RECREATION BENEFITS OF WATER QUALITY: ROCKY MOUNTAIN NATIONAL PARK, SOUTH PLATTE RIVER BASIN, COLORADO

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May 1978

ENVIRONMENTAL RESOURCES
CENTER

Colorado State University
Fort Collins, Colorado

Colorado Water Resources Research Institute
Technical Report No. 12

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The work upon which this report is
based was supported in part by

Colorado State University Experiment Station Project 264, WR-118,

Colorado State University Experiment Station Project 1769,

and

by funds provided by the U. S. Department of the Interior, Office of Water Research and Technology, as authorized by the Water Research Act of 1964, and pursuant to Grant Agreement No. 13-01-0001-3065.

May, 1978

COLORADO WATER RESOURCES RESEARCH INSTITUTE

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ABSTRACT

The purpose of this study was to develop and apply a procedure for measuring the effects of water quality on recreation benefits. A random sample of 141 households visiting Rocky Mountain National Park were interviewed during the summer of 1973. A substantial portion of the park is located in the South Platte River Basin, Colorado. Perception of water quality was based on color photos depicting six levels of water quality in the River Basin. Willingness to pay questions were designed to measure consumer surplus which is the area under the demand curve for outdoor recreation. The demand curve shifts with changes in the level of water quality. The stepwise multiple regression procedure was utilized to develop linear demand functions. Standard statistical tests of significance were shown. Although the willingness to pay questions were hypothetical, they were designed to be as realistic as possible. Willingness to pay was measured in terms of a recreation entrance fee, the value of waterfront recreation property and travel time. These are familiar methods of paying for outdoor recreation resources. The valuation procedure used in this study has been successfully applied to other natural resource and public good problems.

Park visitors were willing to pay an average of $5.42 more in entrance fees, 165 percent more for waterfront recreation property and devote 89 percent more travel time to gain natural water quality. The statistical relationship between benefits and perception of water quality as measured on a 100-point scale from worst to best conceivable showed that park visitors were willing to pay \$0.06 more daily recreation fee to avoid each one unit decrease in water quality. They were willing to travel 0.9 percent more and to pay 1.9 percent more for waterfront recreation property.

The annual benefits of water quality are shown for the park, and non-resident benefits are calculated for the river basin and the state. Present value of perpetual benefit streams are developed for the three areas. The study shows the statistical relationship between benefits from water quality and patterns of participation in outdoor recreation activities, attitudes, and other socioeconomic variables. Policy implications are developed for governmental agencies in outdoor recreation and water quality management.

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RECREATION BENEFITS OF WATER QUALITY: ROCKY MOUNTAIN NATIONAL PARK, SOUTH PLATTE RIVER BASIN, COLORADO

Richard G. Walsh, Ray K. Ericson, John R. McKean, and Robert A. Young[1/]

INTRODUCTION

With increased use of the National Parks, there is a growing concern regarding damages to the quality of the environment. The parks were set aside to preserve unique geologic and biologic resource quality, yet many are threatened by man's desire to see and utilize the areas for recreation, and by community and industrial development in the vicinity of the parks. Thus, studies have been undertaken to determine the costs and benefits of avoiding man induced changes in the quality of the environment so that decisions on the acceptable level of changes in resource quality can be made by park administrators.

The demand for recreation activities provided by water and related land resources has grown at an accelerated rate since World War II, and is projected to grow at a rate 25 percent greater than for other outdoor recreation activities to the year 2000 [Cicchetti, Seneca, and Davidson, 1969]. Water-based recreation in the year 2000 in expected to be 2.5 times 1965 levels. Since the ability to augment the supply of water resources is severely constrained, pollution of nearly 30 percent of the lakes and streams is now, and will continue to be, an important problem [Council on Environmental Quality, 1972]. Increasing the recreation use of polluted water resources is not necessarily synonymous with an increase in benefits derived from the recreation activities.

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The 1972 Water Pollution Control Act, P.L. 92-500 designated recreation as one of the principle beneficiaries of the federal water quality management program. The primary goal of the Act is

> . . . water quality which provides for the protection and propagation of fish, shellfish and wildlife and provides for recreation in and on water be achieved by July 1, 1983 [U.S. Code, 1972].

As water quality is improved, there is an accompanying increase in the quality of each individual unit of recreation activity. Effective management of water resources requires measurement of the magnitude of the relationship between water quality and recreation benefits, and its integration into a comprehensive model. This report provides the rudiments of such an analysis.

The purpose of this study was to develop and apply a procedure to measure the relationship between water quality and recreation benefits. A random sample of 141 households were interviewed at Rocky Mountain National Park, Colorado, in the summer of 1973. The specific objectives were to:

(1) determine the benefits of improved water quality as measured by willingness to pay an increased entrance fee, to pay for waterfront recreation property, and to increase travel time;

(2) estimate the statistical relationship between these benefits and water quality as perceived by park visitors on a 100-point scale from worst to best conceivable;

(3) estimate the statistical relationship between benefits from improved water quality and patterns of recreation participation, attitudes, and other socioeconomic variables;

(4) discuss policy implications for governmental agencies in recreation and water quality management.

This report is intended to aid decision makers in water quality management planning at all levels of government. It should prove useful to the Colorado Water Quality Commission in setting water quality standards for particular lakes and streams in the state. It should prove helpful in estimating the recreation benefits of alternative water quality standards. In the past, governmental agencies in the state have lacked recreation information presented in this report and thus have had no alternative but to rely on biological tests of fish survival. This report demonstrates the benefits from water quality to fishing, boating, swimming, camping, and sightseeing. Fishing is a small part of total water-based recreation activity, and a small part of total recreation benefits of water quality.

The ability of Colorado, with scenic environmental qualities, to continue to attract nonresident tourists depends on protecting its water resources at sufficiently high levels suitable for water-based recreation activities. This may require the distribution of water treatment funds to selected areas in the state where recreation potential is the highest. Grand Lake and Granby Lake, the Roaring Fork River below Aspen and Clear Creek below Central City are examples of waterways with high recreation values and pollution problems. Water quality standards for a particular waterway should be based largely on potential recreation benefits, as it has been estimated that recreation accounts for approximately 70 percent of total benefits from improved water quality [Tihansky, Abel and Walsh, 1974].

Chapter 2 of this report describes the literature dealing with the relationship between water quality and recreation benefits, and develops a model capable of empirical testing. The third chapter discusses the research procedures used to collect the data. The fourth and fifth chapters present the empirical results and a simple managerial model of benefit estimation. Finally, the last chapter summarizes the report.

CHAPTER 2

CONCEPTS OF BENEFITS

This section reviews the literature dealing with the relationship between water quality and recreation benefits, and develops a model capable of empirical testing. It contains an outline of the concept of demand for a recreation site such as Rocky Mountain National Park. Water quality shifts the demand curve and economic benefits are defined as the area between demand with and without water pollution. Shifts in demand may be both horizontal changes in the number of household recreation days and vertical changes in price and value per household recreation day. Most of the recent literature has focused attention on increased levels of participation as the measure of benefits associated with improved water quality. They have assumed that benefits per recreation day are unaffected. Most studies have considered two levels of water quality: the current polluted level and a level meeting water quality standards. This study considers a range of water quality levels to determine marginal benefits of incremental improvements in water quality. Demand analysis which has as its goal inferences about consumer surplus benefits of improved water quality should utilize demand functions which permit price to shift with water quality levels. How the shape and shift of the demand curve varies with changes in water quality is an important consideration. Answering this question is the major purpose of this report.

Two Approahces to Benefit Studies

Freeman [1976] has outlined the concept of recreation benefits for water quality at a single recreation site such as Rocky Mountain National Park, holding all other relevant economic variables constant. There exists a demand for this recreation area which relates quantity of recreation services demanded, i.e., household recreation days, to price, i.e., costs of access and participation. The demand curve can be interpreted as a marginal willingness to pay curve, relating marginal value to quantity. This demand curve is plotted holding constant average income, prices and availability of substitutes, and the quality of this recreation site. When price is known, as indicated by the line P in Figure 1, actual recreation quantity demand can be predicted.

If the park became polluted the demand curve with pollution would shift to the left as shown, and the quantity of recreation days would be $Q\text{-}Q_1$. The net value or benefit attributable to a polluted park is the area A-B-C. This is a consumer surplus measure of value. Now, assume that a pollution control program restored water quality in the park. In economic terms, the effect is to shift the demand curve out and to the right, the demand curve shown without pollution in Figure 1. The net economic benefit of the improved water quality is the increase in consumer surplus, defined as the area between the two demand curves and above price, B-C-E-D.

The benefits from improved water quality can be divided into two categories. The first is the increase in utility of consumer surplus to those $Q\text{-}Q_1$ visitors who were using the park even when polluted. This is the area B-C-F-D. This area represents their increase in willingness to pay to maintain present use rates at this recreation site.

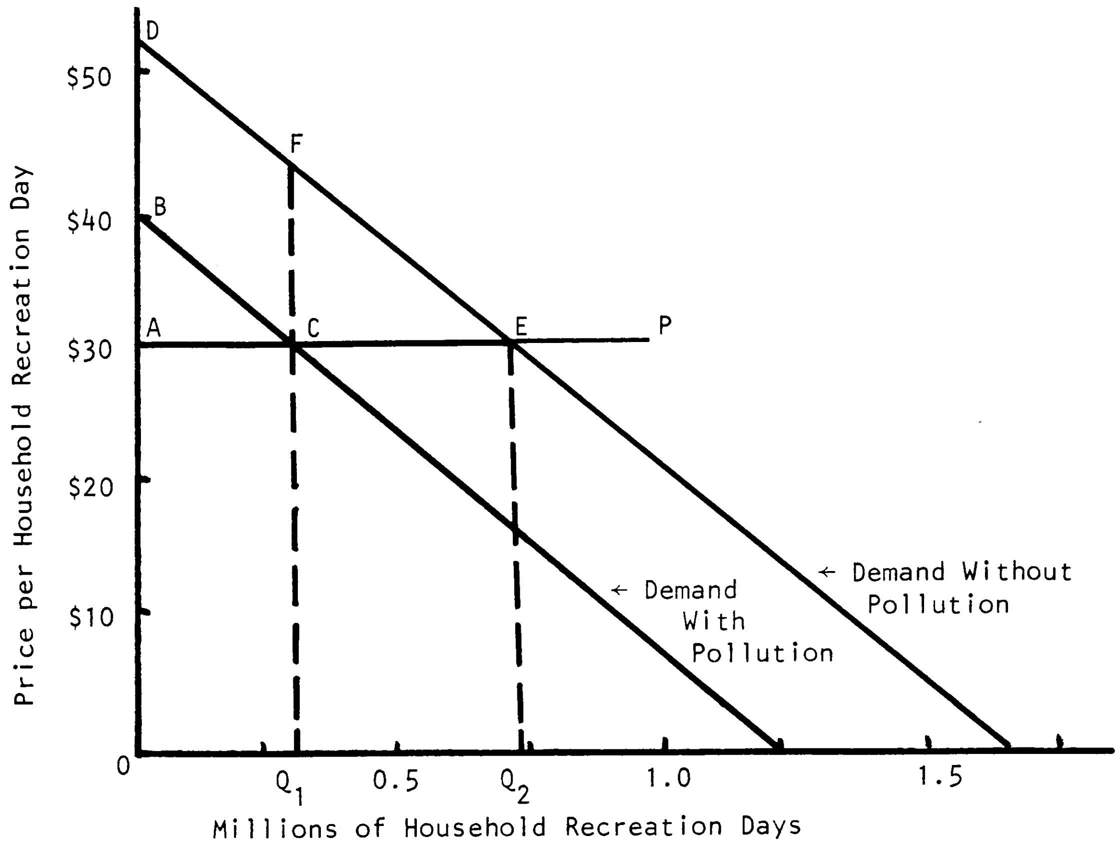

Figure 1. Shift in Demand Curve with Improved Water Quality at a Recreational Site.

Source: Freeman [1976]

In addition, with improved water quality the greater attractiveness of the park relative to alternative recreation sites and alternative consumption activities other than recreation, results in an increase in recreation days at the park equal to Q_1-Q_2. There is a benefit associated with this increase in park use which is equal to the area C-E-F.

Thus, the analysis of Figure 1 shows changes in water quality will be associated with both changes in willingness to pay and changes in quantity of participation. Freeman recommended that two types of research are needed: (1) a national recreation participation survey incorporating socioeconomic variables as well as water quality and quantity variables, and (2) studies of specific sites to measure shifts in the demand curve as water quality changes. This study is an example of the second type of recommended research.

Most of the recent literature has estimated changes in participation in recreation resulting from change in water quality from the current polluted level to a level meeting water quality standards. Participation in household recreation days is the dependent variable in a demand equation for a recreation area, which includes the parameter, attractiveness of the area in acres of surface water available for recreation use. For example, a multiple regression may show the number of household recreation days increases by 100 for each additional surface water acre. Without pollution, the number of surface acres available increases from 7,500 to 15,000 and total demand is forecast to increase from 750,000 to 1.5 million household recreation days annually. The effect is the non-parallel shift in demand from D_1 to D_2 indicated in Figure 2. The vertical intercept for price was not changed by the parameter, attractiveness of the water resource in acres of surface

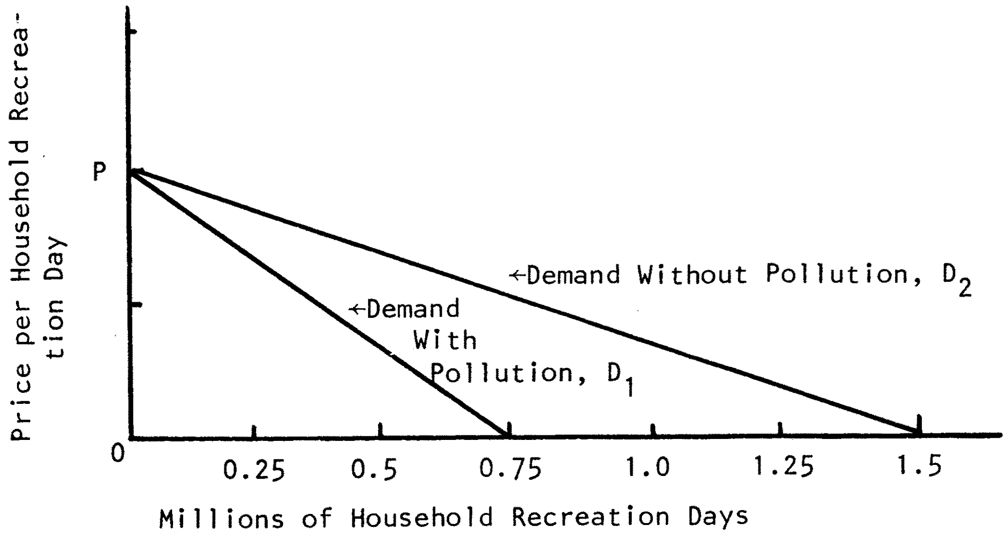

Figure 2. Horizontal Shift in Recreation Demand With Increased Supply of Water Suitable for Recreation Use.

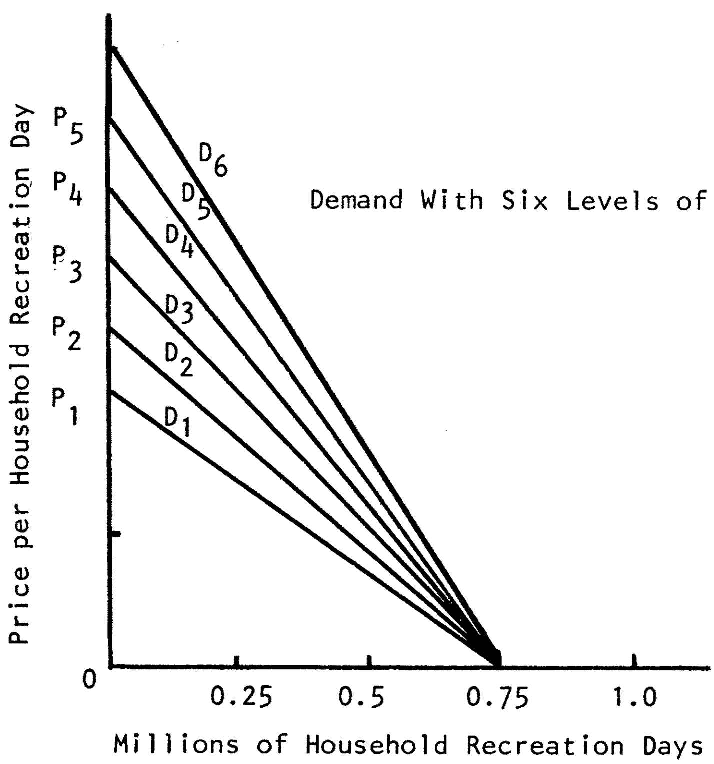

Figure 3. Vertical Shifts in Recreation Demand With Improved Water Quality, Rocky Mountain National Park, Colorado, 1973.

water available for recreation use. A parallel shift in demand would require the quantity demanded to increase by the same absolute amount for all prices. The latter effect would be a special case requiring all new participants as water supply grows to have an inelastic price elasticity of demand for recreation activities [Cicchetti and Krutilla, 1970; Shepard, 1933].

Most studies have assumed benefits per recreation day are unaffected by changes in water quality. A constant average benefit per recreation day is multiplied by the change in number of recreation days. This is the usual case for private goods of a specified quality, where individuals or household demand curves are summed horizontally to obtain a market or industry demand curve. The value of water quality is measured by the difference in the area under the demand curve for recreation activity with and without pollution. This attributed all of the benefits from increased participation to increased water quality. Water quality is a necessary but not sufficient condition for maximum enjoyment of the recreation experience, as other resources and conditions of the site would also affect recreation benefits. It would be useful to separate the value of each level of water quality from the value attached to the other site-specific characteristics.

For many goods and services, of which water-based recreation is one, attributes of the experience are affected by the quality of the resource. Lancaster [1966] developed a consumer decision model in which individuals demand goods and services to satisfy a desire for a basic set of attributes associated with them. The level of water quality affects the attributes of recreation services and, therefore, individual satisfaction and benefit from consumption. It is possible to outline a model which can accommodate such situations. In it the utility an individual derives from a particular service is a function of both the quantity of recreation activity and the quality of water at the recreation site. In the case of water-based recreation, the rationale for such a relationship stems from the effect of water quality upon the attributes of each day of recreation activity. Consequently, it is expected that an individual's willingness to pay for a unit of service will depend upon the quality of the water resource producing it. The equations in Appendix A of this report specify an individual willingness to pay function for water-based recreation derived from such a utility specification.

Willingness to pay is the dependent variable in the demand equation for a recreation area which includes the parameter, attractiveness of the area in units of water quality (0 to 100 index), indicating for example, the price per household recreation day increases by 0.6 cents for each additional one unit increase in water quality. So that without pollution, D_6, the price of water quality is forecast to increase from P_1 to P_6 per household recreation day. As water quality varies, the effect is the non-parallel vertical shifts in demand as the spokes on a wheel shown in Figure 3, from D_1 to D_6. Price increases from P_1 to P_6 do not effect the horizontal intercept, household recreation days, which remains 700,000 at zero price.

The value of water quality is measured by the difference in the area under the demand curve with and without pollution. When the natural resource providing the service changes in quality, the value of benefits is the change in the area under the demand curve for each of six levels of quality. Questions can be designed so that respondents' welfare would be the same before and after paying the amount specified. This is the Hicksian [1956] consumer surplus measure of benefits, defined as the area under a willingness to pay curve for water quality. It is measured as the maximum increased payment, leaving the respondent equally well off before and after incurring the incremental improvement in water quality specified, all other conditions remaining unchanged. The benefits received by visitors from other resources in the park and other attributes of the experience do not change, as shown by the white pie shaped area under the demand curve D_1 in Figures 2 and 3. These benefits remain identical when the questions specify two identical recreation areas equal distance and equally suitable for recreation activities except for a difference in water quality levels at the two sites.

Many recreation services including visits to national parks are virtually zero priced because of their public good nature and national policy governing such conditions. The park admission fee in 1973 was a nominal $1 per vehicle. This policy limits observations to the quantity demanded at near zero entrance fee. As water quality increases, there seems to be no reason to expect the quantity of recreation visits to the park demanded at zero fee to vary in the absence of other changes such as an increase in leisure time. In any case, questions can be designed so that values reported for water quality are incremental above a base price, i.e., costs of access and participation.

Participation Measures of Benefits

The quality of water for recreation activities is influenced by a number of factors. Man-made causes of water pollution greatly exceed natural causes. Aukerman [1971] showed the effect on recreation participation at nine Illinois lakes with and without the presence of 18 types of water pollution. He found that with the presence of sewage in the water, 67 percent of the sample would terminate recreation use of the lake. For litter and debris, this was 47 percent; oil, gas and grease, 41 percent; chemicals, 55 percent; bacteria, 62 percent; manure and animal wastes, 55 percent; insecticides, 48 percent; soap and detergents, 46 percent; dead fish, 47 percent; broken glass, 36 percent; fertilizer, 41 percent; odor, 36 percent; dirty water, 32 percent; algae, 25 percent; sharp stones, 33 percent; mud, silt and sand, 41 percent; weeds and plants, 26 percent; and unclear water, 22 percent. Fishermen were especially sensitive to water pollution. If pollution made fish undesirable to handle, 75 percent would discontinue fishing at the site, 50 percent if fish acquired an odor, and 33 percent if fish acquired an off-taste. If the number of fish caught declined as a result of water pollution, 57 percent of the fishermen reported they would reduce participation.

Willeke [1968] showed the effects of water pollution on recreation use of San Francisco Bay. Personal evaluations of water quality were most influential in recreation decisions. He found that visual pollution and odor influenced the perception of water quality reported by 79 percent of those interviewed. With pollution of the bay, 77 percent of the water skiiers and 67 percent of the swimmers discontinued recreation use compared to only 9 percent of the fishermen and 6 percent of the boaters.

David, Howe and Quigley [1970] studied the relationship between types of water pollution and participation in recreation activities in the Wisconsin River Basin. Eighty percent of the sample reported they stopped swimming when algae was present in the water. With the presence of glass, curtailment was 70 percent; unclear water, 40 percent; dirty water, 40 percent; litter and debris, 40 percent; manure or animal wastes, 30 percent; and suds and foam, 20 percent.

Parkes [1973] studied the relationship between types of water pollution and participation in recreation at three recreation sites in Saskatchewan, Quebec, and Nova Scotia, Canada. For example, in Saskatchewan he reported that number of swimming recreation days had declined by 36 percent compared to a 13 percent reduction in fishing days, 12 percent reduction in boating and 1 percent reduction in picnicking. Individuals reported they would be willing to pay $5.18 per week for improved water quality. In Saskatchewan Province, 40 percent of respondents reported algae pollution, and 26 percent reported objectionable weeds present. Types of pollution included floating objects, foam, algae, discoloration, cloudiness, oil scums, domestic sewage, weeds, odor, irritation (ski, eyes, and ears), and taste. He reported that 71 percent recommended general improvement in water quality.

Cecil [1972] studied the relationship between water quality and participation in recreation activities on the Mississippi River in Minnesota. He interviewed a sample of residents of the Minneapolis-St. Paul Metropolitan Area and nonresident tourists in the area. Ninety-one percent of the residents reported they had terminated use of the river for recreation activities, compared to 76 percent of nonresident visitors to the area. Water pollution was the principal reason for not participating in recreation activities on the Mississippi River, reported by 54 percent of those interviewed. Other reasons for curtailment of recreation activities at river sites included crowding and noise, 16 percent, and inferior recreation facilities, 14 percent. Residents were more aware of river pollution than nonresidents. Fifty-eight percent of the residents cited water pollution as the most important reason for not participating in recreation activities there compared to 41 percent of the nonresidents.

Ditton and Goodale [1972] provides the best available estimate of the relationship between water quality and participation in water-based recreation activities. They interviewed a sample of residents of the five-county area around Green Bay, Wisconsin. Sixty-four percent of the swimmers and 54 percent of the fishermen reported they would substitute less convenient recreation sites if water quality deteriorated at Green Bay, as would 49 percent of the boaters. Thirty-one percent of the fishermen would discontinue participating in these recreation activities as would 25 percent of the swimmers and 22 percent of the boaters. A small proportion reported they would continue to participate at the same location despite water pollution. This was indicated by 14 percent of the boaters, 6 percent of the fishermen and only 2 percent of swimmers. Some would continue to participate at the same location despite water pollution but would participate less, how much less was not reported. This was the case indicated by 15 percent of the boaters and by 8 percent of the fishermen and swimmers. Most residents reported that the water in the bay was polluted: 49 percent considered it dirty, 21 percent somewhat dirty, 16 percent reasonably clean, and 5 percent clean. Twice as many residents of the City of Green Bay reported the bay was dirty as those living near its mouth, or 69 percent compared to 35 percent. Quality improves as the bay merges with Lake Michigan.

Myles [1972] found the observations of respondents at recreation sites an ineffective means to discover perception of water quality. He interviewed a sample of recreationists at Pyramid, Lahontan, Tahoe, and Rye Patch Lakes in western Nevada. Comments in reply to open-ended questions on water quality were vague, with water described as either clean and clear, dirty and mucky, or all right.

Most studies of the benefits of water quality improvement have treated the problem as if it were the same as the development of new water resources, and estimated benefits with and without the project, so that benefits were zero or much reduced without the project, so that benefits were zero or much reduced without the project and fully available with it. Stevens [1966] partially overcame the inability of this approach to treat the problem of a change in the quality of water used for recreation activities. He fitted an econometric model to data on participation by individuals in fishing, with average number of fish caught per trip as an index of recreation site quality. Based on this earlier work, Stoevener, et al. [1972] estimated the damages to fishing quality for alternative locations of a proposed paper mill on the Yaquina Bay, Oregon. Mathews and Brown [1970], Stevens [1966] and Parkes [1973] are the only published studies that estimate the relationship between water quality and willingness to pay for a particular water-based recreation experience. All other studies so far have assumed that the body of water in question was either available or not available for recreation use and thus could not measure shifts in the demand curve caused by changes in water quality.

Stoevener, et al. [1972] estimated the relationship between water quality and benefits from fishing for salmon, clams and bottomfish at Yaquina Bay, Oregon. A demand equation for fishing at existing levels of water quality was provided by Stevens [1966]. It showed the relationship between number of fishing days and number of fish caught based on survey results. Biologists estimated the change in fishermen success resulting from alternative effluent disposal plants for the Kraft paper mill near Yaquina Bay. The study concluded that disposal of effluents below Yaquina Bay increased fishermen benefits by $7,906 to $20,230 per year compared to dumping at a more convenient location above the Bay. These benefits resulted from the increased participation of fishermen with higher water quality. The increased benefits result from a horizontal shift in the demand curve by an amount equal to the larger number of fishing days. This procedure omits benefits which result from vertical shifts in the demand curve with increased satisfaction from fishing in water of higher quality.

Reiling, Gibbs and Stoevener [1973] estimated the effects of water quality at Klammath Lake, Oregon, on benefits from the recreation activities of swimming, water skiing, boating and fishing. Consumer surplus was estimated from Clawson-type travel costs demand equations. The relationship between participation in water-based recreation and water quality was estimated at the EPA Pacific Northwest Water Quality Laboratory in Corvallis. Increased participation with increased water quality shifted the demand curve horizontally and did not change the vertical or price intercept. Recreation use value of water quality in the lake was reported as $9.86 per person for trips averaging 2.83 days.

Davidson, Adams and Seneca [1966] estimated the effect of water pollution in the Delaware Estuary on participation in boating and fishing. They estimated participation in the area with and without water pollution in 1965 and projections to 1990. Participation was estimated by multiplying population by the probability of participation from a multiple regression. This was with and without recreation use of the Delaware River. Benefit levels were illustrated with hypothetical benefits of $1 to $5 per day. These showed that the present value of annual benefits were more affected by the level of daily benefits assumed than by participation estimates.

Russell [1972] estimated the effect of water pollution of the Nashua River in Massachusetts on participation in water-based recreation. Participation was forecast with and without recreation use of the river. He adapted a demand equation for recreation on lakes and reservoirs in Texas [Grubb and Goodwin, 1968] to conditions in Massachusetts. The estimated equation from Texas had shown the relationship between acreage of usable water and participation. It also provided Clawson-type travel cost estimates of willingness to pay per acre of water suitable for water-based recreation activities.

Faro and Nemerow [1969] estimated the effect of improved water quality at Onondago Lake in New York State on the gross expenditures of recreation users and the operating agency. Expenditures were estimated at current levels of water quality and with improved quality, and the difference was considered a benefit of the improvement. Increased participation levels were assumed. No consumer surplus estimates of benefits were prepared.

Mathews and Brown [1970] illustrate the relationship between catch of salmon and net value per day fishing in four regions of the state of Washington: Pacific Ocean Beach, Strait, Puget Sound, and fresh water rivers and lakes. The study found that 32 percent of salmon fishermen would discontinue the activity entirely if their favorite fishing site became polluted, and 68 percent would shift to alternative higher priced sites. The study also asked fishermen their willingness to pay if the number of fish caught increased. Fish population is related to the quality of water. Salmon are large fish that typically dress out at eight pounds each. Doubling daily catch from two to four pounds of dressed fish is associated with a 50 percent increase in the value per day from $27 to $40. Value continues to increase for a reasonable range of catch per day, up to 12 pounds, possibly higher, but at a decreasing rate. Increasing the catch by the same two pounds, from eight pounds to ten pounds per day increases fishing value per day by only 9 percent from $55 to about $60.

Megli and Gamble [undated] showed the relationship between water quality in Pennsylvania streams and regional economic impact. The study showed that regional income increased $125 per 100 yards of stream for each one milligram per liter increase in dissolved oxygen (mg/l of D.O.). Yearly regional income increased $194 per 100 yards of stream for each one unit increase in pH, under acid stream conditions with pH values below six to seven. This was based on existing multipliers and input-output models for the counties affected.

Index Measures of Effectiveness

The cost-effectiveness approach to decision making has been used when a cost-benefit approach could not because economic measures of benefits were unavailable. Indexes of effectiveness are familiar in the water quality field. Investigators have developed and applied quality indexes to estimate the effectiveness of water and related land resource development alternatives for some time. The procedure is to: (1) identify and list components; (2) convert physical units of measurement (concentration, volume, length, etc.) to common quality units (i.e. scale of 1 to 10); (3) weight the relative importance of each component; and (4) aggregate to obtain a composite index score.

In all effectiveness studies, investigators identify the relevant components of quality, set their weights and estimate their values. The best results combine the balanced judgment of a research team which includes biologists, engineers, planners, social scientists, and landscape architects. Landwehr and Dininger [1976] tested the relationship between water quality indexes and water quality measured in terms of dissolved oxygen, fecal coliform, pH, BOD, NO_3, PO_4, temperature, turbidity and suspended solids. A group of experts developed an index for 20 sites based on judgment and experience. Correlation was high indicating indexes can be a reliable measure of water quality.

Some effectiveness indices are based solely on water quality for recreation use. Others include components of the landscape and other aspects of resources that compliment water quality as part of the recreation experience. A few very broad indices deal with the environment in general, extending beyond consideration of recreation related components.

Dearinger [1968] indexed the effectiveness of small streams to provide aesthetic and recreation experiences. He included the following attributes: (1) natural features including topography, soil conditions, and vegetation; (2) cultural features including land use capabilities, accessibility, historical resources, and adequacy of existing recreation facilities.

Morisawa and Murie [1969] also indexed the effectiveness of rivers to provide water-based recreation activities. Estimates were based on psychological satisfaction and acceptability. They included the following attributes: landscape, sensual stimuli, intellectual interest, emotional interest, obstacles or discomforts, and culture.

Whitman [1968] indexed the effectiveness of streams to provide water-based recreation activities in urban areas. He rated the aesthetic quality of the following variables: the natural habitat for various species, with a weight of 0.2; vegetation, 0.2; appearance and quality of stream water, 0.2; appearance of the stream channel, 0.1; the flood plain vista, 0.1; view of the valley from above, 0.1; and view of the valley from below, 0.1.

The Environmental Protection Agency [1971] has developed and applied a Pollution Duration Intensity (PDI) index which combines legal pollution levels and estimates of use values.

$$\text{PDI} = \frac{\text{prevalence x duration x intensity}}{\text{total stream miles}}$$

where: (1) prevalence is defined as the number of stream miles violating legal criteria for minimum water quality; (2) duration is a value ranging between zero and one according to the proportion of time the violation is occurring; and (3) intensity reflects the severity of ecological interference, reduction in the usability of water for desired human use, and a deterioration in aesthetics. Though open to interpretation, this index seems to possess a reasonable balance of factors to be taken into account in planning.

Truett [1975] developed a Priority Action Index (PAI) in which current pollution was assigned a weight of 0.17, downstream affected population, 0.17, controllability, 0.26, and the PDI index a weight of 0.40. The primary purpose of the index was to introduce population as an element of effectiveness of improved water quality.

Battelle Institute [Dee, et al., 1972] developed one of the broadest effectiveness index systems, including aspects of ecology, environmental pollution, aesthetics, and human interest. Water pollution estimates were made for toxic substances, pesticides, nitrogen, turbidity, temperature, appearance, odor, and floating materials.

York, Dysart and Gahan [1975] developed a desirability or effectiveness index encompassing the same variables as the Battelle study. In a study of the Santee Swamp area in South Carolina, they estimated the effects of conflict among alternative land uses including recreation activities, land subdivisions, power generation plants, and industrial plants. Applying a compatibility index, they estimated the external effects of alternative land use on water, air, and noise pollution. They also estimated the extent of dispersion of the effects geographically.

Leopold developed a matrix containing 100 actions which could cause 88 types of environmental damage. Applied to resource planning, each cell of the matrix would contain an estimate of the magnitude of environmental effect and a plus or minus sign to signify whether the effect would be adverse or beneficial.

Leopold and Marchand [1968] developed a uniqueness index of rivers and related land resources. They included 46 physical, biological, and human variables which were rated on a five-point scale. Sixteen major river valleys in the West were compared and ranked according to their relative uniqueness. They found that the Snake River in Idaho outranked all the the Grand Canyon of the Colorado River. Physical components included: river width at low flow, depth at low flow, velocity at low flow, bankful depth, flow variability, river pattern, ratio of valley height to width, bed material, bed slope, basin area, stream order, erosion of banks, and deposition. Components describing water included: water color, turbidity, floating material, algae, water condition, larger plants, river fauna, pollution evidence, and land flora of the valley including its diversity and condition. Human use and interest components included: number of occurrences of trash and litter, whether material is removable, artificial controls, accessibility to individuals and capability of mass use, vistas, view confinement, land use, utilities, degree of change, recovery potential, urbanization, special views, historic features and misfits.

Numerous other index procedures have been developed and applied to water and related land resource planning. The availability and quality of water has been included in general environmental quality index procedures developed by government agencies including the U.S. Fish and Wildlife Service, the U.S. Forest Service, Bureau of Reclamation, and Bureau of Land Management [1977]. Heiser [1972] and Chutter [1972] have developed indexing procedures to estimate the biological quality of water. Inhaber [1975] has applied indexing procedures to estimate the level of industry and municipal effluent discharged into Canadian waterways.

CHAPTER 3

RESEARCH PROCEDURES

This section presents the research procedures applied in this study. It contains a description of the study area and the basis for its selection. Rocky Mountain National Park contains a high level of water quality and provides a variety of recreation activities for visitors from all regions of the U.S. The sampling procedure is explained as are the reasons why the personal interview method of data collection was selected over alternative methods such as the mail questionnaire and telephone interview. This is followed by an explanation of the use of color photos to depict six levels of water quality. Color photos are considered superior over alternative methods such as narrative description, recollection of past experience and observation at the interview site. A number of studies have shown that perception of water quality suitable for recreation use is based largely on visual attributes. Finally, the basis for the three methods of payment is explained. Although the questions asked were hypothetical, they were designed to be as realistic as possible. The valuation procedure used in this study has been successfully applied to other natural resource and public good problems.

The Study Area

Rocky Mountain National Park was selected as the study area because the visitor population includes a large proportion of tourists who are nonresidents of the state of Colorado. With a total of 2.5 million recreation visits to the park in 1973, approximately 70 percent were nonresidents of the state. Nonresident recreation, while substantial throughout the mountain areas of the state, accounted for less than one-half, 41.5 percent, of total outdoor recreation in the state. The park provided about 3.75 percent of outdoor recreation in the state. The park is located 65 miles northwest of the Denver Metropolitan Area with a population of about 1.3 million, excluding Boulder county. It is the principle commercial center of the Rocky Mountain Region. The South Platte River Basin includes the Denver Metropolitan Area and Rocky Mountain National Park. It drains an area of 19,450 square miles in northeastern Colorado, approximately one-fifth of the total land area in the state. It extends from the Continental Divide on the western edge to the Nebraska border on the east. It extends from a line just outside Colorado Springs on the south to Wyoming and Nebraska borders on the north. It encompasses an area known as the Northern Front Range of Colorado. Nonresidents accounted for 28 percent of total water-based recreation including fishing, swimming, and boating in the river basin.

Rocky Mountain National Park has a recreation population with a balanced representation of nonresident recreation visitors in the entire state. It includes a diversified cross-section of households in terms of state and region of origin and types of recreation activity preferred. The park is easily accessible to cross-country travelers from two major east-west interstate highways, the I-80 and I-70 routes. A 10 percent pretest of the survey in the Poudre River Canyon, west of Fort Collins, showed nonresidents visiting there were characteristically from the Great Plains states and recreation activities were primarily camping

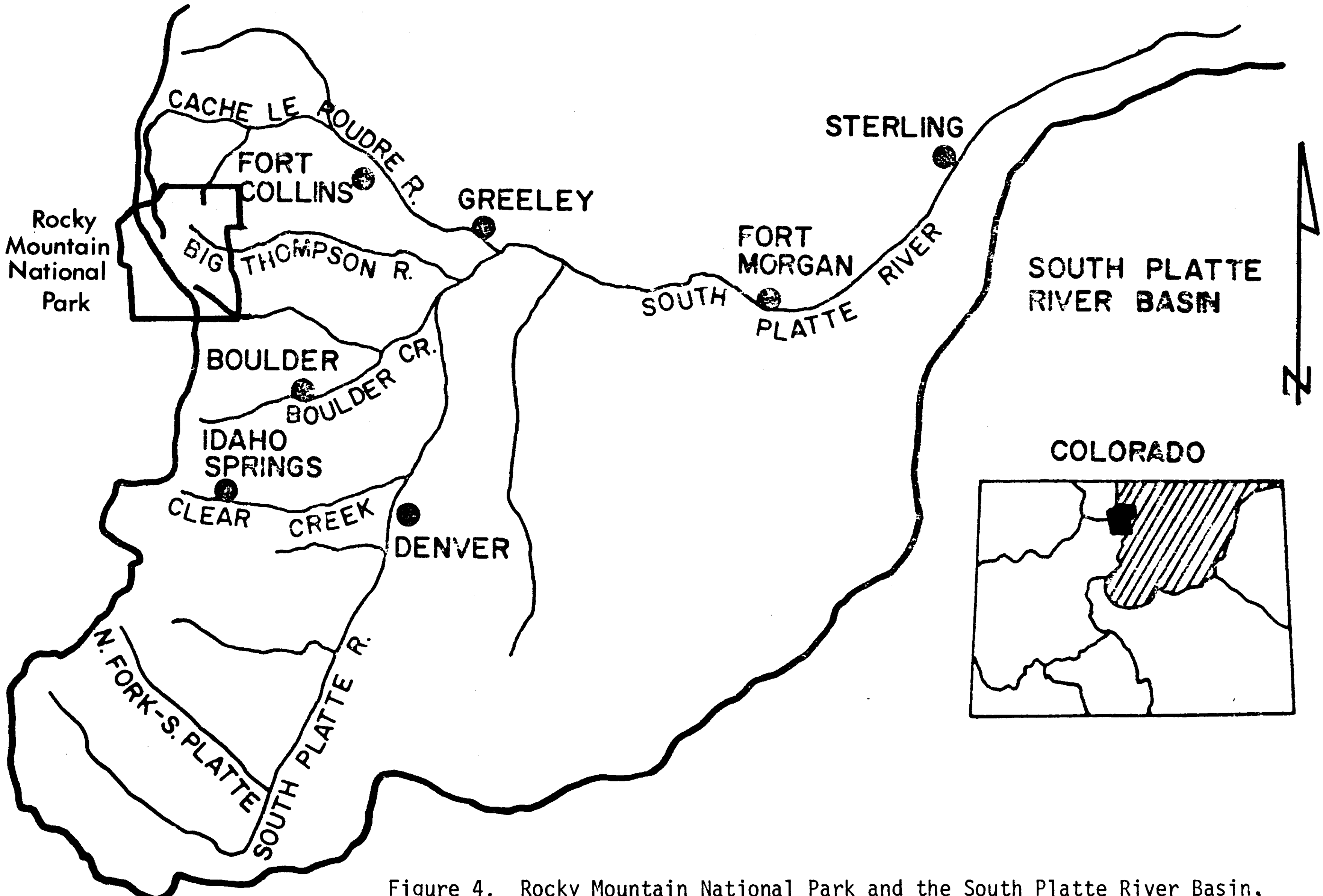

Figure 4. Rocky Mountain National Park and the South Platte River Basin, Colorado.

and fishing. Interviewing in the park avoids possible sample bias associated with a particular type of water-based recreation activity that might have occurred at a smaller area near a particular body of water.

Rocky Mountain National Park is an area of 411 square miles in northcentral Colorado, approximately 0.5 percent of the total land area in the state (Figure 4). It lies between Grand Lake on the west and Estes Park on the east, and is bound by Roosevelt National Forest on three sides. Elevation ranges from 7,640 to 14,225 feet above sea level. It contains 107 named peaks in excess of 10,000 feet elevation. The Continental Divide passes through the midsection of the park with massive peaks, long ridges, and deep valleys, carved by vast sheets of moving ice some 10,000 years ago. Many lakes occupy depressions left by the receding glaciers. Nearly half of the total land area is alpine tundra, and nearly all of the remaining is subalpine forest. At higher elevations is alpine tundra, where trees are sparse and stunted. Lower elevations are primarily conifer forests interspersed with meadows of shrubs, grasses, and wildflowers. Bighorn sheep, black bear, elk, mule deer, beaver, marten, and other small mammals, birds and fish inhabit the park. It has been proposed that 91.5 percent of the park land be designated Wilderness Area under the National Wilderness Act of 1964.

Water quality in the park is good to excellent. Streams originate in the higher mountainous elevations with pristine water quality, and gradually yield to degradation as elevation diminishes and human encroachment increases. There are some areas at high elevations south of the park where streams have become heavily polluted by mine drainage of acid and metals. The park contains the headwaters of the North Fork of the Colorado River. Also originating in the park are the Cache La

Poudre River, the Big Thompson River and the St. Vrain River, major northern tributaries to the South Platte River. The River Basin contains 2,400 miles of fishing stream, about 30 percent of the 8,233 miles in the state capable of sustaining game fish such as trout. The river basin contains 267 lakes and reservoirs suitable for shoreline fishing, 37.6 percent of the 711 lakes and reservoirs in the state. With 1,122 miles of shoreline, the river basin contains 48 percent of the total 2,314 miles of lake and reservoir shoreline in the state.

Recreation use of the park includes scenic drives through the park along Trail Ridge Road, fishing, picknicking, nature walks, wildlife observation, interpretive activities, and overnight vehicle camping. Park use is highly seasonal with two-thirds (68 percent) of the annual use occurring in three summer months, 25.5 percent in the month of August when the survey was conducted. There are over 300 miles of hiking and horseback trails in the park. Hiking accounts for over 600,000 days annually, or 24 percent of park visitor activities. Horseback riding accounts for 35,000 visits per year, or 1.4 percent of the total. About 300,000 park visitors stay overnight in five developed campgrounds with 684 campsites, and one-sixth of these backpack into the 225 remote campsites. Skiing accounts for 40,000 annual visits to the park, or 1.6 percent of the total. The park contains roughly 100 miles of road network, and is heavily used by private vehicles for scenic drives.

Sample Selection

A random sample of 141 household groups were interviewed in Rocky Mountain National Park from August 14 to September 2, 1973. Most water-based recreation activities occur during the summer season in Colorado. With a total of 2.5 million visits to the park in 1973, and an average of 3.6 persons per household group, there were an estimated 694,444 household group visits. Thus, the 141 interviews represent a two-hundredths of one percent (0.02 percent) sample of the population. The number of households interviewed was based on experience with similar recreation surveys where 100 to 200 interviews resulted in statistically significant results.

Interviews were conducted at six sites within the park. Three were at visitor centers, including Park Headquarters, Hidden Valley and Alpine Center. Three were at scenic overlooks along Trail Ridge Road, the highest U.S. highway in the nation and a popular scenic drive. All sites were within reasonable distance from water, two miles at most, but none were immediately adjacent to it. The sites were convenient, offering places for visitors to park their cars, and a large number of individuals from which to sample within a rather restricted area. These six sites were selected because employees of the National Park Service observed that nearly every car entering the park stops at one of these six sites. Cochran, Mosttler, and Tukey [1954] have shown that random sampling requires all sampling units in a population have a nonzero probability of being selected. Interviewing at these sites minimized any systematic bias in the selection of the sample. A nonzero probability of selecting park visitors was assured, according to park administrators. Each site was sampled proportionately with one-sixth of the total sample collected at each of the six sites.

Interviewing was initiated at the beginning of the day with the first visitors to arrive after the interviewer was ready to begin.

Subsequent interviews at the site were randomly selected throughout the day. An attempt was made to avoid interviewing only those park visitors who approached the interviewer with questions about the survey or who expressed eagerness to participate. After completion of each interview, the first household group to stop at the site was selected. This selection process is considered sufficiently random since there is no reason to suspect that systematic ordering would occur in the arrival pattern of park visitors. Interviews continued for the full eight-hour work day. The frequency with which park visitors refused to participate was low, less than five percent. Some respondents had difficulty answering hypothetical value questions, and occasionally they declined to answer questions deemed personal. This basis for omission of respondents from the survey was very infrequent. The sampling unit was defined as a recreation group, usually a family unit or household, visiting the park in a private vehicle. Questions were answered by an adult acting as spokesman for the household group, often after consultation with other family members. Care was taken to assure that answers were representative of the household group, rather than a single individual within the group. The information obtained applies to the household group as a unit.

The personal interview method of data collection was selected over alternative methods such as the mail questionnaire and telephone interview. Personal interviews are usually considered more costly than mail questionnaires, however, the duplication of color photographs would have added to the expense. Also, non-response to personal interviews is usually much lower than for mail questionnaires. High levels of non-response may violate the requirement of randomness necessary for application of statistical tests. Personal interviews are more suitable for data collection in the case of non-market goods such as water quality than are mail questionnaires. The hypothetical nature of the value questions can be more effectively introduced and explained. Personal contact assures a more uniform level of comprehension than a mail questionnaire. Telephone interviews also would have allowed the interviewer to introduce and explain the non-market value problem, however, color photos could not have been shown to the respondent, thus the assessment of suitability of water for recreation use would not have been possible.

Color Photographs

Park visitors were shown pictures of the six levels of water quality illustrated in Figure 5. The photos were presented in a random order, which respondents ranked according to perceived suitability of each for water-based recreation activities in which they participate. The six color photographs depict levels of water quality in the South Platte River Basin, Colorado, which includes most of Rocky Mountain National Park within its western drainage area. They were selected from an inventory of 40 exposures taken of rivers and lakes throughout the River Basin including the Poudre River near Fort Collins and lakes in the suburban areas of Denver. The six color photos were selected to illustrate a wide range of water quality and to limit variations in composition so that water quality would be the sole basis for differentiation, not the setting of the body of water.

Ideally, the color photos should include a visual depiction of all of the water quality characteristics which could influence park visitors

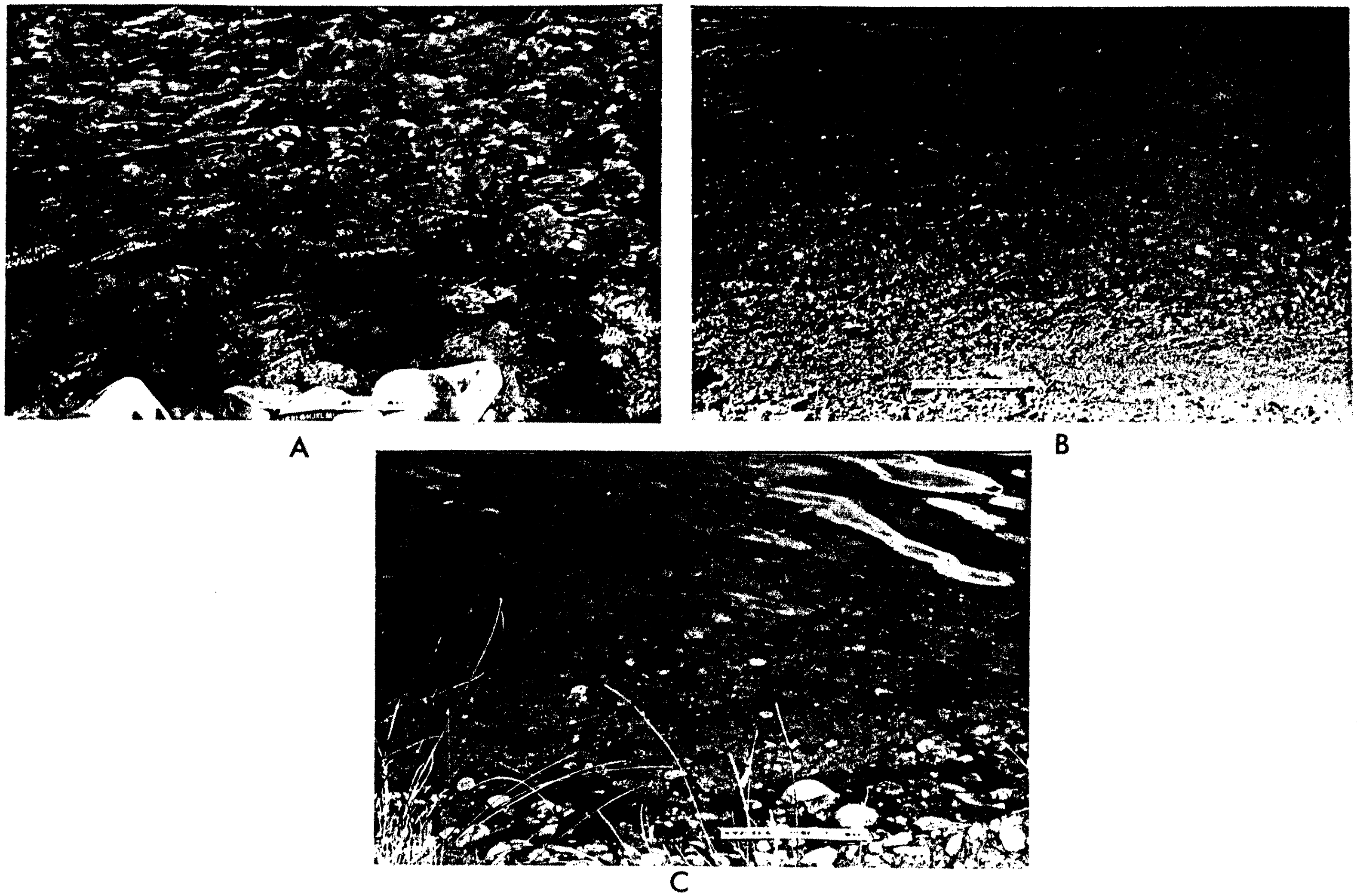

Figure 5. Six Levels of Water Quality, South Platte River Basin, Colorado, 1973.
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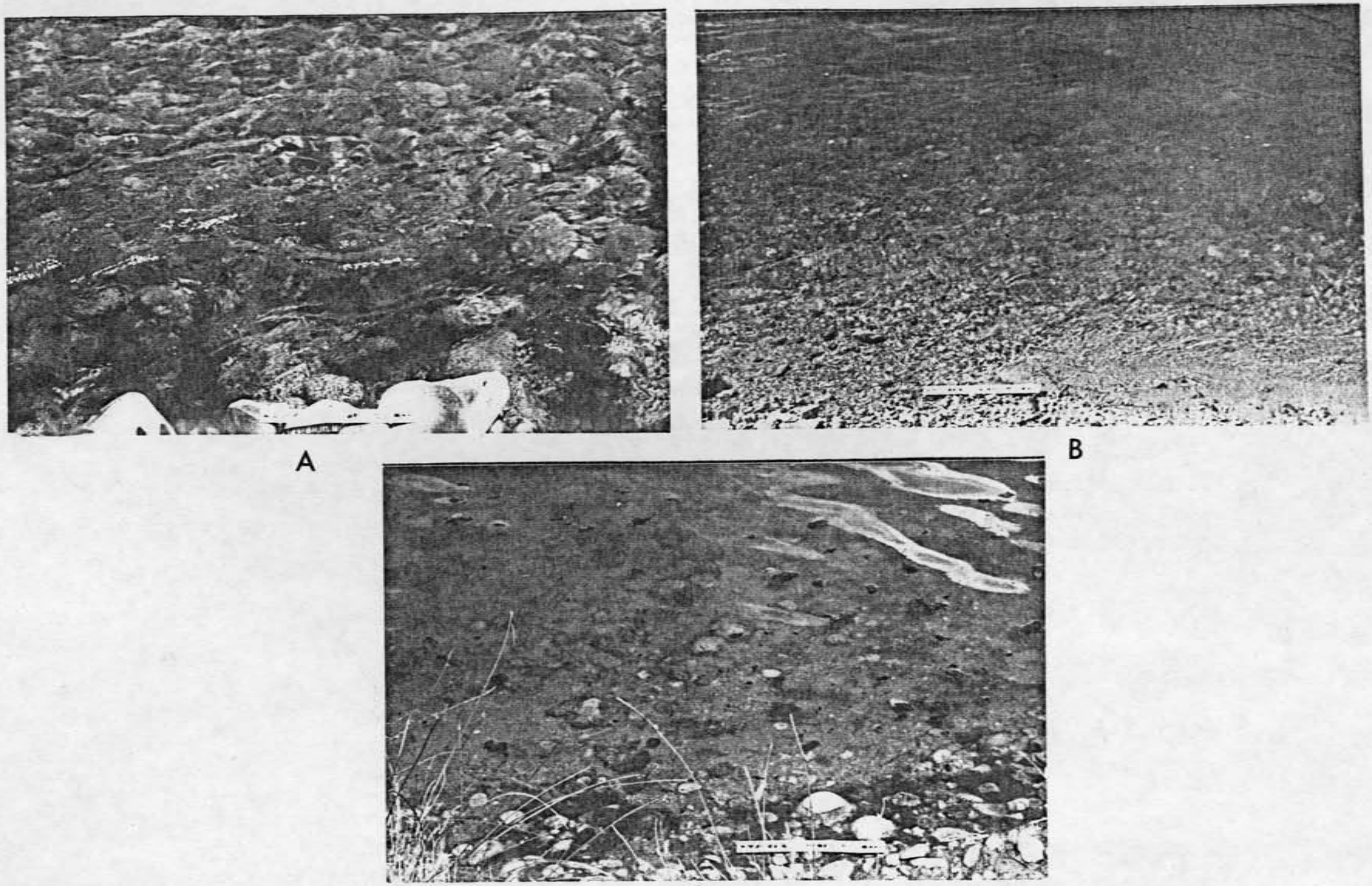

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Figure 5. Six Levels of Water Quality, South Platte River Basin, Colorado, 1973.
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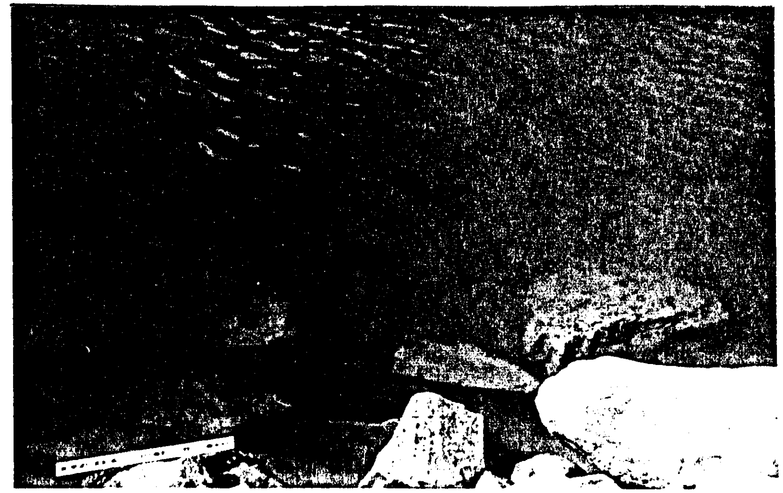

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Figure 5. Six Levels of Water Quality, South Platte River Basin, Colorado, 1973.
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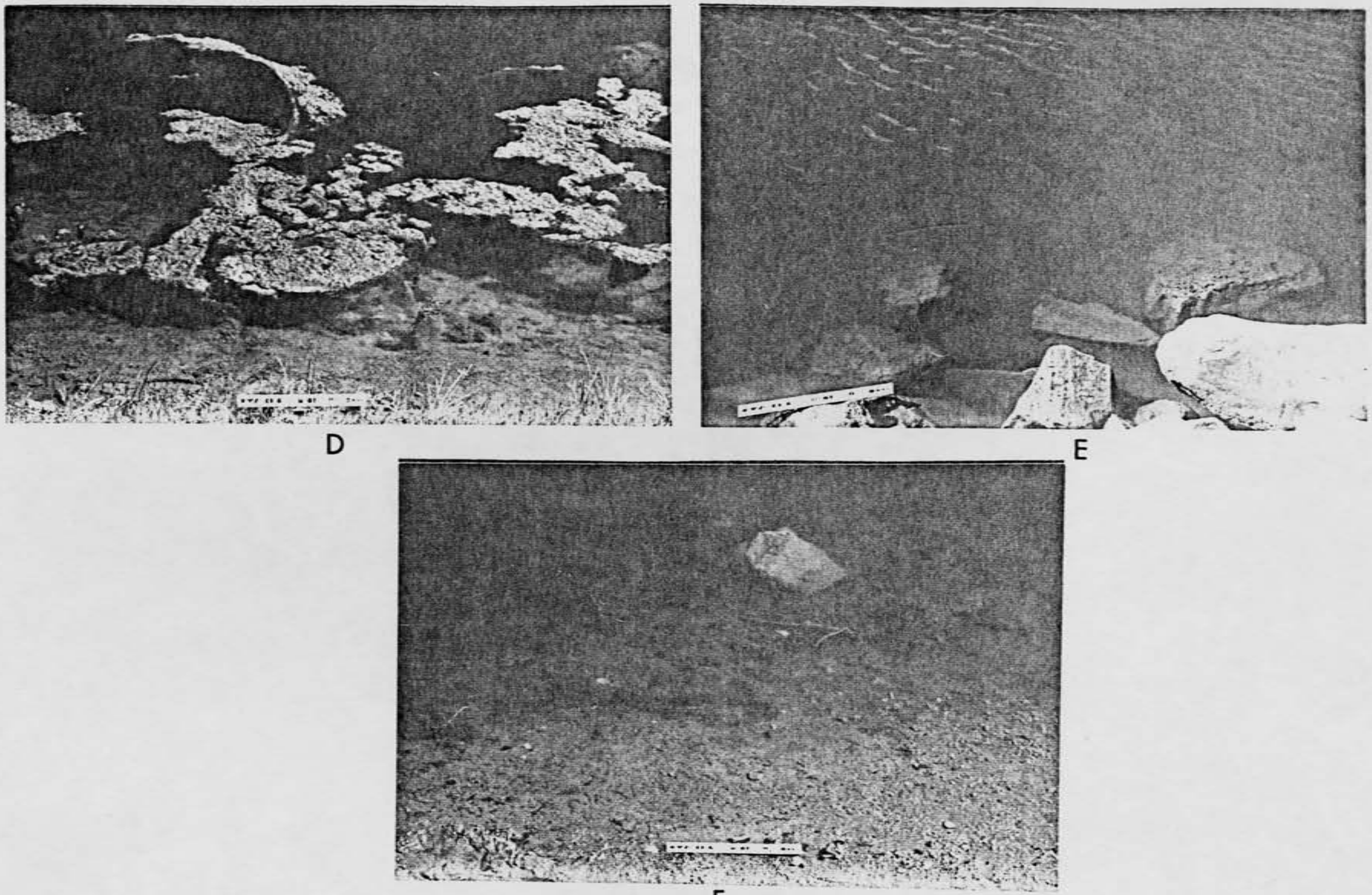

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Figure 5. Six Levels of Water Quality, South Platte River Basin, Colorado, 1973. (continued from previous page)

perception of its suitability for the enjoyment of water-based recreation activities. Color photos can realistically depict evidence of visual pollution such as algae, weeds and sedimentation, while not showing nonvisual pollution such as odor, harmful chemicals and bacteria.

Color photos were selected to depict water quality because of their superiority over alternative methods such as narrative description, recollection of past experience, and observation at the interview site. Color photos are apparently the most effective basis for depicting variations in water quality. Carefully selected, they can contribute to: accuracy, convenience of comparison, and a minimum of distortion.

A number of studies including Parkes [1973], Aukerman [1971] and Willeke [1968] have shown that perception of water quality suitable for recreation use is based largely on <u>visual</u> attributes. These studies suggest that color photos can show most water properties relevant to park visitors. Little else is currently known about the way people select and weigh the various characteristics of water quality to arrive at a judgement. Individuals may differ depending on their attitudes, activity preferences and other socioeconomic characteristics. Rudimentary knowledge about the way individuals work through the perception process suggests that the measurement of water quality can be best approached by providing individuals the opportunity to assign personal weights to each of the components which enter into their overall perception of water quality. From this information, an implicit index of water quality was developed based on the judgement of users. This is considered superior to the alternative explicit index of water quality based on a narrative description of technical measures of the characteristics of water quality. The use of color photos in direct interviews with recreationists is well suited to the implicit index approach adopted in this study.

Color photos are apparently less destorting than a narrative presentation of a technical description of various levels of water quality. Color photos allow a minimum of distortion as respondents themselves choose the characteristics of water quality upon which to judge its quality. Respondents answer questions about one or more characteristics of water quality described narratively, but have little opportunity to relate them to their overall effects on the quality of the recreation experience. Accuracy is limited by the degree to which all relevant aspects of water quality have been presented. Asking questions about the quality of water at an interview site has the advantage that it can be based on respondents' experience with all relevant aspects of water quality, however, the effects of other characteristics of the recreation area cannot be wholly controlled, nor can different levels of water quality be compared. Opportunity to compare different levels of water quality are limited to interviewing at different points in time as water quality at the site changes, or to drawing samples at sites with different levels of water quality. Reliance on the recollection of respondents as to the level of water quality at the site in past years seems less satisfactory than the use of color photos which allow comparison of different water quality levels at one point in time.

Method of Payment

The questions asked respondents, although hypothetical, were designed to be as realistic as possible. Three methods of payment were chosen to maximize the realism and credibility of the hypothetical questions. These were: travel time, waterfront recreation property values, and recreation entrance fees. The three measures represent established, routinized methods of paying for water-based recreation activities. It was, therefore, not difficult for most respondents to comprehend the payment for access to improved water quality by the three approaches.

Visitors to Rocky Mountain National Park were familiar with the practice of paying an entrance fee to recreation areas. The park charges a $1.00 fee of each entering vehicle, and additional charges are made for campground use. People are aware that fees collected are used to provide services in the park such as drinking water and toilet facilities which require wastewater treatment. Thus, it is realistic to conceive of a recreation area collecting an entrance fee and using the income to finance improved water quality. It is general knowledge that entrance fees are collected from all individuals entering the park. This knowledge is expected to reduce the effects of the free-rider problem discussed below.

Most heads of households are familiar with the practice of purchasing private property for their household use and enjoyment. Most people can readily comprehend that the value of waterfront property may vary with the characteristics of the site including water quality. This method of payment introduces the exclusion principle in that improved water quality can be appropriated by individuals in the value of waterfront recreation property. Development of water resources have affected the value of private land nearby and Clawson and Knetsch [1966] have suggested that enhanced land values are one measure of the benefits of governmental resource development programs. Crutchfield [1962] has noted that some of the economic benefits of water resource development accrue to land.

> Property values adjoining both steelhead streams and the best salt-water salmon fishing areas reflect their attraction to fishermen in both residential and commercial use. In effect, our failure to charge a full economic price of access to a limited and valuable sport fishery results in a somewhat higher rate of return to parcels of land that offer some element of control over use of the fishing waters or which provide more convenient access.

Indications are that for most recreation users of water resources, travel time is a part of travel costs. The time traveling to and from a recreation area is correctly treated as a cost if the length of stay at the area would have been increased had the travel been less. However, if the travel is enjoyable in itself because of roadside scenery, the travel time would not be an effective measure of willingness to pay for water quality at recreation destination sites. There is some empirical evidence to suggest that about one-half of total outdoor recreation travel is pleasure driving with the scenery adding to the utility of the trip [Norton, 1970]. However, most households engaged in water-based recreation activities such as fishing, boating, and swimming are destination oriented, and travel time is primarily a disutility detracting from the time available for these activities [Walsh, 1977].

The valuation procedure used in this study had been successfully applied to other natural resource and public good problems [Davis, 1963; Bohm, 1972]. Still, there is not absolute assurance that answers to hypothetical willingness to pay questions accurately reflect consumer preferences. Water quality suitable for use in water-based recreation activities is a public good which means that if it is provided for one individual it is equally available for all to enjoy. There exists no market in which an individual could purchase a desired level of water quality and exclude other individuals from its use. This may lead to biased estimates of the willingness to pay for improved water quality. Samuelson [1954] warned that " . . . it is in the selfish interest of each person to give false signals, to pretend to have less interest . . ." in water quality when he suspects that he may actually have to pay the amount he reveals as his willingness to pay. On the other hand, individuals may overstate their willingness to pay if assured that the amount they specify will not be used as a basis for actual payment [Bohm, 1971, 1972]. This possible bias is defined as any increase or decrease in a park visitor's dollar expression of willingness to pay for any reason other than satisfaction anticipated from the recreation experience resulting from improved water quality. There are several ways to reduce this type of bias in willingness to pay estimates.

All three measures of willingness to pay specified that hypothetical payments would be made personally by the respondents. This was expected to reduce the free rider problem, in which respondents may bias willingness to pay questions if they suspect that they can overstate the true value of improved water quality to themselves, with third parties providing the service at no cost to themselves. Introductory information provided to respondents emphasized that some kind of user charge must be levied in order to improve water quality and without their individual payment, improved water quality would not be available at their favorite outdoor recreation sites. The travel time measure of willingness to pay for improved water quality is particularly helpful in controlling for this possible bias in willingness to pay. It emphasizes the possibility the respondent may actually have to pay the amount he reveals as his willingness to pay, as travel time cannot be appropriated either by government or private companies providing recreation services. Moreover, there is little likelihood that any third party might bear the travel time burden for individual respondents.

Respondents were asked to reveal their willingness to pay in what was clearly hypothetical situations. Respondents knew that the interviewer was a college student and not acting in an official capacity, thus they could infer that their responses would have no direct effect on their payment obligation. If respondents believed that their answers might affect the public decision as to whether to improve water quality, the rational individual may have responded in a way that maximized the likelihood that water quality would be supplied. His response would be the highest figure which he thinks will be believed by authorities collecting the data. It will be an overstatement of his true willingness to pay.

There has been relatively little empirical work to test the possibility of bias in answers to hypothetical willingness to pay questions. Bohm [1972] conducted a controlled experiment comparing five alternative measures of willingness to pay for a public good similar to water quality. Among the alternative methods of payment were both actual immediate payment in cash of the stated willingness to pay, and no actual payment of the stated willingness to pay. The main finding of the experiment is that there was no significant difference in the average reported willingness to pay among the groups presented with the five alternatives. Brookshire, Ives and Schultze [1976] surveyed local residents and three categories of recreationists in Grand Canyon National Recreation Area to determine their willingness to pay to prevent the scenic and aesthetic degradation associated with a proposed coal-fired electric power plant on Lake Powell. Color photos showed the quality of the natural resource with and without the power plant development. The frequency distribution of willingness to pay answers suggests there was no appreciable difference between nonenvironmentalists and environmentalists with respect to zero responses and high responses, and the modal willingness to pay ranged from $2 to $4 per household recreation day for all sample groups.

The willingness to pay measurement of the value of improved water quality was selected over the alternative method, willingness to accept compensation for reduced quality. The economic literature has defined willingness to pay as the "compensating variation" and the acceptance of a subsidy as "the equivalent variation." Congress in P.L. 92-500 determined that polluting rights are not for sale. Thus the question of what level of compensation would be required to allow recreationists to remain no worse off than before pollution of recreation water resources is of only peripheral interest. The appropriate question to ask depends on the kind of resource decision to be made. The willingness to pay approach was selected because more realistic estimates of value are expected under the budget constraints of limited income and time. The acceptance of compensation would increase the respondent's level of income which would lower his marginal utility of money, resulting in estimates unrestrained by the utility of dollars normally earned as income. The compensation approach has resulted in some nonsensical results in previous research. Hammack and Brown [1974] found enormous requests for compensation to relinquish waterfowl hunting, as did Matthews and Brown [1970] for salmon fishing, and Randall, Ives and Eastman [1976] in the case of compensation for polluted air quality in the Four Corners area of New Mexico.

CHAPTER 4

WILLINGNESS TO PAY

This section presents the average benefits reported by park visitors as their willingness to pay for improved water quality. Results of the survey are shown for the three methods of payment: recreation fee, property value and travel time. The empirical results of this study are compared to the available literature. Empirical demand curves for water quality are based on regression coefficients of willingness to pay to avoid one unit decreases in water quality on an interval scale of zero to 100. The results allow managers of recreation and water resources to calculate the annual benefits and present value of any intermediate level of water quality improvement.

The survey results for households are aggregated to the population of visitors to Rocky Mountain National Park and to nonresident recreation in the South Platte River Basin and in the state of Colorado. Total annual benefits provide a basis for calculation of the present value of future benefits. Present value estimates are included for illustration purposes and are based on zero recreation growth which is a conservation expectation of the prospects for tourism in the state. The benefits from maintaining all waterways in their natural condition are compared to benefits from improving the reported 24 percent of the waterways in the state which currently do not support fish life owing to pollution levels.

Perception of Water Quality

For the purposes of this study, water quality was defined in terms of its suitability for water-based recreation activities in which visitors to Rocky Mountain National Park regularly participate. The sample of 141 visitors to the park ranked six color photos showing distinct levels of water quality. Respondents also rated each of the six color photos on an index of zero to 100 with zero defined as the most polluted level known through the media, work experience, or personal knowledge and 100 the cleanest water known. Table 1 shows that park visitors perceived the six ranked photos as representative of water quality varying from a low index of 25 to a high of 93, which is considered reasonably close to the biological quality of the water shown.

Table 1. Perceived Suitability of Water Quality for Recreation Use, Visitors to Rocky Mountain National Park, Colorado, 1973.

Suitability for Recreation Use	Color Photos Illustrating Six Distinct Levels of Water Quality					
Perceived Rank	1	2	3	4	5	6
Perceived Water Quality Index[a]	93	82	64	50	36	25

[a] The perceived water quality index is an interval scale ranging between zero and 100. The maximum value of 100 defined as a measure of water quality entirely suitable for recreation use. The minimum value of zero is defined as a measure of water quality entirely unsuitable for recreation use.

Daily Recreation Entrance Fee

Table 2 shows the average willingness to pay a daily fee for recreation use of five levels of improved water quality. This measure of value is defined as the maximum increase in fees park visitors would be willing to pay for entrance to an otherwise suitable recreation area, if the additional payment would obtain an incremental improvement in water quality. To gain natural water quality defined as the first ranked photo with a water quality index of 93 and avoid the sixth ranked photo with the most quality deterioration (WQI=25), park visitors reported they would be willing to pay a daily recreation fee of $5.42. At intermediate levels of water quality, park visitors reported they would pay less to clean it up. For example, to improve the quality of water shown in the fourth ranked photo (WQI=50), park visitors report a willingness to pay a daily recreation fee of $3.92.

These values for park visitors are comparable to the recreation use value of water quality improvement to residents of the South Platte River Basin [Walsh, Greenley, Young, McKean, and Prato, 1978]. A substantial portion of the Rocky Mountain National Park is located within the South Platte River Basin which extends from the Continental Divide to the Nebraska and Kansas borders and from Colorado Springs to Wyoming. In the summer of 1976, river basin residents in Denver and Fort Collins reported they were willing to pay $3.76 per household activity day or $56.68 annually in added sales tax to improve water quality in the River Basin for recreation use. This was the average value for the 80.8 percent of the households interviewed who expect to continue to use lakes and streams in the River Basin for fishing, boating, swimming, and non-contact recreation activities such as picnicking and sightseeing near water with enhanced aesthetic satisfaction of such recreation experiences.

Residents of the River Basin were also asked to report the option value of the opportunity to choose future recreation use of improved water quality. Adding option value to recreation use value, total

Table 2. Average Willingness to Pay for Water Quality Suitable for Recreation Use, Visitors to Rocky Mountain National Park, Colorado, 1973.a/

Measures of Value	Willingness to Pay to Gain Natural Water Quality, Defined as First Ranked Photo, Water Quality Index (WQI)=93				
	Avoid 2nd Ranked Photo WQI=82	Avoid 3rd Ranked Photo WQI=64	Avoid 4th Ranked Photo WQI=50	Avoid 5th Ranked Photo WQI=36	Avoid 6th Ranked Photo WQI=25
Willingness to Increase Travel Time by (percent) n+141	13.1%	32.3%	52.3%	71.8%	88.7%
Willingness to Pay More for Waterfront Recreation Property by (percent) n=141	19.9%	51.8%	84.9%	131.1%	164.6%
Willingness to Pay more Daily Recreation Fee (dollars) n=141	$0.68	$2.82	$3.92	$4.91	$5.42

a/ Shown is the reported willingness to pay to gain natural water quality defined as the first ranked photo, with a water quality index of 93, and avoid deteriorated water quality conditions as perceived in respondent's second, third, fourth, firth, and sixth ranked photos. For example, the right-hand column shows the average willingness to pay to gain natural water quality with an index of 93 and avoid the lowest level of water quality represented by the sixth ranked photo with an index of 25.

recreation value of improved water quality in the River Basin averaged $79.28 annually, which was equivalent to $5.29 per household recreation day. This was nearly identical to the $5.42 per household day reported by visitors to Rocky Mountain National Park in the summer of 1973. Park visitors from Colorado (17.6 percent) were willing to pay somewhat more, $5.62, while nonresidents of the state visiting the park were willing to pay an average of $5.39 per household recreation day. Water quality is higher in the park than in the river basin as a whole. The park is one of the unique natural areas of the nation, with pristine rivers and lakes, and majestic mountain peaks. This unique natural setting may have resulted in the higher value estimates of park visitors compared to residents of the area.

The value of water quality to park visitors was lower than the value of lake water quality in Oregon [Reiling, Biggs and Stoevener, 1973]. Recreation use value of water quality in Oregon was reported as $9.86 per person for trips of 2.83 days. If the average number of persons per household was within the range of two to four persons, the Rocky Mountain National Park values per household were lower than values for Oregon, calculated as $10.41 (= $9.82/2.83 days x three persons) per household recreation day.

The value of water quality to park visitors was close to values reported in a recent study of the Merrimack River Basin in New Hampshire and Massachusetts. Ostar [1977] interviewed 200 residents of that basin and found an average willingness to pay for pollution abatement of $12 per person annually. If family size averaged four persons, this would be equivalent to a value of $48 per household in that basin. This compared to annual values of $59.62 (= $5.42 x 40 percent of 27.5 days) for visitors to Rocky Mountain National Park. A study of willingness to pay for water quality at two lakes and an estuary in Canada reported values of $0.83 to $5.18 per week [Parkes, 1973]. These findings are difficult to compare as it is not clear whether values are reported for individuals or households. Also, the level of water quality improvement was not always precisely stated in this and in other studies.

No data are available for costs of travel and participating in recreation at Rocky Mountain National Park. A study of the average daily expenses reported by recreation households visiting Yosemite National Park in 1975 showed that travel costs per household recreation day were about $19 and other expenses were $11, totaling $30 per household recreation day [Walsh, 1978]. These costs include added expenditures for food on the recreation trip. Increasing recreation entrance fees by $5.40 per day would equal 18 percent of the current price of $30 per household recreation day at Yosemite National Park.

Waterfront Recreation Property Value

Table 2 shows the average willingness to pay for waterfront property with access to recreation use of five levels of improved water quality. This measure of value is defined as the maximum percentage increase in the purchase price park visitors would pay for waterfront recreation property otherwise suitable for recreation use, if the additional payment would obtain an incremental improvement in water quality. To gain natural water quality defined as the first ranked photo with a water quality index of 93 and avoid the sixth ranked photo with the most quality deterioration (WQI=25), park visitors reported they would be willing to pay nearly one and one-half times more or an increase of

165 percent. At intermediate levels of water quality, park visitors reported they would pay smaller increases for waterfront recreation property. For example, to improve the quality of water shown in the fourth ranked photo (WQI=50), park visitors report a willingness to increase the purchase price for waterfront property by 85 percent.

These property value estimates are not directly comparable to other studies which have not isolated the effects of water quality from other values associated with waterfront property. However, other studies have found that property values are substantially higher near lakes and streams. Coughlin and Hammer [1973] showed that property values within 100 feet of a large stream valley park in Philadelphia increased from a base of $25,000 per acre to $40,000 or by 60 percent. Dornbusch and Barrager [1973] showed that waterfront property values on San Diego Bay, Kanawha, Ohio, and Willamette Rivers increased by 8 to 25 percent with improved water quality. On this basis, they estimated that overall property values in the U.S. could increase by $1.3 billion with improved water quality.

Clawson and Knetsch [1966] have urged that recreation land value enhancement be added to recreation users values in estimating the benefits of water development, and a number of studies have been made. Walsh and Parsons [1972] surveyed seasonal recreation housing in Larimer County in the vicinity of Rocky Mountain National Park in 1970. They sampled 99 households, 43 percent of which were within a ten-minute walk of a lake and 65 percent within ten-minute walk of a stream. Average value of land and improvements was reported as $17,160. As a very rough estimate, increasing the purchase price of typical recreation property held by a family by 165 percent would increase its value by $28,314.

Some of this locational value up to one mile away from lakes and streams may already be included in recreation user benefits. A National Survey of Fishing and Hunting for 1970 showed the 10.8 percent of the total fishing in the U.S. occurred within a distance of one mile from the residences of fishermen, accounting for 5.3 percent of the total travel costs of fishermen [Fish and Wildlife Service, 1972]. A very small amount of fishing occurred between one and five miles of the fisherman's residence, about 0.4 percent of the total, accounting for 0.1 percent of total travel costs.

Travel Time

Table 2 shows the average willingness to increase travel time for recreation use of five levels of improved water quality. This measure of value is defined as the maximum percentage increase in time park visitors would be willing to travel to an otherwise suitable recreation area, if the additional time would obtain an incremental improvement in water quality. To gain natural water quality, defined as the first ranked photo with a water quality index of 93 and avoid the sixth ranked photo with the most quality deterioration (WQI=25), park visitors reported they would be willing to increase travel time by nearly 89 percent. To avoid intermediate levels of water quality, park visitors reported they would be willing to incur a smaller increase in driving time. For example, to have access to the quality of water shown in the fourth ranked photo (WQI=50), park visitors report they were willing to increase driving time by 52 percent.

Other studies have shown that a majority of households engaged in water-based recreation will substitute other recreation areas when a recreation site becomes polluted, but they did not ask respondents how far they would drive or their added travel time. Ditton and Goodale [1972] found that 59 percent of households engaged in water-based recreation at Green Bay, Wisconsin, would travel to less convenient areas if Green Bay became polluted. Cecil [1972] reported that 54 percent of households engaged in water-based recreation on the Mississippi River would travel to less convenient areas to avoid pollution of the river. Myles [1970] reported that two-thirds of households engaged in water-based recreation considered scarcity of time as the principle determinates of level of participation. Horvath [1974] reported that southeast resident fishermen considered travel time as the most important factor in the choice of where to fish, followed by the abundance of fish, and low fisherman population densities at the site.

Travel time is difficult to value in terms of money. Like recreation activities themselves, leisure time is not priced in markets. There is usually a high correlation between travel distance and travel time. Costs of travel can be reasonably estimated from the market prices for gasoline, oil, tires, etc. In recent years, the transportation economic literature has reported on several studies of commuter travel time values, which have implications for recreation benefit studies. Nonwork travel time values for adult travelers have ranged from 25 to 50 percent of individual wage rates, and for children, one-fourth of the adult value [Cesario, 1976]. About one-half of visitors to the park are children. With an average of 3.6 persons per household entering the park, two persons are designated adults and 1.6 persons children. Adult travel time was valued at one-third of annual income after taxes of 20 percent. Park visitors reported income of $19,500, which is equal to $15,600 after taxes. Following the standard procedure by Cesario, net income of $15,600 was multiplied by one-third and then divided by 2,000 work hours (250 eight-hour work days). This results in adult travel time valued at $2.60 per hour. With two adults per household, total adult travel time per household equals $5.20 per hour. With 1.6 children per household at 25 percent of adult values, this adds $1.04 per hour. Thus, travel time per household is valued at $6.24 per hour. The national estimate of travel by fishermen was 42 miles per recreation day in 1970 [Fish and Wildlife Service, 1972]. With average recreation travel time of 40 miles per hour [Clawson and Knetsch, 1966], water-based recreation travel time equals about one hour per household recreation day. Thus, increasing travel time by 89 percent for access to clean water would equal about $5.55 per household recreation day. This value of time in money terms is not significantly different from willingness to pay an entrance fee reported as $5.42 per household recreation day.

Annual Benefits and Present Value of Future Benefits

An estimate of the total annual benefits to park visitors from water quality suitable for recreation use was prepared for Rocky Mountain National Park. An estimate of the annual benefits to nonresident tourists was prepared for the South Platte River Basin and the state of Colorado. These annual values provided the basis for calculating the present value of a perpetual future stream of annual benefits to the park, river basin and state. Table 3 shows these annual and present values of benefits.

Table 3. Annual Value and Present Value of Recreation Benefits from Water Quality, Rocky Mountain National Park, South Platte River Basin, and Colorado.

Location of Benefits	Total Annual Benefits			Present Value of Future Benefits[a/]		
	Nonresidents	Residents[b/]	Total	Nonresidents	Residents[b/]	Total
				Millions of Dollars		
Rocky Mountain National Park	$2.6	$1.1	$3.7	$41.0	$18.2	$59.2
South Platte River Basin	$16.6	$61.1	$77.7	$260.9	$958.5	$1,229.4
State of Colorado	$41.1	$72.2	$115.8	$644.2	$1,163.9	$1,808.1

[a/] Assuming a perpetual benefit stream, where Present Value = B/i, B = total annual benefits and i = Federal Rate of Discount, 6 3/8 percent.

[b/] Resident benefit estimates are calculated from [Walsh, Greenley, Young, McKean and Prato, 1978].

Total annual benefits to park visitors from water quality in Rocky Mountain National Park were calculated as $3.8 million. This was based on an average value of $5.42 per household recreation day in the park. The number of park visitors was reported as 2.5 million in 1973, and with average household size of 3.6 persons, the number of household recreation days was estimated as 696,555. Number of household recreation days was multiplied by the average value per day.

Total annual benefits to nonresident tourists from water quality in the South Platte River Basin were calculated as $16.6 million. This was based on an average value of $5.36 per household recreation day reported by nonresident park visitors. The number of nonresident recreation visitors to the river basin annually was calculated from a study by the Colorado Division of Parks and Outdoor Recreation [1974] which reported 7.7 million nonresident household recreation days in Colorado in 1971, of which an estimated 40.5 percent of 3.1 million were in the river basin counties. The 3.1 million household recreation days were multiplied by the average value per day for nonresident park visitors. Other research has shown that the value of water quality to residents of the river basin was $61.1 million [Walsh, Greenley, Young, McKean and Prato, 1978]. Thus, the nonresident benefits increase total recreation benefits from water quality in the river basin to $77.7 million, or by 27.2 percent.

Total annual benefits to nonresident tourists from water quality in the state of Colorado were calculated as $41.4 million. This was based on an average value of $5.36 per household recreation day reported by nonresident park visitors. The number of nonresident recreation visitors to Colorado was reported as 7.7 million household recreation days in 1971. This was multiplied by the average value per day for nonresident park visitors. Total population in Colorado was reported as 2.45 million persons, and with average household size of 3.5 persons, the number of households was estimated as 700,000. Number of households in the state was multiplied by $106 average annual benefits per resident household in the South Platte River Basin, assuming residents of other river basins in the state receive equal benefits from water quality in their basins. The annual benefits of water quality to residents of the state of Colorado were estimated as $74.2 million, thus the nonresident benefits increase total recreation benefits from water quality in the state to $115.3 million, or by 55.4 percent.

The present value of a perpetual stream of benefits from water quality in Rocky Mountain National Park was calculated as $59.2 million. Present value is the amount of money that would have to be invested at interest today in order to yield the specified annual benefits from water quality for an indefinite period of time. The formula is $PV = B/i$ where PV is the present value of a perpetual stream of annual benefits, B is the annual benefits from water quality and i is the Federal discount rate of 6 3/8 percent used in calculation of benefits and costs of public water projects.

The present value of a perpetual stream of benefits to nonresident tourists from water quality in the South Platte River Basin was calculated as $260.9 million. Other research has calculated the present value of water quality to residents of the river basin as $958.5 million, thus the nonresident estimate increases total recreation benefits from water quality in the river basin to $1,229.4 million, or by 28.3 percent.

The present value of a perpetual stream of benefits to nonresident tourists from water quality in the state of Colorado was calculated as $644.2 million. Based on other research, the present value of water quality to residents of the state of Colorado was estimated as $1,163.9 million, thus the nonresident visitor benefits increase the present value of total recreation benefits from water quality in the state to $1,808.1 million, or by 55.3 percent.

The calculation of present value of future benefits is included for illustrative purposes, and is likely to be a low estimate for a number of reasons. Future annual benefits are assumed to remain constant at 1973 and 1976 levels, which seems unlikely to occur. For one thing, the number of visits to Rocky Mountain National Park has increased by 4 percent annually for the past ten years, and prospects are for continued growth. In addition, the population of the state is expected to continue to grow rapidly in some areas, particularly in the South Platte River Basin, as migration from other parts of the nation continues to occur. These trends suggest that the present value of benefit stream may prove conservative. Also, the measure of benefits is for the range of water quality actually present in the South Platte River Basin, to which park visitors assigned an index ranging from a low of 25 to a high of 93. This means that benefits from the worst known water pollution with an index of zero relative to natural water quality with an index of 100 would be somewhat higher than the benefits shown here. Finally, the benefit estimate for the South Platte River Basin included preservation values such as the willingness to pay for the option to choose recreation use of clean water in the future. Park visitors were not asked for their option values nor values attached to the existence of clean water, and its bequest to future generations. No doubt park visitors would have positive values in these categories, as well as for recreation use.

The calculations for total annual benefits and the present value of future benefits are measures of the benefits from maintaining water quality in its natural condition. Another important question relates to benefits from improving polluted waterways in the state. One widely applied measure of water quality is the ability to sustain fish life. The Colorado Division of Wildlife [1970] reported that water quality improvement in the state potentially could restore fish life in 2,640 miles of stream which are now polluted, representing 24 percent of the approximately 11,136 miles of stream in the state. Water quality improvement would not affect the 917 miles of stream de-watered by irrigation and power users, or restore the 253 miles of streams taken for reservoir construction.

If 24 percent of the waterways in the state which are now polluted were improved to a natural water quality level, annual benefits could rise as much as 24 percent of total state benefits shown above of $27.7 million annually. The present value of a perpetual stream of annual benefits from improving 24 percent of the waterways in the state would be $434.5 million.

It would be possible, in addition, to calculate total annual benefits and the present value of future benefits for intermediate levels of water quality improvement. The following section of this report shows the regression coefficient of the relationship between water quality and benefits as -0.06. Thus, for a water quality index of 50, benefits per household recreation day are $3.00 (= 50 x $0.06). Annual benefits and present value of future benefits could be prepared for this or any level of water quality by multiplying through by the relevant populations as presented earlier in this section of the report.

Empirical Benefit Functions

Figure 6 shows an empirical average benefit function for water quality. This is the linear relationship between changes in recreation benefits per day and changes in perceived suitability of water for recreation use. Park visitors reported they were willing to pay \$0.06 more recreation fee to avoid each one unit decrease in water quality (WQI). This is the beta coefficient for the relationship between the independent variable, water quality, and the dependent variable, willingness to pay a daily entrance fee. Willingness to pay may be influenced by income levels, types of recreation preferred, and other variables. The multiple regression analysis removed the effects of these and other variables, and singly related changes in value to changes in water quality (WQI). The relationship was significant at the 5 percent level, which means that chances exceed 95 out of 100 that the sample represents a true population relationship. The linear regression provided the best fit of the relationship, however, the average marginal benefit of six cents per unit of water quality was not expected to be uniform throughout the length of the water quality index.

The linear relationship was compared to the incremental changes in benefits and water quality between each of the six color photos. Benefits seem to rise at an increasing rate up to intermediate levels of quality and increase at a declining rate at high quality levels. Figure 7 shows that incremental benefits rise from four cents per unit at low quality levels (WQI = 30.5) to 12 cents per unit at intermediate

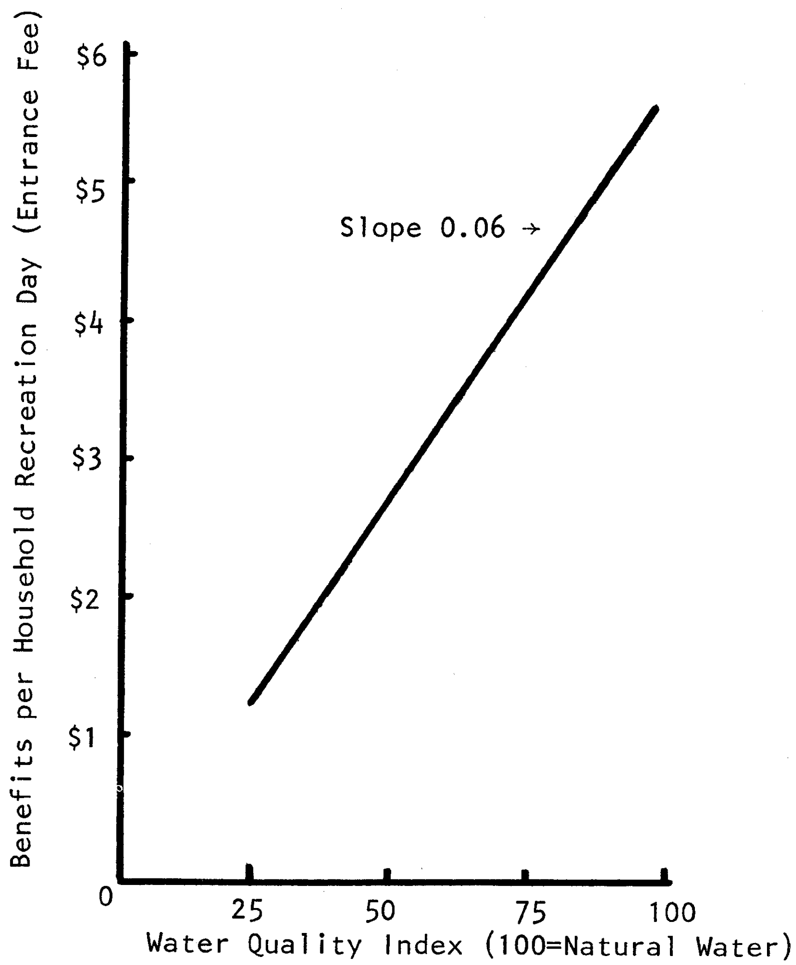

Figure 6. Empirical Benefit Function for Water Quality, Rocky Mountain National Park, Colorado, 1973.

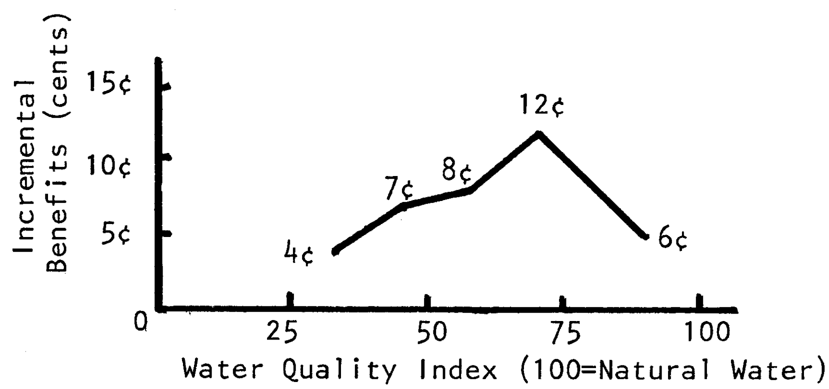

Figure 7. Incremental Benefits from Improved Water Quality, Rocky Mountain National Park, Colorado, 1973.

levels (WQI = 70), and then decline to a level of six cents at high levels of water quality (WQI = 87.5), identical to the linear regression coefficient. Marginal benefits of water quality suitable for recreation use appears to be curvilinear.

Although there remains a general lack of knowledge concerning changes in recreation behavior resulting from small changes in water quality, it is known that there are a number of discontinuities in the recreation benefit curve. For example, public health officials have established quality thresholds that must be attained before any swimming may take place. The best available estimate [Davidson, Adams and Seneca, 1966] is that at least three milligrams per liter (mg/l) of dissolved oxygen are necessary to eliminate odors and allow boating. At least four mg/l of oxygen is necessary to sustain a sport fishery, and five mg/l of oxygen is recommended to allow swimming. Only in the case of high altitude recreation water such as in Rocky Mountain National Park would benefits continue to rise as water quality increased to levels as high as 6.5 mg/l of oxygen, owing to the higher threshold level of dissolved oxygen required for a fishery resource at 8,000 feet elevation. These threshold levels are generally consistent with the observed experience of recreation users [Ditton and Goodale, 1972]. At very low levels of water quality, some boating may be possible on a waterway. At somewhat higher quality levels, not only may boating become more enjoyable with less smell to contend with and less costly with lower boat upkeep, but fishing for a limited number of species may become possible. At still higher levels of quality, water contact sports become possible and fish populations may be upgraded to include sport fish such as bass and trout.

Water agencies are interested in knowing how rapidly the deterioration of water quality erodes recreation values, or how far water quality may deteriorate before the total benefits from recreation use have been virtually eliminated. At a water quality index of 90, benefits are calculated as \$5.40 (= 90 x six cents) per household recreation day. With a water quality index of 25, benefits fall to \$1.50 (= 25 x six cents) per household recreation day. If water quality in the park falls from an index of 90 to 25, the welfare loss would not be \$5.40 but rather the difference between the two benefit levels, or \$3.90 (= \$5.40 - \$1.50) per household recreation day.

The coefficient of the relationship between water quality and recreation benefits as measured by travel time was -0.9, which means that park visitors were willing to travel 0.9 percent more to avoid each one unit decrease in water quality (WQI). The coefficient of the relationship between water quality and recreation benefits measured by property values was -1.9, which means that park visitors were willing to pay 1.9 percent more for waterfront property to avoid each one unit decrease in water quality. This suggests that park visitors may have a higher marginal utility of time than money. The rate of change in benefits as measured by property values was nearly double the rate of change measured by travel time. A one unit change in water quality resulted in nearly one percent (0.9) change in travel time and nearly a two percent (1.9) change in property values. The rate of change in benefits as measured by daily recreation fee was also more than double the rate of change measured by travel time for average benefits and below. For benefits of \$3.00, a unit change in water quality results in a 2 percent (= \$0.06/\$3.00) change in benefits as measured by a daily fee. However, when water quality levels approach an index of 100, the rate of change in benefits as measured by a daily fee approaches 1.0 (= $1.06/$6.00), nearly identical to the rate of change in benefits as measured by travel time. The average income of households interviewed was $19,500 annually which was nearly one and one-half more than average household incomes in the U.S. in 1973. Time budgets for leisure activities were likely to be relatively more constraining than discretionary income, which would support the possibility that marginal utility of money may have been relatively lower than marginal utility of time for the sample as compared to all households in the U.S.

CHAPTER 5

SOCIOECONOMIC VARIABLES

Willingness to pay for water quality suitable for recreation activities may be related to the characteristics, attitudes and recreation behavior patterns of park visitors. Household characteristics include: income, region of residence, size of community, ownership of waterfront recreation property, and amount of paid vacation. Measure of attitudes include: perception of water quality, membership in recreation resource organizations, and preferred amount of water-based recreation. Recreation behavior patterns include: type of water-based recreation activity, amount of water-based recreation, total participation in outdoor recreation, travel time, and number of short and long trips. A discussion of the significant socioeconomic variables is presented in this section, along with tables showing cross tabulation of average values for the more important socioeconomic variables.

The results of the stepwise linear multiple regression analysis are summarized in Table 4. A total of 27 independent variables representing socioeconomic attributes of the sample of park visitors were tested for significance. See Appendix Table 15 for a list of variables. Of these, 19 variables were found to be significant at the 95 to 99 percent level. Together they explained 30 to 35 percent of the variation in willingness to pay for water quality. Regression analysis removes the effects of other variables and singly relates changes in each of the variables to willingness to pay. This is a vital part of the study because value estimates will be applicable to specific planning situations only if

Table 4. Regression Coefficients of Significant Variables and the Value of Water Quality, Visitors to Rocky Mountain National Park, Colorado, 1973.

Significant Independent Variables (5 percent level)a/	Measures of Value		
	Willingness to Increase Travel Time	Willingness to Pay for Water-front Recreation Property	Willingness to Pay a Daily Fee
Perceived Water Quality of Six Color Photographs (scale of 100)	-1.1	-1.9	-0.06
Participant's Recreation Activity Preference			
Fishing	29.7	24.1	
Sightseeing	25.0	32.9	
Swimming			-1.07
Number of Short Trips Taken Per Year		3.1	0.11
Number of Long Trips Taken Per Year	-11.6	-11.1	
Days of Participation on Long Trips Annually			0.08
Days of Participation on All Trips Annually			-0.06
Current Proportion of Leisure Time Budget Allocated to Travel		0.8	0.01
Current Proportion of Leisure Time Budget Allocated to Water-Based Recreation		-0.8	0.02
Preferred Proportion of Leisure Time Budget Allocated to Water-Based Recreation	0.7	1.4	-0.02
Region of Respondents' Residency Within the United States			
Southern	17.0		
Northeastern	13.0	30.8	
Colorado		-27.5	

Table 4. Continued

Significant Independent Variables (5 percent level)[a/]	Measures of Value		
	Willingness to Increase Travel Time	Willingness to Pay for Water-front Recreation Property	Willingness to Pay a Daily Fee
Membership in Recreation Resource Organizations		-23.4	
Annual Household Pretax Income	-0.01		0.01
Size or Type of Community in Which Resident Resides			
Rural		-24.6	
Current Ownership of Recreation Property Adjacent to Water	18.0	51.2	
Number of Weeks of Paid Vacation Per Year		5.5	0.31

[a/] See the Statistical Appendix for tests of significance of the variables. All coefficients shown here are significant at the 95 or 99 percent level.

those variables which influence willingness to pay in addition to water quality, are incorporated into the model. Isolating the influence of these additional variables enables application of the benefit estimates specifically to water quality planning situations.

Household Income

Table 5 shows the relationship between average household income and willingness to pay for improved water quality. It was expected that higher income households would be willing to pay more for improved water quality. Higher income households may have a lower marginal utility of money, which means that households which have more dollars at their command are likely to value each dollar less than those who have fewer. This is based on the observation that high income households have more completely fulfilled the needs that money can satisfy through exchange for goods and services. They have more ability to pay and their lower marginal utility for money is expected to result in more willingness to pay for improved water quality.

The results of this study tend to confirm the proposition that there is a positive relationship between household income and willingness to pay for improved water quality, as measured by dollar value in the case of waterfront recreation property and a daily entrance fee. These average relationships tend to confirm the constraint imposed by the budgetary limitations of income groups. However, time is a resource that all households have in equal proportion, and within limits it can be substituted for dollar resources. Thus, high income visitors to the park were less willing to increase travel time than other lower income visitors.

Table 5. Annual Household Income and Average Willingness to Pay for Water Quality Suitable for Recreation Use, Visitors to Rocky Mountain National Park, Colorado, 1973.

Annual Household Pretax Income	Willingness to Pay to Gain Natural Water Quality, Defined as First Ranked Photo, Water Quality Index, (WQI)=93				
	Avoid 2nd Ranked Photo WQI=82	Avoid 3rd Ranked Photo WQI=64	Avoid 4th Ranked Photo WQI=50	Avoid 5th Ranked Photo WQI=36	Avoid 6th Ranked Photo WQI=25
Willingness to Increase Travel Time	- - - - - - - - - - Percent - - - - - - - - - -				
$30,000 or more n=14	10.0	28.0	38.1	53.4	63.2
$20,000 to $30,000 n=27	23.9	44.4	59.9	80.0	95.4
$10,000 to $2.,000 n=65	10.2	27.2	47.9	66.7	82.9
Less than $10,000 n=27	7.5	28.5	53.7	73.3	79.0
Willingness to Pay More for Waterfront Recreation Property	- - - - - - - - - - Percent - - - - - - - - - -				
$30,000 or more n=14	25.4	52.5	110.0	182.1	237.1
$20,000 to $30,000 n=27	26.8	64.8	97.2	160.6	183.5
$10,000 to $20,000 n=69	14.6	45.7	74.6	112.4	142.4
Less than $10,000 n=26	21.1	49.2	78.1	113.3	137.7

Table 5. Continued

Annual Household Pretax Income	Willingness to Pay to Gain Natural Water Quality, Defined as First Ranked Photo, Water Quality Index, (WQI)=93				
	Avoid 2nd Ranked Photo WQI=82	Avoid 3rd Ranked Photo WQI=64	Avoid 4th Ranked Photo WQI=50	Avoid 5th Ranked Photo WQI=36	Avoid 6th Ranked Photo WQI=25
Willingness to Pay a Daily Recreation Fee	Dollars				
$30,000 or more n=13	0.65	5.19	6.65	7.54	8.39
$20,000 to $30,000 n=25	0.84	3.45	4.40	5.54	6.12
$10,000 to $20,000 n=66	0.62	2.15	3.21	4.25	4.77
Less than $10,000 n=25	0.69	2.82	4.00	4.77	5.00

As household incomes increased from less than $10,000 annually to $30,000 or more, willingness to pay a daily entrance fee increased from an average of $5.00 to $8.39 or by $3.39 per day. Willingness to pay for waterfront recreation property increased progressively from 138 percent to 237 percent or by 100 percent. This variation is larger than for any other variable considered in this study. Regression analysis confirmed the relationship between income and willingness to pay an entrance fee, as 0.01. However, household income was not significant in regression analysis of willingness to pay for waterfront recreation property on water quality.

As household income increased from less than $10,000 annually to $30,000, willingness to increase travel time to avoid polluted water increased from 79 percent to 95 percent or by 16 percent. However, for the highest income group with $30,000 or more, willingness to increase travel time fell to 63 percent, or nearly one-third less than households with income of $20,000 to $30,000. Park visitors with the highest income were less willing to increase travel time than those with lower incomes.

This suggests that park visitors consider their income and time budgets as separate accounts, and rationally attempt to allocate each to achieve an optimum distribution. Users seem to place different relative values on dollars and time, as is evident for visitors with income of $30,000 and over. Apparently, scarcity of time due to alternative commitments does not occur until income levels rise to relatively high levels. The effect of high income visitors on the regression coefficient relating income to travel time was sufficient to reverse the sign to negative, -0.01. This means that for every $1,000 increase in household income, willingness to travel to avoid polluted water declines by 10 percent.

Any multicollinear influences which could have reinforced the relationships between income and willingness to pay are probably confined to the current proportion of time and preferred proportion of time which participants allocate to water-based recreation. Income correlates with preferred proportion of leisure time (r = .21) and the actual proportion of leisure time (r = .19) allocated to water-based recreation. These two variables are positively correlated with willingness to increase travel time, to pay for waterfront recreation property and willingness to pay a daily fee. Any contribution from these two variables would be confined to willingness to increase travel and willingness to pay for waterfront property, but the contribution would be relatively modest. The expected positive relationships between income level and willingness to pay remain intact, as multicollinear reinforcement is small.

Region of Residence

Table 6 shows the relationship between residence in major regions of the U.S. and willingness to pay for improved water quality. Residents from every major region of the U.S. vacation in Rocky Mountain National Park. It was expected park visitors from major regions of the U.S. with more industrial development and population density would particularly value water quality in the park which is higher than in the U.S. as a whole. The park is one of the unique natural areas of the nation, with pristine rivers and lakes, and majestic mountain peaks. This unique natural setting may result in higher values expressed by non-resident park visitors. Residents of the state recognize the park's

Table 6. Regions of Residence and Average Willingness to Pay for Water Quality Suitable for Recreation Use, Visitors to Rocky Mountain National Park, Colorado, 1973.

Region of Residence[a/]	Willingness to Pay to Gain Natural Water Quality, Defined as First Ranked Photo, Water Quality Value (WQI)=93				
	Avoid 2nd Ranked Photo WQI=82	Avoid 3rd Ranked Photo WQI=64	Avoid 4th Ranked Photo WQI=50	Avoid 5th Ranked Photo WQI=36	Avoid 6th Ranked Photo WQI=25
Willingness to Increase Travel Time	- - - - - - - - - -	- - - - - - - - - -	Percent	- - - - - - - - - -	- - - - - - - - - -
Northeastern States	17.1	39.4	58.7	79.8	97.5
Great Lakes States	10.8	30.8	55.5	67.9	81.8
Southern States	22.5	46.9	68.1	91.7	121.7
Plains States	11.0	26.5	36.9	55.2	75.6
Western States	10.5	29.1	51.8	73.5	86.1
Colorado	11.5	34.6	45.5	69.5	85.0
Willingness to Pay More for Waterfront Recreation Property	- - - - - - - - - -	- - - - - - - - - -	Percent	- - - - - - - - - -	- - - - - - - - - -
Northeastern States	35.5	78.5	118.2	191.2	223.1
Great Lakes States	22.4	57.4	103.6	168.8	218.1
Southern States	17.6	50.9	84.1	120.6	169.4
Plains States	19.7	46.7	77.6	107.6	133.3
Western States	14.3	42.9	69.0	103.1	130.2
Colorado	16.7	46.5	78.1	114.0	144.2

Table 6. Continued

Region of Residence[a]	Willingness to Pay to Gain Natural Water Quality, Defined as First Ranked Photo, Water Quality Value (WQI)=93				
	Avoid 2nd Ranked Photo WQI=82	Avoid 3rd Ranked Photo WQI=64	Avoid 4th Ranked Photo WQI=50	Avoid 5th Ranked Photo WQI=36	Avoid 6th Ranked Photo WQI=25
Willingness to Pay a Daily Recreation Fee	- - - - - - - -	- - - - - - - -	Dollars	- - - - - - - -	- - - - - - - -
Northeastern States	0.97	2.98	4.13	5.43	5.89
Great Lakes States	0.61	2.89	3.60	4.27	4.92
Southern States	0.66	2.88	3.84	4.84	5.41
Plains States	0.81	2.76	4.10	5.13	6.00
Western States	0.55	2.78	3.92	4.84	5.12
Colorado	0.05	3.55	4.35	5.15	5.62

[a] For all three measures of value: n=24 for Northeastern households, n=22 for Great Lakes households, n=19 for Southern households, n=21 for Plains households, n=48 for Western households (including Colorado) and n=25 for Colorado households.

special environmental quality, but choose alternative recreation areas in the state which are known to match the natural beauty of most of the park. Park visitors from more distant regions may value water quality more highly because their opportunities for visiting the state are infrequent owing to the travel distance. It was expected that visitors from more distant regions who have traveled farther would be willing to pay more for water quality. Visitors who travel farther tend to pay higher transportation costs and therefore place higher values on the recreation experience. In addition, visitors from the Northeastern states may be willing to pay more because they are more accustomed to private recreation opportunities that entail payment of an access fee.

The results of this study tend to support the proposition that park visitors from major regions of the U.S. with more industrial development and population density would be willing to pay more for water quality than other park visitors. However, the results are not always consistent. Park visitors from the industrial Northeast and Great Lakes regions were willing to pay an average of 85 to 93 percent more for waterfront property than visitors from the Great Plains and Western regions. Regression analysis confirmed the significance of this relationship at the 95 percent level of confidence. Park visitors from the Northeast region were willing to pay 31 percent more for waterfront recreation property than all other park visitors.

Visitors from the industrial Northeast were willing to increase travel time 13 percent more than all other park visitors, although this was somewhat less than visitors from the South who were willing to increase travel time by 17 percent more than other park visitors.

Regression analysis confirmed these results at the 95 percent level of significance.

Northeasterners reported they would pay a higher average daily fee for access to improved water quality than visitors from other regions except those from the Great Plains, which also contains several industrial centers. Visitors from the Northeast were willing to pay an average of $0.77 more daily fee than visitors from the Western region. However, the differences in willingness to pay a daily fee were not significant in the regression analysis.

Visitors from the Western region and from Colorado generally were willing to pay less for improved water quality than other park visitors. The regression analysis showed that Colorado residents were willing to pay only 73.5 percent as much for waterfront recreation property on improved waterways as other park visitors. However, willingness of Western region and Colorado residents to increase travel time was only about 4 to 5 percent less than the average of respondents interviewed. Colorado residents were willing to pay average daily fees of $0.20 per day more than all park visitors, although the difference was not statistically significant at the 95 percent level.

Systematic bias may be partially responsible for the difference in values between the Northeastern and Southern regions as compared with the Western and Plains regions. Large travel distances and higher transportation costs borne by respondents from Northeastern and Southern regions may deter many residents from visiting Rocky Mountain National Park. The relatively great distance may select out visitors less intent on enjoying a leisure experience in Colorado and attract mainly those participants who value the opportunity sufficiently to pay high transportation costs. If so, a greater proportion of actual visitors may value the experience highly and demand more environmental quality than the average of all residents from the Northeast. And if these systematically selected visitors are above average in their valuation of the recreation experience, it is likely that their willingness to pay for improved water quality is above average for that region.

Size of Community

Table 7 shows the relationship between size of the community in which park visitors reside and willingness to pay for improved water quality. It was expected that households living in larger metropolitan areas would be willing to pay more for improved water quality than those living in small towns and rural areas. Industrial development and high population density often result in lower water quality in metropolitan areas and reduced opportunity for water-based recreation nearby. Increased willingness to pay for improved water quality in metropolitan areas would alert water management agencies to the higher value of improved water quality adjacent to areas with high population.

Park visitors who reside in metropolitan areas including the city center and suburban fringe are willing to pay moderately more for waterfront recreation property and to increase travel time. On the average, residents of the suburban fringe of metropolitan areas will pay slightly more for improved water quality than center city residents as measured by willingness to travel and willingness to pay for waterfront property. Metropolitan area residents were willing to increase travel time by about 20 to 25 percent more than residents of small towns and rural areas. They were willing to increase payment for waterfront property

Table 7. Size of Community in Which Respondent Resides and Average Willingness to Pay for Water Quality Suitable for Recreation Use, Visitors to Rocky Mountain National Park, Colorado, 1973.

Size of Community[a/]	Willingness to Pay to Gain Natural Water Quality, Defined as First Ranked Photo, Water Quality Index (WQI)=93				
	Avoid 2nd Ranked Photo WQI=82	Avoid 3rd Ranked Photo WQI=64	Avoid 4th Ranked Photo WQI=50	Avoid 5th Ranked Photo WQI=36	Avoid 6th Ranked Photo WQI=25
Willingness to Increase Travel Time	- - - - - - - - - -	- - - - - - - - - -	Percent	- - - - - - - - - -	- - - - - - - - - -
Metro Center	12.7	31.2	49.4	72.1	91.5
Metro Suburb	20.5	45.2	62.8	78.6	99.1
Smaller Town	6.6	20.2	48.6	64.5	74.6
Rural Areas	6.1	21.8	40.0	66.2	79.8
Willingness to Pay More For Waterfront Recreation Property	- - - - - - - - - -	- - - - - - - - - -	Percent	- - - - - - - - - -	- - - - - - - - - -
Metro Center	20.1	49.6	86.1	145.8	172.3
Metro Suburb	23.9	61.7	96.9	139.9	176.2
Smaller Town	22.1	53.1	84.8	119.7	154.4
Rural Areas	8.1	32.3	57.0	105.4	142.3
Willingness to Pay a Daily Recreation Fee	- - - - - - - - - -	- - - - - - - - - -	Dollars	- - - - - - - - - -	- - - - - - - - - -
Metro Center	0.47	3.06	3.93	4.77	5.12
Metro Suburb	0.89	2.50	3.70	4.67	5.13
Smaller Town	0.78	2.90	4.15	5.43	6.12
Rural Areas	0.39	3.12	4.14	5.04	5.63

[a/] For all three measures of value, n=35 for residents of metropolitan centers, n=50 for residents of metropolitan suburbs, n=32 for residents of smaller towns and n=24 for residents of rural areas.

by 18 to 22 percent more than residents of small towns and by nearly 30 to 35 percent more than residents from rural areas. However, residents of smaller towns were willing to pay average daily fee of about $1.00 more and residents of rural areas would pay about $0.50 more in average daily fee. Size of the community in which park visitors reside was not significant in regression analysis of variables related to willingness to pay for improved water quality, with the exception that rural residents would pay 24.6 percent less for waterfront property than other park visitors.

Ownership of Waterfront Recreation Property

Table 8 shows the average willingness to pay for improved water quality by park visitors who currently own waterfront recreation property and those who do not. It was expected that the 26 respondents who own waterfront recreation property would value improved water quality more highly than the 114 park visitors who do not. Their property values are determined in large part by the quality of the adjacent body of water. Any appreciable deterioration in the quality of water results in a loss of property values [Dornbusch, 1973]. As a result, waterfront recreation property owners were expected to be more aware of the economic effects of water quality than other park visitors.

The results of this study tend to support the proposition that waterfront recreation property owners are willing to pay more for improved water quality than were nonowners. The average relationships shown in Table 8 were supported by the regression results which showed that property owners were willing to pay 51 percent more than nonowners for waterfront recreation property with access to improved water

Table 8. Current Ownership of Waterfront Recreation Property and Average Willingness to Pay for Water Quality Suitable for Recreation Use, Visitors to Rocky Mountain National Park, Colorado, 1973.

Ownership of Waterfront Recreation Property[a]	Willingness to Pay to Gain Natural Water Quality, Defined as First Ranked Photo, Water Quality Value (WQI)=93				
	Avoid 2nd Ranked Photo WQI=82	Avoid 3rd Ranked Photo WQI=64	Avoid 4th Ranked Photo WQI=50	Avoid 5th Ranked Photo WQI=36	Avoid 6th Ranked Photo WQI=25
Willingness to Increase Travel Time	- - - - - - - - - -	- - - - - - - - - -	Percent	- - - - - - - - - -	- - - - - - - - - -
Owner	25.7	52.2	78.0	100.2	142.7
Non-owner	10.9	28.8	47.8	66.8	79.2
Willingness to Pay More for Waterfront Recreation Property	- - - - - - - - - -	- - - - - - - - - -	Percent	- - - - - - - - - -	- - - - - - - - - -
Owner	24.0	77.2	125.2	186.7	250.7
Non-owner	19.3	47.6	78.1	121.8	150.1
Willingness to Pay a Daily Recreation Fee	- - - - - - - - - -	- - - - - - - - - -	Dollars	- - - - - - - - - -	- - - - - - - - - -
Owner	0.77	2.81	3.62	4.90	5.37
Non-owner	0.66	2.84	3.99	4.93	5.44

a/ For all three measures of value, n=26 for owners and n=114 for non-owners.

quality. They were willing to increase travel time 18 percent more than nonowners. However, they were not willing to pay a significantly different daily recreation fee than nonowners. This seems reasonable in light of the fact that property owners have paid for access to water in the acquisition of waterfront property.

Weeks of Paid Vacation

The relationship between number of weeks of paid vacation annually and willingness to pay for improved water quality is not shown in tabular form. It was expected that park visitors who enjoyed longer vacation periods would be willing to pay more for improved water quality. As vacation time increases, the opportunities to engage in water-based recreation activities also increase. Households with more opportunity to participate in outdoor recreation would be more willing to pay for a level of water quality usable for water-based recreation activities. Annual vacation time averaged 2.4 weeks.

The results of this study support the proposition that there is a positive relationship between vacation time and willingness to pay for improved water quality. The regression coefficient for a daily fee is 0.31 which means that for every additional week of paid vacation, park visitors are willing to pay $0.31 more for improved water quality. The regression coefficient for waterfront property is 5.5 which means that for every additional week of paid vacation, park visitors are willing to pay 5.5 percent more for waterfront recreation property with access to improved water quality.

Membership in Recreation Resource Organizations

Table 9 shows the relationship between membership in recreation resource organizations and willingness to pay for improved water quality. It was expected that park visitors who belong to political lobbying organizations which promote the expansion, maintenance or renovation of recreation resources would be willing to pay more for improved water quality than nonmembers. Joining a recreation resource organization indicates an active interest in resource management, at least more interest than the average citizen who does not join.

The results of this study tend to support the proposition that there is a positive relationship between membership in recreation resource organizations and willingness to pay for improved water quality. The average values are shown in Table 9. Members are willing to pay an average of $1.65 more daily recreation fee than nonmembers. They are willing to increase travel time by an average of 8.6 percent more than nonmembers. In addition, members are willing to pay an average of 64.4 percent more for waterfront recreation property than nonmembers. This relationship was not supported by the multiregression analysis of variables associated with willingness to pay for improved water quality. In fact, the regression coefficient for willingness to pay for waterfront recreation property was negative, contrary to expectations based on average values.

Current and Preferred Allocation of Leisure Time to Water-Based Recreation Activity

Tables 10 and 11 show the relationship between the proportion of total leisure time park visitors allocate to water-based recreation activities and willingness to pay for improved water quality. Park

Table 9. Membership in Recreation Resource Organizations and Average Willingness to Pay for Water Quality Suitable for Recreation Use, Visitors to Rocky Mountain National Park, Colorado, 1973.

Membership in Recreation Resource Organization[a/]	Willingness to Pay to Gain Natural Water Quality, Defined as First Ranked Photo, Water Quality Index (WQI)=93				
	Avoid 2nd Ranked Photo WQI=82	Avoid 3rd Ranked Photo WQI=64	Avoid 4th Ranked Photo WQI=50	Avoid 5th Ranked Photo WQI=36	Avoid 6th Ranked Photo WQI=25
Willingness to Increase Travel Time	- Percent -				
Member	12.7	37.7	58.8	78.2	95.3
Non-member	13.2	30.7	50.4	69.9	86.7
Willingness to Pay More for Waterfront Recreation Property	- Percent -				
Member	30.1	65.6	108.7	177.0	214.2
Non-member	16.9	47.7	77.8	117.4	149.8
Willingness to Pay a Daily Recreation Fee	- Dollars -				
Member	0.74	3.67	5.07	6.00	6.69
Non-member	0.66	2.57	3.58	4.58	5.04

[a/] For all three measures of value, n=33 for members and n=108 for non-members.

Table 10. Current Proportion of Leisure Time Allocated to Water-Based Recreation and Average Willingness to Pay for Water Quality Suitable for Recreation Use, Visitors to Rocky Mountain National Park, Colorado, 1973.

Current Proportion of Time	Willingness to Pay to Gain Natural Water Quality, Defined as First Ranked Photo, Water Quality Index (WQI)=93				
	Avoid 2nd Ranked Photo WQI=82	Avoid 3rd Ranked Photo WQI=64	Avoid 4th Ranked Photo WQI=50	Avoid 5th Ranked Photo WQI=36	Avoid 6th Ranked Photo WQI=25
Willingness to Increase Travel Time	- - - - - - - -	- - - - - - - -	Percent	- - - - - - - -	- - - - - - - -
61% or more n=30	13.2	34.2	63.5	84.3	117.5
39% to 50% n=33	8.8	28.9	42.0	62.7	78.5
21% to 39% n=30	13.8	35.8	63.5	85.8	96.9
Less than 21% n=41	16.0	31.1	44.3	59.8	69.9
Willingness to Pay More for Waterfront Recreation Property	- - - - - - - -	- - - - - - - -	Percent	- - - - - - - -	- - - - - - - -
61% or more n=30	22.3	58.3	103.8	139.3	185.2
39% to 60% n=33	14.6	53.5	89.3	145.1	188.9
21% to 39% n=31	18.2	47.9	71.2	117.6	140.8
Less than 21% n=43	23.7	49.2	78.5	125.0	149.4

Table 10. Continued

Current Proportion of Time	Willingness to Pay to Gain Natural Water Quality, Defined as First Ranked Photo, Water Quality Index (WQI)=93				
	Avoid 2nd Ranked Photo WQI=82	Avoid 3rd Ranked Photo WQI=64	Avoid 4th Ranked Photo WQI=50	Avoid 5th Ranked Photo WQI=36	Avoid 6th Ranked Photo WQI=25
	- - - - - - - - - -	- - - - - - - - - -	Dollars	- - - - - - - - - -	- - - - - - - - - -
Willingness to Pay a Daily Recreation Fee					
61% or more n=28	0.80	3.14	4.32	5.20	5.95
39% to 60% n=30	0.28	3.30	4.50	5.42	5.90
21% to 39% n=30	0.62	2.33	3.43	4.51	4.74
Less than 21% n=42	0.92	2.65	3.63	4.69	5.25

Table 11. Preferred Proportion of Leisure Time Allocated to Water-Based Recreation and Average Willingness to Pay for Water Quality Suitable for Recreation Use, Visitors to Rocky Mountain National Park, Colorado, 1973.

Preferred Proportion of Time	Willingness to Pay to Gain Natural Water Quality, Defined as First Ranked Photo, Water Quality Index (WQI)=93				
	Avoid 2nd Ranked Photo WQI=82	Avoid 3rd Ranked Photo WQI=64	Avoid 4th Ranked Photo WQI=50	Avoid 5th Ranked Photo WQI=36	Avoid 6th Ranked Photo WQI=25
Willingness to Increase Travel Time	- - - - - - - - - -	- - - - - - - - - -	Percent	- - - - - - - - - -	- - - - - - - - - -
76% or more n=12	12.1	42.9	90.4	113.8	161.3
51% to 75% n=24	17.3	38.7	59.0	79.4	100.4
26% to 50% n=31	9.2	29.6	46.1	68.5	80.5
Less than 26% n=67	13.6	29.4	46.0	63.1	75.3
Willingness to Pay More for Waterfront Recreation Property	- - - - - - - - - -	- - - - - - - - - -	Percent	- - - - - - - - - -	- - - - - - - - - -
76% or more n=12	27.1	70.8	123.3	172.1	225.8
51% to 75% n=24	37.8	79.6	127.9	180.9	228.3
26% to 50% n=32	17.5	46.7	67.7	116.4	145.6
Less than 26% n=70	14.0	42.0	71.7	114.8	142.3

Table 11. Continued

Preferred Proportion of Time	Willingness to Pay to Gain Natural Water Quality, Defined as First Ranked Photo, Water Quality Index (WQI)=93				
	Avoid 2nd Ranked Photo WQI=82	Avoid 3rd Ranked Photo WQI=64	Avoid 4th Ranked Photo WQI=50	Avoid 5th Ranked Photo WQI=36	Avoid 6th Ranked Photo WQI=25
Willingness to Pay a Daily Recreation Fee	- Dollars -				
76% or more n=12	0.92	2.37	3.50	4.50	4.92
51% to 75% n=20	0.80	3.20	4.67	5.70	6.54
26% to 50% n=31	0.59	2.14	3.18	4.56	5.13
Less than 26% n=67	0.65	3.12	4.14	4.94	5.33

visitors reported the proportion of leisure time allocated to water-based recreation activities during the previous 12 months and their preferred allocation of time to water-based recreation to achieve the most satisfaction from these activities. With a given amount of total leisure time during the past 12 months, the difference between the two is an indication of the supply constraint of limited water suitable for water-based recreation activities. The average park visitor currently allocated about 40 percent of his leisure time to water-based recreation compared to a preferred 50 percent.

The measure indicates the relative preference of park visitors for water-based recreation compared to other recreation activities. It was expected that park visitors who now devote more time to water-based recreation activities or who would prefer to do so in the future would be willing to pay more for improved water quality. Given a total leisure time budget, park visitors who have chosen to engage in relatively more water-based recreation activities can engage in a lesser amount of other recreation. Those who have foregone increasingly larger proportions of other leisure pursuits for additional water-based recreation are probably foregoing increasingly valuable leisure experiences. They would not be motivated to trade-off other recreation activities unless even more satisfying experience could be obtained in exchange. Therefore, satisfaction and willingness to pay for water-based recreation probably exceed the satisfaction from other recreation activities relatively more for the highly oriented users. If their recreation experience is more valuable, then the willingness to pay for components of that experience would also be higher. One important component is water quality, which is expected to be valued more highly by park visitors who prefer relatively more water-based recreation.

The results of this study tend to support the proposition that relative preference for water-based recreation is positively associated with willingness to pay for improved water quality. Those who engage in water-based recreation the most, allocating over 60 percent of their total leisure time to it, reported they were willing to pay an average entrance fee of $5.95 per day for improved water quality. This was $0.75 more than those who prefer water-based recreation the least, allocating 20 percent or less of their leisure time budget to water-based recreation. Regression analysis showed that for each one percent increase in leisure time devoted to water-based recreation, willingness to pay a daily fee increased $0.01. However, the regression coefficient for the ideal preferred proportion of leisure time devoted to water-based recreation was negative -0.02, which seems contrary to expectations. This suggests that the available supply of water suitable for water-based recreation has acted as an effective constraint, and park visitors would not be willing to increase payment of a daily fee unless they can realize preferred increase in water-based recreation.

Park visitors who most preferred water-based recreation were willing to pay more for waterfront recreation property. Those who would allocate over 50 percent of their leisure time to water-based sports were willing to increase the purchase price of waterfront recreation property by about 227 percent, which was 85 percent more than those who least preferred water-based recreation, allocating 25 percent or less of their leisure time to these activities. Regression analysis showed that for each additional percentage of leisure time devoted to water-based recreation, park visitors were willing to pay an additional 1.4 percent for waterfront recreation property. However, under current levels of leisure time devoted to water-based recreation, park visitors reduced their willingness to pay for waterfront recreation property by -0.8 percent. This suggests that supply of water suitable for water-based recreation has acted as an effective constraint. In addition, park visitors who engage in more water-based recreation activities possibly prefer to visit a number of recreation sites rather than limit their activities primarily to a waterfront recreation site which they might own, irrespective of the water quality level there.

Table 11 shows that park visitors who most preferred water-based recreation activities were most willing to travel for access to waterways with improved water quality. Park visitors who would allocate three-fourths of their leisure time to water-based sports were willing to increase travel time by 161 percent, which was 87 percent more than those who least preferred water-based recreation, allocating one-fourth or less of their leisure time to these activities. Regression analysis showed that for each additional percentage of leisure time preferred to be devoted to water-based recreation, park visitors were willing to travel an additional 0.7 percent. Similar average values are shown in Table 10 for the present pattern of participation in water-based recreation activities, however, there is some variation among the group averages, and regression results were not significant at the 95 percent confidence level. Park visitors may attach a lower utility to money than travel time under current patterns of participation in outdoor recreation.

Types of Water-Based Recreation Activity

Table 12 shows the relationship between types of water-based recreation activities of park visitors and average willingness to pay for improved water quality. It was expected that households engaged in recreation activities with a high degree of water contact as in the case of swimming and fishing would be willing to pay more for water quality. Swimmers are in the water and fishermen usually eat fish taken from the water. Boaters are on the water and are often sprayed when the water surface is rough or when traveling at high speeds. Boaters have less water contact than swimmers or fishermen, but many kinds of water pollution can be easily seen from a boat. Campers and sightseers may see less water pollution from the shore. They have no body contact with the water. They are interested in the scenic value of water, which is not wholly determined by its quality, and the value of scenic resources includes the quality of the forest and uniqueness of rock formations nearby.

Fishermen reported they were more willing to increase average travel time than other park visitors, and they were willing to pay more for waterfront property. But they were not more willing to pay entrance fees. Regression analysis showed a significant positive relationship between fishing and the value of water quality as measured by willingness to travel and willingness to pay for waterfront property. Fishermen were willing to travel about 30 percent more than other park visitors and pay 24 percent more for waterfront property. Fishing was not significantly related to willingness to pay a daily recreation fee. Other studies also suggest that fishermen are more willing to travel than other park visitors. Sixty-two percent of the fishermen

Table 12. Types of Preferred Recreation Activity and Average Willingness to Pay for Water Quality Suitable for Recreation Use, Visitors to Rocky Mountain National Park, Colorado, 1973.

Most Preferred Recreation Activity[a]	Willingness to Pay to Gain Natural Water Quality, Defined as First Ranked Photo, Water Quality Index (WQI)=93				
	Avoid 2nd Ranked Photo WQI=82	Avoid 3rd Ranked Photo WQI=64	Avoid 4th Ranked Photo WQI=50	Avoid 5th Ranked Photo WQI=36	Avoid 6th Ranked Photo WQI=25
Willingness to Increase Travel Time	- - - - - - - - - -	- - - - - - - - - -	Percent	- - - - - - - - - -	- - - - - - - - - -
Boating	14.3	33.0	43.4	53.0	65.7
Camping	8.8	24.5	38.6	58.1	74.0
Fishing	10.5	32.6	60.1	87.2	112.9
Sightseeing	18.8	34.2	45.4	60.2	68.1
Swimming	14.4	35.2	60.6	78.4	93.4
Willingness to Pay More for Recreation Property	- - - - - - - - - -	- - - - - - - - - -	Percent	- - - - - - - - - -	- - - - - - - - - -
Boating	30.3	69.5	101.8	164.2	189.5
Camping	13.6	56.0	75.5	118.8	157.1
Fishing	19.4	50.6	76.4	120.5	164.0
Sightseeing	22.0	47.0	87.1	133.4	164.0
Swimming	17.3	50.9	90.0	131.5	157.1

Table 12. Continued

Most Preferred Recreation Activity[a]	Willingness to Pay to Gain Natural Water Quality, Defined as First Ranked Photo, Water Quality Index (WQI)=93				
	Avoid 2nd Ranked Photo WQI=82	Avoid 3rd Ranked Photo WQI=64	Avoid 4th Ranked Photo WQI=50	Avoid 5th Ranked Photo WQI=36	Avoid 6th Ranked Photo WQI=25
Willingness to Pay a Daily Recreation Fee	- - - - - - - - - -	- - - - - - - - - -	Dollars	- - - - - - - - - -	- - - - - - - - - -
Boating	0.46	3.26	4.50	5.59	6.47
Camping	0.68	2.62	3.75	4.83	5.22
Fishing	0.65	2.74	3.91	4.99	5.66
Swimming	0.63	2.65	3.53	4.18	4.51

[a] For all three measures of value: n=15 for users preferring to boat; n=27 for users preferring to camp; n=41 for users preferring to fish; n=39 for users preferring to sightsee; and n=25 for users preferring to swim.

interviewed at Green Bay, Wisconsin, would travel further to avoid pollution [Ditton and Goodale, 1962].

Swimmers reported they were more willing to increase average travel time than other park visitors, second only to fishermen. However, they were not willing to pay more for waterfront property, or to pay more daily fees. Regression analysis showed that the relationship between swimming and willingness to increase average travel time was not significant at the 95 percent confidence level. Regression confirmed that there is no signficant relationship between swimming and willingness to pay for waterfront property. Regression analysis showed a significant negative relationship between swimming and the value of water quality, as measured by willingness to pay a daily recreation fee. Swimmers willingness to pay a fee was $1.07 per day less than other park visitors. This may be related to their experience with entrance fees which tend to be lower for swimming than for boating or camping. Other studies suggest that swimmers are more willing to travel than other park visitors. Two-thirds of swimmers in San Francisco Bay stopped swimming there when it became polluted, and traveled to more distant sites [Willeke, 1968]. However, only 36 percent of swimmers interviewed in Saskatchewan, Quebec and Nova Scotia reduced participation when lakes became polluted [Parkes, 1973]. Sixty-two percent of the swimmers at Green Bay, Wisconsin would travel further to avoid pollution [Ditton and Goodale, 1972].

Boaters reported they were least willing to increase average travel time of all park visitors, however on the average, they were willing to pay more for waterfront recreation property and for recreation entrance fees. Regression analysis did not support the statistical significance of these relationships at the 95 percent confidence level. Still, boaters take more day and weekend trips, and may be averse to increased travel for long distances with boat trailers. Ownership of waterfront property would allow them to leave boat and equipment there, reducing the inconvenience of travel with a boat trailer. Boaters spend more for recreation equipment than most other park visitors and an entrance fee is a smaller proportion of total cost of the recreation experience. In addition, willingness to pay a higher recreation fee may reflect existing fee levels for boat launching and marina services.

Other studies also have shown that boaters are less willing to terminate use of a polluted site and travel to a more distant one. Only 6 percent of the boaters on San Francisco Bay reported they had terminated its use when it became polluted [Willeke, 1968]. Only 7 percent of the boaters in a Canadian study reduced use of a site when pollution increased [Parkes, 1973]. Contrary to these findings, one-half of the boaters in Green Bay, Wisconsin, reported they would travel further if boating sites they use became polluted [Ditton and Goodale, 1972].

Sightseer values shown in Table 12 were about average for the sample of park visitors. However, regression analysis showed a significant positive relationship between sightseeing activity and the value of water quality as measured by willingness to travel and willingness to pay for waterfront property. Sightseers were willing to travel 25 percent more than other park visitors and pay about one-third more for waterfront property. Sightseeing was not significantly related to willingness to pay a daily recreation fee.

Camper values shown in Table 12 were about average for the sample of park visitors, with the possible exception of willingness to pay for waterfront property, which averaged lower. Regression analysis confirmed that there was no significant relationship between the activity of camping and willingness to pay for waterfront property, a recreation fee, or to increase travel time.

Annual Days of Participation in Outdoor Recreation

Table 13 shows the relationship between average annual participation in recreation activities by park visitors and willingness to pay for improved water quality. Park visitors reported an average of 27.5 days of outdoor recreation annually in 1973. Of these, 16.2 days were on 1.4 long trips, and 11.3 days were on 6.5 short trips. Participation levels may be quantified as number of recreation activity days or as number of trips, each of which also may be separated meaningfully between short trips on outings for a single day or a weekend and long trips on vacations. These four variables were tested in the regression analysis of factors explaining variation in willingness to pay for water quality. It was expected that those who participate more would be willing to pay more for water quality. They would have more contact with the resource and would benefit more by its improved quality. Amount of participation was expected to be related to level of expenditures and presumably those who pay more are willing to do so because the expenditure yields a higher return in terms of satisfaction. For them, more outdoor recreation activity is consumed before the utility gained falls to a sufficiently low level that other pursuits become more rewarding.

The results of this study tend to confirm the proposition that participation in outdoor recreation is positively related to willingness to pay for improved water quality. Those who participate the most,

Table 13. Annual Days of Participation and Average Willingness to Pay for Water Quality Suitable for Recreation Use, Visitors to Rocky Mountain National Park, Colorado, 1973.

Annual Days of Participation	Willingness to Pay to Gain Natural Water Quality, Defined as First Ranked Photo, Water Quality Index (WQI)=93				
	Avoid 2nd Ranked Photo WQI=82	Avoid 3rd Ranked Photo WQI=64	Avoid 4th Ranked Photo WQI=50	Avoid 5th Ranked Photo WQI=36	Avoid 6th Ranked Photo WQI=25
Willingness to Increase Travel Time	- - - - - - - - - - Percent - - - - - - - - - -				
36 days or more n=26	14.3	33.4	51.5	73.5	97.5
29 to 35 days n=19	13.9	37.4	56.0	68.7	78.7
22 to 28 days n=28	9.6	25.1	57.7	79.6	95.8
15 to 21 days n=37	12.0	28.4	46.8	66.5	92.6
Less than 15 days n=20	20.3	46.7	58.2	78.2	76.9
Willingness to Pay More for Waterfront Recreation Property	- - - - - - - - - - Percent - - - - - - - - - -				
36 days or more n = 28	27.0	73.0	118.6	177.5	225.7
29 to 35 days n=19	23.7	69.7	112.4	186.6	213.9
22 to 28 days n=28	16.9	43.0	76.2	118.2	153.9
15 to 21 days n=38	13.9	39.6	61.7	99.3	135.9
Less than 15 days n=20	26.5	45.7	79.5	108.2	123.5

Table 13. Continued

Annual Days of Participation	Willingness to Pay to Gain Natural Water Quality, Defined as First Ranked Photo, Water Quality Index (WQI)=93				
	Avoid 2nd Ranked Photo WQI=82	Avoid 3rd Ranked Photo WQI=64	Avoid 4th Ranked Photo WQI=50	Avoid 5th Ranked Photo WQI=36	Avoid 6th Ranked Photo WQI=25
Willingness to Pay a Daily Recreation Fee	- - - - - - - - - -	- - - - - - - - - -	Dollars	- - - - - - - - - -	- - - - - - - - - -
36 days or more n=28	0.70	3.66	4.59	6.27	6.87
29 to 35 days n=20	0.76	3.36	4.60	5.42	5.72
22 to 28 days n=25	0.70	2.70	3.90	4.61	5.02
15 to 21 days n=36	0.53	2.48	3.64	4.56	5.09
Less than 15 days n=20	0.93	2.22	3.37	4.18	4.93

engaging in outdoor recreation for 36 days or more annually, reported they were willing to pay an average entrance fee of $6.87 per day. This was nearly $2.00 more per day than those who participate the least, engaging in outdoor recreation less than 15 days annually. The regression analysis showed that for each daily increase in participation on long trips, willingness to pay a daily fee increased by $0.08. Also, for each additional short trip taken annually, willingness to pay a daily fee increased $0.11. However, regression analysis also showed that for each additional day of participation, willingness to pay a daily fee declined by -0.06, which seems contrary to expectations based on the average values shown in Table 13, and can only be explained as due to multicollinearity. Partial correlation coefficients generated with entrance of each additional variable indicate the relationship between willingness to pay a daily fee and days of participation annually would have been positive if entry of participation days had occurred earlier in the sequence of variables. Number of short trips and number of days participation on long trips entered first and were shown as the sources of positive influence.

The literature on water quality provides some limited support for the proposition that participation tends to be associated with willingness to pay for water quality. Ditton and Goodale [1968] reported that participants in Green Bay, Wisconsin, would pay more for improved water quality than non-participants. Also, participation by residents of the South Platte River Basin, Colorado, was related to willingness to pay for improved water quality when measured by average cross sorts, but multiple regression analysis did not support the relationship at the 95 percent confidence level [Walsh, Greenley, Young, McKean and Prato, 1978].

Park visitors who participate the most were also willing to pay more for waterfront recreation property. Those who participated for 36 days or more were willing to increase the purchase price of waterfront recreation property by 226 percent, which was 102 percent more than those who participated the least, engaging in outdoor recreation less than 15 days annually. Regression analysis showed that for each additional short trip taken annually, willingess to pay for waterfront recreation property increased by 3.1 percent. However, regression analysis did not confirm the average relationship between days of participation and willingness to pay for waterfront property. Also, contrary to expectations, the regression coefficient for number of long trips taken annually and willingness to pay for waterfront recreation property was negative -11.1, which may be the result of multicollinearity, or park visitors who take more vacation trips annually may prefer to visit a variety of recreation sites rather than limit their outdoor recreation activities primarily to a waterfront recreation site which they might own, irrespective of the water quality level there.

Table 14 shows that park visitors who participated the most were willing to travel slightly more for access to waterways with improved water quality. However, the results are mixed. Those who participated for 36 days or more were willing to increase travel time by 97.5 percent, which was 20.6 percent more than those who participated the least, with less than 15 days annually. But those who participated 15 to 28 days annually were willing to travel nearly as much as those who participated for 36 days or more. Moreover, regression analysis did not confirm the average relationship between days of participation annually and willingness to increase travel time. Also, contrary to expectations, the regression coefficient for number of long trips taken annually and willingness to increase travel time was negative -11.6, indicating that willingness to travel to gain access to improved water quality declined by 11.6 percent for each additional trip taken. This suggests that park visitors who take more vacation trips annually may attach a higher marginal utility to travel time than money, with additional travel time a more scarce resource.

Proportion of Leisure Time Devoted to Travel

Table 14 shows the relationship between travel time as a proportion of total leisure time and willingness to pay for improved water quality. Park visitors devoted an average of 35 percent of their leisure time to travel, and it was expected that more active travelers would be willing to pay more for improved water quality. Some park visitors consider traveling itself as a recreation activity, but most consider it as primarily a necessary cost of participating in outdoor recreation. This view is consistent with the recreation economic literature which treats travel as a proxy for willingness to pay for the outdoor recreation experience [Clawson and Knetsch, 1966]. The larger the portion of their leisure time budget which park visitors currently allocate for travel to and from recreation sites, the larger are expected benefits from the recreation experience, not otherwise available at shorter distances. Apparently the added benefits more than offset the higher travel and time costs. Thus, they are expected to be more sensitive to quality of the recreation experience in general, and to water quality in particular.

Table 14. Proportion of Leisure Time Budget Allocated to Travel and Average Willingness to Pay for Water Quality Suitable for Recreation Use, Visitors to Rocky Mountain National Park, Colorado, 1973.

Current Proportion of Leisure Time	Willingness to Pay to Gain Natural Water Quality, Defined as First Ranked Photo, Water Quality Index (WQI)=93				
	Avoid 2nd Ranked Photo WQI=82	Avoid 3rd Ranked Photo WQI=64	Avoid 4th Ranked Photo WQI=64	Avoid 5th Ranked Photo WQI=36	Avoid 6th Ranked Photo WQI=25
Willingness to Increase Travel Time	- - - - - - - - - -	- - - - - - - - - -	Percent	- - - - - - - - - -	- - - - - - - - - -
60% or more n=15	9.3	29.0	56.7	83.3	104.0
45% to 59% n=31	8.4	24.2	37.9	49.7	60.6
30% to 44% n=22	7.5	30.4	65.3	83.6	87.5
16% to 29% n=36	12.8	31.2	51.1	70.0	84.0
Less than 16% n=25	18.0	37.4	50.2	76.8	117.3
Willingness to Pay More for Waterfront Recreation Property	- - - - - - - - - -	- - - - - - - - - -	Percent	- - - - - - - - - -	- - - - - - - - - -
60% or more n=16	33.0	75.0	136.4	202.1	257.8
45% to 59% n=31	20.5	47.3	77.4	137.4	170.3
30% to 44% n=23	16.5	54.6	76.3	118.9	134.3
16% to 29% n=36	12.6	36.3	65.3	103.3	137.4
Less than 16% n=26	22.7	64.4	98.0	138.8	180.0

Table 14. Continued

Current Proportion of Leisure Time	Willingness to Pay to Gain Natural Water Quality, Defined as First Ranked Photo, Water Quality Index (WQI)=93				
	Avoid 2nd Ranked Photo WQI=82	Avoid 3rd Ranked Photo WQI=64	Avoid 4th Ranked Photo WQI=50	Avoid 5th Ranked Photo WQI=36	Avoid 6th Ranked Photo WQI=25
Willingness to Pay a Daily Recreation Fee	- - - - - - - - - -	- - - - - - - - - -	Dollars	- - - - - - - - - -	- - - - - - - - - -
60% or more n=16	1.06	3.28	4.03	5.26	5.75
45% to 59% n=29	0.85	3.26	4.53	5.55	6.01
30% to 44% n=21	0.79	2.80	3.95	4.90	5.50
16% to 29% n=34	0.33	2.44	3.62	4.59	5.12
Less than 15% n=25	0.46	2.72	3.80	4.74	5.31

The results of this study tend to support the proposition that travel would be positively related to willingness to pay for improved water quality. However, the results are not always consistent. The most active travelers, with 60 percent or more of their leisure time allocated to travel, were willing to pay 78 to 124 percent more for waterfront recreation property than other park visitors. Regression results showed that for every 1 percent increase in travel time as a proportion of total leisure time, park visitors were willing to pay 0.08 percent more for waterfront property. The most active travelers were willing to pay 25 to 89 cents more daily entrance fee than other park visitors. Regression results show that for every 1 percent increase in travel time as a proportion of total leisure time, park visitors were willing to pay $0.01 more in daily fees. Willingness to increase travel time was not significant at the 95 percent confidence level because the non-linear patterns shown in Table 14 did not register in the linear regression. The least active travelers with less than 16 percent of their leisure time allocated to travel, were more willing than other park visitors to increase travel time for improved water quality. They reported they were willing to travel an average of 117 percent more than at the present time. This was 13 to 56 percent more than other park visitors. The most active travelers with 60 percent or more of their leisure time allocated to travel, were still willing to increase travel time by an average of 104 percent. This was only 13 percent less than the least active travel group of park visitors, and suggests that the relationship was non-linear.

CHAPTER 6

SUMMARY AND CONCLUSIONS

The purpose of this study was to develop and apply a procedure for measuring the relationship between water quality and nonresident recreation benefits. A random sample of 141 households were interviewed in Rocky Mountain National Park during the summer of 1973. A substantial portion of the park is located in the South Platte River Basin, Colorado. Perception of water quality suitable for recreation use is based largely on visual attributes. Respondents ranked six color photographs of water quality in the river basin and rated each photo on an index of zero to 100 with zero defined as the most polluted level and 100 the cleanest. Color photos were considered superior to alternatives such as a narrative description of technical measures of water quality, recollection of past experience, and observations at the interview site.

Willingness to pay questions were designed to measure consumer surplus benefits which is the area under the demand curve for outdoor recreation. Empirical measures were developed to show shifts in the demand curve with changes in water quality. Although the willingness to pay questions were hypothetical, they were designed to be as realistic as possible. Willingness to pay was measured in terms of a recreation entrance fee, the value of waterfront recreation property, and travel time. These are familiar methods of paying for outdoor recreation resources. The valuation procedure used in this study has been successfully applied to other natural resource and public good problems.

The stepwise multi-regression procedure was utilized to develop linear demand functions. This showed the regression coefficient or slope values of the relationship between benefits and water quality, attitudes, patterns of participation in outdoor recreation, and other socioeconomic variables.

Park visitors reported average benefits of $5.42 per household recreation day to gain natural water quality defined as the first ranked photo with a water quality index of 93 and avoid the sixth ranked photo with the most water pollution (WQI=25). This measure of benefit was defined as the maximum increase in fees for entrance to an otherwise suitable recreation area, if the additional payment would obtain the specified level of water quality. Intermediate levels of water quality were associated with intermediate shifts in benefits as measured by the area under five demand curves for the same recreation site.

Park visitors reported they were willing to pay an average of 165 percent more for waterfront property with access to recreation use of natural water quality defined as the first ranked photo with a water quality index of 93 and avoid the sixth ranked photo with the most water pollution (WQI=25). This measure of benefit was defined as the maximum increase in willingness to pay for waterfront recreation property otherwise suitable for recreation use, if the added payment would obtain the specified level of water quality. Intermediate levels of water quality were associated with intermediate shifts in benefits as measured by the area under demand curves for otherwise identical recreation property.

Park visitors reported they were willing to increase travel time by an average of 89 percent to gain natural water quality defined as the first ranked photo with a water quality index of 93 and avoid the sixth ranked photo with a water quality with the most pollution (WQI=25). This measure of benefit was defined as the maximum percentage increase in travel time to an otherwise suitable recreation area, if the additional time would obtain the specified level of water quality. Intermediate levels of water quality were associated with intermediate shifts in benefits.

Total annual benefits from water quality in Rocky Mountain National Park were estimated as $3.7 million. The present value of a perpetual stream of annual benefits equals $59.2 million, based on the Federal discount rate of 6 3/8 percent.

The nonresident tourist benefits from water quality in the South Platte River Basin were estimated at $16.6 million annually. The present value of a perpetual stream of annual benefits amounts to $260.9 million. Adding these nonresident benefits to resident benefits estimated by another study, total annual benefits from water quality in the River Basin amount to $77.7 million and the present value equals $1,229.4 million.

The nonresident tourist benefits from water quality in the state of Colorado were estimated as $41.4 million annually and the present value of a perpetual stream of annual benefits amounts to $644.2 million. Adding these nonresident benefits to resident benefits estimated by another study, total annual benefits from water quality in Colorado amount to $115.3 million and the present value equals $1,808.1 million.

If 24 percent of the waterways in the state which are now polluted were improved to natural water quality, it seems likely that annual benefits would equal approximately 24 percent of total state benefits, or $27.7 million annually. The present value of a perpetual stream of annual benefits from improving 24 percent of the waterways in the state equals $434.5 million.

The relationship between changes in water quality and recreation benefits was -0.06 which means park visitors were willing to pay $0.06 more recreation fee to avoid each one unit decrease in water quality on a scale of zero to 100. The regression equation removed the effects of other variables and singly related changes in benefits to changes in water quality.

The relationship between water quality and recreation benefits as measured by travel time was -0.9 which means park visitors were willing to travel 0.9 percent more to avoid each one unit change in water quality. The relationship between water quality and recreation benefits measured by property values was -1.9 which means that park visitors were willing to pay 1.9 percent more for waterfront property to avoid each one unit change in water quality. The rate of change in benefits as measured by property values and entrance fees, with an elasticity at the midpoint of 2.0, were more than double the rate of change measured by travel time. This suggests that park visitors may have a higher marginal utility of time than money. A one unit change in water quality resulted in nearly a one percent change in travel time compared to a two percent change in recreation fees and property values.

These linear regression coefficients were compared to incremental changes in benefits and water quality between each of the six color photos. With only five incremental benefit points, it is somewhat heroic to generalize about the nature of the slope of the marginal benefit curve for water quality. The incremental benefit points suggest that the relationship may be curvilinear. As water quality increases, marginal benefits increase more than proportionately when the quality index is in the neighborhood of 70 units and then increases at a decreasing rate at rather low and at rather high levels of water quality.

Income was positively related to willingness to pay a recreation entrance fee for improved water quality, with a beta coefficient of 0.01. However, household income was not significant in regression analysis of the variables associated with willingness to pay for waterfront recreation property. Moreover, income was negatively related to willingness to increase travel time, with a beta coefficient of -0.01. This means that for every $1,000 increase in household income, willingness to travel declines by 10 percent. This suggests that park visitors consider their income and time budgets as separate accounts, and place different relative values on dollars and time. Average household income was reported by park visitors as $19,500, or about 150 percent of the average for the U.S.

Residents from every major region of the U.S. vacation in Rocky Mountain National Park. The results of this study tend to support the proposition that park visitors from regions with more industrial development and population density would be willing to pay more for water quality in the park. For example, park visitors from the industrial Northeast were willing to pay an average of 31 percent more for waterfront property than visitors from the Great Plains and Western regions. Visitors from the Northeast were willing to increase travel time by 17 percent more and pay $0.77 more daily fee. Visitors from the Western region and from Colorado generally were willing to pay less for water quality than other park visitors, with value measured by property values and travel time. However, Colorado residents reported they would pay an average of $0.20 per day more entrance fee, although this was not significantly different than other park visitors at the 95 percent confidence level.

The hypothesis that size of community may affect willingness to pay for improved water quality received scant support. There was no significant difference in willingness to pay among residents of metropolitan areas and small towns, however, rural residents would pay 24.6 percent less for waterfront property than other park visitors. Metropolitan area residents were willing to increase average travel time about one-fourth more than residents of small towns and rural areas, however, the relationship was not statistically significant at the 95 percent confidence level. Residents of small towns were willing to pay $1.00 more in average daily fees, although this was not statistically significant from other park visitors.

Ownership of waterfront recreation property reported by 26 respondents was significantly related to willing to pay for water quality. Property owners were willing to pay 51 percent more than nonowners for waterfront recreation property with access to improved water quality. They were willing to increase travel time 18 percent more than nonowners. However, they were not willing to pay a significantly different daily recreation fee. This seems reasonable in light of the fact that property owners have paid for access to water in the acquisition price.

Weeks of paid vacation had a significant effect on willingness to pay for improved water quality for recreation use. For each additional week of paid vacation annually, park visitors were willing to pay $0.31 more daily recreation fee for improved water quality. For each additional week, they were willing to pay 5.5 percent more for waterfront recreation property with access to improved water quality.

The expectation that members of recreation resource organizations would be willing to pay more for improved water quality than nonmembers was not supported by this study. The regression coefficient for waterfront recreation property was negative, contrary to expectations based on average values. There was no significant difference in willingness to drive and pay a daily fee, although on the average members were willing to pay $1.65 more daily recreation fee than nonmembers.

Proportion of leisure time devoted to water-based recreation activities was significantly related to willingness to pay for improved water quality. Park visitors who devote more time to water-based recreation or who would prefer to do so in the future are willing to pay more for water quality. Regression analysis showed that a 1 percent change in leisure time devoted to water-based recreation was associated with a $0.01 change in willingness to pay a daily fee for improved water quality. They were willing to pay an additional 1.4 percent for waterfront recreation property, and for each percentage of leisure time preferred to be devoted to water-based recreation, park visitors were willing to travel an additional 0.7 percent.

Water-based recreation activities of park visitors with direct water contact such as swimming and fishing were expected to affect willingness to pay for improved water quality compared to those activities with less water contact such as camping and sightseeing. Regression analysis showed a significant positive relationship between fishing and the value of water quality as measured by willingness to travel and to pay for waterfront property. Fishermen were willing to travel about 30 percent more than other park visitors and pay 24 percent more for waterfront property. Regression analysis showed a significant negative relationship between swimming and the value of water quality, as measured by a daily recreation fee. Swimmer values were \$1.07 per day less than other park visitors. Sightseeing households were willing to travel 25 percent more than other park visitors and pay about one-third more for waterfront property. Regression analysis showed no significant relationship between the activity of camping and willingness to pay for water quality.

It was expected that annual days of participation in outdoor recreation would be positively related to willingness to pay for water quality. Regression showed that for each daily increase in participation on long trips, willingness to pay a daily fee increased by \$0.08. For each additional short trip taken annually, willingness to pay a daily fee increased \$0.11. The regression results showed that willingness to travel on long trips declined by 11.6 percent for each additional trip taken. This suggests that park visitors who take more vacation trips annually may have a higher marginal utility of travel time than money, with additional travel time a more scarce resource.

The larger the proportion of leisure time devoted to travel the larger are expected benefits from the recreation experience and from improved water quality. The regression showed that for every 1 percent increase in travel time as a proportion of total leisure time, park visitors were willing to pay 0.08 percent more for waterfront recreation property. For every 1 percent increase in travel time as a proportion of total leisure time, park visitors were willing to pay \$0.01 more in daily fees. Although not statistically significant, the average cross-sorts suggest that the least active travelers with less than 16 percent of their leisure time allocated to travel, were more willing than other park visitors to increase travel time for access to improved water quality.

The willingness to pay approach to measuring the value of public goods was successful in meeting the objectives of valuing the benefits of improved water quality. The willingness to pay approach had been successfully used as a research tool for valuation of recreation activities and air quality in the past. The technique appears appropriate for valuation of a wide variety of non-market goods including water quality. It should be remembered, however, that willingness to pay is the hypothetical response of individuals faced with hypothetical situations. Thus, considerable care must be exercised in the design of willingness to pay questions and the conduct of surveys, to ensure that the results obtained are as realistic as possible.

The results of this study should help water quality agencies identify waterways where benefits of improvement would justify allocation of limited budgets to undertake substantial water quality improvement. The recreation benefits of alternative water quality standards can be estimated. In the past, governmental agencies of the state have lacked recreation benefit information and thus have had no alternative but to rely on biological tests of fish survival. This report demonstrates that fishing is a small part of total water-based recreation activity and thus a small part of total recreation benefits of water quality. Moreover, marginal benefits of water quality improvement seem to be curvilinear, rising most rapidly when the water quality index is near

70 units and rising less rapidly at higher quality levels and at rather low quality levels.

The variables included in the regression equation explained 30 to 35 percent of the variation in the value of water quality. Research is needed to test the influence of socioeconomic variables not included in this study such as age of household head, size of household, race, occupation, and proportion of leisure time devoted to each recreation activity. Future research should test the influence of other aspects of the recreation resource such as water temperature; adequacy of recreation facilities at the site such as boat ramps, comfort stations, and campsites; provisions for safety; adequacy of site maintenance; and aesthetics of the surrounding scenery. These variables affect the total satisfaction derived from the recreation experience and could influence the recreation benefits of improved water quality.

There is a need for research to test the relationship between visual perception of water quality by recreation consumers and biological measures of water quality variables. Previous research suggests that description of the technical characteristics of water quality alone have not been sufficient. The suitability of water quality to recreation users has been shown to be primarily related to visual perception. Future surveys should combine the use of color photos with technical biological information about the quality of water. This would provide the necessary link between improvement costs based on technical characteristics and benefits based on user perception of visual characteristics.

Research should explore the benefits of improved water quality as measured by travel time. Money and time may be distinct dimensions of consumer benefits. Park visitors who already allocate a high proportion of their leisure time to travel resist further increases in travel time to gain access to improve water quality, although they will rapidly pay more for improved water quality. It is not surprising to find that households with higher incomes will pay more for improved water quality but will not allocate proportionately more travel time for access to improved water quality. Willingness of households with lower income to increase travel time may indicate that they value improved water quality as much as higher income households.

In addition to the recreation benefits of water quality, there may be long-run ecological benefits that are not included in recreation values. It is impossible to predict what these might be, let alone put a dollar value on them and incorporate them into a benefit estimate. For this reason, it seems that present benefit figures represent a conservative estimate of possible total benefits of water quality. The inability of economic analysis to place a dollar value on ecological effects should be recognized in making decisions concerning water quality.

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APPENDIX A

REGRESSION ANALYSIS OF WATER QUALITY VALUES

In this study, the multiple regression technique is used to test the relation between the dependent variables willingness to increase travel time, willingness to pay for waterfront property and willingness to pay a daily fee and 27 independent variables hypothesized to influence the recreation users' evaluation of water quality. Using stepwise multiple regression analysis, an estimate of the partial influence of each of the hypothesized variables can be shown. The estimated relationship is tested in four ways. An F test determines entry of variables which statistically influence users' evaluation of water quality. The t tests measure the statistical significance of each relationship between value and the independent variables that have been entered. The multiple coefficient of determination cumulatively measures the percent of variation in value explained by all independent variables combined. The fourth measure generated in regression analysis is the beta coefficient, showing change in the value of water quality as a given independent variable changes by one unit.

The complete mathematical formulation contains all variables as defined in Table 15. The formulation for estimating consumer surplus, $Y'_j - Y_1$, measured as willingness to pay more for improved water quality, is:

$Y'_j - Y_1$ = f (PREFBOAT, PREFCAMP, PREFFISH, PREFSITE, PREFSWIM, LDAYS, SDAYS, LTRIP, STRIP, INOW, IOPT, TTNOW, WQI_{1j}, NORESTRN,

SOUTHERN, GRTLAKES, GRTPLNS, WESTERN, COLORADO, ECOL, INCOME, CFRURAL, CFTOWN, CFSUBURB, CFCITY, POWN, ANNVAC)

where:

$Y_j' - Y_1 = TT_{1j}$ and $j = 2, 3, 4, 5, 6$;

$= PPP_{1j}$ and $j = 2, 3, 4, 5, 6$;

$= DF_{1j}$ and $j = 2, 3, 4, 5, 6$;

and:

TT_{1j} = Willingness to increase travel time for improved water quality simulated by gaining the first ranked photograph with perceived water quality indexed at Q_{wq}^{1st} and avoiding the "jth" ranked photograph with perceived water quality indexed at Q_{wq}^{jth};

PPP_{1j} = Willingness to pay more for waterfront recreation property on waterways with improved water quality simulated by gaining the first ranked photograph with perceived water quality indexed at Q_{wq}^{1st} and avoiding the "jth" ranked photograph with perceived water quality indexed at Q_{wq}^{jth}; and

DF_{1j} = Willingness to pay a daily fee for improved water quality simulated by gaining the first ranked photograph with perceived water quality indexed at Q_{wq}^{1st} and avoiding the "jth" ranked photograph with perceived water quality indexed at Q_{wq}^{jth}.

The equation for the general model which includes all variables from Table 15 is:

$$\begin{aligned}\text{Value of Water Quality} = {} & B_0 + B_1(\text{PREFBOAT}) + B_2(\text{PREFCAMP}) + B_3(\text{PREFFISH}) \\ & + B_4(\text{PREFSITE}) + B_5(\text{PREFSWIM}) + B_6(\text{DAYSALL}) + B_7(\text{LDAYS}) \\ & + B_8(\text{SDAYS}) + B_9(\text{WQI}) + B_{10}(\text{LTRIP}) + B_{11}(\text{STRIP}) + B_{12}(\text{INOW}) \\ & + B_{13}(\text{IOPT}) + B_{14}(\text{TTNOW}) + B_{15}(\text{ANNVAC}) + B_{16}(\text{CFRURAL}) \\ & + B_{17}(\text{COLORADO}) + B_{18}(\text{CFTOWN}) + B_{19}(\text{CFSUBURB}) + B_{20}(\text{CFCITY}) \\ & + B_{21}(\text{NORESTRN}) + B_{22}(\text{SOUTHERN}) + B_{23}(\text{GRTLAKES}) \\ & + B_{24}(\text{GRTPLNS}) + B_{25}(\text{WESTERN}) + B_{26}(\text{POWN}) + B_{27}(\text{INCOME}) \\ & + B_{28}(\text{ECOL}).\end{aligned}$$

The following three equations contain the estimates of the hypothesized relationships between the independent variables which have been found to be statistically significant and the value of water quality expressed in terms of willingness to increase travel time, willingness to pay for waterfront recreation property and willingness to pay a daily fee. The absence of any variable listed in the general model above from the estimated equations means that the variable failed to meet the required significance for entry at the 95 percent level of confidence.

The equations are:

$$\begin{aligned}\text{Willingness to Increase Travel Time (percent)} = {} & \underset{(6.0)}{79.99} - \underset{(16.7)}{1.13}(\text{WQI}) + \underset{(4.7)}{0.68}(\text{IOPT}) + \underset{(2.6)}{17.04}(\text{SOUTHERN}) \\ & + \underset{(4.4)}{29.69}(\text{PREFFISH}) + \underset{(2.1)}{13.03}(\text{NORESTRN}) - \underset{(4.1)}{11.61}(\text{LTRIP}) \\ & + \underset{(3.3)}{17.95}(\text{POWN}) - \underset{(2.5)}{0.01}(\text{INCOME}) + \underset{(3.4)}{24.98}(\text{PREFSITE}) \qquad R^2 = .32\end{aligned}$$

$$\begin{aligned}\text{Willingness to Pay More For Waterfront Property (percent)} = {} & \underset{(4.8)}{108.6} - \underset{(17.2)}{1.9}(\text{WQI}) + \underset{(2.9)}{30.8}(\text{NORESTERN}) + \underset{(5.7)}{1.4}(\text{IOPT}) \\ & + \underset{(5.7)}{3.1}(\text{STRIP}) - \underset{(2.9)}{27.5}(\text{COLORADO}) - \underset{(3.5)}{0.8}(\text{NOW}) + \underset{(5.7)}{51.2}(\text{POWN}) \\ & + \underset{(4.6)}{0.8}(\text{TTNOW}) - \underset{(2.3)}{11.1}(\text{LTRIP}) - \underset{(2.3)}{24.6}(\text{CFRURAL}) + \underset{(3.1)}{5.5}(\text{ANNVAC}) \\ & + \underset{(2.7)}{32.9}(\text{PREFSITE}) + \underset{(2.3)}{24.1}(\text{PREFFISH}) - \underset{(2.4)}{23.4}(\text{ECOL}) \qquad R^2 = .35\end{aligned}$$

$$\text{Willingness to Pay More Daily Fee (Dollars)} = \underset{(10.7)}{5.24} - \underset{(17.0)}{0.06}(\text{WQI}) + \underset{(6.2)}{0.31}(\text{ANNVAC}) - \underset{(4.2)}{1.07}(\text{PREFSWIM})$$

$$+ \underset{(7.0)}{0.11}(\text{STRIP}) - \underset{(5.6)}{0.06}(\text{DAYSALL}) + \underset{(5.0)}{0.08}(\text{LDAYS}) + \underset{(3.2)}{0.01}(\text{INCOME})$$

$$- \underset{(2.6)}{0.02}(\text{IOPT}) + \underset{(2.4)}{0.02}(\text{INOW}) + \underset{(2.0)}{0.01}(\text{TTNOW}) \qquad R^2 = .30$$

Table 15. Variables in the Regression Analysis of Water Quality Values, Visitors to Rocky Mountain National Park, Colorado, 1973.

Abbreviation	Definition	Units	Question No.
TT	Willingness to increase travel time	percent	6
PPP	Willingness to increase the purchase price for waterfront recreation property	percent	7
DF	Willingness to increase payment of a daily fee	dollars	8
	Participants recreation activity preference	categorical	1
PREFBOAT	Boating		
PREFCAMP	Camping		
PREFFISH	Fishing		
PREFSITE	Sightseeing		
PREFSWIM	Swimming		
SDAYS	Annual days of participation on short trips	days/year	2
STRIP	Annual number of short trips taken	trips/year	2a
LDAYS	Annual days of participation on long trips	days/year	3
LTRIP	Annual number of long trips taken	trips/year	3a
INOW	Current proportion of leisure time budget allocated to water-based recreation	percent	4a
IOPT	Preferred proportion of leisure time budget allocated to water-based recreation	percent	4b

Table 15. Continued

Abbreviation	Definition	Units	Question No.
TTNOW	Willingness to travel as a proportion of leisure time allocated to water-based recreation	percent	5
WQI_{1j}	Perceived water quality of six color photographs	Index: 0-100	9
	Region of respondents residency within the United States	categorical	12
NORESTRN	Northeastern Region		
SOUTHERN	Southern Region		
GRTLAKES	Great Lakes Region		
GRTPLNS	Great Plains Region		
WESTERN	Western Region		
COLORADO	State of Colorado		
ECOL	Membership in recreation resource organizations	categorical variable	13
INCOME	Annual household pretax income	dollars/year	15
	Size or type of community in which resident resides	categorical	14
CFRURAL	Rural Area		
CFTOWN	Smaller Town		
CFSUBURB	Metropolitan Suburb		
CFCITY	Metropolitan Center		
POWN	Current ownership of recreation property adjacent to water	categorical	16
ANNVAC	Number of weeks of paid vacation per year	weeks/year	11

Each equation results from the sequential introduction of one variable after another into the equation in stepwise fashion. The relative ability of the remaining independent variables to explain the residual variance determines the order of entry. As the equation is being built, the ranking of explanatory power is measured by the F ratio for unentered variables. The F ratio is the basis for selecting the next variable for entry at each step of the iterative construction of the estimated model. After each entry of one more variable, the remaining unentered variables are ordered by an F ratio which is computed on the reduction of residual variance. The unentered variable found to have the largest computed F ratio is entered next. Entry terminates when all remaining variables are found to have an F ratio that is less than two, below which variables are of questionable statistical significance. At termination, the equation is then considered to be in final form.

These estimated equations may be read in the following way. To the left of the equal sign is the measure of value. The y intercept is the first number located directly to the right of the equal sign, giving the value of water quality when all other variables in the equation are zero. Each remaining variable in the equations would change the magnitude of willingness to pay for improved water quality which is located on the left side of the equal sign by the amount of the coefficient attached to the respective variable when there is an increase of one unit in magnitude of that variable. Student t tests which measure relative significance in the hypothesized relationships are listed in parentheses beneath the variable. Values above 1.96 are considered significant at the 95 percent level. All variables in the equations are significant at the 95 to 99 percent level. At the end of each equation is listed the multiple coefficient of determination, R^2. They show that 30 to 35 percent of the variation in the dependent variable, value of water quality, has been explained by the independent variables included in the equations.

APPENDIX B

FREQUENCY DISTRIBUTION OF RANKED PHOTOS

Table 16 shows the frequency with which respondents ranked photos first through sixth in terms of suitability for water-based recreation use. There is very little variation in individual perception of water quality for the first ranked photo A, although 12.8 percent ranked photo B first. The same is true for the second ranked photo B, although 13.5 percent ranked photo A second. Water quality of photo C was the most frequently ranked third, although 15.6 percent ranked photos D, E, and F as third. Photos of water of relatively high quality are easily distinguishable from those of lower quality. Photos A, B, and C are conceived as distinct in quality.

Quality differences between the photos D, E, and F with relatively more pollution present, are less distinguishable to park visitors. Water quality of photo D was the most frequently ranked fourth, although 22-26 percent ranked photos D, E, and F as fourth. Water quality of photo E was most frequently ranked fifth, although photo F was nearly as frequently ranked fifth, and 18.4 percent ranked photos C and D as fifth. The most frequent sixth ranked photo was D although 24 percent ranked photos E and F as sixth.

This suggests that park visitors may not always distinguish between deteriorated water and any subsequent improvement until the water has been substantially restored to natural conditions. Thus, an expenditure of funds insufficient to achieve substantial restoration necessary to enable park visitors as a group to distinguish the improved quality from an initial deteriorated condition could lessen economic gains at these levels of improvement.

Table 16. Frequency With Which Respondents Ranked Photographs First, Second, Third, Fourth, Fifth, and Sixth in Terms of Suitability for Water-Based Recreation, Rocky Mountain National Park, Colorado, 1973.

Photograph	Rank of Photograph					
	1st	2nd	3rd	4th	5th	6th
A	120	19	0	1	0	0
B	18	110	11	1	0	0
C	0	3	55	30	27	25
D	2	3	21	40	26	48
E	1	3	23	32	48	33
F	0	0	22	37	47	34

APPENDIX C

WATER QUALITY VALUE SURVEY, ROCKY MOUNTAIN NATIONAL PARK, COLORADO

The Department of Economics at Colorado State University is conducting research on outdoor recreation in several areas of the state and nation. We are interested in the importance to your enjoyment of outdoor recreation of water quality in the lakes and streams. The purpose of this study is to describe the value of water for outdoor recreation. For the study to be completed successfully, we need your help. All information you provide will be considered strictly confidential.

1. Different outdoor recreation users gain varying levels of pleasure depending on the activity in which they participate. Please indicate which of the following water-based recreation activities you most prefer.

   Boating ________
   Camping ________
   Fishing ________
   Sightseeing ________
   Swimming ________

2. a. During the last 12 months, how many days have you spent participating in outdoor recreation activities? Of the total, how many days have been spent on short outings of one weekend or less? How many days have been spent on longer vacations requiring time off from work?

   Participation during the last 12 months (days):
   Total ________
   Short Trips ________
   Long Trips ________

   b. During the last 12 months, how many short outings of one weekend or less have you taken? How many longer trips have you taken?

   Short Trips ________
   Long Trips ________

3. a. Of the total time which you have allocated to outdoor recreation during the last 12 months, what portion was devoted to participation in water-based recreation activities?

   Actual Proportion ________ percent

b. If you could have allocated your leisure time available for outdoor recreation during the last 12 months in an ideal manner to obtain the highest level of satisfaction, what would have been the ideal proportion of time you would have devoted to water-based recreation?

Ideal Proportion __________ percent

4. Based on the total time which you have allocated to outdoor recreation during the last 12 months, what proportion has been devoted to transportation between your home and destination points? That is, what portion of your leisure time has been spent in travel?

Proportion of leisure time devoted to travel __________ percent

5. We are interested in your perception of the suitability of water with various different levels of quality for the water-based recreation activities in which you regularly participate. We are going to ask you to rank the six color photographs which are before you from first to sixth based on your perception. Will you please examine each of the six photographs and then rank them according to your impression of their relative suitability for water-based recreation activities you enjoy most?

Photograph ranked first __________
Photograph ranked second __________
Photograph ranked third __________
Photograph ranked fourth __________
Photograph ranked fifth __________
Photograph ranked sixth __________

6. Assume there are two identical recreation areas equally suitable for the water-based recreation activities which you enjoy except for a difference in water quality levels at the two sites. Referring to the six photographs which you have ranked from first to sixth in relative suitability for recreation use, please state the largest percentage increase in the time currently spent traveling if you could enjoy improved water quality defined as:

Gaining water quality shown by your first choice photograph and avoiding water quality shown in your second choice photograph __________ percent
first choice rather than third choice __________ percent
first choice rather than fourth choice __________ percent
first choice rather than fifth choice __________ percent
first choice rather than sixth choice __________ percent

7. Assume waterfront recreation property situated suitably to meet your requirements for recreation, which abuts a water body of usable size for the pursuit of water-based recreation activities which you enjoy. Also, assume that the only limitation on its suitability is quality of the water adjacent to the property. Referring to the six photographs which you have ranked from first to sixth in

relative suitability for recreation use, please state the largest percentage increase in price you would be willing to bid for water-front recreation property to enjoy improved water quality defined as:

Gaining water quality shown by your first choice photograph and avoiding water quality shown in your second choice photograph __________ percent
first choice rather than third choice __________ percent
first choice rather than fourth choice __________ percent
first choice rather than fifth choice __________ percent
first choice rather than sixth choice __________ percent

8. Assume there are two identical recreation areas equally suitable for the pursuit of water-based recreation activities which you enjoy except for a difference in water quality levels at the two sites. Referring back to the six photographs which you have ranked from first to sixth in relative suitability for recreation use, please state dollar terms the largest increase in daily entrance fee at the recreation area you would be willing to pay in the future if you could enjoy improved water quality defined as:

Gaining water quality shown by your first choice photograph and avoiding water quality shown in your second choice photograph __________ dollars
first choice rather than third choice __________ dollars
first choice rather than fourth choice __________ dollars
first choice rather than fifth choice __________ dollars
first choice rather than sixth choice __________ dollars

9. We would like to refine the information that you have given us so far about your impressions of the photographs. Still thinking in terms of the suitability of water at various levels of quality for your water-based recreation activities, we are going to ask you to rate each of the photographs on a scale. The scale has a maximum value of 100 and a minimum value of zero. The minimum of zero is a value attached to the most deteriorated water quality level known to you through the media, work experience or personal knowledge. The maximum of 100 is the value of water completely suitable for recreation use and of the most pristine quality known. Would you please assign an index number to each photograph that most accurately rates your perception of the suitability of water for recreation use.

Photograph ranked first __________
Photograph ranked second __________
Photograph ranked third __________
Photograph ranked fourth __________
Photograph ranked fifth __________
Photograph ranked sixth __________

10. How many weeks of paid vacation do you receive annually?

    Weeks paid __________

11. What was your pre-tax household income from all sources during the last 12 months?

    Estimated Income __________

12. Do you belong or have you belonged to an organization which represents your general views about the management of resources for the purpose of meeting your recreation needs? This could include organizations which promote the preservation or conservation of resources, the development of recreation facilities, and the maintenance of sporting game stock.

    Member __________
    Non-member __________

13. Would you please describe the size or type community in which you now reside

    Near the center of the city __________
    In a suburb or fringe of the metropolitan area __________
    In a separate community or town __________
    In rural or unincorporated area __________

14. Do you now own or have you owned waterfront recreation property? Have you ever purchased property for your own use that included, at least partially, use of the land for access to water-based recreation activities which you enjoy?

    Ownership __________
    Non-ownership __________

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