The Forest Service’s National Visitor Use Monitoring (NVUM) Program
USDA Forest Service

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ABSTRACT

The National Visitor Use Monitoring (NVUM) data underlies the Forest Service’s estimates of recreation visitation volume as well as both the market and nonmarket benefits of visitation. Applications include evaluating the effects of natural disasters, site characteristics, and climate change, and also expenditure and benefit transfers. Keywords: Recreation, visitation, economics,

INTRODUCTION

The Forest Service’s National Visitor Use Monitoring (NVUM) program is a nation-wide monitoring effort that serves two concurrent goals. One is to estimate the volume of recreation visits to units of the National Forest System (NFS). The other is to describe salient characteristics of those visits, including activity participation, visit duration, demographics, and satisfaction elements. In addition, data is obtained that allow estimates of contribution to local economies and of net values via Travel Cost Method analysis. In part because it pursues both goals through one data collection effort, the NVUM program is widely recognized as the best and most complete effort of its kind.

Estimates are obtained for every NFS unit on a regular 5-year schedule. About 20% of the forest units in each FS region actively collect field data each fiscal year. Estimates are obtained for a year at a NF level. That is, visitation is calculated for the entire NF for the entire year. Each year, the agency spends about $2 million obtaining field data, accomplishing some 5,800 days of field data collection per year. Each year, roughly 45,000 public contacts are made; on average, 40% to 45% of those are recreation visitors who are completing their recreation visit. The NVUM Results application provides summary tables from each forest’s data collection, and is available at https://apps.fs.usda.gov/nvum/results. Persons wishing to request individual recreation survey data can do so via that same application.

In this paper, we present a short synopsis of the NVUM program and some of the key uses of the data. We document the conditions that lead to the creation of the NVUM program, outline the sampling and visit estimation approaches employed by the program. Then, we describe the process used for estimating market (i.e., job and income) effects of recreation visits and give a synopsis of the process for evaluating the effects of area closures due to natural disasters. We

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also review some research that has used NVUM data of for estimating nonmarket effects of recreation access on national forests.

**SHORT HISTORY**

In its 1995 RPA Program documents (USFS 1995), the Forest Service reported that there were about 730 million recreation visits to NFS lands, or approximately 2.8 visits per capita for the US population at the time. That visitation figure came from the Agency’s Recreation Information Management (RIM) system. The RIM system relied on self-reported site-level visit counts from site managers. The counts were intended to represent the number of unique visits to the site. Counts were aggregated to higher organization levels with essentially no oversight or validation.

One key part of the RPA Program document was to show the contribution FS programs made to the jobs and GDP of the US. The recreation visitation levels lay at the heart of the estimates of economic contribution from recreational use of NFS. Graphs displayed in the document indicated that recreation accounted for more than 75% of the jobs and GDP effects of all FS programs combined.

Not all economists welcomed or agreed with the agency’s estimates of the importance of recreation. Several challenged the results. Not from concerns about the visitor spending profiles or economic models, but from the estimates of recreation use. Agency recreation staff were unable to validate or document the accuracy of the visit numbers.

An internal review of the reported visitation counts showed a variety of problems. Many were simply a fixed percentage expansions of previous years’ reporting. Quite a number were totally fabricated, as a means to increment recreation budgets. Some counts measured activity occasions: each incidence of a different activity (for example, picnicking, swimming, camping, and bird watching) was counted separately even at the same site. In some cases, instances of people travelling past NFS lands and viewing the scenery from their cars were included in recreation counts because recreation dollars were used to manage the view shed. Such activity should not have been included: it did not qualify as visitation because the individuals never got onto NFS lands.

In 1998, the FS assembled a national team of agency scientists and staff who began to develop an approach for obtaining a reliable visitation estimate at the national level. Discussion with line officers in the agency moved the spatial resolution of the results to the NFS unit level. A national beta test of the NVUM process began January 1, 2000 (English, et al, 2002). During that test, some adjustments were made to the field method and some small edits to the survey instrument. Beginning in FY2005, the NVUM method that is still in use began to be applied. As the Fy2019 data become available, three national ‘rounds’ of data collection will have been completed.

As they are completed, National summary reports are made available at: [https://www.fs.fed.us/about-agency/nvum](https://www.fs.fed.us/about-agency/nvum). Results for each completed survey iteration for each national forest can be viewed through the publicly-available results application:
NVUM APPROACH

Sampling Frame. Perhaps the greatest strength of the NVUM program lies in its sampling approach. The approach used in NVUM is analogous to other agency efforts for estimating timber volumes or the size of wildlife populations. As with all of the biophysical monitoring done by the Forest Service, the sampling framework for NVUM has temporal and spatial dimensions. Estimates of the size of the population of NF recreation visits is built up from samples drawn from within this sampling framework. The spatial dimension defines the access points that the public uses to get to places to recreate. The temporal dimension is each day in the fiscal year for which visit estimates are developed. The combination of location and time (a site-day) is the primary sampling unit for NVUM.

Recreation staff on each forest follow a consistent process to create the sampling frame for their forest. By utilizing the local knowledge of the timing and locations of the pulse of recreation, the NVUM program improves both its local acceptance and incorporates and unique aspects for the forest. Recreation staff first define the set of sites where traffic will be monitored to estimate visitation. Four types of sites are used. Two of the four are concerned with developed sites, with moderate to high degrees of development. Developed Day Use Sites includes picnic areas, ski areas, visitor centers, swimming areas, shooting ranges, and similar types of developed areas. Overnight Use Developed areas capture places whose primary function is overnight lodging, such as campgrounds, cabins, lodges, and some resort facilities located on FS lands.

There are two types of access points to dispersed recreation opportunities. Access points to designated Wilderness and some Wild and Scenic Rivers are included. These special areas are included to be able to specifically estimate their recreation visitation. The final category represents access points to all other areas of the forest, which is the vast majority of the NFS. This category is titled ‘General Forest Areas’. These are the access points to the forest landscape where most people hike, bike, fish, etc. As an example, Figure 1 shows the more than 60 NVUM sites identified for the Chattooga River District on the Chattahoochee-Oconee NF in Georgia.

The NVUM process measures visits as they end. Each visit can only end once; by measuring at the visit’s ending, respondents know how long they were there, what activities they did, and how happy they were. The process recognizes that the volume of visitation can vary quite greatly from weekday to weekend and from season to season. Accordingly, each day of the fiscal year
for which the estimate is to be generated is classified into one of 5 levels of exiting recreation traffic volume: None, Low, Medium, High and Very High. Within general guidelines, forest staffs define where the thresholds are between levels, and apply them consistently across all days for each site of the same type on that forest. Each combination of site type and exit volume level represents one of the NVUM sampling strata.

Figure 2 shows the exit volume assignments for one GFA site on the Chattooga River District for FY2019. This site shows no exiting traffic (grey) weekdays from early November through late April volume. Low exiting traffic (green) occurs weekdays in October and mid-April to mid-May. Medium exiting recreation traffic (blue) occurs weekends in October through April, and weekdays from mid-May through September. High exiting traffic occurs on weekends starting in the middle of May and continuing through September.

Figure 2 about here

For a number of developed sites and a few dispersed access points, there are administratively available counts of metrics that: (1) are directly related to visitation, (2) cover all or large portions of the fiscal year, and (3) represent all users of the site or area. Good examples include skier visits at downhill areas, site usage reports from campground concessionaires, and permanent traffic counters at visitor centers. Such counts are typically available quarterly or annually. These visitation proxy measures are employed wherever possible to greatly improve the accuracy of the forest-wide visitation estimate. For these types of sites, the relevant stratification is by the type of information obtained, and consequently the information needed to convert to visitation.

One important implication of the NVUM sampling approach is that it is easily adapted to spatial intensification. Spatial intensification of sampling has been done in order to obtain estimates of visitation and visitor characteristics for several National Recreation Areas (Moosalamoo, Spring Mountains), National Monuments (Mount St. Helens Volcanic Monument), Wilderness Study Areas (Hyalite-Porcupine-Buffalo Mountain), and for several reporting units wanting to distinguish between spatially separate portions (NFS in FL, Cimarron-Comanche national grasslands, NFS in NC).

Field Sampling effort and data

Over a 5-year national cycle, field data is collected on an annual average about 5800 days or 230 to 240 survey days per national forest. The range is from about 75 days on the Midewin Tallgrass Prairie to over 300 on some larger forests, such as the NFS in North Carolina. Forests that have recently been combined, such as the Fremont-Winema, may have around 400 or so survey days assigned to them.

The sampling schedule for any forest is a stratified random sample of site-days drawn from the population for each sampling stratum. For visit estimation purposes, the spatial and temporal
distribution of the sample days in any stratum is immaterial. However, it is important to ensure adequate representation of visitor characteristics that often vary across seasons and/or parts of the forest. As a result, the algorithm that selects the set of site-days for sampling accounts for the spatial and temporal distribution of the population of site-days in each stratum.

On an assigned sample day, the person doing the data collection is to be at the assigned site for a 6-hour period. During that time, there are two tasks: count exiting traffic and survey as many of the exiting people/cars as can be accomplished. The observed counts of exiting traffic are expanded to estimate the total exiting count from the site for the calendar day.

Surveys are administered in order to collect the data needed to calibrate the total exiting count to exiting recreation visitation. Not all exiting traffic has a recreation purpose; not all exiting recreation traffic is completing their visit for the day. Those respondents who are not recreating or not completing their visit answer only a few screening questions. Those respondents who are completing a recreation visit to the site are asked additional questions that are used to describe the population of recreation visits.

To limit respondent burden and minimize partial responses, NVUM employs three survey types. All respondents receive questions for estimating visitation volume, demographics, visit duration, and activity participation. About one-third also receive economics questions needed for estimating market and nonmarket effects, including trip spending, household income, substitute activity, and distance to substitute sites. About one-third receive satisfaction and importance questions about 14 different aspects of the site visited including scenery, facility condition, employee helpfulness, and perception of safety. Importance-performance results from the satisfaction data are intended to help forest managers decide where to focus limited resources across various elements of site quality.

Gaps and issues

For safety reasons, field data (traffic observation and surveys) are collected only during daylight hours. As a result, any visits wherein the person is exiting the site or area after dark are missed. An example would be deer hunters who stay on stand until dark and then leave. Only public access points are included in the sampling frame. Adjacent landowners who have informal or exclusive access routes onto NFS lands are also missed.

Anecdotal evidence exists to suggest that repeat users of the same sites or travel routes are unlikely to stop to be interviewed more than once per survey season. We liken this to the ‘trap shyness’ phenomenon known in studies of wildlife populations using mark-and-recapture techniques. For NVUM, stopping for the survey is the analog to the trap. Both recreation and non-recreation visits are subject to this form of trap shyness; it is assumed that the two balance each other so that estimates of the proportion of exiting traffic that is finishing a visit are unbiased.

Estimating Visits
Let $T_s =$ the mean daily exiting traffic calculated over the sampled days in stratum $s$;
$P_s =$ the proportion of exiting vehicle/groups surveyed in stratum $s$ that were finishing a
recreation visit;
$PV_s =$ the mean number of people in recreating vehicles/groups surveyed in $s$;
$SF_s =$ the mean number of different sites visited per group during their NF recreation visit.

Site visits (SV) per day in $s = T_s \times P_s \times PV_s$
NF visits per day $= \frac{SV \text{ per day}}{SF_s}$

Total visits for any stratum are the daily visit estimates times the number of site-days in the
stratum. Once the total visits in a stratum is computed, it is possible to determine the sampling
rate of recreation visits in the stratum. The key point is that because of the sampling approach,
every recreation response is associated with a specific sampling stratum. Weighting the
recreation responses to expand to the population of visits is simply the inverse of the sampling
rate (visits in the stratum / number of surveys obtained in that stratum). Consequently, weighted
analyses using recreation responses from across all sampling strata will represent the entire
forest’s population of visits. Weights so constructed do not represent the population of
individuals who make the visits to NFS lands. To create a weight to represent persons, the visit
expansion weight should be divided by the reported number of times the individual visits the
forest.

**ESTIMATING MARKET EFFECTS OF RECREATION VISITS**

Estimating the economic activity from recreation visits and associated visitor spending requires
an estimate of a total spending by visitors within a specific geography and a modeling system, or
parameters, to translate that final demand into economic activity within that geography. The
NVUM survey data is used to estimate the average spending of visitors which is combined with
NVUM visitation figures to estimate total visitor spending at the forest level. In Forest Service
applications, that total spending is then combined with the input-output model IMPLAN to
estimate economic effects.

Compared to benefit estimation, the peer-reviewed guidance for measuring visitor trip spending
with visitor surveys is very limited (Stynes and White 2006). The general goal for developing
estimates of average spending of visitors is to estimate average spending for a group of mutual
exclusive visitor segments that have meaningfully different spending patterns and for which use
estimates can be developed (White and Stynes 2008). Prior to NVUM, the Forest Service
developed estimates of average spending for visitors engaged specific activities using data
collected from the PARVS and CUSTOMER recreation monitoring programs. With the advent
of the NVUM Program, the Forest Service began estimating average visitor spending for visitors
in a group of seven mutually-exclusive trip types. Six of the segments are based on whether the
resident has traveled more than 30 miles from home to the recreation site (non-local versus local)
and whether the trip to the area was 1) a day trip, 2) an overnight trip on the national forest, 3) an
overnight trip spent in the nearby area off the national forest. A seventh segment is created for those visits where the reason for the trip was something other than visiting the national forest (see White 2017). This approach takes advantage of the power of trip-type in explaining variation in recreation visitor spending (White and Stynes 2008).

Non-primary visits

As done in benefit estimation, we focus on estimating the economic activity that results from the existence of the recreation resource. In the NVUM analysis, we identify the primary reason the survey respondent left home on the present trip using a close-ended question about the trip purpose. Those who identify any primary trip purpose other than recreating at the destination national forest are classified as “non-primary” visits and their spending is used only in constructing the average spending for the “non-primary” visitor segment. Although we compute that average spending of non-primary visitors for completeness, in Forest Service economic contribution analyses, we apply the average spending of local day visitors to non-primary visits. In a pure economic impact analysis, the spending of non-primary visits (and visits by local residents) would be excluded entirely from the analysis. But for the purpose of an economic contribution analysis, we believe adding the in the marginal additional expenses associated with visiting the forest while already in the local area (i.e., local day trip spending) is a conservative approach at accounting for the small amount of additional spending on non-primary trips attributable to the presence of the national forest.

Our approach to isolating primary purpose trips for economic contribution analysis is similar to how benefit estimation focuses solely on primary activities and primary-purpose trips. However, unlike traditional consumer surplus estimation approaches, we do not account for the presence of substitute recreation sites in developing the average spending estimates. If one wanted to account for the presence of substitutes, one could adjust the visit estimate downward for those who identified the presence of a recreation substitute. That approach would be consistent with how we estimate the loss of economic activity from closures related to natural disturbances (see below).

Activity-specific spending profiles for focused analyses

Recreation consumer surplus estimates are often reported for distinct primary activity sets (e.g., Rosenberger et al. 2017). For visitor spending, the primary recreation activity has a relatively small role in determining overall trip spending. For Forest Service visitors, recreation activity explains only about 3% of the variation in individual spending (White and Stynes 2008). In comparison, the type of recreation trip (i.e. local/non-local, day/overnight) explains about 21% of variation in trip spending. Ultimately, an angler on a day trip has expenditures in the area around the recreation destination that are more similar to a cross-country skier on a day trip than to an angler on an overnight trip. This is because lodging, gasoline, and food and drink account for the majority of trip expenditures and activity-specific expenses, such as sporting goods and equipment rental account for relative small shares of trip expenses. A key exception to this general pattern is downhill skiing and snowboarding. Expenses for access and equipment rental can account for large shares of expenses and lead to meaningfully different spending patterns.
Although activity plays a relatively small role in determining visitor spending, many project planning and management efforts focus on one or more specific activities. To facilitate those efforts, we develop spending averages for 11 specific activity groupings. These averages are still computed within trip type and using national-level data sets. The activity-specific spending averages are likely the appropriate ones to use in project analyses that estimate both economic benefit and economic contribution for specific activities. For the Forest Service, we use the same group of activity sets in the consumer surplus estimates (Rosenberger et al. 2017) that are available for use in planning applications.

**Average spending patterns**

Average spending of national forest visitors ranges from about $36 ($2014) per party for those on day trips who live in the local area to nearly $580 per party per trip for those traveling from outside the local area and staying overnight in privately-owned accommodations in town (Table 1). Non-local visitors and overnight visitors have greater spending than their local and day trip counterparts. Those who are visiting the national forest secondary to some other trip purpose spend about $422 per party per trip and have spending patterns that are more consistent with general tourism rather than outdoor recreation. Across all segments, lodging, food in restaurants and grocery stores, and gasoline account for the majority of recreation trip expenses. The prominence of these types of expenditures explains why trip type is the most effective predictor of recreation visitor trip spending.

| Table 1 about here |

Spending averages from downhill skiers and snowboarders have spending averages that range from about $60 per party for those on day trips who live in the local area to nearly $745 per party per trip for those staying overnight locally. The greater trip spending by skiers and snowboarders can be traced primarily to greater expenses for entry fees and recreation and entertainment (i.e., gear rentals). In the other expense categories, skiers and snowboarders tend to spend a little more than other visitors in restaurants and a little less in grocery stores and, for those on overnight trip types, gasoline.

**Stability through time**

The NVUM Program and data provide the ability to examine patterns in recreation visitor trip spending over time. Over the 10 years of rounds 2 and 3, average spending, within trip type, by visitors to Forest Service lands have remained generally consistent from year to year (Figure 3). This time range includes periods of economic growth and downturn. Completing the analysis within trip type, allows for one to explore patterns in expenditure patterns without the potential confounding factor of changes in trip type (e.g., substituting local day trips for distant overnight trips) caused by changing macroeconomic conditions. In addition to stability in the amount spent during national forest recreation trips, we have also found general stability in the mix of expenses during recreation trips (Figure 3). Lodging, gasoline, and food have consistently
accounted for the largest shares of expenses over the 10 year period. Further, the relative shares spent on those items (and others) have remained mostly stable over the period. We have observed non-local overnight visitors spending a slightly larger shares of their expenses on lodging and non-local day visitors spending a slightly larger share of their expenses on gasoline and slightly lower share on restaurant food.

Sample size effects

Although hundreds of economic surveys may be collected from visitors to each forest in every NVUM round, those sample sizes are typically inadequate for developing reliable forest-specific spending estimates within trip type and after excluding outliers and contaminants (see White 2017). Instead, visitor spending averages for the 7 trip types are developed using data collection across the National Forest System. To accommodate the variation around national forests in opportunities to spend money and local prices, we compute alternate “high” and “low” spending profiles to accommodate above- and below-average spending areas. Briefly, we develop those profiles by data on subsets of national forests where visitor spending observations are statistically higher or lower than the national averages. See White et al. (2013) for a detailed description of the process. We identify individual NFS units that appear to have above- or below-average spending in the guidance (White 2017) on how to apply the Forest Service spending averages. In addition to those forest-level analyses, the alternate spending profiles may be used for analyses of specific sub-forest places that likely have above- or below-average spending. This is somewhat similar to potentially modifying average consumer surplus estimates developed from meta-analysis to reflect above- or below-average site quality (e.g., Rosenberger) or doing direct value transfer using sites of similar high- or low-quality.

Updating parameters

Application of the NVUM spending profiles to compute total spending by visitors to a national forest or other geography requires several additional parameters. Trip segment shares are used to split the single estimate of visits for to national forest into the number of visits in each of the seven segments. Average party sizes are used to convert those segment visits into party visits, to be consistent with the units of the spending averages. Alternately, we could place spending on a per person basis, but because spending is better considered on a per party basis (Stynes et al. 2003), we elect to compute party visits. Parameter estimates are computed at the forest-level. National-level party-size averages are substituted for individual trip-type segments on national forests with insufficient sample sizes. Parameter estimates are updated annually incorporating the
most recent 5-years of NVUM data while the spending averages are updated only every several years.

Economic Area of Influence

NVUM visit, trip type and trip spending data are used to estimate the current economic contribution of recreation on national forests and grasslands, as well as the economic impact of proposed alternatives for recreation management. Input-output (I-O) models are used to describe local economies and the effects of recreation spending, but the credibility and value of I-O analysis is in large measure dependent upon using the right geographic (analysis) area. A critical step is determining the area that provides functional economic integrity so that the effects of spending and re-spending recreation-related expenditures is fully captured. The delineation of small or very rural analysis areas is more demanding than those of large areas. A limited economic base and weak labor flows among rural counties can provide a challenge for identifying areas with economic integrity. On the other hand, a highly developed, urban economy close to, or encompassing, national forests may be so large and complex that it is difficult to identify the area within it that is directly affected by the spending of visitors. A county containing FS recreation sites may be good a place to begin the delineation process, but it is not a reliable guide for the final delineation. The analysis area must contain counties with cities and towns where actual recreation-related transactions are likely to occur. When locating probable recreation-based spending, consider access routes to identify “gateway communities”. Recreationists spend money in gateway communities that may be in a different county than their recreation site. Though the NVUM survey question asks visitors to identify expenditures made within 50 miles of the recreation site, analysts usually look for gateway communities within 50 miles of the forest boundary for simplicity.

Estimating Effects of Natural Disasters

Natural disturbances such as wildfire or flooding can present a variety of management challenges. In the context of recreation, policy-makers and managers occasionally desire information on the economic losses (economic effects and well-being) from natural disturbances that alter the conditions or availability of recreation resources. Although there may be marginal changes in well-being or visitor spending because of how a disturbance alters recreation resource conditions, policy-makers and managers, in recent years, have been more frequently interested in losses resulting from recreation resource closures because of natural disturbance. Those closures may be for large areas (i.e., an area closure) or for specific recreation resources (e.g., trails or campgrounds). In the past, such closures typically were initiated during the natural disturbance and then extended for a short period of weeks or months after the disturbance. In recent years, in addition, managers are sometimes opting to close areas deemed to be at high risk of an imminent natural disturbance. For example, in 2018 several national forests in northern New Mexico established area closures in early summer because of extreme fire danger (although there were no large active fires at the time). Similarly, a large portion of the Entiat Ranger District on the Okanogan-Wenatchee National Forest was maintained under an area closure in 2017/2018 post-wildfire because of concerns by managers about potential flooding and debris flow that could have resulted if there was a high-intensity rain event. As natural disturbance frequency and
severity increases with climate change, we anticipate more frequent requests to understand the economic implications of associated closures.

The first step in estimating visitation losses from natural disasters is to identify the NVUM sites in the affected area and the appropriate time window affected. Per day visit estimates for that set of site days are summed to yield a pro-rata estimate of total visits potentially lost. A second optional step examines the responses to the question about substitute activities and sites. The appropriateness of this step will depend on the size and duration of the areas that get closed. An analyst can choose to not count as ‘lost’ the proportion of visits that would have returned to the site later (after the closure ends), and/or that may have a proximate substitute location (that is, the alternate site is within the same economic region as the closed site/area).

A variety of spending averages could be used to estimate the loss in visitor spending that results from recreation area closures or reduced visitation because of natural disturbance. If the closure or disturbance affects a wide range of recreation opportunities (such as campgrounds, hiking trails, developed recreation sites) then one of the general trip-type spending profiles is likely best. The analysis may use the trip-type profile that was identified as most appropriate to the unit as a whole (e.g., the below-average spending profile) or may use one that is more appropriate to the spending opportunities and prices in the affected area (e.g., the high spending profile for an area popular with tourists). For closures or natural disturbances that affect a narrow range of activities, such trail closures that limit hiking or mountain biking, the analysis may rely on the spending averages specific to those activities. Again, above-, below-, or average-spending profiles for each activity may be used in the analysis.

The spending averages represent visitor spending made within about 50 miles of the interview location. For most applications, the impact area for the natural disturbance analysis will likely be sufficiently large to accommodate the spending averages as they are. If the impact area is especially small or if there are limited spending opportunities in the impact area, then the spending averages may need to be reduced. This could be done by a blanket reduction across all expenditure categories or by removing expenses for items for which there are no spending opportunities (e.g., restaurants) within the impact area.

Job and income effects estimated in the input-output analysis will generally represent year-long employment. Typically, closures or reduced visitation levels will not persist for an entire year. Because of that disconnect, it is imperative that the estimate of visit loss from the closure or disturbance properly account for temporal substitution of a later visit to the affected area. In many cases, such visits should not be considered lost to the affected area for the purpose of the economic effects analyses. However, in cases where the spending opportunities are highly seasonal in nature (e.g., lodging, restaurants, or outfitters that close during the winter months) then some economic activity will likely be lost to the impact area even when there is a temporal substitution in the visit and that loss should be considered.

ESTIMATING NONMARKET VALUES
NVUM survey data have been used in a number of analyses aimed at describing the demand and ultimately deriving a nonmarket monetary value for recreation access on national forests. The principal methodology for these studies has been travel cost modeling (TCM) wherein a price-quantity relationship or a demand curve is derived (Freeman et al. 2014). To do so, annual visits to a national forest are regressed upon a number of relevant factors including a composite price variable of travel costs (e.g., pecuniary cost per mile traveled, opportunity cost of time traveled, necessary access fees, guide fees, etc.), and a number intercept shifters typically including demographic characteristics, income, site characteristics, main activity, and substitute sites. As NVUM is an onsite survey of last exiting recreationists, econometric techniques used to estimate demand curves must account for: count data (trips are reported as integers), zero truncation (respondents report at least one trip), and endogenous stratification (sample probability is correlated with visits) (Landry et al. 2016).

The first NVUM-based study to focus on nonmarket values associated with national forest recreation access was conducted by researchers at the University of Georgia and the Forest Service (Bowker et al. 2009). This study employed TCM to assess per visit recreation access values across at national and RPA regional levels across 14 main activities common on many national forests. Within each of the spatial aggregate demand models, activity price responses were differentiated using slope interaction terms. A number of sensitivity analyses were conducted based on various assumptions about pecuniary costs, wage rates, travel distances, and other factors. Using the most conservative assumptions at the national level, consumer surplus ranged from $25 pppt (per person per visit, 2003 dollars) for developed camping to $117 pppt for snowmobiling.

Sardana et al. (2016) also used NVUM data with TCM to estimate national forest demand and per trip consumer surplus by setting type in Forest Service Region 8. The settings based approach addresses the issue of multiple purpose visits arguably better than an activities based alternative. They employed a Poisson lognormal estimated corrected for truncation and endogenous stratification to demonstrate that consumer surplus for access to designated wilderness ($86 pppt, 2015 dollars) in Southern national forests was generally higher than developed day use sites ($62 pppt), overnight developed sites ($50 pppt), and general forest areas sites ($63 pppt). A key message from this study is that land managers typically manage settings and not activities, especially on a long term or strategic basis. Long term planning to optimize all benefits (and costs) requires information on recreation benefits and how they may vary by altering the provision of forest settings. Preliminary results were also used to develop visitation models used to project recreation visitation and visitor density on Southern national forests to 2050 as part of the Southern Forest Futures Project (Bowker et al. 2013). These projection models are now being refined for the 2020 Resource Planning Act (RPA) Assessment to project visit quantity by site type.

More recently, studies applying TCM to NVUM data have been conducted looking at issues related to settings and activities. Landry et al. (2018), incorporate an incomplete demand systems approach into a TCM specified as a truncated Poisson weighted to account for avidity bias to examine demand for recreation access to forest service designated wilderness by region
and ecosystem type. Preliminary findings reported in Bowker et al. (forthcoming) indicate a national consumer surplus of $72 pppt (2016 dollars). Shifters positively correlated with visits included age, male gender, and eco-regions including the Great Plains (Boundary Waters) and North American Deserts (Colorado, Montana, New Mexico, Wyoming), and Marine West Coast Forests. A common travel cost variable precluded price response or consumer surplus differentiation by ecoregion.

Chapagain et al. (2017 and 2018) examined nonmotorized boating and downhill skiing and snowboarding on national forests. For nonmotorized boating, TCM models were developed at the national level and used to test whether Congressional Wild and Scenic designation affected consumer surplus derived from recreation on rivers within the national forest system. Preliminary findings indicate that on rivers in the national forest system, there was no statistical difference in demand or consumer surplus for recreation access based on Congressional designation. In both cases, annual mean consumer surplus ranged from $66 to $87 pppt (2016 dollars).

Chapagain et al. (2018) also used TCM models for downhill skiing/snowboarding to address the effects of projected climate change on demand and aggregate consumer surplus. Their model incorporated site-level data on elevation, snow depth, seasonal temperature and seasonal precipitation. They developed relationships and simulated changes in the climate-related variables entering their TCM model using past and projected future climate conditions from RPA climate models. Their findings for consumer surplus pppt trip were consistent with those of Bowker et al. (2009) ranging from $91 to $185 pppt depending on assumed time costs. However, given the change in projections for climate variables significant in their TCM model, they found that future skiing visitation would decline sufficiently to reduce aggregate consumer surplus for skiing access on national forests by up to 9% or by nearly $400 million.

Data issues

NVUM data are generally amenable to developing TCM models subject to the econometric difficulties associated with on-site probabilistic sampling mentioned above. However, a number of issues and compromises remain in addition to the usual ones which plague TCM. First, as only 30% of those surveyed receive the questions about income and proxy substitute variables, they must be omitted or estimated for the remaining 70% of all respondents. This is can also be a limiting factor if travel costs include considerable fees on-site above and beyond mileage costs, e.g., downhill skiing. While these additional on-site fees can be estimated or imputed similar to income, there is a tradeoff between sample size and potential issues associated with stochastic regressors depending on the method chosen to fill missing observations. Second, as the existing questionnaire is presented, respondents are queried about their trips to the specific national forest in the past 12 months and not, ideally, to the specific site where they are sampled. The individual is also asked about group composition, main/secondary activities, and time on site. The individual is also asked about visits in the past 12 months for the same main activity. Thus, considerable researcher judgment is required to formulate a reliable dependent variable appropriate for the specific analysis. Finally is the issue of weighting. The studies above incorporate some form of weighting (explicitly or in the associated likelihood function) which
accounts for avidity bias. However, given the NVUM protocol involves internal expansion weights, it is not clear that simply weighting observations by the inverse of annual visits is entirely appropriate.

OTHER USES OF NVUM DATA

Palmer and English (forthcoming) compared rates of participation in viewing scenery as a secondary (non-primary) activity, for visits that had other activity as the primary activity. The findings supported guidance given in the agency’s scenery management. Viewing scenery was far more common for visits with primary activities of hiking, backpacking, and wildlife viewing than for visits where the primary activity was snowmobiling, downhill skiing, gathering forest products, or hunting.

English et al (2014) projected use of local visitation to National Forests. The approach was quite straightforward. The work projected the estimated visitation per capita rate from residents in areas near (within 50 miles) forests from NVUM onto Census estimates of population growth. Results indicate about a dozen forests could expect at least 250,000 more visits from local residents in the next 10 or so years.

Askew et al (2017) examined importance-performance results over multiple ‘rounds’ of NVUM data collection. Their intent was to evaluate if, overall, the agency was making gains in meeting the needs of its recreation consumers, and whether there were significant mismatches between the importance users assigned to an attribute compared to the agency’s performance on that attribute.

REFERENCES


Table 1—National forest visitor spending profiles by trip-type segment and spending category, dollars per party per trip$^a$

<table>
<thead>
<tr>
<th>Spending categories</th>
<th>Nonlocal</th>
<th>Local</th>
<th>Non- primary</th>
<th>All visits$^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Day</td>
<td>OVN-NF</td>
<td>OVN</td>
<td></td>
</tr>
<tr>
<td>Motel</td>
<td>0.00</td>
<td>44.77</td>
<td>203.85</td>
<td>0.00</td>
</tr>
<tr>
<td>Camping</td>
<td>0.00</td>
<td>27.79</td>
<td>13.68</td>
<td>0.00</td>
</tr>
<tr>
<td>Restaurant</td>
<td>14.77</td>
<td>27.47</td>
<td>116.41</td>
<td>5.66</td>
</tr>
<tr>
<td>Groceries</td>
<td>10.67</td>
<td>55.09</td>
<td>72.52</td>
<td>6.62</td>
</tr>
<tr>
<td>Gas and oil</td>
<td>30.20</td>
<td>62.27</td>
<td>82.47</td>
<td>15.43</td>
</tr>
<tr>
<td>Other transportation</td>
<td>0.58</td>
<td>1.34</td>
<td>4.98</td>
<td>0.16</td>
</tr>
<tr>
<td>Entry fees</td>
<td>4.12</td>
<td>7.13</td>
<td>12.85</td>
<td>2.70</td>
</tr>
<tr>
<td>Recreation and entertainment</td>
<td>2.96</td>
<td>7.36</td>
<td>33.31</td>
<td>1.01</td>
</tr>
<tr>
<td>Sporting goods</td>
<td>3.15</td>
<td>10.77</td>
<td>13.75</td>
<td>3.83</td>
</tr>
<tr>
<td>Souvenirs and other expenses</td>
<td>1.93</td>
<td>7.73</td>
<td>25.87</td>
<td>0.60</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>68.39</strong></td>
<td><strong>251.74</strong></td>
<td><strong>579.70</strong></td>
<td><strong>36.00</strong></td>
</tr>
<tr>
<td><strong>Sample size (unweighted)</strong></td>
<td><strong>2,112</strong></td>
<td><strong>3,600</strong></td>
<td><strong>2,289</strong></td>
<td><strong>9,225</strong></td>
</tr>
<tr>
<td><strong>Standard deviation of total</strong></td>
<td><strong>72</strong></td>
<td><strong>399</strong></td>
<td><strong>714</strong></td>
<td><strong>53</strong></td>
</tr>
</tbody>
</table>

Source: White 2017

$^a$ Outliers are excluded and exposure weights are applied in estimating spending averages. All figures expressed in 2014 dollars. These averages exclude visitors who claimed their primary activity was downhill skiing.

$^b$ The all-visit averages are computed as a weighted average of the columns using the national trip segment shares for nondownhill skiing as weights.
Figure 1. NVUM sites, Chattooga River Ranger District, Fy2019.
Figure 2. Exiting traffic volumes, Wildcat Road GFA site, Chattooga Ranger District.
Figure 3—Visitor spending over time: Trip spending within 50 miles of the recreation site for seven types of recreation trips (a) and shares of expenses in specific categories for non-local overnight-off-forest visitors.