Angler Preference Study
Final Economics Report

CONTINGENT VALUATION OF MONTANA TROUT FISHING BY RIVER AND ANGLER SUBGROUP

Prepared for
Montana Department of Fish, Wildlife and Parks

By

John Duffield
Department of Economics
University of Montana

and

Stewart Allen
Department of Wildland Recreation
University of Idaho

With Research Assistance by

Joe Holliman
University of Montana

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EXECUTIVE SUMMARY

Objectives

The major objective of this study was to provide contingent valuation estimates of net economic values for trout fishing on nineteen Montana rivers. A secondary objective was to estimate the net value associated with changes in fishery quality. Specifically, angler net willingness to pay was estimated for improved chances to catch larger trout and improved chances to catch more trout. The general approach to both of these objectives was to estimate economic models of demand for recreation opportunities. A related third objective was to explore the issue of market definition, in this case the types of recreation experience. Fishing, or even more narrowly trout fishing on Montana rivers, is an activity with many different styles, settings, technologies and purposes. Because of this, the fishing experience varies considerably from one angler to the next. By defining different angler types, it is possible to show how net economic values vary across user groups.

This study is based on the Angler Preference Survey administered by the Montana Department of Fish, Wildlife and Parks in the summer and fall of 1986. A description and analysis of survey findings with respect to angler characteristics, preferences, behavior and attitudes is provided in a companion study by Allen (1987). The latter includes a discussion of angler perception of river and fisheries management policies.

Methods

Net economic values are defined here as net willingness to pay. The latter is the net difference between the maximum an individual would be willing to pay before foregoing the use of a resource or commodity and the amount they must actually pay. Many federal agencies are required by the U.S. Water Resource Council Principles and Guidelines to use the net willingness to pay concept to measure the economic value of both marketed and nonmarket goods.

The basic approach used to estimate net economic values was the contingent valuation method (CVM). This is one of two basic methods that are recommended by the Water Resources Council for valuing recreation. (The other is the travel cost model.) The CVM method uses survey techniques to ask people about the values they would place on nonmarket commodities if markets did exist. Two specific versions of the CVM method were employed: open-ended and dichotomous choice. In the open-ended CVM approach individuals were asked "What is the maximum increase in your actual trip cost you would have paid to fish the (name of river fished) instead of having to fish elsewhere______(dollars)?" In the dichotomous choice approach, individuals were asked "...would

you still have made the trip if your share of expenses had been (dollar bid amount) more? ___yes ___no". In the latter, the bid amount was randomly varied from $1 to $500 and respondents indicated a yes or no response. Similar questions were developed to identify net economic values for doubled chances of catching large trout or more trout.

The analysis of the open-ended CVM is fairly simple; one merely calculates the mean of the dollar responses. One problem with this method is in interpreting extreme values: either zero response or very high values. Another problem is that respondents may find it a difficult question to answer. By contrast, the dichotomous choice question requires only a yes or no to a given dollar amount. The disadvantage of the dichotomous choice approach is that a fairly complex analysis is required in order to determine net willingness to pay. Basically, the data is used to estimate how the probability of a "yes" response varies with the bid amount and other explanatory variables such as income. The analysis reported below assumed a standard logistic probability distribution function; accordingly the specific dichotomous choice model estimated here is conventionally referred to as a logit model. The mean net willingness to pay is derived by integrating the logit function from zero to the upper limit of sample bids (in this case $500).

The basic method used to determine angler types was a cluster analysis. The survey included a list of 17 possible reasons for fishing a specific river on the angler's most recent trip. The reasons include "to catch large trout", "to catch many trout", "to be with my family", "to experience solitude", etc. The respondent ranked the reasons on a four interval scale from "very important" to "not at all important". The cluster analysis is a multivariate statistical technique; here it was used to identify the most distinct subgroups of anglers based on their reasons for fishing.

Data

The data for this analysis was based on a sample of resident and nonresident license holders. A total of 2672 questionnaires were mailed in the summer and fall of 1986. A total of 2171 completed questionnaires were received or a response rate of 81 percent. This is a very high response rate for a mail survey and indicates that trout anglers have a keen interest in Montana fisheries.

Results

The cluster analysis is reported in detail in Allen (1987). The cluster analysis showed that the most clearly defined subgroupings were with four angler types. The groups included two generalist types, an occasional angler group and a specialist group. Members of the specialist groups are twice as likely to be fly fishermen compared to the other three groups (60 percent versus 30 percent) and have higher income levels. Occasional fishermen are twice as likely to catch no fish as the other groups and fish one-third as much. The two generalist types differ mainly in that one is more oriented toward the outdoors and solitude while the other is more oriented toward the fishing itself.

Logit functions were estimated for each cluster (angler group) and separately for each river. In general the probability of a "yes" response was found to be significantly correlated to the standard economic demand variables (price (bid), income, quantity (number of trips and days fished per trip), measures of taste and preference (reasons for fishing, how much the angler prefers fishing to other activities, etc.) and measures of angler success (number of trout caught). In addition, the sign of the estimated coefficients were generally consistent with the economic theory of demand. For example, the higher the income level of the respondent, the more likely a "yes" response to a given bid level. The high significance level of the estimated parameters, the large number of significant variables and the theoretical consistency of the signs indicate the logit model provides a good specification for the dichotomous choice responses. In general, the river specific sample sizes were around 100 to 150 respondents. However, functions could not be estimated on several rivers due to limited samples.

The estimated net economic values varied dramatically across cluster group for the logit analysis. As one might expect, mean value per trip increases the more specialized and committed to the sport the angler is. For example, with respect to mean values for the current trip, the occasional user has a net value per trip of only $7.56, while the generalist groups are at $91.03 and $117.07 and the specialist group has a value of $170.28.

The open-ended CVM responses also show large differences across clusters. However, the open-ended CVM analysis was not particularly successful in that 40 to 45 percent of all respondents indicated a zero willingness to pay. It was found that many individuals who said they would pay "zero" on the open-ended CVM in fact responded "yes" when faced with a specific amount in the logit portion of the survey. One possible interpretation is that the open-ended CVM has not successfully elicited responses for a large subsample of survey respondents. This may be in part because of the difficulty of answering the open-ended question. Because of these problems, not much credibility can be placed on the open-ended estimates.

The logit estimates also varied considerably across rivers, from $58 per trip on the Bitterroot to $228 on the Madison. The mean net economic value per trip averaged across 17 rivers is $117. A limitation of the analysis is that on several rivers, the highest bid asked (generally $500) was not sufficiently high to identify the point where the probability of a "yes" response is driven down to near zero. This was especially a problem on the Big Hole, Beaverhead and Gallatin, where a high proportion of respondents were willing to pay even the highest bid asked. This problem was compounded in several cases by the limited sample size.

Logit values were also calculated for angler net willingness to pay for changes in fishery quality. One finding was that anglers were willing to pay significantly more for doubled chances of catching large trout on 60 percent of the sample rivers. By contrast, anglers were willing to pay significantly more for doubled catch on only around 15 percent of the rivers.

In order to validate the logit estimates, they were compared to results of a travel cost model of Montana stream fishing (Duffield, Brooks, and Loomis, 1987). The data base for the latter study was derived from a 1985 survey of Montana anglers. The travel cost model uses observations of travel distance (and costs) as a measure of price and actual observed recreation trips as a measure of quantity to statistically trace out a demand equation. The travel cost model estimate of net economic value per trip (for the same set of 17 rivers used in the logit analysis) is $122 based on angler reported travel costs. This is almost identical to the logit mean estimate of $127. There is also considerable agreement on site specific values in the two separate studies. The Pearson product-moment correlation coefficient for the sample of 17 rivers is .73; this indicates that the logit and travel cost model values for these sites are highly and positively correlated. Similarly, a relatively high value for the nonparametric Spearman's correlation coefficient (.73) indicates that the two methods tend to provide a consistent ranking of sites according to net value per trip.

It would appear that the consistency of site level results provide a measure of validation for both the travel cost model and the logit CVM results. The similarity of estimates is remarkable given the very different methods and the separate data bases employed.

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 planning) are being made. The values per trip can be converted to net present values that can be used in trade-off analysis with marketed resources, such as timber, coal or grazing. The net economic values presented here are limited to the direct use values associated with Montana stream fishing resources. Accordingly, these net economic values are an underestimate of the total value associated with this resource, since indirect values (existence, bequest and option uses) have not been estimated.

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I. INTRODUCTION

This report provides contingent valuation method estimates of net willingness to pay for trout fishing on nineteen Montana rivers. The study is based on the Angler Preference Survey administered by the Montana Department of Fish, Wildlife and Parks in summer and fall of 1986. A more complete description and analysis of survey findings with respect to angler characteristics, preferences, attitudes and behavior is provided in a companion paper by Allen (1987).

The major goals of the overall study are as follows:

1. To estimate net economic value of cold water stream fishing in Montana by subgroups of trout anglers and by river. This information can be used to inform fishery management and resource allocation decisions where tradeoffs with marketed commodities must be evaluated.

2. To learn more about Montana trout fishermen, including demographic characteristics, reasons for fishing and angler preferences and beliefs. This information can serve as baseline data for future studies.

3. To learn about anglers' perceptions of possible recreational conflicts or management problems and to measure their attitudes toward potential river and fisheries management programs. Fisheries managers can use this information to review existing management policies.

4. To estimate the net economic value associated with changes in fishery quality. Specifically, to estimate angler net willingness to pay for improved chances of catching larger trout and more trout.

5. To contribute to the development of methods used by resource professionals in the analysis of recreation behavior.

The main focus of this paper is on estimating the economic values associated with trout fishing in Montana. A key issue that we have addressed is the problem of market definition. Economic theory suggests that markets are defined for relatively homogeneous commodities. In attempting to measure the value of a recreational activity such as fishing, it is therefore necessary to first define the recreation experience. Fishing, or even more narrowly trout fishing on Montana rivers, is an activity with many different styles, settings, technologies and purposes. Because of this, the fishing experience varies considerably from one angler to the next. While fishing is subjective and personally experienced, research suggests several ways to develope a reasonable number of angler "types", people who are seeking the same types of experiences through fishing (Adams, 1979). It makes sense to estimate dollar values not just for fishing, but for specific types of fishing experiences found on Montana trout streams. From the standpoint of economic theory, these types of fishing experience define relatively homogeneous commodities in the market for outdoor recreation.

Hobson Bryan's (1979) research on angler specialization paved the way for this area of research. By observing and interviewing anglers on several trout streams in Montana and Idaho, Bryan developed a typology of anglers, ranging from the occasional angler to the technique and setting specialists who do nothing but fly fish. We have identified four angler types using cluster analysis. The basic data utilized is angler response to questions listing seventeen possible reasons for choosing the river fished on the most recent trip. The detailed preference information developed in the survey was also useful in providing explanatory variables in the economic models.

Two basic methods were used to estimate net economic values: open-ended and dichotomous choice contingent valuation methods (CVM). The latter uses survey techniques to ask people about the values they would place on nonmarket commodities if markets did exist. In other words, individuals are asked to value resources or experiences contingent on the creation of a market or other means of payment such as taxes or fees. The other major approach to estimating values associated with outdoor recreation is the travel cost model (TCM). As described in a previous report (Duffield, Loomis, and Brooks, 1987), the latter method has also been applied to Montana cold water stream and lake fishing. A major issue in the economics of outdoor recreation is whether any of these nonmarket benefit estimation methodologies provide a good approximation to market values. This study provides a side-by-side application of the models for purposes of validation.

The next section of this paper provides a brief literature review and a description of the CVM and cluster analysis methodologies. The following two sections describe the estimated models and the resulting net willingness to pay. The last section provides a comparison of the CVM and TCM results.

II. METHODOLOGY

A. Definition of Economic Benefits

Economic benefits are defined here as net willingness to pay. The latter is the net difference between the maximum an individual would be willing to pay before foregoing the use of a resource or commodity and the amount they must actually pay. Net willingness to pay is the appropriate measure in applied welfare economics (Just, Hueth and Schmitz, 1982). Many federal agencies are required by the U.S. Water Resources Council Principles and Guidelines (1983) to use the net willingness to pay concept to measure the economic value of both marketed goods (e.g., agricultural commodities, hydropower, etc.) and non-marketed resources (e.g., recreation) in benefit cost analysis or evaluation of federal actions. When performing natural resource damage assessments, the U.S. Department of Interior regulations require that the calculation of economic values gained (or lost) to society by measured in terms of net willingness to pay (U.S. Department of Interior, 1986).

In general, use of the net willingness to pay measure provides a theoretically consistent measure of the allocative impacts of policy choices. The recreational value estimates developed here can be used to evaluate tradeoffs with marketed commodities and to identify the net effect of a given resource allocation decision. Specific applications might include evaluating a proposed hydroelectric project. The implicit criteria is economic efficiency: maximize the net present value of a given resource from the standpoint of the whole society.

Net willingness to pay is distinct from recreation expenditures. The latter information is useful for defining the relationship between the recreation activity and the local or regional economy. For example, one might estimate the number of jobs or the personal income generated by a given recreation resource. This type of regional economic analysis may also be relevant for policy decisions, but only if one is willing to deviate from strict economic efficiency and include distributive or other considerations. Such an analysis is beyond the scope of this project.

B. Contingent Valuation Methods: Literature Review

The two most widely used methods for estimating net willingness to pay for outdoor recreation are CVM and TCM. These are also the two general methods recommended by the U.S. Water Resources Council for valuing recreation in federal cost benefit analysis. The travel cost approach estimates demand functions for a given site from observed visit rates corresponding to the supply prices (travel costs) from origins surrounding the site. A regional TCM application to Montana fisheries is described elsewhere (Duffield, Loomis and Brooks, 1987).

In the CVM approach individuals are directly surveyed as to their willingness to pay for the services of a given resource contingent on the existence of a hypothetical market situation. This is a very flexible technique and has been applied to a wide range of environmental and resource issues including air and water quality changes, scenic beauty, and wildlife (Cummings, Brookshire and Schulze, 1986). The only limitation of the method is the ability of the researcher to frame understandable questions and the willingness and ability of the respondent to accurately value the good or service.

Bishop and Heberlein (1985) have described six key methodological choices in a CVM application: 1) target population, 2) product definition, 3) payment vehicle, 4) question format, 5) method of analysis, and 6) supplemental data. With respect to population, the choice generally hinges on what types of values are being addressed. TCM by necessity and often most CVM focus on the values associated with direct use; accordingly the target population is direct users (eg. hunters, fishermen etc.). However, there is a considerable literature on indirect or nonuser values such as option, existence and bequest values (Fisher and Raucher, 1984). Estimating the latter typically implies a regional population addressed through a household survey (for example, Sutherland, 1982).

Product definition and payment vehicle are two key features of the hypothetical market. The resource or service at issue must be clearly described to the individual. This may be difficult for valuing changed conditions, such as the specific physical characteristics of a proposed hydropower installation (Duffield, 1984) or visibility impacts of a coal-fired plant (Rowe, D'Arge and Brookshire, 1980). Visual aids such as photos and charts have been used (Desvousges, Smith and McGivney, 1983). A problem is that the specific information given the individual can bias the response. A general approach is to vary the level of information and test for benefit sensitivity (Brookshire, 1976).

Just as for the product definition, it is generally agreed that a payment vehicle must be specified for the respondent. Mitchell and Carson (1981) suggest two criteria for an appropriate vehicle: realism and neutrality. Taxes or site fees may be means of payment that could be realistically employed for public resource use. However, responses to such vehicles may be more influenced by dissatisfaction with high taxes or aversion to fee fishing (for example) than by the value placed on the resource. A vehicle that has been used successfully for hunting studies is an increase in trip expenses. Hammack and Brown (1974) used this approach in an innovative study of waterfowl hunting. As Bishop and Heberlein (1985) note, this is an appealing vehicle for such studies since respondents are familiar with paying expenses and expenses appear relatively neutral compared with other vehicles such as hunting fees.

The major methodological choice in a CVM study is the question format or value elicitation procedure. The latter also usually implies the type of analysis that will be undertaken. There are numerous variations, but four general approaches for asking CVM questions can be identified: open-ended questions, bidding games, dichotomous-choice questions, and contingent-ranking techniques. It is beyond the scope of this paper to review these methods in detail (for a recent review see Cummings, Brookshire and Schulze, 1986); however, the key features of each will be briefly described.

The open-ended is the simplest approach: respondents are asked their maximum willingness to pay for use of the given resource. This approach can be utilized in a mail survey and is therefore low cost. Interpretation is also fairly straightforward, requiring only the calculation of the mean offer amount. One difficulty can be in interpreting extreme values. For example, responses of "zero" may indicate a protest response against the payment vehicle or even against the idea that a given resource has a finite value. Generally follow-up questions are included that attempt to identify the reasons for a zero response. Similarly, it is often not clear what credibility can be attached to extremely high values. In general, the limitation of this approach is that respondents may not have sufficient information or stimulation to fully consider the value they place on the resource.

The most widely used alternative to the open-ended format is a bidding game, where interviewers ask the respondent for a yes or no response to a specific bid amount. If the respondent is willing to pay, for example, $10, the bid is raised in increments until the maximum willingness to pay is determined. Stoll (1983) argues that such an iterative approach is necessary to force individuals to engage themselves in the hypothetical market and continuously reconsider their willingness to pay. There is some disagreement in the literature as to whether the two approaches in fact yield consistently different results. Cummings, Brookshire and Schulze (1986) conclude that open-ended results are generally lower. However, Bishop et al (1984) compared open-ended questions and bidding games and found no significant difference. There are two major limitations to the bidding game approach. It is costly in that it requires face to face or telephone interviews. Secondly, many studies have shown a positive correlation between the initial (and arbitrary) bid and the final maximum bid. Empirical evidence of this starting point bias has been presented by Mitchell and Carson (1981), Duffield (1984), and Boyle, Bishop and Welsh (1985).

The dichotomous choice approach combines some of the better features of both open-ended and bidding. In dichotomous choice, the individual is faced with a single specific dollar bid and (like bidding games) response is a simple market-like yes or no. The dollar bid amount is systematically varied across respondents. Since the format is non-iterative (like the open-ended), it is amenable to mail survey and is therefore relatively low cost. This approach is relatively new, but has been successfully applied to valuation of hunting permits (Bishop and Heberlein, 1979), boating and scenic beauty (Boyle and Bishop, 1984), reservoir recreation (Sellar, Chavas and Stoll, 1985) and beach recreation (Bishop and Boyle, 1985). The major disadvantage of dichotomous choice is that analysis is more complex. This method exploits some of the considerable advancement in methods for modeling discrete choice over the last decade (Amemiya, 1981). Econometric models, such as the logit model are used to predict the probability of accepting an offer as a function of the stated bid and other socio-economic variables (as detailed below). There is some debate over the appropriate measure of central tendency (Hanneman, 1984 and Cameron, 1987) and issues regarding truncation and functional form (Bishop, Heberlein and Kealy , 1983; Boyle and Bishop, 1984; Boyle, 1985; Welsh, 1986; and Sellar, Chavas and Stoll, 1986).

A related method is contingent-ranking. Here the respondent ranks alternative combinations of environmental resources and monetary outlay. This method also requires the application of econometric techniques (Desvousges, Smith and McGivney, 1983).

As for any model of economic demand, the CVM estimates are generally improved and informed by including at least the conventional demand shifter variables such as income, price and availability of substitutes, and measures of tastes and preference. This is most critical for the dichotomous choice case, where incomplete specification could lead to omitted variable bias. As noted, for the open-ended and bidding game methods, analysis amounts to taking the mean of the maximum willingness to pay bids. However, for these two methods it is conventional practice to estimate "bid equations" that relate willingness to pay to demand shifter variables to help establish the credibility of responses.

As is obvious from this review of the CVM literature, there are advantages and disadvantages to each method. The open-ended and dichotomous choice methods were selected for this study. Major considerations were high interview cost and starting point bias associated with the bidding game format. In addition, recent research indicates that the open-ended and dichotomous choice models can provide fair approximations to market transactions (as developed in the following section). The specific methodologies employed (including the cluster analysis) are described in greater detail below.

C. Validation of Benefit Estimates

An important issue with respect to CVM estimates of net willingness to pay is whether they are accurate compared to real markets. This question has been addressed in several ways. From a theoretical standpoint, there is a considerable literature on the likelihood and direction of bias in subject CVM responses (for example, Brookshire, 1976). Rowe, D'Arge and Brookshire (1980) noted three main types of potential bias: strategic, information and hypothetical. The first of these could result from a respondent trying to strategically influence results to favor his preferred outcome. A number of studies have attempted to test for strategic behavior; the general finding is that it does not appear to be a problem (Thayer, 1981). However, as noted previously, researchers have noted sensitivity of benefit estimates to information provided the respondent and to starting bids (for a bidding game format). Hypothetical bias would imply a problem with the basic working assumption of CVM: that the hypothetical market institutions described to the respondent are not sufficiently real to generate valid responses. The presence or absence of the latter is not readily identified.

An alternative to attempting to measure and identify bias through internal consistency of subject responses is to compare CVM results to cash transactions. The earliest and best known of these experiments compare CVM responses (logit dichotomous choice) to the response to cash offers for goose hunting permits on a Wisconsin wildlife refuge. The average cash value accepted for a permit was $63 compare to the average market value of $101 for the corresponding CVM for willingness to accept. A CVM estimate for willingness to pay for permits was $21. A similar experiment was conducted for deer hunting (Welsh, 1986) in Wisconsin. In this case cash values for willingness to pay were $25 compared to $31 for the CVM. A number of other similar studies are reviewed by Anderson and Bishop (1986). The general conclusion from the comparison of simulated markets to CVM is that respondents attempt to give their true values. In some cases CVM appears to understate and in some cases overstate the market value. The degree of difference in general is small. Based on these results, it appears that one can have confidence that the willingness to pay responses derived from CVM methods are a fair approximation to the responses that would hold in real markets.

Another approach to validating CVM is to compare the results to those from other methods in a side by side application. For example, a study by Brookshire, Schulze, Thayer and D'Arge (1982) compared the results of a hedonic property value approach to a CVM survey. The comparison was between property value differentials as a function of air quality and CVM estimates of the value of a reduction in air pollution. The finding was that the stated WTP was significantly less than the property value differences. Most comparisons have been made to TCM estimates (Bishop and Heberlin, 1979; Desvousges et al, 1982; Duffield, 1984; and Seller, Stoll and Chavas, 1985). Some analysts have confidence in the TCM estimates since they are at least in part based on observed behavior. The general finding has been that TCM and CVM are in the same range. Often the comparison is sensitive to how time is valued in the TCM analysis.

In general, research on the validity of CVM methods is encouraging. Willingness to pay measures may not be perfectly accurate, but appear to be close to the values derived by other methods and in cash transaction experiments.

D. Dichotomous Choice Study Design

In dichotomous choice, individuals respond "yes" or "no" as to their willingness to pay a specific cash amount for a specified commodity or service (eg. $20 to fish on the Madison River). The proportion of respondents answering "yes" to a given bid level is utilized in a statistical model relating the probability of a "yes" to explanatory variables such as the bid amount, tastes, income, and other standard demand shifter type variables. The specific model is:

1) $P=F(x)$

where P is the probability of buying, x is a vector representing explanatory variables, and F(.) is a cumulative probability distribution function. In the probit model, F(.) is the standard normal cumulative density function (cdf) and in the logit model F(.) is the cdf of a standard logistic variate, or:

2) $P=(1+e^{a+bx})^{-1}$

where a is the constant term or intercept; b is the vector of regression coefficients. The equation to be estimated can be derived as:

3) $L=\ln(P/1-P)=a+bx$

where L is the "logit" or log of the odds of a "yes". Hanemann (1984) has shown that the specific linear logit formulation in Equation 3) is consistent with the hypothesis of utility maximization. A log formulation is not consistent but has been widely used in the literature:

4) $L=\ln(P/1-P)=a+b\ln(x)$

This formulation can of course be rewritten to make the vector of explanatory variables explicit:

5) $L = \ln(P/1-P) = a + b_1x_1 + b_2x_2 + \ldots + b_nx_n$

where the explanatory variables include the bid amount and typical demand shifter variables such as quantity (number of trips for the case at hand), income and measures of taste and preference. In a recent paper (1986), Sellar, Chavas and Stoll have shown that an inverse demand curve can be derived from 5) and have explored the implications of functional form for consistency with economic theory. Their basic finding is that a linear logit specification was found to be inappropriate by implying an upward sloping demand curve. Although other specifications may also be possible, a log-linear specification was found to be superior in terms of meeting the theoretical restrictions. Given these findings, we have chosen to estimate a logit model of the log-linear form as in equation 5).

For the demand function to be downward sloping with respect to quantity consumed, Sellar, Chavas and Stoll also show that the estimated coefficient on trips must be negative and have an absolute value less than one. (This restriction on empirical findings will be referred to below in the results section.)

Equation 5) is generally estimated with maximum likelihood techniques. That is the approach taken here; the Probit program in $SPSS^X$ was used to estimate the logit model. (The probit model is not reported below; the logit is computationally more convenient and a subsample of cases showed very little difference in estimates between the two statistical models.)

Once the estimated model parameters are available, either the mathematical expectation (mean) of maximum willingness to pay or the median of the distribution (where the probability of acceptance equals .5) can be used as a measure of welfare surplus. The specifics of these calculations will be briefly discussed.

Note that the estimated equation 5) can be solved for P as in equation 2). The latter can be evaluated at the means of the untransformed independent variables to estimate a bivariate equation with the probability of acceptance (P) as a function of the bid amount (x_1). This function can easily be graphed with probability on the vertical axis and bid on the horizontal. At low bid amounts, the probability of acceptance is high and declines (asymptotically approaches zero) as the bid amount increases. The median is obtained by integrating the logit function from a bid value of 0 to some upper limit. Since the mean corresponds to the area under the two dimensional curve, it has the intuitive interpretation of probability times bid amount. This is of course consistent with the definition of a mathematical expectation or mean. Estimation of the median is simpler: the bivariate estimate of 5) is simply solved for P=.5. (Note that ln(P/1-P) evaluated at P=.5 is ln(1) or zero; accordingly the median is equal to the calculated intercept over the slope coefficient on bids.)

There is currently an unresolved debate in the economics literature over which of these measures of central tendency is most appropriate. Hanemann (1984) suggests that the median is more robust. However, in most applications results have been presented in terms of the mean (for example, Bishop and Heberlein, 1979 and Seller, Stoll and Chavas, 1985). It can be noted that in the use of other methodologies such as open-ended CVM and TCM, the mean is the reported estimate, not the median. Both the median and mean will be reported below. Cameron (1987) has recently developed an alternative model for interpreting qualitative response data where there is continuous information on the choice threshold (here, the bid level). It is beyond the scope of this study to provide an application here of Cameron's censored logistic regression approach. However, it can be noted that the medians presented below for the conventional logit model correspond to the means (and medians) in Cameron's approach.

It should be noted that there is no clear basis for choice of the upper limit of integration in the estimation of the mean. We have chosen to truncate the estimate at two alternative levels: 1) at the maximum bid utilized in the sample and 2) at the maximum bid for which a "yes" response is received. The argument for 1) is that extrapolating beyond the range of the sample data is inappropriate on statistical grounds. 2) is a more conservative choice and provides information on the sensitivity of the estimate to this methodological choice. It may be noted that truncation is not an issue if benefits are not sensitive to the upper limit. If benefits are sensitive, it may be an indication that the range of offer bids in the sample was not sufficiently high. In other words, one will generally want to have sufficient high bids to clearly establish the point at which probability of a "yes" goes to zero.

Three specific logit questions were developed for this study. One question addressed the willingness to pay for current conditions, and the other two willingness to pay to double the chances of catching larger trout and to double the overall catch respectively. A complete copy of the questionnaire is in Appendix A; the economics questions are in Section III. As a lead in to the CVM questions (following Hammack and Brown, 1974), respondents were asked what their total trip expenditures were for their most recent trip. They were also asked if the trip was worth more than they spent. The dichotomous choice CVM on current conditions follows as: "If YES, would you still have made the trip if your share of expenses had been (bid amount) more?" (yes/no response) The bid amount was randomly varied across questionnaires and ranged from $1 to $500 in 27 specific amounts (1,2,4,5,6,8,10,15,18,20,22,25,30,35,40,45,50,60,70,80, 100,150,200,250,300,400,500).

The phrasing of the second question is: "Imagine that everything about this last trip were the same except that your chances of catching a large trout was twice as great AND that your trip costs were (bid amount) more than your actual costs. Would you still have made the trip under these circumstances?" (yes, no response). The bid amounts used were the same as for the first question. The third question is identical except that respondents were asked to suppose that they caught "twice as many trout".

E. Open-ended CVM Study Design

The design and interpretation of the open-ended questions is more straightforward. Respondents are directly asked their maximum willingness to pay. The mean and median willingness to pay are directly estimated from the distribution of responses. The specific questions are again listed in Appendix A and pursue the same issues as the dichotomous choice. As an example, the open-ended CVM for current conditions (which follows the corresponding dichotomous choice question (Appendix A)) is: "What is the maximum increase in your actual trip cost you would have paid to fish the (name of specific river fished) instead of having to fish elsewhere?" _____________ Dollars

After the open CVM question, the following is asked to identify protest responses: "If your answer was zero, could you briefly explain why?" The questions on large trout and doubled catch are similar (Appendix A).

In order to establish the credibility of the open-ended responses, a bid equation of the following form is generally estimated:

6) $Y = A + BX$

where Y is the respondent bid, A is an intercept term, B is a vector of estimated parameters, and X is a vector of explanatory variables including the conventional demand shifter variables such as income and tastes and preference. When a quantity variable is included, 6) may be interpreted as an inverse demand function. The equation is estimated with OLS regression and the functional forms investigated can include linear or log-linear.

The key CVM methodological choices can be summarized as follows: target is the user population (intrinsic values are ignored in this study); the product is a fishing experience; the payment vehicle is trip expenses; question formats are dichotomous choice and open-ended.

F. Market Segmentation Study Design

As noted in the introduction, a central goal of this study is to identify specific angler subgroups and to investigate how economic values vary across experience or angler types. A theoretical basis for angler types has been developed by Bryan (1979). Both canonical analysis and cluster analysis have been previously applied to water-based recreation to define recreation subgroups (Ditton, Goodale and Johnsen,1975; Adams, 1979). Cluster analysis is utilized in this study. The cluster analysis methodology is described in the companion paper by Allen (1987) and will be briefly summarized here.

Included in the survey (Appendix A) is a list of 17 possible reasons for fishing a specific river on the angler's most recent trip. The reasons include "to catch large trout", "to catch many trout", "to be with my family", "to experience solitude", etc. The respondent is asked to rank the reasons on a four interval scale from "very important" to "not at all important". These responses indicate the types of experiences anglers were seeking. Although responses are for a specific river, they indicate the general type of experience the angler gets from fishing.

A cluster analysis package (SPSSx) can be used to identify subgroups of anglers based on the reasons for fishing. The analyst must select the desired number of clusters in running the statistical package. In choosing the cluster number, a consideration is that the smallest subgroup include sufficient size for economic analysis (at least 100). The main criteria is that the clusters make sense conceptually and that the subgroups of anglers defined are distinct. This is in part determined by examining cluster centers (or mean values) for each of the reason values and also the means of other descriptive socio-economic variables (such as income, age, residence, etc.) for the defined subgroups. Well-defined clusters will have distinct differences across both reasons for fishing (eg. large trout versus many trout, solitude versus family, etc.) and across demographic characteristics.

From the standpoint of the economic analysis, the key output of the cluster analysis is a cluster membership ID variable that is used to segment the Montana trout fishing market into subgroups of experience or angler types. The CVM analysis described above is then preformed for each of the market segment subsamples. The working hypothesis is that economic values will be significantly different across subgroup and consistent with the socio-economic and preference variables that characterize the experience types (eg. income, residence, age, etc.).

III. DATA

The sample frame was a list of residents and non-residents who purchased Montana fishing licenses and were contacted in Montana Department of Fish, Wildlife and Parks annual fishing pressure survey in 1985. The desired sample size was approximately 200 people for each of 20 rivers.

An adaption of Dillman's (1978) Total Design Method was used to conduct the mail survey. A questionnaire booklet (Appendix A), cover letter, and an addressed, stamped return envelope was mailed to the sample. A postcard reminder was sent one week later. Two weeks after that, a follow-up letter and second copy of the booklet was sent to people who had not responded. This method typically yields response rates of over 70 percent. A pretest indicted that the questionnaire, while lengthy and detailed, was clearly understood by respondents and that respondents would take the time to participate in the survey.

The available DFWP angler data did not allow us to meet the target sample size on many rivers. This was offset somewhat by the excellent rate of response, which averaged 81 percent across rivers. Table shows the number of questionnaires mailed and returned by river. The uniformly high response rates indicate not only that the survey methodology could be implemented, but that trout anglers have a keen interest in fisheries management issues.

An overview of the descriptive variables in the survey is provided in Allen (1987).

IV. ESTIMATED EQUATIONS

A. Complete Sample: Logit

The estimated logit equations for the complete sample (approximately 1750 observations with complete information) are presented in this section. The equations (corresponding to the general specification presented above as equation 5) are shown in Table 2. Included variables were all significant at the 90 percent level or better. It should be noted that the specification is log-linear as noted above. The log variable transformation is not shown explicitly in Table 2.

In almost every case the theoretically correct sign on the regression coefficient occurs. For example, coefficients on bid amount are consistently negative (higher bid price implies a lower probability of a yes response) and very precisely estimated. Similarly, INCOME is positive and significantly correlated to willingness to pay in all cases. The sign on the quantity variable (STRPSHM or separate trips from home to the given river destination) is consistently negative and meets the theoretical constraint suggested by Seller, Chavas and Stoll (absolute value less than one). The coefficient on DYSFSHED is consistently positive (the longer the trip, the more probable a yes response). Similarly, the longer the angler fished per day (HRSDAY), the more likely a yes becomes.

Measures of angler preferences were also successful: the less the respondent liked to fish (COMPARE) and the worse the given river compared to other rivers (TCOMPARE), the less probable a yes response becomes (negative correlation). Several of the reasons for fishing were also used for preference measures: to catch many trout (REASON03) and to catch large trout (REASON06). These variables were significant only for one case: equation 9) for double catch of large trout. In this equation REASON06 is significant and of the right sign (the less important this reason, the less likely a yes response).

Measures of fishing success were the only variables with unexpected signs. For the current conditions equation 7), the sign on number of large trout caught (LRGCOT) is positive as expected. However, one would expect that the sign might have the opposite value for doubling the catch of large trout (people who catch fewer large fish would pay more to catch some). In fact, the sign is positive in both equation 8) and 9) for both LRGCOT and TROUTCOT (trout catch). This suggests that anglers who are already catching relatively more trout and more large trout are also most willing to pay to increase their catches.

It was also found that if the river was not the only river fished on the given trip (RVRMAIN) and if the trip had more purposes (REASON) than fishing (visiting relatives, business, etc.), a yes was more probable. This is an interesting result in that an a priori hypothesis is not obvious. Since the length of time actually spent on the river has been corrected for (HRSDAY AND DYSFSHED) there is no obvious reason to expect that fishing experienced as part of a multipurpose or multidestination trip would be valued more or less highly. The result is potentially important with respect to comparison of CVM and TCM estimates. Where possible, TCM models are always estimated on a subsample of single destination and single purpose trips in order that trip costs can be interpreted as the supply price for the given experience. If in fact anglers on multiple-destination and multiple purpose trips value a comparable fishing experience more highly than the TCM subsample, one would expect TCM estimates to generally fall below CVM. In addition, such a result would suggest that one can conservatively apply TCM mean estimates to the entire direct user sample in developing total site values. Further analysis may indicate other underlying reasons for this correlation; for example, typically multiple-destination and multiple-purpose trips will be more likely for non-residents traveling from longer distances.

In general the high significance level of the estimated parameters, the large number of significant variables, and the theoretical consistency of the signs indicates the logit model provides a good specification for the dichotomous choice responses.

The goodness of fit statistic available on the SPSSx probit package is the Pearson chi-square. The latter is only calculated for grouped data. A rule of thumb is that the chi-square is not reliable if more than 20 percent of the cells have expected frequencies of less than 5. Given this limitation, only a bivariate case (with data grouped on the bid variable) can be reliably interpreted. For the bivariate case, the chi-square statistics were uniformly quite large, indicating that the null hypothesis (that the sampled distribution matched the theoretical logit distribution) should be rejected. It is not clear to what extent the fit is improved in the multivariate model reported here. In any case, the complete sample aggregates across very different rivers and angler subgroups. It may be that attempting to develop a single equation model could require river specific dummy variables and angler cluster membership. As will be shown below, when the data is disaggregated by river and cluster, the chi-square statistic in many cases indicates a good fit to the data.

B. Complete Sample: Open-ended CVM

The bid equations for the complete sample open-ended CVM are shown in Table 3. The specification is log-linear and again the log transformation is not made explicit. Because the log model excludes zero bid observations, the overall sample varies from 880 to 965 for the three equations. The overall explanatory power of the model is fair (adjusted R square of .33 to .36). As for the logit model, a large number of independent variables were highly significantly correlated to the bid amounts and the signs were generally of the correct sign. All of the variables that were significant in the logit model were significant in the open CVM including quantity measures and income. In addition, several other variables came in significant in one or more equation.

The measure of days per year the angler fished (DYSFSHYR) was positively correlated to the bid amount. Older anglers (AGE) and those with greater experience on a given river (YRSFSHRV) stated generally lower bid amounts. Interestingly, those with higher total catches were again willing to pay more, but those who kept more trout (TROUTKPT) were willing to pay relatively less. This is an interesting result and is consistent with results from the cluster analysis. As will be noted below, the subgroup of anglers most interested in catching fish for food had average willingness to pay much lower than other subgroups.

These results indicate that the open CVM bids are generally consistent with economic theory and can be in part explained by conventional demand function variables. Because of the sequence of questions in the survey instrument (with open CVM following the dichotomous choice), a second set of equations (Table 4) were estimated that included the logit bid. The question is whether if the logit bid is relatively high (say $200 rather than $20), the respondents open CVM is also relatively high. In other words, the logit bid may be causing something like starting bid bias in a bidding game format.

The basic finding is that open CVM bids are significantly and positively correlated to the random logit bids. For example in the equation for current conditions (13), the coefficient on the corresponding logit offer bid (DOLAMT) is +.106477. Since the specification is log-linear, this parameter represents the elasticity of the open CVM bid with respect to the logit bid. In other words, a one percent increase in the logit offer bid results in a .11 percent increase in the open CVM bid. As a specific example, if the logit bid is $300 instead of $10, on average the open CVM will be 44 percent higher. While significant, it can be noted that the elasticity on most other variables is much higher (for example, income is .28 and days fished is .47).

One implication of this finding is that if both open CVM and other question formats are used on the same survey instrument, it may be better to have them in separate sections rather than grouped by issue (eg. larger trout). On the other hand, grouping undoubtedly makes the survey less burdensome for the respondent.

C. <u>Logit Equations by Cluster</u>

The cluster analysis is reported in detail in Allen (1987). However, the basic cluster types will be briefly characterized here. The cluster analysis showed that the most clearly defined subgroupings were with four angler types. Based on the cluster type characteristics, the groups include two generalist types (resident and non-resident), an occasionalist group and a specialist group. A listing of the groups and summary characteristics are provided in Table 5. As an example, the specialist group is twice as likely to be fly fishermen as the other three groups (60 percent versus around 30 percent) and have higher income levels (68 percent of all respondents with incomes over 100,000 are in this group). Occasional fishermen are twice as likely to catch no fish as the other groups and fish one-third as much. In general, the group characteristics suggest fairly well defined groupings as developed in detail in Allen (1987). Interestingly, clustering on reasons for fishing resulted in a grouping of angler types that is quite consistent with Bryan's (1979) theoretical model.

Equations for each of the clusters and for the three bidding questions are presented in Tables 6, 7 and 8. As for the complete sample, variables included are significant at the 90 percent level or better. In general, all variables except catch again have the expected sign. In all cases where it is significant, the quantity variable (STRPSHM) satisfies the theoretical constraints. Perhaps due to smaller sample size, fewer variables were found to be significant (five to eight) compared to the complete sample where nine to eleven variables were significantly correlated to the probability of a yes response.

Bivariate equations were also estimated in order to examine the goodness of fit (chi-square statistic). The null hypothesis was rejected in six of twelve cases. However, in several of the estimates the chi-square was very small and had a probability as high as .50 to .90, indicating an excellent fit to the data. In at least several of the cases where the null hypothesis is rejected, the rule of thumb for cell size is exceeded. Again, it is also unclear how much the multivariate model improves the fit. It would be useful to develop additional goodness of fit information for model evaluation.

Based on the t-statistics for the estimated coefficients, number of significant variables, and theoretically consistent signs, the logit cluster estimates compare quite favorably with other dichotomous choice models reported in the economics literature.

D. Open CVM Equations by Cluster

Open CVM bid equations by cluster are summarized in Tables 9, 10, and 11. The results are comparable to those for the complete sample in terms of significance level, signs and overall explanatory power of the models. It is interesting to note that generally the models for the generalist and specialist subgroups have twice the explanatory power of the occasional user subgroup response. This may indicate that more committed anglers are better able to value their experience.

E. Logit Equations by River

The estimated logit equations by river are listed in Table 12 for the current conditions bid question. The large trout and doubled catch bid question equations are listed in Tables 13 and 14 respectively. The estimates are similar to those for cluster and complete samples. Generally fewer variables are included in these estimates (two to five significant variables).

The sample sizes for the logit estimates by river are listed in Table 15. Two of the rivers, Upper Clark Fork and South Fork of the Flathead, had insufficient observations (29 and 11 responses respectively) for the maximum likelihood estimate to converge. The next smallest samples were for the Smith (44 to 46 observations), Boulder (67 to 69), Kootenai (70 to 73) and Rock Creek (72 to 78). All other rivers had sample sizes of around 100 to 150. It should be noted that the sample sizes by river vary across bid equation depending on the specific variables included and the number of missing observations for each of those variables. These sample sizes are comparable to those reported in the literature. For example, Sellar, Stoll and Chavas (1985) report logit estimates for four sites with samples of 70,74,47 and 15. No variables were found to be significant for their smallest sample and one to two significant (95 percent level) correlations were found for the larger samples. Bishop and Heberlein (1979) reported samples of around 200 and one significant variable.

The sign of the included variables reported in Tables 12, 13 and 14 generally correspond to the theoretical expectation. All bid variables are negatively correlated with the probability of a yes response and are highly significant. Where significant, the coefficient on quantity (STRPSHM) is in every case negative and less than one in absolute value. In short, the logit estimates compare favorably with others reported in the literature.

In order to obtain a goodness of fit statistic for the river specific estimates, bivariate (only one independent variable, the bid amount) equations were also estimated. The chi-square statistic is used to test the hypothesis that the observed distribution (of yes responses) matches the theoretical logit distribution. The calculated chi-square was found to be greater than the critical value (5 percent level) for only eight of the total 51 river specific equations. In other words, in most cases the bivariate logit model appears to provide a good fit to the data at the river specific level. However, because of the relatively small river-specific samples, the chi-square calculations typically include a large number of cells with less than 5 expected observations. In general the chi-square is not reliable if there are a large number of cells with few observations. All of the eight cases where the null hypothesis is rejected have a number of cells with less than five responses.

F. <u>Open CVM Equations by River</u>

Open CVM equations by river are reported in Tables 16,17 and 18. The functional form for all equations is log linear; the log transformation is, however, not shown explicitly in the variable listing. Because the log transformation is undefined for values of zero and because a large share of open CVM bid responses were zero, the number of observations reported by river is somewhat lower than for the logit model. In general the results of these bid equations by river are similar to those for the complete and cluster samples. The bid equations show moderate to high explanatory power and the significant variables generally have the theoretically correct signs. These results indicate that the non-zero open CVM responses are generally consistent with economic theory.

V. BENEFIT ESTIMATES

A. Logit: Complete Sample

Net economic values per trip based on the complete sample logit estimate are summarized in Table 19. The mean value for current conditions is $90.74 based on a sample of 1751 responses. This estimate is comparable to the net value per trip based on a regional travel cost model as reported in Duffield, Loomis and Brooks (1987). The latter average value per trip based on actual trips (Gum and Martin approach) is $54 for standard cost and $116 for reported travel costs. A more complete comparison of values for different methodologies is provided in section VI. below.

Complete sample logit mean values for doubling catch of large trout and doubling trout catch are somewhat higher than the $90 mean for current conditions: $101.77 and 97.52 respectively. Because these estimates are based on the multivariate logit equations reported above, a confidence interval estimate is not readily available. The upper limit of integration for the means reported here is $500, which is the maximum observed "yes" response and also the maximum bid asked.

Table 19 also provides an estimate of median logit values. The current condition median per trip is $24.51. The median value for doubled chances of a large trout is considerably higher: $48.84. The doubled catch median is also higher: $36.07.

For the complete sample, the mean and median have divergent findings with respect to the importance of doubled catch and large trout. The mean shows little net increased willingness to pay, while the median shows nearly doubled. Both measures show that doubling catch of large trout is more valued than doubling overall catch. The mean is probably the preferred measure since it incorporates the values associated with individuals in the high end of the distribution and corresponds to the theoretical measures used in other methodologies such as travel cost.

As will be shown below, logit estimates have also been successfully estimated when the data base is disaggregated by river and by cluster. The best overall estimates for the sample may be obtained by averaging over the results by river (to avoid aggregation error). However, the preceding results for the complete sample are included here to provide additional perspective on the analysis.

B. <u>Complete Sample Results for Open CVM</u>

Table 20 provides a summary of the descriptive statistics for the open CVM bid responses. As may be recalled, open CVM net values per trip are simply the mean of the bid response. The mean for current conditions, large trout and doubled catch questions are not significantly different: $28.54, $28.82 and $26.64 respectively.

The most striking feature of the open CVM responses is the high proportion of zero responses. Approximately 40 to 45 percent of all respondents indicated that they valued the trip or changed conditions at zero (Table 20). As will be recalled, the only analytical issue with respect to open CVM is whether all extreme bid values should be included (specifically zeros and very high bids). The results in Table 20 exclude zero bids that were found, by the follow-up question on why the bid was zero (Appendix A), to be protest responses. The protest question responses were coded as shown in Appendix B. The approach taken here was to exclude the responses coded 3) "I pay taxes for use of public resources", 4) "Opposed to fee fishing" and 5) "question doesn't make sense/ I don't understand". The zero responses for other reasons appear to indicate that the individual participated in the question and had reasons for a zero response consistent with economic behavior. For example response 1) "could not afford additional cost" indicates an income constraint, etc. The total number of excluded zero responses is quite small. For the current conditions question, for example, only 72 responses were coded as 3, 4 or 5. This is approximately 7 percent of the 970 some zero responses.

At the high end of the bid range, each question had one response coded "9999". This response is excluded in Table 20. The highest remaining bids were $2000 to $2500 as shown. The other statistics provided in Table 20 give further information on the shape of the distribution: the large and positive kurtosis statistic indicates that the distribution is more peaked than a normal (bell-shaped) distribution. The peak in this case is at zero, which is also the mode of the distribution. The large and positive skewness statistic indicates that values cluster at the left side of the distribution (zero) with a long tail of extreme values to the right.

The main question with respect to the open CVM is whether all of the zero responses (even after excluding the obvious protest responses) are really valid. As may be recalled from the literature review, some analysts question whether a simple open-ended question will engage the respondent sufficiently to get a valid response. In this case it was possible to test for consistency with the logit responses. A cross-tabulation routine was run on the data to compare logit responses by individuals who bid "zero" on the open CVM versus the non-zero open CVM subsample. It was found that many individuals who said they would pay "zero" on the open CVM in fact responded "yes" when faced with a specific amount in the logit portion of the survey. Specifically, for the current conditions question, there were a total of 869 in the zero open CVM response group with sufficient information to be included in the logit sample. Of these, 385 or 44 percent responded "yes" to a nonzero logit bid. For example, 23 of 23 asked if they would pay $1 indicated yes on the logit question. Obviously, the responses for a very large portion of the sample are inconsistent across the two questionnaire types. One possible interpretation is that the open CVM has not successfully elicited responses for a large subsample of the survey respondents. This would imply that many of the zero responses indicate nonparticipation. This is perhaps not too surprising given how much more difficult it is to respond to an open-ended question ("what is the maximum you would be willing to pay"...etc.) compared to responding to a close-ended "would you be willing to pay an additional $10".

Another perspective on the high share of zero responses in the open CVM is obtained by examining the responses to very low logit bids. The "yes" response rate for the lowest fixed logit bid amounts ($1 and $2) averages 90 percent for all three logit questions combined (380 yes out of 423 bids).

Given the logit findings and the inconsistency of the zero open CVM responses, means for several different subsamples of the open CVM responses were calculated as shown in Table 21. One assumption might be that a zero response is unrealistic and that all zeros should be excluded. The result of this approach is that means approximately double to $46 to $52 per trip (Table 21). Sensitivity of the means to excluding the very highest bids was also explored. For example, if the nine bids over 500 are also excluded (in addition to zeros) for the current condition bid, the mean drops from $52 to $42. The basic finding here is that open CVM bid means are sensitive to exclusion of extreme values.

Also reported in Table 21 is the mean value for the subsample that would be used in a travel cost model. The latter is defined by including single destination and single purpose trips and is about half the complete sample (956 of 2183 observations for current conditions). The single destination-single purpose mean for current conditions is $23.59 which is significantly lower than the comparable full sample mean of $32.20. This is an interesting result with respect to interpreting the comparison of TCM and CVM models. It appears that the multi-destination and multi-purpose trip groups include a large fraction of non-residents. The latter group, other things equal (income, etc.) have a higher willingness to pay.

The open CVM means show no significant difference across bid questions. This result holds for all subsamples shown in Table 21. In short, the complete sample open CVM results indicate that anglers are not willing to pay for improved fishing with respect to larger or more trout. As noted previously, a caveat here is that the complete sample is included for purposes of perspective. Since the bid questions are asked for specific (and quite different) rivers, greater weight should be placed on the interpretation of the river specific results.

C. Logit Estimates by Cluster

Net economic values by angler user group are reported in Table 22. The most significant finding is that both mean and median values vary considerably across user group. As one might expect, net economic value per trip increases the more specialized and committed to the sport the angler is. For example, with respect to mean values for the current trip, the occasional user has a net value per trip of only $7.56, while the generalist groups are at $91.03 and $117.07 and the specialist group (no. 4) has a value of $170.28. A similar range is reflected in the median values.

It is interesting to note that only the occasional user group has a very large increased willingness to pay for doubled catch of large trout and doubled overall catch. Occasional users are willing to pay $7.56 for the current trip but $67.51 for doubled chances of a large trout and $45.26 for doubled overall catch. None of the other user groups show a large difference between the three bid questions based on means. In fact, the direction of difference for specialist group and generalist group no.2 is opposite of what one would expect. The median values, however, show the opposite result. All user groups have considerably higher willingness to pay for increased catch of large trout. Only the occasional user group also is willing to pay considerably more for doubled overall catch.

The mean and median results vary across the bid questions because of differences in the shapes of the logit distributions. For example, the mean values for current conditions and large trout bids are nearly identical for the specialist user group ($170 and $167 respectively). This indicates that the total area under the two logit distributions are about the same. However, the median for the large trout bid is somewhat higher for the specialists: $106 versus $72 for current conditions. This indicates that there is a higher probability of a yes response for bids to the 100 dollar range for large trout compared to current conditions. However, at even higher bid levels the probability of a yes drops off more rapidly for the large trout question. In other words, specialists are relatively more willing to respond yes to high bid amounts for current conditions. The shape of these distributions is indicated by the intercept and slope parameters shown previously in Table 6. For example, the coefficient on the specialist group current conditions equation for the bid variable is -.74 compared to -1.36 for large trout. As the bid value rises, the probability of a yes drops off much faster for the large trout question.

D. <u>Open CVM by Cluster</u>

Results of the open CVM bid equation by cluster are summarized in Tables 23, 24, and 25 for the complete sample, for the subsample with zero bids excluded and for the subsample of bids greater than zero and less than or equal to 500, respectively. As for the logit estimates, mean values again vary across clusters, with the two generalist groups having similar bid values, the occasional users very low mean bids, and the specialist group relatively high bids. For example, for current conditions the generalist bids are not significantly different ($29.03 and $28.33 for clusters 1 and 2 respectively). The occasional user group mean bid is $9.48 and the specialist bid $40.14.

Unlike the logit results, however, there is very little difference across bid questions for a given cluster. For example, even the occasional user group (which had very large differences across bid questions in the logit analysis (Table 22)) has almost identical mean bids across questions: $9.48, $9.44 and $8.44 for the current conditions, large trout and doubled catch questions respectively.

As one would expect, when all zero bids are excluded the means are approximately doubled (Table 24). However, cluster responses still do not vary across bid question. This same result holds when bids over $500 are also excluded (Table 25). When the extremely high bids are excluded, it may be noted that the estimated standard error declines noticeably (indicating that the means are more precisely estimated). For the most restrictive subsample (Table 25), it is interesting to note that the two generalist categories are not significantly different on mean bids for current conditions. However, for large trout and for doubled trout catch cluster no. 2 has a significantly higher mean bid. For the most restrictive subsample, the difference between the specialist and generalist groups is most pronounced, with the specialist mean bid being approximately double that of the average generalist bid. This is similar to the relative values derived in the logit analysis.

While there is some consistency between the logit and open CVM bid results, there are also some significant differences. Given the very high number of zero bid responses to the open CVM questions, greater credibility may be placed on the logit results.

E. Logit Results by River

Logit bid results by river are summarized in Tables 26, 27 and 28 for the three bid questions. Two different mean bid estimates (net value per trip) are displayed for each question. One estimate is based on truncation of the logit function integration at the highest bid for which a "yes" response is obtained. This varies from $500 to $250 as may be noted (Table 26). The other estimate is based on a truncation at $500 for all rivers; the latter is the largest bid value used in the sample. Four of the rivers had a yes response to $500 and accordingly have only one estimate.

For the truncation at the highest "yes" bid, mean values vary from $43 for the Bitterroot to $218 for the Big Hole (and $204 for the Madison). For the upper limit of $500, values vary from $59 on the Bitterroot to $228 on the Madison. As will be developed in section VI below, there is a strong correlation between the TCM values by river developed in Duffield, Loomis and Brooks (1987) and the logit mean estimates presented here.

Sensitivity of the mean estimates to higher truncation levels varies somewhat by river. For example, the mean for the Boulder at $250 truncation is $97 while the value is $149 at a $500 maximum bid. By contrast, the mean for the Missouri varies from only $59 to $63 for truncation at $300 and $500. With reference to Table 12, this difference in sensitivity is due to the relative magnitude of the coefficient on the bid variable for the two rivers (-.64 versus -1.62). In other words, the probability of a "yes" response drops off very rapidly with higher bid values for the Missouri.

In general, the sensitivity of mean values per trip to the upper limit of integration is a major weakness of the logit method. For this application, the problem appears to be compounded by two limitations of the survey sample. The first limitation is that it appears that bids higher than $500 should have been used on at least some of the rivers in order to establish the point at which the probability of a yes closely approaches zero. For example, on the Big Hole river 100 percent of respondents that were asked if they would pay $500 indicated they would pay that amount to fish at current conditions. However, the 100 percent response is unfortunately based on a sample of one. Accurate information on the upper end of the bid distribution was further limited by the failure to allocate a representative share of bid questions to high bid levels. Specifically there were 27 bid categories varying from $1 to $500 or an average of 81 bid questions for every dollar bid level (given a total of 2183 completed surveys). However, only an average of about 25 bid questions were for the top three bid values ($300, $400 and $500). In other words, on average each of the 17 rivers would have at best one to two bid questions at $500.

The basic result of these sample limitations is that on seven of the rivers no respondents were faced with a $500 bid. Not surprisingly, this group of seven rivers includes all three rivers with the smallest samples in the study (Smith at 44, Flathead at 65 and Boulder at 69). This is particularly a problem on rivers that are likely to have relatively high values. For example, on the Upper Yellowstone, the highest bid level asked was $300 and two out of three indicated a willingness to pay this amount. On the other hand, the sample size and number of high value bid questions may have been sufficient for other rivers. For example, on the Missouri the highest bid asked was $300 (zero yes for the one $300 bid asked or 0/1) but responses approach zero for even lower bids: 1/8 at $200 and 2/9 at $100. As will be recalled, the Missouri mean value is not particularly sensitive to truncation. This is in part because the Missouri sample is relatively large (148 responses) and because the upper limit is probably well established.

Perhaps the river where the upper limit is most poorly established is the Big Hole. At $500, the yes response proportion was one of one and at $400 the response was two of three. It is not clear at what bid levels the probability of a yes would approach zero for this river. To provide further perspective on the logit distributions, values were calculated for each river using as an upper limit the point where the probability of a yes response dropped to 10 percent. This limit on the Missouri corresponds to a bid of $137 but on the Big Hole is $11,409. The corresponding mean values are $50 on the Missouri but $2142 on the Big Hole. In addition to the Big Hole, two other rivers show a 10 percent probability of a yes at very high bid levels: the Beaverhead (at $2669) and the Gallatin ($6342). The corresponding mean values at $586 and $1166 at a 10 percent upper limit of integration. The Gallatin, like the Big Hole showed a yes response to the one $500 bid asked.

Median bids are also displayed in Table 26. These tend to be no more than one-half to as little as one-sixth the value of the corresponding mean.

The range across rivers in the bid response for doubled chances of catching large trout and doubled trout catch (Tables 27 and 28 respectively) are similar to the range in the current conditions bids.

The means for a given river can also be compared across bid questions as summarized in Table 29. Nine rivers show the bid for large trout and doubled catch both being larger than the current conditions bid. If the latter holds, anglers are willing to pay for an improvement in current conditions on the given river. Based on comparison of means, three rivers show anglers willing to pay considerably more for large trout but not doubled catch: the Beaverhead, Big Hole and Madison. On two rivers (Gallatin and Rock Creek), current conditions mean values were larger than either of the other bid values. (For a listing of rivers in each category see Table 42 below and the accompanying discussion.) Further analysis would be needed to determine if these relative responses are a function of angler perception of management problems or potential on a river (quality of the fishery) or if responses mainly indicate what types of angler groups predominate on a given river. It may be that relative responses are a function of both types of factors.

A limitation of the analysis is that confidence intervals are not readily available for the logit means. It is therefore not possible to say if the differences across bids by river are statistically significant. The only statistical output available with regard to confidence intervals from the SPSSx probit package is an interval on the median for a simple bivariate (logit as a function of bid level only) model. These bivariate equations and estimates are not reported here; however, a comparison of medians from a bivariate model across bid questions is summarized in Table 30. The comparison is between the median bid by river for current conditions versus either doubled chance of catching large trout or doubled trout catch. For an informal test, medians were classed as significantly different if the median of one bid question lies outside the confidence interval on the median of another bid. The basic finding is that on approximately 60 percent of the rivers, anglers were willing to pay significantly more for doubled chances of catching large trout. By contrast, anglers were willing to pay significantly more for doubled catch on only around 15 percent of the rivers.

F. Open CVM by River

Tables 31 through 39 provide a summary of the open CVM mean (and median) bids by river. The three bid questions are summarized for three different samples: complete (excluding only protest bids), subsample excluding zero bids and subsample excluding zero bids and bids greater than $500.

The mean bids are summarized for all three bid questions for the complete sample in Table 31. For current conditions, the mean bids range from $5 for the Upper Clark Fork to $52 for the Madison. With respect to confidence intervals, the underlying population distribution of bids are not normal (recall Table 20). However, the sample sizes are sufficiently large (greater than 50 except the Upper Clark Fork and South Fork of the Flathead) that the central limit theorem applies. Assuming then that the distribution of the sample means is normal, the ninety percent confidence intervals are plus or minus the standard error estimate times 2.0. For example, the 90 percent interval for the mean bid value on the Madison is about $32 to $72. Because of extreme values, confidence intervals on some rivers are quite large. On the Upper Yellowstone, the mean is $60, but the confidence interval is approximately $10 to $110. As can be noted, when extreme values are excluded (Table 37 for example), the standard errors tend to decline. For example when zero bids and bids over $500 are excluded, the Upper Yellowstone mean declines to $46 for current conditions (Table 37), but the confidence interval is approximately $24 to $68 (a somewhat more precise estimate). The implication is that a possible basis for selecting an appropriate open CVM subsample is improved statistical properties of the estimate.

Mean bids across bid questions are compared in Table 40 for the subsample where zero bids are excluded. Only about one third of the sample shows either increased catch of large trout valued greater than current conditions or doubled catch valued more. The other two-thirds of the rivers of course show the opposite direction. Since standard errors are available, statistically significant differences can be identified. For the subsample where both kinds of extreme values are excluded (zeros and greater than $500), only on the Upper Clark Fork are anglers willing to pay significantly more for either larger trout or more trout.

The differences across bid questions for the open CVM and logit estimates by river are summarized in Table 41. The comparison excludes the Upper Clark Fork and the South Fork of the Flathead as samples were too small for the logit estimate to converge. The logit shows twice as many rivers where there is willingness to pay for improved conditions (12 versus 6 to 7 for open CVM). The specific rivers that fall in each relative bid category are shown in Table 42 for each methodology. For example, rivers where anglers were willing to pay only for larger trout improvement included the Beaverhead, Big Hole and Madison using the logit method but the Gallatin and Smith by the open CVM. In general, the two methods suggest completely different patterns. The only agreement for the two methods is on the Clark Fork (only doubled trout catch has positive value) and on the Flathead and Kootenai (both improvements have positive value). Given the limitations of the open CVM response as discussed above and in the absence of further information, the logit is probably the more reliable.

VI. COMPARISON OF CVM AND TCM ESTIMATES BY RIVER

This section provides a comparison of site specific net economic values per trip for Montana trout fishing. Three basic methods of estimating values for nonmarket use are compared: TCM (from Duffield, Brooks and Loomis, 1987), dichotomous choice CVM and open-ended CVM (from the current study). The TCM estimates are based on a 1985 survey while the CVM are for 1986. No attempt has been made here to correct for changes in overall price levels or for general fishing conditions (1985 was a drought year). These differences are likely to be minor compared to differences across methods. Values are compared for the 17 different river sections where estimates were available for all three approaches.

For each of the basic methods, several alternative measures have been developed as follows: logit mean, logit median, open CVM mean and median (both with and without zero bids included), TCM based on either standard or reported cost, and TCM based on predicted versus actual trips. (The latter is the Gum and Martin method.) The basis for these ten specific estimates has been developed in detail above and in Duffield, Brooks and Loomis (1987).

Based on the detailed development elsewhere, there is some a priori expectation of what comprises the "best" estimates. In general, means are preferred to medians as a measure of central tendency. Only means can be correctly used to infer aggregate site values from value per trip estimates. (In addition, TCM estimates are only available for means.) With respect to the open CVM, the large number of zero responses and the inconsistency with the logit responses suggests that the open CVM was not particularly successful in this application. As was noted in the literature review, other analysts have had reservations about the ability of open CVM questions to elicit participation and meaningful responses. Within the open CVM the most credence can perhaps be attached to estimates where zero bids are excluded. Based on previous studies comparing CVM estimates to cash transaction responses (as described in the literature review), the logit estimated means should be fairly reliable. Within the TCM estimates, one might expect that travel costs based on actual reported costs would be superior to use of a price specification based on so-called "standard" costs of owning and operating a vehicle. In addition, as developed in Duffield, Loomis and Brooks (1987) the TCM estimates based on using actual trips (Gum and Martin method) avoid the bias due to model prediction error.

Table 43 provides a listing of mean and standard deviation across all 17 sites for the ten estimates. It should be recalled that three different bid questions were asked in the CVM survey. The TCM estimates are comparable to the current conditions CVM bid questions. For completeness, Table 43 also provides a listing of variables for the large trout and doubled catch bid questions as well. The focus here will be on examining consistency between the various measures of value for trips taken on a given river under current conditions.

One basic result from Table 43 is that median estimates tend to be below the means. This suggests that the distribution of net values per trip is not symmetrical about the mean but is skewed toward the higher end of the value scale. Logit means are about two and one-half times as great as the average median value ($127 versus $49); open CVM means and medians are in about the same ratio ($50 to $17).

The TCM estimates are based on average (or mean) net economic value. Accordingly, the correct comparison is to the estimated means for the logit and open CVM estimates. The logit mean (based on an upper limit of integration of $500 at all sites) is $127. The TCM estimate based on the Gum and Martin method and reported costs (hereafter TCMGR) is quite similar at $122. (Corresponding standard deviations are also quite similar between these two estimates at $58 and $60 respectively). The TCM estimate based on predicted trips and reported costs is somewhat higher (TCMPR at $179). Both TCM estimates based on standard costs are about one-half as great as the corresponding reported cost estimate (reflecting the difference in the standard and reported travel cost per mile parameter of 12.6 and 27.0 cents respectively). The open CVM average for site means is $28 for the complete sample and $51 when zero bids are excluded.

A complete listing by river of the ten current conditions estimates is provided in Table 44.

Another way to describe the similarity or differences across estimates is to examine the site level correlation. Table 45 provides a listing of Pearson and Spearman correlation coefficients. The Pearson product moment correlation coefficient shows the correlation taking into account actual dollar differences between the estimates. The Spearman correlation is based on nonparametric methods and shows the similarity in site ranking between the methods. The two statistics provide very similar results here. One basic finding is that the correlation between the Gum and Martin TCM estimates and the logit mean is quite strong (.71 to .73) and nearly double the correlation of the logit and predicted TCM (.38). This is in accord with a priori expectations. The logit mean and the open CVM means are also positively correlated at .43 to .49 for the various measures. While the open CVM means are also correlated to the Gum and Martin TCM estimates (.47 to .61), there is no significant correlation between the open CVM means and the predicted TCM estimates (correlation is .04 to .14).

The basic conclusion, based on site averages and correlation analysis, is that the logit mean and the TCM estimates derived from reported costs and the Gum and Martin approach (TCMGR) are the most consistent of the various estimates. This is in accord with expectations based on a review of the methods. In the following section, the logit mean and TCMGR are examined in greater detail to explore remaining differences.

Table 46 provides a listing of logit and TCMGR estimates by river, including a description of sample size. This listing also provides the ratio of TCM/CVM estimates by site. As can be determined from the ratio statistic, most estimates (in fact, 11 of 17) are within a 25 to 35 percent range of the corresponding site estimate. This similarity is perhaps the most that one could hope for, given the statistical models involved and the sample sizes. Unfortunately, there is not currently available in the literature a method of calculating confidence intervals for the TCM estimates. It is likely that were the appropriate statistics available, the precision of the TCM estimates would prove to be no better than the precision of open CVM site level estimates for comparable sample sizes. (As can be readily determined from Table 33, the 90 percent confidence interval on the mean for most of the sites in this study is no better than plus or minus 50 percent of the estimate.) The point here is that it is likely that at least for 11 of the sites (and perhaps for all), the TCM and logit CVM estimates are not significantly different. It would appear that the site level results here provide strong validation for both models. The similarity of estimates is remarkable given the very different methods and separate data bases employed.

Examining the site level estimates in greater detail, it can be noted that estimates for four of the rivers (the Madison, Gallatin, Missouri and Stillwater) are in fact within 10 or 11 percent of the corresponding estimate. For example, the TCM estimate for the Madison is $234 while the logit CVM is $228. The similarity of the estimates is encouraging in that all four rivers have relatively large sample sizes for both CVM and TCM. Specifically, the Madison, Gallatin and Missouri have the three largest TCM samples (265 to 396 trips) and are among the four largest CVM samples (148 to 155 observations). Correspondingly, the poorest agreement across sites if for rivers with relatively few observations. Specifically, the TCM and CVM estimates for Rock Creek, Boulder, Flathead, Beaverhead, Smith, Upper Yellowstone and Kootenai diverge by a ratio of nearly 2:1 to 1.5:1. These seven rivers include all four of the thinnest TCM samples (less than 5 trips per zone) and all five of the smallest

CVM samples (less than 80 observations). Only the Beaverhead is something of an anomaly in that both the CVM sample (108) and TCM sample (120 trips or 6.3 trips/zone) are at least average. The differences on the Beaverhead may be related to imprecise estimates of response proportions at high bid levels as noted above.

The influence of sample size as noted here is encouraging with regard to validation of both the TCM and CVM models. It appears that precision of the estimates is related to sample size, as one would expect. Much of the difference between the two methods in this application appears to be largely attributable to limited samples.

Table 47 provides a comparison of correlation coefficients between CVM and TCM for the complete sample of 17 rivers and also for the subsample of 12 rivers with at least 80 CVM observations. The correlation coefficients (both Pearson and Spearman) improve for the TCMGR and logit mean correlation when small sample size sites are excluded. For the complete sample the correlation is .71 (Spearman) to .73 (Pearson); for the subsample of 12 rivers the correlation is .80 to .81, which is a very high correlation. Interestingly, the correlation between logit mean and predicted TCM values is worse for the smaller sample (drops from .51 to .38). This provides further evidence that the Gum and Martin approach is probably more accurate than use of predicted trips in calculating net values from the stream TCM model. The correlations are also worse for logit mean and the open CVM mean and TCMGR-open CVM when sites with less than 80 logit CVM observations are excluded. In fact, the latter correlations are no longer significant at the 10 percent level based on the Spearman correlation. In general the evidence suggests that the logit mean and TCM estimates based on the Gum and Martin method are the most consistent.

Another perspective on comparison of the alternative estimates is provided by bivariate linear regression analysis summarized in Table 48. Logit means and open CVM means are regressed on all four TCM estimates (Gum and Martin and predicted for both standard and reported costs). If the values compared were nearly identical, the intercept term would approach zero and the slope coefficient would approach plus 1.0. For the full sample set, the overall equation between logit means and predicted TCM values is not significant at the 10 percent level. The adjusted R square statistic is very low (.09) indicated a poor correlation. The regression model however shows a good fit between logit means and TCM Gum and Martin values. The adjusted R square is .49 and the overall equation is highly significant based on the F statistic. The intercept is $42, but based on a t-test the intercept is not significantly different from zero at the 90 percent level. The slope coefficient for the standard cost model is 1.483 and the reported cost model is .692. Both are highly significant, and the 90 percent confidence interval includes the value 1.00. The basic conclusion is that the bivariate regression indicates a good correlation between the logit mean and TCM Gum and Martin estimates.

The bivariate regression model relating open CVM (zero bids excluded) and the TCM estimates is also reported in Table 48. The basic finding is that there is almost no correlation between the open CVM means and the predicted TCM, but there is a significant correlation to the Gum and Martin TCM (adjusted R square of .335), though not as strong as the logit mean correlation.

When the subsample excludes CVM sites with fewer than 12 observations, the TCM predicted model is barely significantly correlated to the logit mean. The logit mean and TCM Gum and Martin estimate model also improves and shows high explanatory power (adjusted R square of .603). The intercept moves closer to zero ($36) and the slope coefficients are 1.682 and .785. The latter model shows a slightly better relationship for the reported than for the predicted TCM.

VII. SUGGESTIONS FOR FUTURE RESEARCH

This section provides a brief summary of suggestions relating to future research.

Perhaps the major limitation of this study was the sample size and the distribution of bids asked on the logit portion of the survey questionnaire. Future research of this type would be improved if a minimum of 150 to 200 observations per site could be obtained. In addition, it was found that the highest bid asked in this study ($500) was insufficient to identify the point at which the probability of a "yes" response approaches zero for a number of rivers. It would be useful in future research to more carefully pretest the bid range. In addition, it is essential that a fair proportion of the survey questionnaires utilize bids from the higher range.

A major analytical issue that should be explored is the implication of alternative measures of central tendency for the estimated net economic values. Within the conventional logit framework, both the mean and median are plausible candidates. In addition, Cameron (1987) has proposed an alternative methodological framework that could be applied in future work.

An interesting finding in the current study is that net willingness to pay for improvements in fishing quality (either larger trout or more trout) vary considerably across rivers both in magnitude and pattern. For example, on some rivers only improvements in chances of catching large trout had positive values. The existing data base could be utilized in an economic analysis of management alternatives relating to catch. Such a project would require at least a simple model of how management alternatives and fishing pressure affect the fishery population and success rates. Given the economic valuation, the management alternative that maximizes net present worth could be identified.

The existing data base could also be used to explain the observed differences in net willingness to pay for fishery quality improvements across river sites. For example, is net willingness to pay for improved fishery quality largely a function of the site's current characteristics or a function of who is fishing the given site. The answer is probably a mixture of both phenomenon. It may be possible for example to exploit the cluster analysis characterization of fishermen types in pursuing this line of research. What is needed is a model that better relates site (including management) characteristics to how many and what type of fisherman is attracted.

A related line of research that would appear to be the logical next step in the analysis of Montana fisheries is to more formally integrate the economic analysis into a biological and physical model of a given fishery. For example, the biological structure (age distribution and size class) of the fishery influences the type of fishing opportunities available (success rates, proportion of trophy fish, etc.). This in turn influences the economic demand for the site (number and type of visits). Over time this social and biological system interaction is modified and directed by management. For example, catch and release regulations modify the impact of fisherman on the age and size structure of the biological population and therefore impact future opportunities (success, etc.) and economic demand. This area of research requires that time be explicitly incorporated in the model and that the simultaneity between the biological and social systems be recognized. A model for this area of research is the work that has been done in applying mathematical bioeconomics to marine fisheries. To date, this level of sophistication has not been achieved in the analysis of fresh water fisheries. The nature of this research might imply initially modeling a single site (as opposed to the multi-site direction of the current research). Latter the methodology could be extended to multiple sites to better account for site substitution.

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APPENDIX A

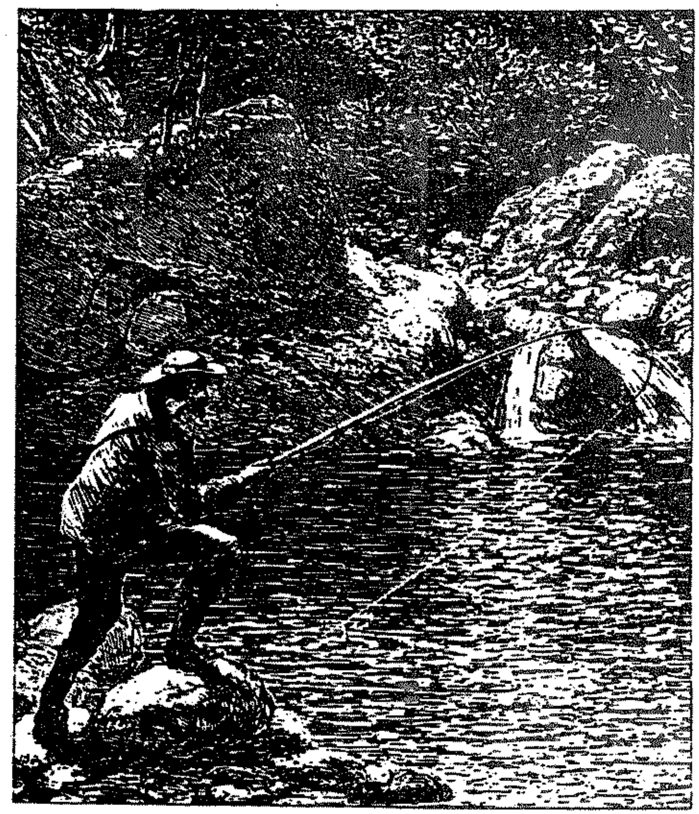
SURVEY QUESTIONNAIRE

Thank you for your help. Is there anything else you'd like to tell us about fishing this river? We would appreciate any comments.

Thanks again. If you would like to receive a copy of the survey results, please write "Results requested" and your address on the back of the return envelope (not on this questionnaire).

FLATHEAD RIVER
ANGLER SURVEY

Summer 1986



Montana Department of Fish, Wildlife & Parks

I. FIRST, WE HAVE SOME GENERAL QUESTIONS ABOUT YOUR FISHING.

1. How many years have you been fishing? _____ Years

2. About how many days a year do you fish for trout? _____ Days

3. About how many of these days are spent in Montana? _____ Days

4. How would you rate trout fishing compared to other outdoor recreation activities you do? (please check one)

___ It's my favorite outdoor recreation activity

___ It's one of my favorite outdoor recreation activities

___ It's just one of several outdoor recreation activities that I do

___ I prefer to participate in other outdoor recreation activities

5. About what percent of your fishing time do you spend at each of these types of water?

Large lakes	_____ %
Small lakes	_____ %
Large rivers	_____ %
Small rivers	_____ %
Creeks	_____ %
Spring creeks	_____ %
Total:	100

II. THE NEXT FEW QUESTIONS ASK ABOUT YOUR MOST RECENT FISHING TRIP TO THE FLATHEAD (BETWEEN THE LAKE AND THE CONFLUENCE OF THE NORTH AND MIDDLE FORKS) AND YOUR EVALUATION OF THE FISHING THERE.

1. Approximate date(s) of this last trip: ____________

(a trip could be anything from an hour to several or more days)

2. On this trip, did you fish a section of the Flathead that has special fishing regulations? (Please check one)

___ Yes

___ No

___ I'm not sure

3. How many days did you fish the Flathead on this trip?

___ Days

4. About how many hours per day were you fishing?

___ Hours per day

5. What type of fishing equipment did you use?

___ Bait

___ Lures

___ Flies (6. Did you tie your own? ___Yes ___No)

___ Combination

7. About how many trout did you catch on this most recent trip?

___ Trout caught

8. How many of these trout did you keep?

___ Trout kept

9. Did you use a fishing guide or outfitter on the Flathead?

___ Yes ___ No

10. Did you fish from shore, from a boat, or both?

___ Shore ___ Boat ___ Both

11. How many other anglers were in your party?

___ Other anglers came with me

12. Was the Flathead the main (or only) river you fished on this trip, or did you fish other rivers? (Please check one)

___ The Flathead river was the main (or only) river I fished on this trip away from home

___ Fishing at other rivers was just as important as fishing on the Flathead on this trip.

___ Fishing at other rivers was more important than fishing the Flathead this trip.

13. Was fishing the main purpose of your trip away from home when you fished the Flathead or did you make the trip for other reasons such as business or a family vacation?

___ Fishing was the main purpose of this trip

___ Fishing was one of several reasons for making the trip

___ The main purpose of this trip was not to fish, but for other reasons.

14. Was this your first visit to the Flathead?

___ Yes

___ No

15. If not, how many years have you been fishing the Flathead ?

___ Years

16. How many separate trips did you make from your home to the Flathead this year?

___ Separate trips from home this year

17. People fish for many reasons. We'd like to know some of the reasons you fished the Flathead this trip, to help us understand different types of anglers and their preferences.

Following is a list of possible reasons for fishing. Please check the box that says whether that reason was a very important reason, an important reason, not an important reason, or not at all important a reason you fished the Flathead this trip.

	Very Important	Important	Not very Important	Not at al Importa--	Not Sure
1. To catch wild trout	☐	☐	☐	☐	☐
2. To experience solitude	☐	☐	☐	☐	☐
3. To catch many trout	☐	☐	☐	☐	☐
4. To learn more about trout	☐	☐	☐	☐	☐
5. To get away from it all	☐	☐	☐	☐	☐
6. To catch large trout	☐	☐	☐	☐	☐
7. It's close to home	☐	☐	☐	☐	☐
8. To be outdoors	☐	☐	☐	☐	☐
9. To catch trout to eat	☐	☐	☐	☐	☐
10. To view the scenery	☐	☐	☐	☐	☐
11. Because of the special regulations	☐	☐	☐	☐	☐
12. To test my fishing skills	☐	☐	☐	☐	☐
13. To be with my family	☐	☐	☐	☐	☐
14. It's where my friends were going	☐	☐	☐	☐	☐
15. To get away from other anglers	☐	☐	☐	☐	☐
16. I've had good fishing here before	☐	☐	☐	☐	☐
17. To fish somewhere new	☐	☐	☐	☐	☐

18. Could you please look back over this list and circle the numbers of the <u>three</u> most important reasons you fished the Flathead?

19. Based on your experience fishing the Flathead, do you feel that there are any major problems with how it is managed?

___ Yes ___ No ___ Not sure

20. If you said yes, please check any of the following problems you feel exist on the river:

___ Too many anglers	___ Access not adequate
___ Too many boats	___ Poor fish habitat
___ Too few fish	___ Poor scenic quality
___ Fish are too small	___ Too much access
___ Water levels	___ Water quality

___ Other: ______________________________

21. About how many other anglers did you see while you were fishing the Flathead on this trip?

___ Other anglers seen while fishing the Flathead

22. Was this number more than you expected to see, less than you expected to see, or about as many as you expected?

___ More than I expected to see

___ About as many as I expected to see

___ Fewer than I expected to see

___ I didn't have any expectations

23. Did other anglers present affect your fishing?

___ Yes ___ No

24. If yes, please explain how:

25. Do you plan to continue fishing the Flathead?

___ Yes ___ No

26. If yes, about how frequently do you plan fish the Flathead? (please check one)

___ As frequently as I do now

___ More frequently than I do now

___ Less frequently than I do now

___ I'm not sure

27. How does the Flathead compare to other trout streams in Montana? (please check one)

___ It's my favorite place to fish

___ It's one of my favorite places to fish

___ It's one of many places where I fish

___ I prefer to fish other places

28. Are there any other rivers or streams in Montana that you feel provide a fishing experience comparable to the Flathead?

___ Yes ___ No

29. If yes, please name them:

30. If you could not have fished the Flathead, where might you have fished instead?

________________ Name of stream or river

31. About how far is it from your home to this alternative fishing location?

___ Miles

32. How does it compare to fishing the Flathead?

III. THE NEXT FEW QUESTIONS WILL HELP US TO UNDERSTAND THE VALUE PEOPLE PLACE ON FISHING THE FLATHEAD.

WE REALIZE YOU AREN'T USED TO CONSIDERING FISHING THIS WAY, BUT PLEASE THINK ABOUT IT AND GIVE US YOUR BEST ESTIMATE!

1. About how far is it from your home to where you fished the Flathead this trip?

_____ Miles (one-way)

2. How long did it take to travel from your home to the Flathead?

___ Hours (include any stops made en route)

3. If you drove, how many anglers were in the vehicle with you?

___ Other anglers

4. About how much did you personally spend on this trip? Include expenses such as gas and oil, food and beverages, any lodging or camping fees, car rentals, airfares, equipment purchased just for this trip, fishing access fees, and other trip expenses. If you can't recall the exact amount, please give your best estimate.

__________ Total amount I spent on this trip

5. Was this trip worth more than you actually spent?

___ Yes

___ No

6. If YES, would you still have made the trip if your share of the expenses had been $250 more?

___ Yes

___ No

7. What is the maximum increase in your actual trip cost you would have paid to fish the Flathead instead of having to fish elsewhere?

________ Dollars

8. If your answer was zero, could you briefly explain why?

9. About how big would a trout you caught on this trip have to be before you would consider it to be large?

_______ Inches

10. How many large trout did you catch on this trip to the Flathead?

___ Large trout caught

11. Imagine that everything about this last trip were the same, except that your chance of catching a large trout was twice as great AND that your trip costs were $20 more than your actual costs. Would you still have made the trip under these circumstances? (Please check one)

___ Yes, I would still have made the trip

___ No, I would not have made the trip

12. What is the maximum increase in actual trip costs you would pay to double your chances of catching a large trout?

________ Dollars increase in trip cost

13. If your answer was zero, could you briefly explain why?

14. If you caught at least one trout, imagine that everything about this last trip were the same, except that you caught twice as many trout as you actually did AND that your trip costs were $20 more than your actual cost. Would you still have made the trip under these circumstances?

___ Yes, I would still have made the trip

___ No, I would not have made the trip

15. What is the maximum increase in actual trip costs you would pay to catch twice as many trout as you actually did?

________ Dollars increase in trip cost

16. If your answer was zero, could you briefly explain why?

IV. THE NEXT FEW QUESTIONS ASK YOUR OPINION ON DIFFERENT STATEWIDE FISHERIES MANAGEMENT OPTIONS.

1. In general, which two of the following management programs do you favor the most for managing Montana trout streams? (Please rank your top two choices)

   ___ Stocking rivers with hatchery trout

   ___ Protecting trout habitat

   ___ Special fishing regulations

   ___ Improving fishing access

   ___ Would need more information

2. If restrictions are needed to increase the number of larger trout in a stream, which two of the following regulations would you prefer? (Please rank your top two choices)

   ___ Gear restriction (such as artificial lures only)

   ___ Reduce limit on number of trout kept

   ___ Reduce limit on size of trout kept

   ___ Shorten fishing season

   ___ Limit fishing access sites

   ___ Would need more information

3. If special regulations are needed to increase the number of larger trout in a stream, which two of the following regulations would you prefer? (Please rank your top two choices)

   ___ Catch and release all trout

   ___ Keep only small trout

   ___ Reduce total limit

   ___ Slot limit (catch and keep trout under a minimum size and one trout over a maximum size)

   ___ Would need more information

V. THESE LAST FEW QUESTIONS WILL HELP UNDERSTAND YOUR RESPONSES BY KNOWING SOME BASIC INFORMATION ABOUT YOU.

1. Where are you from? City: ______________ State:______

2. What is your age? ________ Years

3. Are you: ___ Male ___ Female

4. Are you a member of any fishing, conservation, or sport organizations?

   ___ Yes ___ No

   5. If so, which ones?

6. What is the highest year of formal education you completed?

   ___ Some grade school ___ Some college

   ___ Finished grade school ___ Finished college

   ___ Finished junior high school ___ Some postgraduate work

   ___ Finished high school ___ Finished postgraduate

7. If you had not gone fishing this trip, would you have been working instead?

   ___ Yes ___ No

8. During the fishing season this year, were you: (check one)

   ___ Employed full time ___ Retired

   ___ Employed part time ___ Homemaker

   ___ Unemployed ___ Other: ____________

9. Please check your household's income before taxes last year:

   ___ Under 5,000 ___ 20,000 - 24,999 ___ 40,000 - 49,000

   ___ 5,000 - 9,999 ___ 25,000 - 29,999 ___ 50,000 - 74,999

   ___ 10,000 - 14,999 ___ 30,000 - 34,999 ___ 75,000 - 100,000

   ___ 15,000 - 19,999 ___ 35,000 - 39,999 ___ over 100,000

TABLES

Table 1

Response Rate on Angler Preference Survey

River	Questionnaires Mailed	Returns
Beaverhead	151	125
Kootenai	107	79
Bighorn	197	172
Clarkfork	182	146
Upper Clarkfork	38	35
Stillwater	176	136
Rockcreek	124	101
Upper Yellowstone	179	140
Middle Yellowstone	145	115
Boulder	93	77
Flathead	107	84
Southfork Flathead	15	14
Smith	62	50
Missouri	201	165
Blackfoot	134	107
Big Hole	185	158
Gallatin	200	162
Bitterroot	160	131
Madison	216	174
TOTAL	2,672	2,171

Overall response rate: 81.3 percent

Table 2

Multivariate LOGIT Equations Complete Sample

n	Constant	DOLAMT	DOLDBLE1	DOLDBLE2	COMPARE	TCOMPARE	STRPSHM	LRGCOT	RVRMAIN	REASON	HRSDAY	DYSFSHED	TROUTCOT	REASON06	INCCME
A) Current Conditions:															
1749	1.52706	-.8315			-.5346	-.72730	-.30326	.21946	.92470	.29078	.41556	.43066			.49974
	(27.14)	(-16.65)			(-3.53)	(-4.89)	(-5.61)	(5.55)	(4.62)	(4.12)	(3.33)	(4.45)			(5.79)
B) Large Trout:															
1751	4.22908		-1.23028		-.52836	-.70772	-.26544	.15792	1.04056	.44008		.76724	.0868	-.3871	.4745
	(31.05)		(-19.22)		(-3.14)	(-4.30)	(-4.47)	(3.32)	(4.74)	(2.46)		(6.65)	(1.92)	(-2.72)	(5.05)
C) Double Catch:															
1751	2.69894			-.99800	-.63242		-.28044		.54676	.36476		.62172	.10466		.39514
	(33.38)			(-18.12)	(-4.09)		(-5.17)		(2.78)	(2.20)		(6.14)	(2.59)		(4.43)

Notes:
DOLAMT = Bid amount for current condition question.
DOLDBLE1 = Bid amount for large trout question.
DOLDBLE2 = Bid amount for doubled catch question.
COMPARE = Rate fishing compared to other activities: favorite (1) to prefer other activities (4).
TCOMPARE = Rate river compared to others: 1 = favorite to 4 = prefer others.
STRPSHM = Separate trips from home to this river per year.
LRGCOT = Number of large trout caught this trip.
RVRMAIN = River was main trip destination (1) to other rivers more important this trip (3).
REASON = Fishing was main reason for trip (1) to not main reason reason (3).
HRSDAY = Hours per day fished this trip.
DYSFSHED = Days fished this trip.
TROUTCOT = Trout caught this trip.
TROUTKPT = Trout kept this trip.
REASON06 = Reason to fish is to catch large trout: very important (1) to not at all important (4).
INCOME = Mean household income category (under 5000 to over 100,000).
DYSFSHYR = Total days fished per year.
YRSFSHRV = Years fished this river.
AGE = Age in years.

Table 3

Open CVM Equations for the Full Sample

Dependent	Constant	DYSFSHED	STRPSHM	HRSDAY	DYSFSHYR	YRSFSHRV	TROUTCOT	TROUTKPT	LRGCOT	RVRMAIN	REASON	REASON06	COMPARE	ICOMPARE	INCOME	AGE
Current Conditions:																
DOLTOGO	3.23386	+.438929	-.221208	+.262049	---	---	+.093448	-.039817	+.070983	+.491481	+.289235	---	-.257511	-.424015	+.261283	-.319674
	(7.30)	(7.09)	(-6.60)	(2.98)			(3.41)	(-1.75)	(2.67)	(3.73)	(2.53)		(-2.63)	(-4.52)	(4.77)	(-3.19)
Observations: 882		$\bar{R}^2$: .327		F: 36.732												
Large Trout:																
DBLECOT	1.528319	+.375509	-.226532	+.226016	+.180273	-.105437	+.103995	-.059049	+.049631	+.412325	+.280519	-.174817	---	-.216767	+.302947	---
	(5.84)	(6.63)	(-6.49)	(2.83)	(3.87)	(-2.96)	(4.16)	(-2.82)	(2.02)	(3.43)	(2.77)	(-2.32)		(-2.57)	(6.28)	
Observations: 965		$\bar{R}^2$: .332		F: 37.802												
Double Catch:																
DOLDBLCOT	2.18483	+.446008	-.262674	+.168714	+.207911	---	+.087427	-.065411	+.0643	+.40229	+.262049	-.155942	---	-.277059	+.347062	-.266908
	(5.75)	(7.47)	(-7.45)	(2.17)	(4.48)		(3.44)	(-3.18)	(2.62)	(3.28)	(2.61)	(-2.05)		(-3.27)	(7.02)	(-2.97)
Observations: 925		$\bar{R}^2$: .368		F: 42.377												

Note: DOLTOGO = bid response variable for current conditions.
DBLECOT = bid response variable for doubled catch of large trout.
DOLDBLCOT = bid response variable for doubled catch.

For other variable definitions, see Table 2.

Table 4

Open CVM Equations for the Full Sample Including Starting Bids

Dependent	Constant	DOLAMT	DOLDBLE1	DOLDBLE2	DYSFSHED	STRPSHM	HRSDAY	DYSFSHYR	YRSFSHRV	TROUTCOT	TROUTKPT	LRGCOT	RVRMAIN	REASON	REASON06	COMPARE	TCOMPARE	INCOME	AGE
Current Conditions:																			
DOLTOGO	2.703535	+.106477	---	---	+.407767	-.24308	+.230909	+.089897	---	+.073974	---	+.064101	+.450130	+.256467	---	-.205154	-.42024	+.276893	-.333833
	(5.79)	(4.27)			(6.58)	(-6.51)	(2.61)	(1.71)		(2.79)		(2.45)	(3.44)	(2.26)		(-2.06)	(-4.45)	(5.12)	(3.39)
Observations: 982		$\bar{R}^2$: .340		F: 35.926															
Large Trout:																			
DBLECOT	1.22353	---	.127944	---	+.407921	-.192976	+.205327	+.16278	+.097272	+.100607	-.063505	+.052364	+.42774	+.234285	-.176842	---	-.193037	+.270571	---
	(4.65)		(5.79)		(7.29)	(-5.62)	(2.63)	(3.57)	(-2.80)	(4.12)	(-3.10)	(2.18)	(3.65)	(2.36)	(-2.40)		(-2.34)	(5.72)	
Observations: 962		$\bar{R}^2$: .363		F: 40.045															
Double Catch:																			
DOLDBLCT	1.890514	---	---	+.100265	+.435415	-.246613	+.150203	+.201052	---	+.085963	-.060276	+.05881	+.39546	+.252679	-.158581	---	-.264315	+.339326	-.264984
	(4.94)			(4.32)	(7.35)	(-7.01)	(1.94)	(4.36)		(3.40)	(-2.93)	(2.42)	(3.35)	(2.53)	(-2.10)		(-3.14)	(6.90)	(-2.96)
Observations: 921		R^2: .381		F: 41.425															

Table 5

Summary of Cluster Type Characteristics

	Generalist	Generalist	Occasional	Specialist
% Flies	30	34	29	60
% None Caught	15	14	34	15
% High Catch Rate	24	21	16	19
% Large Caught	51	50	73	54
% Fish More Than 50 Days per Year	18	20	7	20
% Fishing is Favorite Activity	20	22	14	30
% on Favorite Stream	22	23	14	15
% Main Reason Trip	74	77	68	69
% Main River Fished	89	88	92	77
% Yes Management Problems	49	44	40	43
% Fishing the Madison	6	8	5	13
% Fishing the Bitterroot	5	5	7	6
% Montana Resident	81	72	83	58
% 10 to 20 Years Old	6	10	6	7
% of Group with Income Greater Than $100,000	9	13	11	68

Table 6

Multivariate Logit Equations

For Current Conditions by Cluster

Cluster	Constant	DOLAMT	STRPSHM	INCOME	DYSFSHED	LRGCOT	HRSDAY	COMPARE	TCOMPARE	REASON	RVRMAIN	DYSFSHYR
1	4.27132	-.97476	-.50706	---	+.66102	+.29362	+.67334	-1.17286	-1.06886	.93286	---	---
	(16.02)	(-7.09)	(-3.48)		(2.73)	(2.90)	(1.93)	(-2.78)	(-2.73)	(1.99)		
2	4.36052	-.83184	-.35534	---	---	+.38832	---	-1.5688	---	+.9721	---	---
	(24.98)	(-7.02)	(-3.05)			(4.45)		(-4.18)		(2.37)		
3	-1.34832	-1.05848	-.40798	+.78690	---	---	---	---	-1.26042	+1.85736	---	+.77738
	(-7.11)	(-6.29)	(-1.86)	(2.83)					(-2.66)	(3.67)		(3.20)
4	2.16274	-.74118	-.29584	+.43348	+.61436	+.18334	---	---	-.95946	---	1.03948	---
	(17.88)	(-8.69)	(-3.12)	(2.91)	(3.29)	(2.74)			(-3.42)		(3.21)	

Table 7

Multivariate Logit Equations

for Large Trout by Cluster

Cluster	Constant	DOLDBLE1	STRPSHM	DYSFSHED	COMPARE	TCOMPARE	LRGCOT	RVRMAIN	REASON03	REASON06	INCOME	HRSDAY
1	5.41962	-1.26368	---	+1.1819	-.93696	-1.00908	+.25018	+1.20032	---	---	---	---
	(20.52)	(-7.70)		(4.36)	(-2.10)	(-2.52)	(2.27)	(1.96)				
2	7.07974	-1.55158	-.4734	+1.44	---	-.85084	-.2029	---	---	-.75128	---	---
	(18.53)	(-8.44)	(-3.04)	(4.40)		(-2.05)	(1.88)			(-1.99)		
3	-.68532	-1.28872	---	+.91684	---	---	---	+1.27934	+1.70674	---	+.47326	+.60614
	(-6.70)	(-6.81)		(2.54)				(1.91)	(2.16)		(1.86)	(1.65)
4	4.00282	-1.36095	-.3364	+.80248	---	-1.05902	+.17136	+1.53576	---	---	+.77024	---
	(16.60)	(-10.96)	(-3.00)	(3.56)		(-3.21)	(2.06)	(3.84)			(4.24)	

Table 8

Multivariate Logit Equations

for Doubled Catch by Cluster

Cluster	Constant	DOLDBLE2	STRPSHM	DYSFSHED	COMPARE	TCOMPARE	LRGCOT	RVRMAIN	REASONO3	DYSFSHYR	INCOME	EDUCATE
1	3.28458	-1.08384	-.48714	---	-.82186	---	+.35932	---	---	.68604	---	---
	(15.80)	(-9.65)	(-3.17)		(-2.02)		(3.76)			(3.16)		
2	4.61944	-1.30546	-.26844	+.78262	---	---	+.35896	---	---	---	---	---
	(22.45)	(-7.94)	(-2.12)	(2.94)			(3.70)					
3	1.25672	-1.29072	---	+.8775	---	---	---	---	+1.65268	---	.66666	-1.3147
	(6.64)	(-6.65)		(2.51)					(2.06)		(2.28)	(-1.94)
4	2.2427	-1.08772	-.65326	+.97306	---	-.81812	+.12862	+.58336	---	.35736	+.605	---
	(13.54)	(-9.77)	(5.31)	(4.68)		(-2.56)	(1.65)	(1.66)		(2.31)	(3.56)	

Table 9

Open CVM Equations by Cluster Grouping: Current Conditions

Cluster	Constant	DISFSHED	STRPSHM	HRSDAY	DISFSHYR	YRSFSHRV	TROUTCOT	RVRMAIN	REASON03	REASON06	TCOMPARE	INCOME	AGE	YRSFSH
1	1.223513	+.481479	-.442645	---	+.423587	---	---	+.701112	---	---	-.639577	+.378722	---	---
	(2.32)	(4.21)	(-4.57)		(3.34)			(2.11)			(-3.10)	(3.14)		
Observations: 160		$\bar{R}^2$: .349		F: 15.202										
2	4.791186	+.454711	-.329898	---	---	---	+.180481	---	-.36076	-.378295	-.863802	---	---	-.25857
	(10.45)	(3.12)	(-4.87				(3.18)		(-1.81)	(-2.10)	(-4.38)			(-2.16)
Observations: 170		$\bar{R}^2$: .426		F: 18.905										
3	1.256901	+.481243	---	+.350676	---	-.267029	---	---	---	---	---	+.334022	---	---
	(2.75)	(3.05)		(1.90)		(-2.89)						(2.51)		
Observations: 92		$\bar{R}^2$: .206		F: 6.904										
4	3.363543	+.752685	-.210182	+.474606	---	---	---	.559308	---	---	-.551225	+.355129	-.512071	---
	(4.47)	(6.99)	(-3.64)	(3.42)				(2.60)			(-3.35)	(3.34)	(-2.59)	
Observations: 291		R^2: .393		F: 27.864										

Table 10

Open CVM Equations by Cluster Grouping: Large Trout

Cluster	Constant	DYSFSFED	STRPSHM	HRSDAY	DYSFSHYR	YRSFSHRV	TROUTCOT	TROUTKPT	LRGCOT	RVRMAIN	REASON	REASON03	REASON06	COMPARE	TCOMPARE	INCOME	YRSFSH
1	1.079315	+.233985	-.270036	---	+.268821	---	---	---	+.138938	---	---	---	---	---	---	+.417632	---
	(2.32)	(2.25)	(-3.25)		(2.54)				(2.87)							(3.70)	
	Observations: 189	$\bar{R}^2$: .196	F: 10.177														
2	3.040616	+.645574	-.273631	+.347765	---	---	---	---	---	---	---	---	-.597196	-.403154	---	---	---
	(7.83)	(5.55)	(-4.19)	(2.05)									(-3.33)	(-1.99)			
	Observations: 190	$\bar{R}^2$: .335	F: 20.05														
3	1.780536	+.439247	---	---	---	-.324339	+.116437	---	---	---	---	---	---	---	---	---	+.338981
	(4.86)	(2.61)				(-2.87)	(2/03)										(2.29)
	Observations: 98	$\bar{R}^2$: .179	F: 6.067														
4	1.464585	+.633416	---	+.382976	---	-.240761	+.105412	-.076604	---	+.553101	+.311145	-.448656	---	---	-.263991	+.278859	+.23218
	(3.09)	(5.77)		(2.67)		(-3.51)	(2.53)	(-2.02)		(2.90)	(1.92)	(-2.43)			(-1.78)	(3.10	(2.20)
	Observations: 298	$\bar{R}^2$: .394	F: 18.575														

Table 11

Open CVM Equations by Cluster Grouping: Double Catch

Cluster	Constant	DYSFSHED	STRPSHM	HRSDAY	DYSFSHYR	YRSFSHRV	TROUTCOT	TROUTEPT	LRGCOT	RVRMAIN	REASON	REASON03	REASON06	TCOMPARE	INCOME
1	1.294052	+.307434	-.263933	---	+.219770	---	---	---	+.203708	---	---	---	---	---	+.450504
	(2.98)	(2.93)	(-3.34)		(2.13)				(4.39)						( )
Observations: 183		$\bar{R}^2$: .288		F: 15.737											
2	4.188078	+.630893	-.170929	---	---	-.188598	---	---	+.12721	+.987953	-.622238	-.344599	-.51329	-.457288	---
	(14.85)	(4.57)	(-2.63)			(-2.19)			(2.52)	(3.44)	(-2.31)	(-1.81)	(-2.93)	(-2.48)	
Observations: 182		$\bar{R}^2$: .440		F: 16.808											
3	1.710685	+.57875	---	---	---	---	+.234056	---	-.148838	---	---	---	---	---	---
	(10.23)	(3.37)					(3.61)		(-1.92)						
Observations: 97		$\bar{R}^2$: .222		F: 10.147											
4	2.044087	+.744214	-.133661	+.261839	---	---	---	-.068932	---	---	---	-.52049	---	---	+.331344
	(4.90)	(6.73)	(-2.56)	(2.00)				(-1.82)				(-2.86)			(3.78)
Observations: 276		$\bar{R}^2$: .339		F: 24.631											

Table 12

Multivariate Logit Equations

for Current Conditions by River

River	Constant	DOLAMT	STRPSHM	DYSFSHED	COMPARE	TCOMPARE	LRGCOT	RVRMAIN	REASON	AGE	EDUCATE	INCOME
1	3.62584	-.58374	---	---	---	-1.72972	+.45354	+2.36180	---	-1.11842	---	.96648
	(5.84)	(-3.04)				(-2.74)	(2.83)	(3.02)		(-1.73)		(2.37)
2	-1.26466	-.45052	---	+.92102	---	---	---	---	---	---	---	.76842
	(8.27)	(-3.33)		(2.82)								(2.51)
3	-.74750	-.74204	-.51088	---	---	---	+.63160	---	---	---	+2.41168	---
	(6.09)	(-4.08)	(-2.56)				(3.65)				(2.78)	
4	-3.53808	-.57130	---	---	---	---	---	---	+1.01818	+1.38334	---	---
	(3.23)	(-3.15)							(1.85)	(2.42)		
5	.57570	-.64862	---	---	-1.61220	---	---	---	---	---	---	+.8650
	(6.73)	(-2.91)			(-2.01)							(1.88)
6	1.72320	-.76158	-.39408	---	-1.37850	---	+.32924	---	---	---	---	+.77538
	(8.67)	(-4.66)	(-2.28)		(-2.47)		(2.92)					(2.40)
8	-2.58064	-.58682	---	+.63220	---	---	---	---	---	---	---	+1.02986
	(5.92)	(-3.51)		(1.81)								(2.78)
10	6.03022	-1.03866	-.48340	+1.47056	---	---	---	---	---	-1.55814	+2.20118	---
	(5.57)	(-2.98)	(-1.77)	(2.27)						(-1.87)	(1.76)	
12	1.98104	-.43298	-.38362	+1.35656	---	---	+.37340	---	---	---	---	---
	(17.10)	(2.82)	(-2.38)	(2.68)			(2.71)					

Table 12

(continued)

River	Constant	DOLAMT	STRPSHM	DYSFSHED	COMPARE	TCOMPARE	LRGCOT	RVRMAIN	REASON	AGE	EDUCATE	INCOME
13	-.46636	-.87392	-.62486	---	---	-2.06522	---	---	---	---	3.33846	---
	(4.42)	(-3.38)	(-2.18)			(-2.33)					(2.66)	
14	8.99468	-1.16828	---	+.63690	-1.20044	---	+.29076	---	---	---	-3.25892	+.65322
	(7.69)	(-5.33)		(1.84)	(-1.95)		(2.09)				(-2.95)	(1.70)
15	2.55158	-1.62826	---	---	---	---	+.32268	---	---	---	---	+.90212
	(8.75)	(-5.96)					(3.77)					(2.24)
16	1.40974	-.98736	---	---	-2.77338	---	---	---	---	---	---	+1.06146
	(7.34)	(-3.97)			(-3.21)							(2.25)
17	3.45280	-.85354	---	+1.62224	-2.07864	---	---	---	---	---	---	---
	(10.24)	(-2.43)		(2.05)	(-2.07)							
18	3.95316	-.97656	---	+2.23262	---	-2.43306	---	+2.42668	---	---	---	---
	(13.45)	(-4.34)		(3.72)		(-3.11)		(2.50)				
20	3.68796	-.71842	-.46290	---	---	---	+.33810	---	---	---	---	---
	(17.10)	(-4.00)	(-2.73)				(2.47)					
21	5.41720	-.76416	---	+.51848	---	---	---	---	---	-1.07640	---	---
	(7.26)	(-4.01)		(1.77)						(-1.91)		

Table 13

Multivariate Logit Equations

for Large Trout by River

River	Constant	DOLDBLE1	STRPSHM	DYSFSHED	COMPARE	TCOMPARE	LRGCOT	REASON	RVRMAIN	REASON06	INCOME	EDUCATE	AGE
1	5.68108 (13.09)	-1.40302 (-4.69)	---	+2.07812 (3.43)	---	-1.69640 (-2.40)	---	---	+1.15495 (2.81)	---	---	---	---
2	8.64432 (9.97)	-1.41618 (-5.46)	---	+1.12346 (2.60)	---	---	+.61776 (3.18)	+1.78504 (2.58)	+1.36598 (1.77)	---	---	-1.4558 (-1.83)	---
3	-.33790 (8.67)	-1.03082 (-4.57)	---	+1.52038 (2.99)	---	---	+.39406 (2.23)	---	---	---	+1.27972 (3.29)	---	---
4	4.53584 (12.95)	-1.09846 (-4.48)	---	1.47748 (2.42)	---	---	---	---	---	-1.73348 (-2.70)	---	---	---
5	-.35780 (2.31)	-1.23050 (-3.14)	---	---	---	---	---	---	---	-1.54472 (-1.69)	+1.62704 (2.21)	-3.25058 (-2.18)	+1.96812 (1.89)
6	5.08238 (7.54)	-2.17004 (-5.44)	-.50552 (-1.91)	+1.85002 (2.66)	-2.29148 (-2.49)	---	+.52178 (2.70)	+2.45166 (2.08)	---	---	+1.52030 (3.15)	---	---
8	3.25760 (7.82)	-1.99372 (-5.48)	---	+.87644 (1.71)	-1.67792 (-2.19)	---	---	+1.91318 (2.23)	---	---	1.11698 (2.54)	---	---
10	1.23754 (7.18)	-.84776 (-3.22)	---	+1.26162 (2.49)	---	---	---	---	---	-1.56576 (-2.21)	---	+1.81858 (1.72)	---
12	4.47990 (16.98)	-1.13218 (-5.36)	-.57364 (-2.95)	---	---	---	---	---	+2.03726 (2.76)	---	---	---	---

Table 13

(continued)

River	Constant	DOLDBLE1	STRPSHM	DYSFSHED	COMPARE	TCOMPARE	LRGCOT	REASON	RVRMAIN	REASON06	INCOME	EDUCATE	AGE
13	4.21932	-.78054	-.46124	---	---	---	+.38068	---	---	---	---	---	---
	(11.95)	(-3.36)	(-2.06)				(1.85)						
14	5.13056	-1.02160	-.37596	+1.03954	-.91208	---	---	---	---	---	---	---	---
	(15.32)	(-5.28)	(-1.94)	(2.99)	(-1.67)								
15	.7024	-1.01152	---	+1.29566	---	---	---	---	---	---	---	1.47212	---
	(8.33)	(-5.24)		(3.61)								(2.10)	
16	2.99016	-1.87662	---	-1.59048	---	---	---	---	+2.99360	---	+2.99360	---	---
	(6.98)	(-4.08)		(2.27)					(2.49)		(2.49)		
17	7.35762	-1.85670	---	+2.16270	-2.70692	---	---	---	---	---	---	---	---
	(7.15)	(-3.32)		(2.68)	(-2.32)								
18	9.09974	-1.32096	---	+1.78934	---	---	---	---	+2.07340	---	---	---	-1.37204
	(7.55)	(-5.05)		(2.67)					(1.87)				(-2.26)
20	2.44384	-1.02910	-.33890	---	---	---	+.44296	---	---	---	+.85656	---	---
	(7.55)	(-4.68)	(-1.78)				(2.41)				(2.12)		
21	8.28240	-1.42862	---	+.77958	---	---	+.40064	---	---	---	---	-2.29538	---
	(9.17)	(-4.53)		(2.18)			(1.86)					(-2.34)	

Table 14

Multivariate Logit Equations for Doubled Catch by River

River	Constant	DOLDBLE2	STRPSHM	DYSFSHED	COMPARE	TCOMPARE	LRGCOT	TROUTCOT	REASON	RVRMAIN	REASON03	INCOME	EDUCATE	AGE
1	4.8926	-1.45268	---	---	-2.11996	-2.08042	+.3714	---	+2.8855	+2.31872	-1.64504	+1.3532	---	---
	(8.52)	(-4.40)			(-2.61)	(-2.51)	(2.20)		(2.93)	(2.62)	(-2.25)	(2.80)		
2	1.44026	-1.10002	-.48774	---	---	---	+.51646	---	---	+1.6816	---	+1.06706	---	---
	(8.32)	(-4.72)	(-2.30)				(3.20)			(2.25)		(2.66)		
3	-1.01812	-.70678	---	+2.02452	---	---	---	---	---	---	+1.06954	+.64948	---	---
	(6.47)	(-3.40)		(2.99)							(1.67)	(1.81)		
4	3.15424	-.79034	---	+1.4942	---	---	---	---	---	---	-1.2394	---	---	---
	(13.93)	(-3.70)		(3.12)							(-1.78)			
5	5.22722	-.69068	---	---	-2.16048	---	---	---	---	---	---	+1.00924	-2.29228	---
	(6.38)	(-2.88)			(-2.14)							(1.81)	(-1.82)	
6	1.56544	-.85314	---	---	---	---	+.44674	---	---	---	---	+1.1881	-1.39168	---
	(8.63)	(-5.18)					(3.61)					(3.34)	(-1.80)	
8	3.51398	-.9794	-.46808	---	---	---	+.31932	+.3132	---	---	---	---	---	---
	(14.79)	(-4.37)	(-2.20)				(1.93)	(1.90)						
10	1.30066	-.46682	---	+1.52598	---	---	---	---	---	---	---	---	---	---
	(16.45)	(-2.37)		(2.78)										

Table 14

(continued)

River	Constant	DOLDBLE2	STRPSHM	DYSFSHED	COMPARE	TCOMPARE	LRGCOT	TROUTCOT	REASON	RVRMAIN	REASON03	INCOME	EDUCATE	AGE
12	3.6835	-1.02698	---	---	-1.59132	---	---	+.3872	---	+2.16424	---	---	---	---
	(16.21)	(-5.25)			(-2.65)			(2.62)		(3.35)				
13	6.61276	-1.54326	-.6877	---	---	---	---	---	---	---	---	---	---	---
	(9.94)	(-4.02)	(-2.44)											
14	6.05246	-1.5041	-.43244	+1.2682	-1.74468	---	---	+.43918	---	---	---	---	---	---
	(14.68)	(-5.99)	(-2.14)	(3.10)	(-2.92)			(2.58)						
15	3.77136	-1.20552	---	1.0350	---	---	+.25104	---	---	---	---	---	---	---
	(18.31)	(-5.48)		(2.73)			(1.84)							
16	-.82594	-2.6274	-.71662	+2.4874	---	---	---	---	---	+2.20652	---	---	---	+2.47144
	(-1.83)	(-3.75)	(-1.70)	(3.17)						(1.95)				(1.75)
17	11.07916	-2.18984	---	+3.93058	-2.8383	-4.03884	---	---	---	---	---	---	---	---
	(5.06)	(-2.78)		(2.43)	(-2.05)	(-2.02)								
18	3.12316	-1.18032	---	+1.57036	---	---	---	---	---	+2.32246	---	---	---	---
	(16.01)	(-4.76)		(3.32)						(2.19)				
20	4.46628	-.93938	-.50760	---	---	---	+.39054	---	---	---	---	---	---	---
	(16.06)	(-4.34)	(-2.88)				(2.77)							

Table 14

(continued)

River	Constant	DOLDBLE2	STRPSHM	DYSFSHED	COMPARE	TCOMPARE	LRGCOT	TROUTCOT	REASON	RVRMAIN	REASON03	INCOME	EDUCATE	AGE
21	2.3014	-.8715	---	+.88294	---	---	---	---	---	---	---	---	---	---
	(16.66)	(-3.90)		(2.48)										

Table 15

Sample Size for Logit by River

River Code	River Name	Bid Equation: Current Conditions	Large Trout	Double Catch
1	Beaverhead	108	113	104
2	Big Hole	140	148	132
3	Bitterroot	117	112	102
4	Blackfoot	97	94	94
5	Boulder	69	67	69
6	Bighorn	151	147	152
7	Upper Clark Fork	29 *	29 *	29 *
8	Clark Fork	126	126	130
10	Flathead	65	68	72
11	South Fork of Flathead	11 *	11 *	11 *
12	Gallatin	152	147	143
13	Kootenai	72	73	70
14	Madison	155	167	161
15	Missouri	148	158	151
16	Rock Creek	78	75	72
17	Smith	44	46	44
18	Stillwater	113	115	110
20	Upper Yellowstone	121	115	123
21	Middle Yellowstone	105	98	95

* Estimate did not converge.

Table 16

Open CVM Equations by River: Current Conditions

River	Constant	DYSFSHED	STRPSRM	HRSDAY	DYSFSHYR	YRSFSHRV	YRSFSH	TROUTCOT	TROUTKPT	RVRMAIN	REASON	REASON03	REASON06	TCOMPARE	INCOME	AGE	EDUCATE
1	2.323228	+1.205624	---	---	---	---	---	---	-.187806	+1.466443	---	---	---	-.695381	---	---	---
	(7.65)	(4.23)							(-2.04)	(3.24)				(-1.93)			
	Observations: 57		$\bar{R}^2$: .402	F: 10.392													
2	-.111898	+.73807	---	---	---	---	---	---	---	+1.360363	---	---	---	---	---	---	---
	(-1.68)	(3.52)								(3.33)							
	Observations: 65		$\bar{R}^2$: .308	F: 10.5													
3	2.141177	---	---	---	---	---	---	+.377787	---	---	+.966628	---	---	---	---	---	---
	(10.67)							(3.70)			(1.92)						
	Observations: 40		$\bar{R}^2$: .253	F: 7.599													
4	-.661994	---	---	+.823252	+.578794	---	---	---	+.229141	---	---	---	---	---	---	---	---
	(-.895)			(1.95)	(3.15)				(2.50)								
	Observations: 42		$\bar{R}^2$: .319	F: 7.411													

Table 16

(continued)

River	Constant	DYSFSHED	STRPSHM	HRSDAY	DYSFSHYR	YRSFSHRV	YRSFSH	TROUTCOT	TROUTKPT	RVRMAIN	REASON	REASON03	REASON06	TCOMPARE	INCOME	AGE	EDUCATE
5	.202006	+.583541	-.523989	---	---	---	---	---	---	-1.381361	---	---	---	---	+1.015517	---	---
	(.275)	(2.21)	(-2.83)							(-2.69)					(4.39)		
	Observations: 33		$\bar{R}^2$: .683	F: 18.242													
6	3.724872	+1.172372	-.281662	---	---	---	---	---	---	---	---	---	---	-.46254	---	---	---
	(13.75)	(6.17)	(-3.43)											(-2.08)			
	Observations: 85		$\bar{R}^2$: .480	F: 26.859													
7	-.196679	---	---	+1.594851	---	---	---	---	---	---	---	---	---	---	---	---	---
	(-.18)			(1.91)													
	Observations: 11		$\bar{R}^2$: .210	F: 3.662													
8	3.680271	+.691543	---	---	---	---	-.67509	---	---	---	---	---	---	---	+.569396	---	-.665611
	(3.08)	(3.17)					(-2.80)								(2.55)		(-1.69)
	Observations: 54		$\bar{R}^2$: .271	F: 5.914													

Table 16

(continued)

River	Constant	DISFSHED	STRFSHM	HRSDAY	DISFSHYR	YRSFSHRV	YRSFSH	TROUTCOT	TROUTKPT	RVRMAIN	REASON	REASON03	REASON06	YCOMPARE	INCOME	AGE	EDUCATE
10	3.593903	---	-.838787	---	+1.031396	---	---	---	---	---	---	---	---	---	---	-1.611449	-1.905326
	(2.31)		(-5.18)		(3.82)											(-4.03)	(2.79)
	Observations: 24		$\bar{R}^2$: .698	F: 14.272													
12	2.306052	+1.260004	---	---	---	---	---	---	---	+1.060127	---	---	---	---	---	---	---
	(17.84)	(2.88)								(3.28)							
	Observations: 69		$\bar{R}^2$: .289	F: 14.835													
13	2.633168	+.1430232	---	---	---	---	---	---	---	---	---	---	---	-.777625	---	---	---
	(10.32)	(4.44)												(-2.77)			
	Observations: 32		$\bar{R}^2$: .489	F: 15.855													
14	1.855164	+.82921	---	+.596732	---	---	+.296716	---	---	+.822016	---	-.873937	---	---	---	---	---
	(2.18)	(5.44)		(1.98)			(2.01)			(2.69)		(-2.66)					
	Observations: 75		$\bar{R}^2$: .545	F: 18.703													

Table 16

(continued)

River	Constant	DYSFSHED	STRPSHM	HRSDAY	DYSFSHYR	YRSFSHRV	YRSFSH	TROUTCOT	TROUTKPT	RVRMAIN	REASON	REASON03	REASON06	TCOMPARE	INCOME	AGE	EDUCATE
15	2.700073	+.855312	---	---	---	-.247383	---	---	---	---	---	+1.136422	-1.027966	---	---	---	---
	(5.57)	(4.08)				(-1.96)						(2.59)	(-3.10)				
	Observations: 94		$\bar{R}^2$: .215	F: 7.370													
16	2.26463	---	---	+.783672	---	---	---	---	---	---	---	---	-1.125425	---	---	---	---
	(4.86)			(2.92)									(-3.71)				
	Observations: 40		$\bar{R}^2$: .307	F: 9.630													
17	.541342	---	---	+.436208	---	+.391943	---	---	---	-1.586265	---	---	+1.472358	---	---	---	---
	(1.398)			(2.17)		(3.94)				(-3.47)			(5.92)				
	Observations: 16		$\bar{R}^2$: .816	F: 17.678													
18	4.532665	---	-.307883	---	---	---	---	---	---	---	+.696985	---	---	-1.822189	---	---	---
	(7.59)		(-1.88)								(1.70)			(-3.91)			
	Observations: 46		R^2: .304	F: 7.538													

Table 16

(continued)

River	Constant	DYSFSHED	STRPSHM	HRSDAY	DYSFSHYR	YRSFSHRV	YRSFSH	TROUTCOT	TROUTKPT	RVRMAIN	REASON	REASON03	REASON06	TCOMPARE	INCOME	AGE	EDUCATE
20	4.288664	---	-.341202	---	---	---	---	+.255851	---	---	---	-1.083329	---	---	---	---	---
	(7.81)		(-2.91)					(2.37)				(-2.30)					
	Observations: 54		R^2: .321	F: 9.367													
21	2.549081	+.535398	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	(18.98)	(4.06)															
	Observations: 43		$\bar{R}^2$: .269	F: 16.470													

Table 17

Open CVM Equations by River: Large Trout

River	Constant	DYSFSHED	STRPSHM	HRSDAY	YRSFSHRV	YRSFSH	TROUTCOT	TROUTKPT	LRGCOT	RVRMAIN	REASON	REASON03	REASON06	CCMPARE	TCOMPARE	INCOME	AGE	EDUCATE
1	2.667747	+.825127	---	+.61342	-.369887	---	---	-.249038	+.284286	+1.72614	+1.295923	---	---	---	-.982193	---	---	---
	(4.12)	(3.39)		(2.22)	(-3.04)			(-3.92)	(3.97)	(5.29)	(3.26)				(-3.26)			
	Observations: 64	$\bar{R}^2$: .680	F: 17.731															
2	3.843447	+.671265	---	---	-.406504	---	---	-.187968	---	+1.106323	---	---	---	---	-.467396	---	---	---
	(11.43)	(3.90)			(-4.04)			(-3.29)		(2.34)					(-1.93)			
	Observations: 70	$\bar{R}^2$: .436	F: 11.676															
3	2.46818	+.430807	---	---	---	---	.210861	---	---	---	---	---	---	---	---	---	---	---
	(15.12)	(1.95)					(2.48)											
	Observations: 54	$\bar{R}^2$: .171	F: 6.476															
4	3.150213	+.676609	---	+.623868	-.567707	+.698777	---	---	---	---	---	---	-.447397	---	---	---	---	-1.299239
	(5.06)	(4.41)		(2.63)	(-4.74)	(3.35)							(-2.00)					(-3.48)
	Observations: 50	$\bar{R}^2$: .545	F: 10.764															

Table 17

(continued)

River	Constant	DYSFSHED	STRPSHM	HRSDAY	YRSFSHRV	YRSFSH	TROUTCOT	TROUTKPT	LRGCOT	RVRMAIN	REASON	REASON03	REASON06	COMPARE	YCOMPARE	INCOME	AGE	EDUCATE
5	.364397	+.523648	---	---	---	---	---	---	-.180001	---	---	---	---	---	---	+.614196	---	---
	(.50)	(2.37)							(-1.73)							(2.95)		
	Observations: 35		$\bar{R}^2$: .421	F: 9.255														
6	1.093248	1.07588	---	+.726343	---	---	---	---	---	---	---	---	---	---	---	+.472396	---	-.643619
	(1.40)	(5.70)		(2.59)												(2.89)		(-1.88)
	Observations: 90		$\bar{R}^2$: .435	F: 18.108														
7	.306318	---	---	+1.612215	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	(.39)			(2.75)														
	Observations: 13		$\bar{R}^2$: .353	F: 7.544														
8	3.730197	---	-.289171	---	---	---	+.285574	---	---	---	---	---	---	---	---	---	---	-.565993
	(6.60)		(-2.41)				(3.54)											(-1.79)
	Observations: 61		$\bar{R}^2$: .208	F: 6.246														

Table 17

(continued)

River	Constant	DYSFSHED	STRPSHM	HRSDAY	YRSFSHRV	YRSFSH	TROUTCOT	TROUTKPT	LRGCOT	RVRMAIN	REASON	REASON03	REASON06	COMPARE	TCOMPARE	INCOME	AGE	EDUCATE (-1.79)
10	7.179874	+1.124613	---	---	---	---	---	---	---	---	---	---	---	---	---	---	-1.377352	---
	(3.40)	(2.49)															(-2.34)	
	Observations: 27		$\bar{R}^2$: .308	F: 6.784														
12	2.245088	---	---	---	---	---	---	---	---	+1.239809	+1.005233	---	---	---	---	---	---	---
	(16.71)									(4.22)	(2.80)							
	Observations: 80		$\bar{R}^2$: .231	F: 12.879														
13	4.602519	+.386478	-.506948	---	-.354911	---	---	---	+.386075	---	---	---	---	---	---	---	---	---
	(11.93)	(1.87)	(-5.96)		(-2.46)				(4.61)									
	Observations: 33		$\bar{R}^2$: .643	F: 15.389														
14	1.548634	+.893381	---	---	---	---	---	-.172198	---	+.688069	---	---	---	---	---	+.352636	---	---
	(2.28)	(4.90)						(-2.42)		(2.08)						(1.87)		
	Observations: 79		$\bar{R}^2$: .376	F: 12.767														

Table 17

(continued)

River	Constant	DYSFSHED	STRPSHM	HRSDAY	YRSFSHRV	YRSFSH	TROUTCOT	TROUTKPT	LRGCOT	RVRMAIN	REASON	REASON03	REASON06	CCMPARE	TCOMPARE	INCOME	AGE	EDUCATE
15	1.157564	+.772459	---	---	---	---	---	---	---	---	---	+.752889	-.760204	---	---	---	---	+.705321
	(1.84)	(4.74)										(2.11)	(-2.78)					(2.13)
	Observations: 99		$\bar{R}^2$: .241	F: 8.780														
16	2.672663	+1.19237	---	---	---	---	---	---	---	+1.443411	---	---	-.572770	---	---	---	---	---
	(9.26)	(5.12)								( )			(-1.71)					
	Observations: 37		$\bar{R}^2$: .459	F: 11.198														
17	11.052019	---	+.222685	---	---	+5.06957	---	---	+.322562	---	+1.773903	---	---	-2.868355	---	---	-6.422811	---
	(21.03)		(3.62)			(34.09)			(16.27)		(9.70)			(-25.57)			(-22.70)	
	Observations: 10		$\bar{R}^2$: .996	F: 369.183														
18	2.564063	+.745848	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	(16.10)	(3.26)																
	Observations: 47		$\bar{R}^2$: .173	F: 10.646														

Table 17

(continued)

River	Constant	DISFSHED	STRPSHM	HRSDAY	YRSFSHRV	YRSFSH	TROUTCOT	TROUTEPT	LRGCOT	RVRMAIN	REASON	REASON03	REASON06	COMPARE	TCOMPARE	INCOME	AGE	EDUCATE
20	1.690405	---	---	---	---	---	---	---	+.209394	---	---	-.775809	---	---	+.614174	+.544767	---	---
	(1.95)								(2.27)			(-2.02)			(1.71)	*(2.62)		
	Observations: 67		$\bar{R}^2$: .232	F: 5.997														
21	.645308	+.522802	---	---	---	+.462869	---	---	---	---	---	---	---	+.587587	---	---	---	---
	(.898)	(4.00)				(2.34)								(1.74)				
	Observations: 44		$\bar{R}^2$: .314	F: 7.716														

Table 16

Open CVM Equations by River: Doubled Catch

River	Constant	DISFSHED	STRPSHN	HRSDAY	DISFSHYR	YRSFSHRV	YRSFSH	TROUTCOT	TROUTEPT	LRGCOT	RVRMAIN	REASON	REASON03	REASON06	COMPARE	TCOMPARE	INCOME	AGE	EDUCATE
1	2.069036	+1.03264	-.250793	---	---	---	---	---	-.152729	---	---	---	---	-.613596	---	---	+.374874	---	---
	(3.29)	(3.55)	(-2.04)						(-1.96)					(-2.25)			(2.04)		
	Observations: 55		$\bar{R}^2$: .503	F: 11.934															
2	3.169277	+.697344	---	---	---	-.226421	---	---	---	---	+1.524771	---	---	---	---				
	(11.66)	(4.13)				(-2.19)					(2.51)								
	Observations: 64		$\bar{R}^2$: .330	F: 11.33															
3	-.071946	---	---	+.571421	---	---	---	---	---	---	---	+.932128	---	---	---	---	---	---	+.936652
	(-.061)			(1.73)								(2.33)							(2.00)
	Observations: 52		$\bar{R}^2$: .131	F: 3.711															
4	.969614	---	---	---	+.447457	---	---	+.322264	---	---	---	---	---	---	---	---	---	---	---
	(2.05)				(2.69)			(3.94)											
	Observations: 52		$\bar{R}^2$: .423	F: 19.7															

Table 18

(continued)

River	Constant	DYSFSHED	STRPSHM	HRSDAY	DYSFSHYR	YRSFSHRV	YRSFSH	TROUTCOT	TROUTKPT	LRGCOT	RVRMAIN	REASON	REASON03	REASON06	COMPARE	TCOMPARE	INCOME	AGE	EDUCATE
5	.324433	+.649381	---	---	---	---	+.753987	---	---	---	---	+.706683	---	---	---	---	---	---	---
	(.498)	(3.22)					(3.58)					(1.79)							
	Observations: 34		$\bar{R}^2$: .472	F: 10.834															
6	2.004822	+1.048947	-.232943	---	+.363247	---	---	---	-.099554	+.097397	---	---	---	---	---	-.382141	+.537011	---	-.901842
	(3.30)	(5.51)	(-2.80)		(3.16)				(-2.06)	(2.03)						(-1.97)	(4.08)		(-3.40)
	Observations: 83		$\bar{R}^2$: .675	F: 22.261															
7	8.730448	---	---	---	---	---	+1.590791	---	+.570765	---	---	---	-2.608267	-1.474757	---	---	---	-2.158121	---
	(3.70)						(4.34)		(4.53)				(-7.58)	(-3.32)				(-2.44)	
	Observations: 13		$\bar{R}^2$: .87	F: 17.034															
8	2.151755	+.420056	-.533871	+.877824	---	---	-.483495	---	---	---	---	---	---	---	---	---	+.505555	---	---
	(2.55)	(2.52)	(-4.71)	(3.92)			(-2.86)										(3.13)		
	Observations: 55		$\bar{R}^2$: .476	F: 10.828															

Table 18

(continued)

River	Constant	DYSFSHED	STRFSHM	HRSDAY	DYSFSHYR	YRSFSHRV	YRSFSH	TROUTCOT	TROUTKPT	LRGCOT	RVRMAIN	REASON	REASONO3	REASONO6	COMPARE	YCOMPARE	INCOME	AGE	EDUCATE
10	4.86819	+2.134017	---	---	---	---	---			---	---	---	---	---	---	---	---	-1.481	+1.69114
	(2.46)	(3.47)																(-2.67)	(1.77)
	Observations: 24		$\bar{R}^2$: .525	F: 9.484															
12	2.272791	---	---	---	---	---	---	---	---	---	+1.159162	+.7064	---	---	---	---	---	---	---
	(17.44)										(4.29)	(2.08)							
	Observations: 70		$\bar{R}^2$: .225	F: 11.042															
13	4.67361	---	-.420835	---	---	-.356138	---	---	---	+.45787	---	---	---	---	---	---	---	---	---
	(14.52)		(-5.89)			(-3.02)				(6.36)									
	Observations: 36		$\bar{R}^2$: .621	F: 20.119															
14	2.286679	---	-.651655	---	+.354987	---	---	---	---	---	---	---	-.880866	---	---	-.940758	+.643415	---	---
	(2.21)		(-5.29)		(2.07)								(-2.61)			(-2.99)	(3.15)		
	Observations: 79		$\bar{R}^2$: .438	F: 13.154															

Table 18

(continued)

River	Constant	DYSFSHED	STRPSHM	HRSDAY	DYSFSHIN	IRSFSHRV	IRSFSH	TROUTCOT	TROUTKPT	LRGCOT	RVRMAIN	REASON	REASON03	REASON06	COMPARE	TCOMPARE	INCOME	AGE	EDUCATI
15	3.230112	+.581344	-.278607	---	---	---	---	---	---	+.158686	---	---	---	---	---	---	---	---	---
	(12.33)	(2.94)	(-2.72)							(2.09)									
	Observations: 95		$\bar{R}^2$: .231	F: 10.411															
16	2.706172	+.812706	---	---	---	---	---	---	---	---	+1.338204	---	---	-.699479	---	---	---	---	---
	(11.46)	(4.30)									(3.27)			(-2.61)					
	Observations: 39		$\bar{R}^2$: .439	F: 10.897															
17	4.852212	---	---	---	---	---	+2.747842	+.183375	---	---	---	---	---	---	-2.113021	---	---	-2.718172	---
	(5.79)						(10.44)	(3.97)							(-9.70)			(-7.29)	
	Observations: 11		$\bar{R}^2$: .951	F: 50.003															
18	7.61109	---	-.770289	---	---	---	---	---	+.163118	---	---	---	---	---	---	+.163118	---	-.955278	---
	(8.65)		(-6.47)						(2.89)							(2.89)		(-4.26)	
	Observations: 48		$\bar{R}^2$: .526	F: 14.026															

Table 18

(continued)

River	Constant	DISFSHED	STRFSHN	HRSDAY	DISFSHYR	YRSFSHRV	YRSFSH	TROUTCOT	TROUTKPT	LRGCOT	RVRMAIN	REASON	REASON03	REASON06	COMPARE	YCOMPARE	INCOME	AGE	EDUCATE
20	.837293	---	---	---	---	-.567444	+.871506	---	---	+.195457	---	---	-.884461	---	---	---	+.526302	---	---
	(1.02)					(-2.92)	(3.93)			(2.32)			(-2.52)				(2.58)		
	Observations: 61		$\bar{R}^2$: .440	F: 10.425															
21	1.771724	+.527905	---	---	---	---	---	---	---	+.176806	---	---	---	---	---	+.901912	---	---	---
	(5.17)	(3.45)								(1.92)						(2.38)			
	Observations: 50		$\bar{R}^2$: .308	F: 8.259															

Table 19

Logit Estimated Net Economic Value Per Trip Complete Sample

Bid Question	Mean	Median	Sample Size
Current Conditions	90.94	24.51	1751
Double Catch of Large Trout	101.77	48.[illegible]4	1719
Double Catch	97.52	36.07	1749

Note: Mean integration estimate truncated at $500 (maximum observed "yes" response and maximum bid asked).

Table 20

Summary of Open CVM
Statistics for Complete Sample

Statistic	Variable		
	Current Conditions	Large Trout	Double Catch
Mean	28.54	28.82	26.64
Standard error	2.55	2.04	1.91
Observations	2110	2122	2120
Median	5	5	5
Range	2500	2500	2000
Percent Zero	46.1	39.5	42.5
Mode	0	0	0
Kurtosis	235.53	259.05	181.52
Skewness	13.17	12.66	10.95

Notes: Excluded observations: bid values coded 9999 and protest responses (WHYZEROj = 3 or 4 or 5).

Where: Current conditions = WTP for current conditions.

Large trout = WTP to double chance of large trout.

Double catch = WTP to double total catch.

Table 21

Influence of Selected Subsamples on Open CVM Mean Willingness-to-Pay

Statistic	Subsample				
	Complete	Not 9999	Not 0	0<Resp<=500	TCM
Current Conditions:					
Observations	2183	2182	1105	1096	956
Mean	32.20	27.63	52.18	41.70	23.59
Standard error	5.19	2.47	4.62	2.31	3.25
Large Trout:					
Observations	2183	2182	1233	1227	956
Mean	32.67	28.10	47.68	41.96	26.45
Standard error	4.98	1.99	3.33	2.07	5.50
Doubled Catch:					
Observations	2183	2182	1168	1162	956
Mean	30.53	25.96	46.17	40.64	22.20
Standard error	4.93	1.85	3.26	2.12	2.31

Notes: Subsamples are:
- Not 9999 excludes bid values coded 9999.
- Not 0 excludes zero value responses.
- 0<Resp<=500 excludes responses equal to zero and greater than 500.
- TCM is the subsample that would be used in a travel cost model and includes only main purpose and single destination trips.

Table 22

Logit by Cluster

Net Economic Values per Trip

Cluster	Current Conditions	Large Trout	Double Catch
	Bid Variable		
Median Values:			
1 Generalist	31.42	56.10	41.47
2 Generalist	34.40	49.38	38.43
3 Occasional User	1.42	30.23	18.67
4 Specialist	72.03	105.91	74.03
Mean Values:			
1 Generalist	91.03	110.54	99.96
2 Generalist	117.07	86.46	80.81
3 Occasional User	7.56	67.51	45.26
4 Specialist	170.28	166.75	145.56

Notes: Mean values based on integration truncated at maximum observed "yes" response by cluster ($500 in all cases).
Current Conditions = bid for current conditions.
Large Trout = bid for double chance of large trout catch.
Double Catch = bid to double catch.
Sample size for Current Conditions:
Cluster: 1 = 294, 2 = 319, 3 = 211, 4 = 546;
Large Trout: 1 = 296, 2 = 314, 3 = 218, 4 = 550;
Double Catch: 1 = 297, 2 = 310, 3 = 207, 4 = 529.

Table 23

Open-Ended CVM Mean Bids by Cluster

Complete Sample

Bid Question	Cluster	Mean	Median	Std. Error	n
Current Conditions	1	29.028	5.00	9.116	288
	2	28.327	5.00	4.954	309
	3	9.482	0.00	1.543	232
	4	40.144	8.00	4.321	585
Large Trout	1	25.965	10.00	8.767	288
	2	30.265	10.00	4.775	309
	3	9.44	1.00	1.796	232
	4	43.202	10.00	3.969	585
Double Catch	1	26.215	10.00	5.986	488
	2	31.061	10.00	5,100	309
	3	8.444	0.00	1.343	232
	4	38.154	10.00	4.570	585

Notes: Excluded observations: bid values coded 9999 and protest responses (WHYZEROj = 3 or 4 or 5).
Where: Current Conditions = WTP for current conditions.
Large Trout = WTP to double chance of large trout.
Double catch = WTP to double total catch.

Table 24

Open-Ended Cum. Mean Bids by Cluster Group

Response Not Equal to Zero Excluded

Response	Cluster	Mean	Median	Std. Error	n
Current Conditions	1	46.188	10	14.367	181
	2	44.658	20	7.574	196
	3	19.643	10	2.910	112
	4	66.347	20	6.792	354
Large Trout	1	35.441	10	11.908	211
	2	42.703	20	6.559	219
	3	18.644	10	3.325	118
	4	66.173	25	5.744	382
Double Catch	1	36.473	15	8.224	207
	2	46.367	20	7.389	207
	3	17.336	10	2.503	113
	4	63.771	25	7.331	350

Table 25

Open-Ended CVM Mean Bids by Cluster Group

0 < Response <= 500

Response	Cluster	Mean	Median	Std. Error	n
Current Conditions	1	32.556	10	4.561	180
	2	39.759	20	5.805	195
	3	19.643	10	2.910	112
	4	55.980	20	4.925	349
Large Trout	1	23.705	10	2.024	210
	2	38.312	20	4.894	218
	3	18.644	10	3.325	118
	4	63.197	25	4.926	381
Double Catch	1	26.585	12	3.110	205
	2	41.738	20	5.787	206
	3	17.336	10	2.503	113
	4	58.223	25	4.805	349

Table 26

Logit by River: Mean Values

Bids for Current Conditions (Multivariate)

River Code	River Name	Limit of Max "Yes" Bid Response		Limit of $500 Bid		
		Max Bid	Mean	Mean	Median	Sample
1	Beaverhead	400	162.07	188.20	75.52	108
2	Big Hole	500		217.77	103.25	140
3	Bitterroot	250	43.43	58.83	9.19	117
4	Blackfoot	400	115.75	132.86	28.22	97
5	Boulder	250	97.39	148.75	45.30	69
6	Bighorn	500		158.50	62.97	151
8	Clark Fork	300	64.85	86.49	10.60	126
10	Flathead	300	82.49	99.13	38.91	65
12	Gallatin	500		179.98	46.95	152
13	Kootenai	500		38.13	7.01	72
14	Madison	400	203.98	228.12	168.34	155
15	Missouri	300	58.55	62.53	35.54	148
16	Rock Creek	250	70.92	92.17	32.62	78
17	Smith	150	77.96	152.87	65.32	44
18	Stillwater	400	78.49	84.87	28.30	113
20	Upper Yellowstone	300	112.13	150.25	52.57	121
21	Middle Yellowstone	200	48.84	74.35	14.76	105

Table 27

Logit by River: Mean Values

Bids for Large Trout

River	Limit of Maximum "Yes Bid Response: Max Bid	Limit of Maximum "Yes Bid Response: Mean	Limit of $500 Bid: Mean	Median	Sample
1	500		173.27	113.83	113
2	500		303.12	301.07	148
3	500		176.27	98.85	112
4	400	83.04	88.87	35.60	94
5	250	138.84	192.45	126.33	67
6	500		128.44	96.15	147
8	500		50.69	33.64	126
10	300	134.82	179.24	89.78	68
12	500		75.12	29.37	147
13	500		134.75	46.16	73
14	500		225.91	159.66	167
15	500		115.83	47.92	158
16	500		27.34	16.93	75
17	400	82.10	84.09	54.99	46
18	400	102.18	108.18	56.72	115
20	500		206.00	132.61	115
21	250	81.48	96.58	52.55	98

Table 28

Logit by River: Mean Values

Bids for Doubled Catch

	Limit of Maximum "Yes" Bid Response		Limit of $500 Bid		
River	Max. Bid	Mean	Mean	Median	Size
1	500		139.27	85.41	104
2	500		153.33	81.21	132
3	500		200.59	103.73	102
4	500		120.17	54.11	94
5	500		227.81	145.76	69
6	500		188.73	100.68	152
8	400	65.69	70.59	21.67	130
10	300	183.51	278.04	312.51	72
12	500		108.77	44.19	143
13	400	44.05	45.09	23.37	70
14	500		169.94	114.45	161
15	500		89.96	40.45	151
16	500		70.27	55.42	72
17	300	88.03	92.28	67.31	44
18	400	83.66	88.95	38.88	110
20	500		116.91	44.66	123
21	250	82.56	113.69	38.73	95

Table 29

Comparison of Bid Responses by River for Logit Method

River	River Name	Logit Mean Values * Current Conditions	Large Trout	Doubled Catch
1	Beaverhead	162.07	173.27	139.27
2	Big Hole	217.77	303.12	153.33
3	Bitterroot	43.43	176.27	200.59
4	Blackfoot	115.75	83.04	120.17
5	Boulder	97.39	134.84	227.81
6	Bighorn	158.50	128.44	188.73
8	Clark Fork	64.85	50.69	65.69
10	Flathead	82.49	134.82	183.51
12	Gallatin	179.98	75.12	108.77
13	Kootenai	38.13	134.75	44.05
14	Madison	203.98	225.91	169.94
15	Missouri	58.55	115.83	89.96
16	Rock Creek	70.92	27.34	70.27
17	Smith	77.96	82.10	88.03
18	Stillwater	78.49	102.18	83.66
20	Upper Yellowstone	112.13	206.00	116.91
21	Middle Yellowstone	48.84	81.48	82.56

Difference Across Bid Questions

River	River Name	Large Trout Minus Current Conditions	Doubled Catch Minus Current Conditions
1	Beaverhead	11.20	- 22.80
2	Big Hole	85.35	- 64.44
3	Bitterroot	132.84	157.16
4	Blackfoot	- 32.71	4.42
5	Boulder	37.45	130.42
6	Bighorn	- 30.06	30.23
8	Clark Fork	- 14.16	.84
10	Flathead	52.33	101.02
12	Gallatin	- 104.86	- 71.21
13	Kootenai	96.62	5.92
14	Madison	21.93	- 34.04
15	Missouri	57.28	31.41
16	Rock Creek	- 43.58	- .65
17	Smith	4.14	10.07
18	Stillwater	23.69	5.17
20	Upper Yellowstone	93.87	4.78
21	Middle Yellowstone	32.64	33.72

* Integration upper limit maximum "yes" bid response.

Table 30

Summary

Comparison of Median

Logit Bids by River

(Bivariate Equations)

	Significantly Different		Not Significantly Different		Missing
	Number	Percent	Number	Percent	Number
DOLDBLE1 and DOLAMT:					
Test 1	10	55	8	44	1
Test 2	6	67	3	33	10
DOLDBLE2 and DOLAMT:					
Test 1	3	20	12	80	4
Test 2	1	11	8	89	10

Where: Number = number of rivers.
Percent = percent of nonmissing rivers.
Missing = number of rivers with no confidence interval output.
DOLAMT = Bid to continue fishing the river.
DOLDBLE1 = Bid to continue fishing the river, but with doubled chance of catching large trout.
DOLDBLE2 = Bid to continue fishing the river, but with doubled catch.
Test 1 = DOLAMT compared to 95% confidence interval on DOLDBLE__.
Test 2 = DOLDBLE compared to 95% confidence interval on DOLAMT.

Table 31

Open-Ended CVM Mean Bid by River

(Excludes Protest Bids)

River	River Name	Current Conditions Mean	Current Conditions n	Large Trout Mean	Large Trout n	Double Catch Mean	Double Catch n
1	Beaverhead	29.475	120	31.008	121	27.050	119
2	Big Hole	26.200	150	22.721	154	21.166	151
3	Bitterroot	28.888	127	24.837	129	24.434	129
4	Blackfoot	11.058	103	29.924	105	30.533	105
5	Boulder	44.078	77	29.312	77	23.857	77
6	Bighorn	38.437	167	54.331	160	50.710	162
7	Upper Clark Fork	5.457	35	11.529	34	21.294	34
8	Clark Fork	13.679	140	13.474	137	14.614	140
10	Flathead	29.914	81	25.938	81	24.173	81
11	South Fork of Flathead	11.786	14	18.929	14	24.786	14
12	Gallatin	15.510	153	24.849	159	16.025	159
13	Kootenai	11.104	77	18.127	79	16.779	77
14	Madison	52.243	177	54.774	177	54.800	175
15	Missouri	36.957	162	24.193	161	23.419	160
16	Rock Creek	13.240	100	19.152	99	16.000	101
17	Smith	35.469	49	27.32	50	16.857	49
18	Stillwater	16.315	127	15.955	132	15.451	133
20	Upper Yellowstone	60.000	138	43.212	137	37.475	139
21	Middle Yellowstone	14.119	109	13.589	112	15.018	111

Table 32

Open-Ended CVM Mean Bids by River: Response Equal to Zero Excluded (Summary)

	Current Conditions		Large Trout		Double Catch	
River	Mean	n	Mean	n	Mean	n
1	53.591	66	48.693	75	48.694	62
2	47.349	83	37.924	92	36.988	86
3	52.931	58	44.083	72	44.632	68
4	21.491	53	36.889	63	37.391	64
5	82.780	41	50.156	45	41.750	44
6	56.327	104	76.283	113	78.865	104
7	11.938	16	19.350	20	36.200	20
8	24.694	72	22.388	80	27.444	72
10	43.906	32	51.650	40	58.727	33
11	33.000	5	33.125	8	43.375	8
12	28.590	83	34.184	103	24.287	87
13	20.238	42	30.533	45	26.367	49
14	103.337	89	97.887	97	100.978	92
15	59.870	100	36.952	105	36.686	102
16	25.600	50	35.902	51	28.060	50
17	64.000	27	67.050	20	39.550	20
18	36.268	56	35.088	57	31.274	62
20	114.264	72	69.518	85	66.649	77
21	27.036	56	22.774	62	23.044	68
All	52.176	1105	47.679	1233	46.165	1168

Table 33

Open-Ended CVM Mean Bids by River: Response Equal to Zero Excluded Current Conditions

River	Mean	Median	Standard Error	n
1	53.591	20	12.552	66
2	47.349	20	9.408	83
3	52.931	10	12.172	58
4	21.491	10	4.420	53
5	82.780	20	31.595	41
6	56.327	20	8.335	104
7	11.938	10	2.967	16
8	24.694	10	5.915	72
10	43.906	10	18.983	32
11	33.000	20	17.000	5
12	28.590	10	5.593	83
13	20.238	10	3.750	42
14	103.337	50	18.134	89
15	59.870	10	21.611	100
16	25.600	15	4.975	50
17	64.000	30	18.430	27
18	36.268	10	10.392	56
20	114.264	20	49.094	72
21	27.036	15	4.860	56
All	52.176	15	4.624	1105

Table 34

Open-Ended CVM Mean Bids by River:

Response Equal to Zero Excluded

Large Trout

River	Mean	Median	Standard Error	n
1	48.693	25	7.652	75
2	37.924	20	4.938	92
3	44.083	17.5	9.756	72
4	36.889	15	15.761	63
5	50.156	20	15.791	45
6	76.283	25	13.901	113
7	19.350	10	5.618	20
8	22.388	10	3.485	80
10	51.650	10	24.852	40
11	33.125	21.5	11.569	8
12	34.184	10	7.153	103
13	30.533	10	5.690	45
14	97.887	50	14.603	97
15	36.952	15	7.670	105
16	35.902	20	5.206	51
17	67.050	40	24.870	20
18	35.088	20	10.697	57
20	69.518	20	29.856	85
21	22.774	15	3.188	62
All	47.679	20	3.331	1233

Table 35

Open-Ended CVM Mean Bids by River:

Response Equal to Zero Excluded

Double Catch

River	Mean	Median	Standard Error	n
1	48.694	25	7.303	62
2	36.988	20	4.443	86
3	44.632	11.5	11.113	68
4	37.391	10	11.190	64
5	41.750	20	12.388	44
6	78.865	25	20.586	104
7	36.200	10	24.484	20
8	27.444	10	4.570	72
10	58.727	10	31.243	33
11	43.375	12.5	16.625	8
12	24.287	10	3.571	87
13	26.367	10	5.641	49
14	100.978	50	16.307	92
15	36.686	10	7.533	102
16	28.060	17.5	4.948	50
17	39.550	27.5	14.365	20
18	31.274	10	9.894	62
20	66.649	20	21.379	77
21	23.044	10	4.013	68
All	46.165	20	3.258	1168

Table 36

Open-Ended CVM Mean Bids by River:

0 < Response <= 500

River	DOLTOGO Mean	DOLTOGO n	DBLECOT Mean	DBLECOT n	DOLDBLCOT Mean	DOLDBLCOT n
1	45.185	65	48.693	75	48.694	62
2	47.349	83	37.924	92	36.988	86
3	52.931	58	44.083	72	44.632	68
4	21.491	53	21.355	62	37.391	64
5	42.154	39	50.156	45	41.750	44
6	56.327	104	66.250	112	60.214	103
7	11.938	16	19.350	20	36.200	20
8	24.694	72	22.388	80	27.444	72
10	25.968	31	27.333	39	29.313	32
11	33.000	5	33.125	8	43.375	8
12	28.590	83	34.184	103	24.287	87
13	20.238	42	30.533	45	26.367	49
14	82.724	87	88.49	96	85.444	90
15	40.273	99	36.952	105	36.686	102
16	25.600	50	35.902	51	28.060	50
17	64.000	27	67.05	20	39.550	20
18	36.268	56	25.00	56	21.951	61
20	46.100	70	40.583	84	47.789	76
21	27.036	56	22.774	62	23.044	68
All	41.701	1096	41.963	1227	40.638	1162

Table 37

Open-ended CVM Mean Bids by River: 0 < Response <= 500

Current Conditions

River	Mean	Median	Std. Error	n
1	45.185	20	9.466	65
2	47.349	20	9.408	83
3	52.931	10	12.172	58
4	21.491	10	4.42	53
5	42.154	12	13.899	39
6	56.327	20	8.335	104
7	11.938	10	2.967	16
8	24.694	10	5.915	72
10	25.968	10	6.414	31
11	33.000	20	17.000	5
12	28.590	10	5.593	83
13	20.238	10	3.750	42
14	82.724	50	11.152	87
15	40.273	10	9.202	99
16	25.600	15	4.975	50
17	64.000	30	18.430	27
18	36.268	10	10.392	56
20	46.100	20	11.261	70
21	27.036	15	4.860	56
ALL	41.701	15	2.309	1096

Table 38

Open-ended CVM Mean Bids by River: 0 < Response <= 500

Large Trout

River	Mean	Median	Std. Error	n
1	48.693	25	7.652	75
2	37.924	20	4.938	92
3	44.083	17.5	9.256	72
4	21.355	12.5	2.711	62
5	50.156	20	15.791	45
6	66.250	25	9.707	112
7	19.350	10	5.618	20
8	22.388	10	3.485	80
10	27.333	10	5.263	39
11	33.125	21.5	11.569	8
12	34.184	10	7.153	103
13	30.533	10	5.690	45
14	88.490	50	11.295	96
15	36.952	15	7.670	105
16	35.902	20	5.206	51
17	67.050	40	24.870	20
18	25.000	20	3.624	56
20	40.583	20	7.448	84
21	22.774	15	3.188	62
ALL	41.963	20	2.071	1227

Table 39

Open-ended CVM Mean Bids by River: 0 < Response <= 500

Double Catch

River	Mean	Median	Std. Error	n
1	48.694	25	7.303	62
2	36.988	20	4.443	86
3	44.632	11.5	11.113	68
4	37.391	10	11.190	64
5	41.750	20	12.388	44
6	60.214	25	8.797	103
7	36.200	10	24.484	20
8	27.444	10	4.570	72
10	29.313	10	10.865	32
11	43.375	12.5	16.625	8
12	24.287	10	3.571	87
13	26.367	10	5.641	49
14	85.444	50	11.968	90
15	36.686	10	7.533	102
16	28.060	17.5	4.948	50
17	39.550	27.5	14.365	20
18	21.951	10	3.366	61
20	47.789	20	10.201	76
21	23.044	10	4.013	68
ALL	40.638	15	2.120	1162

Table 40

Comparison of Bid Responses by River for Open CVM Method

	Open CVM Mean Values[1]		
River	Current Conditions	Large Trout	Doubled Catch
1	53.59	48.69	48.69
2	47.35	37.92	36.99
3	52.93	44.08	44.63
4	21.49	36.89	37.39
5	82.78	50.16	41.75
6	56.33	76.28	78.87
7	11.94	19.35	36.20
8	24.69	22.39	27.44
10	43.91	51.65	58.73
11	33.00	33.13	43.38
12	28.59	34.18	24.29
13	20.24	30.53	26.37
14	103.34	97.89	100.98
15	59.87	36.95	36.69
16	25.60	35.90	28.06
17	64.00	67.05	39.55
18	36.27	35.09	31.27
20	114.26	69.52	66.65
21	27.04	22.77	23.04

1 Excludes zero bid responses.

Table 40

(continued)

	Differences Across Bid Questions	
River	Large Trout Minus Current Conditions	Doubled Catch Minus Current Conditions
1	-4.90	-4.90
2	-9.43	-10.36
3	-8.85	-8.30
4	15.40	15.90
5	-32.62	-41.03
6	19.95	22.54
7	7.41	24.56
8	-2.30	2.75
10	7.74	14.82
11	.13	10.25
12	5.59	-4.30
13	10.29	6.13
14	-5.45	-2.36
15	-22.92	-23.18
16	10.30	2.46
17	3.05	-24.45
18	-1.18	-5.00
20	-44.74	-47.61
21	-4.27	-4.00

Table 41

Summary Comparison of Bid Question Response by River:

Logit and Open CVM

	Current Conditions Minus Large Trout Bid		Current Conditions Minus Doubled Trout	
River	Logit	Open CVM	Logit	Open CVM
1	11.20	-4.90	-22.80	-4.90
2	85.35	-9.43	-64.44	-10.36
3	132.84	-8.85	157.16	-8.30
4	-32.71	15.40	4.42	15.90
5	37.45	-32.62	130.42	-41.03
6	-30.06	19.95	30.23	22.54
8	-14.16	-2.30	.84	2.75
10	52.33	7.74	101.02	14.82
12	-104.86	5.59	-71.21	-4.30
13	96.62	10.29	5.92	6.13
14	21.93	-5.45	-34.04	-2.36
15	57.28	-22.92	31.41	-23.18
16	-43.58	10.30	-.65	2.46
17	4.14	3.05	10.07	-24.45
18	23.69	-1.18	5.17	-5.00
20	93.87	-44.74	4.78	-47.61
21	32.64	-4.27	33.72	-4.00
NUMBER OF POSITIVE DIFFERENCES	12	7	12	6
NUMBER OF NEGATIVE DIFFERENCES	5	10	5	11

Table 42

Comparison of Bid Question

Responses by River: Logit and Open CVM

	Logit Method	Open CVM Method
a) Positive for Large Trout Question Only:		
	Beaverhead	Gallatin
	Big Hole	Smith
	Madison	
b) Positive for Doubled Trout Catch Only:		
	Blackfoot	Clark Fork
	Bighorn	
	Clark Fork	
c) Positive for Both Large Trout and Doubled Catch:		
	Bitterroot	Blackfoot
	Boulder	Big Horn
	Flathead	Flathead
	Kootenai	Kootenai
	Missouri	Rock Creek
	Smith	
	Stillwater	
	Upper Yellowstone	
	Middle Yellowstone	
d) Negative for Both Large Trout and Doubled Catch:		
	Gallatin	Beaverhead
	Rock Creek	Big Hole
		Bitterroot
		Boulder
		Madison
		Missouri
		Stillwater
		Upper Yellowstone
		Middle Yellowstone

Table 43

Montana Trout Stream Fishing

Means and Standard Deviation for Alternative TCM and CVM

Measures of Net Economic Value Per Trip (By River)

Variable	Cases	Mean	Standard Deviation
1. Current Conditions:			
LOGITMN1	17	126.6941	57.3389
OPENALM1	17	28.0418	15.0118
OPENZRM1	17	50.7224	28.0042
LOGITMD1	17	48.5512	40.1432
OPENALD1	17	4.4706	3.2810
OPENZRD1	17	17.0588	10.3167
TCMPS	17	83.7088	51.0493
TCMPR	17	179.3753	109.3895
TCMGS	17	56.7882	28.0375
TCMGR	17	121.6876	60.0790
RIVER	17	10.8824	6.5468
2. Large Trout:			
LOGITMN2	17	131.4824	69.2199
OPENALM2	17	27.8065	12.4035
OPENZRM2	17	46.9376	20.2766
LOGITMD2	17	87.7688	68.7983
OPENALD2	17	6.4706	4.0638
OPENZRD2	17	20.1471	10.6972
3. Doubled Catch:			
LOGITMN3	17	125.4853	53.8014
OPENALM3	17	25.1971	12.1242
OPENZRM3	17	44.1994	21.2345
LOGITMD3	17	80.7376	68.9741
OPENALD3	17	5.0588	2.8167
OPENZRD3	17	17.4412	10.5281

(continued)

Table 43 (continued)

Variable Definitions

Logitmn1	"Logit means dolamt"
Logitmn2	"Logit means doldble1"
Logitmn3	"Logit means doldble2"
Logitmd1	"Logit medians dolamt"
Logitmd2	"Logit medians doldble1"
Logitmd3	"Logit medians doldble2"
Openalm1	"Open all means doltogo"
Openalm2	"Open all means dblecot"
Openalm3	"Open all means doldblct"
Openald1	"Open all medians doltogo"
Openald2	"Open all medians dblecot"
Openald3	"Open all medians doldblct"
Openzrm1	"Open zero means doltogo"
Openzrm2	"Open zero means dblecot"
Openzrm3	"Open zero means doldblct"
Openzrd1	"Open zero medians doltogo"
Openzrd2	"Open zero medians dblecot"
Openzrd3	"Open zero medians doldblct"
Tcmps	"TCM predicted standard"
Tcmpr	"TCM predicted reported"
Tcmgs	"TCM gum-martin standard"
Tcmgr	"TCM gum-martin reported"

Note: For CVM variables names last digit means: 1) bid question for current conditions; 2) bid for doubled catch of large trout; and 3) doubled trout catch. Openal are open CVM complete sample. Openzr are open CVM sample excluding zero bids.

Table 44

Listing of Net Economic Value per Trip

for Ten Methodologies and Measures (by River)

River Code Number	River	LOGITMN1	LOGITMD1	OPENALM1	OPENALD1	OPENZRM1	OPENZRD1	TCMPS	TCMPR	TCMGS	TCMGR
1	Beaverhead	188.20	75.52	29.48	5.0	53.59	20	114.40	245.13	52.13	111.70
2	Big Hole	217.77	103.25	26.20	10.0	47.35	20	100.06	214.41	76.39	163.70
3	Bitterroot	58.83	9.19	28.90	.0	52.93	10	26.63	57.07	33.88	72.60
4	Blackfoot	132.86	28.22	11.06	2.0	21.49	10	80.31	172.09	66.18	141.81
5	Boulder	148.75	45.30	44.08	5.0	82.78	20	133.66	286.41	83.93	179.84
6	Bighorn	158.50	62.97	38.44	10.0	56.33	20	150.88	323.32	56.45	120.95
8	Clark Fork	86.49	10.60	13.68	2.0	24.69	10	37.12	79.54	31.71	67.96
10	Flathead	99.13	38.91	29.91	.0	43.91	10	8.10	17.35	26.35	56.46
12	Gallatin	179.98	46.95	15.51	5.0	28.59	10	92.26	197.71	75.32	161.41
13	Kootenai	38.13	7.01	11.10	2.0	20.24	10	65.83	141.07	26.29	56.33
14	Madison	228.12	168.34	52.24	5.0	103.34	50	138.77	297.35	109.32	234.26
15	Missouri	62.53	35.54	36.96	5.0	59.87	10	96.37	206.51	27.96	59.92
16	Rock Creek	92.17	32.62	13.24	5.0	25.60	15	164.97	353.51	80.58	172.66
17	Smith	152.87	65.32	35.47	10.0	64.00	30	56.95	122.03	43.77	93.80
18	Stillwater	84.87	28.30	16.32	.0	36.27	10	127.30	272.30	38.29	82.05
20	Upper Yellowstone	150.25	52.57	60.00	5.0	114.26	20	14.56	31.20	107.50	230.35
21	Middle Yellowstone	74.35	14.76	14.12	5.0	27.04	15	14.88	31.90	29.35	62.89

Note: For variable definitions, see Table 43.

Table 45

Comparative Analysis Across Angler Studies

Correlation Coefficient: Pearsons and Spearmans [1]

n = 17

Pearsons:

	LOGITMN1	LOGITMD1	TCMPS [2]	TCMGS [3]
LOGITMN1			.3818	.7253
LOGITMD1	.8592		.4246	.6454
OPENALM1	.4618	.5785	.0430	.5320
OPENALD1	.5978	.5102	.3481	.3594
OPENZRM1	.4859	.6053	.0564	.6139
OPENZRD1	.6811	.8824	.3180	.5936

Spearmans:

	LOGITMN1	LOGITMD1	TCMPS	TCMGS
LOGITMN1			.3750	.7132
LOGITMD1	.9191		.3848	.6176
OPENALM1	.4314	.6520	.1005	.3750
OPENALD1	.6249	.7097	.3862	.4671
OPENZRM1	.4706	.6912	.1422	.4657
OPENZRD1	.7076	.7903	.3558	.6341

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1 For variable definition, see Table 43.

2 Identical correlation for TCMPR.

3 Identical correlation for TCMGR.

Table 46

Sample Size and Comparison of TCM and CVM

Net Economic Value per Trip

River Code Number	River	TCM Sample Size: Zones	Trips	Trips/Zone	Value Per Trip: TCM[1]	CVM[2]	Ratio[3]	CVM Sample Size
1	Beaverhead	19	120	613	112	188	.59	108
2	Big Hole	37	187	5.1	164	218	.75	140
3	Bitterroot	12	88	7.3	73	59	1.24	117
4	Blackfoot	26	149	5.7	142	133	1.07	97
5	Boulder	16	57	3.6	180	149	1.21	69
6	Bighorn	28	160	5.7	121	159	.6	151
8	Clark Fork	17	231	13.6	68	86	.79	126
10	Flathead	12	66	5.5	56	99	.57	65
12	Gallatin	31	264	8.5	161	180	.89	152
13	Kootnai	11	121	11.0	56	38	1.47	72
14	Madison	55	396	7.2	234	228	1.03	155
15	Missouri	26	357	13.77	60	63	.95	148
16	Rock Creek	21	89	4.2	173	92	1.88	78
17	Smith	14	43	3.1	94	153	.61	44
18	Stillwater	15	133	8.9	82	85	.96	113
20	Upper Yellow.	32	81	2.5	230	150	1.53	121
21	Middle Yellow.	17	174	10.2	63	74	.85	105

Notes:

1 Based on actual trips (Gum and Martin Method) and reported trave costs.

2 Logit means with integration truncated at $500 bid value.

3 TCM/CVM

Table 47

Summary Correlation Coefficients

For CVM and TCM by CVM Subsample

LOGITMN1 With TCMPR	LOGITMN1 With TCMGR	LOGITMN1 With OPENZRM1	OPENZRM1 With TCMGR
I. Complete Sample (n=17):			
		Pearson Correlation Coefficients	
0.5149	0.7253	0.4859	0.6139
p=.043	p=.000	p=.024	p=.004
		Spearman Correlation Coefficients	
0.5105	0.7132	0.4706	0.4657
sig.045	sig.001	sig.028	sig.030
II. Subsample Excluding CVM Sites With Less Than 80 Observations (n=12):			
		Pearson Correlation Coefficients	
0.3818	0.7993	0.3784	0.6814
p=.065	p=.001	p=.113	p=.007
		Spearman Correlation Coefficients	
0.3750	0.8112	0.2448	0.3287
sig.069	sig.001	sig.222	sig.148

Note: For variable definition see Table 43.

Table 48

Montana Trout Stream Fishing

CVM and TCM Bivariate Regressions

N	Dependent	Constant	TCMPS	TCMPR	TCMGS	TCMGR	$\bar{R}^2$	F
			Independent Variable					
17	LOGITMN1	90.797	.429				.088	2.56
	(T-STAT)	(3.48)	(1.60)				(SIG	.13)
17	LOGITMN1	90.797		.200			.088	2.56
		(3.48)		(1.60)			(SIG	.13)
17	LOGITMN1	42.466			1.483		.494	16.65
		(1.855)			(4.08)		(SIG	.00)
17	LOGITMN1	42.466				.692	.494	16.65
		(1.855)				(4.08)	(SIG	.00)
17	OPENZRM1	48.131	.031				-.063	.05
	(T-STAT)	(3.499)	(.219)				(SIG	.83)
17	OPENZRM1	48.131		.014			-.063	.05
		(3.499)		(.219)			(SIG	.83)
17	OPENZRM1	15.90			.613		.335	9.07
		(1.240)			(3.01)		(SIG	.01)
17	OPENZRM1	15.90				.286	.335	9.07
		(1.240)				(3.01)	(SIG	.01)
12*	LOGITMN1	81.675	.647				.192	3.61
	(T-STAT)	(2.527)	(1.900)				(SIG	.09)
12*	LOGITMN1	81.675		.302			.192	3.61
		(2.527)		(1.900)			(SIG	.09)
12*	LOGITMN1	36.485			1.682		.603	17.69
		(1.405)			(4.21)		(SIG	.00)
12*	LOGITMN1	36.485				.785	.603	17.69
		(1.405)				(4.21)	(SIG	.00)

* Excludes sites where CVM sample is less than 80.