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VALUING THE LOSS IN ACCESS: AN INSTITUTIONAL AND WELFARE ANALYSIS OF ROCK CLIMBING ON U.S. PUBLIC LANDS

BY

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DISSERTATION

Submitted in Partial Fulfillment of the
Requirements for the Degree of

Doctor of Philosophy
Economics

The University of New Mexico
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To Mom and Dad

Acknowledgments

This research would not have been conducted if it were not for the many rock climbers who willingly participated in a detailed survey on rock climbing access. Their time and contribution to this research has been invaluable. I would also like to thank ARC'TERYX, BLACK DIAMOND, and CLIMBING MAGAZINE for product donations used to entice climbers to participate in my survey research.

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ABSTRACT

Environmental public resources provide a myriad of goods and services, and like any choice, selecting among alternative bundles of these goods and services requires evaluation of both market and nonmarket benefits and costs. The public management of environmental resources can often be an issue of considerable controversy because of difficulties associated with balancing multiple uses of these resources. This dissertation addresses recent public land use debates regarding conflicts between competing uses of public lands—rock climbing and environmental preservation.

The motivation for this research is based on an emerging institutional trend in public land management to ration or restrict rock climbing use on public lands. Two highly publicized cases involve the U.S. Forest Service's initiative to ration rock climbing in U.S. Forest Service (USFS) wilderness areas, and Texas Parks and Wildlife Department's initiative to restrict climbing access at Hueco Tanks Texas State Park. Thus, as the title of this dissertation implies, the overriding objective of this dissertation is to estimate economic losses to rock climbers due to changes in institutional rules for rock climbing access on federal and state public lands. The techniques for estimating the economic losses to climbers are presented in Chapter 1.

Using Bromley's (1989) hierarchical view of the policy process, an institutional analysis is presented in Chapter 2 to explain possible reasons why the USFS proposes to restrict climbing access in wilderness areas. The USFS struggles to balance uses of designated wilderness areas: rock climbing, an impure public good, and wilderness preservation, a pure public good. This conflict gives rise to a new USFS interpretation of the 1964 Wilderness Act, in which the USFS argues that climbing practices are antithetical to the intent of the Act.

Based on a thorough review of institutional arrangements currently governing wilderness areas, a case can be made that rock climbers have standing; that is, prior to finalizing its rule the USFS may be required to conduct a benefit-cost analysis recognizing the economic losses to climbers. According to Executive Orders 12866 and 12291, a benefit-cost analysis must be conducted on all major federal regulations. As one criterion, any proposed federal regulation is considered major if it has an annual effect on the economy of $100 million or more. This means that if the economic losses to climbers resulting from the USFS policy proposal exceed $100 million annually, the USFS would need to conduct a benefit-cost analysis comparing economic losses of climbing access restrictions with benefits of wilderness preservation.

In Chapter 3, a repeated-discrete choice random utility model is used to determine whether annual economic losses to climbers, resulting from the USFS policy proposal, exceed $100 million. To implement this modeling strategy, this dissertation uses unique survey data on trip-taking behavior for 597 climbers living throughout the U.S.; the data account for approximately 13,000 trips to 60 nationally dispersed climbing areas. Results show that restricting climbing access in USFS wilderness areas has an economic loss to climbers of more than $100 million annually, thus providing *prima facie* evidence that the proposal by the USFS may indeed constitute a major regulatory change.

In addition to the USFS proposing new rationing rules for rock climbing on federal public lands, managers of state public lands have also addressed concerns about climbing impacts on state land resources. Climbers throughout the world recognize Hueco Tanks Texas State Park to be one of the most valuable climbing resources. According to park managers, the popularity of Hueco Tanks as a world-class climbing destination threatens the geologic and archeological resources at the park. Consequently, in 1998 Texas Parks and Wildlife Department (TPWD) severely restricted open-recreational access at Hueco Tanks.

In Chapter 4, the economic losses to climbers due to restricted open-recreational access at Hueco Tanks are estimated using several count data regression models by pooling revealed and stated preference trip data. Stated preference (SP) trip data is obtained by asking climbers to state how many trips they would take to Hueco Tanks if access to the park was restricted. In addition, as an alternative to pooling revealed preference (RP) and SP trip data, I suggest estimating RP and SP trip data jointly in a seemingly unrelated Poisson regression model (SUPREME). Results show that a SUPREME is an appropriate regression technique for combining SP and RP trip data.

As an additional analysis in Chapter 4, I analyze the validity of augmenting RP trip data with pre-policy SP trip data. This validity test is conducted using data from surveys implemented both before and after the policy change. Pre-policy RP and SP intended trip data are obtained from climbers prior to the change in policy; post-policy RP trip data are obtained from climbers after TPWD restricted open-recreational access at

Hueco Tanks. This post-policy RP trip data is used to test the validity of pre-policy intended SP trip responses. Results indicate that methods of augmenting RP data sets with SP data show promise as a tool for policy analysis, especially in the case of rock climbing.

Each of the three main chapters, Chapters 2 through 4, contains specific conclusions. Chapter 5 summarizes the results from Chapters 2 through 4 and contains ideas for future research.

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1.1. Introduction

Environmental public resources provide a myriad of goods and services, and like any choice, selecting among alternative bundles of these goods and services requires evaluation of both market and nonmarket benefits and costs. The public management of environmental resources can often be an issue of considerable controversy because of difficulties associated with balancing multiple uses of these resources. This dissertation addresses recent land use debates regarding conflicts between competing uses of public lands—rock climbing and environmental preservation—and employs several nonmarket valuation techniques to value rock climbing on public lands.

1.2. Approaches to Valuing Nonmarket Environmental Goods and Services

Environmental valuation techniques are generally used to measure the demand for environmental quality and resources. The measurement of value for environmental resources and quality is a critical step in the development of environmental policy and public land management (Loomis 1993a). The beginning of nonmarket environmental valuation is usually credited to Ciriacy-Wantrup (1947, 1952) and Hotelling (1949), yet the earliest applications did not appear for many years. Today, literally over 1000 applications of nonmarket valuation exist.

Ciriacy-Wantrup (1947, 1952) suggested the use of survey techniques to determine the demand for environmental goods and services, particularly recreational benefits. Hotelling's involvement in nonmarket environmental valuation arose when

Hotelling was asked by the Department of the Interior to evaluate recreational benefits associated with large scale water development and diversion projects. In response, Hotelling proposed a method for measuring benefits provided by recreation sites; however, his method was ignored until Clawson (1959) used and popularized Hotelling's method.[1] In the 1960s and 1970s, nonmarket valuation techniques suggested by Ciriacy-Wantrup and Hotelling were primarily applied to outdoor recreation and public land projects (Smith 1993).[2] In the 1980s, impetus for valuing nonmarket environmental benefits and costs was based on Executive Order 12291. According to Executive Order 12291, a benefit-cost analysis was required of new major regulations, which includes both market and nonmarket benefits and costs.

Environmental resource values can be classified into two broad groups: direct use values and passive or nonuse values. Direct use values are related to uses of a good, such as recreational or extractive uses of natural resources. While this dissertation employs several nonmarket valuation techniques for evaluating direct use values, nonmarket valuation techniques are often applied to evaluate nonuse values.

Unlike direct use values, nonuse values are not associated with a behavioral choice. These values include, but are not limited to, indirect use values, option values, bequest values, and existence values. Indirect use values include, for example, watershed protection or ecosystem services. Option values refers to the fact that individuals may be willing to pay for the future availability of an amenity. Bequest values refer to the desire of passing healthy resources onto future generations. Existence values are based on the

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[1] Hotelling's response is often cited as the "famous Hotelling letter" to the National Park Service.

idea that individuals value the existence of an environmental resource. For example, many people may be negatively affected by oil spills because of the damage to the environment, even if these people do not live in the area affected by the spill. In order to calculate nonuse values—such as the economic damages to an ecosystem caused by an oil spill, which may be used in natural resource damages assessment cases—analysts must construct choice situations to observe individual trade-offs. Often, for example, researchers will use survey instruments where respondents are asked to make a series of choices regarding their preferences for environmental amenities; these choices often include statements about the amount of money individuals would be willing to pay to protect environmental amenities.

In addition to the different types of environmental values, there are several different methods for valuing resources. Methods for estimating resource values can be categorized into to stated preference (SP) and revealed preference (RP) approaches. These approaches can be further categorized into direct and indirect methods.

In SP approaches, individuals can either be asked to state the value they have for a resource (direct method), or they could be asked to infer a behavioral response given a contingent change in a resource (indirect method). In the context of recreation, individuals may be asked directly to state their willingness-to-pay (WTP) for improved recreational opportunities, such as those that arise from water quality improvements. This is referred to as the contingent valuation method (CVM). While a rather difficult

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[2] Examples of early studies include Matthews and Brown (1970) for Salmon Fishing; and Cicchetti and Smith (1973) for evaluating the effects of congestion on wilderness recreation.

and controversial method, over 1000 applications of contingent valuation can be found in the literature.[3]

As an alternative, rather than asking individuals to state their maximum WTP for or the minimum amount of compensation required to forego improved water quality at a recreational site, the contingent behavior (CB) method asks individuals to state how their visitation to a resource may change in response to a change in water quality. Thus, CB can be used for evaluating behavioral responses to proposed policy changes when such behavior has not yet been observed or revealed by consumers. Some recent applications of the CB method include Cameron et al. (1996), Englin and Cameron (1996), Loomis (1997), and Rosenberger and Loomis (1999).

To value direct use values, the literature on nonmarket valuation generally suggests the use of RP approaches (Englin and Cameron 1996); however, this does not imply that SP methods should not be employed.[4] RP approaches are based on observed or revealed individual behavior.

The direct RP method obtains individual values by simulating a competitive market using competitive market prices. For example, Bishop and Heberlein (1979) simulated a competitive market by offering to purchase goose hunting permits at stated prices from Wisonson hunters.

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[3] Carson et al. (1996) reference a bibliography of over 1600 applications of contingent valuation.
[4] See Smith (1993) and Carson et al. (1996) for alternative perspectives.

In the indirect RP framework, the value of an environmental service is derived by a relationship between market goods and environmental service flows. The idea is that individuals reveal their preferences for environmental goods and services through the choices they make about related market goods. Two examples of this approach include the hedonic property value method and the travel cost method (TCM). The hedonic property value method is commonly used to decompose market prices of a resource, such as a plot of land or a home, to the attributes of the resource. For example, the value of a home can be decomposed into structural components, such as the number of rooms, and to proximity to environmental resources, such as the proximity to a river.

The TCM is often applied to recreation demand modeling (e.g., Clawson and Knetsch 1966; and Shaw and Jakus 1996). The TCM uses travel expenditures to a recreational site as implicit prices for recreational trips; thus, the demand for an environmental resource is calculated by relating the number of trips an individual takes to the site to travel expenditures. The basic assumption underlying the TCM is that distance is costly.

This dissertation uses indirect RP and SP approaches to estimate demand for rock climbing resources. To study climbing demand nationally, a variant of the TCM is employed. Specifically, a discrete choice random utility model is employed where climbing site choices are specified as a function of travel expenses and site quality. To study demand at a single rock climbing site, stated-indirect (contingent behavior) and revealed-indirect trip data are combined in a travel cost model. Because this dissertation primarily uses the TCM, the remainder of this chapter briefly outlines the development of the TCM, followed by a summary of my dissertation research.

1.3. The Development of Travel Cost Method

Some of the earliest studies that employed the TCM relied on zonal or county data (e.g., Cicchetti, Fisher, and Smith 1973; Clawson 1959); these models are often referred to as zonal travel cost models. This method relies on using aggregate data on the total number of visitors from a number of different zones visiting a specific recreational area. Consequently, such trip data does not account for whether an individual takes more than one trip to a site.

For the zonal TCM, distance to a site is typically measured from the centroid of each county or zone. Zonal trip and expenditure data is then supplemented with socioeconomic characteristics of the resident population of each zone. Implicit in this approach are the following assumptions: (1) each visitor is assumed to have unlimited access to the site's services; (2) each individual has identical demand for the site's services; (3) each individual is assumed to spend the same amount of time visiting the site; and (4) each individual is assumed to have the same socioeconomic characteristics as her zone (Smith 1975).

Alternatively, researchers can use individual recreation data to estimate demand for a recreational site. To collect individual trip or socioeconomic data, individuals may be interviewed at a recreation site or possibly asked at a recreation site if they would be willing to participate at a future date in a mail survey about their recreational decisions. A recent development in travel cost modeling is to combine RP and CB stated trip data (Cameron et al. 1996; Englin and Cameron 1996; Loomis 1997; and Rosenberger and Loomis 1999). By augmenting RP trip data with CB trip data, researchers can estimate consumer welfare change measures from proposed policy changes in site quality.

For both zonal and individual travel cost models, single site demand functions are typically estimated. These single site demand models are attractive to use when the valuation question is one of a price change at a single site, or as a special case elimination of that site. The welfare measure is found by integrating the area under the estimated demand function for a price change where the coefficient on price (i.e., travel costs) reflects the effect of a price change holding all else constant.

Estimating demand for a single site is appropriate if the research question involves valuing the availability of or changes in quality at that site only. Often, however, policy changes affecting a single site may also affect the demand for substitute sites. In such cases, substitution effects among sites should be modeled explicitly (Freeman 1993).

When substitute site information is important, one suggestion by the literature is to use a multi-site travel cost model that captures interactions and substitution effects among sites (Freeman 1993). A drawback of the multi-site demand model is that it does not facilitate the valuation of site characteristics because no variation in any given site's quality will be observed over individuals (Bockstael, Hanemann, and Kling 1987). In addition, multi-site models can be difficult to estimate, especially when: (1) there is considerable multicollinearity among prices; and (2) the number of demand equations increases (see Bockstael, McConnell, and Strand (1991) for a complete description). As an alternative, a discrete choice model can be used to model individual recreational choices (Bockstael, McConnell, and Strand 1991; Bockstael, Hanemann, and Kling 1987; and Freeman 1993).

The discrete choice or random utility model (RUM) is used to model individual choice among a group of substitutable sites. Whereas the TCM models demand for a site over a period of time, the RUM describes how people choose among a group of recreation sites each time a choice is to be made. This modeling strategy is particularly attractive to value changes in site characteristics, such as water quality, because these characteristics generally explain how individuals select a site. In addition, the RUM can also be used to value losses (benefits) from eliminating (introducing) a site(s).[5]

One shortcoming of the RUM, however, is that the RUM cannot explain the total number of trips an individual takes to a site in a season. To derive seasonal demand, per trip welfare measures obtained from the RUM need to be multiplied by a predicted number of trips in the season (Morey, Shaw, and Rowe 1991). Alternatively, recent literature has suggested using a repeated nested RUM to predict seasonal participation and site choice simultaneously in one model (Morey, Shaw, and Rowe 1991). The repeated nature of the model captures an individual's decision to take multiple recreational trips over the course of a season; on each trip occasion an individual first decides whether to take a trip, then she selects where (i.e., site choice).

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[5] George Parsons cites over 100 applications of random utility models used to value recreation demand. A list of these citations can be found at http://www.voicenet.com/~kwkrick/rum.htm, or by searching the Department of Economics webpage at the University of Delaware.

1.4. Structure of Research

The primary objective of this dissertation is to estimate the economic losses to rock climbers associated with restrictions in rock climbing access on federal and state public lands. The motivation for this research is based on an emerging institutional trend in public land management to ration rock climbing on public lands. Two of the most highly publicized cases involve the U.S. Forest Service's initiative to ration rock climbing in U.S. Forest Service wilderness areas, and Texas Parks and Wildlife Department's initiative to restrict climbing access at Hueco Tanks Texas State Park.

In 1998 the U.S. Forest Service (USFS) announced intent to impose a policy prohibiting the use of climbing safety anchors in wilderness areas—essentially eliminating wilderness area climbing. Prior to this action by the USFS, the Bureau of Land Management (BLM) and the National Park Service (NPS) proposed similar rules for rock climbing on public lands under their care. Recently, however, the BLM and the NPS stated to withhold any new policy rules for rock climbing until the USFS has determined its final policy (Access Fund 1999). In addition, during the fall of 1998, Texas Parks and Wildlife Department (TPWD) severely restricted open-recreational access at Hueco Tanks State Park due to increasing use by climbers.

Variants of the TCM are employed to measure the economic losses to climbers resulting from these proposed and actual site access restrictions. To undertake this research, this dissertation uses unique survey data consisting of both RP and SP trip responses. (A more thorough description of these methods are described in the chapter summaries described in section 1.4.1.)

Because these policies reflect changes in institutional rules, this dissertation first evaluates possible reasons for the proposed rule changes. To understand the institutional process, a full analysis of the institutional arrangements for public lands, particularly USFS wilderness areas, is presented. Understanding institutional arrangements for USFS wilderness areas is important for discerning whether climber preferences (i.e., economic losses) warrant consideration in a full benefit-cost analysis (BCA). That is, answering the question, do policies governing wilderness areas resolve whether climbers have standing in a benefit-cost analysis (Trumbull 1990; and Whittington and MacRae 1986)?

Each primary research question—should the losses to climbers be considered in a full benefit-cost analysis and what are the economic losses to climbers due to restrictions in access to public lands—is addressed separately in three manuscripts. Chapter 2 addresses the issue of standing and concludes that indeed climbers may have standing for BCA. Chapter 3 evaluates the losses to climbers due to the USFS wilderness area climbing policy proposal. Chapter 4 evaluates the losses to climbers due to restrictions in site access at Hueco Tanks. Avenues for future research are presented in Chapter 5. A brief review of Chapters 2 through 4 is presented in the following section.

1.4.1. Chapter Summaries

Using Bromley's (1989) hierarchical view of the policy process, Chapter 2 uses an institutional analysis to explain possible reasons why the USFS proposes to restrict climbing access in wilderness areas. The USFS struggles to balance uses of designated wilderness areas: rock climbing, an impure public good and direct use value, and wilderness preservation, a pure public good and a nonuse value. This conflict gives rise to a new USFS interpretation of the 1964 Wilderness Act, in which the USFS argues that climbing practices are antithetical to the intent of the Act.

Based on a thorough review of institutional arrangements currently governing wilderness areas, a case can be made that rock climbers have standing; that is, prior to finalizing its rule the USFS may be required to conduct a benefit-cost analysis recognizing the economic losses to climbers. According to Executive Orders 12866 and 12291, a benefit-cost analysis must be conducted on all major federal regulations. As one criterion, any proposed federal regulation is considered major if it has an annual effect on the economy of $100 million or more. This means that if the economic losses to climbers resulting from the USFS policy proposal exceed $100 million annually, the USFS would need to conduct a benefit-cost analysis comparing economic losses of climbing access restrictions with benefits of wilderness preservation.

In Chapter 3, a repeated-discrete choice random utility model is used to determine whether the annual economic losses to climbers, resulting from the USFS policy proposal, exceed $100 million. To implement this modeling strategy, this dissertation uses unique survey data on trip-taking behavior for 597 climbers living throughout the U.S.; the data account for approximately 13,000 trips to 60 nationally dispersed climbing areas. Results show that restricting climbing access in USFS wilderness areas has an economic loss to climbers of more than $100 million annually, thus providing *prima facie* evidence that the proposal by the USFS may indeed constitute a major regulatory change.

In Chapter 4, the economic losses to climbers due to possible area closures at Hueco Tanks are estimated using several count data regression models by pooling revealed preference-stated preference trip data. SP trip data is obtained by asking climbers to state how many trips they would take to Hueco Tanks if access to the park was restricted. In addition, as an alternative to pooling RP and SP trip data, I suggest estimating RP and SP trip data jointly in a seemingly unrelated Poisson regression model (SUPREME). Results show that a SUPREME is an appropriate regression technique for combining RP and SP trip data.

As an additional analysis in Chapter 4, I analyze the validity of augmenting RP trip data with pre-policy SP data. This validity test is conducted using data from surveys implemented both before and after the policy change at Hueco Tanks. Pre-policy RP and SP intended trip data are obtained from climbers prior to the change in policy; post-policy RP trip data are obtained from climbers after TPWD restricted open-recreational access at Hueco Tanks. This post-policy RP trip data is used to test the validity of pre-policy SP intended trip responses. Results indicate that methods of augmenting RP data sets with SP data show promise as a tool for policy analysis, especially in the case of rock climbing.

Each of the three main chapters, Chapters 2 through 4, contains specific conclusions. Chapter 5 contains a brief summary of this research and prospects for future research.

2. CHAPTER 2: A Question of Standing: Institutional Change and Rock Climbing in Wilderness Areas.

2.1. Introduction

The public management of rock climbing access in designated wilderness areas has been an issue of considerable recent controversy in the U.S. On June 1, 1998, the U.S. Forest Service (USFS), under the U.S. Department of Agriculture (USDA), announced intent to implement a policy restricting the way climbers could recreate in wilderness areas (USDA 1998b). The USFS claimed that its proposal was based on the legislative intent, as they interpret it, of the Wilderness Act (WA) of 1964. The USFS proposal would prohibit the use or placement of fixed climbing anchors in designated wilderness areas. Accordingly, climbers would not be allowed to use or place fixed protective gear for ascending and descending climbing routes safely. The normative implication of this institutional change is that a nontraditional resource user group (rock climbers) would lose access privileges in wilderness areas. However, due to congressional pressures, the USFS agreed to undergo a negotiated rulemaking.

This paper has two objectives. First, using Bromley's (1989) view of institutional change and the policy hierarchy, this paper examines the USFS's struggle to find balance between competing uses of designated wilderness areas: rock climbing, an impure public good, and the preservation of wilderness character, a pure public good. This conflict between impure and pure public goods explains, in part, the USFS's change in interpretation of the WA.

The second purpose is to present a case that the USFS is restricted in its ability to make interpretative changes. The proposed policy for climbing in wilderness areas would impose costs on climbers without an accounting of the economic values of those losses. Given that climbing in wilderness areas is a privilege and not a right, it would appear that climbers do not have standing (Trumbull 1990; Whittington and MacRae 1986). The USFS may not be obligated to recognize climber losses in a benefit-cost analysis nor to compensate climbers for these losses as if this were a regulatory takings. However, the USFS's ability to make such an interpretative change is restricted. If the proposed change results in an annual loss of $100 million to climbers, then under Executive Orders 12866 and 12291 the USFS must conduct a full benefit-cost analysis. Evidence from two national telephone surveys concerning climbing participation trends suggests evidence that the loss to climbers could exceed $100 million annually. If so, a case can be made that rock climbers have standing; that is, the USFS may be required to conduct a benefit-cost analysis recognizing economic losses to climbers using nonmarket valuation techniques. As of this writing, the USFS has not conducted such an analysis.

This paper begins by reviewing Bromley’s (1989) definition of institutional change and the policy hierarchy. This view, which emphasizes that institutions are endogenous to social processes or economic events, provides a framework to assess behavioral transactions that have launched concerns by the USFS about the impacts of rock climbing on natural resources. A brief history of National Forest management will be presented to show how National Forest management goals have changed and evolved through time due to changing preferences or knowledge about scarcities; this review will illustrate how changes in National Forest management fit Bromley's view of institutional change.

The next sections of paper will evaluate the hierarchical institutional structure governing use of wilderness areas—the policy level, the organizational level, and the operational level. The policies governing wilderness areas are the basis for determining whether climbers have standing. At the organizational level, possible reasons why the USFS proposes to ration rock climbing access in wilderness areas will be presented. One possible reason explaining the USFS’s proposal is due to uncertainties about the growth in outdoor rock climbing and the impacts on resources caused by rock climbing. Finally, an assessment of operational level activities (i.e., rock climbing) will include analyses of data from a national telephone survey sample; a probit regression is used to explain U.S. rock climbing participation. The final sections of this paper will address the possibility that the USFS's actions will set precedent for other land managers, and reviews the question of whether climbers have standing for a benefit-cost analysis (BCA).

2.2. The Institutional Process for Public Lands

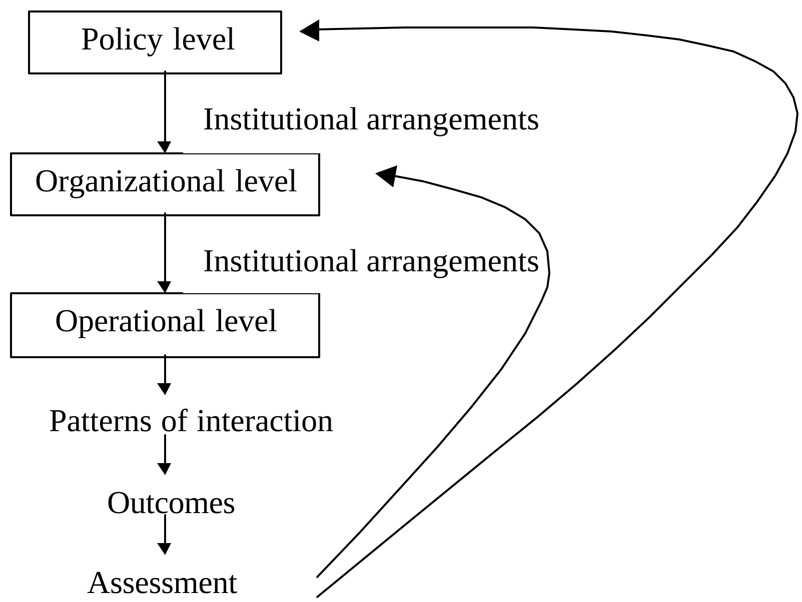
Following Bromley (1989), institutions can be defined as the set of rules that govern relations between individuals, both liberating and constraining behavior. Institutions can be both formal (e.g., property rights and entitlements) and informal (e.g., social norms and traditions). Bromley also emphasizes the normative content of institutions; this involves the role of institutions in determining what counts as costs and benefits, and to who these costs and benefits are important—this is the issue of standing. Standing can be thought of as whether the interests of a particular individual or group are accounted for in a decision process, such as a BCA (Trumbull 1990; Whittington and MacRae 1986).[6]

Institutional change may result when social, economic, or environmental conditions change (Bromley 1989). For example institutional change may occur when technology advances, scarcity concerns arise, or consumer demands change (Bromley 1989). Ostrom (1990, 208) views institutional change as a process of making informed judgments about uncertain benefits and costs. Different groups in society will purposefully attempt to modify institutional arrangements given these evolving situations (Bromley 1989).

Since institutional change is the *raison d' etre* for public policy, Bromley (1989) uses the institutional hierarchy depicted in Figure 1–1 to describe policy processes. At the top of the hierarchy, Bromley defines the policy level. The institutional arrangements at this level define the desired structure of society. The WA is an example of a policy level institutional arrangement. The middle of the hierarchy is the organizational level. Organizations, such as the USFS, implement policy level institutional objectives by establishing additional institutional arrangements, generally in the form of rules or guidelines. For example, the USFS establishes wilderness area management guidelines and rules according to how it interprets the WA.

[6] Whittington and MacRae (1986) claim that standing can have other meanings in addition to having one's preferences counted in BCA. Other types of standing include the right to represent one's own preferences, and the right to have one's preferences represented by others. Following from Whittington and MacRae (1986), standing is often <u>the</u> issue of many public policy debates. For example, in 1969 the Sierra club filed a suit against a ski resort project in Mineral Kings valley (a valley surrounded by Sequoia National Park), which was to be developed by Walt Disney Productions. The U.S. Supreme Court ruled that the Sierra Club lacked standing to sue (Krutilla and Fisher 1975).

Figure 2-1. The Policy Process as Hierarchy



Source: D. Bromley (1989, 33)

At the bottom of the hierarchy is the operational level. At this level, policy and organizational level institutional arrangements define the scope of individual choice sets and behavior. Behaviors observed at the operational level—the patterns of interaction—result in outcomes that are assessed by society as either good or bad (Bromley 1989, 33). When faced with an incongruity between outcomes and policy objectives, members of society will collectively respond and attempt to change current institutional arrangements (Bromley 1989). Institutional arrangements, therefore, establish essentially two types of behavioral transactions—behavior defined (that is, determined) by institutional arrangements and behavior undertaken to modify existing institutional arrangements (i.e., choice sets). Bromley (1989) uses the term *institutional transactions* to refer to those collective actions that successfully achieve the goal of modifying institutional arrangements.[7]

According to Bromley (1989), institutional transactions are at the core of a dynamic economy. This view is shared by Commons (1950) who believes that an institution has history, is changing and evolving, and is made up of potentially conflicting interests. For example, there once was a time when dogs could freely roam neighborhoods, but this behavior obviously came at cost to some households without pets. This conflict led to an institutional transaction, and consequently dogs must now be on leashes to roam neighborhoods. Institutional transactions will expand choice sets for some members of society while restricting choice sets for others.

Institutional transactions may consist of multi-level transactions, such as negotiating and bargaining (Commons 1950). Alternatively, institutional transactions may show up as willingness to ration behavior in order to maintain or establish advantage. For example, as Ostrom (1990, 208) writes:

> One should expect individuals to be willing to adopt new rules that will restrict their appropriation activities when there are clear indicators of resource degradation, generally perceived to be accurate predictors of future harm, or when leaders are able to convince others that a "crisis" is impending.

[7] Bromley (1989) defines four different types of institutional transactions: (1) those that enhance productive output; (2) those that redistribute income; (3) those that reallocate economic opportunity (i.e., define new choice sets); and (4) those that either maintain or redistribute economic advantage.

In the context of rock climbing on public lands, this statement suggests the possibility that if climbers are convinced that they may be causing resource degradation or may lose access privileges, they may be willing to ration use to secure continued access.

Public policy is essentially about the structure of institutional arrangements (Bromley 1989). According to Ostrom (1990), the institutional arrangements for public lands, such as those for USFS wilderness areas, depend endogenously upon resource conditions and behavioral transactions. USFS wilderness areas provide multiple goods and services including market, pure public, and impure public goods.[8]

The different types of goods and services provided by public lands often compete for scarce resources. Pure public goods are typically defined as non-excludable and non-rival in consumption—no one may be excluded from its use, and one person's consumption does not impair another's consumption. Examples of pure public goods provided by forest resources include existence values for ecologically healthy wilderness areas and aesthetic beauty of landscapes. Impure public goods, as defined by Cornes and Sandler (1996), are partially rival, partially excludable, or both. Benefits from backcountry recreation, such as rock climbing, are at some level non-rival to all users. Beyond a certain level of activity, some climbers may be negatively affected by congestion, or some individuals, who value ecosystem preservation, may feel as though

[8] Public goods are generally defined as goods in which all individuals share property rights to the good; that is, these goods are non-rival in consumption and non-excludable. Generally, the problem with public environmental resources is that common access leads to resource exploitation; a person only considers their net benefits without considering the effects of their actions on other owners. Another problem with public goods is the free-rider problem. That is, given society holds value for public goods, public goods will be underprovided because each member of society has incentive to free-ride on other members for the provision of these goods.

climbing congestion damages ecosystems. If members of society are not satisfied with the outcomes, their preferences will be expressed through collective action.

In the U.S., institutional arrangements for public lands are implemented by public agency. These agencies (e.g., the USFS) are responsible for implementing policy objectives by establishing additional management objectives; both objectives form institutional arrangements for public lands, and thus define the possible set of resource uses. As with any policy process, when a conflict exists between behavior and public land objectives, institutional transactions will occur to modify current institutional arrangements, and thus choice sets. The policy process is summarized best by Bromley (1989, 250):

> The linkage between institutions, patterns of interaction, and outcomes provides a model of cause and effect. The linkage between outcomes and policy objectives provides a model of feedback process out of which corrective action may or may not arise. The control mechanism is found in the institutional arrangements that link policy objectives to patterns of interaction.

Bromley's (1989) view of institutional change and the policy hierarchy is used in this paper to illustrate the institutions and the process of institutional change for USFS wilderness areas. This study analyzes a possible conflict between wilderness area uses and management objectives. Institutional interpretations by the USFS will either constrain or liberate individual choice sets for rock climbers and others.

2.3. Brief History of Conflicts and the Evolution of National Forest Policy

The purpose of presenting a brief review of the history of National Forest policy is important for two reasons. First, the history shows how National Forest management goals have changed and evolved through time due to changing preferences or knowledge about scarcities. Second, the history shows how a longstanding utilitarian USFS philosophy poses difficulties in balancing resources among the different classes of goods (market, impure public, and pure public goods).

During the Disposition Era (mid-late 1800s), the Federal government transferred land-acquired through the Louisiana Purchase, the Oregon Compromise, the Mexican Cession, and the Alaskan purchase-to private citizens (Loomis 1993a). The government hoped that private citizens would cultivate the land for growth and development. This lead to several Acts, including the Homestead Act of 1862 (12 Stat. 392 (1862) codified at 43 U.S.C. §§161 et seq.). The Homestead Act of 1862 allowed citizens to obtain up to 160 acres of land for a minimal fee.

Around 1870, the U.S. began setting aside lands for National Forests and Parks, rather than transferring lands to private citizens. Three possible explanations for this change were because of: (1) new demands for resource use; (2) negative externalities resulting from fraudulent land disposal practices; and (3) concerns about potential resource shortages (especially timber) (Loomis 1993a; see Loomis 1993a for an extensive review of this era). Two major public land policy changes were advanced during this era. First, National Park Reservations, which included Yellowstone National Park, were established in 1872 (due to preservationist demands) to protect scenic landscapes and natural wonders of the U.S. (Loomis 1993a). Second, due to concerns about timber shortages, Congress appointed and established the Division of Forestry in the USDA to study the usage of forest resources; although, during this time, the Department of Interior (DOI) administered and managed Forest Reserves (Loomis 1993a). The Division of Forestry held a utilitarian philosophy arguing that wood was scarce and necessary for life (Loomis 1993a).

By 1891 the Forest Reserve Act was passed granting the President the authority to further reserve public land as "public reservations" from homesteading and private entry. Since this policy would remove land from productive use, the Department of Forestry and many westerners greatly opposed it (Nelson 1995). Consequently, Congress and President McKinley passed the Organic Act of 1897 (16 U.S.C. §§473-475) (Loomis 1993a; Nelson 1995). The Organic Act of 1897 established purposes and rules for use of Federal Reserves. These purposes were: (1) to preserve and protect the forest within the reservation; (2) to secure favorable conditions of water flow; and (3) to furnish a continuous supply of timber for the use and necessities of the people of the United States (Dana and Fairfax 1980, 62). This policy emphasized use over preservation, recognizing two main resources, timber and water. This utilitarian policy paved the way for a growing conservationist movement.

Under the tenure of President Theodore Roosevelt intensive forest management became a major focus of the Division of Forestry (Loomis 1993a; Nelson 1995). In 1905, President Roosevelt transferred administration of the Forest Reserves from the DOI to the USDA. At this time Gifford Pinchot, head of the Division of Forestry, established one of the most famous principles for forest management for the twentieth century (Nelson 1995):

> In the administration of the forest reserves it must be clearly borne in mind that all land is to be devoted to its most productive use for the permanent good of the whole people, and not for the temporary benefit of individuals or companies….
>
> You will see to it that water, wood, and forage of the reserves are conserved and wisely used for the benefit of the home builder first of all, upon whom depends the best permanent use of lands and resources alike. The continued prosperity of the agricultural, lumbering, mining and livestock interests is directly dependent upon a permanent and accessible supply of water, wood, and forage …. (Pinchot 1947, 190).

Forest Reserves were to be devoted to their most productive use with water, wood, and forage as the key resources to be managed.

By 1939, due to growing demands for recreation and wilderness preservation, Congress passed the "U-regulations," which created three new land classifications called wilderness, wild, and recreation (Dana and Fairfax 1980, 132). Roads and timber harvesting were permitted on recreation lands, but were not permitted on wilderness and wild lands. Further, motorized access was not allowed in wilderness and wild lands. All other national forest lands were managed according to the Organic Act of 1897.

During the post-World War II housing boom, demand for timber grew significantly. The USFS accommodated these demands by changing their position from custodian to producer (Loomis 1993a). Likewise, demand for backcountry recreation was significantly growing (Bowes and Krutilla 1989). Consequently, zoning land into respective uses was no longer sufficient to meet multiple growing demands (Loomis 1993a).[9] By 1960, the USFS sought congressional authorization to support a concept of multiple-use forest management (i.e., formal recognition that forests provide multiple goods and services). In 1960 Congress passed the Multiple-Use, Sustained-Yield Act (MUSYA) (P.L. 86-517), and in 1964 Congress passed the WA. Essentially, the WA established wilderness as an acceptable use under the MUSYA (Loomis 1993a; Nelson 1995).

In the 1970s, several policies were written during a period when society was learning that human actions may negatively impact our environment. In 1974, the Renewable Resources Planning Act (RPA) was passed (P.L. 93-378). Under the RPA, every ten years the USFS is required to prepare a national assessment (referred to as the Assessment) of the demand for and supply of forest resources. In addition, the RPA requires that the USFS design a management program (referred to as the Program) every five years. In 1976, the National Forest Management Act (NFMA) was passed as an amendment to the RPA (P.L. 94-588). The NFMA specifically required that demands for and supplies of renewable resources be measured according to economic and environmental criteria. During this period, other national environmental policies, such as the National Environmental Planning Act of 1969 (P.L. 91-190), the Clean Air and Clean Water Acts (P.L. 89-675; P.L. 91-604; P.L. 95-95; and P.L. 95-217), and the Endangered Species Act (P.L. 93-205), were passed. Generally, these policies required that costs of human behavior on the environment be considered.

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[9] Nelson (1995) points out that there was a desire to change the process of zoning lands because of a growing skepticism that the USFS would maintain permanent reservations for wilderness lands.

During the 1990s, the USFS further questions the effects on ecosystems from traditional public land uses. The USFS management philosophy, called ecosystem management, recognizes that economic stability and environmental protection are interrelated (Dombeck 1998). The primary objective of ecosystem management is to sustain the integrity of ecosystems for future generations while recognizing current demands for environmental goods and services (Jensen et al. 1996).[10] Therefore, sustaining ecosystems seems to accord with the RPA, the NFMA, and the MUSYA. The USFS will attempt, under ecosystem management, to balance recreational use, traditional-extractive use, and ecosystem integrity within the context of policy level institutions.

2.4. Policy-level Institutions for Wilderness Areas

Congress has created a number of institutional arrangements directing the USFS on how to manage National Forests and wilderness areas. Today, the guiding principles of USFS wilderness area management lie in the accumulation of regulations emanating from the Organic Act of 1897, the Multiple-Use, Sustained Yield Act (MUSYA) of 1960, the Wilderness Act (WA) of 1964, the National Environmental Planning Act (NEPA) of 1969, the Renewable Resources Planning Act (RPA) of 1974, and the National Forest Management Act (NFMA) of 1976.[11] This body of legislation recognizes that National

[10] Some may suggest that ecosystem integrity could have multiple meanings (e.g., ecosystem resilience, ecosystem stability, or ecosystem diversity); therefore, the USFS may define ecosystem integrity differently than how others may define it.

[11] In the 1998 Forest Service Report, the USFS identifies the following policies for National Forest management: The Organic Act of 1897, Clarke-McNary Act of 1924, McSweeny-McNary Act of 1928, the MUSYA, the WA, the NEPA, the RPA as amended, the NFMA, Cooperative Forestry Assistance Act of 1978, Chief Financial Officer's Act of 1990, Farm Bill of 1990, Government Performance and Results Act of 1993, and the Federal Agriculture Improvement Reform Act of 1996 (USFS 1999).

Forests and wilderness areas supply many environmental goods and services.

In addition to these acts, Executive Order (EO) 12291, issued by President Reagan, requires that a BCA be conducted on all major federal regulations. This EO would apply to any major regulatory change in public land management.

The remainder of this section will review the above policy level institutions. It begins by describing policies that specifically address National Forest and wilderness area management, and concludes with a review of the NEPA and EO 12291.

Until 1960, the Organic Act of 1897 (16 U.S.C. §§ 473-475) was the guiding policy for National Forest management. The Organic Act emphasized managing forests for continuous water flow and timber supplies. In 1960, Congress passed the MUSYA (P.L. 86-517), which recognized that environmental resources supply multiple, and often conflicting, goods and services. Specifically, multiple-use was defined as:

> The management of all the various renewable surface resources of the National Forests so that they are utilized in the combination that will best meet the needs of the American people; making the most judicious use of the land for some or all of these resources … without impairment of the productivity of the land, with consideration being given to the relative values of the resources, but not necessarily that combination of uses that will give the greatest dollar return or greatest unit output. (P.L. 86-517 § 4)

The MUSYA directs the USFS to manage multiple National Forest outputs based on relative values, and to ensure that current harvests do not interfere with future production of renewable resources. One important implication of the MUSYA is that there is considerable room for interpretation. For example, the MUSYA does not specify how the USFS should measure resource values or determine sustained yield.[12]

Despite USFS opposition to the WA, the WA (P.L. 88-577) recognized wilderness as an acceptable forest use. The USFS's objection stemmed from the idea that wilderness areas may be classified as single-use, which may weaken the USFS's authority in these areas (Loomis 1993a).

The purpose of the WA was to secure enduring wilderness benefits to current and future generations without interfering with the purposes of National Forests established by the MUSYA and the Organic Act of 1897. Specifically, the WA states:

> [Wilderness areas] shall be administered for the use and enjoyment of the American people in such a manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, [and] the preservation of their wilderness character …. (P.L. 88-577 § 4)

Further, the WA defines wilderness as:

> an area of undeveloped federal land retaining its primeval character and influence … which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable, (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation …. (P.L. 88-577 § 2)

To preserve wilderness character, several activities and features typically allowed in National Forests are restricted from wilderness areas:

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[12] Sustained yield is defined in P.L. 86-517 § 4.

> except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, no motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area. (P.L. 88-577 § 4)

But, the WA also contains provisions to allow activities that would otherwise be excluded. Some key provisions are:

> Within wilderness areas designated by this Act the use of aircraft or motorboats, where these uses have already become established, may be permitted to continue subject to such restrictions *as the Secretary of Agriculture deems desirable*. …Grazing of livestock, where established … shall be permitted to continue subject to such reasonable regulations *as are deemed necessary by the Secretary of Agriculture*. …Commercial services may be performed within the wilderness areas designated by this Act to the extent necessary for activities which are proper for realizing the recreational or other wilderness purposes of the area [italics added]. (P.L. 88-577 § 4 (d) (1), (4), (6))

Recalling that institutions frame behavior, these clauses will be used by climbers to justify climbing as an established, unconfined wilderness activity. However, the italicized phrases highlight that these clauses are subject to interpretation.

By late 1960 and early-mid 1970s, the public realized that the USFS was predominantly managing National Forests for timber harvests without realizing other valued uses, such as recreation and biological diversity (Loomis 1993a; Wilkinson 1992). Growing scrutiny of USFS management practices lead to the passage of the RPA, amended by the NFMA (P.L. 93-378 codified at 16 U.S.C. §§ 1600-1687). These Acts required that supplies of and demands for natural resources be periodically assessed based on economic and environmental criteria.

Two key features of the RPA are preparation of a national assessment of forest uses and supplies (the Assessment); and preparation of a management program (the Program) that is consistent with the Assessment (Loomis 1993a). The Assessment includes: (1) an analysis of present and anticipated uses, demand for, and supply of renewable resources of forest, range and other associated lands with the consideration of international resource situation, and emphasis on pertinent supply and demand and price relationship trends; and (2) an inventory of present and potential renewable resources and an evaluation of opportunities for improving their yield of tangible and intangible goods and services (P.L. 93-378). The Assessment is completed every ten years, while the Program is designed every five years.

While undergoing the Assessment and Program phases, the USFS is required to incorporate several forest planning principles. For example, the USFS is required to: (1) recognize that National Forests provide important ecological services; (2) use interdisciplinary planning and establish quantitative and qualitative standards for land and resource planning; (3) engage the public in early and frequent participation; (4) manage National Forests in a manner that is sensitive to economic efficiency; and (5) respond to changing conditions of land and resources, and to changing social and economic demands for forest resources (Loomis 1993a, 42; see Loomis 1993a, 42 for a list of 14 forest principles). These principles recognize the dynamic nature of National Forest management.

From an economic perspective, an important provision of the NFMA is the explicit objective of managing National Forests "towards the desired result of maximizing net public benefits" (47 FR 1982, 43026; P.L. 93-378 codified at 16 U.S.C. §§ 1600-1687). The USFS (47 FR 1982, 43039) defines net public benefit as "an expression used to signify the overall long-term value to the nation of all outputs and positive effects (benefits) less all associated inputs and negative effects (costs) whether they can be quantitatively valued or not."

Other federal policies, which affect all federal agencies, establish additional institutional arrangements for National Forest management. Two particularly important policies are the NEPA (P.L. 91-190) and EO 12291 (46 FR 1981, 13193-98). These two policies highlight the importance of employing a BCA.

Through the 1950s and 1960s, BCA included benefits and costs based on market values only (Andrews 1984). These practices raised many objections from political and environmental communities (Andrews 1984). For example, Congress was concerned that the decision criteria for BCA would reject regional projects that generally would be government subsidized. Environmentalists were opposed because BCA failed to include environmental costs (Andrews 1984). One important Act that came out of this period was the NEPA. The NEPA required that environmental impact statements be completed or all major federal regulations (P.L. 91-190 § 101). This policy was important because it recognized that benefits and costs could extend beyond the market (Andrews 1984).[13]

Finally, the policy that operates as a possible constraint on proposed federal regulations is EO 12291.[14] EO 12291 requires that all federal agencies use BCA to analyze the impact on the private sector of new *major* regulations.[15] Major is defined as any regulation that is likely to result in: (1) an annual effect on the economy of $100 million or more; (2) a major increase in costs or prices for consumers, individual industries, Federal, State, or local government agencies, or geographic regions; or (3) significant adverse effects on competition, employment, investment, productivity, innovation, or on the ability of United States-based enterprises to compete with foreign-based enterprises in domestic or export markets (EO 12291 Section 1). Literally, EO 12291 recognizes that government actions may unfairly burden some individuals, and thus requires that agencies pick regulatory alternatives that maximize net benefits (Goodstein 1995).

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[13] The economic literature on estimating nonmarket values for outdoor recreation is now over 30 years old, and includes hundreds of published (and many unpublished) studies. According to Rosenberger, Loomis, and Shrestha (1999), over 170 individual nonmarket valuation studies for recreation providing over 750 various recreational values. These studies cover the range of outdoor recreational activities, including rock climbing (e.g., Hanley et al. 1999; and Shaw and Jakus 1996). Some recent examples of nonmarket valuation studies that estimate the value of recreation given resource quality changes include studies by: Jakus et al. (1997) that evaluated benefits associated with sportfish consumption advisories; Needelman and Kealy (1995) that measured swimming benefits associated with water quality improvements; and Lin, Adams, and Berrens (1996) that measured welfare effects of fishery policies under Native American treaty rights.

[14] President Clinton's EO 12866 of 3 September 1993, "Regulatory Planning and Review," supersedes EO 12291 (58 FR 1993, 51735). EO 12866 still requires a BCA for significant regulatory actions, choosing those that maximize net benefits, however, now net benefits are parenthetically qualified to include “potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity” (Clinton 1993; Goodstein 1995, 386).

[15] "Regulation" or "rule" means an agency statement of general applicability and future effect designed to implement, interpret [underscore added], or prescribe law or policy or describing the procedure of practice requirements of the agency (EO 12291 Section 1).

If an agency regulation meets the definition of major, EO 12291 requires that: (1) administrative decisions shall be based on adequate information concerning the need for and consequences of proposed government action; (2) regulatory action shall not be undertaken unless the potential benefits to society for the regulation outweigh the potential costs to society; (3) regulatory objectives shall be chosen to maximize the net benefits to society; (4) among alternative approaches to any given regulatory objective, the alternative involving the least net cost to society shall be chosen; and (5) agencies shall set regulatory priorities with the aim of maximizing the aggregate net benefits to society, taking into account the condition of the particular industries affected by regulations, the condition of the national economy, and other regulatory actions contemplated for the future. Implementation of these requirements will entail a regulatory impact analysis, in effect a BCA (EO 12291 Section 3).[16] The normative implication of policy level institutions for National Forests is that maximizing net public benefits is the appropriate decision criterion for regulatory alternatives. To fully account for benefits and costs of proposed changes, agencies must consider both market and nonmarket values.

[16] BCA is rooted in welfare economics and is intended to provide a pragmatic method for implementing this theory (Smith 1984, 17). The basic premises of welfare economics are that the purpose of economic activity is to increase the well-being of individuals who make up a society; and that each individual is the best judge of their well-being (Freeman 1993). In its most practical form, this criterion is called the potential Pareto improvement, which requires that resources be allocated to their highest valued uses. The potential Pareto improvement criterion answers two possible questions: (1) whether it is possible for "winners" to fully compensate "losers" from a proposed policy, and still leave some better off (the Kaldor potential compensation test); or (2) whether it is possible for the "losers" to bribe the "winners" to forgo the proposed policy change (the Hicks potential compensation test) (Freeman 1993, 60).

2.5. Organizational-level Institutions

The laws governing National Forests require that the USFS manage multiple outputs of these lands. Since market, pure public, and impure public goods are acceptable forest outputs, the USFS has the especially difficult task of deciding among alternative bundles of goods and services (both market and nonmarket) that benefit society the greatest. To meet regulatory requirements, the USFS must account for both market and nonmarket environmental values.

This section reviews three possible reasons why the USFS proposes to restrict the use and placement of fixed climbing anchors in wilderness areas. These include: (1) a new land management philosophy held by the USFS called "ecosystem management"; (2) recent public scrutiny of USFS management practices of wilderness areas; and (3) uncertainties about the potential damages caused to resources by the expected high growth in outdoor rock climbing. The first reason can be described as new or improved knowledge about scarcities, and thus underscore a possible conflict with reason (3), while reasons (2) and (3) represent changes in competing consumer demands.

2.5.1. USFS Management Objectives for Wilderness Areas

As outlined by Sedjo (1999), the USFS management objectives for National Forests have gone through a number of stages. Prior to the post-World World II period, the USFS acted as custodian of National Forests. By the post-war period, the USFS became an active producer of forests. By the 1960s, a flood of legislation evolved, and the role of the USFS changed from producers to managerial consultants (Sedjo 1999).

In the introduction of the 1998 Report of the Forest Service, the USFS states that its latest operating philosophy is “ecosystem management” (USFS 1999):

> The agency takes an ecological approach to the implementation of multiple-use management …. The Forest Service has embraced ecosystem management as its operating philosophy and is committed to the preservation of wilderness ….

The specific goal of ecosystem management is to restore and maintain the sustainability of ecosystems while also maintaining other forest uses (Dombeck 1998). This operating philosophy may represent a change in an informal (i.e., no formal policy initiative) institutional arrangement at the organizational level, and thus, may change "rules of the game."

According to the USFS Objective 1.7 in the 1998 Report of the Forest Service, the USFS believes that wilderness preservation is key to ensuring ecosystems, and that increasing use of wilderness areas may harm biological and social benefits (USFS 1999). The USFS is explicitly recognizing a possible conflict between use and preservation. Given this conflict, the USFS states that it will assess different wilderness policy and management alternatives (USFS 1999).

Landres et al. (1998) attribute public and congressional scrutiny of USFS wilderness management as another possible reason why the USFS is devoting more attention to wilderness areas. Consequently, Landres et al. (1998) suggest that the USFS will manage National Forests differently than wilderness areas (Landres et al. 1998).[17] This management practice is referred to by Landres et al. (1998) as the "wilderness separate" approach to distinguish it from the "wilderness similar" approach.[18] Wilderness similar is interpreted to mean that public land agencies manage wilderness and other lands under their care similarly (Landres et al. 1998). It appears that the USFS will administer wilderness areas in strict accordance with the WA given ecosystem and wilderness separate management objectives.

Two WA clauses—to preserve wilderness character for current and future use, and to prohibit structures or installations in wilderness areas—are the basis of the USFS climbing access proposal. As stated by Darrel Kenops, the reviewing officer in Washington, D.C., fixed anchors are installations, which interfere with wilderness character:

> The Wilderness Act prohibits the use of installations 'except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act...' [ellipsis in original] It is our *opinion* [italics added] that fixed anchors qualify as installations and are not necessary to meet minimum requirements for the administration of the area for the purpose of the Act. (Achey 1998, 140)

Liz Close of the USFS Washington D.C. office further claims that the USFS has had this interpretation since 1990 (Achey 1998).

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[17] Landres et al. (1998) argue that by responding to congressional pressures, the USFS would be able to secure congressional funding for wilderness areas, thus giving the USFS incentive to respond to Congress.
[18] The USFS and the Bureau of Land Management follow the wilderness separate approach while the NPS and the Fish and Wildlife Service follow a "wilderness similar" approach (Landres et al. 1998).

2.5.2. Impacts on Resources Caused by Rock Climbing

Another possible reason the USFS wants to prohibit the use and placement of fixed climbing anchors and protection in wilderness areas is because the growth of climbing and the impacts on resources caused by climbing remain uncertain. For example, in one case the USFS claims that fixed anchors may damage rocks and affect cliff dwelling birds, moss and lichen, and other flora and fauna (Access Fund 1998c). As a point of irony, in a report on the results from the 1994-95 National Survey on Recreation and the Environment (NSRE) conducted by the USFS, Cordell et al. (1997) state that climbing is generally not damaging to resources. As argued by climbers, anchors are virtually unnoticeable and new anchors are rarely placed, thus fixed anchors pose minimal disturbance on resources (Access Fund 1998c). Conversely, recent evidence may suggest otherwise. Krajick (1999) argues that climbing reduces plant cover and drives off birds.[19] For example, in a study by Camp and Knight (1998), cliff plant communities are sampled and compared on the basis of climbing activity at Joshua Tree National Park, California. They find that plant species richness is lower on cliff faces and at the base of cliffs with increases in climbing activity. Kelly and Larson (1997) also show that living tree densities on cliff faces at the Niagara Escarpment in Canada are lower in climbed areas.

[19] However, *Science Magazine* received several letters following Krajick's article published in *Science Magazine*. These letters argued that land managers have established climbing policies to protect sensitive cliff dwellings, and that less than one percent of Joshua Tree, referred to in Krajick's article, is climbed.

Thus, there is considerable uncertainty about climbing impacts. Ostrom (1990, 208) argues that:

> Instead of viewing decisions about changes in rules as mechanical calculation processes, a better theoretical stance is to view institutional choices as processes of making informed judgments about uncertain benefits and costs.

This statement suggests that uncertainties about conflicts that climbing may create with other wilderness values, such as ecosystem preservation, may be the basis of the proposed rationing policy for rock climbing in wilderness areas.

Camp and Knight (1998), and Kelly and Larson (1997) argue that climbing policies should be developed to minimize harmful effects of climbing on cliff resources. The 1998 rationing response proposed by the USFS is to restrict climbing access by making use or placement of fixed climbing anchors illegal. By relying on the principle of "no installations", the USFS is comparing climbing safety anchors to roads, motor vehicles, dams, motorboats, and aircraft.[20] Fixed anchors may be an imprint of man's work, but relative to other installations, they are largely unnoticeable, and historically, neither federal land managers nor Congress have considered the use of climbing safety anchors to be antithetical or damaging to wilderness resources (Access Fund 1998a). Further, several environmental organizations, such as the Sierra Club, do not interpret the WA to prohibit fixed anchors (Access Fund 1998a; Sierra Club 1995).[21] An explanation for this change in interpretation of the WA may be that the USFS is responding to

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[20] Typically, climbing anchors are a piece of steel 3/8 " wide by 3" long or a small loop of nylon 1" wide.

[21] The Sierra Club Policy Fixed Anchors in Wilderness was adopted by the Board of Directors on November 5-6, 1977 and was amended in 1995. The policy specifically states; "Climbing is an appropriate use of wilderness. Fixed anchors may be used, but shall be subject to limitations ..."

potential high growth of climbing, which may mean that fixed climbing anchors are no longer "virtually unnoticeable."

2.6. Operational-level Activities

Policy level institutions, such as the MUSYA and the WA, and organizational level institutional arrangements, such as how the USFS implements these policies, define the scope of individual behavior and choice sets in wilderness areas. The purpose of this section is to highlight some rock climbing activities that are or may be occurring in wilderness areas by: (1) estimating the number of U.S. citizens participating in rock climbing using data from a national telephone survey and a probit model of the probability of participating in rock climbing; (2) linking climbing activities that exist today in wilderness areas to provisions in the WA (recalling that institutions frame behavior); and (3) reviewing institutional transactions used by climbers and climber advocacy groups to influence institutional arrangements.

2.6.1. Rock Climbing Participation

Rock climbing has existed on public lands since the beginning of the 20^{th} century, and has been recognized as one of the oldest uses of wilderness lands (Access Fund 1997). During the earliest days of climbing, climbers would ascend a route and remove their climbing protection, such as small metal pitons (generally 3/8" in width by 3" in length), and in some cases they would place fixed protection to descend climbing routes safely. Similar climbing practices exist today, especially in wilderness areas since climbers tend to follow “Leave No Trace” principles and practices (Access Fund 1998c). However, if the USFS implements their proposal, which prohibits the use or placement of fixed climbing protection in wilderness areas, a large number of historic climbs will no longer be accessible (Access Fund 1998a). The overriding concern of the USFS is that the growth in climbing causes a conflict with other wilderness values.

During 1994 and 1995, the USFS conducted its periodic National Survey on Recreation and the Environment (NSRE), as part of the RPA Assessment, to study current demand for and trends in recreational activities on USFS lands. Since the last NSRE conducted in 1982, the USFS found that non-consumptive recreational activities (e.g., hiking) were rising while consumptive activities (e.g., fishing) were declining. According to the results from the NSRE, approximately 7 million U.S. citizens (age 15 or older) went rock climbing (3.7% of the national population), and 9.5 million went mountain climbing (4.5% of the national population) in 1994 and 1995. The survey was not able to determine growth in climbing because climbing was not included in the 1982 survey. However, in 1993 the National Park Service (NPS) claimed that growth in rock climbing was causing greater impacts on park resources (58 FR 32878-80); and in 1995 it was estimated that approximately 100,000 U.S. citizens try climbing each year (*Economist* 1995).

To help quantify the potential number of rock climbers in the U.S., a question about rock climbing participation was included in a 1998 national telephone survey. The random digit-dialed survey of more than 1000 households was conducted by the Survey Research Center of the Institute for Public Policy (IPP) at the University of New Mexico. The specific question of interest read:

> "Have you ever participated in outdoor technical rock climbing that required ropes and rock climbing protective gear, or outdoor bouldering that required crashpads and spotters?"

This question was answered yes by 9.7% of the respondents. Given a 1998 population estimate of 270 million from the U.S. Census Bureau, this indicates that by 1998 approximately 25 million U.S. citizens had participated in outdoor rock climbing or bouldering.

Table 2–1 compares participant frequency distributions from the NSRE, the IPP survey, and the 1990 U.S. census. The sample sizes vary considerably across the NSRE and the IPP surveys, but for the most part, participant demographics are similar. The striking difference between the two surveys is the difference in rock climbing participation estimates. In order to infer any conclusions about climbing trends based on the IPP survey, a comparison of survey results is used to determine whether rock climbing participation is explained similarly across both surveys.

Table 2-1. Comparison of Participant Frequency Distributions from the NSRE, the IPP Survey, and the 1990 U.S. Census

	IPP Proportion of Sample[a]	NSRE Proportion of Sample[b]	Census Proportion of Sample[c]
Age			
18-24	10	15[d]	9[e]
25-29	11	9	10
30-39	22	24	23
40-49	22	20	21
50-59	15	13	14
>60	20	20	23
Race			
Hispanic	5	NA	11
Caucasian	55[f]	85	82
African-American	6	6	12
American Indian	2	1	1
Asian	2	2	4
Other	30[f]	6	-
Gender			
Female	58	58	52
Male	42	42	48

[a] Based on 1084 random-digit dialed household phone interviews with Americans above the age of 18.
[b] Based on approximately 17216 random-digit dialed household phone interviews with Americans above the age of 15.
[c] 1997 populations estimates from the 1990 U.S. Bureau of the Census Current Population Reports. Listed estimates are for individuals above age 20.
[d] This figure represents citizens age 15 to 24.
[e] This figure represents citizens age 20 to 24.
[f] According to the IPP, 90% of individuals classified as other would likely be classified as Caucasian, yet are classified as other because of verbatim responses, such as “just white.” This adjustment would increase Caucasian to 82%.

A probit regression is used on the IPP data to explain 1998 participation. Explanatory variables are presented in Table 2–2. Climbing participation (CLIMBER) is specified as a function of age, sex, environmental membership, number of members in a household, income and education.[22] Results are presented in Table 2–3. As one might expect, men are more likely than women to be climbers. In addition, the probability of participation rises with increases in education and with environmental membership. On the other hand, the number of members in a household and age of an individual are inversely related with participation, while income has no effect on participation. These findings are similar to the NSRE results.

[22] Given the binary observed variable, CLIMBER (1=yes; 0=no), the probability of having participated in rock climbing or bouldering is given by Prob(CLIMBER=1) = Prob($\varepsilon_i > -\beta' x_i$), which equals $1 - F(-\beta' x_i)$. The probability of not having participated in rock climbing or bouldering is given by Prob(CLIMBER=0) = $F(-\beta' x_i)$. The vector x includes the explanatory variables: AGE, MALE, ENVIRON, HH, INC2 through INC11, HSGRAD, VOCAT, SOMECOLL, COLLGRAD, and POSTGRAD for individual i; β is the vector of parameters to be estimated; and F is the cumulative distribution function (CDF) for the random error, ε. The probit model emerges from the normal CDF with mean 0 and variance σ^2 (Maddala 1983, 22). The likelihood function is $L = \prod_{CLIMBER=0} F(-\beta' x_i) \prod_{CLIMBER=1} \left[1 - F(-\beta' x_i)\right]$.

Table 2-2. Variable Definition and Descriptive Statistics for Rock Climbing Participation — IPP National Telephone Survey[a]

Variable Name	Description	Mean[b]
AGE	The age, scaled by 100, in years of respondent	0.448
MALE	Dummy variable — 1 indicates the person is male, 0 otherwise	0.422
ENVIRON	Dummy variable — 1 indicates whether the person is a member of any environmental organizations, 0 otherwise	0.073
HH	The number of household members, scaled by 10, in the respondent's household	0.282
INC1	Dummy variable — 1 indicates a person's income level is less than $10,000, 0 otherwise	0.040
INC2	Dummy variable — 1 indicates a person's income level is 10,000-20,000, 0 otherwise	0.084
INC3	Dummy variable — 1 indicates a person's income level is 20,000-30,000, 0 otherwise	0.133
INC4	Dummy variable — 1 indicates a person's income level is 30,000-40,000, 0 otherwise	0.107
INC5	Dummy variable — 1 indicates a person's income level is 40,000-50,000, 0 otherwise	0.268
INC6	Dummy variable — 1 indicates a person's income level is 50,000-60,000, 0 otherwise	0.108
INC7	Dummy variable — 1 indicates a person's income level is 60,000-70,000, 0 otherwise	0.072
INC8	Dummy variable — 1 indicates a person's income level is 70,000-80,000, 0 otherwise	0.050
INC9	Dummy variable — 1 indicates a person's income level is 80,000-90,000, 0 otherwise	0.035
INC10	Dummy variable — 1 indicates a person's income level is 90,000-100,000, 0 otherwise	0.030
INC11	Dummy variable — 1 indicates a person's income level is greater than 100,000, 0 otherwise	0.075
ELEM_HS	Dummy variable — 1 indicates a person's education level is elementary to some high school, 0 otherwise	0.070
HSGRAD	Dummy variable — 1 indicates a person's education level is high school graduate, 0 otherwise	0.292
VOCAT	Dummy variable — 1 indicates a person's education level is vocational or trade, 0 otherwise	0.025
SOMECOLL	Dummy variable — 1 indicates a person's education level is some college, 0 otherwise	0.270
COLLGRAD	Dummy variable — 1 indicates a person's educational level is college graduate, 0 otherwise	0.238
POSTGRAD	Dummy variable — 1 indicates a person's education level is post graduate work, 0 otherwise	0.105

[a] Dependent variable is CLIMBER, where CLIMBER equals 1 if the respondent has ever participated in outdoor technical rock climbing or bouldering.
[b] The number of observations is 1084.

Table 2-3. Probit Regression Results on Climber Participation[a, b]

Probit Model			
Variable	Coefficient[c]	Variable	Coefficient[c]
Constant	–1.068 (–2.304)[d]		
AGE	–2.476***[e] (–5.491)	INC7	0.104 (0.272)
MALE	0.520*** (4.476)	INC8	–0.076 (–0.181)
ENVIRON	0.737*** (4.206)	INC9	0.042 (0.095)
HH	0.187 (0.548)	INC10	0.470 (1.121)
INC2	–0.387 (–0.922)	INC11	–0.119 (–0.306)
INC3	–0.069 (–0.188)	HSGRAD	0.187 (0.548)
INC4	0.233 (0.643)	VOCAT	0.343 (0.691)
INC5	0.005 (0.014)	SOMECOLL	0.502* (1.505)
INC6	–0.056 (–0.153)	COLLGRAD	0.496* (1.473)
INC7	0.104 (0.272)	POSTGRAD	0.634** (1.763)
Total Log-likelihood		–298.725	
McFadden R^2		0.134	

[a] Dependent variable is CLIMBER
[b] The number of observations is 1084.
[c] Estimated coefficient for scaled variables.
[d] Numbers in parentheses represent t–statistics.
[e] *, **, *** represent significance at the 0.10, 0.05, and 0.01 levels, respectively.

The NSRE results find that younger, higher educated individuals, and men are more likely to participate in adventure activities.[23] Contrary to the IPP survey results, however, the NSRE finds a positive relationship between 1994-95 participation and income (until income reaches approximately $75,000), and participation and number of people in a household. An explanation for why participation is positively related with household size may be due to the broad spectrum of activities defined by the USFS as adventure activities. Several activities included in this category, such as hiking or orienteering, can be done as a family outing. By comparison, one, two, or sometimes three people generally engage in climbing activities.

There are several things to note about the IPP and the NSRE survey results. As a cautionary note, the differences in rock climbing participation between the two surveys may be attributable to the questions asked. In the NSRE, respondents were asked about 1994-1995 rock climbing participation; in the IPP survey, respondents were asked if they have *ever* participated in outdoor rock climbing or bouldering. Nonetheless, what is clear is that the NSRE predicts *annual* U.S. climbing participation to be 7 million individuals, while the IPP results indicate that *potential* U.S. climbing participation could be as high as 25 million. What can we infer from this evidence? It is likely that the USFS (and other public land agencies) will continue to address increasing climbing activities and issues.

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[23] Empirical results were not explicitly reported in the NSRE results. The report just summarized results. Adventure activities include hiking, backpacking, horseback riding, orienteering, mountain climbing, rock climbing, caving, and off-road driving.

2.6.2. Institutional Arrangements and Rock Climbing in Wilderness Areas

Policy and organizational level institutional arrangements for wilderness areas define individual choice sets in these areas, and in part, will frame behavior. For example, the WA specifically emphasizes that wilderness areas should provide for an unconfined, primitive type of recreation. Further, the WA states that the "…continuation of aircraft or motorboat use are allowed because these activities have already become established" (P.L. 88-577 § 4). Climbing and the use of fixed climbing protection have existed in wilderness areas for over sixty years, and many of these areas became wilderness following the effective date of the WA (Access Fund 1997). For example, the Sandia Mountains in New Mexico became a wilderness area in 1980, yet several of the earliest climbing ascents in the Sandias were recorded as early as 1944. Such examples are common.

The USFS is arguing that fixed climbing anchors and protection are installations and are prohibited by the WA. However, as long as these features are used for *safety*, the WA permits these features to exist. Fixed climbing anchors and protection enable climbers to safely ascend and descend climbing routes. These features are similar to manmade trails, trail signs, wooden handrails, bridges, or wooden steps that assist hikers in ascending steep hills or traveling across rivers or canyons. Literally, climbing routes can be considered a vertical hiking trail.

Finally, the WA allows for man's imprint as long as it is substantially unnoticeable. Climbing and the use of fixed protection pose minimal disturbance to wilderness resources and is virtually unnoticeable (Access Fund 1998c). For example, even climbers have a hard time finding anchors (Access Fund 1998a). In addition, climbers will not place new anchors unless a fixed anchor needs replacing for safety reasons or unless climbers ascend a previously unascended route (referred to as a first ascent).[24] However, in order for climbers to climb safely in wilderness areas, they will have had to use the fixed protection provided by other climbers.[25]

2.6.3. Institutional Transactions

As Bromley (1989) and others emphasize, individuals can engage in institutional transactions to influence the policy process. J.R. Commons (1934), an early American economist and institutional theorist, recognizes that institutional change is the process of purposeful behavior.

At the operational level, there are two major organizations, the Access Fund and the American Alpine Club bargaining and negotiating on behalf of climber privileges to recreate on public lands.[26] For example, the Access Fund will help finance trail maintenance or other activities in order to secure climbing access. However, it must be noted that only a small number of climbers belong to these organizations. Climbers, therefore, can also ration climbing behavior by acknowledging voluntary climbing

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[24] In ongoing research at the University of New Mexico, climbers were surveyed about their 1997-98 climbing trips. Climbers indicated that approximately 10% of their trips were taken to U.S. designated wilderness areas.

[25] Often removable climbing protection becomes stuck; thus, stuck protection would be considered fixed protection.

[26] The Access Fund was founded in 1989. In 1999 there were approximately 8775 Access Fund members. The American Alpine Club (a national 501(c) non-profit organization) was founded in 1902. In 1999 there were approximately 5500 American Alpine Club members.

restrictions in recognition of archeologically sensitive areas, spiritual celebrations by other user groups, and specie habitation (e.g., nesting patterns). For example, climbers voluntarily restrict climbing activities at Devil's Tower in Wyoming to recognize tribal spiritual celebrations and to protect nesting raptors.[27]

2.7. Precedent–Setting Implications

An important point in reviewing the policy hierarchy for USFS wilderness areas is that it illustrates a process of institutional change due to a conflict between rock climbing use and other wilderness area values. Given that rock climbing takes place on other public lands (i.e., not just USFS wilderness areas), it is likely that other public land agencies are addressing similar conflicts. The USFS's actions may establish precedent for other agency decisions.

In 1993, the NPS may have been the first agency to respond to climbing activities on public lands. In 1993, the NPS stated:

> While rock climbing has been a long accepted recreational activity in most park areas …. An explosive growth of rock climbing in recent years, along with increased impacts to park resources because of this activity, suggest that regulations and guidelines need to be developed to protect park resources while providing for a quality experience. (58 FR 1993, 32878–80)

The NPS acknowledges climbing as an acceptable, established use of public lands, but is also aware that climbing may cause conflicts with other resource uses.

[27] Jodice, Pyke, and Davidson (1999) argue that over 94 U.S. climbing areas have ecologically-based climbing policies.

Initially, the USFS was not sure what rule to invoke to limit the use and placement of fixed climbing anchors. The original citations included "abandonment of personal property" and "defacing a natural feature" (Achey 1998). Eventually, they decided against writing a new rule, and instead decided to clarify the meaning of the WA. By clarifying the meaning of the WA, the USFS can possibly fight public criticism and gain congressional support. If the USFS is able to establish, via congressional support, that fixed climbing protection and anchors are installations as defined by the WA, they may set precedent for other agencies.

This interpretation of the WA, in regards to fixed climbing protection, by the USFS has not been an isolated case. In 1996, the Bureau of Land Management (BLM) proposed a rule that prohibited the use of permanent fixed climbing protection in BLM wilderness areas (61 FR 1996, 66968-74). However, both the NPS and the BLM decided to postpone final approval of their climbing guidelines until the USFS rulemaking is completed, thus this underscores the possibility of precedent (Access Fund 1999).

On a state level, public agencies have proposed similar climbing access rules. During the spring of 1999, park managers proposed to prohibit new fixed climbing anchors at the Garden of the Gods near Colorado Springs (Access Fund 1999). Further, in September 1998, Texas Parks and Wildlife Department (TPWD) severely restricted open-recreational access at Hueco Tanks State Park due to the growing number of recreational users, especially climbers, visiting the park. Over the years, Hueco Tanks offered multiple benefits to the public including pure (e.g., archeological and geologic resource benefits) and impure public goods (e.g., camping, hiking, climbing), yet only a few of these services are explicitly recognized in Hueco's mission statement:

> The primary mission of Hueco Tanks State Historical Park is to restore, preserve, and interpret the prehistoric, historic, geologic, and natural features of the site. (Hueco Tanks SHP Resource Management Plan Draft 3.2, 19 September 1997)

One explanation for closing open-recreational access at Hueco (other than not being explicitly stated in the mission statement) was because climbing causes damage to Hueco's geologic and archeological resources:

> Park planners with TPWD began to realize, even as they planned for increased recreational use of the site, that conflicts were going to occur between park users and there was a great need to protect the priceless rock art found throughout the park. The place was literally being loved to death by thousands of hikers, climbers, and picnickers. Increasing use by rock climbers from around the world is beginning to impact the park permanently through increased erosion of archeological deposits, broken rocks at popular climbs, epoxy applied to handholds, and perhaps other as yet unrecognized impacts. (Hueco Tanks SHP Resource Management Plan Draft 3.2, 19 September 1997)

The hypothesis is that the response by these agencies, specifically the USFS and TPWD, is guided, in part, by a conflict between rock climbing and ecological or archeological preservation. If other public land agencies are confronted with similar problems caused by increased climbing congestion, it is likely that these agencies will make new institutional arrangements to ration climbing use.

2.8. Standing for Climbers on Public Lands

After fully reviewing the policy process and the hierarchical institutional structure for USFS wilderness areas, the issue of standing for rock climbers can now be addressed more explicitly. Policy level institutional arrangements are used to answer the question of standing; that is, policies define "who counts." For example, Trumbull (1990) writes that all individuals affected by a proposed policy have standing for BCA as long as institutions do not impose any constraints on including them.[28] National Forest policies, such as the MUSYA, the RPA, and the NFMA, may give climbers standing depending on how the USFS interprets these policies. However, if the USFS proposal results in a loss to society in excess of $100 million annually, then standing is affirmed for climbers under EOs 12866 and 12291. That is, the USFS would be restricted in its ability to make regulatory or interpretative changes and would be required to do a full assessment of the benefits of climbing on National Forest wilderness areas.[29]

On the other hand, others may argue that climbers do not have a property right to public lands; therefore standing should be denied. For U.S. public lands, public agencies are responsible for management and allocation decisions. For example, the USFS has a right to exclude or deny access, while individuals have a duty to observe use or access

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[28] Whittington and MacRae (1986) argue that questions of standing depend on support and consensus from society.

[29] As Duffield (1989, 105) notes, "The establishment of economic values of resource outputs (or so-called RPA values) is central to this process in that it allows a comparison of alternative plans on a consistent net present value basis." Estimating values for pure and impure public goods lies in the area of nonmarket valuation.

rules defined by policy and organizational level institutions (Bromley 1989). In static terms, users of National Forests have a privilege, but not a right. The dynamic correlate is that users are vulnerable to agency power (Bromley 1989, 45). However, institutional changes initiated by public agencies are subject to a constraint imposed by EO 12291. A case can be made that given the growth in rock climbing, the economic loss to climbers could indeed exceed $100 million annually. If so, climbers may have standing.

The proposed USFS climbing policy has been congressionally challenged. Congressman Sam Farr (D-CA), a strong supporter of wilderness, argues that the ban on climbing anchors represents "a misguided interpretation of the 1964 Wilderness Act" that is "not in the public interest concerning safety and access." Farr further states that climbing should be preserved as "part of the allure and romance of wilderness" (Farr 1998; see also Access Fund 1998b). On August 14, 1998, Jim Lyons, under Secretary for Natural Resources and Environment for the USDA, suspended the USFS policy banning fixed climbing anchors in wilderness (USDA 1998a), and instructed the USFS to initiate a negotiated rulemaking.

The implication of policy level institutions, as underscored by Congressman Farr, is that climbers have standing. Further, in 1997, in a point of irony, the USDA implicitly gives standing to nontraditional recreational users in its funding for the western regional project W-133 titled "Benefits and Costs of Resource Policies Affecting Public and Private Land." In this report, the USDA states:

> The growth of new outdoor recreation activities has resulted in a wide array of ecological and management problems. Problems associated with "non-traditional" recreation activities such as mountain biking and rock climbing have forced land managers into developing management plans

> for these users (e.g., BLM, 61 (1996) FR 66968-66974). Many of the proposed regulations are likely to result in *economically significant impacts as defined in EO 12866* [italics added], but the economic values of these activities are not well known. (USDA 1997, 2)

Although a difficult task, estimating nonmarket environment values is a widely practiced field, and often has been used by the USFS as part of the RPA Assessment (Duffield 1989). Values for rock climbing access in wilderness areas should be included as part of the policy process.

2.9. Conclusion

Managing the use of wilderness areas is an important national policy issue. These areas confer values to many groups. The purpose of this paper was to explore reasons behind the USFS's change in interpretation of the WA as it applies to climbing fixed anchors and protection, and to determine whether the USFS is restricted in its ability to make this interpretative change. Many would question the USFS's action as being inconsistent with their current wilderness practices. How are climbing anchors prohibited when other installations, such as trails, trail signs, bridges, and outhouses, are permitted in wilderness areas? These features are needed for safety and administrative purposes, and so are permitted under the WA. By prohibiting the use and placement of fixed climbing anchors, the USFS substantially increases the risks to climbers, and somehow this safety requirement is not covered, given the USFS's interpretation, by the WA. If a social norm for consistency exists, would trails, trail signs, and bridges also be prohibited? Yet, if the USFS prohibited the maintenance and use of trails, would the

USFS be acting contrary to the spirit of the WA by not providing a safe, primitive, unconfined type of recreation?

Policy level institutions for National Forest wilderness areas give direction for how the USFS should manage these resources, but leave considerable room for interpretation. For example, the MUSYA declares that National Forests, including wilderness areas, should be managed on a multiple-use basis, yet there is no exact method for following this policy. Without specific decrees, the USFS has the especially difficult task of interpreting vague policy prescriptions to meet the objectives of US Forest management. The USFS's objectives and philosophies may give standing to different classes of users. Thus, user privileges are susceptible to these institutional arrangements.

In this paper, the USFS climbing policy for wilderness areas has been analyzed using Bromley's (1989) view of institutional change. The USFS proposal seems to be in response to three factors: (1) the emergence of an evolving ecosystem philosophy; (2) congressional scrutiny of USFS wilderness management; and (3) uncertainty about climbing impacts. Rules governing National Forests cater to a particular set of tastes and preferences or perceptions about scarcity. When preferences change, for example a change in society's values for wilderness preservation, a new policy rule will evolve. In the case of USFS wilderness areas, interpretative change of the WA reflects the growing concerns for ecosystems and demands for wilderness preservation. Public land managers argue that climbing resources are scarce and are potentially confronted with climbing congestion. This possible congestion represents a conflict with pure public goods, ecosystem or wilderness preservation. As a result, this conflict may lead to a change in institutional arrangements, and such, a proposal has been forwarded by the USFS.

This institutional analysis raises two important issues. The first issue is concerned with how this response by the USFS affects the way other public land agencies interpret the Wilderness Act, or possibly how state public land agencies interpret state wilderness policies. The USFS's actions may lead to far greater consequences for climbers. If other land managing agencies face uncertainties about resource damage or congestion caused by rock climbing, or congressional pressures about wilderness management practices, they too are confronted with a possible conflict in land use, which will likely lead to changes in institutional arrangements. However, the institutional change forwarded by the USFS is constrained by the policy level.

The second and most important implication of this study is determining whether climbers have standing. Policy level institutional arrangements including the MUSYA, the WA, the RPA, the NFMA, the NEPA, and EO 12291, establish the objectives for National Forest management. Under the MUSYA and the WA, climbing is an acceptable use of National Forest wilderness areas; however, these polices are open to interpretative differences. In addition, EO 12291 requires that all federal agencies conduct a benefit-cost analysis on all new major regulations; thus federal agencies are restricted in their ability to make regulatory changes. Together, these policies literally define who counts, and an argument can be made that climbers have standing.

As of today, the USFS has not conducted a BCA, nor have they given climbers standing. Further research, which is beyond the scope of this paper, would determine whether the loss is significant enough to be recognized as an appropriate use under the MUSYA, and whether the loss to climbers would satisfy the $100 million criteria under EOs 12866 and 12291.

3. CHAPTER 3: Valuing the Loss in Access: A National-level Repeated Nested logit Random Utility Model of Rock Climbing.

3.1. Introduction

Public land managers continuously face the challenge of balancing multiple, and often competing, uses of environmental resources. This chapter addresses a recent U.S. Forest Service (USFS) land use debate between rock climbing and wilderness preservation. The rationing response by the USFS is to prohibit the use of fixed climbing protection in wilderness areas. Accordingly, climbers would not be allowed to use or place fixed protective gear for ascending and descending climbing routes safely. The normative implication of this institutional change is that a resource user group (rock climbers) would lose access privileges in wilderness areas. In addition, it should be noted that other federal and state public land agencies, including the National Park Service and the Bureau of Land Management, have proposed similar rules for rock climbing access on public lands.

Changing the USFS's position on rock climbing in wilderness areas requires that a *prima facie* case be made—this requires substantiating sufficient evidence that the USFS proposed policy constitutes a major regulatory change under Executive Orders 12866 and 12291 and imposes significant economic losses on climbers that warrant consideration for benefit-cost analysis (BCA). According to Executive Orders 12866 and 12291, any regulation that is likely to result in an annual effect on the economy of $100 million or more requires a BCA. If losses to climbers resulting from the USFS proposed policy exceed $100 million, the USFS is restricted in its ability to finalize its rule and would be required to conduct a BCA comparing economic losses to climbers with benefits of wilderness preservation.

The objective of this chapter is to determine whether the USFS proposed policy constitutes a major regulatory change. Specifically, this study tests the hypothesis that the annual nonmarket values for the loss of access to wilderness areas by rock climbers exceed $100 million. Welfare losses are estimated using a national-level, repeated-discrete choice random utility model. To implement the modeling strategy, this study uses survey data on trip-taking behavior for 597 climbers (living throughout the U.S.); the data account for 13,000 trips to 60 nationally dispersed climbing areas. Results indicate that the economic losses to climbers exceed $100 million annually, and thus the proposed USFS rule is likely to constitute a major regulatory change. As such, the USFS is required to conduct a BCA prior to finalizing its rock climbing policy for wilderness areas. Further, a scope analysis reveals that economic losses to climbers increase significantly when an increasing number of sites are removed from climbers' choice sets.

3.2. Background on Rock Climbing in the U.S.

Rock climbing has existed on public lands since the beginning of the 20th century, and has been recognized as one of the oldest uses of wilderness lands (Access Fund 1997). During the earliest days of climbing, climbers would ascend a route and remove their climbing protection, such as small metal pitons (generally 3/8" in width by 3" in length), and often they would place fixed protection to descend climbing routes safely. Similar climbing practices exist today, especially in wilderness areas since climbers tend to follow “Leave No Trace” principles and practices (Access Fund 1998a). However, if the USFS implements their proposal, which prohibits the use or placement of fixed climbing protection in wilderness areas, a large number of historic climbs will no longer be accessible (Access Fund 1998b). Further, if other federal public land agencies, such as the National Park Service (NPS), implement a similar rock climbing policy for wilderness areas under their care, then climbers will not be able to climb safely additional historic climbs, such as those on El Capitan in Yosemite National Park.

Today, outdoor rock climbing in the U.S. is concentrated in approximately 50 national public land areas. These areas provide numerous climbs and various types of rock climbing opportunities including traditional rock climbs, sport climbs, and boulder problems. Although all three types of climbing exist in different wilderness areas, traditional climbing is predominant. In addition, traditional climbs are often part of a mountaineering adventure.

In traditional climbing, climbers must be skilled in both climbing and placing removable climbing protective gear. As climbers ascend a climb, they temporarily place protective gear, such as metal camming devices or pitons, and subsequently clip the rope into this gear. Once the climber finishes the route, she will belay a second climber who climbs the route removing the line of gear as she ascends. The climber placing the gear is known as the lead climber, while the climber belaying for the lead climber is typically known as the follower. Traditional climbs may be over 1000 feet high and can take multiple days to complete. To descend, climbers can either rappel from a natural structure, such as a tree trunk, or from fixed protective gear placed previously by other climbers. Sometimes climbers are able to descend by hiking down a trail.

In sport climbing, climbers ascend pre-bolted (i.e., fixed-protective gear) climbing routes rather than placing additional removal-protective gear as in traditional climbing.

Similar to traditional climbing, a lead climber will clip the rope into the protection as she ascends. Sport climbs can range from 30 feet to over 1000 feet. To descend, climbs are lowered by belayers (on shorter routes), rappel from fixed protection, or hike down a trail. In the U.S., traditional and sport climbing ability is based on a climber's ability to lead climbs. The U.S. rating system for fifth class climbs is generally used to identify ability. The fifth class rating system is used for technical climbs that require ropes and protective gear.

Bouldering does not require ropes, climbing protective gear, or knowledge about climbing protection. Strong, agile climbers climb on boulder problems generally not higher than 25 feet. Foam crash pads (approximately three inches thick and nine square feet) and spotters (i.e., other climbers) protect climbers from a fall. Climbers can generally walk off the back of boulders to descend. The grades used to identify the difficulty of boulder problems are often based or converted to the U.S. fifth class rating system for technical climbs.

While rock climbing on public lands has existed for many years, it is perceived that the demand for outdoor rock climbing on federal and state public lands has been growing rapidly. In 1995, it was estimated that 100,000 people try rock climbing each year in the U.S. (*Economist* 1995). Based on results from the National Survey of Recreation and the Environment (NSRE) conducted by the USFS, *annual* rock climbing and mountain climbing participation in 1994-1995 was predicted to be 7 million and 9.5 million U.S. citizens, respectively (Cordell et al. 1997). By comparison, based on a national telephone survey conducted by the Institute for Public Policy (IPP) at the University of New Mexico in 1998, it was predicted that the *potential* number of rock climbers in the U.S. may be as high as 25 million.[30] Given its estimated growth and concentration on public lands, rock climbing has become a highly visible public land management issue.

Climbing areas on public lands are likely to become increasingly congested. Consequently, the rationing response by some state and federal public land agencies has been to propose rules restricting climbing access. For example, on a state level, Texas Parks and Wildlife Department severely restricted open-recreational access at Hueco Tanks State Park, a prominent bouldering destination, due to the growing number of rock climbers visiting the park. On a federal level, the National Park Service (NPS) has stated that "the increased impacts to park resources because of this activity suggest that regulations and guidelines need to be developed to protect park resources" (58 FR 1993, 32878-80). Additionally, in 1996 the Bureau of Land Management (BLM) announced a decision to prohibit the use of fixed climbing anchors in BLM wilderness areas (61 FR 1996, 66968-74). And in 1998, the USFS announced its policy prohibiting the use or placement of fixed climbing anchors in USFS wilderness areas (USDA 1998b). Both the BLM and the USFS proposals essentially make it impossible for climbers to safely ascend and descend any climbing routes in wilderness areas. Consequently, climbers would lose access privileges in unique wilderness areas. However, as of August 1998, the USFS was required to initiate a negotiated rulemaking. In addition, it should be noted that as of this writing, both the NPS and the BLM have postponed final approval of new

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[30] IPP survey respondents (1084 random-digit dialed telephone respondents) were asked whether they had *ever* participated in outdoor technical rock climbing or bouldering; whereas NSRE respondents (17216 random-digit dialed telephone respondents) were asked about *annual* climbing participation.

climbing guidelines until the USFS rulemaking has been completed (Access Fund 1999). Thus, this underscores the possibility that the USFS rock climbing policy will set precedent.

3.3. Background on the Random Utility Model

Random utility models (RUM) are commonly used to model choice among a set of alternatives. For example, an individual may choose a recreation site from a number of alternative site choices. A logit model can be used to estimate the probability that an individual will visit site j out of K possible sites. Site j is chosen if site j yields the greatest level of utility to the individual.

Typically, the RUM is used to value changes in site characteristics, such as fish catch rates or hunt bag limits. For example, Morey, Rowe, and Watson (1993) use a special case of a RUM, a repeated-discrete choice model, to derive consumer surplus measures for different levels of salmon availability in the Penobscot River in New England. Needelman and Kealy (1995) use a RUM to estimate recreational swimming benefits resulting from controlling point and nonpoint pollution in New Hampshire's lakes. A RUM is also used by Jakus et al. (1997) to derive consumer economic losses associated with fish consumption advisories (i.e., warnings about water quality at a resource) at fishing sites in two Tennessee regions. Less commonly, a RUM can also be used to value economic losses associated with loss in access to a site (Lin, Adams, and Berrens 1996; and Parsons and Kealy 1995). This study uses a RUM to estimate the welfare losses to climbers associated with loss in climbing access to several USFS wilderness areas.

The standard site choice RUM assumes that on a given trip occasion an individual i chooses site j by maximizing utility:

(1) $$U_{ij} > U_{ik} \ \forall j \neq k.$$

The utility associated with each alternative is divided into a systematic component and random component. The utility associated with individual i choosing site j is

(2) $$U_{ij} = V_{ij} + \varepsilon_{ij} \,,$$

where V_{ij} is the systematic component of utility measurable by the researcher. Generally, it is assumed that the systematic component of utility is specified as a linear function of its parameters:

(3) $$V_{ij} = \beta_0 + \beta_1 \left(Y_i - p_{ij}\right) + \beta_2 q_{ij} \,,$$

where Y_{ij} is the income available to individual i, p_{ij} is the price (travel costs) for individual i to site j, and q_{ij} is the quality level of site j perceived by individual i. The β coefficients are the parameters to be estimated, where β_1 is the marginal utility of income, which is assumed constant in this study.[31] A common assumption of this model is that the errors, ε, are independently and identically distributed as type I extreme value (Weibull) variates, resulting in the multinomial logit (MNL) model:

(4) $$\pi_{ij} = \frac{\exp\left[V_{ij}\left(Y_i - p_{ij}, q_{ij}\right)\right]}{\sum_{j}^{K} \exp\left[V_{ij}\left(Y_i - p_{ij}, q_{ij}\right)\right]} \,,$$

[31] By assuming constant marginal utility of income, the Marshallian consumer surplus, the equivalent variation, and the compensating variation will be equal. When marginal utility of income is not constant the issue of standing plays an important empirical role in deciding whether an individual has a property right to a pre-policy level of utility or to a post-policy level of utility.

where π_{ij} is the probability that person i selects site j, conditional on deciding to recreate. The associate log-likelihood function maximized across N individuals and K sites is

(5) $$\ln L = \sum_{i}^{N} \sum_{j}^{K} d_{ij} \ln \pi_{ij} ,$$

where d_{ij} equals one if alternative j is chosen by individual i.

The standard site choice model has several weaknesses. The first shortcoming of the MNL model is the implicit assumption of independence of irrelevant alternatives (IIA). IIA maintains that the relative odds of choosing any combination of alternatives remain constant regardless of changes that may occur in the remainder of the choice set. This may be a very restrictive assumption when there are obvious patterns of substitution or complementary choices.

Second, the model does not include alternative activities as part of the choice set or decision process. This means that choosing to participate in an alternative activity is not included as the $K + 1$ alternative.

The third drawback of the site choice RUM is that it yields per trip consumer welfare change measures only (for example see, Bockstael, Hanemann, and Strand 1984; and Carson, Hanemann, and Wegge 1987). To get a seasonal welfare change measure, the per trip measure is multiplied by a predicted number of seasonal trips (Lin, Adams, and Berrens 1996). As a cautionary note, seasonal trip predictions, provided by a separate source, may not be derived from a model of utility maximization that is consistent with the site choice RUM. Accordingly, multiplying these seasonal predictions by the per trip welfare change measure would yield inconsistent seasonal welfare estimates (Morey, Shaw, and Rowe 1991). There are instances, however, when the predicted number of trips and the per trip welfare change measure are obtained from the same utility theoretic standard site choice RUM, yet the issue remains as to determining the appropriate trip prediction to use (Morey, Shaw, and Rowe 1991). Should analysts use predictions based on the current or proposed state? If an improvement in site quality results in a significant increase in total trip predictions, then multiplying the per trip surplus measure by trip predictions from the initial state will cause a downward bias in the seasonal prediction.

These three issues—the implicit assumption of IIA, modeling the participation decision, and obtaining consistent seasonal welfare predictions—can be addressed by employing a repeated-nested MNL (RNL) model, also known as the repeated-discrete choice (RDC) model (Morey, Rowe, and Watson 1993).

When there is a general pattern of dependence among sites, a nested MNL model avoids the assumption of IIA between elements of different groupings. In designing a nested MNL model, similar elemental alternatives are grouped together. This allows for different correlation patterns between groups than within groups. Statistically, this means that knowing the random error component, ε, for one alternative within a group reveals something about the random error component for another alternative within the same group. For example, Bockstael, Hanemann, and Strand (1984) use a nested model to group beach alternatives as either freshwater or saltwater beaches. All freshwater beach alternatives may be better substitutes for one another than would a saltwater beach alternative. Estimation of the nested MNL model will reveal whether alternatives are similar.

The nested MNL model can be derived if the random errors, ε, are drawn from a Generalized Extreme Value (GEV) model for stochastic utility maximization (McFadden 1978). For the GEV model, let $G(\cdot)$ be a function with the following properties. The function $G(\cdot)$ is non-negative, homogenous of degree μ >0, and defined for non-negative arguments. When any one of the j^{th} arguments of $G(\cdot)$ approaches positive infinity, $G(\cdot)$ will approach positive infinity, and the m^{th} partial derivative with respect to j distinct arguments will be non-negative for odd m and negative for even m (Ben-Akiva and Lerman 1985, 305). The cumulative distribution function is given by

(6) $$F(\varepsilon_{i1}, \varepsilon_{i2},\ldots, \varepsilon_{iK}) = \exp\{-G[\exp(-\varepsilon_{i1}), \exp(-\varepsilon_{i2}),\ldots, \exp(-\varepsilon_{iK})]\}.$$

If $U_{ij} = V_{ij} + \varepsilon_{ij}$ and the alternative with the highest utility is chosen, (6) implies the choice probabilities take the form

(7) $$P_{ij} = \frac{\exp(V_{ij})G_j\left[\exp(V_{i1}),\exp(V_{i2}),\ldots,\exp(V_{ik})\right]}{\mu G\left[\exp(V_{i1}),\exp(V_{i2}),\ldots,\exp(V_{ik})\right]},$$

where i and j are defined as in (1), and G_j is the derivative of $G(\cdot)$ with respect to its j^{th} argument.

Consider the following two-nest $G(\cdot)$ function with two scale parameters, μ_r and μ_s, and where the site choice set (1, …, K) is partitioned into R nonoverlapping sets $\mathbf{D}_r$, r = 1,…, R.

(8) $$G(\cdot) = \sum_{r=1}^{R}\left(\sum_{j\in D_r}\exp(\mu_s V_j)^{\mu_r/\mu_s}\right),$$

where the subscript i has been dropped for simplicity. The scale parameter μ_s measures the degree of similarity among all sites, while μ_r measures the degree of similarity among the nonoverlapping sets, for example regions.[32]

To satisfy the GEV conditions for utility maximization, the scale parameters must be greater than zero, and μ_r/μ_s must be less than or equal to one. Substituting (8) into (7) gives the following nested model with the probability of choosing the j^{th} site in region r as

(9) $$P_{rj} = \frac{\exp(\mu_s V_j)}{\exp(IV_r)} \cdot \frac{\exp\left(\frac{\mu_r}{\mu_s} IV_r\right)}{\sum_{r=1}^{R} \exp\left(\frac{\mu_r}{\mu_s} IV_r\right)}.$$

where the inclusive value for region r, IV_r, is defined as

(10) $$IV_r = \ln \sum_{j \in \mathbf{D}_r} \exp(\mu_s V_j).$$

Ben-Akiva and Lerman (1985, p. 282) define the IV as the systematic component of the expected maximum utility of a subset of alternatives. Thus, the IV for region r summarizes the attractiveness of region r experienced by individual i (Hausman, Leonard, and McFadden 1995). Equation (9) can be written as the product of two terms: the chance of choosing the j^{th} alternative given region r is chosen,

(11) $$P_{j|r} = \frac{\exp(\mu_s V_j)}{\exp(IV_r)},$$

and the probability of choosing region r,

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[32] It is common to normalize one of the scale parameters to one (Ben-Akiva and Lerman 1985, 287).

(12)
$$P_r = \frac{\exp\left(\frac{\mu_r}{\mu_s} IV_r\right)}{\sum_{r=1}^{R} \exp\left(\frac{\mu_r}{\mu_s} IV_r\right)}.$$

The scale parameters identify the statistical distribution of the nested logit model. If the parameter estimate on the *IV*, μ_r/μ_s, is less than one, then the nested logit structure captures group similarities; thus, this structure would be preferred to the standard site choice RUM.[33] In the case where the scale parameters are equal, $\mu_r = \mu_s$, the nested model collapses to a MNL site choice model in which IIA holds across and between elements of different groupings (Ben-Akiva and Lerman 1985, 310).

The GEV model can be extended to multiple subgroups by allowing additional correlation terms. Recall one shortcoming of the standard site choice RUM is that the model estimates welfare measures for a single recreational trip. In order to model seasonal participation, the RDC model of Morey, Rowe, and Watson (1993) can be used to estimate utility-theoretic seasonal welfare measures. The repeated nature of the model adds an additional "participation" nest, which repeatedly captures the decision to participate on numerous choice occasions. For example, on each choice occasion an individual faces the decision of going to a beach. After deciding to visit a beach, an individual then selects a specific beach site. If the individual decides not to go to a beach, then this individual reveals that they receive a greater amount of utility from an alternative activity, *h*. When the participation decision is extended over a season

[33] This is necessary for global consistency. See Herriges and Kling (1996) for the derivation of local conditions that allow the coefficient on the *IV* to be greater than one.

representing multiple trip opportunities, the repeated nature of the model allows the individual to consider participation numerous times.

The RDC (or RNL) model is implemented by calculating the expected maximum utility from the site choice stage, where the probability of individual i choosing site j conditional on deciding to participate, p, on a choice occasion t is

(13) $$\Pr_{j|p} = \frac{\exp\left(V_{ij}(\cdot)\mu_j\right)}{\sum_{j=1}^{K}\exp\left(V_{ij}(\cdot)\mu_j\right)}.$$

The scale parameter, μ_j, measures the degree of correlation among all j through K alternatives. Following from equation (10), the IV is

(14) $$IV_i = \ln\left[\sum_{j=1}^{K}\exp\left(V_{ij}(\cdot)\mu_j\right)\right].$$

On a choice occasion t, a person compares the utility of recreating at site j against the utility associated with an alternative activity h (i.e., the $K + 1$ alternative). The probability of person i choosing to participate on a given choice occasion t is

(15) $$\Pr_{ip} = \frac{\exp\left(\frac{1}{{}_j}IV_i\right)}{\exp\left(\frac{1}{m_j}IV_i\right) + \exp\left(-a'\mathbf{Z}_i\right)},$$

where $\mathbf{Z}_i$ with parameters α is the vector of arguments characterizing the i^{th} person's decision to participate. Subtracting (15) from one yields the probability of not participating,

(16) $$\Pr_{ih} = \frac{\exp(-\alpha'Z)}{\exp\left(\frac{1}{\mu_j}IV_i\right) + \exp\left(-\alpha'Z_i\right)}.$$

The choice probability of an individual i taking a trip on a choice occasion t can be expressed as the product of conditional probabilities,

(17) $$\Pr_{ipj} = \Pr_{j|p} \times \Pr_{ip}.$$

The likelihood function is maximized over all individuals i, choice occasions t, and sites j to obtain parameter estimates β (where by equation (13) β is scaled by μ_j), α, and μ_j:

(18) $$\ln L = \sum_{i}^{N} \sum_{t}^{T} \sum_{j}^{K} Y_{itj} \ln \Pr_{ipj} + \left(1 - Y_{itj}\right) \ln\left(1 - \Pr_{ipj}\right).$$

The term Y_{itj} equals one if a trip is observed, and zero otherwise. The likelihood function simultaneously estimates site choice and participation decisions by full information maximum likelihood (FIML).

The RNL model can be extended to include several decision processes. A recent example of a four-level RNL recreational site choice model is a study by Hoehn et al. (1996). Hoehn et al. (1996) use the following nest structure to model angler decisions about fishing trips in the Great Lakes region. On each choice occasion, anglers decide whether or not to fish. If anglers decide to participate, then it is assumed that anglers decide whether to take a single-day or multiple-day fishing trip. After deciding trip length, anglers choose a type of fishing trip (referred to as the "product line"), such as a warm water lake fishing trip or a cold water river fishing trip. Finally, conditional on a product line, anglers select a site. This study uses a similar strategy to model rock climbers' decisions about rock climbing trips in the U.S.

The RNL model can then be used to estimate the economic losses associated with loss in site access. These losses can be estimated by simulating the removal of site choices from the model. The seasonal loss in consumer surplus (*CS*) is estimated as

(19) $$CS = -\frac{\left(IV_i^0 - IV_i^1\right)}{\beta_1 \mu_j} \times T \; .$$

The superscript 0 refers to the site choice set with unrestricted site access, and the superscript 1 refers to the site choice set with restricted site access. The utility difference (IV_i^0- IV_i^1) is converted to a money metric by dividing the parameter relating to utility to income ($-\beta_1$) (Small and Rosen 1981). The per choice occasion *CS* measure is multiplied by *T*, the number of choice occasions, to get a seasonal measure.

3.4. The National Climbing Model

The RNL modeling approach used in this study is unique for several reasons. First, it is the first study to apply the RNL model to estimate recreation demand on a national scale. Second, it is one of only a few studies (Morey, Rowe, and Watson 1993; Shaw and Ozog 1999) to develop a nested model with three layers. Third, the RNL model is estimated by full information maximum likelihood (FIML).

In this paper, a national-level RNL-RUM is used to test the hypothesis:

H_0: Welfare losses to rock climbers due to the USFS wilderness area climbing proposal are less than $100 million annually.

H_1: Welfare losses to rock climbers due to the USFS wilderness area climbing proposal are greater than or equal to $100 million annually.

Two attractive features of the RNL model are that it can be used to model repeated decisions to participate in outdoor climbing trips over the course of a season and to model climbing site choice among a set of nationally dispersed sites. These two features are important for two primary reasons. First, because the proposed USFS policy will affect more than one site, the modeling strategy must include affected wilderness sites and possible substitute sites. Substitute sites should be included because economic losses that climbers may incur due to the policy change could be partially influenced by increases in demands for substitute sites. The RNL model can then be used to simulate the loss of access to several sites in testing $\mathbf{H_0}$ versus $\mathbf{H_1}$. And second, in order to determine whether the proposed USFS policy is considered a major regulatory change, the model must account for seasonal, in this case annual, demand.

In modeling the site choice decision, however, care must be taken in specifying choice sets to avoid violating the property of IIA. In this study, climbing site choices are grouped by geographic regions. By grouping climbing sites by region, it is assumed that sites located within a specific region are more correlated with one another than they are to sites in alternative regions (Hausman, Leonard, and McFadden 1995). In theory, any number of nests can be formulated.

In summary, the decision process for climbers is assumed to be as follows. During the climbing season with T choice occasions, a climber decides whether to take a climbing trip on a choice occasion t. Conditional on participation, a climber then chooses among several regional climbing areas. Conditional on a region selection, a climber then selects a site.

Using a unique data set with approximately 13,000 recorded single-day and multiple-day climbing trips, the model derives seasonal consumer welfare loss estimates associated with the loss in climbing access to several USFS wilderness areas.[34] The climbing season used in this study begins May 1, 1997 and ends April 30, 1998.

3.4.1. Survey Implementation

The objective of the data collection process was to obtain information about annual climbing trips from a national sample of climbers. The preferred method of data collection would have been to draw a random sample from the general population, but because climbers make up a relatively small proportion of the national population, obtaining a random sample would have been quite expensive. As an alternative, climbers were intercepted at several major U.S. climbing locations and asked if they would participate in a follow-up mail survey on rock climbing access. For this study, three prominent but distinct areas were chosen to intercept climbers: Red Rocks (RR) Canyon National Conservation Area in Nevada, Hueco Tanks Texas State Park (Hueco), and the Obed River Area in Tennessee (Obed).

By using a follow-up survey method, the surveys could be designed in a way that would allow respondents to record trip data from subsequent choice occasions (McFadden 1996). In survey trip diaries, climbers were asked to identify all sites they visited and to record the number of trips taken to each site; thus, for each site a climber did not visit, zero trips were recorded.[35] Climbers also provided details about each trip

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[34] Four site alternatives outside the U.S. were included in the set of site choices: El Potrero Chico outside of Monterey Mexico; Squamish, British Columbia Canada; the Niagara Escarpment, Ontario Canada; and Lionshead, Ontario Canada. As indicated by climbers in their completed surveys, these four areas are reasonable driving distances for many U.S. residents. They are included in the RNL model to model substitution patterns.

[35] The problem of incomplete destination data may not be completely corrected. Collecting data on each trip destination is a demanding requirement for survey respondents that may result in lower response rates, incomplete reporting of trips, or reporting error.

including trip lengths, lodging expenses, and travel expenses. Further, each survey contained a set of identical questions on trip-taking behavior, socioeconomics, and climber experience (see Appendix B for a copy of the Hueco Questionnaire).

In the design stage, numerous climbers and a focus group reviewed the three surveys; approximately 20 climbers screened the Hueco survey and anonymously provided edits, clarifications, and suggestions to include examples for difficult questions. Further, the RR survey was presented to a focus group of climbers at the climbing gym in Reno, Nevada.

The three areas chosen to intercept climbers differ by climbing type, ranging from bouldering to traditional rock climbing, and by seasonal differences. Further, the management of rock climbing access at each of these three areas has been a point of recent controversy between rock climbers and public land stewards.

Red Rocks (RR) National Conservation area (NCA) in Nevada, the first intercept location, is a world famous climbing area known for its traditional rock climbs and as a winter climbing destination.[36] RR is managed by the BLM as a National Conservation Area (NCA) with two significant climbing areas designated as wilderness study areas (WSAs). The two WSAs are managed strictly according to the Wilderness Act of 1964. For example, placement of fixed climbing anchors is prohibited because anchors are considered installations that are prohibited by the Wilderness Act. However, to safely descend most climbs at RR, fixed anchors are used and maintained by climbers. Further,

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[36] Professor Douglass Shaw from the University of Nevada-Reno coordinated the data collection from RR.

in general, many climbing guidelines for the other areas at RR accord with the Wilderness Act, although NCAs are not officially designated wilderness areas.

Climbers' names were also collected from Hueco Tanks Texas State Park (Hueco).[37] Hueco is a world famous climbing destination known for bouldering and as a premier winter climbing destination. Many climbers argue that the only close substitute bouldering area to Hueco is located somewhere in South Africa. (Survey respondents in their response to survey question B13 provided substitute site information.) During the on-site sampling period at Hueco, Texas Parks and Wildlife Department (TPWD) proposed a management plan recommending gradual restrictions in open-recreational access. TPWD believed that Hueco's geologic and archeological resources were threatened by the increased popularity of Hueco as a world class bouldering destination. And indeed, as of September 1, 1998, TPWD closed three of four mountain areas at Hueco to open-recreational access.[38] Consequently, TPWD has eliminated a world recognized bouldering area. It should be noted that survey participants returned completed questionnaires prior to September 1, 1998, prior to the change.

The third intercept location is the Obed river area in Tennessee (Obed).[39] The Obed is a famous eastern sport climbing location and offers climbing during the spring, summer, and fall seasons. The Obed River is managed by the National Park Service (NPS) and is designated a Wild and Scenic River. Allowing fixed protective gear at the

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[37] Therese Cavlovic from the University of New Mexico coordinated the data collection from Hueco.

[38] Some may argue that all four mountain areas were closed to "open" recreational access because in order to access the one remaining open area, recreational users must call in advance and reserve a time for their visit. In some cases, this does not guarantee entrance as park limits access to the one open area to 50 visitors. In addition, all park users must attend an extensive orientation.

[39] Professor Paul Jakus from the University of Tennessee coordinated the data collection from the Obed.

Obed remains an open debate between the NPS and climbers. The NPS intends on developing a climbing management plan for the Obed in accordance with any new NPS climbing regulations (*Rock and Ice* 1994).

The number of climbers intercepted and the response rates vary across the three surveys. A summary of these differences are presented in Table 3–1. The RR survey was sent to 284 climbers with 119 returning a questionnaire and 113 returning a usable questionnaire; thus, representing a 42% response rate and a 40% usable response rate. The relatively low response rate for this survey may have been due to the large lapse in time between when climbers were intercepted, summer 1997, and when the climbers actually received the survey, spring 1998.

Climbers were intercepted at Hueco during the fall and winter of 1997, and the winter and spring of 1998 (see Appendix C for a copy of the on-site participant consent form). The survey was mailed during the spring of 1998. For the Hueco survey, 413 of 750 intercepted climbers (15 of the 750 mailed surveys contained bad addresses) returned a completed questionnaire representing a 54% response rate (a 56% response rate adjusted for bad addresses). Of these 413 climbers, ten were from overseas including eight from Europe, one from Israel, and one from Australia.[40] For the Hueco sampling frame, a follow-up, reminder letter was sent to nonrespondents four weeks after the original survey mailing (see Appendix C for a copy of the reminder letter). In addition, a follow-up survey and reminder letter was mailed to 100 random climbers who had not yet responded.

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[40] Overseas respondents were dropped from the sample.

The Obed survey was mailed to 272 climbers during the spring of 1998 with a reminder postcard sent a week later. Of the 272 mailed, 81 climbers returned a completed questionnaire, while 40 surveys were returned as undeliverable. The unadjusted and adjusted response rates were 30% and 35%, respectively. The low response rate for the Obed survey may have been because the respondents were not personally contacted for participation prior to the survey being mailed. Rather than intercepting climbers at the Obed, members and competition participants of the University of Tennessee Climbing Wall were mailed a survey.

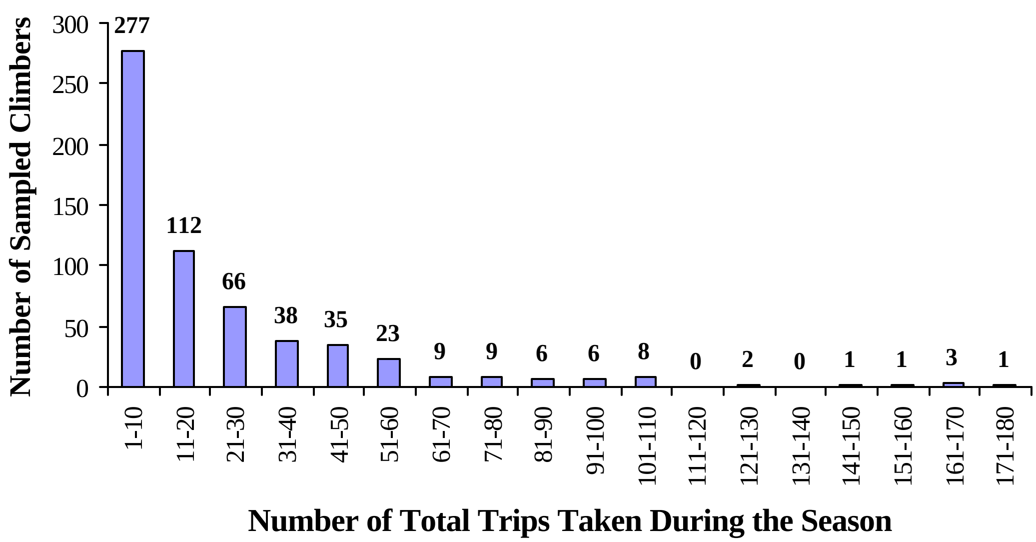
Table 3-1. Summary of Response Rates for the Hueco, RR, and Obed Surveys

Survey	On-site Sampling Period	Date Surveys Mailed	Number of Surveys Mailed	Number of Bad Addresses	Returned Surveys / Usable Surveys	Usuable Response Rate Adjusted for Bad Addresses
RR	Summer 97	Spring 98	284	Not Available	119 / 113	40%
Hueco	Fall 97 – Spring 98	Spring 98	750	15	413 / 403	55%
Obed	Spring 98	Spring 98	272	40	81 / 81	35%

3.4.2. Model Specification

In order to estimate the RNL model, the number of choice occasions *T*, the selection and design of regions, and the mapping of site choices into respective regions must be specified. The climbing season used for this study begins May 1, 1997 and ends April 30, 1998. On average, climbers indicate that during the climbing season they took a climbing trip more than once a week and that each trip lasted approximately 2.1 days. Accordingly, if a climber took a new trip every 2.1 days, they would face 173 choice occasions (365 ÷ 2.1) during the season. If *T* equals 173, only three trips (one individual took 176 trips during the season) would be cut from the data. Since capturing true climber trip-taking behavior is paramount, *T* is set at 176 to capture as high of a percentage of all climber trips.[41] A histogram of total trips is presented in Figure 3–1.

Figure 3-1. Frequency of Total Trips (May 1, 1997 - April 30, 1998)



Because this study uses a regional nest to group sites that are likely to be similar, the second step for model specification is regional mapping. Seasonal similarities may be one way to identify distinct regions. For example, assume a climber from New York is deciding to climb during the winter, they may pick a region conducive to winter climbing, such as Southern California. Conditional on choosing Southern California, the

[41] Lupi (1998) shows that the specification of the number of choice occasions will have little effect on seasonal welfare measures. He argues that changes in the number of choice occasions will be offset by a comparable change in the probability of taking a trip; thus, seasonal welfare measures will remain qualitatively unchanged.

climber then picks a site. This structure assumes that all sites located in Southern California may be closer substitutes for one another than a site in another region.

There may be other possible nesting structures, such as type of climbing area (e.g., bouldering areas versus traditional or sport climbing areas), but geographic nesting is perhaps the most useful for modeling substitution among sites (Hausman, Leonard, and McFadden 1995). Thus, deciding what sites constitute a regional choice set will also depend on the geographic concentration of climbing sites. For example, assume a climber from New York is deciding to take weekend climbing trip. This climber may consider sites located within their resident state and in neighboring states, such as New Hampshire or even Ontario, Canada. By comparison, a climber from Colorado deciding to take a weekend trip may only consider sites located in Colorado. The conjecture is that an avid climber from New York may be willing to drive a further distance for the opportunity to climb than would an avid climber from Colorado.

The selection of region-site combinations reflects these factors—seasonal differences and geographic concentration of sites.[42] Figure 3–2 provides a depiction of the nesting structure, and Table 3–2 explicitly defines region-site combinations (see also Appendix A for a depiction of each regional sub–nest).

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[42] In trip diaries, climbers provided summary data about trips and sites selected, including the seasons they climbed at a site. Generally, climbers listed multiple seasons per site. For example, several climbers from New York indicated that they had taken trips to the Gunks in New York during all four seasons. Consequently, adding a seasonal nest could not be employed to differentiate among sites.

Figure 3-2. The Nested Structure for National Rock Climbing Trips

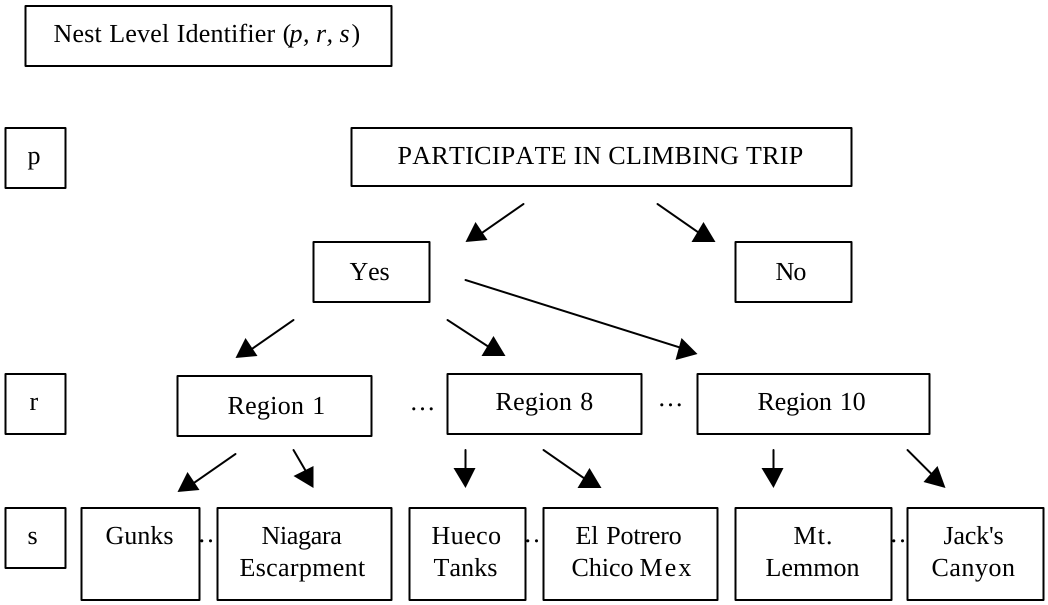

Table 3-2. Sites Organized by Region

Region Number and Name	Sites
Region 1 Northeast	Rumney, NH; North Conway, NH; "The Gunks", NY; and Niagara Escarpment, Ontario, Canada.
Region 2 Southeast	New River Gorge, WV; Red River Gorge, KY; Obed, TN; Seneca Rocks, WV; Tennessee Wall, TN; Foster Falls, TN; Looking Glass, NC; and Linville Gorge, NC.
Region 3 Midwest	Wichita Wildlife Refuge, OK; Robbers Cave, OK; Jackson Falls, IL; Devil's Lake, WI; and Lions Head, Ontario, Canada.
Region 4 Upper Rocky Mountains and Great Plains	Lander (Sinks Canyon and Wild Iris), WY; The Grand Tetons, WY; City of Rocks, ID; Devil's Tower, WY; Vedauwoo, WY; and Black Hills, SD.
Region 5 Colorado	Eldorado Canyon; Boulder Canyon; Rifle; Shelf Road; Estes Park; Horsetooth Reservoir; Penitente; and South Platte including Turkey Rocks.
Region 6 S. California, S. Nevada, and Utah	Red Rocks, NV; Joshua Tree, CA; Tahquitz, CA; Moab, UT; Zion, UT; American Fork, UT; Maple Canyon, UT; and Virgin River Gorge, AZ.
Region 7 N. California, N. Nevada, and Pacific Northwest	Yosemite and Toulomne, CA; Owens River Gorge, CA; Buttermilks, CA; Smith Rock, OR; and Squamish, British Columbia, Canada.
Region 8 Texas, Arkansas, and Mexico	Hueco Tanks, TX; Austin, TX; Enchanted Rock, TX; and El Potrero Chico, Mexico.
Region 9 New Mexico	Enchanted Tower; Los Alamos; El Rito; Box Canyon; The Tunnel; Sandia Mountains; and Questa Dome.
Region 10 Arizona	Jack's Canyon; Queen's Creek; Mt. Lemmon; Cochise Stronghold; and Paradise Forks.

The final stage for specifying the model is defining the choice sets. For identifying substitution patterns and deriving welfare measures, defining choice sets is an important issue, and remains a lively topic, in RUM modeling. The RUM framework maintains that all possible sites are considered by individuals on a choice occasion (Kaoru, Smith, and Liu 1995). This means that all sites have a nonzero probability of being visited, which is not likely true for all individuals. Some individuals never consider some sites. Such being the case, the RUM may overemphasize substitution possibilities and understate the probability of selecting relevant sites (Kaoru, Smith, and

Liu 1995). The practical objective of the national climbing model is to include nationally recognized sites.

The literature suggests several ways to define choice sets. These methods include: (1) using a method of site aggregation (e.g., Kaoru, Smith, and Liu 1995); (2) using the random draw technique (e.g., Parsons and Kealy 1992); (3) using a set of sites known to the researchers; or (4) including only those sites actually visited or considered by individuals (e.g., Peters, Adamowicz, and Boxall 1995). For example, in the latter case an individual would be asked in a survey to define all sites considered on a choice occasion.

Site aggregation involves grouping, for example by county, seemingly homogenous sites and creating a new "composite" site. Site aggregation removes biases associated with overemphasizing substitution possibilities, however, to the extent that not all aggregated sites are homogenous, a new distortion may be introduced in the aggregated site characteristics (Kaoru, Smith, and Liu 1995). Kaoru, Smith, and Liu (1995) investigate site aggregation, and find pronounced differences in welfare estimates for different levels of aggregation. Using the Hausman-McFadden (1984) specification test to evaluate site aggregation, they find support for using the most disaggregate specification.

Parsons and Kealy (1992), and Parsons and Needelman (1992) avoid specifying choice sets by using the random draw technique. They use a random selection of choice sets along with the sites actually visited by an individual. This method permits model estimation, but fails to estimate a correct Hicksian welfare measure since the site choice model does not include all possible alternatives (Kaoru, Smith, and Liu 1995).

Two recent studies have emerged in the literature specifically addressing and empirically testing the choice set definition process. Peters, Adamowicz, and Boxall (1995) consider three alternative choice set definitions. First, they only select sites known to the researcher. Second, they use individually specified choice sets obtained via a survey instrument. Third, they estimate a model using random draw choice sets. Similar to the findings by Kaoru, Smith, and Liu (1995), they find individually defined choice sets yield different parameter and welfare estimates than researcher defined choice sets. To produce a consistent behavioral model and per trip welfare measure, they favor using individually specified choice sets or a set of site alternatives that are considered by all individuals. If, however, an individual faces many site alternatives or takes many trips during a season, recollection of all sites considered could be quite difficult for survey respondents. Thus, this method could possibly present a new information bias problem or increase the probability of nonresponse.

Haab and Hicks (1997) follow-up on the issue of choosing individually defined choice sets of Peters, Adamowicz, and Boxall (1995) by employing an endogenous choice set model. As motivation for their research, they are concerned with the biases resulting in welfare measurement if *unknown* [to the researcher] alternatives are not included in the choice set. They endogenously model the individual's choice set as a subset of site alternatives. The method works by identifying all possible combinations of

S sites. For example, for ten sites there are 1024 different choice sets.[43] Since the researcher cannot be certain of the individual's true choice set, they estimate the probability that a subset is indeed the choice set. An unfortunate shortcoming of this approach is that it becomes unwieldy if the number of sites becomes too large. For example, assume the number of sites increases by only 5 to 15. The number of possible choice sets increases to 32,768. They argue that as the number of alternatives increase, the inclusion or exclusion bias may be reduced. This means that a MNL model with a large number of site alternatives performs comparably to the endogenous choice set model, even if researchers inadvertently omit *unknown* site alternatives.[44]

In all of these studies, the key issue is picking the approach that results in a behaviorally correct model. These issues are especially important for the national climbing model where the objective is to include nationally recognized sites. Deciding to use a national model rather than a regional model is because climbing resources are limited to specific geographic or topographical conditions. For example, climbers living in Florida would have to travel outside their geographic residence for the opportunity to climb outdoors. Since it is likely that climbers consider geographically dispersed alternatives, a model limited by region would not be appropriate. However, there is a

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[43] A simple way to calculate the number of choice sets is given by 2^S. Formally, the number of possible choice sets, *CH*, is given by

$$CH = C_k^S = \sum_{k=0}^{S} c_k^S = \sum_{k=0}^{S} \binom{S}{k} = \sum_{k=0}^{S} \frac{S!}{k!(S-k)!}$$, where *k* refers to the size of a choice set (Ross 1988, 10). For example, assume there are 60 possible sites, the number of possible choices sets will be approximately 1.15292E+18 choice sets!

[44] Some may argue that inadvertent exclusion of choices may be implicitly modeled by the participation decision in a RNL model. What this means is that an individual's utility maximizing site decision for a site omitted from the model gets modeled as participation in the alternative activity *h*.

concern that by including nationally dispersed sites the model will overemphasize site substitution possibilities and understate the probability of choosing relevant sites.

To explore the issue of whether geographically distant sites impact parameter estimates, Parsons and Hauber (1998) estimate a choke distance, beyond which the addition of a distant site does not impact the site choice decision. This means that the introduction of an irrelevant distant site should not change the relative probabilities of choosing among relevant sites. By comparison, however, Parsons and Hauber (1998) find that narrow boundary definitions produce inflated welfare estimates. This issue would likely exist if a climbing site choice model were limited to a regional analysis.[45]

For this study, survey trip diaries were used to elicit information about climbers' choice sets. To aid climbers in recalling their previous twelve-month climbing trips, calendars and dates for extended weekend holidays were provided in the survey. With *a priori* conjectures that climbers frequently take climbing trips, which was confirmed by survey responses (Question A3 in Appendix B), the trip diaries elicited information on actual trips taken rather than asking climbers to additionally recall all sites considered on a choice occasion. As it was, climbers listed well over 100 different national climbing sites, many of which were visited by a single climber only.

Since the objective of the climbing model requires including all major U.S. climbing sites, criteria for site selection avoids aggregation and random draw techniques by drawing on the findings of Peters, Adamowicz, and Boxall (1995), Haab and Hicks (1997), and Parsons and Hauber (1998). All climbing sites included in a region need to

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[45] One shortcoming of the Parsons and Hauber study is that they changed choice sets without changing the number of trips.

reflect some degree of climber consideration. This includes choosing sites that have nonzero probabilities of consideration by all climbers, or at the very least, nonzero probabilities of consideration by climbers living within a site's region. For example, many boulderers from Albuquerque, New Mexico visit a local bouldering area called Big Block. It is unlikely, however, that a climber from New York or even a climber from Las Cruces, New Mexico will consider Big Block as a site alternative. Since the objective of this project is to study national climbing and substitution patterns, Big Block should not be included in the choice set.

A process for site selection is used to identify nationally and regionally recognized sites. Using trip information from the survey trip logs (Question B7 in the questionnaire), climbers indicate that they had visited over 100 identifiable climbing sites, and over 100 unidentifiable climbing sites. The simplest way to begin is by dropping unidentifiable trip locations from the data. For example, a climber may have indicated that they climbed at the Needles without giving any other geographic information. This presents a problem because there are several locations in the U.S. known as the Needles, for example the Needles in Colorado or the Needles of South Dakota. Thus, it is not clear if the climber is referring to the Needles of South Dakota or the Needles in Colorado. Sometimes climbers may list a site that hosts numerous sites. For example, if a climber lists a climbing location like "Arizona" or "Albuquerque areas" they are essentially aggregating several very different sites into a composite site.[46] Trips

[46] Other reasons for unidentifiable sites may be because a climber's handwriting was illegible, or possibly because a climber used a name for a site that differed from what the general climbing population called the site. Attempts to correct for the latter situation were made, however, it is likely the problem may still exist in the data. Also, as indicated in footnote 44, it is possible that decisions to climb at a "dropped" site may be implicitly modeled through the participation decision.

to these composite areas are also dropped. In addition, overseas climbing trips are excluded.[47]

For the remaining identifiable sites, site selection depends on trip frequency and climber-to-trip ratios. The idea is to ensure that the data account for the most frequently visited sites, hopefully including national sites considered by most if not all climbers, such as Hueco Tanks but not Big Block.

Climber-to-trip ratios help identify sites in a region that appear to be considered by most individuals living in that same region. For example, suppose twelve climbers have a choice between two sites, Site A and Site B. Site A is visited ten times by ten climbers, a 1:1 climber-to-trip ratio, while Site B is visited ten times by two climbers, a 1:5 climber-to-trip ratio. In this case, Site A is selected because most climbers would include Site A in their choice set. There could be many reasons why sites have low climber-to-trip ratios. Some possible reasons include the following: (1) a site might be located on private land with very limited access; (2) a site has only a few climbs, yet is walking distance from a climber's home; or (3) possibly a site has only recently become developed and remains a "secret" (i.e., not considered as an alternative) to most climbers (as such, these sites are likely categorized as unidentifiable).

A shortcoming of this approach is that several of the selected sites maintain zero probabilities of consideration by some climbers. By relying on the findings of Parsons and Hauber (1998), this will not be a problem if a site has a zero probability of being considered by a climber living in a region different than the site. To the degree that

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[47] U.S. climbers took approximately 52 trips to sites in Australia, England, France, Germany, Spain, Sweden, and Switzerland.

climbers consider a larger set of sites within their resident region, the nesting structure will emulate these choice differences. Sites chosen for each region hopefully maintain nonzero probabilities of consideration by climbers living within the respective regions. For example, a site like Big Block should be included if most climbers from New Mexico consider it as an alternative.

Sixty sites remain after eliminating sites with insufficient location information, a low number of trips, and low climber-to-trip ratios (i.e., sixty sites were frequently identified by climbers). The total number of trips to these sites is 12,952. These trips account for 85% of all identifiable (including one site in Mexico and 3 sites in Canada) surveyed climber trips.

3.4.3. Explanatory Variables

Explanatory variables used to explain each stage in a climber's decision process are shown in Table 3–3. Starting with the climbing participation decision, a climber decides to participate on a choice occasion if the utility of participation leaves the person at least as well off as nonparticipation. Since the full range of alternative activities with respective utility values are not available, and since economic theory does not give direction for other variables influencing the climbing decision, climber experience and socioeconomic variables are used. For example, years of climbing experience, climber type (e.g., traditional climber, sport climber, or boulderer), and climber ability may proxy climber experience. Climbers with more experience are expected to participate more frequently.

It is conjectured that climbers choose specific climbs or climbing areas that are comparable with their skills. Such being the case, a climber's ability can be determined by the difficulty of climbing routes that climbers choose to climb. In survey questions A14 and A15, climbers identify their climbing ability based on the U.S. rating system for fifth class climbs.[48] Table 3–4 shows the U.S. rating system for fifth class climbs; these values are transformed to a monotonic technical ability scale.

Socioeconomic variables used to describe the decision to participate include gender, income, work flexibility, household size, and number of climbers in a household.[49] Further, following Shaw and Feather (1999), it is conjectured that recreational demand may be conditioned on the amount of time a climber allocates to work (Pollak 1969). For example, assume that over a specified period the following time constraint exists for labor and leisure, T = H + L, where H is work time and L is non-work time. If H is allocated outside the relevant market (i.e., pre-determined), then the amount of time remaining for L will depend on H. Consequently, the conditioning good, H, should appear in the recreation demand function. In this study, the conditioning good is total hours worked over the course of the season (TOTHOURS) and is included in several model specifications.[50]

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[48] The U.S. rating system classifies a climb according to its maximum difficulty and the amount of climbing protection needed. There are three general classes of climbing: (1) Class 3 which refers to off-trail scrambling or very easy climbing; (2) Class 4 which refers to rugged, exposed scrambling or easy climbing that sometimes requires ropes; and (3) Class 5 which refers to technical climbing that requires climbing protective gear and ropes.

[49] Due to a high correlation between age and years climbing experience (0.55), age is dropped from estimation. Also, the correlation between average income and age is 0.46.

[50] Dummy variables for two of the three survey instruments were also included at the participation stage (RR and Obed). These variables were included to determine whether there was anything unique about the representative sample of climbers from each survey location. The coefficient on the RR dummy variable was negative and significant at the 10% level. Closer examination reveals a positive correlation between RR and MTN (0.40). Thus, it is suspected that the sample of climbers from the RR's survey is more likely to represent a sample of mountaineers.

The variables influencing the regional decision are listed in the center section of Table 3–3. In addition to the *IV* (labeled SIV), the region's climate, size, and percentage of federal land ownership are used to describe the decision process.[51] Temperature and percentage of federal land ownership are expected to be positively related with region choice. It is not clear *a priori* what effect size will have on region choice, yet size is included to control for the subjective design of regions. For example, some regions, such as "Colorado", contain a single state with a relatively large number of nationally recognized climbing sites, while other regions, such as the "Northeast", contain several states with a relatively lower number of nationally recognized sites.

The remaining portion of Table 3–3 shows the explanatory variables used at the site choice stage. These include a price variable, based on travel costs, and several indicators of site quality, including the number of climbs and boulder problems available at a site.

[51] Precipitation was also considered as a region variable, however, due to a high, negative correlation between precipitation and federal land ownership (–0.71), the model includes federal land ownership only as an explanatory variable.

Table 3-3. Description of Variables

Variable	Description	Mean (Standard Error)[a]
	Participation Stage	
YRSCLIMB	Number of years climbing experience. Variable scaled by 100.	0.078 (0.069)
$YRSCLIMB^2$	YRSCLIMB squared.	0.011 (0.019)
SPORT	Dummy Variable – 1 indicates whether the person is primarily a sport climber, 0 otherwise. This is the base category dropped during estimation.	0.094 (0.292)
TRAD	Dummy Variable – 1 indicates whether the person is primarily a traditional climber, 0 otherwise.	0.045 (0.208)
BOULD	Dummy Variable – 1 indicates whether the person is primarily a boulderer, 0 otherwise.	0.074 (0.262)
MTN	Dummy Variable – 1 indicates whether the person is primarily a mountain climber, 0 otherwise.	0.037 (0.189)
GYM	Dummy Variable – 1 indicates whether the person is primarily a gym climber, 0 otherwise.	0.032 (0.176)
STB	Dummy Variable – 1 indicates whether the person equally is a sport climber, a traditional climber, and a boulderer, 0 otherwise.	0.718 (0.427)
SPORTLEAD	A climbers best lead for a sport climb (see Table 3–4 for scale) scaled by 10.	1.473 (0.703)
TRADLEAD	A climbers best lead for a traditional climb (see Table 3–4 for scale) scaled by 10.	0.679 (0.513)
SEASON	Dummy Variable – 1 indicates a climber is willing to climb during multiple seasons, 0 otherwise.	0.757 (0.429)
INCOME2	Dummy Variable – 1 indicates a person's income level is between $35,000-69,999, 0 otherwise.	0.246 (0.431)
INCOME3	Dummy Variable – 1 indicates a person's income level is greater than $70,000, 0 otherwise.	0.109 (0.312)
FLEX	Using a scale of 1 to 7, measures the degree of flexibility in a person's work schedule; 1 is the least flexible. FLEX is scaled by 10.	0.437 (0.196)
TOTHOURS	Total hours an individual worked during the year scaled by 1000.	1.550 (0.074)
MALE	Dummy Variable – 1 indicates male, 0 otherwise.	0.769 (0.422)
HH	Number of household members scaled by 10.	0.229 (0.128)
HHCLIMB	Number of climbers in a household scaled by 10.	0.155 (0.074)
RIV	The inclusive value calculated from the regional decision.	

	Regional Stage	
TEMP	Median annual temperature for a region scaled by 100.	0.534 (0.076)
FEDLAND%	The percentage of federally owned land in a region.	0.287 (0.230)
ACRES	The size of a region in acres scaled by 1 billion.	0.116 (0.052)
SIV	The inclusive value calculated from the site choice decision stage.	
	Site Choice Stage[b]	
TC1	Roundtrip miles at $0.325 per mile.	43.229 (12.305)
TC2	TC1 plus lodging expenses.	43.478 (12.333)
TC3	TC2 plus the opportunity cost of time calculated at 1/3 wage rate. Time includes time in travel and time spent at the site, assuming 8 hour days.	51.201 (17.252)
TC4	Travel expenditures based on mode of transportation. If a climber traveled by car, then TC1. If climber traveled by airplane, then use travel expenditures provided by survey respondents.	43.047 (12.170)
FLY	Dummy variable – 1 indicates that and individual *i* traveled by airplane to site *j*, zero otherwise.	0.397 (0.785)
BOULD	Number of boulder problems located at a site scaled by 1000.	0.040 (0.163)
CLIMBS	Number of climbs located at a site scaled by 1000.	0.498 (0.633)

[a] The means and standard errors for the inclusive value indices vary by model specification.
[b] All travel cost figures (TC1 through TC4) are scaled by 1000.

Table 3-4. U.S. Fifth Class Climb Ratings

Rating[a]	Scale
Have never lead, and 5.0	0
5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5,8, 5.9	1, 2, 3, 4, 5, 6, 7, 8, 9, respectively
5.10a, 5.10b, 5.10c, 5.10d	10, 11, 12, 13, respectively
5.11a, 5.11b, 5.11c, 5.11d	14, 15, 16, 17, respectively
5.12a, 5.12b, 5.12c, 5.12d	18, 19, 20, 21, respectively
5.13a, 5.13b, 5.13c, 5.13d	22, 23, 24, 25, respectively
5.14a, 5.14b, 5.14c, 5.14d	26, 27, 28, 29, respectively

[a] Listed in ascending order from easiest to most difficult.

Specifying the travel cost variable is a difficult and longstanding issue in recreation demand modeling (Randall 1994). Given the focus of this study in testing **H_0 vs. H_1**, rather than using one specification, this study evaluates a set of different travel cost specifications. In the first specification (TC1), travel expenditures are calculated as the product of an individual's per mile travel expense and their roundtrip travel miles, plus toll or ferry expenses. In this study \$0.325 is used for per mile travel expenses.[52] Road distances to sites are calculated using ZIPFIP (Hellerstein et al. 1993). ZIPFIP calculates the shortest road distance in miles between two zipcodes. Although this approach is generally used in the recreation demand literature, a problem with this approach may exist if climbers choose to travel by airplane to a site. Accordingly, the primary travel expense would be the price of an airplane ticket. Such being the case, the travel cost calculation would no longer accurately measure relative prices of a trip.

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[52] \$0.325 is the standard mileage rate allowed by the IRS for 1998 business travel expense deductions. This amount takes into account basic car expenses including depreciation, maintenance and repairs, gasoline, oil, insurance, and vehicle registration fees.

To control for possible measurement error in the travel costs, several model specifications include a dummy variable (FLY) to identify those individuals who flew to a site. Climbers who choose to fly either perceive the site to be of significant quality such that they are willing to fly, or they may be able to fly to a site because the relative price of flying as compared to driving is actually much lower. As an alternative to including the dummy variable FLY, travel expenditures for climbers who flew to a site are pulled directly from survey responses and used in an alternative specification (TC4). It is believed that individuals have an easier time recollecting travel expenditures if they travel by airplane.

Lodging expenses or other trip related expenses and a measure for the opportunity cost of time (e.g., hourly wage rate) are also added to travel costs in different specifications (TC2 and TC3). The issue of including lodging expenses and a measure for the opportunity cost of time may be especially important in the national climbing model since the model does not differentiate for varying trip lengths. Longer trips will take time away from other activities or work, and the relative price of this decision should be considered. The opportunity cost of time is calculated by multiplying trip length by an hourly wage rate.[53]

In summary, there are four different specifications of travel costs. TC1 includes travel expenditures based on roundtrip travel distance. TC2 adds lodging expenses to

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[53] Survey respondents provided trip length information in the trip diaries. It was assumed that this time included time in travel. We adopt the common assumption for calculating opportunity cost of time. The per-hour opportunity value of time in travel and on-site activities is assumed to be 1/3 of the climber's total income divided by total hours worked. Eight hours is assumed to be the amount of time available per day for recreational activities.

travel expenditures used in TC1. TC3 adds an opportunity time cost to TC2. And finally, TC4 uses a travel expenditure amount determined by the mode of transportation.

Site quality, as experienced by individual *i*, is also expected to influence site choice. The number of climbs and boulder problems available at a site are used to measure site quality, regardless if climbing opportunities vary by climber ability. If a site has fewer beginner climbs relative to difficult climbs, a beginner climber may frequently select this area if they are influenced by more experienced climbers. Sometimes the thickness alone of a guidebook is sufficient to signal a good quality area with plenty of climb alternatives and grades. As described above, FLY may also be an indicator of site quality.

3.5. Estimation and Results

The results for 12 alternative specifications of the national climbing RNL model are presented in Tables 3–5 through 3–8. Various models are estimated using different site price proxies and different recreation demand specifications. For each model, the nesting structure is designed to group sites that are likely to be similar. Model estimation will reveal whether the nesting structure is appropriate.

Summary statistics for each model are presented in the bottom sections of Tables 3–5 through 3–8. The χ^2 test statistic is used to test the null hypothesis that all coefficients are jointly equal to zero; that is, imposing *K*-linear restrictions, where *K* refers to the number of coefficients restricted to zero. The term ρ^2 indicates by what proportion a model explains climber trip patterns. For the estimation of the same data, ρ^2 will always increase when new variables are added (Ben-Akiva and Lerman 1985).

For this reason, this measure is adjusted by the number of explanatory variables included in a model. The adjusted measure is $\bar{\rho}^2$.

The remainder of this section is organized as follows. First, a review of how each model is specified in terms of explanatory variables is presented. Second, the criteria used for identifying preferred models are discussed, including a discussion of model summary statistics and goodness-of-fit measures. Third, a discussion about the variables that statistically explain each decision—participation, region choice, and site choice—will be presented.

Models I through III include the same set of explanatory variables for the participation and region choice stages. At the site choice level, Model I includes TC1, Model II includes TC2, and Model III includes TC3. The results for Models I, II, and III are presented in Table 3–5.

Table 3–6 presents the results for Models IV, V, and VI. These models are similar to Models I, II, and III, but FLY is included as a site choice explanatory variable. Table 3–7 presents the results for Models VII, VIII, and IX. Following from Shaw and Feather (1999), TOTHOURS is included at the participation stage in each of these models. In addition, at the site choice stage, Model VII includes TC1, Model VIII includes TC2, and Model IX includes TC2 and FLY.

Models X, XI, and XII are presented in Table 3–8. These models are similar to Models I, II, and VIII, yet replace travel expenditures with a transportation mode travel cost calculation. This calculation varies depending on mode of transportation used to visit a site. If a person drove to a site travel expenditures are the product of roundtrip travel miles and $0.325, plus toll or ferry expenses (i.e., TC1), otherwise individually reported travel expenditures are used. The last model, Model XII, includes TOTHOURS at the participation stage.

Table 3-5. RNL Results for Models I, II, and III

Participation Stage			
Variable Names	Model I	Model II	Model III
CONSTANT	-4.928***[a] (-10.943)[b]	-4.995*** (-12.989)	-5.228*** (-8.754)
YRSCLIMB	-7.429*** (-3.105)	-7.367*** (-3.191)	-7.819*** (-3.066)
$YRSCLIMB^2$	19.200** (2.223)	19.215** (2.283)	16.167* (1.737)
TRAD	0.218 (0.920)	0.212 (0.881)	0.324 (1.089)
STB	-0.009 (-0.087)	0.004 (0.029)	0.120 (0.754)
MTN	-0.564** (-2.008)	-0.558** (-2.004)	-0.538** (-1.965)
BOULD	-0.295 (-1.521)	-0.289 (-1.466)	-0.173 (-0.883)
GYM	-0.495** (-1.954)	-0.491* (-1.926)	-0.533** (-1.989)
SPORTLEAD	0.5345*** (6.772)	0.533*** (6.753)	0.547*** (3.332)
TRADLEAD	0.229** (2.126)	0.230** (2.107)	0.236 (0.811)
SEASON	0.5125*** (4.779)	0.519*** (4.985)	0.510*** (4.625)
INCOME2	0.113 (1.035)	0.115 (1.134)	0.241** (2.344)
INCOME3	-0.171 (-1.099)	-0.166 (-1.074)	0.497*** (2.864)
MALE	-0.306*** (-2.917)	-0.313*** (-3.181)	-0.350*** (-3.126)
FLEX	0.2492 (0.928)	0.235 (1.055)	0.108 (0.400)
HH7	-0.0621 (-0.099)	-0.068 (-0.149)	0.048 (0.045)
HHCLIMB	0.087 (0.089)	0.109 (0.166)	0.379 (0.571)
RIV	0.472*** (5.502)	0.462*** (7.305)	0.334*** (6.320)

Regional Stage			
TEMP	1.916***	1.824***	1.497***
	(3.201)	(4.299)	(4.140)
FEDLAND%	-0.036	-0.067	0.085
	(-0.120)	(-0.363)	(0.243)
ACRES	-0.684	-0.357	0.844
	(-0.968)	(-0.674)	(1.582)
SIV	0.836***	0.956***	1.602***
	(2.945)	(3.732)	(3.193)
Site Choice Stage			
TC1	-3.844***	-	-
	(-5.805)		
TC2	-	-3.708***	-
		(-7.105)	
TC3	-	-	-2.271***
			(-6.732)
BOULD	0.992***	1.061***	1.166***
	(7.051)	(7.351)	(6.258)
CLIMBS	0.134**	0.147***	0.190***
	(1.960)	(3.566)	(2.824)
μ_s	2.532***	2.265***	1.867***
	(6.084)	(7.267)	(5.905)
μ_r	2.117***	2.165***	3.000***
	(5.502)	(7.306)	(6.319)
Summary Statistics[c]			
χ^2	266.782	265.778	261.712
ρ^2	0.579	0.577	0.569
$\bar{\rho}^2$	0.471	0.469	0.460

[a] ***, **, and * denote the estimate is significantly different than zero at the 0.01, 0.05, and 0.10 levels, respectively.

[b] Numbers in parentheses are the ratio of the coefficient to the asymptotic standard error.

[c] The χ^2 statistic = $-2[L(\hat{\beta}_r) - L(\hat{\beta}_u)]$, where the subscripts r refers to the value of the likelihood function when restricting all parameters to zero, and u refers the value of the unrestricted likelihood function. The χ^2 is distributed with $(K_u - K_r)$ degrees of freedom, where K_u and K_r are the numbers of estimated coefficients in the unrestricted and restricted models, respectively. The term ρ^2 is given by $1 - L(\hat{\beta}_u)/L(\hat{\beta}_r)]$, and the term $\bar{\rho}^2$ is given by $1 - [L(\hat{\beta}_u) - K_u]/L(\hat{\beta}_r)]$ (Ben-Akiva and Lerman 1985, 167).

Table 3-6. RNL Results for Models IV, V, and VI (FLY)

Participation Stage			
Variable Names	Model IV	Model V	Model VI
CONSTANT	-4.701***[a] (-12.156)[b]	-4.757*** (-13.206)	-5.074*** (-13.516)
YRSCLIMB	-8.164*** (-3.535)	-8.046*** (-3.567)	-8.570*** (-3.441)
$YRSCLIMB^2$	21.186** (2.533)	20.981** (2.523)	19.568** (2.180)
TRAD	0.236 (0.196)	0.230 (0.953)	0.325 (1.321)
STB	-0.022 (-0.070)	-0.011 (-0.094)	0.104 (0.832)
MTN	-0.586* (-1.879)	-0.573** (-2.076)	-0.576** (-2.092)
BOULD	-0.291 (-1.078)	-0.292 (-1.502)	-0.169 (-0.874)
GYM	-0.510* (-1.682)	-0.501* (-1.927)	-0.558** (-2.115)
SPORTLEAD	0.525*** (6.544)	0.524*** (6.533)	0.550*** (6.815)
TRADLEAD	0.253** (2.208)	0.246** (2.224)	0.251** (2.193)
SEASON	0.531*** (4.605)	0.539*** (5.145)	0.510*** (4.865)
INCOME2	0.098 (0.898)	0.102 (0.995)	0.238** (2.322)
INCOME3	-0.188 (-1.174)	-0.175 (-1.146)	0.469*** (2.679)
MALE	-0.308*** (-2.800)	-0.308*** (-3.128)	-0.351*** (-3.428)
FLEX	0.155 (0.618)	0.144 (0.630)	0.103 (0.440)
HH	0.036 (0.029)	0.032 (0.063)	0.099 (0.253)
HHCLIMB	0.185 (0.228)	0.188 (0.324)	0.430 (0.715)
RIV	0.445*** (3.583)	0.438*** (6.839)	0.337*** (6.576)

	Regional Stage		
TEMP	1.721***	1.642***	1.474***
	(3.817)	(4.547)	(4.308)
FEDLAND%	0.007	-0.022	0.083
	(0.010)	(-0.125)	(0.680)
ACRES	-0.668	-0.394	1.042**
	(-1.408)	(-0.829)	(2.255)
SIV	0.779**	0.876***	1.411***
	(1.932)	(3.422)	(3.355)
	Site Choice Stage		
TC1	-3.713***	-	-
	(-3.986)		
TC2	-	-3.598***	-
		(-6.579)	
TC3	-	-	-2.439***
			(-6.118)
BOULD	0.907***	0.988***	0.940***
	(4.215)	(6.007)	(5.947)
CLIMBS	0.846***	0.903***	0.995***
	(5.966)	(6.394)	(5.911)
FLY	0.117*	0.131***	0.180***
	(1.851)	(3.677)	(5.233)
μ_s	2.884***	2.609***	2.101***
	(4.114)	(6.583)	(6.487)
μ_r	2.248***	2.284***	2.964***
	(3.583)	(6.838)	(6.576)
	Summary Statistics[c]		
χ^2	267.712	266.767	266.856
ρ^2	0.581	0.579	0.571
$\bar{\rho}^2$	0.468	0.466	0.458

[a] ***, **, and * denote the estimate is significantly different than zero at the 0.01, 0.05, and 0.10 levels, respectively.
[b] Numbers in parentheses are the ratio of the coefficient to the asymptotic standard error.
[c] The χ^2 statistic = $-2[L(\hat{\beta}_r) - L(\hat{\beta}_u)]$, where the subscripts *r* refers to the value of the likelihood function when restricting all parameters to zero, and *u* refers the value of the unrestricted likelihood function. The χ^2 is distributed with $(K_u - K_r)$ degrees of freedom, where K_u and K_r are the numbers of estimated coefficients in the unrestricted and restricted models, respectively. The term ρ^2 is given by $1 - L(\hat{\beta}_u)/L(\hat{\beta}_r)]$, and the term $\bar{\rho}^2$ is given by $1 - [L(\hat{\beta}_u) - K_u]/L(\hat{\beta}_r)]$ (Ben-Akiva and Lerman 1985, 167).

Table 3-7. RNL Results Models VII, VIII, and IX (TOTHOURS)

Participation Stage			
Variable Names	Model VII	Model VIII	Model IX
CONSTANT	-5.081***[a] (-13.227)[b]	-5.258*** (-12.917)	-4.981*** (-13.397)
YRSCLIMB	-7.955*** (-3.434)	-7.509*** (-3.155)	-8.266*** (-3.398)
$YRSCLIMB^2$	20.571** (2.444)	17.415** (2.062)	19.370** (2.284)
TRAD	0.202 (0.834)	0.218 (0.773)	0.197 (0.743)
STB	-0.013 (-0.090)	-0.008 (-0.031)	-0.067 (-0.379)
MTN	-0.619** (-2.211)	-0.550* (-1.956)	-0.559** (-1.994)
BOULD	-0.274 (-1.346)	-0.270 (-1.100)	-0.308 (-1.384)
GYM	-0.475* (-1.889)	-0.462* (-1.717)	-0.510* (-1.813)
SPORTLEAD	0.545*** (6.867)	0.546*** (6.717)	0.548*** (6.376)
TRADLEAD	0.246** (2.266)	0.256** (2.167)	0.263** (2.325)
SEASON	0.505*** (4.779)	0.505*** (4.725)	0.495*** (3.779)
INCOME2	0.036 (0.346)	0.045 (0.429)	0.019 (0.166)
INCOME3	-0.252* (-1.602)	-0.216 (-1.409)	-0.232 (-1.228)
TOTHOURS	0.122** (2.251)	0.135** (2.498)	0.146** (2.330)
MALE	-0.312*** (-3.164)	-0.324*** (-3.270)	-0.307*** (-2.615)
FLEX	0.358 (1.577)	0.330 (1.474)	0.266 (0.941)
HH	0.0592 (0.161)	0.110 (0.271)	0.193 (0.415)
HHCLIMB	-0.090 (-0.198)	-0.067 (-0.137)	-0.015 (-0.047)
RIV	0.461*** (7.673)	0.463*** (7.744)	0.441*** (6.176)

Regional Stage			
TEMP	1.861***	1.848***	1.688***
	(4.708)	(4.632)	(4.567)
FEDLAND%	-0.025	-0.050	-0.012
	(-0.145)	(-0.282)	(-0.047)
ACRES	-0.672	-0.285	-0.363
	(-1.320)	(-0.556)	(-0.736)
SIV	0.836***	0.958***	0.870***
	(3.836)	(3.930)	(3.164)
Site Choice Stage			
TC1	-3.750***	-	-
	(-7.388)		
TC2	-	-3.708***	-3.632***
		(-7.460)	(-6.126)
BOULD	0.970***	1.060***	1.007***
	(7.492)	(7.516)	(5.874)
CLIMBS	0.128***	0.148***	0.900***
	(3.687)	(4.138)	(6.216)
FLY	-	-	0.132***
			(3.311)
μ_s	2.597***	2.256***	2.605***
	(7.398)	(7.507)	(6.123)
μ_r	2.171***	2.161***	2.267***
	(7.672)	(7.745)	(6.175)
Summary Statistics[c]			
χ^2	266.856	265.859	266.838
ρ^2	0.579	0.577	0.579
$\bar{\rho}^2$	0.467	0.464	0.462

[a] ***, **, and * denote the estimate is significantly different than zero at the 0.01, 0.05, and 0.10 levels, respectively.
[b] Numbers in parentheses are the ratio of the coefficient to the asymptotic standard error.
[c] The χ^2 statistic = $-2[L(\hat{\beta}_r) - L(\hat{\beta}_u)]$, where the subscripts r refers to the value of the likelihood function when restricting all parameters to zero, and u refers the value of the unrestricted likelihood function. The χ^2 is distributed with $(K_u - K_r)$ degrees of freedom, where K_u and K_r are the numbers of estimated coefficients in the unrestricted and restricted models, respectively. The term ρ^2 is given by $1 - L(\hat{\beta}_u)/L(\hat{\beta}_r)]$, and the term $\bar{\rho}^2$ is given by $1 - [L(\hat{\beta}_u) - K_u]/L(\hat{\beta}_r)]$ (Ben-Akiva and Lerman 1985, 167).

Table 3-8. RNL Results for Models X, XI, and XII (TC4)

Participation Stage			
Variable Names	Model X	Model XI	Model XII
CONSTANT	-4.722***[a] (-11.094)[b]	-4.768*** (-11.273)	-5.100*** (-12.173)
YRSCLIMB	-7.883* (-1.611)	-7.278** (-2.393)	-7.951** (-2.153)
$YRSCLIMB^2$	19.005 (1.250)	18.001* (1.673)	17.291 (1.418)
TRAD	0.202 (0.796)	0.179 (0.711)	0.196 (0.770)
STB	-0.045 (-0.317)	-0.038 (-0.278)	-0.047 (-0.334)
MTN	-0.511* (-1.884)	-0.498* (-1.741)	-0.512* (-1.824)
BOULD	-0.368* (-1.811)	-0.368* (-1.843)	-0.343* (-1.712)
GYM	-0.527** (-1.970)	-0.514* (-1.929)	-0.479* (-1.839)
SPORTLEAD	0.543*** (6.595)	0.533*** (6.503)	0.561*** (6.461)
TRADLEAD	0.231* (1.659)	0.221** (2.043)	0.255** (2.370)
SEASON	0.525*** (4.740)	0.514*** (4.571)	0.505*** (4.459)
INCOME2	0.087 (0.717)	0.088 (0.740)	0.011 (0.081)
INCOME3	-0.135 (-0.762)	-0.208 (-1.200)	-0.203 (-1.176)
TOTHOURS	-	-	0.165*** (2.973)
MALE	-0.287*** (-2.890)	-0.296*** (-2.866)	-0.316*** (-3.123)
FLEX	0.117 (0.261)	0.104 (0.339)	0.231 (0.628)
HH	-0.061 (-0.086)	-0.167 (-0.412)	0.128 (0.290)
HHCLIMB	0.015 (0.081)	0.060 (0.106)	-0.173 (-0.282)
RIV	0.493*** (7.850)	0.484*** (7.563)	0.478*** (8.214)

Regional Stage			
TEMP	1.898***	1.869***	1.882***
	(4.645)	(4.537)	(4.826)
FEDLAND%	-0.054	-0.086	-0.021
	(-0.287)	(-0.428)	(-0.119)
ACRES	-0.357	-0.139	-0.031
	(-0.634)	(-0.256)	(-0.071)
SIV	0.797***	0.876***	0.877***
	(3.805)	(3.719)	(3.979)
Site Choice Stage			
TC4	-4.599***	-	-
	(-7.654)		
TC4 with lodging expenses	-	-4.370***	-4.357***
		(-7.453)	(-8.055)
BOULD	0.889***	0.953***	0.946***
	(6.815)	(6.841)	(6.784)
CLIMBS	0.124***	0.142***	0.137***
	(3.558)	(3.834)	(4.154)
μ_s	2.547***	2.358***	2.385***
	(7.015)	(7.010)	(7.402)
μ_r	2.029***	2.066***	2.091***
	(7.851)	(7.563)	(8.213)
Summary Statistics[c]			
χ^2	269.196	268.223	268.361
ρ^2	0.585	0.582	0.583
$\bar{\rho}^2$	0.476	0.474	0.470

[a] ***, **, and * denote the estimate is significantly different than zero at the 0.01, 0.05, and 0.10 levels, respectively.
[b] Numbers in parentheses are the ratio of the coefficient to the asymptotic standard error.
[c] The χ^2 statistic = $-2[L(\hat{\beta}_r) - L(\hat{\beta}_u)]$, where the subscripts *r* refers to the value of the likelihood function when restricting all parameters to zero, and *u* refers the value of the unrestricted likelihood function. The χ^2 is distributed with $(K_u - K_r)$ degrees of freedom, where K_u and K_r are the numbers of estimated coefficients in the unrestricted and restricted models, respectively. The term ρ^2 is given by $1 - L(\hat{\beta}_u)/L(\hat{\beta}_r)]$, and the term $\bar{\rho}^2$ is given by $1 - [L(\hat{\beta}_u) - K_u]/L(\hat{\beta}_r)]$ (Ben-Akiva and Lerman 1985, 167).

Given that numerous model specifications are used to describe climbing trip patterns, a process for selecting preferred models is used. Preferred models are selected by choosing those models that satisfy the GEV conditions for utility maximization, that best explain climbing trip patterns, that are consistent with economic theory, and that control for possible measurement error in travel costs.

The preferred models are first identified by determining whether the scale parameters, μ_r and μ_s, satisfy the GEV conditions for utility maximization. These conditions require that all scale parameters be greater than zero and that the coefficients on the SIV (μ_r/μ_s) and the RIV ($1/\mu_r$) be bounded by zero and one. The coefficients on the *IV* indices determine the level of correlation among alternatives. A value close to zero indicates a high degree of correlation within a group, yet not across groups. If $\mu_s = \mu_r$, the model collapses to a MNL site choice model and IIA holds for all 60 sites (Ben Akiva and Lerman 1985, 310).

Most models satisfy the GEV derivative conditions (i.e., $\mu_s \geq \mu_r \geq \mu_p$, where μ_p is normalized to one). The scale parameter μ_r is greater than the scale parameter μ_s in Models III and VI. For those models consistent with the GEV conditions, the coefficients on the SIV range from 0.779 to 0.958, indicating minimal correlation. Further, as shown in Table 3–9, results from a hypothesis test reveal that μ_s is statistically different from μ_r for all models but Models II and VIII. Although only slightly correlated, the random errors for alternatives within a specified region are more correlated with one another than they are with the random errors of other region sites. An additional hypothesis test reveals that for all models μ_r is statistically different than one. This suggests that the random components in the conditional indirect utility functions for each region are more correlated with each other than they are with the random component in the conditional indirect utility function for nonparticipation. Overall, the coefficients on both *IV* indices confirm the maintained assumption of the model; the nesting structure is appropriate to characterize the utility maximizing decisions of when and where to take an outdoor climbing trip.

Table 3-9. Hypothesis Test for H_0: $\mu_r = \mu_s$.

Model	T-statistic	Outcome
I	2.620***	REJECT
II	0.752	CANNOT REJECT
III	4.075***	REJECT
IV	3.379***	REJECT
V	2.057**	REJECT
VI	3.988***	REJECT
VII	3.098***	REJECT
VIII	0.670	CANNOT REJECT
IX	1.731*	REJECT
X	2.958***	REJECT
XI	2.077**	REJECT
XII	2.161**	REJECT

***, **, and * denote that μ_r is significantly different than μ_s at the 0.01, 0.05, and 0.10 levels, respectively.

Summary statistics for each model are presented in the bottom section of Tables 3–5 through 3–8. The χ^2 test statistic indicates that the null hypothesis is rejected that all model coefficients are zero and shows that each model is highly significant at the 0.01 level. The $\bar{\rho}^2$ shows that the models are explaining approximately 46% to 48% of the variation in trip patterns. Using this measure, Model X is preferred, yet only slightly. Finally, the signs and significance levels on estimated coefficients and the test statistics vary only slightly across all models (excluding Models III and VI because each violates the GEV derivative conditions).

The third criterion, economic theory, is used to identify those models that include a theoretically correct price proxy. The first thing to consider is the issue of whether lodging expenses should be included in travel costs. Since multiple-day trips are modeled the same as single-day trips, at the very minimum lodging expenses should be included in travel costs. The question, however, remains as to whether the opportunity cost of one's time should also be included in the price or as a separate variable. When the wage rate is included in the price, recreation is modeled as a complete demand system. Yet, unless other price information and the amount of income allocated to recreation are included, demand is not consistently modeled as a complete demand system (Shaw and Feather 1999). A more attractive alternative is to assume that leisure time, and hence recreation, are conditioned on a predetermined good, total hours worked over the course of the season. Thus, those models that add lodging expenses to travel costs and those that assume that recreational time is conditioned on TOTHOURS are preferred.

Model selection also depends on controlling for measurement error in travel costs. If individuals travel by air to a site, the relative prices of driving to a site (roundtrip miles $\times$ \$0.325) are not correct. If, for example, flying is a cheaper travel alternative, the coefficient on TC1 is biased and may cause inflated welfare estimates. Those models that include FLY as a site choice explanatory variable, or those that modify travel costs to reflect the mode of transportation used (refer to Table 3–3) are preferred.

Based on the above four criteria, the preferred models will be VIII, IX, X, and XII. The remaining discussion of model results will identify the explanatory variables that consistently explain each decision process.

3.5.1. Description of RNL results from the Participation Stage

At the participation stage, a positive and statistically significant coefficient on a climbing decision explanatory variable indicates that the variable increases a climber's chances of taking a climbing trip. For most model specifications, the probability of participation increases with climber ability and avidity. Stronger climbers, as measured by SPORTLEAD and TRADLEAD, are inclined to seek more outdoor climbing opportunities. The coefficient on SPORTLEAD is always positive and significant at the 0.01 level. Similarly, the coefficient on TRADLEAD is always positive, and generally significant at the 0.05 level. In addition, individuals willing to climb in multiple seasons are more likely to participate.[54] These climbers do not restrict climbing to a single season, which may be a clear indicator of climbing preference.

Contrary to climber characteristics that increase the probability of participation, the coefficient on YRSCLIMB is negative and significant at the 0.01 level for Models I through IX, at the 0.05 level for Models XI and XII, and at the 0.10 level for Model X. Yet, the coefficient on the quadratic term of YRSCLIMB ($YRSCLIMB^2$) is positive and significant at either the 0.05 or 0.10 levels across all but two models indicating that a U-

[54] Due to concerns about an endogeneity problem with SEASON, all models were run without SEASON. Dropping SEASON from model specifications does not qualitatively change results. For example, in Model I, the only change is that FLEX is now positive and significant at the 0.10 level. The ρ^2 remains at 0.579, and the welfare change measure increases minimally to \$0.259 (up from \$0.255). Appendix F presents the results of Model I and Model VIII when SEASON is dropped.

shaped relationship exists between participation and years climbing experience. These results suggest that climbers tend to increase participation between 19 and 24 years of experience. Preliminary examination reveals that YRSCLIMB is correlated with a climber's age (0.55). A consistent explanation might be that as a person gains climbing experience, they are approaching an age where career choices and family concerns infringe upon their leisure time. A climber may resume higher participation after their children graduate from primary education (at approximately age 18), and when they have established a stable career that earns them more vacation time.

The participation decision is also related to climber type. The coefficients on both MTN and GYM are negative and significant at either the 0.05 or 0.10 levels across all model specifications. This suggests that mountaineers and gym climbers tend to participate less in outdoor rock climbing, and thus may be substitutes for outdoor rock climbing. Across all model specifications the coefficient on MALE is negative and significant at the 0.01 level—a very unexpected result.

In Models VII, VIII, IX, and XII, the coefficient on TOTHOURS is positive and significant at either the 0.05 level (VII, VIII, and IX) or the 0.01 level (XII). The positive and significant coefficient on TOTHOURS indicates that as time allocated to work increases, a climber’s leisure time becomes scarcer and consequently they will devote a greater proportion of this time to climbing activities.

Finally, participation in an outdoor rock climbing trip is influenced by the *IV* index. The RIV is the expected maximum utility of participation; it describes the systematic component of the maximum utility from participating in any of the 10 regions (Ben-Akiva and Lerman 1985, 282). In all 12 model specifications, the coefficient on

RIV ($1/\mu_r$) is positive and significant at the 0.01 level. This means that a change at the regional stage that improves (degrades) the climber's utility of taking a trip to any region will increase (decrease) the RIV. Therefore, an increase (decrease) in the RIV will increase (decrease) the probability of taking a trip.

3.5.2. Description of RNL Results from the Regional Stage

At the regional stage, the estimated coefficients on all regional variables are scaled by μ_r. Across all model specifications, TEMP is the only explanatory variable that influences the regional choice. The coefficient on TEMP is positive and significant at the 0.01 level across all models. The probability of selecting a region increases (decreases) as TEMP increases (decreases). Further, the size of a climbing region appears to have no effect on the regional choice. That is, even though region 7 (Northern California, Northern Nevada, and the Pacific Northwest) represents approximately 190 million acres while region 5 (Colorado) consists of 36 million acres, the size of a region has no impact on an individual's region choice.

Since the underlying assumptions of the RNL are based on utility maximization, regional choice must also depend on the climber's utility associated with each region. If a change in the site choice stage improves (degrades) the utility a climber receives, the SIV will increase (decrease). The coefficient on the SIV (μ_r/μ_s) is positive and significant across most models at the 0.01 level, and positive and significant at the 0.05 level in Model IV. What this means, for example, is that removing a site from region 10 will decrease the SIV for region 10, and thus will decrease the relative probability of selecting region 10.

3.5.3. Description of RNL Results from the Site Choice Stage

At the site choice stage, the reported parameter estimates are scaled by μ_s. Across all specifications, the coefficients on all explanatory variables are usually significant at the 0.01 level. As expected, the coefficients on all travel cost variables are negative. The coefficient on FLY is positive and significant, indicating that flying may offer an individual a less expensive travel alternative, and therefore increase the probability of site choice. Another interpretation may be that individuals are willing to fly to high quality sites. The coefficients on the remaining explanatory variables, BOULD and CLIMBS, are both positive. A climber is more likely to select sites with higher numbers of climbs or boulder problems.

3.6. Consumer Surplus Estimates

After fully reviewing model results, estimating the economic losses to climbers associated with the loss in access to several sites can now be determined. Of particular importance is determining the economic losses to climbers resulting from the USFS proposal that prohibits the use or placement of fixed climbing protection in wilderness areas. This proposed climbing restriction essentially makes it impossible for climbers to safely ascend any climbing routes in wilderness areas.

Since climbers do not have a property right to climb in wilderness areas, the USFS may not be obligated to recognize climber losses in a benefit-cost analysis nor to compensate climbers for these losses as if this were a regulatory takings. However, if the USFS proposal results in a loss to society in excess of $100 million annually (i.e., the economic losses to climbers), then according to Executive Orders 12866 and 12291, the

USFS would be restricted in its ability to make a change in wilderness climbing policies without first conducting a full BCA.

Economic losses associated with loss in site access can be estimated by simulating the removal of site choices from the model. The seasonal loss in consumer surplus (*CS*) is estimated as

$$CS = -\frac{\left(\mathrm{RIV}^0 - \mathrm{RIV}^1\right)}{\beta_{TC_i}\mu_s} \times T \,. \qquad (20)$$

The superscripts 0 and 1 refer to the "with" and "without" sites, and β_{TC} is the coefficient on travel costs. The per choice occasion *CS* measure is multiplied by *T,* the number of choice occasions, to get the annual welfare measure.

The above equations show the amount that can be taken from an individual's income that equates their utility before the change, RIV^0, to their utility after the change, RIV^1. The change in utility is converted to a money metric by dividing by the parameter relating utility to income ($-\beta_{TC}$). This amount is either the maximum willingness-to-pay (WTP) to avoid the change in site access or the minimum willingness-to-accept compensation (WTA) to endure the change in site access.[55]

[55] If the reference level of utility is associated with the change (site closure), then WTP is the equivalent variation to avoid this change or loss. If the reference level of utility is in the status quo, then WTA is the compensating variation representing the amount of compensation required for a person to endure the loss in access.

Equation (20) will be used to test $\mathbf{H_0}$ **vs.** $\mathbf{H_1}$, whether or not economic losses to climbers resulting from loss in climbing access in USFS wilderness areas exceed $100 million annually. From equation (20), seasonal economic losses are estimated under three alternative, yet actual, policy proposals restricting climbing access. Policy Proposal A restricts climbing access at USFS wilderness areas. Policy Proposal B restricts climbing access at USFS, BLM, and NPS wilderness areas. Policy Proposal C includes all sites in proposal B plus Hueco Tanks. A full description of each policy is presented in Table 3–10. Seasonal welfare measures are then multiplied by the national climbing population to get an aggregate measure.

The RNL predicts RIV^1 for each policy scenario and compares these values to RIV^0. For all model specifications, the per choice occasion and annual *CS* change measures are provided in Tables 3–11 through 3–13, shaded rows identify the preferred models. The welfare measures increase as the policy changes from A to C. Table 3–14 compares the per choice occasion welfare change measures for loss in access under each policy scenario.

Table 3-10. Alternative Policy Proposals Closing Rock Climbing Access on Public Lands

Policy Proposal	Description	Sites Included Under Each Proposal
A	Loss in Access at USFS Wilderness Areas	Sandias (region 9) Questa Dome (region 9) Linville Gorge (region 2) Tahquitz (region 6) Black Hills (region 4) Grand Tetons (region 4)
B	Loss in Access at USFS, BLM, and NPS Wilderness Areas	Sandias (region 9) – USFS Questa Dome (region 9) – USFS Linville Gorge (region 2) – USFS Tahquitz (region 6) – USFS Black Hills (region 4) – USFS Grand Tetons (region 4) – USFS Red Rocks (region 6) – BLM Yosemite (region 7) – NPS
C	Policy Proposal B plus close climbing access at Hueco Tanks.	Sandias (region 9) – USFS Questa Dome (region 9) – USFS Linville Gorge (region 2) – USFS Tahquitz (region 6) – USFS Black Hills (region 4) – USFS Grand Tetons (region 4) – USFS Red Rocks (region 6) – BLM Yosemite (region 7) - NPS Hueco Tanks (region 8) – State Park

Table 3-11. Economic Losses to Climbers Associated with Loss in Access to Sites under Policy Proposal A

Model	Per Choice Occasion Loss	Seasonal Loss
I	$0.255	$44.880
II	0.326	57.376
III	0.728	128.128
IV	0.206	36.256
V	0.257	45.232
VI	0.552	97.152
VII	0.250	44.000
VIII	**0.326**	**57.376**
IX	**0.256**	**45.056**
X	**0.225**	**39.600**
XI	0.269	47.344
XII	**0.264**	**46.464**

Table 3-12. Economic Losses to Climbers Associated with Loss in Access to Sites under Policy Proposal B

Model	Per Choice Occasion Loss	Seasonal Loss
I	$0.343	$60.368
II	0.434	76.384
III	0.955	168.080
IV	0.286	50.336
V	0.348	61.248
VI	0.736	129.536
VII	0.337	59.312
VIII	**0.436**	**76.736**
IX	**0.348**	**61.248**
X	**0.324**	**57.024**
XI	0.369	64.944
XII	**0.367**	**64.592**

Table 3-13. Economic Losses to Climbers Associated with Loss in Access to Sites under Policy Proposal C

Model	Per Choice Occasion Loss	Seasonal Loss
I	$1.545	$271.920
II	1.836	323.136
III	3.354	590.304
IV	1.283	225.808
V	1.500	264.000
VI	2.628	462.528
VII	1.515	266.640
VIII	**1.855**	**326.480**
IX	**1.501**	**264.176**
X	**1.358**	**239.008**
XI	1.543	271.568
XII	**1.528**	**268.928**

Table 3-14. Comparison of Per Choice Occasion Loss Measures

Model	Summary of Model Differences	Policy Proposal A	Policy Proposal B	Policy Proposal C
I	TC1	$0.255	$0.343	$1.545
II	TC2	0.326	0.434	1.836
III	TC3	0.728	0.955	3.354
IV	TC1, FLY	0.206	0.286	1.283
V	TC2, FLY	0.257	0.348	1.500
VI	TC3, FLY	0.552	0.736	2.628
VII	TC1, TOTHOURS	0.250	0.337	1.515
VIII	**TC2, TOTHOURS**	**0.326**	**0.436**	**1.855**
IX	**TC2, FLY, TOTHOURS**	**0.256**	**0.348**	**1.501**
X	**TC4**	**0.225**	**0.324**	**1.358**
XI	TC4 plus lodging	0.269	0.369	1.543
XII	**TC4 plus lodging, TOTHOURS**	**0.264**	**0.367**	**1.528**

The consumer's welfare measures are comparable for all models but Models III and VI (both violate the GEV derivative conditions). By comparing Models I, IV, and X, the welfare measures decrease when FLY is added or when the travel cost calculation is adjusted for differences in modes of transportation. Under Policy Proposal A, the annual welfare loss measure for Model I is $44.88 versus $36.26 for Model IV (includes FLY) and $39.60 for Model X (uses TC4).

The welfare measures change minimally when the specification is modified to include TOTHOURS. The welfare loss estimates under Policy Proposal A for Models I and VII (includes TOTHOURS) are $44.88 and $44.00, respectively; while the welfare loss measures remain at $57.38 for Models II and VIII.

By examining the preferred model welfare measures under Policy Proposal A, Model VIII has the highest welfare measure of $57.38. Model VIII includes lodging expenses, but it does not modify the travel cost variable for differences in modes of transportation (i.e., flying or driving). The remaining preferred models either include the variable FLY or use TC4. The per choice occasion welfare measures decrease to $45.06 in Model IX, to $39.60 in Model X, and $46.46 in Model XII.

There is a noticeable increase in welfare estimates when Hueco is included in the policy scenario. Climbers living throughout the world recognize Hueco as a premier bouldering site. In the survey, climbers frequently indicate that there is no substitute to Hueco. Further, the climate at Hueco, which is warm and arid, is ideal to bouldering and climbing during late-fall, winter, and early-spring seasons. Thus, the high welfare amounts under Policy Proposal C seem reasonable.[56]

To aggregate the consumer welfare measures, a figure for the national climbing population must be obtained. There are several different ways to aggregate the seasonal welfare loss measures: (1) use a conservative estimate of 7 million rock climbers provided by the 1994-95 NSRE survey results (Cordell et al. 1997); (2) use the sum of rock climbers and mountain climbers, 16.5 million, as determined by the 1994-95 NSRE survey results (Cordell et al. 1997); (3) add the estimate of annual rock climbing growth as predicted by the *Economist* (1995) of 100,000 people (for three years) to either 7 million or 16.5 million climbers; or (4) use the *potential* number of total rock climbers in the U.S. of 25 million provided by the IPP survey results.

Table 3–15 lists the annual aggregated welfare losses incurred to climbers under Policy Proposal A for Model IV (the most conservative estimate) and the preferred models using several different figures for the national population of climbers. In all

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[56] As an additional exercise to understand whether a substitution effect is included in the welfare estimates, Model X was simulated for the removal of Hueco only. The per choice occasion *CS* for removal of Hueco only is $0.953. This amount added to the *CS* for Policy Proposal B is $1.277, an amount less than the *CS* under Policy Proposal C. This indicates that, individually, the sum of specific site welfare measures is less than when removal happens simultaneously–an indication of complementary sites (Hoehn 1991).

cases, evidence supports $\mathbf{H_1}$; the aggregate losses far exceed the $100 million threshold. Using the most conservative estimate from Table 3–15 of $254 million, a 95% confidence interval can also be calculated following Morey, Rowe, and Watson (1993, 590). The resulting confidence interval of $161 million to $466 million lies above $100 million. This evidence suggests that the economic losses to climbers should be considered in a BCA. For comparison, Tables 3–16 and 3–17 present the annual aggregated welfare loss measures for Policy Proposals B and C, respectively.

Table 3-15. Aggregate Annual Welfare Estimates for Policy Proposal A (all welfare figures rounded in millions of dollars)

	U.S. Climbing Population (in millions)		
Model	7	16.5	25.0
IV	$254	$598	$906
VIII	$402	$947	$1434
IX	$315	$743	$1126
X	$277	$653	$990
XII	$325	$767	$1162

Table 3-16. Aggregate Annual Welfare Estimates for Policy Proposal B (all welfare figures rounded in millions of dollars)

	U.S. Climbing Population (in millions)		
Model	7	16.5	25.0
IV	$352	$831	$1258
VIII	$537	$1266	$1918
IX	$429	$1011	$1531
X	$399	$941	$1426
XII	$452	$1066	$1615

Table 3-17. Aggregate Annual Welfare Estimates for Policy Proposal C (all welfare figures rounded in millions of dollars)

	U.S. Climbing Population (in millions)		
Model	7	16.5	25.0
IV	$1581	$3726	$5645
VIII	$2285	$5387	$8162
IX	$1849	$4359	$6604
X	$1673	$3944	$5975
XII	$1882	$4437	$6723

At first, these aggregate measures may appear high, but when compared to welfare measures obtained from other RUM studies, these amounts seem appropriate. The recent climbing policies affect national wilderness areas and a national population of climbers. On the other hand, since USFS wilderness areas provide other nationally valued environmental services, such as ecosystem and wilderness preservation, the nonmarket values of these benefits could also likely be quite large.

Table 3–18 presents a comparison of seasonal welfare estimates associated with a change in quality for various recreational activities regionally located in the U.S. Needelman and Kealy (1995) estimate aggregate seasonal benefits for New Hampshire residents for the elimination of pollution problems in New Hampshire Lakes. For clean-up of both point and nonpoint pollution sources, they estimate a per capita seasonal benefit of $4.30, or $3.6 million for the entire population of New Hampshire. Jakus et al. (1997) estimate seasonal consumer surplus estimates as high as $47.40 for the removal of fish consumption advisories at fishing sites in East Tennessee (Jakus et al. did not aggregate across the relevant population). Montgomery and Needelman (1997) find that the elimination of toxic contamination from New York lakes and ponds generates a seasonal benefit of $63 per person.

Table 3-18. A Comparison of Per Person Seasonal Welfare Change Measures

Study (year of study)	Per person Seasonal Welfare Measure (Season)	Recreational Activity	Quality or Site Access Change	Location	Nonmarket Valuation Technique
Needelman and Kealy (1995)	$4.30 (Apr - Aug 1989)	Lake Swimming	Elimination of nonpoint and point pollution	New Hampshire Lakes	RUM
Shaw and Jakus (1996)	$7.85 (1993)	Rock Climbing	Decrease in 50% of climbs	Mohonk Preserve (the "Gunks"), New York	RUM
Montgomery and Needelman (1997)	$63.00 (Apr - Oct 1989)	Freshwater Fishing	Toxic contamination of freshwater fish	New York Lakes and Ponds	RUM
Jakus et al. (1997)	$47.40 (Mar - Aug 1994)	Fishing	Removal of fish consumption advisories	East Tennessee	RUM
Loomis and Fix (1998)	$205 / $235 (Spring 1996)	Mountain Biking	Value of mountain biking trips	Moab, Utah	TCM / CVM
This study (2000)	$36.26 (Apr 1997 - Apr 1998)	Rock Climbing	Loss in access	Six USFS wilderness sites	RUM
This study (2000)	$167.73 (Apr 1997 - Apr 1998)	Rock Climbing	Loss in access	Hueco Tanks, Texas	RUM

Of particular interest are the welfare measures obtained for nontraditional recreational activities, mountain biking and rock climbing. Shaw and Jakus (1996) estimate a seasonal welfare loss of $7.85 associated with a 50% reduction in climbs available at a single site. This study estimates a minimum seasonal welfare loss of $36.26 associated with closing six USFS wilderness sites. Compared to the welfare loss measure associated with the reduction in climbs at a single site only, the economic losses to climbers under Policy Proposal A now appear to be relatively quite small. As argued by Shaw and Jakus (1996), site closures will not result in large welfare losses for climbers when a large set of substitutes is available. Nonetheless, on an aggregate basis, the amount is sufficiently greater than $100 million.

What likely stands out to the reader, are the overwhelmingly large consumer surplus estimates for mountain biking at Moab and rock climbing at Hueco Tanks. The seasonal benefit of mountain biking at Moab starts at $205, while the seasonal loss associated with the loss in rock climbing access at Hueco Tanks is $168 (refer to footnote 53). Both Hueco and Moab are recognized as premier recreation destinations. Moab is known nationally as a premier mountain biking area, and Hueco is known nationally as a premier bouldering destination. The evidence suggests that although there may exist a large number of mountain biking or rock climbing and bouldering sites, these sites are not substitutes for Moab or Hueco.

3.7. Conclusion

This study addresses a recent proposed wilderness area land use rule initiated by the USFS. In 1998, the USFS proposed to restrict climbing access in USFS wilderness areas by restricting the use and placement of climbing safety protective gear. Because climbers do not have a property right to climb in wilderness areas, the USFS may not be required to recognize climber losses in a benefit-cost analysis nor to compensate climbers for these losses as if this were a regulatory takings. However, if the USFS proposal results in a loss to society in excess of $100 million annually, then according to Executive Orders 12866 and 12291, the USFS would be restricted in its ability to make a change in wilderness climbing policies without first conducting a full BCA. Thus, the purpose of this study was to estimate the economic losses to climbers that would result from this new rationing rule, and to determine whether the proposed rule constitutes a major regulatory change.

In this study, a national-level repeated nested logit RUM is developed and used to simultaneously predict demand for climbing and site choice using a multiple decision process. First, the decision process is structured to repeatedly capture a climber's decision to take a climbing trip during the season of interest. Second, if a climber chooses to take a climbing trip, she then selects a climbing region. Regional nesting is useful because it allows for greater flexibility in modeling substitution among climbing sites. Finally, after deciding a region, a climber selects a site. The model results show that this nesting structure is appropriate to characterize the utility maximizing decisions of when and where to take an outdoor rock climbing trip.

By simulating the removal of sites from the choice set, the model predicts welfare change measures associated with loss in climbing access to several national sites. The welfare amounts indicate that climbers highly value climbing in U.S. wilderness areas. The most conservative estimate of the aggregate economic losses to climbers from loss in climbing access to USFS wilderness areas is $254 million, and thus supports $\mathbf{H_1}$. The magnitude of these losses suggests that the USFS proposal meets the definition of a major regulatory change. Further a scope analysis reveals that the economic losses to climbers increase significantly with increasing reductions in climbers' choice sets. Thus, if the USFS proposal has any precedent-setting impact on other federal and state public land agencies, then losses to climbers would grow substantially.

This research makes several contributions to the literature. First, while many studies have estimated recreation demand using the RNL model, this is the first study to apply the RNL model to estimate demand for rock climbing and to predict the economic losses associated with loss in climbing site access. Second, it is the first study to estimate recreational demand on a national scale. All existing recreational demand studies evaluate regional demand for regional sites. Since climbing alternatives are scarce relative to other activities (i.e., require very specific topographical conditions), and since climbers may live in areas not conducive to climbing, a regional study is not appropriate. Third, given growing concerns about rock climbing impacts on public lands and trends in climbing access rationing rules, the results from this study may provide useful input to public land agencies attempting to balance climbing with other uses of public lands. Finally, the consumer welfare estimates are policy relevant; that is, the results may indicate the need for federal agencies to conduct BCAs for any new climbing access rules; such analyses should include the nonmarket economic values associated with rock climbing.

4. CHAPTER4: A Pooled Revealed and Stated Preference Model of Rock Climbing at Hueco Tanks

4.1. Introduction

Hueco Tanks Texas State Park located just outside of El Paso Texas is known throughout the world as a premier climbing destination. In 1998, the Texas Parks and Wildlife Department (TPWD) severely restricted open-recreational access at Hueco Tanks State Park. TPWD believed that increased popularity of Hueco Tanks as a world-class climbing destination threatened the park's archeological and ecological resources. The objectives of this nonmarket valuation study are to estimate demand for Hueco Tanks and subsequent losses in consumer surplus due to restrictions in site access, and to take advantage of a unique opportunity to test the validity of contingent behavior data. This validity test is conducted using data from surveys implemented both before and after the policy change.

Two surveys separate surveys were conducted; one survey was conducted in the spring of 1998 and the other in the spring of 1999. The first survey was implemented prior to the restriction in open-recreational access. In this survey, climbers who had visited Hueco Tanks were surveyed about their actual rock climbing trips and intended trips under alternative policy rules (i.e., pre-policy rules) restricting access. The second survey was administered after the restriction on access was imposed; in this survey climbers were surveyed about their actual post-policy rock climbing trips.

The post-policy revealed preference trip data is used to test the validity of pre-policy contingent behavior data. The results from pooled Poisson and Negative Binomial regression models suggest that contingent behavior data indeed may be a valuable supplement to revealed behavior when policy questions are outside the domain or conditions of observed behavior.

In addition, a seemingly unrelated Poisson regression model (SUPREME) is presented as an alternative to single equation Poisson regression models for the joint estimation of revealed and stated preference trip data. Findings indicate that SUPREME estimates are asymptotically more efficient than single equation Poisson estimates.

4.2. Background on Revealed Preference and Contingent Behavior Methods

The nonmarket valuation of environmental goods and services can be divided into revealed preference (RP) approaches or stated preference (SP) approaches. RP approaches rely on observed individual behavior, often *revealed* in survey instruments, to infer values for environmental goods or services. For recreation demand, economists often use the travel cost method (TCM) to estimate demand, where price of a recreational trip is measured by travel expenditures.

Economists have developed several different stated preferences (SP) techniques to assess the economic value of nonmarket environmental goods. These methods include contingent valuation (CV) and contingent behavior (CB). In CV, for example, respondents are asked to make statements about their willingness-to-pay (or to accept compensation) for changes in environmental quality. CV is especially attractive because it can be used to assess values for nonuse or passive environmental values, such as environmental existence values. Further, in complex valuation settings, total environmental values can be holistically estimated *de novo* via CV (Randall 1991, 312).[57] The contingent behavior (CB) approach is commonly used to assess quality or price changes at a recreational site.[58] In the CB framework, respondents are asked to make statements about their intended visitation to a site given a proposed change in site quality, access, or price.

It is often argued that revealed preference (RP) approaches are preferred over stated preference (SP) approaches for valuing outdoor recreation benefits (Englin and Cameron 1996).[59] However, when the objective of nonmarket valuation is to evaluate effects of future changes in site quality or access, SP data are often used (Englin and Cameron 1996). A recent trend in recreation demand modeling is to combine revealed preference and stated preference (RP-SP) trip data (Cameron et al. 1996; Englin and Cameron 1996; Loomis 1997; and Rosenberger and Loomis 1999).

In the combined RP-SP recreation demand framework, individuals are asked to provide information on actual trips taken to a particular resource under existing resource conditions or management rules (i.e., RP data), and subsequently asked to indicate the number of trips they would take to the site under alternative, hypothetical management rules (i.e., CB data). An example of a contingent behavior question may be: "how many more or fewer climbing trips would you take to this resource if management restricted

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[57] In comparison to the holistic total value framework, a common procedure is to calculate total value by aggregating component values estimated independently; this procedure is called independent valuation and summation (IVS) (Randall 1991). Randall (1991) shows that an IVS measure of total value (where IVS ≠ total valuation) will be systematically biased for policies with many components. Revealed preference approaches are generally used to estimate a single component use value. Thus, revealed preference methods are inappropriate for measuring total value and existence value components (Randall 1991, 315).

[58] As an additional example, Nestor (1998) uses CB data to assess changes in consumer trash disposal behavior for different trash disposal fee structures.

[59] See Smith (1993) and Carson et al. (1996) for alternative perspectives.

access to 50% of the total available climbs?" This combined RP-SP approach is used in this study. A survey was conducted in 1998 to collect data from climbers about their actual rock climbing trips and intentions to visit under alternative rules restricting access; the data account for over 2000 RP trips taken by 413 climbers. This revealed preference trip data is supplemented with pre-policy CB data to value losses to climbers under alternative restrictions in site access.

While a combined RP-SP approach is commonly used to assess *ex ante* behavior, many economists question the validity of CB responses. The underlying concern is that CB questions do not elicit an accurate expression of *ex post* behavior. For instance, will a respondent that states she will take five fewer trips because of a site quality change actually take five less trips if this occurred? Validation of CB data addresses the question of whether respondents report the same behavior in CB surveys as they would if actually confronted with the change (Vossler et al. 1999). Ideally, in order to make such a comparison, researchers would like to compare *ex ante* CB behavioral responses with actual *ex post* RP behavior (Berrens and Adams 1998; and Loomis 1993b). However, the primary reason economists combine RP and SP data is because the change in site quality or access has not yet occurred. Thus, *ex post* RP data is not available to evaluate changes in consumer surplus.

This study is unique because after the change in access policy at Hueco Tanks, climbers were surveyed about their post-policy climbing trips. Hereafter, this trip data will be referred to as **post-RP** trip data to denote post-policy revealed preference trip data versus the pre-policy revealed preference (**pre-RP**) trip data obtained from the initial survey conducted in 1998. Table 4–1 presents a description of the types of data collected from each survey instrument. A CB question used in the original 1998 survey closely resembles the actual change in policy. This question asked climbers to indicate how many more or fewer climbing trips they would take to Hueco Tanks if two of four areas within the park were closed. In September 1998, TPWD actually closed three of four areas. The **post-RP** trip data is used as a natural experiment to test CB responses and to evaluate the economic losses to climbers due to the actual restriction in site access.

Table 4-1: Trip Data Collected From Survey Instruments

Date of Survey Instruments	Data Collected	Acronyms Used in this Study
1998 Survey[a]	Pre-policy revealed preference climbing trip data	**Pre-RP**
	Contingent behavior climbing trip data to hypothetical changes in site access	**SP1** and **SP2**[c]
1999 Survey[b]	Post-policy revealed preference climbing trip data	**Post-RP**

[a] See Appendix B for a copy of survey.
[b] See Appendix D for a copy of survey.
[c] These data sources depend on different contingent behavior questions. A complete description of the contingent behavior questions used are presented in Section 4.4.

Pooled Poisson and Negative Binomial count data regression models are used to test the validity of SP trip data and to estimate consumer surplus (CS) for alternative climbing management plans. In addition, as an alternative to pooling RP and SP trip data, a seemingly unrelated Poisson regression model (SUPREME) is used to evaluate the RP and SP trip data, and is suggested as alternative to single equation Poisson models. If RP and SP trip data are correlated, a SUPREME provides parameter estimates that are asymptotically more efficient than single equation or pooled Poisson models.

The remainder of this chapter is organized as follows. Background information and the history of rock climbing at Hueco Tanks is presented in the next section. Section 4.4 describes the survey instruments and contingent behavior questions. Section 4.5 presents a review of studies that have examined the validity of SP methods and describes the validity experiment used in this study. Section 4.6 describes count data travel cost models and the SUPREME. Dependent and explanatory variables are described in Section 4.7. Section 4.8 presents model estimation results and estimates of consumer surplus. Concluding comments are presented in Section 4.9.

4.3. The History of Hueco Tanks

A summary of the history of Hueco Tanks, which is located approximately 20 miles east of El Paso, is recorded in the Hueco Tanks SHP Resource Management Plan (1997). The brief historical account of Hueco Tanks described below is based on the summary found in this Resource Management Plan.

Prior to 1885, the first recorded date of individual land ownership, Hueco Tanks was visited and inhabited by Jornada Mogollon peoples (probably sometime around A.D. 600), Spanish Explorers (late sixteenth century), Apache Indians (1778), Kiowa Warriors (the Mexican period, 1821-1846), and travelers making their way to California (1848). Because of its unique natural water resources, Hueco Tanks served as a water rest stop for hunters, gatherers and travelers.[60] Pictographs adorn many of the rock walls at Hueco Tanks leaving memories of many past and prehistoric inhabitants. Chemists at Texas A&M have established that many of the pictographs date from as early as A.D. 600.

[60] The word hueco means hollow space. Rainwater will collect in the huecos at Hueco Tanks.

The earliest legal records of individual property ownership of Hueco Tanks were filed by Silverio Escontrias in 1898. During Escontrias' ownership, archeologists became interested in the rock art at Hueco Tanks. By 1940, Hueco Tanks was a tourist attraction, and as a result, the Escontrias family started charging admission fees to Hueco Tanks.

During World War II, military personnel, who were stationed nearby at Fort Bliss, visited Hueco Tanks for recreation and training. Unfortunately during their visits, military personnel destroyed much of the rock art with graffiti. Shortly thereafter, in 1955, the El Paso Historical Society and the Western Texas College "Kliff Klimbers" started efforts to promote recognition of the historical rock art. Despite these efforts, Hueco Tanks became a focal point for future recreation and residential development.

In the late 1950s, the Escontrias sold the land. From this period until 1969, Hueco Tanks became the target of numerous private development schemes. The most notorious of these schemes was the development of a 200-acre recreation lake, which included a large earthen dam. According to current managers of Hueco Tanks, the creation of this dam severely damaged the park's cultural integrity. On October 4, 1969, Hueco Tanks was declared a state park, and by 1972, Hueco Tanks was developed and managed as recreational site.

During the 1980s and 1990s, Hueco Tanks became known to climbers living throughout the world as a premier winter climbing destination providing numerous types of climbs including traditional rock climbs, sport climbs, and boulder problems. Although all three types of climbing exist at Hueco Tanks, the area is famous for its quality and quantity of boulder problems.

Unlike traditional or sport climbing, bouldering does not require ropes, climbing protective gear, or knowledge about climbing protection. Strong, agile climbers climb on boulder problems generally not higher than 25 feet. Foam crash pads (approximately three inches thick and nine square feet) and spotters (i.e., other climbers) protect climbers from a fall. Climbers can generally walk off the back of boulders to descend. The "V" grading system used to identify the difficulty of boulder problems at Hueco Tanks and is often converted to the U.S. fifth class rating system used for technical climbs.

Due to increases in recreational use (primarily rock climbing) during the late 1980s and early 1990s, TPWD became concerned about the recreational impacts on park resources. In 1997, TPWD proposed a management plan recommending gradual restrictions in open-recreational access. TPWD believed that Hueco's geologic and archeological resources were threatened by the increased popularity of Hueco as a world class rock climbing destination:

> Park planners with TPWD began to realize, even as they planned for increased recreational use of the site, that conflicts were going to occur between park users and there was a great need to protect the priceless rock art found throughout the park. The place was literally being loved to death by thousands of hikers, climbers, and picnickers. Increasing use by rock climbers from around the world is beginning to impact the park permanently through increased erosion of archeological deposits, broken rocks at popular climbs, epoxy applied to handholds, and perhaps other as yet unrecognized impacts (Hueco Tanks SHP Resource Management Plan Draft 3.2, 19 September 1997).

It appears that any rationing rules proposed by TPWD will be guided by this conflict between rock climbing and ecological or archeological preservation.

On September 1, 1998, approximately one year after the Hueco Tanks SHP Resource Management Plan was drafted, TPWD closed three of four mountain areas in Hueco Tanks to open-recreational access. As a result, TPWD has essentially eliminated a world recognized bouldering area.

4.4. The Survey Method

Questions this research seeks to answer include: (1) what is the economic value of rock climbing access at Hueco Tanks; (2) how valid are SP trip data obtained from CB questions; and (3) should RP and SP trip data be estimated jointly in a SUPREME? To answer these questions, data were collected from climbers about their actual and intended trips to Hueco Tanks for different rationing rules. To collect this data, climbers were intercepted at Hueco Tanks during the fall and winter of 1997 and the winter and spring of 1998, and were asked if they would participate in Spring 1998 in a mail survey on rock climbing access (see Appendix C for a copy of the on-site consent form).

The 1998 survey was designed to obtain three types of information from climbers: (1) annual climbing trip information to Hueco Tanks (i.e., RP trip data); (2) climber ability, experience and demographic information; and (3) CB and CV data. By using a follow-up survey method, the survey was designed so that respondents would record detailed information about their climbing trips to Hueco Tanks; this includes the number of trips, length of stay, lodging and travel expenses, travel accommodations (e.g., by car or by airplane), and the number of people traveling together on a trip. The survey also contained questions about climber preferences for different climbing areas in Hueco Tanks and purposes of visiting Hueco Tanks. (All climbers indicated that the primary reason for their visit was to climb and boulder.) To evaluate different rules for rock climbing access at Hueco Tanks, several CV and CB questions were included in the survey. In the design stage, many climbers screened the survey. These climbers anonymously provided edits and clarifications, and made recommendations to use examples in the survey to clarify difficult questions.

The survey was mailed during the spring of 1998. A follow-up reminder letter was sent to nonrespondents four weeks after the original survey mailing (see Appendix C for a copy of the reminder letter). In addition, a follow-up survey and reminder letter was mailed to 100 random climbers who had not yet responded. For the Hueco survey, 413 of 750 intercepted climbers (15 of the 750 mailed surveys contained bad addresses) returned a completed questionnaire representing a 54% response rate (a 56% response rate adjusted for bad addresses).

As described above, climbers provided detailed information about their climbing trips to Hueco Tanks during the past year when access was not restricted (i.e., **pre-RP** trip data). During this period, unrestricted access at Hueco Tanks included the following conditions: (1) all four mountain areas were open to recreational access (a map of Hueco Tanks is present in Figure 4–1); (2) the park was limited to 60 vehicles, but made no restrictions on the number of individuals in the park at any one time; (3) the entrance fee was $2, yet climbers had to pay an additional $2 activity fee (the activity fee was reduced if climbers purchased a season Texas Conservancy Passport); and (4) climbers were not allowed to climb near or on prehistoric pictographs.

In addition, the survey included several pre-policy CB questions. The CB questions read as follows (also see Appendix B, Questions D2-D8):

> "Given West Mountain only is closed…Would your trips next season change because of this new policy? (yes or no). [from survey question D2]
>
> [If yes] You stated your trips would change. About how many more or fewer trips would you take next season?" [from survey question D3]

And,

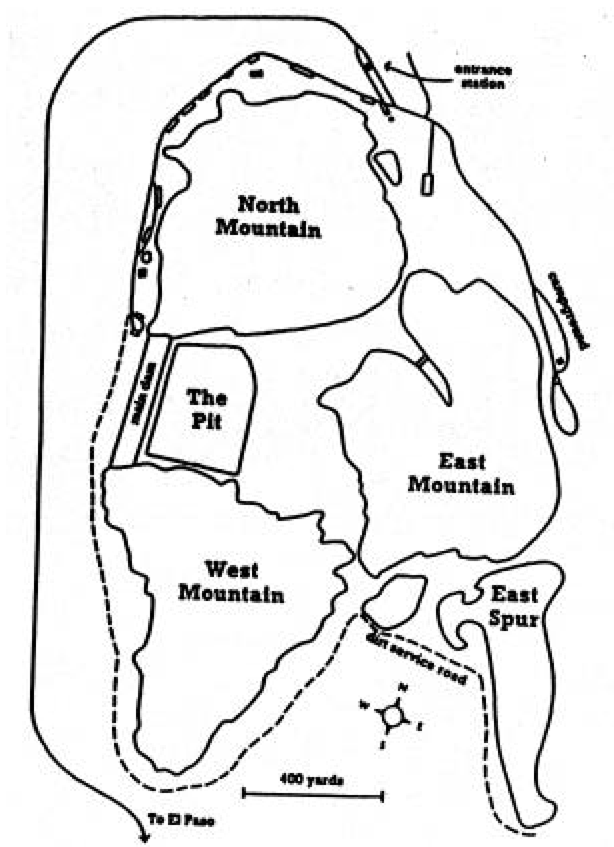
> "Next suppose TPWD eliminates climbing access to both East and West Mountain…Would your trips next season change because of this new policy? (yes or no). [from survey question D7]
>
> [If yes] You stated your trips would change. About how many more or fewer trips would you take next season?" [from survey question D8]

Throughout the remainder of this chapter, responses to D3 and D8 CB questions will be referred to as **SP1** and **SP2** trip data, respectively. Note that climbers responded to these questions prior to knowing about the actual policy change in site access.

On September 1, 1998, TPWD severely restricted open-recreational access at Hueco Tanks; however, climbers could still visit the park. (It should be noted that all climbers who had participated in the original 1998 survey returned their survey prior to September 1, 1998.) The rule limited access in the following ways: (1) open-recreational access was limited to North Mountain non-pictograph areas only, yet to visit North

Mountain, visitors had to call in advance to make a reservation; (2) North Mountain was limited to 50 visitors; (3) the entrance fee remained at $4 (this fee was not reduced if climbers purchased a season Texas Conservancy Passport); (4) before entering, all visitors had to attend a mandatory park orientation; and (5) visitors were allowed to be guided by a park ranger to the remaining three mountain areas—East Mountain, West Mountain, and East Spur Maze—for a two hour period. A map of Hueco Tanks is presented in Figure 4–1.

Figure 4-1: Map of Hueco Tanks



This actual change in policy provided a unique opportunity to question original survey respondents about their trips to Hueco Tanks under this new rule. The second survey, which was mailed to climbers one year after the first survey (April 1999), contained three simple questions: (1) did you take any trips to Hueco Tanks in the last twelve months; (2) if yes, how many trips did you take in the last twelve months; and (3) if you took any trips to Hueco Tanks in the last twelve months, what was the average length of stay? This survey was mailed to 387 of the 413 climbers who participated in the first survey (26 of the original 413 surveys were returned as undeliverable). Of this amount, 246 climbers responded representing a 64% response rate.

4.5. Validity of Stated Preference Data

For defining and assessing validity of SP data, this paper relies on the explanation of validity presented by Mitchell and Carson (1989). The validity of a measure is the degree to which it measures the theoretical construct under investigation (Mitchell and Carson 1989, 190). In the CB context, the theoretical construct is an individual's behavioral response for a change in an environmental good if the proposed change in the good existed.

The American Psychological Association (1974) define three types of validity: content, criterion, and construct validity (see also Mitchell and Carson 1989). Content validity involves assessing whether the instrument used for the construct (usually the wording of the question) is adequate; this usually entails a subjective assessment (Mitchell and Carson 1989). Criterion validity is concerned with whether the measure of the construct is related to other measures that may be regarded as *criteria* (Mitchell and Carson 1989, 190). For example, a criterion validity test may compare *stated* willingness-to-pay responses to *actual* market transactions. Construct validity involves the degree to which a measure relates to other measures as predicted by theory (Carmines and Zeller 1979; and Mitchell and Carson 1989, 191). One form of construct validity, theoretical validity, determines whether the measure is related to other measures of construct in a manner predicted by theory (Mitchell and Carson 1989). For example, suppose an individual is confronted with two quantities of a normal environmental good, say Q^0 and Q^1 where $Q^0 > Q^1$, and the good has strictly positive marginal utility, then it is expected that the individual would value Q^0 more than Q^1 (Mitchell and Carson and Mitchell 1995, 157).

Before describing the modeling strategy used in this study to test for the validity of CB, a brief description of the impetus for validation of SP methods and a review of the current literature on validity is presented. This review will highlight some limitations of validity tests and avenues for future research.

To restate, CB is commonly used to evaluate or predict effects on behavior from future changes in policy, especially when such changes fall outside the range of currently observed behavior. However, similar to CV methods, the use of CB data remains controversial. Critics of SP techniques often argue that respondents cannot accurately identify true statements about WTP or intended visitation (Vatn and Bromley 1995; Arrow et al. 1993). There may be several reasons why *ex ante* behavioral statements differ from true *ex post* behavioral responses: (1) survey respondents do not accurately understand or have difficulty weighing the attributes of the contingent policy scenario proposed by the researcher (Vatn and Bromley 1995); (2) survey respondents may have an incentive to influence the outcome of the experiment by misrepresenting their true behavioral responses (Nestor 1998); or possibly (3) survey respondents do not consider their budget when answering CB questions. These reasons may suggest that hypothetical questions may produce inaccurate or strategic responses.

For similar reasons, the NOAA panel proposed an avenue for future research to test the validity of CV (Arrow et al. 1993).

> A critically important contribution could come from experiments in which state-of-the-art CV studies are employed in context where they can in fact be compared with "real" behavioral willingness-to-pay for goods that can actually be bought and sold.

This type of analysis represents criterion validity of CV and can also be applied to CB. Ideally to assess the validity of CB data for nonmarket environmental goods, researchers would like to compare stated visitation for a proposed policy change, for example a policy improving site quality, with observed or revealed visitation given the same policy change (Berrens and Adams 1998; and Loomis 1993b).

A brief review of the literature on validation of SP methods will outline the development of and demands for this type of research. A number of studies have examined the reliability and validity of CV data using several different approaches.[61] For example, studies have compared CV with indirect valuation methods of observed behavior (Brookshire et al. 1982; Carson et al. 1996; Knetsch and Davis 1966; Loomis, Creel, and Park 1991; and Shabman and Stephenson 1996); actual market transactions

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[61] A distinction needs to be made about the difference between reliability and validity. Reliability is commonly thought of as consistency in measurement; whereas validity is commonly thought of as accuracy in measurement.

(Berrens and Adams 1998; Bishop and Heberlein 1979; Cummings, Harrison, and Rutstrom 1995; Dickie, Fisher, and Gerking 1987; Kealy, Montgomery, and Dovidio 1990; List and Shogren 1998; and Seip and Strand 1992); or actual voting behavior (Carson, Hanemann, and Mitchell 1986; Champ and Brown 1997; Shabman and Stephenson 1996; Vossler and Kerkvliet 1999; and Vossler et al. 1999).[62] A brief, but thorough, review of the literature on validity of CV is presented by Vossler and Kerkvliet (1999).

By comparison, CB validity tests can be grouped as: (1) test-retest methods to test the reliability of CB (Loomis 1993b); (2) survey experiments to test the validity and reliability of CB (Cicchetti, Dubin, and Wilde 1991); (3) statistical methods to control or test for strategic or information bias (Eiswerth et al. 2000; Nestor 1998); (4) comparisons of intended visitation with actual visitation (Cicchetti, Dubin, and Wilde 1991; and Loomis 1993b); and (5) analyses that determine whether intended visitation behavior exhibits statistical differences across different contingent changes in site quality or access (Loomis 1993b). While a number of researchers have examined the validity of CV, there are only a few studies that have examined the accuracy of CB data.[63] Loomis (1993b) and Cicchetti, Dubin, and Wilde (1991) have tested for the reliability and validity of CB data for nonmarket environmental goods. In addition to these studies, however, Nestor (1998) explores the reliability of using CB data to determine changes in household demand for a publicly provided service, trash disposal.

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[62] As another example, Whitehead et al. (1995) assess the validity and reliability contingent values by comparing willingness-to-pay responses from on-site users, off-site users, and nonusers.
[63] In the marketing field, concerns about CB data are often dealt with by comparing intended purchase behavior with later market sales (Loomis 1993b).

The study by Loomis (1993b) analyzes the reliability of CB responses for nonmarket recreational services. Loomis (1993b) uses a test-retest method. The test-retest approach involves administering identical survey questions to the same individuals at two different periods. CB responses from both surveys are then analyzed to test the reliability of CB data. Loomis (1993b) compares visitation responses regarding the likelihood of visiting, and expected number of trips and length of stay; Loomis (1993b) finds that intended visitation responses are reliable. In addition, Loomis (1993b) finds statistically different visitation responses for major differences in site quality (i.e., CB validity test (5)). To test the validity of CB responses, Loomis (1993b) compares intended length of stay data with actual length of stay data, in which both data sources are generated from similar resource conditions (i.e., CB validity test (4)). That is, the hypothetical resource conditions used to generate intended length of stay data match the actual resource conditions for which actual behavior is observed. In this case, Loomis (1993b) finds statistical support for validity.

Cicchetti, Dubin, and Wilde (1991) use a follow-up survey method that is used to compare responses from an earlier survey on intended trip behavior for beach trips in the Fairhaven-New Bedford-Dartmouth area with actual trip behavior revealed in the follow-up survey. As one example of their survey approach, respondents are initially asked to indicate how many trips they intend to take to New Bedford Beaches in April through December 1986. Approximately one year later, the same respondents are asked to indicate the actual number of trips they took to New Bedford Beaches in April through December 1986. Cicchetti, Dubin, and Wilde (1991) find that respondents are relatively accurate in predicting whether they will visit a beach, yet respondents tend to overpredict nonzero beach trips.

The study by Nestor is important because it empirically addresses potential biases associated with CB responses and discrepancies between *ex ante* and actual *ex post* behavioral responses. Nestor (1998) analyzes changes in household trash disposal behavior when fees for trash services are switched from flat fees to volume-based pricing. Using a unique data set, Nestor (1998) is able to supplement observed responses (RP data) to the actual introduction of a volume-based pricing experiment with CB responses to a hypothetical introduction of volume-based pricing. The results from Nestor's (1998) study are mixed; in some cases, she finds some evidence of information and strategic bias in CB responses. Overall, however, Nestor (1998) finds that households correctly predict a negative response to volume-based pricing; this is consistent with economic theory. Nestor (1998) concludes that CB is a valid approach for evaluating policies if data are collected to control for strategic bias.

The validity experiment used in this study is original because of uniqueness of obtaining pre-policy contingent behavior data (i.e., **SP1** and **SP2**) and post-policy revealed preference behavior data (i.e., **post-RP**), in which both sources of climbing trip data are based on similar changes in site access conditions.[64] As a caveat, however, differences in site access policies make the validity test interesting. Recall **post-RP** trip data are based on more severe restrictions in site access. In this study, criterion and construct validity tests are employed where pre-policy SP trip data can be compared with pre-policy and post-policy revealed behavioral responses (i.e., **pre-RP** and **post-RP);** this type of analysis represents a combination of CB validity tests (4) and (5).

In this study, criterion validity is used to determine whether SP trip responses are related to RP trip responses; thus, RP trip data are the criteria. In this case, it is assumed that RP trip data are closer to the theoretical construct than the SP trip responses whose validity is being assessed (Mitchell and Carson 1989).

Further, a construct validity test of scope can be conducted by treating Hueco Tanks as a categorically nested good (Carson and Mitchell 1995). Categorical nesting exists when a good G is composed of two or more objects, such as g and its complement g', where neither g nor g' is an empty set and their intersection is empty (Carson and Mitchell 1995). For example, a park area G may be comprised of several areas within the park, where g could be a proper subset of those areas. Hueco Tanks is comprised of four separate areas within the park, where access to all areas constitute the good G, and access

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[64] Because the recreational access policies at Hueco Tanks are primarily related to preserving the rock art, the validity test of CB climbing trip responses must be based on the underlying assumption that the level of access at Hueco Tanks is weakly complementary with rock climbing trips. If conditions of weak complementarity are satisfied, a decrease in access will shift an individual's demand curve back to the left, and thus, the value of access can be measured as the geometric area between two demand curves (with and without access). While the level of access may be weakly complementary with several goods, such as rock art preservation and rock climbing, for simplicity the level of access is assumed here not to be an argument in the demand for any other goods. Following from the assumption of weak complementarity, an individual does not derive utility from an increase in access when climbing trips are zero. Thus, the resource value strictly represents a measure of use because it is associated with the use of the resource measured by climbing trips. This is a valid assumption given that all climbers indicated in their completed surveys that the primary purpose for their visit was to climb or boulder.

to some subset of areas would be *g*. It is always possible to have multiple levels of nests, but to maintain the property of categorical nesting, in each case the lowest category in the nest must be a proper subset of the next higher nest. Table 4–2 describes the level of access to Hueco Tanks being evaluated, and in each case, the study design maintains the property of categorical nesting.

Table 4-2: Level of Access Being Evaluated at Hueco Tanks

Policy Scenario and Trip Response Data	Level of Access Being Evaluated	Number of Available Boulder Problems
Pre-RP Trips	North Mountain East Spur Maze East Mountain West Mountain	1237
SP1 Trips	North Mountain East Spur Maze East Mountain	1127
SP2 Trips	North Mountain East Spur Maze	706
Post-RP Trips	North Mountain	509

To assess the construct validity of SP trip responses, a few assumptions are specified. First, recreation demand for Hueco Tanks is a normal good. Second, respondents get positive marginal utility from *g* even after consuming its complement *g′*. Based on these assumptions, the values for different elements of a good *G* should vary according to differences in the level of inclusion of the good. This means that the value of the good *G* should be greater than the value of a subset *g*. Further, a comparison of values can be made for the different subsets presented in column two of Table 4–2. Referring to column two in Table 4–2, moving up from the bottom of the table, it would be expected that respondents would value each higher (higher refers to location in the table) subset more than lower subsets. Accordingly, this construct validity test represents what is commonly referred to as a test of scope. Thus the hypothesis is:

Hypothesis H_1: Significant changes in site access at Hueco Tanks will cause significant changes in consumer surplus according to the following relationship:

$$CS(\text{pre-RP}) \geq CS(SP1) \geq CS(SP2) \geq CS(\text{post-RP})$$

Testing this hypothesis constitutes a test of scope for a categorically nested good. Evidence in support of $\mathbf{H_1}$ would be evidence of both criterion and construct validity. In section 4.8, this hypothesis is formally tested.

4.6. Count Data Travel Cost Models

In testing $\mathbf{H_1}$**,** several single site (i.e. Hueco Tanks) travel cost demand models are estimated, where RP and SP trip data are pooled in the same model. An advantage of pooling RP and SP trip data in one model is that the researcher can test for differences in empirical results derived from different sources of data. Use of a single site travel cost demand model is likely a defensible approach when the site is somewhat unique (Eiswerth et al. 2000). Indeed Hueco Tanks is a unique climbing resource known to climbers throughout the world; climbers often indicated in their completed surveys that no substitute site for Hueco Tanks exists.

The TCM is an indirect nonmarket valuation procedure that uses survey information on revealed trip expenditures and behavior. In the recreation demand framework, a demand function for a recreational site is estimated with proxies for quantity and price variables. The quantity variable is the number of visits to the site and the price variable is measured as round trip travel expenditures. When RP trip data is supplemented by SP trip data, a pooled travel cost model can be represented by:

$$v_{ij} = f\left(c_{ij}, y_{ij}, sd_i, q_{ijt}, D_t, D_t \times c_{ij}\right), \quad (21)$$

where v_{ij} is the number of observed or intended visits that individual i took to site j, c_{ij} is the travel cost for individual i to site j, y_{ij} is the income available to individual i on their visit to site j, sd_i is a vector of socioeconomic characteristics of individual i, q_{ijt} is a vector of site characteristics experienced by individual i at site j that vary by level of access (or policy scenario) t, D_t is a dummy variable indicating the trip data source t (i.e., **SP1**, **SP2**, and **post-RP**), and $D_t \times c_{ij}$ is the interaction of data source dummy variables and travel costs.

To estimate a travel cost model, the literature suggests the use of count data regression techniques because trips to a site consist entirely of nonnegative integers (Cameron and Trivedi 1998; and Shaw 1988). A number of count data econometric techniques have been applied to travel cost models of recreation demand (Eiswerth et al. 2000; Englin and Cameron 1996; Englin and Shonkwiler 1995; Rosenberger and Loomis 1999; Shaw 1988; Scrogin, Berrens, and Bohara 2000; and Shaw and Jakus 1996). While several econometric techniques are available for the use of count data, this study employs Poisson and Negative Binomial (NB) regression models.

In addition, as a suggested alternative, a bivariate seemingly unrelated Poisson regression model (SUPREME) is used for the joint estimation of RP and SP trip data (Englin, Boxall, and Watson 1998; Gourieroux, Monfort, and Trognon. 1984; King 1989; and Ozuna and Gomez 1994). A bivariate framework exploits a potential correlation between two behavioral responses and thus increases the efficiency of estimates. The following sections describe these regression techniques.

4.6.1. Pooled RP-SP Poisson and Negative Binomial Regression Models

The most commonly used count data models are Poisson and Negative Binomial (NB). Pooled Poisson or NB regression models can be estimated if the systematic variation across demand equations is captured by independent variables.[65]

In the context of visits to a recreation site, the Poisson regression model assumes that v_{ij}, given the vector of regressors $\mathbf{x}_i$ defined in equation (21), is independently Poisson distributed with density (Cameron and Trivedi 1998, 20),

$$f\left(v_{ij}|\mathbf{x}_i\right) = \frac{e^{-l}\, l_i^{v_{ij}}}{v_{ij}\,!} \qquad v_{ij} = 0, 1, 2, \ldots, N, \tag{22}$$

and mean parameter specified as an exponential link function:

$$l_i = \exp\left(\mathbf{x}_i' \boldsymbol{b}\right), \tag{23}$$

where $\boldsymbol{b}$ are the vector of parameters to be estimated. The exponential link function is attractive for count data because it ensures that the parameter $\boldsymbol{l}_i$ is nonnegative. Further, the Poisson regression model assumes that the conditional mean, $\mathrm{E}[v_{ij}|\mathbf{x}_i]$, and variance $\mathrm{V}[v_{ij}|\mathbf{x}_i]$ are equal (i.e., equidispersed):

$$\mathrm{E}\left[v_{ij}|\mathbf{x}_i\right] = \mathrm{V}\left[v_{ij}|\mathbf{x}_i\right] = \exp\left(\mathbf{x}_i' \boldsymbol{b}\right). \tag{24}$$

The log-likelihood function for the Poisson regression model is

$$\ln L = \sum_{i=1}^{N}\left[-\lambda_i + v_{ij}\left\{ f\left(c_{ij}, y_{ij}, sd_i, q_{ijt}, D_t, D_t \times c_{ij}\right)\right\} - \ln\left(v_{ij}\,!\right)\right]. \tag{25}$$

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[65] As an alternative to a pooled-count data model, Englin and Cameron (1996) suggest using panel data methods to handle unobserved individual heterogeneity not captured by explanatory variables. In their study, Englin and Cameron (1996) estimated fixed effects Poisson regression models. Similarly, Rosenberger and Loomis (1999) apply a random effects Poisson regression model to value ranchland to tourists visiting a resort town in the Rocky Mountains.

For count data models emphasis is often placed on the assumption of the correct specification of the conditional mean and variance (Cameron and Trivedi 1998). As an alternative to Poisson, one can specify a distribution that permits more flexible modeling of the variance by relaxing the assumption that the variance equals the mean, yet maintain the assumption that the mean is $\exp(\mathbf{x}_i'b)$. In this framework, a gamma-distributed unobserved individual heterogeneity term is introduced in the Poisson model to take into account the dispersion in the data (Cameron and Trivedi 1998, 71). Using the general notation from Cameron and Trivedi (1998, 62), the conditional variance of v_{ij} is

$$w_i = \mathrm{V}\left[v_{ij} | \mathbf{x}_i\right], \tag{26}$$

where the variance is a function of the mean and a dispersion scale parameter a. The variance, w_i, is generally specified as

$$w_i = l_i + a\, l_i^{2-k}. \tag{27}$$

The k parameter allows the relation between the conditional mean and conditional variance to take a variety of forms. For $k = 1$, the variance is specified as a linear function of the mean; this specification is referred to as the NB1 variance function:

$$w_i = (1 + a)\, l_i. \tag{28}$$

The NB2 variance function sets $k = 0$, where the variance is quadratic in the mean:

$$w_i = l_i + a\, l_i^2. \tag{29}$$

In both the NB1 and NB2 the dispersion parameter a is to be estimated. In a generalized NB (GNB) model both a and k are estimated.

The NB regression models are estimated by maximum likelihood. Assuming independent observations, the log-likelihood function for NB models is

(30) $$\log L = \sum_{i=1}^{n}\left[\ln\left[\Gamma\left(z_i + v_{ij}\right)\right] - \ln\left[\Gamma\left(z_i\right)\right] - \ln v_{ij}! + z_i \ln\left(\frac{z_i}{z_i + l_i}\right) + v_{ij}\ln\left(\frac{l_i}{z_i + l}\right)\right],$$

where

(31) $$z_i = a^{-1} l_i^k .$$

When $k = 1$ and $k = 0$ equation (30) simplifies to the log-likelihood function for the NB1 and NB2 regression models, respectively.

In testing $\mathbf{H_1}$, estimates for consumer surplus (CS) need to be calculated. Following Bockstael, Hanemann and Strand (1984) and given the set of interaction terms ($D_t \times c_{ij}$), the estimated per trip CS for each policy scenario can be calculated as:

(32a) $$CS_{\text{pre-RP}} = -\,{}^{1}\!\big/_{b_{TC(\text{pre-RP})}},$$

(32b) $$CS_{\text{SP1}} = -\,{}^{1}\!\big/_{\left(b_{TC(\text{pre-RP})} + b_{TC(\text{SP1})}\right)},$$

(32c) $$CS_{\text{SP2}} = -\,{}^{1}\!\big/_{\left(b_{TC(\text{pre-RP})} + b_{TC(\text{SP2})}\right)},$$

and

(32d) $$CS_{\text{post-RP}} = -\,{}^{1}\!\big/_{\left(b_{TC(\text{pre-RP})} + b_{TC(\text{post-RP})}\right)}.$$

The term $b_{TC(\text{pre-RP})}$ represents the estimated coefficient on travel costs (i.e., the base category); the terms $b_{TC(\text{SP1})}$, $b_{TC(\text{SP2})}$, and $b_{TC(\text{post-RP})}$ are the estimated coefficients on the interaction of data source dummy variables and travel costs. The average seasonal CS is the product of the mean number of trips and per trip CS (Bockstael, Hanemann, and Strand 1984).

4.6.2. A Seemingly Unrelated Poisson Regression Model

As an alternative to using pooled count data models, a SUPREME is used in this study for the estimation of a system of recreation demand equations (King 1989). In this study, the system is needed for the different behavioral responses of trip data. To implement this modeling strategy, v_{ij}, obtained from either revealed or stated trip data are jointly estimated as a system of recreation demand equations. If recreation demand equations are correlated, a SUPREME provides parameter estimates that are asymptotically more efficient than pooled Poisson estimates (Ozuna and Gomez 1994). The first paper to apply the SUPREME to recreational site demand was Ozuna and Gomez (1994).

Consider the following recreation demand functions:

(33a) $$v_{1i} = b_0 + b_1 c_{1i} + b_2 y_i + b_3 sd_i + b_4 q_{1i} + e_{1i} ,$$

and

(33b) $$v_{2i} = b_0 + b_1 c_{2i} + b_2 y_i + b_3 sd_i + b_4 q_{2i} + e_{2i} ,$$

where y_i and sd_i are defined in equation (21), v_{1i}, v_{2i}, c_{1i}, c_{2i}, q_{1i} and q_{2i} are the number of visits, prices, and quality levels for two different demand equations. Specifically, here the subscripts 1 and 2 represent trip data from pre-policy and contingent (hypothetical) site conditions. For example, the two demand equations may be **pre-RP** or **SP2** trip data. The terms e_{1i} and e_{2i} are the disturbance terms for trip data sources (e.g., **pre-RP** or **SP2**).

If the disturbances are correlated, efficient estimates are obtained using SUPREME (King 1989). Alternatively, if the disturbances are uncorrelated, then single equation Poisson regression models are acceptable. As an additional note, unlike a characteristic of Zellner's Seemingly Unrelated Regression Model, when disturbances are correlated, a SUPREME will yield a more efficient solution than the equation-by-equation Poisson model, even when independent variables from both equations are identical (King 1989).

The SUPREME can be derived from a bivariate Poisson distribution. Following from King (1989, 240), the bivariate Poisson distribution is presented as follows. Let y_1^* and y_2^* and an unobserved component U be independently distributed Poisson variables with means λ_1, λ_2, and ξ, respectively; and let $y_1 = y_1^* + U$ and let $y_2 = y_2^* + U$. Thus, y_1 and y_2 are univariate Poisson variables with parameters $\theta_1 = \lambda_1 + \xi$ and $\theta_2 = \lambda_2 + \xi$, respectively. The term ξ represents the covariance between y_1 and y_2. Thus, y_1 and y_2 together are distributed as bivariate Poisson :

(34) $$Pr\left(y_{1i}, y_{2i} | \theta_{1i}, \theta_{2i}, \xi\right) = \exp\left(\xi - \theta_{1i} - \theta_{2i}\right) \sum_{j=0}^{\min\left(y_{1i}, y_{2i}\right)} \frac{\xi^j}{j!} \frac{\left(\theta_{1i} - \xi\right)^{\left(y_{1i} - j\right)}}{\left(y_{1i} - j\right)!} \frac{\left(\theta_{1i} - \xi\right)^{\left(y_{2i} - j\right)}}{\left(y_{2i} - j\right)!}.$$

To define the SUPREME allow λ_1 and λ_2 to vary over i observations ($i = 1, \ldots, n$). Further, assume the following: (1) $y_{1i}^* \sim \text{Poisson}(\lambda_{1i})$, $y_{2i}^* \sim \text{Poisson}(\lambda_{2i})$, and $U \sim \text{Poisson}(\xi)$; (2) y_{1i}^*, y_{2i}^*, and U are independent at observation i; and (3) for observations i and k, where $i \neq k$, all three random variables are uncorrelated amongst themselves and each other. The observed dependent variables are functions of the unobserved factors y_{1i}^*, y_{2i}^*, and U:

(35) $$y_{1i} = y_{1i}^* + U\,,$$

and

(36) $$y_{2i} = y_{2i}^* + U\,.$$

Thus, y_{1i} and y_{2i} are distributed as bivariate Poisson with parameters given by

(37) $$q_{1i} = l_{1i} + x \,,$$

(38) $$q_{2i} = l_{2i} + x \,,$$

and

(39) $$C\left(y_{1i}, y_{2i}\right) = x \,,$$

where $C(y_{1i}, y_{2i})$ defines the correlation between y_{1i}, and y_{2i}.

Accordingly, the SUPREME maintains the following properties: (1) y_1 for observation i is uncorrelated with y_1 for observation k ($i \neq k$); and (2) y_2 for observation i is uncorrelated with y_2 for observation k ($i \neq k$). Together these properties suggest that there is no serially correlation within each series. However, there is an association between y_1 and y_2 causing a contemporaneous covariance ($\boldsymbol{x}$) between y_1 and y_2 for observation i.

Similar to the equation-by-equation Poisson regression model with exponential mean function (which ensures a nonnegative mean parameter), let $\boldsymbol{q}_{1i}$ and $\boldsymbol{q}_{2i}$ be exponential link functions of exogenous variables and unknown parameters. Thus the conditional means are given by:

(40) $$E\left(y_{1i} | \mathbf{x}_{1i}\right) = \exp\left(\mathbf{x}'_{1i} b_1\right),$$

and

(41) $$E\left(y_{2i} | \mathbf{x}_{2i}\right) = \exp\left(\mathbf{x}'_{2i} b_2\right),$$

where $\mathbf{x}'_{1i}$ and $\mathbf{x}'_{2i}$ are k-dimensional vectors of exogenous variables, and $\boldsymbol{b}_1$ and $\boldsymbol{b}_2$ are the corresponding vectors of parameters to be estimated. The likelihood function of the SUPREME (King 1989, 243) is

(42) $$L = \prod_{i=1}^{n} \exp\left(x - e^{\mathbf{x}'_{1i}\boldsymbol{b}_1} - e^{\mathbf{x}'_{2i}\boldsymbol{b}_2}\right) \sum_{j=0}^{\min(y_{1i},\, y_{2i})} A_{ij},$$

where

(43) $$A_{ij} = \frac{x^{j}}{j!} \; \frac{\left(e^{\mathbf{x}'_{1i}\boldsymbol{b}_1} - x\right)^{(y_{1i}-j)}}{(y_{1i}-j)!} \; \frac{\left(e^{\mathbf{x}'_{2i}\boldsymbol{b}_2} - x\right)^{(y_{2i}-j)}}{(y_{2i}-j)!}$$

The parameter estimates for the SUPREME are obtained by maximizing the log of the likelihood function.

There are several advantages of the SUPREME. First, there is a gain in efficiency over the equation-by-equation Poisson model given a contemporaneous covariance (x) between y_1 and y_2 for observation i exists. Second, the SUPREME permits cross-equation hypothesis testing. Third, there is no need to test for the advantage of joint estimation over equation-by-equation Poisson regressions because this type of test is an automatic by-product of the SUPREME (Ozuna and Gomez 1994).

The average consumer surplus is calculated as the area under the demand curve at the mean level of visits (Ozuna and Gomez 1994). Thus, consumer surplus can be calculated as:

(44a) $$CS_1 = v_1 / \beta_{1TC},$$

and

(44b) $$CS_2 = v_2 / \beta_{2TC},$$

where v_1 and v_2 are the mean level of visits for trip behavioral responses 1 and 2, respectively; and $\boldsymbol{b}_{1\mathrm{TC}}$ and $\boldsymbol{b}_{2\mathrm{TC}}$ are the coefficients on c_1 and c_2, respectively.

4.7. Dependent and Explanatory Variables

As detailed in Section 4.4, climbers provided in their completed surveys detailed information about their actual pre-policy trips to Hueco Tanks during the period April 30, 1997 through May 1, 1998; they also provided information about pre-policy intended visitation to Hueco Tanks under different site access rules. Then in the brief second survey, climbers provided *ex post* policy trip data.

For pooled Poisson and NB regression models the dependent variable is v_{ij}, where v_{ij} is comprised of **pre-RP**, **SP1**, **SP2**, and **post-RP** trip data. Different bivariate combinations of trip data are estimated in a SUPREME. **SP1** and **SP2** intended trip data are constructed by adding (subtracting) the increase (decrease) in intended visitation to pre-RP trips. After eliminating surveys with inconsistent or missing contingent behavior responses, the number of observations for **pre-RP**, **SP1**, and **SP2** trip data is 390.

Table 4-3: Annual Climbing Trips to Hueco Tanks for Various Changes in Site Access

Dependent Trip Variable	Description	Mean[a] (Standard Deviation)
Pre-RP	The annual number of trips taken to Hueco Tanks prior to any restrictions on access were imposed.	5.487 (11.946) [*n* = 390]
SP1	The annual number of trips that would be taken to Hueco Tanks given West Mountain only is closed.	5.226 (11.841) [*n* = 390]
SP2	The annual number of trips that would be taken to Hueco Tanks given West and East Mountains are closed.	3.867 (10.838) [*n* = 390]
Post-RP	The annual number of trips taken to Hueco Tanks after Texas Parks and Wildlife Department restricted access to West and East Mountains and East Spur Maze.	1.335 (6.623) [*n* = 239]
ALL TRIPS	All trip data sources combined	4.677 (11.439) [*n* = 1409]

[a] Does not include trips to Hueco Tanks taken by Non-U.S. residents.

For **post-RP** trip data the number of observations is 239. The mean number of trips for each data source is presented in Table 4–3. For ALL TRIPS, the size of the standard deviation-to-mean ratio of 2.446 is an indication of overdispersion (i.e., a variance in excess of mean), possibly resulting from a large number of zero observations in **SP2** and **post-RP** data sources. Approximately, 42% of climbers stated that they would not take any trips if both East and West Mountain were closed (i.e., 165 zero observations out of 390). By comparison, 199 out of 239 climbers (83%) did not take any trips to Hueco Tanks after the change in policy. Overall, 35% of 1409 observations are zero trips.

Explanatory variables used in the Poisson, NB, and SUPREME are shown in Table 4–4. The independent variables include: travel costs (TC); the number of boulder problems available under various policy site access rules (BPROBLEM); whether climbers spent the majority of their time during their visit(s) to Hueco Tanks at North Mountain (NORTH); dummy variables denoting the trip data source (i.e., **SP1**, **SP2**, and **post-RP**); interaction terms between trip data source dummy variables and travel costs; socioeconomic variables; and indicators of climber experience and type.

For purposes of testing the reliability of CB data, this study uses a rather conservative specification of travel costs. Travel expenditures are calculated as the product of an individual's per mile travel expense and their roundtrip travel miles. In this study, $0.325 is used for per mile travel expenses.[66] The shortest road distance in miles between two zipcodes is calculated using ZIPFIP (Hellerstein et al. 1993).

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[66] $0.325 is the standard mileage rate allowed by the Internal Revenue Service for 1998 business travel expense deductions. This amount takes into account basic car expenses including depreciation, maintenance and repairs, gasoline, oil, insurance, and vehicle registration fees.

Table 4-4: Description of Independent Variables

Variable	Description	Mean (Standard Deviation)
PREDUM	Dummy variable – 1 indicates if data is **pre-RP**, 0 otherwise. This is the base category dropped during estimation.	
DUMSP1	Dummy variable – 1 indicates if data is **SP1**, 0 otherwise.	0.277
DUMSP2	Dummy variable – 1 indicates if data is **SP2**, 0 otherwise.	0.277
POSTDUM	Dummy variable – 1 indicates if data is **post-RP**, 0 otherwise.	0.169
YRCLIMB	Number of years climbing experience. Variable scaled by 100.	0.076 (0.066)
$YRCLIMB^2$	YRCLIMB squared.	0.010 (0.018)
BOULD	Dummy variable – 1 indicates whether the person primarily is a boulderer, 0 otherwise.	0.087 (0.281)
TC	Roundtrip travel miles at $0.325 per mile. Variable scaled by 1000	0.482 (0.385)
BPROBLEM	Number of boulder problems available at Hueco Tanks based on different policy rules (i.e., the number of boulder problems will vary depending on differences in site closure) and climber's ability range. Variable scaled by 1000.	0.731 (0.306)
NORTH	Dummy variable – 1 indicates that a climber spent the majority of her time climbing and bouldering at North Mountain, 0 otherwise.	0.219 (0.413)
KNOW	Dummy variable – 1 indicates the climber had information prior to taking a trip regarding the intent of the Texas Parks and Wildlife Department to propose a climbing management plan for Hueco Tanks, 0 otherwise.	0.661 (0.473)
TCP	Dummy variable – 1 indicates the climber owned a Texas Conservancy Passport, which allowed them to enter Hueco at a user fee discount, 0 otherwise. After the change in site policy (September 1998), TCP could not be used as a user fee discount.	0.222 (0.416)
UNEARNY	The annual amount of a climber's unearned income scaled by 10000.	0.338 (0.992)
MALE	Dummy variable – 1 indicates the climber is male, 0 otherwise.	0.789 (0.408)
TOTHOURS	Total hours an individual worked during the year scaled by 10000.	0.158 (0.078)
HH	Number of members in climber's household.	2.137 (1.184)
PEOPLE	Average number of people traveling with climber to Hueco Tanks (including the climber)	3.140 (2.204)

It also is conjectured that the number of and difficulty of boulder problems or climbs available at a site (BPROBLEM) will influence a climber's demand for climbing at Hueco Tanks. The number of boulder problems at Hueco Tanks will vary by climber ability and by area (i.e., North Mountain, East Mountain, West Mountain, and East Spur Maze). It is conjectured that climbers select areas at Hueco Tanks offering a number of boulder problems comparable with their climbing skills. For example, if a climber can boulder V5 or better (the "V" rating system is used at Hueco Tanks) and there are 100 boulder problems within the climber's ability at an area (versus 20 at another area), then this characteristic is of interest when choosing to boulder at an area. For example, in regards to different areas at Hueco Tanks, if West Mountain is closed and West Mountain offers more difficult boulder problems, better boulderers may be more affected by this closure than less experienced boulderers. Accordingly, the variable BPROBLEM is constructed to take into account these differences, and thus will vary by climber ability and by area.

The dummy variables for trip data sources (**SP1**, **SP2**, and **post-RP**) and the interaction of these variables with travel costs are included in the pooled count data regression models to measure changes in consumer surplus. (These interaction terms are not included in the SUPREME.) To be consistent with hypothesis $\mathbf{H_1}$, the absolute value of the β coefficients on the various TC variables should have the following relationship (refer to equations 32a through 32d):

Hypothesis $\mathbf{H_2}$:

$$\beta_{TC} \le (\beta_{DUMSP1 \times TC} + \beta_{TC}) \le (\beta_{DUMSP2 \times TC} + \beta_{TC}) \le (\beta_{DUMPOST \times TC} + \beta_{TC})$$

Hypothesis $\mathbf{H_2}$ indicates that changes in site access should result in significant differences in parameter estimates on travel costs, and thus correspondingly different estimates of consumer surplus.

4.8. A Taxonomy of Results for Different Count Models

Several different count data models are estimated to answer the following research questions: (1) what are the economic losses to climbers due to restrictions in site access to Hueco Tanks; (2) how valid are CB data on rock climbing at a Hueco Tanks by testing $\mathbf{H_1}$; and (3) should a SUPREME be used to jointly estimate RP and SP data? The first question is answered by estimating pooled count data models and a SUPREME. The second question is answered by estimating pooled Poisson and several NB regression models and testing for differences in empirical results derived from different sources of data.

4.8.1. Pooled Poisson and Negative Binomial Regression Models

Results for pooled Poisson and NB regression models are presented in Table 4–5. Note in each pooled NB model the estimated α parameter is highly significant; thus, the null of Poisson (H_0: $\alpha = 0$) is rejected. Perhaps, because of the number of zero observations associated with greater restrictions in site access, this result is not surprising. Further, t-tests and likelihood ratio (LR) tests indicate that the GNB model (see bottom section of Table 4–5) is favored over NB1 and NB2 models. Given the results of these selection tests, the remainder of this section will discuss the results from the pooled GNB regression model.

Table 4-5: Parameter Estimates for Pooled Poisson and NB Regression Models

Variable	Poisson	NB1	NB2	GNB
Intercept	0.944***[a]	0.798***	0.273	0.246
	(8.50)[b]	(3.78)	(1.16)	(1.14)
DUMSP1	0.138*	0.081	0.170	0.201
	(1.78)	(0.61)	(1.02)	(1.33)
DUMSP2	0.758***	0.241	0.649***	0.712***
	(8.25)	(1.32)	(3.36)	(3.99)
POSTDUM	0.452***	-0.664**	0.504**	0.618***
	(4.50)	(-2.43)	(2.21)	(2.91)
YRCLIMB	-13.479***	-7.915***	-11.549***	-10.427***
	(-13.31)	(-4.44)	(-5.20)	(-4.92)
$YRCLIMB^2$	35.015***	14.755**	23.814***	19.971**
	(8.42)	(2.11)	(2.75)	(2.43)
BOULD	0.121***	0.226**	0.444***	0.542***
	(2.98)	(2.50)	(3.63)	(3.95)
TC	-4.969***	-1.972***	-2.840***	-2.733***
	(-34.89)	(-11.29)	(-15.91)	(-16.53)
DUMSP1×TC	-0.086	-0.032	-0.072	-0.077
	(-0.43)	(-0.14)	(-0.29)	(-0.35)
DUMSP2×TC	-2.015***	-0.728**	-1.180***	-1.204***
	(-8.11)	(-2.39)	(-3.87)	(-4.29)
POSTDUM×TC	-5.836***	-2.610***	-5.850***	-6.050***
	(-9.47)	(-2.77)	(-6.59)	(-7.21)
BPROBLEM	1.952***	1.359***	1.967***	1.856***
	(19.60)	(7.67)	(9.18)	(9.17)
NORTH	0.381***	0.466***	0.460***	0.384***
	(12.26)	(7.05)	(5.38)	(4.46)
KNOW	0.339***	0.421***	0.449***	0.406***
	(6.38)	(4.10)	(3.76)	(3.58)
DUMSP1×KNOW	0.016	-0.025	-0.037	-0.077
	(0.20)	(-0.18)	(-0.21)	(-0.48)
DUMSP2×KNOW	0.031	0.040	0.001	-0.044
	(0.38)	(0.25)	(0.002)	(-0.25)
TCP	0.777***	0.577***	0.770***	0.719***
	(26.23)	(8.61)	(9.43)	(8.67)
UNEARNY	0.023	0.079**	0.028	0.022
	(1.38)	(2.21)	(0.68)	(0.60)
MALE	-0.137***	-0.150**	-0.204**	-0.181*
	(-3.53)	(-1.99)	(-2.11)	(-1.92)
TOTHOURS	1.008***	0.582	0.558	0.450
	(5.65)	(1.46)	(1.30)	(1.14)
HH	0.036***	0.066***	0.053*	0.054**
	(4.46)	(2.88)	(1.96)	(1.97)
PEOPLE	0.001	-0.004	0.018	0.024
	(0.001)	(-0.26)	(1.00)	(1.36)

Variable	Poisson	NB1	NB2	GNB
a	[*a* = 0]	5.870*** (14.22)	0.856*** (16.35)	0.400*** (5.69)
k	—	[*k* = 1]	[*k* = 0]	-0.477*** (-4.70)
Number of Observations	1409	1409	1409	1409
LnL	-3955.557	-2825.423	-2608.530	-2592.942
Likelihood Ratio Index[c]	0.602	0.286	0.341	0.344
Selection Test from the GNB Model[d]	t-test for NB1 [H_0: *k* = 1] t=-5.15*** t-test for NB2 [H_0: *k* = 0] t=-4.70*** LR test for NB1 [H_0: *k* = 1] χ^2=464.96*** LR test for NB2 [H_0: *k* = 0] χ^2=31.18***			

[a] ***, **, and * denote the estimate is significantly different than zero at the 0.01, 0.05, and 0.10 levels, respectively.
[b] Numbers in parentheses are the ratio of the estimated coefficient to the aysmptotic standard error.
[c] The likelihood ratio index for Poisson is defined as 1-(LnL_{fit}/$LnL_{restricted}$), where LnL_{fit} and $LnL_{restricted}$ are the LnL values for the fitted and intercept-only models (Cameron and Trivedi 1998,155). The likelihood ratio index for the negative binomials is defined as 1-(LnL_{NB}/LnL_{fit}), where the subscript NB refers to NB1, NB2, and GNB.
[d] The hypotheses in brackets represent the implied restrictions in the GNB model. The likelihood ratio (LR) test statistic is defined as $-2[LnL_{restricted} - LnL_{GNB}]$, where the restricted model is either NB1 or NB2, and the fitted model is GNB. The LR test is distributed as χ^2 with ($K_{GNB} - K_{restricted}$) degrees of freedom, where *K* refers to the numbers of estimated coefficients in each type of model.

Overall, the GNB model performs quite well with a number of estimates significant at the 0.01 level. The coefficient on YRCLIMB is negative and significant at the 0.01 level, while the coefficient on the quadratic term of YRCLIMB ($YRCLIMB^2$) is positive and significant at the 0.01 level; thus suggesting a U-shaped relationship exists between the number trips and years climbing experience. Because Hueco Tanks is primarily a bouldering area and climbers generally do not need to be skilled in climbing protective gear (something that generally comes with years of experience), these results are not surprising. Climbers with minimal experience can find many bouldering opportunities at Hueco Tanks. Further, the results show that those climbers who tend to consider themselves primarily boulderers (BOULD) will take more trips to Hueco Tanks than will those who do not consider themselves primarily boulderers. The only socioeconomic variables that affect visits are MALE and HH; the coefficient on MALE is negative and significant at the 0.10 level and the coefficient on HH is positive and significant at the 0.05 level.

Overall the estimated coefficients on TC, BPROBLEM, NORTH, KNOW, and TCP are strong determinants of trip-taking behavior to Hueco Tanks; the coefficients on these site specific variables are significant at the 0.01 level. The estimated coefficient on TC is negative as expected. The number of boulder problems (BPROBLEM) available to an individual (depending on site closure differences and climber ability) has an expected positive sign. The estimated coefficients on NORTH, KNOW, and TCP are positive, thus suggesting that climbers who prefer North Mountain, who had prior knowledge regarding the possibility of site closure, and who owned a TCP pass were likely to take more trips to Hueco Tanks.

The coefficients of interest are those on the trip data source dummy variables and the interaction of these dummy variables with TC and KNOW; the estimated coefficients on these dummy variables and interaction terms are mixed. The estimated coefficients on DUMSP2 and DUMPOST are positive and significant at the 0.01 level. The coefficients on DUMSP2×TC and DUMPOST×TC are negative and highly significant at the 0.01

level. The coefficients on DUMSP1×KNOW and DUMSP2×KNOW are not significant. What these results suggest is that climber trip behavior changes significantly when an increasing number of areas at Hueco Tanks are closed; this result is expected. Further, it appears that climbers did not respond strategically to CB questions based on their prior knowledge (DUMSP1×KNOW and DUMSP2×KNOW) of the possibility of site closure.

After fully reviewing the model results, the question of whether CB responses are valid for evaluating policy changes in the context of rock climbing at Hueco Tanks can now be addressed more specifically. To test $\mathbf{H_2}$ and correspondingly $\mathbf{H_1}$, a Wald test is conducted to explore differences in parameter estimates. A Wald test provides the appropriate hypothesis test for differences in trip behavioral responses because of the consistency of the covariance matrix (Gourieroux, Monfort, and Trognon 1984). The null hypothesis is the following set of independent restrictions:

$$\mathbf{H_3}: \boldsymbol{b}_{TC} = (\boldsymbol{b}_{DUMSP1 \times TC} + \boldsymbol{b}_{TC})$$

$$\mathbf{H_4}: \boldsymbol{b}_{TC} = (\boldsymbol{b}_{DUMSP2 \times TC} + \boldsymbol{b}_{TC})$$

$$\mathbf{H_5}: \boldsymbol{b}_{TC} = (\boldsymbol{b}_{DUMPOST \times TC} + \boldsymbol{b}_{TC})$$

$$\mathbf{H_6}: \boldsymbol{b}_{DUMSP1 \times TC} = \boldsymbol{b}_{DUMSP2 \times TC}$$

$$\mathbf{H_7}: \boldsymbol{b}_{DUMSP1 \times TC} = \boldsymbol{b}_{DUMPOST \times TC}$$

$$\mathbf{H_8}: \boldsymbol{b}_{DUMSP2 \times TC} = \boldsymbol{b}_{DUMPOST \times TC}$$

The results of the Wald tests are relevant to the issue of criterion and construct validity in testing $\mathbf{H_1}$ because the set of hypotheses tests determine whether visitation data exhibit statistically significant differences across substantial changes in site access; this is the test of scope. The results of these hypotheses tests are listed in Table 4–6.

Table 4-6: Hypotheses Tests for Validity

Hypothesis Test	Description of Hypothesis Test[a]	χ^2
H_3	$\boldsymbol{b}_{TC} = \boldsymbol{b}_{DUMSP1\times TC} + \boldsymbol{b}_{TC}$	0.047
H_4	$\boldsymbol{b}_{TC} = \boldsymbol{b}_{DUMSP2\times TC} + \boldsymbol{b}_{TC}$	9.32***[b]
H_5	$\boldsymbol{b}_{TC} = \boldsymbol{b}_{DUMPOST\times TC} + \boldsymbol{b}_{TC}$	46.82***
H_6	$\boldsymbol{b}_{DUMSP1\times TC} = \boldsymbol{b}_{DUMSP2\times TC}$	15.79***
H_7	$\boldsymbol{b}_{DUMSP1\times TC} = \boldsymbol{b}_{DUMPOST\times TC}$	50.50***
H_8	$\boldsymbol{b}_{DUMSP2\times TC} = \boldsymbol{b}_{DUMPOST\times TC}$	32.21***

[a] The estimated coefficients on travel costs are -2.733, -2.813, -3.937, -8.783 for $\boldsymbol{b}_{TC}$, $\boldsymbol{b}_{TC} + \boldsymbol{b}_{DUMSP1\times TC}$, $\boldsymbol{b}_{TC} + \boldsymbol{b}_{DUMSP2\times TC}$, and $\boldsymbol{b}_{TC} + \boldsymbol{b}_{DUMPOST\times TC}$, respectively.
[b] *** denotes that the $\boldsymbol{b}$ coefficients are significantly different than each other at the 0.01 level.

The results of the Wald tests imply that consumer surplus will be statistically different across major differences in site closures at Hueco Tanks. For a minor change in site access (closing West Mountain consisting of approximately 9% (110/1237) of the total number of boulder problems at Hueco Tanks), the sum of the coefficients on TC and DUMSP1×TC are not statistically different than the coefficient on TC alone; that is, the null hypothesis that the coefficient on DUMSP1×TC is not statistically different than zero is not rejected. When East Mountain is closed too, the number of boulder problems available in the remaining two open areas is 706, representing 57% of the original total. Thus, as expected, this major change in site access will lead to substantially different estimates (see hypotheses tests 4 and 6). Hypotheses 5, 7 and 8 show that $\boldsymbol{b}_{DUMPOST\times TC}$ is statistically different from zero, $\boldsymbol{b}_{DUMSP1\times TC}$ and $\boldsymbol{b}_{DUMSP2\times TC}$. As was conjectured, the sum of the coefficients on TC and DUMSP1×TC, and TC and DUMSP2×TC lie within the values of the coefficients on TC and the sum of the coefficients on TC and DUMPOST×TC. These results support $\mathbf{H_2}$.

The coefficients on the various TC variables are used to measure per trip CS. Estimates of CS are presented in Table 4–7. As was hypothesized in $\mathbf{H_1}$, consumer surplus measures get increasingly smaller as more sites are closed at Hueco Tanks. The average seasonal loss to climbers due to restricted access to two areas (East and West Mountain) is $477 per climber. The average seasonal loss to climbers due to the actual policy change (three areas are closed) is $1074 per climber.

Table 4-7: Individual Per Trip Consumer Surplus Loss Measures from GNB Model

Policy Change	Trip Data[a]	Per Trip Consumer Surplus
Open access to four mountain areas at Hueco Tanks	**Pre-RP**	$366***[b] (22.13)[c]
Open access to three mountain areas at Hueco Tanks (West Mountain closed)	**SP1**	$355*** (45.02)
Open access to two mountain areas at Hueco Tanks (West and East Mountain closed)	**SP2**	$254*** (25.44)
Open access to one mountain area (North Mountain) at Hueco Tanks; however, additional access restrictions apply.	**Post-RP**	$114*** (11.46)

[a] The mean number of trips is 4.26.
[b] *** denotes that the estimate is significantly different than zero at the 0.01 level.
[c] Standard errors in parentheses. These standard errors are calculated using the Delta Method Approximation (Greene 1997, 278).

In summary, the results from the Wald test support the validity of CB trip data (at least in the case of rock climbing at Hueco Tanks) and do not suggest that climbers overstate changes in their trip-taking behavior in their responses to CB questions. Specifically, climbers are able to project the direction of their behavioral response to area closures in a way that is consistent with economic theory; in this case, climbers demand for climbing at Hueco Tanks decreases as more areas are closed within the park.[67]

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[67] A concern with these results may be related to the one-year lapse in time between surveys, in which average climate conditions or climber tastes and preferences may differ from the previous year. Average temperatures in El Paso during the **post-RP** trip period were 2.27° Fahrenheit higher and precipitation was 0.15" lower than average temperatures and precipitation during the **pre-RP** trip period (data provided by the El Paso Climate Directory at http://nwselp.epcc.edu/elp/wxclim.html). It is conjectured that higher temperatures and lower precipitation are positively correlated with trips. It was not possible to include climate data in the regressions, as this data does not vary across individuals. Further, differences in climber preferences that may have occurred between the two survey periods were not captured in the models.

4.8.2. Seemingly Unrelated Poisson Regression Model

Now that is has been determined that SP trip data are valid and can be used to supplement RP trip data, at least in the context of rock climbing at Hueco Tanks, the question of the appropriate estimation technique can be addressed. This question is answered by determining whether RP and SP trip data should be estimated jointly.

As an alternative to pooling RP and SP data, a SUPREME is suggested for the joint estimation of different behavioral sources of trip data for a single site. Four different SUPREMEs are estimated. In SUPREME I, **pre-RP** and **SP1** trip data are jointly estimated; in SUPREME II, **pre-RP** and **SP2** trip data are jointly estimated; in SUPREME III, **pre-RP** and **post-RP** trip data are jointly estimated; and in SUPREME IV, **SP2** and **post-RP** trip data are jointly estimated. SUPREME I and II are presented in Table 4–8. SUPREME III and IV are presented in Table 4–9.

Table 4-8: SUPREME I and II Results

	SUPREME I		SUPREME II	
Variable	**Pre-RP**	**SP1**	**Pre-RP**	**SP2**
INTERCEPT	0.944**[a]	1.385***	1.090***	1.261**
	(2.19)[b]	(3.30)	(2.71)	(2.55)
YRCLIMB	-13.016***	-1.226***	-13.633***	-15.700***
	(-2.94)	(-2.81)	(-3.42)	(-2.82)
$YRCLIMB^2$	31.790*	0.295	37.231**	43.690*
	(1.75)	(1.57)	(2.64)	(1.90)
BOULD	-0.023	0.056	-0.004	-0.047
	(-0.11)	(0.29)	(-0.02)	(-0.17)
TC	-5.091***	-6.100***	-5.045***	-7.783***
	(-11.60)	(-11.62)	(-11.90)	(-12.05)
BPROBLEM	1.951***	1.920***	1.749***	3.009***
	(5.67)	(4.86)	(5.03)	(3.88)
NORTH	0.443***	0.315*	0.418***	0.429**
	(2.93)	(1.87)	(2.70)	(2.12)
KNOW	0.473***	0.326*	0.455***	0.193
	(2.74)	(1.93)	(2.78)	(1.00)
TCP	0.698***	0.712***	0.725***	0.905***
	(5.00)	(4.88)	(5.50)	(5.01)
UNEARNY	0.072	0.021	0.073	0.042
	(0.94)	(0.19)	(1.00)	(0.35)
MALE	-0.296*	-0.165	-0.177	0.009
	(-1.91)	(-0.87)	(-1.00)	(0.05)
TOTHOURS	1.061	0.514	0.911	0.645
	(1.07)	(0.53)	(0.97)	(0.51)
HH	0.038	0.034	0.043	0.035
	(1.21)	(1.00)	(1.35)	(0.86)
PEOPLE	0.095	0.003	0.006	0.005
	(0.34)	(0.01)	(0.22)	(0.15)
x	0.025		0.007	
	(2.03)**		(2.13)**	
LnL	-2249.31		-2180.28	
Number of Observations	390		390	

[a] ***, **, and * denote the estimate is significantly different than zero at the 0.01, 0.05, and 0.10 levels, respectively.
[b] Numbers in parentheses are the ratio of the estimated coefficient to the heteroscedasticity consistent standard error.

Table 4-9: SUPREME III and IV Results

	SUPREME III		SUPREME IV	
Variable	**Pre-RP**	**Post-RP**	**SP2**	**Post-RP**
INTERCEPT	1.498**[a]	0.314	1.439*	0.507
	(2.20)[b]	(0.25)	(1.70)	(0.38)
YRCLIMB	-16.004***	-31.301*	-18.147***	-31.026*
	(-3.49)	(-1.84)	(-2.63)	(-1.84)
$YRCLIMB^2$	45.330***	105.110*	54.730**	105.050*
	(2.62)	(1.78)	(2.04)	(1.78)
BOULD	0.263	0.336	-0.006	0.389
	(1.11)	(0.57)	(-0.02)	(0.67)
TC	-4.044***	-12.720***	-6.520***	-13.460***
	(-9.17)	(-3.35)	(-6.11)	(-3.80)
BPROBLEM	1.235***	6.465*	2.526***	5.982
	(2.86)	(1.93)	(2.76)	(1.63)
NORTH	0.592**	-0.030	0.569**	-0.035
	(2.54)	(-0.04)	(2.00)	(-0.04)
KNOW	0.546***	0.278	0.292	0.397
	(3.75)	(0.80)	(1.18)	(1.16)
TCP	0.988***	0.411	1.272***	0.482
	(4.89)	(0.99)	(5.18)	(1.11)
UNEARNY	0.102	-0.415*	0.088	-0.450*
	(1.42)	(-1.93)	(0.82)	(-1.82)
MALE	0.065	-0.342	0.058	-0.361
	(0.25)	(-0.70)	(0.17)	(-0.71)
TOTHOURS	0.453	4.899	0.128	4.837
	(0.38)	(1.61)	(0.07)	(1.50)
HH	0.030	-0.110	0.021	-0.139
	(0.59)	(-0.69)	(0.28)	(-0.84)
PEOPLE	-0.093*	0.085	-0.067	0.087
	(-1.82)	(0.87)	(-1.22)	(0.89)
x	-0.130		-0.006	
	(-1.04)		(-0.79)	
LnL	-1029.20		-975.72	
Number of Observations	239		239	

[a] ***, **, and * denote the estimate is significantly different than zero at the 0.01, 0.05, and 0.10 levels, respectively.
[b] Numbers in parentheses are the ratio of the estimated coefficient to the heteroscedasticity consistent standard error.

For SUPREME I and II, the χ parameters are statistically significantly different from zero indicating that **pre-RP** and **SP1** trip data sources, and **pre-RP** and **SP2** trip data sources are correlated; whereas for SUPREME III and IV, the χ parameters are not statistically significantly different from zero indicating that the trip behavioral responses are not correlated. These results support the use of a SUPREME when CB is used as a supplement to RP data, especially when CB trip data are obtained from the same survey instrument as the RP trip data. For comparison of SUPREME I and II results, **pre-RP**, **SP1**, and **SP2** trips are estimated using single equation Poisson regression models. Results for single equation Poisson regression models are presented in Table 4–10.

The remainder of this section focuses on the comparison of results between single equation Poisson models and SUPREME. Most, but not all, of the parameter estimates from SUPREME I and II are comparable to those obtained in the single equation Poisson models. Generally, however, it appears that single equation Poisson models overpredict the significance of most coefficients. It is not surprising to find differences in estimates because the χ parameters are significantly different than zero at the 0.05 level in both SUPREME specifications. Further, a likelihood ratio test (LR) indicates that SUPREME is superior to single equation Poisson Models (see bottom of Table 4–10).

Table 4-10: Equation Poisson Regressions

	Single Equation POISSON			
Variable	**Pre-RP**	**SP1**	**SP2**	**Post-RP**
INTERCEPT	1.092**[a]	1.158***	1.109**	0.449
	(2.54)[b]	(2.67)	(2.20)	(0.33)
YRCLIMB	-12.759***	-12.607***	-14.941***	-31.752*
	(-3.04)	(-2.90)	(-2.75)	(-1.72)
$YRCLIMB^2$	31.800*	30.980*	40.690*	108.890*
	(1.89)	(1.73)	(1.83)	(1.68)
BOULD	0.027	0.065	0.032	0.424
	(0.14)	(0.30)	(0.12)	(0.67)
TC	-4.900***	-5.082***	-6.871***	-13.730***
	(-11.59)	(-11.11)	(-10.47)	(-4.37)
BPROBLEM	1.732***	1.961***	3.121***	6.201*
	(4.99)	(5.03)	(4.00)	(1.71)
NORTH	0.431***	0.389**	0.463**	0.052
	(2.82)	(2.33)	(2.22)	(0.07)
KNOW	0.463***	0.344**	0.227	0.418
	(2.76)	(1.96)	(1.14)	(1.11)
TCP	0.693***	0.717***	0.878***	0.563
	(5.03)	(4.71)	(4.92)	(1.25)
UNEARNY	0.074	0.043	0.057	-0.441*
	(0.95)	(0.42)	(0.47)	(-1.91)
MALE	-0.187	-0.194	-0.041	-0.472
	(-1.08)	(-1.05)	(-0.19)	(-1.00)
TOTHOURS	1.002	0.761	0.682	5.050
	(1.03)	(0.74)	(0.53)	(1.41)
HH	0.046	0.041	0.044	-0.138
	(1.44)	(1.12)	(1.08)	(-0.76)
PEOPLE	0.001	0.005	-0.011	0.081
	(0.04)	(0.15)	(-0.29)	(0.82)
LnL	-1190.79	-1219.01	-1062.56	-357.03
Number of Observations	390	390	390	239
Likelihood Ratio Tests for SUPREME[c]	SUPREME I: $\chi^2 = 320.98$*** SUPREME II: $\chi^2 = 146.14$***			

[a] ***, **, and * denote the estimate is significantly different than zero at the 0.01, 0.05, and 0.10 levels, respectively.
[b] For single equation Poisson regression models, numbers in parentheses are the ratio of the estimated coefficient to the heteroscedasticity consistent standard error.
[c] LR test statistic is defined as $-2[LnL_{SUPREME} - LnL_{\Sigma}]$, where the subscribt Σ refers to the sum of the LnL values for single equation Poissons for the same trip data specified in SUPREME. The LR test is distributed as χ^2 with $(K_{SUPREME} - K_{\Sigma})$ degrees of freedom. The null hypothesis is that single equation Poisson models are as efficient.

Another advantage of the SUPREME is that it permits the testing of cross-equation hypothesis testing (King 1989). A cross-equation hypothesis test is conducted for the equality of TC parameter estimates for **pre-RP** and **SP1** data and for **pre-RP** and **SP2** data. Using a Wald test, the χ^2 statistics are equal to 17.67 and 53.00 for SUPREME I and II, respectively; thus the null hypothesis that single equation Poisson regression models are as efficient is rejected.

Following equations (44a) and (44b), the per trip and seasonal CS estimates for each policy scenario can be calculated. The CS estimates are presented in Table 4–11. From SUPREME I, the per trip and seasonal CS estimates are approximately $196 and $1078 for unrestricted access (i.e., **pre-RP** trip data), and $164 and $857 for a one-area site restriction (i.e., **SP1** trip data) at Hueco Tanks. The corresponding seasonal loss in CS is $221. From SUPREME II, the per trip and seasonal CS estimates are approximately $198 and $1088 for unrestricted access (i.e., **pre-RP** trip data), and $128 and $497 for a two-area site restriction (i.e., **SP2** trip data) at Hueco Tanks. Thus, the seasonal loss in consumer surplus due to closing East and West Mountains in Hueco Tanks is $591. Finally, from SUPREME III, the per trip and seasonal CS measures are $247 and $1357 for unrestricted access, and $79 and $105 for a three-area restriction. For a three-area restriction in access, the seasonal CS loss is $1252.

For comparison, average CS estimates are calculated from the single equation Poisson regression results. The per trip and seasonal CS estimates are $204 and $1120 for unrestricted access; $197 and $1028 for a one-area site restriction; $146 and $563 for a two-area site restriction; and $73 and $97 for a three-area site restriction. The corresponding seasonal losses in CS are $92, $557, and $1023 for one, two, and three-area restrictions, respectively. The single equation Poisson CS losses are slightly different than those from the SUPREMEs. However, the finding that the x parameter is statistically significant implies that estimates from SUPREME I and II are more efficient than single equation Poisson estimates.

Table 4-11: Seasonal Consumer Surplus: A Comparison of SUPREME and Poisson

	Pre-RP	**SP1**	**SP2**	**Post-RP**	**Seasonal CS Losses**
SUPREME I	$1078 ($196)***[a] [16.94][b]	$857 ($164)*** [14.12]	—	—	$221 [one-area closure]
SUPREME II	$1088 ($198)*** [16.66]	—	$497 ($128)*** [10.65]	—	$591 [two-area closure]
SUPREME III	$1357 ($247)*** [26.96]	—	—	$105 ($79)*** [23.45]	$1252 [three-area closure]
Poisson	$1120 ($204)*** [17.61]	$1028 ($197)*** [17.71]	$563 ($146)*** [13.90]	$97 ($73)*** [16.68]	$92 [one-area closure] $557 [two-area closure] $1023 [three-area closure]

[a] Amounts in parentheses represent per trip consumer surplus estimates. *** denotes that the estimate is significantly different than zero at the 0.01 level.
[b] Amounts in square brackets are the standard errors for per trip consumer surplus measures. These standard errors are calculated using the Delta Method Approximation (Greene 1997, 278).

Two shortcomings of the SUPREME are worth mentioning. First, as currently developed, King's SUPREME is limited to two seemingly unrelated regressions because it is based on the bivariate Poisson distribution. Gourieroux, Monfort, and Trognon (1984) state that the bivariate Poisson model can be generalized for the case of more than two count variables; this would be a likely avenue for future research. Second, the SUPREME assumes that the conditional mean and variance are equidispersed. When the data present overdispersion, SUPREME will produce estimates that are not efficient.

Pooled NB results showed that the trip data used here present overdispersion; thus, a more efficient estimation procedure should be sought.

4.9. Conclusions

In 1998, TPWD severely restricted open-recreational access at Hueco Tanks State Park. TPWD believed that increased popularity of Hueco Tanks as a world-class climbing destination threatened the park's archeological and ecological resources. The objectives of this nonmarket valuation study were to value the loss of access to rock climbers, to take advantage of a unique opportunity to test the validity of contingent behavior data, and to propose a SUPREME for the joint estimation of RP and SP trip data.

To measure economic losses to climbers and to test the validity of pre-policy CB responses, two separate surveys were implemented to collect trip data from climbers before and after the policy change. The first survey was conducted in the spring of 1998 and the second in the spring of 1999. The first survey was implemented prior to the restriction in open-recreational access. In this survey, climbers who had visited Hueco Tanks were surveyed about their actual rock climbing trips and intended trips under alternative policy rules (i.e., pre-policy rules) restricting access. The second survey was administered after the restriction on access was imposed; in this survey climbers were surveyed about their actual post-policy rock climbing trips.

The post-policy revealed preference trip data was used to test the validity of pre-policy contingent behavior data; this entailed a combination of criterion and construct validity tests for CB. The criteria for CB pre-policy trip responses were pre and post-policy RP trip data. The construct validity involved determining whether respondents SP trip responses were related to pre and post-policy RP trip data in a manner expected by theory.

Results from pooled count data regression models indicate that climbers are able to project the direction of their response to site access restrictions and that they do not appear to overstate their change in trip behavior. The scope analysis shows that climbers value access at Hueco Tanks in a manner consistent for categorically nested goods. For example, per trip consumer surplus for access to two areas (i.e., **SP2**) at Hueco Tanks is $254 per climber versus $114 per climber for access to one area (i.e., **post-RP**). These results suggest that methods of augmenting RP data sets with SP trip data show promise as a tool for public land management decisions. However, a remaining question is determining what estimation procedure should be used for the estimation of RP and SP trip data.

A secondary objective of this chapter addresses this question; what is the most efficient estimation procedure for the estimation of RP and SP trip data? This study adds to the existing literature on recreation demand that combines RP and SP trip data in that it proposes a seemingly unrelated Poisson regression model (SUPREME) for the estimation of a system of recreation equations. In this study, the system of equations is determined by the sources of the trip data (i.e., RP and SP trip data). The findings suggest that SUPREME provides estimates that are asymptotically more efficient than equation-by-equation Poisson estimates. However, two limitations of SUPREME are presented. First, SUPREME is limited to two seemingly unrelated regression equations. Second, an underlying assumption of SUPREME is that the conditional mean and variance are equidispersed. When the data present overdispersion, as do the trip data used in this study, SUPREME will produce estimates that are not efficient; a more efficient estimation procedure should be sought.

The contributions of this research are thus twofold. First, it is the first study to conduct a validity test on CB recreation data that combines *ex ante* and *ex post* policy trip data. Other CB validity studies exist, but none have been able to explore the accuracy of pre-policy CB visitation data with *ex post* policy trip data. Second, it is the first study to suggest the use of SUPREME for the joint estimation of RP and SP trip data. Overall, the findings of this study suggest that indeed SP trip data are a valuable supplement to RP data when policy questions are outside the domain of observed behavior, and that RP and SP trip data should be estimated as a joint system of equations.

5. CHAPTER 5: Summary Comments and Avenues for Future Research

5.1. Chapter Summaries

The public management of rock climbing access in federal and state public lands has been an issue of considerable recent controversy in the U.S. The overriding objective of this dissertation was to estimate the economic losses to rock climbers associated with restrictions in rock climbing access on federal and state public lands. The motivation for this research was based on an emerging institutional trend in public land management to ration rock climbing on public lands. Two of the most highly publicized cases were the U.S. Forest Service's initiative to ration rock climbing in U.S. Forest Service wilderness areas, and Texas Parks and Wildlife Department's initiative to restrict climbing access at Hueco Tanks Texas State Park.

In 1998 the U.S. Forest Service (USFS) announced intent to impose a policy prohibiting the use of climbing safety anchors in wilderness areas—essentially eliminating wilderness area climbing. Prior to this action by the USFS, the Bureau of Land Management (BLM) and the National Park Service (NPS) proposed similar rules for rock climbing on public lands under their care. As of this writing, however, the BLM and the NPS stated to hold off on implementing or writing any new policy rules for rock climbing until the USFS has determined its final policy (Access Fund 1999). In addition, during the fall of 1998, Texas Parks and Wildlife Department (TPWD) severely restricted open-recreational access at Hueco Tanks State Park due to growing numbers of climbers visiting the park.

This dissertation is primarily comprised of three separate, but typically related, manuscripts. In chapter 2 an overview of the institutional arrangements governing USFS wilderness areas was presented. This overview of institutional arrangements governing USFS wilderness areas was important for discerning whether climber preferences warrant consideration in a full benefit-cost analysis. Chapter 2 concluded by arguing that if the economic losses to climbers resulting from the USFS policy proposal exceed $100 million annually, the USFS would be need to conduct a full benefit-cost analysis comparing the economic losses of climbing access restrictions with the benefits of wilderness preservation (Executive Orders 12866 and 12291).

In Chapter 3, a repeated-discrete choice random utility model was used to determine whether the annual economic losses to climbers, resulting from the USFS policy proposal, exceed $100 million. To implement this modeling strategy, this dissertation used unique survey data on trip-taking behavior for 597 climbers living throughout the U.S.; the data accounted for approximately 13,000 trips to 60 nationally dispersed climbing areas. Results showed that restricting climbing access in USFS wilderness areas has an economic loss to climbers of more than $100 million, thus providing *prima facie* evidence that the proposal by the USFS may constitute a major regulatory change.

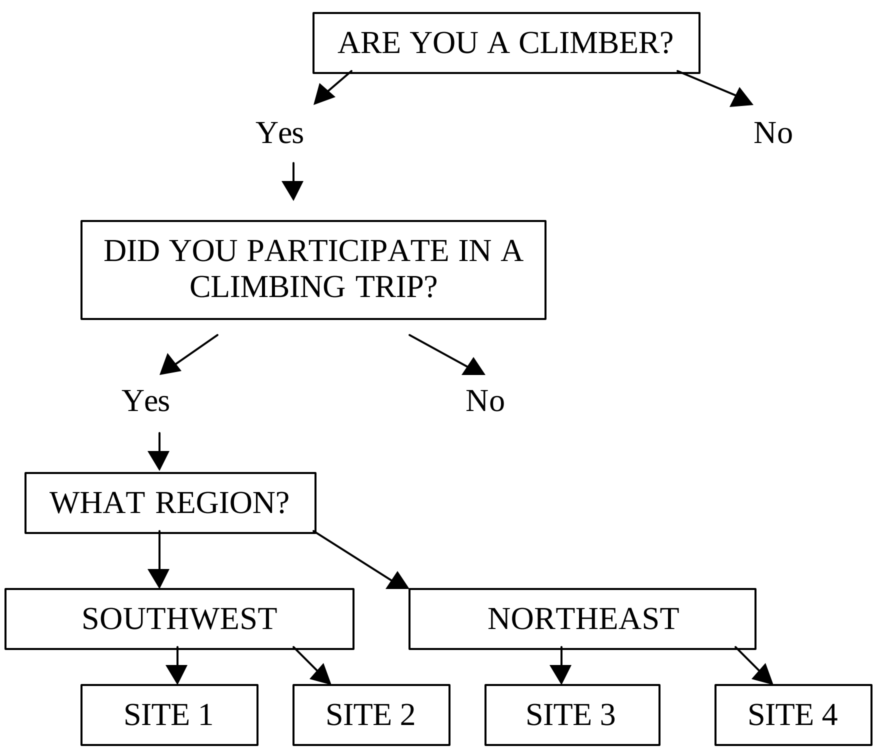
In Chapter 4, the economic losses to climbers due to possible area closures at Hueco Tanks were estimated using several count data regression models. The data consisted of pre-policy revealed preference data, pre-policy contingent behavior data, and post-policy revealed preference data. Chapter 4 consisted of two additional objectives: (1) to test the validity of pre-policy contingent behavior trip data; and (2) to suggest a seemingly unrelated Poisson regression model (SUPREME) for the joint estimation of revealed preference and stated preference trip data. The results showed that the seasonal economic losses to climbers were quite substantial ranging from $477 to over $1000 per climber. In addition, results from a set of hypotheses tests indicated that methods of augmenting revealed preference data with stated preference data show promise as a tool for policy analysis, especially in the case of rock climbing. Finally, the results also showed that SUPREME is a potentially useful regression technique for combining revealed and stated preference trip data.

5.2. Avenues for Future Research

This manuscript may be complete in its current form, but there remain additional avenues for future research. Primarily, these research avenues extend to the research methods used in Chapters 3 and 4. Briefly, some research avenues include: (1) testing for sample selection or survey response bias; (2) exploring different or more elaborate nesting structures for the repeated discrete choice random utility model presented in Chapter 3; (3) conducting a validity test comparing the results of indirect valuation methods of observed behavior with contingent valuation results; and (4) investigating the application of a seemingly unrelated negative binomial regression when trip data present overdispersion.

Because both Chapters 3 and 4 use data from an on-site intercept plus follow-up survey instrument, the survey sample may be plagued with sample selection or nonresponse bias problems (Cameron, Shaw, and Ragland 1999). In regards to Chapter 3, testing for sample selection bias may involve developing a more elaborate nesting structure. The current structure—participation, region choice, and site choice—could be extended to include a higher nest that captures whether a person is a rock climber, provided there is a data source that has this information. (Recall, everyone in the on-site survey sample ***is*** a rock climber.) It is suggested that the data collected from a national random digit-dialed telephone survey could be used to create this nest. To create the data for the "are you a climber" nest, a proportional mapping design would need to be created. This means that if approximately 90% of the population are nonclimbers (as indicated by results from a national random digit-dialed telephone survey conducted by the Institute for Public Policy, see Chapter 2), then the sample must be increased to 5970 observations where 10% of the sample are climbers and 90% (or 5373) are nonclimbers. The decision to be a climber is then described by socioeconomic characteristics. A depiction of this nesting structure is presented in Figure 5–1; this depiction has been simplified to include only two regions and four sites.

Figure 5-1: Expanded Nested Structure for National Climbing Model



For the data used in Chapter 4, there may be many opportunities for explicit modeling of survey response/nonresponse (Cameron, Shaw, and Ragland 1999) and sample selection. To test for nonresponse bias, supplementary data from on-site participant consent forms is available for both respondents and nonrespondents (see Appendix C); this data could be used to evaluate survey response (Whitehead, Groothuis, and Blomquist 1993). The data on the consent forms include years of climbing experience and number of prior climbing trips to Hueco Tanks. In addition, climber zipcode information could be used to collect additional socioeconomic information.

Another area for future research includes testing for potential sample selection problems associated with the onsite sample of climbers visiting Hueco Tanks used in Chapter 4. To test for possible sample selection problems, pre-policy revealed preference trip data to Hueco Tanks could be pooled from three survey sources: the Hueco survey, the Red Rocks survey, and the Obed survey. A single site travel cost demand model for Hueco Tanks could then be estimated from this pooled data. Dummy variables could be used for survey data sources and interacted with explanatory variables. An advantage of pooling trip data from various survey sources is that the researcher can test for differences in estimated coefficients derived from different survey sources, and thus determine whether the onsite sample is representative of Hueco climbers.

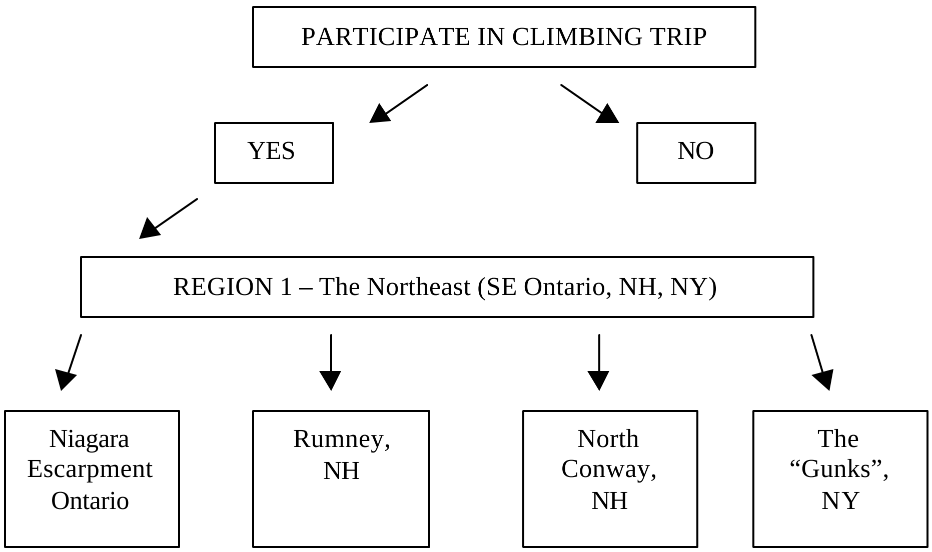
Another avenue for future research may includes a validity test of contingent valuation. Randall (1991, 320) suggests that researchers should consider using both revealed preference and contingent valuation methods to facilitate cross-technique comparisons. In Chapter 4, the demand for Hueco Tanks and subsequent consumer surplus measures were calculated from pre-policy revealed preference trip data, pre-policy contingent behavior trip data, and post-policy revealed preference trip data. However, the survey instrument used to collect these trip data also included several contingent valuation questions that were based on the same hypothetical scenarios as the contingent behavior questions. In response to the contingent valuation questions, climbers made statements about their annual maximum willingness-to-pay (WTP) for unrestricted access. Welfare estimates obtained from these WTP statements could be compared to the estimates obtained from the travel cost models estimated in Chapter 4 (Carson et al. 1996; Knetsch and Davis 1966; and Loomis, Creel, and Park 1991).

Finally, Chapter 4 concluded with several suggestions for future research. The primary suggestion is based on empirical findings that the revealed and stated trip data present overdispersion and that a bivariate SUPREME provides estimates that are asymptotically more efficient than equation-by-equation Poisson estimates. However, two limitations of SUPREME are presented. First, SUPREME is limited to two seemingly unrelated regression equations. Second, an underlying assumption of SUPREME is that the conditional mean and variance are equidispersed. When the data present overdispersion, as the Hueco Tanks climber trip data do, SUPREME will produce estimates that are not efficient; a more efficient estimation procedure should be sought.

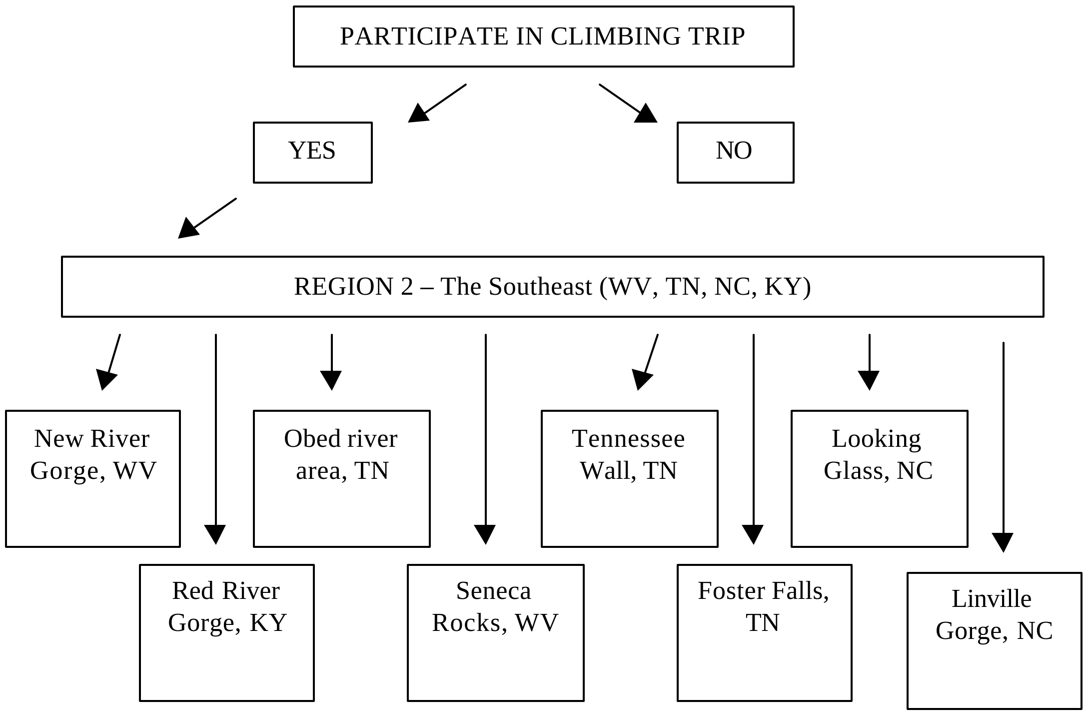
APPENDICES

APPENDIX A: REGIONAL SUB–NESTS FOR NATIONAL CLIMBING SITES

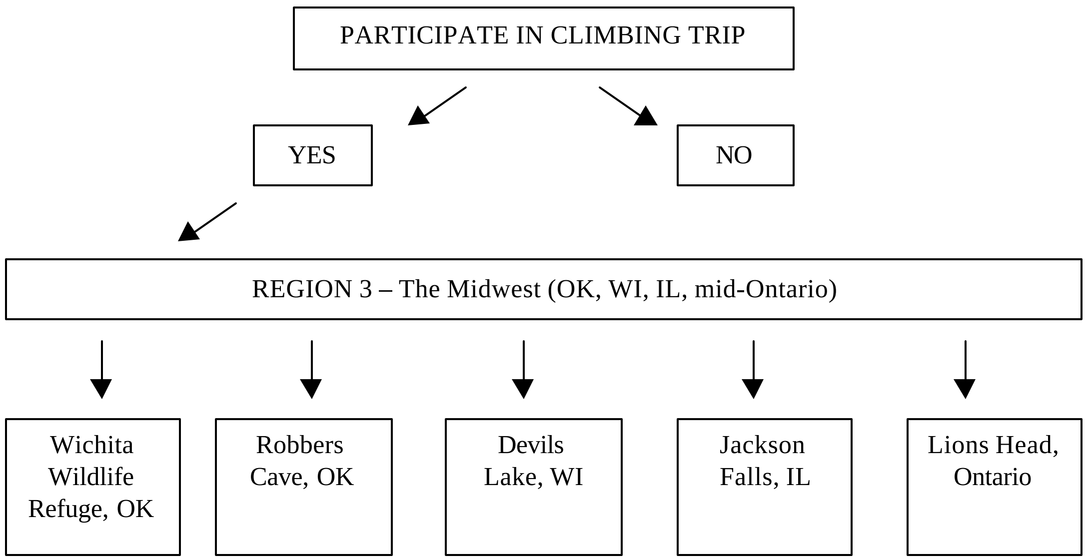
Region 1: The Northeast



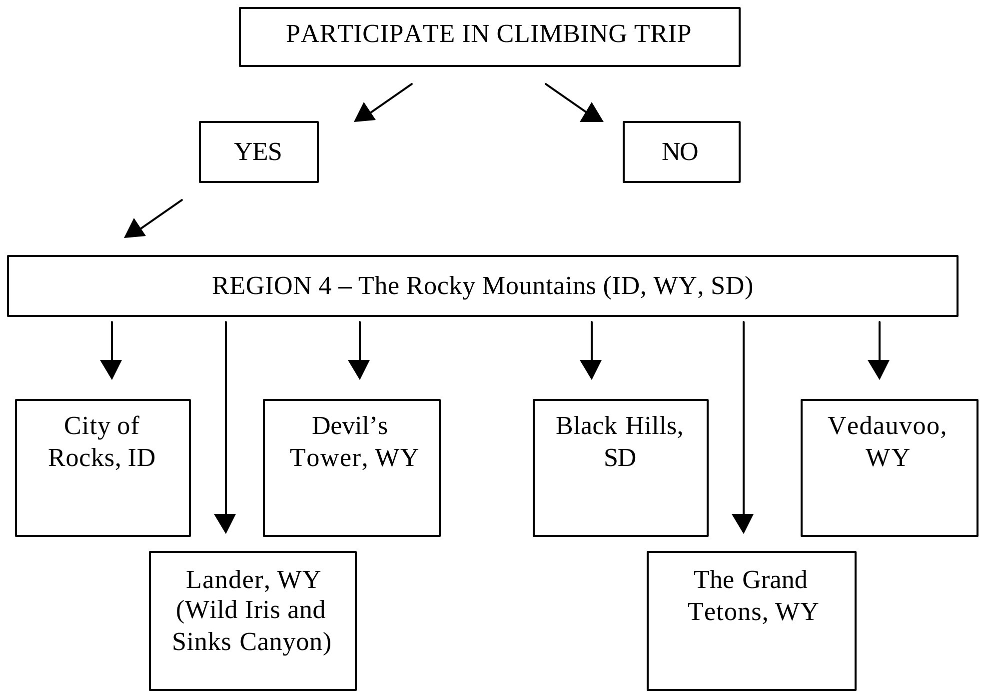
Region 2: The Southeast



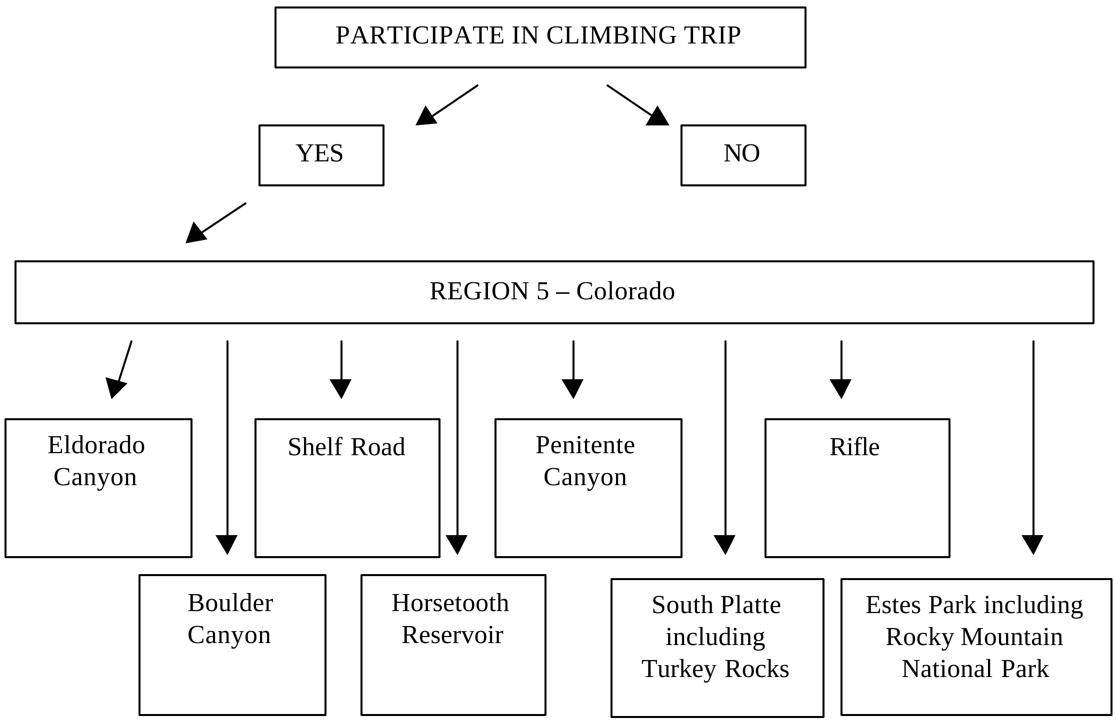
Region 3: The Midwest



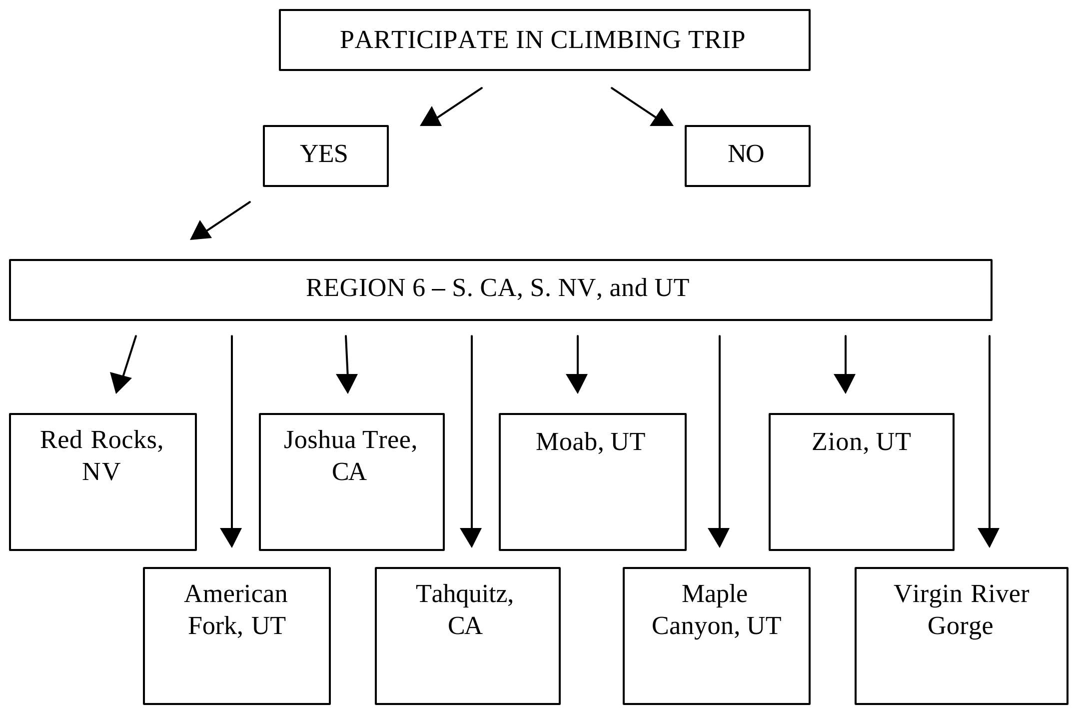
Region 4: Upper Rocky Mountain and Northern Plains



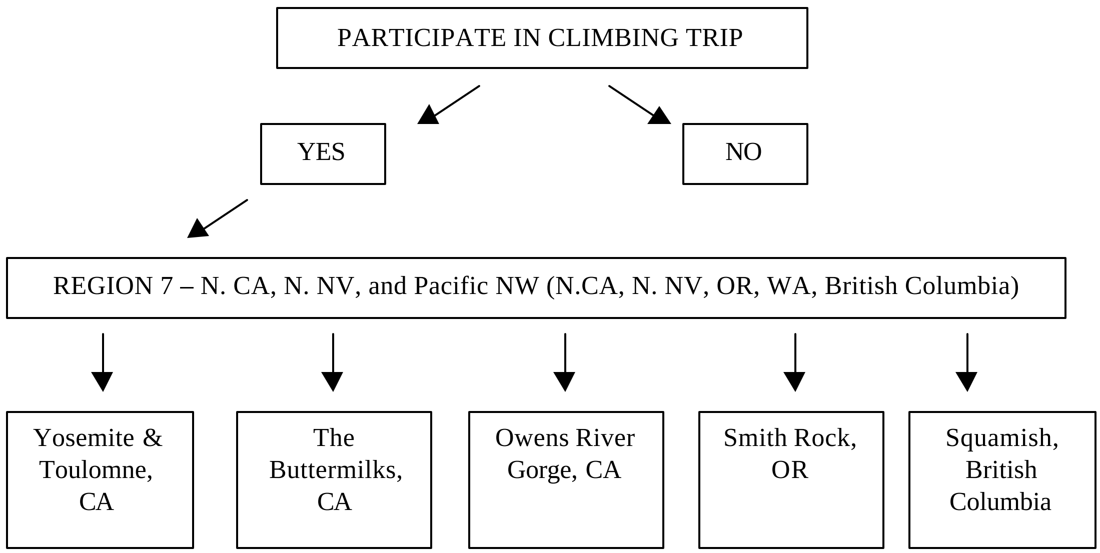
Region 5: Colorado



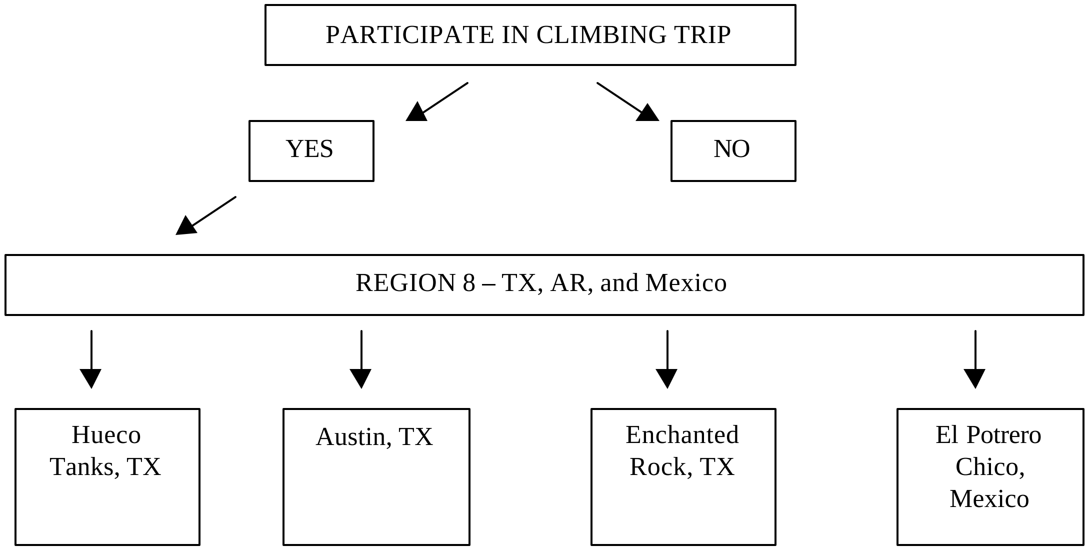
Region 6: Southern California, Southern Nevada, and Utah



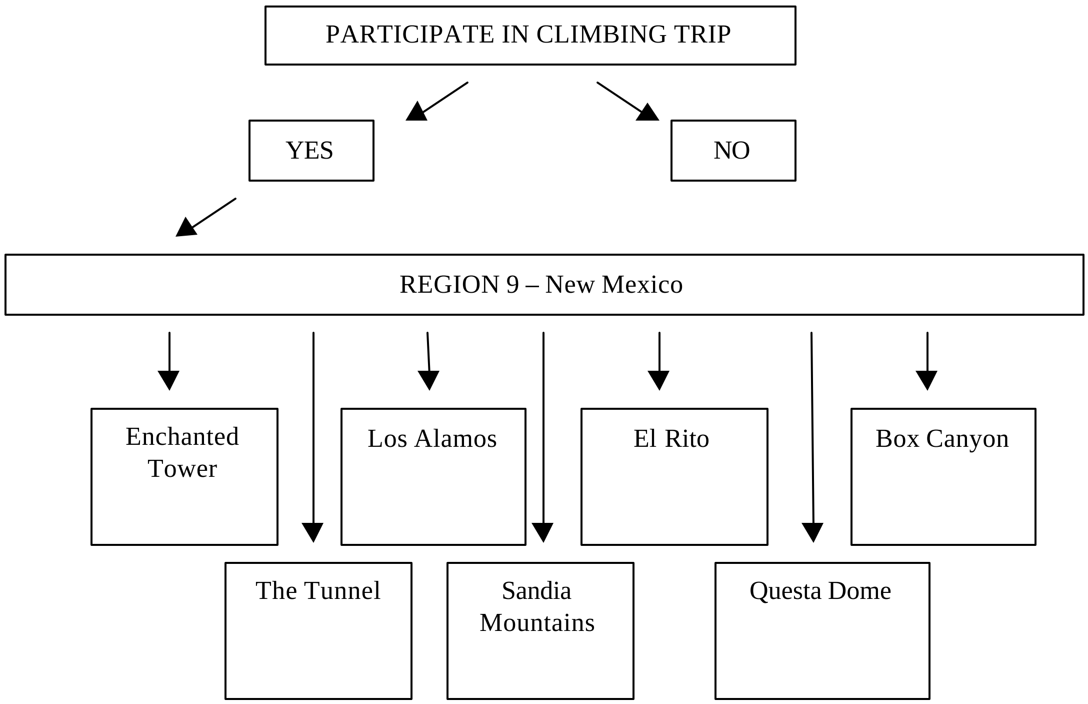
Region 7: Northern California, Northern Nevada, and Pacific Northwest



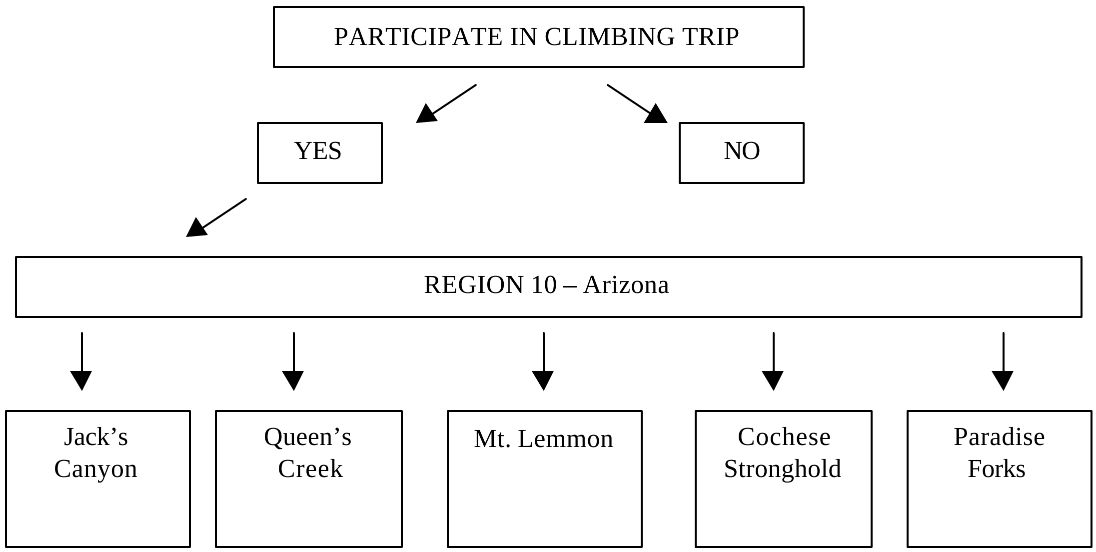
Region 8: Texas, Arkansas and Mexico



Region 9: New Mexico



Region 10: Arizona



APPENDIX B - CLIMBER ACCESS SURVEY

NOTE: The survey was compiled into a 5 1/2" by 8" booklet. The survey appears in this appendix with a larger font and page size.

Cover Design

Introduction to Survey

This survey questionnaire will be used to collect data on rock climbers who have or have not visited Hueco Tanks Texas State Park, and other rock climbing areas in the region. Information will be used to assess the impact on climbers of possible policy changes at Hueco Tanks and other areas. Even if you have not taken a trip to Hueco Tanks, we encourage you to respond to all other questions pertaining to you.

We encourage you to carefully read this survey. We realize that the survey contains many questions which may be difficult or will take time to answer. However, all of this information contained in the survey is important if your survey questionnaire is to be used in tabulating the results. Therefore, please answer all questions as best as you can. None of the information here will be linked in any way to your name.

On the following pages are calendars for 1997 and 1998 that may be used to assist in answering some of the questions contained in this survey. The following table can be used to help you recall some important U.S. national holidays

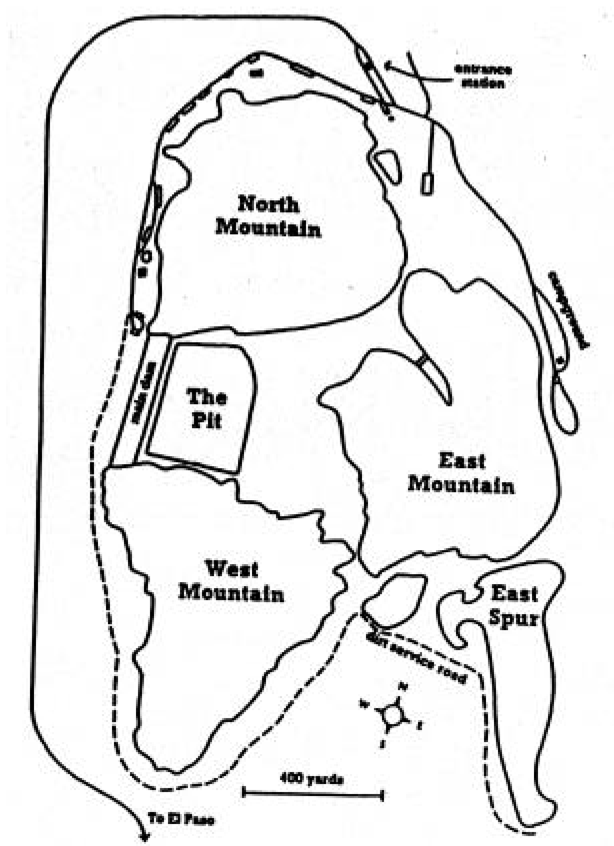
Holiday	Date (1997)	Date (1998)
Martin Luther King Day	January 20	January 19
Valentine's Day	February 14	February 14
President's Day	February 17	February 16
St. Patrick's Day	March 17	March 17
Easter	March 30	April 12
Memorial Day - observed	May 26	May 25
Independence Day	July 4	July 4
Labor Day	September 1	September 7
Columbus Day - observed	October 13	October 12
Halloween	October 31	October 31
Thanksgiving	November 27	November 26

[Calendars on following pages]

Hueco Tanks Map

Some notable boulders and climbs within each mountain area at Hueco Tanks:

North Mountain	East Mountain	East Spur	West Mountain
Mushroom boulder	Dragon’s Den	East Spur Maze (Better Eat Your Wheaties)	The Round Room
Warm-up Boulder	Osterizer	45 Degree Wall	Crash Dummy
The Gymnasium	Hobbit in a Blender	New Religion	Star Power
Sea of Holes (climb)	3 Star Aréte	Amazing Little ½ boy	Devil’s Butthole
Window Pain (climb)	Kid Stuff Wall	Sex After Death	
Uriah’s Heap (climb)	Warm-up Roof		
Indecent Exposure (climb)	Moonshine Roof		



1997 Calendar

1997

January

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

February

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	

March

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

April

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

May

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

June

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

July

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

August

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

September

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

October

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

November

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

December

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

1998 Calendar

1998

January

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

February

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

March

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

April

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

May

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

June

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

July

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

August

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

September

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

October

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

November

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

December

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

A1 through A5

A. ABOUT YOU AND YOUR CLIMBING

A1 How many years have you been rock climbing?__________

A2 Please describe yourself as a rock climber: (circle the most appropriate response)

a) Sport rock climber (seek out bolted climbs)
b) Traditional rock climber (only seek out rocks needing protection)
c) Boulderer – mostly go bouldering
d) Both a sport rock climber and a boulderer
e) Both a sport and traditional rock climber
f) Equally enjoy sport climbing, traditional climbing, and bouldering
g) Gym climber – pretty much stick to workouts in the gym

A3 About how frequently do you go rock climbing out of doors? (circle the most appropriate response)

a) One or two times per year
b) Between three and six times per year
c) About once a month
d) About two times per month
e) About once a week
f) More than once a week

A4 In what seasons does your climbing take place? (circle all that apply).

a) Winter
b) Spring
c) Summer
d) Fall

A5 Do you climb indoors? (circle the most appropriate response).

a) No
b) Yes, circle the season(s) you do: winter / spring / summer / fall

A6 through A11

A6 Approximately, how much do you believe you have invested in the past 12 months in climbing gear and equipment (for example, ropes, shoes, climbing protection, climbing guides, crash pads)? (circle the most appropriate response)

a) Less than $200
b) $200 - $499
c) $500 - $799
d) $800 - $999
e) $1000 - $1500
f) more than $1500

A7 Do you lead sport climbs? (circle the most appropriate response)

a) No
b) Yes; for how many years? __________

A8 Do you lead traditional climbs? (circle the most appropriate response)

a) No
b) Yes; for how many years? __________

A9 Have you ever bolted or placed fixed anchors on an outdoor climbing route? (circle the most appropriate response)

a) No
b) Yes

A10 Have you ever put up a first ascent? (circle the most appropriate response)

a) No
b) Yes, how many? ________________

A11 Have you ever taken a bad fall climbing or bouldering? (circle the most appropriate response)

a) No
b) Yes; did this fall change your climbing behavior in any way?
Please explain in the space provided.

____

____

A12 through A13

A12 Consider the following set of possible management rules. Please circle the number which reflects whether you most strongly disagree (1) or strongly agree (7) with these possible rules at climbing areas:

	Disagree						Agree
Climbers could not use existing fixed anchors	1	2	3	4	5	6	7
Climbers could not place new bolts by any method	1	2	3	4	5	6	7
Climbers could place new bolts by hand drilling only	1	2	3	4	5	6	7
Climbers could not replace existing bolts	1	2	3	4	5	6	7
Climbers could use fixed anchors and replace existing bolts, but cannot place new bolts	1	2	3	4	5	6	7
Climbers would be allowed to do whatever they wish in regard to bolting, including using power drills	1	2	3	4	5	6	7

A13 Do you wish to make any comments regarding the answers you provided above. Please use the space below to explain:

____

____

____

____

____

____

____

A14 through A15

A14 What do you consider to be your **best** climbing and bouldering redpoint* achievement for the following types of climbs. If you have never lead a climb, please consider your best top rope achievement.

Circle one for each category. For climbs with a, b, c, and d ratings, please circle the appropriate letter.

Bouldering (Hueco rating system)	**Sport Climbing (U.S. rating system)**	**Traditional Climbing (U.S. rating system)**
V0-	5.5	5.2
V0	5.6	5.3
V0+	5.7	5.4
V1	5.8	5.5
V2	5.9	5.6
V3	5.10 a b c d	5.7
V4	5.11 a b c d	5.8
V5	5.12 a b c d	5.9
V6	5.13 a b c d	5.10 a b c d
V7	5.14 a b c d	5.11 a b c d
V8	Other: _________	5.12 a b c d
V9		5.13 a b c d
V10		5.14 a b c d
V11		Other: __________
V12		
V13		
Other: _________		

*Redpoint is defined as completing a climb without a fall regardless of the number of tries.

A15 What range do you consistently climb? Enter the appropriate range based on the ratings of climbs given in A14.

EXAMPLE:

Bouldering (Hueco Rating)	Sport climbing (U.S. Rating)	Traditional climbing (U.S. Rating)
V0 through V3	5.7 through 5.11c	5.3 through 5.9

ENTER INFORMATION IN THESE BOXES

Bouldering (Hueco Rating)	Sport climbing (U.S. Rating)	Traditional climbing (U.S. Rating)

B1 through B5

B. ABOUT YOUR 1997/1998 ROCK CLIMBING TRIPS

A trip is an outing to a rock climbing area for any length of time – whether for a part of a day, for several days, or for several months.

B1 How many **total** rock climbing trips have you taken in the past 12 months?

______________ Trips.

B2 Are there any unusual aspects to some of the trips you took during this time? (An example would be if you were injured and took very few trips in comparison to a normal year for you). (circle the most appropriate response)

a) No
b) Yes; Please explain below.

____

____

____

B3 Have you ever climbed at Red Rocks near Las Vegas, NV? (circle the most appropriate response)

a) No
b) Yes

B4 Have you ever climbed in the OBED River Tennessee area? (circle the most appropriate response)

a) No
b) Yes

B5 Have you ever climbed in Hueco Tanks Texas State Park? (circle the most appropriate response)

a) No
b) Yes

B6

B6 On the following page, please provide information for each outdoor climbing area you visited during the past 12 months. Examples are shown at the top of the chart on the next page.

If you keep a climbing diary to record your activities, it will help you fill out the chart. If you used a climbing diary, please circle the appropriate response below.

a) No, I do not use a diary
b) Yes, I used a diary to fill out the chart

We strongly encourage you to read the examples at the top of the chart to aid in clarifying any of your questions.

B7

B7 In this section you will be asked to produce, recollecting as best as you can, a record of the outdoor climbing trips you took during the past 12 months. In each row, you will be asked to identify a climbing destination and to identify the total number of trips taken to that climbing destination (refer to the first example). If you need extra room, please use extra space on previous page or back cover of survey.

Trip(s) I.D.	Destination, Please include state and if outside U.S.A., please include country.	Trip Month(s)	# of Trips	Average Stay (in days) per trip	What was means of transportation? Examples may be; (1) airplane and rental car, (2) car, or maybe (3) bus.	On average how many others were traveling with you?	On average your per trip share of travel expenses (examples to include: the price of airline ticket, rental car, fuel expenses)	On average your per trip lodging expenses
Example	Hueco Tanks, TX	Sept 97 thru Mar 98	**25 trips**	1 trip – 10 days 24 trips – 2 days on avg. 2 days per trip	Car	1 other	$30 per trip (fuel, oil and tolls)	$2 per night or on avg $4 per trip
Example	Eldorado Canyon, CO	Aug 97	**1 trip**	5 days	Flew to Denver, Co and rented a car	0 others	$400 (airfare, car rental, & fuel)	$0
1								
2								
3								

The trip log table included 10 rows.

B8 through B10

The following questions pertain to trips taken to Hueco Tanks Texas State Park in the past 12 months. If you did not take a trip to Hueco Tanks in the past 12 months skip questions B8 through B14.

B8 Was the primary reason for visiting Hueco Tanks State Park to climb routes or boulder? (circle the most appropriate response)

a) No
b) Yes, circle primary activity: climb / boulder

B9 Other reasons for visiting Hueco. (circle all that apply).

a) View historic pictographs
b) Scenic
c) Hiking
d) Other, please describe

____

____

____

B10 Of your trips listed in question B7, approximately what percentage of your time was spent bouldering or climbing at each of the four mountain areas highlighted in the map on the cover of the survey. ***Your time should add up to 100%***.

Example: 95% of *my time was spent bouldering amongst the 4 areas, and only 5% of my time was spent climbing at North Mountain.*

Bouldering		**Climbing**	
Percent of time	Area	Percent of time	Area
20%	N. Mountain	5%	N. Mountain
50%	E. Mountain	0%	E. Mountain
20%	E. Spur	0%	E. Spur
5%	W. Mountain	0%	W. Mountain

B10 (cont'd) through B14

ENTER INFORMATION IN THESE BOXES

Bouldering		Climbing	
Percent of time	Area	Percent of time	Area
______	N. Mountain	______	N. Mountain
______	E. Mountain	______	E. Mountain
______	E. Spur	______	E. Spur
______	W. Mountain	______	W. Mountain

B11 Did you purchase a Texas Conservancy Passport (TCP) during the period July 1996 through June 1997?

a) No
b) Yes, expiration date: ______________________________

B12 Do you currently own a TCP?

a) No
b) Yes, expiration date: ______________________________

B13 What do you consider to be a substitute climbing or bouldering destination(s) to Hueco Tanks. Please list;

Destination	Have you ever climbed here?

B14 What other expenses did you incur for your trips to Hueco.

$ ______________ Hueco Tanks Climbing and Bouldering Guide
$ ______________ Bouldering Crash Pad
$ ______________ Climbing Shoes
$ ______________ Harness
$ ______________ Climbing Protective Gear
$ ______________ Other, please list:______________________

C1 through C3

C. RECENT TEXAS PARKS AND WILDLIFE ISSUES

C1 Are you familiar with the State Legislative issues over the past year regarding Texas State Parks, which proposes restrictions on climbing access at Hueco Tanks? (circle the most appropriate response)

a) No
b) Yes

C2 If yes, how did you hear about the State Legislative Issues regarding Texas State Parks? (circle all that apply)

a) Friend
b) Access Fund Literature, Internet Homepage, or Events
c) Texas State Legislature
d) Texas Parks and Wildlife Department
e) Outdoor Journals or Magazines
f) Internet
g) Read a copy of the Public Use Plan ***draft*** for Hueco Tanks written in September 1997.
h) Other, please list;

____

____

C3 Did the access issues for climbers at Hueco Tanks influence your trip taking behavior to Hueco Tanks over the past 12 months?

a) No
b) Yes ≡≡ (enter amounts in the blanks provided below)

I took _________ FEWER trips as result

I took _________ MORE trips as a result

AND / OR

my average length of stay of a representative trip

INCREASED by ___________ days

DECREASED by _____________ days

D1 through D4

D. YOUR REACTION TO POSSIBLE CHANGES IN PUBLIC USE AT HUECO TANKS

Texas Parks and Wildlife Department (TPWD) is responsible for the management of Hueco Tanks Texas State Park. TPWD is considering limiting access for climbing and bouldering at Hueco Tanks in order to restore and preserve the historical and natural resources of the park. At the moment, there are no definite changes in rules that would limit access.

D1 Phase 1 of the Public Use Plan drafted in September 1997 suggests closing West Mountain and other selected boulders within the park.

Have you ever climbed or bouldered at West Mountain? (circle most appropriate response)

a) No
b) Yes

D2 Given West Mountain only is closed, would your trips to Hueco Tanks or the typical length of stay in days per trip at Hueco Tanks change in response to this new policy?

Would your trips next season change because of this new policy? (circle most appropriate response)

a) No (go to question D4)
b) Yes

D3 You stated your trips would change. About how many more or fewer trips would you take next season?

______________________ More

______________________ Fewer

D4 You may have stated that your trips would or would not change due to this policy, yet would the typical length of stay in days of a representative trip change? (circle most appropriate response)

a) No (go to question D6)
b) Yes

D5 through D9

D5 You stated your length of stay in days would change. About how many more or fewer days would you stay per trip next season?

______________________ More

______________________ Fewer

D6 You may have stated that your trips would not change due to this policy. Is this because you would go to other areas at Hueco Tanks not subject to the policy change, or because you do not boulder or climb at West Mountain, or some other reason? Please explain.

____

____

____

D7 Next suppose TPWD eliminates climbing access to both East and West Mountain. Would your trips to Hueco or the typical length of stay in days change in response to this new policy?

a) No (go to question D9)
b) Yes

D8 You stated your trips would change. About how many more or fewer trips would you take next season?

______________________ More

______________________ Fewer

D9 You may have stated that your trips would or would not change due to this policy, yet would the typical length of stay in days for a representative trip change? (circle most appropriate response)

a) No (go to question D11)
b) Yes

D10 through D14

D10 You stated your length of stay in days would change. About how many more or fewer days would you stay per trip next season?

______________________ More

______________________ Fewer

D11 You may have stated that your trips would not change due to this change in policy. Please explain.

____

____

____

D12 Do you believe climbers or other recreational users of Hueco Tanks Texas State Park should be required to pay for access?

a) No
b) Yes

D13 Next, we would like you to consider a voluntary annual contribution to a fund that might be set up by a group such as a Climber's Club to protect climbing and bouldering at Hueco Tanks. If everyone contributes, the money can be used to help TPWD and other agencies manage climbing areas in a safe fashion with no new changes in access at Hueco Tanks from what exist at present.

What would be your annual maximum willingness-to-pay to such a fund if it ensured that climbers could continue to boulder at the 4 mountain areas?

$ ________________

D14 If you stated that you would not make an annual contribution to such a fund in question D13, please explain why you rejected this opportunity to make a voluntary contribution?

____

____

____

____

D15 through D18

D15 Now suppose that West Mountain is closed. What would be your annual maximum willingness-to-pay to such a fund if it ensured that climbers could continue to boulder at the other 3 mountain areas in Hueco Tanks?

$ __________________

D16 If you stated that you would not make an annual contribution to such a fund in question D15, please explain why you rejected this opportunity to make a voluntary contribution?

____

____

____

____

____

D17 Now suppose that both West Mountain and East Mountain are closed. What would be your annual maximum willingness-to-pay to such a fund if it ensured that climbers could continue to boulder at the other 2 mountain areas in Hueco Tanks?

$ ___________________

D18 If you stated that you would not make an annual contribution to such a fund in question D17, please explain why you rejected this opportunity to make a voluntary contribution?

____

____

____

____

____

E1 through E7

E. <u>ABOUT YOU</u>

None of the information here will be linked in any way to your name. However, all of this information is important if your survey questionnaire is to be used in tabulating the results.

E1 What year were you born in? ________________________

E2 What is your gender? (circle most appropriate response)

a) Male
b) Female

E3 Annual income is often a very good indicator of participation in outdoor recreation. What is your approximate 1997 income, including income from interest and investments. ***Please circle the appropriate category for you***:

0-9,999	35,000-39,999	65,000-69,999	140,000-159,999
10,000-14,999	40,000-44,999	70,000-79,999	160,000-179,999
15,000-19,999	45,000-49,999	80,000-89,999	180,000-199,999
20,000-24,999	50,000-54,999	90,000-99,999	200,000-249,999
25,000-29,999	55,000-59,999	100,000-119,999	250,000-275,000
30,000-34,999	60,000-64,999	120,000-139,999	Over 275,000

E4 What amount of this income was earned through wages or salary?

$ ____

E5 How many hours do you normally work for each pay week?_______

E6 How many weeks do you work per year?_________

E7 On the scale below, please indicate how flexible your work hours are each week by circling the most appropriate number from 1 to 7.

I have no flexibility – must work fixed hours each day	1	2	3	4	5	6	7	I have total flexibility – can choose hours and days

E8 through E13

E8 Was this income year unusual in any way for you?

a) No
b) Yes; Please explain

____

____

____

E9 How many people, including yourself, are in your household?______

E10 How many in the household, including yourself, go rock climbing?

____

E11 Are you a member of any other outdoor recreational or environmental groups? If so, please list (for example, Nature Conservancy, Sierra Club, REI, local outdoor recreation organizations, etc.)

____

____

____

____

____

E12 Are you employed by government, any environmental group, or climbing-related business (for example, magazine, equipment, guiding, or sponsorship). (circle most appropriate response)

a) No
b) Yes, please identify affiliation(s):

____

____

E13 Please name the city, state, zip code and country of residence during the past 12 months.

____

E14 through E15

E14 Do you own a vacation home, particularly one near a rock climbing area? (circle most appropriate response)

a) No
b) Yes; What is the zip code for this 2nd home? ______________

E15 Do you have any final comments concerning climbing, climbing policies, this survey, or Hueco Tanks? (Use space below)

Back Cover

Your contribution to this effort is very greatly appreciated.

Questions or comments can be directed to Therese Cavlovic
Email: cavlovic@unm.edu
Tel: 505-277-5304
University of New Mexico Department of Economics, Albuquerque, NM   87131

APPENDIX C - SURVEY LETTER AND PARTICIPANT FORMS

On-Site Participant Form

CLIMBING & BOULDERING AT HUECO TANKS?

Are you willing to participate in a mail survey?

We are graduate students at the University of New Mexico working towards our doctoral degrees in Environmental Economics. We are interested in determining your preferences for climbing and bouldering at Hueco Tanks. We want to determine why climbers choose Hueco Tanks as one of their climbing destinations and what their preferences are for access and management policy. Based on your responses to a series of questions regarding past and future climbing travel plans, we will estimate the use values climbers have for Hueco Tanks.

In order to do this, we need climber participation in a mail survey. The survey would be mailed during the upcoming year. The primary purpose of our recreational study is for the application of a behavioral science, economics, to a recreational activity. **We are not working for an outside organization**.

If you are interested in participating in our survey, please answer the questions below and complete the section for your name and address. If you decide to participate, your name and responses will be confidential. We hope you will participate in our mail survey.

Number of years of climbing experience? ___________

Have you made any previous trips to Hueco Tanks Texas State Park?

☐ Yes. Approximately, how many trips have you taken in the past? ______________________

☐ No

Name	
Address	
City, State, Postal Code	
Country	

Thank you for your time and consideration.

Sincerely,

Therese Cavlovic
Tel. 505-277-8692
Email: cavlovic@unm.edu

Steve Stewart
Tel. 505-277-1951
Email: sstewart@unm.edu

All names and responses will remain confidential

University of New Mexico Department of Economics 87131

Cover Letter Mailed with Survey to U.S. Citizens

NOTE: To fit to one page, font size adjusted from original letter format

CLIMBER ACCESS SURVEY

BE HEARD

April 16, 1998

Dear Climber,

Managers of climbing areas across the country have proposed a variety of regulations designed to lessen the impact of climbers on climbing resources. Various federal and state resource management agencies are interested in developing climbing management plans. Climber organizations often represent the interests of climbers, but no one really knows what climbers like you think about these plans. As fellow climbers, we believe that how these possible access changes may affect you should be heard.

You are among a number of people who are being asked about their climbing activities, experience, and opinions about possible land management plans. By completing and returning the enclosed questionnaire, researchers from the University of New Mexico will be able to advise land managers with the information you provide.

This study is one of three concurrent research efforts being conducted in the United States. The University of Tennessee is surveying climbers about access to OBED River in Tennessee while the University of Nevada Reno is surveying climbers about the impact of bolting and fixed anchor limitations in Red Rocks near Las Vegas, Nevada. The results will be combined into the first major multi-regional study of climbing.

Your opinions are important to us. Please try to answer all questions as best as you can. You are under no obligation to answer all questions, however, all of the information contained in the survey is important if your questionnaire is to be used in tabulating results. You may receive a summary of results by writing "COPY OF RESULTS" with your name and address on the back of the return envelope, or by emailing or writing to Therese Cavlovic at the below address.

To insure anonymity, all completed questionnaires will be kept separate from your name. Please do not put your name anywhere on the survey. The number coded by your name on the mailing envelope, which corresponds to the number on the return envelope, will be used to track survey response rates and to enter your name in a raffle. If we receive your ***completed questionnaire on or before May 29***, your name will be entered into a raffle to win one of several climbing and bouldering prizes*.

Your contribution to this research is greatly appreciated. If you have any questions regarding this research project, please feel free to contact either Therese Cavlovic or Dr. Robert Berrens.

Sincerely,

Therese A. Cavlovic Dr. Robert Berrens

*Contributers & prizes include: ARC' TERYX Vapor Harness, BLACK DIAMOND Sweatshirt, BLACK DIAMOND chalk bag, CLIMBING [magazine] book titled *Quick Clips*, and other prizes purchased at local retailers including climbing hold sets and climbing shorts.

Therese Cavlovic
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University of New Mexico
Albuquerque, NM 87131
Email: cavlovic@unm.edu
Tel: (505) 277-5304

Dr. Robert Berrens
Department of conomics
University of New Mexico
Albuquerque, NM 87131
Email: rberrens@unm.edu
Tel: (505) 277-9004

Cover Letter Mailed with Survey to non-U.S. Citizens
NOTE: To fit to one page, font size adjusted from original letter format

CLIMBER ACCESS SURVEY

BE HEARD

April 16, 1998

Dear Climber,

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You are among a number of people who are being asked about their climbing activities, experience, and opinions about possible land management plans. By completing and returning the enclosed questionnaire, researchers from the University of New Mexico will be able to advise land managers with the information you provide.

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To insure anonymity, all completed questionnaires will be kept separate from your name. Please do not put your name anywhere on the survey. The number coded by your name on the mailing envelope, which corresponds to the number on the return envelope, will be used to track survey response rates and to enter your name in a raffle. If we receive your ***completed questionnaire on or before May 29***, your name will be entered into a raffle to win one of several climbing and bouldering prizes*. We have included postal paid international reply coupons in the survey to pay for the postage required to return the survey to us in the United States. The coupons are redeemable at your local post office or mail courier.

Your contribution to this research is greatly appreciated. If you have any questions regarding this research project, please feel free to contact either Therese Cavlovic or Dr. Robert Berrens.

Sincerely,
Therese A. Cavlovic   Dr. Robert Berrens

*Contributers & prizes include: ARC' TERYX Vapor Harness, BLACK DIAMOND Sweatshirt, BLACK DIAMOND chalk bag, CLIMBING [magazine] book titled *Quick Clips*, and other prizes purchased at local retailers including climbing hold sets and climbing shorts.

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Tel: (505) 277-9004

Follow-up Reminder Letter
NOTE: To fit to one page, font size adjusted from original letter format

CLIMBER ACCESS SURVEY
BE HEARD

May 31, 1998

Dear Climber,

About four weeks ago we mailed to you a *Climbing Access Survey*. As of today, we have not received your completed questionnaire.

We have undertaken this study because we believe your opinions to climbing access issues should be considered in the formation of public policies. We are writing to you again because of the significance each questionnaire has to the usefulness of this study. In order for this study to be truly representative of climbers, it is essential for each person in our sample to complete and return their questionnaire.

If you did not receive the questionnaire mailed on April 16, 1998 or if you have misplaced your original questionnaire, please contact us immediately. Also, it has come to our attention that some of the surveys mailed on April 16th were improperly collated. If you have noticed any problems with the survey mailed to you, such as missing pages or improperly collated pages, please contact us immediately. We will immediately send you another survey. A message can be left at the toll-free telephone number or email address listed below. In your message, please include your **name, telephone number, and address**.

Tel: 1-800-484-6902, when prompted enter the following 4-digit code, 9689

Email: cavlovic@unm.edu
Local (Albuquerque Residence) Tel: (505) 265-9120

Due to the importance of this study to climbers, if we receive your ***completed questionnaire on or before June 18, 1998***, your name will be entered into a second raffle to win one of a couple prizes (this includes all those participants who were included in the May 29th raffle).* Even if for some reason you are unable to complete your survey by June 18, your opinions are important to us and can be used in our study. Please complete your survey at your earliest convenience.

We appreciate your contribution to this study. If you have any questions regarding this research project, please feel free to contact either Therese Cavlovic or Dr. Robert Berrens.

Sincerely,

Therese A. Cavlovic   Dr. Robert Berrens

* Contributers & prizes for May 29th raffle include: ARC' TERYX Vapor Harness, and BLACK DIAMOND Sweatshirt. Contributers & prizes for June 18th include: BLACK DIAMOND chalk bag, CLIMBING [magazine] book titled *Quick Clips*, and other purchased prizes.

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APPENDIX D - HUECO TANKS POSTCARD SURVEY

Postcard Survey
[APPROXIMATE SIZE OF POSTCARD: 3 1/2" by 5"]

CLIMBER ACCESS SURVEY – FOLLOW-UP

RECOLLECTING AS BEST AS YOU CAN, PLEASE ANSWER THE FOLLOWING;

1. Did you take any trips to Hueco Tanks in the last 12 months; that is, since we last surveyed you?
   a. Yes
   b. No

2. If yes, how many trips did you take to Hueco Tanks in the last 12 months?

   ________________________ trips.

3. If you took any trips to Hueco Tanks in the last 12 months, what was the average length of stay (in days) per trip?

   ________________________ days/trip.

[ADDRESS-SIDE]

THERESE CAVLOVIC
UNIVERSITY OF NEW MEXICO
DEPARTMENT OF ECONOMICS
ALBUQUERQUE, NM 87131

Postcard Cover Letter and Thank You

Thank You
For participating in the
CLIMBER ACCESS SURVEY

Spring 1999

Dear Climber

Thank you for participating last spring in the CLIMBER ACCESS SURVEY. Over 50% of those intercepted at Hueco tanks returned a completed questionnaire. The answers you provided will allow us to estimate the values you have for climbing at Hueco Tanks and on other U.S. public lands. Land stewards when deciding about climbing access may use these values to assess the economic impact of their decision. More information about your responses can be found on the internet at http://www.unm.edu/~cavlovic.

Last fall, the Texas Parks and Wildlife Department restricted open recreational access at Hueco Tanks. As a result, your intended trips to Hueco Tanks during the past season may have been altered. Enclosed is a self-addressed, stamped postcard, which gives you the opportunity to tell us about your trips to Hueco Tanks over the past 12 months; that is, since we last surveyed you. By returning the enclosed postcard, we can estimate the economic losses due to the recent access restrictions at Hueco Tanks. If you did not take a trip to Hueco Tanks, it is still important to complete the questions. To insure anonymity, your responses will be kept separate from your name.

Your continued contribution to this research is greatly appreciated. If you have any questions regarding this research project, please feel free to contact either Therese Cavlovic or Dr. Robert Berrens.

Sincerely,

Therese A. Cavlovic　　　　Dr. Robert Berrens

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APPENDIX E - COPY OF SURVEY RESULTS MAILED TO PARTICIPANTS

Summary of Results
NOTE: Form adjusted from original format

CLIMBER ACCESS SURVEY
Summary of Results
Hueco Tanks

Spring 1999

Introduction

Last year while visiting Hueco Tanks Texas State Park, we collected names of climbers who would be willing to participate in a follow-up mail survey. We mailed surveys to over 750 climbers living throughout the world. Of these 750 climbers, over 410 climbers completed and returned their survey to us! These climbers answered detailed questions about their climbing ability, climbing trips, and various questions about the impact of climbing access regulations on their climbing travel plans. We would like to thank these climbers for participating in our study. In addition, two other climbing surveys were conducted last year. Researchers at the University of Nevada, Reno and the University of Tennessee conducted similar surveys. The information from the three surveys will be used to estimate a national model of demand for climbing in the United States. By estimating demand for climbing, the economic losses incurred by climbers when public land stewards restrict the way you can use public land can be calculated.

Our analysis is not complete, but today per your request, we are providing you with a preliminary analysis of your responses.

What your answers will help us do

Shortly after we mailed the surveys to you, climber access in the U.S. faced many restrictions. In June 1998, the U.S. Forest service announced that the use of fixed climbing anchors and protective gear would no longer be allowed in U.S. Wilderness areas (on August 14, 1998 Jim Lyons, U.S. Department of Agriculture Under Secretary for Natural Resources and the Environment, initiated negotiations for the rulemaking of fixed climbing anchors). In addition, on a state level, Texas Parks and Wildlife made an announcement limiting open recreational access to Hueco Tanks beginning September 1, 1998. The majority of Hueco Tanks would be closed to unrestricted access, and all users would face higher park entrance fees. Your answers to our survey questions will enable us to analyze the economic losses to climbers due to these policy changes.

To get our analysis started, we entered all the information you gave us into a comprehensive database. We entered everything, including all the information you told us about your previous 12 month climbing trips (question B7). You may have wondered why we were interested in this data. This information will be used to estimate the economic costs associated with national climbing access restrictions. The information you gave us in section D of the survey, *Your Reaction to Possible Change in Public Use at Hueco Tanks*, combined with your trip information to Hueco, will be used to estimate the economic losses to climbers due to the restrictions at Hueco Tanks. These amounts can be and should be used by policymakers in assessing the economic costs and benefits of proposed policy changes.

What you told us

Below is a table that lists standard descriptive statistics about the answers you gave us. The first column identifies the question number used in the survey. The second column is the question asked, or a brief description of the question, and the remaining columns provide standard statistics about your answers.

Question	Description	Number of responses	Average (mean)
A1	Years climbing	409	7.6 years
A2	Type of climber	409	48% said they equally participate in sport, trad, and bouldering
A3	How often you climb	409	42% said more than once a week
A5	Do you climb indoors	406	78% said yes
A6	How much have you invested in past 12 months in climbing gear	409	37% picked the category $200 - $499
A7	Do you lead sport climbs	409	89% said yes
A8	Do you lead traditional climbs	408	72% said yes
A9	Have you ever placed a bolt on a route	409	36% said yes
A10	Have you ever put up a first ascent (can include boulder problems)	409	42% said yes
A11	Have you ever taken a bad fall climbing or bouldering	409	45% said yes
A12	Your views on bolting regulations	401-406	For the most part you all agreed that more information was needed to answer, but if you answered and added comments, most of you thought that bolting regulations should be based on area, ethics, and/or local bolting committees who would issue permits to bolt. Yet, many of you believe bolting has minimal impact on the environment. Very few of you thought climbers should be able to do whatever they wish in regards to bolting.

Question	Description	Number of responses	Average (mean)
B1	Number of trips taken in past 12 months	407	43 trips on average per individual
B3	Have you ever climbed at Red Rocks	408	49% said yes
B4	Have you ever climbed at Obed	408	7% said yes
B5	Have you ever climbed at Hueco	409	93% said yes
C1	Are you familiar with access issues at Hueco over past year	408	88% said yes
D1	Have you ever climbed at West Mountain (Hueco)	408	86% said yes
D2	If west mountain were closed, would your travel plans to Hueco change	409	16% said yes
D7	If both East and West mountain were closed, would your travel plans to Hueco change	409	58% said yes
D12	Do you think recreational users should have to pay for access	401	79% said yes
D13	What would be your annual maximum willingness-to-pay to keep climbing access open at the four mountain areas at Hueco	396	$40 (the minimum contribution was $0 and the maximum contribution was $500)
E1	Date of birth (age)	402	30 years old
E2	Male or female	408	79% male
E3	Average salary (based on averages in income ranges given in the question)	399	$34,242
E7	On a range of 1 to 7, how flexible is your job	404	Majority of responses were 6 (7 is most flexible)

This is not a complete list of all questions answered, if you want information regarding other questions or follow-up comments, please email Therese Cavlovic at cavlovic@unm.edu

Where did you come from

It may be of interest to some of you to know how far many of you traveled to visit Hueco Tanks. How far you travel to a climbing destination is critical to estimating the economic value you have for climbing at a specific area. Being a world class climbing site, it is no surprise that climbers who visited Hueco Tanks traveled from Canada, Europe, Australia, and Israel!

Where you traveled from	Number of those who completed and returned a survey	Percent of respondents (out of 412) *All figures rounded*
Australia	1	.2%
Israel	1	.2%
Europe	9	2%

Where you traveled from	Number of those who completed and returned a survey	Percent of respondents (out of 412) *All figures rounded*
Canada	12	3%
Pacific Northwest (OR, WA)	8	2%
Northeast (NY, NJ, NH, PA, VT, CT, MA, MD, ME, VA)	26	6%
Southeast (WV, KY, TN, NC, SC, LA, FL, GA, AR)	29	7%
Midwest (OK, IL, OH, WI, MN, MO, MI)	36	9%
Rocky Mountain (CO, SD, WY, ID, CO, MT)	58	14%
CA, NV, UT, AZ	54	13%
Texas and New Mexico	TX=94 and NM=84	43%

Where we go from here

With the data entered, we can apply economic models to estimate demand. As simple as it may seem, the road ahead of us is long and challenging. For example, the other two surveys were conducted similar to the Hueco survey. To begin, we all collected names of climbers from popular climbing destinations located in the western and eastern United States. The three destinations offered various climbing opportunities ranging from bouldering to traditional climbing. We need to ensure that we control for any bias problems that may exist in our sampling frames. Once we estimate demand for climbing by our sampled population, we need to aggregate this amount across the relevant climbing population not sampled by any of the three surveys. Therefore, the complications of estimating demand, controlling for any sampling bias problems, and aggregating across the relevant climbing population will require us to estimate demand with highly technical statistical methods.

Where to look for these results

We hope to publish our results in economic academic journals. If you would like, you can periodically check our homepage at http://www.unm.edu/~cavlovic to see if the results are complete and where you can find them.

Again, we thank you for your participation in our study. Please feel free to contact Therese Cavlovic at cavlovic@unm.edu or (505) 277-5304.

Sincerely,

Therese Cavlovic Robert Berrens

APPENDIX F – RNL MODEL RESULTS DROPPING SEASON

RNL Results for Models I and VIII, excluding SEASON

Variable Names	Model I	Model IV
Participation Stage		
CONSTANT	-4.839***[a]	-5.103***
	(-12.965)[b]	(-13.101)
YRSCLIMB	-7.423***	-7.782***
	(-3.202)	(-3.235)
$YRSCLIMB^2$	19.383**	18.233**
	(2.285)	(2.124)
TRAD	0.110	0.082
	(0.479)	(0.364)
STB	0.0226	0.018
	(0.162)	(0.134)
MTN	-0.492*	-0.500*
	(-1.748)	(-1.725)
BOULD	-0.183	-0.147
	(-0.866)	(-0.717)
GYM	-0.571**	-0.518**
	(-2.348)	(-2.235)
SPORTLEAD	0.595***	0.585***
	(7.414)	(7.306)
TRADLEAD	0.251**	0.323***
	(2.269)	(2.970)
SEASON	-	-
INCOME2	0.096	0.009
	(0.960)	(0.075)
INCOME3	-0.195	-0.260*
	(-1.251)	(-1.624)
TOTHOURS	-	0.164***
		(2.935)
MALE	-0.278***	-0.295***
	(-2.754)	(-3.055)
FLEX	0.409*	0.501**
	(1.895)	(2.220)
HH	-0.150	-0.062
	(-0.396)	(-0.147)
HHCLIMB	0.030	-0.074
	(0.117)	(-0.133)
RIV	0.501***	0.473***
	(8.106)	(7.213)

Regional Stage		
TEMP	2.106***	1.968***
	(5.259)	(4.720)
FEDLAND%	-0.076	-0.122
	(-0.436)	(-0.691)
ACRES	-0.859	-0.552
	(-1.581)	(-1.013)
SIV	0.823***	0.939***
	(4.053)	(3.633)
Site Choice Stage		
TC1	-4.067***	-
	(-7.609)	
TC2	-	-3.701***
		(-6.590)
BOULD	1.031***	1.060***
	(7.778)	(7.114)
CLIMBS	0.149***	0.162***
	(4.735)	(4.177)
μ_s	2.427***	2.252***
	(7.683)	(6.993)
μ_r	1.997***	2.114***
	(8.108)	(7.214)
χ^2	266.462	265.565
ρ^2	0.579	0.577
$\bar{\rho}^2$	0.474	0.468
Per Choice Occasion CS – Policy Proposal A	**$0.259**	**$0.324**

[a]***, **, and * denote the estimate is significantly different than zero at the 0.01, 0.05, and 0.10 level, respectively.
[b]Numbers in parentheses are the ratio of the coefficient to the asymptotic standard error.

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