Sport-Fishing Use and Value:
Snake River Above Lewiston, Idaho

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EXECUTIVE SUMMARY

Two surveys were conducted on sport fishers on the Snake River above Lewiston, Idaho for the purposes of: (1) measuring willingness-to-pay for fishing trips and, (2) measuring expenditures by sport fishers. Steelhead was the primary specie caught with 91.5 percent of anglers including steelhead in their catch. The surveys were conducted by a single mailing using a list of names and addresses collected from sport fishers along the free flowing Snake River during September 1997 through March 1998. The sport-fishing demand survey resulted in 247 usable responses. The response rate for the complex travel cost questionnaire was about 72 percent. The high response rate is thought to be a result of the excellent impression made by the initial on-site contacts by University of Idaho students, the return address for the questionnaire to the University of Idaho, and a two dollar bill included as incentive.

The sport-fishing demand analysis used a model that assumed anglers did not (or could not) give up earnings in exchange for more free time for sport-fishing. This model requires extensive data on angler time and money constraints, time and money spent traveling to the river fishing sites, and time and money spent during the sport-fishing trip for a variety of possible activities. The travel cost demand model related sport-fishing trips (from home to site) per year by groups of sport fishers (average about 12.38 trips per year) to the dollar costs of the trip, to the time costs of the trip, to the prices on substitute or complementary trip activities, and other independent variables. An individual angler's cost of a trip was based on the cost observed in the Lower Snake River reservoirs study of 7.6 cents per mile times the round trip distance.

The primary objective of the demand analysis was to estimate willingness-to-pay per trip for fishing on the free flowing Snake River. Consumer surplus (the amount by which total consumer willingness-to-pay exceeds the costs of production) was estimated at $35.71 per person per travel cost trip. The average number of sport-fishing trips per year from home to the free flowing Snake River was 12.38 resulting in an average annual willingness-to-pay of $442 per year per angler. The total annual willingness-to-pay for all anglers is estimated at $368,628 to $408,408.

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MEASURING ECONOMIC VALUE OF SPORT-FISHING

A public enterprise like the Snake River differs in two significant ways from a competitive firm. First, the public project is very large relative to the market that it serves; this is one of the reasons that a public agency is involved. Because of the size of the project, as output (sport-fishing access) is restricted the price that people are willing to pay will increase (a movement up the market demand curve). Price is no longer at a fixed level as faced by a small competitive firm. Second, the seller (a public agency) does not act like a private firm which charges a profit-maximizing price. A public project has no equilibrium market price that can easily be observed to indicate value or, i.e., marginal benefit.

If output for sport-fishing at the free flowing Snake River was supplied by many competitive firms, market equilibrium would occur where the declining market demand curve intersected the rising market supply curve. The competitive market equilibrium is economically "efficient" because total consumer benefits are maximized where marginal cost equals marginal benefits. If marginal costs exceed marginal benefits in a given market "rational" consumers will divert their spending to other markets. A competitive market price would indicate the marginal benefit to consumers of an added unit of sport-fishing recreation. However, calculation of total economic value produced would require knowledge of the market demand because many consumers would be willing-to-pay more than the equilibrium price. The amount by which total consumer willingness-to-pay exceeds the costs of production is the total net benefit or "consumers surplus." If output was supplied by many competitive firms, statistical estimation of a market demand curve could use observed market quantities and prices over time.

Economic value (consumers surplus) of a particular output (sport-fishing) of a public project also can be found by estimating the consumer demand curve for that output. The economic value of sport-fishing at the free flowing Snake River can be determined if a statistical demand function showing consumer willingness-to-pay for various amounts of sport-fishing is estimated. Because market prices cannot be observed, (sport-fishing is a non-market good), a *surrogate price* must be used to model consumer behavior toward sport-fishing (U.S. Army Corps of Engineers 1995; Herfindahl and Kneese 1974; McKean and Walsh 1986; Peterson et al. 1992).

The sport-fishing demand survey collected information on individuals at the river showing their number of sport-fishing trips per year and their cost of traveling to the river fishing site. The price faced by sport fishers is the cost of access to the fishing site (mainly the time and money costs of travel from home to site), and the quantity demanded per year is the number of sport-fishing trips they make to the free flowing Snake River. A demand relationship will show that fewer trips to the river are made by people who face a larger travel cost to reach the river from their homes (Clawson and Knetsch 1966). " The Travel cost method (TCM) has been preferred by most economists, as it is based on observed market behavior of a cross-section of users in response to direct out-of-pocket and time cost of travel." (Loomis 1997)[1] "The basic premise of the travel cost method (TCM) is that per capita use of a fishing site will decrease if the out-of-pocket and time costs of traveling from place of origin to the site increase, other things remaining equal." (Water Resources Council 1983, Appendix 1 to Section VIII).

Figure 1 shows a market for sport-fishing. (It is a convention to show price on the vertical axis and quantity demanded on the horizontal axis)

A market supply and demand graph for sport-fishing shows the economic factors affecting all sport fishers in a region. The demand by anglers for sport-fishing trips is negatively sloped, showing that if the money cost of a fishing trip (round trip from home to site and back) rises sport fishers will take fewer trips per year. Examples of how money trip costs might rise include: increased automobile fuel prices, sport-fishing regulators close nearby sites requiring longer trips to reach other sites, entrance fees are increased, boat launching fees are raised, or nearby sites become congested requiring longer trips to obtain the same quality sport-fishing. The supply of sport-fishing opportunities is upward sloping. The upward slope of sport-fishing supply is caused by the need to travel ever further from home to obtain quality sport-fishing if more people enter the "regional sport-fishing market". Increased sport-fishing-trips in the region can occur when a larger percentage of the population becomes interested in sport-fishing, when more non-local anglers travel to the region to obtain quality sport-fishing, or if the local population expands over time. The market demand/supply graph is useful for describing the aggregate economic relationships affecting recreationist behavior but a "site-demand" model is used to place a value on a specific sport-fishing site (such as the free flowing Snake River above Asotin, Washington.)

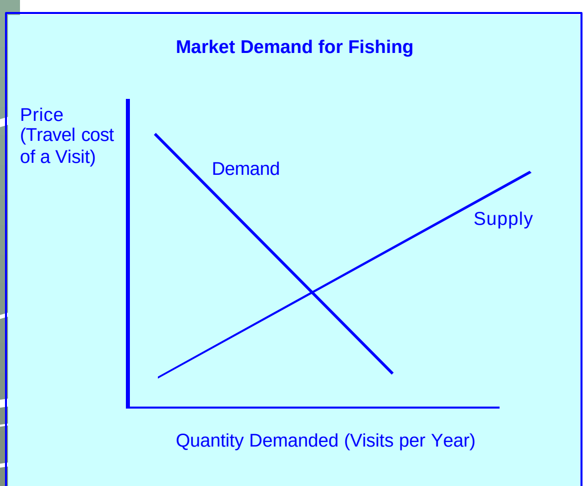

Figure 1 Market demand for fishing.

Figure 2 describes the demand by a typical angler for sport-fishing at the free flowing Snake River. Angler demand is negatively sloped indicating, as before, that a higher cost or price to visit the sport-fishing site will reduce sport-fishing visits per year.

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[1] Travel cost models are incapable of predicting contingent behavior and involve current users. Another set of economic models, contingent behavior and contingent value models, are typically used for projecting behavior or measuring non-use demand.

The supply curve for a given angler to visit a given site is horizontal because the distance from home to site, which determines the cost of access, is fixed. The supply curve would shift up if auto fuel prices increased but it would still be horizontal because the number of trips from home to fishing site per year would not influence the cost per trip.

The vertical distance between the angler's demand for sport-fishing and the horizontal supply (cost) of a sport-fishing trip is the net benefit or consumer surplus obtained from a sport-fishing trip. The demand curve shows what the angler would be willing-to-pay for various amounts of sport-fishing trips and the horizontal line is their actual cost of a trip. As more sport-fishing trips per year are taken, the benefits per trip decline until the marginal benefit (added satisfaction to the consumer) from an additional trip equals its cost where cost and demand intersect. The sport fisher does not make any more visits to the river because the money value to this angler of the added satisfaction from another sport-fishing trip is less than the trip cost. The equilibrium number of visits per year chosen by the angler is at the intersection of the demand curve and the horizontal travel cost line.

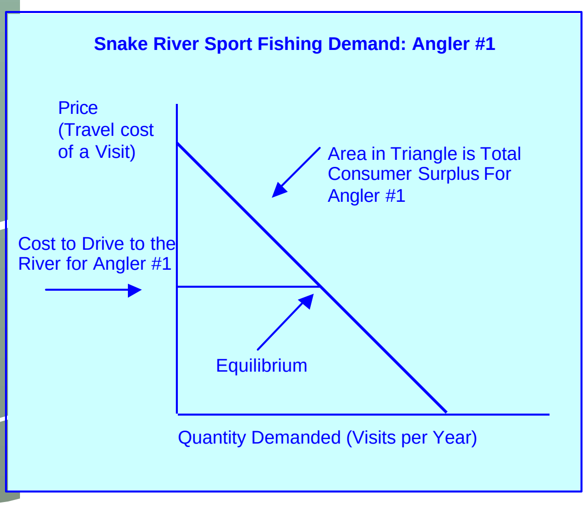

Figure 2 Fishing demand for angler #1.

Each angler has a unique demand curve reflecting how much satisfaction they gain from sport-fishing at the river, their free time available for sport-fishing, the distance to alternate comparable sport-fishing sites, and other factors that determine their likes and dislikes. Each angler also has a unique horizontal supply curve; at a level determined by the distance from their home to the fishing site of their choice, the fuel efficiency of their vehicle, access fees (if any), etc.

The critical exogenous variable in the travel cost model is the cost of travel from home to the sport-fishing site. Each angler has a different travel cost (price) for a sport-fishing trip from home to the river. Variation among anglers in travel cost from home to sport-fishing site (i.e., price variation) creates the free flowing Snake River site-demand data shown in Appendix III. The statistical demand curve is fitted to the data in Appendix III using regression analysis.[2] Non monetary factors, such as available free time and relative enjoyment for sport-fishing, will also affect the number of river visits per year. The statistical demand curve should incorporate all the

[2] It is possible that some anglers might select a residence location close to the reservoirs to minimize cost of travel (Parsons 1991). The travel cost model assumes that this doesn't happen. If anglers locate their residence to minimize distance to the reservoir fishing site then the assumption that travel cost is exogenous is invalid and a simultaneous equation estimation technique would be required.

factors which affect the publics' willingness-to-pay for sport-fishing at the river. It is the task of the free flowing Snake River sport-fishing survey to include questions that elicit information about anglers that explains their unique willingness-to-pay for sport-fishing.

The goal of the travel cost demand analysis is to empirically measure the triangular area in Figure 2 which is the net dollar value of satisfaction received or angler willingness-to-pay in excess of the costs of the sport-fishing trips. The triangular area is summed for the 247 anglers in our sample and divided by their average number of trips per year (which, for anglers in our sample was 12.38 trips per year). This is the estimated consumer surplus per sport-fishing trip or, i.e., net economic value per trip. The estimated average net economic value per trip (consumer surplus per trip), derived from the travel cost model, can be multiplied times the total angler trips from home to the river in a year to find annual net benefits of the free flowing Snake River for sport-fishing.

Appendix III shows unadjusted sample data relating sport-fishing trips from home to site per year and dollars of travel expense per trip at the river for 247 respondents. Appendix III shows the sample data relating sport-fishing trips per year to the hours required to travel between home and the river fishing site. The data shown in both graphs reveal an inverse relationship between money or time required for a sport-fishing trip to the river and trips demanded per year. Both out-of-pocket cost per trip and hours per trip act as prices for a sport-fishing trip. Even before adjustment for differences among anglers' available free time, sport-fishing experience, and other factors affecting angler behavior, it is clearly shown by Appendix III that anglers with high travel costs or high travel time per trip take fewer sport-fishing trips per year. Therefore, observations across the sample of 247 anglers can reveal a sport-fishing demand relationship.

In summary, each price level along a down-sloping demand curve shows the marginal benefit or angler willingness-to-pay for that corresponding output level (number of sport-fishing trips consumed). The gross economic value (total willingness-to-pay) of the sport-fishing output of a public project is shown by the area under the statistical demand function. The annual net economic value (consumer surplus) of sport-fishing is found by

Figure 3: Study region south of Lewiston Idaho.

subtracting the sum of the participants access (travel) costs from the sum of their benefit estimates. Which is equivalent to summing the consumer surplus triangles for all anglers at the river.

METHODS

The sport-fishing "demand" survey provided detailed information on samples of individuals who participated in fishing on the free flowing Snake River. The information provided by these samples was used to infer the spending behavior of anglers on the free flowing Snake River. In capsule, the data collected by the demand survey provided information that was used to estimate the "willingness-to-pay" (marginal benefits) by consumers for various amounts of sport-fishing. Estimation of the marginal benefits (demand) function allowed calculation of "net economic value" per sport-fishing trip.[3]

Study Area

The surveys were conducted using a list of names and addresses collected from sport fishers along a reach of the free flowing Snake River upstream of Asotin, Washington. Figure 3 locates the study region south of Lewiston, Idaho where the Snake River forms the boundary between the states of Washington and Idaho. Figure 4 shows

[3] Measurement of economic value is discussed in the following section.

the river access on Asotin County Road 209 on the west side of the river and the principal river access sites. The length of the study reach between Chief Looking Glass Park near the town of Asotin, Washington and the Oregon border is about 30 miles. The confluence of the Grande Ronde River and the Snake River is about 24 miles upriver from Asotin, Washington.

Shore anglers may access the river using County Road 209 throughout the reach

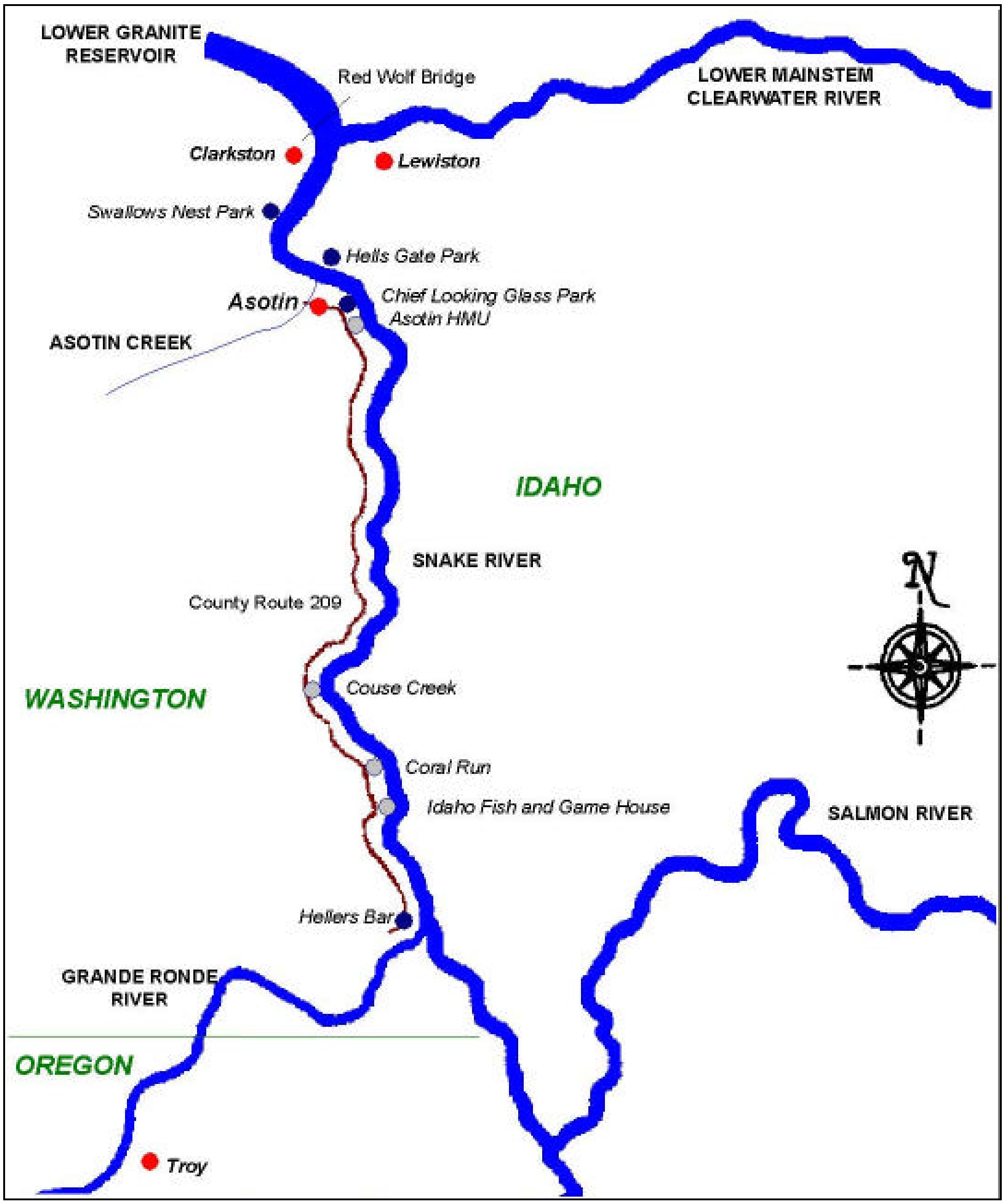

Figure 4: Principal access sites on the free-flowing Snake River

from Asotin to the confluence of the Snake River with the Grande Ronde River. Boat anglers used developed boat launches at Hellers Bar, near the end of County Road 209, and at other developed launch sites at Lewiston (Hells Gate Park), Clarkston (Swallows Nest Park), and Asotin (Chief Looking Glass Park) or one of four undeveloped launch sites along County Road 209.[4] The undeveloped boat launch sites have no formal names but are identified by nearby landmarks. These sites include Asotin ramp located at the south end of Asotin next to a baseball field; Couse Creek ramp, at the confluence of Couse Creek about midway between Asotin and Hellers Bar; Coral Run ramp, located ¼ mile upriver from Buffalo Rapids; and species (22.3%) among the species caught. The questionnaire used for the mail survey is shown in Appendix II and is similar to the sport-fishing questionnaire used on the lower Snake River reservoirs (Normandeau Associates et al. 1998b). The questionnaire used in this study is also similar to those used previously to study sport-fishing demand on the Cache la Poudre River in northern Colorado and for Blue Mesa Reservoir in southern Colorado (Johnson 1989; McKean et al. 1995; McKean et al. 1996). Both of the latter surveys were by personal interview while the Snake River survey was by mail.[5]Idaho Fish and Game House ramp, located opposite the Idaho Fish and Game House about two miles upstream of Coral Run (See Figure 4). The free flowing Snake River expanded demand survey includes detailed socio-economic information about anglers and data on money and physical time costs of travel, sport-fishing, and other activities both on and off river fishing sites. Steelhead was the primary fish caught. Anglers listed steelhead (91.5%), smallmouth bass (43.7%), rainbow trout (27.1%), northern squawfish (25.9%), channel catfish (18.6%), and all other.

Anglers in this study were contacted at the river over the period from September 1997 through March 1998 and requested to take part in the sport-fishing demand mail survey. Most persons contacted on-site were agreeable to receiving a mail questionnaire and provided their name and mailing address. A small share of those contacted preferred a telephone interview and provided a telephone number.

Our sport-fishing demand mail survey resulted in a sample of 247 useable responses out of 288 surveys returned. Some surveys had to be discarded because they were incomplete. A total of 344 surveys were mailed out yielding a useable response rate of 72 percent for the demand model.

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[4] Swallows Nest Park, Hells Gate Park, and Chief Looking Glass Park are all located on Lower Granite Reservoir.

[5] The personal interview surveys had sample sizes of 200 and 150 while this survey had 247 useable responses. Sample size has varied widely in published water-based recreation studies. Ward (1989) used a sample of 60 mail surveys to estimate multi-site demand for water recreation on four reservoirs in New Mexico; Whitehead (1991-92) used a personal interview sample of 47 boat anglers for his fishing demand study on the Tar-Pamlico River in North Carolina; Laymen, et al. (1996) used a sample of 343 mail surveys to estimate angler demand for chinook salmon in Alaska.

Travel Cost Model Design

There has been disagreement among practitioners in the design of the travel cost model, thus wide variations in estimated values have occurred (Parsons 1991). Researchers have come to realize that nonmarket values measured by the traditional travel cost model are flawed. In most applications, the opportunity time cost of travel has been assumed to be a proportion of money income based on the equilibrium labor market assumption. Disagreements among practitioners have existed on the "correct" income proportion and thus wide variations in estimated values have occurred.

The conventional travel cost models assume labor market equilibrium (Becker 1965) so that the opportunity cost of time used in travel is given by the wage rate (see a following section). However, much dissatisfaction has been expressed over measurement and modeling of opportunity time values. McConnell and Strand (1981) conclude, "The opportunity cost of time is determined by an exceedingly complex array of institutional, social, and economic relationships, and yet its value is crucial in the choice of the types and quantities of recreational experiences." The opportunity time value methodology has been criticized and modified by Bishop and Heberlein (1979), Wilman (1980), McConnell and Strand (1981), Ward (1983, 1984), Johnson (1983), Wilman and Pauls (1987), Bockstael et al. (1987), Walsh et al., (1989), Walsh et al. (1990a), Shaw (1992), Larson (1993), and McKean et al. (1995, 1996).

The consensus is that the opportunity time cost component of travel cost has been its weakest part, both empirically and theoretically. "Site values may vary fourfold, depending on the value of time." (Fletcher et al. 1990). "... the cost of travel time remains an empirical mystery." (Randall 1994).

Disequilibrium in labor markets may render wage rates irrelevant as a measure of opportunity time cost for many anglers. For example, Bockstael et al. (1987) found a money/time tradeoff of $60/hour for individuals with fixed work hours and only $17/hour with flexible work hours.

The results from our previous studies and this study on the free flowing Snake River suggest using a model specifically designed to help overcome disagreements and criticisms of the opportunity time value component of travel cost. We use a model that eliminates the difficult-to-measure marginal value of income from the time cost value. Instead of attempting to estimate a "money value of time" for each individual in the sample we simply enter the actual time required for travel to the fishing site as first suggested by Brown and Nawas (1973), and Gum and Martin (1975) and applied by Ward (1983,1989). The annual income variable is retained as an income constraint.[6]

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[6] An added advantage of not using income to measure opportunity time value is that colinearity between the time value component of travel cost and the income constraint should be greatly reduced.

Disequilibrium Labor Market Model

The travel cost model used in this statistical analysis assumes that site visits are priced by both (1) out-of-pocket travel expenses, and (2) opportunity time costs of travel to and from the site. Opportunity time cost has been conventionally defined in economic models as money income foregone (Becker 1965; Water Resources Council 1983). However, a person's consideration of their limited time resources may outweigh money income foregone given labor market disequilibrium and institutional considerations. Persons who actually could substitute time for money income at the margin represent a small part of the population, especially the population of anglers. Retirees, students, and unemployed persons do not exchange time for income at the margin. Many workers are not allowed by their employment contracts to make this exchange. Weekends and paid vacations of prescribed length are often the norm. Thus, the equilibrium labor market model may apply to certain self-employed persons, e.g., dentists or high level sales occupations, where individuals, (1) have discretionary work schedules and, (2) can expect that their earnings will decline in proportion to the time spent recreating. (Many professionals can take time off without foregoing any income). The equilibrium labor market subgroup of the population is very small. According to U.S. Bureau of Labor Statistics and National Election Studies (U.S. Bureau of the Census 1993), only 5.4 percent of voting age persons in the U.S. were classified as self-employed in the United States in 1992. The labor market equilibrium model applies to less than 5.4 percent of anglers who are over-represented by retirees and students.

Bockstael et al. (1987), hereafter B-S-H, provide an alternate model in which time and income are not substituted at the margin. B-S-H show that the time and money constraintscannot be collapsed into one when individuals cannot marginally substitute work time for leisure. Thus, <u>physical travel time</u> and <u>money cost</u> per trip from home to site enter as separate price variables in the demand function. (Figures 5 and 6 show actual money cost and time cost plotted against fishing trips demanded per year). <u>Discretionary time</u> and income enter as separate constraint variables. Money cost and physical time per trip also enter as separate price variables for closely related time-consuming goods such as alternate sportfishing sites. The B-S-H travel cost model can be estimated as;

$$r = b_0 + b_1 c_0 + b_2 t_0 + b_3 c_a + b_4 t_a + b_5 INC + b_6 DT \qquad \textbf{(1)}$$

where the subscripts o and a refer to own site prices and alternate site prices respectively, *c* is out-of-pocket travel cost per trip, *t* is physical travel time per trip, *INC* is money income, and *DT* is available discretionary time.

Disequilibrium and Equilibrium Labor Market Differences

The equilibrium labor market model makes the explicit assumption that opportunity time value rises directly with income. Thus, the methodology that we have rejected assumes perfect substitution between work and leisure. McConnell and Strand (1981, 1983) (M-S) specify price in their travel cost demand model as the argument in the right hand side of equation two:

$$r = f\left[c + (t)\, g'(w) \right] \tag{2}$$

Where, as before, r is trips from home to site per year, c is out-of-pocket costs per trip, and *t* is travel time per trip. The term g'(w) is the marginal income foregone per unit time. It is assumed in the M-S model that any increase of travel cost, whether it is out-of-pocket spending or the money value of travel time expended, has an equal marginal effect on visits per year. The term [c + (*t*)g'(w)] imposed this restriction because it forces the partial effect of a change in out-of-pocket cost (Mf/Mc) to be equal in magnitude to a change in the opportunity time cost Mf/M[(*t*)g'(w)]. An important distinction in model specification is demonstrated by M-S. The equilibrium labor market model requires that out-of-pocket and opportunity time value costs be added together to force an identical coefficient on both costs.[7] In contrast, the B-S-H disequilibrium labor market model requires separate coefficients to be estimated for out-of-pocket costs and opportunity time value costs.

Measurement and statistical problems often beset the full price variable in empirical applications. Even for those self-employed persons who are in labor market equilibrium, measuring marginal income is difficult. Simple income questions are unlikely to elicit true marginal opportunity time cost. Only after-tax earned income should be used when measuring opportunity time cost. Thus, opportunity cost may be overstated for the wealthy whose income may require little of their time. Conversely, students who are investing in education and have little market income will have their true opportunity time costs understated. In practice, marginal income specified by theory is usually replaced with a more easily observable measure consisting of average family income per unit time. Unfortunately, marginal and average values of income are unlikely to be the same.

Closely Related Goods Prices

Ward (1983,1984) proposed that the "correct" measure of price in the travel cost model is the minimum expenditure required to travel from home to fishing site and return since any excess of that amount is a purchase of other goods and is not a relevant part of the price of a trip to the site. This own-price definition suggests that the other (excess) spending during the trip is associated with some of the closely related goods whose prices are likely to be important in the demand specification. For example, time-on-site can be an important good and it is often ignored in the specification of the TCM. Yet time-on-site <u>must be</u> a closely related good since the weak complementarity principle upon which

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[7] Although the equilibrium labor market model requires that the marginal effects of out-of-pocket cost and income foregone on quantity demanded be equal, empirical results often fail to support the model if the two components of price are entered separately in a regression.

measurement of benefits from the TCM is founded implies that time-on-site is essential. Weak complementary was the term used to connect enjoyment of a recreation site to the travel cost to reach it (Maler 1974). It is assumed that a travel cost must be paid in order to enjoy time spent at the recreation site. Without traveling to the site, the site has no recreation value to the consumer and without the ability to spend time at the site the consumer has no reason to pay for the travel. With these assumptions, the cost of travel from home to site can be used as the price associated with a particular recreation site (Loomis et al. 1986).

The sign of the coefficient relating trips demanded to particular time "expenditures" associated with the trip is an empirical question. For example, time-on-site or time used for other activities on the trip have prices which include both the opportunity time cost of the individual and a charge against the fixed discretionary time budget. Spending more time-on-site could increase the value of the trip leading to increased trips, but time-on-site could also be substituted for trips. Spending during a trip for goods, both on and off the site, consist of closely related goods which are expected to be complements for trips to the site. Finally, spending for extra travel, either for its own sake, or to visit other sites, can be a substitute or a complement to the site consumption. For example, persons might visit site "a" more often if site "b" could also be visited with a relatively small added time and/or money cost. If the price of "b" rises, then visits to "a" might decrease since the trip to "a" now excludes "b". Conversely, persons might travel more often to "a" since it is now relatively less expensive compared to attaining "b" (McKean et al. 1996).

Many recreational trips combine sightseeing and the use of various capital and service items with both travel and the site visit, and include side trips (Walsh et al. 1990b). Recreation trips are seldom single-purpose and travel is sometimes pleasurable and sometimes not. The effect of these "other activities" on the trip-travel cost relationship can be statistically adjusted for through the inclusion of the relevant prices paid during travel or on-site and for side trips. Furthermore, both trips and on-site recreation are required to exist simultaneously to generate satisfaction or the weak complementarity conditions would be violated (McConnell 1992). A relation between trips and site experiences is indicated such that marginal satisfaction of a trip depends on the corresponding site experiences. Therefore, the demand relationship should contain site quality variables, time-on-site, and goods used on-site, as well as other site conditions. Exclusion of these variables would violate the specification required for the weak complementarity condition which allows use of the TCM to measure benefits.

In this study of the free flowing Snake River, an expanded TCM survey was designed to include money and time costs of on-site time (McConnell 1992), on-site purchases, and the money and time cost of other activities on the trip. These vacation-enhancing closely related goods prices are added to the specification of the conventional TCM demand model. Empirical estimates of partial equilibrium demand could suffer under specification bias if the prices of closely related goods were omitted.[8]

Traditional TCM demand models seemingly ignore this well known rule of econometrics and exclude the prices of on-site time, purchases, and other trip activities which are likely to be the principal closely related goods consumed by anglers.

RESULTS

The definitions for the variables in the disequilibrium and equilibrium travel cost models are shown in Table 1. The dependent variable for the travel cost model is (r), annual reported trips from home to the sportfishing site. Annual sportfishing trips from home to the free flowing Snake River is the quantity demanded. The average angler took 12.38 trips from home to the fishing site on the free flowing Snake River during the period September 1997 - March 1998.

The t-ratios for all important variables to estimate the value of sportfishing are statistically significant from zero at the 5 percent level of significance or better. All of the tests for over dispersion (Cameron and Trivedi 1990; Greene 1992) for the Poisson regression were positive. Therefore, as discussed earlier, the truncated Poisson regression was replaced by the truncated negative binomial regression method. Use of the truncated negative binomial model eliminated the overstatement of the t-ratios found in the Poisson regression results.

Travel Cost Demand Variables

The definitions for the variables in the disequilibrium and equilibrium travel cost models are shown in Table 1. The dependent variable for the travel cost model is (r), annual reported trips from home to the sportfishing site. Annual sportfishing trips from home to the free flowing Snake River is the quantity demanded.

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[8] Bias in the consumer surplus estimate, created by exclusion of important closely related goods prices, depends on the sign of the coefficient on the excluded variable, and the distribution of trip distances (McKean and Revier 1990). Exclusion of the price of a closely related good will bias the estimate of both the intercept and the demand slope estimate (Kmenta 1971). Both these effects bias consumer surplus. Since the expression for consumer surplus generally is nonlinear, the expected consumer surplus is not properly measured by simply taking the area under the demand curve. The distribution of trips along the demand function can affect the bias in consumers surplus, depending on the combination of intercept and slope bias created by the under specification of the travel cost demand. Both intercept and slope biases <u>and</u> the trip distribution must be known in order to predict the effect of exclusion of the price of a related good on the consumer surplus estimate.

Trip Prices From Home to Site

The money price variable in the B-S-H model is c_r, which is the out-of-pocket travel costs to the sportfishing site. In order to make this study comparable with the Lower Snake River study the same 7.6 cents per mile per angler travel cost was used in both cases. Reported one-way travel distance for each party was multiplied times two and times $0.076 to obtain money cost of travel per person per trip. Cost per mile was based on average angler-perceived cost rather than costs constructed from Department of Transportation or American Automobile Association data. Anglers' perceived price is the relevant variable when they decide how many sportfishing trips to take (Donnelly et al. 1985).

The physical time price for each individual in the B-S-H model (disequilibrium labor market) is measured by t_o which is round trip driving time in hours. Average round trip driving time was 10.95 hours with an average round trip distance of 385.32 miles. Thus, average speed was 35.2 miles per hour. Possible differences in sensitivity to the time cost of a trip were accommodated in the model by creating separate time price variables for different occupations. Eight occupation or employment status categories were obtained in our survey.[9] Dummy variables (0 or 1) were created for each of the occupations and the time price, t_o, was multiplied times the dummies to create separate price variables for each occupation category. For example, t_{o1} is either the "retired persons" round trip travel time to the sportfishing site or zero if the angler is not self-employed. In this manner, the price elasticity of demand with respect to travel time c is allowed to vary, or be zero, for each of the occupation classes.[10]

It would be expected that employment status with the least flexibility to interchange work and leisure hours would be the most sensitive to time price. Hourly workers and retirees showed highly significant time price effects on trips per year. Evidently retirees have firm time commitments. The "professional" employment status category showed no affect of time price on trips per year and was excluded from the final regression. Professionals are likely to have the ability to interchange work and leisure hours.

Closely Related Goods Prices

The B-S-H model calls for the inclusion of t_a, round trip driving time from home to an alternate sportfishing site, as the physical time price of an alternate sportfishing site. This

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[9] Several employment categories were empty or nearly empty. The categories were, retired (17.4%), student (2.4%), unemployed (0.4%), self-employed (11.3%), hourly wage earner (24.3%), professional (33.6%), housewife (0.0%) and all other (10.5%).

[10] Price elasticity with respect to travel time is defined as the percentage reduction in quantity demanded (trips per year) for a one percent increase in time required to travel from home to the fishing site.

variable was not significant and appeared to be highly correlated with the monetary cost of travel. Another alternate site price variable is c_a, which is the out-of-pocket travel costs to the most preferred alternate sportfishing site from the anglers home. This substitute price variable also was not significant.

A price variable, c_{md}, measuring money travel cost for the second leg of the trip for anglers visiting a second fishing site was included. This variable would indicate if the number of trips to the free flowing Snake River was influenced by the cost of going from the first river fishing site to the second site for those with multi-destination trips. A positive coefficient would indicate the second site is substituted for the first if fishing is poor on the Snake River. In that case, a multi-destination trip was not the initial intention of the angler. The sign for the money travel cost of the second leg of the trip was negative indicating the second site was a complement rather than a substitute to the first site. Anglers whose second site was costly to reach made fewer trips per year. The average distance to travel from the first fishing site to the second site was only 27.7 miles.

The variable to measure available free time is *DT*. The discretionary time constraint variable is required for persons in a disequilibrium labor market who cannot substitute time for income at the margin. Restrictions on free time are likely to reduce the number of sport-fishing trips taken. The discretionary time variable has been positive and highly significant in previous disequilibrium labor market recreation demand studies and was highly significant in this study (Bockstael et al. 1987; McKean et al. 1995, 1996). The average number of days that anglers in the survey were “free from other obligations” was 99 days per year.

The income constraint variable (*INC*) is defined as average annual family income resulting from wage earnings. The relation of quantity demanded to income indicates differences in tastes among income groups. Although restrictions on income should reduce overall purchases, it may also cause a shift to low cost types of consumer goods such as fishing. Thus, the sign on the income coefficient conceptually can be either positive or negative. The income variable was not significant perhaps indicating offsetting effects.

Three other closely related goods prices were significant in the model: t_{os}, time spent on site at the river (33.3 hours per trip), c_{os} money purchases at the river ($124.66 per trip), and c_{as}, money spent on-site at alternate sportfishing sites during the fishing trip ($57.20 per trip). The signs of the coefficients for the time variables indicate how they are considered by anglers. As discussed earlier, spending more time-on-site at the river, (or at alternate sites during the trip), could increase the value of the trip leading to increased trips, but time-on-site could also be substituted for trips. Money purchases at the river should be a complement to fishing with a negative sign.

Other Exogenous Variables

The expected sportfishing success rate variable, *E(Catch)* is the individual's previous average catch per day on the free flowing Snake River. Anglers average catch was reported at 3 fish per travel cost trip and varied from one to eight. Trips from home to site per year are hypothesized to relate positively to expected sportfishing success based on the individuals past experience fishing at the free flowing Snake River.

The strength of an angler's preferences for sportfishing over other activities should positively influence the number of sportfishing trips taken per year. The variable, *TASTE*, days fished (at all sites) divided by the angler's available days (time free from obligations), is used as one indicator for angler tastes and preferences for fishing. Nearly 29 percent of available days were used for fishing by anglers in the survey. A second indicator of taste related particularly to the study site is the number of years that the angler has visited the free flowing Snake River. The variable *EXP* measures this second aspect of taste. Anglers had an average of 12.6 years experience fishing on the free flowing Snake River.

Age has often been found to influence the demand for various types of sportfishing activity. The average age of anglers in the survey was 47.7 years. Age of the angler was tested in the statistical demand model and found non-significant.

Nearly two thirds of the anglers in the survey used a boat at least part of the time. However, a dummy variable (*BOAT*) that identified anglers that used a boat for fishing either all or part of the time was found non-significant. Anglers with a boat did not visit the fishing site any more often than shore anglers.

Estimated Demand Elasticities

The estimated regression coefficients and elasticities from the truncated negative binomial regression estimation for the free flowing Snake River sportfishing demand models are reported in Tables 2 and 3.[11] Most of the exogenous variables in the truncated negative binomial regressions were log transforms. When the independent variables are log transforms the estimated slope coefficients directly reveal the elasticities. When the independent variables are linear the elasticities are found by multiplying the coefficient times the mean of the independent variable. Elasticity with respect to dummy variables could be estimated for at least three situations, the dummy variable is zero, the dummy variable is one, or the average value of the dummy variable. Given a log transform of the dependent variable, elasticity for a dummy variable is zero if the dummy is zero, the estimated slope coefficient if the dummy is one, and the slope coefficient times the E(dummy) if the average value of the dummy is used. We will report the elasticity for the

[11] Elasticity refers to the percentage change in the dependent variable (trips) caused by a one percent change in the independent variable (unless otherwise noted).

case where the dummy is one.[12]

Price Elasticity of Demand

Price elasticity with respect to out-of-pocket travel cost is -0.80. As expected for a regionally unique consumer good (fishing on the free flowing Snake River), the number of trips per year is not very sensitive to the price. A ten percent increase in travel costs would reduce participation by only eight percent.

The elasticity with respect to physical travel time for retirees in the sample is -0.255. If the time required to reach the site increased by ten percent, visits would decrease by 2.55 percent. Elasticity with respect to travel time for the self employed is not statistically significant. Price elasticity of travel time for hourly wage earners is -0.185. The coefficient on “other” and “professional” occupations was not significant. Most of the remaining occupation categories had very few members represented in the sample and were excluded from the regression.

Price Elasticity of Closely Related Goods

Price elasticity with respect to the cost of the second leg of the journey for those visiting more than one site (other than at the free flowing Snake River) was -0.078. Three other closely related goods prices were significant in the model: t_{os}, time spent on site at the river had an elasticity of -0.09. Larger expenditures of time at the river per trip reduces the number of trips. Thus, the time on site price of a trip is a complement to fishing trips because as the time on site price of a trip increases fewer trips are made. Money purchases (c_{os}) at the river per trip also has an elasticity of -0.17 indicating that on-site purchases are a complement to fishing trips. Increased cost per trip of on-site purchases reduces the number of trips. Money spent per trip on-site at alternate sportfishing sites away from the river during the fishing trip, c_{as}, has a price elasticity of -0.11. Thus, increases in the cost of purchased inputs at alternative sites also is a complement to fishing trips to the free flowing Snake River.

Elasticity With Respect to Other Variables

Income elasticity is not significantly different from zero. Quantity demanded (sportfishing trips from home to the river per year), was not affected by income. It is not unusual to find that sportfishing is unrelated to income.

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[12] Let the regression equation be $\ln(r) = \alpha_1 + \alpha_2 D + \alpha_3 \ln(Z)$ where Z represents all the continuous independent variables. The equation can be written as $r = e^{(\alpha_1 + \alpha_2 D)} Z^{(\alpha_3)}$. Elasticity of r with respect to D is defined as ε = (% change in r) / (% change in D) = $(\partial r/\partial D)(D/r)$. $\partial r/\partial D = \alpha_2 e^{(\alpha_1 + \alpha_2 D)} Z^{(\alpha_3)}$; D can be 0, 1, or E(D); and r is defined above. Elasticity reduces to $\varepsilon = \alpha_2 D$. Thus, ε becomes zero if D is zero and ε takes the value α_2 if D is one.

Elasticity with respect to discretionary time is 0.18. As in past studies, the discretionary time was positive and highly significant. A ten percent increase in free time results in a 1.8 percent increase in sportfishing trips to the river. As expected, available free time acts as an important constraint on the number of sportfishing trips taken per year.

Elasticity with respect to *TASTE* for fishing was positive showing that anglers who fished a larger fraction of available days were likely to take more sportfishing trips per year to the Snake River. Those who fished ten percent more of their available days would tend to take 4.56 percent more sportfishing trips per year to the Snake River.

The sportfishing experience variable showed that those who have fished the river over a long period of time tend to make more sportfishing trips to the river. A ten percent increase in years visited the river results in a 2.36 percent in annual trips to the river. Past experience of fishing success was very important in explaining demand for sportfishing on the free flowing Snake River. A ten percent increase in expected catch resulted in a 2.47 percent increase in trips per year.

Estimating Consumers Surplus

Consumers' surplus was estimated using the result shown in Hellerstein and Mendelsohn (1993) for consumer utility (satisfaction) maximization subject to an income constraint, and where trips are a nonnegative integer. They show that the conventional formula to find consumer surplus for a semilog model also holds for the case of the integer constrained quantity demanded variable. The Poisson and negative binomial regressions, with a linear relation on the explanatory own monetary price variable are equivalent to a semilog functional form. Adamowicz et al. (1989) show that the annual consumers surplus estimate for demand with continuous variables is E(r)/(-ß), where ß is the estimated slope on price and E(r) is average annual visits. Consumers surplus per trip from home to site is 1/(-ß). (Also note that the estimate of consumers surplus is invariant to the distribution of trips along the demand curve when surplus is a linear function of Q. Thus, it is not necessary to numerically calculate surplus for each data point and sum as would be the case if the surplus function was nonlinear.)

Consumers Surplus Per Trip From Home to Site

Estimated coefficients for the travel cost model with labor market disequilibrium, and assuming travel cost per mile of 7.6 cents per mile per person are shown in Table 2. The assumption of 7.6 cents per mile per person is identical with that used in the fishing demand model estimated for the four reservoirs on the Lower Snake River (Normandeau Associates et al. 1998b). However, actual cost per mile reported by anglers fishing upstream of Lewiston was smaller at 5.3 cents per mile.

Application of truncated negative binomial regression, and using angler-reported travel distance times $0.076 per mile per person to estimate out-of-pocket travel costs, results in an estimated coefficient of -0.028 on out-of-pocket travel cost. Consumers surplus per angler per trip is the reciprocal or $35.71. Average angler trips per year in our sample was 12.38. Total surplus per angler per year is average annual trips x surplus per trip or 12.38 x $35.71 = $442 per year. This result assumes that anglers upstream of Lewiston and anglers on the four reservoirs on the Lower Snake River use vehicles having similar fuel efficiency. Money travel cost per mile for a vehicle is based on the much larger sample collected for the reservoirs (537 observations versus 247 observations).

Total Annual Consumers Surplus

An important objective of the demand analysis was to estimate total annual willingness-to-pay for fishing on the 30 mile reach of the free flowing Snake River. As discussed above, consumer surplus was estimated at $35.71 per person per travel cost trip. The average number of sportfishing trips per year from home to the free flowing Snake River was 12.38 resulting in an average annual willingness-to-pay of $442 per year per angler. The annual value of the sport fishery or willingness-to-pay by our sample of 247 anglers is 247 x $442 = $109,174.

The total annual willingness-to-pay for all anglers requires knowledge of the total population of anglers which fish on the 30 mile reach. The number of anglers can be inferred from our sample values for hours per day fished and days fished per year combined with the estimated total annual hours fished (88,940 hours) on the 30 mile reach (Normandeau Associates et al. 1998c). Hours fished per year for the average angler is estimated from the product of average hours per day (7.2 hours) times average days per year (14.82) or 7.2 x 14.82 = 106.7 hours fished per year for an angler. Dividing total annual hours fished by our estimate of hours per year for an individual yields total anglers or 88,940/106.7 = 833.6 unique anglers on the 30 mile stretch.[13] Multiplying annual value per angler times the number of unique anglers yields total annual willingness-to-pay of $442 x 834 = $368,628

Non-response Adjustment to Total Annual Willingness-To-Pay

An adjustment for bias caused by non-response could increase the total annual willingness-to-pay (and angler expenditures also) by as much as 11 percent. About 28 percent of anglers contacted did not return a useable survey. A survey of non- responders was not attempted for this data set. However, a telephone survey on non-responding anglers in the Lower Snake River Reservoir survey resulted in an average of 13 trips per

[13] Adjustment for non-response bias in the reservoir angler travel cost study resulted in an increase of 16.7 percent in the estimated number of unique anglers.

year compared to about 20 trips per year for those who did respond (Normandeau Associates et al. 1998b). These data suggest about 35 percent less participation by non-respondents. A crude adjustment for non-response bias assumes that the 35 percent reduction in trips also applies to angler hours per year from our survey. Given that assumption, the average hours per year remains 106.7 for responders and becomes 106.7 x (1-0.35) for non-responders and the adjusted average hours per angler is [106.7 x 0.72] + [106.7 x (1-0.35) x 0.28] = 96.24 where the response rate was 0.72 and the non-response rate was 0.28. The result of the adjustment for lower participation by non-responders is to lower the hours per year from 106.7 to 96.24 which is a 9.8 percent reduction in estimated average fishing hours per year per angler. As before, the total number of unique anglers was estimated by dividing total angler hours per year by annual hours per angler (88,940/96.24 = 924 unique anglers). Compared to our previous estimate of 834 unique anglers before the adjustment for non-response, this is a 10.8 percent increase in unique anglers. Multiplying annual value per angler times the number of unique anglers yields total annual willingness-to-pay of $442 x 924 = $408,408 compared to $368,628 prior to the adjustment for non-response bias. The adjustment for non-response bias is not substantial because a relatively large share (72 percent) of the persons contacted returned a useable survey.

Effect of Multi-destination Trips

About 102 anglers out of 288 fished at sites other than upstream of Asotin during the trip. (The sample of 288 was reduced to 247 for the regression analysis because of missing data on trips per year or miles traveled).

In order to measure the influence of multi-destination visitors we removed them from the sample. First, we eliminated persons in the sample (total of 38) who spent as much or more time fishing away from the site as fishing on-site. The result was that average travel distance from home to site increased from 192 miles to 202 miles and consumer surplus per visitor per trip increased slightly. The model continued to fit well. We then eliminated 33 persons in the sample who spent one half as much or more time fishing away from the site as fishing on-site. The result was that average travel distance from home to site increased from 192 miles to 215 miles and consumer surplus per visitor per trip increased again. The model still fit well to the data.

The results described above are the opposite of what is normally expected. Evidently, eliminating those who visit multiple sites eliminates mainly locals. Perhaps non-locals tend to stay on the river upstream of Lewiston because they don't know other local sites that are good fishing or they have signed up with a guide service which keeps them on the river. About 27 percent of boat anglers used guides but this percentage would be much larger for non-locals. Locals may visit other sites, but the sites usually are not far away; apparently they visit the reservoirs or tributaries to the Snake upstream. The average distance to the alternative site is only 27 miles for the entire sample. If a few huge outliers are removed the distance to the alternate site drops to about 11 miles. Our conclusion is that multi-destination visitors tend to be locals who visit nearby sites either on upriver tributaries or on the reservoirs. Few of the visitors are on an extended journey across the country. Eliminating anglers who fished at other sites from the sample does not accomplish the goal of reducing overstatement of benefits to multi-destination visitors because it mainly eliminates locals. Thus, consumer surplus per person per trip increases rather than decreases when multi-destination visitors are removed from the sample.

Comparison of Willingness-To-Pay With Other Studies

Comparisons of net benefits for fishing among demand studies is difficult because of differences in the units of measurement of consumption or output. Comparisons of value per person trip are flawed unless all studies compared have similar length of stays. Comparisons of value per person per day are difficult because some sites and fish species are fishable all day (or even at night) and others only at certain hours. Conversion problems for sportfishing consumption data makes exact comparison among studies impossible. Many studies are quite old and the purchasing power of the dollar has declined over time. Adjustment of values found in older studies to current purchasing power can be attempted using the consumer price index. Another problem with older studies is the changes in both economic and statistical models used to measure value. Adjustment for different travel cost model methodologies, as well as contingent value methodologies, and inflation, is shown in Walsh et al. (1988a; 1988b; 1990a). Some of the more recent studies used higher cost per mile than we did for travel and also used income rate as opportunity time cost that was added to the monetary costs of travel. If these outmoded methods resulted in an overstatement of travel cost, a near proportional overstatement of estimated consumer surplus will occur. In addition, some of the studies used Poisson regression and obtained extremely large t-values. Although no test for over-dispersion was mentioned, the very high t-values suggest that the requirement of Poisson regression that the mean and variance of trips per year be equal was violated. If that is the case, the Poisson regressions are inappropriate and should have been replaced with negative binomial regression.

Olsen et al. (1991) used a contingent value survey to obtain estimates for steelhead and salmon fishing in the Columbia River Basin including the lower Columbia River. Their estimate is $90 per person per trip for steelhead. The average trip length was about two days with 0.68 steelhead caught on average during the trip.

Willingness-to-pay per travel cost trip from home to site in the present study was estimated to be $35.71. This result is slightly higher than our estimates for reservoir fishing on the Lower Snake River of some $32 (Normandeau Associates et al. 1998b).[14]

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[14] The difference in the value of fishing is believed reliable because the same economic model and estimation techniques were applied to the reservoirs and the free-flowing Snake River.

Table 1 Definition of variables [15]

r =	annual trips from home to the free flowing Snake River fishing site (dependent variable
c_0 =	the angler's out-of-pocket round trip travel cost to the sport-fishing site, in dollars
$L(t_{01})$ =	"retirees" round trip travel time to the sport-fishing site, in hours
$L(t_{04})$ =	"Hourly wage earners" round trip travel time to the sport-fishing site, in hours
$L(t_{05})$ =	"Professionals" round trip travel time to the sport-fishing site, in hours
$L(t_{08})$ =	"Other occupation" round trip travel time to the sport-fishing site, in hours
$L(t_{0s})$ =	time spend on-site at the river sport-fishing during the trip, in hours
$L(c_{md})$ =	the angler's out-of-pocket travel cost (if any) for the second leg of the trip for anglers visiting a second site away from the free flowing Snake River, in dollars.
$L(c_{0s})$ =	the angler's out-of'pocket purchases while at the sport-fishing site, in dollars
$L(c_{as})$ =	the angler's out-of-pocket purchases during the trip at an alternate fishing site, in dollars
L(INC) =	annual family earned and unearned income, in dollars
L(DT) =	the angler's discretionary time available per year, in days
L(TASTE) =	the angler's ratio of days fished (at all locations) divided by their available days
L(E(CATCH)) =	the angler's reported historical catch rate at the Snake River site, fish per day
L(EXP) =	the angler's total sport-fishing experience at the river, in years

[15] L in front of the variable indicates a log transformation.

Table 2. Travel costs results for the free flowing Snake River above Lewiston.

Variable	Coefficient	t-ratio	Mean of Variable	Elasticity
Constant	2.73	4.65	na	na
c_o	-0.028	-8.71	28.66	-0.80
L(t_{o1})	-0.255	-2.15	-	-0.26
L(t_{o4})	-0.0244	-0.22	-	ns
L(t_{o5})	-0.1847	-1.86	-	-0.18
L(t_{o8})	-0.1901	-0.93	-	ns
L(t_{os})	-0.0869	-1.40	2.65	-0.09
L(c_{md})	-0.0777	-1.33	0.76	-0.08
L(c_{os})	-0.1676	-4.11	3.51	-0.17
L(c_{as})	0.1058	2.73	1.30	0.11
L(*INC*)	-0.0015	-0.03	10.39	ns
L(*DT*)	0.1775	3.41	4.11	0.18
L(*TASTE*)	0.4562	11.57	-1.56	0.46
L(*E(CATCH)*)	0.2469	3.36	0.73	0.25
L(*EXP*)	0.2358	4.19	2.08	0.24

Travel cost per mile per angler assumed to be $0.076. Truncated negative binomial regression[16], r = trips per year to the river r = dependent variable), mean r= 12.38. R^2 = 0.60 (estimated by a regression of the predicted values of trips from the truncated negative binomial model on the actual values.)

[16] See Appendix I for a discussion of the statistical methodology.

Table 3 Effects of exogenous variables on an angler's trips per year

Exogenous Variable	Effect on Trips/Year of a **+10%** Change
Angler's Money Cost of Round Trip (dollars/trip)	-8.00%
"Retiree" Angler's Round Trip Travel Time (hours/trip)	-2.60%
"Hourly Wage Earner" Angler's Round Trip Travel Time (hours/trip)	ns
"Professional Occupation" Angler's Round Trip Travel Time (hours/trip)	-1.86%
"Other Occupation" Angler's Round Trip Travel Time (hours/trip)	ns
Angler's Time Spent at the Snake River Sportfishing (hours/trip)	-0.87%
Anglers's Money Cost (if any) of the Second Leg of the Journey To Another Fishing Site (dollars/trip)	-0.78%
Angler's Purchases While at the Snake River Fishing Site (dollars)	-1.68%
Angler's Purchases During the Trip While Fishing Away From the Snake River Site (dollars)	1.06%
Annual Family Income (dollars/year)	ns
Angler's Discretionary Time Available (days/year)	1.78%
Angler's Fraction of Available Days Spent on Fishing (ratio)	4.56%
Angler's Historical Catch Rate at the Snake River Site (fish per day)	2.47%
Anglers's Total Years of Fishing Experience (years)	2.36%

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Appendix I Statistical Concerns for Demand Curve Estimation

Truncated Poisson or truncated negative binomial regression is appropriate for dependent variables with count data (integer), and truncated negative binomial regression is used in this study (Greene 1981; Creel and Loomis 1990, 1991; Hellerstein and Mendelsohn 1993). An alternate approach is to separate the decision process into two parts. The potential visitor first decides whether or not to visit the site. For those who decide to visit the site a second decision is made on the number of visits per year. Two stage estimation techniques such as Tobit, Heckman, and Cragg models do not account for the integer nature of the recreation trips variable resulting in significant error (Mullahy 1986). Because the data for the dependent variable (visits per year), are integers, truncated below one visit per year, equation estimation by ordinary least squares regression (OLS) is inappropriate. Truncation occurs when part of the data are excluded from the sample. The on-site survey excluded persons not consuming recreation at the study site. Maddala (1983) shows that the regression slopes estimated by OLS will be biased toward zero when the dependent variable data are truncated. The result is that the least squares method understates price elasticity and overstates consumers' surplus. Where price elasticity is defined as the percentage change in quantity demanded (trips) caused by a one percent change in money trip price (out-of-pocket cost of a trip).

Poisson and negative binomial regression functional form is mathematically equivalent to a logarithmic transformation of the dependent variable. Most of the independent variables are log transformed. The resulting functional form for these variables in the demand equation is double log. Out-of-pocket travel cost is not transformed resulting in a semi-log functional form.

The significance of the coefficients in a Poisson regression can be greatly overstated if the variance of the dependent variable is not equal to its mean (overdispersion). The negative binomial regression does not have this shortcoming but the iterative solution process sometimes fails to converge.[17] Convergence was not a problem for this data set. Tests for over-dispersion in the truncated Poisson regressions were positive. Tests developed by Cameron and Trivedi (1990), and shown in Greene (1992), were conducted. These tests indicated that over-dispersion was present in the Poisson regression models. Also, the t-values appeared inflated in the Poisson regressions. A second test is available by actually running the negative binomial regression. When the truncated negative binomial regression was estimated, the coefficient on the over-dispersion parameter, " , was 0.4623 with a t-value of 7.60. This result provided strong evidence of over-dispersion because the negative binomial model implies:

$$var(r) / E(r) = \{1 + a\, E(r)\} = \{1 + 0.4623\, E(r)\}$$

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[17] The distinguishing characteristic of many recent non-linear econometric estimation techniques is that the have no explicit analytical solution. In such cases an iterative numerical calculation approach is used (Cramer 1986).

and our sample estimate of E(r) was 12.38 sportfishing trips from home to the river per year. The Poisson model assumption that var(r)/E(r) = 1 is clearly violated. The t-values found in the truncated negative binomial model were smaller than in the truncated Poisson model. That result was further evidence that Poisson model had over-dispersion. Therefore, the truncated negative binomial regression technique was used in place of truncated Poisson regression.

Appendix II Questionnaire

FIELD(FirstName) FIELD(LastName)
FIELD(Address)
FIELD(City), FIELD(State) FIELD(PostalCode)

Dear FIELD(FirstName) FIELD(LastName),

Recently you helped the University of Idaho by participating in a use survey at FIELD(Where contacted) on the Snake River. It is our understanding that you, or a household member who was present on the first survey, would be willing to assist this project by completing the attached “Follow-up” survey for a more in-depth view of the Snake River. The information you supply concerning the money you or your party spent in going to the recreation site, at the site, and returning home is of high importance for this study.

Please find enclosed a stamped pre-addressed envelope for mailing to the project home office.

Enclosed is a small token of our appreciation, for you to keep, for your participation in this effort to learn more about the use of the Snake River.

All information will be confidential and will be used only as totals with no individual names or information released to any person or agency.

Thank you for your assistance in completing the survey forms.

Sincerely,

Project Consultant

SPORTFISHER SURVEY   SNAKE RIVER UPSTREAM FROM LEWISTON (OMB #0710-000 Expires September 30, 1998) Thank you for agreeing to participate in this sportfisher survey. This questionnaire pertains to the Snake River, upstream of Lewiston, near where you were surveyed.

1.Circle one ... **{mainly fish from boat}   {mainly fish from bank} {equal amount from boat and bank}**

2.Circle one ... stayed in: **{camper}   {trailer}   {commercial campground} {motel}   {with friends}   {public campground}   {didn't stay overnight}   {other, describe:__________________ }**

3.How many hours per 24 hour day do you fish on average? _________ **hours per day**

4.Typically, how many days per year are you on fishing trips to the river where you were surveyed? _________ **days per year**

5.Typically, how many days per year are you on fishing trips to places other than the river where you were surveyed? _________ **days per year**

6.How many fish of all kinds do you typically catch per day at the river where you were surveyed? ________ **fish per day**

7.Circle all that apply ... What kind of fish do you typically catch?**{steelhead}   {rainbow trout} {northern squawfish}   {channel catfish} {smallmouth bass}   {other, describe_________}**

8.How many miles (one-way) is it from your home to the river where you were surveyed? _________ **miles one-way**

9.Circle all that apply ... How did you travel to the Snake River fishing site upstream of Lewiston? **{pickup truck}   {car}   {boat}   {bus}   {plane}   {other, describe other________}**

10.How many years have you fished on the Lower Snake River? _______ **years**

11.How many days per year are you free from other obligations so that you could go fishing or undertake other recreation? ______ **days per year**

12.What is your total time (hours) away from home on a typical trip to the river where you were surveyed? ______ **hours**

13.What is the typical total cost to you of a trip to the river where you were surveyed including round trip transportation, equipment, supplies, food, accommodations, entertainment, etc.? **$** ______ **cost to you.**

14.Please enter your typical hours away from home and typical trip cost (answered above) in the last row of the table below.

Column 2: please allocate hours away from home across the trip activities listed on the left. **Column 3:** please allocate trip cost across the activities listed on the left.

(1) TRIP ACTIVITY	(2) HOURS AWAY FROM HOME	(3) TRIP COSTS IN DOLLARS
Fishing at the river		
Fishing at other sites than the river upstream of Lewiston during the trip		
Travel to and from the fishing site from your home		
Other recreation activities at the river		
Recreation at other places than the river during the trip		
Other Activities on Trip (explain below)*		
	TOTAL HOURS =	**TOTAL DOLLARS =**

* Please describe other activities on trip
____

15.What is your occupation? Describe type of employment, or student, housewife, retired, unemployed, school teacher, truck driver, etc.___________________________________

16.How many days of vacation, excluding weekends, do you typically take each year? ______ **days per year**

17.What is the one-way distance from your home to your most preferred alternative fishing site if you didn't fish upriver from Lewiston on the Snake River? _____ **miles one-way**

18.What is the name & location of your most preferred alternative fishing site?_________________

19.Circle one ... Will you typically leave the site where you were surveyed for alternative reservoirs, lakes, or streams, if fishing conditions are bad here? {yes} {no}

20.If the answer to question 19 above is yes, what is the distance one-way from the site where you were surveyed to the alternate site? ______ **miles one-way**

21.For the kind of fishing you like to do, how many other sites besides the river where you were surveyed are available to you? ______ **other sites**

22.Typically, how many fishing trips per year do you take to the river where you were surveyed? ______ **trips per year**

23.What is your age? Circle one ... **{less than 20} {20-25} {25-30} {30-35} {35-40} {40-45} {45-50} {50-55} {55-60} {60-65} {65-70} {70-75} {75-80}**

24.Circle one ... Do you give up wage or salary income (i.e. non-paid vacation) when traveling to this site or while fishing at the site? {yes} {no}

25.If the answer is yes to question 24 above, how much income do you give up for a typical fishing trip to the river where you were surveyed? **$**______________

26.What is your current wage or salary income in $ per year? Circle one ...
{0-10,000} {10,000-20,000} {20,000-30,000} {30,000-40,000} {40,000-50,000} {50,000-60,000} {60,000-70,000} {70,000-80,000} {over 80,000}

27.What is your current pension, interest income, etc., in $ per year? Circle one ...
{0-10,000} {10,000-20,000} {20,000-30,000} {30,000-40,000} {40,000-50,000} {50,000-60,000} {60,000-70,000} {70,000-80,000} {over 80,000}

Appendix III Raw data plots.

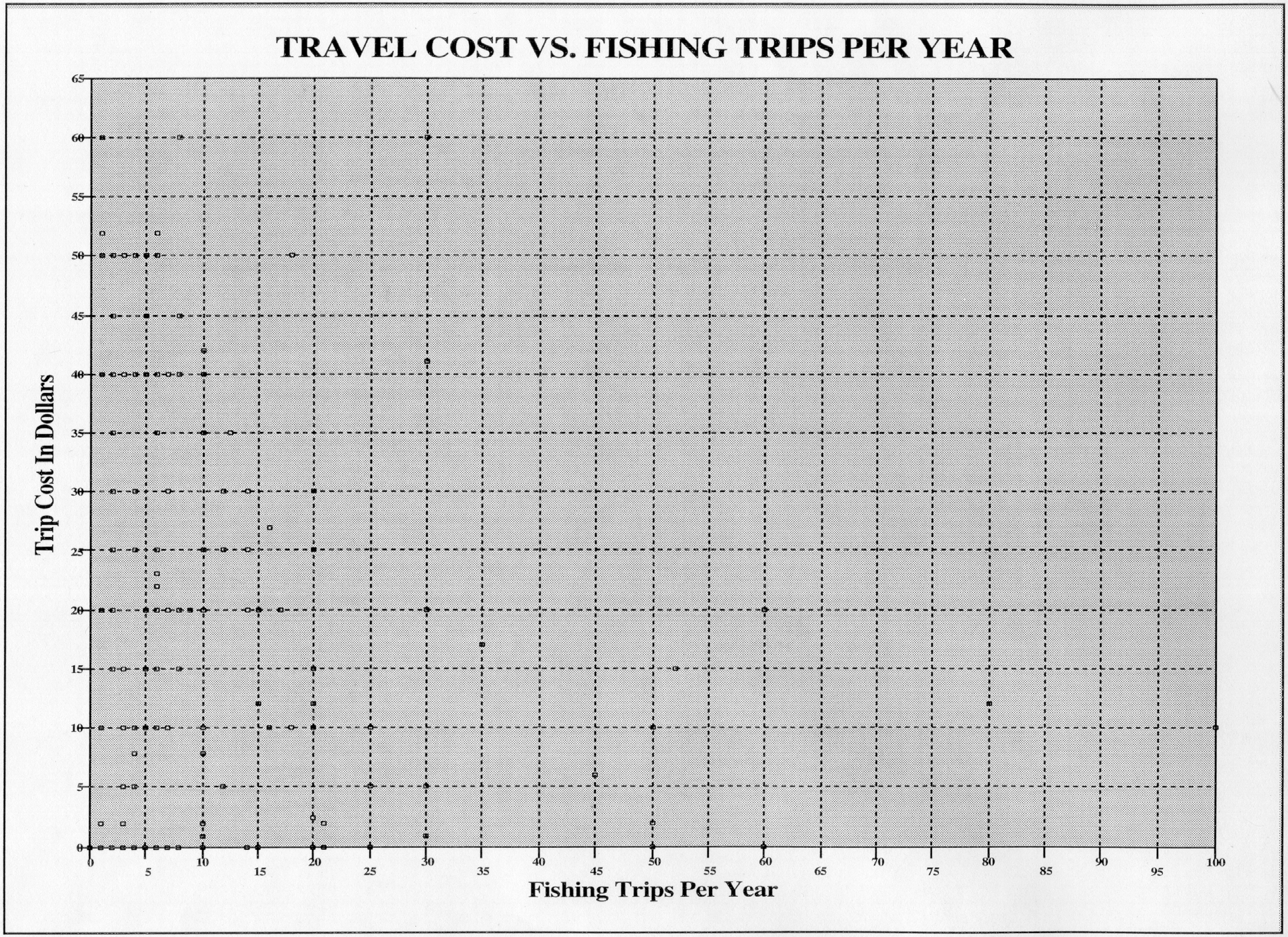

Figure 5 Travel cost versus fishing trips per year

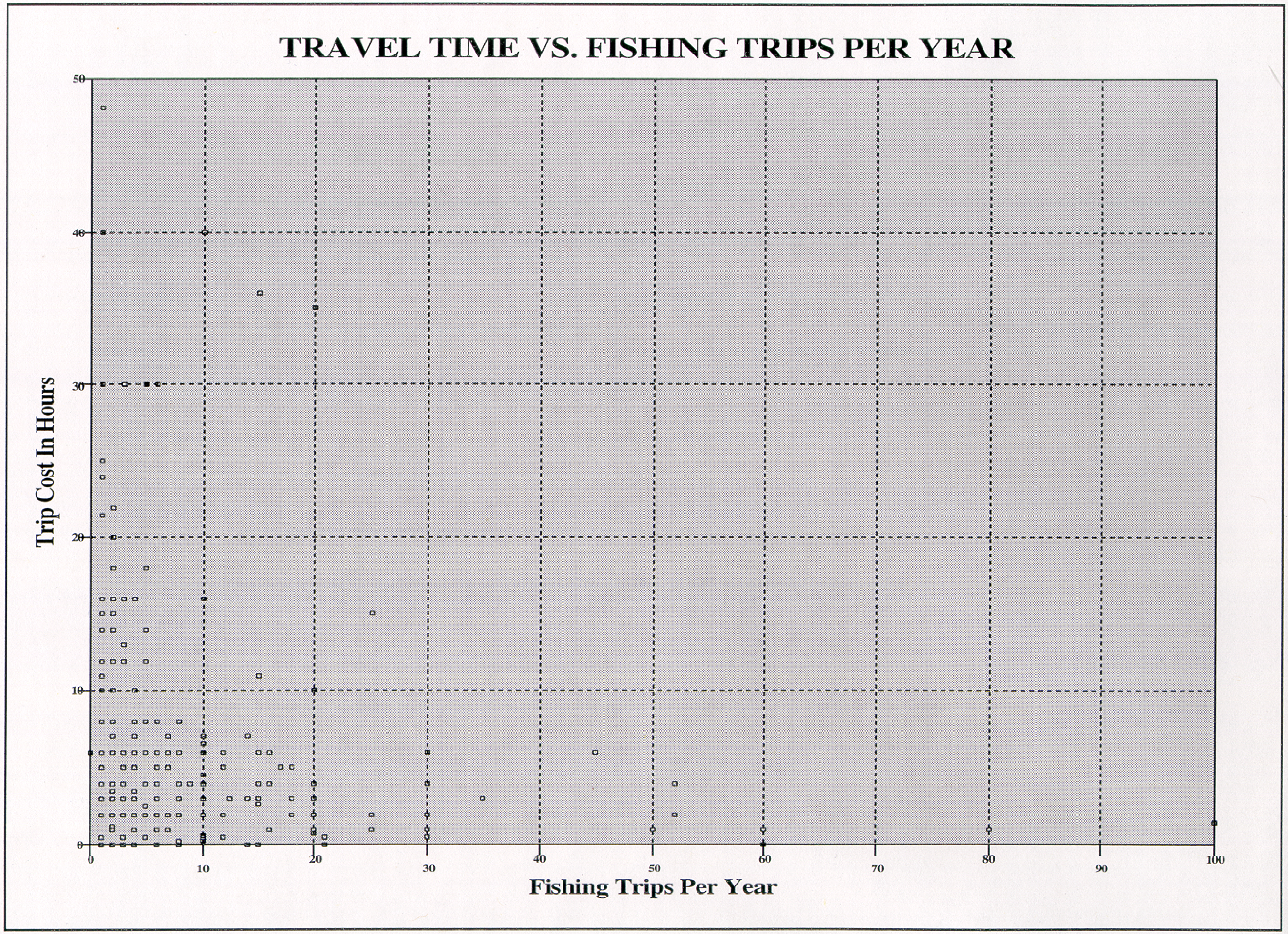

Figure 6 Travel time versus fishing trips per year