ESTIMATING THE BENEFITS OF INSTREAM FLOWS: CASE STUDIES FROM ARIZONA AND NEW MEXICO

by

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STATEMENT BY AUTHOR

This thesis has been submitted in partial fulfillment of requirements for an advanced degree at The University of Arizona.

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To my parents

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ABSTRACT

Water instream provides many benefits, including opportunities for water-based recreation and the preservation of riparian habitats. This thesis contributes to our understanding of the instream benefits of water by estimating the recreational benefits of streamflows at four sites in Arizona and New Mexico. Aggregate total and marginal benefits are computed, and the effect of higher flows on aggregate benefits is examined. The convergent validity of benefit transfer is also analyzed. The results show that the direct transfer of benefit estimates from one site to another site does not produce valid estimates even under relatively controlled conditions. The transfer of the benefit function is shown to yield valid estimates for the two Arizona sites, but not for the New Mexico sites. Possible explanations for this result are analyzed.

1. THE RESEARCH PROBLEM

1.1 Introduction

Rivers support a variety of natural resources and provide valuable services, including fish and wildlife habitat and the opportunity for various recreational activities. The quality and value of these resources depend on streamflow levels. Historically, western-state water laws have not considered the reservation of water for instream flows as a beneficial use. On the other hand, most communities welcomed new dams and water diversions as a source of income and economic growth (Sanders, Walsh and Loomis, 1990). As a consequence, water rights traditionally have been allocated to consumptive offstream uses without regard for the instream values of water. Today, reductions in flow levels threaten the ecology and recreational opportunities at many unique river systems. In Arizona, close to 90 percent of natural riparian habitat already have been lost to land development and consumptive water uses (Arizona Riparian Council, 1991).

Purchases of water rights specifically for recreational and environmental uses are occurring more frequently, and this is one indicator that concern about preserving stream flows and riparian areas is growing. However, due to the public goods character of instream flows, actual transactions do not reflect the full economic value of maintaining flow levels and habitat. While the value of water for traditional offstream uses is well-documented (Gibbons, 1986), this is not the case for the environmental and recreational values of water instream. This study adds to our understanding of the economic contributions of streamflows by estimating recreational values at four sites in the southwestern U.S. using the contingent valuation method (CVM).

The use of CVM is controversial, both within the economics profession and among policy makers, regulated industries and environmental interests. There is a lot of ongoing debate about the reliability of CVM estimates and the circumstances under which CVM should be used. In a recent article, Vatn and Bromley (1994) challenge the assumption that choices based on hypothetical benefit estimates are always superior to those made without explicit pricing, arguing that hypothetical valuation of environmental goods often fails to capture all the information pertinent to an environmental choice. However, the estimation of a public good's recreational values as held by resource users is an ideal setting for the use of CVM. In defining "reference operating conditions" for enhancing the accuracy of CVM estimates, Cummings, Brookshire and Schulze (1986) stress that respondents should be familiar with the resource being valued and should have experience with paying for this type of resource. Both conditions are satisfied in the present study of values held by recreation site users. Among the possible applications of CVM, the estimation of willingness to pay by resource users familiar with the commodity being valued is likely to produce relatively reliable estimates.

While previous studies have estimated the value of instream flows for specific sites in the western United States, these studies involve a variety of sites and site characteristics and often are hard to compare. The question arises whether benefit estimates obtained in a site-specific study can be used to estimate benefits of habitat preservation or streamflow enhancement at other sites. This question, often referred to as the "benefit transfer controversy", is being debated among academic and public agency economists interested in valuing natural amenities. While economists are understandably skeptical about benefit transfer procedures, public agencies are embracing the concept as a cost-saving means to value non-market amenities. Economists can assist in developing criteria for determining when benefit transfer is a valid approach.

This study estimates recreational values of streamflows and riparian habitat at four different sites in southern Arizona and northern New Mexico. Contingent valuation data for Ramsey Canyon Preserve and San Pedro Riparian National Conservation Area in Southern Arizona are used to estimate the total economic value of preserving a riparian habitat. For two reaches of the Rio Grande in northern New Mexico, contingent valuation data is used to estimate total and marginal values of instream flow for river-rafters. For three of the four sites, the proportion of total value assigned to nonuse values (i.e. values <u>not</u> associated with direct recreational use) is estimated, and motivations for nonuse values are examined. (It is important to keep in mind that these are nonuse values held by site users familiar with the commodity being valued, <u>not</u> nonuse values of persons who have never visited the particular site and are unfamiliar with it. The application of CVM to the latter situation is quite controversial (Cummings and Harrison, 1992). Implications of the results for water allocation and water management and for the benefit transfer debate are analyzed.

1.2 Economic Issues

Water instream is a public good. It is non-rival because, in the absence of congestion, many people can benefit from flows simultaneously since recreational activities are nonconsumptive. An exception is the case of recreational fisheries, where the fish catch (and the marginal cost per fish caught) of each recreationist may depend on the total number of anglers. Also, congestion can reduce the utility obtained from recreation. Instream water is also often non-exclusive where access to river systems is unrestricted. This leads to the opportunity for free-riding and the problems associated with an open-access resource. As a consequence, market transactions typically fail to indicate the full benefits associated with water instream. Entrance fees to streamside areas on public land are not based on demand and supply and do not indicate economic benefits accruing to visitors.

Moreover, many of the benefits of leaving water in a river are realized downstream, including additional recreation benefits as well as downstream opportunities for consumptive uses. In addition, nonuse values associated with the general preservation of rivers, riparian vegetation and habitats are likely to be substantial. As a consequence, a price based on a market transaction to acquire water for instream uses at a specific site is likely to be lower than the cumulative social value of the increased flows. To achieve the goal of an economically efficient (i.e. net benefit maximizing) allocation of water among alternative uses, it is necessary to estimate the full economic value of water used for maintaining streamflows.

Water instream does not produce tangible outputs in the way irrigation and other consumptive uses do. Therefore, non-market valuation methods are required. The two most commonly used methods are contingent valuation and the travel cost method. Hedonic valuation also can be applied to natural amenities. These three valuation approaches are discussed in section 2.1.

One characteristic of a public good is that individual marginal values must be summed to derive an aggregate marginal value. The estimated aggregate marginal value of water instream must be compared to the opportunity cost of diverting the water from a competing use to identify the allocation that is economically efficient. Economic efficiency is greatest when the marginal value of water is equated across all uses. This criterion for an economically optimal flow level stands in contrast with engineering, hydrological and biological concepts of "minimum flows" (e.g. for the survival of fish), which, historically, have dominated policy discussions about flow levels. Economists thus have the potential to provide information on marginal values that can lead to a more efficient allocation of water among competing users.

1.3 Policy Issues

Benefit-cost analysis can be of great assistance to policy makers in making decisions about the preservation of natural environments and water allocation among alternative uses. Without improved information on instream values, water policy decisions will continue to emphasize consumptive offstream uses of water with more easily documented values. Water policy decisions determine the legal protection available for streamflows as well as purchases of water rights for streams using public funds.

In the U.S., the demand for benefit-cost analyses related to instream flows has primarily come from three sources: (1) government agencies which are interested in the effects of water policies on the value of stream-dependent resources, (2) agencies whose actions fall under Executive Order 12291, which mandates that a benefit-cost analysis has to be conducted for all major regulations (Krupnick, 1993), and (3) citizen groups and environmental advocates, which conduct benefit-cost analyses to help them evaluate public policies and document needed improvements in water allocation and management.

Estimating benefits of preserving stream flows or other natural resources requires time and resources. It is not feasible for public agencies to conduct an original study for every site that may be affected by proposed regulations. Therefore, benefit transfer is viewed as desirable by public agencies facing fixed budgets and growing demands for economic valuation of nonmarket amenities. Do existing benefit estimates provide a credible basis for policy decisions involving sites other than the study site for which benefits were estimated? Many questions arise as to whether benefit estimates are transferable among sites and, if so, under which conditions. These questions are discussed in section 2.1.4.

1.4 Water Rights Transfers

Many studies, as reviewed in section 2.2, have shown that current water allocations among alternative uses are economically inefficient. To increase efficiency, water rights have to be transferred to uses with higher marginal values until marginal values are equalized across competing uses. A number of water rights transfers from consumptive offstream to non-consumptive instream uses have occurred in the western U.S. The role of voluntary and involuntary transfers to maintain instream flows and the institutional context in which these transfers occur is discussed in section 2.3.

1.5 Objectives of the Thesis

The objective of this thesis is to estimate the recreational value associated with two stream-dependent sites in southern Arizona (Ramsey Canyon Preserve and San Pedro National Conservation Area) and streamflows at two reaches of the Rio Grande in northern New Mexico (Taos Box and Lower Gorge). Benefit estimates are used to address the following four questions:

1. What are the aggregate total benefits generated by water-based recreation?

2. Do the total benefits of water instream behave in a way that is consistent with economic theory, increasing with flow level at a decreasing rate up to an optimal flow level, and then decreasing thereafter? (Northern New Mexico only)

3. Do nonuse values form a significant portion of the total WTP by resource users? (for

three sites)

4. Do the estimated benefit measures and bid functions provide useful information that can be transferred to estimate benefits at other sites? (Intra-regional comparison of the two sites within each region)

In addition, the following research questions are addressed briefly:

- Do survey respondents consider their household income and expenses in formulating their WTP statement? Is income level related to WTP? When asked to consider how they would reduce spending on other household expenses to make the contribution stated as their WTP, do they change their bid significantly? What other items in their household budget do respondents choose to reduce spending on in order to finance a given WTP bid?

- Which are the main motivations for positive nonuse values?

- Does the specific description (in the CV survey instrument) of the resource to be valued affect the outcome of the valuation exercise when the underlying resource condition (preservation of perennial stream flow) is held constant across survey instruments?

- How do the marginal benefits of leaving water instream compare to the marginal benefits of alternative irrigation uses?

1.6 Description of the Study Sites

This study focuses on four riparian areas in Southern Arizona and northern New Mexico. Ramsey Canyon Preserve in Southern Arizona is a relatively small canyon with riparian features dependent on the perennial flows of Ramsey Creek. It is southern Arizona's most prominent site for bird watching and is nationally recognized for its wide variety of hummingbirds. The Preserve is currently owned and managed by The Nature Conservancy. The San Pedro Riparian National Conservation Area (RNCA) is a river corridor which is managed by the Bureau of Land Management (BLM). It is one of the most extensive continuous stretches of riparian habitat remaining in the south-western desert. The San Pedro RNCA is nationally renowned as one of the best spots for bird watching due to the wide variety of bird species which can be found within the area. Streamflows of the San Pedro river are increasingly being threatened by increased water demand associated with rapid residential development in the Sierra Vista area in southern Arizona.

The two study sites in New Mexico are two subsequent stretches of the Rio Grande River: the Lower Taos Box and the Lower Gorge. Both provide excellent opportunities for white water rafting. The Lower Taos Box is a deep, majestic canyon. The Rio Grande here has strong rapids, providing for a medium to very difficult river running experience. The quality and safety of river running in the Taos Box is believed to be very sensitive to stream flow levels. The Lower Gorge is more tranquil and less spectacular. Rafting opportunities are of medium difficulty. Part of the Lower Gorge is the location of an annual white water race. Streamflows on both stretches of the Rio Grande are largely determined by agricultural water use in the San Luis Valley in southern Colorado and are subject to large fluctuations.

All four sites are dependent on streamflow levels. With riparian areas diminishing in the American Southwest, these sites not only provide rare opportunities for water-based recreational activities but they also may have high nonuse values. A detailed description of the four sites is presented in section 4.1. A description of economic and demographic characteristics of the study areas is given in Chapter 4.2. This section also describes some of the issues regarding water use and allocation in these areas.

1.7 Survey Design and Implementation

This thesis is based on data collected as part of several larger research projects under the direction of Dr. Bonnie G. Colby. The design of the individual surveys varies with the focus of the larger research project. Moreover, CVM questions were varied slightly within the same project to test for the effects of different survey designs.

Site visitors were personally contacted by researchers at all four sites in order to conduct a preliminary interview and to obtain visitor agreement to respond to a mail survey. Mail surveys were sent 1-2 weeks after visitor contact at the site. While the

Arizona surveys concentrated on bird watching and other shoreline recreational activities, the New Mexico surveys focused exclusively on commercial white water rafting. All surveys used contingent valuation questions to elicit the recreationists' willingness to pay for resource preservation or enhancement. While the Arizona surveys focused on the general preservation of a riparian habitat, the New Mexico surveys were aimed at estimating marginal benefits of water instream at various flow levels. Three of the surveys included questions on the proportion of nonuse values and motivations for nonuse values. Details on visitor contact, sampling and on the surveys are presented in section 4.3 and Appendix A.

1.8 Summary of Procedure, Model and Results

A theoretical model of the demand for outdoor recreation is formulated in Chapter 3. The model is used to illustrate the welfare measures elicited in this study. A theoretical interpretation of nonuse values also is given. Finally, the effects of increased flow levels on individual and aggregate participation in the recreational activity are addressed.

Section 4.4 and Appendices B and D show response rates (which were high for most of the survey types) and statistics on survey respondent characteristics, and summarize treatment of protest responses. Motivations for nonuse values are examined. The results indicate that nonuse values comprise a substantial portion of the total value held by resource users. Analysis of the effects of reminding respondents of their budget constraint indicate that respondents seem to be rational in their WTP statements. WTP bids are most commonly financed by a reduction in entertainment expenses and savings.

Bid functions are estimated for each site and CVM question. In addition, participation functions are estimated for rafting on the Taos Box and Lower Gorge of the Rio Grande. The regression results are used to compute aggregate total and marginal benefits associated with streamflows. The results are reported in chapter 5.1 and 5.2. The marginal value of flows on the Rio Grande under current conditions are relatively low but might very well exceed those of water use in the production of hays and irrigated pasture in some periods. The provision of higher flows through July and August would substantially raise the aggregate benefits from rafting.

The results of the benefit transfer analysis are reported in chapter 5.3. Direct transfer of the benefit estimate from one site to another was found to produce biased estimates. Benefit function transfer produces valid benefit estimates for the Arizona sites based on several different measures of "successful" benefit transfer. However, benefit function transfer performed poorly in estimating benefits associated with rafting on the Taos Box and Lower Gorge. Possible explanations for these results are analyzed.

In section 5.4, the present study is compared to guidelines for the design and implementation of CVM studies which were recently published by the National Oceanic and Atmospheric Administration. Chapter 6 summarizes the results of this thesis and its implications for policy analysis.

2. LITERATURE REVIEW

2.1 Theory of Nonmarket Resource Valuation

2.1.1 Overview of Existing Methods

The two most commonly used non-market methods for resource valuation are the travel cost method and the contingent valuation method. Both use surveys to estimate the willingness to pay (WTP) for a certain condition of the resource, e.g. for different flow levels in a river. The travel cost method (TCM) bases its WTP estimates on observable behavior, i.e. the travel costs of recreationists. Then, econometric methods are applied to derive a Marshallian demand function from which consumer surplus can be estimated. Primary problems of the TCM are the difficulty of measuring travel time costs and the inability to deal with multi-destination trips. Also a sufficient variation in travel costs is required to obtain a demand schedule. Moreover, the TCM can measure only use values.

While the TCM bases its estimates on observable behavior, the contingent valuation method (CVM) uses hypothetical markets, asking recreationists directly how much they would be willing to pay to maintain or achieve a certain environmental condition. The WTP estimates obtained represent a Hicksian welfare measure, i.e. compensating surplus for a favorable change and equivalent surplus for an unfavorable change. The CVM has been criticized for presenting incentives for strategic behavior and representing hypothetical rather than actual behavior. However, it is the only method currently available for the estimation of nonuse values. It can be used to estimate visitors' as well as the general public's WTP for a change in the provision of a public good.

A third method which can be used for the valuation of natural amenities is hedonic valuation. This approach is based on the assumption that the demand for a non-market environmental commodity can be inferred from prices of marketed goods. Specifically, it is assumed that the price of a marketed good can be expressed as a function of the good's characteristics. Using econometric procedures, this relationship can be estimated (implicit price function). A marginal implicit price function for a specific characteristic, e.g. environmental quality, is found by differentiating the price function with respect to the characteristic. Then, this relationship is combined with restrictions on the demand and supply of the characteristic to estimate a demand function for the characteristic. The demand function is used to estimate consumer surplus measures of welfare changes due to a change in the characteristic. While the hedonic valuation technique can theoretically be applied to the valuation of any use category, in practice it is most commonly used in property value studies. House and land values are assumed to be a function of an environmental characteristic such as air quality or proximity to a recreational site. Problems of the hedonic valuation method include the necessity for complete and detailed data on all relevant characteristics as well as sufficient data on market transactions, lack of knowledge about the functional form of the price function, and the unobservability of expectations influencing the price of market goods. Multicollinearity between quality variables and other characteristics such as income can also impose problems. A problem with applying the hedonic method to measuring the value of water quality characteristics like instream flows, lies in the seasonal variation in flow levels. Moreover, only a limited number of property buyers like experienced recreationists have sufficient knowledge about flow levels.

Since this study uses the contingent valuation method the following section provides a more detailed discussion of advantages, disadvantages and controversial issues regarding this method. In the following sections, the discussion about the economic valuation of non-use values as well as the benefit transfer debate are reviewed.

2.1.2 The Contingent Valuation Method

2.1.2.1 History of CVM

The CVM was first used by Davis (1963) to estimate recreational benefits in a Maine backwoods area (Mitchell and Carson, 1989). Since the early 1970's, the CVM has been used by economists to measure the benefits associated with a wide variety of non-market goods. An early influential study, noted for its theoretical rigor and its innovative survey design was that by Randall, Ives, and Eastman (1974) on the value of air visibility in the Four Corners area. In 1979, the Water Resources Council included the CVM as one of three recommended methods for the estimation of project benefits in its "Principles and Standards for Water and Related Land Resources Planning". In the mid 1970s, the U.S. Environmental Protection Agency funded a research program on the performance and theoretical foundation of the CVM. In 1983, the EPA appointed a review panel which included Nobel laureate Kenneth Arrow to conduct a state-of-the-art assessment of the CVM (Cummings, Brookshire and Schulze, 1986). The panel concluded that although the method is promising, some major challenges remain, including the development of a theoretical framework for the individual's behavior in contingent market settings.

The CVM has been continuously refined, and is widely used by public agencies and private researchers in measuring use and nonuse benefits of changes in natural resources. The CVM has also been increasingly used in litigation concerning damages from oil and hazardous material spills. Within this context, CVM estimates area used to define actual compensation payments. Since natural resource damages potentially affect a very large number of people, the accuracy of the value estimates is of particular importance which is why the CVM has come under increased scrutiny. Moreover, while CVM estimates of use values can at least be compared to value estimates obtained from other (indirect market-based) techniques, nonuse values cannot be validated externally. In 1992, the National Oceanic and Atmosperic Administration (NOAA), which is responsible for issuing regulations regarding the assessment of damages from oil spills, appointed a blue ribbon research panel, including several Nobel laureates, to conduct a thorough study on the reliability of the CVM in measuring nonuse values. The panel concluded that CVM studies can produce reliable estimates if the studies are thoroughly conducted (Arrow et al., 1993). The panel also listed a number of guidelines and expresses the opinion that any study which is to be used in natural resource damage assessments should follow these guidelines as closely as possible. Based on the panel's suggestions, NOAA issued a list of proposed rules for natural resource damaged assessment in January 1994 (National Oceanic and Atmospheric Administration, 1994).

2.1.2.2 Advantages of CVM

The main advantage of the CVM over other methods of non-market valuation is its flexibility. Since the CVM is not constrained to analyzing observed conditions, it can be used to predict impacts of policies without being limited by the current institutional context or levels of provision (Mitchell and Carson, 1989). It is also the only method currently available to measure option and nonuse values. Another important advantage of the CVM is that it estimates points on Hicksian compensated demand curves rather than ordinary Marshallian demand curves. The CVM thereby avoids the problem of potential bias resulting from the use of Marshallian rather than Hicksian welfare measures.

2.1.2.3 Willingness To Pay Versus Willingness To Accept Payment

The choice between WTP and WTA measures in CV studies is a question of property rights. In dealing with public goods where rights are held collectively, the property rights are often not clearly defined (Mitchell and Carson, 1989). CV field studies as well as laboratory experiments have consistently found WTA measures to be 2 to ten times larger than WTP measures. Willig (1976) showed that traditional welfare theory predicts that the Marshallian consumer surplus for price changes lay between WTP and WTA, and that the bound between WTP and WTA was relatively small for commodities in which expenditures make up a small share of income. Randall and Stoll (1980) extended Willig's results to quantity changes. However, the theoretical findings failed to explain the large empirical differences between WTP and WTA which continued to be found in CVM studies. CVM studies also found that WTA questions tended to produce substantially higher percentages of protest responses and infinitive values than WTP questions.

Hoehn and Randall (1983) argued that respondents who are uncertain, lack the time to optimize their decision, or are risk-averse, will tend to give lower WTP amounts and higher WTA amounts than they would if these conditions were alleviated. This theory seemed to be confirmed by laboratory experiments where respondents were allowed to become familiar with making WTP and WTA judgements. The experiments showed that WTA statements declined with market experience while WTP statements were fairly stable, and that by the time the actual transfer took place WTP and WTA bids were statistically similar.

An alternative explanation for the disparity between WTA and WTP measures is provided by prospect theory, which states that the value function is steeper for losses than for gains, thus representing a kink in the utility function (Kahneman and Tversky, 1974). Another explanation was provided by Hanemann (1991), who showed that WTP and WTA may differ substantially in a standard economic model of consumer choice when a public good is involved for which substitution possibilities are small.

Finally, Boyce et al. (forthcoming) developed a model which explains disparities between WTP and WTA in the following way: People state very high WTA values because, in accepting money, they would be accepting moral responsibility for a deterioration in the environmental amenity. On the other hand, WTP values are low because many people would feel that it is not their responsibility to pay for the destructive activities of others. Boyce et al. (forthcoming) conclude that "if this argument is correct, WTA measures intrinsic value while WTP only measures intrinsic value to the extent that consumers accept moral responsibility in a WTP context." Thus, WTA values might be the appropriate measure of use and nonuse values. In reviewing the above study, Schulze (1993, p. 221) draws the conclusion that "in a real world setting where preservation of a natural resource is at stake, large compensatory demands motivated by moral reasoning may be the appropriate measure of natural resource damage in that slightly smaller offers of compensation would actually be refused."

Since WTP is the more conservative measure, and is therefore more acceptable to policy makers, the WTP value is used in most CVM studies even when the property rights would suggest a WTA measure (i.e. for a quantity decrease).

2.1.2.4 Elicitation Methods

In using the CVM to obtain WTP values directly, researchers have to construct hypothetical markets that are meaningful to the respondents, but at the same time avoid the imposition of biases. In trying to elicit realistic WTP bids, researchers have used mainly the following three methods: bidding game, payment card, and dichotomous choice.

The bidding game is the oldest approach. Similar to an auction, the interviewer proposes an initial amount and then increases or decreases the bid iteratively, depending on whether the respondent states that she is willing to pay that amount or not. The advantage of this method is that it imitates a situation that the respondent is familiar with, i.e. the decision whether she is willing to pay a specific price or not. Moreover, the iterative procedure can help respondents to search their preferences thoroughly. However, the bidding game method cannot be used in mail surveys. Moreover, studies have shown that the starting point of the bidding game imposes a bias on the elicited WTP. Due to these problems, the bidding game has lost importance in current studies.

The payment card method consists of a single question asking the respondent for her WTP, combined with a visual aid showing an array of potential WTP amounts, ranging from $0 to some large amount (Mitchell and Carson, 1989). Respondents is asked to choose that amount on the card or indicate any other amount that represents the most she is willing to pay for the good being valued. The advantage of this approach is that it does not create a starting point bias but does elicit the maximum WTP. However, the ranges used on the payment card could potentially cause biases. Moreover, there might be strategic bias, e.g. the respondent could exaggerate his bid to promote a desired policy. The payment card method is also criticized for facing the respondent with the unfamiliar situation of finding his maximum WTP directly.

The dichotomous choice format, also referred to as referendum format or "take-it-or-leave-it approach", consists of asking the respondent if he is willing to pay a predetermined amount. The amount is taken from a range of values chosen to bracket the expected maximum WTP for most respondents, and is varied across respondents. The respondent either accepts or rejects the given price without any further iterations. The advantage of this approach is that it faces the respondent with the familiar choice of deciding whether to buy or not to buy at a given price. With respect to public goods the respondents' choice problem is equivalent to a public referendum on a proposed policy. The scenario of a plurality voting rule implied by the method causes an incentive for the respondent to answer truthfully. Like the payment card approach, the dichotomous choice format can be used in mail surveys. It can also be used in telephone surveys. However, the referendum method has several drawbacks. Since the method elicits a binary choice decision rather than the maximum WTP, interpreting the results requires the researcher to make assumptions about the specification of the valuation function or the indirect utility function to obtain a mean WTP. In order to achieve an acceptable level of statistical precision, the referendum method requires a much larger sample size than the other elicitation methods. Moreover, Mitchell and Carson (1989) point out that the referendum method may be subject to a "nonzero background level of yea-saying", which is similar to the starting point bias in bidding games. Despite these problems, the referendum method has gained wide popularity in current research, mainly due to its simplification of the respondents' valuation choice and the possibility to use the method in mail and telephone surveys (Mitchell and Carson, 1989).

2.1.2.5 Strategic Behavior

Strategic behavior exists when respondents intentionally misrepresent their preferences for the good being valued. Two forms of strategic behavior relevant for CVM studies are "free riding" and "overpledging". "Free riding" refers to the situation where respondents understate their true WTP in the belief that they will actually have to pay the stated amount and that the amenity is likely to be provided independently of their bid. "Overpledging" occurs when respondents overstate their true WTP because they believe that they will not have to pay the stated amount and that the provision of the good depends on their bid. Mitchell and Carson (1989) summarize theoretical and empirical evidence on the existence of strategic behavior in CVM studies. They conclude that motivations for strategic behavior are weak for most respondents in CV surveys due to several factors: high informational requirements for strategic behavior; low perceived likelihood of the effectiveness of "overpledging" due to large perceived sample sizes; choice of payment vehicles often evokes strong budget constraints, which makes it unlikely that people overstate their WTP; unlikeliness of "underpledging" due to the fact that the provision of the public good is uncertain in most CVM scenarios.

2.1.2.6 Meaningfulness of Hypothetical Data

One concern that many economists have about the CVM, is that the hypothetical framework might not provide incentives to respondents for providing accurate responses. Responses to hypothetical WTP questions could be rather careless and might not reflect the true preferences of respondents. One question raised by this concern is whether respondents' stated opinions are stable when elicited at successive points in time. Another issue is whether hypothetical WTP statements, even if they represent true preferences rather than random answers, are good predictions of actual behavior, i.e. would respondents really pay the stated amount if they were confronted with an actual market for the good being valued.

Numerous tests have examined these questions (see Mitchell and Carson, 1989, for a summary). These tests provide strong support for the ability of surveys to predict actual behavior (Mitchell and Carson, 1989). However, two recent experiments on nonuse values by Seip and Strand (1992) and Duffield and Patterson (1991) showed hypothetical WTP to be significantly higher than actual WTP. In their report to the NOAA, Arrow et al. (1993) express concern about the absence of a meaningful budget constraint in CVM studies. The panel states that if respondents were actually asked what other items in their household budget they would forgo in order to pay for their expressed WTP, they might revise their bid downward. The panel criticizes that few surveys have reminded respondents convincingly of their budget constraint. In three of the surveys used in our study, we examine the question whether respondents will change their WTP bid when reminded of their budget constraint.

2.1.2.7 Reliability and Validity of CVM Estimates

Because of the hypothetical nature of the CVM surveys, economists have been particularly concerned about the reliability and validity of CVM estimates. Smith (1993) summarizes the findings of evaluations of these issues. He lists six types of evaluations: (1) comparisons of indirect and CVM estimates; (2) comparisons of CVM estimates with results from constructed markets, in which commodities not usually sold were offered; (3) comparisons of CVM estimates for actual marketed commodities to the market demands; (4) test/retest comparisons of the stability of CVM estimates from the same sample over time; (5) laboratory experiments in which hypothetical and actual sales of amenities were undertaken; and (6) evaluation of the consistency of CVM estimates with the strong axioms of revealed preference theory. Smith (1992b, p. 9) finds that most evaluations "supported the CVM estimates as being 'comparable' in performance to the alternative approach providing the reference point".

In the following, the concepts of reliability and validity are analyzed in more detail.

a) Reliability

Reliability refers to the extent to which the variance of an estimate is due to random sources (Mitchell and Carson, 1989). The reliability of a mean WTP estimate is usually measured as the standard error of the mean. Confidence intervals can be calculated to give an indication of the reliability of the estimate. The variance of a mean WTP estimate consists of a deterministic and a random component. In CVM studies, the random error is likely to be influenced by the survey instrument (i.e. its concepts, wording, and method of presentation) and by sampling procedures.

Instrument bias can be examined using test-retest procedures, i.e. by repeating the same survey with the same sample at a later point in time and comparing the estimates. Sampling variance can be assessed by comparing estimates across several independent subsamples. Both methods are likely to be very costly for CVM studies. An alternative indicator of the reliability of CVM estimates is the R^2 obtained when regressing WTP on theoretically relevant variables. A high R^2 would be an indication that the WTP responses are not simply random responses (Mitchell and Carson, 1989).

The reliability of results obtained from a CVM study can be enhanced by using large sample sizes, testing for outliers, and using a CV scenario which is understandable, plausible, and meaningful to the respondent. However, adding realism to the hypothetical scenario may cause estimates to be biased due to an overload of information. Consequently, there might be a trade-off between reliability and validity. This problem of how much context to provide in describing the contingent valuation scenario has been a frequent subject of recent discussions. Careful pretesting of the survey instrument is recommended. Other factors that can reduce random errors in CV estimates are the inclusion of a "Don't know" option in the WTP questions and the separation of true zeros from protest bids.

b) Validity

Validity refers to the extent to which a method yields an unbiased estimate of the true value. Thus, while reliability is associated with random errors, validity is concerned with systematic errors. Assessing the validity of CVM estimates is difficult since most CVM studies estimate values of goods for which no market measure is available. Mitchell and Carson (1989) distinguish three types of validity: content validity, criterion validity, and construct validity.

Content validity refers to the degree to which a CVM estimate adequately reflects the structure of the market and the description of the amenity. Content validity can only be assessed through subjective judgements about the questionnaires on which CVM findings are based. Criteria for content validity include whether the description of the good is unambiguous and meaningful to the respondents, and whether the property rights and payment vehicle are plausible to the respondents.

Criterion validity involves the issue whether the CVM estimates are related to other measures which may be regarded as criteria, such as actual market prices. Unfortunately, suitable criteria are not always available, especially in dealing with the valuation of public goods. However, researchers have performed tests on the criterion validity of CVM estimates for quasi-public goods, from which people can be excluded, such as hunting permits.

Construct validity is concerned with two issues. The first issue is whether CVM estimates are correlated with alternative measures of the same theoretical construct ("convergent validity"). The second issue is whether CVM estimates are consistent with theory, e.g. the price-quantity and income-quantity relationships predicted by economic theory ("theoretical validity").

Numerous studies have tested for convergent validity by comparing CVM estimates to measures obtained by travel cost or hedonic pricing techniques. Two of these studies, related to water-based recreation, are summarized in section 2.2.1. Mitchell and Carson (1989) point out that the benefits measured by the CVM and the behavior-based methods are not exactly comparable, since the CVM produces ex-ante measures including nonuse values while, for example, the TCM yields ex-post measures and excludes nonuse values.

Theoretical validity is commonly measured by regressing the WTP estimates obtained from a CV study on specific variables, which theoretical models predict to be significant determinants of WTP. The size and sign of the coefficients are then compared to the theory. Another test for theoretical validity consists in comparing mean WTP estimates for different conditions, e.g. for different levels of provision of the public good, and to compare the findings to theoretical predictions regarding these relationships. In this study I will apply both of the above tests.

Numerous studies have presented positive evidence on theoretical validity of the CVM measures. However, some studies have obtained WTP estimates which seemed to be inconsistent with rational choice. An example of such a study is that by Kahneman and Knetsch (1992) in which the authors found what they call an "embedding effect", i.e. "the same good is assigned a lower value if WTP for it is inferred from WTP for a more inclusive good rather than if the particular good is evaluated on its own" (Kahneman and Knetsch, 1992, p. 58). The authors argued that respondents might be stating WTP values for "the purchase of moral satisfaction" rather than for the public good itself. In a comment on the article, Smith (1992b) argues that the findings of Kahneman and Knetsch are likely to be due to poor survey design and data analysis. Smith (1992b) believes that respondents did not fully understand what was being valued. Moreover, he shows that, in a situation where the commodities being offered were not described to respondents adequately, the findings can be explained by conventional economic theory. Mitchell and Carson (1989) also stress the importance of well specified descriptions of the amenity to avoid this kind of problems. Arrow et al. (1993) point out that it is important that respondents do not rely on heuristics in valuing the amenity offered, because they might answer a different question from that being asked. In their blue ribbon panel report to the NOAA, Arrow et al. (1993) recommend a high standard of richness in context to achieve a realistic background. The issue of context, however, can involve a tradeoff between biases due to lack of context and biases induced by context information, as mentioned earlier.

2.1.2.8 NOAA Recommendations on Contingent Valuation

Based on Arrow et al.'s (1993) evaluation of the CVM, the NOAA issued a set of proposed rules that should be followed in the design and implementation of CV surveys in order for CVM estimates to qualify as a source of reliable information (National Oceanic and Atmospheric Administration, 1994). It needs to be kept in mind, that the NOAA panel's analysis of the CVM was designed to evaluate the reliability and validity of CVM estimates of non-use values, particularly for natural resource damage assessments. NOAA's list of proposed rules is explicitly targeted at the estimation of compensable values for natural resource damage assessment. Since this study estimates total values for stream flows held by recreational users of the resource only, many of the concerns expressed by the NOAA panel are much less relevant for our study. Nevertheless, those of NOAA's proposed rules for an ideal CVM survey which are not clearly limited to natural resource damage assessment will be summarized below. In chapter 5.4. I will examine deviations of our study from these guidelines.

NOAA rules for CVM studies

1) During the development of the survey, it shall be determined whether respondents understood and found credible the description of the object of valuation.

2) Prior to the value elicitation, the natural resource context and substitutes shall be identified.

3) Respondents shall be reminded of their budget constraints and alternative expenditure possibilities. They shall be reminded that their WTP for the environmental program in question would reduce their expenditures on other goods. This reminder shall take place before and after the value elicitation. Respondents shall be given the opportunity to reconsider and change their bids.

4) The survey instrument shall use a credible choice mechanism and payment vehicle. The choice mechanism shall be incentive compatible. Follow-up questions shall be asked to determine whether the respondents accepted the choice mechanism and payment vehicle as credible.

5) The survey instrument or analysis method shall provide a mechanism for calibrating hypothetical WTP to actual WTP. If such a mechanism can not be provided, actual WTP shall be presumed to be one-half of stated WTP.

6) Survey development shall include adequate field testing to ensure that the above design criteria are met.

7) A probability sample shall be drawn from the target population for the administration of the final survey. The sample size shall be sufficient to draw statistically significant population inferences and to estimate WTP valuation functions or to test relevant

statistical hypotheses.

8) Nonresponse bias shall be minimized to the extent practicable by striving for as high a response rate in the final survey as possible, consistent with the requirements of reasonable cost. In no case shall the response rate be less than seventy percent.

9) The rationale for the selected mode of survey administration shall be documented. An experienced survey research organization shall be used to administer the survey.

10) If interviewers are used, the survey administration shall be conducted by trained interviewers who are supervised by experienced interviewer field managers.

11) Respondent confidentiality should be ensured.

12) Reports of CV studies shall discuss the relevant factors identified in the standards pertaining to survey instrument design and development, survey administration, and nature of results. A copy of the survey instrument shall be included.

2.1.3 Nonuse Values

Two slightly different versions of the distinction between use and nonuse values exist in the literature. The first goes back to Krutilla and Fisher (1975), and is used, for example, by Smith (1987). It draws the distinction between use and nonuse value based on whether in situ contact with the resource is involved. The second approach goes back at least to McConnell (1983) and is based on the concept of weak complementarity. According to this concept, use value includes all consumption that is linked through weak complementarity to market purchases. The two approaches differ with respect to "indirect" uses (e.g. reading about the resource, seeing films about the resource, etc.). While the first approach would consider indirect uses to be nonuse values, the concept of weak complementarity would consider them as use values.

Much attention has been given to the motivations for holding nonuse values. A problem in the literature on nonuse values is the lack of agreement with respect to the terminology used to describe these motivations. The following terminology is based on Mitchell and Carson (1989). They define nonuse values (or existence values) as values which respondents would still hold if their own use was constrained to be zero. Ignoring indirect use values, nonuse values include vicarious consumption values and stewardship values. Vicarious consumption values are motivated by benefitting from knowing that others can enjoy the resource. Stewardship values include bequest and inherent values. Bequest values are related to the desire of preserving a resource for future generations. On the other hand, inherent values exist when respondents gain utility from simply knowing that the resource is preserved regardless of whether it will ever be used by anyone. In addition to nonuse and recreational use values, total value also includes option value which is basically a risk premium associated with the uncertainty about future use.

Two important advances on the issue of option value were recently made through Graham's "net benefit function" (1992) and Ready's concept of "maximum agreeable payment" (1993).

Some economists (e.g. Brookshire, Eubanks and Sorg (1986)) have argued that existence values, although they might represent real WTP, should not be included in economic analysis because they may reflect ethical considerations other than the efficiency ethic underlying benefit-cost analysis, which could lead to "counter-preferential choices" (HBRS, Inc., 1991). However, as HBRS, Inc. point out, this runs contrary to the concept of revealed preference.

Another criticism of including nonuse values in benefit-cost analysis is called "the adding-up effect". It refers to the observation that WTP bids for several proposed policies obtained from separate CV studies cannot be added up in order to obtain a WTP estimate for a combination of these policies. Thus, the results of separate CV studies might overstate the benefits of a proposed policy if the policy would be introduced in combination with other policies. This problem is not unique to nonuse values, but is inherent to valuation in general. Economists always analyze parametric changes under the "ceteris paribus" condition. It would be theoretically incorrect to add up several values which were calculated in isolation (HBRS, Inc., 1991). HBRS, Inc., point out that the problem is less severe when dealing with irreversible impacts on relatively unique resources.

2.1.4 Benefit Transfer

2.1.4.1 "Demand" for Benefit Transfer

Boyle and Bergstrom (1992) define "benefit transfer" as "the transfer of existing estimates of nonmarket values to a new study which is different from the study for which the values were originally estimated" (p. 651). The site for which the original estimates were obtained is often referred to as the "study site" while the site under consideration for a new policy is termed the "policy site" (Desvousges, Naughton and Parsons, 1992).

In general, although benefit transfers have been the practice in political decisionmaking processes in many public agencies, the scientific debate is a relatively new one and many issues remain open. Critics argue that it is impossible to obtain meaningful, defensible estimates by benefit transfer. However, several forces are causing benefit transfer to become increasingly widespread practice: (1) the high demand for benefit estimates caused by Executive Order 12291; (2) the high cost of primary studies; (3) the lead time required for primary studies; (4) future increase in the demand for benefit estimates by local and state governments; and (5) an increase in the demand for valuation research by developing countries (McConnell, 1992, and Desvousges, Naughton and Parsons, 1992). The U.S. Environmental Protection Agency (EPA), National Oceanic and Atmospheric Administration (NOAA), and the U.S. Forest Service (USFS) are researching data and protocols for benefits transfer. Boyle and Bergstrom (1992) suggest that to argue that benefit transfer is impossible is to deny the role of research in providing improved knowledge for policy decisions.

2.1.4.2 Concerns and Propositions

Brookshire and Neill (1992) point out that the accuracy of any benefit transfer is limited by the quality of the original benefit estimates used in the transfer. Therefore, all concerns about the accuracy of the various nonmarket valuation techniques also apply to the process of benefit transfers. Smith and Kaoru (1990) use metaanalysis to demonstrate how benefit estimates depend upon modeling assumptions.

Smith (1992a) demonstrates that benefit transfers for similar valuation objects can lead to different conclusions due to judgments made on parameters that are exogenous to the specific economic analyses. His paper represents a strong argument for establishing a systematic protocol for benefit transfer applications to reduce the extent of arbitrary judgments left to the researcher. One of the studies examined by Smith (1992a) is a study on water pollution controls for the pulp and paper industries by Desvouges, Naughton and Parsons (1992). In conducting a benefit transfer analysis they encountered the following problems: an undefined market size for water quality improvements, differences in quality ranges, different relationships among site characteristics and improvement values, absence of "usable estimates for substitute prices", and different types of benefits such as use and nonuse values (Brookshire and Neill, 1992).

Deck and Chestnut (1992) state that a main difficulty in transferring benefit estimates of recreation values lies in accounting for regional factors (such as the range and quality of substitute sites) and site-specific factors (such as congestion). The determination of the "spatial extent of the market", i.e. the size of the population that would be or is affected by a recreation quality or quantity change, is another problem. Smith (1992a) stated that uncertainty about the extent of the market may in fact have a greater impact on the results of a benefit transfer than the uncertainty in the average WTP per household. Krupnick (1993) pointed out that the problem of determining the extent of the market becomes even more difficult when admitting nonuse values into the benefit transfer exercise.

To address the problem of differences in regional, site-specific and population factors, most authors agree that the transfer of demand functions (TCM) or value functions (CVM) should be preferred over the direct transfer of average unit values (such as average benefits per visitor day). Using the coefficient estimates from study site demand equations provides a way of accounting for site characteristics in determining the benefit estimate for the policy site. According to Loomis (1992), the bulk of benefit transfer efforts have <u>not</u> involved transferring demand functions or WTP equations. This study demonstrates the transfer of bid functions (see section 5.3).

Deck and Chestnut note that transferring functions increases the difficulty of benefit transfer procedures since data must be collected for the policy site on those variables found by the original study to affect WTP.

Opaluch and Mazzotta (1992) point out that each source of variation between benefit measures at different sites is composed of identifiable components and random (nonidentifiable) components. If the distribution of random components differs across the two sites, benefit estimates from the study site are likely to misrepresent the true policy site value, even when differences in the identifiable components are corrected for. A similar problem arises if the contribution of "identifiable" factors is different at the two sites, e.g. due to cultural or weather differences. The authors conclude that "for benefit measures to be suitable for transfer, unexplained variation must be limited to an 'acceptable' level". In consequence, they stress the importance of acceptable explanatory power of the demand or WTP equation, usually measured as the equation's R^2, in addition to the usual focus on the significance of the explanatory variables.

Deck and Chestnut (1992) point out that existing transfers often use socioeconomic variables for adjustment of the original benefit estimate to the policy site. However, these variables often have low explanatory power, indicating that they are not good calibrating variables for benefit transfer. The authors conclude that researchers have to focus on finding and including variables that better explain variations in preferences. Those variables could include attitude statements about the importance of an activity or the experience level of participants. However, data on these variables is usually not as easily available as data on socioeconomic characteristics. Therefore, it might be necessary to conduct a small survey for the policy site, consisting of the same series of attitude/experience questions asked in the original study. Such a survey could, however, void part of the potential cost and time savings that were intended by using benefit transfer. Alternatively, researchers could try to minimize differences between the sites, which will tend to minimize unknown sources of variation.

Acknowledging that benefit transfer will increase the degree of uncertainty involved in benefit estimates, several authors point out that the degree of accuracy required from a benefit estimate depends on the institutional context and the intended use of the value (Brookshire, 1992; Deck and Chestnut, 1992). The question whether benefit transfer is adequate therefore involves considering the role of benefit analysis in the decision-making process, i.e. the value of additional information compared to its cost.

Benefit transfer generally requires conducting a thorough literature search to identify appropriate study sites. Desvouges, Naughton and Parsons (1992) proposed five criteria to select among original studies to be used for benefit transfer:

1) An original study has to be scientifically defensible. That includes adequate data collection, sound economic method, correct empirical technique, and careful reporting of results.

2) The object of valuation at the study site(s) should be similar to that at the policy site.

3) The original study should contain regression results that describe WTP as a function of socioeconomic characteristics and of site characteristics.

4) The study site(s) and the policy site should have similar populations. Preferences of households differ not only with socioeconomic characteristics but also by region.

5) In absence of usable information on own and substitute implicit prices from the study site(s), the markets for both sites should be similar.

Another criterion mentioned by Boyle and Bergstrom (1992) is that the assignment of property rights at both sites must lead to the same theoretically appropriate welfare measure.

2.1.4.3 Suggestions for Future Research

Several authors suggest a research agenda to identify conditions under which defensible benefit transfer estimates can be derived. One line of research that was proposed by several authors is the concurrent estimation of nonmarket values at the study and policy site using primary data collected at both sites and the comparison of the site-specific benefit estimates with those derived from benefit transfer (Boyle and Bergstrom, 1992; Desvouges, Naughton and Parsons, 1992; Opaluch and Mazzotta, 1992). If the values can be shown to be not statistically different, convergent validity would be established. On the other hand, if the estimates obtained by benefit transfer are biased, researchers need to examine the size of the bias, the direction of the bias and possibilities to adjust the study site estimates to mitigate bias. Thereby, researchers could identify conditions where benefit transfer works and procedures required to make benefit transfer operational (Boyle and Bergstrom, 1992). Two studies have followed this line of research.

Loomis (1992) tested the performance of TCM demand equation transfer for recreational fishing in Oregon, Washington and Idaho. He estimated identically specified multi-site TCM demand equations and then compared how statistically similar were the coefficients, thereby testing the cross-state transferability of demand equations. In addition, he uses the demand equation obtained from n-1 Oregon rivers to predict benefits at the nth river, thereby determining the percentage error associated with within-state benefit transfers. The author's results lead to rejection of the equality of demand coefficients across states. Benefit transfers to rivers within the state of Oregon are shown to be accurate to within 5-15 percent. Loomis (1992) also compares the performance of demand equation transfer to the technique of simply using the average benefits per trip as an indicator of benefits for the unstudied site and showed that the error margins are much higher for the latter practice in most cases. As stated by the author himself, problems of his study were that the data sets originated from different dates and that the data was collected for purposes other than demand estimation, resulting in a relatively simple demand specification and one limited by the weaker of the data sets. This might be part of the explanation why the coefficients of the demand equations differ across the states.

Downing and Ozuna (1994) test the reliability of the transfer of value functions ("benefit function transfer") using dichotomous choice CVM data collected from anglers surveyed across eight contiguous Texas Gulf Coast by regions over three distinct time periods. The authors analyze the reliability of benefit transfer across time, within and across bays in a total of 128 regressions. They found that the equality of the regression coefficients for study site and policy site could not be rejected in many cases. However, when testing the statistical equality of the welfare measures using 95 per cent confidence intervals, the authors found that the welfare measures were statistically different in about 90 per cent of the cases. They conclude that benefit function transfer is not a reliable approach for the case at hand. Moreover, they stress that testing the equality of regression coefficients is not sufficient to ensure the reliability of benefit function transfer, probably due to the nonlinearity of the logit model used to estimate benefit functions and nonlinearity of the benefit estimates themselves. While a strength of Downing and Ozuna's (1994) study is the large number of benefit transfers evaluated, they do include only the bid amounts as explanatory variables in the logit regressions, i.e. they do not account for any differences in socioeconomic or other variables.

Opaluch and Mazzotta (1992) stress the importance of additional studies of this nature in providing a broader basis for evaluating the adequacy of benefit transfers and formulating standards for acceptability in different contexts. This study includes two such evaluations of benefit transfer.

A second line of research suggested by various authors was to examine original value estimates based on primary data to identify which variables significantly affect the benefit estimates and to determine the magnitude and direction of these effects. As Deck and Chestnut (1992) formulate it: "As we gain a better understanding of the effects that variations in our techniques have on benefit estimates for a single situation and on the differences identical techniques produce when used in different situations, we will improve our ability to use benefit transfer techniques and understand the associated uncertainties."

Smith and Kaoru (1990) proposed the use of metaanalysis in tackling this task. "Metaanalysis uses statistical methods to summarize empirical findings in different studies and treats the results from separate empirical evaluations using a common methodological framework and a comparable class of resources as if they were realizations from a more general model." (Smith, 1992a, p. 692). This procedure allows to evaluate the influence of modeling assumptions, site and regional characteristics and the features of the samples used on the benefit estimates obtained in existing studies. It can also provide a plausibility check on the results derived from equation transfers. Smith and Kaoru (1990) focus mainly on showing the impact of methodological choices on value estimates.

Walsh et al. (1992) applied metaanalysis to explain the variation in benefit estimates from TCM and CVM outdoor recreation demand studies from 1968 to 1988. They also give ranges of benefit estimates per recreation day for the various recreational activities (e.g. $17.6-79.75 for nonmotorized boating and $17.7-26.7 for nonconsumptive fish and wildlife). Values represent use values only. The authors go a step further than Smith and Kaoru (1990) by saying that the results from metaanalysis can be used to estimate benefits for a policy site by inserting appropriate values of explanatory variables into the model fitted to data from other study sites. Significant explanatory variables in their analysis included the choice of nonmarket valuation method, substitution, site quality, administration of the site, recreation activity, and regional location.

Brookshire (1992) suggested that future research should also test whether preferences are stable over time, i.e. whether the values from the study site are robust over time if the underlying site characteristics have not changed. He suggests that this could be tested by replicating some of the earlier applications of nonmarket valuation methods. He also recommends testing for interaction effects between the independent variables at study sites. He points out that the more significant the interaction effects the more similar the settings would have to be for a defensible application of benefits transfer.

Several authors point out that original studies and the reporting of their results should reflect their future use as data for benefit transfer. Studies should include mean values for all independent variables and the complete demand or value equations. In designing original studies researchers should also focus more on site-specific, regional, and person-specific variables that might influence benefit estimates and should use functional forms or interactive terms that permit examining confounding factors on marginal valuation (Deck and Chestnut, 1992).

Another issue stressed by many authors is the availability and accessibility of original studies. Brookshire (1992) states that the base of studies that can be used for benefit transfer is quite thin, especially for CVM applications. The reason for this may lie in the existing incentive structure to publish and obtain research funds. Replication of original results usually is not viewed as productive research by journal editors and reviewers and is not rewarded by the profession. In order to extend the base of available studies, which is critical to the improvement of benefit transfer practices, a change in this incentive structure is needed.

Furthermore, many authors request better access to original studies and data. They suggest that journal editors should require that data is included on disks for each article, and that protocols should be established for indicating where reports and other unpublished materials can be obtained. David (1992) proposed the organization of data on economic benefits in an Information System for Complex Data which links authors of original studies to users of their estimates and data.

2.2 Empirical Studies on the Value of Water Instream

2.2.1 Water-based Recreation

Most studies on the economic value of instream flows have focused on recreational use values. Recreational uses include water-dependent activities, such as boating and fishing, as well as water-enhanced activities, such as hiking and picnicking (Brown, Taylor and Shelby, 1992). In general, the marginal value of water left instream for recreational uses depends on the average individual WTP and on participation rates. Both of these components depend on the quality of the recreational experience, which in turn is a function of instream flows. Effects of flow levels on recreational quality can be both concurrent and lagged. Examples of concurrent effects are the direct impact of flow level on water-based recreational activities as well as the impact of flow level on the aesthetics of the site. Lagged effects are effects of past streamflows on current fish stock and streamside vegetation. The value of water instream also will depend on how many different water-dependent recreational activities are available at a particular site. The values obtained for various activities are additive where congestion is not considered a problem.

Several studies have attempted to estimate the marginal value of instream water for various recreational uses. A summary of some representative studies is given in Table 1. Nearly all studies indicate that the value of flow reaches a peak and then decreases as flow level increases. Usually, flow level yields diminishing marginal values. The flow level at which marginal recreation values become negative differs among activities. For example, rafters prefer a higher flow level than anglers.

The marginal value estimates obtained in the studies vary from less than $1 to $130 per acre-foot of water. Generally, values were higher on more heavily used rivers and on smaller rivers where an acre-foot of water would have a great relative impact Brown, 1991). The timing of the availability of the water has also been shown to be of importance since recreational activities are often highly seasonal. Moreover, conditions unique to the arid western U.S. can yield substantially higher values for rivers in this region. In many cases, marginal values of instream flows were found to be higher than those for alternative uses, specifically irrigation, especially when flow levels were relatively low. In general, the techniques used in estimating the value of instream flows have improved over time.

Daubert and Young (1981) did an early study on this topic for the Cache la Poudre River in northern Colorado. Willingness to pay estimates were obtained using a version of the contingent valuation method. The authors estimated separate benefit functions for fishing, shoreline recreation and white-water recreation, assuming the absence of congestion. While this study examined changes in the average individual WTP as flow levels change, the estimated marginal values of instream flows were conservative because they did not adjust for increases in participation with improved flow. They also did not consider congestion effects.

Narayanan (1986) estimated the marginal value of instream flow at the Blacksmith Fork River in Northern Utah. In contrast with Daubert and Young (1981), his estimates are based solely on the changes in use days of current visitors (Loomis, 1987a). He used the zonal form of the travel cost method combined with a contingent valuation question asking at what percentage of current stream flow respondents would cease to visit the site. First, the author estimated the relationship between flow levels and visitation rates using a logistic model. Second, a travel cost equation is estimated for a given flow level. Finally, both equations were combined to derive the recreation demand schedule. The estimated marginal values were very small. The main problem with this procedure is that it assumed that flow levels only affect the participation and not the average WTP per trip. This is a very strict and rather unrealistic assumption. Moreover, the estimated relationship between participation and changes in flow level was based on hypothetical rather than observed behavior, yielding a potential source of estimation error.

Ward (1987) applied a travel cost model to estimate the instream use benefits for fishing and white-water boating on Rio Chama, New Mexico. He estimated benefit functions at several minimum streamflow levels. Results then were used to construct a benefits function associated with upstream reservoir releases which increase natural streamflows. From this benefits function an optimal-control model was formulated to obtain the optimal timing of reservoir releases. The author stressed the small proportion (2-5 percent) of water used for recreation which is "consumed" through evaporation. This yields a very high recreational value per unit of water consumed. The approach used in this study is based on the assumption that visitors are able to predict flow levels ahead of time. While this might be the case for the study river, the method would be inappropriate where river flows are unpredictable or typical visitors lack the required knowledge. Moreover, with respect to fishing, the method used by Ward (1987), (similar to that used by Daubert and Young (1981)), provides the visitor with information on potential, not actual, catch rates under alternative flow levels. Both studies assume that benefits from fishing occur concurrently with streamflow, thereby ignoring lagged effects.

Johnson and Adams (1988), in contrast, acknowledged the dynamic nature of streamflow-fishery production in their study on the marginal value of water for the production of steelhead trout in the John Day River of Oregon. They estimated the relationship between streamflow and fishery productivity and combined the result with a CVM approach to valuing incremental changes in the quality of the recreational fishery. Contrary to the other studies, Johnson and Adams (1988) also accounted for recreational benefits from fishing at locations downstream. Similar to Ward (1987), they estimated the value of water to increase up to 10 times when considering the proportion consumed. The weakness of their estimate lies in the fact that it considers only one fish species and no other recreational activities.

Loomis and Cooper (1990) provided another approach for using actual fish catch data to estimate how demand shifts with changes in instream flow. The authors estimated the demand for trout fishing along the North Fork of the Feather River in Northern California. They used a Two Stage Least Squares regression to estimate a system of two simultaneous equations. The first equation represented the demand for trips obtained through a zonal TCM analysis while the second was a quasi-supply equation for fish catch. The two-equation system allowed the authors to directly relate WTP to different flow levels. Unfortunately, they expressed their results in dollars per cfs rather than dollars per acrefoot, which makes it difficult to compare their results to those of the other studies. The marginal values per cfs varied from $45 to $73 depending on flow level. Weaknesses of this study are the same as for Johnson and Adams (1988). Loomis and Cooper (1990) also pointed out that their approach did not measure the additional value to anglers of improved river aesthetics.

In a study commissioned by the U.S. Department of the Interior as a part of the Glen Canyon Environmental Studies, Bishop et al. (1988) used the CVM to measure the effect of alternative flow levels for whitewater rafters and anglers on the Colorado river downstream of Glen Canyon Dam. The dichotomous choice format was used to elicit surplus measures for actual as well as hypothetical flow scenarios. Hypothetical scenarios included constant flow and fluctuating flow scenarios. All scenarios were described in terms of effects on the flow sensitive attributes of the recreation activity. The results show that fluctuations in flows, which occur when peaking hydropower is generated, reduce the recreational values for both activities at most flow levels. The authors found the values for actual trips and hypothetical scenarios to be reasonably consistent. However, WTP estimates based on hypothetical scenarios consistently fell below those based on actual trips for the same flow conditions. Unfortunately, the authors did not attempt to analyze possible reasons for these differences. The estimates for actual trip values at low flow levels are based on rather small sample sizes. Flow levels were shown to have significant effects on both recreational activities. The consumer surplus per fishing trip were shown to increase with flow level from $60 per trip ($24 per day) at 3000 cfs up to a value of $126 per trip ($50 per day) at 10,000 cfs and to decrease at higher flows. Whitewater boaters received a maximum consumer surplus ranging from $233 per trip ($30 per day) at 5000 cfs to $900 per trip (115 per day) at approximately 29,000 cfs.

Participation was assumed to be independent of flow levels, which appeared realistic in this case since the number of whitewater boaters on the river is strictly regulated and surveys indicated that anglers do not consider flow levels in their decision whether or not to make a trip. The study did not attempt to measure downstream and lagged effects which are likely to be large.

Ward (1989) made an interesting innovation in his TCM study of four water-based recreation sites located in New Mexico's Pecos River Basin. He focused on the fact that the arid West imposes unique conditions for measuring recreation benefits. First, wide open spaces in the West result in long travel distances. This enhances the importance of defensible methods to measure the cost of travel time. The author used an approach which assessed willingness to trade off monetary travel cost to save travel time, rather than the usual approach of multiplying travel time by a portion of the hourly wage rate. Second, sites suitable for water-based recreation are usually scarce in the arid West which leads to large substitution effects. This increases the potential benefits lost by draining a site. A third condition typical in much of the arid West are low income levels. The combination of this factor with the long travel distances can cause visitors to reduce discretionary travel costs as a result of increased distances, i. e. discretionary travel costs become endogenous to the model. Ward (1989) extended the TCM to account for all three of the above mentioned conditions and compared the results to a conventional TCM approach. He demonstrated that conventional estimates are 40 to 60 percent lower than estimates from the extended model. A weakness of his study is the fact that he examined the effect of consecutive total drainage of the four lakes rather than marginal changes in flow levels. This led to estimates which represented average values rather than marginal values and which did not consider variations in participation.

Hansen and Hallam (1991) focused on the fact that most studies concentrated on a river segment or a drainage basin, thereby neglecting the downstream benefits of water left instream. The authors developed a national hydrologic model which linked changes in streamflow levels at points upstream to the availability of fishery resources downstream. In addition, they used the household production function approach to estimate individual fishing behavior of recreationists. Then, they combined both models with prior estimates of average consumer surplus for a day of fishing to value marginal changes in streamflow levels. The values obtained vary across regions due to variations in both the day responses and the fishing day values (Hansen and Hallam, 1991) and are most significant in the southwestern states. The latter observation seems to support the result of Ward (1989). The authors showed that downstream effects represented more than 50 percent of the value of water for recreational fishing in many upstream areas. As a consequence, studies which focus on the recreational value of water within a local area can lead to a significant underestimation of the actual value. However, Hansen and Hallam 1991) did not consider other non-consumptive uses of the water.

Duffield, Neher and Brown (1992) developed a comprehensive multi-period framework for estimating the recreational value of instream flows which included effects of streamflow on participation and the average individual WTP, as well as lagged effects and congestion. The authors applied a simplified single-period version of this general model without lagged effects to Montana's Big Hole and Bitterroot rivers. The value of a recreation trip was estimated using a dichotomous contingent valuation survey of visitors. The authors used experienced rather than hypothetical flow levels as a covariate in the logistic regression. Variables to measure congestion effects were found to be insignificant. Participation was modeled as a polynomial in the flow level which allowed for decreasing use as flow levels reach very high levels. The number of individuals sampled per day were used as a proxy for daily use levels. This leads to an underestimation of participation on the Big Hole at higher flow levels. Recreation values of instream flows were found to be higher for nonresidents than for residents. The effect of flow on average WTP accounted for over two-thirds of the total marginal value on the Bitterroot, with the participation effect comprising the remainder. On the Big Hole both effects were approximately equal. Another improvement in this study compared to others were the estimation of standard errors for the different estimates. Furthermore, the authors compared the estimates obtained from their model to those obtained by simplifying the model. Simplifications consisted in holding either WTP per day or participation constant, similar to the models used by Narayanan (1986) and Daubert and Young (1981) respectively. Duffield, Neher and Brown (1992) demonstrated that both simplifications led to lower estimates. The authors also estimated downstream effects of increased flow levels by assuming equal participation and valuation relationships for the other sections of the rivers. A remaining weakness of their study is that lagged effects could not be estimated, which also led to conservative estimates.

While all of the above studies exploited the indirect link between the demand functions and the utility function, Loomis and Creel (1992) estimated an individual's utility function directly. They used a Site Selection Model linked with a travel cost model to examine the recreational use value of water for fishing, waterfowl hunting and wildlife viewing at rivers in the San Joaquin Valley. The Site Selection Model was used to calculate benefits per visitor for varying streamflow levels. An "inclusive value" which was closely related to the expected utility of a trip was calculated and entered into the Trip Frequency Model (TCM) to predict visitation levels. In this procedure, water quantity is not only a proxy for fishing and hunting success but also for the overall aesthetics of the river. The authors calculated average values rather than marginal values for a rather arbitrarily chosen quantity of reservoir release. The estimated values vary with the timing pattern of the flow releases. The authors did not consider additional downstream benefits, which are likely to be substantial.

Two studies compared estimates obtained by the TCM and the CVM. Sanders, Walsh and McKean (1991) analyzed the consistency of two TCM estimates and two CVM estimates of recreational use benefits on sections of eleven rivers in the Colorado Rocky Mountains. The first CVM approach used a hypothetical increase in direct travel costs to estimate the consumer surplus of an individual trip. The second CVM estimate was obtained by disaggregating an annual total value estimate obtained by asking respondents how much they would be willing to pay into a special fund for protecting the study rivers. Next, the authors compared travel cost functions with and without adjustment for the probability of participation. The probability of participation was estimated using a logit binomial choice model. Sanders, Walsh and McKean (1991) also included estimated fixed and variable costs that enter long-run decisions to participate, which substantially raises the TCM estimates. The four estimates obtained by the authors were in the range of 21 to 24 dollars per visitor day. Unfortunately the values could not be related to specific quantities of water or flow levels. The authors showed that the four estimates obtained were not statistically different.

Crandall, Colby and Rait (1992) compared TCM and CVM estimates in a study about the Hassayampa River Preserve in south-central Arizona. The zonal TCM was used to obtain an estimate of $97 per visitor. Using a CVM, the authors asked how much visitors were willing to pay to restore a site with intermittent streamflow to one with perennial streamflow like the Hassayampa River Preserve. The estimated average individual WTP was $65. Assuming that the TCM and CVM measures were comparable, the authors concluded that a streamflow reduction from perennial to intermittent flow at a riparian site could result in a potentially significant loss of consumer surplus, in this case amounting to over 80 percent. The assumption that both measures are comparable is somewhat questionable since the scope of the study did not allow the authors to disaggregate the CVM estimate into use and nonuse values. As I will show in this study, nonuse values can comprise a high proportion of the total value indicated by resource users. This study also did not relate the estimates to specific quantities of water.

In summary, the review of studies estimating the value of instream water for recreational activities demonstrates that weaknesses of earlier studies have been identified and improved over time. The estimation of simultaneous effects of streamflow on participation and average individual WTP is an important improvement, since focusing on only one of the effects leads to conservative estimates. The inclusion of downstream benefits is another important issue, which can be quite complicated to consider in detail.

The estimation of the effect of flow levels on fishery production has proven useful to improve estimates of the marginal value of instream flows because it reduces the risk of error compared to the use of potential catch rates. However, while this is an improvement of estimates for fishery and could possibly be applied in a varied form for hunting activities, it is of no relevance for other recreational uses. Another deficiency of this approach and most of the other fishery studies is that they do not consider benefits to anglers other than fish catch (e. g. aesthetic improvements). The Site Selection Model introduced by Loomis and Creel (1992) seems to be a promising approach in that regard.

The approach of measuring experienced rather than hypothetical flow levels also reduces the risk of error and has the advantage of being applicable to all uses. However, this approach requires that flow levels show sufficient variation over the study period. In combination with the TCM, this approach also requires that recreationists have unbiased expectations of flow levels.

When using the TCM, inclusion of estimated fixed and variable costs which enter long-run decisions to participate should be considered. Moreover, the consideration of conditions unique to the study region can be essential.

Many studies focused only on selected recreational activities instead of all possible activities, on-site and downstream, thereby underestimating the real value of instream water. Most studies also did not consider congestion effects. Furthermore, all studies are based on single-period models, ignoring future benefits of leaving water instream.

The fact that recreational activities "consume" only a very small proportion of the water used is important since it means that recreational use does not exclude the possibility of consumptive uses further downstream. The calculation of a value per unit of water that is actually consumed is a way to consider this. However, downstream benefits of leaving the water instream then cannot be added, and the values for alternative uses would have to be computed in the same manner.

The review of studies on recreational use values demonstrates that the obtained estimates exceed the opportunity cost of giving up alternative uses in many cases. This shows a potential possibility for policy-makers to increase economic efficiency by reallocating water to instream uses. This is even more the case when we consider that all of the estimates obtained in these studies are conservative since none of the studies has considered all aspects at once. A major problem of all of the above studies is that they focus on recreational use values only, thereby ignoring any nonuse values. WTP bids obtained through CVM questions were assumed to represent pure use values. This assumption as well as the focus on resource users and the application of the TCM appear questionable where nonuse values are likely to be substantial. As shown in the following section of this paper, this is often the case.

TABLE 2.1, Summary of Studies on Instream Flow Values

Author (Date)	River, State	Method	Recreational Activity	Aggregate marginal value of flow		Alternative use ($/AF)
				$/acre-foot	Flow level	
Daubert & Young (1981)	Cache La Poudre, Colorado	CVM, constant visitation	Fishing Shoreline White-water	12 8 5	Low flow (100 cfs)	Irrigation: 7.25
Narayanan (1986)	Blacksmith Fork, Utah	zonal TCM + hypothetical visitation rates	camping, hiking, fishing	0.9	Low flow (80 cfs)	NA
Ward (1987)	Rio Chama, New Mexico	TCM, various seasonal flow levels	fishing & boating	25 (1100 for water consumed)	Low boating flow (1000 cfs)	other basin uses: 40
Johnson & Adams (1988)	John Day, Oregon	CVM + fishery production model	fishing (one species)	2.4 (up to 24 for water consumed)	Mean summer flow (204 cfs)	agriculture: 10-24
Ward (1989)	4 lakes, Pecos River Basin, New Mexico	TCM, extended to account for unique conditions of arid West	various	130	Complete drainage of lake	agriculture: 25-40
Hansen & Hallam (1991)	Many (all continental U.S.)	HH prod. fctn. + hydrologic model	fishing	wide range (mostly < 10)	Actual flows	agriculture: varying
Duffield, Neher & Brown	Big Hole & Bitterroot, Montana	CVM + observed participation	fishing, floating, shoreline	63 (Big Hole) 84 (Bitterroot).	low flow (100 cfs)	agriculture: 20 (Big Hole) 40 (Bitterroot)
Loomis & Creel (1992)	San Joaquin + Stanislaus, California	TCM + Site Selection Model	fishing, waterfowl hunting, wildlife viewing	45-116 (San Joaquin) 11-13 (Stanislaus)	increasing avg. flows by releasing 60,000 (10,000) AF	agriculture (less than 45)

Adapted from: Brown, 1991.

2.2.2 Total Economic Value

Krutilla (1967) presented an influential early discussion of nonuse and option values. Since then, several studies attempted to measure the total economic value of water instream. All authors used the contingent valuation method, which is the only method currently available to measure option and nonuse values. In general, it is hard to compare the various studies because they vary significantly with respect to the nature of the good that is being valued. Moreover, the goods being hypothetically purchased are usually not sufficiently well specified to express the obtained value estimates in terms of specific quantities of water or as marginal value of water instream at different flow levels. Many studies show that nonusers hold significant values as well, and that a major proportion of the total value of both users and nonusers is associated with bequest and inherent values.

Loomis (1987b and 1989) used a mail survey of a random sample of California households to estimate the total economic value of preservation of California's Mono Lake. The lake was threatened through water diversion from streams feeding it. Respondents were asked how much they would be willing to pay in form of an increase in their monthly water bill in order to preserve the lake. Photographs of different lake levels were used to illustrate the effect of continued high water diversion. WTP for total preservation was elicited in form of two increments of the degree of protection. Results showed that the first increment yielded considerably higher WTP bids than the second. In addition, respondents were asked to assign percentages of their WTP bid into four categories: recreational use, option value, inherent value and bequest value. Finally, respondents were asked about the probability of visiting the lake in the current year as well as in the future.

Persons in the sample who indicated that they were planning to visit Mono Lake in the current year assigned 55 percent of their WTP bid into the existence value categories, and 22.5 percent each into option and recreational use value. Respondents who did not plan to visit the lake in the current year but expected to visit it sometime in the future reported 85.7 percent of their WTP as related to existence values, 9.5 percent as option value, and 4.8 percent as use value. The third group of respondents, which did not expect to ever visit the lake, assigned 93.7 percent of their bid into the existence value categories, and reported 3.6 percent and 2.7 percent as option and use value respectively. Total WTP bids were generally highest for the first group and lowest for the third group. The average WTP was estimated to be $115 per household per year or $1.5 billion per year in aggregate, of which 79 percent is associated with existence values. The aggregate value was shown to exceed the total cost of preservation which included water and hydropower replacement cost to the city of Los Angeles.

Clonts and Malone (1990) used a telephone survey of a random sample of Alabama households to estimate the total value associated with the preservation of 15 free-flowing rivers in Alabama. The authors found that 14 percent of the households used the rivers for recreational activities. Users were in general slightly younger than nonusers and had a higher level of education. The average WTP for preservation of the rivers was estimated to be $57 per household per year and $64 million in aggregate. Individual WTP values were generally higher for users than for nonusers.

The authors also disaggregated the total value estimate by asking respondents to put monetary values on specific aspects of river preservation. The highest values were reported to be associated with inherent values, specifically values related to the protection of fish and wildlife habitats and to the protection of the quality of air, water and scenery. Bequest values ranked second, option values third and recreational use values last. Inherent and bequest values together accounted for more than two-thirds of the total value. This result approves the importance of nonuse values, especially existence values. It has been questioned how accurately respondents are able to allocate their total WTP among different motives (Mitchell and Carson, 1989, Cummings and Harrison, 1992). In this study, the authors also asked respondents why they believe river preservation to be important. The results showed a high consistency between motivation for river protection and WTP for that protection, indicating a significant strength in opinion expressed. The scope of this study did not allow for estimating incremental consumer surplus. The authors also did not determine an economic value for any specific river, which makes it difficult to compare the estimates obtained in this study to those in other studies.

Sanders, Walsh and Loomis (1990) did a similar study on sections of eleven rivers in the Rocky Mountains of Colorado. They used a mail survey designed to represent the resident population of the state. Respondents were asked how much they would be willing to pay annually into a trust fund for increases in the number of specific rivers protected, thereby allowing for the estimation of incremental consumer surplus. Respondents were also asked to allocate their total WTP among four categories of value. The relative importance of inherent, bequest, option and recreational use values exactly coincided with that in Clonts and Malone (1990). Sanders, Walsh and Loomis (1990) obtained an average annual WTP of $40 per household for the three most valuable rivers. Nonuse values accounted for approximately 80 percent of this amount. The authors demonstrated that total benefits increased at a decreasing rate as additional rivers were designated for preservation. The average annual WTP for the protection of all eleven rivers was estimated to be $95 per household. The authors examined several other interesting issues, one of which was the effect of uncertainty about the fate of the rivers in absence of protection. They showed that WTP estimates for river protection were about 20 percent lower for a 50 percent chance of loosing the rivers to development projects than for a certain loss.

Finally, Sanders, Walsh and Loomis (1990) attempted to estimate the optimal number of rivers to be protected using a dynamic approach. By multiplying the average WTP by the number of households and discounting over a 50 year planning horizon they obtained the present value of total benefits as a function of the number of rivers protected. This function was then compared to a present value of total cost function which included the opportunity costs of giving up alternative uses as well as management costs for river preservation. Net benefits of river protection are maximized at a number of 13.7 rivers. This estimate is likely to be conservative for several reasons. First, the benefit function did not consider households from other states. Second, benefits and costs are assumed to stay constant over time. This last point is critical since it does not account for population growth. Moreover, Fisher, Krutilla and Cicchetti (1972) and Smith (1972) showed that the benefits of environmental protection rise over time relative to the benefits of alternative uses of a resource because the supply of natural environments is fixed while alternative uses are affected by technological change.

Olsen, Richards and Scott (1991) estimated economic values for doubling the size of salmon and steelhead runs in the Columbia River Basin by using a CVM survey of a sample of Pacific Northwest households. In this study the respondents were asked their WTP in form of a rise in the monthly power bill in exchange for the satisfaction obtained from the knowledge that doubling the fish runs would provide more species diversity and greater ecological stability. No further distinction of underlying motives was attempted. For nonusers who stated no probability of future use the average WTP bid was $2.21 per month, which was assumed to represent a pure existence value. (This assumption is contradicted by the results of Loomis (1987b and 1989).) For nonusers with some probability of future use the average bid was $4.88 per month, which included existence value as well as some fraction of option price. The average WTP for users represented a total value, including use value, option value and existence value, and was estimated to be $6.18 per month.

The authors multiplied the average WTP estimates by the number of households in the Pacific Northwest, correcting for the different proportions of the three groups in the population. Thereby, an annual total value of $171 million for a doubling of the salmon and steelhead runs was obtained. This is equivalent to a value of $68.49 per additional fish. The authors suggest that this value should be compared to the cost per incremental fish in a proposed fishery enhancement project to decide whether such a project would be a Pareto improvement. A major weakness of this study is that it did not allow for disaggregation of the total value.

In summary, studies estimating total value demonstrate that nonuse values are substantial, representing up to 80 percent of total value. Unfortunately, these latter studies did not allow for relating the values obtained to specific quantities of water or flow levels. However, it is clear from this review that water left instream can yield substantial benefits, which approves the importance of assigning water to instream flows. In order to improve decisions regarding water allocations and policies it is therefore important to further improve our estimates of the economic benefits of water left instream.

One point that should be given more focus in future research is the dynamic aspect of benefits overtime. The importance of the recreational use of water is likely to increase over time as population expands, leisure time increases and the availability of water resources decreases in many regions (Hansen and Hallam, 1991). Furthermore, a major part of the total value of water instream is related to the protection of natural environments and habitats. The concern about environmental protection in the population is growing. Moreover, the destruction of natural environments is irreversible while alternative uses often become more efficient over time. Therefore, the importance of leaving water instream is likely to increase relative to alternative uses when examined from a dynamic point of view.

2.3 Laws and Policies Pertaining to Instream Flows

2.3.1 Institutional Context

In the Southwest, water is crucial to economic activities and its use is heavily regulated. The prevailing water law of this region is the doctrine of "prior appropriation" according to which "senior" water rights accrue to the first party who puts a quantity of water to beneficial use (Western Rural Development Center, 1992). Senior rights are superior in reliability to those of subsequent water users (junior rights). A problem of the doctrine is that, historically, only consumptive uses and hydropower generation have been considered as a beneficial use. Therefore, the doctrine did not provide for the appropriation of water for instream uses.

Another problem of the prior appropriation doctrine is that if an appropriator does not use all of the water that was originally appropriated, the appropriator loses the right to the unused water. This rule encourages wasteful practices and the use of water where it has low benefits, instead of leaving the water instream or in the ground, where it could have substantial environmental and recreational benefits.

Some states have modified their laws on water rights transfers to include public welfare criteria. In New Mexico concessions have been made which recognize traditional rights, e.g. the fact that under Spanish and Mexican law water was distributed according to need, equity, and noninjury, not on first use alone (Western Rural Development Center, 1992).

Where no legal restrictions apply, the property right to water is transferable in the marketplace (voluntary transfer) and can be acquired for the maintenance of instream flows. On the other hand, existing laws and regulations can induce involuntary water rights transfers from consumptive to environmental uses. Another possibility is the appropriation of junior rights. However the latter strategy is usually not sufficient for the protection of stream flows where stream systems are already heavily appropriated (Colby, 1993). This section summarizes some recent occurrences of voluntary and involuntary water rights transfers from consumptive uses to maintaining instream flows in the western United States.[1]

2.3.2 Involuntary Water Rights Transfers

Involuntary transfers of water rights are caused by litigation. Litigation changes the existing distribution of property rights (Colby, 1993). In the U.S., several legislative acts are aimed at balancing development goals with those of protection and preservation Clonts and Malone, 1990). These acts include the National Wild and Scenic Rivers Act,

[1] For a more detailed description of water rights transfers, see Colby (1993) and Brown (1991).

Wilderness Act, Endangered Species Act, Clean Water Act, and the Public Trust doctrine. Colby (1993) points out that the threat of litigation can enhance voluntary water rights transfers as parties to litigation try to avoid the costs, delays and uncertainty involved in court rulings by negotiating voluntary agreements. Various involuntary water right transfers from consumptive to environmental uses have occurred over the last fifteen years (Colby, 1993):

In 1980, the Department of the Interior ruled that Stampede Reservoir in Nevada should be used for maintaining flows of the Truckee River and protecting endangered species, instead of for consumptive uses.

In 1983, the California Supreme Court ordered the City of Los Angeles to cut back its diversions under its senior water rights to the Mono Lake area.

In 1992, Congress signed the Grand Canyon Protection Act, which limits daily fluctuations in Glen Canyon dam releases to protect environmental and recreational resources in the Grand Canyon. In the same year, Congress passed the Central Valley Project Improvement Act, which requires that 800,000 acre feet per year of the yield of the federal project, which historically mainly benefited agriculture, must be used for restoration of riparian habitat, fish, and wildlife.

In early 1993, a federal district court in Texas ruled that pumping in the Edward Aquifer for municipal and agricultural uses must be restricted in order to protect spring flows that serve as habitat for endangered species.

Several other litigations aimed at protecting instream flows are under way in the southwestern States, and this kind of water reallocation is likely to be important in the future.

2.3.3 Voluntary Water Rights Transfers

Voluntary transfers occur when two parties agree on a transfer (sale, lease, or exchange) of water rights. A water rights purchase or lease accepts the existing property rights structure and fully compensates the party which is giving up a property right. While the acquisition of water rights for instream uses has become more common, some western states, like New Mexico, still do not allow water rights to be held for instream flow maintenance. Only a few states, like Arizona and Alaska, allow non-governmental entities to appropriate or purchase water rights for instream uses. Another weakness of most western states' water laws (including that of Arizona) is that surface water and groundwater resources are administered as two distinct resources. Consequently, the acquisition of a surface water right does not protect instream flows against being depleted by nearby groundwater pumping.

Even where the acquisition of water rights is not restricted to governmental entities, water rights purchases for instream flows are made by nonprofit organizations or public agencies, due to the public goods character of water instream. Only rarely has a private fishing club or property owner purchased water for instream flows.

The price at which water rights are traded show a great amount of variation. Colby, Crandall and Bush (1993) found that market prices for water rights were significantly related to water right priority dates, the size of transaction, buyer characteristics, and the geographic area in which the transfer occurred. The costs of market transactions are strongly affected by legal and political institutions, which can impose substantial transactions costs.

Where the legal framework permits the acquisition of senior water rights for the protection of stream flows, these kinds of voluntary water rights transfers are becoming increasingly important. Brown (1991) lists several purchases of water for instream flows from 1987 to 1990. Annual prices per acre foot ranged from $2 to 14. Colby (1993) describes a diversity of transactions that have occurred over the past six years. Some examples are summarized here.

In 1993, the Middle Rio Grande Conservancy District in New Mexico, which diverts water from the Rio Grande for irrigation, leased 20,000 acre feet of water from the City of Albuquerque to maintain a minimum flow level of 250 cubic feet per second (cfs) in the Rio Grande throughout the irrigation season.

The Nature Conservancy has been the dominant non-profit organization involved in the acquisition of water rights for the protection of stream flows. In 1992, its Arizona chapter involved in two major purchases of land and water rights in the San Pedro River Basin. One purchase comprised an area of 305 acres and water rights for 600 acre feet, which were acquired from a farmer. In both cases, the Conservancy then transferred the property at cost to the BLM in order to increase the San Pedro Riparian National Conservation Area (which is one object of this study). The Nature Conservancy has been involved in numerous other purchases of water rights for the protection of riparian habitats, wetlands, and endangered species in several states, including California, Wyoming, Nebraska, Idaho, and Colorado. In most cases, the water had originally been used for irrigation purposes (Colby, 1993).

The public sector has involved in numerous water rights transactions for the protection of stream flows. In 1987, the Bureau of Reclamation agreed to alter reservoir releases into the Sacramento River in northern California in order to enhance the Chinook salmon Fishery. This reduced hydropower revenues by more than one million dollars. In 1988, the Bureau agreed to purchase water in storage to be released to increase winter flows on Utah's Provo River in order to alleviate drought impacts. Moreover, a portion of the capacity of Jordanelle Dam was earmarked for the protection of Provo River flows. In 1990, the Bureau of Reclamation signed a contract with the Colorado Water Conservation Board, in which the Bureau agrees to provide an annual volume of 10,000 acre feet from Reudi reservoir for the enhancement of stream flows for endangered fisheries on the upper Colorado river. The agreement, however, leaves room for exceptions in the case of a significant increase in the demand for alternative water uses. In 1992, four irrigation and canal companies made an agreement with the Bureau of Reclamation to use 10,000 acre feet, supplied from the Bureau's Central Valley Project, for wildlife protection in the summer of 1992. In return, the four organizations received additional water supplies in the later months and the permission to transfer water outside their service areas (Colby, 1993).

In 1988, Congress allocated $2.2 million for water right purchases to facilitate environmental restoration in western Nevada and in the Upper Colorado River Basin. In the same year, Congress also appropriated $42.2 million for the augmentation of flows in the Umatilla River Basin of Oregon.

Several public entities in California have been involved in water rights transfers for stream flow protection. In 1989, the California Water Resources Control Board acquired 30,000 acre feet of water from the East Bay Municipal Utility District in order to protect fish and wildlife habitat in the San Joaquin River Basin. In the same year, the California Department of Fish and Game signed a contract with a municipal water district, in which the Department leases effluent for the protection of wetlands and riparian habitats over the next 25 years. In 1991, California's Emergency Drought Relief and Assistance Program was enacted. Under this program, the California Department of Fish and Game purchased 1.8 million worth of water rights for environmental protection in 1991. In 1992, the Department of Fish and Game leased 20,000 acre feet of water from the state water bank for $50 to 90 per acre foot and purchased permanent water rights for 10,000 acre feet, both under the Drought Relief Program (Colby, 1993).

In 1993, the Montana Department of Fish, Wildlife and Parks signed a ten-year lease with irrigators for 65 cfs in the Yellowstone River Basin, at an annual cost of $12,750. Also in 1993, the Colorado Division of Wildlife exercised its option to use 1,750 acre feet of Arkansas River water owned by a water district to provide a fishery pool in a reservoir in southeastern Colorado. The option had cost the Division $100,000 plus $43 per share (approx. an acre foot) when the option is exercised (Colby, 1993).

Despite this variety of voluntary water rights transfers, instream flow values are not well represented in western water markets (Colby, 1993). Reasons for this include the above mentioned legal constraints, relatively high transactions costs, the public good character of stream flows, and the fact that although large numbers of people may benefit from improved flows they are loosely organized for fundraising and lobbying purposes.

3. THEORETICAL FRAMEWORK

3.1 Recreation Demand and Welfare Measures

The behavior of recreationists and their WTP for changes in site characteristics can be modelled within the framework of conventional consumer theory. A consumer is assumed to maximize utility subject to a budget constraint. The problem can be stated as follows (Silberberg, 1990; Deaton and Muellbauer, 1980):

$$\max u = u(x, z, q\, ;s)$$

$$\text{s.t. } p_x x + z = y$$

$$x \geq 0$$

$$z \geq 0$$

where: u = a utility function, which is increasing and quasiconcave in x and z

x = the consumer's involvement in a recreational activity (measured, for example, as trips per year to a site A)

z = a Hicksian composite commodity with unitary price ($z = y - p_x x$); z is "unaffected" by q

q = the characteristic (which may be a quantitative or qualitative variable describing site conditions) of the public good Site A which affects the recreational experience (e.g. flow level)

s = a vector of socioeconomic characteristics, tastes and preferences, and prior experience

p_x= the price of the recreational activity (e.g. the sum of transportation costs, entrance fees, rafting permits etc.)

y = income

This formulation does not attempt to account for substitution among various recreation sites. Another assumption made is that market goods associated with recreational trips (transportation, fees etc.) are consumed in fixed proportion with the number of recreation trips, thereby allowing for the appearance of the number of trips x separately in the utility function.[1]

The solution to the utility maximization problem is the Marshallian demand for the recreational activity, h_x (p_x, q, y; s). Substituting the Marshallian demand into the utility function yields the indirect utility function, v (p_x, q, y; s) = u. The dual of the utility maximization problem is the expenditure minimization problem:

$$\min \; y = p_x x + z$$

$$\text{s.t. } u(x, z, q; s) = \bar{u}$$

$$x \geq 0$$

$$z \geq 0$$

[1] An alternative formulation which relaxes this assumption is the Household Production Function framework, which will be explained in the following section of this chapter.

The solution to the expenditure minimization problem is the Hicksian compensated demand for recreation, $g_x(p_x, q, \bar{u}; s)$, the substitution of which into the objective function yields the expenditure function $e(p_x, q, \bar{u}; s) = y$. In general, four Hicksian welfare measures can be defined (Smith and Desvousges, 1986). These are shown in Table 3.1[2]

TABLE 3.1, Definitions of Hicksian Welfare Measures

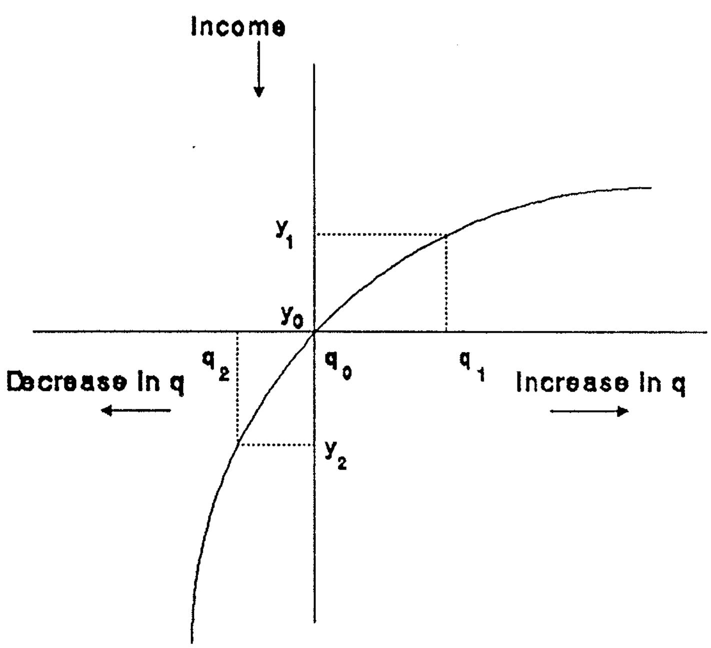
Welfare measure	Definition
Compensating variation	the amount of compensation that must be taken from an individual to leave him at the same level of satisfaction as before a price change
Equivalent variation	the amount of compensation that must be given to an individual, in the absence of the change, to enable him to realize the same level of satisfaction he would have with a price change
Compensating surplus	the amount of compensation that must be taken from an individual, leaving him just as well off as before the change, if he were constrained to buy at the new price the quantity of the commodity he would buy in the absence of compensation
Equivalent surplus	the amount of compensation that must be given to an individual, in the absence of the change, to make him as well off as he would be with the change, if he were constrained to buy at the old price the quantity of the commodity he would buy in the absence of compensation

[2]The definitions assume a "positive change" (i.e. usually a price decrease). For a "negative change" the compensation as stated in the definitions become negative, such that "the compensation that must be taken" becomes "the compensation that must be given" and vice versa.

In general, the difference between compensating and equivalent measures lies in the assumptions on property rights. Since policy decisions involving public goods usually determine the quality of the public good, this quality is exogenous in the individual's utility maximization problem. The welfare measures of interest in evaluating a change in the provision of a public good therefore are usually the surplus measures. In order to examine the effect of a change in the provision of the public good q in our framework, we start by holding the quantity of recreation demanded (x) fixed (e.g. in most surveys we asked for the respondent's WTP per trip). We are thus adding an additional constraint to the constrained optimization problem, which is: $x = x$.

The WTP for a change in q can then be represented in form of a bid curve or total value curve (Bradford, 1970; Randall, Ives and Eastman, 1974; Brookshire, Randall and Stoll, 1980). The bid curve represents trade-offs between income and changes in the quality of a public good (q). Figure 3.1 shows a total value curve. The origin represents the original level of utility given y_0 and q_0. A movement up the income axis represents a decrease in income, while a movement down the income axis indicates an increase in income. The curve is positively sloped assuming that the individual prefers more of q over the range of interest. For cases where q can be defined in unidimensional, cardinal terms (e.g. flow level measured in cubic feet per second) the assumption of diminishing rates of commodity substitution is sufficient to ensure the curvature shown (Brookshire, Randall and Stoll, 1980). The total value curve is simply an indifference curve in the (y,q)-space. Distances on the income axis corresponding to movements along the bid curve represent Hicksian compensating measures since utility is held constant at the initial level. The WTP for an increase in the provision of the public good from q_0 to q_1 is equal to y_0-y_1. The difference y_2-y_0 indicates the individual's willingness to accept (WTA) compensation for a deterioration in q from q_0 to q_2.

FIGURE 3.1, Individual Bid Function for the Public Good q



Hicksian equivalent welfare measures can be represented by adding a second total value curve passing through the new reference level of utility, as presented in Figure 3.2. For a decrease in q from q_0 to q_1, the reference level for an equivalent welfare measure would be the utility given y_0 and q_1. The WTP to avoid the decrease in q is equal to $WTP^e = y_0 - y_1$, the amount of income given up that would make the individual just as well off as with the decrease in q. Similarly, $WTA^e = y_2 - y_0$ represents the WTA in lieu of an increase in q from q_1 to q_0.

FIGURE 3.2, Relationship Between Bid Functions and Hicksian Welfare Measures

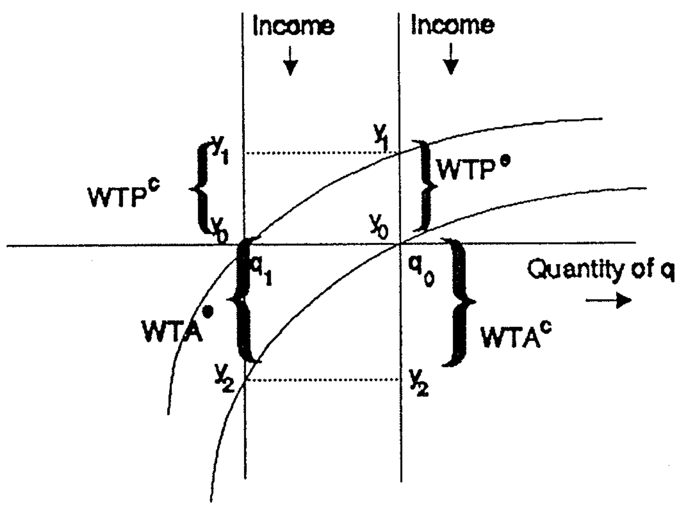


Figure 3.2 can also be used to measure compensating surplus measures. The compensating surplus associated with an increase in q from q_1 to q_0 is equal to WTP^c = y_0-y_1. The compensating surplus associated with a decrease in q from q_0 to q_1 equals WTA^c = y_2-y_0. Therefore, as Brookshire, Randall and Stoll (1980) point out:

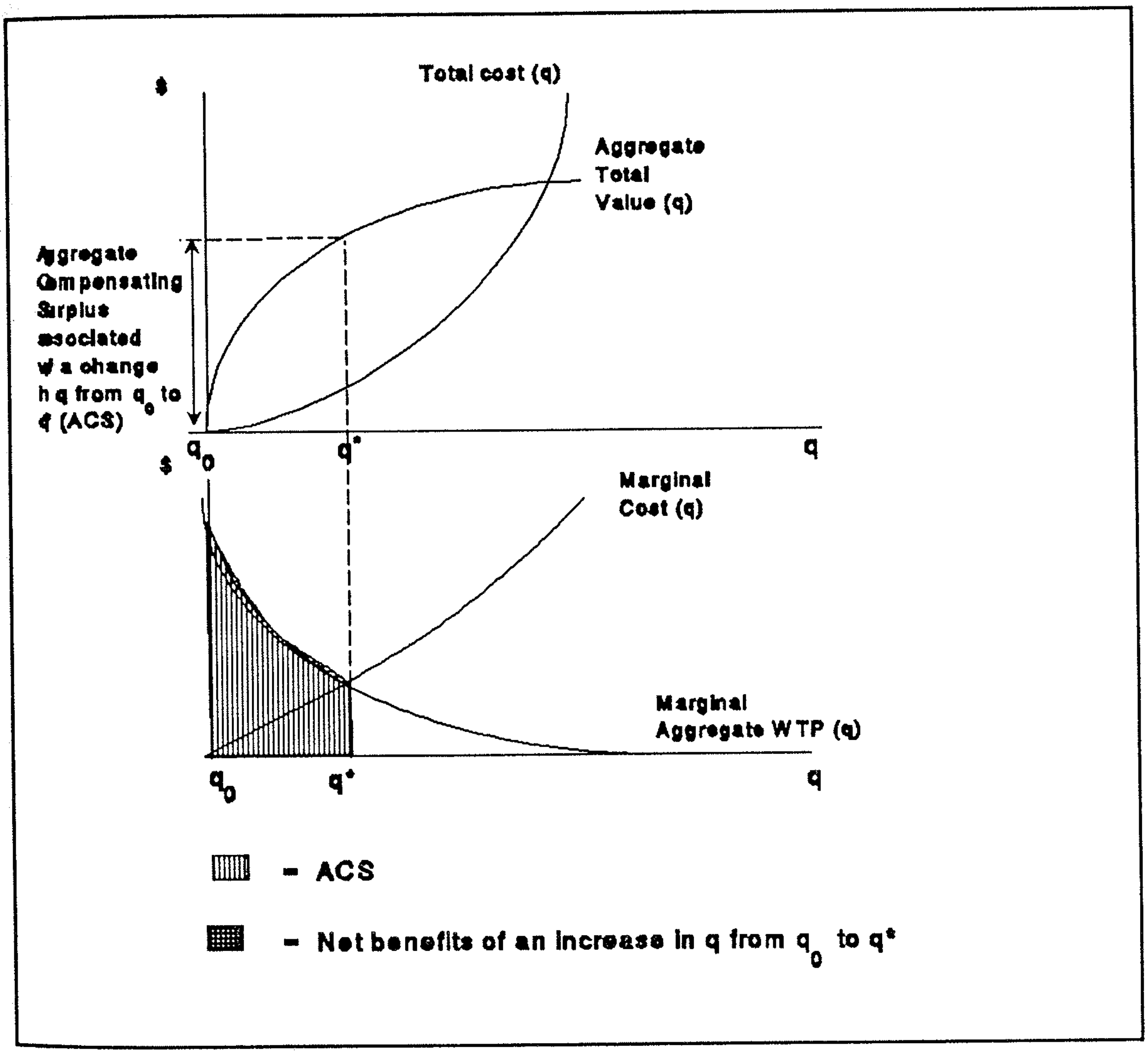
"When comparing two alternative levels of provision of a good, there are four relevant Hicksian value measures: WTP^c to obtain the preferred level; WTP^e to avoid the less preferred level; WTA^c to accept the less preferred level; and WTA^e to forego a promised increment to the preferred level. There is a compensating and equivalent version of WTP, as there is of WTA. ... when comparing any pair of alternative levels of provision of a good, service, or amenity, WTP^c is equal in value to WTP^e, while WTA^c is equal in value to WTA^e."

The difference between WTP^c and WTP^e (and between WTA^c and WTA^e) lies in the definition of the baseline level of q, i.e. which level of q would occur without the policy. For example, WTP^c considers the lower quality (q_1) as the baseline level, while the "without policy" level of q underlying WTP^e is q_0.

The concept of total value curves is useful here because it is the most direct representation of what is measured in a CVM survey. CVM surveys are usually used to estimate WTP as a function of the quality of the public good and other factors. In this study: WTP = f (p_x, q, y; s).

An aggregate bid curve then is obtained through vertical summation of the individual bid curves. The aggregate bid curve represents the total benefits associated with different levels of q, and can be compared to the total cost curve to maximize net benefits. Net benefits are maximized where marginal aggregate WTP equals marginal costs. This concept is shown in Figure 3.3.

FIGURE 3.3, Aggregate Bid Curve and Maximum Net Benefits



Another way to define Hicksian welfare measures, which is equivalent to the individual bid curve concept is in the form of areas under the inverse Hicksian compensated demand curves. Bradford (1970) points out that the bid curve is a total value curve, the derivative of which is a derived compensated demand curve for the quality of the public good, q. Points on the total value curve therefore correspond to areas under an (inverse) compensated demand curve, and the two definitions are equivalent. Since the compensated demand curves can be shown to be the derivative of the expenditure function using Roy's identity, another equivalent way of expressing Hicksian welfare measures is in the form of differences between two points on an expenditure function. In fact, the total value curve is nothing else than an expenditure function mapped in the (q,y)-space, with the origin shifted to represent the current levels of income and public good provision.

Finally, Hicksian welfare measures can be defined using the indirect utility function, which is the inverse of the expenditure function. All definitions are equivalent, but sometimes a particular definition may be preferred over the other in order to demonstrate specific aspects of the problem at hand. Table 2.2. shows three equivalent definitions of the two welfare measures estimated in most CVM studies: WTP to attain an increase in q (compensating surplus) and WTP to avoid a decrease in q (equivalent surplus).

TABLE 3.2, Definitions of WTP Measures

Type of definition	WTP for an increase in q from q_0 to q_1 (compensating surplus)	WTP to avoid a decrease in q from q_0 to q_1 (equivalent surplus)
As area under-neath a derived inverse compensated demand function for q (g_q^{-1})	$CS = \int_{q_0}^{q_1} g_q^{-1}(p_x,q,u_0;s)\,dq$	$EV = \int_{q_1}^{q_0} g_q^{-1}(p_x,q,u_1;s)\,dq$
Using the expenditure function	$CS = e\,(p_x,q_0,u_0;s) - e\,(p_x,q_1,u_0;s) = y_0 - y_1$	$ES = e\,(p_x,q_1,u_1;s) - e\,(p_x,q_0,u_1;s) = y_1 - y_0$ [3]
Using the indirect utility function	$v\,(p_x,q_0,y;s) = v\,(p_x,q_1,y\text{-}CS;s) = u_0$	$v\,(p_x,q_0,y\text{-}CS;s) = v\,(p_x,q_1,y;s) = u_1$

With respect to the choice of appropriate welfare measures for the evaluation of policies affecting the provision of public goods, Brookshire, Randall and Stoll (1980) state: "Following Mishan (1971, 1976), we argue that (...) unless a project or program is proposed primarily for the purpose of redistribution, the potential Pareto-improvement is the proper criterion for benefit-cost analysis and, therefore, Hicksian compensating

[3] y_0 and y_1 generally are not the same in the two expressions for CS and ES

measures are the proper measures of value". However, as explained in chapter 2, CVM studies usually measure WTP measures because they represent the more conservative estimate and because the estimation of WTA is subject to greater difficulties than estimation of WTP.

3.2 The Household Production Function Framework

In the above model, we have treated recreation as a good which can be purchased in the market at a given price. In reality, however, recreation is an activity which is produced by the consumer or household using time and market commodities like transportation, recreational equipment, rafting fees, etc. The cost of producing a day of recreational activity will vary across households according to their capital (e.g. whether they own a vehicle or recreational equipment), their opportunity cost of time, and their technology, which is, for example, a function of prior experience. A framework which takes these characteristics of the household's involvement in a recreational activity into account is household production theory (Gorman, 1956; Becker, 1965; Lancaster, 1966a and b).

Let the consumer's production of days in a recreational activity be denoted by

$$x = x\,(\mathbf{k}; \mathbf{g}, \mathbf{t}, \mathbf{h}),$$

where: x = days of recreational activity

k = vector of variable inputs used to increase x

g = vector of fixed inputs used to increase x

t = vector of time variables

h = vector of household technology variables.[4]

The consumer's annual recreational experience (r) depends on the days of recreational activity and on an exogenously determined environmental quality variable (q), e. g. flow level. Thus: r = r (x, q). Assuming that the utility derived from r is weakly separable from that derived from all other goods (denoted as the composite commodity z) and allowing for nonuse values derived from changes in q, the consumer's utility function can be written as: u = u [r (x, q), z, q; s], where s is a vector of socioeconomic characteristics, tastes and preferences. The indirect utility function now depends on the cost or shadow price of producing a day of recreational activity (w), income (y), and environmental quality (q), given s. Thus: v = v (w, q, y; s).

The inverse of the indirect utility function is the expenditure function e (w, q, u; s), which represents the minimum expenditures required to achieve a given utility level. The Hicksian consumer welfare measures can now again be defined, for example, as a difference between two points on an expenditure functions. The definitions are equivalent to those indicated in the previous section, with the only exception that the price of the recreational activity (p_x)is now replaced by the shadow price of producing it (w).

[4] This model has been adapted from Stoll, Bergstrom and Titre (1989).

3.3 Nonuse Values

A final theoretical concept that is of interest for this study is the definition of use and nonuse values. The Hicksian welfare measures described above represent total values. As defined in chapter 2.1.2, total value consists of a use and a nonuse component.[5] Therefore, if we use the example of a compensating surplus measure for an increase in q from q_0 to q_1, we have:

$$\text{TOTAL VALUE}_c = e\,(p_x,\, q_0,\, u_0\,;s) - e\,(p_x,\, q_1,\, u_0\,;s)$$

and $$\text{TOTAL VALUE}_c = \text{USE VALUE}_c + \text{NONUSE VALUE}_c.$$

Two theoretical constructs for distinguishing use and nonuse value empirically have been proposed Mitchell and Carson (1989). The weak complementarity approach is based on the idea that use value is weakly complementary to some private good and can therefore be measured by the indirect, market-based benefit measurement techniques. The portion of total value that cannot be captured through market-based techniques is the nonuse portion. This method requires the combination of a CVM survey with a market-based technique, such as the TCM, and relies on weak complementarity as the theoretical link (see LaFrance (1993), and Larson (1991, 1992) for detailed discussions). The second method for distinguishing the use and nonuse components of total value is used in this

[5] In the following we assume certainty. For a discussion of nonuse values under uncertainty see, for example, Cory and Saliba (1987), Graham (1992), and Ready (1993).

research. This method measures the nonuse portion by asking respondents how much of their original WTP bid (total value) they still would be willing to pay if they were denied access to the resource. One way to express the restriction of access is to set the price for the recreational activity x so high that the representative individual would choose a level of x equal to zero (Just, Hueth and Schmitz, 1982; Boyle and Bishop, 1987). Let this "choke" price be $p_x{}^{m0}{}_c$ and $p_x{}^{m1}{}_c$ for a quality of q_0 and q_1, respectively. Then, nonuse value can be defined as:

$$\text{NONUSE VALUE}_c = e\,(p_x{}^{m0}{}_c,\ q_0,\ u_0\ ;s) - e\,(p_x{}^{m1}{}_c,\ q_1,\ u_0\ ;s)$$

Use value can simply be seen as the residual category[6]:

$$\text{USE VALUE}_c = \text{TOTAL VALUE}_c - \text{NONUSE VALUE}_c.$$

Correspondingly, for the equivalent surplus measure associated with a decrease in q from q0 to q1, we have:

$$\text{TOTAL VALUE}_e = e\,(p_x,\ q_1,\ u_1\ ;s) - e\,(p_x,\ q_0,\ u_1\ ;s)$$

[6] In the presence of uncertainty, the residual value would present an option price, i.e. the sum of use value and option value.

$$\text{NONUSE VALUE}_e = e(p_x^{m1}{}_e, q_1, u_1; s) - e(p_x^{m0}{}_e, q_0, u_1; s)$$ [7]

$$\text{USE VALUE}_e = \text{TOTAL VALUE}_e - \text{NONUSE VALUE}_e.$$

The appeal of the above theoretical framework for disaggregating use and nonuse value lies in the fact that it can be measured using CVM surveys, without the need for TCM. First, the total WTP for a change in q can be elicited, and then respondents can be asked how much they would still be willing to pay if they had no access to the resource in the future (or alternatively, if they personally would never visit the site again). However, this approach assumes that respondents are able to fully consider the "no-access scenario" and to take the question seriously. Some authors have expressed doubt about the feasibility of this exercise (see, for example, Cummings and Harrison, 1992). An unresolved issue is how much detail should be given in describing the no-access scenario. While a detailed description might help the respondent consider the hypothetical situation, it could stimulate protest responses related to a specific scenario that results in no access.

3.4 Interpretation of WTP Estimates in this Study and Hypotheses

Given the above theoretical concepts, responses to the specific WTP questions in this study can be interpreted, and hypotheses can be formulated to structure empirical

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[7] The value of $p_x^{m0}{}_c$ and $p_x^{m1}{}_c$ here are generally different from that of $p_x^{m0}{}_c$ and $p_x^{m1}{}_c$ in the expression for compensating surplus.

analysis. Applications of theoretical concepts to specific data collected in this study are summarized below.

3.4.1 Ramsey Canyon Preserve and San Pedro RNCA, Arizona

In all Arizona surveys, respondents were asked for their WTP to avoid a decrease in site quality. While the exact good being valued differed slightly across surveys, the underlying condition was always a significant decrease in flow levels, with associated declines in other aspects of site quality. The payment vehicle used in the Arizona surveys was a one-time contribution to a non-profit organization. Therefore, total value in these cases should represent the present value of all use and nonuse values held by the respondent net of actual trip expenditures. Since the net present value depends on the time horizon and the expected number of annual trips to the site, this value is expected to decrease with age and to increase with the expected (or, as a proxy, the past) number of annual trips.

Whether this WTP measure represents compensating or equivalent surplus depends on what is considered to be the baseline level of site quality (or the "without" policy level of q). If the baseline level is considered to be the current streamflows, the WTP bids represent equivalent surplus measures. However, in our study we asked respondents to assume that without specific policy interventions, streamflows and site quality would deteriorate.[8] Therefore, the baseline level of quality is the lower level of q, and the WTP measures can be interpreted as compensating surplus.

Since only one discrete change in the provision of the public good is being measured, the results can be seen as two points on a total value curve. In Figure 2, these points would be represented by the coordinates (q_1,y_0) and (q_0,y_1). Consequently, no hypothesis about the curvature of the total bid curve over an extensive range of quality levels can be tested for the Arizona data. We simply expect that: $WTP = y_0 - y_1 \geq 0$. A second question in the Arizona surveys asked respondents what portion of their total WTP bid they would still be willing to pay if they would not visit again or would not have access to the site. The result represents a nonuse value as defined above. We expect:

$$\text{NONUSE VALUE} \geq 0$$

and $$\text{NONUSE VALUE} \leq \text{TOTAL VALUE.}$$

3.4.2 Rio Grande, New Mexico

All three New Mexico surveys contain two WTP questions. The first asks river rafters how much they would have been willing to pay in addition to their current river running expenses and still have taken the trip at the current flow level. The answer to

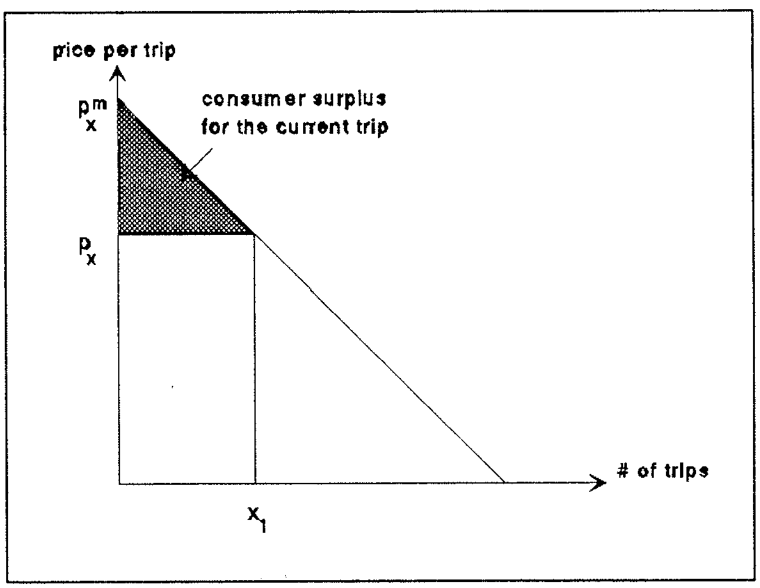
[8] The assumption that, in the absence of policy intervention, streamflows are likely to decline substantially is realistic for the San Pedro river, where increasing development pressure imposes a severe threat to the maintenance of streamflows. Under Arizona water law, groundwater can be pumped regardless of the effects on nearby streams, i.e. the property rights are with the groundwater users.

this question represents a Marshallian consumer surplus measure, i.e.

$$WTP = \int_{p_x^0}^{p_x^m} hx\ (p_x,\ q,\ y\ ;s)\ dp_x\ ,$$

where p_x^m is the price at which x equals zero. Figure 3.4 shows this value graphically, as an area underneath the Marshallian demand for x.

FIGURE 3.4, Consumer Surplus for a Rafting Trip at Flows Experienced



Since the flow level experienced varied across individual river runners, we can formulate a hypothesis about the size of the consumer surplus of a representative individual as flow level varies. In order to do that we have to relax our assumption that the level of the recreational activity x is independent of q. Note, however, that by asking the WTP for the current trip we are effectively holding x fixed at 1. A change in the flow level experienced can then be depicted as a shift in the Marshallian demand curve for the recreational activity x. At a higher flow level experienced, the representative individual would be willing to pay more per trip than at a lower flow level. Since the price of x (transportation, fees) is fixed at p_x and the quantity of x is set equal to 1, the difference in consumer surplus due to a higher experienced flow level can be represented as in Figure 3.5.

Consequently, the following hypothesis can be formulated: *After accounting for differences in the price p_x, income, and the vector s across consumers, we expect the consumer surplus measure to be a positive function of the flow level experienced, as long as the marginal utility of q is positive.* [9] We also would expect that the marginal utility of flow levels is decreasing in flows and after reaching some optimum flow for river running, a further increase in q yields disutility. Therefore, we expect the shift in the Marshallian demand for x to get smaller as flow level increases further and further, and

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[9] Note that this hypothesis is different from a total value curve, since we are now measuring areas under a Marshallian demand curve for x while the total value curve measures areas under the inverse Hicksian demand curve for q. The utility level of the representative consumer varies with the flow level experienced.

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beyond some optimum flow for rafting an increase in q would shift the Marshallian demand for x backwards. Consequently, for the pooled data, *after correcting for differences across respondents with respect to p_x and s, the consumer surplus measure indicated should be increasing at a decreasing rate as flow level experienced increases up to some optimum flow, and should then decrease for respondents who experienced above optimum flows*. This hypothesis is illustrated in Figure 3.6.

FIGURE 3.5, The Effect of Higher Flows on Consumer Surplus

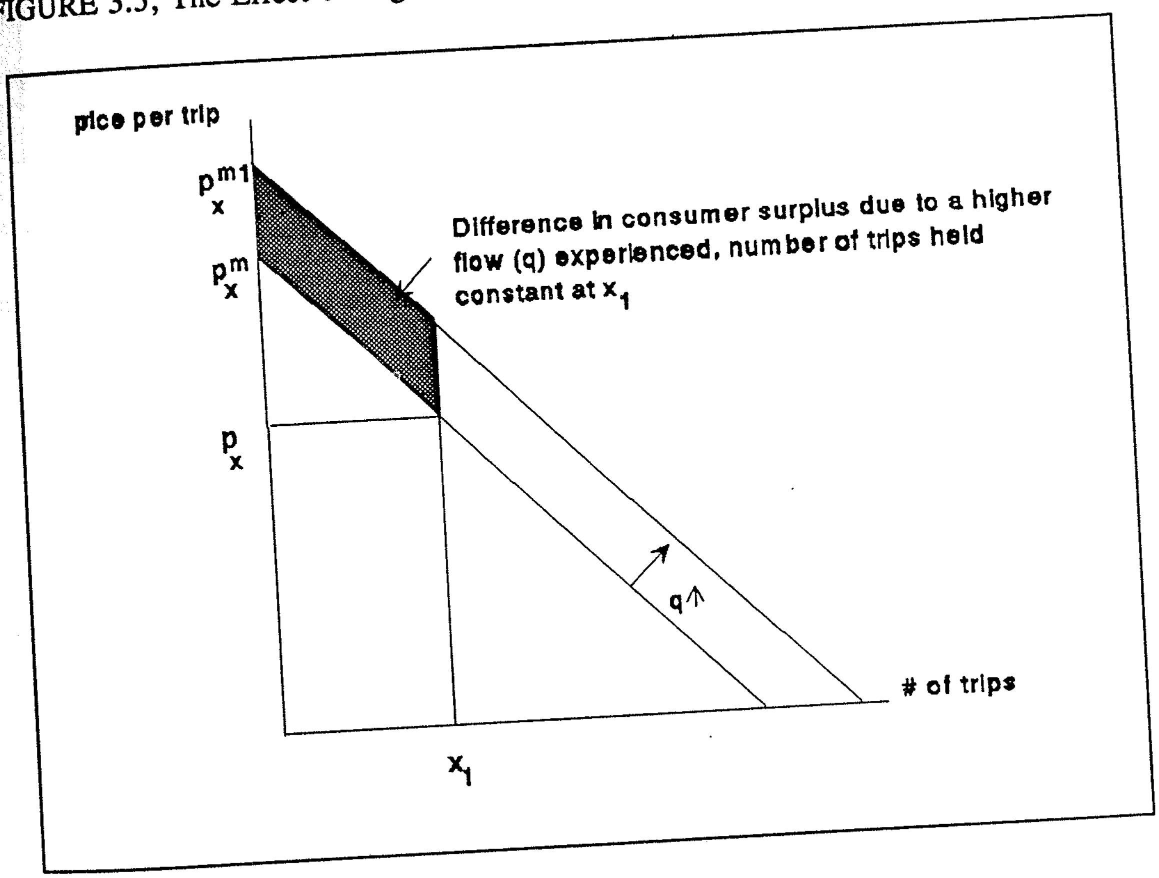
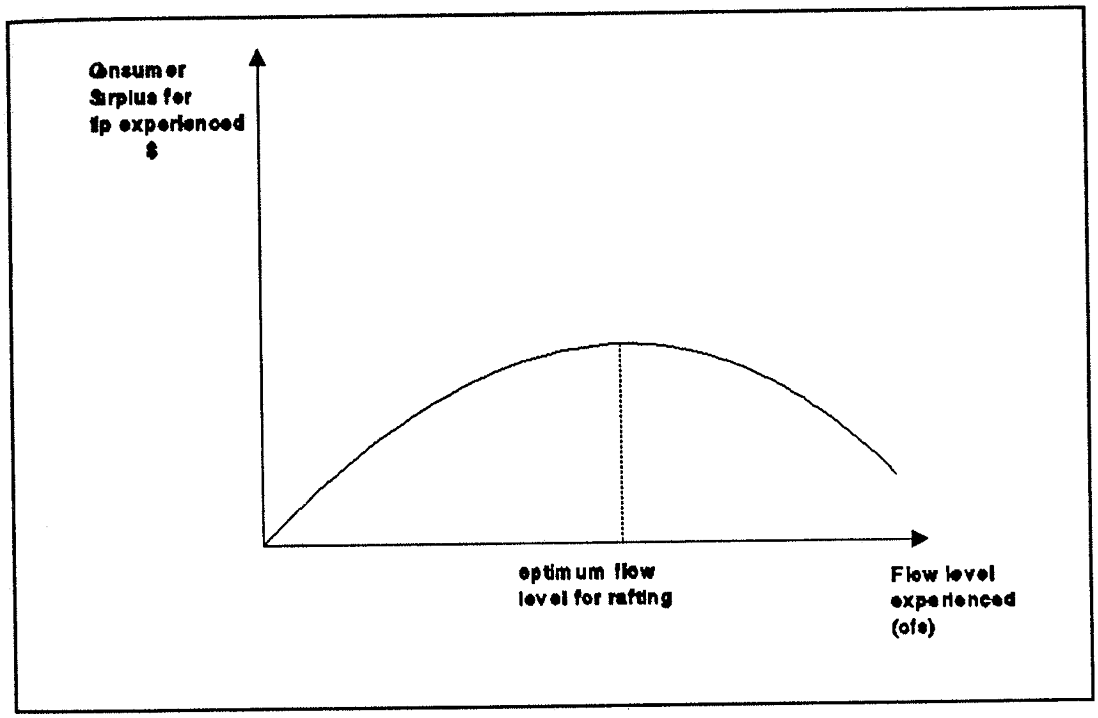


FIGURE 3.6, Consumer Surplus as a Function of Flow Level



The second WTP question in the New Mexico surveys asked respondents how much they would be willing to pay for guaranteed higher flow levels throughout the summer season. Thus we are measuring a compensating surplus for a positive change in the quality of a public good. In this case, the public good being offered contains not only the flow level element, but also the accompanying elimination of flow level uncertainty and a time element, in the form of an extended season for river running. The incremental flow level increase offered in the hypothetical market was randomly varied across individual surveys. By pooling the data from individual surveys, we can estimate a total value function for a representative individual. Since the flow level offered varied across respondents, we can state the following hypothesis: *After correcting for differences among individuals with respect to river running expenses, flow experienced, income, and vector s, the WTP amount indicated should be increasing at a decreasing rate as the flow level offered increases. After reaching some optimum flow level, the WTP amount will decrease.* Mathematically, if we express WTP as a function of current expenses, income, socioeconomic characteristics, and some polynomial of q, e.g.

$$WTP = f(p_x, q, q^2, y; s),$$

then we expect the coefficient on q to be positive and that on q^2 to be negative. We use flow level as the measurement units for the provision of the public good even though some portion of the total bid is likely due to the reduced uncertainty over flow levels and the extended river running season offered. Assuming that respondents assign a non-negative value to these latter two elements, the total value curve must be interpreted to include flow level and these other elements as a bundle of flow-related goods. Any policy-relevant instrument for increasing flow levels inherently would provide these other "goods" as positive byproducts. Our hypothesis on the slope and curvature of the bid curve for flow level must be understood to include these accompanying elements.

Whether the survey data will indicate the expected curvature for bid functions depends on whether respondents understand and value the effect of an offered higher flow level on their rafting experience. We expect to find a stronger relationship between flow level and WTP for individuals that have some degree of prior experience in rafting. Moreover, the effect of flow level on the rafting experience and thereby on the utility of the river runner varies with site characteristics. As will be explained in more detail in chapter 4, incremental flow level increases make more of a qualitative difference for the rafting experience on the narrow upper portion of the Rio Grande (Taos Box) than on the wide and relatively slowly flowing Lower Gorge. Hence, we expect $\delta u/\delta q$ to vary with experience levels and with site characteristics.

Finally, one of the three New Mexico surveys (nonexperienced rafters on the Lower Gorge) also contained a nonuse value question similar to that in the Arizona surveys. The answers can be interpreted correspondingly. The CVM questions in all other survey versions for New Mexico were phrased in terms of additional river running expenses. This payment vehicle, by construction, excludes any nonuse values held by recreationists.

3.5 Participation

As discussed earlier, the individual bid curves need to be aggregated to obtain an aggregate total value curve for q (resource quality) which can then be compared to the total cost curve for q. In the discussion of bid curves, we did not allow individuals to adjust their number of trips in response to a change in q. The points on the estimated bid curves represent values per trip. However, in order to find an aggregate total value curve we need to estimate aggregate participation at each flow level. Sanders, Walsh and McKean (1991) point out that per capita demand of the recreational activity consists of the product of two components of demand:

$$\text{Quantity demanded per capita per year} = \frac{\text{number of participants}}{\text{population}} * \frac{\text{number of trips/year}}{\text{number of participants}}$$

As Sanders et al. (1991) state: "In this approach, the consumer is viewed as making the recreation decision in sequential stages, 'Will I participate?' and then, 'How many times?'" Aggregate participation (N) is the product of the quantity demanded per capita and the number of people in the population:

$$N = \text{Quantity demanded per capita} * \text{population size}$$

$$= \text{Probability of participation} * \text{Number of trips per participant} * \text{Population size}$$

In our model, the number of trips per participant is given by the Marshallian demand curve for x, i.e. h_x (p_x, q, y; s). A change in q represents a shift in this demand curve, such that at a given price p_x the quantity demanded varies with q. The estimation of h_x typically requires an application of the travel cost model. In order to account for the fact that the number of trips is a non-negative, discrete variable, some authors use count data models (maximum likelihood estimation of models based on probability densities like the Poisson distribution) to estimate the choice of an individual over the number of trips to take (see, for example, Creel and Loomis (1992)).

The probability of participation is more difficult to estimate since it depends on the expected utility of choosing to visit one site over another. Thus, modelling the probability of participation requires the introduction of uncertainty into the basic model. An example of an uncertain factor influencing the utility obtained from engaging in a recreational activity is the weather. Moreover, the quality of a site might not be known with certainty at the time the decision about x is made. Site selection models can be used to estimate the distribution of a given number of trips per person across sites (Creel and Loomis, 1992). A simplified approach uses data on visitors and nonvisitors of a given site to estimate a logit model which regresses a binary participation variable on distance from the site and socioeconomic variables, ignoring substitute sites and uncertainty (Sanders, Walsh and McKean, 1991). In any case, estimation of the probability of participation requires data on both participants and nonparticipants.

The data available from our surveys does not allow for the estimation of the probability of participation and the number of trips per participant separately. However, for the empirical analysis it is sufficient to estimate the product of the two effects, i.e.

aggregate participation (N) as a function of q (i.e. flow levels). This can be done by using data on visitor numbers per day and flow levels at the study site. Thus, the effect of flow levels on aggregate participation can be estimated using time series regressions of participation on flow levels and a vector of other possibly influential variables (**c**) (Duffield, Neher and Brown, 1992). Elements of **c** could, for example, be weather indicators and weekdays versus weekends. We would expect that N (q, **c**) increases in q up to an optimum flow level for rafting and then declines.

The aggregate bid curve can then be estimated as the product between average WTP (as a function of q) per trip or per visitor day and the average total number of trips or visitor days (N) as a function of flow level (Duffield, Neher and Brown, 1992):

$$\text{Aggregate total value (TV)} = N\,(q, \mathbf{c}) * WTP\,(px, q, u; s)$$

The welfare effect of a change in q can then be represented as the sum of a participation and a quality effect:

$$\delta TV/\delta q = WTP\,(.) * \delta N/\delta q \;+\; N\,(.) * \delta WTP/\delta q\ .$$

So far we have ignored the possibility of congestion effects. Increased visitor numbers due to higher flow level may cause congestion, thereby lowering the utility obtained from the recreational activity.[10] Congestion effects can be implemented into our model by including aggregate participation N as a variable in the utility function. This would cause the Hicksian welfare measures (WTP) to depend on N as well. Aggregate total and marginal value would then be as follows (Duffield et al., 1992):

$$TV = N(q, c) * WTP(px, q, y, N; s)$$

$$\delta TV/\delta q = WTP(.) * \delta N/\delta q + N(.) * (\delta WTP/\delta q + \delta WTP/\delta N \; \delta N/\delta q)$$

Congestion effects are likely to be minimal at the two study sites where site managers impose restrictions on the number of site users per day, Ramsey Canyon and the Taos Box. Furthermore, the San Pedro RNCA is not yet a well-known site as it opened only a few years ago and congestion is not yet a problem.

[10] On the other hand, higher flow levels can raise the capacity of the river to absorb more rafters. This issue is ignored in our model, but would be one possible explanation of an absence of observed congestion effects.

4. DATA COLLECTION AND ANALYSIS

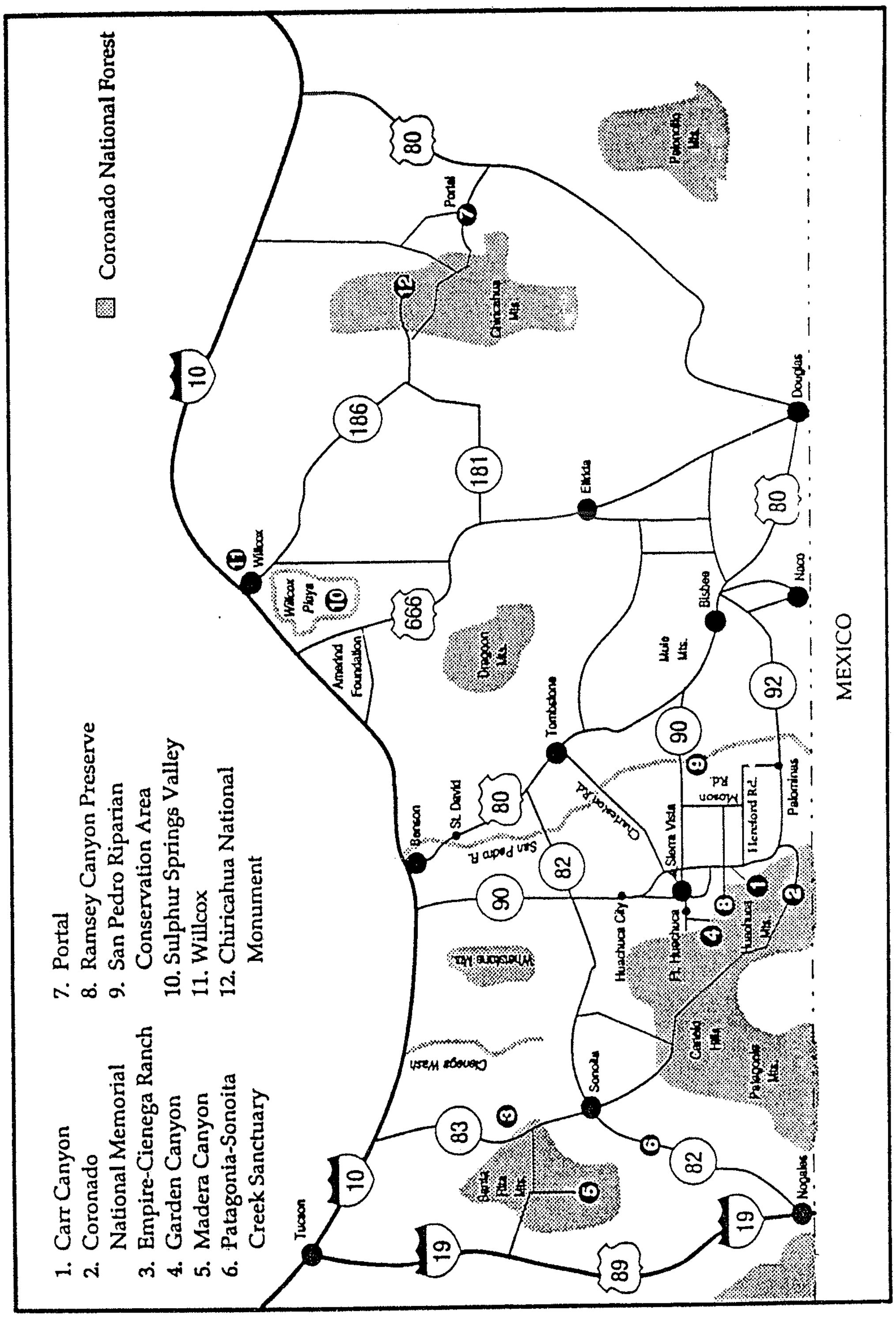
4.1 Description of the Study Sites

4.1.1 Ramsey Canyon Preserve, Southern Arizona

The Ramsey Canyon Preserve is located in Southern Arizona, ten miles from Sierra Vista (see Figure 4.1.), and covers an area of 300 acres. Since 1974, the Preserve has been owned and operated by The Nature Conservancy. It is the area's most prominent birding spot, and nationally renowned for its wide variety of hummingbirds, including the Magnificent, Blue-throated, and White-eared Hummingbirds. Moreover, due to the Preserve's proximity to Mexico, it accommodates bird species which are rarely found in other parts of the United States, like the Eared and Elegant Trogon.

The Preserve is characterized by the perennial flow of Ramsey Creek, lined by sycamores, maples, and columbines. An immense variety of vegetation ranging from desert grassland to pine-fir forest are found within the canyon. Ramsey Creek drains a section of the Huachuca Mountains originating in the Miller Peak Wilderness Area, which borders the Preserve on three sides. The creek runs underground upstream of the Preserve, and then has perennial flows above ground for one mile within the Preserve. Right below the Preserve, it again flows underground until joining the San Pedro River. In order to ensure the creek's continuous, natural flow, the Nature Conservancy acquired an instream flow right for Ramsey Creek which protects the stream from future diversions.

FIGURE 4.1, Recreational Sites in Southern Arizona



Ramsey Canyon Preserve offers two trails for visitor use, including the Hamburg Trail which provides access into the Miller Peak Wilderness area. During the peak season (April, May and August), parking constraints restrict access to the Preserve. This is part of The Nature Conservancy's effort to protect the riparian ecosystem and its habitat for rare species from degradation through overuse by visitors. Nevertheless, about 26,307 people visited Ramsey Canyon during the state fiscal year (July 1991 to June 1992) season, including about 23,628 non-residents (Crandall, Leones and Colby, 1992). Primary recreational activities at the Preserve are bird watching, wildlife viewing, and hiking.

4.1.2 San Pedro Riparian National Conservation Area, Southern Arizona

Like Ramsey Canyon, the San Pedro Riparian National Conservation Area (San Pedro RNCA) in Southern Arizona supports rich riparian habitats which are dependent on perennial streamflow. The San Pedro River enters Arizona from Sonora, Mexico, and then flows north about 100 miles before joining the Gila River near the town of Winkelman. The RNCA's river corridor runs north from the Mexican border for forty miles, and includes most of the land for several miles to each side of the river. Covering an area of over 56,000 acres in Cochise County, it is one of the most extensive riparian ecosystems remaining in the desert southwest. The San Pedro watershed has been recognized by The Nature Conservancy as one of a dozen globally significant natural areas in the Western Hemisphere.

Since 1986, the RNCA has been managed by the BLM which places a priority on the protection and enhancement of the riparian habitat. Cottonwood and willow trees dominate the riparian corridor. The ownership of the surrounding non-riparian lands by the BLM helps to protect the perennial flow of the San Pedro River and its underlying aquifer from irrigation water pumping. However, substantial groundwater pumping in this basin is believed to threaten the San Pedro River. In 1988, Congress designated the BLM San Pedro River properties as a Riparian National Conservation Area and specifically recognized a federal interest in protecting needed instream flows.

The San Pedro RNCA is nationally renowned for being one of the best overall birding spots within the country. It provides habitat for many permanently resident species as well as an important migratory corridor for thousands of migratory birds. Over two-thirds of North America's inland bird species have been sighted along the San Pedro river. Moreover, the RNCA provides breeding habitat for forty percent of the Gray Hawks nesting in the U.S. and also for the rare Green Kingfisher. The RNCA also supports a variety of species of mammals, fish, amphibians and reptiles.

The San Pedro RNCA is open to the public for walking, bird and wildlife viewing, picnicking, nature study and environmental education and other nonconsumptive uses. The RNCA also includes several archeological sites like the Lehner Mammoth Kill Site and the Presidio Santa Cruz Terrenate, which are popular destinations for visitors. Moreover, fishing is permitted in various ponds. Bow hunting is allowed throughout the RNCA and during all seasons. Hunting with firearms is permitted from September to

March in restricted areas only.

There are five parking areas and access points at major roads crossing the RNCA. For this study, the Highway 90 crossing, five miles east of Sierra Vista, was chosen as the visitor contact point, because it is the most frequently used access point and is especially popular among bird watchers. There are no formal records on visitation rates for San Pedro RNCA. Crandall, Leones and Colby (1992) estimated a total number of 11,712 visitors for the fiscal year (July 1, 1991 to June 30, 1992), including 5271 non-residents and 6441 visitors on day trips ("local residents"). The estimates are only for the most popular access point, the Highway 90 entrance. Thus the estimated number of visitors is lower than the actual number.

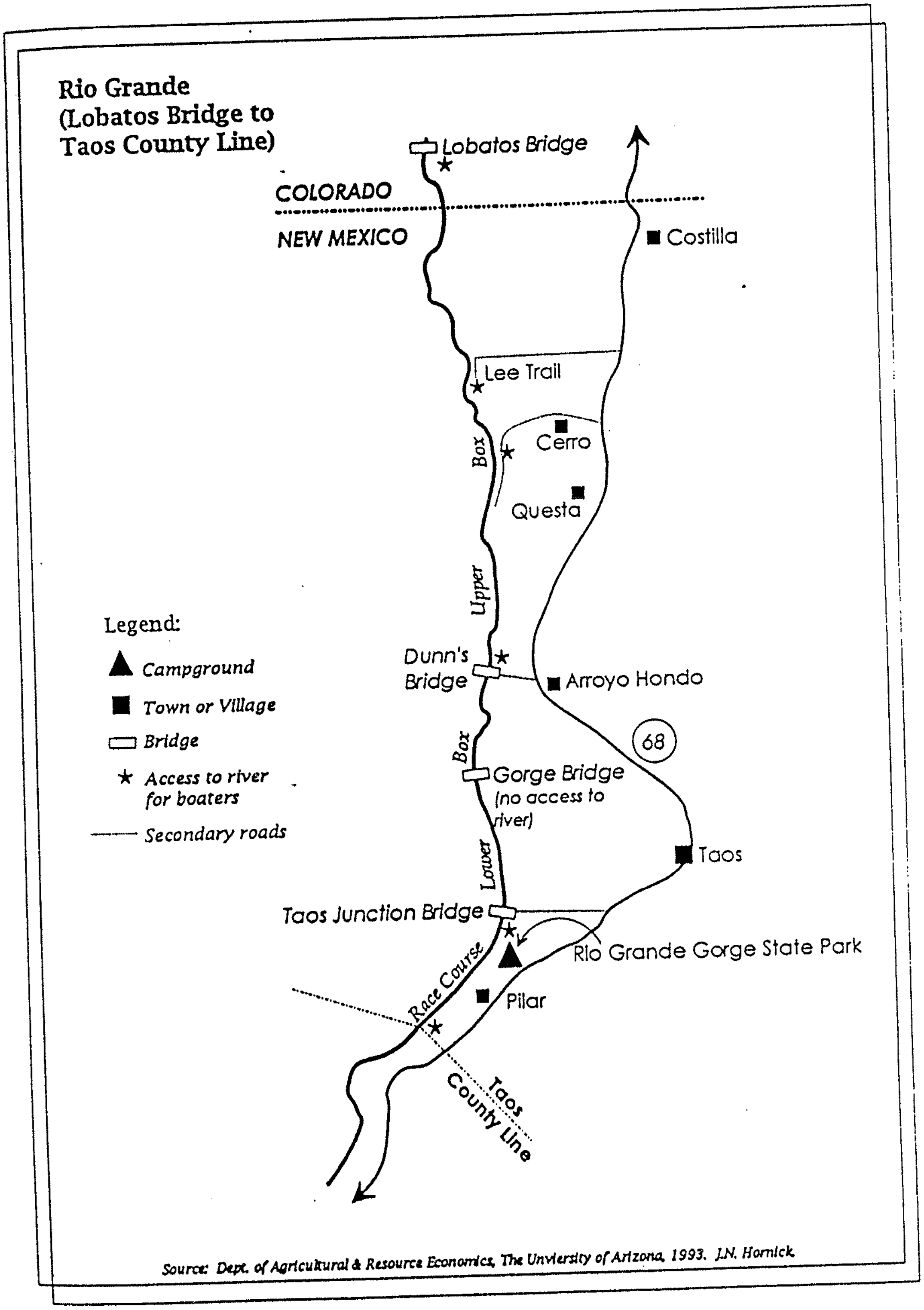
4.1.3 Rio Grande, Taos Box, Northern New Mexico

The Rio Grande originates in the San Juan mountains on the west side of the San Luis Valley in southern Colorado. The Taos Box section of the Rio Grande in northern New Mexico is part of the Rio Grande Wild River Recreation Area which consists of a 48 miles stretch of the river from the New Mexico/Colorado border south to the Taos Junction Bridge, New Mexico (Bureau of Land Management (BLM), 1984). The reach of Rio Grande was one of the first rivers in the United States to be protected under the Wild and Scenic Rivers Act and has been managed by the BLM since 1968. The entire area is part of Taos County, New Mexico. The land along the river is divided among BLM, Indians and private owners. The river environment offers possibilities for many recreational activities including fishing, hiking, picnicking and wildlife viewing. Vegetation varies from the pinyon-juniper type dominated by sagebrush understory in the area above the gorge rim to rich riparian vegetation with cottonwoods and ponderosa pine in the inner canyon. The vertical, up to 800 feet high cliffs along the Rio Grande provide habitat for numerous bird species, including golden and bald eagles and red-tailed hawks. The streams have a reputation for large rainbow and German brown trout. Several prehistoric sites can be found within the area.

The upper Rio Grande offers one of the best white water rafting opportunities in New Mexico, through the Lower Taos Box. The Lower Taos Box begins at the John Dunn Bridge Recreation Site ("put-in") and extends south for 16 miles to the Taos Junction Bridge ("take-out") (see Figure 4.2). These two bridges are the only access points for vehicles within the entire area. The run leads through one of the most scenic sections of the Rio Grande Gorge and exhibits strong and abrupt pool/drop rapids which create a medium to very difficult (Class III to V) white water run depending on flow level (Anderson and Hopkinson, 1982). Proximity to the popular resorts in Taos and easy access to the river have led to good business opportunities for commercial rafting. A river running permit is required by the BLM which restricts the number of users. The main river rafting season extends from April through July, based on a recommended safe runable flow level of 900 cubic feet per second (cfs) (BLM, 1984). By late August, the river flows often become too low for rafting.

The rafting experience at the Taos Box is sensitive to water flow levels.

FIGURE 4.2, The Rio Grande in Northern New Mexico



Maximum flows generally occur in April, May, and June. Streamflows in the Rio GrandeGorge are affected by four conditions: (1) snowpack in the mountainous headwaters in Colorado; (2) rainfall during intense summer storms; (3) upstream diversions for irrigation in the San Luis Valley, Colorado; and (4) accretion from the ground water table (BLM, 1984). There is no direct diversion of streamflows within the Rio Grande Wild River Recreation Area. In 1985, the San Luis Valley Water project was implemented in southern Colorado. The project provides water for stream flows by pumping the Valley's surplus of ground water back into the Rio Grande for irrigation purposes. In 1985, it was expected to provide 80 to 160 cubic feet per second (cfs) to the river in New Mexico (BLM, 1984).

Table 4.1 shows average daily flow levels (in cubic feet per second (cfs)) and minimum and maximum flows on the Taos Box during the 1990 to 1992 rafting seasons as reported by the U.S. Geological Survey. While 1990 was a year of fairly low flows and 1991 exhibited relatively high cfs levels, flow levels in 1992 were about average. The lowest flow during the 1990-1992 rafting seasons occurred toward the end of August in 1992, while the maximum flow observed during the same period occurred on May 23, 1991.

TABLE 4.1, Flow Levels on the Taos Box during the 1990-1992 Rafting Seasons

	Average flow level (cfs)		
Month	**1990**	**1991**	**1992**
April	373[1]	1118[2]	1495[3]
May	874	1566	839
June	537	1141	863
July	385	560	357
August	353[4]	481	383
September	-	444[5]	326[6]
Minimum (date)	309 (8/15)	265 (9/2)	263 (8/24)
Maximum (date)	1950 (5/10)	3600 (5/23)	2200 (4/17)

Source: Adapted from USGS records

Visitor use at the Rio Grande Wild River Recreation Area has increased steadily. The proximity of the "Enchanted Circle" resort triangle which consists of Taos and several other resort communities enhances the flow of visitors and recreationists into the

[1]starting April 20

[2]starting April 20

[3]starting April 8

[4]until August 20

[5]until September 27

[6]until September 8

area. Boating use has been documented by the BLM since the implementation of permit requirements in 1979. The locational origin of boaters is diverse as commercial outfitters draw visitors nationwide. Seven commercial river outfitters currently are permitted by the Bureau of Land Management to provide trips to the public. Presently, the BLM allows 8 launches per day (one company having two permits), with 21 people per launch on weekdays and 26 on weekends. Commercial outfitters offer one, two and three day trips on the Taos Box. One day trips start at the John Dunn Bridge and last about 5 to 7 hours depending on river flows. Two and three day trips include one and two overnight stays on the river, respectively, and start a few miles upstream of John Dunn Bridge at La Junta, which is only accessible by foot. All trips end at the Taos Junction Bridge. Table 4.2 shows average and total numbers of visitors on commercial launches starting on a given day, as reported to the BLM by rafting companies for the period from 1990 to 1992.

TABLE 4.2, Commercial Rafting Trips at the Taos Box during the 1990-1992 Rafting Seasons

	Average daily participation (# of trips)		
Month	**1990**	**1991**	**1992**
April	5[7]	16[8]	12[9]
May	30	68	73
June	24	100	108
July	6	35	27
August	5[10]	11	9
September	-	7[11]	4[12]
Total annual trips	1720	6688	6728

Source: Adapted from BLM records

[7]starting April 20

[8]starting April 20

[9]starting April 8

[10]until August 20

[11]until September 27

[12]until September 8

4.1.4 Rio Grande, Lower Gorge, Northern New Mexico

The Lower Gorge of the Rio Grande starts at the Taos Junction Bridge in the Orilla Verde Recreation Area and is 11 miles long. Recreational opportunities are the same as for the Taos Box. The upper five miles section of the Lower gorge to Pilar is relatively calm and leads through a deep canyon with black basalt walls at the Orilla Verde Recreation Area. The most popular stretch of the Lower Gorge is the "Racecourse", which extends for about five miles along the State Highway 68. The stretch is named after an annual white water race held here in early spring. The put-in for the Racecourse is just below Pilar, and the take-out is located at the County Line Recreation Site (see Figure 4.2.).

The BLM manages this stretch of the river, but does not impose restrictions on numbers of users. Most of the land along the Racecourse is privately owned. Due to its proximity to the highway 68 and the much wider gorge the Racecourse does not exhibit the spectacular scenic beauty that the Taos Box does. The run is less demanding than the Taos Box: rapids are longer but of only medium difficulty (Class III). Nevertheless, this run draws large numbers of rafters, exceeding 500 per day on some weekends. Commercial trips in the Lower Gorge are less expensive than in the Taos Box. Because of this and the lower degree of difficulty, visitors on rafting trips in the Lower Gorge are usually less experienced river runners. Seventy-nine percent of the visitors contacted as part of this study were rafting for the first or second time in their lives.

Parking and public facilities are available at the Taos Junction Bridge and the

County Line Recreation Area. Outfitters offer "half day" trips on the Racecourse, both in the morning and in the afternoon, as well as full day trips which start just below the Taos Junction Bridge. The full day trips are less popular because the river flow at the first five miles of the run within the Orilla Verde Recreation Area is very calm.

The rafting season in the Lower Gorge lasts from March until October in average years. Because of the wider gorge and less difficult rapids, the quality of the rafting experience at the Lower Gorge is not as strongly affected by streamflows as is the Taos Box. Tables 4.3 and 4.4 show average, minimum, and maximum daily flow levels and numbers of visitors on commercial rafting trips during the 1990 to 1992 rafting seasons. Flow levels on the Lower Gorge usually exceed those on the Taos Box because of the confluence of the Red River with the Rio Grande just above the Taos Junction Bridge. The highest observed flow during the 1990-1992 rafting seasons occurred in the last third of May, 1991, while the minimum flow level during this period occurred in mid September 1990. As for the Taos Box, 1990 was a low flow year, 1991 a high flow year, and 1992 exhibited about average flow levels.

TABLE 4.3, Flow Levels on the Lower Gorge during the 1990-1992 Rafting Seasons

	Average flow level (cfs)		
Month	**1990**	**1991**	**1992**
April	509[13]	1542	1791
May	903	1961	1109
June	576	1449	1009
July	440	655	379
August	364	586	391
September	274	527	317
October	440	325[14]	294[15]
Minimum (date)	235 (9/16)	292 (10/19)	271 (9/20&10/8)
Maximum (date)	2080 (5/11)	4390 (5/22&23)	2670 (4/16)

Source: Adopted from USGS records

[13]starting April 18

[14]until October 26

[15]until October 29

TABLE 4.4, Commercial Rafting Trips at the Lower Gorge during the 1990-1992 Rafting Seasons

	Average daily participation (# of trips)		
Month	**1990**	**1991**	**1992**
April	9[16]	9	28
May	45	86	100
June	107	175	177
July	135	209	266
August	111	203	240
September	24	24	54
October	10	9[17]	3[18]
Total annual trips	12998	21695	26340

Source: Adopted from BLM records

[16]starting April 18

[17]until October 26

[18]until October 29

4.2 Demographic and Economic Characteristics of the Study Areas

4.2.1 Southern Arizona

Arizona is one of the most rapidly growing states in the U.S. with annual population growth averaging 4.5 percent between 1985 and 1988 (compared to 1 percent for the whole U.S.). Tourism is a major industry in the state of Arizona. More than 22.4 million people visited Arizona in 1990, spending approximately $6.7 billion dollars (Arizona Hospitality Research and Resource Center, 1992).

Sierra Vista is one of the fastest growing communities in rural Arizona. Its population increased by almost 26 percent between 1976 and 1985 to about 28,790 inhabitants (Zube, Friedman and Simcox, 1989). Because of its elevation (4600 ft), Sierra Vista has a more comfortable climate than most other cities in southern Arizona. As a consequence, Sierra Vista is a popular retirement community. The community can be characterized as rural to suburban in character. Although Sierra Vista City and adjacent Huachuca City have been growing rapidly and diversifying their economies in the last few years, both cities remain very dependent on the Fort Huachuca military base. 36.8 percent of all employment in Cochise County is related to the presence of the Fort. Fort Huachuca is estimated to provide 11,420 jobs and an annual spending of $460 million in the local economy. Compared to the military sector, other sectors, like tourism and recreation, appear relatively small. General tourism brings approximately $180 million in expenditures to Cochise County. Crandall, Leones and Colby (1992) estimate that expenditures from nature-based tourism at Ramsey Canyon and the San Pedro RNCA resulted in approximately $2.1 million in total output and 38 jobs in the Sierra Vista area in the fiscal year from July 1, 1991 to June 30, 1992.

In the short run, Fort Huachuca is likely to continue growing, as it absorbs personnel from other military bases that have been closed. However, tourism has an important role in diversifying the local economy. If military downsizing starts to affect the area in the longer run, the existence of other industries will be needed in order to replace lost military-linked jobs and income. Nature-based tourism, like birding at the San Pedro RNCA and Ramsey Canyon, helps to even out visitor activity across the seasons, since this kind of tourism peaks during spring and summer, thereby complementing the winter visitor peak season.

As nature-based activities become more popular and the number of retirees in the U.S. population grows, the importance of nature-based tourism for areas like Cochise County is likely to increase. The attractiveness of Ramsey Canyon and the San Pedro RNCA depend crucially on the maintenance of adequate streamflows. On the other hand, Sierra Vista and Huachuca City are both totally dependent upon groundwater to meet their municipal and military water needs (Zube, Friedman and Simcox, 1989). The continuing rapid growth of the community increases groundwater pumping, which threatens to lower surface water flows and thereby the riparian habitat at the San Pedro RNCA. Therefore, it is important that policy makers recognize the linkage between groundwater and surface water flows and their importance for tourism at the San Pedro RNCA and seek a sustainable development strategy for the area.

4.2.2 Northern New Mexico

New Mexico in general

In 1980, the population of New Mexico was 53 percent Anglo-American, 36.6 percent Hispanic, and almost 8 percent American Indian. Compared to most other states, New Mexico has low income levels and high poverty rates. The State's economy is highly affected by the federal government's spending patterns. In the mid-1980s, five out of New Mexico's six largest employers were federally funded research and development centers or military installations.

New Mexico is one of the fastest growing states in the U.S. However, most of the jobs are in metropolitan counties while many of the inhabitants of New Mexico, mainly Hispanics and Native Americans, still live in rural areas. Traditional sources of income in rural communities like mining, timber harvesting, and military employment have decreased. As a consequence, the state's per capita income has declined significantly over the past twenty years and income inequalities have increased. New Mexico has sometimes been called a colonial economy because it supplies natural resources to more prosperous regions, while "importing" high-priced finished products. Nature-based tourism, however, is one of the few growing sectors in rural areas. Tourism is the state's largest private sector employer (BLM, 1984).

Taos County, northern New Mexico

With an area of 2,200 square miles and a population of about 22,000 in 1985, Taos County is a relatively large county with a low population density (County of Taos, 1988). Economic activity in Taos County is limited by several factors, including scarce water supplies, the low population density, and the unique system of land ownership. More than 50 percent of the land in Taos County is federally owned, while only about 38 percent is privately owned. In addition, the local economy is influenced by the prevalence of Indian reservation land. Due to the high percentage of federally owned land, Taos' economy depends largely on decision made by the federal agencies managing the land.

Due to its limited economic base, Taos County is characterized by low per capita incomes and high unemployment. In 1984, the per capita income of Taos County was only 81 percent of the state level and 66 percent of the U.S. level. With an unemployment rate of 27.8 percent in 1986, the level of unemployment in Taos County is far above the state level of 9.2 percent.

The population of Taos County is relatively young. In 1980, about 45 percent of the population were younger than 25. In 1980, more than 69 percent of the population of Taos County was Hispanic, 6.4 percent were American Indians, and only every fourth person was Anglo. The 1980 census shows, that Anglos more often have relatively well-paid jobs which require a higher level of education, while Hispanics and Indians are more likely to be employed in services and other low-wage jobs (County of Taos, 1988). Since the 1970s, the Anglo share of the population has been growing steadily due to in-migration. New residents tend to have a high proportion of retirees, and relatively high education and income levels (Stevens, 1991).

Tourism is important in the local economy. The county attracts historically and culturally interested tourists as well as summer and winter outdoor recreationists. The United States Travel Data Center for the State of New Mexico Economic Development and Tourism Department estimated that Taos County travel-related expenditures in 1983 comprised $42 million and created 1,200 jobs. This is about 3 percent of the travel-related economic activity in New Mexico, twice as much as Taos County's share of the New Mexico population. In addition to the high long-term unemployment rate, the strong dependency on winter and summer tourism causes a high level of seasonal unemployment, with an employment low in April and a high in January due to the ski season.

Commercial agriculture and manufacturing are relatively unimportant sectors of the Taos economy. However, subsistence-level grazing and farming is quite common among Hispanic and Native American residents (Stevens, 1991). About 50 percent of the population of Taos County lives in rural areas. For many Hispanic and Native American residents, agriculture is an important part of their cultural traditions. Due to strong variations in temperatures over the year and relatively little rainfall, agriculture in Taos County depends on irrigation. As a consequence, it competes with development projects, and tourism for scarce land and water resources. Grazing on public lands is another controversial issue. In northern New Mexico, economic growth, in-migration by relatively wealthy Anglo Americans, and the growth of the tourism sector, which also attracts mainly Anglo Americans with relatively high income levels, have caused some "anti-tourism, anti-newcomer" sentiments especially in the traditional Hispanic population (Stevens, 1991). There is a feeling that these economic developments are undermining the traditional ways of life. The unique traditional community ditch systems (acequias) have considerable political clout. Acequia leaders have opposed policies to protect flow levels on the Rio Grande and other New Mexican streams because they fear that such policies could restrain their irrigation water use.

Residential development and nature-based tourism also compete for scarce resources. Summer tourists mainly come for water-based recreational activities which depend to various degrees on flow levels. On the other hand, the strong population and development pressure increases the demand for water in alternative uses.

A 1994 study (Ryan, 1994) estimated that whitewater rafting on the Rio Grande generates over $4.6 million in local economic activity and creates about 142 jobs per year. However, rafting opportunities strongly depend on flow levels, and low water supplies from Colorado are cutting off the rafting season in the Taos Box in the middle of the summer recreation season. The above study estimated that if flows could be maintained at adequate levels for high quality whitewater rafting through Labor Day weekend, this could generate an additional $3.3 million in local economic activity and 100 additional jobs. Higher flows across the Colorado/New Mexico border would also benefit riparian habitat, fish and wildlife, as well as the acequias.

4.2.3 San Luis Valley, Southern Colorado

The San Luis Valley (SLV) of southern Colorado is of interest for this study since it is the main consumptive water user upstream from the northern New Mexico Rio Grande. Water use in the San Luis valley therefore affects instream flows of the Rio Grande in Northern New Mexico, and any policy measure to increase flow levels of the Rio Grande would require a restriction in the consumptive water use of the SLV.

The San Luis Valley consists of six counties, and is located about 100 miles from Denver and Albuquerque. It is a rural area with a population of approximately 40,900 in 1986, 43.4 percent of which was Hispanic. The SLV has the lowest per capita incomes in the state of Colorado, and is characterized by high unemployment rates, ranging from 13 to 29 percent in 1987, and a high number of workers earning poverty level incomes. (SLV Regional Development and Planning Commission (SLVRDPC), 1987). Many younger people are leaving the area to find opportunities elsewhere. Nevertheless, the population of San Luis Valley was growing at an annual rate of 7.8 percent between 1980 and 1986, reflecting a strong attachment to the area (SLVRDPC, 1987). Services, including schools and colleges, are the fastest growing sector. The region also has several attractions for nature-based tourism, including the Alamosa National Wildlife Refuge, Rio Grande National Forest and the Great Sand Dunes National Monument.

Irrigated agriculture is the Valley's largest source of employment. However, agriculture accounts for less than one quarter of total earnings and property tax base in the Valley. Approximately 39 percent of the total irrigated acres are used for irrigated pasture, 32 percent for alfalfa and other hay, 17 percent for barley, and 12 percent for grain oats, potatoes, spring wheat and vegetables (Salazar, 1986). Annual water diversions for irrigation amounted to about 2 million acre feet, with irrigated pasture accounting for 46 percent of the diversions, and alfalfa and other hay accounting for 35 percent. At the same time, irrigated pasture and hay crops are the least profitable. An acre foot of water applied to these uses generates less than 4 dollars in net returns (Salazar, 1986). Barley and potatoes account for approximately 14 percent of total water diversions for irrigation, but generate much higher profits. Net returns of an acre foot of water are about $30 for barley and $120 to 135 for potato production (Salazar, 1986).

Water resources are a limiting factor of the region. In most years, there is a shortage in water supply for irrigation in late summer, which often causes crop damage. Municipal water demands are expected to increase, but to stay at less than one percent of the expected agricultural demand. Agricultural water users in the San Luis Valley are fairly well organized in local conservancy districts, ditch companies, drainage districts and water user associations. In 1967, Colorado established the Rio Grande Water Conservation District, which has the purpose of coordinating water development, management and policy in the San Luis Valley (Colby and Harris, 1993). In response to concerns about the Valley's water supplies, the Bureau of Reclamation is building the Closed Basin Project, which is planned to produce about 104,000 acre feet of water through pumping of shallow groundwater. About 60 percent of the additional water is earmarked for existing water users, and several thousand acre feet are designated for wildlife enhancement in Colorado.

Colorado has certain obligations to supply water to the downstream states New Mexico and Texas, and to Mexico. In 1906, the U.S. signed a treaty with Mexico, stating that an annual volume of at least 60,000 acre feet of water have to be supplied to Mexico. In 1939, the Rio Grande Compact was ratified, which obliges Colorado to deliver certain annual amounts of water to the downstream states via Rio Grande surface flows. The annual volume of water to be delivered at the Colorado/New Mexico border depends on annual runoff in the head waters, and varies from about one-fourth of the runoff in dry years to almost two-thirds in wet years. Obligations are zero under full reservoir conditions at Elephant Butte Reservoir downstream in New Mexico.

The Compact does not regulate the timing of the water supplies to New Mexico. Consequently, stream flows of the Rio Grande in northern New Mexico fluctuate from day to day, and depend on water use patterns in the San Luis Valley. Flows often are extremely low in late July, August and September. Extreme fluctuations and low level of flows are affecting the riparian habitat, fish and wildlife, and recreational opportunities on the Rio Grande in northern New Mexico.

4.3 Survey Design and Implementation

This thesis is based on data collected as part of several larger research projects under the direction of Dr. Bonnie G. Colby. The design of the individual surveys varies with the focus of the larger research project. Moreover, CVM questions were varied slightly within the same project to test for the effects of different survey designs. Site users were contacted in person at each of the four sites and asked if they were willing to complete a survey. Preliminary questions were asked to allow testing for non-response bias. Visitors who were willing to participate were sent a mail survey two weeks after the visit. This procedure tends to improve response rates compared to a mail survey that is not preceded by personal contact, and it is less costly than a full person-to-person survey thus providing a larger sample size for a fixed research budget. If a completed survey was not received two weeks after mailing, a reminder and follow-up procedure was used to improve response rates. First, a reminder postcard was sent, followed by another survey mailing two weeks later. Copies of the individual surveys and contact sheets are included in Appendix A.

4.3.1 Ramsey Canyon Preserve

The mail survey sent to Ramsey Canyon Preserve visitors started with several questions about the specific trip, other sites visited during the trip and primary reasons for visiting Ramsey Canyon. Then, an open-ended CVM question was asked using a payment card. The open-ended direct question format has been recommended by federal guidelines for small projects. Respondents were asked how much they would be willing to pay in form of a one time contribution to a non-profit organization, whose only purpose is to preserve Ramsey Canyon's riparian habitat and its diverse bird and wildlife species. This payment vehicle has been recommended by federal guidelines to avoid payment vehicle bias stimulated by methods of payment like a user fee or a tax (Sanders, Walsh and Loomis, 1990). Respondents were asked to assume that without sufficient contributions the riparian habitat and its species diversity would disappear.

The next questions elicited the non-use values associated with the preservation of Ramsey Canyon. Respondents were asked how much they would still be willing to pay if the site would not be open for visitors at all. If respondents indicated a positive nonuse value they were then asked their main motivation for this.

Zero bids were tested for protest answers by asking respondents their motivations for indicating a WTP of zero. Finally, several questions on the socioeconomic characteristics of respondents were asked.

Interviews were conducted on 45 randomly selected contact days during the spring 1992 season (February to May). As many visitors as possible were randomly contacted. Only non-resident visitors who indicated that they were bird-watching were mailed a survey. The survey focused on birders because it was being conducted in collaboration with the Cape May Bird Observatory, which is interested exclusively in birders. 745 contacts were made. Out of these 34 percent were non-birders, 2 percent were local birders, and 3 percent refused to participate in the study. The remaining 61 percent of the total number of people contacted (453 people) were sent surveys.

4.3.2 San Pedro RNCA

The survey design for the San Pedro RNCA was very similar to the one for Ramsey Canyon. However, two different surveys were used here according to whether respondents stayed overnight in the area-(non-resident survey) or not (local resident survey). The same payment vehicle as described above was used. However, the description of the good to be hypothetically purchased was slightly different. Respondents were asked their WTP for the preservation of the San Pedro RNCA riparian habitat and the guarantee that Gray Hawk populations will continue to exist at the site. It was assumed that without adequate contributions Gray Hawks would no longer be found at the San Pedro RNCA. Before, respondents were asked how many times they had seen a Gray Hawk to measure the respondents' experience with the good to be valued.

Nonuse values were measured in a similar way as for Ramsey Canyon. Instead of assuming that the site would be closed for all visitors, in this case respondents were to assume simply that they personally would never visit the San Pedro RNCA again. This allowed for a nonuse value due to satisfaction obtained from knowing that others could use the site.

Interviews at the San Pedro RNCA were conducted on 46 randomly selected days during the Spring 1992 season. Every visitor was contacted on these days. Here, all visitors were included in the sample regardless of whether or not they visited the site primarily for birdwatching. In addition to eliciting socioeconomic information on the respondents, the personal interviews also contained questions on the total and nonuse

WTP of the respondent. However, the object of valuation in the interviews differed from the one in the surveys. In the personal interviews, respondents were shown photos of a river landscape at continuous, reliable, as well as at intermittent, irregular flows. The respondents were then asked to indicate their WTP to preserve the continuous, reliable flows at the San Pedro RNCA and the wildlife and riparian habitat it supports. The payment vehicle and nonuse scenario was the same as in the surveys. The interviews also included a question aimed at testing how realistic people are in their WTP bids. Respondents were asked to consider how they would finance their total WTP bid, i.e. which other items in their household budget they would spent less on. Then, respondents were given the opportunity to reconsider their initial WTP statement.

A total number of 554 people were contacted at the San Pedro RNCA. This included 305 locals and 249 non-residents. About 10.2 percent of the people contacted refused to participate in the study, while 89.8 percent (497 people) were willing to participate in the study and were sent surveys.

In most of the more extensive analysis in this thesis I will focus on the sample of non-resident visitors and on the WTP data obtained from the mail surveys because it is the most comparable to the Ramsey Canyon data. Most of the analysis for the sample of local visitors and the WTP data obtained in the personal interviews is reported in Appendix E.

4.3.3 Rio Grande, Taos Box and Lower Gorge

The Rio Grande surveys were designed in a similar way as the two Arizona surveys. However, these surveys focused on commercial river-rafting and related the WTP bids explicitly to flow levels. The following three slightly different survey versions were used:

COMMERCIAL TAOS (CT): for visitors on commercial rafting trips on the Taos Box,

NONEXPERIENCED COMMERCIAL GORGE (CG): for visitors on commercial rafting trips on the Lower Gorge who indicated that they had rafted less than three times in their life,

EXPERIENCED COMMERCIAL GORGE (ECG): for visitors on commercial rafting trips on the Lower Gorge who indicated that they had rafted at least three times in their life.

In the WTP part of the surveys, the flow level on the contact day was reported to respondents, and respondents were asked whether this level was too low, too high, just adequate or ideal for safe and enjoyable river running. They were then asked how much more in additional river running expenses they would have been willing to pay for this experience. This question measures consumer surplus for the current flow level. The next question asked respondents how much they would be willing to pay for guaranteed higher flow levels during the summer season through Labor Day weekend. The hypothetical guaranteed flow level was varied randomly across individual surveys, representing an increase of 100-1000 cubic feet per second (cfs) above the flow level experienced.

The latter WTP question varied slightly between the three versions. The CT and ECG surveys asked respondents for their WTP in terms of an additional fee, in addition to what they indicated in the first WTP question. For the CG survey, the payment vehicle chosen was a regular annual contribution to a non-profit trust fund, whose only objective is to acquire water supplies to assure the provision of ideal flow levels during all summer season, which would benefit recreationists, fish and wildlife, and the streamside ecosystem. Respondents were asked to assume that without such a trust fund, flow levels would drop too low for safe river running by mid-summer, and trips would have to be canceled for certain stretches of the river.

The CG survey also included some additional questions. Similar to the San Pedro RNCA survey, respondents were asked to state the amount they would still be willing to pay to the non-profit trust fund if they personally would never visit the Rio Grande again. Then, the main motivation for a positive nonuse value was elicited. Finally, like the personal interviews at the San Pedro RNCA, the CG survey included a question asking respondents which part of their household budget they would spend less on in order to finance their total WTP bid, and whether they want to change their bid after reconsidering their budget constraint.

Contact points for the on-site surveys were the take-out points, i.e. the Taos Junction Bridge area for the Taos Box and the County Line Recreation Site for the Lower

Gorge. The contacts were made by two researchers during the period from May 15th and August 2nd, 1992, six days a week, including all weekend days. Because of the shorter and less reliable season at the Taos Box, interviews were conducted at the Racecourse during the morning and at the Taos Box in the afternoon until the end of the Taos Box season in the beginning of July. Thereafter, all effort was concentrated on the Racecourse, allowing surveyors to account at least partially for the strong afternoon visitation there. The contact procedure was to randomly contact 20 percent of each party taking-out of the river. Table 4.5 shows the total number of contacts made at the two contact points, and the refusal and participation rates. Only rafters who are not residents of northern New Mexico were included in this study. Approximately 89 percent of the Taos Box rafters and 83 percent of the Lower Gorge rafters were non-residents. This indicates that the vast majority of recreationists on commercial rafting trips come from outside northern New Mexico.

TABLE 4.5, Contact and Participation Rates for the New Mexico Surveys

Contact Point	Number of Contacts	Agreed to participate in the study	Participation Rate
County Line	1337	1293	96.7%
Taos Junction Bridge	814	778	95.6%

4.4 Summary of the Data and Procedures

4.4.1 Response Rates

Table 4.6 and 4.7 show the response rates for all surveys as well as the final sample size. Invalid surveys were those answered by respondents who indicated they are under 18 years of age. The response rates are relatively high for a mail survey, partially due to the in-person contacts which preceded the mailing of the surveys. In general, respondents seem to have a high interest in the sites. The response rate for the San Pedro RNCA surveys is higher for nonresidents than for residents.

TABLE 4.6, Response Rates for New Mexico

Survey Type	Sent	Received	Response Rate	Invalid
Commercial Taos (CT)	778	590	76 %	4
Experienced Commercial Gorge (ECG)	275	221	80 %	0
NONEXPERIENCED Commercial Gorge (CG)	1018	749	74 %	5

TABLE 4.7, Response Rates for Arizona

Survey Type	Sent	Received	Response Rate	Invalid
Ramsey Canyon Preserve	453	417	92 %	1
San Pedro / Local Residents	273	201	74 %	6
San Pedro / Nonresidents	224	214	95 %	12

A detailed description of the socioeconomic characteristics of the respondents for all surveys is given in Appendix B.

4.4.2 WTP Responses

The abbreviations used in the subsequent discussion of the various WTP measures are defined in Table 4.8. A complete list of all variables used in the data analysis and their definitions is given in Appendix C. Tables 4.9 to 4.10 show the average WTP bids for all surveys. Protest bids were excluded from the analysis. Details on the definition and treatment of protest bids, non-response rates, and general data-cleaning, are given in Appendix D.

TABLE 4.8, Definitions of WTP measures

Abbreviation	Definition
New Mexico:	
RAFTEXP	actual river running expenses
WILLPAY	WTP for flow level experienced in terms of additional river running expenses
ADDPAY	WTP for guaranteed higher flow level and extended river running season -for ECG and CT: in terms of river running expenses, in addition to WILLPAY -for CG: as a regular annual contribution to a non-profit trust fund
Ramsey Canyon:	
TOTWTP	total WTP in form of a one-time contribution to a non-profit organization in order to assure protection of Ramsey Canyon as a nature preserve
NONUSEWTP	portion of TOTWTP that respondent is still willing to pay if Ramsey Canyon would not be open to visitors at all
San Pedro:	
TOTWTP	total WTP in the form of a one-time contribution to a non-profit foundation in order to protect Gray Hawks at San Pedro RNCA (from survey)
NONUSEWTP	portion of TOTWTP that respondent is still willing to pay if she will never visit San Pedro RNCA again (from survey)

TABLE 4.9 (a-b), WTP Bids for New Mexico Data

a) WILLPAY and RAFTEXP

Survey Type	WILLPAY		RAFTEXP		WILLPAY+RAFT EXP	
	Mean	SD	Mean	SD	Mean	SD
Taos Box	22.70 (20.64 /day)	30.39	92.97 (84.52 /day)	56.98	115.67 (105.15 /day)	68.77
Lower Gorge						
All rafters	17.03	25.75	41.66	30.26	58.69	41.82
Experienced	20.10	29.02	44.91	30.88	65.01	46.94
Non-exp.	16.11	24.63	40.68	30.03	56.79	40.00

b) ADDPAY

Survey Type	Mean	Standard Deviation
Taos Box	25.58 (23.25/day)	46.67
Lower Gorge /Experienced	17.41	19.45
Lower Gorge /Non-exp.	11.29	26.70

TABLE 4.10, WTP Bids for Arizona Data (Mail Surveys)

Survey Type	Mean	Standard Deviation
Ramsey Canyon	101.67	175.70
San Pedro RNCA /Locals	45.54	63.99
San Pedro RNCA /Nonresidents	69.03	144.64

The average actual rafting expenditures (RAFTEXP) as well as the WTP for the experienced flow level (WILLPAY) and higher guaranteed flows (ADDPAY) is higher for Taos Box rafters than for experienced Lower Gorge rafters. The average WTP for the experienced flow level is also higher for the Taos Box survey than for nonexperienced rafters on the Lower Gorge. This might be due to a higher level of Taos Box rafters' dedication to rafting in northern New Mexico. Statistics on the respondents' characteristics, as shown in Appendix B, show that Taos Box rafters, on average, spend more days visiting northern New Mexico in a typical year, are rafting more days per year, consider rafting a more important reason for their trip, and contain a higher percentage of people who previously have rafted in northern New Mexico.

Comparing the WTP answers of experienced and nonexperienced rafters on the Lower Gorge, it is important to keep in mind that ADDPAY was defined differently in the two surveys. Experienced rafters were asked for their WTP in terms of river running expenses and in addition to what they indicated as WILLPAY. By contrast, nonexperienced rafters were asked for their WTP in terms of a regular annual contribution to a non-profit trust fund (independently of their answer for WILLPAY). Therefore, the numerical answers for ADDPAY cannot be compared between the two surveys.

The comparison of the answers for WILLPAY between experienced and nonexperienced rafters shows that experienced rafters would have been willing to pay more in additional river running expenses for the trip experienced than nonexperienced rafters. A higher degree of dedication to rafting by experienced rafters is a possible explanation for this observation. However, experienced rafters more commonly perceived the flow level experienced as too low, while less experienced rafters were more often content with the rafting trip. The higher WTP bids of experienced rafters seem to indicate that the stronger dedication to river running more than compensates the less favorable perception of the flow level experienced.

Comparing average WTP bids obtained from the three Arizona surveys shows a significantly higher average WTP for Ramsey Canyon than for the San Pedro RNCA. Within the San Pedro data non-residents show a significantly higher average WTP than local residents. The average WTP of San Pedro RNCA respondents reported in table 4.10. was obtained from the mail surveys. A detailed discussion of the differences between mail and in-person surveys is given in Appendix E.

The benefit transfer analysis in the next chapter will discuss to what extent differences in average WTP across sites can be explained by differences in socioeconomic and other characteristics of the visitor population and to what extent they are due to differences in site quality.

4.4.3 Nonuse Values

Another aspect of the data analysis is that of nonuse values. Questions to elicit nonuse values were included in the surveys for Ramsey Canyon, San Pedro RNCA, and the Non-experienced Commercial Gorge. Average nonuse values and percentages of total values representing nonuse values are shown in Table 4.11. Protests and non-response rates for the nonuse value questions are included in Appendix D.

TABLE 4.11, Nonuse Values

Survey Type	**Average Nonuse Value**	**Average percentage of total value stated as nonuse value**
Lower Rio Grande Gorge / Non-experienced rafters	$15.29 (n=194)	59.8 %
Ramsey Canyon Preserve	$96.23 (n=257)	69.9 %
San Pedro RNCA /Local Residents	$54.56 (n=149)	85.2 %
San Pedro RNCA /Non-residents	$81.34 (n=147)	90.7 %

Nonuse values represent a significant part of total value for all surveys. The results confirm the findings of other studies as reviewed in chapter 2.2.2. The average nonuse value is relatively low for the Rio Grande data, representing, on average, only 52.9 percent of total value. This is partly due to a high percentage of zero bids. As discussed in more detail in Appendix D, the Rio Grande survey did not attempt to elicit motives for zero bids specifically on the nonuse value question. As a consequence, the average nonuse value estimated might be biased downward, if some zero bids represent protests.

Among visitors of the San Pedro RNCA, the percentage of total value assigned to nonuse values was generally higher for non-residents than for local residents. This might reflect the fact that local residents are expecting to visit the RNCA more often in the future, and are therefore assigning higher use and option values to the site.

When comparing the percentages of total value assigned to nonuse values across the Arizona surveys, it needs to be remembered that the question format differed slightly between surveys. While the survey for Ramsey Canyon asked respondents to assume that the preserve would be closed for all visitors, visitors of the San Pedro RNCA were asked to assume that they themselves would not visit the site again. The survey for Ramsey Canyon thus excluded the possibility for altruistic motives, which is an explanation for the lower percentage of total value assigned to nonuse values, as compared to the San Pedro RNCA data.

The frequency of the various motives for positive nonuse values as indicated by the respondents are shown in Tables 4.12 to 4.14. Although respondents were asked to indicate only their main reason for a positive nonuse value, some respondents gave multiple responses. In the San Pedro RNCA surveys, many respondents stressed that they did not only value the Gray Hawk but rather all species or the riparian habitat in general. For Ramsey Canyon and Rio Grande visitors, human satisfaction from knowing that the site will continue to exist is the most common motive for holding nonuse values. For the San Pedro RNCA, the dominating motive is that birds, fish and wildlife have a right to the riparian habitat, regardless of human satisfaction. In all cases, vicarious consumption and bequest motives range last.

TABLE 4.12, Reasons for Positive Nonuse Values: Nonexperienced Commercial Gorge

	n	%
a) I get satisfaction from knowing that the summer Rio Grande flow conditions will benefit recreationists, fish and wildlife, and the streamside ecosystem.	76	50.3
b) I get satisfaction from knowing that the summer Rio Grande flow conditions will benefit other river runners.	16	10.6
c) Fish and wildlife and the streamside ecosystem have a right to river flows, regardless of satisfaction provided to humans.	48	31.8
Other	4	2.6
No explanation.	6	4.0
Positive nonuse value	150	100.0

TABLE 4.13, Reasons for Positive Nonuse Values: San Pedro RNCA / Mail Surveys

	Local		Non-resident	
	n	%	n	%
a) I get satisfaction from knowing that Gray Hawks will continue to exist at the San Pedro RNCA.	16	10.7	24	16.7
b) I get satisfaction from knowing that Gray Hawks will be protected for other visitors and future generations.	33	22.0	36	25.0
c) The Gray Hawk has a right to the riparian habitat at San Pedro RNCA, regardless of satisfaction provided to humans.	71	47.3	63	43.8
a) and b)	0	0.0	1	0.7
a), b) and c)	2	1.3	1	0.7
All birds/wildlife should be protected.	5	3.3	4	2.8
The riparian habitat in general should be protected.	10	6.7	10	6.9
The RNCA should be protected for general recreation.	5	3.3	0	0.0
Other	2	1.3	1	0.7
No explanation.	5	3.4	4	2.8
Positive nonuse value	148	100.0	144	100.0

TABLE 4.14, Reasons for Positive Nonuse Values: Ramsey Canyon Preserve

	n	%
a) I get satisfaction from knowing that the riparian habitat and wildlife will continue to exist at Ramsey Canyon.	127	55.5
b) The birds and wildlife species have a right to this riparian habitat, regardless of satisfaction provided to humans.	80	34.9
a) and b)	12	5.2
Other	4	1.7
No explanation.	6	2.6
Positive Nonuse Value	229	100.0

4.4.4 Reconsidering the Budget Constraint

A further aspect of the data analysis is the question of whether respondents will change their WTP bid when they are asked to consider which other categories in their household budget they would spend less on in order to finance their bid. A question of this form was included in the surveys for the nonexperienced Commercial Gorge, as well as in the personal interviews for the San Pedro RNCA. Table 4.15 shows the results. Only respondents who gave positive WTP bids were asked to answer the question sequence. The percentages of respondents who changed their WTP bid after reconsidering their budget constraint are extremely low. This seems to indicate that respondents think carefully about their WTP bids and feel no need to reconsider when asked to do so. The nonresponse rates on this particular question was higher for the New Mexico data than for the other surveys. This could be due to the fact that this question was one of the last questions on a fairly long survey. This would also explain why nonresponse rates were low for the relatively short personal interviews at the San Pedro RNCA.

Table 4.16 shows the categories that respondents indicated when asked which items in their household budget they would spend less on in order to finance their WTP bid. For all three surveys, the most frequent answer was that respondents would reduce their expenditures on entertainment. Savings, charitable contributions, and contributions to environmental causes were other frequently named categories. However, only about every fourth respondent substitutes his WTP bid for contributions to other environmental or charitable causes.

Table 4.17 shows how respondents who indicated the various budget categories differed in their average income and WTP bids. Those respondents who indicated they would finance their WTP bids by reducing expenditures on groceries had income levels far below the average. Respondents with higher incomes and relatively high stated WTP bids primarily chose to reduce spending on vacation, charitable contributions, or to take the bidded amount out of their savings. Many high income respondents for the Lower Gorge and the Local San Pedro surveys indicated answers other than the given categories. Most of these respondents indicated that they would not reduce spending at all. The average bid among this group of respondents was fairly low. Among visitors of the San Pedro RNCA that came from out of the area, the ones with the highest bids tended to substitute their bids for contributions to other environmental causes or charities.

TABLE 4.15, Reconsidering WTP

	San Pedro RNCA Local Residents		San Pedro RNCA Non-residents		Rio Grande (CG)	
	n	%	n	%	n	%
Positive WTP bid	179	100.0	179	100.0	219	100.0
Changed WTP bid	1	0.6	0	0.0	10	4.5
Did not change WTP bid	173	95.6	176	98.3	177	79.7
No response	5	2.8	3	1.7	32	14.6

TABLE 4.16, Categories in HH Budget that Respondents Indicated to Reduce Spending on in order to Finance their WTP Bid

Category in HH budget	San Pedro - Locals		San Pedro - Nonresidents		Lower Gorge - Nonexperienced	
	n	%	n	%	n	%
Groceries	2	1.1	0	0.0	6	2.7
Entertainment	46	25.7	68	38.1	57	26.0
Savings	30	16.8	43	24.0	26	11.9
Contributions to environmental causes	19	10.6	12	6.7	21	9.6
Vacation	4	2.2	5	2.8	16	7.3
Charitable contributions	26	14.5	21	11.7	33	15.1
Other	13	7.3	7	3.9	15	6.8
No answer	39	21.8	23	12.8	45	20.5
Positive WTP	179	100.0	179	100.0	219	100.0

TABLE 4.17, Average Income and WTP Bid for Respondents Indicating that They Would Reduce Spending on a Particular Category in the Household Budget

Category in HH budget	San Pedro - Locals		San Pedro - Nonresidents		Lower Gorge/ Nonexperienced	
	Average Income	Average WTP bid	Average Income	Average WTP	Average Income	Averag e WTP
Groceries	25000	15.00	-	-	45417	21.17
Entertainment	34033	77.29	61757	77.25	77368	29.21
Savings	39397	128.73	62757	68.62	93812	28.62
Contributions to environmental causes	42667	49.43	55682	152.05	84591	24.62
Vacation	58125	78.13	64000	29.00	81875	31.06
Charitable Contributions	**40790**	31.57	63105	129.78	88109	35.46
Other	48768	82.89	37056	68.93	153353	24.47
No answer	37115	66.97	54222	55.42	83994	21.48
All respondents with positive WTP	39003	73.80	59868	81.33	87604	28.00
Total sample	39673	62.44	59799	74.71	83269	16.11

5. EMPIRICAL RESULTS

5.1 The Value of Streamflows for Rafting on the Rio Grande, Northern New Mexico

5.1.1 Value of the Current Trip

Ordinary Least Squares regressions were used to estimate the individual total bid functions for the trip experienced. The consumer surplus measure (WILLPAY) was added to the actual river running expenses (RAFTEXP) to form the dependent variable. This avoids a simultaneous equation problem, which is likely to occur if WILLPAY was used alone as the dependent variable and RAFTEXP as an independent variable. The estimation of a bid function for WTP per trip has the advantage that it can easily be combined with our participation data which is also given in number of trips. However, as mentioned earlier, rafting trips on the Taos Box ranged from one to three days in length, while commercial outfitters offer one-day and half-day trips on the Lower Gorge. In using total WTP per trip as our independent variable, we are implicitly assuming that consumers decide how much money they are willing to allocate to a rafting trip as a whole and this determines the length of the trip, rather than making two independent and successive decisions about how many days to go rafting and how much to pay for a trip of a given length.[1] It is the total effect of a change in flow levels which usually matters to policy makers. Moreover, the variation in length of trip was relatively low: 89.2 percent of the Taos Box rafters were on one-day trips, 9.1 per cent on two-day trips, and only 1.7 percent on three day trips. Almost 90 percent of the Lower Gorge rafters were on half day trips.

Explanatory variables were selected according to the theoretical model, which indicates that income, flow level, socioeconomic characteristics, and proxies for tastes and preferences should be included. Variables for which the theory does not provide a clear indication whether (and in what form) they should be included were selected using the Schwartz Criterion, which minimizes the variance of the estimate adjusted for the degrees of freedom. With the exception of dummy variables, all variables were initially included in linear and quadratic form. However, for some variables, the linear and quadratic forms were highly correlated. In these cases, the natural logarithm or the linear form of the variable were used, depending on the Schwartz criterion. The data for experienced and non-experienced rafters on the Lower Gorge was combined to allow for a better comparison to the Taos Box results.

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[1] An alternative approach would be to estimate a separate equation for trip length and use the vector of predicted values of trip length as an instrumental variable in the regression for total WTP per trip. In attempting this alternative approach, we found that our regression for trip length had very low explanatory power and the inclusion of the instrumental variable in the WTP regression caused almost all other variables to be insignificant. It is likely that the data on trip length is unreliable; respondents might assume different definitions for trip length, e.g. some might include the transportation to the site or count two consecutive trips as one longer trip.

Table 5.1 shows the statistical results. The R^2 statistics are not atypical for cross-sectional data. For CVM analysis, R^2 values of 0.2 to 0.5 are considered good fits (Mitchell and Carson, 1989) and values around 0.2 are common in CVM research. The tables also show the F-statistics for the null hypothesis that all coefficients on the independent variables are zero. The F-statistics for both models indicated rejection of the null hypothesis at the 1 percent level. The tables also show the t-statistics for testing the hypothesis that a given coefficient is equal to zero. Elasticities at means measure the percentage change in the mean of the dependent variable resulting from a 1 percent change in the mean of an independent variable. Large elasticity measures imply that the dependent variable is very responsive to changes in the independent variable (Pindyck and Rubinfeld, 1991).

TABLE 5.1, Estimated Bid Functions For a Rafting Trip at Flows Experienced

	TAOS BOX		LOWER GORGE	
	ESTIMATED COEFFICIENT (T-RATIO[2])	ELASTICITY AT MEANS	ESTIMATED COEFFICIENT (T-RATIO)	ELASTICITY AT MEANS
INCOME	0.9259E-04 (1.768)*	0.0621	0.1428E-03 (6.915)**	0.2167
LNFLOW	22.427 (2.056)**	1.2686	8.3991 (2.887)**	0.8959
MRLNFLOW	2.9751 (1.449)	0.0631	4.6212 (3.719)**	0.0423
DRLNFLOW	3.2136 (1.978)**	0.0175	3.2704 (2.388)**	0.0097
MAINREAS	7.1706 (1.052)	0.1481	7.2726 (2.521)**	0.1941
GENDER	6.6810 (1.056)	0.0320	5.1739 (1.853)*	0.0430
NM	-28.837 (-3.159)**	-0.0802	-23.966 (-4.108)**	-0.0321
NEIGHBOR	13.854 (1.658)*	0.0372	4.5394 (1.375)	0.0212
CA	42.549 (3.220)**	0.0247	12.407 (3.048)**	0.0319
TOOLOW	-15.453 (-1.744)*	-0.0213	-6.1799 (1.573)	-0.0160
CONSTANT	-63.811 (-0.8907)		-23.855 (-1.263)	
R^2	0.1513		0.1792	
Adjusted R^2	0.1311		0.1683	
F-Statistic	134.69		179.21	
Sample Size	432		763	

[2] * significant at the 0.1 level
** significant at the 0.05 level

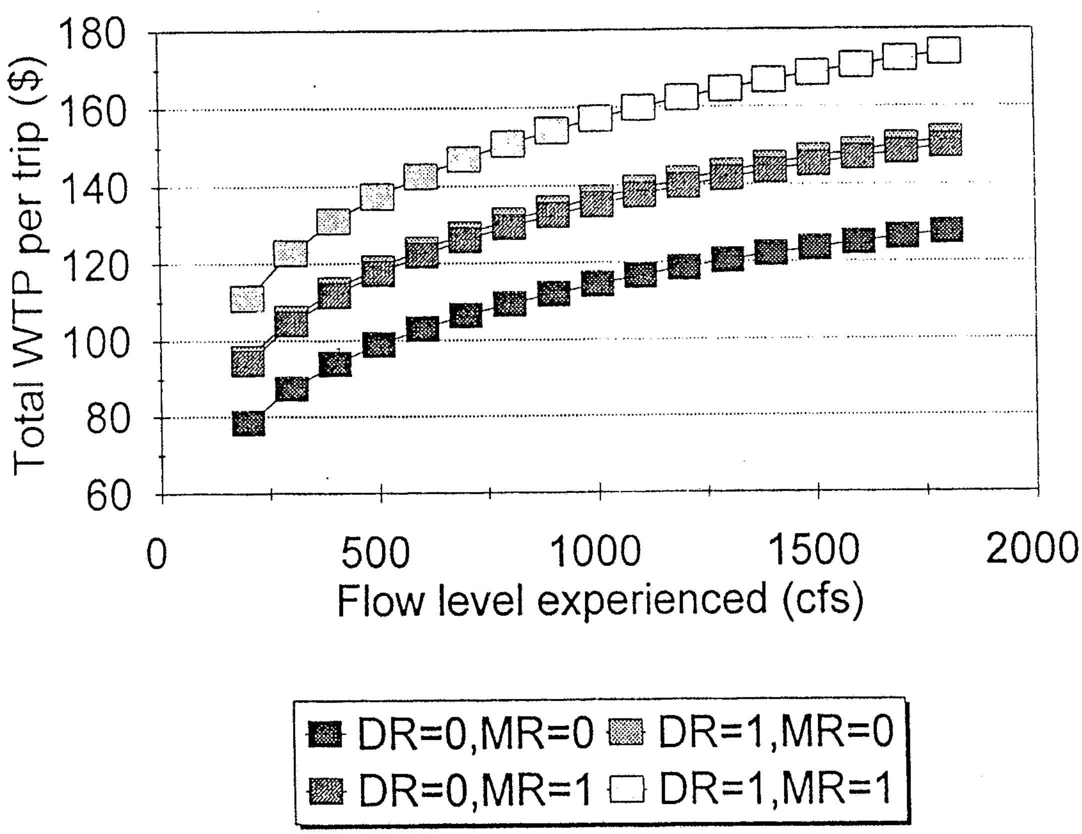
In general, all coefficients in both regression equations were of the theoretically expected signs. The value of the commodity (a rafting trip) increases with income. Flow level was significant and positive. Total WTP increases with flow level at a decreasing rate, consistent with the results of other studies on the marginal value of streamflows for recreation. As a consequence of the logarithmic form which had to be chosen for flow levels due to strong correlation effects between the linear and quadratic forms for flow, WTP does not become decreasing with flow level beyond some optimum level. Since the maximum flow observed during the visitor contact period was 1130 cfs and 1470 cfs for the Taos Box and the Lower Gorge, respectively, it is likely that the optimum flow level was not observed. However, the applicability of the estimated bid function at very high flows (beyond whatever the optimal flow is) is probably limited.

As indicated by the elasticity measures, respondents' total WTP is particularly responsive to flow levels on the Taos Box. This result coincides with the fact that flow levels make more of a difference on that stretch of the river. The effect of flow level on total WTP is higher for those respondents for whom rafting was the most important or the only reason for their trip to northern New Mexico. About 37 percent of the Taos Box rafters surveyed fell into this category, compared to only 8 percent among Lower Gorge rafters. Those respondents who go rafting in northern New Mexico on a regular basis (DR equals 1 if respondents indicated to go rafting at least twice a year and 0 otherwise) also are more responsive to flow levels, probably reflecting the fact that specific cfs levels are more meaningful to these respondents. Only about 9 percent of the Taos Box rafters and 3 percent of the Lower Gorge rafters indicated to go rafting in the area at least twice a year. Figures 5.1 to 5.2 show individual total bid curves as a function of flow levels, where MR is equal to 1 if rafting was the main reason or the only reason for the respondents' trip to northern New Mexico and MR is equal to zero otherwise, and DR is defined as explained above. A measure of general rafting experience throughout the U.S. and its interaction term with flow levels were also tested, but was insignificant for both samples. This result indicates that it is rafting experience in northern New Mexico rather than general rafting experience that influences a respondent's total WTP for a Rio Grande rafting trip.

In addition to the actual flow levels, the subjective perceptions of these flow levels also seem to affect total WTP. Rafters who considered the flows experienced as being too low for safe and enjoyable river running were willing to pay less for the trip experienced than other rafters.

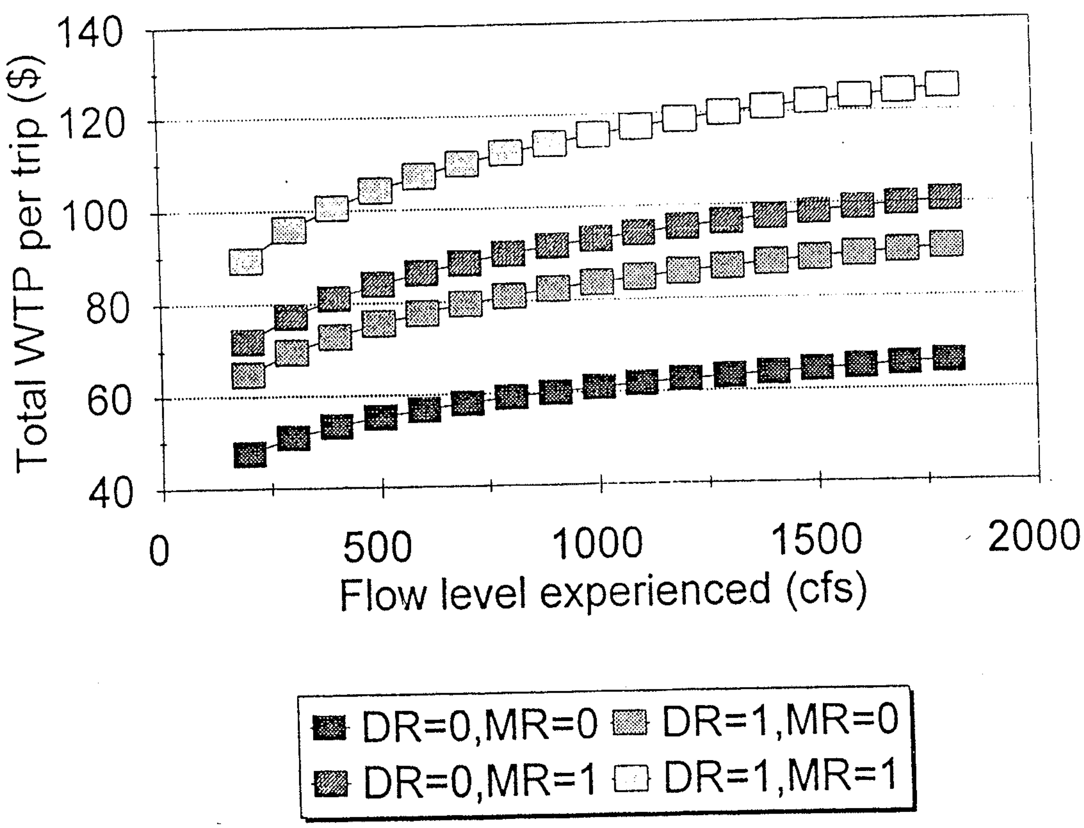
The total value of the trip experienced is higher the more important respondents considered rafting in their overall trip to northern New Mexico. Male river runners seem to be willing to pay more than female river runners, especially among rafters on the Lower Gorge.

FIGURE 5.1, Total WTP for a Rafting Trip as a Function of Flow Level / Taos Box[3]



[3]DR equals 1 if respondents go rafting in northern New Mexico at least twice a year, and DR equals 0 otherwise. MR equals 1 if rafting was the only or the most important reason for the respondent's trip to northern New Mexico, MR equals 0 otherwise.

FIGURE 5.2, Total WTP for a Rafting Trip as a Function of Flow Level / Lower Gorge[4]



[4]DR equals 1 if respondents go rafting in northern New Mexico at least twice a year, and DR equals 0 otherwise. MR equals 1 if rafting was the only or the most important reason for the respondent's trip to northern New Mexico, MR equals 0 otherwise.

Rafters who come from New Mexico were willing to pay significantly less than other respondents. This could be due to the fact that for these respondents river running expenses comprise a very high proportion of their total trip expenses; as a consequence a given increase in rafting expenses seems more significant to them than to visitors from further away who had higher total trip expenses. Visitors from the neighboring states (i.e. Arizona, Colorado, and Texas) were willing to pay more for a rafting trip. Californians also on average exhibited a significantly higher total WTP. This could be due to the fact that rafting trips on California rivers are relatively expensive and crowded compared to the Rio Grande. Daily participation rates were initially included in the regressions to allow for crowding effects on the Rio Grande, but were insignificant.

5.1.2 WTP for Guaranteed Higher Flow Levels

Tobit analysis was used to estimate bid functions for guaranteed higher flow levels. The tobit method was chosen because of the significant number of valid zero responses for ADDPAY. This is the case of a censored sample. Since the dependent variable is truncated at zero, the error terms of the ordinary least squares regression $Y_i=\alpha+\beta X_i+\epsilon_i$ are truncated at $-(\alpha+\beta X_i)$. This means that the lower tail of the distribution of the error term ϵ_i is cut-off and the probabilities are piled up at the cut-off point (Kmenta, 1986). As a consequence, the expected value of the OLS error terms is not equal to zero, and the OLS estimators are biased and inconsistent. The tobit model involves iterative maximum likelihood estimation and is described in Tobin (1958) and

Maddala (1983).

The regression results are shown in Tables 5.2 to 5.3. Regressions for the Lower Gorge were run separately for the samples of experienced and non-experienced rafters. This was necessary given the different format of the ADDPAY question for the two samples. The selection of independent variables and functional forms was as described in section 5.1.1. According to economic theory, both the flow level experienced and the guaranteed higher flow being offered should be included as explanatory variables. However, for the sample of experienced rafters on the Lower Gorge, actual and offered flow levels were highly correlated. Therefore, the difference between the experienced and the offered flows were used instead of the actual flow level. The same model was chosen for the Taos Box data in order to allow for an easier comparison between the two models.

Tables 5.2 to 5.3 show the estimated normalized coefficients of the tobit model. These are equal to the actual regression coefficients (β) divided by the standard error of the estimate (σ). The tables also show asymptotic t-ratios of the coefficients. Since the estimated coefficients cannot be directly interpreted, the derivative of WTP with respect to the independent variables ($\delta E(y)/\delta X_i$) is reported. This derivative is equal to $F(\beta X/\sigma)*\beta_i$, where F is the cumulative density function of the standard normal distribution, and **X** is the vector of independent variables (with X_i being its ith element). The terms for $\delta E(y)/\delta X_i$ can be interpreted in the same way as the regression coefficients in an OLS model. For example, the derivative of WTP with respect to income when income occurs in linear and quadratic form would be equal to δE(y)/δINCOME + δE(y)/δINCSQ * INCOME. The correlation between observed and expected values of ADDPAY provides an indication of the goodness-of-fit of the estimated model. This correlation is relatively low for the Taos Box and Nonexperienced Commercial Gorge data.

Both the Taos Box and Experienced Commercial Gorge samples show an increasing and concave relationship between income and ADDPAY. ADDPAY increases at a decreasing rate with the flow level offered and the difference between actual and offered flows, although the variable LNFLOWDF was insignificant in both regressions. In trying to account for differences in knowledge about flow levels, an interaction term between the offered flow level and a dummy variable (DR) distinguishing those rafters who indicated that they typically raft more than twice a year in northern New Mexico (DR=1) and those who raft less (DR=0) provided the best fit. The flow levels offered have a stronger positive effect on the WTP of those respondents who have more experience with river running in northern New Mexico.

TABLE 5.2, Bid Functions for Higher Flows / Taos Box and Experienced Lower Gorge

VARIABLE	TAOS BOX		EXPERIENCED LOWER GORGE	
	NORMALIZED COEFFICIENT (T-RATIO[5])	δE(Y)/δX$_i$	NORMALIZED COEFFICIENT (T-RATIO)	δE(Y)/δX$_i$
INCOME	0.3068E-05 (1.208)	0.017E-04	0.4077E-05 (0.958)	0.648E-04
INCSQ	-0.9756E-11 (-1.139)	-0.324E-09	-0.1135E-10 (-0.886)	-0.180E-09
LNNEWFL	0.10725 (0.401)	3.55646	0.90733 (2.677)**	14.4169
DRLNNEWF	0.9589E-01 (2.485)**	3.17990	0.11079 (1.923)*	1.7604
LNFLOWDF	0.4741E-01 (0.486)	1.57229	0.35046 (0.782)	5.5686
MAINREAS	0.11243 (2.152)**	3.72844	0.1847E-02 (0.018)	0.294E-01
GENDER	0.21378 (2.118)**	7.08919	0.5657E-01 (0.365)	0.8988
RAFTEXP	0.2265E-02 (0.839)	0.07511	0.1548E-01 (1.994)**	0.2459
EXPSQ	-0.6771E-05 (-1.011)**	-0.225E-03	-0.3078E-04 (-0.776)	0.489E-03
NEIGHBOR	0.21462 (1.920)*	7.11722	-0.32444 (-1.729)*	-5.1551
CA	0.48457 (2.315)**	16.06897	-0.3062E-01 (-0.1507)	0.4865
CONSTANT	-1.3884 (-0.843)		-8.3212 (-1.938)*	
Squared Correlation between observed & expected values	0.0646		0.1323	
Log-Likelihood Function	-2021.39		-715.43	
Standard Error of the Estimate	50.885		20.545	
Sample Size /Limit /Non-Limit	71 367		29 155	

[5] * significant at the 0.1 level
** significant at the 0.05 level

TABLE 5.3, Bid Functions for Higher Flows / Nonexperienced Lower Gorge

VARIABLE	NORMALIZED COEFFICIENT	T-RATIO[6]	$\delta E(Y)/\delta X_i$
LNINC	0.16946	2.5155**	2.96669
NEWFLOWL	0.2178E-03	0.2559	0.3813E-02
LNFLOW	0.2103E-01	0.1938	0.36822
MAINREAS	0.16075	2.3478**	2.81423
GENDER	0.26606	2.5133**	4.65807
RAFTEXP	0.7937E-02	1.8687*	0.13895
EXPSQ	-0.2536E-04	-2.0101**	-0.4440E-03
DAYNUMBE	0.6914E-01	2.0507**	1.21053
DAYNUMSQ	-0.11193E-02	-0.8327	-0.1960E-01
CONSTANT	-3.2705	-2.2470**	

309 LIMIT OBSERVATIONS
214 NON-LIMIT OBSERVATIONS
STANDARD ERROR OF THE ESTIMATE = 47.240
LOG-LIKELIHOOD FUNCTION= -1297.5332
SQUARED CORRELATION BETWEEN OBSERVED AND EXPECTED VALUES=0.080

Figures 5.3 and 5.4 show the relationships between the flow level offered and predicted WTP, given the average flow observed during the survey period. Among those rafters with little experience with rafting in the area, the additional WTP of Lower Gorge rafters for higher flow levels was very responsive to the flows offered, but NEWFLOWL was insignificant for Taos Box rafters. This might be due to the fact that the sample of

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[6] * significant at the 0.1 level
** significant at the 0.05 level

Lower Gorge rafters for this type of ADDPAY question consisted only of experienced rafters, who might have a better ideaabout specific cfs levels than the less experienced rafters in the Taos Box sample. However, a variable measuring general rafting experience and its interaction with the effect of the flows offered was tested for the Taos Box data, but was insignificant.

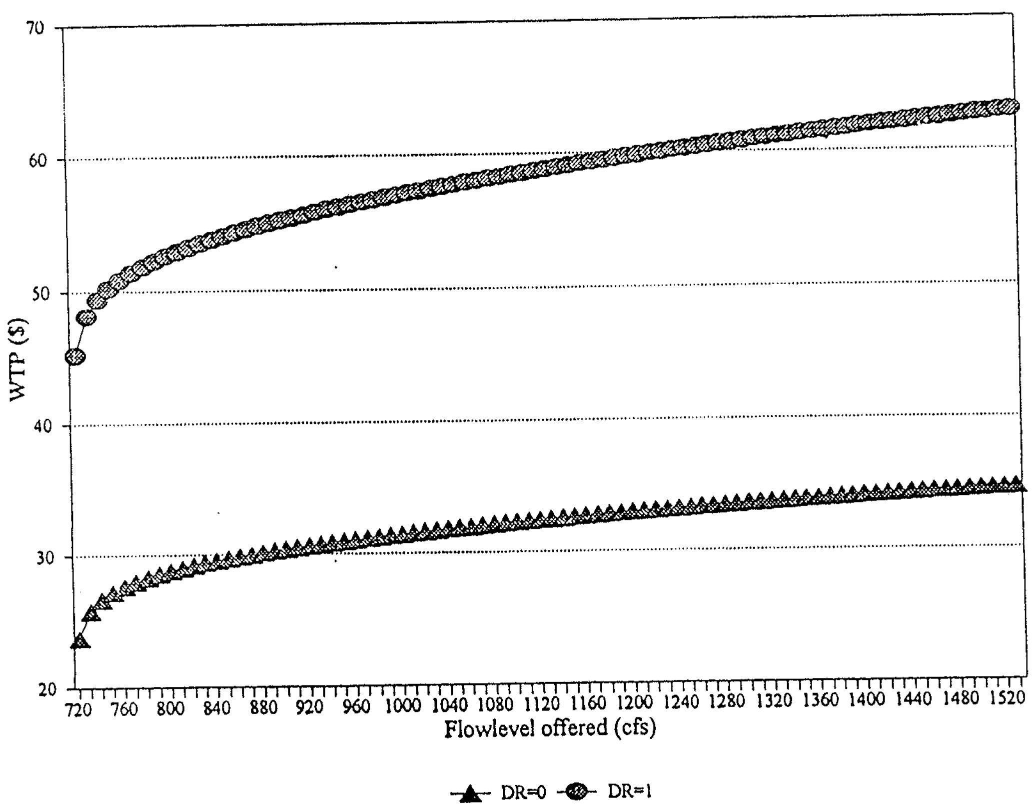
The importance of rafting for taking the trip to northern New Mexico has a significant positive effect on WTP for the sample of Taos Box rafters, but was insignificant for Lower Gorge rafters. This might be due to the fact that the more spectacular Taos Box run is more likely to attract visitors into coming back, while people who came for rafting on the Lower Gorge might consider switching to the Taos Box on their next visit. Men on average indicated higher values for ADDPAY, especially among Taos Box rafters.

Contrary to the regression results for the value of the current trip, the respondents' subjective impression of the actual flows experienced was insignificant in the ADDPAY regressions.

The variables representing visitors' different states of origin were included to allow for differences in overall travel costs and in the availability and price of substitute river recreation opportunities. The results indicate that while visitors from the neighboring states and from California had relatively high WTP values among Taos Box rafters, these visitor groups had relatively low WTP values among rafters on the Lower Gorge. This probably is an indication of the difference in quality of the rafting experience between the Taos Box and the Lower Gorge, and the scarcity of substitutes for high quality rafting trips like those on the Taos Box.

Higher education levels were significant and associated with lower WTP bids among Taos Box rafters, while the level of education had an insignificant effect on the WTP of respondents in the Lower Gorge sample. For both samples, the WTP for guaranteed higher flows is increasing in the amount actually spent in rafting fees for the current trip, except at relatively high levels of rafting fees.

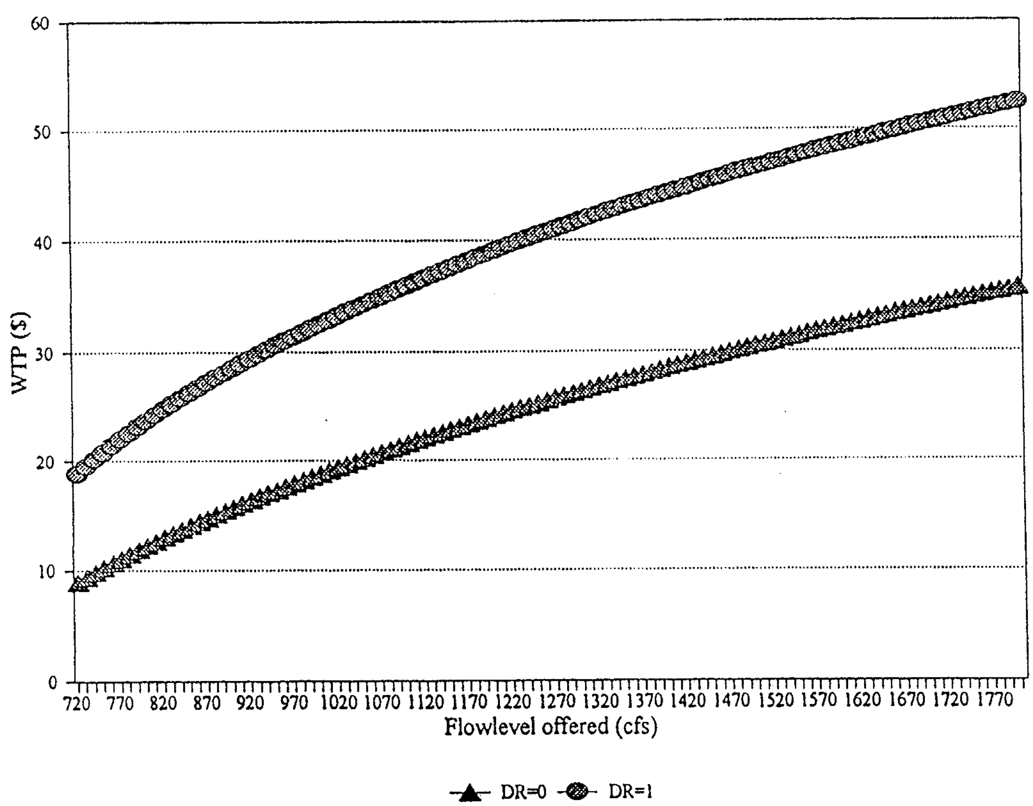
FIGURE 5.3, WTP for Higher Flow Levels as a Function of the Flow Offered[7] / Taos Box[8]



[7] Assuming the average observed flow in 1992 of 717 cfs

[8]DR equals 1 if respondents go rafting in northern New Mexico at least twice a year, DR equals 0 otherwise.

FIGURE 5.4, WTP for Higher Flow Levels as a Function of the Flow Offered[9] / Lower Gorge[10]



[9] Assuming the average observed flow in 1992 of 578 cfs

[10]DR equals 1 if respondents go rafting in northern New Mexico at least twice a year, DR equals 0 otherwise.

For the sample of nonexperienced rafters on the Lower Gorge, ADDPAY was measured as an annual contribution to a non-profit trust fund rather than as an additional river running fee. Therefore, the explanatory variables used in the regression analysis differ from those used for the other samples. Since the sample of nonexperienced rafters, by construction, included only people who had gone rafting twice or less before in their life, rafting experience did not differ significantly within this group and was not included in the model. Instead, the number of days spent visiting northern New Mexico in the last two years, as a proxy for future visits (for rafting or other activities) was used to account for different intensities of use over the payment period. The results show that respondents' WTP bids increase at a decreasing rate the more often they visit the area.

Since the number of days visiting the area and the state of origin are likely to be related, and the variables representing different states of origin were all insignificant, these variables were excluded. The income effect was fairly strong for this data set. The effects of actual rafting fees, gender, and the importance of rafting for the trip to northern New Mexico, were of the same sign as for the other New Mexico data. Education was insignificant. Both the actual and the offered higher flow levels had no significant effect on WTP. This might be due to the fact that the respondents within this sample did not have enough experience with rafting, either in the area or elsewhere, to be capable of distinguishing specific cfs levels, but rather value the guarantee of "ideal flow levels". Moreover, since these respondents are less dedicated to rafting, and since they are asked for an annual contribution they are more likely to value the other aspects of the composite commodity being offered: the extended season (allowing for more rafting trips in a given year and for more flexibility in timing) and the positive effect on the streamside ecosystem and aesthetics in general (whether for rafting, other activities, or nonuse-related motives). The respondents' subjective opinion about the flows experienced had no significant effect on their WTP for higher flows.

5.1.3 Participation effects

In addition to the effect of flow levels on individual WTP, the aggregate value of flows will depend on changes in participation rates. Using BLM data on the number of daily launches and numbers of people per launch for the 1990-1992 rafting seasons, an OLS regression was estimated to analyze how flow levels and other variables affect the aggregate number of rafting trips (PARTICIPATION) on the Rio Grande. Information on daily flow levels was obtained from the U.S. Geological Survey (USGS), and data on temperatures and precipitation was provided by the National Weather Service. First order autocorrelation was detected and corrected for using the Cochrane-Orcutt procedure. The regression results are shown in Table 5.4.

TABLE 5.4, Regression Results for Rafting Participation

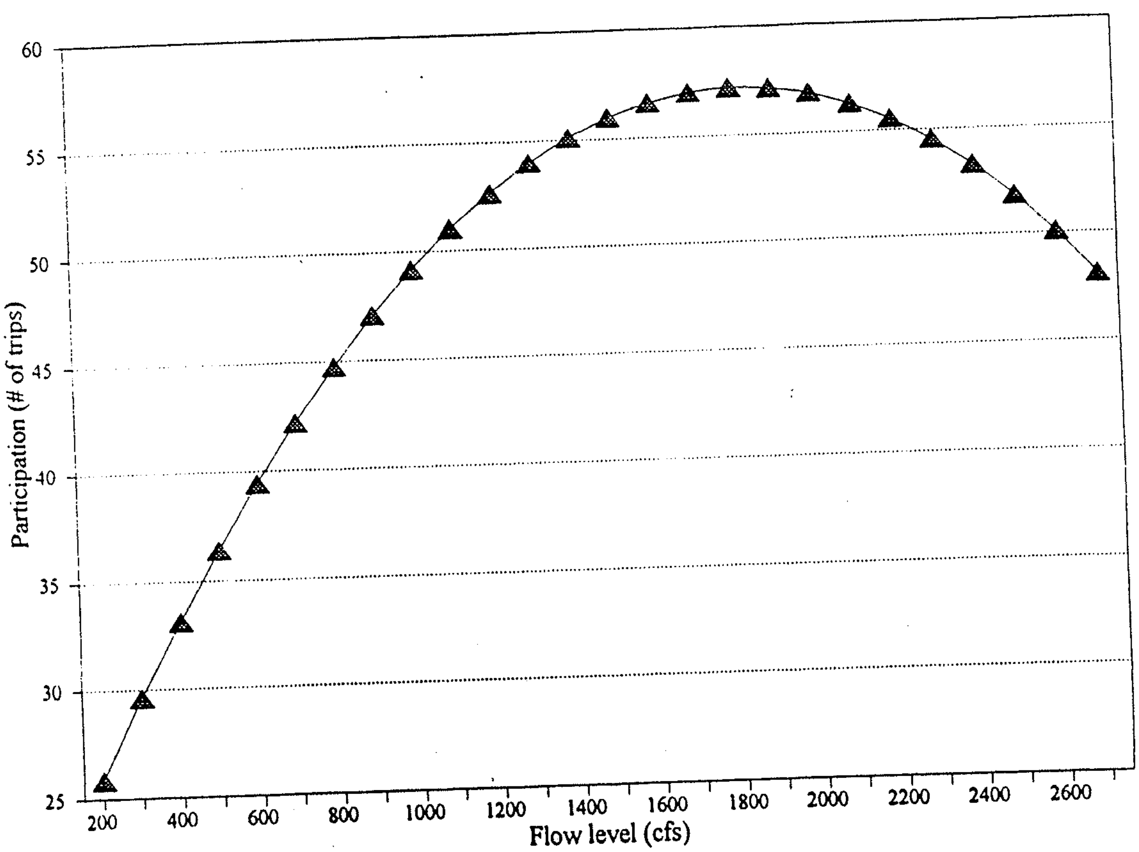
VARIABLE	TAOS BOX		LOWER GORGE	
	ESTIMATED COEFFICIENT (T-RATIO[11])	ELASTICITY AT MEANS	ESTIMATED COEFFICIENT (T-RATIO)	ELASTICITY AT MEANS
FLOW	0.4340E-01 (2.545)**	0.8074	-0.3586E-02 (-0.143)	-0.0244
FLOWSQ	-0.1192E-04 (-2.294)**	-0.2395	0.21449E-06 (0.0345)	0.0018
TEMPMIN	0.33647 (1.187)	0.3668	1.5871 (3.329)**	0.6151
WEEKEND	20.483 (7.528)**	0.1529	38.120 (7.664)**	0.0999
RAIN	-6.0591 (-0.405)	-0.0008	-43.506 (-0.920)	-0.0007
APRIL	-23.970 (-1.952)*	-0.0475	-138.79 (-6.891)**	-0.1023
MAY	19.465 (1.962)**	0.1145	-93.522 (-5.477)**	-0.1410
JUNE	41.851 (4.870)**	0.2488	-34.657 (-2.263)**	-0.0511
AUGUST	-16.783 (-2.024)**	-0.0721	-14.486 (-1.043)	-0.0221
SEPTEMBER	-27.773 (-2.164)**	-0.0312	-139.08 (-9.231)**	-0.1914
OCTOBER	-	-	-146.54 (-7.793)**	-0.0985
YEAR1991	30.669 (3.623)**	0.2796	55.405 (4.414)**	0.1707
YEAR1992	34.313 (4.347)**	0.3174	72.741 (6.340)**	0.2229
CONSTANT	-36.659 (-2.071)**		58.769 (2.047)**	
Sample Size	370		541	
R^2	0.7285		0.7362	
Adjusted R^2	0.7194		0.7297	

[11]* significant at 0.1 level
** significant at 0.05 level

Participation on the Taos Box was found to increase significantly with flow level up to an optimal level of about 1820 cfs, and decreases thereafter. This relationship is demonstrated in Figure 5.5. On the Lower Gorge, flow levels were found to be insignificant. This is not surprising since flows have less impact on the rafting experience there. Moreover, rafters on the Lower Gorge tend to be less experienced and therefore they are likely to pay less attention to flow levels in their decision to go rafting. In addition, the surveys indicated that only 8 per cent of the Lower Gorge rafters considered rafting the main reason for their trip to northern New Mexico, compared to 37 per cent of rafters on the Taos Box. While flow levels do have an effect on Lower Gorge rafters' WTP for a rafting trip (ex post), streamflows do not seem to affect their decision to participate (ex ante).

All other variables had the expected signs and were mostly significant. The minimum daily temperature had a positive effect on participation rates at both sites, and visitation was significantly higher on weekends. Rain showed the expected negative effect, although it was not significant. There were very few days with considerable rain fall during the 1990 to 1992 rafting seasons, with only few days of more than an inch of rain. For the Taos Box, the dummy variables for the various months indicate a concentration of visitors during May, June, and July, with participation being highest in June. On the Lower Gorge, visitation tends to be highest from June through August, with July being the peak month. In both regressions, July was chosen as the baseline level. Rafting visitation at both stretches of the Rio Grande also seemed to become more popular over time, increasing steadily from 1990 to 1992 as indicated by significant positive coefficients on the dummy variables for 1991 and 1992 (with 1990 serving as base year).

FIGURE 5.5, Daily Participation on the Taos Box as a Function of Flow Levels



5.1.4 Aggregate Effects

After estimating bid functions and participation functions we can now determine the approximate aggregate total and marginal benefits of rafting on the Rio Grande at different flow levels. The data on total WTP for the actually experienced flows (RAFTEXP + WILLPAY) is used in these calculations rather than the results on additional WTP for hypothetical flows (ADDPAY). Respondents are likely to be more precise when valuing flow levels they actually experienced than when confronted with hypothetical situations.

While the study covered most of the 1992 summer rafting season it did not cover the full range of flows included in the participation data. To account for this factor, average WTP was estimated for each month separately using average monthly flow levels. The monthly average WTP estimate was then multiplied by the total number of trips per month to obtain aggregate total benefits per month. The summation of the monthly estimates yields the aggregate total benefits to rafters during the 1992 rafting season. The results are reported in Table 5.5. Rafting on the Taos Box generated about \$788,000 in total gross benefits to rafters in 1992. While the monthly average WTP was lower on the Lower Gorge, aggregate values are substantially higher than on the Taos Box due to the larger number of visitors and the longer rafting season. Total benefits to rafters on the Lower Gorge amount to more than \$1.5 million. The total benefit estimates represent gross benefits because they include actual rafting expenditures. Assuming that average rafting expenditures from the interview period can be extrapolated to the entire rafting season, net benefit estimates can be obtained by multiplying the average rafting expenses per trip times the total number of trips during the 1992 season and subtracting these aggregate expenses from the gross benefit estimates. This yields an estimated $162,546 and $448,140 in net benefits to Taos Box and Lower Gorge rafters, respectively ($24.16 and $17.02 per trip, respectively).

TABLE 5.5, Aggregate Total Benefits to Rafters during the 1992 Season

Month	Taos Box			Lower Gorge		
	Average WTP/trip	Trips/ month	Aggregate WTP	Average WTP/trip	Trips /month	Aggregate WTP
April	133.39	215	28,678	69.34	580	40,216
May	119.01	2,275	270,757	64.97	3,115	202,372
June	120.19	3,236	388,940	64.19	5,317	341,290
July	99.49	731	72,724	55.69	8,256	459,813
August	99.69	241	24,025	55.58	7,448	413,992
September	97.45	30	2,923	54.12	1,579	85,458
October	-	-	-	53.49	38	2,033
1992 gross benefits		6,728	788,048		26,333	1,545,173
Aggregate rafting expenses	92.97	6,728	625,502	41.66	26,333	1,097,033
1992 net benefits			162,546			448,140

As explained in Chapter 3, the aggregate marginal value of flow levels can be decomposed into a participation effect ($\delta N(.)/\delta q$*WTP(.)) and a quality effect

(δWTP(.)/δq*N(.)), where N is aggregate participation per day and q is flow level. Table 5.6 shows this decomposition for the Taos Box. The portion of the aggregate marginal value of flows associated with the quality effect decreases with flow level up to about 800 cfs and increases thereafter, ranging from about 31 to 92 per cent. This is due to the different functional forms chosen for flow level in the WTP and participation regressions. Beyond 1800 cfs, the participation effect becomes negative. As explained earlier, the continuing positive effect of flows on WTP beyond 1800 cfs is an artifact of the logarithmic form that had to be chosen for the bid functions due to strong correlation between the linear and quadratic effects of flow level. Since the range of flow levels observed during the interview period did not exceed 1800 cfs, the applicability of the estimated bid function for flows beyond this level is limited. Figure 5.6 shows the aggregate marginal value as a function of flow levels on the Taos Box under average conditions.

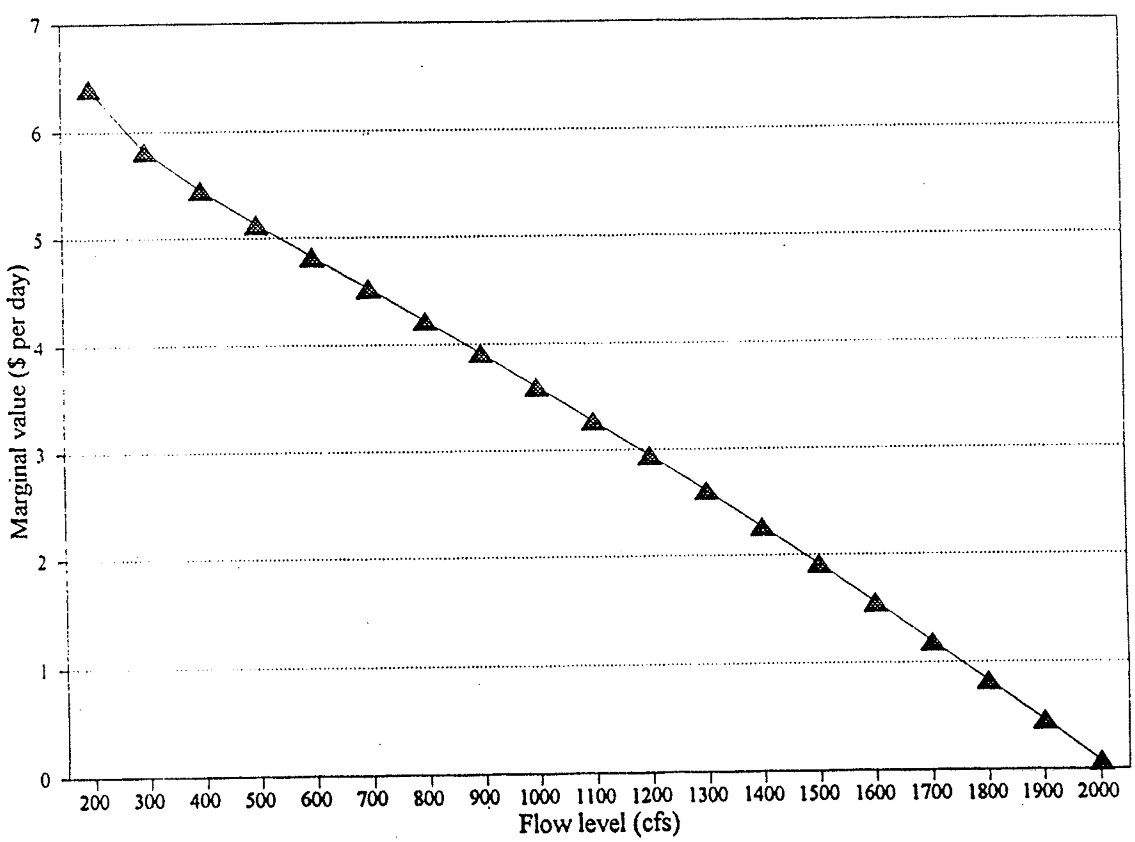
Since the coefficients for flow level in the participation regression for the Lower Gorge were insignificant (δN(.)/δq=0), the participation component of the aggregate marginal value of flows is zero or negligible for the Lower Gorge. The formula for aggregate marginal value of flows on the Lower Gorge becomes: δWTP(.)/δq*N(.), where N does not depend on q.

TABLE 5.6, Participation, Quality and Aggregate Marginal Effects of Flow Levels on the Taos Box[12]

Flow level (cfs)	Participation effect	Quality effect	Aggregate Marginal Value	% of MV due to quality effect
200	3.32	3.08	6.40	48.2
400	3.47	1.97	5.44	36.3
600	3.26	1.57	4.83	32.4
800	2.89	1.33	4.23	31.5
1000	2.43	1.17	3.60	32.5
1200	1.90	1.04	2.95	35.4
1400	1.33	0.94	2.26	41.4
1600	0.71	0.84	1.56	54.2
1800	0.07	0.76	0.83	91.7

[12] in dollars per cfs

FIGURE 5.6, Aggregate Marginal Value (per day) as a Function of Flow Level / Taos Box



Since participation varies significantly by month and between weekends and weekdays, it is helpful to determine aggregate marginal values for each month and type of day separately. Average monthly temperatures and precipitation were used to determine aggregate marginal values per day at average and minimum monthly flows in 1992. The results are reported in Tables 5.7 and 5.8 for the Taos Box and the Lower Gorge, respectively. Marginal values are reported per cfs and per acre foot. To convert from cfs to acre feet I used the simple conversion formula: 1 cubic foot per second flowing continuously for one day (24 hours) equals 1.983 acre feet per day. This conversion method is commonly used in instream flow studies (e.g. Daubert and Young (1981), Duffield, Neher and Brown (1992), and U.S. Department of the Interior (1993)).

The values per acre foot could now be compared to the marginal value of an acre foot of water in alternative uses such as irrigated agriculture and a statement about an economically efficient (i.e. equimarginal) allocation of water could be made. However, the use of the simple conversion formula from cfs to acre feet ignores the fact that water for the generation of recreation benefits is only required during daytime. Moreover, to obtain an additional acre foot on the Taos Box or Lower Gorge more than an acre foot has to be saved in upstream irrigation due to evaporation and other losses.

We did not have sufficient data about the value of water for agriculture in the San Luis Valley to allow for a comparison of marginal values of water between instream and offstream uses. However, our results can be useful in future comparisons of this kind. The distinction of marginal values of instream flows by month is helpful in considering timing effects. The value of an additional acre foot of water for rafting is higher on weekends than on weekdays. Marginal values on the Taos Box are highest in June and July, while the highest marginal value of instream flow on the Lower Gorge occurs in July and August. Under average conditions, the combined marginal benefits of water for rafting on both subsequent stretches of the river is highest in July, followed by August and June. Flows in April and May are likely to exceed optimal flows on some days. If the excess water during these months could be stored and released during the peak rafting season the economic benefits from rafting could be increased.

While we do not know the marginal values of water in agriculture for different months, we do have information on the average value of water for different agricultural uses in the San Luis Valley. An average of 3.2 acre feet per acre is applied to irrigated crops, with 1.6 acre feet per acre being consumptively used (Salazar, 1986). In 1986, with 638,100 irrigated acres, about 2 million acre feet of water were diverted for irrigation. The main irrigation season lasts from April through October. While alfalfa hay and other hay account for 35 per cent of the diversions and irrigated pasture for 46 per cent, these crops are the least profitable. Salazar (1986) estimated that the net return to an acre foot of water applied in alfalfa hay production is approximately $3.60 or less. No estimate is available for the net return to water in pasture irrigation, but it is likely to be even lower than that for alfalfa hay. Irrigated pasture acreage varies the most from year to year as farmers adjust to water availability and changing economic returns.

In general, aggregate marginal values of streamflows for rafting were relatively low for both stretches of the river as compared to other instream flow studies (see Chapter 2.2.1). For the Taos Box, this is probably due to the relatively small number of trips taken per day due to inadequate flows in July and August and to BLM limitations in May and June. While participation rates are high on the Lower Gorge, the participation effect for this stretch of the river was found to be zero and WTP is less responsive to flows. This is probably due to two facts: first, the quality of the rafting experience on the wider Lower Gorge is much less dependent on flow levels than the Taos Box; second, rafters on the Lower Gorge tend to be less experienced and less dedicated to rafting and consequently pay less attention to flow levels.

Although the marginal value of flows at the individual stretches of the Rio Grande appears relatively low, higher flows on one stretch benefit the other stretch as well, and the combined effect (up to $6.13 per acre foot or $12.15 per cfs) may very well exceed the benefits of water in irrigated agriculture. Moreover, our model assumes that the number of times people go rafting in northern New Mexico and the importance of rafting for their trip to the area is not affected by flow level. This assumption is likely to lead to an underestimation of the marginal effects of flow on rafting benefits. Our benefit estimates also do not include rafters on private trips and recreational activities other than rafting. Fishing, hiking and wildlife watching are other popular activities along the Rio Grande in northern New Mexico and are likely to generate substantial recreation benefits. Furthermore, we did not consider benefits (consumptive or nonconsumptive) downstream of the Lower Gorge, which are likely to be significant as well. The single-period model used in this study ignored lagged effects on fish stocks and the streamside environment. Moreover, the payment vehicle of additional rafting expenses, by construction, excludes any nonuse values that resource users may hold for the preservation of streamflows. Finally, we did not attempt to elicit any values which nonusers hold for the protection of streamflows on the Rio Grande. Given nonuse studies in other basins these may be substantial, especially for the stretch of the Rio Grande which is designated under the Wild and Scenic Rivers Act.

TABLE 5.7, Aggregate Marginal Values (MV) per Day at Monthly Average and Minimum Flows / Taos Box

Month	MV per cfs (per acre foot) at average flows			MV per cfs (per acre foot) at minimum flows		
	Avg. Flow	MV/ weekday	MV/ weekend	Min. Flow	MV/ weekday	MV/ weekend
April	1495	1.39 (0.70)	1.72 (0.87)	1120	2.52 (1.27)	2.96 (1.49)
May	839	4.37 (2.20)	4.95 (2.49)	560	5.51 (2.78)	6.38 (3.22)
June	863	4.93 (2.49)	5.50 (2.77)	507	6.85 (3.46)	7.81 (3.94)
July	357	5.01 (2.53)	6.37 (3.21)	279	5.62 (2.83)	7.37 (3.72)
August	383	3.84 (1.94)	5.11 (2.58)	263	4.13 (2.08)	5.98 (3.02)
September	325	3.05 (1.54)	4.55 (2.29)	297	3.16 (1.59)	4.80 (2.42)

TABLE 5.8, Aggregate Marginal Values (MV) per Day at Monthly Average and Minimum Flows / Lower Gorge

Month	MV per cfs (per acre-foot) at average flows			MV per cfs (per acre-foot) at minimum flows		
	Avg. Flow	MV/ weekday	MV/ weekend	Min. Flow	MV/ weekday	MV/ weekend
April	1791	0.21 (0.11)	0.40 (0.20)	1330	0.28 (0.14)	0.54 (0.27)
May	1109	0.79 (0.40)	1.10 (0.55)	766	1.15 (0.58)	1.59 (0.80)
June	1009	1.46 (0.73)	1.79 (0.90)	543	2.70 (1.36)	3.33 (1.68)
July	379	4.89 (2.46)	5.78 (2.91)	316	5.85 (2.95)	6.92 (3.49)
August	391	4.39 (2.21)	5.25 (2.65)	291	5.89 (2.97)	7.06 (3.58)
September	317	1.65 (0.83)	2.71 (1.37)	271	1.93 (0.97)	3.17 (1.60)
October	294	1.14 (0.57)	2.29 (1.15)	271	1.23 (0.62)	2.48 (1.25)

5.1.5 Hypothetical Scenarios

A further aspect of the analysis that is of interest to policymakers is the question of what would happen to aggregate total rafting benefits if it was possible to guarantee higher flows during the late summer months. In 1992, only 11 per cent of the rafting activity on the Taos Box occurred beyond mid July due to declining flow levels. With adequate flows in July and August, a significant number of additional people could raft on the Taos Box. Three hypothetical scenarios were analyzed: (1) a daily increase over actual 1992 flow levels of 500 cfs in July and August; (2) a constant flow of 1200 cfs in July and August; and (3) a constant flow of 1800 cfs[13] in July and August. These changes in flow levels will affect daily participation on the Taos Box in July and August. Moreover, the increased flows are expected to raise the average WTP of visitors during these months. The latter effect will occur for rafters on both the Taos Box and the Lower Gorge, since higher flows affect both stretches of the Rio Grande.

The bid functions for total WTP for the actual flows experienced[14] and the participation model for the Taos Box are used to simulate the effects of the three hypothetical scenarios on average WTP, participation on the Taos Box[15], and aggregate total value of rafting in July and August. The results are presented in Tables 5.9. The simulations assume 1992 temperatures, precipitation, and visitor characteristics. While the aggregate total benefits from rafting reported in Table 5.5 were based on actual 1992 visitation, the simulation results for the hypothetical scenarios were compared to the

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[13] The BLM recommends a flow level of 1200 cfs for rafting the Taos Box and believes that 1800 cfs is ideal for high quality river running in the Taos Box (Mottl, 1993).

[14] The simulations are based on the bid functions for the flows actually experienced (RAFTEXP + WILLPAY) rather than additional WTP for hypothetical flows (ADDPAY) for two reasons: Respondents are more precise when valuing flow levels they actually experienced (flows under the hypothetical scenarios lie within the range of flows observed during the survey period). and data on ADDPAY (in terms of additional rafting trip expenses) is not available for nonexperienced rafters on the Lower Gorge.

[15] The participation model yielded estimates of daily participation in July and August under the various scenarios. The daily estimates were summed to obtain estimated monthly participation which was then multiplied by the estimated individual WTP at average monthly flows.

predicted participation in July and August to account for the fact that the participation model tended to overestimate daily visitor numbers.

The simulation results indicate that an increase in July and August flow levels by 500 cfs would raise the annual total benefits from rafting by about 8 percent. A constant flow of 1200 cfs and 1800 cfs in July and August would lead to an increase in annual benefits of about 11 and 15 percent, respectively. Although the participation effect on the Lower Gorge is zero and the effect on WTP is stronger for the Taos Box, the increase in Lower Gorge benefits accounts for more than two thirds of the total increase due to the large number of rafters using the Lower Gorge. The BLM constraint on daily participation at the Taos Box did not become binding under any of the scenarios.

TABLE 5.9, Change in Aggregate Rafting Benefits in July and August Under the Hypothetical Scenarios

Scenario	Taos Box			Lower Gorge			Combined effect
	Avg. Indiv. WTP	Predicted Partici-pation	Aggregate Total Value	Avg. Indiv. WTP	Actual Partici-pation	Aggregate Total Value	Aggregate Total Value
Actual 1992							
July	99.49	809	80,487	55.69	8256	459,813	540,300
August	99.69	339	33,795	55.58	7448	413,992	447,787
Both months			114,282			873,804	988,087
Scenario 1							
July	120.58	984	118,646	63.22	8256	521,952	640,598
August	120.94	501	60,591	63.25	7448	471,088	531,679
Both months			179,237			993,040	1,172,277
Difference from actual			64,955 (8.2%)[16]			119,235 (7.7%)	184,190 (7.9%)
Scenario 2							
July	128.64	1063	136,734	66.00	8256	544,905	681,639
August	128.64	572	73,601	66.00	7448	491,576	565,177
Both months			210,336			1,036,482	1,246,816
Difference from actual			96,053 (12.2%)			162,677 (10.5%)	258,729 (11.1%)
Scenario 3							
July	138.30	1121	154,973	69.60	8256	574,616	729,589
August	138.30	627	86,712	69.60	7448	518,379	605,091
Both months			241,684			1,092,995	1,334,680
Difference from Actual			127,402 (16.2%)			219,190 (14.2%)	346,593 (14.9%)

[16] The percentages in parentheses represent the percentage change in annual total benefits as reported in Table 5.5.

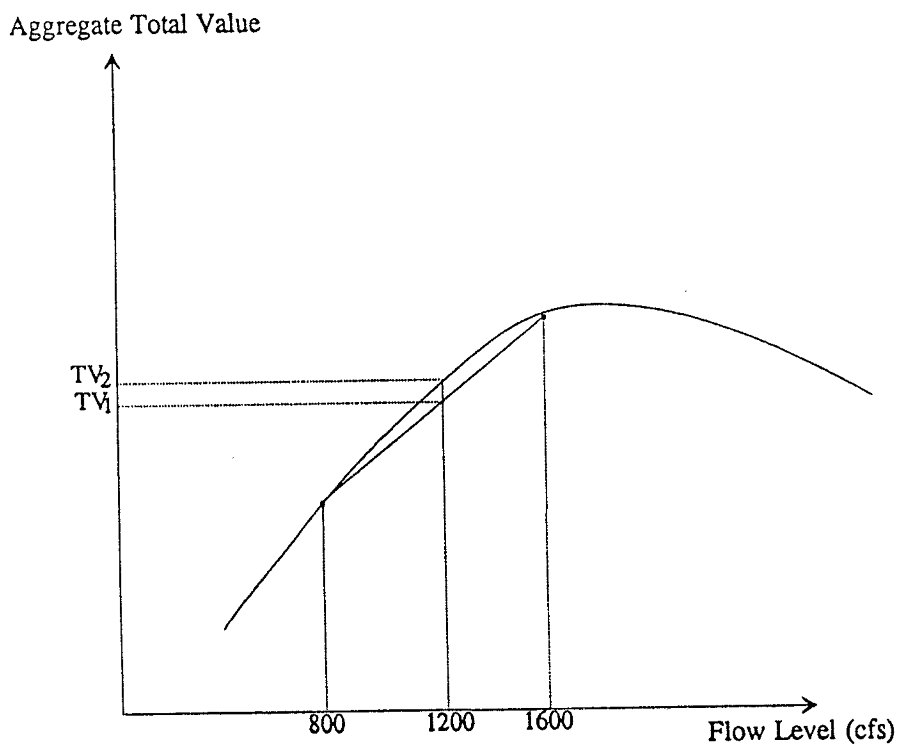
An important difference between the first and the latter two scenarios is that under the first scenario flows would still fluctuate, while under the second and third scenarios flows would be guaranteed to be stable. The difference between fluctuating flows is incorporated into both the bid functions and the participation model through the concave functional form. As can be seen in Figure 5.7, given the concave shape of the aggregate total value curve, the total value of rafting is higher at constant flows (e.g. of 1200 cfs) than it is, on average, under fluctuating flows when the average of the fluctuating flows is the same as the constant flow (e.g. flows of 800 cfs half the time, and 1600 cfs the remaining time).[17]

In addition, to the above difference between fluctuating and stable flows, which is picked up by the model, the guarantee of stable flows and a longer rafting season also eliminates the uncertainty involved in flow fluctuations. This effect is not incorporated in the model for total value of the current trip. The ADDPAY question did include the effect of the guarantee of higher flows and an extended rafting season. A comparison of the average value of ADDPAY and the increase in average total WTP (RAFTEXP + WILLPAY) under the hypothetical scenarios is reported in Table 5.10. The ADDPAY value is higher under the first and second scenario. This kind of comparison is not possible for the Lower Gorge data because the phrasing of the ADDPAY question varied between the samples of experienced and nonexperienced rafters. However, the

[17] Mathematically, this is due to the fact that the logarithm of the average flow is larger than the average of the logarithms of the individual (fluctuating) flows. Similarly, the average of the squared individual flows is larger than the squared average flow.

comparison demonstrates that the estimated changes in total rafting benefits under the hypothetical scenarios (based on TOTALWTP) likely have been underestimated.

FIGURE 5.7, The Difference Between Stable and Fluctuating Flows



TV_1 = Average aggregate total value at fluctuating flows with average 1200 cfs

TV_2 = Aggregate total value at constant flows of 1200 cfs

TABLE 5.10, Comparison of ADDPAY and Change in Total WTP under the Hypothetical Scenarios (Taos Box)

Scenario/Month	Average change in Total WTP		Average ADDPAY (in $)
	in Dollars	in percent	
<u>Scenario 1</u>			
July	21.09	21.2%	32.08
August	21.25	21.3%	32.14
<u>Scenario 2</u>			
July	29.15	29.3%	34.15
August	28.95	29.0%	34.10
<u>Scenario 3</u>			
July	38.81	39.0%	36.57
August	38.61	38.7%	36.54

The change in total rafting benefits due to higher flows in July and August also is likely to be underestimated due to the following two factors. First, the simulations assume that flows on the Lower Gorge are equal to flows on the Taos Box under the second and third scenarios. However, due to the confluence of the Red River, Lower Gorge flows are generally higher than Taos Box flows. Second, the coefficients on the months variables in the participation model for the Taos Box shows that participation on the Taos Box is on average lower in July and August than in May and June <u>independent of flow level</u>. However, July and August are the peak rafting months on the Lower Gorge. The relatively low effects of the July and August variables in the Taos Box model are probably due to recreationists' expectations formed over the many years in which low flows on the Taos Box cut off the rafting season in early July. Consequently, visitors expect the Taos Box season to be over at that time. These expectations would change in the longer run under the hypothetical scenarios as recreationists learn to expect adequate flows in July and August. For these reasons, it is likely that the coefficients on the months variables in the Taos Box participation model are results of the pattern of flows in the past and that they lead to an underestimation of the increase in participation that would result from higher flows in July and August.

5.2 Bid Functions for the Preservation of Streamflows in Southern Arizona

Due to the significant number of valid zero bids on the WTP questions, tobit analysis was used to estimate bid functions for the Arizona data. Since the WTP questions were phrased in terms of a one-time contribution, the WTP bids could not be added to actual expenditures. Expenditures were initially included as an explanatory variable (see Appendix D), but were found to be insignificant in all regressions. The expenditure data was originally collected for local economic impact analysis. As a consequence it focused mainly on local expenses and did not contain sufficient information to obtain reliable estimates of travel costs which are likely to be the most important expenditures in decisions on recreational trips. Moreover, the expenditure data had a high number of missing observations. Therefore, expenditures were left out of the final regression results reported below.

All continuous explanatory variables were included in linear and quadratic form to allow for the highest degree of flexibility in curvature. However, the inclusion of both linear and quadratic forms of some variables led to a very high correlation between regression coefficients. Therefore, only the linear or logarithmic term of these variables was kept in the regressions, depending on which version provided the better fit. The regression results for non-resident visitors of San Pedro RNCA and Ramsey Canyon Preserve are reported below. Bid functions were also estimated for the sample of local visitors of the San Pedro RNCA. These results are reported in Appendix E.

5.2.1 Ramsey Canyon Preserve

Table 5.11 shows the regression results for Ramsey Canyon. Income was positive and significant. WTP increases with the number of times respondents visit Ramsey Canyon in a typical year and decreases with age (although age was not significant). Both results are consistent with economic theory. Since the WTP question was phrased as a one-time contribution, theory would suggest that people indicate the sum of discounted use values over the rest of their lifetime plus their nonuse value. The number of expected uses decreases with age and increases with the frequency of past visits. Visitors from foreign countries are willing to pay significantly less than U.S. citizens, possibly reflecting the fact that these visitors are least likely to ever return to Ramsey Canyon. Other states of origin were found to be insignificant and were excluded. Members of The Nature Conservancy or other environmental organizations and respondents for whom visiting Ramsey Canyon was the main reason for coming to southeastern Arizona were willing to pay more than other respondents. The dedication to birding, in this case measured by the number of days spent birding in a typical year, also had a positive effect on WTP. Moreover, higher levels of formal education were associated with higher WTP values.

TABLE 5.11, Estimated Bid Function for Ramsey Canyon Preserve

VARIABLE	NORMALIZED COEFFICIENT	ASYMPTOTIC T-RATIO[18]	$dE(Y)/dX_i$
INCOME	0.78902E-05	2.4859**	0.95727E-03
INCSQ	-0.1743E-10	-1.4764	-0.21146E-08
LNAGE	-0.19112	-0.9239	-23.18797
LNEDU	0.91593	2.3455**	111.1246
FOREIGN	-0.63578	-2.3149**	-77.13579
ENVORG	0.25766	1.6698*	31.26016
BIRDDAYS	0.40119E-02	1.7488*	0.486739
DAYSSQ	-0.8731E-05	-1.3910	-0.10593E-02
MAINREAS	0.15591	1.1537	18.91594
TRIPNUM	0.17944	2.9195**	21.77091
TRIPSQ	-0.1218E-01	-1.8901*	-1.47771
CONSTANT	2.3088	-1.6116*	

36 Limit Observations
301 Non-Limit Observations
Standard Error Of The Estimate = 176.62
Log-Likelihood Function = -2008.9562
Squared Correlation Between Observed and Expected Values = 0.11222

[18] * significant at the 0.1 level
** significant at the 0.05 level

5.2.2 San Pedro RNCA

The regression results for the mail surveys of non-resident visitors of the San Pedro RNCA are shown in table 5.12. Income was positive but insignificant. The relationship between WTP and age, education, and the variable MAINREAS, was similar to that found for Ramsey Canyon visitors. WTP increases with the number of times respondents think they will return to the site (RETURN). None of the variables for states of origin, including the variable FOREIGN, were significant for the San Pedro sample. The number of times respondents have seen a gray hawk had a significant positive effect on respondents' WTP.

The estimated bid function for the WTP data obtained in the in-person surveys of nonresident visitors of San Pedro RNCA is reported in Appendix E. A likelihood-ratio test was performed to test whether the bid function coefficients varied significantly between mail and in-person surveys (see Appendix E). The hypothesis that the coefficients are equal could not be rejected. This indicates that respondents' WTP bids do not vary significantly with the phrasing of the CVM question (when the underlying condition is the same) nor with the presence of an interviewer.

TABLE 5.12, Estimated Bid Functions for Mail Surveys of Nonresident Visitors of the San Pedro RNCA

VARIABLE	NORMALIZED COEFFICIENT	ASYMPTOTIC T-RATIO[19]	$dE(Y)/dX_i$
LNINC	0.17431	1.5542	16.49752
LNAGE	-0.69520	-2.2434**	-65.79814
LNEDU	1.2211	2.2136**	115.5735
MAINREAS	0.35746	1.8202*	33.83184
RETURN	-0.7075E-01	1.0706	6.696487
RETURNSQ	-0.5459E-02	-1.2883	-0.516666
TIMESHAW	0.10817	2.1204**	10.23823
HAWKSQ	-0.4315E-02	-1.9163*	-0.408420
CONSTANT	-2.4717	-1.1196	

22 Limit Observations
151 Non-Limit Observations
Standard Error Of The Estimate = 147.85
Log-Likelihood Function = -983.07069
Squared Correlation Between Observed and Expected Values = 0.10875

5.2.3 Aggregate Benefits

Since the Arizona surveys measured only two points on the bid functions for flow levels (perennial flows versus intermittent flows) no specific marginal value of flows is estimated. To estimate the aggregate total benefits associated with the protection of perennial streamflows at Ramsey Canyon and San Pedro RNCA, we simply multiply the average WTP estimate by the total annual visitation at the respective site. This procedure

[19]* significant at the 0.1 level
** significant at the 0.05 level

assumes that the bid formation and visitor characteristics do not vary with the time of visit because we are extrapolating data from the 1992 spring season to the entire 1991/1992 fiscal year (July 1, 1991 to June 30, 1992). Moreover, I am assuming that the visitor data did not double-count repeat visitors since the WTP question was phrased in terms of a one-time contribution rather than per trip.

Given an average WTP of $101.67 in terms of a one-time contribution for the preservation of Ramsey Canyon and annual visitation of 23,628 non-resident visitors, aggregate net present value of Ramsey Canyon visitors for the preservation of the site is estimated to be about $2.4 million. While our survey included only birdwatchers the visitation data includes all recreationists. About 34 per cent of the visitors contacted at Ramsey Canyon were non-birders. We are assuming that the WTP of birdwatchers does not vary significantly from that of other recreationists. Given the specific significance of Ramsey Canyon as a birding spot, this assumption might lead to an overestimation of the aggregate benefits. However, the benefit transfer analysis showed no significant differences between birders and nonbirders (see Appendix E).

The average net present value of visitors of the San Pedro RNCA for the preservation of the riparian habitat was $69.03 for non-residents and $45.54 for local residents. Given an estimated number of 5271 non-resident and 6441 local visitors, the aggregate net present value of streamflow preservation at the San Pedro RNCA is approximately $657,000. As stated earlier, these estimates do not include visitors accessing the RNCA at points other than the Highway 90 crossing.

5.3 Benefit Transfer

5.3.1 Evaluation Procedure

The high demand for non-market benefit estimates combined with public sector time and budget constraints have caused benefit transfers to become the practice in political decisionmaking processes in many public agencies. However, the scientific debate is a relatively new one and many issues remain open. Opaluch and Mazzotta (1992) stress the importance of studies comparing site-specific benefit estimates with those derived from benefit transfer. To my knowledge, only two studies have followed this line of research (Loomis, 1992; Downing and Ozuna, 1994), and no study has evaluated the performance of benefit transfer using the open-ended CVM format. Moreover, the two previous studies were limited with respect to the number of explanatory variables included in the valuation functions used for benefit transfer.

The concurrent estimation of nonmarket values at sites which are similar with respect to location, recreational activity and visitor characteristics as described in this study provides an opportunity to test the convergent validity of benefit transfer for two specific cases: benefit transfer between San Pedro RNCA and Ramsey Canyon, southeastern Arizona, and between two subsequent stretches of the Rio Grande, northern New Mexico. While differences in survey design, population characteristics, and object of valuation exist, this only makes the cases at hand more similar to benefit transfer applications in practice.

Two types of benefit transfer will be evaluated. Most researchers agree that the transfer of the benefit function ("benefit function transfer") is preferred to the simple use of the benefit measure obtained from the study site as an estimate for the policy site benefits, (which I will refer to as "direct benefit transfer"). Using the coefficient estimates from study site demand equations provides a way of accounting for differences in population characteristics between study site and policy site. However, direct benefit transfer is often used for simplicity or where either the benefit function for the study site or the values of the independent variables for the policy site are unavailable.

In general, if the values obtained from benefit transfer are not statistically different from those obtained through site-specific estimation, convergent validity is established for the specific cases at hand. Several tests for convergent validity are possible. Let the tobit regression equation for the study site be denoted as

$$WTP_{si} = \beta_s'X_{si} + \epsilon_{si} \text{ if } RHS>0$$

$$WTP_{si} = 0 \text{ otherwise, } i=1,\ldots,n,$$

and that for the policy site be denoted as

$$WTP_{pj} = \beta_p X_{pj} + \epsilon_{pj} \text{ if } RHS>0$$

$$WTP_{pj} = 0 \text{ otherwise, } j=1,\ldots,m,$$

where WTP_{si} and WTP_{pj} are the ith observation of WTP in the study site sample and the jth observation of WTP in the policy site sample, respectively, β_s and β_p are (kx1)-vectors of regression coefficients, $\mathbf{X}_{si}$ and $\mathbf{X}_{pj}$ are (kx1)-vectors of independent variables, and ϵ_{si} and ϵ_{pj} are residuals that are independently and normally distributed, with mean zero and variance σ_s^2 and σ_p^2, respectively. The tobit regression will yield estimates of the regression coefficients and the error variances.

One way of testing for convergent validity of benefit function transfer, equivalent to the procedure used by Loomis (1992), is to test the null hypothesis that $\beta_s=\beta_p$ using a likelihood-ratio test (or a Chow test for the OLS regressions). However, Downing and Ozuna (1994) showed that because of non-linearities in the WTP function, statistical equality of the regression coefficients does not necessarily imply statistical equality of the resulting WTP measures.

Several alternative tests for the reliability of benefit transfer can be constructed using confidence intervals. Let $WTP_{p|p}$ be the expected value of WTP_p given the tobit benefit function for the policy site, i.e.

$$WTP_{p|p} = F(z_{p|p})*\beta_p'\mathbf{X}_{pm} + \sigma_p*f(z_{p|p}),$$

where $\mathbf{X}_{pm}$ is a kx1-vector of the means of the independent variables for the policy site sample, $z_{p|p}$ is equal to $\beta_p'\mathbf{X}_{pm}/\sigma_p$, F is the cumulative standard normal distribution function, and f is the standard normal density function.

Furthermore, let $WTP_{p|s}$ be the benefit transfer estimate of WTP_p given the tobit benefit function for the study site, i.e.

$$WTP_{p|s} = F(z_{p|s})*\beta_s'\mathbf{X}_{pm} + \sigma_s*f(z_{p|s}),$$

where $z_{p|s} = \beta_s'\mathbf{X}_{pm}/\sigma_s$.

Now we can compute 95 per cent confidence intervals over the two WTP estimates for the policy site by using a Taylor series expansion. It can be shown that the 95 per cent confidence interval over WTPp|p is

$$\begin{aligned} CI_{p|p} &= WTP_{p|p} \pm 1.96*var(WTP_{p|p}) \\ &= WTP_{p|p} \pm 1.96*\sqrt{[\rho'\Sigma\rho+(f(z_{p|p}))^2*var(\sigma_p)}), \end{aligned}$$

where $\rho = \delta WTP_{p|p}/\delta\beta_p = F(z_{p|p})*\mathbf{X}_{pm}$, Σ is the (kxk)-variance-covariance matrix of β_p, and $var(\sigma_p)$ is the variance of the estimated σ_p. Similarly, the 95 per cent confidence interval over $WTP_{p|s}$ (denoted as $CI_{p|s}$) can be obtained by replacing $WTP_{p|p}$ by $WTP_{p|s}$, β_p by β_s, $z_{p|p}$ by $z_{p|s}$, and σ_p by σ_s in the above formula.

Finally let WTP_{pm} be the sample mean WTP for the m policy site observations, and let WTP_{sm} be the sample mean WTP for the n study site observations.

In addition to the likelihood-ratio test for the equality of β_s and β_p, the following hypotheses tests can now be constructed:

I. Comparison of predicted values

(1) *Convergent validity of benefit function transfer:*

H_0: $WTP_{p|s} = WTP_{p|p}$

To test whether the WTP estimate for the policy site obtained by transferring the benefit function from the study site is statistically different from the original estimate for the policy site, two comparisons need to be made. It is possible that the two comparisons yield contradicting results in which case the result of the hypothesis test is ambiguous.

a) $WTP_{p|s} \in CI_{p|p}$,

i.e. testing whether the estimate from benefit function transfer lies within the confidence interval over the original estimate.

b) $WTP_{p|p} \in CI_{p|s}$,

i.e. testing whether the original estimate lies within the confidence interval over the benefit transfer estimate.

(2) *Convergent validity of direct benefit transfer:*

H_0: $WTP_{s|s} = WTP_{p|p}$

To test the reliability of the common practice of simply using the predicted WTP for the study site as a benefit estimate for the policy site, without adjusting for differences in the independent variables. Again, two comparisons are required:

a) $WTP_{s|s} \in CI_{p|p}$, and

b) $WTP_{p|p} \in CI_{s|s}$.

II. Comparison of actual sample means

By construction, the tobit prediction of WTP exceeds the actual sample mean, because the tobit model adjusts for the fact that the mean of the error term is greater than zero for the subsample of positive WTP bids. It is not clear which of the two values should be considered as the best estimate. For completeness, the actual sample mean is also compared to the benefit transfer estimates. In particular, the convergent validity of benefit function transfer is evaluated by testing

$$H_0: WTP_{pm} \in CI_{p|s},$$

and the convergent validity of direct benefit transfer is evaluated by testing

$$H_0: WTP_{pm} \in CI_{s|s}.$$

In addition to the question of statistical equality of site-specific and benefit transfer estimates of WTP, the percentage "errors" from benefit transfer are of interest to policymakers (Loomis, 1992). Since the results of the hypotheses tests depend on the width of the confidence intervals, percentage errors from benefit transfer can be fairly large even when two estimates are not statistically different. The notion of percentage errors, of course, assumes that the site-specific benefit estimate is accurate. This assumption is questionable; however, it is made where ever studies use a point estimate of WTP to compute aggregate effects and evaluate alternative policies. Thus, while the notion of percentage errors assumes that the study site values are accurate and this assumption may not be warranted, the following versions of percentage errors are computed and reported in the present analysis in deference to policymakers' interest in this concept:

1) *Percentage error resulting from benefit function transfer*:

a) between the WTP estimate obtained from benefit function transfer and the predicted site-specific estimate:

$$(WTP_{s|p} - WTP_{p|p})*100/WTP_{p|p}$$

b) between the WTP estimate obtained from benefit function transfer and the actual sample mean for the policy site:

$$(WTP_{s|p} - WTP_{pm})*100/WTP_{pm}$$

2) *Percentage error resulting from direct benefit transfer*

a) between the site-specific predicted WTP estimates for the study site and the policy site:

$$(WTP_{s|s} - WTP_{p|p})*100/WTP_{p|p}$$

b) between the actual sample means for the study site and the policy site:

$$(WTP_{sm} - WTP_{pm})*100/WTP_{pm}$$

5.3.2 Benefit Transfer Results for Southern Arizona

To allow for an evaluation of the reliability of benefit transfer between San Pedro RNCA (SP) and Ramsey Canyon Preserve, the regression equations had to be reestimated using only those independent variables which were available for both sites. Since the sample of Ramsey Canyon visitors was designed to include only birdwatchers, the San Pedro sample was restricted to the 77.6 per cent of respondents who indicated that they were birdwatching. The mail survey data was used in order to minimize differences in data collection between the two sites. However, benefit transfer analysis was also performed using in-person data and the entire sample of San Pedro RNCA. Those results are shown in Appendix E. Benefit transfer performed very similarly for all versions. The phrasing of the WTP question, the presence of an interviewer, and the inclusion of non-birders do not seem to affect the reliability of benefit transfer.

The estimated normalized coefficients, asymptotic t-statistics, and standard errors of the estimate from the tobit regressions are shown in Table 5.13. Table 5.14 shows the various WTP estimates used in the hypothesis testing. Table 5.15 and 5.16 show the results of the hypothesis testing and the percentage errors from benefit transfer, respectively.

If we accept the tobit prediction of WTP as the correct site-specific benefit estimate, convergent validity was established for benefit function transfer between San Pedro RNCA and Ramsey Canyon. The WTP estimate obtained through benefit function transfer was found not to be statistically different from the site-specific tobit prediction.

The hypothesis of the equality of the site-specific tobit prediction and the study site estimate was clearly rejected. Benefit function transfers resulted in fairly small biases (below 6 percent). By contrast, direct benefit transfer resulted in percentage errors that were up to 35 times as large as those from benefit function transfer. This confirms the general belief that benefit function transfer is to be preferred over direct benefit transfer.

If we believe that the correct measure of WTP is given by the actual sample mean, benefit function transfer as well as simple transfer of the study site prediction yielded confidence intervals which contained the sample mean WTP from the Ramsey Canyon data. However, neither method of benefit transfer yielded valid estimates of the mean WTP of San Pedro respondents. Moreover, percentage errors were fairly large for both sites. However, benefit function transfer still resulted in slightly smaller biases than direct benefit transfer.

Generally, benefit transfer led to overestimation of the WTP of San Pedro RNCA visitors, while no clear direction of the bias from benefit transfer could be determined for the Ramsey Canyon estimate.

TABLE 5.13, Normalized Regression Coefficients (and T-Statistics) for Arizona Data as used in Benefit Transfer Analysis

VARIABLE	RAMSEY CANYON	SAN PEDRO RNCA
INCOME	0.83626E-05 (2.6555)**	0.75312E-05 (1.4027)
INCSQ	-0.20239E-10 (-1.7149)*	-0.21286E-10 (-1.1554)
LNAGE	-0.17531 (0.86195)	-0.86361 (-2.3873)**
EDUCATION	0.60651E-01 (2.4833)**	0.75146E-01 (1.9467)*
TRIPNUM	0.20357 (3.3912)**	0.21763 (1.7576)*
TRIPSQ	-0.13696E-01 (-2.1489)**	-0.23751E-01 (-1.3559)
FOREIGN	-0.57809 (-2.1245)**	-0.41285E-02 (-0.01201)
MAINREAS	0.21680 (1.6431)	0.39669 (1.8220)*
CONSTANT	-0.52437 (-0.55899)	2.0249 (1.2289)
σ	177.82	159.86
Squared Correlation between observed and expected values	0.10106	0.12827

TABLE 5.14, Actual Means, Predicted WTP, and 95 Percent Confidence Intervals for the Arizona Data

Study Site	Policy Site	WTP_{pm}	$WTP_{p\|p}$	$CI_{p\|p}$	$WTP_{p\|s}$	$CI_{p\|s}$
Ramsey	San Pedro	101.10	122.01	106.75;137.27	128.48	91.50;165.45
San Pedro	Ramsey	77.31	100.44	79.89;120.99	101.01	79.81;122.22

TABLE 5.15, Results of Hypothesis Tests Regarding the Convergent Validity of Benefit Transfer / Arizona[20]

Policy Site	Study Site	$\beta_p=\beta_s$	$WTP_{p\|s} \in CI_{p\|p}$	$WTP_{p\|p} \in CI_{p\|s}$	$WTP_{s\|s} \in CI_{p\|p}$	$WTP_{p\|p} \in CI_{s\|s}$	$WTP_{pm} \in CI_{p\|s}$	$WTP_{pm} \in CI_{s\|s}$
Ramsey	SP	YES	YES	YES	NO	NO	YES	YES
SP	Ramsey	YES	YES	YES	NO	NO	NO	NO

TABLE 5.16, Percentage Errors Resulting From Benefit Transfer / Arizona

Policy Site	Study Site	$WTP_{p\|p}$ vs. $WTP_{p\|s}$	WTP_{pm} vs. $WTP_{p\|s}$	$WTP_{p\|p}$ vs. $WTP_{s\|s}$	WTP_{pm} vs. WTP_{sm}
Ramsey	San Pedro	+5.3%	+27.1%	-17.7%	-23.5%
San Pedro	Ramsey	+0.6%	+30.7%	+21.5%	+30.8%

5.3.3 Benefit Transfer Results for New Mexico

The convergent validity of benefit transfer between the Taos Box and the Lower Gorge of the Rio Grande was tested using the regression results reported in section 5.1.1 and 5.1.2 for total WTP for the current trip (RAFTEXP+WILLPAY) and for the additional WTP for guaranteed higher flows and an extended rafting season (ADDPAY). The ADDPAY regressions could only be compared between Taos Box rafters and

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[20] YES stands for failure to reject and NO for refection of the null hypothesis at the 5 per cent level.

experienced Lower Gorge rafters due to the different payment vehicle used for the sample of nonexperienced Lower Gorge rafters. Tables 5.17 to 5.19 show the results of the benefit transfer analysis.

The null hypothesis that the regression coefficients for the study site and the policy site are equal was clearly rejected in both cases. Moreover, all hypotheses for the convergent validity of benefit transfer were rejected for the total WTP of both Taos Box and Lower Gorge rafters as well as for the ADDPAY estimate for Lower Gorge rafters. Benefit transfer also seems unreliable in estimating the ADDPAY values of Taos Box rafters, although the comparison of the tobit prediction for the Taos Box to the estimate from benefit function transfer was ambiguous, and the confidence interval for the benefit function transfer estimate contained the actual mean WTP of Taos Box rafters.

Benefit function transfer resulted in smaller biases than the simple transfer of the study site estimate, except for the comparison of benefit transfer estimates to the actual sample mean of ADDPAY for Lower Gorge rafters. In general, percentage errors resulting from benefit transfer were very large: at least 40 per cent for the estimated total WTP for the current trip, and above 26 per cent in 7 out of 8 comparisons of the ADDPAY estimates. Both types of benefit transfer consistently led to a substantial underestimation of the Taos Box benefit measures and overestimation of the WTP of Lower Gorge rafters. The direction of this bias is not surprising given the fact that the quality of the rafting experience is higher on the Taos Box, which was not accounted for in the benefit transfer analysis.

TABLE 5.17, Actual Means, Predicted WTP, and 95 Percent Confidence Intervals for the New Mexico Data

Study Site	Policy Site	Independent Variable	WTP_{pm}	$WTP_{p\|p}$	$CI_{p\|p}$	$WTP_{p\|s}$	$CI_{p\|s}$
Taos Box	Lower Gorge	RAFTEXP + WILLPAY	116.37	116.37	106.89;125.85	69.86	64.33;75.38
Lower Gorge	Taos Box		59.62	59.62	55.85;63.38	108.16	96.65;119.68
Taos Box	Lower Gorge	ADDPAY	25.58	31.75	28.04;35.45	23.30	14.40;32.20
Lower Gorge	Taos Box		17.41	18.11	15.18;21.03	29.92	22.21;37.64

Table 5.18 (a-b), Results of Hypothesis Tests Regarding the Convergent Validity of Benefit Transfer / New Mexico

a) RAFTEXP + WILLPAY

Policy Site	Study Site	$\beta_p=\beta_s$	$WTP_{p\|s} \in CI_{p\|p}$	$WTP_{p\|p} \in CI_{p\|s}$	$WTP_{s\|s} \in CI_{p\|p}$	$WTP_{p\|p} \in CI_{s\|s}$	$WTP_{pm} \in CI_{p\|s}$	$WTP_{pm} \in CI_{s\|s}$
Taos Box	Lower Gorge	NO	NO	NO	NO	NO	NO	NO
Lower Gorge	Taos Box		NO	NO	NO	NO	NO	NO

Table 5.18., (continued)

b) ADDPAY

Policy Site	Study Site	$\beta_p = \beta_s$	$WTP_{p\|s} \in CI_{p\|p}$	$WTP_{p\|p} \in CI_{p\|s}$	$WTP_{s\|s} \in CI_{p\|p}$	$WTP_{p\|p} \in CI_{s\|s}$	$WTP_{pm} \in CI_{p\|s}$	$WTP_{pm} \in CI_{s\|s}$
Taos Box	Lower Gorge	NO	NO	YES	NO	NO	YES	NO
Lower Gorge	Taos Box		NO	NO	NO	NO	NO	NO

TABLE 5.19, Percentage Errors Resulting From Benefit Transfer / New Mexico

Policy Site	Study Site	Version	$WTP_{p\|p}$ vs. $WTP_{p\|s}$	WTP_{pm} vs. $WTP_{p\|s}$	$WTP_{p\|p}$ vs. $WTP_{s\|s}$	WTP_{pm} vs. WTP_{sm}
Taos Box	Lower Gorge	RAFTEXP + WILLPAY	-40.0%	-40.0%	-48.8%	-48.8%
Lower Gorge	Taos Box		+81.4%	+81.4%	+95.2%	+95.2%
Taos Box	Lower Gorge	ADDPAY	-26.6%	-8.9%	-43.0%	-31.9%
Lower Gorge	Taos Box		+65.2%	+71.9%	+75.3%	+46.9%

5.3.4 Interpretation of the results

In summary, benefit function transfer seemed to be a valid approach for the Arizona data, while it yielded large biases for the New Mexico data. The WTP of Taos Box rafters for both the current trip and higher flow levels was consistently underestimated by the benefit function of the Lower Gorge, while benefit transfer substantially overestimated the WTP of rafters on the Lower Gorge. For all sites, benefit function transfer generally performed better than simple transfer of the study site estimate. In trying to explain why benefit transfer worked for the Arizona data, but did not work for the New Mexico data, it is helpful to examine to what degree the sites satisfy the criteria for the selection of original studies to be used in benefit transfer as proposed by Desvousges, Naughton and Parsons (1992), and Boyle and Bergstrom (1992, see section 2.1.4.2):

(1) The original studies should be scientifically defensible.

Although the survey design could be improved to satisfy the NOAA guidelines (see the following section of this chapter) we believe that data collection, economic method, empirical methods, and reporting of results in our study generally satisfy this criterion.

(2) The objects of valuation should be similar at the study site and the policy site.

There is some uncertainty in the literature as to how detailed the definition of the object of valuation should be. Using a broad definition, the object of valuation in both Arizona studies is the preservation of streamflows in riparian areas which are significant as habitats for various bird species and which are used for stream-side non-consumptive recreational activities (mainly birdwatching and hiking). For the two New Mexico surveys the objects of valuation were a river running trip at current flows and the guarantee of higher flow levels and an extended rafting season. Thus, using this broad definition, criterion (2) is satisfied for both pairs of sites. However, on a more detailed level, there are differences between the objects of valuation. The two Arizona mail surveys mainly differed with respect to the phrasing of the CVM question, but both sites offer nationally acknowledged opportunities for birdwatching. While the CVM questions were identical for the two New Mexico surveys used in benefit transfer, rafting trips on the two stretches of the Rio Grande vary with respect to length and quality of the rafting experience.

(3) Regression results should describe WTP as a function of socioeconomic characteristics and site characteristics.

Bid functions including socioeconomic characteristics as independent variables were estimated for all sites. Since all our studies were single-site studies no variation in site characteristics was observed, with the exception of flow levels for the Rio Grande data.

(4) Study site and policy site should have similar populations.

The samples of Ramsey Canyon and San Pedro RNCA visitors were overlapping: 70.4 per cent of San Pedro RNCA visitors indicated that they visited Ramsey Canyon as well, and 34.6 per cent of the Ramsey Canyon respondents also visited San Pedro RNCA. Moreover, the two samples were similar with respect to the states of origin of visitors. Differences in socioeconomic characteristics and states of origin should be adjusted for through the use of benefit function transfer as long as the differing characteristics were included in the regressions. Among Rio Grande rafters, the Taos Box tends to attract more experienced and dedicated rafters than the Lower Gorge. Rafters differ with respect to their state of origin: Taos Box rafters include significantly more people from New Mexico and less from California. However, all these differences were accounted for in the benefit functions.

(5) The markets for both sites should be similar.

Ramsey Canyon and San Pedro RNCA are both high quality birding spots with few substitutes of their kind. In contrast, the two stretches of the Rio Grande differ significantly in quality, i.e. the spectacularity and degree of challenge of the rafting experience. Consequently, the availability and price of substitutes as well as the price of a rafting trip (per day) on the two stretches examined in this study vary significantly.

(6) The assignment of property rights at both sites must lead to the same theoretically appropriate welfare measure.

This criterion is satisfied for all sites in this study.

The following tentative conclusions can be drawn from our benefit transfer analysis:

The phrasing of the CVM question and the use of mail versus in-person surveys does not necessarily cause significant differences in WTP as long as the underlying condition is the same, as demonstrated by the Ramsey Canyon and San Pedro RNCA data. Moreover, the inclusion of visitors that came for non-consumptive stream-side recreational activities other than birding did not increase the bias from benefit transfer significantly. These results are encouraging since these types of differences are likely to be present in many benefit transfer applications.

Differences in socioeconomic characteristics and states of origin can be accounted for using the benefit transfer approach, at least if the observed characteristics lie within approximately the same range. However, as other authors have found previously (e.g. Desvousges, Naughton and Parsons, 1992), socioeconomic characteristics have low explanatory power in benefit functions.

Similarity in the broad category of the object of valuation is not sufficient for the convergent validity of benefit transfer. Differences in site characteristics which influence the quality of the recreation experience can cause substantial biases in benefit transfer estimates. In the case of river rafting, flow levels are inadequate measures of site characteristics for inter-site comparisons because similar cfs levels do not necessarily provide comparable rafting experiences across different rivers or stretches of rivers. In this study, benefit transfer did not work well between the narrow, faster Taos Box section of the Rio Grande and the wider, slower Lower Gorge - even though adjacent reaches of the same river.

Differences in the market for the contingent good, especially the availability and price of substitutes, if not accounted for, are also likely to cause biases in benefit transfer estimates. Multi-site studies would be helpful in determining the effect of various site characteristics and market conditions on WTP. Pooled regressions for the New Mexico data including the stretch of the river as a dummy variable showed that rafters on the Taos Box are on average willing to pay $48.52 more for a rafting trip (t-statistic=14.2). In order to determine which site characteristics (e.g. scenic beauty versus classification of rapids) cause this difference in WTP and to what extent, more whitewater rafting studies are required to allow for a multi-site analysis.

5.4 Comparison of the Study with the NOAA Guidelines

In section 2.1.2.8 I summarized NOAA's proposed rules for the design and implementation of CVM surveys. These guidelines were published more than a year after the surveys used for this thesis were designed. No past CVM study has fulfilled all of these guidelines. Moreover, there is a large amount of ongoing discussion among CVM researchers to what extent the NOAA guidelines are useful and whether they should apply to uses other than the measurement of nonuse values for natural resource damage assessment. The estimation of recreationists' non-market benefits for the purpose of policy analysis requires less precision than natural resource damage assessment for litigation. The substantial costs which are likely to be associated with fulfilling many of the NOAA guidelines might outweigh the benefits of increased precision in the estimates.

Moreover, recreationists are familiar with the resource and have experience paying for recreational trips in terms of travel costs, entrance fees etc. Therefore, CVM estimates are generally more reliable in measuring recreational values than nonuser values. Nevertheless, I will discuss deviations from the NOAA guidelines in the design and implementation of the surveys used in collecting the data for the present study.

The relatively low explanatory power in the bid function regressions reported in this chapter indicate that there might be weaknesses in the data used. There are two possible reasons for the low explanatory power: first, respondents' bids may have an element of randomness and not be explainable through economic theory; second, there may be important explanatory variables which are not identified and included in the model. Many of the data deficiencies are due to the collection of the WTP data as part of a larger project given limited funds and are not unique to the data used in this study. However, the analysis of weaknesses can be helpful in the design of future CVM studies. The comparison of the surveys used for this study to the NOAA guidelines is helpful in eliciting some of the weaknesses.

During the development of the survey, it shall be determined whether respondents understood and found credible the description of the object of valuation.

Although the surveys used for this study were pretested, the low explanatory power of the bid function regressions could be an indication that the WTP scenarios and questions were not always meaningful to and understood by respondents. The CVM questions aimed at measuring river runners' WTP for higher flows than they actually experienced on their trip could have been improved by describing how higher flows affect various attributes of the rafting experience (e.g. challenge, safety). Bishop et al. (1988) provide a good example of such a description. Photographs (as used in the San Pedro personal interviews) could be helpful as well to assure that the CVM question is meaningful to the respondents. The low explanatory power of the ADDPAY regressions and the insignificance of flow levels for less experienced rafters provides an indication that the ADDPAY question may have been "too hypothetical" to many inexperienced rafters.

The inclusion of a "no-answer" option in the WTP question would have been helpful in order to eliminate random answers by respondents who did not feel able to answer the CVM question. The inclusion of a question eliciting respondents' motives for positive bids would be useful in examining whether respondents bids were given for the "right" reasons. While I took great care in detecting protest zeros (see Appendix D), some fairly low bids might have been protest responses as well. Random answers and positive protest bids are possible factors causing the low explanatory power of the bid function regressions. A formal outlier analysis would also have been helpful in eliminating these kinds of responses.

Prior to the value elicitation, the natural resource context and substitutes shall be identified.

There is a great deal of ongoing discussion among CVM researchers regarding how much context and information to provide respondents. This issue is relevant in this study. Several respondents to the New Mexico surveys expressed concern about environmental impacts of the CVM scenario in which higher flow levels will be maintained throughout the summer (see Appendix D). Most of these respondents seemed to misunderstand the issue; many expressed the belief that current flows are "natural" and that increasing and maintaining flows would require dams or similar major interventions into "the course of nature". This perception is incorrect (the status quo low flow regime is the result of human intervention upstream), and these protests were excluded. In future surveys it might be possible to avoid these misunderstandings by giving more information on where the additional water would come from and on the fact that current flows are well below the historical "natural" level. However, such contextual descriptions might influence respondents by giving the impression that the status quo condition is "bad".

The analysis of substitutes would also have been helpful, particularly in the Rio Grande surveys. Substitutes for the Taos Box are likely to be different from those for the Lower Gorge because the quality of the rafting experience differs. For all sites, an identification of these substitutes would have been useful in the benefit transfer analysis, and a reminder to respondents about the availability of substitutes would have helped respondents in their WTP decision. However, several respondents who indicated zero bids stated that they could use substitute sites instead of paying for using the study site, especially among recreationists in the Arizona samples. This indicates that respondents did consider the availability of substitutes in their WTP decision.

Respondents shall be reminded of their budget constraints and alternative expenditure possibilities. They shall be reminded that their WTP for the environmental program in question would reduce their expenditures on other goods. This reminder shall take place before and after the value elicitation. Respondents shall be given the opportunity to reconsider and change their bids.

The NOAA panel stated that this issue has not been adequately addressed by past CVM studies. The surveys used for the present study are innovative in that regard. Respondents were reminded of the fact that they would have to reduce spending on other goods in order to finance their WTP bids. Moreover, they were given the opportunity to change their bids after reconsidering their budget constraint. However, the reminder took place only after the value elicitation. The results indicated that respondents seem to think carefully about their answers to the payment questions and that they have an idea which other categories in their household budget they would spend less on in order to finance their bid. he most commonly stated budget category that respondents indicated to reduce spending on.

The survey instrument shall use a credible choice mechanism and payment vehicle. The *choice mechanism shall be incentive compatible. Follow-up questions shall be asked to determine whether the respondents accepted the choice mechanism and payment vehicle as credible.*

While the dichotomous choice format has gained wide popularity in recent CVM studies, the data used for the present study was based on open-ended WTP questions. The sample sizes for the data used in this thesis were subject to time and financial constraints. These sample sizes would not have been large enough to achieve an acceptable level of statistical precision for the dichotomous choice format. The inclusion of a wide range of values on the payment cards should limit anchoring and related forms of bias. However, the existence of strategic bias can not be precluded (but that is not unique to the open-ended format).

While the payment vehicle of a one-time contribution used in the Arizona surveys may appear interesting because it incorporates multi-period effects and changes in trip numbers associated with changes in the quality of the public good, the precision of respondents' answers to this kind of question is likely to be limited. First, a precise answer to the question does not exist because many factors determining the net present value of a public good are uncertain. Second, a reasonable answer in terms of a one-time contribution involves an immense amount of thinking. Most payment vehicles require the respondents to determine their nonuse value and their WTP per trip, which in itself is a difficult task. In addition, the phrasing of the WTP in terms of a one-time contribution requires respondents to consider their annual number of visits to the site (which might change with age), their life expectancy, and an appropriate discount rate. It seems very unlikely that respondents take the time required to consider all these factors in answering the WTP question. In fact, some degree of training in economics is probably necessary for respondents to even think of all the above components of net present value.

Although the precision of the answers to the WTP question in the Arizona surveys is questionable for the above reasons, the signs on age and annual number of trips in the WTP regressions are consistent with economic theory. The transferability of the benefit measures also is encouraging. However, asking for WTP per trip simplifies the respondents decision making as well as the comparison with the value of water in alternative uses.

The survey instrument or analysis method shall provide a mechanism for calibrating hypothetical WTP to actual WTP. If such a mechanism can not be provided, actual WTP shall be presumed to be one-half of stated WTP.

Several authors have compared CVM estimates of recreational values to those obtained from alternative methods (e.g. the travel cost method) and have found estimates to be similar (Smith, 1992b). Therefore, dividing WTP estimates by two as recommended by NOAA does not seem justified here. NOAA's recommendation, although definitely arbitrary, might be appropriate for measuring nonuse values for natural resource damage assessment since CVM estimates are likely to be less reliable in that case, no comparisons to other methods exist for nonuse values, and the use for litigation presents a strong incentive for strategic behavior.

A probability sample shall be drawn from the target population for the administration of the final survey. The sample size shall be sufficient to draw statistically significant population inferences and to estimate WTP valuation functions or to test relevant statistical hypotheses.

Sample sizes for open-ended questions do not have to be as large as for the dichotomous choice format. The sample sizes used for data collection for the present study were fairly large, above 400, except for the San Pedro RNCA. Sampling procedures were up to standards except for the fact that data collection did not cover the entire period of recreational visits. However, surveys covered nearly all of the summer rafting season on the Rio Grande and the spring recreation season at the Arizona sites.

Nonresponse bias shall be minimized to the extent practicable by striving for as high a response rate in the final survey as possible, consistent with the requirements of reasonable cost. In no case shall the response rate be less than seventy percent.

Sample nonresponse rates in this study were fairly low. All response rates were above 70 per cent. Item nonresponses for the WTP question also were relatively low for most surveys. Where item non-response rates were of concern, t-tests were used to determine the direction of potential biases (see Appendix D).

The rationale for the selected mode of survey administration shall be documented.

The collection of the CVM data for the present study was part of larger projects aimed at determining not only non-market values but also local economic impacts and visitor characteristics. Given limited time and funding, the use of personal interviews to elicit all this information would have drastically reduced the sample sizes and might have increased sample nonresponses. Mitchell and Carson state that the difference between mail and telephone surveys is likely to be small when respondents are familiar with the amenity, which is the case for recreational visitors.

In addition to some of the above deviations from the NOAA rules, the low explanatory power of the bid function regressions might also be due to the fact that the CVM question was part of a fairly long and complex survey. This is of particular concern in the New Mexico surveys, where the CVM question was asked relatively late on the survey after a long, detailed question on trip expenditures.

Moreover, the low explanatory power of the bid function regressions in this study might be an indication that data on important explanatory variables is missing. Among the explanatory variables mentioned by the NOAA panel and not included in the surveys are: attitudes toward the environment (except for membership in an environmental organization for the Ramsey Canyon data), understanding of the CVM question, belief in the scenarios, and ability and willingness to perform the valuation exercise. Finally, it would be ideal to have reliable travel cost data because economic theory indicates that

WTP depends on the cost of a recreational trip (which largely consists of travel costs).

6. CONCLUSIONS AND POLICY IMPLICATIONS

6.1 CVM and the Realities of Policy Making

This thesis had four main objectives: (1) to estimate aggregate benefits associated with water-based recreation at two sites in southern Arizona and two reaches of the Rio Grande in northern New Mexico; (2) to determine whether aggregate total and marginal benefits behave in a way that is consistent with economic theory; (3) to examine the importance of nonuse values as a portion of total WTP by resource users; and (4) to evaluate the validity of benefit transfer in estimating recreational benefits.

The contingent valuation method was used to collect willingness to pay data from site users. The use of CVM is controversial among economists as well as policymakers because it relies on hypothetical rather than observed data. Although many evaluations on the reliability of CVM estimates have been performed, the conditions under which it should be used remain a subject of ongoing discussion.

Many justify the use of CVM by the fact that it is the only available method for measuring nonuse values. This implies that "any benefit estimate is better than no estimate" in making decisions on public policies regarding natural resources. In a recent article, Vatn and Bromley (1994) challenge this assumption. The authors point out that the most important natural resource decisions in the past were made without evaluating economic costs and benefits (e.g. the introduction of the national park system in the U.S. and interventions on air pollution in Europe). Vatn and Bromley state that because technical knowledge and public opinions about environmental problems are constantly changing, hypothetical valuation of environmental resources can never be complete and therefore cannot guarantee "better" decisions on irreversible environmental choices.

I believe that the notion that "some number is better than no number" should indeed be questioned. The costly and time consuming estimation of hypothetical costs and benefits might not be appropriate, especially when urgent environmental problems demand timely action by policymakers and there is significant uncertainty regarding benefits and costs. However, in my opinion, two realities of the policymaking process do suggest that CVM is a policy relevant tool for those cases in which it can produce reasonably reliable results.

First, the estimation of the <u>costs</u> of natural resource preservation programs is usually easier than the estimation of the <u>benefits</u> of such programs because the costs are generally more tangible. As a consequence, opponents of environmental protection policies (with substantial assistance from economists) are able to present estimates of the opportunity costs of natural resource preservation. In the specific case of instream flow protection, benefits of water use in irrigation and residential development are tangible, and estimates of these benefits are commonly used by developers and irrigators in lobbying efforts to prevent instream flow and environmental protection. Second, policy makers are influenced by economic interests. The notion of a "beneficial use of water" which is still employed in the provision of water rights in most of the western United States is a good example of this point. Policy makers associate "beneficial use" with tangible economic benefits.

As long as these two factors continue to influence public policy making, CVM estimates often are useful in informing public debate on the costs and benefits of environmental protection. A defensible estimate of the benefits of natural resource preservation often is necessary to well-rounded policy analysis when opportunity cost estimates for preservation are readily available, as in many local development issues. While Vatn and Bromley (1994) are correct that, historically, most fundamental environmental choices have been made without "prices", estimation of non-market benefits does provide useful information when conflicts arise over environmental preservation. Of course, an arbitrary benefit estimate (produced by CVM or any other means) does not serve to inform and improve policy choices.

A problem inherent in nonmarket valuation studies is that the true benefits of the goods being valued are unknown. Therefore, a definite statement on the validity of the benefit estimates obtained is impossible. The valuation exercise performed in this study represents a relatively sound application of CVM. Only the values of resource users, who are familiar with the resource being valued and have experience in paying for recreational use of the resource, are elicited. Previous studies have established convergent validity of CVM estimates under these conditions by comparing CVM estimates to those obtained through alternative techniques (e.g. the travel cost method). Moreover, the consistency of the CVM regression results with economic theory is an indicator for theoretical validity. In this study, all coefficients had the expected sign, although they were not always significant.

Another type of validity is content validity. Criteria for content validity include whether the description of the good is unambiguous and meaningful to the respondents, and whether the property rights and payment vehicle are plausible to the respondents. As analyzed in section 5.4., the CVM question on higher flows (ADDPAY) might not have been meaningful to less experienced rafters. For the Arizona data, the plausibility of a one-time contribution to a non-profit foundation as the payment vehicle also is somewhat questionable. The t-test analysis of protest bids and valid responses, which is reported in Appendix D, is a further reason of concern about the validity of the benefit measures. For the Taos Box and both Arizona sites, protest bidders and respondents who indicated valid bids were found to differ significantly with respect to some of the explanatory variables in the bid functions. As a consequence, the exclusion of protest bids from the analysis is likely to bias the results for those sites.

Another issue regarding the defensibility of CVM estimates is the reliability of the estimates. Two indicators of reliability are confidence intervals and the explanatory power of the bid functions. Both are reported in this study. The confidence intervals for the Arizona data are fairly large. The explanatory power of the bid functions is quite low, although an R_2 around 0.2 is not uncommon in CVM studies. The aggregate and marginal benefit estimates of streamflows at the Rio Grande reported in this study are based on the respondents' WTP for the current trip at flows experienced (WILLPAY) rather than their WTP for hypothetical scenarios (ADDPAY).

The above reasons for concern with respect to the validity and reliability of the estimates are not unique to this study. Research on CVM continues with the objective to improve the validity and reliability of the estimates. Alternative measures like the travel cost method also have many problems and limitations. Nevertheless, the weaknesses of CVM estimates need to be kept in mind when using the results reported in this study.

While not intending to make a case for the current fascination with non-market valuation and the attempt to measure costs and benefits for every environmental choice, this thesis represents an application of the CVM to the measurement of the benefits of water instream in order to provide useful economic information for ongoing policy debates about water allocations for instream versus offstream purposes.

6.2 Recreational Benefits Associated with Streamflows

6.2.1 Benefits of Streamside Recreation in Southern Arizona

The present study shows that visitors to Ramsey Canyon and San Pedro RNCA in southern Arizona value the protection of the perennial streamflows and riparian habitat at the two sites. The net present value to visitors is approximately $2.4 million and $657,000 for the protection of Ramsey Canyon reserve and San Pedro RNCA, respectively, with nonuse values accounting for more than two thirds of total value. The individual bids, on average, represented about 0.12 to 0.15 percent of the annual income. The net present values estimated based on 1992 data are likely to prove to be conservative given several trends: a) the increasing popularity of nature-based recreational activities; b) the increasing number of retirees; and c) the increasing scarcity of perennial streams in the southwestern United States. All of these trends suggest that visitor numbers and aggregate values will be higher in the future than 1992 visitor numbers and bids indicate.

In addition to the non-market benefits estimated in this study, Crandall, Leones and Colby (1992) estimated that visitors to Ramsey Canyon and the San Pedro RNCA spend about $1.6 million in the Sierra Vista area during the fiscal year 1991-1992, resulting in approximately $2.1 million in total output and $1.62 million in value added.

The San Pedro RNCA is relatively new and visitor numbers are likely to grow in the future. At the same time, the Sierra Vista area is growing rapidly and the increased demand for water in residential area development is endangering the perennial flow of the San Pedro river. Local planners need to recognize the link between groundwater use and surface water flows and consider the instream value of water in the San Pedro river. The present study contributes to the knowledge about the importance of stream-dependent recreational activities for the Sierra Vista area and the associated non-market economic benefits.

A complete economic analysis of the comparative benefits of water instream and offstream would need to incorporate hydrologic data on streamflows required to preserve the riparian habitat and on the relationship between groundwater pumping and surface water flows. It also would need to estimate the marginal value of water in agriculture and urban uses. Moreover, this study did not attempt to measure values that nonusers of the two sites hold for the preservation of streamflows and riparian habitats. Given the fact, that about 90 percent of the natural riparian habitat in Arizona has already been lost to consumptive water uses, nonuse values are likely to be substantial. In fact, due to the potentially large number of nonvisitors who might hold nonuse values the aggregate nonuse benefits are likely to exceed the benefits associated with resource users' values indicated in this study by far.

6.2.2 Benefits of Streamflows for Rafting in Northern New Mexico

The present study found that rafting on the Rio Grande in northern New Mexico generated about $610,000 in aggregate consumer surplus in 1992. The aggregate benefits to rafters on the Taos Box and the Lower Gorge of the Rio Grande were found to increase with flow level at a decreasing rate. Taos Box flows were found to reach an optimum at approximately 1800 cfs, beyond which marginal benefits become negative. An optimal flow level was not observed in the Lower Gorge analysis, since the flow levels during the interview period did not exceed 1470 cfs and participation on this stretch of the river was not affected by flows. The average individual consumer surplus measures ($16 to $21 per day) were significantly lower than those found for rafting on the Colorado river below Glenn Canyon Dam ($30 to $115 per day, depending on flow levels (Bishop et al., 1988)). This is not surprising given the spectacular setting in which rafting through the Grand Canyon occurs. In my study, individual bids represented less than 0.04 percent of the average income, which seems plausible given the payment vehicle of rafting fees per trip. It needs to be remembered that this payment vehicle does not allow for nonuse values, which were shown to be a substantial portion of total value in the Arizona surveys.

Flow levels on the Rio Grande in northern New Mexico exhibit large fluctuations from day to day. From late July on, streamflows often drop below 300 cfs. As a consequence, rafting on the Taos Box is cut off in the middle of the summer recreation season. The present study showed that if daily flows in July and August could be increased by 500 cfs the annual total benefits from rafting would increase by about 8 percent. A constant flow of 1200 cfs and 1800 cfs in July and August would lead to an increase in annual benefits of about 11 and 15 percent, respectively.

The Rio Grande Compact does not assure minimum flow levels in northern New Mexico. It also does not restrict the timing of Colorado's delivery obligations. However, the present study found that the marginal value of flows for rafting varies across months and between weekends and weekdays. Under average 1992 conditions, the marginal value of an acre-foot of water for rafting on the two subsequent stretches of the Rio Grande ranged up to $6.13 ($12.15 per cfs) on weekends in July. Marginal values are higher on weekends, at low flow conditions, and during the peak rafting season (June-August).

It is beyond the scope of this study to determine the marginal value of water in irrigated agriculture in different months. However, while hay crops and irrigated pasture account for 81 per cent of the water diversions for irrigation these crops generate returns of less than 4 dollars per acre foot of water applied (Salazar, 1986). It is likely that the marginal value of water for rafting exceeds the marginal value in irrigated agriculture in mid to late summer when instream flows are low and demand for river recreation is high. The results of this thesis are only one input into a more complex economic analysis. A complete analysis of an economically efficient allocation of water between alternative uses requires further research on the following issues:

- the marginal values of water in irrigation across the summer months,
- effects of flow level on the importance of rafting for people's trips to northern New Mexico and on the number of times they go rafting in the area,
- benefits associated with private boating and fishing and other recreational activities that rely on streamflows,
- downstream benefits (consumptive and nonconsumptive),
- lagged effects on fish stocks and the streamside environment,
- nonuse values of resource users (which are excluded through the choice of rafting fees as the payment vehicle), and
- values held by those who do not use the study sites for recreation (nonuse values for preserving flows).

Nonuse values of both resource users and nonusers are likely to be substantial, especially on the Taos Box, which is designated as a Wild and Scenic River. The analysis of nonuse values in this study as well as those of other studies have shown that a large proportion of the total value held by resource users is associated to nonuse values. These values are not captured in the New Mexico estimates (except for the ADDPAY question for nonexperienced rafters on the Lower Gorge, see section 4.4.3). While the individual total value of nonusers is likely to be smaller than that of resource users (Loomis 1987b and 1989; Clonts and Malone, 1990), the number of people who might hold nonuse values for the protection of streamflows at the Rio Grande is potentially large. Therefore, the inclusion of nonuse values is likely to raise the estimated aggregate benefits of streamflows substantially.

Furthermore, visitation rates in past years show an increasing popularity of river rafting. If this trend continues aggregate total and marginal effects will increase in the future.

Providing higher and more reliable flows on the Taos Box and the Lower Gorge would require water acquisitions from the San Luis Valley. To coordinate the timing of water releases would require the cooperation of irrigators and resource managers in Colorado. It is beyond the scope of this thesis to evaluate alternative options for such cooperation. The present study can only serve as useful information for what would be a complex policy process.

6.3 Convergent Validity of Benefit Transfer

In evaluating the convergent validity of benefit transfer, the present study provides two specific examples of benefit transfer performance. Keeping in mind that no generalizations are possible from this limited number of cases and that the accuracy of benefit transfer depends on the accuracy of the original estimates, the following tentative conclusions might be drawn:

While economists have many reservations about the appropriateness of benefit transfer, public agencies involved in resource allocation decisions are currently using benefit transfer due to budget and time constraints and will continue to do so. Economists can provide policy makers with advice on the conditions under which benefit transfer can provide reliable estimates of non-market benefits.

The analysis presented in this study led to a strong rejection of the validity of direct benefit transfer. The direct transfer of the study site estimate led to large biases even under the relatively controlled conditions of this study. The common practice of applying direct benefit transfer between sites which differ far more in quality, location, population, and object of valuation than the ones described in this study is therefore extremely questionable.

If benefit transfer is going to be used in policy analysis, it appears that benefit function transfer is preferable where ever possible. Benefit function transfer generally performed better than the direct transfer of the study site estimate. This result confirms the findings of Loomis (1992).

Convergent validity was established for the benefit function transfer between Ramsey Canyon and the San Pedro RNCA, suggesting that benefit function transfer may be useful where very similar sites are involved. The Arizona results indicate that differences in the exact phrasing of the CVM question and the form of the interview (mail or in-person) do not necessarily lead to biases in benefit transfer estimates. It is important to keep in mind that studies comparing benefit transfer estimates with site-specific estimates use the same data for model specification that is used for testing the convergent validity of benefit transfer.

Benefit transfer analysis for the Rio Grande data demonstrated large statistical differences between the site-specific and the benefit transfer estimates. When the quality of the recreational experience and the market conditions for the recreational trip vary substantially, the information commonly incorporated in bid functions is not sufficient. Socioeconomic variables are commonly used as independent variables in the bid functions, but these variables generally provide low explanatory power. To examine how differences in site quality, market conditions and possible other factors cause differences in benefit estimates multi-site analyses are required. The present study can serve as an input into such analysis.

Until we know more about the effects of quality, market conditions and possible other factors on benefit estimates, policy makers should be careful in the choice of appropriate study sites for benefit transfer. In particular, study and policy site should be similar with respect to the quality of the recreational experience and the availability of substitutes. The large percentage errors from benefit transfer between the Taos Box and the Lower Gorge indicate that if the study site is not chosen with adequate care, benefit transfer can produce misleading results.

It remains to be stressed that whether benefit transfer is appropriate and how reliable it should be depends on the attempted use of the benefit estimate. The value of the additional information from a site-specific study has to be compared to its costs. Where precision matters, especially in litigation over natural resources damage, the appropriateness of benefit transfer is extremely questionable, even more so than the use of CVM itself.

APPENDIX A: SURVEY INSTRUMENTS

NORTHERN NEW MEXICO RIVER RUNNING SURVEY
RIO GRANDE

THE PURPOSE OF THIS SURVEY.

*The Department of Agricultural Economics at **The University of Arizona** studies outdoor recreation in many areas of the western United States. We are conducting this survey to learn more about river recreation in northern New Mexico. All information provided by you as an individual is confidential. Please try to answer every question since missing answers make your survey less useful to us. Those who return completed surveys will be entered in a drawing for a free half-day river trip.*

1. Date you are filling out this survey ________________

About Your Trip to Northern New Mexico

In this set of questions we want to learn about your trip to northern New Mexico and the expenses you incurred on this trip. By northern New Mexico, we mean the areas around Santa Fe, Espanola, Taos, Chama, Red River and Abiquiu. Albuquerque is not part of northern New Mexico. The map below shows the northern New Mexico area.

---

2. In a typical year, how many days do you spend visiting northern New Mexico? ________ (days)

3. Was this your first time river running in northern New Mexico? 1. yes 2. no

   If no, in a typical year, how many days do you spend river running in northern New Mexico? ________ (days)

For the following questions, please refer to the specific trip you were on when we contacted you about this survey (referred to as this/your trip in the survey).

4. What date or dates were you out on the Rio Grande on this trip? (fill in dates)

   May ________________
   June ________________
   July ________________
   August ________________

5. How long were you on the river on this trip? (check one)

   _____ 1-2 hours _____ 5-6 hours _____ two days
   _____ 3-4 hours _____ one day _____ three days
   other: ____________________________

ID Number _______ CT

(over)

6. What was the main type of boat you used on <u>this trip</u>? (circle one number)

1. oar powered raft 3. paddle raft 5. inflatable kayak
2. oar/paddle raft 4. kayak 6. canoe
7. other: ____________________

7. How would you best describe your reason(s) for traveling to northern New Mexico? (circle one letter)

a. River running was the only reason for traveling to northern New Mexico
b. River running was the most important reason for traveling to northern New Mexico
c. River running was one of several important reasons for traveling to northern New Mexico
d. River running was not an important reason for traveling to northern New Mexico

8. Where did you depart from when you set out for <u>your trip</u> to northern New Mexico?

____

9. While in northern New Mexico, how many nights did you spend in: (please fill in number)

________ motel/hotel, ________ bed and breakfast, ________ campground/RV park, ________ home of friends, relatives
________ other, please describe: ____

10. On <u>this trip</u>, how many nights did you spend in or near these towns: (please fill in number)

________ Santa Fe	________ Chama	________ Red River	________ Angelfire
________ Taos	________ Los Alamos	________ Pilar	________ Questa
________ Espanola	________ Chimayo	________ Ojo Caliente	________ Other (where:

)

11. For your trip to northern New Mexico, please estimate your expenses in northern New Mexico, and also estimate your expenses outside of the northern New Mexico area. If you had no expenses in a particular category, please write in a zero.

a. RIVER RUNNING EXPENSES: __________ (payments to rafting company and guides; include trip deposits and tips, if any; also include river guide books and maps, etc.)

b. EXPENSES <u>IN NORTHERN NEW MEXICO</u>:

Lodging __________
Restaurant meals __________
Groceries __________
Shopping __________ (camera, film, books, maps, crafts, art, clothing, souvenirs, sun screen, etc.)
Transportation __________ (car rental, gas, oil, taxi, shuttle service, etc.)
Other tour fees/ permits __________ (tour fees, fishing, rafting, or hunting permits; besides those listed above under 11a.)

c. TRIP EXPENSES PAID <u>OUTSIDE OF NORTHERN NEW MEXICO</u> __________ (airfare, car rental, lodging, meals, supplies, gas and oil, travel books, maps, other)

ID Number________ CT

12. How many people are included in the trip expenses you listed? __________

We are asking the next questions to learn how valuable good river running opportunities are to you. Your individual answers to these questions are strictly confidential and will not have any influence on fees or other costs of river running. There are many different uses for water in the Rio Grande Basin and river flows change due to weather and water use by farms, homes, and businesses. We are interested in how you believe the quality of your river running experience is affected by river flows. The flow of water in a river is measured in cubic feet per second (cfs) passing through a measuring device.

Please take a minute and think about your river running trip through the Taos Box, and the flow level during that trip, which was ____________ cfs.

13. In your opinion, was the flow level you experienced on your trip: (circle one)

a. too high for safe and enjoyable river running b. ideal for safe and enjoyable river running c. just adequate for safe and enjoyable river running d. too low for safe and enjoyable river running

14. Suppose that you had known, before your river running trip, that the cost would be higher to provide the flow level that you experienced in the Taos Box. What is the most that you as an individual would have been willing to pay, in terms of ADDITIONAL river running expenses, **above and beyond what you actually paid** (the amount that you indicated for Question 11a.) and still have taken your river running trip at the flow of _____________ cfs? (please circle one)

1. $0.00 more	6. $30.00 more	11. $100.00 more	16. $400.00 more
2. $5.00 more	7. $40.00 more	12. $125.00 more	17. $500.00 more
3. $10.00 more	8. $50.00 more	13. $150.00 more	18. $750.00 more
4. $15.00 more	9. $60.00 more	14. $200.00 more	19. $1,000.00 more
5. $20.00 more	10. $75.00 more	15. $300.00 more	20. $_________ more (please indicate)

15. In Question 14 we asked you about the flow level that you actually experienced. Now, please consider your values for a higher flow level. As the summer progresses, Rio Grande flow levels typically drop too low for running the Taos Box. Suppose that water supplies were acquired to guarantee a flow of _______ cfs or more in the Taos Box during the summer season through Labor Day weekend. This will greatly lengthen the river running season for the Taos Box. In order to cover the costs of providing this flow level, an ADDITIONAL fee would be charged for every person running the Taos Box. Please refer to the amount you circled for Question 14 and, in the space below, circle the most you as an individual are willing to pay in ADDITIONAL river running expenses, **above and beyond what you indicated for Question 14**, in order to have a guaranteed summer flow of _______ cfs through the Taos Box:

1. $0.00 more	6. $20.00 more	11. $80.00 more	16. $250.00 more	21. $700.00 more
2. $4.00 more	7. $25.00 more	12. $100.00 more	17. $300.00 more	22. $800.00 more
3. $8.00 more	8. $30.00 more	13. $120.00 more	18. $400.00 more	23. $900.00 more
4. $12.00 more	9. $45.00 more	14. $150.00 more	19. $500.00 more	24. $1,000.00 more
5. $16.00 more	10. $60.00 more	15. $200.00 more	20. $600.00 more	25. $________ other (please indicate)

If your answer to either Question 14 or 15 was zero, please answer the question below. Otherwise go to Question 17.

16. Why was your answer to Question 14 or 15 zero? (please check all that apply and then go to the next question)

_____ a. I don't come to northern New Mexico for river running very often.
_____ b. I cannot afford any additional costs at this time.
_____ c. Maintaining the flow in the river is my right and it is unfair to expect me to pay for it.
_____ d. Only area residents should pay.
_____ e. The questions were unclear or too hypothetical. I couldn't answer realistically.
_____ f. Water is too controversial an issue in northern New Mexico.
_____ g. My enjoyment of river running does not depend on water flows.
_____ h. I am concerned that rafting companies will charge more for their trips.

ID Number ________ CT *(over)*

____ i. Other, Please list reasons. ______________________________

In this final section, we have some questions about you. All of your answers are strictly confidential.

17. How old are you? ________ years.

18. Are you? 1. male 2. female

19. What is the highest year of formal schooling you have completed? (circle one number)

4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Elementary school			Jr. High school			High school				college or vocational school				Graduate or Professional		

20. Including yourself, how many individuals are in your household? ________ (adults) ________ (children under 18)

21. What is your annual household income (before taxes)? (circle one number).

1. less than $10,000	7. $25,000 - $29,999	9. $50,000 - $59,999	13. $120,000 - $159,999
2. $10,000 - $14,999	8. $30,000 - $34,999	10. $60,000 - $79,999	14. $160,000 - $199,999
3. $15,000 - $19,999	9. $35,000 - $39,999	11. $80,000 - $99,999	15. $200,000 - $249,999
4. $20,000 - $24,999	10. $40,000 - $49,999	12. $100,000 - $119,999	16. $250,000 and up

22. What is your current employment status? (circle one number)

1. employed full-time	3. retired	5. home maker
2. employed part-time	4. student	6. unemployed

23. Do you have any comments you wish to make about your river running experience on the Rio Grande, or any comments on this survey?

THANK YOU VERY MUCH! Your time is greatly appreciated. *Please place this survey in the attached postage paid return envelope and put it in the mail as soon as possible. Remember, those returning completed surveys will be entered in a drawing for a free half-day river trip.*

ID Number ________ CT

NORTHERN NEW MEXICO RIVER RUNNING SURVEY

RIO GRANDE

THE PURPOSE OF THIS SURVEY.

The Department of Agricultural Economics at The University of Arizona studies outdoor recreation in many areas of the western United States. We are conducting this survey to learn more about river recreation in northern New Mexico. All information provided by you as an individual is confidential. Please try to answer every question since missing answers make your survey less useful to us. Those who return completed surveys will be entered in a drawing for a free half-day river trip.

1. Date you are filling out this survey ____________________

About Your Trip to Northern New Mexico

In this set of questions we want to learn about your trip to northern New Mexico and the expenses you incurred on this trip. By northern New Mexico, we mean the areas around Santa Fe, Espanola, Taos, Chama, Red River and Abiquiu. Albuquerque is not part of northern New Mexico. The map below shows the northern New Mexico area.

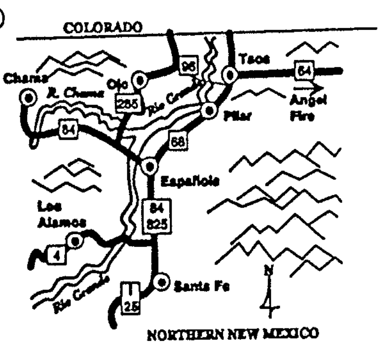
2. In a typical year, how many days do you spend visiting northern New Mexico? ________ (days)

3. Was this your first time river running in northern New Mexico? 1. yes 2. no

   If no, in a typical year, how many days do you spend river running in northern New Mexico? ________ (days)

For the following questions, please refer to the specific trip you were on when we contacted you about this survey (referred to as this/your trip in the survey).

4. What date or dates were you out on the Rio Grande on this trip? (fill in dates)
   - May ________________
   - June ________________
   - July ________________
   - August ________________



5. How long were you on the river on this trip? (check one)
   - _____ 1-2 hours _____ 5-6 hours _____ two days
   - _____ 3-4 hours _____ one day _____ three days
   - other: ____________________

ID Number ________ CG

(over)

6. What was the main type of boat you used on this trip? (circle one number)

1. oar powered raft 3. paddle raft 5. inflatable kayak
2. oar/paddle raft 4. kayak 6. canoe
7. other: ____________________

7. How would you best describe your reason(s) for traveling to northern New Mexico? (circle one letter)

a. River running was the only reason for traveling to northern New Mexico
b. River running was the most important reason for traveling to northern New Mexico
c. River running was one of several important reasons for traveling to northern New Mexico
d. River running was not an important reason for traveling to northern New Mexico

8. Where did you depart from when you set out for your trip to northern New Mexico?

____

9. While in northern New Mexico, how many nights did you spend in: (please fill in number)

_______ motel/hotel, _______ bed and breakfast, _______ campground/RV park, _______ home of friends, relatives

_______ other, please describe: ____

10. On this trip, how many nights did you spend in or near these towns: (please fill in number)

_______ Santa Fe	_______ Chama	_______ Red River	_______ Angelfire
_______ Taos	_______ Los Alamos	_______ Pilar	_______ Questa
_______ Espanola	_______ Chimayo	_______ Ojo Caliente	_______ Other (where: ____________________)

11. For your trip to northern New Mexico, please estimate your expenses in northern New Mexico, and also estimate your expenses outside of the northern New Mexico area. If you had no expenses in a particular category, please write in a zero.

a. RIVER RUNNING EXPENSES: __________ (payments to rafting company and guides; include trip deposits and tips, if any; also include river guide books and maps, etc.)

b. EXPENSES IN NORTHERN NEW MEXICO:

Lodging __________
Restaurant meals __________
Groceries __________
Shopping __________ (camera, film, books, maps, crafts, art, clothing, souvenirs, sun screen, etc.)
Transportation __________ (car rental, gas, oil, taxi, shuttle service, etc.)
Other tour fees/ permits __________ (tour fees, fishing, rafting, or hunting permits; besides those listed above under 11a.)

c. TRIP EXPENSES PAID OUTSIDE OF NORTHERN NEW MEXICO __________ (airfare, car rental, lodging, meals, supplies, gas and oil, travel books, maps, other)

12. How many people are included in the trip expenses you listed? __________

ID Number _______ CG

We are asking the next questions to learn how valuable good river running opportunities are to you. Your individual answers to these questions are strictly confidential and will not have any influence on fees or other costs of river running. There are many different uses for water in the Rio Grande Basin and river flows change due to weather and water use by farms, homes, and businesses. We are interested in how you believe the quality of your river running experience is affected by river flows. The flow of water in a river is measured in cubic feet per second (cfs) passing through a measuring device.

Please take a minute and think about your river running trip on the Rio Grande, and the flow level during that trip, which was ______________ cfs.

13. In your opinion, was the flow level you experienced on your trip: (circle one)

    a. too high for safe and enjoyable river running
    b. ideal for safe and enjoyable river running
    c. just adequate for safe and enjoyable river running
    d. too low for safe and enjoyable river running

14. Suppose that you had known, before your river running trip, that the cost would be higher to provide the flow level that you experienced on the Rio Grande. What is the most that you as an individual would have been willing to pay, in terms of ADDITIONAL river running expenses, above and beyond what you actually paid (the amount that you indicated for Question 11a) and still have taken your river running trip at the flow level of ______________ cfs? (please circle one)

1. $0.00 more	6. $30.00 more	11. $100.00 more	16. $400.00 more
2. $5.00 more	7. $40.00 more	12. $125.00 more	17. $500.00 more
3. $10.00 more	8. $50.00 more	13. $150.00 more	18. $750.00 more
4. $15.00 more	9. $60.00 more	14. $200.00 more	19. $1,000.00 more
5. $20.00 more	10. $75.00 more	15. $300.00 more	20. $_______ more (please indicate)

15. In Question 14 we asked you about the flow level that you actually experienced. Now, please consider your values for a higher flow level. As the summer progresses, Rio Grande flow levels typically drop lower than ideal for safe and enjoyable river running on some stretches of the river. Suppose that those who want adequate, reliable streamflows set up a non-profit trust fund to acquire water supplies so that Rio Grande flows in northern New Mexico are always ideal for river running during the summer season through Labor Day weekend. This would guarantee flows of __________ cfs or more and would greatly lengthen the river running season on the Rio Grande. Assume that the non-profit trust fund can acquire these water supplies and guarantee ideal summer flows, which will benefit recreationists, fish and wildlife, and the streamside ecosystem. Without the non-profit trust fund, river flows will drop quite low by mid-summer, and trips will be cancelled for certain stretches of the river. Please circle the most that you as an individual are willing to contribute to this fund, as a regular annual contribution, to assure that summer river flows will always be ideal for river running:

1. $0.00	6. $20.00	11. $80.00	16. $250.00	21. $700.00
2. $4.00	7. $25.00	12. $100.00	17. $300.00	22. $800.00
3. $8.00	8. $30.00	13. $120.00	18. $400.00	23. $900.00
4. $12.00	9. $45.00	14. $150.00	19. $500.00	24. $1,000.00
5. $16.00	10. $60.00	15. $200.00	20. $600.00	25. $_______ other (please indicate)

16. Suppose, for one reason or another, that you personally will never run the Rio Grande in northern New Mexico again. What portion of the contribution that you circled for Question 15 are you still willing to contribute annually to the fund for river flows? $______________ (fill in dollar amount)

17. If your answer to Question 16 was greater than zero, please indicate the one reason that best explains why you would be willing to contribute to the fund, even though you were asked to assume that you would never run the Rio Grande in northern New Mexico again: (circle only one)

    a. I get satisfaction from knowing that the summer Rio Grande flow conditions will benefit recreationists, fish and wildlife, and the streamside ecosystem.
    b. I get satisfaction from knowing that the summer Rio Grande flow conditions will benefit other river runners.
    c. Fish and wildlife and the streamside ecosystem have a right to river flows, regardless of satisfaction provided to humans.
    d. other, please indicate: ____

ID Number ________ CG

(over)

If your answer to either Question 14 or 15 was zero, please answer the question below. Otherwise go to Question 19.

18. Why was your answer to Question 14 or 15 zero? (please check all that apply and then go to the next question)

_____ a. I don't come to northern New Mexico for river running very often.
_____ b. I cannot afford any additional costs at this time.
_____ c. Maintaining the flow in the river is my right and it is unfair to expect me to pay for it..
_____ d. Only area residents should pay.
_____ e. The questions were unclear or too hypothetical. I couldn't answer realistically.
_____ f. Water is too controversial an issue in northern New Mexico.
_____ g. My enjoyment of river running does not depend on water flows.
_____ h. I am concerned that rafting companies will charge more for their trips.
_____ i. Other, Please list reasons. ________________________________

19. If your answer to Question 15 was greater than zero, please answer the following question:

a. In order actually to make the contribution you circled for Question 15, you would need to reduce spending on other items. Please indicate which one of the following categories you would spend less on: (circle only one)

1. groceries
2. entertainment
3. savings
4. contributions to environmental causes/organizations
5. vacations
6. charitable contributions
7. other: ________________________________.

b. Now that you have thought about how you would rearrange spending to make the contribution that you answered for Question 15, do you want to change the amount that you indicated? ________ yes, ________ no

If yes, please go back to Question 15, cross out your first answer, and circle the revised amount.

In this final section, we have some questions about you. All of your answers are strictly confidential.

---

20. How old are you? ________ years.

21. Are you? 1. male 2. female

22. What is the highest year of formal schooling you have completed? (circle one number)

4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Elementary school			Jr. High school			High school				college or vocational school				Graduate or Professional		

23. Including yourself, how many individuals are in your household? ________(adults) ________ (children under 18)

24. What is your annual household income (before taxes)? (circle one number).

1. less than $10,000	7. $25,000 - $29,999	9. $50,000 - $59,999	13. $120,000 - $159,999
2. $10,000 - $14,999	8. $30,000 - $34,999	10. $60,000 - $79,999	14. $160,000 - $199,999
3. $15,000 - $19,999	9. $35,000 - $39,999	11. $80,000 - $99,999	15. $200,000 - $249,999
4. $20,000 - $24,999	10. $40,000 - $49,999	12. $100,000 - $119,999	16. $250,000 and up

25. What is your current employment status? (circle one number)

1. employed full-time
2. employed part-time
3. retired
4. student
5. home maker
6. unemployed

26. Do you have any comments you wish to make about your river running experience on the Rio Grande, or any comments on this survey?

THANK YOU VERY MUCH! Your time is greatly appreciated. ***Please place this survey in the attached postage paid return envelope and put it in the mail as soon as possible. Remember, those returning completed surveys will be entered in a drawing for a free half-day river trip.***

ID Number ________ CG

RAMSEY CANYON PRESERVE

VISITOR SURVEY

The University of Arizona studies visitor use of streamside areas. In cooperation with the Cape May Bird Observatory and The Nature Conservancy, we are conducting this survey to learn more about birding in southeastern Arizona. All information provided by you as an individual will be confidential.

DIRECTIONS
When answering the following questions, please refer to the trip you were on when we contacted you (referred to in the survey as <u>this/your trip or visit</u>).

1. Was this your first birding visit to southeastern Arizona? [Southeastern Arizona refers to the area including sites such as Madera Canyon, the Patagonia-Sonoita Creek Preserve, Ramsey Canyon, the San Pedro National Riparian Conservation Area, and Cave Creek.]

   1. yes 2. no

2. Was this your first visit to the Ramsey Canyon Preserve?

   1. yes 2. no

   <u>If not</u>, how many trips have you made to the Ramsey Canyon Preserve in the last two years?

   ________ (number of trips)

3. How many people were in your party during your visit to Ramsey Canyon?

   ________ (number of people)

4. How long was <u>this trip</u> to southeastern Arizona?

   ________ (number of days)

5. On <u>this trip</u>, how much time did you spend at Ramsey Canyon?

   ________ number of hours <u>or</u> ________ number of days

6. On <u>this trip</u> to southeastern Arizona, how many nights did you stay in commercial accommodations: (please circle number and fill in blanks for all that apply)

   1. Sierra Vista________nights
   2. Tombstone________nights
   3. Bisbee________nights
   4. Portal________nights
   5. Green Valley________nights
   6. Patagonia________nights
   7. Tucson________nights
   8. Douglas________nights
   9. Other: ________ nights (please specify where: ________________________________)
   10. No overnight stay in commercial accommodations

7. <u>If you did not stay in Sierra Vista</u>, would you have preferred to if lodging had been available? 1. yes 2. no

8. Was visiting Ramsey Canyon the main reason for <u>your trip</u> to the Sierra Vista area?

   1. yes 2. no

   <u>If no</u>, what was the main reason for <u>your trip</u> to the Sierra Vista area? ________________________

ID Number ________

9. During this trip to southeastern Arizona, did you also visit: (circle those that apply)

   1. San Pedro National Riparian Conservation Area
   2. Patagonia-Sonoita Creek Preserve
   3. Chiricahua Mountains
   4. Madera Canyon
   5. Tombstone
   6. Bisbee
   7. Coronado National Monument
   8. Other, (please specify: ____________________________________)

10. What was the primary reason for your visit to Ramsey Canyon? (circle one number)

    1. To view Hummingbirds
    2. General birding
    3. To look for a specific bird--(please list species: ____________________________)
    4. Other, (please specify: ____________________________________)

11. Please help us understand visitor spending patterns by estimating the total expenses for your trip to southeastern Arizona (column a), and how much of those expenses were in the Sierra Vista area (column b). Include only expenditures on items you bought specifically for this trip. If you had no expenses in a particular category, please write in zero. If you were with a tour group, please report your fees paid directly to the tour company and also your out-of-pocket expenses while on the tour for each of the categories listed below.

    Are you reporting expenses for: (please check one) _____ yourself as an individual, _____ a group

    If for a group, how many were in your group? _____ (number of people)

	TOTAL TRIP EXPENSES (a)	EXPENSES IN THE SIERRA VISTA AREA (b)
Airfare	$__________	$__________
Gas and oil for vehicle	$__________	$__________
Car Rental (# of days rented: _____)	$__________	$__________
Groceries and Beverages	$__________	$__________
Purchases in Restaurants and Bars	$__________	$__________
Fees paid directly to tour company: (tour company name:______________)	$__________	$__________
Miscellaneous retail purchases in:	$__________	$__________

(please circle all that apply)
a. photography stores
b. clothing stores
c. bookstores
d. discount stores
e. other retail stores

Lodging (please circle all that apply and list the name(s) of the accommodations you stayed at for each category):	$__________	$__________

a. bed and breakfast (name: ____________________________)
b. hotel/motel (name: ____________________________)
c. RV park (name: ____________________________)
d. campground (name: ____________________________)
e. other: ____________________________

12. Were there items or services you wished to purchase in the Sierra Vista area that were not available?

1. yes 2. no

If yes, please specify: ____________________

The following questions are included to help us learn more about people's values for riparian areas. We are not soliciting contributions, and your responses are confidential.

13. Suppose that the Ramsey Canyon Preserve had never been acquired by The Nature Conservancy, a non-profit organization that presently manages it to preserve its riparian habitat and diverse bird and wildlife species. Instead, assume that Ramsey Canyon is owned by private interests and is slated for development that will eliminate the riparian habitat and the diverse bird and wildlife species. Assume that a non-profit foundation supported by individual contributions is set up for the sole purpose of acquiring Ramsey Canyon and managing it as a nature preserve, open for public use. This would guarantee preservation of Ramsey Canyon's riparian habitat and diverse bird and wildlife species. However, if the non-profit foundation does not receive adequate contributions from individuals like yourself, then Ramsey Canyon's riparian habitat and diverse bird and wildlife species would disappear.

a. Please circle the most you as an individual are willing to contribute to this non-profit foundation, in the form of a one time contribution, in order to purchase Ramsey Canyon and assure its protection as a nature preserve:

1. $0.00	5. $15.00	9. $40.00	13. $150.00	17. $400.00
2. $2.00	6. $20.00	10. $50.00	14. $200.00	18. $500.00
3. $5.00	7. $25.00	11. $75.00	15. $250.00	19. $1,000.00
4. $10.00	8. $30.00	12. $100.00	16. $300.00	20.$______ (other, please indicate)

b. Now, assume that once purchased by the non-profit foundation, Ramsey Canyon would not be open to visitors at all, but would be managed solely to protect its riparian habitat and wildlife species. What portion of the contribution that you circled above are you still willing to contribute to the foundation in order to acquire and preserve this area? $ ________ (please fill in)

c. If your answer to b was greater than zero, please circle the one reason below that best explains why you would be willing to contribute to the foundation, even though you were asked to assume it would not be open to visitors: (circle one number)

1. I get satisfaction from knowing that the riparian habitat and the wildlife it supports will continue to exist at Ramsey Canyon.
2. The bird and wildlife species have a right to this riparian habitat, regardless of satisfaction provided to humans.
3. Other, please explain: ____________________

d. If your answer to either part a or part b was zero, please circle the reasons below that explain why you answered this way: (circle all that apply)

1. I did not fully understand what I was being asked to do.
2. I would not benefit from preservation of riparian habitat and bird and wildlife species at Ramsey Canyon.
3. This preservation of riparian habitat and bird and wildlife species should be undertaken at no cost to me.
4. I can go to other locations to enjoy abundant riparian habitat and diverse bird and wildlife species.
5. I'd rather let others pay for the non-profit foundation's preservation activities.
6. I cannot afford any additional costs at this time.
7. An organization other than a non-profit foundation should be responsible for acquiring and preserving Ramsey Canyon.
8. Other, please explain: ____________________

ID Number ________

In this section of the survey there are some questions about your background so we can compare your answers with those of other people. Your answers to these questions are confidential. You will not be identified in any analysis nor in the presentation of the study results.

14. How old are you? ________ (years)

15. Are you: 1. male 2. female

16. What is the highest year of formal schooling you have completed? (circle one number)

4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Grade School			Jr. High school			High school			college or vocational school					Graduate or Professional		

17. What was your household income (before taxes) last year? (circle one number).

1. less than $10,000	7. $35,000 - $39,999	13. $80,000 - $89,999
2. $10,000 - $14,999	8. $40,000 - $44,999	14. $90,000 - $99,999
3. $15,000 - $19,999	9. $45,000 - $49,999	15. $100,000 - $149,999
4. $20,000 - $24,999	10. $50,000 - $59,999	16. $150,000 - $199,999
5. $25,000 - $29,999	11. $60,000 - $69,999	17. $200,000 - $249,999
6. $30,000 - $34,999	12. $70,000 - $79,999	18. $250,000 or more

18. Including yourself, how many individuals are in your household?

________ (adults) ________ (children under 18)

19. What is your employment status? (circle one number)

1. employed full-time	4. retired
2. employed part-time	5. student
3. unemployed	6. homemaker

20. Are you a member of The Nature Conservancy? 1. yes 2. no

21. Are you a member of any other organization which supports conservation, environmental or wildlife concerns?

1. yes 2. no

If yes, which ones? ______________________________

22. Approximately how many days per year do you spend birding? ________ (number of days)

23. What make and model of binoculars do you use? ______________________________

24. If you own a scope, what is its make and model? ______________________________

THANK YOU VERY MUCH

Your time is greatly appreciated. Please put this survey in the enclosed postage paid return envelope and return it to us as soon as possible.

Cape May Bird Observatory

Recycled

Mile Hi
4

SAN PEDRO RNCA SURVEY

Interviewer Contact Recording Form

(to be filled out by interviewer)

Make contact with visitors after they have walked through area.

ID Number: ______________________ (to be filled in at The U of A)
Date: ______________________
Time: ______________________
Location: ______________________

I am assisting The University of Arizona with a study on outdoor recreation. We're studying visitor use of streamside areas in southeastern Arizona.

1) Have you already been asked to fill out a survey for this study, either here or at Ramsey Canyon?

_______ yes, _______ no.

If no, would you be willing to help us out by presently answering a couple of questions, and by completing a short survey that we will send you in the mail? _______ yes _______ no comments:

2) Do you live around here? _______ yes, _______ no.

If no, is your trip to the Sierra Vista area just for the day, or are you on a longer trip?

_______ day trip, _______ longer

3) Is birding your main reason for visiting the San Pedro RNCA? _______ yes, _______ no
If yes, are you here with a tour company? _______ yes, _______ no
If yes, which one? ______________________ (name)

4) Could I please get your name and mailing address to send you a short questionnaire? This information is confidential and will be used only to contact you for this study. It will not be available for mailing lists or any other purposes.
Name: ______________________
Address: ______________________
____

5) Is this address for a seasonal or year round residence? _______ seasonal, _______ year round

If seasonal, how much longer will you be at this address? ______________________

6) May we have your home phone just in case we lose track of your survey?: ______________________

7) How many times do you expect to return to the San Pedro RNCA within the next two years?
(INTERVIEWER: If it appears the respondent is a regular visitor, have them estimate for one year and then double this.)
_____ (1), _____ (2), _____ (3), _____ (4), _____ (5), _____ (none), _____ don't know, _____ other

8) These last few questions have to do with the river flows and riparian habitat here at the San Pedro RNCA. They are meant to learn about your values for riparian areas and NOT TO SOLICIT CONTRIBUTIONS. (turn to next page)

9) CVM values were given for: _______ individual _______ household

THANK YOU FOR AGREEING TO PARTICIPATE IN OUR STUDY, AND ENJOY THE REST OF YOUR VISIT.

Visitor Comments/Interviewer Remarks:

1.

$ 0	$ 20	$ 75	$ 300
$ 2	$ 25	$ 100	$ 400
$ 5	$ 30	$ 150	$ 500
$ 10	$ 40	$ 200	$1000
$ 15	$ 50	$ 250	

or, please fill in other amount $____________

2. $____________

3. If your answer to question 2 was greater than zero, please indicate the one reason that best explains why you would be willing to contribute to the foundation, even though you were asked to assume that you would never return to the San Pedro RNCA: (circle only one)

   a. I get satisfaction from knowing that the riparian habitat and the wildlife it supports will continue to exist at the San Pedro RNCA.
   b. I get satisfaction from knowing that the riparian habitat and wildlife species at the San Pedro RNCA are protected for other visitors and future generations to enjoy.
   c. Bird and wildlife species have a right to this riparian habitat, regardless of satisfaction provided to humans.
   d. other, please explain: ____________________________

4. If your answer to question 1 was greater than zero, please answer the following question:

   a. In order actually to make the contribution you circled in the top box, you would need to reduce spending on other items. Please indicate which one of the following categories you would spend less on: (circle only one)

   1. groceries
   2. entertainment
   3. savings
   4. contributions to environmental causes/organizations
   5. vacations
   6. charitable contributions
   7. other: ____________________________

   b. Now that you have thought about how you would rearrange spending to make the contribution marked in the top box, do you want to change the amount that you indicated? ________ yes, ________ no

   If yes, please cross out your first answers to questions 1 and 2 and indicate the revised amounts.

5. If your answer to either question 1 or 2 was zero, please indicate the reasons below that explain why you answered this way: (circle all that apply)

   a. I did not fully understand what I was being asked to do.
   b. I would not benefit from preservation of riparian habitat at the San Pedro RNCA.
   c. This preservation of riparian habitat should be undertaken at no cost to me.
   d. I can go to other locations to enjoy abundant riparian habitat and diverse wildlife species.
   e. I'd rather let others pay for the non-profit foundation's preservation activities.
   f. I cannot afford any additional costs at this time.
   g. An organization other than a non-profit foundation should be responsible for preserving riparian habitat at the San Pedro RNCA.
   h. other reasons for zero response(s): ____________________________

ID number ________

SAN PEDRO RIPARIAN NATIONAL CONSERVATION AREA VISITOR SURVEY

The University of Arizona studies outdoor recreation at streamside areas. We are conducting this survey to learn more about birding in southeastern Arizona. All information provided by you as an individual is confidential.

DIRECTIONS

When answering the following questions, please think about the specific trip you were on when we contacted you (referred to as this or your trip in the survey).

1. Was this your first visit to the San Pedro Riparian National Conservation Area (RNCA)?

   1. yes 2. no

   If not, how many trips have you made here during the last two years?

   ________ (number of trips)

2. During what month(s) did you make these trips? ________

3. How many people were in your party during your trip to the San Pedro RNCA?

   ________ (number of people)

4. How long was your trip to southeastern Arizona?

   ________ (number of days)

5. On this trip to southeastern Arizona, how much time did you spend at the San Pedro RNCA?

   ________ number of hours or ________ number of days

6. While visiting southeastern Arizona, how many nights did you spend in commercial accommodations in: (please circle number and fill in blanks for all that apply)

   1. Sierra Vista ________ nights
   2. Tombstone ________ nights
   3. Bisbee ________ nights
   4. Portal ________ nights
   5. Green Valley ________ nights
   6. Patagonia ________ nights
   7. Tucson ________ nights
   8. Douglas ________ nights
   9. Other: ________ nights (please specify where: ________)
   10. No overnight stay in commercial accommodations

7. If you did not stay in Sierra Vista, would you have preferred to if lodging had been available?

   1. yes 2. no

8. Was visiting the San Pedro RNCA the main purpose for your trip to the Sierra Vista area?

   1. yes 2. no

   If no, what was the main reason for your trip to the Sierra Vista area: ________

9. During <u>this trip</u> to southeastern Arizona did you also visit: (circle all that apply)

1. Mile Hi/Ramsey Canyon Preserve
2. Patagonia/Sonoita Creek Preserve
3. Chiricahua Mountains
4. Madera Canyon
5. Tombstone
6. Bisbee
7. Coronado National Monument
8. Other (please specify: ______________________________)

10. What were the main reasons for <u>your trip</u> to the San Pedro RNCA? (circle all that apply)

1. General birding
2. To look for a specific bird (please list species: ______________)
3. Hiking/Walking
4. Exploring historical sites
5. Fishing
6. Hunting
7. Other (please specify: ______________________________)

The following questions are included to help us learn more about people's values for riparian areas and wildlife.

11. The San Pedro RNCA is in the northernmost range of the Gray Hawk, which migrates here for breeding. Gray Hawks can be found during the spring and summer months in limited areas in southeastern Arizona which have abundant riparian vegetation. Because human activities have diminished riparian areas, the Gray Hawk has become rare in the United States. The San Pedro RNCA provides ideal nesting sites and feeding areas for about 15 nesting pairs of Gray Hawks each year, due to its extensive riparian habitat.

a. Have you ever seen a Gray Hawk? __________ yes, __________ no

1. <u>If yes</u>, about how many times? __________ (number of times)

b. Did you see or hear any Gray Hawks during <u>your visit</u> to the San Pedro RNCA? ________ yes, ________ no

Suppose that, due to budgetary constraints, the San Pedro RNCA could not be managed to assure preservation of the riparian habitat needed for Gray Hawk populations. Assume that a non-profit foundation, supported by individual contributions, is set up solely to protect the San Pedro RNCA riparian habitat, and is able to guarantee that Gray Hawk populations will continue to exist at the San Pedro RNCA. However, if the non-profit foundation does not receive adequate contributions from individuals like yourself, then Gray Hawks will no longer be found at the San Pedro RNCA.

c. Please indicate the most that <u>you as an individual</u> are willing to contribute, in the form of a <u>one-time contribution</u>, to this non-profit foundation. (circle one)

1. $0.00	5. $15.00	9. $40.00	13. $150.00	17. $400.00
2. $2.00	6. $20.00	10. $50.00	14. $200.00	18. $500.00
3. $5.00	7. $25.00	11. $75.00	15. $250.00	19. $1,000.00
4. $10.00	8. $30.00	12. $100.00	16. $300.00	20. $______ (other, please indicate)

d. Now, assume that, for one reason or another, you will never visit the San Pedro RNCA again. What portion of the contribution that you circled above are you still willing to contribute to the foundation to protect Gray Hawks at the San Pedro RNCA? $______________ (please fill in)

e. <u>If your answer to d was greater than zero</u>, please circle the <u>one reason below that best explains</u> why you would be willing to contribute to the foundation, even though you were asked to assume that you will never visit the San Pedro RNCA again. (circle one number)

1. I get satisfaction from knowing that Gray Hawks will continue to exist at the San Pedro RNCA.
2. I get satisfaction from knowing that Gray Hawks at the San Pedro RNCA will be protected for other visitors and future generations to enjoy.
3. The Gray Hawk has a right to this riparian habitat at the San Pedro RNCA, regardless of satisfaction provided to humans.
4. other, please explain: ______________________________

11. f. If your answer to part c or d was zero, please circle any of the reasons below that explain why you answered this way: (circle all that apply)

1. I did not fully understand what I was being asked to do.
2. I would not benefit from preservation of Gray Hawk populations at the San Pedro RNCA.
3. This preservation of Gray Hawk populations should be undertaken at no cost to me.
4. I can go to other locations to see Gray Hawks.
5. I'd rather let others pay for the non-profit foundation's preservation activities.
6. I cannot afford any additional costs at this time.
7. An organization other than a non-profit foundation should be responsible for preserving Gray Hawk population at the San Pedro RNCA.
8. Other—please explain: ____________________

12. Please help us understand visitor spending patterns by estimating the total expenses for your trip to southeastern Arizona (column a), and how much of those expenses were in the Sierra Vista area (column b). Include only expenditures on items you bought specifically for this trip. If you had no expenses in a particular category, please write in zero. If you were with a tour group, please report your fees paid directly to the tour company and also your out-of-pocket expenses while on the tour for each of the categories listed below.

Are you reporting expenses for: (check one) _____ yourself as an individual, _____ a group
If for a group, how many were in your group? _____ (number of people)

	TOTAL TRIP EXPENSES (a)	EXPENSES IN THE SIERRA VISTA AREA (b)
Airfare	$ ________	$ ________
Gas and oil for vehicle	$ ________	$ ________
Car Rental (# of days rented: ______)	$ ________	$ ________
Groceries and Beverages	$ ________	$ ________
Purchases in Restaurants and Bars	$ ________	$ ________
Fees paid directly to tour company: (tour company name: ________________)	$ ________	$ ________
Miscellaneous retail purchases in: (please circle all that apply) a. photography stores b. clothing stores c. bookstores d. sporting goods stores e. other retail stores	$	$
Lodging (please circle the types of accommodations you stayed in and list their specific names):	$ ________	$ ________

a. bed and breakfast (name: ____________________)
b. hotel/motel (name: ____________________)
c. RV park (name: ____________________)
d. campground (name: ____________________)
e. other: ____________________

13. Were there items or services you wished to purchase in the Sierra Vista area that were not available?

1. yes   2. no

If yes, please specify: ____________________

ID Number ________

In this section of the survey there are some questions about your background so we can compare your answers with those of other people. Your answers to these questions are confidential. You will not be identified in any analysis or in the presentation of the study results.

14. How old are you? __________ (years)

15. Are you: 1. male 2. female

16. What is the highest year of formal schooling you have completed? (circle one number)

4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Grade School			Jr. High School			High School			College or Vocational School					Graduate or Professional		

17. What was your household income (before taxes) last year? (circle one number).

1. less than $10,000	7. $35,000 - $39,999	13. $80,000 - $89,999
2. $10,000 - $14,999	8. $40,000 - $44,999	14. $90,000 - $99,999
3. $15,000 - $19,999	9. $45,000 - $49,999	15. $100,000 - $149,999
4. $20,000 - $24,999	10. $50,000 - $59,999	16. $150,000 - $199,999
5. $25,000 - $29,999	11. $60,000 - $69,999	17. $200,000 - $249,999
6. $30,000 - $34,999	12. $70,000 - $79,999	18. $250,000 or more

18. Including yourself, how many individuals are in your household?

__________ (adults), __________ (children under 18)

19. What is your employment status? (circle one number)

1. employed full-time
2. employed part-time
3. unemployed
4. retired
5. student
6. homemaker

20. How did you first find out about the San Pedro RNCA? __________

THANK YOU VERY MUCH
Your time is greatly appreciated. Please put this survey in the enclosed postage paid return envelope and return it to us as soon as possible.

APPENDIX B: CHARACTERISTICS OF SURVEY RESPONDENTS

Tables B.1 and B.2 show the socioeconomic characteristics of the respondents for all surveys. Visitors on the Taos Box were on average younger than visitors on the Lower Gorge, had lower income levels, and contained a higher proportion of repeat visitors and of students. A higher percentage of Taos Box rafters came from New Mexico and the neighboring states and a lower percentage came from California than was the case for Lower Gorge rafters. Visitors from foreign contries represented less than one percent of the rafters on both stretches of the Rio Grande. Taos Box rafters indicated to visit northern New Mexico and to go rafting in northern New Mexico more often in a typical year. Average rafting expenditures (both per trip and per day) were significantly higher on the Taos Box than on the Lower Gorge. Among rafters on commercial trips at the Lower Gorge, the sample of experienced rafters contained more males and more repeat visitors, had on average higher incomes, and spent slightly more in river running expenses than the sample of nonexperienced rafters. Experienced rafters on average spent more days visiting norther New Mexico and also spent more days rafting in New Mexico. On average, all rafters had at least a college level education.

Among the respondents to the Arizona surveys, Ramsey Canyon visitors had the highest average income and the highest percentage of women and of retirees. Comparing local and nonresident visitors of the San Pedro RNCA, nonresidents were on average older, had more years of formal education, higher incomes, and contained a lower proportion of retirees than the sample of local residents. Not surprisingly, most of the non-resident visitors did not consider visiting the San Pedro RNCA the main reason of their trip to the Sierra Vista area while for most local residents the RNCA was the main reason for their daytrip. Sixty-five percent of the local residents had visited the site before while this was only true for twenty-eight percent of the nonresident visitors.

Figure B.1 shows how important respondents considered their rafting trip to be for their visit to northern New Mexico. While more than 50 percent of the rafters on the Lower Gorge did not consider river running an important reason for their trip, river running was considered an important reason for the trip by most of the rafters on the Taos Box. More than 17 percent of the Taos Box rafters considered the rafting trip the most important reason for their visit the northern New Mexico, and more than 19 percent stated that rafting was the only reason for their visit. The Taos Box run is more spectacular and challenging than the Lower Gorge, and therefore tends to attract more dedicated river runners.

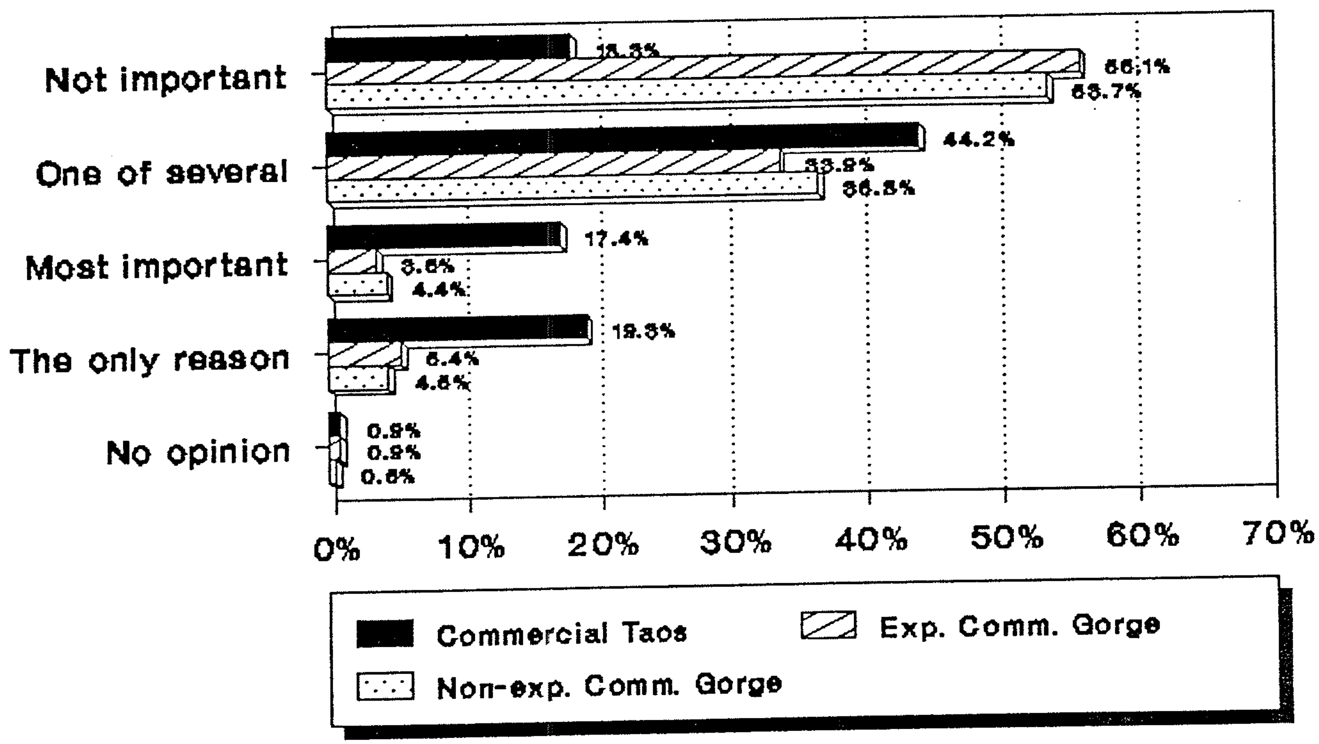
TABLE B.1, Socioeconomic Statistics for New Mexico Respondents

	CT	ECG	CG
Average age of respondent	39 years	41 years	41 years
Percentage of male respondents	55 %	57 %	46 %
Percentage of female respondents	45 %	43 %	54 %
Average years of education	17 years	17 years	17 years
Average annual household income	77,571 dollars	102,940 dollars	83,269 dollars
Average number of individuals in the household	2 adults, 1 child	2 adults, 1 child	2 adults, 1 child
Current employment status	80 % full-time	79 % full-time	75 % full-time
States of origin -from New Mexico -from neighboring states -from California	 32 % 31 % 7 %	 12 % 24 % 20 %	 8 % 28 % 13 %
Percentage of respondents who have been river running in northern NM before	28 %	20 %	5 %
Average number of days spent rafting in northern NM in a typical year	0.42 days	0.39 days	0.05 days
Average number of days spent visiting northern NM in a typical year	8.7 days	5.6 days	0.6 days
Average river running expenses per person per trip (per day)	93 dollars (81 dollars)	45 dollars	41 dollars

TABLE B.2, Socioeconomic Statistics for Arizona Respondents

	Ramsey Canyon	San Pedro Locals	San Pedro Non-resident
Average age of respondent	53 years	44 years	52 years
Percentage of male respondents	55 %	57 %	60 %
Percentage of female respondents	45 %	43 %	40 %
Average years of education	17 years	15 years	17 years
Average annual household income	67904 dollars	39673 dollars	59799 dollars
Average number of individuals in the household	2 adults, no children	2 adults, 1 child	2 adults, no children
Current employment status	48 % full-time 41 % retired	49 % full-time 24 % retired	49 % full-time 36 % retired
State of origin -from Arizona -from neighboring states -from foreign countries	 23 % 22 % 5 %	 100 % from Arizona	 31 % 22 % 6 %
Percentage of respondents for whom visiting the site was main reason for visit to Sierra Vista area/daytrip	75 %	81 %	21 %
Average number of days spent visiting southern Arizona in a typical year	0.87	7.85	0.74
Percentage of respondents who have visited the site before	35 %	64 %	28 %

FIGURE B.1, Importance of Rafting as a Reason for Respondents' Trip to Northern New Mexico



89.2 percent of the Taos Box rafters were on one day trips, while 9.1 percent and 1.7 percent spent one and two nights at the river, respectively. The trip length for rafters at the Lower Gorge was much shorter. 87 percent of the experienced rafters and 90 percent of the nonexperienced rafters were on half day trips, and the remaining people were on one day trips.

Almost 50 percent of the visitors at Ramsey Canyon spent no more than half a day at the preserve. About 18 percent of the respondents stayed one or more nights at the site.

Local residents visiting the San Pedro RNCA spent relatively few hours at the site: more than half of all respondents spent less than three hours and 87 percent spent no more than 4 hours at the site. The percentage of nonresident visitors who spent no more than half a day at the RNCA was 58 percent. About 32 percent of the nonresidents stayed for more than four hours up to a day, and less than nine percent spent more than one day at the site.

Table B.3 shows the primary reasons for visiting Ramsey Canyon. Since only birders were included in the sample for Ramsey Canyon all reasons relate to birding. The majority of the respondents came for general birding while almost one third of the visitors indicated that they came primarily to view hummingbirds.

TABLE B.3, Primary Reasons for Visiting Ramsey Canyon (percentage of total respondents)

To view Hummingbirds	32.6
General birding	58.2
To look for a specific bird	16.2
Other reason	8.2

Figure B.2 shows the main reasons for the respondents' visit to the San Pedro RNCA. While two thirds of the nonresident visitors came mainly for birding and 17 percent came to look for a specific bird, only 35 percent of local residents came for birding. This reflects the national reputation of San Pedro RNCA as a birding spot. 73 percent of the local visitors indicated hiking and walking as the main reason for their visit.

Table B.4 shows the respondents' opinion on the flow level they experienced during their rafting trip on the Rio Grande. Almost half of the rafters on the Taos Box thought that the flowlevel experienced was just adequate for safe and enjoyable river running, one third of the respondents considered the flow levels ideal, and more than 15 percent thought that flows were too low. Very few rafters on the Taos Box as well as on the Lower Gorge thought that flows were too high for safe and enjoyable river running. The opinions reflect the relatively low flows during the 1992 season. One fifth of the experienced rafters on the Lower Gorge considered flow levels too low and more than half of the rafters thought flows were just adequate. Less than one out of four experienced rafters thought that flow levels were ideal for rafting. The sample of nonexperienced river runners contained proportionally more people who thought that flows were ideal and proportionally less people that considered flows just adequate or too low.

FIGURE B.2, Main Reason for the Visit to San Pedro RNCA

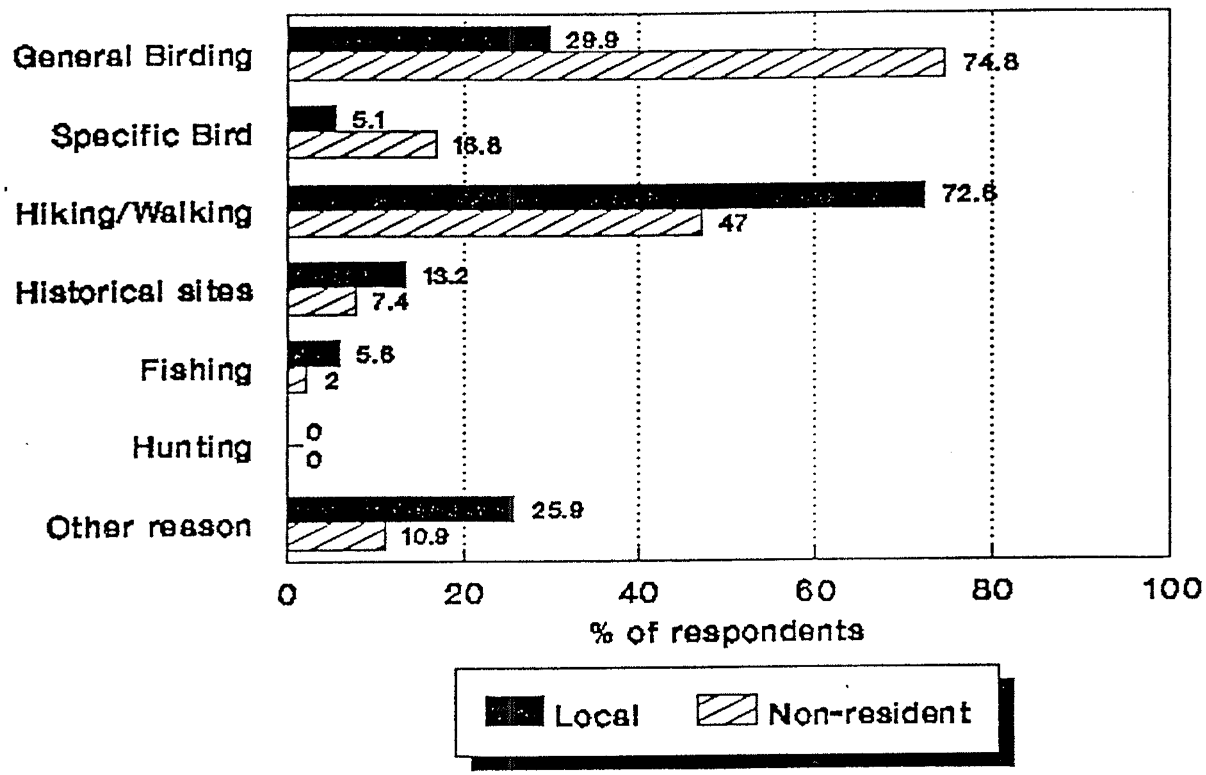


TABLE B.4, Opinion of Flow Level Experienced (percent of total responses)

OPINION	Commercial Taos	Experienced Commercial Gorge	Nonexperienced Commercial Gorge
Too high for safe and enjoyable river running	0.2%	0%	0.1%
Ideal for safe and enjoyable river running	34.0%	23.8%	34.8%
Just adequate for safe and enjoyable river running	47.1%	52.9%	48.3%
Too low for safe and enjoyable river running	15.5%	20.3%	15.1%
No opinion	3.2%	3.1%	1.7%
Total	100.0%	100.0%	100.0%

APPENDIX C: DEFINITIONS OF VARIABLES

Several new variables were defined by combining survey data. A list of variables and their definitions as they are used in this study is given in Tables C.1. to C.4.

TABLE C.1, Variables Used for Northern New Mexico (NM) Data

Variable	Definition
WILLPAY	WTP for flow level experienced in terms of additional river running expenses
ADDPAY	WTP for guaranteed higher flow level and extended river running season -for ECG and CT: in addition to WILLPAY -for CG: as a regular annual contribution
DAYNUMBER	number of days spent visiting northern NM in a typical year
MAINREAS	=1 if river running was not an important reason for traveling to northern NM =2 if river running was one of several important reasons =3 if river running was most important reason =4 if river running was only reason for trip
FLOWEXP	flow level experienced on the rafting trip
NEWFLOW	flow level guaranteed in hypothetical scenario
AGE	age of respondent
GENDER	=0 if female, =1 if male
EDUCATION	highest year of formal education completed
CHILDREN	number of children under 18 in the household
INCOME	annual household income (before taxes)
DAYSRAFT	number of days spent river running in northern NM in a typical year (=0 if first time river running in northern NM)
MAY	=1 if the river running trip took place in May =0 otherwise
JUNE	=1 if the river running trip took place in June =0 otherwise

TABLE C.1, (continued)

Variable	Definition
RAFTEXP	river running expenses per person
IDEAL	=1 if flow level experienced was perceived as ideal, =0 otherwise
TOOLOW	=1 if flow level experienced was perceived as too low, =0 otherwise
FULLTIME	=1 if respondent is employed full-time =0 otherwise
STUDENT	=1 if respondent is a student, =0 otherwise
INCSQ	INCOME squared
LNINC	natural log of INCOME
EXPSQ	RAFTEXP squared
FLOWDIFF	= NEWFLOW - FLOWEXP
LNFLOWDF	natural log of FLOWDIFF
LNNEWFL	natural log of NEWFLOW
MRLNFLOW	LNFLOW * Dummy variable, which =1 if MAINREAS =3 or 4, =0 otherwise
NM	=1 if respondent is a resident of New Mexico; =0 otherwise
CA	=1 if respondent is a resident of California =0 otherwise
NEIGHBOR	=1 if respondent is a resident of Arizona, Colorado, or Texas; =0 otherwise
DRLNNEWF	LNNEWFL * Dummy variable, which =1 if DAYSRAFT>2, =0 otherwise
DAYNUMSQ	DAYNUMBER squared

TABLE C.2, Variables Used for Southern Arizona Data (all 3 surveys)

Variable	Definition
TRIPNUM	number of trips to the site in the past 2 years
MAINREAS	=1 if visiting the site was the main reason for the trip to the Sierra Vista area (non-residents)/for the daytrip (locals) =0 otherwise
AGE	age of respondent
GENDER	=0 if female, =1 if male
EDUCATION	highest year of formal schooling completed
INCOME	household income (before taxes) in previous year
ADULTNUM	number of adults in the household (incl. respondent)
FULLTIME	=1 if respondent is employed full-time =0 otherwise
RETIRED	=1 if respondent is retired, =0 otherwise
LNEDU	natural log of EDUCATION
INCSQ	INCOME squared
LNINC	natural log of INCOME
FOREIGN	TRIPNUM squared
TRIPSQ	=1 if respondent is from a foreign country, =0 otherwise
LNAGE	natural log of AGE

TABLE C.3, Additional Variables Used for Ramsey Canyon Data

Variable	Definition
TOTWTP	total WTP in form of a one-time contribution to a non-profit organization in order to assure protection of Ramsey Canyon as a nature preserve
NONUSEWTP	WTP if Ramsey Canyon would not be open to visitors at all
TNCMEMBER	=1 if respondent is member of The Nature Conservancy, =0 otherwise
OTHENVORG	=1 if respondent is member of another environ-mental organization, =0 otherwise
ENVORG	=1 if respondent is member of Nature Conservancy or any other environmental organization, =0 otherwise
BIRDDAYS	number of days per year spent birding
DAYSSQ	BIRDDAYS squared
HUMMERS	=1 if primary reason for visit to Ramsey Canyon was to view hummingbirds, =0 otherwise
SPECIFIC	=1 if primary reason for visit was to look for a specific bird, =0 otherwise

TABLE C.4, Additional Variables Used for San Pedro RNCA Data

Variable	Definition
TOTWTP	total WTP in the form of a one-time contribution to a non-profit foundation in order to protect Gray Hawks at San Pedro RNCA (from survey)
NONUSEWTP	portion of TOTWTP that respondent is still willing to pay if she will never visit San Pedro RNCA again (from survey)
INPERSWTP	total WTP in the form of a one-time contribution to a non-profit foundation in order to secure continuous reliable river flows (from in-person interview)
INPERSNONU	portion of INPERSWTP that respondent is still willing to pay if she will never visit San Pedro RNCA again (from in-person interview)
SEENHAWK	=1 if respondent has seen a Gray Hawk =0 if respondent has never seen a Gray hawk
TIMESHAWK	number of times that respondent has seen a Gray Hawk
HAWKVISIT	=1 if respondent has seen or heard a Gray Hawk during the visit to San Pedro RNCA, =0 otherwise
BIRDREAS	=1 if birding was main reason for visiting San Pedro RNCA, =0 otherwise
SPECIFIC	=1 if main reason for visit was to look for a specific bird, =0 otherwise
RETURN	number of times the respondent is planning to return to the San Pedro RNCA
HAWKSQ	TIMESHAWK squared
RETURNSQ	RETURN squared

TABLE C.5, Variables Used in the Participation Regressions for the Rio Grande Data

Variable	Definition
FLOW	Flow level in cubic feet per second
FLOWSQ	Flow level squared
TEMPMIN	Minimum temparature on a given day
WEEKEND	=1 if weekend or holiday; =0 otherwise
RAIN	=1 if more than 1 inch precipitation; =0 otherwise
APRIL, MAY, JUNE, AUGUST, SEPTEMBER	Dummy variables for months April, May, June, August, and September
YEAR1991, YEAR1992	Dummy variables for years 1991 and 1992

APPENDIX D: DATA CLEANING, PROTESTS, AND NONRESPONSES

Data Cleaning

All data was checked for inconsistencies. If respondents indicated they were younger than 18 their survey was eliminated from the sample. If no age or an age of zero was indicated, the survey was kept in the sample and the average age of respondents was assigned for regression analysis.

The income categories given in the surveys were replaced by their midpoint. For the last category "$250,000 or more" an income of $300,000 was assumed. Table D.1. indicates the percentage of respondents that indicated an income of 250,000 dollars or more.

TABLE D.1, Percentage of Respondents with Income of $250,000 or more

Commercial Taos	3.2 %
Experienced Commercial Gorge	8.8 %
Non-experienced Commercial Gorge	4.2 %
Ramsey Canyon Preserve	1.9 %
San Pedro RNCA / Local Residents	0.0 %
San Pedro RNCA / Non-residents	1.5 %

Income nonresponses were filled in using simple regressions of income on age, education, and employment status. The estimated regression equations are given in Table D.2.

TABLE D.2, Estimated Equations Used to Replace Income Nonresponses

Survey Type	# of non-responses (% of sample)	Estimated Equation
Ramsey Canyon	61 (13.5%)	INCOME = -78239 + 923.71*AGE + 6517*EDUCATION - 11035*PARTTIME - 28371*UNEMPLOY - 26521*RETIRED - 43191*STUDENT + 52588*HOMEMAKE (R-squared=0.1807)
San Pedro /Locals	15 (5.5%)	INCOME = -31200 + 510.53*AGE + 3708.4*EDUCATION - 11734*PARTTIME - 14644*UNEMPLOY - 21270*RETIRED - 7496.6*STUDENT (R-squared=0.2840)
San Pedro /Non-res.	25 (11.2%)	INCOME = -34381 + 1091.8*AGE + 3277.1*EDUCATION - 22021*PARTTIME - 37777*UNEMPLOY - 40005*RETIRED - 29476*STUDENT - 43365*HOMEMAKE (R-squared=0.1385)
CT	22 (3.8%)	INCOME = -67088 + 1454*AGE + 5374*EDUCATION - 15693*PARTTIME - 39642*RETIRED - 26436*STUDENT + 47172*HOMEMAKE - 19630*UNEMPLOY (R-squared=0.1780)
ECG	12 (5.4%)	INCOME = -102860 + 1727.2*AGE + 7867.1*EDUCATION (R-squared=0.0986)
NCG	68 (9.1%)	INCOME = -98978 + 1703.5*AGE + 6784.1*EDUCATION - 69979*RETIRED - 27777*STUDENT + 40492*HOMEMAKE (R-squared=0.1904)

The following site-specific changes were made:

a) Arizona

Nonresponses on the number of trips within the last two years were replaced by the average number of trips for other respondents, calculated from valid answers of repeat visitors only. For Ramsey Canyon, both the survey and the contact sheet contained a question about whether the respondent had visited the preserve before. In some cases respondents contradicted themselves by indicating different answers. In these cases the more commonly observed case that they had never been to Ramsey Canyon before was assumed. In the personal interviews for the San Pedro RNCA respondents were asked to indicate whether their WTP bid was per individual or per household. For respondents indicating an amount per household, the bid was divided by the number of adults in the household.

For the regression analysis, data on trip expenditures was included initially because it might reflect the importance of the resource to respondents. The expenditure data used in the regressions was obtained as follows: The Sierra Vista expenses reported by survey respondents were divided by the number of people included in the expenditures, and apportioned according to the number of nights spent in Sierra Vista, the time spent at the site, and the reason for the trip to southeastern Arizona (see Crandall, Leones and Colby, 1992 for further details on apportioning and the estimation of missing data). Several respondents did not indicate sufficient data to follow the procedures for filling in missing expenditures as described in Crandall, Leones and Colby

(1992). Moreover, fifty Ramsey Canyon respondents, 35 San Pedro non-resident respondents, and 37 San Pedro local respondents skipped the entire expenditure section of the survey. For these respondents expenditures were estimated as follows: Average values were used to fill in missing data on expenditures for gas, car rental, groceries, restaurants, tour fees, and miscellaneous. Regressions trying to explain differences in these expenditure categories were insignificant. For lodging expenses, a simple regression with income, nights in Sierra Vista, and number of people in the party, was used to fill in the missing data. Alternatively, for those respondents who skipped the entire section a regression as that described for lodging expenses was used to estimate the total expenditures rather than individual categories. Both procedures left a considerable amount of missing data due to non-responses in the explanatory variables. Since the expenditure variables were insignificant in all regressions it was decided to leave out expenditures in the final regressions reported in chapter 5.

b) New Mexico

Nonresponses on the number of days spent rafting in Northern New Mexico per year were replaced by the average number of days, calculated for repeat visitors only. Missing data for actual rafting expenses was filled in using the average expenses for the particular length of rafting trip.

Outliers

While no formal outlier analysis was attempted in this study, unusually high WTP bids were examined to determine whether they represented an unusually high proportion of the respondents' income and whether exclusion of these bids changed the estimated regression coefficients significantly. According to this procedure one bid of $5000 in the Ramsey Canyon data as well as 2 bids of $1000 for the local resident version of the San Pedro survey were excluded from the analysis.

Protest Bids and Non-responses

Each survey contained a question about the motives for indicating a zero willingness to pay. Many respondents gave written explanations where space was provided to write comments. These respondent comments were classified into additional categories. The number of respondents which indicated a specific reason for a zero bid are listed in Tables D.3. to D.8. The tables also show the percentage of total zero bidders (i.e. respondents who bid zero on at least one WTP question) that indicated a specific reason. Moreover, the tables show the distinction between valid zero bids and protest zero bids. According to Desvousges, Smith and Fisher (1987) valid zero bids are bids of respondents who indicate that the contingent commodity is worthless to them or that they could not afford any additional cost.

Desvouges, Smith and Fisher (1987) define three categories of protest bidders:

1) respondents who reject the framing of the contingent commodity (e.g. who

reject the payment vehicle or who find it unethical to place a value on the commodity)

2) respondents who fail to take the valuation exercise seriously, thereby putting less effort into searching their preferences

3) respondents who misunderstand or are incapable of processing the information required to participate effectively in contingent mkt.

In addition, Cummings, Brookshire and Schulze (1986) include as protestors those respondents who believe they have an inherent right to the resource. Adhering to common methodological practice, protest bids were excluded from the benefit analysis. Desvouges, Smith and Fisher (1987, p.253) point out that "in screening out these individuals, we are imposing, at least implicitly, a model of how individuals respond to CV questions. When protest bids are identified within the survey questionnaire, we are assuming that these responses are inconsistent with an implicit model of behavior." In accordance with Milon (1989), zero bids also were excluded if respondents did not give any explanation for their response because in these cases their real motive could not be determined. The percentage of respondents who did not explain their motivation for giving a zero bid was relatively high for the San Pedro RNCA data. Therefore, t-tests were used to test whether these respondents seem to be indeed similar to protest bidders, and not to respondents who gave valid zero bids. The t-test results showed that respondents who did not give an explanation for their zero bid were, on average, different from respondents with valid zero bids with respect to several variables while no statistically significant differences could be found in comparison to protest bidders. This supports the treatment of respondents who did not explain their zero bid as protest bidders.

Although the surveys contained two WTP questions, in asking for the motives for a zero bid no distinction was made between the different WTP questions. Consequently, if a respondent answered zero on both WTP, questions it could not be determined which reason indicated referred to which question, except for reasons which only made sense for specific questions.

There is a great deal of ongoing discussion among CVM researchers regarding how much context and information to provide respondents. This issue is relevant in this study. Several respondents expressed concern about environmental impacts of the CVM scenario in which higher flow levels will be maintained throughout the summer. Most of these respondents seemed to misunderstand the issue; they believed that current flows are "natural" and that increasing and maintaining flows would require dams or similar major interventions into "the course of nature". This perception is incorrect (the status quo low flow regime is the result of human intervention upstream), and these protests were excluded. However, the exclusion of these cases from the analysis could cause a downward bias in the sample mean WTP due to elimination of environmentally conscious people. In future surveys it might be possible to avoid these misunderstandings by giving more information on where the additional water would come from and on the fact that current flows are well below the historical "natural" level. However, such contextual descriptions might influence respondents by giving the impression that the status quo condition is "bad".

Comparing the reasons for zero bids between experienced and nonexperienced rafters on the Lower Gorge, more nonexperienced rafters stated that they could not afford additional cost, while the low flow level was a more common explanation among experienced rafters. This is consistent with the facts that nonexperienced rafters had on average lower incomes than experienced rafters, and that experienced rafters are more likely to be able to make a judgement about flow levels or to compare the flow during their current trip to flows experienced on earlier trips.

Comparing the reasons for zero bids between surveys and interviews at the San Pedro RNCA yields another result. The number of respondents indicating that they cannot afford any additional costs is two to three times higher in the surveys than in the personal interviews. This discrepancy is troubling. Do these inconsistent responses mean that persons with true zero values do not want to report zero values when an interviewer is present? This tendency is unlikely to have influenced this study because the respondents did not have to state their bid to the interviewer. Instead they circled their bid privately. Several other factors which may have caused the generally higher incidence of zero bids in the surveys are discussed in section 4.4.2. An advantage of the in-person interviews is the significantly lower proportion of respondents who did not explain their bid.

Comparing the answers of locals to those of non-residents for the San Pedro RNCA data, shows that a higher percentage of non-resident zero bidders indicate that they already support other causes. Many stated that they supported causes closer to their home. Also a higher portion of nonresident zero bidders believed that the preservation should be at no cost to them or indicated that they would rather let others pay. This might also be related to the general notion that people should pay for the preservation of areas close to where they live.

TABLE D.3, Reasons for Zero Bids / Taos Box

Reasons for zero bids	n	%
Total zero bids	302	100.0 (51.5% of sample)
Valid Reasons for Zero Bids		
I don't visit New Mexico for rafting very often.	155	51.3
I can't afford additional costs at this time.	75	24.8
My rafting enjoyment does not depend on flow level.	62	20.5
Low flow level is not worth anymore.	42	13.9
The trip was expensive enough.	11	3.6
I can adjust my time to when flow levels are high.	8	2.6
I can use substitute sites instead.	7	2.3
I don't go rafting very often.	7	2.3
I value the variability of flows (adventure/variety).	5	1.7
I can involve in other activities instead.	4	1.3
I was content with the flow level experienced.	2	0.7
Rafting is not a priority to me.	2	0.7
Protest Reasons for Zero Bids		
I am concerned that rafting companies will charge more.	73	24.0
Maintaining flow in the river is my right.	41	13.6
Questions were unclear or hypothetical.	36	11.9
Water is too controversial an issue in New Mexico.	34	11.3
I am concerned about environmental impacts/ I oppose the manipulation of "natural flows".	27	8.9
Alternative uses of the water need to be considered.	12	4.0
I don't know how flow level (cfs) affects rafting.	7	2.3
Only area residents should pay.	6	2.0
Others (users/state/BLM) should pay.	3	1.0
Rafting companies charge too much already.	3	1.0
Other protest response.	26	8.6
No explanation.	18	6.0

TABLE D.4, Reasons for Zero Bids / Experienced Commercial Gorge

Reason for zero bids	n	%
Total Zero Bids	101	100.0 (44.5% of sample)
Valid Reasons for Zero Bids		
I don't visit New Mexico for rafting very often.	53	52.5
My rafting enjoyment does not depend on flow level.	18	17.8
Low flow level is not worth anymore.	15	14.9
I can't afford additional costs at this time.	13	12.9
The trip was expensive enough.	5	5.0
Rafting is not a priority to me.	3	3.0
I can use substitute sites instead.	2	2.0
I can involve in other activities instead.	1	1.0
Protest Reasons for Zero Bids		
I am concerned that rafting companies will charge more.	13	12.9
Questions were unclear or hypothetical.	12	11.9
I am concerned about environmental impacts/ I oppose the manipulation of "natural flows".	9	8.9
Water is too controversial an issue in New Mexico.	5	5.0
Alternative uses of the water need to be considered.	3	3.0
I don't know how flow level (cfs) affects rafting.	2	2.0
Maintaining flow in the river is my right.	2	2.0
Others (users/state/BLM) should pay.	2	2.0
Only area residents should pay.	1	1.0
Other protest response.	4	4.0
No explanation.	11	10.9

TABLE D.5, Reasons for Zero Bids / Nonexperienced Commercial Gorge

Reason for zero bids	n	%
Total Zero Bids	569	100.0 (75.8% of sample)
Valid Reasons for Zero Bids		
I don't visit New Mexico for rafting very often.	432	75.9
I can't afford additional costs at this time.	176	30.9
My rafting enjoyment does not depend on flow level.	106	18.6
I support other causes.	16	2.8
Rafting is not a priority to me.	13	2.3
The trip was expensive enough.	6	1.1
I can adjust my time to when flow levels are high.	5	0.9
Low flow level is not worth anymore.	5	0.9
I can use substitute sites instead.	3	0.5
Other valid zero.	2	0.4
Protest Reasons for Zero Bids		
I am concerned that rafting companies will charge more.	63	11.1
Questions were unclear or hypothetical.	52	9.1
Water is too controversial an issue in New Mexico.	38	6.7
Only area residents should pay.	38	6.7
I am concerned about environmental impacts/ I oppose the manipulation of "natural flows".	36	6.3
Maintaining flow in the river is my right.	32	5.6
Others (users/state/BLM) should pay.	17	3.0
I need more information on where additional water would come from.	9	1.6
I oppose/am sceptic about the idea of a non-profit trust fund.	7	1.2
Alternative uses of the water need to be considered.	7	1.2
Other protest response.	12	2.1
No explanation.	25	4.4

TABLE D.6, Reasons for Zero Bids / Ramsey Canyon

Reason for Zero Bid	n	%
Total Zero Bids	155	100.0 (37.3% of sample)
Valid Reasons for Zero Bid		
I cannot afford any additional costs at this time.	45	29.0
I can go to other locations.	21	13.5
I would not benefit from preservation at Ramsey Canyon.	21	13.5
I support other causes (more important/closer to home).	14	9.0
If I pay I want to have access to the preserve.	6	3.9
Ramsey Canyon Preserve is overrated/disappointing.	3	1.9
Protest Reasons for Zero Bid		
I oppose closing Ramsey Canyon to visitors.	37	23.9
I did not fully understand the question.	12	7.7
This preservation should be undertaken at no cost to me.	9	5.8
I oppose the idea of a non-profit foundation.	6	3.9
I'd rather let others pay for the non-profit foundation's activities.	6	3.9
Ramsey Canyon is already too restricted.	4	2.6
I didn't like question/Question was too hypothetical.	3	1.9
I donated during my visit at Ramsey Canyon Preserve.	3	1.9
Other protest response.	8	5.2
No explanation.	13	8.4

TABLE D.7, Reasons for Zero Bids: San Pedro RNCA / Mail Survey

Reasons for Zero Bids	Local		Nonresident	
	n	%	n	%
Total Zero Bids	40	100.0 (20.2% of sample)	51	100.0 (25.1% of sample)
Valid Reasons for Zero Bid				
I cannot afford any additional costs at this time.	14	35.0	21	41.2
I would not benefit from preservation at San Pedro RNCA.	7	17.5	4	7.8
I can go to other locations.	3	7.5	1	2.0
I already support other causes.	0	0.0	6	11.8
Protest Reasons for Zero Bid				
I oppose the idea of a non-profit organization.	6	15.0	3	5.9
Preservation should be undertaken at no cost to me.	3	7.5	7	13.7
I oppose the focus on the Gray Hawk only.	3	7.5	0	0.0
I'd rather let others pay for the non-profit organization's activity.	0	0.0	4	7.8
This is not the right way to approach the problem.	0	0.0	3	5.9
Other protest response.	1	2.5	2	3.9
No explanation.	8	20.0	14	27.5

TABLE D.8, Reasons for Zero Bids: San Pedro RNCA / In-person Interviews

Reasons for Zero Bids	Local		Nonresident	
	n	%	n	%
Total Zero Bids	27	100.0 (13.6% of sample)	29	100.0 (14.3% of sample)
Valid Reasons for Zero Bids				
I cannot afford any additional costs at this time.	5	18.5	10	34.5
I would not benefit from preservation at San Pedro RNCA.	2	7.4	7	24.1
I can go to other locations.	2	7.4	2	6.9
I already support other causes.	1	3.7	2	6.9
Protest Reasons for Zero Bids				
I oppose the idea of a non-profit organization.	5	18.5	7	24.1
The question is unrealistic/too hypothetical.	4	14.8	2	6.9
I did not fully understand the question.	3	11.1	1	3.4
This is not the right way to approach the problem.	3	11.1	1	3.4
Preservation should be undertaken at no cost to me.	2	7.4	3	10.3
I'd rather let others pay for the non-profit organization's activity.	1	3.7	1	3.4
Other protest response.	3	11.1	2	6.9
No explanation.	0	0.0	1	3.4

Given the above distinction between valid and protest bids, four categories of answers to the WTP questions can be defined: valid zero bids, positive bids, protest zero bids, and nonresponses. Positive bids were always left unchanged even though in some cases the bids may have been affected by motivations that led to a protest response for another WTP question for which the bid was zero. Some respondents indicated reasons for zero bids even though they did not respond to the WTP question at all. In these cases the WTP answer was changed from nonresponse to valid zero or protest zero depending on the motive indicated.

If respondents indicated a positive nonuse value but did not answer the questions on total value or indicated a total value of zero, the total value was changed to be the same as the nonuse value. This procedure is based on the theory that total value has to be at least as high as nonuse value since (Mitchell and Carson, 1989):

TOTAL VALUE = USE VALUE + NONUSE VALUE (+ OPTION VALUE)

However, the procedure could lead to a conservative estimate of total value.

The survey for nonexperienced rafters on the Lower Gorge did not attempt to elicit motives for a nonuse value of zero. However, some respondents who gave positive values on WILLPAY and ADDPAY and indicated a zero nonuse value answered the question on motives for zero bids. In these cases, the nonuse value was considered a protest bid if the motive indicated was a protest reason that made sense for a nonuse value of zero.

Tables D.9 to D.11 show the distribution of bids among the four categories. For most surveys the percentage of respondents who indicate protest bids is below or close to the 15 percent recommended by federal guidelines (Sanders, Walsh and Loomis, 1990). However, for the Commercial Taos survey the sample contained a fairly high percentage of protest bidders.

Comparing the reasons for protest bids between the Commercial Taos and the Commercial Gorge survey it seems that a higher percentage of Taos Box rafters were concerned about higher charges by rafting companies or thought that they had a right to the higher flows or that the issue was too controversial. The first concern may be due to the already fairly high rafting fees on the Taos Box. The latter two attitudes could indicate a higher consciousness of the controversy surrounding water issues in Northern New Mexico among Taos Box rafters. Mean values for the variables DAYSRAFT, MAINREAS, DAYNUMBER and VISBEFORE show that respondents of the Commercial Taos survey are on average rafting more days per year, spend more days visiting northern New Mexico in a typical year, consider rafting a more important reason for their trip, and contain a higher percentage of people who previously have rafted in northern New Mexico.

In comparison to the sample of experienced rafters on the Lower Gorge, the sample of nonexperienced rafters contained a significantly higher percentage of respondents who indicated protest and valid zero bids for guaranteed higher flows and an extended rafting season. This could be due to the fact that less experienced rafters have less interest in an extension of the rafting season. On the other hand it could be due to the different payment vehicle. However, only 1.1 percent of the zero bidders indicated that they oppose the idea of a non-profit trust fund.

The comparison of WTP answers for the San Pedro RNCA given in the survey and in the in-person interviews yields an interesting result: the percentage of protest responses, nonresponses and valid zero bids is considerably higher for the surveys than in person. This might be due to two factors. First, the presence of an interviewer might influence respondents' behavior. One possibility is that it causes respondents to take the questions more seriously. On the other hand, the results could also reflect that respondents feel bad about giving a zero bid in presence of an interviewer. This is a common criticism of in-person interviews. However, as mentioned above, respondents were given privacy in answering the WTP questions. Second, the result might be due to the different nature of the contingent good. This seems to be the case at least for local residents; 7.5 percent of local zero bidders indicated that they oppose the focus on the Gray Hawk only. Moreover, the average total WTP of local residents is much higher in the interviews than in the surveys.

Another possible explanation for the higher percentage of protest bids in the surveys compared to the personal interviews is that respondents might have felt as if they were being tested when they received a similar WTP question in the survey as in the previous interview. Finally, the reduced incidence of zero bids in person may reflect the respondent just having visited the site and placing a higher value on the resource after having just experienced the site.

TABLE D.9, Categories of WTP Answers / New Mexico

	Commercial Taos		Exp. Comm. Gorge		Non-exp. Comm. Gorge	
	n	%	n	%	n	%
n	586	100.0	221	100.0	744	100.0
WILLPAY = protest zero	130	22.2	32	14.5	119	16.0
WILLPAY = nonresponse	9	1.5	4	1.8	7	0.9
WILLPAY = valid zero	91	15.5	35	15.8	133	17.9
ADDPAY = protest zero	132	22.5	28	12.7	204	27.4
ADDPAY = nonresponse	10	1.7	4	1.8	5	0.7
ADDPAY = valid zero	71	12.1	29	13.1	316	42.5

TABLE D.10, Categories of Answers on Nonuse Values / Nonexperienced Commercial Gorge

	n	%
Positive ADDPAY	219	100.0
out of these		
Nonuse value = protest response	19	8.7
Nonuse value = nonresponse	6	2.7
Nonuse value = valid zero	44	20.1

TABLE D.11 (a-c), Categories of WTP Answers

a) Arizona

	Ramsey Canyon		San Pedro RNCA / Local		San Pedro RNCA / Nonresident	
	n	%	n	%	n	%
n	416	100.0	195	100.0	203	100.0
Total WTP = protest zero	44	10.6	22	11.3	24	11.8
Total WTP = nonresponse	31	7.5	3	1.5	4	2.0
Total WTP = valid zero	37	8.9	13	6.7	22	10.8
Total WTP > 0 out of these:	304	73.1	157	80.5	153	75.4
Nonuse WTP = protest zero	46	15.1	3	1.9	2	1.3
Nonuse WTP = nonresponse	1	0.3	5	3.1	4	2.6
Nonuse WTP = valid zero	28	9.2	1	0.6	3	2.0

b) San Pedro RNCA / Local Residents

	Survey		In-person Interviews	
	n	%	n	%
n	195	100.0	195	100.0
Total WTP = protest zero	22	11.3	12	6.1
Total WTP = nonresponse	3	1.5	1	0.5
Total WTP = valid zero	13	6.7	3	1.5
Total WTP > 0 out of these:	157	80.5	179	91.8
Nonuse WTP = protest zero	3	1.9	8	4.4
Nonuse WTP = nonresponse	5	3.1	1	0.6
Nonuse WTP = valid zero	1	0.6	3	1.7

TABLE D.11, (continued)

c) San Pedro RNCA / Nonresidents

	Survey		In-person Interview	
	n	%	n	%
n	202	100.0	202	100.0
Total WTP = protest zero	24	11.8	11	5.4
Total WTP = nonresponse	4	2.0	3	1.5
Total WTP = valid zero	22	10.8	10	4.9
Total WTP > 0 out of these:	153	75.4	179	88.2
Nonuse WTP = protest zero	2	1.3	2	1.1
Nonuse WTP = nonresponse	4	2.6	0	0.0
Nonuse WTP = valid zero	3	2.0	6	3.4

The exclusion of protest bids and nonresponses from the WTP analysis raises the question whether this procedure affects the representativeness of the remaining sample, i.e. whether the exclusion of invalid bids leads to a bias in the benefit analysis. Cummings, Brookshire and Schulze (1986) point out that if protest zero bidders have a positive WTP there could be a self selection bias resulting in a downward bias in the estimated sample mean bids. On the other hand, Mitchell and Carson (1989) suggest that protest bidders have relatively low levels of income and education. Therefore, if their true WTP values are relatively low, their exclusion from analysis could lead to an upward bias in the estimated sample mean bids. To determine the existence and likely direction of a bias it is important to compare the characteristics of protest bidders, nonrespondents and valid bidders. Following the example of Desvousges, Smith and Fisher (1987) t-tests were constructed for all variables that might be used in the regression analysis. The variables were tested for differences in their mean value between the following groups of WTP responses: protest bids versus valid bids, nonresponse versus valid bids, and zero bids versus positive bids. The latter test was constructed to examine whether respondents who indicate a true WTP of zero are on average different from respondents with a positive WTP. An F-test was constructed to test the hypothesis that the variances of two groups are equal. If the F-test confirmed the hypothesis at least at a five percent significance level, a pooled variance estimate was used in the t-tests. Otherwise the separate variances were used. Tables D.12 to D.13 show the results for those variables whose means were significantly different across two groups.

TABLE D.12 (a-e), Differences in Means of Variables: New Mexico

a) Commercial Taos / WILLPAY / Protest Bids versus Valid Bid

Variable	Willpay = Protest Bid			Willpay = Valid Bid			Pooled/ Separate Variance	T-statistic	Degrees of Freedom	Two-tailed significance
	Mean	Standard Deviation	n	Mean	Standard Deviation	n				
INCOME	62379.31	46084.20	130	77503.70	61846.90	447	S	-3.03	277.5	0.003

b) Commercial Taos / WILLPAY / Nonresponse vs. Valid Bid

Variable	Willpay = Nonresponse			Willpay = Valid Bid			Pooled/ Separate Variance	T-statistic	Degrees of Freedom	Two-tailed significance
	Mean	Standard Deviation	n	Mean	Standard Deviation	n				
DAYSRAFT	0.11	0.33	9	0.43	0.84	447	S	-2.70	10.2	0.022
MAY	0.67	0.50	9	0.35	0.48	447	P	1.99	454.0	0.047
RIVEREXP	67.19	18.54	8	93.96	59.16	465	S	-3.77	9.7	0.004

TABLE D.12, *(continued)*

c) Commercial Taos / ADDPAY / Valid Bid versus Protest Bid

Variable	Addpay = Valid Bid			Addpay = Protest Bid			Pooled/ Separate Variance	T-statistic	Degrees of Freedom	Two-tailed significance
	Mean	Standard Deviation	n	Mean	Standard Deviation	n				
FLOWEXP	717.92	205.31	444	771.43	205.53	132	P	-2.63	574.0	0.009
NEWFLOW	989.84	218.17	444	1030.53	211.76	132	P	-2.03	574.0	0.042
DAYSRAFT	0.46	0.92	444	0.31	0.67	132	S	2.10	290.5	0.036
GENDER	0.57	0.50	444	0.42	0.50	132	P	3.01	574.0	0.003
IDEAL	0.31	0.46	432	0.48	0.50	128	P	-3.67	558.0	0.000
TOOLOW	0.18	0.38	432	0.09	0.29	128	S	2.66	268.4	0.008
STUDENT	0.08	0.27	444	0.04	0.19	132	S	2.04	304.4	0.042

TABLE D.12, *(continued)*

d) Commercial Taos / ADDPAY / Valid Bid versus Nonresponse

Variable	Addpay = Valid Bid			Addpay = Nonresponse			Pooled/ Separate Variance	T-statistic	Degrees of Freedom	Two-tailed significance
	Mean	Standard Deviation	n	Mean	Standard Deviation	n				
CHILDREN	0.55	0.93	439	0.10	0.32	10	S	4.11	12.9	0.001
MAY	0.36	0.48	444	0.80	0.42	10	P	-2.89	452.0	0.004
JUNE	0.54	0.50	444	0.20	0.42	10	P	2.11	452.0	0.035
FULLTIME	0.80	0.40	444	0.40	0.52	10	P	3.16	452.0	0.002

e) Experienced Commercial Gorge / WILLPAY / Valid Bid versus Protest Bid

Variable	Willpay = Valid Bid			Willpay = Protest Bid			Pooled/ Separate Variance	T-statistic	Degrees of Freedom	Two-tailed significance
	Mean	Standard Deviation	n	Mean	Standard Deviation	n				
RIVEREXP	44.70	30.62	182	32.16	13.66	31	S	3.76	92.2	0.000

TABLE D.13 (a-f), Differences Between Means of Variables: Arizona

a) Ramsey Canyon / Valid Bid versus Protest Bid

Variable	WTP = Valid Bid			WTP = Protest Bid			Pooled/ Separate Variance	T-statistic	Degrees of Freedom	Two-tailed significance
	Mean	Standard Deviation	n	Mean	Standard Deviation	n				
MAINREAS	0.75	0.44	341	0.59	0.50	44	P	2.21	383.0	0.027
AGE	52.55	13.57	340	60.53	12.20	40	P	-3.55	278.0	0.000
OTHENVORG	0.75	0.44	338	0.53	0.51	40	P	2.97	376.0	0.003
HUMMERS	0.31	0.46	340	0.51	0.51	43	P	-2.68	381.0	0.008
SPECIFIC	0.18	0.38	340	0.07	0.26	43	S	2.46	68.3	0.016
FULLTIME	0.52	0.50	340	0.28	0.45	40	P	2.96	378.0	0.003
RETIRED	0.36	0.48	340	0.70	0.46	40	P	-4.22	378.0	0.000

TABLE D.13, *(continued)*

b) Ramsey Canyon / Valid Bid versus Nonresponse

Variable	WTP = Valid Bid			WTP = Nonresponse			Pooled/ Separate Variance	T-statistic	Degrees of Freedom	Two-tailed significance
	Mean	Standard Deviation	n	Mean	Standard Deviation	n				
MAINREAS	0.75	0.44	341	0.55	0.51	31	P	2.41	370.0	0.016
AGE	52.55	13.57	340	59.45	10.39	31	P	-2.76	369.0	0.006
FULLTIME	0.52	0.50	340	0.32	0.48	31	P	2.12	369.0	0.035
RETIRED	0.36	0.48	340	0.58	0.50	31	P	-2.42	369.0	0.016

c) San Pedro / Locals - Valid Bid versus Protest Bid / Survey:

Variable	WTP = Valid Bid			WTP = Protest Bid			Pooled/ Separate Variance	T-statistic	Degrees of Freedom	Two-tailed significance
	Mean	Standard Deviation	n	Mean	Standard Deviation	n				
AGE	44.22	14.39	170	52.50	18.72	22	P	-2.45	190.0	0.015
GENDER	0.57	0.50	170	0.86	0.35	22	P	-2.71	191.0	0.007
RETIRED	0.21	0.41	170	0.41	0.50	22	P	-2.09	191.0	0.038

TABLE D.13, *(continued)*

d) San Pedro / Locals - Valid Bid versus Protest Bid / In-person Interview:

Variable	WTP = Valid Bid			WTP = Protest Bid			Pooled/ Separate Variance	T-statistic	Degrees of Freedom	Two-tailed signifi-cance
	Mean	Standard Deviation	n	Mean	Standard Deviation	n				
SEENHAWK	0.57	0.92	181	0.25	0.45	12	S	2.16	17.8	0.044
AGE	44.23	15.01	182	59.23	10.78	12	P	-3.54	193.0	0.001
INCOME	39450.9	24782.2	173	67000.0	38129.9	10	S	-2.26	9.4	0.049
RETIRED	0.22	0.41	182	0.46	0.52	12	P	-2.01	194.0	0.046

e) San Pedro / Nonresidents - Valid Bid versus Protest Bid / Survey

Variable	WTP = Valid Bid			WTP = Protest Bid			Pooled/ Separate Variance	T-statistic	Degrees of Freedom	Two-tailed signifi-cance
	Mean	Standard Deviation	n	Mean	Standard Deviation	n				
SEENHAWK	0.50	0.62	175	0.21	0.42	24	S	2.98	39.0	0.005
TIMESHAWK	1.52	3.49	171	0.38	0.82	24	S	3.62	153.0	0.000
HAWKVISIT	0.31	0.65	172	0.04	0.20	24	S	4.23	104.4	0.000
SPECIFIC	0.19	0.39	174	0.04	0.20	24	S	2.89	50.8	0.006

TABLE D.13, *(continued)*

f) San Pedro / Nonresidents - Valid Bid versus Protest Bid / In-person interview

Variable	WTP = Valid Bid			WTP = Protest Bid			Pooled/ Separate Variance	T-statistic	Degrees of Freedom	Two-tailed signifi-cance
	Mean	Standard Deviation	n	Mean	Standard Deviation	n				
RETURN	2.46	3.29	164	0.78	0.83	9	S	4.44	26.6	0.000
ADULTNUM	1.90	1.12	188	1.40	0.52	10	S	2.76	14.0	0.015

The t-test results indicate the following:

a) Commercial Taos/Willpay:

The population of protest zero bidders on average had lower income than respondents who indicated valid WTP bids. Income histograms were drawn to examine whether the former result could have been caused by the existence of outliers, but this did not seem to be the case. Therefore, the result indicates that by excluding protest bids from the benefit analysis we might cause an upward bias in the sample mean WTP, assuming that higher incomes mean higher WTP bids.

Nonrespondents on average spent less days rafting per year, were more likely to have visited in May and spent less on river running expenses than respondents who gave valid bids.

Since the variables INCOME and the interaction term between DAYSRAFT and flow level were both significant and positive in the estimated regression equations, it is likely that protest bidders and nonrespondents on average hold lower WTP values than those respondents who indicated valid bids. The exclusion of protest bids and nonrespondents from the analysis is therefore likely to cause an upward bias in the reported average value for WILLPAY for the Taos Box data.

b) Commercial Taos/Addpay:

Protest bidders differ from respondents who gave valid bids in that they on average experienced higher flows and were offered higher flows in the second WTP question. Moreover, protest bidders on average contained a lower proportion of students and males, and spent less days rafting in northern New Mexico in a typical year.

Nonrespondents on average had less children, were more likely to have come rafting in May and less likely to have visited in June, and contained a lower proportion of fulltime employees.

The significant positive effect of the variable LNNEWFL in the ADDPAY regressions could imply that the exclusion of protest bidders led to a downward bias in the calculation of the average bid for ADDPAY. However, the significant positive effect of the variable GENDER counteracts this bias for the Taos Box sample. Moreover, the effect of the interaction term DRLNNEWFL is indeterminate.

c) Commercial Gorge/Willpay:

Among experienced rafters, protest bidders on average spent less on river running expenses than people who indicated valid bids. No significant differences between protest bidders and respondents indicating valid bids were found for the sample of nonexperienced rafters. The number of nonrespondents for both Commercial Gorge surveys was too low to allow for a meaningful t-test construction.

d) Commercial Gorge/Addpay:

No significant differences were found between protest bidders and respondents who indicated valid bids in the Commercial Gorge surveys. For both surveys the number of nonrespondents was too small to allow for meaningful t-tests.

e) Ramsey Canyon/ Total WTP:

Compared to the population of respondents who gave valid bids, protest bidders on average contained a lower proportion of people for whom Ramsey Canyon was the main reason for their visit to southeastern Arizona, a lower proportion of members of The Nature Conservancy and of people who came for general birding, and a higher proportion of people who came to see hummingbirds. The population of protest bidders on average was also older and contained a higher proportion of retired people and a lower proportion of fulltime employees.

The population of nonrespondents showed the same characteristics compared to the population of valid bidders as the population of protest bidders did with respect to age, retirees, fulltime employees and the main reason for their visit.

The age variable was negative in the bid function regression for Ramsey Canyon, while MAINREAS and the membership in an envirionmental organization was positive. This indicates that protest bidders are likely to hold lower WTP values for the preservation of Ramsey Canyon than those respondents who indicated valid bids. Therefore the exclusion of protest bidders from the analysis will tend to lead to an overestimation of the average WTP of respondents. However, this bias is likely to be small since the variables MAINREAS and LNAGE were insignificant.

f) San Pedro/Local Residents

Comparing valid bidders and protest bidders for the surveys, the population of protest bidders is on average older and contains a higher proportion of male and of retired people. The population of protest bidders in the personal interviews is also on average older and contains more retired people than respondents who indicate a valid bid in the interviews. Moreover, protest bidders in the personal interviews on average have higher incomes and contain a lower proportion of people who have seen a Gray Hawk before. The latter result is surprising since the WTP questions in the personal interviews did not mention Gray Hawks at all. It might however be due to a correlation of having seen a Gray Hawk to a general interest in birding and in the San Pedro RNCA. The results on income and education contradict the suggestion by Mitchell and Carson (1989) that protest respondents have relatively low income and education levels, which was, however, confirmed by the data for Commercial Taos. The number of nonrespondents in the sample of local residents in the survey as well as in the personal interviews was too low to allow for meaningful t-tests.

As shown in Appendix E, age and gender had significant negative effects on WTP indicated in the mail surveys. As a consequence, protest bidders are likely to hold lower WTP values than other respondents. Therefore, the exclusion of protest bidders from the analysis is likely to lead to an overestimation of the average WTP of local visitors for the preservation of the Gray Hawk at San Pedro RNCA.

While the difference in age and the variable SEENHAWK tend to bias the average

WTP indicated in personal interviews upward, the difference in income tends to lead to a downward bias. The overall effect of the exclusion of protest bidders on the estimated average WTP bid is indeterminate. However, all three variables were insignificant and the percentage of protest respondents was fairly low (6.1 percent) for the personal interviews. Any bias should therefore be small.

g) San Pedro/Non-residents

Compared to the population of respondents indicating valid bids, the population of protest bidders in the survey had a lower proportion of people who had seen a Gray Hawks once or several times, as shown in the variables SEENHAWK, TIMESHAWK and HAWKVISIT. They also contained a lower proportion of people whose main reason for visiting San Pedro was to look for a specific bird. Protest bidders in the personal interviews had on average a lower number of adults in their households and were expecting to return to the San Pedro RNCA less often. The number of nonresponses in both surveys and interviews was to low to allow for meaningful t-tests.

Since the variable RETURN was significant and positive in the bid function regressions for the personal interviews, and the variable TIMESHAWK was positive and significant in the regressions for mail surveys, the average WTP for both survey types is likely to be overestimated. However, the bias is probably small for the personal interviews since only 5.4 percent of the respondents indicated protest bids in the interviews.

Nonuse Values

The percentages of respondents with positive total values who indicated valid zero bids, protest bids or nonresponses on the nonuse value questions are included in Tables D.9 through D.13. For the Non-experienced Commercial Gorge survey, more than a fifth of the respondents with a positive value for ADDPAY indicated a valid zero bid for nonuse values. However, as mentioned above, the survey did not attempt to elicit the motives for zero bids specifically on the nonuse value question. Therefore, zero bids were considered valid bids unless the respondents explicitly indicated protest reasons. Thus, some of the zero bids for which no motives are known might represent protest zeros.

The percentages of protest bids, nonresponses and valid zero bids on the nonuse questions are small for all San Pedro RNCA data. However, the percentages for valid zero bids and especially for protest bids are relatively large for Ramsey Canyon. The reason for this can be seen from the list of motives for zero bids in Table D.5. Almost 24 percent of all valid and protest zero bidders stated that they oppose closing Ramsey Canyon to all visitors. This was triggered by the formulation of the nonuse question for Ramsey Canyon, which asked respondents to assume that the preserve would be closed for all visitors. On the contrary, the San Pedro RNCA surveys and interviews just asked to assume that the respondent himself would not visit the site again. In future surveys it seems to be preferable to use the latter formulation to avoid the high percentage of protest responses. It will also reduce valid zero responses because it allows for altruistic motives, which were indicated as the main motive for positive nonuse values by 22 to 30 percent of the respondents at the San Pedro RNCA.

APPENDIX E: ANALYSIS OF LOCAL RESIDENTS AND IN-PERSON SURVEYS FOR SAN PEDRO RNCAA

Average Bids

Table E.1 shows the average WTP bids of San Pedro RNCA respondents. Average WTP bids were higher in the personal interviews than in the mail surveys. Another way to compare the WTP results for the San Pedro RNCA between surveys and interviews is to look at the correlation of individual responses reported in table E.2. All four correlation coefficients are significantly different from zero at the 0.001 level, i.e. the probability that a correlation of at least the amount indicated is obtained when there is no linear association in the population between survey and interview responses is less than 0.1 percent. The other comparisons of survey and interview responses listed in Table E.2 also indicate a strong relationship between the two. This means that even though interview responses were on average higher than survey responses, both bids for the same respondent tended to be similar in comparison with the respective sample mean to fall into the same WTP category (i.e. valid response versus protest bid, etc.).

TABLE E.1, WTP Bids of San Pedro RNCA Visitors

Survey Type	Mean	Standard Deviation
San Pedro RNCA /Locals		
-Mail survey	45.54	63.99
-Interview	62.44	94.54
San Pedro RNCA /Non-residents		
-Mail survey	69.03	144.64
-Interview	74.71	139.43

TABLE E.2 (a-b), Comparison of Survey & In-person responses: San Pedro RNCA

a) Total WTP

	San Pedro Locals		San Pedro Nonresidents	
	n	%	n	%
Correlation coefficient	0.3796	-	0.3782	-
Totwtp=Inperswtp	70	35.4	73	36.0
Totwtp>Inperswtp	51	25.8	65	32.0
Totwtp<Inperswtp	77	38.9	65	32.0
out of different answers for Totwtp and Inperswtp:				
both positive	95	74.2	90	69.2
both invalid	2	1.6	1	0.8

TABLE E.2, *(continued)*

b) Nonuse WTP

	San Pedro Local		San Pedro Nonresident	
	n	%	n	%
Correlation coefficient	.3979	-	.3182	-
Totwtp>0 & Inperswtp>0	157	-	149	-
out of these:				
Nonusewtp = Inpersnonu	70	44.6	73	49.0
Nonusewtp > Inpersnonu	51	32.5	65	43.6
Nonusewtp < Inpersnonu	77	49.0	65	43.6
both positive	95	60.5	90	60.4
both invalid	2	1.3	1	0.7

Nonuse values

Both local and nonresident visitors indicated, on average, higher percentages of total value representing nonuse values in the mail surveys than in the on-site interviews. Respondents seem to assign more importance to use values after just visiting the site then at a later period.

TABLE E.3, Nonuse values

Survey Type	Average Nonuse Value	Average percentage of total value stated as nonuse value
Lower Rio Grande Gorge / Non-experienced rafters	$15.29 (n=194)	59.8 %
Ramsey Canyon Preserve	$96.23 (n=257)	69.9 %
San Pedro RNCA / Local Residents		
- Mail Survey	$54.56 (n=149)	85.2 %
- Personal Interview	$54.07 (n=170)	78.7 %
San Pedro RNCA / Non-residents		
- Mail Survey	$81.34 (n=147)	90.7 %
- Personal Interview	$63.85 (n=177)	80.2 %

Table E.4. shows the reasons for positive nonuse values as indicated by San Pedro RNCA visitors in the personal interviews. The motives are similar to those indicated in the mail surveys.

TABLE E.4, Reasons for Positive Nonuse Values: San Pedro RNCA / In-person Interview

	Local		Nonres.	
	n	%	n	%
a) I get satisfaction from knowing that the riparian habitat and wildlife species will continue to exist at San Pedro RNCA.	37	21.9	41	24.0
b) I get satisfaction from knowing that the riparian habitat and wildlife will be protected for other visitors and future generations.	52	30.8	56	32.7
c) Bird and wildlife have a right to the riparian habitat at San Pedro RNCA, regardless of satisfaction provided to humans.	67	39.6	69	40.4
a) and b)	0	0.0	1	0.6
a) and c)	0	0.0	1	0.6
a), b), and c)	6	3.6	1	0.6
Other	3	1.8	0	0.0
No explanation	2	1.2	2	1.2
Positive Nonuse Value	167	100.0	171	100.0

Bid functions for local residents of the San Pedro RNCA

The regression results for the mail surveys and personal interviews of local visitors of the San Pedro RNCA are reported in tables E.5. and E.6., respectively. The same regression equations were used for mail survey and interview results to allow for testing of the null hypothesis that the coefficients are equal for both types of data collection and phrasing of the WTP question.

TABLE E.5, Regression Results for the Mail Surveys of Local Visitors of the San Pedro RNCA

VARIABLE	NORMALIZED COEFFICIENT	ASYMPTOTIC T-RATIO	$\delta E(y)/\delta X_i$	ELASTICITY OF INDEX	ELASTICITY OF E(Y)
LNINC	0.45228	3.7868	18.88819	5.6979	4.2377
LNAGE	-0.24692	-0.96458	-10.31180	-1.1203	-0.8332
GENDER	-0.42905	-2.5585	-17.91805	-0.2996	-0.2228
BIRDREAS	0.89134	4.1696	37.22374	0.2162	0.1608
SEENHAWK	0.32978	1.7388	13.77213	0.1066	0.0793
TRIPNUM	0.68078E-01	4.9244	2.84304	0.6485	0.4823
TRIPSQ	-0.69045E-03	-3.6014	-0.288343E-01	-0.3800	-0.2826
CONSTANT	-3.3211	-2.3085			

12 LIMIT OBSERVATIONS
153 NON-LIMIT OBSERVATIONS
STANDARD ERROR OF THE ESTIMATE = 55.227
LOG-LIKELIHOOD FUNCTION= -839.89858
SQUARED CORRELATION BETWEEN OBSERVED AND EXPECTED VALUES=0.34680

TABLE E.6, Regression results for Personal Interviews of Local Visitors of the San Pedro RNCA

VARIABLE	NORMALIZED COEFFICIENT	ASYMPTOTIC T-RATIO	$\delta E(y)/\delta X_i$	ELASTICITY OF INDEX	ELASTICITY OF E(Y)
LNINC	0.18458	1.6061	12.27898	2.6928	1.7231
LNAGE	-0.28054	-1.1567	-18.66218	-1.4718	-0.9418
GENDER	-0.25911	-1.6024	-17.23686	-0.2135	-0.1366
BIRDREAS	0.43771	2.1408	29.11772	0.1202	0.0769
SEENHAWK	0.14828	0.80575	9.86427	0.0539	0.0345
TRIPNUM	0.39592E-01	4.5242	2.63375	0.4519	0.2892
TRIPSQ	-0.21185E-03	-3.9576	-0.140925E-01	-0.1325	-0.0848
CONSTANT	-0.36799	-0.26235			

TOBIT ANALYSIS, LIMIT = 0
3 LIMIT OBSERVATIONS
171 NON-LIMIT OBSERVATIONS
STANDARD ERROR OF THE ESTIMATE = 87.758
LOG-LIKELIHOOD FUNCTION= -1010.3507
SQUARED CORRELATION BETWEEN OBSERVED AND EXPECTED VALUES=0.15256

A positive and concave relation between income and WTP was found in both mail surveys and personal interviews, however income was not significant for the personal interviews. Respondents who indicated that birdwatching was the main reason for visiting San Pedro RNCA were willing to pay more than those who came primarily for other reasons, probably reflecting the particular significance of the RNCA as an excellent birding area.

Female visitors seem to have higher WTP values than male visitors. The level of formal education was insignificant in both regressions. As expected, the number of trips to the San Pedro RNCA in a typical year was significant and positive, and age had a negative effect on WTP. However, age was insignificant in both mail and in-person surveys. Because of outlier effects, a dummy variable indicating whether respondents have ever seen a Gray Hawk (SEENHAWK) was included rather than the number of times respondents had seen a Gray Hawk. The variable SEENHAWK was positive in both regressions, but insignificant for the personal interviews. The result indicates that respondents might perceive a difference between the phrasing of the WTP question in mail surveys and personal interviews. To test this theory, a likelihood-ratio test as described in Chapter 5.2.2. was performed. The result clearly led to rejection of the null hypothesis that the regression coefficients are equal across the two samples. The way in which local residents answered the WTP questions seems to differ systematically between in-person and mail surveys. This result is surprising since we would expect local residents to be more knowledgable about the underlying circumstances. It might be due to the fact that many local residents visit the RNCA for walking, while non-residents come mainly for birding. Thus, for local residents the protection of a specific bird species (i.e. the Gray Hawk) might be less meaningful than the general protection of streamflows. Unfortunately, the experimental design does not allow us to determine whether the difference in WTP bids is due to interviewer effects or the phrasing of the CVM question.

Bid functions for personal interviews of non-resident visitors of the San Pedro RNCA

The regression results for the personal interviews of nonresident visitors of the San Pedro RNCA are shown in Table E.7.

TABLE E.7, Regression Results for Personal Interviews of Nonresident Visitors of San Pedro RNCA

VARIABLE	NORMALIZED COEFFICIENT	ASYMPTOTIC T-RATIO[1]	$\delta E(y)/\delta X_i$	ELASTICITY OF INDEX	ELASTICITY OF E(Y)
LNINC	0.11977	1.1231	11.51468	2.3752	1.2715
LNAGE	-0.43754	-1.4980	-42.06660	-3.1691	-1.6964
LNEDU	0.71972	1.4558	69.19590	3.7340	1.9988
MAINREAS	0.25585	1.3843	24.59825	0.1013	0.0542
RETURN	0.10794	1.7426*	10.37719	0.4809	0.2574
RETURNSQ	-0.74781E-02	-1.8282*	-0.7189644	-0.2112	-0.1130
TIMESHAW	0.28050E-01	0.5595	2.696759	0.0697	0.0373
HAWKSQ	-0.17365E-022	-0.7792	-0.1669564	-0.0418	-0.0224
CONSTANT	-1.3038	-0.6393			

10 LIMIT OBSERVATIONS
177 NON-LIMIT OBSERVATIONS
STANDARD ERROR OF THE ESTIMATE = 139.07
LOG-LIKELIHOOD FUNCTION= -1132.1372
SQUARED CORRELATION BETWEEN OBSERVED AND EXPECTED VALUES = 0.061098

All variables had the same sign as for the mail surveys (see chapter 5.2.2.). However, several variables were insignificant for the personal interviews. The variable TIMESHAWK was positive as but insignificant for the interviews. This might indicate that respondents did perceive a difference between the phrasing of the WTP questions in mail surveys and in-person interviews.

To test whether respondents' WTP bids differ systematically with the phrasing of the WTP question or with the presence of an interviewer, a likelihood ratio test was

[1]* significant at the 0.1 level
** significant at the 0.05 level

performed.[2] This procedure tests the null hypothesis that the coefficients in the regression equations for personal interviews and mail surveys are equal. A regression is run for the pooled data of both interview and mail survey responses to obtain the log-likelihood value for the restricted model. A test statistic equal to two times the difference between the sum of the log-likelihood values of the unrestricted models and the log-likelihood value of the pooled model is calculated. This test statistic follows the Chi-square distribution. The degrees of freedom are equal to the number of independent variables (including the constant term) plus 1 (for the standard error of the estimate estimated in the tobit model). If the test statistic is greater than the corresponding value from the Chi-square table, we can reject the null hypothesis. We failed to reject the hypothesis that the coefficients are equal across personal interviews and mail surveys at the five percent level. The results indicate that the sample of non-resident visitors did not seem to answer the two WTP questions in a systematically different way. However, the percentage of protest and valid zeros was significantly higher in the mail surveys than in the personal interviews (see Appendix D for more details and possible explanations).

Benefit Transfer with personal interview data and unrestricted sample

The benefit transfer analysis reported in section 5.3.2 is based on mail survey data

[2]Unfortunately, the design of the experiment does not allow us to determine whether differences in WTP bids are due to the different phrasings of the WTP question or to differences between personal interviews and mail surveys (see Mannesto and Loomis [1991] for an analysis of differences between mail and in-person surveys).

for the San Pedro RNCA and the exclusion of non-birders from the San Pedro sample. In addition, the reliability of benefit transfer between the Arizona sites was analyzed using the data on all recreationists, and also using data from the personal interviews, both for the restricted and the unrestricted sample. The results are shown in tables E.8. to E.11.

The results are very similar to those reported in chapter 5.3.2. Independent of the version of the San Pedro data used, the WTP estimate obtained through benefit function transfer was found not to be statistically different from the site-specific tobit prediction. An interesting side aspect is that not only does statistical equality of coefficients not imply statistical equality of the benefit estimates (Downing and Ozuna, 1994), but statistical inequality of the regression coefficients does not imply statistical inequality of the WTP measures either. This can be seen from the benefit transfer between in-person survey data for all San Pedro respondents and the Ramsey Canyon data. The lowest percentage error in the WTP estimate for Ramsey Canyon was obtained by using the San Pedro data from the mail surveys and including all visitors. This is interesting since one would usually expect benefit transfer to work best the more similar the populations at the study site and the policy site are. However, the Ramsey Canyon data worked best (in terms of percentage errors) in predicting mail survey responses of those San Pedro visitors who came for birdwatching (see section 5.3.2). Moreover, the restricted sample of only birdwatchers resulted in lower percentage errors for both sites when the in-person survey data for the San Pedro RNCA was used. In general, all benefit function transfers resulted in fairly small biases (below 6 percent with the exception of 1 case) independent of the phrasing of the CVM question, the presence of an interviewer and the inclusion of non-birders. By contrast, the simple transfer of the study site estimate resulted in percentage errors that were 3 to 35 times as large as those from benefit function transfer. The hypothesis of the equality of the site-specific tobit prediction and the study site estimate was clearly rejected in 6 out of 8 cases (including the two reported in section 5.3.2), and results were ambiguous in the other two cases. This confirms the general belief that benefit function transfer is to be preferred over the simple transfer of the study site estimate.

If we believe that the correct measure of WTP is given by the actual sample mean, benefit function transfer as well as simple transfer of the study site prediction yielded confidence intervals which contained the sample mean WTP from the Ramsey Canyon data. However, neither method of benefit transfer was reliable for the estimation of the mean WTP of San Pedro respondents. Moreover, percentage errors were fairly large for both sites: above 27 percent for all estimates for the San Pedro RNCA, and above 13 percent for Ramsey Canyon as the policy site. In 6 out of 8 cases benefit function transfer resulted in smaller biases than the simple transfer of the study site estimate.

Generally, benefit transfer led to overestimation of the WTP of San Pedro RNCA visitors in 31 out of 32 cases, while no clear direction of the bias from benefit transfer could be determined for the Ramsey Canyon estimate.

TABLE E.8, Regression Coefficients (and T-Statistics) for Arizona Data as used in benefit transfer Analysis

	San Pedro/ Mail Surveys	San Pedro /In-person	
	All respondents	All respondents	Only birders
INCOME	0.73942E-05 (1.6092)	0.11481E-05 (0.26542)	-0.77568E-07 (-0.01528)
INCSQ	-0.19843E-10 (-1.2121)	0.34678E-11 (0.22156)	0.59381E-11 (0.33707)
LNAGE	-0.66455 (-2.2053)	-0.39983 (-1.4005)	-0.88498 (-2.5424)
EDUCATIO	0.70463E-01 (2.0593)	0.43349E-01 (1.3834)	0.44271E-01 (1.2127)
TRIPNUM	0.13986 (1.4067)	0.26353E-01 (0.28436)	0.60511E-01 (0.51595)
TRIPSQ	-0.13859E-01 (-1.2307)	-0.48400E-02 (-0.44486)	-0.77793E-02 (-0.45514)
FOREIGN	-0.80491E-01 (-0.24588)	-0.64856E-01 (-0.20544)	-0.60601E-01 (-0.18048)
MAINREAS	0.42689 (2.1842)	0.30536 (1.6604)	0.20170 (1.0016)
CONSTANT	1.3231 (0.95046)	1.1897 (0.89161)	3.1252 (1.9472)
σ	148.27	139.17	150.34

TABLE E.9, Actual Means, Predicted WTP, and 95 Percent Confidence Intervals for the Arizona Data

Study Site	Policy Site	Version	WTP_{pm}	$WTP_{p\|p}$	$CI_{p\|p}$	$WTP_{p\|s}$	$CI_{p\|s}$
Ramsey	San Pedro	Mail; all respon-dents	101.10	122.01	106.75;137.27	117.96	87.16;148.75
San Pedro	Ramsey		68.78	89.69	73.11;106.28	100.33	78.95;121.71
Ramsey	San Pedro	In-person; all respon-dents	101.10	122.01	106.75;137.27	114.48	87.22;141.73
San Pedro	Ramsey		74.78	97.19	81.43;112.96	100.36	79.19;121.53
Ramsey	San Pedro	In-person; only birders	101.10	122.01	106.75;137.27	115.09	84.32;145.87
San Pedro	Ramsey		79.58	104.31	85.04;123.59	101.62	80.82;122.43

TABLE E.10, Results of Hypothesis Tests Regarding the Convergent Validity of Benefit Transfer[3]

Policy Site	Study Site	Version	$\beta_p = \beta_s$	$WTP_{p\|s} \in CI_{p\|p}$	$WTP_{p\|p} \in CI_{p\|s}$	$WTP_{s\|s} \in CI_{p\|p}$	$WTP_{p\|p} \in CI_{s\|s}$	$WTP_{pm} \in CI_{p\|s}$	$WTP_{pm} \in CI_{s\|s}$
Ramsey	SP	Mail; all respondents	YES	YES	YES	NO	NO	YES	YES
SP	Ramsey			YES	YES	NO	NO	NO	NO
Ramsey	SP	In-person; all respondents	NO[4]	YES	YES	NO	NO	YES	YES
SP	Ramsey			YES	YES	NO	NO	NO	NO
Ramsey	SP	In-person; only birders	YES	YES	YES	NO	YES	YES	YES
SP	Ramsey			YES	YES	YES	NO	NO	NO

TABLE E.11, Percentage Errors Resulting from Benefit Transfer

Policy Site	Study Site	Version	$WTP_{p\|p}$ vs. $WTP_{p\|s}$	WTP_{pm} vs. $WTP_{p\|s}$	$WTP_{p\|p}$ vs. $WTP_{s\|s}$	WTP_{pm} vs. WTP_{sm}
Ramsey	San Pedro	Mail; all respondents	-3.3%	+16.7%	-26.5%	-32.0%
San Pedro	Ramsey		+11.9%	+45.9%	+36.0	+47.0%
Ramsey	San Pedro	In-person; all respondents	-6.2%	+13.2%	-20.3%	-26.0%
San Pedro	Ramsey		+3.3%	+34.2%	+25.5%	+35.2%
Ramsey	San Pedro	In-person; birders only	-5.7%	+13.8%	-14.5%	-21.3%
San Pedro	Ramsey		-2.6%	+27.7%	+17.0%	+27.0%

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[3]YES stands for failure to reject and NO for refection of the null hypothesis at the 5 per cent level.

[4] However, at the 1 per cent level the hypothesis was failed to reject.

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