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THE ECONOMICS OF COLORADO FOURTEENERS: RESEARCH SUMMARY

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Introduction

To many, the mountains are a symbol of Colorado's beauty and natural wonder. Their majestic presence dominates our skyline, and the mountains can serve as a solitary retreat from the hassles every day life. The mountains also serve as an end destination for numerous recreation opportunities. The Colorado Mountains are home to a collection of peaks whose summits rise above 14,000 feet, otherwise known as "Fourteeners." Fourteeners attract visitors from near and far who enjoy hiking, "family time", photography, and wildlife viewing. Famous Fourteeners like Pikes Peak in Colorado Springs and the Maroon Bells in Aspen are prime examples of Fourteeners that serve a multitude of recreational interests. However, to many, these 54 Fourteeners also serve as a focal point to fulfill a lifelong dream of summiting a high peak—or the entire list of Fourteeners.

In recent years, heightened Fourteener visitor use and recreation have resulted in considerable ecological impacts, such as trail widening, soil erosion, and land disturbances. Although visitor use on public lands is somewhat difficult to measure (English et al, 2002), estimates place Fourteener use at approximately 10,000-20,000 at popular Fourteeners along the Front Range (Frazier, 2006), and at least 500,000 visitors each year for the entire state ((Kedrowski (2006);

Rappaport (2007)). Furthermore, the fragile alpine areas are not easily restored ((Kedrowski (2006); The USDA Forest Service (2006); (Evans, 2007)), making a balance between human use and natural area management difficult to achieve. Because visitor use is now at a level where the environment may suffer irreparable damage, policy managers often describe the quandary as mountains that are being "loved to death" (USDA Forest Service, 2006).

While Fourteeners clearly provide a "priceless" experience, many of the problems with visitor use are "economic" in nature. The purpose of this paper is to discuss why economic principles can explain some of the environmental effects surrounding Colorado Fourteeners. We also explain how economics can be used to provide an estimate of the value that the Fourteeners provide to society, and we present policy recommendation on how to manage Fourteener use in order to sustain the resource into the future. In doing so, we also summarize some of our research on the economics of Colorado Fourteeners.

Fourteeners as Public Goods

One classic economic explanation for Fourteener ecological damage is that most Fourteeners are entirely publicly owned and do not require access fees at the main trail heads. As a result of the free access, people will continue to use the mountain until their personal

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costs (which include time and expenditures) exceed the enjoyment that they receive from the experience. Thus they will climb the Fourteener regardless of the environmental and congestion cost their activities impose. Because it is difficult to exclude people from using a public good, it can be over-used. In the case of Colorado's Fourteeners, at low use levels, there may be minimal human impact to the ecosystem. However, as anyone who has climbed the Long's Peak "Keyhole" on a summer day will attest, there is congestion at high levels of use. This can yield danger to other hikers and climbers, as well as sustained environmental damage.

Thus one question is how to manage a valuable public resource like the Colorado Fourteeners. Economists consider "public goods" to be an example of a "market failure". This means that the "price" of the Fourteener (free at most places) doesn't reflect the seemingly "priceless" value of the resource. Crafting the appropriate solution for managing the Fourteeners is tricky. Some good economic issues to consider are:

- How "fair" is it to restrict access to a public good like the Fourteeners?
- How much environmental damage or environmental "cost" balances the benefits enjoyed by Fourteener recreationists before trail access is restricted?
- How can we encourage recreationists to select recreation times that will minimize the environmental impact of their recreation activity (e.g. weekday use vs. weekend use)?
- How do we ensure that policy managers allocate appropriate funding to manage valuable natural resources like the Fourteeners?

We address some of these issues later in the paper. Approximately ten Fourteeners traverse private lands, and involve complicated land management situations. Table 1 summarizes the access issues on privately and publicly owned Fourteeners. It should be noted that there are pending access issues for several of these Fourteeners, which may change shortly after the publication of this paper. It is suggested that you rely on one of the many Fourteener websites for updated information on trail access. Two suggested information resources are: www.14ers.org and www.14ers.com.

2. Outdoor Recreation and the Rural Economy

Recreation is one of the largest sectors of the Colorado economy. Fourteener recreation also contributes a great deal to the economy, although the impact of

Fourteener recreation on the economy has not been made available until relatively recently. While consumer spending patterns may be far from the minds of people while they are enjoying their hike up a Fourteener, the fact of the matter is that outdoor recreation significantly contributes to rural economies, and it can provide sustenance to those who are trying to make a living in a remote area. Two key measures of economic development are *consumer expenditures* and "*value-added*."

Consumer expenditures include things like food, gas, lodging, and other costs. Most recreation studies prefer to calculate expenditures made for that particular trip. Often times the researcher will distinguish whether the expenditures were made close to the recreation site (20-30 mile radius) or in a larger geographical space. It is generally accepted that the further people live from the attraction, that the more money people will spend on the activity.

"*Value-Added*" is a bit more complex, but it is an important measure of economic contribution to a state and local economy. Let's say you buy an energy bar at a local convenience store before you head out on the trail. You have essentially added value to the economy in several different sectors. Your purchase has helped pay for the convenience store clerk's wages. This is a gain to the local economy. The transport of the food to the convenience store, the production of the energy bar and the growing of the raw ingredients used to make the sports bar are contributions to the state economy where the energy bar is produced. To work backwards, there is "value added" to the economy in every step of the production of the energy bar. When the wheat is grown and sold to the baker, the value of the raw materials has increased, because they are now "consumables". When the energy bar is cooked and sold wholesale there is more value, because the convenience store has given money to the baker. Then when you buy the retail product there is even more value, because you have essentially paid the wholesaler for availability. In other words, almost every purchase that is made is part of a "domino effect" and this domino effect can still have a very valuable impact on local and state economies. Furthermore, the wages paid at each step in the production process will get spent elsewhere in the state economy. There are economic models that measure the multiplier effect and value added to the economy at both the county and the state level.

Table 1. Summary of Fourteener Access by Main Trail

Range	Private Peaks	Access Permitted
10-Mile/ Mosquito	Bross	Closed
	Democrat	Closed
	Lincoln	Closed
	Quandary (parts)	YES--trail re-routed to avoid private land
	Sherman	YES--but future access debated
Elk		All Public: Capitol, Castle, North Maroon, Pyramid, Snowmass, South Maroon
Front		All Public: Bierstadt, Evans, Grays, Longs, Pikes, Torreys <i>Note: Evans and Pikes also have paved roads to summits</i>
Sangre de Cristo	Culebra	Fee for Access YES--Pending access issues across private lands
	Crestone Group	YES--trail re-routed to avoid private land
	Little Bear Peak	YES
	Mt. Lindsey	All Public: Blanca Peak, Crestone Peak, Crestone Needle Ellingwood Point, Humbolt Peak, Kit Carson
San Juan	Wilson Peak	Private access fees on traditional access route. Negotiations with landowner are on-going. All Public: El Diente, Eolus, Handies, Mt. Wilson, Redcloud, San Luis Sneffels, Sunlight, Sunshine, Uncompahgre, Wetterhorn Windom
Sawatch		All Public: Antero, Belford, Columbia, Elbert, Harvard, Huron, LaPlata Massive, Missouri, Mt. of the Holy Cross, Oxford Princeton, Shavano, Tabeguache, Yale

3. “Non-market” values

Although natural experiences may seem “priceless,” there is no doubt that they provide value to the participant. Natural resource and environmental economists specialize in estimating dollar values on items and experiences that seem to defy a price. The first reaction for some people is that this is morally “wrong” at some level and that it presents a conflict in value with the natural world. Do natural wonders really need a price tag? The answer is that in order to call attention to something that really is important to the public—like the Colorado Fourteeners—it really is helpful when the economic value is known to the management agencies and the elected officials. Here are some examples of how “non-market” values can be useful:

- **Budget Allocation:** Agencies like the USDA Forest Service have limited funds to devote to many important natural areas. Providing the dollar value of a natural amenity makes a pitch that the area is deserving of funding and management attention, particularly if the public places a higher value on the resource than what is expected.
- **Grant Writing:** Many non-governmental organizations and non-profit groups supplement the efforts of government groups; however, the competition for funding is intense. Providing a dollar value for a natural resource helps grantors better understand the value of the project. It also makes

it easier for the non-profits to justify their budgets and to make a pitch for the worthiness of the cause.

- *Compensation:* When natural areas are destroyed due to either natural causes (e.g. Hurricane Katrina) or by man (e.g. oil spills), quantifying the “non-market” value helps us to understand the magnitude of the impact. It can also provide guidelines for assessing environmental damage liabilities.

The most common way in which we assess the use value of market and “non-market value” for an item is using a measured called “*consumer surplus*”. Without getting too technical, consumer surplus is essentially the difference between the maximum you would have paid and what you actually did pay. For example, say you went to buy a pair of high quality hiking socks and you were ready to pay \$15, but instead, you only had to pay \$10 because they were on sale. Your consumer surplus is \$5, because you were willing to pay the \$15, but you didn’t have to. This extra \$5 in your pocket is your consumer surplus. Here are a few more details about consumer surplus:

- Individuals often have different consumer surpluses. Using this same example, let’s say that your sister also went to the store, but she was only willing to pay \$12 for a pair of socks. She now has a consumer surplus of \$2.
- There can be “zero” consumer surplus. Let’s say your brother went to the store with you, but he was only willing to pay \$10 for a pair of socks. If the price was \$10 and he wouldn’t pay a penny more, then he has a consumer surplus of \$0. He still got the socks, though. Someone who was only willing to pay \$8 wouldn’t even buy the socks.
- We can sum all of the consumer surpluses to determine a “societal” consumer surplus. In this case, the consumer surplus for you, your sister, and your brother is \$5+\$2+\$0=\$7.

Economists use a simulated market survey design combined with statistical analysis to estimate the consumer surplus for natural resources. While the techniques may not be “perfect”, the process of determining a consumer surplus clearly provides insight into the value of the natural resource.

Summary of an Economic Study of Colorado Fourteeners

In 2005, after main trail access to three popular Fourteeners was closed, it became clear to us that Fourteener

access was a very important—and timely—economic issue for Colorado. We distributed approximately 900 surveys at 11 key Fourteeners in 2006 and 2007 across the state of Colorado. We selected these 11 sites that we felt that collectively represented the non-surveyed Fourteeners in terms of geography, degree of hiking and climbing difficulty, and visitor use patterns. This stratification allowed us to generate a representative sample. We began data analysis at the end of 2006, and although data are still being collected, we have made the following *preliminary* results:

1) Fourteener Visitor Expenditure Patterns in Colorado²

We analyzed expenditure data for the entire sample to determine amount of visitor spending on Colorado Fourteeners. These results are summarized in Table 2. This is a substantial amount of spending by visitors, and averages about twice the per person expenditures on National Forest land according to the U.S. Forest Service National Visitor Use Monitoring data (<http://www.fs.fed.us/recreation/programs/nvum/>). The per party expenditures are about one and half times larger than the typical National Park Service overnight visitor (Stynes, 2006). The median time spent hiking the Fourteeners is about six hours, with the average being 13.4 hours. We observed that the mean is pulled upward by several very large observations, which may be the result of individuals extending their days to summit several peaks during a day, or even an overnight while on the trail.

Table 2. Fourteener Visitor Expenditure Patterns in Colorado

Categories	Per Group/ per Trip	Per Group/ per Day	Per Person/ per Day
Camping	\$5.15	\$2.58	\$1.54
Equipment Rental	\$7.79	\$3.90	\$2.34
Equipment Purchase	\$44.98	\$22.49	\$13.48
Groceries	\$36.91	\$18.45	\$11.06
Restaurant Food	\$72.35	\$36.18	\$21.69
Gasoline	\$55.38	\$27.69	\$16.60
Hotel	\$95.39	\$47.69	\$28.60
Supplies	\$8.41	\$4.20	\$2.52
Car Rental	\$31.21	\$15.60	\$9.35
Total	\$357.56	\$178.78	\$107.18

² Results of this study were published in the Spring 2007 edition of the Western Economic Forum (Keske and Loomis, 2007).

The expenditures may be high compared to other studies due to logistics required to summit the mountains. While most Fourteeners are day trips, many trips require an overnight stay the night before to allow for an early morning trailhead departure (e.g., 5am) in order to be off the summit prior to the afternoon lightning storms. Even Front Range Fourteeners that are within two hours of Denver still require an overnight stay. Furthermore, Fourteeners located in the San Juan Range in southwestern Colorado or the Sangre de Cristos in southern Colorado frequently require two-night stays for non-local residents. These results were published in the Spring 2007 Western Economic Forum journal.

The “non-market” value of the Fourteeners, measured in consumer surplus, is also higher than typical outdoor recreation, even compared to more specialized activities such as rock climbing. The average individual consumer surplus per trip was calculated at \$307, with a median of \$246. The 90% confidence interval on mean WTP is \$266 to \$361 per trip. For comparison, a study by Ekstrand (1994) found that rock climbers at Eldorado Canyon outside of Boulder generated consumer surplus values of \$27.95 per day in 1991 (equivalent to \$40 in 2006). Grijalva and Berrens (2003) also estimated a value of rock climbing in Texas at between \$47 and \$56 per day trip. More comparable is the study by Grijalva, et al. (2002) that involves climbing in wilderness areas, where they found a WTP of only \$20 to \$25 per person to avoid closing climbing sites in several National Forest, National Park and BLM Wilderness areas.

2) *Fourteener Access on Closed Mountains*³

In 2005 the main trailhead to three mountains in the Mosquito Gulch Range (Mounts Lincoln, Democrat, and Bross) were closed to public access. The closure was instituted by several private landowners, many of whom were concerned about liability issues, particularly around mine sites.

Elimination of hiker access invokes two economic issues. First, for the local economies in Park County, and southern Summit County, Fourteener closure may result in serious reduced tourism and economic benefits during the summer. As a result of potential loss of revenues, in 2005 the town of Alma and the State of Colorado sought to pass legislation that would essentially indemnify the local landowner from any lawsuits related to injury or death from the old mine sites.

In early 2006 the State of Colorado signed legislation HB 06-1049 into law, effectively placing this policy into effect. In exchange, the landowner agreed to open up access to the public, and in some cases the town of Alma has leased much of the area from private landowners. HB 06-1049 was also supported by a number of local organizations and non-profit hiking and climbing organizations.

With the help of several volunteer groups, we distributed over 200 surveys at nearby Quandary Peak, which we deemed to be a close substitute to the three closed Fourteeners, in terms of proximity, terrain and difficulty. We used the values obtained from the 129 surveys returned and “transferred the benefits” to the closed Fourteeners. We obtained initial expenditure values of \$191.62 per person expenditures in a 25-mile radius of the mountain, and \$221.53 in the state of Colorado. Trimming down some of the categories (such as rental cars) yielded more modest values of \$115.48 and \$168 of expenditures locally and state-wide, respectively. Ironically, the consumer surplus was also \$168 (remember, this is *in addition* to the \$168 expenditures). This study yields three very significant findings:

- 1) Fourteener closure has the potential to significantly impact local economies.
- 2) Fourteener climbers place a high value on access to the peaks (a consumer surplus of \$168 is very high compared to previously mentioned wilderness studies).
- 3) Much of the money is spent locally, and it is worthwhile for local communities to develop creative solutions to ensure that peaks remain open.

3) *The Economic Value of Novel Means of Ascending High Mountain Peaks: A Travel Cost Demand Model of Pikes Peak Cog Railway Riders, Automobile Users and Hikers*⁴

The purpose of this study is two-fold. First, we quantify the economic values of three means of ascending Pikes Peak. Second, we examine whether the presence of motorized vehicles and cog rail passengers affects hiker consumer surplus and net benefits of high mountain peaks.

The literature suggests that there may be negative interactions between different ways of ascending a mountain, which may reduce the benefits for a particular group of recreationists. For example, conflicts are

³ Results of this study have been accepted for publication in the Special Mountain Edition of *Tourism Economics*, forthcoming in 2007. ⁴ Results of this study are preliminary and are currently in review for academic publication.

common between visitors engaging in different recreation activities (e.g., hikers and mountain bikers; hikers and horses) at areas where multiple activities are allowed (Manning, 1985). These conflicts are exacerbated when one set of visitors are motorized and the other non-motorized (Shelby, 1980; Manning, 1985; Jackson and Wong, 1982).

There is heightened management relevance to this issue as well, as increased recreational demand has exerted pressure on national parks and other public lands during the past several decades. Conflicts abound with regards to the continuum of experiences that public recreational areas should provide. This continuum may range from maintaining a purely natural environment at one end of the spectrum, to a highly developed resort area capable of providing accessibility to many potential visitors and generating tourism revenues (Loomis, 2002). Although discussion has taken place for years about how to best manage the land for multiple recreation interests, this is the first study to estimate the differences in recreation benefits associated with different recreational modes on the same mountain peak.

We find that the value of accessing Pikes Peak does indeed depend upon whether the recreation is non-motorized (e.g. by foot or by bike), motorized (auto or motorcycle), or by “novel” means (such as the cog railway). The value to the hikers, as measured by consumer surplus, is more consistent with the consumer surplus shown in other hiking/wilderness studies. Furthermore, the more “unique” experiences (taking a cog or car to the top of a high peak) appear to diminish value to the hikers, who may prefer to substitute to other peaks without the motorized recreation. We find it noteworthy that there are three distinct values that do not show “overlap,” as shown by the upper and lower confidence intervals in Table 3. These results may support management policies that allow for separate activities on different trails or areas on the mountain.

Table 3. Mean Consumer Surplus per Pikes Peak Trip with Confidence Intervals (CI's)

Activity	Mean	Lower 90% CI	Upper 90% CI
Hiking	\$39	\$32	\$51
Motorized Vehicle	\$74	\$62	\$93
Cog Railway	\$188	\$124	\$388

⁵ Results of this study are preliminary and are currently in review for academic publication.

4) *Peak Load Pricing of Colorado's Peaks: Substitution and Use of Price as a Management Tool on High Use Peaks*⁵

As discussed earlier in this paper, from an economic perspective, Colorado's Fourteeners are a “congestible” public good. Because most have no entrance fees, they reach an ecological and social carrying capacity on weekends. In this phase of the study, we evaluate substitutability between Fourteeners, and between Fourteeners and “Thirteeners.”

Roughly 60% of the total visitors reported no substitutes to their current Fourteener if costs (e.g. transportation, food, lodging) increased, and 40% indicated that they would be willing to substitute to either a Fourteener or a Thirteener if costs increased. What is perhaps most noteworthy is that we observed that demand is inelastic for those recreationists not willing to substitute peaks. This inelastic demand yields extremely high mean net benefits of \$510 in consumer surplus per hiker, per trip. Once again, this is considerably higher than visitor net benefits in most recreational use studies.

These results mean that for a large group of recreationists, they will not let much deter them from accessing the peak. In order to reduce visitor use, by 20%, our analysis suggests that a rather hefty fee of \$70 would be required to achieve this overall reduction in use at the popular Fourteeners. Statistically speaking, a \$70 fee would result in a reduction of Fourteener use of 22%. This 22% reduction in use may be substantial enough to take some pressure off the natural environment, trails, soils and vegetation around these popular Fourteeners to allow them to be able to recover, especially if aided by fee financed restoration efforts such as reseeding and netting.

Practically speaking, the logistics of how to implement fees to encourage substitution requires further review by policy makers. Fees are a management tool for signaling to the potential users the increased costs of managing these high volume peaks and providing an incentive to visitors to shift their use to low volume peaks.

We suggest “peak load pricing” —the practice of charging a higher price during times when there is high use— may be a feasible practice on Fourteeners that sustain heavy traffic during the weekends, as is the case with many popular Front Range Fourteeners like Mount Bierstadt, pictured below. Peak load pricing is

frequently used with other natural resources like as energy and water. In the example of energy, prices are higher during periods of higher use, and a lower price is charged during “non-prime” times (like the middle of the night).

Implementing a “peak load pricing” policy on high traffic Fourteeners on the weekends has the potential to mitigate environmental damage and shift the use to the weekdays or to a less commonly used Fourteener. Extra visitation to high use areas requires additional management expenditures on trail maintenance and trail restoration. These additional expenditures are above and beyond the basic level of taxes people pay for management of National Forests. Thus, a “user pay” principle would suggest that visitors to high use peaks should help to pay the additional environmental and management costs their use imposes on these peaks.



Summary and Recommendations

In summary, the natural beauty of Colorado’s mountains provides memorable and seemingly “priceless” experiences for many. Rural communities and the Colorado economy in general also benefit from mountain recreation. However, recreation use also imposes a “cost” to the mountains, and over time, the costs may cause irreparable damage on the natural resource that we treasure. Economics can provide an understanding of the environmental benefits and costs that occur on Fourteeners, and we provide some of the first research studies to quantify the value of these mountains. The value that Fourteeners provide to society and the expenditures associated with climbing the Fourteeners is higher than the “typical” hiking trip. This may be due a number of reasons, including the uniqueness of the

experience and strong desires to achieve personal goals, as well as the logistics of doing so. This information can be used to garner financial support from policy makers to manage the mountains in a sustainable way. There are other ways in which we can reduce damage and have a positive influence on the Fourteener environment:

- Educate others—particularly new climbers and hikers—about the principles of “Leave No Trace” and the fragile nature of the alpine area.
- Volunteer with one of the many non-profits to repair and build sustainable Fourteener hiking trails.
- On more popular peaks, hike during “off-prime time” periods, like weekdays, where there are fewer crowds and less likelihood of trail widening.

There are many positive reasons for identifying the value of the environment. We encourage you to use our research constructively to protect these valuable resources into the future. Should you desire full copies of our research publications, you are welcome to contact us.

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Dr. Catherine Keske is an assistant professor in the Department of Agriculture and Resource Economics at Colorado State University. Dr. Keske is particularly known for her economic research in land protection and conservation easements. She is an avid supporter of outdoor recreation and she has climbed roughly half of the Colorado Fourteeners. She also volunteers for several outdoors groups, including the Colorado Fourteeners Initiative. Dr. Keske is also on the Board of Directors and Executive Committee for the Mountain Area Land Trust, based in Evergreen, Colorado.

Dr. John Loomis is a professor in the Department of Agriculture and Resource Economics at Colorado State University. He is considered one of the foremost experts in non-market valuation, recreation, and public lands management, and he is the author of the book "Integrated Public Lands Management." Dr. Loomis is an active outdoorsman who enjoys hiking, skiing, and mountain biking.

Nearby fourteeners: Pikes Peak (14,115^{ft}). Attracting more than 500,000 visitors a year, Pikes Peak is the most visited summit in North America. Not only is it the only fourteener near Colorado Springs, it's the only fourteener you can summit by train. The world-famous, 127-year old Pikes Peak Cog Railway (the highest railway in North America) ceased operations in 2018 for repairs (reopening date slated for May 2021), but you can still hike to the top of "America's Mountain". Collaborative Applied Research in Economics. View. The connectivity of food security, food sovereignty, and food justice in boreal ecosystems: the case of Saint-Pierre and Miquelon. Colorado's "Fourteeners", peaks with summits above 14,000 feet are no exception. Most of these peaks have no entrance fees, and reach ecological and social carrying capacity on weekends. This paper illustrates how a series of dich... As part of our 2006-2007 economic research study on the value of Colorado Fourteeners, we estimated the value that recreators place on a unique mo View. Conservation Easement Guidelines: What Every Colorado Landowner Should Know. While Colorado's thirteeners (peaks 13,000 feet tall or higher) are often be passed over for popular fourteeners, the slightly lower-elevation mountains actually offer experiences that rival their taller counterparts. The Needle Mountains in southwest Colorado (photo credit: Climbing Cooneys). While they are often overlooked, slightly lower-elevation mountains actually offer experiences that rival their taller counterparts. What is Peak Bagging? A peak bagger (n.) refers to a hiker who attempts to reach the summit of a mountain or collection of peaks, often those above a certain height. They can supply more solitude than fourteeners, and there are options for every type of wilderness explorer.