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Economic Value of Instream Flow

in Montana's Big Hole and Bitterroot Rivers

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Abstract

Instream flow is valuable to recreationists who rely on flows for fishing, boating, and other forms of river recreation. Instream flow is also valuable to many members of society, whether they visit the rivers or not, because flows maintain ecosystem stability and associated fish and wildlife habitat. This study estimates the economic value of these recreation and preservation benefits along the Big Hole and the Bitterroot Rivers in Montana. Valuation and participation information was obtained from recreationists who were interviewed along the rivers, and from households that were sampled using mail and phone surveys. Both dichotomous-choice and open-ended contingent valuation questions were used in these surveys to estimate the value of instream flow. In addition, methodological issues of additivity of preservation values and apportionment of total value into use and nonuse categories were investigated. Results indicate substantial economic value for maintaining instream flows above minimum levels, with most of the value attributable to preservation motives.

Keywords: Instream flow, economic value, contingent valuation, riparian recreation, existence value

Cover: Big Hole River at High Road Bridge near Twin Bridges, Montana in 1988 at following flow levels: 1450 cfs on June 14, 543 cfs on June 29, 55 cfs on September 26, and <10 cfs on August 17. (Photo courtesy of Montana Department of Fish, Wildlife, and Parks.)

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EXECUTIVE SUMMARY

The economic value of instream flow was estimated based on two contingent valuation surveys. First, river users were surveyed onsite to estimate the contribution of instream flow to the value of recreation trips as well as to estimate users' willingness to pay for flow preservation, over and above recreation value. Second, households were surveyed by mail (and nonrespondents were contacted by telephone) to estimate the value of preserving instream flow. Recreation values were estimated using a trip expense vehicle, and preservation values were estimated using a trust fund payment vehicle.

We present a general framework for estimating the recreational value of instream flows. The theoretical model incorporates the influence of instream flow levels directly on both the quality of the recreational experience and on the quantity of users. Additionally, the quality of the recreational experience can be indirectly affected by flow through the effect of flow on total daily use (congestion) and flow on quantity demanded per person (seasonal use). This framework provides a convenient structure for comparing results of previous instream flow research. The model is aggregated at the daily level and can be used to value changes in flow over a season.

The recreational value model is demonstrated in an application to the Big Hole and Bitterroot Rivers in Montana. The Big Hole River is one of the premier trout fisheries in North America, and the Bitterroot River is popular with anglers and shoreline users. Valuation is based on experienced flow levels within a current trip valuation model, with quantity of use measured by onsite observation. A broad range of flows was experienced during the May to August sample season, because the summer of 1988 was one of the driest on record. Marginal values per acre-foot at low flow levels were found to be in the $10 to $25 range.

The value of flow preservation was estimated in the onsite survey by asking users to specify their preferred flow level and their willingness to pay into a trust fund for maintaining preferred flows. Marginal acre-foot values of $4 to $10 were derived for a flow increment from historical to preferred flows in July and August. If flows delivered to these study sections could be assumed to have similar impacts on users of the entire river, acre-foot values are $25 to $35. Preservation values varied by user group, with visitors from outside Montana having values that were roughly double those of Montana residents on the Bitterroot and three times those of Montana residents on the Big Hole.

The mail survey was administered in six population centers to estimate total recreation and preservation values for a set of Montana rivers. Three versions of the survey were used according to which and how many rivers were to be protected by the trust fund donation. One version was for the Bitterroot only, another for the Big Hole, and the multiple river version was for five rivers (the Bitterroot, Big Hole, Clark Fork, Gallatin, and Smith). This variation in number of rivers was introduced to facilitate analysis of the additivity of responses across different combinations of environmental goods (a valuation issue now known as embedding).

Multivariate valuation models based on the mail survey were estimated for both dichotomous-choice and open-ended question formats. Criteria for testing the theoretical consistency of responses with economic consumption theory were developed by examining the analytical implications of the nonsatiation axiom and the law of demand. For a double log specification of a total willingness to pay function, all estimated models met the criteria for consistency with consumption theory.

Analysis of single and multiple river subsample means also tends to support the conclusion that responses were consistent with economic demand theory with respect to additivity. Mean willingness to pay was greater for the multiple river subsample than for the single river subsamples. However, these differences were greater for river users than for nonusers, and were statistically significant only for users. Users were apparently more sensitive in their valuations to the number of rivers protected than were nonusers.

These results provide evidence that valuation of environmental goods, even when existence or preservation motives may be important, is consistent with consumption theory. The instream flow trust fund responses indicate that individuals will donate more money if more rivers are protected, but that the amount for each additional river (the marginal willingness to pay) is declining. Because the basic elements of consumption theory are derived from the standard constrained maximization formulation, these results provide some insights into characterizing the trust fund phenomenon. It appears that trust fund donations can be modeled like the purchase of any other commodity and that these purchases reflect the presence of a budget constraint.

Identification of the share of total value attributable to existence as opposed to use and option motives was a major focus of the mail survey. Little is known about the underlying attitude and belief systems that might explain why people might (or might not) be willing to pay to preserve the existence of natural environments. Purely exploratory research was conducted in an attempt to define and measure basic motives. A five-point Likert-scale format was used to measure how much people agreed or disagreed with each of 23 statements related to reasons for holding preservation values. The statements were derived from largely untested "hypotheses" posed in the literature. Factor analysis of responses to the 23 statements revealed five factors, each representing a somewhat distinct dimension of possible reasons for valuing instream flows, apart from one's past or intended use of the rivers.

A new method was introduced, based on an application of Euler's Theorem, to identify the share of total value attributable to each motive through multivariate regression. The application required the extension of the logit model reparameterization to include other economic benefit measures including a truncated mean. The traditional apportionment method of directly asking the respondent in a follow-up question to apportion his or her willingness to pay among direct and indirect uses was also employed. The regression and direct apportionment methods were found to be in close agreement, with approximately 75% of total valuation associated with existence motives.

The mail sample valuation estimates were extrapolated to an aggregate Montana estimate of willingness to pay into an instream flow trust fund. Several different approaches to aggregation of contingent valuation responses were applied, including estimation of population sample means for independent variables based on an extensive phone survey of those who did not respond by mail. A basic finding was that river users were much more likely to respond to the mail survey.

The estimated total value for the Montana trust fund (age 18 and over), corrected for distance from river protected, is $6.7 million based on a logit mean. If nonrespondents are counted at zero value, the more or less realistic return to a trust fund mailing would be only $1.1 to $2.4 million. The phone survey of nonrespondents indicates that responses to both the dichotomous-choice format and the open-ended question format are sensitive to the choice of method for obtaining responses. For dichotomous choice, phone solicitation of responses appeared to double the estimated value, other things being equal. Additionally, participation in the open-ended format was somewhat higher with the phone survey.

Economic Value of Instream Flow in Montana's Big Hole and Bitterroot Rivers

John W. Duffield, Thomas C. Brown, and Stewart D. Allen

INTRODUCTION

The allocation of water among competing uses is an increasingly important public policy issue in the western United States. As demands for both withdrawals and water-based recreation have increased, laws allowing instream flow reservation have emerged in many states (McKinney and Taylor 1988, Reiser et al. 1989, Colby 1990, Shelby et al. 1992). Future water allocation decisions must take instream flow values into account.

Instream flow has an immediate effect on the quality of various recreation activities. For example, flow levels affect fishing success, boating quality and travel times, wading and swimming possibilities, and scenic beauty. Instream flows also have longer term impacts via the effects of flow on maintenance of gravel bars for camping, maintenance of channel form and function for fish habitat, and control of encroaching vegetation to ensure scenic visibility (Brown et al. 1991). These longer term impacts affect recreation activities, as well as the very existence of fish and wildlife and the integrity of the ecosystem.

The economic benefits of instream flow include the immediate effects of flow on recreation opportunities, as well as longer term ecosystem impacts. Preserving riverine environments by keeping adequate amounts of water in the river may have value to many people regardless of their current use of the flows for recreation. For example, individuals may value simply knowing that fish habitat is being maintained in a given river, or that there is a dramatic river flowing through a certain canyon even if they have not seen it themselves. They also may benefit from knowing that they could visit the river in the future, or preserve this opportunity for future generations.

One basis for identifying appropriate levels of instream flow is to compare its economic value to the values of competing (i.e., consumptive) uses. Irrigated agriculture is the primary consumptive use in the West, and because agricultural products are sold in relatively competitive markets, the value of the irrigation input can often be reliably derived. However, the recreation and preservation values of instream flow are less easily estimated. The overall purpose of this study was to develop and demonstrate methods for estimating the recreation and preservation values of alternative levels of instream flow. It should be noted that the values reported here are net economic values, and thus are consistent with the U.S. Water Resources Council's Principles and Guidelines (1983) to use net willingness to pay (e.g., net economic value) as a measure of value in benefit-cost analysis or evaluation of federal actions.

Several studies of the economic value of instream flow have been performed in the past 10 years (see Loomis 1987a or Brown et al. 1991 for summaries). Most previous studies of instream flow focused entirely on values associated with direct recreational use. We contribute to this literature by estimating both the recreation value and the total nonmarket value of instream flow. Further, we attempt to understand the reasons people are willing to pay for instream flow, in order to identify the share of total value associated with preservation benefits.

The current literature on nonmarket valuation uses various terms to distinguish among the components of total value, including use versus nonuse value, direct versus indirect value, and active versus passive use value. In the current context, all distinctions are essentially between value associated with personal onsite use of a recreation area (whether past, current, or planned) and value associated with knowing that an area will be preserved in some desired condition (whether for other peoples' benefit, commonly called bequest value, or regardless of use by other, called existence value). We call the former recreation value and the latter preservation value. Note that recreation value includes onsite use that does not disturb the area (such as viewing the scenery).

The objectives of our study were to: (1) estimate the economic value of instream flow to recreationists on two Montana rivers, the Big Hole and the Bitterroot, and determine the extent to which such values vary by recreation activity; (2) estimate the economic value of preserving instream flow; (3) investigate the extent to which estimates of preservation value developed for flow in a given river are additive to separately estimated values for other rivers; and (4) investigate the relationship between use and preservation-related benefits.

We used the contingent valuation method (CVM) to obtain our data about the economic value of instream flow. Onsite interviews of recreationists at the two study rivers, using a trip expenditure payment vehicle, provided the basis for meeting objective 1. The onsite survey also used a trust fund payment vehicle that helped meet objective 2. The principal source of data for addressing objectives 2, 3 and 4 was a household mail survey of both river users and nonusers that used a trust fund payment vehicle. The onsite survey was conducted during the summer of 1988, and the mail survey was conducted during the winter of 1988–1989.

In applying the CVM approach, we primarily used the dichotomous-choice or close-ended type question, which may overcome some of the bias and participation problems of the bidding game and open-ended formats (Bishop and Heberlein 1979). In dichotomous-choice CVM, respondents are asked whether or not they would be willing to pay a specific amount, with the amounts varied across respondents. The associated probability of a positive response to a given bid level (identified through a logit specification) is used to derive mean and median net willingness to pay for given flow levels. Additionally, we used the open-ended CVM question format, wherein respondents were simply asked how much they would be willing to pay.

Previous economic studies of the recreation value of instream flow have focused on either the effect of flows on the quality of the recreation experience, or on the number of users to the site. We present a general framework for estimating the recreation value of instream flow that includes the direct effect of flow on trip valuation (the quality change) and on daily use levels (the quantity change). Additionally, the model incorporates the indirect effects of flows on trip values due to changes in daily use levels (congestion) and quantity demanded (seasonal trip total).

Most previous studies have represented alternative flow levels to respondents by photographic or verbal descriptions, relying on the respondents to imagine the onsite experience given such flows. We took a different approach, which did not rely on respondent imagination—we recorded the flow level at the time of the interviews (which were conducted at a wide range of flow levels), and later compared them with users' valuations. With a reparameterization of the basic logistic regression model (following Hanemann 1984 and Cameron 1988), an inverse income compensated demand function was identified for recreational trips that incorporates flow as a covariate. By identifying an inverse demand relationship (where quantity demanded is expressed as a function of price and other variables), the effects of covariates on willingness to pay, including elasticities and partial derivatives, can be easily derived analytically.

Our model of the effect of flow on quantity demanded uses a third-order polynomial to express flow level. This formulation permits identification of optimal flow levels. Because quality changes are measured in an inverse demand specification, the two models (of quality and quantity) can be integrated. This provides a consistent framework for separating the effect of flows on quality and quantity of use across sites. The general method can additionally be modified to incorporate a day-level recreation use simulation model of alternative (historical or hypothetical) flow regimes.

Our approach for examining the variation in instream flow values across user groups and sites is relatively straightforward; separate estimates are made for subsamples defined by respondent characteristics. Following the methods described in Duffield and Patterson (1989), we demonstrate the application of nonparametric methods to measure dispersion for the most widely used economic benefit measure in dichotomous-choice CVM—the truncated mean. These methods allow us to rigorously test differences across user groups and sites.

To address the issue of additivity across sites (objective 3), some respondents were asked what they would contribute to a trust fund (for augmenting instream flows through the purchase of water from irrigators or upstream storage) to protect a single river and others were asked what they would contribute to protect a group of rivers. The naive assumption would be that consistent responses (perfect additivity) require the single river responses to add up to the response for the equivalent river group. We show analytically that, in fact, perfect additivity is not consistent with consumption theory. Specific testable hypotheses for the trust fund responses were developed.

The trust fund survey of households also provided an opportunity to distinguish the share of total willingness to pay that was associated with onsite use as opposed to preservation-related motives. Our approach was to utilize the methods of social psychology to develop psychometric variables indicating use- and preservation-related motives. These were included in a multivariate regression model along with traditional measures of direct use (number of trips or recreation days). We show that when all independent variables are transformed to their natural log value, the relative share due to each factor is a simple function of the estimated parameters. We also compare the direct apportionment method to this multivariate regression approach.

Following the next two sections, which review contingent valuation and describe the study areas, are the three major sections of this report. The first presents the valuation of the current recreation trip (objective 1). The next section reports on the value of instream flow preservation based on the trust fund questions included in the onsite survey (objective 2). The third section reports on the value of instream flow preservation and related methodological questions based on the household survey (objectives 2, 3, and 4).

THE CONTINGENT VALUATION METHOD

The two most widely used methods for estimating net willingness to pay for outdoor recreation are contingent valuation and the travel cost method (TCM). These are also the two general methods recommended by the U.S. Water Resources Council for valuing recreation in federal benefit-cost 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 by Duffield et al. (1987). A regional TCM model was inappropriate for this study because of its inability to measure preservation-related values.

In the CVM approach, individuals are directly questioned about their willingness to pay (WTP) 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 et al. 1986, Mitchell and Carson 1989).

Background on CVM

Bishop and Heberlein (1985) 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. Most CVM studies focus on the values associated with direct use; accordingly the target population is direct users (such as boaters and anglers). However, there is a considerable literature on indirect or nonuser values such as option, existence, and bequest values (Fisher and Raucher 1984, Peterson and Sorg 1987). Estimating the latter typically requires a household survey of a regional population.

Product definition is a key feature of the hypothetical market. The resource or service at issue must be clearly described to the individual. This may be difficult when valuing changed conditions, such as the specific physical characteristics of a proposed hydropower installation (Duffield 1984). Visual aids such as photos and charts have been used (Randall et al. 1974, Daubert and Young 1981, Desvousges et al. 1983). The specific information provided to the respondent must be carefully chosen, because it determines the limits of generalizing the results. A general approach is to vary the level of information and test for response sensitivity.

A meaningful *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 studies of recreation value because respondents are familiar with paying expenses and expenses appear relatively neutral compared with other vehicles such as hunting fees. Past instream flow studies have used trip cost, entrance fee, and sales tax payment vehicles, and studies of water quality benefits have added willingness to drive and the cost of waterfront property (Walsh et al. 1978). We utilized a trip expense vehicle for valuation of direct recreation use on the Big Hole and Bitterroot Rivers.

A user fee or trip expense payment vehicle is inappropriate for expressing the value one places on the preservation or mere existence of something. Payment vehicles that have been used in existence value studies include taxes and utility bills (Greenley et al. 1980), a general increase in taxes and prices (Devousges et al. 1983), and an annual payment into a special fund (Walsh et al. 1984). We utilized an annual trust fund membership as the payment vehicle to identify WTP to protect instream flow.

A major consideration in a CVM study is the *question format* or value elicitation procedure. The elicitation procedure also usually implies the *method of analysis* that will be undertaken. Three general approaches for asking CVM questions are open-ended questions, bidding games, and dichotomous-choice questions. It is beyond the scope of this paper to review these methods in detail (for a recent review see Cummings et al. 1986); however, the key features of each will be briefly described.

The open-ended question is the simplest approach. Respondents are directly asked their maximum WTP for the product. This approach can be readily used in a mail survey and is, therefore, relatively inexpensive. Interpretation is also fairly straightforward, requiring only the calculation of the mean payment amount. The conventional analysis of these responses includes specifying a "bid equation":

$$W = f(\tilde{x}) \qquad [1]$$

where $\tilde{x}$ is a vector of explanatory variables and W is the open-ended WTP response. A double-log specification is often used, where both W and $\tilde{x}$ are transformed to natural log values. This question format can be used to directly identify either marginal value of a given response (e.g., value of the current trip) or total value (e.g., value of all trips taken this year, perhaps through an annual permit payment vehicle).

One difficulty is the interpretation of extreme values. For example, responses of "zero" can 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 bidding game was once a widely used alternative to the open-ended format. Here, interviewers ask the respondents if they are willing to pay some initial amount; if a yes (no) response is obtained, the amount is incrementally raised (lowered) until a no (yes) response is obtained. Stoll (1983) argued that such an iterative approach is necessary to force individuals to engage in the hypothetical market and report their maximum willingness to pay.

There is some disagreement in the literature about whether the open-ended and bidding game approaches yield consistently different results. Cummings et al. (1986) conclude that open-ended results are generally lower. However, Bishop et al.[2] compared the approaches and found no significant difference. There are, however,

[2] Bishop, R.C.; Heberlein, T.A.; Welsh, M.P., Baumgartner, R.M. Does Contingent Valuation Work? Results of the Sandhill Experiment. Paper presented at joint meeting of the Association of Environmental and Resource Economists and the American Agricultural Economics Association and the Northeast Agricultural Economics Council, August 5-8, 1984, Cornell University, Ithica, NY.

two major limitations to the bidding game approach. First, it requires costly face-to-face or telephone interviews. Second, studies (e.g., Duffield 1984) have shown a positive correlation between the initial (and arbitrary) bid and the final maximum bid.

The dichotomous-choice approach combines some of the better features of the open-ended and bidding game formats. In dichotomous choice, the individual is faced with a single specific dollar bid and (like bidding games) the response is a simple market-like "yes" or "no." Furthermore, the format is noniterative (like the open-ended), which is possible because the dollar bid amount is systematically varied across respondents. This approach is relatively new, but it has been successfully applied to valuing hunting permits (Bishop and Heberlein 1979), boating and scenic beauty (Boyle and Bishop 1984), reservoir recreation (Seller et al. 1986), beach recreation (Bishop and Boyle 1985), and other goods.

The major disadvantage of dichotomous choice is that analysis is more complex, exploiting some of the recent advancement in methods for modeling discrete choice (Amemiya 1981). As described below, analysis requires using econometric models, such as the logit model, to predict the probability of accepting an offer as a function of the stated bid and socio-economic variables. Proper analysis also requires considering the current debate over the appropriate measure of central tendency (Hanemann 1984, Cameron 1988) as well as issues regarding truncation and functional form.

As for any model of economic demand, 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 taste and preference. This is most critical for the dichotomous choice case, in which incomplete specification could lead to omitted-variable bias. With the open-ended and iterative methods, analysis amounts to taking the mean of the maximum WTP bids. However, for these two methods it is conventional practice to estimate "bid equations" that relate WTP to demand shifter variables to help establish the credibility of responses.

Dichotomous choice was chosen as the principal elicitation procedure for this study, principally because it tends to place the least burden on the respondent. However, in the household survey, we supplemented the dichotomous-choice procedure with a follow-up open-ended question.

Dichotomous-Choice Model

Our general strategy was to develop a model with instream flow as a covariate and to identify the relation of flow to value analytically. Accordingly, in the discussion of the empirical valuation model that follows, the choice of specification and measure of central tendency is influenced by whether covariate effects can be derived. This emphasis is somewhat different from that of most contingent studies in which the focus is simply on valuation. Because of model complexity, only recently have investigators begun to explore the influence of covariates on welfare measures in dichotomous-choice models (Seller et al. 1986, Cameron 1988). We derived an empirical model that defined derivatives for a variety of welfare measures.

Hanemann (1984) investigated the theoretical motivation for dichotomous-choice models. He provided both a utility difference approach and an alternative derivation based on the relationship of the individual's unobserved true valuation compared to the offered threshold sum (see also Cameron 1988). In the latter, it is assumed that if individuals have a true WTP, then they will respond positively to a given bid only if their WTP is greater than the bid. For example, suppose that an individual is confronted with an offered price (t) for access to a given resource or recreational site. The probability of accepting this offer $\pi(t)$, given the individual's true (unobserved) WTP (W), is then:

$$\pi(t) = \Pr(W > t) = 1 - F(t) \qquad [2]$$

where $F(\cdot)$ is a cumulative distribution function (c.d.f.) of the WTP values in the population. In the logit model $F(\cdot)$ is the c.d.f. of a logistic variate, and in the probit model $F(\cdot)$ is the c.d.f. of a normal variate.

The specification of this model can be briefly illustrated for the case where the WTP values are assumed to have a logistic distribution in the population of interest, conditional on the value of covariates. A statistical model is developed that relates the probability of a "yes" response to explanatory variables such as the bid amount, preferences, income, flow level, and other demand shifter-type variables. The specific model is:

$$\pi(t;\tilde{x}) = \left[1 + \exp(-\alpha t - \tilde{\gamma}'\tilde{x})\right]^{-1} \qquad [3]$$

where $\pi(t;\tilde{x})$ is the probability that an individual with covariate vector $\tilde{x}$ is willing to pay the bid amount t. The parameters to be estimated are α and $\tilde{\gamma}'$ (the constant term is included in $\tilde{x}$). The equation to be estimated can be derived as:

$$L = \ln\left[p/(1-p)\right] = \alpha t + \tilde{\gamma}'\tilde{x} \qquad [4]$$

where L is the "logit" or log of the odds of a "yes" and p are observed response proportions. In application, the logit and probit models are so similar that it is difficult to justify one over the other on the basis of goodness of fit. We chose to use the logistic specification here because the probit model does not lead to closed-form derivatives.

Maximum likelihood estimates (MLEs) of the parameters in equation [4] can be obtained with a conventional logistic regression program. Cameron (1988) provided an alternative parameterization of this model that emphasizes the threshold motivation and the dependence of individual WTP on covariates. In Cameron's derivation, the distribution of WTP conditional on $\tilde{x}$ is logistic with mean $\tilde{\beta}'\tilde{x}$ (with scale parameter k and standard deviation $\pi k/\sqrt{3}$) or:

$$\pi(t;\tilde{x}) = 1 - F(t;\tilde{\beta}'\tilde{x},k) = \left[1+\exp(t/k - \tilde{\beta}'\tilde{x}/k)\right]^{-1} \quad [5]$$

where F(· ;μ,k) is the cumulative distribution function of a logistic random variable with mean μ and scale parameter k. Directly estimating the alternative parameterization requires a general maximum likelihood program. However, due to the MLE invariance property, these parameters can be derived from MLEs for the conventional parameterization (Cameron 1988). Given the p+1 parameters of the two models, $\tilde{\beta}^* = (k,\tilde{\beta})$ and $\tilde{\gamma}^* = (\alpha,\tilde{\gamma})$, there is a one-to-one correspondence between the parameter sets or:

$$g(\tilde{\gamma}^*) = (-1/\alpha, -\gamma_1/\alpha, \ldots, -\gamma_p/\alpha) = \beta^* \quad [6]$$

A recent paper by Shultz and Lindsay (1990) reports both forms of the model (for a groundwater valuation study). However, their paper does not report standard errors for the reparameterized estimates. It has been shown that asymptotic standard errors for the MLEs in Cameron's parameterization can be calculated from the estimated asymptotic covariance matrix for the conventional parameterization (Patterson and Duffield 1991). We provide an application of that procedure. An advantage of the reparameterized model is that the coefficients are more easily interpreted. For example, in a double-log specification, the coefficients are elasticity point estimates of the relation of WTP to a given covariate. For this reason, we report our estimates in the alternative parameterization form of the model.

Hanemann (1984) showed that the linear specification in equation [6] is consistent with utility maximization based on his utility difference motivation. However, Cameron (1988) argued that, from the standpoint of the threshold motivation, any of a variety of WTP distributions are theoretically plausible. This implies that the choice of functional form for F(·) should be based on empirical considerations. Many investigators (e.g., Boyle and Bishop 1988 and Bowker and Stoll 1988) found that WTP distributions are skewed to the right. In these cases, a better estimate may be obtained with a log-logistic model (replacing t in [4] with log t). We examine a range of Box-Cox transformation parameters (Box and Cox 1964) to see whether the true transformation of the bid variable is closer to linear or closer to log (or in between).

The responses to our specific valuation questions (described below) provide a Hicksian compensating variation measure (Hicks 1943, Freeman 1979) of welfare change for increments of recreational services. However, because the dichotomous-choice contingent valuation approach yields a distribution of WTP values, the question remains as to which parameter of the distribution (i.e., which measure of central tendency) to use as a benefit (i.e., welfare) measure. A variety of welfare measures for dichotomous-choice models have been proposed in the literature, including a truncated mean (Bishop and Heberlein 1979), the overall mean (Johansson et al. 1989), and percentiles of the distribution, including the median (Hanemann 1984, 1989). In all cases, the distribution of F is assumed to be continuous and nonnegative.

For the log-logistic model, the mean is given by:

$$\begin{aligned}\mu(\tilde{x}) &= \exp(-\tilde{\gamma}'\tilde{x}/\alpha)\Gamma(1+1/\alpha)\Gamma(1-1/\alpha) \\ &= \exp(\tilde{\beta}'\tilde{x})\Gamma(1-k)\Gamma(1+k)\end{aligned} \quad [7]$$

where $\Gamma(\cdot)$ is the gamma function. We assume that $k < 1$ so that the mean exists (otherwise the mean is infinite). The p^{th} quantile is given by:

$$\begin{aligned}\eta_p(\tilde{x}) &= \exp(-\tilde{\gamma}'\tilde{x}/\alpha)\left[p/(1-p)\right]^{1/\alpha} \\ &= \exp(\tilde{\beta}'\tilde{x})\left[p/(1-p)\right]^{k}\end{aligned} \quad [8]$$

Of course, when p = 0.5, [8] provides an estimate of the median. For the case where WTP values are skewed, the median and the mean may differ considerably, as demonstrated in previous studies (e.g., Bowker and Stoll 1988). As Hanemann (1989) discussed, choice of the welfare measure is a value judgment in that there is an implicit weighing of whose values are to count. Hanemann suggested the 75th percentile as an alternative. We report all three measures: the overall mean, the median, and the 75th percentile, with an emphasis on the 75th percentile. The overall mean is the correct measure to use for aggregation (Johansson et al. 1989) but requires extrapolation beyond the range of the data. This is true for both the logit and probit models with the bid variable logged, although at least for the probit the overall means are always defined. The median is generally much smaller than the mean for these types of models. We view the 75th percentile as a compromise measure in the sense that it is conservative compared to the overall mean, but less so than the median. The other widely used measure for these models, the truncated mean (Bishop and Heberlein 1979), also has the property of approaching the overall mean in value but staying within the range of the available data (for a recent example, see Shultz and Lindsay 1990). We prefer the percentile measure for this application because derivatives can be defined in closed form.

The partial derivatives of [7] and [8] with respect to a covariate x are:

$$\frac{\partial\mu(\tilde{x})}{\partial x_i} = (-\gamma_i/\alpha)\mu(\tilde{x}) = \beta_i\mu(\tilde{x}) \quad [9]$$

$$\frac{\partial\eta_p(\tilde{x})}{\partial x_i} = (-\gamma_i/\alpha)\eta_p(\tilde{x}) = \beta_i\eta_p(\tilde{x}) \quad [10]$$

Obviously, these partial derivatives have the same form. The elasticity of either welfare measure with respect to a linear covariate x_i is equal to $-\gamma_i x_i/\alpha = \beta_i x_i$. For log-transformed variables, elasticity is given by $-\gamma_i/\alpha = \beta_i$. Thus, a proportional change in either of these measures with respect to a fixed change in x_i is constant (Patterson and Duffield 1991). This interesting result applies to a broad range of welfare measures, including the mean and any percentile of the WTP distribution. Again it may be noted that the widely used truncated mean welfare measure does not have defined derivatives.

Three specific dichotomous-choice valuation questions were used in this study: onsite current trip valuation, onsite trust fund contribution for protection of instream flows, and a mail survey trust fund contribution for protection of instream flows. (See Appendixes A and B for the specific wording of each question.) All of these valuation questions were estimated in the form of equation [4], but it should be noted that the interpretations differ. The onsite current trip elicits valuation of the current trip; accordingly this is a marginal valuation with quantity of trips to this river thus far in the season as an explanatory variable.

By contrast, the trust fund questions are for total WTP to protect instream flows over a year or recreation season. The onsite version essentially provides a point estimate on this total valuation function for the given river. However, the mail survey trust fund was used in three versions (to separate subsamples): Bitterroot River only, Big Hole only, and protection of a group of five rivers including the Bitterroot and Big Hole. Accordingly, when mail survey trust fund responses are pooled, responses relate to the distribution of total WTP (annual basis) conditional on the number of rivers protected (one or five).

Previous studies of instream flow values have not examined the precision of welfare estimates. However, recent applications to related nonmarket valuation issues have reported standard errors for dichotomous-choice contingent valuation (Kealy et al. 1988, Duffield and Patterson 1989, Park et al. 1989). Because of model complexity, we use the simulation approach described by Krinsky and Robb (1986) to estimate standard errors for marginal total instream flow value and other terms. It would be very difficult if not impossible to estimate these standard errors through analytical procedures. We drew 1,000 repetitions from the asymptotic multivariate normal distributions for the estimated parameters. It should be noted that "bootstrapping" procedures are somewhat different from the approach used here in that with bootstrapping one draws from distributions based on the original data (Duffield and Patterson 1991).

STUDY AREAS

The Big Hole and Bitterroot Rivers were selected for the onsite survey. The Big Hole is one of the premier trout fisheries in North America. Beginning near Jackson, Montana in a broad valley bounded by the Bitterroot, Pioneer, and Pintler Mountains, it circles around the Pioneers to join the Beaverhead (forming the Jefferson) at Twin Bridges. In the middle section of the river between Wise River and Melrose, the river flows through a canyon world-renowned for its dry fly fish-

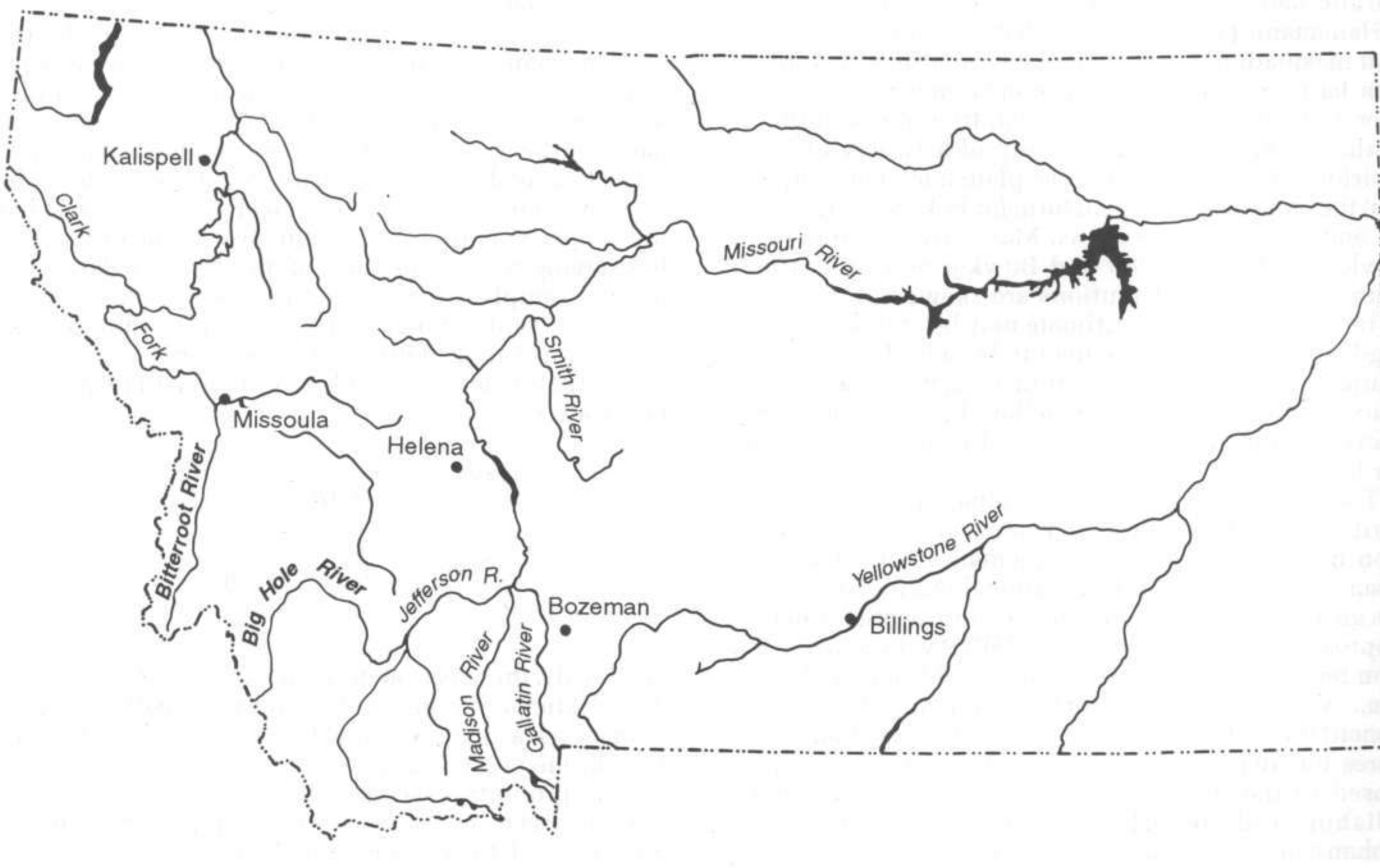

Figure 1. — The Big Hole and Bitterroot Rivers in western Montana.

ing for browns and rainbows. Particularly during the salmon fly hatch in mid-June, the river attracts anglers from across the nation (fig. 1).

The Bitterroot is also an excellent fishery but, reflecting the considerably higher population density of the Bitterroot Valley (compared to the Big Hole), receives the bulk of its use from floaters and general shoreline recreationists. This river flows north from the junction of the East and West Forks south of Darby, Montana to where it joins the Clark Fork in Missoula. Although the Big Hole has a well-defined and generally stable stream bed, the Bitterroot is constantly on the move, redefining its course through braided and cottonwood-lined channels. The Bitterroot has a major reservoir (Painted Rocks) on its West Fork tributary. In recent years, the Montana Department of Fish, Wildlife and Parks (DFWP) has purchased water from this reservoir to supplement summertime flows.

Our study focused on river sections that receive considerable recreational use yet are subject to dewatering: the 52-mile stretch of the Big Hole from Wise River to Glenn and the 20-mile stretch of the Bitterroot from Woodside to Stevensville. Both rivers have been extensively studied by the DFWP to determine relations between flow levels and fishery quality. A recent study examined the effect of management of Painted Rocks Reservoir releases on the trout fishery in our study section of the Bitterroot River (Spoon 1987). Currently, the DFWP is developing specific minimum instream flow recommendations for the entire Upper Missouri River Basin, which includes the Big Hole. Daily flow levels for study sections were available from U.S. Geological Survey gages at Darby on the Bitterroot and Melrose on the Big Hole. Temporary gages have also been installed in the dewatered sections of the rivers at Bell Crossing on the Bitterroot and Wise River on the Big Hole.

We anticipated significant flow variation during the May through August onsite survey period to permit identification of the relationships of value and use to flow. Like most Montana rivers, the Big Hole and Bitterroot have pronounced seasonal variation, with runoff due to snowmelt typically peaking in June and low flows for the year in August or September. Both rivers have good historical flow records. The mean flow at Melrose on the Big Hole is 1153 cfs, based on a 68-year record, with June and August flows averaging 4055 cfs and 479 cfs (fig. 2). The mean flow on the Bitterroot at Darby is 909 cfs based on 54 years of record, with June and August flows of 3,197 and 376 cfs.

The summer of 1988 was to be one of the driest on record, and the Big Hole was particularly hard hit. June flow on the Big Hole averaged about 1600 cfs at Melrose, and only 705 cfs based on a Melrose and Wise River gage average, compared with the historical Melrose mean flow in June of about 4000 cfs. By August, flows averaged only about 50 cfs, or 10% of the historical mean. The Bitterroot was also below normal (fig. 2). As reported in more detail below, recreation use on the Big Hole during summer months is dominated by anglers (e.g., about 85% in 1988), with the remaining users floating or enjoying shoreline activities (e.g., picnicking or swimming). On the Bitterroot, only about 40% of the summer users were fishing, with over 50% engaged in shoreline activities and about 5% in floating.

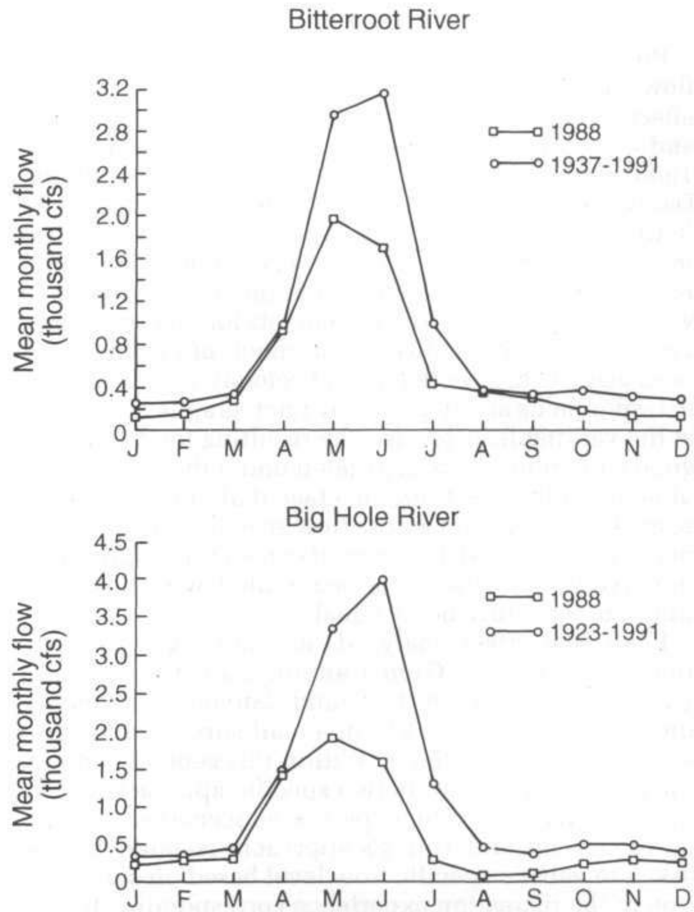

Figure 2. — Mean annual and 1988 hydrographs, at Darby on the Bitterroot River and at Melrose on the Big Hole River.

CURRENT TRIP VALUE

Opportunities for river recreation, such as fishing, floating, picnicking, and camping, are typically available at a zero entrance fee, but this should not obscure the underlying demand relationship between the quantity consumed (trips or days) and the total price of using the resource. Our a priori assumption is that instream flow levels enter this demand relationship as a standard shifter variable that will potentially affect both quantity demanded (at any given price) as well as the reservation price at any given quantity of use. Less abstractly, for any given site one would expect flows to influence both the number of visitors (quantity demanded at current price) and the quality of the experience. These two effects of varying instream flow levels on demand are referred to as the quantity effect and the quality effect.[3]

[3] Much of this discussion is taken from Duffield et al. (1992).

Previous Studies

Previous studies on the economic value of instream flow have generally focused on one or the other of these effects. The seminal study by Daubert and Young (1981) and a recent study in the Grand Canyon (Boyle et al. 1988) provide useful analysis of the quality effect. Daubert and Young used a CVM bidding game format (with both sales tax and entrance fee payment vehicles) to value alternative flow levels on the Cache la Poudre River in Colorado. Onsite respondents were asked to value seven specific flow increments for instream flows varying from 50 to 1150 cfs. The effects of varying flows on angler catch, river depth, and velocity were described to respondents and depicted by photographs of the river at the varying flow levels. The resulting total and marginal valuations were aggregated under the assumption of no quantity effect (e.g., average daily visits were assumed to be constant across flow scenarios at 228 visits per day for anglers). One would expect this approach to understate the total value associated with changing flows, other things being equal.

Boyle et al. (1988) analyzed the quality effect for varying flows (due to Glen Canyon Dam releases) on whitewater boaters in the Grand Canyon. They used a dichotomous-choice CVM in a mail survey with a trip expense payment vehicle. Within this general method, the authors demonstrate two specific approaches. The first, which they call "unexperienced scenarios," is similar to Daubert and Young's approach: respondents are asked to value a specific flow level based on a description of the recreation experience corresponding to that flow. Boyle et al. (1988) carefully developed the scenarios based on a preliminary "attribute survey" to identify the important aspects of the recreational experience and how these vary with flow. The second approach is to simply include actual flow levels as an explanatory variable in the logistic regression estimate (in the general form of [4] above). Plots of marginal value (consumer surplus per trip) against average flow level in cfs are very similar for white-water boaters for both methods. The separate possible influence of flow on the quantity of trips was not investigated, although for whitewater boating in the Grand Canyon this may be entirely appropriate given that use is controlled by permits, which are always fully allocated.

Narayanan's (1986) study of instream flow on the Blacksmith Fork River in Utah focused on the quantity effect. This study used a conventional double-log, single site, zonal travel cost model to estimate total recreational benefits in 1982. Because this was a single site model based on one season of use, flow was not directly included as an explanatory variable in the travel cost model. The quantity effect was instead estimated with an onsite survey where respondents were asked to indicate "at what percentage of current instream flow they would cease to visit the site for the entire season." The percentages given as options were 0, 10, 25, 33, 67, 75, and 100. This amounts to another "unexperienced scenario" type question, but here the response is in terms of quantity of use rather than WTP. Survey responses were used to estimate a simple bivariate logistic model with the ratio of expected use to actual use expressed as a function of flow level. The predicted ratio was then simply multiplied times aggregate WTP for the study year to generate total WTP as a function of flows. As the author notes, this model assumes that instream flow levels affect only the number of trips and not the consumer surplus per trip. In other words, this is a pure quantity effects model.

A specific limitation of Narayanan's study is that, for the logistic specification that he employed, recreation use was a positive function of flows at all levels, which of course rules out identification of an optimum. This specification does not correctly model a decline in use as flows approach flood levels.

Unlike most previous studies, Walsh et al. (1980) developed a joint quality and quantity effects model in an application to nine sites in western Colorado. Their methodology identified the effects of congestion on trip value and the effects of instream flow on expected participation rate and trip value. Both congestion and flow effects were estimated for each respondent for a range of unexperienced use (six levels varying from no encounters to the maximum number acceptable) and flow (five levels varying from 80% to 0% of bankfull) scenarios.

As Narayanan (1986) noted, the results of any study based on different unexperienced flow scenarios will depend on how accurately the respondents perceive the given variations in flow level and are able to evaluate the impact of flow on their recreation experience. The same qualification would apply to unexperienced variations in congestion or other variables. Boyle et al. (1988) demonstrated that scenario-based estimates are plausible, but cautioned that they should not be interpreted as perfect substitutes for values based on actual experience. In any case, it appears that the scenario approach requires considerable effort and careful consideration with regard to the types of information and level of detail presented. Additionally, as Boyle et al. (1988) noted, it may be difficult to identify an optimum flow condition from a finite number of workable scenarios.

Theoretical Model

The approach taken in this study was to measure both quantity and quality effects based on experienced conditions and to express both effects as a function of flow. At the most general level, a model that can represent the main effects of flow on total recreational benefits is:

$$T = R(Q,\tilde{s})W[Q,R(\cdot),\tilde{x},u] \qquad [11]$$

where T is total recreational value per day as a function of flow (Q), $R(Q,\tilde{s})$ is total recreational use at the site per day, and $W(\cdot)$ is an inverse Hicksian demand function where W or willingness to pay has the interpretation of compensating variation per individual-day. $\tilde{x}$ and $\tilde{s}$ are vectors of site environmental conditions and socio-economic factors, and u is previous quantity consumed (seasonal use to date at the site for the average respondent). This model has the general structure of a Bradford (1970) aggregate bid function.

The model in [11] gives total WTP associated with recreational use of the site. However, an inverse Hicksian demand function for *flows* can be derived from [11] by differentiation. The partial total derivative of T with respect to Q is:

$$\frac{dT}{dQ} = W\frac{\partial R}{\partial Q} + R\left(\frac{\partial W}{\partial Q} + \frac{\partial W}{\partial R}\cdot\frac{\partial R}{\partial Q}\right) \qquad [12]$$

where the first term is the quantity effect and the second term is the quality effect in marginal terms (e.g., dollars per day per cfs). This function can be used to derive a marginal valuation schedule at alternative flow levels. It may be noted that the quality effect consists of the direct effect of flow on value, and the indirect effect as flow affects daily use (R) and that use in turn affects value via the influence of congestion. It should also be noted that the influence of use on value (the congestion effect) may be discontinuous; that is, below some threshold, use levels may have little effect on the value of a trip, whereas above that threshold use levels may have a significant impact. (In any case, our data unfortunately did not permit including a congestion term in our empirical model.)

The direct quality effect is measured by incorporating actual average daily flow into the current trip logistic regression model. For example, the variables in equation [4] could be made explicit as:

$$\begin{aligned}\ln[p/(1-p)] &= b_o + b_1\ln(t) + b_2\ln(u) \\ &+ b_3\ln(Q) + \sum_i b_i\ln(x_i)\end{aligned} \qquad [13]$$

where b_i are estimated parameters, t is the bid offer value, u is quantity demanded (trips so far this year), Q is the flow variable, and x_i are other explanatory variables such as total number of users per day (R) as well as environmental and socio-economic factors. Equation [13] provides a parameterization of W and allows calculation of its derivatives.

We follow the procedures specified by equations [5] through [10] to estimate welfare measures and the marginal value of instream flow.

Another element in our total value model (equation [11]) is $R(Q,\tilde{s})$, use per day for a given recreation site. This is modeled as a second (or higher) order polynomial in the flow variable (Q) plus an assumed linear relation to a vector of other explanatory variables $\tilde{s}$ such as a weekend/weekday dummy variable or:

$$R(Q) = c_0 + c_1Q + c_2Q^2 + \sum_i c_is_i \qquad [14]$$

A second order or higher polynomial specification (depending on signs of estimated parameters) may permit identification of an optimal flow level (in quantity terms). The congestion effect is estimated by including total daily use (as a proxy for respondent encounters with other recreationists) in [13].

A basic problem in estimating the value of instream flow for direct use is in combining the value of quality changes on an individual level with the aggregated quantity response of total daily use. The quality effect can be measured on an individual level and for daily (current) flow given seasonal quantity demanded. However, unless one has a large time-series data base, the quantity effect is necessarily on a daily (flow) basis.

The model described above can be aggregated to make total value (T) in [11] specific to some time period j (i.e., T_j). Then [11] is evaluated at the variable values that held for that time period. The main variable of interest, flow, can also be set for each time period. Then T for the season is simply:

$$T = \sum_j T_j, \quad j = 1,\ldots,n \qquad [15]$$

By setting Q_j (flow in period j) at a specific level (actual historical, or any hypothetical pattern), the valuation associated with alternative flow regimes can be evaluated. For example, the incremental benefits associated with maintaining July and August flows at some minimum level over the 20-year historical record can be estimated. For n=1, equation [15] becomes the simple seasonal aggregation at sample means. Depending on the availability of data, time periods could be specified per day, week, or month. In short, this model can be used to value the actual sampled recreation season or be employed as a simulation tool to evaluate alternative policy objectives.

Methods

Empirical Model

The general framework described in the previous section was applied to two rivers in a single period model that integrates both participation and quality effects of streamflow on recreation. Estimates of congestion effects were not feasible with our data.

We estimated a version of equation [12]:

$$\frac{dT}{dQ} = W(\cdot)\frac{\partial R}{\partial Q} + R(\cdot)\frac{\partial W}{WQ} \qquad [16]$$

where T is total value for the season in dollars per acre-foot and Q is in terms of cfs.

Onsite Survey

During the summer of 1988, we interviewed 909 recreationists, 590 along the Big Hole and 319 along the Bitterroot (table 1). The sampling intensity was similar on both rivers; the larger sample on the Big Hole reflects the river's higher use density, particularly in the early season. Appendix A contains the Bitterroot survey form. The Big Hole questionnaire was similar. Interviews were conducted to collect data about respondents and their recreation activities, trip value, and total

Table 1. — Survey sample sizes.

Survey	Sample size
Onsite (Summer 1988)	
Bitterroot	319
Big Hole	590
Total	909
Phone pretest (September 1988)	
Missoula/Big Hole	100
Mail survey (November 1988-January 1989)	
Total mailing	1850
Undeliverable	140
Total response	582
Nonresponse phone survey (April 1989)	
Total sample	251

Note: Response rate (cooperation) for onsite and both phone surveys was nearly 100%.

visitation. Daily river flows from U.S. Geological Survey river gages were added to the data base so each response was associated with actual flow at the time of the interview.

The interviews were conducted from 1 May to 26 August. Thirty-four days of interviewing occurred on the Bitterroot River, with 8 days in May, 10 in June, 12 in July, and 4 in August. The Big Hole interviews were conducted on 37 days, with 6 days in May, 14 in June, 8 in July, and 9 in August. Interviews on the Bitterroot were conducted at four river access sites: Woodside Bridge, Tucker West, Bell Crossing, and Stevensville Bridge. These sites span 19.5 river miles and account for an estimated 11% of recreational use on the entire Bitterroot River. Interviews on the Big Hole were conducted at nine sites: Dickey Bridge, Jerry Bridge, Dewey, Divide Bridge, Divide Camping and Fishing Access, Maiden Rock Bridge, Salmonfly Access at Melrose, Brown's Bridge Access, and Glen Fishing Access. This 52-mile section of river received an estimated 43% of total recreational use on the Big Hole River.

Interviews were conducted along the two rivers during 8-hour sampling days. The Big Hole sample day was split between the up-river and down-river sites, alternating morning and afternoon hours between the two sections. Approximately 45 minutes were spent at each access in the course of a day. On the Bitterroot, two hours were spent at each of the four Bitterroot access points, with time of day randomly varied across sites.

On both rivers, when anglers or shoreline recreators were encountered in a group, one member of the group was randomly selected to be interviewed. If a group of shoreline anglers was spread out along the river's edge, all were interviewed assuming that the other group members could not influence the responses given. In the case of families, one adult was chosen to be interviewed. When not all members of a group were interviewed, group size was noted. Anglers in midstream were interviewed by either calling them over to the bank or wading to them. Floaters were interviewed when they were taking out of the river. When a site was crowded, the person to be interviewed first was randomly chosen. Of the recreationists remaining at the site, the next person to be interviewed was also chosen at random. This procedure continued throughout the time period at the site.

One interviewer was able to interview all individuals or groups encountered along the Bitterroot. One interviewer was also sufficient along the Big Hole during May, July, and August; but during the salmon fly hatch in mid-June, hundreds of anglers—both floating and shoreline—were attracted to the Big Hole River, and one interviewer was not sufficient. During this period of heavy angler use, one interviewer remained in the section between Maiden Rock and Glen, and another interviewed recreators in the upper reaches between Dickey Bridge and Divide. Each spent eight hours interviewing, for a total of 16 sample hours per day, and found that it was possible to interview all recreators at each site, except during afternoon and evening hours at Melrose, when some individuals and groups were missed between 10 June and 12 June.

The onsite surveys gathered information from respondents on a daily basis that could be correlated to daily river flows measured at U.S. Geological Survey gages along each river. The interviews identified respondent characteristics, onsite activities, trip value, and visitation rates. The current trip valuation part of the survey obtained the respondent's estimate of the monetary cost of the trip, and then asked if the respondent "would still have visited" the site if "personal expenses were [offer price] more." A limitation of this form of the question is the ambiguity of the "price," whether it is higher for all visits to the site or just for the current visit. If respondents do not assume that all visits have the higher price, there is an upward bias to the WTP values.

The selection of the bid range and the distribution of the sample among the offer amounts followed procedures developed to minimize the standard error of welfare estimates in logistic dichotomous-choice models (Duffield and Patterson 1991). A previous contingent valuation study of Montana stream anglers (Allen 1988) provided prior estimates of the expected logistic distribution. A general finding by Duffield and Patterson (1991) was that more precise estimates of a given percentile welfare measure result from allocation of a higher proportion of the sample at bid levels near the value of the welfare estimate. In this application, the bid range used was $1 to $2,000 with a higher proportion of the sample allocated at the $250, $350, and $500 bid levels.

The bid levels and distribution of the total sample among the bid amounts differed on the two rivers. Table 2 lists the bid levels, the number of persons responding to each bid level, and the number who responded "yes" to the contingent valuation question. The table excludes invalid cases, those cases where the respondent was on a trip paid by a company or the government or as a promotional scheme, and cases where the respondent was a river guide. It also excludes "outliers" determined by "believability" tests. For example, cases where reported annual expenditures to the site were greater than reported annual income, and cases where annual addi-

Table 2. — Current trip bid levels and distribution.

Bitterroot				Big Hole			
Bid level	Respondents[1]	Number "yes"[2]	Proportion "yes"	Bid level	Respondents[1]	Number "yes"[2]	Proportion "yes"
$1.00	7	7	1.00	$1.00	12	12	1.00
1.50	12	12	1.00	1.50	10	10	1.00
2.00	10	10	1.00	2.00	10	10	1.00
3.00	13	13	1.00	3.00	13	12	.92
4.00	8	8	1.00	4.00	15	15	1.00
5.00	7	7	1.00	6.00	13	13	1.00
6.00	6	5	.83	8.00	11	11	1.00
9.00	14	8	.57	10.00	3	2	.67
12.00	5	5	1.00	11.00	6	6	1.00
16.00	5	4	.80	15.00	4	4	1.00
22.00	7	5	.71	16.00	9	8	.89
30.00	9	4	.44	20.00	5	4	.80
40.00	10	3	.30	22.00	7	6	.86
55.00	8	1	.13	30.00	14	10	.71
75.00	10	3	.30	45.00	16	13	.81
100.00	14	6	.43	60.00	12	5	.42
150.00	12	4	.33	90.00	17	8	.47
175.00	3	1	.33	125.00	16	8	.50
200.00	9	0	.00	175.00	16	3	.19
250.00	21	1	.05	250.00	44	12	.27
350.00	14	0	.00	350.00	31	10	.32
500.00	22	5	.23	500.00	34	3	.09
700.00	18	2	.11	700.00	31	1	.03
1000.00	8	0	.00	1000.00	43	2	.05
1400.00	10	1	.10	1400.00	45	7	.16
2000.00	3	0	.00	2000.00	33	0	.00
Total	265	115	.43		470	195	.41

[1]Invalid cases, outliers, and cases with incomplete information were excluded.
[2]A "yes" response indicates that the respondent would pay the posited bid level.

tional WTP to visit the site (from the dichotomous CVM response) was greater than the mean plus three standard deviations of the mean proportion (across respondents) of annual income spent visiting the site, were considered outliers. These procedures isolated 24 and 17 outliers on the Bitterroot and Big Hole Rivers, respectively. See Butkay (1989) for more on procedures for isolating invalid and outlier cases.

Estimation Procedure

Models of current trip value (equation [4]) and recreation participation (equation [14]) were estimated. For the former, we examined a large subset of the theoretically plausible independent variable combinations using the maximum likelihood logistic regression procedure in SAS (1988). Likelihood ratio tests for the incremental contribution of specific variables or sets of variables were used to test the hypothesis that the valuation function is different for different user groups or at different locations. Because a major focus of the model was on derivatives with respect to discharge, interactive terms for residency status, location (river), trip length, and activity type with discharge were specifically tested. Based on initial comparisons of alternative Box-Cox transformations of the bid variable, we primarily worked with the log transformation. A comparison of alternative transformations for the final reduced model is described below. Ordinary least squares regression results reported here for the relationship of participation to flow levels were computed with the SAS (1988) stepwise regression procedure. Models reported are based on the step with the last variable included having an estimated coefficient significant at the 90% level, based on a *t*-test. Table 3 provides definitions of independent variables for both the participation and valuation models.

Results

Recreation Users

Table 4 summarizes activity participation of survey respondents on the Bitterroot and Big Hole Rivers during the summer of 1988. Fishing was the dominant activity on the Big Hole, comprising 87% of all use. In comparison, anglers comprised 41% of all recreationists on the Bitterroot. Fishing from shore was the chosen activity of about 25% of all users on both rivers, but on the Big Hole there was much more float fishing and camping (50%, compared to only 15% on the Bitterroot). The dominant use on the Bitterroot was general shoreline recreation (picnicking, swimming, etc.). These activities occupied 53% of Bitterroot users compared to only 7% of Big Hole users.

The importance of angling on the Big Hole and this river's fame was reflected in the type of visitor it attracted. Twenty-nine percent of Big Hole users were from out of state, compared to 16% of Bitterroot users (table 5). The mean household income of Big Hole visitors was $41,500 compared to $31,100 on the Bitterroot. Eight percent of Big Hole visitors were on guided trips, compared to less than 1% on the Bitterroot. The typical trip to the Big Hole entailed more time at the site (25.5 hours compared to 6.8 hours on the Bitterroot), and greater expense per person per trip ($330 versus $134). The average Big Hole respondent had taken 2.8 trips so far in 1988 to that river compared to 8.6 trips for the average Bitterroot respondent. Additionally, 20% of Big Hole respondents considered that river to be crowded, whereas only 7% of visitors to the Bitterroot thought it was crowded.

Table 6 shows the monthly average number of individuals sampled per day and the monthly change in respondent characteristics. Based on individuals sampled per day, use peaked in June on the Big Hole and in July on the Bitterroot. Because a formal use survey was beyond the scope of this study, individuals sampled per day was used as a proxy. Individuals sampled per day is a good index of use on the Bitterroot because it was always possible to sample all individuals or groups observed at the access sites. On the Big Hole, which was more crowded than the Bitterroot during good flow levels, it was not always possible to sample all individuals observed. For our purposes, where use (individuals sampled) is regressed on flows to estimate the model in equation [14], this has the effect of underestimating the influence of flows on use for the Big Hole. Accordingly, the quantity effect as defined previously is conservative. On both rivers, nonresident use increased over the season. On the Bitterroot, only 2% of May users were nonresidents, compared to 29% by August. The absolute change was even more pronounced on the Big Hole, increasing from 16% nonresident use in May to 63% in August. Whereas visits

Table 3. — Variable definitions for current trip models.

Variable	Definition
BIDT	Dollar bid offer for current trip
INCOME	Household annual income in dollars
TRIPTM	Hours on site for this trip
Q	Daily average flow in CFS on study sections based on USGS gages at Melrose (Big Hole) and Darby and Bell Crossing (Bitterroot)
AGE	Age of respondent
RES	Dummy variable with 1 = Montana Resident, 0 = nonresident
BITTER	Dummy variable with 1 = visitor to Bitterroot River, 0 = visitor to Big Hole River
FLOATA	Dummy variable with 1 = visitor is a floating angler, 0 = visitor engages in other activity
NSAMPLE	Number of anglers interviewed on a specific day
CROWDED	Perception of visitor as to how crowded the river was ranging from 1=not crowded to 9=very crowded
WKEND	Dummy variable with 1 = interview conducted on weekend day, 0 = weekday
WIND	Dummy variable with 1 = strong winds on river, 0 = no strong winds
k	Scale parameter for the logistic distribution (standard deviation = $\pi\kappa/\sqrt{3}$)
COLD	Dummy variable with 1 = cold temperature on interview day, 0 = not cold
SALDATE	Dummy variable with 1 = a day when greater than 20% of anglers reported fishing the Salmon fly hatch
DAYS	Days per trip
EXPENSES	Expense per person per trip
DIST	One way travel distance in miles

Table 4. — Onsite activity shares by river (percent of total sample).

Activity	Bitterroot	Big Hole
General shoreline (picnic, swim)	53.0	7.2
Float	6.4	5.9[1]
Fish		
Shore fish	24.6	23.6
Fish and camp	1.1	13.6
Float and fish	14.8	35.3
Fish, float, and camp	0.0	14.3
Subtotal Fish	40.5	86.8
Resident[2]		
Float angler	12.8	32.9
Other	66.8	31.6
Nonresident		
Float angler	2.4	13.6
Other	18.0	21.9

[1] Includes 0.6% float and camp

[2] Percentages of Montana residents differ from those of table 5 because of missing observations in the table 4 computations.

Table 5. — Current trip characteristics by river.

Variable		Bitterroot	Big Hole
Total sample		319	590
Discharge (mean cfs)[1]		1498	648
Annual income (mean $)		31,079	41,494
Trips so far this year (mean)		8.6	2.8
Hours on river this trip (mean)		6.8	25.5
Years coming to this river (mean)		10.8	15.8
First visit to river (%)		7.4	11.6
Montana residents (%)		83.7	71.1
One way travel distance (miles)			
	Mean	272	441
	Median	10	100
Trip expense per person ($)			
	Mean	134	330
	Median	10	60
This visit the main or only one this trip (%)		61	62
This site the main or only one this trip (%)		69	58
Considered river crowded (%)		6.6	19.5
On a guided trip (%)		0.3	8.3

[1] Based on flow measured at Darby on the Bitterroot and Melrose on the Big Hole.

to the Bitterroot averaged about 5 hours onsite throughout the summer, onsite visits to the Big Hole increased from 17 hours to 50 hours.

Fishing Success Big Hole anglers had fished an average of 6.5 hours at the time of the interview, while Bitterroot respondents had fished only 1.4 hours. The number of trout caught so far was also significantly higher on the Big Hole, with an average of 5.8 trout caught on the Big Hole vs. 0.6 on the Bitterroot. Thus, on average, the number of fish caught per hour of fishing was almost 0.9 on the Big Hole compared to about 0.4 on the Bitterroot.

Catch rates changed over the course of the summer on each stream (table 7). On the Bitterroot, the August success rate of 0.55 trout per hour was approximately double the May-June success of 0.28 trout per hour and also higher than the July rate of 0.35 trout per hour. On the Big Hole, the August success rate (0.85 trout per hour) was almost as high as in June (0.90 trout per hour) and higher than May (0.77) or July (0.55). The high June success on the Big Hole was probably due to the salmon fly hatch. The generally high success in August may have several explanations, including (1) the fact that a greater proportion of August anglers on both rivers were nonresidents (who traveled long distances and were more likely on average to be dedicated and highly skilled) and (2) the extremely low flows of 1988, concentrating fish in limited areas where they were more easily caught. Fishery biologists reported very high catch rates on the Big Hole in late summer. Some guides reportedly quit fishing because they felt it was wrong to take advantage of trout vulnerability.

It is important to note that although the short-term effect of low flows may be to actually increase angler success, the long-term effect is likely to be negative. For example, biologists found that on some streams heavily affected by low flows in 1988, an entire age class of trout was later missing (Vincent et al. 1989). The lagged effect of flows on reproductive success and survival would require a multi-year model to incorporate.

User Preference for Flow The majority of users on both rivers responded that the flow was adequate for their purposes at the time of the interview. Over the May-August interview period, only 19% of Bitterroot respondents and 31% of Big Hole respondents would have preferred higher flows. However, satisfaction with existing flows differed considerably over the season. During May and June, 4% of Bitterroot visitors and 20% of Big Hole visitors would have preferred higher flows; but for July-August, 30% of Bitterroot visitors and 59% of Big Hole visitors would have preferred higher flows (table 8). Of those offering comments about the flow level, (only about 20% on each river), 65% of Big Hole respondents said the flow was "too low" compared to

Table 6. — Current trip characteristics by month by river.

Measure	May	June	July	August
Bitterroot River				
Sample[1]	53	69	118	17
Interviews per day (mean)	6.6	6.9	9.8	4.3
Number of sample days	8	10	12	4
Discharge (mean cfs)	2959	2783	460	216
Annual income (mean $)	30,865	30,667	30,887	34,833
Montana resident (%)	98	81	81	71
First visit to river (%)	10	10	5	13
Years visiting this river (mean)	12.1	10.9	10.8	5.9
Trips so far this year (mean)	6.1	9.5	8.1	10.9
Hours on river this trip (mean)	4.6	5.6	5.4	4.8
Big Hole River				
Sample[1]	83	263	71	40
Interviews per day (mean)	13.8	19.0	8.9	4.4
Number of sample days	6	14	8	9
Discharge (mean cfs)	1165	705	168	52
Annual income (mean $)	34,815	43,601	40,869	42,929
Montana resident (%)	84	78	48	37
First visit to river (%)	6	12	15	13
Years visiting this river (mean)	15.6	16.4	13.1	16.5
Trips so far this river (mean)	2.1	3.0	2.1	3.1
Hours on river this trip (mean)	16.5	21.2	38.0	49.7

[1] *Sample size reduced by listwise deletion.*

Table 7. — Fishing quality by month.

Measure	May	June	July	August
Bitterroot River				
Trout caught so far	.5	.7	.4	1.3
Hours fished so far	1.1	1.4	1.2	4.2
Trout caught per hour	.28	.28	.35	.55
Big Hole River				
Trout caught so far	5.3	6.1	3.9	7.9
Hours fished so far	4.9	6.6	7.7	7.3
Trout caught per hour	.77	.90	.55	.85

Table 8. — Onsite flow-related responses by river (percent of respondents).

Variable	Bitterroot	Big Hole
Flow was considered adequate	93	88
May–June preference:		
Current flow	63	67
Higher flow	4	20
Lower flow	32	14
July–August preference:		
Current flow	69	41
Higher flow	30	59
Lower flow	1	1
Respondents offering comments about flow level	23	19
Comment:		
Too low	21	65
A little low	29	23
Prior knowledge of today's flow level	59	50
Source of flow information:		
Past experience	41	31
Friends	2	6
Fly shops/guides	2	5

21% of Bitterroot respondents. Thus, it appears that low flows were perceived to be more of a problem on the Big Hole than the Bitterroot in 1988.

Fifty-nine percent of Bitterroot visitors knew the flow conditions in advance of their trip compared to 50% of Big Hole users. The main source of information about flows on both rivers was respondents' past experience. Given a greater share of local users, it is not surprising that Bitterroot visitors were more informed about flow conditions prior to their trip.

Current Trip Value

A logistic regression model that includes a complete set of our theoretically plausible independent variables is summarized in table 9. Data from both rivers were pooled in order to gain efficiency and to test the hypothesis that analogous coefficients differ across locations. The estimates were made on an equation in the form of [4] and reparameterized as in [6] so that the dependent variable is the log of unobserved WTP. Standard errors are derived following Patterson and Duffield (1991). The model was reestimated several times to test the contribution of sets of variables based on likelihood ratio tests. We found that the contribution of variables to measure congestion (CROWDED and NSAMPLE) and the interaction of residency status, activity group, and length of trip with flow level did not provide a significant improvement in the likelihood ratio at the 90% level. Note that the finding of no significant congestion effect contrasts with Walsh et al. (1980), who found that congestion had a significant effect on recreational trip value for a set of Colorado rivers. However, it appears that on average the Colorado rivers are much more crowded than the Montana study sites. The Colorado sites average approximately 12 users per day per mile over the sample season, compared to about 2 users per day per mile on the Big Hole and Bitterroot.

Table 9. — Logistic dichotomous-choice model for valuation of current trip: full model.[1]

Variable	Coefficient	Variable mean	Standard error	Asymptotic t-statistic
Intercept	−3.8982	—	2.52479	−1.5439
k	−.7808	—	.05871	−13.299[2]
ln INCOME	.0452	11.513	.14374	3.1496[2]
RES	−.1329	.697	1.50960	−.0880
ln AGE	.9406	3.661	.36569	2.5720[3]
ln Q	.1988	6.629	.27569	.7214
ln TRIPTM	−.1701	1.913	.53574	−.3182
BITTER	−3.5602	.344	1.68515	−2.1994[3]
BITTER lnQ	.4571	2.204	.24747	1.8471[4]
RES lnQ	−.1837	4.722	.22640	−.8159
TRIPTM lnQ	.0578	12.752	.08137	.7111
FLOATA lnQ	−.3264	2.607	.27426	−1.1901
CROWDED	.0629	1.891	.12803	.4909
NSAMPLE	−.0079	17.546	.01324	−.5956
FLOATA	1.8636	.357	1.92645	.9674

[1] N = 732; (−2 Log Likelihood) = 456.43; dependent variable is the log of unobserved willingness to pay.
[2] significant at 99% level.
[3] significant at 95% level.
[4] significant at 90% level.

A reduced model is reported in table 10. Alternative transformations of the bid variable were examined using a range of 1 to −1 for the Box-Cox transformation parameter λ (where the transformation is $(t^{\lambda}-1)/\lambda$) (Box and Cox 1964). With this parameter at zero, the model corresponds to a log specification, and at $\lambda = 1$, to a linear transformation. A plot of log likelihood statistics against λ for the variable set of table 10 is shown in fig. 3. The log likelihood is maximized at a λ of −0.1 (log likelihood ratio of −229.4) but this transformation results in only a slight improvement over the log transformation (−229.8). Both the −0.1 and log transformations result in large and statistically significant improvements over the linear model (log likelihood of −319.9). Following standard statistical practice, we use the transformation rounded to $\lambda = 0$.

The relationship of discharge to WTP varied significantly across rivers based on a likelihood ratio test of the Bitterroot river dummy variable and discharge in-

Table 10. — Logistic dichotomous choice model for valuation of current trip: reduced model.[1]

Variable	Coefficient	Variable mean	Standard error	Asymptotic t-statistic
	−3.3410	—	1.98459	−1.6835
k	−.7942	—	.05824	−13.636[2]
ln INCOME	.4412	10.296	.14413	3.0614[2]
RES	−1.3864	.697	.29178	−4.7513[2]
ln AGE	.9152	3.661	.36247	2.5249[3]
ln Q	.1361	6.629	.14226	.9568
ln TRIPTM	.2159	1.913	.08907	2.4242[3]
BITTER	−2.9574	.344	1.41068	−2.0964[3]
BITTER · lnQ	.3841	2.204	.20554	1.8685[4]
FLOATA	−.4539	.357	.2393	−1.8967[4]

[1] N = 732; (−2 Log Likelihood) = 459.62; dependent variable is log of unobserved WTP.
[2] significant at 99% level.
[3] significant at 95% level.
[4] significant at 90% level.

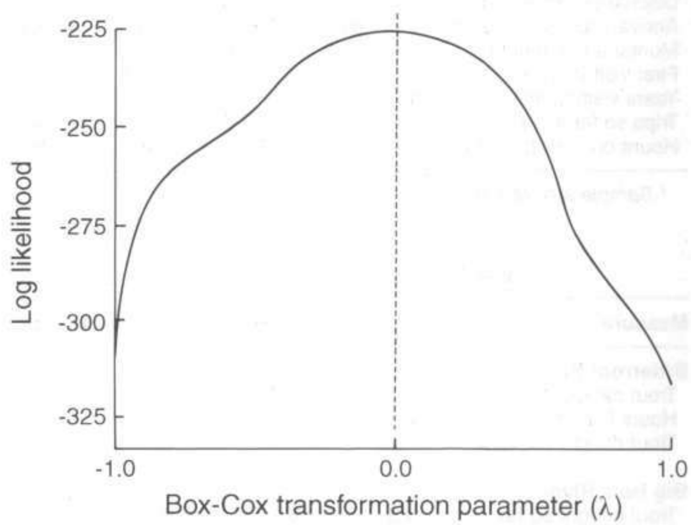

Figure 3. — Log-likelihood statistic for logistic contingent valuation model for a range of Box-Cox transformation parameters.

teraction term. The overall effect of discharge on WTP was positive but not significant. However, the coefficient for the Bitterroot discharge interaction term was positive and significant, indicating that discharge did have a significant effect on WTP on that river. The lack of a significant relationship between discharge and WTP on the Big Hole may be due to the change in sample composition that occurred there. As noted in table 6, nonresident use increased from 16% in May to 63% in August. By August, most of the recreationists continuing to use the Big Hole were probably those least sensitive to flows. Because many potential Big Hole users were not experiencing the low flows, the Big Hole data probably provide a misleading indication of the effect of flows on trip quality. The elasticity of WTP with respect to discharge is 0.14 on the Big Hole River but 0.52 on the Bitterroot River (table 10)[4]. This means, for example, that a 10% increment in streamflow on the Bitterroot leads to a 5.2% increase in trip value, other things being equal.

The bid variable is negatively correlated with odds of a "yes" response and is highly significant. Income, time on site, and age also have the theoretically expected sign, are highly significant and have elasticities of 0.44, 0.22, and 0.92 respectively. The large, negative and highly significant coefficient on the Bitterroot dummy variable (location) indicates that trips on the Bitterroot River are less valuable, other things being equal. The only coefficient sign that appears counter-intuitive is the negative sign on the float angler (activity group) dummy variable, indicating that, other things being equal, these types of trips are less valuable.

Recreation Use

The estimated use equation for the Bitterroot has expected signs for discharge, weekends, and strong winds, and all variables are highly significant (table 11). In addition, discharge squared and cubed are significant at the 99% level. This polynomial fit to discharge indicates that use is initially positively related to discharge, peaks at some optimal flow level (about 1,100 cfs for this model), and then declines. This is consistent with the general expectation that use is low at very low flows and at flood levels and is maximized at moderate flows. The equation for the Big Hole shows significant correlations with expected signs for discharge, discharge squared, and dummy variables for cold temperatures and times when the salmon fly hatch is on. Other things being equal, when salmon flies were present, use doubled.

Recreation Values of Instream Flows

Estimated net economic benefits for recreational trips to the Big Hole and Bitterroot Rivers are presented in table 12 for three specific welfare measures (the median, 75[th] percentile, and the overall mean) and for four subsamples defined by residency status and activity. All measures indicate that trips on the Big Hole River are on average more valuable than trips on the Bitterroot River and that trips by nonresidents have much higher WTP than resident trips. The difference across river types and residency status is in part due to differences in user characteristics (tables 3 and 4) given the elas-

[4] *In the equation of table 10, when BITTER=1 the elasticity of WTP with respect to Q is the sum of the coefficients for the terms lnQ and BITTER · lnQ.*

Table 11. — Daily use as a function of flow level.

Variable/statistic	Bitterroot Coefficient[1]	Bitterroot Variable mean	Big Hole Coefficient[1]	Big Hole Variable mean
Intercept	6.04334 (4.04)	—	6.3247 (3.696)	—
Q	.006584 (1.87)	1153	.010338 (2.241)	931
Q^2	−3.747E−06 (−2.11)	4.941E6	−2.776E−6 (−1.692)	1.592E6
Q^3	4.467E−10 (1.98)	1.973E10	—	—
WKEND	4.6216 (2.83)	.294	3.3926 (1.722)	.432
WIND	−4.7971 (−2.15)	.088	—	—
COLD	—	—	−7.4475 (−2.783)	.135
SALDATE	—	—	5.5931 (1.946)	.162
R^2	.411	—	.571	—
Sample size	34	—	37	—
NSAMPLE (dep)	—	7.50	—	12.892

[1] *t-statistics in parentheses.*

Table 12. — Welfare measures for willingness to pay for recreational trip (1988 dollars).

River/sample	Median (Std. error)[1]	75% (Std. error)[1]	Overall mean
Bitterroot			
Resident, float angler	48 (13)	115 (31)	199
Resident, other user	60 (12)	143 (30)	247
Nonresident, float angler	236 (76)	566 (209)	980
Nonresident, other user	480 (142)	1148 (365)	1988
Big Hole			
Resident, float angler	87 (18)	207 (42)	359
Resident, other user	125 (29)	298 (65)	516
Nonresident, float angler	540 (115)	1291 (308)	2234
Nonresident, other user	816 (215)	1952 (517)	3377

[1] *Based on Krinsky and Robb (1986) simulation procedure with 1,000 repetitions.*

ticities in table 10. The values in table 12 are per trip. Based on the median welfare measure, and generalizing over all use types, the value per day for residents is from about $50 to $70 and the value per day for nonresidents is $90 to $110 on the Bitterroot and $165 to $215 on the Big Hole.

These values can be compared to average values reported in the Walsh et al. (1989) literature review of 88 specific nonmarket fishing value estimates. The median values for our resident users are similar to the literature average values reported for cold water, anadromous and salt water fishing. Our nonresident median per day values ($90 to $215 per day) are at the upper end of the reported range for these types of fishing. The 75th percentile estimates for nonresidents on the Bitterroot are also at the upper end of the reported range, and Big Hole nonresident values are from $400 to $500 per day (see table 12 for corresponding values per trip). These findings indicate that computing average values for recreation on a given stream obscures some important differences among user groups. It also appears that the values for nonresident anglers on a major "destination" trout fishery such as the Big Hole may be quite high. These values may be plausible given the income level, trip length, and expenses of this group of dedicated anglers (table 5).

Standard errors were computed for the two percentile measures using the procedures of Krinsky and Robb (1986). Based on 1,000 repetitions, standard errors for the welfare measures are 12% to 14% of the estimate, indicating 95% confidence intervals that are about ±25% of the estimate.

Using the estimated parameters from tables 9 and 10, marginal recreational values for instream flows, as in equation [12], were computed for both study sites. Table 13 provides a listing of the marginal values per acre-foot for the river study sections at discharge levels ranging from 100 to 2,000 cfs. Values are weighted averages for a given river based on user group subsample shares (table 4). Results are presented for the 75th percentile welfare measure; estimates based on the median would vary in direct proportion to the values of this percentile measure, as reported in table 12.

Marginal values on the Bitterroot range from $10 per acre-foot at 100 cfs to zero value at 1,900 cfs (figure 4). This is the value of an additional acre-foot of water per day through the Bitterroot study section. The effect of flows on quality of the experience (WTP per day) accounts for over two-thirds of the marginal value, with the effect of flows on participation comprising the remainder (table 13). On the Big Hole marginal values range from $25 per acre-foot at 100 cfs to zero at about 2,200 cfs. On this river the marginal value of additional streamflow is about equally due to increased participation and increased WTP per day.

It is interesting to note that the instream values estimated here are in the range of typical transaction prices for instream flows. Ten instream flow transactions reported in *Water Market Update*[5] (1988–1989) were between $1 and $7, two were in the $15 to $25 range and another was $50. One of these transactions was a purchase by the Montana DFWP of 10,000 acre-feet annu-

[5] *Published by Shupe and Associates, Santa Fe, N.M.*

Table 13. — Marginal recreational value as a function of instream flow levels (1988 dollars per acre-foot).[1]

	Bitterroot			Big Hole		
Discharge (cfs)	**Quantity effect**	**Quality effect**	**Marginal value**	**Quantity effect**	**Quality effect**	**Marginal value**
Estimated values						
100	1.22	9.08	10.31	10.08	15.36	25.45
200	1.53	7.05	8.59	10.45	9.36	19.82
300	1.64	6.19	7.84	10.38	7.21	17.59
400	1.63	5.68	7.31	10.10	6.07	16.17
500	1.52	5.33	6.85	9.70	5.35	15.05
600	1.36	5.05	6.40	9.21	4.84	14.06
700	1.14	4.81	5.95	8.67	4.46	13.13
800	.89	4.60	5.48	8.07	4.16	12.22
900	.60	4.40	5.00	7.42	3.90	11.33
1,000	.30	4.21	4.51	6.75	3.69	10.43
1,200	−.36	3.86	3.49	5.31	3.32	8.64
1,400	−1.05	3.51	2.46	3.79	3.02	6.81
1,600	−1.74	3.18	1.44	2.19	2.76	4.94
1,800	−2.40	2.85	.45	.53	2.52	3.04
2,000	−3.01	2.53	−.48	−1.19	2.29	1.11
Standard errors of marginal value estimates[2]						
100			1.67			7.54
500			1.45			3.84
1,000			1.36			2.64
1,500			1.11			2.21

[1] *Based on the 75th percentile welfare measure.*
[2] *Based on a simulation with 1,000 repetitions using procedure of Krinsky and Robb (1986).*

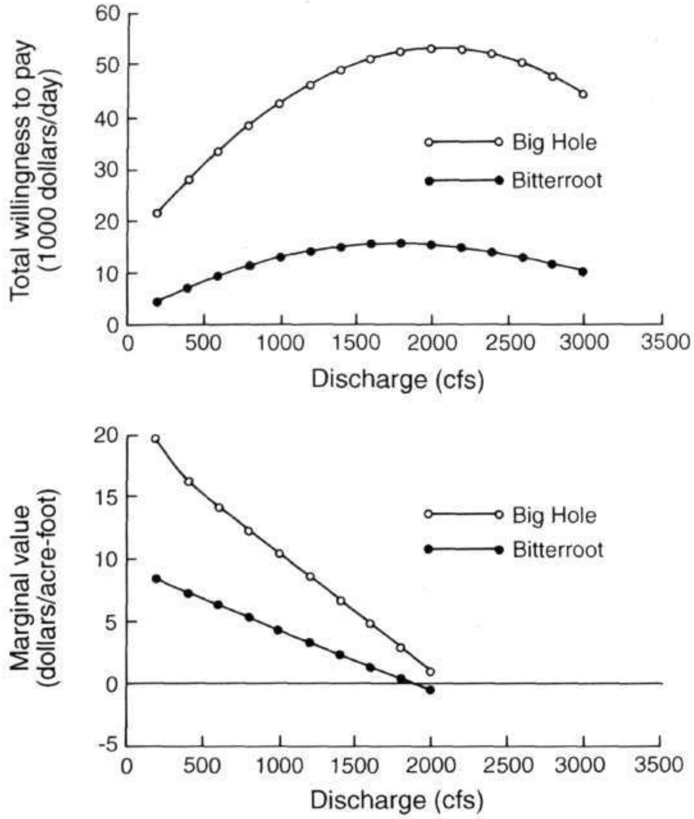

Figure 4. — Marginal and total *recreation* value for Big Hole and Bitterroot River study sections as a function of instream flow (1988 dollars).

ally at the administratively set price of $2 per acre-foot for release from Painted Rocks Reservoir in the Bitterroot headwaters. Given that these releases were during low summer flow conditions, the purchase of these releases appears to be justified by the value measured for the study section alone.

Total recreation values for the two rivers as a function of discharge are also depicted in figure 4. On the Bitterroot, total WTP reaches a maximum of about $15,500 per day at 1,800 cfs, and on the Big Hole, WTP reaches a maximum of about $53,000 per day at a discharge of 2,000 cfs.

Precision of these estimates was also derived using the Krinsky and Robb (1986) procedure. In this case we drew simultaneously from the two multivariate normal distributions of parameter estimates from our two underlying models: the maximum likelihood logistic model of trip valuation and the ordinary least squares (OLS) model of daily use. At lower flow levels, the 95% confidence intervals are from plus or minus 50% to 80% of the estimates.

Comparisons with Abbreviated Models

The information in table 13 provides the basis of a comparison with a simplified model where only the partial derivative term in either the quantity or quality effect measure varies, and the corresponding valuation or use term is held constant at average levels. For example, the quality effect is $R(\cdot)\frac{dw}{dQ}$. When R(·) is held constant at average seasonal use levels, the quality effect is overstated at low flows (because use levels are at a constant average level rather than at the low level of use likely to occur at low flows) and at high flows. Thus, for the Bitterroot at 100 cfs the correct quality effect is $9.08 (table 13), and the constant use quality effect is $12.72. The two measures are, of course, similar at flows that correspond to average use levels, and again diverge at high flows, reaching $2.53 and $3.02, respectively, at 2000 cfs. This constant use quality effect corresponds to the model used by Daubert and Young (1981).

A symmetric interpretation can be made of a constant valuation quantity effect model and the quantity effect of the current model. For example, at 100 cfs the constant value model for the Bitterroot overstates the quantity effect (at $4.03 versus $1.22 as in table 13), but understates total recreational valuation (at $4.03 versus $10.31 as in table 13). The constant value model estimates correspond to an application of the methodology introduced by Narayanan (1986).

This critique is limited to a discussion of the underlying theoretical valuation model. In some particulars of methodology, the applications of Daubert and Young (1981) and Narayanan (1986) may well be superior. For example, an application that used unexperienced scenarios, as did Daubert and Young, may have resulted in a good estimate of the flow-trip valuation relationship on the Big Hole. As it was, use of actual flows did not succeed for the possible reasons outlined above—primarily a dramatic change in sample composition over the summer. Because only daily use levels were found to be a function of flows on the Big Hole, the application to this river is essentially a Narayanan constant valuation quantity effect model. In other words, the marginal value of flows is simply dR/dQ(Q)·W where W or willingness to pay is constant at the sample mean.

PRESERVATION VALUE BASED ON ONSITE SURVEY

The economic values estimated in the previous section were obtained by asking recreationists whether they would still have made the trip if their trip costs were a certain amount higher. Thus, the CVM payment vehicle was trip expense, and the good to be valued was the existing (experienced) recreation trip. That approach allows valuation of recreation trips as well as valuation of site characteristics (such as flow level) that influence trip value. However, that approach does not necessarily capture the intrinsic value of flows (the additional value that recreationists assign to just knowing that flow is maintained at preferred flow levels), over and above any direct use value.

To approach this broader question of economic value, we employed a trust fund payment vehicle in two efforts. First, we queried the recreationists during the onsite interview (described in the previous section) about their willingness to contribute to a trust fund set up for the purpose of enhancing instream flows on the sample river. Second, we employed a household mail survey to examine residents' willingness to contribute to a trust fund for protecting instream flow on one or more Montana rivers. The onsite effort is described in this section, and the mail survey is covered in the following section.

A trust fund payment vehicle is not the only option for measuring the economic value of instream flow maintenance. Other viable payment vehicles include a user fee (at least for the onsite survey) and a tax. However, in the short-term at least, we considered the trust fund to have the greatest chance of actually being used. That is, we viewed the institution of trust funds as potentially playing an important role in the protection of natural environments. Our trust fund question gives some insight into the private, nonprofit sector budget for instream flows.[6]

Determining the value of instream flow protection requires that flow levels be compared by the respondent, and because two flow levels cannot be experienced at the same time, at least one of the flows being compared must be "unexperienced." To utilize the actual conditions in the onsite interview, we used the existing flow as the basis of comparison. The alternative flow level was defined by asking respondents for their "preferred flow." Preceding the trust fund question, a series of questions identified the preferred flow. Thus, the good to be valued in the onsite effort was the increment in flow specified by the difference between the existing flow and the respondent's self-defined preferred flow. This provided a possible efficient substitute to the costly and difficult task of defining a series of photographically represented unexperienced scenarios.

Methods

Survey Questions

A series of questions before the trust fund question established respondents' preferred flow level (see onsite survey in Appendix A). Specifically, individuals were asked if they would have preferred to visit the river at a different flow level. Those who preferred a different level were asked how many inches higher or lower than the current level would be preferred.

Respondents were then reminded that "this section of the [river] typically has low summertime flows and is severely dewatered in drought years such as 1985," that summertime flows could be increased by purchasing water from upstream irrigators or storage reservoirs, and that "one way this could be done would be by forming a trust fund to buy water as needed." Then respondents were asked the dichotomous choice question: "Would you purchase an annual membership in a trust fund costing $____ to maintain flows in the _____ river over the summer at your preferred level?" If they said no, they were asked if they would contribute if the cost were only $1 per year. Purchase of a trust fund membership is clearly a donation. To the extent that respondents believed that a trust fund was not the most appropriate way to enhance flows, this payment vehicle would be expected to underestimate willingness to pay.

Procedures for selecting the bid range and distributing the sample among the various offer amounts were similar to those described above for the current trip valuation. The bid range was from $1 to $1000. Table 14 lists the bid levels, the number of persons responding to each level, and the number who responded "yes."

Economic Value Computations

The equation estimated based on the dichotomous choice valuation responses is of the same general form as [4] and has a similar reparameterization to [13]. However, the equation is not an inverse Hicksian demand relationship, but rather a total valuation function (the question is contribution to maintain flows over the season) with the quantity variable (number of rivers protected) implicitly set at one for all observations. This estimate has some special problems in aggregation. The sample is biased toward more frequent users (the onsite sample frame samples the average day, not the average user). Accordingly, to expand the sample valuation to all users requires some correction (for example, the methods of Edwards and Anderson 1987 or Loomis 1987c may be appropriate). We used information we learned from our mail questionnaire (described in detail in the following section) on visitation frequency, along with information from the Montana DFWP.

A value per cfs per day or per acre-foot of instream flow can be derived with this method by comparing our sample's preferred flow to average historical flows. The total annual value by all river users was divided by the required annual flow increment (to achieve mean respondent preferred instream flow levels). The resulting value is a marginal value per acre-foot (over a fairly large increment). The comparison of preferred to historical actual flows needs to be disaggregated to at least the month level.

Results

The analysis in this section examines the trust fund and preferred flow responses of users surveyed onsite to estimate a value per acre-foot of water. This value might be viewed as an annual water purchase budget estimate (the payment vehicle was an annual membership in the trust fund). It is also of interest to compare the results to the current trip valuation approach. Other things being equal, the latter should only reflect direct recreational use values, and the trust fund should include option and existence values of the user. One would therefore expect the trust fund valuation of a given flow increment to be higher than the current trip valuation based on estimates of a corresponding flow increment.

Preferred Flow Level

Throughout the summer, an increasing proportion of the respondents preferred higher flows than they encountered, which is reasonable given the decline in actual flows. In May, on both rivers, about 65% of the respondents preferred the current flow level; 30% would

[6] *Subsequent to this study, an instream flow trust fund was created by the Montana Legislature.*

Table 14. — Onsite trust fund bid levels and distribution.

Bid level	Bitterroot			Big Hole		
	Respondents[1]	Number "yes"[2]	Proportion "yes"	Respondents[1]	Number "yes"[2]	Proportion "yes"
$ 1.00	7	7	1.00	15	12	.80
1.25	8	8	1.00	12	9	.75
1.50	12	9	.75	12	11	.92
2.00	6	5	.83	15	10	.67
2.50	11	10	.91	15	11	.73
3.00	8	5	.63	16	13	.81
4.00	9	6	.67	13	10	.77
5.00	9	4	.33	18	14	.78
6.00	8	7	.88	17	13	.76
8.00	13	7	.54	17	7	.41
10.00	15	10	.67	15	12	.80
12.00	8	6	.75	12	9	.75
16.00	10	6	.60	13	6	.46
20.00	12	6	.50	13	7	.54
25.00	6	2	.33	16	10	.63
30.00	8	4	.50	12	3	.25
40.00	9	2	.22	12	8	.67
50.00	12	6	.50	16	3	.19
65.00	6	2	.33	13	2	.15
80.00	10	1	.10	13	3	.23
100.00	9	2	.22	15	5	.33
150.00	9	0	.00	19	6	.32
200.00	9	1	.11	21	7	.33
300.00	12	1	.08	23	4	.17
400.00	9	0	.00	21	3	.14
500.00	10	0	.00	25	2	.08
700.00	10	0	.00	28	2	.07
1000.00	10	1	.10	32	0	.00
Total	265	118	.45	469	202	.44

[1] Invalid cases, outliers, and cases with incomplete data were excluded.
[2] A "yes" response indicates that the respondent would pay the posited bid level.

have preferred a lower level; and 5% would have preferred a higher level (table 15). By August no respondent on either river would have preferred lower flows. On the Bitterroot, 61% preferred the current level and 39% would have preferred a higher level. On the more severely dewatered Big Hole, 25% preferred the current level and 75% would have preferred higher flows (table 15).

The average preferred stage height (based on a weighted average of the data in table 15) is shown in table 16. This preferred height declines dramatically on the Bitterroot, from 4.8 feet in May to 2.8 feet in August. The high gage heights in May and June reflect the large share of respondents satisfied with current flows at a time when the river is quite high. The Big Hole responses are more stable, ranging from 2.6 to 3.0 feet across the four months. For the months of May and June, actual 1988 summer flows were either above or near preferred levels on both rivers (table 16). For the critical months of July and August, actual flows were considerably below preferred flows. On the Bitterroot, actual flows (of 462 cfs in July and 216 cfs in August) were 55% and 29% of preferred flows. And on the Big Hole, actual flows (of 168 cfs in July and 52 cfs in August) were 28% and 6% of preferred flows (table 16).

Preferred flows are also compared to historical flows in table 16. Because a long-term record is available only at one gage on each river, the two-gage averages (which are more representative of the study sections) were interpolated to yield the historical averages listed in the table.[7] The estimated historical flows for May and June

Table 15. — Onsite respondent preferred flow level.

Month	Current average stage (feet)	Current flows	Number of respondents preferring:		Preferred average stage (feet) of respondents wanting:	
			Higher flows	Lower flows	Higher flows	Lower flows
Bitterroot						
May	5.13	36	2	17	7.52	3.49
June	4.73	49	4	26	5.22	3.77
July	2.55	109	45	2	3.61	1.72
August	1.99	14	9	0	3.95	—
Big Hole						
May	3.32	60	5	29	4.20	1.76
June	2.79	208	74	27	4.21	1.82
July	2.03	55	53	1	3.15	1.11
August	1.52	17	50	0	3.48	—

[7] There is a possibility that historical records overstate current expected flows because of increased irrigation. Discussions with U.S. Geological Survey personnel indicated that this is unlikely and difficult to establish given existing data.

Table 16. — Onsite respondent preferred and actual flow levels by month.

Month	Preferred flow: Stage height (feet)	Preferred flow: Volume (cfs)	Actual 1988 flow (cfs)	Flow deficit in 1988 (cfs)	Historical average[1] (cfs)	Historical deficit[2] (cfs)
Bitterroot						
May	4.80	2750	2953	−208	2534	—
June	4.44	2397	2779	−382	2692	—
July	2.85	836	462	374	852	176
August	2.76	747	216	531	318	306
Big Hole						
May	2.89	816	1160	−344	1839	—
June	3.05	928	705	220	2176	—
July	2.57	592	168	424	722	103
August	2.98	879	52	827	257	598

[1]Based on 20 years of records. Bitterroot flows measured at Darby, and then adjusted based on more recent flows measured at Bell to better represent the study section. Big Hole flows measured at Melrose and adjusted based on more recent flows measured at Wise River to better represent the study section.

[2]Mean deficit (preferred - historical) for those years when preferred exceeded historical, which occurred on the Bitterroot in 7 of 20 years in July and in all 20 years in August, and on the Big Hole in 8 of 20 years in July and all 20 years in August.

were adequate when compared to preferred flows on both rivers. The historical average flows for July were also similar to preferred. For example, on the Bitterroot, average historical flows in July are 852 cfs, and preferred are 836 cfs. However, comparisons of these averages understate the actual average amount of water that would be needed to maintain a minimum flow of 836 cfs in July. It is instead necessary to look at the year-by-year historical deviation from the preferred level. The sum of these negative deviations from preferred levels averages 176 cfs over the last 20 years for July on the Bitterroot. This method also indicates that to reach preferred flows, on average 306 additional cfs would be needed in August on the Bitterroot, and 103 and 598 additional cfs would be needed for July and August on the Big Hole (table 16).

It is interesting to compare these respondent preferred flows to the minimum instream flows established by biologists who have studied these rivers. In Montana, the basic method employed by biologists to establish minimum flows is the wetted perimeter method (Nelson 1984). This approach is based on the relationship of flow (cfs) to the amount of wetted stream bottom established at typical riffle locations. For the Big Hole River, the Montana DFWP is recommending a minimum instream flow reservation of 800 cfs in DFWP Reach #2 (Pintler Creek to Divide Dam) and 650 cfs in Reach #3 from the old Divide Dam site to the mouth (Nelson, 1989). Our study section is essentially centered on the old Divide Dam site and overlaps both DFWP reaches. The DFWP recommended minimum flows are very similar to the respondent preferred flows. An additional perspective on Big Hole flows is provided by Nelson[8] who estimates that most people quit floating at flows of 500 to 600 cfs.

Spoon (1987) provides an extensive evaluation of the biological impacts of instream flows in the Bitterroot, focusing on the effects of water releases from Painted Rocks Reservoir on the West Fork. He reports a wetted perimeter-based estimate of minimum instream flows for the "dewatered section" (our study section) of 402 cfs. Spoon also reports a minimum flow for drift boats and rafts of 150 cfs. Here, angler preferred flows are almost double the minimum flows based on biological productivity.

[8] Nelson, F.A., personal communication, biologist, Montana Department of Fish, Wildlife, and Parks, Bozeman, MT, 1989.

Recreation Use

To estimate an aggregated trust fund, it is necessary to estimate total use in the study sections. The onsite sample frame, given budget constraints, was designed to provide a sufficient sample of river users for the valuation estimates. Estimating use was a lower priority consideration. Given these limitations, our use estimate (derived in table 17), relies heavily on previous use estimates by the Montana DFWP, which has conducted annual "fishing pressure" surveys for a number of years, based on a large mail sample of fishing license holders. Estimated fishing pressure (user days) is available by stream and stream reach. These estimates for 1985 were interpolated (based on the river miles in the study sections) to estimate total angler use in the study section. Based on a study by Hagmann (1979) of the Clark Fork River, it is assumed that 65% of this use occurred from May through August. The ratio of anglers to total use from the onsite survey was used to inflate this summer angler use estimate for the study sections to an estimate of total May-August days of use of around 10,500 for the Bitterroot and 15,300 for the Big Hole. Total summer season river use was derived from the total use estimate by dividing by days of use per user from the mail survey. Total summer season river use of the study sections is estimated to be 1,850 on the Bitterroot and 3,700 on the Big Hole (table 17).

Sampling Density

The sampling density achieved with our onsite sample can be estimated by comparison with the use data collected by the Montana DFWP (table 17). Comparing average daily use for this 123 day season to our observed user sample indicates a sample fraction of 0.08 to 0.09 on the two rivers (table 18). In other words, on any given day our interviewer observed or contacted approximately 10% of the actual users present in the study sections. (This sample fraction will be used to estimate total value per day based on the current trip responses.)

Economic Value

The key explanatory variables used in estimating economic value are bid, income, trips in the last two years, years visiting the river, a dummy variable for fishing activity, and discharge (table 19). Onsite logit trust fund equations are summarized in table 20. The model for the Bitterroot has highly significant estimated parameters with correct signs for bid, income, years, and trips. It can be noted that, in this case, the "yes" response refers to total annual valuation; accordingly the expected sign on the trips variable is positive. The model for the Big Hole includes bid, income, trips and discharge, as previously noted.

The mean and median user trust fund donations (based on the logit equations reported in table 20) are shown in table 21. The mean based on a truncation level of $1,000 (the maximum bid offer in the sample) is $80.16 for the Bitterroot and $119.70 for the Big Hole. The medians are much lower, $12.47 and $16.36, respectively, indicating that the WTP distributions are quite skewed and that the means are strongly influenced by the upper tail of the response distribution.

These estimated donations are based on onsite sample means for years visiting the site and for discharge, but based on mail survey means for income and trips in the last two years (table 20). Mail survey means are used

Table 17. — Estimated recreational use in river study sections.

	Bitterroot	Big Hole
Angler days in study section[1]	6,371	20,411
Estimated angler summer use at 65%[2]	4,141	13,267
Ratio of angler/total use from onsite survey	.396	.869
Estimated May-August days of total use	10,457	15,267
Average days of recreation/year (mail survey)	5.64	4.10
Estimated summer season river users	1,854	3,724

[1] *Derived from Montana DFWP 1985 angler survey. The Bitterroot study section is about 19.5 river miles long, and is mainly in DFWP river section 2, which had a density of 326.7 anglers per mile per year (11.4% of total Bitterroot angler use). The Big Hole study section is about 52 river miles long, and is in river sections 7 and 2, which had an angler density of 392.5 anglers per mile per year (43% of total Big Hole use).*

[2] *Based on rates of May-August use per year for the Clark Fork River (Hagmann 1979).*

Table 18. — Onsite sample density.

	Bitterroot	Big Hole
Average use/day in study section for 123-day season	85.02	124.12
Onsite survey average observed users/day[1]	6.90	11.47
Sample fraction (weight)	.0812 (12.32)	.0924 (10.82)
Average days/trip for onsite sample	1.453	2.28

[1] *Based on weighted average by month.*

Table 19. — Variable definitions for onsite logit trust fund.

Variable	Definition
BIDF	Dollar bid offer for trust fund contribution
INCOME	Household income in dollars
TRIPL2	Trips taken to this river in last 2 years
YEARS	Number of years visiting this river
FISHACT	Dummy variable for fishing activity (1=fish)
DSCHRG	Daily average CFS

Table 20. — Onsite logit trust fund equations.

Variable/statistic	Bitterroot	Big Hole
Estimated parameters[1]		
Intercept	−1.91756 (4.166)	−3.1614 (4.29)
ln BIDF	−.81238 (−7.129)	−.70126 (−10.94)
ln INCOME	.44516 (2.262)	.26628 (1.817)
ln YEARS	−.4118 (−2.275)	—
ln TRIPL2	.21318 (1.89)	.39402 (4.682)
ln DSCRG	—	.29582 (2.644)
Statistics		
Sample Size	218	506
Chi-square	202.9	504.4
df	211	497
P	.643	.40
Variable means[2]		
INCOME	31740.9 (27470)	42894 (24286)
YEARS	10.785	—
TRIPL2	34.156 (6.44)	12.994 (3.88)
DSCRG	—	611.86

[1] *t-statistics in parentheses.*

[2] *Onsite sample means are biased by over-representing more frequent users. Mail survey means, listed in parentheses, are not.*

Table 21. — Welfare measures for onsite logit trust fund (1988 dollars).

Measure	Bitterroot	Big Hole
Median	12.47	16.36
Mean-truncated at:		
1000	80.16	119.70
500	62.19	86.82

because the onsite sample oversamples more frequent users. Onsite means are appropriate to value the average trip, but for the trust fund a WTP estimate is required for the average user. Accordingly, sample means for visitation frequency and income are taken from the mail survey sample (for users only), which provides a better estimate of typical user characteristics. For example, onsite users reported an average of 13 trips in the last two years, whereas mail survey Big Hole users average only 3.9 trips in the last two years.

Based on the estimate of total users (table 17) and mean trust fund donation per user (truncated at $1,000, table 21), an instream flow trust fund vehicle limited to current river users yields a value of $149,000 on the Bitterroot and $446,000 on the Big Hole (table 22). This estimate is not necessarily the actual money that might be raised through such a fund, which would depend on question format and other details of the actual solicitation. Additionally, transaction costs have not been estimated or deducted. However, this treatment is symmetric with the current trip valuation approach and follows the convention reported in the economics literature.

The historical flow deficits in cfs (table 16) can be converted to acre-feet needed to maintain preferred flows through July and August in a typical year. The totals for the two month period are about 30,000 acre-feet on the Bitterroot and 43,000 acre-feet on the Big Hole (table 22). Comparing required additional flows to the total trust fund, an average value of $5.01 per acre-foot of additional flow is derived for the Bitterroot and $10.34 for the Big Hole (table 22). Again, this is for a single respondent-defined scenario - preferred flows. This increment is quite large and possibly not all available for purchase at prices in the $5 to $10 range. Nevertheless, these values for the flow increments can be compared to the marginal values obtained using the current trip valuation approach. Referring to table 13,

Table 22. — Comparison of onsite trust fund to preferred flow requirements by river.

Item	Bitterroot	Big Hole
Trust fund value		
Per user ($)	80.16	119.70
Summer study section users	1,854	3,724
Trust fund total ($)	148,617	445,762
Preferred flows		
Cfs		
July	176	103
August	306	598
Acre-feet[1]		
July	10,822	6,333
August	18,819	36,770
Total	29,641	43,103
Average budget/acre-foot for study section ($)	5.01	10.34
Average budget/acre-foot if entire river same as study section ($) [2]	43.98	24.05

[1] *Cfs · 1.983 · days/month = acre-feet needed per month.*

[2] *Study section estimates inflated by 1/.114 for Bitterroot and 1/.43 for Big Hole based on ratio of use in study section to use in entire river.*

approximate marginal values per acre-foot at flow levels similar to the preferred levels are $6 on the Bitterroot and $15 on the Big Hole. Given the uncertainty regarding our estimate of total recreational use in the study section, the similarity of estimates from the two approaches is, if anything, encouraging.

The onsite trust fund estimate presented thus far may be overly conservative. As a practical matter, delivering water to the dewatered section of the Bitterroot will likely augment flows and benefit recreationists on the entire river. If so, assuming that only study section users (11% of total users on the Bitterroot) would support the trust vastly understates the value per acre-foot of water. The opposite extreme is to assume that all users would participate in a trust fund to the same extent as the study section sample. In this case the acre-foot values are $44 on the Bitterroot and $24 on the Big Hole (table 22; the increase on the Big Hole is relatively less because a larger share of users (43%) are in the study section).

The onsite trust fund estimate may also be conservative because of the way the trust fund question was posed. Respondents were not explicitly told that enhanced flows would improve fish and wildlife habitat and population survival. The questionnaire emphasized recreation, not ecological health or species diversity (see Appendix A). Existence and bequest motives may not have been salient to some respondents. Furthermore, a trust fund for purchase of needed water was proposed as only "one way" to enhance flows. Respondents who valued improved flows but thought that other ways were better (such as letting the state buy the needed water) may have bid 0 because they rejected the payment vehicle.

PRESERVATION VALUE BASED ON HOUSEHOLD SURVEY

Although the onsite survey provides considerable information on river users, nonusers may also place significant values on protecting instream flows. The household survey, administered by mail to a regional household sample, was intended to survey both users and nonusers.

The trust fund valuation question was designed to address the objectives of partitioning use into direct and indirect components and evaluating additivity across sites. Given these objectives, and particularly the need to ask at least some subsample to value protection of a group of rivers, the definition and valuation of precise site-specific flow increments was not possible. Instead, the question was designed to simulate a workable trust fund mailing and thereby provide an estimate of effective demand for a trust fund. This approach complements the onsite work and provides a needed element for the larger policy analysis context.

The analysis of response to the trust fund mail survey question parallels the onsite trust fund analysis. However, in this case the total valuation function has an observed quantity of rivers protected (set at one or five in the survey). In addition to the dichotomous choice question format, the trust fund mail survey also employed an open-ended format. In this case the total value function follows equation [1], because the latter can be directly estimated using the open-ended response as the dependent variable.

Theory

The value of instream flow goes beyond the value that recreationists place on their recreation trips. Recreationists may also place value on just knowing that streamflows and associated habitat are maintained, and nonusers may also place significant values on protecting instream flows. The onsite survey also asked respondents about the additional value of flow preservation, and the household survey, administered by mail to a regional household sample, surveyed users and nonusers about the value of flow preservation.

Two of the four major objectives of this study focused on theoretical issues of nonmarket valuation, namely the issues of additivity of value across sites (objective 3) and partition of total value into use and nonuse components (objective 4). Before presenting the methods and results of the household survey, we present some background on these two issues.

Additivity

A basic issue in the use of nonmarket valuation techniques is whether results for different sites or resources are consistent and valid estimates. We focus on the specific question of whether preservation values across sites are additive. The naive view of this issue would suggest that if changes at each of two rivers were separately valued by the same population at say $10,000 per annum, then when the same methods were applied to value the changes on the two rivers together, a value of $20,000 should result. In fact, this sort of strict additivity is not implied by consumption theory. Willingness to pay for recreation or preservation benefits, or any other goods, is subject to a budget constraint and shows diminishing marginal utility.

Values of two goods can safely be added in the above manner when one of the following three conditions is met: (1) the two goods were valued concurrently under the same budget constraint; (2) the two goods are valued sequentially under a given budget constraint (e.g., the second good was valued after the budget was diminished by the value of the first good); (3) the two goods are members of mutually exclusive budget categories, each with a separate budget constraint and completely independent in valuation (see Hoehn 1991). If none of these conditions holds, consumption theory suggests that the values of the two goods cannot simply be added to estimate the value of the pair of goods; rather, the value of the pair will likely be less than the sum of the parts. Furthermore, where the two goods are each changes to rivers in the same geographical area, it seems unlikely that they would be completely independent in valuation, suggesting that their individual values are additive only if they were valued concurrently or sequentially under the same budget constraint. Thus, we would expect that the sum of the independently assessed values of two goods, $v(g_1) + v(g_2)$, is greater than the value of the two goods determined concurrently or sequentially, $v(g_1 + g_2)$, which in turn is greater than the independently assessed values of either good 1, $v(g_1)$, or good 2, $v(g_2)$.

The implications of basic consumption theory for the valuation of river protection via trust fund donations can be briefly illustrated using the framework established earlier. Suppose that a total WTP (T) function can be estimated for the given change across a set of homogeneous rivers as

$$T = f(n, \tilde{z}) \qquad [17]$$

where n is quantity demanded (rivers protected or changed) and $\tilde{z}$ is a vector of explanatory variables. Then the marginal valuation function is given by $\partial T/\partial n$. By the nonsatiation axiom of consumption theory, we expect this first derivative to be always greater than zero. The second derivative with respect to number of rivers protected is $\partial^2 T/\partial n^2$. By the law of demand, and the usual convexity assumptions, the second derivative should be negative, implying that average WTP is a declining function of quantity.

If a total WTP function of the general form of [13] is estimated (i.e., given a double-log specification of the total WTP function), then these two hypotheses ($\partial T/\partial n > 0$ and $\partial^2 T/\partial n^2 < 0$) can be made explicit in terms of [13] parameters. It can be shown that $\partial T/\partial n > 0$ (that total WTP is a positive function of quantity demanded) if $-b_2/b_1 > 0$. (Recall from [13] that b_2 is the estimated coefficient on the log of quantity and b_1 is the coefficient on the logged bid offer for the dichotomous- choice logistic regression model.) And it can be shown that $\partial^2 T/\partial n^2 < 0$ (that marginal WTP is an inverse function of quantity demanded) when $-b_2/b_1 < 1$. In short, for the responses to valuation of single versus multiple rivers to be consistent, the parameters of the total WTP response function (as in [13]) must satisfy: $0 < -b_2/b_1 < 1$. These requirements are in terms of the parameters of the dichotomous-choice model. For the open-ended model, the term corresponding to $-b_2/b_1$ of the dichotomous-choice model is simply the estimated parameter on quantity demanded (for the double-log specification of [1]).

Alternative hypothesis tests can be conducted by comparing subsample mean welfare estimates for single river and multiple river responses. For example, if $n_2 > n_1$, then we hypothesize $T(n_2) > T(n_1)$. Similarly, average WTP for single versus multiple rivers can be compared.

When valuing single versus multiple rivers, heterogeneity in value across rivers may confound the comparisons. One way to deal with this is inclusion of a dummy variable for one of the single rivers in the specification of [1] actually estimated. The t-test on the estimated parameter for this dummy variable provides a test of whether valuation of at least the two single rivers (e.g., the Bitterroot and Big Hole) is the same. Another way to deal with the problem of heterogeneity is to ask respondents to allocate their multiple river valuation by percentage among the rivers in the group. This provides a comparison of average WTP at single and multiple rivers that corrects for heterogeneity among rivers. We employ both approaches. As noted previously, consumption theory suggests that the single river mean valuation should be greater than the allocated multiple river mean valuation for the same river.

It is interesting to interpret the Walsh et al. (1985) study in light of this model (see also Sanders et al. 1990). The 1985 study was based on a mail survey of Colorado residents using an open-ended contingent valuation format of willingness to pay into a special trust fund to protect a set of 11 wild and scenic study rivers from development. Each respondent was asked to value different groups of the study rivers including their "three most valuable rivers," their "seven most valuable rivers," and all 11 study rivers. A WTP total valuation function was estimated of the quadratic form: $WTP = 4.67 + 13.03(n) - .44(n)^2$ where n is number of rivers (Walsh et al., 1985). As the authors noted, with the designation of additional rivers, benefits increase at a decreasing rate. Within the range of their sample, the Walsh et al. WTP equation is consistent with the theoretical constraints derived above. Specifically, the first derivative of WTP with respect to quantity of rivers protected is positive up to a level of 15 rivers and the second derivative is negative.

The Walsh et al. (1985) study was not intended to test the same hypotheses we studied because their questionnaire made it clear to respondents before they valued any individual rivers that they would be valuing a total of 11 rivers. That is, the rivers were evaluated concurrently; the study did not directly compare separate and concurrent valuation. A suitable test would be to ask subsamples of the respondent population to value different numbers of rivers.

The additivity issue was recently addressed by Kahneman and Knetsch (1992), who used the term "embedding" to describe CVM question sequencing where the good of interest is a component of a more inclusive good category. Kahneman and Knetsch (1992) conducted phone interviews using open-ended CVM questions with a payment vehicle of "higher taxes, prices, or user fees to go into a special fund..." to value public goods. Separate subsamples were asked the embedded or nonembedded valuation question. The authors found that expressed willingness to pay for a good was larger when it was evaluated on its own than when valued as part of the more inclusive category, which, as we argue, is consistent with consumption theory. However, their results perhaps go beyond the expectations of consumption theory, because they also found that the WTP for the good described in the first valuation question asked was not statistically different whether that good was the specific good of interest or the larger category of goods. In essence, they concluded that $v(g_1) = v(g_1 + g_2)$ where g_2 consists of all the other goods in the larger category to which g_1 belongs.

Kahneman and Knetsch (1992) concluded that use of CVM to value public goods was not valid, at least if the values were intended for comparison to the properly estimated economic values of private goods. They interpreted the CVM responses as indications of WTP for the moral satisfaction of contributing to a worthy cause, which is insensitive to some rather substantial differences in the specific nature of the goods involved. Several questions have been raised, however, about the CVM methods that Kahneman and Knetsch used (Smith 1992), and it is not clear whether the result would be the same if the methods were amended.

Our study allows another look at this issue. As described in a later section, we asked separate subsamples about their WTP to protect either one or five rivers, where the group of five included the river valued by the single-river subsample. Further, our study allows examination of an additional hypothesis based on respondent knowledge of the goods at issue, because our sample includes both users and nonusers of the sites. We expected that WTP would be more sensitive to number of rivers being valued for respondents who were more familiar with the rivers, and especially for respondents who had personally visited the rivers, than for respondents with no previous contact with the specific rivers. That is, the more identity that respondents had formed with the rivers in question, the more likely they would be to consider each additional protection effort as a unique addition, and consequently the more likely their WTP would increase with number of rivers protected.

Apportioning Total Value

In an influential paper, Krutilla (1967) identified several possible values of natural environments, including not only the value of direct recreational use but also what he called existence, bequest and option values. The proposal that total economic value includes both direct and indirect values was made explicit by Randall and Stoll (1983). The concept of total economic value has given rise to many studies that attempt to identify the share of total value that is attributable to direct use, option of future use, existence, and bequest demands (see Loomis 1987b).

One approach to identifying the share attributable to each motive is to first determine total value (for example, through a CVM question) and then ask respondents to apportion total value (by percent) among the various categories (Duffield 1982, Walsh et al. 1984, Sutherland and Walsh 1985). The problem with this approach is that there is no evidence that respondents can, or cannot, give meaningful responses or even that the various categories are well understood. An alternative is to ask a series of CVM questions that attempt to identify valuation with and without direct use (Boyle and Bishop 1987). This may be a good approach, but valuation in sequential questions may be affected by respondent fatigue and bias introduced by previous bids (depending on the question format). A related strategy (Brookshire et al. 1983, Stoll and Johnson 1984) is to ask respondents if they expect to use the site. The WTP response of the subsample who would use the site is assumed to be option price (direct use value plus option value) and the WTP response of nonusers is assumed to be purely existence value. The problem with this approach is that even users may be motivated by existence or bequest concerns. Additionally, only a two-way split of total use is possible.

The approach introduced in this study is to include measures of both recreation and preservation motives as explanatory factors in the valuation model. Techniques from social psychology for defining and measuring motives are used in the context of our theoretical model of consumption behavior. For the case where the specification of the CVM response function is homogeneous of degree r, an interpretation of relative direct and indirect shares can be derived from model parameters. The household survey trust fund for instream flows is an appropriate application given that user and nonuser response can be interpreted as a Randall and Stoll (1983) measure of "total economic value."

A function f(·) that is homogeneous degree r satisfies the condition:

$$f(kx_1, kx_2, \ldots, kx_n) = k^r y \qquad [18]$$

By Euler's theorem, then

$$\sum_i f_i x_i / ry = 1 \qquad [19]$$

where f_i is the partial of the function f(·) with respect to the ith variable, x_i. Accordingly, the term $f_i x_i/ry$ has the interpretation of being the relative share of y due to the ith factor. This interpretation is analogous to a standard result in production theory for homogeneous degree-one production functions: if factors are paid their marginal product then total product is just exhausted. For the case at hand, if f(·) is a functional measure of total WTP, then [19] provides an analytical method for identifying the share of total valuation associated with a given subset of explanatory variables.

The application of this result to our basic dichotomous choice model can be illustrated by rewriting [4], with an explicit set of explanatory variables:

$$\ln[p/(1-p)] = b_0 + b_1 \ln(t) + b_2 \ln(n) + \sum_i b_i \ln(g_i) + \sum_i b_i \ln(h_i) + \sum_i b_i \ln(x_i) \qquad [20]$$

where

- b_i are parameters to be estimated
- t = bid value
- n = quantity demanded (direct use measure)
- g_i = measures of preservation/existence/bequest motives
- h_i = measures of option (future use) motive
- x_i = other explanatory variables (income, etc.)

It can be shown that if [20] is reparameterized in the general form of [5] (with WTP as the dependent variable), it is homogeneous degree $r = \Sigma b_i/b_1$ and that factor shares are given by $b_i/\Sigma b_i$. This result is easily seen, since in its reparameterized form the model is similar to a Cobb-Douglas production function. To provide an interpretation that allocates total value uniquely among direct use, option use, and existence motives, the set of i parameters b_i used to define r can be restricted to those on the direct, option, and existence factors. All other variables are evaluated at their means (such as income, etc.) and collapsed into the constant term. The specification allows for the possibility that more than one specific existence or option variable may be used to define a given motive. Additionally, this formulation provides a general model for exploratory research on motive categories that may or may not include the conventional option, existence, and bequest taxonomy.

Factor shares can also be calculated for motives represented by unlogged independent variables (including for example, dummy variables) in the framework of [20]. It can be shown that for these variables, the numerator in the factor share equation is the estimated parameter times the variable (evaluated at its mean or some other level). In other words, for a semi-log specification, the elasticity of a given independent variable is conditional on the value of that variable. For example, in a specification that includes both logged (x_i) and unlogged (z_j) terms in the estimated equation, the reparameterized equation is

$$y = a \prod_i x_i^{bi} \prod_j \exp(b_j z_j) \qquad [21]$$

where Π is the multiplicative operator. Then the factor share for an x_i variable is $b_i/(\Sigma b_i + \Sigma b_j x_j)$ and the factor share for a z_j variable is $b_j z_j/(\Sigma b_i + \Sigma b_j x_j)$.

Survey Methods

Users and nonusers were contacted through a regional household mail survey designed to measure the level and extent of indirect or preservation values associated with instream flows. The sampling goal was to obtain responses from a wide range of people in the region where the target rivers were located, rather than obtain a probability sample representing the views of a specifically-defined regional population. Six populations were sampled: people listed in the current telephone directories for five Montana areas (Billings, the Bitterroot Valley, Butte, Helena, and Missoula) and one nearby area in Washington (Spokane). These were selected to cover several population centers at varying distances from the study rivers.

Three different mail survey instruments were used, differing primarily on which river(s) were to be protected in the trust fund question (Appendix B). In addition to a Bitterroot only and a Big Hole only hypothetical instream flow trust fund, a five-river version was developed. This group of five rivers included the Bitterroot, Big Hole, Clark Fork, Gallatin, and Smith Rivers, and was selected for the combination of high recreational use plus severe summer dewatering.

The mailing procedure was based on Dillman's (1978) Total Design Method, and included the standard initial mailout with cover letter, questionnaire, and stamped return envelope. A postcard reminder was sent 10 days after the initial mailout, and a second mailing was made to nonrespondents about one month later.

A telephone pretest of the mail survey was administered to 100 Missoula area residents in September 1988 using the Big Hole survey version. The pretest was used to establish the feasibility of the survey and to obtain preliminary estimates of the trust fund response. The latter was included to establish the range and distribution of the dichotomous choice dollar bid levels.

A telephone survey of nonrespondents, described in Appendix C, used an abbreviated version of the mail survey. Conducted in April 1989, the main purpose of the nonrespondent survey was to identify any significant differences between respondents and nonrespondents. This information could then be used to extrapolate the mail survey valuation responses to the regional population.

The first section of the mail questionnaire (Appendix B) asked about recreational use of rivers, including how frequently respondents and members of their household participated in river-related recreation, what activities they pursued on or along rivers, the types of experiences they desired, and the importance they placed on recreation compared to other uses of river water such as irrigation or hydropower. The second section asked respondents about their past use of the target river(s)—Big Hole, Bitterroot, or set of five rivers—including number of visits in the past three years, activity participation, encounters with low flow conditions, and intended future use levels. The next section contained the contingent valuation questions. They were prefaced by a series of four questions designed to measure familiarity and experience with the general objective of increasing instream flows, as well as the trust fund payment vehicle. These questions were asked to collect data and to introduce the payment concept and trust fund payment vehicle.

The lead-in to the contingent valuation questions described the problems of low flows, and the possible benefits of increased flows. The benefits included those related to recreational use ("people would be able to float the river later in the summer") and those not necessarily related to recreational use ("many species of birds, wildlife, and plants would benefit; for example, better habitat would exist for osprey and river otters"). The lead in also included a direct appeal to nonusers ("Even if you don't use the ——— River for recreation, you would know you are helping to keep an important Montana river clean and healthy"). Prefacing the question this way presumed to measure a "total value" that could then be partitioned into direct (recreational use) and indirect benefits.

The contingent value questions were posed in a closed-ended format; respondents were asked if they would purchase, at a specific dollar amount (that varied from $5 to $300), an annual membership in a trust fund to buy water when needed. Table 23 lists the bid levels, the number of persons responding to each level, and the number who responded "yes." If the respondents said "no," they were asked if they would pay a smaller amount, such as $1 per year, and, if the answer was still "no," they were asked to describe their reasons for declining. If they said "yes," they were asked to specify the maximum amount they would pay for such a membership.

People who were willing to contribute any amount were then asked what percent of that amount they would allocate to direct use values (their own current and future use of the river) and the percent allocated to indirect or preservation values (reasons apart from their own use of the resource, including benefits to plants and wildlife, and availability for future generations). A final follow-up question asked, "who, if anyone, should be responsible for maintaining adequate flow levels: no one; the state; the federal government; recreational users; or private trust funds?" This question was designed to assess people's attributions of responsibility, a potentially important mediating variable.

The questionnaire then asked, in a five-point Likert-scaled format, how much the respondent agreed or disagreed with each of 23 statements related to reasons for holding preservation values. The 23 statements were developed by reviewing the literature on motives for

Table 23. —Household trust fund bid levels and distribution.

	Bitterroot		Big Hole		Five River	
Bid level	Respondents[1]	Number "yes"[2]	Respondents[1]	Number "yes"[2]	Respondents[1]	Number "yes"[2]
$5	9	2	11	5	22	8
10	10	1	16	2	12	5
15	12	0	14	3	19	5
25	16	0	25	1	17	1
40	19	1	11	1	15	1
50	18	1	33	1	31	4
100	33	0	36	0	29	0
200	35	0	48	0	31	1
300	10	0	12	0	10	0
Total	162	5	206	13	186	25

[1] *Invalid cases and cases with incomplete data were excluded (28).*
[2] *A "yes" response indicates that the respondent would pay the posited bid level.*

existence or preservation values. The questions were designed to see if any underlying patterns could be found in people's attitude and belief systems that might help explain why people are, or are not, willing to pay for instream flows. The questions capture many concepts or motives, including satisfaction from just knowing the natural environment exists (Krutilla 1967), escape from urban pressures,[9] self-actualization (Maslow 1968), altruism, intrinsic worth, vicarious consumption, uniqueness, philanthropy, sympathy, saving for future needs, commitment, guilt, and the benefits of resource utilization. We anticipated that these questions could be analyzed using factor analysis to identify a set of motive-related variables.

The final section asked about respondents' gender, employment status, education, income, membership in organizations, and level of donation to causes and charities. A blank page was provided for additional comments.

Results

Of the 1,850 mailed questionnaires, 140 were not deliverable and 582 were completed and returned (table 1), providing a 34% response rate. A problem with the mail survey (that may have contributed to the low response rate) was that the second mailing was delayed several weeks so that it did not arrive just before Christmas. A phone survey of nonrespondents is reported in Appendix C.

Respondents

Although the sample was not a random sample of Montana residents, it is still useful to know how similar the respondents are to population average demographic characteristics. This comparison suggests that extrapolation from our sample to a population of Montana residents would not be appropriate.

Sixty-nine percent of the respondents were men, compared to about 50% of the Montana population, according to the 1980 census. The higher proportion of men in our sample resulted, in part, from the sampling method (more telephones are listed in names of males) and the nature of the study (higher nonresponse among women, who are less likely to participate in river recreation). Frost and McCool (1986), for example, found in his statewide survey that 70% of the men sampled had fished in the last 12 months, compared to 42% of the women.

The respondents also had completed more years of education than the average Montana resident; the 1980 census reported that 15% of Montanans had completed college or taken graduate courses, compared to 26% of Frost and McCool's (1986) statewide sample and 43% of our respondents.

A high proportion of our respondents (26%) said they were retired; 20% of our sample was aged 65 years or more, compared to 15% for the state based on the 1980 census. However, the difference also may be due to an increase in the average age of Montana residents.

The statewide survey conducted in 1986 by Frost and McCool (1986) found that 56% of the population had fished at least once (and a median of 12 days) in the past 12-month period. In addition, 25% of Montanans had floated a river or stream in the last 12 months; residents of the DFWP Regions 2 and 3 in west-central and southwestern Montana floated the most (32% reported floating in the last 12 months), and residents of Regions 6 and 7 in eastern Montana floated the least (about 18% reported floating in the last 12 months). Forty-two percent said they had gone swimming in a lake or river in Montana.

The present survey did not ask these identical questions, but some comparisons can be made. Twenty-seven percent said they never or rarely visit rivers, and another 31% said they visit rivers sometimes (several days a year). The remaining 41% said they visit rivers frequently or very frequently—at least 11 days a year. This seems to be a higher rate of participation than that obtained by Frost and McCool (1986). However, their question anchored participation to the previous 12-month period, so the two figures are not directly comparable.

Visitation was strongly linked to distance from the rivers; one or more visits to the target river(s) were made in the last three years by 85% of the respondents from the Bitterroot valley, 74% of the Butte residents, 65% of the Missoula residents, 37% of the Helena residents, 34% of the Billings residents, and 20% of the Spokane residents. The same patterns held for number of visits; 35% of the Bitterroot valley residents and 29% of the Butte residents had visited the river(s) 21 times or more, compared to 0% of the Spokane and Billings residents.

Relationship of WTP to Selected Variables

Analysis of the dichotomous-choice contingent valuation question indicates that 8% of the sample (43 people) said they would pay the amount listed for an annual membership in the trust fund. Of these, one-third had been presented with the lowest amount listed ($5 annual membership), and an additional one-fifth had been presented with the second-lowest amount ($10). Out of the 244 people who had been asked if they would pay either $100, $200 or $300, just one person agreed to purchase an annual membership.

People who responded "no" to the dichotomous choice question were asked if they were willing to pay at least $1 a year to augment instream flows. Of the people who responded to this, 52% said they would pay $1 a year. All respondents who would pay at least $1 were then asked their maximum WTP. Thus, respondents can be divided into three groups: those who were not willing to pay any amount (44%); those who were willing to pay $1 (18%), and those who were willing to pay more than $1 (37%). This breakdown was used to shed light on variables related to membership in each of these three groups.

Most analyses demonstrated that there were significant differences between people who were unwilling

[9] S.D. Allen, Wilderness as an escape button, a paper presented at Wilderness Psychology Group first annual meeting, Great Falls, MT, 1979.

to pay and those who were willing to pay more than $1. The people who were willing to pay just $1 were a difficult group to predict, resembling the nonpaying group on some variables and the over-$1 group on other variables. The response to the $1 option may reflect susceptibility to the high-ball technique. The high-ball technique, along with the low-ball technique, have long been favorite ways to persuade people to undertake a certain behavior. The high-ball technique refers to first asking someone to perform an unreasonable or difficult task; the large proportion of $100, $200, and $300 starting bids used in the current study would certainly qualify for this. Then, people are asked to comply with an easier or more reasonable request, in this case, paying a token amount such as $1.

The low-ball technique (also called "getting a foot in the door") is similar, only the token request—to which almost everyone agrees because compliance is very easy, is followed by a request to perform a more difficult or involved behavior. The finding is similar; people generally comply more with the second (target) request if it is accompanied by the first one than when the target request is made alone (Freedman and Fraser 1966). The sequence of questions on the survey form consisted of both the high-ball technique (the initial bid amount) and then the low-ball technique (asking the maximum amount if people agreed to just $1).

If the pay-$1-only category is dominated by people vulnerable to the high-ball technique, for whatever reason, then it would follow that their responses regarding other variables would tend to be somewhat random and unpredictable. Although some of their responses did tend to fall somewhere between those of the other groups, as would be expected, this did not occur in any particularly consistent, reliable fashion.

This also points out that results could vary if the low-ball technique, instead of the high-ball technique, was employed first. The actual effects of question context and wording would have to be studied using side-by-side alternatives to determine if any systematic differences emerged.

Amount and Type of Recreational Use For people completing Big Hole or Bitterroot questionnaire forms, WTP steadily increased as number of recent trips increased. The proportions of respondents willing to pay over $1 ranged from 33% of those who had visited the rivers before but had made no trips in the last three years, to 62% of those who had made 21 or more trips in the last three years.

The same pattern was found for levels of visits to any river; of those who visited rivers rarely or never, 20% were willing to pay over $1 per year, compared to 34% of those who sometimes visited rivers and 51% of those who frequently or very frequently visited rivers. Number of years visiting rivers for recreation was not related to WTP, most likely because of the confounding influences of age and income.

Among anglers, type of equipment used was related to WTP, consistent with what would be expected based on specialization theory (Allen 1988). Specifically, 49% of the anglers using flies or lures were willing to pay over $1, compared to just 25% of the anglers using bait. In general, the less-specialized anglers were less willing to pay for instream flows, as reflected by their evaluations of the importance of testing fishing skills, catching wild fish, catching large fish, and catching lots of fish.

Past Experiences with Low Flows People who had experienced problems with flow levels were more likely to be willing to pay than were people who had not experienced low flow problems. Of the people who had visited one of the target rivers, 48% said they had experienced difficulties because of low flows on those rivers. Sixty-two percent of the people who had experienced low flow problems were willing to pay more than $1, compared to 36% of those who had not encountered low flow problems.

A confounding variable was past visitation levels. People who visited the target river(s) more frequently in the last three years were more likely to have experienced problems with low flow levels; about 75% of the people who visited 21 times or more said they had experienced such low flow problems, compared to 30–50% of those who'd visited the river(s) just one to five times (the range depended on which river was visited).

Familiarity with Natural Resource Trust Funds In general, people were somewhat familiar with the trust fund concept; 57% said they had heard of such funds, and 21% said they knew a fair amount about them. Thirty percent had donated money or time to natural resource conservation efforts, and about half knew of other people who had. However, 60% said they had never known about the state's past efforts to purchase flows when needed.

The results showed that people who did not use the resource themselves but who were familiar with the trust fund concept, have donated to similar efforts in the past, or who know of other people who have made similar donations were more likely to be willing to pay for instream flows. The same pattern was found among current users of the resource, but the role of these variables in predicting WTP was much less significant. Across both groups (users an nonusers), 18% of the respondents who had never heard of trust funds said they would pay more than $1, compared to about 40% of those who had heard of them or knew a fair amount about them, and to 55% who said they knew a great deal about such trust funds.

However, knowledge of natural resource trust funds also was positively related to participation in river recreation; 36% of users said they knew a fair amount or a great deal about such trust funds, compared to 17% of the nonusers. To determine the effects of familiarity alone, therefore, would require controlling for the effects of target river(s) visitation.

A related variable could be donation to natural resource trust funds. Self-perception theory (Bem 1972) suggests that people who have donated to such funds in the past may view themselves as donators, and may therefore be more willing to pay even if they don't visit rivers for recreation. Among people who had not visited the target river(s), 42% who had donated to trusts in the past were willing to pay over $1, compared to 25% of those who had not donated to such funds. The same pattern was found for users; 57% who had donated before were willing to pay more than $1, compared to 40% who had not donated before.

Perceived Responsibility Willingness to pay was related to beliefs about who, if anyone, should be responsible for maintaining adequate flows in Montana rivers. Respondents believed that some entity should be responsible for maintaining adequate flows in Montana rivers and streams; only 3% said that "no one" should be responsible. Two-thirds believed that the state should be responsible, compared to 27% who felt the federal government should be responsible. About one-third (36%) believed recreational users should be responsible, and 22% checked private trust funds (respondents were asked to check all that applied).

Of the people who believed the state should be responsible, 36% were not willing to pay and 44% were willing to pay over $1; comparable percentages were obtained for those who said the federal government should be responsible.

However, more people who believed recreational users should be responsible refused to pay (45%), and correspondingly fewer were willing to pay over $1 (39%). When controlling for visitation to the target river(s), key differences emerged. Among people who had recently visited the target river(s), 25% of those who felt users should be responsible were unwilling to pay, and 59% were willing to pay over $1. In contrast, among nonvisitors, 59% who believed users should pay were not willing to pay even $1, and just 24% were willing to pay more than $1.

As would be expected, of the people who said private trust funds should pay, more people were willing to pay over $1 (50%) than were those unwilling to pay anything (31%). The number willing to pay over $1 jumped to 60% for people who had visited the target rivers, and dropped to 40% for those who had not. In other words, substantial proportions of people were willing to contribute to the private trust funds regardless of who they felt should be responsible for maintaining instream flows. The proportions were highest, however, for people who believed that trust funds should be responsible, regardless of personal visitation to the target river(s).

Income Past studies suggest that higher-income people do not necessarily donate a higher proportion of their income to causes considered worthy. The results suggested that WTP over $1 was a bi-modal distribution peaking at income ranges $20–25,000 and at $75–100,000 (although the latter category contained few respondents). Unwillingness to pay even $1 showed a similar distribution.

However, income was related to past visitation to the target rivers; the highest participation rate, 65%, was by people in the $20,000–25,000 category, and the lowest rate, 22%, was by people in the highest income category. People who had visited the rivers were more likely to pay over $1 regardless of their income level, with a similar bi-modal distribution evident. Among nonvisitors, WTP over $1 was roughly the same, varying between 28% and 40%, for income categories between $15,000 and $50,000, dropping off above and below this range, but increasing at the highest income categories.

Gender Men and women were equally likely to be willing to pay over $1, despite the fact that 56% of the men had visited the target river(s) compared to 44% of the women. Among people who had visited the rivers, 47% of the men and 51% of the women were willing to pay over $1, compared to 30% of the men and 26% of the women who had not visited the target rivers recently. Gender did not appear to be a key variable in identifying people as willing to pay for instream flows.

Age Willingness to pay over $1 was fairly constant across age categories up to about 50, after which it declined, despite the lack of a corresponding decline in visitation to the target river(s). Visitation was highest (about 60%) for people in their thirties, but remained steady (between 47% and 51%) for the other age categories. Among people who visited the river(s), WTP over $1 dropped as age of respondent increased. Among those who had not visited the river(s), WTP was more normally distributed, peaking at about 41% for respondents in their forties and tapering off to about half that for people in their twenties or sixties. An interaction between age and income is most likely responsible for these results.

Education Educational level and WTP over $1 were linearly and positively correlated; for example, 30% of those with high school educations were willing to pay over $1 compared to 40% of the college graduates and 48% of those having postgraduate degrees. However, visitation to the target river(s) remained fairly constant across educational levels (although visitation was slightly higher among people at the highest level of education). Controlling for visitation showed that, for people who had visited the target rivers, education was not strongly related to WTP. However, among people who had not visited the target rivers, education was positively and linearly related to WTP.

Motivation for Preservation

Responses to the 23 questions exploring beliefs, attitudes, and behaviors potentially related to peoples' WTP for instream flows (aside from onsite use) provided the data for developing variables to be used in further analyses. The responses provide a strong foundation for values other than those stemming from personal use of the rivers; 97% of the respondents said that people can value a river even if they do not visit it, suggesting that nearly everyone understands—and accepts—the concept of nonuse values.

Questions were grouped using factor analysis with varimax rotation (SPSS, Inc. 1985). Five factors emerged, each representing a somewhat distinct dimension of possible reasons for valuing instream flows, apart from one's past or intended use of the rivers. The five factors accounted for 56% of the variance. Nearly all of the 23 items had been intercorrelated, so some of the factor loadings were as low as 0.50, suggesting that the factors were not orthogonal. However, the factors that emerged had face validity, and the emergence of this set of factors allowed some comment on previously advanced taxonomies of value. These comments should be viewed as tentative—more as concerns worthy of further study than conclusions about the nature of indirect values. Of course, the solution depended on the questions asked, so the results do not exhaustively describe all motives or reasons for nonuse values.

The five factors that emerged were subjected to an item analysis to assess their reliability. The Cronbach's alpha for the five factors ranged from 0.75 to 0.89, with the alpha for three of the factors above 0.80, suggesting that acceptably reliable scales could be constructed.

Vicarious Use This first factor represented items describing indirect personal benefits, such as enjoying hearing about others' experiences on rivers, or enjoying books and movies about rivers (table 24).

The Vicarious Use factor also represented the only item related to past use, "I have had inspirational experiences on rivers," suggesting that people who enjoy vicarious uses of rivers also have visited rivers themselves, and that this experience enhances the vicarious enjoyment. In fact, 61% of the people who had visited the target river(s) strongly agreed with this statement, compared to 39% of the people who had not visited.

This factor also contained the item on spiritual and sacred values, suggesting that vicarious users (and onsite users) may have value systems incorporating spiritual aspects of natural resources. Finally, a statement affirming belief in the concept of nonuse values was included on this factor. It is somewhat surprising that this item was related to the Vicarious Use factor, and not at all to the factor labelled Altruism. Perhaps this concept is more closely aligned with indirect enjoyment of the resource than with the slightly more detached knowledge that a resource exists in a healthy form.

Responses to the item having the highest item-total correlation for this scale, the question dealing with "enjoying knowing friends and family can visit rivers," were related to WTP. Fifty-three percent of those who strongly agreed with this statement were willing to pay over $1, compared to 30% of those who just agreed with the state-

Table 24. — Motivation for preservation factors.

Factor	Question
Vicarious Use	I have had inspirational experiences on rivers.
	Rivers do not have many spiritual or sacred values to me.[1]
	I enjoy knowing that my friends and family can visit rivers for recreation if they want to.
	People can think a river is valuable even if they don't actually go there themselves.
	I enjoy hearing about experiences my friends or family have had on rivers.
	I enjoy looking at picture books or going to movies that have rivers in them.
Environmental Concern	I have a great deal of concern for endangered species.
	Endangered species should not be protected if they don't have any benefits to humans.[1]
	I have been concerned about how the recent drought may affect fish and wildlife that depend on rivers.
	I think that most rivers already have enough water in them to be healthy resources.[1]
	Montana's free-flowing rivers and streams are a unique and irreplaceable resource.
	It's important to protect rare plants and animals to maintain genetic diversity.
Personal Contribution	I would be willing to contribute money or time to help keep adequate water in
	Montana rivers even if I could never visit them.
	I feel that I should be doing more for Montana's rivers and streams.
	Donating time or money to worthy causes is important to me.
Altruism	Some land in the U.S. should be set aside from any human use at all so it can remain completely untouched.
	I'm glad there is wilderness in Alaska even if I never get there to see it.
	Our society should consider the needs of future generations as much as we consider our needs today.
	Some days when I'm feeling pressured it reassures me to think that some lands out there are wild and undeveloped, even if I never get to go there.
	I would be willing to visit Montana rivers less frequently if it meant that the resource would be better off in the long run.
Conflicting use values	The decision to develop resources should be based mostly on economic grounds.
	I would like to see more hydroelectric dams on Montana rivers.
	The main reason for maintaining resources today is so we can develop them in the future if we need to.

[1] *Coding was reversed.*

ment (these compare to the overall total of 37% who were willing to pay over $1). Among users, the respective percentages increased to 66% and 45%, whereas among nonusers, the percentages dropped to 44% and 30% (these compare to overall totals of 65% of the visitors and 35% of the nonusers who were willing to pay over $1).

Environmental Concern This second factor represented items pertaining to endangered species, concern for drought effects on fish and wildlife, and other indicators of a broad concern for the state of the natural environment (table 24). Inclusion of the items related to the environmental value and condition of rivers suggests that this could be a subset of a broader environmental concern.

Environmental concern may be linked to outdoor recreation participation. In fact, participation in outdoor recreation appears to be one means of developing environmental awareness and concern (Allen and McCool 1982) that, in turn, could precipitate a number of environmentally-responsible behaviors, such as contributing money toward instream flows.

This was supported by the present data, which showed that, for nearly all of the items composing this factor, people who had visited one of the target rivers had stronger environmental concerns. Most respondents demonstrated concern, the users were just more emphatic. For example, 45% of the users, compared to 31% of the nonusers, strongly agreed that endangered species were important.

Responses to the variable having the highest item-total correlation on this scale, the question on "importance of endangered species," were related to WTP. Fifty-five percent of those who strongly agreed were willing to pay over $1, compared to 31% of those who said they agreed. The respective percentages increased to 62% and 40% for those who had visited the target river(s), and dropped to 45% and 23% for those who had not.

Personal Contribution The third factor to emerge represented items related to behaviors that people could undertake to help rivers or worthy causes in general (table 24). This three-item factor suggested that one reason people might be willing to pay for instream flows is that they consider themselves to be helpers in general. This response may stem from a feeling of personal responsibility, involvement, or altruism.

One of the three items was willingness to contribute time or money even if visits to the rivers were impossible. This item was related to personal contribution and not at all to the Altruism factor. This relation suggests that the personal contribution aspect of the willingness to contribute items was linked more strongly with the donation items than to altruism, emphasizing the importance of the personal contribution concept.

Interestingly, persons who agreed with the statement "I should be doing more..." were not always willing to contribute to the trust fund. Of those who "strongly agree" with the statement, 65% were willing to pay over $1, but 27% were not willing to pay anything. Obviously, donating money is not everyone's way of "doing more."

Altruism The fourth factor represented items that expressed values specifically apart from those related to onsite recreational use (table 24). Every item contained references to the respondent visiting rivers less or not at all, yet they were still positive expressions of value. The underlying concept is therefore very close to altruism—which is voluntary behavior designed to benefit something or someone else without expectation of personal reward.

The items strongly (and not) related to this factor suggest possible comments on the altruism motive as defined by economists. First, items that contained altruistic elements but also focused on personal benefits were related to the Vicarious Use factor, not to Altruism; this supports the validity of the concept of altruism as applied to natural resources. However, because the "escape button" question was related to this factor, we need not weed out any possible personal benefit, no matter how nebulous or indirect, in order to label something altruistic. In other words, the presence of some small or indirect personal benefit should not mean that a behavior cannot be motivated primarily by altruism.

For the items that did not involve rivers directly, there were no differences between the responses of users and nonusers of the target river(s). For the item specific to less river use, more river users had an opinion, although not necessarily the same one. Twenty-five percent of the nonusers had no opinion on this question, compared to just 12% of the users. Among the users, the people who had an opinion were divided evenly between "agree" and "disagree." Users did tend to have stronger positive opinions; although they comprised 53% of the respondents, they comprised 62% of the people who strongly agreed with the statement.

It is possible that reasons other than altruism motivate agreement with these statements. One possibility is that because altruism is a social value, people are prone to expressing it even if they do not really feel that way. The statements could therefore be a measure of the importance of social desirability, not altruism. Another possibility is that people really derive personal benefit from knowing there are wild lands out there, so the motive is not altruism, but selfishness. Perhaps it is best to say that this factor deserves to be studied further, but may be called Altruism in the meantime.

Responses to the question having the highest item-total correlation, "I'm glad there is wilderness in Alaska...," were related to WTP. Fifty-two percent of those who strongly agreed were willing to pay over $1, compared to 32% of those who just agreed (these compare to the overall total of 37% who were willing to pay over $1). For current users, the percentages increased to 61% and 41%, and for nonusers the respective percentages dropped to 40% and 25% (these compare to overall totals of 65% of the visitors who were willing to pay over $1 and 35% of the nonvisitors).

Conflicting Use Values This last factor contained statements that might be supported by people who favor using river flows for purposes other than recreation or preservation (table 24). This was highlighted by the fact that several other items related more strongly to other factors were also related to this factor, but with the relations reversed.

Ironically, the item on the need to base resource development on economic grounds was related to this factor. This demonstrates the traditional notion that economic-based decisions lead to development, not preservation. Perhaps many people who responded to this question would be surprised at the notion of attaching dollar values to resource preservation, even though this was the purpose of the survey effort.

Responses to the item having the highest item-total correlation on this scale, the "more dams" statement, were related to WTP. Of the people who strongly agreed that there should be more dams, 62% were not willing to pay $1 for instream flows; of those who strongly disagreed, just 24% were unwilling (these compare to the overall total of 44% who were not willing to pay even $1).

Attitudes toward hydroelectric power were related to WTP above and beyond the effects of previous use. The same pattern was evident just considering users to the target river(s), but stronger; of those who strongly disagreed, just 15% were not willing to pay. Among current nonusers, the pattern was the same, but weaker; of those who strongly disagreed, 37% were not willing to pay (these compare to overall totals of 32% of the users who were willing to pay over $1 and 57% of the nonusers).

People who agreed that more dams were desirable also were more likely to assign a higher percentage of their money to indirect than to direct use values than were people who disagreed, although both groups valued nonuse benefits more highly than use benefits.

Preservation Value of Instream Flow

The valuation models for the mail survey are based on dichotomous-choice and open-ended format questions about willingness to donate to a trust fund for instream flows. In the equations reported below, the single river (Bitterroot or Big Hole only) responses are combined with the multiple river responses. A "quantity of rivers protected" (QUANT) variable was included that took a value of one or five. When a dummy variable for Bitterroot river surveys was included in the logit trust fund equations, the estimated coefficient on this variable was not statistically significant, implying that the rivers are sufficiently homogeneous to permit estimation of a meaningful total WTP (as a function of number of rivers protected) relationship. Other explanatory variables for both question formats are listed in table 25 and include bid (logit model only), variables describing respondent characteristics and recreation behavior, and three existence motive variables. The interpretation and development of the latter variables is described above in the "Motivation for Preservation" section.

Four different specifications of the complete sample mail logit equations are provided in table 26. Several specifications are presented for two reasons. First, a number of the independent variables had fairly high simple correlations, indicating a potential for multicolinearity in the model. For example, several of the intercorrelations among the motive variables were from 0.5 to 0.6. Because of these high correlations (especially relative to correlations to the dependent variable), estimated standard errors (and accordingly, significance) may be unreliable. Relatedly, these conditions may also lead to problems with omitted variable bias. The approach taken was to examine a variety of specifications and note the stability of estimated parameters and standard errors. The second reason for looking at several specifications was to provide an opportunity for sensitivity analysis of the effect of model specification on the apportionment of total value.

A common feature of all four specifications is that signs are generally as expected. For example, the quantity of rivers protected (QUANT) and the donation (BID) have the correct sign and are highly significant in all specifications. Income also has the correct sign, but tends to decline in significance as additional variables are included (table 26). Measures of current (ACTDAY) and future (FUTURE) use are highly correlated. When ACTDAY or FUTURE is included alone, the sign is as expected and the estimated parameter is highly significant. When both are included, neither is significant at the 90% level. The three existence motive variables, representing altruism (NONUSE), personal contribution (HELP), and environmental concern (PROTECT), are also highly correlated. The estimated parameter on NONUSE declines to near zero when HELP and PROTECT are both included.

The mail survey logit trust fund equations are reparameterized as shown in table 27. Again, the reparameterized coefficients can be interpreted as the elasticity of WTP with respect to a given variable. Because of omitted variable effects, some parameters vary considerably across specifications.

Corresponding estimates for the open-ended trust fund response are provided in table 28. A major differ-

Table 25. — Mail survey trust fund equation variable definitions.

Variable	Definition
BIDT	Dollar bid offer for trust fund donation
QUANT	Number of rivers protected by trust
INC	Household income
DIST	Distance (in one-way miles) of respondent from river(s) to be protected
SEX	Gender = dummy variable (1=male)
ACTDAY	Days of recreational activity on rivers per year
FUTURE	Dummy variable for plan future trip to this (these) river(s) in next three years
NONUSE	Altruism factor (defined in Motivation for Preservation section)
HELP	Personal contribution factor (defined in Motivation for Preservation section)
PROTECT	Environmental concern factor (defined in Motivation for Preservation section)
USER	Dummy variable with value of 1 if visited this (these) river(s) in last three years
DUMFREQ	Dummy variable with value of 1 if visited rivers for recreation sometime, frequently, or very frequently

Table 26. — Mail survey logit trust fund equations.

Variable/statistic	Equation[1] 1	2	3	4	Sample mean[2]
Intercept	-10.9117 (-.19)	-15.3965 (-1.03)	-19.4827 (-1.80)	-39.1690 (-2.31)	
ln BIDT	-1.3293 (-5.89)	-1.4109 (-5.96)	-1.5788 (-5.85)	-1.7345 (-5.23)	
ln QUANT	1.0421 (3.26)	.7163 (2.248)	.6117 (1.85)	1.0115 (2.41)	2.366
ln INC	.6004 (2.16)	.5434 (1.90)	.3937 (1.44)	.4202 (1.27)	28434
ln DIST	-.7843 (-3.09)	-.3992 (-1.51)	-.3870 (-1.45)	-.6255 (-1.82)	157.4
SEX	—	—	—	1.5106 (1.96)	.697
ln ACTDAY	.5589 (2.48)	—	—	-.0443 (-.1357)	25.561
FUTURE	—	2.9364 (2.69)	2.5882 (2.31)	6.0160 (1.06)	.587
ln NONUSE	2.6787 (2.12)	3.6802 (2.63)	—	.0831 (.09)	19.228
ln HELP	—	—	7.2602 (4.099)	6.1397 (2.56)	10.048
ln PROTECT	—	—	—	5.5520 (1.47)	24.861
Sample Size	379	386	384	319	
df	372	379	377	308	
Chi-square	326.62	196.84	148.81	259.56	
P	.597	1.00	1.00	.979	

[1] *t-statistics in parentheses.*
[2] *Means of original variables, not logs.*

ence between the logit and open-ended models is that participation on the latter question format was considerably lower. The sample size for the logit specifications ranged from 386 to 319 (the greater the number of variables, the more likely some data will be missing); however, only about 40% of all respondents completed the open-ended question, resulting in sample sizes from 159 to 165. This sample is smaller, in part, because only individuals that answered "yes" to either the initial logit bid or the follow-up $1 bid were asked the open-ended question (316 respondents, or about 57% of the 555 respondents who participated in the initial logit question). Additionally, of the 316 who could have answered the open-ended question, only 227 (72%) actually provided a response.

For purposes of aggregation, individuals who responded "no" to the $1 logit question and did not answer the open-ended question can be considered to have an open-ended format value of zero. A weighted average open-ended value that accounts for both nonresponse and nonparticipation in the open-ended question is obtained by multiplying the mean for the subsample that did respond by the factor 0.41 (227/555). This method of aggregation implies a value of zero to nonrespondents.

Three specifications of the open-ended trust fund response equation were estimated (table 28). Estimated coefficients on key variables are highly significant and of the correct sign. The overall adjusted R square is, however, only around 0.20 for all specifications. Because the dependent variable in table 28 is the log of the open-ended response, the estimated parameters are elasticities comparable to those in the reparameterized logit equations of table 27.

Table 27. — Reparameterized mail survey logit trust fund equations.[1]

Variable/statistic	Equation 1	2	3	4
Intercept	2.723E-4	1.8228E-5	4.372E-6	1.5582E-10
P/(1-P)	.7523	.7088	.6334	.5765
QUANT	.7839	.5077	.3874	.5832
INC	.4517	.3851	.2494	.2423
DIST	-.5900	-.2829	-.2451	-.3606
SEX	—	—	—	.8709
ACTDAY	.4204	—	—	-.0255
FUTURE	—	2.0812	1.6393	3.468
NONUSE	2.0151	2.6084	—	.0479
HELP	—	—	4.5986	3.5398
PROTECT	—	—	—	3.2009

[1] *Functional form is:* $WTP = EXP\,[B_0+B_3\,FUTURE]\,[P/(1-P)]^{B_1}\,QUANT^{B_2}$......

Table 28. — Mail survey open-ended CVM trust fund equations.

Variable/ statistic	Equation[1] 1	2	3	Sample means[2]
Intercept	−8.2630 (−3.42)	−8.0534 (−3.34)	−4.6773 (−3.25)	
ln QUANT	.2457 (2.61)	.2377 (2.49)	.1925 (2.04)	2.366
ln INC	.3432 (3.95)	.2723 (2.95)	.2344 (2.64)	28343.3
ln DIST	−.1629 (−2.07)	−.1485 (−1.84)	−.1242 (−1.58)	157.42
ln ACTDAY	.1193 (1.79)	.1039 (1.52)	.1160 (1.69)	25.561
FUTURE	.3427 (1.80)	.2660 (1.35)	.2956 (1.53)	.587
ln HELP	—	1.2553 (2.10)	1.7952 (3.64)	10.048
ln PROTECT	2.1190 (3.17)	1.3549 (1.69)	—	24.861
Sample size	165	159	164	
Adjusted R^2	.199	.203	.184	
F(significance)	7.780 (.000)	6.744 (.000)	7.130 (.000)	

[1] t-statistics in parentheses.
[2] Means for original variables, not logs.

Table 29. — Mail survey trust fund equations including use variables.

Variable/ statistic	Estimated Parameters[1] Logit	Open-ended	Sample means[2]
Intercept	2.08188 (9.33)	2.79479 (7.545)	—
ln BIDF	−1.20388 (−6.247)	—	—
ln QUANT	.6567 (2.494)	.198808 (2.291)	2.366
ln DIST	−.4270 (−1.940)	−.210185 (−3.073)	157.42
USER	.97688 (1.970)	—	.520
SEX	.32584 (.727)	−.114316 (.4495)	.697
DUMFREQ	—	.318298 (1.724)	.725
Sample size	387	206	
Chi–square	338.3	—	
F	—	4.21	
df	381	201	
P	.943	.0027	

[1] t-statistics in parentheses.
[2] Means for original variables, not logs.

For both logit and open-ended question formats, the key variables from the standpoint of providing an aggregate estimate of total instream flow valuation are distance and number of rivers protected. Because of multicolinearity and omitted variable effects, these parameters vary considerably across specifications.

An additional estimate of the logit and open-ended question formats for the trust fund is provided in table 29. The motivation for this set of estimates is that the main difference found between the mail survey and nonrespondent survey (Appendix C) had to do with use (whether the respondent used the rivers or not). To provide an aggregate value estimate that takes account of nonrespondent differences therefore required a model estimate that included use variables and other variables common to both the nonrespondent and mail surveys. This is done explicitly in table 29. When motive variables were included (as they were in tables 26 and 28), none of the user dummy variables are significant. Accordingly, equations were estimated for aggregation purposes that contain only the key variables: number of rivers protected, distance, and dummy variables for gender and river visitation (USER and DUMFREQ) (table 29).

Interactive variables were defined by multiplying the direct and future use variables times the various existence motive variables. The estimated parameters on these interactive variables were not significantly different from zero.

The influence of quantity of rivers protected on estimated trust fund donations is displayed in table 30, based on the equations of table 29. Based on the logit mean, average WTP at one river protected is $5.04, for two rivers is $7.36, and rises to $12.14 for five rivers. Corresponding results for the logit median and the open-ended question are also shown in table 30. The corresponding marginal individual donation for the logit mean (table 30) is $2.75 at one river protected, $2.01 at two, and falls to $1.32 at five rivers protected.

Additivity

Total economic valuation responses for protecting instream flow were tested for consistency with the predictions of basic consumption theory. Specifically, the nonsatiation axiom of consumption theory implies that the partial derivative of the total WTP function with respect to quantity be positive. The law of demand implies that the second partial be negative. For the specific functional form utilized in both the reparameterized logit model and the open-ended CVM model (double log), these requirements are satisfied if the estimated parameter on quantity demanded, which is the elasticity of total WTP with respect to the number of rivers protected, is greater than zero and less than one. As seen in table 31, the estimates are consistent with theory. The estimated parameter varies from 0.39 to 0.78 for the logit models and from 0.19 to 0.25 for the open-ended models.

Corresponding elasticities can be derived from Walsh et al. (1985). For that study, the elasticity of total WTP with respect to the number of rivers protected varies from 0.78 at 3 rivers to 0.38 at 11 rivers. These elasticities are also consistent with theory and in the same range as those presented in table 31.

The results in table 31 are based on combining the single river and five-river trust fund responses into a single model. An alternative approach is to compare

Table 30. — Mail survey trust fund average and marginal donations as a function of number of rivers protected.[1]

Number of rivers	Logit mean	Logit median	Open-ended mean
Average individual donation[2]			
1	5.04	1.53	10.23
2	7.36	2.23	11.74
3	9.19	2.78	12.73
4	10.75	3.25	13.48
5	12.14	3.67	14.09
Marginal individual donation			
1	2.75	.83	2.03
2	2.01	.61	1.17
3	1.67	.51	.84
4	1.47	.44	.67
5	1.32	.40	.56

[1] *Results are for DIST equal to sample mean of 157.42 and for participants only (no adjustment for nonresponse to the questionnaire or nonparticipation in the contingent valuation question).*

[2] *Derived from equations in table 29 as:*

$$\text{logit mean} = 30.3492\ QUANT^{.5455}\ DIST^{-.3547}$$
$$\text{logit median} = 9.1762\ QUANT^{.5455}\ DIST^{-.3547}$$
$$\text{open-ended} = 29.6245\ QUANT^{.1988}\ DIST^{-.2102}$$

point estimates of total WTP for single or multiple rivers subsamples, and for user and nonuser subsamples (users are those who reported visiting the given river(s) in the last three years), as reported in table 32 for the dichotomous choice contingent valuation mail trust fund responses. The welfare measure is a nonparametric mean (Duffield and Patterson 1989); this approach was used because it provides a measure of dispersion for the mean (the standard error is reported). Consumption theory suggests that the WTP for the five-river subsample should be greater than the WTP of the single-river subsamples. Combining users and nonusers, the single river means are $4.49 for the Big Hole, $8.19 for the Bitterroot, and $6.38 for the combined single river samples (a simple combination of the Big Hole and Bitterroot samples). These values are lower than the multiple river mean of $15.45. T-tests at the 10% level (table 33) indicate that the multiple river mean is significantly higher than the Big Hole and combined single river means. The Bitterroot mean is not significantly different, but this may only reflect the power of the test (which is a function of sample size).

Comparing single and multiple river means for the user and nonuser subsamples (table 32), no estimates are significantly different for nonusers, but the multiple river means are greater than the single river means for users (table 33). These results suggest that users are more likely to distinguish among the different quantities (one vs. five) than nonusers.

It is also important to note that the mean trust fund donation by nonusers is significantly lower than the mean donation by users, based on a *t*-test at the 10% level. This holds for the complete sample (*t*=3.22), where the mean user donation is $14.04 compared to $4.07 for nonusers, and for the river-specific subsamples as well.

The mean WTP for single rivers can also be compared with the portion of the multiple river response that was

Table 31. — Additivity and consistency with theory: Magnitude and sign of coefficient on quantity.

		Estimated parameter[1]	
Method	**Equation**	$-b_2/b_1$	C_1
Logit model[2]	1	.7839	
	2	.5077	
	3	.3874	
	4	.5832	
Open–ended CVM[3]	1		.2457
	2		.2377
	3		.1925

[1] *Total WTP function for rivers protected for instream flows is consistent with consumption theory if $0<-b_2/b_1$ or $C_1<1$.*

[2] *From table 27, based on b_1 and b_2 from table 26.*

[3] *From table 28.*

Table 32. — Mail survey dichotomous choice WTP to an instream flow trust fund by user and survey type (1988 dollars)[1]

	Subsample				
User type[2]	**Big Hole**	**Bitterroot**	**Big Hole & Bitterroot**	**5-river**	**All surveys**
Users					
Mean	7.03	11.09	9.52	20.22	14.04
N	64	89	153	116	269
SE	4.10	3.04	2.52	5.77	2.73
Nonusers					
Mean	2.46	4.01	3.81	5.24	4.07
N	92	105	197	57	254
SE	1.63	2.30	1.67	2.93	1.46
Users + nonusers					
Mean	4.49	8.19	6.38	15.45	9.40
N	162	206	368	186	554
SE	2.08	2.08	1.43	4.02	1.55

[1] *Values based on nonparametric estimator, dollars per respondent.*

[2] *Defined by response to the question: "Have you visited this (these) river(s) in the last 3 years?"*

Table 33. — Comparison of dichotomous choice mean WTP across sites based on two-tailed t-tests.

Comparison	Users	Nonusers	Users + nonusers
t-statistics			
Big Hole v. Bitterroot	.795	.550	1.256
Big Hole v. 5 River	1.86[1]	.829	2.42[2]
Bitterroot v. 5 River	1.40	.330	1.60
Big Hole + Bitterroot v. 5 River	1.70[1]	.424	[1]2.13[1]

[1] *= significant at 5% level.*

[2] *= significant at 1% level.*

allocated to the respective river. The allocations were provided by respondents to the 5-river questionnaire (see Appendix B). They allocated 15% and 14% of their bids to the Bitterroot and Big Hole Rivers, respectively. The respondents' allocated bid to the Bitterroot ($15.45 times 0.15 or $2.32) was significantly lower (t=2.73) than the single river bid of $8.19. However, the allocated bid for the Big Hole ($2.01) was not significantly lower (t=1.20) than the single river bid of $4.49. The lower allocated bids, compared with the single river bids, are not inconsistent with consumption theory.

Table 34 provides comparable mean donation values for the open-ended CVM responses. These means are based on individuals who answered the question, and have not been corrected to include zero values for those who did not answer the question. The pattern of responses is similar to that for the dichotomous choice responses, but generally with smaller differences across the various subsamples. For example, the complete sample single river donation is $10.62 for the Big Hole and $11.02 for the Bitterroot, somewhat lower than the multiple river value of $16.49. Examination of the separate user and nonuser means suggests, again, that users account for most of the difference between single- and multiple-river complete sample means. Further, the mean user donation is $15.87 and the nonuser donation is $9.33. However, the multiple river means are not significantly greater than the single river means (at the 0.05 level) for the user or nonuser subgroups (table 35). Only for the combined (user plus nonuser) sample are the multiple river means greater than the single river means. The lack of significance in the user and nonuser subsample results may be due to the small sample sizes.

These results provide evidence that trust fund responses of users were consistent with consumption theory. They were willing to donate more if more rivers were protected, but the amount for each additional river (the marginal WTP) was declining. Because the basic elements of the consumption theory model are derived from the standard constrained maximization formulation, these results provide some insights into characterizing the trust fund phenomenon. It appears that trust fund donations can, at least for users, be modeled like the purchase of any other commodity and that these purchases reflect the presence of a budget constraint.

The results for nonusers are less certain. Although both the logit and open-ended formats indicate that the multiple-river bid was greater than the single-river bids, the differences were not significant. Apparently, nonusers did not distinguish among quantity of rivers protected to the extent that users did. Perhaps for nonusers the essential notion is that they are helping to protect rivers; thus, the number of rivers and other details are not perceived as important.

Apportioning Total Value

Respondents allocated greater amounts of their membership fee to indirect than to direct use values; 62% allocated more toward indirect than direct, and 31% allocated equal amounts toward each and just 7% allocated a larger proportion toward direct use. These proportions differed between users and nonusers; 72% of the nonusers allocated more to indirect values, compared to 56% of the users. Similarly, 24% of the nonusers allocated their payments equally, compared to 34% of the users. At first it is surprising that 28% of the nonusers allocated equal or greater portions of their payments to direct use values. However, of the current nonusers of the target rivers, 21% said that other family members sometimes or frequently participated in river recreation, and 26% planned to start visiting the target river(s) themselves. The allocation question had been worded to include values expected from future recreational use, so the finding appears to be reasonable.

Intended use was related to donation among current nonusers. Of the respondents who said they planned to visit the target river(s) in the next three years, 34% were unwilling to donate and 49% said they would pay more than $1; of those who were not planning to visit the target river(s) in the next three years, 65% were unwilling to donate and only 20% were willing to pay more than $1. Roughly equal proportions of each group, about 15%, said they would pay $1 but no more.

Thus, of the people who did not currently visit and had no intentions of visiting (who comprised about 34% of the respondents), 35% were willing to pay something. These, perhaps, were the respondents truly motivated by altruism (although they may visit other rivers for recreation). In fact, 84% of the people who did not plan to visit in the next three years allocated the majority of their donation to indirect values, compared to 55% of those who planned to visit in the next three years.

The preservation motive variables (table 25) can be used to analyze the components of total economic value.

Table 34. — Mail survey open-ended WTP to trust fund, by user and survey type (1988 dollars).[1]

	Big Hole River	Bitterroot River	Big Hole & Bitterroot	Five rivers	All surveys
Users					
Mean	11.80	15.24	13.94	18.07	15.87
N	25	41	66	58	124
Mean S.E.	2.26	2.06	1.54	3.60	1.88
Nonusers					
Mean	9.57	7.63	8.32	12.67	9.33
N	28	51	79	24	103
Mean S.E.	1.71	.84	.81	2.79	.91
Users + nonusers					
Mean	10.62	11.02	10.88	16.49	12.90
N	53	92	145	82	227
Mean S.E.	1.39	1.10	0.86	2.68	1.12

[1] *Including only respondents who answered the open-ended CVM question.*

Table 35. — Comparison of open-ended mean WTP across sites based on two-tailed t-tests.[1]

Comparison	Users	Nonusers	Users + nonusers
t-statistics[2]			
Big Hole v. Bitterroot	−1.13	1.02	−.23
Big Hole v. 5 River	−1.47	-.95	−1.94
Bitterroot v. 5 River	−.68	−1.73	−1.89
Big Hole + Bitterroot v. 5 River	−1.05	−1.50	−1.99[3]

[1] *Based on respondents who answered the open-ended CVM questions.*
[2] *T-tests for the separate (not pooled) variance estimate.*
[3] *= significant at 5% level.*

Results of a regression approach utilizing existence and option variables are summarized in tables 36 (logit) and 37 (open-ended CVM). For the logit model, four different specifications are reported, depending on the combination of existence factor motives (NONUSE, HELP and PROTECT) and option and direct use motives (ACTDAY, FUTURE) that are included. The estimated existence share of total valuation varies from 0.68 to 0.83, and the option-use share varies from 0.17 to 0.32 (table 35). For the open-ended model, three specifications are reported. The relative shares of these models emphasize existence even more, with the existence share varying from 0.86 to 0.91 and the option-use share varying from 0.09 to 0.14 (table 36).[10]

The regression method results can be compared to the direct apportionment of WTP that respondents provide in a follow-up question to the trust fund donation. The apportionment method mean estimated shares are 0.27 for the option/use motive and 0.73 for the existence motive.[11] The means are bracketed by the logit estimated shares and indicate a higher share to option/use motives than the open-ended estimated shares.

These results indicate a remarkable consistency between the two very different approaches to identifying the components of total valuation, and appear to confirm the success of the admittedly exploratory methods used to define the psychometric existence factors. A cautionary note is that the regression approach is dependent on a complete and accurate model of all important factors or motives. To the extent that pertinent variables for either use/option or existence motives are not included, there is potential for biased estimates.

[10] It will be recalled that the open-ended model is only estimated on the subsample that responded to this question format (about 40% of the full sample).

[11] Not all individual allocations totaled 100. In such cases, the allocations were proportionally adjusted to total 100.

Table 36. — Share of total WTP due to existence vs. option-use motives based on mail survey logit trust fund equations.

Variable/statistic	Equation 1	2	3	4
Reparameterized coefficients[1]				
ACTDAY	.4204	—	—	−.0255
FUTURE	—	2.0812	1.6393	3.468
NONUSE	2.0151	2.6084	—	.0479
HELP	—	—	4.5986	3.5398
PROTECT	—	—	—	3.2009
Computation of share to motives				
$\Sigma B_i + \Sigma B_j Z_j$ [2]	2.4355	3.8301	5.5609	8.7988
Sum of use & option B_i	.4204	1.2217	.9623	2.0102
Sum of existence B_i	2.0151	2.6084	4.5986	6.7886
Share to use & option	.173	.319	.173	.228
Share to existence	.827	.681	.827	.772

[1] See table 27 for source of coefficients.

[2] FUTURE is a dummy variable. Share evaluated at sample mean of 0.587.

Table 37. — Share of total WTP due to existence vs. option-use motives based on mail survey open-ended CVM trust fund equations.

Variable/statistic	Equation 1	2	3
Coefficients[1]			
ACTDAY	.1193	.1039	.1160
FUTURE	.3427	.2660	.2596
HELP	—	1.2553	1.7952
PROTECT	2.1190	1.3549	—
Computation of share to motives			
$\Sigma B_i + \Sigma B_j Z_j$ [2]	2.4395	2.8702	2.0847
Sum of use & option B_i	.3205	.2600	.2895
Sum of existence B_i	2.1190	2.6102	1.7952
Share to use & option	.131	.091	.139
Share to existence	.869	.909	.861

[1] See table 28 for source of coefficients.

[2] FUTURE is a dummy variable. Share evaluated at sample mean of 0.587.

The finding here for apportionment of total value can be compared to the results of the Walsh et al. (1985) study of a special fund for Colorado wild and scenic study rivers. These authors used the apportionment method and found that 35% of total value was associated with the use/option motive and 65% with the existence (including bequest) motive. This is comparable to this study's finding of 27% and 73%, respectively, with the apportionment method. Thus, we have no evidence to refute the utility of directly asking respondents to apportion total value.

IMPLICATIONS FOR WATER ALLOCATION

Comparison of Use-related Values

A complete evaluation of the tradeoff between instream use and withdrawal for consumptive use would require modeling flow, storage, allocation, and instream uses—with and without the diversion—for the entire affected river basin, and is beyond the scope of this study. However, relatively simple examples for the Bitterroot and Big Hole shed light on the diversion/instream flow allocation issue.

Irrigation accounts for 96% of consumptive water use in Montana (Gibbons 1986) and is also the primary consumptive use in both the Bitterroot and Big Hole valleys. In Ravalli County, where most of the irrigation water from the Bitterroot River is used, alfalfa and other hays occupy 48% and 38% of the irrigated acreage. Over 90% of the approximately 16,000 acres in other hays is irrigated. Because other hays yield less income per acre-foot of water applied than alfalfa and other crops, and are less sensitive to lack of water than most other crops, we assume it is the main crop on which irrigation would be reduced if water were lacking. The situation is similar in Beaverhead County along the Big Hole.

We estimated the marginal value of irrigation based on the difference in return between irrigated and nonirrigated other hays, which averages 1.1 tons per acre (1.88 minus 0.78 tons) in Ravalli County and 0.6 tons per acre (1.45 minus 0.85 tons) in Beaverhead County (Montana Agricultural Statistics Service 1990). Using an average 1987–1989 price for other hays in Montana of $58 per ton, a short run cost of $20 per acre for flood irrigation, and a net irrigation requirement of 13 inches, yields a value of $40 per acre-foot consumed in irrigating other hays in Ravalli County (Duffield et al. 1990). In Beaverhead County, the net irrigation requirement is 10 inches for a value of $19 per acre-foot consumed for flood irrigation.

These values per acre-foot may tend to overestimate the short run marginal value of irrigation water in that they are for the average acre, not the least productive acre. Irrigation is most likely to be cut back on less productive fields if water is limited. The estimates also assume that all water not consumed by the crop returns to the stream (delivery and on-farm application efficiencies each average about 50%). On the other hand, the example values may tend to underestimate the marginal value of irrigation water because they reflect a year of average water availability, rather than a dry year when water is limited and more valuable.

The value of instream flow in both rivers includes the value of recreation and hydroelectric power generation, plus any existence value (such as of the fishery), for as far downstream as the water remains in the stream. We will ignore existence value. Also, in the well-watered Columbia Basin, we can ignore navigation, plus any final consumptive use downstream. We also ignore these values on the Missouri. We have estimated the marginal recreation value in our study sections to range from $8 per acre-foot on the Bitterroot and $22 on the Big Hole in times of very low flow to $0 when flow is ample. These values apply to the 22% of the Bitterroot length and 33% of the Big Hole length that were included in our study.

In order to estimate the value of an acre-foot of incremental streamflow through the entire river length, it is necessary to estimate marginal recreational values for other river sections. River section specific use estimates for three sections (lower, study, and upper) were derived from McFarland (1989), assuming that the relations of participation and recreation for the study section hold for the other river sections.

The relationship of discharge on the upper section to streamflow on the study section was derived from a regression relationship for the respective gages. Flows on the lower 22 miles of the Big Hole were assumed to be the same as those in the study section. Flows on the lower 32 miles of the Bitterroot were interpolated from nearby gages on the Clark Fork River above and below the Bitterroot confluence. Recreation values further downstream for each river would add to these estimates.

Both the Big Hole and Bitterroot rivers have very substantial instream values associated with hydroelectric power. This is because these streams are in the headwaters (in fact separated by only a few miles at the Continental Divide) of two of the most important hydroelectric resources in the continental United States—the Columbia and the Missouri. Hydroelectricity replaces more expensive power produced at thermal plants. One approach to valuing hydropower is to estimate the short run marginal cost savings: variable costs at thermal plants less variable costs at hydroelectric plants. Gibbons (1986) used a value of 20 mills per kilowatt hour based on replacing coal as the thermal plant fuel. If the hydroelectric energy were assumed to replace energy produced at gas turbine plants, the value would be considerably higher.

Gibbons (1986) reported a cumulative 1,025 kilowatt hours per acre-foot for the mainstem Columbia. Adding the additional 571 kilowatt hours for the Clark Fork of the Columbia and the Spokane River yields a total of 1,596 kilowatt hours per acre-foot. At the conservative cost savings estimate of 20 mills per kilowatt hour, this yields a value of $32 per acre-foot (ignoring evaporative losses). Downstream from the Big Hole there are 1,303 kilowatt hours of generation per acre-foot on the Missouri, indicating a short run value of $26 per acre-foot.

Adding the recreation and hydropower values yields an instream value of from $95 per acre-foot at low flows to $0 at flows over 1,800 cfs on the Big Hole and values of from $113 to $32 on the Bitterroot (fig. 5). Ignoring the lost instream use of water between the diversion and return flow points, the instream flow values should be compared with the marginal value of water consumed in agriculture, which is about $20 per acre-foot on the Big Hole and $40 on the Bitterroot. Applying the usual equimarginal allocation principle, these findings suggest that when the Bitterroot river is discharging under 1,400 cfs, instream flows provide a more valuable use of the water than agriculture. When instream flow is ample, agricultural diversion remains a wise procedure at the margin. On the Big Hole, hydropower values alone exceed irrigation values at all flow levels modeled. Obviously the assumption of constant marginal values for either of these uses is untenable for very large changes in flow. These findings are, of course, premised on our assumption that our valuation and participation models can be applied to other river sections. Given the potential allocative importance of instream uses, a more complete empirical study of these resources may be justified.

Trust Fund Aggregation

As seen in the previous section, use-related values of instream flow appear to outweigh the value of water diversions in the subject rivers during times of low flow. We now estimate the additional value associated with preservation of minimum instream flows, irrespective of recreation or other forms of use, based on the household trust fund CVM.

Aggregated trust fund values were derived for Montana residents based on the mail survey and estimated population characteristics.[12] The geographic scope of

[12] *This exercise is presented even though the mail survey was not designed to be a random sample of the population. Given the apparent sensitivity of valuation estimates to media choice, one could alternatively develop a telephone estimate based on the nonrespondent telephone survey valuation model.*

the analysis is limited to Montana even though state of residence was not found to be a significant explanatory factor in mail trust fund donations. Potentially much higher regional trust fund budgets would be estimated if neighboring states were included in the population definition. A limit to the geographic scope of the population could be defined by comparing the expected marginal return from a trust fund mailing to the marginal cost. This consideration is discussed below.

Because the mail sample was not a true random sample of the population, a number of corrections and approximations need to be made explicit. The respondents did not include individuals under the age of 18. Accordingly, the aggregation is for that segment of the population that is 18 and over. The use of a telephone directory-based sample introduces a gender bias and excludes the subset of the population without telephones. A correction for gender was limited to a correction based on the nonrespondent sample. We assumed that individuals with telephones and individuals without were identical for purposes of this study. A major departure from a random population sample relates to residence distance from the study rivers. This was explicitly corrected in the model.

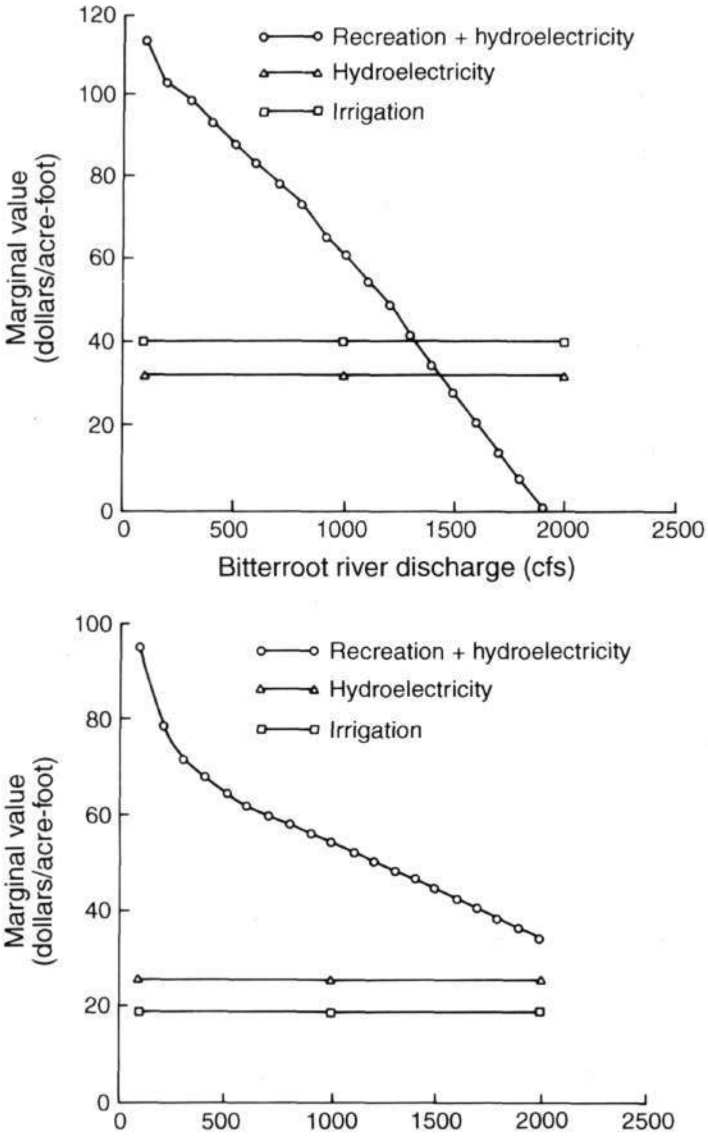

Figure 5. — Comparison of marginal instream flow values for recreation and hydroelectricity versus opportunity cost of irrigation withdrawals for mainstem of Big Hole and Bitterroot Rivers (1988 dollars per acre-foot).

The valuation model for the open-ended format is straightforward, based on the mean of the sample and adjusting for nonparticipation. However, there is a variety of ways to evaluate dichotomous-choice responses, and the literature provides little if any guidance on the appropriate method. Estimated means and medians for the mail survey trust fund logit response are provided in table 38. The nonparametric mean (truncated at $300) is $9.40. The truncated mean based on a simple bivariate (bid as the only independent variable) model is $10.82, with a median of $3.22. Still another alternative is to estimate a multivariate model, and evaluate it at the sample means. Estimates for two specific models are also provided in table 38. The first model (equation 1 in table 26) yields a mean of $10.98 and a median of $4.20. The other model, explicitly developed to include use variables (table 29), yields a truncated mean of $8.99 and a median of $2.76.

The differences between these estimates are not great. Lacking a better criterion, the multivariate equation including use variables was used for the trust fund aggregation on the grounds that it is necessary to correct for the nonuser bias in the mail sample.

A variety of methods has been used for expanding contingent valuation sample estimates to aggregate benefit estimates. Current practice and solutions were recently reviewed by Loomis (1987c). We applied four of the specific alternatives identified by Loomis: (1) sample-based model with estimated population means for independent variables (Schulze et al. 1983), (2) weighted average of stratified sample WTP means (Carson and Mitchell 1984), (3) no adjustment — extrapolate to population using sample-based model and sample means (Walsh et al. 1984, Stoll and Johnson

Table 38. — Mail survey trust fund average logit-based donations as a function of specification (1988 dollars).[1]

Specification/ equation	Intercept[2]	Slope[3]	Mean[4]	Median
Nonparametric (table 32)	—	—	$9.40	—
Bivariate	1.37	−1.17	10.82	$3.22
Multivariate[5]				
Equation 1 (table 26)	1.91	−1.33	10.98	4.20
Equation 1 (table 29)	1.22	−1.20	8.99	2.76

[1] *Based on one- and five-river surveys combined (i.e., with QUANT=2.36).*
[2] *Intercept of bivariate model (bid is independent variable).*
[3] *Slope coefficient on bid.*
[4] *Truncated at $300.*
[5] *Evaluated at sample means.*

1984), and (4) include nonrespondents and nonparticipants at zero value (Bishop and Boyle 1985).

The basic information for applying methods 1 and 2 is provided in table 39. Sample means for user- and gender-related variables are listed along with population weighted averages. For example, the USER dummy variable has a value of 0.52 in the mail survey (52% of mail survey respondents are river users) and 0.303 in the nonrespondent survey. Because respondents and nonrespondents are a sample of the population, these values are weighted at 0.34 (response rate) and 0.66 to yield an estimated population mean for this variable of 0.38. Similar calculations are displayed for the other user variable (DUMFREQ) and gender.

The logit mean based on method 3 (sample means for independent variables) is $8.99 (table 39). When evaluated at estimated population means (method 1), the logit mean is $8.07. This essentially reflects a correction for the proportion of users in the population as opposed to the proportion of users in the mail respondent subsample. The open-ended (participants only) mean based on the predictive model of table 29 is $7.80 for the sample (method 3) and $7.26 for the population (method 1). These values are considerably lower than the simple average of the open-ended responses of $12.90 for the mail survey and $11.75 for nonrespondents. The simple averages would appear to be more reliable. Accordingly, a method 2 (weighted average of stratified samples) approach is reported for the open-ended mean of $12.14. The open-ended $12.14 estimate for participants can be adjusted for nonparticipation to $6.35 (table 39).

Table 39. — Estimated population means for use, gender, and household trust fund valuation.

Variable/statistic	Mail survey	Nonrespondent phone survey	Population[1]
Variable means			
USER	.520	.303	.376[1]
DUMFREQ	.725	.490	.570[1]
SEX	.697	.663	.675[1]
Willingness to Pay (1988 dollars)[2]			
Logit mean[3]	$8.99	—	$8.07[4]
Logit median[3]	2.76	—	2.44[4]
Open-ended mean[3] (predicted)	7.80	—	7.26[4]
Open-ended mean[5] (participants only)	12.90	$11.75	12.14a[1]
Open-ended mean (overall)	5.03[6]	7.03[7]	6.35[1]

[1] Weighted average based on 34% response on mail survey.
[2] All values are with QUANT and DIST at sample averages (2.36 and 157.42, respectively).
[3] Based on table 29 equation.
[4] Based on estimated population means (method 1) with mail survey models.
[5] From table C2.
[6] Based on number of individuals participating in open-ended CVM question (227/582, or 39%).
[7] Based on nonrespondent survey for participation in open-ended CVM question of 60%.

The influence of distance on estimated mean trust fund donations is displayed in table 40, based on the multivariate equations including use variables displayed in table 29. There is a significant variation in mean donation depending on the proximity of the respondent's residence to the river(s) protected. For the logit mean (and for 2.36 rivers protected), respondents only 10 miles from the river(s) will have a mean donation of $35.94; at 100 miles this drops to $15.88, and at 2,000 to $5.49 (table 40). Table 40 also shows the effect of distance on "overall means" that have been adjusted for both nonparticipation and nonresponse. These means are based on method 4 and count all nonrespondents and nonparticipant values at zero. This might be called the "reality method" because it best reflects the actual probable return to an actual trust fund mailing: nonrespondent and nonparticipant donations are necessarily zero. Further real world considerations are that dichotomous choice formats are not efficient ways to actually collect money. The sample mean reflects potential value; the actual return will depend on such factors as how many individuals are only asked for a $1 bid. In this sense, with the open-ended format you get what you see: the sample mean would be the take (aside from hypothetical bias). Interestingly, the open-ended overall mean is only $1.56 at 500 miles and $1.35 at 1,000 miles. Another real consideration is the marginal cost of the mailing. Depending on the purposes of a given study, an appropriate geographical scope to the aggregation exercise could be defined by comparing trust fund mailing marginal costs to marginal return. For purposes of our analysis here, the geographical scope of the aggregation is limited to Montana residents.

The basic location-specific data for the trust fund aggregation are provided in table 41. This group of counties (25 of the 50 in the state) accounts for 85% of the state's population. It is assumed for purposes of the aggregation that the location of the remainder of the state population is identical to the distribution of the 25 population centers. The distance variable used in the multivariate models of table 29 is map distance from the mail survey sample population centers (e.g., Butte, Billings)

Table 40. — Effect of distance on average household trust fund donations.[1]

Distance (miles)	Mean of participants[2]		Overall mean[3]	
	Logit	Open-ended	Logit	Open-ended
10	$35.94	$26.71	$11.66	$3.54
100	15.88	16.47	5.15	2.18
500	8.98	11.74	2.91	1.56
1000	7.02	10.15	2.28	1.35
2000	5.49	8.77	1.78	1.16

[1] Based on average number of rivers protected (QUANT) of 2.36.
[2] Based on logit mean = $81.34323 DIST^{-0.3547}$ and open-ended = $43.34933 DIST^{-0.210185}$ with DIST set at the average of 157.42.
[3] Means with WTP of 0 for both nonrespondents and nonparticipants, as with method 4. Adjustment for logit is 0.34 response ratio times 0.954 (555/582) participation ratio. Corresponding adjustments for open-ended are 0.34 and 0.39 (227/582).

to the Big Hole River at Divide (for Big Hole surveys), the Bitterroot at Hamilton (for Bitterroot surveys), or the average of these two (for five-river surveys). The aggregation calculated here is for a five-rivers trust fund. Accordingly, table 41 lists population by county, distance to the Big Hole River at Divide, distance to the Bitterroot River at Hamilton, the average of these distances, and the corresponding logit mean and median and open-ended donation.

To estimate total values for the state, each county center estimate is inflated by 1/.854 (to account for the 25 county centers not modeled), multiplied by population of that county 18 years old and over in 1980, and multiplied by a factor of 809,000/768,690 (the ratio of current to 1980 population) to bring county level population estimates up to date. Results of this aggregation are reported in table 42 for the various aggregation methods. Method 1, using estimated population means, results in a Montana trust fund valuation for instream flows in five protected rivers of $6.7 million based on a logit mean. The median-based value is about $2 million. Using method 2 (weighted stratified sample) with the open-ended format produces a value of $7.9 million for participants and a value of $4.2 million when nonparticipants are also included. Method 3 (the unadjusted sample-based estimate) produces somewhat higher estimates than the adjusted (method 1) estimates for the logit (mean of $7.5 million and median of 2.3

Table 41. — Montana county-level database for trust fund aggregation.

County	County seat	Bitterroot distance	Big Hole distance	Average distance	Pop.	Logit mean	Logit median	Open-ended
		miles				1988 dollars[1]		
1. Beaverhead	Dillon	163	41	102	5821	14.16	4.28	15.43
2. BigHorn	Hardin	418	295	357	7038	9.08	2.75	11.86
3. Carbon	Red Lodge	379	256	318	5864	9.46	2.86	12.16
4. Cascade	Great Falls	215	178	197	57152	11.22	3.39	13.45
5. Custer	Miles City	508	395	451	9251	8.35	2.53	11.29
6. Dawson	Glendive	566	472	519	8154	7.95	2.40	10.96
7. Deer Lodge	Anaconda	127	33	80	8914	15.43	4.67	16.24
8. Fergus	Lewistown	320	261	291	9371	9.77	2.95	12.38
9. Flathead	Kalispell	162	245	204	36232	11.08	3.35	13.35
10. Gallatin	Bozeman	230	107	169	32661	11.85	3.58	13.89
11. Glacier	Cutbank	288	278	283	6909	9.85	2.98	12.45
12. Hill	Havre	330	293	312	12534	9.53	2.88	12.20
13. Lake	Polson	113	202	158	12986	12.14	3.67	14.09
14. Lewis & Clark	Helena	162	89	126	30441	13.15	3.98	14.77
15. Lincoln	Libby	237	325	282	11741	9.88	2.99	12.47
16. Missoula	Missoula	47	136	92	55774	14.71	4.45	15.79
17. Park	Livingston	256	133	195	9214	11.26	3.40	13.47
18. Ravalli	Hamilton	0	160	80	15573	15.43	4.67	16.24
19. Richland	Sidney	591	520	556	8404	7.76	2.35	10.81
20. Roosevelt	Wolf Point	537	500	519	6866	7.95	2.40	10.97
21. Rosebud	Forsyth	463	350	407	6218	8.67	2.62	11.54
22. Sanders	Thompson Falls	47	236	192	6021	11.32	3.42	13.52
23. Silver Bow	Butte	148	25	87	27285	15.01	4.54	15.98
24. Valley	Glasgow	488	451	470	6951	8.24	2.49	11.20
25. Yellowstone	Billings	372	249	311	76357	9.54	2.88	12.21

[1] *Based on average distance and five rivers protected, participants only.*

Table 42. — Total Montana instream flow five-river trust fund potential (thousands of 1988 dollars).

Method	Logit		Open-ended	
	mean	median	Participants[1]	All[2]
1. Population means for independent variables[3]	6,736	2,037	—	—
2. Weighted average WTP means for stratified sample[4]	—	—	7,944	4,155
3. Mail survey sample means for all variables[5]	7,504	2,304	8,441	3,292[6]
4. Mail survey sample means, but zero value for nonrespondents and nonparticipants[7]	2,434	736	—	1,119

[1] *Those who answered the open-ended question.*
[2] *All questionnaire recipients.*
[3] *Similar to method of Schultze et al. (1983), participants only.*
[4] *Similar to method of Carson and Mitchell (1984).*
[5] *Similar to method of Walsh et al. (1984) and Stoll and Johnson (1984); participants only for logit estimates.*
[6] *The mean WTP for this case is $5.03 (table 39) based on mail survey only (not weighted average as in Method 2).*
[7] *Similar to method of Bishop and Boyle (1985). Reflects 34% response rate for mail survey sample and 95.4% participation for logit and 39.0% for open-ended. This is the best approximation to an actual trust fund solicitation.*

million) and somewhat lower estimates than the adjusted (method 2) estimate for the open-ended format ($3.3 million). The latter is lower because the overall mean for the mail survey ($5.03, table 38) is lower than the weighted average open-ended overall mean ($6.35). Method 4 (including nonrespondents at zero value) results in the lowest estimates: $2.4 million for the logit mean and $1.1 for the open-ended mean.

Table 42 provides several estimates of the preservation value of instream flow on selected Montana rivers, assuming the contributor population is restricted to Montana residents. Perhaps the best approximation of the funds that could be collected in an actual trust fund is the "all" estimate presented in table 42 based on method 4, which assumes a zero donation for those who did not respond to the mail questionnaire and for respondents who did not participate in (did not answer) the open-ended question. This estimate is an annual contribution of about $1.1 million for protecting five rivers, which equals a donation of $224 thousand per river. The corresponding single-river annual trust fund contribution is $812 thousand (based on the proportions in the open-ended column of table 30). Using the more conservative five-river trust fund estimate of $224 thousand for protecting flows in one river, this fund would allow purchase of about 5.6 thousand acre-feet at the $40 irrigation value on the Bitterroot, and about 11.8 thousand acre-feet at the $19 irrigation value on the Big Hole.

These water purchase quantities are equivalent to 93 cfs for a month on the Bitterroot and 196 cfs for a month on the Big Hole. If the preferred flows of table 16 are an indication of flows that a trust fund would help maintain, then these purchases of 93 cfs or 196 cfs for a month would by themselves fall short of making up the deficit. However, when combined with the instream flow users' WTP (fig. 5), the trust fund donations only bolster an already obvious need for instream flow protection during dry years.

These trust fund estimates of course assume that respondents did not over-estimate their actual WTP. Furthermore, it must be remembered that the donations were estimated in the context of donation possibilities at the time of the survey. If additional donation requests were to become available, and if such donations were to some extent substitute for donations to protect instream flow, these additional donation possibilities would reduce river protection trust fund donations. On the other hand, annual contributions would not be needed every year on every river; rather, they could be saved until dry times when they are most needed. The accumulated fund would then allow purchase of much more water than estimated above.

CONCLUSIONS

The theoretical model presented in this study for valuing seasonal riparian recreation includes the effect of instream flow on both the quality of a recreation trip and the quantity of trips per season, where the quality effect is itself potentially influenced by daily use (congestion) and by a lagged effect (previous seasonal use). The model can be used to estimate the value of recreation trips and the recreation-related marginal or average values of changes in flow as a function of these quality and quantity (participation) effects.

Application of this model to the two study rivers incorporated the basic quality and quantity effects, but the data did not yield a significant congestion effect or support measuring the lagged effect of past participation on quality. Dichotomous choice CVM responses using a trip expense payment vehicle were obtained onsite from users over the 1988 season (a relatively dry year). Values of a recreational trip were estimated for three welfare measures (the median, 75th percentile, and overall mean) and for subsets of users. Choice of the welfare measure had a very large effect on estimated values. Assuming the 75th percentile measure, average WTP per day varied from about $110 to $160, depending on river and type of activity, for residents and from about $200 to $600 for nonresidents.

Each onsite survey respondent provided recreation trip WTP responses in the context of the flow level at the time of the interview, without any indication from the interviewer that flow level was of particular interest. The measured flow level at the time was then associated with each interview for model estimation, along with other independent variables. This procedure was expected to avoid any bias, allowing all potential influences on WTP to carry equal weight. Flow level was found to be a significant predictor of participation for both study rivers, but a significant predictor of individual WTP (the quality effect) on only one of the rivers (the Bitterroot). Changes in sample composition over the survey period (especially in residence) for the Big Hole may have interfered with the estimation of a quality effect. Perhaps the alternative method of asking respondents to estimate WTP for several unexperienced scenarios, depicted verbally or photographically, would have more effectively investigated the relation between flow and recreation quality.

Combining across the quality and participation effects, the marginal recreational value of instream flow varied from $10 per acre-foot at low flows to $0 at high flows on the Bitterroot River, and from $25 per acre-foot to near $0 on the Big Hole River. The total recreation value of streamflow rose with flow up to about 1,800 cfs on the Bitterroot and 2,000 cfs on the Big Hole, and dropped with further increases in flow. The quality effect was considerably greater than the participation effect at all flow levels on the Bitterroot River, whereas on the more popular Big Hole the participation effect outweighed the quality effect at most flow levels.

The theoretical model is also a useful structure for evaluating the impact on estimated recreation value of incomplete models, such as some models used in previous instream flow valuation studies, where either the WTP per trip or the participation component is assumed invariant with river flow. In general, incomplete models result in underestimates of marginal values of instream flow at most flow levels.

A household survey, employing a trust fund payment vehicle with dichotomous choice and open-ended response formats, was used to estimate the total value of instream flow maintenance, to address the issue of additivity of value across sites, and to investigate the influence on total value of use and nonuse motives. Mean willingness to pay for an annual trust fund membership, across all sample groups, was $9.40 based on the dichotomous choice responses and $12.90 based on the open-ended responses. Users' bids were greater than nonusers'; for example, based on the dichotomous choice responses, mean user and nonuser willingness to pay were $14.04 and $4.07, respectively.

Regarding additivity, separate subsamples of respondents estimated their WTP to maintain flow in either one or five rivers. Following the expectations of consumption theory, WTP was greater for protecting five rivers than only one river. However, based on the dichotomous choice responses, significant differences in WTP between one and five rivers were found only for persons who had previously visited the rivers; nonusers were apparently less sensitive in their valuations to the number of rivers protected than were users. This finding suggests that sensitivity to quantity of sites protected decreases as the extent to which the goods are perceived by respondents as pure public goods increases. Additional research is needed on the interaction between familiarity with and past use of the goods at issue, on the one hand, and sensitivity in valuation to the quantity or breadth of the goods, on the other hand.

Motivation scales, based on responses to 23 motive questions, and variables measuring past and anticipated river recreation trips, were used in regression models to apportion total WTP into use and nonuse (existence value) components. The results of this approach were compared with a straightforward apportionment by the respondents that was provided by respondents following their WTP responses. The approaches were found to be in close agreement, each allocating about 75% of total value to existence motives.

An important direction for further research is to integrate the elements that have been developed here into a comprehensive model for policy application. An element of this would be to view the trust fund as providing a budget constraint for this subset of environmental services. The appropriate role for the model of the recreational values of instream flow may be to provide a guide to allocation of this "instream flow budget" to a given state or region. This is especially true if meeting recreationists' preferred flows will also ensure achieving biological standards that indicate existence goals are being met. It was found that recreationists' preferred flows exceeded biology-based minimum instream flow standards on the Big Hole and Bitterroot.

A more fundamental issue is the appropriate economic organization of this sector. The trust fund has been treated in this study as little more than a payment vehicle for nonmarket valuation. In fact it is a real institution that has the potential for dramatically impacting the level of environmental services. The success of the Nature Conservancy and the phenomenal growth of the Rocky Mountain Elk Foundation are two examples. Consideration needs to be given to the appropriateness of basing policy decisions on nonmarket values when considerations of real world institutions are ignored. Specifically, most nonmarket valuation exercises (including the one presented here) ignore transaction costs. It is possible that nonmarket valuation tools have much broader potential application than developing market surrogates for policy purposes. The underlying reason for the standard nonmarket valuation exercise is market failure. It may be beneficial in some cases to turn the tools around 180 degrees to face the underlying problem. It would appear that nonmarket tools have the potential to influence the design and application of the real world institutions that arise in response to market failure.

This and previous studies have laid the groundwork for understanding the many reasons why people value natural resources, whether or not the resource is used personally for recreation. However, it is clear that more work is needed before valid, reliable taxonomies of values can be identified. Different people have different taxonomies—ways they value natural resources—so the task is clearly more involved than finding the "right" one. Basic research, preferably personal interviews with many open-ended questions, would go far in exploring the roles of motives such as altruism, philanthropy, sympathy, guilt, self-actualization, commitment, and imitation.

The findings have implications not only for further research, but for private trusts or similar efforts to raise money for natural resource conservation and enhancement. People who use the resource are more likely to contribute than nonusers, but there are probably far more nonusers out there. Appeals to altruistic values, effective to both users and nonusers, should include descriptions of the likely vicarious uses that could be enhanced, as well as benefits to plants, fish, wildlife, and other resources.

The low-ball and high-ball techniques may be effective ways to get at least a small donation from a great many respondents. People who have donated before are more likely to donate, even if the cause differs. Appeals for donations should introduce the trust fund (or other) concept clearly and objectively to familiarize people with the concept. Providing behavioral role models for people to follow also should boost donation rates.

The ethics of research efforts exploring WTP for memberships in natural resource trust funds should not be overlooked. Many of the comments we received suggested that people thought this was an outright request for money (and one person actually sent a check for his amount). Although this is great in terms of reducing hypothetical bias, it poses the same problem as fund-raising efforts that disguise themselves as research.

Two recent examples were 1989 mailings by the Sierra Club and Greenpeace. Both were one-page questionnaires, accompanied by cover letters that stressed the extreme importance of this research effort and of obtaining peoples' responses. The questions, however, especially on the Greenpeace questionnaire, were biased and distorted, and the survey was an obvious introduction to a fund-raising pitch. Cloaked as research, this misleading sales tactic may have worked, but it does a disservice to research efforts.

The point is that if we make our survey efforts too realistic, we are creating the same impression. Ironically, the research needed most at this point is further field testing of the principles learned to date. A legitimate trust fund, set up to maintain instream flows and rely on private donations, would be a mechanism for testing hypotheses as well as for maintaining river resources. As long as the purpose is clear and not misleading and the research practice sound, such efforts would test hypotheses in a market in an ethically sound manner. If accompanied by the type of basic research on preservation values described above, our understanding of this characteristic of human behavior would increase greatly.[13]

[13] *A field test using a trust fund payment vehicle has in fact been carried out, comparing contingent donations with actual deviations to a Nature Conservancy trust fund to protect instream flows in Montana. See J.W. Duffield and D.A. Patterson, Field testing existence values: comparison of hypothetical and cash transactions, presented at Joint Western Regional Science Association/W-133 Session on Measuring Option and Existence Values, South Lake Tahoe, Nevada, February 23-27, 1992.*

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APPENDIX A. ONSITE SURVEY INSTRUMENT

The survey instrument for the Bitterroot River is reproduced here. The Big Hole instrument was basically the same as the Bitterroot instrument. The only differences were that: (1) "Big Hole" replaced "Bitterroot" throughout, and (2) in question 48 the river section referred to was "from Wise River to Melrose" and the purchase option was: "Summertime flows on the Big Hole could be improved by purchasing water on the open market from irrigators. Purchase would allow irrigators to offset the costs of reduced water use or the costs of more efficient irrigation techniques."

Hi. I'm ______________ from the University of Montana. We're doing a study of recreational use on the Bitterroot River. Could I ask you a few questions?

1. How many hours will you be at the Bitterroot today? ____ Hours.
2. Are you here just for the day, or longer? (If so, how many?)

   ____ One day only. ____ # days if more than one.
3. Is this your first visit to the Bitterroot? 1 Yes 2 No
4. (If not), How many years have you been coming here? ____ Years.
5. How many trips have you made to the Bitterroot this year?

   ____ Trips so far this year.
6. How many trips have you made to the Bitterroot over the last two years?

   ____ Trips in last two years.
7. About how many trips will you make to the Bitterroot in the next two years?

   ____ Trips in the next two years.
8. What activities are you participating in on this trip to the Bitterroot ? (Read list and check activities they're doing.)

   ____ Fishing ____ Camping

   ____ Floating ____ Other ______________________________

ASK QUESTIONS 9–18 IF RESPONDENT IS FISHING ON THIS TRIP

9. What type of fishing equipment are you using?

   ____ Bait ____ Lure ____ Combination

   ____ Flies:
10. (If fishing flies) Did you tie your own? ____ Yes ____ No
11. (If fishing flies) Are you fishing a particular hatch (dry flies) or a particular nymph form? ____ Yes ____ No
12. (If yes to 11) Which hatch? ______________________________
13. About how many hours have you been fishing the Bitterroot so far on this trip? ____ Total number of hours.
14. How many trout have you caught so far on this trip? ____ Number of trout caught.
15. How many of these trout did you keep? ____ Trout kept.

16. Did you hire a fishing guide or outfitter on the Bitterroot River on this trip? ____ Yes ____ No

17. Are you fishing from shore, from a boat, or both? ____ Shore ____ Boat ____ Both

18. Do you have any other comments about the fishing here?

ASK QUESTIONS 19–23 IF RESPONDENT IS USING A BOAT

19. Type of boat used: ______________________________

20. Where did you put in? ______________________________ (site)

21. Where did you take out? ______________________________ (site)

22. Were the flow levels adequate for floating? _____Yes _____No

23. ADD DETAIL:

24. How long before today did you decide to visit the Bitterroot? _____ Days ago. (1 = 1 or less)

25. We are interested in knowing the reasons why you're visiting the Bitterroot at this particular time of year. I'm going to read you a list of possible reasons; please tell me whether that reason is very important, important, not very important, or not at all an important reason you're here at this time of year.

26. I have time off from work now	VI	I	U	VU
27. The weather is good	VI	I	U	VU
28. The flow levels are adequate	VI	I	U	VU
29. An insect hatch is going on	VI	I	U	VU
30. It's less crowded now	VI	I	U	VU
31. Other people wanted to come now	VI	I	U	VU

32. Are there any other reasons why you're visiting the Bitterroot at this time of year?

____

33. Did you feel that the river was crowded at any time on this trip? ____ Yes ____ No

34. (If yes to 33) What effects did this have on your experience?

____

The next few questions will help us to understand the value people place on the river related recreation on the Bitterroot River.

We realize you aren't used to considering your recreation this way, but please think about it and give us your best estimate.

35. Is visiting the Bitterroot river the main purpose of this trip from your home? ____ Yes ____ No

36. Is the Bitterroot the main or only recreational site you're visiting this trip? ____ Yes ____ No

37. About how far is it from your home to this section of the Bitterroot? _____ Miles (one-way).

38. How long did it take to travel from your home to the Bitterroot River? _____ Hours (include stops made enroute).

39. About how much do you expect to 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 the trip, guiding fees, shuttle expenses, and other trip expenses. If you don't know what the exact amount was (or will be), please give your best estimate.

    __________Total amount spent on this trip.

40. Suppose that your expenses to visit the Bitterroot on this trip were higher. Would you still have visited the Bitterroot if your personal expenses were ______________more?

    ____ Yes ____ No

41. (If No to 40) Would you still have made the trip if your personal expenses were only $1 more?

    ____ Yes ____ No

42. (If No to 41) Could you please briefly explain why not?

THE FOLLOWING QUESTIONS ADDRESS THE ISSUE OF LOW SUMMERTIME FLOW LEVELS ON THE BITTERROOT RIVER:

43. Was the water level in the Bitterroot River today adequate for the activity you participated in?

    ____ Yes ____ No

    Comments:

44. Did you know what the flow level in the river was going to be today? ____ Yes ____ No

45. (If yes to 44) How did you know?

____ Past experience here

____ Talked to friends

____ Talked to fly shop/outfitter

____ State or federal agency

____ Other: ____

46. Would you prefer to be visiting the river at a different flow level? ____ Yes ____ No

47. (If yes to 46) What would be a better flow level?

_________ Inches higher

_________ Inches lower

Comments:

48. For the next couple of questions I need to give you a little background information. As you may be aware, this section of the Bitterroot River from Hamilton to Stevensville typically has low summertime flows and is severely dewatered in drought years like 1985. However, there is water available in Painted Rocks Reservoir on the West Fork of the Bitterroot River that could be purchased to increase summertime flows on this section of the river. One way this could be done would be by forming a trust fund to buy water as needed. Now here's the question I'd like you to answer.

Would you purchase an annual membership in a trust fund costing _________ to maintain flows in the Bitterroot River over the summer at your preferred level? ____ Yes ____ No

49. (If no to 48) Would you be willing to pay for annual membership in a trust fund to improve minimum flows if the cost were sufficiently low, say only $1 per year? ____ Yes ____ No

50. (If no to 49) Could you please briefly explain why now? ______________________________

____

I have just a few more quick questions to help us understand your responses.

51. Where do you live? City: ______________________________ State: __________

52. How old are you? _________ Years

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

___ Some grade school	___ Some college
___ Finished grade school	___ Finished college
___ Finished junior high	___ Some post graduate
___ Finished high school	___ Finished post graduate

54. Are you a member of any conservation, sport, fishing, or boating organizations? ___ Yes ___ No

55. (If yes to 54) About how many of these groups do you belong to? _________ Groups

56. Can you estimate your total donations over the course of a year for environmental preservation causes (wildlife funds, wilderness preservation, etc.). _________ Dollars

57. (HAND CARD) Could you please give me the letter that corresponds to your household's income before taxes last year:

a. Under $5,000	e. $20,000-24,999	i. $40,000-49,000
b. $5,000-9,999	f. $25,000-29,999	j. $50,000-74,999
c. $10,000-14,999	g. $30,000-34,999	k. $75,000-100,000
d. $15,000-19,999	h. $35,000-39,999	l. Over $100,000

INTERVIEWER SECTION: TO FILL IN AFTER INTERVIEW

ID # ______________________

Sex of respondent: ___ Male ___ Female

Location: ____

Date: ____________ Time started: _________ Time finished: _________

Flow level: ____

Weather: 1 Rain 2 Cloudy 3 Partly cloudy 4 Sunny

Temperature: 1 Hot (>75) 2 Warm (60–75) 3 Cool (<60)

Wind: 1 Strong 2 Moderate or gusty 3 Calm

Major hatches observed ____

Number of boats observed at take-out today: ______________________________

APPENDIX B. MAIL SURVEY INSTRUMENT

The survey instrument of the Bitterroot River is reproduced here. Sections I, IV, and V of the Big Hole and Five Rivers instruments were identical to the Bitterroot instrument. Remaining sections (II and III) of the Big Hole instrument were identical to the Bitterroot instrument except that: (1) "Big Hole" replaced "Bitterroot", and (2) the wording of question 5, section III, was somewhat different. Specifically, the first paragraph of this question stated:

"As you may know, major sections of the Big Hole River typically have very low levels of water during the summer. The river reached record low flow levels in recent years. This season the water level became so low that fishing catch limits had to be reduced to maintain healthy trout populations."

And the third paragraph stated:

"Available water could be purchased when needed from upstream irrigators to increase summertime flows in the Big Hole. This water could be purchased when needed to avoid damaging low flows in the river. A trust fund could be developed specifically to purchase water when needed."

Sections II and III of the Five Rivers instrument differed from the single river instruments. They are reproduced here, after the Bitterroot instrument.

Complete Bitterroot Instrument

I. FIRST, WE HAVE SOME GENERAL QUESTIONS ABOUT YOUR RECREATIONAL USE OF RIVERS; PLEASE ANSWER EVEN IF YOU RARELY OR NEVER VISIT RIVERS FOR RECREATION.

1. About how often do you currently participate in river-related recreation such as stream fishing, boating, swimming in rivers, or picnicking or camping along rivers? *(Please check one.)*

   ☐ Never *(Please go to #7)*

   ☐ Rarely (1 - 3 days per year)

   ☐ Sometimes (4 - 10 days per year)

   ☐ Frequently (11 - 25 days per year)

   ☐ Very Frequently (more than 25 days per year)

2. How many years have you been going to rivers to fish, boat, or participate in other river-related activities?

   ____________ years

3. About how many days per year do you spend doing each of the following recreational activities on or along a river?

   _________ Days fishing from shore on rivers or

   _________ Days fishing from a boat on rivers or

   _________ Days boating on rivers (nonfishing)

   _________ Days swimming in rivers or streams

   _________ Days doing other activities: ______________________________

4. If you fish, what type of equipment do you generally use? *(Please check all that apply.)*

   ☐ Bait ☐ Lures ☐ Flies

5. If you fish, how important to you is each of the following aspects of fishing?

	Very important	Important	Not very important	Not at all important
a. Catching fish to eat	☐	☐	☐	☐
b. Testing fishing skills	☐	☐	☐	☐
c. Catching wild fish	☐	☐	☐	☐
d. Catching large fish	☐	☐	☐	☐
e. Catching lots of fish	☐	☐	☐	☐

6. People visit rivers for many reasons. Following is a list of possible reasons. Please check the box that says how important that reason is for you.

	Always important	Frequently important	Sometimes important	Never important
a. To view the scenery	☐	☐	☐	☐
b. To be with my family	☐	☐	☐	☐
c. To experience solitude	☐	☐	☐	☐
d. To be with friends	☐	☐	☐	☐
e. For the fishing	☐	☐	☐	☐
f. For the boating	☐	☐	☐	☐
g. To view wildlife	☐	☐	☐	☐
h. To relax	☐	☐	☐	☐
i. Other ___________	☐	☐	☐	☐

7. How frequently do any other members of your household participate in river-related recreation such as stream fishing, boating, swimming in rivers, or picnicking or camping along rivers? *(Please check one.)*

☐ Never
☐ Rarely (1–3 days per year)
☐ Sometimes (4–10 days per year)
☐ Frequently (11–25 days per year)
☐ Very Frequently (more than 25 days per year)

8. Following is a list of some possible uses of the water in a stream or river. Please rate how important you feel each use is to society in general.

	Critical	Very important	Somewhat important	Not at all important
a. Irrigation	☐	☐	☐	☐
b. Hydropower	☐	☐	☐	☐
c. Recreation	☐	☐	☐	☐
d. Wildlife	☐	☐	☐	☐
e. Fisheries	☐	☐	☐	☐

II. THIS SECTION ASKS ABOUT YOUR FAMILIARITY WITH MONTANA'S BITTERROOT RIVER.

1. Have you ever visited the Bitterroot River for recreation?

   ☐ YES ☐ NO *(Please go to #6).*

2. What activities have you done along the Bitterroot River in the last three years? *(1986 – 1988; please check all that apply.)*

   ☐ Fishing from shore
   ☐ Fishing from boat
   ☐ Boating (nonfishing)
   ☐ Swimming
   ☐ Hunting
   ☐ Other ______________________________

3. About how many days did you spend recreating on or along the Bitterroot River in the past three years?

   _______ Days in the last three years (1986, 1987, 1988)

4. When visiting the Bitterroot River, either this year or before, have you ever had any problems with low flow levels?

   ☐ YES ☐ NO *(Please go to #6.)*

   5. If yes, what kind of problems?

6. Do you plan to visit the Bitterroot River for recreation in the next three years?

   ☐ YES ☐ NO

   7. If yes, how frequently do you plan to visit the Bitterroot? *(Please check one.)*

      ☐ More than I do now
      ☐ About as frequently as I do now
      ☐ Less than I do now
      ☐ I'm not sure

   8. If you plan to visit more or less frequently than you do now, could you estimate the number of days per year you're likely to visit the Bitterroot?

      _________ Days per year

9. Have you experienced difficulties because of low flow levels on other rivers?

   ☐ YES ☐ NO *(Please go to Section III.)*

   10. If yes, what kind of problems, and on what rivers?

       River: ________________ Problem: ______________________________

       River: ________________ Problem: ______________________________

III. THIS SECTION ASKS HOW FAMILIAR YOU ARE WITH EFFORTS TO CONSERVE NATURAL RESOURCES AND ABOUT YOUR OWN WILLINGNESS TO BECOME INVOLVED.

1. In various parts of the country, trust funds have been set up to purchase water or land resources to conserve unique natural resources. The Nature Conservancy, Ducks Unlimited, and the Rocky Mountain Elk Foundation are examples of the types of groups that can do this.

   How familiar are you with these efforts? *(Please check one.)*

   ☐ I have never heard of such trust funds.
   ☐ I have heard of them but don't know much.
   ☐ I know a fair amount about them.
   ☐ I know a great deal about them.

2. Have you ever donated money or time to a trust fund like this, or to other efforts to help conserve natural resources such as rivers or wildlife habitat?

   ☐ Yes, I have ☐ No, I have not

3. Do you know anyone else who has ever donated money or time to a trust fund like this, or to other efforts to help conserve natural resources such as rivers or wildlife habitat?

   ☐ Yes, I do ☐ No, I do not

4. Did you know that the Montana Department of Fish, Wildlife and Parks has purchased water from reservoirs during recent drought years to maintain adequate flow levels on Montana rivers? *(Please check one.)*

   ☐ No, I never knew this
   ☐ I knew this but not much about it.
   ☐ I know a fair amount about these efforts.
   ☐ I know a great deal about these efforts.

5. As you may know, major sections of the Bitterroot River typically have very low levels of water during the summer. The river reached record low flow levels in recent years.

   If flows were higher, people would be able to float the river later in the summer. Flows would be better for trout populations and fishing. Many species of birds, wildlife, and plants would benefit; for example, better habitat would exist for osprey and river otters.

   Water available in Painted Rocks Reservoir could be used to increase summertime flows in the Bitterroot. This water could be purchased when needed to avoid damaging low flows in the river. A trust fund could be developed specifically to purchase water when needed.

   If enough people contribute to this trust fund, the river would be available for more recreational use both now and in the future. Even if you don't use the Bitterroot for recreation, you would know you are helping to keep an important Montana river clean and healthy.

   If you were contacted within the next month, would you purchase annual membership in this trust fund for ____________ to buy water needed to increase summer flows on the Bitterroot River?

   ☐ YES *(Please go to #8.)*

   ☐ NO *(Please go to #6.)*

6. Would you be willing to donate a smaller amount, such as $1.00 per year, to purchase water when needed for the Bitterroot?

   ☐ YES *(Please go to #8.)*

   ☐ NO *(Please go to #7.)*

7. Could you please briefly explain why you would not purchase an annual membership in this trust fund?

(After answering #7, please go to #10.)

8. What is the maximum amount you would be willing to pay for an annual membership in this trust fund?

____________ Dollars

9. People can value the improvement of instream flows in the Bitterroot for many reasons. What percent of your payment to the trust fund would you assign to each of the following purposes?

A. Payment to guarantee high enough flows for boating and fishing when I actually visit the Bitterroot for recreation, either now or in the future: ________ %

B. Payment for reasons other than my own use, such as just knowing that the Bitterroot has sufficient flows for healthy fisheries, plants, and animal life, or knowing that future generations will benefit from adequate flow levels: ________ %

TOTAL: 100 %

10. Who do you feel should be responsible for maintaining adequate flow levels in Montana rivers and streams like the Bitterroot? *(Please check all that apply.)*

☐ No one
☐ State government
☐ Federal government
☐ People who use the Bitterroot for recreation should pay
☐ Private trust funds
☐ Other: ________________________

IV. THE NEXT QUESTIONS ASK HOW YOU FEEL ABOUT RIVERS AND VARIOUS ENVIRONMENTAL ISSUES.

For each statement, check the box that shows how you feel about that statement. You always have an opportunity to agree with the statement, disagree with it, or say you have no opinion.

	Strongly agree	Agree	Disagree	Strongly disagree	No opinion
a. I have a great deal of concern for endangered species.	☐	☐	☐	☐	☐
b. Some land in the U.S. should be set aside from any human use at all so it can remain completely untouched	☐	☐	☐	☐	☐
c. I would like to see more hydroelectric dams on Montana rivers.	☐	☐	☐	☐	☐
d. I have had inspirational experiences on rivers.	☐	☐	☐	☐	☐
e. The main reason for maintaining resources today is so we can develop them in the future if we need to.	☐	☐	☐	☐	☐
f. I'm glad there is wilderness in Alaska even if I never go there to see it.	☐	☐	☐	☐	☐
g. Rivers do not have many spiritual or sacred values to me.	☐	☐	☐	☐	☐
h. Our society should consider the needs of future generations as much as we consider our needs today.	☐	☐	☐	☐	☐
i. Some days when I'm feeling pressured it reassures me to think that some lands out there are wild and undeveloped, even if I never get to go there.	☐	☐	☐	☐	☐
j. I enjoy knowing that my friends and family can visit rivers for recreation if they want to.	☐	☐	☐	☐	☐
k. Endangered species should not be protected if they don't have any benefits to humans.	☐	☐	☐	☐	☐
l. People can think a river is valuable even if they don't actually go there themselves.	☐	☐	☐	☐	☐
m. I enjoy hearing about experiences my friends or family have had on rivers.	☐	☐	☐	☐	☐
n. The decision to develop resources should be based mostly on economic grounds.	☐	☐	☐	☐	☐
o. I have been concerned about how the recent droughts may affect fish and wildlife that depend on rivers.	☐	☐	☐	☐	☐
p. I enjoy looking at picture books or going to movies that have rivers in them.	☐	☐	☐	☐	☐

	Strongly agree	Agree	Disagree	Strongly disagree	No opinion
q. I think that most rivers already have enough water in them to be healthy resources.					
r. I would be willing to contribute money or time to help keep adequate water in Montana rivers even if I could never visit them.					
s. I would be willing to visit Montana rivers less frequently if it meant that the resource would be better off in the long run.					
t. Montana's free-flowing rivers and streams are a unique and irreplaceable resource.					
u. I feel that I should be doing more for Montana's rivers and streams.					
v. It's important to protect rare plants and animals to maintain genetic diversity.					
w. Donating time or money to worthy causes is important to me.					

V. THIS FINAL SECTION WILL HELP US TO UNDERSTAND YOUR RESPONSES. THANK YOU FOR YOUR TIME AND EFFORT.

1. Are you a member of any conservation, sport, fishing, or boating organizations? ☐ YES ☐ NO

2. If yes, which ones?

3. Do you or your household have a fairly specific budget for donating to various causes or charities that you support?

   ☐ YES ☐ NO

   4. If yes, about how much? ___________ $ per year

5. Where do you live? City: ______________________________ State: ___________

6. What is your age? ___________ Years

7. Are you: ☐ Male ☐ Female

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

   ☐ Some grade school ☐ Some college
   ☐ Finished grade school ☐ Finished college
   ☐ Finished junior high ☐ Some postgraduate
   ☐ Finished high school ☐ Finished postgraduate

9. During this past summer, were you: *(Please check all that apply.)*

   ☐ Employed full-time ☐ Retired
   ☐ Employed part-time ☐ Homemaker
   ☐ Unemployed ☐ Other: ______________________________

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

☐ under 5,000	☐ 20,000–24,999	☐ 40,000–49,999
☐ 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

THANK YOU FOR YOUR HELP.
IS THERE ANYTHING ELSE YOU'D LIKE TO TELL US ABOUT FLOW LEVELS IN MONTANA'S RIVERS, OR OTHER RELATED ISSUES? WE WOULD APPRECIATE ANY COMMENTS.

If you would like to receive a copy of the results of this study, please write your name and address on the back of the return envelope (not on this questionnaire).

Sections II and III of the Five Rivers Instrument

II. THIS SECTION ASKS ABOUT YOUR FAMILIARITY WITH FIVE SPECIFIC MONTANA RIVERS.

1. Have you ever visited the Big Hole, Bitterroot, Clark Fork, Gallatin, or Smith River for recreation in the last three years?

   ☐ YES ☐ NO *(Please go to #6.)*

2. (If yes) about how many days did you spend at each of the rivers in the last three years? *(If you're not sure, please give your best estimate.)*

   __________ Days at the Big Hole

   __________ Days at the Bitterroot

   __________ Days at the Clark Fork

   __________ Days at the Gallatin

   __________ Days at the Smith

3. What activities have you done along any of these rivers in the last three years? *(1986–1988; please check all that apply.)*

   ☐ Fishing from shore ☐ Swimming
   ☐ Fishing from boat ☐ Hunting
   ☐ Boating (non-fishing) ☐ Other

4. When visiting these rivers, either this year or before, have you ever had any problems with low flow levels?

   ☐ YES ☐ NO *(Please go to #6.)*

   5. If yes, what kind of problems?

      ____

6. Do you plan to visit any of these rivers for recreation in the next three years?

   ☐ YES ☐ NO

   7. If yes, how frequently do you plan to visit them? *(Please check one.)*

      ☐ More than I do now ☐ Less than I do now
      ☐ About as frequently as I do now ☐ I'm not sure

   8. If you plan to visit more or less frequently than you do now, could you estimate the number of days per year you're likely to visit them? *(Estimate the total number of days per year you're likely to spend at the five rivers.)*

      _________ Days per year

9. Have you experienced difficulties because of low flow levels on other rivers?

   ☐ YES ☐ NO *(Please go to Section III.)*

   10. If yes, what kind of problems, and on what rivers?

       River: ____________________ Problem: ____________________________

       River: ____________________ Problem: ____________________________

III. THIS SECTION ASKS HOW FAMILIAR YOU ARE WITH EFFORTS TO CONSERVE NATURAL RESOURCES—AND ABOUT YOUR OWN WILLINGNESS TO BECOME INVOLVED.

1. In various parts of the country, trust funds have been set up to purchase water or land resources to conserve unique natural resources. The Nature Conservancy, Ducks Unlimited, and the Rocky Mountain Elk Foundation are examples of the types of groups that can do this.

   How familiar are you with these efforts? *(Please check one.)*

   ☐ I have never heard of such trust funds.
   ☐ I have heard of them but don't know much.
   ☐ I know a fair amount about them.
   ☐ I know a great deal about them.

2. Have you ever donated money or time to a trust fund like this, or to other efforts to help conserve natural resources such as rivers or wildlife habitat?

   ☐ Yes, I have
   ☐ No, I have not

3. Do you know anyone else who has ever donated money or time to a trust fund like this, or to other efforts to help conserve natural resources such as rivers or wildlife habitat?

   ☐ Yes, I do
   ☐ No, I do not

4. Did you know that the Montana Department of Fish, Wildlife and Parks has purchased water from reservoirs during recent drought years, to maintain adequate flow levels on Montana rivers? *(Please check one.)*

   ☐ No, I never knew this
   ☐ I knew this but not much about it.
   ☐ I know a fair amount about these efforts.
   ☐ I know a great deal about these efforts.

5. As you may be aware, major sections of the Big Hole, Bitterroot, Gallatin, Smith and Upper Clark Fork Rivers typically have very low summertime flows. These rivers had very little water in them the past few summers, reaching record low flow levels that harmed fisheries and recreational use.

   If flows were higher, people would be able to float the rivers later in the summer. Flows would be better for trout populations and fishing. Many species of birds, wildlife, and plants would benefit; for example, better habitat would exist for osprey and river otters.

   Available water could be purchased when needed from upstream reservoirs or irrigators to avoid damaging low flows in these five rivers. A trust fund could be developed specifically to purchase water when needed. If enough people contribute to this trust fund, the river would be available for more recreational use both now and in the future. Even if you don't use these rivers for recreation, you would know you are helping to keep important Montana rivers clean and healthy.

   If you were contacted within the next month, would you purchase an annual membership in this trust fund for ____________________ to buy the water needed to increase summer flows on the Big Hole, Bitterroot, Gallatin, Smith and Upper Clark Fork Rivers?

   ☐ YES *(Please go to #8.)*
   ☐ NO *(Please go to #6.)*

6. Would you be willing to donate a smaller amount, such as $1.00 per year, to purchase water when needed for these five rivers?

   ☐ YES *(Please go to #8.)*
   ☐ NO *(Please go to #7.)*

7. Could you please briefly explain why you would not purchase an annual membership in this trust fund?

____

(After answering #7, please go to #11.)

8. What is the maximum amount you would be willing to pay for an annual membership in this trust fund?

____________ Dollars

9. How would you want us to allocate your payment among the five rivers? Please indicate the percent of your donation that you would want to go toward purchasing water for each river *(Percents should total 100%.)*

________ Percent to purchase water for the Big Hole River

________ Percent to purchase water for the Bitterroot River

________ Percent to purchase water for the Gallatin River

________ Percent to purchase water for the Smith River

________ Percent to purchase water for the Clark Fork River

100%

10. People value the improvement of instream flows in the Big Hole, Bitterroot, Gallatin, Smith and Upper Clark Fork for many reasons. What percent of your payment to the trust fund would you assign to each of the following purposes? *(Please read each option before answering.)*

A. Payment to guarantee sufficient flows for boating and fishing when you actually visit these rivers for recreation, either now or in the future: ______________%

B. Payment for reasons other than your own use, (such as just knowing that these rivers have sufficient flows for healthy fisheries, plants and animal life, or knowing that future generations will benefit from adequate flow levels): _________%

Total – 100%

11. Who do you feel should be responsible for maintaining adequate flow levels in these five Montana rivers and streams? *(Please check all that apply.)*

☐ No one
☐ State government
☐ Federal government
☐ People who use the rivers for recreation should pay
☐ Private trust funds
☐ Other: ____

APPENDIX C. NONRESPONDENTS TO THE MAIL SURVEY

Because the mail survey response rate was only 34%, a phone survey of nonrespondents was conducted. The phone survey used 13 questions that were largely a subset of the 39 questions asked on the mail survey (Appendix B). Definitions for specific variables, which have identical or similar meaning for both surveys, are listed in table C1.

Table C1. — Variable definition for survey of nonrespondents.

Variable	Definition
RIVREC	How frequently visit Montana rivers (1–5 scale)
FISH	Participate in fishing
HHRIVREC	How frequently household members participate in river recreation
VISRIV	Visit this river in last three years
DAYS	Number of days users recreate
PLANMT	Plan to visit a Montana river in next three years
BIDF	Bid offer for trust fund ($)
RESPFL1	Response (yes, no) to bid
RESPFL2	Response to $1 bid
OPEN1	Open-ended WTP for participants ($)
OPEN2	Open-ended WTP for complete sample ($)
PERC	Percent of donation for use or future use
PROTH	Percent of donation for other (existence) motives
MEMBER	Member of conservation group
SEX	Gender

The phone survey yielded 251 responses, or 22% of the mail survey nonrespondents (table 1). There was nearly 100% cooperation with the phone survey. The phone survey indicated differences between respondents and nonrespondents that were important in interpreting the results and in extrapolating trust fund results to the regional population. Estimated average values from both surveys are listed in table C2.

A major difference between the two samples is in the proportion of respondents who are river users. For example, 28% of the mail survey respondents reported they "never" or "rarely" visit Montana rivers for recreation (RIVREC), compared with 51% of the nonrespondents. Similarly, 52% of the respondents reported using (in the last three years) the river(s) to be protected (VISRIV), compared with only 30% of the nonrespondents. These results indicate that individuals who participate in river recreation and individuals who use the specific rivers to be protected were more likely to respond to the mail survey. Given the finding that users are willing to donate considerably more than nonusers (tables 26 and 28), this is an important source of potential bias in applying the mail survey-based valuation models to the Montana population.

Regarding other characteristics, however, mail survey respondents and nonrespondents were similar. For example, the percent of individuals who fish was about the same in both samples (around 60%). (Apparently, many of the nonrespondents are lake anglers only.) Also, somewhat surprisingly, both groups reported approximately the same average probability of visiting a Mon-

Table C2. — Comparison of nonresponse telephone survey and mail survey.

	Nonresponse survey			Mail survey		
Variable	Sample	Mean or percent	Standard deviation	Sample	Mean or percent	Standard deviation
RIVREC[1]	251	51	—	575	28	—
FISH[2]	238	63	—	—	60	—
HHRIVREC[1]	231	56	—	538	32	—
VISRIV[2]	251	30	—	547	52	—
DAYS	77	23	27	121	25	32
PLANMT[2,3]	190	59	—	507	59	—
BIDF[4]	251	90	85	578	91	87
RESPFL1[2]	250	13	—	555	8	—
RESPFL2[2]	218	56	—	523	52	—
OPEN1[4]	150	12	19	227	13	17
OPEN2[4]	251	7	—	582	5	—
PERC	143	32	31	277	25	26
PROTH	143	68	31	282	65	32
MEMBER[5]	245	14	—	566	21	—
SEX[6]	249	66	—	577	69	—

[1] *Percent never or rarely (1,2).*
[2] *Percent yes (1).*
[3] *Not an exact comparison; plan to visit Montana river (telephone) vs. plan to visit "this" river or "any of these rivers" (mail).*
[4] *1988 dollars.*
[5] *Percent member.*
[6] *Percent male.*

tana river in the next three years (59%). However, this is not an exact comparison because the mail survey asked the likelihood of visiting one of the *specific* study rivers.

The total days of river recreation (DAYS) that the user subsample in both surveys reported was quite similar (25 days per year for respondents and 23 for nonrespondents). Additionally, the share of trust fund donation that each group allocated to existence motives was similar (68% for respondents and 66% for nonrespondents). Respondents were slightly more likely to be members of conservation groups (21% versus 14%). In comparison with the population as a whole, where males comprise approximately 50%, both groups were biased toward males, who comprised 69% of respondents and 66% of nonrespondents.

Given the mail survey results that nonusers have lower trust fund values, and the finding that users were more likely to respond to the mail survey than nonusers, one would therefore expect nonrespondents on average to have lower values than respondents. However, this is not the case for the dichotomous choice question format. Based on the nonparametric method, nonrespondents have a mean trust fund donation of $18.09, compared to $9.40 for the mail survey. Based on estimated standard errors (3.62 for nonrespondents and 1.55 for respondents) (table 32), the nonrespondent mean is significantly higher than the respondent mean. Although the mean bid offer (BIDF, table C2) is almost identical for the two surveys (around $90), nonrespondents were more likely in aggregate to donate based on the dichotomous-choice response at varying bid levels (8% yes among respondents and 13% among nonrespondents) and also for the $1 bid offer (56% of nonrespondents would donate $1 versus 52% of respondents).

Most likely, these results indicate the sensitivity of dichotomous choice responses to the media employed. Apparently, other things being equal, a personal phone solicitation is generally more successful than a mail solicitation. This is an interesting finding that has relevance for the design of real world trust fund drives.

Results are also available for the open-ended question format. Based on means for participants only, the respondent mean donation ($12.90) is slightly higher than the nonrespondent donation ($11.75) (variable OPEN1 in table C2). However, these results are somewhat misleading because of the pattern of participation in this question format. The phone survey resulted in greater overall participation in this question format (60% versus 39%). One needs instead to look at overall means for the samples, including nonparticipants at zero value. It was presumed that individuals who responded "no" to the $1 dichotomous-choice offer had a zero open-ended value and were not asked the open-ended question. This approach was used on both the mail survey and phone script. Additionally, a share of people who responded "yes" to a logit offer did not answer the open-ended question, which is admittedly a more difficult type of question to answer. Including nonparticipants at zero value yields an overall mean for the open-ended format of $7.03 for nonrespondents and $5.03 for mail survey respondents (variable OPEN2, table C2). These results again illustrate (as for the dichotomous-choice format) that a phone solicitation (other things being equal) appears to elicit higher donations.

Because of the potential effect on willingness to pay responses of the different media (mail versus phone) used, the phone survey of nonrespondents does not provide a viable check on the mail survey valuation estimates. It does, however, facilitate extrapolation of mail survey results to the regional population.

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Rocky Mountains

Southwest

Great Plains

U.S. Department of Agriculture
Forest Service

Rocky Mountain Forest and Range Experiment Station

The Rocky Mountain Station is one of eight regional experiment stations, plus the Forest Products Laboratory and the Washington Office Staff, that make up the Forest Service research organization.

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Flagstaff, Arizona
Fort Collins, Colorado*
Laramie, Wyoming
Lincoln, Nebraska
Rapid City, South Dakota

*Station Headquarters: 240 W. Prospect Rd., Fort Collins, CO 80526