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Mountain substitutability and peak load pricing of high alpine peaks as a management tool to reduce environmental damage: A contingent valuation study

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ABSTRACT

High alpine peaks throughout the world are under increasing environmental pressure from hikers, trekkers, and climbers. 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 dichotomous choice contingent valuation questions can be used to evaluate substitutability between different alpine peaks and quantify the price responsiveness to an entrance fee. Using this approach, we find that peak load pricing would decrease use of popular Fourteeners in Colorado by 22%. This reduction is due almost entirely to substitution, rather than income effects. There is also price inelastic demand, as 60% of the hikers find no substitution for their specific Fourteener at the varying cost increases posed in the survey. The no substitute group has a mean net benefit of $294 per hiker, per trip, considerably higher than visitor net benefits in most recreational use studies.

1. Introduction and purpose

Alpine peaks on nearly every continent are being increasingly impacted by hikers, trekkers and climbers. From South American peaks such as Machu Picchu in Peru and Patagonia in Chile to the Himalayas in Asia to the mountains in Europe (Hanley et al., 2003), weekly tours of visitors hike the trails and camp en route. While "hardening" trails and campsites is one possible response to the impacts, limiting use is another management tool that does not result in a loss in natural values. In a global economy with increasing emphasis on eco-tourism, pricing is one way to shift use from over-used areas and time periods to other areas and times (Chase et al., 1998). This paper illustrates an approach for estimating the price responsiveness of different types of visitors to peak load fees.

Our study site is Colorado's Rocky Mountains, which have 54 peaks that are over 14,000 feet (nearly 3 km) above sea level. These peaks are referred to as "Fourteeners" both individually and collectively. While exact numbers for recreational visitor use can be challenging to obtain (English et al., 2002), data collected by the USDA Forest Service and affiliate groups allow us to estimate that a minimum of 100,000 people from within the state and all across the country specifically seek recreation at Colorado Fourteeners each year (Colorado Fourteeners Initiative, 2007; Frazier, 2006; Kedrowski, 2006). Fourteener recreation activities include day hiking, camping, off road vehicle trails, wildlife viewing and photography opportunities. However, one of the most popular activities is "peak bagging", when the hiker attempts to summit one, or all of the 54 Fourteeners. Despite continuing issues relating to environmental management of these peaks on public lands, there are no estimates of the economic value or price responsiveness of Fourteener hikers to fees.

Outside of Colorado, the states of Alaska, California, and Washington have one or more 14,000 foot peaks, but the majority of the Fourteeners are in Colorado.[1] Due to the popularity with both in-state and out-of-state residents, ecologists often state that the Fourteeners are being "loved to death" (Kedrowski, 2006; USDA Forest Service,

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[1] California and Washington have twelve and two Fourteeners, respectively. Alaska has twenty-one official peaks over 14,000 feet and the twelve highest peaks exceed 15,000 feet. There is some debate as to the "official" criteria for determining Fourteeners, so we have utilized generally accepted measures (Wikipedia, 2007; Roach, 2005).

2007; Evans, 2007). That is, this collection of peaks is being used in excess of their ecological carrying capacity to regenerate tundra vegetation to hold soils in place (Manning, 2002). In a systematic study that documents environmental damage on Fourteeners, Kedrowski (2006) also found that popular Fourteeners have wider trails to accommodate high hiker volume, and more switchbacks were needed to reduce damage due to soil erosion. The ecological damage also presents temporal considerations, as damage to alpine tundra environments often requires decades to regenerate (Summer, 1980, 1986; McQuaid-Cook, 1978). Similar problems have been noted in climbing areas of the United Kingdom (Hanley et al., 2003).

Re-routing trails and trail maintenance is an expensive activity for the USDA Forest Service and they are often forced to rely upon affiliate non-profit organizations like the Colorado Fourteeners Initiative to implement their management plans. Due to the limited funds available to manage these popular peaks, specific ecological research reports on Colorado Fourteeners have been confined to internal USDA Forest Service Reports, conference proceedings, and trail maintenance projects conducted by non-profit organizations. However, there are clearly positive ecological costs of each hiker on these popular peaks. Forty-four of Colorado's 54 Fourteeners are publicly owned and ten are either partly or entirely privately owned. Five of the peaks with some private ownership are either closed or operate on a fee for access basis. Discussions with USDA Forest Service Leadville District and the non-profit organizations suggest that there has been an increasing demand for high altitude mountain recreation during the past decade. It has also been suggested that this demand is due to a popular and readily available peak bagging "list" that makes it easy for visitors to learn information about the trails. Non-profit organizations have speculated that some recreationists would choose to climb a Thirteener if information were readily available about this class of peaks, and that the substitutability between these high alpine peaks may be a matter of communication and education. These organizations have also provided feedback to the authors that insights into peak substitutability may assist them with promoting alternative recreational areas and minimize environmental damage on popular Fourteener trails.

At low levels of use, the publicly owned peaks are non-rivalrous and non-exclusive. However, at high levels of use, such as weekends and holidays, these peaks become "congestible public goods". Congestible public goods are often considered public goods with a consumption externality. That is, there is over-consumption of the goods because consumers ignore the external costs that they impose on each other and on the environment (Weimer and Vining, 1999). Unlike a privately provided market good where increased use brings about increased revenues to maintain the resource, the publicly owned Fourteeners lack access fees, thus compounding overuse and under-funding for trail restoration. In contrast, Culebra Peak, one peak which is entirely privately owned, has restricted access and requires an entrance fee for access. Thus, it is not surprising that it has one of the most pristine environments, according to the Kedrowski study.

In response to the overuse of public peaks, two management questions arise: (a) would some hikers seeking a "wilderness experience" be willing to substitute from popular Fourteeners to other less crowded Fourteeners or lower elevation peaks called Thirteeners, and (b) would instituting an entrance fee at the popular Fourteeners provide the incentive for substitution? As noted by Chase et al. (1998: 479) in their study of Costa Rica parks: "It is clear that a differential pricing approach to entrance fee structures would enable park officials to take advantage of visitors' varying demand elasticities…" In our case, we hypothesize that there are different demand elasticities for hikers who are willing to substitute their Fourteener recreation for another Fourteener or to a Thirteener. We hypothesize that these decreases in demand are due to a substitution effect, rather than the result of an income effect. If the income effect is small, then this would reduce the concern that entrance fees as a rationing device would price out low-income users and those that could not afford access at the new prices. We also investigate the hypothesis that there will be considerably higher value, measured in willingness to pay for peak access, to hikers who have strong preferences for and therefore limited substitutes for their current Fourteener.

We believe the findings from our study can be generalized to include other high alpine peaks, since Fourteener terrain is similar to most alpine peaks in the continental U.S. that are above tree line and that consist of predominately talus slopes. Some of the Fourteeners have trails, like Mount Whitney in California, the highest Fourteener in the continental U.S. Other Colorado Fourteeners and Thirteeners require more technical climbing skills, and are reflective of more challenging peaks found in the Sierras in California, and 13,000 foot peaks such as the Grand Tetons and Gannet Peak in Wyoming.

1.1. Entrance fee effects: substitution or income effects?

Peak load pricing has often been advocated by economists as a means to shift use both spatially from high use areas to low use areas, and from high use time periods to low use time periods (Rosenthal et al., 1984; Harris and Driver, 1987; see Puttakammer, 2001 for an annotated bibliography of recreation fee studies). Economists know implicitly that along a downward sloping demand curve "low valuing" users will be the first to drop out of the market. This is an important principle that explains peak load pricing, where only those with the highest values are willing to pay a premium. Peak load pricing occurs when price increases either at the peak use areas, or peak time periods. Opponents of fee increases present an equity argument, and claiming that most of the reduction in use is from low-income visitors who are "priced out" by high fees. Past research on campground pricing only found a small income effect when fees were raised at popular waterfront campsites (Bamford et al., 1988). Similarly, Chase et al. (1998) also found only a small income effect for increased entrance fees at national parks in Costa Rica. We contribute to this literature by determining whether visitor response to an entrance fee is more influenced by a substitution effect or income effect. If there is a substitution effect, then resource managers could use entrance fees to reduce use at popular peaks to protect fragile alpine environments with less worry about equity considerations. Determining whether there is an income effect or a substitution effect may yield valuable insights regarding use of pricing as an environmental management tool.

To separate out income effects, economists rely upon the Slutsky equation. This equation decomposes a price effect into a substitution effect and income effect (Varian, 1990). The substitution effect reflects the consumer's marginal rate of substitution between the good of interest (in this case, their current Fourteener) and other goods (in this study, other Fourteeners or Thirteeners). In Colorado, it is plausible that the substitution effect may dominant the income effect due to the abundance of mountain recreation alternatives in the region. Some hikers merely seeking outdoor exercise, views, and challenge may not be willing to pay a premium to climb at particular popular Fourteener, given that they have the opportunity to substitute and obtain their recreation experience at more than 50 other Fourteeners and several hundred Thirteeners in the State of Colorado.

2. Methodology

2.1. Using contingent valuation to estimate the effect of entrance fees

To assess how hikers would react to a higher cost of visiting their current Fourteener, we adapt a stated preference technique called

the Contingent Valuation Method (Mitchell and Carson, 1989). The method creates a "simulated market" to elicit intended behavior "contingent" upon the change posed by the survey. In the earlier mentioned study, Chase et al. (1998) used a CVM approach with a payment card to estimate the additional amount tourists would pay for in higher fees for entrance to Costa Rican national parks. Of course, one primary concern with any stated preference method is hypothetical bias. However, Louviere et al. (2000) cite several studies suggesting that intended behavior is a reasonable indicator of actual behavior. Carson et al. (1996) compared nearly one hundred studies of actual behavior based estimates of willingness to pay (WTP) derived from the travel cost model to contingent valuation estimates of WTP. These authors found no statistical difference in mean or median WTP between the two methods. However, several comparisons of actual cash to hypothetical WTP in experiments have found differences typically by a factor of two (Cummings and Taylor, 1999; Loomis et al., 1996). While there has been some success in reducing hypothetical bias using "cheap talk" (Cummings and Taylor, 1999) and uncertainty recoding (Champ et al., 1997), we have not employed either of these mitigating measures. Thus, our estimates of WTP may be somewhat overstated. Further, since we rely on trip cost as our payment vehicle instead of an entrance fee (to minimize protest responses), there may be an underestimate of how visitors would react to a fee (Campos et al., 2007).

To better mimic the "price taking" behavior typical in most markets, and the way entrance fees are administered, we used a dichotomous choice format of the CVM WTP question rather than the payment card used by Chase et al. With the dichotomous choice CVM question format, hikers were asked whether they would pay a predetermined increase in trip cost to continue to visit their current Fourteener. While the predetermined amount is fixed across questions for the respondent, it varies across the sample of respondents. This allows the analyst to trace out a quasi-demand function relating the probability a person will pay to the dollar amount they are asked to pay. Hanemann (1984) views the respondent as evaluating the difference in utility associated with access at a fee amount of $X to full income but no access. If the difference in utility is positive for access, the individual would respond "Yes". If the difference in utility is distributed logistically, a logit model can be used to estimate the parameters and allow for calculation of WTP.

The cumulative logistic distribution function is as follows:

$$\text{Prob}(Y = 1) = [\exp(\beta X_i)]/[1 + \exp(\beta X_i)] \quad (1)$$

β is the set of parameters that reflect the impact of changes in the independent variables, X_i, (where X_i includes higher trip costs) on the probability of responding Yes. From the cumulative distribution function, we can develop the odds ratio of paying for access ($Y = 1$) or not ($Y = 0$):

$$[\text{Prob}(Y = 1)]/[1 - \text{Prob}(Y = 1)] = \exp(\beta X_i) \quad (2)$$

By taking the natural log of the odds ratio, we develop the logit model:

$$L = \ln\{[\text{Prob}(Y = 1)]/[1 - \text{Prob}(Y = 1)]\} = \beta_0 + \beta_i X_i \quad (3)$$

The log of the odds ratio is linear in the coefficients and the independent variables (Gujarati, 2003). Maddala (1996) provides two goodness of fit measures to evaluate the logit model: the McFadden *R*-Squared and the likelihood ratio (LR) statistic. The LR statistic is analogous to the *F*-statistic in OLS regression. For a given logit regression equation, the LR ratio statistic tests the null hypothesis of whether collectively all the coefficients in the logistic regression are, as a group, statistically different from zero.

2.2. Hypothesis testing and calculation of mean WTP and price responsiveness

We evaluate the behavioral reaction to an increase in trip cost for two groups of users: those who would substitute their recreation to another Fourteener or a Thirteener, and those who would not substitute. The equality of behavioral reaction involves a LR test that compares each group's separate logit coefficients versus coefficients from a pooled logit model and then testing:

$$\text{Ho} : \beta_0 = \alpha_0 \text{ and } \beta_1 = \alpha_1 \quad (4)$$

where β_0 and α_0 are the respective intercepts, and β_1 and α_1 are the respective bid slope coefficients, from the groups that would and would not substitute other Fourteeners and Thirteeners. The log likelihood value from a pooled logit model imposes the restriction of equality of the two groups' intercepts and bid slope coefficients, and compares this log likelihood value to the sum of the two separate unrestricted logit models (one for each of the two groups). If the behavior of the two groups is similar (a result of failing to reject Ho), then there will be little difference between the value of the pooled log likelihood function and the sum of the two individual log likelihood functions. If the behavior in the groups is dissimilar in terms of their willingness to substitute for another Fourteener or Thirteener, then we will reject Ho and there will be a difference between the value of the pooled log likelihood function and the sum of the two individual log likelihood functions. This test statistic uses a Chi-square distribution.

Hanemann (1989) provides a formula to calculate the mean WTP assuming that it is non-negative. This assumption is plausible for recreation, where the visitor has already indicated that they value a visit to a Fourteener by incurring substantial travel costs (in our data, averaging $255 per person for a two-day trip). A negative WTP would not be intuitive, as it implies the visitor would have to be compensated to take a trip to the Fourteener. Hanemann (1989) calculates the non-negative mean WTP for a linear in bid model:

$$\text{Mean WTP} = (\ln(1 + \exp(\beta_0)))/|\beta_1| \quad (5)$$

where B_0 is the constant term, and β_1 is the coefficient on the monetary amount the visitor is asked to pay.

In order to test equivalence of WTP between those willing to substitute and those that would not substitute, we calculate the 90% confidence intervals around each group's mean WTP. The confidence interval around the mean WTP can be computed using a simulation approach applied to the coefficients and the variance–covariance matrix (Park et al., 1991). If the confidence intervals do not overlap then there is a statistically significant difference in mean WTP. If the confidence intervals do overlap a more precise statistical test i.e., method of convolutions (see Poe et al., 2005) will be required to determine the exact *z*-statistic associated with the test of the hypothesis of no difference in WTP. We quantify the effect of instituting an entrance fee for the current Fourteener on the probability a visitor would substitute away from their current Fourteener (either to another Fourteener or a Thirteener to avoid the entrance fee) or continue to visit their current Fourteener (which means that they would pay a higher fee to recreate there). To do this we plot out the estimated WTP logistic curves, which allow us to view the probabilities as the percentage of current visitors that would continue to climb the current Fourteener. This curve allows us to determine the percentage reduction in visitor use achieved at alternative fee levels. The formula for calculating the logistic WTP curves from the logit regression coefficients is:

$$\$\text{Amount each percent (Pi) of visitors would pay} = \{(\beta_0) + \ln[(1 - \text{Pi})/\text{Pi}]\}/|\beta_1| \quad (6)$$

2.3. Testing for income effects

In order to test for income effects, we need to include an income variable in the logistic regression equation. Thus the independent variables in the logit model in equation (3) are expanded from simply the bid amount to include income as well:

$$L = \ln\{[\text{Prob}(Y = 1)]/[1 - \text{Prob}(Y = 1)]\} = \beta_0 + \beta_1(\$X_1) + \beta_2\,\text{Income}_i \quad (7)$$

We test to determine if income should enter non-linearly in that model as well by testing the significance of an income-squared term.

Using a logit model with income included (Equation (7)) allows us to recalculate how much of the change in the percentage of visitors that would not pay a given dollar amount is due to the price effect, income effect and substitution effect. To calculate the income effect, we must increase a visitor's income by the amount of income needed to pay a new entrance fee. Thus we add the product of the dollar amount of the proposed fee times the current number of trips, to the visitor's income. We use this new level of income in equation (7) to predict the response of visitation to the increase in fee. The difference in visitation with the increase in income versus original income gives us the estimate of the income effect on visitation. This change in visitation is compared to the overall reduction in percentage of visitors with the fee increase (i.e., the price effect). Per the Slutsky equation the difference between the overall price effect and the income effect is the substitution effect. From this analysis we can compare the relative magnitude of the reduction in percentage of visitors due to substitution effect as compared to income effect to see if it is the income effect that is driving the price response to the higher entrance. Specifically:

$$\text{Price Effect on Visitation} = \text{Substitution Effect} + \text{Income Effect} \quad (8a)$$

$$\Delta\%\text{in Visitors} = \beta_1 + \beta_2(\text{Income} + \Delta\text{Income}) \quad (8b)$$

$$\Delta\%\text{in Visitors} = \beta_1 + \beta_2(\text{Income} + (\Delta\text{Fee}^*\#\text{Trips})) \quad (8c)$$

In the next section we turn to the details of the data, and the empirical models estimated to test how much of the price effect is due to substitution and income effects.

3. Data collection

During the summers of 2006 and 2007 a total of 939 surveys were distributed to hikers visiting a stratified sample of Fourteener peaks throughout Colorado. Approximately half of the surveys were distributed at several of the popular Fourteeners along or nearby the Front Range dominated by Denver, Colorado Springs and the peaks nearby several resort towns (e.g., Breckenridge and Aspen). Mail back surveys were designed along the lines of Dillman's Tailored Design Method (Dillman, 2000) and included an attractive cover and an easy to follow survey booklet. Mail back surveys were distributed by volunteers from Colorado State University and the Colorado Fourteeners Initiative, a non-profit organization responsible for implementing many of the USDA Forest Service's Fourteener Management Plans. To minimize any bias concern about using volunteers from this group, a script was devised for the volunteers to approach the survey respondents, and volunteers were provided a script for Frequently Asked Questions that made it clear that Colorado State University was retaining and analyzing the data. Volunteers approached hikers and other recreationists at the trailhead and in the parking lot at the conclusion of their recreation activity. There were 18 refusals to take the survey, all of which took place at the Maroon Bells in Aspen. After providing the visitors with the Fourteener survey and a postage paid return envelope, volunteers collected follow-up information for the second round of survey distribution to follow Dillman's (2000) repeat mailing recommendation. In total 560 surveys have been returned, for a response rate of 60%.

The survey consisted of several sections, including:

1. Information regarding the specific Fourteener trip: Questions regarding trip purpose and recreational activities.
2. Dichotomous Choice Contingent Valuation Questions. The primary valuation question was:

3a. As you know, some of the costs of travel such as gasoline, campgrounds, and hotels often increase. If the total cost of this most recent trip to the recreation area where you were contacted had been $X higher, would you have made this trip to this Fourteener? Circle one: *YES NO*

The $X bid amount had values ranging from $2 to $950.

In order to ascertain if hikers would switch to another Fourteener to avoid the increase in cost, we asked:

3b. If the total cost of this most recent trip to the recreation area where you were contacted had been $____ higher, would you have made this trip to a different Fourteener where you would not have these higher costs? Circle one: *YES NO*

In order to ascertain if hikers would switch to a lower elevation Thirteener to avoid the increase in cost, we asked:

3c. If the total cost of this most recent trip to the recreation area where you were contacted had been $____ higher, would you have made this trip to a Thirteener (one of Colorado's 13,000 foot summits) where you would not have these higher costs? Circle one: *YES NO*

The three-part dichotomous choice contingent valuation survey questions were presented separately, and were not made contingent upon the answer to the first question. The rationale behind this decision was based upon feedback provided by USDA Forest Service wilderness managers and non-profit organizations like the Colorado Mountain Club and the Colorado Fourteeners Initiative, whose qualitative research revealed that there would be different patterns of substitutability in Fourteener hikers. In summary, the field research conducted by these organizations revealed that there were people who are simply drawn to hike or climb a single Fourteener, or simply a high peak, like a Thirteener (and it often doesn't matter which Thirteener they hike). However, there are other hikers for whom there are no substitutes. These three questions were designed to detect whether there were substitutes for the Fourteener at which the subject was contacted. The survey design was also field pretested with approximately 35 individuals, through efforts coordinated by the three aforementioned organizations.

In order to classify visitors that would and would not substitute for their current Fourteener, the response patterns to questions 3a, 3b and 3c were analyzed and grouped as follows:

Group One: Visitors who would not substitute another Fourteener or Thirteener:

This group consists of two types of response patterns: 44% of the total respondents said YES they would pay more for their current Fourteener (3a = YES), and NO to avoiding the increase in cost by visiting a different Fourteener (3b = NO) and/or a Thirteener (3c = NO). A second category of visitors who did not indicate willingness to substitute are those that said NO to paying the increase (3a = NO) not only at their current Fourteener, but also NO at the substitute Fourteener (3b = NO) and Thirteener (3c = NO). This response pattern indicated to us that if they could not go to their current Fourteener, they did not want to go a different Fourteener or Thirteener either (i.e., they would stay home or do something quite different). This second category represented about 16% of the total sample. Thus, approximately 60% of the total visitors reported no substitutes to their current Fourteener at the bid amount they were asked to pay.

Group 2: Visitors who would substitute another Fourteener or Thirteener:

This group also consists of two categories of respondents with a willingness to substitute as follows: The first category consisted of visitors who stated NO to question 3a on willingness to pay the increase cost for their current Fourteener, and YES on 3b and/or 3c to avoid the cost increase and therefore visit a different Fourteener or a Thirteener. This represented about 27% of the sample. However, the substitution group also included some visitors who initially said they would pay the cost increase to visit their current Fourteener, but then indicated they would switch to another Fourteener (YES on question 3b) or a Thirteener (YES on question 3c) to avoid the cost increase with visiting their current Fourteener (13% of the sample).[2] Thus, overall the substitution group represents about 40% of the total visitors.

Separate WTP curves were estimated for the two groups to quantify the rate at which they would substitute other peaks for the Fourteener they were intercepted. We did this by estimating separate logit regression models for each of these two groups in order to determine their WTP for the current Fourteener and to allow for a likelihood ratio test to determine if their logit coefficients are statistically different. The separate logit regressions allowed us to calculate separate logit WTP curves, illustrating the relationship between the percentages of each type of visitor that would pay different fee increases.

4. Results

Table 1 presents a comparison of demographics of the two groups, as well as a *t*-test of whether there is a significant difference between the two groups. Generally, Fourteener visitors are predominately male, high education and high income. However there are a few differences between the Substitute Group and the No Substitute Group. The Substitute Group is significantly younger (38.6 years) than the No Substitute Group (44.25 years). The Substitute Group traveled significantly less distance (232 miles) as compared to the No Substitute Group (358 miles). While not shown in Table 1, the Substitute Group has an average trip length of 11.4 h while the No Substitute Group has slightly longer trips of 14.5 h, which means many of these No Substitute visitors include an overnight in their itinerary. However, both groups have identical median trip length of 6 h. There are more retired visitors in the No Substitute Group (11%) but this is only significantly different than the Substitute Group (6%) at the 10% level. The other four variables are not statistically different. Both groups of Fourteener visitors are relatively high income (with overall mean income over $100,000). Of particular interest in this study is that there is no significant difference in Income or Percent that Work Full Time between the two groups (see Table 1). This begins to give us an inkling that income effects may not be the primary determinant of the decision of whether to pay the increased cost.

Table 1
Comparison of demographic variables for the Substitute and No Substitute Groups.

	Age	Education	Work fulltime	Income	% Retired	% Female	Travel distance
Mean of subs	38.61	16.66	79%	$ 99,212	6%	31%	231.77
Mean-no subs	44.25	16.51	74%	$ 106,781	11%	36%	358.36
T-statistic	−4.27	.72	1.05	−1.15	1.83	−1.16	−2.69
Significantly different @5%	Yes	No	No	No	No	No	Yes

Table 2 presents the separate logit models for the two groups of visitors: Group 1 (the group not willing to substitute or "No Substitute Group") and Group 2 ("Substitute Group"), as well as the pooled model used for the likelihood ratio test. Our results in Table 2 show that the bid amount is negative and significant for both groups. This intuitive result indicates the higher the increase in cost of the trip, the less likely they would take a trip. The coefficient on Income is positive, the coefficient on Income Squared is negative and statistically significant for the Substitute group, but not statistically different from zero for the No substitute group ($p = 0.129$). This indicates that willingness to pay rises with income, at a decreasing rate for the Substitute group. The significance of income and income squared is of most importance as the Substitute Group is the one for which we will calculate the income effect of higher fees. The likelihood ratio test (LR Statistic) indicates that collectively the independent variables in the separate equations are statistically different from zero. We tested for other socioeconomic variables such as Age, Education and Gender and none of these variables were statistically significant at conventional levels. Furthermore, neither the signs nor significance of the income variables changed with inclusion of the Age, Education and Gender variables. We also tested Trip Length and Group Size as explanatory variables. Neither of these variables was significant in the separate group logit models. The lack of significance of Trip Length may be due to the minimal variation in this variable, since most trips involve one night prior to the climb to get an early start on the climb in order to return below timber line before the expected high altitude afternoon lightning storms. However, we did test trip length in the pooled logit model to see if this variable was significant when both groups were considered together. It, too, was insignificant with a *P* value of 0.8245.

In order to test equality of the logit coefficients of the "Substitute Group" and the "No Substitute Group", we performed a different likelihood ratio test comparing the sum of the log likelihood values from these individual models to a single model that pooled the data from the two groups. The log likelihood of the pooled model is −212.67. The sum of the two individual log likelihood values from Table 2 is −184.16, quite a bit different than that of the pooled model. This suggests that the pooled model's restriction of coefficient equality between the two groups is likely to be rejected. Specifically, the Chi-square for −2 times the difference in these log likelihood values is 57.02, far larger than the

[2] We do not think it is inconsistent behavior for a visitor to say "Yes" to the original Fourteener question, and then say "Yes" to the substitute Fourteener or Thirteener. The reasoning is that a person can state Yes they would pay $X to continue to visit a Fourteener, because at a low $X amount, they receive a consumer surplus. However, if they view the other Fourteener or Thirteener as a good substitute (perhaps because they do not plan to summit the Fourteener we intercepted them at or are not capable of summiting the Fourteener), then they can **increase** their consumer surplus by avoiding paying the increase trip cost (or fee), by switching to a different Fourteener or Thirteener at no additional trip cost.

Table 2
Logit Model estimates of Fourteener hikers.

Variable	No Substitute Group		Substitute Group		Pooled Model	
	Coefficient	*z*-Statistic	Coefficient	*z*-Statistic	Coefficient	*z*-Statistic
Constant	0.2720	0.4828	−1.3293	−1.533	−0.0722	−0.164
Bid Amt	−0.00423***	−5.296	−0.00721***	−4.443	−0.00523***	−7.763
Travel Distance	0.001558***	2.878	0.00246***	3.917	0.0021***	5.038
Income	2.40E−05*	1.8773	3.09E−05*	1.796	1.74E−05*	1.859
Inc Squared	−8.55E−11	−1.517	−1.35E−10*	−1.805	−6.53E−11	−1.596
Mean dependent var	0.757			0.325		0.580
Log likelihood	−107.79			−76.36		−212.67
Restricted log likelihood	134.69			−106.62		−280.26
LR statistic (4 df)	53.79			60.53		135.19
Probability (LR stat)	0.0000			0.0000		0.0000
McFadden R^2	0.20			0.28		0.24
Obs with Dep = 0	59			114		173
Obs with Dep = 1	184			55		239
Total *N*	243			169		412

*, ** and *** indicates statistically significance of 10%, 5%, and 1%, respectively.

critical chi-square of 15.08 at the 1% significance level. Thus, we can conclude that the slope coefficients of the two groups are statistically different. This indicates that the two groups of hikers respond differently to the increase in trip cost.

4.1. Estimates of WTP

Using Equation (5), the mean WTP is calculated from each of the logit models in Table 2. To account for the possibility that visitors answered for their party, rather than themselves (due to wording of the payment vehicle as total trip costs), we divided the WTP by the median group size. Table 3 summarizes the mean WTP and 90% confidence intervals for the Substitute Group and the No Substitute Group. The $294 mean trip value for those not willing to substitute another Fourteener is more than triple the $88 trip value for those willing to substitute another Fourteener or Thirteener.[3] This suggests substantial differences in valuations. As can be seen in Table 3, the 90% confidence intervals do not overlap suggesting that these mean WTP amounts are statistically different (the same is true of the 95% confidence intervals, not shown).

While the visitors in the Substitute Group have a relatively more elastic demand than the No Substitute group, the Substitute Group average net WTP per person of $88 per trip is still substantial. Since these trips average two days in length, the value per day is roughly $44. This is slightly higher than the average value for hiking of $39 in the intermountain west (Loomis, 2005). However, a recent hiking study in Colorado yielded consumer surplus estimate of $55 per day trip (Hesseln et al., 2004) even though the income of hikers was only $67,232, about two-thirds of our Fourteener climbers.

It should be noted that no questions were asked in the survey booklet inquiring whether consistent refusals to pay the bid amount were protests to some feature of our constructed market. However, we systematically reviewed the written comments visitors were encouraged to write on the back of the survey for indication of protest responses to the WTP question. In the first review phase, the qualitative data (entered by ID number), were reviewed for potential protest information. If the comments indicated a potential protest, then the responses to the three contingent valuation questions were examined. Based upon review of the written comments, approximately 17 responses were categorized as having the potential to be protest responses. The majority of these respondents wrote on either the importance of maintaining public access to Fourteeners, the potential for environmental damage due to crowding, or the effect of crowds on their "natural" experience. Interestingly, responses to the contingent valuation questions for these individuals were distributed fairly evenly, and we did not feel as though there were any indications of response bias or protest responses in these 17 responses.

In the second phase of the protest investigation, surveys were screened for individuals who answered "no" to all three dichotomous choice WTP questions in order to examine whether there were any qualitative patterns to their responses. Unfortunately, the majority of these individuals did not provide an explanation for their responses. However, a general review of all written comments indicates that a majority of respondents that did comment, focused on the effect of increased costs on their willingness to either substitute (or to not substitute) to other locations. This indicated to us that respondents understood the WTP questions, and answered accordingly to their preference of whether to substitute.

Nonetheless, omission of a protest screening question is a limitation of this study. However, by retaining all the respondents who refused to pay their bid amounts, our mean WTP estimates are lower than they would have been had we identified and dropped protest refusals to pay. This downward effect on WTP may help offset some of what Campos, Caparros, and Oviedo identified as possible upward effects on WTP from the use of trip costs instead of entrance fees as the payment vehicle. It should also be noted that in actual implementation of user fees, these protest

[3] Restricting the calculation of net WTP to be non-negative after we have used a functional form of the logit model that allows for negative WTP is inconsistent (Haab and McConnell, 2002). Thus our positively constrained WTP estimates overstate net WTP. Inspection of Fig. 1 suggests the overstatement is quite minor for the No Substitute Group, as the logit curve intercepts the axis at close to 100%, indicating that there is not much of the curve in the negative quadrant. The median WTP, which allows for negative WTP, is just 3% less than the restricted mean for this group. However, for the Substitute Group, Fig. 1 shows that about 25% of the distribution would lie in the negative quadrant if the distribution was not truncated. This is consistent with the calculation of the median WTP being 25% lower than our non-negative mean WTP.

Table 3
Mean WTP per person per trip and 90% Confidence Intervals (CI).

Group	Substitute Group	No Substitute Group
Mean	$88	$294
Upper 90% CI	$122	$397
Lower 90% CI	$67	$232

visitors would be actual refusals to pay, so for the purposes of the pricing portion of the study, the protesters are relevant to include in the analysis.

As mentioned in the introduction, there are no comparable Fourteener studies in the literature by which to judge the reasonableness of our per trip benefit estimates. However, there are several rock climbing studies for comparison, including one in Colorado by Ekstrand (1994). He asked rock climbers at Eldorado Canyon outside of Boulder, Colorado what they would pay to do similar climbs but at remote wilderness locations. His value of $27.95 per day in 1991 is equivalent to $40 in 2006, roughly equivalent to the consumer surplus of our Substitute Group. Grijalva and Berrens (2003) estimated a value of rock climbing in Texas at between $47 and $56 per day trip, again quite similar to our Substitute group, but substantially below our No Substitute Group's consumer surplus per day. More comparable to our study is the study by Grijalva et al. (2002) that involves climbing in Wilderness areas. These authors found a WTP of only $20 to $25 per person to avoid closing several climbing sites in several National Forest, National Park and BLM Wilderness areas. Using a count data model for climbing in the Italian Alps, Scarpa et al. (2003) estimated (in Euros, which have been converted to dollars), consumer surplus of $23 to $38 per day trip. However, Scarpa et al. (2003: 118), notes that their consumer surplus figures are probably underestimates due to not accounting for travel time in the travel cost variable.

We believe that the remarkably high consumer surplus can be attributed to the fact that Fourteeners are considered "special" environmental icons that provide place attachment to Colorado visitors and tourists alike. Place attachment theory research prevails in the sociology (Cross, 2001), environmental psychology (Kyle et al., 2004), and geography literature (Manzo and Perkins, 2006). The central concept is that there can be a psychological connection between a community and a natural resource. Research by Blake (1999, 2002, 2008) suggests that Fourteeners are synonymous with Colorado's identity, and that Fourteener references are ubiquitous—appearing on everything from Chamber of Commerce information and local festivals to print advertisements and postcards. Blake (2002) indicates that more easily recognizable Fourteeners such as Long's Peak in Rocky Mountain National Park and Pikes Peak in Colorado Springs also provide a national identity. Thus, our economic findings are consistent with other disciplines that have recognized that there is something unique about both specific and the collection of Fourteeners, and in the minds of some visitors, there may not be substitution between peaks.

4.2. Logit WTP curves and the response of higher fees on visitation

Using Equation (6) and the two respective logit equation coefficients, we calculated and plotted Fig. 1. This figure shows the percentage of visitors from each group that would pay each increase in cost. The demand of the No Substitutes Group is more price inelastic and is higher at all cost increases than the group With Substitutes. However, it should be noted that part of the very price inelastic response of the No Substitute groups may be due to asking the WTP question about their most recent trip to the particular Fourteener. If after planning to climb this peak, some recreationists may have felt committed to the location, so this ex-post WTP may elicit a more inelastic response. However, the alternatives of asking WTP at the time of their actual trip planning would have been nearly impossible, as subjects could not be identified for sampling. Likewise or asking recreationists to imagine they were planning this trip over again is possible but would make the WTP question even more hypothetical.

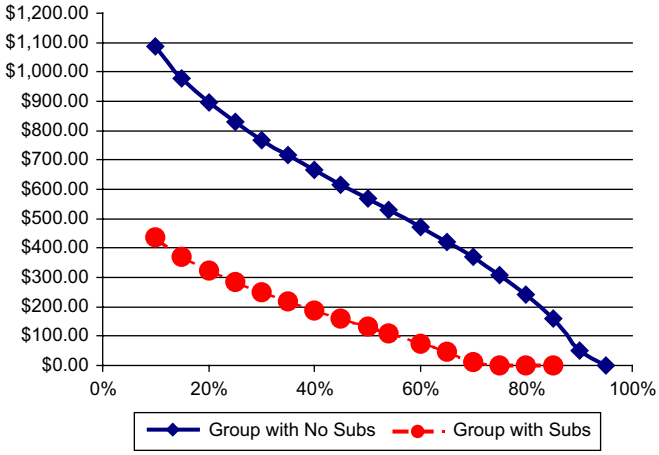

Fig. 1. Logit WTP Curves for No Substitute Group and the Substitute Group.

4.3. Analysis of fee increase to reduce visitor over-use

We can use our analysis to examine the equity effects of a pricing policy to reduce the number of visitors and associated environmental damage. At the time of writing, the USDA Forest Service has not determined a targeted visitor use goal that will reduce environmental damage to an acceptable level. While we selected a 20% reduction in visitor use for purposes of illustration, the curves in Fig. 1 could be used to determine what fee level is necessary for any reduction in visitor use the USDA Forest Service felt appropriate. For purposes of illustration, suppose the USDA Forest Service determined that it was necessary to reduce overall visitor use at the popular Fourteeners by at least 20% to protect the alpine tundra, soils, watersheds, and wildlife. Our analysis would suggest a rather hefty fee of $70 would be required to achieve this overall reduction in use at the popular Fourteeners. In particular, a $70 fee would result in a 40% reduction in visitors from the Substitute Group. Since the visitors in the Substitute Group represent about 40% of the visitors to these popular Fourteeners, the $70 access fee would result in an overall reduction of 16% in overall visitor use (0.4*0.4). However, the $70 fee would result in only an 11% reduction in use by visitors in the No Substitute Group. Since this group of visitors represents about 60% of users, the 11% reduction in their use with the $70 fee would induce an additional reduction of 6.6% (0.6*0.11) in visitation. Thus in total, a $70 fee would reduce overall use at these popular Fourteeners by 22.6% (16% + 6.6%). This example of a 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.

It should be noted that the $70 fee may not be considered unreasonable given that one-day lift ticket to many Colorado ski areas range from $60 to $80, so in principle this $70 fee is consistent with other Colorado alpine recreational activities. In addition, in order to climb one of the Fourteeners where the access is completely on private land (Culebra), a fee of $150 per person is required. Even at that price there appears to be a significant number of peak baggers paying the fee to summit this peak, which corroborates our high willingness to pay values in our findings. However, there is one caveat worth mentioning. We used trip cost as our payment vehicle, not entrance fees in order to minimize protest responses. Campos, Caparros, Oviedo found that using entrance fees as a payment vehicle increased protest responses

relative to using trip costs. However, entrance fees not only induce higher protest responses, they also provide incentives for the respondent to engage in strategic behavior, in this case purposefully understating their WTP to keep recreation fees low. Loomis et al. (2000), compared hunters' actual responses to hunting license fee increases (estimated via a time series analysis of response to past fee increases) versus stated willingness to pay higher hunting license fees. These authors found understatement of willingness to pay higher license fees in the survey responses compared to actual responses to real increases in hunting license fees. Thus the "true" willingness to pay entrance fees is likely less than we estimate, but perhaps not by the large reduction found by Campos, Caparros, and Oviedo.

4.4. Analysis of substitution and income effect of fee increase

In order to assess whether much of the reduction in visitor use among the Substitute Group is from the income effect of the fee increase or from the substitution effect, we performed an analysis using their logit equation. Specifically, we took the fee increase times the average number of trips, to simulate the change in real income associated with the fee increase. According to these calculations, a $70 fee increase represents a change of about $200 in annual income to visitors in the Substitute Group. Thus, one could think of giving these visitors $200 more in income to make their real income or purchasing power with the $70 fee equal to what it was before the fee increase. In this case, they could still afford to purchase their previous number of trips to their current Fourteener at the new higher fee if they chose to do so.

We use this $200 income adjustment in the Substitute Group's logit model (Table 2). Specifically we increased income by $200 and calculated the change in visitation due purely to the change in income, using the income coefficients in the logit model. The income change results in a change in the probability of just 0.00015 or 0.015% change in visitation associated with the $70 fee. Thus of nearly all of the 40% change in visitation from the Substitute Group in response to the $70 fee is the substitution effect, rather than the income effect. This small response in percentage change in visitation due to the income effect is consistent with two other facts. First, the $200 represents only 0.26% of the Substitute Group's median visitor income of $85,000 and an even smaller percentage of average income. Second, is the fact that the $200 represents a 0.26% change in income, but yields only a 0.03% change in WTP, suggesting a fairly income inelastic response. Our finding of a minimal income effect on substitution of outdoor activities is also consistent with earlier studies by Bamford et al. (1988) and particularly Chase et al. (1998), who indicated that park visitation demand was income inelastic.

5. Conclusions

In this paper we demonstrate how a series of dichotomous choice contingent valuation questions could be used to assess the price responsiveness of alpine hikers. Based on our statistical analysis of responses of Fourteener recreationists, we determined that there were two statistically different groups of hikers:

(a) The first group, 89% of whom will pay the $70 fee rather than substitute. Using a dichotomous choice contingent valuation question, the consumer surplus or net WTP of this group was $294 with a 90% confidence interval of $232–$397.
(b) The second group was more likely to substitute to another Fourteener or lower elevation Thirteener to avoid a cost increase at their current Fourteener. This group has a consumer surplus of $88, with a 90% confidence interval of $67–$122. This group would reduce their use of the current Fourteener by 40% at a $70 fee.

Given that 60% of the hikers were in the first group, and 40% of hikers were in the second group, these reductions in use translate into an overall 22% reduction in visitor use to the current Fourteeners. This magnitude of reduction in visitor use may be sufficient to reduce the rate of trail erosion and loss of vegetation so as to stabilize the alpine environment surrounding these peaks. Also, the funding provided by the $70 fee could yield substantial revenue for replacement of the multiple social trails scarring the many popular Fourteeners with a single carefully located and maintained trail. While precise estimates of Fourteener use are not available, the public land management agency and volunteer groups estimate roughly 100,000 Fourteener visitors per year. Given the 22% reduction in use with the $70 fee, the remaining 78% of visitors paying the $70 fee would produce $5.4 million revenue if the fee was applied per person or $2.73 million if the fee was charged per vehicle, as the National Park Service does. However, as noted by Campos, Caparros, and Oviedo these are probably overestimates of the revenue since we did not explicitly use entrance fees as the payment vehicle in order to minimize protest responses. Nonetheless, taken together, the reduction in use, and funding for better management should allow for more sustainable visitor use, and the avoidance of the need to impose daily quotas or caps on visitor use.

Although our findings indicate that introduction of fees at public Fourteeners may have desired effects on Fourteener use, practical implementation of the policy is another matter. Although there was not a clear pattern of protest responses in our survey, more than one dozen respondents provided written comments on the need to maintain unrestricted access to Fourteeners. Interestingly, these comments were counter balanced by individuals who also urged a small fee to enhance trail maintenance and to mitigate environmental damage, including damage due to crowding. Although those "tuned in" to the issue of access fees may represent a minority, it is evident from blogs and USDA Forest Service qualitative studies that this group is likely to present fierce opposition to such a policy.

Thus, it may be more practical to charge the fee per vehicle rather than per person. Most National Parks charge per vehicle rather than per person. This would encourage carpooling and minimizing the amount of degraded area for parking. Another potential compromise may be institution of fees only during high volume weekends, and at the more popular Fourteeners where the large number of hikers has more of an impact on trail widening and ecological damage. This peak loading price policy may be more palatable to recreationists who recognize the environmental damage sustained by high visitor use and therefore change their hiking plans to lower volume weekdays or less popular peaks, where no fee would be charged. In fact, the peak load pricing may result in a more desirable and serene wilderness experience when the use is shifted to days when there are fewer hikers, and thus hikers are better able to remain on the trail. Those opposed to fees could visit during the week when no fees would be charged.

Prior to the federal Fee Demonstration program and its replacement the Federal Land Recreation Enhance Act, public land management agencies were reluctant to use fees to ration recreation use. Fees simply irritated users and the agency received no revenue from the fees. Thus other management options that have been used included a "First Come, First Served" queue, lotteries and

advanced reservations. However, now that 80% of the fees received are spent in the area where they are collected, the increases in fee revenues improve the agency's ability to mitigate and accommodate large numbers of visitors through trail restoration and re-routing of trails.

Private lands do not suffer as much from the problem of overuse, not because they are private per se, but because they are not open access like the National Forests. As noted by Hanley et al., private lands in Northern Europe suffer from similar open access problems due to the cultural tradition of "free access" (Hanley et al., 2003: 40). However, National Parks are public lands that are not open access, and overnight trips to the one Fourteener in a National Park are strictly limited by a quota system, with users required to carry a permit visible on their pack which is checked by ranger patrols. It appears that for many of the Fourteeners there is limited road access to the trailhead (in some cases just one road to the non-technical routes) so it would be feasible to collect fees. This is already done for the Fourteeners at the Maroon Bells near Aspen, Colorado, where visitors must pay either a $10 vehicle entrance fee or a $6 per person fee for those arriving after 9 am and before 5 pm, to ride a mandatory shuttle bus to the trailhead during those times.

Although we have conducted the first research that quantifies the price responsiveness of hikers visiting Colorado Fourteeners, it is clear that there is a need for further study on the human values that recreationists place on a solitary wilderness experience and climbers attitudes towards peak load pricing. We expect equally price inelastic response at other well-known high alpine peaks where the congestion fee is likely to be a small part of the relatively high international trip cost.

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