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A Methodology for Assessing National Outdoor Recreation Demand and Supply Trends

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Abstract *The purpose of this article is to present the model and method developed for the aggregate, national outdoor recreation and wilderness demand and supply assessment required by the Renewable Resources Planning Act (RPA) of 1974. RPA requires aggregate analysis of current and possible future equilibria that could result from different demand and supply futures. Price change was used as the principle indicator of changes in demand relative to changes in supply for individual recreation activities.*

Demand functions and reduced-form consumption functions were estimated for 38 activities, 10 of which are presented here. This approach provided prediction models, indices of future consumption and price trends, and average community demand under various supply conditions. The underlying model is based on household production theory viewed as an appropriate basis for aggregate economic analysis. Adjusted R^2*s for the demand and consumption models ranged between 0.32 and 0.71. Predicted consumption and price changes ranged between 7 and 78% and −5 and +8% (in real terms), respectively. These ranges reflect likely consumption and price trends to the year 2010, depending on whether future supply of recreation opportunities decreases, remains constant, grows moderately, or grows rapidly.*

Results show that equilibrium trip consumption and prices can be estimated nationwide and that these results are quite sensitive to recreation opportunity (supply) growth rates. The methods developed for this analysis should prove useful in other ongoing comprehensive planning and assessment efforts.

Keywords Demand analysis, demand/supply forecasting, national assessment, equilibrium models

Introduction

Assessment of outdoor recreation economic trends is a required component of the Renewable Resources Planning Act (RPA). The purpose of this article is to describe a household market model that was used to assess outdoor recreation demand and supply trends for the 1989 RPA Assessment (Cordell et al., 1990). The article begins by de-

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scribing the household market for outdoor recreation, composed of community level demand and supply curves. Assessment of outdoor recreation demand and supply trends using market-clearing consumption and costs is then discussed. Next, empirical estimates of consumption and costs are presented. Results suggest that the household market model may provide a useful framework for future assessments of outdoor recreation demand and supply. A summary and conclusions are offered in the final section.

Household Market for Outdoor Recreation

The demand and supply of outdoor recreation are elusive concepts. The quantity of outdoor recreation consumed in the United States can be measured in terms of visits, days, trips, or facilities. The quantity measure argued to be most consistent with microeconomic consumer theory is a recreational trip (McConnell 1975). A trip is defined as a purposeful commitment of time away from home to travel to a destination or destinations in order to participate in some primary recreational activity. Days per trip are assumed to be held constant at some fixed quantity for each activity.

Outdoor recreational trips are not produced, sold, and consumed in traditional economic markets. Rather, recreationists themselves act as both consumers and producers of trips. This conceptualization of the demand and supply of outdoor recreation is based on household production theory. In household production theory, demand and supply curves derived from the consumer's perspective are combined to form household markets for economic commodities (Becker 1965; Bockstael and McConnell 1981).

Outdoor Recreation Demand

Outdoor recreation demand was measured for the 1989 RPA Assessment at the community level, rather than at the individual level. Community level demand functions appeared to be more consistent with the RPA goal of analyzing broad, aggregate outdoor recreation economic trends. Community level demand functions also appeared more compatible with the data collected for the 1989 RPA Assessment through the Public Area Recreation Visitor Study (PARVS).

Community demand for outdoor recreation refers to the total number of trips a community is willing and able to take at various direct trip costs. The quantity of trips demanded at various costs is defined by a community demand curve. For example, the community demand curve in Figure 1 indicates that at an average cost or price of \$60 per trip, a community would demand 10,000 trips for the primary purpose of activity *k*. Trip costs refer to the total costs of a two-way trip, including out-of-pocket travel expenditures (e.g., gasoline, food, supplies), fees, and the opportunity cost of travel time (Dwyer, Kelley, and Bowes 1977; Ward and Loomis 1986). The community demand function is specified generally as

$$TRIPS^d = f(P, Z, S, SO, H) \quad (1)$$

where $TRIPS^d$ = recreational trips demanded
P = average price of trip
Z = community population
S = site suitability
SO = substitute recreational opportunities
H = household characteristics.

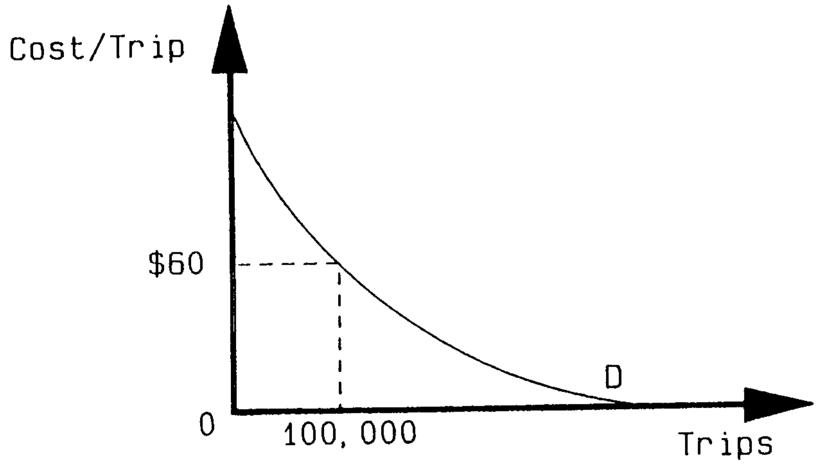

Figure 1. Activity *k* aggregate demand curve for a typical community. Cost/trip includes travel and time costs for a two-way trip.

Outdoor Recreation Supply

Outdoor recreation trips cannot be purchased at a local shopping center. Rather, recreationists combine travel, time, knowledge, gear, supplies, and recreational sites and settings to produce recreational trips. The cost or price of producing a trip is given by total travel costs as defined previously (Bockstael and McConnell 1975; Cicchetti 1973). Outdoor recreation supply, therefore, refers to the total number of trips that can be produced by a community at various trip costs. The number of trips that can be produced or supplied at various average trip costs or prices are defined by a community supply curve for outdoor recreational trips. For example, the community supply curve in Figure 2 labeled $S(RO^2)$ indicates that at an average cost or price of $60 per trip, a community

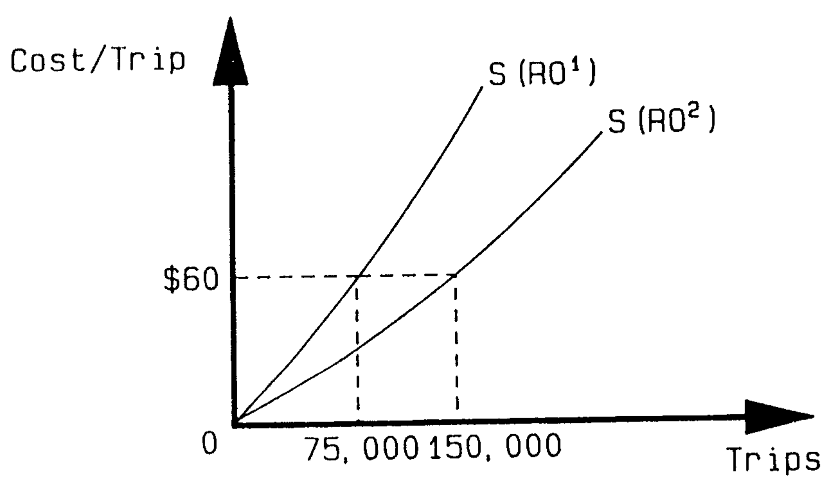

Figure 2. Activity *k* aggregate supply curve for a typical community.

can produce 75,000 activity k trips. The positive slope of the aggregate supply function implies that as average trip costs increase (for example, as people drive greater distances), more recreational opportunities are opened up to a community and the number of trips that can be produced or supplied increases.

Derivation of a community supply curve is illustrated by Figure 3. The black dot in the center of Figure 3*a*, represents a community, say community A. The community is surrounded by six recreational sites represented by the squares numbered 1–6. Each site is assumed to have a capacity of 200 activity k trips per year.

Capacity at a site might be caused by a number of factors including absolute physical constraints, administrative policy, and congestion. For example, capacity for devel-

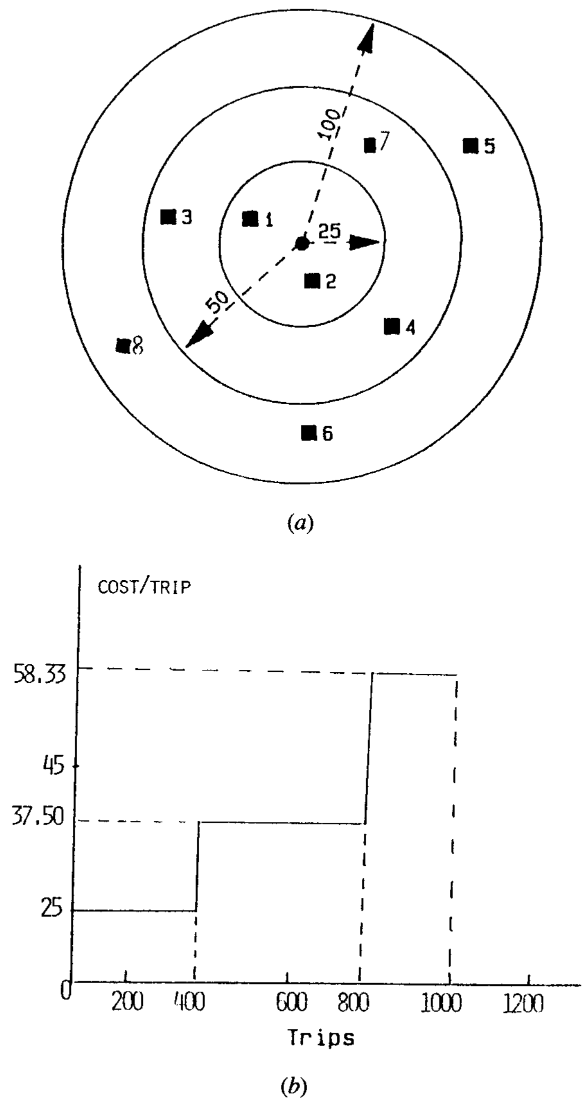

Figure 3. Derivation of activity k aggregate supply curve for a typical community. (*a*) Recreation site within distance zones about a typical commuity. (*b*) Staircase-shaped supply curve.

oped camping at a state park may be defined by absolute physical constraints such as a fixed number of developed campsites. These limited number of campsites are typically rationed on a first-come, first-served or reservation basis.

For some activities, capacity may be determined by congestion. Recreational resources and facilities such as swimming areas and hiking trails may be classified as *congestible goods* (Randall 1987). For a congestible good, Randall argues that congestion costs are negligible up to a certain threshold. After this threshold, congestion costs are argued to increase rapidly. Congestion costs for congestible recreational resources and facilities are illustrated in Figure 4. In Figure 4, Q_1 represents the threshold level of activity k trips after which congestions costs increase rapidly.

It is assumed that, over time, recreationists self-ration activity k trips in making use of a particular congestible recreational resource or facility (e.g., swimming area) such that total trips are kept at or near the congestion threshold level during peak demand periods. That is, when the congestion threshold level is exceeded, some recreationists will discontinue using the site. Thus, provided that alternative recreational resources and facilities exist (e.g., resources and facilities found at sites located farther away), the congestion threshold level is assumed to define an implicit capacity for congestible recreational resources and facilities that are not subject to administrative rationing schemes such as first-come, first-served or reservations.[1]

In sum, each site is assumed to have an explicit or implicit capacity that serves as an upper bound on annual activity k trips. The existence of a maximum capacity at recreation sites is a common assumption in the recreation economics literature. As stated previously, each site in Figure 3 is assumed to have a capacity of 200 activity k trips per year. The portion of a site's capacity that is available to community A is assumed to be what is left over after the consumption of site capacity by all other communities. For example, suppose that community A shares sites five and six in Figure 3 with another community. Suppose further that the other community consumes 100 activity k trips annually from site five and six. Thus, only 100 activity k trips are available to community A at site five and six.[2]

Given these assumptions, the community supply function is derived as follows. In order to produce trips beyond the closest site, recreationists must travel to sites farther and farther away. At an average travel distance of 25 miles, community A can produce a total of 400 trips annually (200 trips each to sites one and two, Figure 3). At an average travel distance of 37.50 miles, community A can produce a total of 800 trips annually (200 trips each to sites one through four). At an average travel distance of 58.33 miles, the community can produce a total of 1000 trips annually (200 trips each to sits one through four and 100 trips each to sites five and six). The number of trips that can be produced at various distances are indicated by the staircase-shaped supply function shown in Figure 3*b*. If sites and available site capacity were located at continuous distances from the community, the staircase-shaped supply function in Figure 3 would become a smooth, upward-sloping community supply function as shown in Figure 2.[3]

As illustrated by Figure 3, a community supply function is dependent on the number, location, and capacity of recreational sites and facilities available to that community, i.e., recreational opportunities. For example, the community supply curve labeled $S(RO^1)$ in Figure 2 is dependent on a fixed level of recreational opportunities denoted by RO^1. Suppose a change in government funding results in increased recreational sites and facilities surrounding a community (e.g., addition of sites seven and eight in Figure 3). As a result, recreational opportunities available to the community increase from RO^1 to RO^2. This increase in recreational opportunities will cause the aggregate supply function

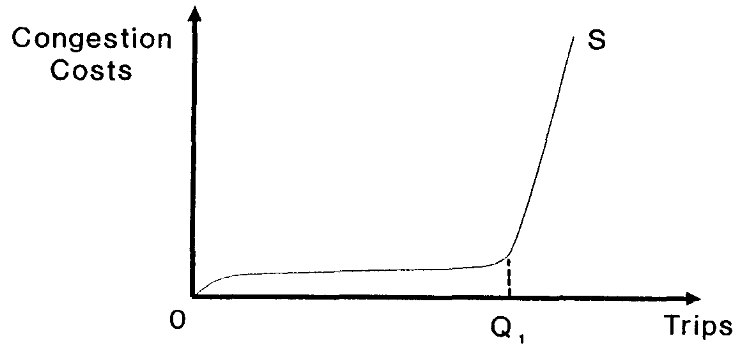

Figure 4. Congestion costs for a congestible recreational resource or facility.

in Figure 2 to shift out from $S(RO^1)$ to $S(RO^2)$. Given this new community supply function, the community can now produce 150,000 trips at an average cost or price of $60 per trip.

Thus, provision of outdoor recreational trips to the public occurs in a two-step process. In the first step, public or private agencies, groups, or individuals make recreational resources and facilities available to the public (e.g., additional sites and/or site capacity). This first step represents the physical and managerial dimension of recreational trip supply. In the second step, households combine these facilities with their own time and resources to produce or take trips. This second step represents the human dimension of recreational trip supply. Projections of the future supply of recreational trip opportunities must consider both of these supply steps or dimensions. In equation form, the community supply function is specified generally as

$$TRIPS^S = h(P, RO, S, H) \tag{2}$$

where $TRIPS^S$ = recreational trips supplied, RO = recreational opportunities, and P, S, and H are as defined previously.

Interaction of Demand and Supply

The household market for outdoor recreation trips is composed of the community demand and supply functions, as illustrated in Figure 5. The intersection of the two functions defines the household market equilibrium point between outdoor recreation demand and supply. In Figure 5, for example, the household market equilibrium point is given by point *A*. At point *A*, the community demand function indicates that at an average cost or price of P_1 per trip, a community would desire to consume Q_1 trips. Also at point *A*, the community supply function indicates that a community can produce or supply Q_1 trips at an average out-of-pocket cost or price of P_1 per trip.

Hence, at the household market equilibrium point, the quantity of trips that recreationists desire to take at a given price is equal to the quantity of trips they can produce at that price. In other words, the marginal costs to recreationists of producing trips are equal to the marginal benefits of consuming trips (on the average)., In Figure 5, P_1 is an equilibrium or market-clearing cost or price, because at this price outdoor recreation demand and supply equilibrate. Equilibrium or market-clearing consumption is given by Q_1 in Figure 5, which illustrates that final trip consumption and costs are functions of both demand and supply factors.

The existence of a household market equilibrium point assumes that a community is not restricted to producing and consuming trips only at local sites. That is, it is assumed that excess capacity exists at sites somewhere such that recreationists can eliminate excess demand by traveling to sites located farther away (e.g., increasing travel distances and costs) until the point is reached where the marginal costs and benefits of additional trips produced and consumed are equal.[4] The number of trips consumed and average cost or price per trip are defined by the household market equilibrium point in Figure 5.

The shape of the community supply function in Figure 5 implies that as more and more trips are produced, average costs or price per trip may increase rapidly. This rapid increase in average trip costs or price, for example, may reflect the increased difficulty of finding available sites for producing increased trips because of the need to travel greater distances and/or spend more time searching for available capacity. At some point, production of more trips may become so difficult that the community supply function turns essentially vertical.

In the next sections, the assessment of demand and supply trends is discussed assuming that household market equilibrium exist as illustrated in Figure 5. It is fully recognized that the conceptual model of community demand and supply presented in this section is somewhat simplistic and limited. It is argued, however, that the conceptual model provides a useful starting point for equilibrium demand/supply analysis that is reasonably consistent with aggregate, on-the-average demand and supply relationships and behavior. The conceptual model reflects the RPA Assessment goal of developing a simple and tractable framework for assessing outdoor recreation demand and supply that is theoretically consistent with demand/supply assessment methods for other natural resource products (e.g., timber, minerals).

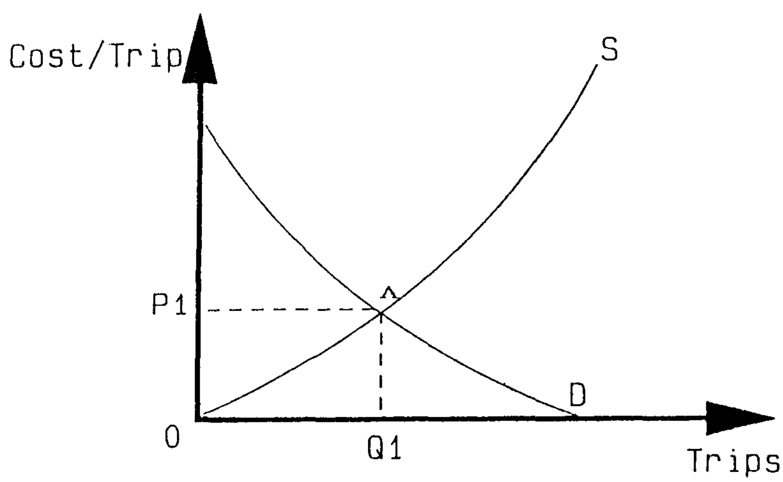

Figure 5. Community-level household market for activity *k* trips.

Assessing Demand and Supply Trends

Changes in Trip Consumption

Given the existence of household market equilibrium points, changes in the demand and supply of outdoor recreational trips can be assessed through changes in equilibrium consumption and costs. Consumption trend lines that show changes in equilibrium trip consumption over time are shown in Figure 6*a*. The relationship of these consumption trend lines to the community-level household market for trips is shown in Figure 6*b*.

The base year level of trips (1987) is given by point *b* in Figure 6*a*, or Q_1 trips. Point *b* corresponds to point *B* in Figure 6*b*. At point *B*, Q_1 trips are consumed at trip costs equal to P_1 per trip. Suppose demand for trips is expected to increase in the year 2000 from *D* to D_1 in Figure 6*b*. Also assume that recreational resources and facilities are fixed at RO^1. Under this assumption, the community supply curve for trips is given by the curve labeled $S(RO^1)$ in Figure 6*b*. The assumption of fixed recreational resources and facilities implies that $S(RO^1)$ is fixed within a defined limit at which households are normally willing to travel. However, it does not imply that available capacity is

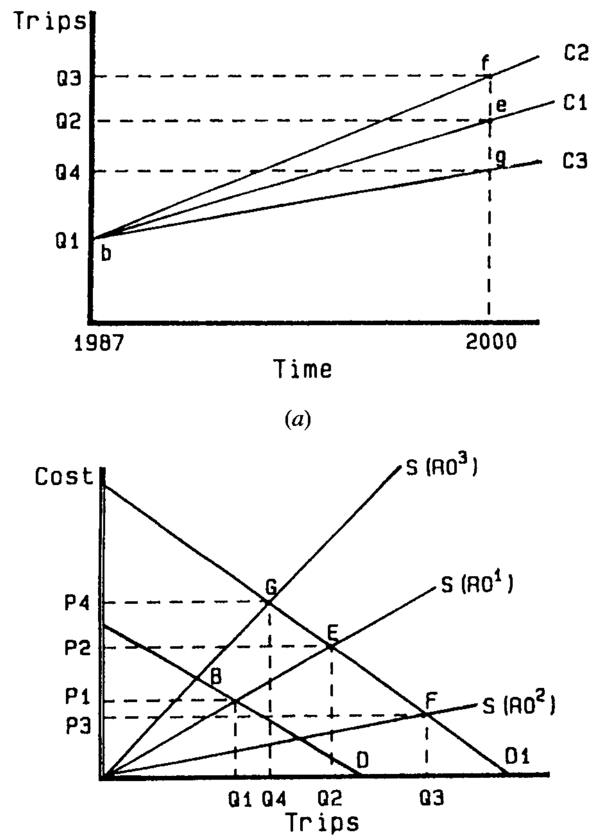

Figure 6. Consumption trend lines under alternative demand/supply scenarios. (*a*) Consumption trend lines. (*b*) Shifting demand and supply conditions.

absolutely fixed at some upper-limit because it is assumed that communities can increase trips by traveling to more distant sites that have the desired characteristics such as location and capacity.

When demand shifts from D to D_1 in Figure 6, a temporary shortage of trips will emerge at current average trip costs equal to P_1. However, in an effort to reach equilibrium, it is assumed that recreationists travel farther or spend more time searching for available excess site capacity.[5] A new household market equilibrium will be established at point E in Figure 6*b*. At point E, Q_2 trips are consumed at average trip costs equal to P_2 per trip. Point E in Figure 6*b* corresponds to point e on the consumption trend line labeled C_1 in Figure 6*a*.

Next, assume again that demand is expected to shift from D to D_1 by the year 2000, but that recreational facilities and resources are also expected to increase from RO^1 to RO^2, which causes the community supply function to shift from $S(RO^1)$ to $S(RO^2)$ in Figure 6*b*. Changes in recreational facilities and resources that would shift the community supply function include increases in individual site capacity and/or increases in the number of sites available to a community, at the same or closer distances. Given these new demand and supply curves, the community will establish a new household market equilibrium at point F in Figure 6*b*. At point F, Q_3 trips are consumed at trip costs equal to P_3. Point F in Figure 6*b* corresponds to point f on the higher consumption trend line labeled C_2 in Figure 6*a*.

Finally, assume once more that demand will shift from D to D_1 by the year 2000. Suppose, however, that recreational resources and facilities will be reduced from $S(RO^1)$ to $S(RO^3)$ in Figure 6*b*. Given these new demand and supply curves, the community will establish a new household market equilibrium at point G in Figure 6*b*. At point G, Q_4 trips are consumed at trip costs equal to P_4. Point G in Figure 6*b* corresponds to point g on the lower consumption trend line labeled C_3 in Figure 6*a*.

As illustrated in Figure 6, different demand/supply assumptions will result in different consumption trend lines. Consumption trend lineds can be used to communicate the impact of alternative public policies affecting the availability of recreational resources and facilities. For example, given an expected change in demand, the consumption trend lines in Figure 6 illustrate the impact of three alternative recreational resource and facility supply growth scenarios on equilibrium trip consumption and costs. Consumption trend line C_1 shows trip consumption and costs assuming moderate recreational resource and facility growth. Consumption trend line C_2 shows trip consumption and costs assuming relatively high recreational resource and facility growth. Consumption trend line C_3 shows trip consumption and costs assuming relatively low recreational resource and facility growth.

A consumption trend line maps out changes in equilibrium consumption of outdoor recreational trips. Hence, points on a consumption trend line are jointly determined by the community demand and supply functions. The equation of a consumption trend line can therefore be specified as the reduced form of Eqs. (1) and (2):

$$TRIPS^c = g(SO, Z, S, RO, H).^6 \qquad (3)$$

In Eq. (3), the dependent variable, $TRIPS^c$, refers to the total number of activity k trips consumed by a community annually. Independent variables are as defined for Eqs. (1) and (2).

Changes in Trip Costs

Relative changes in outdoor recreation demand and supply are indicated by changes in household market equilibrium trip costs. In Figure 6*a*, for example, consumption trend line C_1 indicates that trip consumption will increased from Q_1 to Q_2 by the year 2000 under the assumption of increased demand and stable recreational resource and facility growth. Figure 6*b* indicates that this demand/supply scenario will result in an increase in average trip costs from P_1 to P_2.

In Figure 6*a*, consumption trend line C_3 indicates that under an assumption of increased demand and decreased recreational resource and facility growth, trip consumption will increase from Q_1 to Q_4 by the year 2000. Figure 6*b* shows that this demand/supply scenario will result in a sharp increase in trip costs from P_1 to P_4. Consumption trend line C_2 in Figure 6*a* indicates that under an increased demand, increased recreational resource and facility growth scenario, trip consumption will increase from Q_1 to Q_3. Under this demand/supply scenario, trip costs will decrease from P_1 to P_3 as shown in Figure 6*b*.

In summary, an increase in equilibrium trip costs suggests that demand is increasing faster than supply and outdoor recreational opportunities are becoming more scarce. A decrease in equilibrium trip costs suggests that supply is increasing faster than demand and outdoor recreational opportunities are becoming less scarce. Constant equilibrium trip costs indicate that demand and supply are increasing or decreasing at the same rate; thus, the scarcity of outdoor recreational opportunities is remaining stable. By summarizing relative changes in demand and supply, changes in equilibrium trip costs provide a broad indicator of changes in the scarcity of outdoor recreation. The need for such a scarcity measure has been advocated in the literature by Clawson (1984) and more recently by Harrington (1987) and Cordell and English (1989).

An Empirical Application

In this section, an initial effort to estimate equilibrium consumption and costs of outdoor recreational trips is described. Demand and consumption functions were estimated for a sample of communities in the United States using data from the Public Area Recreation Visitor Study (PARVS). For estimation purposes, a community was defined as a county. The estimated functions were used to estimate equilibrium consumption and costs for selected outdoor recreational activities.

Community Demand Function

The community demand function was derived by first estimating the function:

$$TD_{ij} = exp(b_1PRICE_{ij} + b_2INC345_i + b_3PCT18TMD_i + b_4CCPOP86_i + b_5PCTFARM_i + b_6SUBEROS_i + b_7SUIT_j) \quad (4)$$

where TD_{ij} = annual activity k trips taken (demanded by county i to site j (total trips to site j by persons 12 years and older who participated in activity i)

$PRICE_{ij}$ = total cost of activity k trip from county i to site j (total out-of-pocket costs per person per trip plus 1/2 average community wage rate times hours in travel to site)

$INC345_i$ = percent of county i population with income greater than or equal to \$30,000 per year
$PCT18TMD_i$ = percent of county i population age 18 to 32 years
$CCPOP86_i$ = total county i population 12 years old or older
$PCTFARM_i$ = percent of county i population living on farms which earn income equal to or greater than \$1000 per year
$SUBEROS_i$ = substitute recreational opportunities that compete with activity k for households' time and money
$SUIT_j$ = suitability of site j for activity k (on scale of 0 to 10 as rated by management personnel of site, where 0 is completely unsuitable and 10 is perfectly suitable).

Recreational activity demand functions corresponding to Eq. (1) were estimated for a sample of counties across the United States. Trips and cost data were collected in on-site interviews conducted from 1985 to 1987 at more than 200 recreational areas across the nation. This extensive survey was part of the nationwide Public Area Recreation Visitors Study (PARVS) sponsored by six federal agencies, 11 states, three national recreation associations, and two universities.

Respondents to the PARVS survey represented more than 80% of the counties in the continental United States. A total of 32,000 interviews were conducted, resulting in 26,000 usable observations. A detailed description of the PARVS, including the on-site survey, is provided in Cordell et al. (1987). The specification and estimation of Eq. (4) for various outdoor recreational activities is described in detail by Bergstrom and Cordell (1990).

The substitute variable, $SUBEROS_i$, is an index from 0 to 100 representing amount of other recreational opportunities available within a community's willingness-to-drive radius. It accounts for competing populations from other communities by expressing quantity of opportunity on a per capita basis including competing communities. It accounts for distance from the study community by a distance decay weight that goes to zero at the outer extreme of the community's maximum driving range for activity k. $SUBEROS_i$ is not an exact specification of Clawson's effective acreage because it omits weighting quantity of opportunity by use. Omitting use weights avoids the potential problem of having use on both sides of the consumption model equations. A more detailed explanation of the effectiveness measure is presented in Cordell and English (1989).

Before estimation, Eq. (4) was transformed by taking the natural logarithm of both sides of the equation.[7] Transformed equations were then estimated by ordinary least squares. An equation for a particular activity was estimated only for trips that PARVS respondents indicated were primarily for that activity. Estimates of Eq. (4) for selected activities are reported by Bergstrom and Cordell (1990). The complete set of estimated equations is available from the authors upon request.

Community demand functions were derived by first substituting mean values for all independent variables except for $PRICE_{ij}$ into the estimates of Eq. (4), and solving for a composite constant term. The composite constant term was calculated by the general equation

$$c = a + \mathbf{B}\,\mathbf{X} \tag{5}$$

where c = composite constant term
a = estimated intercept term for Eq. (4)

B = vector of estimated regression coefficients for all independent variables in Eq. (4), except for $PRICE_{ij}$
X = vector of mean values for all independent variables in Eq. (4), except for $PRICE_{ij}$.

Collapsing all independent variables except for $PRICE_{ij}$ into the composite constant term reduced Eq. (4) to

$$TD_{ij} = exp(c - b_2\, PRICE_{ij}) \tag{6}$$

where c = constant composite term
b_2 = estimated regression coefficient for $PRICE_{ij}$ variable
$PRICE_{ij}$ = average trip costs or price.

Equation (7) represents a demand function for the average community for activity k trips to the average site. This equation was then multiplied by the average number of sites used by a county for activity k, or

$$TD_i = n_i exp(c - b_1\, PRICE_{ij})] \tag{7}$$

where TD_i = annual activity k trips taken by community i to all sites;
n_i = average number of sites used by community i for activity k.

Equation (7) represents a community demand function for activity k which approximates Eq. (1) and Figure 1. Estimated community demand functions for the 10 selected recreational activities are given in Table 1. These equations define the number of activity k trips a typical community in the United States will take at various average trip costs or price to all sites used for that activity.

Table 1
Estimated Community Demand Functions for Activity k Trips to All Sites

	Parameter Estimates			
Activity	Composite Constant Term	Cost Coefficient (Standard Error)*	Average 1987 Community Consumption	Average 1987 Cost Per Day[a]
Developed Camping	13.2226	−0.0302 (0.00042)	122,504	$21.39
Picnicking	15.1128	−0.0499 (0.00110)	296,203	$39.69
Sightseeing	14.9591	−0.0183 (0.00029)	456,434	$65.61
Visiting Historic Sites	13.5640	−0.0231 (0.00050)	111,893	$59.97
Running/Jogging	15.1549	−0.1356 (0.01373)	174,748	$12.00
Day Hiking	13.5763	−0.0393 (0.00125)	133,679	$32.35
Nature Study	12.6636	−0.0289 (0.00093)	58,624	$35.17
Backpacking	10.6442	−0.0124 (0.00110)	17,872	$29.26
Motorized Boating	13.7019	−0.0383 (0.00156)	160,300	$39.85
Canoeing/Kayaking	12.7674	−0.0484 (0.00122)	29,599	$38.61

*All models significant at $p < .01$.
[a]Includes both travel and time cost estimates for a two-way trip.

Estimation of community demand functions assumed that the household market for outdoor recreational trips was in equilibrium. Variations in recreational resources and facilities across communities lead to shifts of the community supply function. These shifts lead to variations in trips consumed that identify the community demand function, ceterus paribus (Cicchetti 1973; Kalter and Gosse 1990).

Consumption Function

Community-level, equilibrium consumption of outdoor recreational trips in the United States was estimated using the consumption function:

$$LTC_i = f(INC345_i, PCT18TMD_i, CCPOP86_i, PCTFARM_i, SUBEROS_i, RO_i{*}SUIT_i) \quad (8)$$

where TC_i = natural log of annual activity k trips consumed by county i

RO_i = recreational resources and facilities available to county i for activity k (measured as number of acres, miles, or facilities available within driving range of community)

$SUIT_i$ = average suitability of sites used for activity k by county i

and all other variables are as defined for Eq. (4). Equation (8) corresponds conceptually to Eq. (3). Recall that Eq. (3) is the reduced form of the demand/supply system given by Eqs. (1) and (2).

The dependent variable in Eq. (8), obtained from the PARVS data, is the total number of activity k trips consumed by a community over the immediate past 12-month period. The recreational resource and facility variable (*RO*) was obtained from a data set that shows the quantity of recreational resources and facilities available to a community. Ordinary least squares estimates of Eq. (8) for the recreational activities addressed in the demand function estimation are shown in Table 2. In some equations it was necessary to delete the $PCTFARM_i$ variable because of colinearity problems.[8]

Changes in Trip Consumption and Costs

Trip Consumption. Changes in trip consumption were estimated by first projecting changes in all of the right-side variables of the consumption function for five future time periods: 2000, 2010, 2020, 2030, and 2040. Projections of income and population were provided by Wharton Econometrics. Projections of future availabilities of recreational resources and facilities were based on four policy scenarios; moderate decrease, no change, moderate growth (about 0.5% annually), and high growth (about 1% annually). Future trip consumption was estimated by substituting projections of the right-side variables into Eq. (8) and solving.

Changes in trip consumption, relative to the 1987 base year, are shown by the indices in Table 3. As indicated by these indices, future consumption of recreational trips is sensitive to the availability of recreational resources and facilities. Hence, public policies that affect the growth of recreational facilities and resources may considerably impact the future consumption of outdoor recreation in the United States. The indices in Table 3 suggest that consumption of some activities may be more sensitive to public recreational resource and facility supply policies than others.

Table 2
Estimated Community Consumption Functions for Recreational Activities

Acitivy	Parameter Estimates (Standard Error)										
	INTERCEP	*INC345*	*PCT18TMD*	*CCPOP86*	*SUBEROS*	*PCTFARM*	RO_1	RO_2	*N*	*F*-value	Adjusted R^2
Developed Camping	8.253*	0.065*	0.084*	0.0000012*	−0.060*	—	0.0000047*	—	239	49.488	0.50
	(.750)	(.010)	(.033)	(1.34 E-07)	(.014)		(.0000014)				
Picnicking	8.765*	.051*	.118	.0000012*	−.071*	—	.000044*	—	239	54.607	.53
	(.718)	(.009)	(.032)	(1.30 E-07)	(.014)		(.00001)				
Sightseeing	10.885*	.024*	.108*	.0000010*	−.045*	−0.189*	.0000019*	—	239	80.838	.67
	(.633)	(.009)	(.027)	(1.12 E-07)	(.012)	(.018)	(.000001)				
Visiting Historical Sites	8.755*	.039*	.135*	.00000012*	−.054*	−.205*	.0000032*	—	239	87.398	.68
	(.663)	(.009)	(.029)	(1.18 E-07)	(.012)	(.019)	(.000002)				
Running/Jogging	6.913*	.103*	.122**	.0000013*	−.070	—	.0000050*	—	239	25.164	.34
	(1.362)	(.018)	(.061)	(2.46 E-07)	(.026)		(.000002)				
Day Hiking	8.889*	.054	.116*	.00000019*	−.065*	−.194*	.000024*	—	239	97.476	.71
	(.681)	(.009)	(.029)	(1.21 E-07)	(.016)	(.016)	(.000006)				
Nature Study	5.938*	.063*	.158*	.0000011*	−.068*	—	.00706**	.000021**	239	30.993	.43
	(.925)	(.012)	(.042)	(1.69 E-07)	(.021)		(.003)	(.000008)			
Backpacking	6.030*	.095*	.081	.0000012*	−.105*	—	.000062*	.000000076***	239	21.337	.34
	(1.467)	(.020)	(.067)	(2.66 E-07)	(.035)		(.00001)	(4.44 E-08)			
Motorized Boating	9.780*	.032*	.076**	.0000010*	−.075*	—	.00120*	.000219**	239	31.265	.43
	(.833)	(.011)	(.037)	(1.44 E-07)	(.013)		(.0003)	(.00009)			
Canoeing/Kayaking	5.007*	.072*	.140*	.0000010*	−.038**	—	.01052*	.00158*	239	33.973	.45
	(.958)	(.013)	(.043)	(1.73 E-07)	(.015)		(.004)	(.0006)			

*Significant at 0.01 level; **significant at 0.05 level; ***significant at 0.10 level.

Trip costs. Estimation of changes in trip costs involved two basic steps. First, the community demand curve for activity k in each future time period was calculated. This calculation was based on the same projections of changes in population and socioeconomic variables used for the trip consumption projections. These projections imply a moderate increase in the demand for outdoor recreation over time. Future trip costs were then estimated by substituting future trip consumption projections into the appropriate future demand function and solving for trip costs. This substitution is valid because at the household market equilibrium, trips demanded by a county (LTD_i) equal trips consumed by a county (LTC_i). Change in average trip costs, relative to the 1987 base year, are shown by the indices in Table 4.

The cost indices in Table 4 summarize relative changes in outdoor recreation demand and supply over time. An index greater than 100 indicates that demand is growing faster than supply. An index equal to 100 indicates that demand and supply are changing at about the same rate. An index of less than 100 indicates that supply is increasing faster than demand.

The cost indices in Table 4 indicate the economic effects on recreationists of public policies affecting the growth of available recreational resources and facilities. Under an assumption of either decreasing or zero change of recreational resource and facility availability, trip costs would increase over time for most activities. The implication is that outdoor recreational opportunities are becoming more scarce. For example, people may have to travel greater distances or spend more time searching for available recreational opportunities. In addition, increasing trip costs imply that consumer's surplus, or the net economic value of outdoor recreational activities, may be decreasing.

Under the same assumption of moderate recreational resource and facility growth, trips costs remain constant for many activities. The implication is that the scarcity of outdoor recreation is remaining stable. Thus, maintenance of the status quo with respect to outdoor recreational opportunities may require at least a moderate increase in recreational resources and facilities over time (given the assumption of moderate increases in demand). Trip costs decrease over time for several activities under the assumption of high recreational resource and facility growth. The implication is that recreational opportunities are becoming less scarce. For example, people may be able to travel shorter distances and spend less time searching for available opportunities. Another implication of decreasing trip costs is that the net economic value (e.g., consumer's surplus) of outdoor recreation may be increasing over time. Hence, improvements in the recreationists' welfare over time may require a relatively high rate of recreational resource and facility growth (again, given the assumption of a moderate increase in demand).

Summary and Conclusions

The Renewable Resources Planning Act (RPA) requires that the U.S. Forest Service produce a comprehensive assessment of the demand and supply situation for outdoor recreation in the United States. Outdoor recreation demand, supply, and consumption functions were developed using a community-level household market framework. Community demand and consumption functions were estimated using a nationwide cross-sectional data set. These functions were used to estimate changes in outdoor recreational trip consumption and costs in the United States over time.

Future equilibrium trip consumption and costs were estimated for several demand/supply scenarios. The scenarios assumed moderate demand growth, combined with ei-

Table 3

Future Market-Clearing Trip Consumption Indices Under Alternative Recreational Resource and Facility Growth Scenarios (1987 Base Level = 100)

Trip Consumption Indices By Year and Recreational Resource and Facility Growth Scenario

	2000				2010			
Activity	D	Z	M	H	D	Z	M	H
Developed Camping	116	117	120	123	130	132	137	142
Picnicking	105	107	110	113	111	114	119	125
Sightseeing	115	116	117	118	129	130	132	134
Visiting Historic Sites	118	118	119	121	135	136	138	140
Running/Jogging	126	127	131	134	149	152	158	165
Day Hiking	125	127	130	133	149	152	157	163
Nature Study	102	105	109	114	107	111	119	127
Backpacking	128	131	136	141	152	157	167	178
Motorized Boating	103	105	107	110	107	110	114	118
Canoeing/Kayaking	107	110	116	122	115	120	131	143

	2020				2030			
	D	Z	M	H	D	Z	M	H
Developed Camping	144	147	155	163	158	162	173	184
Picnicking	118	121	129	137	125	130	139	150
Sightseeing	146	148	151	154	167	169	174	178
Visiting Historic Sites	155	157	160	163	182	184	189	194
Running/Jogging	173	178	188	199	200	207	221	237
Day Hiking	177	181	190	200	211	217	231	245
Nature Study	112	117	129	141	120	126	141	157
Backpacking	178	186	202	220	205	215	238	267
Motorized Boating	111	115	120	126	116	120	127	134
Canoeing/Kayaking	123	131	147	164	133	144	165	189

	2040			
	D	Z	M	H
Developed Camping	168	173	186	199
Picnicking	130	135	147	159
Sightseeing	190	193	198	204
Visiting Historic Sites	210	213	219	225
Running/Jogging	220	228	246	265
Day Hiking	247	255	273	292
Nature Study	125	132	149	169
Backpacking	224	237	265	296
Motorized Boating	119	124	132	140
Canoeing/Kayaking	140	153	177	206

Note. D = Decreased recreational resource and facility growth scenario; Z = Zero recreational resource and facility growth scenario; M = Moderate recreational resource and facility growth scenario; H = High recreational resource and facility growth scenario.

Table 4

Future Market-Clearing Trip Cost Indices Under Alternative Recreational Resource and Facility Growth Scenarios (1987 Base Level = 100)

Trip Cost Indices By Year and Recreational Resource and Facility Growth Scenario

	2000				2010			
Activity	D	Z	M	H	D	Z	M	H
Developed Camping	102	101	100	98	104	102	100	97
Picnicking	101	101	99	98	102	101	99	97
Sightseeing	101	101	101	100	102	102	101	100
Visiting Historic Sites	102	101	101	100	103	103	102	101
Running/Jogging	103	102	101	99	104	103	101	99
Day Hiking	103	102	101	99	105	104	101	99
Nature Study	102	100	98	95	103	101	97	93
Backpacking	105	103	98	94	108	105	97	90
Motorized Boating	101	100	99	98	102	101	99	97
Canoeing/Kayaking	102	101	99	97	104	102	98	95

	2020				2030			
	D	Z	M	H	D	Z	M	H
Developed Camping	105	103	100	96	106	104	100	96
Picnicking	103	102	99	97	103	102	99	96
Sightseeing	103	103	102	101	105	104	103	101
Visiting Historic Sites	104	104	103	102	106	105	104	103
Running/Jogging	106	105	102	99	108	106	103	99
Day Hiking	106	105	102	99	108	107	103	100
Nature Study	104	101	96	91	105	102	96	89
Backpacking	111	106	97	87	114	108	96	84
Motorized Boating	103	101	98	96	104	102	98	95
Canoeing/Kayaking	105	103	98	94	107	104	98	93

	2040			
	D	Z	M	H
Developed Camping	107	105	100	96
Picnicking	104	102	99	96
Sightseeing	106	105	104	102
Visiting Historic Sites	107	106	105	104
Running/Jogging	108	107	103	100
Day Hiking	110	108	104	100
Nature Study	106	103	95	88
Backpacking	115	109	96	82
Motorized Boating	104	102	98	94
Canoeing/Kayaking	108	104	98	92

Note. D = Decreased recreational resource and facility growth scenario; Z = Zero recreational resource and facility growth scenario; M = Moderate recreational resource and facility growth scenario; H = High recreational resource and facility growth scenario.

ther negative, constant, moderately positive, or highly positive growth in the provision of recreational resources and facilities. Equilibrium trip consumption for most activities was projected to increase at different rates, depending on which demand/supply scenario was implemented to the year 2040. The results, in general, suggest that equilibrium trip consumption is quite sensitive to changes in recreational resource and facility growth rates.

By summarizing the relative balance between demand and supply, changes in equilibrium trip costs provide a broad outdoor recreation scarcity indicator. Projections of trip costs suggest that for most activities, a moderate or high rate of recreational resource and facility growth is needed to prevent increases in the scarcity of outdoor recreational opportunities (e.g., increases in equilibrium trip costs). Projections of both equilibrium trip consumption and costs provide insight into the effects of public recreational resource and facility growth policies on recreationists.

The conceptual model and empirical procedures described in this paper represent an initial attempt to develop a comprehensive methodology for assessing changes in outdoor recreation demand and supply, and for relating these changes to the availability of recreational opportunities. The methodology is consistent with the objectives of the RPA Assessment to assess broad, aggregate outdoor recreation demand and supply trends. The methodology is also consistent with demand, supply, and assessment procedures followed by the U.S. Forest Service for other natural resource products such as timber and minerals.

The task of assessing outdoor recreation demand, supply, and consumption trends in the United States or at the regional and state levels is an extremely complicated and involved endeavor. The methodology presented in this article is by no means complete or perfect. Much work remains to be done. Because it was not necessary for estimating equilibrium consumption and costs, no effort was made in this study to estimate community supply functions. To determine the actual properties of community supply functions, there is a need to develop methods for estimating outdoor recreation community supply functions.

Another need is to improve data bases, model specification, and estimation procedures used to estimate outdoor recreation demand, supply, and consumption functions. In particular, there is a need to reexamine the simplifying assumptions underlying the modeling discussed in this article and to determine the sensitivity of the conceptual and empirical results to changes in these assumptions. Also, more conceptual and empirical work is needed to identify the welfare and policy implications of changes in trip consumption and costs over time and space. Stimulation and facilitation of future research into these and other problem issues is one of the primary objectives of this article.

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Notes

1. The all-or-nothing nature of congestion costs assumed in this article may be a source of concern. Congestion costs are primarily subjective and are therefore very difficult to define and measure. Other shapes of the congestion cost curve shown in Figure 4 can be postulated. The curve shown in Figure 4, however, is well grounded in the theory of congestible goods and is adopted in this article as a pragmatic starting point. Extensions of the basic model presented in this article to include different assumptions concerning the role of congestion costs are encouraged.

2. A simplistic picture of competition between communities for site carrying capacity is presented. It is argued that this picture is sufficient for the broad, on-the-average analysis conducted for the RPA Assessment. A much more complicated model of competition between communities for site capacity could be formulated. It is not expected, however, that a more complicated model would change the basic results and intuition of the demand/supply modeling approach presented in this article.

3. As suggested by one reviewer, instead of being convex to the trips axis as shown in Figure 2, the community supply function could be concave to the trips axis. Concavity would result from the assumption that total available capacity is proportional to area, and that area available to a community increases with the square of the distance or cost/trip faced by the community. Although a concave community supply function is possible, a convex curve is more likely because competition for available sites from other communities also increases with the square of distance from the community. The shape of the supply function is not a critical issue to this article.

4. The existence of excess capacity at recreational sites is common among public recreation sites, especially during non-peak demand periods.

5. For example, if all available developed camping trips at a close site have been allocated by a reservation system, recreationists not holding reservations would have to turn to sites located farther away in order to find available sites.

6. Taken together, Eqs. (1) and (2) represent a simultaneous equation system where both quantity of trips and trip cost or price are endogenous. The reduced form of this system simply expresses the dependent variable (quantity of trips) as a function of the exogenous variables of the system. All independent variables except for trip costs or price are assumed to be exogenous. A good, basic explanation of the reduced form of a simultaneous equation system is provided by Kmenta (1971), 531–589.

7. The natural log of the dependent variable was originally selected as the most widely accepted functional form for demand function estimation.

8. Simple correlation coefficients indicated that $PCTFARM_i$ was highly correlated with the suitability weighted recreational opportunity variable in a number of the consumption equations. This high correlation reduces the explanatory power of each correlated independent variable and is therefore statistically undesirable.

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