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Potential policy decisions regarding fly fishing in the Yellowstone National Park Area could severely impact the enjoyment possibilities of many of its users. In order to determine the magnitude of the impact, this paper applies a form of the basic travel cost model developed by Bell and Leeworthy [JEEM. 18,189-205 (1990)] to fishing sites in the Yellowstone National Park Area. Bell and Leeworthy have argued that consumer demand for the time spent at a recreation site is inversely related to on-site cost per day, and may be positively related to travel cost per trip. The paper discusses relevant literature on the method, presents background information on the site, and generates a demand curve for users of the resource. A consumer surplus measurement is then derived from the resulting demand data, which gives an estimate for the value of the resource; the consumer surplus is determined to be roughly $751.88 per day spent at the site. The assumptions of the model are then discussed, and an assessment is made of the potential policy implications.

Recreational Demand for Fishing in the
Yellowstone National Park Area: A Travel Cost Model

by

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Scott Elliot Lowe, Author

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Recreational Demand for Fishing in the Yellowstone National Park Area: A Travel Cost Model

INTRODUCTION

Fly fishing has become one of the fastest growing recreational activities in the United States. In 1991, 16 percent of the population (31 million U.S. citizens) participated in freshwater fishing, and spent over 24 billion dollars in the process (Nowell and Kerkvliet, 1994; Johnson and Adams, 1989; U.S. Fish and Wildlife Service, 1991). As with most popular recreational activities, fly fishing has enjoyed an abundance of publicity and endorsement of late, feeding on its own popularity. Fly fishing, as a recreational activity, is not limited to specific age groups or gender, and appeals to members of all socioeconomic classes. Because of this, fly fishing has become a major industry in the United States, and an important component of many local economies.

The area in and around Yellowstone National Park, the birthplace of the National Park movement, offers some of the finest freshwater angling opportunities in the world. The plenitude of accessible trout streams, replete with large, wild fish and scenic environs, provides recreational anglers with one of the greatest fishing paradises on the earth (Brooks, 1984). The Greater Yellowstone Area serves as the headwaters of four major river systems: the Yellowstone, the Snake, the Green and the Missouri rivers. These rivers support a "matchless trout fishery, and are the lifeblood for agriculture and for the towns and cities of the region" (Greater Yellowstone Coalition, 1994). This is especially true of some towns in the Greater Yellowstone Area, including Ennis, Gardner, Bozeman, Livingston and West Yellowstone. More than 220,000 people live in the Greater Yellowstone Area ecosystem; just as the wildlands of Yellowstone support their natural inhabitants, so do they affect the livelihood of the people who call it home (Greater Yellowstone Coalition, 1994). Clearly this is relevant to the U.S. National Park Service's consideration to alter fishing practices in the National Parks. As a preserve, some argue that to promote fishing in the National Parks is in direct violation of their primary purpose (LaPierre, 1993). Policy measures to restrict recreational fishing within the National Parks System could severely impact the surrounding communities.

The purpose of this paper is to estimate the value of the fly fishing resource in the Greater Yellowstone Area. The travel cost method has proven to be an effective revealed preference method by which to measure the benefits provided by a potential recreation site (Mendelsohn and Markstrom, 1988). In the process of measuring these benefits, a brief history of the use of the travel cost method is given (II.). A relatively new form for the model is then proposed, and the implicit assumptions surrounding it are discussed; in particular, the theoretical base of the model is discussed.(III.)The model is then estimated using information obtained from a survey of fishers visiting the Greater Yellowstone Area. The results are estimates of the corresponding demand curves for total fishing days. (IV) From these demand curves, the consumer surplus associated with fly fishing is estimated. (V.) And finally, the implications of these estimates are discussed in the conclusion.

A MODEL OF RECREATIONAL BEHAVIOR

The simple travel cost model of valuing non-market resources was first suggested by Harold Hotelling (1949) in a letter to the Director of the National Park service. Hotelling thought that the benefits to the public could be measured by determining the individual costs of travel to the parks. Clawson and Knetsch (1966) then developed the formal method and popularized its application. The travel cost method (TCM) of Clawson and Knetsch posits that the recreationist will continue to make trips to the given recreation site until the marginal benefit of the last trip is just equal to the cost of getting there. The value of the resource is the excess value of the trip over the travel cost.

The TCM relies on several assumptions, the most significant of which are listed here: First, for each trip to the site, the sole purpose of the recreationist is to visit the site. The added complication of joint costs is difficult to apply to the basic TCM (Freeman, 1993). Second, there is no utility or disutility from the time spent in the process of traveling to the site. Third, the opportunity cost of the trip is the wage rate of the recreationist. Fourth, all visits are of the same duration. Fifth, there are no alternative recreation sites available to the recreationist (Freeman, 1993). Sixth, the recreationist responds to an increase in travel cost the same way that they would to an increase in the price of admission to the area. Seventh, recreationists have similar preferences; it is their behavior that changes as the monetary cost of a trip increases.

In the case of the Greater Yellowstone Area, the fly fishing resource is one of the finest in the United States, and users travel many miles to fish in its waters. The area covered within a two hour drive of West Yellowstone contains roughly 2,000 miles of trout streams, 90 percent of which are public (Brooks, 1984). The Greater Yellowstone Area is unique for its large, wild fish, and scenic surroundings, all of which provide the angler with one of the greatest fishing paradises in the world (Brooks, 1984). Another notability of the area is its accessibility, with "a good portion of [these] trout stream-miles adjacent to, or only a brief distance from, major highways or other good roads" (Brooks, 1984). The proximity of these blue ribbon trout streams to major roads, provided us with a perfect situation by which to collect data for our survey .

Since Clawson and Knetsch first designed the formal travel cost model, there have been many variations of it applied to non-market resources. However, most users of the TCM have ignored the works of Pearse (1968), Gibbs (1974) and more recently Smith and Kopp (1980), and Bell and Leeworthy (1990). Pearse and Gibbs noticed that people react differently to changes in their on-site expenses than they do to changes in the cost of travel. The costs associated with traveling to a recreational site are viewed as fixed costs by a recreationist, while the costs associated with the time spent on-site are variable costs, depending on the length of stay. These on-site costs include licenses and entry fees, camping and hotel/motel fees, recreation expenses, as well as any other money spent while on-site.

Pearse (1968) surveyed big game hunters in British Columbia, and found that by confining the recreational analysis to the recreationists only, he could avoid assumptions on characteristics and the homogeneity of the base population. Pearse was also the first to note that the assumption of a homogeneous visit duration (in days) may be false. Gibbs (1974) surveyed recreationists at the Kissimmee River Basin in Central Florida, and obtained information on their length of stay per visit (in days), daily on-site costs, and round trip travel cost. The estimated demand relationship indicated that on-site costs were inversely related to trip duration (in days,) while that travel costs were positively related to the trip duration (Gibbs, 1974).

Following the Pearse (1968) and Gibbs (1974) models, Smith and Kopp (1980) address what they call the *spatial limits* of the travel cost model. Smith and Kopp argue that the use of a homogeneous trip duration, an assumption which the TCM makes, is not accurate with regards to real world data. They note that recreationists who travel long distances to get to the site are likely to spend more time on-site; the travel cost model fails to recognize these behavioral changes which depend on the recreationist's distance from the site (Smith and Kopp, 1980). In addition to its problems with time spent on site, Smith and Kopp note that the travel cost model has trouble addressing the main objective of the trip. A primary assumption of the model is that visitation to the site in question is the sole purpose of the recreationist. They suggest that the trips of longer distance might encompass several different objectives, and that the cost of travel should not fall entirely on any single destination of the trip. In assessing the cost of travel, Smith and Kopp notice that large variations in the cost of travel can occur, depending on the mode of travel. The travel cost model should therefore vary in accordance with the vehicle by which the trip was undertaken.

Bell and Leeworthy (1990) extend the Pearse (1968) and Gibbs (1974) versions of the TCM by measuring total days recreated over the season as opposed to days per visit. They still theorize that trip duration is positively related to travel cost and inversely related to on-site cost, but they modify it to take into account the net impact towards total recreation days over the season (number of trips times average length of trip) (Bell and Leeworthy, 1990). In the process, Bell and Leeworthy attempt to address the spatial limitations that Smith and Kopp argue; they measure both the distance traveled to the site, and the number of days visited at that particular site over the season. To do this, Bell and Leeworthy propose an alternative travel cost model which differentiates residents from tourists. Tourists are recreationists who have traveled *significant* distances to get to the recreation areas.

In order to participate in recreation activity, Bell and Leeworthy argue that the recreationist must face two types of costs. In the traditional travel cost model, both types of travel costs are aggregated into a single cost. Bell and Leeworthy divide the travel costs into two components: Travel Costs (TC), costs incurred traveling to the area, and On-Site Costs (OSC), costs incurred per day, while on site. The TC component is comprised of those costs incurred in getting to the site, or the traveling costs. The OSC component is comprised of those costs encountered while at the site, on a given day.

Bell and Leeworthy assert that a reasonable model of recreational behavior would be for the recreationist to maximize their total utility subject to a budget constraint. The utility function is comprised of recreational experiences, and a composite of all other available goods and services. The recreational experience includes travel to and from the site, lodging while at the site, the recreational resource itself (measured in total days,) and a composite of other experiences gained during the recreational activity. The budget constraint includes the recreational activity component, as well as the cost of the composite good.

Bell and Leeworthy propose that an exogenous change in one of the recreational cost components will encourage the recreationist to adjust her consumption of recreation services, thus substituting between the number of days per trip (DAYS/T) and total number of trips over the season (T). The final outcome of the recreation decision will result in a combination of DAYS/T and T which maximize the recreationist's utility. This is the exact observation of Pearse (1968) and Gibbs (1974). However, Bell and Leeworthy are concerned with the effect that the exogenous cost changes will have on total recreation days over the season (DAYS). They propose that DAYS will be inversely related to OSC and positively related to TC.

The Bell and Leeworthy hypothesis is that an exogenous change in OSC (we will assume that in this case it decreases,) will encourage the recreationist to adjust the length of her trip. Assuming that total number of trips consumed each year is held constant, the fall in OSC will cause the recreationist to increase DAYS/T. In this case DAYS increases, providing the negative relationship between DAYS and OSC, as is normally seen in the price coefficient in travel cost demand analysis. However, this result is not the utility-maximizing outcome, primarily because the ratio of OSC to TC has changed. As the ratio of costs changes, the recreationist may substitute DAYS/T for T, thus taking fewer trips of longer length. This substitution is the theoretical base for the positive relationship between TC and DAYS/T. The result of the hypothesis is that the fall in OSC relative to TC may cause an actual increase in DAYS after the substitution of DAYS/T for T is accounted for. Theoretically, the sign on the TC coefficient is ambiguous; a change in the TC can both increase and decrease DAYS by moving T and

DAYS/T in opposite directions. Our main concern is the net effect on DAYS, and it is the Bell and Leeworthy hypothesis that the net effect could be positive.

In their comment on Bell and Leeworthy (1990), Hof and King (1992) offer theoretical support for the methodology used in the Bell and Leeworthy demand analysis. Hof and King note that it is a condition of weak complementarity that is used as justification for the traditional travel cost model; the compensating variation (CV) of travel demand is equal to the CV of the recreational experience, and thus the resource itself. They assert that this same condition of complementarity can be extended in the Bell and Leeworthy model so that the recreational experience CV is equal to the CV of on-site use. Thus, if the OSC were to be set at a level at which the demand for the services rendered by those costs is zero, the resulting demand for all other related services would collapse to zero as well. In their application of the Bell and Leeworthy methodology, Hof and King find only one difference: the positive sign on the TC variable; the Hof and King study found the TC sign to be negative.

Hof and King also note several other advantages of the Bell and Leeworthy methodology, including partial solutions to the problem of valuing travel time, and to the problem of varying trip durations. The issue of valuing travel time, a problem with most travel cost analyses, is not as significant an issue when travel prices are only included as demand shifters. In addition, traditional travel cost methodology sets the expenses for trips of different durations exactly the same. By focusing a recreational demand model on DAYS, Hof and King have internalized the issue of different trip durations, so that it is no longer as issue, but rather an element of the demand function.

In order to apply the aforesaid Bell and Leeworthy hypothesis, I have formulated a demand equation for users of the Greater Yellowstone Area trout fishery:

$$DAYS = \Phi(OSC, TC, ORCSTS, SEV, SQV). \tag{1}$$

ORCSTS is comprised of total expenditures on outdoor recreation goods and services over the period, and is used to control for income; ORCSTS is therefore the allotted recreational budget for the recreationist (Shaw, 1991). SEV is a vector of socioeconomic variables, and SQV is a vector of site quality variables. The hypothesis of the model posits that DAYS will be inversely related to OSC, and positively related to TC. The remaining variables are demand shifters, with ORCSTS expected to be positively related to DAYS.

The OSC of the recreationists are the sum of hotel, motel or camping fees for one day, as well as fishing equipment costs, and the cost of travel to get from the lodging location to the fishing spot. The opportunity cost of time spent at the site was not calculated; if we are to include the cost of lost wages while recreating, then we must also include the utility gained, which is the purpose of the valuation in the first place.

The TC include the opportunity cost of time for the time spent in transit, as well as the total cost per mile dependent upon the type of vehicle used. With any activity, there is a corresponding opportunity cost; in the case of the simple travel cost model, this opportunity cost is assumed to be the given wage rate. Therefore, it is assumed that the next best opportunity to the recreation participant is to work. The opportunity cost in this case is valued only for the time on the road or in the air. For air travel, it was assumed that one day (8 hours) is lost to work. For automobile travel, the opportunity cost is equal to the hourly wage rate multiplied by the time spent on the road. The personal yearly income (Y) was calculated by dividing the household income by the number of wage-earners in the family, and by a multiplier for the gender of the recreationist (2/3 for female); if the recreationist was female, and part of a two-income family, then her contribution to the household income is 1/3 of the total. From this number, the hourly wage rate was calculated by dividing the personal yearly income by 1920, the average number of hours worked per year. The time spent on the road was calculated by dividing the total distance traveled by 50 miles per hour. In order to address the issue of paid vacations and fixed income, the total opportunity cost is then multiplied by a factor of 1/3 (Shaw, 1992); this is roughly the percentage of the population which falls into the category above. As with any trip, there is utility associated with the trip itself. There are both pleasures and pains involved with any action, and it is difficult to measure the utility gain or loss associated with these actions. For the sake of simplicity, it is assumed that there is no utility or disutility gained during the trip, for long distance travel to the site (Freeman, 1993).

For those traveling by automobile, a price per-mile value is assigned, dependent on the type of vehicle used (U.S. Federal Highway Administration, 1984). Four different types of automobile costs were accounted for: private car, rental car, motorhome, and private car with a trailer. The cost per mile for private car is $.3539, rental car travel is $.5309 per mile, and a private car with trailer is $.4677 per mile. These values take into account the complete cost of operating the vehicle, and include depreciation, taxes, fuel and insurance, as well as an adjustment for inflation resulting since the original U.S.

Federal Highway Administration values were calculated. Roughly 70 percent of the visits involved *only* automobile transport. If the trip involved motorhome travel, a base charge of $800 was levied on the user, as well as gas costs of $.12 per mile, and a per-mile rental fee of $ .16 for any miles over 800. These values are the average costs, and were generated during interviews with local and national motorhome rental agencies. It is assumed that depreciation, taxes and gas costs are the same whether the motor home is owned or is rented. Roughly four percent of the trips involved motorhome travel.

For trips involving air travel, the total cost of air travel was estimated by using the coefficients from an OLS regression of ticket prices. The ticket prices were calculated through conversations with travel agents, who determined the cost of air travel to the Greater Yellowstone Area. Using 120 actual trips from various domestic airports to both the Bozeman, Montana Airport, and the Jackson Hole, Wyoming Airport, the round-trip ticket prices were calculated. These ticket prices were the dependent variables in a OLS regression which included the one-way distance to the site (DIST), a dummy variable for trips of less than 1500 miles (DUMMY), and a variable comprised of the product of DIST and DUMMY (DIST*DUMMY). The resulting coefficients of this OLS regression were them used to calculate the predicted values for the cost of air travel in our model, using the actual travel information provided by the survey participants. The results of the regression are given below, with t-statistics in parentheses:

$$\underset{}{AIRCOST} = \underset{(4.135)}{280.90} - \underset{(-1.736)}{146.28}(DUMMY) + \underset{(4.151)}{.14011}(DIST) + \underset{(1.144)}{.065369}(DIST*DUMMY).$$

$$R^2 = .804 \qquad F = 76.33 \qquad N = 120 \qquad (2)$$

If the trip to the Greater Yellowstone Area included air travel and a rental car, then the cost was calculated in exactly the same way as air travel alone. It is assumed that the cost of renting a car in Bozeman, Montana, and Jackson Hole, Wyoming is only a small fraction of the total air cost, and therefore insignificant with regards to the total TC. If the car was rented at a distant airport (Denver, Colorado; Boise, Idaho; or Salt Lake City, Utah,) then the smaller cost of air travel, coupled with the fuel costs and rental fees would be comparable to the cost of flying directly to the Greater Yellowstone Area. This information was not available, and therefore could not be used as a part of the model.

Embedded within the decision to visit a site are numerous other decisions regarding the trip. In the case of the simple travel cost model, it is assumed that each trip is made solely for the purpose of visiting the site in question. In this sample, many of the trip responses were multi-site in nature, meaning that the recreationists were on their way to other locations, and made some form of a side trip to get to the Yellowstone area. If this was the case, the distance traveled was equal only to the extra mileage of the side trip. For example, consider a recreationist who is traveling from San Francisco to Minneapolis (roughly 2048 miles,) and makes a side trip to the Yellowstone area. The distance traveled would therefore be the difference between the San Francisco-Minneapolis mileage and the San Francisco-Yellowstone-Minneapolis mileage (roughly 2171 miles, for a difference of 123 miles). The shortest routes are therefore used to determine the distance from the place of origin to the final destination.

The socioeconomic variables allow for greater explanation regarding the sociological and/or economic status of the individual responses in the survey pool. The respondent's AGE and the square of age, AGE-SQUARED, were calculated as well. The self reported SKILL level of the angler, was given a min-max level of (1-10). The number of CHILDREN in the family was also included; this value was entered directly. A dummy variable based on marital status, MAR, was reported; if the respondent was married then this variable was equal to one. The education level of the respondent, EDU, ranged from grade school (1) to graduate/technical/vocational school (7). A dummy variable for the GENDER of the respondent was also reported; if the respondent was male, then this value was equal to one. The site quality variables included the reported fish CATCHRATE. This variable was calculated by dividing the number of fish caught, by the number of hours the angler reported fishing on the day of the survey. The dummy variable PRIMP was included, which measured the recreationists whose primary purpose was to fish. If the primary purpose was to fish, then the value for the dummy variable was equal to one. A congestion variable, NUMANG, is the number of anglers the respondent reported seeing during the day.

Dummy variables were entered for the sites at which the surveys were distributed: GALLITN for the Gallatin river, CABINCR for the Cabin Creek section of the Madison River, YELOSTN for the Yellowstone River, and MADISON for the Madison River. These variables were entered as controls for the five distinctly different fishing sites; the unmeasured qualities of the individual sites include scenery, type of angling regulation, and location. Of the five sites, CABINCR and MADISON are not within the Yellowstone National Park boundaries, and only CABINCR allows for the keeping of some fish. MADISON provides fast water, and difficult angling for very strong rainbow and brown trout. Slough Creek, the control site for the model, consists of slow water with difficult fishing for native cutthroat trout.

Descriptive Statistics				
	MEAN	S.D.	MIN	MAX
OSC	81.338	71.273	.3539	579.73
TC	591.98	611.51	0	3133.53
PRIMP	.94161	.23492	0	1
AGE	44.126	14.453	10	82
SKILL	6.9797	2.1141	1	10
CHILDREN	1.6061	1.6290	0	9
MAR	.70315	.45681	0	1
EDU	5.0620	1.2923	1	7
GENDER	.92300	.27988	0	1
ORCSTS	1298.1	1549.5	0	10000
CATCH RATE	.96083	1.2197	0	8.46
NUMANG	18.777	16.093	0	75
GALLITN	.10949	.31282	0	1
CABINCR	.05839	.23492	0	1
YELOSTN	.31387	.46491	0	1
MADISON	.22628	.41919	0	1

Table 1. Variable Minimum, Maximum and Mean Values

The demand curves are estimated using data from a survey conducted by Nowell and Kerkvliet (1994). The survey data were distributed on randomly selected days throughout the summer of 1993 at five well-known trout fishing locations in the Greater Yellowstone Area. The self-administered surveys were either delivered by hand to anglers on the stream, at access points near the stream, or left on the windshields of angler's cars located in nearby parking areas. The surveys began with a cover letter explaining purpose, requested cooperation, and included a stamped/addressed envelope to be returned by mail.

Of the 1100 surveys distributed, 387 (35 percent) were returned. Of the returned surveys, 284 (73 percent) of the individual surveys were complete enough to be used in the estimation. Fifty questions were asked, and included travel cost and time questions, as well as socioeconomic and recreation-based user questions, in order to differentiate between the types of users and their individual preferences. The survey responses are summarized in Table 1.

EMPIRICAL RESULTS

The form of the travel cost model which we are using proposes that consumer demand for recreation days is positively related to the cost of travel, and inversely related to the on-site costs. To calculate the angler's demand for recreation days, the number of fishing days spent in the Yellowstone area is regressed on the two cost components, socioeconomic variables, and site quality variables. The demand equation was estimated using OLS in linear form, semi-log form, as well as a maximum likelihood estimator. The results of the three regressions are presented in Table 2., with the t-statistics in parentheses.

Travel Cost Estimation Results			
VARIABLE	COEFFICIENT (t-stat)		
	LINEAR OLS	SEMI-LOG OLS	TRUNCATED REGRESSION
CONSTANT	1.639 (0.258)	0.351 (0.816)	0.548 (1.211)
OSC	-0.0198 (-1.972)	-0.00133 (-1.965)	-0.00126 (-1.870)
TC	.00324 (2.925)	0.000372 (4.970)	0.000349 (4.822)
PRIMP	6.123 (2.090)	1.206 (6.090)	0.929 (3.292)
AGE	-0.268 (-0.901)	-0.00208 (-0.103)	0.00301 (0.152)
AGE-SQUARED	0.00470 (1.491)	0.000118 (0.554)	0.0000734 (0.348)
SKILL	1.294 (3.729)	0.0793 (3.383)	0.0782 (3.348)
CHILDREN	-0.884 (-1.772)	-0.0875 (-2.594)	-0.0761 (-2.171)
MAR	-2.679 (-1.423)	-0.182 (-1.428)	-0.205 (-1.638)
EDU	0.439 (0.744)	-0.0167 (-0.419)	-0.00914 (-0.234)
GENDER	-5.878 (-2.378)	-0.217 (-1.296)	-0.236 (-1.427)
ORCSTS	0.000713 (1.508)	0.0000620 (1.939)	0.0000498 (1.592)
CATCH RATE	1.378 (2.375)	0.0929 (2.368)	0.0884 (2.236)
NUMANG	-0.118 (-2.555)	-0.00599 (-1.927)	-0.00591 (-1.885)
GALLITN	-1.672 (-0.690)	-0.153 (-0.932)	-0.153 (-0.935)
CABINCR	1.988 (0.647)	0.328 (1.577)	0.194 (0.945)
YELOSTN	2.769 (1.520)	0.13614 (1.105)	0.139 (1.146)
MADISON	6.370 (3.379)	0.412 (3.230)	0.380 (3.073)
R-Squared (Adjusted R-Sq.)	.27 (.23)	.37 (.32)	
λ_{LR} - Liklihood Ratio Stat.	88.14	128.52	93.18

Table 2. Estimated Demand Equations

For the most part, the results of the data are qualitatively the same regardless of their functional form. The elasticities of the linear and the semi-log forms were calculated at both the mean and median number of DAYS, and their results are presented in table 3. The linear price and income elasticities are similar to the linear calculations of Bell and Leeworthy (1990)

Elasticity Measurements				
VARIABLE	COEFFICIENTS			
	LINEAR		SEMI-LOG	
	MEDIAN	MEAN	MEDIAN	MEAN
OSC	-0.23	-0.15	-0.06	-0.05
TC	0.27	0.18	0.11	0.09
PRIMP	0.82	0.53	0.58	0.48
AGE	-1.69	-1.09	-0.05	-0.04
AGE-SQUARED	1.45	0.94	0.13	0.11
SKILL	1.29	0.83	0.28	0.23
CHILDREN	-0.2	-0.13	-0.07	-0.06
MAR	-0.27	-0.17	-0.07	-0.05
EDU	0.31	0.21	-0.04	-0.04
GENDER	-0.78	-0.5	-0.1	-0.08
ORCSTS	0.13	0.09	0.04	0.03
CATCH RATE	0.19	0.12	0.05	0.04
NUMANG	-0.32	-0.2	0	0
GALITN	-0.03	-0.02	-0.01	-0.01
CABINCR	0.02	0.01	0.01	0.01
YELOSTN	0.12	0.8	0.02	0.02
MADISON	0.21	0.13	0.05	0.04

Table 3. Elasticity Calculations

The data also validate the alternative hypothesis of Bell and Leeworthy; both of the cost components exhibit the expected relationship towards total fishing days. The OSC variable, which will serve as the price in the demand equation, displayed the expected negative sign; TC exhibited a strong, positive relationship to DAYS. According to a one-tailed test, both of the estimates are significant ($\alpha < .05$) for all three specifications.

The positive sign on ORCSTS suggests that fishing activity is a normal good with respect to the recreation budget. As personal expenditures on recreation increase ceteris paribus, we find that total fishing days increase. AGE and AGE-SQUARED variables were included in order to test the traditional lifecycle hypothesis: that recreation is a luxury for the young and old. Although insignificant, the negative sign on AGE and positive sign on AGE-SQUARED demonstrate that the total number of fishing days decrease as the average recreationist ages from youth to adult, and increase as they age from adult to senior. CHILDREN and MAR were included in an attempt to capture the relationship between family responsibilities and recreational demand. The negative signs indicate that married participants and those with children spend fewer total recreation days over the season. The CHILDREN variable was significant ($\alpha < .05$) across the linear and semi-log specifications, but MAR was insignificant in both. The positive, significant sign on SKILL suggests that experienced anglers are more likely to spend a greater time in outdoor recreation during the season. The estimated influence of education level (EDU) differs across specifications, but remains highly significant. The negative sign on the dummy variable GENDER implies that women are likely to spend more time recreating over the season than are men. The GENDER variable is only statistically significant in the linear specification.

If angling is the primary purpose of the recreationist, as displayed by the dummy variable PRIMP, then they spend more days recreating over the season; this positive, significant relationship is shown across all three specifications. Two site-quality variables, NUMANG and CATCH RATE, display the relationship between crowding and total recreation days. If the number of anglers seen over the day is high, we expect total days to decrease. Although many anglers would argue for a positive relationship due to the camaraderie and support of seeing other anglers, for the most part there are negative connotations associated with over-crowding. For this reason, the inverse, significant relationship of the NUMANG variable is found in all three specifications. If the catch rate is poor, we would expect the same result as that of the NUMANG variable. The positive, significant relationship between CATCHRATE and total fishing days indicates that higher utility is associated with increased catch rates, and therefore increased demand for DAYS.

The final four site-quality variables, which include GALLINT, CABINCR, YELOSTN, and MADISON, show the relationship between recreationists at these individual sites and those at the referent site, Slough Creek. For all three specifications, the Gallatin anglers fish fewer days than the referent, but those at the Cabin Creek, Yellowstone, and Madison fish more. The Madison site is the only significant coefficient, but a Chow test conducted on the results of the linear regression for the four sites indicates that they are statistically significant as a whole. The difference between the restricted and unrestricted sum of squared errors is large enough to reject the null hypothesis that the site variables are insignificant as a whole. The results of this test are provided below:

$$\frac{SSE_R - SSE_U}{SSE_U / (T\text{-}K)} \sim F_{[1,(T\text{-}K)]} \quad \text{and,} \quad F_{[1,257]} = 6.63 \quad \text{(Upper 1\% Points)}$$

$$F = \frac{1851.08}{(30520.79 / 257)} = 15.59 \tag{3}$$

The resulting goodness of fit measurements for the linear and semi-log forms are .28 and .37 respectively. Although these estimates are much larger than those generated by Bell and Leeworthy (1990), a comparison across models cannot be made due to the different number of regressors. Likelihood ratio tests performed on the equations reject the null hypothesis that all the coefficients are simultaneously equal to zero. The liklihood ratio test statistics (λ_{LR}) are provided in Table 2., and are calculated using the test outlined below:

$$\text{LR Test} = (\lambda_{LR}) = 2\,[\,\ln l\,(\beta^{\sim}) - \ln l\,(\beta^{*})\,] \sim \chi^2 \tag{4}$$

where (β^{*}) is restricted, ($\beta^{\sim}$) unrestricted, with a χ^2-critical value of 30.19 at the $\alpha = .05$ level of significance.

A visual inspection of the residuals, in addition to a Goldfield-Quandt test allows us to reject the null hypothesis that the given equations exhibit heteroskedasticity. A

Breusch-Pagan test performed on the linear model allows us to validate the results of the visual inspection of the residuals and the Goldfield-Quandt tests. In this testing procedure, the unknown σ^2 in any given specification is replaced with a set of least squares residuals ($e^{\wedge 2}$) taken from a prior estimate of the equation. The resulting SSR (explained variation) from this resulting equation is then used to determine the BP test statistic, presented below:

$$BP = SSR / 2(\sigma^{\sim 2})^2 \quad \text{where} \quad (\sigma^{\sim 2}) = [\Sigma e^{\wedge 2}] / T \qquad (5)$$

The BP test statistic has an approximate χ^2 -distribution, and a large BP test statistic is indicative of heteroskedasticity in the initial estimation. In our case, the BP test statistic is equal to (.615). The χ^2 critical value at the $\alpha < .05$ level of significance is (30.19); therefore the linear model shows no signs of heteroskedasticity.

In the case of recreation, a survey given only to on-site users ignores potential samples in the population; only the recreationists who have spent one or more days are sampled. The endogenous selection of samples creates a model in which participation is limited only to those actually involved (Cramer, 1986). In this case, the data does not contain information on either the explanatory variables or the dependent variables if they fall below the given bound. This bound, or *truncation*, may distort the density of the observed dependent variable, causing bias in the resulting parameter estimates (Cramer, 1986). Griffiths, et al. (1985) offer an excellent example by comparing this situation to one of a shooting range. In this example, the sample population is of those shooting at a given target. It is assumed that we have complete information about those who shoot and hit the target, but limited information on those who miss the target. If we are concerned with accuracy (our dependent variable,) and we know how many people have fired, then we are facing a *censored sample.* On the other hand, if we know nothing about the number of people who have fired and missed, then we are facing a truncated sample. Truncation offers a much more difficult problem than censoring because we have much less information; not only do we lack knowledge of the explanatory variables, but we also have no information on the number of people who have fired.

In relating this to the recreational fishing example, a censored sample situation would be one in which we know the total number of potential recreators, but only have

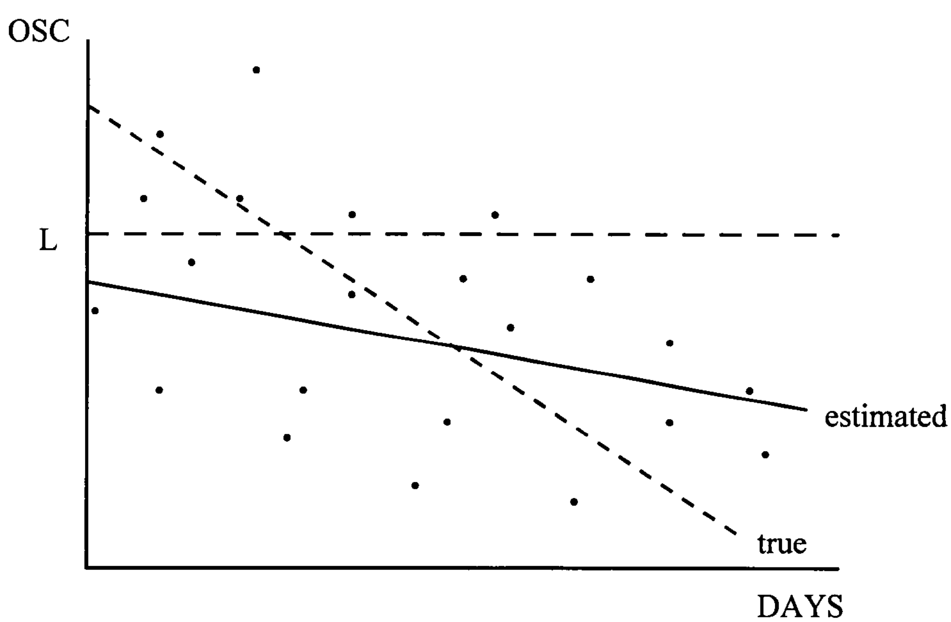

Figure 1. Truncation and the On-site Sample

information on those who actually choose to recreate at that time. Our case is such that we know absolutely nothing about the potential recreationists, not even how many there are. In this case, we will use a truncation estimator in order to minimize the bias associated with such a situation.

If we were to use OLS to estimate the demand equation, then the estimates of the true slope would be biased (Maddala, 1983). Figure 1. offers a visual example of the truncation, and associated slope differences. The truncation level *L* is for those potential recreators who choose to participate; those above this level were omitted from the sample population. In the case of truncation, we must use a truncated regression form of the maximum likelihood estimator to determine the true slope. The maximum likelihood estimator that we use was first proposed by Amemiya (1973) in an attempt to solve for the bias associated with a bound distribution. The maximum likelihood estimator for the truncated sample is provided below (Judge, et al., 1985):

$$\text{Log } L = \sum_{t=1}^{T-S} \left(\ln F_t - \frac{T-S}{2} \ln \sigma^2\right) - \frac{1}{2\sigma^2} \sum_{t=1}^{T-S} (y_t - \beta' X_t)^2$$

$$F_t = F(X_t' \beta / \sigma) \qquad (6)$$

The derivation of this estimator is presented in the literature of Amemiya (1973) and Maddala (1983). The figures were calculated through Green's LIMDEP estimation procedures, version 6.0 (1992).

CONSUMER SURPLUS

Consumer surplus measurements provide us with the economic value of Greater Yellowstone Area fishing for the average angler. By definition, consumer surplus is the difference between what the angler would be willing to pay for access to the Greater Yellowstone streams, and the amount that they actually do pay; this concept is presented visually in Figure 2.

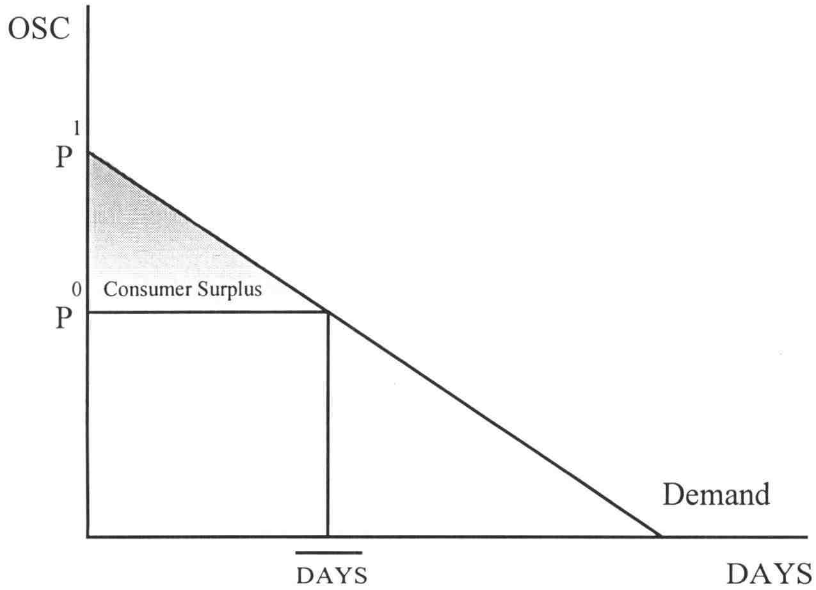

Figure 2. Consumer Surplus Diagram

(Mean) * (Travel Cost Estimation Coefficients)				
	Mean	Linear	Semi-Log	Truncated
TC	591.98	1.918	0.2202	0.2066
PRIMP	0.94161	5.7655	1.1356	0.8748
AGE	44.126	-11.8258	-0.0918	0.1328
AGE-SQUARED	2155.2	10.1294	0.2543	0.15819
SKILL	6.9797	9.0317	0.5535	0.5458
CHILDREN	1.6061	-1.4198	-0.14053	-0.1222
MAR	0.70315	-1.8837	-0.12797	-0.14415
EDU	5.062	2.222	-0.08454	-0.04627
GENDER	0.923	-5.4254	-0.20029	-0.2178
ORCSTS	1298.1	0.92555	0.08048	0.06465
CATCH RATE	0.96083	1.324	0.08926	0.08494
NUMANG	18.777	-0.2216	-0.00133	-0.11097
GALLITN	0.10949	-0.18307	-0.01675	-0.01675
CABINCR	0.05839	0.1161	0.01915	0.01133
YEOSTN	0.31387	0.8691	0.04273	0.04363
MADISON	0.22628	1.4414	0.09323	0.08599
CONSTANT	1	1.639	0.351	0.548
Sum of rows:		14.422	2.1762	2.0986

Table 4. Consumer Surplus Equation Calculation

In order to determine the consumer surplus for this recreational activity, the average values for all regressors (except for OSC) were calculated and substituted into the estimated equation. These values are presented in Table 4 as the *sum of rows*. The results of the three different functional forms are presented in the following direct demand curves:

$$\begin{aligned} &\text{linear:} && DAYS = 14.422 - .0198\ OSC \\ &\text{semi-log:} && \ln(DAYS) = 2.1762 - .00133\ OSC \\ &\text{truncated:} && \ln(DAYS) = 2.0986 - .00126\ OSC \end{aligned} \tag{7}$$

By solving for OSC, we get an inverse demand curve for DAYS:

$$\begin{aligned} &\text{linear:} && OSC = 728.3838 - 50.5051\ DAYS \\ &\text{semi-log:} && OSC = 1636.2406 - 751.8797\ \ln(DAYS) \\ &\text{truncated:} && OSC = 1665.5556 - 793.6568\ \ln(DAYS) \end{aligned} \tag{8}$$

Hof and King (1992) generated the following CS measurements:

$$\begin{aligned} &\text{if linear } (q = a + bp), \text{ the } CS = 0.5\,[\,(p^1 - p^0) * (a + bp^0)\,] \quad \text{where } p^1 = a / b \\ &\text{if semi-log or truncated } (\ln(q) = a + bp), \text{ the } CS = -[e^{a+bp}] / b \end{aligned} \tag{9}$$

Consumer surplus calculations are made by using the <u>median</u> number of DAYS as well as the <u>mean</u> number. Bell and Leeworthy (1990) chose to use the median number only in order to avoid the influence of several large DAYS responses. Although logical, this decision can not be justified without more detailed information on the recreationists. For this reason, both the median and mean CS estimates were calculated.

Consumer Surplus Estimates			
	Linear	Semi-Log	Truncated
Mean (DAYS = 10.83)	2961.84	8142.86	8595.24
Median (DAYS = 7)	1237.36	5263.16	5555.56

Table 5. Consumer Surplus Calculations

For the linear demand function, the intercept P^1, or "choke price", is equal to \$728.38, and the estimated price (P^0) with median DAYS equal to seven is \$374.85. The ordinary consumer surplus is \$1237.36, or \$176.77 per day. Therefore, the average angler in the Greater Yellowstone Area values the fishing experience at \$1237.36, as measured by consumer surplus. Using the mean number of days (10.83), the consumer surplus estimates rise dramatically; in this case the total ordinary surplus is \$2961.84, with an daily surplus measurement of \$273.48.

If the above procedure were performed using the results of the semi-log form, the corresponding consumer surplus measurements would be \$5263.16 for the median number of DAYS and \$8142.86 for the mean number of DAYS. Under the semi-log specification, the recreationist would value the fishing experience at $751.88 per day. For the truncated regression, the consumer surplus measurements would be $5555.56 using the median number of DAYS, and $8595.24 using the mean number of DAYS. With this specification, the recreationist values the fishing experience at $793.65 per day.

The results of these welfare measurements show that even after incurring on-site costs, and costs of travel, the recreationists receive significant levels of surplus from the recreation activity. From this we can infer that the recreationists would be willing to pay a fraction of their resulting consumer surplus in order to participate in the recreation activity. This value is difficult to determine given the disparaging rift between the linear, semi-log, and truncated consumer surplus estimations. In order to determine which of the three specifications is preferable, we will use three different approaches. The first, outlined in Bell and Leeworthy (1990), involves a correction of the linear estimates for potential statistical biases. Bell and Leeworthy (1990) outline a procedure in which the consumer surplus estimates of the linear specifications are divided by $(1+1/t^2)$, where t= the linear Student t-value for OSC in table 2..(Bell and Leeworthy, 1990). The corrected linear consumer surplus measurements are now equal to $140.61 and $217.55 per day, a change of roughly 20%.

The next approach is to compare our results with those of similar recreational angling analyses. Duffield (1992) used the contingent valuation method to obtain surplus measurements for anglers in Montana's Big Hole and Bitterroot river regions. The mean income, time on site, and recreation expenditures of the Big Hole recreationists are comparable to those in this study, as are the angling opportunities and conditions. For this reason, we will assume that the results of the Big Hole survey will provide a good comparison for our own. Duffield (1992) found that the average non-resident Big Hole float angler received $2234 consumer surplus per trip, or $540 per day; the corresponding measurement for the resident is $87 per day. The non-resident estimate is similar to that of our semi-log and truncated specifications specification.

The third approach, as outlined in Griffiths, et al. (1993), involves the J-test, which tests whether one model provides better explanatory power than another. The J-test uses the predictions from the first specification as an explanatory variable in the second. If the resulting coefficient on this explanatory variable is significant, then it can be said that there is information in the first specification which improves the explanatory power of the second. In performing a J-test on the linear and semi-log specifications, it was found that neither specification was significantly capable of improving the explanatory power of the other.

The lack of insight from the J-test, coupled with the results of the Duffield (1992) study and the truncated consumer surplus measurements, suggest that the semi-log estimates are the most reliable. Typically the truncated regression provides a lower bound in consumer surplus estimation, but our models have shown that the results are much closer to those of the semi-log specification.

CONCLUSIONS

The National Park service has begun to review its policy regarding recreational angling in the National parks. This review is performed in response to opponents of angling who see recreational angling as an "incompatible" activity within the National Park system (Behnke, 1994). They feel that by condoning this activity, the National Park Service contradicts its primary mission of protecting the park from damage, and providing for the user's enjoyment. In essence, since hunting is prohibited in the National Park system, all forms of fishing should be as well. Unfortunately, the mission of the Park Service itself is a contradiction; there are many people who receive large amounts of enjoyment from the recreational angling opportunities available in the parks. By outlawing catch and release angling, the Park Service would be restricting the enjoyment possibilities of many of the park's users.

The decision whether or not to allow recreational fishing in national parks is not one that can be made by performing a TCM. In this case, economics has very little to do with the ethics of conservation; however, it does shed some useful light on the magnitude with which recreationists value these resources. Ultimately, the National Park Service will be forced to make a decision regarding this issue. The fact that many park visitors value the ability to use the fishing resource should not be taken lightly; this paper offers an estimate of those values.

The Greater Yellowstone Ecosystem contains 18 million acres, 2 million of which lie within the National Park itself. These 2 million acres serve as the drainage basin for roughly 2,600 miles of rivers and streams. In 1990, approximately 400,000 angler-days were spent in Yellowstone National Park (Greater Yellowstone Coalition, 1994; Behnke, 1994). If our consumer surplus measurements are accurate, the total annual surplus received by Yellowstone anglers sums to over $300 million. This figure equates to roughly $115,000 per mile of river in the National Park. If the corrected-linear equation were to be used as a lower bound for consumer surplus estimation, the total fly fishing-generated surplus would be over $56 million per year, or greater than $21,000 per mile of river. The lower bounds themselves mirror the magnitude of the value that recreationists place on the resources.

Recreational anglers cause minimal damage to the Yellowstone ecosystem, and provide a financial base for many of the local economies. The results of this study show that the users of the fly fishing resource come from considerable income levels, travel large distances to reach the recreation sites, and practice methods of fishing which appear to minimize the harm done to the fish while recreating (of the some 1600 fish reported to be caught in the survey, only 50 were kept). The cost of day-use and week-use fishing permits for use within the park are $5 and $10 respectively. These values seem minuscule when set beside the enormous surpluses that the recreational anglers receive from their activities. Rather than abolishing recreational angling in the National Parks, park managers should first consider the benefits of raising permit prices. Within reason, this policy change would reduce the angler's use of the park, while at the same time increasing revenues. These revenues could be then applied to park maintenance, habitat conservation, or to return damaged areas to their original condition. If nothing else, this policy change will reduce the number of angling users, as was intended with the more drastic abolishment policy.

In addition to generating revenue for the park service, recreational angling has the potential to serve as an alternative profit source for related enterprises. Currently there are activities in and around the park that have been shown to cause significantly more damage to the users of the park and to the park itself (Greater Yellowstone Coalition, 1994). Habitat fragmentation and loss of natural diversity due to oil and gas exploration, poor irrigation policies, timber harvesting, dams and levees for flood control, hydroelectric projects, residential development, and massive gold mines are becoming more and more common within the Greater Yellowstone Area ecosystem. These practices damage the wild elements of the park, elements that are intrinsic to its value; the enjoyment of all users is therefore reduced.

The surpluses of the recreational anglers are almost entirely dependent on the pristine conditions of the surrounding environment. Rather than logging a particular riparian zone, which would undoubtedly damage the surrounding fishing conditions, the logging outfit should consider its alternative options. In this case, the sale of recreational angling licenses would serve as the alternative profit source. Instream flow may not only be the most beneficial use, but also the profit maximizing choice. Not only is the stream preserved, but the company is funded and the recreationists are satisfied. The recent Hyalite timber sale in the Gallatin National Forest, and the Greater Yellowstone Salvage Timber Rider are examples of these opportunities.

Anderson and Leal (1991) argue that privately owned resources tend to be better managed than those that are publicly owned. The incentives associated with preserving the resource are much larger when the decision-makers have a stake in the outcome of the resource's use. Anderson and Leal (1991) site the Federal Forest Service's management practices within the Gallatin National Forest in southwestern Montana; in 1988 the Forest Service charged recreational fees of $191,000 for users of the resource, but incurred costs of over $2 million. Anderson and Leal argue that the Gallatin National Forest would be managed more efficiently if it were turned over to a private owner; in short, the fees associated with using the resource would increase, and the overuse would stop. A private land owner, motivated by profit maximization, would select land use practices that vary depending on the revenue potential for the different areas within the respective ecosystems.

In determining the value of the Greater Yellowstone Area fishing resource, many assumptions were made. These assumptions include variable selection, the correct functional form of the model, the cost and benefit of time spent in travel, and preferences for visits versus visit length. All of these assumptions influence the derived demand curve in one way or another. In each case, there are many different models which can be performed; the opportunity for additional research is abundant. As different forms are presented, variables added, created, and omitted, and values recalculated, it is hopeful that a more accurate approximation of the actual demand curve will be achieved. With these calculations will follow the information that planners need in order to make rational decisions. The present model suggests that there are large surpluses associated with recreational fishing, and that many communities benefit because of these surpluses. Before the National Park Service makes a decision to limit or suspend certain forms of recreational activity, it must first assess all of the potential implications of its actions.

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APPENDICES

GREATER YELLOWSTONE AREA FISHING SURVEY

You received this survey at ___________________ Please answer the fishing questions based on your fishing at this site.

SECTION I (Fishing and general information).

On a scale of 1-10 (1=beginner and 10= expert) how do you rate your fishing skill? Level of skill______

How many days will you spend fishing in the **Greater Yellowstone area** this year (May-October)? Number of days___________

How many days will you spend fishing anywhere between May and October this year? Number of days___

If you had not fished today, what would you have done instead (pick your next best alternative to fishing today):

Stayed home___________ Stayed at camp or motel________ Worked_________ Hiked______
Left the Yellowstone Area___ Backpacked_______ Gone sightseeing_____

Other (please describe)_________________________

If you had no gone fishing today, your next best alternative would cost you about how much more or less compared to what you will spend fishing today?

Much less______ Small amount less______ About the same_____
Small amount more______ Much more________

How many people are you fishing with today? Number of people (including yourself)___

How many round trip miles will you travel to fish today? Number of miles____

What hours will you fish here today?

AM: Beginning hour_____ Ending hour______ PM: Beginning hour______ Ending hour___

Will you fish anywhere else today? Yes_____ no______ if yes, where__________________________

Including today, how many days have you been fishing at this site this year?___________

Counting today, about how many days in the last 3 years have you spent fishing in the **Greater Yellowstone area**? Days_____

What method of fishing are you using on this water? (Check all methods of fishing.)

Dry fly______ Bait______ Lures______ Nymph_______ Streamers____

How many of each type of fish have you caught/released here today?

	#caught	#released		#caught	#released
Rainbow	______	_______	Cutthroat	_______	_______
Brown	______	_______	Brook	_______	_______
Whitefish	______	_______			

Is fishing the primary purpose of your trip to this site? Yes______ no______

If no, what is the primary purpose of your trip to this site?____________________________________

About how many other anglers have you seen today?

None______	1-5_______	6-10______	11-15_____	16-20____	20-25_____
26-30_____	31-40______	41-50_____	51-75_____	More than 75______	

If you had not fished here today would you fished elsewhere? Yes____ no____ If yes, where?___________

Why did you fish at this site today? (RANK IN ORDER OF IMPORTANCE; 1= VERY IMPORTANT; 5= NOT IMPORTANT)

Close location_____	Advice from store_____	Word of mouth____	Past experience_____
Looked good _____	Fishing Regulations____	Cost_______	Other (please specify)________

This is a hypothetical question. This survey will not be used to charge fees for fishing access of fishing licenses. What is the maximum amount you would be willing to pay to fish here today in addition to current fees?

Nothing at all________	$0.01 to .50__________	$.51 to 1.00_________	$1.01 to 1.50________
$1.51 to 2.50________	$2.51 to 3.50_________	$3.50 to 4.50________	$4.51 to 5.50________
$5.51 to 6.50________	$6.51 to 7.50_________	$7.51 to 8.50________	$8.51 to 9.00________
$9.51 to 10.50_______	$10.51 to 12.00_______	$12.01 to 15.00______	$15.01 to 20.00______
$20.01 to 25.00______	$25.01 to 35.00_______	$35.01 to 45.00______	$45.01 to 60.00______
$60.01 to 80.00______	$80.01 to 100.00______	$100.01 to 135______	More than $125______

If you cannot or will not answer the question please explain why

____

What type of fishing license do you have? Resident____ Nonresident_____ Non-fee permit_____

For how may days is your fishing license valid? Season___________ Number of days____________

If you purchased any equipment, flies, lures, or bait just to go fishing today, how much did you spend? $_____

About how many days will you spend in outdoor recreation this summer? Number of days______

About how much will you spend on outdoor recreation activities this summer? $______________

How much did you spend last night on lodging or camping fees? $___________ (If you did not stay overnight, write zero.)

Is your annual household income over $30,000? Yes______ no______

Gender? Male______ Female_________

What is your age in years? _______

Where is your permanent residence?

City____________________County____________ State____________ Zip______Country________

Are you married? Yes_________ no___________

Do you have children? Yes______ number of children______ no_______

What best describes your educational background?

Grade school______ High school_________ High school diploma_______ Some college______
Bachelor's degree_____ Graduate degree_____ Technical/Vocational School_________

What best describes you annual household income?

Less than 19,999____ 20,000-29,999______ 30,000-39,999____ 40,000-49,000_______
50,000-59,000______ 60,000-69,000______ 70,000-99,000____ more than 100,000____

How did you travel to the **Greater Yellowstone area** for this trip?

Plane_____ Rental Car____ Private car_____
Combination plane/rental car_____ Motor home _____ Private car and trailer_____

How many people (including yourself) traveled with you to the **Greater Yellowstone area** on this trip? Number________

How many days will you spend in the **Greater Yellowstone area** on this trip? Number of days _________

About how many days will you spend in the **Greater Yellowstone area** this summer (May-October)? #of days ________

In the past five years, about how many days (including this visit) have you spent in the **Greater Yellowstone area**?

1-2____ 3-5_____ 6-10_____ 11-15_____ 16-20_____ 21-25____ more than 25____

Excluding lodging and travel between your home and the **Greater Yellowstone area**, approximately how much will you spend on food, shopping, recreation, entertainment, etc. while in the **Greater Yellowstone area**?

Less than $25_____ $25-50_____ $51-100_____ $101-150___ $151-200______
$201-300_____ $301-400____ $401-500___ $501-600___ $601-700______
$701-800_____ $801-900____ $910-1,000___ $1,001-1,500___ more than $1,500___

This is a hypothetical question. This survey will not be used to change fees for any activities or travel.

Suppose you had to buy an additional permit to come into the **Greater Yellowstone area**. What is the maximum amount you would be willing to pay (above anything that you have already paid including an entrance permit to the Park) for the additional permit to visit the **Greater Yellowstone area**?

Nothing at all_______ $0.01 to .50__________ $.51 to 1.00_________ $1.01 to 1.50________
$1.51 to 2.50________ $2.51 to 3.50_________ $3.50 to 4.50________ $4.51 to 5.50________
$5.51 to 6.50________ $6.51 to 7.50_________ $7.51 to 8.50________ $8.51 to 9.00________
$9.51 to 10.50_______ $10.51 to 12.00_______ $12.01 to 15.00______ $15.01 to 20.00______
$20.01 to 25.00______ $25.01 to 35.00_______ $35.01 to 45.00______ $45.01 to 60.00______
$60.01 to 80.00______ $80.01 to 100.00______ $100.01 to 135______ More than $125______

If you cannot or will not answer the question, please explain.

____

If Yellowstone area trip involves an overnight stay and you are only visiting the Yellowstone area on this trip, please answer the questions in Section II. If the Yellowstone area trip involves an overnight stay and is part of a trip to other major destinations, please answer the questions in Section III

If Yellowstone area trip does not involve an overnight stay, please go to the end of the survey.

SECTION II (Your trip includes an overnight stay and you are only visiting the Greater Yellowstone.)

If you had not visited the **Greater Yellowstone area** this trip, would you have made an overnight trip somewhere else?

Yes____ no____ (if no go to question 6)

If you answered "yes" to question 1, where would you have travelled if you had not come to the **Greater Yellowstone area**?

Location of next best alternative to **Greater Yellowstone area**________________________________

If you answered "yes" to question 1, how would you have travelled to your alternative destination?

Plane______ Rental car_____ Private car_____
Combination plane/rental car______ Motor home______ Private car and trailer______

If you answered "yes" to question 1, about how many days would have stayed at your alternative destination?
Days_________

If you answered "yes" to question 1, about how much more or less would the alternative trip cost compared to you Yellowstone trip?

Much less_______ Small amount less_______
About the same________ Small amount more______ Much more____

If you answered "no" to question 1, what would you have done instead of going on this trip?

____

End of Section II. Please go to end of survey.

SECTION III (Your trip to the Greater Yellowstone are is part of a trip to other destinations)

After you leave the **Greater Yellowstone area**, what is your next major destination?

Name of destination (city and state, national park, or other)______________________________

Before you came to the **Greater Yellowstone area**, what was your previous major destination?

Name of destination (city and state, national park, or other)______________________________

Including this stop in the **Greater Yellowstone area**, how many major destinations will you visit on this trip?

Number______

If you had not stopped in the **Greater Yellowstone area**, which best describes how your trip plans would have changed (check one).

a. travel plans would not significantly change. I would have traveled through the region on the way to other destinations_______ (go to end of survey)

b. travel plans would have changed significantly ________

If your travel plans would have changed significantly, approximately how much would your trip have cost compared to your Greater Yellowstone trip?

Much less________ Small amount less______
About the same________ Small amount more_______ Much more_______

This is the end of the survey. Thank you for your cooperation.

Please fold the completed survey pages and place them in the postage paid envelope provided.

Seal the envelope and drop it in any convenient mailbox.

Thank you.

Limdep Travel-Cost Program

```
open;output=fish.out$
read; nobs=400; nvar=79; names=8; file=cliff2.dat$
reject; fyel<1$ reject; fyel=7777$ reject; syelt>60$ reject; rtm>500$ reject; travel=7777$
reject; dist=7777$ reject; gogcst>250$ reject; eqcst>500$
recode; rtm; 7777=135.24$ recode; eqcst; 7777=41.25$ recode; syelt; 0=1; 7777=17.6$
recode; age; 7777=43.76$ recode; edu; 7777=5.052$ recode; gender; 7777=.9008$
recode; mar; 7777=.6632$ recode; chil; 7777=1.516$ recode; bowa; 7777=1.77$
recode; orcsts; 7777=0$ recode; browna; 7777=.6364$ recode; cutta; 7777=3.70$
recode; numang; 7777=17; 3=13; 4=18; 5=22; 6=28; 7=35; 8=45; 9=63;
10=75; 1=3; 2=8$
recode; skill; 7777=6.936$ recode; gogcst; 7777=54.09$ recode; numpeof; 0=1;
7777=2.29$
recode; numpeo; 0=1; 7777=2.7$ recode; hhy; 7777=56668.5; 1=10000; 2=25000;
3=35000; 4=45000; 5=55000; 6=65000; 7=85000; 8=103650$
create; hhhy=hhy/1000$
recode; cstyel; 7777=521.73; 1=12.5; 2=37.5; 3=75; 4=125; 5=175; 6=250; 7=350;
8=450; 9=550; 10=650; 11=750; 12=850; 13=950; 14=1250; 15=1500$
create; if (travel=1) moda=1; (else) moda=0$
create; if (travel=2) modrc=1; (else) modrc=0$
create; if (travel=3) modc=1; (else) modc=0$
create; if (travel=4) modarc=1; (else) modarc=0$
create; if (travel=5) modmh=1; (else) modmh=0$
create; if (travel=6) modct=1; (else) modct=0$
create; if (dist<=1500) dum=1; (else) dum=0$
create; airmult=1$
create; chil2= chil+2$
create; if (mar=1 & chil2=numpeo) airmult=chil2$
create; if (mar=1 & age>=50 & numpeo>=2) airmult=2$
create; if (dist>800) distmh=dist-800; (else) distmh=0$
create; if (mar=1) hhy=hhy*.6$
create; if (mar=1) hhhy=hhhy*.6$
create; aircst=280.90-(146.28*dum)+(.14011*dist)+(.065369*dist*dum)$
create; rccst=dist*.5309$
create; carcst=dist*.3539$
create; arccst=280.90-(146.28*dum)+(.14011*dist)+(.065369*dist*dum)$
create; mhcst=800+(.12*dist)+(.16*distmh)$
create; ctcst=dist*.4677$
create; mcsta=moda*aircst*airmult$
create; mcstrc=modrc*rccst$
create; mcstc=modc*carcst$
create; mcstarc=modarc*arccst$
```

```
create; mcstmh=modmh*mhcst$
create; mcstct=modct*ctcst$
create; hw=hhy/1920$
create; distm=dist*hw$
create; opcstc=distm/150$
create; hwm=hw*8$
create; opcsta=hwm/3$
create; moa=moda*opcsta$
create; morc=modrc*opcstc$
create; moc=modc*opcstc$
create; moarc=modarc*opcstc$
create; momh=modmh*opcstc$
create; moct=modct*opcstc$
create;
tc=(mcsta+mcstrc+mcstc+mcstarc+mcstmh+mcstct+moa+morc+moc+moarc+momh+moc
t)$
create; camp=gogcst/numpeo$
create; disttas=(modc*.3539)+(modrc*.5309)+(modarc*.5309)+(moda*.5309)
+(modmh*.4677)+(modct*.4677)$
create; distts=rtm*disttas$
create; osc=gogcst+distts+eqcst$
create; agesq= age^2$
create; catch=cutta+bowa+browna$
create; hrs=(endam-begam)+(endpm-begpm)$
create; tothrs=hrs/100$
create; if (tothrs=0) catchph=0; (else) catchph=catch/tothrs$
create; if (sect=7777 + sect=0) ovrnite=0; (else) ovrnite=1$
create; if (primp=7777 & catch>=1) primp=1; if (primp=7777 & catch<1) primp=0$
create; if (days3yf=7777) days3yf=21$
create; if (place=0) gallitn=1; (else) gallitn=0$
create; if (place=1) cabincr=1; (else) cabincr=0$
create; if (place=2) yelostn=1; (else) yelostn=0$
create; if (place=3) madison=1; (else) madison=0$
create; if (place=4) slough=1; (else) slough=0$
create; visits=fyel/syelt$
create; ttc=tc+osc$
create; lfyel=Log(fyel)$
Regress; Lhs = fyel ; Rhs = one,osc,tc,primp,age,agesq,skill,chil,mar,edu,
gender,orcsts,catchph,numang,gallitn,cabincr,yelostn,madison$
Regress; Lhs = lfyel ; Rhs = one,osc,tc,primp,age,agesq,skill,chil,mar,edu,
gender,orcsts,catchph,numang,gallitn,cabincr,yelostn,madison$
Truncated Regression; Lhs = lfyel ; Rhs = one,osc,tc,primp,age,agesq,skill,
chil,mar,edu,gender,orcsts,catchph,numang,gallitn,cabincr,yelostn,madison;
Maxit=50$
```