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BENEFITS & COSTS IN NATURAL RESOURCES PLANNING

INTERIM REPORT

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ACCOMPLISHMENTS AND CHALLENGES IN VALUING NONMARKETED NATURAL RESOURCES: A PROGRESS REPORT

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OBJECTIVES OF THE W-133 REGIONAL RESEARCH PROJECT

There are three objectives of the W-133 regional research project. These are:

1. Conceptually integrate market and nonmarket based valuation methods for application to land and water resource base services.
2. To develop theoretically correct methodology for considering resource quality in economic models and for assessing the marginal value of competing resource base products.
3. To apply market and nonmarket based valuation methods to specific resource base outputs.

All three objectives contribute to the regional research project's goal of improving the methodologies used in evaluating the economic efficiency of natural resource allocations. The purpose of improved methodologies is to provide more accurate information on the benefits and costs of alternative uses of natural resources to both private and public decision makers. Armed with more complete information about the values of natural resources in alternative uses, optimal allocations of these resources are more probable.

One implicit objective of all regional research projects is to facilitate development of methodology with broad multi-state applicability and to assemble a critical mass of experts working in a highly specialized field of research. As the table of contents of this report indicates, both of these goals are being attained by this W-133 project. Extension and refinement of economic theory to valuation of resource quality is as applicable to environmental quality problems in Arizona as in Washington. Laboratory experiments conducted jointly by University of Georgia and Texas A & M University add to the foundation of our understanding of the Contingent Valuation Method. Insights gained from such research is truly a public good equally applicable to all states planning to undertake Contingent Valuation

applications. In addition, several of the papers in this volume reflect the joint efforts of participants at two or more land grant universities. Such joint efforts are made possible by the funding and "networking" that the W-133 project provides.

ORGANIZATION OF THIS REPORT BY OBJECTIVE

This document is an interim report of the progress made by regional research participants and cooperators toward attainment of these three specific objectives. As such, the papers are grouped according to objectives to which they contribute. This is a difficult task since many papers reflect contributions toward two or more of the project's objectives.

The papers in this volume reflect research papers that have been presented at recent W-133 regional research meetings and/or reflect participants' research that is in process at their land grant university or research station. This in process research and preliminary results are shared in the spirit of facilitating an informed discussion on the issues surrounding such research. The authors of these contributed papers welcome comments and suggestions on their papers. Readers may address such comments to the author's address as displayed on the front of each paper.

OVERVIEW OF PAPERS AND PROJECT RELATED RESEARCH

PAPERS RELATING TO OBJECTIVE #1:

CONCEPTUAL INTEGRATION OF MARKET AND NONMARKET BASED VALUATION METHODS

Functional Form and the Statistical Properties of Welfare Estimates

by Wiktor Adamowicz (MN), Jerald Fletcher (IN) and T. Graham-Tomasi (MI).

Understanding the variance around the estimated mean value of benefits is an important component for performing sensitivity analysis in benefit cost analyses. However, little research has been preformed on the effect of functional form on the variance of welfare estimates such as consumer surplus or compensating variation. Information on the variance of the benefit estimates is needed for both marketed and nonmarketed natural resources to determine if the social values of these resource uses are statistically different.

The authors show that linear and semi-log functional forms will result in greater instability of consumer surplus estimates than will the double log functional form. Rather than pre-specifying one of these functional forms the authors develop a restricted Box-Cox form and relate it to the formula for consumer surplus.

The authors provide an empirical comparison of mean benefits and measures of dispersion around the mean benefits for bighorn sheep hunting in Alberta, Canada. A simple Travel Cost demand model is estimated in linear, semi-log, double log and linear-log functional form. The linear and semi-log models did not have statistically significant coefficients on travel cost. As is not surprising when the price coefficient is insignificant, the standard deviation of benefits around the mean is quite large. However, the double log demand equation had a t-statistic of 4.27 on the travel cost coefficient. The resulting standard deviation of benefits for this functional form is plus or

minus $200 around the sample mean value of $1608. The linear-log model's travel cost coefficient was only significant at the 10% level and had a standard deviation of benefits of $300 around a mean of $1873.

This paper provides an important broadening of the criteria by which functional form of demand equations is chosen. Besides arguing for the consistency of demand specification with utility theory, statistical criteria should be broadened from a narrow view of "best fit" to a concern for the variance as well as the mean as a performance indicator. For many economic evaluations of trade-offs between marketed and nonmarketed resources, a comparison of benefit distributions might be a more "fail safe" applied welfare criterion than simply comparing means.

Empirical Estimation of Supply in a Multicohort Fishery: Implications for Managing the Alaska King Crab Industry by Scott Matulich (WA)

Efficient resource management of a marketed natural resource is important to many different groups in society. For example, in the management of the Alaska King Crab fishery, a boom-bust cycle takes a serious toll on commercial anglers and processors. This boom-bust cycle can be significantly reduced if fishery managers set harvest regulations that account for the long (8 or more years) and complicated lags that are typical of king crab populations.

Matulich develops a "trajectory adjusted intrinsic recruitment" model for the king crab fishery in Bristol Bay. A series of biological models predicting number of legal and nonlegal crabs (by age class) are linked to a series of market models that predict harvest as a function of effort and fleet size. Abundance of legal crab effects both effort and fleet size. The exvessal price for crab is used to reflect processors' derived demand for raw crab. This exvessal price is translated into a wholesale crab price, that along with the price of substitute and disposable per capita income determines

consumer demand for crab.

The failure to use these types of integrative bio-economic models in setting fishing regulations may be a contributor to the boom-bust cycle on this billion dollar crab fishery. Matulich demonstrates that recognition of the long lag structure and the feedback effects in the market for crab is necessary for efficient management of the biological stocks of crab.

Using Volunteer Time as a Payment Vehicle in Contingent Valuation Studies of Endangered Species by Karl Samples (HI) and James Hollyer (HI)

Consistency in comparison of marketed and nonmarketed natural resources hinges, in part, on consistency in the way consumers pay for the goods. Money or the sacrifice of income is the common numeraire in welfare economics and represents the price of most marketed commodities. In dealing with natural resources that are public goods and hence indivisible, establishing a means of payment that is consistent with marketed goods and yet reflective of the way such public goods are paid for has been a challenge. For many of these public good resources such as endangered species, no formal markets or market prices exist. Therefore surrogate means of paying dollars or income in the form of a payment vehicle is often employed when developing hypothetical markets using the Contingent Valuation Method. Examples of common payment vehicles include payment into a trust fund, a higher utility bill, and a "wildlife stamp", just to name a few. However, for many public goods, implicit markets have developed where consumers desiring more of these goods can attempt to purchase additional units for society by paying with their time. By donating time to educational, lobbying or habitat restoration efforts, consumers are implicitly engaging in a transaction that trades their scarce time for a higher probability of increased supply of the public good. Can we use this sacrifice

of volunteer time as an alternative payment vehicle in place of dollars in Contingent Valuation? If we use volunteer time as the means of payment how does one convert this time to dollars in a manner commensurate with the dollar value of other goods or income?

These issues are addressed by Samples and Hollyer in their paper. These authors build upon earlier suggestions made in two papers by W-133 participants (Bocksteal and Strand, 1985; Cory, 1985) that willingness to pay in time be evaluated in addition to willingness to pay in dollars. The trade-off between these two welfare measures is developed in the form of an equivalent surplus locus reflecting different combinations of money and time a person would pay to avoid a decrement in environmental services.

The feasibility of using volunteer time as a payment vehicle in Contingent Valuation was empirically tested using a valuation experiment for two marine mammals. Respondents were asked to pay for preservation of Monk Seals and Humpback Whales. They could choose not to pay in any form, or to pay in either money or time. When given the choice nearly an equal proportion choose to pay in money as in time. One of the most difficult issue in using time as a payment vehicle revolves around how to empirically convert willingness to pay in hours to dollars. This problem is similar to the problem of converting travel time to travel cost in the Travel Cost Method (McConnell and Strand, 1981). Not surprisingly, the final values for preservation of the species depends on the rate at which time is converted to dollars. Additional research on this issue may be necessary to take full advantage of Samples and Hollyer's innovative payment vehicle in Contingent Valuation studies.

PAPERS RELATING TO OBJECTIVE #2: DEVELOPMENT OF THEORETICALLY CORRECT METHODOLOGIES FOR CONSIDERING RESOURCE QUALITY AND ASSESSING MARGINAL VALUATION

Contingent Valuation as an Experimental Science by John Bergstrom (GA) and John Stoll (TX)

Traditionally, the Contingent Valuation Method has been one of the primary techniques for valuing changes in resource quality and the marginal value of increments and decrements in resource availability. CVM has been used to value changes in water quality (Greenley, et al., 1981; Smith and Desvousges, 1986) and air quality (Randall, et al., 1974; Schulze, et al., 1983) as well as to estimate the marginal value of increases in the number of elk (Brookshire, Randall and Stoll, 1980).

One long standing concern that some economists and public decision makers have with CVM is the method's reliance on hypothetical responses to survey questions rather than actual behavior. Technically speaking CVM provides respondent's intended behavior contingent on the characteristics of the market described in the survey.

The validity of this intended behavior as a guide to respondent's actual behavior has been tested in a variety of ways by many W-133 researchers. The paper by Bergstrom and Stoll takes an experimental economics approach to testing the validity of CVM. The authors argue the framework of experimental economics, provides a description of the controlled environment necessary for systematic investigation of the validity of CVM. Bergstrom and Stoll review the experimental economics literature on microeconomic markets to establish the properties that are necessary for a properly structured market. These include nonsatiation of rewards given to the respondent, saliency of responses to real outcomes, privacy of one's own reward schedule and those of others,

parallelism of the contingent market with real markets that might be implemented to provide the good and incentive compatibility for revelation of the respondent's true values.

The authors argue that if the properties of nonsatiation, saliency and privacy are met, this will satisfy the necessary conditions for internal-validity of CVM benefit estimates. This means that benefit estimates could be replicated over similar experiments. If, in addition, the property of parallelism is met, then CVM estimates may have external-validity, i.e. the CVM values can be generalized to real world scenarios.

Bergstrom and Stoll's paper provides a useful guide for conducting laboratory experiments designed to test a particular CVM issue (e.g., information bias, payment vehicle bias, etc.). More importantly, their paper provides a mental checklist for designing a credible CVM survey in a real application. That is, to insure the respondent is valuing what you intend them to value, many of the properties of microeconomic markets described by Bergstrom and Stoll must be met. To insure that values provided by the respondent can be generalized to the actual change in resource quality or resource availability postulated in the survey, such a survey must employ the property of parallelism (i.e., realism). While many of our informal guidelines (e.g., Reference Operating Conditions, etc.) discuss these issues, natural resource economists can improve future applications of CVM by incorporating the guidelines suggested by experimental economics.

Analyzing the Effects of Glen Canyon Dam Releases on Colorado River Recreation: Using Scenarios of Unexperienced Flow Conditions by Kevin Boyle (ME), Michael Welsh (OK), Richard Bishop (WI) and Robert Baumgartner (WI)

This paper by Boyle, et al., evaluates the effect of realism in survey descriptions of unexperienced changes in resource quality versus inference of values from actual experience of the different levels of resource quality. The issue of unexperienced quality levels versus experienced quality levels is a significant empirical issue in valuing resource quality. Ideally, the economist would prefer the consumer to experience each alternative levels of resource quality and then provide their valuations of each. However, in many situations it is not practical to modify the resource quality to value changes (e.g., killing off half of the fish to assess the value of fishing quality). In other cases it may be quite costly to modify resource quality to alternatives levels so as to perform a realistic CVM. For example, operating a large hydropower project for several weeks at alternative release patterns might involve millions of dollars in foregone power benefits. All is not lost if there is some natural fluctuation in resource quality. The economist can survey at different times during the year when site quality is high, medium and low. The values respondents report under these conditions can be related to the resource quality at the time of the survey to quantify the relationship between resource quality and value. In this situation it may even be possible to rely on actual trip behavior and calculate benefits from a Travel Cost demand equation.

This latter approach has two minor drawbacks, however. First, since no one person experiences all of the alternative levels of resource quality, unbiased values can be inferred only if the analyst adequately accounts for differences in respondent characteristics (e.g., tastes, income, skill, etc.) sampled at

different times of the season. If during high water times only skilled boaters visit the site, inference of the value of high water to all boaters will likely be erroneous. In addition, this intra-seasonal approach will not work when resource quality does not vary over the recreation use season.

As a result of these limitations, the intra-seasonal approach has seen limited application. The typical CVM survey often proposes alternative levels of resource quality to the same respondent. This controls for differences in respondent characteristics, the concern involved in the intra-seasonal approach discussed above. However, for some visitors one or more of these alternative levels of resource quality may be outside the range of what they may have experienced. How valid are the benefit estimates for unexperienced changes in resource quality?

The paper by Boyle, Welsh, Bishop and Baumgartner begins to address this later issue regarding the validity of benefit estimates for unexperienced changes in resource quality. The authors use respondents valuation of rafting and fishing under different river flows. Since the sample was taken over the course of a season, different people had actually experienced a high, medium or low flow level, although few people had experienced more than one flow level. Each person was asked a dichotomous choice question to value the trip they had actually taken. These values would reflect the resource quality actually consumed on that trip.

In addition, each respondent was asked a series of dichotomous choice CVM questions for the value of their trip if everything had been the same except the flow was 3,000 cfs, 10,000 cfs, 25,000 cfs and 40,000 cfs. The changes in river characteristics under the four flow scenarios were described in a series of narratives.

The comparison of recreation trip values under the actual trip conditions versus the unexperienced flow scenarios indicates a fairly close ordinal ranking of the preferred flows. In terms of absolute magnitude of the dollar amounts, the value of the unexperienced scenarios is slightly higher at low flows than the actual trip value but slightly lower than the actual trip values at high flows. In general, the differences between the two approaches is about 25%. Some of this difference is attributed by Boyle et al., to the distinction that actual trip values may reflect "ex post values" while the unexperienced scenarios may reflect "ex ante values".

Research addressing experienced versus unexperienced quality changes is also addressed from a slightly different perspective by Walsh, et al., in the next section. This perspective relates to valuations of experienced quality levels based on actual behavior (using the Travel Cost Method) versus valuations of unexperienced quality levels based on intended behavior (using the Contingent Valuation Method). For a description of this paper see Section III.

Valuing Recreational Services With Quality Adjusted Prices by John Hoehn (MI) and Gideon Fishelson

The authors develop a new method for valuing changes in a single site's environmental quality when there is insufficient variation in the site's price or lack of time-series data on quality over time to allow traditional demand estimation. The lack of variation in a site's price or lack of time-series or cross-section data to estimate a coefficient on quality has limited the application of market-based approaches to estimating the value of environmental quality. However, this new approach calculates a "quality adjusted price" by combining price and quality data. The resulting variable provides the necessary variation to allow estimation of the demand function for a environmental quality at a single site.

The paper demonstrates the usefulness of this new approach with an application to estimating the demand for visibility at the Hancock Tower in Chicago. Demand functions are estimated for two air quality characteristics: visual range and visibility. The net willingness to pay or surplus per visit ranges from $18.50 to $30.40. The annual change in total consumer surplus for a 10% increase in visual range is between $56,000 and $69,000.

This new methodology maybe a promising approach to demand estimation for changes in site quality at a single site. The data requirements a greatly simplified over more traditional "varying parameter models", which require collection of data on multiple recreation sites in order to estimate a coefficient on site quality. One additional assumption possibly required to use either of these revealed-preference market-based approaches is that consumers know, ex ante, what site quality will be when making their decision to visit the site. This assumption was easily met in the case of visitors to the Hancock Tower, since the degree of visibility from the Hancock Tower would be readily observable prior to a decision to pay the admission fee.

However, in the case of a more remote site such as a river, ski area or reservoir, prior knowledge of river flow, snow conditions, or reservoir level may be difficult to acquire prior to travel decisions if these site characteristics do no vary in a predictable manner. If site quality is predictable ahead of time, then this quality adjusted price method appears be a potentially useful new tool in valuation of changes in resource quality.

Some Thoughts on the Multiple Destination Trip Problem in Travel Cost Models

by John Hof (U.S.F.S.)

The Travel Cost Method (TCM) is a widely used and in its basic form a relatively straightforward approach to estimate the demand for outdoor recreation. TCM relies on visitor's travel costs as a proxy for site price. This is legitimate only if the travel costs were incurred exclusively to visit that particular site and not to visit several other destinations (e.g., business, other recreation sites, etc.). For many outdoor recreation activities such as hunting, fishing and backpacking this assumption is often met by 80-90% of visitors. However, when valuing recreation sites such as National Parks or those close to major highways, a high percentage of the visitors do visit more than one destination. There are several ways of dealing with this situation. One is to attempt to estimate the model on just the visitors that meet the assumptions of the strict TCM. However, this is not desirable if only 30-50% of the visitors meet the assumption. Alternatively, one might abandon the TCM in this case and apply the Contingent Valuation Method.

The paper by Hof explores a third solution: use a cost function approach to split out the separable costs of visiting any particular site on the overall trip and then logically allocate the remaining joint costs of the trip between sites. The approach specifies a cost function and then demonstrates the multi-destination problem is one of recreation sites having interdependent marginal travel cost functions. One solution is to develop a logical path of integration that allows the costs to be allocated to each site in a manner that exactly allocates total cost. To illustrate the principles involved, a geometric plane is displayed for a recreator having four destinations on his or her trip. The general approach that emerges is that each site receives its full separable costs and its share of any costs required to visit more than

one site. For example, if driving up a particular canyon moves the visitor closer to three of the four sites, then the costs of this leg of the trip would be split equally among the three sites. By examining visitor's trip itineraries, the travel costs necessary for visiting each site can be identified and the cost allocation scheme presented can be applied. While Hof discusses the weaknesses in this approach, it represents a generalization of past approaches used by others. In this way the implicit assumptions of less general methods of cost allocation are made clearer using Hof's framework.

Estimation of Marginal Values of Wildlife and Forage Using the Travel Cost Method by John Loomis (CA), Dennis Donnelly (U.S.F.S) and Cindy Sorg (U.S.F.S)

In some resource settings there is sufficient variation in environmental quality to allow a revealed preference approach to valuation of changes in resource quality. In this paper, the authors demonstrate how marginal valuation of changes in hunting quality (e.g., wildlife availability) can be empirically measured using one type of revealed preference approach, the Travel Cost Method. A pooled multi-site demand function for elk hunting and deer hunting in Idaho is estimated that contains elk harvest and deer harvest, respectively, as demand shifters. Inclusion of these variables allows for calculation of the incremental consumer surplus associated with increasing elk and deer harvests. To account for the possibility of simultaneity of the elk or deer harvest variable in the demand function, two stage least squares is used to estimate the demand functions for each species. The marginal value of an additional elk harvested in two hunting areas in Challis, Idaho ranged from $502 to $647. The marginal value per deer harvested ranged from $155 to $310.

A simple production function was then developed that related elk and deer populations to forage availability, age structure and sex ratio's of the herds. From these simple production functions, the marginal product of forage could be

calculated. Using the marginal value per animal harvested, the value marginal product of the forage to elk and deer was calculated. The marginal values for elk ranged from $6.65 to $8.25 per Animal Unit Month (AUM) of forage. For deer the values ranged from $6.33 to $15.33 per AUM. Comparison with livestock forage values from appraisal surveys and ranch budgets indicates the value of forage to wildlife is competitive with that of livestock.

Exact Welfare Values of Natural Resource Quality: A Regional Approach

by Frank Ward (NM)

Early work on the theoretical foundation of measuring quality changes dealt with just one site at a time and no interrelationships between sites. That is, a change in site quality at one site had no influence on visitation to the other sites. Hanemann (1982) began to investigate utility theoretic demand specifications that accounted for quality changes at one site which was one of a number of recreation sites in a region. Hanemann also addressed the issue of calculating exact welfare measures (i.e., the four Hicksian measures) rather than Marshallian consumer surplus. Ward's paper builds upon and extends the research of Hanemann for quantifying the benefits of a change in quality in one site in a multiple site demand system. In addition, Ward proposes a four step procedure to implement a utility theoretic approach to demand estimation when performing applied studies. The four steps involve specification of a utility function, derivation of the associated ordinary and compensated demand functions as well as the expenditure function, estimation of the ordinary demand function and then use of the estimated coefficients of the demand function with the formula for the expenditure function to derived the Hicksian welfare measures.

Ward provides a numerical example of his four step procedure using simulation techniques. Data are generated, demand models estimated and then compensating and equivalent variations calculated. The model is then exercised to evaluate four policy options that include raising the entrance fee, increasing site quality and then a combination of these approaches. Welfare estimates with each of these policies are provided.

Ward's approach appears to make possible tying theory and practice more closely together in demand estimation of quality changes. As Ward points out, this is particularly desirable when the analyst wishes to use welfare economics to justify the use of the benefit measures as indicators of potential Pareto improvements.

PAPERS RELATING TO OBJECTIVE #3: APPLICATIONS OF MARKET AND NONMARKET BASED VALUATION METHODS TO SPECIFIC RESOURCE BASE OUTPUTS

Travel Cost Demand Models With Linkages to Fishing Quality: Computerized Models for the Pacific Northwest by John Loomis (CA)

Large area watershed planning often involves comparisons of benefits and costs over a multi-state area. For example, evaluation of hydropower and fisheries trade-offs in the Columbia basin involves salmon fisheries in Idaho, Oregon and Washington. Consistent valuation of the fishery impacts from alternative water release patterns for hydropower or irrigated agriculture is enhanced if the same modelling approach is used for all states.

Evaluation of allocation of water between hydropower, irrigated agriculture and andadromous fisheries also involves marginal analysis of shifting water releases in terms of quantity and timing. Performing such marginal analysis of alternative water releases requires the ability to simulate the shifts in the demand for recreational fishing associated with

changes in fishing quality. Unfortunately, Federal agencies such as the Bureau of Reclamation, U.S. Army Corps of Engineers, etc., have historically relied on Unit Day Values from the U.S. Water Resources Council (1979) to estimate the value of an angler day and then used the average number of angler days required to catch a fish to arrive at the change in value of fishing. More recently, these agencies have substituted estimates of the average consumer surplus per angler day from existing site specific studies in place of the Unit Day Values but continue to rely on the average number of angler days per fish caught for a measure of quantity.

The computerized models of anadromous fishing developed by Loomis puts site-specific quality-augmented demand equations and data into the hands of Federal agency economists in a menu driven model. The models allow the agency economist to input the change in fish production at a specific river and the program then shifts the site demand curve and takes the area between the old and new demand curve. The resulting benefit estimate reflects the marginal or incremental gain in recreational fishing benefits associated with the change in fish production. These models thus allow agency economists to generate both the value and use estimates from the same site specific data set.

The demand equations used in the models are estimated using a multi-site regional Travel Cost Method. The TCM demand equations contain fish catch as a shift variable. The fish catch variable provides the link from project effect on fishery habitat (e.g., different river flows, water temperature, dissolved oxygen, sediment, etc.) or fish populations to economic benefits. These multi-site demand equations have been estimated for the major salmon and steelhead rivers in Idaho, Oregon and Washington. The value of ocean sport fishing of salmon in Oregon and Washington is also estimated.

The demand equations and data are provided to the user as a LOTUS 123 spreadsheet file along with a LOTUS MACRO program file. The entire process, from selecting the river or port, entering the annual change in fish catch and calculation of benefits, is menu driven. The program also provides the option to perform discounting of annual benefits.

The programs have recently been used by USDA Soil Conservation Service for evaluation of the benefits of sediment reduction in the Columbia Basin and by the U.S. Army Corps of Engineers for evaluation of river flow augmentation for fish migration and spawning.

Recreational Demand for Trees in National Forests by Richard Walsh (CO), Frank Ward (NM) and John Olienyk (CO)

When assessing the benefits of different levels of environmental quality economist often faces a trade-off between relying on actual behavior and the use of hypothetical behavior implied in the Contingent Valuation Method. While reliance on how recreationists actually adjust their visitation rates to different levels of environmental quality may be preferred by some economists, there are many situations where this approach is not feasible. As discussed earlier in the Boyle, et al. paper on Grand Canyon river flows, if the change in environmental quality is irreversible or difficult to vary in an experimental setting then the analyst is required to rely on hypothetical responses. Closer examination of the nature of these hypothetical responses indicates they reflect what is called "behavioral intentions". Specifically, what does the respondent intends to do if the set of conditions described in the survey took place. Of course economists and decision makers wish to know how well do these behavioral intentions predict actual behavior.

In the Boyle, et al., paper discussed above, the authors addressed this issue by comparing Contingent Valuations of river trips under river flow

levels actually experienced by the visitor versus valuations of river trips under flow levels they had not experienced but rather were described to them. In the Walsh, et al. paper, visitors not only experienced the level of environmental quality but their valuations were based on actual behavior using the Travel Cost Method. Valuation of the unexperienced environmental quality used the same basic approach as Boyle, et al., except that pictures supplemented the narrative descriptions and iterative bidding was used rather than the dichotomous choice approach.

The particular resource quality addressed by Walsh, et al., relates to forest quality, specifically, the number of ponderosa and lodgepole pine trees per acre in the Front Range of the Colorado Rockies. On-site interviews were conducted of visitors during the summer of 1980 to assess how visitation and value per visit to six specific recreation areas would change with different number of trees per acre. Six different photos displaying no trees, 20-40 trees per acre, 60-80 trees per acre, 100-120 trees per acre, 140-160 trees per acre and 200-300 trees per acre were shown to respondents. They were asked the number of days they would visit the site per season and the maximum willingness to pay per day under each of the different scenarios. In addition information was collected on their travel costs and actual number of times they had visited the particular site where they were interviewed.

Using the intended number of trips a "willingness to participate" equation was estimated as a function of trees per acres and a host of other variables. A willingness to pay equation was also estimated as a function of trees per acre and other shifter variables. Trees per acre and trees per acre squared were highly significant. Multi-site Travel Cost demand functions are estimated which contain a variable for trees per acre. Both OLS and two stage least squares are used to test the sensitivity of benefits to demand specifications.

Walsh, et al., make several comparisons between CVM and TCM results. Benefit estimates for the two approaches compare quite closely for existing site conditions. The authors then compare the predicted change in number of trips and benefits per trip for a 10%, 20% and 30% reduction in number of trees per acre. The TCM appears to be more sensitive in relating the change in tree quality to trips per season than CVM. For a 10% and 20% change, TCM predicts almost twice the reduction in trips than CVM. That is, the actual number of trips falls off twice as fast as what visitors stated they would react. However, the reverse is true when evaluating the responsiveness of benefits per day to trees per acre. Here, CVM values showed nearly twice the sensitivity of values per trip than did the TCM. When the effects of changes in value per trip are combined with the changes in number of trips to provide an estimate of the annual value of the change in forest quality, the two effects offset one another for each method. As a result, estimates of the annual change in benefits from a 10% or 20% reduction in the number of trees per acre is nearly identical under both TCM and CVM. There is some disparity for a 30% reduction in trees, with CVM estimates being about 20% larger.

In general, the authors feel that intended behavior for unexperienced levels of environmental quality matches reasonably well with actual behavior. However, more research is needed to explain why CVM derived values per trip are more sensitive to site quality changes than are TCM derived values.

Total and Existence Value of a Herd of Desert Bighorn Sheep by David King (AZ), Deborah Flynn (AZ) and William Shaw (AZ)

The preservation of certain relatively unique natural resources provide benefits beyond simply recreation. The presence of environmental groups specializing in saving relatively remote ecosystems such as the Mono Lake

Committee or isolated species indicates that people often derive satisfaction from knowing a species exists or a certain unique natural environment is protected. While these values have often been discussed, they have seen relatively limited use in Federal benefit cost analysis. This is due, in part, to the paucity of studies that measure such values and in part due to the belief that for many of these areas or species, perhaps recreation benefits captures a bulk of the total social value.

The paper by King et al., adds to our understanding of the empirical importance of existence value by quantifying and explaining the variation in this value for a herd of desert bighorn sheep in Arizona. The authors used a mail survey to perform an open ended Contingent Valuation question regarding the total economic value (e.g., viewing, option for future viewing, existence value) of preserving 70 desert bighorn sheep. This was followed by an open ended willingness to pay question for preserving the bighorn sheep except that to minimize stress to the bighorn sheep, no viewing or other human activity would be allowed in the area. This particular bid is intended to reflect just the pure existence value.

The total annual benefits (i.e., willingness to pay) for preservation of the 70 bighorn sheep was $17 per household. The existence value was $15 or 80% of the mean of total value. Clearly, existence value represents a major component of total value for this bighorn sheep herd. This conclusion is supported by respondents' ranking of altruistic motivations for preserving the bighorn sheep herd ahead of on-site recreational use.

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