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RECREATIONAL DEMAND FOR TREES IN NATIONAL FORESTS[1]

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INTRODUCTION

In the past decade, an extensive body of literature has developed assessing the accuracy of the contingent valuation method (CVM) of estimating individual willingness to pay for the recreational use of environmental resources. Initial results were challenged on the grounds that what people say they are willing to pay contingent on the availability of an environmental resource represent behavioral intentions rather than a directly observable action or historical fact. More recently, the relationship between intentions and actual behavior has been submitted to systematic empirical investigation. Despite some continuing controversies and unsettled points, CVM studies of the recreational benefits of familiar environmental resources have performed reasonably well when compared to the available empirical evidence from travel behavior, actual cash transactions, and controlled laboratory experiments (Cummings, et al., 1986).[2] Levels of accuracy have been reasonable and consistent with levels obtained in other areas of economics and in other disciplines.

The task remains to discover how far these results can be generalized. The importance of continued research is illustrated by the conceptual and empirical difficulties associated with their estimation and the potential importance of recreation benefits in the economic assessment of environmental protection programs, such as forest management (Calish, et al., 1978). Foresters face important problems of evaluating recreation opportunities in a way that will allow comparisons with their economic costs. The problem is especially acute at many forest recreation sites where it would be useful to determine how much recreation users value specific levels of forest quality in order to improve managerial decisions relating benefits to costs of alternative forest management practices.

The CVM is by far the most important tool that we have to decide these questions. The approach has been recommended as providing an acceptable measure of the economic value of recreation opportunities and resources. The interagency committee, the U.S. Water Resources Council (1979 and 1983), specifically authorized use of the CVM for application to environmental quality problems. Since the method represents the most likely path of new empirical research, efforts to clarify several potential problems with the approach and to assess its accuracy will be of continuing interest.

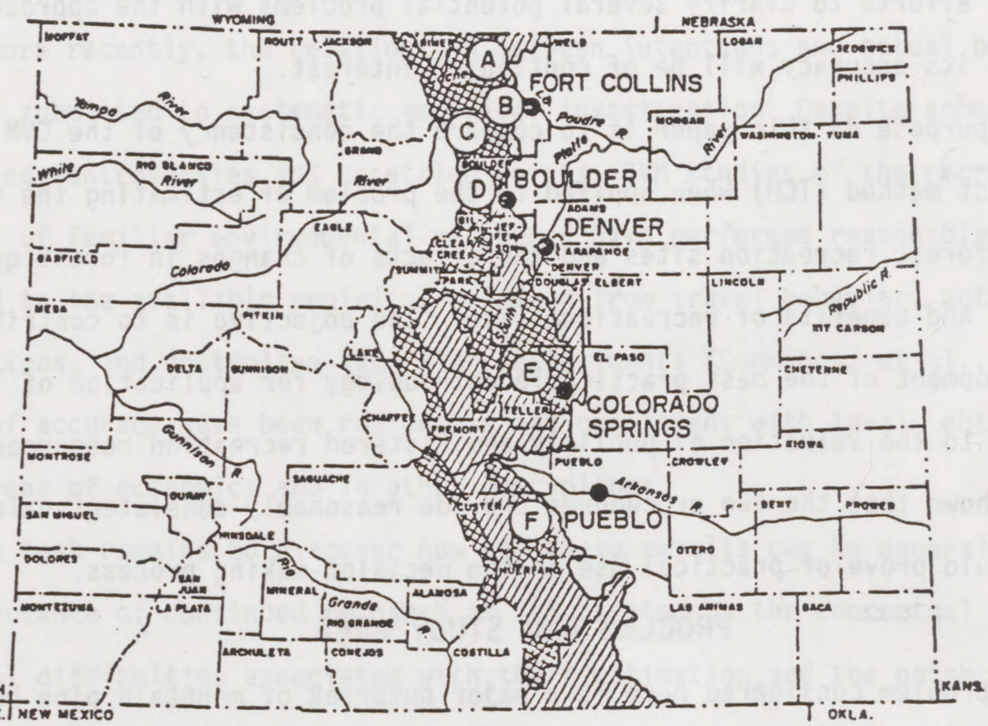
The purpose of this paper is to compare the consistency of the CVM and travel cost method (TCM) when applied to the problem of estimating the value of existing forest recreation sites and the effects of changes in forest quality on demand and benefits of recreational use. The objective is to contribute to the development of the best practicable methodology for application of economics to the valuation of publicly administered recreation resources. It will be shown that the two procedures provide reasonably consistent values which should prove of practical use in the decision-making process.

PROBLEM AND STUDY AREA

The problem considered here is a major outbreak of mountain pine beetles on two million acres of mixed age ponderosa pine in the front range of the Colorado Rocky Mountains (Figure 1). As a result, approximately 15 percent of the trees have been killed at forest recreation sites. Moreover, it has been projected that in the next 10 years, 30 percent of the lodgepole pine at recreation sites on the west slope of the state will be lost to insect infestation. Similar estimates have been made of douglas fir loss to spruce budworm. This problem is not limited to the Rocky Mountains. The pine beetle, spruce budworm, gypsy moth, and other insects have caused extensive damage to forests throughout the United States, particularly in the northwest,

FIGURE 1

Front Range Study Areas, Rocky Mountains, Colorado[a]



a. The front range is shown as the shaded area. The Roosevelt National Forest, part of Arapaho National Forest, Pike National Forest, and Isabel National Forest are shown as the cross-hatched areas. Study sites are identified A-F.

northeast, and south. Nations around the world face similar problems of how much they can afford to pay for the protection of forests from insect pests and other hazards such as acid rain (Crocker, 1985) and wildfire (Vaux, et al., 1984). In addition to the loss of merchantable timber, forest management decisions require knowledge of the loss of aesthetic benefits from trees to visitors at forest recreation sites.

When mountain pine beetles attack and kill ponderosa pine trees, discoloration of needles and dead and down trees detract from the aesthetic beauty of the forest in the short-run. As the dead and down trees are removed or decay, the long-run effect is to reduce the density of the stand of live trees and thus change the quality of the forest. Once the dead trees are removed, it is likely that most first-time visitors to a recreation site will be unaware that a beetle attack ever occurred in the area. The possibility remains, however, that in a forest with fewer trees, persons who would use the site for recreation without the damage may use it less or not at all after the beetle attack. The recreation value and thus the demand for recreation use of the site may be a function of tree density.

The case considered here is the recreation use of the Arapaho, Roosevelt, Pike, and San Isabel National Forests located along the front range of the Rocky Mountains of Colorado. The forests represent an area of nearly 3.2 million acres extending along the east side of the Rocky Mountains the length of the state from approximately 6,000 feet in elevation to the continental divide with peaks over 14,000 feet. Ponderosa pine is common in mixed stands from 6,000 to 8,000 feet elevation.

These forests were selected because they are among the most intensively used and are subject to deteriorating forest quality. In 1980, the agency recorded a total of 8.8 million recreation visitor days (RVD) at front range forests, equal to nearly 1,800 RVDs per square mile, 2.3 times the recreation use of forests nationwide. This reflects the fact that front range forests provide the two million residents of the state's metropolitan areas an opportunity to obtain a forest recreation experience within 1-3 hours drive from their homes. From 1970 to 1980, compound annual growth in recreation use of front range forests averaged 7.4 percent, 1.5 times the 4 to 5 percent rate elsewhere in the system. The rapid growth in demand for recreational services has encouraged public policies to maintain forest quality.

RESEARCH PROCEDURE

Six study sites were selected by the funding agency to represent the range of insect infestation of ponderosa pine forest at recreation sites in the front range. Study sites were designated to encompass the types of recreation within a 10 mile radius of: (A) Lory State Park, 70 miles north of Denver; (B) Red Feather Lakes, 120 miles northwest; (C) Estes Park, 70 miles northwest; (D) Nederland, 45 miles west; (E) Woodland Park, 70 miles southwest, and (F) Lake Isabelle, 150 miles southwest, as shown in Figure 1.

CONTINGENT VALUATION METHOD

The basic economic data were obtained from on-site interviews with a sample of 435 recreation users. Interviews were conducted on random days in the summer of 1980. Since most of the recreation uses affected by forest quality occur during the summer season, the stratified random sample was selected to represent the range of summer recreation uses of the study area including: developed camping, semi-developed camping, backpacking, hiking, fishing, picnicking, driving off-road vehicles, and staying at resorts. Summer activities account for two-thirds of total annual use. The most important activity omitted was hunting in the fall, representing about 5 to 10 percent of total annual use.

The questionnaire was pretested and designed to be completed in less than 30 minutes to minimize inconvenience and respondent fatigue. The survey was administered by four trained interviewers who were graduates of the University program in natural resource economics with previous experience interviewing recreation users of front range forests. Name tags identified them as employees of the University to establish the legitimate scientific purpose of the study. Less than 5 percent of those approached refused to participate in the survey.

The assessment of the CVM by Cummings, et al., (1986) concluded that several reference operation conditions should be met if the approach is to provide reasonably accurate measures of the recreation use value of changes in environmental resources. Respondents who are asked willingness to pay questions should understand the resource to be valued, have had prior experience valuing it and choosing levels of quality to consume under conditions of little uncertainty. There is reason to believe that these conditions are present in this study.

The survey was introduced as a scientific experiment administered to a representative sample of users whose answers may affect forest quality programs. Individuals were assured their answers would be confidential. They were provided information about the deterioration of forest quality at recreation sites and informed that this is likely to continue in the future without an effective forest quality program. They were shown color photos of trees with discolored needles from insect infestation, and of recreation sites with varying numbers of surviving trees.

The interviews began with questions about individual preferences for trees on recreation sites and their importance relative to other resources such as rock outcroppings, nearness to rivers and lakes, topography, and the rocky mountain view. Fully 95 percent reported that forest quality is important to the recreation experience. When preference variables were ranked on a 5-point scale of importance, 85 percent reported that trees are very important on recreation sites compared to 76 percent on adjacent property in the near view, and 68 percent in the far view. Fifty-one percent rated trees more important than view of the mountains, 48 percent more important than rock outcroppings, 44 percent more important than topography, and 35 percent more important than nearness to rivers and lakes. Trees were rated of equal importance to these site quality variables by about 30 to 45 percent of the sample. The replies indicate that they had experience valuing choices with respect to levels of forest quality at the study sites. They took an average of 3.2 trips per year to the study sites averaging 2.7 days each. They generally were knowledgeable of forest quality related to their recreation trip destinations. Uncertainty clearly played a negligible role in this study.

The payment vehicle was selected because it corresponds with how people actually pay for forest quality when they select a recreation site with a previously known or observable tree density. They may take more trips, travel greater distance, and increase their stay at sites with the preferred number of trees. They have had considerable prior experience in paying additional travel cost to obtain access to recreation sites with preferred forest quality. They were asked to assume that payment of trip expenses would be the only way to assure themselves of a desired recreation experience, as affected by forest quality. About 4 percent of the respondents rejected the payment vehicle, and were removed from the analysis.

Respondents were asked to report annual participation and total direct trip costs for transportation (gas, oil, and maintenance), added food, lodging, entrance fees, etc. for the current trip to the site. Then, they were asked to estimate the maximum amount they would be willing to pay rather than forego the recreation experience. The question was: What is the maximum you would pay per trip? Would you pay (an average of) $__ per trip to continue coming to this area __ times per year (the number of trips you usually make to this site?). Direct costs actually paid were subtracted from willingness to pay resulting in an approximation of net benefits, e.g. the area below the demand curve and above direct cost or price.

An iterative technique recommended by the federal guidelines was utilized to encourage respondents to report maximum values, representing the point of indifference between having the amount of income stated or the level of environmental quality. They answered "yes" or "no" to increases in direct trip costs and days until maximum willingness to pay and to participate were identified. Distribution of the values appeared to be consistent with the expectation of little or no strategic bias of the study results.

The anchor or reference point with respect to change in forest quality was the level experienced on the day of the interview. Respondents reported their perceptions of forest quality at the study sites by identifying which of 6 photos most closely approximated the number of trees per acre 6 inches diameter breast height (dbh) or more. The photos showed: no trees, 20-40, 60-80, 100-120, 140-160, and 200-300 trees per acre. Information was provided as to density, including the number of trees per acre and average distance between trees shown in each photo. This base case was recorded as one of four observations of willingness to pay, to participate, and number of trees per acre. From this starting point, respondents estimated changes in willingness to pay and to participate contingent on 3 hypothetical changes in the number of trees per acre. Values were obtained from each respondent for low, medium, and high tree density as depicted in the color photos.

The answers to these questions represent four points on total bid functions for each individual where willingness to participate and to pay are functions of forest density, income, and other socioeconomic variables as in the Seller, et al., (1984) study of boating in Texas. The functions are estimated using the quadratic functional form with linear and squared terms for forest density. The reduced equations are shown below.

<u>Willingness to Participate</u>

$$DAYS = 10.78 + \underset{(2.77)}{0.0826T} - \underset{(-2.35)}{0.0002T^2} \qquad R^2 = 0.76$$

<u>Willingness to Pay</u>

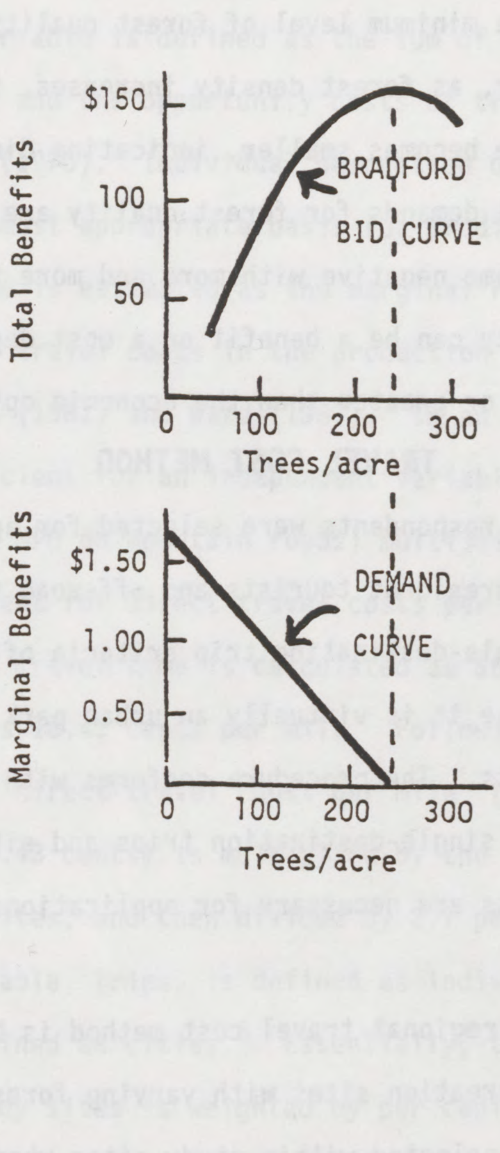
$$WTP = -1.32 + \underset{(4.02)}{0.0767T} - \underset{(-2.39)}{0.00015T^2} \qquad R^2 = 0.51$$

Where WTP = net willingness to pay or benefits per day (dollars); DAYS = annual participation at the study site; and T = number of trees per acre (6 inches dbh or greater). The t-ratios are shown in parentheses below the coefficients.

The regression coefficients for tree density indicate the effect on demand and benefits, with other variables held constant. Tree density is highly significant at the 0.01 level, as indicated by the t-statistics. The complete equations (in Walsh and Olienyk, 1981) include several social and economic variables (income, substitution, site attributes, preferences, etc. which are held constant). The overall equations are significant at the 0.01 level and explain 51 to 76 percent of the variation in willingness to pay and to participate. This is considered a satisfactory level of explanation with data from a cross-sectional survey of individual consumers.

FIGURE 2

TOTAL AND MARGINAL BENEFITS OF FOREST QUALITY PER USER



The upper panel of Figure 2 illustrates the Bradford-type (1970) total benefit function when the willingness to participate and to pay functions are combined. The lower panel shows the changes in total benefits resulting from changes in the amount of forest quality protected. The first derivative of the total benefit function represents the demand curve for forest quality. The demand curve shows that individuals are willing to pay a great deal for a program which protects a minimum level of forest quality due to the scarcity value of trees. However, as forest density increases, the willingness to pay for each additional tree becomes smaller, indicating diminishing marginal benefits. As individual demands for forest quality are fully satisfied, benefits eventually become negative with more and more trees. Clearly, changes in forest density can be a benefit or a cost depending on whether the current stock is lesser or greater than the economic optimum.

TRAVEL COST METHOD

A subsample of 220 respondents were selected for application of the travel cost method. Nonresident tourists and off-road vehicle users were removed to meet the single-destination trip criteria of the method. One study site was excluded because it is virtually an urban park with insufficient variation in travel costs. The procedure conforms with recommendations of the federal guidelines that single-destination trips and sites with sufficient variation in travel costs are necessary for applications of the travel cost method.[3]

Application of the regional travel cost method is based on interviews at a cross-section of 5 recreation sites with varying forest quality. Interview locations were randomly selected within study sites where there are many possible locations to engage in each activity.[4] Respondents were asked to identify the tree density clearly observable at the interview locations.

Since there is sufficient range in tree density experienced by individuals, its effect can be estimated statistically in the demand function. The regression coefficient for tree density indicates the effect on demand and benefits, with other variables held constant. In multiple regressions, it is possible to hold the effects of other site attributes constant so they are not mixed in with the tree density variable (Loomis, et al., 1986a).

The travel cost variable is defined as the sum of direct trip costs reported by respondents and the opportunity costs of travel time, as suggested by Cesario and Knetsch (1970). Individual perception of travel costs actually paid is considered the most appropriate basis for predicting travel behavior. The value of travel time is estimated as the marginal rate of substitution between travel time and travel costs in the production of recreation trips, as in McConnell and Strand (1981) and Ward (1983). In an individual trip equation (not shown), the coefficient for an independent variable specified as round-trip travel time (at 40 MPH on mountain roads) multiplied by hourly income is divided by the coefficient for direct travel costs per trip. On this basis, the opportunity cost of travel time is calculated as $6.57 per hour which divided by 40 MPH equals 16.43 cents per mile. Following the federal guidelines, the sum of direct travel cost per mile (averaging 26 cents) and estimated time cost (16.43 cents) is multiplied by the round-trip miles traveled to the study sites, and then divided by 2.7 persons per vehicle.

The dependent variable, trips, is defined as individual trips per capita from distance zones defined as cities.[5] Essentially, the individual's own demand for trips to study sites is weighted by per capita participation in their zones of origin. The number of trips by each individual is divided by a proportion of population. For example, where 10 individuals come from a particular city, the number of trips by each individual is divided by onetenth of population in 1,000s. This specification, suggested by Brown, et al., (1983), has the advantage of combining both the number of trips per individual and the probability of participation into a single measure while avoiding a problem of the standard zonal approach which averages the socioeconomic characteristics of individuals from origin zones, resulting in a loss of sensitivity to important determinants of demand (Ward and Loomis, 1986). When the individual per capita variable is averaged across all visitors from an origin zone, the result is the standard zonal average visits per capita.

The TCM model is specified in two ways to test the sensitivity of the approach to alternative assumptions as to consumer choice. Ordinary least-squares (OLS) statistical demand functions recommended by the federal guidelines assume that individuals choose the number of trips to a recreation site in response to out-of-pocket and time cost of travel, which is not subject to individual choice. On the other hand, the two-stage least-squares (2SLS) procedure introduced here allows three things -- number of trips, length of stay, and travel cost -- to be choice variables.

The 2SLS procedure is based on recent theoretical work suggesting that quality of the recreation experience can be produced by individuals varying their travel cost and length of stay as well as number of trips to a forest recreation site (Bockstael and McConnell, 1981; Ward, 1984). The 2SLS approach is preferred over OLS because it facilitates estimation of the consumer surplus associated with all three variables when the stock of trees at a recreation site changes. In the first stage, three equations are estimated separately for number of trips, length of stay, and travel cost. In the second stage travel cost equation the independent variables, number of trips and length of stay, are predicted values from the first stage equations. Likewise, in the second stage equations for number of trips and length of stay the independent variable, travel cost, is a predicted value from the first stage. Table 1 shows these three second stage equations, and the OLS equations for purpose of comparison.

Data for the sample of 220 individuals visiting the 5 sites are pooled for efficiency of analysis. Categorical variables for each site (S) and recreation activity (A) are included in the demand functions to account for heterogeneity across sites and to allow their unique characteristics to shift the demand functions. The forest quality variable, square root of trees per acre (T 1/2), is consistent with the expectation of diminishing marginal effects of increased tree density on willingness to pay and visitation to the study sites. The substitution variable (E2) indicates that annual days of recreation at other sites is positively related with travel costs and site time at study sites.[6] Income (Y) is significant and positively related to travel cost as expected, however, it is negatively related to individual trips per capita. Apparently, residents with lower income realize some economies of scale in the use of forest recreation sites. The positive relationship between travel cost and site time indicates that higher travel costs tend to be spread over more days on site. Taste and preference variables are included to account for the psychological importance of trees on site (P1) to shift the demand function for trips.

The 2SLS estimates a demand system to overcome the well-known statistical problem of biased and inconsistent parameter estimates of OLS. The second stage uses predicted values to purge visit rates, travel cost, and onsite time of the component correlated with each disturbance term. Although the procedure yields estimates which are also biased, they are consistent. The regression coefficients generate asymptotic standard errors which are used to construct t-tests of statistical significance, shown in parentheses. While

TABLE 1

Regression Results for the 2SLS and OLS Models of TCM[a]

Two-Stage Least-Squares

(1) Travel Cost

$$TC = 2.47 - \underset{(-2.16)}{15.29V} + \underset{(4.39)}{7.33D} + \underset{(1.81)}{6.01Y} + \underset{(2.28)}{2.80E2} + \underset{(1.60)}{0.65T^{1/2}} + \underset{(2.96)}{10.32A2} - \underset{(-2.25)}{7.87A5} + \underset{(3.20)}{12.78S6}$$

(2) Onsite Time

$$D = 1.39 + \underset{(3.63)}{0.04TC} + \underset{(2.06)}{0.02P2} - \underset{(-3.86)}{0.92A5} - \underset{(-4.62)}{1.19A6} + \underset{(2.64)}{0.82S1}$$

(3) Trips

$$V = 0.0743 - \underset{(-2.70)}{0.0076TC} + \underset{(2.23)}{0.0186T^{1/2}} + \underset{(2.10)}{0.0719P1} - \underset{(-2.64)}{0.002E1} - \underset{(-2.14)}{0.0028Y} + \underset{(4.07)}{0.0084P2} - \underset{(-1.43)}{0.1023A2} + \underset{(1.35)}{0.1040A5} - \underset{(-2.04)}{0.1508S5}$$

Ordinary Least-Squares[b]

(4) Trips

$$V = 0.070 - \underset{(-5.56)}{0.0067TC} + \underset{(2.41)}{0.0175T^{1/2}} + \underset{(2.19)}{0.0703P1} - \underset{(-2.95)}{0.0002E1} - \underset{(-2.87)}{0.0028Y} + \underset{(4.35)}{0.0085P2} - \underset{(-1.48)}{0.1007A2} - \underset{(-1.37)}{0.0966A5} - \underset{(-2.15)}{0.1508S5}$$

a. Where V = individual trips per capita to the study site; TC = sum of direct travel cost and estimated time cost per trip; D = number of days on site per trip; $T^{1/2}$ = square root of the number of trees per acre on-site; Y = household income in $1,000s; E1 = city of residence, population in 1,000s; E2 = annual days of recreation at other sites; P1 = importance of trees on-site, 1-5 scale; P2 = annual days of primary recreation activity at all sites; P3 = does tree density on-site affect recreation satisfaction, categorical 0-1 variable; A2 = recreational activity, semi-developed camping; A5 = fishing; A6 = picnicking; S1 study site, Red Feather Lakes; S5 = Woodland Park; S6 = San Isabel Lake. The t-statistics are shown in parentheses.

b. Shown for comparative purposes, the OLS equation explains 29 percent of the variation in number of trips per capita as indicated by R^2 adjusted for degrees of freedom. The overall equation is significant at the 0.01 level with an F value of 9.5. The t-statistics shown in parentheses indicate that the travel cost, tree density, income, preference, and population coefficients are significant at the 0.01 percent level using two-tailed tests.

these tests apply only asymptotically, the relatively large sample suggests that the t-values are usable for tests of significance. The general order condition of identification (Intriligator, 1978, p. 348) shows that the trip equation is just identified, while the travel cost and the site time equations are over identified.

COMPARISON OF RESULTS

Willingness to pay for the recreation use of existing sites should be approximately the same for both methods since they yield similar though not identical demand curves. The TCM estimates an ordinary Marshallian demand curve while the CVM estimates a Hicksian compensated demand curve. Both approaches specify that benefits are a function of the number of trips and the quality of experience at recreation sites, which are separable in consumption and subject to a budget constraint. If the specification of travel cost, quantity, and other variables are the same, theory suggests that there should be no statistically significant difference between values obtained by the two methods.

The data show that the CVM value is within the range of values for the alternative TCM models.[7] Holding tree density at its mean of 176.7 trees per acre, average benefits per trip are estimated as:

CVM	$20.80
TCM, OLS	$22.59
TCM, 2SLS	$17.72

On this basis, we cannot reject the hypothesis that the willingness to pay for the recreation use of existing sites estimated by the two methods are approximately equal. We conclude that the CVM can provide as close an approximation of the recreational economic welfare effects of forest recreation as the behavior based TCM.

Usually, managers are interested in changes in total benefits for comparison with changes in total costs of forest protection programs.

Comparison of the effects of changes in tree density on total benefit estimates can be made at two levels. Differences in total benefits can arise from differences in benefits per trip and in annual use. Table 2 compares estimates of benefits and use of front range forests from the two different TCM approaches as well as from CVM.

CVM estimates of the effect of tree density tend to be lower than TCM estimates for number of trips and higher for benefits per trip. These differences tend to offset each other when combined to estimate the total benefits foregone with a loss in the range of 10 to 30 percent of existing trees. Within this relevant range of decision-making, we cannot reject the

TABLE 2

Comparison of CVM and TCM Estimates

of Recreation Damages from Changes in Tree Density

Method	Percentage of Existing Trees Lost		
	10%	20%	30%
		(Damages in Percent)	
Number of Trips			
CVM[a]	1.5	3.5	6.2
TCM, OLS	3.5	6.5	9.5
TCM, 2SLS	4.1	7.6	10.9
Benefits per Trip			
CVM[a]	6.1	13.8	22.3
TCM, OLS	3.9	7.8	11.7
TCM, 2SLS	4.6	9.1	13.8
Total Benefits			
CVM[a]	7.5	16.8	27.1
TCM, OLS	7.2	13.9	20.3
TCM, 2SLS	8.5	16.1	23.2

a. The 95 percent confidence limit of the CVM estimate is approximately $\pm$ 40 percent.

hypothesis that the recreation benefit functions for tree density estimated by the two methods are equal. For example with a 20 percent loss of trees, the CVM estimate of the loss of benefits is 16.8 percent compared to the 2SLS TCM estimate of 16.1 percent. By comparison, the OLS TCM estimate is somewhat lower at 13.9 percent. We conclude that the CVM can provide as close an approximation of the recreational economic welfare effects of forest quality.

These results are supported by the growing body of economic literature on the recreational demand for forest quality throughout the United States. Moeller, et al., (1977) survey homeowners and recreation site managers who estimate a 12 to 52 percent reduction in recreation demand resulting from gypsy moth infestation in northeastern U.S. forests.

Michaelson (1975) applies the individual TCM to estimate the effect of mountain pine beetle damage to ponderosa pine as $2.65 per visitor day at six campgrounds in the Targhee National Forest in Idaho. The average elasticity of demand with respect to trees is calculated as 0.27.

Leuscher and Young (1978) apply the zonal TCM to estimate the effect of southern pine beetle damage to ponderosa pine on demand for recreation use of 19 campgrounds located on the shore of two reservoirs in Texas. Elasticity of demand with respect to trees is estimated as 0.64 to 0.68.

Wilman (1984) applies a hedonic TCM model to estimate the economic value to deer hunters from pine beetle damage to ponderosa in the Black Hills National Forest, South Dakota. Hunter success is a function of improved wildlife habitat resulting from the dead and down trees creating small open areas in the forest. Apparently, optimum forest density is less for deer hunting in the fall than for most summer recreation activities.

A study by Crocker (1985) employs CVM to estimate the economic value to recreation users of acid rain damage to ponderosa and jeffrey pine trees in the San Bernardino National Forest, located within 80 miles of Los Angeles.

Brookshire and Coursey (1987) compare CVM estimates of willingness to pay for additional trees and to accept compensation for fewer trees at a proposed neighborhood park serving a 1-square mile residential area in Colorado. After three iterations, willingness to pay is not significantly different from willingness to accept compensation. This supports the use of willingness to pay questions in CVM studies of forest quality.

In addition to the recreation use values reported in these studies, the general population, including recreation users and nonusers, may value the protection of forest quality (Aiken, 1985; Walsh, 1986). A sample of households in Colorado report they are willing to pay an average of $47 per year to protect forest quality in the state with recreation use value representing only 27 percent. Apparently, the public also is willing to pay for the option of recreation use in the future, the knowledge that it exists and is protected, and the satisfaction from its bequest to future generations. For this reason it seems that the estimates of recreation user demand and benefits of forest quality may represent a conservative estimate of its total value to society.

CONCLUSIONS

This paper addressed the problem of estimating the effects of forest quality on demand and benefits of recreation use. Alternative contingent valuation and travel cost procedures were applied to determine the sensitivity of the estimates to the choice of method. Specifically, we allowed respondents to adjust frequency of visits and value estimates simultaneously. It was shown that results vary depending upon the choice of one or the other or both models to use in the analysis. Apparently, a single CVM question or TCM equation may be incomplete as an estimate of value.

Second, when compared to the 2SLS TCM total benefit estimate, the CVM estimate that combines demand and benefit effects is not significantly different. Within the relevant range of decision-making, we cannot reject the hypothesis that the recreation benefit functions for tree density estimated by the two methods are equal. We conclude that the CVM can provide as close an approximation of the economic welfare effects of forest quality on recreation use.

These results are consistent with the findings of previous research on similar problems of environmental quality. A recent assessment of the state of the art by Cummings, et al., (1986) concludes that CVM willingness to pay values are likely to be comparable to TCM values when, as in this case, respondents are familiar with the resource, have prior experience valuing it, and face little uncertainty.

The values reported here should be considered first approximations subject to improvement with further research. Desvousges, et al., (1983) caution that neither approach provides the actual benefits associated with environmental quality. Both are estimates that are limited by their respective assumptions. It is important to acknowledge that judgement affects both approaches: in the questionnaire design and data analysis with the CVM and in the selection of a model specification for the TCM.

The estimates are sufficiently reliable, nonetheless, to demonstrate that the recreation use value of programs to protect forest quality would represent a substantial contribution to the present value of benefits from commercial timber production. Without information on the willingness to pay for recreation use values, insufficient resources would be allocated to the protection of forest quality. It is proposed that the benefit estimation procedures of federal agencies be enlarged to consider recreation use values of forest quality programs. Further research is recommended to test the general application of the methods.[8]

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FOOTNOTES

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2. Previously published studies comparing the consistency of recreation values estimated by alternative methods have generally obtained similar results. The CVM and TCM provide consistent estimates of the benefits of fishing, hunting, and camping trips to forest recreation sites in Maine (Davis and Knetsch 1966), multi-destination trips to national parks in the Southwest (Haspel and Johnson 1981), the recreation use value of water quality in the Northwest (Sutherland 1983) and in the Monongahela River, Pennsylvania (Desvousges, et al., 1983), and boating access to four reservoirs in east Texas (Seller, et al., 1984). The contingent valuation estimate of willingness to pay for goose hunting permits at the Horicon Marsh in Wisconsin are midway between the range of values derived from the travel cost method with travel time valued at 0, 25, and 50 percent of the wage rate (Bishop and Heberlein, 1979). Intended willingness to pay for deer hunting permits at the Sandhills Wildlife study area in Wisconsin are not significantly different from actual payment of cash in sealed bid auctions and referendum-type field experiments (Heberlein and Bishop, 1985). These results are supported by more than 60 studies of the value of 15 forest recreation activities throughout the U.S. (Sorg and Loomis, 1984). Adjusted for inflation, the average value per recreation day for one-third of the studies applying the contingent valuation method are within 25 percent of the average for two-thirds of the studies using the travel cost method. Similar results are shown for hunting and fishing in Idaho (Loomis, et al., 1986b).

3. Exclusion of nonresident tourists is expected to increase the average number of trips per year while reducing the price intercept and consumer surplus estimates. However, exclusion of the urban site B would have the opposite effect, reducing trips per year and increasing consumer surplus estimates. In addition, residents of the state tend to be more sensitive to changes in forest quality than tourists, reflecting knowledge of historic damages (Buhyoff, et al., 1982; Daniel and Vining, 1983).

4. Resource use by individuals staying overnight in campgrounds or resorts is between 1 and 2 acres, as is the case for picnickers. By comparison, fishermen use about 1 linear mile, hikers 4 miles, backpackers 6 miles, and off-road vehicle users 11 miles.

5. In addition, we tested the sensitivity of the results to alternative specification of the dependent variable, trips. We estimated the representative individual's own demand function, i.e. annual trips per individual to a study site, as suggested by Brown and Nawas (1973). The results, available on request, show that estimates of average benefits per trip are more variable, about 50 percent higher with OLS and one-third lower with 2SLS. Damages from loss of tree density at recreation sites are lower but within about 30 percent for the individual per capita OLS and 10 percent with 2SLS. This suggests that the 2SLS may partially overcome the limitations of the individual TCM.

6. With regional demand functions, the effect of substitution can be introduced by including the travel costs of trips to other sites in the equation. To test for the possibility of substitution among the 5 study sites, we estimated a visitation equation for each site in which the travel cost to reach each of the other sites is included as an independent variable. The hypothesis of a zero cross-price effect cannot be rejected by this test. In none of the 5 cases do any of the travel cost variables for other study sites prove statistically significant. Although substitutes undoubtedly exist, the 5 study sites are apparently far enough apart to represent essentially segmented markets. An alternative substitution variable is introduced representing the annual days of recreation at other sites. See Caulkins, et al., (1985).

7. The CVM value also is within the range of unit-day values recommended by the Forest Service Resource Planning (RPA) in the Rocky Mountain Region. Our CVM estimate is equivalent to $15.50 per 12-hour recreation visitor day (RVD) with on-site recreation activities averaging 6 hours per day and 2.7 days per trip.

8. Of significance here is the finding that trees throughout the forest may have aesthetic values. In addition to the number of trees onsite, respondents reported willingness to participate and to pay contingent on number of trees in the near view and far view, size of trees, visible insect damage, dead and down trees, distribution of trees, and presence of large specimen trees. For example, the price elasticity of demand for trees onsite is about 0.28 compared to 0.25 near view and 0.16 far view.