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THE ECONOMIC BENEFITS OF ROCK CLIMBING[1]

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THE ECONOMIC BENEFITS OF ROCK CLIMBING

Abstract

Rock climbing is a form of risky recreation engaged in by millions each year. Recent policies in the United States and Europe have placed climbing access in jeopardy. Several federal agencies in the U.S. proposed bans on the use of fixed anchors and protection in climbing areas on federal lands. In addition, the era of lawsuits against landowners has generated concerns about liability, leading to private landowners' desire to stop climbing on their land. Outdoor recreational users place a high value on their activities and this manuscript summarizes relatively new research that indicates that climbing is no exception. Therefore, the loss of access to climbing potentially results in the loss of millions of dollars in economic benefits. These economic losses can and should be weighed against the potential benefits of any policies to limit rock climbing and its access.

THE ECONOMIC BENEFITS OF ROCK CLIMBING

Therese Grijalva and W. Douglass Shaw

1.0 INTRODUCTION

There is a long history of valuing recreational activities in the United States, stemming back to the era when huge dams where being built and the river-based recreational activities that were displaced had to be considered in the policy decision-making process, as well as those newly generated recreational activities associated with use of a reservoir. Economists developed models to reveal the values that water-based recreational users had for such activities; and hence, these values could be factored into a benefit-cost analysis of a proposed dam.

In this manuscript we examine the recreational activity known as climbing, particularly trying to summarize the values that climbers place on this activity. Recently proposed policies place rock climbing access in jeopardy. A conventional exercise in policy making is to weigh both market and non-market costs against the benefits of a proposed action. For example, several federal agencies in the U.S. proposed bans on the use of fixed anchors and protection in climbing areas on federal lands. These bans would likely impose economic losses on climbers that may warrant consideration in a benefit-cost analysis. However, some policy makers have implicitly assumed there is no loss in benefits from limiting or banning rock climbing.

While rock climbing has existed on public lands for the past century, recreational demand for rock climbing in the U.S. and elsewhere is perceived to have grown significantly over the last several decades (Grijalva et al. 2002a). Mountain and rock climbing drew an estimated 4.2 million participants in the U.S. in 1991, and 17 percent of the 1992 subscribers of the popular magazine *Backpacker* said they rock climbed (Lewis 1993). Staff at a popular U.S. climbing magazine estimated that 100,000 U.S. citizens try climbing each year (Anonymous, The Economist, 1995). In 1995, the U.S. Forest Service estimated that approximately 7 million U.S. citizens (age 15 and older) had gone rock climbing that year. It is believed that individuals in Europe have been climbing longer than in the United States: the legendary exploits of climbers from the United Kingdom, France, Germany, Switzerland, and Spain are well known. We have no estimates at this time for rock climbing participation in European countries. Our guess is that it may be more popular than in the U.S.

The perceived growth in climbing in the U.S. has lead to a variety of new climbing management and access rules on Federal and state public lands (National Park Service 1993). Recreation demand analysts have recently focused on measuring the economic losses to climbers from restrictions in access, and generally measuring the demand for climbing. The purpose of this manuscript is to illustrate the methods used by analysts in measuring values for rock climbing activities, and to review studies that provide values for rock climbing activities in the U.S. and Europe. In measuring the value or the demand climbers have for rock climbing activities, analysts often overlook a perhaps key component of the climber's decision, risk. This manuscript reviews the implications of failing to consider risk in modeling the demand for climbing, and provides suggestions for future research that incorporates risk in demand models.

2.0 The Value Methods

In the late 1940s two methods were developed to assess the values that individuals have for what are now known as non-market goods and services. These are economic goods for which there is no functioning market to provide information on prices that reveal the values that individuals have for market goods. Unlike a pair of shoes or a shirt, one cannot go to a store to purchase a rock climbing trip. There are of course associated markets for climbing equipment, but an economist desires information on the value of the experience, not the equipment. Harold Hotelling proposed a simple idea to reveal the values for trips to national parks in a letter to the director of the U.S. National Park Service. He suggested that an individual's travel costs to and from a destination could be used to proxy the true price of such an outing (i.e., a trip). In the 1950's the Resources for the Future economist Marion Clawson implemented this idea. The resulting model became known as the travel cost model (TCM). Today, the most modern versions of the TCM are barely recognizable in comparison to the early simple models, but the most fundamental aspects are the same (see review in Smith 1989). The TCM reveals the values associated with the use of a resource such as a climbing area, and certain versions of the TCM reveal the values for potential users: those who climb, but who may not currently visit a particular climbing destination.

The second prominent non-market valuation method developed is the contingent valuation method or CVM (see discussion in Hanemann 1994). The CVM asks survey respondents to state their values for hypothetical changes in goods and services (e.g., a change in the quality of an environmental good or service). The changes are constructed in the survey and they may, or may not have much to do with a real event or situation. However, it is well known that the closer the hypothetical situation or change is to reality, the more believable the stated values for the resource change will be. The CVM may be used to obtain values associated with the use of an environmental resource (i.e., recreational use), but in addition, may be used to obtain values associated with preservation or bequest motives; that is, the values obtained are not limited to the use motive. In this manner, for example, economists assessing damages for the

Exxon Valdez oil spill were able to estimate the value of preventing another oil spill, even when an individual had not ever been, nor planned to visit the Prince William Sound.

Generally, both the TCM and the CVM lead to estimates of economic benefits measured by an individual's maximum willingness to pay or WTP. In the economist's jargon, these are estimates of consumer's surplus (i.e., the consumer's net benefit) and are well established in economic theory to be the measure of true benefits for any good or service. In the next section, the literature relevant to the rock climbing experience is considered, and particularly, the application of the TCM to estimation of values for rock climbing.

3.0 Review and Summary of the Literature

Most of the climbing literature related to climbing behavior or decisions is written by climbers, providing their accounts of an adventure. Certainly, however, many scholars have thought about what makes an individual want to climb a mountain or rock. These scholars, primarily in the fields of psychology and philosophy, have attempted to lay out a framework for participation in risky recreation such as rock climbing or similar risky pursuits such as mountaineering, SCUBA, canoeing or white-water rafting, and big-game hunting. Typically the underlying research focuses on *why* individuals become attracted to risky forms of leisure in the first place (*e.g.*, Schreyer and White 1979; Robinson 1992). For example, the "why" of climbing has been considered by Ewert (1985; 1987) and by Slanger and Rudestam (1997). The perception of risk by participants in risky activities has also been studied (Cheron and Ritchie 1982, McIntyre) and, later, Jakus and Shaw (1996) explored the role of risk ratings and technical difficulty in explaining a climber's choice of a particular climb.

Until quite recently there had been no economic analysis of rock or mountain climbing.

In recent years there have been several analyses of the economics of rock climbing, usually applying the random utility or count data versions of the TCM of recreation demand. All of the available rock climbing economics studies that we know of assume certainty on the part of the climber, and do not involve aspects of risk except in a very minor way (Ekstrand, 1994; Shaw and Jakus 1996; Jakus and Shaw 1997; Grijalva (2000); Grijalva *et. al.* 2002a; Grijalva *et. al.* 2002b; Hanley *et. al.* 2001; and Hanley, Alverez-Farizo, and Shaw 2002).

Nearly all of these rock climbing studies examine access to climbing areas in the United States or Scotland. They focus on the traditional modeling of destinations—where do individuals go climbing and how often—over some time period. Many policies in the United States, Scotland and other parts of Europe may threaten climbing access by changing rules and regulations regarding the use of public lands by climbers. Managers of public lands have been concerned that rock climbing harms resources but, perhaps more importantly, they perceive conflicts between rock climbers and other types of public lands users.[2] The models used in previous studies typically explain how an individual's destination, frequency of taking a trip there, or total seasonal participation may change under the new regulatory policies. Basically all of the models assume the same basic framework and or assumptions related to climbing. Though most readers here will be as familiar as we are, or more so, we'll quickly review the assumed setting.

Background

Technical rock climbing on smaller cliffs or "crags" involves the choice of specific routes up the rockface. Routes differ in their degree of difficulty, length and other aesthetic aspects, as

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[2] For example, as reported below Grivalva et al. (2002a) report the possible harm climbers do to Native American rock art.

well as the degree of risk involved. Technical climbing usually involves the use of ropes and climbing gear to protect the climber in the event of a fall.[3] The equipment used to protect the climber from hitting the ground or rock feature after falling varies from metal hardware placed permanently in the rock (a bolt or piton), to metal devices that can be temporarily inserted into cracks and fissures, and later removed. Using either one, as the "leader" climbs, the rope is run through these devices, which act as a fulcrum point in the event of a fall. The second climber (or "second") holds (belays) the rope from the bottom. The leader advances using the features of the rock alone, with the climbing equipment used only to protect against the consequences of a fall. After belaying the leader, the second advances up, also using rock features, but he or she is quite well protected by the rope above, and thus takes little or no risk of injury.

Specific climbs or routes are often rated according to technical or gymnastic difficulty and also for their assessed risk. Technical ratings are initially proposed by the first ascent party, but as the route is climbed by others over the years a consensus rating is determined. Such consensus ratings are published in readily available climbing guidebooks (for popular areas) or spread by word of mouth (for less popular areas). These are much like fishing guides or trail or hiking guides. Guidebooks note the location and length of a route, its technical difficulty[4], and whether the climb can be well protected or not (the risk scale). In the United States, the risk ratings were developed in the 1970s, and were based on the letters used by the Motion Picture

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[3] Some climbers, often featured on television shows or in magazines, climb unroped. This is called “free soloing”; a fall while free soloing a reasonable distance above the ground will almost certainly result in death or serious injury.

[4] The numerical scale for technical difficulty varies in different countries, but in the U.S. the scale runs from the easiest technical climb at 5.0 to the (currently) most difficult, at 5.14. The technical rating is akin to the difficulty rating assigned to dives in diving competitions. Despite different numerical and other classification schemes, the communication of the risk and difficulty can be translated from one country to another.

Association to designate suitability of a film for different viewers: G, PG, R, and X. Specific climbs or routes that the leader can protect safely are rated G (excellent protection) or PG (good protection). Rock climbs that cannot be well protected are typically rated with an R, or when protection is extremely poor to non-existent an X. An R-rating indicates that should the climber fall, even with the use of protective equipment, the fall would likely result in serious injury. For example, an R-rating generally indicates that the climber will likely have to climb long distances between climbing protection points; if a fall occurs it will be a long one, which may heighten the probability of hitting the rock or the ground. An X-rating indicates protection possibilities are so poor that, should the climber fall, death would be a near certainty. A common footnote on X-rated climbs is that the climber shouldn't bother taking a rope.[5] Other than this, little is communicated about risks in rock climbing on a widespread basis, at least in terms of information that climbers can readily access.[6] Based on our experience, we know that climbers often share details with others about routes they have done, and this information is passed along in the community, most often by word-of-mouth.

Given the information available about climbing routes, climbers may choose from a variety of potential outdoor climbing experiences. One climber may push her athletic limit by choosing a well-protected climb with a technical difficulty at or beyond her current technical limit, falling frequently, but safely, in her attempts. Another climber may play a more psychological game by choosing to lead an R- or X-rated climb, perhaps technically easier, but

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[5] This "joke" indeed communicates the risk the climber will take on such a route.

[6] Various organizations do keep total statistics on fatalities and injuries. For example, the American Alpine Club reported an average of roughly 30 climbing-related deaths per year in the U.S. during 1990-97. The Mountain Rescue Council states that six climbers were killed in England and Wales in 1993, out of perhaps as many as 150,000 climbers in Britain (Anonymous, *The Economist*, 1995).

one which requires mind control to complete the risky route. This climber would not wish to fall, since it would likely result in injury. Others may choose an easy day at the crag, climbing only safe routes well within their technical ability, or maximizing the vertical distance or number of vertical feet successfully climbed. Finally, some may choose to minimize risk altogether by always choosing to climb with a rope from above. These activities are clearly in contrast to the assumption by some researchers that the sole goal in climbing is to "get to the top" by any means necessary. Whereas this may be a reasonable assumption to make in considering the sport of big mountain climbing or mountaineering, it is often inappropriate for rock climbing.

Conventional WTP or welfare measures are derived to examine the losses or gains of some access restrictions. These studies are summarized in the next section.

3.1 Mohonk Peserve or Shawangunks Studies

In one of the first economic studies that we know of, Paul Jakus and Douglass Shaw gathered data in the late 1980s and early 1990s on climbers who mainly visit the famous "Gunks" area north of New York City (see Shaw and Jakus 1996 and Jakus and Shaw 1997).[7] The study explored three related behavioral issues associated with climbing: (1) the effect of risk-ratings on a climber's choice of a rock climb; (2) the climber's perception or beliefs about climbing bolting and protection policies; and (3) the value to climbers of climbing in the Gunks. One problem the authors immediately encountered was just how to go about collecting information on climbers. Unlike many household activities, random households could not be contacted because so few households contained rock climbers. The alternatives were to go to the Gunks and do on–site sampling of rock climbers, which leads to a potentially biased sample, or

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[7] It seems that Earl Ekstrand was busy on a Ph.D. dissertation that examined climber's values for the well-known Eldorado Canyon near Boulder, Colorado at about the same time.

to obtain a list of members of the Mohonk Preserve who might rock climb. The authors used both sampling methods. Of the 892 respondents to the Mohonk Preserve survey, 221 stated that they took a climbing trip in 1993 at the time the survey was given. The group who returned the survey is well educated and has a high average household income.

The Mohonk Preserve's lands offer some of the finest rock climbing in the United States, and it is a destination climbing area for individuals from all over the world. Compared to other national climbing areas, the Preserve is somewhat unusual in that it maintains a policy of not allowing new bolts or pitons to be placed in the cliffs. Climbers must use their own protection, or the existing permanent protection (bolts and pitons) that had been permitted in the past.

Results from the Mohonk Preserve sample of rock climbers illustrates that "getting to the top" is not a consideration for nearly half the respondents, and that route difficulty is sought out, not avoided. First, a majority of climbers (60 percent) most frequently choose to do routes that are just at or above, not *below* the grade at which they are technically able to climb without falling. In addition, when asked how they normally finished a climb, 51% said they continue to the top, 11% said they rappelled (descended on the rope) after one or more ropelengths of climbing, and 38% had no preference. Thus, fully half of our responding sample of climbers defined success as something other than completing the route. Respondents were also asked to rate the attractions of a trip to the Preserve on a 1 (most important) to 5 (least important) scale. A large number of climbers gave "physical challenge" a score of 1 (60 percent of those who responded). This supports earlier evidence (*e.g.*, Ewert 1985) that the challenge is important to this group of individuals.

Climbers in the Preserve study were asked whether the Preserve's policy of no bolting should be maintained, or reconsidered. Recall that bolts very likely reduce the risks of injury or death, so one might assume climbers would be in favor of reconsidering this policy. Of those responding to the question, 68% said it should be maintained. Only 1% thought the policy should be revoked, while 31% said it should be reconsidered, with the majority of these saying it should be reconsidered to increase safety. Opinions about bolting policies may suggest the following: first, there are ways of climbing safely without bolts, and a majority of climbers here do not mind these alternatives; second, attitudes toward bolting do not necessarily reveal a preference for taking risks because climbs with poor protection may be avoided; or perhaps third, climbers may be willing to accept more risk for greater environmental preservation. More careful questions have to be asked of the climbers to further explore this issue of bolting and how it relates to risk-taking and the experience.

The Mohonk questionnaire also asked climbers to describe a typical day at the Preserve. Of those who responded, only 7% *always* climb on a toprope, which involves little or no risk because the rope is always above the climber to protect him. An additional 18% said they usually toprope a specific route, with the remaining 75% climbing with a toprope infrequently. This shows that few climbers approach their sport in a manner in which they can always minimize risk.

The risk in these endeavors, whether real or perceived, may decline if the climber leads a route that protects poorly, but is well below his or her level of ability.[8] The authors compared the level at which the climber can lead well-protected climbs to the level at which he leads R- or

[8] This might be compared to the perceived risk of one walking down a flight of stairs, *i.e.*, there is some risk associated with falling, but most of us perceive almost no risk because our abilities allow us to negotiate the stairway safely.

X-rated climbs. Of those who said they led R-rated climbs, 30% said they lead the same level of technical difficulty as they would for a G- or PG-rated climb. But 51% said they lead one level lower than they report leading normally, and 11% said they lead two levels lower.[9] A similar comparison for leaders of X-rated climbs found that only 10% said they lead at the same level of technical difficulty as a G- or PG-rated climb, 41% said one level lower, and 39% said two levels lower. Note that the number who lead at the same level as their ability drops significantly when the outcome from the fall increases from injury (R) to death (X). This finding is consistent with two key aspects of behavior. First, climbers appear to avoid perceived risk and second, the probabilities of failure are controlled to some degree by the climber (see Jakus and Shaw, 1996).

The climber's behavior of adjusting the difficulty of a climb downward when climbing an R- or X-rated route suggests that the conventional expected utility model, which assumes exogenous risk probabilities, is inappropriate unless ability and difficulty can be integrated with the probability of injury. As a related issue, it would be interesting to examine whether those climbers who lead R- and X-rated climbs are more likely to favor restrictions in bolting. We might expect that, if the thrill of the potential injury or death motivates them in choosing climbing routes, this group may be against any new bolts or pitons. However, for the 81 individuals who lead either R- or X-rated climbs, 40% thought the policy should be reconsidered and 19% of this group said so because of safety reasons.

Last, but certainly not least, Shaw and Jakus estimated the benefits of climbing at the Preserve and to prevent certain losses in access from occurring there. Using two different versions of the TCM the value of a climbing trip to and values to prevent losses of a particular

[9] Some missing data is evident in the sum of these two adding to only 92%.

area (Sky Top) at the Gunks are estimated. For the first, application of a conventional count data TCM yields an average of about $80 per trip to the Gunks. This WTP is a little difficult to interpret, but one can think of it as the average WTP to have a trip to the Gunks. It falls within the range of values for high-end recreational experiences, such as salmon fishing.

In regards to the second, Shaw and Jakus estimated what climbers' would be willing to pay to prevent loss in access to the Sky Top portion of the Gunks—an area to which access was threatened. The average value per season to prevent the loss of 50% (an approximation for the loss of climbs at Sky Top) of the routes at the main cliffs is about $7.85. This value is surprisingly small, especially in comparison to the per-trip value discussed above. There may be several reasons for this. In the model that simulates the loss in access to 50% of the total number of routes climbers are allowed to substitute to other key and important northeastern U.S. climbing destinations. In addition however, the model doesn't clearly account for all the routes outside of the main areas at the Gunks, and there are many of these (i.e., there are many sections of cliffs that locals know about that are not in the guidebook and hence this biases the total number of routes we assume to be true. Both factors would tend to reduce the average WTP to prevent the loss of routes as compared to say, single equation count demand models. We therefore don't think any general inferences should be made based on this number.

3.2 National (U.S.) and Hueco Tanks Studies

Grijalva (then Cavlovic - 2002), and Grijalva *et al.* (2002a and 2002b) examine the losses to climbers that visit Hueco Tanks near El Paso Texas, and more broadly, the losses to climbers for access restrictions in wilderness area climbing around the United States. In a nice joint effort that began in about 1998, Paul Jakus (then at the University of Tennessee), Therese

Grijalva (then Cavlovic), her colleagues Bob Berrens and Alok Bohara (from the University of New Mexico), and Douglass Shaw (University of Nevada Reno) collaborated on a study. Grijalva, Shaw, and Jakus simultaneously surveyed climbers in several parts of the United States, mainly using on-site sampling. Climbers were contacted at Hueco Tanks, a park in Texas known worldwide for its stellar bouldering, at Red Rocks National Conservation Area near Las Vegas, and the Obed River Gorge climbing area in Tennessee. Those in the sample represented a national sample, in that climbers lived all over the United States, and some were from countries in Europe.

The nationally-geared study was intended to ascertain values for climbing in U.S. wilderness areas, to which access was threatened due to the U.S. Forest Service (USFS) proposed policy that banned the use and placement of fixed climbing protection. The investigation sought total aggregate damages of the USFS proposed policy. Based on an aggregate figure of about 7 million climbers, Grijalva et al (2002a) report that the loss of all access in wilderness areas on USFS, Bureau of Land Management, and National Park Service lands is in the range of $20 to $25 per person annually, and is in the range of $130 to $179 million in aggregate.

Using much of the same data, but naturally focusing more on the Hueco Tanks survey results, Therese attacked the issue of lost access at Hueco Tanks. The Texas State Parks department made plans to eliminate bouldering at many or all of the sites within the park primarily because they were concerned that bouldering was a threat to historic rock art left by Native American Indians. The study did not explore values for the rock art, which are no doubt important, but did find values for keeping areas within Hueco Tanks Park open for climbing.

Grijalva et al. (2002b) report a value of around $370 per trip to keep all four mountain areas open to climbing, and only $114 per trip to keep only one mountain area (Hueco's North Mountain) open. Seasonal consumer's surplus ranges from $1640 for all four, back down to about $360 to keep only one mountain open.

3.3 Scotland Studies

Very recently, Nick Hanley and several colleagues, mainly Begona Alvarez-Farizo, but also Robert Wright and to a much lesser extent Douglass Shaw, used collected data to assess the impacts of government resource manager's proposed policies affecting access to Scottish climbing areas (see Hanley et al. 2001 and Hanley et al. 2002). These areas include the famous Glencoe, Cairngorms, and Ben Nevis mountain sites. Proposed access policies in these areas stemmed from concern that too many mountaineers and other visitors were contributing to erosion and having a negative environmental impact relating to effects on wildlife (see references in Hanley, Alvarez-Farizo and Shaw, 2002). A different concern was voiced by some private landowners, who complained that they were expected to help maintain good access routes, but received no compensation. Proposed policies thus included a charge on parking one's car at access points, forcing longer times to access routes by closing parking areas for cars, and otherwise trying to lengthen the walk to climbing routes.

The sample used in the analysis is again less than perfectly desirable in that a simple random sample is not used. A list of Scotland's climbing club members was provided to the researchers. The authors estimate the loss in seasonal consumer's surplus for a host of policy options. These include imposing a £5 per day parking fee, and an extra 2 hours of walk-in time to Ben Nevis and the Northern Cairngorms, as well as a few other policy scenarios. The loss of consumer’s surplus is greatest for the policies at the Northern Cairngorms, at an average of £20 per climber for the parking fee and about £23 per climber for the 2 hours of extra walk-in time. The Ben Nevis policies result in about £13 per climber. When all adverse policies are enacted simultaneously, the loss per climber is about £40 per season. If one aggregates to a population of 12,425 active climbers living in Scotland, this worst-case set of policies results in seasonal losses of £497,000.

3.4 North-Eastern Alps Study

We briefly consider a study, which is not confined to rock climbing benefits, but which does report on the general benefits to visitors to the mountains. In brand new work Scarpa, Tempesta and Thiene (2002) model the demand for 18 sites in the North-Eastern section of the Alps using a sample of visitors cut from the Veneto chapter of the Italian Alpine Club. The Alps attract more than 60 million tourists per year, but the manuscript does not provide a complete breakdown of activities for these tourists. In the authors’ sample, about 11 percent appear to engage in technical rock climbing.

The authors report that the WTP per trip for visitors to the Dolomiti-Pasubio is about 25 Euro, and that this is about two times higher than the next highest destination WTP. The WTP per trip for other destinations are in the range of 3.50 Euro to 13.12 Euro.

3.5 Summary

Table 1 summarizes all of the values we have discussed. As seen below, there are many different values that have been estimated for rock climbing at this point. As of this writing, more work is under way, so it is expected that one will need to be watching carefully for studies to emerge. The values in Table 1 range in units, so are not easily compared to one another. We make no attempt to make the units more comparable, for example by adjusting for inflation and changing with exchange rates to a common currency. The reason we forgo this exercise is that there are many important differences in the methods used to generate the values. In short, it would be misleading to think that one could make quick and simple adjustments to see if the consumer's surplus or benefits are the same for similar policies.

Table 1: Summary of Rock Climbing Values

Study/location or climbing site	Values Found	Description/Interpretation of Value Measure
Shaw and Jakus, Gunks	$80 per trip (1993)	Average per trip value
Shaw and Jakus, Gunks	$7.85 to prevent route loss	Per season: Prevent loss of 50% of routes
Ekstrand, Eldorado Canyon	$40 to $49	Average per trip value
Grijalva et al., Hueco Tanks	$114 per trip (one mountain open) to $366 per trip (four mountains open)	WTP to keep mountain areas open to climbing within Hueco Tanks State Park
Grijalva et al., National (U.S.)	$20 to $25 per person annually, $130 to $179 million	WTP to prevent loss of access in wilderness areas managed by USFS, BLM and NPS
Hanley, Alvarez-Farizo, Shaw, Scottish Mountains	£497,000	Losses per season for 12,425 Scottish climbers from multiple adverse policies
Hanley, Alvarez-Farizo, Wright, Scottish Mountains	£0.005 and £0.32 per visit	Change in WTP to prevent 50% increase in approach time at Cairngorms and Glencoe respectively
Scarpa, Tempeste and Thiene, Northeastern Alps	3 to 25 Euro per trip	Average per trip value for any mountain visitor (not just rock climbers)

4.0 New Directions

The standard approach to modeling demand for recreation assumes that the individual has perfect information regarding all choices, and that she or he is certain about outcomes. Climbers, in reality, likely face many risks, including the risk of injury or death, the risk of not completing a route, and risks associated with weather and crowds. Interestingly, a climber sometimes refers to success as “bagging” a route, which conjures up the hunter’s claim of “bagging” a deer or elk. Both involve uncertainty, with no guarantee of success.

Jakus, Riddel and Shaw (2002) show how modeling climbing decisions with risk results in demand models that differ from the usual model of recreation activities. Their discussion is presented within the context of risks associated with injury or death because these are probably the most interesting and important aspects for both climbers and economists. While some authors have considered some type of uncertainty and risk in outdoor recreation, none have considered risk of injury, and none that we know of have used revealed preference data in the empirical modeling.[10] Incorporating the types of risk faced by recreation participants in a plausible but empirically tractable manner leads to a fundamentally different behavioral model than one that does not incorporate risks, as will be shown below.

Injury may take various forms of severity. In a climbing context, let the health status of the

[10] One study estimates the willingness to pay (WTP) for white-water boating using the CVM, but does not directly address risk or risk reduction (Boyle *et. al.* 1993). Another study estimates recreation WTP under uncertainty about congestion levels, again using what is more or less the CVM approach (Prince and Ahmed 1988). Uncertainty or risk has been examined with respect to the probability of fish catch "success" (Larson 1988) or bagging big game (Johansson). We know of no models that use actual behavior or revealed preference (RP) data to derive welfare measures under risk until quite recently (Jakus and Shaw, 2002).

individual be described by some random variable *H*, where *H* is a function of climbing route and climber-specific attributes. In particular, let health status be a random variable and a function of a two route attributes, the technical difficulty rating, *D*, the hazard warning *R* or *X*, and a climber's ability, *A*, so that for an *R*-rated route the function is,

$$H = H(D, R, A) \qquad (2)$$

noting that this can take on a distribution. We might in fact add an error term denoting the random aspects of the climbing experience that can influence deterministic health status, but this is not necessary. For example, a climber may be injured by rockfall, the route may have loose handholds and footholds or, perhaps, the climber may simply fail to successfully climb the route without falling.

In some real sense all climbing is risky, depending on what one considers the goal of climbing, or the risky outcome. If we call reaching the top of the climb the outcome, then each climbing route has the potential for a failure or success, especially if uncertain weather is introduced. Reaching the top seems to be the thought behind the work by some of those who have explored the risk issues to date (Ewert 1985; Robinson 1992; Ewert and Hollenhorst 1989), but does the outcome "completing the route" make sense for rock climbing? Would a rock climber be willing to pay something *ex ante* to avoid failure with certainty? The advent of sport climbing, with a great emphasis on gymnastic ability, makes the answer less clear. It is likely *some* climbers would like success guaranteed, but the very struggle to overcome the difficulties of the route are linked to the enjoyment of the climbing experience—suggested by our hypothetical example of the climber who purposefully chose to do a route whose technical difficulty was at or beyond her limit. To model the demand for rock climbing demand in the presence of risk, we must first decide whether all rock climbing routes are risky, or whether only climbs rated R or X are risky.

What is missing in the above discussion is just how do we quantify the link between the probability of failure and the individual's ability and skill. In modeling the demand for rock climbing others have considered skill (see Shaw and Jakus, 1996 or Grijalva et al. 2002a for example) or have let the skill level work to explain route choice. A more experienced, stronger climber has a greater probability of completing a climbing route of any given difficulty rating relative to a less experienced and skilled climber. We are confident that data will show that many climbers do not necessarily seek a route that is so easy relative to his skills that the probability of failure is equal to zero. In fact, one of the primary reasons for climbing includes the challenge (see Section 3 and Ewert 1985), and many popular mountain climbing books note situations where the climbers would rather retreat than choose an easier route. The risk of failure is part of the experience.

As stated throughout, injury and death risks are probably of most interest to policy makers. As documented in Jakus and Shaw (1996) we know that climbers simply do not ignore these risks. Further, risk-taking attitudes change for different routes, over different days, with different climbing partners and as other factors in a climber’s life change over long periods of time (we age, we have children, etc.). Again, it is likely that highly skilled climbers perceive lower risks of injury or death on a given route relative to less skilled climbers, though we know of no one who has extensively modeled this. Anecdotal evidence suggests that a highly skilled climber simply does not believe he or she will fall on particular routes. What is the probability of a fall resulting in injury or death for that route? It is clearly not equal to one for all climbing routes, though outside viewers of climbing may think so.

The probability of injury or death could be determined in a variety of ways. First, we could use the observed frequency of falls resulting in injury for this, or other climbs. Such statistics are available to a degree, from *Accidents in North American Mountaineering,* an annual survey published by the American Alpine Club and the Canadian Alpine Club. Many climbing area managers also keep such statistics. We could also rely on survey information reporting the climber's perceived probability of injury or death, but collecting such data would be a formidable task. If the route is rated R or X, then all climbers have some indication of the probability of injury or death, or at least they know that the probability is higher for the R or X rated route than for one rated G or PG. Whether there is a statistical relation between R- and X-rated climbs and the probability of failure remains to be seen. While the commonly used expected utility model (EUM) often uses expert-assessed risk estimates, are these the appropriate probabilities for use in modeling risky recreation? Use of subjective probabilities in estimation may be an appropriate, but debatable, approach in modeling uncertainty (see Shaw, Riddel and Jakus).

It is clear that skill and other characteristics of the individual should be linked to risk-taking behavior. This is not going to be easy. First, although true for some, it would be inappropriate to assume many or all climbers are risk averse. This means that the functional form used in estimation of a risk-related welfare measure or WTP has to be flexible enough to allow parameters to differ for different individuals in their preferences for risk. This type of flexibility is not so daunting in certainty models (hence the new wave of modeling individual-specific parameters with simulation methods), but may produce further difficulties in estimation in the context of uncertainty.

Second, we are often able to use only observable recreation data linking one or more climbing trips (at a given travel cost) to the climbing experience at a destination area, where each area has a given set of risks. Thus, typical data sets would likely end up with little variation in risks for given travel costs. Data that allows variation in choice with risk must be collected. This implies that we need to more finely tune our demand models, instead collecting information on the actual routes chosen because the variation in risk will be across these routes, not areas.[11] This differs from the data collected by others where choice information was restricted to the number of trips to climbing areas, which does not allow analysis of risky choices. In other words, what the climber does *during* a given trip becomes important, not just where the trip was taken. These issues also arise when the focus is on the role that time plays in the recreation experience, i.e. as Hanley et al. (2001) investigate, how does a climber allocate his or her time between routes, access to remote cliffs, alternative destinations, etc.

All this may suggest that the hedonic travel cost model might be worth investigating. We are cognizant of the fact that the hedonic travel cost model (HTC) popularized by Brown and Mendelsohn (1984) is also subject to some debate in the economics literature (see Smith and Kaoru 1987). Still, the HTC may have strong potential because it could be used to explore the activities on a given trip, and to value each of the various characteristics of the risk recreation experience. As we have suggested, the probability of injury or death (risk) is a characteristic of the climbing area (or route) that may explain choices, *i.e.*, individuals can be observed to choose from among different climbing areas and routes unless they always make the same choice. If

[11] Similarly, if one were interested in modeling white-water kayaking, the important “location” information may be the particular reach (or reaches) of river that is run as opposed to the put-in point. Further, one may wish to learn if

travel costs vary for either the destination or the route, we can infer the hedonic price or the relevant *ex ante* marginal value for changes in risk from the observed data on trips to areas (or choices of routes).

5.0 SUMMARY AND SUGGESTIONS FOR FUTURE RESEARCH

Our exploration has been into risky recreation, particularly the sport of rock climbing. We reviewed a set of studies that estimate the economic value of rock climbing activities. While a number of studies of the demand for rock climbing exist, and are expected to grow, to date none explicitly include risk in modeling demand for rock climbing. The discussion of information collected from rock climbers provides some interesting insights into modeling risky recreation. First, the data show that risk-taking is part of the climbing experience. Second, the data run counter to the belief that getting to the top is a primary goal of all climbers, instead showing that the details of climbing matter. Here we mean, what characteristics of routes are important to a climber, how much risk she wants to take is a factor and similar factors. Thus, the risky outcome is not, in general, the risk of route completion.

The theoretical discussion of risk suggests that risk and uncertainty models will yield WTP measures that are different from models that do not incorporate uncertain outcomes. Empirical application of any uncertainty model will require information not normally collected by recreation demand modelers; we hope to have outlined the type of information needed to estimate these models in the future. Revealed preference data has the potential to be used to model preferences and values under risk, even without use of stated values or preferences. For example, while others have used survey questionnaires that ask individuals to state their WTP

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certain sections of the river were portaged rather than boated.

for a reduction in risk, we might collect data on the actual route choices (or more generally some set of activities at the larger area) on a given trip, adding the amount of time it takes to get to a given route (the number of minutes they must walk, or wait to do a particular route). This will likely reveal much about the value for risk reduction. So far, we know of only one completed study that tries to use revealed preferences and incorporate something about risks (see Jakus and Shaw, 2002).

The interesting policy questions that relate to risk reduction for rock climbers, including emergency rescue management at a climbing area, can probably best be answered using a risky recreation model. Given the cost of rescues at sites such as Yosemite Valley in California, one might well ask what climbers are willing to pay to reduce risks of injury or death. This could be used to find reasonable insurance payments, if desired.

Finally, we all know that climbers are often deemed fools. What is a fool anyway? We aren't the first to ask this, as many economists have explored whether willing casino-goers are foolish. No matter what the definition, we think this paper has shown that in taking risks all climbers are not fools, and most probably, the average climber is not being foolish. Whether this is true for other risky sports remains to be seen. Despite our accumulated knowledge and the thousands of hours that each author has spent hanging from the side of cliffs, we wonder if there is any model based on rational behavior that can explain why some choose jump to off mountain tops wearing a tiny parachute!

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