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# Geospatial analytics for federally managed tourism destinations and their demand markets



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## ABSTRACT

Understanding geospatial demand for destinations can improve management decisions affecting destination planning, marketing, natural preservation, and resident as well as visitor experiences. Visualization and analysis of demand markets are significantly enhanced by the capabilities of Geographic Information System (GIS) technology and help to support management objectives. This study implements traditional desktop GIS as well as a free, web-delivered decision-support tool for tourism planning and marketing to assess ~7.5 million overnight accommodation reservations made for federal recreational facilities between 1999 and 2007. Visitor origin frequency and median travel distance for overnight accommodations are summarized by visitor zip code and by facility. National results indicate: (1) facilities in the west, the Great Lakes and the southern Appalachians regions draw overnight visitors from the greatest median distances; (2) residents in the Northeast have the lowest per-capita utilization; (3) residents within the south-central Midwest and central-west Southern States have the highest percapita utilization and tend strongly toward local overnight reservations. Three selected national park regions are used to illustrate destinations characterized by highly localized utilization (Hot Springs National Park, AR), both local and regional utilization (Yosemite National Park, CA) and regionally to nationally dispersed utilization with few local residents reserving overnight accommodations (Canyonlands National Park, UT). Market profiling derived from local, regional and national customer origin markets can help any tourism destination, including national parks and their gateway communities, make smarter management and marketing decisions.

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## 1. Introduction

Tourism is unique among business enterprises in that individual businesses in aggregate create experiences for visitors to enjoy at a given geographic locale or destination. Many successful destinations facilitate coordination among various enterprises (activities, accommodation, shopping, etc.) so that the collection of experiences exceeds visitor expectations. Destinations both compete for new visitors and try to maintain flows of repeat visitation all while balancing the needs of residents with the desires of tourists. From a business perspective, often the metrics for success are enterprise growth and increases in the number of customers. Enterprise growth and increased visitation are not, however, always in line with creating desirable experiences for visitors and/or maintaining desirable conditions for residents of those destination communities.

Balancing the needs of residents against the desires of tourists, while providing high-quality visitor experiences, requires that the visiting population of any destination be well characterized and managed. Many efforts to characterize visitors or customers have included sophisticated market segmentation modeling techniques including clustering methods, mixture models, mixture regression models, mixture unfolding models, profiling segments, and dynamic segmentation (Wedel & Kamakura, 2000). However, less sophisticated approaches for characterizing tourists of a particular destination are often preferred by destination managers who desire data-driven market and management decisions. One such approach is to geographically define existing market areas and to create customer profiles based on the demographics of the residents living within those market areas (Supak, Devine, Brothers, Rozier Rich, & Shen, 2014). Unfortunately, market area definition and subsequent customer profiling cannot be accomplished for tourism destinations by simply defining distance rings or drive-time polygons with respect to an attraction (typical in other forms of retail), but rather they should include more precise

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techniques that account for the geographic dispersion of tourists to a destination (Miller, 2008).

National parks worldwide are an exemplary set of tourism destinations for examining distributed geospatial demand because they represent the most unique environmental endowments on the planet and therefore, they are likely to attract geographically diverse visitors. For the combined 56 national parks in the United States (U.S.), more than 60 million recreational visits were recorded and more than \$4 billion was spent by nonlocal tourists visiting these parks in 2008 alone (Stynes, 2009). Further, these parks are part of a larger National Park System with over 300 federally managed destinations that include National Battlefields, National Historic Sites, National Monuments, National Recreation Areas, and other designated areas. This larger system received over 275 million visits in 2008 (Stynes, 2009).

National park systems have been the focus of many studies which aim to model the number of park visits using visitation data along with various other park characteristics, such as services provided inside the park, the natural characteristics of a park or the attractions and services in the regions where the parks are located (e.g. Hanink & White, 1999; Loomis, 2004; Neuvonen, Pouta, Puustinen, & Sievanen, 2010). National park characteristics and the quality of parks themselves have been linked to visitation frequency, with higher-quality parks attracting visitors from a wider area and parks with poorer qualities having a narrower geospatial range of demand (Hanink & White, 1999; Hanink & Stutts, 2002). Hanink and Stutts (2002)'s geospatial demand model posits that the level of recreational use of a site is related to its location relative to the population of potential users. The location and distance of a population in relation to a park is critical because the cost of travel to a park can limit the potential visitors (Neuvonen et al., 2010). This leads to the inherent trade-off between the investment of time, money or effort to achieve the travel and the time one can spend at the end destination, which must be balanced by tourists (Mckercher & Lew, 2003).

For unique destinations, such as U.S. national parks, understanding demand can be important for the stakeholders managing and marketing these destinations, both at the federal level and within the gateway communities that support these national parks. These gateway communities are often seen not only as the portals to cherished landscapes, but as the purveyors of food, lodging, transportation and other business support for visitors to the national parks (McMahon, 1999). Studies examining geospatial demand and tourism flow have found that the beneficial effects from tourist flows are not confined to the tourism-specialized regions, but are also transmitted to the neighboring regions by means of geospatial spillovers (Marrocu & Paci, 2011, 2013). From a geographic perspective, the spillover effect in tourism can be regarded as a particular geospatial interaction among destinations (Yang & Wong, 2012). National parks in the U.S. can experience spillover into gateway communities simply due to limited resources within the parks.

For federally managed destinations within the national park system, specifically for the 56 national parks, the time spent within the park may be externally controlled by the availability of overnight accommodations within the park itself. While the sites in the National Park System attract millions of visitors because of their scenic beauty and outdoor recreation opportunities, only a small percentage of these visitors can be accommodated within the most popular parks each night. For example, of the 4 million visitors to Yosemite National Park in 2010, there were only 142,864 overnight stays (Yosemite National Park Statistics, 2014). The remaining visitors, those who do not stay within the park boundaries, either were passing through on the way to a different destination, live locally or stayed on public or private land within or adjacent to neighboring gateway communities.

When planning a visit to a federally managed destination, in which an overnight stay is desired, prospective visitors can search

a single web-presence ([www.recreation.gov](http://www.recreation.gov)) to browse, query and make reservations at one of 60,000 facilities (campsites, cabins and group facilities) at over 2500 locations. The recommended facilities are selected based on proximity and customer interest, rather than by the managing agency (Recreation.gov About Us, 2014). If an overnight stay is not available for a prospective visitor's desired date and location, alternative federally managed facilities within the region are recommended, so that a prospective visitor may choose another suitable location. Reservations made on this website are on the order of one million per year and they represent a big data opportunity for characterizing the demand markets for federally managed tourism destinations themselves as well as the gateway communities who provide services to specific national parks. Understanding geospatial demand for a destination from temporal and spatial data such as these can improve management decisions affecting destination planning, marketing, and natural preservation, which are all necessary for balancing the experiences of residents and visitors.

The main purposes of this study are to examine the general geospatial demand for overnight recreation on federal lands prior to the 2008 recession and to examine the specific geospatial demand for selected national park regions. The national geospatial demand for overnight recreation on federal lands provides a snapshot from which specific national park regions were selected for further investigation. The geospatial demand for the selected national park regions were then used to characterize the destination as having some combination of local, regional or national visitors. By investigating the geospatial distribution of visitors to national parks regions, destination managers for both the federally managed facilities within the region and their corresponding gateway communities can improve marketing and management decisions. Specifically, understanding existing customers more fully and targeting new prospective markets more precisely are direct benefits. These benefits can be particularly powerful for gateway communities that desire enterprise growth but also need to maintain a balance between marketing efforts and desired visitor experiences. As demand market data for national park gateway community destinations is often hard to assemble, we see this study as presenting an approach for characterizing the visiting populations to any gateway community. Although we present analysis and interpretations for only three selected national park regions, managers of other national parks and their respective gateway communities can utilize this approach to become smarter destinations.

## 2. Geospatial data analytics for tourism destinations

For reservation data systems, such as the one described for overnight federal facility reservations, the volume of data presents big data challenges related to data curation, querying, sharing, transferring, and analysis. Visualization of such large datasets and the insights that can be gained from exploring geospatial relationships among the data can be significantly enhanced by the capabilities of a Geographic Information System (GIS). The geospatial analytic and visualization capabilities of a GIS allow for analysis and display of past or current trends, providing geospatial context to strategic tourism planning and management in destination communities (McAdam, 1999).

The ability of a GIS to employ a variety of internal and external datasets for analysis of geospatial and temporal relationships for market and customer profiling makes these systems invaluable for destination management (Bell & Zabriskie, 1978; Elliott-White & Finn, 1998; Grimshaw, 1999; Miller, 2008). Not only is the travel and tourism industry in need of GIS tools that can help account for the geographic dispersion of customers, but it is well suited for geospatial analysis, primarily because most transactions produce a record of

client names and addresses (Elliott-White & Finn, 1998), allowing for customer-specific geospatial origin analysis. Tourism organizations with a database of customers' street addresses or zip codes can generate maps displaying where their customers live in relation to each other and to destinations. The identification of these geospatial relationships among tourist origins and their collective relationship to attractions enables the evaluation and targeting of marketing efforts, customization of visitor packages, development of new opportunities and the discovery of potential collaborative arrangements among partners (Chancellor & Cole, 2008).

Traditional application of geospatial analyses in strategic planning in tourism typically has been limited to corporate efforts (corporate hotel chains and attractions) and resource supply-chain flows rather than destinations (Chen, 2007). In these efforts, trained professionals conduct the data collection and analysis and results are presented via maps and charts to inform corporate leaders during the decision-making process. Beyond corporate efforts, many other organizations find implementing geospatial analytics to be challenging due to its complexity and expense. The majority of GIS software applications are generic, complicated and expensive; however, a trend is emerging related to the development of innovative and often collaborative, customized web-based mapping applications for creating and sharing geographic information (Haklay, Singleton, & Parker, 2008). As the Internet continues to change the perception and use of geographic information, web-based mapping and geo-processing services continue to spread across many domains (Dragičević, Li, Brovelli, & Veenendaal, 2011), including those for landscape ecology (Frehner & Brandli, 2006), natural resource management (Kearns, Kelly, & Tuxen, 2003), forest management (Xie et al., 2011), public participatory GIS (Hall, Chipeniuk, Feick, Leahy, & Deparday, 2010) public health (MacEachren, Crawford, Akella, & Lengerich, 2008; Supak et al., 2012) and tourism (Supak et al., 2014). Specifically, development of web-based GIS is improving accessibility and reducing complexity, thereby decreasing user training needs and allowing a wider audience with varied computer and GIS knowledge to participate. These applications will be essential to the tourism field, given that tourism data flows (supply, demand, and influencers) are generated on the order of terabytes of data per day and that the richness of the available raw data is frequently more of a problem than the lack of data.

Both the web-based mapping application described in Supak et al. (2014) and traditional desktop GIS were utilized in the process of converting 7.5 million overnight accommodation reservations into actionable intelligence. For the national dataset spanning eight years prior to the national recession of 2008, geospatial supply and demand was visualized by facility and visitor origin utilization frequency as well as distance traveled using traditional desktop GIS. Based on observations from the national dataset, subsets of the reservation database were created to explore three specific national park regions, which represent distinct distributions of origin–destination distances. The distributive use and demand populations who visited these selected national park regions were then visualized using a customized, easy to use, open source, web-delivered decision-support tool for tourism planning and marketing. We hoped this demonstrates that characterizing the demand population for any destination, both geospatially and demographically, can be accomplished easily for big data sets.

### 3. Materials, methods and limitations

Properly characterizing the demand population for a tourism destination should include evaluating the geographic dispersion of the destination's clientele. One way to assess any specific destination's

demand population is to acquire transactional records associated with that destination region. Obtaining all retail transactions (lodging, food, gas, shopping, etc.) from a given destination region would allow for the entire demand population to be captured; however, the same visitors may be captured multiple times within this dataset and some transactions may pertain to residents. Another effective way to assess a destination's demand population is to look at transactions from a tourist activity that captures unique visiting parties. Utilizing overnight accommodation data to characterize a demand population can help isolate distinct visitor trips, whereas food, gas and shopping transactions are likely to occur multiple times per visit to a destination. While obtaining all lodging records for a regional destination may be unrealistic, examining a subset of lodging transactional records can provide insight related to the demand population of a specific destination region.

Since 1999, the National Recreation Reservation Service (NRRS) has provided reservation services including those for camping and lodging for participating federal partner agencies (e.g. National Park Service, Bureau of Land Management, and Forest Service) in support of outdoor recreation. As a byproduct, they have maintained a reservations database. We were granted access to ~7.5 million overnight accommodation reservations from 1999 to 2007, with the exception of 2005 (data unavailable). These data represent a modern, pre-recession view of overnight outdoor recreation on federal lands. We plan to examine the post-recession data when they become available.

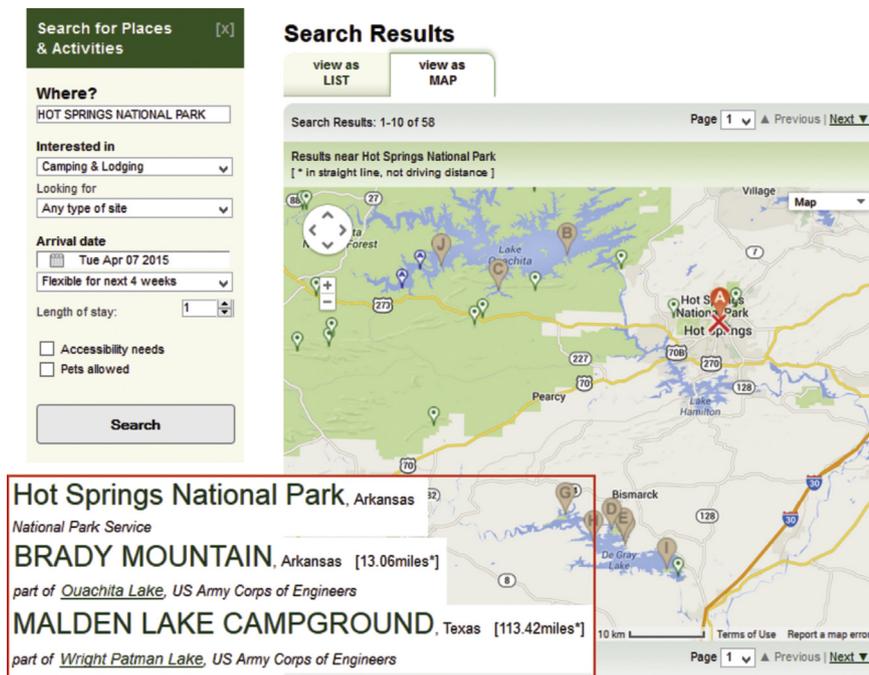
There are several limitations related to the NRRS dataset and the methodology that should be considered. First, the database does not identify no-show reservations and therefore some reservations likely did not result in visitation. Second, the dataset only captures those visitors who created reservations prior to their visit. This means that visitors who arrived at the national parks or federally managed neighboring facilities without reservations, who were subsequently allowed to stay overnight, are not included in the analysis. Third, other overnight visitors who stayed on private land or other publically managed land are not accounted for in this analysis. Fourthly, visitors who choose to stay at these federally managed facilities may conceivably be different from those who choose to stay in the gateway communities; however, accessing and aggregating all overnight reservations for visitors to a specific destination region would be virtually impossible. The NRRS dataset presented here is therefore taken as a surrogate for the total tourism destination demand populations, including the demand for visits to gateway communities.

The NRRS dataset includes records for both foreign and domestic travelers and locational attributes for both the federally managed facilities being reserved and the customers making those reservations. Both of these locational attributes are provided at the zip code scale, which in turn controlled the geospatial resolution of our analysis. Given that a main purpose of this analysis was to geospatially characterize demand populations, records without valid origin and destination zip codes were dropped during processing from the dataset. This included all records with international origin information. Data cleaning further eliminated all records with incomplete zip code fields. Further, many facilities within the database shared a destination zip code with facilities of different names and/or managing agencies. For simplicity, all facilities sharing a destination zip code were deemed to belong to a single federal management unit (FMU).

After the initial data cleaning, the remaining origin and destination zip codes were matched with the geographic coordinates of the centroids for each respective zip code. From the original NRRS reservations database, roughly 81% ( $n=6,048,624$ ) of the records could be geolocated for both customer and FMU destination. Table 1 provides a summary of the aggregated reservations by year, as well as the number of unique agencies, park names and site types. Annual descriptive statistics presented

**Table 1**  
National recreation reservation service summary statistics by year from 1999 to 2007.

Year	Raw data reservation count	No. of geolocated reservations for both customers and parks	No. of unique agencies	No. of unique park names	No. of unique site types	Median distance (mile)	Median no. of people	Mode no. of people
1999	584,515	421,671	4	1606	210	56.1	3	2
2000	896,257	695,515	4	1659	232	52.3	2	2
2001	976,258	801,548	4	1719	205	50.4	2	1
2002	961,512	798,388	4	1749	216	51.0	2	1
2003	1,002,105	827,468	7	1847	226	49.9	2	1
2004	1,030,800	851,443	8	1730	235	50.1	2	1
2005	-	-	-	-	-	-	-	-
2006	1,060,468	868,344	8	2235	241	48.8	2	1
2007	971,012	784,247	8	2225	244	48.0	2	2
Total	7,482,927	6,048,624						



**Fig. 1.** Camping and lodging options for Hot Springs National Park provided by <http://www.recreation.gov>. There were 58 results returned, the furthest of which was 113.42 miles (straight line distance) from the park. Similarly distant alternatives are presented for other National Parks.

in Table 1 include the median great circle distance between the customer zip code centroids and destination or FMU zip code centroids, as well as the median and mode of the reported number of participants per reservation. Note the increasing participation by agencies and generally increasing reservations counts from 1999 to 2007 (Table 1). The median travel distances shifted over time as well, generally decreasing from about 56 miles in 1999 to 48 miles in 2007. During this same period, the number of transactions nearly doubled (Table 1).

On the national level, the distributed demand for overnight accommodations on federal land was evaluated by aggregating all 6,048,624 geolocated records by customer state (not presented here), by unique customer zip code and by unique destination zip code or FMU. All thematic map figures presented in the national results section were generated using ESRI's ArcGIS for Desktop 10.1 (ArcGIS 10.1 for Desktop Basic, 2012) and utilize the summarized, geolocated data from 1/1/1999 to 12/31/2007 (excluding 2005). To help elucidate the demand for recreation on federally managed lands, each customer zip code is visualized showing a utilization index reflecting the total number of overnight reservations per capita and the median great circle distance for all reservations originating in each zip code. Median travel distances also are examined from the supply side, or destination perspective.

After evaluating the national supply and demand for overnight accommodations on federal land, all national park destinations (USA Federal Lands, 2013) were examined as potential cases for further investigation. Since visitors seeking overnight accommodations at national parks are potentially offered camping and lodging options that are up to ~120 mile away from the desired park (Fig. 1), the potential geospatial spillover to neighboring facilities and gateway communities must be considered. Buffers of 30, 60 and 120 miles were applied to each of the national parks boundaries to determine an appropriate region over which to associate reservations. While the 120-mile buffer was chosen for evaluation because it was the maximum distance given for recommended alternative accommodations (Fig. 1), the 60-mile buffer was selected to represent a region from which a day trip (less than a 2 hour drive) could easily be made to the national park. A 30-mile buffer was selected to represent visitors who were unable to stay within the national park, but who still wanted ready access.

Regardless of managing agency or facility name, reservations associated with all FMUs whose zip code centroids fell within each national park buffer were aggregated and used to generate travel distance histograms. After evaluating these results for each of the national parks, the 60-mile buffer was selected because it

produced histograms that were similar to those of the 30-mile buffer and quite dissimilar to those of the 120-mile buffer, for which a day trip might not be reasonable. Hereafter, any discussion of national park destinations or regions refers to all reservations made for all FMUs whose zip code centroids fall within a 60-mile buffer of that specific national park.

Three national park regions were selected as case studies based on their total reservation counts and/or their distribution of origin–destination distances. These include Hot Springs (HSNP) and Yosemite (YOSNP) National Parks, which represent the two park regions with the greatest total number of reservations. A third national park, Canyonlands (CLNP), was selected because of its relatively high median travel distance. Each of the three national park regions has a distinct distribution of origin–destination distances, which are further investigated in a series of visualizations created using the MapMyClients (MMC) application (Supak et al., 2014). This application allows for direct uploading of transactional or tabular datasets as spreadsheets at the zip code scale. Data are then processed and displayed as spatial frequency, color-coded thematic maps, where each spatial unit displays a count of the total number of reservations originating from that zip code. Each zip code with a reservation is then matched with secondary datasets representing consumer behaviors, market demographics, and socioeconomic characteristics. For details regarding GIS functionality of MMC including software components, workflow, handling and coding of zip code input, and output mapping, see Supak et al. (2014).

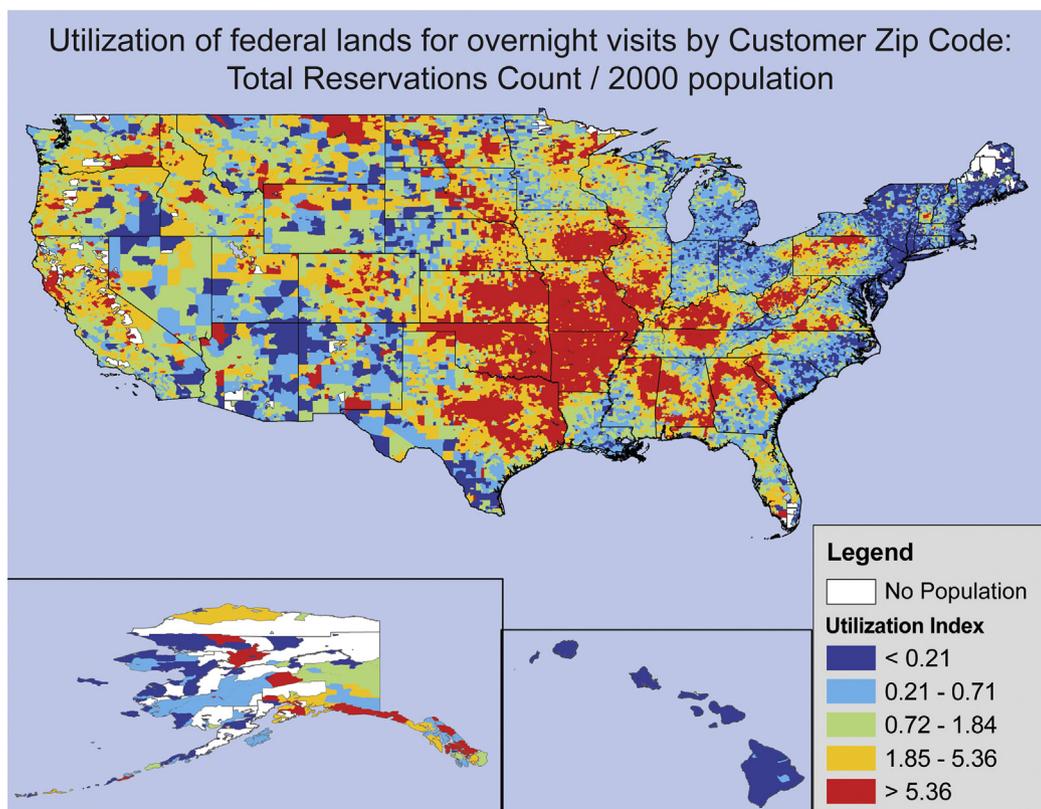
#### 4. National results

As described in the previous section, the general patterns of recreational use on federally managed lands are evaluated by customer origin zip code and by destination or FMU zip code from

1999 to 2007, excluding 2005 (Figs. 2 to 5). Summarized customer zip code information is visualized for the entire nation as a thematic map, where each geospatial unit (zip code polygon) is filled with a uniform color representing a single attribute. Two attributes are presented here, the first of which is the total number of reservations for all years by zip code divided by the 2000 population value for each zip code (Fig. 2). This per-capita value can be considered a zip code level utilization index to assess residents' interest in utilizing federal lands for overnight visits. It is important to note, that the number of reservations per zip code is not the same as the number of unique persons or parties reserving, as multiple reservations may originate from the same persons or parties; however, each reservation most likely represents a distinct visit.

The thematic map reveals that the south-central Midwest and central-west Southern States exhibit the highest utilization indices within the contiguous U.S. This means that per capita, residents from these regions make overnight accommodation reservations on federal lands more often (red in Fig. 2) than those within other regions. In general, New England and the Michigan–Indiana–Ohio regions underutilize federal lands for overnight reservations relative to the national population. This decreased demand may be a function of the lack (or limited availability) of federal facilities in this region (Figs. 4 and 5); however, alternative reasons such as lack of interest in overnight visits to federal land, propensity to stay on private or state land for overnight stays, or general disinterest in outdoor recreation require further examination.

The second attribute, which is first investigated from the demand side, is the median great circle distance traveled between each customer zip code centroid and the destination or FMU zip code centroid (Fig. 3). The median travel distance was selected as the summary statistic rather than the average distance because the distance distribution for the NRRS dataset was not normally



**Fig. 2.** Utilization index for overnight visits to federally managed lands by customer zip code, 1999 to 2007. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

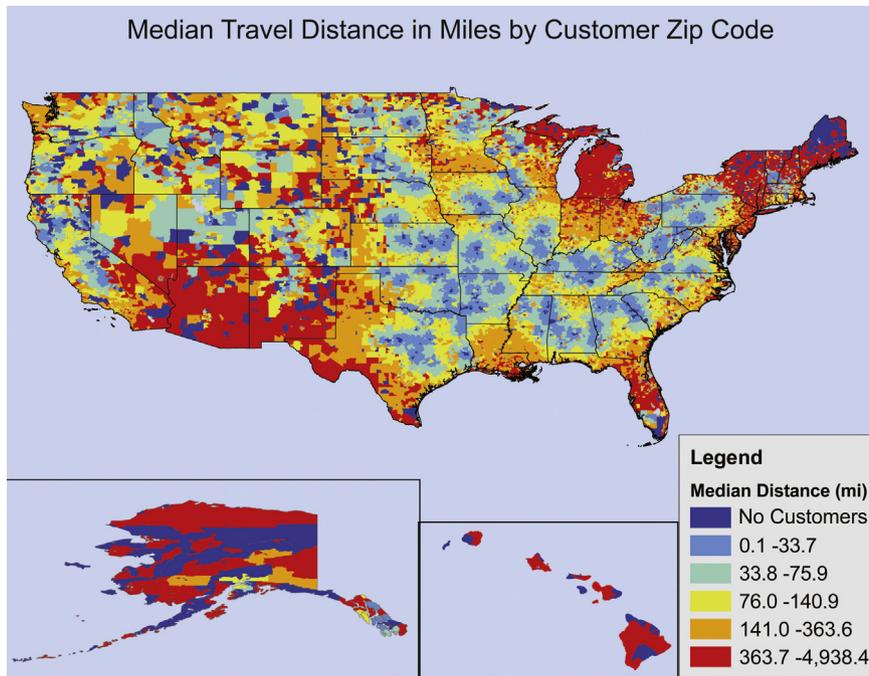


Fig. 3. Median origin–destination travel distance to federally managed camping or lodging facilities by customer zip code, 1999 to 2007. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

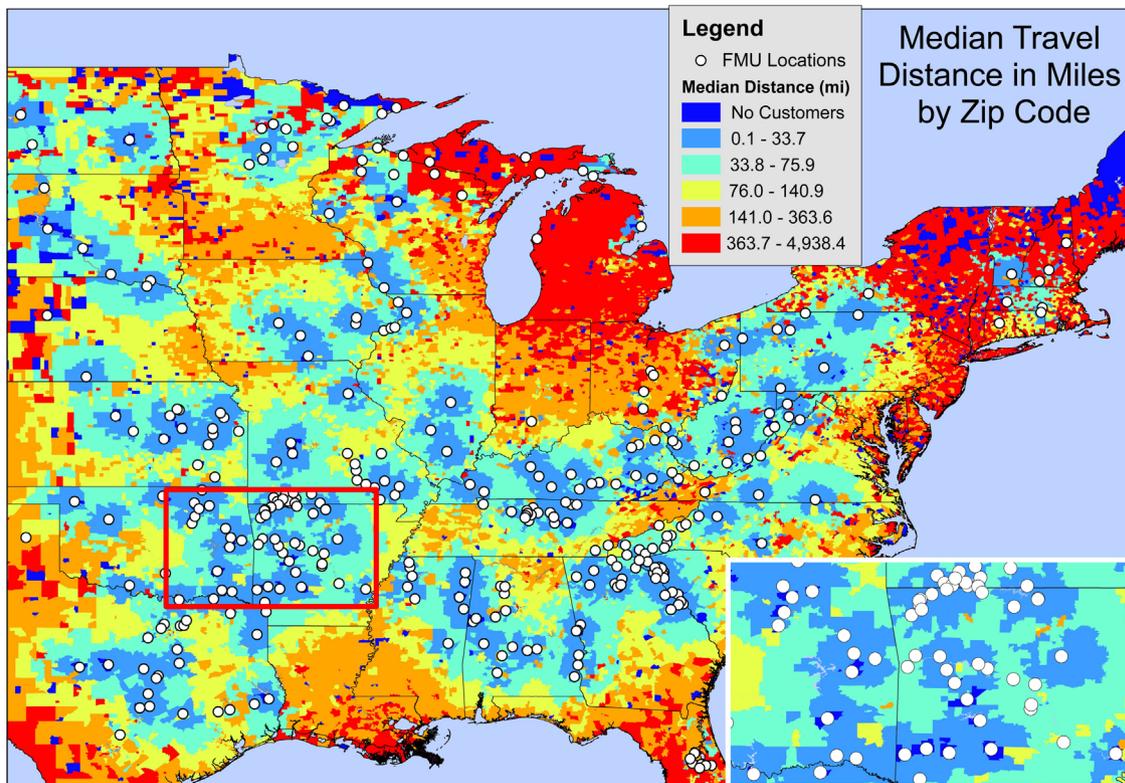


Fig. 4. Median origin–destination travel distance to federally managed camping or lodging facilities by customer zip code, 1999 to 2007. Destination FMUs shown as white circles, which in many instances are at the center of low median travel distance zip code clusters, suggesting that residents within nearby communities are utilizing local facilities for overnight recreational experiences.

distributed. Customer travel throughout much of the central U.S. is typified by low median distance (medium to light blue in Fig. 3). Customers from the Southwest U.S., Michigan, central Florida and the Northeast all travel greater median distances, indicating either increased distances to the nearest federal facilities or lack of interest in overnight accommodations on federal lands near one's

home. Zip codes with no customers may either represent populations with no interest in making overnight accommodation reservations on federal lands or a complete lack of population for that zip code (e.g. federal or state land).

Further investigation of the low median distance clusters reveals a geospatial association with the destination facilities or

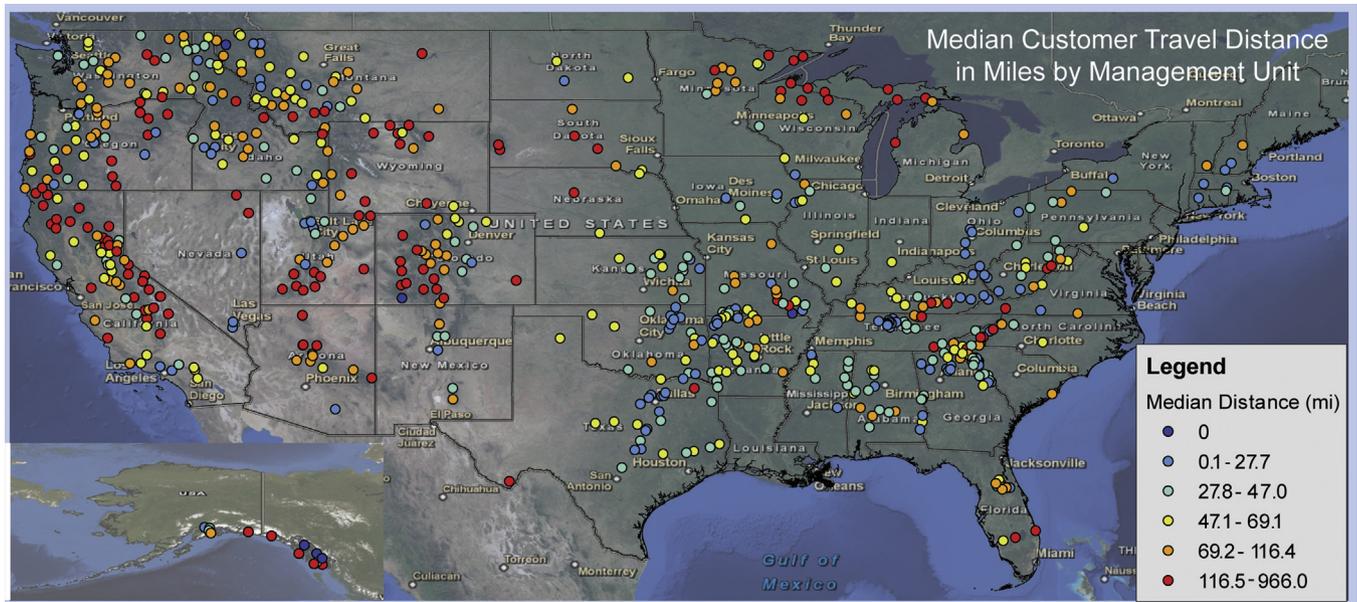


Fig. 5. Median travel distance to federally managed camping and lodging attractions by facility, 1999 to 2007.

FMUs (Fig. 4). When the clusters of low median travel distance are plotted with the FMUs, the clustered pattern can be better interpreted. In many cases, an FMU (or group of FMUs) becomes the bulls-eye at the center of a distance cluster, showing that customer median travel distance increase with increased distance from the FMU (medium blue to yellow). This suggests that residents within nearby communities are in fact utilizing local facilities for overnight recreational experiences. Moreover, belts of localized utilization (or clusters of bull's-eyes) overlap with the regions shown to have the highest per-capita utilization (Fig. 2).

Examining the demand for overnight recreation on federal land was accomplished by visualizing the summarized attributes of customers by origin zip code. From the supply side, Fig. 5 displays the median travel distance (mi) for each of the 658 FMUs as determined by summarizing all records by FMU. The median travel distances range from 0 to 966 miles. Note the geospatial distribution of the FMUs within the context of the physical geography. There is a dearth of facilities within the Great Plains physiographic region, starting in west Texas and leading northward all the way to Montana and North Dakota. There is also a horseshoe of facilities concentrated around the state of Nevada, while there are no facilities on the majority of Nevada land. This is surprising as ~85% of Nevada is owned by the federal government (Hicken, 2014); however, much of this land is not intended for recreational purposes. Additionally, no FMU's were present in the database for Hawaii.

The geospatial distribution of median distances by FMU map (Fig. 5) can aid in the reinterpretation of the previous demand related maps (Figs. 2 to 4). Visitors to the south-central U.S. (eastern Texas to Georgia) generally travel shorter distances to reach their reserved FMU when compared to the rest of the country. This is consistent with previous results (Figs. 3 and 4) showing localized utilization by customers in these areas. FMUs located in Western U.S. states received reservations from customers living farther away when compared to other FMUs within the system. Also, there appear to be pockets of FMUs that draw overnight visitors from long distances: the mountains of central and northern California; western Washington and Oregon; southwest Utah; southwest Colorado; the Great Lakes region; and the southern Appalachians (Fig. 5).

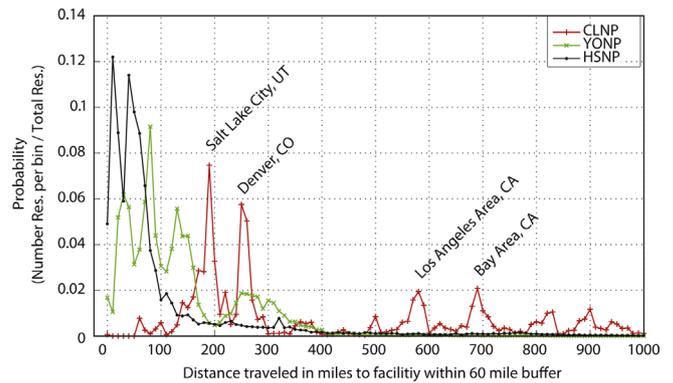


Fig. 6. Distance traveled distributions for visitors to Canyonlands (CLNP), Yosemite (YOSNP), and Hot Springs (HSNP) National Parks regions (1999 to 2007). The distributions depict dispersed, regional and localized origins for overnight visitors, respectively.

## 5. Case studies for selected national parks

The following case studies demonstrate the ability to provide national park management and gateway communities with information regarding: origin market clusters and characteristics, levels of success of existing marketing efforts, and/or to provide basic clientele profiles useful in identifying potential alternative origin markets to target. This case study analysis utilizes the NRRS dataset and a free GIS tool that are both accessible to national park or gateway community managers for the evaluation of their demand markets. While we only present analysis for three of 56 U. S. national parks, we encourage this style of analysis to be replicated by destinations not described here as they develop management plans or marketing campaigns.

In order to capture the geospatial spillover to the neighboring FMUs, 60-mile buffer regions were created as described in Section 3. The distribution of the origin–destination distances associated with all FMUs that fall within the 60-mile buffer regions for Hot Springs National Park (HSNP), Yosemite National Park (YOSNP) and Canyonlands National Park (CLNP) are presented in Fig. 6. For each of the three park regions, the distances from the origin zip codes to the destination zip codes were divided by the total reservation

count for all facilities within the region. This allows for the share of reservations coming from specific distances to be compared among the three parks. Reservations for HSNP are concentrated within 100 miles from the park's region, indicating highly localized use. YOSNP has both a local and regional draw, with the majority of reservations originating within 200 miles from the park's region. CLNP visitors are more widely distributed and they originate from four distinct origin clusters, which is unique among the national park cases selected. The histogram for CLNP presented in Fig. 6 depicts separate origin markets corresponding to specific metropolitan areas rather than the close proximity origin markets observed for HSNP and YOSNP.

Demand market area dispersion is examined for each of the national park regions which include gateway communities such as: Hot Springs, Arkansas (HSNP); Groveland, Mariposa, and Oakhurst, California (YOSNP); and Moab, Utah (CLNP). Using MMC, reservation data can help determine visitor profiles as well as how far visitors are willing to travel to experience a specific tourism destination. Using these visitor profiles, managers can identify new potential demand markets that exhibit similar distance and demographic profiles to those of current visitors. Visitor characteristic/profile information for the highest reserving customer origin zip codes is presented for one of the three case studies (HSNP); however, similar profile information and client dispersion maps can be generated to examine any destination's demand market provided reliable visitor origin data are available.

### 5.1. Hot Springs National Park

The HSNP Region is in central Arkansas and includes 12 FMUs (unique destination zip codes) with 41 unique facility names within the 60-mile park buffer. Aggregated reservations for this region total 236,415 over the eight-year period (excluding 2005). This region was selected for case study due to the high concentration of customers traveling relatively short distances as well as the

bull's-eye clustered pattern of customers that defines distinct groups around the facilities. Further investigation of the pattern of customers showed visitors coming to the HSNP Region make reservations most frequently from zip codes fewer than 80 miles from the destination (Fig. 6). To place the histogram peaks in a geospatial context, national geospatial demand as well as demand from customers traveling fewer than 80 miles is presented in Figs. 7 and 8, respectively.

The spatial frequency distribution of all origin zip codes nationwide is shown in Fig. 7 and illustrates the concentration of reservations in the south central U.S. near HSNP. A larger scale version of this map centered on HSNP (Fig. 8) displays the total overnight reservation counts for zip codes in the destination region from 1999 to 2007. This thematic map shows that many zip codes within 50 miles of the park have reservation counts above 2500.

From viewing the geospatial distributions in Figs. 7 and 8, it is evident that locals utilize the overnight recreational opportunities in the HSNP destination region more than customers from further away. Knowing that visitor origins concentrate in the south central U.S., managers can use the data overlays provided in the MMC application to investigate visitor characteristics. A single thematic map example (Fig. 9) shows zip codes by category of high, medium and low average annual lodging expenditures per household using the same geographic extent as Fig. 8. Destination managers using this application can toggle between the remaining layers (left of the map image) in order to assemble basic visitor profile information for the zip codes with the highest total reservation counts. For example, managers at HSNP or the gateway communities servicing this national park could select one origin zip codes or a cluster of zip codes of interest based on characteristics provided in the maps layers. With zip codes of interest selected, managers can easily create a table where visitor characteristics can be compared. For example, in Table 2 we can see commonalities and differences for the high stay origin zip codes, useful in creating customer profiles and identifying areas for potential growth.

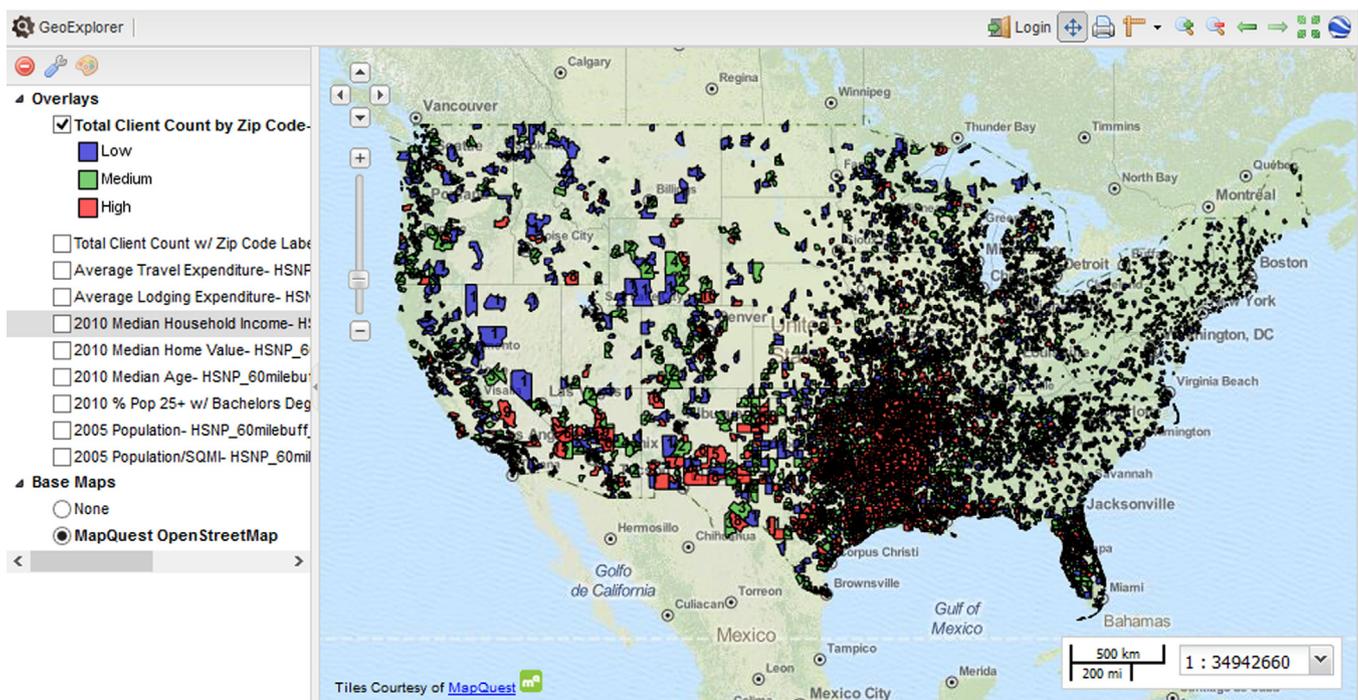


Fig. 7. National demand for overnight accommodations on federally managed land for the Hot Springs National Park (HSNP) Region by origin zip code, 1999 to 2007. Map generated using MMC application (<http://152.1.0.195:8888/mapmyclients/>).

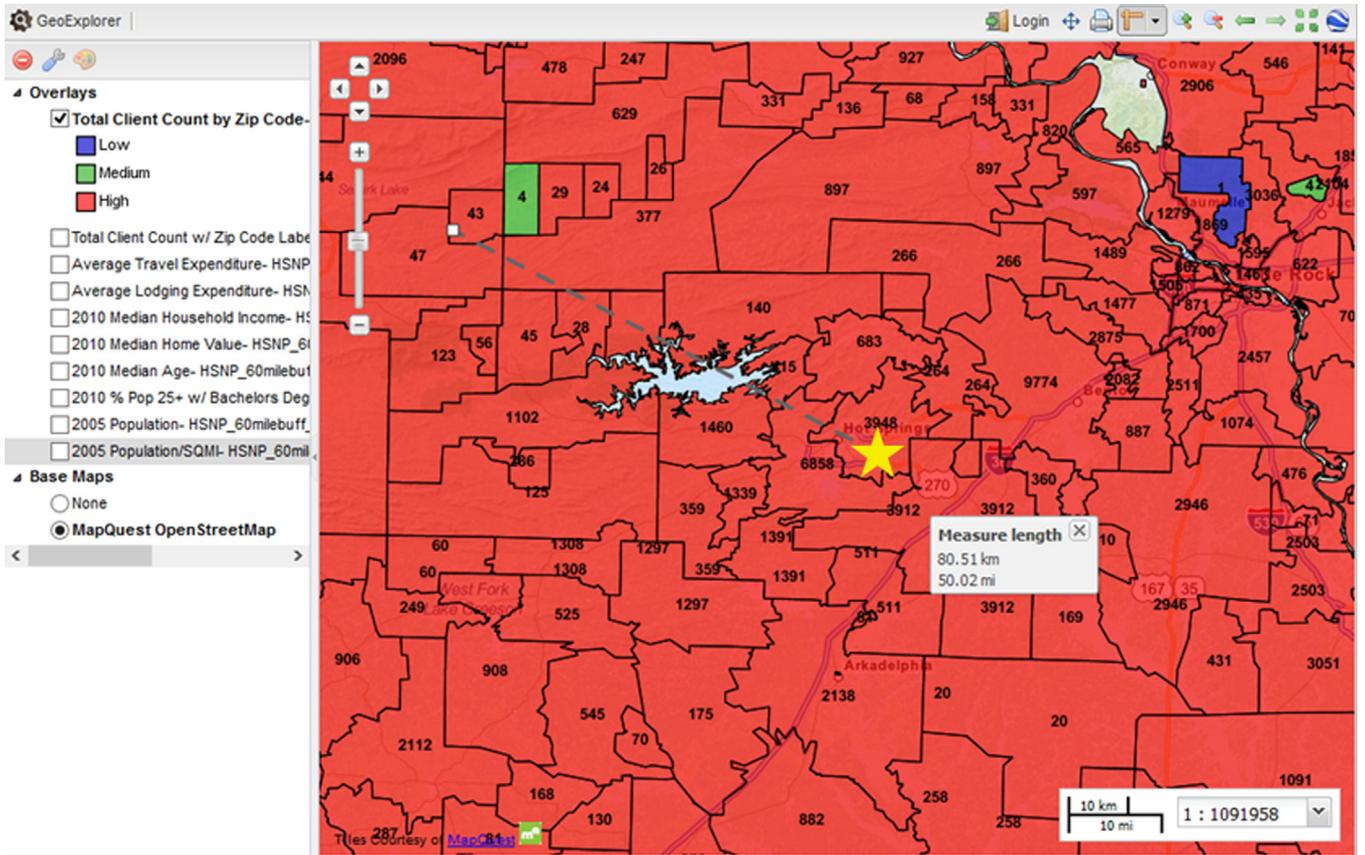


Fig. 8. Total overnight reservation counts for local origin zip codes near to Hot Springs National Park Region, 1999 to 2007. The yellow star indicates the park location and the grey dashed line indicates a measured length of 50 miles from the park in the northwest direction.

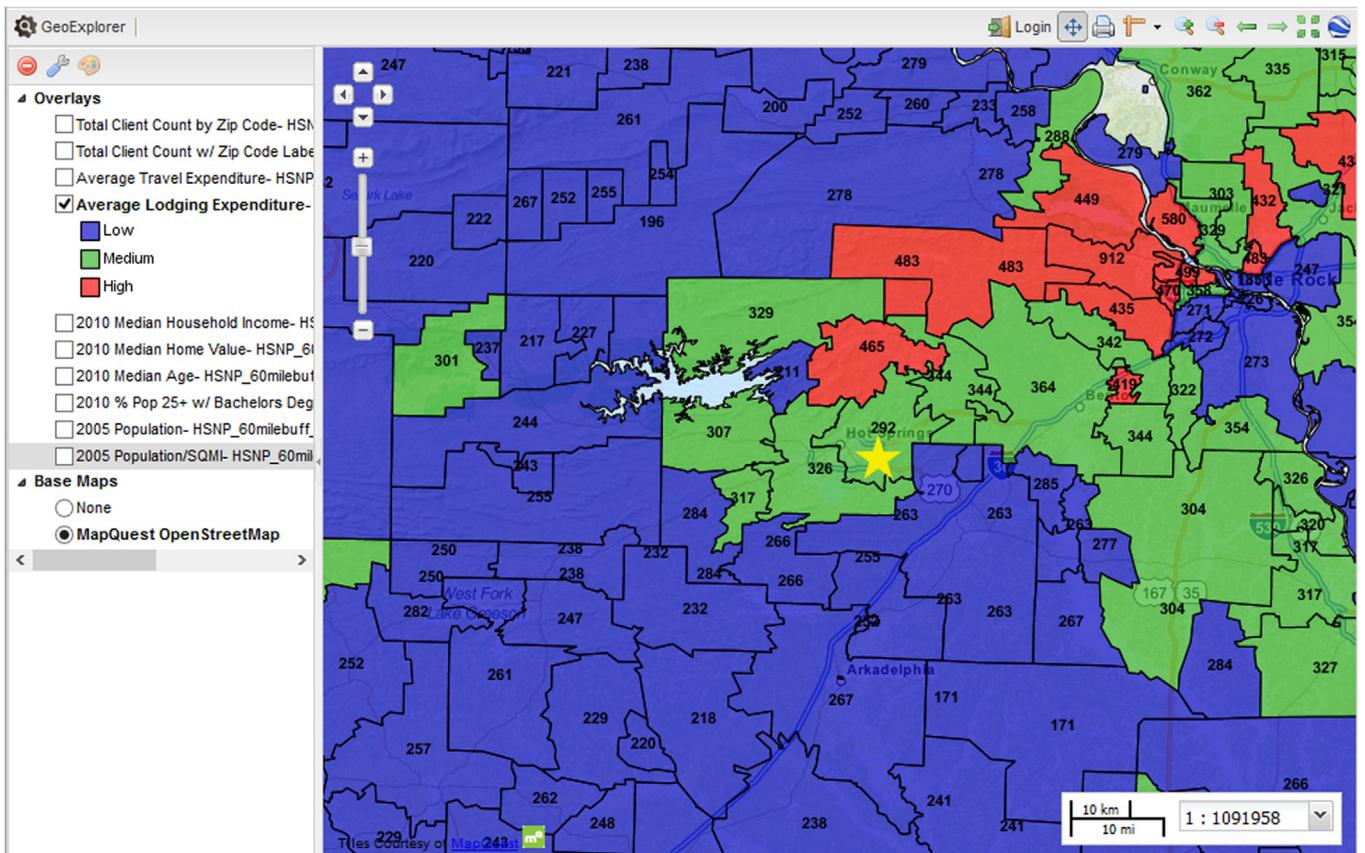
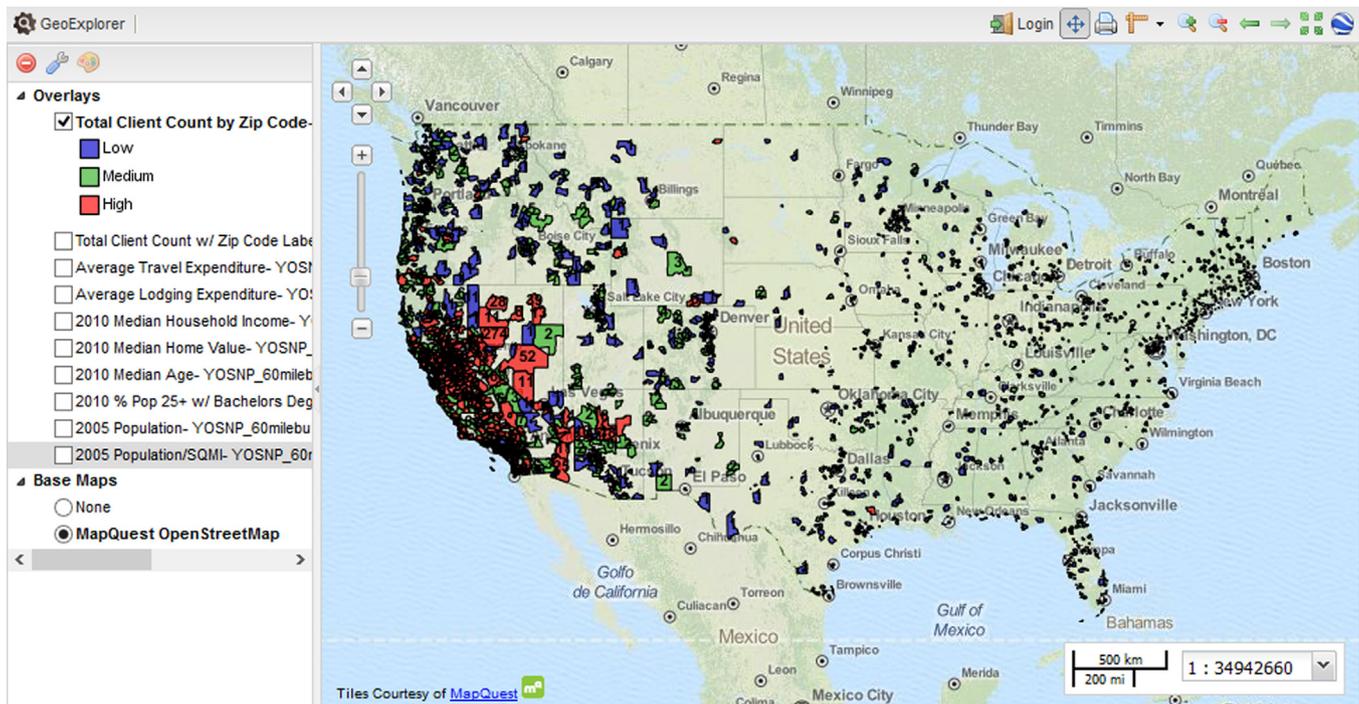


Fig. 9. Average annual household lodging expenditure by origin zip code for the Hot Springs National Park Region, 1999 to 2007.

**Table 2**  
Demographic, socioeconomic and consumer behavior metrics associated with the origin zip codes with the highest reservation counts for the Hot Springs National Park Destination Region from 1999 to 2007.<sup>a</sup>

Zip code	Reserve count	Average annual dollar amount spent on travel	Average annual dollar amount spent on lodging	2010 Median income	2010 Percent of population over 25 years with a bachelor's degree	2010 Median home value	2010 Median age	2005 Population	2005 Population density per square mile
72015	9774	1567-M	364-M	51,801-M	10.72-M	96,274-M	38-M	43,495-H	191-M
71913	6858	1405-M	326-M	42,782-M	13.41-M	107,043-M	46-H	39,959-H	321-M
71901	3948	1269-M	292-M	35,647-L	13.36-M	95,273-L	43-H	29,755-H	291-M
72104	3912	1133-L	263-L	39,282-L	9.28-L	82,283-L	40-M	22,718-H	66-M
71603	3051	1406-M	327-M	43,876-M	14.89-M	80,332-L	39-M	36,088-H	224-M

<sup>a</sup> Values are mapped using the MMC application, where each metric is displayed as a thematic map with one third of the total unique zip codes shaded to represent each high (H), medium (M) and low (L) category base on that metric.



**Fig. 10.** National demand map for overnight accommodations on federally managed land for the Yosemite National Park region by origin zip code, 1999 to 2007.

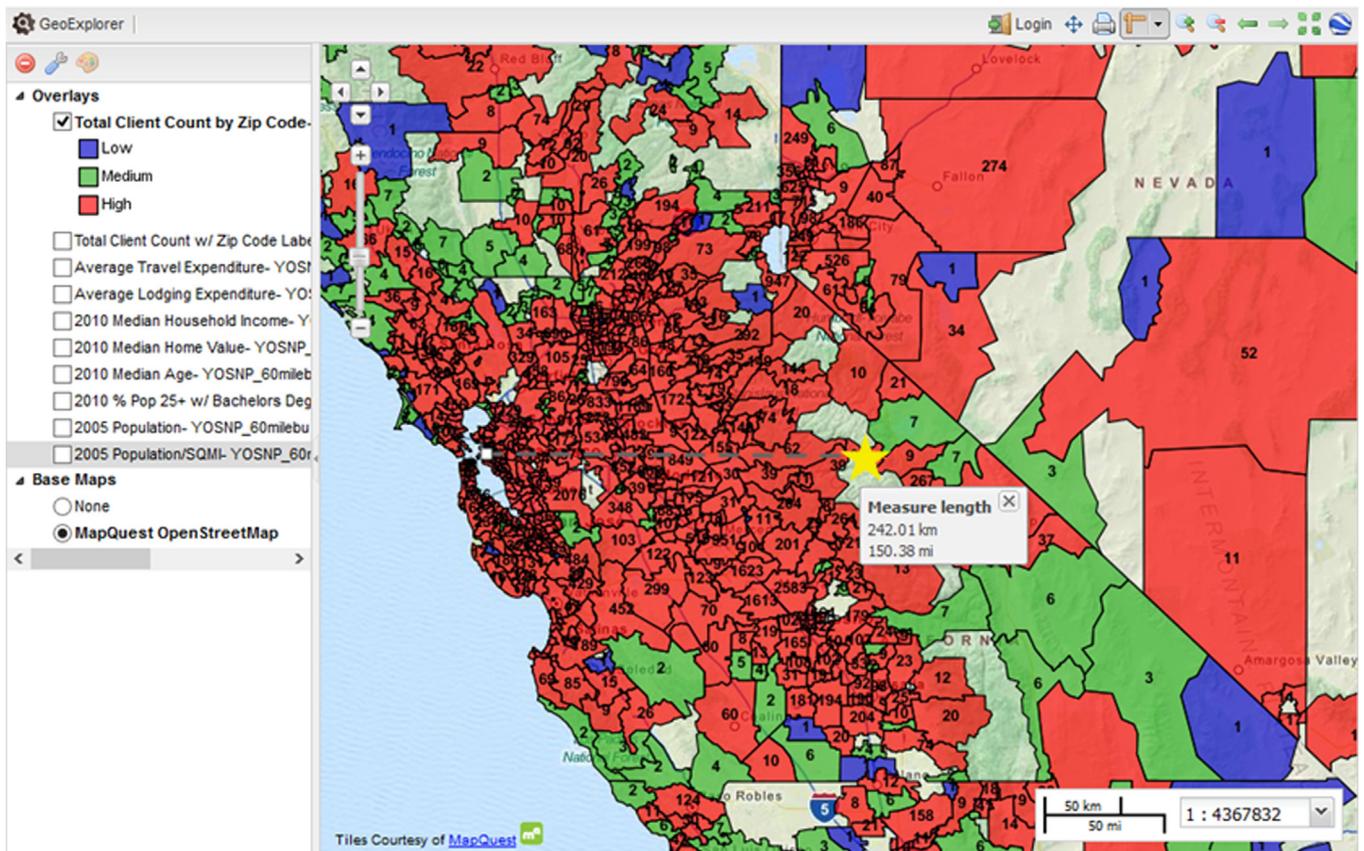
The zip code level metrics available for analysis using MMC include 2010 median age, 2010 median home value, 2010 median income, 2010 percent of population over 25 years with a bachelor's degree, average annual dollar amount spent on travel and average annual dollar amount spent on lodging from ESRI's BAO data repository (Table 2). Additionally, the 2005 population and population density per square mile for each unique zip code are provided. The distribution of client frequency values and supplemental data values for the entire uploaded data set are used to define break points for classifying each of these nine metrics into three categories of symbology. A quantile style classification methodology aims to put an even number of unique zip codes into high, medium and low groupings; however, maintaining uniqueness among the groups may lead to uneven classification distributions for some datasets.

Destination management organizations can use GIS tools, such as this one, to visualize the geographic dispersion of past visitors so that they may answer questions such as where do the clients live, do they cluster, and what characteristics define their socioeconomic background. Knowing the answers to these questions can lead to smarter destinations that better service current customers and better predict future customers. For the five origin zip codes with the highest reservation counts in the HSNP region

(Table 2), 62% of the 40 metrics presented were in the medium category. Annual household spending on travel and lodging were in the medium category for four of the five zip codes. However, all five zip codes are categorized as having high populations when compared to the populations of other zip codes that have at least one reservation. Household incomes and median home values for 2010 were in the low and medium categories for all five zip codes.

### 5.2. Yosemite National Park

The YOSNP Region is located in inland central California and includes 17 FMUs (unique destination zip codes) with 51 unique facility names within the 60-mile park buffer. Aggregated reservations for this region total 182,100 over the eight-year period (excluding 2005). The national distribution of reservations origin zip codes for YOSNP (Fig. 10) depicts the high concentration of reservations originating from the west coast of the U.S. From Fig. 6, we know that there are several peaks that correspond to high frequency visitation within 250 miles from the park. Using the distance tool in MMC, corresponding reservation clusters to these peaks in the histogram are further investigated. For example, the three peaks with the highest reservation probability correspond to customer clusters in northern California (Fig. 11). Fig. 11 captures



**Fig. 11.** Regional demand map for overnight accommodations on federally managed land for the Yosemite National Park Region by origin zip code, 1999 to 2007. The yellow star indicates the park location and the grey dashed line measures 150 miles from the park to the San Francisco Bay area.

all three of these peaks including the San Francisco Bay metropolitan area peak at ~150 mile, the largest peak for the YOSNP region corresponding to California Central Valley customers at ~90 miles, and the truly local customers residing in the surrounding mountains at < 50 miles from their reserved destination within the YOSNP region (Fig. 6). The somewhat broader and less substantial probability peak in Fig. 6 between 250 and 300 miles represents the more geospatially dispersed metropolitan Los Angeles area (Fig. 12). These data indicate that YOSNP attracts a similar number of visitors from the northern and southern suburbs of the Los Angeles metropolitan area.

### 5.3. Canyonlands National Park

The CLNP Region, which includes neighboring Arches National Park, is represented by one FMU (unique destination zip code) with one unique facility within the 60-mile park buffer. Total reservations for this region are 5143 over the eight-year period (excluding 2005). As stated above, CLNP was selected as a case for this study due to the unique distance distribution of reservations for the park region. CLNP is located in eastern Utah. There are few population concentrations near to the park region, and the square mileage for the tabulated zip code areas near the park region tend to be larger relative to other parts of the U.S. The national distribution of reservation origin zip codes for CLNP (Fig. 13) depicts a more dispersed visitor distribution than the previous case studies, although the number of reservations is more than an order of magnitude smaller than for either of the previous cases presented.

The peaks of high frequency visitation identified in Fig. 6 are labeled for four distinct customer origin regions in the Western U.S. The identities of these origin regions (Salt Lake City, Denver, Los

Angeles and San Francisco) were determined using the MMC distance tool. The origin with the highest geospatial concentration or cluster of customers occurs in the Salt Lake City area, approximately 200 miles from CLNP (Fig. 14). The other geospatial regions of high client concentrations for CLNP (not pictured) are the Denver metropolitan area, where the majority of reservations correspond to the ~275-mile peak in Fig. 6, the Los Angeles metropolitan area corresponding to the ~580-mile peak, and the San Francisco metropolitan area corresponding to the ~690-mile peak. Notably, the probability of residents living within 110 miles of CLNP reserving overnight accommodations at this facility is substantially lower from either of the other case studies previously presented (Fig. 6). The probability of an overnight visitors originating from one of these identified dispersed origin clusters, rather than from a more local market, likely reflects the disparity in the population sizes of these origin markets when compared to the local population.

## 6. Summary and conclusions

National parks in the U.S. provide unique opportunities for tourism experiences and are valued assets to gateway communities, which provide park visitors with accommodations and services. This study examined the national geospatial supply and demand for overnight accommodations on federal lands prior to the 2008 recession. This was accomplished using ~7.5 million reservations made for federal recreational facilities (campsites, cabins and overnight group sites) between 1999 and 2007. Visitor origin frequency and median travel distance associated with overnight accommodation reservations are summarized for each facility and each customer zip code.

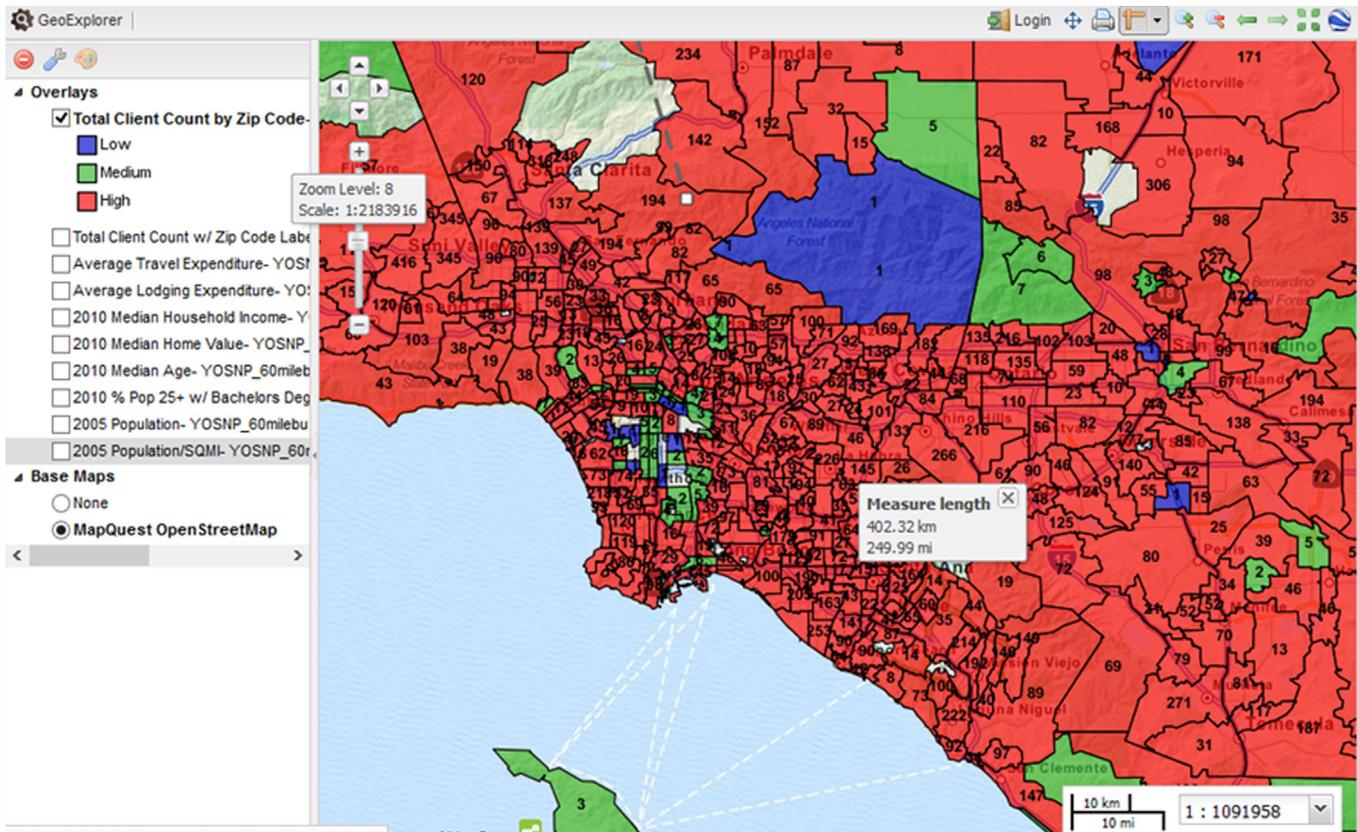


Fig. 12. Los Angeles Metropolitan Area regional demand map for overnight accommodations on federally managed land within the Yosemite National Park Region by origin zip code, 1999 to 2007.

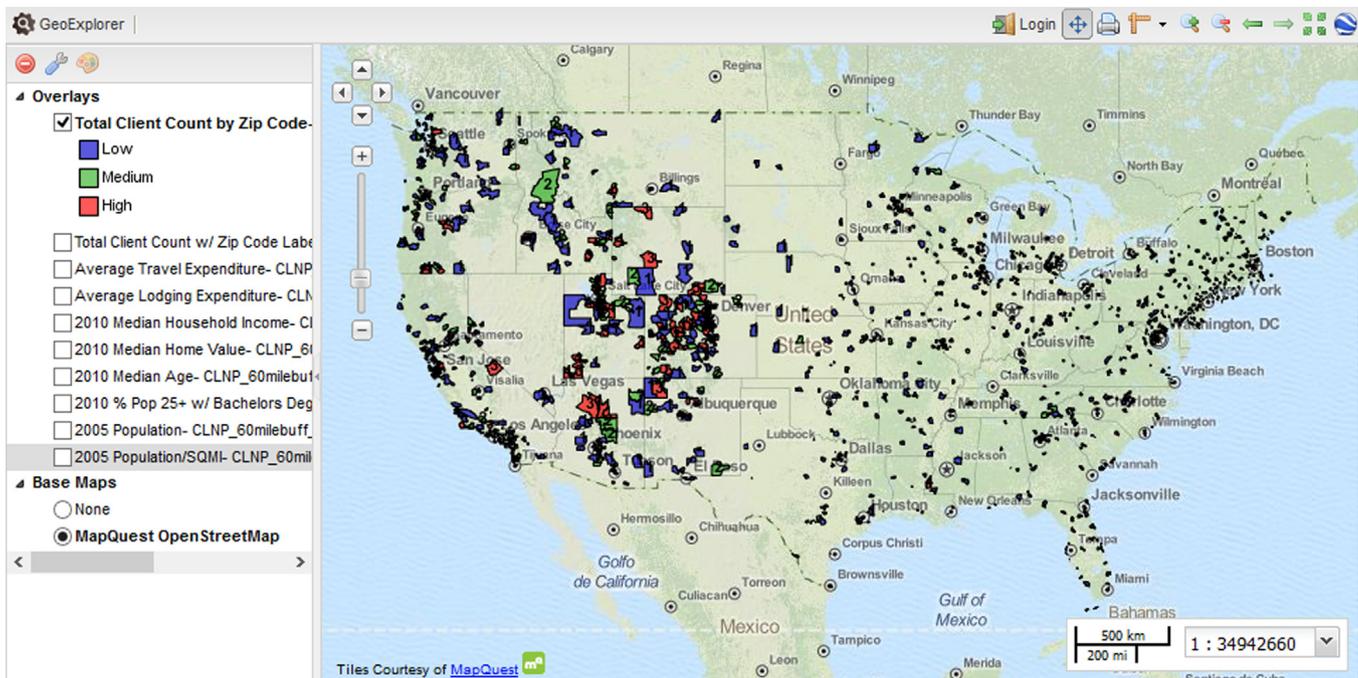
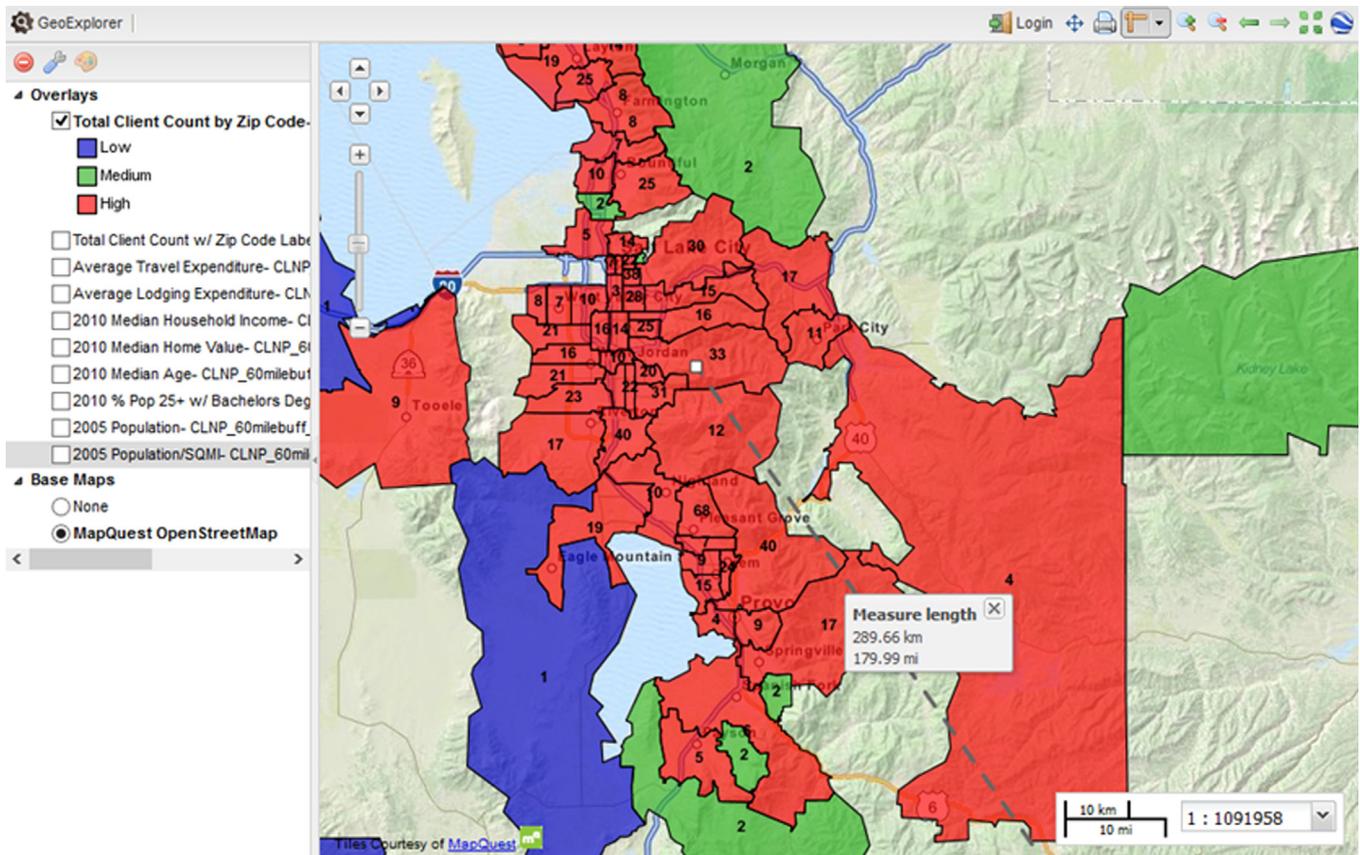


Fig. 13. National demand map for overnight accommodations on federally managed land for the Canyonlands National Park Region by origin zip code, 1999 to 2007.

Residents in the Northeast had the lowest per-capita utilization of federally managed overnight facilities (Fig. 2). Residents within the south-central Midwest and central-west Southern States displayed the highest per-capita utilization, and these same

communities strongly favored the use of local facilities (Figs. 2 and 3). Within the contiguous U.S., the overnight facilities drawing visitors from the greatest distances were concentrated in the west, as well as clustered in the Great Lakes and the southern



**Fig. 14.** Salt Lake City area regional demand map for overnight accommodations on federally managed land within the Canyonlands National Park Region by origin zip code, 1999 to 2007. The grey dashed line indicates a measured length of 180 miles from the park to the Salt Lake City area.

Appalachians regions of the country (Fig. 5). Three national park case studies were selected to illustrate the variable geospatial dispersion of origin markets participating in overnight outdoor recreation on federal lands. For the Hot Springs National Park Region (AR), the demand market for overnight accommodations was highly localized to that region, as it is for much of the central U.S. For the Yosemite National Park Region (CA), there was a strong local constituency reserving overnight facilities, but the demand market also draws heavily from the regional metropolitan areas of Los Angeles and San Francisco. For the Canyonlands National Park Region (UT) customers residing in Salt Lake City, UT and Denver, CO were among the most frequent overnight visitors. Local residents within the sparsely populated region surrounding the park tended not to utilize it for overnight stays.

Utilizing overnight camping and lodging reservation data for federally managed sites can help facilitate data-driven planning and marketing efforts by both the parks and their gateway community stakeholders. Understanding geospatial demand for specific destinations can improve management and marketing decisions affecting natural preservation, visitor enjoyment, and community planning. The data analytics and visualization approaches presented in this paper used a combination of commercial GIS (ArcGIS 10) and a free web-mapping application (MapMyClients) that was designed specifically for tourism researchers and professionals. The latter can be used to identify demographic information that may be useful to managers as they plan marketing campaigns (Supak et al., 2014).

Local governments and businesses within a national park's gateway community can use these approaches to geospatially define demand markets and demographically profile their customers, allowing for smarter, data-driven decision making. While this study has focused on the gateway communities associated

with national park attractions, this methodology can be applied easily to other destinations where visitor origin information is being collected by individual businesses, chambers of commerce, or tourism bureaus.

## Acknowledgements

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