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Benefits of Wilderness Expansion With Excess Demand for Indian Peaks

Richard G. Walsh and Lynde O. Gilliam

The contingent valuation approach was applied to the problem of estimating the recreation benefits from alleviating congestion at Indian Peaks wilderness area, Colorado. A random sample of 126 individuals were interviewed while hiking and backpacking at the study site in 1979. The results provide an empirical test and confirmation of the Cesario and Freeman proposals that under conditions of excess recreational demand for existing sites, enhanced opportunities to substitute newly designated sites by reducing congestion results in external benefits to the remaining peak day users who do not substitute, and should be added to the recreational use benefits of new sites.

Under conditions of excess demand for recreation use of Indian Peaks wilderness area in Colorado, enhanced opportunities to substitute newly designated wilderness in the Rocky Mountain region may reduce congestion. Since this would be a consequence of wilderness expansion, increased willingness to pay by those who continue to use Indian Peaks should be considered an external benefit of the newly designated areas. This paper provides an empirical test and confirmation of the economic significance of this external benefit to the valuation of new or expanded wilderness areas. It is concluded that benefit estimation procedures of federal agencies should be enlarged to consider the effects of excess demand for some existing sites.

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In the past, the recreation benefits of those who choose to use a new or expanded site have been based correctly on estimates of increased consumer surplus, as recommended by the U.S. Water Resources Council guidelines. Net benefits of recreation use have been measured as the area under the demand curve above price of recreation at a new or expanded site, which represents users maximum willingness to pay given the existence of other sites, as demonstrated by Knetsch. In the absence of guidelines to estimate the extent of excess demand, changes in the benefits accruing to continuing users of existing sites have been ignored in calculating the net benefits attributable to a new or expanded site. By ignoring these benefits, researchers have implicitly assumed that consumers who continue using existing sites are no better or worse off than before the introduction of a new or expanded site.

In two recent works, Cesario and Freeman proposed elements of a conceptual model which appears to provide a theoretical basis for project evaluation under conditions of excess demand at existing sites defined as a rate of use in excess of the aggregate benefit maximizing level. The availability of a new or expanded recreation site in a region would encourage some participants to substitute it for existing sites. This would reduce conges-

tion at some existing sites with excess demand. Reduced congestion would increase willingness to pay by those who continue to use these existing sites. Reducing use of existing sites toward benefit maximizing levels would be a consequence of the new site and should be counted as an external benefit.

Previous research on the recreation congestion problem has not adequately addressed the issue of excess demand at existing sites. Cicchetti and Smith used the contingent value approach in a mail survey of 195 individuals who visited the Spanish Peaks primitive area, Montana. The authors estimated the effect of trail and camp congestion on willingness to pay and optimum daily use of the site. McConnell used a regional contingent value approach to interview 229 swimmers at six beaches in Rhode Island. The study estimated the effect of beach congestion on willingness to pay and optimum daily use of the six sites. Freeman and Haven considered the problem of pricing to ration use of recreation sites under conditions of homogeneous and heterogeneous tastes for congestion avoidance. Corey analyzed the effects of income distribution on equitable pricing to ration use of recreation sites with excess demand. McConnell and Duff estimated the effect of the probability of exclusion when a facility is used to capacity. Although others have considered various aspects of the recreation congestion problem, the particular issue addressed here has not been studied, with perhaps one exception. Shechter and Lucas reported that in the opinion of managers and users there was excess demand for recreation use of the Desolation wilderness area in California.

Study Site and Region

In 1980, Colorado contained 13 wilderness areas whose 1,875 square miles accommodated nearly 1 million visitor days of recreation use. Apparently, there was little or no excess demand for most wilderness areas despite a 9.2 percent compound annual increase in recreation use during the preceding

decade. Annual recreation use of most areas was within a comfortable range of 200 to 500 visitor days per square mile, depending on location and site characteristics including the amount of useable terrain.

Some wilderness areas may have experienced excess demand, particularly Indian Peaks near Denver and to a lesser extent Maroon Bells-Snowmass near Aspen. In the 1979-80 fiscal year, recreation use of Indian Peaks was equal to 7.3 times the national average of 330 visitor days per square mile, and Maroon Bells-Snowmass 3.6 times. Singly, Indian Peaks accounted for 29 percent of the total recreation use of wilderness in the state with 113.5 square miles or about 6 percent of the wilderness area.

Indian Peaks was selected as a study area because it was the closest wilderness to the Denver metropolitan area and excess demand problems seemed likely to be present. Moreover, a reduction in excess demand would contribute to evaluating benefits of proposed wilderness designation nearby. Located south of Rocky Mountain National Park about 60 miles northwest of Denver, it offered nearly two million urban residents of the state an opportunity to obtain a wilderness experience within 1-2 hours drive from their homes. Thus, it was used mostly by small groups of hikers and backpackers taking one- and two-day trips on weekends and holidays. The resulting peak weekend pattern of demand was expected to contribute to problems of congestion.

The physical features of the study site also may contribute to a congestion problem. The Continental Divide passes through the area with massive peaks of bare rock and fragile tundra reaching into deep canyons. Elevation ranges from 10,000 to 14,000 feet with thin soil supporting forest below timberline of 11,500 feet. The predominantly open landscape provides vistas of many miles. Erosion of trails on the thin soil and tundra has been severe. Several alpine lakes occupy depressions left by receding glaciers. Headwaters of the Boulder, St. Vrain, and most notably the Colorado River originate with pristine water

quality and gradually yield to degradation as elevation diminishes and human encroachment increases.

Recently, opportunities for substitution of other wilderness areas within the region were increased substantially. In 1981, Congress designated 14 new wilderness areas and expanded six others with a combined area of 2,224 square miles. This more than doubled the designated wilderness area in the state of Colorado. Of particular interest, newly designated Mount Evans and Lost Creek wilderness areas are located one-half as far from the Denver metropolitan areas as Indian Peaks, and have 2.5 times the capacity.

Theoretical Approach

A conceptual basis for the empirical estimation of the effect of crowding on willingness to pay for wildland recreation was developed by Fisher and Krutilla more than a decade ago. The general procedure is firmly based in the economic theory of consumer demand. Congestion is viewed as a quality attribute of a wilderness recreation experience and enters an individual's utility function as a separate variable. A statistical willingness to pay function is specified as:

$$\text{Net Willingness to Pay} = f(\text{congestion, income, availability of substitutes, user days, travel time, etc.})$$

The effects of all other variables are controlled, and a condensed function is derived in which congestion has a significant negative effect on individual willingness to pay per day of wilderness recreation.

Figure 1 shows average individual willingness to pay, AB, to be a declining function of the number of users per day. The vertical intercept, A, represents the amount an individual would be willing to pay if the wilderness area is uncongested. The horizontal intercept, B, shows the maximum number of individuals who will eventually choose to participate if use rates are unrestricted, since an individual user will participate so long as his willingness to pay is positive.

Figure 2 depicts a Bradford aggregate bid

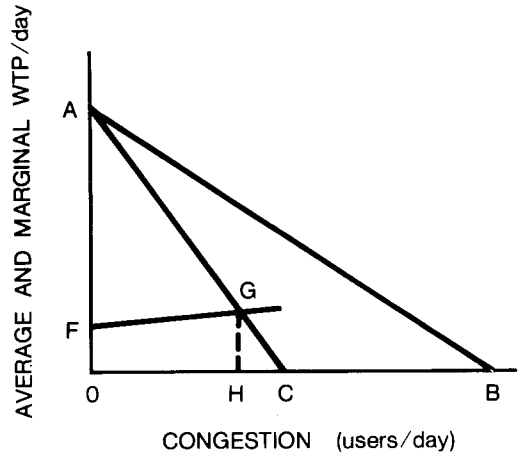


Figure 1. Effect of Congestion on Average Individual and Marginal Willingness to Pay Per Day of Wilderness Recreation.

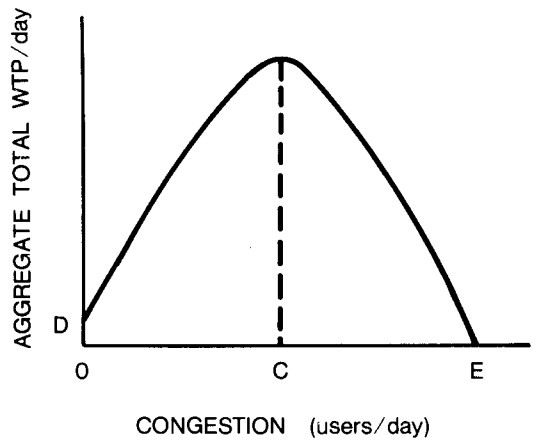


Figure 2. Effect of Congestion on Aggregate Willingness to Pay Per Day of Wilderness Recreation.

or benefit function, DE, derived by multiplying individual willingness to pay by the total number of users per day at each level of congestion. As long as the gain from admitting additional users exceeds the loss due to congestion, aggregate total willingness to pay increases. Beyond a point where the loss to existing users equals the gain experienced by an additional user, aggregate total willingness to pay diminishes with further admission. If there are no costs, optimum capacity

occurs at C where aggregate total willingness to pay is maximized and marginal willingness to pay is zero. Excess demand is defined as any use to the right of C.

The benefit maximizing level of capacity will change with the introduction of agency costs of recreation management and environmental degradation.¹ Marginal cost function, FG, in Figure 1 represents the change in these costs as intensity of use increases. The marginal cost curve intersects the marginal willingness to pay curve at G which represents a lower use rate than optimum use, C, which was based solely on the analysis of willingness to pay effects of congestion. A perpendicular dropped from the intersection of marginal cost and marginal willingness to pay curves to the horizontal axis at H indicates the optimum capacity of a wilderness area inclusive of cost considerations. Given the relevant physical and institutional constraints, resources are allocated efficiently at this level of use because net willingness to pay is maximized, i.e., the excess of aggregate total willingness to pay over total cost exceeds that which would result from alternative levels of use. Excess demand becomes any use to the right of G.

Contingent Valuation

The contingent value method used in this

¹Accordingly, it is desirable to distinguish these costs from the losses in willingness to pay associated with congestion. Assume a wilderness area has present value of benefits of \$20 million at optimum use, congestion disbenefits of \$5 million with excess demand, and present value of agency costs of \$10 million. In this case, the correct benefit cost ratio is

$$\frac{20-5}{10} = 1.5.$$

If the disbenefits of congestion had been treated as costs, the benefit cost ratio would have been

$$\frac{20}{10+5} = 1.33$$

or substantially less.

study was recently recommended by the U.S. Water Resources Council as providing an acceptable procedure for measuring the economic value of recreation and environmental quality. The interagency committee established procedures to survey recreation users concerning their maximum willingness to pay contingent on changes in the quantity and quality of recreation experience. The approach has been applied to a number of recreation valuation problems since its proposal by Knetsch and Davis fifteen years ago.

The basic data used in the analysis were obtained from interviews with a sample of 126 recreational users of the Indian Peaks wilderness area, including 57 hikers and 69 backpackers. Sample size was determined by standard practice to obtain results within the 95 percent level of statistical significance. Interviews were conducted on random days throughout the months of August and September, 1979. Interviewing was initiated at the beginning of the day with the first person encountered at the study site. Subsequent interviews were conducted with persons randomly selected throughout the day. This procedure was designed to assure that all recreation users of the study site would have an equal chance of selection. Name tags identified the interviewers as employees of the University to establish the legitimate scientific purpose of the study. Less than 5 percent of those approached refused to participate in the survey.

An iterative bidding technique was recommended by the Council to encourage recreation users to report maximum values, representing the point of indifference between having the amount of income stated or the level of congestion. Respondents answered "yes" or "no" to random increases in value specified by the interviewer until the maximum willingness to pay was identified. We can equate willingness to pay to equivalent variation for increases in direct costs per day, and to compensating variation for cost decreases. The former amount will leave the individual in his subsequent welfare position in the absence of the cost change and the

latter will leave him in his initial welfare position following the change in cost.

The sample was stratified to test for significant difference between willingness to pay with an iterative bidding procedure and an open-ended direct question approach. Approximately one-half of the sample was asked an iterative bidding question while the other half was asked an open-ended direct question. Results showed no significant statistical difference in the values reported at the 95 percent level of confidence, thus the two subsamples were combined in the analysis.

Respondents were asked to report the maximum amount they would be willing to pay for their primary recreation activity in the study area on the day of the interview rather than forego the experience. Individual direct costs actually paid were subtracted from willingness to pay so that the resulting value was consumer surplus, e.g. the area below the willingness to pay or demand curve and above direct cost or price. Respondents also reported the number of persons other than members of their own party encountered in the wilderness area on the day of the interview. This base case was recorded as one of four observations of the relationship between net willingness to pay and number of encounters.

From this starting point, respondents then were asked to report changes in net willingness to pay contingent on changes in the number of persons encountered. Values were estimated for the vertical intercept (Figure 1) where the number of persons encountered is zero, and for an intermediate level. Finally, the number of persons encountered at the horizontal intercept where willingness to pay is zero was estimated by asking respondents to report the maximum level of crowding they would tolerate before discontinuing recreation use of the site. The four observations trace out an individual's congestion dependent benefit function, each point of which approximates average benefit per day below shifts in demand curves resulting from increased congestion.

A combination of factors contributed to the

credibility of the simulated market situation. Most users had observed medium to high levels of congestion at the study site. The imminent possibility that recent designation of the site as a wilderness area (1978) would result in a substantial increase in the number of recreation users in the next few years provided a realistic setting for investigating the effect of congestion on values. The contingent value approach provided the only known method to value high levels of congestion before they occur. To wait until after excess demand resulted in potential irreversible damage to the fragile environment would be an unnecessarily costly form of experimentation.

The value questions were designed to be as realistic and credible as possible. For example, respondents were first asked to report out of pocket or direct trip cost. Then, they were asked to estimate the maximum amount they would have been willing to pay rather than forego the recreation experience. Direct trip cost represents a generally accepted method of paying for the recreational use of wilderness areas. This relatively neutral measure of value was selected over alternatives such as an entrance fee or tax in an effort to avoid emotional reaction and protest against the method of valuing congestion. The incidence of zero response as protest against the payment vehicle was within the 15 percent limit recommended by the Council. Protest responses were not included in the analysis.

Tests of the possibility of strategic bias were performed as recommended in the case of contingent value studies. There is a possibility that individuals may engage in strategic behavior, overstating true willingness to pay in order to encourage wilderness managers to reduce congestion while avoiding actual payment of the stated amount, or understating values to discourage managers from establishing wilderness entrance fees. If respondents biased their willingness to pay responses, a frequency distribution would show clustering of values at abnormally high and/or low levels. Distribution of the values reported did not indicate abnormal behavior,

which suggests that there was little or no strategic bias of the study results.

Statistical Analysis

Following the usual procedure in recreation benefit studies, the stepwise least squares statistical method was used to estimate the relationship of willingness to pay to number of persons encountered per day and other important economic variables for the representative individual. The willingness to pay functions for hiking and backpacking are presented in Table 1. The number of observations was sufficient for statistically significant analysis; the equations were significant at the 0.01 level as indicated by F values of 14.41 and 19.37. All regression coefficients included in the equations were significantly

different from zero at the 0.01 to 0.05 level. Exclusion of insignificant variables in the stepwise procedure did not affect the stability of the coefficients for congestion.

The coefficients of determination, R^2 , adjusted for degrees of freedom, indicate that 25 to 29 percent of the variation in willingness to pay was explained by the independent variables included in the equations, which is considered a satisfactory level of explanation with data from a cross sectional survey of individual consumers. The congestion variable explained 6 to 13 percent of the variation in willingness to pay.

Alternate forms of the equations were evaluated including linear, quadratic, semi- and double-logarithmic models. The quadratic form provided the best fit of the relationship of primary interest, congestion; the natural

TABLE 1. Ordinary Least Square Equation Estimates of Willingness to Pay Per Day of Hiking and Backpacking at Indian Peaks Wilderness Area, Colorado, 1979.

Variables	Units	Mean Values		Regression Coefficients	
		Hiking	Backpacking	Hiking	Backpacking
Congestion	Persons	37.23	22.40	-0.2052 (-5.41)	-0.2649 (-3.97) ^a
Congestion Squared	(Persons) ²	4,381.55	2,684.56	0.0005 (3.05)	0.0004 (2.75)
Log of Household Income	In Dollars	9.69	9.24	b	4.5407 (3.19)
Time at This Site	Hours	17.67	81.94	-0.1140 (-3.73)	
Distance Traveled	Miles Round Trip	527.82	1,240.92	-0.0123 (-4.98)	
Distance to Nearest Substitute	Miles One-Way	43.16	157.19	0.0296 (1.96)	
Average Distance to Substitutes	Miles One-Way	276.40	637.04		0.1039 (7.36)
Member Sportsman Organization	0-1	.12	.11		28.9927 (6.29)
Colorado Resident	0-1	.58	.74	-24.3812 (-5.12)	
Resident of N.E. Region U.S.	0-1	.04	.09	9.0177 (2.04)	
Constant				42.6840 (8.32)	-30.4344 (-2.27)
Adjusted R ²				0.25	0.29
F Value				19.37	14.41
Observations				57	69

^aNumber in parentheses below each coefficient represents student t-ratios for the null hypothesis. All variables are significant at the 0.05 to 0.01 level.

^bBlanks indicate that the variable did not enter the stepwise regression at the 0.05 level of significance.

logarithm of income; and the linear form of all other independent variables. All variables had the expected sign. The usual tests of the assumptions of the model including multicollinearity and heteroscedasticity revealed no significant effects on the study results.

The functions were condensed to isolate the effect of congestion on average individual willingness to pay (WTP). All variables except persons encountered (Q) and persons encountered squared (Q^2) were set at their mean values. This procedure resulted in the following quadratic functions:

Hiking

$$\text{WTP} = 17.68 - 0.2052Q + 0.0005187Q^2$$

Backpacking

$$\text{WTP} = 23.41 - 0.2649Q + 0.00044Q^2$$

These equations indicate that with no other persons encountered, the average individual would be willing to pay nearly \$18 per day of hiking compared the \$23 per day of backpacking. With otherwise identical conditions, willingness to pay for hiking would decrease about \$0.21 per day with each additional person encountered compared to \$0.27 for backpacking. The quadratic form permits the effect of congestion to change as its level changes. The larger the congestion variable, the smaller the marginal effect of congestion on willingness to pay. The function provides a reasonable representation of the effect of encounters on benefits per day for the range in numbers of encounters relevant to decision making. Willingness to pay falls to zero in the neighborhood of 130 hiking and 110 backpacking encounters per day.

Other variables which were significantly associated with willingness to pay include: annual household income, time at this site, distance traveled, distance to substitute sites, residence, and organizational affiliation. For example, with each additional 12-hour day at this site, willingness to pay for hiking declined by \$1.37 per day. With each additional hour of travel time at 40 miles per hour, willingness to pay declined by nearly \$0.50 per day. With an additional 10 miles

distance to substitute sites, willingness to pay for backpacking increased by \$1.04 per day compared to \$0.30 for hiking. Income was not significantly associated with willingness to pay for hiking, while for backpacking a \$1,000 change in mean income of \$16,000 per year was associated with a mere \$0.28 change in willingness to pay per day.² Colorado residents were willing to pay less for hiking than residents of other states while residents of the Northeastern Region of the U.S. were willing to pay more. Members of sportsmen organizations were willing to pay more for backpacking than non-members.

Converting Encounters to Total Users

Thus far, the analysis has considered recreation benefits to be dependent on the quantity of congestion, defined as the individual user's estimate of the number of persons encountered per day in the study area. For the results to be useful to managers of wilderness areas, it is necessary to convert the subjective estimates of congestion to the corresponding total recreation use of the study area (defined as twelve-hour visitor days by the U.S. Forest Service). Insufficient resources and time were available to do a simulation analysis of the relationship of encounters to total use of the study area, as recommended by Smith and Krutilla. Fortunately, an estimate was available from a recent simulation analysis of the Desolation wilderness area in California by Shechter and Lucas. Although the relationship is expected to be site specific, characteristics of use and capacity of the Desolation were sufficiently similar to be applicable in the case of Indian Peaks.³

²Thus, with little or no income effect, price rationing of use may be both efficient and equitable in the case of wilderness areas. For a discussion of the effects of income distribution on equitable pricing to ration use, see Cory.

³The Desolation had annual recreation use of 256,100 visitor days compared to 274,100 at Indian peaks, 99.2 square miles compared to 113.5 and 2,582 visitor days per square mile compared to 2,415.

It was assumed that each trail and camp encounter by the average individual user of Indian Peaks corresponded to 0.55 visitor days per square mile of wilderness area. Shechter and Lucas estimated that the number of parties per square mile was 0.45 times the number of parties encountered on trails and 0.40 times parties encountered while camping in the backcountry. Brown, Haas and Manfredo reported that 25 percent of the trail users at Indian Peaks were also camp users. Thus, the ratio of 0.45 for trail encounters was increased by 0.10 ($= 0.25 \times 0.40$) to include camp encounters.

When either number of encounters per day or total annual visitor days is known, the other can be estimated by adjusting for the seasonal pattern of recreation use and size of the wilderness area. Over 95 percent of annual use occurs during four months from the middle of June to the middle of October. During this 120-day season, 65-75 percent of backcountry recreation use generally occurs on weekends and holidays, according to Lucas and Adams, Lewis and Drake. On this basis, it was assumed that 70 percent of total annual visitor days occur on 37 days of peak weekend and holiday use at Indian Peaks. When encounters have been converted to visitor days per mile for these peak days, multiplying by 1.43 would add off-peak use during weekdays and other seasons. Multiplying the result by the number of square miles in the wilderness area would provide an estimate of total annual visitor days of recreation use, given the seasonal pattern of recreation demand.

Optimum Capacity

Table 2 illustrates the effect of expanding the survey results to the population of recreation users of Indian Peaks wilderness area. Individual encounters per day were converted to the equivalent total visitor days of use. Then individual willingness to pay per day at each level of congestion was multiplied by total use to estimate the aggregate total willingness to pay function. This is analogous to

the Bradford aggregate bid or benefit function. As long as gains from additional numbers of hikers and backpackers exceed the losses due to congestion, aggregate willingness to pay increases. Results indicate that beyond 53 encounters per day, losses due to congestion exceed the gains experienced by additional users and aggregate total willingness to pay falls. Aggregate total willingness to pay is maximized where the losses from incremental congestion equal the gains from incremental use, hence the marginal willingness to pay function at that point is zero.

If there were no costs of wilderness management, the optimum daily capacity of Indian Peaks would be estimated in the neighborhood of 3,300 visitor days, equivalent to 53 encounters by the typical visitor, where aggregate total willingness to pay is maximized and marginal willingness to pay is zero. With the introduction of Forest Service costs of management to prevent environmental degradation, optimum capacity is reduced. Marginal costs of management have been estimated as approximately \$2.75 per visitor day for Indian Peaks.⁴ Thus, optimum daily capacity inclusion of management costs is estimated as nearly 2,700 visitor days, equivalent to 43 encounters, where marginal cost equals marginal willingness to pay.

These estimates of optimum encounters at Indian Peaks are considerably higher than for other wilderness areas in Colorado and other western states. Higher capacity is associated with scarcity of wilderness recreation opportunities near large population centers where users have learned to accept higher levels of congestion. With 3.6 persons per party, the

⁴The Roosevelt and Arapahoe National Forest, Fort Collins, reported total variable costs of wilderness management which were converted to marginal costs per visitor day. These costs include restoration of environmental degradation from recreation use. Observations of the physical condition of the study area suggest evidence of additional environmental degradation, which if quantified, would shift the point of optimum capacity further to the left, at least in the short run, to allow the most severely scarred landscape to recover from past abuse, much of which occurred prior to wilderness designation (1978).

TABLE 2. Effect of Congestion on Willingness to Pay Per Day of Hiking and Backpacking at Indian Peaks Wilderness Area, Colorado, 1979.

Number of Persons Encountered	Total Users/Day ^a (Recreation Visitor Days)	Individual WTP/Day		Total ^b	Aggregate WTP/Day ^b		Marginal WTP/Person/Day		
		Hiking	Backpacking		Hiking	Backpacking	Hiking	Backpacking	Total
10	624	\$15.68	\$20.81	\$16.96	\$ 7,338	\$3,246	\$13.76	\$18.24	\$14.88
20	1,248	13.79	18.29	14.92	12,907	5,706	10.09	13.34	10.90
30	1,872	11.99	15.86	12.96	16,834	7,422	6.77	8.70	7.25
40	2,496	10.31	13.52	11.11	19,300	8,437	3.75	4.33	3.90
50	3,120	8.72	11.27	9.36	20,405	8,791	1.05	0.22	0.84
60	3,744	7.24	9.10	7.71	20,330	8,518	-1.34	-3.63	-1.91
70	4,368	5.86	7.02	6.15	19,197	7,666			
80	4,992	4.59	5.03	4.70	17,185	6,277			
90	5,616	3.42	3.13	3.35	14,405	4,395			
100	6,240	2.35	1.32	2.09	10,998	2,059			
110	6,864	1.39	-0.41	1.39	7,156				
120	7,488	0.53		0.53	2,976				
130	8,112	-0.23		-0.23					

^aBased on a ratio of recreation visitor days (one person for 12 hours) per square mile of wilderness to number of persons encountered per day of 0.55 reported by Shechter and Lucas. Thus, with 113.47 square miles in Indian Peaks, the factor for converting individual encounters per day to aggregate visitor days is 62.4.

^bWith 75 percent hiking and 25 percent backpacking use as reported by Brown, Haas and Manfredo.

optimum number of encounters per day at Indian Peaks was equivalent to 12 parties with management costs and 15 parties without.⁵ This compares to optimum encounters of 6-8 parties at other wilderness areas in Colorado, approximately 7-8 parties at the Desolation wilderness area in California, and 4-7 parties at the Spanish Peaks primitive area in Montana without management costs.⁶ These studies suggest that if tastes for congestion avoidance were homogeneous across wilderness areas in the west, the optimum capacity of Indian Peaks would be nearly one-half the level estimated here.

Substitution Benefits

The results of this study provide an estimate of the potential benefits of reducing congestion. The U.S. Forest Service reported a total of 274,100 visitor days at Indian Peaks during the 1979-80 fiscal year of which an estimated 70 percent occurred on 37 peak days during weekends and holidays in the 120-day summer and early fall season. This suggests that average peak day use was nearly 5,200 visitor days compared to 2,700 visitor days at optimum capacity. The difference represents average excess demand of 2,500 visitor days on 37 peak days or total annual excess demand of 92,500 visitor days.

Table 2, column 5, shows that if 92,500 visitors substituted newly designated wilderness areas for Indian Peaks, benefits to the remaining 100,000 peak day visitors who do not substitute would increase by an es-

timated \$7.40 per day or \$740,000 annually. This would have a present value attributable to newly designated wilderness of \$10 million when discounted at 7.35 percent as recommended by the U.S. Water Resources Council.

It is difficult to attribute these potential benefits to particular newly designated sites without more information on regional demand for wilderness recreation. The substitution variables in the Indian Peaks willingness to pay equations suggests that a substantial portion, if not all, of the potential benefits may be a direct result of designation of the Mount Evans and Lost Creek wilderness areas in 1981. They are conveniently located 30 miles from the Denver Metropolitan area compared to Indian Peaks' 60 miles. They could surely accommodate additional peak day use of 2,500 visitor days with a combined area nearly 2.5 times that of Indian Peaks. Their average peak day use was estimated as less than 1,500 visitor days in 1980.

The Indian Peaks regression coefficients for substitution suggest that with the location of similar wilderness areas 30 miles closer to where users live, willingness to pay for hiking and backpacking at Indian Peaks would decrease by \$0.90 and \$3.12 per day respectively. Assuming that the substitution variable results in a parallel shift in individual demand curves, peak day hiking and backpacking demand at Indian Peaks would decrease by approximately 10 and 30 percent respectively. This would represent a voluntary reduction in excess demand of nearly 30,000 visitor days per year. Moreover, the regression coefficient for miles traveled suggests that excess demand for hiking at Indian Peaks would decrease by an additional 12,000 visitor days.

If nearly one-half of the benefits of reduced congestion at Indian Peaks can be attributed to designation of the Mount Evans and Lost Creek wilderness areas, as appears to be the case, it would have a substantial effect on the level of benefits estimated for these areas. Walsh, Gillman and Loomis used the travel

⁵By comparison, the optimum number of encounters per day of auto camping at Brainard Lake recreation area near Indian Peaks was 1.6 times these levels, equivalent to nearly 20 parties with management costs of \$2.50 per visitor day and 24 parties without. $WTP = 12.02 - 0.0622Q$ $R^2 = 0.44$ and $N = 45$.
(-2.04)

⁶Optimum encounters for a peak season day at Maroon Bells-Snowmass wilderness area in Colorado have been established for four zones which differ as to permitted uses, levels of use, development, and acceptable environmental change: transition, 20 parties; semi-primitive, 5-20 parties; primitive, 0-5 parties; and pristine, 0-2 parties.

cost approach to estimate the present value of recreation use of Colorado's 10 million acres of potential wilderness over a fifty year planning period. The proportion of present value of recreation benefits attributed to the Mount Evans and Lost Creek wilderness areas was \$19.2 million. Allocation of one-half of the \$10 million potential benefits of reduced congestion at Indian Peaks to substitution of these newly designated wilderness areas would increase their present value by approximately one-fourth.

Conclusions

This paper addressed the empirical problem of estimating benefits of wilderness expansion under conditions of excess demand for an existing area. Specifically, it was shown that the enhanced opportunities to substitute newly designated wilderness in the Rocky Mountain region would be expected to generate external benefits by reducing congestion at Indian Peaks. A procedure was developed to estimate the resulting benefits to the remaining peak day users of Indian Peaks who do not substitute. It was shown that attributing these external benefits to new and expanded wilderness areas would substantially increase the present value of recreation use benefits of the new areas estimated by the traditional methods. In the absence of information on the potential benefits of reduced congestion at some existing areas, insufficient public land would be allocated to wilderness protection. It is concluded that the benefit estimation procedures of federal agencies should be enlarged to consider the effects of excess demand for some existing wilderness areas. Further research is recommended to test the general application of these results to benefit cost analysis of other types of recreation facilities.

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