THE NET ECONOMIC VALUE OF FISHING IN MONTANA

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EXECUTIVE SUMMARY

The objective of this study was to estimate the net economic value (net willingness to pay) of stream and lake anglers in Montana. A regional Travel Cost Model (TCM) was used to statistically derive a demand equation from survey data collected from stream and lake anglers during the fall of 1985.

The regional TCM approach is recommended by the Water Resources Council (1979, 1983) and the U.S. Department of Interior (1986) as one of the two preferred techniques for estimating recreational benefits. In addition, a number of Federal agencies are required by the Water Resource Council and U.S. Department of Interior to use the concept of net economic value when evaluating Federal agency actions.

The TCM method uses the distance traveled as a measure of price and the number of trips taken from a given origin to a particular site as a measure of quality to trace out a demand curve for the recreation site. The resulting demand equation is used to calculate the additional amount anglers would be willing to pay, over and above their travel costs, to have the opportunity to fish at the site in question.

The state average net economic value for lake fishing is $89 per trip. For streams, the value is $113 per trip. This means an angler would be willing to pay $89 and $113 more per trip to have the opportunity to fish lakes or streams, respectively. On a per-day basis, the net economic value for lake fishing is $70 and $102 for stream fishing. Converting these values to a Forest Service Recreation Visitor Day (RUD) yields a value of $280 for stream fishing and $342 for lake fishing. The annual aggregate value of Montana's stream and lake fishing is $122 million and $93 million, respectively. Net economic values are also derived on a site-specific basis.

The angler expenditure data collected by the same survey indicates the average fishing trip by resident anglers cost $48 per trip while the average nonresident angler spent $360 per trip in Montana. The average expenditures per day for stream and lake fishing by residency is revealing. The average cost per day for resident stream fishermen was $22.00 and $32.00 for lake fishermen. Nonresidents on the other hand spent $116 per day for stream fishing and $50.00 per day for lake fishing. Total expenditures for stream fishing were $52.4 million ($20.4 million by residents and $32 million by residents) in 1985 while lake fishermen spent $47.3 million ($33.9 million by residents and $13.4 million by nonresidents). Total expenditures for stream and lake fishing in 1985 amounted to $52.4 million and 47.3 million respectively.

The net economic values presented in this paper are the appropriate values to use in benefit/cost analysis or where economic efficiency decisions (i.e. forest or range planning) are being made. If the annual values of stream and lake fishing are put into net present value, they can be used in trade-off analysis with marketed resources such as timber, coal, or grazing. For example, the present value of the net willingness to pay values for stream fishing are conceptually comparable to stumpage prices.

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ACKNOWLEDGEMENTS

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INTRODUCTION

Purpose and Scope of Research

The objective of this research is to statistically estimate the net economic value (net willingness to pay) for fishing in Montana using a survey of Montana anglers. The fishing benefit estimates are derived from a regional (multi-site) TCM demand equation. A secondary objective was to collect data on resident and nonresident angler expenditures

This study does not quantify the entire "Total Economic Value" of fisheries resources in Montana. Many people besides current anglers derive economic benefits from knowing Montana's fisheries resources and associated aquatic habitats exist (i.e. existence value) or knowing that these resources exist for future generations (i.e. bequest value). In addition, many non-current anglers would be willing to pay to maintain the opportunity to fish in Montana in the future (i.e. option value).

Research by Walsh et al. (1985) indicates that for large scale, irreversible changes (e.g. damming, dewatering, etc.) to rivers that these options, existence and bequest values, represent 80% of the total economic value of these resources. Thus, recreation reflects only about 20% of the total economic value. However, for many management actions which result in relatively small changes in fish populations or fish habitats, most of the economic effects are limited to anglers. Therefore, these angler values are of primary interest for evaluation of many land management actions associated with National Forest Plans, timber sales, and Bureau of Land Management resource management plans.

Definition of Benefits

Many Federal agencies are required by U.S. Water Resources Council Principles and Guidelines (1983) to use of net willingness to pay (e.g., net economic value) as a measure of value in Benefit Cost Analysis or evaluation of Federal actions. For example, the U.S. Forest Service uses net economic value in its FORPLAN analysis of Forest Plans. When performing natural resource damage assessments, U.S. Department of Interior regulations require calculation of economic values lost to society be measured in terms of net willingness to pay (U.S. Department of Interior, 1986). Use of net willingness to pay is also recommended in textbooks on Benefit Cost Analysis [Sassone and Schaffer, 1978; Just, Hueth and Schmitz (1982)]. Net willingness to pay reflects the direct benefits to the users and the net benefits to society. By contrast, expenditures are actually costs to the users and society but may reflect gains in local income and employment. Expenditures, when translated to local value added, is useful to evaluate local economic impacts. Expenditures are used by the U.S. Forest Service in the IMPLAN analysis of Forest Plans.

SPECIFICS OF RECREATION DEMAND AND BENEFIT ESTIMATING METHODOLOGY

Methodology

The method employed in this study is a regional Travel Cost Method. This approach is recommended by the U.S. Water Resource Council (1979, 1983) as one of the two preferred techniques for estimating recreation benefits. The method is one of the most widely applied demand estimating techniques. TCM uses observations of travel distance as a measure of price and trips taken as a measure of quantity to statistically trace out a demand equation. The resulting first stage or per capita demand equation allows the analyst to calculate the additional amount the recreationists would pay over and above their travel costs to have access to the site for fishing. This calculation is made using a "second stage" or site demand curve that relates added distance or added travel cost to visitation. See Clawson and Knetsch (1966), Dwyer, Kelly and Bowes (1977), or Sorg and Loomis (1985) for a discussion of the basic TCM approach.

Estimating First Stage or Per Capita Demand Equation

The basic per capita or first stage TCM demand equation estimated for stream and lake fishing as well as warmwater lake fishing is given in Equation 1 as:

$$(1)\ (TRIPSij/POPi) = Bo - B1(RTDISTij) + B2(SUMTRTj) + B3(DEMOGi) + B4(QUALj) + B5(SUBSik)$$

where:

TRIPSij/POPi = Angler trips per capita from county i to site j.

RTDISTij = Round trip distance from angler's county of residence i to the river or lake j.

SUMTRTj = Total trout catch at river or lake j.

DEMOGi = Demographics such as income, age, years fished, etc. of anglers in county i.

QUALj = Quality of site j as reflected in measures such as surface acres for lakes, accessibility as measured by land ownership.

SUBSik = An index reflecting quality and location of substitute fishing sites k available to county i.

When implementing this basic model, we used counties as zones of origin for anglers living relatively near the site. We used groups of counties for anglers visiting at greater distances from the site to avoid recording zero visits from some intermediate distance counties. For single destination, single purpose anglers visiting from states not contiguous to Montana, we used the entire state (and its population) as a zone of origin.

Assumptions of the Travel Cost Method

Like any modeling effort, the TCM method has a few assumptions. The critical assumptions in terms of estimation of economic values are interpretation of travel cost as price paid to visit the site and statistical requirements related to cost estimating the demand function. These will each be discussed in turn.

The reasonableness of the travel cost as price assumption depends on two factors: multidestination trips and value of travel time.

With respect to the first factor, for travel cost to be considered the price paid to visit the site, such travel costs must be incurred exclusively to gain access to the recreation site. If the trip has many destinations, we cannot correctly interpret all of the travel cost as a price paid for fishing at any one particular site. To satisfy this assumption, we asked the angler if this river or lake was their primary destination. That is, would they have made the trip if fishing at this site was not available. If they said they would still make the trip, then this angler was excluded from the sample since their trip's primary purpose was to visit another site or to engage in some nonfishing activity (e.g. business). In other words, such trips did not meet the assumption of single destination trips needed to interpret travel cost as price of access to the site.

The issue of converting travel distances to a monetary price involves accounting for two costs of travel: transportation cost and opportunity cost of travel time. To convert distance to 1984 dollars, we used two measures of vehicle costs. One is the variable costs of vehicle operation from the U.S. Department of Transportation's "Cost of Owning and Operating a Vehicle-1984." This is not only a widely used source for operating costs but is recommended by the U.S. Water Resources Council (1979, 1983) for use in performing Travel Cost Method studies. However, the cost per mile obtained from this report does not reflect the higher vehicle operating costs associated with driving vehicles often used for recreation, recreational road driving conditions, etc. To account for this, we also calculated benefits using data on reported trip expenditures in our sample. This approach will be discussed in more detail later.

Since time is scarce, time spent traveling has an opportunity cost in terms of either foregone time fishing at the recreation site or foregone time spent in other activities which may be other recreation, leisure (sleeping, watching TV, reading, etc.), or working. Long travel times act as a deterrent in visiting more distant sites, even to anglers with sufficiently high income such that transportation cost is not a factor. There is empirical evidence that travel time is viewed as costly both in the transportation planning literature (Cesario, 1976) and in sport fishing (McConnell and Strand, 1981). In the case of Rhode Island saltwater sport anglers, comparison of the deterrent effect of travel time and travel cost indicated that anglers valued the time spent traveling at about 60% of their wage rate. The value of time saved is recognized in highway benefit cost studies as well. The U.S. Water Resources Council (1979, 1983) relies on Cesario's (1976) work and suggests using a value between one-fourth and one-half the wage rate as a proxy for the opportunity cost of time. It should be noted that the wage rate is used solely as a proxy for opportunity cost of time in all other activities, and it is used even if the angler would not have been working. In this study, we used two approaches. The standard time cost estimate is based on one-third of the average wage rate for the value of travel time per the U.S. Water Resources Council, 1983. Our reported time cost value is based on our sample willingness to pay to shorten travel time. This approach will be presented in a later section.

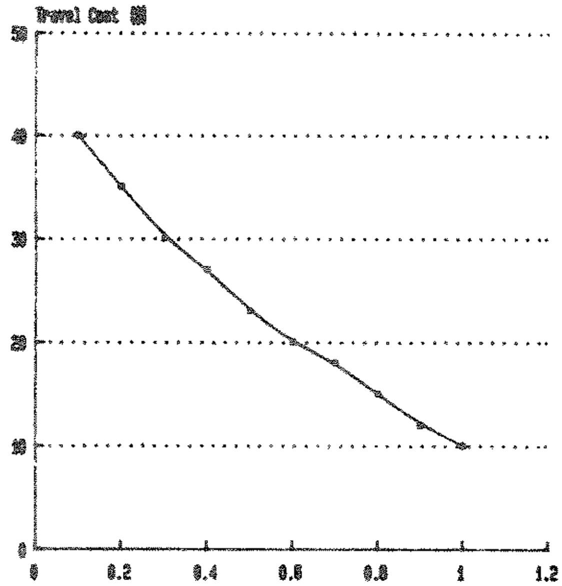
The other basic set of modeling assumptions relate to the statistical method used to estimate the travel cost per capita demand function: ordinary least squares regression. In any statistical estimation that relies on ordinary least squares regression, certain assumptions must be met for the regression (slope) coefficients to have the desired properties of best linear unbiased estimates. While most of the assumptions are met when using cross section data such as is required in TCM, one assumption is of particular concern: omitted variables. In particular, if the omitted variable is strongly correlated with the price variable, our estimates of net benefits may be over or underestimated. Two explanatory variables that one often wishes to include when performing TCM analyses are income and price-quality of substitutes. In cases where these variables were significant, they are included in the demand equations. When such variables were not significant (in the particular forms tried), they were not included in the final demand equations.

Another basic statistical assumption is that the variance of the dependent variable is constant (homoscedasticity). As discussed below, a double log specification is used here to minimize heteroscedasticity.

<u>Calculation of Benefits from the Per Capita Demand Equation</u>

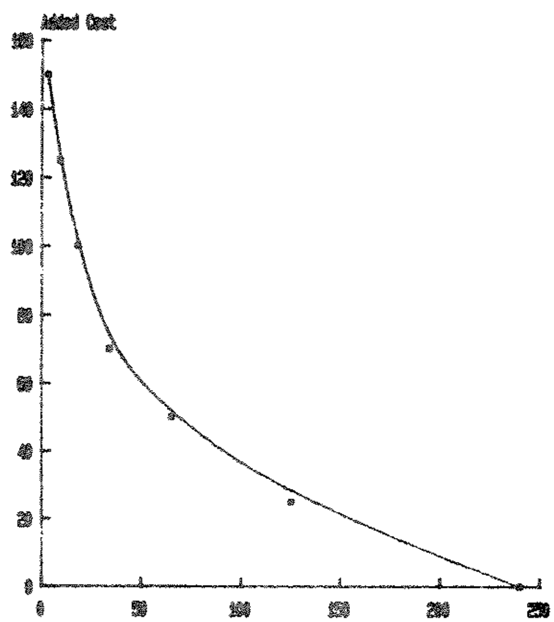
Once the per capita demand equation of the form in Equation 1 is estimated using ordinary least squares regression, benefits can be calculated in several ways. First, the per capita curve could be integrated for each zone of origin between the current distance and the maximum distance that would drive visits to less than one to calculate net willingness to pay for each zone. Site benefits would be the population's weighted sum of each zone's net willingness to pay. Alternatively, a "second stage" or site demand curve relates total site visitation to increases in distance (or travel costs) over and above the existing distance (or cost). The area under this site demand curve is net willingness to pay. This second stage demand curve approach is used in estimating lake fishing benefits since it is more amenable to programming with LOTUS 123. The first stage approach was used in estimating stream fishing benefits because of special problems created by origins very close to a given site (as will be discussed in more detail below). The equivalence of these two approaches has been demonstrated in the literature (Burt and Brewer, 1971; Menz and Wilton, 1983). Figure 1 provides an overview of the two step process illustrating the first stage and second stage TCM demand curves.

FIGURE 1
Travel Cost Method



First Stage or Per Capita Demand Curve

Second Stage or Site Demand Curve



DATA SOURCES

The data used to calculate net willingness to pay using the Travel Cost Model was collected from two separate surveys designed and administered by the Department of Fish, Wildlife and Parks. (Survey questionnaires are displayed in Appendix A).

The Fisheries Survey is designed to estimate fishing pressure on Montana's sport fishing waters. Questionnaires are mailed out monthly to 1,500 fishing license holders. During 1985, this rate was increased to 3,000 surveys per month. From May through October, 1,500 surveys were sent out every two weeks to minimize recall bias. This method of sampling provides the department with a snapshot of an angler's fishing activity during the year. Approximately 36,000 surveys were mailed to resident (92% of the sample) and nonresident (8% of the sample) fishermen. Fifty-four percent (54%) or 19,271 surveys were returned.

Of the 19,271 surveys returned, 69% (13,287) responded that they had not fished during the time period in question. The remaining 31% (5,984) said they had fished during the time period in question. They provided information on where they fished, what they caught, and what they kept along with information on the purpose of the trip, round trip distance, and whether they had stayed overnight.

The data concerning the area fished and whether it was an overnight trip was coded into ten (10) categories. These categories, in conjunction with the responses to the purpose of their trip to a particular site, determined if that particular trip was a multipurpose and/or multiple site trip. If so, this data was deleted from the file for the purposes of estimating the Travel Cost Method demand function.

In addition to the annual Fisheries Survey, a supplemental angler telephone survey was administered in September and October of 1985. This survey provided detailed socio-economic (i.e. trip expenditures, vehicle driven, travel time, income, age, etc.) data on both resident and nonresident fishermen. A sample of two thousand fishing license holders was drawn and interviewed. The respondents were initially asked if they had fished in Montana this year (1985), if the primary purpose of their most recent fishing trip was to fish and if they fished just one lake, river, or stream. Unless they answered yes to these questions, the interview was ended.

The overall response rate for the supplemental angler survey was seventy-five (75) percent. Resident fishermen comprised 80% of the sample (1,600 out of 2,000) while 20% (400) were nonresidents. Response ratio by residency was: Residents - 80% (1284 out of 1600) and Nonresidents - 52% (207 out of 400).

The lower response rate for nonresidents can be attributed to the tight screening questions since a large portion of the nonresidents were on multipurpose trips.

These two data sets were then merged in a two-step operation. Demographic data (age, income, etc.) was appended to the Fisheries Survey on an origin basis. Origins were either single or multiple counties or states. Site characteristics, i.e. fishing equipment, catch, time spent fishing, etc., were appended to the Fisheries data on a fishing site basis. Finally, travel cost and travel time information and other trip data from the supplemental survey was merged with the Fisheries data on an origin-destination basis.

STATISTICAL ESTIMATION OF FISHING DEMAND EQUATIONS

TCM Equation Variables

The basic variables shown in Equation 1 were obtained from the two surveys discussed above. However, some of the variables represent the sum of values reported by anglers. For cold and warm water fish catch, the variable represents the sum of surveyed angler catch at that specific site.

The substitute variable was constructed using both the distance variable and the sum of a site's fish catch. The substitute index measures the availability of substitute fishing sites for each county of origin. If an alternative site is regarded as more attractive than the actual site visited, then it is a potential substitute for that site. For simplicity, the attractiveness of a site is defined as that site's fish catch divided by the angler's round trip distance to that site. For each observation, if any other site's attractiveness index is greater than or equal to that of the site actually visited, then that alternate site is a substitute to the site actually visited. For each observation, the attractiveness index of all the substitute sites are summed. This summation is the substitute index. The estimated coefficient for this variable should be of a negative sign as the greater the availability (more sites that are closer) and attractiveness (greater the fish catch) of substitute fishing sites to the actual site visited in any particular observation, the lower the angler's willingness to pay is for the site actually visited would be.

Lake TCM Demand Equations

The results of the estimation of the first stage demand curve for lakes is as follows:

(2) $\ln(TRIPSij/POPj) = 3.683 - 1.930\ [\ln(RTDISTij)]$

$+ 0.310\ [\ln(SUMTRTj)] + 0.108\ [\ln(STWWCA)]$

$- 0.081\ [\ln(SUBSik)] - 0.191\ [\ln(AVINCOi)]$

$+ 0.431\ [\ln(AVYRSFi)] - 1.942\ [\ln(AVEDi)]$

{t-statistics}: (-35.012)

(4.664) (3.402)

(-2.967) (-2.134)

(2.305) (-3.579)

where:

TRIPSij = Lake fishing trips from origin i to site j.

POPj = Origin i's population.

RTDISTij = Round trip distance from origin i to site j.

SUMTRTj = Sum of trout catch at site j.

STWWCAj = Sum of other sport fish caught at site j, including warm water species.

SUBSINik = Substitute index reflecting the fish catch per mile at site k with higher fish catch per mile than site j.

AVINCOi = Average income of anglers in origin i.

AVYRSFi = Average years fished of anglers in origin i.

AVEDi = Average education of anglers in origin i.

R^2 = 0.780, Observations = 465, F-Statistic = 231.40.

Both the R^2 and the F-Statistic are very high for a TCM demand equation. Furthermore, all the coefficients are of the expected sign (other than income and eduction) and are significant at the 95% level. The equation was estimated in the double-log form for a number of reasons. First, economic theory indicates that there is diminishing marginal value for catching additional fish. That is, each additional fish caught is worth less than the first few fish caught. One functional form consistent with diminishing marginal value is the double-log form. Interpreting Equation 2, we see that a 10% increase in trout catch results in a 3% increase in trips per capita. With the percentage increase in trips being smaller than the percentage increase in fish, the marginal value per fish will fall for increases in fish catch. Alternatively, the marginal value of a fish will rise when fish catch is reduced. The other reason for choosing a log model is that past research has shown that taking the natural log of the trips per capita minimizes two problems that arise with a linear model. First, with the log of trips per capita, the possibility of predicting negative trips per capita from distant counties that actually visited is eliminated. Second, heteroscedasticity associated with zones of different population sizes is minimized using the log of the dependent variable.

Because average income has a negative coefficient, it appears the number of lake fishing trips varies inversely with the participant's income. This negative relationship may also reflect the higher opportunity cost of time facing higher income anglers. That is, since fishing is a time intensive activity, the time costs of a fishing trip rise with income and therefore higher income anglers might take fewer trips. Lake fishing demand also appears to be inversely related to the participant's level of education.

Site Attribute Variables

In an effort to describe the recreational sites in more detail than is usual for the TCM model, the TCM equation was also estimated with the addition of several site attribute variables. In the previous case, the two fish catch variables were the only descriptors included.

Of several attribute variables tested, only two, Shore Access and Total Surface Area, were significant on the basis of one or two-tailed T-tests. Shore Access measures the level of private ownership of a site which is an indirect measure of the degree of difficulty an angler would experience in attempting to enter that site. This variable has a negative sign because it is an index measure, where the highest number (6) represents complete private ownership with no public access allowed. The smallest number (1) represents complete public access that is guaranteed due to public ownership (State or Federal) around the entire water body. The index increases in value as more of the shoreline is controlled by private ownership, making access more difficult. Therefore, demand should vary inversely with Shore Access.

Total Surface Area measures the total surface area of the water bodies included in the data set. Sites with greater surface acres provide both greater fishable waters, higher aesthetic levels, and opportunities for other recreation activities such as boating and waterskiing. Thus, we would expect the desirability of a site to anglers should be a positive function of Total Surface Areas.

For estimation purposes, Shore Access and Total Surface Area are abbreviated as SHACC and TSA, respectively. The resulting equation is:

(3) $\ln[TRIPS^{ij}/POP^{i}) = 3.194 - 1.931\ [\ln(RTDIST_{ij})]$

{t-statistics}: (-34.820)

$+ 0.257(SUMTRT_{j})] + 0.109\ [\ln(STWWCA)]$

(3.174) (2.795)

$- 0.081\ [\ln(SUBS_{ik})] - 0.203\ [\ln(AVINCO_{i})]$

$$(-2.980) \qquad (-2.241)$$

$$+ 0.462 [\ln(AVYRSF_i)] - 1.876 [\ln AVED_i]$$

$$(2.165) \qquad (-3.391)$$

$$- 0.417 [\ln(SHACC_j)] + 0.099 [(\ln TSA_j)]$$

$$(2.152) \qquad (1.506)$$

R^2 = 0.780, Observations = 449, F-Statistic = 177.36.

Again, both the R^2 and the F-Statistic are very high for a TCM demand equation. Furthermore, all the coefficients are of the expected sign (except income and education) and are significant at the 95% level. The only exception is lnTSA, which is significant at slightly less than the 90% level. This equation is also in the double-log form for the reasons discussed above.

The comparatively small changes in coefficients between Equation 2 over Equation 3 indicate that the attribute data added only limited explanatory power. This insignificant difference indicates that the attribute variables missing from Equation 2 were not strongly correlated with the critical price coefficient. The largest change is for the coefficient on trout catch which moves from .310 to .257.

Estimated total trips for the entire sample data set was 3,870 with Equation 2 and 3,766 with Equation 3. The actual reported total trips were 3,222. Overall, this is not a poor prediction, but with an R^2 near 80% one would have hoped for a closer prediction.

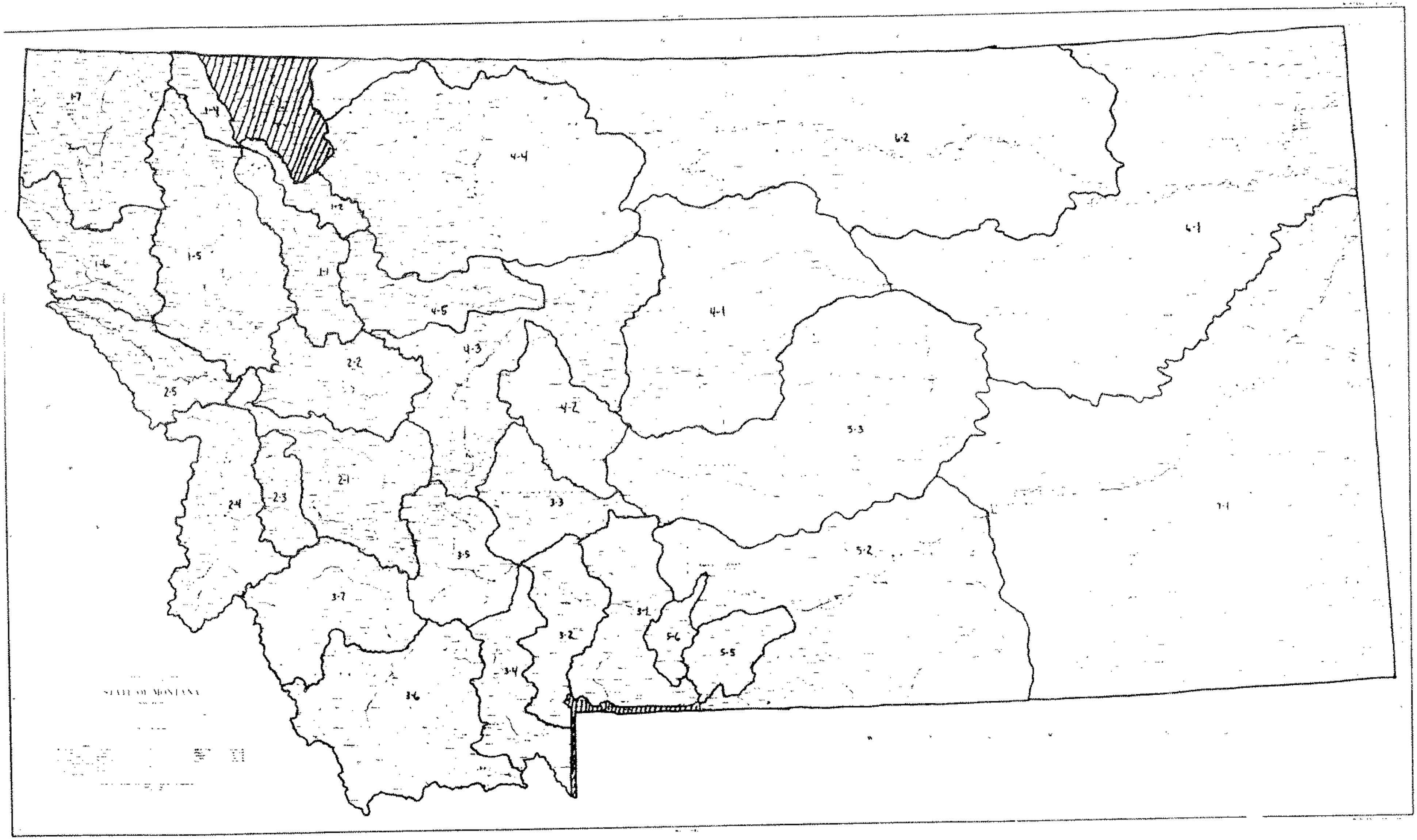
Stream Variables and Data Subsets

The stream demand equation was estimated for a set of 49 specific Montana rivers and tributaries (see Table 1 and Figure 2 below). One portion of this complete set includes the 20 "unique waters" identified by the Montana Department of Fish, Wildlife and Parks (DFWP) for the purposes of this study. These rivers are identified by a code number from 80 to 99 (Table 1). The unique waters include only major river reaches such as the Missouri between Holter and Cascade. The remaining waters included in the complete set of streams are either tributaries to the unique waters or are watersheds including both a river and its tributaries (for example, the Jefferson). The non-unique waters have codes from 11 to 71 (where the first digit corresponds to the DFWP administrative region). As an example, in the Table 1 listing, the entry Madison with code number 34 is the tributaries to the Madison River, while Madison, code 92, is the Madison River itself from the West Fork to its mouth.

Table 1. Montana streams, definition of sites.

RIVER CODE NO.	RIVER	DEFINITION
11	South Fork Flathead	Entire drainage
12	Middle Fork Flathead	Entire drainage
14	North Fork Flathead	Entire drainage
15	Flathead	River and tributaries below confluence with S. Fork an excluding River 89
16	Lower Clark Fork	River and tributaries below confluence with Flathead (Paradise)
17	Kootenai Tribs	Excludes mainstem River 91
21	Upper Clark Fork Tribs	Above confluence with Blackfoot (Milltown) and excluding Mainstem River 86
22	Blackfoot Tribs	Excludes Mainstem River 83
23	Rock Creek Tribs	Excludes Mainstem River 94
24	Bitterroot Tribs	Excludes Mainstem River 82
25	Middle Clark Fork Tribs	Paradise to Milltown excluding Mainstem River 87
31	Upper Yellowstone Tribs	Springdale to Gardner excluding Mainstem River 98
32	Gallatin Tribs	Excludes Mainstem River 90 and 88
33	Upper Missouri (Region 3)	River and tributaries from Three Forks to Canyon Ferry
34	Madison Tribs	Excludes Mainstem River 92
35	Jefferson	Entire drainage
36	Beaverhead Tribs	Excludes Mainstem River 80
37	Big Hole Tribs	Excludes Mainstem River 81
41	Middle Missouri	River and tributaries below Marias River and above Fort Peck
42	Smith Tribs	Excludes Mainstem River 95
43	Upper Missouri (Region 4)	Canyon Ferry to Marias River excluding Mainstem River 93
44	Marias	Entire drainage
52	Middle Yellowstone Tribs	Springdale to confluence with Bighorn excluding River 99, 84, 85, 96, 55 and Boulder tributaries
55	Stillwater Tribs	Excludes Mainstem River 96
56	Boulder Tribs	Excludes Mainstem River 84
61	Lower Missouri	River and tributaries from upper end of Fort Peck Reservoir to N. Dakota border
62	Milk	Entire drainage
71	Lower Yellowstone	River and tributaries below Bighorn confluence
80	Beaverhead	Mainstem
81	Big Hole	Mainstem
82	Bitterroot	Mainstem to confluence of E. and W. Forks
83	Blackfoot	Mainstem
84	Boulder	Mainstem
85	Bighorn	Mainstem
86	Upper Clark Fork	Mainstem above Milltown
87	Middle Clark Fork	Mainstem Milltown to Paradise
88	East Gallatin	Mainstem
89	Upper Flathead	Mainstem above Flathead Lake to confluence of S. Fork
90	Gallatin	Mainstem
91	Kootenai	Mainstem
92	Madison	Mainstem
93	Missouri Holter-Casc	Mainstem Holter to Cascade
94	Rock Creek	Mainstem (near Missoula)
95	Smith	Mainstem
96	Stillwater	Mainstem (near Absarokee)
97	Swan	Mainstem
98	Upper Yellowstone	Mainstem Springdale to Gardner
99	Middle Yellowstone	Mainstem Springdale to confluence with Bighorn

Figure 2



1-7
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6-1
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STATE OF MONTANA

The stream analysis utilized the same basic angler data sets as the lakes. Accordingly, the set of possible socio-economic, quantity, and price variables was identical. Substitute variables were also developed as described for the lake sample. However, site attribute variables were available for the stream model from two different sources: the Montana Interagency Stream Data Base and the Pacific Northwest Rivers Study. Both data bases contain detailed hydrological, physical, and biological information on a stream reach basis. This data was aggregated based on stream length-weighted averages to conform to the river sections defined for this study. It was found that for many variables information was incomplete or missing. Because the data tended to be more complete and more easily validated for the major rivers, site attribute variables were developed only for the 20 major "unique waters".

The list of eleven site attribute variables developed for the unique waters are listed in Table 2. Basically, the variables measure site specific aesthetics (scenic quality), access, and physical parameters (length, discharge, and volume). Only two of the variables, WESTHTIC (weighted aesthetic index) and WINGRESS (weighted ingress measure), are from the Interagency data base. The remainder are from Pacific Northwest Rivers Study except for DISCHARGE (flow in cubic feet per second), which was obtained from U.S. Geological Survey records and VOLUME, which is a computed variable and equals discharge times river length.

Stream TCM Demand Equations

An estimate of a double log specification of the first stage demand curve for streams is as follows:

(4) $\ln(TRIPS^{ij}/POP_i) = -1.615 - 1.798[\ln(RTDIST^{ij})$

(t-statistics) (-2.96) (-50.13)

$+ .389[\ln(SUMTRT)] - 4.43[\ln(AVYRSF_i)$

(7.25) (-4.32)

where:

TRIPSij = Stream fishing trips from origin i to site j

POPi = Origin i's population

RTDISTij = Round trip distance from i to j.

SUMTRTj = Sum of trout catch at j.

AVYRSFi = Log of average years fished of anglers in origin i.

Adjusted R^2 = .782, Observations = 727, F-Statistic = 870.0

TABLE 2

Site Attribute Variables

Montana Streams

variable	definition
WESTHTIC	aesthetics index (stream data base)
WINGRESS	ingress measure (stream data base)
LENGTHR	river length in miles
SNOSITER	number of recreation sites
WBTFISHR	fishable from a boat
WACCESSR	access index
WSCENICR	scenic index (river data base)
WVALUER	final value (river data base)
WROSR	ROS class
DISCHARGE	cubic feet per second average flow
VOLUME	discharge times length

As for the lake demand equation, the R^2 and F-Statistic are very high, indicating high explanatory power for the model. The key parameter for purposes of consumer surplus estimation is the slope coefficient on distance. This parameter is highly significant, has the expected sign, and is precisely estimated with a 95 percent confidence interval that is only plus or minus 4 percent of the estimate in Equation 4. The success variable SUMTRTj (total trout catch) and the demographic variable AVYRSFIi (trip average years fished) are also highly significant (99 percent level), but the sign on AVYRSFi is opposite of what one would expect. Two other demographic variables (average years schooling and average income) had the right sign but were significant at only about the 80 percent level. The substitute variable was not significant.

In addition to statistical significance and consistency with the theoretical model, the travel cost demand model estimate can be evaluated on how well it predicts. While the model is estimated on per capita trips, it is an accurate prediction of total trips that is critical for the consumer surplus estimate. As for the lake model, total trips are overpredicted: 8,257 against an actual of 5,214. This is an overestimate of almost 60%. Trip prediction versus actual for Equation 4 is shown in Table 3. An analysis of trip prediction on the origin-destination level indicated that just 15 of the approximately 750 origin-destination pairs (with complete information) could account for almost the entire overestimate. For these 15 cases, the actual trips were 352 while the predicted trips were 3,592. All 15 cases were for origins less than 35 miles round trip from the site and typically less than 20 miles away. In short, the log-log model overpredicts for very close sites.

A more complete analysis of residuals indicated that the model was not only overpredicting trips for nearby sites but also for very distant sites. Intermediate distances were generally underpredicted. The Glejser (1969) test for heteroscedasticity showed that residual variance was nonconstant (significantly correlated to distance). These results indicate that the double log transformation is not entirely successful at producing a model that is linear in the transformed variables.

The first stage demand function estimate for the unique waters subsample is as follows:

$$(5)\quad (TRIPS_{ij}/POP_i = -5.031 - 1.894[\ln(RTDIST_{ij})]$$

(t-statistic) (-3.34) (-31.46)

$$+ .484[\ln(SUMTRT)_j] - .652[\ln(AYRSF)_j]$$

(6.11) (-4.24)

$$+ .412(XENGTHR)_j + .924[\ln(AVED)_i]$$

(2.09) (1.77)

Adjusted R^2 =.758, F-statistic=226.61, Observations=361.

where:

XENGTHR = Log of river length in miles.
$AVED_i$ = Log of average years of education.

(other variables as noted previously).

The estimate for the unique waters subsample is similar to Equation 4 for the complete sample. The R^2 and F are quite high, and the variables included are all significant at the 90% level. The signs of the estimated parameters are generally consistent

Table 3. Montana streams trip prediction compared to actual.

RIVER	RIVER CODE NO.	ORIGIN ZONES	TOTAL TRIPS	PREDICTED TRIPS
S. FORK FLATHEAD	11	4	10	14.65
MIDDLE FORK FLATHEAD	12	7	16	30.13
NORTH FORK FLATHEAD	14	10	23	14.52
FLATHEAD	15	18	90	125.18
LOWER CLARK FORK	16	20	103	111.24
KOOTENAI TRIBS	17	11	91	100.61
UPPER CLARK FORK TRIBS	21	16	106	131.14
BLACKFOOT TRIBS	22	11	39	66.14
ROCK CREEK TRIBS	23	1	6	10.16
BITTERROOT TRIBS	24	16	224	455.31
MIDDLE CLARK FORK TRIBS	25	9	36	48.85
UPPER YELLOWSTONE TRIBS	31	24	65	138.19
GALLATIN TRIBS	32	14	66	342.12
UPPER MISSOURI REGION 3	33	16	109	134.40
MADISON TRIBS	34	23	76	67.28
JEFFERSON	35	20	151	472.49
BEAVERHEAD TRIBS	36	26	100	136.68
BIG HOLE TRIBS	37	17	61	332.09
MIDDLE MISSOURI	41	18	99	159.75
SMITH TRIBS	42	6	25	142.82
UPPER MISSOURI REGION 4	43	27	278	314.45
MARIAS	44	19	82	107.60
MIDDLE YELLOWSTONE TRIBS	52	35	288	335.79
MUSSELSHELL	53	11	75	397.80
STILLWATER TRIBS	55	7	40	72.12
BOULDER TRIBS	56	7	9	16.11
LOWER MISSOURI	61	4	23	0.00
MILK	62	6	33	24.61
LOWER YELLOWSTONE	71	8	16	13.40
BEAVERHEAD	80	19	120	78.95
BIG HOLE	81	37	187	171.12
BITTERROOT	82	12	88	313.31
BLACKFOOT	83	26	149	102.78
BOULDER	84	16	57	112.76
BIGHORN	85	28	160	142.32
UPPER CLARK FORK	86	16	94	151.03
MIDDLE CLARK FORK	87	17	231	159.89
EAST GALLATIN	88	10	37	259.73
UPPER FLATHEAD	89	12	66	261.81
GALLATIN	90	31	265	231.35
KOOTENAI	91	11	121	68.35
MADISON	92	55	396	225.10
MISSOURI HOLTER-CASC	93	26	357	120.50
ROCK CREEK	94	21	89	136.53
SMITH	95	14	43	62.99
STILLWATER	96	15	133	133.75
SWAN	97	10	26	34.42
UPPER YELLOWSTONE	98	32	81	636.62
MIDDLE YELLOWSTONE	99	17	174	537.65
TOTALS			5214.00	8256.62

with the theoretical model. The only attribute variable that came in significant was river length. The coefficient on distance is again precisely estimated and is not significantly different from the corresponding estimate from the complete sample.

The major limitation of the unique waters estimate is again poor prediction of total trips. Actual for the subsample of 20 rivers is 2,874, and predicted is 5,284 or an 83% error.

The double-log estimates reported in Equations 4 and 5 are consistent with the travel cost model demand specification typically reported in the economics literature. The estimates compare favorably with published findings in terms of overall statistical significance and will be used in the benefit estimates reported below. However, because the estimates are heteroscedastic, an analysis was undertaken of alternative functional forms. This work is reported in a supplementary technical paper: "Alternative Specifications of TCM Demand Functions for Montana Cold Water Stream Fishing".

BENEFIT ESTIMATES

Benefit Calculations and Conversion of Miles to Dollars

As noted above, one approach to estimating site benefits is to calculate each site's second stage demand curve from the per capita demand equations. Since the price variable in the per capita demand equations is in terms of miles, the area under the second stage demand curve represents willingness to pay in additional miles. In order to calculate net economic values in dollars, the angler's additional willingness to pay in miles must be converted to willingness to pay in dollars. This involves multiplying the added distance by a cost per mile of distance. This travel cost per mile is the sum of two components, time opportunity cost per mile and variable out-of-pocket travel expenses (including vehicle operation).

As noted previously, opportunity cost of travel time reflects the deterrent effect that longer drives have on visiting more distant sites independent of the vehicle operating costs. For example, many higher income people could afford the extra $8.00 or so of gasoline costs incurred if they drove an additional two hours to fish, but many could not "afford" the additional time cost in terms of other activities foregone. Some fraction of the hourly wage is generally used as a proxy for this opportunity cost of time. This is due, in part, to work by Cesario (1976) which showed the opportunity cost of time in commuting studies equaled between one-fourth and one-half of the wage rate. In this study, two estimates of the opportunity cost of time are utilized. One estimate is based on the U.S. Water Resources Council Principles and Guidelines (1983) which suggests an opportunity cost of time at one-third of the average wage rate. For our study, this estimate is 7.0 cents per mile based on an estimated wage rate for our sample of $9.44 per hour and average sample travel speed of 45 miles per hour.

The other approach is to use our survey data on angler reported willingness to pay to shorten travel time. As developed in Appendix B, regression analysis shows that Montana anglers were willing to pay $2.06 an hour to shorten travel time or 4.6 cents per mile (at 45 miles per hour). These results suggest that the opportunity cost of time for recreational travel is one-fifth of the wage rate. This is somewhat lower than the range of opportunity costs estimated for commuter travel (one-fourth to one-half the wage rate). This is not surprising since recreational travel may be less onerous (or even enjoyable) for many people.

Variable out-of-pocket travel expenses were also figured by two different methods. The "standard" approach recommended by the Water Resources Council is based on the variable costs of operating a motor vehicle. This cost was obtained from the U.S.

Department of Transportation's Cost of Owning and Operating Vehicles and Vans-1984 and is 15.2 cents per mile. This amount is based on the variable cost of operating a large-size vehicle since the latter most closely approximates engine efficiencies and size of typical vehicles utilized by anglers. The cost per passenger mile is then 5.6 cents based on our sample average of 2.76 passengers per vehicle. The reported variable travel cost is derived by regression analysis from our sample data on angler travel expenditures and equals 22.4 cents per passenger mile. See Appendix B for more details on the calculation of reported variable travel cost.

The net result is that the standard travel cost parameter estimate (Water Resource Council Method) sums to 12.6 cents per mile and the reported parameter is 27.0 cents (Table 4 below).

Table 4. Travel cost parameters (cents per mile).

	Transportation Cost	Opportunity Cost of Time	Sum
Water Resources Council Method	5.6	7.0	12.6
Montana Sample	22.4	4.6	27.0

Lake Fishing

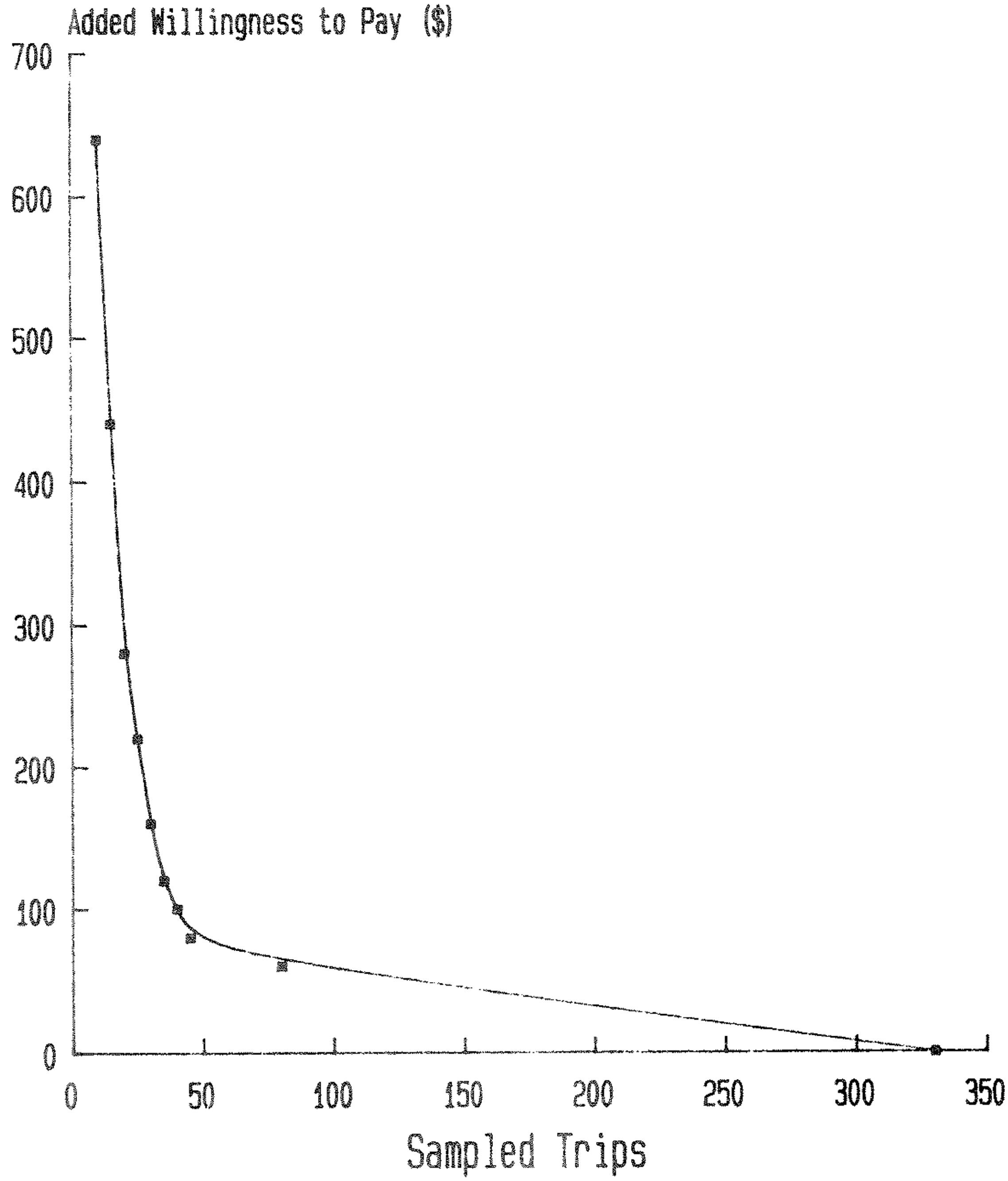
As stated earlier in this report, lake benefits are estimated based on the second stage demand curve. Specifically, the area under the second stage demand curve represents the angler's net willingness to pay, over and above the expenditure, for the opportunity to fish at this site.

To arrive at this figure, total actual trips per site must be estimated at existing travel distances. Then, additional distance is added to the existing distance in demand Equations 2 and 3 and site trips are re-estimated at this added distance. The process of adding miles to current distance is repeated to derive the site's demand schedule which shows site visitation at higher and higher fees. Such a second stage demand schedule is shown in Figure 3 for Flathead Lake.

With the double log model, trips would never fall exactly to zero and, in some cases, the added distance where trips dropped close to zero exceeded a site's likely market area. To be conservative, we truncated the top of the second stage demand curve at the highest observed distance of all the origins

FIGURE 3

Second Stage TCM Demand Curve



FLATHEAD LAKE SITE #1518

visiting that specific site. The area under the resulting second stage demand curve is the net willingness to pay, or the amount the consumer is willing to pay above the actual amount paid.

Because operating cost per mile and the opportunity cost of time is measured in two different ways, consumer surplus per trip was estimated separately under each of the two alternatives. Tables 5 and 6 list net willingness to pay per trip for Equation 2 based on both the standard cost and reported cost calculations. Site average surplus per trip values are reported at the bottom of each table, equalling $88.79 per trip for the reported cost basis and $41.43 for the standard basis. Per trip values are calculated for each site as the sum of the total consumer surplus divided by the total number of estimated trips. As discussed in Loomis and Hof (1985) as well as Mumy and Hanke (1975) average consumer surplus per trip may be equal to the marginal value per trip since the public fishing sites in Montana are not price rationed.

The results discussed above are based on Equation 2. Equation 3 included additional site characteristics beyond fish catch. As one would expect given the similarity of the two equations, the benefit estimates are almost identical. For example, for reported costs the value per trip is $88.79 with Equation 2 and $87.93 with Equation 3. Accordingly, only Equation 2 results are listed here.

The location of the lake fishing sites is shown in the state map displayed as Figure 2.

It is worthwhile to note that some of the lake fishing sites listed in Tables 5 and 6 are actually mixed fisheries offering both trout fishing and other sport fish including warmwater species. Based on the anglers' reported catch, we feel the following might be classified as mixed lake fisheries: Lower Clark Fork Lake fishery (#16), Blackfoot (#22), Canyon Ferry Reservoir (#33), and the Lower Missouri (#61).

The marginal value per fish trout caught and per surface acre (in Equation 3 only) can all be calculated from these equations. Marginal value per fish can be calculated by changing the value of the fish catch variable to some new higher level (if an enhancement takes place) or some lower level (if some negative impact occurs) and then predicting the new trips at current distance. By adding distance to current distance, a new second stage demand curve can be traced out under the new fishing conditions. By subtracting the original site net economic value (NEV) from the site net economic value under the changed fishing conditions, the incremental NEV (marginal value) of the change in fish conditions, the incremental NEV (marginal value) of the change in fish catch can be calculated. Such a process can be

Table 5. Montana lake data net economic value per trip, equation without site attribute data (standard cost)

SITE #	SITE NAME	VALUE PER TRIP	AVG DAYS PER TRIP	VALUE PER DAY	NO. OF ZONES
11	S. Fork Flathead	$25.34	1.06	$23.91	8
15	Flathead Area Lakes	50.52	1.27	39.78	34
15.18	Flathead Lake	55.48	1.32	42.03	28
16	L. Clark Fork Area L.	36.92	1.46	25.29	12
17	Kootenai Area Lakes	37.09	1.26	29.44	7
17.19	Lake Koocanusa	61.84	1.38	44.81	19
21	U. Clark Fork Area L.	9.04	1.28	7.06	8
21.26	Georgetown Lake	38.98	1.18	33.03	19
22	Blackfoot Area Lakes	48.64	1.30	37.42	18
24	Bitterroot Area Lakes	32.52	1.06	30.68	6
25	L. Clark Fork Area L.	34.83	1.22	28.55	8
31+32	U. Yellow. + Gallatin	20.68	1.80	11.49	13
33	U. Missouri (Region 3)	19.37	1.38	14.04	5
33.39	Canyon Ferry Reservoir	28.77	1.37	21.00	31
34	Madison Area Lakes	90.19	1.31	68.85	18
36	Beaverhead Area Lakes	23.65	1.21	19.55	10
36.38	Clark Canyon Reservoir	90.34	1.54	58.66	26
37	Big Hole Area Lakes	48.06	1.33	36.14	12
42.48	Newlin Creek Reservoir	10.47	1.32	7.93	12
43	U. Missouri (Region 4)	5.24	1.06	4.94	11
43.46	Hauser Reservoir	15.38	1.13	13.61	13
43.47	Holter Reservoir	32.56	1.40	23.26	19
44	Marias Area Lakes	99.98	1.26	79.35	20
52	M. Yellow. + Cooney	69.23	1.25	55.38	32
53	Musselsh. + Deadman's	57.13	1.11	51.47	18
55	Stillwater Area Lakes	77.85	1.21	64.34	9
61	Lower Missouri Area L.	11.84	1.14	10.39	8
62	Milk Area Lakes	28.21	1.04	27.13	11
	SITE AVERAGE	**$41.43**	**1.27**	**$32.48**	

Table 6. Montana lake data net economic value per trip, equation without site attribute data (reported cost).

SITE #	SITE NAME	VALUE PER TRIP	AVG DAYS PER TRIP	VALUE PER DAY	NO. OF ZONES
11	S. Fork Flathead	$ 54.30	1.06	$ 51.23	8
15	Flathead Area Lakes	108.27	1.27	85.25	34
15.18	Flathead Lake	118.89	1.32	90.07	28
16	L. Clark Fork Area L.	79.12	1.46	54.19	12
17	Kootenai Area Lakes	79.48	1.26	63.08	7
17.19	Lake Koocanusa	132.52	1.38	96.03	19
21	U. Clark Fork Area L.	19.37	1.28	15.13	8
21.26	Georgetown Lake	83.53	1.18	70.79	19
22	Blackfoot Area Lakes	104.22	1.30	80.17	18
24	Bitterroot Area Lakes	69.69	1.06	65.75	6
25	L. Clark Fork Area L.	74.64	1.22	61.18	8
31+32	U. Yellow. + Gallatin	44.31	1.80	24.62	13
33	U. Missouri (Region 3)	41.51	1.38	30.08	5
33.39	Canyon Ferry Reservoir	61.66	1.37	45.01	31
34	Madison Area Lakes	193.26	1.31	147.53	18
36	Beaverhead Area Lakes	50.68	1.21	41.88	10
36.38	Clark Canyon Reservoir	193.59	1.54	125.71	26
37	Big Hole Area Lakes	102.99	1.33	77.44	12
42.48	Newlin Creek Reservoir	22.43	1.32	16.99	12
43	U. Missouri (Region 4)	11.22	1.06	10.58	11
43.46	Hauser Reservoir	32.96	1.13	29.17	13
43.47	Holter Reservoir	69.77	1.40	49.84	19
44	Marias Area Lakes	214.25	1.26	170.04	20
52	M. Yellow. + Cooney	148.34	1.25	118.67	32
53	Musselsh. + Deadman's	122.42	1.11	110.29	18
55	Stillwater Area Lakes	16.81	1.21	137.86	9
61	L. Missouri Area Lakes	25.37	1.14	22.25	8
62	Milk Area Lakes	60.46	1.04	58.13	11
	SITE AVERAGE	**88.79**	**1.27**	**$ 69.61**	

automated using LOTUS 123 MACROS, but the effort required is beyond the time and money presently available.

As can be seen from the tables, the net economic value estimates vary over a wide range. Some of the variation may be explained in terms of the site's location relative to Montana's population centers, quality of fishing, and availability of substitute sites. A detailed analysis of the variability in site values is beyond the scope of this work.

The average values reported here seem reasonable. The state average lake fishing values for standard cost are nearly identical to what Sorg et al. (1986) reported for Idaho fishing using standard cost per mile. Our net willingness to pay estimates for reported costs per mile are nearly double Idaho's. This is due in part to converting net willingness to pay in miles to dollars in Montana using a variable cost per mile that is nearly double what was used in Idaho. In Idaho, little difference was found between the reported transportation costs and standard costs. As discussed earlier, quite a difference was found between reported trip costs (including variable food and lodging costs) and standard transportation costs.

Stream Fishing

Stream fishing benefits were calculated as the area under the site demand curves, the same as for lakes. However, the specific methods differ slightly. One difference is that direct integration of the first stage demand curve was used instead of the trapezoidal approximation of the second stage demand curve. Direct integration is an exact method and was used because the numerical approximation approach was sensitive to the low origin-to-site distances found in the stream database.

The results presented for lakes are based on integrating the TCM demand curve using the predicted intercept of the demand curve with the quantity axis. The predicted intercept is the total trips predicted to be taken when the site price is zero. For cases where the model's trip prediction is not in close agreement with the actual trips taken to a site, Gum and Martin (1975) suggest using actual trips as the starting point for benefit estimates. This approach has been widely used in the literature. Because predicted trips and actual trips differed by an average of 60% for the stream model (Table 3 above), site values based on the Gum and Martin approach are also reported here. For comparison to the lake benefit estimates, site values based on a predicted intercept are provided in Appendix C.

Stream benefit estimates for Equation 4 (complete sample) are shown in Tables 7 and 8. The average net economic value per trip across all sites is $53.08 for standard cost (.126 dollars/mile) and $113.74 for reported travel costs (.27 dollars/mile). Figure 2 provides a map of site locations. Because of small sample sizes, four stream sites were excluded from the listings in Table 1. These include the South Fork of the Flathead (Code 11), tributaries to Rock Creek (Code 23), Boulder River (Code 56), and the Lower Missouri (Code 61). These sites were excluded because results may not be reliable for sites with few origin zones and few trips per zone.

As noted, the results in Tables 7 and 8 are based on Equation 4 for the complete sample. Because Equation 5 with site

Table 7. Montana streams net economic value per trip, equation without site attribute data (standard cost, Gum and Martin approach).

RIVER CODE	RIVER	VALUE PER TRIP	AVG DAYS PER TRIP	VALUE PER DAY	NO. OF ZONES
12	MIDDLE FORK FLATHEAD	$ 76.14	1.13	$ 67.68	7
14	NORTH FORK FLATHEAD	64.63	1.30	49.55	10
15	FLATHEAD	46.12	1.10	41.93	18
16	LOWER CLARK FORK	72.65	1.13	64.51	20
17	KOOTENAI TRIBS	36.11	1.08	33.53	11
21	UPPER CLARK FORK TRIBS	44.52	1.00	44.52	16
22	BLACKFOOT TRIBS	68.29	1.18	57.89	11
24	BITTERROOT TRIBS	34.88	1.09	31.89	16
25	MID. CLARK FORK TRIBS	38.46	1.11	34.61	9
31	U. YELLOWSTONE TRIBS	98.04	1.11	88.51	24
32	GALLATIN TRIBS	87.33	1.09	80.05	14
33	U. MISSOURI REGION 3	41.69	1.02	40.93	16
34	MADISON TRIBS	152.87	1.29	118.55	23
35	JEFFERSON	38.68	1.05	36.97	20
36	BEAVERHEAD TRIBS	78.75	1.21	65.09	26
37	BIG HOLE TRIBS	55.20	1.15	48.10	17
41	MIDDLE MISSOURI	37.06	1.02	36.33	18
42	SMITH TRIBS	7.90	1.04	7.60	6
43	U. MISSOURI REGION 4	29.77	1.04	28.64	27
44	MARIAS	33.78	1.23	27.43	19
52	MID. YELLOWSTONE TRIBS	27.25	1.07	25.40	35
53	MUSSELSHELL	29.60	1.13	26.11	11
55	STILLWATER TRIBS	38.08	1.15	33.12	7
62	MILK	10.57	1.00	10.57	6
71	LOWER YELLOWSTONE	51.59	1.00	51.59	8
80	BEAVERHEAD	52.13	1.17	44.68	19
81	BIG HOLE	76.39	1.51	50.66	37
82	BITTERROOT	33.88	1.05	32.41	12
83	BLACKFOOT	66.18	1.01	65.30	26
84	BOULDER	83.93	1.33	62.95	16
85	BIGHORN	56.45	1.29	43.84	28
86	UPPER CLARK FORK	24.23	1.01	23.97	16
87	MIDDLE CLARK FORK	31.71	1.05	30.27	17
88	EAST GALLATIN	68.44	1.03	66.64	10
89	UPPER FLATHEAD	26.35	1.02	25.96	12
90	GALLATIN	75.32	1.06	71.03	31
91	KOOTENAI	26.29	1.02	25.86	11
92	MADISON	109.32	1.45	75.16	55
93	MISSOURI HOLTER-CASC	27.96	1.19	23.49	26
94	ROCK CREEK	80.58	1.30	61.82	21
95	SMITH	43.77	1.33	33.02	14
96	STILLWATER	38.29	1.21	31.63	15
97	SWAN	30.52	1.08	28.34	10
98	UPPER YELLOWSTONE	107.50	1.10	97.84	32
99	MIDDLE YELLOWSTONE	29.35	1.01	29.18	17
	SITE AVERAGES	**$ 53.08**	**1.13**	**$ 46.11**	

Table 8. Montana streams net economic value per trip, equation without site attribute data (reported cost, Gum and Martin approach).

RIVER CODE NO.	RIVER	VALUE PER TRIP	AVG DAYS PER TRIP	VALUE PER DAY	NO. OF ZONES
12	MIDDLE FORK FLATHEAD	163.15	1.13	145.03	7
14	NORTH FORK FLATHEAD	138.50	1.30	106.18	10
15	FLATHEAD	98.84	1.10	89.85	18
16	LOWER CLARK FORK	155.68	1.13	138.24	20
17	KOOTENAI TRIBS	77.37	1.08	71.84	11
21	UPPER CLARK FORK TRIBS	95.40	1.00	95.40	16
22	BLACKFOOT TRIBS	146.35	1.18	124.06	11
24	BITTERROOT TRIBS	74.74	1.09	68.34	16
25	MID. CLARK FORK TRIBS	82.42	1.11	74.17	9
31	U. YELLOWSTONE TRIBS	210.08	1.11	189.66	24
32	GALLATIN TRIBS	187.13	1.09	171.54	14
33	U. MISSOURI REGION 3	89.33	1.02	87.72	16
34	MADISON TRIBS	327.57	1.29	254.04	23
35	JEFFERSON	82.89	1.05	79.21	20
36	BEAVERHEAD TRIBS	168.76	1.21	139.47	26
37	BIG HOLE TRIBS	118.28	1.15	103.07	17
41	MIDDLE MISSOURI	79.41	1.02	77.84	18
42	SMITH TRIBS	16.94	1.04	16.29	6
43	U. MISSOURI REGION 4	63.79	1.04	61.36	27
44	MARIAS	72.39	1.23	58.77	19
52	MID. YELLOWSTONE TRIBS	58.39	1.07	54.42	35
53	MUSSELSHELL	63.42	1.13	55.96	11
55	STILLWATER TRIBS	81.61	1.15	70.97	7
62	MILK	22.64	1.00	22.64	6
71	LOWER YELLOWSTONE	110.56	1.00	110.56	8
80	BEAVERHEAD	111.70	1.17	95.75	19
81	BIG HOLE	163.70	1.51	108.55	37
82	BITTERROOT	72.60	1.05	69.45	12
83	BLACKFOOT	141.81	1.01	139.94	26
84	BOULDER	179.84	1.33	134.88	16
85	BIGHORN	120.95	1.29	93.94	28
86	UPPER CLARK FORK	51.92	1.01	51.37	16
87	MIDDLE CLARK FORK	67.96	1.05	64.87	17
88	EAST GALLATIN	146.66	1.03	142.80	10
89	UPPER FLATHEAD	56.46	1.02	55.62	12
90	GALLATIN	161.41	1.06	152.22	31
91	KOOTENAI	56.33	1.02	55.41	11
92	MADISON	234.26	1.45	161.06	55
93	MISSOURI HOLTER-CASC	59.92	1.19	50.33	26
94	ROCK CREEK	172.66	1.30	132.47	21
95	SMITH	93.80	1.33	70.76	14
96	STILLWATER	82.05	1.21	67.78	15
97	SWAN	65.39	1.08	60.72	10
98	UPPER YELLOWSTONE	230.35	1.10	209.65	32
99	MIDDLE YELLOWSTONE	62.80	1.01	62.53	17
	SITE AVERAGES	$113.74	1.13	$ 98.82	

attributes was very similar to Equation 4 and applied only to unique waters, only Equation 4 results are shown here. A comparison of benefit estimates from these two equations is provided in the supplementary technical report, "Sensitivity Analysis of Montana Cold Water Stream Angler Benefit Estimates".

The values per trip shown in Tables 7 and 8 vary considerably across sites. In general, the relative values seem plausible. Some of the highest valued trips are on the Madison and its tributaries, Rock Creek, the Big Hole, and the Upper Yellowstone. The lowest valued waters include the Milk, Musselshell, Upper Clark Fork, Kootenai, and Flathead.

Relative values, of course, reflect both quality and location. The site specific travel cost model (TCM) values for streams (Tables 7 and 8) have been compared with site level values based on a companion contingent valuation method (CVM) study (Duffield and Allen, 1987). The comparative analysis is summarized in the latter report. In general, the results indicate consistency between the TCM and CVM methods. TCM estimates based on the Gum and Martin method and reported costs are most similar to the CVM site level values. The similarity of results from the two very different methodologies provides a measure of validation for both models.

Tables 7 and 8 also show net values per day. The average over all sites is $46.11 per day (standard basis) and $98.82 per day (reported cost basis). The (angler days) values per day were multiplied by angler pressure estimates for 1985-86 to calculate the fishing-related recreational value of the specific sites.

The angler pressure estimates were obtained from Bob McFarland of the Montana Department of Fish, Wildlife and Parks. The estimates are for the license season of 1 March to the end of February. Total fishing pressure on all trout streams in the state is estimated to be 1,221,331 for 1985-1986.

Our sample of streams excludes approximately 2% of the total state pressure (28,673 angler days). The specific sites excluded from our sample due to limited use and observations are: Sun River, St. Mary's River, South Fork of the Flathead, Lower Missouri, tributaries to the Boulder and Rock Creek, and the following river sections: Milk River (Region 4 only), Clark Fork (Region 3 only), and Musselshell (Region 4 only).

The state total values are $57 million and $122 million for standard and reported cost basis respectively (Tables 9 and 10). Since 1985 was a drought year, these estimates may be a conservative estimate of site values for a normal or average water year.

It should also be noted that these are annual values; the corresponding present values of these annual streams depend on the interest rate, the assumed rate of change in the annual values over time and the time horizon. For example, assuming no growth, an infinite time horizon and a four percent real discount rate, the present angling-related recreational value of Montana's trout streams is between $1.5 and $3.1 billion. This estimate would roughly correspond to the market value of these waters as a recreational asset.

Since Montana's stream fisheries are a renewable (non-stocked) resource, the assumption of an infinite horizon is appropriate. To the extent that there is increased fishing pressure over time, the assumption of no growth provides a conservative bias in addition to the effect of using a drought year as a base. Lower discount rates would, of course, result in higher present values and conversely higher rates. The Northwest Power Planning Council, for example, has used a 3 percent real discount rate in its economic analysis of energy resources. It is beyond the scope of this study to identify the appropriate rate for the purposes at hand. However, by comparison with the rate used by the Northwest Power Planning Council, the rate used here further ensures that the present value estimates are a defensible lower bound for policy purposes. In fact, site values may be considerably higher.

The relative comparison of sites in terms of annual site values is of interest. The mainstem Madison has the heaviest pressure of any stream in the state (108,712 angler days/year) and also has one of the highest per day value. As a result, the Madison is the most valuable stream in the state with a value that is approximately twice that of any of the next most valuable waters (Upper Yellowstone, Gallatin, and Big Hole).

A statewide average net economic value per fishing day can be derived from Tables 9 and 10 by dividing total site value by total angler days. The result is $102.56 and $47.86 per day, respectively, for the reported and standard cost basis. Because fishing pressure tends on average to be greater on the higher valued streams, the overall state averages are somewhat higher than corresponding single (not weighted by use) site averages reported in Tables 7 and 8 ($98.82 and $46.11 respectively). Use-weighted state average values <u>per fishing trip</u> are $117.65 and $54.90 (reported and standard basis) based on the stream sample average days fished per trip (1.1471).

Tables 5 and 6 also show values per day of lake fishing based on the average day per trip by site. The site averages are $69.61 and $32.48 per day per trip for the reported and standard cost basis. The per day values are multiplied times the estimated annual fishing pressure (angler days) to derive the site net economic values associated with lake fishing use. The

Table 9. Montana streams, total recreation value by site (Standard cost, Gum and Martin approach).

RIVER CODE	RIVER	VALUE PER DAY	FISHING PRESSURE	SITE VALUE ($1000)
12	MIDDLE FORK FLATHEAD	$ 67.68	5851	$ 396
14	NORTH FORK FLATHEAD	49.55	8037	398
15	FLATHEAD	41.93	35545	1490
16	LOWER CLARK FORK	64.51	21237	1370
17	KOOTENAI TRIBS	33.53	26081	874
21	UPPER CLARK FORK TRIBS	44.52	24207	1078
22	BLACKFOOT TRIBS	57.89	9075	525
24	BITTERROOT TRIBS	31.89	33676	1074
25	MIDDLE CLARK FORK TRIBS	34.61	6835	237
31	UPPER YELLOWSTONE TRIBS	88.51	12424	1100
32	GALLATIN TRIBS	80.05	14045	1124
33	UPPER MISSOURI REGION 3	40.93	25419	1041
34	MADISON TRIBS	118.55	11224	1331
35	JEFFERSON	36.97	29129	1077
36	BEAVERHEAD TRIBS	65.09	25878	1684
37	BIG HOLE TRIBS	48.10	18624	896
41	MIDDLE MISSOURI	36.33	22340	812
42	SMITH TRIBS	7.60	7143	54
43	UPPER MISSOURI REGION 4	28.64	67557	1935
44	MARIAS	27.43	5925	162
52	MIDDLE YELLOWSTONE TRIBS	25.40	30132	765
53	MUSSELSHELL	26.11	11218	293
55	STILLWATER TRIBS	33.12	13002	431
62	MILK	10.57	5965	63
71	LOWER YELLOWSTONE	51.59	995	51
80	BEAVERHEAD	44.68	24239	1083
81	BIG HOLE	50.66	47910	2427
82	BITTERROOT	32.41	56024	1816
83	BLACKFOOT	65.30	28794	1880
84	BOULDER	62.95	17429	1097
85	BIGHORN	43.84	44814	1965
86	UPPER CLARK FORK	23.97	17578	421
87	MIDDLE CLARK FORK	30.27	30414	921
88	EAST GALLATIN	66.64	6191	413
89	UPPER FLATHEAD	25.96	15262	396
90	GALLATIN	71.03	63871	4537
91	KOOTENAI	25.86	22591	584
92	MADISON	75.16	108712	8171
93	MISSOURI HOLTER-CASC	23.49	72788	1710
94	ROCK CREEK	61.82	27881	1724
95	SMITH	33.02	11824	390
96	STILLWATER	31.63	32857	1039
97	SWAN	28.34	8746	248
98	UPPER YELLOWSTONE	97.84	52016	5089
99	MIDDLE YELLOWSTONE	29.18	31156	909
	STATE TOTAL		**1192658**	**$57081**

Table 10. Montana streams, total recreational value by site (reported cost, Gum and Martin approach).

RIVER CODE	RIVER	VALUE PER DAY	FISHING PRESSURE	SITE VALUE ($1000)
12	MIDDLE FORK FLATHEAD	$145.03	5851	$849
14	NORTH FORK FLATHEAD	106.18	8037	853
15	FLATHEAD	89.85	35545	3194
16	LOWER CLARK FORK	138.24	21237	2936
17	KOOTENAI TRIBS	71.84	26081	1874
21	UPPER CLARK FORK TRIBS	95.40	24207	2309
22	BLACKFOOT TRIBS	124.06	9075	1126
24	BITTERROOT TRIBS	68.34	33676	2301
25	MIDDLE CLARK FORK TRIBS	74.17	6835	507
31	UPPER YELLOWSTONE TRIBS	189.66	12424	2356
32	GALLATIN TRIBS	171.54	14045	2409
33	UPPER MISSOURI REGION 3	87.72	25419	2230
34	MADISON TRIBS	254.04	11224	2851
35	JEFFERSON	79.21	29129	2307
36	BEAVERHEAD TRIBS	139.47	25878	3609
37	BIG HOLE TRIBS	103.07	18621	1919
41	MIDDLE MISSOURI	77.84	22340	1739
42	SMITH TRIBS	16.29	7143	116
43	UPPER MISSOURI REGION 4	61.36	67557	4146
44	MARIAS	58.77	5925	348
52	MIDDLE YELLOWSTONE TRIBS	54.42	30132	1640
53	MUSSELSHELL	55.96	11218	628
55	STILLWATER TRIBS	70.97	13002	923
62	MILK	22.64	5965	135
71	LOWER YELLOWSTONE	110.56	995	110
80	BEAVERHEAD	95.75	24239	2321
81	BIG HOLE	108.55	47910	5201
82	BITTERROOT	69.45	56024	3891
83	BLACKFOOT	139.94	28794	4029
84	BOULDER	134.88	17429	2351
85	BIGHORN	93.94	44814	4210
86	UPPER CLARK FORK	51.37	17578	903
87	MIDDLE CLARK FORK	64.87	30414	1973
88	EAST GALLATIN	142.80	6191	884
89	UPPER FLATHEAD	55.62	15262	849
90	GALLATIN	152.22	63871	9722
91	KOOTENAI	55.41	22591	1252
92	MADISON	161.06	108712	17509
93	MISSOURI HOLTER-CASC	50.33	72788	3664
94	ROCK CREEK	132.47	27881	3693
95	SMITH	70.96	11824	837
96	STILLWATER	67.78	32857	2227
97	SWAN	60.72	8746	531
98	UPPER YELLOWSTONE	209.65	52016	10905
99	MIDDLE YELLOWSTONE	62.53	31156	1948
	STATE TOTAL		1192658	$122315

state total for Montana lake fishing sites is $43 million and $93 million respectively for the standard and reported cost basis (Tables 11 and 12). These are annual values. The present value of these sites assuming no growth in use or value and a four percent real discount rate is around $1.1 to $2.3 billion dollars.

Summary of Benefit Estimates

Table 13 presents the values per trip, angler day, and 12 hour Wildlife and Fish User Day (WFUD) used by the U.S. Forest Service. The lake fishing values per day are $69.61 (reported cost basis). To calculate a 12 hour WFUD, the lake fishing sample average of 2.44 hours of fishing per day was used. Thus, the $342.34 per WFUD (reported cost basis of .126 dollars/mile) represents about 5 angler days given the relatively short amount of each day actually spent fishing. The reported stream fishing value per day is $102.56. Based on the stream fishing sample, anglers fished 4.39 hours per day. This implies a reported cost basis stream fishing WFUD of $280.35 Table 13 also provides a summary of values where travel costs are at their standard value of 12.6 dollars per mile.

Table 11. Montana coldwater lake data -- net economic value by site -- standard values

SITE #	SITE NAME	VALUE PER DAY	TOTAL RECREATIONAL FISHING VALUE
11	S. FORK FLATHEAD	$23.91	$304,709
15	FLATHEAD AREA LAKES	39.78	4,665,876
15.18	FLATHEAD LAKE	42.03	3,192,767
16	L. CLARK FORK AREA L.	25.29	567,002
17	KOOTENAI AREA LAKES	29.44	632,253
17.19	L. KOOCANUSA	44.81	5,118,601
21	U. CLARK FORK AREA L.	7.06	60,714
21.26	GEORGETOWN LAKE	33.03	1,408,994
22	BLACKFOOT AREA LAKES	37.42	1,591,122
24	BITTERROOT AREA LAKES	30.68	249,181
25	L. CLARK FORK AREA L.	28.55	150,041
31+32	U. YELLOW. + GALLATIN	11.49	392,234
33	U. MISSOURI (REGION 3)	14.04	58,579
33.39	CANYON FERRY RESERVOIR	21.00	1,596,735
34	MADISON AREA LAKES	68.85	2,846,514
36	BEAVERHEAD AREA LAKES	19.55	252,121
36.38	CLARK CANYON RESERVOIR	58.66	2,105,894
37	BIG HOLE AREA LAKES	36.14	493,484
42.48	NEWLIN CREEK RESERVOIR	7.93	73,305
43	U. MISSOURI (REGION 4)	4.94	65,991
43.46	HAUSER RESERVOIR	13.61	315,480
43.47	HOLTER RESERVOIR	23.36	1,768,329
44	MARIAS AREA LAKES	79.35	8,448,863
52	M. YELLOW. + COONEY	55.38	4,085,795
53	MUSSELSHELL + DEADMAN'S	51.47	786,070
55	STILLWATER AREA LAKES	64.34	355,257
61	LOWER MISSOURI AREA L.	10.39	235,466
62	MILK AREA LAKES	27.13	1,434,628
	STATE TOTAL		**$43,256,004**

Table 12. Montana coldwater lake data -- net economic value by site -- reported values

SITE #	SITE NAME	VALUE PER DAY	TOTAL RECREATIONAL FISHING VALUE
11	S. FORK FLATHEAD	$51.23	$652,829
15	FLATHEAD AREA LAKES	85.25	9,999,374
15.18	FLATHEAD LAKE	90.07	6,841,939
16	L. CLARK FORK AREA L.	54.19	1,214,980
17	KOOTENAI AREA LAKES	63.08	1,354,692
17.19	L. KOOCANUSA	96.03	10,969,295
21	U. CLARK FORK AREA L.	15.13	130,137
21.26	GEORGETOWN LAKE	70.79	3,019,680
22	BLACKFOOT AREA LAKES	80.17	3,408,847
24	BITTERROOT AREA LAKES	65.75	533,978
25	L. CLARK FORK AREA L.	61.18	321,525
31-32	U. YELLOW. + GALLATIN	24.62	840,339
33	U. MISSOURI (REGION 3)	30.08	125,502
33.39	CANYON FERRY RESERVOIR	45.01	3,422,130
34	MADISON AREA LAKES	147.53	6,099,300
36	BEAVERHEAD AREA LAKES	41.88	540,148
36.38	CLARK CANYON RESERVOIR	125.71	4,512,910
37	BIG HOLE AREA LAKES	77.44	1,057,374
42.48	NEWLIN CREEK RESERVOIR	16.99	157,078
43	U. MISSOURI (REGION 4)	10.58	141,400
43.46	HAUSER RESERVOIR	29.17	676,118
43.47	HOLTER RESERVOIR	49.84	3,772,514
44	MARIAS AREA LAKES	170.04	18,105,128
52	M. YELLOW. + COONEY	118.67	8,755,316
53	MUSSELSH. + DEADMAN'S	110.29	1,684,367
55	STILLWATER AREA LAKES	137.86	761,200
61	L. MISSOURI AREA L.	22.25	504,346
62	MILK AREA LAKES	58.13	3,074,144
	STATE TOTAL		**$92,676,590**

Table 13. Net economic values per trip, angler day, and WFUD[5] for Montana lake and stream fishing

A. BASED ON STANDARD COST OF .126 DOLLARS/MILE

ACTIVITY	VALUE PER TRIP	VALUE PER DAY	VALUE PER WFUD[5]
lake fishing[1]	$41.43	$32.48	$159.74
stream fishing[2]	54.90[3]	47.86	130.82[4]
combination	48.61	40.68	144.32

B. BASED ON REPORTED COST OF .27 DOLLARS/MILE

ACTIVITY	VALUE PER TRIP	VALUE PER DAY	VALUE PER WFUD
lake fishing[1]	$88.79	$69.61	$342.34
stream fishing[2]	117.65[3]	102.56	280.35[4]
combination	104.18	87.18	309.28

[1] Site average

[2] State fishing pressure weighted average

[3] Derived from value per day using stream sample average of 1.1471 days/trip

[4] Derived from value per day using stream sample average of 4.39 hours of fishing per day

[5] WFUD is a 12 hour wildlife and fish user day utilized by the U.S. Forest Service

ANGLER EXPENDITURE DATA

The values reported above for stream and lakes are net economic values associated with fishing recreational use. This is the estimated value that users derive over and above trip costs.

Another measure of the economic significance of lake and stream fishing in Montana is angler expenditures. Average expenditure per fishing trip in Montana is $91.59 (Table 14) based on our sample of 1,343 individual anglers.

This total does not vary greatly between lakes and streams, at $91.90 and $96.74 respectively. However, there are significant differences between residents and nonresidents. The state average is $48.13 and $360.24 dollars per trip for residents and nonresidents, respectively (Table 14). The greatest difference is for the stream subsample where nonresidents outspend residents by a ratio of 15:1 ($536 versus $36). Table 14 also reports expenditure per day fished. This averages $42.21 and ranges from $22.13 per day for resident stream anglers to $116.37 for nonresident stream anglers.

More detailed expenditure information in Tables 15, 16, and 17, shows that the major expenditures are on transportation, lodging, and food. Round trip travel distance is also shown. The average fishing trip in Montana is 258 miles round trip. However, the average resident travels only 119 miles to fish Montana streams while the nonresident stream fisherman travels on the average of 1,521 miles per trip. Obviously, expenditures and distance traveled are closely correlated (as is developed in some detail in Appendix B).

When expenditures and net economic values are added together, the sum is termed "gross willingness to pay" (WTP). This measures the gross total value associated with the activity. The latter may correspond roughly to the market price for a package fishing trip including all expenses. Gross values are not appropriate for valuing a site since they include the costs associated with many other services and assets utilized on a given trip such as gasoline and food.

On a reported cost basis, the average gross WTP associated with lake fishing in Montana is average expenditure per trip ($91.90) plus net economic value per trip ($88.79)[1] or <u>$180.69</u> Similarly, for streams gross WTP is <u>$214.39</u> or expenditure of $96.74 plus an average net value of $117.65. These values are shown in Figure 4.

[1] This is a site average.

Table 14. Summary -- total average angler expenditure -- Montana lakes and streams -- 1985 dollars

CATEGORY	ALL	RESIDENTS	NONRESIDENTS
TOTAL AVERAGE EXPENDITURE PER TRIP:			
LAKES	91.90	62.54	249.05
STREAMS	96.74	36.15	536.47
ALL WATERS	91.59	48.13	360.24
TOTAL AVERAGE EXPENDITURE PER DAY[a]:			
LAKES	37.98	31.91	50.31
STREAM	47.89	22.31	116.37
ALL WATERS	42.21[b]	26.89	75.05

SAMPLE SIZE: LAKES (648), STREAMS (611), ALL WATERS (1343).

[a] Average per day fished.

[b] Overall weighted average of 2.17 angler days per trip for both stream and lake.
Overall weighted average of 3.48 hours per day for both stream and lake.

Table 15. Average angler expenditure per day -- Montana complete sample -- 1985 dollars

ITEM	MEAN ALL	MEAN RESIDENT	MEAN NONRESIDENT
TRANSPORTATION	28.24	15.73	105.58
LODGING FEES	13.06	4.70	64.70
FOOD - RESTAURANTS	13.08	5.22	61.65
FOOD - STORES	25.18	16.50	78.85
TACKLE	6.55	3.24	27.02
GUIDE	1.63	1.04	5.28
OTHER	3.86	1.71	17.16
TOTAL	91.59	48.13	360.24
ROUND TRIP DISTANCE (MILES)	258	139	992
SAMPLE SIZE	1,343	1,156	187

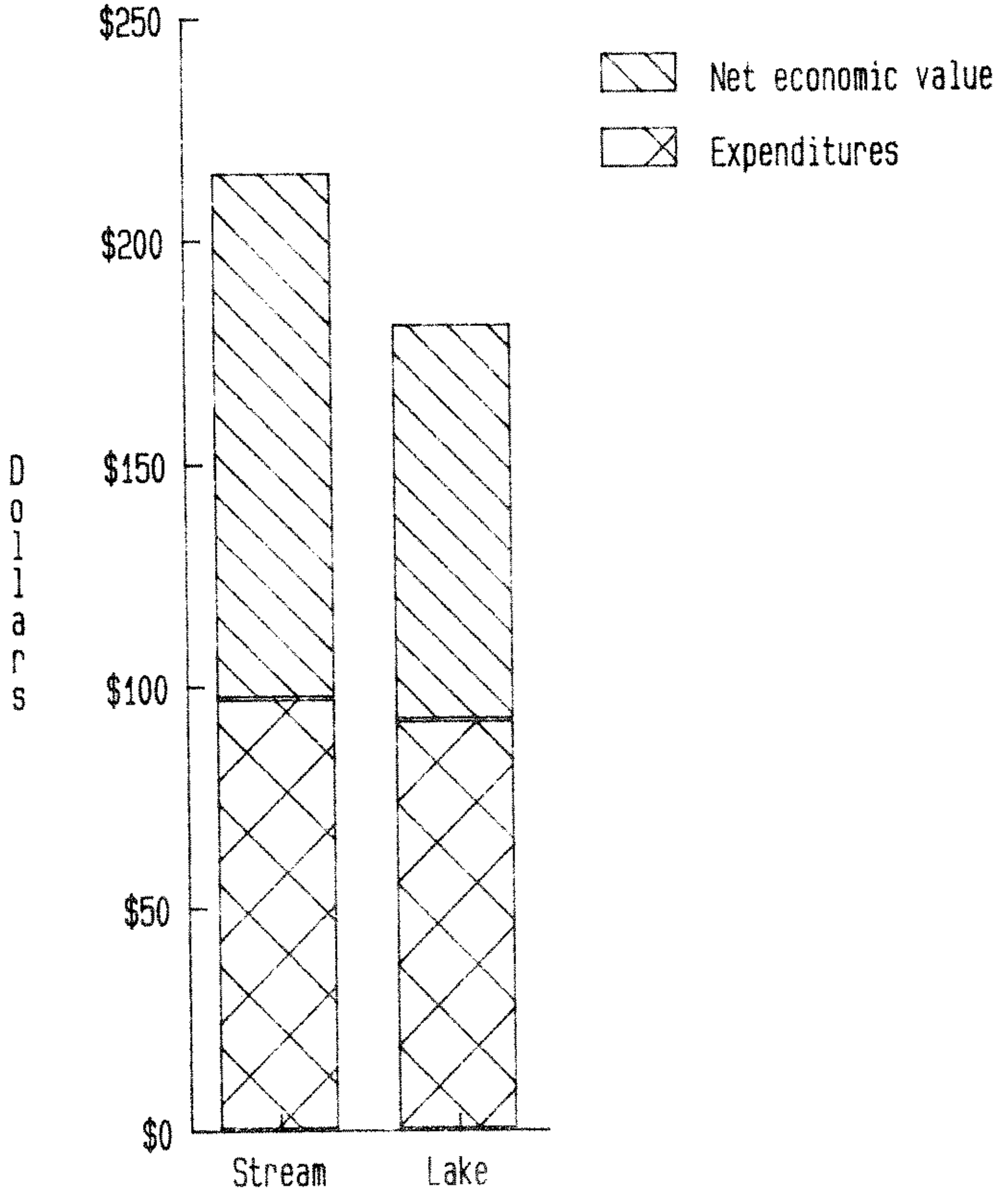
Table 16. Average angler expenditure per trip, Montana Stream (1985 dollars).

ITEM	MEAN ALL	MEAN RESIDENT	MEAN NONRESIDENT
TRANSPORTATION	31.64	13.05	166.51
LODGING FEES	14.66	1.13	112.81
FOOD-RESTAURANT	15.84	4.92	95.10
FOOD-STORES	19.68	11.31	80.39
TACKLE	8.23	2.72	48.23
GUIDE	3.47	2.20	12.66
OTHER	3.24	.82	20.77
TOTAL	**96.74**	**36.15**	**536.47**
ROUND TRIP DISTANCE (MILES)	289	119	1521
SAMPLE SIZE	611	537	74

Table 17. Average angler expenditure per trip, Montana lakes (1985 dollars).

ITEM	MEAN ALL	MEAN RESIDENTS	MEAN NONRESIDENTS
TRANSPORTATION	26.85	19.09	68.40
LODGING FEES	12.36	8.69	31.97
FOOD-RESTAURANT	10.90	5.84	37.97
FOOD-STORES	31.82	22.40	82.22
TACKLE	5.13	3.72	12.65
GUIDE	.04	.05	.00
OTHER	4.81	2.75	15.84
TOTAL	**91.90**	**62.54**	**249.05**
ROUND TRIP DISTANCE (MILES)	241	167	640
SAMPLE SIZE	648	546	102

FIGURE 4
Gross Willingness to Pay
Montana Stram and Lake Fishing



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APPENDIX A

Survey Questionnaires.

ANGLER PHONE SURVEY

PLACE LABEL HERE

Interview date: ________

Interviewer name: ________

1) DID YOU FISH IN MONTANA THIS SEASON? (3/85 - 2/86) YES=1 NO=2 |__| 1

2) I'D LIKE TO ASK SOME QUESTIONS ABOUT YOUR MOST RECENT FISHING TRIP IN MONTANA - SPECIFICALLY, THE LAST TRIP FOR WHICH FISHING WAS THE MAIN OR ONLY REASON YOU TOOK THE TRIP, AND WHERE YOU WERE PRIMARILY FISHING ONE LAKE, RIVER, OR STREAM.

If interview is ended here because fishing was NOT main reason or trip was multiple destination, write down reason and names of multiple destinations.

Code: |__|__|-|__|__|__|__| 2 3 4 5 6 7

NAME OF LAKE/STREAM: ________ ☐ ✓ if Special Regulation Stream

CLOSEST TOWN: ________

REASON: ________

DESTINATIONS: ________

3) WHEN DID YOU MAKE THIS TRIP TO ____? DATE: |__|__|/|__|__|/|__|__| (mo. 8 9, day 10 11, year 12 13)

4) WHAT TYPE OF FISHING EQUIPMENT DID YOU USE? |__| 14 EQUIPMENT

1)Bait 2)Flies 3)Lures 4)Combination

5) DID YOU SPEND MOST OF YOUR TIME FISHING FROM A BOAT OR FROM SHORE? |__| 15 BOAT/SHORE

1)Boat 2)Shore

6) HOW MUCH TIME DID YOU SPEND AT ____? |__|__|.|__| 16 17 18 HOURS

(Total time spent at site, NOT the amount of time they actually fished) |__|__| 19 20 DAYS

7) IF MORE THAN ONE DAY: |__|__|.|__| 21 22 23 HOURS PER DAY

About how many hours a day did you fish?

7) IF LESS THAN ONE DAY: |__|__|.|__| 24 25 26 HOURS

About how many hours did you fish?

8) WHAT WAS THE PRIMARY TYPE OF FISH YOU WERE TRYING TO CATCH?

9) ABOUT HOW MANY FISH (OF EACH TYPE) DID YOU CATCH AND HOW MANY DID YOU KEEP?

LIST ALL SPECIES:	CODE:	# CAUGHT	# KEPT
1) ________	27 28 29	30 31	32 33
2) ________	34 35 36	37 38	39 40
3) ________	41 42 43	44 45	46 47

☆ The next few questions ask about some of the trip details and expenditures.

10) HOW DID YOU TRAVEL FROM YOUR HOME TO ____? MODE: CODE:

1) ________ |__|__| 55 56

(List all transportation modes)

2) ________ |__|__| 57 58

If car was driven, ASK #11 and #11a.
If NOT, go to #12.

11) WHAT TYPE OF VEHICLE WERE YOU IN? CODE |__| 59

1)Compact(4 Cylinders) 4)4W Drive
2)Intermediate(6 Cylinders) 5)Recreational
3)Full-Size(8 Cylinders)

11A) WERE YOU DRIVING, RIDING IN THE VEHICLE, OR BOTH? CODE |__| 60

1)Driving 2)Riding 3)Both

12) ABOUT HOW LONG DID IT TAKE TO TRAVEL FROM YOUR HOME TO ____? ★ |__|__| 61 62 MINUTES

(This should start when they left home and end when they arrived at the fishing site, including stops along the way.) |__|__| 63 64 HOURS

|__|__| 65 66 DAYS

13) COULD YOU ESTIMATE THE DISTANCE YOU TRAVELED FROM YOUR HOME TO ____? (One-way distance, sum of all modes including stops along the way) |__|__|__|__| 67 68 69 70 MILES

14) WOULD YOU ESTIMATE THE AMOUNT OF MONEY YOU SPENT ON TRANSPORTATION TO AND FROM ____?

MODE	AMOUNT SPENT
71 72	$ 73 74 75 76 .00
77 78	$ 79 80 81 82 .00

Money spent on such things as tires should not be included because they aren't specifically for the trip.

If car or other vehicle was used, ASK #15 - #21.
If NOT, skip to #22.

15) HOW MUCH OF THIS COST WAS FOR GAS? $ GAS ONLY $|__|__|__|__|.00 83 84 85 86

16) DID YOU CONSIDER WEAR AND TEAR ON THE VEHICLE DRIVEN AS PART OF THE TRANSPORTATION COST? YES=1 NO=2 |__| 87

17) WHAT WOULD YOU ESTIMATE AS THE COST PER MILE OF WEAR AND TEAR ON THE VEHICLE DRIVEN? $|__|.|__|__| 88 89 90 PER MILE

18) ON WHAT TYPE OF ROAD DID YOU SPEND MOST OF YOUR TIME TRAVELING? CODE: |__| 91

1)Interstate 2)Highway 3)Rural(paved) 4)Rural(unpaved)

19) HOW MANY PEOPLE WERE IN THE VEHICLE? |___|___| PEOPLE (92 93)

20) HOW MANY OF THESE WERE FISHING AT _____? |___|___| ANGLERS (94 95)

21) HOW MANY OF THESE PEOPLE FISHING WERE CHILDREN UNDER 12? |___|___| UNDER 12 (96 97)

The next 2 questions ask about the time you spent travelling to _____?

22) SUPPOSE YOU COULD SHORTEN YOUR TRAVEL BY ONE-HALF, SO INSTEAD OF ____(insert time from #12) IT TOOK ONLY ____(1/2 #12) TO GET FROM YOUR HOME TO ____. WHAT IS THE MAXIMUM AMOUNT YOU WOULD BE WILLING TO PAY TO REACH ____ IN HALF THE TIME YOU ACTUALLY TOOK? $|___|___|___|___|.00 (98 99 100 101)

If amount in #22 is 0, ASK #23. If NOT, skip to #24.

23) WHY WOULDN'T YOU PAY MORE TO REDUCE THE TIME YOU SPENT TRAVELLING? CODE |___|___| (102 103)

REASONS: ______________________

24) DID YOU ENJOY THE TIME YOU SPENT TRAVELLING TO _____? CODE YES=1 NO=2 |___| (104)

OTHER: ______________________ OTHER CODE |___|___| (105 106)

☆ The next few questions will help us to determine how much people spend on Montana fishing trips. Could you tell me how much you spent, if anything, on each of the following categories during the trip?

25)

a) LODGING, SUCH AS HOTELS, OR CAMPGROUND FEES? $|___|___|___|___|.00 (107 108 109 110)

% SPENT IN ROUTE? |___|___|___|% (111 112 113)

% SPENT NEAR FISHING SITE? |___|___|___|% (114 115 116)

b) FOOD AND BEVERAGES BOUGHT IN RESTAURANTS? $|___|___|___|___|.00 (117 118 119 120)

% SPENT IN ROUTE? |___|___|___|% (121 122 123)

% SPENT NEAR FISHING SITE? |___|___|___|% (124 125 126)

c) FOOD AND BEVERAGES BOUGHT IN STORES? $|___|___|___|___|.00 (127 128 129 130)

% SPENT AT HOME? |___|___|___|% (131 132 133)

% SPENT IN ROUTE? |___|___|___|% (134 135 136)

% SPENT NEAR FISHING SITE? |___|___|___|% (137 138 139)

d) TACKLE AND BAIT BOUGHT FOR THIS TRIP? $|___|___|___|___|.00 (140 141 142 143)

% SPENT AT HOME? |___|___|___|% (144 145 146)

% SPENT IN ROUTE? |___|___|___|% (147 148 149)

% SPENT NEAR FISHING SITE |___|___|___|% (150 151 152)

e) FEES FOR GUIDES OR OUTFITTERS? $|___|___|___|___|.00 (153 154 155 156)

f) ANY OTHER ON SITE PURCHASES SUCH AS BOAT GAS OR RENTAL, DOCKING FEES, FILM, AUTO REPAIRS, ETC. $|___|___|___|___|___|.00 (157 158 159 160 161)

☆ Finally, I have a few more questions about you and your household that don't relate specifically to your trip to ____, but will help us to compare the information we get from different types of anglers.

26) HOW MANY YEARS HAVE YOU BEEN FISHING? |___|___| YEARS (162 163)

27) HOW MANY DAYS PER YEAR DO YOU FISH, ON THE AVERAGE? |___|___|___| DAYS PER YEAR (164 165 166)

28) HOW DOES FISHING COMPARE TO OTHER TYPES OF OUTDOOR RECREATION YOU DO? CODE |___| (167)

1) FAVORITE
2) ONE OF YOUR FAVORITE
3) ONE OF MANY ACTIVITIES
OTHER: ______________

29) COULD YOU ESTIMATE THE TOTAL AMOUNT OF MONEY YOU HAVE INVESTED IN FISHING RELATED EQUIPMENT SUCH AS FISHING BOATS, RODS, TACKLE BOXES, WADERS, ETC? $|___|___|___|___|___|.00 (168 169 170 171 172)

☆ These last questions are for statistical purposes, and will be kept in strict confidence.

30) AS I READ THE FOLLOWING AGE CATEGORIES, PLEASE INDICATE WHICH ONE YOU ARE IN. |___| (173)

1) 12 - 15
2) 16 - 20
3) 21 - 29
4) 30 - 39
5) 40 - 49
6) 50 - 61
7) 62 or older

31) HOW MANY PEOPLE LIVE IN YOUR HOUSEHOLD? |___|___| PEOPLE (174 175)

32) HOW MANY YEARS OF EDUCATION HAVE YOU HAD? |___|___| YEARS (176 177)

33) AS I READ THE FOLLOWING INCOME CATEGORIES, PLEASE INDICATE THE CATEGORY YOUR TOTAL HOUSEHOLD INCOME BEFORE TAXES IN 1984 IS IN. INCOME |___|___| (178 179)

1) 0- 5,000
2) 5,000-10,000
3) 10,000-15,000
4) 15,000-20,000
5) 20,000-25,000
6) 25,000-30,000
7) 30,000-40,000
8) 40,000-50,000
9) 50,000-75,000
10) More than 75,000

Montana Department of Fish, Wildlife & Parks

FISHERIES SURVEY

DID YOU FISH IN MONTANA DURING AUGUST 16-31

☐ YES ☐ NO

PLEASE CHECK THE TYPE OF LICENSE YOU PURCHASED

☐ FISHING OR FISHING/CONSERVATION COMBINATION FOR RESIDENT OR NONRESIDENT

☐ SPORTSMAN

☐ DISABLED RESIDENT CONSERVATION

☐ RESIDENT CONSERVATION ONLY

IF YOU ARE A PIONEER (62 OR OLDER) OR A YOUTH (12 TO 14), DO YOU PLAN ON USING YOUR CONSERVATION LICENSE TO FISH?

☐ YES ☐ NO

PLEASE REFER TO THE MAPS TO HELP US IDENTIFY THE WATERS YOU FISHED

DATE FISHED AUGUST 16-31	NAME OF LAKE OR STREAM FISHED	SECTION NUMBER IF INDICATED ON MAP	NEAREST TOWN AND/OR POINT OF ACCESS OR LANDMARK	TOTAL HOURS FISHED PER DAY	TOTAL NUMBER OF FISH CAUGHT		TOTAL NUMBER OF FISH KEPT		WAS THE MAIN PURPOSE OF YOUR TRIP TO FISH? (Y OR N)	DID YOU STAY OVERNIGHT? (Y OR N)	ROUND TRIP DISTANCE TRAVELED**
					TROUT AND SALMON	OTHER SPORT FISH*	TROUT AND SALMON	OTHER SPORT FISH*			
ENTER EACH DAY AND EACH WATER FISHED ON A SEPARATE LINE. LIST ALL FISHING IN MONTANA, NOT JUST WATERS INDICATED ON THE MAP											
AUGUST											
AUGUST											
AUGUST											
AUGUST											
AUGUST											
AUGUST											
AUGUST											
AUGUST											
AUGUST											

* SUCH AS: THE NUMBEROF WHITEFISH, WALLEYE, PERCH, BASS, ETC.

** IF YOU STAYED OVERNIGHT, PLEASE MAKE A SEPARATE ENTRY FOR EACH FISHING TRIP.

THIS INFORMATION WILL BE HELD IN STRICT CONFIDENCE AND WILL BE USED FOR MANAGEMENT PURPOSES ONLY

APPENDIX B

TRAVEL COST PARAMETER ANALYSIS

Literature Review

The travel cost method has a special measurement problem in that the visitor's perceived price is not directly observed. Typically the estimated travel cost (or supply price) for a visitor is based on no more than the estimated round trip distance to the site and published national estimates of the variable cost of automobile transportation. Even with survey evidence of the costs of travel, there is considerable variability across studies as to which travel or on-site expenditures to include. In addition, as was noted in even some of the earliest studies (Knetsch, 1963), the omission of the value of time can bias valuation estimates downward. A considerable literature has addressed the issue of how much time involved is costly and the appropriate value to place on this time (Cesario and Knetsch, 1970); Cesario, 1976; McConnell, 1975). In the following sections, the travel cost literature on transportation and time cost parameters is briefly reviewed and estimates specific to this study's sample of Montana fishermen are derived.

For the typical zonal travel cost application, only data on round trip distance is available for each origin-destination observation. In the absence of travel expenditure and travel time data for each observation, it is necessary to infer both a transportation and time cost cents/mile parameter that can be applied to round trip distance. This method implies an assumption of homogeneous travel cost per mile across zones.

Where origin-destination level data is available on both travel time and expenditure, the two variables can be included directly in the first stage demand curve model. However, aggregation in the zonal model results in strong collinearity between distance and travel time. As a result, the convention has been to use estimated variable automobile costs for a transportation cost parameter and (following Cesario, 1976) to value travel time at 25% to 50% of the wage rate. The empirical basis for applying these values is weak, since the estimates are derived from the transportation literature on urban computers. Where the individual observation travel cost model can be applied, average cost and travel time can be included as separate regressors. The estimated parameters should be unbiased, but the poor overall explanatory power of the reported estimates (Brown and Nawas, 1973; Gum and Martin, 1975) is not encouraging.

The evidence on the opportunity cost of time in recreational travel is limited and can be briefly summarized. McConnell and Strand (1981) used the individual model and the assumption that response to monetary and travel time costs should be the same. They derived an estimate of the value of travel time at 60 percent of the wage rate for a sample of sport fishermen. Desvousges et al. (1983) tested both the hypothesis that opportunity costs of time are equal to the full wage rate and the Cesario hypothesis that costs are one-third the wage. For a sample of 22 sites, each hypothesis was rejected with about the same frequency (about one-third of the cases). Desvousges et al. also made direct estimates of opportunity cost as an approximate constant multiple of the wage rate (following McConnell and Strand, 1981); most of these estimates were either negative or greater than unity. In general, their findings appeared to be limited by the available data. In their application, Desvousges et al (1983) chose to use the full wage rate. Given the uncertainty concerning the travel time value, some analysts have used a range of values. For example, in a recent paper Bishop and Heberlein (1980) showed the sensitivity of consumer surplus estimates to time valued at zero or at 50% of the wage rate. Including travel time at 50% of the wage rate quadrupled the estimated average consumer surplus (per hunter) from $8 to $32.

The variety of approaches taken for estimating the transportation cost parameter in the recent literature can also be compared. For monetary costs, there are at least two models which can be considered in deciding on the appropriate travel cost per mile. One model describes decisions on a household basis. In this approach, taken by Knetsch and Davis (1966) for example, the costs per mile are on a vehicle or group basis. The other approach focuses on the individual and may require a measured or assumed number of individuals per vehicle to identify shared costs. Of the studies referenced above, both Desvousges et al. and Bishop and Heberlein defined monetary travel costs as the variable costs of operating an automobile, based on national estimates for 1976 of gas, oil, maintenance, and parts per vehicle-mile (around 8 to 10 cents). While both studies appear to be on an individual basis, it is not clear that vehicle costs were changed to a per-passenger-mile basis. The latter adjustment can be significant. For example, Sutherland (1982) also used a vehicle-mile cost of about 8 cents (1976 dollars), but he used a cost per individual of about 3 cents per mile based on his sample of 2.7 passengers per vehicle. These are accounting problems; a more fundamental difficulty is that there is no basis for excluding other costs of travel such as vehicle wear and tear and lodging. Such costs have been included in some other studies and can result in per-mile travel costs that are up to four times higher than those limited to vehicle operating costs. For example, Burt and Brewer (1971) regressed reported trip expenditures on distance traveled and interpreted the estimated slope coefficient as the variable monetary cost of travel.

Approach Used in Montana Angler Study

Given the considerable range of both transportation cost and opportunity cost of travel time shown in the literature, we have developed estimates specific to our sample of Montana fishermen.

The variable transportation cost is estimated following Burt and Brewer; the value of time is estimated with a willingness to pay survey question. These estimates are described in the following sections. In addition, for comparison purposes we will also report consumer surplus values based on travel cost parameters recommended by the U.S. Water Resources Council (1979, 1983). Specifically, the latter has relied on Cesario's (1976) work and recommends a value between one-fourth and one-half the wage rate as a proxy for the opportunity cost of time. One-third of the wage rate is used here for illustrative purposes. It should be noted that the use of the wage rate is solely as a proxy for opportunity cost of time in all other activities and is used even if the angler would not have been working. The wage rate for our sample was derived from reported household income based on the ratio of U.S. average hourly earnings ($8.33 in 1984) to median household income ($22,415) as reported in the 1986 U.S. Statistical Abstract. Our sample median household income was $25,400, implying average hourly earnings of $9.44. At one-third the wage rate, the opportunity cost of time is $3.15 per hour based on the Water Resource Council method. Because our survey results included hours of travel and distance to the site, it was possible to calculate average speed of travel. Using our sample median of 45 miles per hour, the opportunity cost of travel time is 7.0 cents per mile.

The transportation cost estimate recommended by the U.S. Water Resource Council is limited to the variable cost of vehicle operation. The recommended source for the latter is the U.S. Department of Transportation's "Cost of Owning and Operating a Vehicle". The most recent report in this series provides costs for 1984 automobiles (large, intermediate, compact and subcompact) and passenger vans. Our survey indicated that most recreationists utilize full size or four-wheel drive vehicles (combined 69% of the sample). Only 9.1% report driving intermediate size vehicles, 14.2% compacts, and 7.4% recreational vehicles. The DOT estimates for large vehicles are taken as being the most representative for our sample. The variable cost for a large size vehicle for 1984 is 6.0 cents for maintenance, accessories, parts and tires and 9.2 cents for gas and taxes or a total of 15.2 cents per mile. With our sample average of 2.76 people per vehicle, the cost per passenger mile is 5.6 cents. The sum of transportation (5.6 cents) and time costs (7.0 cents) using the Water Resources Council method is 12.6 cents per mile.

Before developing an alternative estimate, the limitations of using the DOT transportation cost estimate can be briefly noted. The latter may not reflect the higher vehicle operating costs associated with driving vehicles often used for recreation, recreation road driving conditions, etc. In addition, a more serious limitation of the DOT estimate is that it is based on the cost of operating a new car in the given year. By contrast, vehicles used for recreation are more likely to reflect the efficiency of the average U.S. car, which is not new but 7.4 years old (U.S. Statistical Abstract, 1985). The DOT gas cost is based on unleaded full serve gasoline. The 1984 cost used was 1.389 $/gallon which is about 20 cents higher than self serve in this period. The DOT estimates also require assumptions as to which type of car is typical (compact, intermediate, etc.) and which costs to include. The DOT reports separately estimates of depreciation, gas and oil, maintenance and parts, parking, insurance and taxes. Following U.S. Water Resources Council, we have taken maintenance and parts and gas and oil as representing the perceived variable costs of vehicle operation on the part of recreationists.

Transportation Cost Estimate

Expenditure Data

Our estimate of the transportation cost component of the cents per mile travel cost parameter is derived from our telephone survey undertaken in early fall 1985. A copy of the survey is in Appendix A. There are a total of 1505 observations in the angler mail survey. A number of observations were not usable because residence was not coded (15), distance traveled was zero (77), or water types were not in the current study (70). This leaves the total of 1343 records that were utilized in our analysis. Among other things, respondents were asked their expenditure on transportation, lodging, food, etc. [The basic expenditure data is discussed in Chapter V and shown in Table B-1]. The average total expenditure per trip per respondent was $91.59. Only about 31% of the total trip cost was for transportation. This is consistent with other recreation surveys. For example, Clawson and Knetsch (1966) report that based on a sample of 19 different surveys, transportation averaged only about 25% of total trip expenditure. Based on total trip expenses of $91.47 and an average round trip distance of 258 miles, average cents per mile is 35.5. However, the latter is not an appropriate estimate for the transportation cost parameter required by the travel cost model since it includes both fixed and distant dependent costs. In addition, the aggregated cost estimates need to be evaluated with respect to respondent perception of costs and whether the data is individual or group. These issues will be discussed in turn below.

Transportation Mode and Perceived Costs

As noted above, there is some ambiguity as to how recreationists perceive their transportation costs. The assumption of the travel cost model is that travel costs function like a supply price for visits to a given site. The problem is that only distance is unambiguously observed, not the perceived price. A preliminary issue here is what mode of travel recreationists are using. It is generally assumed that most travelers use a personal vehicle. This approach is supported by the mail survey results. Travelers were given an opportunity to record two different travel modes. For the first travel mode with 1343 respondents, 98% used a personal vehicle of some kind.

Nobody took a bus or train and only 15 (1%) reported taking a plane. Another 1% either walked, motorcycled or rode a horse. Only 60 respondents reported using a second mode of transportation. Half of these also used personal vehicles and 35% reported walking. The remaining 9 respondents took a plane (3), rode a horse (4) or motorcycled (2). These results indicate that it is appropriate to focus on the costs of driving for transportation costs and that the travel cost model assumption of relatively homogeneous costs across zones is appropriate. As noted above a high proportion of the respondents reported using four-wheel drive (33%) and large size (36%) vehicles suggesting that recreational vehicle travel costs might be higher than national averages for all types of travel.

A specific problem with respect to the costs of driving is that it is not clear whether recreationists are traveling as though costs were only out of pocket (gas, repairs) or included other variable costs such as wear and tear or depreciation. Several questions were included in the mail survey to attempt to resolve this issue. Respondents were explicitly asked (No. 16, Appendix A) if they considered wear and tear on the vehicle as part of their transportation cost. A very large majority of respondents (83% or 893 respondents) stated that they did not consider wear and tear part of their trip cost. Respondents were also asked to estimate wear and tear cost in cents per mile, but over 80% of responses showed zero cost or a median of zero. A related finding was that the reported trip costs for transportation and for gasoline were very similar, with average reported gas costs accounting for 93% of the reported transportation cost. In fact, reported gas cost and transportation cost were identical in 1084 of the 1310 cases where both were reported. The preliminary conclusion here is that when the recreationist's perceived vehicle costs are limited to using national estimates of vehicle costs, only the gasoline component (not parts and repairs) may be appropriate for inclusion.

Cost Allocation

A second issue in interpreting travel expenditures is whether the data is individual or group (vehicle basis). If the expenditure data is on a vehicle basis, but the trips are for individuals, then it is appropriate to divide per mile expenses by number of passengers per vehicle. In the mail survey, questions were phrased to elicite expenditure by the individual (eg. "the amount of money you spent on...", Appendix A). In order to validate transportation expenditures and to analyze how vehicle expenses were shared, respondents were asked whether they were drivers, riders or both. Drivers comprised 58% of the sample, riders (passengers) were 36% and another 6% rode and shared driving. The sample was also crosstabulated by the number of people per vehicle by driver type (Table B-2); for example, only about 10% of the recreationists sample drove alone while about 40% traveled two to a car. Three different means were calculated to compare trip cost sharing: average gasoline cost in dollars per mile (AGASCTM), average total trip costs (including gas, food, lodging, tackle, etc.) (AVTLCST), and average total cost excluding gas (ANGCST). These means are shown in Table B-2 by number of people per vehicle and driver type. The sample with full information on costs is 1214 observations. To exclude outliers, observations were restricted to AGASCTM<.30 (implying at least four miles per gallon) and AVTLCST<2.0. This reduced the sample by only about 6%. The basic findings are as follows.

With respect to average gas costs, the cost reported by drivers was significantly greater than the cost reported by riders. At all passenger levels, riders reported paying around 7 cents per mile and drivers reported paying around 11 cents (Table B-2). The AGASCTM for drivers did not vary significantly with the number of people per vehicle, but did increase somewhat. Reported gas costs can be compared to other independent estimates of vehicle operating costs. Average gas costs for the Western U.S. region reported by the Bureau of Labor Statistics for April to August 1985 was $1.23 per gallon. Average miles per gallon for all cars, for example in 1983, was 15.1 (Statistical Abstract of the U.S.). This implies 8.1 cents per mile and reflects an average vehicle age of seven years. The costs for drivers alone are 9.7 cents and range up to 12.0 cents with four passengers. These numbers are slightly higher than 8.1 cents but not implausible given that "fishing cars" may be older and somewhat less efficient than the U.S. average. Also as noted above low efficiency modes (4WD, etc.) may be more predominant in the recreationist sample. When results were disaggregated for several transport modes (intermediate and full size vehicles) means were 10.4 cents and 11.6 cents or 13.7 to 10.9 miles per gallon respectively. These are also plausible compared to the Statistical Abstract average. By contrast, the Department of Transportation estimates for 1984 range from 4.4 cents to 7.0 cents for subcompact to large vehicles. These are of course based on new 1984 cars and imply 27 to 17 miles per gallon. It would appear that these are not a good basis for estimating average recreation vehicle costs.

Variable gas costs were also estimated by regressing reported total gas cost on reported round trip distance in miles. When the sample was disaggregated by vehicle type, the intercept was not significantly different from zero in four out of five cases and the coefficient on distance was 7.2 to 10.6 cents per mile. The adjusted R square statistic ranged from .50 to .93 indicating a strong correlation between the distance and gas cost responses. When the sample was disaggregated by driver type, the coefficient on distance was 9.1 cents per mile (683 observations and an adjusted R square of .54) for the driver subsample. This result implies an average miles per gallon for the sample of 13.5 This is certainly plausible compared to national average vehicle efficiency especially given the proportion of large size and four-wheel drive vehicles in the sample.

While the gas costs reported by drivers may be consistent with actual vehicle costs, the sum of implied driver and rider gas costs is not. For example (Table B-2), for the driver plus one rider case, implied total vehicle gas costs are 18 cents per mile (10.5 cents for the driver plus 7.5 cents for the rider). For the driver plus two passenger case, implied cost is 22.2 cents and for three passengers, 32.4 cents. In fact, the gas expenditure reported by both riders and drivers does not vary significantly with the number of passengers. Rather than rider and drivers for example sharing gas costs equally, it appears that riders feel obligated to pay approximately half the gas cost independent of the number of other passengers.

Another perspective on the rider/driver gas cost sharing is derived by examining average gas cost when observations of zero expenditures are excluded. For example in Table B-3, only about 5% of all drivers report zero gas expenditure. This proportion is generally independent of the number of people per vehicle. Some share of even the drivers traveling alone report zero gas expenditure; this is to be expected since it will not be necessary to fill the gas tank on every trip. (Parenthetically, the lack of a perfect correlation between gas expense and distance, even when disaggregated by mode type, may be explained in part by the random distribution of gasoline in the car at the start of a trip, tank size, and the vehicle's mile/gallon efficiency.) Excluding zero expenditure observations for drivers results in little change in the average gas cost per mile. By contrast, 30 to 50% of riders report zero gas expenditure. When there are only two people per vehicle, 70 % of the riders report paying some gasoline cost. This drops to 50% to 60% of riders reporting some gas expenditure with more passengers. Interestingly, when zero expenditures are excluded, the average gas cost reported by riders is very similar to that reported by drivers (around 11 cents per mile, Table B-3) and does not vary significantly across the number of passengers. In short, about half the time riders report paying gas costs, and when they do pay on average they pay for all the gas.

Given the consistency of the disaggregated reported average gasoline costs with actual gas costs and vehicle efficiency, it would appear that the reported costs are valid. However, the sum of rider and driver gas expenditure clearly exceeds actual vehicle costs. It may be that drivers typically actually pay for the gasoline, and are later reimbursed in many cases by riders. Drivers appear to be reporting their gross gasoline expenditure, rather than expenditure net of reimbursement by riders. It might be argued that all we know about perceived costs are reported costs. Drivers may be making trip choices based on gross expenditure, since rider contributions are not certain but generally offered after the fact as a courtesy. The more conservative approach would be to limit gasoline expenditure to net out of pocket costs. This is easily done by only including driver gasoline expenditures in total trip costs, and setting all rider gas expenditure at zero.

Variable Transportation Costs

Variable trip costs were estimated by regressing total expenditure on distance. Three alternative definitions of total trip expenditure were used: TOTLCST1 (sum of reported transportation, lodging, restaurant and store-bought food, tackle, guiding fees and other); TOTLCST2 (same as 1 but substituting gasoline cost for transportation cost); and TOTLCST3 (same as 2 but counting only driver gasoline expenditures). For the full sample of 1248 observations, the respective coefficients on distance were 27.6, 24.5 and 22.4 cents per mile (Table B-4). The cents per mile variable cost estimates are not extremely sensitive to the different definitions of total cost. A conservative estimate of monetary transportation costs would be to use the 22.4 cents per mile. It may be noted that a large share of the variation in total costs was explained by distance in this simple model, with the coefficient of determination (adjusted R square) varying from .47 to .54. Fixed trip costs (intercept) were 12 to 15 dollars. Distance dependent total costs (based on a sample average of about 260 miles round trip) averaged around 70 dollars or about 85% of total costs.

The sample was also disaggregated by residents and nonresidents as a partial test of whether variable travel costs were relatively homogeneous across zones. In fact, variable travel costs were very similar between the two samples (Table B-4). For example, using the TOTLCST3 definition of trip expenditures, the coefficients are 20.7 and 20.5 cents per mile for residents and nonresidents respectively. However, the fixed trip costs (intercept) vary considerably: 64 dollars for nonresidents and 11 for residents.

Several travel cost on distance regressions were also tried that included the number of people per vehicle. This variable was not significant.

Opportunity Cost of Time Estimate

Average Willingness to Pay

As described previously, a sample of individuals holding Montana fishing licenses was asked how much they would pay to shorten their reported travel time by one-half (Appendix A). Average willingness to pay (dollars per hour) for each fisherman was calculated by dividing the reported amount by one-half reported travel time. The mean willingness to pay for the entire sample (1166 observations) was 11.50 per hour. However, the sample median is zero since over 80% were reportedly willing to pay nothing to reduce travel time. The mean of 11.50 results from a skewed distribution that includes some implausibly high values. As an example, there were 152 observations (13% of the sample) where the average willingness to pay per hour exceeded the reported household wage rate. The mean of this subsample was

$83.07 per hour (Table B-5). When these high values are excluded, the mean drops to $.77 (based on 1014 observations).

While the majority of responses indicated zero opportunity cost of travel, the nonzero responses appear to be logically related to residence, income, and whether or not the trip was judged to be "enjoyable" (Appendix A). For example, nonresidents were almost three times as likely to be willing to pay some amount to reduce travel time as residents: 44% of nonresidents were willing to pay versus 18% of residents. Most anglers reported enjoying their travel (over 90%). However, those who reported not enjoying their travel were about twice as likely to be willing to pay as those who did not. For non-residents 71% of those who did not enjoy the travel were willing to pay. Compared to the entire sample, the subgroup who were willing to pay something (but less than the reported household wage) had much higher mean household income ($38,716 versus $28,239) and reported significantly higher one-way travel time (7.2 hours versus 2.8).

Regression Analysis

The relationship between the amount fishermen were willing to pay and explanatory variables was estimated using the following model:

(SHORTENi)=Bo+B1(HHTIMi)+B2(RTDISTi)+B3(SINCOMEi)+Ei

where:

SHORTENi = amount angler i would pay to reduce travel time

HHTIMi= one half reported travel time

RTDISTi= round trip distance in miles

SINCOMEi= mean of reported income interval

and Bj are parameters to be estimated and Ei is an error term.

The coefficient on the travel time variable in this model (B1) can be interpreted as an estimate of the opportunity cost of travel in dollars per hour, corrected for the independent effects of income and distance. The hypothesis is that the amount fishermen are willing to pay to reduce travel time is positively related to hours traveled, income, and distance. The model was estimated with an OLS stepwise regression package. The basic finding is that the opportunity cost of travel is relatively stable across subsamples at around $2.00 to $3.00 per hour (Table B-6).

For the entire sample, the estimate is $2.30. The result for the subsample with average willingness to pay less than the reported household wage is quite similar, $2.06. The result for the small subgroup with positive amount (but less than household wage) is $2.81. In all cases, all three variables were significant and had the expected signs. Not surprisingly, there is some multicollinearity between distance and travel time (with simple correlations of around .6 to .7). While the estimated correlations should be unbiased, the standard errors of the regression parameter may tend to be high. In fact, the 95% confidence interval on B1 for the full sample is $.05 to $4.55 and for the small subsample of positive amounts only is $1.14 to $4.47 (Table B-6). It might be argued that the estimate should be restricted to the subsample of fishermen with average willingness to pay less than the household wage rate. This clearly results in the most conservative estimate ($2.06) and this estimate also has a much lower standard error and 95% correspondingly smaller confidence interval ($1.49 to $2.63).

Taking $2.06 as our estimate of the opportunity cost of time (and assuming 45 miles/hour travel speed) results in a 4.6 cents per mile time cost parameter. This estimate is a little over half that derived using the Water Resources Council method and implies an opportunity cost of time that is about one-fifth of the household wage rate. The sum of time and transportation costs for both methods (12.6 cents and 27.0 cents) is derived in Table B-7.

The linear formulation of the regression model above reflected the assumption that the opportunity cost of travel is constant across zones. This assumption was tested with several alternative specifications. When the natural log of hours of travel was included as an independent variable in place of hours, it was not found to be significantly correlated to the amount anglers would pay. This finding supports the hypothesis of constant time costs. When a squared hours term was included, it was significant in all cases. However, hours of travel and squared hours are highly multicollinear (correlation of over .80 in all samples) and the HHRTIM variable became insignificant in two cases and negative in another. It appears that the assumption of constant time costs is a reasonable one.

Conclusions

This analysis suggests that the travel expenditures reported are on an individual basis (accordingly it is not appropriate to divide by the number of people per vehicle). Transportation expenditures are almost identical to reported gasoline expenditures. Perceived vehicle travel costs appear to be limited to out of pocket expense for gasoline, and exclude wear and tear. The analysis of rider and driver cost sharing indicated that drivers are reporting gross expenditure and not netting out rider contributions. Driver gasoline expenditures appear to be consistent with independent estimates of actual gasoline costs and vehicle efficiency. A conservative estimate of total trip expenditures includes only driver reported gasoline expenditure (excludes riders' reported gas costs). Based on the latter, variable trip costs are 22.6 cents per mile per individual. Based on a disaggregation of resident and nonresident trips, variable travel costs appear to be homogeneous across zones. The opportunity cost of recreational travel time based on willingness to pay survey data is estimated at one-fifth the wage rate or somewhat less than the lower range of the values derived from studies of urban commuters. The two alternative levels of travel cost per mile for this study are 12.6 cents based on the Water Resource Council method and 27 cents based on our sample of Montana fishermen.

Table B-1. Summary of angler expenditure variables.

Variable	Dollars Per Trip Mean
Transportation	28.24
Lodging Fees	13.06
Food-Restaurant	13.08
Food-Stores	25.18
Tackle	6.55
Guide	1.63
Other	3.86
Total Cost	91.59
Avg. Cost (per mile round trip)	35.5
Round trip distance	257.9

Note: Total observations = 1343

Table B-2. Allocation of gasoline costs and total trip costs among drivers and riders[1].

Variable[3]	Rider or Driver	Number of People per Vehicle 1	2	3	4
AGASCTM	Driver	.097[2] (.006) n=102	.105 (.004) n=304	.110 (.005) n=128	.120 (.008) n=90
	Rider		.075 (.005) n=178	.056 (.007) n=107	.068 (.008) n=96
AVTLCST	Driver	.236 (.029) n=102	.300 (.014) n=304	.365 (.030) n=128	.457 (.036) n=90
	Rider		.239 (.016) n=178	.271 (.031) n=107	.338 (.034) n=96
ANGCST	Driver	.139 (.027) n=102	.195 (.013) n=304	.255 (.029) n=128	.337 (.034) n=90
	Rider		.164 (.014) n=178	.215 (.029) n=107	.270 (.031) n=96

Notes: 1 Excluding outliers: AGASCTM is less than .30 and ATLCST is less than 2.00 or exclude about 6% of sample.

2 Means, with standard error in parenthesis and n indicating sample size.

3 Variable definitions: AGASCTM = Average gasoline cost in dollars per mile.
AVTLCST = Total trip costs (gas, food, lodging, guiding fees, tackle) ($/mile)
ANGCST = Average non-gas total costs

Table B-3. Comparison of average gas cost per mile for riders and drivers.

No. of People per Vehicle	Driver Mean	Driver % zero	Driver non-zero mean	Rider Mean	Rider % zero	Rider non-zero mean
1	.097 (102)*	8	.105 (94)			
2	.105 (304)	5	.111 (288)	.075 (178)	30	.108 (124)
3	.110 (128)	5	.116 (121)	.056 (107)	51	.115 (52)
4	.120 (94)	4	.131 (86)	.068 (96)	42	.117 (56)

* Number of observations in parenthesis

NOTE: Rule for excluding outliers: AVTLTCST is less than 2.00
AGASCTM if less than .3

Table B-4. Total cost regressed on distance.

Dependent Var	a	b	R^2	residual df
Complete Sample				
TOTLCST1	12.151 (2.893)	.276 (38.408) 95%: .261-.290	.542	1247
TOTLCST2	16.847 (4.236)	.245 (36.137) 95%: .232-.259	.511	1247
TOTLCST3	13.453 (3.406)	.224 (33.257) 95%: .211-.238	.470	1247
Residents				
TOTLCST1	11.619 (3.909)	.251 (19.013) 95%: .225-.276	.251	1074
TOTLCST2	11.545 (3.938)	.239 (18.41) 95%: .214-.265	.239	1074
TOTLCST3	10.93 (3.761)	.207 (16.088) 95%: .182-.232	.193	1074
Nonresidents				
TOTLCST1	51.96 (1.668)	.261 (12.316) 95%: .219-.303	.467	171
TOTLCST2	81.353 (2.831)	.219 (14.201) 95%: .180-.258	.420	171
TOTLCST3	63.66 (2.215)	.205 (10.479) 95%: .166-.244	.388	171

Notes: t-statistic in parenthesis. 95% is 95% confidence interval on the slope coefficient. "Residual df" is residual degrees of freedom.

Definition of Variables: TOTLCST1= Sum of reported expenditures for transportation, lodging, restaurant and store-bought food, tackle, guide fees and other.

TOTLCST2= Same as 1 but substituting gasoline expenditure for transportation.

TOTLCST3= Same as 2 but including only driver gasoline expd.

Table B-5. Average willingness to pay to shorten travel time (dollars/hour).

Statistic					
Mean	std. error	Median	n	WTP equals zero n	WTP equals zero %
	A.) WTPSHORT is less than HHWAGE				
.773	.103	0.0	1014	940	93
	B.) WTPSHORT is greater than 0 and less than HHWAGE				
10.591	.779	10.0	74	-	-
	C.) WTPSHORT is greater than HHWAGE				
83.07	35.60	29.29	152	-	-

Where WTPSHORT = amount willing to pay to shorten travel time (dollars/hour)

HHWAGE = household wage rate.

Table B-6. Regression results of willingness to pay to reduce travel time.

A. Estimated Parameters

Sample	df	R^2	intercept	HRTIM/2	RTDIST	INCOME
All	1165	.120	-16.74	2.299	.0426	.000659
			(-3.262)	(2.006)	(6.41)	(4.098)
WTP<HHW	1011	.238	5.982	2.062	.0103	.000128
			(4.835)	(7.112)	(5.335)	(3.331)
0/WTP<HHW	71	.676	-34.26	2.807	.0498	.000840
			(-2.67)	(3.365)	(7.052)	(2.709)

B. 95% confidence interval for coefficient on HRTIM/2

All	.051 to 4.547
WTP<HHW	1.493 to 2.631
O<WTP<HHW	1.144 to 4.471

Notes: Estimated quation:

$$SHORTEN = B_o + B_1 (HRTIM/2) + B_2\ RTDIST + B_3\ INCOME$$

where: SHORTEN = amount willing to pay to reduce travel time, HRTIM/2 = 1/2 travel time; RTDIST = round trip distance, INCOME = average income.

Values in parenthesis are t-statistics

Table B-7. Travel cost parameters (cents per mile).

	Transportation Cost	Opportunity Cost of Time	Sum
Water Resources Council Method	5.6	7.0	12.6
Montana Sample	22.4	4.6	27.0

APPENDIX C

Stream Benefit Estimates Using Predicted Trips

As noted in the text, lake benefit estimates are based on use of a predicted intercept while stream estimates are based on an actual trip intercept (Gum and Martin method). In order to provide a more direct comparison to the lake estimates, stream estimates based on a predicted intercept are reported in this appendix.

Table C-1 presents values per day and trip by site for the standard cost approach using predicted trips as the intercept. The overall site average per trip is $62.27 which is slightly higher (about 15%) than the estimate based on actual trips ($53.08, Table 7). Being based on actual trips, the site specific values in Table 7 may be more reliable. The estimates for some sites differ considerably across the two methods. For example in Table C-1 (predicted intercept approach), the Upper Yellowstone and Middle Yellowstone are valued about the same at $14.56 and $14.88 per trip respectively. This is about the same as the value placed on trips to the Milk River ($16.87). Based on relative quality of the fishery (and ignoring location), one would expect the Upper Yellowstone to be valued more highly. When actual trips are used as the intercept (Table C-1), the Upper Yellowstone jumps to $107.50 per trip and the Middle Yellowstone to $29.35. By comparison, the Milk River drops to $10.57. Site specific values are clearly quite sensitive to using predicted intercept versus the Gum and Martin approach. It appears that site values based on the latter may be more reliable. The differences across sites are discussed in greater detail in the previously referenced sensitivity analysis technical paper. As noted previously, the comparative analysis of TCM and CVM approachs on Duffield and Allen (1987) appears to provide evidence that for streams, the Gum and Martin approach is more reliable.

Table C-2 provides values per trip by site for reported costs. Total recreational values by site based on the predicted trips approach are provided in Tables C-3 and C-4. The aggregate estimates are slightly higher than the corresponding estimates in Tables 9 and 10 (based on actual trips).

Table C-1. Montana streams net economic value per trip, equation without site attribute data (standard cost).

RIVER CODE NO.	RIVER	VALUE PER TRIP	AVG DAYS PER TRIP	VALUE PER DAY	NO. OF ZONES
12	MIDDLE FORK FLATHEAD	22.49	1.13	19.99	7
14	NORTH FORK FLATHEAD	71.56	1.30	54.86	10
15	FLATHEAD	39.27	1.10	35.70	18
16	LOWER CLARK FORK	81.58	1.13	72.44	20
17	KOOTENAI TRIBS	44.27	1.08	41.11	11
21	U. CLARK FORK TRIBS	26.82	1.00	26.82	16
22	BLACKFOOT TRIBS	55.89	1.18	47.38	11
24	BITTERROOT TRIBS	48.95	1.09	44.75	16
25	MID. CLARK FORK TRIBS	41.01	1.11	36.91	9
31	U. YELLOWSTONE TRIBS	84.11	1.11	75.93	24
32	GALLATIN TRIBS	45.83	1.09	42.01	14
33	U. MISSOURI REGION 3	58.31	1.02	57.26	16
34	MADISON TRIBS	174.46	1.29	135.30	23
35	JEFFERSON	18.33	1.05	17.52	20
36	BEAVERHEAD TRIBS	86.54	1.21	71.52	26
37	BIG HOLE TRIBS	23.17	1.15	20.19	17
41	MIDDLE MISSOURI	93.92	1.02	92.06	18
42	SMITH TRIBS	4.42	1.04	4.25	6
43	U. MISSOURI REGION 4	52.71	1.04	50.70	27
44	MARIAS	48.67	1.23	39.52	19
52	MID. YELLOWSTONE TRIBS	64.68	1.07	60.28	35
53	MUSSELSHELL	5.09	1.13	4.49	11
55	STILLWATER TRIBS	35.69	1.15	31.03	7
62	MILK	16.87	1.00	16.87	6
71	LOWER YELLOWSTONE	55.24	1.00	55.24	8
80	BEAVERHEAD	114.40	1.17	98.05	19
81	BIG HOLE	100.06	1.51	66.35	37
82	BITTERROOT	26.63	1.05	25.47	12
83	BLACKFOOT	80.31	1.01	79.25	26
84	BOULDER	133.66	1.33	100.24	16
85	BIGHORN	150.88	1.29	117.19	28
86	UPPER CLARK FORK	31.28	1.01	30.95	16
87	MIDDLE CLARK FORK	37.12	1.05	35.43	17
88	EAST GALLATIN	19.10	1.03	18.60	10
89	UPPER FLATHEAD	8.10	1.02	7.98	12
90	GALLATIN	92.26	1.06	87.01	31
91	KOOTENAI	65.83	1.02	64.76	11
92	MADISON	138.77	1.45	95.40	55
93	MISSOURI HOLTER-CASC	96.37	1.19	80.95	26
94	ROCK CREEK	164.97	1.30	126.57	21
95	SMITH	56.95	1.33	42.96	14
96	STILLWATER	127.30	1.21	105.16	15
97	SWAN	28.71	1.08	26.66	10
98	UPPER YELLOWSTONE	14.56	1.10	13.25	32
99	MIDDLE YELLOWSTONE	14.88	1.01	14.80	17
	SITE AVERAGES	62.27	1.13	53.14	

Table C-2. Montana streams net economic value per trip, equation without site attribute data (reported cost).

RIVER CODE	RIVER	VALUE PER TRIP	AVG DAYS PER TRIP	VALUE PER DAY	NO. OF ZONES
12	MIDDLE FORK FLATHEAD	48.19	1.13	42.83	7
14	NORTH FORK FLATHEAD	153.35	1.30	117.57	10
15	FLATHEAD	84.14	1.10	76.49	18
16	LOWER CLARK FORK	174.82	1.13	155.22	20
17	KOOTENAI TRIBS	94.86	1.08	88.09	11
21	UPPER CLARK FORK TRIBS	57.47	1.00	57.47	16
22	BLACKFOOT TRIBS	119.76	1.18	101.53	11
24	BITTERROOT TRIBS	104.89	1.099	95.90	16
25	MID. CLARK FORK TRIBS	87.88	1.11	79.09	9
31	U. YELLOWSTONE TRIBS	180.23	1.11	162.70	24
32	GALLATIN TRIBS	98.20	1.09	90.01	14
33	U. MISSOURI REGION 3	124.95	1.02	122.69	16
34	MADISON TRIBS	373.84	1.29	289.92	23
35	JEFFERSON	39.27	1.05	37.53	20
36	BEAVERHEAD TRIBS	185.45	1.21	153.26	26
37	BIG HOLE TRIBS	49.65	1.15	43.27	17
41	MIDDLE MISSOURI	201.25	1.02	197.27	18
42	SMITH TRIBS	9.48	1.04	9.11	6
43	U. MISSOURI REGION 4	112.94	1.04	108.64	27
44	MARIAS	104.30	1.23	84.68	19
52	MID. YELLOWSTONE TRIBS	138.60	1.07	129.18	35
53	MUSSELSHELL	10.91	1.13	9.63	11
55	STILLWATER TRIBS	76.48	1.15	66.50	7
62	MILK	36.15	1.00	36.15	6
71	LOWER YELLOWSTONE	118.38	1.00	118.38	8
80	BEAVERHEAD	245.13	1.17	210.11	19
81	BIG HOLE	214.41	1.51	142.18	37
82	BITTERROOT	57.07	1.05	54.59	12
83	BLACKFOOT	172.09	1.01	169.81	26
84	BOULDER	286.41	1.33	214.80	16
85	BIGHORN	323.32	1.29	251.12	28
86	UPPER CLARK FORK	67.02	1.01	66.31	16
87	MIDDLE CLARK FORK	79.54	1.05	75.92	17
88	EAST GALLATIN	40.93	1.03	39.85	10
89	UPPER FLATHEAD	17.35	1.02	17.10	12
90	GALLATIN	197.71	1.06	186.45	31
91	KOOTENAI	141.07	1.02	138.78	11
92	MADISON	297.35	1.45	204.43	55
93	MISSOURI HOLTER-CASC	206.51	1.19	173.47	26
94	ROCK CREEK	353.51	1.30	271.23	21
95	SMITH	122.03	1.33	92.06	14
96	STILLWATER	272.78	1.21	225.34	15
97	SWAN	61.52	1.08	57.13	10
98	UPPER YELLOWSTONE	31.20	1.10	28.40	32
31.90	MIDDLE YELLOWSTONE	31.90	1.01	31.71	17
	SITE AVERAGES	**133.43**	**1.13**	**113.87**	

Table C-3. Montana streams, total recreational value by site (standard cost).

RIVER CODE	RIVER	VALUE PER DAY	FISHING PRESSURE	SITE VALUE ($1000s)
12	MIDDLE FORK FLATHEAD	19.99	5851	117
14	NORTH FORK FLATHEAD	54.86	8037	441
15	FLATHEAD	35.70	35545	1269
16	LOWER CLARK FORK	72.44	21237	1538
17	KOOTENAI TRIBS	41.11	26081	1072
21	UPPER CLARK FORK TRIBS	26.82	24207	649
22	BLACKFOOT TRIBS	47.38	9075	430
24	BITTERROOT TRIBS	44.75	33676	1507
25	MIDDLE CLARK FORK TRIBS	36.91	6835	252
31	UPPER YELLOWSTONE TRIBS	75.93	12424	943
32	GALLATIN TRIBS	42.01	14045	590
33	U. MISSOURI REGION 3	57.26	25419	1455
34	MADISON TRIBS	135.30	11224	1519
35	JEFFERSON	17.52	29129	510
36	BEAVERHEAD TRIBS	71.52	25878	1851
37	BIG HOLE TRIBS	20.19	18621	376
41	MIDDLE MISSOURI	92.06	22340	2057
42	SMITH TRIBS	4.25	7143	30
43	U. MISSOURI REGION 4	50.70	67557	3425
44	MARIAS	39.52	5925	234
52	MIDDLE YELLOWSTONE TRIBS	60.28	30132	1816
53	MUSSELSHELL	4.49	11218	50
55	STILLWATER TRIBS	31.03	13002	404
62	MILK	16.87	5965	101
71	LOWER YELLOWSTONE	55.24	995	55
80	BEAVERHEAD	98.05	24239	2377
81	BIG HOLE	66.35	47910	3179
82	BITTERROOT	25.47	56024	1427
83	BLACKFOOT	79.25	28794	2282
84	BOULDER	100.24	17429	1747
85	BIGHORN	117.19	44814	5252
86	UPPER CLARK FORK	30.95	17578	544
87	MIDDLE CLARK FORK	35.43	30414	1078
88	EAST GALLATIN	18.60	6191	115
89	UPPER FLATHEAD	7.98	15262	122
90	GALLATIN	87.01	63871	5557
91	KOOTENAI	64.76	22591	1463
92	MADISON	95.40	108712	10371
93	MISSOURI HOLTER-CASC	80.95	72788	5892
94	ROCK CREEK	126.57	27881	3529
95	SMITH	42.96	11824	508
96	STILLWATER	105.16	32857	3455
97	SWAN	26.66	8746	233
98	UPPER YELLOWSTONE	13.25	52016	689
99	MIDDLE YELLOWSTONE	14.80	31156	461
	STATE TOTAL		1192658	72972

Table C-4. Montana streams, total recreational value by site (reported cost).

RIVER CODE	RIVER	VALUE PER DAY	FISHING PRESSURE	SITE VALUE ($1000s)
12	MIDDLE FORK FLATHEAD	42.83	5851	251
14	NORTH FORK FLATHEAD	117.57	8037	945
15	FLATHEAD	76.49	35545	2719
16	LOWER CLARK FORK	155.22	21237	3297
17	KOOTENAI TRIBS	88.09	26081	2297
21	UPPER CLARK FORK TRIBS	57.47	24207	1391
22	BLACKFOOT TRIBS	101.53	9075	921
24	BITTERROOT TRIBS	95.90	33676	3230
25	MIDDLE CLARK FORK TRIBS	79.09	6835	541
31	UPPER YELLOWSTONE TRIBS	162.70	12424	2021
32	GALLATIN TRIBS	90.01	14045	1264
33	U. MISSOURI REGION 3	122.69	25419	3119
34	MADISON TRIBS	289.92	11224	3254
35	JEFFERSON	37.53	29129	1093
36	BEAVERHEAD TRIBS	153.26	25878	3966
37	BIG HOLE TRIBS	43.27	18621	806
41	MIDDLE MISSOURI	197.27	22340	4407
42	SMITH TRIBS	9.11	7143	65
43	U. MISSOURI REGION 4	108.64	67557	7340
44	MARIAS	84.68	5925	502
52	MIDDLE YELLOWSTONE TRIBS	129.18	30132	3892
53	MUSSELSHELL	9.63	11218	108
55	STILLWATER TRIBS	66.50	13002	865
62	MILK	36.15	5965	216
71	LOWER YELLOWSTONE	118.38	995	118
80	BEAVERHEAD	210.00	24239	5093
81	BIG HOLE	142.18	47910	6812
82	BITTERROOT	54.59	56024	3058
83	BLACKFOOT	169.81	28794	4890
84	BOULDER	214.80	17429	3744
85	BIGHORN	251.12	44814	11254
86	UPPER CLARK FORK	66.31	17578	1166
87	MIDDLE CLARK FORK	75.92	30414	2309
88	EAST GALLATIN	39.85	6191	247
89	UPPER FLATHEAD	17.10	15262	261
90	GALLATIN	186.45	63871	11909
91	KOOTENAI	138.78	22591	3135
92	MADISON	204.43	108712	22224
93	MISSOURI HOLTER-CASC	173.47	72788	12627
94	ROCK CREEK	271.23	27881	7562
95	SMITH	92.06	11824	1088
96	STILLWATER	225.34	32857	7404
97	SWAN	57.13	8746	500
98	UPPER YELLOWSTONE	28.40	52016	1477
99	MIDDLE YELLOWSTONE	31.71	31156	988
	STATE TOTAL		**1192658**	**156376**