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Wilderness and Primitive Area Recreation Participation and Consumption: An Examination of Demographic and Spatial Factors

J.M. Bowker, D. Murphy, H.K. Cordell, D.B.K. English, J.C. Bergstrom, C.M. Starbuck, C.J. Betz, and G.T. Green

This paper explores the influence of demographic and spatial variables on individual participation and consumption of wildland area recreation. Data from the National Survey on Recreation and the Environment are combined with geographical information system–based distance measures to develop nonlinear regression models used to predict both participation and the number of days of participation in wilderness and primitive area recreation. The estimated models corroborate previous findings indicating that race (black), ethnicity (Hispanic), immigrant status, age, and urban dwelling are negatively correlated with wildland visitation, while income, gender (male), and education positively affect wildland recreation participation and use. The presence of a distance or proximity factor mitigates some of the influence of race and ethnicity. The results of the cross-sectional models are combined with U.S. Census projections of total population, changes in population characteristics, and estimates of current National Forest Wilderness visitation estimates to give some insight into pressure that might be expected on the nation's designated wilderness during the next half century. Results generally indicate that per-capita participation and visitation rates will decline over time as society changes. Total wilderness participation and visitation will, however, increase, but at a rate less than population growth.

Key Words: logistic, negative binomial, participation, recreation, visits, wilderness

JEL Classifications: Q21, Q26, Q24

Visits to wilderness and primitive areas are increasing in the United States (Taylor). Recreational use of the original 54 Wilderness areas, as designated by the Wilderness Act of 1964, increased by 86% between 1965 and 1994 (Cole). Participation monitoring has demonstrated that Wilderness use was increasing faster than outdoor recreation use in general (Watson, Cordell, and Hartmann). Recent trends indicate that visitor use of Wilderness is still increasing and will continue to increase with additional designations (Watson and Cole). Recreation use of National Forest (NF) Wilderness grew 9.6% annually between 1965 and 1974 and by 10% annually between 1975

J.M. Bowker, H.K. Cordell, and C.J. Betz are research social scientist, project leader, and outdoor recreation planner, respectively, USDA Forest Service, Southern Research Station, Athens, GA; J.C. Bergstrom, D. Murphy, and C.M. Starbuck are professor, and former research coordinators, respectively, University of Georgia, Department of Agricultural and Applied Economics, Athens, GA; D.B.K. English is program manager, National Visitor Use Monitoring Project, USDA Forest Service, Washington, DC; G.T. Green is assistant professor, University of Georgia, Warnell School of Forestry and Natural Resources, Athens, GA.

and 1985. After 1985, as designation leveled off, the increase in use grew more slowly with an increase of 8.4% by 1993. The same pattern was seen in National Park Service (NPS) Wilderness use following designation (Cordell et al. 1999). Cordell and Teasley conservatively estimated 40.4 million visits to Wilderness or other primitive areas for 1995. Future estimates show increased use per acre and an increase in the number of people who want to experience the opportunities afforded by Wilderness (Cordell et al. 1999).

Alternatively, recent and continuing changes in the ethnic fabric of U.S. society raise questions about culturally induced shifts in outdoor recreation preferences and a subsequent decline in Wilderness visitation (Johnson et al. 2004; Taylor; Murdock et al.). In-depth analyses and understanding of shifting social, spatial, and economic variables, as well as impacts of growing demand for Wilderness or other primitive area recreation, are needed to inform Wilderness and other public land managers about potential user conflicts and pressures on the resource. Moreover, information about the number of future users can serve as a barometer for societal support for maintaining recreation access to the National Wilderness Preservation System (NWPS).

In this study statistical models for individual participation in and consumption of Wilderness and primitive area recreation are explored and developed. The influence of sociodemographic and spatial factors on people's decision-making process whether to participate in Wilderness recreation, and if so how often, are also tested. Lastly, estimated models are combined with census projections of expected changes in total population and population composition over the next half century and NF Wilderness visitation to forecast recreation participation and use on NF Wilderness and the NWPS overall.

Data and Methods

This study uses data from a variety of sources. Statistical models were based on data from the National Survey on Recreation and the Environment (NSRE). The NSRE is the eighth version of the U.S. National Recreation Surveys started in the 1960s. The current survey started in 2000 and continued through 2004 (Cordell, Green, and Betz). The NSRE is a random-digit-dialing telephone survey of more than 90,000 households nationally. The survey gathers information on a number of outdoor recreation and environmental topics, including outdoor recreation participation, environmental attitudes, natural resource values, attitudes toward natural resource management policies, household structure, lifestyles, and demographics. The data are weighted using post-stratification procedures to adjust for nonresponse according to age, race, gender, education, and rural/urban strata (Cordell, Green, and Betz). Data for this study were taken from the eighth of 18 versions of NSRE between March and June 2001. The total sample size was just under 5,000 observations.

In order to examine the impact of spatial factors on participation, zip codes from the U.S. zip code points (ESRI Data and Maps) were matched with respondent's zip codes to create a base location map for respondents. These points were placed at the delivery based centroid representing 5-digit zip code areas. Zip codes with few or no delivery locations were assigned a single business in the area (ESRI). The Wilderness Areas of the U.S. boundary map (U.S. Geological Service) was used to locate designated Wilderness areas in relation to respondent zip codes.

Data for participation and use forecasting were primarily obtained from U.S. Census Bureau data from 2004 and were used to determine interim projections by age, gender, race, and Hispanic origin. Woods and Poole, Inc., data were used to determine metropolitan population projections. National Visitor Use Monitoring (NVUM) survey data (U.S. Department of Agriculture, Forest Service) were used to determine the number of NF Wilderness days and NF Wilderness visitors for 2002. These base numbers were used to create an index to project future use.

Regression Models

Logistic regression was used to describe recreation participation behavior. Participation

was based on the probability of a visit to a wildland area in the past year and was modeled as a function of various sociodemographic and spatial explanatory variables. The general form of the logistic equation is

$$(1)\quad \text{Probability (participate)} = 1/[1 + \exp(-\mathbf{X}B)],$$

where, exp represents the exponential function, **X** is a matrix of explanatory variables, and *B* is a vector of parameters. This type of model is commonly used in the recreation and social science research examining individual choice behavior (Bowker, Cordell, and Johnson; Johnson et al. 2004; Johnson, Bowker, and Cordell; Miller and Hay).

The binary (yes/no) dependent variable in this model was drawn from the NSRE question, "Did you visit a wilderness or other primitive, roadless area (within the last 12 months)?" Sociodemographic independent variables included in the *X* vector were the age of the respondent, gender, whether a person was born in the United States, education level, and household income. The relationship between ethnicity and participation was examined by using three categorical variables for Hispanic, black, and other (American Indian, Asian, Native Hawaiian). Additional variables were used to describe population density of the county of residence (metro or rural) and whether a respondent belonged to an environmental organization. This variable served as a proxy measure for environmental awareness of Wilderness and other primitive areas. All of the above variables are listed and defined in Table 1.

An important addition to the NSRE data was the inclusion of a distance or availability proxy variable. The respondent's zip code was used to calculate the distance to the nearest Wilderness area. ArcView 8.3 was used to calculate the distance from each zip code point to the nearest Wilderness area by joining zip code points with the Wilderness areas based on spatial location. This calculates the distance from each point to the nearest Wilderness area. Because the zip code points are delivery based centroids and the distance calculated falls on the nearest point of the closest Wilderness area, these distances are not meant to be exact. They do, however, provide a proxy for availability of a wildland setting. In order to calculate exact distance, more precise information on the respondent's location and the exact location of the Wilderness entrances would be needed. With this information, a network analysis could be performed using the cost-weighted direction function, which used road maps to determine the route along the least-cost path that the respondent could take to the closest Wilderness area. Other types of calculation that could be performed with more specific information include straight-line distance from the respondent's home to the nearest Wilderness entrance or the cost-weighted distance, which modifies the straight-line distance by some other factor (e.g. elevation).

Table 1. Variables Used In The Empirical Models

Independent Variables	Definitions
AGE	Age of respondent in years
SEX	Gender; 1 if male; 0 otherwise
HISPANIC	1 if Hispanic; 0 otherwise
BLK	1 if Black; 0 otherwise
OTHER	1 other; 0 if Black or White
BORNUSA	1 if born in the U.S.; 0 otherwise
EDUC	1 if BS or above; 0 otherwise
URBAN	1 if metro; 0 if rural
INCOME	1. $4,999 or less 2. 5,000–9,999 3. 10,000–14,999 4. 15,000–19,999 5. 20,000–24,999 6. 25,000–34,999 7. 35,000–49,999 8. 50,000–74,999 9. 75,000–99,999 10. 100,000–149,999 11. 150,000 or more
MEMBER	Member of an environmental/conservation group: 1 if member; 0 otherwise
MILES	Distance to the nearest wilderness area in miles
WILDERN	Willingness to visit wilderness or other primitive areas: 1 if interested; 0 otherwise

A negative binomial regression model was used to determine intensity of participation or the number of participation days. Negative binomial models have been used extensively in recreation visitation modeling (Betz, Bergstrom, and Bowker; Zawacki, Marsinko, and Bowker 2001). Following Yen and Adamowicz, the negative binomial probability distribution can be represented as

$$(2)\quad \text{Prob}(Y_i = y_i;\ y_i = 0, 1, 2, \ldots) = \frac{\Gamma(y_i + 1/\alpha)}{\Gamma(y_i + 1)\Gamma(1/\alpha)}\{(\alpha\lambda_i)^{y_i}(1 + \alpha\lambda_i)^{-[y_i+(1/\alpha)]}\},$$

where $\lambda_i = \exp(\Omega, X, u_i)$, with variables as listed for Equation 1; Ω is a parameter vector; Γ represents the gamma function; and α is the overdispersion parameter. The expected value for the number of days, $E(Y_i)$, is λ_i, and the variance, $\text{Var}(Y_i)$, is $\lambda_i(1 + \alpha\lambda_i)$. An asymptotically significant α indicates the presence of overdispersion, making the negative binomial model appropriate. When the overdispersion parameter α is zero, both $E(Y_i)$ and $\text{Var}(Y_i)$ are equal to λ_i and the Poisson model is appropriate (Yen and Adamowicz). Exp (u_i) is assumed to follow a gamma distribution with mean 1.0 and variance (Greene 2000). The dependent variable for this model, also obtained from NSRE data, was the individual's response to, "On how many days did you visit a wilderness or primitive area in the past 12 months?" Those not answering affirmatively to the participation question were assigned 0 days. The same explanatory variables that were used to describe participation probability in the logistic regression were used to estimate and project the amount of use (number of days).

Results

Table 2 contains sample means, both postsample weighted and unweighted, for data used in the analysis. These means indicate the presence of some response bias according to certain demographic variables. The postsample weighting procedure brings these variables in line with census values.

Table 2. Weighted and Unweighted Means for Explanatory Variables

Variable	Weighted	Unweighted
AGE	42.8	43.7
GENDER	0.474	0.438
BLACK	0.138	0.076
HISPANIC	0.152	0.067
OTHER	0.048	0.038
BORNUSA	0.882	0.945
MEMBER	0.229	0.259
INCOME	6.92	7.09
EDUCATION	0.208	0.320
URBAN	0.793	0.658
MILES	75.7	76.7

The logistic participation and negative binomial days regression models were estimated using LIMDEP 7.0 (Greene 1995). Results of the logistic participation regression are presented in Table 3. Quantitative interpretation of the logistic regression parameters is not transparent; hence the last column in Table 3 displays the change in probability of participation with a one-unit change in the relevant explanatory variable. For example, with other factors set to sample means, a male is 12.2% more likely than a female to have visited a wilderness or primitive area in the past year. Similarly, a black is 19% less likely than a white to have visited this type of site.

Past studies have shown that the typical outdoor recreation participant is white, male, able bodied, and well educated, with an above average income (Cordell, Bergstrom, and Bowker; Johnson et al. 2004; Cordell et al. 1999). The average age among Wilderness visitors is increasing (Watson), but for the general population the likelihood of participation in Wilderness recreation decreases with age (Johnson et al.). Also, while the proportion of female participants appears to be increasing (Watson), women are still less likely to visit a wilderness or primitive area (Johnson et al. 2004). Past studies have indicated that blacks, Latinos, and Asians are less likely to say that they have ever visited a Wilderness area and that immigrants are less likely then native born respondents to visit Wilderness (Johnson et al.). The estimated models corroborate previ-

Table 3. Logistic Regression Parameter Estimates, $n = 4400$

Variable (Weighted)	Parameter	Std. Error	Pr > ChiSq	Change in Visit Probability
Intercept	−1.99	.291	.0000	−.386
AGE	−.019	.002	.0000	−.003
GENDER	.634	.070	.0000	.122
BLACK	−.986	.122	.0000	−.19
HISPANIC	−.824	.176	.0000	−.159
OTHER	−.585	.182	.0013	−.113
BORNUSA	1.31	.211	.0000	.254
MEMBER	.768	.078	.0000	.148
INCOME	.088	.021	.0000	.017
EDUCATION	.101	.086	.2363	.019
URBAN	−.139	.085	.1039	.026
MILES	−.002	.0006	.0003	−.0004

ous findings indicating that income, gender (male), immigrant status (born in the United States), and environmental awareness are all factors positively correlated with wildland recreation participation; while race (black and other), ethnicity (Hispanic), age, and urban dwelling negatively affect wildland recreation participation and intensity. Education did not have a significant impact on the probability of participation.

Although not included in the literature cited above, another factor that is negatively correlated with wildland recreation participation is distance, with the chance of participation decreasing as distance increases. The presence of a distance or proximity factor tends to mitigate some of the influence of race and ethnicity (e.g., 5% decrease in black coefficient). Studies indicate that visitors are generally from the state the Wilderness area is located in and from the closest region in the state (Roggenbuck and Watson). Part of the negative correlation between race and visitation could be due to the geographic distribution of black populations (Johnson et al. 2004), hence the importance of including both distance and race in participation models.

Table 4. Negative Binomial Parameter Estimates, $n = 4357$

Variable	Parameter Estimate	Std. Error	*P*-Value
Intercept	.046	.280	.0939
AGE	−.009	.002	.0000
GENDER	.42	.071	.0000
BLACK	−1.39	.085	.0000
HISPANIC	−1.40	.189	.0000
OTHER	.037	.171	.8269
BORNUSA	1.72	.151	.0000
MEMBER	.751	.088	.0000
INCOME	.057	.018	.0015
EDUCATION	−.359	.100	.0003
URBAN	−.721	.079	.0000
MILES	−.003	.0004	.0000

Results of the negative binomial regression are presented in Table 4. Results indicate that the explanatory variables have similar qualitative effects on wilderness and primitive area visitation days as on the probability of participation. Unlike the logistic regression, interpretation of the parameter estimates for the negative binomial is more transparent. With expected days specified in a semilog form, parameter estimates can be interpreted as the percentage change in days per one-unit change in the explanatory variable. Hence, other factors constant, males can be expected to spend about 42% more days per year visiting Wilderness and primitive areas than females. Education still has a positive correlation with the number of days that a person visits but has a more significant impact than on participation. This indicates that the level of education a person has may not significantly impact whether on not a person visits a wilderness or primitive area, but if a person does visit, then the num-