An Evaluation of Angler Preferences for Stocking Public Fishing Lakes in Tennessee

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I am submitting herewith a thesis written by Pratikshya Silwal entitled "An Evaluation of Angler Preferences for Stocking Public Fishing Lakes in Tennessee." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Forestry.

Neelam Poudyal, Major Professor

We have read this thesis and recommend its acceptance:

Xuqi Chen, Augustin Engman

Accepted for the Council:

Dixie L. Thompson

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)
An Evaluation of Angler Preferences for Stocking Public Fishing Lakes in Tennessee

A Thesis Presented for the
Master of Science
Degree
The University of Tennessee, Knoxville

Pratikshya Silwal
May 2021
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Abstract

Public fishing areas are important resources for anglers interested in fishing and related activities. In Tennessee, The Tennessee Wildlife Resources Agency (TWRA) stocks fish in many small and large fishing lakes as well as rivers and streams across the state to provide fishing opportunities for residents and non-resident anglers. Understanding the characteristics of diverse angler population and their preference for certain fish is vital to the fishery managers. This study conducted a mixed-mode survey of licensed anglers from Tennessee in 2020 to assess their motivation and preference for fishes. The first study in this thesis employed hierarchical cluster analysis to segment the angler population based on the importance they placed on six catch-related aspects of fishing and identified four distinct segments that varied in terms of their catching aspects: *Trophy anglers* (30%), *Native fish consumers* (45%), *Non-specific consumers* (17%), and *Non-consumptive anglers* (8%). Statistically significant differences were observed across the identified segments in terms of demographic characteristics, fishing behavior, and preference for various fish. Results from this study revealed how the segments differ from each other in terms of their unique characteristics, fishing behavior, and species preference for stocking at public fishing areas. The second study used rank ordered logit model to evaluate relative preference for the seven fishes namely, Bluegill, Catfish, Crappie, Largemouth bass, Redear sunfish, Trout and Walleye. Angler relative preferences for various fishes were significantly influenced by catch-related aspects of fishing and fishing behavior. Results from this study showed that the catch-related aspects of fishing, fishing behavior and demographics has a role in determining angler preferences for certain fish.
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Chapter 1

Introduction
Recreational fishing has significant social and economic importance (Cooke and Schramm, 2007) in Tennessee and the United States. According to a nationwide study conducted by the US Fish and Wildlife Service (USFWS) in 2016 approximately 36 million people participated in freshwater and saltwater fishing across the country and spent $ 46.1 billion in fishing-related activities. Participation in recreational fishing has grown with the growth of the population across the world (Cooke and Schramm, 2007). The U.S. Fish & Wildlife Service’s (USFWS) 2018 report also suggested that the fishing license sales generated more than $700 million in license revenues for wildlife agencies across the country. During the period of 2009 to 2019), the number of fishing license holders in the United States increased by 5%, indicating an increase in participation (USFWS, 2009-2019).

In Tennessee, the Tennessee Wildlife Resources Agency (TWRA) is the state agency that is responsible for stocking public fishing areas and providing fishing opportunities to residents and non-resident sportspersons. Anglers in Tennessee have been fishing in agency lakes, rivers, streams and reservoirs for many years for various purposes such as catching fish, enjoying the scenic beauty, spending time with family, etc. Fishing and hunting are popular recreational activities in Tennessee, but Tennesseans spent more time on fishing-related activities than hunting. In fact, 0.826 million people were involved in fishing related activities in 2011; they fished a total of 17 million days, and spent $283 million in trip related activities i.e., food and lodging, transportation and $803 million on other activities such as equipment (USFWS, 2011).

However, the declining number of anglers in recent years is a major concern for fisheries management agencies. From National fishing license reports provided by USFWS, the number of paid fishing license holders in Tennessee has decreased by approximately 3% over 10 years (2009-2019). The success of recreational fisheries management to some extent depends on the
satisfaction of anglers (Royce, 1983). In addition to catching as many fish as they like, many anglers consider catching desirable fish taxa equally important to angling satisfaction. While agencies responsible for managing public fishing areas have interests in stocking fish that are desirable to anglers, identifying what species are important in the minds of anglers themselves is often challenging. In Tennessee, for example, seven fishes (i.e., Bluegill, Catfish, Crappie, Largemouth Bass, Redear Sunfish, Trout, Walleye) are either currently being stocked or considered for stocking, but the agency needs more information about whether and how anglers value these fishes or rank them according to their preference. Stocking public lakes with fish species that are biologically feasible and have high consumer preference can be instrumental in sustaining public fisheries. As stocking the species that are not consistent with the preference of angler community can lead to controversy and conflicts (Churchill et al., 2002), understanding how anglers rank or value available fish species and what factors influence their preference will shed light on angler-demand for fish species.

Angler preferences for one species over others may depend on the importance they place on fish attributes (i.e., size and numbers) and fishing attributes (i.e., specialization, method of fishing, location in the region, group size, tournament vs. recreational, harvest vs. release, local vs. distant) and their own demographic characteristics (i.e., age, income, household size, education). Understanding how these factors influence angler preferences for certain fish over others will help agencies to predict, which species will be in greater demand. While past studies have mainly focused on the valuation of individual strategies of fisheries management (harvest regulations such as daily bag limit) (Rypel, 2015), catch and release (Gaeta et al., 2013), how anglers rank their preference among various fish species still remains unclear.
One of the major management challenges in public fisheries is having an accurate understanding of angler characteristics and preferences for fish species and other amenities associated with fishing. For example, catch-related aspects of fishing (catch rate, species preference, catch and release etc.) as well as non-fishing related motives (site seeing, spending quality time with family and friends, boating etc.) can influence angler satisfaction while fishing at public fishing areas. Angler populations can be heterogeneous in motivations and interests; thus, they cannot be treated as a single unit of consumers. Understanding diverse angler populations and their fishing behavior and preference for various fish species is important for the management of fishing lakes.

To address these issues, the objectives of the research presented in this thesis:

- To assess the value-based heterogeneity among anglers in Tennessee by identifying distinct segments of anglers based on their preferences for the catch-related aspects of fishing and comparing these segments in terms of their fishing behavior, demographics, and preferences for certain fishes.
- To evaluate angler relative preferences for the stocking of various fishes in public fishing areas and identify the factors influencing their preference.

The above research objectives were met by conducting a mixed-mode survey of licensed anglers of Tennessee in the January and February of 2020. The next two chapters address the two objectives with details on sub-objective and hypothesis, relevant literature, methodology, results, and conclusions. The final chapter presents key conclusions of this thesis.
Chapter 2

A typology of Anglers in Tennessee: Catch Orientation and Species Preference for Stocking Public Lakes
Abstract

Angler populations are often heterogenous, implying that they seek a variety of fishing experiences. Understanding the typology of anglers that value different experiences and comparing them regarding management preference helps fishery managers meet angler expectations and enhance satisfaction. This study segmented a sample of angler population in Tennessee based on the importance placed on catch-related aspects of fishing and compared the segments in terms of their demographic characteristics, fishing behavior, and preference of various fishes for stocking at public lakes. A hierarchical cluster analysis of survey responses (2,222 respondents, 30% response rate) collected with a mixed-mode survey identified four distinct segments that varied in terms of their catch-related aspects: Trophy anglers (30%), Native fish consumers (45%), Non-specific consumers (17%), and Non-consumptive anglers (8%). Statistically significant differences were observed in the demographic characteristics, fishing behavior, and preference for fishes of the identified segments. Findings from this study offer important insights to fishery managers in understanding the underlying variation among the angler population and making informed decisions in selecting fishes for stocking public lakes.

Keywords: fishing, public fishing area, agency lakes, segmentation, cluster analysis
Introduction

Public fishing lakes are an important means for state agencies to meet the angling needs of the public. In Tennessee, The Tennessee Wildlife Resources Agency (TWRA) manages 18 public fishing lakes across Tennessee. These lakes, also referred to as “Family fishing lakes” are open year-round, are small to medium-sized impoundments and provide fishing, boating and other water-based recreation opportunities for the public. Ten of the lakes are located in west Tennessee and range from 87 acres to 560 acres in size. The remaining eight lakes are located in middle Tennessee and range from 12 acres to 325 acres in size. Effectively managing public fishing lakes involves understanding challenges and taking appropriate actions in a timely manner. One of the major management challenges in public fisheries is having an accurate understanding of angler characteristics and preferences for fish species and other amenities associated with fishing. For example, catch-related aspect of fishing (catch rate, species preference, catch and release etc.) as well as non-fishing related motives (site seeing, spending quality time with family and friends, boating etc.) can influence angler decisions to visit public fishing lakes. As angler populations can be heterogeneous in motivations and interests, they cannot be treated as a single unit of consumers.

The issue of understanding diverse angler populations is becoming more important due to rapidly changing demographic and cultural diversity in the United States and underlying differences in fishing participation and preferences (Poudyal et al. 2011). Public participation in recreational fishing has been declining as a result of factors related to urbanization and demographic change (Poudyal et al. 2011). In serving a heterogeneous market, a one-size-fits-all strategy for management decisions may not be effective and could lead to conflicts. For example, the stocking of a non-native fish in Norris lake, Tennessee, resulted in intense angler conflicts.
(Churchill et al. 2002). Hence, decisions regarding the selection of fish species for stocking public fishing waters may be informed by understanding the diverse preferences of anglers within a region. In addition, linking species preference with demographic characteristics and fishing behavior can help develop models to predict demand for various species based on the expected change in demographics and fishing practices. Hence, segmenting the angler population to understand preferences and management-related attitudes is an important step toward sustainable public fisheries management (Murdock et al. 1996).

Angler segmentation has been widely used in fisheries studies to identify distinct groups of an angler population with shared within-group characteristics. Understanding how angler groups (i.e., market segments) differ according to their fishing preferences and describing characteristics (e.g., demographics, fishing behavior) of these groups is a first step in identifying factors that may correlate with preferences. This approach of segmentation helps fish and wildlife agencies to understanding the heterogeneity in their consumer base and develop management strategies to suit user needs.

Researchers have used a variety of approaches in segmenting anglers. The theoretical framework developed by Bryan (1977) uses recreational specialization to explore heterogeneity in angler populations. Studies following this framework have measured fishery resource use and fishing experience, investment in fishing gears (Aas et al. 2000), the centrality of fishing to angler lifestyles (Chipman and Helfrich 1988; Hutt and Bettoli 2007), angler connection to fishing relative to value orientation and experiences (Connelly et al. 2000; Paudyal et al. 2015), relationships and commitment characteristics (Salz and Loomis 2005), and behavior, skills, knowledge, and commitment (Oh and Ditton 2006) as the basis for segmentation. Other studies have segmented anglers based on catch orientation (Arlinghaus 2006), site preferences (Hutt and
Neal 2010), and the characteristics of a fishing trip that are significant to the anglers (Adams 1979; Driver et al. 1984; Connelly et al. 2001). This approach involves having anglers rate the importance of attributes related to their fishing experience and subsequently conducting multivariate analysis to identify factors that contribute most strongly to the experience or conducting cluster analyses to identify distinct groups of anglers (Arlinghaus and Mehner 2005; Hutt and Bettoli 2007). This classification process allows researchers to identify angler groups that seek distinct experiences and opportunities while fishing (Fisher 1997).

For most, catching a fish is the main motivation of taking a trip, and their satisfaction largely depends on their ability to catch a fish of their preferred type (Arlinghaus 2006). In the literature on human dimensions of fisheries, angler attitudes toward catch-related aspects of fishing such as catching fish, catching large fish (size), and catching large amounts of fish (numbers) are termed ‘consumptive orientation’ (Fisher 1997). However, studies conducted on the motivations of angling found that the key motivations for fishing did not necessarily involve catch success (Fedler and Ditton 1994). This is because anglers are interested in variety of aspects of catch ranging from being able to catch particular types of fish (size, species, number) to being able to release them. Thus, many studies on angler segmentation have focused on overall trip experience, and limited attention has been paid to catch-related aspects, only (e.g., Arlinghaus 2006; Kyle et al. 2007). This research builds on those studies and focuses on angler segmentation based on the importance placed on various catch-related aspects of the fishing experience.

The specific objectives of this study are to assess the value-based heterogeneity among anglers in Tennessee, to identify distinct segments of anglers based on their preferences for the catch-related aspects of fishing, and to compare these segments in terms of their fishing
behavior, demographics, and preferences for certain fishes. It is hypothesized that there is a typology of anglers regarding their attitudes towards the various aspects of fishing and angler groups differ significantly in terms of their demographics, fishing behaviors and preferences for fishes.

**Literature Review**

A variety of criteria have been adopted in angler segmentation. The theoretical framework developed by Bryan (1977) uses recreational specialization to explore heterogeneity in angler populations. Studies following this framework have measured fishery resource use and fishing experience, investment in fishing gears (Aas et al. 2000), the centrality of fishing to angler lifestyle (Chipman and Helfrich 1988; Hutt and Bettoli 2007), angler connection to fishing relative to value orientation and experiences (Connelly et al. 2000; Paudyal et al. 2015), relationships, and commitment characteristics (Salz and Loomis 2005), behavior, skills, knowledge, and commitment (Oh and Ditton 2006) as the basis for segmentation. Other studies have segmented anglers based on catch orientation (Arlinghaus 2006), site preferences (Hutt and Neal 2010) etc.

Chipman and Helfrich (1988) used Hierarchical cluster analysis (Ward’s method) to identify subgroups of Virginia river anglers based on several angler specialization variables including fishery resource use, experience, level of investment and centrality of fishing to the angler lifestyle (Chipman and Helfrich 1988). Due to the rapid changes in angler diversity in the United States and specialization differences, segmentation of angler clientele is essential to understanding the angler preferences for management regulations (Murdock et al. 1996). Hutt and Bettoli (2007) segmented Tennessee trout anglers into subgroups using hierarchical cluster analysis of 14 variables related to experience, resource use, investment, and centrality of fishing.
to their lifestyle. The study found that compared to less-specialized anglers, specialized anglers placed higher importance on catching a trophy fish, experiencing the catch, developing fishing skills, releasing fish, and restrictive regulations.

Aas et al. (2000) in Norway studied angler responses to harvest regulations alternatives. Three harvest regulation variables (minimum size limit, bag limit, and bait type allowed) and two expectation variables (expected average fish size and expected catch numbers) were considered in the discrete choice experiment. To explore angler group differences, anglers were segmented based on gear use. Three types of anglers were reported namely: non-fly anglers, general anglers, fly-only anglers. Similarly, Salz and Loomis (2005) categorized anglers in four groups (least specialized, moderately specialized, very specialized, and most specialized) based on responses to the statements describing a participant’s connection to saltwater fishing relative to orientation, experiences, relationships, and commitment characteristics. Using mail survey data, they examined angler attitudes towards two marine fisheries management measures: mandatory catch-and-release areas, and “no fishing” areas involving marine protected areas. This study suggested that the highly specialized anglers showed a greater awareness of the negative impacts of recreational harvest compared to less specialized anglers. However, no significant difference was found between highly specialized and less specialized anglers in terms of their attitudes toward allowing catch-and-release in marine protected areas (Salz and Loomis 2005).

A similar study by Oh and Ditton (2006) segmented angler groups using three recreation specialization models (i.e., behavior, skill and knowledge, and commitment). Through k-means cluster analysis, three specialization groups namely: casual, intermediate, and advanced anglers were identified. Nguyen et al. (2012) segmented anglers of Fraser River in Canada according to their current and preferred communication channels. Three patterns of anglers current and
preferred information sourcing namely: traditional, investigative, and networking was identified through latent-class cluster analysis. Anglers, who commonly preferred information via in-person communication are differentiated as “Traditional” anglers. Likewise, anglers who preferred obtaining information via internet or from regulation handbooks and would consider being active in the angling community (e.g., fishing tournament) are under “Investigative” anglers and anglers who largely rely on tackle shops and publications (e.g., leaflets) for current information and strongly prefer to acquire information through interactions and networking with other people (e.g., anglers, fishery officers, etc.) are classified as “Networking” anglers. Johnston et al. (2010) identified three angler types: generic, trophy fishers and consumption-oriented anglers. Generic anglers were assumed to be the least specialized, consumptive anglers were intermediate, and Trophy anglers were the most specialized and analyze the influence of changes in the fish stock in a northern pike fishery. Optimal minimum-size limits were generally intermediate for generic anglers, low for consumptive anglers, and high for Trophy anglers.

Arlinghaus et al. (2014) identified three classes of anglers in Lower Saxony, north-western Germany by asking to allocate 10 potential angling days among three fishing alternatives, through a latent class choice model. The three classes of anglers varied along characteristics related to catch orientation (e.g., catch something, catch large number of fish), specialization (i.e., skill, and psychological attachment to the activity), satisfaction, and behavioral commitment (e.g., enthusiasm). The three classes were divided based on level of commitment (most committed, intermediately committed, and least committed). The most committed groups were found to benefit from the size of fish. Intermediately committed groups were found to benefit from the size and catch numbers. The least committed group were mostly indifferent to catch related aspects of the fishing experience (Arlinghaus et al. 2014).
Connelly et al. (2000) used five methods for segmentation of anglers in New York; geographic, fishing experience, motivations, preferences, and product-related segmentation through cluster analysis. Under experience-based segments five types of anglers were identified: No experience or future, Past only, Potential, Sporadic and Consistent. Tingley III et al. (2019) determined various sub- groups of anglers through latent class analysis and identified 5 different subgroups namely: prefer quality Bluegill, committed to fish, willing to stay home, prefer Largemouth Bass and action oriented based on fishery preference.

**Methodology**

*Sampling and Data Collection*

Data utilized in this study were collected through a mixed-mode (email and mail) survey of 8,000 licensed anglers in January and February of 2020. The sampling frame included licensed anglers in Tennessee in 2019. Stratified random sampling was used to ensure that all types of license holders (lifetime, annual etc.) were represented in the sample because the fishing permit is included in many types of hunting and fishing licenses sold in Tennessee. Contact information of licensed anglers, including name, address, and license type, was obtained from the Tennessee Wildlife Resources Agency (TWRA). For the email survey, respondents who had email addresses in the file were invited to participate with a personalized email message describing the purpose of the survey and a link to the survey in Qualtrics.com. Following the initial invitation, three additional reminders were sent within a period of two weeks, with two to three days between each correspondence. The mail survey was conducted for those who either did not respond to the email invitation or did not have an email address in the file. The mail survey process began with a mail out of a pre-notification postcard. A week later, a mail packet including a personalized cover letter, an 8-page questionnaire, and a pre-paid business reply
envelope was mailed out. Two weeks later, a follow-up reminder packet including a letter, a copy of the questionnaire, and a pre-paid business reply envelop was sent out to encourage participation.

Survey Questionnaire

The survey utilized an eight-page questionnaire including four different sections (Appendix A). Section A (Fishing, Participation & Satisfaction) included questions about fishing experience, fishing methods, and aspects of fishing. Section B (Fishing Tournaments in Tennessee) included questions about their participation and expenditure in fishing tournaments, and beliefs regarding tournament fishing. Section C (Awareness and Use of Agency/ Family Fishing Lakes in Tennessee) included questions about agency lakes visited and relative preference for the stocking of various fishes in public lakes. Finally, section D included questions about the demographic characteristics of respondents.

Anglers were asked to respond to questions on the importance of aspects of fishing on a 5-point Likert scale (1-not important, 5-very important). Those aspects included catching many fish, catching trophy fish, catching native fish, catching many types of fish, catching fish that I can eat, releasing fish back to the water, being with family/friends, short driving distance, nature and scenery, familiarity with site, and simplicity of regulations. To measure their preference for stocking public lakes in their area, a list of seven fishes (Table 1.6) were presented with a 5-point Likert scale (1-least preference, 5- highest preference). Those seven fishes were chosen because they are either currently being stocked or are being considered for stocking by the agency in public lakes in Tennessee.
Data Analysis

A multivariate cluster analysis was used to segment respondents based on the catch-related aspects of fishing. Cluster analysis is a multivariate technique that classifies a heterogeneous population into relatively homogenous segments (e.g., clusters) based on given criteria. In cluster analysis, the inter-group difference in response to a set of survey questions is maximized, and the intra-group difference is minimized so that the resulting clusters can be described uniquely. Cluster analysis has been used to segment anglers based on specialization (Chipman and Helfrich 1988; Fisher 1997; Oh et al. 2005; Oh and Ditton 2006; Hutt and Bettoli 2007); experience (Connelly et al. 2000), information sources (Nguyen et al. 2012), catch orientation (Stensland and Aas 2014) and perception of trip quality (Smith et al. 2010). For this study, two clustering algorithms were assessed and compared. The first algorithm was the non-hierarchical cluster analysis (k-means clustering), which at first selects k initial cluster centers and then generates homogenous clusters (i.e., segments) around these centers based on similarity of cases to the central case. The second clustering algorithm was the hierarchical technique (Ward’s method). Ward method is based on a classic sum-of-squares criterion and produces groups that minimize within-group dispersion at each binary fusion. Ward’s method also searches for clusters in multivariate Euclidean space (Murtagh and Legendre 2014). Inter-cluster differences and similarities were compared based on the mean score of each variable by clusters. After comparing outputs from both methods, it was determined that the Ward’s method provided the most distinct clusters (i.e., segments) and therefore was chosen for the presentation of results. Naming of each cluster was achieved in two ways. First was, looking at which aspect was scored highest by the cluster and second was comparing the score placed on the catch-related aspects of fishing with other clusters. Since the objective of this study was to identify the typology of
anglers based on catch-related aspects, importance level (1-not important, 5-very important) placed on six different aspects (a-catching many fish, b-catching trophy fish, c-catching native fish, d-catching many types of fish, e-catching fish that I can eat, and f-releasing fish back to water) was used as the basis of segmentation.

After the segments were determined, the demographics, fishing behavior and trip profile, importance placed on various aspects of fishing, and fish preferences were compared among the segments. Analysis of variance was used to determine differences between segments. Kruskal-Wallis H test, which is a rank-based nonparametric alternative to analysis of variance (ANOVA) was also used to compare means for different ordinal variables. If the test showed a significant difference among segments, a follow-up mean-separation test was conducted with Tukey’s post-hoc analysis for the quantitative variables and Bonferroni test for the categorical variables if the test showed a significant difference among the segments. Data analysis was conducted using Stata software.

**Results**

**Survey respondent characteristics**

Of 8,000 total contacts, 11 were undeliverable because the person had moved or was deceased, reducing the effective target sample to 7,989. After completion of email and mail correspondence, a total of 2,388 surveys were returned for an adjusted response rate of 30%. Further, only 2,222 were determined to be anglers because the remaining indicated that they do not fish or use the fishing permit included in their sportsman license. In fact, in Tennessee TWRA does not have a Tennessee resident annual fishing-only license. So, if you are a hunter and want an annual license or a sportsman license you end up licensed to fish but might not fish. Demographic information included gender, education level, income level, household size, and
employment status. Descriptive statistics of respondent demographic characteristics are presented in table 1.1. Of the 2,222, 83% were male which shows the dominance of male population in recreational fishing and the average age of the respondents was 50 years which shows the active involvement of elderly people in fishing activities rather than young adults. The average household size of the respondents was three, and the average number of anglers in respondents’ household was two. A majority (70%) of the respondents had a full-time job which shows that the job holder people are more engaged in fishing related activities. In terms of education, most of the respondents had a high school degree (32.8%). In terms of annual household income, 11% of the respondents indicated making $25,000 or less, and about 25% reported more than $100,000 per annum. The average years of fishing experience for the sample was 32.

Cluster analysis of 2,072 respondents with complete information yielded four distinct segments (Table 1.2). Even though two clustering algorithms (i.e., k-means clustering and Ward’s method) were assessed and compared, results from the Ward’s method are provided because it yielded unique clusters. The four groups of the anglers shared similar attributes with one another in some cases but exhibited significant differences according to the importance they placed on different aspects of fishing. The Kruskal-Wallis test comparing means among angler segments revealed significant differences in responses to the questions regarding the importance of catch-related aspects of fishing. Moreover, Tukey’s test for post-hoc analysis of mean comparisons confirmed the statistical significance of the difference between various segments.

The four segments in table 1.2 were each given unique and descriptive names based on their mean importance scores. For this, a two-step procedure was followed. First, I looked at the aspect on which a particular segment had the highest mean score among six aspects (i.e., within
Table 1.1 Key demographic characteristics of survey respondents.

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>50</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>83%</td>
</tr>
<tr>
<td><strong>Household characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>Total in household</td>
<td>3</td>
</tr>
<tr>
<td>Total anglers</td>
<td>2</td>
</tr>
<tr>
<td><strong>Employment status</strong></td>
<td></td>
</tr>
<tr>
<td>Full-time job</td>
<td>70%</td>
</tr>
<tr>
<td>Retired</td>
<td>20%</td>
</tr>
<tr>
<td>Unemployed</td>
<td>3%</td>
</tr>
<tr>
<td>Others (military, student etc.)</td>
<td>7%</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
</tr>
<tr>
<td>Below high school</td>
<td>4.1%</td>
</tr>
<tr>
<td>High School diploma, GED</td>
<td>32.8%</td>
</tr>
<tr>
<td>Associate degree</td>
<td>8.6%</td>
</tr>
<tr>
<td>Some college</td>
<td>25.8%</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>17.9%</td>
</tr>
<tr>
<td>Post-graduate degree</td>
<td>10.8%</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td></td>
</tr>
<tr>
<td>$25,000 or less</td>
<td>11%</td>
</tr>
<tr>
<td>$25,001 to $50,000</td>
<td>20%</td>
</tr>
<tr>
<td>$50,001 to $75,000</td>
<td>22%</td>
</tr>
<tr>
<td>$75,001 to $100,000</td>
<td>22%</td>
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<td>$100,001 or more</td>
<td>25%</td>
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<tr>
<td><strong>Fishing experience</strong></td>
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<tr>
<td>Average years of fishing</td>
<td>32</td>
</tr>
</tbody>
</table>
the cluster comparison). Second, I compared how the mean scores for all aspects for this segment were different from those in the remaining clusters (i.e., between clusters comparison). For example, the aspect with the highest mean score in both the Native fish consumers and Non-specific consumers was catching fish that they can eat (4.4 and 4.2 respectively). Therefore, both were considered as consumers. Then, comparing each of these segments with the remaining three segments revealed that one segment (i.e., Native fish consumer) had the highest mean score on catching native fish (3.7) relative to other segments. Hence, this segment was labeled as Native Fish Consumers. The other consumer segment (i.e., Non-specific consumers) consistently scored lowest among all segments except the Non-consumptive segment in the mean scores on specific types of catch including trophy, big, native etc. Therefore, they were labeled as Non-specific consumers.

As shown in table 1.2, the first cluster was labeled Trophy anglers because respondents in this segment placed the highest importance on catching many fish, catching trophy/big fish and releasing fish back to water. This segment made the 30% of the total sample. The second cluster was labeled Native fish consumers because respondents in this segment placed the highest importance on catching native fish, catching fish that they can eat and releasing fish back to the water. This comprised the largest segment of the total sample (45%). Similarly, the third segment was labeled as Non-specific consumers because respondents in this segment placed a high level of importance on catching fish that they could consume but did not place high importance on catching special types of fish such as native, trophy/big. They also had the lowest level of importance placed on releasing fish back to the water. This segment made about 17% of the total sample. Finally, the fourth segment was labeled Non-consumptive anglers because for the respondents in this category, the most important motivation was releasing fish back to water and
the importance placed on the consumptive aspect of fishing such as catching many fish, big fish or fish they can eat were lowest among all segments. This segment made the smallest portion of the total sample (8%).

*Importance of non-catch-related aspects of fishing among angler segments*

The Kruskal-Wallis test of mean comparison among angler segments exhibited significant differences regarding importance placed on non-catch-related aspects (Table 1.3). Anglers placed high importance, with average importance rating being greater than three out of five, for all the non-catch-related aspects mentioned in the survey. Among four angler segments, the *Native fish consumers* had the highest average importance rating for all the non-catch-related aspects. The lowest mean importance was observed in the *Non-specific consumers* segment for being with friends/family, nature and scenery, and simplicity of regulations aspects. Similarly, *Non-consumptive anglers* had the lowest level mean importance rating placed on short driving distance and familiarity with site. A post-hoc Tukey test confirmed that inter-segment differences in mean importance rating were statistically significant.

*Demographic characteristics of angler segments*

Comparisons of angler segment demographics revealed significant similarities and differences in their characteristics (Table 1.4). Angler segments were not significantly different in terms of the number of people in the household and the number of anglers in the household. However, *Trophy anglers* were significantly younger than those in the remaining segments. This probably indicates contrasting fishing preference along an age continuum. Education level within each segment was almost similar for all the four segments but some differences found between the segments. The percentage of anglers with bachelor's degrees was significantly higher for *Trophy anglers*, followed by *Native fish consumers* and *Non-consumptive anglers* with equal
Table 1.2 Comparison of mean importance of catch-related aspects of fishing among Tennessee angler segments (N = 2,072).

<table>
<thead>
<tr>
<th>Catch-related aspects of Fishing</th>
<th>Sample</th>
<th>Trophy anglers (30%)</th>
<th>Native fish consumers (45%)</th>
<th>Non-specific consumers (17%)</th>
<th>Non-consumptive anglers (8%)</th>
<th>Kruskal-Wallis test (χ² statistic)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catching many fish</td>
<td>3.3</td>
<td>3.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.8&lt;sup&gt;c&lt;/sup&gt;</td>
<td>309.2**</td>
</tr>
<tr>
<td>Catching trophy/big fish</td>
<td>2.8</td>
<td>3.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.9&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.0&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.4&lt;sup&gt;d&lt;/sup&gt;</td>
<td>505.6**</td>
</tr>
<tr>
<td>Catching native fish</td>
<td>3.0</td>
<td>3.1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.7&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>684.3**</td>
</tr>
<tr>
<td>Catching many types of fish</td>
<td>2.4</td>
<td>2.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.9&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.6&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.3&lt;sup&gt;d&lt;/sup&gt;</td>
<td>419.1**</td>
</tr>
<tr>
<td>Catching fish that I can eat</td>
<td>3.3</td>
<td>1.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.4&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.2&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.4&lt;sup&gt;d&lt;/sup&gt;</td>
<td>1269.1**</td>
</tr>
<tr>
<td>Releasing fish back to water</td>
<td>4.0</td>
<td>4.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.7&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.0&lt;sup&gt;c&lt;/sup&gt;</td>
<td>4.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>547.7**</td>
</tr>
</tbody>
</table>

Note: Importance was measured with a 5-point Likert scale (1 - not important at all, 5 - very important). Mean with the same letter across rows are not significantly different at 5% level. ** and * indicate the significance of statistics at 1% and 5% level, respectively.
percentages and was least for Non-specific consumers. A post-hoc Bonferroni test also confirmed that the Trophy anglers were significantly different from Native fish consumers and Non-specific consumers. Compared to the Non-specific consumers and Non-consumptive anglers, the Trophy anglers and Native fish consumers segments had a significantly higher proportion of male and full-time job holders but a lower proportion of retirees.

Average income reported was significantly different among segments and was highest among Trophy anglers (Table 1.4). The lowest mean reported income was in the Non-specific consumers segment. This is not surprising because those at the higher end of the income bracket are probably interested in non-consumptive aspects of angling experience and are more specific in their target species and types (trophy), but those at the lower end of the income may be more interested in catching for consumption.

Fishing characteristics and behavior of angler segments

Significant differences were found between various angler segments in terms of their fishing trip profile, fishing experience, fishing approach, fishing location, and participation in fishing tournaments (Table 1.5). For example, mean annual fishing trips were higher for Trophy anglers followed by Native fish consumers, Non-specific consumers, and least for Non-consumptive anglers segments. A post-hoc Bonferroni test showed that Trophy anglers and Native fish consumers segments had significantly higher annual fishing trips and days of fishing than the Non-specific consumers and Non-consumptive anglers.
Table 1.3 Comparison of mean importance of non-catch-related aspects of fishing among Tennessee angler segments.

<table>
<thead>
<tr>
<th>Non-catch-related aspects of Fishing</th>
<th>Sample</th>
<th>Trophy anglers</th>
<th>Native fish consumers</th>
<th>Non-specific consumers</th>
<th>Non-consumptive anglers</th>
<th>Kruskal-Wallis test (χ² statistic)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Being with family/friends</td>
<td>4.4</td>
<td>4.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>15.8**</td>
</tr>
<tr>
<td>Short driving distance</td>
<td>3.3</td>
<td>3.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.5&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>31.5**</td>
</tr>
<tr>
<td>Nature and scenery</td>
<td>4.3</td>
<td>4.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.2&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>25.9**</td>
</tr>
<tr>
<td>Familiarity with site</td>
<td>3.7</td>
<td>3.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.8&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.2&lt;sup&gt;c&lt;/sup&gt;</td>
<td>38.4**</td>
</tr>
<tr>
<td>Simplicity of regulations</td>
<td>4.1</td>
<td>4.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.3&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>24.3*</td>
</tr>
</tbody>
</table>

Note: Importance was measured with a 5-point Likert scale (1- not important at all, 5- very important). Mean with the same letter across rows are not significantly different at 5% level. ** and * indicates parameters are significant at 1% level and 5% level, respectively.
Mean annual days of fishing in the *Trophy anglers* and *Native fish consumers* segments were significantly higher than in the *Non-specific consumers* and *Non-consumptive anglers*. Moreover, both metrics of fishing effort were highest in the *Trophy anglers* and lowest in the *Non-consumptive anglers*. The distance traveled for fishing was highest for *Trophy anglers* and days spent fishing were highest for *Trophy anglers* followed by *Native fish consumers*. Also, the average number of fishing years was significantly higher for *Native fish consumers* followed by *Non-specific consumers*, *Trophy anglers* and was least for *Non-consumptive anglers*.

There was no significant difference among angler segments in the proportion that fish in small lakes (smaller than 1,000 acres). However, a significantly higher proportion in *Trophy anglers* and *Native Fish Anglers* segments, compared to *Non-specific consumers* and *Non-consumptive anglers*, fished at large lakes (larger than 1,000 acres). Moreover, the proportion that fished at rivers and streams was significantly higher in *Native fish consumers* than the other three segments. This result highlights the locational preference of different types of anglers and may have implications in better understanding the demand at those sites. Also, rivers and streams in Tennessee may be more likely to have a greater proportion of native to non-native fish than reservoirs.

Regarding fishing approach, at least half of the respondents in each segment reported fishing from both motorized boat and bank. However, compared to the other segments, a significantly lower proportion in the *Non-consumptive* segment reported fishing from a motorized boat. In contrast, a significantly lower proportion in the *Trophy anglers* indicated fishing from a bank or a dock. A significantly higher proportion in *Trophy anglers* and *Native fish consumers* reported fishing by wading, than the *Non-specific consumers* and *Non-specific consumers* and *Non-consumptive anglers*. The lowest proportion in the *Non-specific consumers*
Table 1.4 Comparing demographic characteristics among Tennessee angler segments.

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Sample</th>
<th>Trophy anglers</th>
<th>Native fish consumers</th>
<th>Non-specific consumers</th>
<th>Non-consumptive anglers</th>
<th>Test statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>50.1</td>
<td>47.9&lt;sup&gt;b&lt;/sup&gt;</td>
<td>50.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>51.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>52.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>9.7**</td>
</tr>
<tr>
<td>Gender (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>83</td>
<td>88&lt;sup&gt;a&lt;/sup&gt;</td>
<td>85&lt;sup&gt;a&lt;/sup&gt;</td>
<td>72&lt;sup&gt;b&lt;/sup&gt;</td>
<td>75&lt;sup&gt;b&lt;/sup&gt;</td>
<td>17.2**</td>
</tr>
<tr>
<td>Household characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(mean)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total in household</td>
<td>2.9</td>
<td>3.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.0</td>
</tr>
<tr>
<td>Total anglers</td>
<td>2.1</td>
<td>2.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.8</td>
</tr>
<tr>
<td>Total under 18 years</td>
<td>0.8</td>
<td>0.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.5</td>
</tr>
<tr>
<td>Employment status (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full time job</td>
<td>70</td>
<td>77&lt;sup&gt;a&lt;/sup&gt;</td>
<td>72&lt;sup&gt;a&lt;/sup&gt;</td>
<td>61&lt;sup&gt;b&lt;/sup&gt;</td>
<td>59&lt;sup&gt;b&lt;/sup&gt;</td>
<td>13.3**</td>
</tr>
<tr>
<td>Part-time job</td>
<td>4</td>
<td>3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.0</td>
</tr>
<tr>
<td>Student</td>
<td>1</td>
<td>2&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>0.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>3.2*</td>
</tr>
<tr>
<td>Retired</td>
<td>20</td>
<td>14&lt;sup&gt;a&lt;/sup&gt;</td>
<td>19&lt;sup&gt;a&lt;/sup&gt;</td>
<td>26&lt;sup&gt;b&lt;/sup&gt;</td>
<td>31&lt;sup&gt;b&lt;/sup&gt;</td>
<td>11.6**</td>
</tr>
<tr>
<td>Military</td>
<td>1</td>
<td>1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.1</td>
</tr>
<tr>
<td>Unemployed</td>
<td>3</td>
<td>3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.9</td>
</tr>
<tr>
<td>Education (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below high school</td>
<td>4</td>
<td>1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>4.3**</td>
</tr>
<tr>
<td>High School diploma, GED</td>
<td>33</td>
<td>28&lt;sup&gt;a&lt;/sup&gt;</td>
<td>33&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>37&lt;sup&gt;b&lt;/sup&gt;</td>
<td>36&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>3.4*</td>
</tr>
<tr>
<td>Associate degree</td>
<td>9</td>
<td>9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>10&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.0*</td>
</tr>
<tr>
<td>Some college</td>
<td>26</td>
<td>25&lt;sup&gt;a&lt;/sup&gt;</td>
<td>27&lt;sup&gt;a&lt;/sup&gt;</td>
<td>26&lt;sup&gt;a&lt;/sup&gt;</td>
<td>27&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.4</td>
</tr>
</tbody>
</table>
Table 1.4 Continued

<table>
<thead>
<tr>
<th></th>
<th>Bachelor’s degree</th>
<th>Post-graduate degree</th>
<th>Household income (in thousands dollar)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>18 24&lt;sup&gt;b&lt;/sup&gt;</td>
<td>17&lt;sup&gt;a&lt;/sup&gt;</td>
<td>14&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>17&lt;sup&gt;a&lt;/sup&gt;</td>
<td>17&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>5.8&lt;sup&gt;**&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>11 13&lt;sup&gt;a&lt;/sup&gt;</td>
<td>9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>12&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>12&lt;sup&gt;a&lt;/sup&gt;</td>
<td>13&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.1</td>
</tr>
<tr>
<td></td>
<td>70.3 79.4&lt;sup&gt;b&lt;/sup&gt;</td>
<td>68.9&lt;sup&gt;c&lt;/sup&gt;</td>
<td>62.4&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>62.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>71.3&lt;sup&gt;c&lt;/sup&gt;</td>
<td>21.4&lt;sup&gt;**&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Mean or percentage with the same letter across rows are not significantly different at 5% level.

** and * indicates parameters are significant at 1% level and 5% level, respectively.

For post-hoc analysis, Tukey test was conducted for quantitative data such as age, income, household characteristics, fishing trips whereas Bonferroni test was done for categorical variables.
segment indicated fishing from non-motorized boat such as kayaks, canoe etc.

Participation in fishing tournaments varied among angler segments. For example, the proportion of tournament participants was highest in *Trophy anglers* and lowest in the *Non-specific consumers*. Also, the total number of tournament participants was highest for *Trophy anglers* and lowest for *Non-consumptive anglers*. A post-hoc Tukey test showed that the *Trophy anglers* segment was significantly different from other angler segments. Likewise, the distance traveled to tournaments was also highest for the *Trophy anglers* segment and lowest for *Non-specific consumers*. Average trip expenditures of anglers on a particular tournament were highest for *Native fish consumers* and lowest for *Non-consumptive anglers*. However, there were no significant differences among angler segments in the distance traveled for tournaments and trip expenditure.

*Preference for fish species among angler segments*

Among the seven different fishes given, the top three highly preferred fishes for stocking public fishing lakes were Largemouth Bass (*Micropterus salmoides*), Crappie (*Pomoxis* spp.) and Bluegill (*Lepomis macrochirus*) which is shown in figure 1.1. At the same time, the least preferred fishes for stocking were Redear Sunfish (*Lepomis microlophus*) and Trout (*Oncorhynchus* spp.).

The Kruskal-Wallis test of mean comparison among segments was significantly different in response to their preference for various fishes while stocking public fishing lakes in Tennessee (Table 1.6). A series of post-hoc Tukey test for mean comparison further confirmed that observed differences in mean preference scores among angler segments were statistically
Table 1.5 Fishing characteristics and behavior of angler segments.

<table>
<thead>
<tr>
<th>Fishing characteristics and behavior</th>
<th>Sample</th>
<th>Trophy anglers</th>
<th>Native fish consumers</th>
<th>Non-specific consumers</th>
<th>Non-consumptive anglers</th>
<th>Test statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trip profile (mean)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total annual trips</td>
<td>22.4</td>
<td>28.4&lt;sup&gt;b&lt;/sup&gt;</td>
<td>22.3&lt;sup&gt;c&lt;/sup&gt;</td>
<td>15.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>14.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>14.3**</td>
</tr>
<tr>
<td>Total annual days</td>
<td>26.2</td>
<td>33.6&lt;sup&gt;b&lt;/sup&gt;</td>
<td>26.0&lt;sup&gt;c&lt;/sup&gt;</td>
<td>17.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>15.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>15.3**</td>
</tr>
<tr>
<td>Distance travelled (miles)</td>
<td>30.2</td>
<td>32.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>30.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>29.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>24.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.8</td>
</tr>
<tr>
<td><strong>Fishing experience (years)</strong></td>
<td>32.1</td>
<td>29.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>33.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>33.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>28.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.7</td>
</tr>
<tr>
<td><strong>Fishing sites (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small lakes (&lt; 1,000 acres)</td>
<td>49.7</td>
<td>47.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>52.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>47.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>48.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.3</td>
</tr>
<tr>
<td>Large lakes (&gt;1,000 acres)</td>
<td>69.2</td>
<td>75.2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>70.4&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>63.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>61.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.8**</td>
</tr>
<tr>
<td>Fee fishing ponds or pay lakes</td>
<td>9.1</td>
<td>8.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>10.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.2</td>
</tr>
<tr>
<td>Private lakes/ponds that I do not own</td>
<td>26.6</td>
<td>28.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>27.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>23.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>19.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.5</td>
</tr>
<tr>
<td>Private lakes/ponds that my family owns</td>
<td>17.3</td>
<td>15.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>19.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>16.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>14.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.9</td>
</tr>
<tr>
<td>Rivers /streams</td>
<td>74.9</td>
<td>74.0&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>79.8&lt;sup&gt;b&lt;/sup&gt;</td>
<td>72.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>66.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.5**</td>
</tr>
<tr>
<td><strong>Fishing approach (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>From a motorized boat</td>
<td>67.4</td>
<td>69.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>70.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>65.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>50.0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>9.8**</td>
</tr>
<tr>
<td>From a bank</td>
<td>64.0</td>
<td>55.7&lt;sup&gt;b&lt;/sup&gt;</td>
<td>67.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>68.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>70.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>10.3**</td>
</tr>
<tr>
<td>By wading</td>
<td>27.2</td>
<td>33.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>28.8&lt;sup&gt;ac&lt;/sup&gt;</td>
<td>18.6&lt;sup&gt;b&lt;/sup&gt;</td>
<td>21.4&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>9.6**</td>
</tr>
<tr>
<td>From a non-motorized boat (kayak, canoe etc.)</td>
<td>24.1</td>
<td>25.8&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>27.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>18.9&lt;sup&gt;b&lt;/sup&gt;</td>
<td>20.8&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>3.6*</td>
</tr>
<tr>
<td>From a dock</td>
<td>26.8</td>
<td>24.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>28.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>26.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>28.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.8</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Tournament fishing (mean)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participate in tournaments (%)</td>
<td>14.9</td>
<td>25.6&lt;sup&gt;b&lt;/sup&gt;</td>
<td>11.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>31.6**</td>
</tr>
</tbody>
</table>
Table 1.5 Continued

<table>
<thead>
<tr>
<th></th>
<th>8.6</th>
<th>11.0&lt;sup&gt;a&lt;/sup&gt;</th>
<th>5.3&lt;sup&gt;b&lt;/sup&gt;</th>
<th>5.7&lt;sup&gt;b&lt;/sup&gt;</th>
<th>3.0&lt;sup&gt;b&lt;/sup&gt;</th>
<th>7.7 **</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of tournaments</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance travelled for tournaments</td>
<td>43.9</td>
<td>46.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>43.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>32.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>41.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.7</td>
</tr>
<tr>
<td>(miles)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tournament trip expenditure ($)</td>
<td>193.3</td>
<td>188.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>221.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>148.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>137.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.9</td>
</tr>
</tbody>
</table>

Mean or percentage with the same letter across rows are not significantly different at 5% level. ** and * indicates parameters are significant at 1% level and 5% level, respectively. For, post-hoc test, Tukey test was conducted for quantitative data such as age, income, household characteristics, fishing trips whereas Bonferroni test was done for categorical variables.
significant. Compared to all other segments, the Native fish consumers placed the highest preference for stocking all fishes except Largemouth Bass. Preference for both Bluegill and Catfish were highest for the Native fish consumers, followed by the Non-specific consumers and Non-consumptive anglers. The Trophy anglers segment reported the lowest preference for this fishes. Also, the highest mean preference for Crappie was observed in the Native fish consumers followed by the Non-specific consumers and Trophy anglers, whereas the lowest was found in the Non-consumptive anglers segment. Preference for Largemouth Bass was highest among the Trophy anglers and lowest in the Non-specific consumers.

The preference for Redear Sunfish and Walleye were similar among all segments except the Native fish consumers, which had significantly higher preference for these species compared to other segments. The only segment that was different in preference for Trout was Non-specific consumers, these respondents placed significantly lower preference for Trout than the rest of the segments.

Discussion

The findings of this study suggested that Tennessee anglers form distinct segments based on six catch-related aspects of fishing. Results were consistent with previous findings that focused on the catch-related aspects of fishing for segmentation. For example, segmentation of German anglers by Arlinghaus (2006) based on their reported catch orientation identified low/minimally catch oriented, intermediately catch oriented, and highly catch oriented segments, suggesting that angler populations place a varying level of importance on different aspects of catch while fishing. All the anglers segment placed more importance on non-catch-related aspects such as being with family/friends, being with nature and scenery etc. suggests that people do fishing for recreational purposes rather than other purposes such as consumption.
Figure 1.1 Mean preference for various fishes for stocking in fishing lakes
Table 1.6 Relative preference for fish stocking among Tennessee angler segments.

<table>
<thead>
<tr>
<th>Preference for fishes</th>
<th>Sample</th>
<th>Trophy anglers</th>
<th>Native fish consumers</th>
<th>Non-specific consumers</th>
<th>Non-consumptive anglers</th>
<th>Kruskal-Wallis test (χ² statistic)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluegill</td>
<td>3.5</td>
<td>3.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.7&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.5&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>3.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>30.3**</td>
</tr>
<tr>
<td>Catfish</td>
<td>3.4</td>
<td>3.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.6&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.5&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>79.5**</td>
</tr>
<tr>
<td>Crappie</td>
<td>4.2</td>
<td>3.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.4&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.3&lt;sup&gt;c&lt;/sup&gt;</td>
<td>3.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>110.9**</td>
</tr>
<tr>
<td>Largemouth Bass</td>
<td>4.3</td>
<td>4.5&lt;sup&gt;c&lt;/sup&gt;</td>
<td>4.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.9&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.1&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>57.3**</td>
</tr>
<tr>
<td>Redear Sunfish</td>
<td>3.1</td>
<td>2.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.3&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>49.0**</td>
</tr>
<tr>
<td>Trout</td>
<td>3.2</td>
<td>3.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.9&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.0&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>29.9**</td>
</tr>
<tr>
<td>Walleye</td>
<td>3.3</td>
<td>3.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.5&lt;sup&gt;c&lt;/sup&gt;</td>
<td>3.0&lt;sup&gt;ad&lt;/sup&gt;</td>
<td>2.8&lt;sup&gt;d&lt;/sup&gt;</td>
<td>39.5**</td>
</tr>
</tbody>
</table>

Note: Importance was measured with a 5-point Likert scale (1 - least preference, 5 - highest preference). Mean with the same letter across rows are not significantly different at 5% level. ** and * indicate the significance of parameter at 1% and 5% level, respectively.
Angler segments in a study by (Arlinghaus 2006) indicated more importance to non-catch-related aspects such as relaxing in the outdoors, experiencing a natural setting, and enjoying clear water while fishing. In a study of trout anglers in Tennessee, Hutt and Bettoli (2007) found that non-consumptive specialists showed little importance in harvesting trout but strongly agreed that they would be just as happy to release the trout they caught. Results on characteristics of angler segments in our study are consistent with those reported in previous studies elsewhere (Chipman and Helfrich 1988; Ditton et al. 1992; Fisher 1997), which identified several angler subgroups that ranged from the low to the high end of the specialization continuum as outlined by Bryan (1977). These studies typically found one or two highly specialized segments that placed greater interest on the angling experience's catch-related attributes such as catching large or trophy fish and less interest in harvesting fish. Those studies also identified several subgroups of lesser specialization that emphasized the non-catch-related motives.

Results on the inter-segment difference in non-catch related aspects of fishing experience were generally in line with the findings reported in previous studies. Similarly, Beardmore et al. (2011) found that the anglers in their study rated non-catch motivation items such as experiencing nature, being with friends and family and enjoying solitude more important than the overall catch motivation factors such as catching a fresh fish for a meal with family/friends, to catch trophy fish etc. This is similar to our study as anglers placed high level of importance on non-catch-related aspects of fishing. Arlinghaus (2006) found that an overwhelming majority (90%) of the anglers surveyed in Germany indicated that some anglers consider a fishing day successful even with no catch at all, possibly because angler fish only to enjoy nature or to be with family or friends. Also, in a study of Blue catfish anglers, Hyman et al. (2017) reported that
all angler segments agreed that they enjoy getting out on the lake and that catching fish is not that important to them. This may be because these anglers fish only to enjoy nature or be with family or friends, which is similar with our findings that all the anglers segments placed higher importance on being with family/friends and being with nature and scenery. Similarly, Schoeder and Fulton (2013) found that the anglers placed high importance on being with family/friends and enjoying nature and scenery. There was no significant difference among the angler segments in terms of distance travelled for fishing which contrasted with the findings by TenHarmsel et al. (2019) who found that the distance to the fishing site was significantly different between three identified groups of trout anglers in Georgia. Also, our results showed that the majority of anglers population fish in large lakes. This implies that stocking agency should stock these lakes with more fish to enhance fishing participation and satisfaction of anglers. Also, all the four segments top preferred fishes were Largemouth bass and Crappie. Hence this shows that while making stocking decision fishery manager should stock more of these fishes in comparison to other fish in public lakes.

A study of anglers in South Carolina by Kyle et al. (2007) found four groups (Lots ‘o Fish, Bigguns, Nothin’, and Keepers) based on their consumptive orientation. In the study, Lots ‘o fish group had a strong preference for catching many fish, which to some extent corresponds to the Native fish consumers in our study. The similarity between these two groups (Lots ‘o fish and Native fish consumers) was further verified, where Lots ‘o fish group indicated that fishing trips were enjoyable even if no fish were caught and Native fish consumers of our study placed high importance on being with family/friends or enjoying nature and scenery. Similarly, in the study, the Bigguns fish group had a strong preference for catching big fish and is similar to the Trophy anglers segment in our study. Also, anglers in the Nothin’ group indicated that catching
many fish, catching big fish, and keeping their catch unimportant, which makes it similar to the

Non-consumptive anglers in our study.

Also study of anglers in Germany by Beardmore et al. (2011) found five groups (Nature-oriented Trophy-seeking, Social, Consumptive and Non-trophy challenge-seeking) based on their catch and non-catch related motivations. In the study, Trophy seeking had a strong preference for catching trophy fish, which corresponds to the Trophy anglers in our study. Similarly, in the study, the Consumptive group primary purpose of fishing was to obtain fish for a single meal with family and friends or we can say for consumption purposes which also corresponds to the Non-specific consumers segment in our study. Comparisons of the angler segments revealed significant differences in terms of gender, education level, and employment status. Previous studies on demographic comparison of angler segments are mixed with Smith et al. (2010) reporting no difference and Kyle et al. (2007) finding a significant gender difference among angler segments in Santee Cooper lake, South Carolina. Recently, Golebie et al. (2020) had identified five segments of salmonid anglers (Local residents, Avid generalists, Tourist anglers, Committed specialists, and Experienced specialists) fishing on Lake Michigan and the characteristics of local residents in that study shared some similarity with the Non-consumptive anglers of our study, because local residents traveled shorter distance for the fishing and tended to release their catch (i.e., non-consumptive). Also, both of these segments made the smallest proportion of the sample in respective studies. Finally, the average number of fishing years was significantly higher for Native fish consumers followed by Non-specific consumers, Trophy anglers and was the least for Non-consumptive anglers. In terms of fishing experience, significant difference was found among the Native fish consumers and Trophy anglers which was in line with Golebie et al. (2020) ’s findings but in contrast with Smith et al. (2010), who
found no significant difference in experience across the angler segments. Also, the proportion that participates in fishing tournament was higher for *Trophy anglers* segment and the number of tournament participation was higher for *Trophy anglers* segment and lowest for *Non-consumptive anglers*. A post-hoc Tukey test showed that the *Trophy anglers* segment was significantly different from other angler segments and was significantly different from another group. This might be because most of the fishing tournaments are related with catching big/trophy fish. This implies that fish included for the fishing tournament can influence the preference of anglers for that fish species.

**Conclusions and Implications**

Human dimension studies in fisheries management thus far have revealed that angler population could have heterogeneity in fishing experience preferences. Accordingly, maintaining angler satisfaction requires understanding the underlying characteristics and preferences of a diverse angler population and adopting programs to meet angler expectations. For example, stocking decisions in the past have been controversial and met with resistance from the angling community, largely because their species preferences were not considered or prioritized (Churchill et al. 2002). Based on the importance anglers place on catch-related aspects of fishing, stocking programs may be uniquely designed to meet the expectations of angler communities.

This study uncovered a typology of anglers in Tennessee with the identification of four distinct segments, namely: *Trophy anglers, Native fish consumers, Non-specific Consumer, and Non-consumptive anglers*. *Trophy anglers* were characterized with a higher inclination towards catching trophy fish, catching many fish, and releasing fish back to the water. While catching native fish, catching fish that they can eat, and releasing fish back to water were more important for *Native fish consumers*. Similarly, catching fish that they can eat was more important for *Non-
specific consumers than the other catch-related aspects. At the same time, Non-consumptive anglers placed higher importance on releasing fish back to water while no other fishing aspects seemed to be important for them.

Fisheries agencies and public lake managers can use the information presented in this paper to understand the heterogeneity among different angler groups in their region and make managerial decisions such as selecting particular species for in stocking public lakes. Since most of the Tennessee anglers are Native fish consumers and Trophy anglers, prioritizing stocking native fish species and managing trophy fisheries in public fishing lakes may enhance angler satisfaction and increase their fishing. In terms of fish preference, Largemouth Bass and Crappie were the most preferred fishes by Trophy anglers, and Catfish was the most preferred fish by Native fish consumers. This shows a clear difference among angler segments in terms of what fish they prefer at public lakes, which means it is important for agency to understand the underlying charactering of lake visitors and make appropriate stocking choices. Mismatch in species being sought by anglers and being stocked could lead to conflict or leave a lot of anglers unsatisfied with their fishing experience as well the agencies responsible for fisheries management.

Findings from this study offer new insights in explaining the linkage between fishing behavior, demographic characteristics, and preference for fish. For example, information can help us answer such questions as to how and where anglers fish for certain types of fishes (native, trophy size-classes), what types of anglers are likely to participate in tournament fishing etc. For example, in our study Trophy anglers mostly fish in large lakes and they fish from the motorized boat whereas Non-consumptive anglers fish in rivers/streams and they are more likely to fish from the bank. Moreover, the similarity and contrasts between segments will identify the
significant and unique predictors of demand for various types of fish. Identification of each of the four angler segments demographic characteristics and fishing behavior provides insights on how anglers of different motivations differ in their demographic traits and fishing behavior. Organizers of tournament fishing, or certain types of fishing exhibition or show could use this information in targeted outreach and marketing efforts.

The relative size of these groups within the population provides valuable insights into these market segments' composition. It will help predict how the expected change in demographics may lead to a change in the composition of angler types and demand for certain types of fish in the future. For example, with a shift in anglers income from lower to higher, there is higher probability of anglers belonging in Trophy anglers segment. In addition, the heterogeneity in anglers presented by this study clearly suggests that “one size fits all” is not an ideal approach to stock public lakes. While dealing with anglers in an individual basis may not be feasible, managers could use this information to understand the community characterizes of the angler population they are serving and then design stocking programs with the community’s interest in mind.
References


Chapter 3

Angler Preferences for Alternative Fish Species to Stock Public Fishing Areas: A Ranked Ordered Analysis
Abstract

It is important for fisheries managers to incorporate angler preferences while selecting fishes for stocking public fishing areas. This study evaluated angler preferences for the stocking of various fishes in public lakes in Tennessee. By using data from a mixed-mode survey of licensed anglers in Tennessee, this study evaluated how aspects of fishing, fishing behavior and demographic factors influence angler relative preferences for fishes (Bluegill, Catfish, Crappie, Largemouth Bass, Redear Sunfish, Trout, and Walleye). Results from a rank-ordered logistic regression showed that the anglers were more likely to prefer Largemouth Bass than other fishes. Results from an expanded model showed that the importance placed on catch-related aspects of fishing, fishing behavior, and some demographic characteristics significantly influenced angler fish-preference. This study offers important insights to fishery managers on selecting or prioritizing fishes in stocking decisions and enhancing angler participation and satisfaction in public fishing areas.

Keywords: fishing, species selection, stocking decision, public lakes, Tennessee
Introduction

Preference associated with one type of fish is not necessarily similar to the preference associated with another type of fish. It is no new that level of preference for a fish species can differ between angler to angler as every angler has their own interests and fishing motivations. However, an individual angler himself/herself might have different level of preferences for different types of fishes. Where heterogeneity in angler preferences and motivations based on angler characteristics has been well documented in the literature, almost no attention has been given to possible heterogeneity in angler preferences for different species of fish. In fact, in fisheries management, stocking programs are often based on the principle that stocking increases fish abundance, which leads to higher catch rates and more satisfied anglers (Patterson and Sullivan, 2013). While assurance of fish abundance in fishing areas through stocking is important to meet angling satisfaction, it is equally important to make sure that different types of fish species, which are preferred by anglers are stocked on a regular basis.

In addition to catching many fish, many anglers consider catching desirable fish taxa equally important to their angling satisfaction. Historical cases of fish stocking in many places have observed conflicts between local angler communities and agencies responsible for managing fisheries, especially when species stocked are not desirable to local anglers (Churchill et al., 2002). Stocking decisions of fisheries professionals are not always aligned with angler attitudes and preferences (Connelly et al., 2000). Studies assessing angler preferences for management options have focused on opinions, where anglers are asked to indicate their preference (i.e., stated preference approach) (Smith, 1983), or observing or analyzing actual fishing behavior (i.e., a revealed preference approach) (Louviere, 1988). Studies on preference have mostly focused on the preference anglers place on fishing sites or associated attributes.
Careful selection of species while stocking public fishing areas is critical in sustaining the fishing economy. Approximately 36 million people participated in fishing-related activities in 2016, spending 459 million days, and generating $46 billion in trip-related expenditures on food, lodging, transportation and equipment (USFWS, 2016). However, the declining participation rate in recent years could be a concern for fisheries agencies. For example, the percentage of the national population participating in fishing declined from 37% in 2011 to 34% in 2016 (USFWS, 2016). While it is not clear what proportion of this decline is attributed to people stopping fishing in the state or quitting fishing altogether, understanding the public's motivations and species preferences and increasing angler satisfaction are management actions that may lead to effective retention and recruitment of anglers.

Literature on human dimensions of fisheries has shown that angler populations are diverse in terms of preferences (Kyle et al., 2007; Beardmore et al., 2011). Every angler has a different preference for fish species, and various factors such as demographics, fishing aspects (catching many fishes, catch and release etc.) may influence angler preference for various fishes. For example, anglers who like to catch trophy-sized fish may prefer Largemouth Bass and anglers who like to catch the fish that they can eat may prefer Crappie. Likewise, anglers that use different fishing approaches (boat, bank etc.) or belong to different income or demographic groups may show a different level of preference for a particular fish species. In other words, the demand for fish species could be very diverse due to preference heterogeneity among consumers or anglers. From the supply perspective, managers know what species are biologically feasible to stock in public fishing areas but could benefit from understanding which species anglers would
prefer to have stocked. It is also important for managers to know what factors influence angler preferences for certain species so that a better understanding of determinants of demand can be developed to inform management.

Thus far and to our knowledge, no study has assessed how anglers rank alternative fish species available for stocking public fishing areas. Many state fish management agencies are investing resources to seek angler input in understanding their preference for fish species (FWC News, 2021). To fill this gap in knowledge, the objective of this study was to analyze angler rankings of various fishes that are currently stocked or being considered feasible to stock in Tennessee and evaluate whether and how psychosocial factors and personal characteristics of anglers relate with the preferences among fishes. This was achieved by combining a rank-ordered logistic regression with data collected from an angler survey. It is hypothesized that anglers show a significantly different level of preference among fishes and their preferences are significantly influenced by the importance placed on catch or non-catch aspects of their fishing experience, fishing characteristics and behavior, and demographic characteristics of the anglers.

Literature Review

Thus far, studies assessing angler preferences for management options have focused on opinions, where anglers are asked to indicate their preference (i.e., stated preference approach) (Smith, 1983), or observing or analyzing actual fishing behavior (i.e., a revealed preference approach) (Louviere, 1988). Managers are faced with the challenge of balancing the interests of angling groups using fisheries resources with worries about sustaining fish populations (Peterson and Evans, 2003; Arlinghaus, 2006). However, current management strategies such as limiting the number or size of fish harvested, stocking practices, catch and release, etc. have not always been successful in achieving the required balance between fish population and the aquatic
ecosystem health due to lack of sustainable recreational-fisheries management (Post et al., 2002; Lewin et al., 2006). It is crucial to integrate angler preferences to determine the best management actions so that it assists in the decision-making process and reduces the potential conflicts (Johnston et al., 2010; Hutt and Bettoli, 2007).

A conjoint analysis by Gillis and Ditton (2002) investigated angler preferences for various management scenarios that included six attributes of fishing (bag and size limits, hook restrictions, seasonal closures, tournaments, average number of hookups, and average size of the catch) with two levels for each attribute. Respondent evaluation choices were most influenced by the tournaments where anglers preferred no-kill tournaments over no new tournaments. Arlinghaus et al. (2019) conducted a discrete choice experiment to elicit angler preferences for different fish species in Germany, incorporating two types of attributes; generic attributes (e.g. stocking frequency, trophy fish frequency, etc.) and species-specific attributes (e.g. average number of fish caught, the average size of target fish species, etc.) found that the anglers strongly preferred fishing alternatives characterized by high catch rates, the greater probability of catching trophy fish and, on average, large fish compared with catching fewer, smaller fish in crowded situations. Anglers received more utility from greater catch rates and greater average size. Connelly et al. (2001), in New York, asked anglers to indicate the extent to which they desired each opportunity on their fishing trips using a 5-point and 7-point scale. The questions used to measure the preferences for those opportunities came under six categories; opportunities to catch fish, develop skills, demonstrate skills, eat fish, visit remote areas, target cold-water species and developed family sites. The study segmented the anglers into seven types and revealed that most anglers preferred catching fish or having a chance to catch fish on most or all their fishing trips. The angler types were ranged from the largest groups, namely, skilled, cold-
water, fish consumers and low-skilled, warmwater, fish consumers, to the smallest group, namely, skilled, cold-water, stream anglers.

Beardmore et al. (2015) examined the relationship between angler specialization, catch and non-catch-related trip characteristics and catch satisfaction across six freshwater fish species in northern Germany. Centrality to lifestyle, catch skill, knowledge and expertise were used as a measure of specialization for anglers. As expected, catch satisfaction was primarily determined by catch rate and fish size in all fish species. However, the relative importance of these two outcomes i.e., catch related trip characteristics and non-catch related trip characteristics varied considerably across species. Greater trip distances improved satisfaction among committed anglers and diminished satisfaction for casual anglers. Non-catch characteristics (e.g., the number of other anglers seen while fishing) had significant negative influence on catch satisfaction.

Roehl et al. (1993) used a metric conjoint model to assess angler preferences for charter boat trips with the following attributes: trip price, fishing quality, service quality, and catch. Four attributes (each with two possible values) resulted in 16 product profiles. Price was the most important factor in determining trip preference, followed by catching a favorite fish species, fishing quality, and service quality, respectively. In a survey conducted by Oh and Ditton (2006) in Texas among anglers who target Red drum in coastal water. They concluded that the advanced anglers were less interested in relaxing harvest restrictions in the place they enjoy fishing. However, casual anglers showed a high preference for catching more fish by relaxing current harvest restrictions. In addition, the advanced group was more likely to spend more fishing days, have more money invested in fishing-related equipment, participate in tournaments and clubs, and attribute more importance to fishing activity (Oh and Ditton, 2006).
Melstrom and Kaefer (2020) studied preferences of anglers in Oklahoma City for urban fishing sites using a discrete choice model. The anglers were presented with two choice scenarios, and each scenario consisted of two fishing alternatives defined by seven attributes (i.e., lake circumference, catfish catch rate, sunfish catch rate, presence of a playground, presence of restrooms, a tree-lined bank edge, and driving distance). Sites with restrooms and bank trees were preferred to those without. The same study also found individual heterogeneity in the value of Catfish and Sunfish. For example, i.e., on average, male anglers valued Catfish more on the margin than female anglers. Angler preferences for fishing urban sites were negatively related with travel cost. Similarly, another study by Melstrom and Lupi (2013) found catch rate to strongly influence fishing trip decisions. Arlinghaus et al. (2019) used a stated choice experiment to elicit species-specific preference heterogeneity in German freshwater anglers. They revealed that substantial preference heterogeneity was present among German anglers specifically for catch-related aspects of fishing experience, crowding and cost of fishing. Anglers have also been found to exhibit different preferences for fishing site attributes (Fenichel et al., 2013).

Methods and Econometric Models

Study Area

This study was conducted in Tennessee, USA. The Tennessee Wildlife Resources Agency (TWRA) manages and stocks various public fishing areas that include streams, rivers, small and large lakes. Considering the geographic variation across the state from the Southern Appalachian Mountains in the east to the plains of Mississippi in the west, anglers in Tennessee have diverse fishing opportunities. The National Fishing License Report by USFWS showed that in state license sales generated approximately 20 million for the wildlife agency (USFWS, 2020). The estimated number of paid fishing license holders in the state decreased from 874,371 in the
year 2019 to 860,884 in the year 2020 i.e., 1.5% decline in a year (USFWS, 2019-2020). While this change is statistically insignificant, the trend taken together with the increase in the state’s population implies a decline in participation rate or per-capita demand for fishing. Seven fishes are either currently being stocked or are considered appropriate for stocking in TWRA public fishing lakes. These include Bluegill, Catfish, Crappie, Largemouth Bass, Redear Sunfish, Trout, and Walleye.

**Sampling and Data Collection**

Data for this study were collected with a mixed-mode (email and mail) survey of 8,000 licensed anglers in Tennessee during January and February of 2020. A modified tailored designed method was followed in administering the survey (Dillman et al., 2014). Stratified random sampling was used to ensure that all types of license holders (lifetime, annual etc.) were represented in the sample. Contact information of licensed anglers was obtained from the TWRA license database. The survey was conducted in two phases. In the first phase, respondents who had email addresses in the file were invited to participate with a personalized email message describing the purpose of the survey and a link to the survey in Qualtrics.com. Following the initial invitation, three additional reminders were sent within a period of two weeks, with two to three days between each correspondence. In the second phase, the mail survey was conducted for those who either did not respond to the email invitation or did not have an email address in the file. The mail survey process began with a mail out of a pre-notification postcard. A week later, a mail packet including a personalized cover letter, an 8-page questionnaire, and a pre-paid business reply envelope was mailed out. Two weeks later, a follow-up reminder packet including a letter, a copy of the questionnaire, and a pre-paid business reply envelop were sent out to encourage participation.
Survey Questionnaire

The survey consisted of four sections. The first section included questions about fishing experience, fishing methods, and the importance placed on various aspects of fishing. Using a 5-point Likert scale (1- not important at all, 5- very important), respondents were asked to rate the importance they placed on different aspects of fishing. The aspects of fishing that were rated included catching many fish, catching trophy fish, catching many types of fish, catching native fish, catching fish that I can eat and releasing fish back to water, being with family/friends, short driving distance, nature and scenery, familiarity with site and simplicity of regulations. The second section included questions about their participation and expenditure in fishing tournaments, and beliefs regarding tournament fishing. The third section included questions about their relative preference for various fishes for the purpose of stocking public lakes in their area. The respondents were asked to provide their relative preference for the seven fishes (Bluegill, Catfish, Crappie, Largemouth Bass, Redear Sunfish, Trout, and Walleye) in a 5-point Likert scale (1-least preference, 5 highly preferred). The final section included questions about the demographic characteristics of respondents.

Rank-ordered Logit Models

Econometric framework modeling consumer choice and preference are based upon utility maximization theory (McFadden 1974), which assumes that when choosing a fish species among a set of alternatives species, anglers will select a fish that maximizes their utility (i.e., satisfaction). Utility maximization arises by integrating the attributes of a fish species and the angler individual preferences for those attributes. The random utility model (RUM) has been widely used to derive angler preferences for various fishing attributes such as fishing sites (Schuhmann and Schwabe, 2004; Hunt, 2005). RUM is based on the notion that among a set of
various alternatives, an individual derives utility by choosing an alternative (Walker and Ben-Akiva, 2002). Among many estimation methods that rely on utility theory, the rank-ordered logit (ROL) model was chosen in this analysis because a rank-ordered model obtains a complete ranking of the alternatives compared to a choice experiment, which allows respondents to choose only one most preferred alternative amongst the set of multiple alternatives (Lancaster et al., 2017). Also, the ROL model can estimate the preferences more efficiently (Fok et al., 2012). Moreover, the ROL model has been widely applied in the ranking of the alternatives. It estimates the probability of any ranking of the alternatives from the most preferred to the least preferred alternatives (Zheng et al., 2016). This model has been used in modeling consumer preferences for electric cars (Beggs et al., 1981), consumer preference for duck meat attributes (Zheng et al., 2016) and homeowners’ preferences for irrigation technology features (Zhang and Khachatryan, 2019).

Consider an angler $i$ who ascribes a utility $U_{ij}$ to set of fish species through alternative $j$ where $i = 1, \ldots, N$ represents individuals and $j = 1, \ldots, J$ represents the alternatives. Let us assume that all alternatives are available for ranking for each individual, and that individuals provide a full ranking of the alternatives. The utility function can be written as:

$$U_{ij} = \beta' x_{ij} + \xi_{ij} ; \beta_i = b + \bar{\beta}_i, \bar{\beta}_i \sim MVN_L (0, \Omega)$$

(1)

$x_{ij}$ is an $(H \times 1)$-column vector of exogenous attributes (including a constant for each alternative, except one of the alternatives), and $\beta_i$ is an individual-specific $(H \times 1)$-column vector of corresponding coefficients that varies across individuals based on unobserved individual attributes. Assume that the vector $\bar{\beta}_i$ is a realization from a multivariate normal distribution with a mean vector $b$ and covariance matrix $\Omega = LL'$. Also, assume that $\xi_i$ is independent and identically normally distributed across $i$, but allows a general covariance structure across
alternatives for individual $i$. Specifically, let $\xi_i = (\xi_{i1}, \xi_{i2}, \ldots, \xi_{iJ})'$ ($J \times 1$ vector). Like traditional discrete choice models, only utility differentials matter in ranking choice models too (Alvo and Yu, 2014). Taking the utility differentials with respect to the first alternative, only the elements of the covariance matrix $\Lambda_i$ of $\xi_i = \xi_i - \xi_{i1}$ ($i \neq 1$) can be estimated. Thus, if individual $i$ is observed to choose ranking $\theta_i$, the covariance matrix $\Lambda_{\theta_i}$ is desired for the individual.

The model above can be written by defining the following vectors and matrices as:

$$U_i = (U_{i1}, U_{i2}, \ldots, U_{ij})'$$ ($J \times 1$ vector) and $x_i = (x_{i1}, x_{i2}, x_{i3}, \ldots, x_{ij})' (J \times H$ matrix) where $x_i$ is a vector of variables that describes the characteristics of the respondent $i$ and $\beta_j$ is a vector of parameters to alternative. Then, equation (1) can be written in matrix form as:

$$U_i = x_i b + x_i \beta_j + \xi_i,$$ (2)

For estimation, let us consider an individual $i$ is based on the observed ranking $r_i$ of alternatives for the individual. Let the first ranked alternative for an individual $i$ be $r_i^1$, the second $r_i^2$, and so on until the last-ranked alternative $r_i^J$. Then, the following ($J-1$ vector) inequalities should hold:

$$U_{ir_i^2} - U_{ir_i^1} < 0, \quad U_{ir_i^3} - U_{ir_i^2} < 0, \quad \ldots, \quad U_{ir_i^J} - U_{ir_i^{J-1}} < 0$$

Based on the theoretical model presented above, adopted from Nair et al. (2018), an econometric model was estimated to evaluate whether and how aspects of fishing, fishing experience, fishing methods, and demographic factors influence angler preferences for various fishes. The regression model predicting preference for alternative fishes included independent variables in three groups, (1) importance placed on aspects of fishing, (2) fishing characteristics and behavior, and (3) demographic characteristics. Fishing characteristics and behavior included years of fishing, self-assessed level of fishing skills, and trip behavior. Demographics group
included age, gender, household size, education, and income. Data analysis was conducted in Stata software.

Following Zhang and Khachatryan (2019), two separate models (Model 1 and Model 2) were estimated to analyze species only effects, and species and other variables effects. Model 1 includes only the dummy variables (i.e., species variables) indicating the species for which the preference was indicated. Model 2 is the extended version of Model 1 as it also includes interactions of species variables with many explanatory variables that are hypothesized to impact species preference. For model 2, we used two fishes that got the least and the highest mean ranking on average, i.e., Redear Sunfish and Largemouth Bass as a base variable in the regression model to see if there is any difference regarding the effects of various factors on preference. Results didn’t vary whether we choose Redear Sunfish or Largemouth Bass a base fish (Appendix B). Hence, we chose Redear Sunfish as a base fish. The estimated ranking parameter results for the rest of the fishes were then interpreted as respondents’ preference in relation to the least preferred fish i.e., Redear Sunfish. In Model 1, the estimated parameters represented the log odds ratio of the corresponding fish against the base fish. The odds ratios were calculated as the exponential of the parameter estimates of the corresponding variable. In Model 2, which included the individual characteristic effects, we also reported the odds ratio as an exponential value of the parameter estimates of the corresponding variable for the categorical characteristic variables and the percent change in the odds ratio for quantitative variables. The percent change in the odds of preferring the specific characteristic over the base species of one unit increase in the quantitative variable was calculated by $100[\exp(\beta)−1]$. 


Results

Survey Response and Sample Characteristics

Of 8,000 total contacts, 11 were undeliverable because the person had moved or was deceased, reducing the effective target sample to 7,989. After completion of email and mail correspondence, a total of 2,388 surveys were returned for an adjusted response rate of 30%. A total of 2,222 respondents completed the survey questionnaire. Among them, 1,745 answered the ranking question regarding the preference for seven fishes.

The average age of the respondents was 50 years, and 82% were male. The average number of people in the household was 3, and the average number of anglers in the household was 2. Regarding education, 29% of the respondents indicated that they completed bachelor’s degree or higher education level. Likewise, 69% of the respondents had an annual income greater than $50,000. In terms of fishing characteristics, respondents reported 32 years of average fishing years. Only 17% of the respondents indicated that they were experts in one of the fishing methods. 77% of respondents indicated that they fish from a boat. Similarly, 24% of the respondents indicated that they fish in the agency lakes. When asked if the respondents participate in tournament fishing or not, 15% indicated that they participated in the fishing tournament. Over the past 12 months, respondents average annual fishing trips and annual days of fishing were 23.11 and 26.83, respectively. Respondents had traveled an average distance of 30.54 miles for fishing. Table 2.1 provides a summary of the variables used in the regression analysis.

Table 2.2 shows the summarized proportion of respondents for the ranking of each fish, along with the ranking mean and standard deviation. On average, respondents mean ranking
order of the seven fishes from the least preferred to the most preferred was Redear Sunfish, Walleye, Trout, Catfish, Bluegill, Crappie and Largemouth Bass.

We observed identical rankings for the mean ranking and the ranking from the model 1. However, there was a difference in rankings for the mean ranking and model 2 (Table 2.3). The mean ranking, taken from the survey results, were as Largemouth Bass > Crappie > Bluegill > Catfish > Trout > Walleye > Redear Sunfish. For model 2 ranking were as Largemouth Bass > Catfish > Trout > Bluegill > Crappie > Walleye > Redear Sunfish.

Preference Estimates

For Model 1, the estimated coefficient and odds ratio for each fish are presented in Table 2.4. The odds ratios indicate how many times other fishes were preferred over the base fish (i.e., Redear Sunfish). Redear Sunfish was chosen as a base because this fish had the lowest ranking mean than the other fishes. Furthermore, the estimated odds ratios for Largemouth Bass and Crappie indicated that they were 4.02 and 3.83 times more preferred over the Redear Sunfish (base fish).

Effect of respondents’ characteristics

Table 2.5 presents the estimated coefficients for the influence of individual characteristics. The estimated coefficients revealed the influence of catch-related aspects of fishing on their preferences for various fishes.

Effect of fishes

Table 2.5 shows the effect of fishes on fish ranking. All the fishes except Walleye had a significant effect on fish ranking. The odds ratios indicated how many times other fishes were preferred over the base fish (i.e., Redear Sunfish). The estimated odds ratios for the Largemouth
Table 2.1 Description and summary statistics of explanatory variables used in estimation with sample means.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Obs</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aspects of fishing</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catching many fish</td>
<td>Importance placed on catching many fish</td>
<td>1,738</td>
<td>3.36</td>
<td>1.19</td>
</tr>
<tr>
<td>Catching trophy/big fish</td>
<td>Importance placed on catching trophy/big fish</td>
<td>1,732</td>
<td>2.82</td>
<td>1.40</td>
</tr>
<tr>
<td>Catching native fish</td>
<td>Importance placed on catching native fish</td>
<td>1,720</td>
<td>3.01</td>
<td>1.40</td>
</tr>
<tr>
<td>Catching many types of fish</td>
<td>Importance placed on catching many types of fish</td>
<td>1,728</td>
<td>2.42</td>
<td>1.25</td>
</tr>
<tr>
<td>Catching fish that I can eat</td>
<td>Importance placed on catching fish that I can eat</td>
<td>1,728</td>
<td>3.32</td>
<td>1.57</td>
</tr>
<tr>
<td>Releasing fish back to water</td>
<td>Importance placed on releasing fish back to water</td>
<td>1,732</td>
<td>4.00</td>
<td>1.19</td>
</tr>
<tr>
<td><strong>Fishing characteristics and behavior</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fishing experience</td>
<td>Number of years of fishing</td>
<td>1,711</td>
<td>31.99</td>
<td>16.93</td>
</tr>
<tr>
<td>Fishing skills expertise</td>
<td>A binary variable that equals 1 if the respondent claimed expert in at least one of the fishing methods (rod and reel, jug lining, fly fishing, bow and arrow fishing and hand fishing for catfish) and 0 otherwise</td>
<td>1,745</td>
<td>0.17</td>
<td>0.38</td>
</tr>
<tr>
<td>Boat fisher</td>
<td>A binary variable that equals 1 if the respondent fished from boat, and 0 otherwise</td>
<td>1,745</td>
<td>0.77</td>
<td>0.42</td>
</tr>
<tr>
<td>Agency lake fisher</td>
<td>A binary variable that equals 1 if the respondent fished in agency lakes, and 0 otherwise</td>
<td>1,745</td>
<td>0.24</td>
<td>0.43</td>
</tr>
<tr>
<td>Tournament fisher</td>
<td>A binary variable that equals 1 if the respondent participated in fishing tournament, and 0 otherwise</td>
<td>1,737</td>
<td>0.15</td>
<td>0.36</td>
</tr>
<tr>
<td>Total trips</td>
<td>Annual fishing trips</td>
<td>1,642</td>
<td>23.11</td>
<td>34.85</td>
</tr>
<tr>
<td>Total days</td>
<td>Annual days of fishing</td>
<td>1,391</td>
<td>26.83</td>
<td>38.58</td>
</tr>
<tr>
<td>Total distance</td>
<td>Distance travelled for fishing in miles</td>
<td>1,720</td>
<td>30.54</td>
<td>42.17</td>
</tr>
<tr>
<td><strong>Demographic characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>Age of respondents</td>
<td>1,745</td>
<td>49.57</td>
<td>12.78</td>
</tr>
<tr>
<td>Gender</td>
<td>A binary variable that equals 1 if the respondents was male, and 0 otherwise</td>
<td>1,742</td>
<td>0.82</td>
<td>0.39</td>
</tr>
<tr>
<td></td>
<td>Number of people in a family</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>------------------------------</td>
<td>-------</td>
<td>-------</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1,700</td>
<td>2.93</td>
<td>1.42</td>
<td></td>
</tr>
<tr>
<td><strong>Anglers</strong></td>
<td>1,557</td>
<td>2.08</td>
<td>1.14</td>
<td></td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td>1,732</td>
<td>3.55</td>
<td>1.45</td>
<td></td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td>1,635</td>
<td>69839.89</td>
<td>33231.11</td>
<td></td>
</tr>
</tbody>
</table>

An ordinal variable (1-below high school, 2-High school diploma, GED, 3-associate degree, 4-some college, 5-bachelor’s degree, 6-post graduate degree)
Bass (11.84) and Catfish (8.29) indicate that Largemouth Bass, and Catfish were 11.84 and 8.29 times more preferred than Redear Sunfish (base fish).

*Effect of the importance of catch aspects of fishing*

The importance placed on catching many fish had a significant negative effect on the probability that the Trout would be preferred over the base fish (Redear Sunfish). The odds ratio showed that a one-unit increase in the importance of catching many fish decreased the preferences for Trout over Redear Sunfish by 12% (Table 2.5). Further, the estimated coefficients showed that more importance on catching trophy/big fish increased the likelihood that Largemouth Bass, Trout and Walleye would be ranked above the base fish. A one-unit increase in the respondent importance on catching trophy fish makes it more likely that Largemouth Bass, Trout and Walleye would be ranked over the base fish by 31%, 13%, and 13%, respectively. Respondents’ preferences for these fishes shows that anglers like to fish big fish.

However, more importance on catching native fish was associated with a reduced probability that Largemouth Bass and Walleye would be ranked higher than the Redear Sunfish. A one-unit increase in the respondent importance about catching native fish makes it 17% and 11% less likely to prefer the Largemouth Bass and Walleye species over the base species. Also, with a one-unit increase in the respondent importance on catching many types of fish makes it less likely to prefer Bluegill and Largemouth Bass over the base species by 11% and 12%, respectively.
Table 2.2 Proportion of respondents for each fish species ranking.

<table>
<thead>
<tr>
<th>Fish</th>
<th>Rank =1 (%)</th>
<th>Rank =2 (%)</th>
<th>Rank =3 (%)</th>
<th>Rank =4 (%)</th>
<th>Rank =5 (%)</th>
<th>Ranking mean</th>
<th>Ranking standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluegill</td>
<td>11.18</td>
<td>14.83</td>
<td>18.40</td>
<td>16.92</td>
<td>10.96</td>
<td>3.44</td>
<td>1.26</td>
</tr>
<tr>
<td>Catfish</td>
<td>15.75</td>
<td>16.72</td>
<td>16.25</td>
<td>14.59</td>
<td>11.44</td>
<td>3.33</td>
<td>1.37</td>
</tr>
<tr>
<td>Crappie</td>
<td>4.21</td>
<td>5.86</td>
<td>9.86</td>
<td>18.92</td>
<td>21.13</td>
<td>4.14</td>
<td>1.08</td>
</tr>
<tr>
<td>Largemouth Bass</td>
<td>4.69</td>
<td>4.74</td>
<td>9.34</td>
<td>14.47</td>
<td>24.23</td>
<td>4.22</td>
<td>1.10</td>
</tr>
<tr>
<td>Redear Sunfish</td>
<td>18.82</td>
<td>21.47</td>
<td>19.76</td>
<td>12.35</td>
<td>7.72</td>
<td>3.03</td>
<td>1.33</td>
</tr>
<tr>
<td>Trout</td>
<td>22.55</td>
<td>19.57</td>
<td>12.50</td>
<td>11.31</td>
<td>12.44</td>
<td>3.18</td>
<td>1.51</td>
</tr>
<tr>
<td>Walleye</td>
<td>22.79</td>
<td>16.81</td>
<td>13.89</td>
<td>11.43</td>
<td>12.08</td>
<td>3.17</td>
<td>1.50</td>
</tr>
</tbody>
</table>
Table 2.3 Ranking of fish species in different models.

<table>
<thead>
<tr>
<th>Fish</th>
<th>Sample mean</th>
<th>ROL (Model 1) (fish only)</th>
<th>ROL (Model 2) (fish and individual characteristics)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluegill</td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Catfish</td>
<td>4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Crappie</td>
<td>2</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Largemouth Bass</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Redear Sunfish</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Trout</td>
<td>5</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Walleye</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>
Table 2.4 Parameter estimates and odds ratios for Rank-Ordered Logit (ROL) Model 1 with fish only.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Bluegill</th>
<th>Catfish</th>
<th>Crappie</th>
<th>Largemouth Bass</th>
<th>Trout</th>
<th>Walleye</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Fishes</em> (Redear Sunfish as the base variable)</td>
<td>0.45***</td>
<td>0.28***</td>
<td>1.34***</td>
<td>1.39***</td>
<td>0.10</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>-0.05</td>
<td>-0.05</td>
<td>-0.05</td>
<td>-0.05</td>
<td>-0.05</td>
<td>-0.05</td>
</tr>
<tr>
<td>Log likelihood = -6736.462</td>
<td>[1.56]</td>
<td>[1.32]</td>
<td>[3.83]</td>
<td>[4.02]</td>
<td>[1.10]</td>
<td>[1.07]</td>
</tr>
<tr>
<td>p-value= 0.0000</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

***, ** indicate 1%, 5%, and significant level, respectively. Standard errors are provided in parentheses. Odds ratios are provided in brackets.
Similarly, more importance on “catching fish that I can eat” is associated with an increased probability that the Crappie and Walleye would be ranked higher than the Redear Sunfish but reduced the probability that Largemouth Bass would be ranked higher than the base fish. A one-unit increase in the respondents’ importance on “catching fish that I can eat” makes them 14% and 13% more likely to prefer Crappie and Walleye over the base fish. Respondents’ preferences for these fishes shows the preference for those fishes that can be consumed. However, a one-unit increase in the importance respondent placed on “catching fish that I can eat” makes it 24% less likely to prefer the Largemouth Bass over the base species. Also, with a one-unit increase in respondents’ importance on releasing fish back to water, respondents would be 20% more likely to prefer Largemouth Bass over the base fish.

*Effect of fishing behavior*

Respondents’ fishing behavior may also affect their preferences for fishes which is shown in table 2.5. The results revealed that as fishing experience increased respondents were less likely to prefer Largemouth Bass, Trout and Walleye over the base fish, respectively. With respondents fishing experience increased by one year, they would be 2%, 1% and 1% less likely to prefer Largemouth Bass, Trout and Walleye over the base fish, respectively. This indicates that experienced anglers have less preference for these fishes. Similarly, if the respondent fish in agency lake, then it reduced the probability of preference for Trout and Walleye over base fish but increased the probability of preference for Catfish over base fish. If the respondent fished in agency lakes, then they were 0.61 and 0.44 times less likely to prefer Trout and Walleye and 1.55 more likely to prefer Catfish over the base fish, respectively. The level of expertise in the fishing method had a significant effect on the ranking of Trout over the base fish. If the respondents were skilled in any fishing method, then the preference for trout increased by 1.54
times more than the base fish i.e., Redear Sunfish. Likewise, if the respondent fished from a boat, then they would be 0.71 and 0.63 times less likely to prefer Catfish and Trout over the base fish, respectively. Tournament fisher had a significant effect on the preference for Largemouth Bass; if the respondents participated in fishing tournaments, then they were 2.63 times more likely to prefer Largemouth Bass over the base fish. There was no significant difference in results regarding the effect of other trip-related various including total trips taken, total days spent, and distance travelled for fishing.

Effect of demographics

Most of the demographic variables i.e., gender, household size, number of anglers in a household, age and income were non-significant. Age was significant for the preference of Catfish and Trout. With an increase in respondents' age, they were 1% and 2% less likely to prefer Catfish and Trout over the base fish, respectively. Likewise, with an increase in education level respondents were 13% and 11% less likely to prefer and rank Catfish and Crappie over the base fish.

Discussion

Findings suggest that the anglers showed a significantly different level of preference among fishes. Similarly, the aspects of fishing, fishing behavior, and demographic characteristics also significantly influenced the Tennessee angler preferences regarding fishes for stocking public lakes. Among the seven identified fish species, the ranking mean was highest for Largemouth Bass and least for Redear Sunfish.

In both models Largemouth Bass was the most preferred species among the anglers suggesting that stocking agency will benefit by stocking Largemouth Bass in their lakes. This finding was contrasted with the findings by Tingley III et al. (2019) in Wisconsin who used
Table 2.5 Parameter estimates and odds ratios for Rank-Ordered Logit (ROL) Model 2.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Bluegill</th>
<th>Catfish</th>
<th>Crappie</th>
<th>Largemouth Bass</th>
<th>Trout</th>
<th>Walleye</th>
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<tbody>
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<td><strong>Effect of fishes (Redear Sunfish as the base variable)</strong></td>
<td></td>
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<tr>
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<td>2.11***</td>
<td>1.23**</td>
<td>2.47***</td>
<td>1.41**</td>
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<tr>
<td><strong>Effect of fishing aspects</strong></td>
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<td></td>
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</tr>
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<td>Catching many fish</td>
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<td>-0.02</td>
<td>0.01</td>
<td>-0.13**</td>
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<td>0.13**</td>
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<td>-0.05</td>
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**Effect of demographics**

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<th>Total family in a household</th>
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<tr>
<td>Education</td>
<td></td>
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<tr>
<td>Income (mean)</td>
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<td>0.00</td>
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Log likelihood = -4044.488

p-value = 0.0000

***, ** indicate 1%, 5%, and significant level, respectively. Standard errors are provided in parentheses. Odds ratios are provided in brackets.
stated preference to assess angler preferences associated with Bluegill, Largemouth Bass and Walleye using a Likert scale where only about one fourth (24.5%) showed a preference for Largemouth Bass. However, for the non-resident anglers of the same study, Largemouth Bass was the most important fish. The positive relationship between catching trophy/big fish and preference for Largemouth Bass suggests that angler may consider Largemouth Bass to be more likely to be caught at trophy sizes than the other species. Anglers may consider that there is more prestige associated with catching a trophy Largemouth than there is with catching a trophy-class fish of another species, such as Redear Sunfish. This finding was consistent with the findings by Arlinghaus et al. (2014) who found that the anglers strongly preferred fishing alternatives characterized by greater probability of catching trophy fish and received more utility from greater average size. Also, a positive relationship between catching trophy fish and for preference for Trout also suggest that anglers are more likely to prefer Trout as a Trophy fish. This finding was somehow consistent with the findings by Hutt and Bettoli (2007) where 69% of the Trout anglers fishing in Tennessee tailwaters reported Trout as their most preferred sport fish.

Similarly, the negative effect of the catching fish that I can eat on preference for Largemouth Bass suggested that respondents do not prefer Largemouth Bass for consumption. The positive relationship between releasing fish back to water and preference for Largemouth Bass suggested that respondents are more likely to practice catch and release if the fish is Largemouth Bass. Similarly, the negative effect of the catching fish that I can eat on preference for Largemouth Bass suggested that respondents do not prefer Largemouth Bass for consumption. The positive relationship between releasing fish back to water and preference for Largemouth Bass suggested that respondents are more likely to practice catch and release if the
fish is Largemouth Bass. This finding is similar to the findings by Schroeder and Fulton (2013), who found that for the Minnesota Largemouth Bass anglers, catch orientation i.e., keeping fish was negatively correlated with the regulatory preference i.e., catch and release only regulations. Also, the positive relationship between catching fish that I can eat, and Walleye in our study could be due to respondents’ preference for Walleye for consumption, which be a reason that this fish ranked higher than the base fish i.e., Redear Sunfish. This finding was similar to the finding by Schroeder and Fulton (2013) where Walleye anglers rated keeping fish as the most important catch orientation.

Results also implied that the respondents participating in fishing tournaments were more likely to prefer Largemouth Bass. Since, TWRA identifies Largemouth Bass as a sport fish and bass tournaments are popular in Tennessee, stakeholders interested in promoting tournament fishing may see benefit in selecting this fish for stocking. Negative relationship between anglers fishing by boat and their preference for Catfish and Trout implies that Catfish and Trout may not be preferred for fishing by anglers who fish by boat and the agency should focus on stocking these fish in lakes with shoreline and dock access. Also, the negative relationship between anglers fishing in agency lakes and their preference for Trout and Walleye implies that Trout and Walleye may not be beneficial for selecting these fishes for stocking in agency lakes. Likewise, anglers fishing in agency lakes had a positive relationship with a preference for Catfish which implies that anglers fishing in agency lakes have higher preference for Catfish. This may be because of availability of this fish in the agency lakes. Most of the demographic variables were not significant in explaining the preference of fishes, which indicates that demographics may not play an important role in determining angler preferences for various fish species. This also suggests that other factors such as catch-related aspects of fishing, fishing behavior are more
important in predicting angler preferences. This corroborates the findings of Arlinghaus and Mehner (2005) that psychosocial factors such as beliefs, orientation are more reliable variables than demographics in predicting angler preferences for fish species. Also, in a study by Long and Melstrom (2016) found that angler preferences for certain fish species is related to the trip expenditure where anglers who preferred Bass tended to spend more than those who preferred to fish for other fish species. Hence, promoting Bass species for stocking would help in increasing the revenues of the state. For example, in a study by Chen et al. (2003) found that the anglers fishing trophy Largemouth Bass at Lake Fork, Texas, spent approximately US$27.5 million in fishing trips where 92% of the total expenditures was contributed by anglers outside the local area. Therefore, fishery agencies that enhance the stocking of trophy-size fish can have significant economic benefits and improve the economies of local areas.

**Conclusions and Implications**

Recreational fishing is a popular outdoor activity in Tennessee and managing the fishing lakes as per angler demand is important, since it will enhance fishing participation, satisfaction and ultimately increase the revenue of the state. Using a rank order logit model, this study reveals that not all fishes were equally desired by anglers and their ranking and preference differs from one fish to another. In the case of Tennessee, Largemouth Bass was preferred far more than other fishes. Findings from this study have several implications in management of fishing lakes and various activities related with fishing. Fisheries agencies and public lake managers can use the information presented in this paper to understand the preference of anglers and make managerial decisions. First, fishery managers should assess angler preferences for certain fishes and their motives for fishing before selecting fish for stocking fishing areas. Second, after assessing the preference of anglers, managers can stock various fish in fishing areas as per
anglers need depending on fish species feasibility on the fishing areas. For example, Largemouth Bass was preferred more than other fishes hence while making selection of fish for stocking, this fish should be selected more frequently for stocking in all the fishing areas in Tennessee to meet angler expectation and enhance satisfaction.

Likewise, our findings also showed that various factors influence angler preferences for various fishes. Various psychosocial factors such as anglers fishing behavior and importance they placed on various aspects of fishing had significant influence on angler preferences. This indicates that angler attitude may be an important factor in predicting the demand for certain fish species. For example, in our study anglers who preferred catching trophy fish were more likely to prefer Largemouth Bass. Hence, this shows that while catching trophy fish, anglers have more preference for Largemouth Bass than other fishes. Most of the demographic variables were not significant. This indicates that demographic variables may not influence angler preferences and these variables may not play important role in predicting angler demand for certain fish species and fishery managers should not rely only on demographic characteristics in predicting angler preferences.

Similarly, findings of the study will also assist the fisheries management agencies in supporting their R3 efforts: recruitment, retention, and reactivation. First, evaluating the fishing behavior and preference for fish species of the anglers who have comparatively less fishing experience can help the agency to act accordingly to attract people who have never fished before. Second, findings will inform the agency that how they can satisfy the current anglers so that they will continue fishing in future. Third, knowing the preferred fish species in overall the agency can stock with those species so that people who have stopped fishing because of not finding the preferred fish may start fishing again. Also, results from this study can be used to compare
results from other regions to see the difference in preference for certain fish which helps in understanding the difference/similarity in preference of fish species of anglers of other places. For example, anglers in our study value Largemouth Bass more than other fish whereas anglers in Wisconsin value Walleye fish more than the other fish species (Tingley III et al., 2019). Finally, this study contributes to the literature that evaluates angler preferences for certain fishes. However, there is need for more of such study to see how the ranking between fish changes when fishes in the ranking model have more similar characteristics vs less similar fishes. Validating the results from this study by conducting similar research in different geographical regions will ensure its usefulness. Study can be conducted to see the influence of other factors that are considered in this study on angler preferences to identify other factors that may influence angler preferences for various fish.
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Chapter 4

Conclusions
Proper management of public fishing lakes is important to enhance recreational fishing. However, proper management requires information on lakes and people who come to the lakes for various fishing related activities. Based on the importance placed on catch-related aspects of fishing, four distinct segments of anglers were found in Tennessee namely: Trophy anglers, Native fish consumers, Non-specific consumers and Non-consumptive anglers. Understanding the angler typology based on their catch related aspects of fishing is critical in knowing their fishing motives, what they are looking for and most importantly meeting angler expectation. Enhancing angler satisfaction is important aspect of successful fisheries management. Accordingly, knowing the angler preferences for various fish species is critical for stocking desired fish in the public fishing areas such as lakes, rivers, and reservoirs. As limited information on heterogeneity within angler community and angler preferences for fish species exists in fisheries management literature, this study presents some interesting insights in advancing the human dimensions of fisheries and offers important implications in managing public fishery.

Angler preferences for various fishes were different and influenced by various factors. Among the seven given different fishes angler relative preferences for Largemouth Bass was higher than other fishes. This indicates Tennessee angler value Largemouth Bass more than other fishes for fishing. Likewise, psychosocial aspects such as angler attitudes towards fishing aspects had also important role in influencing their preference for particular fish. This indicates that understanding angler attitude is important for fishery managers while managing public lakes. Most of the demographic variables were not significant for angler preferences for certain fishes. This indicates that fishery managers should not rely only on demographic characteristics in determining angler preferences. Stocking agencies need to focus on other factors such as fishing behavior, attitudes towards various aspects of fishing etc. to predict angler demand for certain
fishes which will enhance angler satisfaction and increase their participation in recreational fishing.

Future studies should evaluate how angler preferences for various fish changes over time. It will be helpful to understand how the change in the determinants that shape preference may drive the preference and relative ranking of the fishes will help us better understand the temporal dynamics of fisheries demand. This will provide an insight to further understand anglers fishing behavior which will allow the fishery managers and various stakeholders to manage public fishing lakes and implement programs as per anglers need. In overall, this study contributes to the literature in fishery management and can be taken as a reference study for future research.


Appendix
Appendix A
Survey Questionnaire
Tennessee Anglers Survey on Fishing Experience, Satisfaction and Attitudes towards Management Issues

Department of Forestry, Wildlife, and Fisheries
University of Tennessee

You are one of the few randomly selected sportsmen and sportswomen in Tennessee to participate in this study about fishing. The answers you provide will help the Tennessee Wildlife Resource Agency in understanding the needs and preferences of anglers so they can make informed decisions. Your responses will be fully confidential and not shared with anyone.

A study conducted by University of Tennessee with the support of Tennessee Wildlife Resource Agency
SECTION A: FISHING PARTICIPATION & SATISFACTION

1. Have you fished in Tennessee in the past two years (i.e., 2019, 2018)?
   □ Yes, skip to Q. 3
   □ No, Continue below

2. Which of the following best describes your reason for saying “No” above?
   □ I usually fish in Tennessee, but the last two years were an exception, [go to Q. 3 below]
   □ I quit fishing in Tennessee, [Please complete only Q3 below and return this survey]
   □ I do not use the fishing right that comes with my license, [Please complete only Q3 below and return this survey]
   □ I have never fished in Tennessee, [Please complete only Q3 below and return this survey]

3. Which of the following best describe the reasons you do not fish in Tennessee? [Check all that apply]
   □ Not interested in fishing
   □ Too crowded
   □ Lack of time
   □ Poor behavior of other anglers
   □ Hard to get enough catch
   □ Water level too low/high
   □ Difficult/complex regulations
   □ I only fish outside of Tennessee

4. For how many years have you been fishing in Tennessee? _______ years

5. In which of the following areas do you typically fish in Tennessee? [Check all that apply]
   □ Small lakes (less than 1,000 acres)
   □ Large lakes (bigger than 1,000 acres)
   □ Agency lakes or family fishing lakes
   □ Fee fishing ponds or pay lakes
   □ Private lakes/ponds that I do not own
   □ Private lakes/ponds that my family owns
   □ Rivers /streams
   □ State park lakes

6. Do you own or live in a property with a fishing lake or pond?
   □ Yes
   □ No, skip to Q8 below

7. Do you allow anyone other than your family members to fish your private pond?
   □ Yes
   □ No

8. From where do you usually do your fishing in Tennessee? [Check all that apply]
   □ From a motorized boat
   □ From a non-motorized boat (kayak, canoe etc.)
   □ From a bank
   □ From a pier
9. What gear do you typically use while fishing in Tennessee?
☐ Live bait ☐ Dead bait ☐ Prepared bait ☐ Artificial lure

10. If you use live or dead bait, which of the following do you use? [Check all that apply]
☐ Worms ☐ Minnows/Shiners ☐ Shad
☐ Skipjack herring ☐ Crayfish ☐ Salamanders

11. If you use live or dead bait, where do you get it? [Check all that apply]
☐ Catch from the waters where I fish ☐ Purchase from a retail store or bait dealer
☐ Catch from other waters and take it with me

12. How do you dispose of leftover live baits?
☐ Throw into water ☐ Discard on-site
☐ Take home for later use ☐ Take home to discard

13. Over the past 12 months, how many trips and days did you go fishing in Tennessee?
_____ total trips (a trip is when you travel from home to your fishing site.)
_____ total days (whether you go more than once on the same calendar day, it still counts as one day of fishing)

14. Typically, how far from your residence do you travel to fish in Tennessee?
.......................miles (one way)

15. What species do you fish for? [Check all that apply]
☐ Bluegill ☐ Catfish ☐ Crappie
☐ Bass ☐ Redear Sunfish ☐ Trout
☐ Walleye ☐ Striped Bass

16. On a scale of 1 (Not important), to 5 (Very important), how do you rate the importance of the following aspects of fishing?

<table>
<thead>
<tr>
<th></th>
<th>Not Important</th>
<th>Importance</th>
<th>Very Important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catching many fish</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Catching trophy/big fish</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Catching native fish</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
Catching many types of fish | 1 | 2 | 3 | 4 | 5
Catching fish that I can eat | 1 | 2 | 3 | 4 | 5
Releasing fish back to water | 1 | 2 | 3 | 4 | 5
Being with family/friends | 1 | 2 | 3 | 4 | 5
Short driving distance | 1 | 2 | 3 | 4 | 5
Nature and scenery | 1 | 2 | 3 | 4 | 5
Familiarity with site | 1 | 2 | 3 | 4 | 5
Simplicity of regulations | 1 | 2 | 3 | 4 | 5

17. Considering everything important to your fishing experience, how would you rate your satisfaction with your recent fishing in Tennessee?

☐ Very Dissatisfied
☐ Somewhat Dissatisfied
☐ Neither Dissatisfied nor Satisfied
☐ Somewhat Satisfied
☐ Very Satisfied

18. How do you rate yourself as an angler in using following fishing methods? [Check one box per row]

<table>
<thead>
<tr>
<th>Method</th>
<th>Beginner</th>
<th>Average</th>
<th>Above Average</th>
<th>Expert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rod and Reel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Juglining</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fly fishing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bow and arrow fishing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hand fishing for cat fish</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SECTION B: FISHING TOURNAMENTS IN TENNESSEE

19. Do you participate in fishing tournaments in Tennessee?

☐ Yes, continue below
☐ No, Skip to Q 26 on next page

20. In 2019, how many tournaments did you participate in Tennessee?

# __________

21. What kinds of tournaments did you participate in?

☐ Local club tournaments
☐ National or Regional organization tournaments (i.e. BASS, FLW)
☐ Local jackpot tournaments
☐ Benefit tournaments
22. Please indicate all types of tournaments in Tennessee you participated in 2019.

- [ ] Bass
- [ ] Striped Bass/hybrid
- [ ] Catfish
- [ ] Trout
- [ ] Crappie
- [ ] Muskie
- [ ] Sunfish
- [ ] Walleye

23. Approximately, how far do you typically travel to participate in fishing tournaments in Tennessee? ____________ miles one-way distance from residence

24. How many members of your family typically travel with you to fishing tournaments?

# ____________ including myself

25. How much do you or your family spend on a typical trip to a tournament? (consider all expenditures including travel, accommodation, meal, fishing gears, boat rental, tournament or guide fees etc.)

$ ____________

26. Please indicate your level of agreement with the following statements regarding fishing tournaments in Tennessee. [Check one box per row]

<table>
<thead>
<tr>
<th>Statements</th>
<th>Strongly Agree</th>
<th>Somewhat Agree</th>
<th>Neutral</th>
<th>Somewhat Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tournament fishing negatively impacts my ability to fish</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tournament fishing adds to my fishing satisfaction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tournament fishing is an important part of fisheries in</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tournament fishing has no effect on the future of sports fishing in</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tennessee</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TWRA should improve regulations and facilities to promote tournament fishing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

27. Considering the lakes where you mostly fish in Tennessee, how do you feel about the current level of the following?

<table>
<thead>
<tr>
<th>Statements</th>
<th>Not enough</th>
<th>Just about right</th>
<th>Too Many</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency of fishing tournament</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of participants in tournaments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ramps available to tournament participants</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Availability of basic facilities (e.g. parking, restrooms)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### SECTION C: AWARENESS AND USE OF AGENCY/ FAMILY FISHING LAKES IN TENNESSEE

**PLEASE READ:** As you may know, TWRA manages 15 Agency lakes (see the table below in Q. 28 for a full list), located in middle and west Tennessee that are open year-round. Some of the lakes are operated by concessionaires (private businesses under contract) and offer complete services for the fishing public. *In addition to regular fishing license, a daily lake permit is required to fish these lakes.* These lakes are also called “family fishing lakes.”

28. **Do you fish at any of these Agency Lakes listed below?**
   ___ Yes, Check box next to each lake you fish
   ___ No, Skip to Q 33 on page 6
   
   - Brown’s Creek
   - Carroll
   - Coy Gaither-Bedford
   - Davy Crocket
   - Garrett
   - Gibson County
   - Glenn Springs
   - Herb Parsons
   - Lake Graham
   - Laurel Hill
   - Maples Creek
   - Marrowbone
   - VFW
   - Whiteville
   - Williamsport

29. **In 2019, how many daily lake permits did you purchase to fish these lakes?**
    _______ permits

30. **On a scale of 1 (Not important), to 5 (Very important), how do you rate the importance of the following amenities and opportunities if provided at Agency lakes you fish?**

<table>
<thead>
<tr>
<th>Amenities/facilities</th>
<th>Not Important</th>
<th>Important</th>
<th>Very Important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access for shoreline fishing (including piers)</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Fish cleaning stations</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Picnic tables</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Boat ramps</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Boat rental</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Ability to use gas powered outboard motor at no wake speed</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Limiting to only electric or human powered boats</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Availability of bait and tackle on site</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Night fishing opportunities</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Restrooms</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
Opportunity for non-fishing recreation such as paddling a kayak or stand up paddleboard | 1 | 2 | 3 | 4 | 5
Lake permit available to buy online | 1 | 2 | 3 | 4 | 5

31. Several Agency lakes have on-site concessionaires to provide fishing supplies such as bait, snacks, etc. How often do you use these services?
☐ Never  ☐ Rarely  ☐ Sometimes  ☐ Often  ☐ Always

32. Most TWRA Agency lakes are managed for Bass and Bluegill. If the opportunity for stocking additional fish were to be possible, how would you rank the following types based on your preference for opportunity to fish? [Circle a number in each row]

<table>
<thead>
<tr>
<th>Fish</th>
<th>Least Preference</th>
<th>Preference level</th>
<th>Highest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluegill</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catfish</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crappie</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Largemouth Bass</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Redear Sunfish</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trout</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walleye</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

33. Please indicate your level of agreement or disagreement with the following statements about concessionaires at TWRA Agency lakes.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Strongly Agree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concessionaires are valuable to me for purchasing last minute supplies</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Concessionaires take away from my fishing experience</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Concessionaires help anglers by providing visitor services on site</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Even though I do not use them, concessionaires are valuable additions at Agency lakes</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Concessionaires do not add to my fishing experience at Agency lakes</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I prefer to buy lake permits online instead of at concessionaire on-site</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
SECTION D: DEMOGRAPHICS

Questions below will help us ensure respondents of this survey are representative of the broader population of anglers in Tennessee. Your answers will be kept strictly confidential.

34. What is your gender? ______ Male ______ Female

35. How many people live in your household?

        # total        # # anglers
        # under 18 years

36. What is your current employment status? [Check all that apply]

        □ Full-time job □ Student □ Military
        □ Part-time job □ Retired □ Unemployed

37. What is the highest level of education you have completed?

        □ Below high school □ High School diploma, GED
        □ Associate degree □ Some college
        □ Bachelor’s degree □ Post-graduate degree

38. In what range was your annual household income from all sources this past year?

        □ $ 25,000 or less □ $ 25,001 to $ 50,000
        □ $ 50,001 to $75, 000 □ $ 75,001 to $ 100,000
        □ $100,001 or more

Thank you for completing this survey!

Please use the space provided below for any additional comments you have.
If you have any additional questions, please contact
Dr. Neelam Poudyal – 865.974.8771; npoudyal@utk.edu

Please return this survey in the enclosed postage-paid envelope. If you have misplaced the envelope, send the completed survey to:

Dr. Neelam C. Poudyal ID
Associate Professor
Department of Forestry, Wildlife, & Fisheries
University of Tennessee
274 Ellington Plant Science Bldg.,
Knoxville, TN 37996
Appendix B

Table 3. Parameter estimates and odds ratios for Rank-Ordered Logit (ROL) Model 2 with Largemouth Bass as a base fish.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Bluegill</th>
<th>Catfish</th>
<th>Crappie</th>
<th>Redear Sunfish</th>
<th>Trout</th>
<th>Walleye</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Fish species</em> (Largemouth Bass as the base variable)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coef.</td>
<td>-1.122</td>
<td>-0.357</td>
<td>-1.237**</td>
<td>-2.472***</td>
<td>-1.058</td>
<td>-2.275***</td>
</tr>
<tr>
<td>Catching many fish</td>
<td>-0.030</td>
<td>-0.015</td>
<td>-0.029</td>
<td>-0.013</td>
<td>-0.141**</td>
<td>-0.052</td>
</tr>
<tr>
<td>Catching trophy/big fish</td>
<td>-0.377***</td>
<td>-0.314***</td>
<td>-0.195***</td>
<td>-0.272***</td>
<td>-0.151**</td>
<td>-0.147**</td>
</tr>
<tr>
<td>Catching native fish</td>
<td>0.129**</td>
<td>0.128**</td>
<td>0.103</td>
<td>0.181***</td>
<td>0.141**</td>
<td>0.065</td>
</tr>
<tr>
<td>Catching many types of fish</td>
<td>0.011</td>
<td>0.029</td>
<td>0.023</td>
<td>0.128**</td>
<td>0.118</td>
<td>0.113</td>
</tr>
<tr>
<td>Catching fish that I can eat</td>
<td>0.255***</td>
<td>0.357***</td>
<td>0.404***</td>
<td>0.273***</td>
<td>0.244***</td>
<td>0.397***</td>
</tr>
<tr>
<td>Releasing fish back to water</td>
<td>-0.108</td>
<td>-0.170***</td>
<td>-0.162**</td>
<td>-0.181***</td>
<td>-0.100</td>
<td>-0.061</td>
</tr>
<tr>
<td>Fishing experience</td>
<td>0.014***</td>
<td>0.012**</td>
<td>0.017***</td>
<td>0.016***</td>
<td>0.006</td>
<td>0.001</td>
</tr>
<tr>
<td>Agency lake fisher</td>
<td>0.089</td>
<td>0.372**</td>
<td>-0.217</td>
<td>-0.067</td>
<td>-0.563***</td>
<td>-0.897***</td>
</tr>
<tr>
<td>Expertise in fishing methods</td>
<td>0.281</td>
<td>0.291</td>
<td>0.199</td>
<td>0.142</td>
<td>0.572***</td>
<td>0.475**</td>
</tr>
<tr>
<td>Boat fisher</td>
<td>-0.275</td>
<td>-0.547***</td>
<td>0.105</td>
<td>-0.210</td>
<td>-0.675***</td>
<td>-0.092</td>
</tr>
</tbody>
</table>
Table 3 Continued

<table>
<thead>
<tr>
<th></th>
<th>Tournament fisher</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-0.758***</td>
<td>-1.318***</td>
<td>-0.689***</td>
<td>-0.966***</td>
<td>-1.253***</td>
<td>-0.679***</td>
</tr>
<tr>
<td>Total trips</td>
<td>0.003</td>
<td>0.002</td>
<td>0.006</td>
<td>0.003</td>
<td>-0.004</td>
<td>0.003</td>
</tr>
<tr>
<td>Total days</td>
<td>-0.003</td>
<td>-0.001</td>
<td>-0.004</td>
<td>-0.002</td>
<td>0.002</td>
<td>-0.005</td>
</tr>
<tr>
<td>Distance (miles)</td>
<td>0.002</td>
<td>0.001</td>
<td>0.001</td>
<td>0.002</td>
<td>0.002</td>
<td>0.002</td>
</tr>
<tr>
<td>Gender</td>
<td>0.014</td>
<td>0.027</td>
<td>0.188</td>
<td>-0.009</td>
<td>0.160</td>
<td>-0.024</td>
</tr>
<tr>
<td>Age</td>
<td>0.000</td>
<td>-0.011</td>
<td>0.005</td>
<td>0.002</td>
<td>-0.014</td>
<td>0.004</td>
</tr>
<tr>
<td>Total family in a household</td>
<td>-0.021</td>
<td>0.030</td>
<td>-0.078</td>
<td>-0.030</td>
<td>-0.042</td>
<td>-0.119</td>
</tr>
<tr>
<td>Total angler in a household</td>
<td>-0.006</td>
<td>-0.068</td>
<td>-0.028</td>
<td>0.042</td>
<td>-0.044</td>
<td>0.043</td>
</tr>
<tr>
<td>Education</td>
<td>0.025</td>
<td>-0.097</td>
<td>-0.076</td>
<td>0.045</td>
<td>0.108**</td>
<td>0.044</td>
</tr>
<tr>
<td>Income (mean)</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>
Appendix C

. use "C:\Users\psilwal\OneDrive - University of Tennessee\Anglers survey stata file\TNAnglersOnlySurveyData052020\(usedforanalysis).dta"
. do "C:\Users\psilwal\AppData\Local\Temp\STD194c_000000.tmp"
. tabstat q16_many q16_trophy q16_native q16_types q16_eat q16_release, by(clu4s)

Summary statistics: mean
by categories of: clu4s

<table>
<thead>
<tr>
<th>clu4s</th>
<th>q16_many</th>
<th>q16_tr-y</th>
<th>q16_n~ve</th>
<th>q16_ty~s</th>
<th>q16_eat</th>
<th>q16_re~e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.58121</td>
<td>3.570064</td>
<td>3.111465</td>
<td>2.41879</td>
<td>1.705414</td>
<td>4.792994</td>
</tr>
<tr>
<td>2</td>
<td>3.577131</td>
<td>2.923409</td>
<td>3.703344</td>
<td>2.875944</td>
<td>4.37972</td>
<td>3.73247</td>
</tr>
<tr>
<td>3</td>
<td>2.971347</td>
<td>1.902579</td>
<td>1.618911</td>
<td>1.595989</td>
<td>4.151862</td>
<td>2.994269</td>
</tr>
<tr>
<td>4</td>
<td>1.809524</td>
<td>1.375</td>
<td>1.702381</td>
<td>1.315476</td>
<td>1.440476</td>
<td>4.571429</td>
</tr>
</tbody>
</table>

Total | 3.333012 | 2.821911 | 3.010618 | 2.39527  | 3.292471 | 3.997587 |

end of do-file
summarize age q4_years q35_total q35_anglers
tab q34
tab q36
tab q37
tab q38
mean q16_many
mean q16_many, over(clu4s)
mean q16_trophy,
mean q16_trophy, over(clu4s)
mean q16_native,
mean q16_native, over(clu4s)
mean q16_types
mean q16_types, over(clu4s)
mean q16_eat
mean q16_eat, over(clu4s)
mean q16_release
mean q16_release, over(clu4s)
kwallis q16_many, by(clu4s)
anova q16_many clu4s
pwcompare clu4s, mcompare(tukey) effects
kwallis q16_trophy, by(clu4s)
anova q16_trophy clu4s
pwcompare clu4s, mcompare(tukey) effects
kwallis q16_types, by(clu4s)
anova q16_types clu4s
pwcompare clu4s, mcompare(tukey) effects
kwallis q16_native, by(clu4s)
anova q16_native clu4s
pwcompare clu4s, mcompare(tukey) effects
kwallis q16_eat, by(clu4s)
anova q16_eat clu4s
pwcompare clu4s, mcompare(tukey) effects
kwallis q16_release, by(clu4s)
anova q16_release clu4s
pwcompare clu4s, mcompare(tukey) effects
kwallis redearsunfish, by(clu4s)
mean q16_friends
mean q16_friends, over(clu4s)
mean q16_distance,
mean q16_distance, over(clu4s)
mean q16_nature,
mean q16_nature, over(clu4s)
mean q16_familiarity
mean q16_familiarity, over(clu4s)
mean q16_regulation
mean q16_regulation, over(clu4s)
kwallis q16_friends, by(clu4s)
anova q16_friends clu4s
pwcompare clu4s, mcompare(tukey) effects
kwallis q33_sunfish, by (clu4s)
anova q33_sunfish clu4s
pwcompare clu4s, mcompare(tukey) effects
kwallis q16_distance , by(clu4s)
anova q16_distance clu4s
pwcompare clu4s, mcompare(tukey) effects
kwallis q16_nature , by(clu4s)
anova q16_nature clu4s
pwcompare clu4s, mcompare(tukey) effects
kwallis q16_familiarity , by(clu4s)
anova q16_familiarity clu4s
pwcompare clu4s, mcompare(tukey) effects
kwallis q16_regulation , by(clu4s)
anova q16_regulation clu4s
pwcompare clu4s, mcompare(tukey) effects
mean age
mean age , over(clu4s)
anova age clu4s
pwcompare clu4s, mcompare(tukey) effects
tabulate q34
by clu4s, sort : tabulate q34
oneway q34 clu4s, bonferroni
mean q35_total
mean q35_total , over(clu4s)
anova q35_total clu4s
pwcompare clu4s, mcompare(tukey) effects
mean q35_anglers
mean q35_anglers , over(clu4s)
anova q35_anglers clu4s
pwcompare clu4s, mcompare(tukey) effects
mean q35_below18
mean q35_below18 , over(clu4s)
anova q35_below18 clu4s
pwcompare clu4s, mcompare(tukey) effects
by clu4s, sort : tabulate fulltime
oneway fulltime clu4s, bonferroni
by clu4s, sort : tabulate parttime
oneway parttime clu4s, bonferroni
by clu4s, sort : tabulate student
oneway student clu4s, bonferroni
by clu4s, sort : tabulate retired
oneway retired clu4s, bonferroni
by clu4s, sort : tabulate military
oneway military clu4s, bonferroni
by clu4s, sort : tabulate unemployed
oneway unemployed clu4s, bonferroni
by clu4s, sort : tabulate parttime
oneway parttime clu4s, bonferroni
by clu4s, sort : tabulate student
oneway student clu4s, bonferroni
by clu4s, sort : tabulate belowhighschool
oneway belowhighschool clu4s, bonferroni
by clu4s, sort : tabulate highschoolGED
oneway highschoolGED clu4s, bonferroni
by clu4s, sort : tabulate associatedegree
oneway associatedegree clu4s, bonferroni
by clu4s, sort : tabulate somecollege
oneway somecollege clu4s, bonferroni
by clu4s, sort : tabulate bachelordegree
oneway bachelordegree clu4s, bonferroni
by clu4s, sort : tabulate postgraduatedegree
oneway postgraduatedegree clu4s, bonferroni
mean income
mean income , over(clu4s)
anova income clu4s
pwcompare clu4s, mcompare(tukey) effects
mean q13_trips
mean q13_trips, over(clu4s)
anova q13_trips clu4s
pwcompare clu4s, mcompare(tukey) effects
mean q13_days
mean q13_days, over(clu4s)
anova q13_days clu4s
pwcompare clu4s, mcompare(tukey) effects
mean q14_miles
mean q14_miles, over(clu4s)
anova q14_miles clu4s
pwcompare clu4s, mcompare(tukey) effects
mean q4_years
mean q4_years, over(clu4s)
anova q4_years clu4s
pwcompare clu4s, mcompare(tukey) effects
tab q5_1
by clu4s, sort : tabulate q5_1
oneway q5_1 clu4s, bonferroni
tab q5_2
by clu4s, sort : tabulate q5_2
oneway q5_2 clu4s, bonferroni
tab q5_3
by clu4s, sort : tabulate q5_3
oneway q5_3 clu4s, bonferroni
tab q5_4
by clu4s, sort : tabulate q5_4
oneway q5_4 clu4s, bonferroni
tab q5_5
by clu4s, sort : tabulate q5_5
oneway q5_5 clu4s, bonferroni
tab q5_6
by clu4s, sort : tabulate q5_6
oneway q5_6 clu4s, bonferroni
tab q5_7
by clu4s, sort : tabulate q5_7
oneway q5_7 clu4s, bonferroni
tab q5_8
by clu4s, sort : tabulate q5_8
oneway q5_8 clu4s, bonferroni
tab q8_1
by clu4s, sort : tabulate q8_1
oneway q8_1 clu4s, bonferroni
tab q8_2
by clu4s, sort : tabulate q8_2
oneway q8_2 clu4s, bonferroni
tab q8_3
by clu4s, sort : tabulate q8_3
oneway q8_3 clu4s, bonferroni
tab q8_4
by clu4s, sort : tabulate q8_4
oneway q8_4 clu4s, bonferroni
tab q8_5
by clu4s, sort : tabulate q8_5
oneway q8_5 clu4s, bonferroni
tab q8_6
by clu4s, sort : tabulate q8_6
oneway q8_6 clu4s, bonferroni
tab q19
by clu4s, sort : tabulate q19
oneway q19 clu4s, bonferroni
mean q20
mean q20, over(clu4s)
aov q20 clu4s
pwcompare clu4s, mcompare(tukey) effects
mean q23
mean q23, over(clu4s)
anova q23 clu4s
pwcompare clu4s, mcompare(tukey) effects
mean q25
mean q25, over(clu4s)
anova q25 clu4s
pwcompare clu4s, mcompare(tukey) effects
mean q33_bluegill
mean q33_bluegill, over(clu4s)
kwallis q33_bluegill, by(clu4s)
anova q33_bluegill clu4s
pwcompare clu4s, mcompare(tukey) effects
mean q33_catfish
mean q33_catfish, over(clu4s)
kwallis q33_catfish, by(clu4s)
anova q33_catfish clu4s
pwcompare clu4s, mcompare(tukey) effects
mean q33_crappie
mean q33_crappie, over(clu4s)
kwallis q33_crappie, by(clu4s)
anova q33_crappie clu4s
pwcompare clu4s, mcompare(tukey) effects
mean q33_bass
mean q33_bass, over(clu4s)
kwallis q33_bass, by(clu4s)
anova q33_bass clu4s
pwcompare clu4s, mcompare(tukey) effects
mean q33_sunfish
mean q33_sunfish, over(clu4s)
kwallis q33_sunfish, by(clu4s)
anova q33_sunfish clu4s
pwcompare clu4s, mcompare(tukey) effects
mean q33_trout
mean q33_trout, over(clu4s)
kwallis q33_trout, by(clu4s)
anova q33_trout clu4s
pwcompare clu4s, mcompare(tukey) effects
mean q33_walleye
mean q33_walleye, over(clu4s)
kwallis q33_walleye, by(clu4s)
anova q33_walleye clu4s
pwcompare clu4s, mcompare(tukey) effects
use "C:\Users\psilwal\OneDrive - University of Tennessee\Anglers survey stata file\usedforranklo
> git(onlyanglersgivingfullrankingobs).dta"
. do "C:\Users\psilwal\AppData\Local\Temp\STD254c_000000.tmp"
. rologit fishranking bluegill catfish crappie largemouthbass trout walleye, 
group(id) nolog

Rank-ordered logistic regression
Group variable: id

Ties handled via the exactm method
Obs per group:

<table>
<thead>
<tr>
<th></th>
<th>min</th>
<th>avg</th>
<th>max</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7</td>
<td>7.00</td>
<td>7</td>
</tr>
</tbody>
</table>

LR chi2(6) = 1608.45
Log likelihood = -6736.462

| fishranking | Coef.  | Std. Err. | z     | P>|z|  | [95% Conf. Interval] |
|------------|--------|-----------|-------|------|----------------------|
| bluegill   | .4462947| .0498323  | 8.96  | 0.000| .3486251 .5439643    |
| catfish    | .2759263| .0500273  | 5.52  | 0.000| .1778745 .3739781    |
| crappie    | 1.341878 | .0515264 | 26.04 | 0.000| 1.240888 1.442868    |
largemouthbass | 1.390901 0.0518188 26.84 0.000 1.289338 1.492464
trout | 0.0986348 0.051613 1.91 0.056 -.0025249 0.1997945
walleye | 0.0635511 0.0521081 1.22 0.223 -.0385788 0.165681

end of do-file
mean age
tab q34_gender
tab q35_total
tab q35_anglers
tab fulltime
tab retired
tab unemployed
tab parttime
tab student
tab military
tab belowhighschool
tab highschoolged
tab associatedegree
tab bachelordegree
tab postgraduatedegree
tab q38_income
by species, sort : summarize rank
by rank, sort : tabulate bluegill
by rank, sort : tabulate catfish
by rank, sort : tabulate crappie
by rank, sort : tabulate largemouthbass
by rank, sort : tabulate redearsunfish
by rank, sort : tabulate trout
by rank, sort : tabulate walleye
sum q16_many q16_trophy q16_native q16_types q16_eat q16_release
sum fishingexperience expertfishingmethods boatfisher agencylakefisher
tournamentfisher q19 total_trips total_days distance_miles
sum age q34_gender q35_total q35_anglers q37_education income_mean
rologit fishranking bluegill catfish crappie largemouthbass trout walleye
c.fishingexperience#c.(bluegill catfish crappie largemouthbass trout walleye)
c.q16_many#c.(bluegill catfish crappie largemouthbass trout walleye)
c.q16_trophy#c.(bluegill catfish crappie largemouthbass trout walleye)
c.q16_native#c.(bluegill catfish crappie largemouthbass trout walleye)
c.q16_types#c.(bluegill catfish crappie largemouthbass trout walleye)
c.q16_eat#c.(bluegill catfish crappie largemouthbass trout walleye)
c.q16_release#c.(bluegill catfish crappie largemouthbass trout walleye)
c.total_trips#c.(bluegill catfish crappie largemouthbass trout walleye)
c.total_days#c.(bluegill catfish crappie largemouthbass trout walleye)
c.distance_miles#c.(bluegill catfish crappie largemouthbass trout walleye)
c.boatfisher#c.(bluegill catfish crappie largemouthbass trout walleye)
c.agencylakefisher#c.(bluegill catfish crappie largemouthbass trout walleye)
c.expertfishingmethods#c.(bluegill catfish crappie largemouthbass trout walleye)
c.q34_gender#c.(bluegill catfish crappie largemouthbass trout walleye)
c.q35_total#c.(bluegill catfish crappie largemouthbass trout walleye)
c.age#c.(bluegill catfish crappie largemouthbass trout walleye)
c.q35_anglers#c.(bluegill catfish crappie largemouthbass trout walleye)
c.income_mean#c.(bluegill catfish crappie largemouthbass trout walleye)
c.q37_education#c.(bluegill catfish crappie largemouthbass trout walleye),
group(id) nolog
Vita

Pratikshya Silwal is from Nepal. She went Tribhuvan University in 2014 and graduated in 2018 with a bachelor’s degree in Agricultural Sciences. She then attended the University of Tennessee from 2019-2021 and earned a Master of Science in Forestry. Her research interest lies in social and economic aspects of natural resources.