Repair	84 (522)	2 (10)	14 (71)	10 (44)	-	4 (62)	45 (394)
	Total	308 (571)	108 (119)	115 (95)	110 (61)	49 (19)	101 (95)	209 (442)

Table 17. Continued.

Trip Type	Category	Bass	Crappie	Sunfish	Catfish	Striped Bass	Anything	All
Day		(N=101)	(N=25)	(N=17)	(N=8)	(N=2)	(N=44)	(N=197)
	Fuel	85 (56)	60 (68)	64 (31)	71 (28)	37 (22)	52 (3)	72 (52)
	Lodging	-	-	-	-	-	-	-
	Grocery	18 (28)	20 (33)	14 (9)	18 (15)	13 (4)	15 (12)	18 (24)
	Restaurant	10 (38)	6 (8)	4 (9)	15 (19)	-	5 (12)	8 (28)
	Equipment/Bait	15 (44)	9 (7)	5 (6)	7 (8)	-	8 (11)	11 (32)
	Tournament Fee	23 (62)	6 (30)	-	1 (1)	-	-	13 (47)
	Launch Fee	3 (3)	2 (4)	2 (3)	4 (9)	-	1 (2)	2 (3)
	Repair	5 (30)	2 (12)	29 (85)	-	-	12 (76)	8 (49)
	Total	160 (146)	105 (112)	119 (77)	115 (46)	49 (19)	94 (84)	132 (124)

Table 17. Continued.

Trip Type	Category	Bass	Crappie	Sunfish	Catfish	Striped Bass	Anything	All
Overnight		(N=94)	(N=14)	(N=8)	(N=11)	(N=0)	(N=22)	(N=149)
	Fuel	92 (59)	44 (38)	56 (60)	31 (27)	-	114 (39)	65 (57)
	Lodging	64 (54)	33 (71)	10 (30)	32 (39)	-	100 (54)	47 (56)
	Grocery	28 (41)	14 (23)	18 (21)	28 (22)	-	85 (25)	25 (36)
	Restaurant	21 (26)	13 (33)	13 (34)	3 (5)	-	35 (18)	16 (26)
	Equipment/Bait	11 (26)	2 (2)	15 (23)	3 (4)	-	30 (21)	8 (23)
	Tournament Fee	25 (47)	-	-	-	-	-	13 (40)
	Launch Fee	2 (2)	1 (1)	1 (2)	1 (2)	-	0 (2)	2 (2)
	Repair	106 (744)	1 (6)	-	11 (72)	-	4 (6)	55 (594)
	Total	349 (784)	109 (120)	112 (129)	109 (72)	-	367 (106)	230 (641)

Table 18. Summary of angling party expenditures ($) by fishing method (boat/shore), and species per trip day, SD in parenthesis, obtained during the follow-up telephone survey, Lake Eufaula, 2017.

Method	Category	Bass	Crappie	Sunfish	Catfish	Hybrid	Anything	All
Boat		(N=195)	(N=37)	(N=25)	(N=19)	(N=2)	(N=58)	(N=336)
	Fuel	80 (58)	48 (58)	60 (41)	37 (30)	37 (22)	37 (35)	62 (54)
	Lodging	50 (51)	27 (52)	6 (18)	28 (34)	-	22 (38)	37 (47)
	Grocery	26 (36)	16 (30)	16 (13)	27 (20)	13 (4)	22 (19)	23 (31)
	Restaurant	19 (34)	12 (23)	9 (21)	5 (14)	-	8 (14)	14 (28)
	Equipment/Bait	12 (37)	3 (7)	11 (15)	3 (6)	-	8 (16)	9 (29)
	Tournament Fee	24 (55)	1 (25)	-	0 (1)	-	-	13 (45)
	Launch Fee	2 (3)	1 (4)	1 (3)	1 (6)	-	1 (2)	2 (3)
	Repair	84 (522)	2 (11)	14 (71)	10 (44)	-	4 (66)	46 (400)
	Total	297 (571)	110 (119)	116 (95)	111 (61)	49 (19)	101 (96)	205 (447)

Table. 18 Continued.

Method	Category	Bass	Crappie	Sunfish	Catfish	Hybrid	Anything	All
Boat		(N=195)	(N=37)	(N=25)	(N=19)	(N=2)	(N=58)	(N=336)
	Fuel	80 (58)	48 (58)	60 (41)	37 (30)	37 (22)	37 (35)	62 (54)
	Lodging	50 (51)	27 (52)	6 (18)	28 (34)	-	22 (38)	37 (47)
	Grocery	26 (36)	16 (30)	16 (13)	27 (20)	13 (4)	22 (19)	23 (31)
	Restaurant	19 (34)	12 (23)	9 (21)	5 (14)	-	8 (14)	14 (28)
	Equipment/Bait	12 (37)	3 (7)	11 (15)	3 (6)	-	8 (16)	9 (29)
	Tournament Fee	24 (55)	1 (25)	-	0 (1)	-	-	13 (45)
	Launch Fee	2 (3)	1 (4)	1 (3)	1 (6)	-	1 (2)	2 (3)
	Repair	84 (522)	2 (11)	14 (71)	10 (44)	-	4 (66)	46 (400)
	Total	297 (571)	110 (119)	116 (95)	111 (61)	49 (19)	101 (96)	205 (447)

Table. 18 Continued.

Method	Category	Bass	Crappie	Sunfish	Catfish	Hybrid	Anything	All
Shore		(N=0)	(N=2)	(N=0)	(N=0)	(N=0)	(N=8)	(N=10)
	Fuel	-	1 (2)	-	-	-	31 (23)	31 (24)
	Lodging	-	-	-	-	-	21 (29)	21 (26)
	Grocery	-	1 (1)	-	-	-	19 (16)	20 (15)
	Restaurant	-	-	-	-	-	17 (23)	17 (21)
	Equipment/Bait	-	2 (8)	-	-	-	4 (7)	6 (7)
	Tournament Fee	-	-	-	-	-	-	-
	Launch Fee	-	-	-	-	-	-	-
	Repair	-	-	-	-	-	-	-
	Total	-	3 (11)	-	-	-	92 (80)	95 (74)

Table 19. Summary of angling party expenditures ($) by state residency per trip day, SD in parenthesis, obtained during the follow-up telephone survey, Lake Eufaula, 2017.

Category	Alabama	Georgia	Other State
	(N= 200)	(N= 112)	(N= 34)
Fuel	67 (46)	64 (65)	51 (51)
Lodging	32 (37)	40 (55)	39 (55)
Grocery	23 (30)	24 (25)	22 (44)
Restaurant	16 (32)	14 (21)	12 (23)
Equipment/Bait	11 (32)	8 (26)	7 (21)
Tournament Fee	12 (42)	16 (38)	9 (67)
Launch	2 (3)	2 (3)	1 (2)
Repair	96 (498)	28 (189)	7 (46)
Total	259 (549)	196 (240)	147 (158)

Table 20. Total angler trips (trip days) and total extrapolated expenditures by targeted species and spending categories obtained during the instantaneous count, aerial boat count, and follow-up telephone survey, Lake Eufaula, 2017.

Target	Trips	Fuel ($)	Lodging ($)	Groceries ($)	Restaurant ($)	Equipment/Bait ($)	Tournament Fees ($)	Launch Fees ($)	Repair ($)	Total ($)
Bass	33,752	3,042,377	1,691,816	871,917	639,968	398,931	826,263	79,536	2,844,906	10,395,715
Crappie	12,958	609,246	348,582	200,846	154,292	40,283	14,251	11,116	20,807	1,399,423
Sunfish	6,555	391,449	36,190	103,273	56,491	68,937	-	9,180	88,268	753,788
Catfish	3,471	124,051	98,778	92,605	16,394	12,036	208	3,217	34,500	381,787
Striped Bass	1,111	40,661	-	13,761	-	-	-	-	-	54,422
Anything	16,387	599,055	356,173	358,123	144,842	134,764	-	4,389	57,709	1,655,056
Total	74,234	4,806,839	2,531,539	1,640,525	1,011,987	654,951	840,722	107,437	3,046,189	14,640,191

Table 21. Total extrapolated expenditures by state residency obtained during the instantaneous count, aerial boat count, and follow-up telephone survey, Lake Eufaula, 2017.

Category	Alabama Residents	Georgia Residents	Other State	All
Fuel	1,838,617	1,760,903	1,207,317	4,806,839
Lodging	758,301	957,669	815,568	2,531,539
Grocery	571,543	605,632	463,349	1,640,525
Restaurant	397,566	357,531	256,889	1,011,987
Equipment/Bait	288,569	209,142	157,239	654,951
Tournament Fee	284,253	378,856	177,612	840,722
Launch	50,492	41,456	15,489	107,437
Repair	2,253,328	653,555	139,305	3,046,189
Total	6,442,670	4,964,749	3,232,772	14,640,191

Table 22. Tax revenue by location generated by all angler expenditures obtained during the follow-up telephone survey Lake Eufaula, 2017.

Location	General Sales Tax	General Sales Expenditures[1] ($)	General Sales Tax Revenue ($)	Fuel Tax ($)	Fuel Expenditures ($)	Fuel tax Revenue ($)	Lodging Tax	Lodging Expenditures ($)	Lodging Tax Revenue ($)	Total tax Revenue ($)
Abbeville, AL	5%	13,845	692	0.01	25,098	113	-	-	-	805
Headland, AL	5%	100,956	5,048	0.01	62,773	282	-	-	-	5,330
Clio, AL	5.5%	2,472	136	0.04	6,086	109	-	-	-	245
Eufaula, AL	5.5%	3,426,173	188,440	0.04	2,392,894	43,038	6%	3,078,425	184,706	416,183
State of Alabama non-contiguous	4%	2,555,393	102,216	0.18	941,648	76,213	-	-	-	178,428
State of Alabama contiguous	4%	3,543,448	141,738	0.18	2,486,851	201,274	-	3,078,425	123,137	466,149
Alabama Total	-	6,098,841	438,269	-	3,428,499	321,029	-	3,078,425	307,843	1,067,140
Lumpkin, GA	4%	-	-	-	6,719	-	-	-	-	-
Omaha, GA	4%	18,131	725	-	88	-	1% + $5/night	28,121	281	1,006
Georgetown, GA	4%	141,751	5,670	-	158,640	-	-	159,353	-	5,670
Fort Gains, GA	4%	73,760	2,950	-	38,215	-	-	48,181	-	2,950
State of Georgia non-contiguous	4%	332,538	13,302	0.26	621,114	77,861	-	-	-	91,163
State of Georgia contiguous	4%	233,642	9,346	0.26	203,662	25,531	-	235,654	-	34,876
Georgia Total	-	566,180	31,993	-	824,776	103,392	-	235,654	281	126,039
Other States	4%	105,489	4,220	0.23	302,326	29,200	-	-	-	33,420
Total All States	-	6,770,510	474,482	-	4,555,601	453,621	-	3,314,080	308,124	1,236,226

[1] Includes expenditures incurred from groceries, restaurant meals, equipment /bait, and repair/maintenance

[2] Total expenditures including general sales, fuel, and lodging was $12.6 million in Alabama, $1.6 million in Georgia, and $0.4 million in all other states

Table 23. Results from the TCM regression (negative binomial distribution) to explain the demand for visitation by all recreational anglers (N= 320), Lake Eufaula 2017. Dependent variable is *visits*.

Variable	Parameter Estimate	Standard Error	Pr > ChiSq	Mean	SD (Mean)
Intercept	10.4248	1.0570	<0.0001	N/A	N/A
Travel cost per visit	-0.0023	0.0003	<0.0001	$374.77	$875.58
Gender	-0.9728	0.4847	0.0447	0.03	0.17
Age	0.0066	0.0050	0.1824	52.80	14.91
Log of household income	-0.5098	0.0929	<0.0001	11.33	0.58
Ethnicity	0.9813	0.1598	<0.0001	1.07	0.30
Tournaments	0.0176	0.0048	0.0003	3.48	7.61
Years of Experience	-0.0014	0.0047	0.7730	38.40	16.04
CPE	-0.0068	0.0051	0.1848	3.23	6.48
Substitute Site Opportunity Cost	0.0216	0.0144	0.1330	4.61	8.47
Dispersion	25.0743	1.6836			
DF (Error)	310				
Consumer Surplus per angler visit	$435				
Consumer Surplus per angler day	$189				
Log-likelihood	318,547				
Scaled Pearson X^2	411				
AIC	3,908				

Table 24. Results from the TCM regression (negative binomial distribution) to explain the demand for visitation by recreational bass anglers (N= 179), Lake Eufaula, 2017. Dependent variable is *visits*.

Variable	Parameter Estimate	Standard Error	Pr > ChiSq	Mean	SD (Mean)
Intercept	7.0925	1.1404	<0.0001	N/A	N/A
Travel cost per visit	-0.0041	0.0007	<0.0001	$430.08	$1,117.38
Gender	0.8834	0.3682	0.0164	0.02	0.15
Age	0.0233	0.0078	0.0029	51.68	15.15
Log of household income	-0.144	0.0964	0.1354	11.37	0.60
Ethnicity	-0.0003	0.2237	0.9990	3.41	7.66
Tournaments	0.0049	0.0074	0.5060	3.41	7.66
Years of Experience	-0.0161	0.0081	0.0472	37.02	16.04
CPE	-0.0197	0.0258	0.4453	2.60	5.56
Substitute Site Opportunity Cost	-0.0210	0.0072	0.0035	4.91	10.77
Dispersion	25.4457	2.2908			
DF (Error)	169				
Consumer Surplus per angler visit	$244				
Consumer Surplus per angler day	$111				
Log-likelihood	150,090				
Scaled Pearson X^2	172				
AIC	2,128				

Table 25. Results from the TCM regression (negative binomial distribution) to explain the demand for visitation by recreational crappie anglers (N=38), Lake Eufaula, 2017. Dependent variable is *visits*.

Variable	Parameter Estimate	Standard Error	Pr > ChiSq	Mean	SD (Mean)
Intercept	13.7319	3.8164	0.0003	N/A	N/A
Travel cost per visit	-0.0202	0.0086	0.0184	$336.48	$512.21
Gender	0.0462	0.6830	0.9461	0.03	0.16
Age	0.0163	0.0175	0.3508	55.00	16.08
Log of household income	-0.7719	0.3108	0.0130	11.17	0.51
Ethnicity	0.7864	0.6442	0.2222	1.08	0.36
Tournaments	-0.1354	0.0357	0.0001	3.00	5.36
Years of Experience	0.0070	0.0197	0.7201	42.55	15.96
CPE	-0.0755	0.0586	0.1973	2.86	3.67
Substitute Site Opportunity Cost	-0.1440	0.0910	0.1133	2.69	2.72
Dispersion	24.6499	4.8633			
DF (Error)					
Consumer Surplus per angler visit	$50				
Consumer Surplus per angler day	$19				
Log-likelihood	58,992				
Scaled Pearson X^2	19				
AIC	506				

Table 26. Results from the TCM regression (negative binomial distribution) to explain the demand for visitation by recreational sunfish anglers (N=26), Lake Eufaula, 2017. Dependent variable is *visits*.

Variable	Parameter Estimate	Standard Error	Pr > ChiSq	Mean	SD (Mean)
Intercept	10.7146	1.6061	<0.0001	N/A	N/A
Travel cost per visit	-0.0466	0.0107	<0.0001	$204.73	$179.99
Gender	-0.7698	0.4115	0.0614	0.04	0.20
Age	0.0065	0.0125	0.6043	47.31	11.23
Log of household income	-0.2997	0.1220	0.0140	11.15	0.61
Ethnicity	-2.1611	0.6506	0.0009	1.12	0.33
Tournaments	-0.0379	0.0102	0.0002	5.42	12.82
Years of Experience	0.0125	0.0115	0.2767	35.92	14.55
CPE	-0.0848	0.0724	0.2414	2.54	3.18
Substitute Site Opportunity Cost	0.0661	0.0522	0.2051	3.28	4.66
Dispersion	4.0043	1.0651		36.81	47.35
DF (Error)	16.0000				
Consumer Surplus per angler visit	$21				
Consumer Surplus per angler day	$16				
Log-likelihood	19,534				
Scaled Pearson X^2	20				
AIC	297				

Table 27. Results from the TCM regression (negative binomial distribution) to explain the demand for visitation by recreational catfish anglers (N=16), Lake Eufaula, 2017. Dependent variable is *visits*.

Variable	Parameter Estimate	Standard Error	Pr > ChiSq	Mean	SD (Mean)
Intercept	18.9876	13.3916	0.1562	N/A	N/A
Travel cost per visit	-0.0124	0.0062	0.0469	$146.69	$116.72
Gender	-2.4698	9.5514	0.7960	0.06	0.25
Age	-0.0144	0.0651	0.8247	57.56	16.69
Log of household income	-1.2588	0.9293	0.1755	11.51	0.41
Ethnicity	-1.2762	2.5668	0.6191	1.13	0.34
Tournaments	-0.0808	0.1073	0.4514	1.19	3.76
Years of Experience	0.0766	0.0278	0.0059	40.94	18.19
CPE	-0.0180	0.1309	0.8909	10.46	18.09
Substitute Site Opportunity Cost	0.0076	0.1690	0.9641	4.31	3.48
Dispersion	12.8770	3.9592			
DF (Error)	6				
Consumer Surplus per angler visit	$81				
Consumer Surplus per angler day	$25				
Log-likelihood	1,5247				
Scaled Pearson X^2	7				
AIC	195				

Table 28. Results from the TCM regression (negative binomial distribution) to explain the demand for visitation by recreational anything anglers (N=61), Lake Eufaula, 2017. Dependent variable is *visits*.

Variable	Parameter Estimate	Standard Error	Pr > ChiSq	Mean	SD (Mean)
Intercept	7.1293	4.7539	0.1337	N/A	N/A
Travel cost per visit	-0.0084	0.0022	0.0001	$373.18	$386.86
Gender	-0.1351	0.5188	0.7945	0.03	0.18
Age	-0.0797	0.0176	<0.0001	56.12	12.94
Log of household income	0.1654	0.3960	0.6762	11.30	0.58
Ethnicity	-0.2386	0.3854	0.5359	1.03	0.18
Tournaments	-0.0765	0.0228	0.0008	3.68	6.48
Years of Experience	0.0593	0.0122	<0.0001	40.62	15.42
CPE	-0.1247	0.0300	<0.0001	3.77	4.71
Substitute Site Opportunity Cost	0.1266	0.0689	0.0661	6.27	11.02
Dispersion	21.8484	3.3586		38.92	58.23
DF (Error)	50.0000				
Consumer Surplus per angler visit	$119				
Consumer Surplus per angler day	$46				
Log-likelihood	7,7950				
Scaled Pearson X^2	41				
AIC	755				

Table 29. Results from the TCM regression (negative binomial distribution) to explain the demand for visitation by tournament bass anglers (N=94), Lake Eufaula, 2017. Dependent variable is *visits*

Variable	Parameter Estimate	Standard Error	Pr > ChiSq	Mean	SD (Mean)
Intercept	9.0941	1.5914	<0.0001	N/A	N/A
Travel cost per visit	-0.0061	0.0013	<0.0001	$378.28	$667.42
Gender	-4.3515	3.2922	0.1862	N/A	N/A
Age	-0.0193	0.0103	0.0607	52.47	13.91
Log of household income	-0.1561	0.1300	0.2301	11.51	0.65
Ethnicity	-0.2587	0.4036	0.5215	1.06	0.35
Tournaments	-0.0231	0.0267	0.3868	3.82	7.05
Years of Experience	0.0159	0.0139	0.2516	37.70	14.89
CPE	-0.1302	0.0653	0.0461	1.84	2.01
Substitute Site Opportunity Cost	-0.0100	0.0082	0.2244	5.68	9.27
Dispersion	21.2407	2.5683			
DF (Error)	84				
Consumer Surplus per angler visit	$164				
Consumer Surplus per angler day	$63				
Log-likelihood	87,895				
Scaled Pearson X^2	70				
AIC	1,141				

Table 30. Results from the TCM regression (negative binomial distribution) to explain the demand for visitation by local anglers (N=74), Lake Eufaula, 2017. Dependent variable is *visits*.

Variable	Parameter Estimate	Standard Error	Pr > ChiSq	Mean	SD (Mean)
Intercept	6.0732	2.3099	0.0086	N/A	N/A
Travel cost per visit	-0.0789	0.0168	<0.0001	$75.04	$88.94
Gender	0.3033	0.5258	0.5641	0.05	0.22
Age	0.0045	0.0074	0.5460	52.95	15.37
Log of household income	0.0528	0.2155	0.8064	11.38	0.69
Ethnicity	-0.1247	0.2960	0.6735	1.09	0.29
Tournaments	-0.0460	0.0141	0.0011	4.43	10.70
Years of Experience	0.0017	0.0075	0.8167	37.70	17.44
CPE	-0.0635	0.0260	0.0146	3.25	4.91
Substitute Site Opportunity Cost	-0.0285	0.0462	0.5369	5.36	4.51
Dispersion	25.1226	3.5243			
DF (Error)	64				
Consumer Surplus per angler visit	$13				
Consumer Surplus per angler day	$5				
Log-likelihood	101,913				
Scaled Pearson X^2	51				
AIC	961				

Table 31. Results from the TCM regression (negative binomial distribution) to explain the demand for visitation by non-local anglers (N=246), Lake Eufaula, 2017. Dependent variable is *visits*.

Variable	Parameter Estimate	Standard Error	Pr > ChiSq	Mean	SD (Mean)
Intercept	9.4631	1.0921	<0.0001	N/A	N/A
Travel cost per visit	-0.0074	0.0011	<0.0001	$464.57	$979.69
Gender	-0.8932	0.3992	0.0253	0.02	0.14
Age	-0.0162	0.0054	0.0029	52.76	14.80
Log of household income	-0.2602	0.1025	0.0112	11.32	0.62
Ethnicity	0.0561	0.1354	0.6784	1.06	0.31
Tournaments	-0.0046	0.0071	0.5118	3.19	6.41
Years of Experience	0.0134	0.0057	0.0191	38.61	15.63
CPE	-0.0010	0.0062	0.8743	3.22	6.90
Substitute Site Opportunity Cost	-0.0046	0.0132	0.7300	4.32	5.91
Dispersion	26.9278	2.0474			
DF (Error)	236				
Consumer Surplus per angler visit	$135				
Consumer Surplus per angler day	$54				
Log-likelihood	218,700				
Scaled Pearson X^2	1022				
AIC	2999				

Table 32. Sections weighted by ADCNR biologist, actual percentage of sampling by section, number of times sections were sampled by section, and actual interviews by section, Lake Eufaula, 2017.

Section	ADCNR Weight (%)	Actual (%)	Number of Times section sampled	Number of actual interviews
A	25	24	52	124
B	25	25	55	123
C	35	38	83	309
D	15	12	26	17
Total	-	-	217	573

Table 33. Anglers targeting specific species by season for anglers who participated in the follow-up telephone survey, Lake Eufaula, 2017.

Angler Type	Winter		Spring		Summer		Fall		Total	
	N	%	N	%	N	%	N	%	N	%
Bass	10	77	105	56	48	49	32	67	195	56
Crappie	2	15	24	13	5	5	8	17	39	11
Sunfish	0	0	14	7	10	10	1	2	25	7
Catfish	0	0	5	3	11	11	3	6	19	6
Striped Bass	1	8	1	1	0	0	0	0	2	1
Anything	0	0	38	20	24	25	4	8	66	19
Total	13	100	187	100	98	100	48	100	346	100

Table 34. Anglers targeting specific species by reservoir section who participated in the follow-up telephone survey, Lake Eufaula, 2017.

	A		B		C		D		Total	
Angler Type	N	%	N	%	N	%	N	%	N	%
Bass	44	57	41	57	103	56	7	50	195	56
Crappie	12	15	7	10	19	10	1	7	39	11
Sunfish	2	3	5	7	18	10	0	0	25	7
Catfish	6	8	5	7	8	5	0	0	19	6
Striped Bass	2	3	0	0	0	0	0	0	2	1
Anything	11	14	14	19	35	19	6	43	66	19
Total	77	100	72	100	183	100	14	100	346	100

VIII. FIGURES

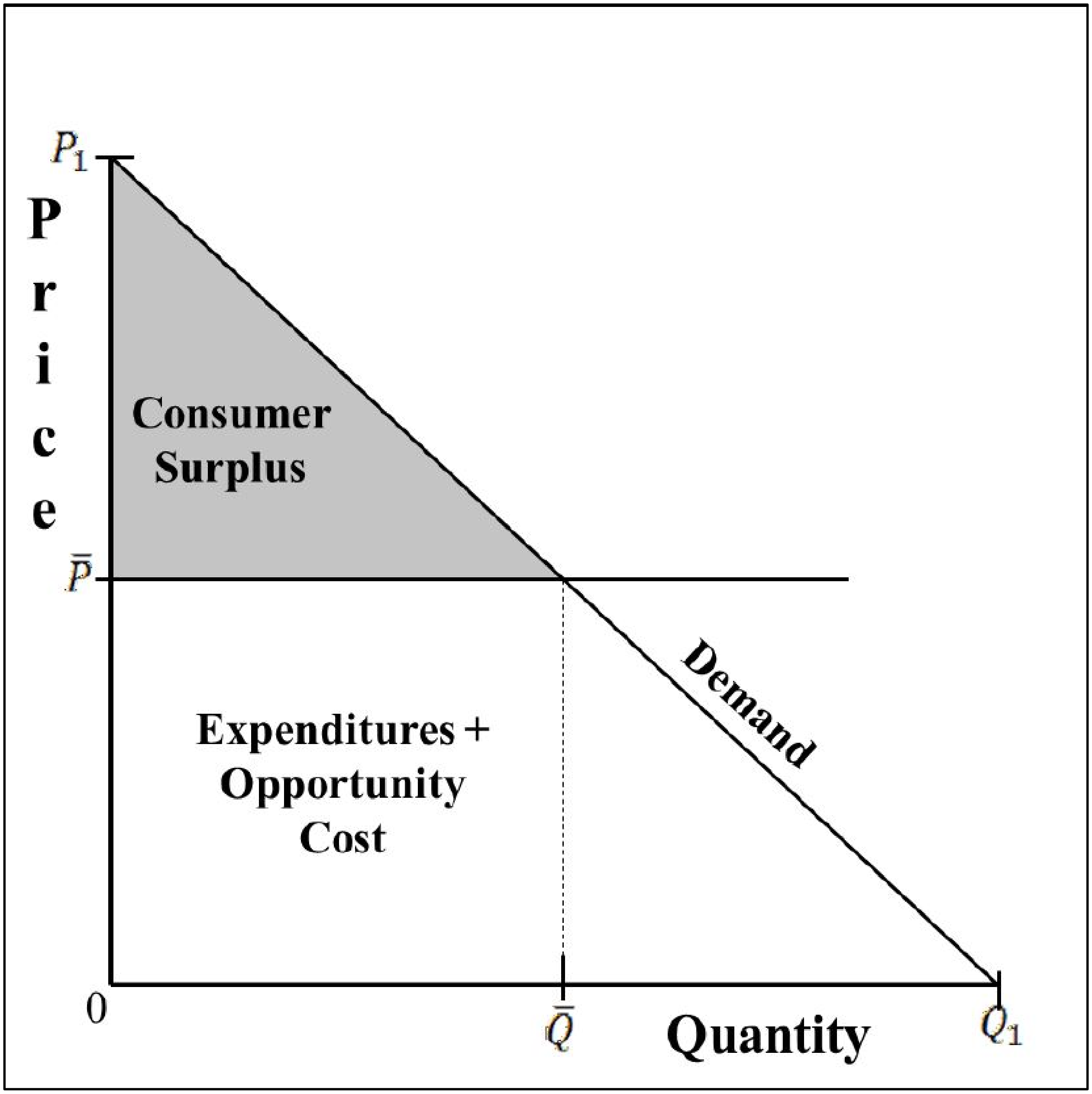

Figure 1. Graphical representation of a demand curve (quantity demanded) and consumer surplus. P_1 is the maximum visit price that one is willing to pay and Q_1 is the maximum number of visits a consumer will demand at a price of $0. $\bar{P}$ Is the equilibrium (mean) price paid and $\bar{Q}$ is the equilibrium (mean) number of visits demanded by a typical (average) consumer. Consumer surplus is the willingness-to-pay for a recreational visit above and beyond a person's actual visit expenditures and is the area below the recreational visit demand curve and above the equilibrium visit cost ($\bar{P}$). Expenditures are actual purchases incurred by the person on the visit plus the opportunity cost of time based on the respondent's wage rate and the calculated roundtrip travel time to the site. Taken from Parsons (2003)

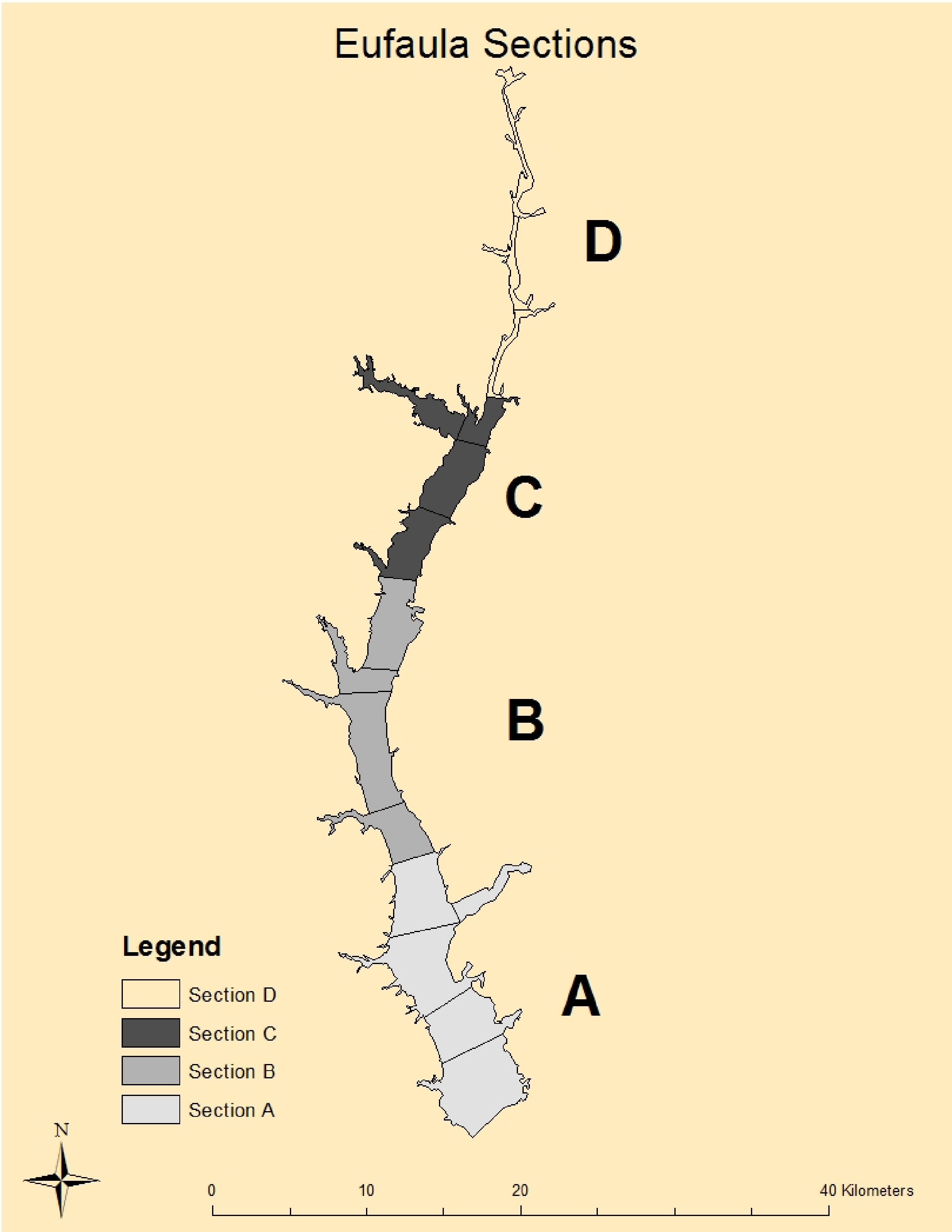

Figure 2. Sampling sections A-D for Lake Eufaula 2017.

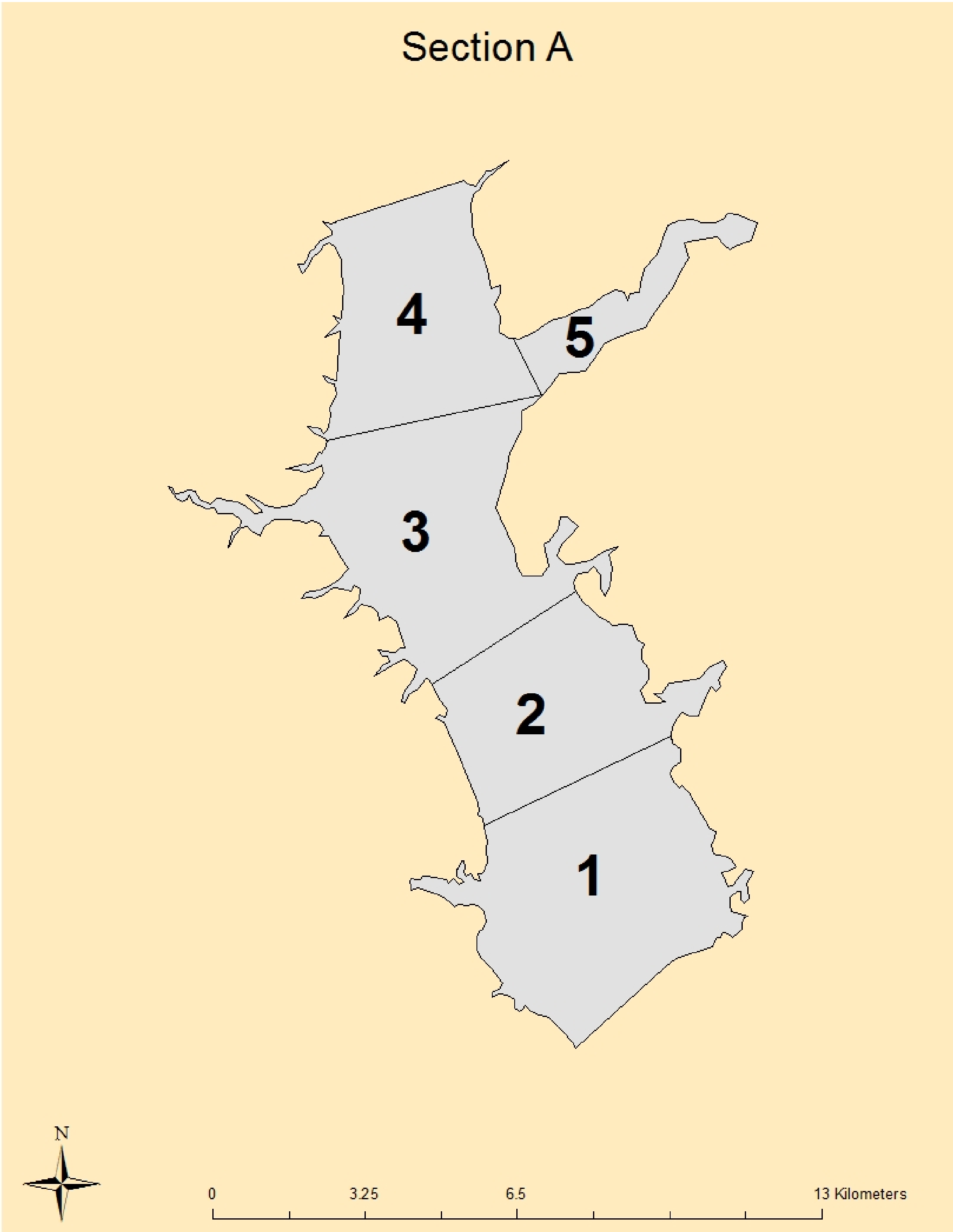

Figure 3. Section A with corresponding 5 sub-sections for Lake Eufaula 2017.

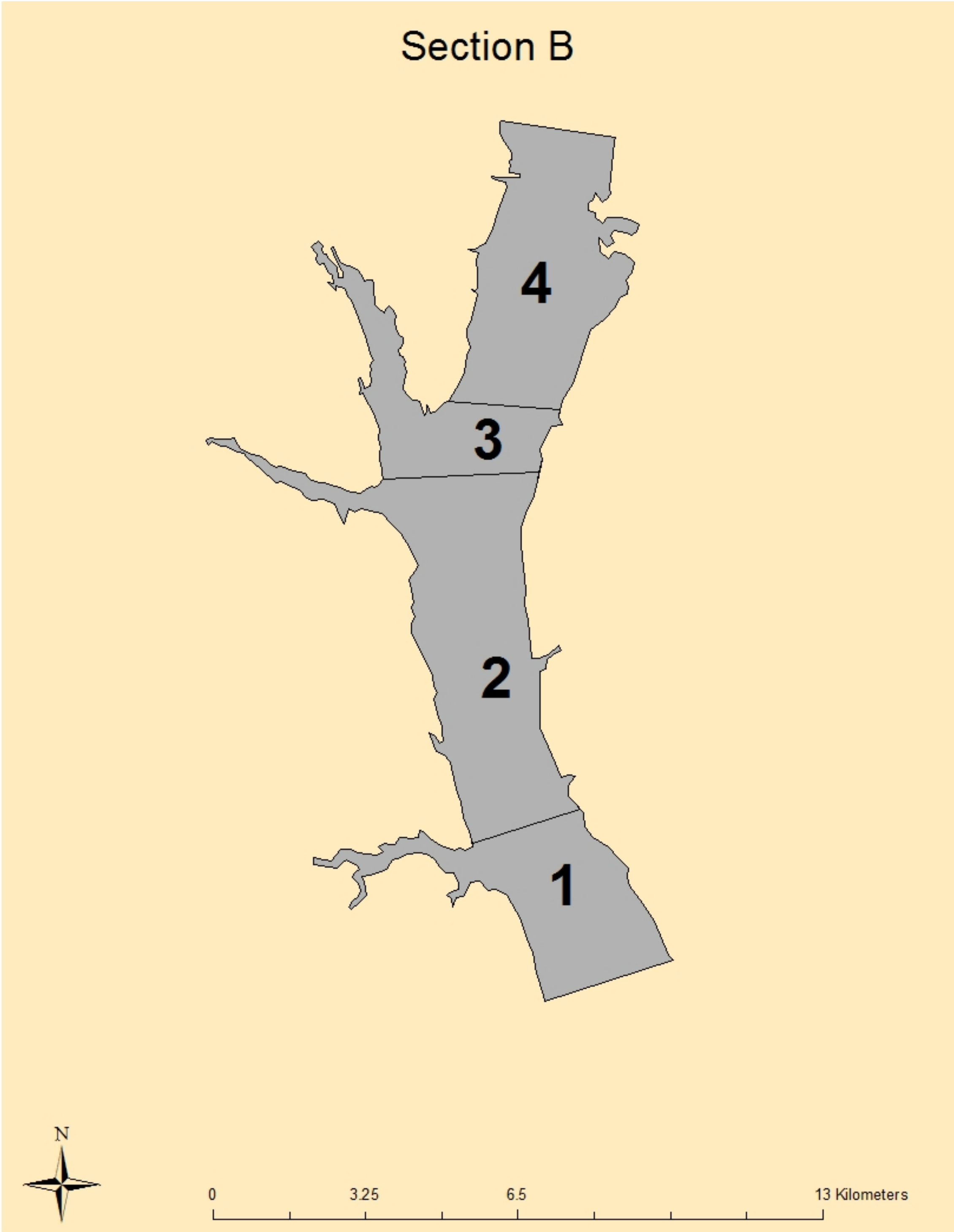

Figure 4. Section B with corresponding 4 sub-sections for Lake Eufaula 2017.

Figure 5. Section C with corresponding 4 sub-sections for Lake Eufaula 2017.

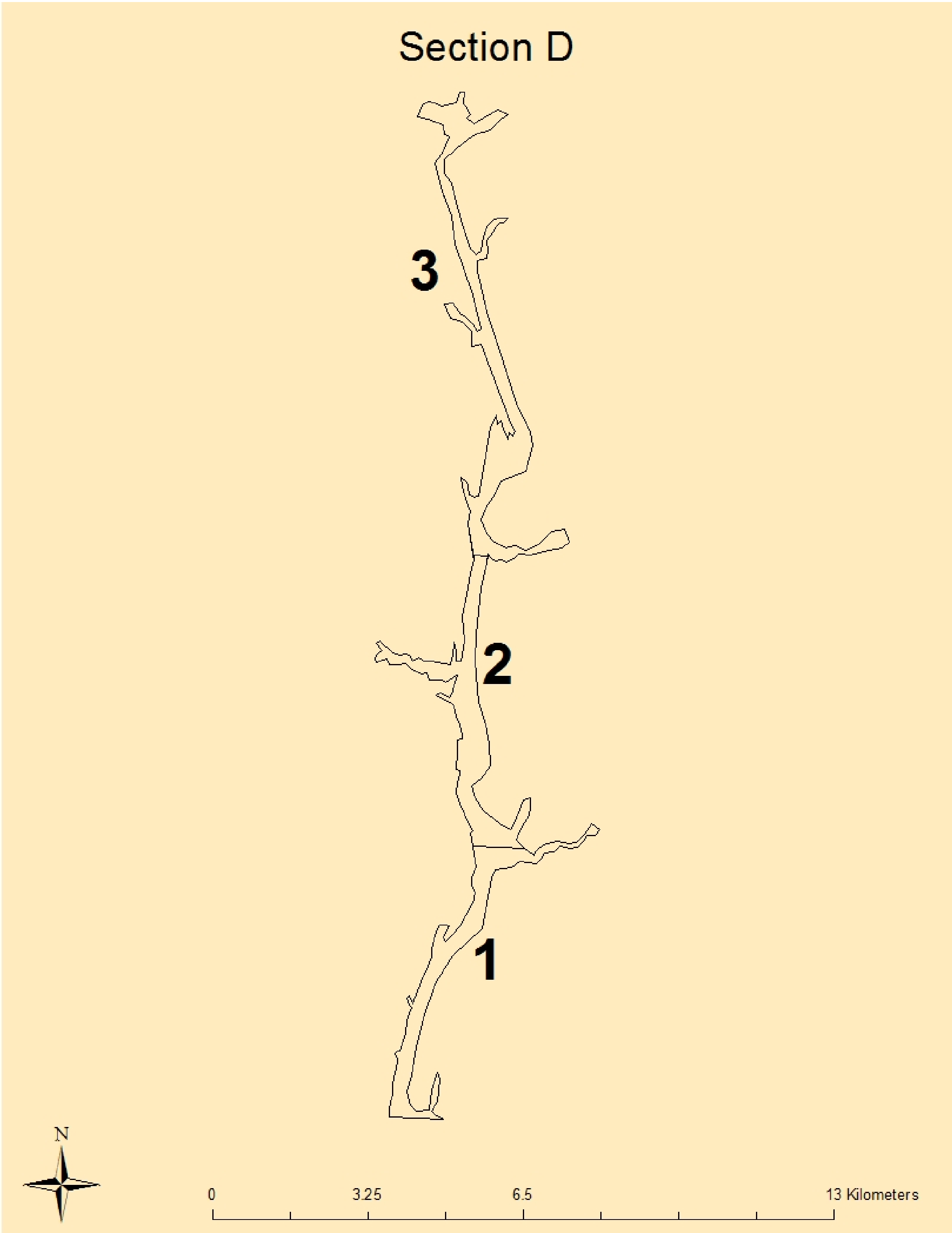

Figure 6. Section D with corresponding 3 sub-sections for Lake Eufaula 2017.

IX. APPENDICIES

IX.1. Instantaneous Count Survey Form

Lake Eufuala Initial Count

Sample Dates: ____________ Crew: ____________

Date	Sub Sec.	Shift	Start Time	End Time	Wind Speed (mph)	Air Temp. (°C)	Water Temp. (°F)	Precip. (Y/N)	Fishing Boats* (# ppl/boat if multiple*)	Shore Anglers	Other Boats Fishing (ie. Pontoon)*	Boats Not Fishing*	Interviews

*Write the number of how many people are in a boat

Example 1: If you see 2 boats, each with only 1 person...write as 1, 1

Example 2: If you see three boats, one with one person, one with 5, and the other with 3...write as 1, 5, 3

IX.2. On site Roving Creel Survey Form

Lake Eufaula Interview Form 2017

Date: _______ **Major River Section:**___________ **Creel Clerks:** ____________ **Interview #** ______
Interview Time (*military*)**:** ___________ **WPT:** _______ **Latitude:** ___________ **Longitude:** __________
Circle One: *Fishing Boat* *Pontoon Boat* *Shore* *Other* ______________
Hello, we are working with Auburn University Fisheries Department… May we interview you? *Y* *N*
- -(*if yes, continue*) -

1. What are you primarily fishing for? *Bass/ Crappie /Sunfish/ Catfish/ Striped Bass or Hybrid Anything/ Other*_________

2. How many of each species have you caught today?

Bass	Crappie	Catfish	Striper	Sunfish:_________
Keep: _______	Keep: _______	Keep: _______	Keep: _________	Keep:__________
Release: _______	Release: _______	Release: _______	Release: _________	Release:_________
Livewell: _______	Livewell:_______	Livewell: _______	Livewell:_________	Livewell:________

3. Is this fishing trip in any way related to a tournament? *Y* *N*
   If ***YES***, a. Currently in a tournament b. Prefishing c. Tournament name __________________

4. Is this a guided trip? *Y* *N*

5. Have we contacted you before about this survey? *Y* *N*
   a. If ***YES***, Have we contacted you on this particular fishing trip? *Y* *N*

6. What time did you start fishing today? __________
   a. What time do expect to quit fishing today? ________________

7. What city do you live in?
   b. City: __________________ State __________
   c. Trip type: *Day* *Overnight* If overnight, how many days? __________
   d. Launch site: ___________________________
   e. Waterfront property? *Y* *N* *Cabin*

8. How many miles 1-way did you travel from your home to fish? ________

9. How much will your completed trip cost, including gas, lodging, food, drinks, ice, fishing equipment, tournament and license fees, and any other items?____________ **Circle One:** *Individual* *Boat*
   a. Of the *$xxx* you will spend on this trip, how much will be spent within "20" miles of this river/reservoir section? ___________

10. How many days have you fished for *species* at this stretch of the river or reservoir in the past 12 months? ___________

11. Number of adult anglers in party ____*m* ____*f* ::::::::: Number of children < 16 ____*m* ____*f*

12. Would you be willing to allow us to contact you by phone for a more detailed survey? Y N

Contact information: Name:______________________ Phone number: ______________________

M/F Age _______ Ethnicity __________ Occupation _____________________

IX.3. Follow-up Telephone Survey Form

Call Date: __________ **Clerk:** _______ **Call attempts:** ______ ***Interview #:*** ________ ***Name:*** ____________________________ ***Target Species*** _________________

Creel Telephone: ___________________ ***Creel Fishing Trip Total Cost (yyy):*** ______ ***Creel Date:*** _________________ ***Was the Survey Complete*** *Y N*

(Fill out the italicized headings before conducting the interview)

Hello, I am with Auburn University Fisheries Department. I contacted you at Walter F. George Reservoir (aka Lake Eufaula), (or 'along the Chattahoochee River) on *date*. You gave me permission to conduct a follow up survey about your fishing trip that day. The interview should take only 10 minutes of your time. All the information you give me today will remain confidential, anonymous, and no one will try to sell you anything. May I interview you?

1. Was fishing for *target species* your sole purpose for visiting Lake Eufaula/Chattahoochee River? *Y N*
   A. If ***NO*** what was the primary purpose of the trip? ________________________
2. How many hours did you fish the day I interviewed you on Lake Eufaula/Chattahoochee River? ___________
3. For your fishing trip on *date*, the same trip I interviewed you when you were fishing for *target species*, would you rate the quality of that trip as poor, fair, average, good, or excellent? *Poor Fair Average Good Excellent*
4. Do you plan on returning to Lake Eufaula/Chattahoochee River to fish for *target species* in the future? *Y N*
   a. ***(Yes)*** How many trips do you expect you will go on within the next 12 months? ____________________
   b. ***(No)*** Why not? ____
5. What ramp do you use the most? ____________________________________
6. Was this an overnight trip? *Y N*
7. How many days did you spend at Lake Eufaula/Chattahoochee River? _________________
8. What kind of lodging did you use on the fishing trip? *Hotel/Motel Bed and Breakfast RV park (private) USFS site State site County siteCity site Friends/Families Private property (pp) Other* ____________________ *None*

   If PRIVATE PROPERTY:
   A. Do you own, rent, or lease this property? (*circle one*) *Own Rent Lease*

   If they rented or leased a property:
   B. How much do you pay to lease/rent? (*circle one*)
   ______________ per *month year*
   C. Is fishing the primary reason you use this property to fish at Lake Eufaula/Chattahoochee River? *Y N*
   D. What city, state is it in? _________________________________

9. If fishing for ____*(target species)*____ was not available at Lake Eufaula, where would you go to fish for ____*(target species)*____ instead?

____

a) How many miles is ____*(answer to #9)*____ from your house one-way? ____________________

b) Which is better (*circle one*), **Lake Eufaula** or ____***Answer to 9a.***____ ?

10. Do you ever fish for *target species* at night? *Y* *N* How many days per year? _____

11. Do you ever target any other species at night? *Y* *N* How many days per year? _____

12. How many tournaments have you fished on Lake Eufaula/Chattahoochee River in the past 12 months? _______________
A. Tournament info: Name(s)____

13. Are you a member of any fishing club? *Y* *N* Name: __________________________

14. How many other reservoirs have you fished on in Alabama in 2017? ___________

a) What are the names of them? ____

b) Which one was the best to fish at including Eufaula? __________________________

15. Would you prefer (*circle one*), *more* *less* *same* amount of aquatic vegetation in Lake Eufaula?

16. How many years of fishing experience do you have? ______

17. Would you prefer (*circle one*), *more* *less* *same* amount of hybrid striped bass in Lake Eufaula?

18. What is your household income? ______

19. Next, we would like to break down your _$yyy_ that you spent to fish for _target species_ on the trip by what items and by what city you bought it in. If you weren't in a city when you purchased an item, the county will work. How much was spent and where was it bought for:

*Circle one: *Individual expenses* *Entire boat*

Item	TOTAL Cost	Town/County	Cost	Town/County	Cost	Town/County	Cost	Town/County	Cost
Used boat gas									
Lodging									
Groceries/drinks/ice									
Restaurant meals									
Fishing equipment/bait									
Guide fees/tips									
Boat/fishing rentals									
Tournament fees									
Boat launch/Storage fees									
Repair/Maintenance									
Car Gas Location Only									

That is all we need from you at this time. Thank you very much for your time. Do you have any comments about the lake you would like to share?
COMMENTS: ____

____

Mr./Ms. _______________, that is all the questions that I have for you. I would like to thank you again for your time.

IX.4. Aerial Boat Count Survey Form

<table>
<tr><td colspan="3">Clerk:</td><td colspan="2">Aerial Boat Count</td><td>Date:</td></tr>
<tr><td>Start Time</td><td>End Time</td><td colspan="3">Angler Boats</td><td>Pontoon Boats</td></tr>
<tr><td></td><td></td><td colspan="3"></td><td></td></tr>
<tr><td colspan="3">Clerk:</td><td colspan="2">Aerial Boat Count</td><td>Date:</td></tr>
<tr><td>Start Time</td><td>End Time</td><td colspan="3">Angler Boats</td><td>Pontoon Boats</td></tr>
<tr><td></td><td></td><td colspan="3"></td><td></td></tr>
<tr><td colspan="3">Clerk:</td><td colspan="2">Aerial Boat Count</td><td>Date:</td></tr>
<tr><td>Start Time</td><td>End Time</td><td colspan="3">Angler Boats</td><td>Pontoon Boats</td></tr>
<tr><td></td><td></td><td colspan="3"></td><td></td></tr>
</table>