ECONOMIC VALUATION OF THE LOWER ILLINOIS TROUT FISHERY IN OKLAHOMA UNDER CURRENT AND HYPOTHETICAL MANAGEMENT PLANS

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CHAPTER I

INTRODUCTION

Background

The state of Oklahoma has many different ecosystems and natural areas that are used for recreation. These recreation areas are managed by private individuals, state organizations such as the Oklahoma Department of Wildlife Conservation (ODWC), and the Oklahoma Tourism and Recreational Department (OTRD). These institutions are responsible for managing a most of Oklahoma's natural resources and they strive to promote awareness, of the educational, recreational and economic benefits to residents of Oklahoma. Concern about the trout fishery in eastern Oklahoma, the ODWC funded this recreational value and trout creel survey. The trout fishery, located on the Lower Illinois River (LIR) below the Tenkiller Ferry Dam, is a stocked fishery.

The aim of this study is to collect information regarding users' demand for the resource in order to guide ODWC's efforts to purchase water rights and manage the fishery efficiently. The objective of this study was to collect more information regarding the visitation rate of this fishery. The information collected in this dissertation will focus on economic measurements such as recreation benefits, costs to stock the fishery, projected changes in management, and estimations of use of the resource. There is a need to measure the value of this fishery resource to develop an institutional strategy that will maximize the visitor's leisure experience.

Historical Overview

The LIR trout fishery was created after the construction of the Tenkiller Dam. The dam was completed in 1953 and it is the second highest dam in Oklahoma at 97ft. The purpose of the dam is for hydroelectric power generation and flood control. Oklahoma State Highway 100 extends across the top of the dam and spillway.[1] Construction of this hydroelectric dam altered the water flow and water temperature, which displaced the habitat for warm water fish. Water released from the dam for hydropower generation provides enough cold water to maintain a year round trout fishery. The water released from the dam is cold because the release comes from 120 ft down the water column making the temperature within the range for trout habitat. Trout are stocked by the ODWC as mitigation for the loss of the warm water fish that were present prior to installation and operation of the dam; it has been designed as a put and take fishery since its origin.

The ODWC began its trout stocking program in 1965 at the request of trout anglers with the agreement that the program would be self-sufficient (Hyler, 2006). As subsidies to the stocking program, most of the trout are provided free of charge by the federal government through its federal hatchery system in Arkansas. However, trout were not expected to survive long term due to the irregular water releases and the lack of

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[1] Tenkiller Net Website. Lake Tenkiller history and background lake information. Retrieved on March, 22,2006. http://www.tenkiller.net/lakeinfo.htm

dissolved oxygen in the water. Trout were not expected to live far away from the dam due to the increase in water temperature as the distance increases. Nonetheless, there was evidence that some of the trout survive for longer periods of time but there is no estimate of how many fish survive or for how long.

In Oklahoma, trout anglers are required to purchase a $10 trout stamp in addition to a fishing license that costs $20 per year (ODWC, 2004). The trout stamp is required for all people regardless of age or whether or not they are Oklahoma residents. Trout are purchased with earnings from the collection of these license fees. In 2004 there were 29,851 adult trout licenses (age 17 or older) sold. In addition, 7223 youth license were sold for $5, as well as several non-resident fishing/hunting permits. Income from the trout stamp is distributed among the state's trout fisheries according to an estimated number of hours of utilization among the fisheries. The percentage of income that was assigned to the LIR trout fishery was 33.6% of the total income based on estimates of visitation by the ODWC (Crews, 2002).

Along several miles below the dam, cold water releases from hydropower generation make it impossible for non-native fish species like trout, to live in this altered ecosystem. Strong currents generated by the dam helps to create deeper pools which trout prefer; but they do not necessarily like extremely strong currents. The trout season lasts year round and the LIR trout fishery is one of two year-round trout fisheries in Oklahoma. The other year-round trout fishery is located in the Mountain Fork River below Broken Bow Lake in southeastern Oklahoma (ODWC, 2004). There are 6 other trout fishing sites in Oklahoma, but they are not year round fisheries. The designated trout area in the LIR is seven and three quarter miles from Tenkiller Dam to the bridge on

Highway 64 near Gore Oklahoma (Figure I-1). There are six public or private access points along the trout area, including several pools that were constructed off of the river to allow for trout fishing when there is strong current caused by the hydroelectric cold water releases (ODWC website).

Overnight camping is allowed only at the Gore Landing site and the Marvel resort campsite on the LIR. The daily limits for this fishery depend on what type of trout you catch. The brown trout daily limit is one fish (20-inch minimum) and for Rainbow trout the daily limit is six with no size limit (ODWC, 2004). The fishery on the LIR provides an opportunity for tourism and development of related service industries such as restaurants, campsites, stores, rental of fishing equipment, guides, etc., which can greatly benefit the local economy of the Sequoyah County.

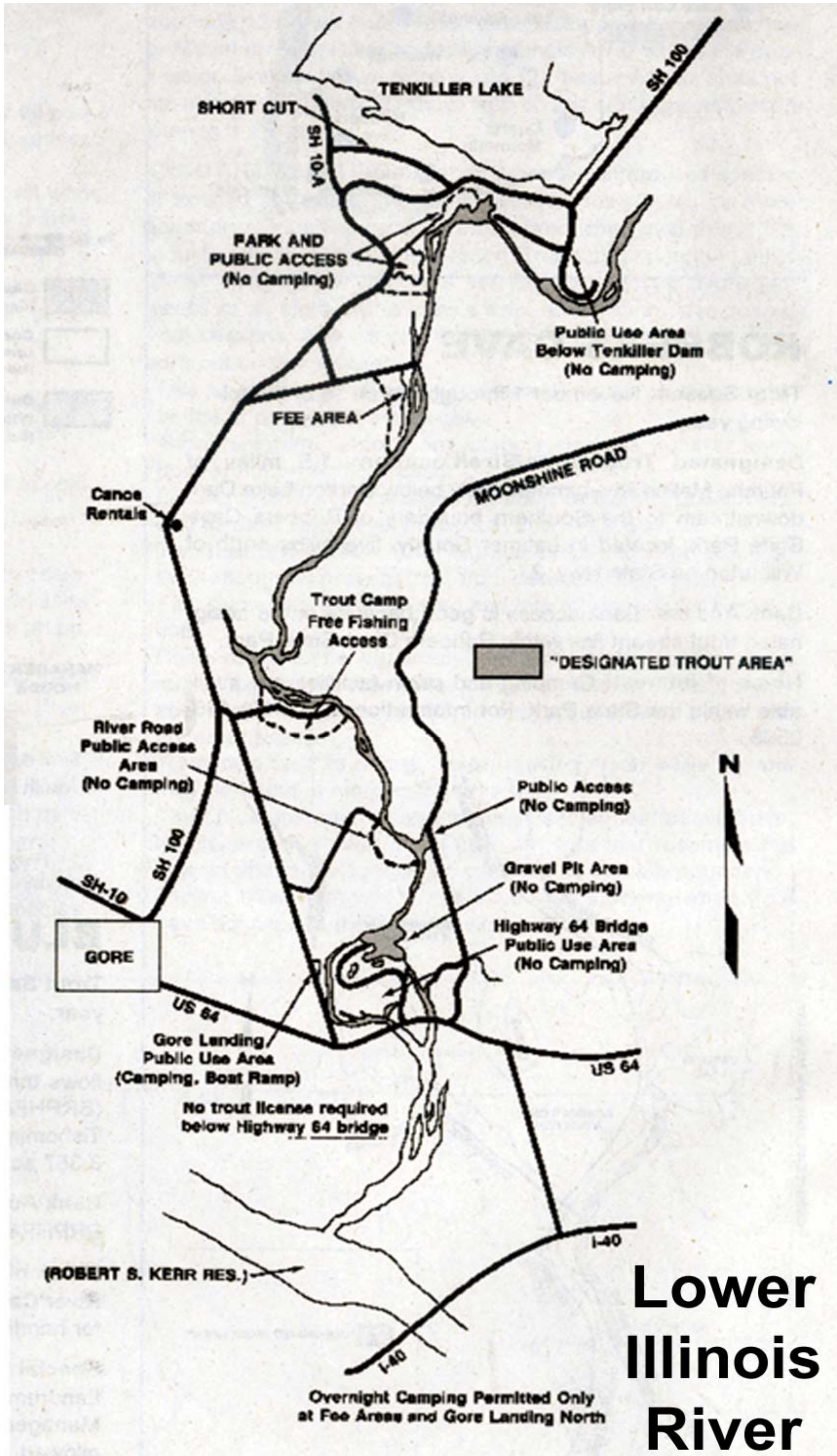


Figure I-1. Map of the Lower Illinois River Trout Fishery
Source: ODWC, (2004)

Economic Overview of Sequoyah County, OK

The LIR trout fishery is located in Sequoyah County, Oklahoma. Sequoyah County is located in the eastern part of the state and borders Arkansas (Figure I-2). The land area of the county is 674 square miles and consists of rolling hills, a major lake (Tenkiller), and two major stream systems: the Arkansas and Illinois River (Oklahoma Department of Commerce, 2005). The region is also called the 'Oklahoma Ozarks.' To understand the demographics of the county, U.S. Census Bureau data for Sequoyah County are compared to state and national data (Table I-1, I-2). The population of Sequoyah County has increased near the national rate of 4.3 percent from the year 2000 to 2004. The total estimated population in the region was 40,578 for the year 2004. In 1999, the per capita personal income was $13,405 per year with 19.8% of its population living below poverty line. The median household income of Sequoyah County was $27,615, which was more than 34% lower than the national median income of $41,994. Sequoyah County was below both the state per capita personal income and the state median household income. Table I-1 contains this information from the U.S. Census Bureau of 2000.

Table I-1. Comparison Between Population Facts in Sequoyah County, the State of Oklahoma and the U.S.

Population Facts	Sequoyah County	Oklahoma	USA
Population, 2004 estimate	40,578	3,523,553	293,655,404
Population, percent change, April 1, 2000 to July 1, 2004	4.1%	2.1%	4.3%
Population, 2000	38,972	3,450,654	281,421,906
Population, percent change, 1990 to 2000	15.2%	9.7%	13.1%
Persons under 5 years old, percent, 2000	7.1%	6.8%	6.8%
Persons under 18 years old, percent, 2000	27.4%	25.9%	25.7%
Persons 65 years old and over, percent, 2000	13.5%	13.2%	12.4%
Female persons, percent, 2000	50.7%	50.9%	50.9%

Source: 2002 Census of Agriculture, National Agricultural Statistical Service

Small-scale agricultural industries in the county have declined between 1997 and 2002 (Table I-3). The number of farms, as well as the total farm acreage in the county, has decreased greatly. The total number of acres farmed has decreased 24 % in only 5 years. The agriculture sector's market value of production changed from $39,583,000 to $25,213,000, which represents a decrease of 36 % in the total market value of production in only 5 years. Of the total $39,583,000 earned in the agricultural sector in 2002, $4,780,000 corresponds to total crop sales, including nursery and greenhouse goods; and $20,433,000 corresponds to livestock sales including poultry and their products. In fact, there is great concern about the side effects of the developing poultry industry, such as the poultry waste management, which negatively affects the quality of the lakes/rivers in the region, including the LIR and its trout fishery (Maxwell, 2006).

Table I-2. Income and Number of Households per County Level, State Level and National Level.

Income	Sequoyah County	Oklahoma	USA
Households, 2000	14,761	1,342,293	105,480,101
Persons per household, 2000	2.61	2.49	2.59
Median household income, 1999	$27,615	$33,400	$41,994
Per capita money income, 1999	$13,405	$17,646	$21,587
Persons below poverty, percent, 1999	19.8%	14.7%	12.4%

Source: 2002 Census of Agriculture, National Agricultural Statistical Service

The data from the Census of Agriculture shows that the market value of the total agricultural output in this county decreased rapidly and the market value of production per farm also decreased rapidly in this 5 year period, as well as government payments per farm. Agriculture was a significant activity in the area, but farm income decreased. Observing the agricultural farm situation in Sequoyah County, the per capita income, and declining population, it is apparent that this region needs other economic activities to promote growth, income and regional development. The trout fishery and natural resources in this region may represent a viable option for maintaining and potentially increasing economic development in the area.

Table I-3. Agricultural Farms in Sequoyah County. Data are from the 2002 Census of Agriculture.

Sequoyah County Farms	1997	2002	Change (%)
No. of farms	1309	1259	-4
Land in farms (acres)	303,485	222,350	-27
Average size of farm (acres)	232	177	-24
Market value of production	$39,583,000	$25,213,000	-36
Market value of production per farm	$30,239	$20,026	-34
Government payments	$89,000	$256,000	188
Government payments, average per farm receiving payments	$2,556	$1,816	-29

Figure I-2. Area of Study, Sequoyah County located in the eastern part of the state of Oklahoma.

Source: University of Texas on-line Library.

Problem Statement

Over 95% of the water stored in the Tenkiller dam is allocated by permit for different uses. A total of 12,000 acre ft of water is allotted to Sequoyah Fuels Corporation, a uranium and thorium processing plant and the ODWC to maintain a minimum year round flow for the fishing area (ODWC). The Oklahoma Department of Wildlife and Conservation (ODWC) anticipates that the imminent decommissioning of the Sequoyah Fuels plant will require the purchase of water rights to maintain the fishery. Accordingly, the ODWC needs to estimate the value of the fishery to anglers in its present state and what the willingness to pay would be under alternative improved management scenarios. Furthermore, there is a need to estimate the value of this fishery in case the Oklahoma Water Resources Board has to decide to whom to assign the water rights after the Sequoyah Fuels Corporation is decommissioned. Currently the City of Sallisaw, which has had a permit request since the late 1970s, is likely to receive the right to purchase Sequoyah's water rights since the Oklahoma Water Resource Board (OWRB) operates on a first-come first-serve basis. The Cherokee Nation and the ODWC also would like to have access to these water rights (Hyler, 2006). The LIR trout fishery is a non-market good, i.e., there is no readily observed price for the fishery (except for the stamp price of $10 per year). Non-market valuation techniques can be used to estimate values for the non-market services provided by recreational sites even though the services they provide are not exchanged in established markets. Valuation gives us a way of comparing our policies with alternative policies having in mind that the final goal is having better or more efficient resource allocation of natural resources.

Estimating the value of non-market benefits of a natural resource is the first step toward making sound policy decisions. Without an estimate of the benefits of the existence or enhancement of a recreational site, we cannot establish whether the benefits out weight the costs of management, i.e., the guiding decision-criterion for benefit-cost analysis.

Although there is some information on alternative fisheries in Oklahoma, no site specific information about angler preferences, visitation rates, or willingness to pay (angler benefits) for trout fishing in the LIR trout fishery currently exist. There is a previous study regarding recreational fishing and socioeconomic characteristics of eastern Oklahoma stream anglers (Fisher et al., 2002). In their study annual benefits for trips to eastern Oklahoma streams were estimated at $24million in 1993 dollars. The benefits were estimated using a 1992 telephone survey of 1147 anglers who fished in these streams. A previous survey on the Mountain Fork River trout fishery, the other year round trout fishery in Oklahoma, was commissioned by the ODWC in 1993(Choi, 1993). However, this information is over a decade old and transferring such estimates between different recreational sites, a method called benefit-transfer is sketchy at best. As mentioned previously, the estimated number of trout stamp holders was over 37,000 (including youth licenses) for 2004 for all trout fishing areas in Oklahoma (ODWC,2004). Improvement in angler satisfaction can only occur by knowing the users' preferences for fishery management and quality.

The proposed study will estimate the recreational use value of the fishery as revealed by current use and travel costs and users' preferences for the trout fishery as a multi-attribute good for which there could be several potential management improvements. For example, What is the value and visitation rate of the trout fishery on the lower Illinois River? How can it be improved to increase angler's satisfaction? And are the benefits of the fishery greater than the management costs? Answers to these questions will provide ODWC policy makers with a clearer understanding of recreational value of trout fishing and an idea of what specific changes are preferred by current users.

Objectives of the Study

General Objective:

To help the Oklahoma Department of Wildlife Conservation (ODWC) make more informed decisions regarding current and future management scenarios for the LIR trout fishery.

Specific Objectives:

1. Determine the socio-economic characteristics of trout anglers that use the lower Illinois River.
2. Determine the value (estimated consumer surplus) of the fishery using actual anglers' use of the fishery and anglers' expenditure patterns (revealed preferences via the travel cost method).
3. Determine future angler's preferences, attitudes and willingness-to-pay for the LIR trout fishery under potential management changes such as: increasing stocked fish size, increasing fish stocking numbers, and creating catch and release zones (stated preference via discrete choice method).
4. Determine the occurrences and magnitudes of recall bias by the anglers.
5. Estimate total angler trips per year to the fishery based on pressure count and creel surveys comparing traditional creel methodology with probability analysis.
6. Estimate total economic benefits and compare them to the costs of managing the fishery.

This study will utilize primary data collected in 2004 for the Lower Illinois trout fishery under Cooperative Agreement GRANT NUMBER: F-58-R-1 between Oklahoma Department of Wildlife Conservation and the Oklahoma Fish and Wildlife cooperative Unit. On site creel surveys were supervised by Dr. James Schooley at Northeastern State University, Tahlequah, Oklahoma, and economic analysis was conducted in the Department of Agricultural Economics, Oklahoma State University.

Organization of the Study

The rest of the dissertation is organized under seven additional chapters. Chapter II is a literature on valuation techniques for non-marketable commodities. Chapter III discusses the results from the on-site survey as well as a telephone survey summarizing the characteristics of the LIR users. Chapter IV discusses the travel cost methodology and its results. Chapter V discusses the conjoint choice methodology and its respective results. Chapter VI discusses the interviewer recall bias and estimating total angler visitation. Chapter VII includes cost-benefit analysis of the upkeep of the non-native trout fishery and two potential management changes. Chapter VIII summarizes the conclusions and recommendations of the study.

CHAPTER II

LITERATURE REVIEW

Overview of Valuation

A summary of important economic concepts is presented as well as the theoretical basis for non-market valuation and welfare analysis. The starting point of our framework is the definition of consumer welfare and consumer behavior.

In economic analysis it is very useful and convenient to represent individual well-being or consumer behavior by means of a utility function. The ordinal utility function is a convenient way of expressing consumers' preferences. It is called ordinal because despite its other characteristics such as completeness, reflexivity, transitivity, continuity, monotonicity, and convexity, the relevant feature is its ordinal character, or in other words the ability to rank preferences among goods (Varian, 1992). We assume that a consumer will maximize his or her utility function, the shape of which describes the consumer's preferences, subject to constraints such as time and budget. This allows for the estimation of demand functions for all goods and services, in this case, the consumption of a recreational good. The derived demand curve represents the marginal benefits, also called the marginal willingness to pay or value of the goods (resources) in question.

The problem is that environmental services, such as an aesthetically pleasing view while fishing, are not usually traded or purchased in a competitive market. If they were, we could easily estimate demand functions from market data. Public lands in Oklahoma are common property resources in which access is open, but fishing is excludable by a nominal permit fee. Fishing itself is rivalrous in that any fish caught by another angler is no longer available to another angler. In this system where anglers are able to openly enter a fishery without paying a per visit fee (annual or lifetime fishing license only), we must use non-market valuation techniques to estimate the value of each trip for a fisherman. We assume that the cost of travel and gear to undertake a trip is complementary expenditure to the trip itself, and thus serves as a lower bound on the use value of that site to an angler. A problem of quasi-public goods is that the price users pay for i.e. a fishing permit, does not reflect the true cost of the fishing activity, and thus the value to the angler. The value of recreational use, in turn, represents only a portion of total economic value of that resource whereby other values such as the existence of the resource (non-use) or non-fishing values are neglected. Such publicly owned goods managed in common have quasi-public good aspects in that access is virtually non-excludable by fee and it is difficult to get individuals to reveal their true willingness to pay. The point is that the type of estimated economic value for the non-market good depends on the question being asked, the resource, the scope of the project and the method used for valuation. For valuing the use value for a recreational good such a trout fishery, the travel cost method is well suited because it measures expenditures that are complementary to actually using the resource. In plain English, if I am willing to pay $200 in gear, gas and expenses to go fishing for a weekend, I value the fishing experience for that two day trip at least that much. Such a technique that measures travel costs alone does not measure whether a non-user simply values that the resource exists as habitat for fish or other non-usable or non-recreation species.

A second technique used in this study, discrete choice analysis, poses hypothetical management scenarios, and could be used to find individuals non-use values for a resource, but in this case, was used for concrete proposals for recreational uses. Later in the chapter, these methods are explained in more detail.

Estimating benefits involves a two-step process: finding the individual benefits, and a means of expanding these benefits to the relevant population (Haab and McConnell, 2002). Essentially, econometric techniques are used to fit a function to individuals' data from surveys of individuals' consumption of a resource at different implied or hypothetical prices to estimate a demand function for the good. The theory of individual preference and demand for goods is presented before introducing the different welfare measures. Individual preferences are characterized as a utility function, i.e., how individuals trade off consumption between multiple goods to achieve utility or satisfaction with consuming a bundle of goods (Haab and McConnell, 2002). That is:

(2.1) $$u(\mathbf{x}, \mathbf{q}).$$

In this case let $\mathbf{x}$ be a vector of private goods $\mathbf{x} = x_1, x_2, \ldots, x_m$, and $\mathbf{q}$ a vector of public goods $\mathbf{q} = q_1, q_2, \ldots, q_n$. Individuals choose their $\mathbf{x}$ but not their $\mathbf{q}$ because q is exogenous. The $\mathbf{x}$ are assumed to have a price vector $\mathbf{p} = p_1, p_2, \ldots, p_m$ and an individual person maximizes their utility subject to income *y*. The indirect utility is represented by:

(2.2) $$V(\mathbf{p}, \mathbf{q}, y) = \max_x \left\{ u(\mathbf{x}, \mathbf{q}) \middle| \mathbf{p}\mathbf{x} \le y \right\}.$$

The dual of the indirect utility function is $m(\mathbf{p},\mathbf{q},u)$, the minimum expenditure function

(2.3) $$m(\mathbf{p},\mathbf{q},u) = \min_{x} \left\{ \mathbf{p}.\mathbf{x} \,\middle|\, u(\mathbf{x},\mathbf{q}) \geq u \right\}.$$

The indirect utility and the minimum expenditure function are assumed to be well behaved (homogeneous of degree zero in prices, quasi-convex in prices, continuous in prices and expenditures) the derivative of the expenditure function with respect to price gives the Hicksian demand.

(2.4) $$h_i^u(\mathbf{p},\mathbf{q},u) = \frac{\partial m(\mathbf{p},\mathbf{q},u)}{\partial p_i}$$

To obtain the Marshallian or ordinary demand curve, the negative ratio of the derivatives of the expenditure function with respect to price and income is calculated, this is according to Roy's identity, and the demand function can be expressed in terms of the derivatives of the indirect utility function.

(2.5) $$x_i(\mathbf{p},\mathbf{q},y) = -(\partial V(\mathbf{p},\mathbf{q},y)/\partial p_i)/(\partial V(\mathbf{p},\mathbf{q},y)/\partial y).$$

All these equations provide the theoretical framework for welfare estimation and because the utilities are not observed we can describe individual's behavior as they respond to prices and income by means of the Marshallian demand. According to Varian (1983) and Freeman (2003) this is possible if the demand function satisfies the symmetry and negative semidefinite of the Slutsky matrix of substitution terms:

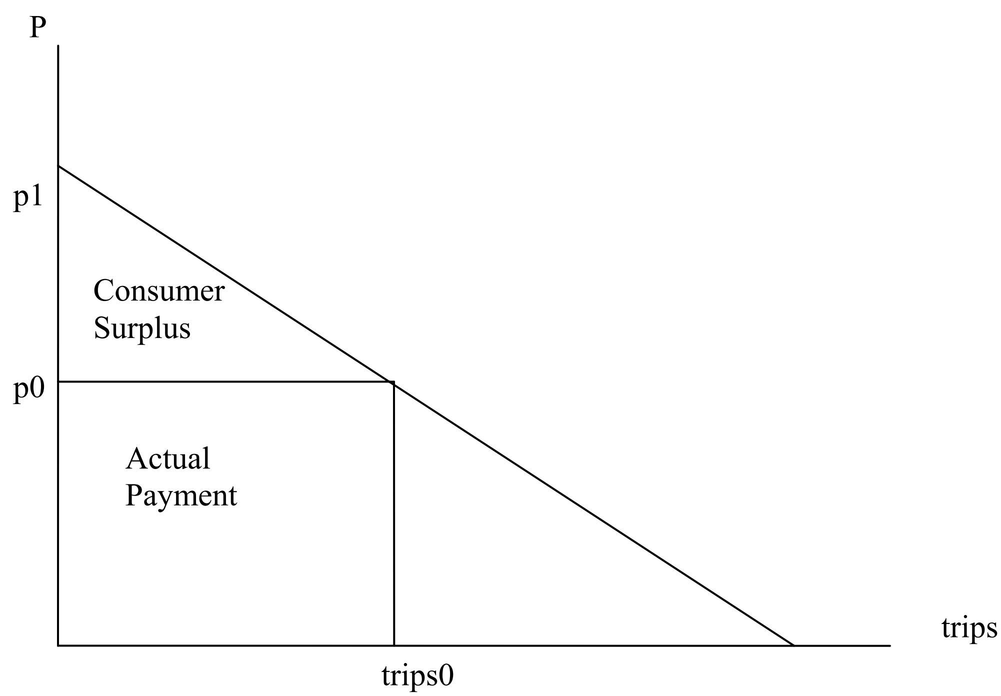
(2.6) $$\frac{\partial h_i(\mathbf{p},\mathbf{q},u)}{\partial p_j} = \frac{\partial x_i(\mathbf{p},\mathbf{q},y)}{\partial p_j} + \frac{\partial x_i(\mathbf{p},\mathbf{q},y)}{\partial y} x_j.$$

If this condition is satisfied it is possible to obtain a complete description of the preferences as well as exact measures of welfare change (Freeman, 2003).

There are five different measures of welfare change in economic literature, these are: consumer surplus, compensating variation, equivalent variation, compensating surplus, and equivalent surplus. Consumer surplus is the most commonly used measure of welfare but it lies in a group by itself. It lies in a group by itself because is the only measure that can be defined in terms of income and not utility (Choi, 1993). Consumer surplus is the area under the ordinary demand curve but above the price line. Based on Varian (1992) if *x(p)* represents the demand of a good as a function of price then consumer surplus is associated with price movement from p^0 to p^1 and can be expressed as

(2.7) $$CS = \int_{p^0}^{p^1} x(t)dt \,.$$

Figure II-1. Consumer Surplus



In other words consumer surplus is defined as the willingness to pay in excess of their actual payment and is represented as the area under the demand curve and above the price line (Figure II-1). There are four other measures of welfare that are based on Hicksian measures and these are (Hicks, 1956):

Compensating Variation (CV): is the amount of compensation (money income) that must be taken/paid to an individual to leave him at the same initial level of satisfaction (real income) as before the change.

Equivalent Variation (EV): is the amount of compensation that must be received/paid which leaves the individual at the final level of satisfaction.

Compensating Surplus (CS): is the amount of money income that must be taken to an individual, leaving him at the same initial level of satisfaction as if he were to buy at the new price the quantity of the commodity

Equivalent Surplus (ES): Compensation that must be given to an individual (minimum willingness to accept), in the absence of change, to enable him to have the same level of satisfaction he would have with the quantity change.

Figure II-2 (top part) graphically shows the measures of welfare gain as a result of a price decrease of the good x_1 from p_1^0 to p_1^1, price of good x_2 does not change and the price (of good x_2) is assumed to be one. There are two indifference curves for the individual u^0 and u^1. The original consumption bundle for the individual was point A and after the change in price the individual will consume at the new point B with a new utility level u^1. Equivalent surplus (ES) is the vertical distance between point A and point F keeping the same level of good x_1. Compensating surplus is the vertical distance between point B and point E keeping the new quantity of consumption x_1^1.

The other welfare changes associated with this price change are measured using the bottom part of figure II-2. Consumer surplus (CS) measure is the area $p_1^0 \mathrm{A\,B}\, p_1^1$

which are on the Marshallian demand curve, compensating variation (CV) is $p_1^0 \mathrm{A\,C}\, p_1^1$,

and equivalent variation (EV) is $p_1^0 \mathrm{D\,B}\, p_1^1$ both of them on Hicks-compensated demand

curves.

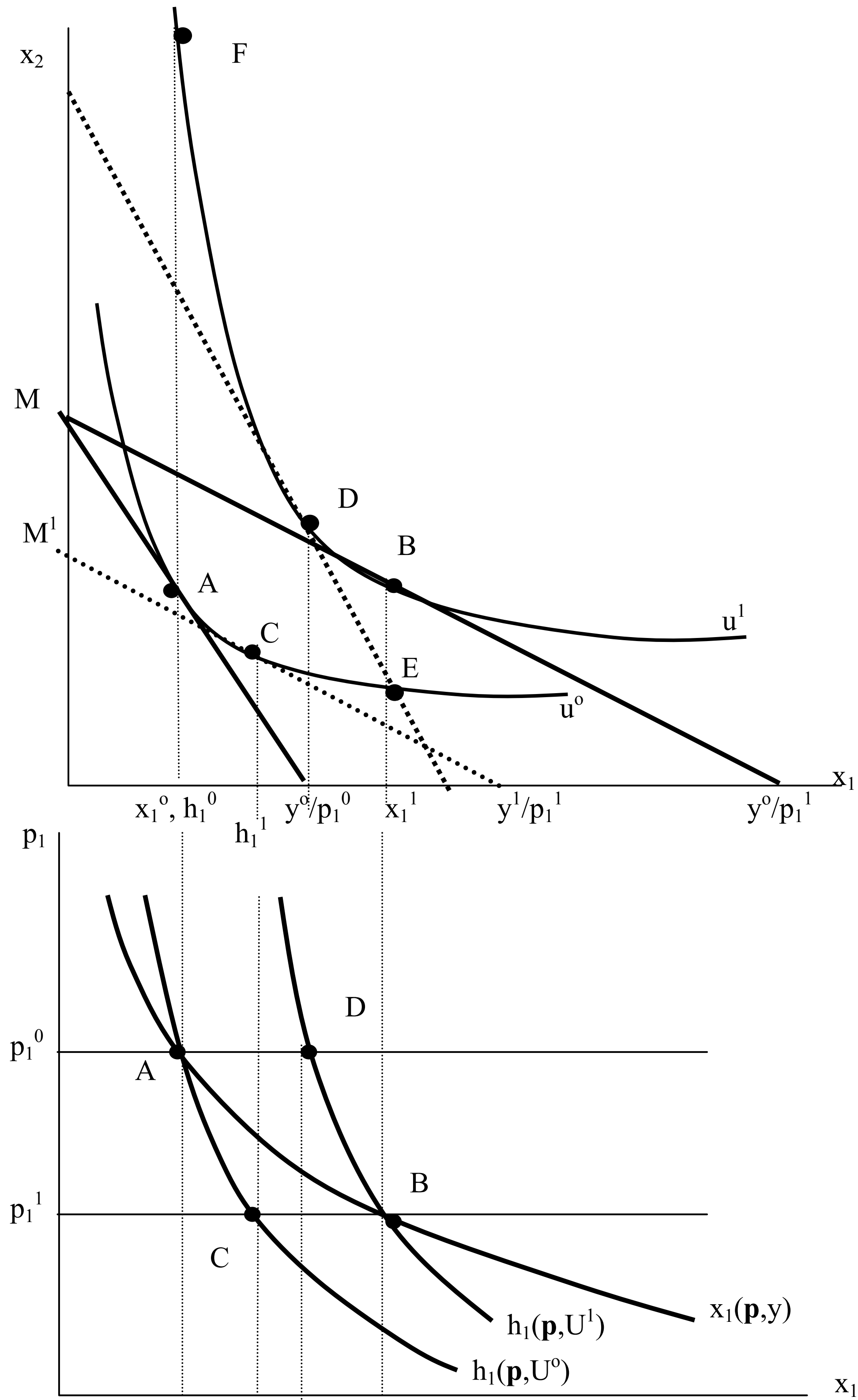


Figure II-2. Measures of Welfare Change from a Price Decrease for a Normal Good (Source: Freeman, 2003)

Non-market Valuation of Recreational Activities

According to Haab and McConnell (2002), over the past decades economic analysis has spread from its traditional market orientation to trickier areas of public policy such as: natural resources, health & obesity, disposal of nuclear waste, drug use, etc. where neoclassical market techniques do not suffice. All of these topics in economics are a consequence of resource allocation. The measurement of efficient allocation of resources is very important in the case of recreational goods.

Natural resources, such as a trout fishery, are widely used for recreation and are treated as quasi-public goods in that the quality and quantity of the resource is underprovided by the private market and access and management of the resource is usually provided publicly. According to Freeman (2003) these services have two important economic features: the value depends on the quality characteristics of the site, and access to the resource is typically open at a zero price or a nominal fee. This is not necessarily related to the actual cost of providing access to the fishing site. Despite this lack of information on actual costs, environmental economists have developed techniques to define and measure the value of the services that these natural resources provide.

There are two approaches used by applied economists in benefit estimation for public goods and environmental amenities: indirect or behavioral methods (revealed preference) and direct methods (stated preference). With indirect methods researchers follow expenditure and behavioral changes in response to changes in recreational amenities and with these changes attempt to infer the value of the resource. The price individuals are willing to pay to use a resource is supposedly complementary or related to the quality or value of the site. By contrast, the stated preference approach is characterized directly asking respondents to state a value using by a contingent or hypothetical scenarios where respondents' trade off improvements in goods and services for money (sometimes also called the income approach). The stated preference approach as described by Haab and McConnell is: "…an omnibus name for a variety of approaches of which the most prevalent is contingent valuation. Others include contingent ranking, contingent choice and conjoint analysis." Developments in the field include applications of Adamowicz, Louviere, and Williams, 1994; Carson et al. 2001; Hannemann, Loomis, and Kanninen, 1991 with a double bounded dichotomous choice contingent valuation; Bishop, 2003; Smith V.K. and Desvousges, 1986; McFadden (1994) contingent valuation and social choice; and many more.

Travel Cost

The travel cost method (a revealed preference approach) calculates an indirect value measure from expenditures incurred by the visitors to visit and use a recreational site. Using this observed behavior we can estimate the use value to these recreationists and demand for the resource in its current state and use. In microeconomic theory of behavior, we assume that the consumer maximizes utility subject to budget and time constraints. This maximization gives us the economic values as shadow prices of this maximization problem. The analysis goal is to estimate demand functions for non-market goods and estimate consumer surplus in order to make policy recommendations.

The revealed preference approach has been used in a variety of studies to elicit valuation estimates based upon actual preference data, i.e. actual market transactions. It is based on Clawson and Knetch work in the 1950 and Trice and Woods (1958). The original travel cost model was developed as a zonal travel cost where the cost of the travel time is used as a proxy for the price of the experience and the expected frequency of use is expected to decline as travel time and travel cost increases. It was called zonal travel cost because the visitations to the site were aggregated from each visitation zone and the average travel cost from each zone was calculated. Using this methodology it was possible to develop iso-cost rings to the travel site in question and the number of visits per population for each zone was determined. The data necessary for the zonal travel cost includes county population (zones are divided in counties or zip codes), per capita income, tastes and preferences, travel costs (gas, tolls, time, etc). Applications include work by Bowes, and Loomis (1980); English and Bowker (1996), among others.

Revealed preference methods, such as travel cost models, rely upon surveys to elicit information on the number of trips taken to the site in question and to construct proxies for the price of traveling to the site, including the cost of travel to the site (Azevedo, Herriges, and Kling, 2003). Travel cost will yield a Marshallian demand curve but it has been proven that the ordinary demand is a close approximation to hicks-compensated welfare measures (Willig, 1976) if the income effect is small.

In addition to the zonal travel cost model, a individual travel cost model is widely used in the literature. It has its advantages because individual preferences and characteristics are preserved and the data does not have to be aggregated in zones. The individual travel cost model can be divided into two principal methodologies: a single-site model and multiple-site model. A single-site model is the easiest application when the objective is to estimate the 'value' of the site with no real substitutes and it works like a conventional downward sloping demand curve. A multiple-site model is based on random utility maximization (RUM) where an individual has several discrete choices for a recreation site and the choice of the site depends on the quality characteristics of the site and the other available site characteristics (Parson and Wu, 2001).

An important matter with travel cost is the sampling strategy. If the sample is collected on-site there are several advantages such as intercepting directly the target population and minimizing recall bias. There are several issues of concern when conducting on-site sampling. First the data will be truncated at one trip, i.e. you do not get non-users. Second, it is very difficult to obtain a random sample but some devices exist to minimize this problem, such as randomizing the days of the week, randomizing the visitors interviewed, and randomizing the time of the day the survey interviewing starts. On-site sampling will also over-sample more frequent users (endogenous stratification) but corrections exist for this problem (Shaw, 1988). This will be explained with more detail in Chapter IV.

For multiple site studies, the advantage is that changes in willingness to pay for quality among sites can be measured by comparing sites statistically and controlling for other variables. Substitution effects among characteristics can be modeled, such as the tradeoff for site quality versus additional travel cost, which is very useful for management purposes. Multiple sites models can be estimated as Random Utility Model (RUM) or as a system of equations taking into account the other sites and the substitute prices for the other sites. These systems of equations can become very tedious to estimate if there are many sites that are being valued. The system of equations applications can be found in Smith, Desvousges, and McGivney (1983); Kling, C. (1989); Englin, and Mendelsohn (1991). Another useful approach is to use Random Utility theory and Random Utility models (RUM). This group of travel cost methods can predict the probability of an individual to choose a site among a determined set of sites based on the individual's travel cost to the site, income, socioeconomic characteristics and specific site characteristics. For applications see Morey (1993); Smith, V.K. (1990); Pendleton, and Mendelsohn (1998); Herriges and Kling (1999) and others.

Time Value

A consensus has not been reached on how to value an individual's opportunity cost of time in recreation demand models, i.e. what is an hour of leisure worth? If time is money, is an hour of time off worth an hourly wage earners hourly pay? Perhaps, for some individuals at the margin of a few extra hours of overtime, this tradeoff may hold true. The waters become murkier when an hour of leisure is valued for a salaried worker for whom paid time off is a given number of days. No single best procedure exists to clear up the time issue, but there is a general accord that the demand estimates are better if valuation of time is included in the analysis. The demand estimates and the welfare measurements are more accurate if there is an inclusion of time cost rather than just leaving it out of the analysis. Leaving the opportunity cost of time out of the analysis will produce biased results (Freeman, 2003).

The usual practice when dealing with time spent in travel and at a recreation site is to value it at the wage rate or a fraction of the wage rate. The reason this is a common practice is because it derives from the classical labor-leisure framework. The consumer maximizes his/her utility subject to a time constraint and a budget constraint. When work hours are not fixed, the decision maker can freely choose the number of hours he or she is willing to work and thus maximize his or her utility. The time constraint can be solved for work time and then replaced in the budget constraint to solve into the budget constraint. The time cost is reflected as a monetary cost using the wage rate (Bockstael, Strand, Hanemann, 1987).

Sometimes the decision maker cannot choose his or her optimal work hours (salary based) or he/she might be unemployed. In these cases the opportunity cost is harder to estimate because the wage rate is not observable. Feather and Shaw proposed a method of estimating time cost for individuals who are not in the labor force following the Heckman model (1974) for 'Shadow prices, market wages, and labor supply'. Their estimates differed by more than three times depending how the cost was estimated. This demonstrates the importance of having a good estimate for leisure time because of the large variations of consumer surplus measurement depending on the cost of leisure time.

Another alternative to using the wage rate (or a fraction there of) as the opportunity cost of time is to use a hedonic model. Hedonic wage equations (Smith, Desvougues and McGivney, 1983) are obtained through econometric methods to predict the hedonic wage rate. This is obtained by regressing the log of the wage rate on age, gender, experience, and education. A shadow wage rate equation is obtained which predicts the opportunity cost of time. This procedure predicts wages at the sample mean with a smaller variance compared to actual data (Feather and Shaw, 1998).

Another approach to dealing with the opportunity cost of time is to enrich the survey by adding a contingent valuation type question about respondent's willingness to accept a compensation to forgo a recreational experience. Individuals will reflect a more accurate estimate of the opportunity cost of time using this method, which hypothetically is superior because it measures the trade-off between work and leisure, generally. This was the method originally planned for the measurement of the opportunity cost of time in this study but at the data collection stage, the monetary compensation offered to the respondents was on the lower side such that very few individuals decided to accept the compensation. Due to this drawback, a more common approach was selected for this study; it comes from McConnell and Strand (1981). The opportunity cost of time is estimated as a fraction of the individual's wage

Stated Preference

The stated preference approach, according to Freeman, is a "survey-based study in which respondents are asked questions that are designed to reveal information about their preference or values…usually they are questions about monetary value for an environmental change."

Robert Davis' initiated in the field of environmental valuation by the use of contingent valuation (Davis, 1963). A few years later a strong economic theory was established by Lancaster (1966) using household production theory. The idea of random utility maximization and discrete choice theory was developed and refined by McFadden (1974) which was based on the concept that individuals make choice that maximize their utility. Since then a lot of applications and refinement of the procedure has been accomplished, including enrichment of the data by combining stated preferences with revealed preferences (Adamowicz, Louviere, Williams, 1994) (Louviere, Hensher, and Swait, 2000).

Stated preference methods remain controversial because the hypothetical nature of the questions may introduce bias, prompting the creation of the NOAA panel report on guidelines for creating a credible willingness to pay using contingent valuation (NOAA 1993). Stated preference methods might introduce bias because the stated preference responses vary from the individual's true preferences when they face the real choice of payment. The variation occurs because the respondents fail to account for their budget constraint and the availability of substitute commodities in responding to these hypothetical scenarios (hypothetical bias) (Azevedo, Herriges and Kling, 2003). The most common stated preference method is contingent valuation but conjoint choice is another option for valuation of natural resources.

Stated preference methods have several advantages according to Adamowicz, Boxal, and Louviere (1998). First, the experimental stimuli are under control of the researcher (including the inclusion of new attributes associated with passive use). The use of statistical design theory yields greater statistical efficiency and eliminates collinearity between explanatory variables. Furthermore, there is a multidimensional response surface that provides a richer description of preferences than what can be obtained by the valuation of single with vs. without scenarios.

Choice Experiments

Conjoint analysis presents respondents with a set of choices representing goods or situations with varied attributes. The respondent is asked to rank, rate or pick one of several of more choices according to his or her preferences about that set of attributes for that bundle or multi-attribute good. Price can be included as one of the attributes to elicit a willingness-to-pay and therefore the implicit marginal prices of the attributes can be estimated (Baarsma, 2003).

Choice experiments (CE) are attribute based experiments that are used in ranking, rating, and choice selection (discrete choice). It assigns value to multi-attribute goods and are based on the random utility maximization theory, which assumes that utility is the aggregation or summation of random components and deterministic components (Mackenzie, 1993).

The random utility model is well suited to capture the effects of variation in site quality on the demand for a site (Freeman, 2003). The theoretical background for CE is based in Lancaster's model of consumer choice (Lancaster, 1966) where consumers derive their utility not only from consumption per se but from the combination of attributes inherent in the good itself. Luce's choice axiom (Luce, 1959) together with McFadden's analysis of economic choice idea of random utility models (McFadden, 1974) provides the econometrics tool that we currently know as the multinomial Logit and the conditional Logit model.

The fact that you can segregate environmental values based on specific attributes makes this technique very useful for environmental economists. Studies include three type of major response format: ranking, rating, and choice. Smith and Desvougues (1986) evaluated water quality in the Monongahela River. Adamowicz et al. (1988) showed that choice experiments have several benefits over contingent valuation (CV), and that choice experiments provide estimates similar to Contingent Valuation (CV) for measuring passive use values. Adamowicz, (1994) showed that this CE methodology can be use to evaluate different flow scenarios of rivers in Canada. Adamowicz et al. (1998) have used choice experiments to elicit passive use value for caribou moose in Canada using five different factors at four levels each. The factors include caribou population, wilderness area, recreation restrictions, forest industry employments, and change in income tax as a payment vehicle. The estimation of WTP was done using both a linear and a quadratic model and the respective welfare measure were reported. Advantages over CV are shown such as attribute values, impact of welfare on the choice of functional form, and endowment effects. In a study by Hanley, Mourato, and Wright (2001) they valued the WTP for rock climbing attributes such as length of climb, quality of climb, crowding at route, scenic quality of route, the final attribute was miles traveled to the site (which was the payment vehicle estimated as a travel cost). The Mackenzie study (1993) used a conjoint measure approach to evaluate unpriced attributes of recreational waterfowl hunting trips in Delaware. Five important trip attributes were included in the design and these are trip time, total cost of the trip, type of hunting party i.e. family member, friend, acquaintance, congestion, hunting success, and finally the annual hunting license fee was also a sixth attribute considered but was dropped from the model because it was not significant. Results included WTP attributes using a rating model, a ranking model, and a binary model as well as confidence intervals for all the WTP estimates. Mackenzie concludes that the mean WTP from all models was very similar and unbiased and contingent rating was appropriate for valuing heterogeneous non-market goods.

In this dissertation, the choice response format is used and thus far is one of the few choice experiments to measure recreational alternatives in Oklahoma.

Recreational Studies in Oklahoma

There are very few previous studies about economic analysis and valuation of recreational amenities and natural resources in Oklahoma. Because of the common-property and quasi-public good characteristics of natural resource it creates a tendency for Oklahoma's public to put a low value (or no value at all) on natural resources. There is a great need to continue valuing Oklahoma's resources so that legislators and the public become aware that Oklahoma's natural resources have direct both market and non-market values that function as economic assets.

With respect to recreational fishing in Oklahoma a few studies have been done utilizing similar methods to estimate demand for fishing trips (Choi and Schreiner, 1994); and they all have used variations of travel cost methods. A previous survey about the Mountain Fork River trout fishery (Choi, 1993), the other primary trout fishery in Oklahoma, revealed valuable socioeconomic information about use and users of the fishery including: demand estimation, expenditures, and some general angler characteristics to guide management. The anglers' net benefit of the Mountain Fork River was $1,009,000, $965,000, and $1,126,000 for the years 1989, 1990, and 1991 respectively (in 1991 dollars). The estimated numbers of trips for the year 1991 was 11,075 with a net angler benefits per trip per person to the Mountain Fork River of $111 for the three years (1991) dollars. The net angler benefits per trip per person adjusted for 2004 dollars would be in the amount of 151.69 dollars using annual CPI index from the bureau of labor statistics.

The trout survey for Oklahoma made by Crews and Summers (2002) provides valuable information on the preferences for trout anglers in the state of Oklahoma, but not benefit estimations. In 2002, the Oklahoma Tourism and Recreation Department (OTRD) conducted a state park visitor survey and much descriptive information was collected but very little economic analysis (valuation) was performed (Caneday and Jordan, 2003). Another study is the 'Oklahoma Statewide Comprehensive Outdoor Recreation Plan' (OTRD, 2001), but also contained little or no valuation information on natural assets. This is why there is a need to start valuing the state's natural resources and focus on the economic benefits they provide to the users.

Ancev, Storm and Stoecker (2003) used a zonal travel cost to estimate the cost (benefit reduction) caused by increased phosphorus pollution in a similarly impaired watershed, the Eucha-Spavinaw. As phosphorus application increased in the watershed, the recreational value was reduced in the watershed area in eastern Oklahoma. They estimated a total consumer surplus for the state parks in the Eucha-Spavinaw region of $633,222 with a total predicted number of visitors in the amount of 263,256 visits with the lowest phosphorus loading of 18,000 kg/yr. If the phosphorus loading level increases to 46,000 kg/yr the predicted number of visits decreases to 17,238 with a consumer surplus estimate of $129,851.

This dissertation will evaluate demand for trout fishing in the lower Illinois River using both revealed preference and stated preference methods. The travel cost portion will differ from the previous studies in Oklahoma because of the use of count data models, giving us more accurate welfare estimation. Second, using a discrete choice experiment, an attribute based method, which has only relatively recently been used for non-market goods, will give us information about hypothetical changes before any actual management change is done. Parametric bootstraps will be used to find confidence intervals of the estimated welfare measures.

Creel Survey

Creel surveys are collected in every state in the U.S. The purpose of these creel surveys are to estimate anglers effort, catch and catch per unit of effort for the different fisheries throughout the U.S. The definition of fishing effort according to Pollock, Jones and Brown is “A measure of resource use by anglers. Typical units of effort are number of trips on the water, angler-hours, party-hours, and boat hours”. Estimating angling effort and catch are obtained using two most common angler surveys, roving and access site surveys (Lockwood, Bence, and Benjamin, 1999). Each state department of natural resource and each department of fisheries and wildlife use their own variations of catch and effort models that best fit their particular situations. Examples on the most common literature in the subject are Pollock, Jones, and Brown (1994); Robson (1991) with the roving creel survey methodology; Malvestuto (1983) with the sampling of the recreational fishery; and Pollock, Hoeing, Jones, Robson, and Greene (1997) defining catch rate estimation for roving and access point surveys. Each state agency uses creel surveys tailored to fit their needs. In the case of Oklahoma, the creel survey collection method is described by Summers (2006) with detail in Chapter VI.

Recall Bias

Recall bias is present almost in every survey because people have a difficult time remembering details of events that happened in the past. There is empirical evidence suggesting that the timing of the interview affects the survey respondent's recall of events. There is a medical study from Harel et al (1994) measuring the effects of recall on estimating annual non fatal injury rates for children and adolescents, suggesting that recall bias is present in every sub-samples of the population in their experiment and there are several degrees of recall bias. Other areas of study dealing with recall bias includes media and advertisement use (Price and Zaller, 1993). In a study by Ansolabehere, Iyengar, and Simon (1999), individuals were exposed to different advertisements, including a political advertisement. After half an hour of the exposure, only 50% of individuals recalled even seeing a political advertisement. Another study of recall in political participation was conducted by Silver, Anderson, and Abramson (1986).

Tarrant and Manfredo (1993) measured the effects of recall bias and non-response bias in self reported estimates of angling participation. They address the interaction between both types of biases, recall bias being assessed as the immediate recall period, three months after, and six months after. The variable being studied was number of days fished per three month period of time and results showed that respondents were more likely to overestimate their participation rates. On the other hand, non respondents tended to underestimate participation rates as the recall period increased. Their conclusion was to control for these biases and sample frequently over short period of time. The problem with recall bias is that it will bias the multivariate regression coefficients. In a study using an economic model to value recreational angling resources in Michigan, Hoehn et al. (1996) found evidence of recall bias because their reported angling trips were not consistent with the details of the angling trips. Their results showed an upward bias in the number of trips reported and the solution was to shorten the recall period and allowing anglers to revise their trip count. Our data of the LIR trout fishery will allow us to capture and measure the degree of recall bias.

CHAPTER III

DATA AND RESULTS

This chapter presents descriptive statistics related to anglers' actual fishing experience and demographic information. The first section of the chapter contains the information collected during the telephone survey in 2004 (Section I), and the second section contains information obtained during the on-site survey (Section II). Both sections contain the response rates of the 2004 survey and the descriptive statistics of the angler's most recent trip to the LIR. The response rate for the 2004 LIR survey is presented in Table III-1. From a total of 291 contact names, there were 226 completed usable surveys. All the analysis that follows in this chapter is based on the responses of these 226 anglers throughout the whole fishing season of 2004. This chapter will provide us with basic information from the survey. Survey research methods prescribed by Dillman (1978) were used to guide survey development; the Oklahoma Bureau of Social Research services conducted the telephone survey.

Section I. Telephone Survey Data

This section will be divided according to the 32 questions asked on the telephone survey. A general description of the responses as well as the frequency of the responses is briefly explained. The data collection process was conducted throughout 2004 and data from the telephone survey were reported in four quarters (4 seasons) that were collected as follows: 27% of all samples were collected in the first quarter, 30.1% in the second, 24.8% in the third quarter, and 18.1% in the final quarter of the year.

3.1. Total time spent on the trip to the LIR including travel on that trip.

First of all, anglers were asked the length of their fishing trip including travel time. The total average time spent on a trip to the LIR was 33.33 hours (including travel) with a maximum of 756 hours and a minimum of 3 minutes, the median value was 8 hours and the value that was repeated the most (the mode) was also 8 hours per trip (Table III-2). The original data had responses in minutes, hours, and days but to standardize the data to the same units all responses were changed to hours where a day is equivalent to 24 hours. If we consider a day trip of 12 hours or less, then 65.5% of the sample completed the whole trip in less than a day. The last individual (Table III-2) stated that his/her total trip time lasted over 31 days which is considered an outlier compared with the rest of the responses. If this observation is eliminated from the data set, the average time spent on the trip is 30 hours and six minutes. The median is still 8 hours indicating that most of the trips to the LIR are completed within a day.

Table III-1. Responses and response rates for telephone economic survey of anglers fishing on the lower Illinois River, Oklahoma.

	Dec 2003-Feb 2004		Mar-Jun 2004		Jul-Sept 2004		Oct-Dec 2004		Total
Survey response	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number
Completed	61	85.90%	68	73.10%	56	76.00%	41	77.00%	226
Potential:									
Refusal	0	0.00%	0	0.00%	1	1.00%	0	0.00%	1
Active	1	1.40%	5	5.40%	0	0.00%	2	4.00%	8
12 or more attempted contacts	3	4.20%	4	4.30%	12	16.00%	2	4.00%	21
Physical/language problem	1	1.40%	0	0.00%	0	0.00%	0	0.00%	1
Eliminated:									
Not a correct number	1	1.40%	7	7.50%	1	1.00%	8	15.00%	17
Not a working number	3	4.20%	5	5.40%	2	3.00%	3	6.00%	13
Not qualified	1	1.40%	4	4.30%	2	3.00%	5	9.00%	12
Total	71	100.00%	93	100.00%	74	100.00%	53	100.00%	291
Response rate*		92.40%		88.30%		81.16%		91.11%	88.24%
Cooperation rate**		98.40%		93.20%		98.24%		95.35%	96.30%

* Response Rate=Completed/(Total-Eliminated)
**Cooperation Rate=Completed/(Completed+potential)

Table III-2. Total Time Spent on the Trip to the Lower Illinois River Including Travel Time

Time (hours)	Frequency	Percent	Cumulative Percent
0	2	0.9	0.9
0.16667	1	0.4	1.3
1	2	0.9	2.2
2	10	4.4	6.6
2.5	2	0.9	7.5
3	11	4.9	12.4
3.16667	1	0.4	12.8
3.5	2	0.9	13.7
4	14	6.2	19.9
4.5	2	0.9	20.8
5	13	5.8	26.5
5.16667	1	0.4	27.0
5.5	2	0.9	27.9
6	19	8.4	36.3
6.5	3	1.3	37.6
7	15	6.6	44.2
8	23	10.2	54.4
9	3	1.3	55.8
9.5	1	0.4	56.2
10	13	5.8	61.9
11	1	0.4	62.4
12	7	3.1	65.5
14	1	0.4	65.9
15	2	0.9	66.8
16	1	0.4	67.3
24	5	2.2	69.5
35	1	0.4	69.9
36	4	1.8	71.7
48	12	5.3	77.0
50	2	0.9	77.9
52	1	0.4	78.3
56	2	0.9	79.2
60	2	0.9	80.1
72	19	8.4	88.5
96	8	3.5	92.0
108	1	0.4	92.5
120	5	2.2	94.7
144	2	0.9	95.6
168	7	3.1	98.7
216	1	0.4	99.1
756	1	0.4	99.6
Don't know	1	0.4	100.0
Total	226	100.0	

3.2. Hours to drive to the fishing area round trip.

The average driving time for a round trip to the (LIR) was 2 hours and 41 minutes with a maximum of 20 hours and minimum of a few minutes (few minutes ≈ 0 hours) for the people that live in the area (Table III-3A). This table shows that 32 of the respondents (14.2%) declared that the time it took them to drive to the fishing area (round trip) was less than an hour (60 minutes). The response frequency of these 32 individuals was recorded and shown in (Table III-3B). Out of this group of 32 people, over 95% indicated that their round trip to the fishing area was less than 30 minutes. Regarding travel time, 14.2% responded that their total travel time is less than an hour. The fraction of the sample that had a travel time of 1 hour is also 14.2%. The most common travel time for the round trip was 2 hours with 29.6% of the total sample. Only 15% indicated that their trip time was 3 hours and 13.3% said the travel time was 4 hours. The other 13.7% showed that their trip time to and from the fishing area was between 4-20 hours.

Table III-3. Total Hours It Takes to Drive to the Fishing Trip Area –Round Trip-III-3A

Hours	Frequency	Percent	Cumulative Percent
0***	32	14.2	14.2
1	32	14.2	28.3
2	67	29.6	58.0
3	34	15.0	73.0
4	30	13.3	86.3
5	11	4.9	91.2
6	12	5.3	96.5
8	1	0.4	96.9
10	2	0.9	97.8
12	2	0.9	98.7
14	1	0.4	99.1
20	1	0.4	99.6
Don't know	1	0.4	100.0
Total	**226**	**100.0**	

III-3B

Minutes	Frequency	Percent	Cumulative Percent
Missing Values	194	85.8	85.8
1	1	0.4	86.3
10	4	1.8	88.1
16	2	0.9	88.9
20	4	1.8	90.7
3	1	0.4	91.2
30	10	4.4	95.6
40	5	2.2	97.8
45	2	0.9	98.7
5	1	0.4	99.1
50	1	0.4	99.6
6	1	0.4	100.0
Total	**226**	**100.0**	

Note: * If person selected 0 hours, then how many minutes did it take you to drive to the fishing site**

3.3. Type of vehicle used for the recreational experience

Almost 78% of the anglers that go to the LIR use a sport utility vehicle (SUV) or truck and almost 10% of users ride in a car. It appears that the percent of car users is very low; this might be due to the fact that accessibility to the LIR is more suited for a truck rather than a car or the population in the area prefers trucks over cars. The rest of the users either used a recreational vehicle (RV) or some other means of transportation (Table III-4).

3.4. Is fishing the primary reason for the trip?

The importance of this question lies in the estimation process of the travel cost method. A trip that is not specifically planned for the fishing activity will reflect costs that are not associated with fishing but with another recreational activity also provided by the LIR such as swimming, boating, camping, etc. and it should not be included in the travel cost. In our sample fishing was the primary reason for 88.5% of all trips, and fishing was not the main purpose 11.5% of the trips (Table III-5).

Table III-4. Type of Vehicle Used to Drive to the Fishing Location
III-4.A

Vehicle type	Frequency	Percent	Cumulative Percent
Car	22	9.7	9.7
SUV or Truck	176	77.9	87.6
Recreational vehicle	11	4.9	92.5
Van/Mini-van	14	6.2	98.7
Other ***	3	1.3	100.0
Total	226	100.0	

Note: *** If selected other, please see Table III-4.B

III-4.B

Other type of vehicle	Frequency	Percent	Cumulative Percent
Missing values	223	98.7	98.7
Golf Cart	1	0.4	99.1
Walk	1	0.4	99.6
We brought a truck and a car.	1	0.4	100.0
Total	226	100.0	

3.5. Trip purpose: recreation, business, or both recreation and business

From the survey we could differentiate if the trips were single purpose or multiple purpose trips. Among all the trips in the sample to the LIR, 94.2% were single purpose and the sole purpose of the trip was recreational. Only 1% of trips were for business purposes and 4.9% were for both business and recreational purposes (Table III-6). Of this 4.9% that were both on a business and a recreation trip, the percentage that was spent just on business ranged from 5% to 100%. Any trip that was for business only, not recreation, was eliminated when estimating the recreational demand for the LIR. These percentages are shown on the bottom part of table III-6.

Table III-5. Fishing is the Primary Reason for the Trip to the Lower Illinois River

	Frequency	Percent	Cumulative Percent
Yes	200	88.5	88.5
No	26	11.5	100.0
Total	226	100.0	

Table III-6. Trip Purpose to the Lower Illinois River: Business, Recreation, Or Both

III-6.A

	Frequency	Percent	Cumulative Percent
Recreation	213	94.2	94.2
Business**	2	.9	95.1
Both**	11	4.9	100.0
Total	226	100.0	

III-6.B Percentage of the trip that was spent just on business

	Frequency	Percent	Cumulative Percent
Missing values	213	94.2	94.2
5	1	.4	95.1
10	2	.9	96.0
15	2	.9	96.9
30	1	.4	97.3
40	1	.4	97.8
50	3	1.3	98.2
100	2	0.9	99.6
Don't know	1	.4	100.0
Total	**226**	**100.0**	

Note: ** If respondent selected either category, please see Table III-6.B

Table III-7. **Trout Catch on the Lower Illinois Fishing Trip**

Trout catch*	Frequency	Percent	Cumulative Percent
0	49	21.7	21.7
1	7	3.1	24.8
2	15	6.6	31.4
3	13	5.8	37.2
4	16	7.1	44.2
5	4	1.8	46.0
6	45	19.9	65.9
7	8	3.5	69.5
8	10	4.4	73.9
9	5	2.2	76.1
10	4	1.8	77.9
11	1	.4	78.3
12	8	3.5	81.9
13	1	.4	82.3
14	3	1.3	83.6
15	3	1.3	85.0
17	2	.9	85.8
18	1	.4	86.3
20	3	1.3	87.6
23	1	.4	88.1
25	3	1.3	89.4
28	2	.9	90.3
30	4	1.8	92.0
35	2	.9	92.9
40	3	1.3	94.2
45	2	.9	95.1
48	1	.4	95.6
50	1	.4	96.0
65	1	.4	96.5
70	1	.4	96.9
75	1	.4	97.3
80	1	.4	97.8
100	1	.4	98.2
189	1	.4	98.7
Don't know	3	1.3	100.0
Total	226	100.0	

Note: * (whether they kept them or not)

Table III-8. Trout Size-on Average

Size (inches)	Frequency	Percent	Cumulative Percent
1	1	0.4	0.4
4	2	0.9	1.3
5	2	0.9	2.2
6	10	4.4	6.6
7	11	4.9	11.5
8	24	10.6	22.1
9	27	11.9	34.1
10	40	17.7	51.8
11	25	11.1	62.8
12	24	10.6	73.5
13	5	2.2	75.7
14	3	1.3	77.0
15	1	0.4	77.4
16	1	0.4	77.9
Don't know	1	0.4	78.3
Missing value	49	21.7	100.0
Total	226	100.0	

3.6. Trout catch

Anglers were asked how many trout they caught and were asked to report this number regardless of whether they kept them. The frequency of responses is shown in (Table III-7). Of the respondents 21.7% of anglers did not catch any trout during their latest trip to the LIR. However, of the subset that did catch fish, 65.9% of the anglers indicated that their total catch for the trip was the daily limit of 6 trout or less and the other 34.1% reported their catch at more than 6 trout per trip. This number matches the cumulative percentages of Table III-2, the total time spent on the trip. If we consider a day trip of 12 hours, 34.5% of respondents spent more than a day of total time on the LIR. This is why the anglers catch was more than the daily limit. The mean catch was almost 10 trout per trip per angler (9.87) with a median value of 6 trout, which again is the daily limit and is what we would expect if anglers obeyed limits. The catch value that was reported the most was a catch of zero (21.7% of trips).

3.7. Trout size

From the phone survey results, the average trout size was 9.6 inches with a minimum reported size of 1 inch and a maximum size of 16 inches. If we eliminate the 1 inch fish from the sample the next smallest size was 4 inches. The most common responses were between the ranges of 6-12 inches, 90% of the anglers stated that their catch size was in this range. The most common reported trout size was of 10 inches (Table III-8). The total number of trout harvested was 2,201 for 224 users, 49 of these users did not catch any trout and 1 refused to answer. The average catch per angler was 9.66 (trout per angler), according to the 175 anglers that did catch trout with a minimum of 4 inches and a maximum of 16 inches. The mode and the median for trout size was 10 inches. The top three species that anglers sought at the Lower Illinois River were Rainbow trout, Brown trout, and striped bass; 96.9% reported that rainbow trout was one of the top three species they were trying to catch (Table III-9).

Table III-9. The Top Three Species Anglers Were Trying to Catch at The Lower Illinois River

III-9.A

	Freq "Yes"	**(%) "Yes"**
Rainbow Trout	219	96.9
Brown Trout	102	45.1
White/sand Bass	7	3.1
Striped Bass	20	8.8
Hybrid striped Bass	1	0.4
Channel Catfish	3	1.3
Blue Catfish	1	0.4
Flathead Catfish	0	0
Sunfish	0	0
Other*	16	7.1

Note: * for responses of the 'other' category, please refer to III-9.B

III-9.B.	**Other responses**
Baitfish	
Black Bass	
Black Rooster tail	
Brook Trout	
Carp	
Carp, large mouth bass	
Crappie	
Crappie, skip jack	
Cutthroats	
Golden Trout	
Large fish, didn't matter what kind of trout.	
No preference	
Nothing in particular. just there to fish.	
Small-mouthed bass	

3.8. Expected catch on their latest trip

In the phone survey, anglers were asked to state as an individual how many trout they expected to catch before they left home. This was an open-ended question and responses varied greatly from none to a maximum expected catch of 210 for an individual who stayed on site for four and a half weeks. If we disregard this observation, the next highest value for expected trout catch is 70 for a person who stayed a week on site. The majority of anglers, 34.5%, stated that their expected catch was six trout for their latest trip to the LIR (Table III-10). When asked how many trout the anglers expected to catch, the total sample average was 10.68 trout, which is a very close estimate of the real average catch of 9.66 trout per angler actually caught.

Table III-10. The Expected Number of Trout, as an Individual, Anglers Expected to Catch

Expected Catch	Frequency	Percent	Cumulative Percent
0	25	11.1	11.1
1	5	2.2	13.3
2	6	2.7	15.9
3	7	3.1	19.0
4	5	2.2	21.2
5	17	7.5	28.8
6	78	34.5	63.3
7	3	1.3	64.6
8	3	1.3	65.9
9	2	.9	66.8
10	6	2.7	69.5
11	1	.4	69.9
12	13	5.8	75.7
15	2	.9	76.5
18	4	1.8	78.3
20	7	3.1	81.4
21	1	.4	81.9
24	3	1.3	83.2
25	4	1.8	85.0
30	4	1.8	86.7
35	4	1.8	88.5
36	2	.9	89.4
40	1	.4	89.8
45	2	.9	90.7
50	1	.4	91.2
55	1	.4	91.6
60	1	.4	92.0
70	1	.4	92.5
210	1	.4	92.9
Don’t know	16	7.1	100.0
Total	**226**	**100.0**	

3.9. Stocking day

In the phone survey, anglers were asked a question regarding their knowledge of stocking days. Table III-11 shows whether or not the angler had prior knowledge that the day he/she was fishing on a stocking day, either by looking it up or by being familiar with the schedule. This also indicates prior fishing experience, or a proxy for anglers familiar with the site. A serious angler collects information about weather conditions and the site prior to taking the trip. 45.6% of anglers knew whether or not it was a trout-stocking day. This result is important because it tells us that slightly more than half of the anglers do not know the stocking schedule, most likely they are not familiar with the LIR stocking schedule or this is their first fishing trip to the area.

Table III-11. Anglers Familiar with the Trout Stocking Schedule

Knowledge of stocking schedule **	Frequency	Percent	Cumulative Percent
Yes	103	45.6	45.6
No	123	54.4	100.0
Total	226	100.0	

Note: ** knowledge of the trout stocking day or not (either by looking it up or being familiar with the schedule)

3.10. Fished at 'other' location within the same trip to the LIR

The proportion of anglers that fished only in the trout fishing area along the Lower Illinois River was 79.2 percent, versus 20.8 percent that spent time at other locations in the area within the same trip, i.e., any place other that the Lower Illinois River trout fishing area. The other locations and the time spent on these locations are reported in Table III-12.

3.11. Recreational activities other than fishing while on the trip

Individuals were asked to indicate if they engaged in any other recreational activity other than fishing while on their trip. Exactly 85% of the respondents said that they did not engage in other recreational activities, while 15% of users did engage in other activities (Table III-13). If the respondent answered that they did participate in other recreational activities, the activities that were mentioned included: swimming, hiking, camping, and bird watching. The amount of time that these recreational activities took them away from fishing is shown in (Table III-14).

Table III-12. Did Anglers Spent Time Fishing At Other Locations in The Area-Within The Same Trip (Any place other than the trout fishing area along the Lower Illinois River.)

III-12.A

	Frequency	Percent	Cumulative Percent
Yes	47	20.8	20.8
No	179	79.2	100
Total	226	100	

Table III-12 Continued
OTHER LOCATIONS AND HOURS SPENT ON EACH LOCATION

Above the dam - 10 hours and at Marvel camp - 10 hours
Above the Dam - 2 hours
Above the dam - 6.5 hours
Along the river - 5 hours
Behind the dam - 1.5-2 hours
Behind the dam - 3 hours
Below Marvel, for 1.5 hours
Below the dam - 5-6 hours; downstream to the bridge - 1 hour
Even lower on the Illinois River, it's below Marvel - 1 hour
Gore Landing:3 hours
Greenleaf - couple hours, Tenkiller - couple hours
Greenleaf River: 4 hours Lake Tenkiller: 4 hours
Just farther down the river - a couple hours
Lake Eufaula - 2 hours
Lake Fort Gibson - 4-5 hours
Lake Tenkiller - 3 hours
Lake Tenkiller: 1 day
Lake Tenkiller: 4 hours
Marvel - 5 mins; Gore Landing - 4 hours
Marvel's - an hour, down below the lock-in dam at Gore - about thirty minutes
Marvel's family resort - 3 hours
Marvel - 1.5 hours, Gravel Pit -30 minutes
Marvel - 24 hours Below the dam - 2 hours
Marvel - 3 hours, 10 hours, 6 hours
Marvel - 3 hours; Below the dam - not sure
Marvel - 4 hours, up at the dam - 4 hours
Marvel - hour and a half, 2 hours
Marvel - not sure how long.
Marvel Campground - 6 hours; Marvel Campsite
Marvel trout camp - 4-5 hours
My dock on Tenkiller lake at my cabin - 1 hour
Powerhouse - 2 hours, Farther down the river at public hunting area - 2 hours
Right by the dam - 2 hours; Further down the river from the dam - 2 hours
Sally Jones Lake - 3 hours
Tenkiller - 2 days; Webber Falls - 2 days; Arkansas River - 2 days
Tenkiller Dam - unknown amount of time
Tenkiller lake - 3 hours, Greenleaf lake - 3 hours
The park below the dam - 2 hours; the dam - 2-3 hours; government land - 2-3 hours
The Rock Quarry - 2 hours; mouth of the Arkansas - 3-4 hours
Towards the dam - about 1-2 hours; the access road - about 1-2 hours
Webber - half an hour; 6 hours
Near the camp where I did the on-site survey - 1 hour

Table III-13. Did Anglers Engage In Other Recreational Activities Other Than Fishing While on the Trip to the Lower Illinois River?

III-13.A

	Frequency	Percent	Cumulative Percent
Yes	34	15.0	15.0
No	192	85.0	100.0
Total	226	100.0	

III-13.B

OTHER type of recreational activities	Freq "Yes"	(%) "Yes"
Swimming	15	44
Float trip or non-fishing boating activity	2	6
Shopping & Souvenir Hunting	1	3
Hiking or Bird watching	16	47
Hunting	1	3
Other**	10	29

III-13.C

** 'Other' Responses
Bicycling, playing on the playground
Camping
Cooking, camping, played harmonica
Four-wheeling
Golf
Putt-putt
Sightseeing
Visiting

Table III-14. Amount of Time Other Activities Take Away From Fishing

Responses
1-2 hours
1 hour
10 minutes
10 minutes or so
15 hours
2 days (half the time)
2 hours
2.5 hours
20 minutes
3 hours
3.75 days (75 percent of my time)
30 minutes
5 hours
6 hours
An hour a day for 4.5 weeks
None
None.
That's the way I had it planned, I just kind of snuck in fishing as I could.

3.12. Quality of the fishing trip

Anglers were asked to rank the quality of their last fishing trip to the LIR (Table III-15). Slightly less than a third, 32.3%, of anglers responded that their trip was good, and 13.7% ranked the quality of the fishing experience as excellent. On the other hand, 22.1 percent said the trip was poor, which a relatively high percentage, also 16.8% said the experience was fair, and 15 percent said that the overall quality of the fishing experience was average. In other words, 61% of the anglers considered that the overall quality of the fishing trip on the LIR was either average, good, or excellent.

Table III-15. How Would You Rate The Quality Of This Fishing Trip?

	Frequency	Percent	Cumulative Percent
Poor	50	22.1	22.1
Fair	38	16.8	38.9
Average	34	15.0	54.0
Good	73	32.3	86.3
Excellent	31	13.7	100.0
Total	226	100.0	

3.13. What other activities would anglers engage if they had not made the trout fishing trip

Assuming that the individual could not take the fishing trip, respondents were asked what other form of entertainment they would have chosen to substitute for the fishing experience. The responses for this question are shown in (Table III-16). An interesting finding is that if they had not made the fishing trip to the LIR, 42.9% of the anglers would either fish at another location or fish for other species than trout. This indicates that the LIR provides a unique fishing experience such that more than half of the anglers said if they could not fish at the LIR they would rather engage in other recreational activities like a sporting activity, golfing, baseball, home based activity like watching T.V., or other activities. These dispositions are shown in the bottom part of (Table III-16).

Table III-16. Other Recreational Activities, Hobby, or Form of Entertainment Anglers Would Pursued If They Have 'Not' Made This Trout Fishing Trip to the Lower Illinois River

III-16.A

	Frequency	Percent	Cumulative Percent
Fishing at another location***	67	29.6	29.6
Fishing for another species	30	13.3	42.9
A home-based recreational activity like watching TV or gardening	47	20.8	63.7
A community-based activity like attending a movie or ballgame	11	4.9	68.6
Another sporting activity like hunting, golfing, or baseball	50	22.1	90.7
Other**	7	3.1	93.8
Don't Know	14	6.2	100.0
Total	**226**	**100.0**	

III-16.B

** Other recreational activity you would you have pursued
I would have worked.
Motorcycle riding
Nothing
RV-ing
Sitting with my bedfast wife.

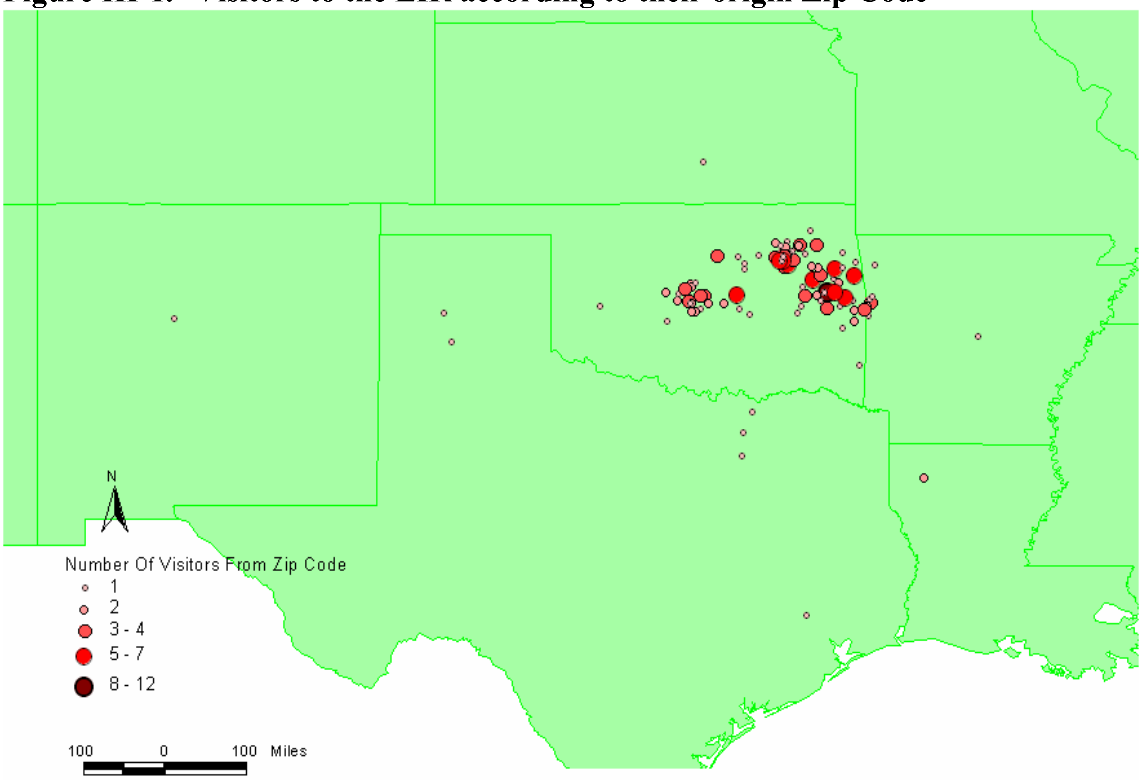
III-16.C

*** Other location you would have been fishing - if not the Lower Illinois
Above the dam, or farther down the river.
Any of the 20 different sites I visit in a year.
Arkansas.
Pretty Water Lake in Sapulpa
Barren Fork
Beaver's Bend or Tanycomo
Beaver Lake
Below Ft. Gibson dam for catfish
Blue River
Some places near McAlester.
Broken Bow
Either on a private property pond or Lake Hefner
Fort Gibson Lake
Greenleaf
Gulf
Just somewhere else
Kerr Lake
Keystone Lake
Lake Eufaula
Oologah
Little Sallisaw Creek, Arkansas River, and Farm Pond
Lower Mountain Fork
Missouri
Montana
Mountain Fork River, Eufaula or Canton Lake (Texoma)
Pawhuska City Lake for trout.
Probably at Webber because it's close to my house
Probably closer to the dam
Roaring River
Robbers Cave
Some of the smaller lakes
Seminole County, my family has a ranch there.
Skiatook Lake
Tenkiller Lake or Hudson
The Mountain Fork at Beaver's Bend
Upper Illinois for brown bass
White River, Arkansas

3.14. Fishing trips per year to the LIR trout fishing area

The annual frequency of fishing trips to the LIR is shown in (Table III-17). During the previous year (2003), the average number of fishing trips was 15 trips per year, the median 6 trips and 1 trip per year was the most common answer. The maximum reported number of trips was 215 for one angler in the last year. Of the individuals in the sample, 57.5% took 9 trips or less per-person-per-season to the LIR.

Figure III-1. Visitors to the LIR according to their origin Zip Code



The figure above shows the origin (by zip code) of the visitors to the LIR. Most of the visitors live within the state of Oklahoma. A few anglers visit from the states surrounding, especially Arkansas because of its proximity to the site.

3.15. Length of the trout fishing trips

Anglers were asked on average if they spend the same amount of time fishing on this trip as they normally do. Their answers are shown in (Table III-18). From the total sample 77.9% responded yes and 21.7% responded no. The average length of all the trout fishing trips to the LIR is 6 hours and 12 minutes. The median response is 4 hours, which confirms that most of the trips to the LIR are daily trips. The minimum response was 1 hour and the maximum trout fishing trip time is 48 hours. 51.3% of the sample said that their trips to the LIR lasted less than 4 hours and 84.5% said that their trip length was 8 hours or less (Table III-18).

Table III-17. In The Last Year, How Many Fishing Trips Did You Make to the Lower Illinois Trout Fishing Area (Including Current Trip)?

	Frequency	Percent	Cumulative Percent
1	41	18.1	18.1
2	23	10.2	28.3
3	15	6.6	35.0
4	14	6.2	41.2
5	13	5.8	46.9
6	11	4.9	51.8
7	2	0.9	52.7
8	9	4.0	56.6
9	2	0.9	57.5
10	11	4.9	62.4
12	12	5.3	67.7
14	2	0.9	68.6
15	11	4.9	73.5
17	1	0.4	73.9
18	1	0.4	74.3
20	13	5.8	80.1
22	1	0.4	80.5
23	1	0.4	81.0
24	1	0.4	81.4
25	5	2.2	83.6
27	2	0.9	84.5
30	6	2.7	87.2
31	1	0.4	87.6
35	4	1.8	89.4
40	3	1.3	90.7
48	1	0.4	91.2
50	3	1.3	92.5
52	2	0.9	93.4
60	1	0.4	93.8
89	1	0.4	94.2
98	1	0.4	94.7
100	3	1.3	96.0
150	2	0.9	96.9
200	1	0.4	97.3
215	1	0.4	97.8
Don't know	5	2.2	100.0
Total	226	100.0	

Table III-18. On Average, Did You Spend The Same Amount Of Time Fishing On This Trip (To The Lower Illinois) As You Normally Do, Yes Or No?

III-18.A

	Frequency	Percent	Cumulative Percent
Yes	176	77.9	77.9
No	49	21.7	99.6
Don't know	1	.4	100.0
Total	226	100.0	

III-18.B What is the average length of all of your trout fishing trips to the lower Illinois River?

Hours	Frequency	Percent	Cumulative Percent
1	15	6.6	6.6
2	32	14.2	20.8
3	43	19.0	39.8
4	26	11.5	51.3
5	23	10.2	61.5
6	18	8.0	69.5
7	11	4.9	74.3
8	23	10.2	84.5
9	4	1.8	86.3
10	8	3.5	89.8
11	2	.9	90.7
12	6	2.7	93.4
14	1	.4	93.8
15	1	.4	94.2
16	1	.4	94.7
24	2	.9	95.6
30	3	1.3	96.9
33	1	.4	97.3
36	2	.9	98.2
48	2	.9	99.1
Don't know	2	.9	100.0
Total	**226**	**100.0**	

3.16. Trout fishing trip expenditures

The amounts of the angler trip expenditures were separated between: lodging, food and beverages, transportation, purchased items, purchased services, and other expenses. The expenditure questions were asked in different parts and the responses were based on how much money the individual spent to make that trip to the Lower Illinois River area. The categories were mentioned and the respondent stated if he/she purchased or paid for the items mentioned on his/her trip. The results of lodging expenses are shown in Table III-19, where 69.9% of the respondents did not spend any money on lodging. The maximum amount of money spent on lodging was $600. Expenditures on food and beverages including restaurant and groceries are shown in (Table III-20). A total of 13.7% of the individuals did not spend any money on food and beverages. The maximum amount of food expenditures was $2000 for one individual from the sample. Moreover, 61.5% of the respondents spent $25 or less in food and beverages for the fishing trip. Furthermore, with regards to transportation expenditures, they were reported in Table (III-21) with a minimum transportation expenditure of $0 (locals who walked to the area) and a maximum of $200. The average expenditure per angler was $31.47 per fishing-trip and the median expenditures were $20 per trip-per angler. Reported transportation costs included gas, oil, and car rental (if applicable).

Reported costs of 'purchased items' are shown in (Table III-22). The purchased items expenditures include: bait, tackle, insect repellent, and souvenirs. A total of 30% of sampled individuals did not incur these types of costs, and 80.1% of the total sample spent $35 or less on this type of cost. The mean cost of 'purchased item' was $24.18 and the median expenditure under this category of $10. Only two anglers out of the whole sample (0.8%) indicated that they incurred any additional costs of ‘purchased services’ and they were in the amounts of $11 and $25, which were spent on purchased services such as canoe rental or fishing guides. In addition, 97.8% did not spent any money on this type of service and 1.3% responded that they did not know. Finally two anglers indicated that they incurred other expenses in the amounts of $60 and $100 for entertainment purposes at Cherokee village and water sampling equipment, respectively. 98.2% of individuals did not incur any ‘other’ expenses.

Table III-19. How much did you spend on LODGING, such as motel, cabins, or camping fees?

Dollars ($)	Frequency	Percent	Cumulative Percent
0	158	69.9	69.9
8	1	0.4	70.4
10	1	0.4	70.8
20	1	0.4	71.2
25	1	0.4	71.7
28	1	0.4	72.1
35	1	0.4	72.6
40	3	1.3	73.9
48	1	0.4	74.3
50	3	1.3	75.7
60	6	2.7	78.3
65	1	0.4	78.8
70	2	0.9	79.6
72	1	0.4	80.1
75	2	0.9	81.0
80	1	0.4	81.4
84	2	0.9	82.3
90	4	1.8	84.1
100	4	1.8	85.8
120	4	1.8	87.6
122	1	0.4	88.1
140	2	0.9	88.9
150	3	1.3	90.3
160	1	0.4	90.7
170	1	0.4	91.2
180	1	0.4	91.6
200	7	3.1	94.7
250	1	0.4	95.1
270	1	0.4	95.6
286	1	0.4	96.0
300	2	0.9	96.9
350	1	0.4	97.3
370	1	0.4	97.8
400	1	0.4	98.2
450	1	0.4	98.7
600	1	0.4	99.1
Don't know	2	0.9	100.0
Total	226	100.0	

Table III-20. How Much Did You Spend On FOOD And BEVERAGES - Including Restaurants And Groceries?

Dollars ($)	Frequency	Percent	Cumulative Percent
0	31	13.7	13.7
1	2	.9	14.6
2	4	1.8	16.4
3	5	2.2	18.6
4	1	.4	19.0
5	14	6.2	25.2
6	3	1.3	26.5
7	4	1.8	28.3
8	2	.9	29.2
10	21	9.3	38.5
12	3	1.3	39.8
13	1	.4	40.3
14	2	.9	41.2
15	18	8.0	49.1
20	21	9.3	58.4
25	7	3.1	61.5
30	12	5.3	66.8
33	1	.4	67.3
40	4	1.8	69.0
45	1	.4	69.5
50	12	5.3	74.8
55	1	.4	75.2
60	3	1.3	76.5
70	2	.9	77.4
75	5	2.2	79.6
80	1	.4	80.1
85	1	.4	80.5
100	15	6.6	87.2
125	1	.4	87.6
150	8	3.5	91.2
170	1	.4	91.6
200	7	3.1	94.7
250	1	.4	95.1
300	5	2.2	97.3
2000	1	.4	97.8
Don’t know	5	2.2	100.0
Total	226	100.0	

Table III-21. How much did you spend on TRANSPORTATION - including gas, oil, and car rental?

Dollars ($)	Frequency	Percent	Cumulative Percent
0	9	4.0	4.0
1	3	1.3	5.3
2	4	1.8	7.1
3	6	2.7	9.7
4	2	.9	10.6
5	9	4.0	14.6
6	3	1.3	15.9
8	4	1.8	17.7
10	31	13.7	31.4
12	3	1.3	32.7
14	1	.4	33.2
15	15	6.6	39.8
18	1	.4	40.3
20	39	17.3	57.5
25	12	5.3	62.8
30	15	6.6	69.5
32	1	.4	69.9
35	2	.9	70.8
40	11	4.9	75.7
45	3	1.3	77.0
50	15	6.6	83.6
60	7	3.1	86.7
62	1	.4	87.2
75	6	2.7	89.8
80	2	.9	90.7
90	1	.4	91.2
100	9	4.0	95.1
120	1	.4	95.6
125	1	.4	96.0
150	4	1.8	97.8
200	2	.9	98.7
Don’t know	3	1.3	100.0
Total	226	100.0	

Table III-22. How much did you spend on PURCHASED ITEMS - including bait, tackle, insect repellent, and souvenirs?

($)	Frequency	Percent	Cumulative Percent
0	68	30.1	30.1
1	1	.4	30.5
2	1	.4	31.0
3	4	1.8	32.7
4	2	.9	33.6
5	9	4.0	37.6
6	3	1.3	38.9
7	4	1.8	40.7
8	4	1.8	42.5
9	1	.4	42.9
10	21	9.3	52.2
12	2	.9	53.1
15	12	5.3	58.4
17	2	.9	59.3
20	21	9.3	68.6
25	9	4.0	72.6
29	1	.4	73.0
30	11	4.9	77.9
32	2	.9	78.8
33	1	.4	79.2
35	2	.9	80.1
40	5	2.2	82.3
50	15	6.6	88.9
60	2	.9	89.8
70	2	.9	90.7
75	4	1.8	92.5
80	1	.4	92.9
100	6	2.7	95.6
110	1	.4	96.0
120	1	.4	96.5
150	1	.4	96.9
160	2	.9	97.8
230	1	.4	98.2
500	1	.4	98.7
Don't know	3	1.3	100.0
Total	226	100.0	

Table III-23. How much did you spend on PURCHASED SERVICES - such as canoe rentals or fishing guides?

	Frequency	Percent	Cumulative Percent
Nothing	221	97.8	97.8
$11	1	.4	98.2
$25	1	.4	98.7
Don't know	3	1.3	100.0
Total	226	100.0	

Table III-24. How much did you spend on OTHER expenses?

($)	Frequency	Percent	Cumulative Percent
$0	222	98.2	98.2
$60	1	.4	98.7
$100	1	.4	99.1
Don't know	2	.9	100.0
Total	226	100.0	

TABLE III-24.A What were your "other" expenses?

Responses
Entertainment at Cherokee Village in Tahlequah
None
Not applicable
Water sampling, taking pH levels, test tubes to get the insects out and help us to mimic the flies, and buying all of the equipment to do this.

Table III-25. Total Angler Expenditures for This Last Fishing Trip to the Lower Illinois

Expenditures ($)	Frequency	Percent	Cumulative Percent
0	4	1.8	1.8
3	1	.4	2.2
5	3	1.3	3.5
7	1	.4	4.0
8	2	.9	4.9
9	1	.4	5.3
10	8	3.5	8.8
11	1	.4	9.3
12	1	.4	9.7
13	1	.4	10.2
15	10	4.4	14.6
16	1	.4	15.0
20	12	5.3	20.4
22	1	.4	20.8
25	17	7.5	28.3
26	2	.9	29.2
30	12	5.3	34.5
35	7	3.1	37.6
40	8	3.5	41.2
45	4	1.8	42.9
50	14	6.2	49.1
55	1	.4	49.6
60	9	4.0	53.5
65	3	1.3	54.9
70	3	1.3	56.2
75	5	2.2	58.4
80	1	.4	58.8
85	1	.4	59.3
100	12	5.3	64.6
120	1	.4	65.0
125	1	.4	65.5
130	2	.9	66.4
150	8	3.5	69.9
170	1	.4	70.4
175	3	1.3	71.7
180	1	.4	72.1
200	9	4.0	76.1
215	1	.4	76.5
240	1	.4	77.0
250	5	2.2	79.2
300	11	4.9	84.1
325	1	.4	84.5
350	3	1.3	85.8
400	8	3.5	89.4
450	2	.9	90.3
500	8	3.5	93.8
530	1	.4	94.2
550	1	.4	94.7
600	4	1.8	96.5
650	1	.4	96.9
800	3	1.3	98.2
900	1	.4	98.7
1000	1	.4	99.1
Refused	1	.4	100.0
Don't know	1	.4	99.6
Total	**226**	**100.0**	

3.17. Total expenditures

The total out of pocket expenditures for the fishing trip for 224 anglers summed to $32,906. The average total expenditure per trip to the LIR was $146.90, with the most common answer of $25 total per trip. The total expenditure responses have a minimum of $0 and a maximum of $1000; the median total expenditure for this last fishing trip is $57.50 with 53.5% of all persons spending $60 or less per trip. Table III-25 shows the response frequency for total expenditures to the LIR reported in the telephone survey.

3.18. Expenditures within Oklahoma

Table III-26 shows the percentage of expenditures that occur within 25 miles of the LIR but still within Oklahoma, the percentage spent outside the 25 mile area of the LIR, but still within Oklahoma, and finally the percentage spent outside Oklahoma, respectively. With respect to expenses spent within the 25-mile area of the LIR, over 41.2% of the total anglers spent their money within the 25 mile area of the LIR. In general, 91.6% of the angler expenditures occurred within the state of Oklahoma.

Table III-26. What percentage of your total expenses was spent within the 25 mile area of the Lower Illinois River, versus other areas in Oklahoma and areas outside Oklahoma?

III-27.a

Percentage	Frequency	Percent	Cumulative Percent
No response	4	1.8	1.8
0	15	6.6	8.4
5	4	1.8	10.2
10	9	4.0	14.2
15	1	0.4	14.6
20	6	2.7	17.3
25	6	2.7	19.9
30	11	4.9	24.8
33	4	1.8	26.5
35	1	0.4	27.0
40	6	2.7	29.6
50	18	8.0	37.6
60	3	1.3	38.9
66	1	0.4	39.4
70	5	2.2	41.6
75	13	5.8	47.3
80	10	4.4	51.8
90	6	2.7	54.4
95	6	2.7	57.1
100	93	41.2	98.2
Don't know	4	1.8	100.0
Total	226	100.0	

TABLE III-26 Continued

What percentage was spent outside the 25 mile area of the Lower Illinois River - but still within Oklahoma?

Percentage	Frequency	Percent	Cumulative Percent
No response	4	1.8	1.8
0	97	42.9	44.7
5	7	3.1	47.8
10	6	2.7	50.4
15	1	0.4	50.9
20	11	4.9	55.8
25	10	4.4	60.2
30	7	3.1	63.3
34	1	0.4	63.7
40	5	2.2	65.9
50	19	8.4	74.3
55	1	0.4	74.8
60	7	3.1	77.9
65	2	0.9	78.8
67	4	1.8	80.5
70	7	3.1	83.6
75	6	2.7	86.3
80	7	3.1	89.4
85	3	1.3	90.7
90	5	2.2	92.9
95	2	0.9	93.8
100	12	5.3	99.1
Don't know	2	0.9	100.0
Total	226	100.0	

What percentage was spent outside Oklahoma?

Percentage	Frequency	Percent	Cumulative Percent
0	207	91.6	91.6
5	2	0.9	92.5
15	1	0.4	92.9
20	1	0.4	93.4
25	2	0.9	94.2
30	1	0.4	94.7
40	1	0.4	95.1
50	3	1.3	96.5
100	1	0.4	96.9
Don't know	3	1.3	98.2
No response	4	1.8	100.0
Total	226	100.0	

3.19. Employment status of user of the LIR

Anglers were asked to reveal their current employment status and asked whether they were currently employed by the hour, on a salary, seeking work, a homemaker, or retired. At the time of the interview, 31.9% said that they were employed by the hour, and almost 28.8% worked on a salary basis, 24.8 percent indicated that they are retired and 1.8% were seeking work (Table III-27). This is important because a significant number of users that demand recreational services are retired.

Table III-27. Are you currently employed by the hour, on a salary, seeking work, a homemaker, or retired?

III-27.A

	Frequency	**Percent**	**Cumulative Percent**
Employed by the hour	72	31.9	31.9
On a salary	65	28.8	60.6
Seeking work	4	1.8	62.4
Homemaker	2	.9	63.3
Retired	56	24.8	88.1
Self-employed	18	8.0	96.0
On commission	4	1.8	97.8
Other*	5	2.2	100.0
Don't Know	226	100.0	

Note: Salaried individuals are people who work a fixed-hour schedule, such as 9 to 5 Monday through Friday.

III-27.B ***What is your employment status?**

Responses
Contract work
Disabled
Full-time student
I'm a homemaker, but I also baby-sit for the Cherokee Nation, and I get paid monthly.
Student

Table III-28. If you were paid at an additional<amount offered ($)/hour> for working which mean you could not fish, would you take the paid overtime, yes or no?

Amount offered ($)	Frequency 'YES'	Frequency 'NO'	Percent 'yes'	Percent 'no'
4	6	17	25	75
5	11	52	17	83
6	15	37	29	71
7	8	35	18	82
9	9	33	21	79
Don't know		3		
Total	49	177		

This table show the responses targeted to elicit the opportunity cost of time for the angler. Out of the total sample, 77 percent of anglers would not trade their fishing experience ('no' respondents) for any additional paid overtime. Of the 23 percent that did want to work for additional paid overtime, the percentages are shown in the table above. The majority of individuals will not trade their fishing experience for any additional overtime income. It is possible that the suggested overtime bids were increased at a level higher than $9/hour, more people would haven taken the chance to work overtime rather than fish.

3.20. Other trout fishing locations in Oklahoma

The anglers were asked to indicate at what other locations in Oklahoma they fished for trout in the last year. In the sample, 60.6% responded that they have not trout fished at any other location in the last year. The next highest response was the Lower Mountain Fork River for which 21.2% of respondents indicated that they trout fished in this river. The Blue River was also visited by 14.6% of total anglers (Table III-29).

Table III-29. What other locations in Oklahoma have anglers trout fished in the last year?

III-29.a

		Freq "Yes"	(%) "Yes"
1	Blue River	33	14.6
2	Dolese Park Pond (OKC)	3	1.3
3	Lake Carl Etling	1	0.4
4	Lake Pawhuska	9	4
5	Lower Mountain Fork River/Broken Bow Reservoir or Beaver's Bend	48	21.2
6	Pretty Water (Sapulpa)	13	5.75
7	Quartz Mountain (Altus)	1	0.4
8	Robbers Cave	19	8.4
9	Watonga Lake	2	0.9
10	Other*	15	6.6
11	None	137	60.6

III-29.b

* "Other" response
Arbuckle
Grand Lake trout fishing stream
Greenleaf Lake
Lake Tenkiller, a few creeks, and also near Adair county
Lake Thunderbird
Roaring River; Marietta
Roman Nose, Lake Ellsworth
Tenkiller, Greenleaf, Arkansas River, Lake Eufaula
Wilburton, Roman Nose

3.21. Overall quality of trout fishing

Respondents were asked to rate how they viewed the quality of trout fishing on the LIR overall, the results are shown in Table III-30. Of the respondents, 8% ranked the overall quality of trout fishing as *excellent*, 31.4% ranked it as *good*, 27.4% said it was *average*, 21.2% said it was *fair*, and 11.1% indicated is was *poor*. This adds up to 59.7% of anglers that stated their overall level of satisfaction was average or below average, while the other 40.3% considered it either good or excellent.

Table III-30. How do you view the quality of trout fishing on the Lower Illinois overall?

	Frequency	Percent	Cumulative Percent
Poor	25	11.1	11.1
Fair	48	21.2	32.3
Average	62	27.4	59.7
Good	71	31.4	91.2
Excellent	18	8.0	99.1
Don't Know	2	.9	100.0
Total	226	100.0	

3.22. Demographic information

The average angler's age was 48.5 years old and over 42.5 percent were over 50 years old. The minimum age for surveyed anglers was 21 years old with a maximum age of 85 years old (Table III-31). With respect to party size, 20.8% of anglers traveled to the site and fished alone and 44.2% fished in pairs. Of the respondents, 95.6% of anglers said that their total fishing party was of 4 persons or less (Table III-32).

Anglers' household size was as follows: 8.4% of anglers lived by themselves, 39.4% shared the household with another person, 25.2% lived in a three person household, and 17.7% lived in a four person household (Table III-33). Anglers were then asked how many wage earners were living in their household. A total of 30.5% said that they were the only wage earners, and 46.9% said that there was another person in the household that was also a wage earner. The results are shown in Table III-34, anglers' individual earnings per year averaged $49,451 and the median income was $40,000. Of the respondents, 53.1% had annual earnings of $45,000 or less per year (Table III-34). Respondents estimated their own total household income for which the income brackets are given in Table (III-35). The most common household income per year was greater than $60,000 of which 46% of individuals who fit into this category. Finally 89.82% of our sample consisted of males and 10.18% consisted of female anglers (Table III-36).

Table III-31. Anglers Age Distribution

Age	Frequency	Percent	Cumulative Percent
21	3	1.3	1.3
23	4	1.8	3.1
24	4	1.8	4.9
25	2	0.9	5.8
26	2	0.9	6.6
27	2	0.9	7.5
28	2	0.9	8.4
29	4	1.8	10.2
30	4	1.8	11.9
31	3	1.3	13.3
32	4	1.8	15.0
33	4	1.8	16.8
34	4	1.8	18.6
35	4	1.8	20.4
36	2	0.9	21.2
37	6	2.7	23.9
38	4	1.8	25.7
39	3	1.3	27.0
40	7	3.1	30.1
41	6	2.7	32.7
42	7	3.1	35.8
43	5	2.2	38.1
44	6	2.7	40.7
45	7	3.1	43.8
46	10	4.4	48.2
47	4	1.8	50.0
48	5	2.2	52.2
49	7	3.1	55.3
50	5	2.2	57.5
51	3	1.3	58.8
52	6	2.7	61.5
53	3	1.3	62.8
54	4	1.8	64.6
55	3	1.3	65.9
56	1	0.4	66.4
57	10	4.4	70.8
58	4	1.8	72.6
59	7	3.1	75.7
60	2	0.9	76.5
61	4	1.8	78.3
62	5	2.2	80.5
63	3	1.3	81.9
64	4	1.8	83.6
65	2	0.9	84.5
66	5	2.2	86.7
67	3	1.3	88.1
68	2	0.9	88.9
69	4	1.8	90.7
70	7	3.1	93.8
71	1	0.4	94.2
72	1	0.4	94.7
73	2	0.9	95.6
74	1	0.4	96.0
76	3	1.3	97.3
78	1	0.4	97.8
81	1	0.4	98.2
85	2	0.9	99.1
Refused to answer	2	0.9	100.0
Total	226	100.0	

Table III-32. How many other people came in the vehicle with you to the Lower Illinois?

Party number	Frequency	Percent	Cumulative Percent
0	47	20.8	20.8
1	100	44.2	65.0
2	40	17.7	82.7
3	29	12.8	95.6
4	7	3.1	98.7
5	2	.9	99.6
6	1	.4	100.0
Total	**226**	**100.0**	

Table III-33. Not including yourself, how many other people are currently living in your household?

III-33.A

Household size	Frequency	Percent	Cumulative Percent
0	19	8.4	8.4
1	89	39.4	47.8
2	57	25.2	73.0
3	40	17.7	90.7
4	17	7.5	98.2
5	1	.4	98.7
6	3	1.3	100.0
Total	226	100.0	

How many of these individuals are wage earners?

III-33.B

Wage earners	Frequency	Percent	Cumulative Percent
Missing values	19	8.4	8.4
0	69	30.5	38.9
1	106	46.9	85.8
2	26	11.5	97.3
3	6	2.7	100.0
Total	226	100.0	

Table III-34. Individual earnings per year

Income	Frequency	Percent	Cumulative Percent
0	5	2.2	2.2
2,000	1	0.4	2.7
6,000	1	0.4	3.1
8,000	2	0.9	4.0
9,000	2	0.9	4.9
10,000	1	0.4	5.3
11,000	1	0.4	5.8
12,000	3	1.3	7.1
13,000	1	0.4	7.5
14,000	2	0.9	8.4
15,000	5	2.2	10.6
18,000	2	0.9	11.5
19,000	3	1.3	12.8
20,000	11	4.9	17.7
22,000	3	1.3	19.0
25,000	6	2.7	21.7
26,000	1	0.4	22.1
27,000	2	0.9	23.0
28,000	3	1.3	24.3
29,000	3	1.3	25.7
30,000	12	5.3	31.0
32,000	1	0.4	31.4
33,000	1	0.4	31.9
34,000	1	0.4	32.3
35,000	7	3.1	35.4
36,000	2	0.9	36.3
37,000	1	0.4	36.7
38,000	5	2.2	38.9
39,000	1	0.4	39.4
40,000	14	6.2	45.6
41,000	1	0.4	46.0
42,000	1	0.4	46.5
43,000	1	0.4	46.9
44,000	2	0.9	47.8
45,000	12	5.3	53.1
46,000	1	0.4	53.5
48,000	1	0.4	54.0
49,000	2	0.9	54.9
50,000	17	7.5	62.4
53,000	1	0.4	62.8
54,000	1	0.4	63.3
55,000	2	0.9	64.2
57,000	1	0.4	64.6

TABLE D-34 Continued

Income	Frequency	Percent	Cumulative Percent
64,000	1	0.4	69.5
65,000	2	0.9	70.4
67,000	1	0.4	70.8
70,000	2	0.9	71.7
72,000	1	0.4	72.1
75,000	10	4.4	76.5
78,000	1	0.4	77.0
80,000	2	0.9	77.9
90,000	3	1.3	79.2
99,999	1	0.4	79.6
100,000	6	2.7	82.3
102,000	1	0.4	82.7
105,000	1	0.4	83.2
120,000	2	0.9	84.1
125,000	1	0.4	84.5
140,000	1	0.4	85.0
150,000	1	0.4	85.4
160,000	1	0.4	85.8
172,000	1	0.4	86.3
200,000	1	0.4	86.7
300,000	1	0.4	87.2
450,000	1	0.4	87.6
Don’t Know	12	5.3	92.9
Refused	16	7.1	100.0
Total	226	100.0	

Table III-35. Total Household Income from All Sources per Year

		Freq	(%)
1	Under $5000	0	0
2	$5000- but less than $10,000	3	1.3
3	$10,000- but less than 15,000	1	0.4
4	$15,000- but less than 20,000	7	3.1
5	$20,000- but less than 25,000	11	4.9
6	$25,000- but less than 30,000	11	4.9
7	$30,000- but less than 35,000	9	4.0
8	$35,000- but less than 40,000	11	4.9
9	$40,000- but less than 45,000	14	6.2
10	$45,000- but less than 50,000	10	4.4
11	$50,000- but less than 55,000	10	4.4
12	$55,000- but less than 60,000	8	3.5
13	$60,000 or more	104	46.0
88	Don't Know	11	4.9
99	Refused to answer	16	7.1

Table III-36. Gender

		Freq	(%)
1	Male	203	(89.82)
2	Female	23	(10.18)

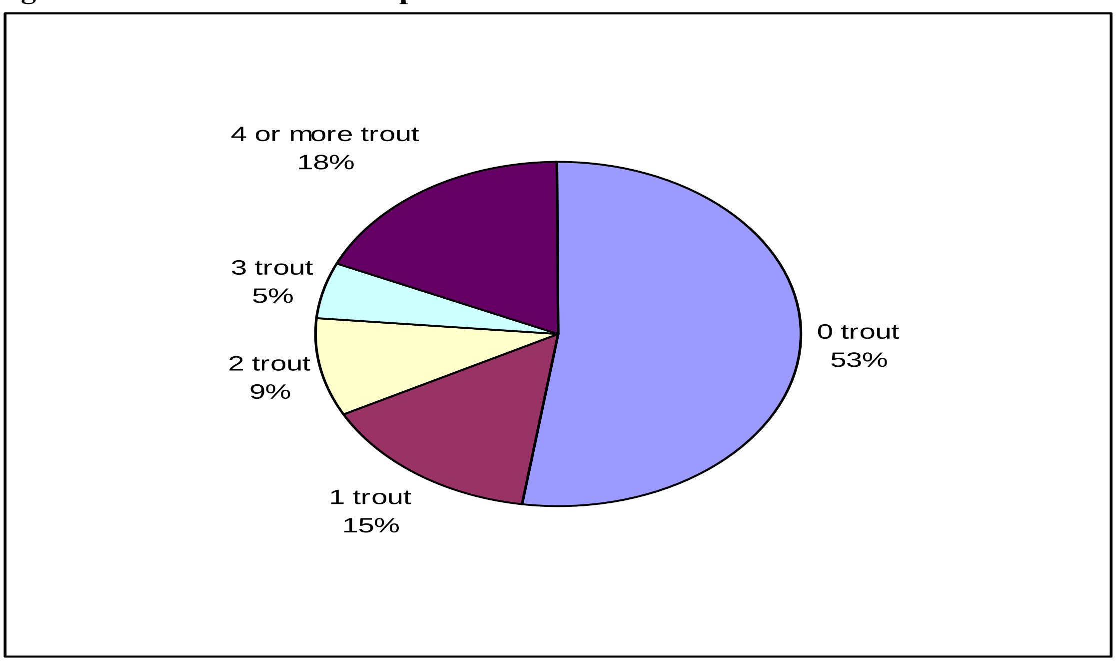
Section II. On-Site Survey Data

The response frequency and descriptive statistics of the questions asked on the on-site survey is presented in this section.

3.23. Trout catch

The responses for this question, the number of trout caught, are shown in Figure III-2. Some people responded with ranges i.e. their catch was between 10-15 trout, in order to estimate descriptive statistics the average was obtained in this case (10+15)/2 which is equal to 12.5 trout was used for numeric calculations. Of the total respondents, 52.2% stated that they did not catch any trout while on the LIR. 1, 2, and 3 trout were the most common answer with 15%, 9.3%, and 5.3% respectively (Figure III-2). The maximum number of trout catch per trip was 20 for a group of 4 anglers.

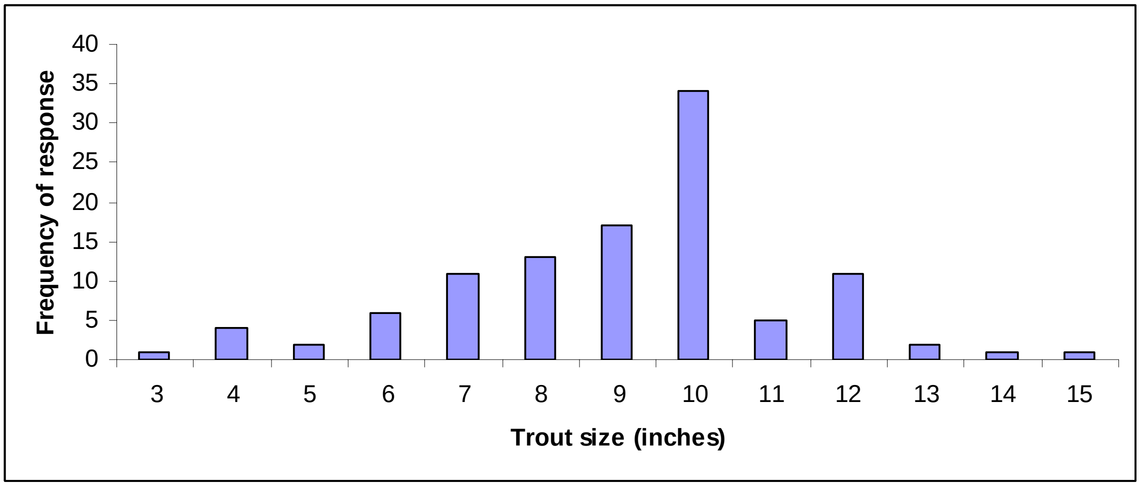
Figure III-2. Trout Catch Reported on Site



3.24. Trout size

Many anglers did not catch any trout (118 out of 226), but taking into account only the anglers that did catch trout the mean was 9 inches; the most common response (the mode) was a size of 10 inches followed by 9, 8, and 4th placed tied between 7 and 12 inches (Figure III-3).

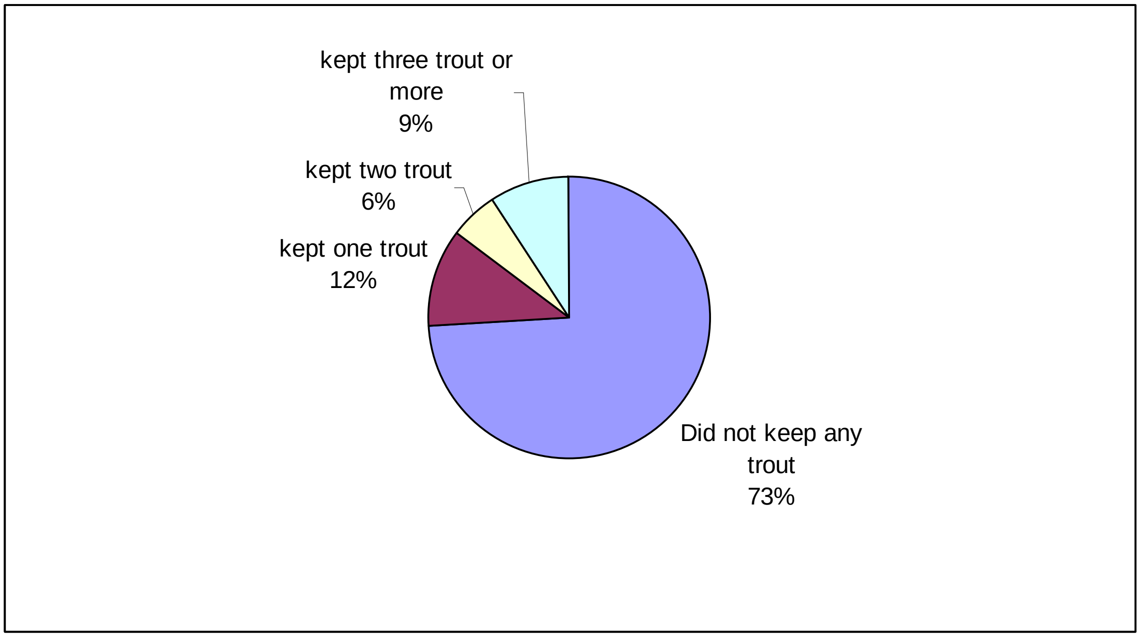
Figure III-3. Frequency of Responses Regarding Trout Size



3.25. Number of trout kept

On the on-site survey, 73.9% indicated that they did not keep any trout either because they did not catch any or they released all of them back to the LIR. A total of 11.5% of anglers kept 1 trout and 5.5% kept two trout (Figure III-4). With respect to *expected catch*, many responded that before leaving their homes their expected catch of the day was the daily limit of 6 trout, this was the most common response.

Figure III-4. Number of trout kept.



3.26. Fishing times

A question was designed to indicate the time of the day the angler started fishing and the time that they concluded fishing for this specific trip to the LIR. Out of the sample, only 48.67% anglers completed the fishing time information. This might be due to the fact that some of the anglers were in the process of fishing while the on-site survey took place and had not completed their trip. For those who had completed their trips for the day, the average fishing time was 3 hours and 45 minutes.

3.27. Trip time information

Information regarding travel time and total length of time spent on the LIR is recorded in (Table III-37). The responses in total length of time varied from minutes, hours, days, even weeks so the raw responses were converted to hours. Descriptive statistics of the trip time in hours are shown in the table below. The mean number of hours is skewed due to the fact that 60 individuals stayed longer than a recreation day on site. The median time spent per trip was 8 hours.

Table III-37. Descriptive Statistics for the Total Trip Time to the LIR

	Trip Time (in hours)
Mean	28
Standard Error	3
Median	8
Mode	8
Standard Deviation	41
Sample Variance	1691
Kurtosis	4
Skewness	2
Range	215
Minimum	1
Maximum	216
Sum	6304
Count	222

3.28. Rank the quality of trout fishing in the lower Illinois overall

Anglers ranked the quality of the trout fishing while they were on site (Figure III-5). Of the total anglers, 9.3% rated the quality of trout fishing as excellent, 45.5% as good, 11.1% as average, 17.3% as fair, and 15.9% as poor.

3.29. Total dollars anglers expect to spend on this fishing trip

Expected expenditures for the fishing trip are recorded in Table III-38. Expected expenditures were solicited because anglers have not yet returned home to complete the trip. The average total expected cost for the anglers' last trip was $93.88 with a minimum of $0 and a maximum of $1000.

Figure III-5. Percentage Ranking of the Overall Quality of the Fishing Trip

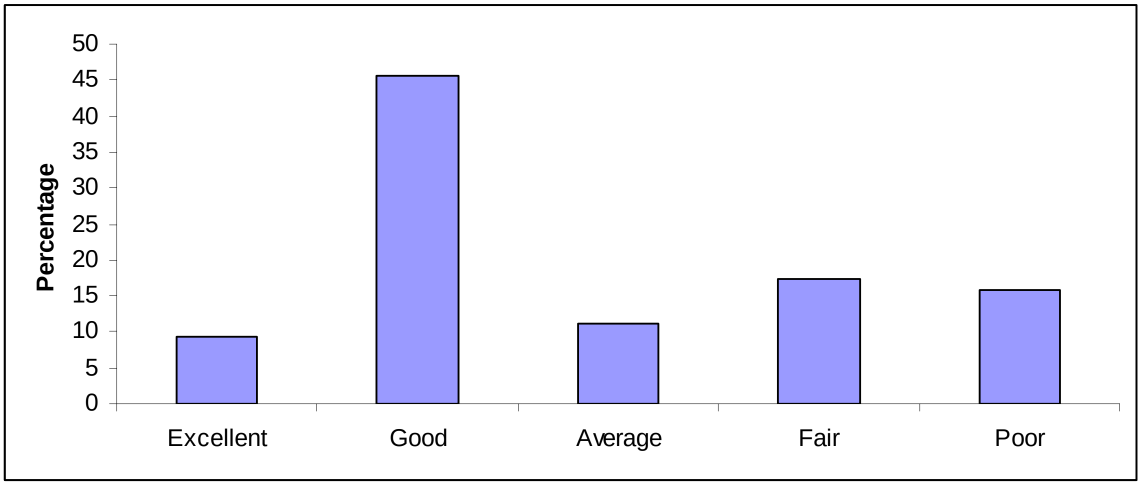


Table III-38. Total Angler Expenditures on their latest trip to the LIR.

Total Angler Expenditures	
Mean	$93.89
Standard Error	$9.11
Median	$30.00
Mode	$20.00
Standard Deviation	$136.12
Sample Variance	$18,527.48
Minimum	0.00
Maximum	1000.00
Sum	20937.15

3.30. Age

Age was also recorded for the on-site interview and it matches the responses given on the telephone survey. The average age is 48 yrs old with a minimum age of 21 and a maximum of 85 (Table III-34).

3.31. Number of persons per vehicle

The average reported vehicle occupancy to the LIR was 2 persons per vehicle. The minimum number of persons that came in the vehicle is 0 (for participants who walked), and the maximum is 10. The frequency of responses is shown in (Table III-39).

Table III-39. Persons per Vehicle at the LIR

	Persons per Vehicle
Mean	2.018
Standard Error	0.079
Median	2
Mode	2
Standard Deviation	1.166
Sample Variance	1.360
Kurtosis	9.521
Skewness	1.995
Range	10
Count	217

3.32. Management scenarios

Two sets of hypothetical management scenarios were shown to each angler. Each angler was shown two scenario cards randomly. These were recorded as one from the management scenario 1 and one from management scenario 2. Each group had a potential to have 16 different combinations but only one of these was selected at random for each individual. The angler had three options from each card and the response frequency of these scenarios is shown in table III-40. In this table the percentage of anglers who responded to the different scenarios (scenario A, B, and C) is also given. Note that choice C is the option of having no change in current management. The methodology of this discrete choice experiment is described in Chapter V.

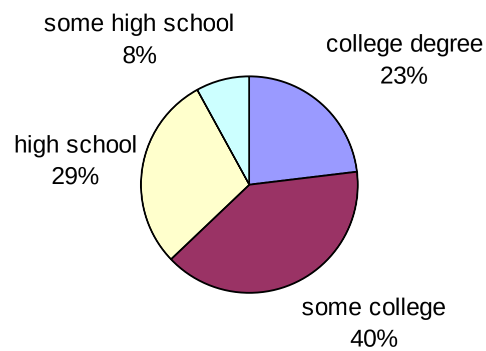
Table III-40 Choice Frequency for the different Management Scenarios

Choice	Frequency	Percent (%)
A	151	33.41
B	168	37.17
C	133	29.42
Total	452	100

3.33. Education

With respect to the highest level of education attained, 23.11% of anglers completed a college degree, a total of 40% of the anglers went to college but did not complete their degrees, 28.89% completed their high school, and 8% of anglers did not finish their high school (Figure III-6).

Figure III-6. Education attained by Anglers of the LIR



The final question for the on-site interview was if household income was greater than $40,000 per year for which 30.04% indicated that their annual income was less than $40,000 a year and the other 69.96% had an income greater than $40,000 annually.

CHAPTER IV

TRAVEL COST MODEL

Conceptual Framework

As a non-commercial, state managed fishery for which a yearly trout stamp but no unique entry fee, is required, the lower Illinois River (LIR) trout fishery represents the epitome of a non-market good. In other words, there are certain characteristics that are not traded in the market, i.e. recreation, wildlife, scenic views, etc.. Because certain amenities or goods are not priced, it does not mean that they do not posses a value. The question is how do we assign a value to these commodities?

The LIR provides benefits to users and non-users, the benefits can be marketable benefits such as water inputs into production of power as well as non-marketed benefits such as aesthetic value, social value, and environmental value. The total economic value of the LIR or any non-market good consists of two components, a use value and a non-use value. The non-use value includes existence value, bequest value and option value (Freeman, 2003). Existence value refers to the value an individual may be willing to pay for a resource independent of its actual use or any potential future use. Existence value also includes a bequest value, which can be seen as a value to an individual of knowing that a natural resource exists so that future generations can use it, in other words 'a gift value' The use value of a good includes both option value and use value. First, option value is the money people are willing to pay for the resource to reserve the right to have the option to use it in the future. Finally although use values of goods such as fish for food consumption have an obvious market value, an additional use value of concern in the Lower Illinois River is the non-marketable good aspect, i.e., the recreational value of using the total resource in its current state.

For the purpose of this study, the ODWC is interested in the recreational use value for fishing only, which is a subset of the total economic value of the site. The recreational use value of this resource is the summation of the willingness-to-pay (WTP) for the natural resource, which is the total area under the aggregate compensated demand curve. The first step for this analysis is to estimate an individual demand equation. Individuals incur different travel expenses to visit a recreation site. Different individuals also make the decision to travel to a site several times per year according to their travel costs, time availability, and recreational quality perceived for each trip. This allows us to estimate an individual travel cost demand function.

The use value in theory should be the area under the individual compensated demand curve, but because this compensated demand curve is not observable, by convention the ordinary demand curve is used for valuation purposes (Freeman, 2003). Willig (1976) has shown that the ordinary demand equation gives a very close approximation of the true welfare measure if the income effect is small (which is the case in recreational expenditures). The individual demand function for visits comes from maximizing a consumer's utility function subject to his or her budget constraint and a time constraint.

In this study we use a single-site model because there are few substitutes for this activity. The only relatively comparable site, the Mountain Fork River trout fishery, is located in the south-east corner of the state of Oklahoma. In our sample, the percentage that would only fish for trout is 29.6% at another location if they could have not taken the trip to the LIR.

The *quantity demanded* is the number of trips (recreation days) taken per person to a recreation site per season (year) and the *price* is the travel cost incurred in reaching the recreational site (Parson, 2003). This yields a conventional downward sloping demand curve where trips decline with an increase in distance. Usually other factors such as: income, age, experience in the recreation activity affect individuals' demand as well as the trip cost. The simplest form of a single site can be represented as

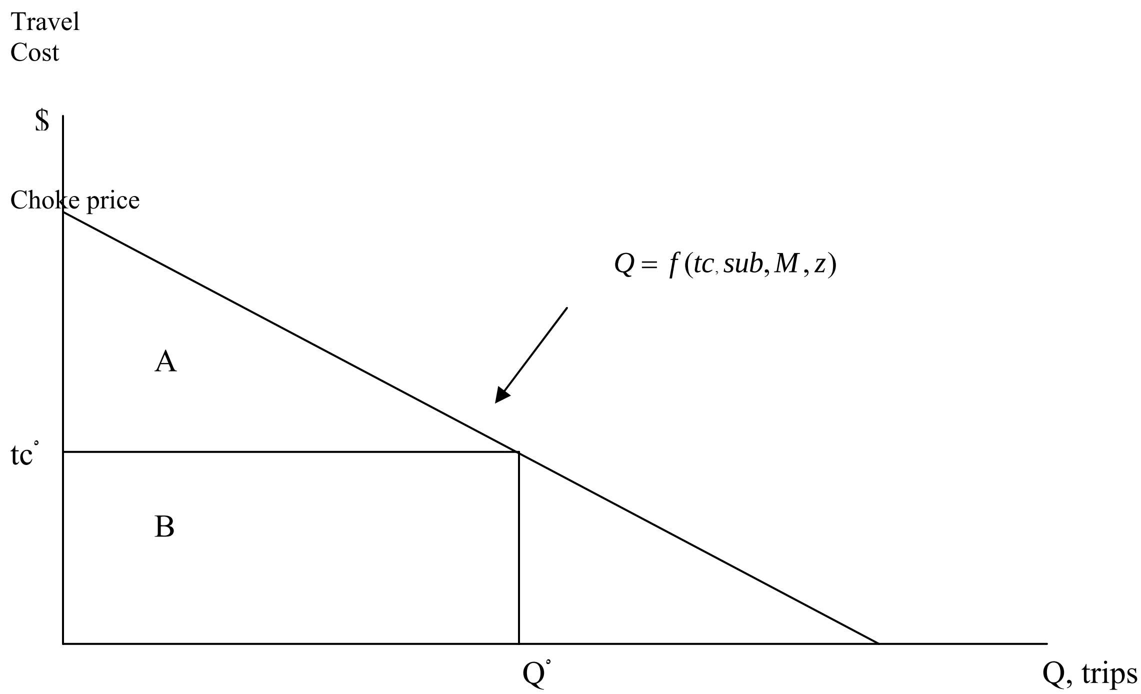
(4.1) $$Q = f(P^*)$$

where *Q* is the number of trips per person per year to a site as a function on the trip price *P** to reach the recreational site (also known as the travel cost). If we include income, substitute prices and other demographic variables our equation would become

(4.2) $$Q = \beta_1 tc + \beta_2 Sub + \beta_3 M + \beta_4 z$$

where the β represents the coefficients to be estimated; tc is the travel cost to the site; *sub* the travel cost to go to a substitute site; *M* represents income and *z* other demographic variables; Q represents the number of trips per person per season. Figure IV-1 shows a linear version of the equation and area A is the consumer surplus, area B is the travel cost incurred to visit the site by an individual taking *Q* trips at a cost of *tc* per trip.

Figure IV-1. Demand Curve for a Single-site Model



Later in this chapter, a formal way of how to estimate consumer surplus will be presented when we discuss welfare measures. The choke price is the price at which individuals cease to demand recreational trips because the price is too high.

Steps in Estimation

According to George Parson 2003 (Chap. 9, 'A Primer on Non Market Valuation'), the steps in estimation for a TC are presented in Table IV.1.

Table IV-1. Steps in Estimating a Single-site Model

Step 1	Define the Site to be Valued
Step 2	Define the Recreation Uses and the Season
Step 3	Develop a Sampling Strategy
Step 4	Specify the Model
Step 5	Decide on the Treatment of Multiple Purpose Trips
Step 6	Design and Implement the Survey
Step 7	Measure Trip Cost
Step 8	Estimate the Model
Step 9	Calculate Access Value

Define the Site to be Valued

The site to be valued is a stocked trout fishery located on a river segment consisting of 7.75 miles along the Lower Illinois River. There are five sites along the river where individuals can trout fish and all the access points are taken into account in this study.

Define the Recreation Uses and the Season

There are multiple recreational uses of the Lower Illinois River such as: fishing, swimming, floating, camping, canoeing; but for this study the focus will be on the trout fishing aspect. The estimated demand function is for the fishing activity only with an additional specification, a demand shifter for multiple activity trips, to test if anglers are different from those who do multiple activities. Sometimes people engage in different activities while at the recreational site. For that reason, at the beginning of the on-site interview there was a question to identify if fishing was the primary reason for the trip. Later in the survey another question was asked regarding recreational activities performed while on the fishing trip. If individuals performed other recreational activities they were separated into another group of multipurpose users of the LIR, apart from the fishing-only group. A model is estimated which accounts for this heterogeneity in the sample group (Parson and Wilson, 1997). Now that we have separated the single purpose users of the LIR (anglers) from the multiple purpose users, we can test the difference between consumer surpluses among both groups. Our null hypothesis is that the traditional TCM-consumer surplus will be the same as the TCM-consumer surplus estimates using distinction between multiple purpose trips. In order to test this hypothesis we need confidence intervals of our estimates. The confidence intervals will be obtained following a Taylor series approximation as used by Englin and Shonkwiler (1995) and a simulation using a bootstrap method.

The fishing season is defined by a calendar year and access to the site is available 365 days a year, unless the water releases from the Tenkiller Dam make the sites inaccessible to fishing.

Develop a Sampling Strategy

According to Parson (2003) there are two main approaches to develop a sampling strategy: on-site and off-site sampling. In this case on-site sampling is used, because it is easier to intercept users at the site rather than using a random dial survey which requires a large sample. The drawback of on-site sampling is that only a small percentage of the population in Oklahoma has visited this site, therefore we are more likely to intercept more avid users of the site, and the methods for ascertaining total visitation per site are uncertain because we have only a random sample rather than a gate entry count.

On-site sampling has benefits but also there are several problems when developing an on-site sample. The segment of the population that does not visit the site is completely missing from the sample. We will not know if a non-user might be enticed to fish had there been a small change in price or quality of the recreation amenity. Furthermore a strategy has to be developed so that randomness is attained with the on-site sample such as choosing: random sampling days, random sampling sites, and different sampling times of the day (AM, PM) in order to maintain an unbiased sample. All of these random sampling methods were performed in this study. The common problems associated with on-site samples, according to Shaw (1988) are as follows:

i) Non-negative integers: The dependent variable, the number of trips taken, is a non-negative integer.

ii) Truncation: Only those people who have taken at least one trip are sampled, all other information regarding non-users is truncated from the sample.

iii) Endogenous stratification: Frequent users are more likely to be sampled than non-frequent users. It is called endogenous stratification because the anglers who are most avid essentially self-select to fish more often and thus are more likely to be sampled. Therefore, the number of trips taken by those sampled on-site is not the same as a truly random sample of anglers, thus the number of trips is endogenous or determined from within. All of these matters will be addressed in this study.

Specify the Model

Before the data is collected the investigator has to decide which variables to include in the model so that the survey instrument elicits this specific information. Some of the most common variables that are included in the TC model are:

family size, age, gender, occupation, education, experience in the recreational activity, clubs or environmental memberships, and other demographic variables (The survey instrument is included in Appendix C). Some of the variables used in our study and their respective expected sign are presented in the following table.

Table IV-2. Demand shifters and their expected signs

Variable name	Description	Expected effect on the number of trip taken
Hhsize	household size	negative
Age	anglers age	positive
Agesq	anglers age squared	negative
Gender	gender (1= males, 0 otherwise)	positive
Educ	Level of Education (1= B.S. or higher, 0 some college or less)	negative
Income	Income level ($)	positive/negative
Tc	Travel cost	negative
Occup	Anglers occupation	positive/negative
Tcsub	Travel cost to substitute sites	positive/negative

The expected income sign is positive because recreation is expected to be a normal good; travel cost to a substitute site can have both signs depending on the substitute site if it is a complement or a substitute of the site that we are interested in valuing; education is expected to have a negative sign because the more educated the individual, the higher the opportunity cost of time thus reducing the time spent fishing. In our case we expect trout angler's age to follow a quadratic pattern because as age increases the trips increase, reaches a maximum and then decreases.

Treatment of Multiple Purpose Trips

The focus of the study is on individuals whose sole purpose was to fish (specifically trout) at the Lower Illinois River; these trips are usually day trips. Over 26% of individuals from our total sample stated that their trip was a multiple purpose trip i.e. swimming, floating, camping, fishing, and hiking, so multiple purpose trips were treated differently. If the whole data set were comprised of anglers only, it would be very common approach to assume that all trips are single purpose. Another common approach is to drop multiple purpose trips from the analysis because of the complication of identifying the marginal cost spent on the fishing activity only as well as the marginal cost spent in other activities on the same trip. Another way to deal with this problem is to report only single purpose trips which are destined only for fishing (Parson, and Wilson 1997; Parson, 2003).

For the treatment of multiple purpose trips, this study follows the methodology of Parson and Wilson (1997) and Loomis (2006), which modified the model for multiple destination trips and multiple purpose trips. The inclusion of an intercept shifter and a slope shifter is expected to catch the average shift in recreation demand between the groups of single purpose visits and multiple purpose visits using the pooled data set. Significance in the intercept shifter indicates that the intercept for the two types of recreators is different. If the sign is positive, it means that multiple purpose visits work as complements for the single fishing group (Loomis, 2006). If there is significance in the slope shifter, this indicates that the measures of consumer surplus are different between both groups. We can test the hypothesis of whether the consumer surplus for the two groups is equal, i.e., $CS_{\text{single-purpose}} = CS_{\text{multiple-purpose}}$ and estimate confidence intervals for these measures of welfare.

Design and Implementation of the Survey

Dr. Tracy Boyer from Oklahoma State University designed the survey instrument and students from Northeastern University in Tahlequah, OK implemented the survey. The survey was conducted throughout the year 2004, and 68 different days were selected at random to conduct the survey—68 creel days were actually completed and of those days, only 49 had usable interviews for the travel cost survey. Car count data and information for the full 68 days was used for visitation estimates. A pilot survey was conducted in November of 2003.

During the actual 2004 survey, all anglers present at each site during an hour long survey period on the "bus-stop" rotation of sites were intercepted and asked questions about the fishing experience on this trip to the LIR. Also on this initial contact they were shown a set of questions about hypothetical management (creel survey) (see the on-site creel survey in Appendix B). Anglers intercepted on site were asked if they were willing to complete a more extensive telephone survey within a month of the initial contact. The on-site survey was done in conjunction with students of Northeastern State University in Tahlequah, Oklahoma. It consisted of general questions about the fishing experience like: trout catch, fishing time, travel time, a rating of the trout fishing experience (Likert scale), and total dollars spent on the fishing trip. As mentioned earlier, the total number of surveys collected was 226 throughout 2004. Because some surveys had incomplete information (item non-response), were missing key information, did not provide a current phone number for follow-up, refusal to participate, potentially inaccurate responses, such as an excessive number of trips to the LIR per year (>100 trips), they were not in the final data analysis. In the formal estimates, only 191 completed surveys were used in the travel cost model (TCM). These surveys were collected during 68 different days of 2004 but only 49 days were in the usable sample because of non-response or lack of interviewable anglers on some days. Sampled days including weekdays and weekends randomly selected throughout the year. Only 191 surveys were used to estimate the TC model because surveys where the respondent did not answer key information such as the number of trips, income to determine the opportunity cost of time, or the distance traveled to the recreation site were eliminated. Observations with missing other key data included in the model were also deleted from the sample. Individual observations who reported over 100 fishing trips per year to the LIR trout fishery were eliminated from the sample because of the excessive reported number of recreational trips (a total of 4 observations).

The telephone interview was designed to obtain complete information to conduct a travel cost estimate, specifically expenditures to conduct a fishing trip, such as how much money was spent on lodging, fishing, transportation, food, etc. Another goal of the telephone interview was to get information that to estimate the opportunity cost of time of the angler. Sets of questions about a hypothetical increase in hourly wages were asked and the respondents were asked whether they would forgo a fishing trip to obtain extra overtime earnings. Because the overtime value was set at five levels $4, $5, $6, $7, and

$9, respondents did not choose to take the bid and most of them decided to go fishing rather than to work. From the total sample of 226 individuals, 50 decided to take the bid (which represents 22% of our sample) despite the fact that the bid amount was set at a low hourly wage rate. We could estimate a lower bound on the opportunity cost of time with this sub-sample despite the majority of individuals' value of recreation time is more than $9/hr.

Measuring Trip Cost

The total trip cost variable (TC) includes monetary cost to travel to the site plus the opportunity cost of time. The opportunity cost of time was obtained by dividing distance traveled (round trip) by an average speed of 50 miles/hour and multiplying this value by a third of the hourly wage rate (annual earnings divided by 2000 hours), assuming the person works 40 hours a week for 50 weeks per year. Travel cost (tc) was estimated for the ith person by multiplying the one way distance to the site in miles (Miles) by two to account for the round trip which is then by a per mile cost of 37.5 cents per mile (IRS cost per mile estimate for 2004). This cost is the rate set for taxpayers using their personal vehicles for business.

$$(4.3)\quad tc_i = [(Miles \times 2 \times 0.375) + (\frac{Income}{2000})(\frac{Miles \times 2}{50})(\frac{1}{3})]$$

where *miles* is the number of miles traveled from home to the recreation site; *Income* is the annual income divided by 2000 which is the number of hours worked by an individual per year (40 weeks times 50 weeks per year).

Two other models were estimated using different estimates for travel cost to illustrate the sensitivity of the welfare measures, they were the reported on-site travel cost

(TCOST) and the reported travel cost (TELCOST) from the telephone survey. Three different models were estimated using these three travel cost variables separately. The second variable, TCOST, is the total expenditure reported by the angler during the on-site interview when anglers were not prompted to break the costs down by category but to give a rough estimate of total trip costs and this was used for model 2. The third travel cost variable, TELCOST, includes total travel expenses for the round trip as reported by the individuals in the phone survey after they returned from the trip. Expenses covered included expenses such as: transportation cost, purchased items (bait, tackle), and purchased services (fishing guides).

Theoretical and empirical issues regarding modeling

Because of the nature of the dependent variable (Number of trips), count models are used to estimate the demand function, in this study two functional forms will be used: Poisson and Negative Binomial. In the following section, the Poisson process is explained, as well as the procedure to estimate welfare measure

The Poisson Model

Following Haab and McConnell (2002), the Poisson probability of observing an individual take *y* trips in a season is given by the function

(4.4) $$\Pr(y_i = y) = \frac{\exp(-\lambda_i)\lambda_i^y}{y!} \quad , \quad y = 0,1,2,3,...$$

Using the Poisson distribution the parameter λ_i is both the mean and the variance of the distribution. Sometimes this assumption of equal mean and variance of trips is too restrictive, so a negative binomial distribution is selected to relax this assumption.

Because it is necessary that λ_i be greater than zero, it is common to specify the exponential function:

(4.5) $$\lambda_i = \exp(\mathbf{X}_i \boldsymbol{\beta})$$

When using proc Genmod in SAS 9.1 (2003), this is called the link function which can be represented as a log linear relationship. We can obtain the likelihood function in terms of the parameters β . We observe the individual trips and then use the PDF of the Poisson distribution to write the probability of observing that number of trips. The sample likelihood function becomes

(4.6) $$L(\boldsymbol{\beta} \mid \mathbf{x}, \mathbf{y}) = \prod_{i=1}^{T} \frac{\exp(-\exp(\mathbf{X}_i \boldsymbol{\beta})) \exp((\mathbf{X}_i \boldsymbol{\beta}) y_i)}{y_i!}$$

and the log likelihood function is

(4.7) $$\ln(L(\boldsymbol{\beta} \mid \mathbf{x}, \mathbf{y})) = \sum_{i=1}^{T} [-e^{x_i \beta} + \mathbf{X}_i \boldsymbol{\beta} y_i - \ln(y_i)!]$$

Welfare Measurement in the Poisson Model

The Poisson distribution model can be used to calculate the willingness to pay for use value of visiting a site by calculating monetary value of the area under the expected demand function. All the derivations are based on the expected demand function

(4.8) $$E(y_i) = \lambda_i$$

The total value of the site is the area under the demand curve, keeping in mind that for an exponential function the choke price is infinite (*C**). Having this in mind, consider the demand specification

(4.9) $$y_i = e^{\beta_o + \beta_i C}$$

where C is the travel cost and $y_i > 0$. If we set C^0 as the current travel cost, consumer surplus for use value is

(4.10) $$WTP = \int_{C^0}^{\infty} e^{\beta_0+\beta_1 C}\, dC = \left[\frac{e^{\beta_0+\beta_1 C}}{\beta_1} \right]_{C=C^0}^{C \to \infty} = -\frac{y}{\beta_1}$$

For this expression for sample mean WTP, instead of y, one can also use the mean of observed trips ($\overline{y}$) or mean of the expected trips because the means are identical, this property is called the mean fitting property of the Poisson distribution (Haab and McConnell, 2002).

<u>The Negative Binomial Model</u>

The Poisson distribution model has its disadvantages because it is subject to potential misspecification of the assumption that the conditional mean of the number of trips (y) and variance are equal:

(4.11) $$E(y_i | x_i\beta) = V(y_i | x_i\beta) = \lambda_i$$

For recreational cases it is common to find that the variance in the number of trips is greater than the mean, implying overdispersion (Haab and McConnell, 2002). In cases of overdispersion, the standard errors are underestimated, often causing us to reject often the null hypotheses of no association between the dependent variable and the explanatory variable (Haab and McConnell, 2002).

Many versions of the binomial model exist. The following notation follows Cameron and Trivedi (1986), which uses a compound Poisson model. A compound

Poisson model has a gamma distributed error term in the mean. The log of the conditional mean is expressed as

(4.12) $$\log(E(y_i)) = x_i\beta + \omega_i$$

where ω_i represents the unobserved individual differences (unobserved heterogeneity). In other words, this variation could come from any omitted exogenous variables represented as an error term. This means that the model now can account for systematic and random variations in the mean across individuals. The new probability for a Poisson random variable to obtain the distribution for trips conditional on ω_i is:

(4.13) $$\Pr(y_i \mid \omega_i) = \frac{\exp(-\exp(x_i\beta + \omega_i))\exp(x_i\beta + \omega_i)y_i}{y_i!}$$

If $\exp(\omega_i) = v_i$ has a normalized gamma distribution, with $E(v_i) = 1$, then the density of v_i will be given by

(4.14) $$h(v_i) = \frac{\alpha^{\alpha}}{\Gamma(\alpha)}\exp(-\alpha v)v^{\alpha-1}$$

The unconditional probability function for the number of trips y_i is found by integrating out the error v. The resulting probability function is the negative binomial (Haab and McConnell, 2002).

(4.15) $$\Pr(y_i) = \frac{\Gamma(y_i + \frac{1}{\alpha})}{\Gamma(y_i+1)\Gamma(\frac{1}{\alpha})}\left(\frac{\frac{1}{\alpha}}{\frac{1}{\alpha}+\lambda_i}\right)^{\frac{1}{\alpha}}\left(\frac{\lambda_i}{\frac{1}{\alpha}+\lambda_i}\right)^{y_i}$$

where $\lambda_i = \exp(\mathbf{x}_i\beta)$. The mean is now

$E(y_i) = \lambda_i = \exp(\mathbf{x}_i\beta)$ and the variance is $Var(y_i) = \lambda_i(1 + \alpha\lambda_i)$

The parameter α can now be interpreted as the overdispersion parameter. If $\alpha = 0$ no overdispersion exists and the negative binomial collapses to the Poisson distribution in the limit as shown.

$$(4.16) \quad \lim_{\alpha \to \infty} \Pr(y_i) = \frac{\Gamma(y_i + \frac{1}{\alpha})}{\Gamma(y_i + 1)\Gamma(\frac{1}{\alpha})} \left(\frac{\frac{1}{\alpha}}{\frac{1}{\alpha} + \lambda_i} \right)^{\frac{1}{\alpha}} \left(\frac{\lambda_i}{\frac{1}{\alpha} + \lambda_i} \right)^{y_i} = \frac{e^{-\lambda} \lambda^{y}}{y!}$$

The parameter $\alpha = 0$ can now be used as a test for both as a test for both overdispersion and a test of negative binomial against the null hypothesis of a Poisson (Haab and McConnell, 2002).

Models for On-Site Sampling

Truncation

With an on-site sample we can only observe a positive number of trips $y_i > 0$. The demand for these individuals will have a truncated error, or truncated demands. By truncated we mean that the values of the variable of interest (Y) below a certain value (y_L) will be truncated and the distribution of the observed count is restricted (in this study it is left truncation or truncation from below). In our case, the zeros of the Poisson distribution are not observed. Consider a simple general demand function and $g(y_i)$ is the probability density function for trips. The probability that an individual will have positive trips is $\Pr[y_i > 0]$. The conditional density function for individuals with positive trips becomes

$$(4.17) \qquad g(y_i | y_i > 0) = \frac{g(y_i)}{\Pr[y_i > 0]}, \text{ for } y_i > 0$$

Endogenous Stratification

If the sample is drawn from an on-site survey, we have a problem of avidity bias, whereby the anglers are endogenously stratified according to the number of trips per year. Individuals who use the site more often have a higher chance of being selected to complete the survey. In other words if an angler visits the site 10 times per year, he is 10 times more likely to be sampled than a person who only goes once a year. The basic analysis to correct for this endogenous stratification is done by Shaw (1988).

Consider for simplicity a homogeneous population where N_y represents the number in the population taking y trips: $y \in \{0, 1, 2, ...\}$. Let N be the population of users. The population proportion of individuals taking y individual trips is N_y / N. The on-site sample proportion of individuals taking y trips $h(y)$, will be (Haab and McConnell, 2002)

(4.18) $$h(y) = \frac{yN_y}{\sum_{t=1}^{\infty} tN_t}$$

where the numerator is the total trips taken by individuals taking y trips, and the denominator is the total trips taken by the full population. For the population, the expected number of trips for a randomly drawn individual will be

(4.19) $$E_p(y) = \sum_{y=0}^{\infty} yP_y$$

where P_y is the population portion of individuals taking y trips.

Because the on-site interviewing process is more likely to intercept avid anglers, the sample average number of trips will be higher than the population mean.

To correct the likelihood function we need to account for this overdispersion of recreationists. The relationship between the samples observed proportion of individuals taking each quantity of trips *h(y)* and the population number of individuals taking these trips is presented in the next equation. Dividing the numerator and denominator by the total number of individuals in the population *(N)* gives us

$$(4.20) \qquad h(y) = \frac{y(N_y/N)}{\sum_{t=1}^{\infty} t(N_t/N)} = \frac{yP_y}{\sum_{t=1}^{\infty} tP_y}$$

Because the population proportions (P_y) are not known, the number of trips taken by an individual in the population can be expressed as a discrete random variable with a probability function:

$$(4.21) \qquad \Pr(trips = y) = g(y) \ , y \in \{0,1,2,3,\ldots\}$$

P_y can be expressed as $P_y = g(y)$ substituting this into the previous equation gives us the sample probability of observing *y* trips as a function the population probability

$$(4.22) \qquad h(j) = \frac{jg(j)}{\sum_{t=1}^{\infty} tg(t)}$$

Noting that for a non-negative integer valued random variable (y)

$$(4.23) \qquad \sum_{t=1}^{\infty} tg(t) = \sum_{y=1}^{\infty} tg(t) = E(y) \ ,$$

we can write the probability of observing *j* trips from an individual in an on-site sample as (Haab and McConnell, 2002):

$$h(j) = \frac{jg(j)}{E_p(y)} \tag{4.24}$$

This equation accounts for truncation present in an on-site sample. If we consider the population of users, this will be truncated at zero, because no zero trips are observed. The probability of observing an individual drawn at random from the population is

$$\Pr(trips = y \mid trips > 0) = g(y \mid y > 0) \tag{4.25}$$

$$= \frac{g(y)}{\Pr(y > 0)},$$

$$y \in \{0, 1, 2, 3, \ldots\}$$

Furthermore the probability of observing *y* trips in an endogenously stratified truncated sample becomes

$$h(j \mid y > 0) = \frac{j\dfrac{g(j)}{\Pr(y > 0)}}{\sum_{t=1}^{\infty} t\dfrac{g(t)}{\Pr(y > 0)}} = \frac{jg(j)}{\sum_{t=1}^{\infty} tg(t)} = h(j). \tag{4.26}$$

The final step is to incorporate the individual effects into the model. Let the individual-specific distribution of trips for an individual drawn from the population be $g(y \mid \mathbf{x}_i, \omega)$ and the probability of observing a given individual drawn from an on-site sample taking *j* trips is

$$h(j \mid \mathbf{x}_i) = \frac{jg(j \mid \mathbf{x}_i, \omega)}{E_p(y_i)} \tag{4.27}$$

(Haab and McConnell, 2002)

The Poisson Model

For the Poisson model $g(y_i) = \frac{e^{-\lambda}\lambda_i^{yi}}{y_i!}$ with $E_p(y_i) = \lambda_i$. The truncated and endogenously stratified Poisson probability is

(4.28) $$f(Y_i = y_i \mid Y_i > 0) = \frac{\exp(-\lambda_i)\lambda_i^{yi-1}}{(y_i - 1)!}$$

To estimate marginal effects and half elasticities we use the following estimation (Haab and McConnell, 2002). The marginal effects are defined as

(4.29) $$\frac{\partial E(y|\mathbf{X})}{\partial x_i} = \beta_i \exp(\mathbf{x}\boldsymbol{\beta});$$

in other words the marginal effect of an independent variable is the derivative of the prediction function. Note that the marginal effects vary with the level of the independent variables and most times they are evaluated at the sample mean. Marginal effect is the average change in predicted trips due to an infinitely small change in the covariate. Suppose that a marginal effect of *x* is *m*, and then a 1 unit increase in *x* is associated with an *m* x 100 percent increase in the expected trips to the LIR (Lusk, 2006). The half elasticity, which is a one unit change in the covariate, is represented as

(4.30) $$\frac{\partial E(y|\mathbf{X})}{\partial x_i} \frac{1}{\partial E(y|\mathbf{X})} = \beta_i .$$

The next step is to estimate our model. The parameter λ is the expected number of trips and is assumed to be a function of the following variables

(4.31) $$\ln(\lambda) = \beta_1 + \beta_{tc}(TC) + \beta_3(AGE) + \beta_4(AGESQ) + \beta_5(M) + \beta_6(HH) +$$
$$\beta_7(educ) + \beta_8(gender) + \beta_9(Mult) + \beta_{dtc}(Mult*TC) + \beta_{11}(subsite) +$$
$$+\beta_{12}(Dsalary)$$

substituting the above expression into the truncated and endogenously stratified Poisson probability density, gives us an expression of observing an individual taking *y* trips as a function of: *TC* which represents trip cost, which is the opportunity cost of time added to the total travel expenses to get to the site. *AGE* represents the individual's age in years; *AGESQ* represents the individual's age squared; *M* represents annual income; and *HH* represents the number of persons in the household. The variable, *educ* represents a dummy variable of 1 if the individual has completed a B.S. or above, 0 for some college, high school or less than high school. The *gender* variable takes a value of 1 if the individual is a male, 0 otherwise. The variable *Mult* is an indicator variable takes a value of 1 if the recreation trip was not specifically for fishing trout and if the individual engaged in other recreational activities such as: camping, hiking, rafting, and 0 if the individual trip was specifically taken only for trout fishing; *Mult*TC* is the interaction term between the indicator variable for multiple purpose trips and the travel cost. The variable *subsite* represents a proxy variable for the price of substitute sites, in this case is the miles to travel to a substitute site the Mountain Fork River trout fishery. The variable *Dsalary* equal to 1 if the individual has a salary based job, 0 if otherwise.

The previous model has an intercept shifter (*Mult*) and an interaction term if the trip is for multiple purposes or if the individual takes part in several activity trips (*Mult*TC*). The idea is to capture the shift in demand for multi-activity trips (Parson and Wilson, 1997). If the slope coefficient and/or interaction prove significant, it means that the consumer surplus of the two groups of recreationists is different. The consumer surplus for single use trips (fishing trips) is $\left|\frac{1}{\beta_{tc}}\right|$, on the other hand the consumer surplus for multiple use trips is $\left|\frac{1}{\beta_{tc}+\beta_{dtc}}\right|$ (Loomis,2006). One of the objectives of segregating the sample into two different groups is to verify if there is a statistical difference between the welfare estimates for the two distinct groups. In order to hypothesize this we need standard errors of the consumer surplus measure. In order to do this we will follow the recommendation used in Englin and Shonkwiler, (1995) of using a second-order Taylor series approximation to obtain the variance of the welfare measure. This is done by using

$$(4.32) \qquad Var\left(\frac{1}{\beta_{tc}}\right)=\frac{\gamma^2}{\beta^4{}_{tc}}+2\frac{\gamma^4}{\beta^6{}_{tc}}$$

where γ represents the standard error of β_{tc}. In order to obtain $Var(1/\beta_{tc}+1/\beta_{dtc})$ we used the following property

$$(4.33) \qquad Var\left(\frac{1}{\beta_{tc}}+\frac{1}{\beta_{dtc}}\right)=Var\left(\frac{1}{\beta_{tc}}\right)+Var\left(\frac{1}{\beta_{dtc}}\right)+2\operatorname{cov}\left(\frac{1}{\beta_{tc}},\frac{1}{\beta_{dtc}}\right)$$

Another way to estimate confidence intervals of the welfare estimation is to use parametric bootstrap

Parametric bootstrap

Once we have estimated the parameter estimates, it is necessary to get confidence intervals for our welfare measures. The confidence intervals will be estimated using the parametric bootstrap method. This statistical method is a simulation method used to validate the parameter estimates, the elasticities, and the marginal effect of each regressor on the decision to take a trip to the LIR. We replicated the parameter estimates with 10,000 bootstrap simulations. The parametric bootstrap was done by defining the data generating process, generating random deviates using Cholesky's decomposition, estimating the simulated parameters, and finally ordering them to obtain confidence intervals. These confidence intervals will be used to compare them with the confidence intervals obtained using the Taylor series approximation (Englin and Shonkwiler, 1995).

Results

Table IV-1 shows the descriptive statistics of the variables used in the equations. Using the sub-sample out of the on-site surveys of for the travel cost estimation (n= 191), the mean travel cost was $257.38 per trip per group with a mean of 12.77 trips per year. This number is different from the 15 trips per year estimated in the previous section because individuals who took more than 100 trips to the LIR were eliminated from this sub-sample. They were eliminated from the sample because some anglers stated that they travel to the site between 100-215 times per year they represents the extreme end on the distribution of angling frequency. This means that on average they go more than 10 times per month to fish to the LIR trout fishery. Regarding the distance traveled, 88.81 miles were traveled on average per trip to reach the LIR; 41% of the anglers completed at least a college degree; 89% of the anglers were male with an average annual income of $50,088; the average household consisted of 2.84 members; the average miles to travel to the closest substitute site is approximately 206 miles; 29% of the visitors have a job which is salary based, rather than an hourly wage; and 21% of the visitors were categorized as taking a multipurpose trip to the LIR.

Table IV-3. Summary statistic of the variables used in the study

	All Data		Single-purpose trip		Multiple purpose trip	
Variable	**Mean (n=194)**	**Standard Deviation**	**Mean (n=151)**	**Standard Deviation**	**Mean (n=43)**	**Standard Deviation**
Trips	12.76	17.84	14.28	19.23	6.1	9.42
Miles	88.81	80.16	86.87	86.12	96.16	51.36
TC	257.38	572.13	272.49	641.77	204.31	171.79
Tcost-onsite	96.16	137.68	75.66	122.55	171.11	162.79
TCost-telephone	56.29	65.98	48.55	54.83	87.11	93.38
Mult	0.21	0.41	n/a	n/a	n/a	n/a
Mult*Trip Cost	40.11	110.92	n/a	n/a	n/a	n/a
Education	0.41	0.49	0.38	0.49	0.48	0.51
Gender	0.89	0.31	0.89	0.32	0.91	0.28
miles substitute site	205.84	63.19	203.84	69.54	213.49	27.08
Salary	0.29	0.46	0.24	0.43	0.45	0.51
Age	48.31	14.05	48.74	14.59	46.63	11.75
Agesq	2530.28	1394.71	2588.33	1455.94	2309.46	1118.26
Income ($1000)	50.0876	47.0824	51.88	52.09	43.74	21.01
Household size	2.8	1.21	2.81	1.21	2.99	1.16

Table IV-3 show summary statistics of the variables used in the study. Note than the mean number of trips differs greatly between the single-purpose group (anglers) and the multi-purpose group. For single purpose groups they take an average of 14.28 trips per person per year, compared with 6.1 trips per year for the multiple purpose group. Note also that there is diference between travel cost expenses and difference also between yearly incomes. Finally there are 45% of individuals in the multi-purpose group that have a salary based job versus 29% that have salary based jobs in the angler-only group. Table IV-4 below shows the correlation matrix of independent variables, note than income is slightly correlated with education as we would expect, and income is correlated with the travel cost variable (0.4).

Table IV-4. Correlation Matrix of Independent Variables for the Travel Cost Model

	Age	Age sqrd	Educ	Gender	TC	Substitute site	Income	HH size	Salary
Age	1.00	0.99	0.08	-0.11	0.03	-0.10	0.09	-0.32	-0.16
Age squared	0.99	1.00	0.06	-0.11	0.01	-0.09	0.06	-0.35	-0.19
Education	0.08	0.06	1.00	-0.04	0.09	0.10	0.15	0.03	0.27
Gender	-0.11	-0.11	-0.04	1.00	0.02	0.10	-0.01	0.05	0.03
TC (Travel Cost)	0.03	0.01	0.09	0.02	1.00	0.46	0.40	0.04	0.05
Substitute site	-0.10	-0.09	0.10	0.10	0.46	1.00	-0.02	0.13	0.04
Income	0.09	0.06	0.15	-0.01	0.40	-0.02	1.00	0.10	0.14
Household size	-0.32	-0.35	0.03	0.05	0.04	0.13	0.10	1.00	0.08
Salary	-0.16	-0.19	0.27	0.03	0.05	0.04	0.14	0.08	1.00
N	221	221	221	222	194	222	194	222	222

Tables IV-5, IV-6, and IV-7 show the results of the travel cost estimations using negative binomial count regression models using the estimated TC variable, TCOST variable, and TELCOST variable. The TCOST variable was measured as the total expenses reported by the respondent during the on-site interview, and the TELCOST variable is the reported expenses collected on the telephone survey. The models from now on will be called **model 1** for the TC variable obtained in the classical travel cost method, **model 2** for the model estimated using the TCOST variable, and **model 3** for the reported TELCOST variable.

As we expected the cost of the trip in all models is negatively related with the number of trips (the demand is downward sloping) but not always significant. Income has a positive effect on the number of trips but in two of the models the income variable is not significant (model 2 and 3). Age has a quadratic effect on the number of trips for the negative binomial models. This indicates that the number of trips decreases as the age increases, then it reaches a minimum and as age increases the number of trips increases again. This result is as we expect because of the high proportion of retired anglers in the study. In model 1 and model 3 (Table IV-5 and Table IV-7 respectively), the age variable was not significant, except in model 2. Household size has a negative effect on the number of trips in all models, but it was not significant in all three regressions.

Table IV-5. Results of the Negative Binomial Regression for the number of trips to the LIR per year using TC (travel cost) variable including Marginal Effects (Model 1)

n=191

Variable	Parameter Coefficient	Std. Err.	Marginal Effect
Intercept	3.8434***	1.0908	
Trip Cost	-0.0019***	0.0005	-0.0168
Mult	-0.2117	0.3343	1.8778
*Mult*TC*	-0.0023*	0.0013	0.0204
Education	0.3299	0.2091	2.9262
Gender	-0.1951	0.3070	1.7306
Substitute site	0.0004	0.0018	0.0035
Salary	-0.4178*	0.2264	3.7059
Age	-0.0671	0.0430	-0.5952
Agesq	0.0009*	0.0005	0.0080
Income ($1000)	0.0096**	0.0038	0.0852
Household size	-0.1235	0.0867	-1.0955
Overdispersion	1.4325**		

Notes: Three asterisks denote that the coefficient is statistically significant at the 99% level; two denotes significance at 95%; and one significance at 90%.

Table IV-6. Results of the Negative Binomial Regression for the number of trips to the LIR per year using TCOST variable (obtained from on-site interview) and the Covariates Marginal Effects (Model 2)

n=191

Variable	Parameter Coefficient	Std. Err.	Marginal Effect
Intercept	5.1485***	1.1329	
TCost	-0.0012	0.0009	-0.01136
Mult	0.031	0.31	0.293359
*Mult*TCost*	-0.0055***	0.0019	-0.05205
Educ	0.2571	0.2127	2.432988
Gender	-0.1915	0.3127	-1.8122
Substitute site	-0.0029**	0.0014	-0.02744
Salary	-0.4006*	0.2329	-3.79096
Age	-0.0813*	0.0453	-0.76936
Agesq	0.001**	0.0005	0.009463
Income ($1000)	0.0012	0.0029	0.011356
Household size	-0.1299	0.0914	-1.22927
Dispersion	1.4954**	0.1683	

Notes: Three asterisks denote that the coefficient is statistically significant at the 99% level; two denotes significance at 95%; and one significance at 90%.

Table IV-7. Results of the Negative Binomial Regression for the number of trips to the LIR per year using TelCOST variable (Model 3) obtained from the Telephone Interview.

n=191

Variable	Parameter Coefficient	Std. Err.	Marginal Effect
Intercept	4.7774***	1.1217	
TelCost	-0.0013	0.0021	-0.0123
Mult	-0.1814	0.3337	-1.71662
*Mult*TelCost*	-0.0084*	0.0043	-0.07949
Educ	0.3117	0.2126	2.949678
Gender	-0.1351	0.3177	-1.27848
Substitute site	-0.003**	0.0015	-0.02839
Salary	-0.3935*	0.2268	-3.72377
Age	-0.0673	0.0442	-0.63687
Agesq	0.0008*	0.0005	0.007571
Income ($1000)	0.0008	0.0026	0.007571
Household size	-0.1087	0.0903	-1.02865
Dispersion	1.4935**	0.1685	

Notes: Three asterisks denote that the coefficient is statistically significant at the 99% level; two denotes significance at 95%; and one significance at 90%.

The parameter $\alpha = 0$, as mentioned earlier can now be used as a test for both overdispersion and a test of the null hypothesis that the negative binomial and poisson would yield the same parameters. The test for the dispersion parameter α indicates that overdispersion exists ($p< 0.05$). Therefore, the negative binomial is the correct model to use to account for the overdispersion in the variance in the number of trips taken in our sample.

Using the results from the models, we estimate the per trip consumer surplus for a trout fishing to be between \$79.18 (Model 1) and \$194.38 (Model 1) with a 90 percent confidence interval. Once we adjust the consumer surplus to a per-person-per-trip value using the estimated trip cost we get a mean consumer surplus of \$100.51 per person per recreation day in 2004 (Model 1) taking everyone in the sample as anglers only. If we take into account only single purpose trips (fishing trips) the estimated per person per recreation day consumer surplus is \$112.54, and for multiple purpose trips to the LIR an estimated per person per trip consumer surplus of \$32.19 (model 1). These large changes in consumer surplus are due to the characteristics and behavior of the group that take multi-activities while on the LIR. The average group size is bigger and the recreation days spent per trip is also greater than the fishing only group. The per-person per recreation day estimates are obtained by dividing the consumer surplus per trip by the mean group size (party size) divided by the mean recreation days spent on site. These results indicate that aggregating single purpose and multiple purpose trips actually decreases the CS estimate per trip. In our case more accurate estimates of anglers CS are obtained if we separate the users in these two groups of users.

If we use the reported on-site trip cost (TCOST) from Model 2 our consumer surplus per person per recreation day is $159.15 per average user for the Lower Illinois River trout fishery (all user aggregated). Finally in our last model the TELCOST variable was used, which also is a cost that was reported by the individual within a month of completing his trip to the LIR trout fishery. Our consumer surplus per person was $146.90 per person per trip using this reported trip cost (model 3 aggregating both groups). However, the parameter estimates for the travels costs in both Model 2 and Model 3 (TCOST and TELCOST) were statistically not significant, leading us to trust our consumer surplus estimates from Model 1 more because that parameter estimate as measured by distance and wage opportunity costs was significant at the 99% confidence level.

The following table (Table IV-8) shows the consumer surplus estimates from model 1 assuming that all individuals are anglers with the sole purpose of fishing and also consumer surplus estimate when there is a distinction among users of the LIR and taking into account multipurpose trips.

Table IV-8. Comparison of Net WTP per Person per Trip for All trips (Model 1)

Travel Cost Method	All Data	Single Purpose Trips	Multiple Purpose Trips
Mean WTP	$100.51	$112.54	$31.66
Taylor Series approximation			
Lower 90%CI	$77.15	$67.92	$26.74
Upper 90% CI	$143.87	$157.15	$79.37
Bootstrap Simulation			
Lower 90%CI	$70.73	$79.19	$20.81
Upper 90% CI	$173.51	$194.38	$70.19

Table IV-8 shows that the bootstrap confidence intervals are wider in range than the Taylor series approximation. By looking at the Taylor series approximation the confidence intervals from all the data pooled together is very similar to the confidence interval of the fishing only group (single purpose group). By confidence intervals we mean a range of values which is likely to include the true unknown population parameter. In this case the true population willingness to pay, is likely to fall within the given interval estimate obtained by the sample data set 90 percent of the time. Statistically there is no significant difference in the welfare estimates of individuals who take trips for the sole purpose of fishing and individuals from the pooled data set using both bootstrap confidence intervals and Taylor series approximation confidence intervals. With respect to the multiple-purpose group, which was the group that took part in other recreational activities other than fishing while at the LIR, their consumer surplus estimates are statistically different than the consumer surplus of the individuals that went to the LIR for fishing purposes only using the bootstraps confidence interval estimates. With respect to the Taylor series confidence intervals, the confidence intervals, overlap in the consumer surplus estimates occurred because of the wide range of welfare estimates from the multiple purpose group ($26.74, $79.37).

Table IV-9. Marginal effect including 90% Confidence Interval using 10,000 Bootstrap Samples (Model 1)

Variable	Marginal Effect	Bootstrap Marginal Effect	Bootstrap 90%lowerCI	Bootstrap 90%upperCI
Trip Cost	-0.01680	-0.01306	-0.03557	-0.00001
Dummy	1.87779	-1.36384	-4.12176	0.51384
D*Trip Cost	0.02040	-0.01584	-0.04172	0.00000
Education	2.92624	2.49417	-0.00067	6.36824
Gender	1.73055	-0.63793	-3.22292	0.61742
Substitute site	0.00355	0.00823	-0.00421	0.01965
Salary	3.70593	-0.17156	-1.54139	0.97048
Age	-0.59518	0.16296	-0.23941	0.02353
Agesq	0.00798	0.01011	0.00000	0.02382
Income ($1000)	0.08515	0.07369	0.00004	0.19102
Household size	-1.09546	0.46767	0.50937	1.25980

The effect of the travel cost variable expressed in half elasticity term for the TC model (Model 1) indicates that a $1 increase in travel costs causes a 0.13% reduction in the number of trips. For the individuals taking multipurpose trips a $1 increase in the travel cost causes a 0.97% reduction in the number of trips. Note that this is the half elasticity (Haab and McConnell, 2002) because the full elasticity is a function of the respective covariate

$$\frac{\partial \ln y}{\partial x} = \beta; \quad \frac{\partial \ln y}{\partial y} = \frac{1}{y}; \quad \frac{\partial y}{\partial x} \cdot \frac{x}{y} = \beta x \tag{4.31}$$

CHAPTER V

DISCRETE CHOICE MODEL

Conceptual Framework

The travel cost method allows us to estimate the recreational use value of the current resource by inferring that expenditures to fish at the site provide an estimate for individuals' willingness to pay for a resource, i.e., that trip costs are complementary or related to value. It gives us a snapshot of the current lower bound of willingness to pay for a trout fishing experience under current management scenarios. However, since we were not able to look at management differences for multiple trout sites, a single site travel cost model such as this cannot be used to estimate the value of changes to the site (a multiple site Random Utility Model (RUM) would). To account for this limitation of TCM, we used a hypothetical stated preference model (discrete choice experiment) to examine willingness to pay for management changes such as creation of a catch and release area or stocking of larger or bigger fish.

In this case the proposed management changes of environmental quality are limited only to the Lower Illinois River (LIR) and are limited to management problems completely under the control of the ODWC. To evaluate these attributes, an on-site survey was conducted. The first section of the survey asked for anglers' information regarding trip characteristics, trip expectations, and economic and demographic characteristics. The second section contained a choice experiment where stated preferences were used to evaluate the attributes of the LIR.

The choice experiment (CE) is another type of non-market valuation technique and its goal is to identify willingness to pay for each of the attributes of the LIR as well as to predict anglers' choice. It uses stated preference methodology and is an appropriate method for jointly measuring benefits generated by the multiple services the LIR provides. The use of the conjoint choice model will determine preferences for changes in the LIR trout fishery using surveys that pose hypothetical management scenarios.

In the choice experiment for the LIR, respondents were asked to compare three alternatives simultaneously and to select one option out of the three. The third alternative was always given as no change. The alternatives used in this study were described by different combinations of price, size of the stocked fish, quantity of stocked fish, and portions of the river designated as catch and release only or without areas for catch and release. The attributes used in this study were selected because of their importance to the trip and angling experience to the LIR, The attributes, as well as their respective levels, are presented in Table V-1. Only four attributes were selected to impact the recreational fish experience, one of which was price, so that the different attributes can be compared in monetary terms. The price was posed as a varied yearly increase in the price of the trout stamp and the price range was kept within reasonable price limits given by the ODWC. The range of prices was chosen to range from 'no change' to an $8/yr increase in the trout stamp, which is a realistic price change for a trout permit stamp.

Figure V-1. **Lower Illinois River Attributes and Levels in the Discrete Choice Survey**

LIR Attribute	Factor Levels
Portion of River as Catch and Release Only	0% 30%
Size of Stocked Rainbow Trout	No change (8-9 inches) Larger fish (10-12 inches)
Number of Rainbow Trout Stocked	No change 20% more
Increase in the yearly trout license fee	no change $2 $4 $6 $8

The attribute, "Portion of river as catch and release only," refers to designated areas along the LIR trout fishery that are selected only for catch and release. If ODWC were to create a catch and release area, this means that all anglers that fish trout would be required to return the trout to the river and release it. This allows for the trout to grow to a bigger size and makes it more challenging to fish in these areas because trout are more aware of their environment, thus requiring better fishing skills. The hypothetical change for this factor is from a 'no catch and release area' to a 30% of the river destined to catch and release. This attribute represents a key factor in the quality of fishing because it makes it more challenging to fish in the area, therefore greatly affecting anglers' decision to go to the LIR.

The next factor, "size of the stocked rainbow trout," has been recognized as a major attribute in the recreational experience. Again this attribute is self explanatory; the bigger the fish, the better. Currently the rainbow trout that are stocked in the LIR are between 8-9 inches in size, and it is a major concern for anglers who wish to catch bigger trout. The levels for this factor are two: no change in currently stocked trout size, and a larger fish that ranges from 10 to 12 inches.

The final attribute used in the study was “the number of rainbow trout stocked in the LIR”. This factor was determined by the ODWC to be very important in the fishing experience because it directly affects the catch rate per period of time, which is a major factor in the recreational fishing experience. Two levels were used in the study, a ‘no change level’ which represent the same number of fish currently stocked in the LIR, and a second level of 20% increase in the number of fish stocked.

The total number of possible unique scenarios obtained by combining all the attribute levels is $L^n = 2^3 \times 5^1 = 40$. It would be very tedious and infeasible for a respondent to evaluate so many choices on site. To simplify the experiment a fractional factorial design was used with main effects only, which consisted of 32 orthogonal comparisons of alternative management scenarios for the LIR. These were randomly blocked to sixteen different combinations, each with 2 choice sets. An example of a choice set is shown in Figure V-2.

Figure V-2. Sample Choice Experiment Question

Below you will find two management scenarios being considered to improve the lower Illinois River trout area. Please consider among options A, B, and C.

	Option A	Option B	Option C
Catch and Release	30% of Trout area made Catch & Release	30% of Trout area made Catch & Release	NO CHANGE: Neither A or B is preferred I would rather keep the management of the L. Illinois trout area the way it is today than pay any increase in the trout license.
Size of Stocked Rainbow Trout	Same as now (8-9 inches)	10-12 inch fish (25% larger than now)	
Numbers of Rainbow Trout	20% more fish which could increase fish reeled in per trip	No change in numbers of stocked fish	
Increase in the yearly trout license fee	$1	$2	

I would choose (check only one) ☐ A ☐ B ☐ C (no change)

The responses to these scenario questions were analyzed using a conditional logit model explained in the next section of the paper. The random utility framework was used to accomplish this objective of estimating the value of a recreational site and the benefits of changes in characteristics. Following Train (2003), let the utility of an individual i for trout fishing scenario j be represented as U_{ij}. The individual will pick the scenario that maximizes the value of his utility. The behavioral response can be indicated as:

(5.1) if $U_{ij} > U_{ik}$

the individual will choose alternative j over k only if (5.1) holds $\forall j \neq k$.

The individual will obtain a certain utility for each decision he/she makes and this utility is known to the individual but not known to the researcher. The researcher only observes part of the individual's utility denoted as V_{ij}, the unobservable portion of the utility that is unknown to the researcher is denoted as ε_{ij}. Utility can be represented as

$$U_{ij} = V_{ij} + \varepsilon_{ij} \tag{5.2}$$

Given that utility is a function of observable attributes V_{ij} can be expressed as a grouping of fishing attributes

$$V_{ij} = \beta_j + \beta_1(R_{ij}) + \beta_2(S_{ij}) + \beta_3(N_{ij}) + \beta_4(P_{ij}) \tag{5.3}$$

where $\beta's$ are the parameters to be estimated including β_j is the alternative specific constant (ASC) which captures the effect in utility from selecting that option compared to the utility of not selecting an option; R is the catch and release area; S is the size of the trout fished at the LIR; N is the number of rainbow trout stocked; and P is the increase in yearly trout license fee; i represent the individual decision maker; and j represents the options that individual has.

With respect to the error term ε_{ij} the joint density of the random vector is represented as

$$\varepsilon_i = (\varepsilon_{i1}, \varepsilon_{i2}, \ldots, \varepsilon_{ij}) \tag{5.4}$$

and denoted as $f(\varepsilon_i)$. As Train shows, having obtained the density of the error term, it is now possible to estimate the probability of individual i selecting alternative j is

$$P_{ij} = P(U_{ij} > U_{ik}) \tag{5.5}$$

$$= P(V_{ij} + \varepsilon_{ij} > V_{ik} + \varepsilon_{ik})$$

$$= P(\varepsilon_{ij} > \varepsilon_{ik} + [V_{ik} - V_{ij}]) \quad \forall j \neq k$$

This is now a cumulative probability function which can be rewritten as:

(5.6) $$P_{ij} = \int I(\varepsilon_{ij} > \varepsilon_{ik} + [V_{ik} - V_{ij}]) f(\varepsilon_i) d\varepsilon_i$$

Where $I(.)$ is an indicator variable taking value of 1 when the expression in parenthesis is true and taking a value of 0 otherwise. The integral will take a closed form for $f(\varepsilon_i)$ if we use logit.

Conditional Logit model

A logit model is obtained by assuming that the error term is independently and identically distributed according to the extreme value distribution. This distribution is also called type I extreme value distribution. The density function for the unobserved part of the utility is:

(5.7) $$f(\varepsilon_i) = e^{-\varepsilon_{ij}} e^{-e^{-\varepsilon_{ij}}},$$

and the cumulative density function is

(5.8) $$f(\varepsilon_i) = e^{-e^{-\varepsilon_{ij}}}.$$

This distribution will give us a mean that is not zero, but because the actual utility is not important, this will not be a problem. The relative choice is our concern in the study and when an individual chooses option A over option B, and C this must happen:

(5.9) $$U_{iA} > U_{iB} > U_{iC}$$

$$V_{iA} + \varepsilon_{iA} > V_{iB} + \varepsilon_{iB} > V_{iC} + \varepsilon_{iC}$$

Utility derived from selecting option A, B, and C respectively are:

(5.10) $$U_{iA} = V_{iA} + \varepsilon_{iA}$$

(5.11) $$U_{iB} = V_{iB} + \varepsilon_{iB}$$

(5.12) $$U_{ic} = 0 + \varepsilon_{ic}$$

which implies that the utility derived from selecting option C is ε_{ic} because the utility of selecting option C or no change is set to be a vector of zeros plus the error. Using the Conditional logit model (5.6) can be represented as (Train, 2003):

(5.13) $$P_{iA} = \frac{e^{V_{iA}}}{e^{0} + e^{V_{iA}} + e^{V_{iB}}}.$$

Equation (5.13) is the probability of respondent i selecting choice A. Equation 5.13 differs from the logit model in that the subset of choices for V_{ia} and V_{ib} changes for each person, i.e., the choice is conditional on what choice set the researcher gave the respondent.

The likelihood function for respondent i is:

(5.14) $$LF_i = [\Pr_{iA}]^{y_{iA}}[\Pr_{iB}]^{y_{iB}}[\Pr_{iC}]^{y_{iC}} \text{ for } i = 1,\ldots,n$$

where y_{iA} is an indicator variable, which takes the value of 1 if the individual selects option A, zero otherwise; y_{iB} is an indicator variable, which takes the value of 1 if the individual selects option B, zero otherwise; In the same way y_{iB} is an indicator variable, which takes the value of 1 if the individual selects option C, zero otherwise. The likelihood function for all responses is given by the product of (5.14) over all individuals. The utility parameters are estimated by maximizing the log likelihood function,

(5.15) $$Ln(LF_i) = \ln \prod_{i=1}^{n} LF_i$$

this is done using proc MDC (Multinomial discrete choice procedure) in SAS. The parameters represent the marginal contribution to each individual's utility because of each attribute selected. The actual parameters estimates show the direction of the individual probability of choosing an attribute and when used with the parameter estimate on price show the mean willingness to pay for an attribute. Willingness to pay is calculated using these parameter estimates.

Conditional Model with Interactions

The basic conditional model assumes that the preferences are homogenous among anglers. However, in our situation we suspect that this is not the case and assume that anglers have different preferences according to which segment of the population they belong. If we take into account this heterogeneity, our estimated parameters will be unbiased and reflect individual preferences. How can individual-specific effects be incorporated in the model?

One way to account for this variation is to include individual characteristics as interactions with choice attributes or with the alternative specific constant. They are included as interactions because if the individual economic and demographic characteristics are included in the model they will cancel out[2] unless they enter the equation as interactions (model 2).

Not all the interactions with socioeconomic factors can be included, but five demographic variables are thought to influence the value of the LIR attributes were. The

[2] Note: $\log(Prob(j))/\log(Prob(k))=V_{ij}-V_{ik} = B(X_j-X_k)$

demographic variables shown in Table V-1 and these are education, age, income, and recreational trips per year.

The indirect utility function in equation (5.3) was modified to include all interaction effects between the four LIR management attributes and the four different respondent characteristics. The final estimated conditional logit equation is:

$$(5.16)\quad V_{ij} = \beta_j + \beta_1(R) + \beta_2(S) + \beta_3(N) + \beta_4(P) + \delta_1(R \times I_{age}) + \delta_2(S \times I_{age}) + \delta_3(N \times I_{age}) + \delta_4(P \times I_{age}) + \delta_5(R \times I_{education}) + \delta_6(S \times I_{education}) + \delta_4(N \times I_{education}) + \delta_5(P \times I_{education}) + \delta_6(R \times I_{income}) + \delta_7(N \times I_{income}) + \delta_8(S \times I_{income}) + \delta_9(P \times I_{income}) + \delta_{10}(R \times I_{fishing}) + \delta_{11}(N \times I_{fishing}) + \delta_{12}(S \times I_{fishing}) + \delta_{13}(P \times I_{fishing})$$

where $\beta's$ are the parameters to be estimated including β_j the alternative specific constant (ASC) which captures the effect in utility from selecting that option compared to the utility of not selecting an option; *I* are indicator variables taking a value of 1 or zero depending on the anglers individual characteristics; $\delta's$ are the parameters to be estimated from the interaction terms. *R* is the catch and release area; *S* is the size of the trout fished at the LIR; *N* is the number of rainbow trout stocked; and *P* is the increase in yearly trout license fee; *i* represent the individual decision maker; and *j* represents the options that individual has; *Iage* represents the age of the individual, for simplicity only two levels are chosen for individuals demographics such as age: young and old; *I income* is an indicator variable that has two levels: greater than $40,000 per year or less than $40,000 per year.; *I education* if the individual has completed some college or completed a college degree takes a value of one and zero otherwise; *I fishing* is an indicator variable that takes a value of one if the individual takes 12 fishing trips per year or more, and a value of zero if the individual takes less than 12 trips per year to the LIR trout fishery.

Any combination of groups could be created such as: highly educated males with an income less than $40,000 per year who are older in age and who visit the site less than twelve times per year. This will give us each effect of individual characteristics and each attribute on the utility and therefore the probability of choice for that specific demographic group (Lusk, Roosen and Fox, 2003).

Table V-1. Variable names

Variable	Definition
ASC	Alternative specific constant
Price	$2, $4, $6, $8
Stocked	1 if 20% more rainbow trout are stocked; 0 otherwise
Size	1 if larger fish are stocked (10-12 in); 0 if no change (8-9 in)
CR	1 if 30% of the river is catch and release only; 0 if no portion of river is catch and release
Gender	1 if male; 0 if female
I age	1 if respondent >47 ; 0 if respondent is less than or equal to 47 yrs old
I fishing	1 if fishing trips per year are more than 12 (1 trip/month); 0 if fishing trips are less than or equal to 12
I income	1 if income is greater than $40,000; 0 otherwise
I education	1 if angler have some college or completed college degree; 0 if anglers completed a high school diploma or less

Welfare Measures in Conditional Logit

Following Morey (1999) we can express the maximum utility as $\max(U_{ij})=\max(V_j+\varepsilon_j) \quad \forall j$, and the expected value of the maximum utility for a particular choice can be expressed as:

(5.17) $$E(U)=\ln(\sum_{j=1}^{J}\exp(V_j))+D$$

where D is a term known as the 'Euler's constant' (D=0.57722). Now an expression for compensating variation can be formulated,

(5.18) $$CV=(\frac{1}{\lambda_Y})[\ln(\sum_{j=1}^{J}\exp(V_j^1))-\ln(\sum_{j=1}^{J}\exp(V_j^0))]$$

taking into account that λ_Y is the marginal utility of money and compensating variation is a money measure that must be given to the individual or taken away to make him as well off after a change as they were before the change (same utility as before at new prices) which is basically the change in utility or the difference in the two expected values of maximum utility; where V_j^1 is the utility before the change and V_j^0 is the utility after the change. As a result, the welfare change that occurs when moving from a situation given by V^0 to a situation given by V^1. This calculation represents the maximum anglers would be willing to pay for a choice change.

Following Lusk (2006) from class notes on primary data analysis, if we know with certainty that a particular alternative will be chosen, for the linear utility function

(5.19) $$V=\alpha+\beta_1 x_1+\beta_2 x_2+...+\beta_n x_n+\lambda_Y P,$$

where *P* is price and λ_Y is the marginal utility of income. The WTP for an angler to increase x_{ij1} from 0 to 1 unit is found by solving 5.20 and 5.21 for the price difference that keeps the individual at the same level.

(5.20) $$(V\mid x_1=0)=\alpha+\beta_1 0+\beta_2 x_2+...+\beta_n x_n+\lambda_Y P_0$$

(5.21) $$(V\mid x_1=1)=\alpha+\beta_1 1+\beta_2 x_2+...+\beta_n x_n+\lambda_Y P_1$$

Using both equations and solving for the price difference (P_0-P_1) we obtain:

(5.22) $(P_0 - P_1) = -\beta_1 / (\lambda_Y)$

Thus, given that a particular alternative will be chosen for sure, WTP to move an attribute from 0 to 1 is:

(5.23) $$WTP = -1\left(\frac{\beta_{attribute}}{\lambda}\right),$$

which represents the marginal rate of substitution between income and the attribute in question.

Choice Experiment Data

For the choice experiment a sample was used consisting of a total of 456 choice experiments. Two scenarios were given to each angler at the moment of the on-site interview. A brief explanation was given to the angler as follows:

> On each side of this sheet you will find one of two management scenarios being considered for improving the lower Illinois River trout area. Please vote for one option on each side as if it were the only one considered today….please turn the page and consider another set of options independent of your first choice.

The discrete choice survey was administered as part of the on-site creel clerks' initial contact with anglers. After anglers indicated that they were willing to participate in the survey on site, clerks handed anglers a randomly selected laminated card with two choice sets total (one on the front and another on the back). A total of 228 anglers were intercepted on-site and all of them completed the discrete choice experiment conducted by the creel clerk, which gives us a response rate of 100 percent. All of the surveys were usable and most respondents were mostly from Oklahoma. A total of 228 anglers were interviewed with 89% of respondents' males and the average age was 47. The average household size was 2.83 individuals. The most common income response was over $60,000 per year; individual earnings per year had a mean value of $48,226. Education ranged from less than high school, some college, and college degree.

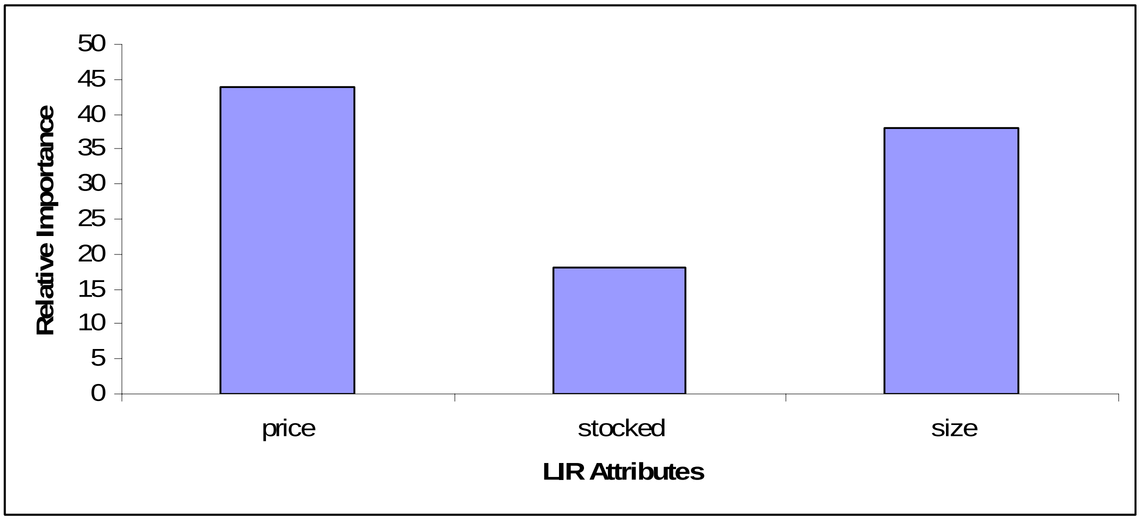
The response rate for these experiments is shown in table V-2. Although A and B represented randomized combinations of potential management scenarios, choice C represented no change to the price or management of the fishery.

Table V-2. Discrete Response Profile

Choice	Frequency	Percent (%)
A	151	33.41
B	168	37.17
C	133	29.42
Total	452	100

With regards to the relative importance of the attributes, figure V-3 indicates the relative importance of the LIR attributes for the choice decision. The attribute importance was measured by changing the levels of the attributes from one extreme to the other in the Logit model and measuring the relative change in probability of that particular choice (Lusk and Fox, 2000). The change in utility associated with the change in the level of a specific attribute indicates that price is the most important factor (the given ranges was 0 to $8), secondly size of fish (no change to larger fish) and finally number of stocked fish (no change to 20% more).

Figure V-3. Relative importance of LIR attributes



Note: Relative importance is measured in percentage points.

The attributes of the LIR for the choice experiment were coded as zeros and ones for the two level attributes and the option C (neither A or B option) were coded as zeros. Table V-3 shows the parameter estimates for the Conditional Logit model and the Conditional Logit model with interactions. The Alternative Specific Constant (ASC) that corresponds to the expectation of the error term and therefore represents preferences which are inherent to the survey setup and independent of each specific attribute value, ie, for some reason individuals might always mark B if the survey drew them visually to that choice. The ASC was not significant for both models, showing that individuals did show a bias based on survey setup. McFadden's value of the pseudo R^2 indicates model 1 did not fit very well, which is the model with no interaction terms, but a reasonably good fit was obtained for the model with interactions with an R^2 of 0.11.

In the first model all the coefficients have the expected signs; the negative price coefficient indicates that an increase in price is linked with a decrease in utility, and therefore a reduction in the probability that anglers will go trout fishing (Table V.3). Anglers prefer an increase in the size of the stocked fish, since the coefficient on *size* is significantly and positive. The other variable *number of trout stocked* also indicates a preference for increasing the number of rainbow trout that is stocked at the LIR. This suggests that the utility anglers receive from the fishing experience is due to anglers' desire to increase the size of the stocked rainbow trout; the parameter for the number of these trout that are stocked for 'portion of the river that is designated as catch as release only' is not significantly different from zero.

Table V-3. Conditional Logit Estimates for LIR Attributes

	MODEL 1		MODEL 2	
	Basic Conditional Logit Model		Conditional Logit Model with Interactions	
Attributes and Interactions	Coefficient	(std err)	Coefficient	(Std. error)
ASC			0.1844	(0.3411)
Price	-0.0996***	(0.0314)	-0.2261**	(0.0965)
Stocked	0.3394**	(0.1482)	-0.1658	(0.4411)
Size	0.9183***	(0.1290)	1.2671***	(0.3651)
Catch & Release (CR)	-0.0407	(0.1484)	-0.2311	(0.4389)
price*age			0.0895	(0.0666)
price*education			0.0642	(0.0722)
price*income			0.0297	(0.0722)
price*fishing			-0.0091	(0.0722)
ASC*age			0.1096	(0.2364)
ASC*education			0.00838	(0.2364)
ASC*income			-0.067	(0.2354)
ASC*fishing			-0.134	(0.2723)
Stocked*Age			-0.4094	(0.3246)
Stocked*education			0.6639*	(0.3401)
Stocked*income			0.5359	(0.3498)
Stocked*fishing			-0.3446	(0.3453)
Size*Age			-0.9376***	(0.2755)
Size*Education			-0.1145	(0.2965)
Size*Income			0.4213	(0.3033)
Size*Fishing			-0.2038	(0.2965)
CR*Age			-0.3329	(0.3379)
CR*Education			0.7111**	(0.3507)
CR*Income			-0.0954	(0.3724)
CR*Fishing			-0.1071	(0.3694)
Log Likelihood	-468.60			-439.90
Pseudo R-squared	0.0563			0.1132
Sample size	452			452

*** Statistically significant at the 0.01 level
** Statistically significant at the 0.05 level
* Statistically significant at the 0.1 level

As shown in table V-3, model 1, because the *size* coefficient is larger in absolute value than that of the *price* coefficient, a marginal change in the size of the trout fish will have a larger impact on the anglers' decision to pay for that attribute. The same can be said for the *stocked* coefficient, a marginal change in the number of trout stocked will have a greater impact than a marginal change in price in the decision to take a trip to the LIR.

Using the parameter estimates obtained with the Conditional Logit model we can estimate different plausible bundles of goods and measure the marginal rate of substitution between attributes and the scenarios are presented in Table V-4 where only one attribute is varied for each scenario. Respondents indicated that they are willing to pay $9.22/ year in a hypothetical increase in the trout stamp (model 1) to increase the size of the stocked trout. An increase in the number of stocked rainbow trout is an important attribute as well and anglers are willing to pay $3.41/ year for an increase in 20% on the number of rainbow trout stocked on the LIR (model 1). Given these results we can see that anglers prefer an increase in the trout size and quantity. These values could be viewed as price premiums for bigger fish and a better stocked fishery.

The results of the conditional logit model with interactions are presented also in Table V-2. The conditional logit model does not incorporate individual heterogeneity in the model so this heterogeneity among the population enters the model as interactions. Interactions of the anglers' specific characteristics with the LIR attributes are a way to introduce heterogeneity among anglers' preferences, i.e., different groups of people may have different preferences or magnitudes of preferences. Four respondent characteristics such as age (young and old), education (college or no college), income (high or low income), and fishing (more than once a month) were included (as shown in Table V-1), but many of the parameter estimates were not significant. All of these characteristics enter the model as indicator variables and measured as shown in Table V-3.

Table V-4. Marginal Willingness to Pay for Attributes using Model 1, Conditional Logit model.

Scenario	LIR Attributes	Option A	Option B
1	Price	$6	$6
	Number of stocked trout	No change	20% more
	Trout size	Larger fish	Larger fish
	Catch and Release areas		
	Probability of selecting option	31.95%	44.86%
	Price change required for indifference		$3.41
2	Price	$6	$6
	Number of stocked trout	20%more	20% more
	Trout size	No change	Larger fish
	Catch and Release areas		
	Probability of selecting option	20.83%	52.19%
	Price change required for indifference		$9.21

Note: probability does not add to 100% because Option C (neither option) is not shown

The price and size coefficients are significant and have the expected a priori sign. Again an increase in price decreases the angler's utility and an increase in the trout fish size will increase the angler's utility. With respect to the interactions terms the anglers with university education prefer the option with catch and release and having more stocked fish in the LIR, as the interaction term between the angler characteristics and the LIR attribute is positive and significant (at an $\alpha = 0.1$ level). Furthermore, model 2 shows that individuals older than 47 years of age are less willing to pay from bigger fish, possibly getting more satisfaction catching more fish rather than bigger fish and they are willing to pay $2.41 for an increase in the size of trout. Also from model 2 we obtain willingness to pay estimates for young anglers (less than 47 years old) of $5.60 for an increase in the trout size.

Policy Implications

This chapter contributes to the value estimation of non-market goods and is one of the few choice experiments for non-market valuations in Oklahoma. The results indicate that there are positive, significant preferences for stocking a greater number of fish and larger fish. There are some angler's characteristics that affect the group specific values for these attributes, such as education and age. Anglers are willing to pay for specific attributes and the ODWC managers can now target management towards the attributes which are more important for the angler's fishing experience; anglers prefer bigger fish with an increase in the number of trout stocked. Model 1 shows that they are willing to pay $9.22 per year for an increase in the size of trout from 8-9 inches to 10-12 inches, and $3.41 per year for an increase in 20% in the number of trout stocked in the area. With respect to model 2 we allow for the sample differences for age, income, and education. Regarding catch and release areas we can say that individuals with post high school education would prefer these areas in the LIR (the interaction term is significant at the 95% level) and they are willing to pay $2.96 for catch and release areas in the LIR. For the less educated group the catch and release term is negative which means that they are less willing to pay, the coefficient is not significantly different from zero and we can make no conclusions. Also from model 2 we can see that older anglers are less willing to pay for bigger fish in the amount of $2.41 compared to the younger group which is willing to pay up to $5.60 as an increase in the price of the trout stamp for bigger fish.

The segment of the population with higer education is willing to pay more for the stocked trout in the amount of $3.08, while the anglers without college education are less willing to pay for an increase in stocked fish. Again this coefficient is not significantly different from zero, so we cannot conclude if the anglers without college education are less or more likely to pay for more stocked trout. Finally, the values obtained for the attributes can be combined with cost data to conduct a cost-benefit analysis of whether these marginal changes to management are financially feasible.

CHAPTER VI

ESTIMATING ANGLER COUNTS AND MEASURING RECALL BIAS

This chapter will be divided in two sections; the first section (Section VI.1) will contain the estimation of annual visitors to the LIR trout fishery which will be used to estimate a total value for the fishery. The second section will deal with the issue of recall bias (Section VI.2). By recall bias, we mean if there are any disparities between the respondents' reported travel costs and catch rates between the on-site responses and the telephone responses. The primary data collection was done in two separate parts, the first part was an on-site survey and the second was a telephone survey within a month of the fishing trip.

Section VI-1. Concepts of Angler Counts

Previously we estimated per person per trip use value. If we want to obtain an aggregate measure of the total value of the LIR we need to estimate the number of annual anglers and horizontally sum all individual demands to obtain an aggregate measure of value. There is no gate-count of anglers available so we choose to use two different methods (both using our creel survey) to estimate the total visitors to the site per season. The first one is a combination of a traditional bus-route method and a car count method used by ODWC. The traditional bus route expansion method used by many researchers such as Lockwood, Benjamin, and Bence (1999), Dauk (2000), and Murray and Shields

(2004) estimates total fishing effort using car counts and angler interviews. We devised a second method to allow for day specific weather information using a count regression of the probability of encountering anglers against weather variables and the day of the week.

The first method assumes that all weekdays are on a different stratum than weekend days. The ODWC knows from past experience that 'fishing pressure' (no. of hours of fishing) is higher on weekends than weekdays (Summers, 2006). This is why the creel data is separated into these two stratums. It was necessary to stratify the survey schedule to have more sampling days on the weekends. This non-uniform sampling schedule between weekends and weekdays also facilitates analysis to be stratified for this variable as well. The weekend stratum includes Thursdays because on many of the Thursdays in 2004 were stocking days, and by previous experience the number of anglers increases on these stocking days.

Sixty eight days were selected for the creel survey throughout the year (roughly a 3:2 ratio weekend and weekdays). According to the ODWC this ratio provides acceptable results within 80-85% confidence limits (Summers, 2006).

The second method uses probability theory and day specific weather information to model the probability of encountering an angler on site during a creel survey and uses this estimate to forecast the total visits to the site in a year. Two models are obtained following this probabilistic method, one using angler counts per creel shift, and the other one using car counts.

Car Count Method

Fishing effort is an estimation of the time expended or resources used by the anglers. It is measured in angler-hours and is often reported as total effort per year. A bus route access-access design (Pollock et al, 1994) was used to measure creel count (car count) and consequently effort. In our case the survey encompassed 68 random days of the calendar year 2004.

Each sampling day was split between the five access points where the numbers of anglers were recorded, car counts, time of the day, site, as well as the time spent on each site. There are two ways to estimate effort: (1) with a time interval count of anglers' cars present on each site or (2) with an expansion of trip interviews. Car counts are used when there is no contact made with the anglers but a measure of effort is needed, i.e., the angler has walked far from the parking lot and is not intercepted by the surveyor. The creel clerk drives up to the different sites along the river, starting at a randomly chosen site each day, and counts the number of cars when he arrives and after a period of time counts the cars that are still present, departed, and arrived while at each site. This provides an estimate of cars per unit of time and thus we can estimate the number of people per car and the time they spent fishing (from the on-site interview). In this study a direct car count expansion method is used because car count was used as well as the time spent fishing reported by the anglers. For two sites (Dam and Marval), actual interviews with anglers were used because Dr. Schooley, who administered the survey on site, believed that most anglers were accessible to the creel clerks.

Each time a pressure count is made it is considered an instantaneous snapshot of the number of people fishing during a time period. In this case that time period is one hour; it is necessary to actually do the pressure count in one hour or less. Consider this snapshot as the number of anglers fishing on that body of water in that given hour. We could make several of these pressure counts during a day and then get a mean number of anglers per hour. If we determine the number of daylight hours available for fishing for that time period (day, month, quarter, etc.) we then multiply this mean by the number of daylight hours available over a given period and we then have an estimate of total hours of fishing that has taken place. This is done for each stratum in our sampling design, and then the summation of all the strata will give us a measure for total fishing pressure (Summers, 2006).

The direct expansion method is another way to estimate effort using the bus-route method using direct angler interviews. This differs from the car count only because many cars can be present that may not belong exclusively to anglers, so anglers complement the required information, and the number of anglers present per unit of time is recorded. These car counts are extrapolated to anglers by taking the average number per party from completed trip interviews for all interviews regardless of strata (area and weekday/weekend) and multiplying it by the average car count. The average number of anglers is the same as the average number of hours for a given strata if you assume that it occurs in one-hour time intervals. Hence the average number of anglers per hour for a given strata is extrapolated to total hours per strata by multiplying by the total daylight hours in that particular strata. The next step is to multiply the number of anglers fishing at each site times the average fishing time per angler obtained from contacting the anglers. This will give us an estimation of effort per person per unit of time (Summers, 2006).

The car count-bus route method will be described following the methodology of Pollock, Jones, and Brown (1994).The expansion method is designed to cover many access points and to cover large geographic areas. The time interval formula used by the ODWC (Summers, 2006) is

$$\hat{E} = (T\sum_{i=1}^{n}\frac{1}{w_i}\sum_{j=1}^{m}e_{ij})\times daylighthrs \qquad (6.1)$$

where E is effort in hours per day; T is the total time to complete a full circuit of the route, including traveling and waiting; w is the waiting time on ith site; e is the total car count the jth car at the ith site. In our sample the days were divided into hourly snapshots of instantaneous car counts (done by our creel clerk) out of a day that has *daylighthrs* hours of sunlight (fishing time). In other words the creel survey provided a per hour average of fishing effort and we multiplied this per hour fishing effort by the hours of sunlight available for that day. The daylight hours changed each month to account for the changes in seasons (length of day) as shown in Table VI.1. We also asked for the average fishing time per person so we can estimate the number of daily visitors by dividing the total level of effort by average fishing time per person. This will give us total number of visitors per season from the time interval count, in other words the seasonal stratum. The next step is to estimate yearly visitors for the fishery and therefore estimate total yearly benefits and compared them with the total cost of the fishery. Table VI.2 provides a sample schedule of the car count route that covers five access points in a 6-hour workday.

Table VI-1. Daylight Hours per Month used for Effort Estimation in the LIR

Month	Mean hrs/day	days/month	Daylight hours/month
Jan	10	31	310
Feb	11	28	308
Mar	12	31	372
Apr	13	30	390
May	14	31	434
Jun	14.5	30	435
Jul	14	31	434
Aug	13.5	31	419
Sep	12.4	30	372
Oct	11.5	31	357
Nov	10.4	30	312
Dec	10	31	310

Source: ODWC, 2006

Table VI-2. Bus route schedule PM

Site	Schedule wait time	Length of wait (w) (min)	Travel time (min)
1	12:00-1:00 pm	50	10
2	1:00-2:00 pm	50	10
3	2:00-3:00 pm	50	10
4	3:00-4:00 pm	50	10
5	4:00-5:00 pm	50	10
2	5:00-6:00 pm	50	10
All		300	60

With this car count we get a total number of effort (hours fishing). With this information we divide total effort by the average fishing time per person, which is three hours and forty five minutes and this will give us an estimate of yearly visitors to the LIR. The total number of visitors to the LIR trout fishery for 2004 is 18,391 using the modified car count methodology from the ODWC. Table VI-3 shows the effort estimation per stratum (weekday/weekend), by site, and by season. The fishing pressure is influenced by the daylight hours available and a total angler fishing hours of 68,966 were estimated for 2004

Table VI-3. 2004 Lower Illinois River Creel Survey (Total Effort Hours per Year).

Area	Season	weekday/ weekend	no. counts	sum of counts	mean count	daylight hrs available	Fishing Pressure (hrs)
Dam	Winter	weekday	9	21	2.33	650	1515
		weekend	14	58.5	4.18	260	1087
	Spring	weekday	12	14.5	1.21	858	1038
		weekend	11	74	6.73	338	2275
	Summer	weekday	10	22	2.2	924	2033
		weekend	12	39	3.25	364	1183
	Fall	weekday	8	22.5	2.81	748	2102
		weekend	14	38	2.71	300	813
Marval	Winter	weekday	11	2	0.18	650	117
		weekend	13	27	2.08	260	541
	Spring	weekday	8	4.5	0.56	858	481
		weekend	13	125	9.62	338	3252
	Summer	weekday	12	2.5	0.21	924	194
		weekend	11	8.5	0.77	364	280
	Fall	weekday	9	12	1.33	748	995
		weekend	12	7	0.58	300	174
Park	Winter	weekday	2.1	1.1	2.3	650	1495
		weekend	1.7	2.9	4.9	260	1274
	Spring	weekday	1	1.2	1.2	858	1030
		weekend	1.9	2.5	4.8	338	1622
	Summer	weekday	3	0.5	1.5	924	1386
		weekend	1	4.5	4.5	364	1638
	Fall	weekday	1.6	1.3	2.1	748	1571
		weekend	3.1	2.5	7.8	300	2340
River Road	Winter	weekday	1.8	0.4	0.7	650	455
		weekend	1.7	0.5	0.9	260	234
	Spring	weekday	1.5	0.1	0.2	858	172
		weekend	1.3	1	1.3	338	439
	Summer	weekday	1	0.3	0.3	924	277
		weekend	1.8	0.4	0.7	364	255
	Fall	weekday	1.5	0.1	0.2	748	150
		weekend	2	0.7	1.4	300	420
Gore	Winter	weekday	2	6.1	12.2	650	7930
		weekend	1.5	6	9	260	2340
	Spring	weekday	1.5	4.3	6.5	858	5577
		weekend	1.5	8.7	13.1	338	4428
	Summer	weekday	1.5	1.6	2.4	924	2218
		weekend	1.5	2.5	3.8	364	1383
	Fall	weekday	1	2.6	2.6	748	1945
		weekend	4	3.1	12.4	300	3720
						TOTAL	**68,966**

Source: ODWC, 2006.

Count Regression

A count regression equation is used to estimate a model of the number of daily visitors encountered per day based on weather data and our creel sample. This equation is used to predict the number of visitors per day based on the Oklahoma Mesonet weather data available for the region for all days in 2004. The Oklahoma Mesonet is a network of environmental weather stations designed by scientists at Oklahoma State University and the University of Oklahoma. Every county in the state has at least one automated weather station and we used the data from the Webbers Falls weather Mesonet station for the year 2004. The raw data set contains weather related information such as temperature (max, min, average), humidity, wind velocity, solar radiation, rain precipitation, etc. We used the angler counts for the sample days with the weather conditions available on those days to estimate a regression equation to represent the likelihood of intercepting anglers on site. Using year round data weather data available from Mesonet, the estimated regression was used to predict visitors to the fishery (Mesonet, 2006). A Poisson distribution was used with the number of anglers interviewed on a sample creel day as the dependent variable. Another Poisson Probability was obtained using car counts as the dependent variable. The number of anglers interviewed (or the car counts) during the bus route is a count variable that can only take positive values $y \geq 0$.

$$\Pr(y_i = y) = \frac{\exp(-\lambda_i)\lambda_i^y}{y!}, \quad y = 0,1,2,3,...$$

Because it is necessary that $\lambda_i > 0$ it is common to specify the exponential function such as:

$$\lambda_i = \exp(\beta_0 + \beta_1(Maxtemp) + \beta_2(Avhum) + \beta_3(Ahhum^2) + \beta_4(shifttime) +$$

$$\gamma_1(weekend) + \gamma_2(winter) + \gamma_3(spring) + \gamma_4(summer))$$

our dependent variable is the number of individuals observed per creel survey day at the LIR trout fishery; where the β 's and γ are the parameter to be estimated using maximum likelihood estimation; *Maxtemp* is the maximum temperature recorded for that specific day by the Oklahoma Mesonet automated weather station of the region, measured in degrees F. *Avhum* is the average humidity recorded for that specific day and it is measured in percentage; *Avhumsq* is the average humidity squared; *Rain* is a measure of daily precipitation, the units are inches of rain; *shiftime* is a variable that accounts for the length of the creel bus route on that specific day in hours which is also the number of sites visited in a day; *weekend* is an indicator variable that takes the value of 1 if the day of the year is a weekend or Thursday (stocking days), and 0 if it is a weekday; *spring* (April, May, June), *winter* (January, February, March), and *summer* (July, August, September) are seasonal variables that take a value of one if the individual was interviewed in that specific season, zero otherwise. Fall is the base season which is omitted from the estimation so that the other three seasonal variables are measured as relative changes in visitation. Because the estimate accounts for weather variables, the seasonal indicators are included to pick up changes in work or school variability rather than simple temperature. These variables were selected with guidance from ODWC because they were theoretically most important in the decision to go fishing. The correlation matrix for some weather variables is presented in Table VI-4 to verify the degree of correlation among them and to make sure that average humidity is not highly correlated with rain.

Table VI-4. Correlation matrix between weather variables used in the Poisson Model to Predict Visitations to the LIR based on Weather data.

	weekend	*maxtemp*	*avhum*	*avhumsq*	*rain*
weekend	1				
maxtemp	-0.0319	1			
avhum	-0.02911	0.18187	1		
avhumsq	-0.02542	0.156402	0.996967	1	
rain	0.018515	0.017146	0.417944	0.433046	1

The estimated parameters as well as descriptive statistics from our sample are expressed in Table VI-5. The parameters have the expected signs. For example, an increase in rainfall will reduce the probability of encountering an angler. During winter the probability of encountering anglers is less compared to the base group of fall. However, the opposite happens during spring and summer. As expected, weekend days will increase the likelihood of visitation compared to weekdays. Humidity and the squared form of humidity show the expected negative effect on anglers interviewed, and are significant.

Table VI-5. Count Regression Parameters and descriptive statistics

n=68

Variables	Parameters	Std errors	Mean	Std dev.	Min	Max
Intercept	-9.5768***	2.2				
Winter	1.2363***	0.12				
Spring	-0.0486	0.12				
Summer	-0.909***	0.14				
Maximum temp	0.038***	0.01	74.79	16.07	37	97
Average humidity	0.1943***	0.06	76.01	9.59	54	94
humidity squared	-0.0012***	0.01	5880	1434	2916	8836
Rain	-1.6688***	0.26	0.11	0.26	0	1.28
Weekend	0.613***	0.086	0.55	0.51	0	1
creel shift	0.1683	0.11	5.98	0.04	5	7

*** denotes significance at the 99% level

Predicting Visits

Using the above parameter estimates, we predicted the yearly number of visitors to the LIR (annual effort) using Mesonet weather data for 2004 from Webbers Falls (Mesonet, 2006), and a typical 6 hour creel data. The daily numbers for the six hour creel day were multiplied by sunlight hours divided by six to get a daily total for each predicted day; the data was obtained from the NOAA website (NOAA, 2006) for Oklahoma City which is at the same latitude of the LIR trout fishery; The total monthly predicted number of anglers is shown in Table VI-6. The total yearly estimated number of anglers using the poisson method for bus route interviews is 7,038.

Table VI-6. Estimated Total Monthly Visitors of the LIR using Poisson Regression and Daily Weather Data

Month of the Year	Estimated Anglers
January	925
February	656
March	1180
April	137
May	807
June	804
July	421
August	450
September	408
October	634
November	340
December	277
TOTAL	7038

Because the creel survey collected information regarding anglers observed at the site together with the cars observed at the site, we can do another probabilistic estimate using the car count information in our new model. The idea of the car count probabilistic method is the same as on the previous poisson model. We wish to predict the observed cars at each site based on weather conditions of those specific days and then use the predicted car counts, average visitors per car, and daily sunlight hours to get a total visitation estimate. Our predicted visitors are shown in table VI-7

Table VI-7. Predicted Visits to the LIR Using a Car Count Poisson Estimation

Month of the Year	Estimated Anglers (predicted cars x 1.5 anglers/car)
January	620
February	523
March	689
April	749
May	1141
June	964
July	545
August	575
September	563
October	447
November	325
December	319
TOTAL	7460

The probabilistic car count method shows that more visits occur in April, May and June. This car count estimation predicts a number of trips to the LIR for the year 2004 that is very similar to the individual probabilistic method. Using the car count probabilistic estimate as our dependent variable the total number of trips is 7,460 and if we use the angler count probabilistic method the total number of trips to the LIR is 7,038

Using a poisson probabilistic method for predicting interviews on-site and cars counted provides an alternative to the traditional effort estimation which assumes that the strata take the seasonal weather variations into account. The traditional method does not take into account random weather data which greatly affects the decision to make a trip to the LIR trout fishery. Our estimate using a poisson estimation of visitors and car counts was lower compared to the traditional bus route (car count) method used by ODWC. In other words our total visits using the weather data is 7,038 and 7,460 per year, respectively, compared to the ODWC annual visits estimate of 18,391 annually. Using the weather data yields more than fifty percent less of what is estimated using traditional car count.

Table VI-8. Parameter estimate of the Probabilistic Poisson Car Count

n=68

Variables	Parameters	Std errors	Mean	Std dev.	Min	Max
Intercept	-7.7794***	1.62				
Winter	0.6664***	0.09				
Spring	0.6917	0.09				
Summer	-0.0622***	0.11				
Maximum temp	0.0171***	0.01	74.79	16.07	37	97
Average humidity	0.2475***	0.04	76.01	9.59	54	94
humidity squared	-0.0017***	0.01	5880	1434	2916	8836
Rain	-0.3663***	0.13	0.11	0.26	0	1.28
Weekend	0.7181***	0.06	0.55	0.51	0	1

*** denotes significance at the 99% level

There are several reasons why the count estimate might be different, i.e. the assumption that there are 1.5 people, regardless of season, in every car is very general. We might not have all the anglers in the intercept bus route method. Finally the reason for this difference might be that the method to count anglers using weather data takes into account other variables not controlled in the regular creel survey effort estimation; i.e. such as the temperature thresholds below 40 degrees Fahrenheit and above 90 degrees Fahrenheit.

Section VI-2. Recall bias

Recall bias is a type of bias that occurs when the survey respondents answer a question that is affected by both the correct answer, but also by the respondent's memory. We know that there are several types of biases such strategic bias, whereby the respondent believes he or she may influence policy by exaggerating an answer. Recall bias is a concern despite inclusions of survey elements that stimulate recall. There is little information regarding recall bias due to the difficulty in measuring it, especially if surveys are conducted nationwide and deal with sensitive information that the respondent allegedly does not want to remember i.e. medical studies dealing with patients that have had cancer or abortions. In these cases there is evidence that the survey respondent remembers the facts, but does not want to report his or her true experiences (Rookus, and vanLeeuwen, 1996; Lazovich, et al., 2002). If there is suspicion of recall bias, investigators must ask probing questions to be able to detect this type of bias. If we believe this type of bias is present we must adjust for it, and minimize it, if not our estimates will be biased.

Because of the way our survey was designed, we were able to record on-site responses about the quality of the trout fishing experience (Likert scale 1-5), size of fish, number of fish, and travel costs. In addition to the on-site data, a telephone interview was conducted a month later with the same anglers in order to collect more information. The same questions regarding size of fish, number of fish caught, quality of the trout fishing experience, and travel costs were repeated during the telephone interview. Although we expect the first three variables to be the same on-site and up to one month later, it seems logical that the later travel cost number would tend to be higher because all costs are accounted for upon the completion of the trip. Furthermore the way the questions were designed for the telephone survey, it probes the individual to remember all the expenses according to different categories such as lodging, transportation, food and beverages, etc. With these two sources of information it is possible to estimate the differences in reported travel cost, size of fish, number of fish, and quality of the trout fishing experience and place a two standard error bounds on the error of estimation.

Recall bias results

A comparison between the two responses by each individual between travel costs was obtained by the onsite reported travel cost (Y_1) and the phone interview travel cost response (Y_2) (which was obtained approximately one to four weeks after the onsite interview). Each sample consisted of $n = 218$ reported costs within individuals. The measurement for the difference between the two types of responses were obtained and the following mean and variance were computed

$\bar{Y}_{diff} = 50.36$

$S^2_{diff} = (117.89)^2$

where the subscript *diff* represents the telephone response minus the on-site response. The objective is to estimate the difference in reported travel costs on-site and off-site through the phone interview and place a two standard error bound on the error of estimation. The difference in telephone travel cost and on-site travel cost was obtained because these two measures are correlated. To see if there is statistical difference we conducted a t-test for the difference in reported costs.

The point estimate of (μ_{dif}) is

$$\text{(13)} \qquad \sum_{i=1}^{218} (y_{2i} - y_{1i}) / 218 = 50.36 \text{ dollars}$$

and the standard error of the estimation is

(14) $$\sigma_{(\text{ydif})} = \sqrt{\frac{\sigma_d^2}{n_d}}$$

We cannot know the true parameters, but the estimated parameters were obtained from the experimental data by using the unbiased estimator

(15) $$\hat{\sigma}_d^2 = S_d^2 = \frac{1}{n_d - 1}\sum_{j=1}^{218}(y_{dj} - \bar{y})^2$$

Finally we have

(16) $$\sigma_{(d)} = \sqrt{\frac{S_d^2}{n_d}} = \sqrt{\frac{13898}{218}} = 7.98 \text{ Dollars}$$

The estimated difference in mean cost difference is $50.36 and the expected error of estimation is calculated to be less than $2\,\sigma_{(diff)}$ or $15.95 with a probability of approximately 95 percent. This is a significant difference in reported on-site and reported telephone costs. The difference might be attributed to recall bias and also to the fact that when doing the on-site interview some anglers were in the process of fishing and had not yet completed their fishing trip, therefore did not have to total cost estimate for the trip.

A similar test was performed to estimate the difference in mean trout catch. The objective is to estimate the difference in reported mean trout catch and place a two standard error bound on the error of estimation. The point estimate of the difference in reported trout catch for individual *i* is $\mu_{idiff} = (\mu_{itel} - \mu_{ionsite})$ is

(13) $$\sum_{i=1}^{218}(y_{2i} - y_{1i})/218 = 6.85,$$

and the standard error of the difference between reported telephone and on-site catch is

(15) $$\hat{\sigma}_1^2 = S_1^2 = \frac{1}{n_1 - 1}\sum_{j=1}^{n_1}(y_{1j} - \bar{y})^2$$

(14) $$\sigma_{(d)} = \sqrt{\frac{S_d^2}{n_d}} = \sqrt{\frac{147.56}{218}} = 0.83$$

The results indicate that the estimated difference in mean trout catch is 6.85 fish; the expected error of estimation is calculated to be less than $2\sigma_{(\bar{y}_2 - \bar{y}_1)}$ or approximately 2 fish (1.66 fish) with a probability of 95%. This result indicates again a disparity between the on site data and the telephone survey data. The difference might be due to recall bias or again to the possibility that anglers after being interviewed on site continue their fishing experience and increase their catch after the on site data was collected.

Regarding the size of the fish, the estimated difference in mean size of the fish between samples (telephone reported size of fish minus on-site reported size) is only 1.28 inches with a $\sigma_{(diff)}$ of 0.31. This indicates that there is statistically significant mean difference between both samples (telephone minus on-site) at a 95% confidence level. There is recall bias when anglers state the size of the fish, which is what we expected because usually anglers want to brag about 'catching the big one', the difference was 1.28 inches in size between the telephone reported catch size and the on site reported catch size.

Finally the estimated difference in quality of the trout fishing experience (on a scale of 1-5 where 1 is poor and 5 is excellent) was of 0.11153 and the $\sigma_{(\bar{y}_2 - \bar{y}_1)}$ was 0.11420. It is important to notice that there was no statistically significant mean difference in the quality level of the trout fishery from the onsite sample with respect to the telephone sample.

The results of these tests suggest that bias is present when determining the cost of the trip to the LIR and when determining the catch per trip. Caution must be taken when attributing this difference to recall bias alone due to the fact that some of the difference might be on site data when the trip to the LIR was not yet completed, therefore obtaining partial data on site.

Chapter VII

COST BENEFIT ANALYSIS

Introduction to cost benefit analysis

Cost benefit analysis (CBA) became a tool for analyzing water projects more than 50 years ago. It started with the economic need of the U.S. Corp of Engineers to measure if a project is worthwhile. CBA became the basis for making decisions especially regarding water resource investments (Eckerstein cited by Freeman, 2003). Federally funded environmental projects must undergo a benefit cost analysis by executive order. On January 1, 1970 President Nixon signed the National Environmental Policy Act of 1969 where it directed federal agencies to include actions that would affect the human environment (Tietenberg, 2002). The basic idea of the CBA is that it is a consistent methodology, of potential Pareto improvement, measuring the total benefits of a project (to whomever they accrue). The decision criterion in all CBA projects is such that the present value of total benefits of the project has to exceed the total present value of costs of that project over the lifetime of that project, i.e., the net present value of the project is greater than zero or the benefit/cost ratio is greater than 1.

In order to decide whether to proceed with a project or not, we need to express all the benefits and costs in monetary terms. When cost benefit analysis is done from the public policy perspective rather than the private firm, social prices are used for the analysis in which private prices are adjusted to remove the effects of subsidies, taxes, and other market distortions (Weimer, and Vining, 2004). Furthermore, a discount rate is applied to take into account the time dimension and the risk involved in the projects. Often, the social discount rate used is lower than that used for private projects. This is because the discount rate can be defined as the social opportunity cost of capital that includes 1) the riskless cost of capital and 2) the risk premium. If the public sector can use a lower discount rate, it can complete more projects with longer payoff periods that are worth completing (Tietenberg, 2002). Unlike many other environmental projects with long time delays for benefits (such as habitat restoration), the use of a lower discount rate is not as crucial for this project.

Nature as an asset

Natural resources provide a wide variety of products that are used for consumption or as primary products for other goods. Some of these products are wood, fish, seeds, and environmental services, such as recreation, life support, air quality, etc. which are valuable assets to humans. Some of these benefits have marketable value and some of them have non-marketable values. The values that these natural resources provide enter economic agent's preferences as benefits into a utility function. These benefits are measured and expressed as willingness to pay, which is the area underneath the demand curve and above the market price. In our case, the benefits of the LIR trout fishery have been determined in the previous sections using the travel cost method.

Costs are measured as producer surplus which is the area above the supply curve (marginal cost curve) and below the price line. Using these economic terms we can measure total net economic benefits, total costs, marginal benefits, and marginal cost.

Assumptions of the CBA

The point of comparison for the cost benefit analysis is the future with versus the future without a particular project or policy. Conducting a cost-benefit analysis is done under a strong set of assumptions. First, we assume the project is minor in terms of the overall economy. Second, it is usually assumed there are no major distortions in other markets. If significant distortions exist, such as is common in developing countries, shadow pricing methods are used (Little and Mirrlees, 1974). Third, the income, tastes and preferences of the current generation are taken as representative for future generations over the lifetime of the project unless some other assumptions are made. Finally, in this case we will assume to have constant cost and constant benefits for the lifetime of the project.

In the rest of the section we consider three cost benefit scenarios. Scenario one is the overall CBA of the LIR trout fishery. Scenario two is the CBA for the change in management scenario of increasing the trout stockings to 20% more fish. The third and final scenario is the CBA for the change in management scenario of increasing the size of the fish from 8-9 inches to 10-12 inches. Furthermore, it is important to note that the analyses below should be considered crude at best, since we have only considered rough estimates for costs of stocking the fishery without the inclusion of ODWC worker hours and costs which were not readily available.

Scenario 1: The existence of the Trout Fishery

The CBA that we will analyze in this section is the future with the LIR trout fishery and the future without this trout fishery. The objective is to determine the net benefits of the project and evaluate it compared to discontinuation of stocking trout in the LIR. Two estimates are obtained, one is from the financial perspective (wether license expeditures cover costs) of the ODWC and the other is from a social perspective using the non-market benefits derived from the travel cost calculations.

From the agency perspective, we can crudely calculate whether the income from trout licenses covers the cost of stocking the fishery. Table VII-1 contains the financial analysis of the project. It includes the income and expenses of the LIR trout fishery in 2004 dollars. The total income minus expenses sums up to $116,653 this number is based on the total number of licenses sold for 2004 as well as previous income estimates from the 2002 statewide trout survey. The total numbers of licenses sold in 2004 were 29,851 adult trout stamps and approximately 7,223 youth licenses. These totals are statewide for the year 2004 and the percentage for that corresponds to the LIR is 33.6% of these numbers. This percentage was obtained by Crews and Summers (2002) in a statewide survey in 2002. The total trout revenue was estimated only for the trout stamps for the LIR as $112,435. The total trout revenue includes youth and adult trout stamps sold on 2004 only for the LIR. Associated non-resident license revenue and associated resident license revenue is calculated by multiplying each base fishing license purchased by someone trout fishing by the proportion of total fishing for any species that was attributable to trout fishing at the LIR. In the absence of complete information on combined hunting licences and distribution of effort across trout areas statewide, we assumed that the numbers provided for the 2002 were the same for 2004 (See footnote 3). Associated license revenues were adjusted from 2002 dollars to 2004 using the consumer price index (CPI) for Oklahoma provided by the U.S. Bureau of Labor Statistics (2006) and not adjusted for seasonality (the base year is 1982).

Costs for the fishery included agency indirect costs plus stocking and transportation costs. However, the cost of the fish is subsidized by the federal government through the federal hatchery system in Arkansas. The trout are obtained free of charge. This is why only $2000 is allocated to purchase additional trout above the federal allotment plus ODWC payment for transportation costs. ODWC reported a 16.4% rate of indirect costs. A 10% cushion for unforeseen expenses was included. Considering both revenue and costs, the net financial benefits were $116,653 for the year 2004.

Table VII-1. LIR Trout Program Financial Analysis (Income and Expenses) for 2004

Item	Percent of Total Trout Licenses Used on LIR	33.60%	
	Percent of Total Non-Resident Trout Licences used on LIR	11.00%	
(a)	No. Youth trout license sold ($5/e.a.)	2427	
(b)	No. Adult trout licenses sold ($10/e.a.)	10030	
(c)=(a)x$5+(b)x$10	Total Resident trout License Revenue	$112,435.00	
	Associated Non-Resident Trout License Revenue[3]		
(d)	5-day	$6,558	
(e)	Annual	$6,851	
(f)=(d)+(e)	Total Non-Resident Trout License Revenue	$13,409	
	Associated Resident License Revenue		
(g)	Fishing	$40,576	
(h)	Combination License	$2,482	
(i)=(g)+(h)	Total associated license revenue	$43,058	
TR=(c+f+i)	Total Revenue (TR)		**$168,902**
(j)	Trout Purchase Costs	$2,000	
(k)	Operation Costs (transportation)	$38,806.34	
(l)=(j+k)x0.164	Indirect Costs***	$6,692.24	
(m)=(l+j+k)	Trout Expenses plus indirect	$47,499	
(n)=m x 0.1	10% unforeseen expenses	$4,749.86	
(o)=(m+n)	Total Expenses		**$52,248.86**
Q=(TR-o)	Total Revenue minus Expenses		**$116,653**

* Attributed to specific LIR trout area based on a statewide survey, 2002

** Based on the trout survey report (Crews, and Summers; 2003) and adjusted for inflation from 2002 to 2004 prices.

***Indirect costs for 2004 are 16.4% of total operating cost (Summers, 2006)

[3] According to Crews and Summer, 2002, “Trout anglers must have a fishing license in addition to the trout license. For example, Oklahoma residents may purchase an annual fishing or combination hunting and fishing license, while nonresident anglers may purchase a 5-day, 10-day or annual nonresidentlicense. A proportion of these license fees can also be attributed as trout program incomeby dividing the total days fishing in Oklahoma by the total number of days trout fishing (Table 5) and applying that ratio to the cost of the fishing license purchased. For example, if an angler spent 50 total days fishing in Oklahoma, 20 days of which were spent in pursuit of trout, then 40% of his/her fishing license cost could be counted as trout program income. Fishing and trout license revenue were calculated after subtracting the $1 fee that is retained by the license vendor. Income from lifetime and senior license holders were not used as trout program income because of the difficulty of estimating their relative contribution over the course of many years.Trout license income and associated fishing license income”

Social Cost-Benefit Analysis

When using CBA from the social perspective, it is necessary to include the true cost of maintaining the trout fishery and the total benefits to society of the fishery, include non-marketed benefits. Currently many trout are provided to the ODWC from a federal hatchery at the cost of transportation only. The cost of the fish, a subsidy to the state of Oklahoma, must be included.

The true cost of fish should account for the cost of fish purchase, transportation, and overhead costs. Trout were stocked 33 different times in the 2004 season and each time the number of stocked trout varied from 2,600 to 3,900 fish per truck with most of them carrying rainbow trout. On average each trip had 3,250 rainbow trout (Hyler and Peterson, 2006). The market price for trout is approximately $2.00 per pound if the fish come from a private hatchery. There are 3.3 trout per lb (on average); taking all these factors into account and the total stocking trips of 33 per year this gives us a grand total for 2004 of $65,000 for direct trout expenses. These costs have to be taken into account when doing the social analysis.

The transportation expenses accounts for approximately 33 different trips and one trip per stocking, 5 other fingerling size truckloads were stocked into the LIR with approximately 12,412-16,600 per truck load. The total estimated transportation cost adds up to $38,806 (Hyler and Peterson, 2006). Indirect Costs were calculated as 16.4% of the total direct expenses of operation the LIR trout fishery (Summers, 2006). An additional 10% in costs were added to provide a cushion for some unforeseen costs.

For the social CBA, we also need to take into account the price of the water rights since they are vital to maintaining water flow for the trout survival. As mentioned in

Chapter I, the water rights belong to the Sequoyah fuels plant and once it is decommissioned its water will be available to the purchaser of the existing rights. Currently, the ODWC receives these water rights free of charge. However, the current contract states that for a 12,000 acre ft of water per year, they will pay $20,000 per year for the right to store the water in the lake. The accounting system for the water is as follows, the normal elevation of the water level is 632 ft and anytime the lake goes above 632 ft the usage level goes back to zero. Actually 12,000 acre ft per year is not enough flow for the trout fishery but every time the water level rises above this threshold the account goes back to zero. This is sufficient when it rains a lot and the water level is normal, but in dry weather years there is concern that there will not be enough water and the temperatures in the river will become lethal for trout.

This process of assigning water rights is still very uncertain and there are a lot of pending issues between all the parties involved. We will assume that the LIR trout fishery will have to pay this water right if they wish to keep in operation. The choice of the discount rate is based on a real discount rate. This real discount rate is the nominal discount rate adjusted for inflation and with a risk adjustment depending on the project being evaluated. If we assume that the long term government bond yield is 7% and the rate of inflation is 4%, the real discount rate for this study would be 3%. The CBA for the recreational fishing use of the LIR is presented in Table VII-2

Table VII-2 provides the results of the social CBA for the LIR trout fishery assuming that the lifetime of the fishery is indefinite, by this we mean that the project should continue until perpetuity, so the benefits and the costs occur at the same levels year after year, but the total net present value varies with respect to the interest rate used. The value (benefits) generated from recreation is derived from the recreational use value for angling in the LIR. The total non-market use value of the fishery comes from the individual benefits of $112.54 per trip from model 1 to the LIR trout fishery (not counting license expense to the individual) multiplied by the total trips for the year 2004. This gives us an aggregate measure of use value for the LIR trout fishery. Using the various interest rates we can see that in all cases the benefits exceed the costs with a benefit cost ratio of 14.16 which assures us that the benefits are greater than the cost. If we want to more realistically model the uncertainty of projects, we can do a sensitivity analysis to the assumptions made in the model

Table VII-2. Social CBA-Lifetime Benefits minus Costs for the LIR trout fishery

Benefits					
CS per trip estimated by TCM	$113	$113	$113	$113	$113
Number Of trips For 2004	18,391	18,391	18,391	18,391	18,391
Total Use Value Of The LIR	$2,078,183	$2,078,183	$2,078,183	$2,078,183	$2,078,183
Total Revenue Income	$116,653	$116,653	$116,653	$116,653	$116,653
Yearly Benefits	$2,194,836	$2,194,836	$2,194,836	$2,194,836	$2,194,836
Costs/year					
Trout Purchase Costs	$65,000	$65,000	$65,000	$65,000	$65,000
Operation Costs (transportation)	$38,806	$38,806	$38,806	$38,806	$38,806
Direct Trout Expenses	$103,806	$103,806	$103,806	$103,806	$103,806
Indirect Costs (16.4%)	$17,024	$17,024	$17,024	$17,024	$17,024
Trout Expenses plus indirect	$120,830	$120,830	$120,830	$120,830	$120,830
Water right cost	$20,000	$20,000	$20,000	$20,000	$20,000
10% unforeseen expenses	$14,083	$14,083	$14,083	$14,083	$14,083
Yearly expenses	$154,913	$154,913	$154,913	$154,913	$154,913
Discount rate	**3%**	**6%**	**9%**	**12%**	**16%**
Total Benefits (Infinite lifetime)	**$73,161,200**	**$36,580,600**	**$24,387,067**	**$18,290,300**	**$13,717,725**
Total Cost (Infinite lifetime)	**$5,163,773**	**$2,581,887**	**$1,721,258**	**$1,290,943**	**$968,208**

The objective of the sensitivity analysis below is to measure the robustness of our results to changes in the levels of the costs, benefits, discount rates, or time horizon. In the analysis below, we adjust the discount rate, the time horizon of the fishery, and estimates of the cost and benefits. The measurement of benefits is the greatest source of variation due to the fact that the estimated annual visitors per year differ depending on which travel cost estimate of per trip value (consumer surplus) and which estimate of total visitation is used, i.e., the traditional creel or the probabilistic weather-dependent predictions (See Table VI-6 and Table VI-7). If we shorten the lifespan of the fishery to 10, 25, 50 years our results from the lifetime model still hold in Table VII-3 at a 10% rated. In Table VII-3, the benefit cost ratio is still greater that 1 at a discount factor of 10%. Table VII-3 shows the results of a sensitivity analysis using a 10% discount factor. This sensitivity analysis takes into account the aggregate benefit estimates in three different ways, (model 1) the count regression using daily weather data and visitors count per creel shift as the dependent varible, (model 2) count regression using car count as the dependent variable, and (model 3) the total effort provided by the ODWC. The B/C ratio is greater than 1 in all cases and with all of the different life spans of the projects indicating that the project should continue, the benefits are greater than the costs.

Table VII-3. Sensitivity Analysis for BCA for the LIR trout fishery with a 10, 25, 50 year lifespan for the project and a 10% discount rate*

Lifetime of the Project	1 year (undiscounted)	10 years	25 years	50 years
CS Per Angler per trip Estimated By TCM	$113	$113	$113	$113
Trips for 2004 (probabilistic visitor count)	7038	7038	7038	7038
Trips for 2004 (probabilistic car count)	7460	7460	7460	7460
Trips for 2004 (ODWC)	18391	18391	18391	18391
Yearly Use Value (probabilistic car count)	$842,980	$842,980	$842,980	$842,980
Yearly Use Value (probabilistic visitor count)	$795,294	$795,294	$795,294	$795,294
Yearly Use Value (ODWC)	$2,078,183	$2,078,183	$2,078,183	$2,078,183
Yearly Expenses	$154,913	$154,913	$154,913	$154,913
Net Present Value (probabilistic visitor count)	$640,381	$2,286,482	$2,551,847	$2,561,487
Net Present Value (car count)	$688,067	$2,456,745	$2,741,870	$2,752,229
Net Present Value (ODWC)	$1,923,270	$6,867,042	$7,664,016	$7,692,970

*For the NPV of 10, 25, 50 year projects, the costs and benefits are assumed to occur at the end of the year, and are thus discounted back to year 0 or day 1 of the project.

In all cases the Net Present Value (NPV) of the resource is positive, confirming that the total discounted streams of benefits are greater than cost of the fishery over the four possible lifetimes of the project (1, 10, 25, and 50 years). In Table VII-4 another sensitivity analysis is performed by assuming a 25 year lifespan and adjusting the interest rate to 3,-25%. Again our results are robust and the net present value of benefits minus costs is greater than zero, even at a 25% discount rate (in turn, the b/c ratio is greater than 1, even at a 25% discount rate).

Table VII-4. CBA of the LIR with a 25 year lifespan and a discount rate of 3%, 8%,12%, and 25%*

CS Per Angler per trip Estimated By TCM	$113	$113	$113	$113
Trips for 2004 (probabilistic visitor count)	7038	7038	7038	7038
Trips for 2004 (probabilistic car count)	7460	7460	7460	7460
Trips for 2004 (ODWC)	18391	18391	18391	18391
Yearly Use Value (probabilistic car count)	$842,980	$842,980	$842,980	$842,980
Yearly Use Value (probabilistic visitor count)	$795,294	$795,294	$795,294	$795,294
Yearly Use Value (ODWC)	$2,078,183	$2,078,183	$2,078,183	$2,078,183
Yearly Costs	$154,913	$154,913	$154,913	$154,913
Discount rates	3%	8%	12%	25%
Net Present Value (probabilistic visitor count)	$11,151,049	$6,835,924	$5,022,597	$2,551,847
Net Present Value (car count)	$33,490,185	$20,530,477	$15,084,474	$7,664,016
Net Present Value (ODWC)	$11,981,412	$7,344,961	$5,396,605	$2,741,870

For the NPV of 10, 25, 50 year projects, the costs and benefits are assumed to occur at the end of the year, and are thus discounted back to year 0 or day 1 of the project.

Hypothetical Changes in the Management Plans

There are two hypothetical changes in the management plans that were statistically significant in the results in Chapter V, i.e, a preference for larger trout and greater number of stocked trout. Below we will conduct two CBA analyses for the marginal changes in fish management separately.

Scenario 2: Stocking Larger Trout

The anglers are willing to pay $9.22 for an increase in the size of the trout stocked at the LIR. They are willing to pay this amount if the trout stocked are increased from 8-9 inches to 10-12 inches. As the payment vehicle, an increase in the yearly trout stamp is used. We assume the transportation cost for the ODWC to get trout would still be the same, except they would have to buy more pounds of fish per year. Currently the ODWC pays between $2-2.40/ lb of trout, but instead of getting 3.3 fish per pound they would get only 1.85 fish per pound on average (Hyler and Peterson, 2006). Translated into cost per fish, if the cost per pound of trout is $2.00, the ODWC pays $0.60 to stock a 9 inch fish, and $1.08 for stocking a bigger fish (10-12 inches). This is a marginal increment of $0.65 per fish. Currently the total number of fish stocked is 107,250 small fish per year (33 truckloads times an average of 3250 fish per truckload). If the ODWC wants to maintain this number of stocked fish it would cost them an extra $69,498 per year to stock bigger fish. This number can be compared to what anglers are willing to pay for bigger fish. An individual angler is willing to pay $9.22/ year increase in trout stamp and if we want an aggregate willingness to pay we multiply this number times the total trout stamps sold for the LIR in 2004 (10,030). The aggregate willingness to pay for this change in management scenario is $92,477. If we compare the willingness to pay against the costs we get a net benefit of $22,979 per year. This is assuming that the number of trout stamps sold will remain constant despite of the increase in price of the stamp.

Marginally this is a very feasible management strategy to increase angler satisfaction at a marginal cost increase. The marginal gains outweigh the marginal cost but it will all depend on the number of anglers that will purchase the trout stamp at this additional price. This is the most important factor that anglers would like to change and several complaints have been made to the ODWC about the size of the trout stocked. The ODWC recently renewed a contract to ensure that the trout stocked in the LIR are of bigger size (Hyler and Peterson, 2006).

Scenario 3: Stocking More Trout

The other change proposed in the management plan was the change in the number of fish stocked. Anglers are willing to pay a marginal fee of $3.41 per year in the price of the trout stamp for an increase in 20% on the number of trout stocked in the area. This 20% increase of the trout stocked in the area implies a change in the number of stocking days from 33 to 40. This is 7 additional truckloads per year from the federal hatchery in Norfolk, AR. At an average of 3250 trout per truckload, this implies and additional trout cost plus transportation cost of $20,787 ($1000 transportation cost plus $1969 in trout cost per truckload) at a selling price of $2/lb and an average of 3.3 trout per pound. The total willingness to pay would be the individual WTP of $3.41 times the number of anglers per year if we assume anglers do not cease to come because of an increase in the trout stamp. In our case (using the ODWC numbers of 10,030 annual trout stamps sold for the LIR this would add up to $34,202. The net gains from this marginal change in scenarios would be $13,415 ($34,202-$20,787). In this case benefits are greater that the costs with this change in management scenario. It is recommended to proceed with this change in management policy.

CHAPTER VIII

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this study was to find the use value of the Lower Illinois River Trout Fishery, by using both revealed preference approach and stated preferences approach. The study was conducted in four main parts. Part I analyzed the valuation of the fishery in Oklahoma using a travel cost method with the data collected from the angler survey, parametric bootstrap was used to estimate confidence intervals on the use value estimations. In this situation, a per visit consumer surplus, ie., willingness to pay per angling trip, was obtained and this was aggregated to get the total use value by multiplying it times the number of trips per year to the Lower Illinois Rivers. The number of trips to the LIR trout fishery was determined to be insensitive to own price changes for all trips (Half elasticity of 0.13%). This means that the trout fishing experience is very price inelastic. If there is a small price change, people will still visit the trout fishery, mainly because there are very few substitutes to the trout fishing experience. Individuals who took part in multiple-purpose trips are a little bit more responsive to price changes (price elastic) than the trout anglers only (Half elasticity of 0.97%). This means that as the price changes to visit they will still demand recreation trips to the LIR, but for large prices changes; they can easily substitute camping, hiking, floating on the river at another place in the area. This confirms that the trout fishing experience is a unique recreational site and people are willing to pay a significant amount of money to visit the site. The income elasticity was estimated at 0.48. In other words, it is what we expected in that the recreation trips function like normal goods for anglers, i.e., as the income increases, the demand for trout trips increases but at a very small rate.

The calculated average consumer surplus per angler per recreation day is estimated at $112.54 with a 90% confidence interval between ($79.19, $194.38) using the bootstrap confidence intervals using the estimates for distance and time costs in model 1 (Additional results for other specifications are given in Table IV-8). For those who went to the LIR for multiple recreation activities, rather than just angling, the average consumer surplus per person per recreation day is $31.66. The total consumer surplus generated from the LIR trout fishery, assuming all visitors are single purpose visitors (anglers only), is $2,069,723/year (using ODWC annual 18,391 visits and Consumer surplus from Model 1 of the travel cost estimation ($112.54)).The total benefits of keeping the trout fishery in operation exceeds the total costs to manage it in all of the tested scenarios from the perspective of ODWC's income and social cost benefit analysis in Section VII.

Part II examined the stated preference methods, i.e. discrete choice analysis of potential management changes to the trout fishery. In this case, a choice experiment was used in order to value the changing three main attributes of the fishery. In Section V, we found that anglers were willing to pay $9.22/year in a trout stamp change for stocking larger fish (from 8-9 inches to 10-12 inches) and $3.41/year in the trout stamp for 20% more fish, but did not significantly prefer creation of a catch and release area on the river. However, by disaggregating anglers, we did find that more educated anglers would prefer creation of a catch and release area. A detailed summary of the answers to specific questions in the survey and characteristics of anglers is given in Part III.

Section VII provides a simple cost benefit analysis of the continued support for the existence of the trout fishery and a basic analysis of whether stocking larger or more trout would be feasible.

Key Results:

Although results are available at the end of each section, key results for the overall study are suggested below.

1. The value of the trout fishery for recreational angling alone outweighs the costs of maintaining the year round fishery for all scenarios tested. It is recommended that the Oklahoma Department of Wildlife conservation continue to stock trout.

2. Changes in management: The willingness to pay for stocking larger trout or more trout is greater than the cost to ODWC. We recommend that they consider these preferences in their stocking plans. We can not definitively say wether creation of catch and release area would benefit users. There is some evidence users with a college education would favor catch and release areas. Although we did not conduct an economic analysis of the willingness to pay for other changes in management, comments on the creel survey and telephone survey suggest that there is a demand for improved facilities on site, such as access to restrooms and litter cleanup.

In addition, the lawsuit pending between, Oklahoma's Attorney General, Drew Edmondson, filed June 13, 2005, against 14 Arkansas poultry companies for pollution of Oklahoma's waterways including the Lower Illinois River suggests that future studies should examine anglers willingness to pay to avoid pollution and the impact of pollution on the number of anglers in the fishery (Maxwell, 2006). Although the turbidity of the dam release will increase the bioavailability of oxygen in water releases, there may be other unforeseen consequences of upstream algae blooms and water quality problems on the downstream trout fishery. This study did not examine the effect of water quality on anglers' willingness to pay for the trip or management changes.

3. Survey techniques.

Additional creel surveys and travel cost surveys should be done at the LIR to obtain data sets for several trout seasons. A larger sample size may be necessary to capture all the variability among visitors to the LIR.

The current study accounts for only for trout user benefits and it excludes the benefits for visitors who engage in only other recreational activities along the LIR as well as the non-use benefits. Failure to include non-anglers and the non-use value of the resource is leads to an underestimation of the total benefits of the LIR.

The use of the two methods, the travel cost to measure the use value of current users and the discrete choice to measure willingness to pay for management changes was essential to measure current and future willingness to pay. However, to evaluate the use value of trout fishing in the state as a whole, a complete mail or phone survey of all anglers for all sites will better measure differences in site quality and allow for substitution among sites. Conducting traditional creel estimation for effort on-site would obviously be cost-prohibitive.

The issue of how the survey is conducted can greatly affect the results of an economic analysis as shown in the section on recall bias (Section VI-2). While on-site interviews may minimize recall bias for certain variables such as the size of fish, other variables such as total trip cost will be underestimated because the trip has yet to be completed. However, follow-up surveys or random mail surveys that do not directly follow a trip may also bias results since respondents may not remember true costs or characteristics of a trip.

4. Estimation of total visits

In the absence of gate admissions for total visitors, many valuation studies of natural resources and recreational sites simply report a per trip value for the recreational experience when often federal regulation or policymakers wish to know the total willingness to pay by all users. Although there are traditional creel count methods such as the car count method, more investigation of probabilistic measures using random weather data is needed to accurately estimate the total number of visitors and total visits to a site. The Poisson Count model in Section VI provides a start for including day specific weather and calendar year information into the likelihood of encountering an angler on site. More improvement in data collection and model specification is needed.

5. Angler Demographics and Satisfaction

Overall anglers are satisfied with the trout fishing experience, 44% ranked the quality of the trout fishing experience as good, but in aggregate 46.3% ranked the trout fishing experience as average or below average. This means that there is a lot of room for improvement in the management of the trout fishing experience at the LIR (additional comments that anglers provided are shown in appendix E).

With respect to angler demographics, 79.9% are between the ages of 16 and 64 years old (including total number in party), and 6.2% are older than 65 years old indicating a large segment of anglers that are in the retirement age. Participation in the trout fishing activity at the LIR is mainly male (89%) and only 11% of anglers interviewed were female. This suggests that there is a need to incorporate more females and younger anglers in trout fishing activities at the LIR. The education distribution among anglers indicates that 40.5% of anglers completed some high school or finished high school, while the rest of the sample (59.5%) have some college education or completed a college degree.

The most important information from the telephone interview is regarding expenditures. The majority of anglers' households (65%) have an income greater than $40,000 per year, whereas the average median household income for Sequoyah County is $27,615 in 2000. The average angler reported a total average expenditure of $146.90 (from telephone survey); if we multiply this number by the total trips to the LIR (18,391, ODWC) we obtain a total expenditures amount of $2,701,638 of which 41% of anglers indicated that they spent all their money within the 25 mile radius of the LIR trout fishery. The total amount spent within 25 miles of the LIR fishery is $1,106,671 creating much needed income for the local service economy.

In sum, the results above support the initial objective of the ODWC in supporting this study. The per trip willingness to pay for trout fishing, justifies the purchase of the water rights to maintain the fishery. The fishery as currently managed, is financially self sufficient from the agency perspective as shown by the financial cost benefit analysis.

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APPENDIX A

LOWER ILLINOIS RIVER TROUT SURVEY

The following survey is a being conducted by researchers at Oklahoma State University and Northeastern State University to determine the demand and impact of fishing on the lower Illinois River and the economic impact on the community. By answering this short questionnaire, you will greatly help improve and protect this resource. We want to assure you that your answers will remain confidential.

1. How many trout did you catch? _________
2. What size were the trout on average? _________inches
3. How many trout did you keep? _________
4. Before you left home, how many fish did you expect to catch on this trip?

   ____
5. Began Fishing _________ am/pm Ended Fishing _________ am/pm
6. Home zip code _________
7. Travel Time _____hours _________minutes
8. Total length of time spent on trip to lower Illinois River? _________
9. How do you view the quality of trout fishing in the lower Illinois overall?

   ☐Poor ☐Fair ☐Average ☐Good ☐Excellent

10. How many **TOTAL** dollars do you expect to spend on this fishing trip?

    ____

    (lodging, meals, snacks, gas, bait, etc.)

Questions about your group and how to improve your fishing experience.

11. Age _____

12. How many people came in the vehicle to the lower Illinois? _____

13. Ages of the people in car? _____

Time: ________am/pm Month ______Day ____ Year

14. Management Scenario # ___ Selection ☐A ☐ B ☐ C (no change)

15. Management Scenario # ____ Selection ☐A ☐ B ☐ C (no change)

16. How far did you go in school?

☐ < 12th grade ☐ H.S. Diploma ☐ Some college ☐ B.S./B.A or higher graduate

17. Is your combined household income greater than $40,000 from all sources?

☐ Yes ☐ No

18. Do you have any additional comments?

____

____

This is the end of the survey. Thank you for your time answering our questions. If we have additional questions, may we call you in the future?

1. ☐YES 2. ☐NO

Name ________________________

Telephone ( ) ____________________

Address: ________________________
(street, city, &
zip) ________________________

Best time to reach you ___________________

To be filled out by the survey taker on site:

19. Date of the Trip:
Time______Month ____ Date & Day _________Year_______ 20. Temperature _________

21. Sex of respondent ☐ Male ☐Female 22. Surveyor: _____________________

Please contact Tracy Boyer, Asst Prof, Agricultural Economics with questions (405) 744-6169 or boyert@okstate.edu

APPENDIX B

LOWER ILLINOIS RIVER PRESSURE CARD

Creel Clerk Name ____

Site Name and Number ____________________________________

Time: _______am or pm

Date: Month (Spell first three)________ Day ______Year_______

Temperature _________

Weather Sunshine☐ Cloudy☐ Windy☐ Rainy ☐ Snowy☐

Vehicle Count on Arrival ____________

Angler Count on Arrival ____________

Time of Departure Time_________am or pm

Vehicle Count on Departure ____________

Angler Count on Departure _____________

Notes: ____

____

____

____

____

APPENDIX C

PREFERENCE SURVEY OF ANGLERS AT THE LOWER ILLINOIS RIVER TROUT FISHERY

Below you will find two management scenarios being considered to improve the lower Illinois River trout area. Please consider among options A, B, and C.

	Option A	Option B	Option C
Catch and Release	30% of Trout area made Catch & Release	30% of Trout area made Catch & Release	NO CHANGE: I would rather keep the management of the L. Illinois trout area the way it is today than pay any increase in the trout license.
Size of Stocked Rainbow Trout	Same as now (8-9 inches)	10-12 inch fish (25% larger than now)	
Numbers of Rainbow Trout	20% more fish which could increase fish reeled in per trip	No change in numbers of stocked fish	
Increase in the yearly trout license fee	$1	$2	

I would choose (check only one) ☐ A ☐ B ☐ C (no change)

	Option A	Option B	Option C
Catch and Release	None No change	30% of Trout area made Catch & Release	NO CHANGE: I would rather keep the management of the L. Illinois trout fishery the way it is today than pay any increase in the trout license.
Size of Stocked Rainbow Trout	10-12 inch fish (25% larger than now)	No change: Same as now (8-9 inches)	
Numbers of Rainbow Trout	No change	No change	
One-time increase in the yearly trout license fee	$2	$2	

I would choose (check only one) ☐ A ☐ B ☐ C (no change)

APPENDIX D

SCRIPT FOR THE TELEPHONE SURVEY

Q:HELLO1
T: 1 1
Hello, this is _____, and I am calling from Oklahoma State University. A short while ago, you answered a brief on-site survey about trout fishing on the lower Illinois River and agreed to let us call you with a few follow-up questions. These questions have to do with that fishing trip and your expenses to go fishing on that trip. We want to assure you that your answers will remain confidential. The interview will take about 10 minutes. Will this be a good time to do the interview?

*ENTER '1' to continue

T:15 1 1
Hello, my name is _____ and I'm calling from Oklahoma State University's Bureau for Social Research. We spoke with _____ previously regarding a trout fishing survey. I'm calling now to finish that interview.

*ENTER '1' to restart

I:
COL 121 21
COL 121 25
NUM 1 1
QAL Notqal

INTDATE = SYSDATE
INTTIME = SYSTIME
CMDI ATTNUM "NumberOfAttempt"
CMDI RECNUM "RecordNumber"
CMDI IWERID "CurrentInterviewerID"

Q: HELLO2
T: 5 1
By answering this short questionnaire about that fishing trip as accurately as you can, you will greatly help improve and protect this resource.

*IWER: SELECT 1 TO CONTINUE,
PRESS (CTRL+END) IF NOT AVAILABLE.

I:
COL 121 9
COL 121 10
NUM 1 1

Q: Q1
T: 5 4

What was the total time you spent on your trip to the lower Illinois River including travel on that trip?

(Starting when you left home and ending when you returned home)

#days/hours/minutes

```
I:
OPN 12 4 15 75
X=ANSLEN Q1
IF (X=0)
 BEEP
 REASK
ENDIF
H:
Picking up others is fine, but no lay-overs
ENDHELP
```

```
Q: Q2a
T: 5 4
```

How many hours did it take you to drive to your fishing area round trip?

Range: 0-20

*IWER: ENTER number of hours here:

0 = less than one hour
88 = don't know
99 = refused

```
I:
COL 121 9
NUM 0 99 2 0 9 45
IF (ANS>20)
 IF (ANS<88)
  BEEP
  REASK
 ENDIF
ENDIF
IF (ANS>88)
 IF (ANS<99)
  BEEP
  REASK
 ENDIF
ENDIF
```

```
Q: Q2b
```

```
T: 5 4
How many minutes did it take you to drive to your fishing area round trip?

            Range: 1-59 minutes

            *IWER:  ENTER number of minutes here:

            88 = don't know
            99 = refused
I:
IF (Q2a <> 0) SKP
COL 121 9
NUM 1 99 2 0 9 47
IF (ANS>59)
 IF (ANS<88)
  BEEP
  REASK
 ENDIF
ENDIF
IF (ANS>88)
 IF (ANS<99)
  BEEP
  REASK
 ENDIF
ENDIF

Q: Qvehic
T: 5 4
What type of vehicle did you drive/ride to your fishing location?
Was it a...?
T: 10 4
1. Car
2. SUV or Truck
3. Recreational vehicle
4. Van/Mini-van
5. Motorcycle
6. Other
[7. INVALID ANSWER]
8. Don't Know
9. Refused to answer
I:
LOC 10 9 1
HLA .3
NUM 1 9
IF (ANS > 6)
  IF (ANS < 8)
```

```
    BEEP
    REASK
  ENDIF
ENDIF
H:
Recreational vehicle includes trucks with 5th wheel

Code two cars as OTHER

Hummers = SUV
ENDHELP

Q: Qvehoth
T: 5 4
What type of vehicle did you drive/ride?
I:
IF (Qvehic <> 6) SKP
OPN 10 4 12 75
X = ANSLEN Qvehoth
IF (X = 0)
  BEEP
  REASK
ENDIF

Q: Qfish
T: 5 4
Was fishing the primary reason for your trip, yes or no?
T: 10 4
1. Yes
2. No
[3. INVALID ANSWER]
[4. INVALID ANSWER]
[5. INVALID ANSWER]
[6. INVALID ANSWER]
[7. INVALID ANSWER]
8. Don't Know
9. Refused to answer
I:
LOC 10 9 1
HLA .3
NUM 1 9
IF (ANS > 2)
  IF (ANS < 8)
    BEEP
    REASK
  ENDIF
```

```
ENDIF

Q: Q3
T: 5 4
Was the purpose of the trip recreation, business, or both recreation
and business?
T: 10 4
1. Recreation
2. Business
3. Recreation and Business
[4. INVALID ANSWER]
[5. INVALID ANSWER]
[6. INVALID ANSWER]
[7. INVALID ANSWER]
8. Don't Know
9. Refused to answer
I:
LOC 10 9 1
HLA .3
NUM 1 9
IF (ANS > 3)
  IF (ANS < 8)
    BEEP
    REASK
  ENDIF
ENDIF

Q: Q4
T: 5 4
What percentage of your trip was spent just on business?

            Range: 0-100%

            *IWER:  ENTER percentage here:

            888 = don't know
            999 = refused
I:
IF (Q3=1) SKP
COL 121 9
NUM 0 999 3 0 9 40
IF (ANS>100)
 IF (ANS<888)
  BEEP
  REASK
 ENDIF
```

```
ENDIF
IF (ANS>888)
 IF (ANS<999)
  BEEP
  REASK
 ENDIF
ENDIF
```

Q: Q5
T: 5 4
How many trout did you catch?

Range: 0-100

*IWER: ENTER number here:

888 = don't know
999 = refused

I:

```
COL 121 9
NUM 0 999 3 0 9 36
IF (ANS>100)
 IF (ANS<888)
  BEEP
  REASK
 ENDIF
ENDIF
IF (ANS>888)
 IF (ANS<999)
  BEEP
  REASK
 ENDIF
ENDIF
```

Q: Q6
T: 5 4
On average - what size were the trout - in inches?

Range: 1-50

*IWER: ENTER inches here:

88 = don't know
99 = refused

I:

```
IF (Q5=0) SKP
```

```
COL 121 9
NUM 1 99 2 0 9 36
IF (ANS>50)
 IF (ANS<88)
  BEEP
  REASK
 ENDIF
ENDIF
IF (ANS>88)
 IF (ANS<99)
  BEEP
  REASK
 ENDIF
ENDIF
```

Q: Q7
T: 5 4
What were the top three species you were TRYING to catch?

*IWER: Mark three choices - IN ORDER

```
I:
COL 121 7
SHOWLIST Q7LIST 10 4 19 1
LOC 10 10 1
OTH 10 19 10 19 65
SEL 10 1 3 0 OFF

FOR Q7LIST
  T=Q7.LISTNUM
  IF (T=10) SAVE Q7OTH
ENDFOR
H:
The three choices refer to the order in which they name the fish.
ENDHELP
```

Q: Q8
T: 5 4
Before you left home, as an INDIVIDUAL, how many trout did you EXPECT to catch on this trip?

Range: 0-100

*IWER: ENTER number here:

888 = don't know

```
      999 = refused
I:
COL 121 10
NUM 0 999 3 0 10 36
IF (ANS>100)
 IF (ANS<888)
  BEEP
  REASK
 ENDIF
ENDIF
IF (ANS>888)
 IF (ANS<999)
  BEEP
  REASK
 ENDIF
ENDIF

Q: Q9
T: 5 4
Did you look up if it was a trout stocking day or not?
T: 10 4
1. Yes
2. No
[3. INVALID ANSWER]
[4. INVALID ANSWER]
[5. INVALID ANSWER]
[6. INVALID ANSWER]
[7. INVALID ANSWER]
8. Don't Know
9. Refused to answer
I:
LOC 10 9 1
HLA .3
NUM 1 9
IF (ANS > 2)
  IF (ANS < 8)
    BEEP
    REASK
  ENDIF
ENDIF
H:
Stocking - the activity of supplying a stock of trout to a body of water.
ENDHELP

Q: Q10
T: 5 4
```

Did you spend time fishing at OTHER locations in the area
- within the same trip?

(Any place other than the trout fishing area along the lower Illinois River.)

```
T: 12 4
1. Yes
2. No
[3. INVALID ANSWER]
[4. INVALID ANSWER]
[5. INVALID ANSWER]
[6. INVALID ANSWER]
[7. INVALID ANSWER]
8. Don't Know
9. Refused to answer
I:
LOC 12 9 1
HLA .3
NUM 1 9
IF (ANS > 2)
  IF (ANS < 8)
    BEEP
    REASK
  ENDIF
ENDIF
```

```
Q: Q11
T: 5 4
```

Could you please tell me what other locations, and how many hours you spent at other locations.

*IWER: RECORD 1) location and 2) # hours for each

```
I:
IF (Q10<>1) SKP
COL 121 8
OPN 10 4 15 75
X=ANSLEN Q11
IF (X=0)
 BEEP
 REASK
ENDIF
H:
```

Other than the 8-mile stretch from south of Tenkiller dam to HWY 63
ENDHELP

Q: Q12a
T: 5 4
Did you engage in any recreational activities other than fishing while on your trip, such as swimming or hiking, yes or no?
T: 10 4
1. Yes
2. No
[3. INVALID ANSWER]
[4. INVALID ANSWER]
[5. INVALID ANSWER]
[6. INVALID ANSWER]
[7. INVALID ANSWER]
8. Don't Know
9. Refused to answer
I:

```
LOC 10 9 1
HLA .3
NUM 1 9
IF (ANS > 2)
  IF (ANS < 8)
    BEEP
    REASK
  ENDIF
ENDIF
```

Q: Q12b
T: 5 4
What recreational activities did you engage in besides fishing?

*IWER: MARK all that apply; READ options...
I:

```
IF (Q12a<>1) SKP
COL 121 7
SHOWLIST Q12BLIST 10 10 15 1
LOC 10 6 1
OTH 6 15 10 15 75
SEL 6 1 6 0

FOR Q12BLIST
  T = Q12B.LISTNUM
  IF (T = 6) SAVE Q12BOTH
ENDFOR
```

Q: Q12c
T: 5 4
What percentage of time did these other recreational activities take

away from your fishing?

Range: 0-100%

*IWER: ENTER percentage here:

888 = don't know
999 = refused

```
I:
IF (Q12a<>1) SKP
COL 121 10
NUM 0 999 3 0 10 40
IF (ANS>100)
 IF (ANS<888)
  BEEP
  REASK
 ENDIF
ENDIF
IF (ANS>888)
 IF (ANS<999)
  BEEP
  REASK
 ENDIF
ENDIF
```

Q: Q13
T: 5 4
How would you rate the quality of this fishing trip?
Would you say it was...
T: 10 4
1. Poor
2. Fair
3. Average
4. Good
5. Excellent
[6. INVALID ANSWER]
[7. INVALID ANSWER]
8. Don't Know
9. Refused to answer

```
I:
LOC 10 9 1
HLA .3
NUM 1 9
IF (ANS > 5)
  IF (ANS < 8)
    BEEP
```

```
    REASK
  ENDIF
ENDIF

Q: Q14
T: 5 4
If you had NOT made this trout fishing trip to the lower Illinois,
what other recreational or pleasurable activity would you have pursued?
Would it have been...
T: 10 4
1. Fishing at another location
2. Fishing for another species
3. A home-based recreational activity like watching TV or gardening
4. A community-based activity like attending a movie or ballgame
5. Other
[6. INVALID ANSWER]
[7. INVALID ANSWER]
8. Don't Know
9. Refused to answer
I:
LOC 10 9 1
HLA .3
NUM 1 9
IF (ANS > 5)
  IF (ANS < 8)
    BEEP
    REASK
  ENDIF
ENDIF
H:
Refers exclusively to TROUT FISHING
ENDHELP

Q: Q14oth
T: 5 4
What other recreational or pleasurable activity would you have pursued?
I:
IF (Q14 <> 5) SKP
OPN 10 4 12 75
X = ANSLEN Q14oth
IF (X = 0)
  BEEP
  REASK
ENDIF

Q: Q14spec
```

T: 5 4
What other location would you have been fishing
- if not the lower Illinois?
I:
IF (Q14 <> 1) SKP
OPN 10 4 15 75
X=ANSLEN Q14spec
IF (X=0)
 BEEP
 REASK
ENDIF

Q: Q15
T: 5 4
In the last year, how many fishing trips did you make to the lower
Illinois trout fishing area (including current trip)?

Range: 1-300

*IWER: ENTER # trips here:

888 = don't know
999 = refused

I:
COL 121 10
NUM 1 999 3 0 10 37
IF (ANS>300)
 IF (ANS<888)
  BEEP
  REASK
 ENDIF
ENDIF
IF (ANS>888)
 IF (ANS<999)
  BEEP
  REASK
 ENDIF
ENDIF
H:
Refers to ALL trips made to the Lower Illinois for trout fishing
- including the trip when they completed the on-site survey.
ENDHELP

Q: Q16
T: 5 4

On average, did you spend the same amount of time fishing on this trip
(to the Lower Illinois) as you normally do, yes or no?
T: 10 4
1. Yes
2. No
[3. INVALID ANSWER]
[4. INVALID ANSWER]
[5. INVALID ANSWER]
[6. INVALID ANSWER]
[7. INVALID ANSWER]
8. Don't Know
9. Refused to answer
I:
```
LOC 10 9 1
HLA .3
NUM 1 9
IF (ANS > 2)
  IF (ANS < 8)
    BEEP
    REASK
  ENDIF
ENDIF
```

Q: Q17num
T: 5 4
What is the average length of all of your trout fishing trips to the
lower Illinois River?

Range: 1-59

*IWER: ENTER # here:

88 = don't know
99 = refused

I:
```
COL 121 10
NUM 1 99 2 0 10 31
IF (ANS>59)
 IF (ANS<88)
  BEEP
  REASK
 ENDIF
ENDIF
IF (ANS>88)
 IF (ANS<99)
  BEEP
```

REASK
ENDIF
ENDIF
H:
Refers exclusively to TROUT FISHING
ENDHELP

Q: Q17typ
T: 5 4
*IWER: ENTER days/hours/minutes

Average Length =
T: 10 4
1 = Days
2 = Hours
3 = Minutes
[4. INVALID ANSWER]
[5. INVALID ANSWER]
[6. INVALID ANSWER]
[7. INVALID ANSWER]
8 = don't know
9 = refused
I:
IF (Q17num = 88) skp
IF (Q17num = 99) skp
COL 121 5
SHOW Q17num 7 21 2
LOC 10 9 1
HLA .3
NUM 1 9
IF (ANS > 3)
IF (ANS < 8)
BEEP
REASK
ENDIF
ENDIF
H:
Refers exclusively to TROUT FISHING
ENDHELP

Q: Q18_1
T: 5 4
Now I am interested in about how much money you spent to make that trout-fishing trip to the Lower Illinois area. I am going to give you some categories of items you might have purchased or paid for on your trip. Please give me an amount that you spent on these goods, or

estimate what percent of your total expenses were used for that category.

How much did you spend on LODGING, such as motel, cabins, or camping fees?

Range: $0-$1,000

*IWER: ENTER $ here:

8888 = don't know
9999 = refused

```
I:
COL 121 15
NUM 0 9999 4 0 15 31
IF (ANS>1000)
 IF (ANS<8888)
  BEEP
  REASK
 ENDIF
ENDIF
IF (ANS>8888)
 IF (ANS<9999)
  BEEP
  REASK
 ENDIF
ENDIF
```

Q: Q18_1DK
T: 5 4
What percentage of your total expenses were spent on LODGING?

Range: 0-100%

*IWER: ENTER percentage here:

888 = don't know
999 = refused

```
I:
IF (Q18_1 <1001) SKP
COL 121 9
NUM 0 999 3 0 9 40
IF (ANS>100)
 IF (ANS<888)
  BEEP
  REASK
 ENDIF
ENDIF
```

```
IF (ANS>888)
 IF (ANS<999)
  BEEP
  REASK
 ENDIF
ENDIF
```

Q: Q18_2
T: 5 4
How much did you spend on FOOD and BEVERAGES - including restaurants and groceries?

Range: $0-$1,000

*IWER: ENTER $ here:

8888 = don't know
9999 = refused

I:

```
COL 121 10
NUM 0 9999 4 0 10 31
IF (ANS>1000)
 IF (ANS<8888)
  BEEP
  REASK
 ENDIF
ENDIF
IF (ANS>8888)
 IF (ANS<9999)
  BEEP
  REASK
 ENDIF
ENDIF
```

H:
Include purchases made at home that were specifically for the trip.
ENDHELP

Q: Q18_2DK
T: 5 4
What percentage of your total expenses were spent on FOOD and BEVERAGES?

Range: 0-100%

*IWER: ENTER percentage here:

888 = don't know
999 = refused

```
I:
IF (Q18_2 <1001) SKP
COL 121 10
NUM 0 999 3 0 10 40
IF (ANS>100)
 IF (ANS<888)
  BEEP
  REASK
 ENDIF
ENDIF
IF (ANS>888)
 IF (ANS<999)
  BEEP
  REASK
 ENDIF
ENDIF
H:
Include purchases made at home that were specifically for the trip.
ENDHELP
```

Q: Q18_3
T: 5 4
How much did you spend on TRANSPORTATION - including gas, oil, and car rental?

Range: $0-$1,000

*IWER: ENTER $ here:

8888 = don't know
9999 = refused

```
I:
COL 121 10
NUM 0 9999 4 0 10 31
IF (ANS>1000)
 IF (ANS<8888)
  BEEP
  REASK
 ENDIF
ENDIF
IF (ANS>8888)
 IF (ANS<9999)
  BEEP
  REASK
```

```
 ENDIF
ENDIF
H:
Include purchases made at home that were specifically for the trip.
ENDHELP

Q: Q18_3DK
T: 5 4
What percentage of your total expenses were spent on TRANSPORTATION?

        Range: 0-100%

        *IWER:  ENTER percentage here:

        888 = don't know
        999 = refused
I:
IF (Q18_3 <1001) SKP
COL 121 9
NUM 0 999 3 0 9 40
IF (ANS>100)
 IF (ANS<888)
  BEEP
  REASK
 ENDIF
ENDIF
IF (ANS>888)
 IF (ANS<999)
  BEEP
  REASK
 ENDIF
ENDIF
H:
Include purchases made at home that were specifically for the trip.
ENDHELP

Q: Q18_4
T: 5 4
How much did you spend on PURCHASED ITEMS - including bait, tackle,
insect repellent, and souvenirs?

        Range: $0-$1,000

        *IWER:  ENTER $ here:

        8888 = don't know
```

```
        9999 = refused
I:
COL 121 10
NUM 0 9999 4 0 10 31
IF (ANS>1000)
 IF (ANS<8888)
  BEEP
  REASK
 ENDIF
ENDIF
IF (ANS>8888)
 IF (ANS<9999)
  BEEP
  REASK
 ENDIF
ENDIF
H:
Include purchases made at home that were specifically for the trip.
ENDHELP

Q: Q18_4DK
T: 5 4
What percentage of your total expenses were spent on PURCHASED ITEMS?

        Range: (0-100%)

        *IWER:  ENTER percentage here:

        888 = don't know
        999 = refused
I:
IF (Q18_4 <1001) SKP
COL 121 9
NUM 0 999 3 0 9 40
IF (ANS>100)
 IF (ANS<888)
  BEEP
  REASK
 ENDIF
ENDIF
IF (ANS>888)
 IF (ANS<999)
  BEEP
  REASK
 ENDIF
ENDIF
```

H:
Include purchases made at home that were specifically for the trip.
ENDHELP

Q: Q18_5
T: 5 4
How much did you spend on PURCHASED SERVICES - such as canoe rentals or fishing guides?

Range: $0-$1,000

*IWER: ENTER $ here:

8888 = don't know
9999 = refused

```
I:
COL 121 10
NUM 0 9999 4 0 10 31
IF (ANS>1000)
 IF (ANS<8888)
  BEEP
  REASK
 ENDIF
ENDIF
IF (ANS>8888)
 IF (ANS<9999)
  BEEP
  REASK
 ENDIF
ENDIF
```

Q: Q18_5DK
T: 5 4
What percentage of your total expenses were spent on PURCHASED SERVICES - such as canoe rentals or fishing guides?

Range: (0-100%)

*IWER: ENTER percentage here:

888 = don't know
999 = refused

```
I:
IF (Q18_5 <1001) SKP
COL 121 10
NUM 0 999 3 0 10 40
```

```
IF (ANS>100)
 IF (ANS<888)
  BEEP
  REASK
 ENDIF
ENDIF
IF (ANS>888)
 IF (ANS<999)
  BEEP
  REASK
 ENDIF
ENDIF
```

Q: Q18_6
T: 5 4
How much did you spend on OTHER expenses?

Range: $0-$1,000

*IWER: ENTER $ here:

8888 = don't know
9999 = refused

I:

```
COL 121 9
NUM 0 9999 4 0 9 31
IF (ANS>1000)
 IF (ANS<8888)
  BEEP
  REASK
 ENDIF
ENDIF
IF (ANS>8888)
 IF (ANS<9999)
  BEEP
  REASK
 ENDIF
ENDIF
```

H:
Include purchases made at home that were specifically for the trip.
ENDHELP

Q: Q18_6DK
T: 5 4
What percentage of your total expenses were spent on OTHER expenses?

```
            Range: 0-100%

            *IWER:  ENTER percentage here:

            888 = don't know
            999 = refused
I:
IF (Q18_6 <1001) SKP
COL 121 9
NUM 0 999 3 0 9 40
IF (ANS>100)
 IF (ANS<888)
  BEEP
  REASK
 ENDIF
ENDIF
IF (ANS>888)
 IF (ANS<999)
  BEEP
  REASK
 ENDIF
ENDIF
H:
Include purchases made at home that were specifically for the trip.
ENDHELP

Q: Q18_6ot
T: 5 4
What were your "other" expenses?
I:
IF (Q18_6 = 0) SKP
OPN 10 4 15 75
X=ANSLEN Q18_6ot
IF (X=0)
 BEEP
 REASK
ENDIF
H:
Refers exclusively to TROUT FISHING

Include purchases made at home that were specifically for the trip.
ENDHELP

Q: Q19
T: 5 4
So, having estimated those previous amounts, what would you say your TOTAL
```

expenditures for this fishing trip were? (You don't have to add up the exact amount)

Range: ($0-$6,000)

*IWER: ENTER $ here:

8888 = don't know
9999 = refused

```
I:
COL 121 11
NUM 0 9999 4 0 11 31
IF (ANS>6000)
 IF (ANS<8888)
  BEEP
  REASK
 ENDIF
ENDIF
IF (ANS>8888)
 IF (ANS<9999)
  BEEP
  REASK
 ENDIF
ENDIF
```

Q: Q20_1
T: 5 4
Now I’m interested in knowing what percentage of your total expenses were spent within the 25 mile area of the lower Illinois River, versus other areas in Oklahoma and areas outside Oklahoma.

So, thinking about your expenses for this trip, what percentage was spent within 25 miles of the lower Illinois River area - but still within Oklahoma?

Range: 0-100%

*IWER: ENTER percentage here:

888 = don't know
999 = refused

```
I:
COL 121 15
NUM 0 999 3 0 15 40
IF (ANS>100)
 IF (ANS<888)
```

```
  BEEP
  REASK
 ENDIF
ENDIF
IF (ANS>888)
 IF (ANS<999)
  BEEP
  REASK
 ENDIF
ENDIF
```

Q: Q20_2
T: 5 4
What percentage was spent outside the 25 mile area of the lower Illinois River - but still within Oklahoma?

Range: 0-100%

*IWER: ENTER percentage here:

888 = don't know
999 = refused

I:

```
COL 121 10
NUM 0 999 3 0 10 40
IF (ANS>100)
 IF (ANS<888)
  BEEP
  REASK
 ENDIF
ENDIF
IF (ANS>888)
 IF (ANS<999)
  BEEP
  REASK
 ENDIF
ENDIF
```

Q: Q20_3
T: 5 4
What percentage was spent outside Oklahoma?

Range: 0-100%

*IWER: ENTER percentage here:

888 = don't know
999 = refused

```
I:
COL 121 9
NUM 0 999 3 0 9 40
IF (ANS>100)
 IF (ANS<888)
  BEEP
  REASK
 ENDIF
ENDIF
IF (ANS>888)
 IF (ANS<999)
  BEEP
  REASK
 ENDIF
ENDIF
```

Q: Qemploy
T: 5 4
Are you currently employed by the hour, on a salary, seeking work,
a homemaker, or retired?

*IWER: Salary individuals are people who work a fixed-hour schedule, such as 9 to 5 Monday through Friday.

T: 12 4
1. employed by the hour
2. on a salary
3. seeking work
4. a homemaker
5. retired
[6. Other]
[7. INVALID ANSWER]
8. Don't Know
9. Refused to answer

```
I:
COL 121 8
COL 121 9
LOC 12 9 1
HLA .3
NUM 1 9
IF (ANS > 6)
  IF (ANS < 8)
    BEEP
    REASK
  ENDIF
```

```
ENDIF

Q: Qempoth
T: 5 4
What is your employment status?
I:
IF (Qemploy <> 6) SKP
OPN 10 4 12 75
X = ANSLEN Qempoth
IF (X = 0)
  BEEP
  REASK
ENDIF

Q: QOVT
I:
OTVAL = RANDNUM (4 6)
PAUSE .3

Q: Q21_4
T: 5 4
If you were to be paid overtime at an additional $4/hour for working
- which would mean you could not fish, would you take the paid
overtime, yes or no?
T: 10 4
1. Yes
2. No
[3. INVALID ANSWER]
[4. INVALID ANSWER]
[5. INVALID ANSWER]
[6. INVALID ANSWER]
[7. INVALID ANSWER]
8. Don't Know
9. Refused to answer
I:
IF (OTVAL <> 4) SKP
LOC 10 9 1
HLA .3
NUM 1 9
IF (ANS > 2)
  IF (ANS < 8)
    BEEP
    REASK
  ENDIF
ENDIF
H:
```

If retired, unemployed or not working:
Assume you were offered $4/hour to skip the fishing trip, would you take the pay?

If salary employee:
Assume you could get overtime pay - at $4/hour - to skip the fishing trip, would you take the pay?
ENDHELP

```
Q: Q21_4Y
T: 5 4
Would you take the overtime if it were lowered to $3.50/hour?
T: 10 4
1. Yes
2. No
[3. INVALID ANSWER]
[4. INVALID ANSWER]
[5. INVALID ANSWER]
[6. INVALID ANSWER]
[7. INVALID ANSWER]
8. Don't Know
9. Refused to answer
I:
IF (OTVAL <> 4) SKP
IF (Q21_4 <> 1) SKP
IF (Q21_4 = 8) SKP
IF (Q21_4 = 9) SKP
LOC 10 9 1
HLA .3
NUM 1 9
IF (ANS > 2)
  IF (ANS < 8)
    BEEP
    REASK
  ENDIF
ENDIF
H:
```

If retired, unemployed or not working:
Assume you were offered $3.50/hour to skip the fishing trip, would you take the pay?

If salary employee:
Assume you could get overtime pay - at $3.50/hour - to skip the fishing trip, would you take the pay?
ENDHELP

Q: Q21_4N
T: 5 4
Would you take the overtime if it were raised to $4.50/hour?
T: 10 4
1. Yes
2. No
[3. INVALID ANSWER]
[4. INVALID ANSWER]
[5. INVALID ANSWER]
[6. INVALID ANSWER]
[7. INVALID ANSWER]
8. Don't Know
9. Refused to answer
I:

```
IF (OTVAL <> 4) SKP
IF (Q21_4 <> 2) SKP
LOC 10 9 1
HLA .3
NUM 1 9
IF (ANS > 2)
  IF (ANS < 8)
    BEEP
    REASK
  ENDIF
ENDIF
```

H:
If retired, unemployed or not working:
Assume you were offered $4.50/hour to skip the fishing trip, would you take the pay?

If salary employee:
Assume you could get overtime pay - at $4.50/hour - to skip the fishing trip, would you take the pay?
ENDHELP

Q: Q21_5
T: 5 4
If you were to be paid overtime at an additional $5/hour for working
- which would mean you could not fish, would you take the paid
overtime, yes or no?
T: 10 4
1. Yes
2. No
[3. INVALID ANSWER]
[4. INVALID ANSWER]
[5. INVALID ANSWER]

[6. INVALID ANSWER]
[7. INVALID ANSWER]
8. Don't Know
9. Refused to answer
I:
IF (OTVAL <> 5) SKP
LOC 10 9 1
HLA .3
NUM 1 9
IF (ANS > 2)
  IF (ANS < 8)
    BEEP
    REASK
  ENDIF
ENDIF
H:
If retired, unemployed or not working:
Assume you were offered $5/hour to skip the fishing trip,
would you take the pay?

If salary employee:
Assume you could get overtime pay - at $5/hour - to skip the fishing trip,
would you take the pay?
ENDHELP

Q: Q21_5Y
T: 5 4
Would you take the overtime if it were lowered to $4.50/hour?
T: 10 4
1. Yes
2. No
[3. INVALID ANSWER]
[4. INVALID ANSWER]
[5. INVALID ANSWER]
[6. INVALID ANSWER]
[7. INVALID ANSWER]
8. Don't Know
9. Refused to answer
I:
IF (OTVAL <> 5) SKP
IF (Q21_5 <> 1) SKP
IF (Q21_5= 8) SKP
IF (Q21_5 = 9) SKP
LOC 10 9 1
HLA .3
NUM 1 9

```
IF (ANS > 2)
  IF (ANS < 8)
    BEEP
    REASK
  ENDIF
ENDIF
H:
If retired, unemployed or not working:
Assume you were offered $4.50/hour to skip the fishing trip,
would you take the pay?

If salary employee:
Assume you could get overtime pay - at $4.50/hour - to skip the fishing trip,
would you take the pay?
ENDHELP

Q: Q21_5N
T: 5 4
Would you take the overtime if it were raised to $5.50/hour?
T: 10 4
1. Yes
2. No
[3. INVALID ANSWER]
[4. INVALID ANSWER]
[5. INVALID ANSWER]
[6. INVALID ANSWER]
[7. INVALID ANSWER]
8. Don't Know
9. Refused to answer
I:
IF (OTVAL <> 5) SKP
IF (Q21_5 <> 2) SKP
LOC 10 9 1
HLA .3
NUM 1 9
IF (ANS > 2)
  IF (ANS < 8)
    BEEP
    REASK
  ENDIF
ENDIF
H:
If retired, unemployed or not working:
Assume you were offered $5.50/hour to skip the fishing trip,
would you take the pay?
```

If salary employee:
Assume you could get overtime pay - at $5.50/hour - to skip the fishing trip,
would you take the pay?
ENDHELP

Q: Q21_6
T: 5 4
If you were to be paid overtime at an additional $6/hour for working
- which would mean you could not fish, would you take the paid
overtime, yes or no?
T: 10 4
1. Yes
2. No
[3. INVALID ANSWER]
[4. INVALID ANSWER]
[5. INVALID ANSWER]
[6. INVALID ANSWER]
[7. INVALID ANSWER]
8. Don't Know
9. Refused to answer
I:
IF (OTVAL <> 6) SKP
LOC 10 9 1
HLA .3
NUM 1 9
IF (ANS > 2)
  IF (ANS < 8)
    BEEP
    REASK
  ENDIF
ENDIF
H:
If retired, unemployed or not working:
Assume you were offered $6/hour to skip the fishing trip,
would you take the pay?

If salary employee:
Assume you could get overtime pay - at $6/hour - to skip the fishing trip,
would you take the pay?
ENDHELP

Q: Q21_6Y
T: 5 4
Would you take the overtime if it were lowered to $5.50/hour?
T: 10 4
1. Yes

2. No
[3. INVALID ANSWER]
[4. INVALID ANSWER]
[5. INVALID ANSWER]
[6. INVALID ANSWER]
[7. INVALID ANSWER]
8. Don't Know
9. Refused to answer
I:

```
IF (OTVAL <> 6) SKP
IF (Q21_6 <> 1) SKP
IF (Q21_6 = 8) SKP
IF (Q21_6 = 9) SKP
LOC 10 9 1
HLA .3
NUM 1 9
IF (ANS > 2)
  IF (ANS < 8)
    BEEP
    REASK
  ENDIF
ENDIF
```

H:
If retired, unemployed or not working:
Assume you were offered $5.50/hour to skip the fishing trip,
would you take the pay?

If salary employee:
Assume you could get overtime pay - at $5.50/hour - to skip the fishing trip,
would you take the pay?
ENDHELP

Q: Q21_6N
T: 5 4
Would you take the overtime if it were raised to $6.50/hour?
T: 10 4
1. Yes
2. No
[3. INVALID ANSWER]
[4. INVALID ANSWER]
[5. INVALID ANSWER]
[6. INVALID ANSWER]
[7. INVALID ANSWER]
8. Don't Know
9. Refused to answer
I:

```
IF (OTVAL <> 6) SKP
IF (Q21_6 <> 2) SKP
LOC 10 9 1
HLA .3
NUM 1 9
IF (ANS > 2)
  IF (ANS < 8)
    BEEP
    REASK
  ENDIF
ENDIF
H:
If retired, unemployed or not working:
Assume you were offered $6.50/hour to skip the fishing trip,
would you take the pay?

If salary employee:
Assume you could get overtime pay - at $6.50/hour - to skip the fishing trip,
would you take the pay?
ENDHELP

Q: Q22
T: 5 4
How many hours would you need to be offered at <SHOW $amount> for you to
skip your trout fishing trip?

            Range: 1-72 hours

            *IWER:  ENTER number of hours here:

            88 = don't know
            99 = refused
I:
IF (Q21_4 = 1)
  IF (Q21_4Y = 1)
   SHOW "$3.50/hour" 5 51 58
  ENDIF
ENDIF

IF (Q21_4 = 1)
  IF (Q21_4Y = 2)
   SHOW "$4.00/hour" 5 51 58
  ENDIF
ENDIF

IF (Q21_4 = 2)
```

```
  IF (Q21_4N = 1)
   SHOW "$4.50/hour" 5 51 58
  ENDIF
ENDIF

IF (Q21_4 = 2)
  IF (Q21_4N = 2)
   SHOW "$4.50/hour" 5 51 58
  ENDIF
ENDIF

IF (Q21_4 = 1)
  IF (Q21_4Y > 2)
   SHOW "$4.00/hour" 5 51 58
  ENDIF
ENDIF

IF (Q21_4 = 2)
  IF (Q21_4N > 2)
   SHOW "$4.50/hour" 5 51 58
  ENDIF
ENDIF

IF (Q21_4 > 2)
  IF (Q21_4N = 1)
   SHOW "$4.50/hour" 5 51 58
  ENDIF
ENDIF

IF (Q21_4 > 2)
  IF (Q21_4N = 2)
   SHOW "$4.50/hour" 5 51 58
  ENDIF
ENDIF

IF (Q21_4 > 2)
  IF (Q21_4N > 2)
   SHOW "$4.50/hour" 5 51 58
  ENDIF
ENDIF

IF (Q21_5 = 1)
  IF (Q21_5Y = 1)
   SHOW "$4.50/hour" 5 51 58
  ENDIF
ENDIF
```

```
IF (Q21_5 = 1)
  IF (Q21_5Y = 2)
   SHOW "$5.00/hour" 5 51 58
  ENDIF
ENDIF

IF (Q21_5 = 2)
  IF (Q21_5N = 1)
   SHOW "$5.50/hour" 5 51 58
  ENDIF
ENDIF

IF (Q21_5 = 2)
  IF (Q21_5N = 2)
   SHOW "$5.50/hour" 5 51 58
  ENDIF
ENDIF

IF (Q21_5 = 1)
  IF (Q21_5Y > 2)
   SHOW "$5.00/hour" 5 51 58
  ENDIF
ENDIF

IF (Q21_5 = 2)
  IF (Q21_5N > 2)
   SHOW "$5.50/hour" 5 51 58
  ENDIF
ENDIF

IF (Q21_5 > 2)
  IF (Q21_5N = 1)
   SHOW "$5.50/hour" 5 51 58
  ENDIF
ENDIF

IF (Q21_5 > 2)
  IF (Q21_5N = 2)
   SHOW "$5.50/hour" 5 51 58
  ENDIF
ENDIF

IF (Q21_5 > 2)
  IF (Q21_5N > 2)
   SHOW "$5.50/hour" 5 51 58
```

```
  ENDIF
ENDIF

IF (Q21_6 = 1)
  IF (Q21_6Y = 1)
   SHOW "$5.50/hour" 5 51 58
  ENDIF
ENDIF

IF (Q21_6 = 1)
  IF (Q21_6Y = 2)
   SHOW "$6.00/hour" 5 51 58
  ENDIF
ENDIF

IF (Q21_6 = 2)
  IF (Q21_6N = 1)
   SHOW "$6.50/hour" 5 51 58
  ENDIF
ENDIF

IF (Q21_6 = 2)
  IF (Q21_6N = 2)
   SHOW "$6.50/hour" 5 51 58
  ENDIF
ENDIF

IF (Q21_6 = 1)
  IF (Q21_6Y > 2)
   SHOW "$6.00/hour" 5 51 58
  ENDIF
ENDIF

IF (Q21_6 = 2)
  IF (Q21_6N > 2)
   SHOW "$6.50/hour" 5 51 58
  ENDIF
ENDIF

IF (Q21_6 > 2)
  IF (Q21_6N = 1)
   SHOW "$6.50/hour" 5 51 58
  ENDIF
ENDIF

IF (Q21_6 > 2)
```

```
  IF (Q21_6N = 2)
   SHOW "$6.50/hour" 5 51 58
  ENDIF
ENDIF

IF (Q21_6 > 2)
  IF (Q21_6N > 2)
   SHOW "$6.50/hour" 5 51 58
  ENDIF
ENDIF


COL 121 10
NUM 1 99 2 0 10 45
IF (ANS>72)
 IF (ANS<88)
  BEEP
  REASK
 ENDIF
ENDIF
IF (ANS>88)
 IF (ANS<99)
  BEEP
  REASK
 ENDIF
ENDIF
H:
Refers exclusively to TROUT FISHING
ENDHELP


Q: Q23
T: 5 4
What other locations in Oklahoma have you trout fished in the
last year?

            *IWER:  MARK all that apply
I:
COL 121 8
SHOWLIST Q23LIST 10 10 20 1
LOC 10 11 1
OTH 10 19 10 19 65
SEL 11 1 10 0

FOR Q23LIST
 T = Q23.LISTNUM
```

```
 IF (T=10) SAVE Q23OTH
ENDFOR

Q: Q24
T: 5 4
How do you view the quality of trout fishing on the lower Illinois
overall?  Would you say it is...
T: 10 4
1. Poor
2. Fair
3. Average
4. Good
5. Excellent
[6. INVALID ANSWER]
[7. INVALID ANSWER]
8. Don't Know
9. Refused to answer
I:
LOC 10 9 1
HLA .3
NUM 1 9
IF (ANS > 5)
  IF (ANS < 8)
    BEEP
    REASK
  ENDIF
ENDIF

Q: Q25
T: 5 4
We're almost finished with the interview. Now I need to ask a
few questions about you.  What is your age?

            Range: 1-110 years old

            *IWER:  ENTER age here:

            888 = don't know
            999 = refused
I:
COL 121 10
NUM 1 999 3 0 10 33
IF (ANS>110)
 IF (ANS<888)
  BEEP
  REASK
```

```
 ENDIF
ENDIF
IF (ANS>888)
 IF (ANS<999)
  BEEP
  REASK
 ENDIF
ENDIF
```

Q: Q26
T: 5 4
How many other people came in the vehicle to the lower Illinois?

Range: 0-10 persons

*IWER: ENTER #persons here:

88 = don't know
99 = refused

I:

```
COL 121 9
NUM 0 99 2 0 9 38
IF (ANS>10)
 IF (ANS<88)
  BEEP
  REASK
 ENDIF
ENDIF
IF (ANS>88)
 IF (ANS<99)
  BEEP
  REASK
 ENDIF
ENDIF
```

H:
Persons must be traveling in the same vehicle with the respondent.
ENDHELP

Q: Q27
T: 5 4
What are the ages of the other people in the car?
I:

```
IF (Q26 = 0) SKP
IF (Q26 = 8) SKP
IF (Q26 = 9) SKP
OPN 10 4 15 75
```

```
X=ANSLEN Q27
IF (X=0)
 BEEP
 REASK
ENDIF
```

Q: Q28
T: 5 4
Not including yourself, how many other people are currently living in your household?

Range: 0-10 persons

*IWER: ENTER #persons here:

88 = don't know
99 = refused

```
I:
COL 121 10
NUM 0 99 2 0 10 38
IF (ANS>10)
 IF (ANS<88)
  BEEP
  REASK
 ENDIF
ENDIF
IF (ANS>88)
 IF (ANS<99)
  BEEP
  REASK
 ENDIF
ENDIF
```

Q: Q29
T: 5 4
How many of these individuals are wage earners?

Range: 0-10 persons

*IWER: ENTER # wage earners here:

88 = don't know
99 = refused

```
I:
If (Q28 = 0) SKP
COL 121 9
```

```
NUM 0 99 2 0 9 44
IF (ANS>10)
 IF (ANS<88)
  BEEP
  REASK
 ENDIF
ENDIF
IF (ANS>88)
 IF (ANS<99)
  BEEP
  REASK
 ENDIF
ENDIF
H:
A person who contributes to the houshold living expenses with regular
or consistent employement.
ENDHELP
```

```
Q: Qidearn
T: 5 4
As we said in the beginning, all answers will remain confidential.
Could you please estimate your INDIVIDUAL earnings per year?

        Range 0 - $100,000

        *IWER:  enter amount given here:

        888,888 = Don't Know
        999,999 = Refused
        Press F1 to enter range
I:
COL 121 10
NUM 0 999999 6 0 10 42
IF (ANS>100000)
 IF (ANS<888888)
  BEEP
  REASK
 ENDIF
ENDIF
IF (ANS>888888)
 IF (ANS<999999)
  BEEP
  REASK
 ENDIF
ENDIF
```

Q: Q30
T: 1 4
Could you please estimate the total household income per year
(income from all sources)?
T: 5 4
1. Under $5000
2. $5000- but less than $10,000
3. $10,000- but less than 15,000
4. $15,000- but less than 20,000
5. $20,000- but less than 25,000
6. $25,000- but less than 30,000
7. $30,000- but less than 35,000
8. $35,000- but less than 40,000
9. $40,000- but less than 45,000
10. $45,000- but less than 50,000
11. $50,000- but less than 55,000
12. $55,000- but less than 60,000
13. $60,000 or more

*IWER: ENTER response here:

88 Don't know
99 Refused

```
I:
COL 121 19
NUM 1 99 2 0 19 37
IF (ANS>13)
 IF (ANS<88)
  BEEP
  REASK
 ENDIF
ENDIF
IF (ANS>88)
 IF (ANS<99)
  BEEP
  REASK
 ENDIF
ENDIF
H:
What did you report on your taxes?
ENDHELP
```

Q: Q31
T: 5 4
*IWER: RECORD gender of respondent:
T: 10 4

1. Male
2. Female
[3. INVALID ANSWER]
[4. INVALID ANSWER]
[5. INVALID ANSWER]
[6. INVALID ANSWER]
[7. INVALID ANSWER]
8. Don't Know
9. Refused to answer
I:

```
LOC 10 9 1
HLA .3
NUM 1 9
IF (ANS > 2)
  IF (ANS < 8)
    BEEP
    REASK
  ENDIF
ENDIF

CPL
DISPOS = 110
```

Q:THANK
T: 5 4
Those are all of my questions. Thank you for your participation!
I:

```
PAUSE 4
ENDQUEST
```

Q:Notqal
T: 5 4
I'm sorry, but we need to speak to persons who completed an onsite trout survey. Thank you for your time.

*IWER: PRESS '1' to terminate

I:

```
COL 121 8
NUM 1 1
ENDQUEST
```

APPENDIX E

OKLAHOMA STATE UNIVERSITY IRB APPROVAL

Oklahoma State University
Institutional Review Board

Protocol Expires: 8/12/2004

Date: Wednesday, August 13, 2003 IRB Application No AS046

Proposal Title: A SOCIO-ECONOMIC EVALUATION OF THE LOWER ILLINOIS RIVER FISHERY

Principal
Investigator(s):

Dana Winkelman	Tracy Boyer
432 LSW	321 Ag Hall
Stillwater, OK 74078	Stillwater, OK 74078

Reviewed and
Processed as: Exempt

Approval Status Recommended by Reviewer(s): Approved

Dear PI :

Your IRB application referenced above has been approved for one calendar year. Please make note of the expiration date indicated above. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

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

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved projects are subject to monitoring by the IRB. If you have questions about the IRB procedures or need any assistance from the Board, please contact Sharon Bacher, the Executive Secretary to the IRB, in 415 Whitehurst (phone: 405-744-5700, sbacher@okstate.edu).

Sincerely,

Carol Olson, Chair
Institutional Review Board

APPENDIX F

ANGLERS COMMENTS REGARDING THE LOWER ILLINOIS RIVER

1. Conditions were bad or I would have probably caught more. I did enjoy it although I did not catch a lot of fish. I would be more likely to return had I caught more fish.
2. Every time I go I take a garbage bag with me to pick up garbage. I would like a garbage bin placed at the entrance and exit points with more general cleanup of the area.
3. I believe we could have an excellent trout fishery if the state and the Corps of Engineers could work together.
4. I do not see the need for the increase in price for the license, and I think they should release bigger fish.
5. I don't ordinarily trout fish. I usually fish lakes, so trout fishing is kind of different for me.
6. I enjoyed it but wish I had caught some fish. I enjoyed it and will definitely go back.
7. I enjoyed it. I caught some fish, at least.
8. I enjoyed the trip but not the fishing.
9. I feel that the area is under funded and underutilized.
10. I find the rates for the trout stamp too expensive. I fished in Canada, bought a license for one year and it cost less than half of what it costs here. It was all inclusive for any fish type. The state should cease stocking of striper fish.
11. I hope the state puts in the fish habitat to hold the fish a little better so we don't lose so many.
12. I just enjoy it, we both do, and we'd like to see some bigger fish down there.
13. I just hope that they can control the flows out of there, because the oxygen levels deplete when the water levels drop. This would make it a better quality fishing area.
14. I just wish that they could stock bigger fish and do more of it.
15. I just wish the fish were bigger.
16. I just wish they would do something that other states do. New Mexico makes the first 1/8 mi. below the dam quality water; you can only fly fish, use barb less hooks and its catch and release only. It does less damage to the fish and most survive.
17. I just wish they would fix it to where if you didn't want to keep the trout and just fish, you could do it for about $5 or something.
18. I just wish they'd release some bigger trout.
19. I know they've been working on the dam & they haven't been doing many water releases, but that's the first time I've fished there and not had the water flowing because it was so low, which needs fixed. I know it's probably come up 6'-7', but trout have to
20. I really appreciate the surveying to improve the area.
21. I really appreciate the trout that are stocked in the Lower Illinois.
22. I sell fishing equipment, so I just ask that people continue fishing!
23. I think fishing is good in the state of Oklahoma.
24. I think some improvements need to be made to the river as far as various dams and when they are generating; it could improve the fishing. Stocking isn't the problem,

it's getting it to where it could be fished, because they're ruining the fishing business

25. I think some of the fish that get stocked there are too small.
26. I think that the management is not very good. They need a catch and release area, and they would grow some great big fish. There isn't a lot of other games in town for those who like to fly fish, and that could make a big tourist attraction and generate
27. I think that we would benefit from a "catch and release" area for those who plan to do so. We need 1 at Marvel, the dam section & the river road access. If not at all 3 we need one at least 1. We need game wardens, signs to report over catching/courteous.
28. I think they should wait for the trout to get to be 12 inches before they stock them. It's hard to eat them if they're smaller. Others turn back those smaller fish and then they die.
29. I think they're doing a great job there.
30. I thought it went rather well.
31. I understand the rate schedule and the power structure, as far as paying for the trout stamp, but I do resent some of the "power-baiters" who fish over their limit. That doesn't seem fair.
32. I want a catch and release section, a trophy section. They ought to not allow lawn chairs. People around here don't know how to trout fish. Also, a lot of people are cheating, taking more trout than the limit. They should have a full-time game warden.
33. I want a trash can down there by the river. There's a lot of littering because there's not a trash can close by. People are too lazy to walk to the parking lot to the dumpster.
34. I was disappointed that I didn't catch any trout.
35. I went again about a month later and was quite successful and quite pleased.
36. I wish that they would stock larger trout, and I also wish that they would quit running the water so profusely on the days that they stock the trout. You can't catch them because the water is coming so fast that you can't get to them and washes them downs
37. I wish there were larger fish. They could put in larger fish when they stock.
38. I wish they could farm bigger rainbows.
39. I wish they would do something about the river such as more boulder dams and jay-hooks. There also needs to be something done about the washout.
40. I wish they would stock bigger fish. I think the new management at Marvel's has had a very good impact on the area. I really enjoy the area and the river.
41. I wish they would stock it with bigger trout somehow, and also that they would stock more brown trout. I'd rather catch fewer big trout than a lot of small ones.
42. I would like more access points along the river for trout fisherman, Ideally I would like to see you regulate the water flowing to be more accommodating to fisherman. Stock bigger trout and more of them.
43. I would like to re-emphasize that I would like larger trout instead of more trout.
44. I would like to see bigger trout and more browns stocked, the roads by the gravel pit needs to be removed.

45. I would like to see more improvements done and am looking forward to when they get the work on the dam done. Glad they enacted the scenic river legislation; it was really a positive thing.
46. I would like to see more supervision along the river. I see violations, like people taking more than their limit, using more than one rod, netting and snagging. A lot of people fish without trout stamps, especially at Marvel's during tournaments.
47. I would like to see some quality water, catch and release, and no bait fishermen.
48. I would like to see the area cleaner around the river.
49. I would like to see the fishery managed better, for example, water flow and things of that nature.
50. I would like to see the rangers have a greater presence on the River.
51. I would like to see them stock a little bit bigger trout, maybe gets some feeders down in there.
52. I'd like to have bigger fish.
53. I'd like to see them stock bigger trout. We pay more money, but the fish are small. Arkansas has big trout, and they didn't go up on their prices. I feel like we got gypped.
54. If the river would shop around for a better hatchery, they could get higher quality trout for cheaper. I know there are a few hatcheries within 100 miles.
55. If they could post when they are going to let the water through the dam it would really be an advantage to the fishermen.
56. If they raise the trout fishing license price again, I will not purchase one. They just raised it last year. I think the trout fishing up there is a good resource for us Oklahomans. I hope they don't screw that up.
57. If you fish any other place in the country, there are boulders, trees, structures for fish, & I've noticed that this river is a straight line with no natural habitat for the fish. This is not good for the fish or fishermen. They need to create something
58. I'm handicapped, and it's really hard to get around. There's no place for handicapped people. There's no ramp near the dam.
59. I'm just glad you're looking into it; because I'm sure you'll take the data and do something good with it.
60. I'm leaving today to go try it again with two other people. We're going to be there four days. I liked it enough that I'm going to go back and really try to trout fish a lot more.
61. I'm thankful for fishing; I think the game and fish department for Oklahoma is wonderful and have done a good job bringing trout into Oklahoma.
62. It didn't look like they have been stocking in a while which is probably why the fishing is lousy.
63. It is a great place.
64. It was a great trip, and I'd enjoy doing that just over and over again.
65. It was a lot of fun.
66. It was a really good trip and is really fun to fish down there. It would help if they made the water a little lower.
67. It was gorgeous and I really enjoyed it.
68. It was great. I enjoyed every minute and I plan on going back. I'll try to pick a time when the weather is better.

69. It was primarily a camping trip. The secondary reason was for fishing. We try to go during the week to miss the crowds and actually get some fishing in.
70. It was wonderful!
71. It would be better if they stocked larger sized fish.
72. It would be nice if they improved the river conditions such as there needs to be some boulder dams to prevent flooding and displacement of rocks. The water could be cleaner.
73. It's a beautiful spot, beautiful camping with great scenery. Fishing wasn't that good but we more or less go for recreation. Catching fish is icing on the cake.
74. Just I wish they could make the fish larger there. They tend to be small because it's a new thing in Oklahoma. I don't know if that's the water quality or what.
75. Just stock bigger trout.
76. Just the licensing fees are a little high for out of state. For only 3 days, it's 28 dollars, so it's like you might as well buy the year-round license. To have the trout stamp, that's a lot of extra money.
77. My concern about the Lower Illinois is that they could stock more. I feel it should be hook and release. Safety concern; we never know that the water is rising at the dam.
78. Need better access to the river and more nicer restrooms.
79. No, but the water was really muddy which was the main problem.
80. No, but we're glad to have that facility so close to home (Ft. Smith), but I wish it was basically all catch and release, though.
81. No, I had a good time.
82. No, I just hope they keep doing what they're doing and run a little more water so we can keep getting out there.
83. No, I'm just happy that they're starting to collect some data. I would like to see a minimum flow to enhance the trout population and a little more predictable waters. Otherwise, I don't know much about this area--I fish all over the nation.
84. No, it was beautiful. I love the outdoors here in Oklahoma, I've been here 23 years. I wish we could catch more trout and that they would stock bigger trout and it wouldn't bother me if they raised the trout.
85. No, not at this time.
86. No, not really. They need a better place to determine the water levels. The information was supposed to be available on the internet, but not accurate.
87. No, other than it's close enough for me to do as a day thing or just for the afternoon to run over and fish. I can do this within an hour's drive.
88. No. I just usually enjoy it quite a bit. It's my getaway year round.
89. No. It was enjoyable, even though we didn't catch a lot of fish. I'm going Thursday. It's really clean and nice.
90. Not really. I like the scenery there. I wish there was a little bit more camping in the area. It's pleasant. Be careful of the habitat so it doesn't screw up the fishing.
91. On the on-site survey, I think one question had to deal with individuals have their lifetime license. If you have your lifetime license, the survey taker said it cost over $10 for a trout stamp. If you don't, it's only $10.

92. Only thing I wish they would do is to stock a little bit bigger trout if that's possible, because so many of the smaller ones are killed when they're hooked too deep, and the fish dies.
93. Other times we do spend money in Oklahoma (for food, licenses, recreation, gas etc.) This trip it was not necessary. Quality of environment at Broken Bow is much better. It would be a benefit if the state could take over the operation of the Illinois.
94. Put more fish in.
95. Stock bigger trout and put up places that hold more water and keep the water running more steadily.
96. Stock them a little bigger!
97. That particular trip was just a run out to pre-fish the area, because a couple of days later I did a guide (bringing people with me, stayed longer, spent more money, etc.).
98. The biggest problem is not knowing when the water will be flowing or not. You have to drive a long way and then you don't know what the water level is going to be like. The number of fish hasn't been great this year and the water quality has deteriorated.
99. The corps is improving the fishing on the river, so that's great!
100. The Corps of Engineer needs to run water more often in the summer with a pre-set schedule. The moss was really bad last summer, and that started when the bridge collapsed two years ago
101. The people who operate the generation put a schedule on their tape and take every opportunity to change it. Fisherman are very unhappy, there is no consideration for them. Quality of fish has gone down while license prices have gone up; no correlation.
102. The problem I have when I go down there is to time it when they've stocked. Otherwise, it's not worth going down there. If they stocked every week, I might get down there more.
103. The quality of the water this year seems to be the worst I've ever seen. There is a lot of stagnant, green water even though the water was moving. Also water seemed warmer. The water quality seems to be going down.
104. The regulating agency (I don't know who it is) needs to make better publications of maps and access to the rivers. I had no idea the place I went to was there. I thought I might have been trespassing, but I found the road. They need to show public/private
105. The river was too cloudy. Feels like the water quality put the trip off and not the trout stockers or anything else.
106. The state has a beautiful habitat but they are not taking care of it; needs to be cleaned up and the state needs to spend more money on it. Needs a constant water flow. Bathrooms are atrocious. Publicize when generating. Has no game enforcement.
107. The trout could be a little bigger.
108. The water was cold.
109. There needs to be a corporation between sportsmen, taxpayers, the corps of engineers, etc. This would greatly improve the river. If the corps of engineers would maintain a minimum flow, they would raise the fish.

110. There needs to be more access to the Lower Illinois. Especially closer to Highway 64. Gore Landing is the last exit and it's closed off all the way down Highway 64 so they can't fish off the bank unless they walk all the way down there.
111. They need more fish.
112. They are talking a lot about catch and release areas to increase the size of the trout, but a lot of them in Idaho and Illinois are barb less hooks (mainly for the cutthroat streams), which is safer for the fish and increased the survivability of the trout
113. They could do a bit of cleanup on the bathrooms. It was awful. We began going to one by the dam, and that's the only ones they have down there, and if you have to use the restroom, you have to go 15 miles up the Gore to use the bathroom, I want a seat.
114. They had done some habitat work on the river and I was really impressed with that. I have fished that river off and on and the only reason I went this time was to teach my daughter-in-law to fly fish. The insect abundance in the river was a lot lower.
115. They need a one-day fishing license for non-residents. It's ridiculous to pay $28.50 for one day catching 5" fish. A lot of other states have that, and it's a better deal and there is better fishing there, too.
116. They need more trashcans.
117. They need to do something about the water on Lake Tenkiller and the Lower Illinois. It smells like sulfur and is very muddy.
118. They need to put a hatchery below the Tenkiller Dam.
119. They need to put bigger fish in.
120. They need to stock more quality instead of quantity. They need to stock bigger fish.
121. They ought to let us catch eight fish; sometimes I go and they don't stock on the days that they are supposed to. I think that this is unfair because it's paid for in my license.
122. They should not have over-stocked the Brown Trout, because they are overtaking the Rainbows.
123. They stocked too many baby Brown Trout, it caused the Rainbow Trout to go downstream. If they're going to raise the trout stamp again, there needs to be more stocking locations.
124. Trout fishing is more of a year round species which makes them a little more accessible year round.
125. Usually when I go down there, I don't expect too much. Fishing for trout in the summer isn't usually good, so I try for stripers in the summer. In the winter and fall, trout usually gets better. I think because the water is colder.
126. Water flow does not seem to be enough to keep the fish healthy. When they generate you can't fish because it's so dirty. There is no medium. It is either too heavy or not enough.
127. We always have fun, but sometimes get cut off when the water is up.
128. We enjoy Marvel Resort. They changed ownership, and we like the changes.
129. We enjoy the trips whether we catch any fish or not. We enjoy just being out there.
130. We had a good time; it was just really bad weather with a lot of rain and storms.

131. We just enjoy fishing. We always have, and it's something that we both can do; it's just something that we love.
132. We just need more trout and a little more control on the water.
133. We love going.
134. We went down to Robbers Cave and they have little roads, real restrooms, 30-40 campsites, etc. The Lower Illinois needs better restrooms and picnic areas on the river itself, with a place to wash our hands and use the restroom; then it would be awesome,
135. When the people stock, they advertise it, so people come and fish it out right away. I think they should close off areas of the river and keep them strictly for stocking so that the fish can grow.
136. When they turn the generators on turn both on so that it circulates the water, and cut them both off at the same time.
137. When you're on the Illinois trout fishing is always excellent.
138. While we were there, we were treated very well at the campground on the lake. It was very nice facilities. The fishing is good on the Lower Illinois, but I'd like to see more public access points.
139. Would like to have a way to tell when the water is up.
140. Yeah, they need slow down with the spillway, it ruins my favorite spot. I can't wade the river because of that.

VITA

Baltazar E. Prado

Candidate for the Degree of

DOCTOR OF PHILOSOPHY

Dissertation: ECONOMIC VALUATION OF THE LOWER ILLINOIS TROUT FISHERY IN OKLAHOMA UNDER CURRENT AND HYPOTHETICAL MANAGEMENT PLANS

Major Field: Agricultural Economics

Biographical:

Personal Data**:** Born in San Salvador, El Salvador, on May 29, 1976, the son of Baltazar Prado and Julia Araniva.

Education: Graduated from 'Zamorano' Pan-American School of Agriculture with an Associates degree in Agronomy, December 1997; received a Bachelor of Science degree in Agricultural Operations Management from the University of Florida, Gainesville, December 1998; received a Master of Science degree in Agricultural Economics from Oklahoma State University, May 2004; completed the requirements for the Doctor of Philosophy degree in Agricultural Economics at Oklahoma State University in July 2006.

Experience: Graduate Research Assistant, Oklahoma State University, Department of Agricultural Economics, August 2004 to June 2006; Extensionist, USAID-SalvaNatura water project, March 2001 to July 2002; Farm Manager for the Botanical Gardens of El Salvador, January 2000 to March 2001;Assistant Grower for Lovell Farms Inc, Miami FL, January 1999 to December 1999.

Name: Baltazar Prado Date of Degree: July, 2006

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: ECONOMIC VALUATION OF THE LOWER ILLINOIS TROUT FISHERY IN OKLAHOMA UNDER CURRENT AND HYPOTHETICAL MANAGEMENT PLANS

Pages in Study: 252 Candidate for the Degree of Doctor of Philosophy

Major Field: Agricultural Economics

Scope and Method of Study: A valuation study of the Lower Illinois River trout fishery in northeastern Oklahoma estimated users' demand for trout angling, visitation rates, and economic efficiency of maintaining the resource. During 2004, an on-site creel survey and a discrete choice survey were conducted to estimate visitation rates and preferences for different management changes in the fishery. A follow-up interview was given by telephone to gather travel cost and demographic information. A travel cost model was used to measure demand for angling using a negative binomial count model. Results from the on-site and telephone survey were statistically tested for recall bias. The total visitation rate was estimated using a traditional angler and car count method and a poisson count model. A simple cost-benefit framework to test feasibility of the project and management changes was conducted.

Findings and Conclusions: The calculated average consumer surplus per angler per recreation day is estimated at $112.54 with a 90% confidence interval between ($79.19, $194.38). For those who went for multiple recreation activities, the average consumer surplus per person per recreation day is $31.66. The total consumer surplus generated from the LIR trout fishery, assuming all visitors are single purpose visitors (anglers only), is $2,069,723/year (using annual 18,391 annual visits). The total benefits of keeping the trout fishery in operation exceeds the total costs to manage it in all of the tested scenarios in both the financial and social cost benefit analysis. A comparison of travel costs obtained by the on site reported travel costs and the phone interview travel cost responses (a month later) showed the mean difference in travel costs was $50.36 and was attributed to incomplete trips on site and potential recall bias. The discrete choice experiment indicated that anglers are willing to pay for an increase in the size of the stocked trout in the amount of $9.22/ year and $3.41/ year for an increase of 20% in the number of rainbow trout stocked. The creation of catch and release areas is not preferred.

ADVISER'S APPROVAL: Dr. Tracy Boyer