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Article

Outdoor Recreation in Southeastern United States National Forests: An Investigation of the Influence of Ethnicity and Gasoline Price on Individual Participation

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Abstract: Outdoor recreation is one of the most widely recognized ecosystem services provided by forests and grasslands in the world. This paper examined the influence of factors not related to landscape values, such as ethnicity and gasoline prices, on individual participation in outdoor recreation in the southeastern region of the U.S. The model results showed that there were no significant ($p > 0.05$) differences between the race groups (Caucasians and non-Caucasians) for participation in the different activities either between racial groups or among National Forest (NF). This may be due to the very high proportion of Caucasian participants in the study. The results also revealed that travel costs negatively influence the number of NF visits. The number of NF visits decreases if the gasoline price increases by 20% and more. The results of this study have practical importance for different entities such as stakeholders, tourism operators, the United States Department of Agriculture (USDA) Forest Service, and local authorities.

Keywords: National Forests; forests; outdoor recreation; travel time; visitors; Southeastern United States; model; surveys

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1. Introduction

Outdoor recreation is one of the most widely recognized ecosystem services provided by forests and grasslands in the world [1]. Indeed, it connects people with nature in a variety of unmatched settings, activities, and traditions. In recent centuries, human societies have increased the value they place on leisure time, which also increases the demand for open areas for outdoor recreation access on National Forest lands [2]. A part of this interaction can be contextualized in the form of human perceptions of the tangible and intangible benefits that forest landscapes provide [3]. In this context, today's growing demand for the use of National Forests (NFs) for recreational activities has resulted in the need to understand attitudes toward valuing public recreational resources and the potential conflicts with other functions of the forests. According to the U.S. Forest Service, National forests and grasslands received 168 million visits in 2020—an increase of 18 million compared to 2019 [4]. Approximately 84% of the visitors indicated that recreation opportunities provided by National Forests were the primary reasons for making a trip from home to a national forest [4].

There is enough evidence to consider that landscape values have different importance for different social groups. The main drivers to participate in forest recreation can differ for other people due to subjective aspects of values [5] because people are different. Brown [6] reported that the importance of landscape values in (Kangaroo Island, South Australia) differs between tourists and residents. Similar results were obtained by Mäntymaa et al. [7].

Based on differences in the significance of forest attributes, Mäntymaa et al. [7] determined three groups of visitors to the Ruka-Kuusamo area in Finland: forest-owners, responsible recreationists, and everyman's rights enthusiasts.

Moreover, the demographic structure of the U.S. population has changed with increasing ethnic diversity and an aging population that present unique challenges [8]. The "new" ethnically diverse participants are likely to have differing perceptions, attitudes, values, and interpretations regarding natural resources, but little is often known about their demand for outdoor recreation [9]. In general, improved socio-economic prosperity among recreationists offers multiple opportunities to travel to National Forest (NF) areas [10]. However, the requirements of lower socioeconomic class individuals may be different from those of their wealthier counterparts.

It is also important to understand other underlying motivational factors, such as travel costs, that can impact the frequency and duration of visits to NFs. Gasoline price, for example, is an essential part of the travel cost, so an increase in the gasoline price may negatively affect NF visit frequency. A number of previous studies have indicated a negative association between total travel costs and the frequency of visits to a particular site [11,12], utilizing the Travel Cost method (TCM) introduced by Clawson [13]. Therefore, rising total travel cost is an important barrier for an individual to visit the forests for recreation. Yet its effects can differ for visitors participating in forest recreation activities [14]. Similarly, it can be suggested that different sociodemographic groups respond differently to changes in total travel costs. Likewise, information on hypothetical visitors' behavior at the different levels of entrance/user fees [15] utilizing contingent behavior methodology (CBM) [16] suggests a decrease in the proportion of visitors willing to pay a larger amount for entrance/user fees because empirical studies indicate a high price-elasticity of demand of tourist visits in recreational regions [17].

However, results of previous studies also indicate that visitors' willingness to pay for access to certain areas has links to landscape quality, biodiversity, and service quality [7,18]. Shrestha et al. [19] found that improving recreational facilities positively influences visitors' willingness to pay more in the case of recreational fishing in Brazilian Pantanal. The positive impact of recreational services quality on willingness to pay for access to the national park was confirmed in other studies [15,20,21]. There is also enough evidence to consider that there is a positive linkage between visitors' satisfaction and future hypothetical behavior in the case of different kinds of leisure pursuits [22,23]. From another angle, visitors' satisfaction has a positive linkage with service quality [24]. It suggests the possibility of a link between the current environmental and amenity service quality and willingness to pay.

Unfortunately, studies that considered ethnicity-based differences or explored socioeconomic class in demand models to explain trip-taking behavior in recreation demands on National Forest lands in the Southeastern United States are limited. Therefore, an investigation to examine the influence of factors unrelated to landscape values, such as ethnicity and gasoline price, on individual participation in outdoor recreation in NFs has high importance for tourism development on NF lands in the Southeastern United States. Focusing on these aspects and based on previous literature discussed, the following hypotheses were considered for this study:

Hypothesis 1 (H1). *Caucasians are more involved in recreation compared to non-Caucasians.*

Hypothesis 2 (H2). *An increase in gasoline prices affects the frequency of forest visits that varies with sociodemographic groups (gender, age, and number of people in the vehicle).*

2. Materials and Methods

2.1. Study Site

Fourteen National Forests (NFs) in the Southeastern US with different characteristics were chosen for this study. These NFs are distributed across 13 states in Region 8 (see Figure 1). They represent recreational sites with different landscapes and various recreational demands. These National Forest sites offer immense recreation opportunities for activities such as bicycling, hiking, swimming, and canoeing to their visitors. It is important to note that five wildlife areas are also located in these NFs. These wildlife areas provide additional fishing, boating, camping, horseback riding, picnicking, and wildlife viewing as recreational activities. Numerous species of birds, fish, mammals, amphibians, and reptiles inhabit these NFs. People can view rare and endangered species in these wildlife areas, such as the flattened musk turtle, the gopher tortoise, and the red-cockaded woodpecker. Elevations and landscape in these NFs differ widely, ranging from 30.48 m in the Coastal Plain to over 640.08 m in the Appalachian areas [2].

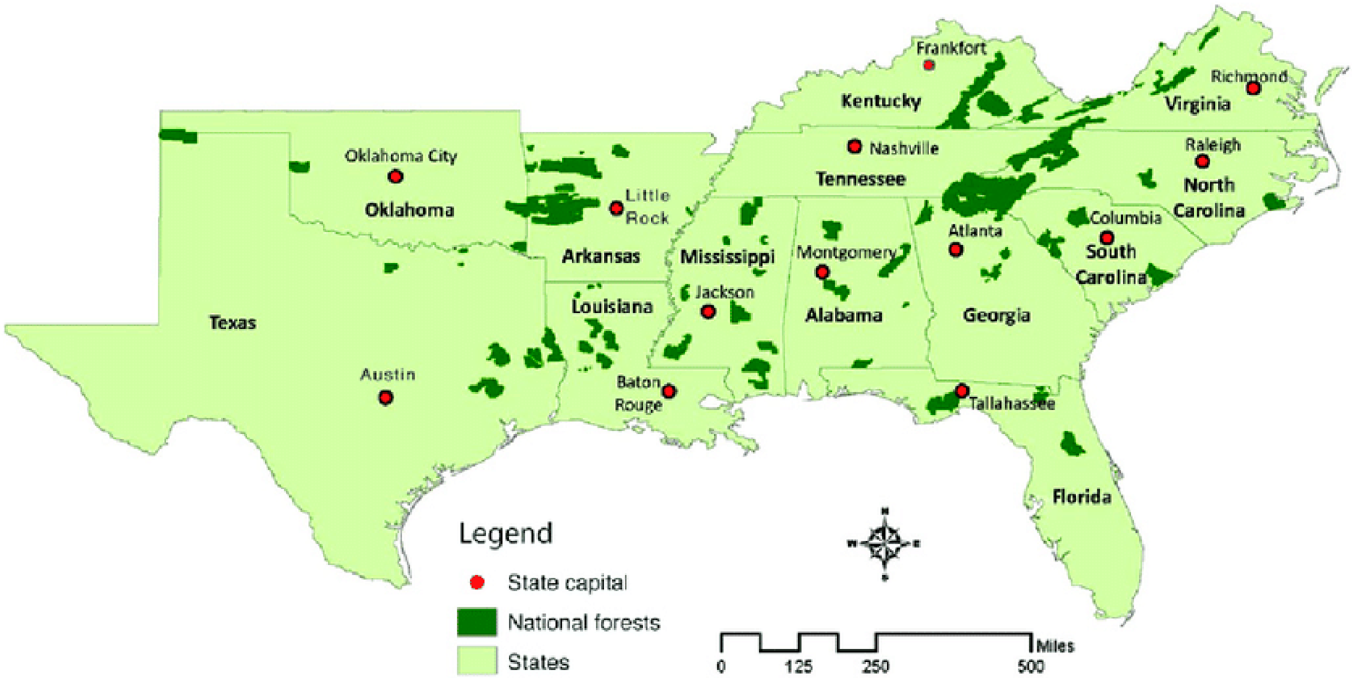

Figure 1. Spatial distribution of the National Forests in the Southeastern region in the United States (source: fs.usda.gov accessed on 19 February 2020/Alabama forest, 2017).

2.2. Sampling and Data Collection Procedure

The National Visitor Use Monitoring (NVUM) 2010 to 2014 dataset was used as the data source for this study [25]. The objectives of the NVUM program were: first, to estimate the number of recreational visits to national forests and, second, to produce descriptive information about visitation, including activity participation, demographics, visit duration, measures of satisfaction, and trip spending connected to the visit. The dataset for this research was obtained from the United States Department of Agriculture (USDA) Forest Service in 2018. This dataset was based on a survey of over 155,000 visitors at 7532 different sites across 120 national forests during 1368 days of sampling between January 2010 and September 2014 [26]. Among the recorded visitors, 136,584 agreed to be interviewed (88% participation rate).

Interviewers (typically Forest Service employees), trained by instructors of the national training and certification program, conducted face-to-face, on-site interviews using a 4-page National Visitor Use Survey form. The survey form had questions relating to demographics and visit descriptions as well as six economic relating questions. Moreover, one-third of the forms had 16 satisfaction and 14 satisfaction question elements. The duration of the interview varied between eight minutes and 12 minutes [2].

The surveys used a double sampling method with a two-step approach. In the first step, the survey days and sites were randomly selected from a stratified set of days and recreational sites, with strata defined by site type and daily exit volume. The exact survey location was determined by road/weather conditions, type of road, and stopping distance.

Interviews were given to randomly selected vehicles or groups that stopped at the randomly selected sites. In the second step, an interview was conducted with the individual who had the most recent birthday in the randomly selected vehicle exiting the selected recreational site. For each chosen site day, six hours of exit interviews were conducted. Site-visit estimates were acquired for each sample day, averaged by strata, and then expanded by a stratified-sampling weight. Results from the NVUM program were used to construct NVUM data. The NVUM quality-assurance-check procedure was implemented to ensure the quality of the survey data [2].

2.3. Application of National Visitor Use Monitoring (2010–2014) Dataset

2.3.1. Estimation of Ethnicity-Based Differences in Recreation Demands

To estimate the significance of the linkage between recreation demands and ethnicity, a truncated negative binomial regression model [27] was used. To detect the ethnic differences in forest recreation demand, all respondents were grouped into two ethnic groups; Caucasians and non-Caucasians. The interaction between the binary variable Caucasian/non-Caucasian and specific forest recreation activities captures ethnic differences related to the demand for activities, categorized as Water, Trail, Viewing, Picnicking, Education, Recreational-vehicle, and Gathering, introduced by Cho et al. [14]. The interaction between Caucasians and Travel costs allows testing of ethnic differences in price response between the two ethnic groups. The deterministic part of the model was defined as follows:

$$\ln(N_{visit}) = \beta_0 + \beta_w \cdot W + \sum_{i=1}^{7} \beta_{wRAi} W \cdot RA_i + \beta_{tc} TC + \beta_{wtc} \cdot W \cdot TC + \sum_{i=1}^{11} \beta_{Ci} \cdot C_i \quad (1)$$

where

N_{visit}—number of NF visits during the last two months;

W—binary variable for the race (1 = Caucasians, 0 = non-Caucasians);

RA_i—seven recreational activities included in the model (Water, Trail, Viewing, Picnicking, Education, Recreational vehicle, and Gathering) according to Cho et al. [13,14];

TC—travel cost;

C_i—eleven control variables (Juveniles, number of people in the vehicle, age group (>60 and <60), Gender, and seven recreation activities) were included in the model.

The difference in forest recreation demands between Caucasians and non-Caucasians was tested with H0: $\beta_w = 0$, while the differences in specific recreation activities demand can be tested with H0: $\beta_{wRAi} = 0$. The differences in the slope of the forest recreation demand function between Caucasians and non-Caucasians were tested with H0: $\beta_{wtc} = 0$. The fit model was based on Akaike's Information Criteria (AIC) and Bayesian Information Criteria (BIC) criteria calculated for three models: Poisson, Zero-truncated Poisson, and Zero-truncated negative binomial. The choice of the most appropriate model was based on the smallest values of AIC and BIC.

2.3.2. Clustering Technique to Estimate the Effect of Gasoline Prices on Travel Cost

First, visitors were clustered by their recreation behavior. The survey included 28 questions related to recreational activities that the respondents participated in during their current visit to the NF. Winter activities were not reflected in the data set. So, P_DOWNHILL_SKI, P_SNOWMOBILE, and P_XC_SKI were excluded from the clustering. The variable "PARTICIPATE_GATHERING " was not considered because only 21 respondents reported gathering as a main activity.

The Jaccard distance was used for clustering. Hierarchical clustering was used because this method could use the Jaccard distance for binary variables. The Jaccard similarity coefficient J for two objects X and Y that have a number of asymmetric binary attributes (0.1) can be calculated as:

$$J = \frac{M_{11}}{M_{11} + M_{01} + M_{10}} \quad (2)$$

where:

M_{11} represents the overall number of attributes where both X and Y have a value of 1.

M_{10} represents the overall number of attributes where the attribute of X has a value of 0, and the attribute of Y has a value of 1.

M_{01} represents the overall number of attributes where the attribute of X has a value of 1, and the attribute of Y has a value of 0.

The Jaccard distance, dJ, is calculated as

$$D = 1 - J = \frac{M_{01} + M_{10}}{M_{11} + M_{01} + M_{10}} \quad (3)$$

Two up to eight cluster solutions were considered using hierarchical clustering. The 3-cluster solution was used as it was the most stable among all forests and for all forests in one dataset. In addition, the 3-cluster solution is simple for understanding and interpretation using the number of activities in which respondents participated during their visit NF (Table 1).

Table 1. Description of the cluster.

Generalist Recreationists	Intermediate Recreationists	Specialized Recreationists
Just visit forests for recreation Are ready to participate in any available forest recreation activity	Visit forests with certain purposes Are ready to participate only in some preferable activities	Have a strongly certain aim visiting the forest Are ready to participate only in an initially chosen activity

Hierarchical clustering also revealed an interesting cluster of individuals that can be identified as forest enthusiasts and actively participate in all and any activities accessible to them during their visits without any particular preferences. This cluster was termed "generalist recreationists (GRs)." The average number of activities for these individuals was understandably the highest among individuals in all other clusters. The second cluster included individuals who visited the forest with the purpose of participating in a limited number of activities and were observed not to participate in more than three activities per visit, with a group average of around two activities per visit. This cluster was named "intermediate recreationists (IR)." The third cluster identified included individuals who preferred a single activity (or a maximum of two), with a group average slightly above one activity per visit. They did not participate in other activities. This cluster was named "specialized recreationists (SRs)." Based on a 3-cluster solution, zero-truncated Poisson regression was estimated to capture the impact of the gasoline price on the number of visits NF for recreation. Mileage rates provided by the US General Service Administration (GSA) were used to calculate the travel costs.

Three models were estimated: Poisson regression (considering that outcome is count data) and zero-truncated Poisson, and negative binomial regression (considering that outcome is zero-truncated because if respondents reported the outcome, then they visited a NF at least once during the year). The choice of the most appropriate model was based on the lowest values of AIC and BIC.

2.3.3. Missing Data

The NVUM survey data have a lot of missing values for some important variables. Especially, the number of visits to NF in the last 12 months was completely unavailable in the dataset for Nantahala, Pisgah, Uwharrie, Croatan, Francis Marion, Sumter, and Davy Crockett, Angelina, Sabine, Sam Houston, Caddo Lyndon B., Johnson Grasslands Forests with missing variables in the dataset were excluded from further analysis. Also, the variable "distance from home to an alternative NF" was also missing for about 90% of the reported cases in most forest survey records. The "income" variable was also underreported in the dataset. The percentage of the missing data for the variable "total spending on gasoline" was missing for more than 70% of the cases for all forests. Therefore, these variables were excluded from the regression analysis.

2.3.4. Variable Preparation

The reported distance was grouped into ten intervals at 50 miles increments (0–50 miles, 50–100, and so on) due to the fact that respondents often rounded their travel distance to 50 miles. The data which contained a small number of unrealistic reported distances, such as 2000 miles or 3000 miles with possible zero counts within the cells (subgroups) within the regression analysis, were also dropped from the analysis. To calculate travel costs, the mileage rates provided by the US General Service Administration (GSA) were used; 0.55$/mile for 2009, 0.50$/mile for 2010, 0.51$/mile for 2011, 0.56$/mile for 2012, 0.57$/mile for 2013, and 0.56$/mile for 2014 (GSA, 2018). The product of the median of these values with the corresponding mileage rate was used to calculate the travel cost for each respondent who reported the travel distances. A similar procedure was applied to calculate the travel costs to the nearest alternative NF.

3. Results

3.1. Ethnicity and Forest Recreation Demand

3.1.1. Model Selection and Determination

To detect the ethnicity differences in forest recreation demand, all respondents were grouped into two ethnic groups: "Caucasians" and non-Caucasians." The model selection was based on Akaike's Information Criteria (AIC) [28,29] and Bayesian Information Criteria (BIC) [30] calculated for three models: Poisson, Zero-truncated Poisson, and Zero-truncated negative binomial. AIC was used to estimate prediction error and, thus, the relative quality of a statistical model, while BIC is used for scoring and selecting models [31]. Both AIC and BIC predict best-fit models based on low scores. As a result, in this study, the zero-truncated negative binomial model was selected to examine the relationship between ethnicity and National Forest visits because it has the least overall score for all the forests, using both AIC (score = 48638.33) and BIC (score = 48797.82) (Table 2). Also, this model had the lowest AIC and BIC scores for all the individual forests compared to the two other models (Table 2).

Table 2. Criteria for model selection on the relationship between ethnicity and forest recreation demands.

National Forest	Poisson Regression		Zero-Truncated Poisson Regression		Zero-Truncated Negative Binomial Regression	
	AIC	**BIC**	**AIC**	**BIC**	**AIC**	**BIC**
All forest overall	284,403.14	284,555.69	282,742.46	282,895.02	48,638.33	48,797.82
(Daniel Boone)	30,533.03	30,645.56	30,211.93	30,324.45	7036.60	7154.24
(Chattahoochee-Oconee)	21,630.73	21,727.13	21,349.68	21,446.08	3902.58	4003.36
(Cherokee)	53,187.77	53,301.03	53,013.48	53,126.74	9257.30	9375.71
(Apalachicola, Osceola, Ocala)	35,127.39	35,225.92	34,866.28	34,964.81	4268.20	4371.21
(Kisatchie)	24,133.97	24,238.03	24,079.72	24,183.78	5678.07	5786.86
(George Washington-Jefferson)	44,787.39	44,897.91	44,463.51	44,574.03	7237.51	7353.05
(Ozark)	11,817.77	11,905.91	11,677.48	11,765.62	2211.06	2303.21

AIC: Akaike's Information Criteria, BIC: Bayesian Information Criteria.

It is worth noting that the forests of Nantahala, Pisgah, Uwharrie, Croatan, Francis Marion, Sumter, Davy Crockett, Angelina, Sabine, Sam Houston, and Caddo Lyndon B., Johnson grasslands were excluded because the outcome variable was missing for these forests. Also, NF William B. Bankhead, Talladega, Tuskegee, Conecuh, De Soto, Homochito, Bienville, Delta, Tombigbee, Holly Springs, St. Francis, Ouachita, (El Yunque, El Yunque were excluded because the number of non-Caucasians was small and produced a problem with the estimation of the model. The zero-truncated model was then estimated for all forests (overall) and seven National Forests.

3.1.2. Relationship between Ethnicity and Forest Recreation Demands Using Zero−Truncated Model−Estimates

The results revealed that, for the total of the forests, the log count of the visit of NF is 0.58 larger for Caucasians in comparison with non−Caucasians. This coefficient demonstrates a significant ($p < 0.05$) support for the essential shift in forest recreation demand between Caucasians and non−Caucasians. This demand is higher for Caucasians as compared to non−Caucasians. However, the interaction term between race variable and travel costs is not significant ($p > 0.05$), indicating no significant ($p > 0.05$) differences in the slopes of demand curves for Caucasians and non−Caucasians. In contrast, the intercept is larger for Caucasians. Also, no significant ($p > 0.05$) differences were found between the race groups for participation in the different activities in the case of the dataset (Table 3).

Table 3. Regression analysis of various predictors relating to ethnicity and forest recreation demands based on zero-truncated model estimates.

	Forests							
Predictors	**Total Forests**	**(Daniel Boone)**	**(Chattahoochee-Oconee)**	**(Cherokee)**	**(Apalachicola, Osceola, Ocala)**	**(Kisatchie)**	**(George Washington-Jefferson)**	**(Ozark)**
(Intercept)	−5.67	0.30	1.87	2.08	−8.37	2.16	2.54	−13.00
	(0.834)	(0.847)	(0.182)	(0.077)	(0.939)	(0.048)	(0.096)	(0.000)
Juveniles	−0.07	0.00	−0.03	0.18	−0.01	0.26	−0.07	−0.34
	(0.009)	(0.971)	(0.785)	(0.012)	(0.939)	(0.002)	(0.293)	(0.021)
People in the vehicle	−0.12	−0.12	−0.22	−0.21	−0.15	−0.47	−0.28	0.06
	(0.000)	(0.003)	(0.000)	(0.000)	(0.033)	(0.000)	(0.000)	(0.585)
Gender (male, baseline−female)	0.06	0.19	−0.28	0.07	0.19	0.18	−0.05	0.68
	(0.328)	(0.163)	(0.205)	(0.549)	(0.388)	(0.212)	(0.736)	(0.016)
Seniors (>60, baseline <60)	0.57	−0.32	0.96	0.21	1.06	0.70	0.31	−0.10
	(0.000)	(0.113)	(0.001)	(0.215)	(0.000)	(0.000)	(0.130)	(0.781)
Caucasians (baseline—non−Caucasians)	**0.58**	1.11	1.53	1.14	0.81	0.97	−0.58	0.81
	(0.014)	(0.115)	(0.252)	(0.332)	(0.367)	(0.373)	(0.439)	(0.457)
Water	0.14	1.43	1.30	−0.17	−0.62	1.05	−0.25	−0.73
	(0.580)	(0.254)	(0.369)	(0.768)	(0.396)	(0.248)	(0.796)	(0.444)
Trail	0.01	1.25	0.01	−0.32	−1.09	−0.61	−1.33	−1.16
	(0.981)	(0.229)	(0.993)	(0.606)	(0.145)	(0.412)	(0.120)	(0.285)
Viewing	0.34	1.82	1.88	0.86	−0.48	−0.55	−0.22	0.67
	(0.199)	(0.039)	(0.076)	(0.428)	(0.639)	(0.514)	(0.745)	(0.466)
Picnicking	−0.68	−1.09	−2.52	0.65	−1.66	1.33	−3.76	−1.69
	(0.005)	(0.176)	(0.022)	(0.320)	(0.047)	(0.114)	(0.000)	(0.315)
Education	−0.16	−1.46	−1.98	−0.23	2.62	−1.64	2.38	6.23
	(0.618)	(0.086)	(0.184)	(0.728)	(0.008)	(0.109)	(0.070)	(0.207)
Recreational vehicle	0.69	−0.48	−8.41	0.95	−0.28	−0.09	−10.25	−25.54
	(0.235)	(0.811)	(0.748)	(0.463)	(0.877)	(0.962)	(0.844)	(0.000)
Gathering	0.41	−1.39	−0.80	0.78	2.26	1.50	1.18	−5.42
	(0.247)	(0.257)	(0.578)	(0.372)	(0.018)	(0.112)	(0.564)	(0.242)

Table 3. *Cont.*

Predictors	Forests							
	Total Forests	**(Daniel Boone)**	**(Chattahoochee-Oconee)**	**(Cherokee)**	**(Apalachicola, Osceola, Ocala)**	**(Kisatchie)**	**(George Washington-Jefferson)**	**(Ozark)**
Travel cost	−0.02	−0.05	−0.038	−0.01	−0.02	−0.03	−0.04	0.02
	(0.000)	(0.000)	(0.022)	(0.055)	(0.128)	(0.107)	(0.000)	(0.773)
Caucasians Travel cost	0.00	**0.03**	0.016	−0.01	**−0.02**	0.02	0.02	−0.05
	(0.876)	**(0.031)**	(0.329)	(0.249)	**(0.039)**	(0.316)	(0.068)	(0.453)
Water Caucasians	0.15	−0.67	−1.89	0.67	0.61	−0.83	0.36	0.70
	(0.559)	(0.595)	(0.202)	(0.248)	(0.426)	(0.371)	(0.713)	(0.489)
Trail Caucasians	−0.212	**−2.10**	−0.58	0.22	0.64	0.46	1.16	1.12
	(0.382)	**(0.046)**	(0.533)	(0.730)	(0.407)	(0.546)	(0.185)	(0.315)
Viewing Caucasians	−0.38	**−1.84**	**−2.64**	−0.96	0.72	0.55	−0.09	−0.81
	(0.156)	**(0.041)**	**(0.015)**	(0.382)	(0.491)	(0.522)	(0.895)	(0.411)
Picnicking Caucasians	0.29	1.03	**2.99**	−0.97	0.96	−1.60	**3.21**	0.79
	(0.252)	(0.206)	**(0.010)**	(0.144)	(0.279)	(0.062)	**(0.003)**	(0.649)
Education Caucasians	−0.122	1.19	2.36	−0.01	**−2.61**	1.10	**−2.87**	−6.41
	(0.705)	(0.168)	(0.126)	(0.986)	**(0.009)**	(0.286)	**(0.031)**	(0.195)
R_vechicle Caucasians	−0.51	1.02	10.687	−0.57	0.75	0.15	10.58	**25.42**
	(0.397)	(0.619)	(0.684)	(0.675)	(0.685)	(0.937)	(0.839)	**(0.000)**
Gathering Caucasians	0.203	1.72	1.38	−0.86	−0.65	−0.81	0.57	5.75
	(0.579)	(0.170)	(0.354)	(0.338)	(0.522)	(0.399)	(0.786)	(0.217)

Among forests, differences in the recreation demand between the two race groups are non−significant ($p > 0.05$), likely due to the small number of non−Caucasian visitors when considering data from individual forests. Despite this insignificance ($p > 0.05$), the interaction between the race variable and travel cost for the dataset was observed to be significant ($p < 0.05$) for two forests (Daniel Boone) and (Apalachicola, Osceola, Ocala). For the first forest (Daniel Boone), the travel cost had a lesser impact on recreation demand for Caucasian visitors compared to non−Caucasian visitors. The log count of NF visits at this location during the year decreased for non−Caucasians by 0.05 and for Caucasians by 0.02 (−0.05+0.03), with each increase in travel cost at 1$ per 50 miles. In the case of NF (Apalachicola, Osceola, Ocala), the log count of NF visits during the year did not depend on travel costs for non−Caucasians. In contrast, the log count of NF decreased by 0.02 for each increase in travel cost at 1$ per 50 miles for Caucasians (Table 3).

When considering individual forests, several significant ($p < 0.05$) "between−race differences" were found for specific recreation activities. For Caucasians, a significantly ($p < 0.05$) lower demand in trail activities was observed for Daniel Boone forest compared to non−Caucasians. Similarly, significant ($p < 0.05$) trends were also observed for viewing activities versus race in the Daniel Boone and Chattahoochee−Oconee forests and for "education" activities versus race in the forests Apalachicola, Osceola, Ocala, and George Washington−Jefferson forests. On the other hand, the Caucasians had a significantly ($p < 0.05$) higher demand for "picnicking" in the Chattahoochee−Oconee and George Washington−Jefferson forests and "Recreational vehicle" activities in the Ozark Forest (Table 3).

3.2. Effect of Gasoline Price on Forest Recreation Demands

3.2.1. Model Selection and Estimation

Three models were estimated: Poisson regression (considering that outcome is count data), zero−truncated Poisson, and negative binomial regression (considering that outcome is zero−truncated because if respondents reported outcome, they at least reported once during the year visited NF). Based on the AIC and BIC, Poisson regression was applicable to analyze the data in all forests. Zero−truncated Poisson and Zero−truncated negative binominal regressions were not applicable in three and two forests, respectively (Table 4). Moreover, for all forests (overall), Zero−truncated negative binomial regression had the least score for AIC (48605.53) and BIC (48709.52). Also, this model recorded the lowest AIC and BIC scores for the forests (William B. Bankhead, Talladega, Tuskegee, Conecuh), (St. Francis, Ouachita), and (Land Between the Lakes). Therefore, the zero−truncated negative binomial model was used for the relationship between recreation activities and gasoline prices in the southeastern NFs.

Table 4. Criteria for model selection on the relationship between gasoline prices and forest recreation demands.

Forest	Poisson Regression		Zero−Truncated Poisson Regression		Zero−Truncated Negative Binominal Regression	
	AIC	**BIC**	**AIC**	**BIC**	**AIC**	**BIC**
All forest overall	287,914.06	288,011.12	286,083.76	286,180.82	48,605.53	48,709.52
(William B. Bankhead, Talladega, Tuskegee, Conecuh)	6974.22	7029.92	6916.78	6972.49	2412.20	2471.89
(Daniel Boone)	31,171.89	31,243.46	30,729.17	30,800.74	7057.25	7133.94
(Chattahoochee−Oconee)	22,587.40	22,648.75	22,313.04	22,374.39	3877.10	3942.83
(Cherokee)	55,303.00	55,364.78	55,081.81	55,143.59	9237.53	9304.46
(Apalachicola, Osceola, Ocala)	39,330.87	39,393.54	39,050.94	39,113.61	4296.77	4363.93
(Kisatchie)	24,691.77	24,757.99	24,657.23	24,723.45	5661.11	5732.06
(De Soto, Homochito, Bienville, Delta, Tombigbee, Holly Springs)	9500.03	9555.23	9399.86	9455.06	2442.46	2501.60
(George Washington− Jefferson)	45,810.28	45,880.61	45,449.75	45,520.08	7241.58	7316.94
(St. Francis, Ouachita)	12,386.83	12,439.67	NA	NA	1630.71	1687.33
(Ozark)	12,096.36	12,148.45	NA	NA	NA	NA
(El Yunque)	264.62	290.47	NA	NA	NA	NA
(Land Between the Lakes)	6132.79	6185.45	5906.55	5959.22	1802.67	1859.10

AIC: Akaike Information Criteria, BIC: Bayesian Information Criteria, NA: model estimations are not available due to sample size or problem with convergence.

The relationship between individual factors and forest recreation demands is summarised in Table 5. This would ensure that only factors with significant ($p < 0.05$) association with forest recreation will be integrated into the model, thus optimizing the model. The results revealed that juveniles (the number of people under the age of 16 in a recreation group), people in the vehicle, gender, age, Caucasians, the specialized recreationists, and travel cost are factors that significantly ($p < 0.05$) influenced the number of the visits of NF (Table 5). For model optimization, these factors were integrated into a regression model, which related forest recreation activities to travel costs

Table 5. Relationship between individual predictors and forest recreation demands.

Model Estimation	Coefficients	p−Value
(Intercept)	−12.653	0.982
Juveniles	−0.100	0.000
People in vehicle	−0.120	0.000
Gender (male, baseline—female)	0.197	0.009
Seniors (>60, baseline <60)	0.393	0.000
Caucasians (Caucasians, baseline—non-Caucasians)	0.378	0.006
IRs (baseline—GRs)	−0.036	0.629
SRs (baseline—GRs)	0.284	0.007
Total travel cost	**−0.023**	**0.000**
IRs Total travel cost (baseline—GRs travel cost)	**0.006**	**0.000**
SRs Total travel cost (baseline—GRs travel cost)	**−0.003**	**0.171**
Male Total travel cost (baseline—Female travel cost)	**−0.001**	**0.315**
Senior Total travel cost (baseline <60 Travel cost)	**0.003**	**0.011**
Caucasians Total travel cost (baseline—non−Caucasianstravel cost)	**−0.002**	**0.442**

GRs: Generalists recreationists, IRs: intermediate recreationists, SRs: Specialized recreationists; Juveniles: number of respondents under the age of 16 years in a recreation group, Seniors: Number of respondents older than 60 years in a recreational group.

The coefficient value of 0.10 for "Juveniles" indicates that the log count of the visits during the last 12 months decreases by 0.1 for each increase in "Juveniles" (Table 5). The log count of the NF visits decreases by 0.12 for each increase in the number of "People in the vehicle." The 0.197 coefficient value for males suggests that the log count of NF visits for males is 19.7% larger than for females. The log count of NF visits for respondents older than 60 was 0.393 larger than those younger than 60. Also, the log count of NF visits for Caucasians was 0.38 large in comparison with respondents from non−Caucasians. Within the clusters, the log count of NF visits for intermediate recreationists does not differ from the one for generalist recreationists. However, specialized recreationists visit NF more often in comparison with GRs.

In this current study, the log count of NF visits decreases by 0.023 for each increase in travel cost at 1$ per 50 miles. These results support the hypothesis that travels cost negatively influence the number of NF visits (Table 5). In addition, the decrease noted above was less for those respondents who belong to IRs (when compared with GRs) and for older respondents in comparison to respondents who were younger than 60 years old (Table 5).

The regression analysis for the factors obtained above was summarized in Table 6. The results revealed that the coefficients for total travel costs are negative for all forests. However, a significant ($p < 0.05$) impact was found in five of the nine investigated forests. These forests are Daniel Boone, Chattahoochee−Oconee, Cherokee, George Washington−Jefferson, and Land Between the Lakes. For the other four forests, no significant ($p > 0.05$) effect was found (Table 6).

Within the clusters, the increase in travel costs had a smaller effect on Intermediate Recreationists in comparison with Generalist Recreationists for NF (Daniel Boone) and larger for NF (Chattahoochee−Oconee). The number of visits decreases more strongly for specialized recreationists in comparison with GRs if travel costs increase for forests (William B. Bankhead, Talladega, Tuskegee, Conecuh), (Chattahoochee−Oconee), and (George Washington−Jefferson) (Table 6).

Table 6. Regression analysis of various predictors relating to travel costs and forest recreation demands based on zero−truncated negative binomial model estimates among forests.

Predictors	Forests								
	William B. Bankhead, Talladega, Tuskegee, Conecuh	**Daniel Boone**	**Chattahoochee−Oconee**	**Cherokee**	**Apalachicola, Osceola, Ocala**	**Kisatchie**	**De−Soto, Homochito, Bienville, Delta, Tombigbe, Holly Springs**	**George Washington−Jefferson**	**Land−Between the Lakes**
(Intercept)	3.66	−10.147	3.78	3.19	−14.36	1.90	1.82	−1.06	1.31
	(0.000)	(0.990)	(0.000)	(0.000)	(0.990)	(0.000)	(0.010)	(0.887)	(0.116)
Juveniles	0.11	0.076	0.09	0.15	0.01	0.20	−0.32	−0.16	0.10
	(0.345)	(0.389)	(0.425)	(0.040)	(0.954)	(0.016)	(0.016)	(0.007)	(0.573)
People in vehicle	−0.40	(0.133)	−0.29	−0.21	−0.16	−0.39	−0.05	−0.16	−0.48
	(0.000)	(0.001)	(0.000)	(0.000)	(0.010)	(0.000)	(0.011)	(0.000)	(0.001)
Gender (male, baseline—female)	0.35	0.071	−0.93	−0.14	0.58	0.63	−0.09	0.73	−0.27
	(0.184)	(0.722)	(0.002)	(0.354)	(0.049)	(0.000)	(0.807)	(0.000)	(0.383)
Seniors (>60, baseline <60)	0.79	−0.039	0.48	−0.15	0.81	0.93	1.93	0.47	0.55
	(0.037)	(0.887)	(0.124)	(0.439)	(0.025)	(0.000)	(0.000)	(0.082)	(0.119)
Caucasians (Caucasians, baseline—non−Caucasians)	−0.76	−0.681	−0.67	0.08	1.35	0.61	0.08	0.38	2.54
	(0.260)	(0.188)	(0.324)	(0.807)	(0.001)	(0.110)	(0.872)	(0.326)	(0.000)
IRs (baseline—GRs)	−0.73	−0.769	0.38	0.07	−1.05	0.16	0.40	0.14	0.22
	(0.037)	(0.003)	(0.124)	(0.669)	(0.009)	(0.372)	(0.294)	(0.751)	(0.451)
SRs (baseline—GRs)	0.47	0.365	0.21	0.00	−0.58	0.95	−1.91	1.20	0.64
	(0.228)	(0.105)	(0.823)	0.000	(0.049)	(0.000)	(0.288)	(0.001)	(0.092)
Total travel costs	−0.05	**−0.038**	**−0.05**	**−0.02**	−0.01	0.00	−0.01	**−0.04**	**−0.03**
	(0.142)	(0.000)	(0.002)	(0.000)	(0.565)	(0.648)	(0.499)	(0.000)	(0.009)
IRs Total travel costs	0.01	**0.008**	**−0.01**	0.00	0.01	0.00	−0.01	0.01	0.00
	(0.194)	(0.023)	(0.001)	(0.309)	(0.316)	(0.922)	(0.394)	(0.528)	(0.719)

Table 6. *Cont.*

Predictors	Forests								
	William B. Bankhead, Talladega, Tuskegee, Conecuh	**Daniel Boone**	**Chattahoochee−Oconee**	**Cherokee**	**Apalachicola, Osceola, Ocala**	**Kisatchie**	**De−Soto, Homochito, Bienville, Delta, Tombigbe, Holly Springs**	**George Washington−Jefferson**	**Land−Between the Lakes**
SRs Total travel costs	**−0.04**	0.006	**−0.04**	**0.00**	−0.01	−0.01	−0.01	**−0.04**	0.00
	(0.042)	(0.179)	(0.012)	0.000	(0.055)	(0.215)	(0.872)	(0.000)	(0.654)
Gender Total travel costs	−0.01	0.002	0.02	0.01	−0.01	−0.02	0.00	−0.02	0.02
	(0.026)	(0.552)	(0.000)	(0.001)	(0.096)	(0.000)	(0.920)	(0.000)	(0.000)
Seniors Total travel costs	−0.01	0.001	0.01	0.01	0.01	−0.01	−0.05	0.00	0.00
	(0.280)	(0.746)	(0.026)	(0.004)	(0.411)	(0.059)	(0.001)	(0.287)	(0.776)
Caucasians Total travel costs	0.04	0.009	0.02	0.00	−0.02	0.00	0.00	0.02	−0.02
	(0.242)	(0.238)	(0.179)	(0.349)	(0.023)	(0.883)	(0.830)	(0.089)	(0.024)

GRs: General recreationists, IRs: intermediate recreationists, SRs: Specialized recreationists, Juveniles: number of respondents under 16 years old in a recreation group, Seniors: Number of respondents older than 60 years in a recreational group.

Then, using the model with the significant term at travel costs, the predicted number of visits was estimated in case of an increase in gasoline prices at 5%, 10%, 15%, 20%, 25%, and 30%.

3.2.2. Simulation of Gasoline Price Increasing

Based on the results, the number of visits per 12 months was predicted using the zero−truncated negative binomial model for all forests overall and for each of the nine NFs (Table 7). NF (St. Francis, Ouachita) was excluded because there was a problem with convergence in estimation.

Table 7. The number of National Forest visits in case of the gasoline price increase.

National Forests	Actual Data	Baseline Predicted	Gasoline Price Increasing, %					
			5%	10%	15%	20%	25%	30%
Number of the visits								
All forests	133,475	120,508	118,201	113,619	106,739	97,536	86,051	72,492
(William B. Bankhead, Talladega, Tuskegee, Conecuh)	4353	4274	4161	3939	3611	3187	2688	2152
(Daniel Boone)	15,636	14,492	14,149	13,478	12,493	11,219	9704	8019
(Chattahoochee-Oconee)	11,326	10,541	10,315	9871	9215	8360	7331	6174
(Cherokee)	28,474	27,055	26,612	25,725	24,373	22,527	20,162	17,282
(Apalachicola, Osceola, Ocala)	16,502	15,232	14,877	14,173	13,122	11,731	10,025	8066
(Kisatchie)	14,694	14,202	13,984	13,545	12,871	11,940	10,733	9250
(De Soto, Homochito, Bienville, Delta, Tombigbee, Holly Springs)	5067	5057	4926	4667	4287	3793	3209	2573
(George Washington-Jefferson)	23,332	21,918	21,386	20,341	18,799	16,787	14,357	11,614
(Land Between the Lakes)	4085	3836	3756	3600	3370	3069	2704	2284
Decreasing the number of NF visits, % to the baseline value								
All forests			−1.91	−5.72	−11.43	−19.06	−28.59	−39.85
William B.Bankhead, Talladega, Tuskegee, Conecuh			−2.64	−7.84	−15.51	−25.43	−37.11	−49.66
Daniel Boone			−2.36	−7.00	−13.79	−22.58	−33.04	−44.66
Chattahoochee-Oconee			−2.14	−6.36	−12.58	−20.69	−30.46	−41.43
Cherokee			−1.64	−4.92	−9.92	−16.74	−25.48	−36.12
Apalachicol, Osceola, Ocala			−2.33	−6.96	−13.85	−22.99	−34.19	−47.05
Kisatchie			−1.53	−4.63	−9.37	−15.93	−24.42	−34.87
De Soto, Homochito, Bienville, Delta, Tombigbee, Holly Springs			−2.60	−7.71	−15.24	−24.99	−36.55	−49.13
George Washington-Jefferson			−2.43	−7.19	−14.23	−23.41	−34.50	−47.01
Land Between the Lakes			−2.08	−6.15	−12.15	−19.99	−29.51	−40.46

According to Table 7, a 5% increase in gasoline price non−substantially decreases the number of NF visits (−1.91% for all forests and from −1.53 to −2.64 among forests). However, the number of NF visits decreases substantially if the gasoline price increases by 20% or higher. For example, a 30% increase in gasoline price led to a substantial decrease in NF visits for all data (−40%) and caused an almost 50% decrease in visits to forests such as (William B. Bankhead, Talladega, Tuskegee, Conecuh) and (George Washington−Jefferson). Furthermore, a non−linear relationship was observed between gasoline price and the number of NF visits (Figure 2).

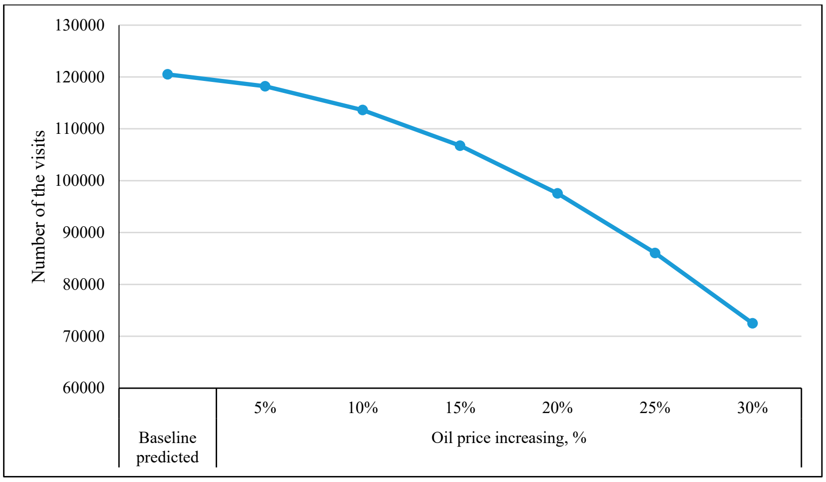

Figure 2. Relationship between the number of national forest visits and increase in gasoline price in case of all forest data.

3.3. Effect of Increasing Gasoline Price on the Number of NF Visits for Recreation

Following Cho et al. [13,14], all 28 recreation activities were grouped into eight aggregate activities: Water, Trail, Viewing, Picnicking, Education, Recreational vehicle, Gathering, and Winter. Considering that winter activities were not present in the data, seven recreation activities were included in the model. The number of NF visits during the last 12 months was chosen as the dependent variable. Other variables and models were similar in the case of the model with three clusters of respondents.

Overall, three models were estimated for each forest considering the count nature of the outcome (the number of NF visits during the last 12 months). These models were Poisson, zero−truncated Poisson, and zero−truncated negative binomial. As in the previous findings, for the overall forests, both calculated BIC (48,554.34) and AIC (48,706.90) results indicated zero−truncated negative binominal regression as more appropriate for data. The results were similar in the individual forest group (Table 8).

Table 8. Criteria for model selection on the relationship between gasoline price increase and forest recreation demands.

Forest	Poisson Regression		Zero-Truncated Poisson Regression		Zero-Truncated Negative Binominal Regression	
	AIC	BIC	AIC	BIC	AIC	BIC
All forest overall	282,736.08	282,881.70	280,874.34	281,019.96	48,554.34	48,706.90
(Daniel Boone)	30,345.60	30,453.01	29,904.67	30,012.08	6998.40	7110.92
(Chattahoochee-Oconee)	21,245.26	21,337.28	20,986.65	21,078.67	3863.99	3960.39
(Cherokee)	53,514.43	53,622.55	53,312.72	53,420.83	9248.99	9362.25
(Apalachicola, Osceola, Ocala)	34,951.11	35,045.16	34,680.08	34,774.13	4244.15	4342.68
(Kisatchie)	24,018.50	24,117.82	23,969.47	24,068.80	5660.28	5764.33
(De Soto, Homochito, Bienville Delta, Tombigbee, Holly Springs)	8771.70	8854.56	8633.97	8716.83	2445.62	2532.42
(George Washington-Jefferson)	44,981.48	45,086.98	44,606.69	44,712.19	7238.72	7349.25
(St. Francis, Ouachita)	9831.15	9910.61	9523.12	9602.58	1624.69	1707.93
(Ozark)	11,416.69	11,500.82	11,227.36	11,311.49	2203.69	2291.83
(Land Between the Lakes)	5922.62	6001.63	5653.09	5732.10	1804.36	1887.12

AIC: Akaike Information Criteria, BIC: Bayesian Information Criteria.

The results for zero−truncated negative binomial model estimations among forests and for all forests in the dataset are reported in Table 9.

Table 9. Regression analysis of various predictors and forest recreation demands based on Zero−truncated negative binomial model estimations among forests.

Predictors	Forests										
	Total Forests	**Daniel Boone**	**Chattahoochee−Oconee**	**Cherokee**	**Apalachicola, Osceola, Ocala**	**Kisatchie**	**De−Soto, Homochit, Bienville, Delta, Tombigbee, Holly Springs**	**George Washington−Jefferson**	**St. Franci, Ouachita**	**Ozark**	**Land Between the Lakes**
(Intercept)	−0.34	2.53	4.71	3.50	−2.75	2.69	2.18	1.33	−9.00	−8.89	1.67
	(0.875)	(0.000)	(0.000)	(0.000)	(0.906)	(0.000)	(0.000)	(0.481)	(0.917)	(0.964)	(0.019)
Juveniles	−0.07	0.01	0.13	0.17	0.01	0.26	−0.22	−0.03	0.26	−0.22	0.17
	(0.015)	(0.900)	(0.203)	(0.013)	(0.953)	(0.002)	(0.147)	(0.642)	(0.300)	(0.074)	(0.345)
People in vechicle	−0.12	−0.13	−0.24	−0.21	−0.14	−0.45	−0.06	−0.29	−0.26	0.03	−0.43
	(0.000)	(0.001)	(0.000)	(0.000)	(0.029)	(0.000)	(0.003)	(0.000)	(0.067)	(0.772)	(0.003)
Gender (male, beseline—female)	0.06	0.27	−0.40	0.08	0.41	0.27	0.07	−0.05	0.08	0.62	0.43
	(0.321)	(0.048)	(0.048)	(0.522)	(0.070)	(0.047)	(0.799)	(0.749)	(0.876)	(0.024)	(0.059)
Seniors (>60, baseline <60)	0.51	−0.48	0.76	0.17	0.81	0.67	1.04	0.24	−0.08	−0.17	0.77
	(0.000)	(0.014)	(0.001)	(0.307)	(0.005)	(0.000)	(0.000)	(0.254)	(0.844)	(0.619)	(0.005)
Caucasians (Caucasians, baseline—nonCaucasians)	0.23	−0.25	−0.35	−0.18	0.83	0.60	0.15	0.69	1.12	0.10	1.52
	(0.038)	(0.353)	(0.329)	(0.502)	(0.026)	(0.052)	(0.631)	(0.014)	(0.259)	(0.819)	(0.006)
Water	0.08	−0.02	−0.36	0.41	0.03	0.20	−0.23	0.07	−0.02	0.34	0.37
	(0.346)	(0.929)	(0.342)	(0.016)	(0.925)	(0.289)	(0.579)	(0.815)	(0.983)	(0.466)	(0.222)
Trail	−0.07	−0.55	−0.62	0.06	−0.29	0.04	0.51	−0.21	1.18	−0.14	0.36
	(0.333)	(0.017)	(0.019)	(0.705)	(0.332)	(0.801)	(0.250)	(0.385)	(0.023)	(0.719)	(0.318)

Table 9. *Cont.*

Predictors	**Forests**										
	Total Forests	**Daniel Boone**	**Chattahoochee−Oconee**	**Cherokee**	**Apalachicola, Osceola, Ocala**	**Kisatchie**	**De−Soto, Homochit, Bienville, Delta, Tombigbee, Holly Springs**	**George Washington−Jefferson**	**St. Franci, Ouachita**	**Ozark**	**Land Between the Lakes**
Viewing	−0.07	−0.07	−0.70	−0.34	1.35	−0.07	−0.33	−0.65	−0.97	−0.56	0.07
	(0.355)	(0.776)	(0.018)	(0.144)	(0.000)	(0.705)	(0.432)	(0.002)	(0.066)	(0.159)	(0.858)
Picnicking	−0.75	−0.75	−0.68	−0.46	−1.73	−0.68	−0.31	−1.25	0.07	−1.37	−0.13
	(0.000)	(0.002)	(0.038)	(0.005)	(0.000)	(0.000)	(0.494)	(0.000)	(0.914)	(0.001)	(0.722)
Education	−0.19	0.67	−0.28	−0.19	−0.13	−0.89	−0.39	−0.06	2.60	1.29	−0.36
	(0.047)	(0.033)	(0.452)	(0.325)	(0.715)	(0.000)	(0.678)	(0.841)	(0.029)	(0.096)	(0.350)
Recreational vehicle	−0.09	1.04	−1.16	0.67	0.11	0.13	−85.55	0.60	−2.57	−0.13	0.56
	(0.581)	(0.183)	(0.061)	(0.161)	(0.826)	(0.742)	(0.492)	(0.803)	(0.003)	(0.915)	(0.159)
Gathering	0.75	0.04	0.87	0.12	1.45	0.71	0.45	2.10	−0.13	0.14	−1.00
	(0.000)	(0.911)	(0.080)	(0.604)	(0.000)	(0.001)	(0.377)	(0.000)	(0.903)	(0.821)	(0.010)
Travel cost	**−0.03**	**−0.03**	**−0.04**	**−0.02**	**−0.03**	**−0.02**	0.01	**−0.03**	**−0.02**	**−0.05**	**−0.03**
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.006)**	(0.659)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Water Travel cost	**0.01**	**0.02**	0.00	0.00	0.01	0.00	−0.02	0.01	0.01	−0.01	**0.01**
	(0.000)	**(0.000)**	(0.592)	(0.939)	(0.501)	(0.849)	(0.113)	(0.322)	(0.300)	(0.217)	**(0.042)**
Trail Travel cost	**−0.003**	−0.01	0.01	−0.01	0.00	−0.01	−0.04	0.00	0.00	0.00	−0.01
	(0.045)	(0.160)	(0.325)	(0.147)	(0.636)	(0.115)	(0.024)	(0.761)	(0.376)	(0.640)	(0.284)
Viewing Travel cost	0.00	0.00	0.01	0.01	**−0.04**	0.00	0.00	**0.01**	0.00	**0.03**	0.00
	(0.058)	(0.361)	(0.134)	(0.090)	**(0.000)**	(0.988)	(0.832)	**(0.005)**	(0.915)	**(0.035)**	(0.666)
Picnicking Travel cost	**0.01**	**0.01**	**0.02**	0.00	**0.04**	**0.02**	0.01	**0.01**	**−0.02**	0.01	−0.01
	(0.000)	**(0.000)**	**(0.005)**	(0.097)	**(0.000)**	**(0.000)**	(0.322)	**(0.002)**	**(0.024)**	(0.123)	(0.077)

Table 9. *Cont.*

Predictors	Forests										
	Total Forests	**Daniel Boone**	**Chattahoochee−Oconee**	**Cherokee**	**Apalachicola, Osceola, Ocala**	**Kisatchie**	**De−Soto, Homochit, Bienville, Delta, Tombigbee, Holly Springs**	**George Washington−Jefferson**	**St. Franci, Ouachita**	**Ozark**	**Land Between the Lakes**
Education Travel cost	−0.002	**−0.01**	0.00	0.00	0.01	**0.01**	0.00	−0.01	−0.01	**−0.03**	0.00
	(0.204)	**(0.001)**	(0.405)	(0.871)	(0.121)	**(0.010)**	(0.820)	(0.051)	(0.541)	**(0.018)**	(0.867)
Recreational vehicle Travel cost	**0.01**	−0.04	**0.04**	0.00	0.02	0.00	6.16	−0.01	**0.02**	−0.01	−0.01
	(0.000)	(0.108)	**(0.000)**	(0.722)	(0.100)	(0.930)	(0.486)	(0.891)	**(0.007)**	(0.782)	(0.529)
Gathering Travel cost	**−0.004**	0.00	−0.02	0.00	0.00	0.00	**−0.08**	−0.01	0.02	0.01	**0.03**
	(0.034)	(0.689)	(0.181)	(0.167)	(0.751)	(0.604)	**(0.001)**	(0.270)	(0.617)	(0.629)	**(0.000)**

According to Table 9, increases in travel costs due to the rise in gasoline price had a negative impact on the number of NF visits. The log count of NF visits decreases by 0.02−0.05 for each increase in travel cost in 1$ per 50 miles for all forests excluding (De Soto, Homochito, Bienville, Delta, Tombigbee, Holly Springs).

This impact is less strong for visitors who participated in Water activities in the forests of (Daniel Boone), (Land Between the Lakes) and all the forests, Recreational vehicle activities in (Chattahoochee−Oconee), (St. Francis, Ouachita), and all the forests, and Picnicking in (Daniel Boone), (Chattahoochee−Oconee), (Kisatchie), (George Washington−Jefferson), and all the forests). This may be due to the fact that people visiting parks to take part in water activities have free time and the willingness to spend money on travel to get to sports events. However, a strong effect of travel costs can be observed in the number of visitors participating in Picnicking in the forest (St. Francis, Ouachita) and in the number of visitors who participated in Trail activities in all the forests studied. Similarly increase in travel costs had a strong impact on the number of visitors traveling for Viewing activity in (Apalachicola, Osceola, Ocala). Still, it was not as strong for the forests of (George Washington− Jefferson) and (Ozark) in comparison with visitors non−participating in Viewing activities. For Educational activities, this effect was stronger in comparison with the effect of travel cost for visitors non−participating in the given activity for NF (Daniel Boone) and (Ozark), but it was not as strong for NF (Kisatchie). For Gathering, it was found to strongly impact in comparison with the effect of travel cost for visitors non−participating in the given activity) for NF (De Soto, Homochito, Bienville, Delta, Tombigbee, Holly Springs) but not as strong for NF (Land Between the Lakes). Then, the number of visits for activities with significant interaction with travel costs was predicted using a zero−truncated negative binomial model (Table 10).

Table 10. Predicted number of visits (%) for hypothetical increases in travel costs.

Forests	**Activities**	**Base**	**Gasoline Price Increasing, %**					
			5%	**10%**	**15%**	**20%**	**25%**	**30%**
Daniel Boone	Water	4716	4652	4524	4332	4072	3743	3344
	Picnicking	2684	2620	2498	2325	2113	1879	1645
	Education	2254	2160	1984	1744	1465	1175	899
Chattahoochee−Oconee	Picnicking	978	962	932	887	828	758	686
	Recreational vehicle	299	310	339	400	542	944	2567
Apalachicola, Osceola, Ocala	Viewing	13,029	12,510	11,507	10,075	8300	6325	4357
	Picnicking	2141	2094	2001	1864	1687	1475	1241
Kisatchie	Picnicking	2590	2576	2546	2502	2441	2365	2284
	Education	1277	1269	1254	1230	1199	1162	1130
George Washington−Jefferson	Viewing	10734	10526	10114	9497	8671	7639	6418
	Picnicking	1303	1278	1229	1156	1060	943	811
St.Francis, Ouachita	Picnicking	1188	1157	1097	1010	897	760	605
	Recreational vehicle	70	70	68	66	64	61	58
Ozark	Viewing	2838	2773	2648	2466	2233	1955	1642
	Education	427	406	367	317	260	203	150
Land Between the Lakes	Water	2058	2022	1952	1847	1708	1536	1333
	Gathering	312	309	303	293	280	263	243

Table 11 reports the predicted respondents' welfare calculated using the estimated visitors' welfare for each activity and forest.

Table 11. Predicted respondents' welfare (USD) for hypothetical increases in travel costs.

Forests	Activities	Welfare/ Visit/Person	Base	Gasoline Price Increasing, %					
				5%	10%	15%	20%	25%	30%
(Daniel Boone)	Water	45.71	215,553.62	212,630.83	206,808.00	198,015.44	186,138.07	171,076.42	152,840.71
	Picnicking	69.14	185,550.12	181,149.19	172,698.33	160,737.13	146,093.17	129,941.59	113,716.09
	Education	86.50	194,976.72	186,852.83	171,623.97	150,883.30	126,739.40	101,602.23	77,768.35
(Chattahoochee-Oconee)	Picnicking	56.64	55,379.03	54,510.63	52,793.04	50,239.23	46,894.68	42,922.04	38,860.84
	Recreational vehicle	43.02	12,842.49	13,354.83	14,592.70	17,227.87	23,315.66	40,594.10	110,418.93
(Apalachicola, Osceola, Ocala)	Viewing	39.99	521,089.71	500,316.08	460,208.44	402,923.18	331,964.33	252,958.57	174,247.11
	Picnicking	40.74	87,231.45	85,298.86	81,507.00	75,932.83	68,707.83	60,087.88	50,543.53
(Kisatchie)	Picnicking	33.86	87,719.22	87,225.08	86,231.60	84,714.00	82,651.24	80,086.15	77,335.65
	Education	40.25	51,406.80	51,091.38	50,461.07	49,510.07	48,249.10	46,770.07	45,487.75
(George Washington-Jefferson)	Viewing	54.70	587,190.37	575,828.94	553,292.57	519,504.69	474,329.36	417,884.38	351,070.57
	Picnicking	55.92	72,847.18	71,454.92	68,706.52	64,626.64	59,267.66	52,758.43	45,351.09
(St. Francis, Ouachita)	Picnicking	63.86	75,839.89	73,878.13	70,058.92	64,485.47	57,261.38	48,532.77	38,620.90
	Recreational vehicle	103.55	7300.12	7218.13	7062.91	6847.15	6585.60	6290.94	5968.84
(Ozark)	Viewing	47.30	134,244.03	131,172.85	125,221.39	116,611.07	105,592.71	92,463.12	77,638.23
	Education	68.78	29,338.58	27,903.39	25,267.40	21,785.12	17,871.77	13,933.78	10,323.54
(Land Between the Lakes)	Water	63.88	131,458.10	129,170.16	124,661.86	117,966.83	109,107.21	98,124.40	85,126.27
	Gathering	59.89	18,684.94	18,498.20	18,122.78	17,548.63	16,763.06	15,759.56	14,551.41

Table 12 presents the percentage change in respondents' welfare in case of hypothetical changes in travel costs.

Table 12. Predicted welfare changes (%) for hypothetical increases in travel costs.

Forests	Activities	Base	Gasoline Price Increasing, %					
			5%	10%	15%	20%	25%	30%
(Daniel Boone)								
	Water		−1.36	−4.06	−8.14	−13.65	−20.63	−29.09
	Picnicking		−2.37	−6.93	−13.37	−21.26	−29.97	−38.71
	Education		−4.17	−11.98	−22.61	−35.00	−47.89	−60.11
(Chattahoochee-Oconee)	Picnicking		−1.57	−4.67	−9.28	−15.32	−22.49	−29.83
(Apalachicola, Osceola, Ocala)	Viewing		−3.99	−11.68	−22.68	−36.29	−51.46	−66.56
	Picnicking		−2.22	−6.56	−12.95	−21.24	−31.12	−42.06

Table 12. *Cont.*

Forests	Activities	Base	Gasoline Price Increasing, %					
			5%	10%	15%	20%	25%	30%
(Kisatchie)	Picnicking		−0.56	−1.70	−3.43	−5.78	−8.70	−11.84
	Education		−0.61	−1.84	−3.69	−6.14	−9.02	−11.51
(George Washington-Jefferson)	Viewing		−1.93	−5.77	−11.53	−19.22	−28.83	−40.21
	Picnicking		−1.91	−5.68	−11.28	−18.64	−27.58	−37.74
(St. Francis, Ouachita)	Picnicking		−2.59	−7.62	−14.97	−24.50	−36.01	−49.08
	Recreational vehicle		−1.12	−3.25	−6.20	−9.79	−13.82	−18.24
(Ozark)	Viewing		−2.29	−6.72	−13.14	−21.34	−31.12	−42.17
	Education		−4.89	−13.88	−25.75	−39.08	−52.51	−64.81
(Land Between the Lakes)	Water		−1.74	−5.17	−10.26	−17.00	−25.36	−35.24
	Gathering		−1.00	−3.01	−6.08	−10.29	−15.66	−22.12

According to Table 12, an increase in travel costs influenced Education for the forests of (Daniel Boone) and (Ozark). In general, these results indicated a negative impact of travel costs on the number of visitors for all reported activities at all forest locations.

3.4. Data Distribution of Distance Traveled and Frequency of Visits in the Last 12 Months

We also analyzed the distance decay relationship between visitation patterns and the distance they traveled to the NFs. Figure 3 shows the strength of the interaction increases when the distance is reduced, and the interaction dramatically decreases with increasing distance. With the advent of modern transportation and communication technologies, the frictional effect of distance has largely been reduced, but in our particular example of people traveling to National forests for recreation purposes, the friction of distance is still relevant and is the main deterrent factor or reduced number of visits as the distance increases.

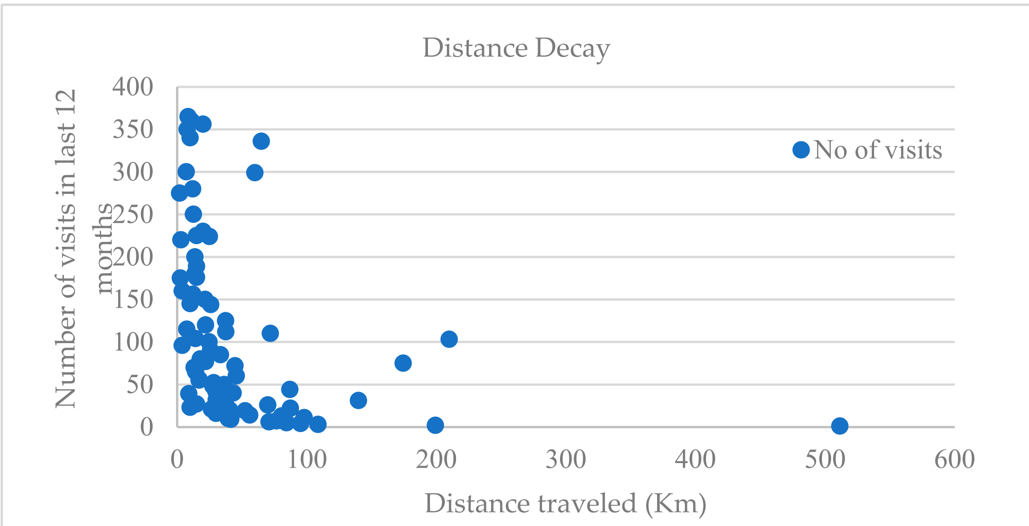

Figure 3. Relationship between the number of national forest visits and distance traveled by the recreationists.

4. Discussion

Ethnicity and gasoline prices are two factors that can affect forest recreational activities worldwide [14,32]. In this study, we analyzed the impact of these two factors on forest recreation demand in the southeastern region of the US based on 2010 to 2014 data from National Visitor Use Monitoring (NVUM). For ethnicity, it is worth noting that a previous study found differences in outdoor recreation demands of the US population [33]. Still, outdoor recreation was investigated in general without specifically considering forest recreation. In this study, the overall significant ($p < 0.05$) higher demands for National Forest (NF) visits among Caucasians compared to non−Caucasians (Table 3) may be due to the high number of Caucasian participants in the study because, historically, in the US, Caucasians recreate in outdoor recreation areas at a rate greater than those of ethnic and racial minorities [34,35]. On the other hand, the main drivers to participate in forest recreation can differ for different people due to subjective aspects of values [2] because people are different.

It is worth noting that racial and ethnic differences affect the connectedness of individuals to nature [36] and hence, their preferences in recreational activities. For instance, there is enough evidence to support the differences in the importance of landscape values for different social groups, including conditions for immediate forest surroundings [37]. Garcia−Martin et al. [38] found a statistically significant association between respondents' relationship with the area and landscape values. Also, a significant association has been found between respondents' age and landscape values [26,38]. At the same time, however, some research indicated no differences in perception values related to ecosystem services across ages, genders, or different professions [39–41].

Travel costs generally have a negative effect on recreational activities [11,12,14]. Increased prices have been thought to affect people's travel choices. A strong relationship exists between consumer demographic profiles and gasoline consumption for traveling [42]. In this study, three models were estimated to investigate the travel costs impact on NFs recreation: Poisson regression (considering that outcome is count data), zero−truncated Poisson, and negative binomial regression (considering that outcome is zero−truncated because if respondents reported outcome, then they visited NF at least once during the year). The general trend is similar to our findings; the higher the travel cost, the less frequent the visits, and vice versa (Tables 6 and 9), implying that travel costs negatively influence the number of NF visits. However, this effect was greater in some respondents than others; for instance, the decrease in NF visits due to an increase in travel cost was smaller for intermediate recreationists in comparison with generalist recreationists and was more for older respondents in comparison with respondents younger than 60 years old (Table 6). Generally, the gasoline price is an essential part of the travel costs, so an increase in the gasoline price negatively affects NF visit frequency via increasing travel costs [43]. In this study, the substantial decrease in the number of NF visits due to an increase in the gasoline price by 20% or more and subsequent augmentation of travel costs (Tables 10–12) indicate that increasing the total travel costs is one of the most important barriers for an individual to visit the forests for recreation. Similarly, Borzykowski et al. [12] found that in the case of Swiss forests, a 1% increase in total travel costs corresponds to a decrease in the annual frequency of the visits by 0.04–0.32 times. Also, the results of previous studies (in Masouleh forest park, Iran) indicate a negative, statistically significant relationship between the access cost to the natural forest park and the number of visitors [11]. However, the effect of changes in gasoline prices on visit frequency can be different for visitors who participate in different types of forest recreation activities [14]. In addition, consistent unstable and increasing gasoline prices can affect travel participation, and behavioral adaptations are likely to occur. A direct relationship between gasoline prices and park visitation has been identified in a study with behavioral adaptations and people more likely to find equivalent substitutes. As gasoline prices increase, park travelers may decide to shift use to a location closer to home, or to shift activities that can take place elsewhere. Travelers with different social and economic characteristics also react differently about their travel decisions with increase in travel costs [43]. Similarly, based on our results, it could be suggested that changes in gasoline prices could have a different impact on the forest visit frequency for different sociodemographic groups. With the available visitor's data, we also analysed the effect of NF visitation on the distance traveled. The impact of distance had a linear relationship with the NF visits. The effect of distance decay is observed to increase with increasing distance. Several studies have identified the factors such as commercial land use ratio, industrial land use ratio, and motorway density to reduce distance decay [44–46].

5. Conclusions

Several theoretical and applied research studies have investigated the recreation demand on public lands. Information about the behaviors of recreationists visiting National Forests (NFs) lands is an important driver in forest planning and site−level management in the context of recreational demand and supply of recreational experiences. Recently, ethnic diversity in the US and the fluctuations in travel costs are the two factors affecting visits to National Forests. This study used regression models to elucidate the effects of both factors on NF visits in the southeastern US. A significant ($p < 0.05$) difference existed in forest recreation for Caucasians compared to non−Caucasians, when considering total forests, but a non−significant ($p > 0.05$) difference existed for individual forests. On the other hand, forest recreation activities decreased with increased travel costs, especially gasoline price hikes of 20% and above. Economic theory also suggests that prices and income affect people's decision−making processes. The results of this study have several policy implications. Increased fuel prices are expected to decline the frequency NFs visitation. In this case, does the political will exist to sustain them? This question remains unanswered by scientific research. Our study also highlights that some groups or visitors were more affected by the alterations in travel cost than others. Notably, the decrease in visits was smaller for IRs respondents (when compared with GRs) and for older respondents compared to respondents younger than 60. Increases in travel costs consistently affect the number of visits negatively (and thus cause losses in aggregate visitor surplus) across all national forests. However, the magnitudes of the effects varied significantly. A strong effect of travel costs was observed in the number of visitors participating in picnic and trail activities. This finding implies that allocating funds for the development of the trail and backpacking−based recreational activities will not attract visitors if travel costs are increased.

This data supports existing knowledge on some non−topographic factors which affect NFs visits and the role of individual differences in the outcome. The results of this study have practical importance for different stakeholders, such as tourism operators, local authorities, and local businesses. Particularly national forest managers facing declining visits from the effect of increased gasoline prices can use these results for effective decision−making about allocating scarce budget resources to recreation activities with the greatest potential to raise the number of national forest visits.

We recommend increased accessibility to public transportation to the recreational areas of the national forest. The findings of our study suggest that people in vehicles are more likely to be affected by the increased travel costs compared to other users. Besides helping retain visitors, public transportation availability will reduce congestion and air pollution.

Some study limitations need to be acknowledged. First, the study period was limited to 2010−2014. A more extensive study period may have provided a better context regarding recent gasoline prices. It may have also provided event references for retrospective analysis and comparisons (for example, some studies investigated the differences between two periods: before and after a tsunami, before and after COVID−19, and so on). However, the present study period is sufficient to provide an in−depth insight into the behavioral response of people from different racial and socio−economic classes to increased gasoline prices. In the post−pandemic economy, there have been changes in the size of different socio−economic classes. However, considering that travel and tourism activities have begun to recover, people's behaviors toward higher fuel prices will continue to be impacted by the factors mentioned in the study.

Most participants' ethnicity was Caucasian, which may have biased the analysis based on this criterion. Including more ethnic groups may have impacted the results significantly. Missing data was problematic; applying an imputation method rather than excluding missing data is a better approach when analyzing data sets with missing data. Another future recommendation is to include seasons as a criterion to facilitate the investigation of seasonal differences on the main drivers of NFs visits and outdoor activities. When analyzing the effect of increased travel costs, this study did not take into account the costs of public transportation. Future studies can consider various means of transportation and their respective costs and benefits to achieve a more holistic solution.

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