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Theory and Techniques for Assessing the Demand and Supply of Outdoor Recreation in the United States

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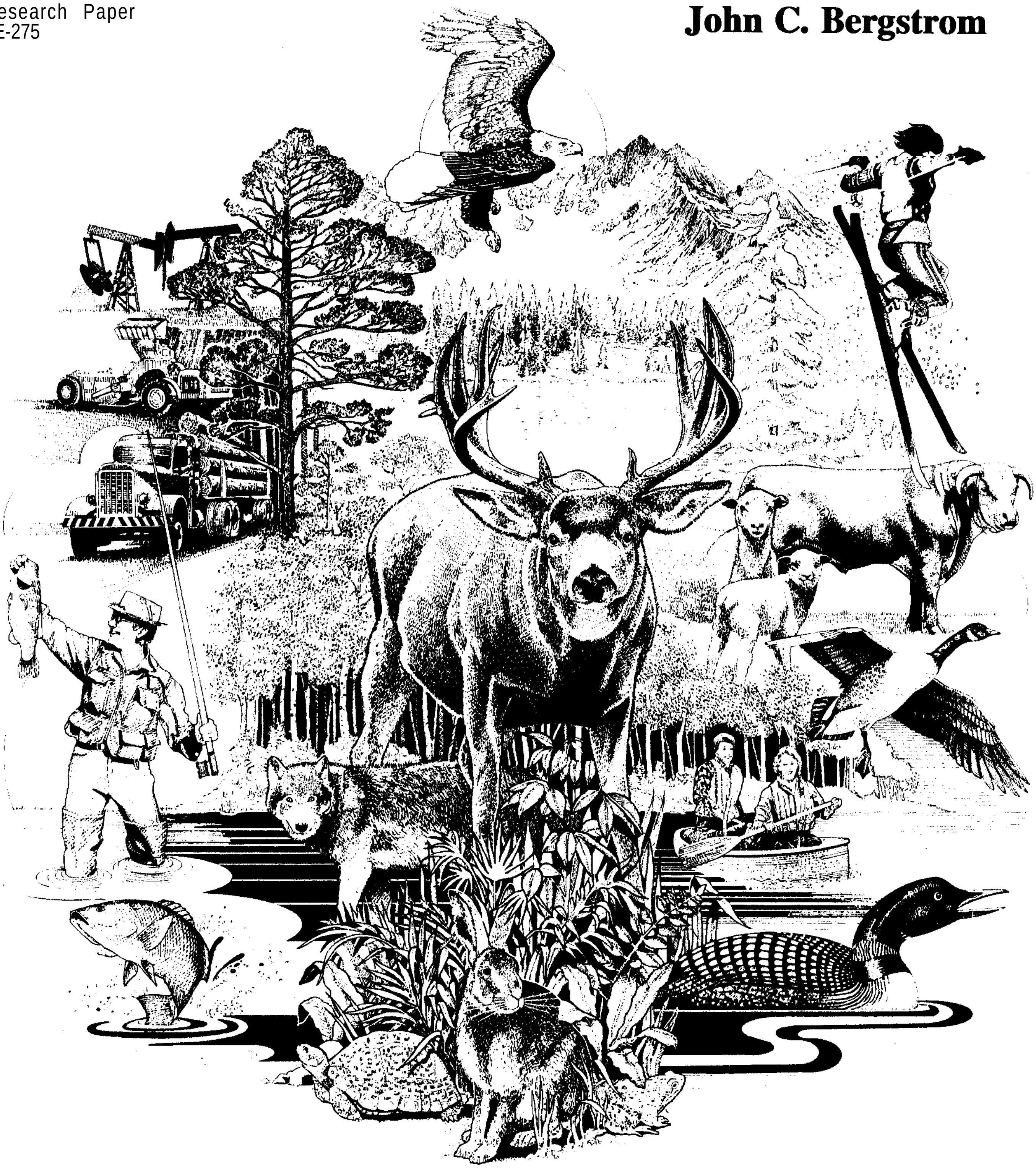

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Abstract

Modeling and estimating consumption, demand, supply, values, scarcity, future equilibria, and price changes have been major challenges in comprehensive recreation assessment and planning. The results of 6 years of work reported in this Paper show research advancements toward meeting these challenges. Accomplished as the central analysis for the 1989 Renewable Resources Planning Act Assessment, a household market model covering 37 recreational activities was computed for the United States. Equilibrium consumption and costs were estimated, as were likely future changes in consumption and costs in response to expected demand growth and alternative development and access policies. Except for consumptive wildlife and fishing activities, most outdoor recreation demand and supply equilibria will grow to much higher levels of consumption in future years. For most activities, aggressive expansion of resource access and site development to provide more recreation opportunities will be necessary if rapid increases of opportunity scarcity are to be avoided.

Keywords: Outdoor recreation, market equilibrium, demand, supply, forecasts, household production theory.

Summary

A conceptual model of outdoor recreation demand, supply, and equilibrium consumption and costs is described in this Paper. This model is based on community-level, household demand and supply functions. The aggregate demand function shows total annual trips for an activity that a community will demand at various trip costs. The aggregate supply curve, based on household production theory, shows total annual trips for an activity that a community can produce at various trip costs, given the existing availability of opportunities or destinations.

Equilibrium trip consumption and costs are defined from a community-level household or consumer perspective. Equilibrium trip consumption refers to the number of trips consumed when aggregate demand and supply are equal. Equilibrium trip costs are the costs or price of a trip where the number of trips demanded by a community is equal to the number of trips available to a community. At the household equilibrium point, the marginal benefits of trip consumption are equal to the marginal costs to households of trip production.

Equilibrium consumption and costs were estimated for several demand/supply scenarios. These scenarios assumed moderate demand growth, combined with either negative, zero, moderate, or high growth of available facilities and resources. For a typical community, equilibrium consumption of most recreational activities was projected to increase under all demand/supply scenarios to the year 2040. Notable exceptions included big-game hunting, small-game hunting, and warm-water fishing. The results, in general, indicate that equilibrium consumption is quite sensitive to changes in recreational facility and resource growth rates.

The interaction of outdoor recreation demand and supply over time is summarized in the form of changes in market equilibrium trip costs. Increases in equilibrium trip costs indicate that demand is increasing faster than supply and that outdoor recreational opportunities are becoming more scarce. Decreases in equilibrium trip costs indicate that supply is increasing faster than demand and that outdoor recreational opportunities are becoming more abundant. Constant equilibrium trip costs indicate that demand and supply are increasing or decreasing at the same rate and that the scarcity of recreational opportunities is remaining about the same over time.

By summarizing the balance between demand and supply, market equilibrium trip costs provide a broad indicator of the relative scarcity of recreational opportunities over space and time. The need for a broad recreation scarcity indicator has also been advocated in the recreation literature (Clawson 1984; Cordell and English 1989; Harrington 1987). Equilibrium trip costs were applied in this Paper to assess the impact of public policy pertaining to recreational facility and resource growth on the provision of recreational opportunities. Results indicate that for most activities, a moderate to high rate of public facility and resource growth will be needed to satisfy future demand and to prevent increases in the relative scarcity of recreational opportunities.

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CONTENTS

The Purpose for This Research

The Renewable Resources Planning Act (RPA) of 1974 requires that the USDA Forest Service comprehensively assess demands for and supplies of forest and range resources at lo-year intervals. The next assessment report will be published for release in 1989. The RPA requires estimates of demand and supply trends for a number of recreational settings, resources, and activities. Previous recreation assessments were limited by inadequate data, theories, and methods. This Paper reports advancements in all three of these dimensions of the assessment process, leading to a capability to model and forecast within a market equilibrium framework. This framework provides a conceptually strong, unique, and comprehensive means for resource assessment consistent with RPA research, planning, and policy thrusts.

The first section provides a discussion of community-level household demand and supply. A conceptual model of household equilibrium consumption and costs for recreational trips is then presented. This conceptual model shows that equilibrium consumption and costs can be estimated from aggregate demand and consumption functions. Empirical estimation of the aggregate demand functions, aggregate consumption functions, equilibrium consumption, and equilibrium costs are then discussed.

Recreational Trip Demand and Supply

Background Considerations

Demand for and supply of outdoor recreation are elusive concepts. Most outdoor recreational activities are provided as public goods, for which the market situation is quite different from that for other forest products. Most other forest products are private goods, like timber. Since market-determined recreational opportunities as conceptualized by classical economics are nonexistent, outdoor recreation demand and supply must be assessed using extra market techniques. Outdoor recreation demand and supply analysis is further complicated by two other problems. Fist, it is difficult to define exactly what is being demanded and how to measure recreation demand. Second, once a demand quantity measure has been selected, defining theoretically appropriate demand and supply curves tends to be very problematic.

For the RPA analysis herein reported, recreational trips were considered to be the most conceptually appropriate measure of quantity consumed (McConnell 1975). A trip is defined as a purposeful commitment of time away from home to travel to a destination(s) for enjoyment of a particular type of recreational opportunity. Measuring the demand for and supply of recreational trips is consistent with the RPA goal of assessing the overall availability of recreational opportunities to the nation, rather than the demand for a particular site or facility by a particular segment of the population. For the latter purpose, a visit or an estimate of the amount of recreation participation time is the appropriate measure. National data on recreational trip consumption were available for this research from the Public Area Recreation Visitors Study (PARVS).

Demand

Recreation demand functions are generally of two types--aggregate or individual. Aggregate demand functions provide the basis for the zonal travel cost method (ZTCM). In the ZTCM approach, as usually applied, recreationists are grouped into zones around a site. Demand curves are derived by estimating the statistical relationship between aggregate trips from a zone and the distance from the zone to the site (Clawson and Knetsch 1966; Dwyer and others 1977; Ward and Loomis 1986).

A major criticism of the ZTCM is the loss of detail on recreation demand behavior which results from aggregating individuals and trips within zones. A method developed for retaining detailed information is the individual travel cost method (ITCM) in which the unit of observation is an individual's consumption of trips. ITCM demand curves are derived by estimating the statistical relationship between an individual's trips and the distance traveled from residence to recreational site (Brown and Nawas 1973; Gum and Martin 1975; Ward and Loomis 1986).

The choice between ZTCM or the ITCM is dependent on several considerations. For one, the ZTCM is often selected because less data are required. A further advantage is that it adjusts for both probability and frequency of participation using a single equation that can be estimated by ordinary least squares. Several more complex statistical procedures have been developed as adjustments for both the probability and frequency of participation when the ITCM is chosen. Much debate remains, however, over the appropriateness of these adjustments (Walsh 1986; Ward and Loomis 1986).

There are also several perceived disadvantages of the ZTCM which have led to increased use of the ITCM in recent years. First, when aggregation is selected as the appropriate analysis objective, there is difficulty in reconciling its results with utility theoretic models of individual choice. Also, the ZTCM assumes that individual characteristics and participation rates are constant within zones. These assumptions probably are not realistic (Bockstael and McConnell 1981). Also, the ZTCM eliminates within-zone variation in socioeconomic characteristics and trip consumption behavior. Hence, it may be difficult to estimate statistically significant relationships between individual socioeconomic variables and the quantity of trips consumed (Brown and Nawas 1973; Rosenthal 1985; Ward and Loomis 1986).

In general, if the objective of an analysis is to explain individual consumption behavior, the ITCM is likely to be more appropriate and efficient than the ZTCM. By focusing on individual observations, the ITCM approach allows for more statistically robust and theoretically consistent analyses of individual recreation consumption behavior. The primary disadvantages of the ITCM are large data requirements and complicated estimation procedures (Ward and Loomis 1986).

Although consideration of the relationships between individual socioeconomic characteristics and consumption behavior is important, the primary objective of the RPA Assessment, for which this research was done, is to analyze aggregate relationships and trends in national outdoor recreation demand and supply. Estimation of aggregate demand and consumption functions using the ZTCM is appropriate to this overall objective. An additional consideration used to select ZTCM as the more appropriate modeling procedure was that the data collected for the RPA assessment through PARVS are more compatible with an aggregate model. A final consideration was that statistical implementation procedures, particularly with respect to adjustments for probability of participation, are well established in the ZTCM. The ZTCM has been successfully employed in hundreds of applications over the last three decades (Walsh 1986; Ward and Loomis 1986).

For the RPA Assessment, it was necessary to modify the classical ZTCM to account for regional recreational opportunities. This modification was accomplished with a region-based **zonal** travel cost method for multiple destination opportunities (RZTCM) (Sorg and others 1985). RZTCM is designed to model trips for an activity from a zone to all sites used by the population in that zone. For the RPA Assessment, zones were defined as counties, each assumed to be a homogeneous community. The modeling task was therefore to develop aggregate demand and consumption functions for trips to all sites used by a county population for a particular activity.

Community-level (county) recreation trip-consumption behavior is influenced by trip costs, community population characteristics, and the availability and diversity of suitable recreational opportunities. Community characteristics, such as the percentage of households of middle-income status, affect the proportion of the community population that participates (analogous to probability) and the frequency of consumption of outdoor recreational trips. Availability of suitable recreational opportunities throughout the region determines the cost of recreational trips and the quantity of substitutes. Trip costs and substitutes affect not only the frequency of participation but also the probability of participation. Community-level recreation demand behavior was modeled for the RPA Assessment with the following specification:

$$ATRIPS^D = f(P, S, SO, Z, H)\ , \qquad (1)$$

where

$ATRIPS^D$ = annual trips demanded for activity k by a community,
P = cost or price of trips for activity k,
S = suitability of sites used for activity k,
SO = substitute recreation opportunities available to a community,
Z = community population 12 years old and older,
H = community characteristics.

Figure 1 illustrates a community-level demand function for trips for activity k. This demand function holds site suitability (a crude measure of quality), substitute recreational opportunities, county population size, and county population characteristics constant. Thus, it shows the total number of trips a community will demand at various trip costs. For example, at a cost of $60 per trip, 100,000 trips are demanded. Trip costs include both out-of-pocket travel expenditures and the opportunity cost of time used for travel for a two-way trip.

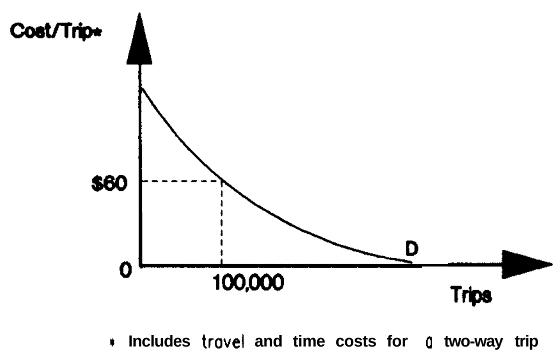


Figure 1-Activity k aggregate demand curve for a typical community.

Supply

Outdoor recreation trips cannot be purchased as most goods can at a local shopping center. Rather, trips must be "produced," a process carried out by the recreationists themselves. Recreationists for example, may combine gasoline, time, equipment, supplies, and recreational facilities to produce a trip for the activity of hiking. The conceptualization of recreationists as producers of trips is derived from household production theory (Becker 1965; Bockstael and McConnell 1981).

As travel distance or time is increased, more recreational opportunities are available to a community and the number of trips which can be produced or supplied increases. The number of trips that can be produced at a given trip cost is determined by the availability of recreational opportunities; knowledge, skills, and abilities (KSAs) of households in the community; and technology available to households, such as light-weight backpacking gear. In the absence of measures of KSAs, household characteristics are used as proxies. Trip production was modeled for the RPA Assessment with an aggregate household supply function conceptually specified as:

$$ATRIPS^S = h(P, RO_k, H) \ , \qquad (2)$$

where

$ATRIPS^S$ = annual number of trips supplied for activity k by a community,
P = cost or price of trips for activity k,
RO_k = recreational opportunities available to a community for activity k,
H = household characteristics affecting trip production technology.

Equation (2) is a modified version of Bockstael and McConnell's supply or marginal cost function for wildlife recreation which focused on trip production by individuals. In contrast to Bockstael and McConnell's models, equation (2) focuses on total annual trip production by a community and is more general in that it applies to many other activities, in addition to wildlife recreation. This community production perspective is consistent with the conceptual analysis of aggregate outdoor recreation supply conducted by Harrington (1987). Equation (2) describes trip supply for a given time period (e.g., 1 year), during which P and RO_k are assumed to be exogenous variables.

In equation (2), recreational opportunities (RO_k) refer to specific sites and facilities. Amount and location of these recreational opportunities are fixed in the short run. This fixed amount and location of recreational opportunities are expressed conceptually by the equation:

$$RO_k = (LMC_k, B, M) \ , \qquad (3)$$

where

LMC_k = long-run marginal costs of providing recreational sites used as inputs for activity k, as provided by public and private resource managers,
B = annual recreation budget available to resource managers,
M = current management policies.

Equation (3) implies that availability of recreational opportunities is determined by the costs of providing recreational sites (such as expenditures on new public facilities), an exogenously determined budget (such as congressional appropriations), and current attitudes and policies (such as attitudes and policies regarding new land acquisitions) (Hof and Kaiser 1983). The variable, RO_k , is an important variable. A change in public management policies, for example, may change RO,. A change in RO_k , in turn, will impact the ability of a community to produce recreational trips through equation (2).

Aggregate household supply functions for activity k are illustrated by the curves labeled S_1 and S_2 in figure 2. Each curve represents a different fixed amount of recreational opportunities for activity k. The curve labeled St indicates that at an average trip cost of $60, a hypothetical community can produce 75,000 trips. Suppose a change in government management policies increases the availability of recreational opportunities, RO_k. This increase will cause the aggregate household supply curve to shift from St to S_2. Given S,, a typical community can now produce 150,000 trips at an average trip cost of $60.

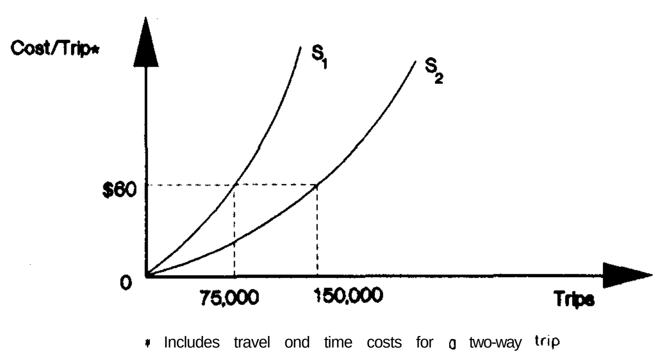
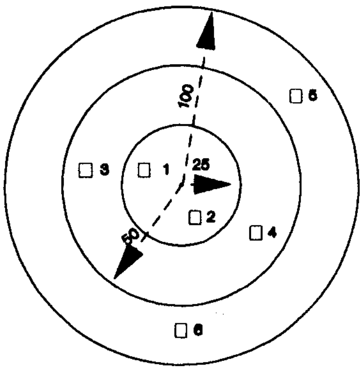
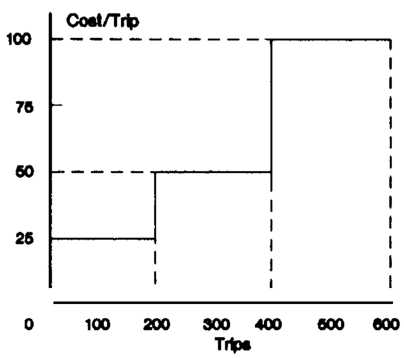


Figure 2-Activity k aggregate supply curves for hvo levels of available opportunities for a typical community.

Derivation of an aggregate household supply curve is demonstrated further by the diagrams in **figure** 3. The black dot in the center of figure **3a** represents the location of a community surrounded by six recreational sites represented by squares numbered l-6. Each site is assumed to have the capacity to accommodate 100 trips per year for activity k. In order to produce more trips than those which the closest site can accommodate, community residents must travel to sites farther away. If residents travel up to 25 miles, they can produce a total of 200 trips annually (100 trips each to sites 1 and 2). If residents travel up to 50 miles, they are able to produce a total of 400 trips annually (100 trips each to sites 1, 2, 3, and 4). At distances up to 100 miles, residents can produce a total of 600 trips annually (100 trips each to sites 1, 2, 3, 4, 5, and 6).



(a)



(b)

Figure 3-Derivation of activity k aggregate supply curve for a typical community.

The numbers of trips that can be produced at various distances by the community, shown in figure **3a,** are indicated by the staircase-shaped aggregate supply curve in figure 3b. Figure 3b assumes, for convenience, that each additional mile of travel costs exactly one more dollar. This "staircase" supply function assumes that the community first exhausts capacity at closer sites before traveling to more distant sites. If a large number of sites were located at continuous distances from the community, the staircase-shaped curve in figure 3b would become the smooth, upward sloping aggregate supply curve shown in figure 2. Changes in the number, capacity, or location of sites shift the aggregate supply function. For example, if additional sites were provided between 25 and 100 miles of the community shown in figure **3a,** the aggregate supply curve would shift to the right, such as from S_1 to S_2 in figure 2. Conversely, if sites or site capacity were reduced between 25 and 100 miles of the community, shown in figure **3a,** the aggregate supply curve would shift to the left, such as from S_2 to St in figure 2.

Household Market for Recreational Trips

Trip Consumption

In the context of the Bockstael and McConnell (1981) household production model, equilibrium consumption and costs are defined by the household market demand and supply curves illustrated in figure 4.

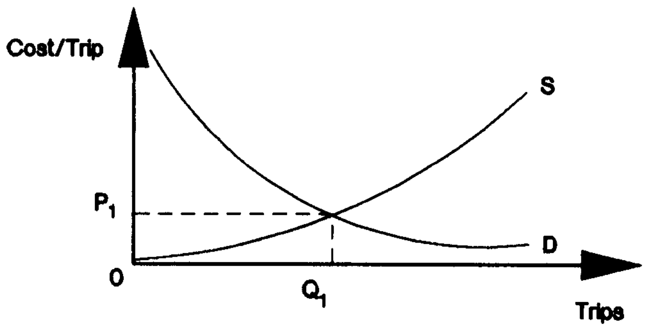


Figure **4--Community-level** household market for activity k trips.

As indicated by the demand curve, at a cost of P_1 per trip, households in the community desire and **will** consume Q_1 trips. As indicated by the aggregate supply curve, at a cost of P_1 per trip, households in the community are able to produce Q_1 trips. Thus, the quantity of trips households in a community would like to consume is equal to the quantity of trips they can produce. From the community's perspective, aggregate demand and supply are in equilibrium. At the equilibrium number of trips, the marginal costs to the community of producing trips are equal to the marginal benefits to them of consuming trips. This equilibrium is in the nature of a general equilibrium as the aggregate demand and supply curves account for overall recreational opportunities across multiple sites.

The intersection of these aggregate demand and supply curves defines the current number of activity k trips consumed, Q_1, and the cost of these trips, P_1 and represents a community-level household market equilibrium.

The existence of a household market equilibrium assumes that the community is not restricted to producing and consuming trips only at local sites. Restriction to local sites would be the case, for example, if the community were on an island and all feasible recreational sites were located on that island. In this island situation, the aggregate trip supply curve would be truncated at the point corresponding to the maximum capacity of sites at any one time. At maximum capacity, the aggregate supply curve effectively turns vertical, indicating that no more trips can be produced using the existing stock of sites (Cicchetti 1973; Loomis and Hof **1985).** This situation is illustrated in figure 5.

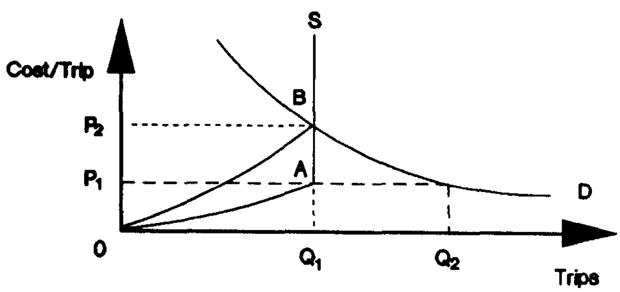


Figure S-Community-level household market for activity k trips (alternative case) with truncated aggregate supply function.

If the aggregate demand curve intersects the effective aggregate supply curve in this vertical segment (point B in figure 5) and if negligible congestion costs are assumed, a household market disequilibrium results. Because of capacity constraints, trip consumption is rationed at Q_1 trips. The marginal cost of producing these trips is equal to P_1 per trip. Given the aggregate demand curve in figure 5 and a marginal cost of P_1 per trip, community households would desire to consume Q_2 trips. Thus, there is a shortage of trips equal to Q_2-Q_1.

The limited number of trips denoted by Q_1 are usually rationed by **nonprice** mechanisms (such as first come, **first** served or reservations). If trip costs were increased to P_2, however, the limited number of trips would be rationed by the cost or price of a trip. One way of increasing trip costs to P_2 is to charge an entrance fee equal to P_2-P_1 per trip. This fee would shift the effective aggregate supply curve from OAS to OBS, and result in a new household market equilibrium at point B in figure 5.

In the more common case where a community is not on an island, local site capacity does not restrict consumable trips to effectively truncate the aggregate supply curve. While it is assumed that local site capacity is used up first, recreationists are free to move into other regions to seek other destinations until the point is reached where the marginal benefits and costs of additional trips produced and consumed are equal. The number of trips consumed is illustrated by the household market equilibrium in figure 4. If the cost of producing more trips using more distant sites increases rapidly, the household market equilibrium may occur at relatively few trips and high costs per trip.

Consumption Trend Lines

A further objective of the RPA Assessment is to compare demand and supply of recreational opportunities at future times. Comparisons over time are made using consumption trend lines. The total number of trips consumed by a community is determined by the intersection of the aggregate demand curve shown in equation (1) and figure 1 and the aggregate supply curve in equation (2) and figure 2. This intersection, illustrated in figure 5, represents the solution to the simultaneous equation system given by equations (1) and (2). The solution to this demand/supply simultaneous equation system can be estimated from the reduced form of the system:

$$ATRIPS = g\,(SO, Z, S, RO_k,H)\ , \qquad (4)$$

where

ATRIPS = annual number of trips for activity k consumed by a community.

The derivation of a consumption trend line is illustrated graphically in figure 6. In panel (a) of figure 6, the base level of consumption at a defined point in time is shown by the intersection point a on the vertical axis, Q_1 trips. Point a corresponds to the household market equilibrium point A in panel **(b).** At point A, Q_1 trips are consumed at costs of P_1 per trip.

Assume next that by the year **2000,** demand for trips is expected to increase from D to D_1 in panel (b). Given this new demand curve, the community will desire to consume Q_2 trips at the current trip costs of P,. Consumption level Q_2 is referred to as "preferred demand." Preferred demand is defined generally as the number of outdoor recreational trips a community would take if the cost or price of a trip remained what it is today. Preferred demand in 2000 is represented by point B in panel (b), which corresponds to point b on the line labeled L_1 in panel (a). Given the aggregate trip supply function labeled S in panel (b), however, only Q_1 trips can be produced and consumed at a cost of P_1 per trip. This constant level of trips over time is represented by point A in panel (b), which corresponds to point e on the line labeled La in panel (a).

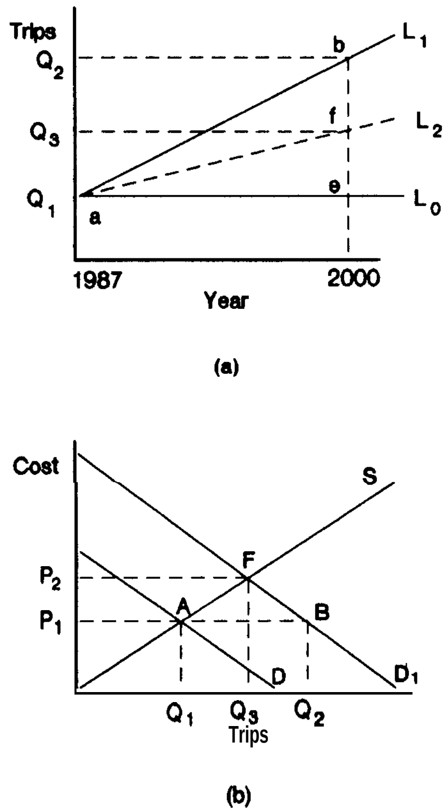


Figure 6-Conceptual derivation of consumption trend lines.

In an effort to reach a household market equilibrium, it is assumed that recreationists will incur increased costs to produce more trips. These trips will be produced along the aggregate supply curve in figure 6, panel (b). Increased trip production, for instance, may involve travel to more distant sites and increased time spent searching for available facilities at more local sites. Increased trip production will continue until the marginal benefits and costs of trip production and consumption are equal at point F in panel (b). At this household market equilibrium, Q_3 trips are consumed at costs equal to P_2 per trip. Point F in panel (b) corresponds to point f on the line labeled L_3 in panel (a).

In a household market for recreational trips, it is assumed that temporary trip shortages caused by increases in demand but no increase of sites and facilities will be eliminated by increased trip production with an associated increase in trip costs as more distant sites are accessed. The number of trips consumed after trip production and demand have equilibrated at higher trip costs is mapped out by the line labeled L_2 in figure 6. L_2 is an example of a consumption trend line showmg the number of recreational trips consumed over time with community-level household market for trips adjusting to new equilibria at every future point in time. Notice that there is still a gap between preferred demand mapped by L_1 and expected trip production and consumption mapped by L_2. This gap is given by the distance $Q_2 - Q_3$ in figure 6b and the distance b-f in figure 6a.

Consumption Trend Lines Under Alternative Scenarios

Consumption trend lines under three alternative supply scenarios are shown in panel (a) of figure 7. The relationship of these consumption trend lines to the community-level household market for trips is illustrated in panel (b) of figure 7. The base year level of trips (1987 for RPA) is given by point b in panel (a), Q_1 trips. Point b in panel (a) corresponds to point B in panel (b). At point B, Q_1 trips are consumed at costs or price equal to P_1 per trip. Suppose demand for trips is expected to increase by the year 2000 from D to D_1 in panel (b). Also, assume that available recreational facilities and resources (RO) will be held constant. Under this assumption, the aggregate supply curve for trips is given by the curve labeled S_1 in panel (b). With this aggregate supply curve and the new aggregate demand curve given by D,, the community will establish a new household market equilibrium at point E in panel (b). At point E, Q_2 trips are consumed at trip costs or price equal to P,. Point E in panel (b) corresponds to point e on the consumption trend line labeled C_1 in panel (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 available to the public are also increased, from RO, to RO_2, causing the aggregate supply curve to shii out from S_1 to S_2 in panel (b). Given these new demand and supply curves, the community will establish a new household market equilibrium at point F in panel (b). At point F, Q_3 trips are consumed at trip costs equal to P_3. Point F in panel (b) corresponds to point f on the higher consumption trend line labeled C_2 in panel (a).

Finally, assume once more that demand will shift from D to D_1 by the year 2000. Suppose, however, that recreational facilities and resources will be reduced from RO, to RO_3 causing the aggregate supply curve to shift from S_1 to S_3 in panel (b). Given these new demand and supply curves, the community will establish a new household market equilibrium at point G in panel (b). At point G, Q_4 trips are consumed at trip costs equal to P_4. Point G in panel (b) corresponds to point g on the lower consumption trend line labeled C_3 in panel (a).

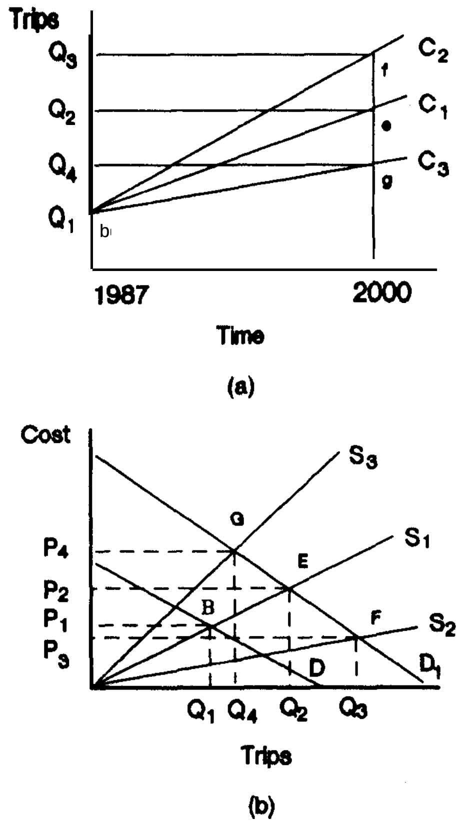


Figure 7--Consumption trend lines under alternative demand/supply scenarios.

As illustrated in figure 7, different demand or supply assumptions will result in diierent consumption trend lines. These lines can be used to demonstrate the impact of alternative policies affecting the amount of available recreational facilities and resources. For example, given an expected increase in demand from D to D,, the consumption trend lines in panel (b) of figure 7 illustrate the impact on trip consumption and costs of three alternative supply scenarios. Consumption trend line C_1 shows trip consumption and costs, assuming that RO quantity of recreational facilities and resources are available through the year 2000. Consumption trend line C_2 shows trip consumption and costs at a relatively higher quantity of recreational facilities and resources, RO,. Consumption trend line C_3 shows trip consumption and costs at a lower quantity of recreational facilities and resources, RO_3, available without change through 2000.

Equilibrium Trip Costs or Price

Changes in equilibrium trip costs or price determined by the household market indicate the relationship between changes in recreational demand and supply over time. Assume that the consumption trend lines shown in figure 7 are derived from equation (4), the consumption function for trips for activity k. Using this consumption function, it is estimated that under a scenario of increased demand from D to D_1 and quantity RO_1 of recreational facilities and resources, consumption of trips for activity k will increase from Q_1 in the base year to Q_2 in the year 2000. Q_2 trips are indicated by point e on consumption trend line C_1 in panel (a) of figure 7.

Point e in panel (a) of figure 7 corresponds to household market equilibrium point E in panel (b) of figure 7. Hence, the household market trip costs or price associated with Q_2 trips are determined by substituting Q_2 trips into the demand function for year 2000, derived from equation (1), and then solving for trip costs. The solution is trip costs equal to P_2. Under a scenario of increased demand and a stable quantity of recreational facilities and resources into the future of RO_1, household market trip costs or price would increase from P_1 to P_2

Another possibility is that demand will increase, but that recreational facilities and resources will be less in the future. Under this scenario, consumption of trips for activity k will increase to Q_4 as shown in panel (b) of figure 7. Q_4 trips is indicated by point g on consumption trend line C_3 in panel (a) and the household market equilibrium point G in panel (b). The equilibrium trip costs associated with Q_4 are estimated by substituting this quantity of trips into the demand function for the year 2000 and solving for trip costs. The solution is trip costs equal to P_4. Thus, if demand increases and available recreational facilities and resources decrease to quantity RO_3 in the future, market trip costs will increase sharply from P_1 to P_4.

Next, assume that it is estimated from the consumption function that increased demand and a higher quantity of recreational resources and facilities will result in increased consumption of trips for activity k to Q_3 in the year 2000. Q_3 number of trips is indicated by point f on consumption trend line C_2 in panel (a) of figure 7, and the household equilibrium point F in panel (b). Household market trip costs associated with Q_3 would, therefore, be estimated by substituting Q_3 into the year 2000 demand function and solving for trip costs. The solution is market trip costs equal to P_3. Thus, if future recreational facilities and resources were increased to a higher level, household market trip costs would be expected to decrease from P_1 to P_3.

Over several future points in time, an increase in equilibrium trip costs suggests that demand is increasing faster than supply. A decrease in equilibrium trip costs suggests that supply is increasing faster than demand. Constant equilibrium trip costs over time indicate that demand and supply are increasing or decreasing at the same rate, or that neither is changing. Thus, changes in equilibrium trip costs provide a convenient means for summarizing the relationships between changes in recreational demand and supply over time and provide a measure of adequacy of trends in making resources, facilities and services available for public recreational uses.

Empirical Approach

To carry out a national analysis of the magnitude implied by the preceding model, and to meet the RPA Assessment mandate, extensive data and analysis were needed to describe the factors identified in the demand, supply, and consumption equations. The principal source of the data on number of trips, trip costs, and consumer characteristics was the Public Area Recreation Visitors Study, PARVS. The National Outdoor Recreation Supply Information System, NORSIS, provided data on resources and facilities available for production of recreational trips. These two national data sets were each aggregated. to the community (county) level for this analysis, and a sample of 239 representative counties was used to construct cross-sectional models.

Trip Consumption and Cost Data

The PARVS data set was developed through a cooperative effort of 17 State and Federal agencies from the summer of 1985 through the fall and winter of 1987. These data were assumed to be homogeneous across time with respect to equilibrium levels of consumption, and therefore were assumed to represent consumption during a single year, 1987. PARVS trip consumption data were developed through onsite interviews of visitors at over 280 recreation sites across the country. The total number of interviews conducted during the above period was over 32,000, nearly 26,000 of which were usable for this analysis, having neither recording errors nor missing values for questionnaire items needed for modeling.

The PARVS questionnaire contains data identifying the recreational activity that was the main reason for visiting the destination site, location of origin, trip costs (distance and time), profile of number of trips by activity taken during the last 12 months prior to the interview (including the current trip), and the respondent's household characteristics. Origins were recorded as both county name and Zip Code, thus enabling identification of place of residence. From this identification, a map plotting of Zip Codes and longitude/latitudes indicated that respondents represented almost 80 percent of the counties in the country. Counties not represented were mostly the very sparsely populated ones in the Midwest and several others which were mostly composed of public land, primarily in the West.

The principal dependent variable for empirical estimation of demand and consumption models was annual number of trips by residents in the 239 representative counties. Computation of total trips by residents of these counties was accomplished by weighting each respondent's reported trips, costs, and characteristics such that the percentages of respondents across 32 socioeconomic strata (representing age, race, gender, and rural-urban residence) were proportionately adjusted to match the socioeconomic makeup of participant respondents to 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 United States population and thus could serve as a base for weighting the PARVS data. Thus the PARVS records, each representing individual-level trips, were weighted to proportionately represent the U.S. population's profile of trips by activity. These weighted individual trip totals were then aggregated to the community (county) level and multiplied by the ratio of number of participants in outdoor recreation in the community to the weighted number of PARVS respondents in the community. This same weighting, and as appropriate, extrapolations, were performed for all variables in the PARVS data set.

Trip costs, described in more detail later, were developed by combining transportation costs to travel the distances adjusted to reflect route circuity from each origin to each destination with the wage value of travel time. The total number of origin-by-destination combinations with relevant travel distances for the activities considered was over 7,200. Relevant travel distances were computed across reported single destination trips as the distance at the 95th percentile, separately developed for each activity. All sites on which PARVS interviewing had been conducted and which lay within these relevant-travel-distance radii composed the set of representative trip destinations for people living in the 239 representative origins (communities equivalent to counties). Trips and trip costs between this set of representative origins and destinations formed the consumption and price observations for this analysis.

Defining the Representative Communities

Respondents to the PARVS survey represented **almost** 80 percent of the counties in the United States, except for those which are very sparsely populated. Subregions within the four major assessment regions (North, South, Rocky Mountains, and Pacific Coast) were identified by combining counties with similar rural-urban proportions and physiographic characteristics and lying adjacent to one another. To assure sufficiency in number of PARVS respondents per subregion, counties with PARVS respondents were added until a minimum of 90 respondents was achieved. These subregions, therefore, did not overlap, and counties within them were combined in such a manner as to result in a block or circle of adjacent counties, rather than a strip or band. Selection of **90** as the minimum number of respondents was based on a preliminary analysis to identify the minimum sample size needed to achieve reasonable stability of standard deviations about trip consumption and travel means. Within each of the 239 thusly defined subregions (excluding Alaska and Hawaii), the one county nearest the center which had a high percentage of the subregion's respondents was selected as the single origin to represent the subregion. All respondents, trip consumption, and travel were assumed to originate from this central county (community). The maps in figure 8 show the locations of these representative communities. All data aggregations and descriptions of resident populations used in this study pertain to these 239 counties.

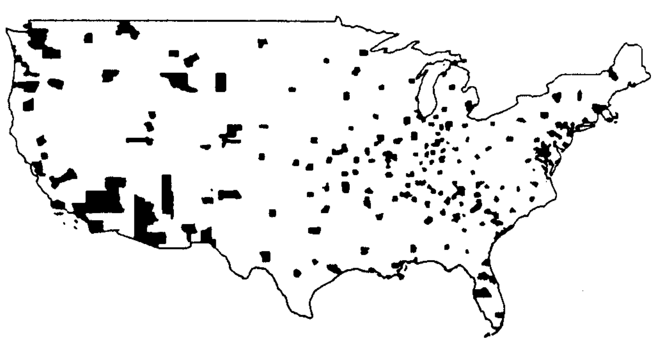


Figure &Location of the 239 representative communities (counties) used estimating national models.

Resource and Facility Data

The NORSIS data set includes primary- and **secondary-**source data describing over 400 different dimensions of public and private areas, facilities, and services available for or servicing public recreational uses. **Secondary-**source data ranged in vintage from 1982 to 1987, always using the most recent available source. Primary data were collected in 1986 and included national studies of private lands and municipal and county governments. The coverage of the NORSIS data set included wilderness and other remote wild lands to the most highly developed and accessible of resorts, theme parks, and high-visitation facilities, including urban parks.

The NORSIS, aggregated at the county level and representing all counties in the United States, provided data describing opportunities directly relevant to the activities modeled in this research, as well as an index of substitute opportunities. An example of direct opportunities includes Federal, State, local, and private camping sites. The substitute indices were computed using approximately the method proposed by **Clawson** (1984) and described by Cordell and others (in press). These substitute indices measured comprehensively the magnitude of "other" opportunities available within a distance that community residents were willing to travel, adjusted to reflect (1) how many other people were competing for use of these opportunities and (2) how distant they were from the community's geographic center. This distance was adjusted with a straight-line distance-decay function to down weight the more distant opportunities (Cordell and others, in press).

Other Data

Data describing household characteristics for each of the 239 representative communities were obtained from the Bureau of the Census County Data File. These data reflected the most recent census, 1980. Measures of the recreational suitabilities of each destination site were obtained through a survey of site managers, including State and national parks, reservoirs, State and national forests, and wildlife management areas. Suitabilities for each of 16 recreational activity categories were scored on a scale of 0 to 10 by each manager for their own site. In developing models for any one activity, sites rated as not suitable were excluded as destinations; for example, a State forest with no reservoir or river was rated at zero suitability for water-skiing.

Organization of the Data

All data were organized around the 239 representative U.S. communities. Trips were aggregated to express countywide totals of trips for each of the 37 activities for which there was a sufficient number of respondents interviewed at PARVS sample sites to provide statistically reliable estimates of distance and time of travel. Activity specific recreational opportunities and substitute opportunities for these communities represented the full set of opportunities **within** relevant travel radii of each community centroid, typically including,adjacent, and sometimes quite distant, other counties.

The resulting **final** data set provided a 239 by 310 matrix of data values. Each community was identified by the Federal Information Processing Standards (FIPS) code and longitude and latitude of its centroid. All data were triple checked for accuracy of entry.

Demand Curve Estimation

Trips for activity k are expected to vary across communities because of differences in costs of producing trips; in availabilities of opportunities; in suitabilities of available, directly relevant sites; in population size; and in demographic and socioeconomic characteristics. The relationships between each of these variables and trips for activity k were estimated by the general model:

$$\mathbf{TRIPS_{kij}} = \exp\,(\mathbf{B_0} - \mathbf{B_1}\,\mathrm{PRICE}_{kij} + \mathbf{B_2}\,\mathbf{INC345_i} + \mathbf{B_3}\,\mathbf{PCT18TMD_i} + \mathbf{B_4}\,\mathbf{CCPOP86_i} - \mathbf{B_5}\,\mathbf{PCTFARM_i} - \mathbf{B_6}\,\mathbf{SUBEROS_{ki}} + B_7\,\mathbf{SUIT_{kij}}), \quad (5)$$

where

$\mathbf{TRIPS_{kij}}$ = annual trips for activity k demanded from community i to site j,

$\mathbf{PRICE_{kij}}$ = cost of trips for activity k from community i to site j,

$\mathbf{INC345_i}$ = percent of community i population with annual income of at least $30,000,

$\mathbf{PCT18TMD_i}$ = percent of community i population age 18 to 32,

$\mathbf{CCPOP86_i}$ = total community i population (12 years old and older),

$\mathbf{PCTFARM_i}$ = percent of community i population living on farms,

$\mathbf{SUBEROS_{ki}}$ = an index of substitute recreational opportunities available to community i and which compete with activity k for available household time and money,

$\mathbf{SUIT_{kj}}$ = suitability of site j for activity k.

The dependent variable in equation **(5)**, TRIPS_{kij}, was constructed in several steps. First, trips per **capita** for each of the 239 subregions, covering the entirety of the coterminous 48 States, was calculated by dividing the estimate of total number of trips for activity k by the respective population of each subregion (12 years old or older). As discussed by Walsh **(1986)**, this procedure accounts for both the **probability** of participation and the frequency of participation. Hence, the estimates of trips per capita account for both **participants** and nonparticipants in outdoor recreation.[1]

Total trips for activity k from each representative community within each subregion were estimated by multiplying trips per capita for the subregion by the resident population of the community (12 years old or older). Because it is a function of trips per capita, the specification of total trips as the dependent variable for equation (5) implicitly accounts for both participants and nonparticipants (Walsh 1986; Ward and Loomis 1986). Thus, the problem of excluding nonparticipants in the demand analysis, which is often encountered in applications of the individual travel cost model, was avoided (Ward and Loomis **1986**).[2]

In equation **(5)**, site j refers to a specific recreational site (e.g., a State park) used by community i for activity k. Sites used by community i for any of the 37 types of outdoor recreation modeled were identified from destinations reported in the PARVS data.

For each site, the probability that it was visited for activity k by persons living in community i was calculated. This probability was a function of the distance to the site from the geographic center of the community and the suitability of that site for a particular activity. This estimate of **probability** that site j was visited by community i for activity k served to allocate a percentage of the total trips for activity k from community i. These allocated trips, or $\mathbf{TRIPS_{kij}}$, were the observations for the dependent variable for equation (5) and contained trips for activity k to each site visited by people from each of the 239 communities (zones in the ZTCM context), approximately 7,200 observations.

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[1] The probability of participation in activity k is given by the total number of participants in community i divided by total population of community i (participants and nonparticipants). The frequency of participation is given by the total number of activity k trips from community i/total number of participants in community i. Trips per capita from community i, or $\mathbf{TRIPS}_{ki}$, is given **by:**

$$\mathbf{TRIPS}_{ki} = \frac{\textbf{participants}}{\text{total population}} \times \frac{\text{total } \textbf{trips}}{\text{participants}} \times \frac{\text{total trios}}{\text{total population}}$$

[2] Results reported later (e.g., consumption and cost indices) can still only be extrapolated back to the population of activity k participants, not the general population. Estimates of activity k participants in the United States, which were derived from several data sources, are shown in tables 5, 7, 9, and 11.

The price variable in equation (5), $PRICE_{kij}$, was derived by first calculating the straight-line distance from community i to site j and then applying a calculated circuity factor.

These circuity factors were computed as the ratio of reported travel distance to straight-line distance across all PARVS respondents, about 32,008. Travel miles were then converted to transportation costs, including the opportunity cost of travel time. Transportation cost was based on vehicle operating costs as reported by the U.S. Department of Transportation. The assumed vehicle operating cost was $0.278 per mile, the cost of operating an intermediate-size automobile. The opportunity cost of travel time was valued at one-half the reported wage rate for a community, as recommended by Rosenthal (1985). The average travel speed was calculated by travel time and distance as reported in the PARVS data.

The substitute variable in equation (5), SUBEROS,, was derived from the effective recreational opportunity supply data base discussed previously. This substitute variable combines recreational service, facility, and resource variables, indicating the range of opportunities for activities that compete with activity k for a household's recreation time and money. Effectiveness of substitute opportunities accounts for distance of the opportunities from community i and number of people in other communities who compete for these recreational opportunities.

The suitability variable in equation (5), $SUIT_{kj}$, represents the suitability of site j for activity k. The suitability variable is based on responses to the nationwide survey of site managers discussed previously. Socioeconomic variables in equation (5), including $INC345_i$, $PCT18TMD_i$, $CCPOP86_i$, and $PCTFARM_i$, were obtained from U.S. Census data.

The semilog functional form of equation (5) has been recommended in previous studies. This functional form has been found to be theoretically consistent with recreation demand behavior and reduces heteroscedasticity (Rosenthal 1985; Ward and Loomis 1986; Ziemer and others 1980). Equation (5) was estimated by ordinary least squares for 37 recreational activities. These estimated individual community-by-site equations or demand functions are shown in table 1.

After estimating equation (5) for each of the 37 activities, an aggregate or market demand function across sites, corresponding to equation (1), was derived for each activity. These demand functions were derived by substituting mean values for all independent variables, except cost, into equation (8) and solving for a composite constant term representing the sum of the products of these means multiplied by their respective partial regression coefficients. This simplified equation was then multiplied by the average number of sites used for activity k across all communities so that the equation represented total trips consumed by a typical community at each average trip cost. The results of this operation were aggregate demand curves for each activity for a typical U.S. community. These aggregate demand functions are shown in table 2.

Estimation of the aggregate demand functions depicted by equation (1) assumed that the cross-sectional modeling approach correctly identified the community-by-site demand functions. The identification question requires consideration of the community-level household market for trips illustrated in figures 4 and 5. In figure 5, the observed cost-quantity relationship would be P_1 and Q_1 trips. However, this consumption point is not on the aggregate demand function. Hence, if observed consumption data corresponded to the household market disequilibrium situation shown in figure 5, the aggregate demand function would not be identified.

The vertical portion of the effective aggregate supply curve in figure 5 implies that trip production was limited to local sites. Such would be the case if each community were located on an island. In order to identify the aggregate demand curve, it was assumed that local site capacity did not truncate the aggregate supply curve. Rather, it was assumed that recreationists were free to move into other regions (to other destinations) until the point was reached where the marginal benefits and costs of the last trip produced and the last one consumed were equal. This situation is illustrated in figure 4.

The availability of public recreational facilities and resources varied across the 239 U.S. communities used in this study. Variations in public recreational facilities and resources lead to variations in the aggregate supply function. Other things being equal, changes in consumption caused by changes in the aggregate supply function identify the aggregate demand function for trips (Cicchetti 1973; Kalter and Gosse 1970).

Consumption Function Estimation

As with the estimation of the aggregate demand functions, estimation of consumption functions assumed that community-level household markets for trips were in equilibrium. Household market equilibrium consumption is explained generally by equation (4). For estimation purposes, equation (4) was specified as:

$$TRIPS_{ki} = \exp(B_0 + B_1\, INC345_i + B_2\, PCT18TMD_i + B_3\, OCPOP86_i - B_4\, PCTFARM_i - B_5\, SUBEROS_{ki} + B_6\, [FACILITY_{ki} * SUIT_{ki}]) , \quad (6)$$

where

$TRIPS_{ki}$ = annual trips for activity k consumed by community i,

$FACILITY_{ki}$ = quantity of recreational facilities directly relevant to activity k and available to community i.

All other variables are as defined for equation (5). Equation (6) represents the reduced form for the recreation demand/supply system given generally by equation (4).

The calculation of the dependent variable in equation (6) was discussed previously. The variable RO_{ki} was obtained from the extensive recreational resource and facility data set maintained by the Forest Service's Outdoor Recreation and Wilderness Assessment Group. This data set enabled computation of the quantity of various types of recreational facilities and resources available for each of the 37 activities and found within the relevant travel radii of each community in the United States. Specific facilities and resources which are relevant to activity k were selected from this data set. As indicated by equation (6), these facilities and resources were then weighted by the average suitability of sites used by community i for activity k. The data set only shows recreational facilities and resources within 60- to 120-mile travel radii of each community. These travel radii represented the mean plus one standard deviation of the actual distances reported by PARVS respondents across 12 categories of resources relevant to the 37 recreational activities modeled.

Equation (6) was estimated by ordinary least squares for 37 recreation activities. In some equations the $PCTFARM_i$ variable was deleted because of collinearity. The estimated consumption functions are shown in table 3. The recreational resource and facility variables used in the consumption functions are defined in table 4. Estimated consumption functions were used to project numbers of trips for activity k from a typical community to the year 2040.

In tables 5, 7, 9, and 11, future trip consumption indices relative to the 1987 base year are projected for four possible future recreation opportunity scenarios. Across all four scenarios, demand determinants, such as income, were projected to increase the same in the future at a likely, moderate rate as provided by the Bureau of the Census. Thus, differences in consumption across the four scenarios are the result only of differences in growth of availability of opportunities across time, and simulate the effects of alternative future supply policies, independent of demand growth.

In the low-supply growth scenario, facilities and resources for activity k decrease in the future. In the zero-supply growth scenario, facilities and resources for activity k remain at current levels into the future. Facilities and resources for activity k increase at a moderate growth rate (about 0.5 percent annually) in the medium-supply growth scenario. Finally, in the high-growth scenario, facilities and resources for activity k increase at a growth rate of about 1 percent annually. The indices in tables 5, 7, 9, and 11 indicate that future consumption of recreational trips is sensitive to the availability of recreational facilities and resources for most activities. The strength of recreational facility and resource supply effects varies across the different recreational activities.

Household Market Costs

Future household market trip costs were estimated by substituting future trip-consumption estimates into the future aggregate demand functions and solving for costs. The appropriate future aggregate demand function is determined by shifting the current aggregate demand function (see table 2) to reflect probable future demand schedules based upon assumed futures for the variables shown in equation (5). Indices of future household market costs relative to the 1987 base year are shown in tables 6, 8, 10, and 12. The four demand/supply scenarios shown correspond to the scenarios explained above for the consumption indices.

The cost or price indices (tables 6, 8, 10, and 12) summarize the relationship between outdoor recreation supply and demand over time. An index greater than 100 indicates that trip demand is growing faster than supply. An index equal to 100 indicates that trip demand and supply are increasing at about the same rate. An index less than 100 indicates that supply is increasing faster than demand.

The cost or price indices also summarize the impact on recreation consumption of public policy on growth of available recreational facilities and resources. With decreasing or zero public-facility growth, household market costs would increase for most activities. Such increases in household market costs, in general, would be most pronounced for land-based activities. The implication of increasing household market costs is that recreational opportunities would become more and more scarce. People, therefore, would have to travel greater distances or spend increased time searching for available recreational opportunities.

Under the assumption of medium **public-recreational-**facility growth, household market costs remain about constant for many activities. The implication is that growth of recreational opportunities at this medium rate would just maintain a balance between demand and supply. Thus, for many activities, maintenance of the status quo with respect to recreation demand and supply requires at least a moderate increase (about **1/2** of 1 percent per year) in public recreational facilities and resources. For some activities, maintenance of the status quo with respect to demand and supply requires a 1 percent growth of public recreational facilities and resources.

Household market costs decrease for several activities under the assumption of high public-recreational-facility growth. The implication in this case is that rapid growth of recreational opportunities would cause them to become more abundant over time relative to demand growth. People would typically be able to travel shorter distances and spend less time searching for available recreational opportunities. Thus, improvements in the availability of recreational opportunities would require a relatively high rate of public-recreational-facility growth for a number of activities, **adding** about 45 percent to the total stock over the next 50 years.

Research Conclusions

More research is needed to improve estimates of aggregate demand, supply, equilibrium consumption, and costs or prices. A particular need is to collect sufficient data compatible with conceptual models so that complicated, time-consuming, and sometimes questionable procedures for adjusting data to satisfy model assumptions can be avoided. For the most part, the abundance of the data used to support the work reported here demonstrates this point. In addition to improving the quality of available data, additional research is needed to identify the most appropriate and cost-effective statistical procedures for estimating aggregate demand and supply curves, and for estimating equilibrium consumption and costs. There is also a specific need to develop procedures for including congestion costs, and the effects of varying quality of recreational opportunities. Finally, much more conceptual and empirical work, and convincing of policy makers, are needed to identify the public welfare and policy implications of changes in equilibrium consumption and costs, not only over time but also across spatial dimensions.

For previous RPA Assessment efforts, the economic analyses, using existing data, technology, and theory, were unable to produce recreation demand/supply and price trend comparisons equivalent to those produced for commodity outputs, such as timber. With the accomplishment of the research described above, measurable improvements in the appropriateness, accuracy, and believability of aggregate outdoor recreation demand/supply analyses have been achieved. The theory and techniques described in this Paper, it is argued, provide a stronger foundation for advanced economic assessment of the demand and supply situation of outdoor recreation in the United States.

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Tables

Table 1--Estimated community demand functions for recreational activities

Activity	Parameter estimates (standard error)								N	F-value	Adjusted R_2
	INTERCEPT	$PRICE_{ijk}$	$INC345_i$	$PCT18TMD_i$	$CCPOP86_i$	$PCTFARM_i$	$SUBEROS_{ki}$	$SUIT_{kj}$			
LAND											
Developed camping	4.503*	-0.018*	0.075*	0.088*	[illegible]		-0.026*	[illegible]	3161	509.337	0.49
	(.330)	(.0004)	(.004)	(.014)	(4.43 E-08)		(.005)	(.016)			
Picnicking	4.882*	-.050*	073*	[illegible]	[illegible]		[illegible]	093*	2883	522.744	[illegible]
	(.400)	(.0011)	(.005)	(.016)	(6.72 E-08)		(.006)	(.016)			
Sightseeing	7.016*	-.018	029*	081*	00000088*	-0.180	[illegible]	[illegible]	4538	954.731	[illegible]
	(.248)	(.0003)	(.003)	(.010)	(3.30 E-08)	(.007)	(.004)	(.010)			
Family gathering	3.902*	-.023*	078*	.131*	0000011*	—	-.040*	.146*	4179	838.602	[illegible]
	(.273)	(.0004)	(.003)	(.011)	(3.78 E-08)	—	(.005)	(.012)			
Pleasure driving	5.872*	-.036*	076*	077*	0000013*	—	017*	.159*	2877	347.847	.42
	(.005)	(.001)	(.005)	(.017)	(6.61 E-08)		(.007)	(.016)			
Visiting historic sites	6.780*	-.023*	[illegible]	[illegible]	[illegible]	-.200*	-.039*	215*	3050	623.000	.59
	(.303)	(.0005)	(.004)	(.013)	(4.12 E-08)	(.008)	(.005)	(.010)			
Attending special events	4.214*	-.029*	[illegible]	.112*	0000011*	—	-.052*	.142*	3307	501.783	.48
	(.317)	(.0007)	(.004)	(.014)	(4.77 E-08)		(.005)	(.015)			
Visiting museums	5.535*	-.023	[illegible]	[illegible]	0000011*		[illegible]	183*	2749	376.924	.45
	(.367)	(.0007)	(.004)	(.016)	(5.39 E-08)		(.006)	(.012)			
Off-road driving	[illegible]	-.044	013	083**	[illegible]		-.053*	286*	800	55.331	29
	(.864)	(.004)	(.011)	(.036)	(1.82 E-07)		(.012)	(.031)			
Biking	3.488*	-.031*	[illegible]	.123*	0000013*		-.015*	.120*	2998	434.239	.46
	(.386)	(.001)	(.005)	(.017)	(6.20 E-08)		(.006)	(.015)			
Running/jogging	[illegible]	-.135*	[illegible]	070***	[illegible]		-.009	171*	843	67.158	32
	(1.100)	(.014)	(.013)	(.047)	(2.46 E-07)		(.017)	(.047)			
Walking	5.001*	-.027*	[illegible]	.131*	0000012*		-.034*	.147*	3534	581.972	.50
	(.310)	(.001)	(.004)	(.013)	(4.70 E-08)		(.005)	(.012)			
Cutting firewood	[illegible]	[illegible]	[illegible]	.177*	[illegible]	.181*	-.060*	-.024	506	42.010	36
	(.784)	(.004)	(.014)	(.033)	(1.73 E-07)	(.030)	(.011)	(.037)			
Collecting berries	5.556*	-.024*	[illegible]	232*	[illegible]	[illegible]	-.072	.048	[illegible]	58.246	.41
	(.800)	(.003)	(.012)	(.030)	(1.31 E-07)	(.028)	(.010)	(.034)			
Visiting prehistoric sites	7.595*	[illegible]	.008	-.012	0000012*	[illegible]	[illegible]	.175*	1935	220.036	.44
	(.441)	(.001)	(.006)	(.019)	(7.55 E-08)	(.012)	[illegible]	(.014)			
Photography	2.967*	-.022*	.094	[illegible]	0000012*	—	[illegible]	[illegible]	3128	402.231	.44
	(.357)	(.0009)	(.004)	(.015)	(5.37 E-08)		(.006)	(.016)			
Day hiking	5.711*	[illegible]	064*	.108*	[illegible]		.004	083*	2656	414.921	.52
	(.395)	(.001)	(.005)	(.016)	(6.86 e-08)		(.006)	(.015)			
Horseback riding	4.498*	-.046*	079*	.025	0000013*		[illegible]	223*	2688	316.176	.41
	(.431)	(.001)	(.005)	(.019)	(7.72 E-08)		(.007)	(.017)			
Small-game hunting	[illegible]	-.063*	011	071**	[illegible]		-.074*	174*	1144	84.664	31
	(.786)	(.003)	(.010)	(.034)	(1.35 E-07)		(.012)	(.028)			
Big-game hunting	5.400*	-.034*	[illegible]	.116*	[illegible]		[illegible]	276*	[illegible]	268.759	49
	(.503)	(.001)	(.006)	(.022)	(7.45 E-08)		(.008)	(.017)			
Nature study	1.634*	-.029*	079*	.156*	0000011*		-.021*	176*	3272	341.182	38
	(.397)	(.0009)	(.005)	(.017)	(5.84 E-08)		(.007)	(.018)			
Backpacking	3.237*	-.012*	[illegible]	-.006	[illegible]		-.030*	[illegible]	2277	191.289	33
	(.515)	(.001)	(.006)	(.022)	(7.59 E-08)		(.008)	(.018)			
Primitive Camping	[illegible]	[illegible]	[illegible]	072*	[illegible]		[illegible]	236*	2946	501.580	.50
	(.344)	(.0007)	(.004)	(.015)	(5.20 E-08)		(.006)	(.013)			
Wildlife Observation	5.622*	-.022*	[illegible]	084*	00000089*	-.166	[illegible]	.181*	3940	712.564	.56
	(.269)	(.0004)	(.003)	(.011)	(3.73 E-08)	(.007)	(.004)	(.012)			

Continued

Table 1--Estimated community demand functions for recreational activities--Continued

Activity	Parameter estimates (standard error)								N	F-value	Adjusted R2
	INTERCEPT	$PRICE_{ijk}$	$INC345_i$	$PCT18TMD_i$	$CCPOP86_i$	$PCTFARM_i$	$SUBEROS_{ki}$	SUIT,			
WATER											
Pool swimming	3.136*	-0.036*	0.107*	0.241*	0.0000012*	--	0.024	--	857	131.410	0.43
	(.891)	(.002)	(.011)	(.041)	(1.41 E-07)		(.022)				
Motorized boating	6.280*	-.038*	.061*	.068*	.0000014*	--	-.033*	0.155*	1537	176.174	.41
	(.596)	(.002)	(.007)	(.024)	(1.00 E-07)		(.008)	(.019)			
Water-skiing	4.575*	-.028*	.067*	.062*	.0000014*	--	-.012	.187*	1553	136.448	.34
	(.590)	(.002)	(.007)	(.024)	(9.56 E-08)		(.008)	(.019)			
Rafting/tubing	4.653*	-.033*	.064*	.064***	.0000014*	--	.006	.300*	1379	96.158	.29
	(.816)	(.002)	(.009)	(.036)	(1.28 E-07)		(.012)	(.030)			
Canoeing/kayaking	1.285	-.048*	.087*	.167*	.0000013*	--	-.019*	.250*	2381	455.052	.53
	(.442)	(.001)	(.005)	(.019)	(7.61 E-08)		(.006)	(.016)			
Rowing/other boating	2.066*	-.024*	.074*	.124*	.000013*	--	-.023*	.221*	2413	248.152	.38
	(.418)	(.001)	(.005)	(.019)	(7.39 E-08)		(.006)	(.015)			
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)			
Saltwater fishing	4.304*	-.019*	.029*	.202*	.0000021*	--	.038***	--	664	109.797	.45
	(.805)	(.001)	(.009)	(.039)	(1.69 E-07)		(.022)				
Warm-water fishing	7.149*	-.049*	.046*	.038***	.0000013*	--	-.024*	.153*	2290	316.040	.45
	(.477)	(.001)	(.006	(.021)	(8.71 E-08)		(.009)	(.018)			
Cold-water fishing	7.625*	-.027*	.028*	.020	.0000013*	--	-.019*	.261*	1290	132.738	.38
	(.504)	(.002)	(.006)	(.022)	(8.52 E-08)		(.007)	(.018)			
Anadromous fishing	-0.790	-.026*	.118*	-.071	.0000021*	--	.128*	.156*	991	31.171	.15
	(2.373)	(.006)	(.018)	(.072)	(2.84 E-07)		(.020)	(.052)			
SNOW AND ICE											
Downhill skiing	7.765*	-0.031*	0.059**	0.135***	0.00000037*	-0.368*	0.001**	--	138	22.706	0.49
	(2.43)	(.005)	(.028)	(.083)	(1.80 E-07)	(.081)	(.0005)				
Crosscountry skiing	1.185	-.034*	.216*	-.130*	.0000015*	--	.002*	0.338*	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.

Table 2--Abbreviated demand functions for a typical U.S. community, by activity, 1987

	Parameter estimates	
Activity	Intercept	cost (standard error)*
LAND		
Developed camping	13.2226	-0.0182 (0.00042)
Picnicking	15.1128	-.0499 (0.00110)
Sightseeing	14.9591	-.0183 (0.00029)
Family gathering	14.2297	-.0232 (0.00043)
Pleasure driving	15.1268	-.0359 (0.00109)
Visiting historic sites	13.5640	-.0231 (0.00050)
Attending events	13.2127	-.0286 (0.00076)
Visiting museums	13.3323	-.0227 (0.00073)
Off-road driving	13.0965	-.0437 (0.00380)
Biking	14.1572	-.0315 (0.00106)
Running/jogging	15.1549	-.1356 (0.01373)
waking	15.1723	-.0271 (0.00066)
Cutting firewood	12.3011	-.0319 (0.00447)
Collecting berries	11.9465	-.0244 (0.00338)
Visit prehistoric sites	11.2391	-.0261 (0.00140)
Photography	13.2304	-.0221 (0.00090)
Day hiking	13.5763	-.0393 (0.00125)
Horseback riding	12.5163	-.0459 (0.00142)
Small-game hunting	13.1748	-.0632 (0.00334)
Big-game hunting	13.1341	-.0345 (0.00103)
Nature study	12.6636	-.0289 (0.00093)
Backpacking	10.6442	-.0124 (0.00110)
Primitive camping	12.6221	-.0294 (0.00070)
Wildlife observation	13.7336	-.0220 (0.00046)
WATER		
Pool swimming	14.6800	-0.0364 (0.00208)
Motorized boating	13.7019	-.0383 (0.00156)
Water-skiing	12.4289	-.0275 (0.00152)
Rafting/tubing	6.0026	-.0326 (0.00204)
Canoeing/kayaking	12.7674	-.0484 (0.00122)
Other boating/rowing	11.6530	-.0237 (0.00116)
Stream/lake swimming	14.9339	-.0341 (0.00073)
Saltwater fishing	11.4034	-.0194 (0.00123)
Warm-water fishing	14.6418	-.0490 (0.00129)
Cold-water fishing	13.1901	-.0272 (0.00151)
SNOW AND ICE		
Cross-country skiing	8.6520	-0.0340 (0.00237)
Downhill skiing	11.2286	-.0308 (0.00460)

*All models significant at *p c* 0.01.

Table 3--Estimated community consumption functions for recreational activities

Activity	Parameter estimates (standard error)								N	F-value	Adjusted R_2
	INTERCEP	INC345	PCT18TMD	CCPOP86	SUBEROS	PCTFARM	RO1	R02			
					LAND						
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)				
Family gatherings	8.604*	.062*	.087*	.0000013*	-.060*		.00024*		239	57.467	54
	(.777)	(.010)	(.037)	(1.41 E-07)	(.013)		(.0001)				
Pleasure driving	9.579*	.061*	.103*	.0000012*	-.058*		.0000036*		239	51.895	52
	(.727)	(.01)	(.032)	(1.32 E-07)	(.014)		(.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)				
Attending events	7.353*	.068*	.123*	.0000012*	-.081*		.0000051*		239	56.683	.54
	(.761)	(.010)	(.034)	(1.37 E-07)	(.014)		(.000002)				
Visiting museums	7.079*	.079*	.129*	.0000012*	-.067*		.0000046**		239	57.763	54
	(.780)	(.010)	(.036)	(1.44 E-07)	(.015)		(.000002)				
Off-toad driving	8.070*	.037*	.099***	.0000012*	-.027		.0000041		239	14.905	.23
	(1.155)	(.015)	(.052)	(2.10 E-07)	(.026)		(.000008)				
Biking	7.238*	.098*	.132*	.0000013*	-.042*		.0000027*		239	53.677	52
	(.874)	(.011)	(.039)	(1.58 E-07)	(.016)		(.000002)				
Running/jogging	6.913*	.103*	.122**	.0000013*	-.070		.0000050*		239	25.164	.34
	(1.362)	(.018)	(.061)	(2.46 E-07)	(.026)		(.000002)				
Walking	8.647*	.075*	.134*	.0000013*	-.062*		.0000039*		239	58.998	.55
	(.777)	(.010)	(.035)	(1.40 E-07)	(.014)		(.000001)				
Cutting firewood	9.186*	.018**	.112*	.00000074*	-.043*		.000012*		239	53.924	57
	(.682)	(.009)	(.030)	(1.21 E-07)	(.015)		(.000004)				
Collecting berries	8.255*	.019***	.134*	.00000092*	.032**	-.219*.	.000022*		239	55.490	.58
	(.796)	(.011)	(.034)	(1.42 E-07)	(.013)	(.023)	(.000006)				
Visiting prehistoric sites	8.736*	.021**	.071**	.0000011*	-.033	-.230*	.0000027*		239	77.633	.66
	(.691)	(.010)	(.030)	(1.23 E-07)	(.013)	(.020)	(.000002)				
Photography	7.618*	.085*	.114*	.0000012*	-.084*		.000055*		239	59.638	.55
	(.834)	(.011)	(.037)	(1.50 E-07)	(.017)		(.00001)				
Day hiking	8.889*	.054	.116*	.00000019*	-.065*	-.194*	.000024*		239	97.476	.71
	(.681)	(.009)	(.029)	(1.21 E-07)	(.016)	(.016)	(.000006)				
Horseback riding	8.780*	.050*	.033	.0000010*	-.088*		.000041*	.00059*	239	22.482	.35
	(1.02)	(.014)	(.047)	(1.86 E-07)	(.022)		(.00001)	(.0003)			
Small-game hunting	10.724*	-.016	.045	.00000079*	-.111*		.000020*		239	9.984	.16
	(1.16)	(.015)	(.051)	(2.06 E-07)	(.021)		(.000009)				
Big-game hunting	8.873'	.014	.085*	.00000073*	-.102*		.000024*		239	16544	.25
	(.881)	(.011)	(.040)	(1.57 E-07)	(.019)		(.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)	(444 E-08)			
Primitive camping	7.320*	.056*	.094*	.0000011*	-.076*		.000054*		239	45.018	.48
	(.788)	(.010)	(.035)	(1.4 E-07)	(.018)		(.00001)				
Wildlife observation	7.910*	.068*	.106*	.0000011*	-.066*		.000026*	.00677*	239	49.075	.55
	(.729)	(.010)	(.033)	(1.33 E-07)	(.017)		(.000007)	(.0022)			

Table 3-Estimated community consumption functions for recreational activities--Continued

Activity	INTERCEP	INC345	PCT18TMD	CCPOP86	SUBEROS	PCTFARM	RO1	R02	N	F-value	Adjusted R_2
	Parameter estimates (standard error)										
					WATER						
Pool swimming	3.091* (1.199)	0.090* (.012)	0.058** (.036)	0.0000010* (1.43 E-07)	-0.023* (.014)		0.00143* (.0005)	0.109* (.015)	239	58521	0.59
Motorized boating	9.780* (.833)	.032* (.011)	.076** (.037)	.0000010* (1.44 E-07)	-.075* (.013)		.00120* (.0003)	.000219** (.00009)	239	31.265	A3
Water-skiing	8.229 (.903)	.045* (.012)	.080** (.040)	.0000011* (1.62 E-07)	-.054* (.015)		.00144* (.0004)		239	29.446	.37
Rafting/tubing	-12.760* (5.004)	.183* (.066)	.429*** (.223)	.0000012* (9.20 E-07)	-.041 (.094)		.000384* (.0001)	.9553** (.431)	239	6.431	.12
Canoeing/kayaking	5.007* (.958)	.072* (.013)	.140* (.043)	.0000010* (1.73 E-07)	-.038** (.015)		.01052* (.004)	.00158* (.0006)	239	33.973	.45
Sailing/rowing	6.392* (.919)	.066* (.012)	.123* (.041)	.0000010* (1.66 E-07)	-.062* (.015)		.000739** (.0003)		239	32.137	.40
Stream/lake swimming	9.258* (.827)	.039* (.011)	.104* (.030)	.0000011* (1.41 E-07)	-.066* (.013)		.000876* (.003)	.000622* (.0002)	239	43.275	52
Saltwater fishing	1.637 (1.96)	.089* (.026)	.230* (.088)	.0000013* (3.53 E-07)	-.038 (.031)		.005809* (.001)		239	21.944	.31
Warm-water fishing	10.143* (.935)	.010 (.012)	.122* (.042)	.00000095* (1.70 E-07)	-.140* (.015)		.001225* (.0005)		239	32.607	.40
Cold-water fishing	8.263* (.862)	.055* (.011)	.089** (.039)	.00000099* (1.57 E-07)	-.032*** (.019)		.197887* (.070)	.00128* (.0004)	239	20.027	.39
Anadromous fishing	1.584 (4.851)	.140* (.046)	-.140 [a] (.149)	.0000019* (6.13 e-07)	.122** (.056)		.000514* (.0001)		239	12.451	.19
					SNOW AND ICE						
Downhill skiing	11.45s (2.146)	0.104* (.023)	-0.162** [a] (.068)	0.0000011* (2.74 E-07)	0.0013** (.0005)	-0.256* (.046)	.001086* (-0003)		239	41.848	52
Cross-country skiing	7.570** (4.061)	.187* (.043)	-.248** [a] (.124)	.0000014* (5.06 E-07)	.0025* (.001)	–	.000033* (.000007)		239	23.268	.32

*Significant at 0.01 level; **Significant at 0.05 level; ***Significant at 0.10 level. [a] For these activities, age variable was MEDAGE = medium age of central county population.

Table 4--Recreational resource and facility variables used in activity consumption functions

Activity	R01	R02
	LAND	
Developed camping	Federal road mileage converted to acres and Federal and State land located within 1/2 mile of a road*	--
Picnicking	Federal and State land located within 1/2 mile of a road, and State forest land open to recreation*	--
Sightseeing	Federal road mileage converted to acres, and Federal and State land located within 1/2 mile of a road*	--
Family gatherings	Federal road State, local and private campgrounds*	
Pleasure driving	Federal road mileage converted to acres, and Federal and State land located within 1/2 mile of a road	--
Visiting historical sites	Federal road mileage converted to acres, and Federal and State land located with 1/2 mile of a road*	--
Attending events	Federal road mileage converted to acres, and Federal and State land located within 1/2 mile of a road*	--
Visiting museums	Federal road mileage converted to acres, and Federal and State land located within 1/2 mile of a road*	--
Off-road driving	Federal road mileage (except for U.S. Army Corps of Engineers and Tennessee Valley Authority) converted to acres, National Recreational Trail mileage open to motorcycles converted to acres, and Federal and State land located within 1/2 mile of a road*	
Biking	Federal road mileage converted to acres, Federal and State land located within 1/2 mile of a road, and State forest acres open to recreation*	
Running/jogging	Federal road mileage converted to acres, Federal and State land located within 1/2 mile of a road, and State forest acres open to recreation*	

Table 4--Recreational resource and facility variables used in activity consumption functions--Continued

Activity	R01	R02
walking	Federal road mileage converted to acres, and Federal and State land located within 1/2 mile of a road*	--
Cutting firewood	Federal land located within 1/2 mile of a road, Federal and State land located within 1/2 to 3 miles of a road, and acres of nonindustrial forest land open to recreation, both leased and nonleased*	--
Collecting berries	Industrial and nonindustrial forest lands*	--
Visiting prehistoric sites	Federal road mileage converted to acres, Federal and State land located within 1/2 mile of a road, Federal and State land located within 1/2 to 3 miles of a road, and rural transportation use acres*	--
Photography	Federal and State land located within 1/2 mile of a road, and State Forest acres open to recreation*	--
Day hiking	Federal and State land located within 1/2 mile of a road, Federal and State land located 1/2 to 3 miles of a road, and Federal wilderness*	--
Horseback riding	Federal and State land located within 1/2 to 3 miles of a road, and nonwilderness land more than 3 miles from a road	Miles of National Recreational Trails open to horseback riding
Small-game hunting	Federal land located within 1/2 mile of a road, Federal land located within 1/2 to 3 miles of a road, industrial forest-land acres, and nonindustrial private-land acres open to recreation, both leased and not leased*	--
Big-game hunting	Federal land located within 1/2 mile of a road, Federal land located 1/2 to 3 miles of a road, industrial forest-land acres, and nonindustrial private-land acres open to recreation, both leased and not leased	

Table 4--Recreational resource and facility variables used in activity consumption functions--Continued

Activity	R01	R02
Nature Study	Acres of water in river/streams up to 660 feet wide, and acres of flat-water bodies	Federal and State land located within 1/2 mile to 3 miles of a road, nonwilderness land located over 3 miles from a road, and Federal wilderness acres*
Backpacking	Federal and State land located within 1/2 to 3 miles of a road, nonwilderness land located over 3 miles from a road, and Federal wilderness acres*	National Recreation Trail State park trail miles*
Primitive camping	Federal and State land located within 1/2 mile of a road, and State forest acres open to recreation*	--
Wildlife observation	Federal and State land located within 1/2 mile of a road, Federal and State land located with 1/2 to 3 miles from a road, nonwilderness land located more than 3 miles from a road, Federal wilderness acres, The Nature Conservancy acres, and State fish and game land*	Acres of water in rivers/streams up to 660 feet wide, acres of flat-water bodies, and acres of Federal water bodies open to recreation*
	WATER	
Pool swimming	Public and private swimming pools, State parks with some swimming facilities, and tourist accommodations	--
Motorized boating	Acres of flatwater bodies and acres of Federal water open to recreation	Number of boat ramps*
Water-skiing	Acres of flatwater bodies and acres of Federal water open to recreation*	--
Rafting/tubing	Miles of Federal wild and scenic rivers, miles of rivers designated by States as being significant for historic, cultural, scenic or recreational reasons, and miles of Bureau of Land Management recreational rivers*	Indicator variable for presence of mountains (0 = no mountains; 1 = mountains)*
Canoeing/kayaking	Acres of flatwater bodies, and acres of water in river/streams up to 660 feet wide*	Canoe rental firms and canoe outfitters*
Sailing/rowing	Acres of flatwater bodies, acres of water in rivers/streams up to 660 feet wide, and acres of Federal water bodies open to recreation*	

Table 4--Recreational resource and facility variables used in activity consumption functions--Continued

Activity	R01	R02
Stream/lake/ocean swimming	Federal developed swimming areas*	Miles of public ocean beach*
Saltwater fishing	Miles of public ocean beach*	
Warm-water fishing	Acres of flatwater bodies, acres of water in rivers/streams up to 660 feet wide, and acres of Federal water bodies open to recreation*	--
Cold-water fishing	Acres of water in rivers/streams up to 660 feet wide, and acres of Federal water bodies open to recreation*	Indicator variable for presence of mountains (0 = no mountains; 1 = mountains)*
Anadromous fishing	Miles of Federal wild and scenic rivers, and miles of rivers designated by States as being significant recreational resources* [a]	--
	SNOW AND ICE	
Downhill skiing	Daily ski-lift capacity	--
Cross-country skiing	Federal and State lands located within 1/2 mile of a road, Federal and State lands located within 1/2 to 3 miles of a road, and acres of rural transportation use*	--

*Resource and facility variables are weighted by the average suitability of sites used by a community for an activity. Average suitability was derived from responses to a survey sent to site managers.

[a] States where no anadromous fishing occurs were assigned an average suitability of zero.

Table 5--Future market-clearing trip indices under low public-supply-growth and medium-demand-growth assumptions, by activity

(1987 base level = 100)

Activity	Baseline consumption in U.S. (million)	Year 2000	2010	2020	2030	2040
		LAND				
Developed camping	60.6	116	130	144	158	168
Picnicking	262.0	105	111	118	125	130
Sightseeing	292.7	115	129	146	167	190
Family gathering	74.4	112	123	134	146	154
Pleasure driving	421.6	112	122	133	145	153
Visiting historic sites	73.1	118	135	155	182	210
Attending events	73.7	111	121	132	144	152
Visiting museums	9.7	115	129	143	160	171
Off-road driving	80.2	104	109	114	120	124
Biking	114.6	121	140	160	182	198
Running/jogging	83.7	126	149	173	200	220
walking	266.5	113	125	137	151	161
Cutting firewood	30.3	110	119	131	147	165
Collecting berries	19.0	110	121	134	153	175
Visiting prehistoric sites	16.7	128	150	177	209	244
Photography	42.0	118	135	152	170	183
Day hiking	91.0	125	149	177	211	247
Horseback riding	63.2	116	129	142	154	162
Small-game hunting	58.6	90	84	80	78	76
Big-game hunting	55.2	93	90	88	88	88
Nature study	70.8	102	107	112	120	125
Backpacking	26.0	128	152	178	205	224
Primitive camping	38.1	110	120	129	139	146
Wildlife observation	69.5	111	122	133	145	153
		WATER				
Pool swimming	221.0	130	155	181	208	228
Motorized boating	219.5	103	107	111	116	119
Water-skiing	107.5	109	117	125	133	139
Rafting/tubing	8.9	98	106	113	131	143
Canoeing/kayaking	39.8	107	115	123	133	140
Rowing/paddling/other boating	61.8	110	120	130	142	150
Stream/lake swimming	238.8	102	106	110	114	118
Saltwater fishing	77.3	103	109	116	127	134
Warm-water fishing	239.5	90	87	84	84	83
Cold-water fishing	83.8	111	121	130	141	148
		SNOW AND ICE				
Downhill skiing	64.3	141	173	205	238	260
Cross-country skiing	9.7	133	152	164	171	158

Table 6--Future market-clearing price indices under low public-supply-growth and medium-demand-growth assumptions, by activity

(1987 base level = 100)

Activity	Baseline cost per day (1987)	Year 2000	2010	2020	2030	2040
LAND						
Developed camping	$21.39	102	104	105	106	107
Picnicking	39.69	101	102	103	103	104
Sightseeing	65.61	101	102	103	105	106
Family gathering	67.52	103	105	106	108	109
Pleasure driving	40.26	101	102	103	104	105
Visiting historic sites	59.97	102	103	104	106	107
Attending events	54.49	102	103	104	105	106
Visiting museums	57.08	102	103	104	105	106
Off-road driving	34.04	101	101	102	102	103
Biking	40.82	102	103	105	106	107
Running/jogging	12.00	103	104	106	108	108
walking	44.91	102	103	104	105	105
Cutting firewood	26.09	102	104	105	106	108
Collecting berries	30.06	103	105	107	108	110
Visiting prehistoric sites	14.11	102	103	104	106	107
Photography	31.42	103	105	107	108	109
Day hiking	32.35	103	105	106	108	110
Horseback riding	33.16	103	104	106	107	108
Small-game hunting	32.87	102	103	104	105	105
Big-game hunting	47.77	102	103	103	104	104
Nature study	35.17	102	103	104	105	106
Backpacking	29.26	105	108	111	114	115
Primitive camping	23.61	102	103	104	105	106
Wildlife observation	41.47	103	104	106	107	108
WATER						
Pool swimming	$46.52	103	105	106	108	109
Motorized boating	39.85	101	102	103	104	104
Water-skiing	41.04	101	102	103	104	105
Rafting/tubing	46.91	107	114	119	126	130
Canoeing/kayaking	38.61	102	104	105	107	108
Rowing/paddling/other boating	39.79	101	102	103	104	105
Stream/lake swimming	57.28	101	102	102	103	104
Saltwater fishing	88.38	101	103	104	105	106
Warm-water fishing	40.58	101	101	102	102	102
Cold-water fishing	40.97	101	102	103	104	104
SNOW AND ICE						
Downhill skiing	27.81	106	109	112	115	116
Cross-country skiing	42.59	107	110	113	114	114

Table 'I-Future market-clearing trip indices under zero public-supply-growth and medium-demand-growth assumptions, by activity

(1987 base level= 100)

Activity	Baseline consumption in U.S. (million)	Year 2000	2010	2020	2030	2040
LAND						
Developed camping	68.6	117	132	147	162	173
Picnicking	262.0	107	114	121	130	135
Sightseeing	292.7	116	130	148	169	193
Family gathering	74.4	116	130	144	158	168
Pleasure driving	421.6	113	124	136	148	157
Visiting historic sites	73.1	118	136	157	184	213
Attending events	73.7	112	123	135	148	157
Visiting museums	9.7	116	130	146	162	174
Off-road driving	80.2	105	110	115	121	125
Biking	114.6	122	142	162	186	202
Running/jogging	83.7	127	152	178	207	228
walking	266.5	114	127	140	155	165
Cutting firewood	30.3	111	122	134	151	170
Collecting berries	19.0	112	124	139	159	182
Visiting prehistoric sites	16.7	129	152	179	212	248
Photography	42.0	120	139	157	178	192
Day hiking	91.0	127	152	181	217	255
Horseback riding	63.2	119	133	148	161	171
Small-game hunting	58.6	92	88	85	83	82
Big-game hunting	55.2	96	95	95	96	97
Nature study	70.8	105	111	117	126	132
Backpacking	26.0	131	157	186	215	237
Primitive camping	38.1	112	122	133	144	151
Wildlife observation	69.5	114	127	139	153	163
WATER						
Pool swimming	221.0	131	158	186	215	236
Motorized boating	219.5	105	110	115	120	124
Water-skiing	107.5	110	118	127	135	142
Rafting/tubing	8.9	108	124	141	169	190
Canoeing/kayaking	39.8	110	120	131	144	153
Rowing/paddling/other boating	61.8	111	121	132	144	152
Stream/lake swimming	238.8	104	109	114	119	124
Saltwater fishing	77.3	104	112	120	133	141
Warm-water fishing	239.5	91	88	85	85	85
Cold-water fishing	83.8	111	121	132	142	150
SNOW AND ICE						
Downhill skiing	64.3	146	182	219	258	283
Cross-country skiing	9.7	137	160	176	185	173

Table &-Future market-clearing price indices under zero **public-supply-growth** and medium-demand-growth assumptions, by activity

(1987 base level = 100)

Activity	Baseline cost per day (1987)	Year 2000	2010	2020	2030	2040
		LAND				
Developed camping	$21.39	101	102	103	104	105
Picnicking	39.69	101	101	102	102	102
Sightseeing	65.61	101	102	103	104	105
Family gathering	67.52	101	102	103	104	104
Pleasure driving	40.26	101	102	102	103	103
Visiting historic sites	59.97	101	103	104	105	106
Attending events	54.49	101	102	103	103	104
Visiting museums	57.08	101	102	103	104	105
Off-road driving	34.04	100	101	101	102	102
Biking	40.82	102	103	104	105	106
Running/jogging	12.00	102	103	105	106	107
walking	44.91	101	102	103	103	104
Cutting firewood	26.09	101	102	103	104	105
Collecting berries	30.06	101	102	103	104	105
Visiting prehistoric sites	14.11	103	104	106	108	109
Photography	31.42	102	103	104	105	105
Day hiking	32.35	102	104	105	107	108
Horseback riding	33.16	102	103	104	105	105
Small-game hunting	32.87	101	101	101	102	102
Big-game hunting	47.77	100	100	100	100	100
Nature study	35.17	100	101	101	102	103
Backpacking	29.26	103	105	106	108	109
Primitive camping	23.61	101	102	103	103	104
Wildlife observation	41.47	101	102	103	104	104
		WATER				
Pool swimming	$46.52	102	104	105	106	107
Motorized boating	39.85	100	101	101	102	102
Water-skiing	41.04	101	102	102	103	103
Rafting/tubing	46.91	102	105	108	113	116
Canoeing/kayaking	38.61	101	102	103	104	104
Rowing/paddling/other boating	39.79	101	102	103	103	104
Stream/lake swimming	57.28	100	101	101	101	102
Saltwater fishing	88.38	100	101	102	103	104
Warm-water fishing	40.58	101	101	101	101	101
Cold-water fishing	40.97	101	102	102	103	103
		SNOW AND ICE				
Downhill skiing	27.81	104	106	108	110	111
Cross-country skiing	42.59	104	107	108	109	108

Table 9--Future market-clearing trip indices under medium public-supply-growth and medium-demand-growth assumptions, by activity

(1987 base level = 100)

Activity	Baseline consumption in U.S. (million)	Year				
		2000	2010	2020	2030	2040
LAND						
Developed camping	60.6	120	137	155	173	186
Picnicking	262.0	110	119	129	139	147
Sightseeing	292.7	117	132	151	174	198
Family gathering	74.4	120	137	155	174	187
Pleasure driving	421.6	115	128	141	155	165
Visiting historic sites	73.1	119	138	160	189	219
Attending events	73.7	115	128	142	157	167
Visiting museums	9.7	118	134	150	169	182
Off-road driving	80.2	105	111	117	124	128
Biking	114.6	124	145	168	193	211
Running/jogging	83.7	131	158	188	221	246
walking	266.5	116	131	146	163	176
Cutting firewood	30.3	112	124	138	157	176
Collecting berries	19.0	114	128	144	167	192
Visiting prehistoric sites	16.7	131	155	184	219	258
Photography	42.0	125	147	170	195	214
Day hiking	91.0	130	157	190	231	273
Horseback riding	63.2	122	139	157	174	186
Small-game hunting	58.6	95	93	91	90	89
Big-game hunting	55.2	100	102	104	106	108
Nature study	70.8	109	119	129	141	149
Backpacking	26.0	136	167	202	238	265
Primitive camping	38.1	115	127	140	154	163
Wildlife observation	69.5	120	137	155	174	188
WATER						
Pool swimming	221.0	133	102	193	224	246
Motorized boating	219.5	107	114	120	127	132
Water-skiing	107.5	111	121	131	141	148
Rafting/tubing	8.9	134	175	225	298	355
Canoeing/kayaking	39.8	116	131	147	165	177
Rowing/paddling/other boating	61.8	112	123	134	147	156
Stream/lake swimming	238.8	107	113	120	128	133
Saltwater fishing	77.3	108	119	130	146	157
Warm-water fishing	239.5	92	90	88	88	88
Cold-water fishing	83.8	113	123	134	146	154
SNOW AND ICE						
Downhill skiing	64.3	151	192	237	283	314
Cross-country skiing	9.7	147	179	205	223	212

Table 10--Future market-clearing price indices under medium public-supply-growth and medium-demand-growth assumptions, by activity

(1987 base level = 100)

Activity	Baseline cost per day (1987)	Year 2000	2010	2020	2030	2040
LAND						
Developed camping	$21.39	100	100	100	100	100
Picnicking	39.69	99	99	99	99	99
Sightseeing	65.61	101	101	102	103	104
Family gathering	67.52	99	99	99	99	99
Pleasure driving	40.26	100	100	100	100	101
Visiting historic sites	59.97	101	102	103	104	105
Attending events	54.49	100	100	100	100	100
Visiting museums	57.08	100	101	101	102	102
Off-road driving	34.04	100	100	100	101	101
Biking	40.82	101	101	102	103	103
Running/jogging	12.00	101	101	102	103	103
walking	44.91	100	100	100	100	100
Cutting firewood	26.09	100	100	100	100	101
Collecting berries	30.06	99	99	99	99	100
Visiting prehistoric sites	14.11	102	103	104	105	106
Photography	31.42	99	98	97	97	97
Day hiking	32.35	101	101	102	103	104
Horseback riding	33.16	100	100	101	101	101
Small-game hunting	32.87	99	99	99	98	98
Big-game hunting	47.77	99	98	97	%	%
Nature study	35.17	98	97	96	%	95
Backpacking	29.26	98	97	97	%	%
Primitive camping	23.61	100	100	100	100	100
Wildlife observations	41.47	98	97	%	%	95
WATER						
Pool swimming	$46.52	101	102	103	104	104
Motorized boating	39.85	99	99	98	98	98
Water-skiing	41.04	100	100	100	100	100
Rafting/tubing	46.91	91	87	84	84	83
Canoeing/kayaking	38.61	99	98	98	98	98
Rowing/paddling/other boating	39.79	100	101	101	101	102
Stream/lake swimming	57.28	99	99	99	99	99
Saltwater fishing	88.38	99	99	98	99	99
Warm-water fishing	40.58	100	100	100	100	100
Cold-water fishing	40.97	100	101	101	101	102
SNOW AND ICE						
Downhill skiing	27.81	102	103	104	105	105
Cross-country skiing	42.59	100	99	98	97	95

Table 11--Future market-clearing trip indices under high public-supply-growth and medium-demand-growth assumptions, by activity

(1987 base level = 100)

Activity	Baseline consumption in U.S. (million)	Year 2000	2010	2020	2030	2040
LAND						
Developed camping	60.6	123	142	163	184	199
Picnicking	262.0	113	125	137	150	159
Sightseeing	292.7	118	134	154	178	204
Family gathering	74.4	125	146	168	191	207
Pleasure driving	421.6	117	131	147	163	174
Visiting historic sites	73.1	121	140	163	194	225
Attending events	73.7	117	132	149	166	179
Visiting museums	9.7	119	137	155	175	189
Off-road driving	80.2	106	113	119	126	131
Biking	114.6	125	148	173	200	220
Running/jogging	83.7	134	165	199	237	265
walking	266.5	118	135	153	172	186
Cutting firewood	30.3	114	127	142	162	183
Collecting berries	19.0	116	131	150	175	202
Visiting prehistoric sites	16.7	132	158	189	227	268
Photography	42.0	129	156	184	215	237
Day hiking	91.0	133	163	200	245	292
Horseback riding	63.2	126	146	168	188	202
Small-game hunting	58.6	98	97	97	97	98
Big-game hunting	55.2	104	108	113	118	122
Nature study	70.8	114	127	141	157	169
Backpacking	26.0	141	178	220	267	2%
Primitive camping	38.1	118	133	149	165	176
Wildlife observation	69.5	126	148	172	198	217
WATER						
Pool swimming	221.0	135	166	199	233	258
Motorized boating	219.5	110	118	126	134	140
Water-skiing	107.5	113	124	135	146	154
Rafting/tubing	8.9	167	248	358	522	665
Canoeing/kayaking	39.8	122	143	164	189	206
Rowing/paddling/other boating	61.8	113	125	137	151	160
Stream/lake swimming	238.8	109	118	127	136	143
Saltwater fishing	77.3	112	126	141	161	175
Warm-water fishing	239.5	93	91	90	91	92
Cold-water fishing	83.8	114	125	137	150	158
SNOW AND ICE						
Downhill skiing	64.3	157	204	256	310	348
Cross-country skiing	9.7	158	200	238	267	260

Table 12--Future market-clearing price indices under high public-supply-growth and medium-demand-growth assumptions, by activity

(1987 base level= 100)

Activity	Baseline cost per day (1987)	Year 2000	2010	2020	2030	2040
LAND						
Developed camping	$21.39	98	97	%	96	96
Picnicking	39.69	98	97	97	96	96
Sightseeing	65.61	100	100	101	101	102
Family gathering	67.52	98	96	95	94	%
Pleasure driving	40.26	99	99	98	98	98
Visiting historic sites	59.97	100	101	102	103	104
Attending events	54.49	98	98	97	97	96
Visiting museums	57.08	100	99	99	100	100
Off-road driving	34.04	100	99	99	99	99
Biking	40.82	100	100	100	100	101
Running/jogging	12.00	99	99	99	99	100
walking	44.91	99	98	98	97	97
Cutting firewood	26.09	98	98	97	97	97
Collecting berries	30.06	97	96	95	94	94
Visiting prehistoric sites	14.11	100	101	101	102	103
Photography	31.42	%	93	91	89	88
Day hiking	32.35	99	99	99	100	100
Horseback riding	33.16	99	98	98	97	97
Small-game hunting	32.87	98	97	%	95	94
Big-game hunting	47.77	97	95	93	92	91
Nature study	35.17	95	93	91	89	88
Backpacking	29.26	94	90	87	84	82
Primitive camping	23.61	99	98	97	97	97
Wildlife observation	41.47	95	92	90	88	87
WATER						
Pool swimming	$46.52	101	101	102	102	102
Motorized boating	39.85	98	97	%	95	94
Water-skiing	41.84	99	98	98	97	97
Rafting/tubing	46.91	80	70	60	55	51
Canoeing/kayaking	38.61	97	95	94	93	92
Rowing/paddling/other boating	39.79	99	99	99	99	100
Stream/lake swimming	57.28	98	97	97	%	%
Saltwater fishing	88.38	97	96	95	94	94
Warm-water fishing	48.58	100	99	99	99	98
Cold-water fishing	40.97	100	100	100	100	100
SNOW/ICE						
Downhill skiing	27.81	100	100	100	99	99
Cross-country skiing	42.59	95	92	88	85	81

Cordell, H. Ken; Bergstrom, John C. 1989. Theory and techniques for assessing the demand and supply of outdoor recreation in the United States. Res. Pap. SE-275. Athens, GA: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. 33 pp.

As the central analysis for the 1989 Renewable Resources planning Act Assessment, a household market model covering 37 recreational activities was computed for the United States. Equilibrium consumption and costs were estimated, as were likely future changes in consumption and costs in response to expected demand growth and alternative development and access policies.

Keywords: outdoor recreation, market equilibrium, demand, supply, forecasts, household production theory.

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