

DISSERTATION

ECONOMIC BENEFITS OF RESOURCES USED FOR
ROCK CLIMBING AT ELDORADO CANYON STATE PARK, COLORADO

Submitted by
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In partial fulfillment of the requirements
for the Degree of Doctor of Philosophy
Colorado State University
Fort Collins, Colorado
Summer 1994

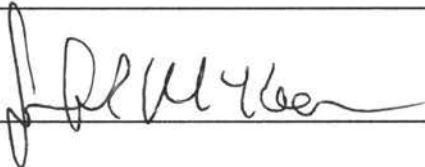
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WE HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER OUR SUPERVISION BY EARL R. EKSTRAND ENTITLED ECONOMIC BENEFITS OF RESOURCES USED FOR ROCK CLIMBING AT ELDORADO CANYON STATE PARK, COLORADO BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

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ABSTRACT OF DISSERTATION

ECONOMIC BENEFITS OF RESOURCES USED FOR ROCK CLIMBING AT ELDORADO CANYON STATE PARK, COLORADO

Rock climbing has gained popularity in recent years, with estimates of 15 percent annual growth as shown by increased congestion at climbing sites, growth of the indoor climbing facilities, and development of professional competitions. Many resources used for rock climbing are on public lands, but no estimates of value have been previously determined for these resources. Managers of these resources can improve decision-making with values provided by this research.

This study surveyed climbers at Eldorado Canyon State Park in Colorado during Summer 1991. This canyon is internationally recognized as one of the premier climbing areas in the world. It has over 800 named routes in the main area of the canyon, with over 30,000 climbing days each year. Overall, the respondents were willing to participate and express their feelings about the climbing issues.

The travel cost and contingent valuation methods used data collected from the questionnaires to value resources at this site. Four models were estimated using the travel cost method, comparing continuous and discrete distribution assumptions. The Poisson model provided slightly better results,

but many similarities existed between the four models. Consumer surplus values were estimated for these models, with values ranging from \$39.51 to \$48.73, with higher values from the discrete distribution models.

The contingent valuation method was used to estimate net willingness to pay equations for three levels of congestion. For current levels of congestion at the study site, consumer surplus was estimated at \$10.55 per day, well below the travel cost estimates. However, about 60 percent of the travel cost values represented the travel time portion, adjustment to the contingent valuation amount of \$10.55 increased the consumer surplus for current conditions to \$26.38, but still less than travel cost estimates.

Increased levels of congestion decreased levels of net benefits. For 15 minutes increased waiting, daily net benefits were \$5.87. For 30 minutes increased waiting, daily values averaged \$3.64. Net benefits for remote wilderness climbing provided daily values of \$27.95, about 165 percent increase over current conditions of Eldorado Canyon State Park.

Using the \$26.38, net benefit for a day of climbing at Eldorado Canyon State Park, total annual net benefits can be estimated. With about 30,545 climbing days annually, resources used for climbing provided about \$805,777 in value to climbers for 1991.

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ACKNOWLEDGMENTS

I would like to thank those who assisted me in this effort. Foremost was Dr. Richard G. Walsh, my major adviser, who provided critical assistance, advice, and encouragement. Without such a mentor, this process would not have ended so positively. Dr. John McKean, Dr. Charles Revier, and Dr. John Olienyk gave further assistance which was greatly appreciated.

Dr. S. Lee Gray, Chair of the Department of Agricultural and Resource Economics, provided both financial support and encouragement. Through his effort, part of my funding as a graduate student was provided by the Colorado Agricultural Experiment Station.

Also, I would like to express my appreciation to those who manage Eldorado Canyon State Park for their assistance. Finally, this research would not have been possible without the cooperation of the climbers who willingly participated in this study.

DEDICATION

To Jessica, Melissa and Gillian for providing encouragement,

To Diane and Matthew for their belief that I could finish,

To Roland, for being the perfect father and role-model,

And most of all, to Tracy for her love and infinite patience.

Hazel, I think this is what you had in mind 27 years ago.

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CHAPTER 1

INTRODUCTION

Rock climbing has gained in popularity in recent years, as can be seen by the increasing crowds at climbing areas and the development of professional competitions. In 1965, it was estimated that 1.4 percent of the population 16 years and older participated in mountain/rock climbing (Outdoor Recreation Resources Review Commission, 1972). Current estimates indicate that over 5.6 million persons, or 2.9 percent of the population 16 years and older¹, climbed at least once during 1992 (NPD Group Inc. 1993). In a telephone conversation with an editor of Climbing magazine, estimates of annual growth ranged between 15 to 20 percent over the past decade. This rapidly increasing popularity places more pressure on sites where people climb. Protection of current sites and potential sites is essential to provide opportunities for future participation.

Rock climbing is defined as the ascent of mountains or rocks with the use of gear such as ropes, ice axes, crampons, special shoes, and other hardware (Outdoor Recreation Resources Review Commission, 1972). Rock

¹Based on data from the Statistical Abstract of the United States, 1992, page 33. See United States Department of Commerce, Bureau of the Census 1992.

climbing is the joy of mountain climbing by the most direct route. Most children instinctively climb on rock whenever given the opportunity and some continue experiencing this joy in adult life. Others never expected to participate in this sport during early adult life, but experienced a change in attitude, leading to participation.

Rock climbing has grown out of the more general sport of mountaineering. A good source for the history of mountaineering and climbing is Mountaineering: The Freedom of the Hills. The eighteenth and nineteenth centuries led to development of great mountaineering achievements. These mountaineers usually tried to find the easiest way to "conquer" a mountain, this accomplishment being a great challenge at that time. As more mountains were climbed and fewer unclimbed peaks were available, new experiences were sought from already climbed peaks, using other more difficult routes, requiring additional levels of skill and aid to climb to the summit. At the same time, many climbers discovered that they liked rock climbing for its own sake and during the twentieth century, rock climbing developed as a sport of its own. Early methods often used pitons-anchors pounded into the rock. To these anchors, climbers would attach their ropes and other aids. Many of these aids included little rope ladders, commonly called etriers, so the climber was not really climbing the rock as much as these ladders in many difficult spots, referred to as direct aid climbing.

However, recent attitudes consider this method unethical for many climbs, due to the damage to rock. Most popular climbs are now done without the use of pitons and other direct aids, called free climbing. Instead of pitons, temporary chocks are placed on route for protection, these chocks being quite often wires or small rope looped through steel pieces designed for providing temporary protection from falling. Today, numerous new chock designs have come onto the market, allowing increased choice of difficult routes to the climbers.

The sport is expanding in different directions. It is no longer a sport for the young. Two or three decades ago, most of the climbers were in their twenties. As equipment was not as advanced, it has been suggested that climbers hurt themselves so often they had a tendency to quit serious climbing by their thirties. Also, since until recently there were no professional climbers; after a few years many climbers would settle down and get a real job. Today, the age of climbers ranges from children to retired persons. While a majority of climbers are still young, many more still climb throughout adult life.

Climbers are pushing into new areas for climbing. No longer are climbers restricting themselves to the great walls at Eldorado Canyon or Yosemite. They are discovering challenging new routes in every little canyon that shows promise, even if the climbs are only forty or fifty feet high. In climbing periodicals, new areas are continually being identified. For

example, during the spring and summer of 1992, climbers wrote of new areas being tried at Rifle Gap in western Colorado and various sites in Clear Creek Canyon outside Golden, Colorado (for example, see Thornburg 1992).

Climbers also have discovered indoor gyms. For many climbers in the United States, no access to outdoor climbing areas exists. One climber who was interviewed manages a gym in Chicago which houses a five story climbing wall (see Climbing, 1991, p. 34). Most cities now have indoor climbing walls, reflecting the increased demand from growth of the sport. This increase in climbing walls is also leading to increased numbers of people climbing. Places like Fort Collins and Loveland have enough demand to make at least one indoor climbing wall available. Indoor climbing areas are used by many climbers for conditioning and preparation for the outdoor season or when outdoor climbing is unavailable. In addition, many other climbers are finding that indoor climbing is a segment of the sport they prefer and may never wish to climb outdoors.

The last few years have seen development of professional climbing throughout the U.S. and Europe. Numerous competitions with various amounts of prize money allow top climbers to earn up to \$50,000 a year. The development of professional climbing has been partially responsible for development of indoor climbing, as artificial climbing walls were developed to provide an even level of opportunity to all competitors. Prior to artificial walls, local cliffs were used, and local climbers had an advantage, having

more opportunity to climb the routes used in competition. Professional climbing has helped develop new ways to more rapidly improve skills. This has led to changes concerning the "rules" of climbing and a split between traditionalists and sport climbers.

This split among the two types of climbing is the most important change in the sport today. The traditionalists insist that routes be climbed in the "old-fashioned" way of starting at the bottom and working up, learning the route along the way. If the climber falls, he starts over at the bottom. This has been the method commonly used until recently, when climbers in Europe began to surpass U.S. climbers in skill. European (mostly French) climbers began the new technique of sport climbing, starting at the top of a route and climbing down on a rope. Hanging on the rope allows faster learning of the route, and climbers can work on the harder moves more frequently, not having to climb back up after each fall. They also clean the route, sweeping away any loose dirt, gravel, or vegetation. A main source of conflict between sport climbers and traditionalists is the use of bolts.

The most difficult routes are not "protected" easily with traditional methods, that is, placement of gear in the usual fashion to protect the climber. Therefore, sport climbers started using power drills to put bolts and hangers in the rock every few feet. Bolts have been used for years, but sport climbers increased the use dramatically. Use of bolts allows the climber to carry less weight in gear when he finally attempts to climb the

route "officially" from the bottom. Traditionalists believe that bolting every few feet is destroying the rock and disgracing the sport. Traditionalists believe a climber should take what the rock offers, and climb only natural lines, not man-made ones.

Bolting a route has been controversial, with many battles fought among climbers. These include traditionalists chopping out or pulling the bolts on routes and cutting the ropes left on the routes by sport climbers. One climber, who had a habit of chopping all bolts he found on routes, indicated that he could not climb at Eldorado Canyon for a long time because other climbers would break his truck windows whenever possible. Other stories of conflicts have been reported in climbing chronicles (Osius, 1992). Many climbers raise their voices about whether it is ethical to use bolts. The sport may be slowly moving in the direction of accepting sport climbing. Many of the ambitious younger climbers quickly become sport climbers; some traditional climbers convert to develop competitively. Of the 187 climbers answering a preference question in this study, 110 indicated no preference. However, many traditionalists, especially those not earning a living as professional climbers, remain adamant. It remains to be seen if younger climbers become more traditional or if the traditional climbing philosophy changes over time.

The split between sport climbers and traditionalists appears to reflect what they seek in climbing. Sport climbs tend to be more gymnastic in

nature, the physical moves are to be learned and conquered using whatever tools available including bolts, power drills, and chalk. Sport climbers use many extreme measures to succeed, including filing the skin off their fingers to make them thinner, refusing to carry their own gear to climbs (as this builds bulk in muscles not necessary for climbing, leading to unnecessary weight) wearing only brief nylon underwear while climbing, and maintaining restrictive diets (also in order to avoid unnecessary weight).

Traditionalists seem to revere the rock more than sport climbers. Purity in the rock is important, and not debasing the route with improper climbing appears to be part of this climbing code. Many from this group have commented that they prefer to climb in remote areas, hiking to climbs miles from the closest road. To them, the best climbs include the possibility of remoteness and interaction with nature. It has been reported that some will not park at trail heads to avoid contact with crowds while on the hike to the climbing site. These climbers seem to attach greater value to many remote activities such as backpacking or fishing, in addition to climbing.

The purpose of this study is to determine the value of a climbing day for rock climbing. It looks at the impact of changes in congestion on the value of climbing and compares the results to values for climbing in remote wilderness sites. These values are determined using the travel cost and contingent valuation methods.

PROBLEM STATEMENT

Climbing sites, like other recreation areas, contain potential resources for many uses besides climbing. The sites could provide resources for other uses, such as housing developments or mining, leading to conflicts concerning use. Managers of public lands are required to recognize multiple purposes when creating an overall plan of management or use. Using public areas for climbing and similar activities requires that public land management consider minimizing other uses of the resources; mining and timber harvesting are not normally compatible with recreational activities.

A major issue facing climbers in the United States is concern over closures of climbing areas (Access, 1992) as rock is classified off-limits to climbing due to legal liability and other concerns. For instance, recently Eldorado Canyon State Park posted restrictions on climbing areas and types of climbing activity allowed (Eldorado Canyon Climbing Plan). The National Park Service has banned drilling holes for bolts in Rocky Mountain National Park, Joshua Tree National Monument, and Yosemite National Park. Other areas have been closed to climbing even though it was the main recreation activity at the sites. While the interests of climbers tend to be highly fragmented, the one issue that most draws them together is access to climbing areas. Information on the value of climbing would be an important step toward preservation of climbing areas most susceptible to closure.

While other considerations are important, one of the most important determinants of efficient resource use is economic value. Users who develop resources have advantages in determining economic values. Industries can measure demand for the output, identify a price for the product, and show the value of the output as houses, roads, and other goods that provide comfort and convenience. Climbing cannot be valued by market price as in other non-recreational activities that use public lands. Also, its value to individuals is not observable, i.e., it increases the welfare of people in intangible ways, creating a sense of physical and mental well-being, accomplishment, and satisfaction. Measurement of the economic value of technical climbing is more difficult because participants do not pay for it in the same way as they do for lumber. Economic valuations can help to more accurately identify the value of technical climbing and thus help preserve climbing areas controlled by public agencies. In addition, as demand grows for preservation of unprotected climbing areas, decision makers will be able to more adequately assess the value of these undeveloped areas as climbing sites.

OBJECTIVES AND HYPOTHESES

The objectives of this study are to (1) measure the economic value of technical climbing sites, (2) measure the effect of increased crowding on economic value, and, (3) determine how environmental quality, i.e.,

remoteness of the climbing site, affects individual enjoyment of the activity and its economic value. In addition, comparison of different distributional models are shown in the travel cost method.

The questionnaire used in this study was designed to provide data to use in both travel cost (TCM) and contingent valuation (CVM) methods. Research has indicated that estimates of value determined from both the TCM and the CVM can produce consistent and stable recreational use values (Cummings, et al., 1986) and this study will provide a comparison of the two methods. A possible problem is that the travel cost data may not have enough variation, preventing accurate measurement of the TCM.

CONCLUSIONS

Following this introduction are six additional chapters. The next chapter outlines the economic theory used to value recreational activities by users of the resources. It also includes previous studies relevant to this research. Chapter three describes the study site, Eldorado Canyon State Park. Chapter four provides information on sampling procedure used in this study. Chapter five analyzes the data using the travel cost method, comparing four models of valuation. Chapter six provides the results of analysis for the contingent valuation method, for three levels of congestion at this site and for remote climbing areas. Chapter seven summarizes the results.

CHAPTER 2

VALUING RESOURCES USED FOR ROCK CLIMBING: LITERATURE REVIEW AND THEORETICAL DEVELOPMENT

CLIMBING LITERATURE

There has been only one effort to study the economic values related to climbing, by Shaw (1992a). This study looked at the impact of congestion on the recreation demand for rock climbing at the Mohonk Preserve, close to New York City. Because there are few opportunities for climbing in the northeastern United States, climbing use is heavy at this site. Both mail surveys and personal interviews were used to collect data. Using a Mohonk Preserve membership list, users were sent a mail survey, resulting in 366 responses, mostly from climbers. On-site responses were sought on a Sunday in October from those who had not sent in mail surveys, resulting in 83 more responses: of these, most were not climbers. The questionnaire sought opinions on the level of crowding at the site, from climbing and non-climbing perspectives. The results suggested that, for non-climbers, overcrowding is not a major issue. Climbers, however, responded that they were bothered by crowding, especially on weekends. Skill level appeared to affect the response. Shaw suggests that more experienced climbers have

more alternative sites available than beginners. One reason is that guidebooks list only those routes that are officially in the Preserve, while experienced climbers know of many climbing areas nearby, but not in the Preserve. Shaw also noted that many respondents "were extremely hostile or at least questioned why the survey was being conducted" (pp. 12-13).

Shaw measured congestion as the length of time a climber had to wait to begin climbing. The first regression in this study considered the "yes" or "no" answer to the overcrowding question as a function of age, distance traveled, total days spent at the Preserve, total days spent in a row at the site, and household income. He stated that the results were "quite poor, showing little ability of the explanatory variables to explain the probability of a 'yes' answer" (p. 13). The only significant variable was age.

He also estimated a regression considering the amount of time a climber waits, due to waiting at the bottom of a climb, waiting to park, or having to walk to more distant climbs. He estimated this time as a function of age, travel cost, total annual days spent at the site, other days spent climbing elsewhere, a dummy variable for the overcrowding question, and the number of climbs available in the climber's ability range. Shaw states that results appeared to be stronger for those on a single-day trip. Of climbers spending only one day at the site, significant variables were total annual days at the site, numbers of climbs available, and age, with negative

coefficients. Of those climbers who stayed overnight, the number of climbs available was the only significant variable, again with a negative coefficient.

He concluded that congestion may be difficult to model and measure. Results were affected as approximately 50 percent of those approached refusing to participate and by the fact that some questions were found to be ambiguous by respondents. Other pertinent questions he proposed were not allowed by the Preserve officials. Shaw concluded that congestion affects recreationists from different sports at different levels and the marginal impact on climbers is not the same as for other recreationists. Climbers felt overcrowding was an issue, while many non-climbers did not. He noted that different abilities are affected differently, i.e., higher-skilled climbers seemed to be bothered less by crowding. In addition, he expressed concern that respondents to the economic valuation questions may have had ulterior motives in their answers.

CROWDING LITERATURE

A major impact on the quality of climbing is congestion at the climbing site. As climbing grows in popularity, many of the popular climbing sites become crowded. Congestion occurs when use exceeds capacity of the site and is expressed as a ratio of the number of users to the physical or economic capacity of the site. Measurable congestion occurs when the density of users has increased, reducing the level of enjoyment of the

activity for all those at that site. In the case of climbing, congestion will have a negative impact not only on the time it takes to start a route, but could impact safety (others knock rock down from above) or enjoyment (waiting half-way up a route as another team is finishing that section).

As the benefit is reduced by increasing levels of congestion, users' willingness to pay is decreased. However, the cost of use remains constant, as travel and other significant costs do not change due to changes in congestion. Initially, with low levels of congestion, the recreationist has few encounters and the quality of the experience is high: benefits slowly fall with increasing levels of congestion. However, as encounters increase, the quality of the experience falls and benefits decrease at a more rapid pace. The level of benefits falls until, finally, net benefits are reduced to zero (Walsh, 1986, p. 181).

Congestion usually impacts economic models as a variable in the demand function, being a demand shifter (Freeman and Haveman, 1977). As congestion levels change, a demand curve can be estimated at each level of congestion (Walsh, 1986). When congestion levels are minimal, gains from additional users exceed losses from increased congestion for other users, and aggregate total benefits increase. As congestion increases, net benefits fall to zero for current users, then each additional user reduces the benefit to all others so that the net change in aggregate benefits is negative. Each new user does not consider the impact on others' utility functions

when choosing but only on his own utility function. This externality has a tendency to create overuse, reducing aggregate total satisfaction below optimal levels (Walsh, 1986).

Various measures have been used to establish levels of congestion. McConnell (1977) measured the number of users per acre per day on six different beaches. Cicchetti and Smith (1976) and Walsh and Gilliam (1982) looked at the number of encounters per day while in a wilderness setting. Walsh, Miller, and Gilliam (1983) measured congestion as the number of minutes skiers spent waiting in lift lines. Shaw (1992a) also used a measure of time-minutes spent waiting to rock climb. He noted that a better measure may be the length of time necessary to complete the climb but that information was not available.

McConnell (1981) determined that different beaches in the same general area required substantially different levels of density to change willingness to pay by users, depending upon the type of clientele that frequented each beach. Walsh, Miller, and Gilliam (1983), in a study of back-country hiking and backpacking, found different rates of change in willingness to pay, depending on activity. Wilderness campers tended to be more sensitive to congestion than hikers. Walsh (1986) noted that nearness to a large population center affected enjoyment; as users were in a wilderness area near a large population center, users tolerated higher levels of encounters than in other wilderness settings. The Walsh, Miller, and

Gilliam study (1983) noted that the effect of congestion on willingness to pay differed, depending on the size of the ski area. They concluded that a higher price for access creates greater expectations by the user, affecting the perception of congestion. They also estimated benefits from reducing congestion, suggesting that finding optimal levels of use and levels of site expansion can be determined. Shaw (1992a) found that skill level, along with expectations, affected the perception of congestion for rock climbers in New York. More experienced climbers were more tolerant of higher density levels than less experienced climbers. He found that the type of activity affected perceptions, i.e., climbers felt crowded, while, at the same time, other recreationists did not. Also, the presence of bicyclists seemed to make recreationists more uncomfortable than the presence of other types of users.

ENVIRONMENTAL REMOTENESS LITERATURE

Remoteness of climbing sites can have an impact on consumer surplus of climbers. A remote or wilderness area has been defined by the Outdoor Recreation Resources Review Commission (1972) as an area which was not accessible by improved roads and had no developed camp sites. Many climbers expressed that they have a higher level of enjoyment climbing at remote sites. Therefore, on the questionnaire, climbers may reveal a different willingness to pay for climbing at remote locations. While there are

no studies looking at consumer surplus for remote sites for climbing, other recreational activities have economic values available. These include cross country skiing, backpacking, hiking, fishing, and hunting.

Walsh, Johnson and McKean (1990 p. 172-173) reported a summary of net economic values for a sample of these studies from 1968 to 1988. These are adjusted to third quarter 1987 dollars and adjusted for omissions or travel time, and other factors. For different classes of hunting, the mean for net benefits for users was \$41.69 per day. Big game hunting had the highest values with a mean of \$45.47 and small game hunting had the least at \$30.82. Anglers provided a mean of \$39.25 per day with salt water fishing showed the highest level, at a mean of \$72.49 with warm water fishing at \$23.55. In addition to these two studies, the category of "wilderness recreation" is also reported, with a mean value of \$24.58.

Additional work by Bergstrom and Cordell (1991, p. 79) reports similar values from a sample of over 26,000 users. Data was collected between 1985-1987 from over 200 sites, mostly public recreation areas, to identify use of public areas for outdoor recreation by various agencies. Their study provided levels of consumer surplus per day for hunting between \$11.98 to \$12.07, for fishing ranging from \$12.53 to \$23.57, and backpacking at \$25.88. Another activity reported, related to remoteness and wilderness use, is primitive camping. This activity reports a slightly lower level of consumer surplus at \$8.24.

Economic values for various recreational activities in wilderness settings have been reported recently. Richards et al. (1990) obtained data from visitors to forest campgrounds using TCM and CVM questions. They looked at willingness to pay for forest conditions and scenic beauty. Their consumer surplus estimates per person per trip for ten campgrounds ranged from \$3.48 to \$21.43, partly based on forest conditions. However, their conclusions included concern due to little correlation between the willingness to pay estimates based on photographs and values from actual forest conditions or travel cost estimates. Additional work on forest conditions was provided by Walsh et al. using CVM and TCM to value tree density in a case study of damage to forest quality in the Colorado Rocky Mountains. Using mean densities of trees, their mean average benefits per trip ranged from \$17.72 to \$22.59, depending on statistical procedure for the CVM and TCM data. As tree density declined, the benefits reported declined also.

Economic values for cross country skiing have been reported by Walsh, Radulaski, and Lee (1984) and McCollum, Gilbert, and Peterson (1990). Walsh et al. found values for hiking and cross-country skiing in roaded vs nonroaded areas in a national forest using CVM. The skiers reported maximum willingness to pay for groomed trails as opposed to trails not maintained. Values reported showed that groomed trails had a higher value per activity day (\$15) than areas not groomed (\$10). McCollum et al.

looked at several sites in Vermont. The mean economic values obtained ranged from \$14.94 to \$33.90, depending on the site and amenities.

Walsh and Gilliam (1982) applied the CVM approach to find the benefits of expanding wilderness due to excess demand. They looked at the marginal willingness to pay to find optimal levels of congestion through application of the willingness to pay data of hikers and backpackers in the Indian Peaks wilderness area in Colorado in 1979. The willingness to pay per recreation visitor day, based on minimal level of encounters were \$15.68 for hikers and \$20.81 for backpackers. These values declined as increased congestion was considered to the point where 43 encounters per day was considered the maximum before aggregate benefits for the wilderness area started declining.

Value of hiking in national forests has been reported by Walsh, Radulaski, and Lee (1984) and Rosenthal and Walsh (1986). Walsh et al. studied the impact on hikers' benefits in two northern Colorado national forests from interviews of 106 hikers, 33 in roaded zones and 73 in nonroaded areas. Estimated average benefits at optimal levels of use for the roaded zones were \$9 while the nonroaded zones resulted in a \$13 amount. This difference of \$4 implies a higher value for the more remote areas of these forests. Rosenthal and Walsh interviewed 202 hikers during 1981 in a national forest along the Front Range of the Colorado Rockies. They compared consumer surplus for hikers in three classes of remoteness. This

study reported, for single destination trips, hikes in the primitive class had the highest consumer surplus (\$36.56), semi-primitive nonmotorized class was second highest (\$19.60), and motorized class had the least (\$12.74). However, as measured in recreation visitor days, due to a longer length of time for the primitive trips, any difference between classes disappeared. Multiple destination hikers had values higher than single destination hikers but did not vary significantly by zone. The average consumer surplus per trip for multiple destination hikers was \$122.03 per trip, or \$22.80 per recreation visitor day. When all hikers, single and multiple destination, were combined into one average consumer surplus, no difference was reported per trip but, for a recreation visitor day, the primitive class had lower consumer surplus (\$8.64) compared to the semi-primitive nonmotorized class (\$14.91), again due to more time spent on the trips.

A study of nonuse values for wilderness is provided by Walsh, Loomis, and Gillman (1984). Their study addressed the problem of estimating preservation value of increments in wilderness protection. They estimated use value at \$14.00 per visitor day with preservation value to Colorado residents per household at \$13.92. Their total annual recreation use and preservation value in aggregate to Colorado households was \$28.5 million. This data indicates that insufficient public lands would be allocated to wilderness preservation without recognition of preservation values.

These studies show that wilderness/remote areas provide high levels of enjoyment and satisfaction for users. It is suggested that, as the quality of the sites diminish, that the value of the experience decreases accordingly. Climbers may show similar results, having different willingness to pay for remote climbing sites.

THEORETICAL MODEL-MEASUREMENT OF BENEFITS

The purpose of this study is to estimate a demand function for climbing resources at Eldorado Canyon State Park, Colorado. Various techniques have been used to measure demand for recreational activities. Currently accepted methods include the household production process (HPP), the travel cost method (TCM), and the contingent valuation method (CVM). The last two are the methods used in this study. The HPP, first suggested by Becker (1965), combines dollars, time, and effort by the recreationist to produce the recreation experience. Becker stated that consumers maximize utility by combining purchased goods and services with their skills, time, and effort to produce a recreational product. The TCM was first applied by Clawson (1959). Travel cost is used as a proxy for price in order to develop a demand curve for number of trips, which declines with distance traveled. The CVM was first applied by Davis (1963). The area under the demand curve is found by asking consumers to state their maximum willingness to pay (WTP) rather than foregoing access. The

reported WTP is assumed to be similar to the price of other goods and services consumed, i.e., the consumer indicates a willingness to pay by purchasing the good or service.

Support for the TCM and CVM methods is found in the Federal Register (1979) giving revised "Principles and Standards for Water and Related Land Resources Planning" from the Water Resources Council, providing standards for project evaluation. The methods deemed acceptable by the Water Resources Council included CVM and TCM. CVM later received additional recognition by the U.S. Department of Interior (1986) as being deemed the method used for measuring benefits and damages under the Superfund Act of 1980.

These three methods assume that the utility function can be expressed as:

$$U = [R(T,Q),G]$$

where R is the bundle of recreational goods consumed, subject to two characteristics, T and Q. T is the quantity of trips and Q is the quality of the recreational experience. G is all nonrecreation goods and services consumed.

An assumption of the utility function is that it is separable between recreation and nonrecreation characteristics. The separable condition requires that recreation goods and nonrecreation goods be mutually exclusive so that the changes in the consumption of one group does not

affect the marginal utility of the other. Changes in the prices of the goods in one group only affects the total expenditures on the other group (Nicholson 1992).

Household Production Process

The HPP was developed on the assumption that the recreationist is the producer of one's own recreation. Production occurs through use of inputs such as one's own time and effort, items purchased for recreation, such as equipment, and public resources. The HPP explicitly recognizes non-monetary factors as part of the decision process by the recreationist. Demand for goods and services used in the production process then is recognized as derived demand for inputs needed in the production process for final goods.

Because individuals are the producers of recreation, they can have control of some of the quality variables. Bockstael and McConnell (1981) pointed out that optimal quantity and quality are determined simultaneously as the inputs are combined. Inputs controlled by the individual, such as skill, along with the quantity of public goods and the total travel costs, affect total costs of the production process and the quantity of trips simultaneously (Loomis, 1983). With skill being endogenous, the HPP assumes that the climber will choose to develop a level of skill, learning better technique, to maximize this enjoyment. In the short run though, the

endogenous variables become exogenous as the user cannot change skill level or other quality variables affecting enjoyment. In the case of rock climbing, climbers choose which climbs will provide the greatest enjoyment, based on the climber's skill.

The TCM and CVM do not allow for this endogenous use of quality; quality is provided by the environment and the management of the resources. Munley and Smith (1976) determined skill to be an exogenous variable within the CVM in their study of white water canoeing. Different levels of skill were associated with different levels of willingness to pay for recreation and can proxy for tastes and preferences of the individual. Crowding at climbing sites affects quality and cannot be changed by the user but only by the manager of the park. Crowding, then, is not an endogenous variable, but exogenous to the climber.

Quality (Q in the utility function) is then a function of the price of inputs used in producing quality, the environment or resources available, and skill level used as an input in the production process (Loomis, 1983). The first two characteristics of quality are determined exogenously, but the third could be endogenous to quality in the long run. When quality is not endogenous, but determined by external means, and if trip costs are constant, then the TCM and HPP become identical functions (Bockstael and McConnell, 1981). In this situation, the quantity is the only endogenous variable. Quality and skill are then demand shifters.

Travel Cost Method

The TCM is an indirect method of estimating net benefits. The TCM measures demand for a recreation site by observing travel data created by the recreationists. One approach, the zonal method, assumes that, as the distance to a recreation site increases, the number of visits to the site decreases as travel costs rise. An alternative approach, the individual method, uses trips per year as the dependent variable. The TCM assumes that the only endogenous variable for recreationists is the number of visits per year to the site. TCM measures demand for a site at the current level of quality by measuring the number of visits to the site against measurement of travel expenses. Travel cost also has the limitation that it can only value the current range in level of quality and available resources, that is, site quality is determined by the public sector and is an exogenous variable. Besides the effect of travel cost on number of visits, other variables that are important for determining consumers' decisions include income, individual tastes, and substitution effects, among others.

Other issues impact the calculation of travel costs. Cost of time spent traveling to the site needs to be added to travel cost. Travel cost also needs to be adjusted if a multiple-purpose trip occurs. Dividing the travel costs among the various sites is one method of adjusting travel costs. Also, TCM has measurement problems if most visitors are from the same area or zone, as travel cost will not have variation in the data, causing statistical

problems. This was a concern at the beginning of the study, as many of the climbers are from the Front Range of Colorado. However, the travel cost model was estimated without any difficulty due to this issue.

The TCM model assumes an individual maximizes a utility function subject to an income constraint with any quality variables exogenous to individual trip decisions. Value of the recreation experience is based on the consumer surplus measure associated with changes in travel costs. This can be expressed as:

$$T_{ij} = f(D_{ij}, S_{ij}, Q_j, TP_i)$$

with T_{ij} = number of trips to the site, j , by individual i per year,
 D_{ij} = the round trip distance, a proxy for price,
 S_{ij} = measure of proximity and/or quality of alternative site to site j for the individual i ,
 Q_j = quality of the site per trip, i.e., weather, remoteness, crowding, etc.,
 TP_i = socioeconomic variables that may influence demand for the site, income, age, family size, skill of the individual, equipment, etc.

If direct costs are used rather than distances, out-of-pocket costs are the only recognized cost used. Equipment purchases before the trip should not be a travel cost. However, travel time is a cost of the trip and should be added to direct travel cost.

The two approaches toward measuring TCM can provide similar results. Sorg and Loomis (1984) point out that two approaches yield similar results only if the participation rate does not depend on distance traveled. The individual approach does not consider the effect of travel costs on the

probability of participation and may yield higher site values with increased availability of alternative sites the farther one lives from the site. The individual demand curve is expected to be more inelastic in comparison to the zonal, particularly for sites of high quality that draw from long distances, such as Eldorado Canyon State Park. However, the participation rate is not affected as much by travel costs when an activity such as rock climbing requires special equipment and skills, in which case the two methods tend to yield similar values (Sorg and Loomis 1984).

Contingent Valuation Method

A third approach to measurement of net benefits to consumers is the contingent valuation method (CVM). This is a direct survey approach to estimate values for non-market goods. Consumers are asked to report the maximum value they would be willing to pay rather than foregoing the good. CVM provides an inverse demand curve, with the dependent variable being willingness to pay. Number of visits, or quantity, is an independent variable. CVM has an advantage over TCM, in that changes in quality can be considered. The recreationist can be asked to value quality levels not currently available. Therefore, possible changes in quality and alternative management programs can be valued using CVM.

The CVM requires that the consumer carefully consider information provided about hypothetical changes. Surveys need to be properly designed

to capture accurately the information desired and so that the consumer is not purposely biasing answers to influence the results. Overstatement of values could result if consumers wish to increase expected values or understatement may result if they believe it will have a negative impact to consumption (higher entrance fees). Careful design of the questionnaire can reduce this strategic bias.

The usual CVM model is from Schulze, d'Arge, and Brookshire (1981), who used the same utility function as Bockstael and McConnell (1981) which provides the compensated demand curve for TCM. Mitchell and Carson (1989) suggest an expenditure function approach:

$$\text{Expenditures} = [e(P, Q, U) = Y]$$

with P = vector of prices,
 Q = vector of fixed public goods,
 U = a given level of utility,
 Y = the minimum level of income needed to maintain the consumer utility at U , given prices P , and the vector of publicly supplied goods, Q .

Compensating Surplus equals $[e(P_0, Q_0, U_0) = Y_0] - [e(P_0, Q_1, U_0) = Y_1] = Y_0 - Y_1$. When this is positive, then Q_1 is preferred to Q_0 and the consumers are willing to pay so utility is the same as in the initial situation.

Equivalent surplus equals $[e(p_0, Q_0, U_1) = Y_0^*] - [e(P_0, Q_0, U_1) = Y_1^*] = Y_0^* - Y_1^*$. Note that Y_1^* and Y_0^* may not be the same as Y_1 and Y_0 in compensating surplus. When Q_1 is preferred to Q_0 , a willingness to accept value is found. If Q_0 is preferred to Q_1 we have a willingness to pay, measuring compensating surplus of a quality-level decrease. For a quality

decrease, equivalent surplus is the amount one is willing to pay to avoid the decrease.

CVM surveys usually ask for willingness to pay (WTP) for a given quality or change in quality of publicly supplied goods. The results (WTP) provide a Hicksian compensated site demand curve rather than Marshallian demand curve. For given prices and trip characteristics, the only difference between true net values under TCM and CVM demand curves should be the difference between Marshallian consumer surplus and Hicksian compensating surplus, with the consumer surplus (TCM) being slightly larger. Willig (1976) though, shows the estimates from either method would not be expected to differ significantly.

Three common techniques used by CVM for asking contingent valuation questions are iterative bidding, the payment card, and dichotomous choice. These three are used in a format that includes a description of the item being valued and the market which would provide the exchange. Boyle and Bishop (1988) compared results from the three techniques in a survey of canoeists in Wisconsin and found comparable Hicksian surplus valuations.

Improvements in nonmarket valuation techniques provide an opportunity to transfer information from past studies to estimate values for future policy analyses (Walsh, Johnson, and McKean, 1989 and Loomis, 1987). There is a need for increased use of CVM in general benefit-cost

framework. Walsh et al. analyzed 287 recreation benefit estimates from 1968 to 1988 and show that the results from these studies are promising enough to merit further development for possible information transfer from past nonmarket studies. Loomis concluded his work by stating that generalizing from samples warrants greater attention.

Mannesto and Loomis (1991) studied the effectiveness of mail vs in-person CVM questionnaires in a survey of boaters and anglers in California. They found that in-person interviews had a much higher completion rate than mail surveys. As they placed the mail surveys on the windshields of the vehicles belonging to the recreationists, they had no names with which to follow up on non-respondents. Concerning item non-response rates, "mail method had higher individual question response rates than the in-person method for sensitive (income) and CVM (complex, future-oriented) questions. The mail method may be better suited for CVM questions because it allows for contemplation and reduces pressure for an immediate answer." Concerning data comparability, analysis of the results showed little difference in values.

Comparisons of CVM and TCM have shown that the two methods can produce consistent values. For example, Sanders, Walsh, and McKean (1991) compared TCM and CVM formats for valuing stretches of 11 rivers in the Colorado Rocky Mountains considered for protection under the Wild and Scenic Rivers Act. Surveys were mailed to a sample of households in

Colorado. Mean values per visitor day ranged from \$20.91 to \$24.38, leading to the conclusion that estimates appear to be sufficiently reliable to demonstrate consistent and reasonably stable recreational use values.

CHAPTER 3

STUDY SITE

Choosing Eldorado Canyon State Park as the climbing site for an economic valuation seemed appropriate as it is Colorado's premier climbing site and an internationally recognized climbing mecca. As this area is considered to be among the top climbing areas in the U.S. and the world, climbers from other countries are common (Rossiter).

Eldorado Canyon State Park is located about 7 miles southwest of Boulder, Colorado, and 25 miles northwest of Denver, a metropolitan area of some 1.6 million persons. This proximity makes it a common climbing area along the Front Range of Colorado. Within the park are over 800 named climbing routes (Rossiter, p 89), many well known internationally. Many of the classic routes for rock climbing, along with noted rock climbers, gained fame here in the last thirty years.

As Eldorado Canyon State Park is known for outstanding climbing, this is probably its largest single use, other than sightseeing. The site also provides opportunities for picnicking, hiking, fishing, and other outdoor pursuits. The park does not allow camping, much to the dismay of international visitors (their most common complaint). It is 845 acres in size

with many sheer sandstone walls within its boundaries. These cliffs rise over 800 feet from the canyon floor.

Prior to creation of the state park, the canyon was part of a privately operated spa, with access from Denver and Boulder by railroad. It was originally settled as a forestry homestead site and was considered a prime site during the 1920s as place for a hydroelectric dam. Rock climbing began during the late 1940s as some of the famous names in the canyon's history arrived. However, prior to this time, many resort visitors climbed on the walls in their tennis shoes, with the first fatal fall occurring in 1942. The spa was not profitable for much of its history, and the owners of the canyon spent many years trying to give it to the state for use as a park. The state opened the park in 1978, and it is administered by the Colorado Division of Parks and Outdoor Recreation. Many climbers stated that the land was acquired by the state with the intention of preserving the climbing cliffs for the public.

Entrance requires payment of a \$3 daily admission fee for vehicles or \$1 for walk-ins and is closed at night with a locked gate. The site honors Colorado State Parks season passes, with an annual cost of \$30 in 1991. Many of the regular users purchase a season pass, as they climb more than 10 days per year at the site.

After entering the gate, the visitor passes through the main parking lot, a widening of the road, with room for about 30-40 vehicles. Within 300

feet of the entrance, the visitor enters the canyon, with vertical walls on both sides towering to over 800 feet (Rossiter, p. 89). Most climbing is on the north side where the walls are the highest and the steepest. However, one famous cliff, The Bastille, is along the south side of the road. The park is less developed than other state parks, with the road being too narrow for two cars to pass alongside The Bastille. Climbers are usually standing along the roadway, climbing or belaying, which is an additional hazard.

While the park is two miles long, climbing intensity is the greatest in the first half-mile, near the entrance (Rossiter, p. 90). Most climbers park just inside the entrance at the main parking lot and walk to the area where they want to climb. As there is no other parking near, those picnicking, hiking, or sightseeing drive on through to the other end of the park. Also, the narrow road through the park is the only access for some homes on private property farther up the canyon, which results in some through traffic. A few climbers who live nearby and walk instead of driving were included in the study as they pass through the gate where cars enter.

Eldorado Canyon State Park had an average of 15,000 visitors per month in 1990-1991, or an average of 500 per day. Table 3-1 provides a monthly break-down showing numbers of visitors and climbers. Visitors are counted as they pass through the entrance gate each day. The park is becoming more popular, as recent data indicates a growth rate for visitors of

about 15 percent per year, based on the monthly entrance counts from July 1989 to July 1991.

Table 3-1:

Number of visitors and climbers at Eldorado State Park, Colorado, 1990-1991.

Month	Total Visitors	Total Climbers	Notes
August 1990	19,665	2,949	2 fallen climbers
September 1990	14,850	3,415	
October 1990	13,911	2,682	
November 1990	8,995	1,225	warm
December 1990	3,195	651	cold
January 1991	4,209	905	above avg. snowfall
February 1991	6,182	979	
March 1991	14,849	3,415	warm and dry
April 1991	15,991	3,838	cold month
May 1991	23,491	3,498	normal weather
June 1991	24,181	3,627	normal weather
July 1991	25,855	3,361	warm weekends
	-----	-----	
Monthly average	15,202	2,606	
Total for Year	175,374	30,545	

The number of climbers each month, averaging 2,606 persons or 17 percent of park users, is an estimate by the park manager. This data was disputed by park rangers who stated that an informal survey indicated nearly half (or 7,500 persons per month) of the visitors are climbers. The official, more conservative, numbers given by the park manager are used in this study. The data show at least 30,545 climber-days at Eldorado from August 1990 through July 1991. According to the rangers, many other visitors

come to watch climbers, stating that when there are few climbers, many persons turn around at the gate and do not enter the park.

CHAPTER 4

SAMPLING PROCEDURE

Data were obtained using a mail survey of climbers at Eldorado Canyon State Park during the Summer of 1991. In total, 265 climbers were approached and asked to fill out the questionnaire. Only three refused to participate in the study. One was a climber who did not speak English and could not communicate with the interviewer, who did not speak French. Two others claimed they were not regular climbers, were not familiar with climbing or climbing sites, but were visiting a friend in Boulder who climbed regularly. They chose not to participate. The remaining 262 agreed to participate in the study.

Of these 262 original contacts, 180 were from the Front Range of Colorado, mostly the Boulder and Denver area. An additional 17 lived elsewhere in Colorado, 56 were from other states in the U.S. while 9 were from outside the U.S., mostly England. About 59 percent initially responded to this request. Follow-up postcards and questionnaires were sent to those who failed to respond to the initial contact. Nine percent responded to the postcard reminder, returning the questionnaire, while another seven percent answered the third request, sending in the duplicate questionnaire.

Overall, 75.2 percent (197 of 262) of the surveys were returned with a response rate of 81.1 percent (146 of 180) from the Front Range, 70.6 percent (12 of 17) from the rest of Colorado, 58.9 percent (33 of 56) from elsewhere in the U.S. and 66.7 percent (6 of 9) from outside the U.S. The climbers were friendly and happy to respond once they were assured that the results would not be used to close down the right to climb at Eldorado Canyon (a common concern). The response rate may have been increased due to trade magazines recognizing access as the main issue facing climbers today. For example, every issue of Climbing has a regular feature called "Access".

Of the 197 who responded, seven refused to provide answers, stating that "climbing should be free." An additional nine provided willingness to pay values of zero, stating a belief that answering the questionnaire would raise the cost of climbing. These sixteen (8.1 percent of the respondents) were considered protest bids. An additional six respondents were removed from the sample due to incomplete answers. While many respondents failed to answer all questions, these six left critical questions blank, making it impossible to include them. In the travel cost model, four additional responses were removed. Two indicated wait times over one hour, a response quite different from all other respondents and two others had answers which were not logical, leaving 171 in the travel cost sample. In the contingent valuation analysis, an additional 17 (13 in addition to the four

just mentioned) were removed as they provided travel cost data but did not answer the CVM questions, leaving 158 climbers in this sample.

The procedure used by the interviewer assumed that most climbers arrived by the main entrance to the canyon, the only entrance accessible by road. Climbers normally parked in the main parking area and while arriving or departing, they were approached. The researcher identified himself as a Colorado State University employee requesting information on climbing. A brief description of the purpose of the study was explained to the climbers, with a request that they fill out the questionnaire at a time convenient to them and return it at a later time in a postage-free envelope. During the discussion, many climbers had questions about the study, which were answered as openly as possible.

Almost all climbers were very knowledgeable of the issues impacting climbers and climbing sites. Most had climbed at many climbing areas along the Front Range and throughout the Western United States. They were able to discuss, at length, which climbing areas were being threatened with closure, what organizations were involved in working to keep these areas open, and which government agencies were involved. Many climbers could discuss basic geology, even if they had never been formally educated in the field, as this knowledge is important to prevent protection from coming loose when climbing. They were familiar with levels of congestion at many sites, choosing where to climb based on this knowledge. In general, if they

climbed frequently, they knew a lot about the sport and often knew the prominent climbers making the news of the day.

Random days were selected throughout the summer to collect the data during a three-to four-hour period. The time of day was varied in order to have as random a sample as possible. An attempt was made to include all persons who arrived or left within the specified time. Anyone who appeared to possibly be a climber was approached and handed a questionnaire. Usually, climbers were easy to identify, carrying ropes, climbing shoes, and other hardware of the sport. Those who indicated that they were not climbers were not included in the survey. Using mail-in questionnaires rather than personal interviews resulted in many more persons being included in the study.

QUESTIONNAIRE DESIGN

Originally, the questionnaire was designed as an in-person survey. Pre-testing on-site, early in the season, indicated that in-person surveying would have problems. A pre-test showed personal interviews would have provided few responses in the same time period, as some days several climbers tended to walk through the parking lot around the same time, then long periods of no activity. Also, climbers tended to tire of the questions when asked in person during a pre-test. This problem led to the decision to redesign the questionnaire and survey procedure so that the respondent

would write in the answers later and return the questionnaire by mail. After additional pre-testing, a final questionnaire was prepared, early in the summer.

The questionnaire was designed around four main ideas. First, the dollar amount of travel expense was sought for travel cost analysis. This amount was also used as a starting point for willingness to pay questions. Second, each climber was asked to state a maximum willingness to pay for the climbing experience. Third, a change in willingness to pay questions followed, describing increasing levels of congestion, affecting the quality of the climbing experience. Fourth, they were asked to compare the value of climbing at Eldorado Canyon State Park to a remote (wilderness) alpine climbing experience.

The questionnaire contained 34 questions following a brief introduction (Appendix A). The first page contained questions concerning their climbing habits and skill in addition to questions asking their current trip destinations. Page two emphasized travel cost data and asked for a maximum willingness to pay to climb the same number of days per year as the respondent climbed at that time. The CVM questions in this study are all open-ended questions incorporating a payment card showing a range of possible values. The payment vehicle chosen was increased cost of travel in order to avoid any connotation that this survey would lead to increased entrance fees.

Page three continued the CVM questions. These questions were concerned with two areas, the impact of crowding and value of a remote alpine experience in comparison to the Eldorado Canyon experience. The same format was used as in the original CVM question. The climber was first asked to approximate normal waiting time to climb. He was then asked to evaluate willingness to pay and anticipated number of climbing days relative to two possible waiting times, longer than the current waiting time. A final CVM question was asked about willingness to pay and to participate in remote wilderness climbing environments.

Page four requested socioeconomic data along with a few other items. These included number of years climbing, age, place of residence, sex, income, and other data. Page five asked for the respondent's opinions on current issues in climbing. Page five contained questions that the manager of Eldorado Canyon State Park suggested, relating to the quality of the climbing experience at Eldorado Canyon.

Travel cost information was obtained by asking individuals to identify out-of-pocket travel expenses for the trip to the site. The questionnaire first asked for automobile expenses, then for other relevant trip costs. These expenses were summed and divided by the number of participants to obtain a per person travel expense. For the climbers on trips with multiple sites, the per person expenses were pro-rated over the total days of the trip. Only

costs that applied to this trip were accepted, and amortization of expenditures for gear lasting several climbing seasons was not included.

Willingness to pay questions followed the travel cost section.

Climbers were asked whether the total cost per person was the maximum value they would pay to climb the same number of times per year. If they answered "NO", they were then asked to consider the maximum value. The question specified a payment vehicle of increased travel costs-gasoline or other costs. Following the question, a modified payment card was presented, listing dollar amounts, in addition to a blank line. The respondent could either fill in the blank or circle an amount as a means for answering the question.

Increased travel cost was chosen as the payment vehicle because it represents something exogenous to the climbers and to the state of Colorado. Using individual travel cost provided a starting point that varied for each climber. Starting point bias is a concern for open-ended CVM questions. Using different starting points to find maximum willingness to pay is recommended to prevent this problem.

Using increased travel costs as the payment vehicle also avoided other problems with alternatives such as increased entrance fees. The payment vehicle needs to be neutral in relation to the public good being valued so that the respondent is valuing the good, not the vehicle. Using increased entrance fees or a state tax would have encountered resistance,

resulting in a larger percentage of protest bids. The most common comment by climbers, when given the questionnaire, was whether this study would increase the cost of entrance fees. Climbers were already very sensitive to having to pay an entrance fee at this site when they considered the rock to be a public good, and available at most climbing sites without entrance fees. (However, it has been pointed out that increased entrance fees would reduce participation and therefore, congestion.)

A payment vehicle commonly used in CVM studies is a public trust fund, for preservation of the resource. As the resource in this case, vertical cliffs, is already publicly owned, use of a trust fund could have encountered resistance. They would likely view this method as another way of paying more money to the state, as the state would eventually receive the funds related to this site.

Amounts used on the payment card were determined by responses in the pre-test. Pretesting showed that many climbers would bid small amounts, with a few bidding larger amounts, \$100 or more. By using amounts starting at \$5 and increasing in \$5 increments through \$50, then \$10 increases to \$100 provided a value close to most bids, allowing for easy response. Some climbers chose to write an answer on the blank line rather than circling an amount on the payment card. The blank was used by many to respond with an amount either not listed or greater than \$100.

SUMMARY STATISTICS

Table 4-1 provides basic statistical summaries for the main variables in this study for the sample of 171 respondents. The average willingness to pay was \$24.10 per day with a range of \$.50 to \$300. A low of \$.50 is feasible considering that many climbers live close to Eldorado Canyon State Park and walk to the site, without any travel cost. The average for travel cost per person was \$9.39 per day for direct variable travel expenses, and range from \$0 to \$123.00. The difference between willingness to pay and travel cost is net willingness to pay, equal to \$14.58 per day, and ranging from \$0.0 to \$273.00. The number of days climbed per year is highly variable, ranging from 1 to 240, with a mean of 27.0 days per climber. They spend 4.7 hours on average at the site, with some spending only one hour while some were there as long as 10 hours. Some climbers do not have to wait to climb, but most report some wait time. The average wait is 7.7 minutes with the longest time being 30 minutes.

The second willingness to pay question presented the climber with the issue of increased congestion, having to wait an additional 15 minutes. At this level of congestion, the average willingness to pay drops to \$15.42, a decrease of \$8.68. This reduces the average net willingness to pay to \$9.17, although the range remains the same, \$0.00 to \$273.00. Also, with more congestion, individuals report they would climb less, averaging 14.5 days on site, down by 12.5 days. Many climbers report they would go

Table 4-1:
Descriptive Statistics for a Sample of Climbers at Eldorado
Canyon State Park, Colorado, 1991. Sample of 171 respondents.

<u>Variable</u>	<u>Mean</u>	<u>Minimum</u>	<u>Maximum</u>
Current conditions:			
Willingness to pay	\$24.10	\$0.50	\$300.00
Travel cost per day	\$ 9.39	\$0.00	\$123.00
Net willingness to pay	\$14.58	\$0.00	\$273.00
Days climbed	27.0	1.0	240.0
On-site time-hours	4.7	1.0	10.0
Wait time to begin-minutes	7.7	0.0	30.0
15 minute increased waiting:			
Willingness to pay	\$15.42	\$0.00	\$300.00
Net willingness to pay	\$ 9.17	\$0.00	\$273.00
Days climbed	14.5	0.0	100.0
30 minutes increased waiting:			
Willingness to pay	\$11.00	\$0.00	\$300.00
Net willingness to pay	\$5.81	\$0.00	\$273.00
Days climbed	8.9	0.0	100.0
Other variables:			
Skill level	9.7	4.0	13.0
Major sport	0.69	0.0	1.0
Days at all sites	69.8	3.0	280.0
Distance one-way from home to site	334.7	2.0	8000.0
Distance for one day climbers	23.4		
Distance to alternative site	69.7	0.5	1200.0
Year climbed	8.3	0.0	36.0
Age	31.5	17.0	72.0
Sport climbers	0.06	0.0	1.0
Traditional climbers	0.39	0.0	1.0
Sex, Female = 1	0.25	0.0	1.0
Income, each unit equals \$10,000	4.0	1.0	16.0
Trip variables:			
Trips to the site	26.4	1.0	240.0
Travel cost per trip	\$146.22	\$0.37	\$3148.00
Travel cost for one day climbers only	\$14.12		
On-site time	9.2	1.0	108.0
Days per trip	1.9	1.0	30.0
Remote wilderness variables:			
Willingness to pay	\$36.97	\$0.00	\$300.00
Net willingness to pay	\$27.46	\$0.00	\$273.30
Days climbed at remote sites	15.1	0.0	137.0

elsewhere and the range drops from 240 days to only 100 days.

The third contingent valuation question proposed an additional 15 minute wait, making the increase 30 minutes over their normal wait time. With this increase, willingness to pay drops to \$11.00, down \$13.12 from the current level with net willingness to pay down \$8.80 to \$5.81. This amount represents only 40 percent of the original value. Also, they would climb less also, 8.9 days on average, a reduction of 18.1 days compared to the current level. The range remains at zero to 100 days though, with many more climbers reporting they would go elsewhere to climb.

These individuals are on average, very good climbers, with skill level of 9.7 on a scale of 0 to 13. Only those with exceptional ability will have a skill level of 11 or above. Just a few years ago, a skill level of 9 or 10 was exceptional, but due to improved gear and training, higher levels are now being achieved. Of the climbers in the final sample, 118 (69%) state that climbing is their major sport or recreational activity. They climb on average 69.8 days per year at all sites with a maximum of 280 days reported. Their climbing at the study site represents 38.7 percent of all climbing. The average distance traveled to the site is 334.7 miles, but that is weighted by a few persons from Europe. For those on one day trips, the average distance traveled is 23.4 miles. In contrast, their next preferred site is an average of only 69.7 miles from home.

These climbers average 8.3 years of climbing experience and 31.5 years of age. Their ages range from 17 to 72 years. Most do not specify a strong preference toward either sport or traditional climbing. Only 11 are sport climbers with 66 traditional climbers (sport and traditional climbers are terms which are defined on pages 6 and 7). Forty-three are female, or 25 percent, so climbing tends to be a male sport. But like many sports which in the past were dominated by men, the percentage of women participants is growing. Average income is \$35,500 with a range from close to zero to about \$155,000.

The travel cost analysis uses trip data with climbers averaging 26.4 trips to this site in 1991. The average travel cost is \$147.96 per trip, due to some climbers traveling long distances to climb at Eldorado Canyon State Park. For those on one day trips, the average is \$14.12. They spend an average of 9.2 hours climbing per trip with 1.9 days per trip at this site. Most climbers are on one day trips (83 percent), but several spend close to a month at this site, bringing the average close to 2 days.

The questionnaire also asked for willingness to pay for climbing in an alpine wilderness or remote setting. On average, this type of climbing is more valuable to the climbers, with a willingness to pay of \$36.97 and a net willingness to pay averaging \$27.46. Not all climbers report an interest in this type of climbing, however. They report an average of a little over 15 days a year climbing in a wilderness setting. The maximum days reported is

137, a large number for this type of climbing. However, one woman reported that she spends most of her summer outdoors, not having a home address, home being where the tent is pitched. Also, some climbers report they are guides, or work for Outward Bound, providing the opportunity to climb extensively in remote environments.

ANALYTICAL PROCEDURES

Analysis of the data collected on the questionnaires requires use of multiple regression as there are several independent variables. This method provides coefficients for each variable, which tell the impact or magnitude on the dependent variable based a unit change in this variable, and holding all other variables constant.

A common statistic is the coefficient of determination, or R^2 . This statistic represents the proportion of variation in the dependent variable that is explained by the independent variables. As R^2 is a ratio of the explained variation (sum of squared deviations of the estimated values of the dependent variable around their mean) to the total variation (sum of squared deviations of the dependent variable about its mean) and ordinary least squares is designed to minimize the difference between the two, using ordinary least squares to estimate the regression maximizes R^2 . Because of this, a common goal of regression analysis is to maximize this ratio. Doing so, implies a better fit from the data.

Many of the regressions have a non-linear transformation of the dependent variable, such as a log value. In these regressions, the reported R^2 s were determined for predicted values of the dependent variable, which were then converted to linear values. These converted values were regressed against the original linear form of net willingness to pay. The resulting regression provided the R^2 s.

Multiple regression requires certain assumptions be met. These include proper specification of the model, assumptions of the error terms, and lack of linear relationships between independent variables. Specification of the model requires a dependent variable being a function of independent variables and an error term. These independent variables need to represent all the important variables affecting the dependent variable. These variables also need to have coefficients that are consistent. It is assumed that the relationship between the dependent variable and the independent variables is a linear one. When this is not true, a transformation of variables needs to be undertaken, such as finding the natural logarithms of the variables.

The error term is assumed to have an expected value of zero, have a constant variance over all samples, and not be correlated. Failure to have expected value of zero leads to a biased intercept. Non-constant variance of the error terms is referred to as heteroskedasticity. Correction for this problem is required, if encountered, by use of a weighting of the independent variables.

Linear relationships between independent variables is called multicollinearity and this creates errors in the coefficients for the variables. Correction is required before the significance of variables can be determined, if the significance of these variables is required in the results. Also, requiring no linear relationships between independent variables implies that the number of observations are larger than the number of variables in the model.

Numerous other conditions may cause problems. Truncated populations being sampled, non-normal distributions for the sample data or limited dependent variables can be found in samples. These problems may lead to errors in the analysis of the data, if not recognized. These problems are violations of ordinary least squares assumptions and adjustments to the ordinary least squares estimation technique can be made in order to find proper values in quantitative solutions.

CHAPTER 5

TRAVEL COST METHOD

The travel cost method (TCM) uses direct observation of travel cost to provide a proxy for price of the recreational activity. The TCM is based on the assumption that because travel cost is usually the largest part of expenditure on recreation activities, it is a good proxy for price, assuming a weak complementary assumption. TCM is the preferred method for estimating benefits from recreation activities at existing, new, and expanded sites (Walsh 1986). According to Fletcher, Adomowitz, and Graham-Tomasi (1990), the travel cost model is ideally suited for sites with one access point, as is the case of rock climbers at Eldorado Canyon State Park. Compared to CVM, the TCM has an advantage in that it uses observed behavior rather than hypothetical behavior. However, this reliance on observed behavior can also be a disadvantage because it usually cannot measure potential changes in quality at a single site, which can be measured with CVM.

Two types of travel cost method are common, zonal and individual. The zonal approach uses observations of groups of recreationists from different regions, grouping participants traveling similar distances into zones

determining visits per capita. When travel costs change, the zonal method has the advantage over the individual method because changes in participation within each zonal area are reflected in the resulting demand curve. This technique is preferred when recreationists usually take only one trip per year to the site as there is not enough variation in trips to use the individual approach.

The individual method, developed by Brown and Nawas (1973), uses observed data from each user to determine quantity consumed. Number of trips per participant is regressed on travel cost, travel time, income, and other variables representing socio-economic characteristics, and taste and preference. Some disagreement exists concerning whether zonal and individual methods determine the same value. But Sorg and Loomis (1984) find that zonal and individual methods are about the same if the recreational activity requires specialized equipment and skills, as is the case for rock climbing. One advantage of the individual method is that it is better when analysis of congestion is an issue (Fletcher, et al. 1990) Analysis of individual observations is the method used in this study.

Price for non-market goods is not usually easy to observe as it is in the case of market goods. The TCM estimates price by including variable cost of travel and opportunity cost of time traveling to and from the site. Price is considered to be exogenous (fixed) in most situations (Ward and Loomis 1986). Ward (1984) suggested that under some conditions, price

could be a choice variable for recreationists. Parsons (1991) expanded this idea suggesting that when recreationists choose their location of residence based on recreation activities, then price is endogenous. Fletcher, et al. (1990) conclude that determination of time values are far from resolved since time constraints vary among individuals, and it is not clear that one approach is superior. For the purpose of this study, price will not be a choice for the recreationist.

Travel time is another major component of the price of participating in the recreational activity. Increased travel time required for distant sites negatively impacts one's ability to visit those sites. Travel time can be entered as a dollar amount using opportunity cost of time to the participant as a way of converting travel time to cost. Usually, one-third to one-half of the wage rate is used as the opportunity cost. This conversion value has received much discussion but no consensus has been reached on the optimal opportunity cost of time. Travel time can also be used without converting to a dollar amount, using actual time as the variable, avoiding the problem of opportunity cost of time to the participant. Consumer surplus is understated if travel time is not considered as travel time rotates the demand to the right.

On-site time has also received much discussion (Cesario and Knetsch 1976). It should be included, according to McConnell (1980) as part of the price variable. Others argued against including on-site time (Cesario and

Knetsch 1976). Ward (1984) suggested that it could be endogenous to the user and if so, should only be included if proper adjustments are made for endogeneity. Ward and Loomis (1986) recognized utility gained from recreation is directly due to on-site time, suggesting that the cost is offset by the benefit. They stated that accounting for this variable may be accomplished by estimating different demand equations for different trip lengths.

Shaw (1992b) concluded that satisfaction for rock climbers is due to intensity of the climb rather than length of the experience. He stated that climbers make fun of tourists who emphasize speed (length of time climbing) as the most important factor, since climbers find satisfaction in success at a level challenging to them.

Additional time on-site enhances the value but is costly, according to McConnell (1992). People have different on-site time benefits and costs, and the effect on demand equations is unknown. If on-site time is exogenous, it becomes part of the travel cost, in linear proportion to trips. He suggested on-site time may be endogenous impacting trip quality. Then, the traditional travel cost model with an on-site variable would be specified. Estimation and interpretation of the demand curve remains the same, since this variable becomes a shift to the demand curve as are other variables.

McConnell stated that this variable, if exogenous, should be linear to trips. For rock climbing, though, on-site time cost may be linear but benefits

could be greatest for the first hour of recreation, suggesting a non-linear relation. After a certain length of time a person gets tired because climbing is more physically demanding than other recreational activities. As individuals become satiated with the activity, they end the day's recreation when the marginal cost of another hour is greater than the marginal utility gained from additional climbing experience (Walsh, Sanders, and McKean 1990). This implies two things. First, a non-linear relationship, to allow for decreasing motivation by the climber as on-site time increases. Second, on-site time is similar to many quality variables which are exogenous, such as fishing catch rate or water quality of a stream. Over the long run, an angler can improve fish catch rate by learning new skills, but for each trip, level of quality is fixed, not a choice variable for anglers, and the same is true for climbers.

Variables such as travel time, on-site time, and site quality variables need to be included in the demand equation. The current methodology is to treat trips which have different values for variables such as length of stay as different demand functions. McKean, Walsh, and Johnson (1993) state that this approach provides a solution if values for these variables are unknown, but this technique "avoids the issue rather than resolving it." They state that the "demand relationship must contain site quality variables, time on site, and goods used on site as well as weather and other site conditions. Exclusion of these variables would violate the specification required for the

weak complementarity condition which allows use of the TCM to measure benefits" (page 6). They also point out that the number of trips and length of trips can be dependent on on-site time.

Other variables should be included to avoid omitted variable bias (Bishop and Heberlein 1979). Fletcher et al. suggest recreationists have individual differences represented by shift variables in the demand function including an alternative site price, congestion, socio-economic conditions, and taste and preference. In this research, price of alternative sites is represented by distance to the next preferred site or distance converted to travel cost at a standard \$0.15 per mile.

McConnell (1980) stated that conditions for a demand curve require constant congestion so a shift variable is required for differences in congestion. Differences in congestion occur at different times of the week, with weekends normally being more congested. For rock climbing at Eldorado Canyon State Park, summer weekends are congested. Seasonal variation is not considered in this study as climbers were interviewed in the summer months. Summer is the most congested season for rock climbing in Colorado. A dummy variable is included, called "midweek," to shift between weekend and weekday climbs. An additional change in congestion is caused by the weather as rainy days are not good climbing days. Therefore, another variable is added, called weather, for those who climb on the few bad weather days.

Socio-economic variables include income, age, sex, organizational affiliation, employment constraint, and area of residence. Many of these variables were insignificant in this research and not included in the final analysis including age, sex, and employment constraints. Income was included in a linear form. Organizational affiliations, such as membership in climbing and environmental groups were represented by a dummy variable called "clubs" which also proved to be insignificant in the equations.

The climbers' location of residence was aggregated into five areas; Boulder, the Front Range of Colorado, the rest of Colorado, the rest of the U.S. and outside the U.S. These categories were chosen as indicators of more than distance from the site, and represent unobserved variables pertaining to those locations. For instance, it could be argued that some climbers may climb more often and value it more, causing them to live closer to climbing sites, in areas such as Boulder.

Taste and preference for climbing differ for each individual, but are not directly observable. Variables representing taste and preference include years climbed, skill level, total days climbing per year, wait-time on the site, and type of climber. However, some of these variables were not significant in the regression, including years climbed, wait-time, and type of climber.

Higher skilled climbers may know more about the routes at the site and may wish to climb more frequently, making more trips to the site. Total days climbed indicates a strong desire to climb and preference for climbing.

Total days could also be a proxy for an unmeasured variable representing fewer time constraints. However, fewer constraints, which would prevent climbing days implies that climbing has a higher priority than other activities. Both skill and days climbed were included in the analysis.

Whether an individual is a traditional or sport climber (these terms are defined on pages 6 and 7) could affect the desire to climb at Eldorado Canyon State Park. Many of the new routes have been first climbed by sport climbers as that is the trend of climbing. However, sport climbers are restricted by the "no bolting" rule on-site and most of the routes are usually "traditional." When the questionnaire was being handed to climbers, some were vocal about their strong feelings toward the other group. Most climbers, though, did not indicate a strong feeling toward either of the groups. Dummy variables indicated either "traditional" or "sport" for those responding affirmatively. These dummy variables also were insignificant in the final analysis.

Functional form has received much discussion (Ward and Loomis 1986) as there are problems with each form. A linear analysis can predict negative trips for high costs. The semi-log form, taking the log of trips, suggests number of trips diminish at an increasing rate as distance increases, which may better represent the behavior of recreationists. A double log assumes constant elasticity of demand. The best fit of the data appears to determine the actual form used. Even though these forms may

fit the data well, one problem with all three methods, linear, semi-log and double log, is that they are based on continuous values for the dependent variable and do not accurately reflect that trips are integer values, truncated at some positive value.

As a solution to this problem, use of count data models have been suggested recently, using discrete functional forms for the dependent variable (Hellerstein 1992, Creel and Loomis 1990). Count data models use Poisson and negative binomial distributions and are considered a better fit to the discrete nature of the data. Efficiency is gained using count data distributions as numbers of non-participants increases (Hellerstein 1992). Count data models have found to generate higher values for the same sites by as much as 50 percent (Dobbs 1993) with impact expected to be greater when visitors report small numbers of visits each year. This difference has not been completely explained to date. Dobbs also states that count data models are more robust, particularly in small samples than continuous models. This study considers the discrete nature of the data in the analysis.

On-site surveys, as in this study, have another problem to consider, since they sample only users of the site, creating truncated samples. As only participants are surveyed, those who do not use the site because cost is too high or do not participate in the activity are not included in the sample, leading to a less elastic demand curve (Hellerstein 1992, Brown et

al. 1983). To solve this problem, truncated analysis techniques are considered in this research.

The first test of the data was to determine proper functional form. Functional form should be determined by economic theory when possible, but theory does not provide a definitive answer, as discussed above. A procedure described by Box and Cox (1964) and Zarembka (1974) compared functional forms for economic models. Box and Cox do not indicate any specific distributional requirements for this procedure. This procedure requires transforming the dependent variable by multiplying by the inverse of the geometric mean of the dependent variable, standardizing the dependent variable for the two forms such that the variance does not change as the units of measurement are changed. Standardization allows direct comparison of residual sum of squares providing the basis for determining a chi-square statistic with one degree of freedom. For a confidence level of 99 percent, chi-square with one degree of freedom is 6.635. Two test statistics were calculated for the data, one using all climbers and the second using only local climbers (days per trip equals one) as most of the climbers in the survey are in this second category. The chi-square statistics are 176.95 and 87.17 respectively, both exceeding the 99 percent confidence level suggesting the double log model is preferable. The double log model is the model used in the ordinary least squares (OLS) and the truncated regression equations.

An exception to the log-log form is the count data models where they are discrete distributions, so taking the log of trips creates non-integer results, no longer a discrete distribution. However, analysis of count data models assumes a semi-log form, $y = e^{Bx}$ and transformation automatically takes place in analysis creating a double log form when price (x) is transformed to a log.

It has been suggested that different demand curves may be necessary for different lengths of on-site time (McConnell 1975). To consider this suggestion, climbers were placed in groups based on number of days on-site per trip. The first group included climbers visiting for one day, totalling 142 observations, with a second group of multi-day visitors totalling 28 climbers. The second group was considered too small to divide further. This group was not considered for analysis as only one climber had more than one trip, providing little variation in the dependent variable. (The total sample was 171, but these two groups do not sum to this amount as some climbers did not fit either group. Five reported one day trips to the site but traveled from 500 to 2000 miles one way. They were removed from the one day group.)

This research uses individual observations from each survey respondent, asked to provide direct expenditure information for the trip to the site. Number of trips to the site was regressed against the independent variables indicated above. The results of this analysis are shown below (Table 5-1). Four models were regressed; OLS, truncated OLS regression,

Poisson, and negative binomial distributions. All but the OLS model were truncated for only positive values for the dependent variable. OLS is the standard least squares procedure. Truncated OLS regression is designed to recognize that travel cost data from an on-site survey has a truncated normal distribution. Poisson and negative binomials are discrete distribution models, also using truncated distribution for these regressions.

Table 5-1 provides results of the regressions for those climbers reporting one day trips. Overall, the adjusted R^2 s are high, with the Poisson regression highest with 53.4 percent, 48.2 percent for both truncated regression and OLS, and 44.4 percent for the negative binomial regression².

For all models, the log of total travel cost, (including cost of travel time) is negative and significant, in agreement with economic theory. The coefficient in all equations is between -0.253 and -0.267, the difference being insignificant. As this coefficient is for double log models, it is also the elasticity of demand, with -0.253 to -0.267 being very inelastic. An inelastic demand for recreation is supported by several other studies, with similar values (Walsh 1986, Walsh et al, 1989).

The variable which represents the cost of travel to an alternative site to climb is included. As a substitute, the sign on the coefficient should be positive, but this coefficient is not. A negative coefficient represents a

²The R^2 s reported for non-linear regressions have been calculated using the procedure described on page 50.

complementary good rather than a substitute. This implies that climbers with higher numbers of trips to Eldorado Canyon State Park also live closer to other climbing sites. As most of the climbing tends to be along the foothills and most of the climbers in the sample live along the Front Range, the distance to alternative sites could be positively correlated with the distance to Eldorado Canyon. The Poisson model had the highest "t-value" for this variable, significant at about the 92 percent level. The coefficient for the models ranges from $-.00165$ (Poisson) to $-.00736$ (OLS), indicating very little change in number of trips for changes in cost to substitute sites, the cross-price elasticity being very small, less than $.09$.

On-site time is not significant for three of the models but is significant, with a t-value of 3.31 for the Poisson regression. This variable for hours per trip was transformed by the Box/Cox transformation with $\lambda = -1.0$. This transformation creates a new variable which increases at a decreasing rate. The longer one spends at the site, the number of trips increases at a decreasing rate. The average time on-site is 4.7 hours with a coefficient of $.412$ implies an increase of about 0.5 trips when one more hour is spent on-site, having little impact on numbers of trips. For the other regressions, the small t-values indicate that this coefficient in those models is not significantly different from zero.

The variable for income represents a linear approximation of the income earned by the climber. On the questionnaire, income was grouped in

TABLE 5-1: Comparisons of travel cost regressions for day users at Eldorado Canyon State Park, Colorado, 1991.

Dependent variable	OLS	Truncated	Poisson	Negative
	<u>Regression</u>	<u>Regression</u>		<u>Binomial</u>
	-----log of trips-----		-----trips-----	
Sample size	142	142	142	142
R ²	48.6	48.6	53.7	44.8
Adjusted R ²	48.2	48.2	53.4	44.4
Log-likelihood	-662.2	-662.2	-654.7	-667.2
Total variation	181683	181683	181683	181683
<u>Independent variables:</u>				
Constant	0.261 (0.384)	0.197 (0.297)	0.127 (0.649)	-0.407 (-0.536)
Log of the trip travel cost	-0.256 (-2.61)	-0.266 (-2.78)	-0.264 (-9.53)	-0.253 (1.80)
Travel cost to alternative site	-0.00736 (-1.61)	-0.00720 (-1.62)	-0.00165 (-1.74)	-0.00556 (-0.923)
On-site time, lambda=-1.0	0.161 (0.331)	0.177 (0.377)	0.412 (3.31)	0.462 (0.616)
Income, each unit equals \$10,000	0.0988 (3.57)	0.101 (3.76)	0.0784 (10.0)	0.103 (2.75)
Skill level	0.175 (3.82)	0.178 (4.01)	0.170 (13.2)	0.204 (4.14)
Total climbing days per year	0.00920 (6.77)	0.00920 (7.03)	0.00731 (25.5)	0.00928 (6.16)
Member-climbing environ. club	-0.161 (-1.22)	-0.168 (-1.31)	-0.0906 (-2.62)	-0.228 (-1.57)
Weather, if bad, value = 1.0	0.242 (0.963)	0.252 (1.03)	-0.109 (-1.30)	0.185 (0.598)
Midweek, Yes =1.0	0.262 (1.91)	0.270 (2.02)	0.267 (7.64)	0.158 (0.915)
Boulder resident Yes = 1.0	0.477 (1.53)	0.504 (1.66)	0.817 (8.47)	0.816 (2.08)
Front Range resident, Yes=1.0	0.592 (2.17)	0.625 (2.32)	0.986 (10.1)	0.947 (2.62)
Sigma		0.684 (16.7)		0.396 (8.24)

\$10,000 increments for easy response so a value of 1 for this variable represents under \$9,999 with 2 representing \$10,000 to \$19,999, etc. It was assumed that each value represented the mid-point, i.e., 2 represented \$15,000. Economic theory suggests that income should have a positive significant coefficient, and all models are positive and significant at greater than the 99 percent level. The coefficients range from .0784 to .103, a difference of .025 and with standard errors as low as .0078. The small difference is significant. However, the elasticity of income for the models is close, ranging from .31 (Poisson) to .41 (negative binomial). These values are similar to other studies summarized in Walsh (1986) that report inelastic demand based on income for several recreation activities. For example, using the coefficient from the Poisson model, an increase in income of \$10,000 from the mean level of about \$35,000 shows an increase of 2.7 trips per climber per year.

The variable, skill, represents skill levels based on the Yosemite Decimal System (YDS), which was developed over 70 years ago and is the standard for most climbs in the United States. The respondents were asked to provide their highest level climbed. The current range of ability in the YDS is 0 to 14, with 13 and 14 representing a few exceptional climbs throughout the world. The range of skill for the climbers in this study is from 4 to 11 with the mean of 9.7. Skill is significant in all models with Poisson having the highest t-value. The negative binomial model provides a

coefficient of .204 while the other three are between .170 and .179. The coefficient is significant for skill, and a change of 1 level of skill represents about 3.87 more trips per year. A change of one unit for this variable does not have a sizable impact on trips, but comparing a beginner climber, with skill level of 4 with a more experienced climber, with a skill level of 10, implies about 23 more trips per year to this site for the experienced climber, a sizable difference.

Four variables, total days climbed, membership in clubs, Boulder resident, and Front Range resident, represent taste and preference. The variable for total days climbed represents the number of total days of climbing for one year at all sites. It is assumed that those more interested in climbing will participate more frequently at all sites and this variable will be positively related to trips. The variable is positive and significant as expected. A coefficient of .00731 implies an increase of one trip to Eldorado Canyon State Park for 6.5 days increase of total climbing days.

The variable for membership is a dummy variable representing membership in either a climbing or an environmental organization. It could be expected to have a positive sign, those who climb more will belong to organizations that support preservation of this activity or resource. This is not the case as the coefficients for this variable is negative. Only the Poisson model shows it significantly different from zero, however.

Belonging to this type of organization reduces the number of trips by -2.95 trips per year.

The variables for Boulder and Front Range residents are dummy variables representing the location of the climber's residence, equal to one if the person lives in the respective location. Seven of the eight coefficients are significant at the 90 percent level. The positive sign implies that individuals living in Boulder or along the Front Range climb more frequently at this site than other climbers in Colorado. For those living in Boulder, the coefficients ranges from .477 to .817, representing an increase of about 8 to 18 trips above the average of the other climbers. For Front Range climbers, the increase ranges from about 9 to 20 trips. These variables raise the concern that they represent zonal distances from the site and should be part of the price variable. But it is the assumption that these variables represent something different from price, an unmeasured preference variable indicating an interest in climbing. Including these dummy variables did not appear to have any sizable impact on the slope of the resulting equation.

Weather and Midweek dummy variables represent quality shifters that adjust for congestion, as suggested by McConnell. Weather is equal to one when the weather adversely affects the ability to climb. This variable is not significantly different from zero, possibly because of very little bad weather during the summer climbing season. An early rain will dry out by mid-

morning allowing climbing to continue. An afternoon shower does not drive away climbers as they expect it to be short and wait for the rock to dry.

The midweek dummy variable equals one for midweek climbing as opposed to the weekend. Many climbers have to work during the day, but still fit climbing into their schedule during the week. Midweek times have less climbing congestion at the site than weekend times. This variable is significant and positive, as expected. Climbers prefer to climb with less congestion and will climb on week days if it is possible. Many would climb after work or leave work early to climb. Except for the negative binomial model with a coefficient value of .158, this variable has a coefficient between .262 (OLS) and .270 (Poisson). These levels suggest 3 to 6 more trips for those climbing midweek, or an increase of about 31 percent for the equations with significant coefficients for this variable.

As this was an on-site survey, truncated models should provide a better result than non-truncated models. The OLS regression is the only non-truncated model in this study and theory suggests it should not be considered. However, OLS and truncated regression models provide very similar results to the count data models. The R^2 for the OLS model is almost identical with the truncated regression model, which provided only slightly better results. The coefficients on the independent variables are also virtually identical for the two models and, as will be shown later, consumer surplus estimates are similar. Truncated regression shows slightly higher t-

values for the coefficients. Choosing between the two, based on the results, truncated regression model is slightly better.

Hellerstein and others suggest that count data models are the preferred choice for samples with dependent variables as integers. Comparing the results of all models in this analysis (total variations equal) finds Poisson preferred. The adjusted R^2 is highest for the Poisson model and log-likelihood is smallest, also indicating a "best" choice. Also, the independent variables consistently have higher t-values for this model.

CONSUMER SURPLUS ESTIMATES

Consumer surplus can be calculated for the area under the demand curve and above travel cost. This was determined by integrating for each individual, with the integration ranging from the individual's travel cost to \$80.00. The amount, \$80.00, was chosen as the cutoff point as this represented an estimate of the maximum travel cost for climbers in this sample. The equation for the demand curve, using mean values, for the Poisson model is:

$\text{trips} = e^{4.06} \times (\text{travel cost})^{-.263}$. Averaging the total consumer surplus for all climbers provides a consumer surplus of \$1,455.64 per climber per year, or an average of \$45.08 per trip (a median value of \$35.13), assuming an average number of trips of 32.3. For a 12 hour day, consumer surplus is \$115.35.

The other models' demand curves, using mean values for the variables, are as follows:

Negative binomial, $\text{trips} = e^{4.03}(\text{travel cost})^{-.253}$,

Truncated Regression $\log(\text{trips}) = 3.90 - .266 \log(\text{travel cost})$, and

OLS $\log(\text{trips}) = 3.86 - .256 \log(\text{travel cost})$.

Integrating each curve for individuals as in the Poisson model, provides an average consumer surplus for each of these models. The negative binomial function yields consumer surplus equal to \$1,573.30 per year or \$48.73 per trip (median value is \$34.22). For a 12 hour day, consumer surplus is \$124.42. Integrating the truncated regression function gives a yearly consumer surplus of \$1,275.66, or \$39.51 per trip (median value is \$28.08), with a 12 hour day equal to \$100.88. Finally, for the OLS function, annual consumer surplus is \$1,295.07 or \$40.11 per trip (median value is \$28.63), a 12 hour day equals \$102.41.

Average consumer surplus per trip ranged from \$39.51 to \$48.73, similar results for the models. From a theoretical perspective the count data models should be superior, and they do perform slightly better, providing the higher levels of consumer surplus in comparison to the continuous dependent variable models.

Consumer surplus for rock climbing compares closely with other recreation that is highly skilled. For example, big game hunting, cold water fishing, upland gamebird hunting, and downhill skiing require high levels of

skill to be proficient. Walsh, Johnson and McKean (1989) reviewed numerous demand studies estimating net economic values per day from TCM and CVM and found mean values for these higher skilled activities all above \$30.00. In contrast, less skilled activities, such as picnicking or swimming showed means of \$17.33 and \$22.97 for consumer surplus. Other less skilled activities had lower net values, such as nonconsumptive fish and wildlife activities with a mean of \$22.20.

CONCLUSION

The travel cost method provides the opportunity for indirectly determining the valuation of resources used in recreation through observation of the revealed preference of the participant. The individual TCM was one method used to determine the valuation of resources used by rock climbers at Eldorado Canyon State Park.

This study developed four empirical models which were used to analyze the data collected on-site. The models were based on the distributional assumptions of the dependent variable. These procedures were ordinary least squares (OLS), truncated OLS regressions, Poisson, and negative binomial. The first two assumed a continuous dependent variable, historically, the more traditional assumption. OLS is the more "usual" method for analyzing data. OLS is the only method which does not adjust for the problem of a truncated sample. Truncated regression does adjust for

truncation, but assumes the data to be continuous. Poisson and negative binomial distributions differ from the previous two as they assume that the dependent variable represents discrete values. The number of trips recreationists participate in are discrete, meeting this requirement. Poisson and negative binomial estimations are two different distributional assumptions that could be considered to match the data more closely.

Estimates for the models provide equations which can be used to describe this data. However, the final regressions used only the climbers who participated in one day trips, segregating the results by on-site time, with 142 climbers included. The models had adjusted R^2 's ranging from 44.4 to 53.4 percent. It could be concluded that the models were not different enough to conclude one better than the other. However, as the total variation was identical for the models, they can be compared. As the Poisson model had the highest R^2 and the lowest log-likelihood, it could be considered to explain better than the others. But as the differences between the worst and best, based on these comparisons are so small, conclusions may be difficult to determine.

The models had very similar coefficients for the price variable in the equation, travel cost. This coefficient represented the elasticity, showing that trips is inelastic relative to the price of the good. Other significant variables included income, skill, total days climbed, and location variables.

Consumer surplus for each of the models was determined using average values in the equations. Area under the demand curve, and above the price line, provided total consumer surplus for the year. These values were very similar for the models, a result consistent with the assumption that the models were very similar. Consumer surplus was between \$39.51 to \$48.73 per trip, on average, with the higher values found with the count data models. This is similar to results found for other skilled recreation activities.

CHAPTER 6

CONTINGENT VALUATION METHOD

The Contingent Valuation Method (CVM) values non-market goods by asking individuals to provide a willingness to pay to use the recreational resources. Willingness to pay can relate to either the current level of use of the resources or hypothetical changes in conditions (Walsh 1986). The CVM can measure unobserved behavior and is the only method for measuring hypothetical changes in quality of the resource.

For this study, a mail questionnaire collected information from rock climbing participants at Eldorado Canyon State Park with four questions asking for maximum willingness to pay. The climber was first asked if the value of the climbing experience was worth more than the reported travel cost. If the respondent answered "yes" to that question, the respondent was then asked to consider the possibility that travel costs could increase. The respondent was asked to report the "maximum you would pay per trip to continue climbing in Eldorado Canyon the same number of times per year." Following this question was a blank and a modified payment card listing amounts from \$5 to \$100. The respondent either circled an amount

or wrote on the blank line. These responses were used to determine a base willingness to pay for current conditions.

The next section considered impact of change in quality of climbing due to an increase in congestion at this climbing site. Each climber was asked to report the length of time having waited to climb. Then the climber was asked to consider waiting longer due to increased numbers of climbers on the chosen route and to report the maximum willingness to pay for a 15 minute longer wait. A third maximum willingness to pay amount was sought if the wait increased by an additional 30 minutes. In addition to the maximum willingness to pay questions, the climber was asked to consider the impact of additional wait time on frequency of trips to this site, how many days he or she would climb at this site with the 15 minute longer wait and then with the 30 minute longer wait.

For comparison purposes, one last contingent valuation question was asked pertaining to remote alpine climbing experiences. In this study, remote or wilderness climbing was defined as requiring a substantial walk to the site, and occurring where it is unlikely others will be climbing close by. Remote climbing experience is quite different from climbing at Eldorado Canyon State Park where participants park within a short walk of the climbing routes, with a well-traveled road running through the center of the canyon, within view of hundreds of other persons climbing at the same time. In contrast, many remote climbs are available in the high peaks in Colorado,

still close to the Front Range. Considering that many pounds of gear are often necessary for a successful climb, the approach walk can be demanding and the climbing often involves overnight stays at the site. As these remote climbs can be in locations where no one else will be climbing or hiking, the demand on self-reliance and the risk from injury increases. Many climbers stated that remote climbs are much more important to them while others stated they have no desire for climbing in remote places. Climbers were asked to provide the number of days per year that they climb in remote locations and the maximum willingness to pay for this experience, similar to previous willingness to pay questions.

Analyzing the data collected from the questionnaires to determine benefit functions for recreational resources first required determining a model. Economic theory is not specific concerning functional form. Therefore, several models were considered and tested for best fit using the Box and Cox test (Box and Cox 1964). The models were made of combinations of linear and log values for net willingness to pay and quantity. This test requires transformation of the dependent variable so that when both the linear form and the log of the dependent variable are regressed on the independent variables, the total variation in errors is the same. This allows the sum of the errors of the residuals to be compared. A chi square statistic was found, with one degree of freedom, which requires a value greater than 6.635 to reject at 99-percent confidence level. For this data

set, the chi square value was 593.93, much greater than the 6.635 required, indicating that the log/log form is the better choice.

Net willingness to pay was the dependent variable for the following CVM regressions pertaining to congestion levels at Eldorado Canyon State Park. Net willingness to pay was found by subtracting the travel cost reported in the questionnaire from the maximum willingness to pay. The dependent variable was non-negative because this data represented users only, so a truncated regression was analyzed rather than ordinary least squares. Results from the truncated regression are reported in Table 6-1. As these were log/log models, the reported R^2 s were determined for predicted values of the dependent variable, which were then converted to linear values. These converted values were regressed against the original linear form of net willingness to pay. The resulting regression provided the R^2 s.

The first CVM question asked for maximum willingness to pay for climbing at this site under the current conditions. For this case, the adjusted R^2 was 58.3 percent³. The mean level for net willingness to pay is \$14.33 for a day of recreation, 4.7 hours on average. Net willingness to pay had a range of \$0.0 to \$213.00.

³The R^2 s reported for non-linear regressions have been calculated using the procedure described on page 50.

Table 6-1:

Results of regressing on net willingness to pay
for current conditions:

Dependent variable = log of net willingness to pay

Mean of net
willingness to pay = \$14.33

Number of observations = 158

Adjusted R² = 58.3

	<u>Coefficient</u>	<u>t-ratio</u>	<u>Significance</u>
Independent variables:			
constant	2.53	4.48	99
Log of days	-0.235	-2.89	99
Income	0.0636	2.09	96
Distance of alternative climbs	0.00319	1.88	94
Reported wait time	0.0253	2.74	99
Days climbing at all sites	0.00292	1.65	90
Member of environmental organization	0.370	1.51	87
Skill	-0.0532	-0.895	63

Independent variables included a variable for days climbing on site, substitutability at other sites, socio-economic variables, and variables for taste and preference. Log of days climbed at this site was the variable representing quantity in this benefits analysis, with a coefficient of -0.235, significant at 99 percent. This coefficient shows that a change of 10 percent (2.7 days) in this variable from its mean of 27.1 would decrease net willingness to pay by 2.4 percent.

A variable to represent climbing at another site was included equal to the average daily distance to the next most preferred climbing site. The coefficient of this variable had a positive sign which indicates the other sites are substitute goods. A positive coefficient indicates that as the price of the substitute good rises, the consumer is willing to pay more for the good being priced. The value of the coefficient was 0.00319, and, while this was significant at the 93 percent level, it had a small impact on net willingness to pay. An increase of ten miles in distance to the substitute site is an increase of 27.0 percent over the mean distance of 37.0 miles, but has an impact of 3.2 percent increase in net willingness to pay.

Socioeconomic variables considered included income, years climbed, and age of the climber. Economic theory indicates that income should have a positive significant impact on willingness to pay. Years climbed represents increasing commitment to the sport and should provide a positive impact on the dependent variable. Age of the climber could have a positive impact also, if older climbers have climbed longer and climb more. But if older climbers have reduced their climbing days in favor of other activities and are less dedicated to improving their climbing skills and the sport, then this variable could have a negative sign. However, age and years were not significant variables and were not included in the final models.

The variable income had a positive coefficient of 0.0636, significant at the 96 percent level. The climbers reported a range of income from about

zero to \$150,000, with a mean of about \$35,000. One unit change in income represents a \$10,000 change in income for the respondent or about 29.0 percent. A \$10,000 increase in income causes a change in net willingness to pay of 6.5 percent.

Variables such as time spent waiting to climb, skill level, and overall days at all sites are proxies for taste and preference. Time spent waiting at the base of a climb can vary considerably between climbers. Some climbers expressed their desire to climb a certain route and were willing to bear the opportunity cost of time spent in a long wait for their turn. They stated that this site was unique and spending a day there very worthwhile, the time spent waiting allowed for comraderie with other climbers, and observation of others' techniques. On the other hand, some climbers stated they were there to climb. If the chosen route was busy, they moved on to another choice, not wanting to wait, implying a different set of priorities. They wanted to climb as much as possible, possibly seeking comraderie later, over a few beers. Many of this second group stated that if the canyon became too crowded, they would find climbing elsewhere, possibly valuing the climbing activity more than the unique experience of this particular site.

These comments suggest that time spent waiting to climb could have a positive sign as some climbers who wait longer may value this site more. However, this positive relationship may not be transferrable to climbing in general, being a proxy for a general attitude toward Eldorado Canyon as a

premier climbing area. Waiting to climb had a coefficient of 0.0253, significant at the 99 percent level. For example, the mean of waiting time, 7.6 minutes, represents \$1.57 of net willingness to pay to climb at the study site. While the variable for time spent waiting to climb had a positive coefficient across all climbers, it is expected to have a negative impact on willingness to pay by each climber with greater congestion.

Skill level is based on the Yosemite Decimal System. This system currently ranges from 0 to 14 for all climbing sites and, for this sample of climbers, the range was from 4 to 11. The average in this sample is about 9.7, which would have been the upper limits in the recent past. Climbers have improved their skills and, with better equipment (shoes, etc.), can climb more difficult routes. Levels of 13 and 14 are now the upper limits in the world and only a few climbers achieve these levels with levels of 11 or 12 considered excellent for most climbers.

Usually skill and value are positively correlated so willingness to pay is expected to increase with skill level. However, skill was found to be not significant at the 90 percent level due to high multi-collinearity with other variables. One of the correlated variables was total days climbed at all sites, with a correlation of 52.4. In this regression, multi-collinearity more than doubles the reported sampling variance for the coefficient of these variables, which effectively reduces the reported t-statistic by about 50 percent, leading possibly to the incorrect conclusion that the variable is not relevant

(Johnston 1984). If a relevant variable is omitted from the regression, coefficients will be biased, variance overestimated, and inference procedures invalid. Including irrelevant variables is preferred over omitting relevant variables as the negative impact of including irrelevant variables is reduced precision in the regression estimation. Variables for skill and total days climbed, therefore, are assumed to be relevant variables and are left in the empirical model even though the significance of the coefficients appear to be small.

Total days climbed at all sites represented a preference variable for overall desire to climb and a higher number of days should represent higher net willingness to pay. This variable was significant at a 90 percent level with a positive coefficient, as expected, of 0.00292. The variable had little impact on net willingness to pay as a 10 percent increase in days climbed would increase the dependent variable by only 2.1 percent.

CONSUMER SURPLUS FOR CURRENT CONDITIONS

The estimated equation can be expressed as:

$\text{Log (net willingness to pay)} = 2.85 - .235 \log (\text{days})$. The annual consumer surplus for this model is found by multiplying the days climbed by the net willingness to pay for each climber, as this equation represents average, not marginal, willingness to pay (McKean and Walsh 1986). Net benefits equals \$286.30, annually, or about \$10.55 per day, assuming an

average of 27.1 climbing days a year. This daily value is less than the average of net willingness to pay amounts for each person of \$14.33, as the climbers with lower net willingness to pay amounts climbed more days, weighting lower values more. This value is also less than the net benefit estimated by the TCM models, with consumer surplus ranging from \$39.51 to \$48.73. However, about 60 percent of the TCM value was due to travel time, a value not measured in the CVM model. If the CVM value is adjusted, assuming that the net willingness to pay dollars of \$10.55 (\$14.33) per day represents 40 percent of total net benefit, including the time input portion, the CVM total net benefit per day would be \$26.38 (\$35.83) per climber, closer to the amounts found in the TCM models, but still not as high.

Theory suggests that CVM estimates should be lower than TCM estimates for consumer surplus as CVM is estimating a Hicksian function rather than a Marshallian function. This difference is usually not large, however, as Willig (1976) observed. Also, this difference can be attributed to use of individual travel cost models which can overstate consumer surplus when compared to zonal travel cost models. Walsh et al. (1988) point out that individual travel cost models can be less elastic which often overstates recreation benefits when the probability of participation decreases at higher travel costs.

Measurement error probably represents the difference. As noted in chapter 5, the value for travel time is an estimate of opportunity cost based

on distance to the site and income reported by the respondent, values which are not known with certainty. McKean et al. (1994) state that many recreationists do not trade time and income at the margin, which increases errors in the level of travel cost estimates. As adjustments were not made in the travel cost estimates, differences could have occurred.

IMPACTS OF CONGESTION ON NET WILLINGNESS TO PAY

Rock climbing is a rapidly growing sport with the number of resources available for climbing continually changing, and new climbing sites being developed. As the activity only requires rock that is vertical, sites could be available in many new locations. However, new sites tend to have shorter routes and possibly poorer quality. Even with new developments, there are few sites equal to the quality of Eldorado Canyon State Park.

While new sites are being developed to provide resources to meet the increasing demand, many sites now available are also being closed. For example, climbing in Canyonlands National Park is under review and may be closed beginning in 1994. Climbing in Yosemite and Denali National Parks are the only activities being considered in those parks for special fees. Other sites are being restricted substantially, either by forbidding parking near the climbing areas or preventing access to the rock by forbidding trespassing on the land around the rock. While climbers are trying to

reverse the trend, closures reduce climbing areas, forcing more climbers into fewer areas, increasing congestion.

Impact of congestion was determined by the second and third CVM questions, measuring maximum willingness to pay with increased wait times of 15 and 30 minutes respectively. These results were analyzed by regressing relevant variables on the changes in willingness to pay and to participate with each scenario (Table 6-2). The first regression analyzes changes in willingness to pay due to increased wait time of 15 minutes. The dependent variable, change in willingness to pay, was determined by taking the difference between willingness to pay for current conditions and willingness to pay for 15 minutes additional wait time. This regression had an R^2 equal to 12.0 percent with a mean change in willingness to pay of \$8.50 per day.

Four variables were regressed against change in willingness to pay. These were days climbed at the site, total days climbed at all sites, skill level, and a variable indicating local climbers. The latter variable equalled one for climbers living in Colorado. While some parts of Colorado are too far from the site to be considered local, no climbers from those parts happened to be in the sample. All respondents came from areas of Colorado close to the canyon, including the Front Range and Steamboat Springs. Other areas that also could be considered local, such as southern Wyoming, had no respondents in this sample.

Table 6-2:

Analysis of changes in willingness to pay and
in days climbed due to increasing congestion:

	<u>Change of 15 minutes</u>		<u>Change of 30 minutes</u>	
	<u>WTP</u>	<u>Days</u>	<u>WTP</u>	<u>Days</u>
Adjusted R ²	12.0	18.1	17.1	27.0
Mean change	\$8.50	13.1	\$12.96	19.0
Independent variables:				
Constant	14.2 (1.40)	-42.4 (-2.57)	18.5 (1.69)	-42.0 (-2.57)
Days climbed	-0.0361 (-0.697)		-0.0522 (-0.933)	
Days climbed at all sites	0.0236 (0.730)	0.160 (3.75)	0.0420 (1.20)	0.218 5.14)
Member of an environmental organization			11.4 (2.48)	9.88 (1.54)
Skill level	0.755 (0.724)	2.22 (1.42)	0.796 (0.712)	1.93 (1.25)
Local climber Colorado Resident	-16.5 (-4.26)	15.3 (2.67)	-19.4 (-4.66)	20.3 (3.58)
On-site time		2.06 (1.61)		1.81 (1.41)

T-values are in parentheses under the coefficients.

Days climbed at the study site had a coefficient of -0.036, indicating less impact due to congestion for higher number of days climbed. This coefficient was not significant at 90 percent level partly due to multicollinearities of the variables days climbed, skill, and total days climbed at all sites. Because of the relevance of these variables, and because they may be

significant if the colinearity did not exist, they were left in the equation. The correlations are:

<u>Variables</u>	<u>Correlation</u>
Days-skill	35.7
Daysall-skill	52.4
Daysall-days	54.9

A negative coefficient for days implies that climbers who participate more frequently have more opportunities (and knowledge) to substitute days or climbing sites. Better opportunities for substitution decreases the impact of congestion.

Skill had a positive coefficient (0.755) which was not significant at the 90 percent level. Shaw suggested that higher skilled climbers are affected less by congestion, having more opportunities to substitute other climbing routes for the one chosen, implying a negative sign. However, greater opportunity for substitution along the Front Range can also imply substitution at other sites in addition to other climbing routes at this site, since there are many other sites in the Boulder area. This substitutability across sites supports a positive coefficient for skill.

The coefficient for days climbed at all sites is positive and not significant. The positive sign suggests that the more one climbs, the greater the likelihood of knowing the locations and congestion conditions of other climbing sites, which increases the ability to avoid congestion at this site.

The coefficient for local climbers had a negative coefficient, 16.5, and significant at the 99 percent level. Congestion has more impact on those traveling greater distances to climb at this site. Those not considered local climbers may plan a climbing vacation to this area of Colorado. Given less flexibility in their schedules, congestion would have greater impact on these climbers, reducing their willingness to pay (and their vacation value) significantly.

The second regression (Table 6-2) estimated the impact of an additional 15 minute wait on number of days climbed. The dependent variable, change in days, was calculated as the hypothetical number of climbing days with wait time increased by 15 minutes from the current days climbed. This regression had an adjusted R^2 of 18.1 percent, with a difference of about 13.1 days. Four variables were regressed against change in days, including skill, days climbed at all sites, a local climber variable, and on-site time.

The coefficient (2.22) for skill is again insignificant with a t-statistic of 1.4 while the variable for days climbed at all sites had a coefficient of 0.160, significant at the 99 percent level. The variable for local climbers, equal to one for those living in Colorado, also had a positive coefficient, 15.3, significant at 98 percent level. These variables suggest that the greater the skill and the more one climbs, the greater the likelihood that the climber would find alternative sites that would not be as congested. This

also applies to local climbers, who have more knowledge of close alternative sites. Being close to Eldorado Canyon and having the luxury of changing their climbing schedule, they may believe they could find a time when congestion would not be as great. On-site time has a positive coefficient of 2.06, significant at the 89 percent level. The more time one spends at the site, the greater the impact of congestion.

The final two equations, presented in Table 6-2, analyzed congestion with increased wait times of 30 minutes using the dependent variables, change in willingness to pay from the current level of congestion and change in number of days, similar to the previous two equations. The first regression, analyzing change in willingness to pay had an R^2 of 17.1 percent with a change in willingness to pay of \$12.96. Five independent variables were days at this site, days climbed at all sites, skill, the variable for local residency, and a variable for membership in an environmental organization.

Days climbed at this site had a coefficient of -0.0522, skill 0.0796, and days climbed at all sites 0.0420, all insignificant and the same signs as in the first regression measuring impact of congestion. The variable for local climbers is again positive, significant (at 99 percent level), and equal to 19.4. The variable for membership in an environmental organization has a coefficient of 11.4, significant at 98 percent level. Those who join environmental organizations indicated a greater impact on willingness to pay due to congestion.

The fourth equation considered changes in days climbed on site for a 30 minute additional wait to climb. The mean change in days climbed was 19.0 with an R^2 of 27.0. This regression used five independent variables, days climbed at all sites, skill, on site time, and variables for local climbers and membership in an environmental organization.

The coefficient for days climbed at all sites is positive, consistent with the previous regression measuring impact of congestion. This coefficient had a value of 0.220, significant at the 99 percent level. Skill had an insignificant coefficient of 1.93, also consistent with the previous analysis. The same can be said for the local variable, with a coefficient of 20.3, significant at the 99 percent level. The variable representing membership in an environmental organization was significant at the 87 percent level with a coefficient of 9.88 the coefficient for on-site time was 1.81, significant at the 84 percent level, similar to the previous equation.

Benefit Functions for Hypothetical Levels of Congestion

In addition to the equations analyzing impacts of increased congestion, consumer surplus was measured for willingness to participate at the increased levels of congestion. Climbers reporting they would not continue to participate were removed from the sample. The remaining users determined the net benefits function for a given level of congestion. For the next two regressions, the same functional form was used as with the first

net benefits regression. The dependent variables, representing net willingness to pay for each respective level of congestion, and the independent variable, days, are converted to natural log form, also as in the first net benefits function.

For the sample with an additional 15 minutes wait time, the truncated regression provided an adjusted R^2 of 68.0⁴ with a mean net willingness to pay of \$12.06 (Table 6-3). The size of this sample was 116 climbers of the original 158 in the first group. Independent variables were similar to the first net benefits equation. The quantity variable, log of days, represents hypothetical days climbed at this site as provided by the respondent in this section of the questionnaire. The other independent variables included were income, distance to alternative sites, reported wait time, days climbed at all sites, skill, and whether the climber was employed during the daytime.

The quantity variable was the log of days one would climb during the year given the hypothetical situation of 15 additional minutes of wait time. The mean of this variable equaled 17.2 days, with a range from 1 to 100 days, with a coefficient equal to -0.417, significant at the 99 percent level. For a climber with about 10 percent more climbing days (1.7 more days), all other variable unchanged, the net willingness to pay would be about 4.2 percent lower.

⁴The R^2 s reported for non-linear regressions have been calculated using the procedure described on page 50.

Table 6-3:

Results of regression for net willingness to pay with increased wait time to climb of 15 and 30 minutes.

Dependent variable	=	log of net willingness to pay	
		<u>15 minute wait</u>	<u>30 minute wait</u>
Mean	=	\$12.06	\$9.54
Number of observations	=	116	82
Adjusted R ²	=	68.0	78.4

Independent variables coefficients:

Constant		1.52 (2.56)	-0.791 (-0.757)
Log of days		-0.417 (-4.50)	-0.487 (-3.40)
Income		0.0985 (3.08)	0.148 (2.81)
Distance of alternative climbs		0.00345 (1.80)	0.00433 (1.87)
Reported wait time		0.0361 (3.74)	0.0574 (4.09)
Days climbing all sites		0.00221 (1.22)	0.00124 (0.476)
Skill		-0.0143 (-0.242)	0.00335 (0.413)
Day employment, Yes = 1		0.311 (1.85)	0.141 (0.597)

T-statistics are in parentheses.

The variable for distance to an alternative site, had a coefficient of 0.00336, significant at the 92 percent level. The sign on the coefficient is positive as expected, but with little impact on the dependent variable.

Adding 10 miles (about 28 percent increase) to the mean of 35.6 miles changes net willingness to pay by 3.4 percent.

The coefficient for income equals 0.0985, significant at the 99 percent level. An increase in income by one unit (equal to \$10,000) would increase net willingness to pay by 9.9 percent. Time spent waiting to climb is also significant at the 99 percent level and had a coefficient of 0.0361. As in the first net benefits equation, the coefficient is positive, those who wait longer had higher net willingness to pay. The variables for skill and days climbed at all sites had coefficients which were insignificant, equal to -0.0143 and 0.00221 respectively, again with multi-collinearity equal to 52.4 percent.

The variable representing employment during daytime was the last independent variable in this regression, equal to one for those with day time employment. This variable had a positive coefficient of 0.311, significant at the 93 percent level, which shifted net willingness to pay by 36.5 percent.

The estimated equation for this hypothetical scenario is:

$$\text{Log (net willingness to pay)} = 3.086 - 0.417 \times \text{log (days)}.$$

Consumer surplus is found by multiplying the number of days times the net willingness to pay and averaging for each climber. For the complete sample of 158 climbers, including those reporting zero days (and therefore zero net benefits), the net benefit was \$82.29 annually, or \$5.87 per climbing day (assuming an average of 14.0 days per year). This daily average is about

44.4 percent less than the net benefit found for current level of congestion, with a value of \$10.55 per day. This reduced level of consumer surplus is expected since increased congestion reduces the quality of the climb and the value to the climber.

The increased level of congestion cause 26.6 percent of the climbers to decide they would no longer climb at this site. The large number of zero days brought the average consumer surplus down. However, the consumer surplus would have also dropped if only the remaining climbers' net benefits were included. The average net benefits for the reduced sample of continued users would have been only about 23.5 percent higher (about \$1.38 per climber per day) than the \$5.87, about \$127.47 annually, or \$7.25 per day for those who remain as users of the site.

Table 6-3 also shows the results of regressing against net willingness to pay for an additional wait time of 30 minutes. The sample for this estimation, reduced to 82 climbers, included only those reporting a positive willingness to pay amount at this level of congestion. The mean net willingness to pay with this scenario is \$9.54 and an adjusted R^2 of 78.4⁵. Independent variables were the same as in the previous regression, as shown in the table. The quantity variable was the log of days for the hypothetical situation of 30 minutes additional wait time, which had a mean

⁵The R^2 s reported for non-linear regressions have been calculated using the procedure described on page 50.

of 8.2 days. Its coefficient was -0.487, significant at the 99 percent level. If days climbed increased by 10 percent, or 0.8 days, the net willingness to pay would decrease by about 4.5 percent.

A variable was included representing the average distance to an alternative site. This variable had a coefficient of 0.00433, significant at the 93 percent level in this equation. The sign of the coefficient is positive as expected, but again has little impact on net willingness to pay. Adding 10 miles (about 27 percent increase) to the mean of this variable of 37.1 miles, changes net willingness to pay by only 4.4 percent. Income had a positive coefficient as expected, equal to 0.148, significant at the 99 percent level. An increase in income by one unit (equal to \$10,000) would increase net willingness to pay by 16 percent. The variable for time spent waiting to climb was also significant at the 99 percent level and had a coefficient of 0.0574. The coefficient was positive, meaning those who wait longer had higher net willingness to pay.

Skill and days climbed at all sites had insignificant coefficients equal to 0.0335 and 0.00124 respectively. These variables were left in the equation, as before, due to multi-colinearity. The last independent variable in this regression was a dummy variable representing day time employment with a coefficient of 0.141, but was not significant in this equation.

The estimated equation for this hypothetical scenario is:

$\text{Log (net willingness to pay)} = 2.859 - 0.487 \times \text{log (days)}$. Consumer surplus is found by multiplying the number of days times the net willingness to pay and averaging for each climber. For the sample of 158 climbers, 76 reported zero days (and therefore zero net benefits) for this level of congestion. Including these zero values, the net benefit was \$29.73 annually, or \$3.64 per climbing day (with an average of 8.2 days per year). This represents a loss of about 65.5 percent of the \$10.55 per day net benefit reported with the current level of congestion. This reduction in consumer surplus is expected since increased congestion reduces the quality of the climb and the value to the climber.

The increased level of congestion resulted in 48.1 (76/158) percent of the climbers choosing to no longer climb at this site. With about 48.1 percent of the respondents reporting zero days, the average value was reduced from the level reported by those who would have continued to recreate. The consumer surplus would have been about 58.5 percent higher (about \$ 2.13 per climber per day) for those who remained as users at this level of congestion. This value would have equalled \$75.77 annually, or \$5.77 per day (based on an average of 13.1 days of use per year).

In summary, with the current level of congestion, the consumer surplus was \$10.55 (unadjusted for travel time), but dropped when congestion increased. Increased waiting of 15 minutes decreased consumer surplus by 44.4 percent to \$5.87 as 26.6 percent of the climbers reported

zero values. Increasing waiting time by 30 minutes reduced net benefits to \$3.64, a reduction of 65.5 percent of the original value. The number of zero values with this level of congestion increased to 76, or 48.1 percent of the original sample of 158 climbers.

VALUING REMOTE CLIMBING SITES

For comparison purposes, climbers were asked a CVM question about climbing participation in remote sites. In pretests, many climbers suggested that climbing in the wilderness, away from the crowds provides the best climbing of all sites. Others stated they do not like to walk far, and do not like to camp. Because of these comments, comparing net benefits between Eldorado Canyon and remote sites became of interest.

Climbers responded to the questions relating to remote climbing sites in the same manner as they did to the previous questions. The data were analyzed by regressing relevant variables on changes in willingness to pay and to participate under each scenario (Table 6-4), similar to the methods described on Table 6-2. A substantial majority of the climbers were interested in participation in remote climbing. Of the 158 climbers responding to the CVM questions, 132 indicated interest in climbing in these areas.

The first regression analyzed the difference between maximum willingness to pay at Eldorado Canyon State Park and remote climbing sites,

found by subtracting the willingness to pay for current levels of climbing in Eldorado Canyon from willingness to pay at remote sites. This regression had an R^2 of 7.0 percent with a difference in willingness to pay of \$12.11 as shown on Table 6-4. Four variables were regressed against this difference in willingness to pay. These variables were days climbed at all sites, skill level, travel cost to remote sites, and on site time.

The coefficient for skill was significant in this equation at the 95 percent level with a positive value of 3.75. A positive coefficient increases the willingness to pay for wilderness. Remote climbs can be more demanding due to increased risk, uncertainty over route finding and greater skill requirements. Climbers with higher skill levels handle these problems more easily, allowing greater appreciation of the activity and one's ability to succeed with the climbs.

Total days climbed at all sites has been a significant variable in the previous models and is included here even though it is not significant in this equation. However, the coefficient, -0.0402, would be significant if it did not have the high co-linearity with skill. Climbing in remote sites requires increased dedication to related activities such as backpacking and route-finding, which may take away actual days climbed, suggesting a negative coefficient, as observed. Those who do not value more days of climbing in remote areas may do so because they avoid climbing in difficult to reach places.

Table 6-4:

Analysis of changes in willingness to pay and in days climbed due to difference between remote climbing and Eldorado Canyon State Park, 1991.

	<u>Change in willingness to pay</u>	<u>Change in days</u>
Adjusted R ²	7.0	14.7
Mean change	\$12.11	11.5
Variables:		
Constant	-41.9 (-2.33)	-33.7 (-1.57)
Days climbed per year at all sites	-0.0402 (-0.780)	0.106 (1.80)
Skill	3.75 (2.01)	-0.0750 (-0.035)
Travel cost	-0.188 (-1.27)	
On site time	4.72 (3.15)	3.29 (1.86)
Boulder residency, Yes = 1		36.6 (4.80)
Front Range residency, Yes = 1		20.3 (2.63)

T-values are in parentheses under the coefficients.

Travel cost had a negative coefficient of -0.188, although not significant. The negative sign indicates that as travel cost increased, climbers found less difference between the sites. For those living greater distances, travel cost (and willingness to pay) may already be high compared to those closer to the study site. Travel cost to remote sites was not reported by the respondents, but was estimated from other answers. For

those climbers living along the Front Range of Colorado, it was assumed that travel distance to a remote climbing area was about 1.5 times the distance to Eldorado Canyon State Park. For the remaining climbers in the sample, travel was assumed to be about the same distance.

On-site time had a positive coefficient of 4.72, significant at the 99 percent level, indicating that the more time one spends at this site, the greater value of remote climbing. An increase of one hour of on-site time (an increase of 21.3 percent of a day's activity) increased wilderness benefits by \$4.20, a 31.4 percent change.

The second regression considered the difference between the days spent climbing in each area. It had an adjusted R^2 of 14.7 percent, with a mean of 11.5 days, indicating that climbers averaged about 11.5 more days climbing at Eldorado Canyon State Park than in remote climbing areas. As remote climbing can be more difficult and requires more time per trip, less opportunity may be available for remote climbing resulting in fewer days at remote sites.

Five variables were regressed against change in days. These were total days climbed at all sites, skill level, on-site time, and two variables equal to one if the climber was a Boulder resident or a resident of the Front Range of Colorado, not including Boulder. The coefficient for skill was relatively small and insignificant in this equation. Days climbed at all sites had a positive coefficient (0.106), significant at the 92 percent level. A

positive relationship implies that the more one climbs, the larger is the difference between the two sites, supporting the conclusion reached in the previous equation. However, the impact of this variable is small, an increase in 10 days of climbing throughout the year implies an increase in the dependent variable of about one day. On-site time was significant at the 93 percent level with a coefficient of 3.29. An increase in on-site time of one hour per day (about 21.3 percent) increased the difference of days between the sites by 3.3 days.

Both variables indicating residency in Boulder and along the Front Range were significant at the 99 percent level. For Boulder residents, this represents a shift of 36.6 days while for Front Range residents, a shift of 20.3 days. Both groups have increases in the difference in days, indicating they climb substantially more at Eldorado Canyon State Park compared to remote sites.

The final equation estimated a regression for climbing at remote sites using a linear truncated regression for this sample of 132 respondents. The dependent variable was total willingness to pay as models regressed against net willingness to pay provided very little explanation of variation in the dependent variable. Total willingness to pay provided a better explanation of variation in the data for a truncated regression model.

The regression had an R^2 of 28.5 and a mean willingness to pay of \$35.37 with a range of \$5.00 to \$300.00. Independent variables included

days spent climbing in remote areas, income, travel cost, on-site time, days climbed at all sites, skill level, and a variable equal to one for membership in an environmental group as shown on Table 6-5.

Table 6-5:

Results of the total willingness to pay function for remote climbing experience, 1991.

Dependent variable	=	willingness to pay
Mean		\$35.37
Number of observations		132
Adjusted R ²		28.5
Independent variables coefficients:		
Constant		-175 (-2.55)
Remote days climbed		-0.384 (-0.671)
Income		4.13 (1.48)
Travel cost to the site		1.60 (5.28)
Days climbing all sites		-0.146 (-0.747)
Skill		8.42 (1.33)
On site time at Eldorado Canyon		14.1 (3.09)
Distance to alternative sites		0.0957 (0.527)

T-statistics are in parentheses.

While the quantity variable, days at remote sites, had a negative coefficient of -0.384 which is expected in this model, the t-statistic of -0.671, indicated that the coefficient was not different from zero. The mean value for days climbed in remote sites was 15.0 with a range of 2 to 100 days. The coefficient of 4.13 for income was significant at the 86 percent level, and positive as expected. An increase in one unit, representing \$10,000 increase in income, increased willingness to pay by \$4.13, or 11.7 percent. The coefficient of on-site time, equal to 14.1, is significant, at the 99 percent level.

Travel cost had a coefficient of 1.60, significant at the 99 percent level, indicating that willingness to pay was directly related to cost of travel. An increase of 10 miles of round-trip distance increases willingness to pay by \$15.99. The coefficient for days climbed at all sites was not significant and is -0.146, the negative sign agreed with the previous two regressions. Skill had a coefficient of 8.42 and was not significant. The last independent variable in this equation was distance to an alternative site, with a coefficient of 0.0957 and not significant. The value of the coefficient is similar to the previous willingness to pay equations, having little impact if it would be significant.

Benefits Function for Remote Climbing Sites

The estimated equation for this hypothetical scenario is:

Willingness to pay = $41.13 - 0.384 \text{ days}$. Consumer surplus is found by multiplying the number of days times willingness to pay and averaging for each climber. The net value was \$419.24 annually, or \$27.95 per climbing day (assuming an average of 15.0 days per year). This daily average compares favorably with values from the first CVM regression, with a consumer surplus of \$10.55 per day for the complete sample of 158 climbers. If only this sample of 132 respondents were used, then \$9.39 would be reported as the average consumer surplus per day for current conditions at Eldorado Canyon State Park. Therefore, this sample of respondents valued remote sites at 165 percent higher than for current conditions at Eldorado Canyon State Park.

CONCLUSION

Four CVM scenarios were used to value natural resources for rock climbing. The first and fourth valued current conditions experienced by the respondents at the study site and remote wilderness areas. The second and third scenarios valued hypothetical increased levels of congestion at the study site.

These scenarios provided the basis for four regressions estimating benefit functions for each. The R^2 ranged from 28.5 percent for the remote

wilderness areas to 78.4 percent for the hypothetical scenario of 30 minutes additional wait time.

For current conditions at Eldorado Canyon State Park, the average net benefit of climbing was about \$10.55 per day, or \$286.30 annually. This value is less than results reported in the previous chapter using TCM. The TCM estimated the average net benefit of climbing as between \$39.51 and \$48.73 per day. As the TCM includes the opportunity cost of travel time as part of the travel cost, it should be a greater amount. Travel time was determined to account for about 60 percent of the value of TCM. Adjusting the CVM estimate for travel time increases the value to \$26.38, still only 66.8 percent of the TCM value.

For the two hypothetical scenarios representing increased congestion, 15 and 30 minutes of increased waiting time to climb, estimates of consumer surplus were derived from the benefit functions. As expected, increasing levels of congestion reduced the average consumer surplus of the climbing experience. Using all 158 respondents for comparison purposes, an additional 15 minutes of wait time reduced net benefits to \$5.87, a 44.4 percent decrease. For 30 minutes of wait time, average net benefits are reduced to \$3.64 per day, a 65.5 percent decrease leaving only 34.5 percent of the value found under current conditions. While increased congestion reduced average consumer surplus for all climbers in the sample, under each scenario many of the respondents indicated they would no

longer climb if congestion was as bad as described. Consumer surplus was found for the climbers who would remain. These values were \$7.25 and \$5.77 for 15 and 30 minutes of waiting, respectively.

Additional regressions were estimated to explain changes in willingness to pay and to participate for the two levels of increased congestion. The regressions used the 158 respondents from the base level estimation of a net benefit function for the study site. The results of these regressions showed increased effects of changes due to increased congestion as would be expected. Willingness to pay decreased by \$8.50 for 15 minutes additional wait time and by \$12.96 for 30 minutes. Climbers indicated they would participate less frequently as congestion increased, 13.1 days would be given up for the 15 minute increase in congestion, and for 30 minutes, 19.0 days.

The last scenario represented climbing in remote wilderness sites. Some climbers indicated no interest in these areas, but most stated a desire to climb in remote places. Willingness to pay increases by about \$12.11 for an average day of remote climbing. As remote climbs require more access time, respondents indicated that they climb 11.5 fewer days per year.

A benefits function was estimated, using a sub-sample of 132 climbers who indicated they would participate at these areas. The coefficient for the quantity variable was not significant. The consumer surplus estimate for remote climbing was equal to \$27.95 per day or about

165 percent higher than the estimated value for current conditions of the study site for these 132 climbers.

The CVM was successful in estimating net benefits for resources used for rock climbing under the four scenarios. The last scenario, remote wilderness climbing did not provide as strong a result as the previous three benefits functions. But for the three congestion scenarios at the study site, results indicate substantial decline in net benefits as congestion increases.

CHAPTER 7

CONCLUSION TO THIS STUDY

Rock climbing is gaining in popularity world-wide. With the development of competitive climbing and indoor walls, increasing numbers of people are being exposed to the sport and taking an interest in rock climbing. For years, climbers had few problems of access to climbing sites, but the access issue has been increasing. Some of the traditional climbing sites are becoming crowded and land managers are becoming more concerned with legal liability. Crowding creates conflicts, either between groups of climbers or between climbers and other recreationists. As these problems arise, land managers and owners find the quickest solution is to ban climbing entirely. This solution may not be the best decision for optimal use of the resources in question.

Economic valuation of resources used in recreation activities is an important tool in decision making by land managers, but optimal decisions will not be chosen when information is not available. For this reason, finding economic values for resources used in climbing is important to retaining climber access to these resources. In addition, as demand continues to grow, congestion creates loss of economic value to

participants. Knowledge of the impact of congestion can help identify an optimal level of resources that should be allocated to climbing activities. Also, in order to maximize climbers' enjoyment, resources may need to be preserved in different settings as different climbers prefer different levels of remoteness.

Finding economic values for resources used by all rock climbers in the United States is not possible due to the numbers of climbers and different sites currently used. Eldorado Canyon State Park provides a large representation of climbers due to the variety of climbs and a reputation as a premier climbing site throughout the world. Analysis of the data and results from this study should provide a foundation for answers to the questions of economic value. Managers of these resources will then have additional information for deciding on the future of resource use.

Travel cost and contingent valuation models were tested through use of data gathered with a mailback questionnaire. The individual travel cost method provided the opportunity for indirectly determining the valuation of resources used in recreation through observation of the revealed preference of the participant.

The four models were based on the assumptions of different distributions, comparing ordinary least squares (OLS), truncated OLS regressions, Poisson, and negative binomial distributions (Table 7-1). The last three recognized that the dependent variable came from a truncated

Table 7-1:

Comparison of results for economic valuation techniques, Eldorado Canyon State Park, 1991.

<u>Valuation method</u>	<u>Consumer surplus</u>
Travel cost models:	
OLS	\$40.11
Truncated OLS	39.51
Poisson	45.08
Negative Binomial	48.73
Contingent Valuation models:	
Current conditions	10.55
Adjusted for travel time	(26.38)
Wait of 15 minutes	5.87
Wait of 30 minutes	3.64
Remote wilderness	27.95

distribution; the number of trips were always positive. The Poisson and negative binomial distributions assume that the dependent variable represents integer values.

Equations were estimated for the four models using only the climbers who participated in one-day trips, segregating the results by on-site time, with 142 climbers included. The models had adjusted R^2 's ranging from 44.4 to 53.4 percent. The results indicated that the models provided similar results and demand was shown to be inelastic in all models. Also,

consumer surplus was determined using average values in the equations and shown to be very similar in all four, as shown on Table 7-1. Consumer surplus was between \$ \$39.51 to \$48.73 per trip, on average, with the higher values found with the count data models, similar to results found for other skilled recreation activities.

In addition, four contingent valuation scenarios were applied to the problem of valuing the quality of resources used for rock climbing. The scenarios were based on alternative assumptions about congestion levels. The first represented the current level of congestion, next were two hypothetical increases in levels of congestion, and finally a "no-congestion" scenario for remote wilderness climbing.

These scenarios provided the basis for regressions used to estimate demand equations for net willingness to pay. The R^2 s for these equations ranged from 30.6 percent for the remote wilderness areas to 78.4 percent for the hypothetical scenario of 30 minutes additional wait time.

Current conditions at Eldorado Canyon State Park resulted in average net benefit of about \$10.55 per climbing day, or about \$286.30 annually (Table 7-1), significantly less than the TCM estimate of \$39.51 and \$48.73. As 60 percent of the travel cost in the TCM method represents travel time of the participant, comparisons require adjustment of the CVM result for time. This adjustment increases the CVM value to \$26.38, still only 66.8 percent of the TCM value. Economic theory suggests that CVM estimates

should be slightly less as they are Hicksian demand functions. However, Willig pointed out that this difference should be small, not accounting for the magnitude of difference found in this study. The remaining difference can be attributed to measurement error in the data.

Two hypothetical scenarios representing increased congestion, 15 and 30 minutes of increased time waiting to climb, provided estimates of consumer surplus. Increased levels of congestion reduced the average consumer surplus (Table 7-1). An additional 15 minutes of wait time reduced net benefits to \$5.87, a 44.4 percent decrease. For 30 minutes of wait time, average net benefits are reduced to \$3.64 per day, 65.5 percent decrease from current conditions. Increased congestion decreased average consumer surplus and many climbers indicated that they would no longer climb at these increased levels of congestion. If those climbers who indicated they would not climb at increased levels of congestion are removed from the sample, the estimated consumer surplus values are higher. Average daily consumer surplus values are \$7.25 and \$5.77 for 15 and 30 minutes of waiting, respectively.

Additional regressions were estimated to determine changes in willingness to pay and to participate with the two levels of increased congestion, compared to the current conditions of the study site. The results of these regressions showed increasing impacts on the dependent variables as levels of congestion increased. Willingness to pay decreased by

\$8.50 for 15 minutes additional wait time and by \$12.96 for 30 minutes. Climbers indicated they would participate less frequently as congestion increased, with 13.1 days given up for the 15 minute increase in congestion, and 19.0 days less for 30 minutes increase.

The last scenario represented climbing in remote wilderness sites. Some climbers indicated no interest in these areas, but most stated a desire to climb in remote places. Regressions indicated that willingness to pay for remote climbing increases for an average day of climbing by about \$12.11. As these climbs require more time, these respondents indicated that they climb 11.5 fewer days per year.

A demand equation was estimated, using a sample represented by the 132 climbers who indicated they would participate at these areas. The coefficient for the quantity variable was not significant. Consumer surplus estimate for this function was found equal to \$27.95 per day or \$419.24 annually. The value of \$27.95 was about 165 percent higher than the estimated value for current conditions of the study site.

The CVM was successful in estimating net benefits for resources used for rock climbing under all four scenarios. The last scenario, remote wilderness climbing, did not provide as strong a result as the previous three willingness to pay functions due to zero slope for the demand curve. For the three congestion scenarios at the study site, results indicate substantial decline in net benefits as congestion of the site increases, as expected.

Using the values for a day of climbing found in this study, managers of public land can improve management practices. Using a range of values for current conditions, the low value being the adjusted CVM value of \$26.38 and the high value from the negative binomial model equal to \$48.73, an estimate of value for the resources can be made. For Eldorado Canyon State Park, assuming an average of 2606 climbers per month or 30,545 per year for 1991 (Table 3-1), the range of value estimated is from \$805,777 to \$1,488,458. Using the low of the range and assuming a four percent discount, these resources have a current net benefit to society of \$20,144,428. This value is highly sensitive to the discount rate and to the numbers of climbers. The evidence suggests that climbing is growing at 15 percent per year, therefore, the values would also grow at this rate.

For all sites in the U.S., a similar analysis could be attempted if the number of climbers were known. In chapter 1 an estimate of 3 million climbers was provided. Assuming a value of \$26.38 could be applied to all climbers, a total value for rock climbing resources for 1991 would be about \$1.98 billion. For decision-making, a comparative cost would be necessary and such cost is not available for the resources nationwide or for Eldorado Canyon State Park. For this one study site, the canyon is now held publicly. Transfer of value to other sites would require decisions concerning comparability of the resources in question.

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APPENDIX A: Questionnaire used in the study

TECHNICAL MOUNTAIN CLIMBING SURVEY

Hello. My name is Earl Ekstrand and am employed by Colorado State University in Ft. Collins. We are studying the problems of technical climbing from overcrowding, bolting, and other issues through interviews with a small sample of climbers to provide information on climber preferences and values. Your participation can make a difference and may improve mountain management. You personally will not be identified in reporting any of the results of the study.

Please answer the first two questions only if you are away from home for more than one day. If you came here to climb for one day or less, begin with question number 3.

1. How many days are you away from home on this trip? ____

2. What other areas did or will you climb or visit on this trip?

_____ How many hours? _____

_____ How many hours? _____

_____ How many hours? _____

3. How many hours did you climb at Eldorado Canyon today? ____

4. Approximately, how many days per year do you usually climb at Eldorado Canyon? ____

5. Has the bolting ban affected the number of days you climb here this year?
Yes __ No __

If yes, what is the change in number of days?

More days this year: __ or Less days this year: __

6. What level of difficulty (Decimal Rating) do you climb? ____

7. Do you consider climbing to be your major sport/activity?
Yes __ No __

8. About how many days a year do you climb at all climbing sites? __

9. About how many miles from home to this climbing site, one-way? ____

10. Please estimate the cost of this trip including:

a. The amount spent only on travel including all costs for the automobile (or other transportation?).

\$ _____

b. Are there other costs of this trip?
If so, please estimate these in total.

\$ _____

c. Did you pay an entrance fee?

\$ _____

Total costs:

\$ _____

d. How many people are in your party who share these costs? _____

e. Total costs per person are:

\$ _____

11. What is the value of your climbing experience on this trip? Is it worth more than the cost per person (from 10e.) actually spent on the trip?

Yes ___ No ___

12. If yes, assume that your costs of traveling here to climb became more expensive perhaps due to increased gasoline prices or other costs, what is the maximum (total amount) you would pay per trip to continue climbing in Eldorado Canyon the same number of times per year? (Please circle an amount or write in an amount if your value is not represented.)

\$5 \$10 \$15 \$20 \$25 \$30 \$35 \$40 \$50 \$60 \$70 \$80 \$90 \$100 \$ _____

FOR THE NEXT FEW QUESTIONS, WE ARE TRYING TO FIND OUT HOW QUALITY OF THE EXPERIENCE AFFECTS YOUR WILLINGNESS TO PAY FOR THIS TRIP. This is a hypothetical experiment intended to provide some notion of how strongly you feel about the numbers of people present and the climbing environment. Assume that your payment of trip expenses is the only way to assure yourself of a quality recreation experience. This information is not to be used to increase your costs of climbing.

13. Approximately, how long do you normally wait at the base of the climb before beginning? _____

14. Now, assume for each time you came to climb you will have to wait longer because other climbers are ahead of you and other comparable climbs also require waiting. Consider your willingness to pay for the current experience as you answered in question 12. Now what would be this value of the experience with a longer wait as shown below?

15 minute wait

\$5 \$10 \$15 \$20 \$25 \$30 \$35
 \$40 \$50 \$60 \$70 \$80 \$90 \$100
 \$ ____

30 minute wait

\$5 \$10 \$15 \$20 \$25 \$30 \$35
 \$40 \$50 \$60 \$70 \$80 \$90 \$100
 \$ ____

15. Would having to wait longer to begin your climb change how often you climb here as you stated in question 4? Yes __ No __

16. If yes, how many days would you now climb in Eldorado Canyon with a 15 minute longer wait? _____

17. If yes, how many days would you continue to climb here if the wait was 30 minutes longer? _____

Some climbing areas are more remote, with a higher alpine environment than Eldorado Canyon, providing more of a wilderness experience. These climbs require a hike of more than a couple of miles. During the climb you could expect to have little contact with others.

18. How many days per year do you spend on climbs of this type? _____

19. As in question 12, how much is this experience worth to you?

\$5 \$10 \$15 \$20 \$25 \$30 \$35 \$40 \$50 \$60 \$70 \$80 \$90 \$100 \$ ____

20. If you were unable to climb at Eldorado Canyon, how many miles would you travel from your home to your next most preferred climbing area? _____

21. How many years have you climbed? _____

22. Which kind of climbing do you prefer?
(Circle your choice.)

- a. Sport climbing
- b. Traditional climbing
- c. Mixed type of climbing

If you answered no to question 11 or zero to question 12, 14, or 19, please answer question 23. Otherwise go on to question 24.

23. Why is your answer(s) no or zero? Please check the appropriate reasons.

- a. It is not worth anything to me.
- b. I am not planning on climbing here in the future.
- c. I cannot afford increased costs of travel at this time.
- d. Additional waiting will cause me to climb elsewhere.
- e. I do not climb in remote, alpine environments.
- f. I believe that providing a value will raise the cost of climbing.
- g. Other reason? _____

24. Where do you live? City (& State): _____

25. What is your age? _____

26. Sex: F ___ M ___

27. Do you belong to: Climbing organization? _____
Environmental organization? _____

28. To the best of your knowledge, what was your household income last year (before taxes)? Circle the correct number.

- | | |
|-------------------------|-------------------------|
| 1. Under \$9,999 | 5. \$40,000 to \$49,999 |
| 2. \$10,000 to \$19,999 | 6. \$50,000 to \$59,999 |
| 3. \$20,000 to \$29,999 | 7. \$60,000 to \$69,999 |
| 4. \$30,000 to \$39,999 | 8. \$70,000 to \$79,999 |

If greater than \$79,999, Please specify to nearest \$10,000: \$ _____

29. How flexible is your work time? What type of employment situation do you have? (Circle any of the following which apply to you.)

- | | | |
|-------------------|---------------------|-----------------|
| 1. Fixed hours | 4. Day employment | 7. Full-time |
| 2. Flexible hours | 5. Night employment | 8. Part-time |
| 3. Self-employed | 6. Not-employed | 9. Summers free |
| | | 10. Other _____ |

30. What would be the effect of uncontrolled bolting in the canyon on the quality of the experience? _____

31. Would there be an effect on the quality of experience for limited bolting? _____

32. What is the effect of a no bolting policy on the quality of the experience? _____

33. What is the effect of a contrasting color chalk on the quality of your experience? _____

34. What is your preference for a climbing area; sport climbing vs. traditional vs. mixed area? _____

THANK YOU VERY MUCH

Your time and effort in completing this survey is greatly appreciated.

Please put this in the attached envelope and mail as soon as possible.