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**Research Paper
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The Net Economic Value of Recreation on the National Forests: Twelve Types of Primary Activity Trips Across Nine Forest Service Regions

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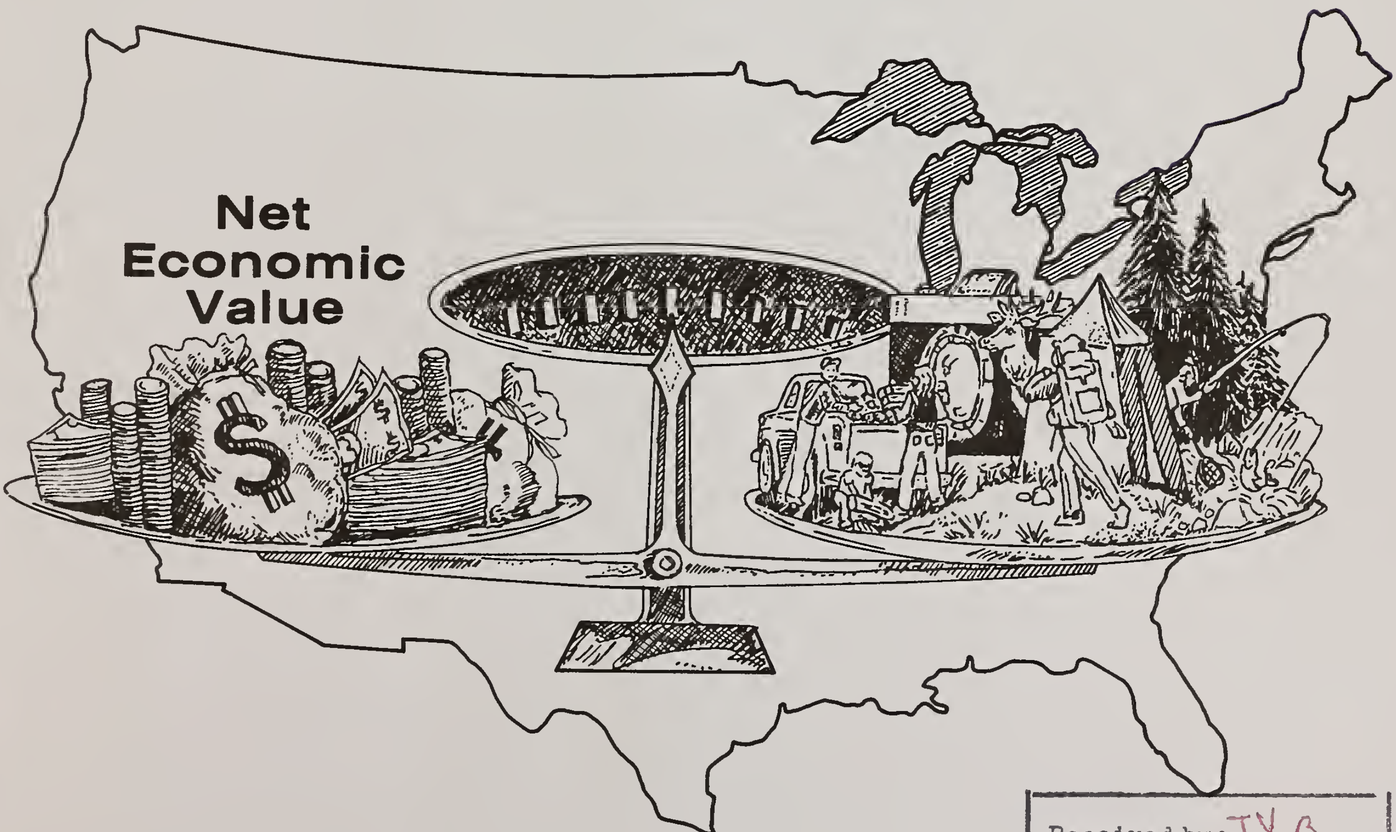

Abstract

The Public Area Recreation Visitors Survey (PARVS) was used to estimate demand models, from the point of view of a site operator, for recreation on Forest Service lands for twelve types of primary activity trips in all nine Forest Service regions. The models were estimated using the travel cost method with a "reverse multinomial logit gravity model." At the first stage, they are share models estimating the probability that a trip observed at a given recreation site originated in a particular county. This probability is equivalent to the expected proportion of total trips to a site coming from a particular origin. A second staging process, identical to that used in traditional travel cost models, was used to derive site demand functions from the point of view of a site operator. These functions were used to estimate average consumer surplus. The relative values for different primary activity trips across different regions of the country are examined, as are relative values for different primary activity trips within the regions.

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Preface

The information in this report is the product of one of several special studies intended to provide technical advice on the economic value of recreation for use in the 1990 RPA Program Analysis. The monetary values reported herein were estimated using the travel cost method with data collected by the Public Area Recreation Visitors Survey (PARVS) at Forest Service sites only. The estimated values are advisory and do not constitute official Forest Service policy.

The research and computer assistance of Michelle Haefele contributed immeasurably to the completion of this work. Her contribution is gratefully acknowledged. Glen Brink and Norman Merritt provided valuable programming support for this project. Ken Cordell, at the Southeastern Forest Experiment Station, provided helpful comments and feedback on several sections of this report. Gary Elsner, Richard Guldin, John Loomis, Greg Super, and Richard Walsh also reviewed earlier drafts and provided comments and criticisms, which we have endeavored to incorporate. An early report of this work was presented at the joint meetings of Western Regional Research Project W-133, Benefits and Costs in Natural Resource Planning, and the Western Regional Science Association, in San Diego, CA, February 20–22, 1989. Useful comments and discussion were contributed by several participants. The authors, however, are responsible for any errors.

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Introduction

The Forest and Rangeland Renewable Resources Planning Act of 1974 (RPA), as amended by the National Forest Management Act of 1976 (NFMA), was passed to make natural resource planning more rational and accountable. The RPA calls for planning at two levels: the national level and the forest level.

Two key documents produced at the national level are the Assessment and the Program. The Assessment describes the current forest and rangeland situation, and analyzes the environmental, social, and economic trends (and their consequences) that will likely affect the resource situation over the next 50 years. Opportunities for change, and obstacles to making changes, in current and future resource situations are described for both public and private lands. Based on the findings of the Assessment, the Secretary of Agriculture recommends to the Congress a 50-year RPA Program for the Forest Service. The Recommended Program is a strategic plan that establishes long-term resource management goals. In the planning process, alternative national plans are developed to reflect different emphases on the various resource management goals—different strategies for meeting societal needs over the next 50 years. Each alternative includes elements for all three branches of the Forest Service—the National Forest System, Research, and State and Private Forestry. Each strategy consists of many intermediate objectives that measure performance in attaining the goals.

In choosing which strategy or plan to recommend, the Secretary of Agriculture considers the environmental, social, and economic consequences of each alternative. To analyze the economic consequences of each plan, it is helpful for different levels and timing of resource outputs to be reduced to a common metric and period in time. Dollars have been selected as the metric and the present time as the period of comparison. Demand-side unit values must be estimated for each resource output or category of outputs to compute the value of benefits generated by each alternative plan. These unit values have been casually referred to as "RPA values." When supply costs are subtracted from the demand-side value of total resource outputs in any single year, the remainder is net value. Discounting net value to the present yields net present value (NPV). NPV is used to rank alternatives in decreasing order of economic value. The NPV by resource output and the overall ranking are important decision criteria. The guidelines, and some of the conceptual framework, for resource pricing and valuation for the RPA Program are discussed in USDA Forest Service (1989).

RPA values are also used in the forest planning process established under the NFMA. Again, these values are used to analyze economic consequences of differences in the level and mix of resource outputs, and to rank alternatives.

The effort reported here represents the first time a consistent method has been applied across regions and activities to estimate the economic value of recreation on Forest Service lands. Indeed, it is the first time RPA values have been estimated from primary data. The background work for the 1985 RPA values was a review of the economic literature on recreation demand values by Sorg and Loomis. Such information is useful but, as Sorg and Loomis state, "Surveys of the literature are not substitutes for region-specific estimates of the value of recreation" (Sorg and Loomis 1984:1).

The economic literature is replete with valuation studies of particular recreation areas under particular conditions for particular activities (see Sorg and Loomis (1984) and the updating of that work by Walsh et al. (1988)). Those studies used a variety of data sources from a variety of subsets of the general population, and a variety of modelling frameworks with a variety of independent variables and functional forms. They applied a variety of assumptions and came up with a variety of results. None of the studies is universally applicable, but all have something to say about the value of recreation. The study presented here is an attempt to employ the same source of data from the same time period, and the same model with uniform assumptions for several categories of recreation activities across several regions of the country. The Public Area Recreation Visitors Survey (PARVS) data used in this study were collected expressly for the purpose of providing information about the recreation uses and users of public lands. Some valuation work conducted for the 1990 RPA Assessment also used the PARVS data, but the context of that work was household markets, and the objective was to estimate resource scarcities and price variations (Cordell and Bergstrom 1989).

The advantage of using the same data source and the same model is the comparability it provides across activities and regions of the country. This study is unique in the insight it can provide to the relative values across activities within a region and between regions of the country.

What Question Does the 1990 RPA Program Analysis Pose?

The RPA Program Analysis is intended to contribute toward a strategic plan that establishes long-term resource management goals. One component of the Analysis involves consideration of the economic consequences of alternative strategies and a ranking of alternatives. Such consideration requires that resource outputs be expressed in a common metric for comparison. The chosen metric is dollars. Many forest outputs, particularly recreation outputs, do not move through formal markets and, hence, are not priced by the market in the same way outputs like timber are priced. Thus, the need arises for a valuation exercise like the one reported here.

A critical prerequisite to interpreting and applying the results of this study is to clearly specify the question being asked. Two possibilities are: (1) What is the value of the marginal unit of forest recreation output? What is the value the last person appearing at the site places on his recreation experience? (2) What would be the economic benefit lost if the site was closed to recreation? Another way to phrase the latter question is: What is the value of the recreation experience averaged over all users of the site?

The answers to these two questions are very different. The first question is usually answered by the price, the same concept of price as that for a loaf of bread. Price is termed a marginal value. This value is found at the intersection of the supply and demand functions. The *critical caveat* to this concept of value is that it depends on the good being price rationed.

The answer to the second question is the average consumer surplus. Consumer surplus is the difference between the maximum amount an individual is willing to pay to obtain a bundle of goods and the amount he actually pays. Graphically, it is the area under the demand function and above the price paid for the bundle of goods. Consumer surplus is a dollar measure of the excess value (or benefit) an individual receives from consuming a good, over and above what he pays to obtain the good. It represents the net benefit received by people recreating at a site.[2] Consumer surplus is generally a nonmarginal value. It is our view that the second question is the one being posed in the RPA Program Analysis. Consumer surplus is the valuation concept that correctly answers this question.

Some further distinction needs to be made between marginal and nonmarginal values. A nonmarginal value is the sum of the values of consumption units excluded (or included) by a nonmarginal change in the demand or supply of a good. A nonmarginal change in demand or supply is generally taken to result from a large change in quantity (or price) or condition of the good. A marginal value is the value of the unit of use excluded (or included) by a marginal change in the demand or supply of the good. A marginal demand or supply change is generally taken to result from a small change in quantity or condition of the good, for example, a change such that one less unit of the good is available. A key factor in this discussion is whether the good is price rationed.

Price rationing means that a fee, or price, is charged to use the good. All users who value the good at less than the fee are excluded from use. When goods are price rationed and price is increased, the nonmarginal value is the sum of the values of all those users who can no longer use the good because their value is less than the new (higher) fee or price. In the case of a price decrease, the nonmarginal value is the sum of the values for those users who can now use the good because their value is greater than the new (lower) price. In both cases, those users have the lowest values of all who consume the good. The marginal value for a price rationed good is the lowest valued unit consumed. When the price is raised, the user with the lowest value is excluded. When price is lowered, the user with the next lowest value is included.

The situation changes, however, when the good is not price rationed. When price is not used as a rationing device, the marginal value is not necessarily the lowest value. In this case, and recreation on public lands is a prime example, it is equally probable that any user of the good will be excluded (or included) when the demand or supply changes. Hence, the marginal value (as well as the nonmarginal value) can be anywhere in the range of values—from lowest to highest. In such a case, price, as the marginal value is frequently referred to, is not a useful concept of value. What is needed is the mathematical expectation of the value any randomly chosen user would place on the good. This expected value is the average consumer surplus.

This view is supported by the economic literature. In a widely accepted paper, Mumy and Hanke (1975) address exactly this issue. The first case they examine is one where the price of a publicly provided good is zero. This is the case at many Forest Service sites for many activities when no access fee is charged to recreate on Forest Service land. The second case is that of underpricing, when a price is charged but no pretense is made that it is related to economic efficiency or that it covers the cost of providing the good. This case is also relevant for some Forest Service sites and activities. In both these cases, where price is not used as a rationing mechanism, the theoretically correct concept of value is the average consumer surplus. The basis of this conclusion is that all demand units have an equal probability of being satisfied, as discussed above. Hence, it is not correct to assign the value that one individual (the last or marginal user) places on the good as the value of the recreation experience at the site. The correct value to assign is the mathematical expectation of the values received by all satisfied units of demand. This expected value corresponds to the average consumer surplus.

[2] *In order to capture that value in a market, the producer of the good would have to perfectly price discriminate. In that case, each individual would pay his maximum willingness to pay and consumer surplus would be zero. But whether the producer price discriminates (i.e., whether the surplus can be extracted) or not, the consumer surplus represents real economic value.*

Some Background on PARVS

The 1985–1986 Public Area Recreation Visitor Survey (PARVS) was (according to the PARVS Training Manual and Codebook) "a nationwide project developed by the USDA Forest Service, the National Park Service, the U.S. Army Corps of Engineers, the Tennessee Valley Authority, and several state agencies to provide highly credible and broadly comparable estimates of the economic importance of providing recreation opportunities on public lands." PARVS had three primary objectives:

1. "To describe the activity patterns of recreators onsite on public recreation lands."
2. "To obtain a description of the people visiting public recreation areas for recreation."
3. "To provide visitor expenditure data that would result in estimates of the income and employment growth resulting from publicly provided recreation opportunities."

PARVS consisted of an onsite questionnaire, administered to randomly selected recreation site users, and a detailed mail-back questionnaire. The mail-back questionnaire was administered to the people interviewed onsite who agreed to complete the more detailed questionnaire. The onsite portion of the survey was approved by the Office of Management and Budget (OMB) for use at all sites nationwide. The mail-back questionnaire was approved only for use in the Southern Region (Forest Service Region 8; fig. 1). The survey was administered at a variety of sites including national forests, national parks and monuments, U.S. Army Corps of Engineers reservoir sites, TVA recreation areas, state parks, state forests, and other state recreation areas. The only portion of the PARVS data accessible for this study was that collected at Forest Service sites.

Three distinct samples were used in this study. All are subsets of the PARVS Forest Service data set. The first subsample is the recreation sample. The intent with this subsample was to represent recreation at typical Forest Service ranger districts in the "lower 48" states. This sample was partitioned into primary activity trips to attempt to capture differences between different types of recreation activities. The second subsample was the Alaska recreation sample. This subsample was intended to represent recreation at typical Forest Service ranger districts in Alaska. Again, partitions were made in the data to look at different types of recreation activities. The wilderness subsample was intended to represent recreation use at Forest Service sites specifically designated as wilderness areas. At wilderness sites, no attempt was made to distinguish between different types of activities. The wilderness subsample contains sites both in the lower 48 states and in Alaska.

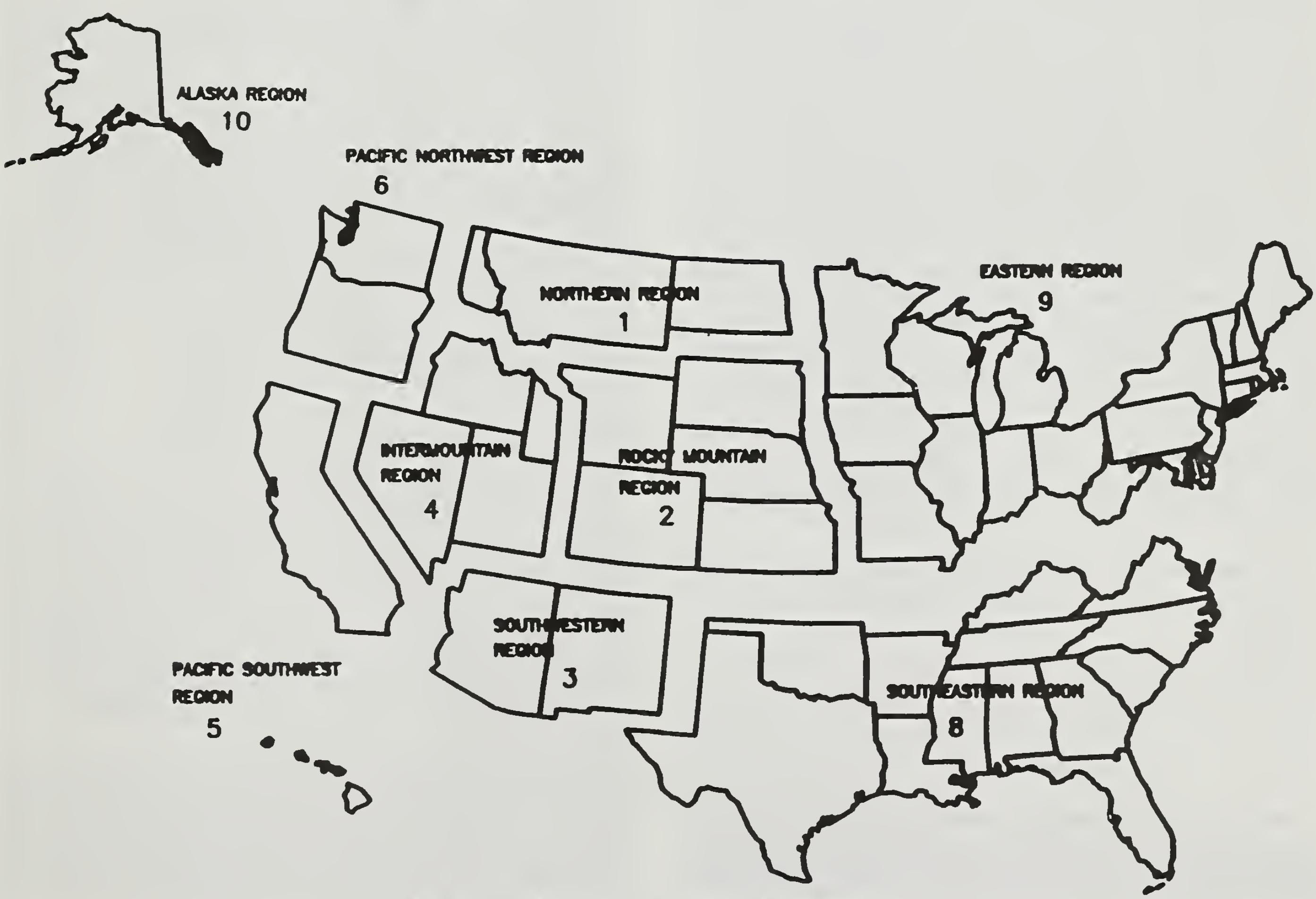

Figure 1.—Regions of the National Forest System.

The Reverse Gravity Model

The model used to estimate demand functions for this study was a variation of the gravity model. The gravity model has been used for modelling recreation demand in several studies (Cesario and Knetsch 1976, Ewing 1980, Sutherland 1982). The standard gravity model, as applied to recreation demand, considers the individual's choice of a recreation site, weighting alternative sites in inverse proportion to the cost of visiting them. The "reverse gravity model" used here considers the likelihood that a recreation visit observed at a particular site originated in one of a number of origins. In this variation of the gravity model, trip origins are weighted in inverse proportion to the cost to the users of reaching the recreation site.[3] This type of model was necessitated by the sampling strategy used in PARVS. PARVS used a choice-based sample of group trips at the recreation sites rather than a sample of the general population. Such choice-based samples are very common in recreation demand studies.

The PARVS sampling plan defined the Forest Service ranger district as the study site for sampling recreation users. Our data were a sample of recreation users interviewed at selected ranger districts. Because only a small number of sites were selected, it was not possible to model the variety and diversity of recreation sites available to people at a given origin location. We had to model the variety of origins providing trips to a given site. Additionally, an aggregate zonal model was required because recreationists were surveyed during one visit to a site. All observations represent one trip to the site. With no variation in the dependent variable (trips per individual or household), an individual model could not be estimated. The units of the dependent variable must be aggregated to trips per capita based on some larger population group. The units of aggregation were defined as counties, and independent variables were the relevant county averages. No information was available on the sampling rates at the sites from which to estimate total use of the sites during the sampling period. In short, the data limited the choice of models. The limitation is that the model must be theoretically appropriate for the type of choice-based sample PARVS represents. As long as the model is theoretically appropriate for the data, the results should be unbiased. The limited choice of models does not necessarily imply an adverse effect on the results.

The model consists of two independent components: the trip generation component and the trip distribution component.

Trip Generation Component:

$$N_j = g(h(A_j), M_j) \quad [1]$$

Trip Distribution Component:

$$Pr(i|j) = f(K_i, TC_{ij}, S_i) \quad [2]$$

where

N_j = the total number of recreation trips to site j;
$h(A_j)$ = a function of site characteristics or site attractiveness;
M_j = an index of accessibility of site j to the market area from which it attracts trips (market areas will be discussed in the data section);
$Pr(i|j)$ = the probability that a trip observed at site j came from origin i;
K_i = a vector of characteristics of origin i;
TC_{ij} = the cost of a round trip to site j from origin i;
S_i = a vector of the prices of substitutes for a trip to site j from origin i.

The trip generation model estimates the total number of recreation trips that will arrive at a given site. The trip distribution model estimates the relative proportions of those total trips coming from each origin within the relevant market area. The total demand for trips to site j from origin i, then, is the product of the trip generation component and the trip distribution component:

$$N_{ij} = N_j \, Pr(i|j) \quad [3]$$

where N_{ij} is the number of trips from origin i to recreation site j.

Equation [3] is a trip demand function from the point of view of the site operator. It represents the number of trips the site operator can expect to appear at the gate as a function of user cost, site characteristics, and market area characteristics. The site operator can induce changes in demand by manipulating site characteristics. For example, he could increase the capacity of a campground or open a new nature trail. These effects would enter the model through the trip generation component. The site operator can also experience exogenous (to the site) changes in the distribution of demanded trips from changes in the relationship between the site and its surrounding market area. For example, a new housing development could be built close to the site, or a new road could be built that dramatically reduced the time and expense of getting to the site. These effects would enter the model through the trip distribution component.

In the short run, site characteristics are fixed. With constant levels of site characteristics, consumer surplus per trip can be derived using only the trip distribution component of the model. Hence, we can abstract from the total model and focus on the distribution model, with the total trips to a site taken as given. Abstracting from the trip generation component of the model actually implies a trip generation model. This implied model, and the trip generation model in general, are discussed in appendix 1.

The behavioral process implied by the model used here has been explored from the point of view of the origins, and found to be plausible. The behavioral process is based on a fixed effects Poisson distribution, and is similar to that discussed by Hausman, Hall, and Griliches (1984).

[3] *The "reverse gravity model" will be discussed in detail by: Hellerstein, D. M.; McCollum, D. W.; Peterson, G. L. 1989, in preparation. A reverse gravity specification for the travel cost model. Draft manuscript, Rocky Mountain Forest and Range Experiment Station, Forest Service, USDA, Fort Collins, CO.*

Because we are able to abstract from the trip generation component of the model, it becomes nothing more than a scaling factor. Total trips can be taken as given. This, combined with the problems of not knowing the PARVS sampling rate or total trips to the sites, led us to standardize the number of trips. Current (at the time PARVS was conducted) levels of trips to each site were set to 100, and all further work was done in the units "proportion of current trips." Hence, the dependent variable in the estimated equation was the number of trips (out of a total of 100 trips to the site) arriving at a site from a particular origin.

The Applied Trip Distribution Model

The trip distribution component of the model was specified as a multinomial logit model:

$$Pr(i|j) = \frac{\exp(f(K_i, TC_{ij}, S_i))}{\sum_{h=1}^{m} \exp(f(K_h, TC_{hj}, S_h))} \quad [4]$$

where $f(K_i, TC_{ij}, S_i)$ was of the form:

$$b_k \ln(K_i) + b_c \ln(TC_{ij}) + b_s \ln(S_i)$$

and there are m origins that deliver trips to site j. Because the model was estimated as an aggregate model with the aggregation units defined as counties, the independent variables in the model were defined as follows:

K_i = origin characteristics; these were:
- POP = county population
- INC = per capita personal income in the county
- EDUC = proportion of the county population with a college education
- URBAN = proportion of the county population living in an urban area as defined by the Census Bureau
- WHITE = proportion of the county population classified by the Census Bureau as white.

$$TC_{ij} = 2\ DIST_{ij}\ CPM + GRP_i\ 2\ \frac{DIST}{40}_{ij}\ \frac{0.3\ INC}{2080}_i;$$ where

- DIST = one-way distance from origin i to site j
- CPM = vehicle operating cost per mile
- GRP = group size
- $\frac{DIST}{40}$ = estimated one-way travel time from i to j
- $\frac{0.3\ INC}{2080}$ = value of travel time = 30% of the estimated hourly wage rate
- S_1, S_2 = travel cost from origin i to the two closest Forest Service districts other than j.

The origin characteristics were taken from the 1980 Census of Population (U.S. Bureau of the Census 1983). Those data were 6 years old at the time the PARVS data were collected. Nevertheless, it was considered to be the best data available on a consistent basis across origin zones. Because group trips were used in the dependent variable, per capita income was selected over personal or household measures of income. Travel cost was based on round-trip distance from the center of the origin county to a point on the Forest Service ranger district identified by the district as the most heavily used area or access point. Vehicle operating cost was 13 cents per mile; it included costs for gasoline, oil, and maintenance items. This represents the marginal cost of operating a vehicle. Cost was determined using data from the U.S. Department of Transportation (1984) inflated to 1986 dollars using the consumer price index for gasoline. Higher mileage charges, such as those allowed by the Internal Revenue Service, include more than the marginal cost of operating a vehicle and are not appropriate for this study. Group size was the average number of people travelling together in the same vehicle, reported on the PARVS questionnaire. Travel time was estimated by dividing the distance by an average speed of 40 miles per hour. Travel time was valued at 30% of the wage rate estimated by dividing per capita income by 2080 hours. Valuing travel time at 30% of the wage rate is consistent with recent entries in the economic literature (Bishop et al. 1988, Kealy and Bishop 1986) and with the guidelines set forth by the Water Resources Council.

Substitutes were defined to be the two closest Forest Service ranger districts other than the one on which the PARVS respondent was contacted. This was done for pragmatic reasons because the only data on substitutes consistently available for all origins were for Forest Service ranger districts. A broader range of substitute sites, including national parks and forests, state and county parks, forests, and recreation areas would have been more desirable. Likewise, in the wilderness models, substitutes were defined as the two closest Forest Service designated wilderness areas other than the one at which the respondent was contacted. The travel cost to the substitute sites was calculated the same way as for the site to which the recreation trip was taken. We are working with group trips in the dependent variable and group cost for the travel cost and substitute variables.

This model specification reduces to a multiplicative power function:

$$Pr(i|j) = \frac{POP_i^{b_1}\ TC_{ij}^{b_2}\ S_{1i}^{b_3}\ S_{2i}^{b_4}\ EDUC_i^{b_5}\ URBAN_i^{b_6}\ WHITE_i^{b_7}\ INC_i^{b_8}}{\sum_{h=1}^{m} POP_h^{b_1}\ TC_{hj}^{b_2}\ S_{1h}^{b_3}\ S_{2h}^{b_4}\ EDUC_h^{b_5}\ URBAN_h^{b_6}\ WHITE_h^{b_7}\ INC_h^{b_8}} \quad [5]$$

The parameters b_1 through b_8 were estimated using maximum likelihood techniques.

The estimated trip distribution model is analogous to the first-stage demand function (visitation rate equation) in the traditional travel cost model. A standard second-stage travel cost process was used to produce a site demand function. The travel cost variable (TC_{ij}) in the numerator of the trip distribution model was increased incrementally up to a maximum travel cost, and a second-stage demand function was traced out. The denominator in the trip distribution model was held constant as TC_{ij} was increased in the numerator. Because TC_{ij} appears in only one component of the summation, the difference between the summed denominator when TC_{ij} is increased and when it is not should be relatively small. The result of holding the denominator constant during the integration is part of the implied trip generation model discussed in appendix 1. It is the second-stage demand function that is actually observed by the site operator. Hence, this is the function from which the measures of consumer surplus were derived.

The Alaska Model

There were some differences in the way the trip distribution model was applied to Alaska (Forest Service Region 10) relative to the preceding discussion of the recreation and wilderness models in the lower 48 states. First, it was considered unrealistic to think that a person from the lower 48 states would go to Alaska to visit a single Forest Service ranger district. As a result, the "site" was considered to be the whole of Alaska. People taking multiple destination trips to Alaska, when all their destinations were in Alaska, were considered to be taking a single destination trip to Alaska. Therefore, the values reported for Alaska are to be interpreted as the value of a trip to Alaska and not for any particular site within Alaska. Second, the origin zones were defined to be states rather than counties. This was done because of the relatively small number of counties that were represented in the PARVS data. If counties had been used as the aggregation units there would have been much less variation in the dependent variable (trips from an origin) and a huge number of origins delivering zero trips. Admittedly, the higher level of aggregation could lead to other problems, such as assuming away differences that may exist in subgroups of the aggregation. In view of the alternative, the higher level of aggregation appears reasonable. In addition, for the Alaska wilderness model, the size of the sample made it necessary to aggregate some neighboring origin states. Third, substitute sites were left out of the Alaska models because of our consideration of the whole of Alaska as the recreation site as well as the problem of defining what would be a consistent substitute for a trip to Alaska. This means we are implicitly assuming Alaska to be a unique recreation site—not a totally unreasonable assumption. Finally, the aggregation of activities was somewhat different for the Alaska recreation models than for those in the lower 48 states.

The cost of travel to Alaska was calculated by summing two separate travel cost components. The first component used road miles between the origin state and Seattle. It was assumed that people making the trip to Seattle would travel on main highways rather than the primarily local roads used in visiting sites in the lower 48 states. Hence, travel time was estimated by dividing the distance by an average speed of 50 miles per hour, rather than the 40 miles per hour used in the lower 48 states. The second component of travel cost assumed that people would take a ferry from Seattle to Alaska; it used the great circle distance times a factor of 18 cents per person per mile and a speed of 20 miles per hour. The cost per mile and average speed estimates came from the Alaska Department of Fish and Game.

Levels of Modelling and Aggregation

Two levels of modelling were used in this study. The first was the general recreation level. For the general recreation models, all trips were aggregated, regardless of primary activity, and a separate model estimated for each Forest Service region. An important distinction to be made is that the regional models discussed here are not truly regional, in the sense of capturing the diversity contained in a Forest Service region. An example of a regional model in that sense is found in Sutherland (1982). Rather, the models presented here are intended to model a "typical Forest Service recreation site" in that region. The term "regional models," as used in this report, denotes that the model was estimated using only sites in the given region.

It was assumed that the same underlying demand process was present at all sites within a region. This allowed observations from each site in the region to be stacked. Hence, the models were estimated as if all observations from all sites in a region were from a single site. This process homogenizes sites and behavior in a region, and ignores differences between sites. To the extent that one is interested in looking at the value of a trip to a typical Forest Service site in a region, such homogenization is acceptable.

The second level of modelling was by primary activity. For these models, trips were partitioned based on the reported primary activity of the trip. While recreationists did not necessarily participate exclusively in their reported primary activity, it was assumed that other activities were secondary to the declared primary activity. Hence, the value of the trip could be attributed to that primary activity. This involves a double layer of weak complementarity[4] assumptions. First, weak complementarity is invoked to allow the value of the trip to be attributed to the recreation site. Another weak complementarity-like assumption is invoked to allow the value of the trip to be attributed to a primary activity.[5] A preferable course might be to admit that recreation trips are inherently multiple activity trips. The value would be interpreted as the value of a trip whose primary purpose is X, rather than as the value of activity X. It

[4]*Weak complementarity is a technical condition that, if it holds, allows demand functions for nonmarket (or public) goods to be revealed by demand functions for market (or private) goods. A public good and a private good are weakly complementary if, when consumption of the private good is zero, the demand, or marginal willingness to pay, for the public good is also zero. In the case at hand, we are assuming the demand for recreation at Forest Service sites and trips to the sites are weakly complementary. If no trips are taken to the site, then the demand for recreation at the site is zero. Weak complementarity is discussed by* Mäler (1974) and by Freeman (1979).

[5]*This second layer of weak complementarity assumes that if the primary activity were not available at the recreation site, the trip would not have been made. If the primary activity were available but other activities were not, the trip would still be made. Hence, the value of the trip can be attributed to the primary activity.*

is a subtle but important distinction. As with the general recreation level models, these models are intended to model participation in the primary activities on typical Forest Service districts in the region.

It was not possible to estimate a regional model for each primary activity trip type and region. Sparseness of data in some activity partitions caused us to aggregate regions. When aggregation was necessary, we aggregated as little as possible. Table 1 shows the aggregation level that was used for each primary activity and region. The Alaska models (Region 10) do not appear in table 1 because of the aforementioned differences in activity aggregations. All of the Alaska models were estimated exclusively for Alaska. They were all regional models.

The Data and Associated Methods

This section provides more detail about the Public Area Recreation Visitors Survey (PARVS). It also describes the data transformations and manipulations that were applied to the raw PARVS data.

Table 1.—Levels of aggregation for first-stage activity demand models.

Activity	Region	Level of aggregation[a]
Developed camping	1	Regions 1,2,4
	2	Regions 1,2,4
	3	Regional
	4	Regions 1,2,4
	5	Pacific Coast
	6	Pacific Coast
	8	Regional
	9	Regional
Primitive camping	1	Rocky Mountain
	2	Rocky Mountain
	3	Rocky Mountain
	4	Rocky Mountain
	5	Pacific Coast
	6	Regional
	8	Eastern
	9	Eastern
Big game hunting	1	Regional
	2	Regional
	3	Regions 1,3,4
	4	Regional
	5	No Model
	6	Regional
	8	Regional
	9	Eastern
Cold water fishing	1	Regional
	2	Regional
	3	Regions 3,4
	4	Regional
	5	Pacific Coast
	6	Pacific Coast
	8	Eastern
	9	Regional
Warm water fishing	1 – 6	No models
	8	Eastern
	9	Eastern
Sightseeing	1	Rocky Mountain
	2	Rocky Mountain
	3	Rocky Mountain
	4	Rocky Mountain
	5	Pacific Coast
	6	Pacific Coast
	8	Eastern
	9	Regional

Activity	Region	Level of aggregation[a]
Day hiking	1	Rocky Mountain
	2	Rocky Mountain
	3	Rocky Mountain
	4	Rocky Mountain
	5	Pacific Coast
	6	Pacific Coast
	8	Eastern
	9	Regional
Picnicking	1	Rocky Mountain
	2	Rocky Mountain
	3	Rocky Mountain
	4	Rocky Mountain
	5	Pacific Coast
	6	Pacific Coast
	8	Eastern
	9	Regional
Swimming	1 – 4	No models
	5	Regional
	6	Pacific Coast
	8	Regional
	9	Eastern
Wildlife observation	1	Western
	2	Western
	3	Western
	4	Western
	5	Western
	6	Western
	8,9	No models
Gathering forest products	1	Rocky Mountain
	2	Rocky Mountain
	3	Rocky Mountain
	4	Rocky Mountain
	5	Western
	6	Western
	8	No model
	9	Nationwide
Wilderness recreation	1	Regions 1,3,4
	2	Regional
	3	Regions 1,3,4
	4	Regions 1,3,4
	5	Regional
	6	Pacific Coast
	8	Regional
	9	Eastern
	10	Regional

[a]*Regional indicates that the model was estimated with data exclusively from that region. Other levels of aggregation are:*
Rocky Mountain—Regions 1,2,3,4
Pacific Coast—Regions 5,6
Eastern—Regions 8,9
Western—Regions 1,2,3,4,5,6
Nationwide—All regions except Alaska.

The Public Area Recreation Visitors Survey

The basic sampling unit for PARVS was a Forest Service ranger district. From the 786 ranger districts on all national forests, 57 were selected for PARVS recreation site interviewing (table 2). Districts were selected to ensure representation of recreation use at the regional level based on three main criteria: (1) total recreation use in a district—heavy versus light use districts; (2) type of use—developed versus dispersed recreation use districts; and (3) downhill skiing—within heavy use districts, the districts with the lightest downhill skiing use were selected. Districts were also selected across regions to reflect major physiographic types (mountains, coastal areas, lakes, piedmont, etc.). An effort was made to gather data at a representative sample of Forest Service

Table 2.—PARVS Forest Service recreation sites.

Ranger District	Forest	State	FS Region	Interviews
Elk City	Nezperce	ID	1	40
Salmon	Nezperce	ID	1	42
Priest Lake	Idaho Panhandle	ID	1	69
Ashland	Custer	MT	1	15
Beartooth	Custer	MT	1	102
Hungry Horse	Flathead	MT	1	43
Dillon	White River	CO	2	91
Blanco	White River	CO	2	64
Pine	San Juan	CO	2	27
South Platte	Pike-San Isabel	CO	2	108
Tensleep	Bighorn	WY	2	68
Wapiti	Shoshone	WY	2	30
Springerville	Apache-Sitgreaves	AZ	3	63
Payson	Tonto	AZ	3	71
Espanola	Santa Fe	NM	3	24
Mimbres	Gila	NM	3	44
Glenwood	Gila	NM	3	62
New Meadows	Payette	ID	4	70
Teton	Targhee	ID	4	11
Flaming Gorge	Ashley	UT	4	47
Cedar City	Dixie	UT	4	57
Logan	Wasatch-Cache	UT	4	134
Big Piney	Bridger-Teton	WY	4	29
Valyermo	Angeles	CA	5	153
Monterey	Los Padres	CA	5	28
Minarets	Sierra	CA	5	34
El Dorado	Lake Tahoe Basin M.U.	CA	5	37
Mammoth	Inyo	CA	5	30
Goosenest	Klamath	CA	5	9
Oak Ridge	Willamette	OR	6	35
McKenzie	Willamette	OR	6	15
Crooked River	Ochoco	OR	6	53
Klamath	Winema	OR	6	26
Big Summit	Ochoco	OR	6	110
Unity	Wallowa-Whitman	OR	6	28
Ashland	Rogue River	OR	6	58
Cle Elum	Wenatchee	WA	6	124
White River	Mt. Baker-Snoqualmie	WA	6	175
Boston Mnt	Ozark-St. Francis	AR	8	19
Seminole	NFS in Florida	FL	8	87
Oconee	Chattahoochee-Oconee	GA	8	47
Chickasawhay	NFS in Mississippi	MS	8	62
Cheoha	NFS in North Carolina	NC	8	42
Croatan	NFS in North Carolina	NC	8	18
Wambau	Francis Marion & Sumter	SC	8	25
Tellico	Cherokee	TN	8	90
Unaka	Cherokee	TN	8	55
Tell City	Wayne-Hoosier	IN	9	100
Mio	Huron-Manistee	MI	9	59
Androscoggin	White Mountain	NH	9	68
Ironton	Wayne-Hoosier	OH	9	67
Eagle River	Nicolet	WI	9	99
Greenbriar	Monongahela	WV	9	8
Juneau	Tongass	AK	10	167
Ketchikan	Tongass	AK	10	27
Anchorage, Seward[a]	Chugach	AK	10	103

[a]*Combines data from the two selected districts on the Chugach National Forest.*

ranger districts within each region. Overall recreation use was the criterion, with consideration given to developed versus dispersed recreation, not use or quality of the experience for any particular recreation activity. Besides the 57 ranger districts selected for recreation interviewing, 17 wilderness area sites (of the 158 designated wilderness areas nationwide) were selected (table 3). The targets were to conduct 200 interviews on each ranger district: 100 during the summer and 50 each during the fall/winter and winter/spring periods.

Local Forest Service managers were consulted in selection of interview locations on each district. Roadside traffic stops were set up at each interview location with the intent to interview people in their vehicles as they exited the Forest Service district at the end of their recreation trip. Bad weather and safety considerations forced some interviewing indoors to visitor centers, museums, interpretive sites, and other such areas in the middle of the respondents' trip. Interviewers were also to keep track of the number of vehicles leaving the area between and during the interviews in order to estimate a sampling rate. This procedure was difficult to administer, particularly at the indoor locations, so the number of intervening vehicles was not recorded. Hence, no data are available from which a sampling rate could be estimated.

Once the roadside interview location was set up, the flag person stopped the first vehicle to come by. If that vehicle was from the targeted group, namely recreationists exiting the site, an interview was conducted, contingent on willingness of the respondent to participate. Upon completion of the interview, the next vehicle that could be directed into the interview station without disrupting or confusing the flow of traffic was pulled over and the cycle begun again. This process constituted a random selection of groups using the recreation site. Within each vehicle, the person to be interviewed was selected randomly. Only persons aged 12 or older were eligible to be interviewed. Random selection of groups, and respondents within a group, was also done for nonroadside interviews.

The interviews conducted on Forest Service lands were conducted at specific times, not periodically throughout the season. In accordance with the PARVS training manual and codebook, 7 days were spent on each ranger district.

Refining the Raw Data

The total Forest Service component of the lower 48 state PARVS interviews numbered 7,172, of which 976 came from designated wilderness areas. Of the remaining 6,196, 448 refused the interview, and 171 had no recreation site identified on the survey form, leaving a sample of 5,577 interviews from the 57 PARVS sites, 90% of the original nonwilderness sample.

Missing responses in the data limited the usefulness of some parts of the PARVS questionnaire, including reported miles to the site, respondents' identification of substitute sites and activities, reported distances to substitute sites, reported hours spent participating in specific recreation activities, and amount of time spent at other recreation sites on multiple destination trips. Missing data for other variables (origin of the recreation trip, whether the trip was single or multiple destination, primary activity/purpose of the trip, etc.) limited the sample sizes. To the extent possible, statistical procedures were used to classify missing observations into useful codes. The following procedures were used to minimize the impact of missing data on key variables in our analysis.

Travel cost models require identification of an origin and destination for each observation in the data set. Counties were selected as the basic unit of analysis for this study. County origins were not listed for 400 respondents (about 6% of the potential PARVS recreation interviews). Where possible, the respondent's zip code was used to identify an origin county. One hundred seventy-eight respondents were assigned county codes in this manner. The county used was always the county of ori-

Table 3.—PARVS Forest Service wilderness sites.

Wilderness areas	Forest	District	State	Region
Great Bear	Flathead	Hungry Horse	MT	1
La Garita	Gunnison-Rio Grande	Cebolla	CO	2
Indian Peaks	Arapaho/Roosevelt	Boulder	CO	2
Pusch Ridge	Coronado	Santa Catalina	AZ	3
Kachina Peaks	Coconino	Flagstaff	AZ	3
Dome	Santa Fe	Jemez	NM	3
Jedediah Smith	Targhee	Teton Basin	ID	4
Mt. Shasta	Shasta-Trinity	Mt. Shasta	CA	5
San Gorgonio	San Bernardino	San Gorgonio	CA	5
Wenaha-Tucannon	Umatilla	Pomery	OR	6
Mt. Jefferson	Willamette	Detroit	OR	6
Colonel Bob	Olympic	Quinault	WA	6
Juniper Prairie	Ocala	Lake George	FL	8
Joyce Kilmer/Slickrock	Nantahala	Cheoha	NC	8
Hercules Glades	Mark Twain	Ava	MO	9
Blackjack Springs	Nicolet	Eagle River	WI	9
Misty Fjord	Tongass	Misty Fiords	AK	10

gin for the trip, even if that was not the home county of the respondent. The PARVS questionnaire contained questions to make that distinction.

An assumption made in traditional travel cost analysis is that the site being studied is the sole destination and purpose of the trip. A question on PARVS asked respondents to classify their trip as single or multiple destination. Six hundred ninety-five respondents listed their trip as multiple destination. In the absence of information on the proportion of their trip spent at the site in question, there was no way to allocate joint costs or trip value among all the destinations visited on the trip. (A PARVS question that would have allowed an allocation of joint costs and trip value was one of the questions with missing data problems.) Those respondents (the 695) were dropped from the analysis. Another 1,803 respondents did not respond to that particular question. In an attempt to recover as many of those 1,803 observations as possible, a two-step procedure was developed to classify the nonrespondents as single destination trips or indeterminate. If 80% of the respondents to the single/multiple destination trip question at a given site (each site was analyzed separately) indicated the trip was single destination, that site was classified as a "primarily single destination trip site." Those sites were eligible for step two of the procedure. The missing observation respondents from sites not meeting the 80% criterion were dropped from the analysis. Forty-five sites qualified for step two.

In the second step, a nonparametric chi-square analysis was used to compare those not answering the single/multiple destination trip question with the respondents who classified their trip as single destination. The reported number of hours spent travelling to the site was used as the nonparametric variable for the analysis. This variable was converted to a categorical variable for the test. The chi-square analysis compared the observed frequencies (from the missing response group) with the expected frequencies (from the single destination trip group). A significant difference between the two rejected the hypothesis that the two groups came from the same population. Again, separate analyses were carried out for each site. At 18 of the 45 sites eligible for this second step, this hypothesis *could not* be rejected. For those sites, the missing data group was combined with the single destination trip group. At the remaining 27 sites, the missing data group was dropped from the analysis. This two-step procedure resulted in 546 of the 1,803 respondents whose single/multiple destination trip response was missing being successfully classified as single destination trips and recovered for the analysis.

The RPA program analysis calls for recreation values to be reported by specific recreation activities. The PARVS questionnaire responses to the activity participation questions indicated that the recreation trips observed by PARVS were undeniably multiple activity trips. A question on the survey did, however, ask respondents to name the activity that was the main reason for their trip to the site. On this basis the sample was partitioned into primary activity trip types. Table 4 shows the PARVS activities that were combined to make up the primary activity groups used in this study. Using the weak complementarity assumption discussed earlier, the value of the trip was attributed to the primary activity.

Table 4.—PARVS activities included in primary activity groups.

Primary activity group	PARVS activities
Developed camping	Camping in developed campgrounds
Primitive camping	Backpacking
	Camping in primitive campgrounds
Swimming	Outdoor pool swimming
	Other outdoor swimming
	Sunbathing
	Surfing
	Unclassified swimming
Wildlife observation	Wildlife observation and photography
	Other nature study
	Photography
Day hiking	Day hiking
	Walking for pleasure
	Running or jogging
	Bicycling
Cold water fishing	Cold freshwater fishing
	Anadramous fishing
Warm water fishing	Warm freshwater fishing
Big game hunting	Big game hunting
Picnicking	Picnicking
	Family gathering
	Enjoying outdoors
	Going to parks
	Other places of enjoyment
	Relaxing
Sightseeing	Sightseeing
	Driving for pleasure
	Travelling
Gathering forest products	Gathering firewood
	Collecting berries
All other activities	Canoeing or kayaking
	Horseback riding
	Small game hunting
	Using self-guided trails
	Reading roadside markers
	Visiting museums
	All other PARVS activities

Discriminant analysis was used to assign primary activities to respondents not answering the primary activity question. Within each primary activity group (composed of those who *did* answer the primary activity question), the proportion of total activity time spent in each activity was calculated. These time-in-activity profiles were used in the discriminant analysis to derive classification functions. The classification functions were then used to predict the primary activity for those persons who left the primary activity question blank. This analysis did not affect the overall sample size (used for the general recreation level models) but did increase the sample size in each of the primary activity partitions (used for the primary activity trip level models).

The final sample size of PARVS general recreation interviews was 3,072. If the classification procedures discussed above had not been used, the sample size would have been 2,348. The classification procedures increased our sample by 31%.

The PARVS recreation sample of 3,072 was used to estimate models for the "lower 48" states. It includes neither Alaska nor the designated wilderness areas. The final sample used to estimate the Alaska models consisted of 297 interviews with out-of-state visitors. These data, too, were partitioned into primary activity groups. The final usable wilderness area sample consisted of 615 interviews (576 in the lower 48 states and 39 in Alaska). In both cases, Alaska and wilderness, the procedures described above for the lower 48 states were used to recover interviews where missing data presented a problem.

Table 5 shows the final sample sizes (in terms of the number of interviews completed) in each of the primary activity partitions and in wilderness recreation for each Forest Service region in the lower 48 states. Table 6 gives comparable information for Alaska. The column totals in tables 5 and 6 give the number of interviews making up the general recreation model sample in each region. In addition, table 6 shows the activity aggregations used in the Alaska models—different than those used in the lower 48 states.

Table 6.—Numbers of PARVS recreation interviews by primary activity in Forest Service Region 10 (Alaska).

Primary activity		Interviews
Developed site activities		37
Camping, picnicking, swimming		
Sightseeing		135
Mechanized travel and viewing scenery		
Wildlife related activities		31
Hunting	1	
Fishing	18	
Nonconsumptive wildlife	12	
Other activities		94
Total (General recreation)		297
Wilderness recreation		39

Origins, Destinations, and Market Areas

The number of trips observed to each of the recreation sites is equal to the number of interviews completed at each site. As discussed previously, the reverse gravity model used in this study is essentially a share model. The dependent variable used in the model was the number of trips to a site from a particular origin. Some origins delivered more than one trip and other origins within a site's market area delivered zero trips. Hence, the number of observations (or data points) used in the estimation procedure was the number of origins in a site's market area rather than the number of trips to the site.

Counties were the basic unit of origin in this study. The sites were Forest Service ranger districts. Distances between origins and sites were estimated by using circuity factors to adjust the great circle distances between latitude and longitude points to highway miles. The great circle distance is essentially the air miles between two points. Circuity factors are state-specific adjustment factors to convert, on average, great circle distance to highway miles—both on an intrastate and interstate basis (U.S.

Table 5.—Numbers of PARVS recreation interviews by primary activity and Forest Service Region.

Primary activity	Forest Service Region 1	2	3	4	5	6	8	9	Total
Developed camping	48	37	71	32	54	109	35	52	438
Primitive camping	10	19	11	8	8	74	27	24	181
Swimming	7	1	1	2	42	16	120	85	274
Wildlife observation	3	4	4	2	7	17	2	5	44
Day hiking	7	27	17	12	28	8	4	23	126
Cold water fishing	45	81	43	53	41	69	23	27	382
Warm water fishing	0	0	1	2	5	8	12	26	54
Big game hunting	37	60	17	109	4	77	63	22	389
Picnicking	15	24	17	15	44	22	41	40	218
Sightseeing	43	34	25	27	25	58	27	30	269
Gathering forest products	16	1	12	11	9	21	0	6	76
Other activities	80	100	45	75	24	145	91	61	621
Total (General recreation)	311	388	264	348	291	624	445	401	3,072
Wilderness recreation	7	91	72	23	104	86	165	28	576

Department of Commerce 1978). The estimations were done using a precursor to the ZIPFIP software package.[6] Distances were calculated from the geographic center of the origin county to a representative point on the ranger district. These representative points were determined in conjunction with district recreation staffs. The points were defined as the single recreation site or area that attracts the most trips (visits) by recreationists or a site near the center of the most heavily used geographic area of the district, excluding downhill ski areas.

There would have been some advantages to using the reported distances from the PARVS data. Two factors prevented this, however. On many of the surveys the distance question was left blank. Second, there were counties used in the estimation that delivered zero trips to the site. There were no survey responses at all for those origins. As a result, calculated distances between origins and sites were used.

Market areas are the geographic areas from which the recreation sites attract visits. To define market areas, a graphics/mapping program was used to display the distribution and frequency of recreation trips coming from the counties around each PARVS site. Market areas were delineated on a site by site basis with consideration given to both the distribution and frequency of visits to the site. This is consistent with the arguments presented by Smith and Kopp (1980). In order to estimate the models, consideration also had to be given to the number of zero visit counties included in a site's market area. This amounted primarily to eliminating very distant origins delivering one trip. At one site in Colorado, for example, the bulk of the visits came from a relatively local band of counties around the site. There were, however, visits observed from three or four counties in Texas. It was decided to drop those counties from the market area on the assumed basis that trips to the site from that distance involved a different underlying demand process. It was also considered probable that those were misclassified multiple destination trips. Origins dropped from the market area were not used to estimate the first-stage share models. Determination of market areas was done at the general recreation level—based on all trips to the site—and not for each individual primary activity trip type. About six trips per PARVS site, for a total of 331 trips across all sites, were eliminated because they came from outside a defined market area.

The distances to substitute sites, identified for each origin in a market area, were calculated as great circle distances adjusted by circuity factors, the same as the distances to the sites at which the interview occurred. The demographic variables, describing characteristics of each origin county, came from the 1980 Census of Population. Demographic variables presented the same problem as the distance variable; namely, there were missing responses in the PARVS data, and no survey data at all for zero-visit counties.

[6] *Hellerstein, D.M.; McCollum, D.W.; Donnelly, D.M. 1989. "ZIPFIP: A Zip and FIPS Database Package." Draft manuscript, USDA, Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.*

Characteristics of Recreation Trips

Tables 7, 8, and 9 show the average group size and average number of days onsite for each region and primary activity trip type, across the recreation, Alaska, and wilderness samples. These simple averages of the responses to questions on the PARVS were used as the conversion factors for moving between the units reported in the Results section. Group size is the reported number of people travelling together in the same vehicle. Average days onsite per person per trip was derived by dividing the average total hours onsite per person per trip by 24. Average total hours onsite is the difference, in hours, between the time the respondent reported arriving onsite and the time he reported leaving the site, both recorded in the PARVS data. The accuracy of these numbers depends on the accuracy of the respondent's recall of when the group arrived onsite and the projected time they would be leaving the site in the case of a nonexit interview. In the case of an exit interview, the time of the interview is the departure time. Average days onsite per person per trip represents the number of calendar days the person spent onsite. This corresponds to the number of activity occasions per person per trip. An activity occasion is defined as a person participating in an activity on a calendar day. This is the unit agreed to by the RPA staff to be reported in place of the more traditional, but widely controversial, recreation visitor day (RVD).

The conversion factors are presented for each region and for each type of primary activity trip. They are also presented on a nationwide basis (all regions combined) for each primary activity trip type, and on a general recreation basis (all trip types combined) for each region. In calculating these conversions, the mean was substituted for regions and activities having small sample sizes. When the sample size dropped below five for either the group size or onsite time variable, the national mean (by primary activity trip type) for that variable was substituted. In addition, the Region 4 warm water fishing trips were excluded from the national averages because both the group size and the length of time onsite greatly exceeded the averages from all other regions and were judged to be outliers.

Results

Model Estimation

The estimated trip distribution models are summarized in appendix 2. The coefficients from the final models, their *t*-statistics, and goodness-of-fit measures, along with sample size information, are presented en masse. The dependent variable was the number of trips arriving at the site from a particular origin. For the general recreation models, the coefficients on the travel cost variables are uniformly negative and very significant. The coefficients on population are positive, ranging from 0.453 to 0.974, and very significant. The two measures of substitute sites were highly correlated, so one of the measures was dropped from the model. In all regions, the coefficient

Table 7.—Conversion factors for recreation site consumer surplus values.

Region	Units	Devel. camp.	Prim. camp.	Swim.	Wildlife obsv.	Day hiking	Cld wat fishing	Wrm wat fishing	Big game hunting	Picnic	Sight-seeing	For. prod.	Gen. rec. (all trps)
		Primary Activity Trip Type											
1	Avg. Group Size[a]	3.20	2.96[c]	3.33	2.64[c]	2.29	3.09	2.61[c]	2.42	3.40	2.64	2.36[c]	2.97
	Avg. Days[b]	3.90	3.17	0.63[c]	2.94[c]	1.24[c]	1.15	1.44[c]	5.18[c]	2.56	0.90	2.42[c]	2.81
2	Avg. Group Size	2.89	2.56	3.39[c]	2.64[c]	2.42	2.80	2.61[c]	2.19	3.15	2.48	2.36[c]	2.52
	Avg. Days	2.14	2.06	0.63[c]	2.94[c]	0.76	3.25	1.44[c]	3.25	1.91	0.45	2.42[c]	2.09
3	Avg. Group Size	2.91	2.50	3.39[c]	2.64[c]	2.46	2.65	2.61[c]	2.60	3.83	2.90	2.45	2.77
	Avg. Days	3.72	2.73[c]	0.63[c]	2.94[c]	1.39	3.24	1.44[c]	2.65	1.82	0.88	2.42[c]	2.80
4	Avg. Group Size	3.58	2.96[c]	3.39[c]	2.64[c]	1.91	2.65	2.61[c]	2.25	3.85	3.16	2.36[c]	2.81
	Avg. Days	3.26	3.17	0.63[c]	2.94[c]	1.24[c]	3.40	1.44[c]	7.31	2.47[c]	0.63	2.42[c]	3.98[d]
5	Avg. Group Size	3.08	2.75	2.90	2.33	2.29	2.49	2.61[c]	2.33[c]	3.53	2.83	2.36[c]	2.81
	Avg. Days	3.73	2.99	1.26	2.94[c]	2.93	1.31	1.44[c]	5.18[c]	2.61	0.90[c]	2.42[c]	2.28
6	Avg. Group Size	2.63	2.66	2.88	3.12	2.28[c]	2.58	2.61[c]	2.44	3.25	2.28	2.10	2.58
	Avg. Days	4.39	2.68	0.45	1.80	1.24[c]	1.09	1.44[c]	7.73	1.14	0.84	3.84	3.06
8	Avg. Group Size	2.34	3.15	3.55	2.64[c]	2.28[c]	2.45	2.61[c]	2.42	2.79	1.92	2.36[c]	2.91
	Avg. Days	5.42	2.21	0.44	2.94[c]	1.24[c]	1.86	1.44[c]	3.43	3.22	1.73	2.42[c]	1.85
9	Avg. Group Size	3.20	3.26	3.51	2.64[c]	2.45	2.65	2.42	2.14	2.88	2.44	2.36[c]	2.88
	Avg. Days	5.04	4.24	0.45	2.94[c]	0.83	2.73	1.80	4.73	3.44	0.98	2.42[c]	2.45
All Reg.	Avg. Group Size	2.93	2.96	3.39	2.64	2.28	2.69	2.61[d]	2.33	3.22	2.54	2.36	2.76
	Avg. Days	4.06	2.73	0.63	2.94	1.24	2.26	1.44[d]	5.18	2.47	0.90	2.42	2.66

[a] *Average number of people travelling in a vehicle to Forest Service district.*
[b] *Average days onsite per person per trip.*
[c] *The mean value across all regions was substituted due to a small sample size.*
[d] *Region 4, warm water fishing, was excluded from calculation of the mean due to an excessively large conversion factor, judged to be an outlier.*

Table 8.—Conversion factors for recreation site consumer surplus values in Forest Service Region 10 (Alaska).

Primary activity[a]	Average group size[b]	Average days per trip[c]
General recreation	2.64	18.40
Developed	3.03	18.59
Sightseeing	2.61	16.61
Wildlife	2.83	26.16

[a] *These activities are not strictly comparable to those used in the "lower 48" models. The activities listed here for Alaska are aggregations of primary activities used in the lower 48. These activity aggregations are:*

Developed.—Developed site activities, including camping, picnicking, and swimming.

Sightseeing.—Mechanized travel and viewing scenery.

Wildlife.—All wildlife related activities, including hunting, fishing, and nonconsumptive.

General recreation.—All primary activities.

[b] *Average number of people travelling together to Alaska.*
[c] *Average days in Alaska per person per trip. Note that this differs from the onsite time used to calculate average days per trip in the lower 48 states models. Because Alaska was defined to be a single site, the time on site is the total time in Alaska. This was calculated as total trip time minus round-trip travel time as reported in the PARVS survey.*

Table 9.—Conversion factors for wilderness recreation consumer surplus values.

Region	Average group size	Average days per trip
1	2.28	1.97[a]
2	2.23	1.00
3	2.64	1.40
4	3.29	2.35
5	3.03	2.68
6	3.00	3.44
8	2.97	1.48
9	2.65	3.74
10	1.73	18.40[b]

[a] *All of the respondents in Region 1 (all 7 of them) had missing information in one or more of the responses used to calculate days on site. The days per trip for Region 1 is an average of those observed in Regions 1, 3, and 4 since Region 1 was included in a Region 1,3,4 demand model.*
[b] *All of the respondents in Region 10 had missing information in one or more of the responses used to calculate days per trip. The days per trip reported here is the overall average days per trip from the Alaska recreation sites.*

on the remaining substitute site measure was positive and significant. It is not clear exactly what effects were being captured by the variables representing origin characteristics. Income was dropped as a separate explanatory variable because it already appeared in the model as part of the travel cost. In almost all cases, the income coefficient was not significantly different from zero and had a negligible effect on the fit of the model. The remaining three origin characteristic variables did not appear to be consistently significant nor did they consistently have the same sign.

Turning to the primary activity trip models, the observations are much the same as they were in the general recreation models. In almost all cases, the coefficients on travel cost were negative and significant, and those on population were positive and significant. In a little over one-third of the region and activity pairs, the coefficient on the substitute measure was not significantly different from zero. In six of the pairs (out of a total of 74 region and primary activity pairs) the coefficient on the substitute measure was negative. In none of those six, however, was the coefficient significantly different from zero. It is not inconceivable to get negative coefficients on the substitute measure, though we expect them to be positive. This could be due to our measurement of substitute opportunities as the two closest Forest Service ranger districts other than the one at which the recreationist was contacted. A negative coefficient indicates that the other sites are complements to the chosen site rather than substitutes. Such a finding would not be totally unreasonable. People may choose locations where there are more recreation opportunities available so if one area is congested they can easily move to another. It could also indicate that multiple destination trips are present, even though the data were filtered for such trips using one of the PARVS questions.

In general, the workings of substitution between recreation goods is not well understood and could vary between sites, times, activities, or individuals. In some sense, it is surprising that our very rough measure of substitute opportunities worked as well as it apparently did.

As in the general recreation models, the coefficients on the origin characteristic variables were not consistently significant nor did they consistently have the same sign across regions and activities. Individual origin characteristic variables were taken out of the final models when they were insignificant. The substitute variable and the population variable were always included in the final model for theoretical reasons.

The travel cost coefficients in the Alaska models were larger in absolute magnitude (more negative) than those for the lower 48 states, indicating that trips to Alaska are more price sensitive than trips in the lower 48 states—not surprising given the expense of a trip to Alaska. This could well be true for any recreation trip that involved great expense. The model for wildlife-related activities in Alaska was the only model in which per capita income appeared as an independent variable. The effect of income in this particular model was so strong that it could not be excluded.

The wilderness models in the lower 48 states were similar to the general recreation models. The travel cost coefficients were negative and significantly different from zero. Population coefficients were positive and significantly different from zero. The substitute term coefficients were positive and generally significant. The magnitudes of individual coefficients vary somewhat, but the range is generally consistent with that seen in the general recreation models.

The travel cost coefficient in the Alaska (Region 10) wilderness model was smaller in absolute value than those in the Alaska recreation models. This difference indicates that trips to Alaska for wilderness recreation are less price sensitive than trips for general recreation purposes. Whether this difference is real or merely a consequence of the particular sample of data cannot be determined without further empirical work. As in the Alaska recreation models, the travel cost variable assumed travel to Alaska from Seattle by ferry.

Consumer Surplus Estimates

Table 10 shows the average consumer surplus values for the general recreation models, for each of the regional activity models, and for the wilderness models; table 11 shows these values for the Alaska models. The values were derived by calculating the area under the second-stage demand function, discussed earlier, for *each sampled site* in each region. Hence, for most region and activity pairs there were several values estimated—one for each site. The high, low, and average values for each region and activity pair are shown in table 10. For the lower 48 states recreation sites, the integration was carried out to a *maximum travel cost* of $195. For Alaska (table 11), the integration was carried out to $3,020 for the recreation sites and $1,700 for the wilderness site. The discrepancy in maximum travel costs between the Alaska recreation sites and the Alaska wilderness site was due to the difference in average group size observed between these sites (we are dealing with group trips and group costs). Alaskan recreation sites had a higher maximum travel cost because the cost was for a larger group. In addition, the slopes of the demand functions were different, implying a different cutoff price. The lower 48 states wilderness sites were integrated out to a maximum travel cost of $225. *All of these maximum travel cost values were calculated using the maximum round-trip distance observed in each of the three data subsamples before market areas were determined.*

Sites within the PARVS sample were included in a particular regional activity value calculation only if they delivered primary activity trips of that type. An individual site that delivered no big game hunting trips was excluded from the big game hunting model. The values are presented for three units of aggregation—group trips, person trips, and person days. The conversions were given in tables 7, 8, and 9. The unit of observation in the PARVS data, which was the unit used to estimate the models, was the group trip. As a result, the values in terms of group trips represent our best estimates of consumer surplus. These are to be interpreted as the value of the trip for the entire group. The values were converted to person trips (group trips divided by group size) and person days (group trips divided by group size and average days onsite) using the conversion factors derived from the PARVS data. The values in the converted units are only as accurate as those conversion factors.

Also shown in tables 10 and 11 are the estimated fee increases that would cut recreation use of the site to 50% of its current level. The assumption is that if these fee increases were imposed on recreation at the sites, use of the sites would drop to 50% of current use levels. These are fee increases above and beyond any existing fees (which were assumed to be zero). The fee increases

Table 10.—Consumer surplus values (in dollars) for primary activity trips by Forest Service Region.

Region	Units	Average consumer surplus			Average price (fee increase) at 50% current use [a]		
		High	Low	Average	High	Low	Average
		General Recreation Models					
1	Group trips[b]	72.10	21.15	60.99	88.78	3.70	49.48
	Person trips[c]	24.28	7.12	20.53	29.89	1.25	16.66
	Person days[d]	8.63	2.53	7.30	10.63	0.44	5.93
2	Group trips	61.68	42.99	50.00	54.68	18.44	29.20
	Person trips	24.48	17.06	19.84	21.70	7.32	11.59
	Person days	11.70	8.16	9.49	10.38	3.50	5.54
3	Group trips	60.39	33.10	53.56	61.16	12.54	43.04
	Person trips	21.80	11.95	19.34	22.08	4.53	15.54
	Person days	7.78	4.27	6.90	7.88	1.62	5.55
4	Group trips	98.67	33.58	53.98	79.13	4.79	33.11
	Person trips	35.11	11.95	19.21	28.16	1.70	11.78
	Person days	8.83	3.00	4.83	7.08	0.43	2.96
5	Group trips	56.15	32.28	47.11	45.07	11.23	30.05
	Person trips	19.98	11.49	16.77	16.04	4.00	10.69
	Person days	8.76	5.04	7.35	7.03	1.75	4.69
6	Group trips	33.02	18.48	25.23	17.58	7.26	11.28
	Person trips	12.80	7.16	9.78	6.81	2.81	4.37
	Person days	4.19	2.34	3.20	2.23	0.92	1.43
8	Group trips	35.03	12.66	23.31	15.01	3.85	8.43
	Person trips	12.04	4.35	8.01	5.16	1.32	2.90
	Person days	6.51	2.35	4.33	2.79	0.72	1.57
9	Group trips	54.98	13.47	38.63	46.43	3.70	24.01
	Person trips	19.09	4.68	13.41	16.12	1.28	8.34
	Person days	7.79	1.91	5.47	6.58	0.52	3.40
		Developed Camping					
1	Group trips	96.73	55.22	86.57	133.84	16.95	97.60
	Person trips	30.23	17.26	27.05	41.82	5.30	30.50
	Person days	7.75	4.42	6.94	10.72	1.36	7.82
2	Group trips	97.58	80.52	90.58	137.04	87.52	109.37
	Person trips	33.76	27.86	31.34	47.42	30.28	37.85
	Person days	15.79	13.03	14.66	22.17	14.16	17.70
3	Group trips	50.67	31.56	46.15	48.78	13.48	33.81
	Person trips	17.41	10.85	15.86	16.76	4.63	11.62
	Person days	4.68	2.91	4.26	4.50	1.24	3.12
4	Group trips	147.99	85.28	104.07	159.36	80.31	117.78
	Person trips	41.34	23.82	29.07	44.51	22.43	32.90
	Person days	12.68	7.31	8.92	13.66	6.88	10.09
5	Group trips	42.11	25.47	36.40	35.39	9.00	20.47
	Person trips	13.67	8.27	11.82	11.49	2.92	6.65
	Person days	3.66	2.22	3.17	3.08	0.78	1.78
6	Group trips	39.54	24.88	33.28	19.93	9.85	15.24
	Person trips	15.03	9.46	12.65	7.58	3.75	5.79
	Person days	3.42	2.15	2.88	1.73	0.85	1.32
8	Group trips	53.69	23.25	38.93	27.44	6.53	15.40
	Person trips	22.94	9.94	16.64	11.73	2.79	6.58
	Person days	4.23	1.83	3.07	2.16	0.51	1.21
9	Group trips	77.09	40.59	66.28	100.40	12.01	58.95
	Person trips	24.09	12.68	20.71	31.38	3.75	18.42
	Person days	4.78	2.52	4.11	6.22	0.74	3.65

Table 10.—Continued.

Region	Units	Average consumer surplus			Average price (fee increase) at 50% current use [a]		
		High	Low	Average	High	Low	Average
			Primitive Camping				
1	Group trips	102.94	80.21	94.03	132.77	73.26	103.49
	Person trips	34.78	27.10	31.77	44.85	24.75	34.96
	Person days	10.97	8.55	10.02	14.15	7.81	11.03
2	Group trips	103.66	79.53	97.47	142.23	72.21	117.06
	Person trips	40.49	31.07	38.08	55.56	28.21	45.73
	Person days	19.67	15.09	18.50	26.99	13.70	22.21
3	Group trips	103.30	83.28	93.12	129.43	48.12	92.48
	Person trips	41.32	33.31	37.25	51.77	19.25	36.99
	Person days	15.12	12.19	13.63	18.95	7.05	13.54
4	Group trips	101.54	98.71	99.94	135.63	128.65	131.53
	Person trips	34.30	33.35	33.76	45.82	43.46	44.44
	Person days	10.83	10.52	10.65	14.46	13.72	14.02
5	Group trips	50.06	44.75	47.41	35.65	28.69	32.17
	Person trips	18.20	16.27	17.24	12.96	10.43	11.70
	Person days	6.09	5.44	5.77	4.34	3.49	3.91
6	Group trips	35.38	25.89	32.44	16.18	9.97	14.55
	Person trips	13.30	9.73	12.19	6.08	3.75	5.47
	Person days	4.96	3.63	4.55	2.27	1.40	2.04
8	Group trips	27.44	7.87	16.21	12.62	3.22	6.81
	Person trips	8.71	2.50	5.15	4.01	1.02	2.16
	Person days	3.94	1.13	2.33	1.81	0.46	0.98
9	Group trips	43.10	18.95	32.35	34.76	7.77	21.82
	Person trips	13.22	5.81	9.92	10.66	2.38	6.69
	Person days	3.12	1.37	2.34	2.52	0.56	1.58
			Swimming				
5	Group trips	45.42	28.12	39.13	25.06	9.95	19.75
	Person trips	15.66	9.70	13.49	8.64	3.43	6.81
	Person days	12.44	7.70	10.72	6.87	2.73	5.41
6	Group trips	71.60	61.25	65.18	53.76	33.67	41.25
	Person trips	24.86	21.27	22.63	18.67	11.69	14.32
	Person days	24.86[e]	21.27[e]	22.63[e]	18.67[e]	11.69[e]	14.32[e]
8	Group trips	42.72	17.21	29.58	19.04	4.89	10.73
	Person trips	12.03	4.85	8.33	5.36	1.38	3.02
	Person days	12.03[e]	4.85[e]	8.33[e]	5.36[e]	1.38[e]	3.02[e]
9	Group trips	52.79	16.68	35.45	38.65	4.31	18.50
	Person trips	15.04	4.75	10.10	11.01	1.23	5.27
	Person days	15.04[e]	4.75[e]	10.10[e]	11.01[e]	1.23[e]	5.27[e]
			Wildlife Observation				
1	Group trips	82.71	69.52	76.12	89.77	40.24	65.01
	Person trips	31.33	26.33	28.83	34.00	15.24	24.62
	Person days	10.66	8.96	9.81	11.57	5.19	8.38
2	Group trips	78.42	71.88	75.15	77.99	63.54	70.77
	Person trips	29.70	27.23	28.47	29.54	24.07	26.80
	Person days	10.11	9.26	9.68	10.05	8.19	9.12
3	Group trips	84.31	68.08	77.66	110.81	66.94	95.07
	Person trips	31.94	25.79	29.42	41.97	25.36	36.01
	Person days	10.86	8.77	10.01	14.28	8.63	12.25
4	Group trips	67.33	67.33	67.33	50.67	50.67	50.67
	Person trips	25.50	25.50	25.50	19.19	19.19	19.19
	Person days	8.68	8.68	8.68	6.53	6.53	6.53
5	Group trips	79.80	38.63	64.90	84.51	32.92	58.39
	Person trips	34.25	16.58	27.85	36.27	14.13	25.06
	Person days	11.65	5.64	9.47	12.34	4.81	8.52
6	Group trips	81.86	77.83	79.80	100.06	61.42	77.87
	Person trips	26.24	24.95	25.58	32.07	19.69	24.96
	Person days	14.57	13.85	14.20	17.80	10.93	13.86

Table 10.—Continued.

Region	Units	Average consumer surplus			Average price (fee increase) at 50% current use [a]		
		High	Low	Average	High	Low	Average
		Cold Water Fishing					
1	Group trips	89.34	73.42	85.49	118.12	62.62	96.02
	Person trips	28.91	23.76	27.67	38.23	20.27	31.07
	Person days	25.17	20.68	24.08	33.27	17.64	27.05
2	Group trips	99.41	90.60	94.97	132.86	95.84	106.38
	Person trips	35.50	32.36	33.92	47.45	34.23	37.99
	Person days	10.92	9.96	10.44	14.60	10.53	11.69
3	Group trips	106.59	81.90	96.02	131.89	82.60	107.72
	Person trips	40.22	30.91	36.24	49.77	31.17	40.65
	Person days	12.41	9.53	11.18	15.35	9.62	12.54
4	Group trips	90.51	56.25	67.28	87.37	27.52	44.31
	Person trips	34.15	21.23	25.39	32.97	10.38	16.72
	Person days	10.05	6.24	7.47	9.70	3.05	4.92
5	Group trips	70.98	55.48	61.82	60.35	27.41	43.79
	Person trips	28.51	22.28	24.83	24.24	11.01	17.59
	Person days	21.77	17.02	18.96	18.51	8.41	13.43
6	Group trips	70.78	59.85	66.94	61.77	31.50	46.54
	Person trips	27.43	23.20	25.95	23.94	12.21	18.04
	Person days	25.19	21.30	23.82	21.98	11.21	16.56
8	Group trips	52.44	51.00	51.54	22.47	21.25	21.69
	Person trips	21.40	20.82	21.04	9.17	8.67	8.85
	Person days	11.50	11.18	11.30	4.93	4.66	4.76
9	Group trips	70.49	44.94	60.40	69.67	17.06	46.24
	Person trips	26.60	16.96	22.79	26.29	6.44	17.45
	Person days	9.75	6.22	8.35	9.64	2.36	6.40
		Warm Water Fishing					
8	Group trips	45.60	32.79	41.11	19.43	10.98	16.31
	Person trips	17.47	12.56	15.75	7.44	4.21	6.25
	Person days	12.13	8.72	10.93	5.17	2.92	4.34
9	Group trips	65.59	21.28	45.88	63.33	5.23	34.49
	Person trips	27.10	8.79	18.96	26.17	2.16	14.25
	Person days	15.04	4.88	10.52	14.53	1.20	7.91
		Day Hiking					
1	Group trips	79.89	44.97	67.72	78.93	10.90	50.15
	Person trips	34.89	19.64	29.57	34.47	4.76	21.90
	Person days	28.13	15.83	23.85	27.79	3.84	17.66
2	Group trips	81.03	70.48	74.46	93.10	42.73	63.08
	Person trips	33.48	29.12	30.77	38.47	17.66	26.07
	Person days	33.48[e]	29.12[e]	30.77[e]	38.47[e]	17.66[e]	26.07[e]
3	Group trips	86.17	67.35	77.90	107.47	35.32	79.05
	Person trips	35.03	27.38	31.67	43.69	14.36	32.13
	Person days	25.20	19.69	22.78	31.42	10.33	23.11
4	Group trips	65.74	62.01	63.76	43.77	28.72	34.16
	Person trips	34.42	32.47	33.38	22.92	15.04	17.89
	Person days	27.74	26.16	26.90	18.47	12.12	14.41
5	Group trips	98.91	77.44	92.35	118.58	80.66	102.25
	Person trips	43.19	33.82	40.33	51.78	35.22	44.65
	Person days	14.74	11.54	13.76	17.67	12.02	15.24
6	Group trips	103.27	99.58	101.30	141.34	123.63	131.69
	Person trips	45.29	43.68	44.43	61.99	54.22	57.76
	Person days	36.49	35.19	35.80	49.94	43.69	46.53
8	Group trips	74.43	38.86	55.89	52.45	10.48	28.10
	Person trips	32.64	17.04	24.51	23.00	4.60	12.32
	Person days	26.30	13.73	19.75	18.53	3.70	9.93
9	Group trips	86.17	58.47	74.49	103.79	21.15	64.24
	Person trips	35.17	23.87	30.40	42.36	8.63	26.22
	Person days	35.17[e]	23.87[e]	30.40[e]	42.36[e]	8.63[e]	26.22[e]

Table 10.—Continued.

Region	Units	Average consumer surplus			Average price (fee increase) at 50% current use [a]		
		High	Low	Average	High	Low	Average
		Big Game Hunting					
1	Group trips	70.64	30.59	57.81	66.59	5.83	38.08
	Person trips	29.19	12.64	23.89	27.52	2.41	15.73
	Person days	5.63	2.44	4.61	5.31	0.46	3.04
2	Group trips	45.27	19.59	29.75	30.45	6.48	14.09
	Person trips	20.67	8.95	13.59	13.90	2.96	6.43
	Person days	6.36	2.75	4.18	4.28	0.91	1.98
3	Group trips	85.57	63.32	75.52	114.51	29.67	77.91
	Person trips	32.91	24.35	29.04	44.04	11.41	29.96
	Person days	12.42	9.19	10.96	16.62	4.31	11.31
4	Group trips	120.03	50.09	71.56	116.62	15.09	56.99
	Person trips	53.35	22.26	31.81	51.83	6.71	25.33
	Person days	7.30	3.04	4.35	7.09	0.92	3.46
6	Group trips	115.42	88.85	104.94	152.99	84.34	120.97
	Person trips	47.30	36.41	43.01	62.70	34.57	49.58
	Person days	6.12	4.71	5.56	8.11	4.47	6.41
8	Group trips	78.91	47.06	62.76	64.69	15.09	35.01
	Person trips	32.61	19.45	25.94	26.73	6.24	14.47
	Person days	9.51	5.67	7.56	7.79	1.82	4.22
9	Group trips	94.85	69.38	84.25	117.84	29.41	74.16
	Person trips	44.32	32.42	39.37	55.07	13.74	34.65
	Person days	9.37	6.86	8.33	11.64	2.91	7.33
		Picnicking					
1	Group trips	85.64	60.82	76.21	94.13	42.53	71.30
	Person trips	25.19	17.89	22.41	27.69	12.51	20.97
	Person days	9.84	6.99	8.76	10.82	4.89	8.20
2	Group trips	85.02	75.73	80.38	110.51	60.73	86.00
	Person trips	26.99	24.04	25.52	35.08	19.28	27.30
	Person days	14.12	12.58	13.35	18.36	10.09	14.29
3	Group trips	85.33	77.94	82.07	109.16	77.65	90.31
	Person trips	22.28	20.35	21.43	28.50	20.27	23.58
	Person days	12.24	11.18	11.77	15.66	11.14	12.96
4	Group trips	79.49	70.36	74.93	100.99	44.63	72.81
	Person trips	20.65	18.28	19.46	26.23	11.59	18.91
	Person days	8.36	7.40	7.88	10.62	4.69	7.66
5	Group trips	55.82	37.43	45.31	40.31	15.52	25.33
	Person trips	15.81	10.60	12.84	11.42	4.40	7.17
	Person days	6.06	4.06	4.92	4.38	1.69	2.75
6	Group trips	47.93	32.05	41.52	26.61	10.17	20.17
	Person trips	14.75	9.86	12.77	8.19	3.13	6.21
	Person days	12.95	8.66	11.22	7.19	2.75	5.45
8	Group trips	50.39	21.80	37.01	24.51	6.09	14.36
	Person trips	18.06	7.81	13.27	8.78	2.18	5.15
	Person days	5.61	2.43	4.12	2.73	0.68	1.60
9	Group trips	69.67	26.63	54.07	75.29	7.04	45.81
	Person trips	24.19	9.25	18.77	26.14	2.44	15.91
	Person days	7.03	2.69	5.46	7.60	0.71	4.62

Table 10.—Continued.

Region	Units	Average consumer surplus			Average price (fee increase) at 50% current use [a]		
		High	Low	Average	High	Low	Average
				Sightseeing			
1	Group trips	54.89	6.77	35.85	46.57	1.98	20.74
	Person trips	20.79	2.56	13.58	17.64	0.75	7.86
	Person days	20.79[e]	2.56[e]	13.58[e]	17.64[e]	0.75[e]	7.86[e]
2	Group trips	49.28	28.38	38.55	30.36	9.80	19.15
	Person trips	19.87	11.44	15.55	12.24	3.95	7.72
	Person days	19.87[e]	11.44[e]	15.55[e]	12.24[e]	3.95[e]	7.72[e]
3	Group trips	51.25	29.64	44.35	35.83	11.87	27.06
	Person trips	17.67	10.22	15.29	12.36	4.09	9.33
	Person days	17.67[e]	10.22[e]	15.29[e]	12.36[e]	4.09[e]	9.33[e]
4	Group trips	38.98	11.88	27.92	21.98	1.77	10.96
	Person trips	12.34	3.76	8.84	6.96	0.56	3.47
	Person days	12.34[e]	3.76[e]	8.84[e]	6.96[e]	0.56[e]	3.47[e]
5	Group trips	51.12	38.59	45.70	41.12	16.72	27.74
	Person trips	18.06	13.64	16.15	14.53	5.91	9.80
	Person days	18.06[e]	13.64[e]	16.15[e]	14.53[e]	5.91[e]	9.80[e]
6	Group trips	45.73	34.97	40.78	28.22	15.20	20.26
	Person trips	20.06	15.34	17.89	12.38	6.67	8.89
	Person days	20.06[e]	15.34[e]	17.89[e]	12.38[e]	6.67[e]	8.89[e]
8	Group trips	25.01	10.39	18.89	8.69	3.44	6.46
	Person trips	13.03	5.41	9.84	4.53	1.79	3.36
	Person days	7.53	3.13	5.69	2.62	1.04	1.95
9	Group trips	66.88	22.32	49.25	77.02	6.04	37.13
	Person trips	27.41	9.15	20.19	31.57	2.48	15.22
	Person days	27.41[e]	9.15[e]	20.19[e]	31.57[e]	2.48[e]	15.22[e]
				Gathering Forest Products			
1	Group trips	80.71	52.81	72.85	83.28	18.72	62.21
	Person trips	34.20	22.38	30.87	35.29	7.93	26.36
	Person days	14.13	9.25	12.76	14.58	3.28	10.89
2	Group trips	80.76	80.76	80.76	82.16	82.16	82.16
	Person trips	34.22	34.22	34.22	34.81	34.81	34.81
	Person days	14.14	14.14	14.14	14.39	14.39	14.39
3	Group trips	84.90	60.99	74.39	92.46	25.52	69.99
	Person trips	34.65	24.89	30.36	37.74	10.42	28.57
	Person days	14.32	10.28	12.54	15.59	4.30	11.80
4	Group trips	76.13	49.68	63.78	74.10	14.26	41.52
	Person trips	32.26	21.05	27.03	31.40	6.04	17.59
	Person days	13.33	8.70	11.17	12.98	2.50	7.27
5	Group trips	67.13	67.13	67.13	43.30	43.30	43.30
	Person trips	28.44	28.44	28.44	18.35	18.35	18.35
	Person days	11.76	11.76	11.76	7.58	7.58	7.58
6	Group trips	76.76	74.02	75.49	67.63	51.94	59.31
	Person trips	36.55	35.25	35.95	32.20	24.73	28.24
	Person days	9.52	9.18	9.37	8.39	6.44	7.36
9	Group trips	77.45	68.90	73.18	64.75	43.99	54.37
	Person trips	32.82	29.19	31.01	27.44	18.64	23.04
	Person days	13.56	12.07	12.82	11.34	7.70	9.52

Table 10.—Continued.

Region	Units	Average consumer surplus			Average price (fee increase) at 50% current use [a]		
		High	Low	Average	High	Low	Average
				Wilderness Recreation			
1	Group trips	16.26	16.26	16.26	5.77	5.77	5.77
	Person trips	7.13	7.13	7.13	2.53	2.53	2.53
	Person days	3.62	3.62	3.62	1.28	1.28	1.28
2	Group trips	43.82	16.26	30.04	21.23	4.48	12.86
	Person trips	19.65	7.29	13.47	9.52	2.01	5.76
	Person days	19.65[e]	7.29[e]	13.47[e]	9.52[e]	2.01[e]	5.76[e]
3	Group trips	36.89	15.50	26.20	15.35	4.67	10.01
	Person trips	13.97	5.87	9.92	5.81	1.77	3.79
	Person days	9.98	4.19	7.09	4.15	1.26	2.71
4	Group trips	37.18	37.18	37.18	15.66	15.66	15.66
	Person trips	11.30	11.30	11.30	4.76	4.76	4.76
	Person days	4.81	4.81	4.81	2.03	2.03	2.03
5	Group trips	31.26	18.85	25.06	13.49	8.55	11.02
	Person trips	10.32	6.22	8.27	4.45	2.82	3.64
	Person days	3.85	2.32	3.09	1.66	1.05	1.36
6	Group trips	27.69	21.42	24.66	10.75	6.72	9.13
	Person trips	9.23	7.14	8.22	3.58	2.24	3.04
	Person days	2.68	2.08	2.39	1.04	0.65	0.88
8	Group trips	34.91	30.15	32.53	12.89	10.59	11.74
	Person trips	11.75	10.15	10.95	4.34	3.57	3.95
	Person days	7.94	6.86	7.40	2.93	2.41	2.67
9	Group trips	47.89	12.29	30.09	22.38	3.25	12.82
	Person trips	18.07	4.64	11.35	8.45	1.23	4.84
	Person days	4.83	1.24	3.04	2.26	0.33	1.29
10	Group trips	302.71	302.71	302.71	252.75	252.75	252.75
	Person trips	174.98	174.98	174.98	146.10	146.10	146.10
	Person days	9.51	9.51	9.51	7.94	7.94	7.94

[a] *The average fee increase (price) necessary to reduce recreation use to 50% of the current use level.*
[b] *Average net value per trip of a visit to Forest Service district.*
[c] *Average net value per person per trip of a visit to Forest Service district (group trip value divided by average group size).*
[d] *Average net value per person per day of a visit to FS district (person trip value divided by average calendar days per trip). This corresponds to value per activity occasion.*
[e] *Denotes that average days per trip is less than one. Hence, the value per activity occasion (person day) is the same as the value per person per trip.*

are presented as a high value, low value, and average value for each region and activity pair, as were the consumer surplus values. The same conversion factors were used to convert the fee increases to units of person trips and person days that were used to convert the consumer surplus values. These fee increases do not warrant a lot of discussion. Their meaning is questionable because cutting use of the recreation sites to 50% of current levels would involve shifts in the demand functions, not just movement along the functions. They are useful, however, as an indication of the slopes of the demand functions. Those regions and primary activity trip types requiring a high fee increase to cut use to 50% of their current levels have a relatively steeper demand function than those requiring a small fee increase.

It appears, from table 10, that the consumer surplus values vary among regions. It also appears that, within each region, consumer surplus values vary among primary activity trips. It is instructive to look at each region and see the types of activity trips having the highest and lowest values. The weakest conversion data is the length of trip, because of missing data. Hence, we focus on the results in terms of group trips (which we regard as our most reliable results) and person trips (which we perceive to be most comparable with other entries in the economic literature).

Table 12 is a summary of the consumer surplus values for each primary activity trip type and region. The two highest primary activity trip values in each region (compare columns within a row) for group trips and person trips are highlighted with a double underline. The two lowest values are single underlined. Overall, primitive camping, day hiking, and big game hunting are most likely to be the highest valued primary activity trip types in a region. Sightseeing, developed camping, and primitive camping are most likely to be the lowest valued

Table 11.—Consumer surplus values (in dollars) for Alaska Recreation.

Primary activity[a]	Average consumer surplus	Average price (fee increase) at 50% current use[b]
General recreation		
Group trips[c]	439.64	347.40
Person trips[d]	166.80	131.81
Person days[e]	9.06	7.16
Developed		
Group trips	381.08	303.17
Person trips	125.83	100.10
Person days	6.77	5.38
Sightseeing		
Group trips	419.35	319.10
Person trips	160.57	122.19
Person days	9.67	7.36
Wildlife		
Group trips	482.92	360.79
Person trips	170.79	127.60
Person days	6.53	4.88

[a] *These activities are not strictly comparable to those used in the "lower 48" models. The activities listed here for Alaska are aggregations of primary activities used in the lower 48. These activity aggregations are:*

Developed.—Developed site activities, including camping, picnicking, and swimming.
Sightseeing.—Mechanized travel and viewing scenery.
Wildlife.—All wildlife related activities, including hunting, fishing, and nonconsumptive.
General recreation.—All primary activities.

[b] *The average fee increase (price) necessary to reduce recreation use to 50% of the current use level.*
[c] *Average net value per trip of a group visit to Alaska.*
[d] *Average net value per person per trip of a visit to Alaska (group trip value divided by average group size).*
[e] *Average net value per person per day of a visit to Alaska (person trip value divided by average calendar days per trip).*

primary activity trip types. Primitive camping is particularly interesting. It is one of the two highest valued trip types in Regions 1, 2, 3, and 4, and one of the two lowest valued trip types in Regions 6, 8, and 9. Big game hunting is similarly interesting. It is one of the two lowest valued trip types in Regions 1 and 2, and one of the two highest valued trip types in Regions 6, 8, and 9. Sightseeing is uniformly one of the two lowest valued trip types in Regions 1, 2, 3, and 4—what might be called the Rocky Mountain region. Developed camping is uniformly one of the two lowest valued trip types in Regions 5 and 6—the Pacific coast, and in Region 3—the Southwest. Day hiking trips are among the highest valued in Regions 5, 6, 8, and 9. In Region 4, day hiking trips are among the lowest valued in terms of group trips and among the highest valued in terms of person trips. This latter observation illustrates the possible impact of the conversion factors. Depending on which unit of aggregation is considered, a trip type is either the highest or lowest valued in the region. Forest product gathering trips—a major element of which is collecting firewood—is highly valued in Regions 1, 2, 5, and 9. Cold water fishing trips are highly valued in Regions 2 and 3.

Several reasons exist as to why any particular activity might show different consumer surplus values in different regions. One is the presence or absence of substitute sites at which to participate in the activity. The more available substitutes, the lower the value of any particular site. These values are tied to the sites at which the data were gathered. Forest Service sites in some regions might not be the places where certain activities are engaged in, though for most of the activities considered here, that is probably not the case. A particular subset of the data for some region-activity pair might be less than perfectly representative, causing the values to be either too high or too low. There is always some probability, though usually small, of a given sample or subsample being unrepresentative when statistical sampling techniques are used.

Table 13 is the same summary of values presented in table 12, except the comparisons in table 13 are between rows within a column. The two regional values that are the highest for a given trip type (compare rows within a column) in group trips and person trips are highlighted by double underlining; the two lowest regional values are single underlined. The focus of table 12 is on particular regions, across activities, whereas the focus of table 13 is on particular activities, across regions. The highest values for a given activity are most frequently found in Regions 2 and 6. The lowest values are most frequently found in Regions 8 and 4.

In many cases the most consistent values across regions come from models aggregated across regions. This can be seen by putting together the information in table 1, in the model section, with the information in table 13. The model appearing to be best as far as consistency of values across regions may not be the best in terms of explaining the behavior in a particular region. The consistency of values between regions may, in some cases, be the result of using a model aggregated over more than one region, rather than consistency of economic behavior in the regions.

Alaska (Forest Service Region 10) does not appear in either table 12 or 13 because the activity aggregations used in Alaska were somewhat different from those used in the lower 48 states. The general recreation level values for Alaska, however, are comparable with those from the lower 48 states because all trips are included, regardless of primary activity. The values from Alaska are also comparable with those from the lower 48 states for trips whose primary activity is sightseeing. The only difference, in both models, is that in Alaska the whole state was considered to be the site. Multiple destination trips were included as long as all destinations were in Alaska. In the case of general recreation, the values are the average value for any trip in the region, i.e., any primary activity trip to Alaska. In the lower 48 states, the values are the average value for a trip to a typical site in the region. The general recreation values for Alaska were $439.64 per group trip and $166.80 per person trip, compared with ranges of $23 to $61 and $8 to $21, respectively, in the lower 48 states. The primary activity trip values for sightseeing in Alaska were $419.35 per group trip and $160.57 per person trip, compared with ranges

Table 12.—Average consumer surplus (in dollars) for primary activity trips by region. (Values highlighted within regions[a])

Region	Units	Devel. camp.	Prim. camp.	Swim.	Wildlife observ.	Day hiking	Cld wat. fishing	Wrm wat. fishing	Big game hunting	Picnic	Sight-seeing	For. prod.
1	Group trips[b]	86.57	94.03	NM[e]	76.12	67.72	85.49	NM	57.81	76.21	35.85	72.85
	Person trips[c]	27.05	31.77	NM	28.83	29.57	27.67	NM	23.89	22.41	13.58	30.87
	Person days[d]	6.94	10.02	NM	9.81	23.85	24.08	NM	4.61	8.76	13.58[f]	12.76
2	Group trips	90.58	97.47	NM	75.15	74.46	94.97	NM	29.75	80.38	38.55	80.76
	Person trips	31.34	38.08	NM	28.47	30.77	33.92	NM	13.59	25.52	15.55	34.22
	Person days	14.66	18.50	NM	9.68	30.77[f]	10.44	NM	4.18	13.35	15.55[f]	14.14
3	Group trips	46.15	93.12	NM	77.66	77.90	96.02	NM	75.52	82.07	44.35	74.39
	Person trips	15.86	37.25	NM	29.42	31.67	36.24	NM	29.04	21.43	15.29	30.36
	Person days	4.26	13.63	NM	10.01	22.78	11.18	NM	10.96	11.77	15.29[f]	12.54
4	Group trips	104.07	99.94	NM	67.33	63.76	67.28	NM	71.56	74.93	27.92	63.78
	Person trips	29.07	33.76	NM	25.50	33.38	25.39	NM	31.81	19.46	8.84	27.03
	Person days	8.92	10.65	NM	8.68	26.90	7.47	NM	4.35	7.88	8.84[f]	11.17
5	Group trips	36.40	47.41	39.13	64.90	92.35	61.82	NM	NM	45.31	45.70	67.13
	Person trips	11.82	17.24	13.49	27.85	40.33	24.83	NM	NM	12.84	16.15	28.44
	Person days	3.17	5.77	10.72	9.47	13.76	18.96	NM	NM	4.92	16.15[f]	11.76
6	Group trips	33.28	32.44	65.18	79.80	101.30	66.94	NM	104.94	41.52	40.78	75.49
	Person trips	12.65	12.19	22.63	25.58	44.43	25.95	NM	43.01	12.77	17.89	35.95
	Person days	2.88	4.55	22.63[f]	14.20	35.80	23.82	NM	5.56	11.22	17.89[f]	9.37
8	Group trips	38.93	16.21	29.58	NM	55.89	51.54	41.11	62.76	37.01	18.89	NM
	Person trips	16.64	5.15	8.33	NM	24.51	21.04	15.75	25.94	13.27	9.84	NM
	Person days	3.07	2.33	8.33[f]	NM	19.75	11.30	10.93	7.56	4.12	5.69	NM
9	Group trips	66.28	32.35	35.45	NM	74.49	60.40	45.88	84.25	54.07	49.25	73.18
	Person trips	20.71	9.92	10.10	NM	30.40	22.79	18.96	39.37	18.77	20.19	31.01
	Person days	4.11	2.34	10.10[f]	NM	30.40[f]	8.35	10.52	8.33	5.46	20.19[f]	12.82

[a] *Across a row, a double underline identifies the two highest valued primary activity trips within a region; a single underline identifies the two lowest valued.*
[b] *Average net value per trip of a group visit to Forest Service district (all participants included).*
[c] *Average net value per person per trip of a visit to Forest Service district (group trip value divided by average group size).*
[d] *Average net value per person per day of a visit to Forest Service district (person trip value divided by average calendar days per trip). This corresponds to value per activity occasion.*
[e] *Values of NM indicate that no model was estimated for that region and primary activity trip pair. This occurred when there were no trips in a region that could be classified as being of that primary activity.*
[f] *Denotes that average days per trip is less than one. Hence, the value per activity occasion (person day) is the same as the value per person per trip.*

of $19 to $49 and $9 to $20, respectively, in the lower 48 states. The Alaska trip values are significantly higher than trip values in the lower 48 states. One reason for this difference might be the length of the trips. In the lower 48 states, trips were between 2 and 4 days in length; in Alaska, trips averaged 18 days.

The average consumer surplus values (in terms of person trips) appear generally lower for wilderness recreation than for recreation at nonwilderness sites (as indicated by the general recreation values). Only in Regions 6 and 8 are the values so close as to be virtually the same. Only in Regions 8 and 10 are the wilderness values higher than the general recreation values.

In Region 10 (Alaska) all of the wilderness respondents had missing information in one or all of the survey questions used to calculate trip length. Because of that, the average days per trip for wilderness users was taken to be the same as the average days per trip for all Alaska recreation users (18.4 days). To the extent that this is an overestimate (underestimate) of the true days per trip for wilderness users in Alaska, the person day values will be underestimated (overestimated).

Discussion

The values reported here are conservative estimates, primarily because the limits of integration used in the calculation of consumer surplus (the maximum travel cost values) were set to correspond to the maximum distance observed in the relevant sample. In effect, we are assuming people who travel from the furthest distances have zero consumer surplus. In the same way, we are putting an upper limit on the surplus of people travelling shorter distances. This is likely to be unrealistic, but we agree with those who feel uncomfortable in extending the analysis substantially beyond the range of the data. We feel it is more useful to have an estimate known to be a lower bound (consumer surplus is *at least* $X) than to have one that may be an underestimate or

Table 13.—Average consumer surplus (in dollars) for primary activity trips by region. (Values highlighted within trip types[a])

Region	Units	Devel. camp.	Prim. camp.	Swim.	Wildlife observ.	Day hiking	Cld wat. fishing	Wrm wat. fishing	Big game hunting	Picnic	Sight-seeing	For. prod.	Gen. rec. (all trips)
1	Group trips[b]	86.57	94.03	NM[e]	76.12	67.72	85.49	NM	57.81	76.21	35.85	72.85	60.99
	Person trips[c]	27.05	31.77	NM	28.83	29.57	27.67	NM	23.89	22.41	13.58	30.87	20.53
	Person days[d]	6.94	10.02	NM	9.81	23.85	24.08	NM	4.61	8.76	13.58[f]	12.76	7.30
2	Group trips	90.58	97.47	NM	75.15	74.46	94.97	NM	29.75	80.38	38.55	80.76	50.00
	Person trips	31.34	38.08	NM	28.47	30.77	33.92	NM	13.59	25.52	15.55	34.22	19.84
	Person days	14.66	18.50	NM	9.68	30.77[f]	10.44	NM	4.18	13.35	15.55[f]	14.14	9.49
3	Group trips	46.15	93.12	NM	77.66	77.90	96.02	NM	75.52	82.07	44.35	74.39	53.56
	Person trips	15.86	37.25	NM	29.42	31.67	36.24	NM	29.04	21.43	15.29	30.36	19.34
	Person days	4.26	13.63	NM	10.01	22.78	11.18	NM	10.96	11.77	15.29[f]	12.54	6.90
4	Group trips	104.07	99.94	NM	67.33	63.76	67.28	NM	71.56	74.93	27.92	63.78	53.98
	Person trips	29.07	33.76	NM	25.50	33.38	25.39	NM	31.81	19.46	8.84	27.03	19.21
	Person days	8.92	10.65	NM	8.68	26.90	7.47	NM	4.35	7.88	8.84[f]	11.17	4.83
5	Group trips	36.40	47.41	39.13	64.90	92.35	61.82	NM	NM	45.31	45.70	67.13	47.11
	Person trips	11.82	17.24	13.49	27.85	40.33	24.83	NM	NM	12.84	16.15	28.44	16.77
	Person days	3.17	5.77	10.72	9.47	13.76	18.96	NM	NM	4.92	16.15[f]	11.76	7.35
6	Group trips	33.28	32.44	65.18	79.80	101.30	66.94	NM	104.94	41.52	40.78	75.49	25.23
	Person trips	12.65	12.19	22.63	25.58	44.43	25.95	NM	43.01	12.77	17.89	35.95	9.78
	Person days	2.88	4.55	22.63[f]	14.20	35.80	23.82	NM	5.56	11.22	17.89[f]	9.37	3.20
8	Group trips	38.93	16.21	29.58	NM	55.89	51.54	41.11	62.76	37.01	18.89	NM	23.31
	Person trips	16.64	5.15	8.33	NM	24.51	21.04	15.75	25.94	13.27	9.84	NM	8.01
	Person days	3.07	2.33	8.33[f]	NM	19.75	11.30	10.93	7.56	4.12	5.69	NM	4.33
9	Group trips	66.28	32.35	35.45	NM	74.49	60.40	45.88	84.25	54.07	49.25	73.18	38.63
	Person trips	20.71	9.92	10.10	NM	30.40	22.79	18.96	39.37	18.77	20.19	31.01	13.41
	Person days	4.11	2.34	10.10[f]	NM	30.40[f]	8.35	10.52	8.33	5.46	20.19[f]	12.82	5.47

[a] Within a column, a double underline identifies the regions with the two highest values for that primary activity trip type; a single underline identifies the regions with the two lowest values.

[b] Average net value per trip of a group visit to Forest Service district (all participants included).

[c] Average net value per person per trip of a visit to Forest Service district (group trip value divided by average group size).

[d] Average net value per person per day of a visit to Forest Service district (person trip value divided by average calendar days per trip). This corresponds to value per activity occasion.

[e] Values of NM indicate that no model was estimated for that region and primary activity trip pair. This occurred when there were no trips in a region that could be classified as being of that primary activity.

[f] Denotes that average days per trip is less than one. Hence, the value per activity occasion (person day) is the same as the value per person per trip.

may be an overestimate and not know which it is (consumer surplus may be more or less than $X but we do not know which).

The data section discussed ways in which the raw data were filtered for single or multiple destination trips. Only single destination trips were used in the analysis. It is often difficult to separate single from multiple destination trips. The PARVS data allowed that distinction to be made. It is important because the presence of multiple destination trips in the data would bias the valuation results upward. When a multiple destination trip is taken, the total value of the trip must be allocated among all destinations on the trip. If such trips are included in the analysis of a single site (without some way of attributing partial trip values to the particular site), the total value of the multiple destination trip will be assigned to that site when, in fact, only a portion of the trip value belongs with that site.

At the same time, there is the possibility of a bias being created by leaving multiple destination trips out of the specification of substitutes in the model. To the extent that multiple destination trips substitute for single destination trips, this would be a concern. The whole area of multiple destination trips is one of continuing debate in the economic literature, and the extent of any bias, if it exists, created by not including multiple destination trips in the model as a substitute for single destination trips is unknown.

The careful reader might notice that there is not a perfect correspondence between the regions that most frequently exhibit the highest or lowest primary activity trip values and the regions exhibiting the highest or lowest general recreation values. In particular, Region 6 most frequently exhibits one of the two highest primary activity trip values, yet it shows one of the two lowest general recreation values. Region 4 most frequently exhibits one of the two lowest primary activity trip values, yet it has one of the two highest general recreation values. Region 1 exhibits the highest general recreation values, but is infrequently highest or lowest in primary activity trip values. Several factors are involved in these curious observations. One is that the general recreation values include *all* trips and not just those that could be classified as any particular primary activity. In each region there was a sizable number of trips that could not be classified as any primary activity. These trips pull the general recreation value up or down without affecting the primary activity trip values. A second factor is that all general recreation level models were estimated using regional models. The general recreation values came exclusively from sites within the region. As the data were partitioned into primary activity trip types, it became necessary to aggregate regions in many cases. Hence, the models from which regional primary activity trip values were derived were sometimes estimated using observations from other regions. While the models were second-staged on each individual site, and regional values were taken only from sites in the region, the effect of other regions on the first-stage parameter estimates cannot be filtered out.

Values reported here must be taken in the context of the data with which they were estimated. It was pointed out earlier that these models were estimated using only the Forest Service component of the PARVS data. In designing the sampling frame for that component, efforts were made to ensure a representative sample of Forest Service ranger districts. Therefore, values estimated from these data can only be extended to "typical Forest Service sites." They are not for premium sites, nor are they for substandard or degraded sites. They are for average Forest Service sites.

In terms of absolute numbers, some of the primary activity trip values reported here are different from values reported in existing studies in the economic literature. Sorg and Loomis (1984) and Walsh et al. (1988) present relatively exhaustive reviews of the literature on valuation of outdoor recreation. Several factors must be considered before coming to a conclusion on whether a particular set of values are right or wrong, good or bad. First, of course, is the quality of the study. Sorg and Loomis, and Walsh et al. adjusted the values from the studies they found to "approach more uniformity of method." Travel cost values were increased by 30% when the study omitted travel time, and 15% when the study truncated out-of-state users. Travel cost values were decreased 15% when an individual travel cost model was used rather than an aggregated or zonal model. Our intent is not to argue with those adjustments, but to point out that final values are sensitive to the specification of the model and the independent variables it includes. Values may also be sensitive to the theoretical appropriateness of the model used in the study.

One important factor not considered by Sorg and Loomis or Walsh et al. was whether the model considered the effect of substitute sites. Unless one is dealing with a unique resource, for which there are no good substitutes, economic theory indicates that substitutes belong in the demand model. In general, leaving substitutes out of the model leads to inflated estimates of consumer surplus. Finally, we would reiterate that our reported values are conservative. The studies cited by Sorg and Loomis and Walsh et al. likely cover a wide range of assumptions regarding how far the integration was carried out in calculating consumer surplus.

One must also realize that values for recreation are site-specific. Because of that, site quality enters in. One would expect differences in value between a premium hunting or fishing site and an average site. To some extent, values for recreation are individual-specific. One would expect different values for a site used primarily by local people and one to which people travel from all over the country. In this regard, values are very dependent on the sample of users from which the model is estimated. Great care must be taken to ensure a representative sample. Results and values can only be attributed back to and interpreted vis-a-vis the population that the sample represents. All too often values are estimated using a very specific subpopulation and attributed blindly back to a much broader group. Care must be taken to avoid such careless application of results.

Concern was expressed by some reviewers of these values that the wildlife values—fishing, and particularly big game hunting—were markedly lower than values reported in previous studies. Concern was also expressed over low values in some regions for developed camping and primitive camping. We share some of those concerns. The values reported here for some regions and primary activity trip types are low compared to those reported elsewhere. For some other regions and primary activity trip types the values may appear high based on intuition.

The PARVS sites were chosen to be representative of the range of sites available on Forest Service lands. The goal was to model recreation behavior on a typical Forest Service ranger district. Districts were chosen to represent all levels of use—high, moderate, and low. That implies the values reported here apply to the typical Forest Service district. The operative words in the preceding sentence are typical district. Districts were chosen for inclusion in PARVS based on overall recreation use, not use in any particular activity. The big game hunting values, therefore, represent big game hunting on a typical Forest Service district, not big game hunting on a typical Forest Service big game hunting district. The distinction is subtle but critical. A typical Forest Service district may or may not be a typical Forest Service big game hunting district. To some extent, one might expect an inverse relationship between hunting use at a site and other recreation use at the same site. The point is that values must be interpreted in light of the sample.

Another critical element is the timing of the sample. To the extent that different activities occur at different times of the year, participants in a particular activity may be underrepresented, or missed entirely, by sampling at any given time. Again, take big game hunting as an example. Fall sampling for PARVS was done in October. This is prime time for people going out to the forest to view the fall colors, but may be too early for the primary hunting season in some parts of the country. For example, the various gun deer and elk seasons in Colorado run from mid-October to mid-December. In Wisconsin, gun deer hunting season runs from mid to late November. Depending on exactly when sampling was done in a particular area, the bulk of big game hunters may have been missed.

Region 2 big game hunting was looked at in particular detail because of the lower than expected values that came out of that model. Based on goodness of fit, the Region 2 big game hunting model was one of our better models in terms of explaining the behavior reflected by the data. One thing we did to further explore that model was to raise the truncation level in the calculation of consumer surplus. Because of the particular coefficients in that model, raising the truncation level to over $1000 (originally the maximum travel cost was $195) had very little effect on the consumer surplus values. The character of the sample in Region 2 (and in others) was overwhelmingly local. The character of the region is that there are a lot of sites that are similar in terrain, habitat, etc. This means there are a lot of available substitutes, particularly in Colorado and Wyoming where the Region 2 PARVS sites were. The consumer surplus, or willingness to pay, may genuinely be low for those particular sites. How much would a hunter be willing to pay to hunt at site A when he can go ten miles down the road and hunt under virtually the same conditions for a lower cost or at no cost? Probably not very much. It was pointed out, by a reviewer, that a survey done by the State of Colorado showed annual hunter expenditures averaged hundreds of dollars to hunt big game in Colorado. That may be true, but it is irrelevant when the correct measure of value is consumer surplus—willingness to pay above and beyond existing costs and fees. Indeed, those high expenditure levels may be taking up so much of the total value that the remaining consumer surplus is small.

Big game hunting is illustrative of many of the primary activity values reported here. The sample was by and large relatively local. The character of Forest Service sites is such that, in many areas of the country, there are substitutes readily available. This does not imply that recreation on Forest Service lands is of low value. It does imply that the value of recreation on Forest Service lands that can be picked up by a recreation demand model is relatively low. The values captured by the travel cost method are strictly use values. Nonuse values, such as existence value and option value, are ignored. (See Bishop et al. (1987), Peterson and Sorg (1987), and Randall (1987) for discussions of nonuse values.) For resources such as National Forests, nonuse values may be quite large. By nature, the travel cost method provides more of a lower bound value than a maximum value. Conservative estimates of value are prudent, but they should be recognized as such.

The real value of this study might be not so much the absolute magnitudes of the values but the relative values between regions and primary activity trip types. It is a big advantage, in making such comparisons, to use the same modelling framework estimated with data collected using the same survey instrument for all regions and primary activity trips. Another advantage of this study is that the focus, for all types of primary activity trips, is exclusively on Forest Service sites.

Conclusions

Having presented the results and discussed the issue of directly comparing those results to results of other studies, let us address the question: "What do these values represent?" The values presented here are estimates of average consumer surplus for recreation trips whose primary purpose is a particular category of activity. They are not the same as prices in the sense that one pays a price for a loaf of bread. In economics jargon, they are the average of the excess prices a discriminating monopolist would charge, over and above existing prices, if he could charge a separate price for each trip. If the Forest Service were to establish an individualized access fee to its lands that would be exactly the difference between the maximum amount an individual would pay to recreate on Forest Service land, rather than forgo recreating on Forest Service land, and the sum of the costs and fees he already pays, the average of all those access fees would be the values reported here. They do not represent the cost of providing the recreation opportunity and they do not represent the intersection of a supply and a demand function. They are a measure of the average individual net benefit received from recreating on Forest Service lands. These values answer the question, identified in an earlier section as being the question posed by the 1990 RPA Program Analysis: "What is the net value of the recreation experience at a typical Forest Service site averaged over all users of the site?"

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Appendix 1. More on the Trip Generation Model

We originally intended to estimate the trip generation component of the reverse gravity model as well as the trip distribution component. For the immediate purpose of estimating recreation values for the 1990 RPA Program Analysis, we realized that the trip generation component of the model was unnecessary. The lack of data on the total numbers of trips to the sites reinforced our decision not to estimate the trip generation component of the model.

In a more general and complete analysis it would be desirable to estimate the trip generation component of the model. The trip generation component was specified above to be a function of site characteristics or attractiveness and an index measuring the accessibility of a site to the market area from which it attracts trips. To move toward a measure of site characteristics or attractiveness, a factor analysis was performed using a vector of site characteristics to explain variation in annual recreation visitor days (RVD's) on Forest Service ranger districts. The RVD's and site characteristics came from the Recreation Information Management (RIM) System data base maintained by the Forest Service.[1]

The factor analyses showed that different site characteristics are important for different activities. There were, however, several common characteristics or similar characteristics important to several activities. Proximity (within 10 miles) to a lake or river was important in about two-thirds of the activities considered. Proximity to camping sites was important in several activities. Proximity to picnic areas, hiking trails, and potable water were important in more than one activity. Acres of particular Recreation Opportunity Spectrum (ROS) class lands were important to particular activities. For example, acres of land classified as primitive were important to primitive camping and backpacking, gathering forest products, hiking, and big game hunting. These factor analyses indicate that there are certain quantifiable site characteristics that can be used to predict recreation participation at a site. The remaining task is to put these factors into an index or other form that can be used in a regression-type analysis.

One possibility for the measure of market access to the site would be to use the denominator from the trip distribution component of the model. That, in fact, is the usual practice in the traditional gravity model, where recreation opportunities are modelled from the point of view of origins rather than destinations. This term, referred to as the "inclusive value," would provide a relative measure of the accessibility of each site to its respective market area. There are, no doubt, other measures that could be used as well.

[1]*The RIM base is compiled from information supplied by Forest Service ranger districts. It includes various site characteristics such as: acres of land in different ROS (Recreation Opportunity Spectrum) classes (primitive, roaded natural, semi-primitive motorized, etc.), numbers of camp units and other facilities such as picnic areas and boat launch areas on the district, capacities of some facilities, proximity to lakes and rivers, site elevation, proximity to gas stations and grocery stores, availability of potable water, miles of hiking trails, among many others. It also includes annual RVD's in 53 activity groups. A debate has gone on for a long time regarding the appropriateness and usefulness of RFD's as a measure of recreation participation. The reliability of the numbers and the methods by which they are estimated have been called into question. Without getting involved in that debate let us assert that RIM RVD's are useful for determining what site characteristics affect total participation in a given activity. Because of the way RVD's are defined and estimated, however, RIM RVD's are not a usable quantity from which to derive the number of trips to a site.*

The major roadblock to estimating the complete reverse gravity model is data on the total numbers of trips to the sites. If such data were available for some set of sites, it would enable researchers to estimate the effects of site quality, different levels of site facilities, congestion, and the like on recreation visitation.

We recognize that by abstracting from the trip generation component of the model we have, in fact, implied a trip generation component. Recall the complete model (in equation [3]):

$$N_{ij} = N_j \; P(i|j) = \frac{N_j \; e^{u_i}}{\sum_{k=1}^{m} e^{u_k}} = A_0 e^{u_i}$$

where A_0 is the quantity $\frac{N_j}{\Sigma e^{u_k}}$, assumed to be constant, and u_i and u_k are functions of travel cost and origin characteristics. The denominator of the trip distribution model is part of the constant A_0 because travel cost at a particular site, TC_{ij}, in the denominator was held constant while TC_{ij} in the numerator was increased incrementally to trace out the second-stage demand function. The implied trip generation model resulting from the assumption of a constant A_0 is

$$N_j = \frac{N_0 \Sigma e^{u_h}}{\Sigma e^{u_k}}$$

where N_0 is some initial level of trips to the recreation site, Σe^{u_k} is the constant denominator (when u_i is incremented only in the numerator when the function is integrated), and Σe^{u_h} is the true denominator (when u_i is incremented both in the numerator and the denominator during the integration). The complete model is

$$N_{ij} = \frac{N_0 \Sigma e^{u_h}}{\Sigma e^{u_k}} \; \frac{e^{u_i}}{\Sigma e^{u_h}} \; .$$

As long as Σe^{u_h} and Σe^{u_k} are approximately equal as u_i changes when the function is integrated, the assumption of a constant A_0 has a negligible effect on the model. When the function is integrated, only one element in Σe^{u_h} changes (the travel cost at one site in the summation of sites) so the effect on the sum should be relatively small. To the extent that Σe^{u_h} is greater (less) than Σe^{u_k} over time, additional trips to the site are being generated (lost). One implication of this implied trip generation model is that changes in total trips to a site are induced by changes in the market area that delivers trips to the site. Another implication is that site characteristics do not affect the number of trips to a site. In the short run, such conditions may be believable.

Appendix 2. The Estimated (First-Stage) Trip Distribution Models

The four goodness of fit measures shown here are based on Peterson and Stynes (1986). "Eta squared" measures the actual magnitude agreement between the observed and predicted number of visits. "Corr" is the correlation coefficient between the observed and predicted number of visits. "MAE" and "MAPE" are the mean absolute value absolute error and the mean absolute value proportional error, respectively. They reflect the (absolute value) average error in prediction in absolute and proportional terms. "n" refers to the sample size, the number of origin counties used as data points in the estimation of the model.

Regional indicates that the model was estimated with data exclusively from that region. Other levels of aggregation are:

Rocky Mountain—Regions 1,2,3,4
Pacific Coast—Regions 5,6
Eastern—Regions 8,9
Western—Regions 1,2,3,4,5,6
Nationwide—All regions except Alaska.

General Recreation Models

Region 1 Model = Region 1

Independent Variable	Coefficient	t-statistic
Travel Cost	-0.876	-16.974
Population	0.866	12.866
Substitute Site	0.989	8.755
% Urban	-0.130	-3.317
% White	3.045	2.295
Education	0.660	2.725

Eta Squared = 0.858 MAE = 4.471
Corr = 0.870 MAPE = 0.813
n = 82 origins containing 311 trips

Region 2 Model = Region 2

Independent Variable	Coefficient	t-statistic
Travel Cost	-1.102	-15.704
Population	0.453	10.365
Substitute Site	0.720	8.123
% Urban	0.155	4.042
% White	1.422	2.880

Eta Squared = 0.694 MAE = 4.030
Corr = 0.703 MAPE = 0.809
n = 107 origins containing 388 trips

Region 3 Model = Region 3

Independent Variable	Coefficient	t-statistic
Travel Cost	-1.233	-9.728
Population	0.794	15.217
Substitute Site	1.573	7.315
% Urban	-0.282	-4.644
% White	0.766	2.771

Eta Squared = 0.859 MAE = 3.860
Corr = 0.859 MAPE = 0.634
n = 60 origins containing 264 trips

Region 4 Model = Region 4

Independent Variable	Coefficient	t-statistic
Travel Cost	-1.060	-19.399
Population	0.644	15.089
Substitute Site	0.807	6.397
Education	1.653	9.012

Eta Squared = 0.733 MAE = 4.345
Corr = 0.736 MAPE = 0.885
n = 90 origins containing 348 trips

Region 5 Model = Region 5

Independent Variable	Coefficient	t-statistic
Travel Cost	-1.192	-14.284
Population	0.974	13.632
Substitute Site	0.259	3.249
% White	5.190	6.012
Education	-1.365	-4.793

Eta Squared = 0.751 MAE = 4.478
Corr = 0.766 MAPE = 0.666
n = 93 origins containing 291 trips

Region 6 Model = Region 6

Independent Variable	Coefficient	t-statistic
Travel Cost	-1.933	-24.012
Population	0.538	11.271
Substitute Site	0.751	5.561
% Urban	0.293	4.929
% White	-3.121	-2.450

Eta Squared = 0.767 MAE = 4.228
Corr = 0.782 MAPE = 0.102
n = 180 origins containing 624 trips

Region 8 Model = Region 8

Independent Variable	Coefficient	t-statistic
Travel Cost	-1.352	-18.927
Population	0.665	9.441

Independent Variable	Coefficient	t-statistic
Substitute Site	0.199	2.436
% White	1.784	4.868
Education	−0.627	−3.545

Eta Squared = 0.547 MAE = 3.988
Corr = 0.552 MAPE = 0.870
n = 149 origins containing 445 trips

Region 9 Model = Region 9

Independent Variable	Coefficient	t-statistic
Travel Cost	−1.327	−26.337
Population	0.836	11.966
Substitute Site	1.066	8.168
% Urban	−0.063	−1.615
% White	1.832	2.308

Eta Squared = 0.823 MAE = 2.607
Corr = 0.882 MAPE = 0.589
n = 190 origins containing 401 trips

Developed Camping

Region 1 Model = Regions 1,2,4

Independent Variable	Coefficient	t-statistic
Travel Cost	−0.476	−3.991
Population	0.923	8.947
Substitute Site	1.000	5.733
Education	−0.669	−1.685
% White	6.115	2.983

Eta Squared = 0.777 MAE = 1.685
Corr = 0.828 MAPE = 0.576
n = 110 origins containing 107 trips

Region 2 Model = Regions 1,2,4

[Same as Region 1 values.]

Region 3 Model = Region 3

Independent Variable	Coefficient	t-statistic
Travel Cost	−1.555	−5.546
Population	0.893	7.386
Substitute Site	1.124	3.165
Education	−0.651	−1.317

Eta Squared = 0.847 MAE = 2.257
Corr = 0.848 MAPE = 0.504
n = 45 origins containing 70 trips

Region 4 Model = Regions 1,2,4

[Same as Region 1 values.]

Region 5 Model = Pacific Coast

Independent Variable	Coefficient	t-statistic
Travel Cost	−1.561	−8.299
Population	0.772	7.002
Substitute Site	0.326	2.103
% White	6.337	5.089
Education	−1.037	−2.412

Eta Squared = 0.826 MAE = 1.856
Corr = 0.838 MAPE = 0.469
n = 71 origins containing 142 trips

Region 6 Model = Pacific Coast

[Same as Region 5 values.]

Region 8 Model = Region 8

Independent Variable	Coefficient	t-statistic
Travel Cost	−0.991	−3.462
Population	0.678	2.546
Substitute Site	−0.126	−0.273
% White	1.784	0.839

Eta Squared = 0.619 MAE = 1.677
Corr = 0.620 MAPE = 0.484
n = 40 origins containing 31 trips

Region 9 Model = Region 9

Independent Variable	Coefficient	t-statistic
Travel Cost	−0.740	−4.470
Population	0.710	5.217
Substitute Site	0.848	2.075

Eta Squared = 0.516 MAE = 1.366
Corr = 0.517 MAPE = 0.540
n = 117 origins containing 47 trips

Primitive Camping

Region 1 Model = Rocky Mountain

Independent Variable	Coefficient	t-statistic
Travel Cost	−0.039	−1.406
Population	0.601	4.820
Substitute Site	0.645	1.960

Eta Squared = 0.676 MAE = 1.379
Corr = 0.717 MAPE = 0.470
n = 54 origins containing 33 trips

Region 2 Model = Rocky Mountain

[Same as Region 1 values.]

Region 3 Model = Rocky Mountain

[Same as Region 1 values.]

Region 4 Model = Rocky Mountain

[Same as Region 1 values.]

Region 5 Model = Pacific Coast

Independent Variable	Coefficient	t-statistic
Travel Cost	−1.543	−6.784
Population	0.545	7.011
Substitute Site	1.081	2.892

Eta Squared = 0.876 MAE = 1.503
Corr = 0.878 MAPE = 0.476
n = 37 origins containing 65 trips

Region 6 Model = Region 6

Independent Variable	Coefficient	t-statistic
Travel Cost	−1.662	−5.358
Population	0.418	3.374
Substitute Site	1.135	2.721
% Urban	0.423	1.029

Eta Squared = 0.846 MAE = 1.718
Corr = 0.848 MAPE = 0.495
n = 36 origins containing 62 trips

Region 8 Model = Eastern

Independent Variable	Coefficient	t-statistic
Travel Cost	−1.964	−4.576
Population	2.068	4.618
Substitute Site	0.283	0.619
% Urban	−0.391	−1.917

Eta Squared = 0.753 MAE = 1.054
Corr = 0.771 MAPE = 0.497
n = 36 origins containing 25 trips

Region 9 Model = Eastern

[Same as Region 8 values.]

Swimming

Regions 1 – 4 No models estimated

Region 5 Model = Region 5

Independent Variable	Coefficient	t-statistic
Travel Cost	−1.398	−3.376
Population	0.685	4.539
Substitute Site	0.159	0.579
% White	5.845	2.408

Eta Squared = 0.779 MAE = 2.003
Corr = 0.779 MAPE = 0.769
n = 37 origins containing 39 trips

Region 6 Model = Pacific Coast

Independent Variable	Coefficient	t-statistic
Travel Cost	−0.825	−3.435
Population	0.358	5.373
Substitute Site	−0.143	−0.773

Eta Squared = 0.666 MAE = 2.260
Corr = 0.666 MAPE = 0.573
= 45 origins containing 53 trips

Region 8 Model = Region 8

Independent Variable	Coefficient	t-statistic
Travel Cost	−1.153	−7.234
Population	0.479	3.174
Substitute Site	0.544	2.877
% Urban	−0.173	−3.337
Education	−1.021	−2.713

Eta Squared = 0.277 MAE = 3.317
Corr = 0.282 MAPE = 0.477
n = 52 origins containing 120 trips

Region 9 Model = Eastern

Independent Variable	Coefficient	t-statistic
Travel Cost	−1.216	−12.721
Population	0.551	4.709
Substitute Site	0.357	2.800
% Urban	−0.078	−1.852
% White	−1.447	−2.600
Education	−1.279	−4.293

Eta Squared = 0.700 MAE = 3.201
Corr = 0.726 MAPE = 0.498
n = 76 origins containing 202 trips

Wildlife Observation

Region 1 Model = Western

Independent Variable	Coefficient	t-statistic
Travel Cost	−0.681	−2.117
Population	1.038	3.385
Substitute Site	0.816	1.633
% White	13.783	2.477
Education	−2.104	−1.808

Eta Squared = 0.388 MAE = 1.088
Corr = 0.389 MAPE = 0.396
n = 41 origins containing 21 trips

Region 2 Model = Western

[Same as Region 1 values.]

Region 3 Model = Western

[Same as Region 1 values.]

Region 4 Model = Western

[Same as Region 1 values.]

Region 5 Model = Western

[Same as Region 1 values.]

Region 6 Model = Western

[Same as Region 1 values.]

Regions 8,9 No models estimated

Day Hiking

Region 1 Model = Rocky Mountain

Independent Variable	Coefficient	t-statistic
Travel Cost	−0.646	−4.253
Population	0.376	3.407
Substitute Site	0.561	2.013
Education	1.036	2.660

Eta Squared = 0.800 MAE = 0.926
Corr = 0.805 MAPE = 0.327
n = 62 origins containing 55 trips

Region 2 Model = Rocky Mountain

[Same as Region 1 values.]

Region 3 Model = Rocky Mountain

[Same as Region 1 values.]

Region 4 Model = Rocky Mountain

[Same as Region 1 values.]

Region 5 Model = Pacific Coast

Independent Variable	Coefficient	t-statistic
Travel Cost	−0.394	−1.795
Population	0.278	2.935
Substitute Site	−0.207	−1.020

Eta Squared = 0.373 MAE = 1.358
Corr = 0.373 MAPE = 0.404
n = 39 origins containing 31 trips

Region 6 Model = Pacific Coast

[Same as Region 5 values.]

Region 8 Model = Eastern

Independent Variable	Coefficient	t-statistic
Travel Cost	−0.686	−2.260
Population	0.229	0.621
Substitute Site	0.545	0.999

Eta Squared = 0.504 MAE = 1.131
Corr = 0.519 MAPE = 0.437
n = 28 origins containing 15 trips

Region 9 Model = Region 9

Independent Variable	Coefficient	t-statistic
Travel Cost	−0.552	−1.682
Population	1.236	3.443
Substitute Site	−0.032	−0.049
% Urban	−0.320	−1.681
Education	−1.737	−1.809

Eta Squared = 0.533 MAE = 1.096
Corr = 0.536 MAPE = 0.483
n = 55 origins containing 20 trips

Cold Water Fishing

Region 1 Model = Region 1

Independent Variable	Coefficient	t-statistic
Travel Cost	−0.536	−3.105
Population	0.751	3.669
Substitute Site	1.907	4.549
Education	1.035	2.076
% Urban	−0.210	−1.999

Eta Squared = 0.812 MAE = 1.886
Corr = 0.842 MAPE = 0.672
n = 42 origins containing 45 trips

Region 2 Model = Region 2

Independent Variable	Coefficient	t-statistic
Travel Cost	−0.426	−2.413
Population	0.246	2.721
Substitute Site	0.911	4.441
% Urban	0.169	1.791

Eta Squared = 0.542 MAE = 1.994
Corr = 0.542 MAPE = 0.494
n = 60 origins containing 74 trips

Region 3 Model = Regions 3,4

Independent Variable	Coefficient	t-statistic
Travel Cost	−0.348	−2.471
Population	0.640	5.971
Substitute Site	0.530	1.329
Education	1.119	2.830
% Urban	−0.288	−3.839

Eta Squared = 0.725 MAE = 2.054
Corr = 0.726 MAPE = 0.564
n = 53 origins containing 80 trips

Region 4 Model = Region 4

Independent Variable	Coefficient	t-statistic
Travel Cost	−0.739	−4.928

Population	1.128	5.845
Substitute Site	0.991	2.742
Education	2.565	3.290
% Urban	−0.464	−3.473

Eta Squared = 0.660 MAE = 2.135
Corr = 0.672 MAPE = 0.750
n = 49 origins containing 49 trips

Region 5 Model = Pacific Coast

Independent Variable	Coefficient	t-statistic
Travel Cost	−0.832	−5.734
Population	0.309	4.752
Substitute Site	0.224	0.968
% Urban	0.221	1.809

Eta Squared = 0.447 MAE = 2.619
Corr = 0.452 MAPE = 0.411
n = 79 origins containing 107 trips

Region 6 Model = Pacific Coast

[Same as Region 5 values.]

Region 8 Model = Eastern

Independent Variable	Coefficient	t-statistic
Travel Cost	−0.815	−4.714
Population	0.813	5.018
Substitute Site	0.329	1.393

Eta Squared = 0.449 MAE = 1.410
Corr = 0.449 MAPE = 0.498
n = 77 origins containing 43 trips

Region 9 Model = Region 9

Independent Variable	Coefficient	t-statistic
Travel Cost	−0.906	−4.363
Population	0.940	3.613
Substitute Site	0.804	1.700
% Urban	−0.212	−1.186

Eta Squared = 0.578 MAE = 1.348
Corr = 0.579 MAPE = 0.523
n = 46 origins containing 22 trips

Warm Water Fishing

Regions 1 – 6 No models estimated

Region 8 Model = Eastern

Independent Variable	Coefficient	t-statistic
Travel Cost	−1.008	−3.935
Population	1.019	3.214
Substitute Site	0.591	1.300
Education	−1.407	−1.373

Eta Squared = 0.707 MAE = 1.591
Corr = 0.724 MAPE = 0.655
n = 44 origins containing 23 trips

Region 9 Model = Eastern

[Same as Region 8 values.]

Big Game Hunting

Region 1 Model = Region 1

Independent Variable	Coefficient	t-statistic
Travel Cost	−0.932	−4.966
Population	0.435	3.572
Substitute Site	1.431	4.084

Eta Squared = 0.500 MAE = 2.651
Corr = 0.502 MAPE = 0.731
n = 34 origins containing 36 trips

Region 2 Model = Region 2

Independent Variable	Coefficient	t-statistic
Travel Cost	−1.716	−8.026
Population	0.460	3.012
Substitute Site	0.827	2.507
Education	−1.109	−1.955
% Urban	0.225	2.350

Eta Squared = 0.873 MAE = 1.935
Corr = 0.876 MAPE = 0.597
n = 39 origins containing 56 trips

Region 3 Model = Regions 1,3,4

Independent Variable	Coefficient	t-statistic
Travel Cost	−0.645	−9.002
Population	0.329	5.883
Substitute Site	0.501	4.165
Education	1.552	6.034

Eta Squared = 0.430 MAE = 2.980
Corr = 0.437 MAPE = 0.623
n = 136 origins containing 161 trips

Region 4 Model = Region 4

Independent Variable	Coefficient	t-statistic
Travel Cost	−0.787	−8.764
Population	0.414	6.072
Substitute Site	0.599	3.772
Education	1.364	4.280

Eta Squared = 0.447 MAE = 3.547
Corr = 0.453 MAPE = 0.642
n = 69 origins containing 108 trips

Region 5 No Model Estimated

Region 6 Model = Region 6

Independent Variable	Coefficient	t-statistic
Travel Cost	−0.289	−1.253
Population	0.797	7.689
Substitute Site	0.616	2.382
% White	−9.523	−3.556

Eta Squared = 0.762 MAE = 2.895
Corr = 0.782 MAPE = 0.630
n = 40 origins containing 74 trips

Region 8 Model = Region 8

Independent Variable	Coefficient	t-statistic
Travel Cost	−0.663	−3.372
Population	0.813	3.939
Substitute Site	0.794	3.902
% Urban	−0.126	−1.311
% White	4.800	4.338

Eta Squared = 0.520 MAE = 1.699
Corr = 0.521 MAPE = 0.630
n = 59 origins containing 60 trips

Region 9 Model = Eastern

Independent Variable	Coefficient	t-statistic
Travel Cost	−0.457	−3.012
Population	0.678	5.696
Substitute Site	0.330	1.738
% White	2.389	2.727

Eta Squared = 0.459 MAE = 1.804
Corr = 0.462 MAPE = 0.550
n = 85 origins containing 72 trips

Picnicking

Region 1 Model = Rocky Mountain

Independent Variable	Coefficient	t-statistic
Travel Cost	−0.627	−4.043
Population	0.148	1.545
Substitute Site	1.195	4.604
% Urban	0.284	2.276

Eta Squared = 0.703 MAE = 1.451
Corr = 0.718 MAPE = 0.379
n = 65 origins containing 65 trips

Region 2 Model = Rocky Mountain

[Same as Region 1 values.]

Region 3 Model = Rocky Mountain

[Same as Region 1 values.]

Region 4 Model = Rocky Mountain

[Same as Region 1 values.]

Region 5 Model = Pacific Coast

Independent Variable	Coefficient	t-statistic
Travel Cost	−1.324	−3.199
Population	0.868	6.748
Substitute Site	1.730	3.284
% Urban	−0.269	−1.892
Education	−1.886	−2.828

Eta Squared = 0.878 MAE = 1.702
Corr = 0.882 MAPE = 0.597
n = 38 origins containing 56 trips

Region 6 Model = Pacific Coast

[Same as Region 5 values.]

Region 8 Model = Eastern

Independent Variable	Coefficient	t-statistic
Travel Cost	−1.025	−8.324
Population	0.523	3.702
Substitute Site	0.223	1.075

Eta Squared = 0.633 MAE = 1.870
Corr = 0.654 MAPE = 0.589
n = 87 origins containing 67 trips

Region 9 Model = Region 9

Independent Variable	Coefficient	t-statistic
Travel Cost	−0.959	−5.706
Population	0.490	1.442
Substitute Site	0.745	1.558
% Urban	0.734	0.947

Eta Squared = 0.671 MAE = 1.629
Corr = 0.696 MAPE = 0.579
n = 56 origins containing 29 trips

Sightseeing

Region 1 Model = Rocky Mountain

Independent Variable	Coefficient	t-statistic
Travel Cost	−0.772	−7.665
Population	0.634	8.161
Substitute Site	1.704	6.889
% Urban	−0.152	−2.941
% White	4.473	3.232

Eta Squared = 0.676 MAE = 1.826
Corr = 0.687 MAPE = 0.589
n = 138 origins containing 127 trips

Region 2   Model = Rocky Mountain

[Same as Region 1 values.]

Region 3   Model = Rocky Mountain

[Same as Region 1 values.]

Region 4   Model = Rocky Mountain

[Same as Region 1 values.]

Region 5   Model = Pacific Coast

Independent Variable	Coefficient	t-statistic
Travel Cost	−1.368	−4.693
Population	0.636	4.796
Substitute Site	0.850	2.919
% White	7.861	4.303
Education	−1.475	−2.480

Eta Squared = 0.695   MAE = 1.745
Corr = 0.702   MAPE = 0.577
n = 37 origins containing 70 trips

Region 6   Model = Pacific Coast

[Same as Region 5 values.]

Region 8   Model = Eastern

Independent Variable	Coefficient	t-statistic
Travel Cost	−1.462	−6.535
Population	0.458	2.117
Substitute Site	−0.359	−1.507
Education	0.620	0.987

Eta Squared = 0.928   MAE = 0.924
Corr = 0.928   MAPE = 0.497
n = 57 origins containing 43 trips

Region 9   Model = Region 9

Independent Variable	Coefficient	t-statistic
Travel Cost	−1.065	−3.661
Population	1.731	3.458
Substitute Site	0.953	1.178
% Urban	−0.436	−1.668

Eta Squared = 0.729   MAE = 0.841
Corr = 0.730   MAPE = 0.441
n = 39 origins containing 18 trips

Gathering Forest Products

Region 1   Model = Rocky Mountain

Independent Variable	Coefficient	t-statistic
Travel Cost	−0.665	−4.885
Population	0.237	0.906
Substitute Site	0.728	2.015
% Urban	−0.151	−1.406
Education	1.652	2.621

Eta Squared = 0.771   MAE = 1.310
Corr = 0.771   MAPE = 0.369
n = 46 origins containing 32 trips

Region 2   Model = Rocky Mountain

[Same as Region 1 values.]

Region 3   Model = Rocky Mountain

[Same as Region 1 values.]

Region 4   Model = Rocky Mountain

[Same as Region 1 values.]

Region 5   Model = Western

Independent Variable	Coefficient	t-statistic
Travel Cost	−0.699	−6.678
Population	0.195	3.375
Substitute Site	0.201	1.079

Eta Squared = 0.524   MAE = 2.573
Corr = 0.526   MAPE = 0.600
n = 64 origins containing 62 trips

Region 6   Model = Western

[Same as Region 5 values.]

Region 8   No model estimated

Region 9   Model = Nationwide

Independent Variable	Coefficient	t-statistic
Travel Cost	−0.678	−6.560
Population	0.144	2.049
Substitute Site	0.126	0.691
Education	0.419	1.036

Eta Squared = 0.514   MAE = 2.412
Corr = 0.515   MAPE = 0.632
n = 68 origins containing 71 trips

Wilderness Recreation

Region 1   Model = Regions 1,3,4

Independent Variable	Coefficient	t-statistic
Travel Cost	−1.499535	−9.422410
Substitute Site	0.687326	2.601425
Population	0.911484	11.485727

Eta Squared = 0.781   MAE = 1.701
Corr = 0.784   MAPE = 0.491
n = 49 origins containing 100 visits

Region 2 Model = Region 2

Independent Variable	Coefficient	t-statistic
Travel Cost	−1.506165	−4.458333
Substitute Site	0.684342	2.420209
Population	0.716298	4.426121
Education	2.633297	3.654250

Eta Squared = 0.981 MAE = 1.738
Corr = 0.983 MAPE = 0.466
n = 24 origins containing 91 visits

Region 3 Model = Regions 1,3,4

[Same as Region 1 values.]

Region 4 Model = Regions 1,3,4

[Same as Region 1 values.]

Region 5 Model = Region 5

Independent Variable	Coefficient	t-statistic
Travel Cost	−2.201687	−10.246808
Substitute Site	1.503417	6.581052
Population	0.975647	9.341115
% White	2.486736	1.715977

Eta Squared = 0.957 MAE = 1.723
Corr = 0.963 MAPE = 0.542
n = 51 origins containing 102 visits

Region 6 Model = Pacific Coast

Independent Variable	Coefficient	t-statistic
Travel Cost	−1.532289	−10.458061
Substitute Site	0.222800	1.447362
Population	0.815725	6.507590
% Urban	1.520557	2.864825
% White	4.594286	3.741577

Eta Squared = 0.651 MAE = 2.731
Corr = 0.651 MAPE = 0.623
n = 92 origins containing 188 visits

Region 8 Model = Region 8

Independent Variable	Coefficient	t-statistic
Travel Cost	−1.377112	−8.499027
Substitute Site	0.242063	1.718959
Population	0.712243	8.159330
Education	0.724473	2.835057

Eta Squared = 0.550 MAE = 1.742
Corr = 0.550 MAPE = 0.468
n = 83 origins containing 165 visits

Region 9 Model = Eastern

Independent Variable	Coefficient	t-statistic
Travel Cost	−1.340642	−9.494486
Substitute Site	0.117296	0.938132
Population	0.756736	10.060440
Education	0.604390	2.475480

Eta Squared = 0.533 MAE = 1.801
Corr = 0.533 MAPE = 0.525
n = 120 origins containing 192 visits

Region 10 Model = Region 10

Independent Variable	Coefficient	t-statistic
Travel Cost	−1.964434	−2.745348
Population	1.414905	4.376974
% Urban	3.739754	2.204041

Eta Squared = 0.914 MAE = 1.222
Corr = 0.915 MAPE = 0.321
n = 28 origins containing 39 visits

Summary of Alaska Models

General Recreation

Independent Variable	Coefficient	t-statistic
Travel Cost	−3.721468	−12.671220
Population	0.987641	15.799839
Education	1.700653	3.911669

Eta Squared = 0.930 MAE = 2.850
Corr = 0.935 MAPE = 0.659
n = 49 origins containing 296 visits

Developed Site Recreation

Independent Variable	Coefficient	t-statistic
Travel Cost	−4.079057	−5.290486
Population	0.949929	5.034120
Education	3.248104	2.733365

Eta Squared = 0.759 MAE = 1.552
Corr = 0.764 MAPE = 0.505
n = 49 origins containing 36 visits

Sightseeing

Independent Variable	Coefficient	t-statistic
Travel Cost	−3.659092	−10.394194
Population	1.451694	10.293691
% White	2.345404	1.611265

Eta Squared = 0.936 MAE = 2.092
Corr = 0.938 MAPE = 0.722
n = 49 origins containing 135 visits

Wildlife Activities

Independent Variable	Coefficient	t-statistic
Travel Cost	−3.725684	−4.408718
Population	0.702114	2.429812
% White	9.550927	2.560744
Per Capita Income	10.008452	3.796937

Eta Squared = 0.824 MAE = 1.330
Corr = 0.826 MAPE = 0.485
n = 49 origins containing 31 visits

Wilderness Recreation (repeated to keep all Alaska models together)

Independent Variable	Coefficient	t-statistic
Travel Cost	−1.964434	−2.745348
Population	1.414905	4.376974
% Urban	3.739754	2.204041

Eta Squared = 0.914 MAE = 1.222
Corr = 0.915 MAPE = 0.321
n = 28 origins containing 39 visits

McCollum, Daniel W.; Peterson, George L.; Arnold, J. Ross; Markstrom, Donald C.; Hellerstein, Daniel M. 1990. The net economic value of recreation on the national forests: twelve types of primary activity trips across nine Forest Service regions. Res. Pap. RM–289. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 36 p.

The Public Area Recreation Visitors Survey (PARVS) was used to estimate demand models and values for recreation on Forest Service lands for 12 types of primary activity trips in all nine Forest Service regions. Models were estimated using the travel cost method with a "reverse multinomial logit gravity model."

Keywords: Logit model, recreation values, user benefits, consumer surplus, gravity model, travel cost model

U.S. Department of Agriculture
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Rocky Mountain Forest and Range Experiment Station

Rocky Mountains

Southwest

Great Plains

The Rocky Mountain Station is one of eight regional experiment stations, plus the Forest Products Laboratory and the Washington Office Staff, that make up the Forest Service research organization.

RESEARCH FOCUS

Research programs at the Rocky Mountain Station are coordinated with area universities and with other institutions. Many studies are conducted on a cooperative basis to accelerate solutions to problems involving range, water, wildlife and fish habitat, human and community development, timber, recreation, protection, and multiresource evaluation.

RESEARCH LOCATIONS

Research Work Units of the Rocky Mountain Station are operated in cooperation with universities in the following cities:

Albuquerque, New Mexico
Flagstaff, Arizona
Fort Collins, Colorado*
Laramie, Wyoming
Lincoln, Nebraska
Rapid City, South Dakota
Tempe, Arizona

*Station Headquarters: 240 W. Prospect Rd., Fort Collins, CO 80526