Pre-print ahead of press: Rice, W. L., Rushing, J. R., Thomsen, J. M., & Whitney, P. (2022). *Exclusionary effects of campsite allocation through reservations in U.S. national parks: Evidence from mobile device location data*. Journal of Park and Recreation Administration. http://dx.doi.org/10.18666/JPRA-2022-11392

Exclusionary effects of campsite allocation through reservations in U.S. national parks: Evidence from mobile device location data

William L. Rice[1,2]

Jaclyn R. Rushing[2]

Jennifer M. Thomsen[1,2]

Peter Whitney[1,2]

[1]University of Montana Parks, Tourism and Recreation Management

[2]University of Montana Department of Society and Conservation

Funding information:

Data collection used for this publication was supported by the National Institute of General Medical Sciences of the National Institutes of Health (P20GM130418).

Executive Summary

Campsites represent highly-sought-after recreational amenities in the national parks of the United States. Equitable allocation of scarce recreational resources has long been a key management issue in U.S. national parks, but has become increasingly difficult in an era of increasing demand. At present, a growing number of national park campsites are allocated through an online reservation system well-in-advance of a camper's arrival at a park. Compounding the challenge of allocating these campsites is a long history of exclusivity within national park camping—institutionalized through campground design and predicated on a legacy of the leisure class's affinity for camping in national parks. Given national park camping's history of exclusivity, this exploratory study seeks to explore how online reservation systems may impact the demographics of national park campers. Using mobile device location data, estimated demographics were calculated for campers in five national park campgrounds in the U.S. that each contained some sites requiring reservations and some sites available on a first come, first served basis. We detail results from analyses of variance between campsites requiring reservations and those that are available on a first come, first served basis. Results suggest that for each of the five campgrounds, those campers camping in sites that require reservations came from areas with higher median household incomes, on average. In three of the five campgrounds, this difference was significant. Additionally, in an urban-proximate setting, those camping in sites requiring reservations came from areas with a higher portion of White residency than those campers in campsites not requiring reservations, on average. We conclude with discussion that includes management implications concerning the growing prominence of online reservation systems for outdoor recreation amenities, and a brief research agenda for diversity, equity, and inclusion (DEI) as they relate to campgrounds. Principally, the former group of implications

includes the realization that online reservation systems present the unintended consequence of excluding low-income, and perhaps non-White, would-be campers—a conclusion drawn from the results of this exploratory study. This discussion includes an analysis of the distributive justice of online reservation systems.

Keywords: campgrounds, equity, allocation, reservations, exclusion, mobile device data

Exclusionary effects of campsite allocation through reservations in U.S. national parks: Evidence from mobile device location data

The national parks of the United States are great source of national pride and identity for many Americans; some have even likened U.S. national parks to "American covenants" (Soukoup & Machlis, 2021, p. 585). Despite this, U.S. national parks do not serve all Americans equally. Compared to U.S. residents in the 2010 census, national park visitors are wealthier (i.e., 6% earn less than $25,000 compared to 24% of U.S. residents), more educated (i.e., 32% have a graduate degree compared 16% of U.S. residents), and vast majority white (i.e., 95% compared to 72% of U.S. residents) (Vaske & Lyon, 2014). Demographics of national park visitors compared to the U.S. population have changed since 2010; for instance, it is now estimated that 80% of visitors are White (Hicks et al., 2021), however visitor demographics remain glaringly unrepresentative of the U.S. population.

In an effort to make U.S. national parks relevant, diverse, and inclusive (NPS, 2021), the National Park Service (NPS) needs to ask itself some difficult questions regarding privilege such as "what agency practices reinforce inequities?" (Roberts, 2021, p. 443). Camping in national parks is one practice that historically reinforced inequities (Young, 2009). Yet, there is very limited contemporary research examining the demographics of campers in national parks and how they compare to the U.S. population. This research examines the use of online-based reservations systems in frontcountry camping in U.S. national park campgrounds, and explores how researchers can use mobile device data as a means to understand who protected areas, such as national parks, serve and how fairly that service is distributed.

Camping in the United States and National Parks

Camping is defined by the NPS as "erecting of a tent or shelter of natural or synthetic material, preparing a sleeping bag or other bedding material for use, parking of a motor vehicle, motor home or trailer, or mooring of a vessel for the apparent purpose of overnight occupancy" (Parks, Forests, and Public Property, 2020). Most camping in national parks is considered frontcountry camping, "where visitors drive to an established campground… that typically consists of camping loops (roads shaped in an actual loop), and each loop has numerous camping sites established to accommodate tents, and in some cases, towed campers and RVs [recreational vehicles]" (NPS, 2018a, para. 1).

Since the late 19th century, camping has been a primary means of outdoor recreation in the U.S. (Young, 2017). Though originally conceptualized as a means of leisure to escape urban stresses in an increasingly industrialized society, the primary motivations for camping soon expanded to include affordable and/or novel accommodations while traveling or vacationing in—or proximate to—parks and protected areas (Newcombe, 2016; Young, 2021). Camping thus became a means *to* tourism for many residents in the United States (i.e., a place to stay), as opposed to a means *of* leisure or recreation (i.e., a way to experience leisure) (Young, 2021). This shift led to two concurrent trends in modern camping: 1) a counter effort by the leisure class to reappropriate camping as a leisure activity utilized largely by the wealthy (Young, 2021) and 2) the significant long-term growth within the camping industry (Young, 2021). Both trends, and their historical impacts, are experienced by campers today (Hogue, 2011; Young, 2021).

Historically, exclusivity in camping is noted in national parks, where post-World War II campground designs offered a "striking visual foreshadowing of a suburban housing development" that included "evocative street names, curvilinear road system[s], [and] more

clearly demarcated site boundaries" (Young, 2021, p. 189) that emulated suburban hedges and fences. Through designing campgrounds that mirrored White spaces and emphasized ownership through reservations, Young (2021) concludes that the NPS drew strong connections between campsite design and homeownership and therefore contributed to a post-war social contract that disenfranchised less affluent and non-White Americans—in camping and more broadly—"as both homeownership and outdoor recreation continued to contain mechanisms of discrimination" (p. 191). Today, campers remain largely white in the U.S. (78 percent; The Outdoor Foundation, 2017) and relatively wealthy—from 2014 to 2016 U.S. national park campers had an annual median household income $4,000 higher, on average, than the larger U.S. population (Walls et al., 2018). Because of these demographic discrepancies, U.S. national parks and other camping areas are often conceptualized as exclusionary spaces (Finney, 2010, 2014; More, 2002; Scott & Lee, 2018; Weber & Sultana, 2012).

Camping now generates $166 billion in economic activity annually within the U.S. (The Outdoor Industry Association, 2017). Demand for campsites within frontcountry campgrounds in U.S. national parks increased significantly during the previous decade (Rice et al., 2019), accelerating at the onset of the COVID-19 pandemic (Ma et al., 2021; Michelson, 2021). Increasing demand has led many national park campsite administrators to move to online reservation systems, primarily Recreation.gov (Michelson, 2021; Rice et al., 2019). This online reservation platform allows users to search for campsites by location using advanced filtering tools and book them up to six months in advance. Online reservation systems such as Recreation.gov allow for improved trip planning for campers and efficient allocation of campsites for managers. However, high demand for some campsites, paired with the ability for users to book remotely, has led to a market for campsites where supply regularly fails to meet

demand. As reported by the administrators of Recreation.gov (2021), “A popular campground with 57 campsites can see close to 19,000 people all trying to reserve the same campsites for the same dates immediately after they’re released for reservation” (para. 8). Due to the incredibly high demand for campsite reservations, obtaining a campsite ahead of time is likewise very competitive and requires the ability to plan up to six months in advance, access to highspeed internet, and institutional knowledge related to the park and Recreation.gov. Thus, issues of equity have been raised concerning the allocation of U.S. national park campsite reservations (Rice & Park, 2021).

Unintended Impacts of Campsite Reservation Systems on Distributive Justice

In U.S. national parks, extremely high demand for a limited number of campsites has led to concerns about the impacts of reservation systems on distributive justice (Rice & Park, 2021). In the context of recreation and tourism, Park et al. (2007) define distributive justice as being “concerned with a gain to loss ratio, or the exchange of compensation in terms of input-output consistence with social position” (p. 90). More directly, Manning and Lime (2000) define it as a management principle “whereby individuals obtain what they ‘ought’ to have based on criteria of fairness” (p. 38). Because fairness is a multidimensional concept, Shelby et al. (1989) recommend the analysis of four—sometimes competing—tenets when making decisions about the allocation for recreation resources (e.g., campsites): equality, equity, need, and efficiency. With these tenets in mind, Shelby et al. (1989) note that reservation systems seek to maximize equality—assuming “everyone has an equal chance to plan ahead” (p. 63)—while generally failing to adequately address goals related to need (e.g., improving or ensuring access to shaded campsites for individuals with low heat tolerance or underlying medical conditions), equity (e.g.,

improving or ensuring access for locals with limited financial resources for travelling elsewhere), or efficiency (e.g., “no show” reservation holders causing underutilization of the campsites).

Although reservation systems are based on equality, obtaining campsites through online systems like Recreation.gov may be associated with various constraining factors that could cater to higher socio-economic groups (Floyd & Stodolska, 2014; Taylor et al., 2011), which are often White (Bowser, 2007; Stodolska & Shinew, 2014; US Bureau of Labor Statistics, 2011). Reserving a national park campsite online requires (a) institutional knowledge (including campground knowledge and website navigation knowledge), (b) ability to plan up to six months in advance, and (c) ability to access the internet for reservation system websites, all of which have been identified as constraints for participation in various forms of outdoor recreation.

Skills such as effectively navigating competitive online reservation systems require experience and/or mentorship which have cultural ties and equity implications. Previous research has identified the exclusionary nature of parks and outdoor recreation activities coupled with socio-economic factors (i.e., place of residence and poverty) have created an environment in which many ethnic and racial groups have less access to institutional knowledge and skills related to outdoor recreation (e.g., Bixler et al., 2011; Edmonds, 2019; Scott & Lee, 2018). In the context of camping, campers with previous experience and greater expertise pay significantly more attention to the availability of locations when selecting a campsite (Gursoy & Chen, 2012). Therefore, successfully reserving a popular campsite often requires a reasonably high level of institutional knowledge—thus leading to the possibility of exclusion of less experienced or knowledgeable campers (Rice & Park, 2021).

Previous research refutes the assumption that all campers have equal ability to plan ahead. Early research of campsite reservation systems in 1973 found that only 34 percent of

campers in California had jobs that allowed them to plan their trips twelve weeks in advance (Magill, 1976). A more recent study on online reservations found that for most national park campsites, 50% of reservations are made more than one week in advance (Supak et al., 2017). Furthering this issue of exclusion, at least two proprietary services have emerged to alert customers—for a fee—when a campsite becomes available for their preferred time and place (Michelson, 2021), thus potentially giving those able to pay an unfair advantage when attempting to reserve campsites.

Campsite reservations are most commonly made online through sites such as Recreation.gov, which brings up potential issues of equity in terms of access to internet. Despite the pervasive role of the internet and smartdevices in today's culture, access to internet devices (e.g., smartdevices, tablets, and desktop or laptop computers) vary among racial groups and are associated with disadvantages (Atske & Perrin, 2021; Winter et al., 2019). Atske and Perrin at the Pew Research Center (2021) found that Black/African American and LatinX adults in the U.S. "remain less likely than White adults to say they own a traditional computer or have high-speed internet at home" (para. 1). Especially in a highly competitive market, such as that for popular campgrounds, internet access and access to high speeds can be crucial for ensuring a successful reservation.

Thus, there is a need to understand if online campsite reservation systems are exclusionary toward specific groups. Demographic research of campers confirms that the group remains mostly White and skews wealthier than the greater U.S. population (The Outdoor Foundation, 2017; Walls et al., 2018). However, differences in the ethnic diversity and level of wealth among campers utilizing campsites that require reservations and those utilizing first come, first served campsites have not been assessed to date. This gap in the research may be due

to the difficulty of gaining a robust sample of the two types of campers across multiple campgrounds. The advent of gaining basic demographic information about campers' home locales through mobile device location data offers a means of overcoming this potential barrier (Lawson, 2021).

Using Mobile Device Data to Estimate Demographics in Parks

Location data gathered from personal mobile devices is an emerging means of monitoring and measuring tourism and visitor use in parks and protected areas (Lawson, 2021). In recent years, a small—albeit rapidly growing—body of research has emerged to this end (e.g., Creany et al., 2021; Kim et al., 2020; Kubo et al., 2020; Liang et al., 2021; Merrill et al., 2020; Monz et al., 2019; 2021). Mobile device data provides a potentially more cost-effective means of measuring managerially important variables in park spaces (i.e., visitor travel and use patterns, activity styles, and demographics) compared to traditional surveying methods (Monz et al., 2021). This data may be purchased or otherwise obtained from an array of vendors (e.g., AirSage, Near, SafeGraph, and Streetlight) that aggregate and anonymize location data from cell phones with GPS capabilities (Lawson, 2021). These vendors gather data from "a sample of about 30% of U.S. cell phone users" (Lawson, 2021, p. 30). Given this large sample size, reputable vendors can provide estimates for visitor use and visitor demographics with very high levels of confidence. Concerning income, Near (formally UberMedia, or UM)—the mobile location data vendor used in the following analysis—reports that "the Pearson's correlation between the (inferred) number of UM device users per income bracket and the number of census respondents per income bracket is $r = 0.994$, which is both very high and highly significant ($p<0.01$)" (UberMedia, 2021b, p. 4). Further, concerning ethnicity, "the Pearson's correlation between population counts and device counts across ethnicity is 0.999, which is both very high

and highly significant ($p < 0.01$)" (UberMedia, 2021b, p. 4). Lawson (2021) notes that in parks and protected areas these estimates are likely most accurate in more densely used areas. Additionally, given that mobile location data vendors typically retain archival mobile device location data, researchers are able to use this accurate archival data to study previous park visitation and trends analysis—a practice usually not possible in traditional survey research (Monz et al., 2019).

To date, two studies have used aggregated mobile device data to estimate demographics of park visitors (Liang et al., 2021; Monz et al., 2021). Both of these previous studies focused on assessing and validating the representativeness of visitor demographics estimates based on data purchased or provided by mobile location data vendors. When comparing demographic estimates between mobile device data provided by the vendor StreetLight and survey data, Monz et al. (2021) found visitor race/ethnicity distributions and income levels estimated via mobile device data "were, for the most part, consistent" (p. 128) with previous survey-based research. When comparing demographic estimates between mobile device data provided by the vendor SafeGraph and survey data, Liang et al. (2021) found significant differences in the estimated proportional distributions of four of seven income groups and significant differences among the estimated proportional distributions of one of three racial/ethnic groups. However, these significant differences between the SafeGraph and survey data may be due to poor cell phone service coverage in their study location—Yellowstone National Park (NPS, 2020b). In addition to these studies specific to park settings, numerous other studies have utilized mobile device data to estimate visitor home locations (also referred to as the common evening locations of their mobile devices) in tourism (Calabrese et al., 2010; Ma & Kirilenko, 2021; Park & Pan, 2018).

Study Purpose

Given the legacy of ethnic and economic exclusion in camping, the issues of distributive justice inherent to reservation systems, and the growing popularity of online reservation systems in U.S. national park campgrounds, this study seeks to quantify potential demographic differences of campers in campsites requiring reservations and those note requiring reservations. At present, the lack of research to this end leaves national park campground managers without vital data to guide their decision-making when considering the implementation of online reservation systems. U.S. national park campgrounds were selected as the research setting due to availability of data concerning their reservation statuses and the noted high demand for their campsites (Rice et al., 2019). This research represents a first, exploratory attempt to examine demographic differences among reservation-holding and first come, first served campers, and provide subsequent management implications. The following two research questions guide this research:

R1: In the selected NPS-managed campgrounds, do U.S. campers in campsites requiring reservations come from locales with higher median annual household incomes than those in campsites not accepting reservations?

R2: In the selected NPS-managed campgrounds, do U.S. campers in campsites requiring reservations come from locales with higher portions of White residency than those in campsites not accepting reservations?

Methods

Study Site

Study sites were selected using the following criteria: a) NPS-managed campground with at least one campground loop requiring reservations in 2019 and at least one loop not accepting

reservations in 2019 and b) having mobile device LTE data coverage provided by at least three major cell phone service providers (e.g., Verizon, AT&T, Sprint, T-Mobile) according to Federal Communication Commission (FCC) 2018 data (FCC, 2020). Using the NPS "Find a Campground" explorer tool (NPS, 2020a), five campgrounds were identified that met the defined criteria: Buckhorn Campground in Chickasaw National Recreation Area (Oklahoma), Green River Campground in Colorado National Monument (Colorado), Loft Mountain Campground in Shenandoah National Park (Virginia), Oak Ridge Campground in Prince William Forest Park (Virginia), and Saddlehorn Campground in Dinosaur National Monument (Utah; see Figure 1). Given the exploratory nature of this research, it is acknowledged that these sites may not be fully representative of U.S. national park campgrounds, however all five campgrounds follow the traditional NPS design (Young, 2018) comprising a series of one-way driving loops branching from a common drive, each loop containing a number of campsites. Additionally, all five campgrounds require reservations in certain loops via Recreation.gov during "peak season" (generally April through October). Importantly, neither price nor access to amenities (e.g., picnic tables, campfire rings, access to electricity) were dependent on reservation status in these campgrounds, as discovered through a review of NPS.gov (e.g., NPS, 2017; 2018b; 2019a; 2019b; 2019c). In Buckhorn (Chickasaw National Recreation Area) and Loft Mountain (Shenandoah National Park) Campgrounds, price was directly correlated with access to electricity; however, sites with and without electricity (and therefore at higher and lower prices) were available via both reservation and first come, first served status (NPS, 2017; 2019a). Electricity access was not available at any of the sites in Green River (Dinosaur National Monument), Oak Ridge (Prince William Forest Park), and Saddlehorn (Colorado National

Monument) Campgrounds; therefore, all campsites were of equal price (NPS, 2018b; 2019b; 2019c). A full listing of campground attributes is contained in Table 1.

Data Collection

Using ArcGis Pro and referencing official NPS maps, polygons were delineated around each of the loops within each campground. Using these polygons, data were then exported from aggregated mobile device location data provided by Near (formally UberMedia), for only U.S.-based mobile devices. Location data provided by Near is captured by applications (apps) in mobile devices that have location services enabled, which report coordinates from the operating system of individual GPS-enabled mobile device (Near, 2021a). Raw data is then aggregated, screened for accuracy and quality, and organized to the study's requested parameters in a data export.

Data is gathered by proprietary Software Development Kits (SDKs) embedded into device applications (Near, 2021a). SDKs, provided by Near or other location-gathering vendors, are embedded into the operating software of mobile-device applications by app and web developers. From pop-up ads to apps like Pokémon Go, raw data from over 100,000 applications contribute to the location dataset (Near, 2021a). The Near dataset used for this study included four data sources; ~50% of data was 'second-party' data (gathered by other location-data providers and shared with Near), ~48% of data was 'bid stream data' (collected through software embedded into banner and video advertisements), ~1% of the aggregated data was provided by 'first-party' apps (those developed with publishers that have a direct relationship with Near), and ~1% gathered through apps created by Near (UberMedia, 2021c). Given the volume and variability inherent to mobile device location data, Near applies several layers of data screening to its long-term dataset. Basic screening removes faulty data reporting from individual devices,

'power law' screening removes implausibly high levels of device requests or device density, fraudulent data created by 'bad actor' devices is removed. Additional levels of screening include audit-based data testing and other report-based screening methods (Near 2021a).

Data were exported for the entire 2019 "peak season" defined for each campground when reservations are required for certain loops (as defined by the NPS, 2017; 2018b; 2019a; 2019b; 2019c). Further, to reduce the impact of individuals and vehicles passing through the campground loops en route to another loop or exploring the campground, location data were only exported from 20:00 to 5:00 local time and any devices traveling at a speed greater than three miles per hour for their entire duration within a loop were excluded. The subsequent mobile location data exports were comprised of spreadsheets—respective to each campground loop—listing U.S. Census block groups containing the "common evening location" of at least one visitor's mobile device and the number of visitor mobile devices falling within each block group (See Figure 2). As defined by Near, common evening location is "estimated by determining where a device most frequently appears during the 'non-work' hours" (UberMedia, 2021a, p. 2). "Non-work hours" are defined as between 18:00 and 08:00 on Mondays through Fridays and all day on Saturdays and Sundays (UberMedia, 2021a). The defined common evening location is then "jittered in 50 m [meters] a random direction" to "help maintain the de-identification of device-level data" (UberMedia, 2021a). The exported spreadsheets also contained demographic information for each U.S. Census block group containing the common evening location of at least one visitor's mobile device. This demographic information was queried from the U.S. Census Bureau's 2016 American Community Survey (UberMedia, 2021b).

As mobile device location data is derived from an opt-in anonymous identifier, demographic data cannot be directly associated with individual device locations. Instead, the

established proxy for determining users' demographic characteristics is the census block group of the device user's common evening location (UberMedia, 2021b). In the study data, U.S.-based devices with established common evening locations were associated to their census block group's median household income and racial distribution. For both of these measures, demographic representativeness is measured by reporting the Pearson's correlation between the inferred number of device users and the number of census correspondents. Each measure is found to be both very high and highly significant ($p>0.01$) (UberMedia, 2021b, p. 5)

Assessment of Mobile Device Location Data Representativeness

To understand if the common evening locations of campers—derived from the mobile device location data—in each campground sufficiently represented the geographic distribution of home locations among the population of campers in each campground, we compared (a) the zip codes of campers' common evening locations among our data—derived through Near mobile device location data—to (b) the zip codes collected by the NPS—through the reservation website Recreation.gov—for campers making reservations in the study's campgrounds for the same 2019 dates listed in Table 1. All reservations made through Recreation.gov are archived on the publicly-available Recreation Information Database (Supak et al., 2017). Importantly, we only used the common evening locations of campers in campground loops requiring reservations in this analysis—to ensure we were comparing the correct datasets (i.e., excluding campers camping in first come, first served campsites, not available for reservation on Recreation.gov). Using zip code centroid point data of both (a) the common evening location zip codes of campers in our mobile device location dataset and (b) the zip codes recorded from all reservation transactions on Recreation.gov, we assessed spatial correlation among the point densities of both datasets across the United States using the band collection statistics tool in ArcGIS Pro (e.g.,

Ghalambordezfooli & Hosseini, 2019; Sajid Mehmood et al., 2021) which outputs a correlation matrix for determining the degree of correlation between the spatial coverages of the two datasets.

Analysis

Differences in demographics in campground loops requiring reservations and those not accepting reservations (first come, first served) were analyzed via aggregated datasets for each campground—for example, common evening locations of campers in Loft Mountain (Shenandoah National Park) Campground's Loops F, G, and Upper north (requiring a reservation) and Loops A, B, C, D, E, Lower, and Upper south (not accepting reservations) were aggregated, respectively, prior to analysis. Following the defined research questions, the median annual household income and portion of White residency were analyzed for the home locales (U.S. Census block groups) for campers in campground loops requiring reservations and campground loops not accepting reservations. One-way analyses of variance (ANOVAs) were carried out to compare differences in the average median annual household income and portion of White residency for campground loops requiring and not accepting reservations (first-come, first-serve). Averages and portions were weighted according to the number of devices within common evening locations coming from within each block group. ANOVAs are useful in determining differences in the averages (or means) for continuous variables across groups (Vaske, 2008). Following Huberty and Morris (1989), two one-way ANOVAs were selected over a single MANOVA due to the small number of dependent variables (median annual household income and portion of white residency) and the exploratory nature of the study. Levene's F test was used to assess if equality of variance could be assumed for each dependent variable (Vaske,

2008). When equality of variance could not be assumed for the dependent variable, Welch's test of Equality of Means was used to correct the significance level of the omnibus test.

Results

Common evening locations from approximately 3,250 mobile devices, representing campers home locales, were exported from the Near data explorer. The spatial distribution of common evening location zip codes derived from the mobile device location data and the zip codes derived from reservations made through Recreation.gov ranged from highly correlated to nearly identical across the five campgrounds in the study (see Table 2), with negligible differences likely resulting from campers hailing from different home locales than their friends or family members who made the campsite reservation. Thus, based on these universally high levels of correlation, we determined that the mobile device location data presented a reliable sample of campers from which conclusions concerning the demographics of their home locales (i.e., census block groups) could be drawn. Descriptive and ANOVA results are listed in Table 2. Differences in the total samples (number of mobile devices) used for each of the two ANOVAs (median annual household income and portion of white residency) within each campground result from unequal availability of census data for block groups (e.g., 591 census block groups which contained common evening locations for Green River Campground campers had available racial residency data vs. 581 census block groups had available median household income data). In all five campgrounds, the mean median annual household income for camper's home locales was higher in loops requiring reservations than those not accepting reservations. For three of the five campgrounds—Buckhorn (Chickasaw National Recreation Area), Green River (Dinosaur National Monument), and Loft Mountain (Shenandoah National Park) Campgrounds—the average (mean) median annual household income was *significantly* higher in loops requiring

reservations at a minimum 95% confidence interval. Concerning the portion of white residency in campers' home locales, one of five campgrounds—Oak Ridge (Prince William Forest Park) Campground—contained a *significant* difference between loops requiring reservations and those not accepting reservations. Oak Ridge (Prince William Forest Park) Campground contained a difference of 6.86% in the portion of White residency between reservation statuses.

Discussion

Institutional Barriers to Campsite Use in NPS

Based on our findings from this exploratory research, the allocation of national park campsites through reservation systems can prove exclusionary toward lower income and non-White individuals in the United States. This suggests that reservation systems act as institutional barriers to campsite use in U.S. national parks. This finding juxtaposes the democratic nature of the national park idea as described by journalist and early national park advocate Robert Sterling Yard (1922):

> Already the national parks are beneficently affecting the national mind…Of great importance is their strong tendency to redemocratize in a period which needs it. Nowhere else do people from all the states mingle in quite the same spirit as they do in their national parks…Here the social differences so insisted on at home just don't exist. (p. 583)

Yet, national parks were historically managed as White spaces— largely off limit to people of color. This is exemplified through the policies discouraging African American visitation (O'Brien & Wairimu Ngaruiya, 2012), the exclusion of African Americans from parks in the South (Byrne & Wolch, 2009; Scott, 2014), and designing parks—and the campgrounds therein— for the preferences of White visitors (Le, 2012; Young, 2021). Krymkowski and

colleagues (2014) hypothesize that these historical policies may have resulted in people of color, especially African Americans, feeling like national parks do not belong to them.

Despite overwhelming evidence to the contrary (Davis, 2019; Erickson et al., 2009; Scott & Lee, 2018; Weber & Sultana, 2012; Young, 2017), national parks are still largely romanticized for their role in American culture (Grebowicz, 2015), as popularized through Ken Burns' (2009) film *The National Parks: America's Best Idea*:

> At the heart of the park idea is the notion that by virtue of being an American, whether your ancestors came over on the Mayflower or whether they just arrived, whether you're from a big city or from a rural setting, whether your daddy owns the factory or your mother is a maid….they [the national parks] belong to you. (00:6:20)

In reality, as seen through this addition to a growing body of research, national parks are exclusive places where public ownership does not guarantee equitable access for the diverse public. Further, as demand increases for limited amenities (e.g., campsites, trails, parking) and reservation systems are implemented to manage supply, this exclusion is only likely to increase. Though this study revealed campsites requiring reservations to have significantly higher portions of White residency in just one of five campgrounds, significantly higher average median annual household incomes was revealed among campsites in three of the five campgrounds.

In an instance, as reported by Recreation.gov (2021), "A popular campground with 57 campsites can see close to 19,000 people all trying to reserve the same campsites for the same dates immediately after they're released for reservation" (para. 8), only 0.3% of would-be campers are able to negotiate the constraints involved with getting a campsite through the highly competitive online reservation system. Constraints for obtaining a NPS campsite reservation and for visiting a national park are manifold and span intrapersonal (e.g., fear, anxiety, perceived

self-skills), interpersonal (e.g., family obligations, cultural expectations), and structural constraints (e.g., access to highspeed internet, ability to plan in advance). Some of the potential constraints for obtaining an advanced reservation through Recreation.gov include: the ability to take a vacation to a national park, access to camping equipment, ability to plan up to six months in advance, internet access for obtaining a reservation, flexibility of work schedules to make reservations when they come available, the ability to pay for an external service for monitoring campsite availabilities (e.g., Campnab), and the institutional knowledge of when and how to obtain a reservation through Recreation.gov.

There have been substantial efforts to enhance diversity, equity, and inclusion (DEI) in the NPS, and in recreation and tourism more broadly (Thakur et al., 2021). For example, Schultz et al. (2019) found a total of 1,359 relevancy, diversity, and inclusion programs were reported across 161 park units from 2005-2016 with 12% of programs focused on ethnicity, 12% on race, and 10% on economic status. However, our research illuminates the ongoing constraints within the NPS and, in particular, campsite reservation systems that may further exacerbate inequities across socio-economic groups. Similarly, Schultz et al. (2019) concluded their review of NPS DEI programs by emphasizing the disparity in representing different forms of diversity, the need to strengthen relationships between the NPS and external partners in communities, and the importance of sustaining programs over time to achieve DEI outcomes.

Research Priorities for Campgrounds and DEI

Despite the growing body of research on DEI and public lands and outdoor recreation (e.g., Winter at al., 2020; Flores et al., 2018; Lee et al., 2020), there remains major gaps specific to frontcountry camping, particularly in NPS settings, that can inform priorities for future research. Frontcountry camping is the fifth most popular outdoor recreation activity among all

U.S. residents, is among the top four most popular outdoor recreation activities among African American, Asian, and Hispanic U.S. residents, has the second highest level of interest among low-income U.S. residents not yet participating in outdoor recreation, and is the third most popular outdoor recreation activity among U.S. residents ages 6 to 17 years old (Outdoor Foundation, 2020). Yet, this activity appears to receive very little research interest (beyond the annual KOA North American Camping Report), compared to other activities (e.g., hiking—which is less popular among African Americans, Asians, and Hispanics and U.S. residents ages 6 to 17; Outdoor Foundation, 2020). The lack of research in this area stands at odds with its growing interest among an increasingly diverse U.S. population.

Additionally, this research addresses permitting and reservation equity, which has received little attention in the literature. We were only able to find one study to this end—from decades ago (i.e., Magill, 1976)—and NPS reservation systems and the constraints people face have changed in many ways since then. We recommend future research to focus on the different types of intrapersonal, interpersonal, and structural constraints, different types of campground reservation systems (e.g. in-person, online, etc.) and different types of campgrounds (e.g. frontcountry, backcountry, RV, etc.). Several of the campgrounds studied here have transitioned a significant portion of their first come, first served sites to reservation-only since 2019 (i.e., Loft Mountain and Saddlehorn) or are now completely reservation-only (i.e., Oak Ridge)—thus, highlighting the importance of this line of research. Additionally, a large focus of previous research has been on people who were able to obtain a permit or get a campsite versus the people who were unsuccessful (e.g. those not successful in securing a campground are not present for surveying). When studying constraints of online reservation systems, it is particularly important to have a representative sample. Social media, mobile device data, and surveys outside NPS sites

(e.g., Liang et al., 2020; Barros et al., 2020; McCreary et al., 2020) can be particularly important to reaching populations who are not successful in getting the campsites or may not have any interest in getting the campsites due to various constraints or disconnect of these populations with NPS sites.

Management considerations for implementing a reservation system

As seen through this exploratory study, NPS campsite allocation systems requiring reservations favor wealthier individuals and, in the case of the urban-proximate Prince William Forest Park, White individuals. As the agency moves more campsites onto Recreation.gov and out of first come, first served systems, national park camping will likely become an even-more exclusive activity. We recommend that the NPS, and other land management agencies, consider distributive justice in their decision-making concerning campsite allocation. First, consider *who* is currently using the campgrounds, how this population has changed over time in comparison with census and local demographics changes. Additionally, think of *who* is not currently using the campgrounds and visiting NPS sites and how does this population compare to the various aspects and dimensions of diversity.

Second, consider *how* reservations are made for campgrounds and other permits and *how* information is communicated on working with these systems to break down barriers and constraints. Recent trailed strategies to this end—which could be used to inform *how* reservations are made—include Yosemite National Park's 2022 reservation access lottery for campsites in the popular North Pines Campground, through which hopeful campers enter a lottery for an equal chance to reserve a campsite during peak summer season, with the intention of offering "a new method for reserving campsites at this high-demand location for a more equitable experience" and addressing "perceptions of an unfair reservation process" (NPS, 2022,

para. 2). Viewed through a distributive justice lens, such a program strives for equity while also seeking to minimize unintended negative impacts toward equality and efficiency (Shelby et al., 1989). Additionally, this research agenda must address *how* changes in the reservation and permit system reflect have changed *who* is using the sites?

Third, *when* were these changes made and is equity an issue for the timing and access of reservations? Lastly, *where* are the campgrounds, facilities, resources that require reservations and permits? What is the proximity to urban areas and how many are frontcountry versus backcountry or wilderness sites? When considering these different aspects, managers can transition from decision-making based on specific crowding or demand metrics to decision-making that meaningfully integrates aspects of DEI to support a more just process.

Conclusion and Limitations

This exploratory study used an innovative approach to examine the use of online-based reservations systems in frontcountry camping in U.S. national park campgrounds, and explores how researchers can use mobile device data as a means to understand who national park campgrounds serve and the equitably of that service. The findings illuminate the trends in online-based reservation systems that may exacerbate the issue of exclusion of BIPOC (Black, Indigenous, and people of color) populations from national parks and campgrounds. Considering the growing use of online-based reservation systems, ticketed entry, and other required permits through online systems, this topic requires more research to inform decisions by management and agency decisions to use these approaches.

While cellular device location data represents a powerful tool for monitoring and measuring tourism and visitor use in parks and protected areas, there are important limitations to the application of this data that should be considered. In computing demographic information

about individual device users in the United States, UberMedia analyses census data at the census block group level. Data are tested for bias between census block groups, but differences within individual blocks are not visible. Therefore, reported demographic information is based on the census block group in which one resides, rather than the actual demographic background of the individual. Given this limitation, bias is easier to detect and remove in areas that have "highly typified neighborhoods, such as one with many ethnic or economic enclaves" and more difficult to detect in an area that has a "well-integrated population with few ethnic or economic enclaves" (UberMedia, 2021b). Another consideration when interpreting cellular device location data is in the sample selection. By virtue of the method of data collection, the sample can only include campground visitors that had a mobile device with location services activated while onsite. Other users, those who do not have a mobile device or do not have an application with location services activated, are not captured. Therefore, there is no way to ensure a truly random sample of campground visitors.

The changing socio-demographic landscape of the U.S. and other countries offers opportunities to enhance the relevancy, diversity, and inclusion in national parks and protected areas. However, the increasing demand for visitation to these places has created a tension for managers on how to control crowding and sustain resources while not creating exclusionary practices such as online reservation systems and ticketed entry. The lack of research on this topic further limits the ability to inform decisions based on sound science. We hope this exploratory study catalyzes meaningful discussion on these management systems through the lens of relevancy, diversity, and inclusion and can enhance the equity and access to campgrounds, national parks, and protected areas.

References

Atske, S. & Perrin, A. (2021). *Home broadband adoption, computer ownership vary by race, ethnicity in the U.S.* Pew Research Center https://www.pewresearch.org/fact-tank/2021/07/16/home-broadband-adoption-computer-ownership-vary-by-race-ethnicity-in-the-u-s/.

Barros, C., Moya-Gómez, B., & Gutiérrez, J. (2020). Using geotagged photographs and GPS tracks from social networks to analyse visitor behaviour in national parks. *Current Issues in Tourism, 23*(10), 1291-1310.

Bixler, R. D., James, J. J., & Vadala, C. E. (2011). Environmental socialization incidents with implications for the expanded role of interpretive naturalists in providing natural history experiences. *Journal of Interpretation Research, 16*(1), 35-64.

Bowser, B. P. (2007). *The Black Middle Class*. Lynne Rienner.

Burns, K. (Director). (2009). Going Home [Documentary Episode]. In K. Burns, & D. Duncan (Producers), *The national parks: America's best idea*. Public Broadcasting Service.

Calabrese, F., Pereira, F. C., Di Lorenzo, G., Liu, L., & Ratti, C. (2010). The geography of taste: Analyzing cell-phone mobility and social events. In P. Floréen, A. Krüger, & M. Spasojevic (Eds.), *Pervasive Computing: Vol. 6030 LNCS* (pp. 22–37). Springer.

Craig, C. A., & Karabas, I. (2021). Glamping after the coronavirus pandemic. *Tourism and Hospitality Research*, *21*(2), 251–256.

Creany, N. E., Monz, C. A., D'Antonio, A., Sisneros-Kidd, A., Wilkins, E. J., Nesbitt, J., & Mitrovich, M. (2021). Estimating trail use and visitor spatial distribution using mobile device data: An example from the nature reserve of orange county, California USA. *Environmental Challenges*, *4*, 100171.

Davis, J. (2019). Nature and Space Black faces, Black spaces: Rethinking African American underrepresentation in wildland spaces and outdoor recreation. *Environment and Planning E: Nature and Space*, *2*(1), 89–109.

Edmonds, D. A. (2019). *Perceptions of African-American Outdoor Experiences*. [Master's Thesis, North Carolina State University].

Erickson, B., Johnson, C. W., & Kivel, B. D. (2009). Rocky Mountain National Park: history and culture as factors in African-American park visitation. *Journal of Leisure Research*, *41*(4), 529–545.

Federal Communication Commission (2020, February 20). *LTE coverage by number of providers - YE 2018*. Reports & research. https://www.fcc.gov/reports-research/maps/lte-coverage-number-providers-ye-2018/

Finney, C. (2014). *Black faces, White spaces: Reimagining the relationship of African Americans to the great outdoors*. The University of North Carolina Press.

Finney, C. (2010). This land is your land, this land is my land: People and public lands redux. *The George Wright Forum 27*: 247-254.

Floyd, M. F. & Stodolska, M. (2014). Theoretical frameworks in leisure research on race and ethnicity. In *Race, ethnicity and leisure*, Monika Stodolska, Kim J. Shinew, Myron F. Floyd, and Gordon J. Walker (Eds). Champaign, IL: Human Kinetics.

Ghalambordezfooli, R., & Hosseini, F. (2019). The spatial correlation between social capital and crime: A case study of the new town of Pardis, Iran. *Environmental and Socio-Economic Studies, 7*(4), 62–68.

Grebowicz, M. (2015). *The national park to come*. Stanford University Press.

Gross, R. (2018). From buckskin to Gore-Tex: Consumption as a path to mastery in twentieth-century American wilderness recreation. *Enterprise and Society*, *19*(4), 826–835.

Gursoy, D., & Chen, B. T. (2012). Factors influencing camping behavior: The case of Taiwan. *Journal of Hospitality Marketing and Management*, *21*(6), 659–678.

Hicks, A. S., Malone, Z., Moore, M. A., Powell, R., Thompson, A., Whitener, P. A., & Williams, R. (2021). Green inequities: Examining the dimensions of socioenvironmental injustice in marginalized communities. *Parks Stewardship Forum*, *37*(3), 534-540.

Hogue, M. (2011). A Short History of the Campsite. *Places Journal*, *5*.

Huberty, C. J., & Morris, J. D. (1989). Multivariate analysis versus multiple univariate analyses. *Psychological Bulletin*, *105*(2), 302–308.

Kim, Y. J., Lee, D. K., & Kim, C. K. (2020). Spatial tradeoff between biodiversity and nature-based tourism: Considering mobile phone-driven visitation pattern. *Global Ecology and Conservation*, *21*, e00899. https://doi.org/10.1016/J.GECCO.2019.E00899

Kubo, T., Uryu, S., Yamano, H., Tsuge, T., Yamakita, T., & Shirayama, Y. (2020). Mobile phone network data reveal nationwide economic value of coastal tourism under climate change. *Tourism Management*, *77*, 104010. https://doi.org/10.1016/J.TOURMAN.2019.104010

Lawson, M. (2021). *Innovative New Ways to Count Outdoor Recreation: Using data from cell phones, fitness trackers, social media, and other novel data*. Headwaters Economics. https://headwaterseconomics.org/outdoor-recreation/counting-outdoor-recreation/

Liang, Y., Kirilenko, A. P., Stepchenkova, S. O., & Ma, S. (2020). Using social media to discover unwanted behaviours displayed by visitors to nature parks: Comparisons of nationally and privately owned parks in the Greater Kruger National Park, South Africa. *Tourism Recreation Research*, *45*(2), 271–276.

Liang, Y., Yin, J., Pan, B., Lin, M., & Chi, G. (2021). Assessing the validity of SafeGraph data for visitor monitoring in Yellowstone National Park. In B. Pan, S. O. Stepchenkova, & S. Elliot (Eds.), *Collection of TTRA 2021 Research Papers and Abstracts - 51st Annual Travel and Tourism Research Association International Conference*. Fort Worth, TX: Travel and Tourism Research Association.

Ma, S., Craig, C. A., Feng, S., & Liu, C. (2021). Climate resources at United states national parks: A tourism climate index approach. *Tourism Recreation Research*, 1–15. https://doi.org/10.1080/02508281.2021.1946652

Ma, S., & Kirilenko, A. (2021). How reliable is social media data? Validation of TripAdvisor tourism visitations using independent data sources. In Wolfgang Wörndl, Chulmo Koo, & Jason L. Stienmetz (Eds.), *Information and Communication Technologies in Tourism* (pp. 286–293). Springer.

Magill, A. W. (1976). *Campsite reservation systems: The camper's viewpoint. USDA Forest Service Research Paper PSW-121.* Berkeley, CA: U.S. Department of Agriculture, U.S. Forest Service, Pacific Southwest Forest and Range Experiment Station.

Manning, R. E., & Lime, D. W. (2000). Defining and Managing the Quality of Wilderness Recreation Experiences. In D. N. Cole, S. F. McCool, W. T. Borrie, & J. O'Loughlin (Eds.), *Wilderness Science in a Time of Change Conference-Volume 4: Wilderness visitors, experiences, and visitor management; 1999 May 23-27; Missoula, Montana* (Vol. 4, pp. 13–52). U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

McCreary, A., Seekamp, E., Davenport, M., & Smith, J. W. (2020). Exploring qualitative applications of social media data for place-based assessments in destination planning. *Current Issues in Tourism*, *23*(1), 82-98.

Merrill, N. H., Atkinson, S. F., Mulvaney, K. K., Mazzotta Id, M. J., & Bousquin, J. (2020). Using data derived from cellular phone locations to estimate visitation to natural areas: An application to water recreation in New England, USA. *PLoS ONE*, *15*(4), e0231863.

Michelson, M. (2021, May 7). *How to snag a campsite this summer*. Outside Magazine. https://www.outsideonline.com/adventure-travel/destinations/north-america/book-campsite-summer/

Monz, C., Creany, N., Nesbitt, J., & Mitrovich, M. (2021). Mobile device data analysis to determine the demographics of park visitors. *Journal of Park and Recreation Administration*, *39*(1), 123–130.

Monz, C., Mitrovich, M., D'Antonio, A., & Sisneros-Kidd, A. (2019). Using mobile device data to estimate visitation in parks and protected areas: An example from the nature reserve of Orange County, California. *Journal of Park and Recreation Administration*, *37*(4), 92–109. https://doi.org/10.18666/jpra-2019-9899

More, T. A. (2002). "The parks are being loved to death" and other frauds and deceits in recreation management. *Journal of Leisure Research*, *34*(1), 52–78. https://doi.org/10.1080/00222216.2002.11949960

National Park Service (2017, June 28). *Campgrounds*. Chickasaw National Recreation Area. https://web.archive.org/web/20190612052419/https://www.nps.gov/chic/planyourvisit/campgrounds.htm

National Park Service (2018a, July 25). *Frontcountry camping (car camping)*. Camping. https://www.nps.gov/subjects/camping/frontcountry-camping.htm

National Park Service (2018b, December 11). *Green River campground*. Dinosaur National Monument. https://web.archive.org/web/20190611141738/https://www.nps.gov/dino/planyourvisit/greenrivercampground.htm

National Park Service (2019a, February 1). *Loft Mountain campground*. Shenandoah National Park. https://web.archive.org/web/20190706051533/https://www.nps.gov/shen/planyourvisit/upload/LoftMountain_CampgroundMap.pdf

National Park Service (2019b, February 4). *Saddlehorn campground.* Colorado National Monument. https://web.archive.org/web/20190706024059/https://www.nps.gov/colm/planyourvisit/saddlehorn-campground.htm

National Park Service (2019c, March 6). *Oak Ridge campground.* Prince William Forest Park. https://web.archive.org/web/20190705063001/https://www.nps.gov/prwi/planyourvisit/oakridge.htm

National Park Service (2020a, March 23). *Find a campground.* Where can I camp? https://www.nps.gov/subjects/camping/campground.htm

National Park Service (2020b, July 7). *Cellular and Wi-Fi.* Goods and services. https://www.nps.gov/yell/planyourvisit/goodsandservices.htm

National Park Service (2021, March 11). *Office of Relevancy, Diversity, and Inclusion*. https://www.nps.gov/orgs/1244/index.htm

National Park Service (2022, February 10). *North Pines Campground early access lottery pilot.* Yosemite National Park. https://www.nps.gov/yose/planyourvisit/lottery-pilot.htm

Near (2021a). Understanding mobile location data. *Near.*

Newcombe, E. (2016). Camping, climbing, and consumption: The Bean Boot, 1912-1945. *Material Culture*, *48*(1), 10–27.

Park, J., Ellis, G. D., Kim, S. S., Ruddell, E. J., & Agrusa, J. (2007). Predictors of social equity and price acceptability judgments of user fees. *Journal of Travel & Tourism Marketing*, *21*(2–3), 89–103.

Park, S., & Pan, B. (2018). Identifying the next non-stop flying market with a big data approach. *Tourism Management*, *66*, 411–421

Parks, Forests, and Public Property, 36 CFR § 1.4 (2020).

Recreation.gov (2021, May). *Increased demand for popular activities*. The Story Board: May 2021 [Newsletter]. https://recreationgov.activehosted.com/index.php?action=social&c=564&m=48049

Rice, W. L., & Park, S. (2021). Big data spatial analysis of campers ' landscape preferences : Examining demand for amenities. *Journal of Environmental Management*, *292*, 112773.

Rice, W. L., Park, S., Pan, B., & Newman, P. (2019). Forecasting campground demand in US national parks. *Annals of Tourism Research*, *75*, 424–438.

Roberts, N. S. (2021). Does systemic racism and structural power activate increase access? *Parks Stewardship Forum 37*(3), 442-447.

Sajid Mehmood, M., Li, G., Jin, A., Rehman, A., Wijeratne, V. P. I. S., Zafar, Z., Khan, A. R., & Khan, F. A. (2021). The spatial coupling effect between urban street network's centrality

and collection & delivery points: A spatial design network analysis-based study. *PLoS ONE*, *16*(5), e0251093. https://doi.org/10.1371/journal.pone.0251093

Scott, D., & Lee, K. J. (2018). People of color and their constraints to national parks visitation. *The George Wright Forum*, *35*(1), 82.

Shelby, B., Whittaker, D., & Danley, M. (1989). Idealism versus pragmatism in user evaluations of allocation systems. *Leisure Sciences*, *11*(1), 61–70. https://doi.org/10.10k80/01490408909512205

Soukup M. A. & Machlis, G. E. (2021). National parks as American covenants. *Parks Stewardship Forum 37*(3), 585-591.

Stodolska, M. & Shinew, K. J. (2014). Leisure among Latino Americans. In *Race, Ethnicity and Leisure*, Monika Stodolska, Kimberly J. Shinew, Myron F. Floyd, and Gordon J. Walker, Eds. Champaign, IL: Human Kinetics.

Supak, S., Brothers, G., Ghahramani, L., & Van Berkel, D. (2017). Geospatial analytics for park & protected land visitor reservation data. In Z. Xiang & D. R. Fesenmaier (Eds.). *Analytics in smart tourism design* (pp. 81-109). Berlin, Germany: Springer.

Thakur, P., Khoo, C., & Pyar, W. Y. K. (2021). Diversity training: Where are we, and where should we be heading? A systematic literature review. *Tourism Recreation Research*, 1–24. https://doi.org/10.1080/02508281.2021.1965369

The Outdoor Foundation (2017). *2017 American camper report*. Boulder, CO: The Outdoor Industry Association.

The Outdoor Industry Association (2017). *Outdoor recreation economy report*. Boulder, CO: The Outdoor Industry Association.

UberMedia (2021a). Derivation of common evening and common daytime locations. *UberMedia*.

UberMedia (2021b). Demographic representation of the UM device graph. *UberMedia*.

UberMedia (2021c). Location measurement data and attribution methodology. *UberMedia*.

U. S. Bureau of Labor Statistics. (2011). *Labor force characteristics by race and ethnicity 2010*. Report no. 1032. http://www. Bls.gov/cps/cpsrace2010.pdf.

U.S. Census Bureau (n.d.) *Tallies.* Census reference files. https://www.census.gov/geographies/reference-files/time-series/geo/tallies.html

Vaske (2008). *Survey research and analysis: Applications in parks, recreation and human dimensions*. State College, PA: Venture Publishing.

Vaske, J. J. & Lyon, K. M. (2014). *Linking the 2010 census to national park visitors*: *Natural Resource Technical Report NPS/WASO/NRTR—2014/880*. National Park Service.

Walls, M., Wichman, C., & Ankney, K. (2018). *Nature-based recreation: Understanding campsite reservations in national parks*. Resources for the Future.

Weber, J., & Sultana, S. (2012). Why do so few minority people visit national parks? Visitation and the accessibility of "America's best idea." *Annals of the Association of American Geographers*, *103*(3), 437–464.

Winter, P., Crano, W. D., Basáñez, T., & Lamb, C. S. (2020). Equity in access to outdoor recreation—Informing a sustainable future. *Sustainability 12*(124).

Yard, R. S. (1922). The people and the national parks. *The Survey*, *48*(13), 547–553, 583.

Young, P. S. K. (2021). *Camping grounds: Public nature in American life from the Civil War to the Occupy Movement*. Oxford, UK: Oxford University Press.

Young, T. (2009). “A contradiction in democratic government”: W. J. Trent, Jr., and the struggle to desegregate national park campgrounds. *Environmental History 14*(4): 651-682.

Young, T. (2017). *Heading out: A history of American camping*. Ithaca, NY: Cornell University Press.

Young, T. (2018). E.P. Meinecke and the development of the modern auto campground. *IdeAs*, *12*, 1–22. https://doi.org/10.4000/ideas.3502

Tables

Table 1

Campground Attributes

Campground	Total # of campsites	Total # of reservable campsites	Loops requiring reservation during peak season	Loops not accepting reservation during peak season	2019 peak season[1]	Nearest Metropolitan Statistical Area (population)	Miles to nearest Metropolitan Statistical Area
Buckhorn	134	43	C	A, B, & D	5/25 – 9/9	Oklahoma City, OK (646,244)	78
Green River	80	34	B	A & C	5/15/ - 9/21	Salt Lake City, UT (600,730)	141
Loft Mountain	207	55	F, G, & Upper north	A, B, C, D, E, Lower, & Upper south	5/14 – 10/27	Richmond, VA (633,765)	83
Oak Ridge	100	58	B & C	A	4/1 – 10/31	Washington-Arlington-Alexandria, DC-VA-MD-WV (3,249,197)	29
Saddlehorn	80	20	B	A & C	4/1 – 10/31	Salt Lake City, UT (600,730)	203

[1](NPS, 2017; 2018b; 2019a; 2019b; 2019c)

Table 2

ANOVA results and mobile device/reservation zip code correlations

								Sample Size of Recreation.gov data and Correlations	
	n (# of devices)	Mean	Std. Deviation	Mean Difference	*F*-value/ Welch Statistic	*p*-value	Levine statistic	*n* (# of reservations)	Correlation with common evening location zip codes
Buckhorn (Chickasaw National Recreation Area) Campground								1,032	0.860
Median Annual Household Income	626			$5,940	10.322	0.001[a]	16.227[d]		
Requiring Reservations	285	$59,735	$25,491						
No Reservations	341	$53,796	$19,700						
Portion of White Residency	632			0.0023	0.025	0.875	0.076[e]		
Requiring Reservations	288	0.7182	0.1860						
No Reservations	344	0.7159	0.1922						
Green River (Colorado National Monument) Campground								1,344	0.890
Median Annual Household Income	581			$5,084	3.919	0.048[c]	1.24[e]		
Requiring Reservations	302	$74,364	$32,548						
No Reservations	279	$69,280	$29,066						
Portion of White Residency	591			0.0108	0.450	0.503	0.738[e]		
Requiring Reservations	307	0.7797	0.1911						
No Reservations	284	0.7689	0.1988						
Loft Mountain (Shenandoah National Park) Campground								1,439	0.995
Median Annual Household Income	1289			$6,369	6.484	0.011[b]	11.641[d]		
Requiring Reservations	417	$81,825	$43,863						

No Reservations	872	$75,455	$37,854						
Portion of White Residency	1313			-0.0106	0.677	0.411	1.057[e]		
Requiring Reservations	426	.7266	.2138						
No Reservations	887	.7372	.2218						
Oak Ridge (Prince William Forest Park) Campground								1,035	0.945
Median Annual Household Income	307			$1,991	0.163	0.687	0.003[e]		
Requiring Reservations	187	$97,627	$43,115						
No Reservations	120	$95,636	$40,570						
Portion of White Residency	310			0.0686	6.142	0.014[b]	0.027[e]		
Requiring Reservations	188	.6486	.2387						
No Reservations	122	.5800	.2271						
Saddlehorn (Dinosaur National Monument) Campground								1,746	0.943
Median Annual Household Income	722			$3,899	2.800	0.095	1.221[e]		
Requiring Reservations	341	$71,113	$32,367						
No Reservations	381	$67,214	$30,234						
Portion of White Residency	732			-0.0133	0.874	0.350	0.723[e]		
Requiring Reservations	343	.7710	.1966						
No Reservations	389	.7843	.1883						

Note: Median Annual Household Income and Portion of White Residency are calculated at the U.S. Census Block Group level
[a]Difference in means significant at a 99% confidence interval
[b]Difference in means significant at a 98% confidence interval
[c]Difference in means significant at a 95% confidence interval
[d]Equality of variances cannot be assumed.
[e]Equality of variances can be assumed.

Figures

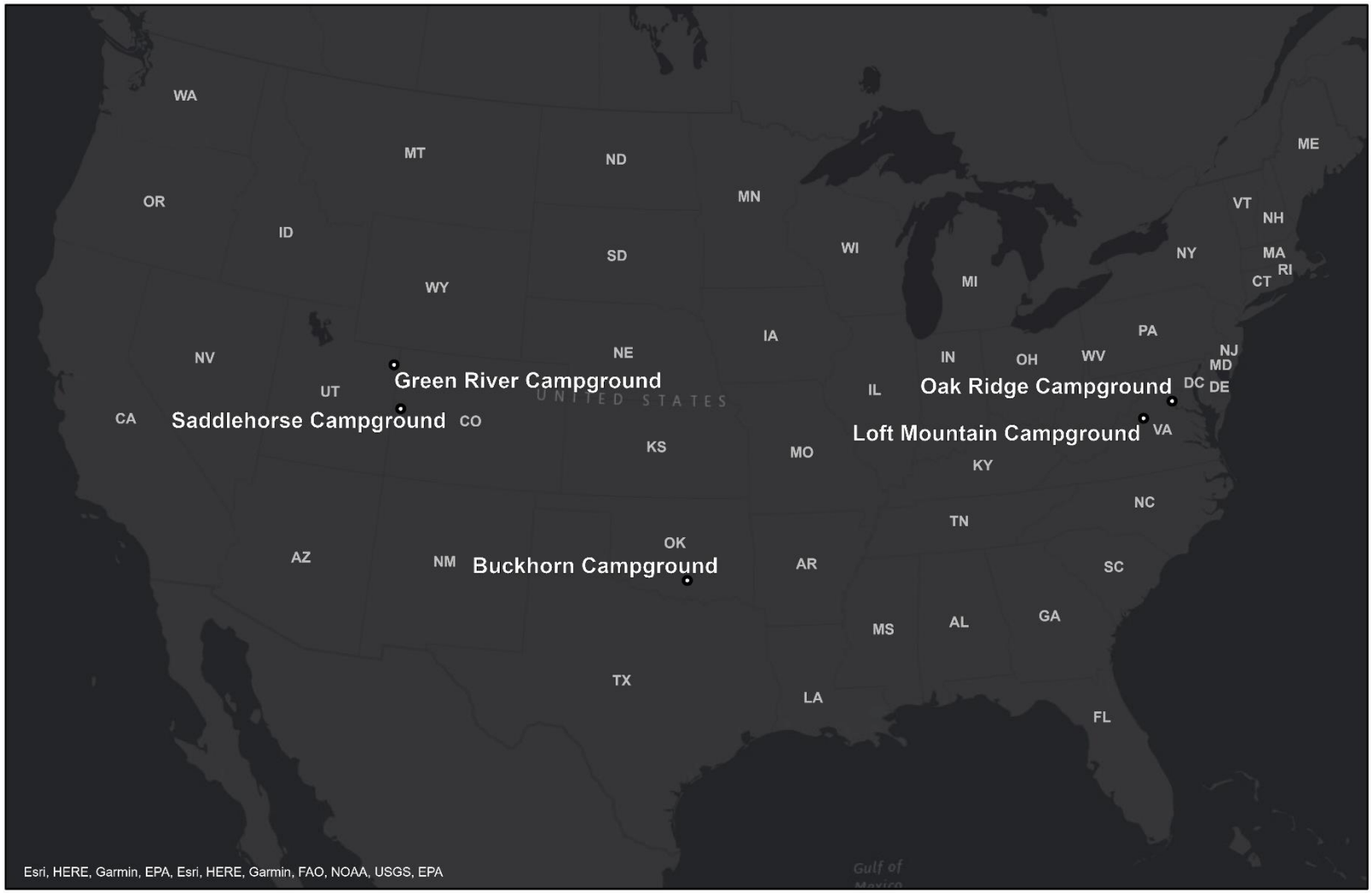

Figure 1. Campgrounds included in the study

Census Block Group ID	# of Devices	Median Household Income	Portion of White Residency
60133230001	1	$110,417	0.6937
60170309011	1	$76,553	0.9594
60190064034	1	$80,259	0.7566
60230011011	1	$63,333	0.8379
60610213222	2	$103,365	0.6206

Figure 2. Example cleaned output of mobile device data