Chapter 10
Recreation Ecosystem Services from Chaparral Dominated Landscapes: A Baseline Assessment from National Forests in Southern California

Cloé Garnache, Lorie Srivastava, José J. Sánchez, and Frank Lupi

Abstract This chapter examines recreation ecosystem services provided by chaparral dominated landscapes. Such areas are popular around the world amongst recreation users, including hikers, mountain bikers, campers, and nature enthusiasts. Yet, relatively few studies have documented the recreation services provided by chaparral landscapes such as national forests. For policy makers to manage these areas effectively, baseline information on the provision of recreation services and the populations who benefit is important, especially given current stressors such as overuse and projected climate change effects. To this end, this chapter examines four chaparral dominated national forests surrounding the Los Angeles and San Diego metropolitan areas, namely the Angeles, Cleveland, Los Padres, and San Bernardino. Using data from the USDA Forest Service's National Visitor Use Monitoring (NVUM) survey, we discuss the types of visitors using these public lands and their recreation use patterns. Our analyses suggest recreation in chaparral dominated national forests is especially important for minorities. Yet, these landscapes are facing altered human and natural disturbance regimes that may affect the recreation services they provide.

Keywords Chaparral · National forests · National Visitor Use Monitoring survey · Recreation demand · Visitor survey

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10.1 Introduction

Chaparral landscapes are enjoyed by outdoor recreationalists in each of the world's five Mediterranean-type climate regions—in the United States (US) and northern Baja of Mexico, the Mediterranean Basin, Chile, South Africa, and Australia. Quantification of these uses and their associated benefits, however, has been limited, both on private and public lands. Policy makers wishing to manage landscapes such as national forests and national parks for present and future recreation use can potentially benefit from an understanding of the provision of recreation services provided and the stressors these services face. Before embarking on a more detailed study of future challenges, baseline information and insight on recreation services is needed.

The United Nation's Millennium Ecosystem Assessment (MEA) provides an assessment framework and defines ecosystem services as "the benefits people obtain from ecosystems [including] provisioning services such as food, water, timber, and fiber; regulating services that affect climate, floods, disease, wastes, and water quality; cultural services that provide recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling" (Millenium Ecosystem Assessment 2005). Thus, recreation is a cultural service within an ecosystem service framework. The United States Forest Service (USFS) has long recognized that ecosystems from public lands provide multiple benefits to users of national forests. The multiple uses acknowledged by national forest policy include outdoor recreation, timber, watersheds, and wildlife and fish, which were made explicit in the Multiple-Use Sustained-Yield Act of 1960. As such, in the United States, recreation has long been an element of the multiple uses management paradigm (Fedkiw 1998).

Recreation activities in natural landscapes appeal to outdoor enthusiasts, in particular when the forests are in close proximity to heavily urbanized areas where substitute outdoor activities may be scarce. In the US, national forests, managed by the USFS, are examples of such landscapes. One of the mandates of the USFS is to manage its land to provide recreation opportunities for the general public (Vincent et al. 2014; USDA Forest Service 2015a). In addition, managers of national forests are increasingly mindful of such pursuits for physical and mental health as they design and implement policies to sustainably manage such landscapes (Bell et al. 2009) both for the present as well as the future. As a first step, it could be helpful for decision makers to understand who visits the national forests for recreation and the types of activities they participate in, so as to prioritize investments of effort and money in national forest maintenance and enhancement.

This chapter reviews studies of recreation services provided by chaparral landscapes around the world, although the existing literature is relatively scant. To develop a baseline assessment that may aid management for present and future generations, we undertake a case study of the recreation services provided by four southern California national forests dominated by chaparral vegetation, namely, the Angeles, Cleveland, Los Padres, and San Bernardino. The proximity of these chaparral dominated national forests to large urban centers makes them unique as they provide recreation opportunities to millions of visitors every year (USDA Forest Service 2015b).

We use the National Visitor Use Monitoring (NVUM) survey to determine the types of visitors and the activities they engage in while in the four national forests. Organized by the USFS, the NVUM surveys—started in 2004 and continuing to the present—collect data from visitors in each national forest using a detailed questionnaire that typically takes five minutes or less to complete. The results provide information on a broad range of recreation activities from day use at picnic areas to overnight visitation. They encompass hundreds of individual sites at each national forest, including trailheads, picnic areas, visitor centers, parking lots, as well as road stops set up throughout the forests. Given the length and depth of data collection, the NVUM data are an important information source. For example, in conjunction with other surveys, these data suggest that multiple factors determine the type and frequency of recreation activities in which visitors participate, including the characteristics of the landscape, the recreation infrastructure, and distance from urban centers. As a result, the NVUM data are potentially helpful to the USFS for forest planning and decision making. For instance, the description of visitor characteristics can help forest staff identify recreation niches for each national forest such as recreating near water sources, provide staff with a profile of the visitors they serve, and help determine their needs.

Regardless of the location of chaparral landscapes, decision makers and managers of these lands are faced with the challenge of how to best manage the natural resources successfully for present and future recreationalists. Many resource-based recreation activities will likely be overused by growing populations seeking natural landscapes for recreation and by climate change as it can potentially affect both weather patterns and landscape characteristics. In the study area of southern California, projected climate effects include changes in precipitation, temperature, drought, and wildfire, along with changes in the distribution of chaparral vegetation (see Chap. 14).

This chapter addresses gaps in our knowledge of visitor characteristics, recreation activities, overuse and degradation, activities by under-represented groups, and the potential effects of climate change by providing a baseline assessment of the study area. An understanding of these issues may help inform appropriate and timely policies to improve natural resource management of chaparral for recreation, especially in the face of human and natural stressors. A baseline assessment of visitor numbers and uses of chaparral dominated forests may be foundational for managers of these public spaces as they plan and budget for initiatives to successfully deal with these challenges.

10.2 Literature Review of Recreation in Chaparral and Similar Landscapes

Despite chaparral landscapes being used for recreation in many parts of the world, few studies have attempted to measure the recreation services provided by these landscapes, much less address future challenges or use by minority groups. Where studies have been undertaken, differences in study designs and their respective

findings make generalizations difficult. For example, multiple environmental studies show the negative effects of human disturbance (e.g., recreation and trail use) within chaparral landscapes (Sauvajot et al. 1998; Witztum and Stow 2004; George and Crooks 2006), but these studies do not document recreation ecosystem benefits provided to visitors. In another example, a study of visitor preferences conducted in central Spain investigates the preferences of cultural tourists for recreation activities and landscape types (Schmitz et al. 2007). Chaparral landscapes, one of the four landscape types examined, was overall less preferred than other landscapes with different vegetation types, such as woodland mosaics.

Koniak et al. (2011) investigated the preferences of hikers and picnickers for different types of natural vegetation formations in Israel. They found that visitors preferred to hike in the open garrigue (a type of chaparral) more than other nearby vegetation types, namely dense scrub or pine forest. Alternatively, picnickers preferred either open garrigue or planted pine forest to dense scrub. Their study suggests chaparral provides a valuable service to recreation users. In contrast, in a classic study of global ecosystem services, Costanza et al. (1997) assign very small recreation values to chaparral, grassland, and rangeland compared to other vegetation types.

We can infer the range of welfare losses due to climate change or overuse and degradation by examining studies of recreation site closures in chaparral and other areas. For example, in the Kassandra peninsula in northeastern Greece, Papaspyropoulos et al. (2015) estimate the loss of a chaparral site for the hunting season increased travel expenditures (a rough proxy for value) by about $67,000 in 2007 dollars, largely due to greater travel distances required to get to alternate sites. In comparison, the closure of trailheads in the Alpine Lakes Wilderness in Washington State in the US is associated with an annual loss ranging from $5,500 to $2,500 (Hilger and Englin 2009). Baerenklau et al. (2010) and Sánchez et al. (2016) show that the closure of popular hiking sites in the San Bernardino National Forest—one of our case study national forests—in southern California results in losses in the range of $0.5 million to $3 million per season per site. These differences in economic value across sites are likely due to the differences in the number of users and the availability of nearby substitute recreation sites, highlighting the need to have a baseline understanding of recreation use.

In our study area of southern California, wildfires have increased in frequency and size as a consequence of fuel accumulation, drought effects, and type-conversion to non-native grasses (see Chaps. 12 and 15). While some research exists on the implications of climate change on forest-based recreation in some parts of the US (e.g., Irland et al. 2001; Richardson and Loomis 2004), a larger literature has explored the effect of wildfire on demand for forest recreation. Duffield et al. (2013) estimate that about 35,000 trips were lost per year due to wildfires in the states of Montana, Idaho, and Wyoming over the period 1986–2011. Nevertheless, the effect of fire on recreation often depends upon the type of activity in which the visitors engage, on landscape and fire characteristics, and on the recovery time after a fire. The extent of the effect has been found to vary by activity, for example, the number of hiking trips reduced by 5%, but mountain biking trips declined by more

than double (−12%) in national forests in Montana (Hesseln et al. 2004). Similarly, demand for camping was affected differently in Montana, Idaho, Washington, and Alberta (Rausch et al. 2010; Duffield et al. 2013).

In terms of landscape and fire characteristics, crown fires (i.e., forest fires that burn through the vegetation canopy) and the percentage of area burned visible from the trail negatively affect the number of recreation trips relative to less intense fires (Loomis et al. 2001). It is noteworthy that almost all fires in chaparral dominated landscapes are crown fires. Studies have also found that the lag time since a fire also affects trip demand. Several studies indicate that trip demand is negatively affected immediately after a fire, but does eventually return to prefire levels (Loomis et al. 2001; Hesseln et al. 2003; Englin et al. 2006; Boxall and Englin 2008), with the lag period dependent upon the activity type. Studies record a spike in visits in response to well-managed prescribed burns and recent fires (Englin et al. 2001; Boxall and Englin 2008; Sánchez et al. 2016). In particular, Hilger and Englin (2009) record a hiking trip demand that surpasses prefire levels just 4 years after a burn in the Alpine Lakes Wilderness in Washington State. Englin et al. (2001) describe the demand dynamics for hiking trips in response to fire for the US Rocky Mountain region as initially resulting in an increase in the number of trips immediately after a fire, followed by a decrease after 3 years, and then the number of trips slowly returned to prefire levels. Several reasons may drive this initial spike in visits to areas impacted by fire, including wildflower blooms following a fire (Loomis et al. 2001) and an abundance of various animal species (Englin et al. 2001; Hilger and Englin 2009). In addition, Starbuck et al. (2006) suggest that since low-intensity fires thin the wood biomass while leaving large trees unharmed, they may be seen as opening and enhancing the viewshed. Indeed, given this finding it could be assumed that a reduction of hazardous fuels and forest restoration activities may be viewed by recreation users as increasing the quality at a given recreation site.

How might wildfires affect the value of lost recreation opportunities in chaparral landscapes? Studies by Shechter and colleagues have addressed recreation use values in Mount Carmel National Park in Israel, which includes notable areas of Mediterranean maquis landscape (a type of chaparral). Using revealed and stated preference approaches, they find values for recreation use in chaparral that parallel the rental value of converting the land to agriculture (Shechter et al. 1998). Freeman (2012) used values from Shechter et al. (1998), along with other values, to develop a model to estimate the economic consequences of a road expansion infrastructure project on woodland succession, a maquis landscape in the Carmel range of northern Israel. The construction of the road was predicted to alter the natural fire regime resulting in an increase of open maquis and loss of moderate and dense maquis. Freeman's findings suggest that the road expansion project would reduce natural maquis cover thereby affecting both economic use values (including recreation) and non-use ecological values (although a breakdown of the effect on recreation was not provided). In summary, although the literature indicates that chaparral landscapes provide valuable services to the public, studies on recreation use in chaparral landscapes remain scant and more studies are needed to improve our ability to meet present and future challenges to these landscapes.

10.3 Case Study: Southern California

We explore relationships between recreation use and chaparral dominated national forests in the study area using National Visitor Use Monitoring data. The information collected by these surveys is now required for national forest plans as part of Executive Order 12862 (Setting Customer Service Standards). Using the NVUM data, we examine visitors' demographics and the activities in which they engage while visiting the four southern California national forests. In addition, by linking NVUM visitor use data to site characteristics such as vegetation type and distance to water, we are able to provide information for managing the threats faced by these national forests. For example, the visitation estimates can be helpful in considering visitor capacity issues to prevent site overcrowding, overuse, and degradation.

10.3.1 Study Area and the National Visitor Use Monitoring Survey

The study area encompasses the four national forests in southern California that border the Los Angeles and San Diego metropolitan areas: the Angeles, Cleveland, Los Padres, and San Bernardino (Fig. 10.1). Collectively, these four national forests cover over 1.4 million ha (3.5 million acres). The most northern one is the Los Padres National Forest, north of Los Angeles and stretching nearly to Monterey, and the most southern is the Cleveland, which runs to the international border with Mexico. The area is heavily urbanized, with a population of over 23 million people across the ten different counties within which at least one of the national forests is situated (US Census Bureau 2014a), with eight million people living within a 1 h drive of these forests (USDA Forest Service 2005a). The primary vegetation type across these national forests is chaparral shrubland, but other vegetation types exist including hardwoods, conifers, and grasslands.

Although the NVUM surveys started in 2004, the initial round of data collection (Round 1) was part of a pilot program to test the methodology. The methodology was subsequently updated and finalized as a result of the pilot. We therefore only use the subsequent Rounds 2 and 3. Each national forest is surveyed once every 5 years to provide representative information on visitors and use, including seasonal variations throughout the year. The Angeles National Forest was surveyed in 2006 (Round 2) and 2011 (Round 3), while the Cleveland, Los Padres, and San Bernardino were surveyed in 2009 (Round 2) and 2014 (Round 3) (USDA Forest Service 2015b). Over the two NVUM rounds, a total of 126 interview sites were surveyed in the Angeles, 136 in the San Bernardino, 126 in the Los Padres, and 92 in the Cleveland. A total of 9614 people were interviewed in Rounds 2 and 3 of NVUM (Table 10.1). Of the visitors intercepted and questioned, 89% stated their primary purpose was to recreate in the national forest (in contrast to simply passing through or being on a work-related visit). Hereafter we refer to these people as "visitors" or "recreation users" of the national forests.

Fig. 10.1 Location of the four national forests in the southern California study area: the Angeles, San Bernardino, Los Padres, and Cleveland. Source: US Forest Service Pacific Southwest Region

Table 10.1 Number of people interviewed in the NVUM survey in Rounds 2 and 3

	Round 2	Round 3	Total
Angeles	1303	2150	3453
San Bernardino	682	558	1240
Los Padres	922	1090	2012
Cleveland	1452	1457	2909

Source: NVUM surveys, rounds 2 and 3 (USDA Forest Service 2015b)

The NVUM survey uses a random stratified sample, ensuring it is representative of total use at the national forest level (English et al. 2002). The sampling frame is defined using a combination of four basic "site type" categories: Day Use Developed Sites (DUDS), Overnight Use Developed Sites (OUDS), Designated Wilderness Areas (Wilderness), and General Forest Areas (GFA). It defines "use level" based on the expected level of recreation visitors for each site and day of the year: very high, high, medium, low, or no use. Days and sites are randomly sampled within each stratum of site type and use level. On average, DUDS represents 25%, OUDS 28%, GFA 34%, and Wilderness 14% of the interview sites across the four forests.

To extrapolate the total estimated number of annual visits to each national forest using the NVUM interviews collected, we used the weights from the stratified sampling scheme to aggregate data from individual interviews to the level of each forest following the procedures developed by English et al. (2002). All the numbers we report regarding users and uses of the national forest take into account total estimated annual visitation. Furthermore, given that two rounds of the NVUM survey are available, our analysis focuses on the average users and uses across the two rounds.

The NVUM survey collects information on age, gender, race, ethnicity, home zip code, date of visit, name of the site visited, primary activity of the user, and activities in which the user engages. Detailed activity information is collected using a list

of 31 potential activities divided into six general categories; fishing/hunting, viewing, learning about nature and culture, non-motorized activities, motorized activities, camping or other overnight activities, and other activities. Using this detailed information, we define water-related activities as fishing and non-motorized and motorized water travel. We also define snow-related activities as downhill skiing and snowboarding, cross-country skiing, snowshoeing, and snowmobile travel.

10.3.2 Additional Data Sources

We combine the NVUM data with other data sources to yield further insights with respect to preferences, income level, and allow spatial analysis. To analyze the distance visitors travel from home to the sites they visit in the national forests, we use the software PC*Miler (http://www.pcmiler.com/). This calculated the travel distance and travel time through a road network from the national forest sites where users are interviewed to the centroid of the visitor's home zip code that was recorded in the surveys.

In addition, to better grasp users' economic background, we matched the visitors' reported zip code from NVUM with Census data (US Census Bureau 2014b). The Census provides information on mean and median socio-economic characteristics at the zip code level. For our purposes, we report information on median income for the home zip code of each visitor.

To indicate the extent that water features may attract visitors, we calculate the distance of each national forest site in the NVUM survey to lakes, and perennial and intermittent streams (CDFW 2015) using ArcGIS. Visitors access streams and lakes using paths and trails; however, since we do not have accurate trail information for most sites, we calculate access to water as the shortest distance to the closest stream or lake (i.e., in a straight line). Note that we do not know whether users actually use the streams and lakes.

Finally, we link each recreation site in the NVUM survey to vegetation data (FRAP 2015) in ArcGIS. We are thus able to examine which vegetation types are most visited in the national forests. While some sites are surrounded by a single vegetation type, others are surrounded by a mix. To facilitate the analysis, we focus on the dominant vegetation type within a 3.22 km (2 mile) radius from the site's parking lot.

10.4 Results: Patterns of Visitation and Activities

Analyzing the NVUM data provides a foundational assessment of recreation within chaparral dominated public forests. We are able to quantify the number of visits across the four national forests, distance travelled by visitors, their socio-demographic characteristics, and recreation activities. In addition, the analysis can

Table 10.2 Total annual visitation estimates (millions) based on two rounds of NVUM data collected across the four southern California national forests

	Round 2		Round 3	
	Total site visits	Total national forest visits	Total site visits	Total national forest visits
Angeles	3.4	3.0	4.4	3.6
San Bernardino	2.7	2.4	2.2	1.9
Los Padres	1.1	0.9	1.3	0.9
Cleveland	0.5	0.5	0.7	0.6

Note: a single national forest visit may include multiple site visits
Source: NVUM Surveys

potentially help to determine overuse of recreation sites, which may have implications for future management decisions of these and other recreation facilities.

10.4.1 Estimated Number of Total Visits to the National Forests

Of the four national forests in southern California, annual visitation is highest at Angeles National Forest with over three million visitors, resulting in four million site visits (as visitors stop at multiple sites), followed by the San Bernardino with around two million visits annually. The Los Padres and Cleveland, which are more spatially dispersed and farther from the city of Los Angeles, attract about 1.6 million visitors annually (Table 10.2). Despite slight variations across the two NVUM rounds (which span 5 years), visitation numbers remain strong and tend to increase over the time period of 2006–2011, with the exception of the San Bernardino. Note, however, that given the extent of snow-driven activities in the San Bernardino, a poor snow year may dramatically lower the number of visitors.

10.4.2 Visitors to the National Forests

Users' demographics reveal that females typically make up less than one-third of all the visitors to the four national forests, with 69% of the visitors in the Angeles being male, 64% in the San Bernardino, 68% in the Los Padres, and 74% in the Cleveland. In addition, Whites generally account for over three quarters of national forest visitors. Hispanics comprise the second largest group of visitors, averaging about 17% of visitors across the four forests (note that some Hispanics self-identify as Whites in addition to Hispanic). Asian-Americans are a distant third place, accounting for an average of about 7% of visitors (again, with some self-identifying as Whites in

Table 10.3 Average percentage of national forest visits by race and ethnicity based on two rounds of NVUM data collected across the four southern California national forests

Race/Ethnicity	Angeles (%)	San Bernardino (%)	Los Padres (%)	Cleveland (%)
White	76	84	87	89
Asian-American	12	7	5	5
African-American	5	3	2	2
Native-American	4	4	4	3
Pacific and Islander	3	2	1	0
Hispanic	21	19	17	12

Note: race was asked separately from ethnicity. Percentages are conditional upon respondents agreeing to answer about the race with which they most closely identify. Sums can be greater than 100% since people could self-identify with more than one group and, in some cases, race and ethnicity may overlap
Source: NVUM surveys

Box 10.1 Minority Outdoor Participation and Perceived Barriers

The Latino Outdoors non-profit organization (http://latinooutdoors.org/) conducted a national survey that focuses on Hispanics who have never (or only a few times) visited national forests, national parks, or other public lands. Individuals and families were recruited by Latino Outdoors to participate in outdoor excursions throughout the US (California, Florida, New York, Texas, and Washington, D.C.) during the 2015 and 2016 calendar years. For this example, we focus on excursions in southern California. Latino Outdoors surveyed participants both before and after the excursions. The non-profit was responsible for recruitment and the administration of the survey. They provided completed surveys to the USFS for analysis (survey response rate is unknown). The voluntary surveys were designed to provide information on outdoor recreation activities, potential barriers, and determine the effectiveness of the Latino Outdoors program in promoting outdoor participation by under-represented visitors.

The pre-trip survey was administered prior to the visit to the local recreation site. The survey asked whether they had ever visited a national or state park or national forest. If they had not, they were asked why. If they had visited one, they were asked questions about the number of those trips in the past 12 months, the travel distance, travel hours, and travel cost. In addition, several questions were asked about the characteristics of national or state parks or national forests that were important to them. The survey also included six open ended questions for survey participants to write qualitative information concerning their sense of responsibility toward public lands, meaning of the outdoors, expectations of participating in outdoor activities, perceptions of Hispanics in the outdoors, and memorable outdoor experiences.

The individuals were then taken on a one-day trip to a local outdoor recreation site. The post-trip survey was composed of three types of questions: (a)

questions about the trip they took, including an open-ended willingness to pay question; (b) similar questions to the pre-trip survey to see if the Latino Outdoors experience had a substantial effect on their responses; and (c) demographic questions (e.g., age, education level, gender, home zip code, and household income). A total of 28 participants completed both the pre- and post-trip surveys in either English or Spanish. The survey respondents were relatively young, averaging 31 years of age, almost half (49%) had at least a bachelor's degree, and the average reported annual household income was $46,000. A significant portion were recent immigrants, as 39% responded that they are the first generation of their family to live in the US. Regarding recreation trips to the outdoors, respondents were willing to pay an average of $27 to visit a local day trip recreation site. Results show that the majority (84%) of respondents have visited a national forest, national park, or other public land in the past 12 months and they travel approximately 61 miles (~100 km) to reach their recreation destination. When visiting a national forest or national park, 82% of respondents felt welcomed by the staff and 77% felt welcomed by other races/ethnicities. The most common activities in which they engaged during their visits are hiking (80%), camping (34%), picnicking (25%), and bird-watching (16%).

Survey respondents believe that public lands have important functions and value them. For example, they rated national forests as important or very important in providing opportunities for recreation, viewing natural scenery, environmental education, spending time with family, a source of inspiration, and habitat for wildlife. Despite these valuable benefits, 65% of respondents believe that their family and friends do not spend enough time visiting national forests. Some reasons provided include lack of financial resources and limited knowledge of recreation opportunities available to the public.

addition to Asian-American). The highest percentages of Hispanic and Asian-American visitors were both found on the Angeles National Forest (Table 10.3).

Most visitors to national forests are over 20 years of age. Nevertheless, our findings show that the number of children under the age of 16 is substantial in all four national forests, especially in the Angeles and San Bernardino (Fig. 10.2, see final bar in each plot).

The vast majority of visitors to these four national forests are local residents, with over half the visits to the Angeles, Los Padres, and Cleveland made by people who live within 80 km (50 miles) of the forests. The San Bernardino attracts people from farther away, in part related to opportunities provided for winter sports (Table 10.4).

The annual household median income for visitor's home zip code, based on the 2015 American Community Survey 1-Year Estimates (US Census Bureau 2014b),

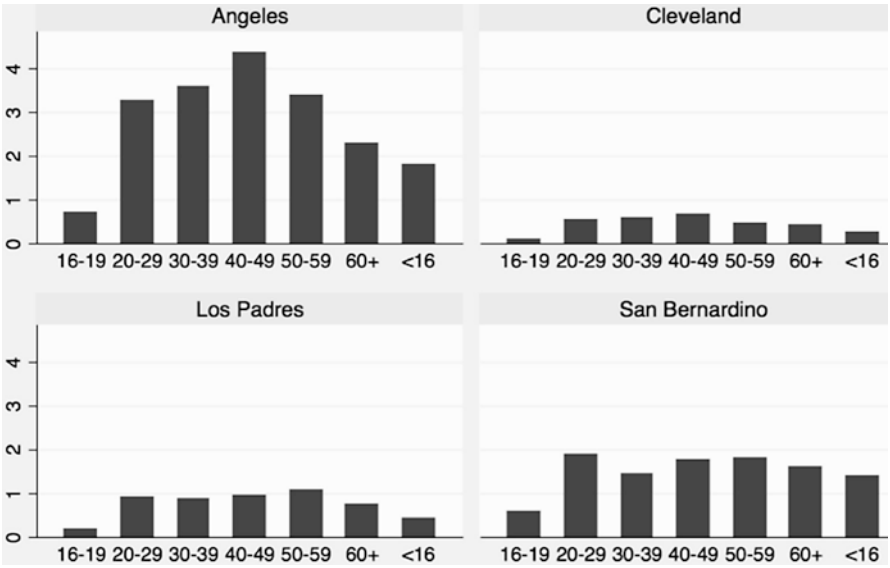

Fig. 10.2 Average self-reported annual visits to the national forests by age. Source: NVUM surveys

Table 10.4 Proportion of visits by average distance to national forests based on two rounds of NVUM data collected across the four southern California national forests

Distance (miles)	Angeles (%)	San Bernardino (%)	Los Padres (%)	Cleveland (%)
<25	40	24	46	33
25–50	24	14	12	29
50–75	18	14	9	29
75–100	14	18	7	4
100–250	3	26	17	3
>250	10	4	10	2

Source: NVUM surveys

provides a partial picture of the neighborhoods from which visitors are drawn (Table 10.5). The annual household median income from visitor's home zip codes appears to be higher than both the national median income (around $54,000) as well as the southern California median income (around $64,000).[1] Over half of visitors come from zip codes where annual household median income is between $50,000–$100,000 (Table 10.5).

[1] The ten counties in which at least one of the four National Forests is situated were used in the median income calculation, which are: Kern, Los Angeles, Monterey, Orange, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barbara, and Ventura. The values are in 2015 dollars.

Table 10.5 Annual household median income for the zip code of origin of visitors to national forests in southern California based on two rounds of NVUM data collected across the four southern California national forests

Income range	Angeles (%)	San Bernardino (%)	Los Padres (%)	Cleveland (%)
<$50,000	14	13	9	28
$50,000–75,000	43	32	48	37
$75,000–100,000	35	37	28	26
$100,000–150,000	6	16	13	8
>$150,000	2	1	2	2

Source: NVUM surveys

Table 10.6 Proportion of national forest visits by dominant vegetation type

Vegetation type	Angeles (%)	San Bernardino (%)	Los Padres (%)	Cleveland (%)
Chaparral (shrubs)	70 (71)	11 (38)	97 (83)	100 (100)
Conifers	30 (29)	89 (61)	2 (16)	0 (0)
Hardwood trees	0 (0)	0 (1)	1 (1)	0 (0)

Note: the proportion of NVUM sites by their dominant vegetation type is reported in parenthesis (e.g., 38% of the NVUM sites in San Bernardino have chaparral shrubland as the dominant vegetation within a 2-mile radius of the parking lot). Our analysis excludes NVUM data from the Monterey District of the Los Padres and from the Palomar District of the Cleveland National Forest, which contain areas with heavily-used conifer and hardwood forests. Source: NVUM surveys

10.4.3 Recreation Within the National Forests

To determine what types of outdoor recreation activities respondents pursued in the national forests we analyzed the NVUM data for relationships between visits and vegetation type, month, type of recreation activity, and recreation features. The analysis of NVUM site location data showed the majority of annual visits to the four national forests were to sites dominated by chaparral vegetation (70% in the Angeles, 97% in the Los Padres, and virtually 100% in the Cleveland). The exception is the San Bernardino where visits to chaparral sites accounted for only 11% of total visits, while conifer vegetation accounted for the remaining visits (Table 10.6). When contrasted with the dominant vegetation type of the sites where the NVUM interviews were conducted, visitors disproportionally targeted chaparral vegetation in the Los Padres, while they disproportionally targeted sites with conifers in the San Bernardino—which can be partially explained by higher elevation, winter sports recreation. For example, in the San Bernardino, 61% of the NVUM sites are conifer but 89% of the visits were to these sites.

The number of visits to these four national forests is generally highest in the summer between June and August, except for the San Bernardino which is most heavily used in the winter between December and April for downhill skiing and other snow-related activities, and the Cleveland which is most popular in the non-summer months (Fig. 10.3).

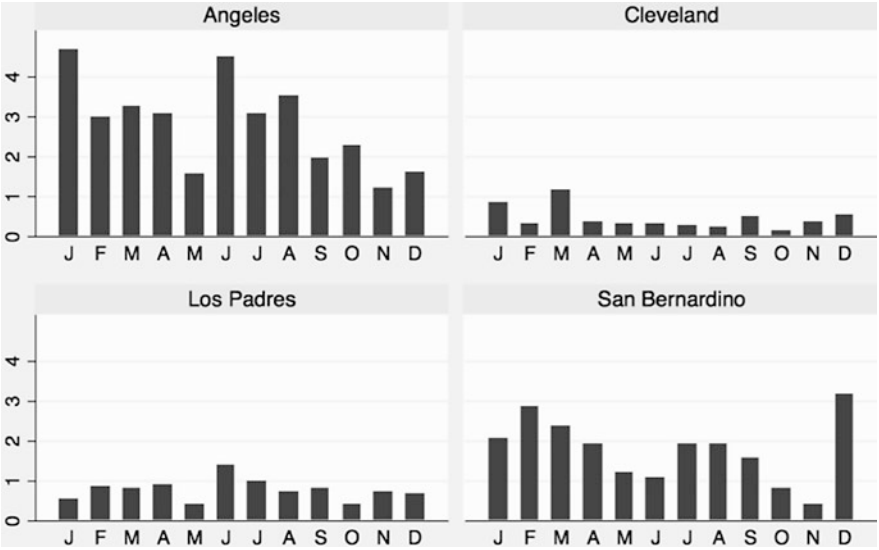

Fig. 10.3 Average monthly visits to the national forests in southern California (millions). Source: NVUM survey

Table 10.7 Average percentage of visits to national forests by primary recreation activity

Activity	Angeles (%)	San Bernardino (%)	Los Padres (%)	Cleveland (%)
Hiking	47	27	39	46
Biking	4	4	9	13
Relaxing, picnic, nature	12	13	21	10
Water activities	9	3	2	0
Snow activities	11	30	1	0
OHV use	3	5	2	2

Source: NVUM survey

In terms of different activities, the most common primary activity in the four national forests is hiking, with the exception of snow-related activities in the San Bernardino. Many visitors also report relaxing, picnicking, or nature viewing as their primary activity. Biking is relatively more popular in the Los Padres and Cleveland than in the Angeles and San Bernardino, where water-related activities and Off-Highway Vehicle (OHV) use are slightly more important (Table 10.7).

Visitors often participate in more than one activity, i.e., other activities in addition to their primary activity. For example, although relaxing, picnicking, and being in nature were not the primary activity of the majority of visitors, virtually all visitors reported participating in these pursuits (Table 10.8). The same applies to hiking, albeit to a lesser extent. In terms of patterns for different ethnicities (not shown in the tables), the distribution of activities that Hispanics engage in is relatively similar to that of the average visitor to these national forests, with slightly higher

Table 10.8 Average percentage of national forest visits by recreation activity

Activity	Angeles (%)	San Bernardino (%)	Los Padres (%)	Cleveland (%)
Hiking	63	47	66	64
Biking	5	6	11	15
Relaxing, picnic, nature	94	78	100	100
Water activities	11	6	4	1
Snow activities	11	30	1	0
OHV use	3	9	4	4

Note: totals for each national forest can exceed 100% as visitors may engage in multiple activities during each visit. Source: NVUM surveys

Table 10.9 Proportion of national forest visits by distance to water

Distance (m)	Angeles (%)	San Bernardino (%)	Los Padres (%)	Cleveland (%)
<100	29	47	34	9
100–250	11	27	2	14
250–500	32	1	3	3
>500	28	25	61	73

Source: NVUM surveys

participation levels in water-related activities and lower participation in snow activities, especially in the San Bernardino.

Our analysis of site survey location to lakes and streams shows most visits take place very close to water sources (Table 10.9). In the San Bernardino National Forest, for example, almost 50% of visits were <100 m from water. Two caveats, however, are important to note. First, the distance measured reflects the shortest distance which may dramatically under-estimate the actual distance a visitor may have to walk to access a stream or lake, especially in areas characterized by steep topography. Second, the presence of a stream or lake nearby does not imply that the visitor takes advantage of this nearby access to water. Nevertheless, this information may be used in conjunction with data on water activities to hypothesize that in addition to water activities, visitors engaged in hiking, picnicking, and other activities may also be drawn to sites near water, for instance, hikers may prefer trails near streams or lakes (Tables 10.7 and 10.8).

10.4.4 Recreation Site Degradation from Overuse

The NVUM survey provides USFS decision makers with baseline data to assess current use patterns that can help inform future initiatives and strategic directions. Overuse and degradation of recreation sites are of concern as they could potentially prevent the agency from fulfilling its mandate to protect public lands for present and future generations. Our analysis of the NVUM data on total visitation by site reveal that although many of the recreation sites within the four southern California national forests receive low or moderate use levels, some sites are heavily used.

Fig. 10.4 Heavy use and user-made recreation dams at the East Fork of the San Gabriel River in the Angeles National Forest. Photo by Charles White

Two sites which are heavily used in the Angeles National Forest, especially during the weekends, include the West Fork of the San Gabriel River on San Gabriel Canyon Road (Highway 39) and the Oaks Picnic Area on East Fork road of the San Gabriel River. Both sites are dominated by chaparral vegetation with oak trees near the parking area and cottonwood and other riparian trees along the stream. The West Fork of the San Gabriel River site is visited by an average of 100,000 visitors per year (representing about 3% of the total annual visits to the Angeles), while the Oaks Picnic Area, which has a much smaller parking area, sees an average of 17,000 visits a year.

These sites are highly used by Hispanics who account for 30% of all visitors at the West Fork of the San Gabriel site, and the majority of visits at Oaks Picnic Area. Access to water is an important characteristic of these sites: 17% of visitors at the West Fork report water activities as their primary activity and 28% report participating in water activities. These activities may involve wading in the stream but also more ecologically disruptive activities such as building dams to form shallow pools in the stream (Fig. 10.4).

10.5 Discussion: Climate Impacts, Overuse, and Creating Opportunities

Chaparral landscapes are sought by outdoor enthusiasts in many parts of the world for their recreation opportunities. Our analysis of NVUM data along with a supplementary community survey conducted by Latino Outdoors (see Box 10.1) provides baseline information that could help land managers better manage public lands when faced with present and future challenges like climate change and resource degradation.

10.5.1 Climate Change and Its Effect on Recreation

Many ecosystem services may be adversely affected by climate change (Millennium Ecosystem Assessment 2005). In the western US, wildfires are predicted to continue to increase in size and frequency (Barbero et al. 2015; Restaino and Safford 2018). Wildfires have been shown to negatively affect the demand for recreation (Duffield et al. 2013) and wildfires often lead to site closures until the site is deemed safe for the public. The NVUM data indicate that the top three recreation activities for visitors are hiking, relaxing/picnic/nature activities, and snow-related pursuits. Unfortunately, the literature indicates that these pursuits can potentially be affected—if not curtailed—by changes in climate. Keeley et al. (2004) suggest the need for better tactical planning to address the destructive fires in southern California, for example, in the form of engineering solutions akin to that of earthquakes and other natural disasters. Whatever the approach chosen to combat wildfires or mitigate their effect, managers may consider the heterogeneous preferences of different groups when weighing their options.

In California, ecosystem services such as water provisioning and snow recreation are predicted to be significantly reduced as a result of climate change (Shaw et al. 2009). Based on our analysis of current use patterns in southern California's national forests using the NVUM data, we can hypothesize that changes in vegetation and access to water can potentially affect visitation. In particular, this might affect the San Bernardino, popular for winter sports, and the Angeles, heavily used in the summer months for water-related activities and consequently the user groups associated with these activities, e.g., Hispanics who prefer picnicking and relaxing in the shade, and those who place a high value on access to water, open views (shrubs), and shade around streams and/or picnic areas.

10.5.2 Recreation Site Degradation from Overuse

The low to moderate use levels of many sites within the four national forests in southern California suggests human disturbance may not be as problematic as it has been at some of the more heavily used sites studied in the literature for California

(Sauvajot et al. 1998; George and Crooks 2006). Nevertheless, the total visitation numbers in the NVUM data indicate potential overuse and resource degradation at several sites, including in the Angeles, likely resulting in ecosystem degradation.

The USFS recognizes increased demand and overuse of some of its recreation sites and facilities (USDA Forest Service 2005a). For example, the San Bernardino National Forest management plan explicitly focuses on relieving "concentrated demand within existing high use areas and…accommodate[ing] future growth and new uses elsewhere" (USDA Forest Service 2005b). One response on the ground by USFS staff has been to post signs at the parking lots of heavily used areas to educate visitors about the ecological damages of certain activities such as building recreation dams in streams (Fig. 10.4), although these practices seem to persist. Nevertheless, funding for providing information and public outreach to address degradation and overuse may be limited in the future.

For instance, during the period 2012–2015 the recreation budget for all four national forests declined both in nominal and real terms by 22% and 25%, respectively. In 2016, a year after part of the Angeles was declared a national monument, it was the only national forest out of the four to have an increase in its recreation budget over the previous year, and in fact higher than 2012, from $1.6 million to $2.2 million (2016 dollars).[2] Excluding the Angeles, the recreation budget for the remaining southern California's national forests declined by 26% over the 2012–2016 period (G. Macias, US Forest Service, pers. comm.).[3]

10.5.3 Recreation Opportunities for Under-represented Visitors: Ethnic and Racial Minorities

A NVUM study (USDA Forest Service 2013) reports that national forest visitors are comprised of 95.3% White, 5.4% Hispanic, 3.2% Asian/Pacific Islander, and 1.1% African American.[4] The NVUM data in our study area align with these findings from the literature and the national NVUM findings that people who did not self-identify as "white" comprised on average 16% of all visitors to the four national forests in southern California (Table 10.3). It is important to note that some respondents identified themselves both as White and other, such as Hispanic or Asian-American. Other studies have found similar responses. For example, in a national

[2] As part of President Obama's initiative to get "Every Kid in a Park," fourth grade classes became eligible to receive reimbursement for transportation costs when visiting the Angeles National Forest and San Gabriel Mountains National Monument, as well as outdoor classroom programming. See: https://www.fs.usda.gov/angeles

[3] Over the years 2012–2016, the US Forest Service allocated an average annual budget of $1.5 billion (in 2015 dollars) for its National Forest System (Hoover 2016). Total budgets have declined by 9% over this period, with an 11% decline in the budget allocated to recreation facilities (USDA Forest Service 2016).

[4] Respondents could choose to self-identify with more than one group.

study, Outdoor Foundation (2015) established that Whites (73%) participate most in outdoor recreation, while only 7% of participants are Asian/Pacific Islander, 8% are Hispanics, and 9% are African-American. Similar to our results, they identified that these under-represented groups do not participate in outdoor recreation activities in national forests, national parks, and other public lands at the same level as Whites (Tierney et al. 1998; Crano et al. 2008; Outdoor Foundation 2015). Without national efforts to connect under-represented groups to the outdoors, this trend is likely to continue.

Management concerns with providing recreation opportunities for under-represented populations may be monitored using future data collected by NVUM. There is evidence to suggest that minority groups may suffer disproportionately from changes in recreation sites due to climate change, e.g., wildfires and droughts, due to their limited financial resources and transportation access to recreation sites further away. Moreover, the scarcity or crowding of substitutes such as parks and other green spaces in the heavily urban environment of southern California may decrease their enjoyment of outdoor pursuits (Tierney et al. 1998).

The barriers to participation found by Latino Outdoors (see Box 10.1), namely financial constraints and limited knowledge of recreation opportunities, mirrors what others have found. Extensive research throughout the decades has focused on constraints faced by under-represented groups to explain their limited participation in outdoor recreation activities. Roberts and Chitewere (2011) found that outdoor participation barriers for minorities are associated with perceived or real discrimination, accessibility issues, and having no prior outdoor experience. In particular, Green et al. (2009) found that some of the perceived constraints for African-Americans and Asian/Pacific Islanders with respect to outdoor recreation were: lack of transportation, inadequate facilities and information, crowded activity areas, and pollution problems. Other studies reported personal safety as a perceived barrier to recreation (Johnson et al. 2001; Scott et al. 2004; Green et al. 2009; Byrne 2012). Relevant for our study area, Crano et al. (2008) surveyed Los Angeles County residents and found that Hispanics tend not to visit national forests due to the lack of transportation means, financial constraints, and physical limitations.

The NVUM data indicate that visitors belonging to minority groups tend to prefer different recreation activities; for example, within the study area Hispanics have a slight preference for water-based activities. Across other minority groups, the literature implies that recreation preferences of under-represented groups differ from those of Whites (Dwyer 1994). For instance, Washburne and Wall (1980) conducted a survey of the continental US population and found that African-Americans prefer urban recreation experiences, while Whites prefer wildland activities. Similarly, African-Americans are less likely than Whites to travel to wildland recreation areas (Washburne 1978; Dwyer 1994; Johnson 1998).

Hispanics also prefer to recreate in a non-traditional way (in the United States), picnicking or barbecuing in large groups for the entire day (Carr and Chavez 1993; Chavez 2002; Chavez and Olson 2009). A recent study of the immigrant Hispanic community of Cache Valley in Utah found they prefer recreation areas characterized by gathering spaces for large groups, facilities, scenery, and close to home (Madsen et al. 2014). Research on outdoor recreation activities of Hispanic and Asians use of

southern California national forests also supports these findings, indicating that they tend to participate in outdoor recreation activities in large groups (Chavez 1992, 1993).

The US Forest Service's mission as summarized by Gifford Pinchot, the first Forest Service Chief, is "to provide the greatest amount of good for the greatest amount of people in the long run." A critical component of this mission is providing recreation opportunities to everyone and, in particular, under-represented communities by reducing barriers to visitation and usage. A better understanding of how minorities use chaparral landscapes and which barriers limit their use may help decision makers better serve these communities.

10.6 Conclusion

There are currently few studies on the recreation services provided by chaparral landscapes across the world. More work is needed to better understand the importance of recreation benefits these environments provide to various populations, especially in the future with stressors such as climate change and resource degradation. As a case study, we focused on the four national forests in southern California — the Angeles, Cleveland, Los Padres, and San Bernardino. Their proximity to highly urbanized counties around Los Angeles and San Diego make these forests a unique and primary outdoor recreation destination, including for under-represented groups.

This chapter discussed several threats faced by chaparral dominated national forests, in particular, climate change and site degradation from overuse. Predicted changes in precipitation, temperature, incidence of droughts, and wildfires can potentially affect chaparral vegetation and the activities in which visitors engage. Water- and snow-based activities may be directly affected. It is currently unclear how visitors participating in those activities might adapt their use of the public lands. For example, in this study we found minorities disproportionately engaged in water-based activities, raising the question of how their participation might change with new conditions—will they concentrate on fewer sites that still offer their preferred activity, engage in other activities, or stop recreating in these national forests?

Aside from climate change, an additional threat to chaparral resources is site degradation, as evidenced by the NVUM data. Though many sites within the forests receive low levels of use, some popular recreation sites are subject to heavy use, often leading to ecosystem degradation by users who seek to alter the natural landscape, e.g., stream modification, erosion, vegetation removal, litter, and facility degradation. These negative effects could be somewhat relieved by providing educational brochures (in multiple languages), adequate oversight of highly-visited sites, and increased maintenance of these sites, although in practice, there might be limited resources within the national forest to do this. Moreover, managers of public lands are faced with the dilemma of serving the public while protecting the natural ecosystem from the very public they serve. Recreation site overuse and degradation highlights the potential trade-off between cultural and other ecosystem services (see

Chap. 8). Recreation is a valuable service to people but increased use may negatively affect the provision and value of other ecosystem services, such as biodiversity or water quality. Policy makers can potentially use information from baseline assessments such as that presented here to understand relationships between vegetation characteristics, visitors, and recreation activities and use this to inform policy planning and management decisions.

Additionally, understanding the social and economic barriers as well as outdoor recreation preferences of under-represented groups can potentially increase outdoor recreation participation for these demographic groups. Based on literature and the case study presented in this chapter of minority outdoor recreation, funding transportation services could be considered to improve participation in outdoor activities. Under the Obama administration, transportation services were being subsidized through "Every Kid in a Park" initiative which targeted all fourth grade children across the country. Under this program, the Angeles National Forest became an eligible destination after part of it was designated as a national monument.[5]

The goal of this chapter is to provide a baseline of information about the recreation services that chaparral provides to southern California residents. Based on the results, we conclude that public lands dominated by chaparral provide valuable recreation services to visitors of the four national forests in southern California. Our analysis reveals minority populations, especially Hispanics, depend on these resources for outdoor recreation. Yet, studies with community groups indicate social and financial barriers exist that prevent some from accessing these national forests.

We also assessed potential threats to these landscapes, including ecosystem degradation from climate change and overuse of recreation sites. For example, as California faces shorter wet seasons and longer dry seasons, this suggests that certain winter and water recreation activities may be limited or eventually non-existent. Consequently, more visitors might visit fewer recreation sites, degrading the sites at a faster rate. In addition, understanding the barriers and the recreation activities in which minorities engage can assist future management planning decisions to reduce these barriers. Finally, this chapter can help decision makers by providing them with information to increase visitation rates by under-represented communities.

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[5] See: https://www.fs.usda.gov/angeles

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