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By

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ABSTRACT

CHARACTERIZING AND MODELING THE RECREATION USE OF DISTANCE SEGMENTED USDA FOREST SERVICE VISITORS

By

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The recreation behavior, consumption patterns, and activity participation of visitors to lands managed by the USDA Forest Service (USDA FS) is highly variable. To adequately manage and plan for recreation at the local level, USDA FS natural resource managers must identify the types and quantity of recreation use at individual national forests. This study presents an approach to segmenting and modeling the recreation use of national forest visitors that informs recreation management and planning decisions. Under the adopted segmentation framework, national forest visitors are classified into distance-based visitor segments based upon the proximity of their home to national forest visited. Three distance segments are recognized: Local, Mid-distance, and Long-distance. Local visitors live very close to the national forest, Mid-distance visitors live within a moderate drive of the forest resource, and Long-distance visitors live in the "rest of the world". Using visitor survey data obtained for USDA FS Regions 2 and 9 via the National Visitor Use Monitoring (NVUM) project, visitors in the three segments are characterized in terms of their recreation behavior, consumption patterns, and activity participation. Statistical tests are completed to determine differences in visitor characteristics both between study regions and between the visitor segments themselves.

Few statistical differences are found between study region after accounting for differences due to visitor segmentation and trip type. Capitalizing on the segmentation framework, recreation use models are developed to predict the forest-level recreation use of Local and Mid-distance recreation segments. Models of Local segment recreation use predict visitation based upon local population counts, participation rates and annual visit frequencies. The recreation use of Mid-distance visitors is modeled via multi-site zonal travel cost models. Separate zonal travel cost models were estimated for Mid-distance day trips and Mid-distance overnight trips. While the parameters and coefficients of the constructed models were consistent with theory, evaluation of model prediction proved inconclusive.

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TABLE OF CONTENTS

Ch[illegible]

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Recreation, encompassing a wide array of activities, is a fundamental component of American life. While many recreation pursuits take place indoors, recreation in the outdoors is prominent. It is estimated that 98% of people in the U.S., 16 years of age or older, participate in some form of outdoor recreation activity in a given year (Interagency Survey Consortium, 2002). The rate of participation in outdoor recreation activity has remained steady to slightly increasing since the early 1960's (Outdoor Recreation Resources Review Commission, 1962; National Park Service, 1986; Interagency Survey Consortium, 1995; Interagency Survey Consortium, 2002). Individuals in the U.S. are most likely to participate in relatively passive outdoor recreation activities such as walking (82%) or taking part in family gatherings (74%). More active outdoor recreation pursuits such as developed camping (26%), mountain biking (21%), or hunting (11%) are undertaken with less propensity (Interagency Survey Consortium, 2002).

While privately-owned lands also provide recreation opportunities, publicly-owned lands have long served a central role in the provision of places for people to recreate. The basis for public entry to lands for the purpose of recreation was established by the "fishing and fowling" laws enacted in the colonial period (Douglass, 1999). The establishment of public recreation areas began in 1710 with the city forest of Philadelphia and continued in the mid 1800's with the work of Frederick Law Olmstead and the advent of city parks (Douglass, 1999). Public recreation on federally-owned lands in the U.S. began in the latter half of the 19th century and expanded rapidly in the early 20th century; concurrent with the expansion of the forest reserves managed by the then U.S. Forest Service and with the establishment of the National Park Service.

In the early 21st century, the role of publicly-owned lands as the primary provider of outdoor recreation opportunities is firmly cemented. Wellman and Propst (2004) state:

> "...these (lands) have allowed many American to participate in forms of recreation that honor their pioneering heritage, respond to their desire to take risks, allow them temporarily to move from their complex everyday environments into quieter and greener places, and offer special opportunities for them to discover things about themselves and their surroundings".

Recreation opportunities are provided on lands owned by all levels of government. City- and county-owned lands may support a limited number of outdoor recreation activities (e.g. walking, picnicking, etc.), while state- and federally-owned land areas may provide opportunities for a greater variety of pursuits (e.g. picnicking, camping, rock climbing, hunting, etc.).

Federally, the USDA Forest Service (USDA FS), the National Park Service (NPS), the Bureau of Land Management (BLM) and the U.S. Army Corps of Engineers (ACOE), among others, manage land for public recreation. In 2003, NPS sites across the nation received an estimated 266 million visits (NPS, Public Use Statistics Office, 2004).

The ACOE receives approximately 385 million visits annually at its managed recreation areas (U.S. ACOE, 2004). Annual visitation to USDA Forest Service lands is estimated to be 205 million visits (English, Pers. Comm.) while the BLM reports approximately 61 million annual visits (BLM, 1999). The NPS manages 95 million acres of land and the ACOE manages 12 million acres of land and water. Both agencies manage lands located throughout the nation. The USDA FS and BLM manage much larger areas than the other two agencies, 191 million acres and 262 million acres, respectively. Lands managed by the BLM are located almost exclusively in the western contiguous U.S. and Alaska while USDA FS land is concentrated in the contiguous west, but located throughout the nation. With extensive land holdings, accessibility to much of the U.S. population, a variety of natural features, and high rates of visitation, the USDA FS is an indispensable provider of recreation opportunity in the U.S. and is the focus of the research presented here.

Research Problem

Characterizing recreation visitors and quantifying recreation use are central to USDA FS planning activities (Dana, 1957; Propst, 1985; Alig and Voss, 1995). Characterizing recreation visitors in regard to their consumption patterns and preferences assists in identifying the types of recreation opportunities that may best meet demand, determining what recreation facilities to develop and where, and selecting specific "on the ground" management actions. Reliable estimates of visitation are useful for forest plan revision, for completing economic impact analysis, in developing estimates of social benefits, and for completing benefit-cost analyses. Visitor characterization and estimation of recreation use are often completed concurrently and can be achieved via three approaches: conducting a complete census of visitors, implementing a visitor sampling program, or developing and applying recreation demand models.

A census of all visitors to USDA FS lands is generally accepted as impractical and unnecessary. Attempts to determine recreation use via a census in the fledgling years of the USDA FS proved mostly futile (Waugh, 1918). The dispersed nature of recreation and the expansive land area, accessible at a multitude of points, precludes the counting of every USDA FS recreation visitor. Furthermore, the reliability of visitor sampling approaches and recreation modeling makes a census unnecessary.

The USDA FS has implemented a number of projects aimed at estimating recreation use and visitors characteristics via visitor sampling. Recent projects of note include PARVS, CUSTOMER, and National Visitor Use Monitoring (NVUM). PARVS and CUSTOMER were initiated in the latter half of the 1980's while NVUM began in the year 2000 and continues today. While PARVS and CUSTOMER surveys provided useful information, the sample sizes were small, implementation was not standardized, and the visitor samples were not representative of all USDA FS visitors (Alward et al., 1998). In response to these problems, USDA FS scientists and analysts developed a national-level, standardized method for quantifying recreation use and visitor characteristics called National Visitor Use Monitoring (English et al., 2002). Through NVUM the USDA FS develops national, regional, and forest-level estimates of visitor use and characteristics.

Models of recreation use can be used to characterize and quantify recreation use under both current as well as alternative conditions and can provide analysts with a greater understanding of the processes behind recreation use patterns and behavior. Grant and others (1997) identified five general applications of scientific models:

1) providing a sound conceptual framework for future research,
2) evaluating alternative hypotheses about system structure or function,
3) describing system behavior under normal conditions,
4) predicting system response to specific management schemes or environmental situations, and
5) heuristically exploring the dynamics of a system of interest.

A limited number of recreation models have been completed specifically for resources managed by the USDA FS (e.g. English and Bowker, 1996; English and Home, 1996; Alig and Voss, 1997; Loomis et al., 2001; Betz et al., 2003). Of these, only models developed by English and Home (1996) were used to estimate recreation use for multiple national forests. The remaining models were aimed at quantifying recreation use for individual sites or for specific activities occurring on individual national forests.

For the purpose of planning and management, USDA FS recreation use has typically been characterized (or segmented) and quantified based upon the primary activities of recreation visitors (USDA FS recreation is also commonly characterized and quantified by Recreation Opportunity Spectrum, ROS, class). This primary activity approach was used in the first census of visitors in 1916 as well as the PARVS surveys of the 1980's (Waugh, 1918; Alward et al., 1998). While this approach quantifies the types of activities users are engaged in it may not provide particularly informative or reliable information concerning behavior and/or patterns of recreation use. Specifically, the behavior and use patterns of visitors within activity segments may be just as variable as those of the visitor population at large.

An alternative approach to segmenting recreation visitors is one based upon the interceding distance between visitor residence and the forest resource. Specifically, does the visitor live very close to the forest (a local visitor), within a moderate drive from the forest (a mid-distance visitor), or several hundred miles or more from the forest (a long-distance visitor)? A limited number of recreation studies have shown that the intervening distance from the visitor's residence to the recreation destination may influence recreation visitor consumption pattern, activity participation, recreation behavior, and trip motivation.

Strauss and others (1993) found the proximity of hunters to the hunting destination influenced their pattern of recreation consumption. Hunters at the Delaware Water Gap who lived outside the local area were found to hunt almost exclusively on Saturdays, while those from the local area hunted on days throughout the week. Though such a pattern is intuitive, the consumption patterns of hunters are frequently characterized without regard to hunter residence. Recreation participation by certain demographic groups may be more likely given their proximity to the resource. Faunce and others (1979), in their study of Maine hunters, found that participation of women hunters was more common among resident Maine hunters than among non-resident

Maine hunters. This difference likely relates to differences in hunter motivation between those living in the State and those living out-of-state.

In regards to recreation behavior, Stynes and White (2003) have shown that the expenditures of USDA FS recreation visitors who live in the local forest area are almost always less than that of non-local users within trip-type segments, regardless of recreation activity. Finally, Etzel and Woodside (1983) found that visitors who recreated near home were motivated more by opportunity for relaxation and recuperation while visitors recreating farther from home expected more stimulation and entertainment in their recreation experience. Additionally, Faunce and others (1979) found that non-resident Maine hunters were more frequently motivated by the social interaction component of hunting than resident hunters.

Segmenting recreation users based upon the distance from their home to the recreation resource may provide for a greater understanding of consumption patterns, activity participation, and recreation behavior of USDA FS visitors. This may lead to more informed decisions by resource managers regarding the provision and management of recreation opportunities. Assuming that visitors within distinct distance segments have unique recreation behaviors, activity participation, and consumption patterns, quantifying forest-level recreation use of the segments would allow individual forests to identify their "recreation markets".

Recreation models can be used to determine the expected forest-level recreation use of the distance-based segments under current and alternate conditions. In addition to predicting use, recreation models developed for individual distance segments can provide insight into the underlying mechanisms influencing recreation use of visitors within those distance segments. An understanding of the mechanisms influencing recreation use of distance segment visitors can aid resource planners and managers in identifying factors that influence the level of recreation use at an individual national forest.

The USDA FS has traditionally taken a regional approach to planning for and managing actual recreation use (e.g. 1990 RPA assessment regional recreation use values). The assumption of regional recreation differences may result, in part, from the perception that regional variation in the types of natural features managed yields differences in recreation behavior and participation. Given this, testing for regional differences in consumption patterns, activity participation, and recreation behavior of distance segmented recreation visitors between distinct USDA FS regions is one component of this study. USDA FS regions 2 and 9 are particularly appropriate for comparative analysis (Figure 1). National forests within these regions are spatially disjoint from one another and the natural features managed are, in general, quite different.

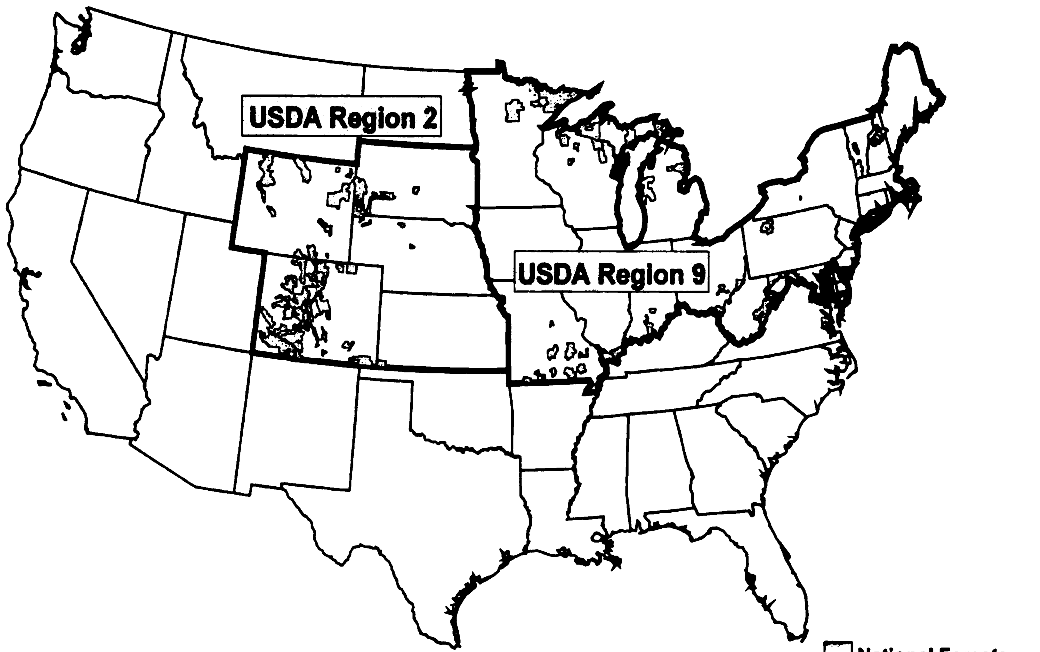

Figure 1. USDA FS Regions 2 and

Research Objectives

Given the above, the general objective of this study is to identify the characteristics and model the forest-level recreation use of distance-segmented USDA FS recreation visitors. The four specific objectives of the study are to:

1) identify the recreation behavior, activity participation, and consumption patterns of Local, Mid-distance, and Long-distance USDA FS visitors in USDA FS Regions 2 and 9,
2) statistically compare the recreation behavior, activity participation, and consumption patterns of visitors to USDA FS Regions 2 and 9 within the distance-based segments,

3) statistically compare the recreation behavior, activity participation, and consumption patterns of Local, Mid-distance, and Long-distance visitors within USDA FS Regions 2 and 9, and
4) model forest-level recreation use of Local and Mid-distance recreation visitors for national forests located in USDA FS Regions 2 and 9.

Organization of the Dissertation

Chapter 2, Literature Review, is an examination of 1) demand and use estimation in forest recreation planning, 2) broad approaches employed to estimate recreation demand and use 3) use of structural recreation demand and use models and 4) the role of recreation segmentation in recreation planning. Also included are discussions of the theoretical basis and evolution of travel cost modeling, descriptions of contemporary applications of recreation modeling utilizing spatial analytical techniques, and identification of commonly employed recreation segmentation approaches.

Chapter 3, Methods, provides a discussion of the data and analytical techniques used in achieving the research objectives identified above. The chapter begins with a conceptual discussion of the distance-based segments and the relationship of the segmentation to the recreation literature. A short description of the NVUM project, survey data and recreation use estimates follows. Further detail on the NVUM sampling scheme and the NVUM procedures for estimating recreation use can be found in Appendix A. The remainder of Chapter 3 is devoted to describing the specific procedures used in analyses. This section begins with delineation of the boundaries separating the distance segments from one another. The approaches to characterizing visitors within the distance segments and the statistical tests employed to identify differences between the study regions and between the distance segments are then identified. The final portion of the Chapter relates to the development and evaluation of the Local and Mid-distance recreation use models.

Chapter 4, Results and Discussion, is divided into two halves; the first relates to objectives 1 – 3 while the second relates to Objective 4. The first half of the Chapter identifies the characteristics of the distance-based visitor segments as well as results of statistical comparisons both between study regions and between distance segments. In the second half of the Chapter, the constructed recreation use models are presented, and the parameters and coefficients are discussed. The predictive ability of the recreation use models is evaluated against NVUM recreation use estimates.

In Chapter 5, Summary, Conclusion, and Policy Recommendations, a summary of the research undertaken is presented, and conclusions related to the research objectives are identified. Policy implications, in regard to forest planning activities, are presented and discussed. The limitations of the research and future research needs are outlined.

CHAPTER 2

LITERATURE REVIEW

The impetus for this research is the need to quantify the types and numbers of national forest recreation users for forest-level planning. The role of recreation use estimation in recreation planning activities is identified in the first section of this chapter. The second section includes discussion of how recreation demand is incorporated in the planning process and the approaches to developing recreation use estimates. The use of recreation models, particularly the travel cost model, is described in greater detail. The third section contains a description of traditional USDA FS approaches to segmenting recreation visitors as well as some alternative approaches to visitor segmentation. The chapter closes with a summary of how the literature relates to this study.

An influential report that deserves a special introductory note is "Assessing Demand for Outdoor Recreation" published in 1975 by the National Academy of Sciences. This report was written by the Committee on Assessment of Demand for Outdoor Recreation Resources established by the now dissolved Bureau of Outdoor Recreation. The committee was tasked with investigating four specific components of recreation demand analysis: identifying the objectives of demand analysis, reviewing systematic models of demand estimation, specifying the parameters of a recommended demand estimation approach, and identifying the steps of to effectively estimate demand. Two appendices were also included in that report. The first (written by Bev Driver and Perry Brown) examined recreation demand from a social-psychological perspective while ca

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the second (written by V. Kerry Smith) provided a comprehensive analysis of recreation demand models. The report (with its appendices) is a preeminent piece of recreation demand literature and is cited frequently within this chapter.

Demand and Use Estimation in Recreation Planning

Public recreation resources are limited. Like all scarce resources, public resources must be allocated between competing demands. Whereas allocation of traded resources can be determined by markets, public recreation resources generally provide non-market public goods and services and, as such, their allocation is not as easily determined. In the course of natural resource planning, the "demand" for recreation resources or activities as well as the benefits or values that those resource or activities provide are frequently quantified. The Renewable Resource Planning Act of 1974 and the National Forest Management Act of 1976 require the USDA FS to complete national-level natural resource assessments every 10 years and to develop individual forest-level plans every 10 to 15 years. Both the national assessment and individual forest plans must incorporate multiple uses (including recreation) of natural resources as mandated by the Multiple Use Sustained Yield Act of 1960. At the state-level, efforts to quantify recreation demand increased dramatically in response to the 1962 report of the Outdoor Recreation Resources Review Commission (ORRRC) and the associated enactment of the Land and Water Conservation Fund.

The specific role of quantifying recreation demand for the purpose of planning is in "illuminating and ... measuring the implications of alternative planning, provision, and management decisions" (NAS, 1975). In particular, quantifying recreation demand provides information for three kinds of planning decisions: policy decisions, allocation decisions, and site-specific resource provision and management. These kinds of planning decisions correspond to three aspects of recreation demand: demand for recreation in the context of broad social and economic policy, demand for alternative types of recreation, and the demand for site-specific recreation resources (NAS, 1975).

The first aspect of recreation demand focuses on the importance of outdoor recreation opportunities as a component of overall social structure. Decisions that affect recreation opportunities have an impact on "...a range of diverse elements, including economic, industrial, and population growth...." (NAS, 1975). The second aspect of demand encompasses those decisions relating to determining the type, quantity, and location of recreation opportunities, and well as the strategy and timing for their implementation (NAS, 1975). Assessment of this aspect of demand requires that the planning agency recognizes what recreation opportunities are desired by users and what management actions are needed to fulfill those desires.

The third aspect of demand focuses on choosing the site and selecting the kind and quantity of recreation resources, facilities, and programs provided (NAS, 1975). This can be achieved by identifying potential users, recognizing the alternative sites available to them, and determining the relationship between site characteristics and the user group

(NAS, 1975). In all cases, recreation decisions are facilitated by quantifying the expected mix of user segments and the activities and site characteristics that these segments desire (Hendee, 1967; NAS, 1975; Dwyer et al., 1977; Bojanic and Warnick, 1994).

While it is mandated that recreation demand be incorporated in planning activities, doing so is made difficult, in part, by disparities in identifying what "recreation demand" represents. In the Preface of the 1975 report of The Committee on Assessment of Demand for Outdoor Recreation Resources (The Committee), the Associate Director of the Bureau of Recreation described the concept of demand as "[o]ne of the most often used, least understood, and most significant concepts in outdoor recreation planning" (NAS, 1975). In the vernacular sense, recreation demand may be conceptualized as the total number of visits to a recreation resource or the expected participation in a recreation activity during a given period. Economists, however, view recreation demand not as one point of consumption but rather as a schedule of expected recreation use given a range of prices or costs (Clawson and Knetsch, 1967). From the perspective of social-psychologists, recreation demand represents the preferences or desires of individuals regardless of whether or not those desires and preferences result in recreation participation (Driver and Brown, 1975).

Methods to Estimate Recreation Demand and Use

The Committee, adopting a broad definition of demand, outlined four approaches to estimating demand for outdoor recreation: application of standards, projections of use, structural models, and expression of perceived wants (NAS, 1975). Standards, used to determine the "desired" number of recreation opportunities for a given population size or area, have been identified primarily for urban settings. The Committee suggested standards are not particularly effective at indicating recreation demand. In part this is due to the assumptions of applying this technique, namely that social recreation desires, the quality and attributes of recreation sites, and population characteristics are homogenous across areas (NAS, 1975). The second approach, projecting demand, is achieved, generally, by extrapolating historic visitation patterns to some point in the future. This technique internalizes the relationship between visit volume and price for every point in time. As such, the use of projections "...ignores the interaction of social and economic conditions with recreation and the changing determinants of individual recreation decisions, which may, in fact, cause people to behave differently in the future" (NAS, 1975).

Structural models (the third approach) estimate demand by parameterization of the relationships between demand/supply of recreation opportunities and the factors that influence demand. This allows the user to explicitly identify the relationships between demand and the factors influencing recreation consumption (NAS, 1975). Structural models allow for demand to be quantified for proposed and existing sites as well as developing demand estimates after proposed quality improvements or degradation at existing sites (NAS, 1975). One of the drawbacks to this method is that while relationships are assumed to be causal they may in fact be spurious. Other limitations to this approach include some difficultly in capturing the motivation of individual recreationists via independent variables and the lack of variation in independent variables—which may lead to poor prediction (NAS, 1975). The final method of estimating demand is accomplished via public input on the number and types of recreation opportunities desired. This can be accomplished through surveys, analysis of public participation in the planning process, and/or examination of operation budgets (NAS, 1975).

Structural Models of Recreation Demand and Use

Models of recreation demand and use can be developed along a continuum from those that are exceedingly simplistic to those that are very complex. Moeller and Echelberger (1974) stated the selected model "should be dynamic so that changes in management policy, recreation supply, price, etc. can be incorporated into the model to determine their potential impact…". Structural models of recreation may be used to estimate recreation use given supply and demand factors (e.g. Walsh et al., 1992; Hanink and Stutts, 2002), to identify the use value of recreation resources (e.g. Bowker et al., 1996; Fix and Loomis, 1997), or to accomplish both (Boxall et al., 1996; Loomis, 2002). Smith (1975) identified three broad classes of models of recreation demand and use: site-specific user models, population-specific models, and site-specific area models.

Site-specific user models depend upon data collected from individual site users. This data may include their motivations, attitudes, or satisfaction levels (Smith, 1975). Models of this type do not assume homogeneity in services consumed from the site to recreation users. On the contrary, "(these) studies attempt to determine what individuals reactions to heterogeneous services will be" (Smith, 1975). Fix and Loomis (1997), Provencher and Bishop, (1997), and Loomis and others (2001) adopted the site-specific user approach to modeling recreation behavior.

Population-specific models differ from the other two model types in that information is collected from both participants and non-participants (Smith, 1975). These types of models generally collect information on demand for particular services or activities (Smith, 1975). From the information collected, participation (or participation rate) for specific activities (or in some cases sites) can be determined for groups of users (Smith, 1975). Smith suggests that two problems exist with this approach. First, the observations (survey responses) are "...the result of the individual's own demand and effective supply". The implication being that the model output incorporates many different individual demand and supply conditions to estimate a single demand relationship. Second, for the purpose of benefit estimation, this procedure may determine average expenditure per day while the demand curve operates on the basis of marginal costs of production. Using this approach results in inappropriate calculations of benefit (Smith, 1975). Population-specific models include those of Cicchetti (1973), Walsh and others (1988), Bowker and others (1999), and Romano and others (2000).

Site-specific area models are also developed from information gathered from site users (Smith, 1975). Most important to the use of this approach is identification of the origin of the visitor. Travel cost models, as described in Clawson and Knetsch (1967), fall into this class of demand models. In general, these models relate the number of recreation visits over a range of distances that recreationists travel (representative of cost from an economic standpoint) to develop the recreation demand curve and expected use for the site. Since the data collected in this method is aggregate in nature, the characteristics of individual users are not identified; rather they are assumed to be homogenous within zones. Models by Hellerstein (1991), Loomis and others (1995), and Cho and others (2001) are contemporary examples of this approach.

Population-Specific Models

Cicchetti (1973) introduced a two-step population-specific model to forecast recreation use for specific recreation activities. Estimation of the model required survey data collected from both participants and non-participants. The first stage of the model predicted the probability that an individual (or individuals) would participate in a given recreation activity while the second stage of the model predicted the expected number recreation occurrences for a participating individual in a given year. The total recreation use in any one activity is obtained by combining the number of participants with the expected number of recreation occurrences per participant. Socio-economic, demographic, and recreation supply variables were included as independent variables in both model stages. Using estimates of future population counts and demographic and socio-economic conditions, Cicchettii (1973) completed several example applications to forecast future recreation use for a variety of water-based and land-based recreation activities.

Travel Cost Models

In their seminal text Clawson and Knetsch (1967) discussed at length the concept of estimating recreation demand curves, recreation use, and recreation benefit, through the use of travel cost models. Despite the prominence of the text, the authors deferred to Hotelling (1949) and Van Doren (1960) as providing the initial impetus to using travel cost to estimate recreation demand curves. Using distance traveled as a proxy for cost, Clawson and Knetsch (1967) constructed recreation site demand schedules for a variety of recreation areas. In general, origins in close proximity to the recreation site (with associated low travel cost) contribute a greater number of visits to the sites (per capita) than origins at a greater distance from the recreation site (higher travel cost). Total economic benefit to society is calculated as the area under the second stage demand curve (Clawson and Knetsch, 1967). The second stage curve represents what the demand schedule would be under increasing price. Given this, total consumer surplus can be calculated as the entire area under the demand curve.

The travel cost approach to demand and benefit estimation, as outlined by Clawson and Knetsch (1967) and further developed by Cicchetti and others (1976) and Cesario and Knetsch (1976), is best applied under the following conditions: 1) travel costs are variable among users, 2) proposed changes are large enough to alter travel costs to users, and 3) travel costs are primarily associated with the recreation site under study (Dwyer et al., 1977). Travel cost modeling is not particularly suited for sites that attract users primarily from areas in close proximity to the site, for sites that attract many passthru or non-primary users, or for sites that are exceptionally large in size with multiple entrances (Dwyer et al., 1977). Several assumptions are required when estimating demand and benefits. Specifically, recreation visits do not include trips to other recreation destinations, the travel portion of the trip does not provide any benefit to the visitor, trips are of uniform duration, and individuals have similar travel patterns and travel means (Loomis and Walsh, 1997). Given the conditions and assumptions, travel cost models are better suited to modeling the recreation use of visitors who visit one recreation resource and who travel a moderate distance to do so. The recreation use of those visitors who live in close proximity to the recreation resource or those who visit the resource as part of a multi-purpose trip is better modeled using a different approach.

Travel cost models can be constructed for single sites (simple travel cost models) or for multiple sites within a region (regional multi-site travel cost models) (Dwyer et al., 1977; Loomis and Walsh, 1997). The regional travel cost model includes multiple recreation sites (frequently) of varying quality so the impacts of potential recreation quality changes on an individual site can be identified. Dwyer and others (1977) stated that regional travel cost models can be of two primary forms; specifically, a system of linear demand equations or a single demand equation incorporating a gravity model. Regardless of form the general procedure to construct a travel cost model is as follows (Dwyer et al., 1977):

1) Complete a survey of visitors or households to collect visit, trip, and demographic information,

2) Classify sites based upon their amenities and the recreation opportunities provided,
3) Define the origin unit of analysis,
4) Estimate travel cost on a round trip basis,
5) Determine round-trip travel time,
6) Identify substitute recreation destinations,
7) Derive socio-economic variables of interest from necessary data, and
8) Estimate the demand model using the appropriate functional form.

Early Travel Cost Applications

The initial applications of the method outlined by Clawson and Knetsch (1967) laid the groundwork for the development of the zonal travel cost model that we know today. Three examples of these early applications are Burt and Brewer (1971), Cesario and Knetsch (1976), and Cicchetti and others (1976).

Burt and Brewer (1971) presented a conceptual model for deriving the social benefit of additions to an existing set of outdoor recreation sites. This is an extension (though the estimation of benefit is approached from a somewhat different perspective) of Clawson and Knetsch's (1967) model of a single recreation site. The authors subsequently applied their model to estimate the demand and benefit of proposed ACOE reservoirs in Missouri using a household survey and a system of demand equations where the explanatory variables are travel price from visitor origins to water-resource destinations and income. For the three proposed reservoirs the authors estimated an annual visitation of 1.1 million household visit days with an associated annual benefit of $8.5 million dollars.

Cicchetti and others (1976) extended the work of Clawson and Knetsch (1967) to explicitly incorporate the availability of substitute recreation destinations in the calculation of social benefit. The authors applied their model to a set of ski areas in southern California to determine the net social benefit associated with development of a proposed ski area. The authors used a system of demand equations incorporating travel cost to develop an estimate of the social benefit of the proposed area. Comparing the total social benefit of the development with the costs (and using appropriate discounting), the authors suggested the proposed development had a negative net social benefit.

In contrast to the previous example Cesario and Knetsch (1976) used a single demand equation to estimate their travel cost model. The traditional travel cost model proposed in Clawson and Knetsch (1967) did not include the use of a travel time variable in predicting demand. This was due in part to the multicollinearity of travel cost and travel time. Cesario and Knetsch (1976) suggested failing to incorporate travel time would lead to overestimation of consumption from users at distant origins. The use of these long-distance visitors would be overestimated as a result of failing to account for the greater cost (value) of the increased time required to reach the recreation site. To correct this overestimation, the authors constructed a composite variable representing both travel costs and time which was then included in the model of demand. The model was found to perform well when applied to a set of Pennsylvania State Parks.

Contemporary Zonal Travel Cost Models

In their 1986 article Ward and Loomis completed a comprehensive overview of the evolution of travel cost modeling from the late 1970's to the late 1980's. The authors described three empirical forms of travel cost modeling that continued to evolve during the period: zonal, individual, and hybrid. The zonal approach to travel cost modeling is described above. To overcome some of the limitations of the zonal technique the individual travel cost model was developed. In this formulation of the travel cost model, individual specific travel times, travel costs, and socioeconomic characteristics are identified. Travel cost models are developed from this information for individuals (rather than zones) where the dependent variable is the individual's trips (rather than zonal per capita trips). The hybrid travel cost model incorporates portions of both the individual and zonal travel cost models. Hybrid models employ nested decision trees to estimate individual demand models (Ward and Loomis, 1986). These models frequently take the form of multi-nomial logit models (e.g. Provencher and Bishop, 1997).

Contemporary examples of zonal travel cost models include Hellerstein (1991), Loomis and others (1995), and Bowker and English (1996). Hellerstein (1991) used permit count data to construct a model of demand for the Boundary Waters Canoe Area (BWCA). The model predicted the per capita visitation from counties surrounding

BWCA. To control for the constrained nature of the dependent variable (i.e. visitation to BWCA from $county_i$) both Poisson and Negative Binomial models were used. For comparison, a semi-log model was specified and fitted using ordinary least squares and a bias correction recommended by Stynes and others (1986). The author found the Poisson model estimated via pseudo-maximum likelihood performed best. Model selection had little influence on the coefficient estimates but had significant influence on the coefficient standard errors.

Loomis and others (1995) developed and tested the transferability of demand models between ACOE districts. The authors constructed demand models for day users and campers for three ACOE districts. The transferability of these models between ACOE districts was subsequently tested. Explanatory variables included visitor demographics (aggregated at the county level), the reservoir characteristics of the site(s) of interest, available substitutes, and characteristics of the facilities available at the site(s). The models were fitted using a non-linear least squares model and the Heckman two-stage model (Heckman, 1979). The authors stated that the Heckman model was particularly suited to data with a large number of zeros in the dependent variable. While both models performed well, the Heckman model had all the expected coefficient signs. Using the Chow test the authors found that coefficient estimates were statistically different between all models and could not be transferred across regions. Despite this, the authors state that the models of ACOE districts in the mid-south (two of the considered districts) were very similar to one another and suggested that geography and similarity of demographics may greatly influence the transferability of demand models.

English and Bowker (1996) developed zonal travel cost models for day trip visitors to the Chatooga River along the border of Georgia and North Carolina. While the primary research objective was to determine the impact of alternate cost specifications on consumer surplus estimates, their paper also serves as a good example of a contemporary approach to model specification when estimating zonal travel cost models. Models were estimated using both single log ordinary least squares regression and Tobit models estimated via maximum likelihood estimation. The OLS model was estimated with the dependent variable number of trips +1, while the Tobit model was fit with the dependent variables number of trips and trips/capita. A value of 1 was added to the OLS formulation to insure that zones with zero trips were included in the model. Without the adjustment these zones would fall out of the model since the natural log of zero is undefined.

Contemporary Recreation Models Incorporating GIS

The advent of Geographic Information Systems (GIS) has greatly improved the ability of researchers to analyze recreation data in a spatial context. Several recent recreation demand studies have explicitly incorporated the use of a GIS in the modeling process (Alig and Voss, 1995; Lovett et al., 1997; Brainard et al., 2001; Hanink and Stutts, 2002).

Alig and Voss (1995) attempted to model current camper use, and to predict future camper use for the Chequamegon and Nicolet national forests in Wisconsin using age-specific participation rates and demographic data. Counties were the unit of analysis for visitor origins. The proximity and demographics of populations living around the national forests were determined via a GIS incorporating spatial databases of county boundaries, national forest boundaries, and U.S. census bureau data. Camper recreation use was modeled as a function of the population and participation rates of those living within 125 miles (the estimated maximum travel distance of campers) of the national forests. The model predictions of recreation use were significantly greater than the observed campground visitation. The authors cited several reasons for failing to validate the model, including the failure to incorporate substitute recreation sites and a non-uniform pattern of population distribution. Furthermore, the authors stated that the estimates of visitation were highly dependent upon the determination of the market area, for which no reliable data existed.

Lovett and others (1997) were more successful in developing a recreation demand model for woodlands in England. First, using a geographic information system (GIS) the authors determined network distance and travel time for origin-destination pairs identified from a sample of woodland visitors. Second, the authors developed a substitute grid surface from a land use classification system to determine a substitute index for each origin, explicitly capturing the availability of substitute sites. Finally, socioeconomic and demographic variables were associated with each origin in the study. Incorporating population, travel time, the interaction between travel time and population, and unemployment rate, the authors used Poisson regression techniques to specify the recreation use model. The model successfully predicted total site visitation but performed poorly at estimating visitation by origin. The authors suggested that identifying different sub-groups within the population and specifying multiple demand functions to represent these groups might improve model performance.

Brainard and others (2001) improved the model constructed by Lovett and others (1997). The primary improvements to the model were the calculation of a market access variable and the inclusion of site amenity data. Market access for each site in the study was quantified by using a distance decay function developed from visitation count data and an interpolated population surface estimated from the U.S. Census. The use of a market access variable greatly improved the performance of the model. The authors suggested using larger sample sizes and developing a set of user-specific models would increase the transferability of the model.

Most recently, Hanink and Stutts (2002) developed demand models for National Battlefield Parks. The model estimated expected visitation based upon market access, the distance to substitute battlefields, and battlefield amenities. Market access in this case was determined based upon distance to metropolitan statistical areas rather than the population of distributed areas. The specified models performed very well at predicting total battlefield visitation. Independent variables explaining a large proportion of variation in visitation were "market potential" and "number of historic battlefield casualties".

Recreation Segmentation

To allocate recreation resources between competing recreation uses, planners must identify the types, quantities, and locations of the recreation opportunities demanded. In turn, decisions related to site-specific management require an understanding of the kind and quality of recreation resources, programs, and facilities demanded by users (NAS, 1975). Models estimating total use or demand in aggregate provide little information in the context of these decisions. To provide more information, expected use levels or demand is frequently estimated within user groups (user segments). These user segments should be meaningful in that they are applicable to planning and management decisions while at the same time explaining recreation behavior within groups.

Segmentation is defined as the "process of dividing a large heterogeneous population into smaller homogenous subsets" (Bojanic and Warnick, 1994). Reid (1989), as cited in Bojanic and Warnick (1994), identified five broad approaches to segmentation: geographic, demographic, psychographic, behavioral, and benefit. Geographic segmentation classifies visitors based upon the location of their residence. The demographic approach classifies visitors based upon demographic and socioeconomic variables such as age, gender, income, race, family status, etc. Psychographic segmentation classifies users based upon the motivations of the user while behavioral segmentation segments visitors based upon their actions or activities. A benefits-based segmentation classifies visitors based upon the personal benefits or utility received from recreating.

The USDA FS has a lengthy history of classifying users based upon their primary recreation activity (one aspect of visitor recreation behavior). The first attempt to census visitors to USDA FS lands was mandated to be made within specific recreation activities (Waugh, 1918). More recent survey efforts, such as the CUSTOMER survey in the 1980's, have also attempted to estimate visitor use within specific activity groups of interest (Alward et al., 1998). The USDA FS also uses a benefits-based segmentation approach when classifying recreation use by Recreation Opportunity Spectrum (ROS) classes. One assumption of the ROS approach is that users of the different ROS class areas have differing expectations and receive differing benefits; that is, visitors who recreate in primitive non-motorized areas likely receive different benefits than visitors recreating in rural areas. This approach to segmentation is complicated by visitors who recreate within multiple ROS classes and uncertainty as to whether many visitors can readily identify and make recreation decisions incorporating the ROS classification.

Activity segmentation is attractive in that the relationships between activities and management actions appear straightforward. However, users within activity groups can still remain very heterogeneous in their recreation characteristics and behavior. Average trip spending for USDA FS fishing parties can vary from $46 to $222 depending upon whether the party is on a day trip from the local area or whether they live outside the local area and are spending the night on the forest (Stynes et al., 2003). Similarly, non-local snowmobile parties spend nearly 50% more in total than local parties; spending $20 more in restaurants and $15 more on gas and oil.

Faunce and others (1979) have found differences in spending, motivation, and participation when comparing resident and non-resident Maine hunters. Non-resident hunters spent nearly twice their resident counterparts and were more frequently motivated by the social interaction aspect of hunting while resident hunters were more motivated by sustenance. The participation rate of women among resident hunters was much greater than non-resident hunters. Etzel and Woodside (1982) found differences in expenditures, frequency of participation, family status, and expectations when comparing "near home" and "distant" general vacation travelers. Travelers staying near home spent less on their trip, had previously visited the area more times, had larger travel groups, and expected rest and relaxation rather than excitement, personal growth, or intellectual stimulation compared to distant travelers.

Some researchers have employed recreation segmentation approaches based on factors other than primary activity. In his dissertation aimed at profiling recreation users, Hendee (1967) segmented visitors into five recreation groups based upon the recreationists' stated recreation resource preference: national forest wilderness users (dispersed areas), national park wilderness users (dispersed areas), national forest car campground users, national park car campground users, and state park users. User groups differed along socioeconomic variables including age, income, family status, and in their attitudes toward management activities and use of natural resources.

Cordell (2003) has segmented the U.S. population based upon recreation behavior and participation patterns using data from the National Survey on Recreation and the Environment. Eight recreationist segments are identified: inactives, passives, nature loving drivers, nature and family, activity samplers, motor consumptives, skiers, and enthusiasts. Inactives represent the largest segment and are least likely to participate in outdoor recreation while enthusiasts represent the second smallest segment but have the highest rates of outdoor recreation participation. Demographic and socioeconomic patterns differ between groups as do attitudes toward natural resource use and management. Identifying meaningful differences in terms of demographic characteristics and attitudes can assist natural resource managers and policy makers in decision-making.

Stynes (1999), Stynes and others (2003), and Stynes and White (2003), for the purpose of explaining spending, have adopted a user segmentation approach based upon the type of trip completed and whether the visitor lives in proximity to the recreation resource. The trip type includes day trips and overnight trips with overnight trips further differentiated by the type of lodging used. Trip type segmentation performs better at explaining individual spending than activity segmentation—the former explaining 18% of variation while the latter explains only 2% (Stynes and White, 2003). In addition, party characteristics, such as trip length, number of people, and number of children, were also found to differ by trip type segment (Stynes and White, 2003; Stynes et al., 2003).

Relationship to the Current Study

Assuming there are differences between distance segments in terms of recreation behavior, activity preference, and participation, models estimating recreation use within segments will assist in long-term, forest-level allocation, and site-specific recreation planning. To be most useful, the model output should produce information that can be used to identify the level of participation in different types of activities, the types of recreation trips undertaken, the characteristics of visitors and visitor parties, and temporal patterns in recreation use. If possible, it would also be useful to identify what spatial patterns of recreation use are expected. The expected recreation use of distance segments accompanied with a characterization of the distance segments is expected to provide such information.

Frequently, recreation use models have estimated the recreation consumption (or demand) for a specific recreation resource conjointly for all potential recreation visitors (or for all visitors participating in an activity of interest). However, it seems logical that visitors located at a range of distances from the resource respond differently to the factors that influence recreation behavior. For example, visitors in close proximity to resources may incorporate travel cost into their recreation behavior differently than those located farther away. In this case, using a single model relating travel cost to recreation use for all visitors does not appear to be appropriate. Inability to replicate visitation by origin while correctly predicting total visitation (e.g. in Lovett et al., 1997) may be a manifestation of this functional change in relationship between travel distance and visitation.

The failure to incorporate substitute recreation sites in the study conducted by Alig and Voss (1995) resulted in poor model performance, specifically overestimation of recreation use. Selecting an approach to quantifying the availability of substitute recreation sites for recreation use models is challenging. In part, this is due to the lack of a clear theoretical basis for identifying substitutes and the small number of studies investigating how recreationists view substitutes and how they decide between alternate recreation areas. Three frequently adopted approaches to quantifying substitute availability include 1) distance (or travel cost) to a single (or a limited number of) alternative recreation site(s), 2) development of a substitute index incorporating distances to multiple sites and the quality (or attractiveness) of those sites, or 3) creation of a spatial substitute layer using a GIS.

Hellerstein (1991) and Boxall and others (1996) adopted the first approach in their travel cost studies of the Boundary Waters Canoe Area in Minnesota and Rocky-Clearwater forest in Alberta, respectively. This approach to quantifying substitutes seems to be more frequently adopted when there is only one recreation resource of interest and a nearby recreation area is clearly identifiable as a substitute. In the former, the substitute site was Algonquin Provincial Park in Ontario (offering similar canoeing and backcountry experiences) while in the latter study the substitute was Bow-Crow Forest (a nearby Alberta Forest Service public land area). In both studies the coefficient on the substitute variable was statistically significant and had the expected positive sign. In a variation of this approach some researchers have identified a number of potential substitute sites (e.g. all state parks) and identified the minimum distance (or travel cost) to the single nearest substitute site for each visitor origin (e.g. Fix and Loomis, 1997).

Substitute indexes were adopted in Loomis and others (1995) and Hanink and Stutts (2002). In the former, the substitute index calculated for each visitor origin was the ratio of lake acres (the selected measure of recreation site quality) to travel distance summed across all identified substitute sites. In the latter, the authors used two substitute indices, one incorporating competing site quality (the number of historic battlefield casualties) and one not incorporating competing site quality. In both of these studies, recreation use models were estimated for multiple recreation areas and there was no clearly identifiable single recreation site that could serve as a substitute. In both studies the statistical significance of substitute index variables were mixed depending upon the chosen functional form of the model.

Brainard and others (2001) opted to develop a "recreation potential surface" for use as a substitute variable in their model of demand for recreation at forestry commission recreation sites in England. The authors first placed a grid of sample points at 5km spacing throughout the study area. A measure of access to publicly-accessible forestland was then computed for each sample point. Interpolation was then used to develop values in the intervening distance between samples, yielding a continuous surface throughout the study area. One problem in the adopted approach is that the modeled recreation sites are included in the calculation of the recreation potential surface—so it is not a strict substitute surface. When incorporated in the models of recreation use the recreation potential variables were statistically significant, though the direction of the relationship was inconsistent.

The use of a single site substitute variable seems inappropriate for the current study since there is likely more than one substitute for any individual national forest. However, one option is to identify a spatial database of potential substitute sites (e.g. national parks, national forests, BLM land, etc.) throughout the study area and identify the nearest substitute destination of each ownership type. The development of a recreation potential surface is probably not feasible given that a substitute-only surface would have to be computed for every origin-forest pair.

The traditional activity-based USDA FS approach to segmentation yields information related to the number of individuals participating in a specific recreation activity. However, within activity groups recreation behavior and participation are highly variable. In addition, classifying visitors by primary activity can be imprecise since many recreationists participate in multiple activities on a given recreation visit. For example, what is the proper activity classification for an angler who also spends two nights camping on the national forest? A further discussion of the limits to segmenting visitors in terms of primary activity can be found in Stynes and others (2003). Alternative approaches to segmentation such as using distance and trip type segmentation and/or visitor motivation have been successful at explaining variation in recreation behavior (e.g. Faunce and others, 1979; Etzel and Woodside, 1982; Cordell, 2003; and Stynes and White, 2003). The adopted distance segmentation (and associated recreation use models) is expected to provide information for forest planning that may not be captured via activity segmentation alone.

Conclusion

This chapter examined three areas of recreation literature relating to the objectives of this study. The initial section of this chapter included a discussion of the role of demand analysis in resource planning. This discussion was centered primarily on the 1975 NAS document "Assessing Demand for Outdoor Recreation" and the types of planning questions addressed through demand analysis. The second area of focus in this chapter was on methods commonly used to estimate recreation demand and use. Specific emphasis was given to the travel cost model. A discussion of some contemporary examples of recreation demand and use models was also included. The final area of literature examined in this chapter was approaches to segmenting recreation visitors. This section described the traditional approach to recreation visitor segmentation, some of the inconsistencies in recreation behavior that result from this approach, and some alternative segmentation approaches.

CHAPTER 3

METHODS

The primary focus of this Chapter is a description of the methods used to achieve the dissertation objectives identified in Chapter 1. This Chapter begins with a conceptual discussion of the distance-based segmentation and the relationships between the segmentation and the recreation literature. Given its importance to this study, a brief description of the NVUM project, the sampling design, and the visitor survey procedures follows. The remainder of the chapter is devoted to description of the specific analytical approaches in this study. The study area is described and the NVUM survey data used in the study are identified. Specific approaches used to delineate the distance-based segments and the statistical tests used to compare segment visitors between USDA FS regions and between distance segments (objectives 1 – 3) are discussed. The closing section details construction and evaluation of the models used to predict the recreation use of Local and Mid-distance visitors for individual national forests in the study regions, Objective 4.

Conceptual Discussion of Distance-Based Visitor Segmentation

The distance-based approach to visitor segmentation adopted in this study classifies recreation users (and potential users) based upon the proximity of their residence to the recreation resource. Three distance-based visitor segments are recognized: Local visitors, Mid-distance visitors, and Long-distance visitors. Within segments, visitors may be further disaggregated by recreation trip-type (e.g. day trip or overnight trip). Visitors are classified based upon their proximity to the recreation resource under consideration. As such, individuals in a single location may be classified as Local visitors (or potential local visitors) to one forest and Mid-distance visitors (or potential Mid-distance visitors) to another forest, etc. Spatially, Local visitors originate from areas in close proximity to the forest boundary, Mid-distance visitors originate from areas farther from the forest boundary, and Long-distance visitors originate from the "rest of the world" (Figure 2). Conceptually, visitors within each of the distance segments share similar recreation behaviors, recreation participation patterns, and have similar responses to the factors that influence recreation (distance, amenities, substitutes, and socioeconomic conditions, etc.) as other visitors within that segment.

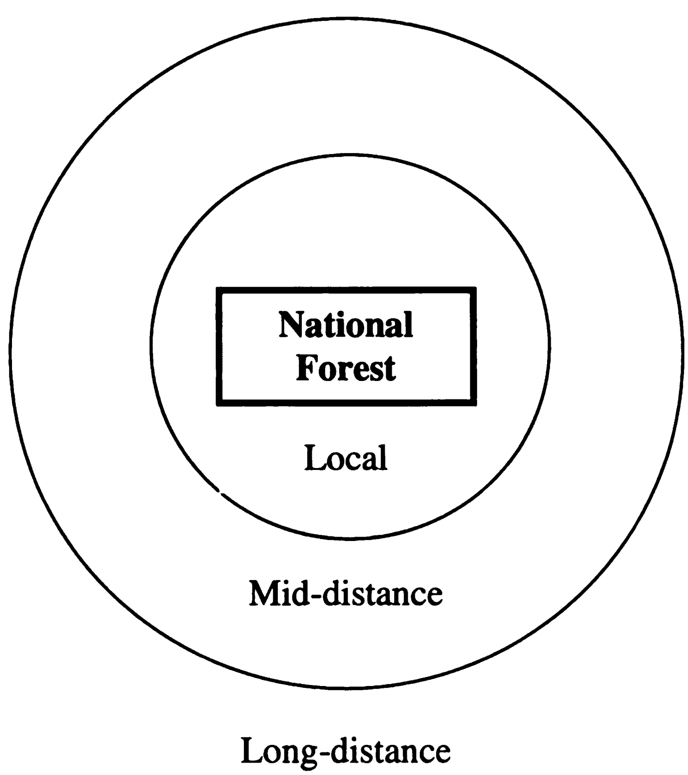

Figure 2. Distance Segmentation of USDA FS Visitors.

The distance-based segmentation can be grounded, to some extent, in the classification of outdoor recreational uses and resources as described in Clawson and others (1960) and in Clawson and Knetsch (1967). Three classes of recreation uses and resources were identified by the authors: user-oriented, intermediate, and resource-based. Under the Clawson and Knetsch classification scheme, individual recreation resources are classified into one of the categories based primarily upon the proximity of the resource to major populations and the natural features of the resource. However, it seems reasonable that a single national forest could represent different resource types (and provide for multiple recreation uses) to multiple individuals. That is, visitors originating from varying distances may recreate at a national forest as if it were a user-oriented resource, an intermediate resource, or a resource-based recreation resource.

User-oriented areas, as outlined in Clawson and Knetsch (1967), are identified by "their ready accessibility to users". This proximity allows users to recreate at the resource with high frequency and during a "variety of leisure times" (daily leisure times and/or weekend leisure times). Visitors to these areas frequently participate in "general" recreation activities such as swimming, picnicking, or walking. Intermediate areas are those that are located at moderate distance from visitors. Given this distance, recreationists are generally constrained to recreating at intermediate areas during long day trips and weekend visits (Clawson and Knetsch, 1967). Recreation activities at intermediate areas more frequently include camping, hunting, and fishing than visitors to user-oriented resources.

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Resource-based areas, under the Clawson and Knetsch (1967) classification, are farthest from populations and have “outstanding physical resources”. Recreation at these resources generally occurs during a vacation and may occur coincident with other activities (the resource may not be the primary purpose of the trip to the area). Individual annual visitation rates are very low. Visitor recreation activities include those at intermediate areas as well as more general and “interpretive” activities such as sightseeing, nature study, and visiting historical places.

Using Clawson and Knetsch’s classification scheme as a framework, postulated characteristics of distance segment visitors were identified. Local visitors have either permanent or seasonal homes in close proximity to the national forest under consideration. Conceptually, these visitors take frequent trips with each trip typically being of short duration—day trips or shorter (Table 1). Longer overnight trips are taken with less frequency and may be associated with special recreation activities (e.g. hunting). Local visitors recreate at a limited number of sites and participate in a limited number of activities on any given trip. Expenditures on individual trips are relatively small—though in aggregate cumulative spending by these visitors may be high. Conceptually, Local visitors are more likely to be involved in forest planning activities and to comment on recreation management decisions. Due to their increased visit frequency and proximity to the forest, these visitors are most affected by natural resource management decisions on an individual forest. The forest-level visitation of this segment is limited mostly by the local population. For many forests these visitors will represent the majority of forest visitation.

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Table 1. Postulated Characteristics of Local, Mid-distance, and Long-distance Visitors.

Recreation Characteristic	Local Visitors	Mid-distance Visitors	Long-distance Visitors
Annual Trip Frequency	high	moderate to low	very low
Trip Duration	short	generally moderate to long	short to moderate
Trip Type	generally day trips	day and overnight trips	pass through day or overnight off-forest trips
Primary Purpose of the Trip is National Forest Recreation	nearly always	typically	infrequently
Sites visited per trip	single or few	multiple	single or few
Activities per trip	single or few	multiple	single or few
Party Size	small	moderate to large	variable
Weekend/weekday Visitation Pattern	throughout week	primarily weekend	may occur throughout the week
Trip Spending (Attributable to Forest)	low	high	variable
Seasonal Pattern of Visitation	year-round	peak and shoulder seasons	peak
Interest in Visitor Programs	low	high	high
Likelihood of Involvement in Forest Planning Activities	very likely	moderately likely	unlikely to be involved
Primary Limiting Factor Affecting Total Group Visitation	local population	proximity of forest to population centers	proximity of forest to tourist destinations, cities, thoroughfares, airports

Mid-distance visitors originate from beyond the local area but within a moderate distance of the forest under consideration. Mid-distance visitors complete up to several recreation visits to the national forest in a given year with annual visitation rates decreasing as the distance to the forest increases (Table 1). These visitors generally have

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longer trip durations, a greater propensity to visit multiple sites within the national forest, and greater likelihood to participate in multiple activities per trip than Local or Long-distance visitors. Mid-distance visitors are more likely than Local visitors to be interested in interpretive programs and visitor centers. Visitors from this area are more likely to include an overnight stay in their trip than visitors from Local or Long-distance areas. Visits to the forest are more likely to be secondary to some other trip purpose for these visitors than for Local visitors.

Recreation spending by Mid-distance visitors initiates the majority of local economic activity directly attributable to recreation on the national forest. As such, the recreation use of these visitors can be very important to economies dependent upon recreation spending. Conceptually, the forest-level recreation use of these visitors is influenced by the distance from the forest to population centers, the existence of substitute recreation areas, the characteristics of the recreation resource, and the socioeconomic characteristics of potential visitors.

Visitors originating from beyond the Mid-distance area (i.e. the "rest of the world") are categorized as Long-distance visitors. This group is comprised of two types of visitors: 1) those in the forest area primarily for some purpose other than recreating on the forest (i.e., business, visiting a nearby tourist destination, visiting friends and relatives, traveling through the area, etc.) and 2) visitors who have traveled to the area expressly to visit the forest. Long-distance visitors may confine their recreation activity to a select number of particularly attractive or well-known recreation sites on the forest

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(Table 1). Regardless of trip-type, visitors in this group have annual visitation rates that are very low. Long-distance visitor typically complete either day trips or overnight off-forest trips. When on day trips, the visitor is frequently passing through the area. A limited number of Long-distance visitors spend the night on the national forest. Since the national forest may not be the primary reason for the trip away from home, much of the spending of by these visitors may not be attributable to the national forest. Conceptually, the number of Long-distance visitors will be influenced by the proximity of the forest to population centers, tourist destinations, lodging, major travel routes, special recreation opportunities, and airports. For most forests, Long-distance segment visitation will represent a small percentage of total forest recreation use.

Some literature lends support to the link between the distance segmentation in the present study and the resource classes of Clawson and Knetsch (1967). Dwyer and others (1977) stated "different values may be placed on recreation participation by different subsets of the population". In particular the authors stated these subsets may be defined by distance from the facility (among other possibilities). Strauss and others (1993) have found distance effects in the participation of hunters in the Delaware Water Gap. Likewise, Nelson and Lynch (1995) found that visitors to undeveloped portions of the forest whose primary residence was within the forest proclamation boundary were more likely to participate in hiking/walking and less likely to participate in off-road vehicle (ORV) use. Spending patterns of recreation visitors have been shown to be related to the proximity of the visitor's residence to the forest (Stynes and White, 2004). Nationally, recreation parties originating from greater than 30 straight-line miles away from the fore

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forest spend 50% more money in the local forest area per trip than parties originating from within the local area (Stynes and White, 2004).

Finally, there is some evidence that distance to the recreation site influences visitor decision-making. Reiling and others (1993) found that campers were indifferent between comparable camping sites when travel times were less than two hours. However, travel time to the sites was highly important in campground selection when traveling greater than two hours from home. Regarding participation in specific recreation activities, Bristow and others (1993) have found that boaters in Massachusetts depended primarily upon local supply of boating opportunities while campers generally traveled outside the local area for camping opportunities.

Distance-based segmentation will provide an alternate way of quantifying and characterizing USDA FS recreation use. Whereas activity-based segmentation identifies the activity patterns of visitors, distance-based segmentation may explain the patterns of recreation participation and consumption as well as the recreation behaviors of visitors. Models predicting the expected recreation use of the distance-based segments will identify the types of recreation visitors expected and may identify the "recreation markets" of individual national forests (assuming the relationships between recreation use and influencing factors remain the same).

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National Visitor Use Monitoring Project

Estimates of USDA FS visitation developed via the USDA FS National Visitor Use Monitoring (NVUM) project and the visitor survey data collected in that process are used in this research. NVUM began as a pilot project in 1998 and was implemented throughout the National Forest System (NFS) in 2000. The goal of NVUM is to develop statistically reliable national, regional, and forest-level estimates of USDA FS recreation use (English et al., 2002). Unlike previous USDA FS visitor survey projects (e.g. PARVS and CUSTOMER), NVUM uses a consistent visitor survey and sampling scheme implemented on all units within the NFS. The data used in this research are drawn from the first four-year NVUM cycle which occurred from calendar year 2000 through fiscal year 2003 (ending in September 2004). In the first NVUM cycle, approximately ¼ of the administrative forests in the NFS were sampled every year.

Concomitant with the implementation of NVUM were changes in the unit of measure for USDA FS recreation use and the adoption of a more conservative approach to defining what "counts" as USDA FS recreation. Previously, the USDA FS relied almost exclusively on the Recreation Visitor Day (RVD) as the unit to measure recreation use. One RVD equals one person recreating for one 12-hour period. Under NVUM, recreation is quantified on a "visit" basis. A visit is "one person entering and exiting a national forest…for the purpose of recreation" (English et al., 2002). A visit may last just a few minutes or several days. An individual camping for a week on a national forest is counted as one visit while an individual staying overnight in a hotel off of national forest land

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land and visiting the forest on three days is counted as three visits. Previously, USDA FS visitation estimates included individuals traveling through national forests for purposes other than recreation as well as individuals viewing national forest scenery from an off-forest roadways, airplanes, ships, etc. Under NVUM, the definition of a recreation visit has changed to exclude these cases from visit counts.

NVUM employs a double sampling approach, completing visitor counts and administering visitor surveys at selected locations on selected days (sample days) within individual forests. Estimates of recreation use are constructed by combining traffic count data with information obtained from visitor surveys.[1] Sample days are selected via a stratified random sample from a population of site days identified for each administrative forest by personnel from that forest. Site days are stratified by the type of recreation location (site type) and the expected level of exiting recreation traffic (site strata).

Site types incorporated in NVUM include day-use developed sites (DUDS), overnight-use developed sites (OUDS), Wilderness areas (WILD), and the general forest area (GFA).[2] DUDS sites have received "moderate to heavy" modifications for the purpose of visitor convenience, education, and comfort as defined in the USDA FS Infrastructure Access (INFRA) database (English et al., 2002). These sites include picnic areas, fishing sites, interpretive sites, visitor centers, etc. OUDS sites are overnight sites that have received "moderate to heavy modification" as defined by INFRA and are generally developed campgrounds, cabins, hotels, resorts, etc. (English et al., 2002).

[1] Appendix A includes detailed descriptions of the NVUM protocol and use estimation procedure.
[2] A fifth site type, viewing corridors, exists within the NVUM sampling process. However, recreation use on this site type does not contribute to the overall visit estimate and is not considered in this study.

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WILD areas are congressionally designated Wilderness areas. Sampling locations for WILD areas are located at trailheads and access points (English et al., 2002). The GFA encompasses the remainder of the forest area not elsewhere classified. Sample locations for the GFA are generally at trailheads, parking lots, and NFS roads exiting the national forest (English et al., 2002).

Site strata are based upon the "expected level of exiting visitor traffic relative to all site days in that site type" (English et al., 2002). Strata include high, moderate, low and closed/no expected exiting recreation use. Individual forest managers classify site days into the site strata based upon their own judgment and the recreation use patterns on the individual forest.

NVUM Visitor Survey

Visitors (or parties) who stop at a voluntary check point established on the sample day are questioned to determine if they are candidates to complete the NVUM visitor survey. Visitors qualify to complete the survey if they are 1) recreating on the forest and 2) exiting the recreation site (DUDS, OUDS, WILD) or forest (GFA) for the last time that day. If a party of visitors, rather than a single individual visitor, stops at the check point the individual 16 years of age or older with the most recent birthday is asked to complete the survey. The survey consists of a general questionnaire completed by all respondents and two supplemental questionnaires (a satisfaction supplement and an economic supplement) that are completed by subsets of survey respondents.

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The NVUM general survey is designed to gather information relating to the duration of time spent recreating on the forest, the number of USDA FS recreation sites visited, participation in recreation activities, past visit frequency to the forest, the home ZIP code of the respondent, the purpose of the trip, party characteristics, and demographic information. The economic supplement to the general survey gathers information on the duration of the trip away from home, annual recreation expenditures, and trip-related expenditures made in the local area. All portions of the survey are designed to be read to survey respondents by trained interviewers and all parts, including the economic addition, are completed on-site during the interview.[3]

Data Weighting Schemes

Three weighting schemes are available for use with the NVUM survey data: exposure weights (ExpWt), national forest visit expansion weights (NVEXPAND), and visit weights (VisWt). Exposure weights adjust the sample for overrepresentation of those visitors who visit multiple sites and/or spend multiple days in the GFA. Due to their extensive movement and extended time in the national forest, these visitors have a greater likelihood of being sampled. Formally, the weight is computed as

$$ExpWt_j = \frac{1}{NSj},$$

where NS_j is the number of sites (and days in the GFA) visited by individual j. Exposure weights for the study area visitor sample range from 0.03 to 1.

[3] There is anecdotal evidence that the economic supplement was sometimes handed to the respondent for completion rather than read aloud.

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The NVEXPAND weights expand the visitor sample to conform to the NVUM use estimate. The weight for an individual respondent j is the product of the number of site visits the respondent represents (SVE_i) and the exposure weight for individual j ($ExpWt_j$):

$$NVEXPAND_j = SVE_i * ExpWt_j.$$

The NVEXPAND weights for data included in this study range from 1.6 to 51,450.

Visit weights correct the sample for overrepresentation of those visitors that visit an individual national forest many times in a given year. Similar to exposure weights, those visiting an individual national forest many times annually have a greater likelihood of being sampled. Weights for individual respondents are based upon the product of $ExpWt_j$ and the inverse of the reported number of annual visits for individual j ($nfv12mo_j+1$):

$$VisWt_j = ExpWt_j * \frac{1}{(nfv12mo_j + 1)}$$

A limited number of individuals reported annual visitation rates greater than 365. In these cases, the reported annual visits were truncated to 365.

This research follows the weighting approach adopted in Stynes and others (2003). Exposure weights (ExpWt) are used when there is no expectation that site type or level of site use (the factors in calculating NVEXPAND) would influence visitor behavior. The characteristics of visits are primarily estimated using ExpWt's. NVEXPAND weights are always used when estimating total visitation or the visitation of a s

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a subset of visitors. The VisWt's are used only when estimating the mean number of annual visits.

Study Area

The study area for this research is USDA FS Regions 2 and 9 (Figure 1, Chapter 1). Region 2 is geographically located in the Rocky Mountain region of the western U.S. while Region 9 encompasses the northern portion of the eastern United States. Twelve administrative forests are located in Region 2 and 14 administrative forests are located in Region 9 (Table 2). Both regions include a mix of "general" and "tourist destination" forests.

Table 2. Administrative National Forests (NF) within USDA FS Regions 2 and 9.

Region 2	Region 9
Arapaho and Roosevelt NF	Allegheny NF
Bighorn NF	Chequamegon / Nicolet NF
Black Hills NF	Chippewa NF
Grand Mesa, Uncompahgre and Gunnison NF	Green Mountain And Finger Lakes NF
Medicine Bow NF	Hiawatha NF
Nebraska NF	Hoosier NF
Pike and San Isabel NF	Huron-Manistee NF
Rio Grande NF	Mark Twain NF
Routt NF	Monongahela NF
San Juan NF	Ottawa NF
Shoshone NF	Shawnee NF
White River NF	Superior NF
	Wayne NF
	White Mountain NF

In addition to national forests, Region 9 includes the Midewin National Tallgrass Prairie (MNTP)—the first federally-designated tallgrass prairie in the Nation. MNTP was est

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established in 1996 on a former ammunition plant and depot near the city of Joliet, Illinois. To insure visitor safety, the site has, for the most part, been closed to public recreation while the remnants of the previous ammunition production and storage facilities are removed. Recently, a limited number of trails, recreation sites, and a visitor center have been established. Given its limited access for recreation activity, its uniqueness as a USDA FS public land area, and limited NVUM sample size (80 respondents), MNTP survey respondents and visit estimates have not been included in this analysis.

In Region 2, four of the 12 administrative national forests also manage nearby national grasslands. NVUM recreation use estimates for the forest/grassland aggregates are reported as a single recreation use estimate for the administrative national forest. Due to the difficulties that may arise from modeling recreation use to national grasslands and national forests in aggregate, the estimates of grassland recreation use on three of the four administrative national forests were subtracted from the respective total administrative national forest recreation use estimates.[4] Correspondingly, surveys completed by respondents sampled on the excluded national grasslands were removed from the survey database.

Recreation visitors sampled on national grasslands managed by the Nebraska NF were included in the NVUM visitor sample and the recreation use of the Nebraska NF

By isolating those NVUM respondents sampled on national grasslands and using the NVEXPAND eights a rough approximation the percentage of total administrative national forest use associated with the lministered national grassland can be made (English, Pers. Comm.). A more comprehensive estimation of assland recreation use would require identification of the number of identified sitedays within stratum on asslands relative to the number on the national forest itself. Having done this the NVEXPAND weights uld be adjusted to identify national grassland recreation use.

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and its managed grasslands was modeled in aggregate. This approach was adopted for three reasons: 1) use on Nebraska NF grasslands accounted for a significant percentage of total Nebraska NF recreation use, 2) a greater percentage of respondent sampled on the Nebraska NF originated from outside the "local area", and 3) differences between the natural features of the national forests and national grasslands within this aggregate are not as substantial.

Survey Data

In the first cycle of NVUM, 16,991 visitor surveys were completed by visitors to administrative forests in USDA FS regions 2 and 9. All respondents completed the general survey and ¼ (4,479) completed both the general survey and the economic addition. Stynes and others (2003) found no statistical differences between the economic sub-sample and the general survey respondents. Variables applicable to this study obtained directly from the survey instrument and variables computed from survey data are shown in Table 5. All NVUM survey data were obtained from NVUM administrators in ASCII flat file format. The data had undergone a preliminary "cleaning" by USDA FS personnel to remove inconsistencies found during the visit estimation process. Additional cleaning activities to facilitate economic analysis were completed by MSU personnel and are outlined in Stynes and White (2002), and Stynes and others (2003).

Several variables used in this study were computed from information provided by NVUM survey respondents (Table 3). The duration of the forest visit (visdur) was estimated as the difference between the reported ending of the forest visit (forend) and the reported beginning of the forest visit (forarrive). This calculation was performed using date and time functions in Microsoft Excel®. The number of sites visited (expose) was computed as the sum of the number of developed recreation sites visited (numsites) and the number of days spent recreating in the GFA (GFAdays). In addition to identifying their primary recreation activity, NVUM respondents were also asked to report all the recreation activities in which they participated. The number of activities (numact) is the count of these reported participation activities.

The study variables fordist and triptype were constructed as part of the economic analysis of the NVUM survey data as reported in Stynes and others (2003) and Stynes and White (2005a). Fordist is the straight-line distance between the centroid of the reported home ZIP code of the NVUM respondent and the nearest boundary of the visited national forest. Approximately 15% (2,770) of non-foreign NVUM respondents in the study area either failed to report a ZIP code or provided a ZIP code that did not correspond to the ZIP code databases used to identify respondent origins. In these cases fordist values are classified as "missing". Additional discussion related to the calculation of forest distance calculation can be found in Stynes and others (2003).

Table 3. NVUM Survey Variables.

Variable	Variable Description	Survey Variable	Computed Variable
region	USDA FS Region	1	
forest	National forest visited	1	
inttime	Month/day/time of interview	1	
forarrive	Month/day/time of arrival at forest	1	
forend	Month/day/time of leaving the forest	1	
nfv12mo	Number of times visited this NF during the past year	1	
numsites	Number of DUDS, OUDS, WILD sites visited	1	
GFAdays	Number of days in the GFA	1	
zipcode	Home ZIP code of respondent	1	
foreign	Respondent is a resident of a foreign country	1	
peopveh	Number of people in the respondent's vehicle	1	
primact	Primary activity	1	
Primpurp[a]	Primary purpose of the trip to the area	1	
nfprime[b]	Is the national forest your primary destination?	1	
lotype[a]	Type of lodging used	1	
visdur	Duration of the forest visit		1
expose	Number of recreation sites visited		1
numact	Number of activities participated in		1
fordist	Distance from respondent's ZIP code to the forest boundary		1
triptype	Respondent's trip type (i.e. day trip, overnight trip, not primary trip)		1
nvexpand	National forest visit expansion weight		1
expwt	1/expose		1
viswt	expwt*(1/nfv12mo+1)		1

[a] Year 4 data only
[b] Years 1 - 3 data only

In the course of development of recreation spending profiles for USDA FS visitors, NVUM survey respondents were classified into one of four trip types: day trips, vernight on forest trips, overnight off forest trips, and not primary trips. Day trip visitors e those who reported they were not spending any nights away from home as part of eir national forest visit. Overnight on forest visitors were those who answered yes to the question "did you spend last night on the forest?". Those visitors who reported they would be spending at least one night away from home, not on the national forest, were classified as overnight off-forest visitors.[5] For the study presented here, the overnight segments have been combined into a single overnight group (OVN/OVNNF). Stynes and White (2005b) found that NVUM respondents likely had difficulty determining whether they indeed "spent last night on the forest". Not primary visitors are those who reported that the national forest was not their primary recreation destination. Due to how the "not primary" question was worded in the first three NVUM years the number of not primary visitors was likely underestimated (see Appendix A and Stynes and White 2005b).

Distance Segmentation of NVUM Survey Respondents

NVUM survey respondents were assigned to one of the three distance segments based upon the distance between their reported home ZIP code and the forest boundary (fordist).[6] To do so, the distance boundaries (i.e. travel distances) separating Local visitors from Mid-distance visitors and Mid-distance visitors from Long-distance visitors had to be identified. This was achieved via the approach described in the following paragraphs, incorporating the NVUM data and NVUM regional visit estimates.

Regional-level visitation estimates for five-mile travel distance bands surrounding ational forests were computed using the NVUM survey data and the NVEXPAND

n the first three years of NVUM, respondents were only asked to report the number of nights away from me rather than the number of nights in the local area. As such, some visitors who were passing through local area and but spending the night away from home outside the local area are classified as overnight forest visitors.
his approach is consistent with the NVUM economic reports: Stynes and White (2002) and Stynes and ers (2003).

weights. Those respondents whose primary activity was downhill skiing were excluded from computation of these visit estimates.[7] The cumulative percentage of the total regional-level visitation was computed for each five-mile travel distance band and depicted graphically (Figure 3).[8] The percentage of total visitation associated with each distance bands and the marked changes in the relationships between travel distance and visitation rate changes were used to inform decisions regarding segment separation distances.

Two important characteristics of the Local visitor segment were included in the conceptual discussion: 1) Local visitors are the majority of total forest visitation (particularly at the regional- and national-level) and 2) travel distance has only a minor influence on the rate of visitation. In their economic analysis of the NVUM data, Stynes and others (2003) utilize a 30-mile boundary to identify local national forest visitors. In both study regions, visitation by those living within 30 miles of forest boundaries constitute more than 50% of total regional-level visitation (Figure 3). Prior to the marked change in slope located at approximately 30 miles, marginal visitation levels of this group of visitors changes very slowly with increasing travel distance. Given the consistency with the postulated Local visitor characteristics and for compatibility with NVUM

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[7] Since most downhill ski areas were NVUM proxy sites, visitor surveys were completed by downhill skiers at a lower intensity than visitors to non-proxy sample sites (see Appendix A). Due to the high use at ski areas and the low intensity visitor surveying, the average NVEXPAND weight for NVUM skier survey respondents is more than 3 times greater than the average NVEXPAND weight for other survey respondents. Given the potential for individual skier respondents to dominate any analysis of recreation use when considered by distance band (using NVEXPAND); downhill skier visits were excluded from segment delineation and from development or evaluation of the recreation use models. Skier survey respondents were included in analysis of visitor segment characteristic—where most analyses are based upon ExpWt.

[8] Cumulative percentages estimated for individual forests in the study area are available from the author.

definition of "local visitors", the travel distance separating Local from Mid-distance visitors was established at 30 miles from origin to forest boundary.

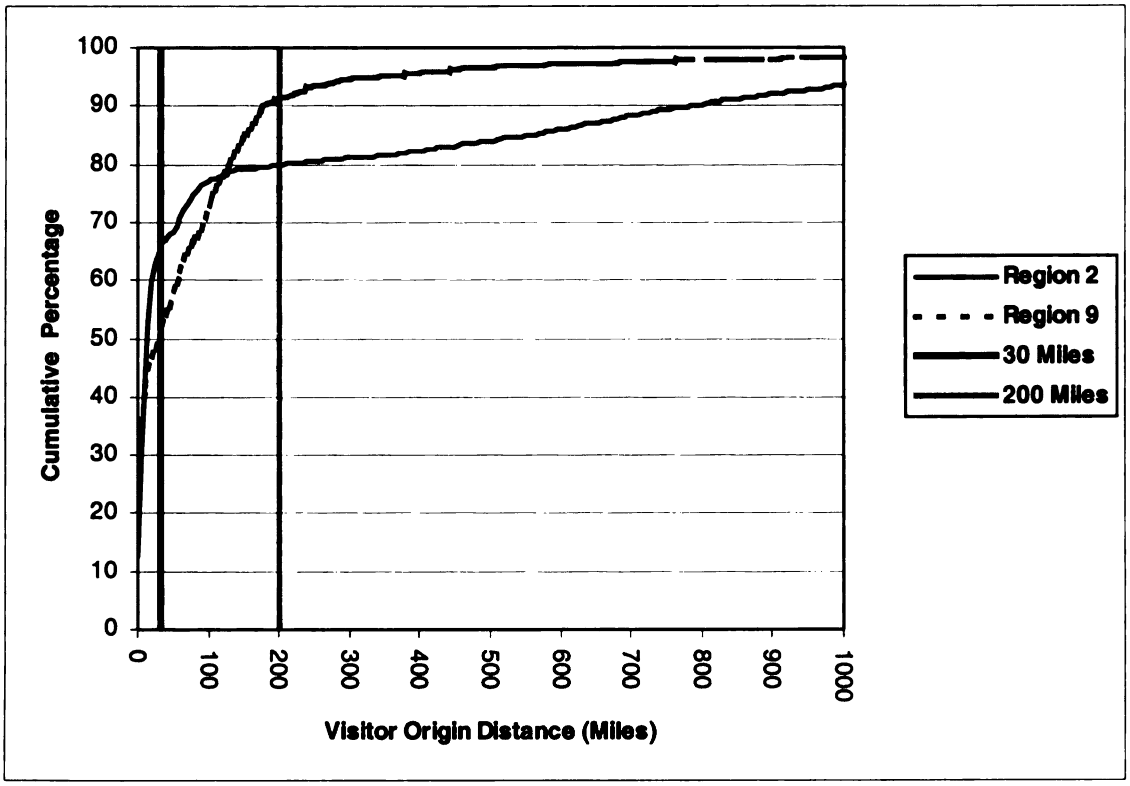

Figure 3. Cumulative Percent of Visitation Across Visitor Origin Distance Bands.

Conceptually, the visitation of the Mid-distance segment should be influenced significantly by travel distance and the total visitation of this segment should comprise the majority of non-local visitation. Between the 30-mile and 200-mile distance bands the influence of travel distance on marginal visitation is apparent (Figure 3). At distances of greater than 200 miles, the cumulative visitation levels of the distance bands increase at a relatively uniformly rate toward 100%—indicating no obvious changes in the relationship between travel distance and marginal visitation. At the 200-mile band, 80% of the visitation in Region 2 and 90% of the visitation in Region 9 has been accounted for. Given these factors, 200 miles was selected as the origin to forest boundary travel distance separating Mid-distance from Long-distance visitors.

Characterizing Distance-based Segments

Visitors within the three distance segments were characterized in regard to the following recreation behavior, activity participation, and consumption pattern variables: annual visit frequency, visit duration, number of sites visited per visit, number of activities per visit, visitor primary activity, party size, visit trip type, and weekday/weekend visit patterns (Objective 1). Statistical tests were conducted to determine if the characteristics of distance segment visitors differed between the study regions (Objective 2). Subsequent to these comparisons, a second group of statistical tests were completed to identify differences between the distance segments themselves (Objective 3). The postulated characteristics of distance segment visitors, as well as the postulated differences between the distance segments, are listed in Table 1 (within the conceptual discussion).

All statistical tests were completed using SPSS 12®. Selection of the appropriate tests was based upon Howell (1997). Statistical tests were not completed if any one group under consideration had less than 30 observations. Chi-square analysis was used in all tests where the variable of interest was nominal in nature (e.g. trip-type). The Mann-Whitney U test was employed when variables that were ratio in nature (e.g. annual visits) were compared between two groups (e.g. study regions). When completing comparisons of a ratio variable between more than two groups a two-step procedure was completed. Kruskal-Wallis ANOVA (K-W ANOVA) was used to determine if there was a statistical differences between all groups under consideration (e.g. Local, Mid-distance, and Long-distance segments). Subsequent to a finding of statistical difference between all groups, a series of Mann-Whitney U tests were completed between pairs of groups (e.g. Local and Mid-distance segments) to determine specific pairwise statistical differences.

The non-parametric tests Mann-Whitney U and the K-W ANOVA were chosen for use in this study over comparable parametric tests (ANOVA and student's t-test) for several reasons. First, the population distributions of the recreation characteristics under consideration do not meet the assumption of normality required for parametric tests.[9] Second, Mann-Whitney U (and the related K-W ANOVA) tests the broad hypothesis that samples were drawn from identical populations—consistent with the objectives of this study (Howell, 1997). Comparatively, the hypothesis of the student's t-test is that samples were drawn from populations with the same mean. Finally, the results of non-parametric tests, as compared to parametric tests, are not overly influenced by the inclusion of extreme values (e.g. annual visit rates of 365) whereas parametric tests can be (Howell, 1997).

Analyses were completed using the following weighting schemes, outlier removal, and data cleaning rules. With two exceptions ExpWt's were used for analyses

[9] Many argue that t-tests are robust to violation of the normality assumption if the sample size is sufficiently large to yield a normal sampling distribution of the mean under the central limit theorem.

relating to visitor characteristics; NVEXPAND weights were employed when estimating the frequency of primary activities while VisWt's were used for analysis of annual visit frequency. When completing analysis of party size, respondents reporting party sizes of greater than 7 individuals were excluded from analysis. Similarly, respondents reporting a trip of greater than 30 days away from home were excluded from estimation of visit duration. Removal of these outliers is consistent with the approach adopted for economic analysis of the NVUM data (Stynes et al., 2003). Lastly, in several cases, individual respondents reported annual visit frequencies (nfv12mo+1) of greater than 365 visits. In these cases, the reported number of annual visits was reduced to 365 visits.[10]

Modeling Segment Visitation

Objective 4 is to model the forest-level recreation use of Local and Mid-distance visitor segments to national forests in USDA FS Regions 2 and 9. The remainder of this chapter includes a general description of the modeling approach, a specific discussion of the procedures used to construct the recreation models for each distance segment, and lastly, explanation of the approach used to verify and validate the predictive ability of the constructed models.

[10] The average numbers of visits annually is not appreciably influenced by reducing the maximum number of annual visit to 100.

General Description

The models constructed here are meant to predict only the recreation use of Local and Mid-distance visitors recreating on national forest land engaged in activities other than downhill skiing. The recreation use of downhill skiers and visitors to national grasslands is not modeled in this research. For both of these recreation use types, the factors influencing recreation use are likely different from those influencing visitors engaged in traditional outdoor activities on national forest land. Moreover, downhill skier use was not modeled as these visitors were sampled at a very low intensity, leading to very high individual NVEXPAND weights that may adversely influence derivation of band-level recreation use (see footnote 7, this Chapter). Approximately 15% of NVUM survey respondents did not provide a valid ZIP code. As the origin of these visitors could not be determined, the recreation use associated with these visitors was also excluded when constructing and evaluating the recreation use models.[11]

The forest-level recreation use of Local visitors was modeled using a simple approach incorporating counts of the population living at several distance zones around national forests, estimates of the percent of those individuals participating in national forest recreation, and estimates of the number of visits completed by participating individuals. Mid-distance recreation use was modeled via more complex multi-site zonal travel cost models. While the recreation models are formulated differently, the basic

[11] Alternatively, it could have been assumed that the origin distribution of those providing a ZIP code was representative of those failing to provide a valid ZIP and this use could have been included in modeled recreation use. However, there is no basis for this assumption and it seems reasonable to expect that some respondents may be more likely to not report a ZIP code.

premise of each is to model forest-level recreation use based upon information about the populations living in zones around national forests and the patterns of national forest recreation use by individuals in those zones. NVUM survey data and recreation use estimates for national forests sampled in NVUM years 2, 3, and 4 were used to construct and verify the performance of the models. Recreation use estimates for forests sampled in NVUM year 1 were retained for model validation (ascertaining the out-of-sample predictive ability). Retaining a portion of the data to test the out-of-sample predictive ability of models is an accepted form of model validation (Grant et al., 1997; Haefner, 1997).

When using a zonal approach to modeling recreation use, the zonal aggregation of the visitor origins must be defined. Typically, zone definition is relatively arbitrary (English and Bowker, 1996). In this study, twenty zones (or distance bands), spanning travel distances from zero miles to 200 miles were delineated (Table 4). The 20 zones are comprised of groups of origins that share a similar distance from origin to forest boundary.[12]

Units of analysis for NVUM survey respondents and for population socio-demographic characteristics represent two datasets. In the case of the former, visitor origins are assumed to be the reported ZIP codes of the NVUM respondents. For the latter, census block groups were selected as the origin unit of analysis. ZIP codes could not be used in this study as the origin unit of analysis for the population data for several

[12] Due to large percentage errors in distance estimation, the 0 – 5 mile band was joined with the 5 – 10 mile band to form one 0 – 10 mile distance band.

Table 4. Distance bands used in Local and Mid-distance recreation use models.

Distance from origin to forest boundary	Band Label
Local Segment Bands	
Origin within forest boundary	0
0 ≤ 10 miles	10
10 ≤ 15 miles	15
15 ≤ 20 miles	20
20 ≤ 25 miles	25
25 ≤ 30 miles	30
30 ≤ 35 miles	35
Mid-distance Segment Bands	
35 ≤ 40 miles	40
40 ≤ 45 miles	45
45 ≤ 50 miles	50
50 ≤ 65 miles	65
65 ≤ 80 miles	80
80 ≤ 95 miles	95
95 ≤ 110 miles	110
110 ≤ 125 miles	125
125 ≤ 140 miles	140
140 ≤ 155 miles	155
155 ≤ 170 miles	170
170 ≤ 185 miles	185
185 ≤ 200 miles	200

reasons: 1) comprehensive spatial databases of ZIP codes are expensive to obtain at this scale of analysis, 2) U.S. Census data are not reported by postal ZIP code (Census data are reported by ZIP code tabulation areas rather than postal ZIP codes), and 3) ZIP codes may apply only to businesses or P.O. boxes. Census block groups were selected as the unit of analysis for population data because the 2000 U.S. Census data are reported by census block group and these data are in the public domain.

The impact of using two datasets is limited as both NVUM origins and population origins are ultimately aggregated by distance bands measured from the respective origin centroid to the forest boundary. Additionally, the recreation use models for Local and Mid-distance visitor segments are estimated incorporating observations from all forests in the respective study regions—further lessening the impact of any errors at the origin level. Despite these controlling factors, this difference remains a potential measurement error in constructing the recreation use models.

The distances from origins to destinations for the NVUM survey respondents were calculated from the NVUM variable "fordist". This straight-line distance was calculated in ArcView3.2a using the "distance by ID" extension (Jenness, 2004) and spatial databases of the geographic centroids of ZIP codes reported by NVUM respondents and the national forest boundaries. The projection for this calculation was Albers Equal Area Conic, distance units equal to miles. "Fordist" was constructed to classify visitors into local and non-local groups for NVUM economic analysis and has been used frequently in analysis of the NVUM data. For a detailed discussion of the fordist variable and its calculation see Stynes and others (2003).

The distances from census block group origins to forest destinations were estimated using a straight-line calculation that incorporated an adjustment for barriers to travel (i.e. large lakes, major rivers). This procedure reduced the potential for assigning to the wrong zones the band population estimates of individual forests. First, straight-line distances were computed for all origin/destination pairs (census block group centroid to national forest boundary) with an intervening distance of less than 200 miles. Second, straight-line routes crossing major lakes and rivers within the study area (Figure 4) were identified. Third, the barrier-adjusted Euclidean distance (BED) was calculated for each of these origin/destination pairs using the procedure below. As with NVUM distance, the analysis projection was Albers Equal Area Conic, distance units equal to miles.

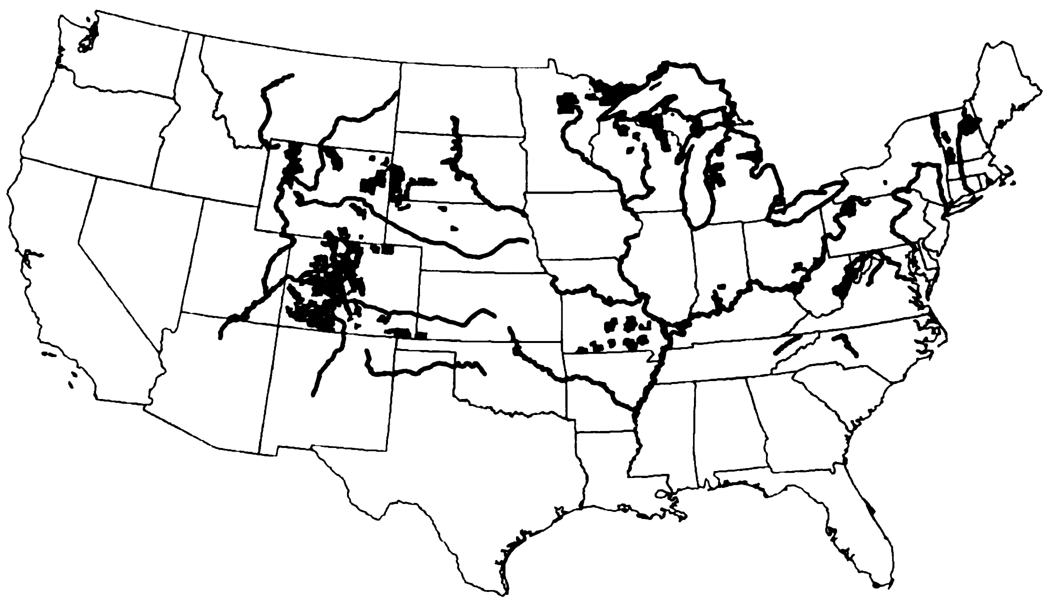

Figure 4. River and lake barriers to travel in the study area.
(Source: ESRI, Redlands, CA)

The latitudes and longitudes of all road bridges and car ferries[13] crossing the barriers shown in Figure 4 were identified using Delorme Street Atlas 2004 were imported to ArcView 3.2a and converted to the analysis projection. Points allowing

[13] The car ferries crossing the Great Lakes were not included in the constructed bridge and ferry database since they charge significantly greater fees than the other general river and/or publicly subsidized ferries.

travelers to circumvent the Great Lakes (e.g. a point south of the southern tip of Lake Michigan) were digitized directly in ArcView 3.2a. Barrier-adjusted Euclidean distance was computed by first identifying the barrier crossing nearest the intersection of the Euclidean route and the barrier. Next, the Euclidean distances from the origin to the crossing identified in the previous step and from the crossing to the nearest boundary on the destination forest were determined. Lastly, these two distances were combined to form BED (Figure 5).

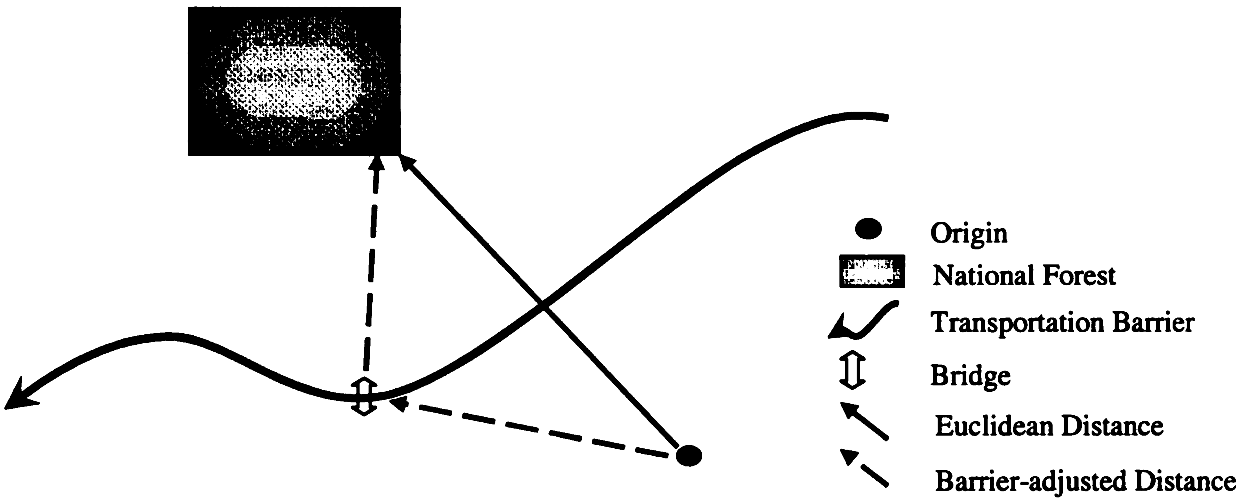

Figure 5. Euclidean and Barrier-adjusted Distance Estimation.

Mountainous areas are often perceived as barriers to travel. However, in the context of this analysis, mountainous regions do generally not meet the definition of barriers, namely "completely inhibiting travel". While often circuitous, travel *through* mountainous regions is generally possible. Individual mountains may serve as barriers to travel; however, identifying individual barrier mountains located within the study area as well as the appropriate bypass points is beyond the scope of this analysis.

Local Visitor Recreation Use Model

The Local population is comprised of those individuals living within 30 miles of the forest boundary. Total Local segment visitation includes the recreation use of permanent as well as seasonal Local residents. The recreation use of these two groups was modeled separately due primarily to differences in how the U.S. Census Bureau quantifies permanent and seasonal residents. Permanent residents are quantified on a person basis while the seasonal population is quantified on a household basis. The permanent resident Local model is presented first followed by the seasonal resident Local model.

Conceptually, the visitation of the permanent Local visitor segment is a function of the local population, the rate of national forest recreation participation, and the annual visit frequencies of Local visitors. The number of Local segment visits to an individual national forest (TVL_j) is computed as

$$TVL_j = \sum_{i=1}^{I} (Pop_{ij} * Part_i * AV_{ij}),$$

where Pop_{ij} is the local population within each distance band i of forest j, $Part_i$ is the percentage of the population in distance band i that participates in national forest recreation estimated at the regional-level, and AV_{ij} is the number of annual visits of participating recreation users in distance band i for forest j. The populations located in five distance bands around each national forest in the study regions (Pop_{ij}) were estimated from the 2000 U.S. Census data, spatial databases of census block group geographic centroids (U.S. Census, 2004b) and national forest boundaries (USDA FS, 2000) (Figure 6).

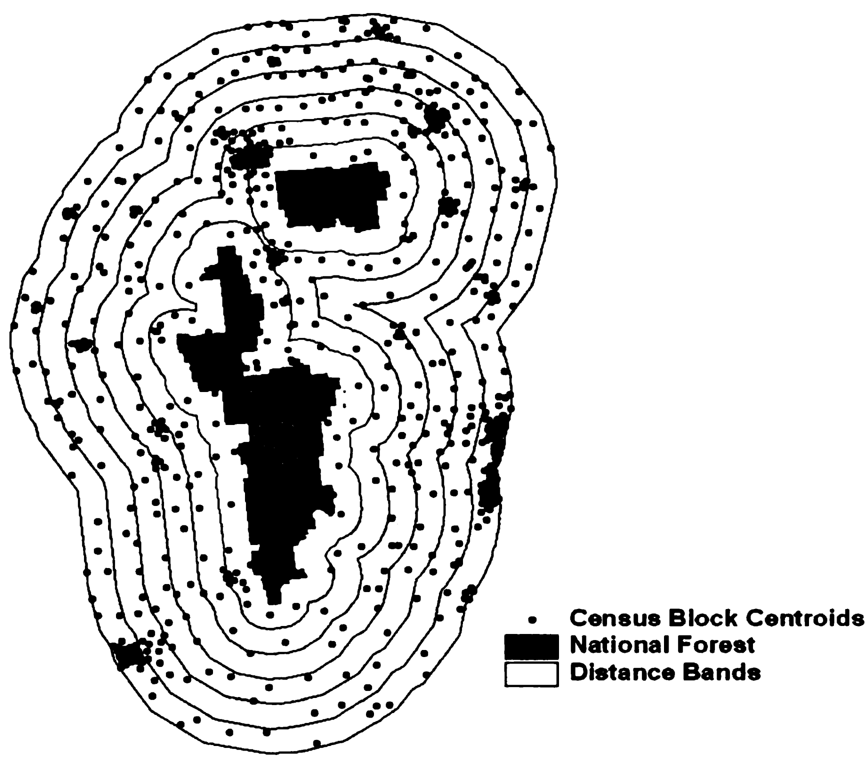

Figure 6. Conceptualization of quantifying a forest's local population.

In some portions of the study area (particularly in Region 2) local populations are located in proximity to multiple administrative national forests. Conceptually, recreation use by this segment is a function of convenient access to the natural resource. Given this, it is assumed that visitors located within 30 miles of multiple national forests would choose to recreate at the closest. To that end, census block groups located proximate to more than one national forest were included only in the population counts of the closest national forest. In cases where census block group centroids were located at equal band distance from more than one administrative national forest the block group population was split evenly between forests. In addition to other national forests, some census block groups are proximate to recreation opportunities managed by other public land agencies. In these cases, it is assumed that the availability of substitutes is accounted for in the annual visitation rates of NVUM respondents sampled on that forest.

AV_{ij} was estimated from the NVUM survey data using the nfv12mo variable, weighting cases with the visit weights (VisWt). Since NVUM respondents were asked to not include the current visit, one visit was added to the reported nfv12mo to compute nfv12mo+1. To preserve local differences, AV_{ij} values were obtained by aggregating respondents across forests located in proximity to one another (Table 5). If less than 30 NVUM cases occurred within a band after forest aggregation, the regional AV_i was substituted for AV_{ij}.

The participation rates of Local visitors were determined at the regional-level based upon the NVUM use estimate for Local visitors, the annual visit frequency of Local visitors, and the local permanent population. Formally, the participation rates of local visitors within band i ($Part_i$) were estimated as

$$Part_i = \frac{TV_i}{(Pop_i * AV_i)},$$

where Pop_i is the study region population of band i, TV_i is the NVUM regional use estimate for visitors from distance band i and AV_i is the average number of annual visits by visitors from band i estimated at the regional-level using the approach outlined above.

Table 5. Forest aggregation for estimating AV_{ij}.

	Region 2		Region 9
1	Bighorn National Forest Shoshone National Forest	1	Hoosier National Forest Mark Twain National Forest Shawnee National Forest
2	Black Hills National Forest Nebraska National Forest	2	Allegheny National Forest Monongahela National Forest Wayne National Forest
3	Arapaho and Roosevelt National Forests Medicine Bow National Forest Pike and San Isabel National Forests	3	Green Mountain And Finger Lakes National Forests White Mountain National Forest
4	Grand Mesa, Uncompahgre and Gunnison National Forests Rio Grande National Forest Routt National Forest San Juan National Forest White River National Forest	4	Hiawatha National Forest Huron-Manistee National Forest Ottawa National Forest
		5	Chippewa National Forest Chequamegon / Nicolet National Forest Superior National Forest

As constructed, a principal assumption of the permanent resident Local model is that individuals within USDA FS regions participate in national forest recreation with the same proclivity as other individuals located at equal distance from forests in that region. It is assumed that much of the forest-level variation in recreation use due to climate, locally-popular recreation pursuits, and natural resource features is captured in the annual visit frequencies.

In areas where seasonal homeownership is common, permanent resident population figures underestimate the effective local population. Based on data obtained in the 2000 Census, approximately 570,000 seasonal homes are located within 30 miles of national forests in the study area—80,000 in Region 2 and 490,000 in Region 9. Seasonal homes located near national forest local areas are most common in the Great Lakes and northeastern portions of Region 9 and along the front range of the Rocky Mountains in Region 2 (Figure 7). Given the potential level of recreation use by seasonal homeowners and their family and friends, it is important to include seasonal homes in any model of national forest visitation.

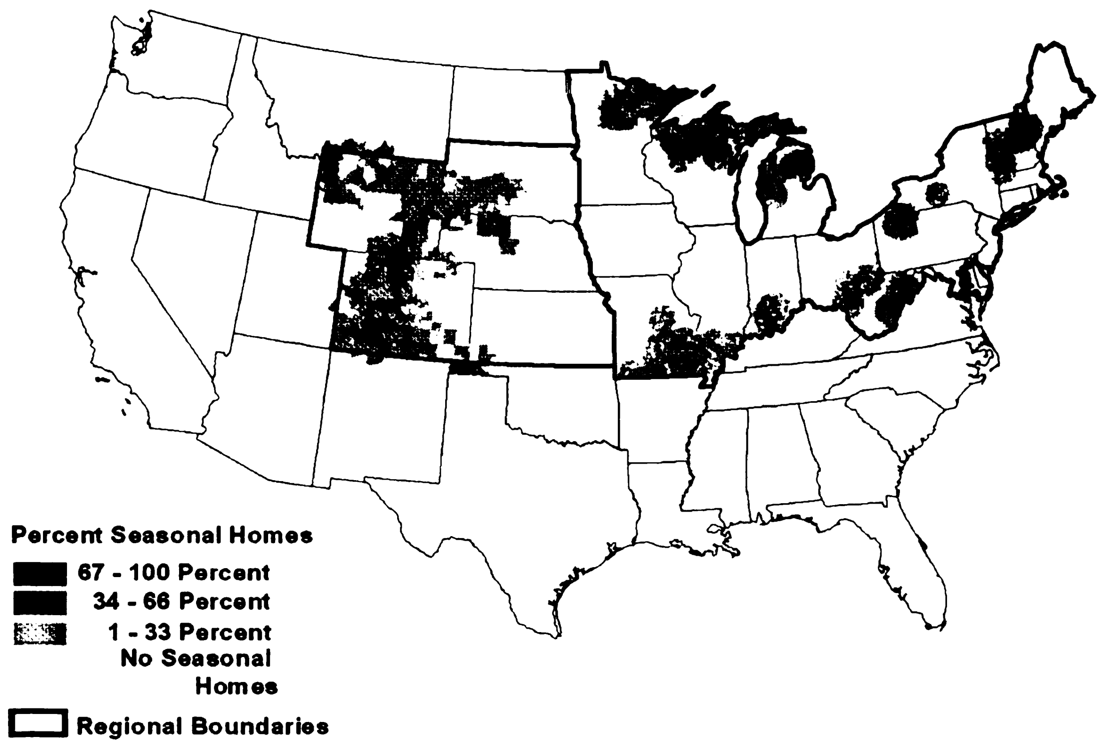

Figure 7. Percent of housing units classified as seasonal homes in Census 2000 for census block groups within 30 miles of national forests in USDA FS regions 2 and 9.

Unfortunately, very little information concerning seasonal homeowners can be gathered from the NVUM survey data. There is no way to identify seasonal homeowners from surveys completed in NVUM years 1 – 3 and only a partial enumeration of seasonal homeowners is feasible using Year 4 NVUM survey data. As such, it was impossible to estimate participation rates and annual visit frequencies by distance band (as in the permanent resident model) for those owning seasonal homes in the local area using the NVUM survey data. Lacking this ability, it was assumed that the participation rates and annual visit frequencies of seasonal local residents were the same as permanent local residents.

The U.S. Census Bureau reports the number of seasonal housing units. Thus, multiplying participation rates by the number of households will underestimate total seasonal homeowner visitation as there are frequently multiple individuals visiting any single seasonal home. To correct for this, the average party size of seasonal homeowner respondents (2.6 individuals) was identified from partial sample of seasonal homeowners available in the Year 4 NVUM data.[14] The resulting model to predict the total visitation of seasonal homeowners in the local area of forest j ($TVLS_j$) is

$$TVLS_j = \sum_{i=1}^{I} SH_{ij} * Part_i * AV_{ij} * PS ,$$

where SH_{ij} is the number of seasonal homes in band i of forest j, $Part_i$ is as defined above, AV_{ij} is the annual visit frequency of local permanent residents in band i of forest j, and PS is the average party size of seasonal homeowner parties. The numbers of seasonal

[14] Due to small sample size, mean party size was estimated from all seasonal homeowners sampled nationally using ExpWt.

homes located in the five distance bands around each national forest in the study regions (SHij) were estimated from the 2000 U.S. Census data following the same approach used for permanent local residents. As in the permanent resident model, census block groups proximate to multiple national forests contributed to the local seasonal population of only the closest national forest.

Mid-distance Visitor Recreation Use Models

Of the three distance segments, the recreation use of Mid-distance segment visitors best matches the assumptions and conditions for successful application of a travel cost model. Visits completed by individuals within this segment are likely to be single destination trips, it is likely that these visitors receive no benefits during travel to the recreation location, and sufficient variation in travel cost exists within the segment (Loomis and Walsh, 1997). It is difficult to apply a travel cost model to model the recreation use of the Local segment since distance band travel distances are very similar within that segment (due to their proximity to the forest and the selection of a 30-mile boundary). Use of a travel cost model for Long-distance recreation use is probably inappropriate given that these visitors likely receive some benefit from traveling to the area and trips completed by this segment are more likely to include multiple destinations.

Mid-distance visitors may complete day trips to the national forest or trips to the national forest that include overnight stays either on or off the forest. Additionally, these visitors may complete national forest visits that are secondary to some other trip purpose.

A confounding issue in developing travel cost models is variation in time spent at the recreation destination. Variation in on-site time may change the relationships between travel cost and recreation use (Loomis and Walsh, 1997). Specifically, visitors who spend a greater amount of time at the recreation area may be willing to incur greater costs than those spending a shorter time. In addition to travel cost, the relationships between recreation participation and the other factors influencing recreation (e.g. resources characteristics, substitutes, etc.) may vary depending upon the type of trip and time spent on site. With these considerations in mind separate travel cost models were developed for Mid-distance segment day trips and Mid-distance segment overnight trips within each study region. Consistent with theory, "not primary" Mid-distance recreation use was excluded from the constructed zonal travel cost models.

Functional forms commonly chosen for use in zonal travel cost models include single-log ordinary least squares (OLS), the Tobit model, and the Heckman two-stage model (e.g. Loomis et al., 1995). The single log OLS model is attractive because 1) interpretation of the independent variable coefficients estimated via OLS is straightforward and 2) use of a single-log dependent variable for visits yields non-negative model predictions of recreation use. A drawback to the single log OLS is that the model cannot be estimated with zero-value observations as the natural log of zero is undefined. The typical solution to this problem is to add one visit (or a small value) to all observations to insure computability (e.g. English and Bowker, 1996). In the Tobit model and two-stage Heckman model, recreation use is modeled as both a function of the likelihood of participation as well as the number of visits of participating populations.

The Tobit model incorporates both the likelihood of participation and level of recreation use in one model while participation and recreation use level is modeled separately in the Heckman two-stage model. Both model formulations explicitly incorporate zero-value observations.

The multi-site travel cost models were estimated for each trip-type/region combination following the general approach to empirical specification adopted by English and Bowker (1996). Models for day trips and overnight trips were estimated using both single log ordinary least squares (OLS) and Tobit formulations. Models were estimated with several different formulations of the dependent variable. Dependent variables used in the OLS formulation included ln(distance band $visits_{ij}$) and ln(distance band $visits_{ij}$/population (1,000's)). Dependent variables in the Tobit model formulation were distance band $visits_{ij}$ and distance band $visits_{ij}$/capita. In all cases, "distance band visits" is the number of day or overnight trips originating from distance band i of forest j. The selected dependent variables were chosen for consistency with theory and for model computability. All models were estimated using Eviews 4.1® (Quantitative Micro Software LLC, Irvine, CA).

When using a natural logarithm dependent variable, English and Bowker (1996) added one visit to each observation to insure model computability. Attempts to make a similar adjustment in this study resulted in poorly performing models that yielded predictions of forest-level recreation use that were unrealistically low. Given this result, this adjustment was not made and zero visit observations were dropped from the OLS formulations. The impact of excluding zero visit observations from the OLS models should be minimal as the range of observed number of visits is large and there are a number of observations with low recreation use (e.g. < 250 visits). Zero visit observations are included in the Tobit model formulation and comparison of the predictive ability of between the two study models should help to identify the impact of dropping zero visit observations in the single-log OLS model.

Dependent variables for the Mid-distance segment models were constructed using the NVUM estimates of the number of forest-level day and overnight visits originating from the Mid-distance segment distance bands identified previously. In the first cycle of NVUM only respondents to the economic survey can be classified by trip-type. As such, a three-step process was required to estimate band-level recreation use for the trip-types under consideration. First, the forest-level recreation use of all trip types (day, overnight, not-primary trips) in each Mid-distance segment distance band was estimated for all forests in the study area (Appendix Table B-1). Second, the percentage of day, overnight, and not primary recreation visits for each forest-level distance band was determined from the NVUM economic subsample and the NVEXPAND weights (Appendix Tables B-2 and B-3). In several cases no economic subsample observations occurred in a given forest/distance band combination. In these cases, the regional trip-type percentages for the distance band were substituted. Third, forest-level visit estimates by trip-type and band were computed as the product of the forest-level visit estimate obtained in step one and the trip-type percentages obtained in step two (Appendix Tables B-4 and B-5).

The forest-level recreation use of Mid-distance day trip visitors (MDD_j) and Mid-distance overnight trip visitors (MDO_j) in Region 2 was modeled as:

$$MDD_j = F(Pop_{ij}, D_{ij}, I_{ij}, SNF_{ij}, SBLM_{ij}, SNPS_{ij}, RUC_{ij}, A_j, U_j)$$

$$MDO_j = F(Pop_{ij}, D_{ij}, I_{ij}, SNF_{ij}, SBLM_{ij}, SNPS_{ij}, RUC_{ij}, A_j, U_j),$$

respectively. Likewise, the forest-level recreation use of Mid-distance day trip visitors (MDD_j) and Mid-distance overnight trip visitors (MDO_j) in Region 9 was modeled as:

$$MDD_j = F(Pop_{ij}, D_{ij}, I_{ij}, SNF_{ij}, SNPS_{ij}, RUC_{ij}, A_j, U_j),$$

$$MDO_j = F(Pop_{ij}, D_{ij}, I_{ij}, SNF_{ij}, SNPS_{ij}, RUC_{ij}, A_j, U_j),$$

respectively. Independent variables include the population in band i of forest j (Pop_{ij}), the maximum distance from band i to forest j (D_{ij}), the median income of band i of forest j (I_{ij}), the distance to the nearest other national forest land of band i of forest j (SNF_{ij}), the straight-line distance to the nearest BLM land of band i of forest j ($SBLM_{ij}$), the straight-line distance to the nearest NPS land of band i of forest j ($SBLM_{ij}$), the Rural Urban Continuum (RUC) code of band i of forest j (RUC_{ij}), the acreage of forest j (A_j), and the number of major separate units on forest j (U_j). The independent variables for each distance band are computed by aggregating the respective values of all census block groups located within each distance band. Additionally, band values for variables I_{ij}, SNF_{ij}, $SBLM_{ij}$, $SNPS_{ij}$, and RUC_{ij} were computed by weighting each census block group observation by the census block group population—forming population-weighted band values for these variables.

The sources of data for the independent variables are as follows. Census block group population estimates and median income figures were obtained from the U.S.

Census Bureau (2004a). Distances from each census block group centroid to the nearest other national forest land[15], the nearest BLM land, and the nearest NPS land were determined using ArcView 3.2a based upon the spatial datasets obtained from the sources identified in Table 6. The RUC codes for each census block group were determined from the database of county-level RUC codes developed by Beale (2004). Each census block group is located within a single county. RUC codes quantify the rurality of individual counties based upon: 1) whether the county is classified as a metropolitan area by the Office of Management and Budget, 2) whether it is adjacent to a metropolitan area if a non-metropolitan area, and 3) the county's urban population. Increasing RUC values indicate increasing rurality.[16] The acreages of individual national forests were obtained from the USDA FS 2004 Land Areas Report (USDA FS, 2004). The number of separate units was determined based upon a subjective count of the number of major spatial units managed by each forest. For example, the number of separate units managed by the Hiawatha NF is two while the number of separate units managed by the Arapaho-Roosevelt NF is one.

Table 6. Spatial data sources for publicly-owned land.

Land Agency	Data Source
USDA Forest Service	USDA FS, 2000
National Park Service	NPS, 2002
Bureau of Land Management	National Atlas of the U.S., 2005

[15] National forests located in regions other than the study region were included in this computation.
[16] RUC code was included in the models as a continuous variable. Inclusion of RUC as a dummy variable (1 = metropolitan area) yielded equivalent results.

Evaluation of Model Predictive Ability

The predictive ability of Local and Mid-distance recreation use models were evaluated in three tiers. First, the model predictions of forest-level recreation use for each segment (i.e. Local and Mid-distance segments) were compared to the NVUM estimates of forest-level recreation use for those segments. Second, the summed model predictions of forest-level Local and Mid-distance recreation use were compared to the NVUM estimates of Local and Mid-distance recreation use. Finally, the forest-level percentages of Local recreation use (as a function of predicted Local and Mid-distance recreation use) were compared to the forest-level NVUM estimates of the percentage of Local recreation use (as a function of the NVUM estimates of Local and Mid-distance recreation use).

NVUM offers a clear advantage over previous USDA visitor sampling programs in that it is implemented on all forests in the NFS via a consistent approach. Additionally, the visitor survey data collected via the NVUM process represent the most comprehensive USDA FS visitor survey dataset available to date. However, the dispersed nature of USDA FS recreation use, the large land areas managed, and the number of access points to individual national forests make USDA FS visitor sampling challenging. Ultimately, the NVUM recreation use figures are estimates of actual visitation, the accuracy of which is dependent upon the appropriateness of the sampling design and application of the visitor sampling protocols.

The accuracy of NVUM forest-level recreation use estimates for particular groups of recreationists (e.g. Locals, snowmobilers, visitors from a given distance band, etc) are particularly dependent upon the ability of NVUM to obtain surveys from visitors in those groups and the appropriateness of weights to expand those samples of visitors to total recreation use. Failure to obtain surveys from visitors in certain visitor groups may lead to recreation use estimates that appear unreasonably low. For example, since no snowmobilers were surveyed on the Huron-Manistee NF (located in the northern lower peninsula of Michigan) the NVUM recreation use estimate for that national forest indicates there was no snowmobile recreation use during the NVUM sample year. Conversely, obtaining a large number of surveys from individuals in a given visitor group may lead to recreation use estimates that seem questionably high. Biases in the obtaining representative visitor samples could influence the estimates of distance-based segment use for individual national forests.

Stynes and others (2003) have raised concerns as to whether the NVEXPAND weights (employed to estimate total recreation use) are appropriate when applied to visitor characteristics (including group membership). Of particular concern is the potential for individual respondents with high NVEXPAND weights to exert undue influence over results of analyses of visitor characteristics (including the recreation use of visitor groups) (Stynes et al., 2003). The influence that individual observations with large NVEXPAND weights have over the results increases as sample sizes decrease. The potential impacts from observations with large NVEXPAND weights (if they occur) will primarily influence estimation of the recreation use models—when a small number of cases are used to identify recreation use by distance band.

Despite the potential limitations, NVUM recreation use estimates are the only comprehensive set of USDA FS recreation use figures obtained via a consistent national-level program. As such, the NVUM use figures are deemed the best figures to evaluate the ability of the constructed models to predict distance-segment recreation use. In all evaluations, statistical uncertainty in the NVUM use figures is reflected in the 80% confidence intervals constructed around the estimates.

NVUM estimates of forest-level Local recreation use range from 57,000 to 2 million visits in Region 2 and from 79,000 to 727,000 visits in Region 9 (Table 7). The forest-level estimates of Local visitor recreation use were obtained via a multi-step process. This is required because the published NVUM estimates of forest-level recreation use differ from recreation use estimates obtained by using the NVUM survey data and NVEXPAND weights alone. First the forest-level recreation use associated with visitors of known origin not engaged in downhill skiing and recreating on national forest land (termed "modeled recreation use") were estimated for each study area forest (Appendix Table B-6). These figures were estimated by multiplying the published NVUM estimates of forest-level recreation use by the NVEXPAND weighted percentage of NVUM survey respondents meeting the modeled recreation use criteria on each forest. Next, the forest-level modeled recreation use figures were multiplied by the

NVEXPAND weighted percentage of NVUM survey respondents classified in the Local visitor segment on each forest (Appendix Table B-7).

Table 7. NVUM Estimates of Local Visitor Recreation Use for USDA FS Regions and National Forests (NF) in the Study Area.

	NVUM Estimate	Lower Estimate	Upper Estimate
Bighorn NF	273,995	198,388	355,876
Black Hills NF	506,796	398,248	622,623
Grand Mesa, U.,G. NF	1,388,635	953,697	1,848,310
Medicine Bow NF	288,978	236,296	345,489
Nebraska NF	56,678	40,789	74,836
Pike San Isabel NF	2,045,153	1,714,877	2,389,610
Routt NF	587,221	501,804	679,250
Shoshone NF	258,705	214,246	306,760
White River NF	1,279,373	1,171,184	1,392,239
Region 2	**6,821,822**	**6,333,542**	**7,321,118**
Allegheny NF	555,824	381,840	744,479
Chequamegon-Nicolet NF	595,152	389,868	822,667
Chippewa NF	726,966	592,578	872,045
Hoosier NF	365,668	295,388	440,773
Huron-Manistee NF	212,354	129,357	307,506
Mark Twain NF	412,738	350,419	477,656
Monongahela NF	262,522	214,339	314,594
Ottawa NF	78,848	61,991	97,583
Shawnee NF	316,315	270,318	365,126
Wayne NF	248,914	200,208	301,341
Region 9	**4,102,540**	**3,734,356**	**4,480,997**

In addition to statistical uncertainty in the forest-level estimates of total recreation use, there is also statistical uncertainty in the forest-level estimates of Local recreation use. The error in this use estimate is a combination of error in estimating total recreation use (estimated by NVUM personnel) and error in estimating the percentage of forest-level recreation use associated with Local visitors. Confidence intervals (at the 80%

level) around the percentages of forest-level Local visitor recreation use were computed as

$$p \pm 1.2817 * \sigma_p ,$$

where p = the sample estimate of the percentage and σ_p is the standard error of the Local percentage:

$$\sigma_p = \sqrt{\frac{p(1-p)}{N}} .$$

The upper estimates of forest-level Local recreation use (Table 7) were obtained by multiplying the upper estimates of total recreation use (Appendix Table B-6) by the upper estimates of the forest-level Local percentage (Appendix Table B-7). Likewise, the lower estimates of forest-level Local recreation use (Table 7) were obtained by multiplying the lower estimates of modeled recreation use (Appendix Table B-6) by the lower estimates of the forest-level Local percentage (Appendix Table B-7).

Forest-level estimates of Mid-distance recreation use were computed following the same approach as above with one addition. The models developed to predict Mid-distance recreation use exclude "not primary" recreation use. To be consistent, estimates of forest-level Mid-distance recreation use also exclude not-primary recreation use (Table 8). Specifically, forest-level estimates of modeled recreation use (Appendix Table B-6) were multiplied by forest-level estimates of the percentage of Mid-distance use and by the forest-level estimates of Mid-distance "primary purpose" recreation use (Appendix Table B-8). Upper and lower percentage estimates were not constructed around the percentages of "primary purpose" recreation use.

Table 8. NVUM Estimates of Mid-distance Visitor Use for Regions and National Forests (NF) in the Study Area.[a]

	NVUM Estimate	Lower Estimate	Upper Estimate
Bighorn NF	99,692	68,193	135,990
Black Hills NF	27,680	15,875	42,481
Grand Mesa, U.,G. NF	312,161	199,280	442,999
Medicine Bow NF	177,220	142,030	215,708
Nebraska NF	32,674	22,516	44,637
Pike San Isabel NF	179,644	130,947	235,966
Routt NF	392,194	328,547	461,412
Shoshone NF	53,634	39,561	69,781
White River NF	702,753	631,665	777,533
Region 2	**1,969,848**	**1,790,973**	**2,156,547**
Allegheny NF	340,138	227,368	466,716
Chequamegon-Nicolet NF	833,607	556,978	1,131,889
Chippewa NF	442,223	349,658	544,799
Hoosier NF	126,631	94,776	162,927
Huron-Manistee NF	456,977	292,176	634,072
Mark Twain NF	55,123	41,207	71,043
Monongahela NF	246,185	203,838	291,264
Ottawa NF	32,836	25,618	40,898
Shawnee NF	133,763	109,090	160,889
Wayne NF	130,716	100,655	164,355
Region 9	**3,000,003**	**2,720,308**	**3,288,796**

[a] Day and overnight primary purpose visits only

The NVUM estimates of forest-level total Local and Mid-distance recreation use (Table 9) were calculated as the sum of the NVUM estimates of Local and Mid-distance recreation use (the "NVUM estimate" columns only) in Tables 9 and 10. The upper and lower estimates around these values figures were calculated using the forest-level 80% error rates reported by NVUM personnel. Finally, the NVUM estimates of the forest-level percentages of Local use (Table 10) were obtained by dividing the NVUM estimates of Local use (Table 7) by the NVUM estimates of summed Local and Mid-distance recreation use (Table 9). No confidence intervals were constructed around these estimates.

Table 9. NVUM Estimates of Summed Local and Mid-distance Recreation Use.[a]

	NVUM Estimate	Lower Estimate	Upper Estimate
Bighorn NF	99,692	68,193	135,990
Black Hills NF	27,680	15,875	42,481
Grand Mesa, U.,G. NF	312,161	199,280	442,999
Medicine Bow NF	177,220	142,030	215,708
Nebraska NF	32,674	22,516	44,637
Pike San Isabel NF	179,644	130,947	235,966
Routt NF	392,194	328,547	461,412
Shoshone NF	53,634	39,561	69,781
White River NF	702,753	631,665	777,533
Region 2	**1,969,848**	**1,790,973**	**2,156,547**
Allegheny NF	340,138	227,368	466,716
Chequamegon-Nicolet NF	833,607	556,978	1,131,889
Chippewa NF	442,223	349,658	544,799
Hoosier NF	126,631	94,776	162,927
Huron-Manistee NF	456,977	292,176	634,072
Mark Twain NF	55,123	41,207	71,043
Monongahela NF	246,185	203,838	291,264
Ottawa NF	32,836	25,618	40,898
Shawnee NF	133,763	109,090	160,889
Wayne NF	130,716	100,655	164,355
Region 9	**3,000,003**	**2,720,308**	**3,288,796**

[a] Mid-distance recreation use includes only primary purpose visits.

Table 10. NVUM Estimates of the Percentage of Local Visitor use as a Function of Summed Local and Mid-distance Use.

	NVUM
Bighorn NF	73%
Black Hills NF	95%
Grand Mesa, U.,G. NF	82%
Medicine Bow NF	62%
Nebraska NF	63%
Pike San Isabel NF	92%
Routt NF	60%
Shoshone NF	83%
White River NF	65%
Region 2	78%
Allegheny NF	62%
Chequamegon-Nicolet NF	42%
Chippewa NF	62%
Hoosier NF	74%
Huron-Manistee NF	32%
Mark Twain NF	88%
Monongahela NF	52%
Ottawa NF	71%
Shawnee NF	70%
Wayne NF	66%
Region 9	58%

CHAPTER 4

RESULTS AND DISCUSSION

Introduction

Results of analyses undertaken to achieve the objectives identified in Chapter 1 are detailed in this chapter. The first half is devoted to characterizing the recreation characteristics of Local, Mid-distance, and Long-distance visitors (Objective 1). Included in this portion of the chapter are the results from statistical comparisons between study regions and between the distance segments (Objectives 2 and 3). The second half of the chapter focuses on the models developed to predict the recreation use of Local and Mid-distance visitors in USDA FS Regions 2 and 9 (Objective 4). The parameters and performance of the constructed models are described in detail.

Characteristics of Distance Segmented Visitors

Segmentation of NVUM Survey Respondents

Of the 19,146 respondents sampled under NVUM in USDA FS regions 2 and 9, 39% (7,378) were classified as Local visitors, 27% (5,210) as Mid-distance visitors, and 20% (3,788) as Long-distance visitors (Table 11). Greater percentages of survey respondents in Region 2 are classified as Local or Long-distance visitors compared to

Region 9. Correspondingly, a greater percentage of survey respondents are Mid-distance visitors in Region 9. Nationwide, approximately 14% of NVUM survey respondents failed to report the ZIP code of their permanent residence or reported an invalid ZIP code. Consistent with this, 14% of non-foreign NVUM survey respondents (2,770) sampled in the study area failed to report a valid ZIP code (or reported an invalid ZIP code). These respondents are categorized as "missing" and excluded from further analysis. NVUM survey respondents originating from foreign countries are classified as Long-distance visitors.

Table 11. Number of NVUM Survey Respondents by Distance Segment and USDA FS Study Region.

	Region 2		Region 9		Total	
Distance Segment	Full Sample	Economic Sample	Full Sample	Economic Sample	Full Sample	Economic Sample
Missing	1,304	79	1,466	62	2,770	141
Local	4,246	1,151	3,132	789	7,378	1,940
Mid-dist.	1,938	530	3,272	878	5,210	1,408
Long-dist.	2,705	691	1,083	299	3,788	990
Total	10,193	2,451	8,953	2,028	19,146	4,479

Objectives 1 through 3 relate to characterizing visitors within the distance segments and completing statistical comparisons. Statistical comparisons are completed between study regions, within segments, and between the distance segments themselves within study regions. Regional comparisons of distance segments are presented first followed by comparisons between segments.

Regional Comparisons within Segments

Local visitors comprise the largest share of total recreation use in both regions—53% in Region 2 and 49% in Region 9 (Table 12).[1] In Region 9, 42% of total recreation use is associated with Mid-distance visitors, substantially greater than the 21% in Region 2. Conversely, Long-distance visitors account for 27% of all use in Region 2 and only 9% of visitation to Region 9 national forests.

Table 12. Percent of Total Recreation Use by Distance Segment and USDA FS Study Region.[a]

	Region 2	Region 9
Local	53%	49%
Mid-distance	21%	42%
Long-distance	27%	9%
Total	100%	100%

[a] Estimated based upon the full NVUM survey sample and NVEXPAND weights.

Differences between regions in the percentages of Mid-distance and Long-distance visitors may be explained, in part, by three factors. First, the populations surrounding national forests in Region 9 are greater and more uniformly spatially distributed than populations around Region 2 national forests—thereby creating a greater number of potential Mid-distance visitors. Second, the unique natural features located in and around Region 2 national forests, particularly those located in Colorado, attract a greater number recreation users traveling more than 200 miles from home. In particular, opportunities for downhill skiing attract a significant number of these visitors. Downhill

[1] Removing skiers, Local visitation represents 63% of use in Region 2 and 50% of use in Region 9. These non-skier shares are consistent with Figure 3 in Chapter 3.

skiers account for approximately 10.7 million visits to Region 2 national forests with more than 40% of these visitors traveling greater than 200 miles to reach the forest. In Region 9, only 320,000 visits are made primarily for downhill skiing; of those visits, only 4% resulted in travel of more than 200 miles from home. Third, Region 2 forests likely receive more visitors traveling through the area on their way elsewhere (e.g. traveling to the western U.S.) than Region 9 forests.

Three types of recreation trips are recognized in this study: day trips (Day), trips involving an overnight stay either on the national forest or off the national forest (OVN/OVNNF), and trips where the primary purpose was something other than recreating on the national forest (Not Primary). Aggregating across distance segments, a significant difference exists between study regions in frequency of trip-type (Table 13).[2] Within distance segments, a statistical difference betweens study regions in trip type frequency exists only for the Mid-distance segment.

In both regions, 72% of Local visits are day trips. Overnight trips represent about 25% of visits while "not primary" trips comprise only a very small percent of all visits. Trip-type propensity is nearly identical between study regions. Mid-distance recreation use most frequently involves an overnight stay away from home (Table 13). However, approximately 20% of Mid-distance visits in each study region are day trips. Compared to Local visits, Mid-distance visits are more frequently "not primary" trips.

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[2] Detailed statistical tables for all statistical tests in this Chapter are available from the author.

Table 13. Trip-type Segment Shares by Distance Segment and USDA FS Study Region.[a]

		Day	OVN/OVNNF[b]	Not Primary[c]	Total	P-value[d]
Local	Region 2	72%	24%	3%	100%	0.77
	Region 9	72%	25%	4%	100%	
Mid-dist.	Region 2	24%	66%	11%	100%	0.01
	Region 9	17%	70%	14%	100%	
Long-dist.	Region 2	8%	59%	34%	100%	0.60
	Region 9	6%	60%	34%	100%	
Total	Region 2	46%	42%	12%	100%	0.00
	Region 9	40%	48%	12%	100%	

[a] Estimated based upon the economic NVUM economic sample and ExpWt.
[b] Recreation trips involving an overnight stay in the local forest area or on the national forest.
[c] Trips not made primarily to recreate on the national forest.
[d] Statistical comparisons between regions within distance segments were completed using contingency table analysis.

The majority of Long-distance visits in both regions are classified as Overnight trips. In both study regions, "Not Primary" trips comprise 34% of Long-distance visitor recreation use. In NVUM year 4, survey respondents were asked to identify the primary reason of their trip away from home.[3] In Region 2, 74% of "Not Primary" Long-distance visitors reported "visiting other recreation areas" as the primary purpose of being away from home. "Not Primary" Long-distance visitors in Region 9 more commonly cited "business and family" (35%) as their primary trip purpose than the same visitors in Region 2.

Given differences (both statistical and practical) between study regions in the distribution of trip-types within the three distance segments, statistical tests of regional

[3] NVUM survey forms are available from Susan Kocis, Field Coordinator National Visitor Use Monitoring Program, USDA Forest Service.

differences in segment characteristics were completed incorporating trip-types using only the NVUM economic sub-sample (Tables 14 and 15). For the most part, after controlling for differences in distance segment and trip type, visitors to national forests in USDA FS Regions 2 and 9 have recreation behaviors that are not statistically different.

The greatest number of statistical differences between study regions occurs in the Local visitor segment. Local visitors in the two regions differ in the number of annual visits, the duration of the national forest visit, the number of people per vehicle and national forest arrival day. Across all trip-types, Local visitors in Region 2 complete fewer annual visits than those in Region 9 (Table 14).[4] Region 2 Local visitors on day trips spend a longer period on the national forest and recreate in smaller parties. On overnight trips, Local visitors in Region 2 spend a shorter period of time on-forest than their Region 9 counterparts.[5] Lastly, Local day trip visitors in Region 2 tend to visit more frequently throughout the week than their Region 9 counterparts (Table 15).

The difference in annual visitation rates between study regions is slight. This difference may be largely driven by the spatial arrangement of populations around national forests in the study regions. In Region 9, a slightly greater percentage of total Local segment use is associated with visitors living within 10 miles of the national forest boundary than in Region 2 (76% compared to 68%).[6] Assuming that those living farther

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[4] Annual visit median values for Local visitors in Regions 2 and 9 are 2.0 and 3.0, respectively

[5] On-forest duration statistics are likely influenced by the ability of NVUM survey respondents to identify and differentiate lands managed by the USDA FS.

[6] Based upon NVUM sample of Local visitors and NVEXPAND weights.

Table 14. Mean Values for Visitor Characteristics of Interest by distance Segment, Trip-type, and USDA FS Region.

Distance Segment	Trip type	Study Region	Annual visits[a]	Visit duration (hours)[b]	Number of Sites	Number of Activities	People/ Vehicle
Local	Day	2		3.0[d]	1.1[c]	3.2[c]	2.1[c]
	Day	9		2.6[d]	1.1[c]	3.1[c]	2.3[c]
	OVN/OVNNF	2		24.0[d]	1.3[c]	4.6[c]	2.5[c]
	OVN/OVNNF	9		40.2[d]	1.3[c]	4.6[c]	2.3[c]
	Not primary	2		2.6[f]	1.3[f]	4.2[f]	2.2[c]
	Not primary	9		3.2[f]	1.1[f]	3.4[f]	2.2[c]
	All trip-types	2	6.1[d]				
	All trip-types	9	6.0[d]				
Mid-dist.	Day	2		4.3[c]	1.1[c]	2.9[c]	2.4[c]
	Day	9		4.2[c]	1.2[c]	3.1[c]	2.2[c]
	OVN/OVNNF	2		22.2[c]	1.3[c]	4.2[c]	2.5[c]
	OVN/OVNNF	9		28.0[c]	1.4[c]	4.4[c]	2.5[c]
	Not primary	2		3.0[c]	1.3[c]	4.2[c]	2.6[c]
	Not primary	9		3.6[c]	1.3[c]	3.6[c]	2.8[c]
	All trip-types	2	2.6[c]				
	All trip-types	9	1.6[c]				
Long-dist.	Day	2		2.0[f]	1.3[f]	3.4[f]	2.4[f]
	Day	9		1.9[f]	1.3[f]	3.8[f]	1.8[f]
	OVN/OVNNF	2		5.5[c]	1.5[c]	3.9[c]	2.8[d]
	OVN/OVNNF	9		8.0[c]	1.6[c]	4.2[c]	2.5[d]
	Not primary	2		3.0[c]	1.5[c]	4.8[e]	2.5[c]
	Not primary	9		2.2[c]	1.4[c]	3.6[e]	2.4[c]
	All trip-types	2	1.6[e]				
	All trip-types	9	1.8[e]				

Note: Statistical tests completed using Mann-Whitney U, ExpWt.
[a] Not computed within trip-types since variable corresponds to previous trips of unknown type. VisExpwt used in statistical analyses,
[b] Median values reported,
[c] P-value > 0.05, no statistical difference between regions,
[d] P-value < 0.05, statistical tests between regions,
[e] P-value < 0.01, statistical tests between regions,
[f] Number of cases in at least one group is less than 30, statistical test not completed.

Table 15. Day of National Forest Arrival by Distance Segment, Trip-type, and USDA FS Region.[a]

Distance Segment	Trip-type	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	P-value
Local	Day[2]	29%	13%	7%	8%	10%	8%	24%	0.001
	Day[9]	34%	10%	5%	6%	6%	8%	33%	
	OVN/ OVNNF[2]	16%	7%	7%	6%	6%	25%	32%	0.265
	OVN/ OVNNF[9]	13%	5%	5%	9%	12%	30%	26%	
Mid-dist.	Day[2]	40%	8%	3%	6%	10%	5%	27%	0.553
	Day[9]	37%	10%	4%	4%	4%	7%	35%	
	OVN/ OVNNF[2]	17%	4%	7%	5%	10%	27%	30%	0.402
	OVN/ OVNNF[9]	12%	5%	4%	6%	11%	30%	31%	
	Not primary[2]	9%	5%	7%	14%	7%	26%	33%	0.064
	Not primary[9]	28%	8%	8%	3%	8%	14%	31%	
Long-dist.	OVN/ OVNNF[2]	15%	13%	15%	14%	8%	15%	20%	0.051
	OVN/ OVNNF[9]	14%	10%	4%	16%	14%	19%	23%	
	Not primary[2]	8%	11%	20%	20%	14%	16%	11%	0.170
	Not primary[9]	10%	10%	13%	11%	13%	18%	25%	

[a] Segment, trip-type combinations with less than 30 cases in at least one region are excluded. Statistical analysis completed using contingency table analysis and ExpWt. Comparisons between regions using exposure weights assumes there is no bias in site stratification or the propensity for visitor sampling to occur on a given day(s) between regions.
[2] Region 2.
[9] Region 9.

from national forests visit with less frequency, it is reasonable that Region 2 Local visitors, overall, would have lower mean annual visitation rates.

Mid-distance visitors in regions 2 and 9 are not statistically different (within trip-types) from one another in terms of annual visit frequency, on-forest duration, number of sites visited, number of recreation activities participated in during recreation visits, or party size (Table 14).[7] Likewise, there are no statistical differences in arrival patterns (Table 15). Statistical similarity between study regions (within this distance segment) contrasts to the commonly held perception that recreation visitor behavior (in terms of these characteristics) differs by USDA FS region. This finding is particularly important, as these visitors (non-locals, whose primary trip purpose is generally visiting the national forest) are frequently the focus of economic impact and resource valuation studies as well as analyses of management alternatives and strategies.

Across all trip-types, Long-distance segment visitors in Region 2 complete fewer national forest visits annually than comparable visitors in Region 9 (Table 14). A greater percent of Region 2 Long-distance visitors (68%) complete just one annual visit compared to Region 9 Long-distance visitors (58%).[8] It is unclear how many of the Long-distance visitors, in either region, are completing their first trip to the national forest.

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[7] Comparisons not incorporating trip-type also resulted in no statistical differences in Activity visitor characteristics between study regions.

[8] Based upon the NVUM survey sample, weighted by VisExpwt.

The prevalence of large parties among Long-distance overnight visitor groups in Region 2 leads to the statistical difference in party size between regions (Table 14). In Region 9, only 1% of recreation use in this segment/trip-type combination is associated with parties of 5 – 7 people. In Region 2, large parties represent 14% of use in this segment. Visitors in large parties in Region 2 primarily participate in general tourism-type activities such as "driving for pleasure" (52%) "nature study" (17%) or "viewing nature" (14%).[9] These large parties likely typify general tourist visitors drawn to Region 2 national forests by unique natural features as well as their proximity to urban centers and large national parks.

Within distance segments, the primary recreation activities of recreation users are largely similar between the study regions (Table 16). Across all distance segments, a substantially greater percentage of recreation use in Region 2 is associated with downhill skiing. This is expected given the renown and sheer number of ski resorts located in the national forests of Region 2. Within distance segments, Local visitors in Region 2 are more commonly engaged in downhill skiing or biking and less commonly in hunting or fishing than their Region 9 counterparts. Likewise 45% of Mid-distance visitors in Region 2 are downhill skiers compared to only 13% in Region 9. Additionally, Mid-distance visitors in Region 2 are more frequently biking and less frequently fishing, hiking, or cross-country skiing than the same visitors in Region 9. Similarly, a greater percentage of Region 2 Long-distance visitors are engaged in downhill skiing and fewer are hiking or fishing than in Region 9.

[9] Based upon NVUM survey respondents reporting between 5 – 7 people per vehicle, weighted by NVEXPAND

Table 16. Primary Activity by Distance Segment and USDA FS Region.[a]

	Local		Mid-distance		Long-distance	
	Region 2	**Region 9**	**Region 2**	**Region 9**	**Region 2**	**Region 9**
Developed Camping	2%	2%	3%	5%	2%	3%
Prim. Camping & Backpacking	2%	1%	1%	4%	0%	3%
Resort	0%	1%	0%	1%	0%	4%
Picnic	2%	3%	2%	0%	1%	1%
Nature-related	8%	7%	5%	7%	10%	13%
General/Relaxing	5%	5%	4%	6%	4%	7%
Fishing	7%	13%	3%	9%	3%	7%
Hunting	5%	13%	6%	9%	3%	5%
OHV use	3%	3%	4%	5%	1%	2%
Driving	3%	6%	2%	2%	4%	1%
Snowmobile	4%	3%	2%	3%	1%	5%
Boating	2%	1%	1%	1%	1%	1%
Hiking	19%	16%	7%	13%	11%	25%
Biking	7%	2%	6%	1%	6%	0%
Downhill skiing	14%	7%	45%	13%	45%	4%
Cross-country skiing	5%	7%	1%	8%	0%	3%
Other non-motorized	4%	3%	2%	2%	1%	2%
Other	3%	4%	1%	1%	1%	4%
No primary Activity	4%	1%	2%	3%	2%	3%
Multiple primary activities	2%	2%	3%	7%	2%	5%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

[a] Estimated from full NVUM sample, weighted by NVEXPAND.

Distance Segment Comparisons

Distance segment visitors were characterized in terms of annual visitation, visit duration, number of sites visited, number of activities, and party size (Table 17). Aggregating across trip-types, Local visitors complete a large number of national forest visits with most visits lasting less than four hours. These visitors recreate at a limited number of sites, generally participating in a moderate number of recreation activities in small recreation parties. Mid-distance visitors generally visit a given national forest up to several times a year, generally spending more than six hours on the national forest. Mid-distance visitors recreate at a greater number of sites, participate in more activities, and have larger recreation parties than Local visitors. Visitors traveling greater than 200 miles to the forest have very low annual visitation rates with on-forest durations of most visits being less than 5 hours. These visitors recreate at the greatest number of sites, participate in the greatest number of activities, and recreate in the largest visitor parties.

Table 17. Mean Values for Visitor Characteristics of Interest by Distance Segment, and USDA FS Region.

Study Region	Distance Segment	Annual visits[a]	Visit duration (hours)[b]	Number of Sites	Number of Activities	People/ Vehicle
2	Local	6.1[1]	3.8[1]	1.1[1]	3.1[1]	2.1[1]
	Mid-dist.	2.6[1]	6.6[2]	1.3[2]	2.8[2]	2.4[2]
	Long-dist.	1.6[2]	4.2[3]	1.4[3]	3.0[3]	2.9[3]
9	Local	6.0[1]	3.4[1]	1.2[1]	2.9[1]	1.9[1]
	Mid-dist.	1.6[1]	7.3[2]	1.2[2]	3.4[2]	2.4[2]
	Long-dist.	1.8[2]	4.0[1]	1.5[2]	3.9[2]	2.5[2]

Note: K-W ANOVA was used to identify statistical differences between all distance segments within regions. Mann-Whitney U was used to identify specific differences between segments. Analyses were completed using the exposure weights.
[a] Weighted by VisExpwt,
[b] Median values reported.
[1, 2, 3] Statistically different subgroups within regions.

There is a clear difference between distance segments in the number of annual visits reported (Figures 8 and 9). More than half of the Long-distance segment visitors sampled complete only one annual visit to the national forest—approximately 95% complete no more than three annual visits. Approximately 40% and 30% of Mid-distance visitors and Local visitors report only one annual visit, respectively. While both of these segments visit more often than Long-distance visitors, Local visitors more frequently complete a greater number of annual visits than Mid-distance visitors. The 95th percentile

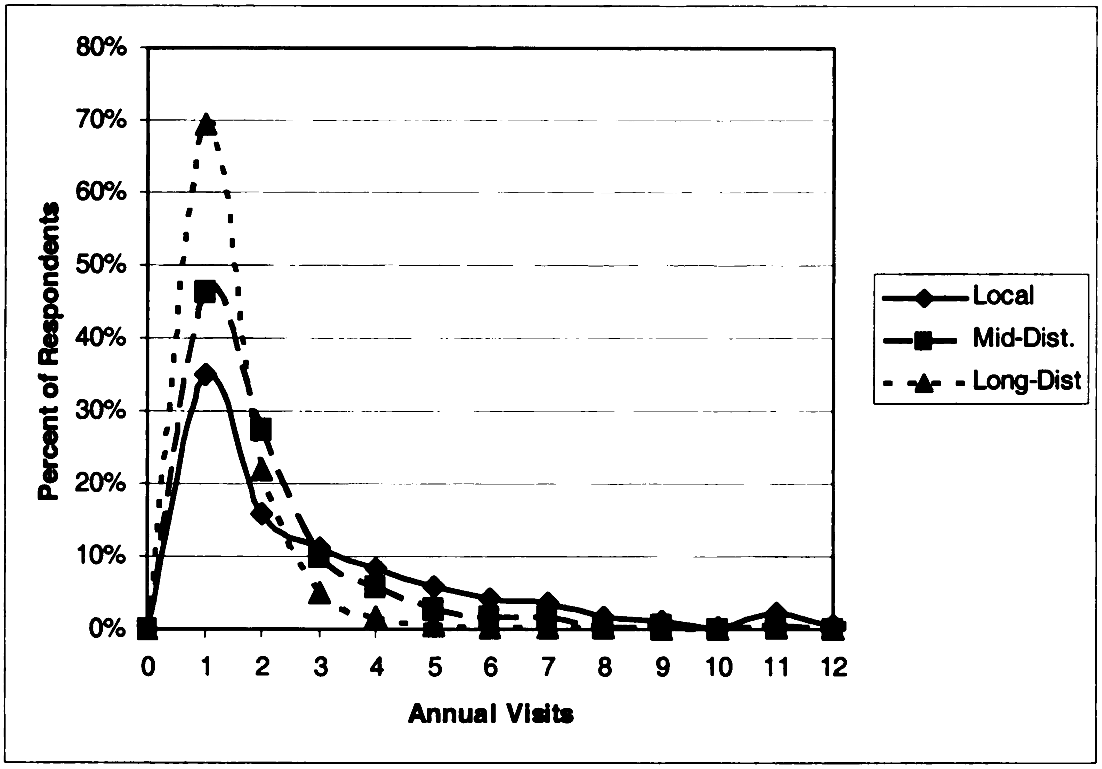

Figure 8. Distance Segment Visit Frequency, USDA FS Region 2 (Truncated at 12 Annual Visits, Exposure Weighted).

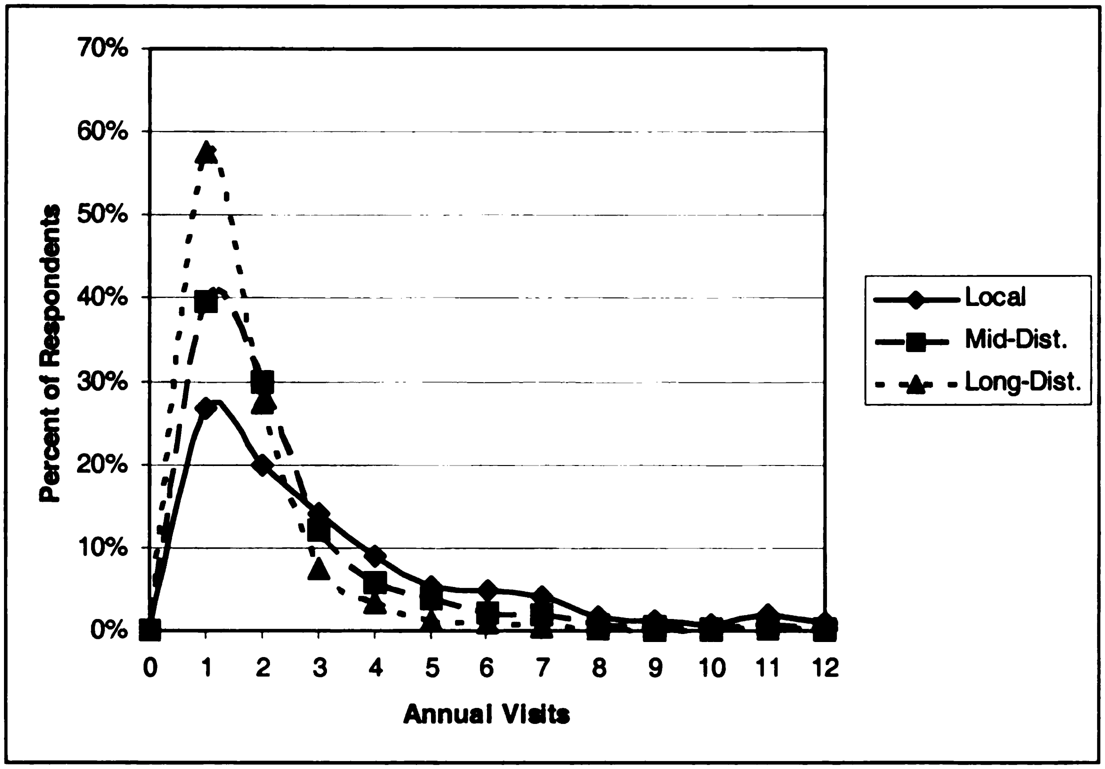

Figure 9. Distance Segment Visit Frequency, USDA FS Region 9 (Truncated at 12 Annual Visits, Exposure Weighted).

for Mid-distance visitors is seven annual visits. Comparatively, the 95th percentile for Local recreation visitors is 20 annual visits.

Within distance segments, substantial variability exists in the duration of on-forest visits. At most, the modes of visit duration for each distance segment are reported by only 19% of respondents (Figures 10 and 11). Though variability is wide, the majority of respondents report visits of 10 hours or less. Local visitors are most likely to have on-forest durations of 1 to 5 hours. Forest visits of greater than 5 hours are reported more frequently by Mid-distance and Long-distance visitors. In both regions, Long-distance visitors are more likely than visitors from the other two segments to have national forest visit durations of one hour or less.

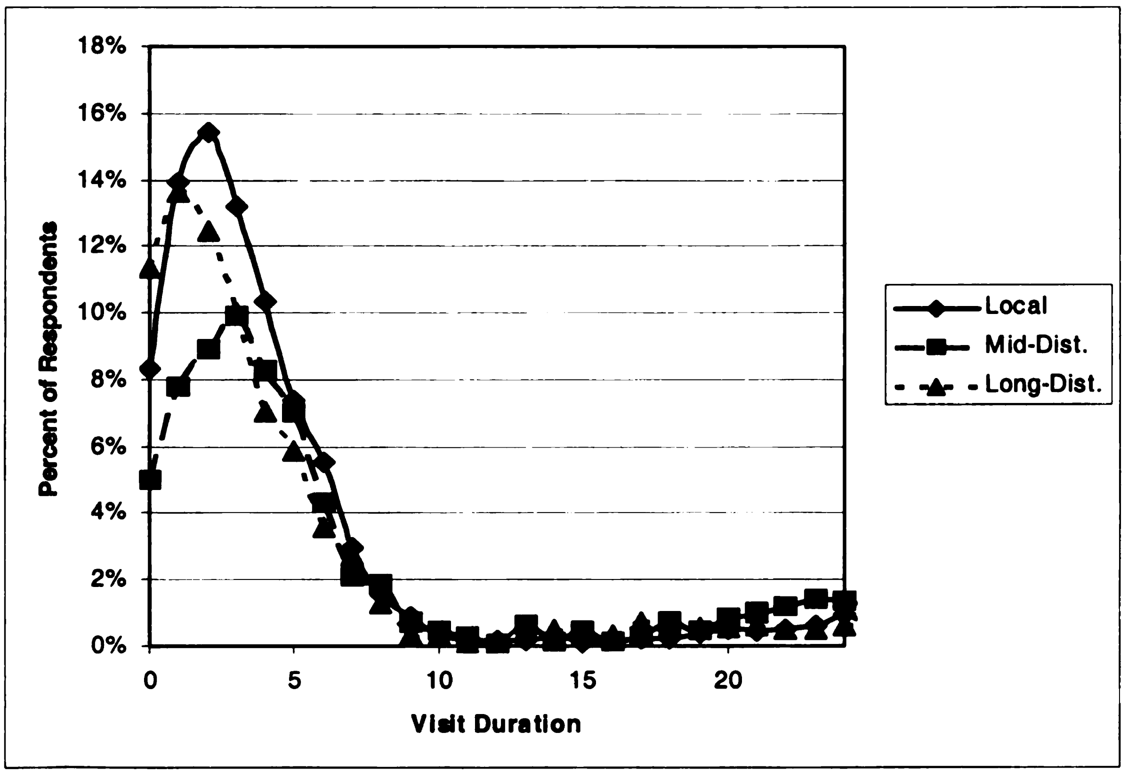

Figure 10. Duration of National Forest Visits by Distance Segments, USDA FS Region 2 (Rounded to Nearest Hour, Truncated at 24 hours, ExposureWtd.).

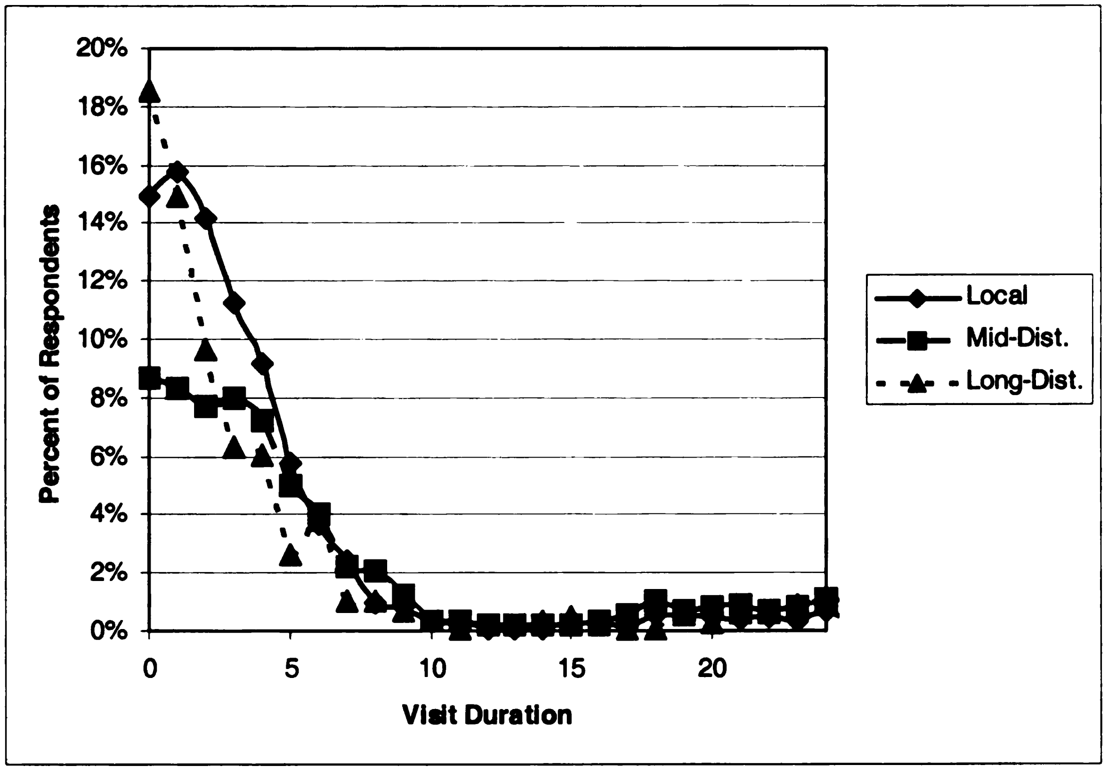

Figure 11. Duration of National Forest Visits by Distance Segments, USDA FS Region 9 (Rounded to Nearest Hour, Truncated at 24 hours, ExposureWtd.).

Compared to the divergent patterns between segments in annual visits and visit duration, the numbers of sites visited by visitors within each distance segment are quite similar (Figures 12 and 13). Approximately 90% of Local visitors in both regions visit only one recreation site or recreate only one day in the GFA. The percentages of single site visitors in the Mid-distance and Long-distance visitor segments are slightly lower. In Region 2, Long-distance visitors are more likely to visit a greater number of sites than Mid-distance visitors. In Region 9, propensity for visiting a large number of sites is similar between the two segments.

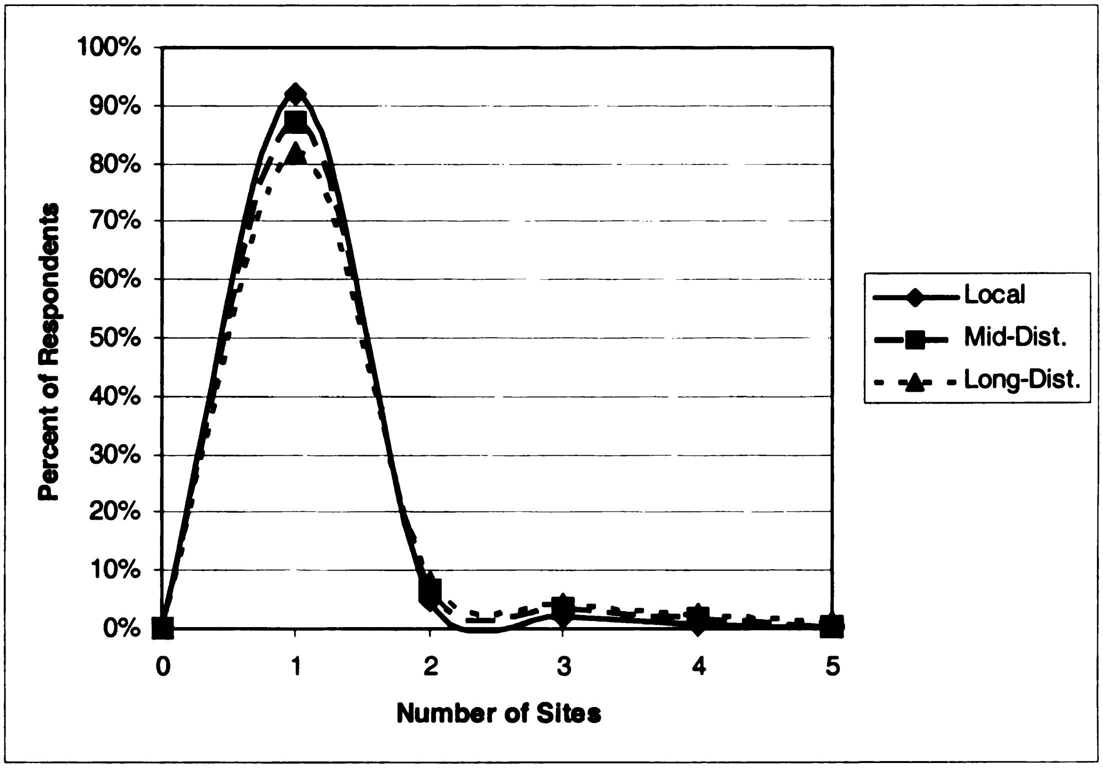

Figure 12. Number of sites (and GFA days) by Distance Visitor Segment, USDA FS Region 2 (Figure Truncated at 5 Sites, Exposure Weighted).

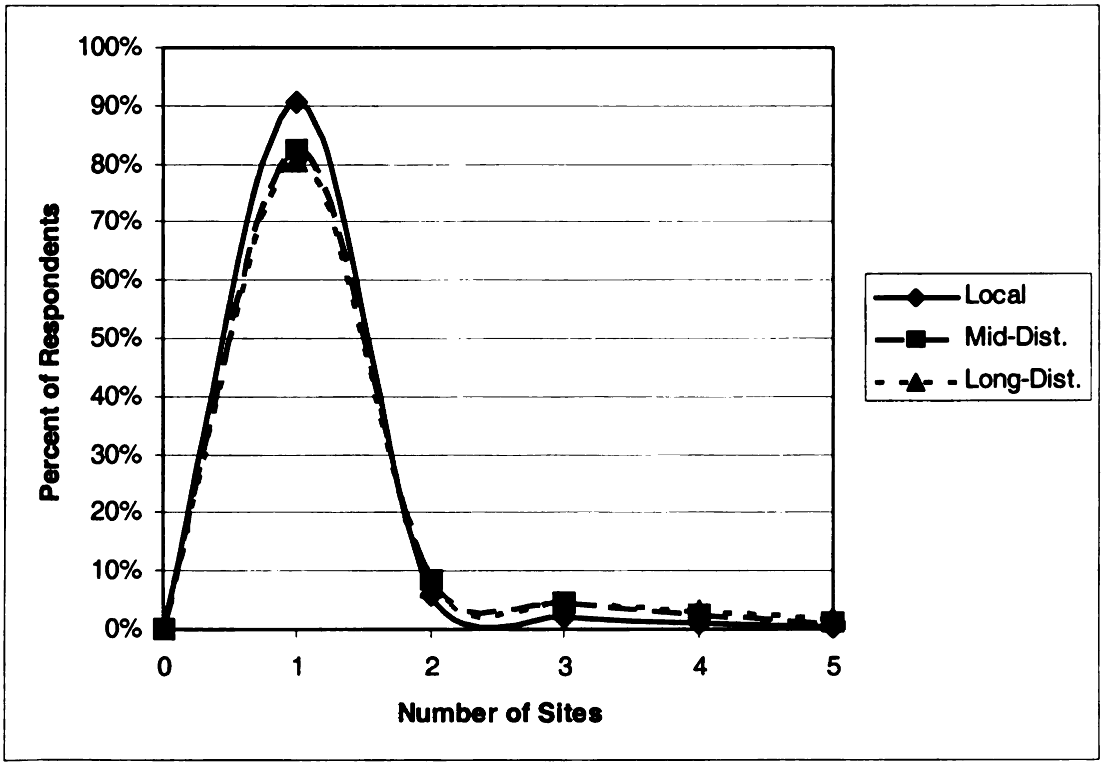

Figure 13. Number of sites (and GFA days) by Distance Visitor Segment, USDA FS Region 9 (Figure Truncated at 5 Sites, Exposure Weighted).

Mid-distance activity participation is somewhat bi-modal (Figures 14 and 15). Visitors are most likely to participate either in a single recreation activity or in 3 to 5 activities. More than four recreation activities are completed with decreased propensity—though such a pattern is most common among Long-distance visitors in Region 2 and among Mid-distance visitors in Region 9. Local visitors less frequently participate in multiple activities than visitors in other visitor segments. Local visitors may be characterized as "focused visitors", coming to the forest and participating only in one or two specific activities, while Mid-distance and Long-distance visitors more frequently participate in multiple recreation activities during a single visit.

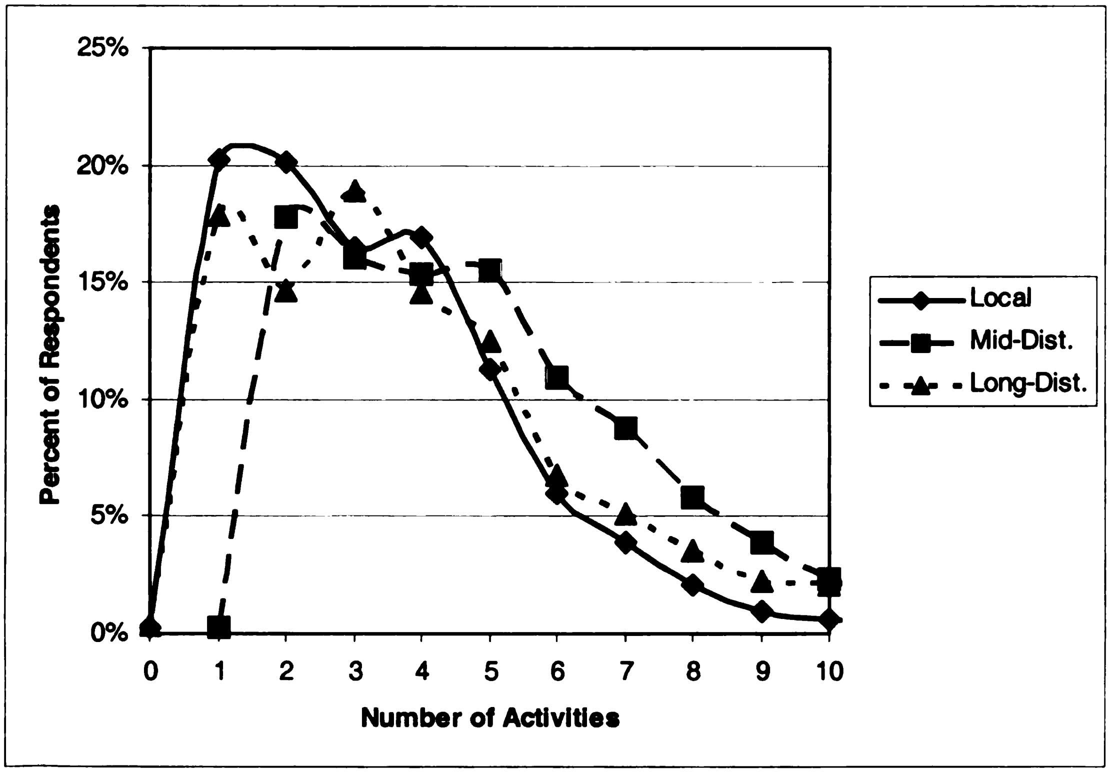

Figure 14. Number of Activities by Distance Segmented, USDA FS Region 2 (Figure Truncated at 10 Activities, Exposure Weighted).

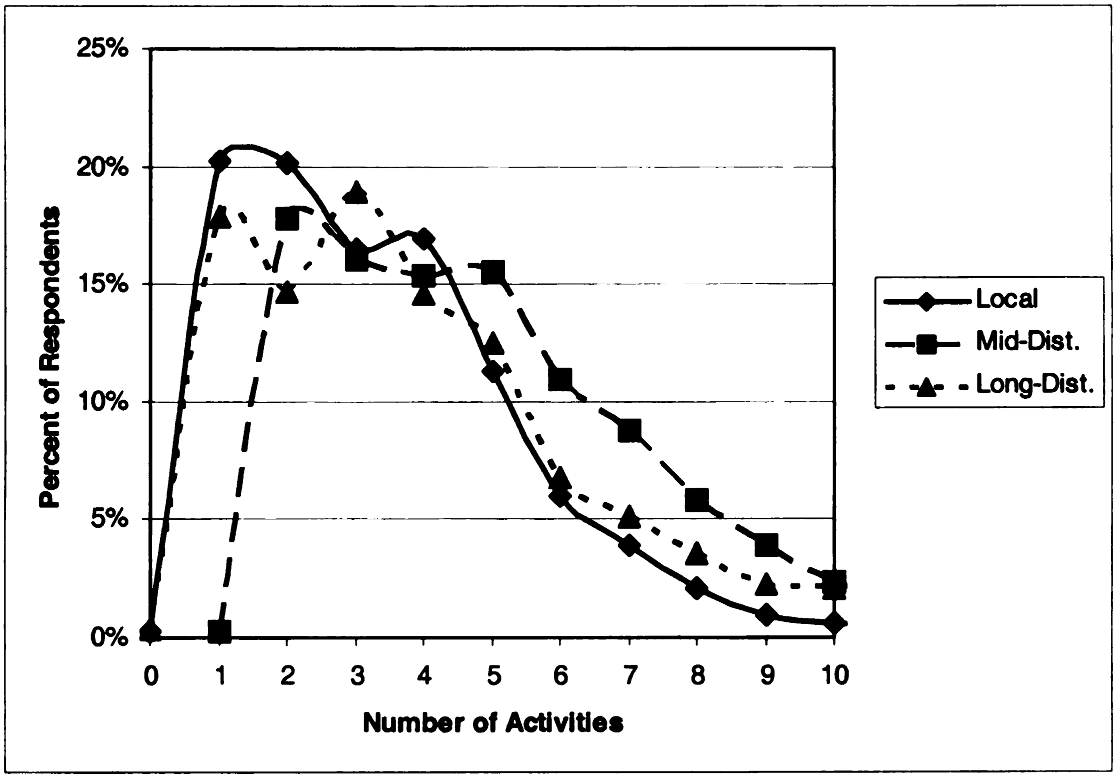

Figure 15. Number of Activities by Distance Segmented, USDA FS Region 9 (Figure Truncated at 10 Activities, Exposure Weighted).

The patterns of party size are moderately bi-modal (Figures 16 and 17). In both regions, Long-distance and Mid-distance visitors are most likely to recreate in either two or four person parties. Three person parties or parties with more than four persons are less common among these visitor segments. Local visitors are most likely to recreate in two person parties and nearly equally likely to recreate in either three or four person parties. Party sizes of more than four people are less common among this segment. Large parties of recreation users are most common in the Long-distance visitor segment.

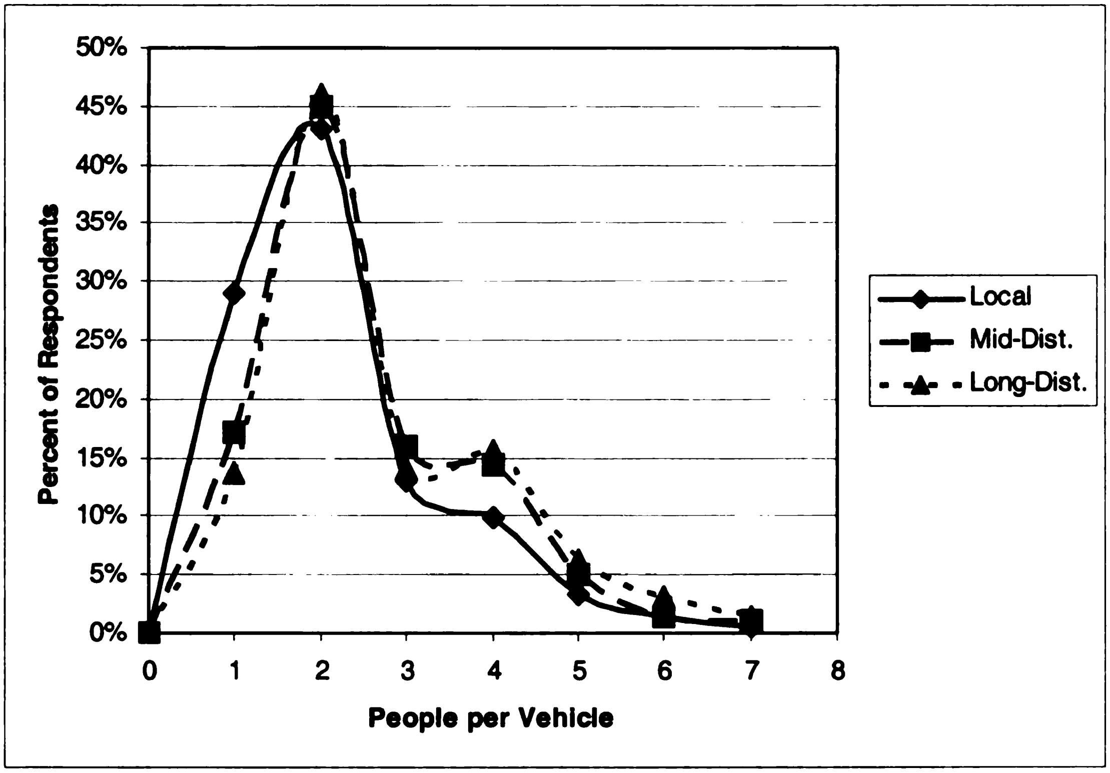

Figure 16. People per Vehicle by Distance Segment, USDA FS Region 2 (Exposure Weighted).

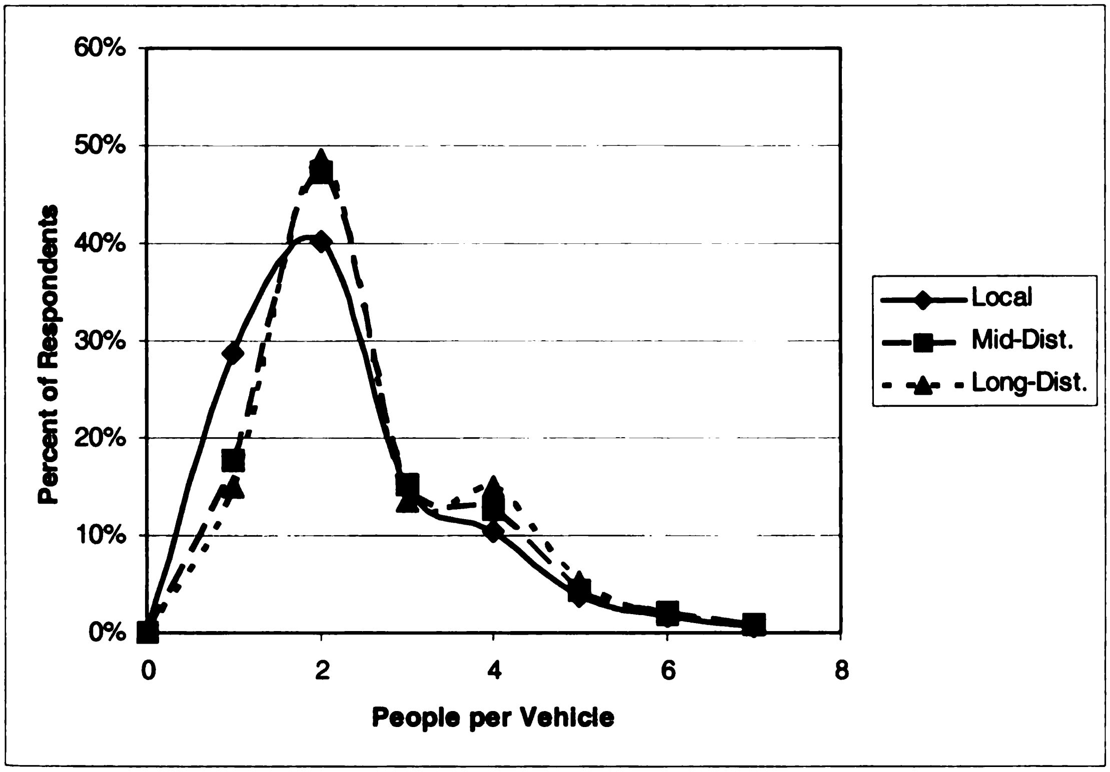

Figure 17. People per Vehicle by Distance Segment, USDA FS Region 2 (Exposure Weighted).

Across all distance segments, the greatest numbers of recreation visitors first arrive at the national forest on Friday, Saturday, or Sunday (Table 18). Arrivals on Monday, Tuesday, Wednesday, or Thursday are more common by Long-distance visitors than other distance segments. This pattern is consistent with the assumption that Long-distance recreation visitors are either on vacation or in the area for business, both likely to include weekday travel. The arrival patterns of Local and Mid-distance visitors are comparable—though Local visitors are slightly more likely to arrive at the national forest during the workweek. This similarity is contrary to the postulated characteristics identified in Chapter 3.

Table 18. Day of National Forest Arrival by Distance Segment and USDA FS Region.[a]

Study Region	Distance Segment	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Total	P-value
Region 2	Local	25%	11%	7%	8%	9%	15%	25%	100%	0.000
	Mid-dist.	21%	7%	7%	6%	10%	23%	26%	100%	
	Long-dist.	15%	12%	16%	14%	11%	15%	17%	100%	
Region 9	Local	27%	8%	5%	7%	8%	15%	31%	100%	0.000
	Mid-dist.	19%	6%	5%	6%	9%	24%	30%	100%	
	Long-dist.	15%	10%	11%	11%	11%	20%	23%	100%	

[a] Statistical analysis completed using contingency table analysis and ExpWt's. Comparisons between regions using exposure weights assumes there is no bias in site stratification or the propensity for visitor sampling to occur on a given day(s) between regions.

In Region 2, greater percentages of Local visitors engage in hunting, fishing, and hiking than visitors within other Region 2 distance segments (Table 19). More of these visitors recreate on the national forest with no particular primary activity. Local visitors in Region 9 are more commonly hunting, fishing, or "driving for pleasure" than other distance segments in the region. Mid-distance visitors in both regions are more likely to be camping, operating OHV's, and downhill skiing than others. In both regions, Long-distance visitors are more commonly completing "nature-related" activities. In Region 2, these visitors more frequently are "driving for pleasure" than other segments while in Region 9 they are more commonly hiking, snowmobiling, or using resorts than other segments.

Table 19. Primary Activity by Distance Segment and USDA FS Region.[a]

	Region 2			Region 9		
	Local	Mid-dist.	Long-dist.	Local	Mid-dist.	Long-dist.
Developed Camping	2%	3%	2%	2%	5%	3%
Primitive Camping & Backpacking	2%	1%	0%	1%	4%	3%
Resort	0%	0%	0%	1%	1%	4%
Picnic	2%	2%	1%	3%	0%	1%
Nature-related	8%	5%	10%	7%	7%	13%
General/Relaxing	5%	4%	4%	5%	6%	7%
Fishing	7%	3%	3%	13%	9%	7%
Hunting	5%	6%	3%	13%	9%	5%
OHV use	3%	4%	1%	3%	5%	2%
Driving	3%	2%	4%	6%	2%	1%
Snowmobile	4%	2%	1%	3%	3%	5%
Boating	2%	1%	1%	1%	1%	1%
Hiking	19%	7%	11%	16%	13%	25%
Biking	7%	6%	6%	2%	1%	0%
Downhill skiing	14%	45%	45%	7%	13%	4%
Cross-country skiing	5%	1%	0%	7%	8%	3%
Other non-motorized	4%	2%	1%	3%	2%	2%
Other	3%	1%	1%	4%	1%	4%
No primary activity	4%	2%	2%	1%	3%	3%
Multiple primary activities	2%	3%	2%	2%	7%	5%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

[a] Estimated from full NVUM sample, weighted by NVEXPAND.

The most marked differences between distance segments occur in trip-type frequency (Table 20). Local visitors generally recreate on day trips and less commonly on overnight trips. "Not primary" trips are rare for this visitor segment. Mid-distance visitors most commonly complete overnight trips, recreating less commonly on day trips and infrequently on "Not primary" trips. Very few Long-distance visitors complete primary purpose day trips, instead taking a large number of "Not primary". These differences are marked and consistent with the expectations identified in Chapter 3.

Table 20. Trip-type Segment Shares by Distance Segment and USDA FS Study Region.[d]

		Day	OVN/OVNNF[e]	Not Primary[f]	Total
Region 2	Local[a]	72%	24%	3%	100%
	Mid-dist.[b]	24%	66%	11%	100%
	Long-dist.[c]	8%	59%	33%	100%
Region 9	Local[a]	72%	25%	4%	100%
	Mid-dist.[b]	17%	70%	14%	100%
	Long-dist.[c]	6%	62%	33%	22%

[a, b, c] Statistically different subgroups within regions.
[d] Estimated based upon the NVUM economic survey subsample. ExpWt's applied. Statistical comparisons between regions within distance segments were completed using contingency table analysis.
[e] Recreation trips involving an overnight stay in the local forest area or on the national forest.
[f] Trips not made primarily to recreate on the national forest.

Within trip-types, the characteristics of visitors in distance segments are less frequently statistically different (Table 21). Statistical differences between distance segments remain for visit duration and the number of people per vehicle when accounting for trip-type. For the most part, patterns of site use and the number of activities are statistically similar across segments within trip-types.

Table 21. Mean Values for Visitor Characteristics of Interest by Distance Segment, Trip-type, and USDA FS Region.

Trip Type	Region	Distance Segment	Visit duration (hours)[a]	Number of Sites	Number of Activities	People/ Vehicle
Day	Region 2	Local	3.0[1]	1.1[1]	3.2[1]	2.1[1]
		Mid-dist.	4.3[2]	1.1[1]	2.9[1]	2.4[2]
		Long-dist.	2.0[a]	1.3[1]	3.4[1]	2.4[1,2]
	Region 9	Local	2.6[1]	1.1[1]	3.1[1]	2.3[1]
		Mid-dist.	4.2[2]	1.2[1]	3.1[1]	2.2[1]
		Long-dist.	1.9[a]	1.3[a]	3.8[a]	1.8[a]
OVN/OVNNF	Region 2	Local	24.0[1]	1.3[1]	4.6[1]	2.5[1]
		Mid-dist.	22.2[1]	1.3[1]	4.2[2]	2.5[1]
		Long-dist.	5.5[2]	1.5[1]	3.9[2]	2.8[2]
	Region 9	Local	40.2[1]	1.3[1]	4.6[1]	2.3[1]
		Mid-dist.	28.0[2]	1.4[1]	4.4[1]	2.5[2]
		Long-dist.	8.0[3]	1.6[1]	4.2[1]	2.5[12]
Not primary	Region 2	Local	2.6[a]	1.3[1]	4.2[1]	2.2[1]
		Mid-dist.	3.0[1]	1.3[1]	4.2[1]	2.6[1]
		Long-dist.	3.0[1]	1.5[1]	4.8[1]	2.5[1]
	Region 9	Local	3.2[a]	1.1[a]	3.4[a]	2.2[a]
		Mid-dist.	3.6[1]	1.3[1]	3.6[1]	2.8[1]
		Long-dist.	2.2[2]	1.4[1]	3.6[1]	2.4[1]

Note: Statistical tests completed using Mann-Whitney U incorporating the exposure weights.
[a] Median values
[b] Not computed within trip-types since variable corresponds to previous trips of unknown type. VisExpwt used in statistical analyses,
[1, 2, 3] Statistically different subgroups within regions.

In both study regions, Local visitors on day trips spend a shorter period of time on-forest than Mid-distance visitors on day trips. This pattern is consistent with the postulated characteristics identified in Chapter 3. Considering overnight visits, the on-forest durations of Local, Mid-distance, and Long-distance visitors follow a continuum from longest forest duration to shortest forest duration, respectively. In Region 2, only the visit duration of Long-distance OVN/OVNNF visitors is statistically different from the other segments while all OVN/OVNNF segments are statistically different from one another in Region 9.

Average party sizes range from 2.1 to 2.8 individuals for all segment trip-type combinations (excluding those with less than 30 cases). The party sizes of Local day trip groups in Region 2 are statistically different from that of parties in the Mid-distance segment in that Region. Similarly, Local visitor groups on overnight trips are smaller than Long-distance segment visitor parties. In Region 9, the size of overnight Local visitor parties is statistically different from that of Mid-distance visitor parties on overnight trips.

Summary of Distance Segment Characteristics

The characteristics of visitors within the three distance visitor segments are largely consistent with those postulated (Chapter 3, Table 1). Local visitors complete multiple trips annually, primarily on short-duration day trips. Local visitors typically visit a small number of sites and participate in few activities on any single visit. When on overnight trips, Local visitors spend a substantial time on-forest and participate in a larger number of activities. Contrary to expectations outlined in Chapter 3, Local visitors primarily first arrive at the national forest during the weekend rather than the weekday—though Monday arrivals are relatively common among Local visitors.

Mid-distance visitors recreate on a given national forest less frequently than Local visitors (though the difference is not statistically significant) and more frequently than

Long-distance visitors. When completing a national forest recreation visit, Mid-distance visitors typically spend the night away from home. Among distance segments, these visitors are least likely to spend only a short period of time (less than 5 hours) on-forest during their recreation visit. In aggregate, these visitors recreate on more sites, participate in more activities, and are in larger recreation parties than Local visitors.

The characteristics unique to Long-distance visitors are low annual visit frequencies and a propensity for national forest visits of very short duration. More than 50% of Long-distance visitors in both regions complete only one annual national forest visit and more than 95% complete less than four visits annually. Approximately 50% all Long-distance visitors spend less than four hours on the national forest. In Region 9, nearly 20% stay for less than one hour. By far, this distance segment has the greatest percentage of visitors classified as "Not Primary", more than 20%. Among distance segments, those traveling greater than 200 miles visit the greatest number of sites, participate in the greatest number of activities, and recreate in the largest parties. Compared to Local and Mid-distance visitors, Long-distance visitors are most likely to arrive at the national forest during the workweek.

Recreation Use Models

Objective 3 of this study is to develop models to predict the annual forest-level recreation use of Local and Mid-distance segment visitors. Recreation use estimates for national forests sampled under NVUM in FY2001, FY2002, and FY2003 were used to construct recreation use models and to verify model operation. Recreation use estimates from forests sampled in calendar year 2000 are used to validate model performance (ascertain the model's out-of-sample predictive ability). In this section, the Local recreation use models are presented first followed by models constructed to predict the recreation use of Mid-distance visitors.

Local Permanent Resident Model

Construction of the models predicting the recreation use associated with permanent Local area residents required estimation of regional-level estimates of the percent of the population participating in national forest recreation, identification of forest-level Local populations, and estimation of annual visitation rates of those participating in national forest recreation, all by distance band. Evaluation of the Local model predictions required development of the NVUM estimates of forest-level Local segment recreation use.

Regional-level participation rates of Local populations living in distance bands surrounding national forests were estimated using the formula developed in Chapter 3. This formula incorporated band-level populations, NVUM use estimates, and annual visitation rates, aggregated within region (Table 22). For the most part, the empirically estimated regional participation rates decrease with increasing distance, as expected. One notable exception to this pattern is a substantial increase in participation in the 25-30 mile distance band in Region 2. This increase in percent participating is a manifestation of the difference in spatial units of analysis between the NVUM data and the Census data.[10]

Table 22. Regional Participation Rates of Populations Residing Within 30 Miles of National Forests in the USDA FS Study Regions.

		Distance Band					
		0	**0-10**	**10-15**	**15-20**	**20-25**	**25-30**
Region 2	NVUM Use Estimate	1,723,516	3,476,959	585,723	647,619	181,577	206,428
	Population	134,035	1,076,205	467,167	680,461	511,090	140,893
	Annual Visits	14.8	7.3	4.8	4.5	3.6	3.5
	Percent Participating	87%	44%	26%	21%	10%	41%
Region 9	NVUM Use Estimate	1,166,158	2,259,467	270,956	90,953	151,668	164,113
	Population	385,018	2,235,003	1,282,808	1,280,169	1,197,016	1,587,431
	Annual Visits	7.8	7.0	4.0	3.6	4.9	3.4
	Percent Participating	39%	15%	5%	2%	3%	3%

Across all bands, the participation rates of those living in Region 2 are greater than those of the Region 9 population. Within bands, the participation rates of those living within national forest boundaries (0 Band) are substantially greater than populations living outside national forest boundaries. The occurrence of very high

[10] A large number of ZIP code origins in the 25 - 30 mile distance band (also the 20 – 25 mile band) in Region 2 are located in the Denver metropolitan area. However, the census block groups in the 25-30 mile band are located, largely, on the outskirts of the Denver metropolitan area (near the Denver airport) in an area with a small population. In the future, it may be advantageous to aggregate the 20-25 mile distance band and the 25-30 mile distance band to smooth this estimate.

participation rates among those living within national forest boundaries is logical as the national forest is "at the doorstep" of this population.

Within regions, Local populations are highly variable (Table 23). In Region 2, only 30,000 people live within 30 miles of the Routt NF while 2.1 million people live near the Pike San Isabel NF. The Local population of the Hiawatha NF is only 93,000 residents while the Local population of the Mark Twain NF is 1.8 Million people. Local populations around Region 9 national forests are typically greater than those of Region 2.

Table 23. Forest-level Distance Band Populations for NVUM forests sampled in FY2001, FY2002, FY2003.[a]

	Distance Band					
	0	**0-10**	**10-15**	**15-20**	**20-25**	**25-30**
Region 2						
Bighorn NF	1,322	11,684	23,162	4,963	4,301	2,490
Black Hills NF	24,371	114,182	8,413	5,013	1,987	0
Grand Mesa, U.,G. NF's	17,937	56,119	81,250	38,399	5,994	625
Medicine Bow NF	0	34,325	15,070	60,605	41,851	39,216
Nebraska NF	4,507	34,338	13,114	10,936	13,147	10,845
Pike San Isabel NF	33,071	755,161	322,666	531,226	408,905	55,697
Routt NF	4,621	16,262	3,370	6,140	0	0
Shoshone NF	3,011	11,345	17,917	5,476	8,398	23,219
White River NF	46,517	55,709	1,833	5,110	1,150	625
Region 9						
Allegheny NF	20,332	113,825	120,692	108,484	74,660	79,758
Chequamegon-Nicolet NF	24,468	94,671	64,285	96,731	72,586	65,320
Chippewa NF	14,866	50,161	30,452	15,733	17,668	11,460
Hoosier NF	26,027	264,409	163,230	122,646	141,626	269,580
Huron-Manistee NF	88,017	380,337	105,201	164,850	180,481	279,015
Mark Twain NF	86,030	559,874	269,382	382,272	290,601	244,049
Monongahela NF	31,414	104,822	65,629	67,451	96,558	248,230
Ottawa NF	10,431	37,426	6,552	18,601	13,230	6,734
Shawnee NF	26,819	249,541	111,037	96,633	67,285	84,795
Wayne NF	56,614	379,938	349,274	208,574	238,802	297,367

[a] Estimated using Barrier-adjusted Band distance. Census block groups applied only to the nearest forest.

The mean numbers of annual visits completed by visitors living within Local distance bands (Table 24) were estimated for the national forest aggregates. The number of annual visits declines with increasing distance from forest up to 15 miles from the forest boundary. From 15 to 30 miles the annual visit frequencies are relatively constant. The annual visit estimates of Region 2 Local visitors are, for the most part, greater than those reported by Region 9 Local visitors.

Table 24. Distance Band Annual Visit Frequencies of Local Visitors by Region and National Forest Aggregation Group.[a]

		Distance Band					
	Aggregation Group[b]	0	0-10	10-15	15-20	20-25	25-30
Region 2	1	14.1	10.7	4.8[c]	6.3	3.6[c]	3.5[c]
	2	10.7	6.7	6.3	4.5[c]	3.6[c]	3.5[c]
	3	11.0	5.7	3.3	2.7	3.0	3.3
	4	16.7	11.7	6.4	5.9	3.6[c]	3.6
	Regional Avg.	14.8	7.3	4.8	4.5	3.6	3.5
Region 9	1	6.8	6.6	3.1	3.5	4.7	4.2
	2	9.3	7.1	4.9	3.6[c]	4.8	3.2
	3	6.7	6.4	4.3	3.6[c]	2.9	3.4[c]
	4	5.6	4.4	4.0[c]	3.6[c]	4.9[c]	2.6
	5	12.3	9.2	4.2	3.6	4.9	3.4
	Regional Avg.	7.8	7.0	4.0	3.6	4.9	3.4

[a] Estimated from the NVUM survey and weighted by VisExpwt. Standard errors available in Table C-1

[b] Aggregation Groups defined below.

Region 2: 1 Bighorn NF, Shoshone NF; 2 Black Hills NF, Nebraska NF; 3 Arapaho and Roosevelt National Forests, Medicine Bow NF, Pike and San Isabel National Forests; 4 Grand Mesa, Uncompahgre, and Gunnison National Forests, Rio Grande NF, Routt NF, San Juan NF, White River NF.

Region 9: 1 Hoosier NF, Mark Twain NF, Shawnee NF; 2 Alleghany NF, Monongahela NF, Wayne NF; 3 Green Mountain and Finger Lakes National Forests, White Mountain NF; 4 Hiawatha NF, Huron-Manistee NF, Ottawa NF; 5 Chippewa NF, Chequamegon/Nicolet NF, Superior NF.

[c] Number of cases is less than 30. Region-level average substituted.

Population counts of those living in distance bands around national forests were combined with regional-level participation rates and estimates of annual visit frequencies to predict forest-level recreation use by those living within 30 miles of the national forest boundary (Table 25). Model predictions of forest-level Local visitor recreation use range from 112,000 visits to 3 million visits for national forests in Region 2 and from 51,500 visits to 903,000 visits for national forests in Region 9.

In Region 2, only one forest prediction of Local visitor use (Black Hills NF) is consistent with the NVUM Local visit estimate. The regional summation of forest-level predictions in Region 2 falls below the Region 2 NVUM Local visitor estimate. Of the eight Region 2 national forests where model predictions are outside the NVUM Use estimates, the model underestimates Local use for six national forests and over-estimates Local use for two national forests. Model predictions for three of the six under-predicted national forests were within 90,000 visits of lower NVUM Local visit estimate. The two forests over-predictions were well above the NVUM upper estimates of Local segment visits.

The Local visitor model performs slightly better in Region 9 than in Region 2. In three cases, the predicted Local visitor use falls within the confidence intervals of the NVUM Local visit estimates. Although not within the confidence intervals, the predicted Local visitor use for Ottawa NF is very close to lower NVUM estimate. The regional summation of predicted forest-level Local visitor use falls within the confidence interval of the NVUM Region 9 Local use estimate. Of the seven Region 9 national forests where model predictions are outside the 80% NVUM confidence interval, the recreation use of Local visitors is under-predicted on four national forests and over- predicted on three national forests.

Table 25. Model and NVUM Estimates of Permanent Resident Local Visitor Recreation Use.

	Local Visitor Use Prediction	NVUM Use Estimate	Lower NVUM Estimate	Upper NVUM Estimate
Bighorn NF	112,122	273,995	198,388	355,876
Black Hills NF	583,526*	506,796	398,248	622,623
Grand Mesa, U.,G. NF	736,311	1,388,635	953,697	1,848,310
Medicine Bow NF	200,592	288,978	236,296	345,489
Nebraska NF	195,758	56,678	40,789	74,836
Pike San Isabel NF	3,004,975	2,045,153	1,714,877	2,389,610
Routt NF	164,189	587,221	501,804	679,250
Shoshone NF	157,285	258,705	214,246	306,760
White River NF	973,054	1,279,373	1,171,184	1,392,239
Total	**6,127,811**	**6,821,822**	**6,333,542**	**7,321,118**
Allegheny NF	246,456	555,824	381,840	744,479
Chequamegon-Nicolet NF	280,043	595,152	389,868	822,667
Chippewa NF	149,101	726,966	592,578	872,045
Hoosier NF	410,796*	365,668	295,388	440,773
Huron-Manistee NF	512,529	212,354	129,357	307,506
Mark Twain NF	903,695	412,738	350,419	477,656
Monongahela NF	279,677*	262,522	214,339	314,594
Ottawa NF	51,438	78,848	61,991	97,583
Shawnee NF	354,919*	316,315	270,318	365,126
Wayne NF	759,006	248,914	200,208	301,341
Total	**3,947,661***	**4,102,540**	**3,734,356**	**4,480,997**

* Model prediction falls within the 80% confidence interval of the NVUM Local visitor use estimate.

The absolute values of raw errors in model predictions range from 76,000 visits to 960,000 visits in Region 2 and from 17,000 visits to 510,000 visits in Region 9 (Table 26). Six of the nine national forests in Region 2 have percentage errors (percentage error = absolute raw error/NVUM Local visit estimate) of less than 50%. Two forest-level percentage errors are below 25%. The absolute value of the raw error between the summation of the Region 2 Local model predictions and the NVUM regional estimate was approximately 700,000 visits, corresponding to a percent error of 10%.

Table 26. Local Visitor Model Errors.

	Absolute Error[a]	Percentage Error[b]
Bighorn NF	161,873	59%
Black Hills NF	76,731	15%
Grand Mesa, U.,G. NF's	652,324	47%
Medicine Bow NF	88,386	31%
Nebraska NF	139,080	245%
Pike San Isabel NF	959,821	47%
Routt NF	423,032	72%
Shoshone NF	101,420	39%
White River NF	306,319	24%
Region 2	**694,011**	**10%**
Allegheny NF	309,368	56%
Chequamegon-Nicolet NF	315,109	53%
Chippewa NF	577,864	79%
Hoosier NF	45,128	12%
Huron-Manistee NF	300,175	141%
Mark Twain NF	490,958	119%
Monongahela NF	17,156	7%
Ottawa NF	27,410	35%
Shawnee NF	38,604	12%
Wayne NF	510,092	205%
Region 9	**154,879**	**4%**

[a] abs(Model prediction – NVUM Local visit estimate)
[b] (absolute error/NVUM Local visit estimate)*100

In Region 2, the predicted Local visitor use for the Nebraska NF (and administered grasslands) was vastly different from the NVUM estimate of Local use. In fact, the predicted use of Local visitors was greater than the NVUM estimate of all recreation use on the Nebraska NF (127,000 total visits). Such a large overestimation is indicative that either the regional participation rates or aggregate annual visit frequencies are inappropriate for the Nebraska NF.

The Region 2 participation rates are largely influenced by national forests located in the Rocky Mountain region of Colorado and Wyoming. The outdoor recreation resources and services available on these mountain national forests likely differ from those of the Nebraska NF. In addition, the recreation behavior and participation patterns of those living around the Nebraska NF may be more similar to populations proximate to Region 9 national forests given the Nebraska NF's distance from the mountain national forests. Substituting the Region 9 participation rates for Region 2 participation rates in the Nebraska NF Local visitor model yields a prediction of 59,881—nearly identical and within the confidence intervals to the NVUM estimate. Given this result, Region 9 participation rates appear more appropriate for the Nebraska NF than Region 2 participation rates.

Errors are generally greater in Region 9 than in Region 2. Only four of ten national forests in Region 9 have percent errors of less than 50%. Percent errors for the Huron-Manistee NF, the Mark Twain NF, and the Wayne NF are all above 100%. On those Region 9 national forests where the model predictions are within the NVUM Local visitor use estimates (Shawnee NF, Hoosier NF, Monongahela NF), both absolute and percent errors are quite small. Summing all Region 9 national forest model predictions, the regional prediction of Local use has an absolute raw error of 155,000 visits, a percent error of only 4%.

The national forests in the study area with the greatest population sizes are the Pike San Isabel, the Mark Twain NF, and the Wayne NF, respectively. The predicted Local use levels for each of these forests are significantly greater than the NVUM estimate. The percent errors for the Wayne NF and Mark Twain NF are among the highest in Region 9. In all three cases, the prediction from the Local visitor model is greater than the NVUM estimate of total recreation use for the national forest. Commonly, the participation rates of large population areas are less than those where population numbers are small. Overestimation for these national forests is indicative of the need to develop adjusted participation rates applicable to forests with large population areas. Such participation rates could be developed by pooling visit estimates among forests with large populations and re-estimating participation rates.

When there are statistical differences between the two, Local model predictions tend to be lower than the NVUM Local visit estimates. Of the 15 cases where statistical differences exist, the model predictions are lower than the NVUM estimates in 10 cases. Non-random error in specifying the model inputs or over-estimation of Local visitor use from NVUM may cause the consistent underestimation of Local segment visits. Concerning the former, the model assumes that all residents within a given distance band participate with the same proclivity. If a disproportionate share of the population within the distance band is located closer to the forest than the Mid-distance, visitation may be underestimated. This may be particularly applicable to the zero – 10-mile band where a large percentage of residents may reside directly adjacent to the forest boundary. Based upon their proximity, these residents may have much higher participation rates than other individuals in the distance band living farther away from the national forest.

Consistent underestimation may also be indicative of errors in the NVUM Local use estimate. In this study, the NVUM estimate of Local use is developed from the visitor survey data and the NVEXPAND weights. Stynes and others (2003) have questioned whether the NVEXPAND weights are appropriate for estimating visitor characteristics and trip types from the NVUM survey data. Use of the NVEXPAND weights assumes that the NVUM approach to stratifying recreation sites captures variability in visitor origins and/or visitor characteristics. The exposure weights, which assume the NVUM stratification does not explain variability in visitor characteristics, have been adopted by Stynes and others (2003) when estimating visitor characteristics and, in some instances, when estimating visitor shares. For national forests in the study area, use of exposure weights yield lower Local visitor shares in many cases (Table 27). In several cases the differences between forest-level estimates of Local segment shares under the alternate weighting schemes are greater than 10 percentage points—particularly in Region 2. Consistently high NVUM estimates of Local use could lead to the pattern of under-estimation found in the Local visitor model.

Table 27. Local visitor Segment Shares Estimated Under Two Alternative Weighting Schemes.

	NVEXPAND	ExpWt
Bighorn NF	52%	31%
Black Hills NF	69%	59%
Grand Mesa, U.,G. NF's	67%	55%
Medicine Bow NF	51%	51%
Nebraska NF	45%	30%
Pike San Isabel NF	73%	75%
Routt NF	39%	38%
Shoshone NF	53%	49%
White River NF	44%	44%
Region 2	**58%**	**51%**
Allegheny NF	57%	54%
Chequamegon-Nicolet NF	38%	38%
Chippewa NF	55%	46%
Hoosier NF	71%	67%
Huron-Manistee NF	30%	38%
Mark Twain NF	84%	70%
Monongahela NF	38%	35%
Ottawa NF	34%	26%
Shawnee NF	62%	61%
Wayne NF	64%	69%
Region 9	**51%**	**49%**

Local Seasonal Resident Model

The number of seasonal homes located within the Local areas of national forests in the study was identified from U.S. Census data (Table 28). In Region 2, Pike San Isabel NF followed by the White River NF and Grand Mesa, Uncompahgre, and Gunnison NF have the greatest number of seasonal homes close to the national forest. The Nebraska NF has the lowest number of seasonal homes in the local area of the National Forest. The Huron-Manistee NF, in Region 9, has more than 100,000 seasonal homes located in its local area—by far the largest number of seasonal homes among national forests in this study. Elsewhere in Region 9, the Chequamegon-Nicolet NF, the Alleghany NF, and the Mark Twain NF all have 30,000 or more seasonal homes located within 30 miles of the forest. The Shawnee NF has the fewest number of seasonal homes proximate to the national forest.

Table 28. Seasonal Homes Proximate to NVUM forests sampled in FY2001, FY2002, and FY2003.[a]

	Distance Band					
	0	0-10	10-15	15-20	20-25	25-30
Region 2						
Bighorn NF	313	598	442	24	271	57
Black Hills NF	1,523	838	33	112	30	0
Grand Mesa, U.,G. NF's	4,014	2,004	145	66	17	2
Medicine Bow NF	0	1,450	327	636	121	535
Nebraska NF	99	586	173	103	210	115
Pike San Isabel NF	5,429	7,964	920	1,690	259	138
Routt NF	1,174	976	391	33	0	0
Shoshone NF	506	513	868	973	785	564
White River NF	7,632	1,847	36	60	25	2
Region 9						
Allegheny NF	9,982	8,212	2,099	4,472	4,976	6,192
Chequamegon-Nicolet NF	12,674	22,831	11,998	10,662	5,170	5,697
Chippewa NF	4,948	9,541	3,250	3,467	3,635	2,597
Hoosier NF	804	2,366	1,431	1,805	2,342	1,022
Huron-Manistee NF	25,106	34,947	12,328	14,021	10,335	11,473
Mark Twain NF	5,256	9,585	2,893	5,355	2,873	8,256
Monongahela NF	5,624	4,004	2,179	5,062	4,448	3,049
Ottawa NF	3,688	8,654	2,241	1,089	1,632	183
Shawnee NF	649	1,375	432	853	485	772
Wayne NF	746	3,853	2,995	2,931	2,338	1,964

[a] Estimated using Barrier-adjusted Band distance. The number of seasonal households within census block groups counted only for the nearest forest.

Due to data limitations, it was assumed that seasonal homeowners in the Local area visit with the same propensity and with the same annual frequency as permanent local residents. An estimate of the average party size of seasonal homeowner parties originating from seasonal homes was identified using the NVUM FY 2003 national-level survey data. Nationally, seasonal homeowner parties average 2.6 individuals per party. For the Local visitor seasonal model it is assumed that recreation parties associated with seasonal households in all Local distance bands are comprised of 2.6 individuals.

The numbers of visits associated with seasonal homes in the local areas of national forests were estimated from the counts of seasonal homes, participation rates, annual visit frequencies, and party sizes (Table 29). The predicted number of national forest visits associated with seasonal homes is highly variable. In Region 2, only 8,500 visits to the Nebraska NF are associated with seasonal homes while more than 310,000 visits are predicted for the White River NF. The model predicts only 8,600 seasonal home visits to the Shawnee NF and nearly 250,000 seasonal home-related visits to the Chequamegon-Nicolet NF. Although there are many more seasonal homes in Region 9, visitation associated with seasonal homes is nearly equal between the two regions—due to the greater assumed participation rates and visit frequencies of Region 2 residents.

It is difficult to verify the performance of the seasonal homeowner Local visitor model. The NVUM visitor surveys used in the first three years of NVUM did not clearly identify seasonal homeowners, precluding direct estimation of seasonal homeowner recreation use for forests sampled during these years. In the Year 4 survey, respondents were asked to report the type of local lodging used, including owned-homes, if they were "staying away from home on this trip". The percent of survey respondents selecting "owned home" can be used to develop the NVUM estimate of seasonal homeowner use. However, this is likely not a complete enumeration of seasonal homeowner use as it is reasonable to expect that many seasonal homeowners may not have answered the question since they were indeed staying at a home they owned (i.e. "not staying away from home").

Table 29. Model Estimates of Seasonal Local Resident Recreation Use.

Forest	Model Estimate
Bighorn NF	19,347
Black Hills NF	43,890
Grand Mesa, U.,G. NF's	179,194
Medicine Bow NF	13,190
Nebraska NF	8,517
Pike San Isabel NF	192,660
Routt NF	59,184
Shoshone NF	31,566
White River NF	313,134
Total	**860,682**
Allegheny NF	121,326
Chequamegon-Nicolet NF	248,499
Chippewa NF	98,865
Hoosier NF	13,466
Huron-Manistee NF	214,881
Mark Twain NF	65,970
Monongahela NF	68,254
Ottawa NF	37,187
Shawnee NF	8,648
Wayne NF	21,118
Total	**829,960**

Three of the seven forest-level model predictions (all in Region 9) for Year 4 national forests fall within the confidence intervals of NVUM seasonal homeowner recreation use estimates (Table 30). Seasonal resident model predictions for Region 2 were all greater than the NVUM estimates. However, it is unlikely that the NVUM estimate of no seasonal homeowner visits to the Shoshone NF is correct given the sheer number of seasonal homes proximate to the NF. For this NF (at least), the NVUM estimate likely underestimates true seasonal homeowner recreation use.

Table 30. Model and NVUM Estimates of Seasonal Resident Local Visitor Recreation Use for FY 2003 NVUM National Forests.

	Count of Seasonal Homes	Local Visitor Use Prediction	NVUM Use Estimate	Lower NVUM Estimate	Upper NVUM Estimate
Black Hills NF	2,536	43,890	3,930	0	13,175
Grand Mesa, U.,G. NF's	6,248	179,194	17,474	5,227	54,177
Shoshone NF	16,399	31,566	0	0	0
Hoosier NF	9,770	13,466*	6,742	217	15,299
Monongahela NF	24,366	68,254*	49,532	31,063	71,708
Ottawa NF	17,487	37,187*	47,669	32,694	65,358
Wayne NF	14,827	21,118	3,394	0	8,642

* Model prediction falls within the 80% confidence interval of the NVUM Local visitor use estimate.

Mid-distance Recreation Use Models

The recreation use of day trip and overnight trip Mid-distance visitors was modeled separately. Day trips are those where the recreation visitor does not spend a night away from their home. Overnight trips include those visits involving an overnight stay on the NF as well as those including a stay overnight off-forest.[11] The models developed for Mid-distance visitation predict only the recreation use where the primary trip purpose is recreation at the NF. "Non-primary" trips are excluded, as these trips are likely a function of factors other than those typically included in travel cost models.

[11] In the first three years of NVUM survey, respondents were asked to report the length of their trip away from home rather than the number of nights in the local forest area. Given this, some modeled overnight trips will include nights spent away from home but not in the local forest area.

The multi-site zonal travel cost models of Mid-distance segment recreation use were estimated using both single-log models estimated via ordinary least squares (OLS) and Tobit models estimated via maximum likelihood estimation (MLE) for each study region. The single-log OLS models were estimated with the dependent variables day and overnight visits and day and overnight visits per thousand population. Tobit models were estimated with the dependent variables day and overnight visits and day and overnight visits per capita. Eviews 4.1 (Quantitative Micro Software LLC, Irvine, CA) was used to estimate all models as well as to forecast forest-level Mid-distance recreation use based upon the fitted models. When forecasting, Eviews 4.1 software corrects for the bias resulting from the retransformation of log estimates. Stynes and others (1986) identified bias in coefficients and use estimates when using log formulations of travel cost models. White's heteroskedasity test was completed on all OLS models. In all cases, the null hypothesis of homogeneity could not be rejected.

The "best performing" single-log OLS and Tobit models in each region were selected to predict forest-level day and overnight Mid-distance segment recreation use. Models were selected based upon 1) consistency of the coefficient estimates with theory and 2) the smallest mean absolute percentage errors between model prediction and observed values of band-level recreation use. The number of observations used for estimating the day and overnight single-log OLS differ from the number of observations used to estimate the Tobit models since zero-visit observations are excluded from the single-log formulations. The greatest number of zero-visit observations occurs for day trip recreation use and, correspondingly, these models have the smallest number of observations.

Preliminary models constructed using alternate dependent variable formulations were compared to one another, in part, based upon their mean absolute percent errors (MAPE). Despite the selection of final models that had the smallest MAPE values (in addition to coefficient estimates consistent with theory) the final model MAPE values are still moderately large for Region 2 models and very large for Region 9 models. When interpreting these MAPE values it is important to recognize that the model MAPE's depict the differences between observed dependent variable (e.g. day trips/capita) and the predicted dependent variable—rather than observed total recreation use versus predicted total recreation use. Given that the dependent variables used in estimating the models are generally small values (e.g. visits per capita), moderate divergences from these values can result in large MAPE values.

In Region 2, day trips are largely dependent upon travel distance. In both model formulations, day trips decrease with increasing distance, all else being equal, as expected (Table 31). In the OLS formulation, the coefficient on RUC is also statistically significant. Increases in RUC code (increasingly rural areas) leads to fewer day trip visits originating from that distance band, all else remaining the same. The coefficients on median income, distance to substitutes, and recreation site acreage and number of units were not statistically different from zero.

Table 31. Day and Overnight Mid-distance Segment Recreation Use Models, USDA FS Region 2.[a]

OLS Model Dep. Variable: ln(Distance Band Visits/ Population(1,000s)),

Variable	Day	T-Value	OVN	T-Value
Constant	12.546	3.53***	6.464	3.72***
Population (1,000's)	0.000	-0.40	0.000	-1.12
Distance	-0.054	-4.19***	-0.015	-4.95***
Med. Income (1,000's)	-0.046	-1.09	0.009	0.39
Nearest Other NF Land	-0.025	-0.92	-0.010	-0.98
Nearest BLM Land	0.011	0.36	0.012	1.29
Nearest NPS Land	0.007	0.44	-0.001	-0.14
RUC Code	-0.514	-1.80*	-0.122	-0.86
Forest Acreage (1,000's)	0.000	-0.68	0.000	-0.95
Number of Separate Forest Units	-0.510	-1.29	-0.312	-2.03**
N	33		95	
Adjusted R-squared	0.35		0.31	
F-Value	2.91**		5.62***	
Mean Absolute Percentage Error	38%		121%	

Tobit Model Dep. Variable: Distance Band Visits/Capita

Variable	Day	Z-Value	OVN	Z-Value
Constant	0.704	1.19	0.842	2.19**
Population (1,000's)	0.000	0.72	0.000	-0.71
Distance	-0.005	-2.05**	-0.003	-3.95***
Med. Income (1,000's)	-0.007	-1.01	-0.004	-0.80
Nearest Other NF Land	-0.004	-0.73	-0.005	-1.86*
Nearest BLM Land	-0.002	-0.46	0.003	1.43
Nearest NPS Land	0.001	0.43	0.000	-0.03
RUC Code	-0.047	-1.06	-0.053	-1.74*
Forest Acreage (1,000's)	0.000	0.74	0.000	-0.39
Number of Separate Forest Units	-0.031	-0.50	-0.055	-1.44
N	124		124	
Tobit σ	0.17		0.22	
Log likelihood	-10.92		-26.64	
Mean Absolute Percentage Error	7%		17%	

[a] Model dependent variables and inputs shown in Table C-2
* p-value < 0.10
** p-value < 0.05
*** p-value < 0.01

Considering overnight recreation use, coefficients for travel distance and the number of separate forest units were statistically different from zero in the OLS overnight model while coefficients on travel distance, distance to nearest substitute national forest, and RUC code were statistically different from zero in the Tobit formulation. In both models, as expected, increasing distance leads to decreases in overnight recreation use, all else remaining equal. In the OLS formulation, a greater number of separate forest units yields lower overnight recreation use. In the Tobit model, origins more rural in character (increasing RUC code) are associated with lower overnight recreation use. The coefficient on distance to nearest substitute USDA FS land is contrary to expectations. However, given the density of USDA FS land in and around Region 2, a complementary rather than substitute relationship between national forests is conceivable.

In Region 9, travel distance is the only statistically significant predictor of day trip recreation use (Table 32). Increasing travel distance leads to significant decreases in day trip recreation use, all else being equal. In the overnight recreation use models, the coefficients on population, travel distance, distance to nearest substitute national forest, and forest acreage and number of separate units are all statistically different from zero in the OLS formulation. The signs of all statistically significant coefficients are consistent with expectations. In the Tobit model, travel distance, RUC code, and forest acreage and number of units are all statistically significant predictors of overnight recreation use. The signs of these statistically significant coefficients are consistent with expectations.

Table 32. Day and Overnight Mid-distance Segment Recreation Use Models, USDA FS Region 9.[a]

OLS Model Dep. Variable: ln(Distance Band Visits/Population(1,000's))

Variable	Day	T-Value	OVN	T-Value
Constant	1.174	0.52	3.680	2.34**
Population (1,000's)	0.000	-1.18	0.000	-1.70*
Distance	-0.024	-4.77***	-0.020	-6.39***
Med. Income (1,000's)	0.059	1.29	0.004	0.15
Nearest Other NF Land	0.004	0.88	0.006	2.13**
Nearest NPS Land	-0.009	-0.94	-0.005	-0.85
RUC Code	0.336	1.42	0.058	0.34
Forest Acreage (1,000's)	0.000	0.03	0.002	3.87***
Number of separate Forest Units	-0.084	-0.74	-0.405	-5.23***
N	69		131	
Adjusted R-squared	0.45		0.56	
F-Value	8.08***		21.31***	
Mean Absolute Percentage Error	110%		252%	

Tobit Model Dep. Variable: Distance Band Visits

Variable	Day	Z-Value	OVN	Z-Value
Constant	-4,877.3	-0.24	30,536.0	1.31
Population (1,000's)	0.3	0.15	-2.1	-0.89
Distance	-143.2	-3.40***	-112.8	-2.51**
Med. Income (1,000's)	349.9	0.91	234.0	0.55
Nearest Other NF Land	-7.8	-0.19	68.3	1.53
Nearest NPS Land	4.6	0.06	-3.0	-0.04
RUC Code	-866.5	-0.41	-7,620.8	-3.18***
Forest Acreage (1,000's)	5.7	1.08	18.1	3.12***
Number of separate Forest Units	40.4	0.04	-3,113.1	-2.76***
N	140		140	
Tobit σ	17,096		20,842	
Log likelihood	-874.41		-1,506	
Mean Absolute Percentage Error	713%		1,182%	

[a] Model dependent variables and inputs shown in Table C-3
* p-value < 0.10
** p-value < 0.05
*** p-value < 0.01

In Region 2, model predictions from either the OLS or Tobit formulations fall within the NVUM estimates for eight of the nine national forests used in model development (Table 33). In four cases predictions from both formulations fall within the confidence intervals. The summation of predicted Region 2 forest-level Mid-distance recreation use also falls within the NVUM regional Mid-distance segment use estimate. Use predictions are generally consistent between the two model formulations, though large differences do exist for the Nebraska NF and the White River NF. In all cases (except the Rout NF) where model predictions fall outside the NVUM confidence intervals, model predictions fall below the NVUM estimates.

Table 33. Model Predictions and NVUM Estimates of Mid-distance Segment Recreation Use, USDA FS Region 2.[a]

	OLS Models	Tobit Models	NVUM Estimate	Lower NVUM Estimate	Upper NVUM Estimate
Bighorn NF	43,177	38,775	99,692	68,193	135,990
Black Hills NF	25,121*	19,713*	27,680	15,875	42,481
Grand Mesa, U.,G. NF's	138,352	290,152*	312,161	199,280	442,999
Medicine Bow NF	167,741*	208,947*	177,220	142,030	215,708
Nebraska NF	39,783*	5,552	32,674	22,516	44,637
Pike San Isabel NF	156,519*	199,490*	179,644	130,947	235,966
Routt NF	419,313*	539,219	392,194	328,547	461,412
Shoshone NF	57,379*	64,966*	53,634	39,561	69,781
White River NF	370,492	642,862*	702,753	631,665	777,533
Region 2	**1,417,876**	**2,009,675***	**1,969,848**	1,790,973	2,156,547

[a] Combined recreation use of Day and Overnight trips. NVUM estimates exclude recreation use where the NF is not the primary trip purpose.
* Model prediction falls within the 80% confidence interval of the NVUM Mid-Dist. visitor use estimate.

There was less consistency between model predictions and NVUM estimates of Mid-distance recreation use in Region 9 (Table 34). In only four of ten cases were forest-level predictions from either model formulation within the NVUM confidence intervals.

Though not within the confidence interval, the OLS prediction for the Wayne NF was within approximately 500 visits of the lower NVUM estimate. In only one case, the Huron-Manistee NF, did model predictions from both the OLS and Tobit models fall within the NVUM estimate. The regional summation of predicted forest-level Mid-distance recreation was outside the NVUM confidence interval. In Region 9, model predictions under the two formulations were frequently disparate. Predictions under the OLS formulation typically were below the NVUM estimates while Tobit model predictions tended to be greater than the NVUM estimates. In particular, Mid-distance segment use predictions for the Ottawa NF and the Mark Twain NF were drastically greater than the NVUM estimates.

Table 34. Model Predictions and NVUM Estimates of Mid-distance Segment Recreation Use, USDA FS Region 9.[a]

	OLS Models	Tobit Models	NVUM Estimate	Lower NVUM Estimate	Upper NVUM Estimate
Allegheny NF	175,380	388,120*	340,138	227,368	466,716
Chequamegon-Nicolet NF	252,227	535,414	833,607	556,978	1,131,889
Chippewa NF	80,425	303,915	442,223	349,658	544,799
Hoosier NF	129,161*	288,652	126,631	94,776	162,927
Huron-Manistee NF	350,460*	517,792*	456,977	292,176	634,072
Mark Twain NF	50,163*	278,779	55,123	41,207	71,043
Monongahela NF	304,444	394,705	246,185	203,838	291,264
Ottawa NF	85,188	303,324	32,836	25,618	40,898
Shawnee NF	73,230	207,301	133,763	109,090	160,889
Wayne NF	100,167	229,221	130,716	100,655	164,355
Region 9	**1,600,844**	**3,447,222**	**3,000,003**	**2,720,308**	**3,288,796**

[a] Combined recreation use of Day and Overnight trips. NVUM estimates exclude recreation use where the NF is not the primary trip purpose.
* Model prediction falls within the 80% confidence interval of the NVUM Local visitor use estimate.

Absolute errors between the Mid-distance segment model predictions and NVUM estimates range from 2,500 visits to 580,000 visits under the OLS formulation and from

8,000 to 450,000 visits under the Tobit formulation (Table 35). Most percent errors in the Region 2 models are less than 30%—all are less than 100%. Percent errors of Region 9 estimates are generally greater, but most are still less than 50%. The percent errors for the Mark Twain NF and Ottawa NF under the Tobit formulation are substantial.

Table 35. Mid-distance Visitor Model Errors.

	Absolute Error (OLS)[a]	Absolute Error (Tobit)[a]	Percentage Error (OLS)[b]	Percentage Error (Tobit)[b]
Bighorn NF	56,515	60,917	57%	61%
Black Hills NF	2,559	7,967	9%	29%
Grand Mesa, U.,G. NF's	173,809	22,009	56%	7%
Medicine Bow NF	9,479	31,727	5%	18%
Nebraska NF	7,109	27,122	22%	83%
Pike San Isabel NF	23,125	19,846	13%	11%
Routt NF	27,119	147,025	7%	37%
Shoshone NF	3,745	11,332	7%	21%
White River NF	332,261	59,891	47%	9%
Total	**551,972**	**39,827**	28%	2%
Allegheny NF	164,758	47,982	48%	14%
Chequamegon-Nicolet NF	581,380	298,193	70%	36%
Chippewa NF	361,798	138,308	82%	31%
Hoosier NF	2,530	162,021	2%	128%
Huron-Manistee NF	106,517	60,815	23%	13%
Mark Twain NF	4,960	223,656	9%	406%
Monongahela NF	58,259	148,520	24%	60%
Ottawa NF	52,352	270,488	159%	824%
Shawnee NF	60,533	73,538	45%	55%
Wayne NF	30,549	98,505	23%	75%
Total	**1,399,159**	**447,219**	47%	15%

[a] abs(Model prediction – NVUM Mid-distance visit estimate)
[b] (absolute error/NVUM Mid-distance visit estimate)*100

The statistical relationships and predictive abilities of the recreation use models estimated in this study using OLS and Tobit model formulations are very similar. Lacking a clear difference in the performance of the two models, the single-log OLS model is more attractive given its common usage and the ease of interpreting variable coefficients and model summary statistics. Independent variable coefficients estimated using the Tobit model are more difficult to interpret as they reflect both the likelihood of participation as well as the level of recreation use of those participating.

Evaluation of Combined Model Predictions

To this point, Local and Mid-distance model predictions have been evaluated individually. The second and third evaluations of model performance are based upon the combined model predictions. The summed model predictions for Local (permanent residents only) and Mid-distance segments were compared with the NVUM estimates of summed Local and Mid-distance recreation use (Table 36). Combined, Local and Mid-distance model predictions for Region 2 generally fall below the NVUM estimates of use. Only the summed model predictions for the Black Hills NF fall within the NVUM estimates. This pattern of underestimation can be traced to the consistent underestimation of Local recreation use predictions. In Region 9, summed model predictions for the Hoosier NF, Huron-Manistee NF, and Shawnee NF fall within the NVUM confidence intervals. The Local and Mid-distance model predictions (individually) were within the NVUM confidence intervals for the Hoosier NF while only the model predictions for Local and Mid-distance use (individually) were statistically consistent with NVUM data for the Shawnee and Huron-Manistee NF, respectively. No clear pattern of error exists for Region 9 combined predictions.

Table 36. Model Predictions and NVUM estimates of Local and Mid-distance Recreation Use.

	Local+OLS Mid-distance	Local+Tobit Mid-distance	NVUM Estimate	Lower	Upper
Bighorn NF	155,299	150,897	373,687	284,152	463,222
Black Hills NF	608,647*	603,239*	534,476	437,362	631,590
Grand Mesa, U.,G. NF's	874,663	1,026,463	1,700,796	1,205,014	2,196,578
Medicine Bow NF	368,333	409,539*	466,198	399,951	532,445
Nebraska NF	235,541	201,310	89,352	71,491	107,213
Pike San Isabel NF	3,161,494	3,204,465	2,224,797	1,913,103	2,536,491
Routt NF	583,502	703,408	979,415	899,887	1,058,943
Shoshone NF	214,664	222,251	312,339	274,515	350,163
White River NF	1,343,546	1,615,916	1,982,126	1,889,759	2,074,493
Region 2	**7,545,687**	**8,137,486**	**8,791,670**	**8,278,236**	**9,305,104**
Allegheny NF	421,836	634,576	895,962	646,078	1,145,846
Chequamegon-Nicolet NF	532,270	815,457	1,428,759	997,702	1,859,816
Chippewa NF	229,526	453,016	1,169,189	1,006,087	1,332,291
Hoosier NF	539,957*	699,448	492,299	415,156	569,442
Huron-Manistee NF	862,989*	1,030,321	669,331	445,975	892,687
Mark Twain NF	953,858	1,182,474	467,861	407,086	528,636
Monongahela NF	584,121	674,382	508,707	439,116	578,298
Ottawa NF	136,626	354,762	111,684	95,870	127,498
Shawnee NF	428,149*	562,220	450,078	400,974	499,182
Wayne NF	859,173	988,227	379,630	320,825	438,435
Region 9	**5,548,505**	**7,394,883***	**7,102,543**	**6,576,245**	**7,628,841**

* Model prediction falls within the 80% confidence interval of the NVUM Local visitor use estimate.

Thus far, the performance of recreation use models has been evaluated based upon ability to predict visit estimates consistent with the NVUM estimates. An alternative evaluation is the ability of the models to predict the percent of recreation use associated with the Local and Mid-distance visitor segments consistent with the percentage estimates of Local and Mid-distance recreation use based upon NVUM. Given the differences in recreation behavior and participation, identifying the percentage of use by alternative visitor segments can enhance recreation managers' decision-making—even if the total number of visits is unknown. For most forests, the percentages of predicted Local visitor use (as a function of summed Local permanent resident and Mid-distance use) are very similar to percentages derived from the NVUM estimates (Table 37).

Table 37. Local Percentage of Local and Mid-distance Segment Recreation Use based upon Model Prediction and NVUM Estimates.

	Local Percentage, Local+OLS Mid-distance[a]	Local Percentage, Local+Tobit Mid-distance[b]	NVUM
Bighorn NF	72%	74%	73%
Black Hills NF	96%	97%	95%
Grand Mesa, U.,G. NF	84%	72%	82%
Medicine Bow NF	54%	49%	62%
Nebraska NF	83%	97%	63%
Pike San Isabel NF	95%	94%	92%
Routt NF	28%	23%	60%
Shoshone NF	73%	71%	83%
White River NF	72%	60%	65%
Region 2	**81%**	**75%**	**78%**
Allegheny NF	58%	39%	62%
Chequamegon-Nicolet NF	53%	34%	42%
Chippewa NF	65%	33%	62%
Hoosier NF	76%	59%	74%
Huron-Manistee NF	59%	50%	32%
Mark Twain NF	95%	76%	88%
Monongahela NF	48%	41%	52%
Ottawa NF	38%	14%	71%
Shawnee NF	83%	63%	70%
Wayne NF	88%	77%	66%
Region 9	**71%**	**53%**	**58%**

[a] (Local model prediction/ (Local prediction + OLS Mid-distance prediction))*100
[b] (Local model prediction/ (Local prediction + Tobit Mid-distance prediction))*100
Note: alternatively, the percent of primary purpose Mid-distance visitor use is (1- Local percent)

Model Application to Out-of-Sample National Forests

The constructed Local and Mid-distance segment models presented in the previous sections were applied to Year 1 NVUM forests to assess their out-of-sample predictive ability. Predictions from the Local permanent resident model fall below the NVUM estimates for all Year 1 forests (Table 38). This pattern of disparity is consistent with the results from model verification.

Table 38. Model and NVUM Estimates of Permanent Resident Local Visitor Recreation Use for Out-of-Sample Forests.

	Model Estimate	NVUM Estimate	Lower	Upper
Region 2				
Arapaho-Roosevelt NF	2,325,266	4,003,679	3,180,636	4,858,144
Rio Grande NF	183,341	753,544	463,998	1,070,810
San Juan NF	553,017	951,972	703,868	1,222,135
Region 9				
Green Mountain NF	568,255	1,459,691	1,181,227	1,756,025
Hiawatha NF	92,644	279,962	230,528	333,743
Superior NF	168,510	2,006,922	1,538,942	2,506,133
White Mountain NF	191,044	471,622	296,058	671,081

Mid-distance model predictions fall within the NVUM estimates for two of three of the Year 1 Region 2 national forests (Table 39). Mid-distance model estimates for Region 9 national forests are all below the NVUM estimates. The Region 9 national forests used in model validation include some of the premier recreation forests in that Region. In particular, the Green Mountain NF and the White Mountain NF located in the

New England portion of the Region offer excellent recreation opportunities. Assuming NVUM estimates are correct, the constructed Mid-distance models likely do not capture the "attractiveness" of these premier Region 9 national forests. Better measures of forest attractiveness may improve the ability of the Mid-distance models to predict recreation use at national forests such as the White Mountain NF.

Table 39. Model Predictions and NVUM Estimates of Mid-distance Segment Recreation Use for Out-of-Sample Forests.[a]

	OLS Models	Tobit Models	NVUM Estimate	Lower	Upper
Region 2					
Arapaho-Roosevelt NF	378,554*	302,062*	309,323	295,844	415,587
Rio Grande NF	277,749	461,068	131,098	90,865	271,829
San Juan NF	173,253	245,964*	273,200	234,152	462,819
Region 9					
Green Mountain NF	178,750	358,706	690,772	537,698	860,306
Hiawatha NF	47,410	199,278	135,298	106,615	167,362
Superior NF	259,214	619,555	1,047,040	780,706	1,340,882
White Mountain NF	130,156	398,000	1,321,450	872,923	1,796,634

[a] Combined recreation use of Day and Overnight trips. NVUM estimates exclude recreation use where the NF is not the primary trip purpose.
* Model prediction falls within the 80% confidence interval of the NVUM Local visitor use estimate.

The Percentages of forest-level Local visitor use, as estimated from the constructed Local and Mid-distance models, are consistent with the NVUM estimates for four of the seven out-of-sample national forests (Table 40). Model-based Local percentages are below NVUM estimates for the Rio Grande NF and the Superior NF and higher than NVUM estimates for the White Mountain NF. These validation results are similar to those found under verification.

Table 40. Local Percentage of Local and Mid-distance Segment Recreation Use based upon Model Prediction and NVUM Estimates, Out-of-Sample Forests.

	Local Percentage, Local+OLS Mid-distance[a]	Local Percentage, Local+Tobit Mid-distance[b]	NVUM
Region 2			
Arapaho-Roosevelt NF	86%	89%	93%
Rio Grande NF	40%	28%	85%
San Juan NF	76%	69%	78%
Region 9			
Green Mountain NF	76%	61%	68%
Hiawatha NF	66%	32%	67%
Superior NF	39%	21%	66%
White Mountain NF	59%	32%	26%

[a] Local model prediction/ (Local prediction + OLS Mid-distance prediction)
[b] Local model prediction/ (Local prediction + Tobit Mid-distance prediction)
Note: alternatively, the percent of primary purpose Mid-distance visitor use is (1- Local percentage)

Discussion of Model Results

A clear difficulty in evaluating the performance of the Local and Mid-distance recreation use models is that both the model predictions and the comparison values (i.e. the NVUM figures) are estimates of the actual recreation use. Given disparity in the estimates, it is impossible to definitively determine which (the model predictions, the NVUM figures, or both) is "incorrect". Even consistency between the two estimates does not definitively confirm that recreation use has been correctly quantified—though it lends support to both estimates.

At the finest level of evaluation (i.e. number of visits), model predictions were frequently inconsistent with the NVUM estimates. The promising exception to this was the performance of the Mid-distance segment models estimated for Region 2 national forests. Summed output from Local and Mid-distance models (the second level of evaluation) also was generally inconsistent with the NVUM estimates. Use was typically underestimated in Region 2 while there was no discernable pattern in Region 9.

At the most aggregate evaluation level (percentage of Local recreation use) model outputs actually compare well with NVUM estimates. In particular, Region 2 predictions are almost entirely consistent with the NVUM estimates. In Region 9, considering only Local percentages from the "Local + OLS Mid-distance" column, model predictions are largely "in the ballpark" with the NVUM estimates. Assuming NVUM is "correct", the models appear to predict reliable estimates of the relative percentages of visitors from the two distance segments considered. The ability to estimate relative percentages of use by distance segments may be beneficial for resource planners when identifying national forest "recreation markets".

One confounding issue (that remains unresolved) in comparing model predictions with NVUM use estimates is seasonal homeowner recreation use. Seasonal homeowner recreation use is clearly identified in the model predictions but is not clearly identified in the NVUM use estimates. There is no single question in the NVUM survey that can be used to identify national forest users recreating on the national forest coincident with use of their seasonal home. In NVUM Year 4, seasonal homeowners can be partially identified via their responses to two questions; however, correct identification depends largely on how respondents interpret the questions. Regardless, if a seasonal homeowner were surveyed it is not clear what ZIP code (permanent or seasonal residence) the respondent would provide as the ZIP code question stated only "what is your home ZIP code?" rather than "what is the ZIP code of your permanent home?". Therefore, it is unclear in what distance segment (i.e. Local, Mid-distance, and Long-distance) that seasonal homeowner recreation use should be counted. Given this uncertainty, predicted seasonal homeowner use cannot be simply added into one distance segment or another and thus remains largely excluded from comparisons with NVUM estimates. This imprecision will more greatly influence the comparisons between model predictions and NVUM estimates for forests with extensive seasonal homeownership and corresponding use. In future years, it would be beneficial to include distinct questions to identify seasonal homeowners and the locations of their seasonal and permanent residences.

Irrespective of the prediction comparisons, the parameters and coefficients of the constructed models are largely consistent with theory. Participation rates and annual visit frequencies estimated for the Local models are downward sloping (for the most part) and appear reasonable. For the Mid-distance models, the coefficients on travel distance are negative and significantly different from zero, as expected. Significant coefficients on other variables in the Mid-distance models appear reasonable and are nearly always consistent with expectations.

The approach to modeling recreation use undertaken in this research differed from other studies in that the recreation use of those living at different proximities to the national forest and completing different trip types (in the case of the Mid-distance segment) were modeled separately rather than in one single model. The aim of this approach was to capitalize on differences in how visitors respond to the factors influencing recreation use (e.g. travel distance, resource characteristics, socioeconomic conditions, etc).

Two common challenges to travel cost modeling are 1) limited variability in travel distance (or cost) and 2) disparities in on-site time between user groups. Separation of models for Local and Mid-distance recreation use likely controlled for both of these problems. Travel distance is relatively similar for those living in the Local area (due largely to the small range in distance) and travel distance appears to have limited impact on marginal visitation rates of those living in this area (Chapter 3, Figure 3). Conversely, the Mid-distance segment can be characterized by highly variable travel distance and decreasing marginal visitation corresponding to increases in travel distance. Concerning on-site time, comparisons of visit durations for Local and Mid-distance visitors revealed statistically significant differences within trip type between the two segments. Use of separate models for these two groups controlled for this statistical difference in visit length.

The development of separate zonal travel cost models for day and overnight trips highlighted the differences in relationships between recreation use and factors influencing recreation between the two trip types that might not be captured in a single zonal travel cost model. In three of four day trip models, travel distance was the sole independent variable with coefficients statistically different from zero. Comparatively, at least two independent variables (more frequently three or more) were statistically significant predictors of overnight recreation use. Separation of Mid-distance visitors into day and overnight trips also controlled for problems related to differences in on-site time that may have otherwise influenced the performance of the travel cost models.

CHAPTER 5

SUMMARY, CONCLUSIONS, AND POLICY IMPLICATIONS

Introduction

This closing chapter serves as a final discussion of the research. In the first section, the research objectives, methods, and results of the research are briefly restated. Based upon the results, the study conclusions and implications for policy are identified in the next two sections. The Chapter closes with a discussion of the study limitations and an outline of recommendations for future research.

Summary

The general objective of this research was to characterize and model the recreation use of USDA FS visitors classified into three distance-based visitor segments. The four specific objectives of the study were to:

1) identify the recreation behavior, activity participation, and consumption patterns of Local, Mid-distance, and Long-distance USDA FS visitors in USDA FS regions 2 and 9,
2) statistically compare the recreation behavior, activity participation, and consumption patterns of visitors to USDA FS Regions 2 and 9 within the distance-based segments,

3) statistically compare the recreation behavior, activity participation, and consumption patterns of Local, Mid-distance, and Long-distance visitors within USDA FS regions 2 and 9, and
4) model forest-level recreation use of Local and Mid-distance recreation visitors for national forests located in USDA FS regions 2 and 9.

Much of the data used in this research were obtained from the USDA FS NVUM project. NVUM visitor survey data were used to identify and complete statistical analyses of the distance segment visitor characteristics, and the NVUM recreation use estimates were employed to estimate and evaluate the predictive ability of the recreation use models.

Prior to addressing the specific objectives of the study, the boundaries separating the distance-based segments from one another were identified. Based upon previous research and an examination of the regional patterns of recreation use, Local visitors were defined to originate from within 30-miles of the national forest, Mid-distance visitors from between 30 and 200-miles of the national forest, and Long-distance visitors from the "rest of the world".

Local visitors typically complete a large number of visits annually, with each visit generally being of short duration. On any one visit, these visitors typically participate in a limited number of activities, visit a limited number of sites, and recreate with few other individuals. In contrast, Long-distance visitors complete very few visits annually, recreate in large parties, visit multiple recreation sites, and participate in a number of recreation activities. For the most part, the characteristics of Mid-distance visitors generally fall between the extremes exhibited by the other two segments. One characteristic of note, however, is that Mid-distance visitors exhibit the longest visit durations of the three distance-based segments.

Within trip-type and distance segment, few statistically significant differences in recreation behavior exist between visitors to national forests located in the two study regions. Worth special mention are the findings of no statistical differences in the recreation characteristics of Mid-distance visitors between USDA FS regions 2 and 9. Statistical differences that were found include differences in annual visits, the duration of visits, and the party sizes of Local and Long-distance visitors on some trip-types.

Across all distance segments, a greater percent of recreation use in Region 9 relative to Region 2 is associated with hunting and fishing. Conversely, downhill skiing and mountain biking are more common for all distance segments in Region 2. In addition to the above differences, Mid-distance visitors in Region 9 are more frequently engaged in cross-country skiing and hiking than comparable visitors in Region 2. Similarly, hiking is much more common among Long-distance visitors in Region 9 than in Region 2.

Comparing the distance segments to one another, statistically significant differences between two or more segments were found for all the visitor characteristics under consideration. The majority of the differences are consistent with the postulated characteristics of distance segment visitors identified in Chapter 3. There were a greater number of statistical differences between segments among Region 2 visitors than among

Region 9 visitors. In Region 2, the recreation characteristics of all three distance segments were frequently statistically different from one another. In Region 9, the recreation characteristics of Local visitors were typically unique from those exhibited by Mid-distance and Long-distance visitors.

Many of the statistical differences between the distance segments can be traced to differences in trip-type. Local visitors are most likely to complete day trips, Mid-distance visitors are most likely to complete overnight visits, and Long-distance visitors take more "not primary" trips than any of the other two segments. When accounting for trip-type, the recreation behavior of visitors in the three distance segments is more similar. However, statistical differences do remain for visit duration and party size variables. Differences in the number of visits annually cannot be tested within trip-types.

Considering recreation activities, Local visitors are more likely to fish than visitors in the other two segments. In Region 2, Local visitors more frequently engage in hiking than visitors in the other two segments, while in Region 9 Local visitors more frequently hunt and drive for pleasure than other visitors. Long-distance visitors more frequently visit the national forest to complete nature-related activities (i.e. viewing scenery, viewing wildlife, nature study, or visiting a nature center) than visitors in the other two segments. Long-distance visitor are also more frequently engaged in hiking than Mid-distance visitors. The most frequently reported primary activities for Mid-distance visitors are downhill skiing and hiking. Additionally, these visitors are more likely than the other two visitor groups to be using OHV's or to be camping in developed portions of the forest.

Separate models were developed for the Local and Mid-distance visitor segments. The recreation use of Long-distance visitors was not modeled as the factors influencing the recreation are not clearly understood. Local recreation use was modeled using population figures obtained from the 2000 Census and participation rates and annual visit frequencies estimated from NVUM survey data and recreation use figures. Mid-distance recreation use was modeled via multi-site zonal travel cost models incorporating variables related to travel distance, income, the degree of rurality, the availability of substitutes, forest acreage, and number of forest units within an administrative forest. For the most part, the parameters and coefficients of the models are consistent with theoretical expectations. In the case of the Local models, the estimated participation rates generally decrease with increasing distance to the national forest. The estimated annual visit frequencies of Local visitors are reasonable and consistent with expectations. Considering Mid-distance models, the coefficients on travel distance are negative and significant in every case. When significant, the coefficients on other variables in the Mid-distance models are reasonable and largely consistent with expectations.

Forest-level predictions of recreation use were generally not consistent with the NVUM estimates of recreation use. In Region 2, only one forest-level prediction of Local visitor use was within the confidence interval of the NVUM estimate. In Region 9, three predictions were within the NVUM confidence intervals. Region 2 model predictions of

Local use typically fell below the NVUM estimates while there was no particular pattern of discrepancy for the Region 9 Local model predictions. Predictions of Mid-distance recreation use were more frequently consistent with the NVUM estimates. Consistency with the NVUM estimates was more frequent in Region 2 than in Region 9. Percent errors for all models were generally below 50%, though percent errors for some forest-level predictions were quite high. At the most aggregate comparison level (percent of Local visitor use), model predictions and the NVUM estimates were largely consistent. This was particularly true in Region 2.

In the modeling approach adopted here, Local visitors were modeled separately from Mid-distance visitors and the recreation use of Mid-distance day trip visitors was modeled separately from recreation use of Mid-distance overnight visitors. In a conventional modeling approach, the recreation use of all these groups would likely have been modeled in aggregate. Considering just Mid-distance visitors, the variables found to be statistically significant predictors of recreation use were quite different. In all but one case, the only statistically significant coefficient in models of day trip recreation use was travel distance. In contrast, in models of overnight Mid-distance recreation use, at least two variable coefficients (and more commonly four) were statistically different from zero. Forest acreage, number of forest units, RUC code of the origin, and travel distance commonly influenced overnight Mid-distance visitor recreation use.

Conclusions

Segmenting recreation users based upon their proximity to the recreation resource yields visitors groups with distinct recreation consumption patterns, recreation behavior, and primary activity preferences. Notable and defining differences occur in the number of visits completed annually, the duration of those visits, party size, and trip-type. Worthy of particular note are the marked differences in trip type frequency. Nearly 75% of Local visitors complete day trips, more than 60% of Mid-distance visitors complete overnight trips, and Long-distance visitors can be typified by the percent of "not primary" visits undertaken (33%). Even when accounting for trip type differences, many of the distinctions and patterns in recreation characteristics remain evident—though not necessarily statistically significant.

Within distance segments and trip-types, the recreation characteristics of national forest visitors in Regions 2 and 9 are generally analogous. Statistical differences do exist in some cases for Local and Long-distance visitors. The most notable difference between the two regions, within segments, is a dramatic difference in the percentages of visitors engaged in downhill skiing. In particular, Mid-distance and Long-distance visitors in Region 2 are much more likely to be downhill skiing than their Region 9 counterparts. Even with a clear difference in recreation activity, there are no statistically significant differences in the recreation characteristics of Mid-distance visitors between the two study regions.

Using NVUM recreation use estimates, NVUM visitor survey data, and Census 2000 population estimates, the participation rates of Local segment visitors were determined as the initial step in development of the Local recreation use model. In general, as expected, the participation rates of Local populations decrease with increasing distance to the national forest. An estimated 87% and 39% of those living within the proclamation boundaries of Region 2 and Region 9 national forests participate in national forest recreation, respectively. At the farthest distances, the participation rates of Local visitors in Regions 2 and 9 fall to approximately 10% and 3%, respectively (excluding the 30-mile band in Region 2). The greatest numbers of visits annually are completed by those living in the two nearest distance bands. The number of visits completed annually is relatively constant for those living beyond 15 miles from the forest boundary.

Multi-site zonal travel cost models of day and overnight Mid-distance recreation use were constructed for USDA FS regions 2 and 9. Mid-distance segment day trip recreation use is related primarily to the travel distance between visitor origin and the national forest. Conversely, the recreation use of overnight Mid-distance visitors is influenced by a number of factors, including travel distance, substitutes, and forest characteristics. Both model formulations adopted in this study appear appropriate for use in estimating the recreation use of USDA FS visitors at this scale of analysis.

It is quite difficult to evaluate the predictive ability of the constructed models. The central limiting factor in an evaluation of the models is that the "true" forest-level recreation use of Local and Mid-distance visitor segments is not known. Consistency between the model predictions and the NVUM estimates (when it occurred) only implies that the two are consistent. Some additional complicating factors in using the NVUM estimates to evaluate model predictions is the inability to quantify recreation use associated with seasonal homes in the NVUM estimates and the significant number of NVUM respondents (and associated recreation use) with an unknown origin.

While there is no evidence to suggest that the current models are sufficient, the forest-level recreation use of Local and Mid-distance visitor segments can be modeled using the basic approach adopted in this study. That is, predicting forest-level recreation use based upon estimates of the populations living in proximity to national forests and knowledge of the recreation consumption patterns of those populations is possible given some model refinements and a more definitive evaluation. A clear benefit of modeling recreation use via the approach adopted here is the ability to predict future recreation use levels given estimates of future conditions under the assumption that all relationships between recreation use and population characteristics remain the same.

Policy Implications

The distance-based approach to segmenting recreation visitors is grounded, somewhat, in the classification of outdoor recreational uses and resources developed by Clawson and Knetsch (1967). The approach presented here classifies visitors based upon their proximity to the resource while Clawson and Knetsch (1967) classify recreation resources based, largely, upon proximity to visitor populations. The observed recreation behavior of Local, Mid-distance, and Long-distance visitors largely correspond to the postulated characteristics of recreation visitors to Clawson and Knetsch's user-oriented, intermediate, and resource-based recreation resources, respectively.

Given their distinct recreation characteristics, distance-based segmentation can provide a framework for classifying USDA FS visitors. Ultimately, distance-based segmentation represents another way for USDA FS planners and managers to consider recreation use. Incorporating the distance-based segmentation adopted in this study with the traditional activity-based segmentation may increase the information provided by both.

Currently, many national forests are undertaking "recreation niche" or "recreation market" analysis. The goal of these analyses is to identify the "role" or "special opportunities" that the individual forests play in providing recreation opportunity to the public. Distance-based segmentation seems to offer an excellent framework for individual national forests to identify, at least in part, their role in the provision of recreation opportunities both now and under future conditions (using predictions of future visitor segment use). For example, a national forest that determines its recreation use is predominantly associated with Local visitors could identify their recreation market as serving frequent visitors who are primarily on day trips, recreating in small visitor parties, and spending only a short period of time on the forest during any one visit. Given the observed pattern of recreation activities presented here, popular recreation activities on this national forest would likely include hunting, fishing, and hiking. Similarly, a national forest attracting a significant number of Long-distance visitors could expect visitors that visit very infrequently, perhaps for the first time, recreate in large parties, and visit a number of recreation sites. A forest attracting a number of Long-distance visitors may do well to offer a variety of interpretive recreation activities since Long-distance visitors frequently engage in passive nature-related pursuits. Further understanding of the motivations of distance-segmented visitors would add the understanding of a forest's market.

Comparisons between visitors in Region 2 and Region 9 revealed few statistical differences after accounting for distance segment and trip-type. Similarly, Stynes and White (2003) have found that USDA FS regions explain very little of the variation in visitor spending. Both of these findings are counter to the notion that USDA FS regions can be used to explain or delineate visitor characteristics. Based upon the results of this study, visitor proximity to the resource and trip-type probably capture more variation in recreation behavior than USDA FS region. Region probably does explain some variation in recreation activity propensities given that some USDA FS regions do have unique natural features conducive to some specific activities.

In this study, zonal travel cost models were employed only for a specific subset of recreation use. In a conventional application, a single model may have been estimated for all recreation use or for all recreation use within a certain trip-type (e.g. day trips). At a minimum, it appears that separate travel cost models should be estimated for visitors engaged in different types of trips. Based upon the results of this study, the factors commonly accepted as influencing recreation use (e.g. distance, substitutes, amenities) likely influence the recreation use of day and overnight visitors differently. Given variation in the recreation characteristics of Local, Mid-distance, and Long-distance visitors, it also seems likely that distance, substitutes, and site amenities influence the recreation use of these groups in different fashions. Models that combine visitors originating from these different distance segments likely fail to capture these different functional relationships. However, a comprehensive evaluation of alternative model formulations is required to determine this for certain.

Limitations and Recommendations for Future Research

This study is based upon the revealed behavior of recreation visitors (as quantified via the NVUM survey data). The recreation characteristics identified in this study do not provide information related to the desires of the distance-segment populations, but rather their consumptive patterns. Additional surveys are required to identify the desires of the distance-based segment visitors and those of the general population. Similarly, the motivations for recreation of national forest visitors were not quantified in this study. It is likely that the motivations of visitors within the three distance segments differ, but additional study is needed to quantify these differences. A greater understanding of visitor motivation in the context of proximity to the recreation resource would likely be very informative.

The models in this study were constructed using data from 19 administrative national forests located in two USDA FS regions. The other 100 administrative national forests located in seven other regions offer a variety of recreation opportunities and serve diverse recreation visitors. The models presented here apply only to visitors to national forests located in USDA FS Regions 2 and 9. There is no evidence to suggest that the parameters and coefficients of the estimated models are transferable to national forests located in other areas. Likewise, there is no support for applying the parameters and coefficients estimated in this study for recreation use on lands managed by other government agencies.

Two measurement problems frequently arise in estimating zonal travel cost models: quantifying the site characteristics that influence the behavior of recreation visitors and quantifying the availability of substitute recreation sites. Coarse measures of both were employed in this study. Different approaches to quantifying the attractiveness of national forests and national forest substitutes may identify relationships between these factors and recreation use not found in this study. Additionally, the incorporation of substitute recreation opportunities managed by state and/or local agencies in the models of recreation use may result in different relationships.

In the course of this study, many opportunities for future research have been identified.

- Seasonal homeowners likely represent a significant component of national forest recreation use, particularly in some portions of the country. Currently it is difficult to identify their recreation use, and little is known about seasonal homeowner visitors. Future studies should be directed at identifying the national forest participation rates and recreation characteristics of these users. With the recent expansion in the second-home market, the extent of seasonal homeowner recreation use will likely increase.

- Local visitor recreation use constitutes more than 50% of the recreation use in regions 2 and 9. Given the importance of their recreation use, a household survey directed specifically at populations living around national forests would be beneficial. Of particular interest is greater information concerning the consumption patterns, motivations, and desires of these individuals.
- This research assumes that Local segment visitors recreate at the nearest national forest when more than one forest is located within 30 miles of the visitor's origin. The validity of this assumption can be examined using the NVUM survey respondents and spatial databases of visitor origins and national forest boundaries. Such an analysis would yield a greater understanding of local visitor consumption patterns.
- The boundaries between the three distance segments were identified via an aggregate approach. Additional research aimed at better identifying the boundaries between Local, Mid-distance, and Long-distance visitors would be beneficial. Further refined boundaries could be identified via analysis of changes in recreation behaviors or based upon the motivations of users. An examination of patterns of day trip use and overnight trip use may be particularly useful in future delineations of the boundaries between distance segments.
- The Local visitor models show promise in the ability to estimate forest-level recreation use of local populations. Future development of these models is

appropriate. Specific future tasks may be to develop participation rates applicable to populations within certain age classes, better understanding of how local users choose between federal, state, and locally-managed recreation opportunities within the local area, and identification of ways to incorporate more local variation into the models.

- Distance is a key variable influencing recreation use. In this study, a Euclidean-based approach incorporating an adjustment for barrier crossings was adopted for calculating distances from populations to forest resources. Alternate approaches to estimating distance post-hoc include using simple Euclidean distance, network distance, or the development of a cost surface using a GIS. Further research is needed to compare these alternate post-hoc approaches to distance calculation and the potential impacts of their use on recreation research.
- In a recent revision of the NVUM survey instrument, survey respondents are asked to report their travel distance. This offers an excellent opportunity to identify the patterns in how visitors report travel distance (e.g. rounding) and to evaluate the consistency of post-hoc travel distance calculations with reported travel distances.
- While the Mid-distance models perform fairly well, some further refinements may lead to more informative models. In particular, development of an alternate approach to aggregating visitor origins into zones may lead to better identification of the factors influencing recreation use by these visitors. Additionally, as stated, refinements in quantifying both the national forest attractiveness and substitute availability may be beneficial. Currently only federal lands are considered as substitutes. Future studies may choose to include recreation areas managed by state and local governments as potential substitutes. Additional information from recreation users regarding the site

characteristics influencing their recreation decision and the other sites they considered would be very useful.

- The recreation use of Long-distance visitors was not modeled—largely due to uncertainty into what factors influence the recreation use of these individuals. Development of models of Long-distance recreation use, coincident with refinement of the other two models, would create a package of models that could estimate the expected recreation use from each distance segment; thereby providing estimates of total recreation use.

APPENDIX A

Introduction

This Appendix includes additional detail on the NVUM process. Included are detailed descriptions of how proxy sites are incorporated in the NVUM process, the process for identifying sample days within national forests, changes to the visitor questionnaire that have occurred during the first NVUM cycle, and of the mathematical procedures used to estimate forest-level recreation use based upon NVUM traffic counts and visitor surveys.

Proxy Sites

At some sites within national forests visitors are required to pay a user fee or obtain a recreation permit[1]. The types of sites that frequently require permits or fees include ski areas, developed campgrounds, and some Wilderness areas. These sites differ from others because reliable estimates of visitation, the permits or fees (the proxy), already exist. As such, visitation at "proxy sites" can be estimated by identifying a conversion factor between the proxy and the number of site visits. The appropriate conversion is identified via additional questions asked of survey respondents on proxy site sample days. On proxy sites the strata is based upon the proxy site type and the type of proxy used (e.g. OUDS with fee envelopes) rather than expected level of exiting recreation traffic. Because visitation estimates could be developed based primarily on the proxy, fewer visitor surveys are administered on sample days at proxy sites.

[1] Some sites require the user to purchase a Recreation Fee Demo sticker or another broadly applicable use permit. Broadly applicable fees and permits are not considered here.

Sample Day Selection

Approximately 200 sample days are allocated to each administrative forest. These 200 sample days represent, on average, 64,000 site days identified for each administrative forests (English et al., 2002). On an individual sample day a traffic counter is installed at the site for a 24-hour period and visitors interviews are conducted during a six-hour interview period (from either 8 am to 2 pm or 2 pm to 8 pm, altered as needed to constrain visitor surveying to daylight hours only). The number of sample days to occur in each stratum within each administrative forest is determined at the USDA FS regional level. The three-step allocation process is described in detail in English and others (2002) and outlined here. Each region is allocated 200 sample days per administrative forest sampled in a given NVUM year. First, each administrative forest is allocated eight sample days for viewing corridor sites. Next, each administrative forest is allocated, via a stratified approach, up to 50 sample days for the proxy strata. Finally, eight sample days are allocated to each non-proxy strata within each administrative forest (each administrative forest may have up to 12 non-proxy strata). Any remaining unallocated sample days (at the regional level) are allocated across strata across administrative forests based upon the product of 1) the standard error of the strata estimated from previous NVUM years[2] and 2) a weight of 20 for high use sites, 10 for medium use sites, and one for low use sites. The effect of this final step is to allocate the remaining sample days to those strata with perceived high levels of recreation use and large variation in observed recreation use.

[2] No standard errors for strata existed in the first two years so this allocation was based solely upon the strata weights.

The selection of individual sample days (dates and locations for sampling) within strata within individual administrative forests is completed by NVUM national-level staff using a simple random sample with the following minor adjustment. Logistical limitations constrain sampling to three or fewer sites on a single calendar day on a single administrative forest. For those calendar days on individual forests where more than three sample days are selected, NVUM personnel retain two of those sample days, place the other(s) back in the population of site days and then resample the necessary number of sample days from the population. In the first cycle of NVUM no attempts were made to insure that a temporally or spatially representative group of sample days within strata within an administrative forest was obtained.

Survey Revisions

During the first NVUM cycle the survey form has undergone several revisions. Copies of the survey forms (including the economic addition) used in the first cycle are available from USDA FS NVUM personnel. Most of the revisions during the first NVUM cycle were made to correct spelling and/or grammatical errors and to change the survey form layout. However, in the final year of the cycle a significantly revised economic supplement was introduced. Changes introduced in this final form (Revision 5) came about, in large part, due to the analyses of survey results collected in the initial years of NVUM. As result of these changes there are some differences between the year 4 data and the data collected in the previous three years.

Three primary changes occurred in Revision 5: 1) substantive changes to the "primary purpose" question, 2) changes in questions relating to the visitor's trip length and stay in the local area, and 3) removal of the "sharing question" and explicitly requesting trip expenditures per party rather than per person. The "primary purpose" question is used to identify visitors whose trip to the forest is secondary to some other trip purpose. Identifying "non-primary" visitors is integral to correctly estimating economic impact and estimating use values, and also provides some information relating to the motivation of the visitor. In the first three years, trip purpose was determined via a two part question (questions 3 and 4 economic addition, forms 1 – 4). In the course of analyzing the economic survey data it was determined that these questions did not definitively determine whether the forest was the primary reason the visitor was away from home and that the answers provided were frequently inconsistent. In Revision 5 these questions were removed and replaced with a single question on the general survey (Question 11 general survey, Revision 5) that specifically determines whether recreation on the national forest is the primary reason the visitor is away from home. Use of the revised question yields a greater percentage of non-primary visitors (Stynes and White, 2005b).

Visitor trip length is primarily used to determine whether visitors are on day or overnight recreation trips. It is also used to place spending on a per-night basis and can be used in analysis of visitor recreation behavior. Revisions 1 – 4 determined trip length, in terms of days and hours away from home, via a single question (Question 2 economics addition, revisions 1 – 4). While the original question determines total trip length what is more informative for economic impact analysis and planning applications is the length of stay in the local area (preferably in terms of nights rather than days). In Revision 5 respondents report both the number of nights away from home (if any) as well as the number of nights in the local area (questions 1 – 3 economic addition, Revision 5). In addition, the respondent is asked to identify the types of overnight lodging used in the local area (Question 4 economic addition, Revision 5). Using the previous surveys, visitors passing through the local forest area and staying overnight away from home were classified as overnight visitors when they should have, in fact, been classified as day trip visitors (since they were not staying overnight locally). The changes to the trip length question alleviates this problem and results in fewer overnight visitors in the Year 4 sample.

NVUM Visit Estimation

The NVUM traffic counters and visitor surveys are used together to develop estimates of total visitation on individual sample days for non-proxy sites. Estimates of sample day visitation for non-proxy sites are computed as follows (all formulae in this section are adapted from English et al., 2004):

$$SV_{hi} = C_{hi} * P_h * V_h$$

where SV_{hi} is the estimate of site visits for given stratum h on sample day i, C_{hi} is the number of cars obtained on the traffic counter adjusted for number of axles and two way traffic, P_h is the proportion of exiting vehicles that are last exiting recreationists (estimated from the visitor survey) averaged across all sample days in the strata, and V_h is the number of persons in last exiting recreation vehicles (estimated from the survey) averaged across all sample days in the strata. The average number of site visits across all sample days in given stratum h are computed as:

$$\overline{SV}_h = \sum_{i=1}^{n_h} \frac{SV_{hi}}{n_h},$$

where n_h is the number of sample days in stratum h. To estimate the number of total site visits for stratum h, the average site visit estimate for stratum h is multiplied times the number of site days (N_h) in the population of stratum h:

$$SV_h = N_h * \overline{SV}_h.$$

Site visit estimates for proxy sites are developed from the following: 1) the annual total proxy count for a given site k within a given proxy stratum h (P_{hk}), 2) the proxy compliance rate for a given site k within a given proxy stratum h (CR_{hk}), and 3) a conversion factor ($\overline{A}_h$) to facilitate transfer from the proxy count for stratum h to a visit count for stratum h. The first two components are combined to develop the effective "compliance based proxy count" for each site day (PC_{hk}):

$$PC_{hk} = \frac{P_{hk}}{CR_{hk}}.$$

The site day proxy count is combined to form a mean daily proxy count for the stratum h:

$$\overline{PC}_h = \frac{\sum_{k=1}^{K} PC_{hk}}{\sum_{k=1}^{K} N_{hk}},$$

where N_{hk} is the number of site days for site k stratum h.

The conversion factor $\overline{A}_h$ is constructed from visitor survey responses completed on the proxy sample day, combining 1) the reported number of proxies completed per visitor or group (e.g. number of fee envelopes used to cover an individual or group while camping) and 2) the reported number of people each proxy covers (e.g. number of people covered by a single fee envelope). Combined they form an aggregate conversion factor for stratum h:

$$\overline{A}_h = \frac{\sum_{i=1}^{n_h} SG_{hi}}{\sum_{i=1}^{n_h} SR_{hi}},$$

where SG_{hi} is the sum of group size for stratum h on given sample day i and SR_{hi} is the sum of number of proxies for stratum h on a given sample day i.

From the compliance based proxy count and the proxy conversion factor the average site visit estimate for proxy stratum h can be computed:

$$\overline{SV}_h = \overline{A}_h * \overline{PC}_h.$$

The total number of site visits for proxy stratum h is computed by multiplying the average site visits for stratum h by the number of site days in stratum h:

$$SV_h = \overline{SV}_h * N_h$$

The average number of site visits for all sample days, combining proxy and non-proxy sites, on a given national forest is computed as

$$\overline{SV} = \sum_{h=1}^{H} W_h * \overline{SV}_h,$$

where

$$W_h = \frac{N_h}{\sum_{h=1}^{H} N_h}.$$

The total number of site visits for a national forest is

$$SV = \overline{SV} * N,$$

where N is the total number of site days on the national forest.

While the number of site visits is of interest for some applications, the number of visits to the national forest as a whole is generally more useful. Since many visitors will recreate at multiple locations within an individual forest the number of site visits overestimates the total number of national forest visits. To convert site visits to national forest visits survey respondents are asked to report the number of sites visited and the number of days spent in the GFA during the current recreation visit (NS_{hij}). With this information the number of national forest visits on a given sample day (NFV_i) can be computed as:

$$NFV_{hi} = C_{hi} * P_h * CBAR_{hi}.$$

$CBAR_i$ is computed as

$$CBAR_{hi} = \frac{1}{LEV_{hi}} \sum_{j=1}^{n} \frac{V_{hij}}{NS_{hij}},$$

where LEV_i is the number of last exiting vehicles in stratum h on sample day i, V_{hij} is the number of visitors in vehicle j in stratum h on sample day i, and NS_{hij} is the number of sites visited by vehicle j in stratum h on sample day i. The average number of forest visits across all sample days in given stratum h are computed as

$$\overline{NFV}_h = \sum_{i=1}^{n_h} \frac{NFV_{hi}}{n_h}.$$

The number of national forest visits for stratum h is then computed as

$$NFV_h = \overline{NFV}_h * N_h.$$

To estimate the number of national forest visits from the proxy sites the conversion factor $\overline{ANF_h}$ is developed:

$$\overline{ANF}_h = \frac{\sum_{i=1}^{n_h} SC_{hi}}{\sum_{i=1}^{n_h} SR_{hi}},$$

where SC_{hi} is defined

$$SC_{hi} = \sum_{j=1}^{j} \left(\frac{V_{hij}}{NS_{hij}}\right).$$

The mean number of national forest visits to proxy sites is then computed as

$$\overline{NFV}_h = \overline{ANF}_h * \overline{PC}_h.$$

From this the total number of national forest visits for stratum h is

$$NFV_h = \overline{NFV}_h * N_h.$$

The average number of national forest visits for all sample days on a given national forest is computed, combining proxy and non-proxy sites, as

$$\overline{NFV} = \sum_{h=1}^{H} W_h * \overline{NFV}_h ,$$

where

$$W_h = \frac{N_h}{\sum_{h=1}^{H} N_h} .$$

The total number of national forest visits for a given national forest is then

$$NFV = \overline{NFV} * N ,$$

where N is the number of site days for the national forest.

APPENDIX B

Table B-1. NVUM Estimates Recreation Use by Forest and Distance Bands from 30 – 200 miles.

National Forests	Distance Band (miles)													
	35	40	45	50	65	80	95	110	125	140	155	170	185	200
Region 2														
Bighorn NF	0	16,494	26	1,122	24,856	29,058	12,942	524	1,157	0	0	1,062	11,400	4,858
Black Hills	0	0	172	0	10,098	336	685	3,859	3,284	3,089	5,702	455	0	0
Grand Mesa, U.,G. NF	5,641	1,565	4,756	2,827	39,634	23,544	180,335	43,599	19,637	4,389	1,992	0	7,096	4,076
Medicine Bow NF	58,041	27,994	6,799	3,618	22,659	20,834	11,659	22,144	9,721	867	6,851	1,595	1,718	1,749
Nebraska NF	0	0	3,253	980	2,893	1,703	4,035	2,219	2,954	3,262	5,726	2,021	4,811	3,932
Pike San Isabel NF	64,241	4,550	17,343	3,342	27,702	4,973	16,401	2,381	24,445	0	3,922	13,394	195	3,922
Routt NF	3,586	43,655	33,138	36,287	71,091	179,445	30,505	21,433	6,132	2,657	3,161	0	0	843
Shoshone NF	1,708	845	954	4,002	17,741	2,168	1,616	7,921	10,414	0	173	1,282	9,823	2,908
White River NF	6,865	790	54,278	33,747	329,738	276,708	61,679	17,438	11,566	1,579	0	0	0	8,057
Region 9														
Allegheny NF	23,274	24,084	12,656	55,068	84,589	95,256	9,181	26,497	8,875	270	938	540	180	8,136
Chequamegon-Nicolet NF	74,863	108,282	69,758	72,930	204,863	53,899	19,335	54,810	39,860	97,085	40,296	19,035	9,036	6,662
Chippewa NF	922	888	1,939	40,282	23,947	60,474	12,874	23,873	26,187	131,388	102,889	14,935	5,061	4,508
Hoosier NF	26,031	29,346	24,295	20,464	19,410	2,351	568	1,779	224	372	156	1,662	2,125	2,509
Huron-Manistee NF	37,085	2,927	3,009	29,882	70,952	56,359	92,609	46,256	43,023	69,131	4,942	5,750	837	189
Mark Twain NF	2,241	5,214	6,606	5,597	7,887	2,106	1,195	5,889	11,572	13,485	1,003	352	1,694	1,245
Monongahela NF	45,828	17,834	5,757	25,691	46,740	47,606	45,385	31,318	32,319	19,166	14,231	5,278	5,036	16,931
Ottawa NF	1,833	2,067	3,903	303	732	4,193	5,103	7,372	17,411	7,097	2,408	4,128	3,732	10,440
Shawnee NF	11,424	13,652	12,861	17,773	27,292	8,235	8,984	5,633	8,221	12,858	3,690	5,206	824	3,706
Wayne NF	9,227	1,820	13,595	9,935	17,734	19,371	20,490	17,363	5,221	4,212	8,444	2,759	1,379	2,759

Table B-2. NVUM Estimates of the Percentages of Day and Overnight Trips by 30 – 200 Mile Distance Band for National Forests in Region 2.[a]

		Distance Band (miles)													
National Forest	Trip-type	35	40	45	50	65	80	95	110	125	140	155	170	185	200
Bighorn NF	Day	0%	94%	0%	0%	24%	6%	22%	0%	0%	0%	0%	0%	0%	0%
Bighorn NF	OVN	0%	6%	92%	0%	76%	94%	78%	100%	100%	0%	0%	100%	100%	84%
Black Hills NF	Day	0%	0%	0%	0%	0%	31%	3%	0%	0%	0%	0%	0%	0%	0%
Black Hills NF	OVN	0%	0%	92%	0%	100%	61%	87%	72%	100%	100%	62%	100%	0%	0%
Grand Mesa, U.,G. NF	Day	64%	0%	0%	0%	50%	5%	1%	0%	0%	0%	0%	0%	0%	0%
Grand Mesa, U.,G. NF	OVN	36%	32%	20%	0%	50%	76%	95%	59%	100%	100%	85%	0%	0%	88%
Medicine Bow NF	Day	36%	11%	0%	0%	10%	0%	0%	17%	4%	0%	0%	0%	0%	0%
Medicine Bow NF	OVN	64%	89%	88%	0%	90%	62%	100%	46%	58%	100%	100%	0%	96%	100%
Nebraska NF	Day	0%	0%	0%	32%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Nebraska NF	OVN	0%	0%	100%	68%	100%	100%	100%	100%	100%	100%	55%	100%	100%	100%
Pike San Isabel NF	Day	19%	23%	0%	48%	100%	39%	0%	0%	0%	0%	0%	0%	0%	0%
Pike San Isabel NF	OVN	81%	75%	100%	0%	0%	61%	100%	72%	100%	0%	62%	100%	96%	100%
Routt NF	Day	33%	0%	0%	29%	0%	26%	0%	0%	0%	0%	0%	0%	0%	0%
Routt NF	OVN	67%	100%	100%	71%	84%	55%	100%	100%	100%	100%	62%	0%	96%	0%
Shoshone NF	Day	100%	23%	0%	0%	22%	62%	3%	0%	0%	0%	0%	0%	0%	0%
Shoshone NF	OVN	0%	75%	92%	67%	67%	0%	87%	100%	100%	0%	62%	100%	97%	86%
White River NF	Day	69%	23%	0%	6%	36%	41%	17%	0%	0%	0%	0%	0%	0%	0%
White River NF	OVN	31%	75%	100%	33%	63%	57%	47%	100%	100%	100%	0%	0%	0%	0%

[a] Visitors were classified into one of three trip types: Day trips, Overnight trips "Not primary" trips.

Table B-3. NVUM Estimates of the Percentages of Day and Overnight Trips by 30 – 200 Mile Distance Band for National Forests in Region 9.[a]

National Forest	Trip-type	Distance Band 35	40	45	50	65	80	95	110	125	140	155	170	185	200
Allegheny NF	Day	0%	0%	0%	0%	8%	2%	13%	0%	0%	14%	1%	0%	15%	0%
Allegheny NF	OVN	100%	100%	68%	100%	92%	87%	84%	82%	100%	84%	88%	91%	71%	100%
Chequamegon-Nicolet NF	Day	12%	12%	76%	0%	56%	9%	0%	0%	0%	36%	0%	0%	29%	0%
Chequamegon-Nicolet NF	OVN	88%	88%	24%	62%	44%	91%	100%	60%	99%	47%	85%	90%	71%	4%
Chippewa NF	Day	42%	15%	0%	30%	0%	0%	0%	0%	0%	0%	5%	0%	15%	8%
Chippewa NF	OVN	57%	82%	100%	70%	100%	100%	70%	100%	100%	100%	95%	100%	71%	44%
Hoosier NF	Day	21%	0%	99%	20%	79%	15%	0%	0%	0%	0%	0%	0%	15%	8%
Hoosier NF	OVN	79%	100%	1%	64%	21%	85%	56%	90%	0%	100%	100%	100%	71%	44%
Huron-Manistee NF	Day	23%	15%	0%	65%	72%	2%	0%	12%	0%	4%	0%	0%	15%	8%
Huron-Manistee NF	OVN	77%	82%	100%	35%	28%	94%	92%	88%	99%	96%	100%	100%	71%	44%
Mark Twain NF	Day	0%	82%	4%	75%	7%	81%	43%	0%	2%	97%	0%	0%	0%	8%
Mark Twain NF	OVN	100%	18%	96%	2%	74%	19%	57%	31%	36%	3%	100%	91%	100%	44%
Monongahela NF	Day	78%	63%	18%	11%	13%	1%	4%	0%	0%	34%	0%	0%	0%	0%
Monongahela NF	OVN	18%	33%	80%	79%	67%	35%	85%	19%	79%	49%	72%	49%	67%	0%
Ottawa NF	Day	100%	0%	71%	0%	0%	8%	10%	0%	7%	0%	1%	0%	0%	0%
Ottawa NF	OVN	0%	0%	28%	0%	100%	6%	63%	59%	34%	0%	88%	38%	50%	46%
Shawnee NF	Day	69%	54%	33%	9%	12%	62%	89%	0%	51%	63%	0%	0%	0%	0%
Shawnee NF	OVN	31%	46%	67%	56%	85%	38%	11%	100%	49%	37%	74%	100%	100%	100%
Wayne NF	Day	97%	0%	92%	100%	45%	15%	51%	0%	0%	0%	0%	0%	15%	50%
Wayne NF	OVN	3%	100%	8%	0%	55%	71%	49%	100%	100%	100%	100%	100%	71%	50%

[a] Visitors were classified into one of three trip types: Day trips, Overnight trips "Not primary" trips.

Table B-4. NVUM Estimates of Day and Overnight Recreation Use by Distance Band for National Forests in Region 2.

National Forest	Trip-type	Distance Band 35	40	45	50	65	80	95	110	125	140	155	170	185	200
Bighorn NF	Day	0	15,554	0	0	5,916	1,851	2,907	0	0	0	0	0	0	0
Bighorn NF	OVN	0	940	24	0	18,940	27,206	10,034	524	1,157	0	0	1,062	11,400	4,078
Black Hills NF	Day	0	0	0	0	0	106	24	0	0	0	0	0	0	0
Black Hills NF	OVN	0	0	159	0	10,098	204	599	2,796	3,284	3,089	3,508	455	0	0
Grand Mesa, U.,G. NF	Day	3,612	0	0	0	19,817	1,230	1,328	0	0	0	0	0	0	0
Grand Mesa, U.,G. NF	OVN	2,029	498	950	0	19,817	17,906	171,201	25,646	19,637	4,389	1,695	0	0	3,598
Medicine Bow NF	Day	21,150	3,176	0	0	2,263	0	0	3,687	349	0	0	0	0	0
Medicine Bow NF	OVN	36,891	24,818	5,983	0	20,396	12,815	11,659	10,178	5,673	867	6,851	0	1,652	1,749
Nebraska NF	Day	0	0	0	316	0	0	0	0	0	0	0	0	0	0
Nebraska NF	OVN	0	0	3,253	664	2,893	1,703	4,035	2,219	2,954	3,262	3,145	2,021	4,811	3,932
Pike San Isabel NF	Day	11,931	1,050	0	1,596	27,702	1,945	0	0	0	0	0	0	0	0
Pike San Isabel NF	OVN	52,311	3,418	17,343	0	0	3,028	16,401	1,725	24,445	0	2,413	13,394	188	3,922
Routt NF	Day	1,175	0	0	10,425	0	45,960	0	0	0	0	0	0	0	0
Routt NF	OVN	2,412	43,655	33,138	25,862	59,391	97,903	30,505	21,433	6,132	2,657	1,945	0	0	0
Shoshone NF	Day	1,708	195	0	0	3,925	1,335	56	0	0	0	0	0	0	0
Shoshone NF	OVN	0	634	881	2,668	11,850	0	1,412	7,921	10,414	0	107	1,282	9,568	2,494
White River NF	Day	4,760	182	0	2,186	118,521	114,711	10,460	0	0	0	0	0	0	0
White River NF	OVN	2,106	593	54,278	11,150	208,327	156,784	28,768	17,438	11,566	1,579	0	0	0	0

Table B-5. NVUM Estimates of Day and Overnight Recreation Use by Distance Band for National Forests in Region 9.

National Forest	Trip-type	Distance Band 35	40	45	50	65	80	95	110	125	140	155	170	185	200
Allegheny NF	Day	0	0	0	0	6,852	2,216	1,163	0	0	37	14	0	27	0
Allegheny NF	OVN	23,274	24,084	8,617	55,068	77,737	83,304	7,677	21,840	8,875	227	825	489	127	8,136
Chequamegon-Nicolet NF	Day	8,761	12,619	52,904	0	114,065	4,651	0	0	0	34,633	0	0	2,613	0
Chequamegon-Nicolet NF	OVN	66,102	95,664	16,854	45,075	90,798	49,248	19,335	32,641	39,512	45,578	34,236	17,111	6,423	268
Chippewa NF	Day	387	137	0	12,070	0	0	0	0	0	0	5,019	0	752	350
Chippewa NF	OVN	524	730	1,939	28,212	23,947	60,474	9,068	23,873	26,187	131,388	97,870	14,935	3,574	1,970
Hoosier NF	Day	5,345	0	24,126	4,149	15,256	342	0	0	0	0	0	0	316	195
Hoosier NF	OVN	20,687	29,346	168	13,041	4,153	2,009	316	1,600	0	372	156	1,662	1,501	1,097
Huron-Manistee NF	Day	8,376	453	0	19,294	51,253	1,402	0	5,749	0	2,455	0	0	124	15
Huron-Manistee NF	OVN	28,708	2,404	3,009	10,589	19,699	52,853	84,855	40,506	42,726	66,676	4,942	5,750	591	83
Mark Twain NF	Day	0	4,267	263	4,179	540	1,714	513	0	256	13,081	0	0	0	97
Mark Twain NF	OVN	2,241	948	6,343	117	5,827	392	682	1,797	4,186	404	1,003	319	1,694	544
Monongahela NF	Day	35,875	11,219	1,016	2,781	5,892	619	1,699	0	0	6,597	0	0	0	0
Monongahela NF	OVN	8,195	5,891	4,620	20,264	31,279	16,529	38,472	6,011	25,410	9,477	10,248	2,596	3,359	0
Ottawa NF	Day	1,833	0	2,771	0	0	356	524	0	1,176	0	35	0	0	0
Ottawa NF	OVN	0	0	1,102	0	732	244	3,228	4,375	5,988	0	2,118	1,583	1,866	4,822
Shawnee NF	Day	7,830	7,330	4,242	1,574	3,376	5,097	7,972	0	4,204	8,049	0	0	0	0
Shawnee NF	OVN	3,593	6,322	8,619	9,867	23,151	3,138	1,011	5,633	4,018	4,809	2,717	5,206	824	3,706
Wayne NF	Day	8,996	0	12,551	9,935	7,928	2,825	10,519	0	0	0	0	0	205	1,380
Wayne NF	OVN	231	1,820	1,044	0	9,805	13,722	9,971	17,363	5,221	4,212	8,444	2,759	974	1,380

Table B-6. Modeled Recreation Use Estimates and Confidence Intervals for National Forests in the Study Area Sampled in FY2001, FY2002, FY2003.

	Modeled Recreation Use	CI 80%	Lower Use Estimate	Upper Use Estimate
Region 2				
Bighorn NF	529,242	24%	402,436	656,048
Black Hills NF	734,802	18%	601,289	868,316
Grand Mesa, U.,G. NFs	2,067,412	29%	1,464,761	2,670,063
Medicine Bow NF	562,138	14%	482,258	642,018
Nebraska NF	126,775	20%	101,433	152,117
Pike San Isabel NF	2,811,811	14%	2,417,876	3,205,746
Routt NF	1,494,708	8%	1,373,338	1,616,079
Shoshone NF	492,390	12%	432,762	552,019
White River NF	2,894,585	5%	2,759,697	3,029,473
Region 9				
Allegheny NF	970,968	28%	700,165	1,241,771
Chequamegon-Nicolet NF	1,550,322	30%	1,082,590	2,018,054
Chippewa NF	1,319,701	14%	1,135,603	1,503,799
Hoosier NF	515,539	16%	434,754	596,324
Huron-Manistee NF	700,099	33%	466,476	933,722
Mark Twain NF	491,409	13%	427,575	555,243
Monongahela NF	694,512	14%	599,503	789,521
Ottawa NF	230,575	14%	197,925	263,224
Shawnee NF	509,560	11%	453,967	565,153
Wayne NF	387,176	15%	327,203	447,150

Table B-7. Local Use Percentages of Modeled Recreation Use for National Forests (NF) in the Study Area.

	Mean Percentage	Lower Percentage Estimate	Upper Percentage Estimate
Region 2			
Bighorn NF	51.8%	49.3%	54.2%
Black Hills NF	69.0%	66.2%	71.7%
Grand Mesa, U.,G. NFs	67.2%	65.1%	69.2%
Medicine Bow NF	51.4%	49.0%	53.8%
Nebraska NF	44.7%	40.2%	49.2%
Pike San Isabel NF	72.7%	70.9%	74.5%
Routt NF	39.3%	36.5%	42.0%
Shoshone NF	52.5%	49.5%	55.6%
White River NF	44.2%	42.4%	46.0%
Region 9			
Allegheny NF	57.2%	54.5%	60.0%
Chequamegon-Nicolet NF	38.4%	36.0%	40.8%
Chippewa NF	55.1%	52.2%	58.0%
Hoosier NF	70.9%	67.9%	73.9%
Huron-Manistee NF	30.3%	27.7%	32.9%
Mark Twain NF	84.0%	82.0%	86.0%
Monongahela NF	37.8%	35.8%	39.8%
Ottawa NF	34.2%	31.3%	37.1%
Shawnee NF	62.1%	59.5%	64.6%
Wayne NF	64.3%	61.2%	67.4%

Table B-8. Mid-distance Use Percentages and Primary Purpose Percentages of Modeled Recreation Use for National Forests (NF) in the Study Area.

	Mean Percentage	Lower Percentage Estimate	Upper Percentage Estimate	Primary Purpose Percentage
Region 2				
Bighorn NF	19.6%	17.6%	21.5%	96.3%
Black Hills NF	3.8%	2.6%	4.9%	100.0%
Grand Mesa, U.,G. NF	16.4%	14.8%	18.0%	92.1%
Medicine Bow NF	34.9%	32.6%	37.2%	90.3%
Nebraska NF	29.8%	25.7%	33.9%	86.5%
Pike San Isabel NF	6.6%	5.6%	7.7%	96.2%
Routt NF	28.9%	26.3%	31.4%	90.8%
Shoshone NF	12.5%	10.5%	14.5%	87.1%
White River NF	27.7%	26.1%	29.3%	87.6%
Region 9				
Allegheny NF	36.0%	33.4%	38.6%	97.3%
Chequamegon-Nicolet NF	56.2%	53.7%	58.6%	95.7%
Chippewa NF	34.1%	31.3%	36.9%	98.2%
Hoosier NF	25.5%	22.6%	28.3%	96.4%
Huron-Manistee NF	66.2%	63.5%	68.9%	98.6%
Mark Twain NF	13.4%	11.6%	15.3%	83.4%
Monongahela NF	51.7%	49.6%	53.8%	68.6%
Ottawa NF	30.7%	27.9%	33.5%	46.4%
Shawnee NF	27.5%	25.2%	29.9%	95.3%
Wayne NF	34.7%	31.6%	37.8%	97.3%

APPENDIX C

Table C-1. Standard Errors of Annual Visit Frequency Estimates by Region and National Forest Aggregation Group.[a]

		Distance Band					
	Aggregation Group[b]	0	0-10	10-15	15-20	20-25	25-30
Region 2	1	12.2	5.4		2.3		
	2	6.3	3.7	5.7			
	3	15.1	1.2	1.6	0.8	1.1	0.9
	4	7.7	4.6	3.4	2.4		2.9
	Regional Avg.	5.3	1.3	1.5	1.0	1.2	0.9
Region 9	1	3.5	2.0	1.3	1.8	2.9	2.8
	2	6.8	1.7	1.7		1.7	1.3
	3	4.9	3.2	2.8		2.8	
	4	5.4	2.5				1.1
	5	7.7	3.8	4.6	3.9	1.3	4.6
	Regional Avg.	2.3	1.1	1.0	1.0	1.3	0.7

[a] Estimated from the NVUM survey and weighted by VisExpwt.
[b] Aggregation Groups defined below.
Region 2: 1 Bighorn NF, Shoshone NF; 2 Black Hills NF, Nebraska NF; 3 Arapaho and Roosevelt National Forests, Medicine Bow NF, Pike and San Isabel National Forests; 4 Grand Mesa, Uncompahgre, and Gunnison National Forests, Rio Grande NF, Routt NF, San Juan NF, White River NF.

Region 9: 1 Hoosier NF, Mark Twain NF, Shawnee NF; 2 Alleghany NF, Monongahela NF, Wayne NF; 3 Green Mountain and Finger Lakes National Forests, White Mountain NF; 4 Hiawatha NF, Huron-Manistee NF, Ottawa NF; 5 Chippewa NF, Chequamegon/Nicolet NF, Superior NF.
[c] Number of cases is less than 30. Region-level average substituted.

Table C-2. Multi-site Zonal Travel Cost Model Inputs, USDA FS Region 2.

National Forest	Dist. Band	Day Use/Cap.	Day Use/Th. Pop.	OVN Use/Cap.	OVN Use/Th. Pop.	Pop.	Med. Income	Dist. Nearest Oth NF	Dist. BLM	Dist. NPS	RUC Code	NF Acres (Th.)	Number of Units
Bighorn NF	35	0.00	0	0.00	0	7,704	33,302	60	9	58	7	1,108	1
Bighorn NF	40	1.67	1674	0.10	101	9,290	34,395	26	10	29	7	1,108	1
Bighorn NF	45	0.00	0	0.01	7	3,258	34,230	59	27	31	6	1,108	1
Bighorn NF	50	0.00	0	0.00	0	2,094	39,918	26	10	34	7	1,108	1
Bighorn NF	65	0.09	90	0.29	287	65,976	35,039	36	15	49	5	1,108	1
Bighorn NF	80	0.01	13	0.19	187	145,176	43,184	41	16	45	4	1,108	1
Bighorn NF	95	0.03	31	0.11	106	94,498	37,974	24	12	132	5	1,108	1
Bighorn NF	110	0.00	0	0.03	26	20,475	32,412	23	11	97	7	1,108	1
Bighorn NF	125	0.00	0	0.04	42	27,463	35,178	17	18	82	7	1,108	1
Bighorn NF	140	0.00	0	0.00	0	31,922	32,626	22	26	74	7	1,108	1
Bighorn NF	155	0.00	0	0.00	0	48,331	36,236	13	24	59	7	1,108	1
Bighorn NF	170	0.00	0	0.01	9	116,709	37,921	12	25	58	6	1,108	1
Bighorn NF	185	0.00	0	0.09	92	124,384	39,806	10	30	36	4	1,108	1
Bighorn NF	200	0.00	0	0.05	49	83,677	36,975	23	21	68	6	1,108	1
Black Hills NF	35	0.00	0	0.00	0	7,714	37,590	32	22	37	4	1,247	2

Table C-2. (Cont'd).

National Forest	Dist. Band	Day Use/Cap.	Day Use/Th. Pop.	OVN Use/Cap.	OVN Use/Th. Pop.	Pop.	Med. Income	Dist. Nearest Oth NF	Dist. BLM	Dist. NPS	RUC Code	NF Acres (Th.)	Number of Units
Black Hills NF	40	0.00	0	0.00	0	19,198	35,647	39	41	43	6	1,247	2
Black Hills NF	45	0.00	0	0.01	7	23,519	43,915	52	26	46	6	1,247	2
Black Hills NF	50	0.00	0	0.00	0	5,687	37,518	33	50	49	7	1,247	2
Black Hills NF	65	0.00	0	0.66	665	15,187	33,053	33	39	54	7	1,247	2
Black Hills NF	80	0.01	8	0.02	15	13,350	33,065	34	49	73	8	1,247	2
Black Hills NF	95	0.00	1	0.01	13	45,223	34,433	37	54	97	7	1,247	2
Black Hills NF	110	0.00	0	0.04	42	66,475	32,956	36	53	109	6	1,247	2
Black Hills NF	125	0.00	0	0.05	47	70,442	32,527	23	28	110	6	1,247	2
Black Hills NF	140	0.00	0	0.04	43	71,702	37,838	30	33	123	5	1,247	2
Black Hills NF	155	0.00	0	0.06	58	60,837	35,578	44	80	98	7	1,247	2
Black Hills NF	170	0.00	0	0.00	3	160,649	35,168	28	33	62	5	1,247	2
Black Hills NF	185	0.00	0	0.00	0	67,580	31,625	61	105	105	7	1,247	2
Black Hills NF	200	0.00	0	0.00	0	56,451	34,498	67	114	115	7	1,247	2
Grand Mesa, U., G. NF	35	0.10	101	0.06	57	35,863	43,152	9	10	41	6	2,957	3

Table C-2. (Cont'd)

National Forest	Dist. Band	Day Use/Cap.	Day Use/Th. Pop.	OVN Use/Cap.	OVN Use/Th. Pop.	Pop.	Med. Income	Dist. Nearest Oth NF	Dist. BLM	Dist. NPS	RUC Code	NF Acres (Th.)	Number of Units
Grand Mesa, U., G. NF	40	0.00	0	0.01	12	42,782	45,014	8	10	32	6	2,957	3
Grand Mesa, U., G. NF	45	0.00	0	0.03	29	32,362	45,856	6	11	43	6	2,957	3
Grand Mesa, U., G. NF	50	0.00	0	0.00	0	38,882	45,047	8	13	40	6	2,957	3
Grand Mesa, U., G. NF	65	0.18	180	0.18	180	110,348	40,920	10	11	30	5	2,957	3
Grand Mesa, U., G. NF	80	0.00	4	0.05	54	329,899	55,759	19	16	27	3	2,957	3
Grand Mesa, U., G. NF	95	0.00	1	0.09	92	1,861,778	54,455	16	32	43	2	2,957	3
Grand Mesa, U., G. NF	110	0.00	0	0.02	24	1,072,170	54,018	21	35	43	1	2,957	3
Grand Mesa, U., G. NF	125	0.00	0	0.08	78	250,164	45,416	21	30	39	3	2,957	3
Grand Mesa, U., G. NF	140	0.00	0	0.01	11	395,152	42,318	22	41	39	3	2,957	3
Grand Mesa, U., G. NF	155	0.00	0	0.01	12	145,600	38,140	26	31	47	5	2,957	3

Table C-2. (Cont'd)

National Forest	Dist. Band	Day Use/Cap.	Day Use/Th. Pop.	OVN Use/Cap.	OVN Use/Th. Pop.	Pop.	Med. Income	Dist. Nearest Oth NF	Dist. BLM	Dist. NPS	RUC Code	NF Acres (Th.)	Number of Units
Grand Mesa, U., G. NF	170	0.00	0	0.00	0	256,444	36,313	22	23	48	4	2,957	3
Grand Mesa, U., G. NF	185	0.00	0	0.00	0	408,111	40,478	18	21	90	3	2,957	3
Grand Mesa, U., G. NF	200	0.00	0	0.00	4	831,622	45,825	14	29	69	2	2,957	3
Medicine Bow NF	35	1.11	1109	1.93	1934	19,071	47,379	34	16	80	6	1,095	4
Medicine Bow NF	40	0.06	61	0.47	474	52,362	49,206	19	28	45	4	1,095	4
Medicine Bow NF	45	0.00	0	0.06	55	108,077	44,947	12	40	29	2	1,095	4
Medicine Bow NF	45	0.00	0	0.06	55	108,077	44,947	12	40	29	2	1,095	4
Medicine Bow NF	50	0.00	0	0.00	0	45,710	60,061	16	37	37	3	1,095	4
Medicine Bow NF	65	0.01	10	0.09	86	237,615	46,503	22	40	39	3	1,095	4
Medicine Bow NF	80	0.00	0	0.05	52	247,796	55,833	15	24	30	3	1,095	4
Medicine Bow NF	95	0.00	0	0.02	18	651,722	55,191	22	32	42	2	1,095	4
Medicine Bow NF	110	0.00	2	0.01	7	1,515,087	52,112	20	39	51	1	1,095	4
Medicine Bow NF	125	0.00	1	0.01	14	419,159	69,315	23	45	61	3	1,095	4
Medicine Bow NF	140	0.00	0	0.01	7	121,288	45,567	22	33	52	5	1,095	4

Table C-2. (Cont'd)

National Forest	Dist. Band	Day Use/Cap.	Day Use/Th. Pop.	OVN Use/Cap.	OVN Use/Th. Pop.	Pop.	Med. Income	Dist. Nearest Oth NF	Dist. BLM	Dist. NPS	RUC Code	NF Acres (Th.)	Number of Units
Medicine Bow NF	155	0.00	0	0.02	21	324,597	45,436	17	23	30	4	1,095	4
Medicine Bow NF	170	0.00	0	0.00	0	554,380	45,023	13	20	33	3	1,095	4
Medicine Bow NF	185	0.00	0	0.01	11	149,128	37,062	21	23	41	5	1,095	4
Medicine Bow NF	200	0.00	0	0.02	16	108,425	37,278	27	32	56	6	1,095	4
Nebraska NF	35	0.00	0	0.00	0	23,794	32,315	96	88	75	8	1,064	5
Nebraska NF	40	0.00	0	0.00	0	21,350	32,899	127	126	94	7	1,064	5
Nebraska NF	45	0.00	0	0.12	124	26,235	31,247	101	99	91	6	1,064	5
Nebraska NF	50	0.00	4	0.01	9	71,982	33,380	143	129	129	6	1,064	5
Nebraska NF	65	0.00	0	0.04	39	73,878	32,101	115	108	103	7	1,064	5
Nebraska NF	80	0.00	0	0.02	23	75,207	33,811	161	155	116	7	1,064	5
Nebraska NF	95	0.00	0	0.04	43	92,906	36,848	152	144	99	7	1,064	5
Nebraska NF	110	0.00	0	0.01	15	152,242	35,912	210	210	124	7	1,064	5
Nebraska NF	125	0.00	0	0.01	11	280,967	37,138	139	143	111	5	1,064	5
Nebraska NF	140	0.00	0	0.02	18	183,994	33,699	177	198	116	6	1,064	5
Nebraska NF	155	0.00	0	0.02	17	188,346	37,178	203	227	89	6	1,064	5

Table C-2. (Cont'd)

National Forest	Dist. Band	Day Use/Cap.	Day Use/Th. Pop.	OVN Use/Cap.	OVN Use/Th. Pop.	Pop.	Med. Income	Dist. Nearest Oth NF	Dist. BLM	Dist. NPS	RUC Code	NF Acres (Th.)	Number of Units
Nebraska NF	155	0.00	0	0.02	17	188,346	37,178	203	227	89	6	1,064	5
Nebraska NF	170	0.00	0	0.00	4	553,472	43,409	87	128	54	4	1,064	5
Nebraska NF	185	0.00	0	0.01	9	511,439	43,830	116	183	69	4	1,064	5
Nebraska NF	200	0.00	0	0.01	7	546,561	45,340	195	273	102	4	1,064	5
Pike San Isabel NF	35	0.04	43	0.19	188	278,809	58,165	17	23	31	2	2,772	3
Pike San Isabel NF	40	0.01	11	0.04	35	97,644	61,499	19	25	37	3	2,772	3
Pike San Isabel NF	45	0	0	0.3	300	57,818	53,528	20	30	45	4	2,772	3
Pike San Isabel NF	50	0.02	17	0	0	95,697	50,372	17	27	35	3	2,772	3
Pike San Isabel NF	65	0.16	163	0	0	170,389	47,519	17	32	39	4	2,772	3
Pike San Isabel NF	80	0.01	5	0.01	8	375,577	43,536	21	40	38	4	2,772	3
Pike San Isabel NF	95	0	0	0.16	162	101,534	38,257	29	35	56	6	2,772	3
Pike San Isabel NF	110	0	0	0.01	10	180,036	37,031	20	18	28	4	2,772	3
Pike San Isabel NF	125	0	0	0.08	80	303,674	41,581	18	19	43	4	2,772	3
Routt NF	35	0.03	32	0.06	65	37,245	51,296	6	14	60	5	1,126	3
Routt NF	40	0.00	0	0.29	292	149,690	50,420	9	27	35	3	1,126	3
Routt NF	45	0.00	0	0.10	103	322,306	52,574	10	26	28	2	1,126	3
Routt NF	50	0.10	100	0.25	249	103,741	66,963	12	24	30	2	1,126	3
Routt NF	65	0.00	0	0.05	53	1,114,929	53,639	20	33	41	2	1,126	3

Table C-2. (Cont'd)

National Forest	Dist. Band	Day Use/Cap.	Day Use/Th. Pop.	OVN Use/Cap.	OVN Use/Th. Pop.	Pop.	Med. Income	Dist. Nearest Oth NF	Dist. BLM	Dist. NPS	RUC Code	NF Acres (Th.)	Number of Units
Routt NF	80	0.04	37	0.08	80	1,226,691	54,870	20	41	52	1	1,126	3
Routt NF	95	0.00	0	0.11	113	269,427	59,212	19	32	36	2	1,126	3
Routt NF	110	0.00	0	0.08	84	255,241	54,253	18	23	35	4	1,126	3
Routt NF	125	0.00	0	0.01	13	463,201	45,181	14	17	35	2	1,126	3
Routt NF	140	0.00	0	0.01	14	189,661	36,815	30	24	93	5	1,126	3
Routt NF	155	0.00	0	0.01	9	205,154	34,936	31	39	77	4	1,126	3
Routt NF	170	0.00	0	0.00	0	85,763	34,479	38	38	87	6	1,126	3
Routt NF	185	0.00	0	0.00	0	81,524	34,412	32	33	68	7	1,126	3
Routt NF	200	0.00	0	0.00	0	127,831	37,095	30	37	62	7	1,126	3
Shoshone NF	35	0.15	146	0.00	0	11,668	38,180	24	20	73	7	2,437	2
Shoshone NF	40	0.01	9	0.03	30	20,983	46,266	24	15	39	7	2,437	2
Shoshone NF	45	0.00	0	0.06	57	15,530	41,936	25	12	48	8	2,437	2
Shoshone NF	50	0.00	0	0.59	588	4,538	36,813	21	33	35	6	2,437	2
Shoshone NF	65	0.03	28	0.08	83	142,684	39,891	28	20	43	5	2,437	2
Shoshone NF	80	0.01	10	0.00	0	130,646	39,748	23	18	46	5	2,437	2
Shoshone NF	95	0.00	1	0.01	15	95,964	38,108	21	11	58	5	2,437	2
Shoshone NF	110	0.00	0	0.07	69	114,051	41,419	24	12	63	4	2,437	2
Shoshone NF	125	0.00	0	0.07	70	148,779	37,144	19	12	111	5	2,437	2
Shoshone NF	140	0.00	0	0.00	0	134,342	39,131	12	11	83	5	2,437	2
Shoshone NF	155	0.00	0	0.00	0	236,580	38,322	11	23	84	5	2,437	2

Table C-2. (Cont'd)

National Forest	Dist. Band	Day Use/Cap.	Day Use/Th. Pop.	OVN Use/Cap.	OVN Use/Th. Pop.	Pop.	Med. Income	Dist. Nearest Oth NF	Dist. BLM	Dist. NPS	RUC Code	NF Acres (Th.)	Number of Units
Shoshone NF	170	0.00	0	0.01	11	121,759	44,207	14	28	89	5	2,437	2
Shoshone NF	185	0.00	0	0.02	19	503,854	49,803	14	38	97	3	2,437	2
Shoshone NF	200	0.00	0	0.00	4	694,218	49,402	11	24	108	2	2,437	2
White River NF	35	0.11	111	0.05	49	42,733	47,461	13	11	23	5	2,276	2
White River NF	40	0.01	6	0.02	21	28,720	45,843	9	12	27	5	2,276	2
White River NF	45	0.00	0	1.61	1607	33,782	72,002	10	23	35	2	2,276	2
White River NF	50	0.04	41	0.21	208	53,498	64,208	12	18	29	4	2,276	2
White River NF	65	0.09	85	0.15	150	1,386,385	55,119	16	32	39	1	2,276	2
White River NF	80	0.10	96	0.13	131	1,200,400	59,284	20	39	46	1	2,276	2
White River NF	95	0.01	13	0.04	36	808,937	47,041	14	26	31	2	2,276	2
White River NF	95	0.01	13	0.04	36	808,937	47,041	14	26	31	2	2,276	2
White River NF	110	0.00	0	0.12	124	140,555	39,308	20	24	53	4	2,276	2
White River NF	125	0.00	0	0.04	43	268,238	36,015	22	24	58	4	2,276	2
White River NF	140	0.00	0	0.01	11	143,156	38,320	26	26	56	6	2,276	2
White River NF	155	0.00	0	0.00	0	63,317	34,381	36	33	75	6	2,276	2

Table C-2. (Cont'd)

National Forest	Dist. Band	Day Use/Cap.	Day Use/Th. Pop.	OVN Use/Cap.	OVN Use/Th. Pop.	Pop.	Med. Income	Dist. Nearest Oth NF	Dist. BLM	Dist. NPS	RUC Code	NF Acres (Th.)	Number of Units
White River NF	170	0.00	0	0.00	0	130,110	36,660	47	28	46	5	2,276	2
White River NF	185	0.00	0	0.00	0	109,934	32,378	45	40	85	6	2,276	2
White River NF	200	0.00	0	0.00	0	494,459	41,222	21	24	119	4	2,276	2

Note: All distance units = miles.

Table C-3. Multi-site Zonal Travel Cost Model Inputs, USDA FS Region 9.

National Forest	Dist. Band	Day Use	Day Use/Th. Pop.	OVN Use	OVN Use/Th. Pop.	Pop.	Med. Income	Dist. Nearest Oth NF	Dist. NPS	RUC Code	NF Acres (Th.)	Number of Units
Allegheny NF	35	0	0	23,274	190	122,242	34,091	130	127	4	513	1
Allegheny NF	40	0	0	24,084	140	171,747	36,259	127	126	3	513	1
Allegheny NF	45	0	0	8,617	35	245,730	36,360	137	112	2	513	1
Allegheny NF	50	0	0	55,068	195	281,968	36,851	129	115	2	513	1
Allegheny NF	65	6,852	5	77,737	57	1,363,317	37,590	105	135	2	513	1
Allegheny NF	80	2,216	1	83,304	31	2,703,106	41,126	90	112	2	513	1
Allegheny NF	95	1,163	1	7,677	5	1,582,831	41,175	83	108	2	513	1
Allegheny NF	110	0	0	21,840	8	2,807,109	44,548	88	83	2	513	1
Allegheny NF	125	0	0	8,875	4	2,267,611	42,848	93	55	2	513	1
Allegheny NF	140	37	0	227	0	1,655,349	42,905	90	76	3	513	1
Allegheny NF	155	14	0	825	0	2,228,484	41,907	85	88	2	513	1
Allegheny NF	170	0	0	489	0	1,904,694	46,632	103	77	2	513	1
Allegheny NF	185	27	0	127	0	3,705,003	55,381	100	74	2	513	1
Allegheny NF	200	0	0	8,136	2	5,195,534	60,517	99	70	1	513	1
Chequamegon-Nicolet NF	35	8,761	69	66,102	518	127,492	39,790	83	98	5	1,522	4
Chequamegon-Nicolet NF	40	12,619	87	95,664	659	145,185	42,460	103	100	4	1,522	4
Chequamegon-Nicolet NF	45	52,904	197	16,854	63	267,935	42,663	110	99	3	1,522	4
Chequamegon-Nicolet NF	50	0	0	45,075	270	166,648	45,987	108	97	3	1,522	4
Chequamegon-Nicolet NF	65	114,065	179	90,798	143	636,087	43,595	98	97	4	1,522	4
Chequamegon-Nicolet NF	80	4,651	11	49,248	112	440,245	42,796	116	90	4	1,522	4
Chequamegon-Nicolet NF	95	0	0	19,335	38	504,473	43,281	151	74	4	1,522	4
Chequamegon-Nicolet NF	110	0	0	32,641	45	724,375	53,388	141	50	3	1,522	4
Chequamegon-Nicolet NF	125	0	0	39,512	19	2,058,187	50,221	152	27	2	1,522	4
Chequamegon-Nicolet NF	140	34,633	23	45,578	30	1,526,207	61,584	164	51	2	1,522	4
Chequamegon-Nicolet NF	155	0	0	34,236	19	1,809,316	46,756	254	93	2	1,522	4
Chequamegon-Nicolet NF	170	0	0	17,111	26	653,456	46,721	256	86	4	1,522	4
Chequamegon-Nicolet NF	185	2,613	4	6,423	9	737,879	43,321	240	84	4	1,522	4
Chequamegon-Nicolet NF	200	0	0	268	0	1,239,496	51,300	254	84	3	1,522	4
Chippewa NF	35	387	14	524	19	27,531	35,255	86	99	6	666	1
Chippewa NF	40	137	5	730	29	25,409	38,547	85	101	6	666	1
Chippewa NF	45	0	0	1,939	32	61,202	34,048	76	92	5	666	1

Table C-3. (Cont'd)

National Forest	Dist. Band	Day Use	Day Use/Th. Pop.	OVN Use	OVN Use/Th. Pop.	Pop.	Med. Income	Dist. Nearest Oth NF	Dist. NPS	RUC Code	NF Acres (Th.)	Number of Units
Chippewa NF	35	387	14	524	19	27,531	35,255	86	99	6	666	1
Chippewa NF	40	137	5	730	29	25,409	38,547	85	101	6	666	1
Chippewa NF	45	0	0	1,939	32	61,202	34,048	76	92	5	666	1
Chippewa NF	50	12,070	548	28,212	1,280	22,034	35,733	68	96	4	666	1
Chippewa NF	65	0	0	23,947	209	114,592	35,910	72	102	5	666	1
Chippewa NF	80	0	0	60,474	237	254,802	39,406	63	84	4	666	1
Chippewa NF	95	0	0	9,068	41	222,581	39,984	87	87	4	666	1
Chippewa NF	110	0	0	23,873	57	416,584	43,309	80	112	3	666	1
Chippewa NF	125	0	0	26,187	63	412,793	52,292	109	62	2	666	1
Chippewa NF	140	0	0	131,388	122	1,073,400	56,134	122	22	2	666	1
Chippewa NF	155	5,019	3	97,870	62	1,588,174	54,584	124	19	2	666	1
Chippewa NF	170	0	0	14,935	40	369,018	57,401	114	39	3	666	1
Chippewa NF	185	752	3	3,574	13	266,908	43,061	105	61	5	666	1
Chippewa NF	200	350	1	1,970	7	301,925	40,613	112	80	5	666	1
Hoosier NF	35	5,345	13	20,687	48	427,134	36,084	116	96	2	196	2
Hoosier NF	40	0	0	29,346	51	577,270	45,952	116	99	2	196	2
Hoosier NF	45	24,126	42	168	0	580,652	47,411	120	104	2	196	2
Hoosier NF	50	4,149	6	13,041	20	648,346	40,676	135	123	2	196	2
Hoosier NF	65	15,256	13	4,153	3	1,215,867	48,637	134	116	2	196	2
Hoosier NF	80	342	0	2,009	2	995,459	43,349	110	124	3	196	2
Hoosier NF	95	0	0	316	0	2,024,884	43,208	104	141	2	196	2
Hoosier NF	110	0	0	1,600	1	1,834,976	43,772	88	130	3	196	2
Hoosier NF	125	0	0	0	0	1,897,410	39,986	87	127	3	196	2
Hoosier NF	140	0	0	372	0	1,649,875	41,554	84	115	3	196	2
Hoosier NF	155	0	0	156	0	1,461,445	40,556	100	112	4	196	2
Hoosier NF	170	0	0	1,662	1	2,069,555	43,234	105	108	3	196	2
Hoosier NF	185	316	0	1,501	0	4,359,779	44,407	111	81	2	196	2
Hoosier NF	200	195	0	1,097	0	5,216,523	45,398	140	80	2	196	2
Huron-Manistee NF	35	8,376	22	28,708	75	380,296	48,127	240	104	3	974	2
Huron-Manistee NF	40	453	2	2,404	11	226,496	44,829	215	103	4	974	2
Huron-Manistee NF	45	0	0	3,009	27	110,178	43,917	162	101	5	974	2

Table C-3. (Cont'd)

National Forest	Dist. Band	Day Use	Day Use/Th. Pop.	OVN Use	OVN Use/Th. Pop.	Pop.	Med. Income	Dist. Nearest Oth NF	Dist. NPS	RUC Code	NF Acres (Th.)	Number of Units
Huron-Manistee NF	35	8,376	22	28,708	75	380,296	48,127	240	104	3	974	2
Huron-Manistee NF	40	453	2	2,404	11	226,496	44,829	215	103	4	974	2
Huron-Manistee NF	45	0	0	3,009	27	110,178	43,917	162	101	5	974	2
Huron-Manistee NF	50	19,294	191	10,589	105	100,984	48,231	161	97	5	974	2
Huron-Manistee NF	65	51,253	87	19,699	33	588,339	43,404	183	124	3	974	2
Huron-Manistee NF	80	1,402	2	52,853	66	801,476	42,896	221	121	2	974	2
Huron-Manistee NF	95	0	0	84,855	127	670,643	43,306	209	129	3	974	2
Huron-Manistee NF	110	5,749	7	40,506	50	815,638	52,420	209	119	3	974	2
Huron-Manistee NF	125	0	0	42,726	32	1,337,727	57,250	202	107	2	974	2
Huron-Manistee NF	140	2,455	1	66,676	32	2,093,929	59,470	233	116	2	974	2
Huron-Manistee NF	155	0	0	4,942	2	2,474,047	41,883	234	109	1	974	2
Huron-Manistee NF	170	0	0	5,750	8	757,632	42,058	151	103	3	974	2
Huron-Manistee NF	185	124	0	591	2	347,746	42,266	112	83	4	974	2
Huron-Manistee NF	200	15	0	83	0	817,714	48,602	120	68	3	974	2
Mark Twain NF	35	0	0	2,241	7	322,133	36,542	63	82	3	1,493	9
Mark Twain NF	40	4,267	17	948	4	258,399	39,868	78	89	3	1,493	9
Mark Twain NF	45	263	1	6,343	16	388,351	49,135	71	96	3	1,493	9
Mark Twain NF	50	4,179	8	117	0	501,936	52,758	69	105	2	1,493	9
Mark Twain NF	65	540	0	5,827	3	1,960,571	39,595	76	114	2	1,493	9
Mark Twain NF	80	1,714	2	392	0	1,065,411	37,470	75	121	4	1,493	9
Mark Twain NF	95	513	1	682	1	941,035	33,761	71	119	4	1,493	9
Mark Twain NF	110	0	0	1,797	2	926,822	35,606	78	133	4	1,493	9
Mark Twain NF	125	256	0	4,186	2	2,168,103	39,515	83	147	2	1,493	9
Mark Twain NF	140	13,081	6	404	0	2,231,017	44,552	115	157	2	1,493	9
Mark Twain NF	155	0	0	1,003	1	1,852,932	43,573	137	166	3	1,493	9
Mark Twain NF	170	0	0	319	0	1,191,293	35,224	105	143	4	1,493	9
Mark Twain NF	185	0	0	1,694	1	1,367,317	37,333	135	159	4	1,493	9
Mark Twain NF	200	97	0	544	0	2,265,465	41,492	144	145	3	1,493	9
Monongahela NF	35	35,875	208	8,195	48	172,276	34,150	35	54	4	909	1
Monongahela NF	40	11,219	38	5,891	20	293,195	35,595	25	32	4	909	1
Monongahela NF	45	1,016	3	4,620	13	366,726	34,567	27	41	3	909	1

Table C-3. (Cont'd)

National Forest	Dist. Band	Day Use	Day Use/Th. Pop.	OVN Use	OVN Use/Th. Pop.	Pop.	Med. Income	Dist. Nearest Oth NF	Dist. NPS	RUC Code	NF Acres (Th.)	Number of Units
Monongahela NF	50	2,781	10	20,264	76	266,787	33,748	35	47	3	909	1
Monongahela NF	65	5,892	5	31,279	29	1,090,238	37,420	36	50	3	909	1
Monongahela NF	80	619	0	16,529	10	1,697,669	40,100	54	84	2	909	1
Monongahela NF	95	1,699	1	38,472	16	2,405,397	45,480	53	77	3	909	1
Monongahela NF	110	0	0	6,011	2	3,214,914	59,581	58	67	2	909	1
Monongahela NF	125	0	0	25,410	6	4,234,911	53,353	69	71	2	909	1
Monongahela NF	140	6,597	2	9,477	2	4,324,712	44,931	71	91	2	909	1
Monongahela NF	155	0	0	10,248	3	3,874,505	43,524	74	100	2	909	1
Monongahela NF	170	0	0	2,596	1	3,597,223	45,830	69	106	3	909	1
Monongahela NF	185	0	0	3,359	1	3,942,635	43,273	74	102	3	909	1
Monongahela NF	200	0	0	0	0	4,981,607	44,389	90	101	2	909	1
Ottawa NF	35	1,833	45	0	0	40,295	35,657	31	71	6	990	1
Ottawa NF	40	0	0	0	0	49,461	34,356	27	75	6	990	1
Ottawa NF	45	2,771	120	1,102	48	23,155	37,631	19	87	7	990	1
Ottawa NF	50	0	0	0	0	18,171	33,829	21	67	7	990	1
Ottawa NF	65	0	0	732	10	71,357	33,743	16	93	7	990	1
Ottawa NF	80	356	3	244	2	127,495	38,258	21	90	5	990	1
Ottawa NF	95	524	2	3,228	13	246,562	40,405	33	115	4	990	1
Ottawa NF	110	0	0	4,375	13	346,129	42,075	43	98	4	990	1
Ottawa NF	125	1,176	2	5,988	10	599,554	45,450	54	102	3	990	1
Ottawa NF	140	0	0	0	0	444,996	43,913	67	92	4	990	1
Ottawa NF	155	35	0	2,118	5	414,589	45,481	81	74	3	990	1
Ottawa NF	170	0	0	1,583	1	1,070,462	53,023	105	42	2	990	1
Ottawa NF	185	0	0	1,866	1	2,118,791	51,398	119	28	2	990	1
Ottawa NF	200	0	0	4,822	4	1,137,429	59,759	125	55	2	990	1
Shawnee NF	35	7,830	64	3,593	29	122,615	32,990	40	99	5	278	2
Shawnee NF	40	7,330	64	6,322	55	115,252	34,984	44	100	4	278	2
Shawnee NF	45	4,242	16	8,619	32	266,882	37,129	47	99	3	278	2
Shawnee NF	50	1,574	6	9,867	38	262,588	42,020	49	102	3	278	2
Shawnee NF	65	3,376	2	23,151	17	1,368,887	39,028	54	106	2	278	2
Shawnee NF	80	5,097	3	3,138	2	1,592,463	47,985	58	112	2	278	2

Table C-3. (Cont'd)

National Forest	Dist. Band	Day Use	Day Use/Th. Pop.	OVN Use	OVN Use/Th. Pop.	Pop.	Med. Income	Dist. Nearest Oth NF	Dist. NPS	RUC Code	NF Acres (Th.)	Number of Units
Shawnee NF	95	7,972	9	1,011	1	859,394	41,587	54	102	4	278	2
Shawnee NF	110	0	0	5,633	8	745,921	37,105	58	97	4	278	2
Shawnee NF	125	4,204	4	4,018	4	1,087,908	39,214	62	95	3	278	2
Shawnee NF	140	8,049	4	4,809	2	2,139,854	41,808	63	109	2	278	2
Shawnee NF	155	0	0	2,717	1	2,183,318	42,963	50	115	2	278	2
Shawnee NF	170	0	0	5,206	4	1,429,686	39,158	58	122	4	278	2
Shawnee NF	185	0	0	824	0	1,900,141	38,944	60	128	3	278	2
Shawnee NF	200	0	0	3,706	2	1,913,457	42,591	82	124	3	278	2
Wayne NF	35	8,996	32	231	1	285,568	40,167	101	102	2	230	3
Wayne NF	40	0	0	1,820	5	384,470	40,277	103	103	2	230	3
Wayne NF	45	12,551	18	1,044	1	708,626	38,338	100	103	2	230	3
Wayne NF	50	9,935	17	0	0	589,046	45,661	95	98	3	230	3
Wayne NF	65	7,928	7	9,805	8	1,180,032	41,590	80	94	3	230	3
Wayne NF	80	2,825	1	13,722	5	2,722,774	38,736	89	91	2	230	3
Wayne NF	95	10,519	3	9,971	3	3,165,126	43,788	89	106	2	230	3
Wayne NF	110	0	0	17,363	6	3,114,392	43,885	81	106	2	230	3
Wayne NF	125	0	0	5,221	2	2,962,458	41,573	104	56	2	230	3
Wayne NF	140	0	0	4,212	3	1,622,707	37,213	64	89	4	230	3
Wayne NF	155	0	0	8,444	4	1,920,987	38,175	67	94	4	230	3
Wayne NF	170	0	0	2,759	1	2,547,105	40,461	57	92	3	230	3
Wayne NF	185	205	0	974	0	2,397,797	41,987	62	92	3	230	3
Wayne NF	200	1,380	0	1,380	0	3,720,472	48,262	73	104	2	230	3

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