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An Analysis of the Demand for and Value of Outdoor Recreation in the United States

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Demand equations for 37 outdoor recreational activities were estimated across a sample of U.S. counties using a multi-community, multi-site travel cost model. Results suggest that determinants of the demand for outdoor recreation in the U.S. include population, residence, income, age, price, quality, and substitutes. Estimates of the net economic value per day of the activities modeled ranged from $2.39 to $29.18. Estimates of the total net economic value of the activities modeled (total days × value per day) ranged from $267 million to $16 million. The sum of total net economic value for all 37 activities was estimated at $122 billion annually. The multi-community, multi-state travel cost model, represents an alternative approach for estimating standard "off-the-shelf" values for outdoor recreation over multiple populations and sites in the United States. Such values are of considerable interest to resource management agencies for policy and planning purposes (e.g., U.S.D.A Renewable Resources Planning Act Assessment and Program).

KEYWORDS: *U.S. outdoor recreation demand, multi-community, multi-site travel cost model, demand determinants, economic value per day, total U.S. days, total U.S. economic value*

INTRODUCTION

There is considerable interest in developing general "off-the-shelf" estimates of the economic value of outdoor recreation in the United States. For example, the Renewable Resource Planning Act (RPA) requires the

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U.S.D.A. Forest Service to develop general estimates of the economic value of a variety of outdoor recreational activities in the United States. For the 1980 and 1990 RPA efforts, these recreational activity values were based primarily on values reported by previous studies of outdoor recreation demand.

Comprehensive reviews of previous outdoor recreation demand studies are provided by Sorg and Loomis (1984) and Walsh, Johnson, and McKean (1988). Most studies these authors reviewed estimated the demand for a single activity provided at a single site. The single-site demand estimation approach may hinder the development of general economic value estimates for outdoor recreation because value estimates generated by a particular study are sensitive to 1) characteristics of the user population (e.g., income), (2) site characteristics (e.g., quality or suitability), and (3) model specification and estimation procedures.

The development of general economic values for outdoor recreation may be improved by estimating multi-regional, multi-site demand models. In this paper, the estimation and application of a multi-regional, multi-site outdoor recreation demand model for the United States is described. The methodology for estimating outdoor recreational demand functions is discussed in the next section. Estimation results and the application of these results to generate estimates of the economic value of outdoor recreation to recreation consumers in the U.S. are then discussed. A summary and conclusions are offered in the final section.

Study Methodology

Background Concepts

There is general agreement among economists that the appropriate measure of the value of outdoor recreation to an individual is consumer's surplus or net economic value (Dwyer, Kelly, & Bowes, 1977; Stoll, Loomis, & Bergstrom 1987; Rosenthal et al. 1986: U.S. Water Resources Council 1983). It is relatively straightforward to estimate consumer's surplus or net economic value from market demand functions. Estimation of the net economic value of outdoor recreation is problematic, however, since many forms of outdoor recreation are not traded in regular economic markets. Hence, some form of nonmarket valuation technique must be used to estimate net economic value. In this study, the demand for and values of outdoor recreation supported by the nation's stock of recreational areas were estimated using the travel cost method (TCM). The TCM is one of two nonmarket valuation techniques recommended by the U.S. Water Resources Council (1983).

There are two basic TMC approaches; the zonal travel cost method (ZTCM), and the individual travel cost method (ITCM). In the ZTCM, recreationists are grouped into origin zones around a site. A demand function for an activity is derived by estimating the statistical relationship between aggregate trips from a zone and the cost of traveling from the zone to the site. In the ITCM, the unit of observation is an individual's total (e.g., annual) consumption of trips. ITCM demand functions are derived by estimating the statistical relationship between an individual's total trips and the distance an individual travels from their residence to a site (Brown & Nawas 1973; Clawson & Knetsch 1966; Gum & Martin 1974; Ward & Loomis 1986).

Several considerations dictate the choice of using the ZTCM or the ITCM. The ZTCM is often selected because of lesser data requirements. Another advantage of the ZTCM is that it adjusts for both probability and frequency of participation using a single equation which can be estimated by ordinary least squares regression. Because it uses individual trips as the unit of observation, the ITCM demand function only considers frequency of participation. Several statistically complex methods have been proposed for adjusting for the probability of participation when estimating ITCM demand equations. The appropriateness of these adjustment procedures is still being debated (Walsh 1986; Ward & Loomis 1986).

The ZTCM is generally less effective than the ITCM for examining the relationships between individual consumer characteristics and recreation trip demand. The efficiency of the ZTCM for examining individual demand behavior is reduced because within-zone variation in individual demand behavior is lost in the aggregation process. The ITCM retains this variation and therefore is a more efficient method for analyzing individual demand behavior (Brown & Nawas 1973; Rosenthal et al. 1986; Ward & Loomis 1986).

The demand analysis conducted for this study provided input into the 1990 Resources Planning Act (RPA) analysis of outdoor recreation conducted by the U.S.D.A. Forest Service. A primary objective of the RPA analysis is to analyze broad, population-level resource use trends and values across the United States. Previous studies have demonstrated the effectiveness of the ZTCM for conducting broad, population-level recreation demand analyses (Sorg & Loomis 1984; Walsh, Johnson, & McKean 1988). Considering the relative strengths of the ZTCM for conducting aggregate demand analysis, the consistency of the ZTCM with broad, RPA analysis objectives, and the fact that this approach was more amenable to available data, the ZTCM was selected for analyzing the general demand for and value of publicly provided outdoor recreation in the United States.

Model Specification

The ZTCM is usually applied only to a specific site. In this case, the demand modeling takes on a "site-specific" perspective where the analyst studies and models trips to that site from various zones around the site. The usual objective of this type of ZTCM analysis is to determine the economic value of the specific site under consideration. A primary motivation for the research reported in this paper was the RPA Assessment of Outdoor Recreation which is concerned with much broader research questions. Such questions include 1) What are the relationships between population characteristics (e.g., age structure) and the demand for outdoor recreation in the nation?, 2) What are the relationships between recreation opportunities and the demand for outdoor recreation in the nation? and 3) What is the total economic value of outdoor recreation in the United States?

In order to address the broad, aggregate research questions asked by the RPA analysis, a "population-specific" perspective where the analyst studies and models trips made by a population or community to all sites seems more appropriate. A "population-specific" perspective on recreation demand analysis can be conceptualized within a household production theory framework. Following household production theory, households in a population or community are viewed as combining recreational resources and facilities with other inputs (e.g., travel) to "produce" desired recreational activity trips (Bockstael & McConnell, 1981). The total amount of activity trips a household can produce (e.g., annual developed camping trips) is dependent on the availability of recreational resources and facilities over all sites, Hence, the dependent variable of interest in a ZTCM demand equation becomes trips taken by a population or community for a recreational activity to all sites used for that activity.

The availability of recreational resources and facilities across all sites represents the *recreational opportunities* available to a population or community. Because of differences in the supply of recreational resources and facilities provided by different sources, recreational opportunities vary across populations or communities in the United States. Populations and communities across the U.S. also vary with respect to socioeconomic characteristics (e.g., age, income). The effects of regional variations in population characteristics and recreational opportunities on outdoor recreation demand in the United States can be accounted for by using a regional zonal TCM (RZTCM) model such as applied by Sorg et al. (1985). The RZTCM also provides a convenient means for estimating the general economic value of outdoor recreation across multiple regions and sites.

In this study, the RZTCM model was specified as:

$$\begin{aligned} LTRIPS_{ij}^{k} = {} & B_o - B_1\, PRICE_{ij}^{k} + B_2\, POP_i + B_3\, SUIT_j^{k} - B_4\, SUBEROS_i^{k} \\ & + B_5\, PCT18TMD_i - B_6\, PCTFARM_i + B_7\, INCOME_i \end{aligned} \tag{1}$$

where,

$LTRIPS_{ij}^{k}$ = natural log of total annual person trips taken from community i to site j for the main purpose of activity k,

$PRICE_{ij}^{k}$ = cost of an activity k trip from community i to site j,

POP_i = total community i population (12 years old and older),

$SUIT_j^{k}$ = suitability or quality of site j for activity k,

$SUBEROS_i^k$ = an index of substitute recreational opportunites available to community i which compete with activity k for recreation time and money,

$PCT18TMD_i$ = percent of community i population age 18 to 32.

$PCTFARM_i$ = percent of community i population living on farms,

$INCOME_i$ = percent of community i population with annual income of at least $30,000.

As shown by Equation 1, total person trips for activity k taken from community i to site j are expected to be influenced by population size, population characteristics, the cost of trips, site quality, and the availability of substitute recreational opportunities. The semi-log functional form for Equation 1 is recommended by previous studies as being most appropriate for TCM demand equations. Advantages of this functional form include theoretical consistency with recreation demand behavior and reduction of heteroskedasticity (Rosenthal et al., 1986; Ward & Loomis 1986; Ziemer et al. 1980).

Data Description

Data for estimating Equation 1 were obtained from the Public Area Recreation Visitors Study (PARVS) and several secondary sources. The Public Area Recreation Visitors Study is an ongoing multi-agency effort to collect data on the use of public areas for outdoor recreation. The major component of the PARVS data collection effort is on-site interviews of recreationists conducted at public recreational areas. The analysis reported in this paper was based on data collected at over 200 sites across the continental U.S. from 1985 to 1987. These sites included National Parks, National Forests, National Rivers, U.S. Army Corps of Engineers and Tennessee Valley Authority reservoirs, and numerous state recreational areas. The total number of interviews conducted between 1985 and 1987 was 32,000. Only 26,000 of these interviews provided complete, usable data for this analysis.

In the on-site PARVS interviews, recreationists were asked to provide information on themselves and their recreation trip patterns. Data were collected on the respondent's personal and household characteristics, the main reason for visiting a site, origin, trip costs (distance and time traveled), and whether the current trip was part of a multiple destination trip. Data were also collected on the respondent's 12-month trip profile. This 12-month trip profile asked respondents to report the total number of trips taken for each of over 50 activities to any sites in the nation during the past 12 months.

PARVS origins were recorded as both county names and zip codes. Recorded origins included almost 80 percent of all counties in the United States. Counties not represented were mostly very sparsely populated counties in the midwest and those comprised primarily of public land located particularly in the west. An extensive weighting process was conducted to adjust the PARVS data to better represent the U.S. population. The PARVS data (e.g., trips) were weighted such that the sample profile across 32 key socioeconomic strata matched the socioeconomic profile in the 1983 National Recreation Survey (NRS). The NRS was designed by the Bureau of Census and weighted to reflect the most current profile of the U.S. population. The NRS therefore provides a reliable base for weighting PARVS individual records so that they proportionately represent the U.S. populations's profile of such variables as number of trips by activity. A detailed description of the Public Area Recreation Visitors Study is provided by Cordell et al. (1987).

In order to have sufficient observations for estimating Equation 1, the United States was divided into 239 multi-county regions. Each of the 239 multi-county regions contained a minimum of 90 observations from the PARVS data set. Each observation represented a recreationist from a particular origin (one of the 239 multi-county regions). A representative county was selected for each multi-county region (generally the geographic or population center). Using the 12-month trip profile reported in the PARVS data, total trips per capita taken from a multi-county region to all sites for each of k activites were estimated. The total trips taken from the representative county for each activity k were then estimated by multiplying trips per capita for the multi-county region where the county was located by the population of the representative county. Following standard TCM procedures, only *single destination* trips taken for the *main purpose* of activity k were included in the analysis. Single destination trips for the main purpose of activity k were determined by responses to questions in the PARVS survey which asked respondents to state the main purpose of their trip to a site, and whether or not the trip they were on involved multiple-destinations.[2]

Unfortunately, the 12-month trip profile questions in the PARVS survey instrument did not ask respondents to report the sites used for outdoor recreational activities. Thus, there was no direct way to derive the total

[2]PARVS interviews were conducted only at federal and state sites. Hence, the PARVS data may not be fully representative of multi-county regions were the use of private and local public sites is large. Because most activities modeled are highly dependent on federal and state sites, the PARVS data is argued to be reasonably representative with respect to sites. Another factor in favor of the PARVS data set is the extremely large sample size. Hence, the data set likely represent users of private and local public sites, even though interviews were conducted only at federal and state sites. This representativeness was verified by analyzing the PARVS data set and observing that a full spectrum of outdoor recreational activities is represented. However, the potential lack of representation may still be the cause for concern with respect to those activities that are highly dependent on private and local public sites (e.g., pool swimming). Another potential concern is that the application of the trips per capita estimate for the multi-county region to the representative county requires that simplifying assumption that trips per capita is uniform throughout the multi-county region. This assumption seems reasonable since within region variation in per capita demand and supply factors is expected to be relatively low.

number of trips taken by community i (defined by representative county i) to site j for activity k (i.e., the dependent variable for the TCM model). To resolve this problem, the 239 representative counties or communities were assumed to generate trips to the 280 destinations in the PARVS sample. An obvious limitation of this assumption is that the PARVS sample likely did not include all sites used by a representative county for a particular outdoor recreational activity.

As mentioned previously, the total number of activity k trips generated by a representative county or community was derived from the PARVS 12 month trip profile (which reported the total number of activity k trips taken to all sites). In order to estimate Equation 1, it was necessary to allocate these activity k trips to the sites used by a representative county or community. For each PARVS site j, the probability that it was visited by community i for activity k was calculated as a function of the distance to the site and the suitability of that site for a particular activity. Site suitability was measured using responses from a site manager survey discussed later.

The probability that a trip for activity k was taken by population i to site j was estimated by the equation:

$$P^k_{ij} = \frac{[(1-(d_{ij}/D^k))*(S^k_j/10)]}{\Sigma_j[(1-d_{ij}/D^k))*S^k_j/10)]} \quad (2)$$

where, P^k_{ij} = probability that community i used site j for activity k
d_{ij} = distance from community i to site j
D^k = average nationwide maximum distance traveled for activity k (95th percentile)
S^k_j = suitability of site j for activity k as measured by a survey of site managers on a scale from 0 to 10, where 0 is not suitable and 10 is perfectly suitable
ΣP^k_{ij} = 1.

Trips taken by community i to site j for activity k were estimated by multiplying Pk_{ij} by the total number of activity k trips taken by community i (derived from the PARVS 12-month trip profile). These allocated trips became the dependent variable for Equation 1. Allocation of origin-generated trips among sites using Equation 2, although reasonable, is not a perfectly acceptable means of determining the dependent variable for Equation 1. In the future, it may be preferable (although perhaps impractical) to directly ask respondents about their total number of trips for a particular activity to each site used for that activity.

As suggested by Walsh (1986), the specification of total trips as the dependent variable in Equation 1 accounts for both the probability and frequency of participation because it is a function of trips per capita. Hence, the problem of excluding nonparticipants completely from the demand analysis is avoided. Exclusion of nonparticipants from the demand analysis is a major problem encountered in applications of the individual travel cost method (Walsh, 1986; Ward & Loomis 1986).

The price variable in Equation 1, $PRICE_{ij}^{k}$, was derived by first calculating the straight-line distance from zone i to site j. The straight-line distance was then converted to driving distance by multiplying it by a circuity factor calculated from the PARVS data set. The circuity factor was calculated by dividing average one-way driving miles reported in the PARVS survey by average straight-line distance traveled between county centroids and sites.

Travel miles were converted to travel costs using a conversion factor which accounted for the costs of operating a medium sized vehicle as reported by the U.S. Department of Transportation, and the opportunity cost of travel time. Travel time was estimated by dividing miles driven (calculated using the straight-line distance and circuity factor) by average nationwide travel speed measured in miles per hour. Average nationwide travel speed was estimated by dividing average nationwide one-way miles driven reported by PARVS respondents by average nationwide one-way travel time reported by PARVS respondents. The opportunity cost of travel time was valued at one-half the wage rate for a county as recommended by Rosenthal et al. (1986)[3]

The suitability or quality variable in Equation 1, $SUIT_{j}^{k}$, was calculated from responses to a survey of the managers of study sites. The PARVS survey instrument did not collect any data on respondents' evaluation of the suitability or quality of recreation sites. In the absence of such information, it was decided to test the feasibility of using site managers' perceptions of site suitability or quality as an explanatory variable for the TCM demand model. Managers of PARVS sites were asked in the survey to rank the suitability of their sites for outdoor recreational activities on a scale from 0 (not suitable at all) to 10 (perfectly suitable). Because of high cooperation in the Public Area Recreation Visitors Study with Federal and state agency personnel, the response rate to the suitability survey was 100 percent.

Previous outdoor recreation demand studies have generally encountered difficulty defining and measuring a conceptually and statistically strong substitute variable. An objective of this study was to develop a comprehensive substitute variable which measures the full spectrum of oudoor recreational opportunities available to a community which may compete with any one activity for total recreation time and expenditures. Such a substitute variable was developed from the National Outdoor Recreation Supply Information System (NORSIS) data set.

The NORSIS data set provides data on the quantity of recreational resources and facilities in the United States at the county level. The data set includes, for example, data on the quantity of public and private camp-

[3]The wage rate for each representative county was calculated by dividing mean per capita income for the county as reported by the 1980 Census by 2,080 (the standard number of working hours per year).

grounds in each county. Using the NORSIS data set, an effective recreational opportunity supply (EROS) index was calculated for each county in the United States. The EROS index uses a distance decay function to define the quantity of recreational opportunities which are "effectively" available to a county. Calculation of the EROS index approximates the methodology first proposed by Clawson (1984). A detailed description of the theory and procedures behind the calculation of the EROS index is provided in other references (Cordell, English, & Bergstrom, 1989).

EROS indices were calculated for each county across the 12 recreational resource and facility categories shown in Table 1. The substitute variable in Equation 1 was then calculated by taking the mean of 11 EROS indices, excluding the EROS index for the category encompassing the activity. For example, developed camping falls into EROS category four, developed lands. The substitute index for developed camping was therefore calculated by taking the mean of all EROS index for developed lands. The resulting substitute index is a comprehensive measure of the spectrum of recreational resources and facilities which a community can use to "produce" recreational activities that are substitutes for developed camping.[4]

Other secondary data sources included the U.S. Bureau of the Census County Data File. This data file was used to derive the socioeconomic variables in Equation 1 (POP_i, $PCT18TMD_i$, $PCTFARM_i$, $INCOME_i$). Data were for the most recent census, 1980.

Results and Implications

Equation 1 was estimated by ordinary least squares for each activity with a sufficient number of observations (arbitrarily selected as 90 observations or more). The same model specification was used for each activity in order to maintain consistency. In many of the demand equations, however, it was necessary to delete the $PCTFARM_i$ variable because of multicollinearity problems. Multicollinearity tests revealed no other collinearity problems.

Demand equations corresponding to Equation 1 were estimated for 37 land, water, and snow and ice based recreational activities. Selected estimated demand equations are shown in Table 2. The full set of estimated demand equations is available from the authors. Adjusted R^2's for the demand equations (with the natural log of activity *k* trips specified as the dependent variable) ranged from .15 to .60, with the majority of of R^2

[4]The "developed land" EROS index is not included in the substitute variable for developed camping because Equation (1) specified that the substitute variable should only reflect opportunities for other activities beside developed camping. However, because the "developed land" EROS index includes more than developed camping opportunities, omitting this index from the substitute variable for developed camping means that opportunities for other developed types of recreation (e.g., picnicking), which may compete with developed camping for recreation time and dollars, are not included in the substitute variable.

TABLE 1
EROS Categories Used to Develop Substitute Variables

EROS Categories
LAND
1. Wilderness, remote backcountry, and extensive roadless areas
2. Extensive undeveloped areas near roads
3. Roaded and partially developed areas
4. Developed lands
WATER
5. Wild and remote waters
6. Lakes and streams near roads
7. Lakes and streams with road access
8. Intensively developed areas
SNOW AND ICE
9. Wildnerness, remote backcountry, and extensive roadless areas
10. Extensive undeveloped areas near roads
11. Roaded and partially developed areas
12. Intensively developed areas

values exceeding .30. The overall F-values for the equations strongly explained recreation trip demand.

Parameter Estimates

The cost variable, $PRICE^{k}_{ij}$, had the expected negative sign and was statistically significant at the .01 level in all 37 estimated equations. The negative sign on the cost variable generates a negatively sloped demand function, which is consistent with economic theory. The $INCOME_i$ variable had an expected positive sign in all equations, and was statistically significant at the .10 level or better in all but four equations (offroad driving, visiting prehistoric sites, photography, and small game hunting).

The age variable, $PCT18TMD_i$, also had an expected positive sign in all but four equations (backpacking, visiting prehistoric sites, anadromous fishing, and cross country skiing). The age variable was statistically significant at the .10 level or better in all but six equations, including all of the equations for which it had a negative sign. Thus, it appears that outdoor recreation demand increases as the percentage of people aged 18 to 32 in a population increases. Historically, this age group has tended to be most actively involved in outdoor recreation. Whether this result will continue to hold as the "baby boom" generation ages is debatable.

The population variable, POP_i, had an expected positive sign and was statistically significant at the .01 level in all equations. Hence, the total population of the region is a strong predictor of the total number of outdoor

TABLE 2

Selected Estimated Demand Equations for Outdoor Recreational Activities in the United States, 1987.#

Resource Category and Activity	Parameter Estimates (Standard Error)										
	INTERCEPT	PRICE$_{ij}$	INC345$_i$	PCT18TMD$_i$	CCPOP86$_i$	PCTFARM$_i$	SUBEROS$_{ik}$	SUIT$_{ik}$	N	F-Value	Adjusted R^2
LAND											
Developed Camping	4.503*	−.018*	.075*	.088*	.0000011*	--	−.026*	.122*	3161	509.337	.49
	(.330)	(.0004)	(.004)	(.014)	(4.43 E-08)		(.005)	(.016)			
Picnicking	4.882*	−.050*	.073*	.136*	.0000014*	--	−.027*	.093*	2883	522.744	.52
	(.400)	(.0011)	(.005)	(.016)	(6.72 E-08)		(.006)	(.016)			
Sightseeing	7.016*	−.018*	.029*	.081*	.00000088*	−.180	−.028*	.204*	4538	954.731	.60
	(.248)	(.0003)	(.003)	(.010)	(3.30 E-08)	(.007)	(.004)	(.010)			
Biking	3.488*	−0.31*	.116*	.123*	.0000013*	--	−.015*	.120*	2998	434.239	.46
	(.386)	(.001)	(.005)	(.017)	(6.20 E-08)		(.006)	(.015)			
Running/Jogging	4.681*	−.135*	.137*	.070	.0000021*	--	−.009	.171*	843	67.158	.32
	(1.100)	(.014)	(.013)	(.047)	(2.46 E-07)		(0.17)	(.047)			
Day Hiking	5.711*	−.039*	.064*	.108*	.0000010*	--	.004	.083*	2656	414.921	.52
	(.395)	(.001)	(.005)	(.016)	(6.86 E-08)		(.006)	(.015)			
Small Game Hunting	7.299*	−0.63*	.011	.071**	.0000010*	--	−.074*	.174*	1144	84.664	.31
	(.786)	(.003)	(.010)	(.034)	(1.35 E-07)		(.012)	(.028)			
Big Game Hunting	5.400*	−.034*	.011***	.116*	.00000071*	--	−.078* −	.276*	1686	268.759	.49
	(.503)	(.001)	(.006)	(.022)	(7.45 E-08)		(.008)	(.017)			
Backpacking	3.237*	−.012*	.106*	−.006	.0000013*	--	−.030*	.279*	2277	191.289	.33
	(.515)	(.001)	(.006)	(.022)	(7.59 E-08)		(.008)	(.018)			
Primitive Camping	3.819*	−.029*	.069*	.072*	.0000012*	--	−.043*	.236*	2946	501.580	.50
	(.344)	(.0007)	(.004)	(.015)	(5.20 E-08)		(.006)	(.013)			
Wildlife Observation	5.622*	−.022*	.051*	.084*	.00000089*	−.166	−.008**	.181*	3940	712.564	.56
	(.269)	(.0004)	(.003)	(.011)	(3.73 E-08)	(.007)	(.004)	(.012)			
WATER											
Motorized Boating	6.280*	−.038*	.061*	.068*	.0000014*	--	−.033*	.155*	1537	176.174	.41
	(.596)	(.002)	(.007)	(.024)	(1.00 E-07)		(.008)	(.019)			
Canoeing/Kayaking	1.285*	−.048*	.087*	.167*	.0000013*	--	−.019*	.250*	2381	455.052	.53
	(.442)	(.001)	(.005)	(.019)	(7.61 E-08)		(.006)	(.016)			
Stream/Lake Swimming	6.100*	−.034*	.057*	.077*	.0000011*	--	−.035*	.183*	2678	521.61	.54
	(.399)	(.0007)	(.005)	(.017)	(5.68 E-08)		(.006)	(.013)			
Warmwater Fishing	7.149*	−.049*	.046*	.038***	.0000013*	--	−.024*	.153*	2290	316.040	.45
	(.477)	(.001)	(.006)	(.021)	(8.71 E-08)		(.009)	(.018)			
Coldwater Fishing	7.625*	−.027*	.028*	.020	.0000013*	--	−0.19*	.261*	1290	132.738	.38
	(.504)	(.002)	(.006)	(.022)	(8.52 E-08)		(.007)	(.018)			
SNOW AND ICE											
Downhill Skiing	7.765*	−.031*	.059**	.135***	.00000037*	−.368*	.001**	--	138	22.706	.49
	(2.43)	(.005)	(.028)	(.083)	(1.80 E-07)	(.081)	(.0005)				
Crosscountry Skiing	1.185	−.034*	.216*	−.130*	.0000015*	--	.002*	.338*	2656	231.917	.34
	(1.08)	(.002)	(.009)	(.033)	(1.27 E-07)		(.002)	(.037)			

*Significant at 0.01 level; ——Significant at 0.05 level; ***Significant at 0.10 level

#The full set of estimated demand equations is available from the authors.

recreational trips taken from that region. The implication is that as the population of regions in the United States grows, the demand for outdoor recreational opportunities will increase as well. The variable measuring percentage of county residents living on farms, $PCTFARM_i$, appeared in seven equations. This variable was statistically significant with an expected negative sign in four equations (visiting historic sites, collecting berries, visiting prehistoric sites, and downhill skiing).

In 29 of the 37 equations, the substitute index ($SUBEROS_i$) had an expected negative sign, and was statistically significant at the .10 level or better in all but five equations (in three of these equations, the substitute variable had an unexpected positive sign). The results imply that as the effective supply of resources and facilities which recreationists can use to produce alternative recreational activities increases, consumption of a particular recreational activity is likely to increase. Thus, the effective supply of recreational opportunities appeared to provide a strong substitute variable for the demand equations. The suitability or quality variable, $SUIT_j^k$, had an expected positive sign in all but one equation (cutting firewood). The suitability variable was also statistically significant in all but two models (cutting firewood and collecting berries). Thus, the suitability variable also appeared to be a strong explanatory variable.

Consumer's Surplus Estimates

The demand function estimates corresponding to Equation 1 for the 37 recreational activities modeled provide an alternative means for estimating standard values for outdoor recreation in the United States. For each activity *k*, Equation 1 was estimated across a nationwide sample of county populations and sites. Hence, consumer's surplus or net economic value derived from the estimate of Equation 1 for activity *k* represents the economic value of an activity *k* trip from a typical county population to a typical (federal or state) recreation site.

Consumers's surplus or net economic value derived from the estimates of Equation 1 are shown in Table 3. Consumer's surplus per trip was derived from the demand equations in Table 2 using standard TCM procedures (Walsh, 1986; Ward & Loomis, 1986). Consumer's surplus per day was calculated by dividing consumer's surplus per trip by average days per trip.[5] Total consumer's surplus in the U.S. was calculated by multiplying

[5]The calculation of consumer's surplus per person per day from the regional zonal travel cost approach involved several implicit assumptions. First, the dependent variable in Equation 1 represents person trips. Thus, estimation of consumer's surplus per person from Equation 1 implicitly assumed that there was only one recreationist per vehicle, or that each recreationist traveling within a group individually derived the estimate of consumer's surplus per day shown in Table 3. No special adjustments were made for children in a vehicle. Second, it is assumed that consumer's surplus per day can be derived simply by dividing consumer's surplus per trip by average days per trip. Both of these assumptions are typically made in TCM studies. Nonetheless, these assumptions are troublesome. Further research is needed to establish more defensible methods for estimating consumer's surplus per person per day from zonal TCM models.

TABLE 3
Net Economic Value of Outdoor Recreation in the U.S., Per Individual and Aggregate, 1987

Resource Category and Activity	Consumer's Surplus Per Trip	Consumer's Surplus Per Day	Total U.S. Trips (million trips)	Total U.S. Days (million days)	Total U.S. Consumer's Surplus (million $)
LAND					
Developed Camping	$54.90	$9.15	60.56	363.36	3324.74
Picnicking	$20.03	$11.85	262.03	442.83	5248.46
Sightseeing	$54.65	$14.23	292.71	1124.00	15996.60
Family Gathering	$42.41	$27.36	74.38	115.29	3154.46
Pleasure Driving	$27.41	$9.65	421.61	1197.37	11556.33
Visiting Historic Sites	$43.20	$21.07	73.09	149.83	3157.49
Attending Special Events	$34.92	$31.18	73.65	82.49	2571.86
Visiting Museums	$44.06	$29.18	9.66	14.59	425.62
Offroad Driving	$22.90	$15.06	80.21	121.92	1836.81
Biking	$31.92	$13.30	114.61	275.06	3658.35
Running/Jogging	$7.37	$2.39	83.70	257.80	616.87
Walking	$36.95	$9.10	266.54	1082.15	9848.65
Cutting Firewood	$31.32	$14.77	30.30	64.24	949.00
Collecting Berries	$41.05	$24.73	19.02	31.57	780.77
Visiting Prehistoric Sites	$38.37	$5.98	16.69	107.15	640.40
Photography	$45.23	$10.54	42.02	180.26	1900.56
Day Hiking	$26.10	$12.31	91.15	193.24	2379.02
Horseback Riding	$21.77	$11.40	63.24	120.79	1376.73
Small Game Hunting	$15.82	$11.98	58.63	78.56	927.53
Big Game Hunting	$28.97	$12.07	55.21	132.50	1599.43
Nature Study	$34.63	$9.78	70.76	250.49	2450.42
Backpacking	$80.48	$25.88	26.01	80.89	2093.28
Primitive Camping	$34.04	$8.24	38.11	157.39	1297.26
Wildlife Observation	$46.11	$12.88	69.51	248.84	3205.11
WATER					
Pool Swimming	$27.47	$15.61	221.02	389.00	6071.42
Motorized Boating	$26.11	$16.32	215.52	351.23	5627.23
Water Skiing	$36.35	$26.92	107.46	145.07	3906.17
Rafting/Tubing	$30.66	$24.14	8.93	11.34	273.79
Canoeing/Kayaking	$20.66	$12.67	39.77	64.82	821.65
Rowing/Other Boating	$42.18	$27.39	61.81	95.19	2607.14
Stream/Lake Swimming	$29.34	$14.82	238.78	472.78	7005.80
Saltwater Fishing	$51.41	$26.50	77.34	150.04	3976.05
Warmwater Fishing	$20.42	$12.53	239.49	390.37	4890.38
Coldwater Fishing	$36.70	$17.82	83.76	172.54	3073.99
Anadramous Fishing	$39.37	$23.57	22.01	36.76	866.53
SNOW AND ICE					
Downhill Skiing	$29.48	$14.81	64.27	127.90	1894.70
Cross Country Skiing	$27.47	$9.57	9.71	27.87	266.73
ALL ACTIVITIES					$122277.33

consumer's surplus per day by total U.S. days for an activity. Days per trip and total U.S. trip estimates were calculated from several data sources. These data sources included the Public Area Recreation Visitors Study, the 1982-83 National Recreation Survey, and the 1985 National Hunting and Fishing Survey.

Consumer's surplus or net economic value per day estimates indicate the welfare impacts on individuals of increased outdoor recreation days. Net economic value per day provides a means for comparing the relative value of outdoor recreation across activities. Net economic value per day ranges from $2.39 for running/jogging to $29.18 for visiting museums. This wide range in values suggests that the welfare (or net economic value) impacts of outdoor recreational activities vary considerably.

Consumer's surplus per day for land-based activities reported in Table 3 are highest ($20-30) for family gatherings, visiting historic sites, attending special events, visiting museums, collecting berries, backpacking, and primitive camping. Land-based activities with moderate consumers's surplus per day estimates ($10-20) include picnicking, sightseeing, horseback riding, small game hunting, big game hunting, and wildlife observation. Relatively low consumer's surplus per day estimates (less than $10) are associated with land-based activities including developed camping, pleasure driving, running/jogging, walking, visiting prehistoric sites, nature study, and primitive camping.

Water based activities with the highest estimated consumer's surplus per day estimates ($20-30) include water skiing, rafting/tubing, rowing/other boating, saltwater fishing, and anadromous fishing. Moderate consumer's surplus per day estimates ($10-20) are associated with water-based activities including pool swimming, motorized boating, canoeing/kayaking, stream/lake swimming, warmwater fishing, and coldwater fishing. Of the snow and ice-based activities, downhill skiing has a moderate consumer's surplus per day estimate ($10-20) and cross country skiing has a relatively low consumer's surplus per day estimate (less than $10).

Comparisons of net economic value per day do not consider the total quantity of outdoor recreational days consumed. The total welfare impacts (or total net economic value) of an outdoor recreational activity with a high average value per day may be relatively low if the total quantity of days consumed is low. The relative values of outdoor recreational activities based on total welfare impacts are indicated by total U.S. consumer's surplus reported in Table 3. Total U.S. consumer's surplus is calculated simply by multiplying consumer's surplus per day (per trip) by the total quantity of U.S. days (trips) per year. The total quantity of U.S. days (trips) per year was estimated by multiplying the number of people in the U.S. who participate in outdoor recreation activity by the mean trips per participant. Total participants and mean trips per participant were estimated from the PARVS data set and secondary data sources including the 1982-83 National Recreation Survey and the 1985 National Hunting and Fishing Survey.

As indicated by the total consumer's surplus numbers in Table 3, the total welfare impacts of outdoor recreation in the United States are substantial. For the land-based activities, total consumer's surplus ranges from $426 million for visiting museums to $16 billion for sightseeing. Total consumer's surplus for water-based activities ranged from $274 million for rafting/tubing to $7 billion for stream/lake swimming. Total consumer's surplus for snow and ice-based activities ranges from $267 million for cross country skiing to $1.9 billion for downhill skiing. The aggregate total consumer's surplus for all activities reported in Table 3 is estimated at approximately $122 billion. In other words, for the U.S., aggregate willingness-to-pay above and beyond current expenditures (or aggregate net economic value) for the outdoor recreational activities listed in Table 3 is estimated at $122 billion annually.

The estimates of total consumer's surplus provide another means for comparing the relative value of outdoor recreational activities in the United States. The land-based resource category contains the three activities with the highest total consumer's surplus; sightseeing ($16 billion), pleasure driving ($11 billion), and walking ($10 billion). The water-based resource category contains two activities with relatively high total consumer's surplus estimates; stream/lake swimming ($7 billion) and pool swimming ($6 billion). Relatively low total consumer's surplus values are associated with visiting museums ($426 million), running/jogging ($617 million), visiting prehistoric sites ($640 million), rafting/tubing ($274 million), and cross country skiing ($267 million).

Towards the Development of General Values

In a recent study, Walsh, Johnson, and McKean (1988) provide a comprehensive review of previous studies which estimated the net economic value of outdoor recreational activities. In order to come up with a general value for an outdoor recreation activity, such as is required by the RPA, it is tempting to average the values reported by previous studies to produce some sort of standard U.S. average value. However, because of differences in user population characteristics, site characteristics, and estimation techniques and assumptions across studies, this practice may be suspect.

A potentially better method for estimating standard values for outdoor recreation, it is argued here, is to estimate general recreation demand models which can be used as value estimator models. That is, general recreation demand model, such as specified in Equation 1, can be estimated across a sample of U.S. communities and sites, as reported in this study. As demonstrated, the general demand equation can then be used to estimate general values associated with a "typical" situation (e.g., trips from a typical community to a typical site). This type of analysis can be conducted on a national level, as reported in this study, or on a smaller regional level.

There are several advantages to estimating general values for an outdoor recreation activity from a single multi-community, multi-site model. First, variations in user population characteristics and site characteristics are accounted for in the demand equation estimation process. Hence, it is possible to use the estimated demand equation to estimate values for a variety of user population and site situations of interest. Second, consistently estimated demand equations are generated for different outdoor recreational activities. In this study, for example, demand equations were estimated for 37 activities using consistent procedures (e.g., model specifications). These consistently estimated demand equations provide a means for comparing the determinants and values of outdoor recreation across activities. Third, estimating a multi-community, multi-site model in a single study is likely to be more expedient and less expensive than the alternative of conducting a series of separate studies site-by-site and(or) community-by-community.

There are also disadvantages to estimating general values for an outdoor recreation activity using a single multi-community, multi-site model. First, it may be very difficult to obtain a representative sample of communities and sites. The Public Area Recreation Visitors Study (PARVS) represents the most extensive multi-community, multi-site outdoor recreation travel data collection efforts to date. The PARVS sample, however, is not entirely representative of communities and recreation sites in the United States. Though the use of weighting procedures based on secondary data sources, it was possible to increase the representativeness of the PARVS data set with respect to user populations. Because of the large sample size, many users of local government and private sites were included in the PARVS data set even though interviews were conducted only at federal and state sites. In future data collection efforts, however, it would be desirable to include local government and private recreational sites.

Another disadvantage of estimating a multi-community, multi-site model is the complexity of econometric estimation procedures. For this reason, a very simple zonal travel cost method was specified for this study. In future studies, more sophisticated estimation procedures should perhaps be explored. In particular, it may be desirable to estimate an individual TCM demand equation which models individual consumption of recreational trips at different sites. It would also be desirable in future studies to test for the sensitivity of valuation results to changes in modeling approaches and estimation techniques.

Most of the studies reported by Walsh, Johnson, and McKean (1988) used a standard single activity, single site TCM modeling approach. In general, the net economic value estimates generated by the multi-community, multi-site model estimated for this study fall within the lower range of values reported by the studies reviewed by Walsh, Johnson, and McKean (1988).[6] It must be kept in mind, however, that the value for an activity

[6]In the PARVS data set, relatively fewer observations were available for downhill skiing as compared to other activities. Hence, value estimates for downhill skiing should be viewed with more caution. More research is needed on the net economic value of snow and ice-based activities, particularly downhill skiing. In general, as compared to the values reported by Walsh, Johnson, and McKean (1988), the values reported in this study appear more conservative.

reported in this study, and the set of values for an activity reported by Walsh, Johnson, and McKean (1988) represent fundamentally different values. The value for an activity reported in this study represents the value of an activity *k* trip to a typical site from a typical community across the United States. The values reported by Walsh, Johnson, and McKean (1988) represent the value of an activity *k* trip to a specific site from a typical community (or individual) in the market area of that site only.

The question might be asked: "Which modeling approach, the multi-community, multi-site approach presented in this paper, or the traditional single-site approach, is the most appropriate?" The two approaches, it is argued here, are designed to answer different questions. The traditional single-site approach is designed to determine the value of outdoor recreational activities at a specific site—and for this purpose, it is most likely the most appropriate approach. For the purpose of estimating general outdoor recreation values over multiple communities and sites across the United States (or some smaller region), a multi-community, multi-site modeling approach such as presented in this paper may be more appropriate. Much more research is needed, however, to verify the appropriateness of multi-community, multi-site TCM modeling approaches.

Summary and Conclusions

The popularity of outdoor recreation continues to grow in the United States (Cordell et al., 1990). As a result, resource management agencies, legislators, and non-government interest groups are becoming more interested in the demand for and value of outdoor recreation. For many efforts, such as the RPA analysis conducted by the U.S.D.A. Forest Service, there is a need to have measures of the general value of outdoor recreational activities across multiple communities and sites. In the past, general outdoor recreation values developed for the RPA have been derived mostly from a composite of values from previous, single-site demand studies.

An alternative method for deriving standard outdoor recreation values is to estimate multi-community, multi-site demand models which can be used as value estimator models. An extensive, national study aimed at estimating multi-community, multi-site demand equations for outdoor recreational activities is described in this paper. Demand equations for 37 recreational activities were estimated across a sample of U.S. counties and recreational sites using a regional zonal travel cost model. These demand equations were used to identify the general determinants of community demand for outdoor recreation in the U.S., and to estimate the economic value of outdoor recreation in the nation.

Several important determinants of the demand for outdoor recreation from U.S. counties (e.g., population groups) were identified. These determinants demonstrated strong positive relationships between outdoor recreation demand and 1) total county population, 2) the percentage of people in a county with an annual income greater than or equal to $30,000, 3) the percentage of people in a county age 18 to 32, and 4) the suitability or quality of sites used by a county for a particular activity. Strong negative relationships were identified between outdoor recreation demand and 1) the cost or price per trip, 2) the percentage of people in a county who live on farms, and 3) the availability of substitute recreational opportunities.

Unique approaches were taken in this study to develop quality and substitute variables with encouraging results. A quality variable was developed from recreation site managers' subjective evaluations of the degree of suitability of their sites for particular outdoor recreational activities. This approach of using "managers perspectives" provides an alternative method for obtaining site quality variables when information on site quality using the typical "users perspective" approach is unavailable.

The substitute variable was developed from indices defining "effective supply" of recreational opportunities available county-by-county (or community-by-community) in the United States. Effective supply, as originally conceptualized by Clawson (1984), combines resource and facility quantity and location with population size and location to define the supply of recreational opportunities which effectively can be used by people to produce recreational activities. The substitute variable developed from the resulting effective supply indices produced a broad measure of alternative recreational opportunities that potentially compete with a particular activity for budgeted recreation time and dollars.

Estimates of consumer's surplus per day suggest that the net economic value of outdoor recreation in the U.S. is substantial. Net economic value per day ranges from a low of $2.39 for running/jogging to a high of $29.18 for visiting museums. These estimates provide consistently derived values for making per unit comparisons of the relative value of outdoor recreation across a wide range of activities. Total U.S. consumer's surplus estimates suggest that the total net economic value of outdoor recreation in the U.S. (e.g., total number of days × value per day) is substantial. Total net economic value ranges from a low of $267 million for cross country skiing to a high of $16 billion for sightseeing. The aggregate total net economic value of outdoor recreation in the U.S., represented by the sum of total net economic value for the 37 activities considered in this study, is approximately $122 billion annually—which is approximately nine times the value of timber harvested nationwide.

The demand equations reported in this paper provide information which is useful for evaluating recreation policies, programs, and resource management alternatives. The demand determinants suggest how changes in the price and quality of recreation, substitute opportunities, and population characteristics affect the quantity of outdoor recreation days demanded in the United States. The consumer's surplus estimates provide a measure of the social welfare impacts of changes in outdoor recreation consumption. Consumer's surplus or net economic value (per day or total) is the appropriate measure of economic value to use in public policy decisions related to economic efficiency and national economic development (Stoll, Loomis, and Bergstrom 1987; U.S. Water Resources Council 1983).

Resource management agencies, legislators, and other interested parties will continue to demand information on the general determinants and value of outdoor recreation in the United States. Thus, there is a need for further research to improve methods for estimating the determinants and values of outdoor recreation over multiple individuals, communities, and sites. Much more research, in particular, is needed to address data collection and modeling problems inherent in multi-community, multi-site demand models. The nationwide multi-community, multi-site demand modeling approach presented in this paper seems to represent an improvement and extension over previous work in this area, much of which was limited by inadequate data. Thus, although subject to a number of its own limitations, the modeling approach presented in this paper is argued to be a useful point of departure for needed future research.

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